FINAL

Baseline Monitoring Document and As-Built Baseline Report
Brown Creek Tributaries Restoration Project

Anson County, North Carolina

DMS Project ID No. 95351, DEQ Contract No. 004641

Permits: SAW-2012-01108, DWR #14-0345

Yadkin River Basin: 03040104-061030

Prepared for:

NC Department of Environmental Quality
Division of Mitigation Services (DMS)
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

Data Collection Period – July 2015

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Prepared by:

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INTERNATIONAL

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 EXECUTIVE SUMMARY

Michael Baker Engineering, Inc. (Baker) restored 8,213 linear feet (LF) of perennial stream, enhanced 2,481 LF of stream, and preserved 518 LF of stream along Hurricane Creek (HC) and unnamed tributaries (UT4) to Brown Creek, a 303(d) listed stream that flows through the Pee Dee National Wildlife Refuge. Baker also planted approximately 33 acres (AC) of native riparian vegetation along the restored and enhanced reaches (Reaches HC-R1, HC-R2, and HC-R3 on the Hurricane Creek portion of the project, and UT4-R1b, UT4-R2, UT4-R3, UT4-R4a, UT4-R4b, UT4-R5a, and UT4-R5b on the unnamed tributary portion of the project). A recorded conservation easement consisting of 43.3 acres protects and preserves all stream reaches, existing wetland areas, and riparian buffers in perpetuity. The Brown Creek Tributaries Restoration Project (Site) is located in Anson County, approximately four miles southeast of the Town of Ansonville (Figure 1). The Site is located in the NC Division of Water Resources (NCDWR) subbasin 03-07-10 and the NC Division of Mitigation Services (DMS) Targeted Local Watershed (TLW) 03040104-061030 of the Yadkin River Basin. The project involved the restoration and enhancement of a rural piedmont stream system (Schafale and Weakley 1990), which had been impaired due to past agricultural conversion and cattle grazing.

Based on the DMS 2009 Lower Yadkin-Pee Dee River Basin Restoration Priority (RBRP) Plan, the Brown Creek Tributaries Restoration Project area is located in an existing targeted local watershed (TLW) within the Yadkin River Basin, although it is not located in a Local Watershed Planning (LWP) area. The TLW selection criteria for the Yadkin Basin specifically targets projects that will address water resource impacts from nonpoint source (NPS) pollution. The restoration strategy for the Yadkin River Basin as a whole targets projects which focus on restoring stream functions by maintaining and enhancing water quality, restoring hydrology, and improving fish and wildlife habitat.

The primary goals of the project were to improve ecologic functions to the impaired areas as described in the DMS 2009 Lower Yadkin-Pee Dee RBRP as identified below:

- Create geomorphically stable conditions along the unnamed tributaries across the site,
- Implement agricultural BMPs to reduce NPS inputs to receiving waters,
- Protect and improve water resources by reducing stream bank erosion, and nutrient and sediment inputs,
- Restore stream and floodplain interaction by connecting historic flow paths and promoting natural flood processes, and
- Restore and protect riparian buffer functions and corridor habitat in perpetuity by establishing a permanent conservation easement.

To accomplish these goals, the following objectives were identified:

- Restore existing incised, eroding, and channelized streams by providing them access to their relic floodplains,
- Prevent cattle from accessing the conservation easement boundary by installing permanent fencing and thus reduce excessive stream bank erosion and undesired nutrient inputs,
- Increase aquatic habitat value by providing more bedform diversity, creating natural scour pools and reducing sediment from accelerated stream bank erosion,
- Plant native species riparian buffer vegetation along stream bank and floodplain areas, protected by a permanent conservation easement, to increase stormwater runoff filtering capacity, improve stream bank stability and riparian habitat connectivity, and shade the stream to decrease water temperature,

- Improve aquatic and terrestrial habitat through improved substrate and in-stream cover, addition of woody debris, and reduction of water temperature, and
- Control invasive species vegetation within the project area and, if necessary, continue treatments during the monitoring period.

This report documents the completion of the restoration construction activities and presents as-built monitoring data for the post-construction monitoring period. Table 1 summarizes project conditions before and after restoration, as well as the conditions predicted in the previously approved project Mitigation Plan. Table 1 is located in Appendix A.

2.0 PROJECT GOALS, BACKGROUND AND ATTRIBUTES

2.1 Project Location and Description

The Site is located in Anson County, NC, approximately four miles southeast of the Town of Ansonville, as shown on the Vicinity Map (Figure 1). The project is located in the NC Division of Water Resources (NCDWR) sub-basin 03-07-10 of the Yadkin River Basin and hydrologic unit 03040104-061030. The project includes one named (Hurricane Creek) and four unnamed tributaries (UTs) to Brown Creek and is located in the Piedmont physiographic region. The Hurricane Creek (HC) portion of the project was divided into three individual Reaches (HC-R1, HC-R2, and HC-R3), and the unnamed tributary (UT4) portion of the project was divided into eight individual Reaches (UT4-R1a, UT4-R1b, UT4-R2, UT4-R3, UT4-R4a, UT4-R4b, UT4-R5a, and UT4-R5b) as shown in Figures 2a and 2b.

Hurricane Creek (HC-R1 and HC-R2) and the mainstem of UT4 (UT4-R3 and UT4-R4) were shown as solid blue-line streams on the USGS topographic quadrangle map (Ansonville Quad). The tributaries to Hurricane Creek (HC-R3) and UT4 (UT4-R1, UT4-R2, and UT4-R5) are not shown as any type of blue-line stream on the USGS map. All stream reaches, except HC-R3, are shown as (unclassified) streams within the project limits on the 2005 Anson County Soil Survey (Anson, 2005). LiDAR imagery for the site showed the presence of historic valleys for each of the project stream systems and field investigations confirmed the locations of these valleys. On-site jurisdictional determinations of intermittent/perennial status were conducted in February of 2013 and determined that reaches HC-R2 and UT4-R3 were perennial, while reaches HC-R1, HC-R3, UT4-R1, UT4-R2, UT4-R4, and UT4-R5 were intermittent.

Based on the DMS 2009 Lower Yadkin-Pee Dee River Basin Restoration Priority (RBRP) Plan, the Brown Creek Tributaries Restoration Project area is located in an existing targeted local watershed (TLW) within the Yadkin River Basin, although it is not located in a Local Watershed Planning (LWP) area. The restoration strategy for the Yadkin River Basin specifically targets projects that focus on restoring stream functions by maintaining and enhancing water quality, restoring hydrology, and improving fish and wildlife habitat.

2.2 Site Directions

To access the site from Raleigh, take US Highway 1 south through Sanford, for approximately 40 miles. Take the exit ramp to US 15/501 South to Carthage and then take NC 24/NC 27 West from Carthage for approximately 33 miles before turning onto NC 109 South. Follow NC 109 South for 20 miles and take the first right past Dennis Road. The UT4 site is located just south of the farm access road about one half mile from NC 109. The Hurricane Creek site is located immediately south of Pleasant Grove Church Road approximately 1.5 miles west of the UT4 site.

2.3 Project Goals and Objectives

The primary goals of the project were to improve ecologic functions and to manage NPS inputs to the impaired areas as described in the DMS 2009 Lower Yadkin-Pee Dee RBRP and are identified below:

- Create geomorphically stable conditions along the unnamed tributaries across the site,
- Implement agricultural BMPs to reduce NPS inputs to receiving waters,
- Protect and improve water resources by reducing stream bank erosion, and nutrient and sediment inputs,
- Restore stream and floodplain interaction by connecting historic flow paths and promoting natural flood processes, and

- Restore and protect riparian buffer functions and corridor habitat in perpetuity by establishing a permanent conservation easement.

To accomplish these goals, the following objectives were identified:

- Restore existing incised, eroding, and channelized streams by providing them access to their relic floodplains,
- Prevent cattle from accessing the conservation easement boundary by installing permanent fencing and thus reduce excessive stream bank erosion and undesired nutrient inputs,
- Increase aquatic habitat value by providing more bedform diversity, creating natural scour pools and reducing sediment from accelerated stream bank erosion,
- Plant native species riparian buffer vegetation along stream bank and floodplain areas, protected by a permanent conservation easement, to increase stormwater runoff filtering capacity, improve stream bank stability and riparian habitat connectivity, and shade the stream to decrease water temperature,
- Improve aquatic and terrestrial habitat through improved substrate and in-stream cover, addition of woody debris, and reduction of water temperature, and
- Control invasive species vegetation within the project area and, if necessary, continue treatments during the monitoring period.

The project will directly address goals identified in the 2009 Lower Yadkin-Pee Dee RBRP, namely to improve watershed conditions, reduce NPS inputs, and prevent increases to impervious surfaces areas. The natural channel design (NCD) approach resulted in a stable riparian stream system that will reduce excess sediment and nutrient inputs to the Brown Creek sub-watershed, while improving water resources conditions that support terrestrial and aquatic species, including priority species identified in the Lower Yadkin River Basin.

3.0 PROJECT STRUCTURE, RESTORATION TYPE AND APPROACH

3.1 Project Components

The project area includes one named stream (Hurricane Creek) and four unnamed tributaries (UTs) to Brown Creek and is located in the Piedmont physiographic region. For assessment and design purposes, the Hurricane Creek (HC) portion of the project was divided into three individual Reaches (HC-R1, HC-R2, and HC-R3), and the unnamed tributary (UT4) portion of the project was divided into eight individual Reaches (UT4-R1a, UT4-R1b, UT4-R2, UT4-R3, UT4-R4a, UT4-R4b, UT4-R5a, and UT4-R5b). Native species riparian buffer vegetation was established and/or protected at least 50 feet from the top of both banks along all project reaches. Cattle were also excluded along all project reaches in which they were previously allowed through the installation of approximately 9,500 feet of permanent fencing outside of the conservation easement. The reach designations have remained in the same order to be consistent throughout the document.

3.2 Restoration Approach

Based on the post-construction as-built survey, the Hurricane Creek portion of the project consisted of 2,043 LF of Restoration on HC-R1,1,393 LF of Restoration on HC-R2 and 564 LF of Enhancement II on HC-R3. Additionally, the UT4 portion of the Site consisted of 518 LF of Preservation on Reach UT4-R1a, 858 LF of Restoration on UT4-R1b, 1,827 LF of Restoration on UT4-R2, 250 LF of Restoration on UT4-R3, 396 LF of Restoration on UT4-R4a, 1,444 LF of Restoration on UT4-R4b, 335 LF of Enhancement I on UT4-R5a and 1,581 LF of Enhancement I on UT4-R5b. Baker also planted approximately 33 acres (AC) of native riparian vegetation along the restored and enhanced reaches, and a recorded conservation easement of 43.3 acres protects and preserves all stream reaches, existing wetland areas, and riparian buffers in perpetuity.

The project involved the restoration, enhancement, and preservation of a rural piedmont stream system, which had been impaired due to past agricultural conversion and cattle grazing. Restoration practices involved raising the existing streambed and reconnecting the stream to the relic floodplain, and restoring natural flows to areas previously drained by ditching activities. The existing channels abandoned within the restoration areas were filled to decrease surface and subsurface drainage and raise the local water table. Permanent cattle exclusion fencing was provided around all proposed reaches and riparian buffers in which they previously had access.

The vegetative components of this project include stream bank, floodplain, and transitional upland plantings. The Site was planted with native species riparian buffer vegetation following Schafale and Weakley's (1990) guidance on vegetation communities for Piedmont/Mountain Bottomland Forest (mixed riparian community) and Dry-Mesic Oak-Hickory Forest (Piedmont Subtype), as shown in Table 7 and Table 8 (Appendix C) and now protected through a permanent conservation easement. Table 1 and Figure 2a and Figure 2b (Appendix A) provide a summary of the project components.

3.2.1 Reach HC-R1 Restoration

A Priority Level I restoration was constructed for this reach to fully restore stream functions and a floodplain connection. The lowest part of the stream valley runs mostly in the adjacent field along the existing tree line to the east of the degraded stream channel. Starting at the project boundary, the bed elevation was raised gradually to provide a reconnection to the geomorphic floodplain. The restored channel was constructed off-line along the field edge, and was built as a Rosgen 'C5' type channel. The stream was constructed as close as possible to the existing tree line. This allowed for ease of construction in the pasture, while also taking advantage of the shading, biomass input, and root mass

of the existing mature riparian trees to remain. This approach also minimized the number of existing trees that needed to be removed during construction.

The width/depth ratio for the channel is approximately 12, and over time the channel may narrow slightly to more of an 'E' stream type from deposition of sediment and stream bank vegetation growth. In-stream structures included constructed riffles for grade control and aquatic habitat, as well as grade control j-hook vanes, log vanes, log jams, geo-lifts, and root wads for stream bed/bank stability and habitat diversity.

The existing, unstable channel was filled along its length using a combination of existing spoil piles that were located along the reach and fill material excavated from construction of the restored channel. Shallow vernal pools were incorporated along the filled abandoned channel to provide habitat diversity and improved detention of runoff.

Riparian buffers in excess of 50 feet were restored or protected along all of HC-R1. No stream crossings or breaks in the easement were installed along HC-R1, and permanent fencing was installed along the entire eastern edge of the easement to exclude cattle from entering the restored stream.

3.2.2 Reach HC-R2 Restoration

A Priority Level I Restoration approach continued downstream along HC-R2. The reach was constructed beyond the existing right bank in existing pasture and again as close as possible to the existing tree line as previously described for HC-R1. In the downstream portion of the reach, a Priority Level II Restoration approach was utilized to lower the stream to the existing bed elevation. These approaches allowed for the restoration of a stable channel form with appropriate bedform diversity, as well as improved channel function through improved aquatic habitat, more frequent overbank flooding, the restoration of riparian and terrestrial habitats, exclusion of cattle and associated pollutants, and decreased sediment loss from bank erosion. The upstream Priority Level I channel section was constructed as a Rosgen 'C5' stream type with a width/depth ratio of 16, though that may narrow slightly over time. The channel transitions to a Rosgen 'Bc' stream type in the downstream Priority Level II section. The mature trees along the channel were preserved whenever possible and the riparian buffers in excess of 50 feet were restored or protected along the entire reach.

At the downstream Priority II section of the reach, the restored channel transitions down to the elevation of Hurricane Creek near the road crossing; therefore constructed riffle structures and rock cross vanes were installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision. Along this downstream transition section the channel banks were graded back to stabilize slopes, bankfull benches were incorporated where possible, and riparian vegetation was re-established.

Riparian buffers in excess of 50 feet were restored along all of HC-R2. The existing ford crossing in the upstream portion of HC-R2 was improved with the addition of Class B stone topped with ABC stone, and permanent fencing was installed along both sides of the easement to exclude cattle from entering the restored stream.

3.2.3 Reach HC-R3 Enhancement

Work on HC-R3 involved a Level II Enhancement approach for the majority of the reach. Likely due to the presence of bank vegetation along much of this reach, the stream showed minimal channel incision. Level II Enhancement provided additional stability to both dimension and profile. Minor channel bank stabilization and in-stream structures including log jams and log weirs were installed to enhance bedform morphology for the portions of the reach where the channel had been most impacted.

A new, culverted crossing was also installed at the beginning of the reach to provide stable access across to the upstream portion of the property. This crossing was designed to pass a 10-year event, with excess capacity on the floodplain to pass larger events without damaging the crossing.

Riparian buffers in excess of 50 feet were restored or protected along all of HC-R3. Additionally, fencing was installed along the northern edge of the easement to permanently exclude cattle from entering the stream.

3.2.4 Reach UT4-R1a Preservation

Preservation was implemented for the upstream portion of reach UT4-R1 to the existing powerline easement. The stream and riparian buffer are currently stable and no future developments or impacts are expected within the upper watershed. No work was performed along this reach and the existing stream and forested riparian buffer are protected within a permanent conservation easement.

3.2.5 Reach UT4-R1b Restoration

Continuing downstream of the powerline easement crossing, the restoration followed a Rosgen Priority Level I approach in the upstream portion, transitioning into a Priority Level II approach at the confluence with UT4-R5. The active headcut at the crossing was also stabilized. In-stream structures such as log step pools, log jams, log vanes, and constructed riffle structures were installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision.

The restored channel was built as a Rosgen 'C5' stream type with a width/depth ratio of approximately 14, though the channel will likely narrow slightly over time. The existing, unstable channel was filled along its length using a combination of existing spoil piles that were located along the reach as well as fill material excavated from construction of the restored reach.

The existing pipe culvert crossing in the powerline easement was replaced with a larger diameter pipe and the crossing improved with Class B stone to allow stable landowner access. Riparian buffers in excess of 50 feet were restored or protected along all of UT4-R1b.

3.2.6 Reach UT4-R2 Restoration

A Priority Level I Restoration approach continued along UT4-R2. The reach was constructed beyond the existing left bank in existing pasture. The implemented techniques allowed for the restoration of a stable channel form with appropriate bedform diversity, as well as improved channel function through more frequent overbank flooding, the restoration of riparian and terrestrial habitats, the exclusion of cattle and associated pollutants, and decreased sediment loss from bank erosion. This reach was built as a meandering Rosgen 'C5' stream type with a channel width/depth ratio of approximately 13. In-stream structures installed included log vanes, root wads, geo-lifts and constructed riffle structures used to control grade, dissipate energy, eliminate incision, promote habitat and bedform diversity, and stabilize banks. The mature trees along the existing channel were preserved wherever possible and the riparian buffers in excess of 50 feet were restored or protected along the entire reach.

At the downstream end of the reach, the restored channel was connected to the bed elevation at the UT4-R3/UT4-R4 confluence; therefore, a series of log jams were installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision. Along this downstream transition section, the channel banks were graded to stable slopes in many locations.

The existing, unstable channel was filled along its length using a combination of existing spoil piles that were located along the reach and fill material excavated from the construction of the restored channel. Vernal pools were incorporated along the filled abandoned channel to provide habitat diversity and improve detention of runoff.

Riparian buffers in excess of 50 feet were restored or protected along all of UT4-R2. The existing ford crossing was improved with the addition of Class B stone topped with ABC stone, and permanent fencing was installed to exclude cattle from entering the restored stream.

3.2.7 Reach UT4-R3 Restoration

A Priority Level III approach was utilized for reach UT4-R3, which begins at the confluence of UT4-R2 and UT4-R4. The channel throughout this shorter section remained a Rosgen 'Gc' stream type, but with a post construction width/depth ratio of 6.4. A lighter touch was used on this reach from the initial design due to the presence of existing mature trees along both banks. While this reach remains incised, its degree of incision has been reduced, and it is stable due to the extensive presence and further establishment of vegetation in and along the channel banks.

The restored channel transitions down to the existing bed elevation near the project boundary and rock step pools, rock cross vanes, and constructed riffle structures were installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision. To promote stability along this reach, channel banks were graded back along much of the left bank, while the mature trees already established along the channel were preserved wherever possible. Additionally, bankfull benches were incorporated in a few locations. Riparian buffers in excess of 50 feet were restored or protected along the entire reach. Permanent fencing was also installed along the western easement boundary to prevent cattle from entering the restored channel.

3.2.8 Reach UT4-R4 Restoration

Restoration in this section primarily followed a Priority Level I approach. In the shorter upstream section above the crossing (UT4-R4a), degraded channel banks were graded back to stable slopes and in-stream structures such as log weirs, log jams, and step pools were installed to control grade, dissipate energies, promote stability, and improve bedform and habitat diversity.

Below the stream crossing, the restored channel (UT4-R4b) was built as a Rosgen 'C5' stream type with a width/depth ratio of approximately 14. The restored channel meanders across the historic floodplain before its confluence with UT4-R2, transitioning into UT4-R3. In-stream structures such as geo-lifts, log jams, log vanes, root wads, and constructed riffle structures were used to control grade, dissipate energy, eliminate incision, promote habitat and bedform diversity, and stabilize banks. The existing, unstable channel was filled along its length using material excavated from construction of the restored channel, with a few vernal pools incorporated along its length.

The existing ford crossing between UT4-R4a and UT4-R4b was improved with Class B stone topped with ABC stone to allow for a stable crossing. This crossing will be used for cattle movement during scheduled grazing rotation and cattle will not have unrestricted access. Riparian buffers in excess of 50 feet were restored or protected along the entire reach length, and permanent fencing was installed to prevent cattle from entering the restored channel.

3.2.9 Reach UT4-R5 Enhancement

Work on UT4-R5 involved a Level I Enhancement approach throughout the reach. Due to the presence of bank vegetation along some of the reach sections, the stream showed minimal channel incision or downcutting, thus Level I Enhancement was proposed to restore a more stable dimension and profile. Localized channel bank regrading and stabilization was performed, and in-stream structures such as log jams, log weirs, log vanes, and constructed rock riffles were installed to enhance bedform morphology for the portions of the reach where the riparian buffer and/or channel had been impacted or where active headcuts were stabilized. Additionally, several small, incised drainages flowing into the channel were graded and stabilized. Riparian buffers in excess of 50 feet were restored and/or protected along all of UT4-R5. Existing wetlands are located throughout the buffer in the uppermost section (UT5-R5a), and ephemeral pools are common here, especially along the right floodplain.

3.3 Project History, Contacts, and Attribute Data

Baker implemented the project under a full delivery contract with DMS to provide stream mitigation credits in the Yadkin River Basin. The chronology of the project is presented in Table 2. The contact information for all designers, contractors, and relevant suppliers is presented in Table 3. Relevant project background information is presented in Table 4. Tables 2, 3, and 4 are located in Appendix A of this report. As-built stationing is outlined in the Construction Summary, below, and in Table 1 in Appendix A.

3.3.1 Construction Summary

In accordance with the approved Mitigation Plan and regulatory permits, construction activities began in early November 2014 with site preparation, installation of sedimentation and erosion control measures, and the establishment of staging areas, haul roads, and stockpile areas. The construction contractor was River Works, Inc. (River Works). Actual in-stream structure location and placement varied slightly from the design plans in various sections (as described below) due to unexpected field conditions such as shallow bedrock or adjacent springs/seeps, as well as to improve vertical or lateral stability at a given location. Any substitutions and/or relocations were made based on existing field conditions and best professional judgment. The as-built plan sheets/record drawings depict actual surveyed areas for the project and show any changes from the final design plans to what was implemented on-site during construction. The as-built plan sheets/record drawings are located in Appendix C.

Channel construction first began at the Hurricane Creek site in mid-November on the upstream portion of HC-R1 at station 10+00 and proceeded downstream into HC-R2 towards Pleasant Grove Church Rd. At the bottom of HC-R2, a downstream beaver dam located off-site within the Pee-Dee National Wildlife Refuge backed water up in the channel. Requests to remove the dam were denied by the managers of the Refuge. With standing water backed up into the channel, the final section of off-line channel could not be constructed. Instead, the new channel was connected back into the existing channel at approximately Station 40+25 and the banks were cut back to stabilize slopes and to help reconnect the channel to its floodplain. The in-stream rock structures were still installed in this section, though with larger sized stone, in the event the dam was ever to be removed the channel would be protected from scour and potential incision.

Construction at Hurricane Creek then continued on the tributary HC-R3 at Station 10+36 and proceeded downstream to its confluence with HC-R1 at Station 16+00. A permanent culvert pipe crossing was installed in the uppermost portion of this reach to replace an unprotected ford crossing just outside the conservation easement at Station 10+00. This will provide the landowner with a stable crossing location that will not impact the restored channels downstream. Invasive species vegetation (Chinese privet) was treated in the floodplain at the intersection of HC-R3 and HC-R1. This will be an area of particular focus in all future monitoring efforts.

Upon completion of the three channel reaches and in-stream structures for the Hurricane Creek site in mid-March 2015, all vegetative plantings and coir fiber matting were installed, and permanent seeding with straw was placed in all remaining disturbed areas before mobilizing to the next project site. Permanent cattle exclusion fencing (woven wire) was installed along all reaches, with access gates as shown on the as-built plan sheets/record drawings in Appendix D. The total as-built length for all reaches on the Hurricane Creek site after construction is 4,001 LF.

Project work began on the Unnamed Tributaries (UT4) site with a separate Riverworks crew in mid-January of 2015 with all the standard site preparation, including the installation of sedimentation and erosion control measures, and the establishment of staging areas, haul roads, and stockpile areas. Actual construction began along Reach UT4-R5a at Station 09+44. Shallow bedrock was encountered for the uppermost 50 feet of this section and so little bank grading was conducted here, nor was the

proposed log weir able to be installed in this uppermost section of channel. Log jams in this upper part were substituted with rock riffles to avoid potential conflicts with the shallow bedrock, though the log weirs and an additional log vane were able to be installed. Moreover, while sections of UT4-R5a (particularly along the left bank) were graded back and stabilized with matting, the lowermost 50 feet of this section ending at a powerline easement were not graded back as it had mature trees with an established root mass growing along its banks and was deemed stable. Work then continued downstream along Reach UT4-R5b with the Enhancement Level I approach, starting past the powerline right of way at Station 14+40 and ending at the confluence with UT4-R1b at Station 30+21. Work included bank grading and installation of in-stream structures such as log weirs and log jams.

Reach UT4-R1a is Preservation only and ends at a break in the easement for a Progress Energy powerline right of way. The break also provides the landowner with a vehicular crossing for his farm equipment. As part of the restoration, the deteriorating existing pipe at the crossing was replaced with a larger 36" RCP. Construction next continued along reach UT4-R1b, where actual in-stream structure location and placement varied only slightly from the design plans: a log jam was substituted for a rock riffle at Station 13+75, a geolift with brush toe wasn't installed at Station 15+25 due to the presence of existing mature trees growing along the bank (which provided ample bank stabilization and protection), and the log weir step pool sequence beginning at Station 18+45 was moved slightly upstream to account for higher than expected backwater conditions.

Construction continued along Reach UT4-R2 at the confluence of UT4-R5b and UT4-R1b. The uppermost 120' section of this reach from the confluence to the improved rock crossing was a long, deep pool creating slight backwater conditions up into R5b and R1b. The section also had extensive mature hardwoods established along both banks. Considering the quality habitat present from the pool, and to the relative stability of this section from the trees, the channel was not realigned here as originally planned. Instead, a rock riffle was added just downstream of the confluence and a few steep banks were graded back and matted. The remainder of UT4-R2 located downstream of the improved rock crossing continued with the Priority Level I Restoration approach found upstream on UT4-R1b. The actual in-stream structure location and placement for UT4-R2 varied only slightly from the design plans: the installation of native transplants/cuttings from on-site sources into the banks at Stations 29+40, 30+50, and 31+75 could not be completed due to an unexpected lack of appropriate source plants. They were substituted with root wads in the first two locations, and a geolift with brush toe on the third.

Work on reach UT4-R3 began at the confluence of UT4-R2 and UT4-R4b utilizing a Priority Level II Restoration approach. Narrow benching was cut in several locations along the reach, and in many areas along the left bank the slopes were graded back and stabilized with matting, though there were sections where established, mature hardwoods were growing where this was not done in an effort to preserve the trees. The location of one of the boulder cross vanes was moved upstream to improve its channel stabilizing function.

Restoration work then began at the top of Reach UT4-R4 and continued downstream to the confluence with UT4-R2. Actual in-stream structure location and placement for UT4-R4 varied only slightly from the design plans. In the upper section of this reach, a single log weir was not installed due to the presence of rock at its proposed location, while an additional log weir was placed just before the rock crossing to further stabilize the channel. The location of the log jam at Station 12+00 was also adjusted downstream by roughly 20' to avoid being undermined by a small tributary flowing in from the western bank. In the lower section of the reach, an additional log weir and root wad were installed near the outfall of the drainage channel at Station 26+70 to provide additional protection and stability to the stream.

Upon completion of all the reach segments in mid-May 2015, permanent seeding with straw was placed in all remaining disturbed areas on the site. The planting of bare-root trees and shrubs in the buffer and

live stakes along the stream channels was completed in mid-March for UT4-R1, UT4-R2, and UT4-R5. Planting was completed in mid-May for the remaining reaches UT4-R3 and UT3-R4. Permanent cattle exclusion fencing (woven wire) was installed along all reaches with cattle access (UT4-R2, UT4-R3, and UT4-R4), with access gates as shown on the as-built plan sheets/record drawings in Appendix D. The total as-built length for all reaches on the UT4 site after construction is 7,211 LF.

Baker and River Works met on site in May 2015 and conducted a final walk through inspection, and generated a punch-list of final items to be completed. River Works completed this punch list and fully demobilized in early June 2015. Baker met DMS personnel onsite for a site inspection in mid-June 2015. Baker completed the installation of all monitoring devices in July of 2015.

3.3.2 Conservation Easement Boundary Adjustment

During project construction on the UT4 portion of the project, problems were discovered with the location of the conservation easement boundary at the two crossings on Reaches UT4-R2 and UT4-R1b. For the first crossing at UT4-R2 located between stations 21+11 and 21+42, Baker discovered that the southern portion of the easement break opening was located within a stand of very mature oak trees. Use of the crossing by the landowner for farm equipment would necessitate the cutting of many of these oaks. That was not a desirable option for Baker, the landowner, or DMS as that stand of mature trees was a direct example of the eventual canopy we are hoping to achieve through our buffer plantings and would serve as a great seed source for years to come. Given that the riparian buffer along this side of the stream was well in excess of 50 feet, Baker worked with DMS and the NC State Property Office (SPO) to adjust the southeastern corner of the crossing. By placing two additional pins in the boundary to cut that corner, we were able to afford enough maneuvering room for farm equipment to use the crossing without having to clear any trees (Appendix F – Figure 1). The area removed from the easement was 870 ft^2. The stream buffer along this modified corner was reduced in width for a small length, but is still a minimum of 50 feet throughout. As such, no reduction in stream credits is warranted.

For the second crossing on UT4-R1b located in a power line easement between stations 10+00 and 11+06, the proposed landowner crossing area was discovered to be located in a very wet, seasonally ponded area. The landowner expressed serious reservations about his ability to get farm equipment through this area from autumn until late spring. Field inspections of this crossing during that timeframe confirmed his concerns. The continued use of the existing crossing, a built-up path that runs next to the wet area was the logical solution to the problem, but was located within the sharply oblique angle the conservation easement makes along the power line easement in this area. Baker again worked with DMS and the SPO to adjust the northwestern corner of the crossing, to exclude the existing built-up crossing (Appendix F – Figure 2). The area removed from the easement here was 1,584 ft^2. As this portion of easement was within the riparian buffer of a section of stream not included in the project restoration (due to the oblique angle of the easement at this location), no reduction in stream credits is warranted.

A revised plat showing the easement modifications for this section of the UT4 site was prepared by a Professional Land Surveyor, and the modifications were accepted by the SPO, which issued a Partial Release of Conservation Easement document on August 18, 2016 formally acknowledging the modification. The document was recorded at the Anson County Register of Deeds on September 14, 2016 (Appendix F).

4.0 PERFORMANCE STANDARDS

Baker has obtained regulatory approval for numerous stream mitigation plans involving NCDOT and NCDMS full-delivery projects. The success criteria for the Site will follow the mitigation plan developed for this project, as well as the *Stream Mitigation Guidelines* (SMG) issued in April 2003 (USACE) and NCDMS's supplemental guidance document *Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation* dated November 7, 2011. All monitoring activities will be conducted for a period of 7 years, unless the Site demonstrates complete success by Year 5 and no concerns have been identified. An early closure provision may be requested by the provider for some or all of the monitoring components. Early closure may only be obtained through written approval from the USACE in consultation with the NCIRT.

Based on the design approaches, different monitoring methods are proposed for the project reaches. For reaches that involve a combination of traditional Restoration (Rosgen Priority Levels I and/or II) and Enhancement Level I (stream bed/bank stabilization) approaches, geomorphic monitoring methods will follow those recommended by the 2003 SMG and the 2011 NCDMS supplemental guidance. For reaches involving Enhancement Level II approaches, monitoring efforts will focus primarily on visual inspections, photo documentation, and vegetation assessments. The monitoring parameters shall be consistent with the requirements described in the Federal Rule for compensatory mitigation sites in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.5 paragraphs (a) and (b). Specific success criteria components and evaluation methods are described in Section 5.0 and report documentation will follow the NCDMS Monitoring Report template and guidance (v 1.3, dated 1/15/10).

5.0 MONITORING PLAN AND SUCCESS CRITERIA

5.1 Stream Monitoring

Geomorphic monitoring of the proposed restoration reaches will be conducted once a year for a minimum of five years but up to seven years following the completion of construction to evaluate the effectiveness of the restoration practices. Monitored stream parameters include stream dimension (cross-sections), pattern (planimetric survey), profile (longitudinal profile survey), and visual observation with photographic documentation. The success criteria for the restored reaches will follow the methods described below in sections 5.1.1 through 5.2 for each parameter. All monitoring features are shown in the as-built plan sheets/record drawings (Appendix D) as well as in Figures 4a and 4b.

5.1.1 Bankfull Events and Flooding Functions

The occurrence of bankfull events within the monitoring period will be documented by the use of crest gauges and photographs. One crest gauge was installed on the floodplain of HC-R2 at Station 34+40, and one crest gauge was installed along UT4-R2 at Station 34+80. Both gauges are within ten feet (horizontal) of the restored channels. The crest gauges will record the highest watermark between site visits. The gauges will be checked at each site visit to determine if a bankfull event has occurred. Additionally, photographs taken by automated cameras mounted near the crest gauge along Reach R2 at Hurricane Creek, and on Reach R4b at Station 18+90 at UT4 will also be used to document the occurrence of bankfull events, debris lines, and sediment deposition on the floodplain between monitoring site visits.

Two bankfull flow events must be documented within a seven-year monitoring period. These two bankfull events must occur in separate years; otherwise, the monitoring will continue until two bankfull events have been documented.

5.1.2 Cross-sections

Fifteen permanent cross-sections were installed for the project, with ten cross-sections located at riffles and five located at pools. Each cross-section was marked on both stream banks with permanent monuments using rebar to establish the exact transect used. A common benchmark will be used for cross-sections and consistently used to facilitate easy comparison of year-to-year data. The cross-section surveys will occur in Years 1, 2, 3, 5, and 7, and must include measurements of Bank Height Ratio (BHR) and Entrenchment Ratio (ER). The monitoring survey will include points measured at all breaks in slope, including top of stream banks, bankfull, inner berm, edge of water, and thalweg, if the features are present. Riffle cross-sections will be classified using the Rosgen Stream Classification System.

There should be little change in as-built cross-sections. Stable cross-sections will establish that the restoration goal of creating geomorphically stable stream cross-sections has been met. If changes do take place, they will be documented in the survey data and evaluated to determine if they represent a movement toward a more unstable condition (e.g., down-cutting or erosion) or a movement toward increased stability (e.g., settling, vegetative changes, deposition along the stream banks, or decrease in width/depth ratio). Using the Rosgen Stream Classification System, all monitored cross-sections should fall within the quantitative parameters (i.e. BHR no more than 1.2 and ER no less than 2.2 for 'C' stream types) defined for channels of the design stream type. Given the smaller channel sizes and meander geometry of the proposed steams, bank pins will not be installed unless monitoring results indicate active lateral erosion.

Reference photo transects will be taken at each permanent cross-section. Lateral photos should not indicate excessive erosion or continuing degradation of the stream banks. Photographs will be taken

of both stream banks at each cross-section. The survey tape will be centered in the photographs of the stream banks. The water line will be located in the lower edge of the frame, and as much of the stream bank as possible will be included in each photo. Photographers should make an effort to consistently maintain the same area in each photo over time.

5.1.3 Pattern

The plan view measurements such as sinuosity, radius of curvature, meander width ratio will be taken on newly constructed meanders during baseline (Year 0) only. Subsequent visual monitoring will be conducted twice a year, at least five months apart, to document any changes or excessive lateral movement in the plan view of the restored channel.

5.1.4 Longitudinal Profile

A longitudinal profile was surveyed for the entire length of restored channel after construction to document the as-built baseline conditions only. The survey was tied to a permanent benchmark and measurements collected included thalweg, water surface, bankfull, and top of low bank. Each of these measurements was taken at the head of each feature (e.g., riffle, pool) and at the maximum pool depth. The longitudinal profile should show that the bedform features installed are consistent with intended design stream type. Longitudinal profiles will not be taken during subsequent monitoring years unless vertical channel instability has been documented or remedial actions/repairs are deemed necessary. These measurements will demonstrate that the restored stream profile provides more bedform diversity than the old channel with multiple natural features (such as pools and riffles) that provide improved aquatic habitat, as per the restoration objectives.

5.1.5 Bed Material Analysis

After construction, there should be a minimal change in the pebble count data or particle size distribution over time given the current watershed conditions and future upstream sediment supply regime. Since the streams are predominantly sand bed systems with minimal gravel, significant changes in particle size distribution are not expected. A representative sample will be collected in Hurricane Creek (HC-R2) and UT4 (Reach UT4-R4b) in locations where constructed riffles were installed as part of the project. The post-construction riffle pebble count samples will be compared to those collected during subsequent monitoring years. Any significant changes (i.e.; aggradation, degradation, embeddedness) will be noted after stream bank vegetation becomes established and a minimum of two bankfull flows or greater have been documented.

5.1.6 Visual Assessment

Visual monitoring assessments of all stream sections will be conducted by qualified personnel twice per monitoring year with at least five months in between each site visit for each year of monitoring. Photographs will be used to visually document system performance and any areas of concern related to stream bank and bed stability, condition of in-stream structures, channel migration, headcuts, live stake mortality, impacts from invasive plant species or animal species, and condition of pools and riffles. This monitoring will be summarized in the Visual Stream Morphology Stability Assessment Table and the Vegetation Conditions Assessment Table, which are used to better document and quantify the visual assessment.

A series of photos over time will be also be used to subjectively evaluate channel aggradation (bar formations) or degradation, stream bank erosion, successful maturation of riparian vegetation, and effectiveness of sedimentation and erosion control measures. More specifically, the longitudinal photos should indicate the absence of developing mid channel or lateral bars within the channel or excessive increase in channel depth, while lateral photos should not indicate excessive erosion or continuing degradation of the banks. The photographs will be taken from a height of approximately five to six feet from the same locations and view directions on the site for each monitoring period, and will be

shown on plan view maps in subsequent monitoring reports. The visual monitoring effort will be conducted per DMS's annual monitoring report guidance (v1.5, June 2012).

5.1.7 Flow Documentation

Monitoring of flow will be conducted to demonstrate that the restored stream systems classified as intermittent exhibit base flow for 30 consecutive days during some portion of the year during a year with normal rainfall conditions. In order to determine if rainfall amounts are normal for the given year, data will be obtained from the Anson County WETS Station and from the automated weather station (Wadesboro, COOP 318964 and Anson County Airport (KAFP-AWOS), approximately two miles south of the site. If a normal year of precipitation does not occur during the first seven years of monitoring, Baker will continue to monitor flow conditions on the site until it documents that the intermittent streams have been flowing during the appropriate times of the year.

The restored intermittent reaches for this project include Reaches R1b and R4 on the UT4 site, as well as Reaches R1 and R2 on the Hurricane Creek site. To document flow at UT4, in-stream flow gauges (pressure transducers) were installed in Reach R1b at Station 14+90, and in Reach R4b at Station 18+80. Additionally, the automated cameras installed along Reach R4b at near the flow gauge at UT4, and along Reach R2 at Hurricane Creek will collect a series of regular and continuous photos over time to illustrate water levels within the channel, and will be included in the annual monitoring reports as part of the visual monitoring effort.

5.2 Vegetation Monitoring

Successful restoration of the vegetation on a site is dependent upon hydrologic restoration, planting of preferred canopy species, and volunteer regeneration of the native plant community. In order to determine if the criteria are achieved, vegetation monitoring quadrants were installed and will be monitored across the project in accordance with the CVS-DMS Protocol for Recording Vegetation – Level 1-2 Plot Sampling, Version 4.2 (2008), and the total number of quadrants were calculated using the CVS-DMS Entry Tool Database version 2.3.1 (CVS-DMS, 2012). The sizes of individual quadrants are 100 square meters. A total of sixteen vegetation plots were installed throughout the project as per the protocol for Level 1-2 Plot Sampling. The individual vegetation monitoring plots are 100 square meters in size.

Vegetation monitoring will occur in the fall, prior to the loss of leaves. Individual quadrant data will be provided and will include species diameter, height, density, and coverage quantities. Individual seedlings have be marked such that they can be found in succeeding monitoring years. Mortality will be determined from the difference between the previous year's living, planted seedlings and the current year's living, planted seedlings.

The planting of live-stakes and bare-root trees and shrubs was completed in mid-March for all of the Hurricane Creek site and for Reaches UT4-R1b, UT4-R5a, UT4-R5b, and UT4-R2 on the UT4 site. Planting was completed in mid-May for the remaining Reaches UT4-R3, UT4-R4a, and UT4-R4b. All monitoring devices were installed on both sites in early July 2015. At the end of the first full growing season (March 6th to November 29th) from baseline/year 0, or after 180 days from planting, species composition, stem density, and survival will be evaluated. The vegetation plots shall be monitored annually for seven years, or until the final success criteria are achieved. The interim measure of vegetative success for the site will require the survival of at least 320, 3-year old, planted trees per acre at the end of year three of the monitoring period. At year five, density must be no less than 260, 5-year old, planted trees per acre. The final vegetative success criteria will be the survival of 210, 7-year old, planted trees per acre at the end of the seven-year monitoring period, which must average 10 feet in height. However, if the performance standard is met by Year 5 and stem densities are greater than 260, 5-year old stems/acre,

vegetation monitoring may be terminated with approval by the USACE and the Interagency Review Team (IRT).

While measuring species density and height is the current accepted methodology for evaluating vegetation success on mitigation projects, species density and height alone may be inadequate for assessing plant community health. It is understood by the IRT that some smaller tree species, such as *Carpinus caroliniana* and some slow growing *Quercus* species, will be unlikely to meet height targets after seven years. For this reason, the vegetation monitoring plan will incorporate the evaluation of additional plant community indices, native volunteer species, and the presence of invasive species vegetation to assess overall vegetative success.

The presence of exotic invasive plant species will be visually assessed semi-annually and controlled by mechanical and/or chemical methods if necessary. Their locations will be shown on the Current Conditions Plan View figures in the annual monitoring reports. Any invasive plant species control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.

Baker will provide required remedial action on a case-by-case basis, such as: replanting more wet/drought tolerant species vegetation, conducting beaver and beaver dam management/removal, or removing undesirable/invasive species vegetation, and will continue to monitor vegetation performance until the corrective actions demonstrate that the site is trending towards or meeting the standard requirement. Existing mature woody vegetation will be visually monitored during annual site visits to document any mortality, due to construction activities or changes to the water table, that negatively impact existing forest cover or favorable buffer vegetation.

Additionally, herbaceous vegetation, primarily native species grasses, seeded/planted throughout the site. During and immediately following construction activities, all ground cover at the project site was in compliance with the NC Erosion and Sedimentation Control regulations and applicable permitting requirements.

5.3 Wetland Monitoring

No wetlands were proposed for the Site. Therefore, no wetland monitoring is required.

5.4 Stormwater Management Monitoring

No stormwater BMPs were proposed for the Site. Therefore, no stormwater BMP monitoring is required.

6.0 AS-BUILT DATA DOCUMENTATION

Stream and vegetation components will be monitored for seven years post-construction to evaluate project success, unless the Site demonstrates complete success by Year 5 and no areas of concern have been identified. The specific locations of vegetation plots, flow/crest gauges, flow cameras, and cross-sections are shown on the as-built plan sheets/record drawings.

6.1 Stream Data

For monitoring stream success criteria, a total of fifteen permanent cross-sections were installed along the two sites. The permanent cross-sections will be used to monitor channel dimension and bank stability over time.

To provide a baseline for evaluating changes in bed conditions over time, cross-sectional and longitudinal surveys were completed for the stream channels following construction. The as-built permanent cross-sections (with photos) and as-built longitudinal data as well as the quantitative pre-construction, reference reach, and design data used to determine restoration approach are provided in Appendix B.

Two post-construction as-built pebble count samples were also collected following project completion. The riffle pebble count samples were taken along HC-R2 and UT4-R4b in constructed riffles, and the results are provided in Table 5 of Appendix B.

To document above bankfull events, two crest gauges were installed along the restored channels on HC-R2 and UT4-R4b. To monitor and evaluate channel flow conditions throughout the year in the restored intermittent reaches, a combination of automated photographic documentation and flow data loggers (in-stream pressure transducers) will be used. The flow cameras are stationed along the top of banks and the pressure transducers and located along the thalweg of the channel near the camera location. For the UT4 site, specific monitoring devices installed include one automated flow camera (a Bushnell-brand wildlife camera) and one in-stream pressure transducer on UT4-R4b, and an in-stream pressure transducer along UT4-R1b. For the Hurricane Creek site, an automated camera was installed near the crest gauge along HC-R2.

The locations of the permanent cross-sections, crest gauges, flow cameras, and in-stream pressure transducers are shown on the as-built plan sheets/record drawings found in Appendix D. Photographs of the selected areas of the restored reaches are provided in Appendix E.

6.2 Vegetation Data

Bare-root trees and shrubs were planted within restoration and enhancement areas of the conservation easement. A minimum 50-foot buffer was established and/or protected along both banks of all stream reaches.

Planting of the Hurricane Creek portion of the project was completed in March 2015, and included all buffer bare-root trees and shrubs as well as live-staking along the stream channel. To monitor vegetation success along the Hurricane Creek reaches, five vegetation monitoring plots were established within the planted riparian buffer areas.

The planting of bare-root trees, shrubs and live stakes along the UT4 portion of the project occurred in two phases for the site. The first planting occurred along UT4-R1, UT4-R2, and UT4-R5, which was completed in March 2015. The second planting took place along UT4-R3 and UT4-R4 and was completed in mid-May 2015. To monitor vegetation success along the UT4 reaches, eleven vegetation monitoring plots were established within the planted riparian buffer areas.

The Mitigation Plan for the Site specifies that the number of quadrants required shall be based on the CVS-DMS Protocol for Recording Vegetation, Version 4.2 (2008), and the total number of quadrants were calculated using the CVS-DMS Entry Tool Database version 2.3.1 (CVS-DMS, 2012). The sizes of individual quadrants are 100 square meters. A total of sixteen vegetation plots were installed throughout the project. The initial planted density within each of the vegetation monitoring plots is provided in Table 8. The average density of planted bare root stems, based on the data from the sixteen vegetation monitoring plots, is 756 stems per acre. The locations of the vegetation plots are shown on the as-built plan sheets/record drawings found in Appendix D.

6.3 Areas of Concern

No areas of concern are noted at this time.

7.0 MAINTENANCE AND CONTINGENCY PLANS

Maintenance requirements vary from site to site and are generally driven by the following conditions:

- Projects without established, woody floodplain vegetation are more susceptible to erosion from floods than those with a mature, hardwood forest.
- Projects with sandy, non-cohesive soils are more prone to bank erosion than cohesive soils or soils with high gravel and cobble content.
- Alluvial valley channels with access to their floodplain are less vulnerable to erosion than channels that have been disconnected from their floodplain.
- Wet weather during construction can make accurate channel and floodplain excavations difficult.
- Extreme and/or frequent flooding can cause floodplain and channel erosion.
- Extreme hot, cold, wet, or dry weather during and after construction can limit vegetation growth, particularly temporary and permanent seed.
- The presence and aggressiveness of invasive vegetation species can affect the extent to which a native species vegetation buffer can be established.
- The presence of beaver can affect vegetation survivability and stream function.

The Site will be monitored on a regular basis and as well as a physical inspection of the Site at least twice per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Maintenance issues and recommended remediation measures will be detailed and documented in the post-construction monitoring reports. Factors that may have caused any maintenance needs, including any of the conditions listed above, shall be discussed. Routine maintenance will be most likely in the first two years following site construction and may include the following components as described below.

7.1 Streams

Routine channel maintenance and repair activities may include modifying in-stream structures to prevent piping, securing loose coir matting, and supplemental installations of live stakes and other target vegetation along the project reaches. Areas of concentrated stormwater and floodplain flows that intercept the channel may also require maintenance to prevent stream bank failures and head-cutting until vegetation becomes established.

7.2 Wetland

No wetland mitigation was proposed for the Site; therefore, no such maintenance is required.

7.3 Vegetation

Vegetation will be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, and fertilizing. Exotic invasive plant species will controlled by mechanical and/or chemical methods. Any invasive plant species control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.

7.4 Site Boundary

Site boundaries will be demarcated in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis.

7.5 Farm Road Crossing

The farm road crossings within the Site may be maintained only as allowed by the recorded Conservation Easement, deed restrictions, rights of way, or corridor agreements.

7.6 Beaver Management

Routine maintenance and repair activities caused by beaver activity may include supplemental planting, pruning, and dam breeching/dewatering and/or removal. Beaver management will be performed in accordance with US Department of Agriculture (USDA) rules and regulations using accepted trapping and removal techniques only within the project boundary.

8.0 REFERENCES

Carolina Vegetation Survey (CVS) and NC Division of Mitigation Services (DMS), CVS-DMS Data Entry Tool v. 2.3.1. University of North Carolina, Raleigh, NC. 2012.

Lee, M., Peet R., Roberts, S., Wentworth, T. CVS-DMS Protocol for Recording Vegetation: Level 1-2 Plot Sampling Only, Version 4.2, 2008.

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Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina, third approximation. North Carolina Natural Heritage Program. Division of Parks and Recreation, NCDENR. Raleigh, NC.

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APPENDIX A

Figures 1 - 4, Tables 1 - 4

Table 1. Project Components and Mitigation Credits

Brown Creek Tributaries Restoration Project: DMS Project No ID. 95351

Mitigation Credits

	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset
Type	R	RE							
Totals	9,753.9	103.6							

Project Components

Project Component or Reach ID	Stationing/ Location [1]	Existing Footage/ Acreage (LF)	Approach	Restoration/ Restoration Equivalent (SMU)	Restoration Footage or Acreage (LF)	Mitigation Ratio
HC-R1	10+00 - 30+43	1,896	Restoration	2,043	2,043	1:1
HC-R2	30+43 - 30+52 & 30+82 - 44+67	1,288	Restoration	1,394	1,394	1:1
HC-R3	10+36 - 16+00	579	Enhancement Level II	225.6	564	2.5:1
UT4-R1a	10+00 - 15+18	518	Preservation	103.6	518	5:1
UT4-R1b	11+07 - 19+64	906	Restoration	858	858	1:1
UT4-R2	19+64 - 21+11 & 21+42 - 38+23	1,673	Restoration	1,828	1,828	1:1
UT4-R3	28+92 - 31+42	244	Restoration	250	250	1:1
UT4-R4a	10+00 - 13+96	395	Restoration	396	396	1:1
UT4-R4b	14+28 - 25+23 & 25+43 - 28+92	1,392	Restoration	1,444	1,444	1:1
UT4-R5a	09+44 - 13+35	386	Enhancement Level I	260.7	391	1.5:1
UT4-R5b	14+40 - 30+22	1,535	Enhancement Level I	1,054.7	1,582	1.5:1

Component Summation

Restoration Level	Stream (LF)	Riparian Wetland (AC)		Non-riparian Wetland (AC)	Buffer (SF)	Upland (AC)
		Riverine	Non-Riverine			
Restoration	8,213					
Enhancement I	1,973					
Enhancement II	564					
Preservation	518					

BMP Elements

Element		Location	Purpose/Function	Notes

BMP Elements: BR= Bioretention Cell; SF= Sand Filter; SW= Stormwater Wetland; WDP= Wet Detention Pond; DDP= Dry Detention Pond; FS= Filter Strip; S= Grassed Swale; LS= Level Spreader; NI=Natural Infiltration Area

[1] All powerline easements and cattle/vehicular crossings were excluded from the conservation easement boundary and so no credit reductions are associated with those features.

Table 2. Project Activity and Reporting History			
Brown Creek Tributaries Restoration Project: DMS Project No ID. 95351			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan Prepared	N/A	N/A	Jan-14
Mitigation Plan Amended	N/A	N/A	Mar-14
Mitigation Plan Approved	Nov-13	N/A	Jun-14
Final Design – (at least 90% complete)	N/A	N/A	Jun-14
Construction Begins	Sep-13	N/A	Nov-14
Temporary S&E mix applied to entire project area	Jul-14	N/A	May-15
Permanent seed mix applied to entire project area	Jul-14	N/A	May-15
Planting of live stakes	Jul-14	N/A	May-15 *
Planting of bare root trees	Jul-14	N/A	May-15 *
End of Construction	Jul-14	N/A	May-15
Survey of As-built conditions (Year 0 Monitoring-baseline)	Jul-14	Jul-15	Jul-15
Baseline Monitoring Report	Feb-15	Jul-15	Nov-16 **
Year 1 Monitoring	Dec-15	Feb-16	N/A
Year 2 Monitoring	Dec-16	Nov-16	N/A
Year 3 Monitoring	Dec-17	N/A	N/A
Year 4 Monitoring	Dec-18	N/A	N/A
Year 5 Monitoring	Dec-19	N/A	N/A
Year 6 Monitoring	Dec-20	N/A	N/A
Year 7 Monitoring	Dec-21	N/A	N/A

* All of HC and Reaches R1, R2, and R5 for UT4 were planted in March, while Reaches R3 and R4 were planted in mid-May for UT4.

** As-built / Baseline Report submission was delayed due to conservation easement adjustment issues.

Table 3. Project Contacts **Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351**	
Designer	
Michael Baker Engineering, Inc.	797 Haywood Rd, Suite 201 Asheville, NC 28806 Contact: Jake Byers, Tel. 828-412-6101
Construction Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Planting Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Seeding Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Seed Mix Sources Nursery Stock Suppliers	Green Resources, Tel. 336-855-6363 Mellow Marsh Farm, 919-742-1200 ArborGen, 843-528-3204
Monitoring Performers	
Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 600 Cary, NC 27518 Contact: Scott King, Tel. 919-481-5731
Stream Monitoring Point of Contact	Scott King, Tel. 919-481-5731
Vegetation Monitoring Point of Contact	Scott King, Tel. 919-481-5731

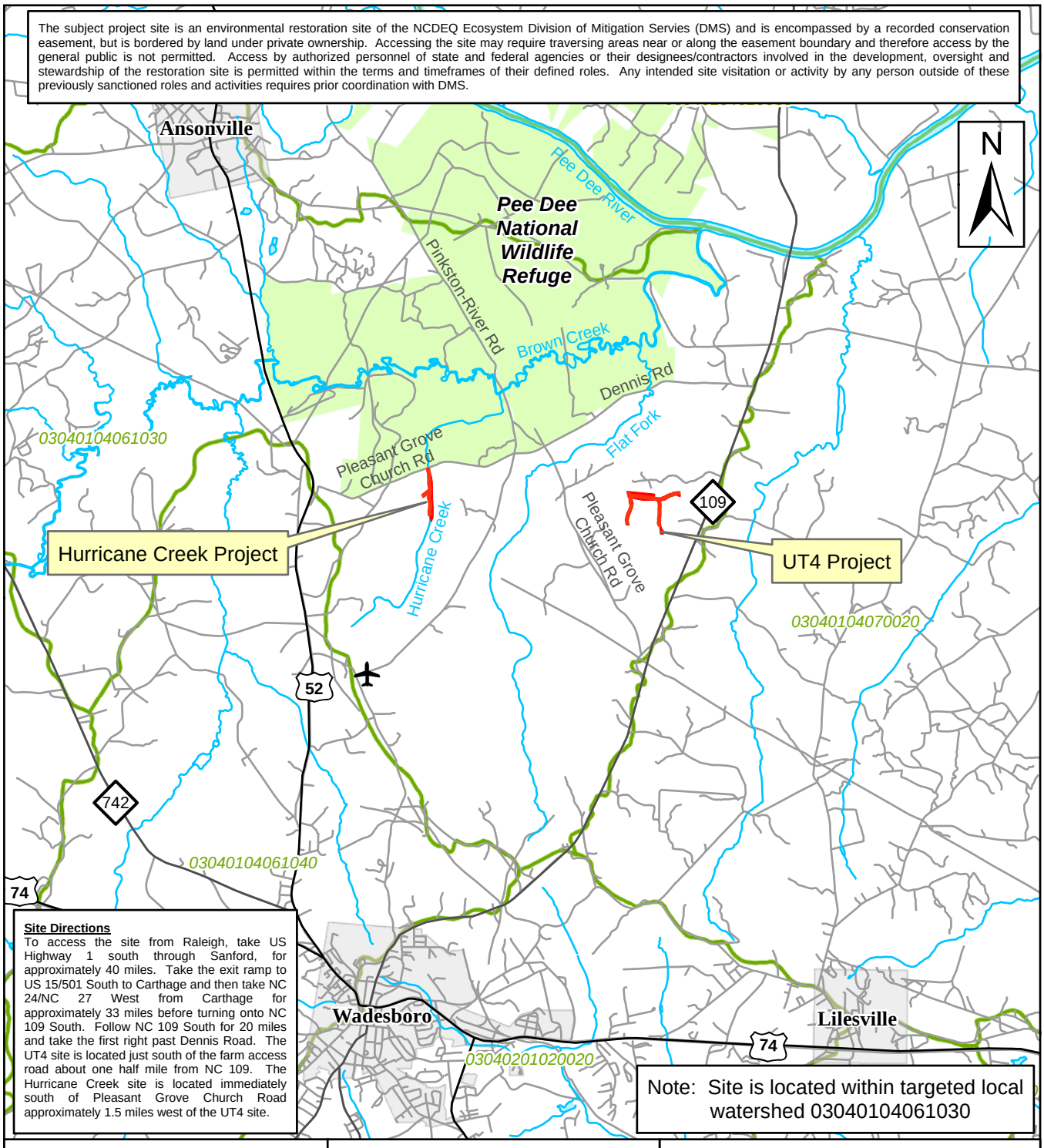
Table 4a. Project Attribute Information - Hurricane Creek (Pre-Construction) Brown Creek Tributaries Restoration Project Stream Mitigation Plan - DMS Project No. 95351			
Project Information			
Project Name	Brown Creek Tributaries Restoration Project – Hurricane Creek		
County	Anson		
Project Area (acres)	14.1		
Project Coordinates (latitude and longitude)	35.0498 N, -80.0665 W		
Watershed Summary Information			
Physiographic Province	Piedmont		
Geologic Unit	Triassic Basin		
River Basin	Yadkin		
USGS Hydrologic Unit 8-digit and 14-digit	03040104 / 03040104061030		
NCDWR Sub-basin	03-07-10		
Project Drainage Area (acres)	1,383		
Project Drainage Area Percentage Impervious	2%		
CGIA / NCEEP Land Use Classification	2.01.01.01, 2.03.01, 2.99.01, 3.02 / Forest (69%) Agriculture (15%) Impervious Cover (2%)		
Stream Reach Summary Information			
Parameters	**HC-R1**	**HC-R2**	**HC-R3**
Length of Reach (linear feet)	1,347	1,384	546
Valley Classification (Rosgen)	VII	VII	VII
Drainage Area (acres)	1,077	1,383	119
NCDWR Stream Identification Score	26.5	31	23
NCDWR Water Resources Classification	Class C		
Morphological Description (Rosgen stream type)	Incised E	Incised E	G/Incised Bc
Evolutionary Trend	Incised	Incised E→G→F	Incised B → G → F
Underlying Mapped Soils	ChA	ChA	CrB
Drainage Class	Somewhat poorly drained	Somewhat poorly drained	Moderately well drained
Soil Hydric Status	Hydric	Hydric	Non-Hydric
Average Channel Slope (ft/ft)	0.0035	0.0024	0.0108
FEMA Classification	Zone AE	Zone AE	Zone AE
Native Vegetation Community	Piedmont Small Stream		
Percent Composition of Exotic/Invasive Vegetation	<5%	<5%	<5%
Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	Categorical Exclusion (Appendix B)
Waters of the United States – Section 401	Yes	Yes	Categorical Exclusion (Appendix B)
Endangered Species Act	No	N/A	Categorical Exclusion (Appendix B)
Historic Preservation Act	No	N/A	Categorical Exclusion (Appendix B)
Coastal Area Management Act (CAMA)	No	N/A	Categorical Exclusion (Appendix B)
FEMA Floodplain Compliance	Yes	Yes	Categorical Exclusion (Appendix B)
Essential Fisheries Habitat	No	N/A	Categorical Exclusion (Appendix B)

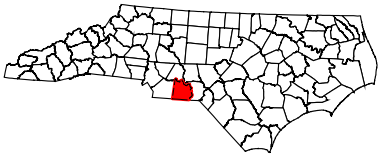
Table 4b. Project Attribute Information - UT4 (Pre-Construction)
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - DMS Project No. 95351

Project Information					
Project Name	Brown Creek Tributaries Restoration Project – UT4				
County	Anson				
Project Area (acres)	29.2				
Project Coordinates (latitude and longitude)	35.0477 N, -80.0274 W				
Watershed Summary Information					
Physiographic Province	Piedmont				
River Basin	Yadkin				
USGS Hydrologic Unit 8-digit and 14-digit	03040104 / 03040104061030				
DWR Sub-basin	03-07-10				
Project Drainage Area (acres)	974				
Project Drainage Area Percent Impervious	<2%				
CGIA / NCEEP Land Use Classification	2.01.01.01, 2.03.01, 2.99.01, 3.02 / Forest (69%) Agriculture (15%) Impervious Cover (<2%)				
Stream Reach Summary Information					
Parameters	**UT4-R1**	**UT4-R2**	**UT4-R3**	**UT4-R4**	**UT4-R5**
Length of Reach (linear feet)	1,417	1,627	242	1,716	1,564
Valley Classification (Rosgen)	VII	VII	VII	VII	VII
Drainage Area (acres)	218	706	974	267	452
NCDWR Stream Identification Score	28.5	29	32	26	23.5
NCDWR Water Resources Classification	Class C				
Morphological Description (Rosgen stream type)	F/G	Incised E	G	G	Incised Bc / C
Evolutionary Trend	Incised E → Gc → F	Bc → G → F	Bc→G→F	Incised E → G → F	Incised E → G → F
Underlying Mapped Soils	ChA	ChA	ChA	ChA, MaB	ChA
Drainage Class	Somewhat poorly drained	Somewhat poorly drained	Somewhat poorly drained	Somewhat poorly drained	Moderately well drained
Soil Hydric Status	Hydric	Hydric	Hydric	Hydric	Hydric
Average Channel Slope (ft/ft)	0.0077	0.0053	0.0009	0.0073	0.0038
FEMA Classification	N/A	Zone AE	Zone AE	Zone AE	N/A
Native Vegetation Community	Piedmont Small Stream				
Percent Composition of Exotic/Invasive Vegetation	<5%	<5%	<5%	<5%	<5%

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	Categorical Exclusion (Appendix B)
Waters of the United States – Section 401	Yes	Yes	Categorical Exclusion (Appendix B)
Endangered Species Act	No	N/A	Categorical Exclusion (Appendix B)
Historic Preservation Act	No	N/A	Categorical Exclusion (Appendix B)
Coastal Area Management Act (CAMA)	No	N/A	Categorical Exclusion (Appendix B)
FEMA Floodplain Compliance	Yes	Yes	Categorical Exclusion (Appendix B)

The subject project site is an environmental restoration site of the NCDEQ Ecosystem Division of Mitigation Servies (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activities requires prior coordination with DMS.





Anson County

Figure 1
Project Vicinity Map
Brown Creek Tributaries

NCDEQ -
Division of Mitigation Services

Michael Baker
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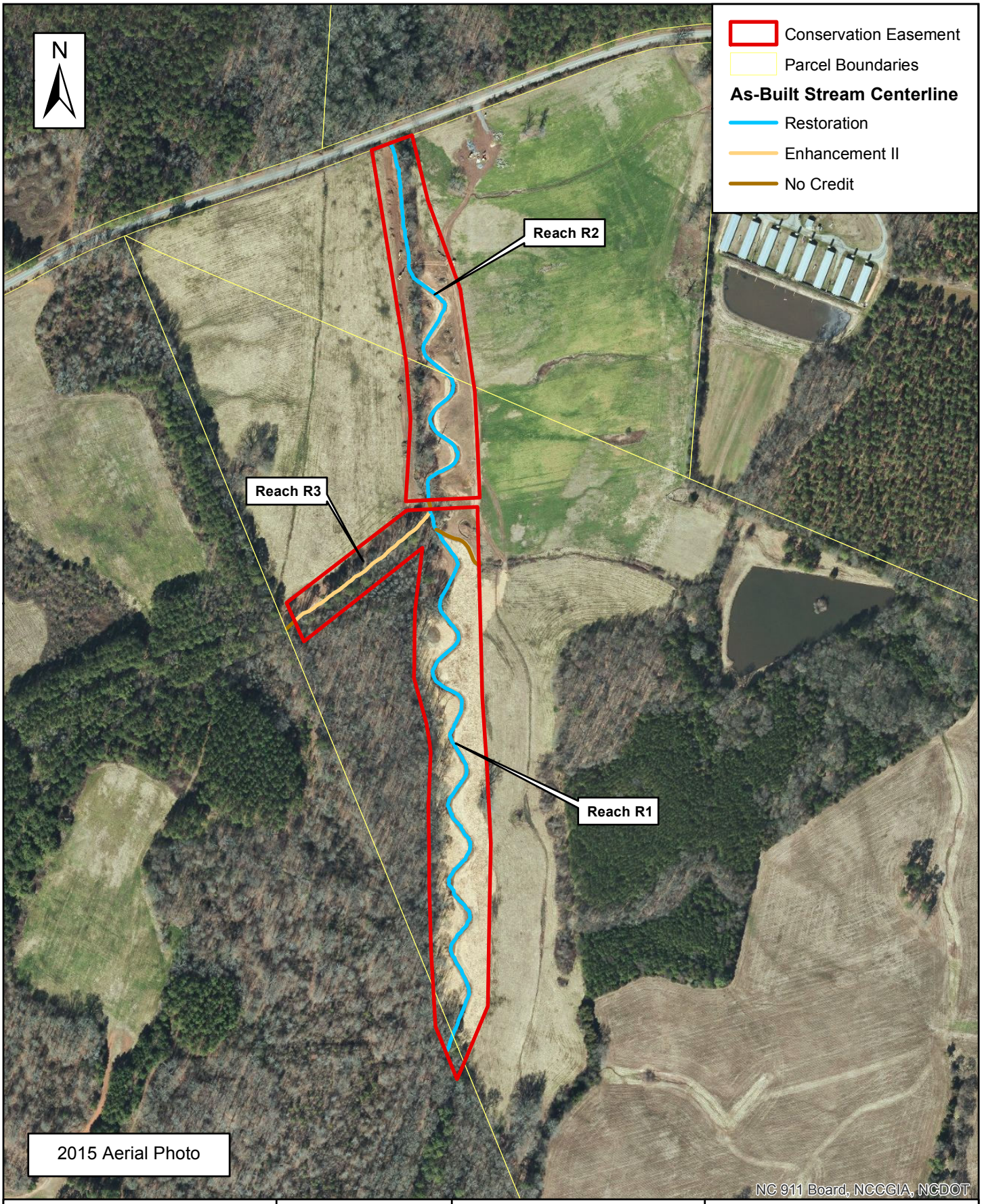
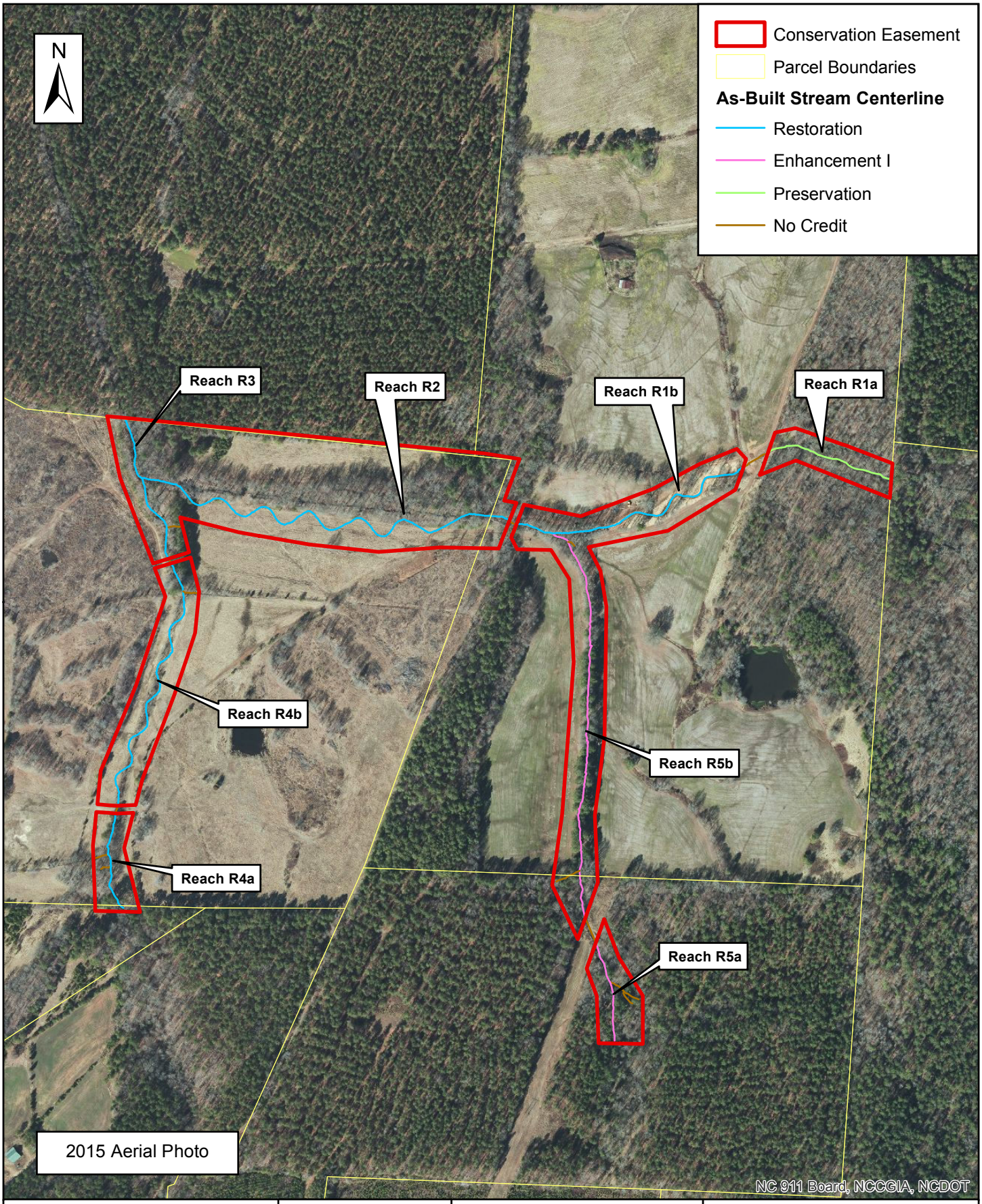
0 0.5 1 2
Miles



Michael Baker INTERNATIONAL	NCDEQ - Division of Mitigation Services	0 250 500 Feet	Figure 2a Restoration Summary Map Hurricane Creek Site

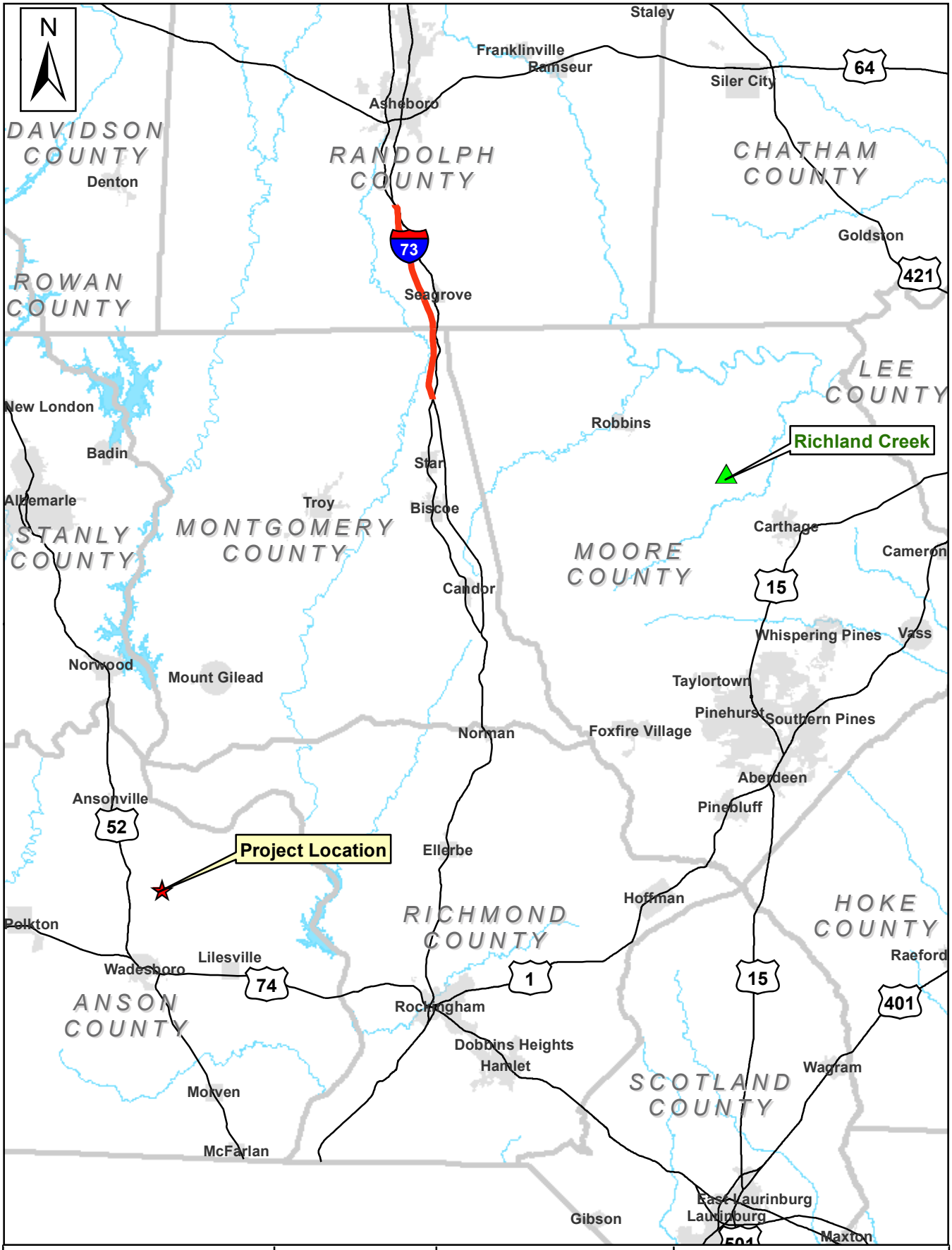


Michael Baker INTERNATIONAL

NCDEQ - Division of Mitigation Services

0 250 500 Feet

Figure 2b
Restoration Summary Map
UT4 Site



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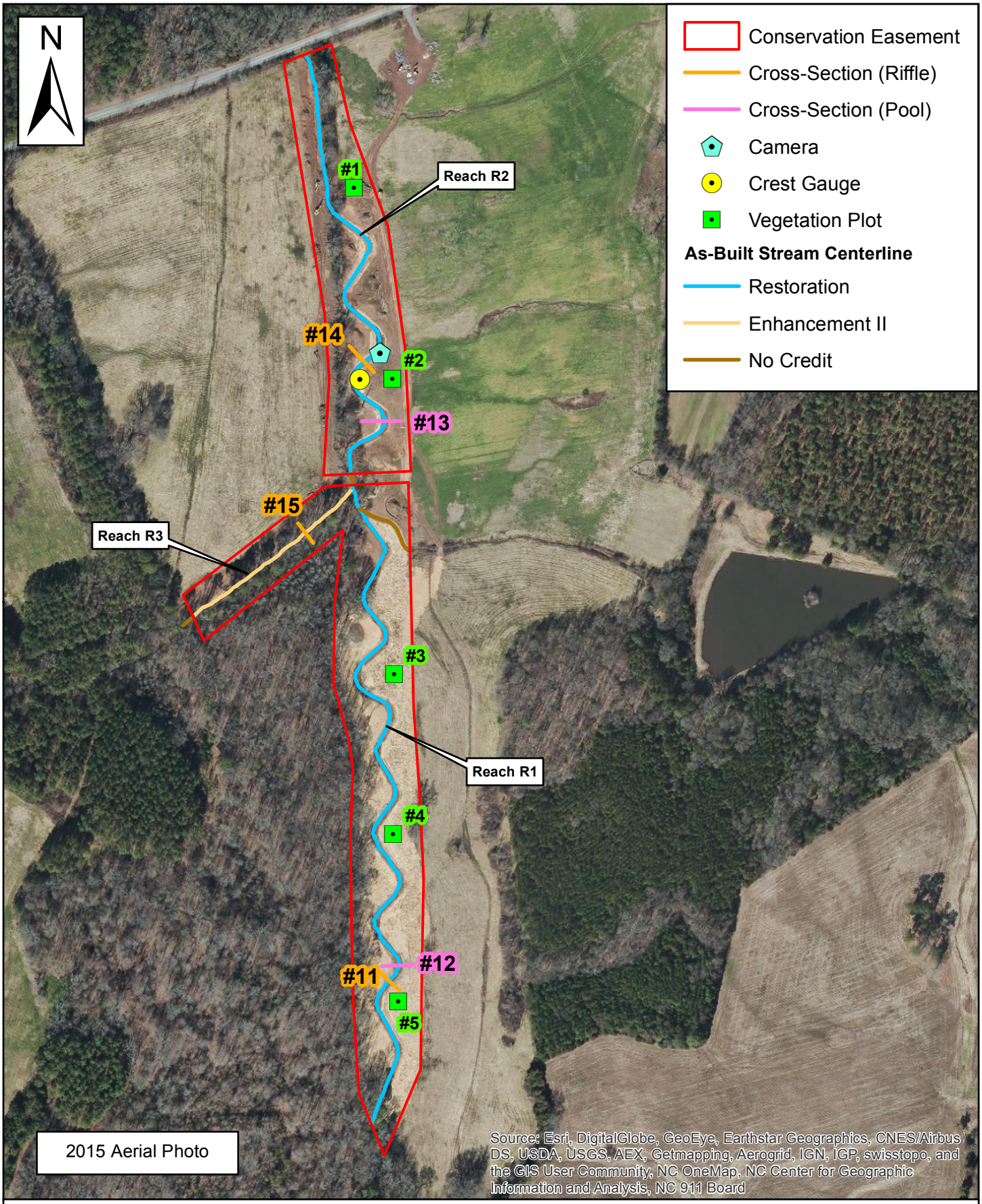
NCDEQ - Division of Mitigation Services

0 2.5 5 10 Miles

Figure 3
Reference Stream Location Map
Brown Creek Tributaries



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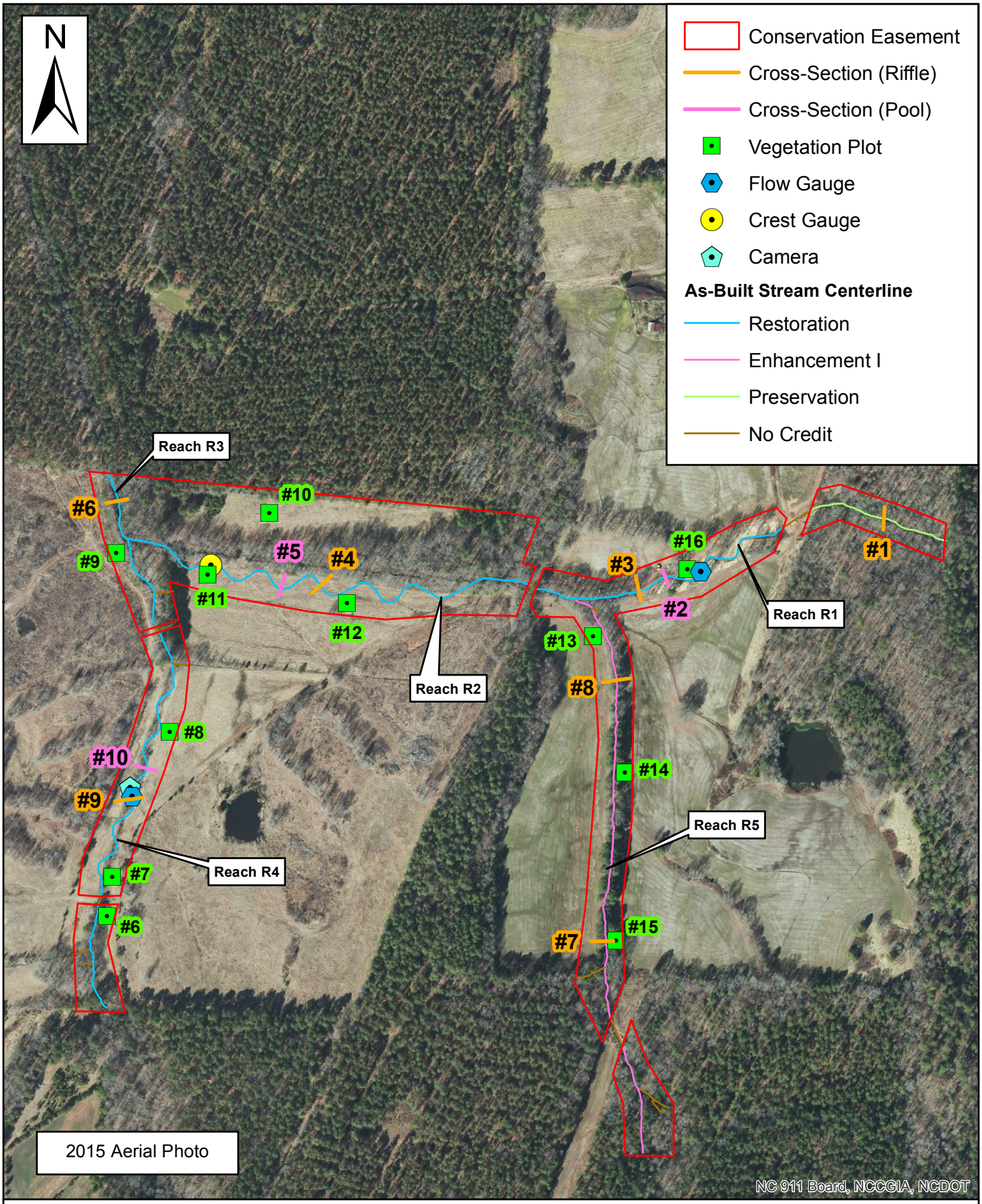
0 250 500 Feet

Figure 4a
As-Built Monitoring Features Overview Map
Hurricane Creek Site



Michael Baker INTERNATIONAL

0 250 500 Feet

Figure 4b
As-Built Monitoring
Features Overview Map
UT4 Site

APPENDIX B

Morphological Summary Data (Tables 5 and 6), Profile and Cross-Section Graphs, and Pebble Count Sheets

Table 5. Baseline Stream Summary
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351
Hurricane Creek (Reach 1) Length 2,043 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	14.8	14.9	-----	-----	-----	-----	13.5	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	19.1	-----	-----	-----	-----	-----	18.9	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	106.0	-----	-----	50.0	-----	-----	53.0	-----	-----	45.0	-----	-----	79.0	-----	-----	-----	71.2	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.3	1.8	-----	-----	-----	-----	2.2	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	1.5	-----	-----	-----	-----	-----	1.6	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	2.8	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.8	-----	-----	-----	-----	-----	2.5	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	22.5	30.5	-----	-----	-----	-----	30.0	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	28.0	-----	-----	-----	-----	-----	30.4	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	6.0	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13.0	-----	-----	-----	-----	-----	11.8	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	7.9	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	3.8	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	1.7	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	0.6	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.9	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	69	-----	-----	140	-----	-----	-----	93.0	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	39.0	-----	-----	55.0	-----	-----	-----	55.0	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	2.9	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	130.0	-----	-----	230.0	-----	-----	-----	227.0	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	3.5	-----	-----	6.5	-----	-----	-----	4.9	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	48.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0170	-----	-----	-----	-----	-----	0.0102	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	80.0	-----	-----	138.0	-----	-----	-----	133.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	3.0	-----	-----	-----	-----	-----	4.0	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			0.13 / 0.33 / 0.6 / 4.5 / 14.1						6.0 / NP,/ 45.0 / 125.0 / NP				-----	-----	-----	-----	-----	-----						
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	1.68	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	1.68	-----	-----	-----	-----	-----	1.68	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	E	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	E5/C5	-----	-----	-----	-----	-----	C5	-----	-----
BF Velocity (fps)	-----	2.9	3.9	-----	-----	-----	-----	4.3	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	87.4	129.5	194.3	-----	-----	-----	129.5	-----	-----	-----	-----	-----	N/P	-----	-----	-----	110	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1745.5	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1896	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2043.0	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.07	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.2	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0023	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0120	-----	-----	-----	-----	-----	0.0029	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0025	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0023	-----	-----	-----	-----	-----	0.0034	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 5. Baseline Stream Summary
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351
Hurricane Creek (Reach 2) Length 1,394 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	14.8	14.9	-----	-----	-----	-----	16.0	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	20.1	-----	-----	-----	-----	-----	22.5	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	162.0	-----	-----	50.0	-----	-----	53.0	-----	-----	49.0	-----	-----	85.0	-----	-----	-----	69.0	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.3	1.8	-----	-----	-----	-----	2.2	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	1.6	-----	-----	-----	-----	-----	1.4	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	3.5	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	2.0	-----	-----	-----	-----	-----	2.3	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	22.5	30.5	-----	-----	-----	-----	34.6	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	31.0	-----	-----	-----	-----	-----	31.6	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	7.4	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13.0	-----	-----	-----	-----	-----	16.1	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	10.1	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	3.1	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	1.3	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	0.3	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.9	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	74	-----	-----	150	-----	-----	-----	100.0	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	40.0	-----	-----	60.0	-----	-----	-----	55.0	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	2.4	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	140.0	-----	-----	250.0	-----	-----	-----	230.0	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	3.5	-----	-----	6.5	-----	-----	-----	4.4	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	54.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0170	-----	-----	-----	-----	-----	0.0080	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	85.0	-----	-----	149.0	-----	-----	-----	149.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	3.2	-----	-----	-----	-----	-----	2.9	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			0.11 / 0.23 / 0.3 / 1.4 / 4.0						6.0 / NP,/ 45.0 / 125.0 / NP				-----	-----	-----	-----	-----	-----			13.6 / 37.6 / 46.2 / 86.0 / 127.6			
Reach Shear Stress (competency) lb/ft^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	2.16	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	2.16	-----	-----	-----	-----	-----	2.16	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	E	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	E5/C5	-----	-----	-----	-----	-----	C5	-----	-----
BF Velocity (fps)	-----	2.9	3.9	-----	-----	-----	-----	4.4	-----	-----	-----	-----	-----	N/P	-----	-----	-----	4.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	87.4	129.5	194.3	-----	-----	-----	155.0	-----	-----	-----	-----	-----	N/P	-----	-----	-----	130	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1159.0	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1288	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1393.0	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.07	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.2	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0023	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0120	-----	-----	-----	-----	-----	0.0029	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0025	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0023	-----	-----	-----	-----	-----	0.0034	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 5. Baseline Stream Summary
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

Hurricane Creek (Reach 3) Length 564 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	16.6	16.6	-----	-----	-----	-----	5.7	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	9.1	-----	-----	-----	-----	-----	5.9	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	9.1	-----	-----	50.0	-----	-----	53.0	-----	-----	21.0	-----	-----	36.0	-----	-----	-----	10.0	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.4	1.9	-----	-----	-----	-----	1.0	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	0.8	-----	-----	-----	-----	-----	0.8	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.3	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	26.8	36.2	-----	-----	-----	-----	5.8	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	6.9	-----	-----	-----	-----	-----	4.7	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	5.6	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	12.0	-----	-----	-----	-----	-----	7.3	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	1.6	-----	-----	3.0	-----	-----	3.3	-----	-----	1.8	-----	-----	2.2	-----	-----	-----	1.6	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	2.0	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	2.3	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	79.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0050	-----	-----	-----	-----	-----	0.0046	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	18.0	-----	-----	50.0	-----	-----	-----	80.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	2.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			(0.29/ 0.63 / 1.0/ 3.4 / 6.7)						6.0 / NP,/ 45.0 / 125.0 / NP				-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Reach Shear Stress (competency) lb/ft^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.19	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	0.19	-----	-----	-----	-----	-----	0.19	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	E	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	B5c	-----	-----	-----	-----	-----	B5c	-----	-----
BF Velocity (fps)	-----	3.0	4.4	-----	-----	-----	-----	4.5	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	106.1	155.0	231.8	-----	-----	-----	26.5	-----	-----	-----	-----	-----	N/P	-----	-----	-----	22	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	559.0	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	579	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	564.0	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.02	-----	-----	-----	-----	-----	1.20	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.01	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0078	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0160	-----	-----	-----	-----	-----	0.0047	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.008	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0025	-----	-----	-----	-----	-----	0.0047	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 5. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

UT4 (Reach 1) Length 1,376 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	7.1	7.5	-----	8.6	-----	-----	11.7	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	11.4	-----	-----	-----	-----	-----	14.0	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	12.7	-----	-----	15.6	-----	-----	50.0	-----	-----	53.0	-----	-----	26.0	-----	-----	46.0	-----	-----	-----	89.2	-----	-----	-----	-----
BF Mean Depth (ft)	-----	0.9	1.1	-----	0.9	-----	-----	1.3	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	0.9	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	1.2	-----	-----	1.9	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.1	-----	-----	-----	-----	-----	1.8	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	7.4	10.3	-----	10.5	-----	-----	11.3	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	10.0	-----	-----	-----	-----	-----	14.1	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	6.5	-----	-----	13.2	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13	-----	-----	-----	-----	-----	13.8	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	1.3	-----	-----	1.5	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	6.4	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	2.1	-----	-----	2.4	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	2.1	-----		-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	40.0	-----	-----	80.0	-----	-----	-----	60.0	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	23.0	-----	-----	34.0	-----	-----	-----	40.0	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	2.9	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	70.0	-----	-----	90.0	-----	-----	-----	146.0	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	3.5	-----	-----	7.0	-----	-----	-----	4.3	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.2	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0078	-----	-----	-----	-----	-----	0.0153	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	39	-----	-----	80	-----	-----	-----	78.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	2.4	-----	-----	-----	-----	-----	2.2	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----		0.06 / 0.34 / 2.12 / 36.6 / 101.8 (R2)						6.0 / NP,/ 45.0 / 125.0 / NP					-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.34	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	0.34	-----	-----	-----	-----	-----	0.34	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	G	-----	-----	F	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C5/B5	-----	-----	-----	-----	-----	C5	-----	-----
BF Velocity (fps)	-----	2.4	3.9	-----	3.6	-----	-----	3.9	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	25.2	40.9	63.0	-----	-----	-----	41.0	-----	-----	-----	-----	-----	N/P	-----	-----	-----	37	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	784	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1,417	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	858	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.15	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.11	-----	-----	-----	-----	-----	-----	-----	1.09	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	-----	-----	0.0101	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0067	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0067	-----	-----	-----	-----	-----	0.0113	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 5. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

UT4 (Reach 2) Length 1,828 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	12.2	12.4	-----	-----	-----	-----	13.8	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	16.5	-----	-----	-----	-----	-----	15.9	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	36.6	-----	-----	50.0	-----	-----	53.0	-----	-----	38.0	-----	-----	66.0	-----	-----	-----	95.2	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.6	1.2	-----	-----	-----	-----	1.7	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	1.3	-----	-----	-----	-----	-----	1.2	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	2.5	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.6	-----	-----	-----	-----	-----	1.7	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	16.7	22.9	-----	-----	-----	-----	23.8	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	21.0	-----	-----	-----	-----	-----	19.0	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	8.0	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13	-----	-----	-----	-----	-----	13.3	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	2.7	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	6.0	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	2.1	-----	-----	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	60.0	-----	-----	100.0	-----	-----	-----	75.0	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	33.0	-----	-----	50.0	-----	-----	-----	46.3	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	2.9	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	115.0	-----	-----	180.0	-----	-----	-----	173.0	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	3.5	-----	-----	6.0	-----	-----	-----	10.9	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	51.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0040	-----	-----	-----	-----	-----	0.0043	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	32	-----	-----	65	-----	-----	-----	105.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	1.8	-----	-----	-----	-----	-----	3.3	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----		0.06 / 0.34 / 2.12 / 36.6 / 101.8 (R2)						6.0 / NP,/ 45.0 / 125.0 / NP					-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	1.10	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	1.10	-----	-----	-----	-----	-----	1.10	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	F	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C5	-----	-----	-----	-----	-----	C5	-----	-----
BF Velocity (fps)	-----	2.6	4.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	62.8	95.6	144.3	-----	-----	-----	95.6	-----	-----	-----	-----	-----	N/P	-----	-----	-----	80.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1590.34	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1,673	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1827	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.15	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.19	-----	-----	-----	-----	-----	-----	-----	1.15	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0034	-----	-----	-----	-----	-----	0.0034	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0067	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0063	-----	-----	-----	-----	-----	0.0039	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 5. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

UT4 (Reach 3) Length 250 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built[5]					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	14.1	14.2	-----	-----	-----	-----	13.1	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	19.8	-----	-----	-----	-----	-----	15.4	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	18.3	-----	-----	50.0	-----	-----	53.0	-----	-----	44.0	-----	-----	76.0	-----	-----	-----	21.0	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.3	1.7	-----	-----	-----	-----	2.2	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	1.4	-----	-----	-----	-----	-----	2.4	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	3.2	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.7	-----	-----	-----	-----	-----	3.2	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	21.0	28.5	-----	-----	-----	-----	28.7	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	28.0	-----	-----	-----	-----	-----	36.8	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	6.0	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13	-----	-----	-----	-----	-----	6.4	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	1.4	-----	-----	3.0	-----	-----	3.3	-----	-----	1.8	-----	-----	2.2	-----	-----	-----	1.4	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.7	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	0.48	-----	-----	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	20.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0130	-----	-----	-----	-----	-----	0.0153	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	45	-----	-----	80	-----	-----	-----	50.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	3.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			0.06 / 0.15 / 0.48 / 10.3 / 130.2						6.0 / NP,/ 45.0 / 125.0 / NP				-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	1.52	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	1.52	-----	-----	-----	-----	-----	1.52	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	G	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	B5c	-----	-----	-----	-----	-----	G5c	-----	-----
BF Velocity (fps)	-----	2.8	4.1	-----	-----	-----	-----	4.1	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	80.7	120.5	181.1	-----	-----	-----	120.5	-----	-----	-----	-----	-----	N/P	-----	-----	-----	103.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	237	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	244	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	250	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.15	-----	-----	-----	-----	-----	1.20	-----	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	1.05	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0078	-----	-----	-----	-----	-----	0.0056	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0067	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0080	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively

[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring

[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design based on previous sand-bed reference reach data and on past project evaluations

[4] Values were chosen

[5] Ultimately, a Rosgen "G" stream type was maintained for this reach due to its stable location with mature trees eastablished along its banks

Table 5. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

UT4 (Reach 4) Length 1,840 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	7.8	8.2	-----	-----	-----	-----	7.7	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	12.0	-----	-----	-----	-----	-----	11.6	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	10.9	-----	-----	50.0	-----	-----	53.0	-----	-----	28.0	-----	-----	48.0	-----	-----	-----	75.9	-----	-----	-----	-----
BF Mean Depth (ft)	-----	0.9	1.1	-----	-----	-----	-----	1.6	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	0.9	-----	-----	-----	-----	-----	0.8	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	2.1	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.1	-----	-----	-----	-----	-----	1.1	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	8.5	11.8	-----	-----	-----	-----	12	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	11.0	-----	-----	-----	-----	-----	9.5	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	5.0	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13	-----	-----	-----	-----	-----	14.1	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	1.1	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	6.5	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	3.1	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	1.50	-----	-----	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.3	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	40	-----	-----	70	-----	-----	-----	55.0	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	24.0	-----	-----	36.0	-----	-----	-----	48.3	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	4.2	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	84.0	-----	-----	140.0	-----	-----	-----	150.0	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	7.0	-----	-----	12.0	-----	-----	-----	13.0	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0100	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	42	-----	-----	82	-----	-----	-----	-----	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	2.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----		0.13 / 0.43 / 1.5 / 14.2 / 22.6						6.0 / NP,/ 45.0 / 125.0 / NP					-----	-----	-----	-----	-----	-----		11.1 / 23.8 / 36.6 / 60.1 / 126.3				
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.42	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	0.42	-----	-----	-----	-----	-----	0.42	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	G	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C5/B5c	-----	-----	-----	-----	-----	C5	-----	-----
BF Velocity (fps)	-----	2.5	3.9	-----	-----	-----	-----	3.9	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.6	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	29.5	47.3	73.4	-----	-----	-----	47.4	-----	-----	-----	-----	-----	N/P	-----	-----	-----	40.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1657	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1,787	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1840	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.15	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.12	-----	-----	-----	-----	-----	-----	-----	1.11	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0063	-----	-----	-----	-----	-----	0.0054	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0067	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0069	-----	-----	-----	-----	-----	0.0062	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 5. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

UT4 (Reach 5) Length 1,973 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	9.9	10.2	-----	16.8	-----	-----	23.5	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	13.9	-----	-----	-----	-----	-----	16.2	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	33.6	-----	-----	94.3	-----	-----	50.0	-----	-----	53.0	-----	-----	32.0	-----	-----	55.0	-----	-----	-----	69.4	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.0	1.3	-----	0.7	-----	-----	0.7	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	1.2	-----	-----	-----	-----	-----	1.8	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	1.3	-----	-----	2.4	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.5	-----	-----	-----	-----	-----	2.7	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	12.3	16.9	-----	11.2	-----	-----	15.4	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	16.0	-----	-----	-----	-----	-----	28.4	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	25.2	-----	-----	36.0	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	12	-----	-----	-----	-----	-----	9.3	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	2.0	-----	-----	4.0	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	4.3	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	1.0	-----	-----	1.7	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	1.30	-----	-----	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	46.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0050	-----	-----	-----	-----	-----	0.0086	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	50	-----	-----	90	-----	-----	-----	101.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	2.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			0.30 / 0.70 / 1.3 / 5.5 / 8.4						6.0 / NP,/ 45.0 / 125.0 / NP				-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.71	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	0.71	-----	-----	-----	-----	-----	0.71	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	E/Bc	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C5/E5	-----	-----	-----	-----	-----	E5	-----	-----
BF Velocity (fps)	-----	2.9	4.5	-----	-----	-----	-----	4.5	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	44.4	69.2	106.1	-----	-----	-----	69.3	-----	-----	-----	-----	-----	N/P	-----	-----	-----	60.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1838	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1,921	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1916	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.08	-----	-----	-----	-----	-----	1.20	-----	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	1.04	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0033	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0033	-----	-----	-----	-----	-----	0.0053	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0035	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0035	-----	-----	-----	-----	-----	0.0061	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 6. Morphology and Hydraulic Monitoring Summary
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Stream Reach	**UT4 Reach 1 (1,376 LF)**																			
	Cross-section X-1 (Riffle)							**Cross-section X-2 (Pool)**							**Cross-section X-3 (Riffle)**						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																					
BF Width (ft)	14.93							15.43							13.95						
BF Mean Depth (ft)	1.02							0.87							1.01						
Width/Depth Ratio	14.58							17.74							13.83						
BF Cross-sectional Area (ft^2)	15.3							13.42							14.07						
BF Max Depth (ft)	1.81							2.16							1.81						
Width of Floodprone Area (ft)	58.95							46.7							89.23						
Entrenchment Ratio	3.9							3.03							6.39						
Bank Height Ratio	1							1							1						
Wetted Perimeter (ft)	17.0							17.2							16.0						
Hydraulic Radius (ft)	0.9							0.8							0.9						
Based on current/developing bankfull feature																					
BF Width (ft)																					
BF Mean Depth (ft)																					
Width/Depth Ratio																					
BF Cross-sectional Area (ft^2)																					
BF Max Depth (ft)																					
Width of Floodprone Area (ft)																					
Entrenchment Ratio																					
Bank Height Ratio																					
Wetted Perimeter (ft)																					
Hydraulic Radius (ft)																					
Cross Sectional Area between end pins (ft^2)																					
d50 (mm)																					

Stream Reach	**UT4 Reach 2 (1,828 LF)**														**UT4 Reach 3 (250 LF)**						
	Cross-section X-4 (Riffle)							**Cross-section X-5 (Pool)**							**Cross-section X-6 (Riffle)**						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																					
BF Width (ft)	15.94							22.4							15.35						
BF Mean Depth (ft)	1.19							1.39							2.4						
Width/Depth Ratio	13.3							16.1							6.4						
BF Cross-sectional Area (ft^2)	19.0							31.16							36.8						
BF Max Depth (ft)	1.72							3.39							3.19						
Width of Floodprone Area (ft)	95.2							74.63							20.98						
Entrenchment Ratio	6.0							3.33							1.4						
Bank Height Ratio	1.0							1							1.7						
Wetted Perimeter (ft)	18.3							25.2							20.2						
Hydraulic Radius (ft)	1.0							1.2							1.8						
Based on current/developing bankfull feature																					
BF Width (ft)																					
BF Mean Depth (ft)																					
Width/Depth Ratio																					
BF Cross-sectional Area (ft^2)																					
BF Max Depth (ft)																					
Width of Floodprone Area (ft)																					
Entrenchment Ratio																					
Bank Height Ratio																					
Wetted Perimeter (ft)																					
Hydraulic Radius (ft)																					
Cross Sectional Area between end pins (ft^2)	-							-													
d50 (mm)	-							-													

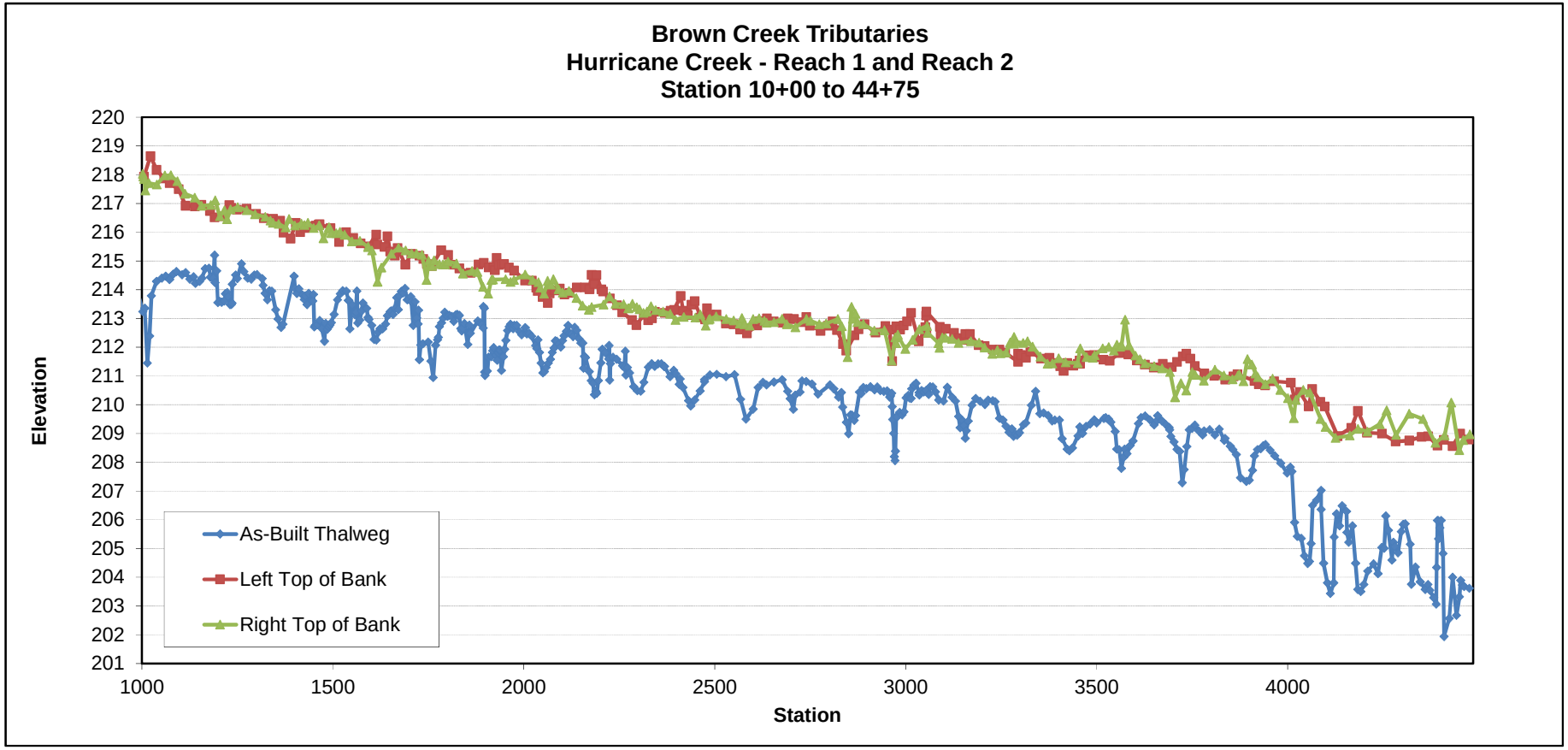
Table 6. Morphology and Hydraulic Monitoring Summary
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

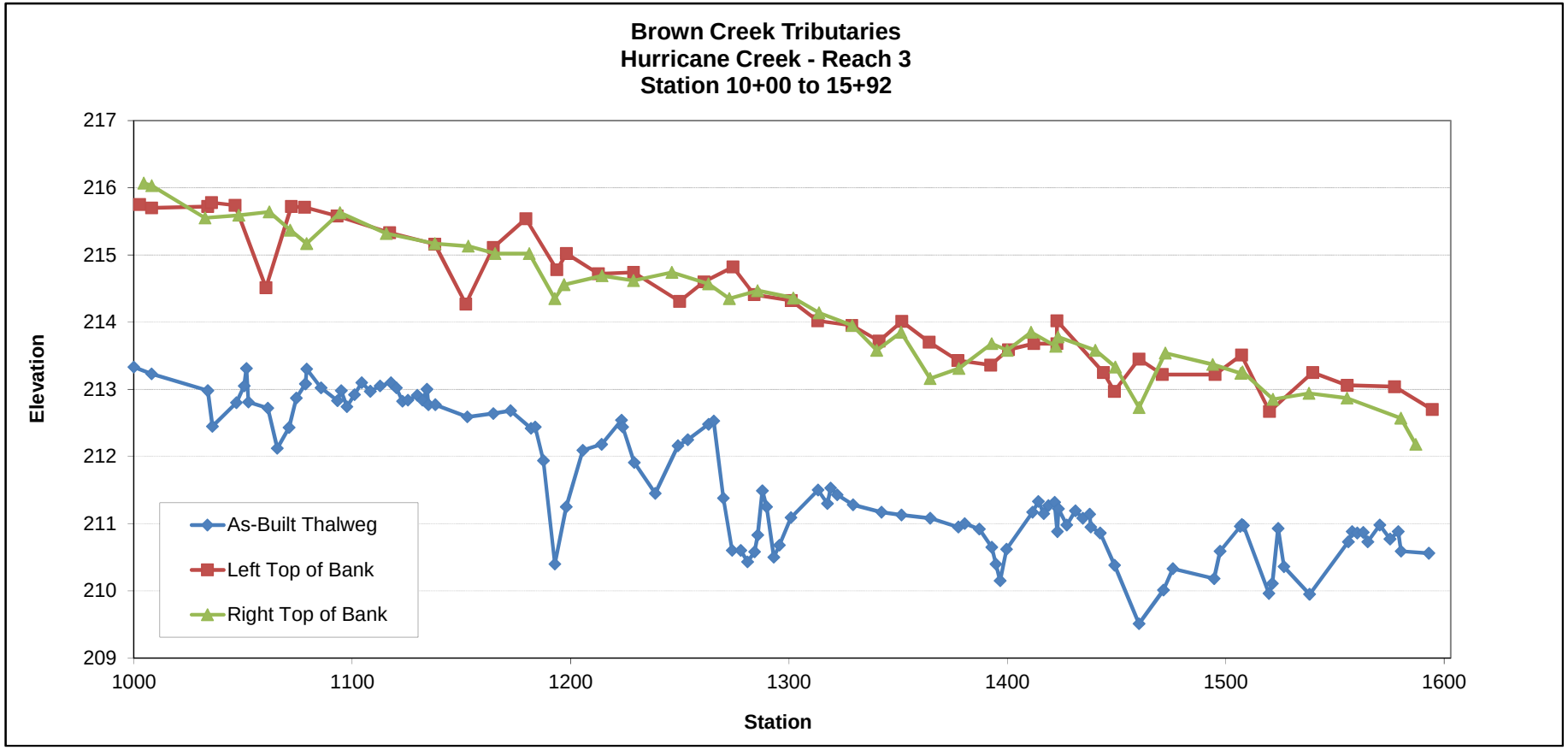
Stream Reach	**UT4 Reach 5 (1,973 LF)**														**UT4 Reach 4 (1,840 LF)**													
	Cross-section X-7 (Riffle)							**Cross-section X-8 (Riffle)**							**Cross-section X-9 (Riffle)**							**Cross-section X-10 (Pool)**						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																												
BF Width (ft)	15.35							16.99							11.58							25.93						
BF Mean Depth (ft)	1.56							1.93							0.82							0.96						
Width/Depth Ratio	9.8							8.8							14.1							27.1						
BF Cross-sectional Area (ft²)	23.9							32.8							9.5							24.8						
BF Max Depth (ft)	2.33							3.15							1.14							2.09						
Width of Floodprone Area (ft)	67.5							71.2							75.9							80.9						
Entrenchment Ratio	4.4							4.2							6.5							3.1						
Bank Height Ratio	1.0							1.0							1.0							1.0						
Wetted Perimeter (ft)	18.5							20.9							13.2							27.9						
Hydraulic Radius (ft)	1.3							1.6							0.7							0.9						
Based on current/developing bankfull feature																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Cross Sectional Area between end pins (ft²)																												
d50 (mm)																												

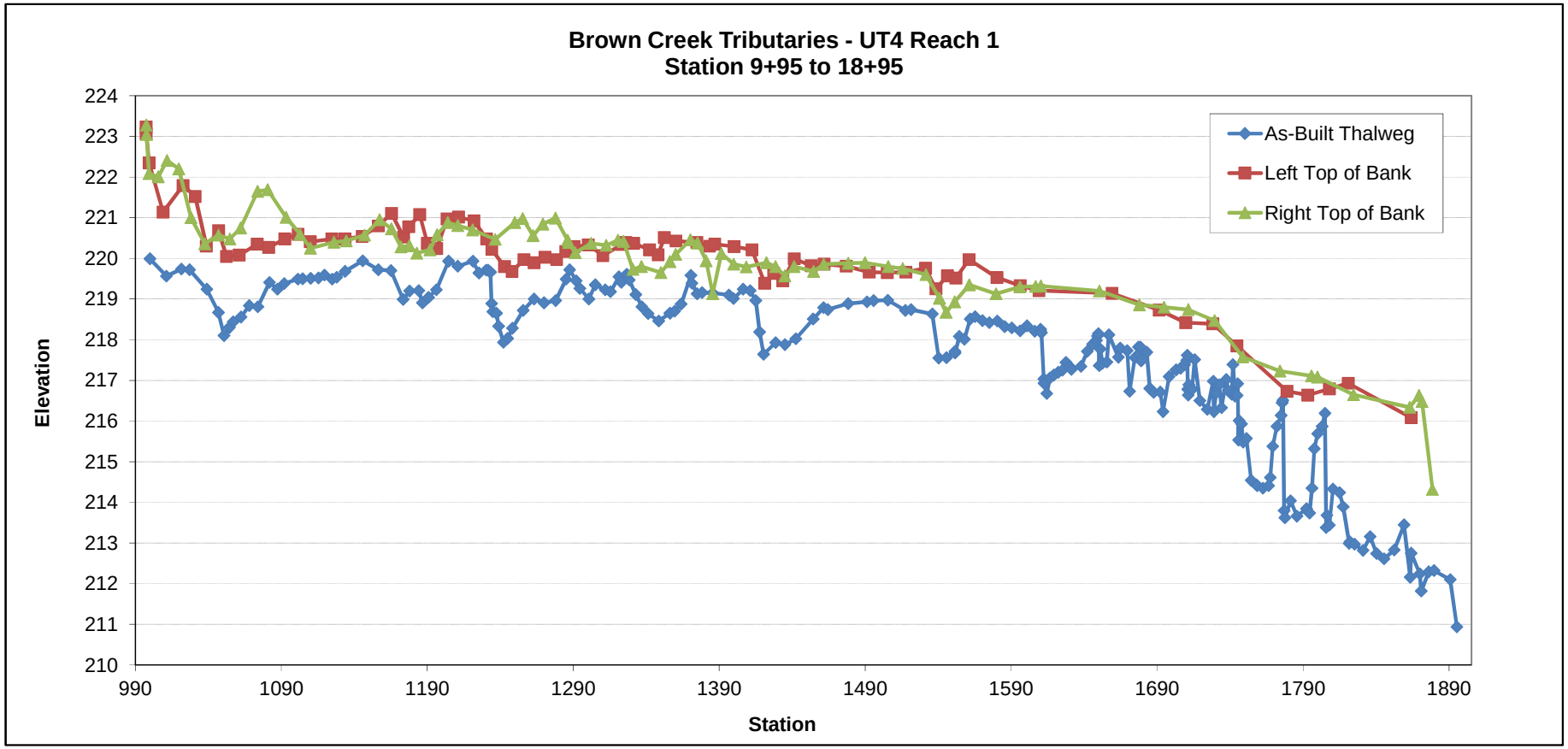
Stream Reach	**Hurricane Creek Reach 1 (2,043 LF)**														**Hurricane Creek Reach 2 (1,394 LF)**													
	Cross-section X-11 (Riffle)							**Cross-section X-12 (Pool)**							**Cross-section X-13 (Pool)**							**Cross-section X-14 (Riffle)**						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																												
BF Width (ft)	18.92							34.27							29.02							22.54						
BF Mean Depth (ft)	1.61							1.84							1.77							1.40						
Width/Depth Ratio	11.8							18.6							16.4							16.1						
BF Cross-sectional Area (ft²)	30.4							63.1							51.5							31.6						
BF Max Depth (ft)	2.47							4.09							2.92							2.26						
Width of Floodprone Area (ft)	71.2							80.1							80.0							68.8						
Entrenchment Ratio	3.8							2.3							2.8							3.1						
Bank Height Ratio	1.0							1.0							1.0							1.0						
Wetted Perimeter (ft)	22.1							38.0							32.6							25.3						
Hydraulic Radius (ft)	1.4							1.7							1.6							1.2						
Based on current/developing bankfull feature																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Cross Sectional Area between end pins (ft²)																												
d50 (mm)																												

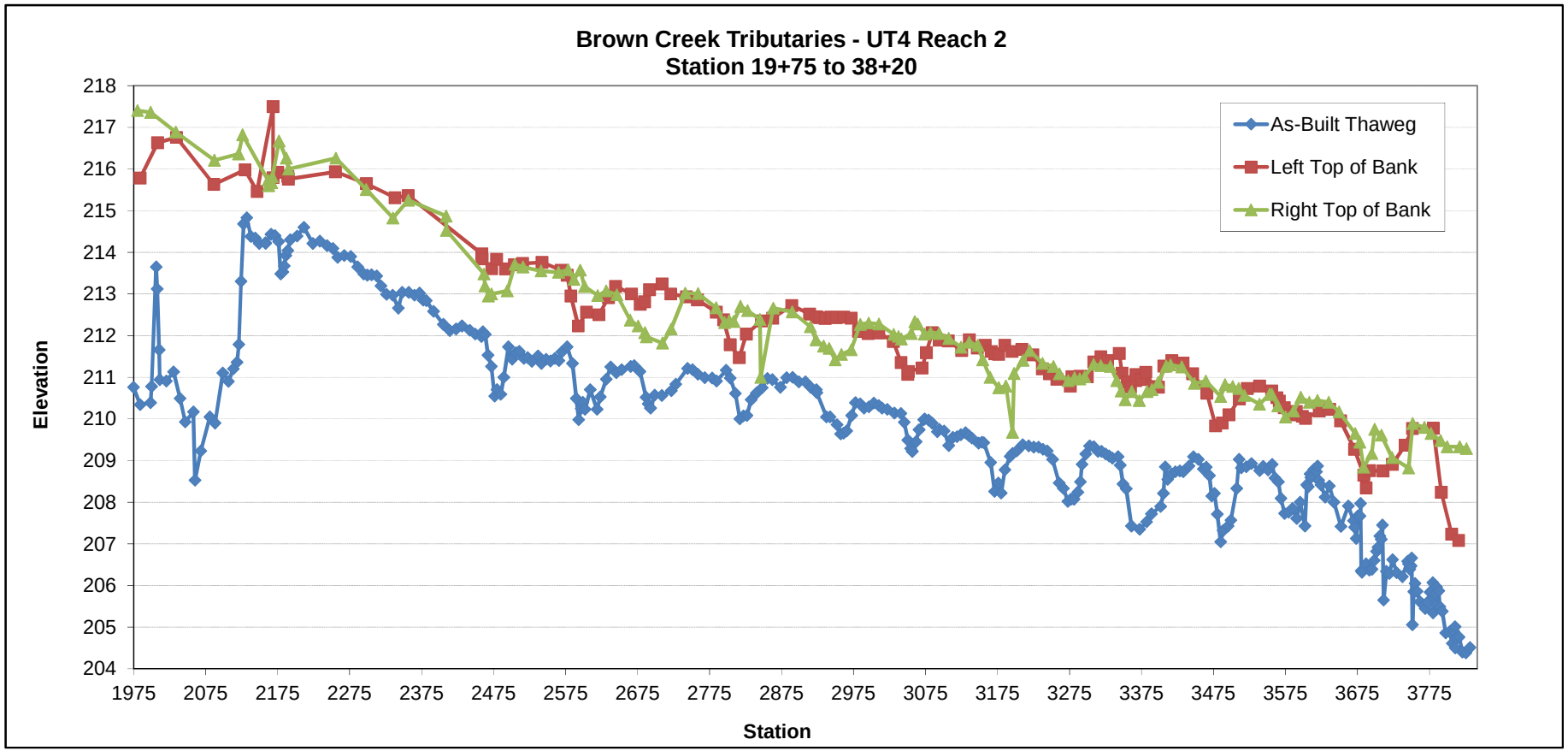
Table 6. Morphology and Hydraulic Monitoring Summary
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

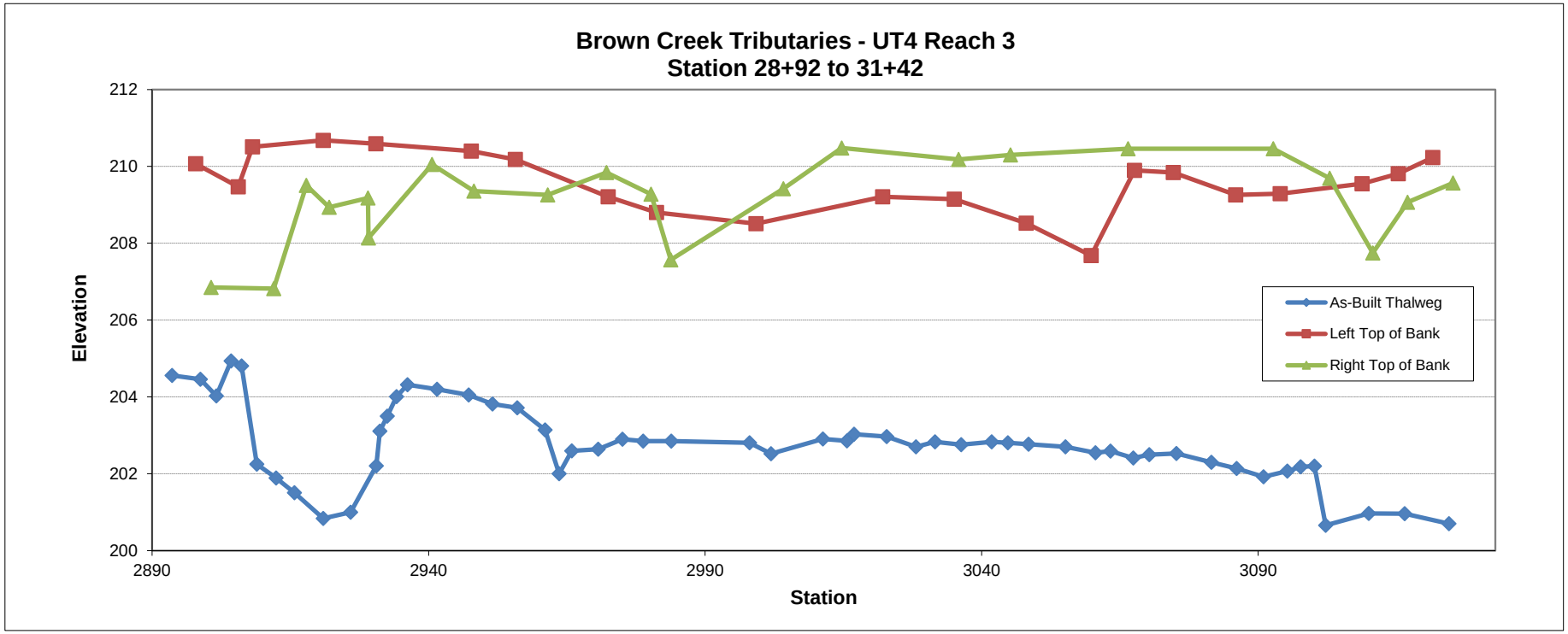
Stream Reach	**Hurricane Creek Reach 3 (564 LF)**									
	Cross-section X-15 (Riffle)									
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+			
Based on fixed baseline bankfull elevation										
BF Width (ft)	5.86									
BF Mean Depth (ft)	0.81									
Width/Depth Ratio	7.3									
BF Cross-sectional Area (ft²)	4.7									
BF Max Depth (ft)	1.28									
Width of Floodprone Area (ft)	10.0									
Entrenchment Ratio	1.6									
Bank Height Ratio	2.3									
Wetted Perimeter (ft)	7.5									
Hydraulic Radius (ft)	0.6									
Based on current/developing bankfull feature										
BF Width (ft)										
BF Mean Depth (ft)										
Width/Depth Ratio										
BF Cross-sectional Area (ft²)										
BF Max Depth (ft)										
Width of Floodprone Area (ft)										
Entrenchment Ratio										
Bank Height Ratio										
Wetted Perimeter (ft)										
Hydraulic Radius (ft)										
Cross Sectional Area between end pins (ft²)										
d50 (mm)										

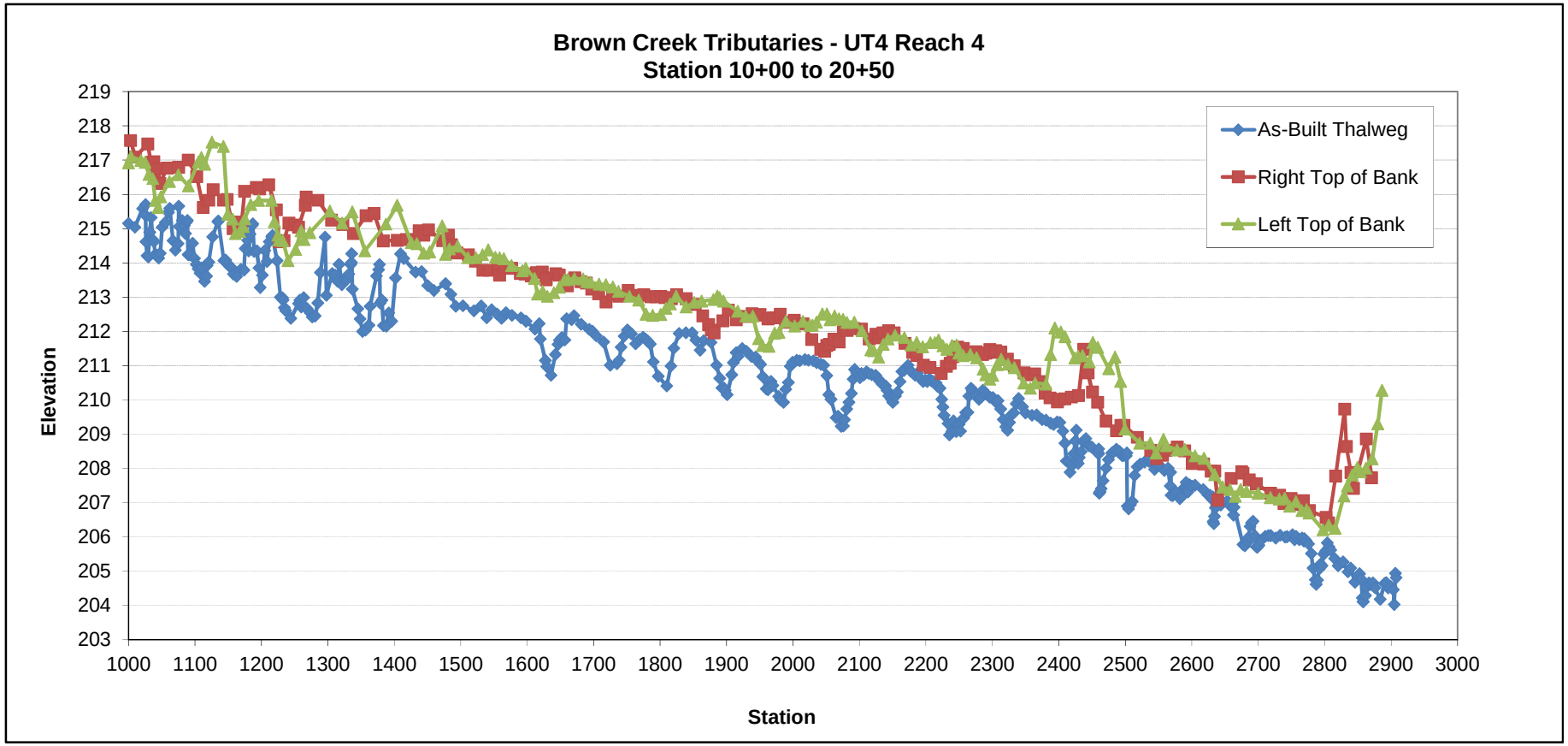

Brown Creek Tributaries
Hurricane Creek - Reach 1 and Reach 2
Station 10+00 to 44+75
Elevation
220
219
218
217
216
215
214
213
212
211
210
209
208
207
206
205
204
203
202
201
1000
1500
2000
2500
3000
3500
4000
Station
As-Built Thalweg
Left Top of Bank
Right Top of Bank

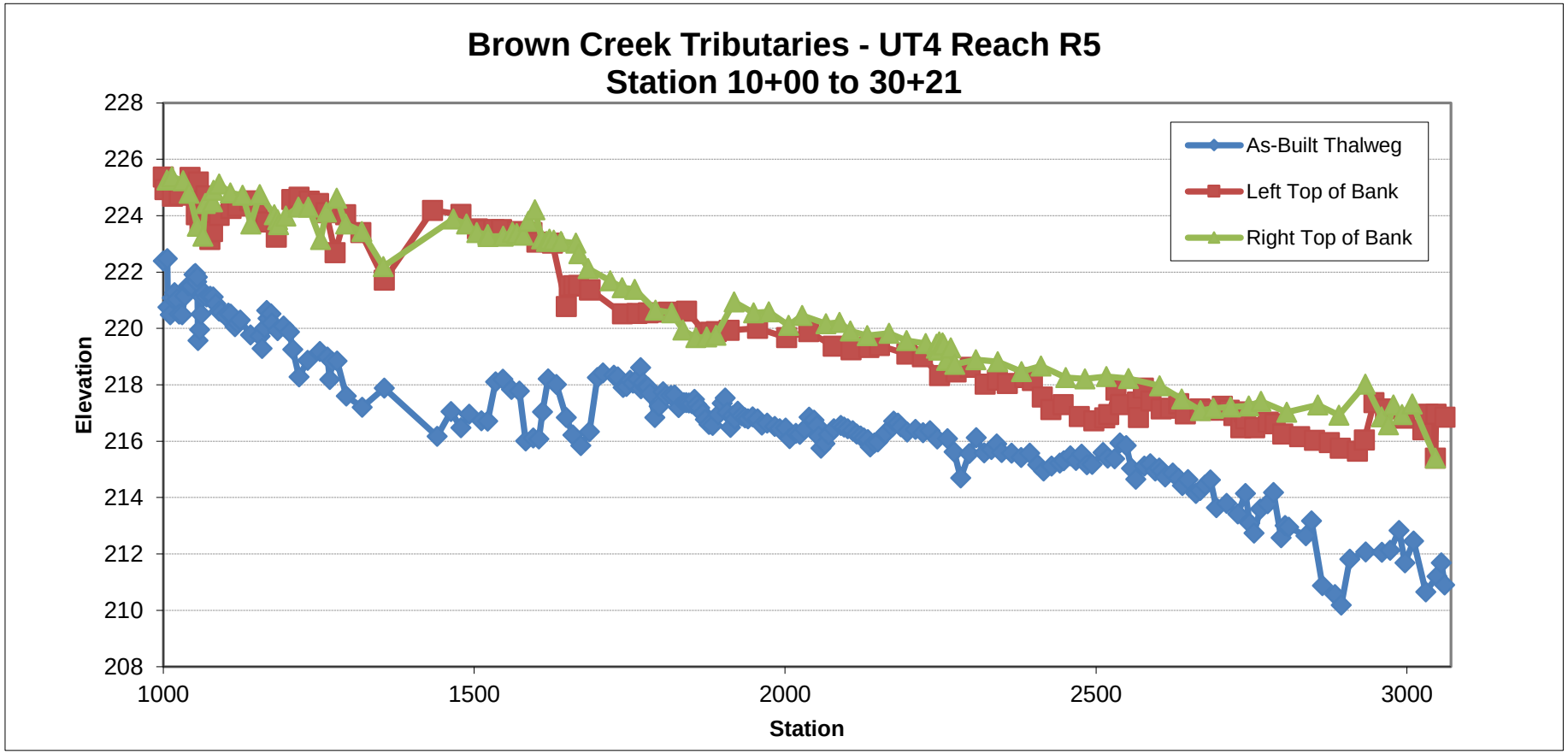

Brown Creek Tributaries
Hurricane Creek - Reach 3
Station 10+00 to 15+92
Elevation
217
216
215
214
213
212
211
210
209
1000
1100
1200
1300
1400
1500
1600
Station
As-Built Thalweg
Left Top of Bank
Right Top of Bank


Brown Creek Tributaries - UT4 Reach 1
Station 9+95 to 18+95
Elevation
224
223
222
221
220
219
218
217
216
215
214
213
212
211
210
990
1090
1190
1290
1390
1490
1590
1690
1790
1890
Station
As-Built Thalweg
Left Top of Bank
Right Top of Bank


Brown Creek Tributaries - UT4 Reach 2
Station 19+75 to 38+20
Elevation
218
217
216
215
214
213
212
211
210
209
208
207
206
205
204
1975
2075
2175
2275
2375
2475
2575
2675
2775
2875
2975
3075
3175
3275
3375
3475
3575
3675
3775
Station
As-Built Thaweg
Left Top of Bank
Right Top of Bank


Brown Creek Tributaries - UT4 Reach 3
Station 28+92 to 31+42
Elevation
212
210
208
206
204
202
200
2890
2940
2990
3040
3090
Station
As-Built Thalweg
Left Top of Bank
Right Top of Bank


Brown Creek Tributaries - UT4 Reach 4
Station 10+00 to 20+50
Elevation
Station
As-Built Thalweg
Right Top of Bank
Left Top of Bank
219
218
217
216
215
214
213
212
211
210
209
208
207
206
205
204
203
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000


Brown Creek Tributaries - UT4 Reach R5
Station 10+00 to 30+21
Elevation
228
226
224
222
220
218
216
214
212
210
208
1000
1500
2000
2500
3000
Station
As-Built Thalweg
Left Top of Bank
Right Top of Bank

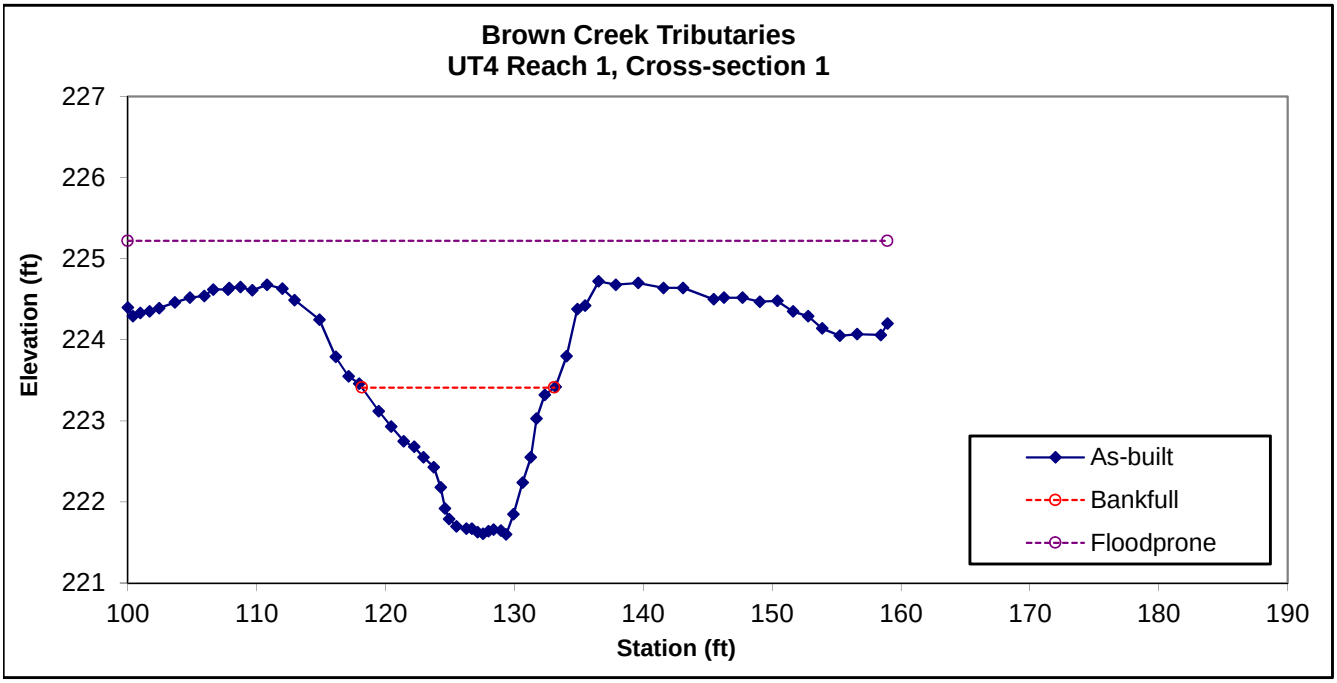
Permanent Cross-section 1

(As-built Data - Collected July 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	15.3	14.93	1.02	1.81	14.58	1	3.9	223.41	223.42



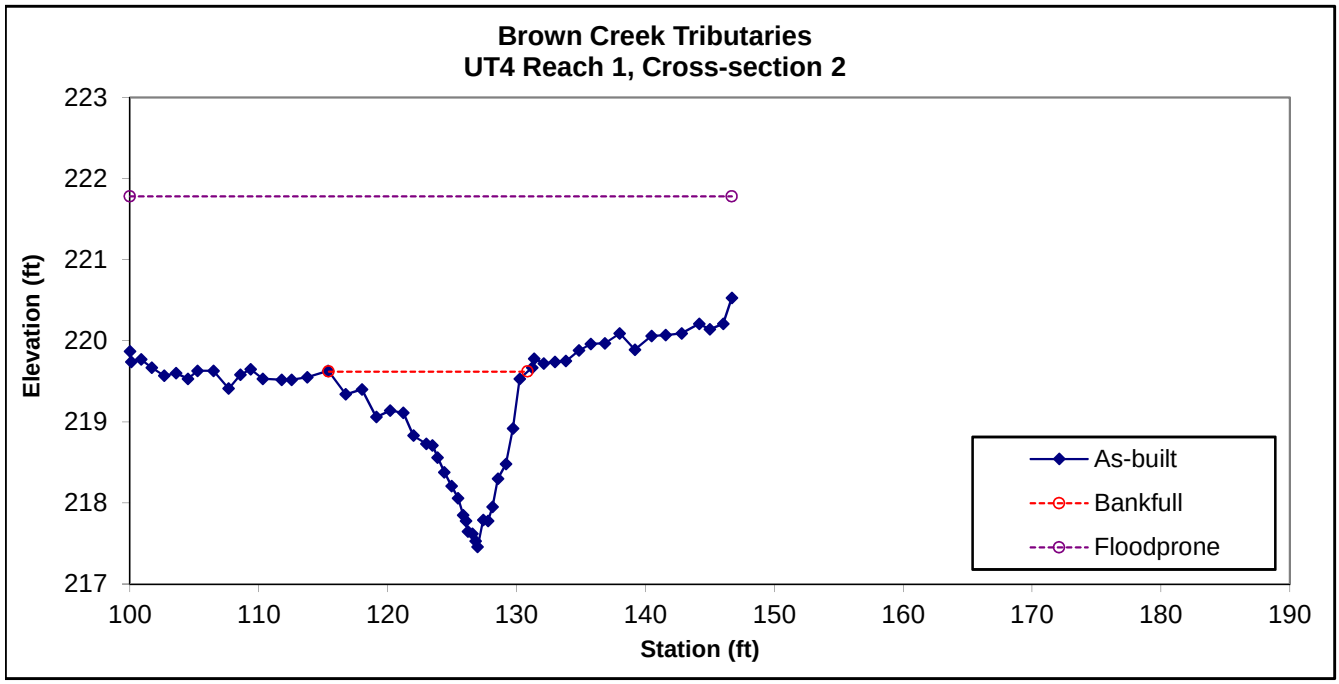
Permanent Cross-section 2

(As-built Data - Collected July 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	-	13.4	15.43	0.87	2.16	17.74	1	3	219.62	219.63



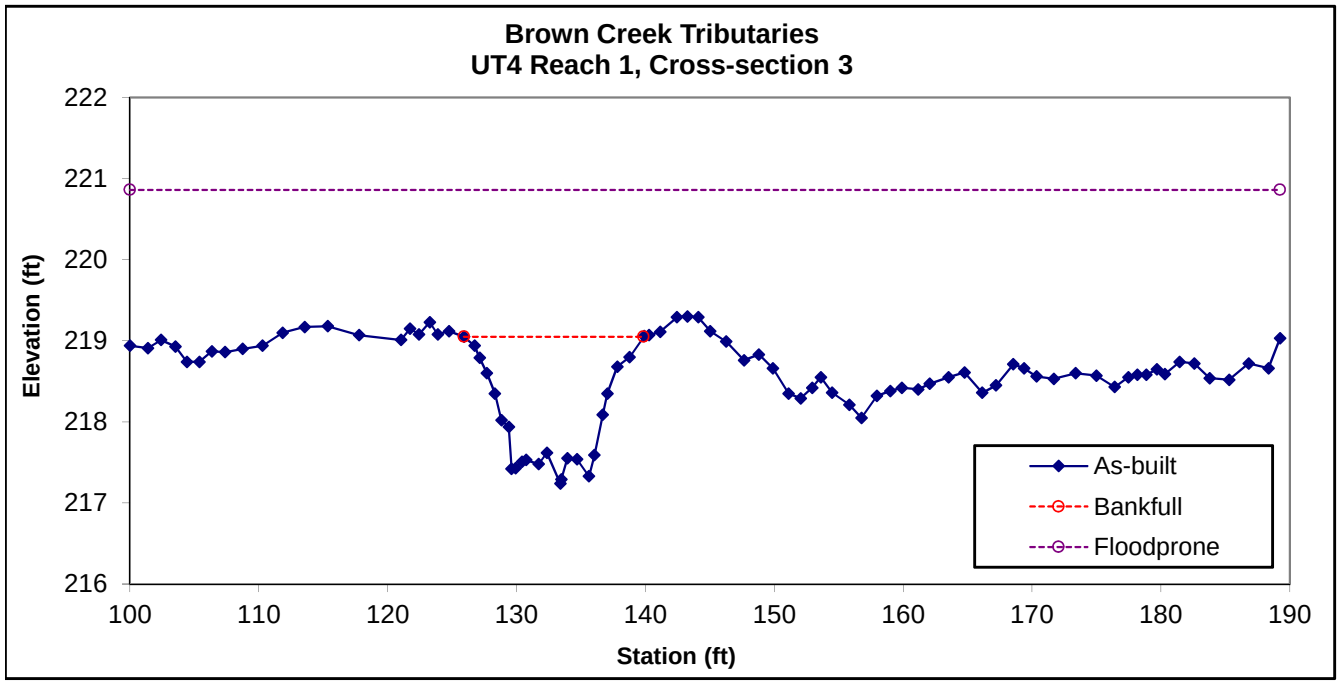
Permanent Cross-section 3

(As-Built Data - Collected July 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	14.1	13.95	1.01	1.81	13.83	1	6.4	219.05	219.05



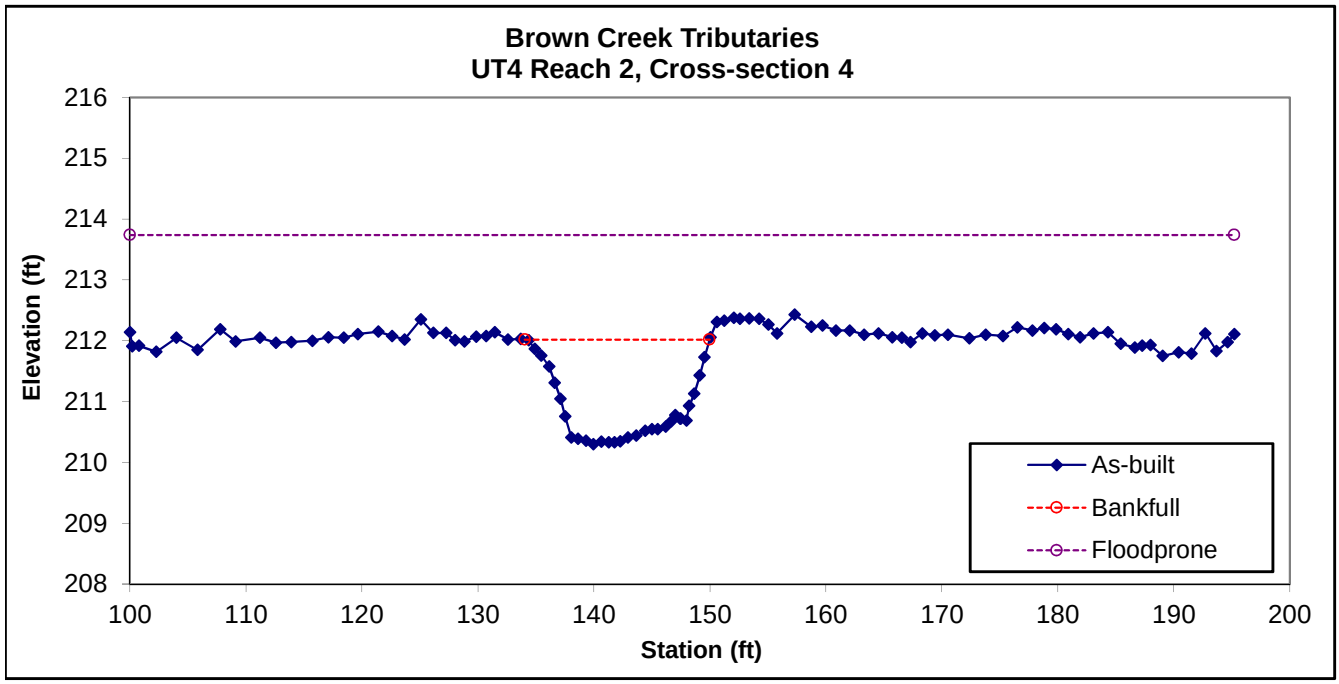
Permanent Cross-section 4

(As-Built Data - Collected July 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	19	15.94	1.19	1.72	13.34	1	6	212.02	212.03



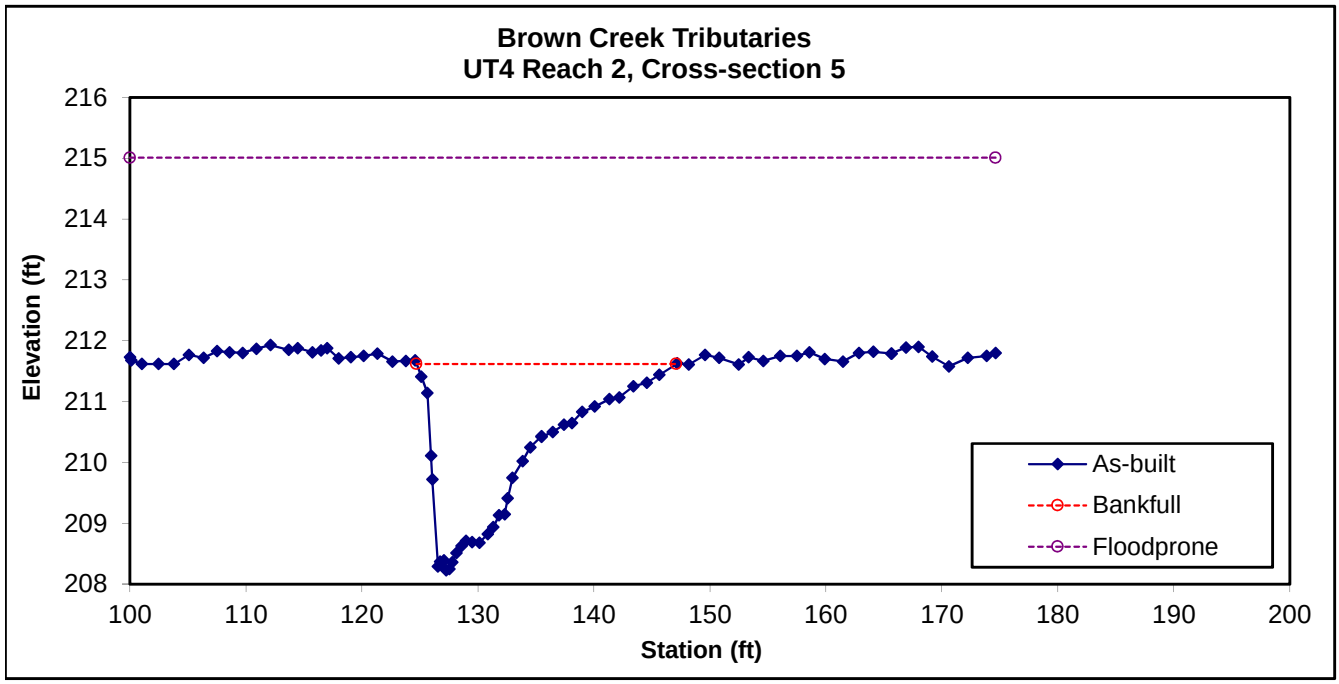
Permanent Cross-section 5

(As-built Data - Collected July 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	-	31.2	22.4	1.39	3.39	16.1	1	3.3	211.62	211.63



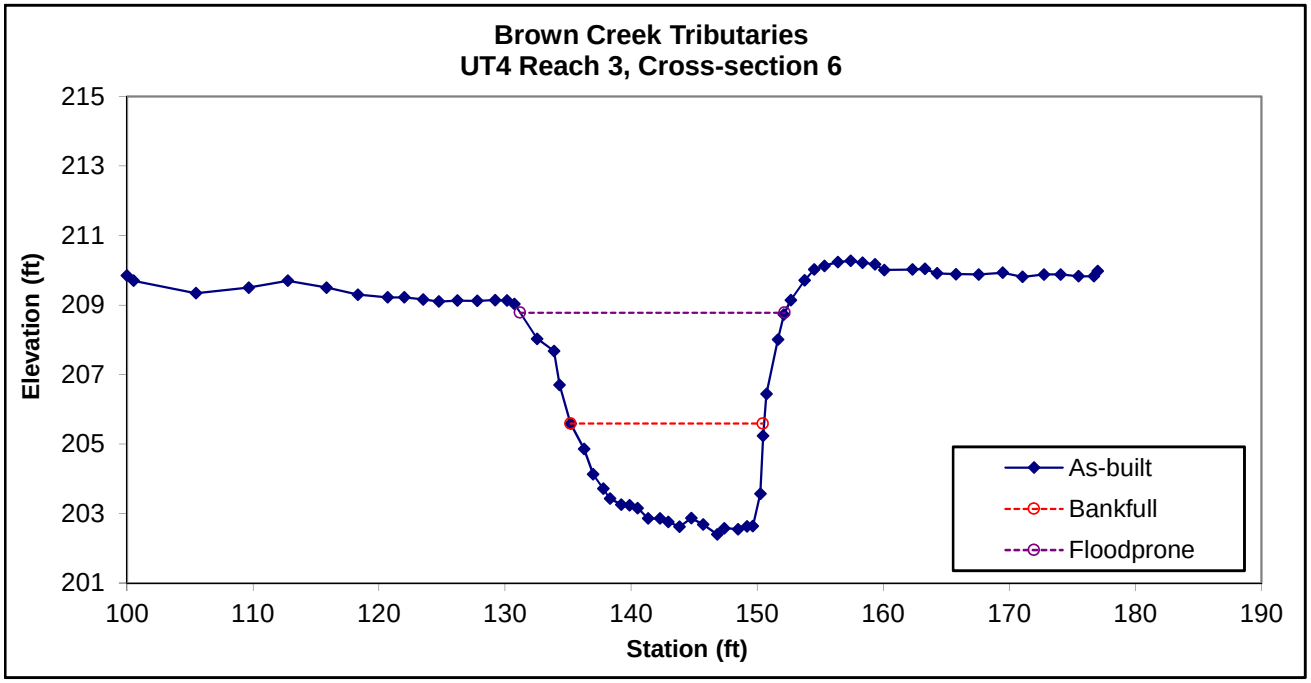
Permanent Cross-section 6

(As-built Data - Collected August 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Gc	36.8	15.35	2.4	3.19	6.4	1.7	1.4	205.59	207.68



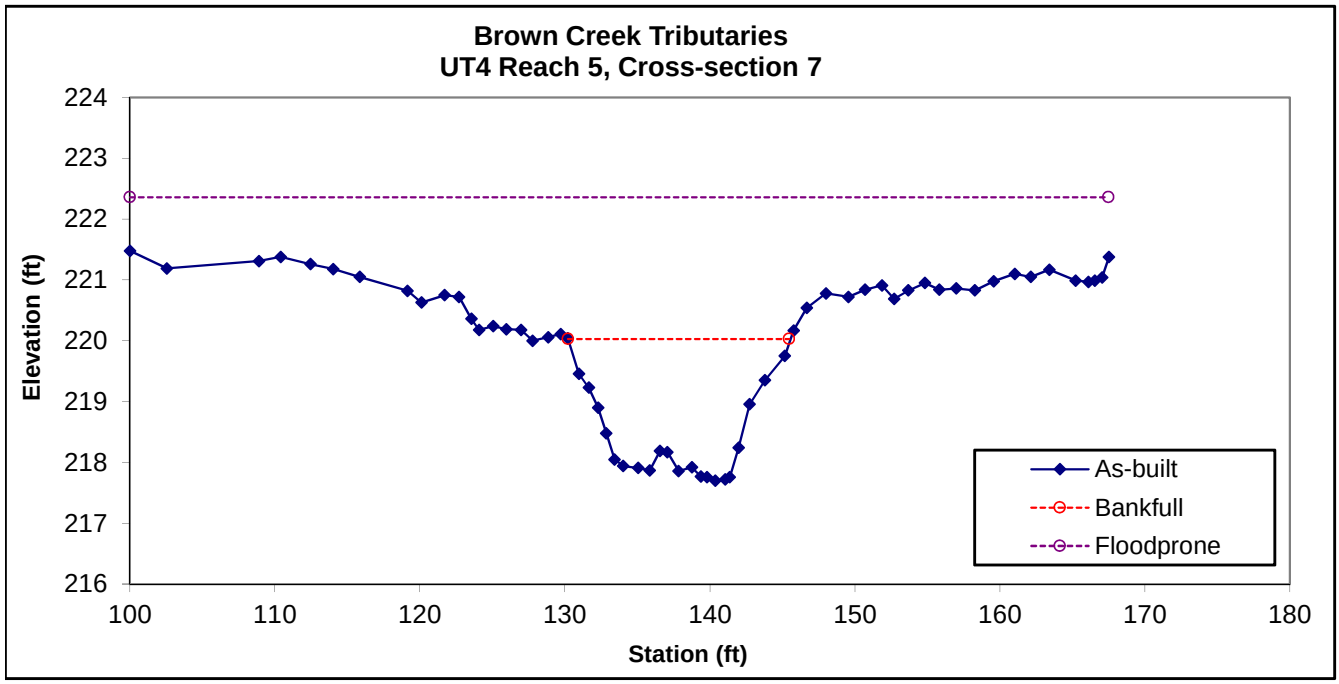
Permanent Cross-section 7

(As-built Data - Collected August 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	23.93	15.35	1.56	2.33	9.8	1	4.4	220.03	220.04



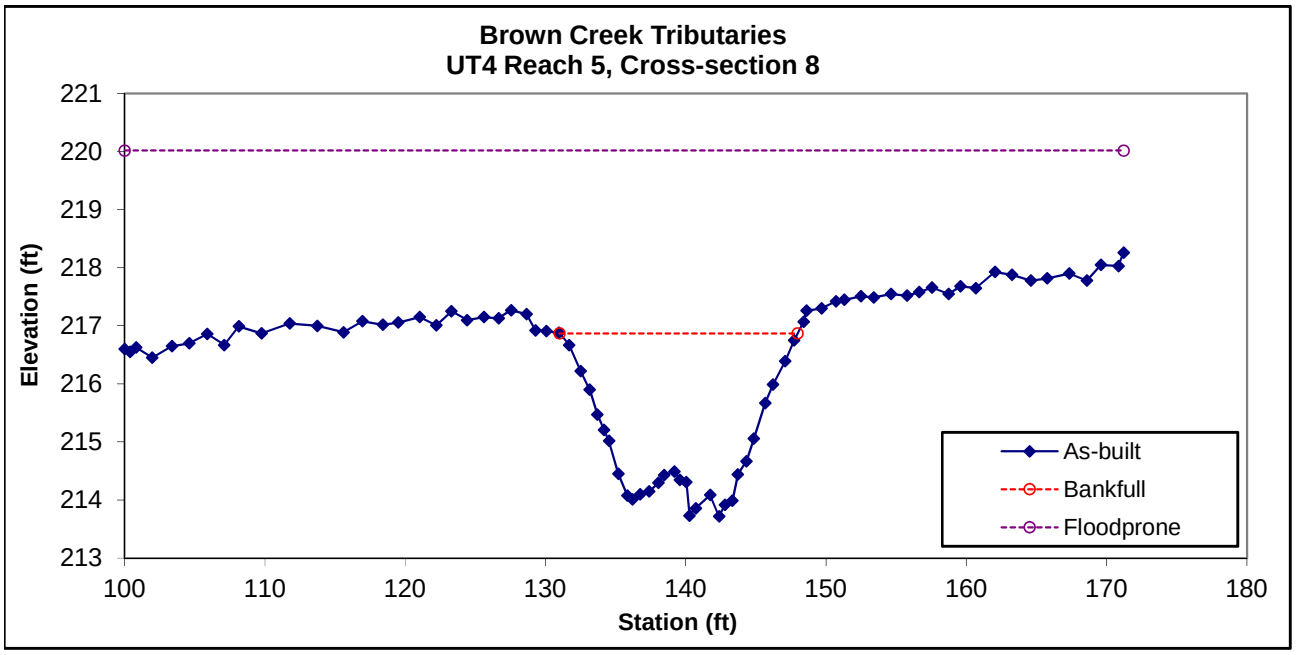
Permanent Cross-section 8

(As-built Data - Collected August 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	32.82	16.99	1.93	3.15	8.8	1	4.2	216.87	216.88



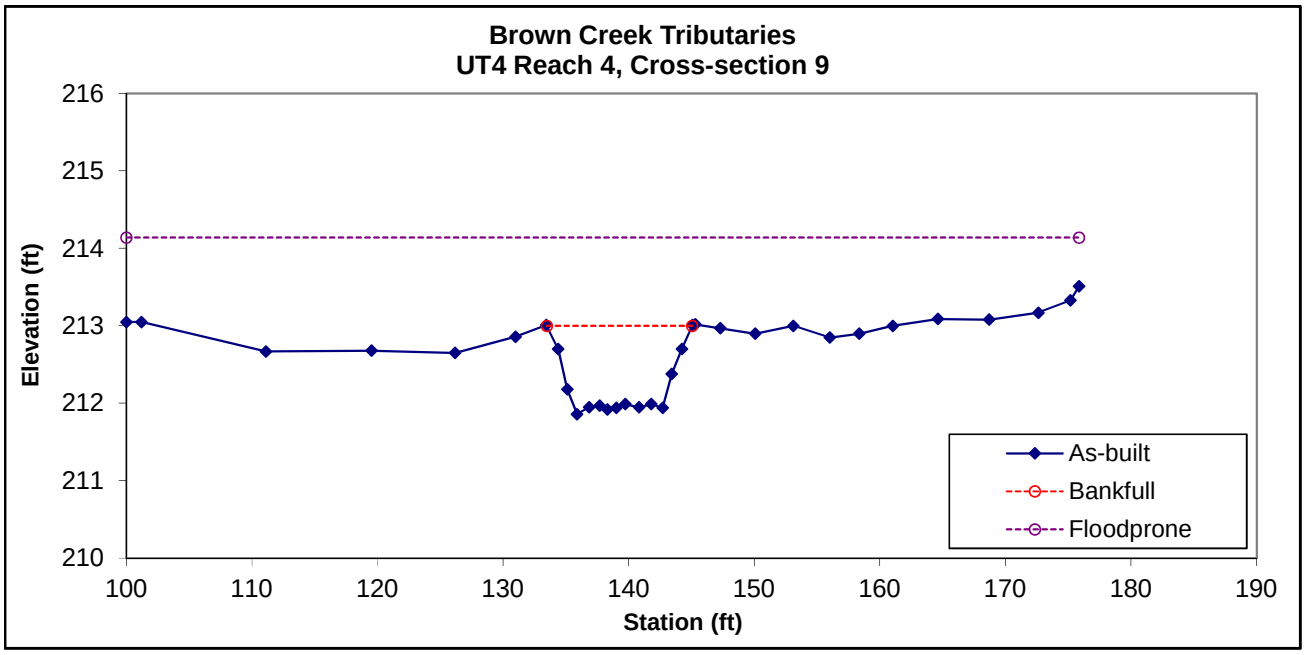
Permanent Cross-section 9

(As-built Data - Collected August 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	9.5	11.58	0.82	1.14	14.05	1	6.5	213	213.01



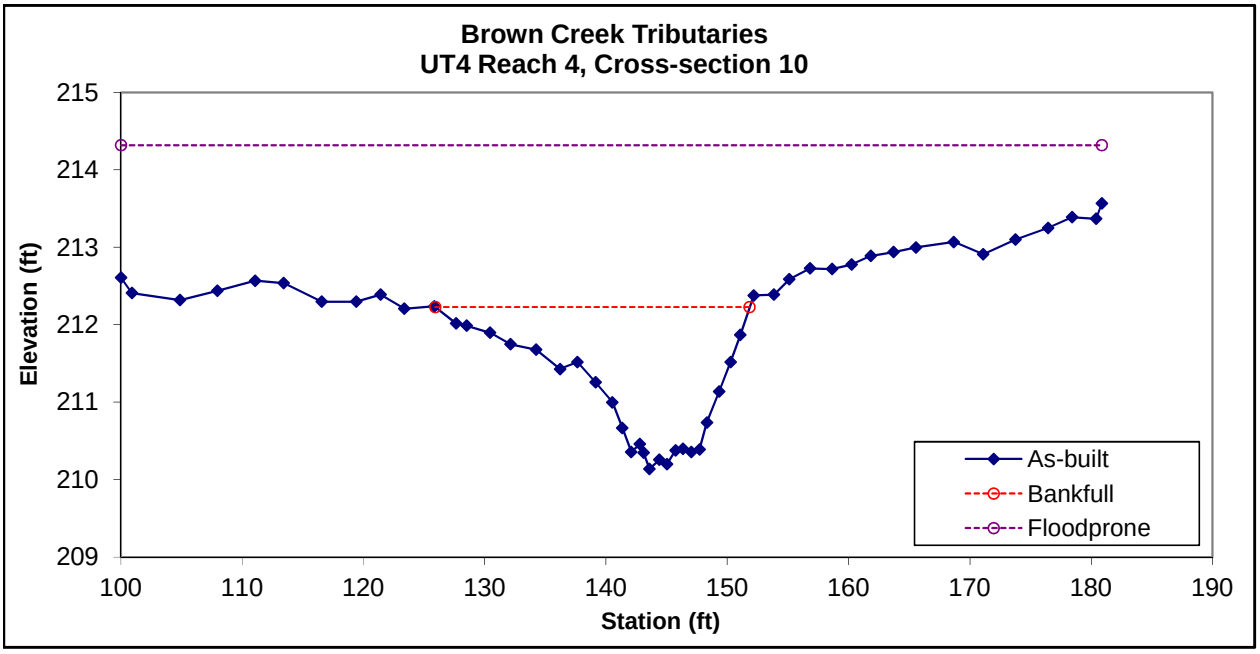
Permanent Cross-section 10

(As-built Data - Collected July 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	-	24.8	25.93	0.96	2.09	27.12	1	3.1	212.23	212.24



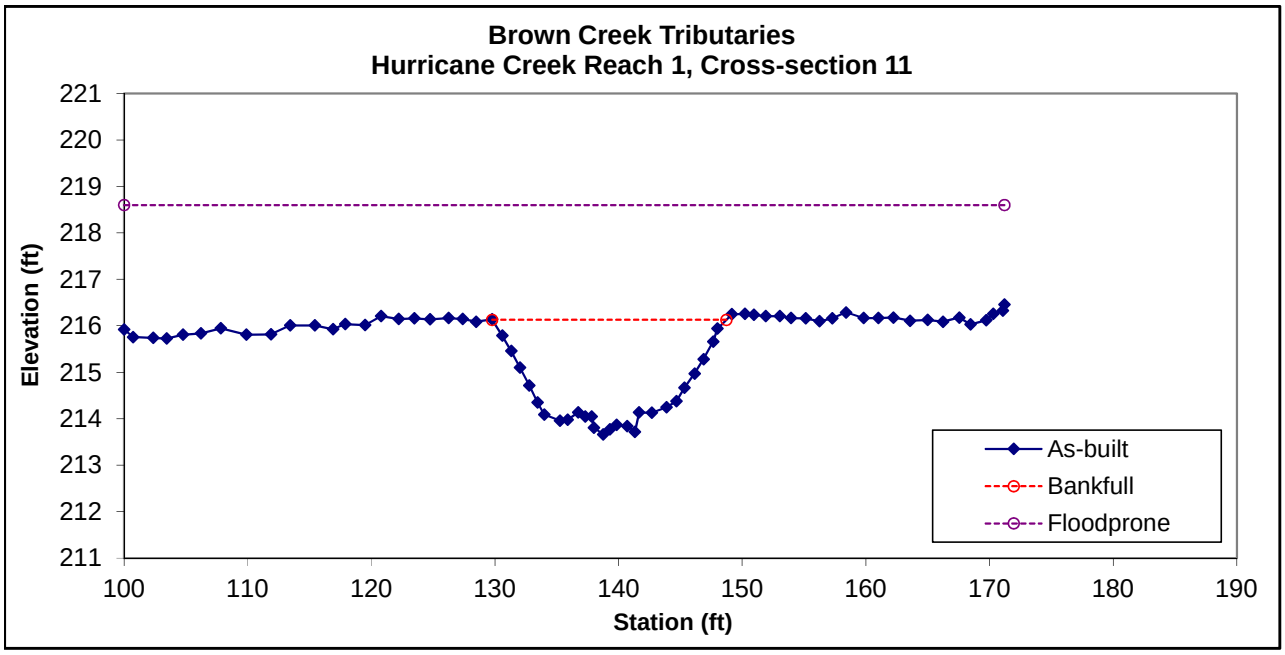
Permanent Cross-section 11

(As-built Data - Collected July 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	30.4	18.92	1.61	2.47	11.77	1	3.8	216.13	216.14



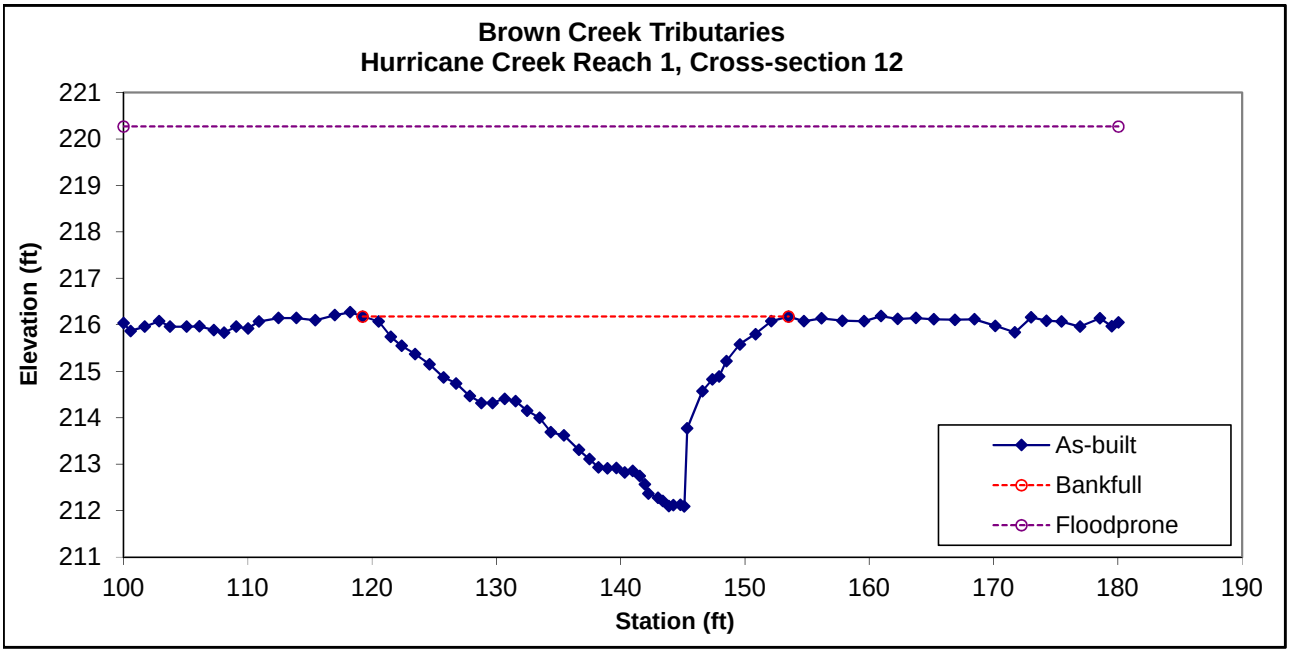
Permanent Cross-section 12

(As-built Data - Collected July 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	-	63.1	34.27	1.84	4.09	18.6	1	2.3	216.18	216.18



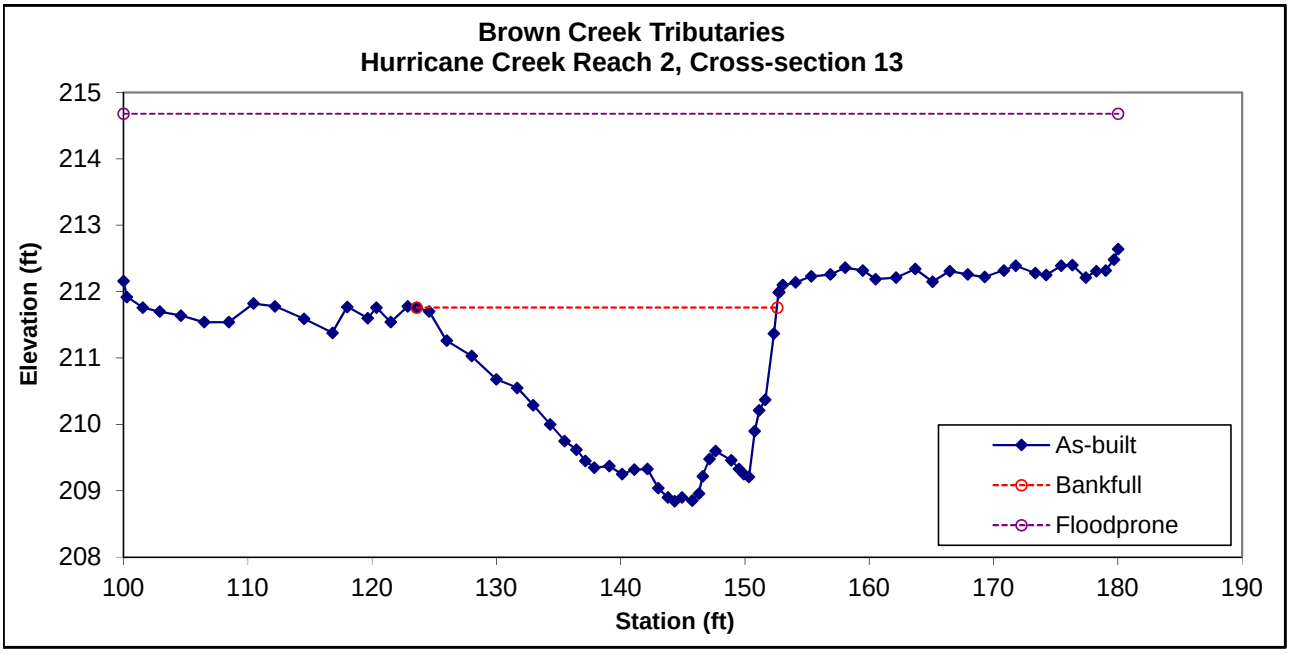
Permanent Cross-section 13

(As-built Data - Collected July 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	-	51.5	29.02	1.77	2.92	16.36	1	2.8	211.76	211.76



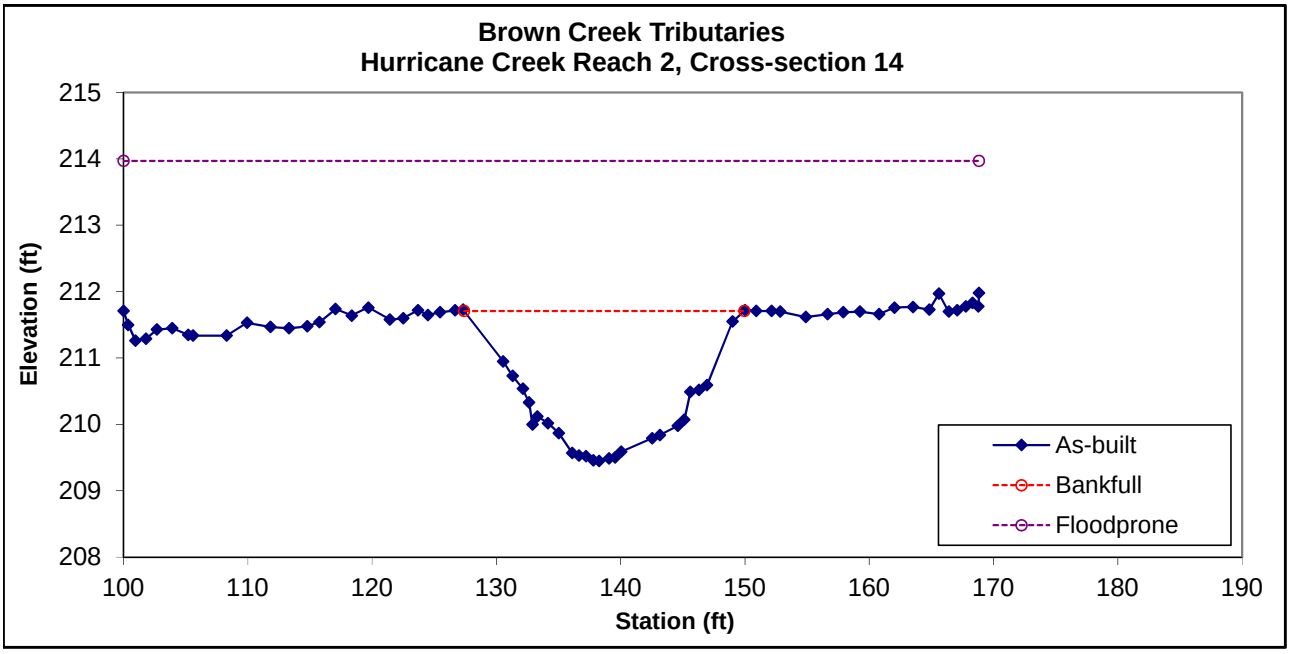
Permanent Cross-section 14

(As-built Data - Collected July 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	31.6	22.54	1.4	2.26	16.08	1	3.1	211.71	211.72



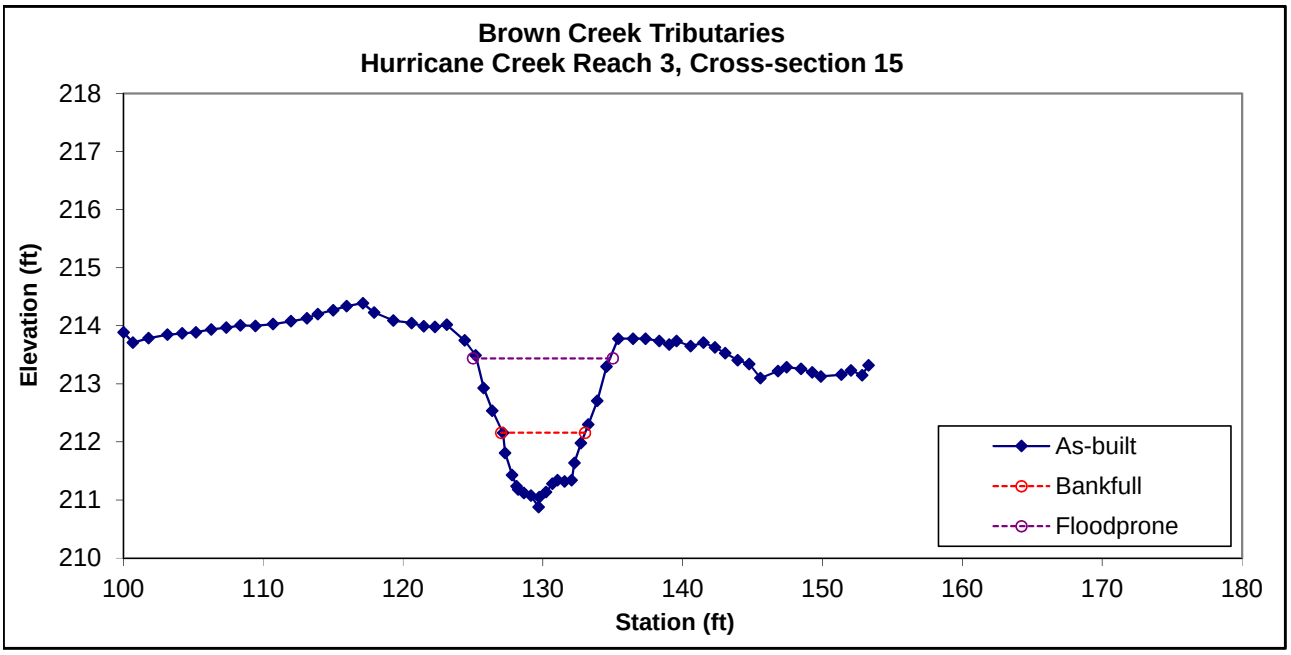
Permanent Cross-section 15

(As-built Data - Collected July 2015)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	4.74	5.86	0.81	1.28	7.3	2.3	1.6	212.16	213.78



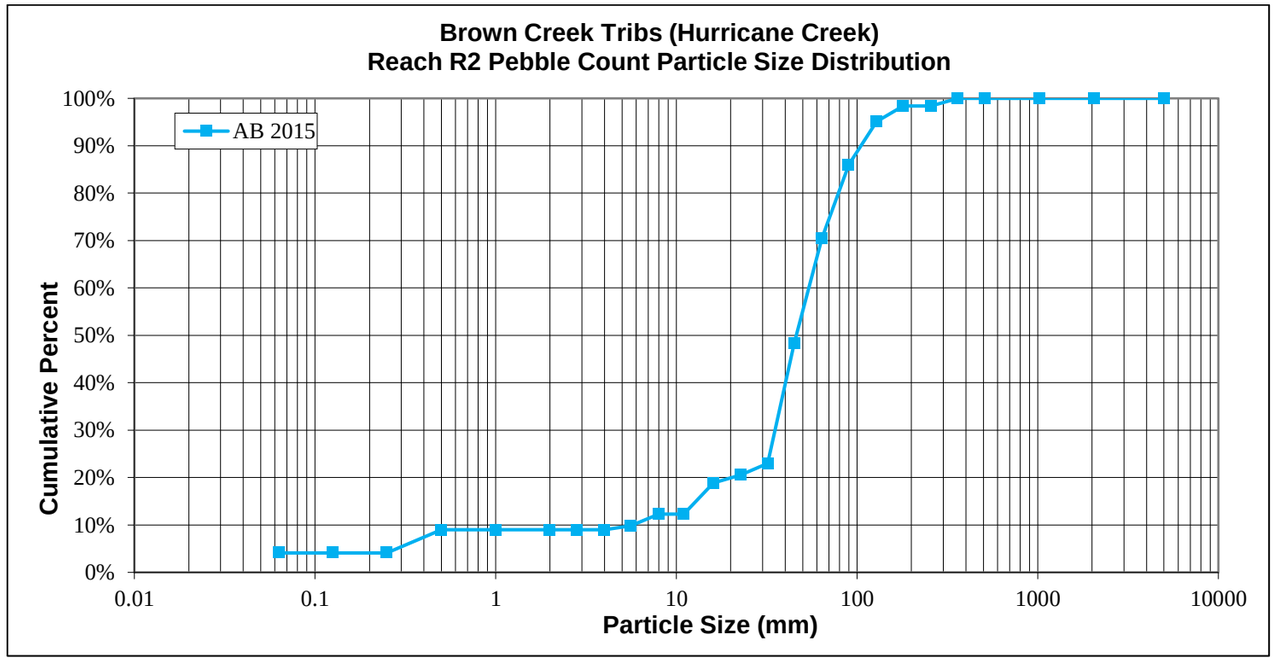
Pebble Count; As-built Survey
Brown Creek Tribs Mitigation Project, DMS# 95351

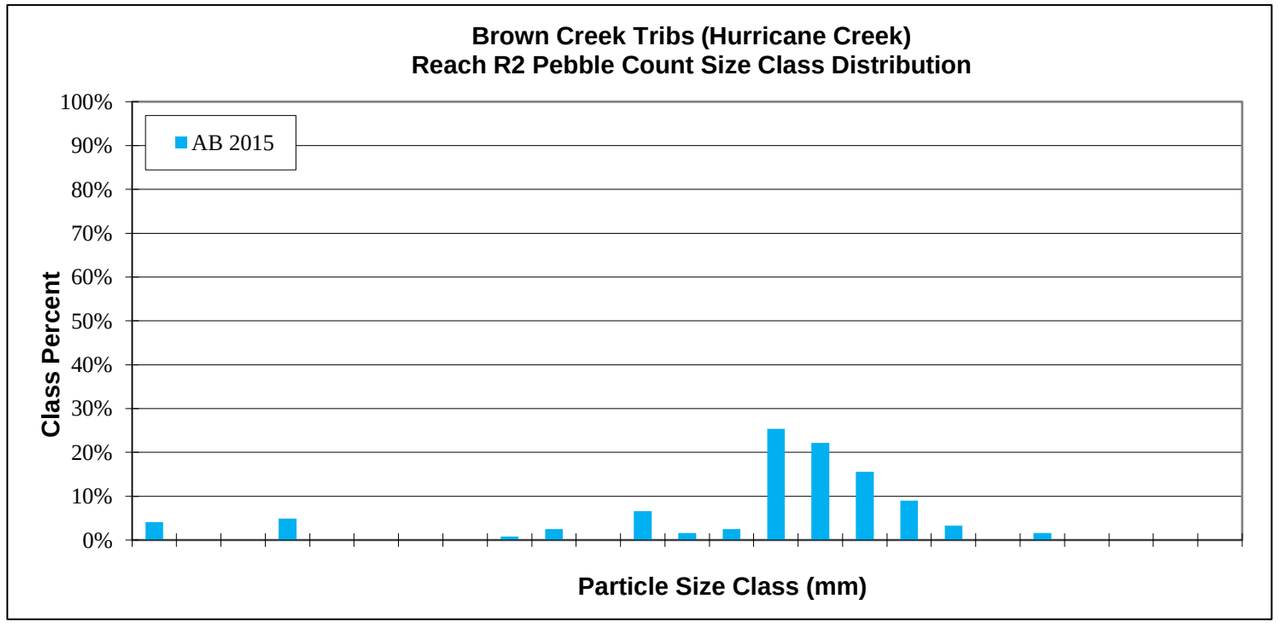
SITE OR PROJECT:	Brown Creek Tribs (Hurricane Creek)
REACH/LOCATION:	Reach R2 (Station 38+00)
FEATURE:	Rock Riffle
DATE:	2-Jul-15

			AB 2015			Distribution
MATERIAL	**PARTICLE**	**SIZE (mm)**	**Total**	**Class %**	**% Cum**	**Plot Size (mm)**
Silt/Clay	Silt / Clay	< .063	5	4%	4%	0.063
Sand	Very Fine	.063 - .125			4%	0.125
	Fine	.125 - .25			4%	0.25
	Medium	.25 - .50	6	5%	9%	0.50
	Coarse	.50 - 1.0			9%	1.0
	Very Coarse	1.0 - 2.0			9%	2.0
Gravel	Very Fine	2.0 - 2.8			9%	2.8
	Very Fine	2.8 - 4.0			9%	4.0
	Fine	4.0 - 5.6	1	1%	10%	5.6
	Fine	5.6 - 8.0	3	2%	12%	8.0
	Medium	8.0 - 11.0			12%	11.0
	Medium	11.0 - 16.0	8	7%	19%	16.0
	Coarse	16 - 22.6	2	2%	20%	22.6
	Coarse	22.6 - 32	3	2%	23%	32
	Very Coarse	32 - 45	31	25%	48%	45
	Very Coarse	45 - 64	27	22%	70%	64
Cobble	Small	64 - 90	19	16%	86%	90
	Small	90 - 128	11	9%	95%	128
	Large	128 - 180	4	3%	98%	180
	Large	180 - 256			98%	256
Boulder	Small	256 - 362	2	2%	100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
Bedrock	Bedrock	> 2048			100%	5000
Total % of whole count			122	100%		

Largest particle= 256

Summary Data			
Channel materials			
D16 =	13.6	D84 =	86.0
D35 =	37.6	D95 =	127.6
D50 =	46.2	D100 =	256 - 362





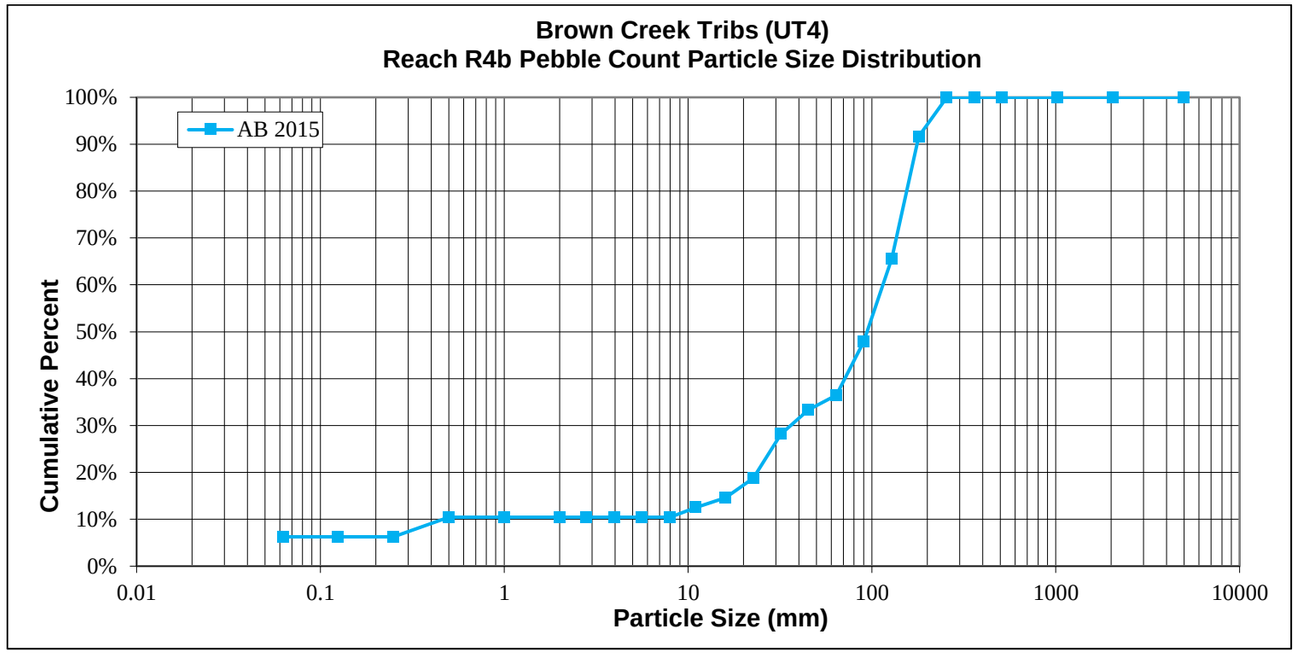
Pebble Count; As-built Survey
Brown Creek Tribs Mitigation Project, DMS# 95351

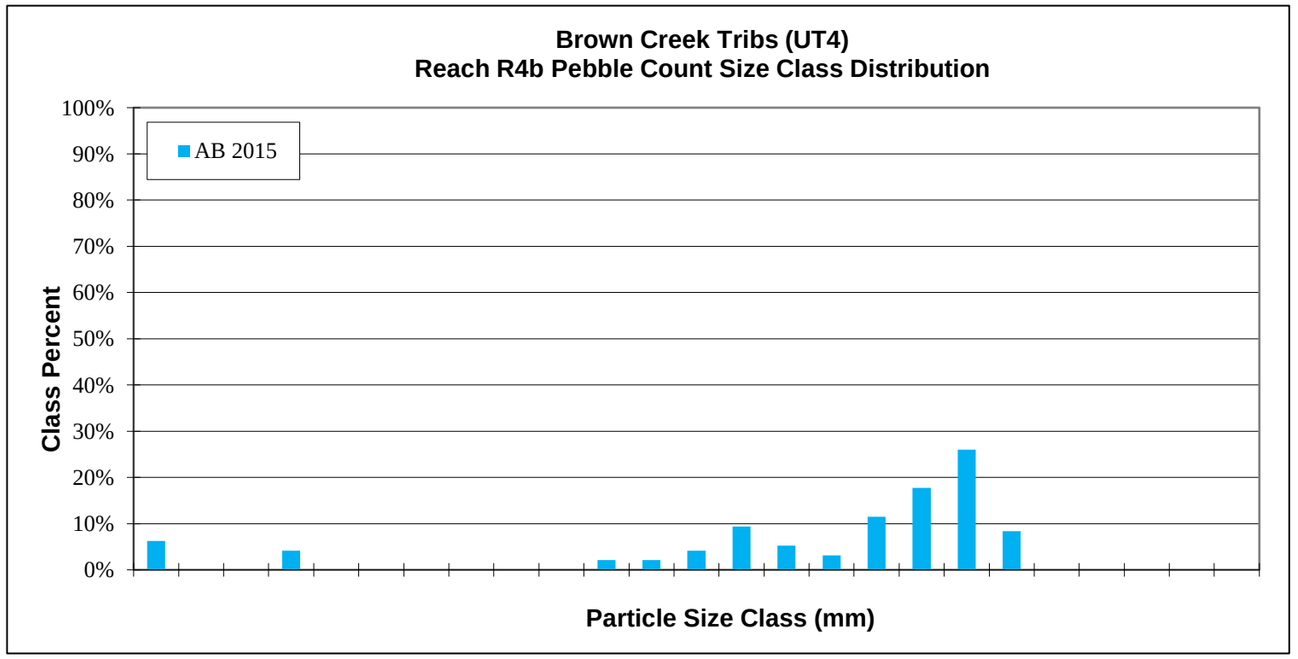
SITE OR PROJECT:	Brown Creek Tribs (UT4)
REACH/LOCATION:	Reach R4b (Station 19+25)
FEATURE:	Rock Riffle
DATE:	2-Jul-15

			AB 2015			Distribution
MATERIAL	**PARTICLE**	**SIZE (mm)**	**Total**	**Class %**	**% Cum**	**Plot Size (mm)**
Silt/Clay	Silt / Clay	< .063	6	6%	6%	0.063
Sand	Very Fine	.063 - .125			6%	0.125
	Fine	.125 - .25			6%	0.25
	Medium	.25 - .50	4	4%	10%	0.50
	Coarse	.50 - 1.0			10%	1.0
	Very Coarse	1.0 - 2.0			10%	2.0
Gravel	Very Fine	2.0 - 2.8			10%	2.8
	Very Fine	2.8 - 4.0			10%	4.0
	Fine	4.0 - 5.6			10%	5.6
	Fine	5.6 - 8.0			10%	8.0
	Medium	8.0 - 11.0	2	2%	13%	11.0
	Medium	11.0 - 16.0	2	2%	15%	16.0
	Coarse	16 - 22.6	4	4%	19%	22.6
	Coarse	22.6 - 32	9	9%	28%	32
	Very Coarse	32 - 45	5	5%	33%	45
	Very Coarse	45 - 64	3	3%	36%	64
Cobble	Small	64 - 90	11	11%	48%	90
	Small	90 - 128	17	18%	66%	128
	Large	128 - 180	25	26%	92%	180
	Large	180 - 256	8	8%	100%	256
Boulder	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
Bedrock	Bedrock	> 2048			100%	5000
Total % of whole count			96	100%		

Largest particle= 256

Summary Data			
Channel materials			
D16 =	11.1	D84 =	60.1
D35 =	23.8	D95 =	126.3
D50 =	36.6	D100 =	180 - 256





APPENDIX C

Vegetation Summary Data

(Tables 7 and 8)

Table 7. Vegetation Species Planted Across the Restoration Site Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351			
Botanical Name	**Common Name**	**% Planted by Species**	**Total Number of Stems**
Riparian Buffer Plantings			
Betula nigra	river birch	9.0	1775
Fraxinus pennsylvanica	green ash	9.0	1775
Liriodendron tulipfera	tulip poplar	6.0	1183
Nyssa sylvatica	black gum	6.0	1183
Platanus occidentalis	American sycamore	9.0	1775
Quercus alba	white oak	6.0	1183
Quercus michauxii	swamp chestnut oak	9.0	1775
Quercus phellos	willow oak	6.0	1183
Riparian Buffer Plantings - Understory			
Alnus serrulata	ironwood	5.0	986
Asimina triloba	paw paw	5.0	986
Carpinus caroliniana	ironwood	5.0	986
Diospyros virginiana	persimmon	5.0	986
Hamamelis virginiana	witch hazel	5.0	986
Itea virginica	Virginia sweetspire	5.0	986
Lindera benzoin	spicebush	5.0	986
Viburnum dentatum	arrowwood viburnum	5.0	986
Riparian Live Stake Plantings			
Cornus amomum	silky dogwood	10%	NA
Salix nigra	black willow	10%	NA
Salix sericea	silky willow	40%	NA
Sambucus canadensis	elderberry	40%	NA

Table 8. Stem Count for Each Species Arranged by Plot
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Botanical Name	Common Name	Hurricane Creek Vegetation Plots					UT4 Vegetation Plots										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Tree Species																	
Betula nigra	river birch	8	6	1	3	2	6	3	10	5	5	5	2	1	5	2	3
Fraxinus pennsylvanica	green ash	3	5	6	1	4	7		2	5	3		3	2	1	3	4
Liriodendron tulipfera	tulip poplar			1	1	1					1			1			
Nyssa sylvatica	black gum				2					1	1	4	1	1	2	4	2
Platanus occidentalis	American sycamore		2	3	3	2	2	2	1	4	4	3	6	3	1		1
Quercus alba	white oak	1		2		2	1	3	2		4	1	2	2	2	1	1
Quercus michauxii	swamp chestnut oak	1	1		2	2		2		1	1	1	2	3	3		1
Quercus nigra	water oak			1													
Quercus phellos	willow oak	1		1	3	2		2		1		2					4
Shrub Species																	
Alnus serrulata	ironwood		2		1		2				1						
Asimina triloba	paw paw											1				1	1
Carpinus caroliniana	ironwood	1						3					3		2	1	1
Cornus ammomum	silkly dogwod				1												
Diospyros virginiana	persimmon				4		2			3		1			1	2	
Hamamelis virginiana	witch hazel													2		3	
Itea virginica	Virginia sweetspire														1		
Lindera benzoin	spicebush				1										1		
Viburnum dentatum	arrowwood viburnum	1	1		1	4		3	2		2				1	3	2
Stems/plot		16	17	15	23	19	20	18	17	20	22	18	19	15	20	20	20
Stems/acre		648	688	607	931	769	809	728	688	809	890	728	769	607	809	809	809
Average Stems/ Acre for Year 0 As-Built (Baseline Data)		**756**															

APPENDIX D

As-Built Plan Sheets/Record Drawings

STATE	BAKER PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	128975	1	34

NORTH CAROLINA
DIVISION OF MITIGATION SERVICES

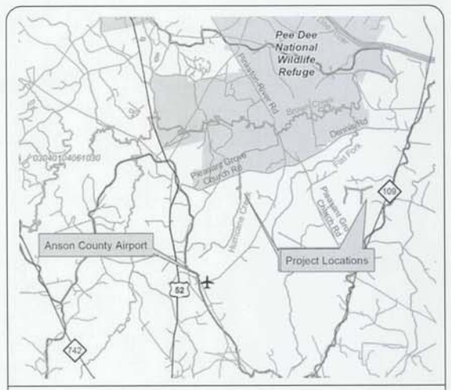
ANSON COUNTY

LOCATION: APPROX. 4 MILES SOUTHEAST OF THE TOWN OF ANSONVILLE.

TYPE OF WORK: AS–BUILT SURVEY / RECORD DRAWINGS

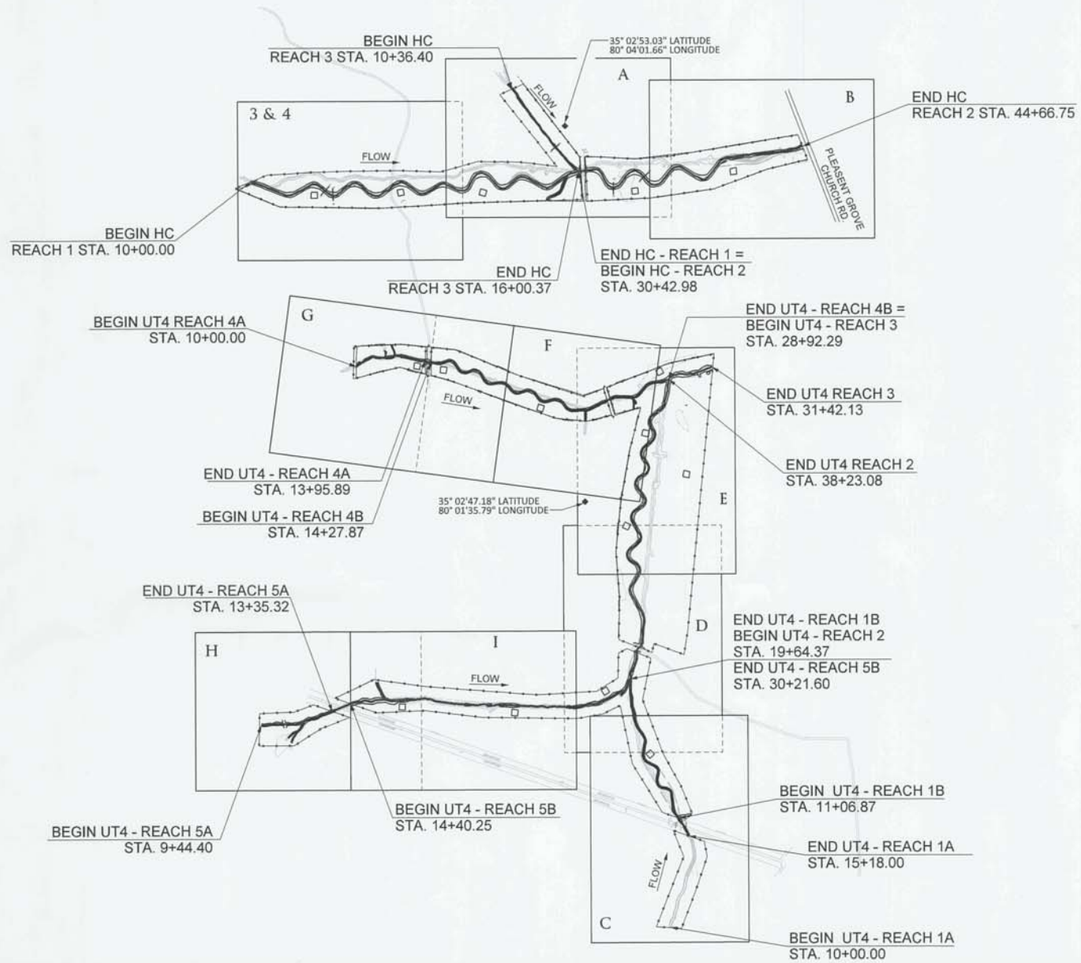
BROWN CREEK TRIBS

PROJECT: 128975



VICINITY MAP

INDEX OF SHEETS



NAD 83

USACE ID: SAW-2012-01108
NCDWR # 14-0345
PCN APPROVED ON: 08/22/14

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR DAVID LEE II
12-7-16

NCDMS ID NO. 95351

GRAPHIC SCALE

20 10 0 20 40
PLANS

DESIGN SUMMARY

AS–BUILT HC REACH 1 LENGTH	=	2043 FEET
AS–BUILT HC REACH 2 LENGTH	=	1394 FEET
AS–BUILT HC REACH 3 LENGTH	=	564 FEET
AS–BUILT UT4 – REACH 1A LENGTH	=	518 FEET
AS–BUILT UT4 – REACH 1B LENGTH	=	858 FEET
AS–BUILT UT4 – REACH 2 LENGTH	=	1828 FEET
AS–BUILT UT4 – REACH 3 LENGTH	=	250 FEET
AS–BUILT UT4 – REACH 4A LENGTH	=	396 FEET
AS–BUILT UT4 – REACH 4B LENGTH	=	1444 FEET
AS–BUILT UT4 – REACH 5A LENGTH	=	391 FEET
AS–BUILT UT4 – REACH 5B LENGTH	=	1582 FEET

PREPARED FOR THE OFFICE OF:

NCDEQ
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699–1652

CONTACT: HARRY TSOMIDES
PROJECT MANAGER

PREPARED IN THE OFFICE OF:

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Michael Baker Engineering Inc.
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Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
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SEPTEMBER 2014
LETTING DATE:

JACOB M. BYERS, PE
PROJECT ENGINEER

SCOTT KING, LSS, PWS
PROJECT MANAGER

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

11/23/16 P.E.
SIGNATURE:

BrownCreekTribs_95351_AB_12/15/2015_F.mxd

2/26/03

STREAM CONVENTIONAL SYMBOLS
SUPERCEDES SHEET 1-B

- ROCK J-HOOK
- ROCK VANE
- OUTLET PROTECTION
- ROCK CROSS VANE
- DOUBLE DROP ROCK CROSS VANE
- TEMPORARY SILT CHECK
- ROOT WAD
- LOG J-HOOK
- LOG VANE
- LOG WEIR
- LOG CROSS VANE
- CONSTRUCTED RIFFLE
- BOULDER CLUSTER
- LOG ROLLER
- GRADE CONTROL LOG JAM
- LOG STEP POOL
- SAFETY FENCE
- TAPE FENCE
- 100 YEAR FLOOD PLAIN
- CONSERVATION EASEMENT
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- LIMITS OF DISTURBANCE
- FOOT BRIDGE
- TEMPORARY STREAM CROSSING
- PERMANENT STREAM CROSSING
- TRANSPLANTED VEGETATION
- TREE REMOVAL
- TREE PROTECTION
- DITCH PLUG
- CHANNEL FILL
- BRUSH MATTRESS
- GEOLIFT

**NOTE: ALL ITEMS ABOVE MAY NOT BE USED ON THIS PROJECT

GENERAL NOTES

1. THE CONTRACTOR IS REQUIRED TO INSTALL INSTREAM STRUCTURES USING A TRACK HOE WITH A HYDRAULIC THUMB OF SUFFICIENT SIZE TO PLACE BOULDERS (3' x 2' x 2'), LOGS AND ROOTWADS.
2. WORK IS BEING PERFORMED AS AN ENVIRONMENTAL RESTORATION PLAN. THE CONTRACTOR SHOULD MAKE ALL REASONABLE EFFORTS TO REDUCE SEDIMENT LOSS AND MINIMIZE DISTURBANCE OF THE SITE WHILE PERFORMING THE CONSTRUCTION WORK.
3. CONSTRUCTION IS SCHEDULED TO BEGIN SUMMER 2014.
4. CONTRACTOR SHOULD CALL NORTH CAROLINA "ONE-CALL" BEFORE EXCAVATION STARTS. (1-800-632-4949)
5. ENGINEER WILL FLAG SIGNIFICANT TREES TO BE SAVED PRIOR TO CONSTRUCTION.
6. ALL GRADING ACTIVITIES SHALL TAKE PLACE WITHIN THE CONSERVATION EASEMENT OR LIMITS OF DISTURBANCE UNLESS SHOWN OTHERWISE.

PROJECT REFERENCE NO.	SHEET NO.
128975	1-A

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

APPROVED BY:

11/16/16
DATE:

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License #: F-1084

NCDMS ID NO. 95351

STANDARD SPECIFICATIONS

NORTH CAROLINA
EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL
MARCH 2009 (REV 2013)

6.05 TREE PRESERVATION AND PROTECTION
6.06 TEMPORARY GRAVEL CONSTRUCTION ENTRANCE
6.24 RIPARIAN AREA SEEDING
6.60 TEMPORARY SEDIMENT TRAP
6.62 TEMPORARY SILT FENCE
6.63 TEMPORARY ROCK DAM
6.70 TEMPORARY STREAM CROSSING

VEGETATION SELECTION

The following table lists the bare root vegetation selection for the project site. Total planting area is approximately 29 acres and will vary based on areas denuded during construction. Species shall be planted at density of 680 stems per acre and a minimum of 50 feet from the stream banks to the revegetation limits. Exact placement of species will be determined prior to site planting and based on apparent wetness of planting locations and per the vegetation specialist. Refer to the Revegetation Plan Sheets & Construction Specifications for vegetation planting locations and riparian buffer requirements.

Riparian Buffer - Trees (8'x8' spacing - 680 stems/acre)				
Scientific Name	**Common Name**	**% Planted By Species**	**Wetland Tolerance**	**Approx. Number of Stems**
Fraxinus pennsylvanica	Green Ash	9%	FACW	1,775
Betula nigra	River Birch	9%	FACW	1,775
Liriodendron tulipifera	Tulip Poplar	6%	FAC	1,183
Quercus phellos	Willow Oak	6%	FACW-	1,183
Quercus michauxii	Swamp Chestnut Oak	9%	FACW-	1,775
Nyssa sylvatica	Black Gum	6%	FAC	1,183
Platanus occidentalis	American Sycamore	9%	FACW-	1,775
Quercus alba	White Oak	6%	FACU	1,183
	Sub-total	60%		**11,832**
Riparian Buffer - Understory (8'x8' spacing - 680 stems/acre)				
Scientific Name	**Common Name**			
Diospyros virginiana	Persimmon	5%	FAC	986
Alnus serrulata	Tag alder	5%	FACW	986
Lindera benzoin	Spicebush	5%	FACW	986
Hamamelis virginiana	Witch hazel	5%	FAC-	986
Viburnum dentatum	Arrowwood Viburnum	5%	FAC	986
Itea virginica	Virginia sweetspire	5%	FACW+	986
Carpinus caroliniana	American Hornbeam	5%	FAC	986
Asimina triloba	Paw paw	5%	FAC	986
	Sub-total	40%		**7,888**
	Total Bare-roots			**19,720**

Permanent herbaceous seed mixtures for the project site shall be planted throughout the floodplain and riparian buffer areas. Permanent seed mixtures shall be applied with temporary seed, as defined in the construction specifications.

Scientific Name	**Common Name**	**% Planted By Species**	**Total lbs per Acre**	**Wetland Tolerance**
Andropogon gerardii	Big blue stem	10%	1.50	FAC
Dichanthelium clandestinum	Deer Tongue	15%	1.50	FACW
Carex crinata	Fringed sedge	10%	2.25	FACW+
Chasmanthium latifolium	River oats	5%	1.50	FACU
Elymus virginicus	Virginia wild rye	15%	1.50	FAC
Juncus effusus	Soft rush	5%	2.25	FACW+
Panicum virgatum	Switchgrass	10%	1.50	FAC+
Polygonum pensylvanicum	Pennsylvania Smartweed	5%	0.75	FACW
Schizachyrium scoparium	Little blue stem	10%	0.75	FACU
Tripsacum dactyloides	Eastern gamagrass	5%	0.75	FAC+
Sorghastrum nutans	Indiangrass	10%	0.75	FACU
	Total	**100%**	**15.0**	

Live staking will be applied to all restored streambanks following the details in this plan set and according to the construction specifications.

Scientific Name	**Common Name**	**% Planted By Species**	**Wetland Tolerance**
Cornus amomum	Silky Dogwood	10%	FACW+
Salix nigra	Black Willow	10%	OBL
Salix sericea	Silky Willow	40%	OBL
Sambucus canadensis	Elderberry	40%	FACW-

The following table lists temporary seed mix for the project site. All disturbed areas will be stabilized using mulch and temporary seed as defined in the construction specifications.

Planting Dates	**Species Name**	**Rate (lbs/acre)**
September to March	Annual Rye Grain (Cool Season)	130
April to August	Browntop Millet (Warm Season)	40

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2/26/03

PROJECT REFERENCE NO.	SHEET NO.
128975	1-B
NCDMS ID NO. 95351	

*S.U.E = SUBSURFACE UTILITY ENGINEER

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

CONVENTIONAL SYMBOLS

BOUNDARIES AND PROPERTY:

- State Line
- County Line
- Township Line
- City Line
- Reservation Line
- Property Line
- Existing Iron Pin — EIP
- Property Corner
- Property Monument — ECM
- Parcel/Sequence Number — 123
- Existing Fence Line
- Proposed Woven Wire Fence
- Proposed Chain Link Fence
- Proposed Barbed Wire Fence
- Existing Wetland Boundary — WLB
- Proposed Wetland Boundary — WLB
- Existing Endangered Animal Boundary — EAB
- Existing Endangered Plant Boundary — EPB

BUILDINGS AND OTHER CULTURE:

- Gas Pump Vent or U/G Tank Cap
- Sign — S
- Well — W
- Small Mine
- Foundation
- Area Outline
- Cemetery
- Building
- School
- Church
- Dam

HYDROLOGY:

- Stream or Body of Water
- Hydro, Pool or Reservoir
- Jurisdictional Stream — JS
- Buffer Zone 1 — BZ 1
- Buffer Zone 2 — BZ 2
- Flow Arrow
- Disappearing Stream
- Spring
- Wetland
- Proposed Lateral, Tail, Head Ditch — FLOW
- False Sump

RAILROADS:

- Standard Gauge — CSX TRANSPORTATION
- RR Signal Milepost — MILEPOST 35
- Switch — SWITCH
- RR Abandoned
- RR Dismantled

RIGHT OF WAY:

- Baseline Control Point
- Existing Right of Way Marker
- Existing Right of Way Line
- Proposed Right of Way Line — RW
- Proposed Right of Way Line with Iron Pin and Cap Marker — RW
- Proposed Right of Way Line with Concrete or Granite Marker — RW
- Existing Control of Access — CA
- Proposed Control of Access — CA
- Existing Easement Line — E
- Proposed Temporary Construction Easement — E
- Proposed Temporary Drainage Easement — TDE
- Proposed Permanent Drainage Easement — PDE
- Proposed Permanent Utility Easement — PUE
- Proposed Temporary Utility Easement — TUE
- Proposed Permanent Easement with Iron Pin and Cap Marker

ROADS AND RELATED FEATURES:

- Existing Edge of Pavement
- Existing Curb
- Proposed Slope Stakes Cut — C
- Proposed Slope Stakes Fill — F
- Proposed Wheel Chair Ramp — WCR
- Existing Metal Guardrail
- Proposed Guardrail
- Existing Cable Guiderail
- Proposed Cable Guiderail
- Equality Symbol
- Pavement Removal

VEGETATION:

- Single Tree
- Single Shrub
- Hedge
- Woods Line
- Orchard
- Vineyard — Vineyard

EXISTING STRUCTURES:

MAJOR:

- Bridge, Tunnel or Box Culvert — CONC
- Bridge Wing Wall, Head Wall and End Wall — CONC WW

MINOR:

- Head and End Wall — CONC HW
- Pipe Culvert
- Footbridge
- Drainage Box: Catch Basin, DI or JB — CB
- Paved Ditch Gutter
- Storm Sewer Manhole — S
- Storm Sewer — S

UTILITIES:

POWER:

- Existing Power Pole
- Proposed Power Pole
- Existing Joint Use Pole
- Proposed Joint Use Pole
- Power Manhole — P
- Power Line Tower
- Power Transformer
- U/G Power Cable Hand Hole — HH
- H-Frame Pole
- Recorded U/G Power Line — P
- Designated U/G Power Line (S.U.E.*) — P

TELEPHONE:

- Existing Telephone Pole
- Proposed Telephone Pole
- Telephone Manhole — T
- Telephone Booth
- Telephone Pedestal — T
- Telephone Cell Tower
- U/G Telephone Cable Hand Hole — HH
- Recorded U/G Telephone Cable — T
- Designated U/G Telephone Cable (S.U.E.*) — T
- Recorded U/G Telephone Conduit — TC
- Designated U/G Telephone Conduit (S.U.E.*) — TC
- Recorded U/G Fiber Optics Cable — T FO
- Designated U/G Fiber Optics Cable (S.U.E.*) — T FO

WATER:

- Water Manhole — W
- Water Meter
- Water Valve
- Water Hydrant
- Recorded U/G Water Line — W
- Designated U/G Water Line (S.U.E.*) — W
- Above Ground Water Line — A/G Water

TV:

- TV Satellite Dish
- TV Pedestal — C
- TV Tower
- U/G TV Cable Hand Hole — HH
- Recorded U/G TV Cable — TV
- Designated U/G TV Cable (S.U.E.*) — TV
- Recorded U/G Fiber Optic Cable — TV FO
- Designated U/G Fiber Optic Cable (S.U.E.*) — TV FO

GAS:

- Gas Valve
- Gas Meter
- Recorded U/G Gas Line — G
- Designated U/G Gas Line (S.U.E.*) — G
- Above Ground Gas Line — A/G Gas

SANITARY SEWER:

- Sanitary Sewer Manhole — SS
- Sanitary Sewer Cleanout
- U/G Sanitary Sewer Line — SS
- Above Ground Sanitary Sewer — A/G Sanitary Sewer
- Recorded SS Forced Main Line — FSS
- Designated SS Forced Main Line (S.U.E.*) — FSS

MISCELLANEOUS:

- Utility Pole
- Utility Pole with Base
- Utility Located Object
- Utility Traffic Signal Box — S
- Utility Unknown U/G Line — ?UTL
- U/G Tank; Water, Gas, Oil
- A/G Tank; Water, Gas, Oil
- U/G Test Hole (S.U.E.*)
- Abandoned According to Utility Records — AATUR
- End of Information — E.O.I.

Revised 02/02/00

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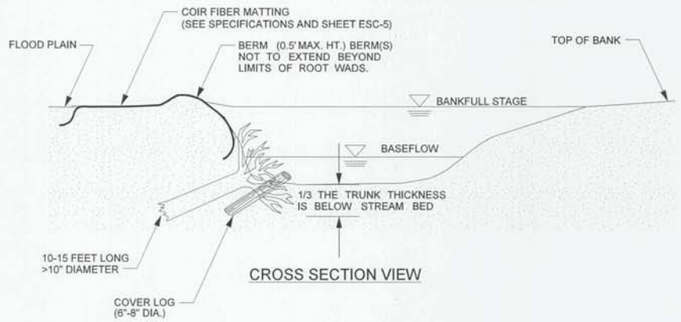
2/26/03

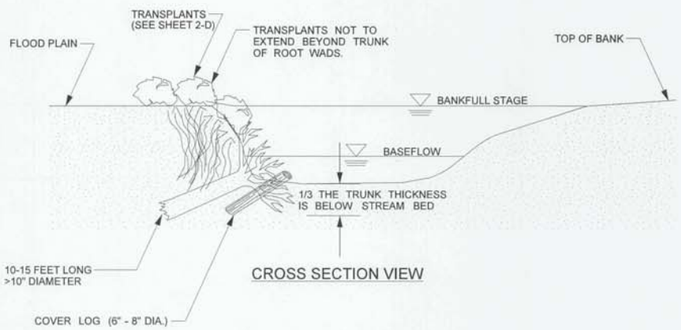
ROOT WADS

ROOT WADS WITHOUT TRANSPLANTS
USE IF TRANSPLANTS ARE NOT AVAILABLE ON-SITE



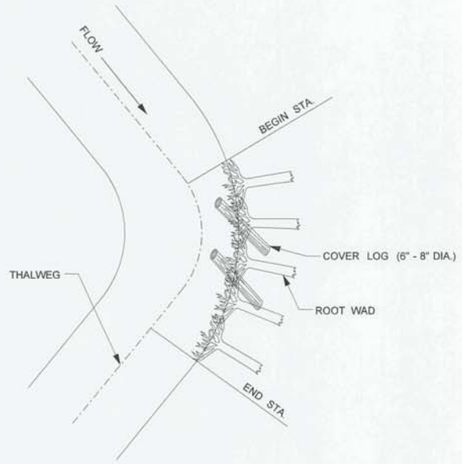
CROSS SECTION VIEW

ROOT WADS WITH TRANSPLANTS
USE IF TRANSPLANTS ARE AVAILABLE ON-SITE



CROSS SECTION VIEW

PLAN VIEW

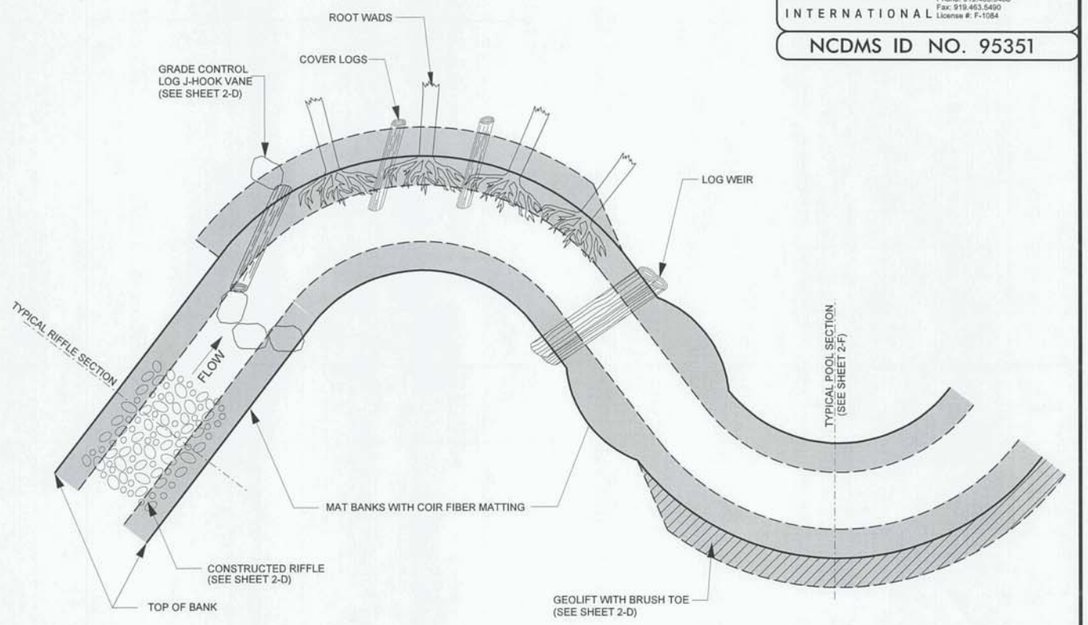


NOTES:
1. INSTALLATION USING THE TRENCHING METHOD REQUIRES THAT A TRENCH BE EXCAVATED FOR THE LOG PORTION OF THE ROOT WAD. ONE-THIRD OF THE ROOT WAD SHOULD REMAIN BELOW NORMAL BASE FLOW CONDITIONS OR CHANNEL BOTTOM.
2. THE NUMBER OF ROOTWADS ESTIMATED MAY VARY DEPENDING ON THE ROOTMASS SIZE. IN GENERAL, ROOTWADS SHOULD PROTECT THE OUTER MEANDER BEND AS SHOWN. SEE PLANS FOR APPROXIMATE STATION AND LOCATION.
3. INSTALL COVER LOGS BETWEEN ROOTWADS TO PROVIDE HABITAT ONLY WHEN AVAILABLE FROM ON-SITE HARVESTING.

TYPICAL STRUCTURE PLACEMENT

STRUCTURE NOTES:
1. GENERALLY LOG WEIRS, ROOT WADS, LOG VANES AND COIR FIBER MATTING WILL BE INSTALLED IN THE LOCATION AND SEQUENCE AS SHOWN.
2. ADDITIONAL STRUCTURES OR CHANGES TO STRUCTURE LOCATIONS MAY BE MADE BY THE DESIGN ENGINEER DURING CONSTRUCTION.

NOTES:
1. COIR FIBER MATTING TO BE INSTALLED ON ALL RESTORED STREAMBANKS EXCEPT ON POINT BARS.
2. IF ROOT WADS DO NOT COVER ENTIRE SLOPE ON OUTSIDE OF MEANDER BENDS, COIR FIBER MATTING IS NEEDED.
3. ROOT WADS SHALL BE ANGLED APPROXIMATELY 90° TOWARDS THE STREAMBANK.



BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

APPROVED BY:

11/10/16
DATE:

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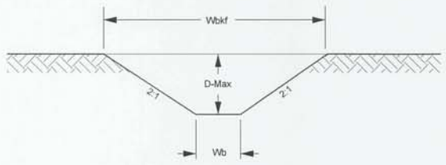
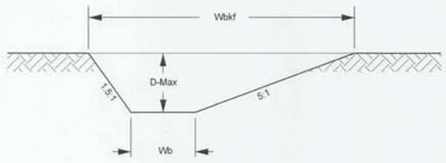
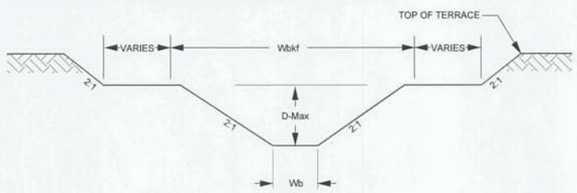
TYPICAL RIFFLE, POOL CROSS SECTIONS



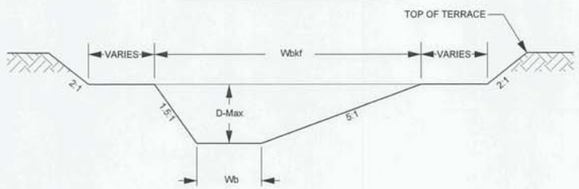
RIFFLE



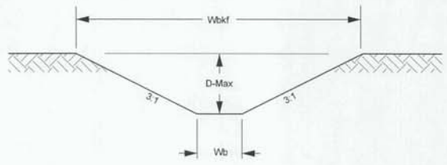
POOL



RIFFLE WITH BANKFULL BENCH



POOL WITH BANKFULL BENCH



STEP-POOL

HURRICANE CREEK						UT4									
REACH 1		REACH 2		REACH 3		REACH 1		REACH 2		REACH 3		REACH 4		REACH 5	
RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL
19.1	26.0	20.1	27.0	9.1	13.0	11.4	15.0	16.5	24.0	19.8	26.0	12.0	16.0	13.9	18.0
1.8	3.0	1.9	3.2	1.0	2.0	1.1	2.4	1.6	3.0	1.7	3.7	1.1	2.2	1.5	2.4
13.0	13.9	13.0	13.7	12.0	12.1	13.0	11.2	13.0	13.5	14.0	13.3	13.0	13.1	12.0	12.5
28.0	48.8	31.0	53.1	6.9	14.0	10.0	20.2	21.0	42.8	28.0	59.1	11.0	19.5	16.0	25.9
11.8	6.5	12.4	6.2	5.3	1.0	7.1	1.8	10.2	4.5	13.0	4.0	7.4	1.7	8.0	3.6

WIDTH OF BANKFULL (Wbkf)
MAXIMUM DEPTH (D-Max)
WIDTH TO DEPTH RATIO (Wbkf / D)
BANKFULL AREA (Abkf)
BOTTOM WIDTH (Wb)

NOTES:
1. DURING CONSTRUCTION CORNERS OF DESIGN CHANNEL WILL BE ROUNDED AND A THALWEG WILL BE SHAPED PER DIRECTION OF ENGINEER.
2. POOLS SHOWN ABOVE ARE LEFT POOLS ONLY.

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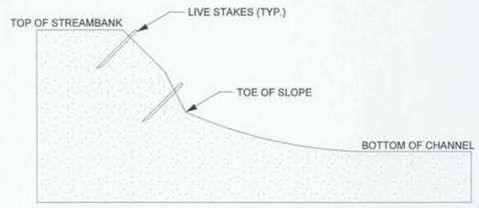
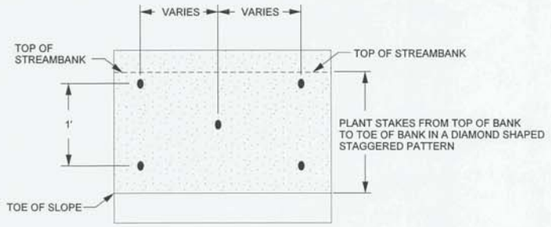
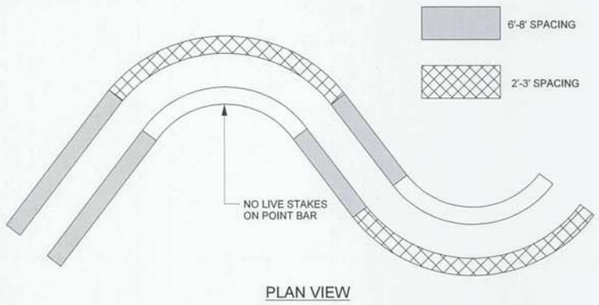
LIVE STAKING



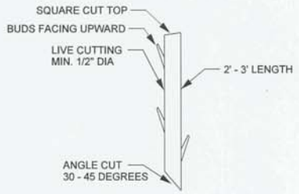
CROSS SECTION VIEW



PLAN VIEW



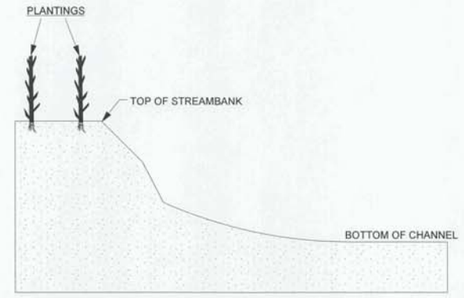
PLAN VIEW



LIVE STAKE DETAIL

NOTES:
1. STAKES PRODUCED FROM ON-SITE SHOULD BE CUT AND INSTALLED ON THE SAME DAY.
2. DO NOT INSTALL STAKES THAT HAVE BEEN SPLIT.
3. STAKES MUST BE INSTALLED WITH BUDS POINTING UPWARDS.
4. STAKES SHOULD BE INSTALLED PERPENDICULAR TO BANK.
5. STAKES SHOULD BE 1/2 TO 2 INCHES IN DIAMETER AND 2 TO 3 FT LONG.
6. STAKES SHOULD BE INSTALLED LEAVING 1/5 OF STAKE ABOVE GROUND.
7. DO NOT LIVE STAKE POINT BARS ALONG MEANDER BENDS.

PLANTING SPECIFICATIONS



CROSS SECTION VIEW OF BARE ROOT PLANTING

NOTES:
1. PLANT BARE ROOT SHRUBS AND TREES TO THE WIDTH OF THE BUFFER/PLANTING ZONE AS SHOWN ON THE PLANS.
2. ALLOW FOR 6-10 FEET BETWEEN PLANTINGS, DEPENDING ON SIZE.
3. LOOSEN COMPACTED SOIL.
4. PLANT IN HOLES MADE BY A MATTOCK, DIBBLE, PLANTING BAR, OR OTHER APPROVED MEANS.
5. PLANT IN HOLES DEEP AND WIDE ENOUGH TO ALLOW THE ROOTS TO SPREAD OUT AND DOWN WITHOUT J-ROOTING.
6. KEEP ROOTS MOIST WHILE DISTRIBUTING OR WAITING TO PLANT BY MEANS OF WET CANVAS, BURLAP, OR STRAW.
7. HEEL-IN PLANTS IN MOIST SOIL OR SAWDUST IF NOT PROMPTLY PLANTED UPON ARRIVAL TO PROJECT SITE.

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2-A

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

APPROVED BY:

11/10/16
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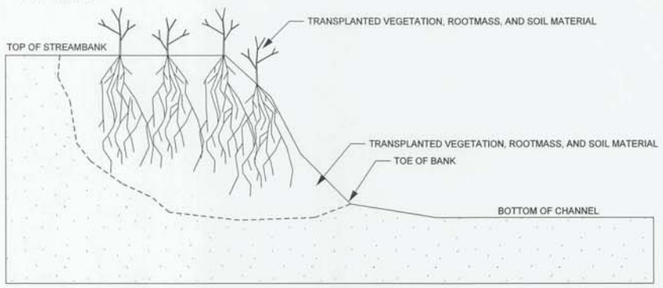
License #: F-1084

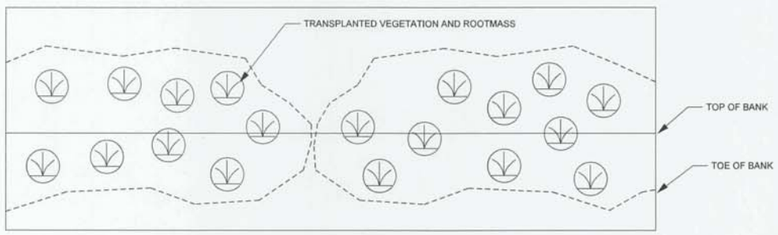
NCDMS ID NO. 95351

TRANSPLANTED VEGETATION

NOTES:
1. EXCAVATE A HOLE IN THE BANK TO BE STABILIZED THAT WILL ACCOMMODATE THE SIZE OF TRANSPLANT TO BE PLACED. BEGIN EXCAVATION AT THE TOE OF THE BANK.
2. EXCAVATE TRANSPLANT USING A FRONT END LOADER. EXCAVATE THE ENTIRE ROOT MASS AND AS MUCH ADDITIONAL SOIL MATERIAL AS POSSIBLE. IF ENTIRE ROOT MASS CAN NOT BE EXCAVATED IN ONE BUCKET LOAD, THE TRANSPLANT IS TOO LARGE AND ANOTHER SHOULD BE SELECTED.
3. PLACE TRANSPLANT IN THE BANK TO BE STABILIZED SO THAT VEGETATION IS ORIENTATED VERTICALLY.
4. FILL IN ANY HOLES AROUND THE TRANSPLANT AND COMPACT.
5. ANY LOOSE SOIL LEFT IN THE STREAM SHOULD BE REMOVED.
6. PLACE MULTIPLE TRANSPLANTS CLOSE TOGETHER SUCH THAT THEY TOUCH.

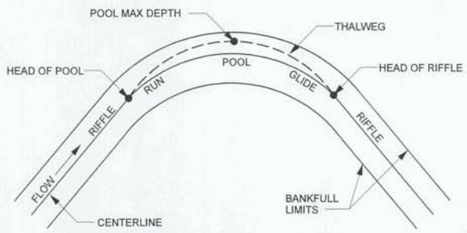


CROSS SECTION VIEW

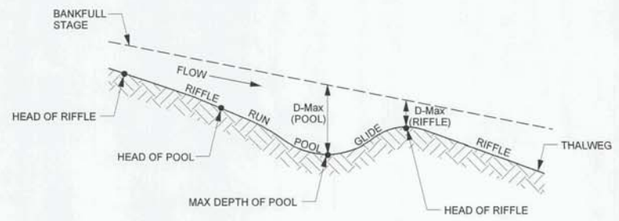


PLAN VIEW

TYPICAL PLAN VIEW AND PROFILE



PLAN VIEW



PROFILE VIEW

NOTES:
1. THE POINTS SHOWN, e.g. HEAD OF RIFFLE, HEAD OF POOL AND MAX DEPTH OF POOL ARE THE CONTROL POINTS USED TO CUT THE PROFILE; HOWEVER, THE CONTRACTOR SHOULD CREATE SMOOTH TRANSITIONS BETWEEN CONTROL POINTS AS SHOWN ABOVE.
2. THE DOWNSTREAM HEAD OF RIFFLE ELEVATION SHOULD NOT EXCEED THE HEAD OF POOL ELEVATION.
3. THE CHANGE IN WIDTH BETWEEN THE RIFFLES AND POOLS SHOULD OCCUR GRADUALLY OVER THE ENTIRE LENGTH OF THE BEND.

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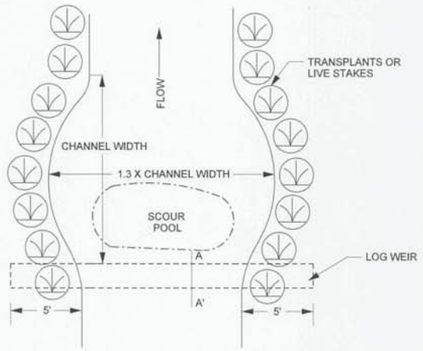
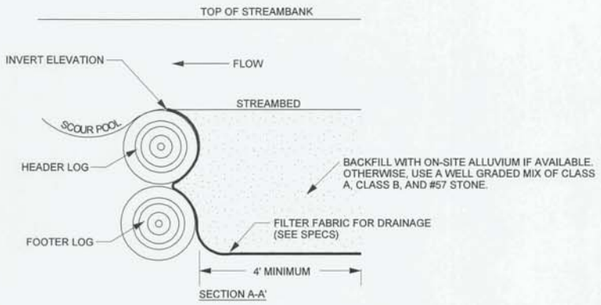
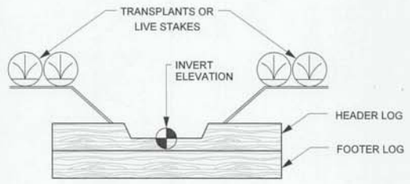
LOG WEIR



PLAN VIEW



SECTION A-A'

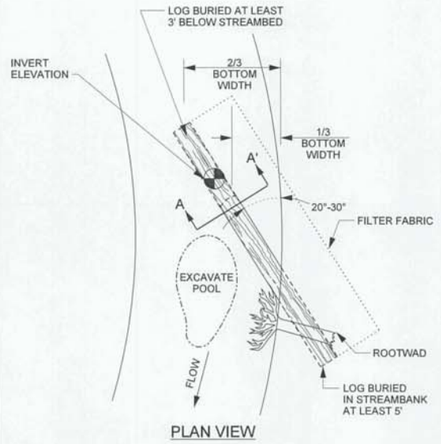


CROSS SECTION VIEW

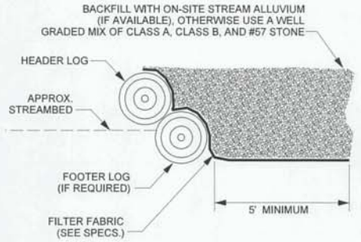
NOTES:

1. LOGS SHOULD BE AT LEAST 12 INCHES IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. LOGS >24 INCHES IN DIAMETER MAY BE USED ALONE WITHOUT AN ADDITIONAL LOG. FILTER FABRIC SHOULD STILL BE USED TO SEAL AROUND LOG.
3. PLACE FOOTER LOGS FIRST AND THEN HEADER (TOP) LOG. SET HEADER LOG AT A MAXIMUM OF 3 INCHES ABOVE THE INVERT ELEVATION.
4. CUT A NOTCH IN THE HEADER LOG APPROXIMATLEY 30% OF THE CHANNEL BOTTOM WIDTH AND EXTENDING DOWN TO THE INVERT ELEVATION. NOTCH SHALL NOT EXCEED 3 INCHES IN DEPTH.
5. USE FILTER FABRIC FOR DRAINAGE TO SEAL GAPS BETWEEN LOGS.
6. PLACE TRANSPLANTS FROM TOE OF STREAMBANK TO TOP OF STREAMBANK.

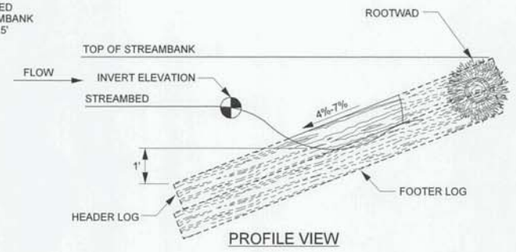
LOG VANE



PLAN VIEW



SECTION A - A'



PROFILE VIEW

NOTES:

1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
3. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT LOCKS THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
4. FILTER FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2-B

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

APPROVED BY:

DATE: 11/10/16

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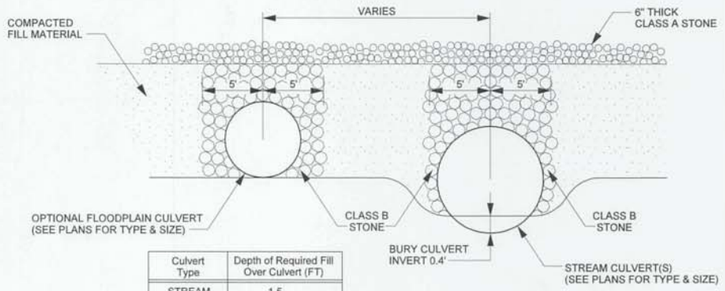
NCDMS ID NO. 95351

PERMANENT ROAD CULVERT CROSSING

NOT TO SCALE

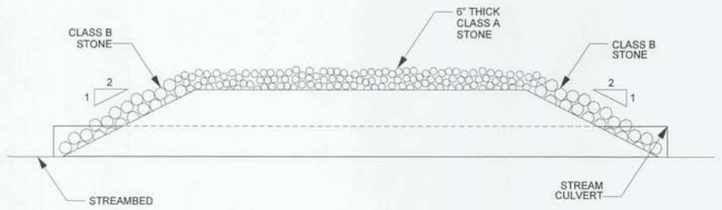


Culvert Type	Depth of Required Fill Over Culvert (FT)
STREAM	1.5
FLOOD PLAIN	1.5

PROFILE VIEW ALONG ROAD

NOTES:

1. INSTALL PIPE CULVERT IN ACCORDANCE WITH DETAIL SPECIFICATIONS.
2. INSTALL COIR FIBER MATTING FOR EROSION CONTROL ALONG FILL SLOPES

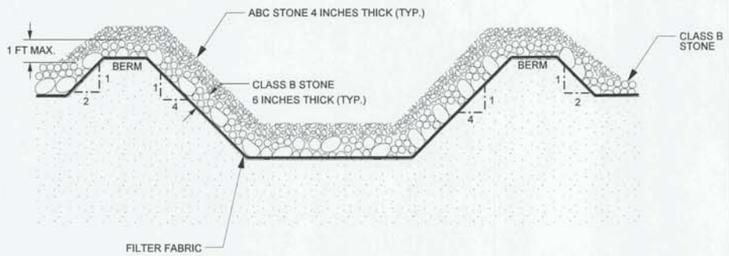


CROSS SECTION

NOTES:

1. TYPICAL SECTION APPLIES TO UT4 REACH 1B AT APPROXIMATE STATION 16+30 AND HC REACH 3, STATION 10+00.
2. CULVERTS ARE TO BE EVENLY SPACED MINIMUM OF 24" APART.
3. MINIMUM OF 18" COVER FOR ALL PIPES.

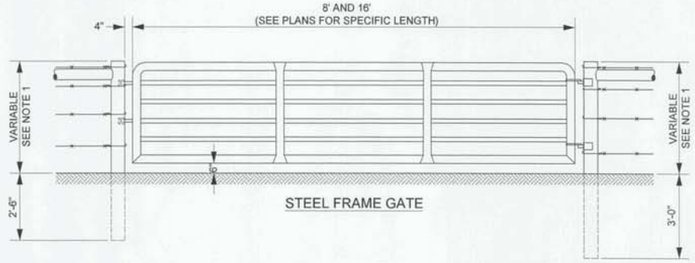
PERMANENT FORD STREAM CROSSING



NOTES:

1. CONSTRUCT STREAM CROSSING WHEN FLOW IS LOW.
2. HAVE ALL NECESSARY MATERIALS AND EQUIPMENT ON-SITE BEFORE WORK BEGINS.
3. MINIMIZE CLEARING AND EXCAVATION OF STREAMBANKS. DO NOT EXCAVATE CHANNEL BOTTOM. COMPLETE ONE SIDE BEFORE STARTING ON THE OTHER SIDE.
4. INSTALL STREAM CROSSING AT RIGHT ANGLE TO THE FLOW.
5. GRADE SLOPES TO A 4:1 SLOPE. TRANSPLANT SOD FROM ORIGINAL STREAMBANK ONTO SIDE SLOPES.
6. MAINTAIN CROSSING SO THAT RUNOFF IN THE CONSTRUCTION ROAD DOES NOT ENTER EXISTING CHANNEL.
7. A STABILIZED PAD OF CLASS B STONE, 1 FOOT THICK, LINED WITH FILTER FABRIC FOR DRAINAGE SHALL BE USED OVER THE BERM AND ACCESS SLOPES. ABC STONE APPROXIMATLEY 4 INCHES THICK ADDED TO TOP LAYER.
8. WIDTH OF THE CROSSING SHALL BE SUFFICIENT TO ACCOMMODATE THE LARGEST VEHICLE CROSSING THE CHANNEL.
9. CONTRACTOR SHALL DETERMINE AN APPROPRIATE RAMP ANGLE ACCORDING TO EQUIPMENT UTILIZED.

STEEL GATES



STEEL FRAME GATE

NOTES:

1. POST HEIGHT DIMENSION SHALL BE THE SAME AS REQUIRED FOR THE ADJACENT FENCE.
2. CONSTRUCT AN END OR STRESS PANEL, AS REQUIRED IN THE SPECIFICATION, ON EACH SIDE OF GATE.
3. HINGES AND LOCKS SHALL BE INSTALLED AS SPECIFIED BY GATE MANUFACTURER.

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BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2-C

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M BYERS

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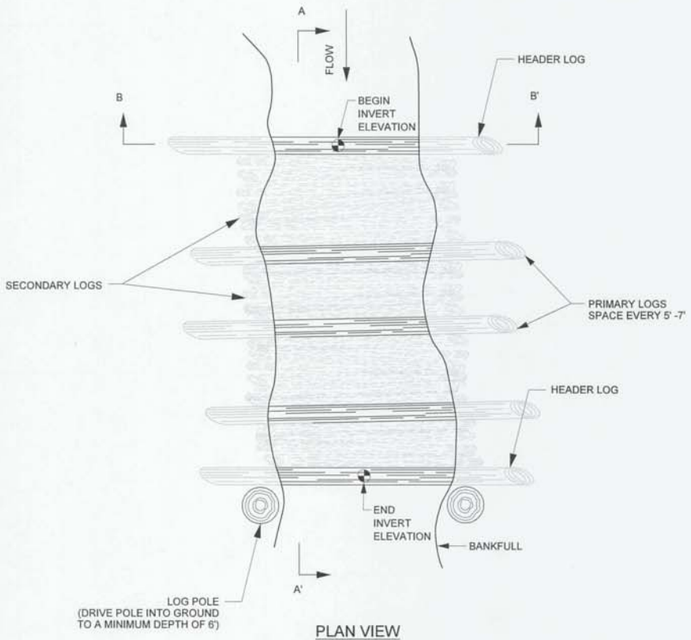
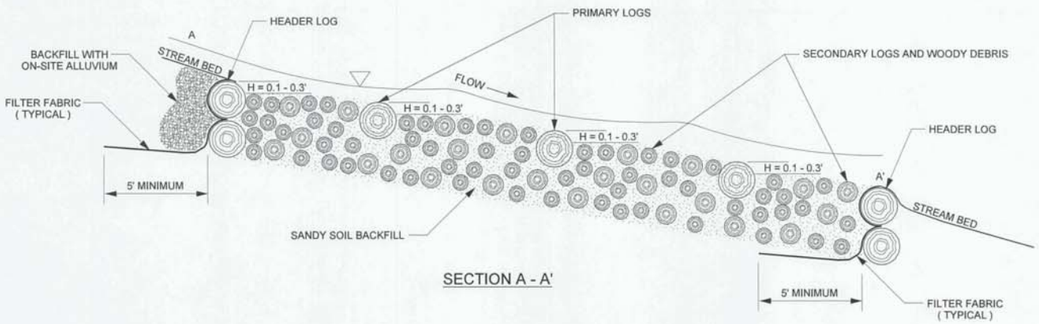
NCDMS ID NO. 95351

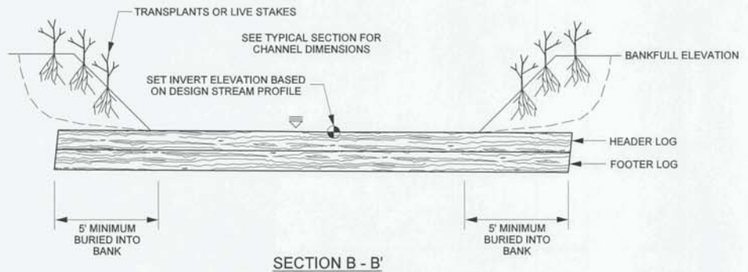
GRADE CONTROL LOG JAM



PLAN VIEW



SECTION A - A'

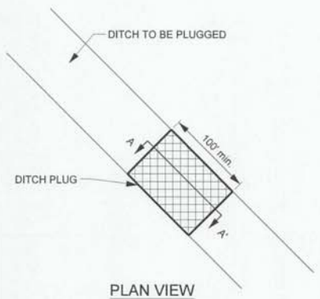


SECTION B - B'

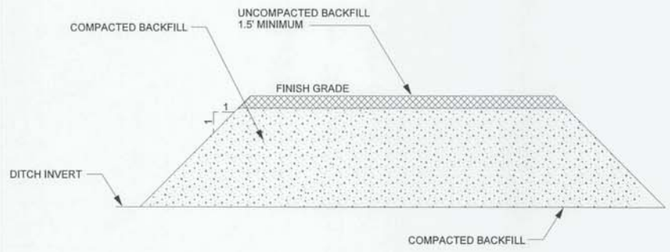
NOTES:

1. PRIMARY LOGS SHOULD BE AT LEAST 10" OR MORE IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD PREFERRED, AND RECENTLY HARVESTED AND EXTENDING INTO THE BANK 5' ON EACH SIDE.
2. SECONDARY LOGS SHOULD BE AT LEAST 1" IN DIAMETER AND NO LARGER THAN 10", AND EXTEND INTO THE BANK 2 FEET ON EACH SIDE. WOOD MATERIAL SHALL BE VARYING DIAMETER TO ALLOW MATERIAL TO BE COMPACTED.
3. VERTICAL POSTS SHOULD BE AT LEAST 10" IN DIAMETER AND SHOULD BE DRIVEN INTO THE GROUND A MINIMUM OF 6'.
4. FILTER FABRIC SHOULD BE NAILED TO THE HEADER LOG BELOW THE BACKFILL.
5. ROOTWADS AND COIR FIBER MATTING CAN BE USED INSTEAD OF TRANSPLANTS OR LIVE STAKES, PER DIRECTION OF ENGINEER.
6. AFTER TRENCH HAS BEEN EXCAVATED A LAYER OF SECONDARY LOGS AND WOODY DEBRIS SHOULD BE PLACED WITH MINIMAL GAPS. A LAYER OF ON-SITE ALLUVIUM SHOULD BE APPLIED TO FILL VOIDS BETWEEN SECONDARY LOGS BEFORE ADDITIONAL LAYERS ARE PLACED.

DITCH PLUG



PLAN VIEW

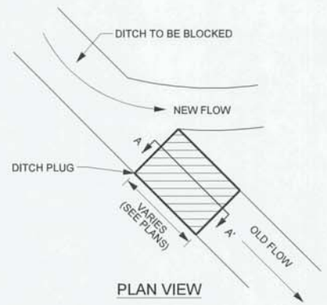


SECTION A - A'

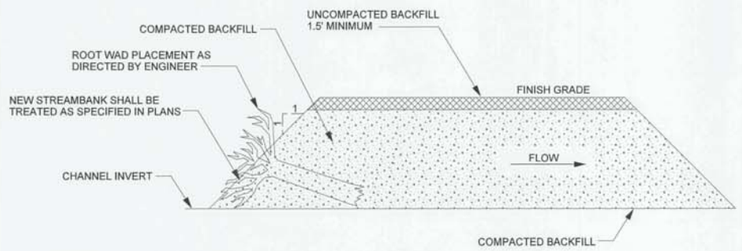
NOTES:

1. COMPACT BACKFILL USING ON-SITE HEAVY EQUIPMENT IN 10 INCH LIFTS.
2. FILL DITCH TO TOP OF BANKS OR AS DIRECTED BY ENGINEER.

CHANNEL BLOCK



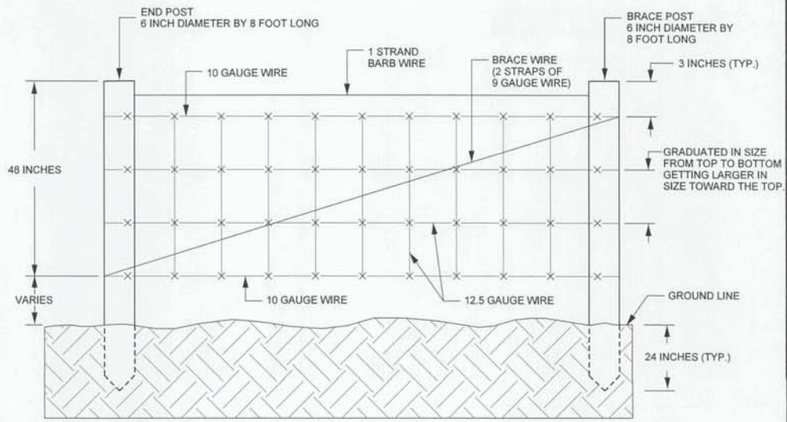
PLAN VIEW



NOTES:

1. COMPACT BACKFILL USING ON-SITE HEAVY EQUIPMENT IN 10 INCH LIFTS.
2. FILL DITCH TO TOP OF BANKS OR AS DIRECTED BY ENGINEER.

WOVEN FIELD FENCE

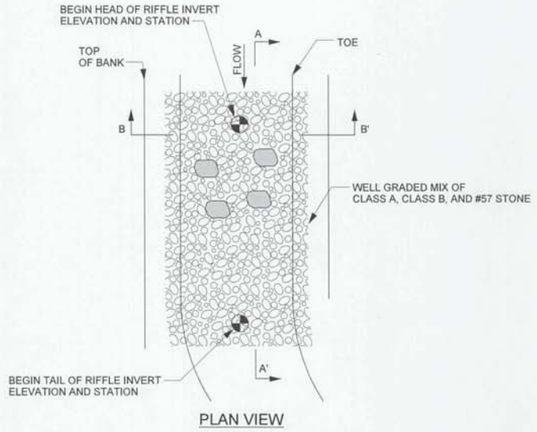


NOTE:

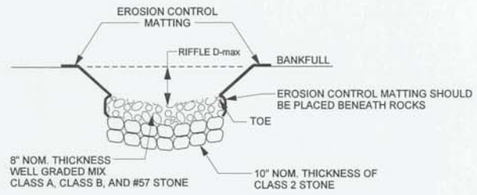
1. END POSTS SHALL BE INSTALLED AT A SPACING OF 10-15 FEET.

2/26/03

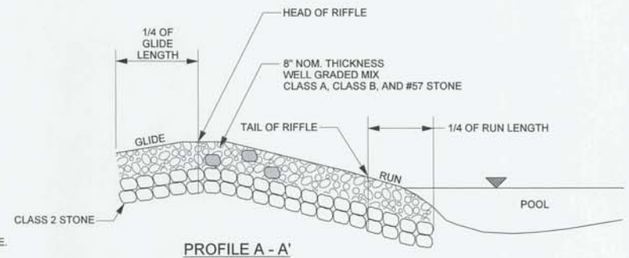
CONSTRUCTED RIFFLE



PLAN VIEW



SECTION B - B'

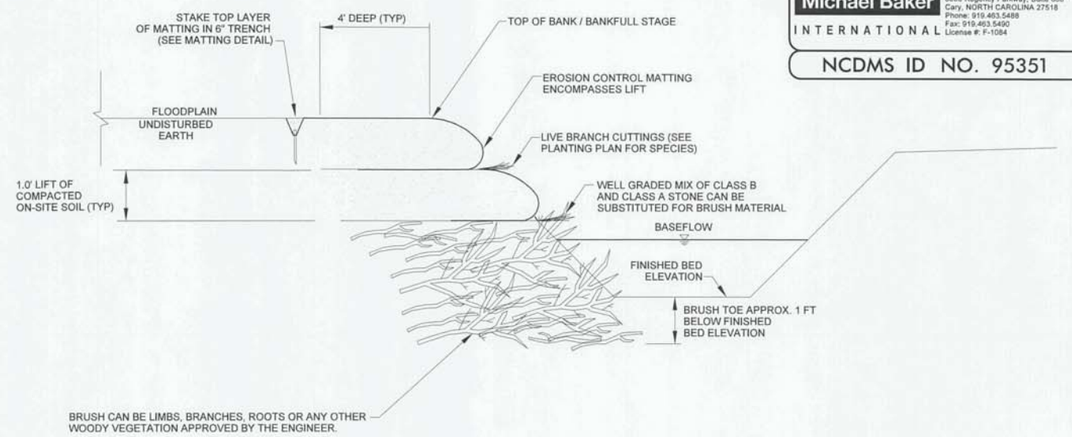


PROFILE A - A'

NOTES:
1. UNDERCUT CHANNEL BED ELEVATION 18 INCHES TO ALLOW FOR LAYERS OF STONE.
2. INSTALL EROSION CONTROL MATTING ALONG COMPLETED BANKS SUCH THAT THE EROSION CONTROL MATTING AT THE TOE OF THE BANK EXTENDS DOWN TO THE UNDERCUT ELEVATION.
3. INSTALL SUB LAYER OF CLASS 2 STONE.
4. INSTALL A WELL GRADED MIX OF SPECIFIED STONE, COMPACTED TO GRADE.
5. FINAL CHANNEL BED SHAPE SHOULD BE ROUNDED, SMOOTH, AND CONCAVE, WITH THE ELEVATION OF THE BED 0.2 FT DEEPER IN THE CENTER THAN AT THE EDGES.
6. RIFFLE LENGTHS WILL VARY. SEE LONGITUDINAL PROFILE AND STRUCTURE TABLE FOR BEGINNING AND ENDING STATIONS AND ELEVATIONS.

GEOLIFT WITH BRUSH TOE

NOTES:
1. LIVE BRANCH CUTTINGS SHALL BE THE SAME SPECIES AS THE LIVE STAKES AND SHALL BE INSTALLED DURING VEGETATION DORMANCY.
2. LIVE BRANCH CUTTINGS SHALL BE INSTALLED AT A DENSITY OF 20-30 CUTTINGS PER LINEAR FOOT AND A MAXIMUM DIAMETER OF 2.5 INCHES.
3. NUMBER OF SOIL LIFTS MAY VARY, IN GENERAL LIFTS SHALL EXTEND TO THE TOP OF BANK OR BANKFULL STAGE.
4. GEOLIFTS TO BE INSTALLED IN CHANNEL SECTIONS ALONG SIDE SLOPES STEEPER THAN 2:1 AND/OR ADJACENT TO HILL SLOPES.



NOTES:
1. WHEN GEOLIFTS ARE BUILT ABOVE ROOTWAD CLUSTER, USE LARGE STONE BACKFILL BEHIND ROOT MASS TO BUILT FOUNDATION.

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2-D

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

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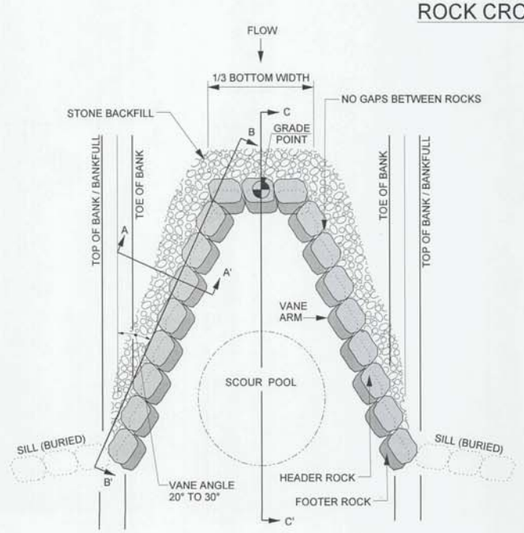
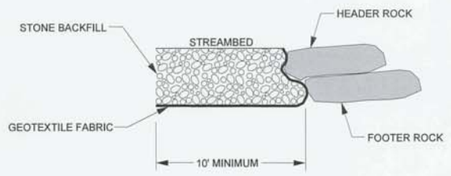
NCDMS ID NO. 95351

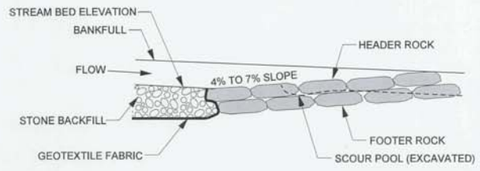
ROCK CROSS VANE



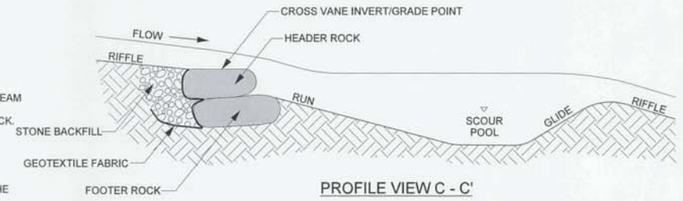
PLAN VIEW



SECTION A - A'



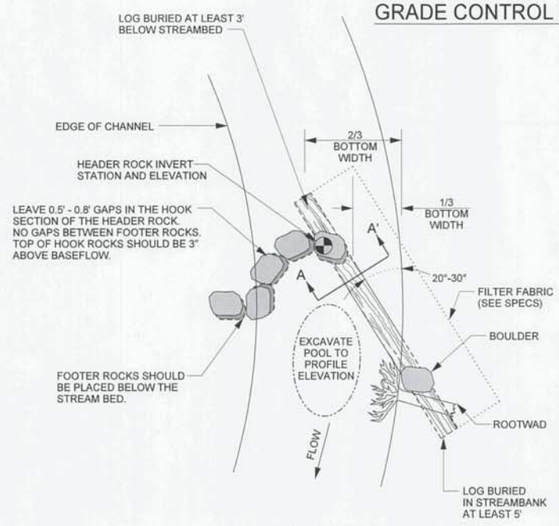
PROFILE VIEW B - B'
VANE ARM



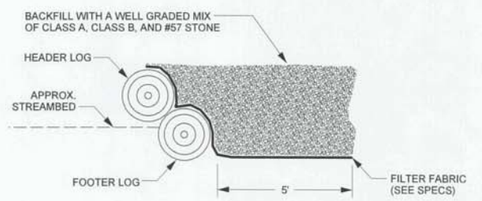
PROFILE VIEW C - C'

NOTES FOR ALL VANE STRUCTURES:
1. INSTALL BEGINNING AT THE TOP OF THE HEADER ROCKS AND EXTEND DOWNWARD TO THE DEPTH OF THE BOTTOM FOOTER ROCK, AND THEN UPSTREAM TO A MINIMUM OF TEN FEET.
2. DIG A TRENCH BELOW THE BED FOR FOOTER ROCKS AND PLACE FILL ON UPSTREAM SIDE OF VANE ARM, BETWEEN THE ARM AND STREAMBANK.
3. START AT BANK AND PLACE FOOTER ROCKS FIRST AND THEN HEADER (TOP) ROCK.
4. CONTINUE WITH STRUCTURE, FOLLOWING ANGLE AND SLOPE SPECIFICATIONS.
5. AN EXTRA ROCK CAN BE PLACED IN SCOUR POOL FOR HABITAT IMPROVEMENT.
6. USE HAND PLACED STONE TO FILL GAPS ON UPSTREAM SIDE OF HEADER AND FOOTER ROCKS.
7. AFTER ALL STONE BACKFILL HAS BEEN PLACED, FILL IN THE UPSTREAM SIDE OF THE STRUCTURE WITH ON-SITE ALLUVIUM TO THE ELEVATION OF THE TOP OF THE HEADER ROCK.

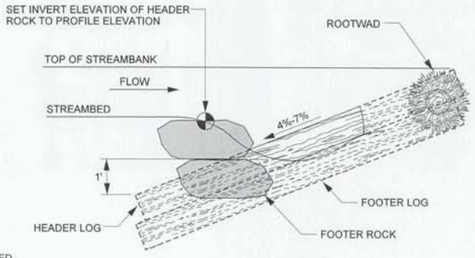
GRADE CONTROL LOG J-HOOK VANE



PLAN VIEW



SECTION A - A'



PROFILE VIEW

NOTES:
1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. BOULDERS MUST BE 3' x 2' x 2'.
3. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
4. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT SECURES THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
5. BOULDERS SHOULD BE PLACED ON TOP OF HEADER LOG FOR ACHORING.
6. HEADER BOULDERS TO BE PLACED 0.5 TO 0.8 FEET APART.
7. NON-WOVEN FILTER FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.
8. FOOTERS SHALL BE INSTALLED SUCH THAT 1/4 TO 1/3 OF THE LENGTH IS DOWNSTREAM OF THE HEADER.

11/9/2016
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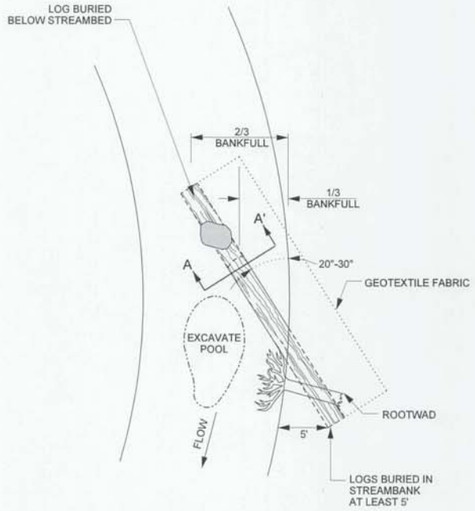
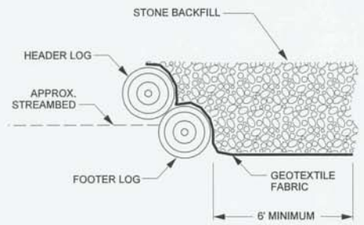
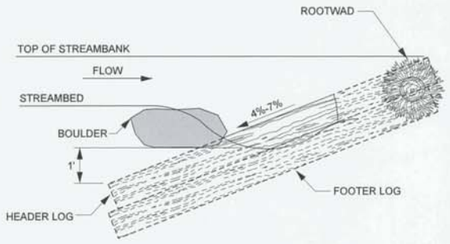
LOG VANE



PLAN VIEW



SECTION A - A'

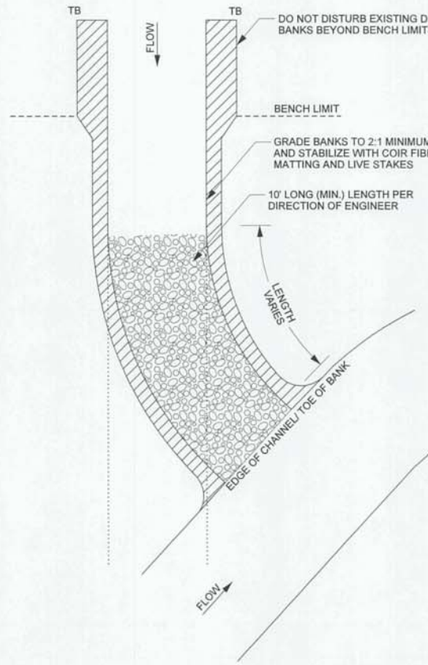


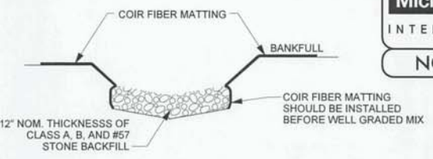
PROFILE VIEW

NOTES:

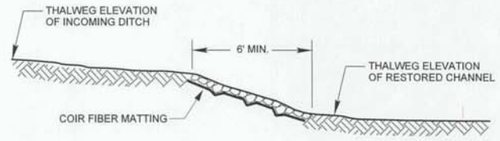
1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. BOULDERS MUST BE OF SUFFICIENT SIZE TO ANCHOR LOGS.
3. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOGS.
4. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT LOCKS THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
5. BOULDER SHOULD BE PLACED ON TOP OF HEADER LOG FOR ANCHORING.
6. GEOTEXTILE FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.
7. TRANSPLANTS CAN BE USED INSTEAD OF ROOTWADS, PER DIRECTION OF ENGINEER.

TIE-IN SWALE





CROSS-SECTION



TYPICAL PROFILE FOR SWALE

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2-E

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

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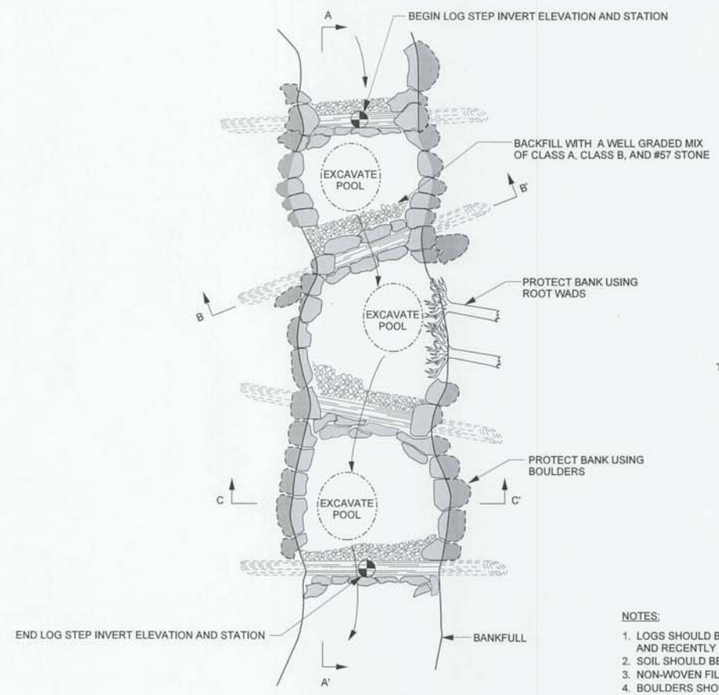
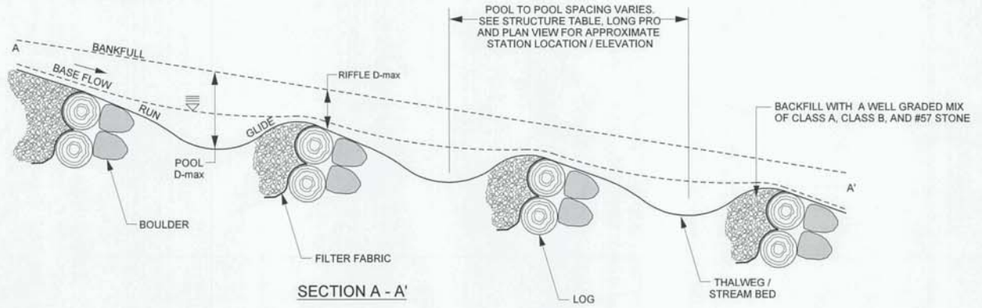
NCDMS ID NO. 95351

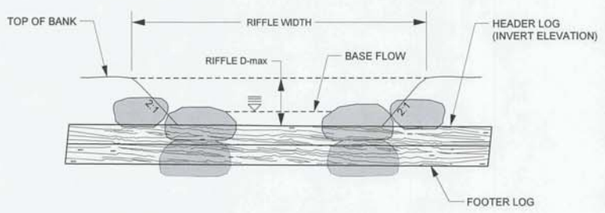
LOG AND ROCK STEP-POOL



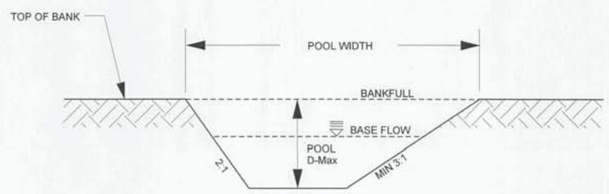
PLAN VIEW



SECTION A - A'



SECTION B - B'



SECTION C - C'

NOTES:

1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED AND EXTENDING INTO THE BANK 5' ON EACH SIDE.
2. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
3. NON-WOVEN FILTER FABRIC SHOULD BE NAILED/STAPLED TO THE LOG BELOW THE BACKFILL.
4. BOULDERS SHOULD BE 3' X 2' X 2' AND PLACED ON TOP OF HEADER LOG FOR ANCHORING.
5. LOGS SHOULD BE ANGLED 60° - 70° FROM THE STREAM BANK AND CROSS SLOPES SHOULD NOT EXCEED 2%.
6. STEP HEIGHTS/DROPS SHALL NOT EXCEED 0.4 FT AND POOL DEPTHS NOT TO EXCEED 1.8 FT.
7. THE NUMBER LOG STEPS MAY VARY BETWEEN BEGIN AND END STATIONING DEPENDING ON LOG DIAMETER SIZE. SEE LONGITUDINAL PROFILE AND STRUCTURE TABLE FOR STATION AND ELEVATION.

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BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	3

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR DAVID LEE II

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BEGIN HC - REACH 1
STA. 10+00.00

NAD 83

3' BARB WIRE FENCE
WOVEN WIRE FENCE
LOG VANE (TYP.)
AS-BUILT TOP OF BANK (TYP.)
GEOLIFT WITH BRUSH TOE (TYP.)
VEG PLOT #5
X-11
X-12
ROOT WADS (TYP.)
AS-BUILT THALWEG
LOG JAM (TYP.)
J-HOOK VANE (TYP.)
LOG WEIR (TYP.)
CONSTRUCTED RIFFLE (TYP.)
VEG PLOT #4
GATE
MATCHLINE SHEET 3A

10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00 23+00

AS-BUILT SURVEY
HURRICANE CREEK
PLAN VIEW

40 20 0 40 80
SCALE (FT)

2/26/03

11/9/2016
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BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	3A

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NAD 83

BEGIN REACH 3
STA. 10+36.40

10+00
INV=213.45'
24" RCP
RIP RAP
INV=214.13'
GATE
WOVEN WIRE FENCE
11+00
12+00
13+00
LOG WEIR (TYP.)
14+00
LOG JAM (TYP.)
X-15
AS-BUILT THALWEG
15+00
END HC - REACH 1
BEGIN HC - REACH 2
STA. 30+42.98
END REACH 3
STA. 16+00.37
ROOT WADS (TYP.)
J-HOOK VANE (TYP.)
30+00
31+00
CONSTRUCTED RIFFLE (TYP.)
AS-BUILT TOP OF BANK (TYP.)
FLOW CAMERA
GEOLIFT WITH BRUSH TOE (TYP.)
32+00
33+00
34+00
35+00
X-13
X-14
CREST GAUGE
STA. 30+51.82
STA. 30+82.26
LOG VANE (TYP.)
24+00
25+00
26+00
27+00
28+00
29+00
MATCHLINE SHEET 3
MATCHLINE SHEET 3B
VEG PLOT #3
VEG PLOT #2
OAK
36C OAK

AS–BUILT SURVEY
HURRICANE CREEK
PLAN VIEW

40 20 0 40 80
SCALE (FT)

11/9/2016
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BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	3B

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR DAVID LEE II

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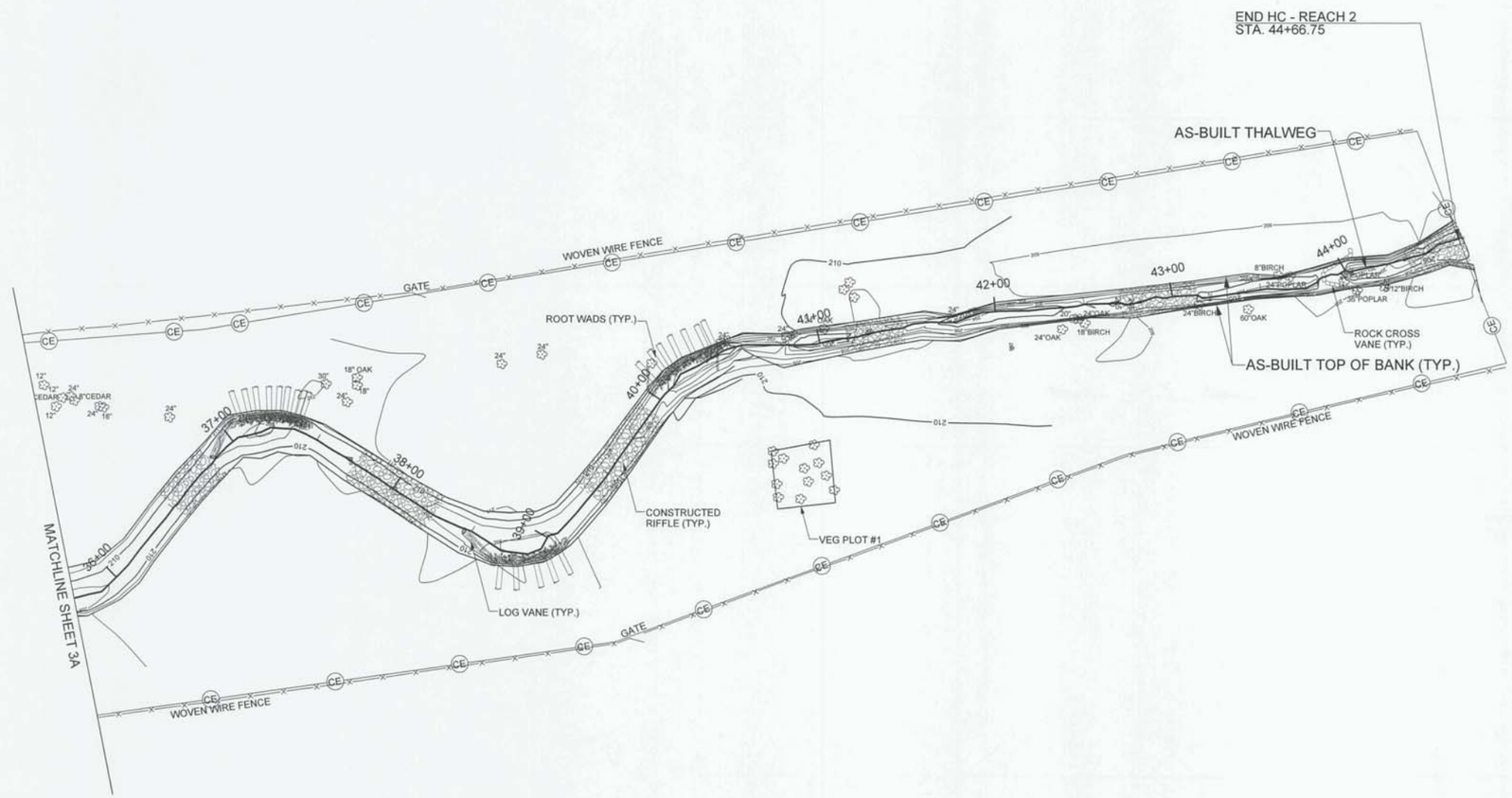
NCDMS ID NO. 95351

NAD 83



AS-BUILT SURVEY
HURRICANE CREEK
PLAN VIEW

40 20 0 40 80
SCALE (FT)

11/9/2016
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2/26/03

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	3C

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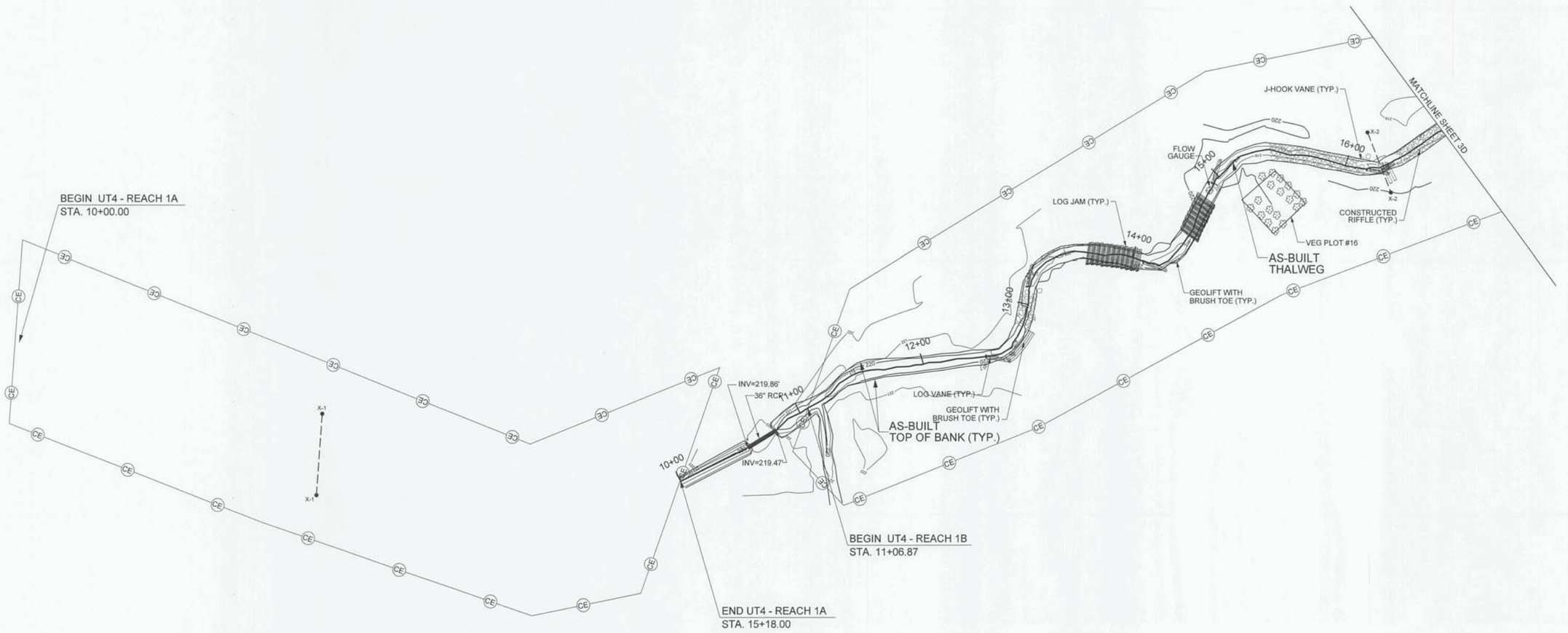
NAD 83



AS-BUILT SURVEY
UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

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BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	3D

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NCDMS ID NO. 95351

MATCHLINE SHEET 3I

AS-BUILT THALWEG

LOG JAM (TYP.)

27+00

28+00

VEG PLOT #13

AS-BUILT TOP OF BANK (TYP.)

29+00

30+00

19+00

20+00

21+00

J-HOOK VANE (TYP.)

18+00

17+00

LOG WEIR (TYP.)

AS-BUILT THALWEG

MATCHLINE SHEET 3C

END UT4 - REACH 1B
BEGIN UT4 - REACH 2
STA. 19+64.37
END UT4 - REACH 5B
STA. 30+21.60

STA. 21+11.16

STA. 21+42.43

CONSTRUCTED RIFFLE (TYP.)

LOG VANE (TYP.)

22+00

23+00

24+00

25+00

26+00

ROOT WADS (TYP.)

GEOLIFT WITH BRUSH TOE (TYP.)

TIE INTO EXISTING FENCE

WOVEN WIRE FENCE

AS-BUILT TOP OF BANK (TYP.)

MATCHLINE SHEET 3E

NAD 83

AS-BUILT SURVEY
UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

2/26/03

11/3/2016
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128975	3E

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NCDMS ID NO. 95351

NAD 83

MATCHLINE SHEET 3F

MATCHLINE SHEET 3D

WOVEN WIRE FENCE

GATE

VEG PLOT #12

AS-BUILT THALWEG

ROOT WADS (TYP.)

GEOLIFT WITH BRUSH TOE (TYP.)

VEG PLOT #11

LOG VANE (TYP.)

AS-BUILT TOP OF BANK (TYP.)

CREST GAUGE

TWN 12"

TWN 18"

LOG JAM (TYP.)

STA. 25+22.69

STA. 25+43.46

AS-BUILT TOP OF BANK (TYP.)

END UT4 - REACH 4B =
BEGIN UT4 - REACH 3
STA. 28+92.29

END UT4 - REACH 2
STA. 38+23.08

VEG PLOT #9

CONSTRUCTED RIFFLE (TYP.)

J-HOOK VANE (TYP.)

ROCK CROSS VANE (TYP.)

TIE INTO EXISTING FENCE

VEG PLOT #10

END UT4 - REACH 3
STA. 31+42.13

25+00 26+00 27+00 28+00 29+00 30+00 31+00 32+00 33+00 34+00 35+00 36+00 37+00 38+00

X-1 X-2 X-3 X-4 X-5 X-6

AS–BUILT SURVEY
UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

2/26/03

11/9/2016
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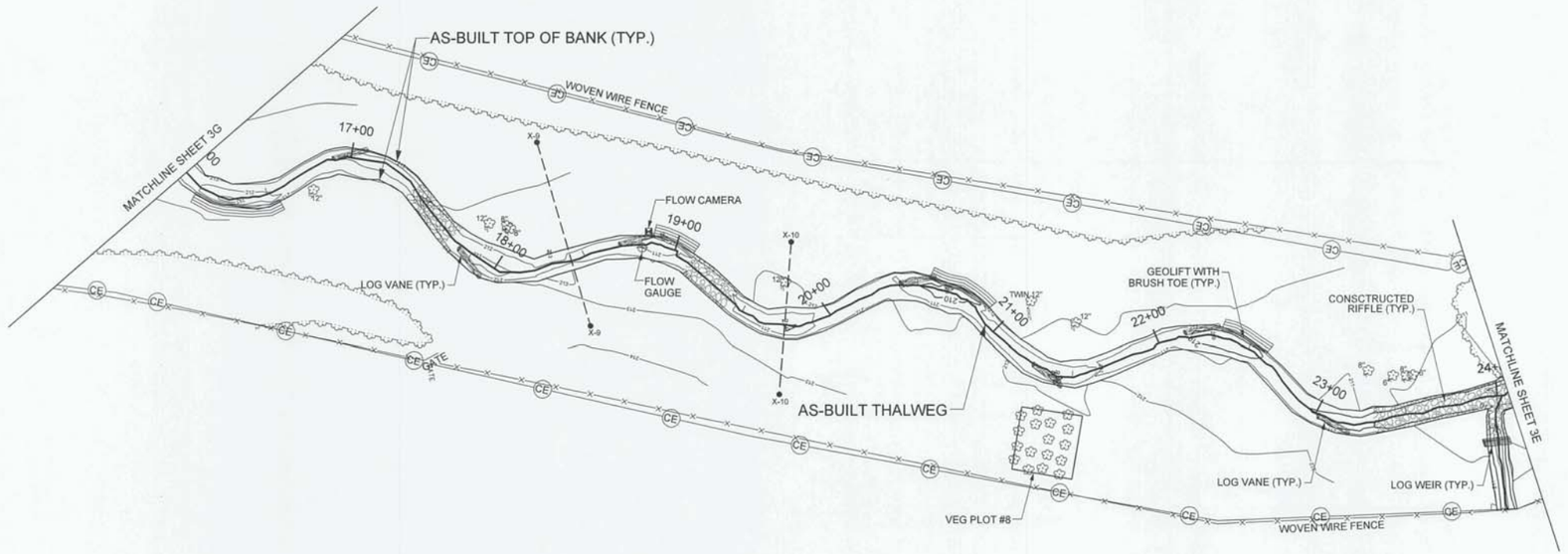
NAD 83



AS-BUILT SURVEY
UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

11/15/2016
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BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	3G

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

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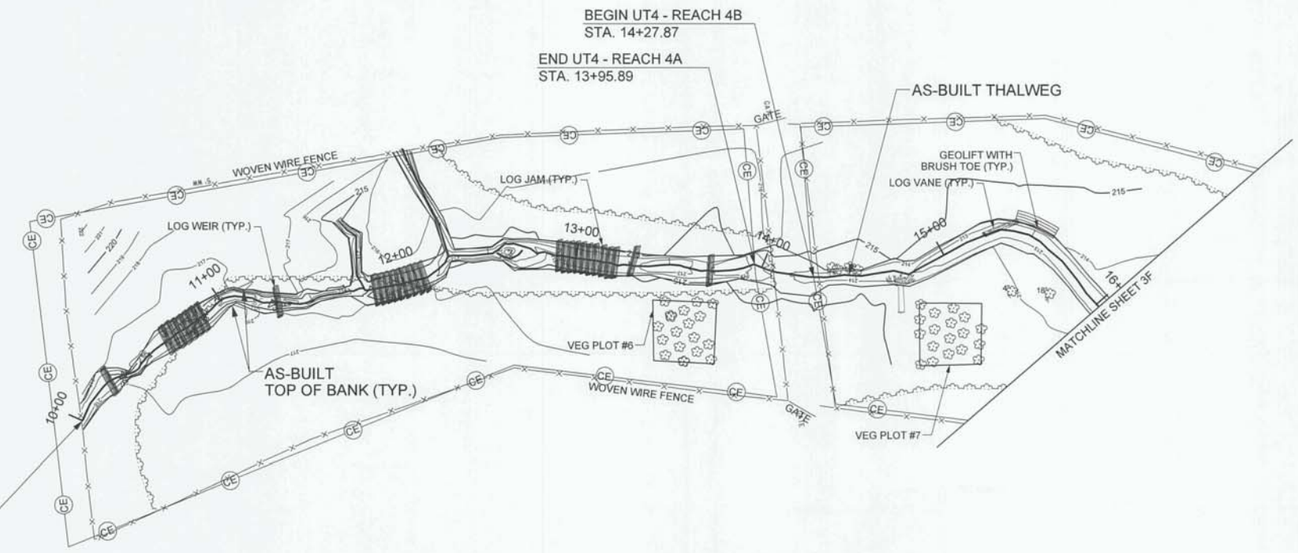

AS-BUILT SURVEY
UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

11/3/2016
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BAKER PROJECT REFERENCE NO.	SHEET NO.
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NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR DAVID LEE II

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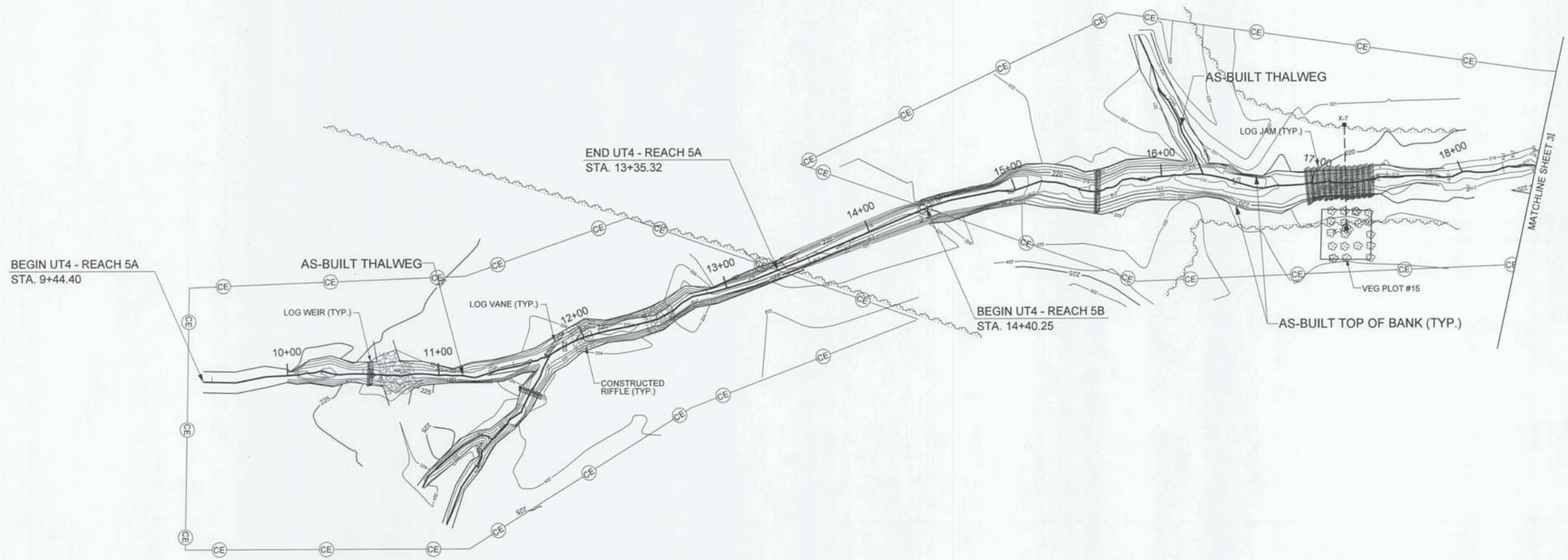
NAD 83



AS-BUILT SURVEY
UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

2/25/03

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2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	31

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR DAVID LEE II

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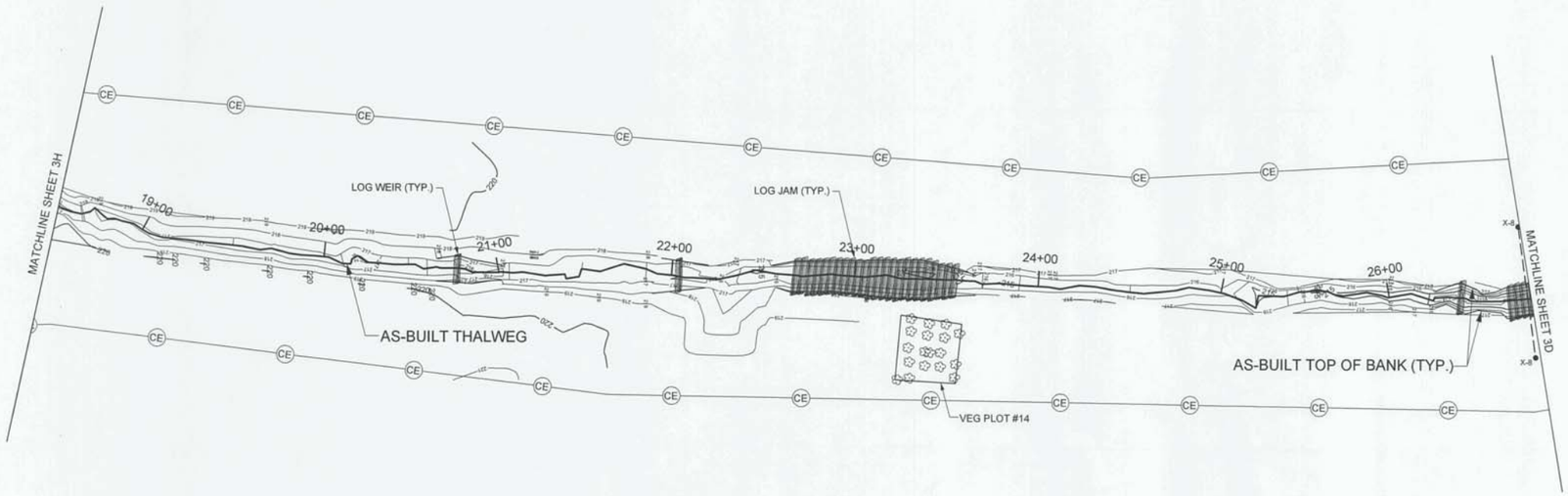
NCDMS ID NO. 95351

NAD 83



AS-BUILT SURVEY
UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

11/3/2016
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BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	4

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

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NCDMS ID NO. 95351

BEGIN HC - REACH 1
STA. 10+00.00

NAD 83

3' BARB WIRE FENCE

WOVEN WIRE FENCE

AS-BUILT TOP OF BANK (TYP.)

LOG VANE (TYP.)

GEOLIFT WITH BRUSH TOE (TYP.)

VEG PLOT #5

ROOT WADS (TYP.)

AS-BUILT THALWEG

LOG JAM (TYP.)

J-HOOK VANE (TYP.)

LOG WEIR (TYP.)

CONSTRUCTED RIFFLE (TYP.)

VEG PLOT #4

DESIGN CHANNEL ALIGNMENT

MATCHLINE SHEET 4A

GATE

VALLEY PROTEINS, INC.
PIN#5477-00-62-1942
656 LITTLE DUNCAN RD.
DB 321 PG 14

T. A. McRAE, III AND WIFE
JANICE S. McRAE
PIN#5487-00-03-0123
2911 PINKSTON RIVER RD.
DB 160 PG 205

RECORD DRAWING
HURRICANE CREEK
PLAN VIEW

40 20 0 40 80
SCALE (FT)

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	4A

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

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License #: F-1084

NCDMS ID NO. 95351

NAD 83

BEGIN REACH 3
STA. 10+36.40

10+00
INV=213.45'
24" RCP
RIP RAP
INV=214.13'
GATE
WOVEN WIRE FENCE
11+00
12+00
DESIGN CHANNEL ALIGNMENT
LOG WEIR (TYP.)
13+00
35° 02'53.03" LATITUDE
80° 04'01.66" LONGITUDE
14+00
LOG JAM (TYP.)
X-15
AS-BUILT THALWEG
15+00
END HC - REACH 1
BEGIN HC - REACH 2
STA. 30+42.98
END REACH 3
STA. 16+00.37
CONSTRUCTED RIFFLE (TYP.)
ROOT WADS (TYP.)
30+00
31+00
AS-BUILT TOP OF BANK (TYP.)
FLOW CAMERA
GEOLIFT WITH BRUSH TOE (TYP.)
34+00
35+00
X-14
MATCHLINE SHEET 4B
J-HOOK VANE (TYP.)
STA. 30+51.82
STA. 30+82.26
32+00
33+00
X-13
CREST GAUGE
LOG VANE (TYP.)
DESIGN CHANNEL ALIGNMENT
24+00
25+00
26+00
27+00
28+00
29+00
MATCHLINE SHEET 4
AS-BUILT THALWEG
GEOLIFT WITH BRUSH TOE (TYP.)
VEG PLOT #3
ROOT WADS (TYP.)
LOG WEIR (TYP.)
AS-BUILT THALWEG
WOVEN WIRE FENCE
GATE
VEG PLOT #2
DESIGN CHANNEL ALIGNMENT

RECORD DRAWING
HURRICANE CREEK
PLAN VIEW

40 20 0 40 80
SCALE (FT)

11/9/2016
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BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	4B

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

APPROVED BY:

14/10/16

DATE:

Michael Baker INTERNATIONAL
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Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
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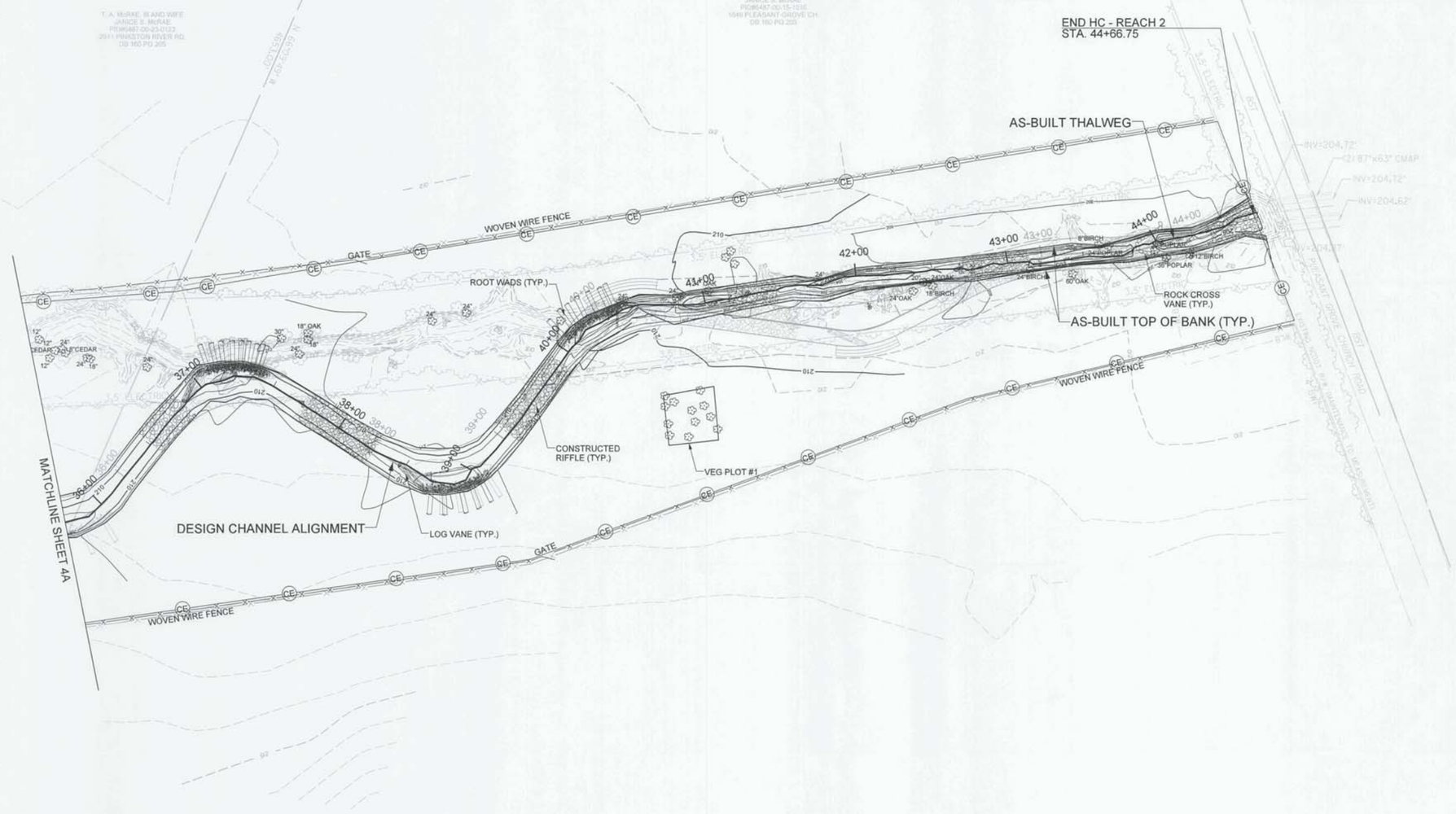
License #: F-1084

NCDMS ID NO. 95351

NAD 83



RECORD DRAWING
HURRICANE CREEK
PLAN VIEW

40 20 0 40 80
SCALE (FT)

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	4C

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M BYERS

APPROVED BY:

11/23/16

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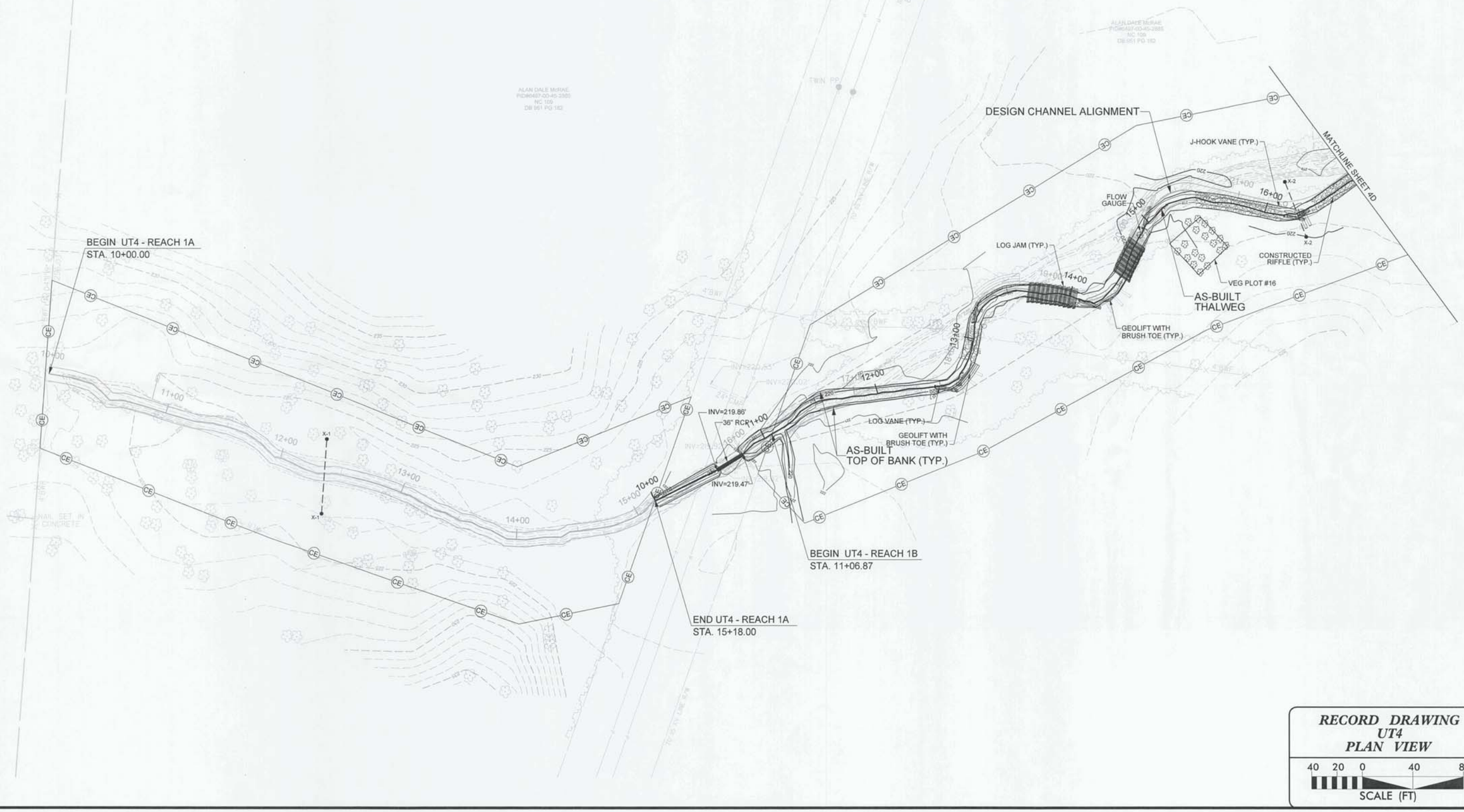
NCDMS ID NO. 95351

NAD 83



RECORD DRAWING
UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

11/16/2016
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mcarey
BrownCreekTribs_95351_AB_12/15/2015_Final

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	4D

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

APPROVED BY:

11/9/16

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NCDMS ID NO. 95351

NAD 83

MATCHLINE SHEET 4I

MATCHLINE SHEET 4C

MATCHLINE SHEET 4E

AS-BUILT THALWEG

LOG JAM (TYP.)

VEG PLOT #13

AS-BUILT TOP OF BANK (TYP.)

DESIGN CHANNEL ALIGNMENT

DESIGN CHANNEL ALIGNMENT

TIE INTO EXISTING FENCE

WOVEN WIRE FENCE

AS-BUILT TOP OF BANK (TYP.)

ROOT WADS (TYP.)

J-HOOK VANE (TYP.)

LOG WEIR (TYP.)

AS-BUILT THALWEG

GEOLIFT WITH BRUSH TOE (TYP.)

LOG VANE (TYP.)

CONSTRUCTED RIFFLE (TYP.)

STA. 21+42.43

STA. 21+11.16

END UT4 - REACH 1B
BEGIN UT4 - REACH 2
STA. 19+64.37
END UT4 - REACH 5B
STA. 30+21.60

ALAN DALE McRAE
PID#9497-00-45-2885
NC 109
DB 851 PG 182

LOUIS EDWARD HATEM, A UNDIVIDED INTEREST
WILLIAM MICHAEL HATEM, JR., A UNDIVIDED INTEREST
PID#9497-00-13-8104
1632 PLEASANT GROVE CH.
DB 404 PG 8

AMERICAN TIMBERLAND II, LLC
C/O POWELL, GOLDSTEIN, FRAZER & MURPHY LLP
PID#9497-00-25-5531
NC 109
DB 507 PG 190

RECORD DRAWING
UT4
PLAN VIEW

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SCALE (FT)

11/9/2016
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mcarey
BrownCreekTribs_95351_AB_12/15/2015_Final

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	4E

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

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Fax: 919.463.5490
License #: F-1084

NCDMS ID NO. 95351

NAD 83

MATCHLINE SHEET 4D

MATCHLINE SHEET 4F

WOVEN WIRE FENCE

GATE

VEG PLOT #12

VEG PLOT #11

VEG PLOT #10

VEG PLOT #9

AS-BUILT THALWEG

AS-BUILT TOP OF BANK (TYP.)

DESIGN CHANNEL ALIGNMENT

GEOLIFT WITH BRUSH TOE (TYP.)

ROOT WADS (TYP.)

LOG VANE (TYP.)

LOG JAM (TYP.)

J-HOOK VANE (TYP.)

CONSTRUCTED RIFFLE (TYP.)

ROCK CROSS VANE (TYP.)

TIE INTO EXISTING FENCE

CREST GAUGE

TWN 12"

STA. 25+22.69

STA. 25+43.46

END UT4 - REACH 4B =
BEGIN UT4 - REACH 3
STA. 28+92.29

END UT4 - REACH 2
STA. 38+23.08

END UT4 - REACH 3
STA. 31+42.13

RECORD DRAWING
UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

2/26/03
11/9/2016
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mcarey
BrownCreekTribs_95351_AB_12/15/2015_Final

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	4F

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

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License #: F-1084

NCDMS ID NO. 95351

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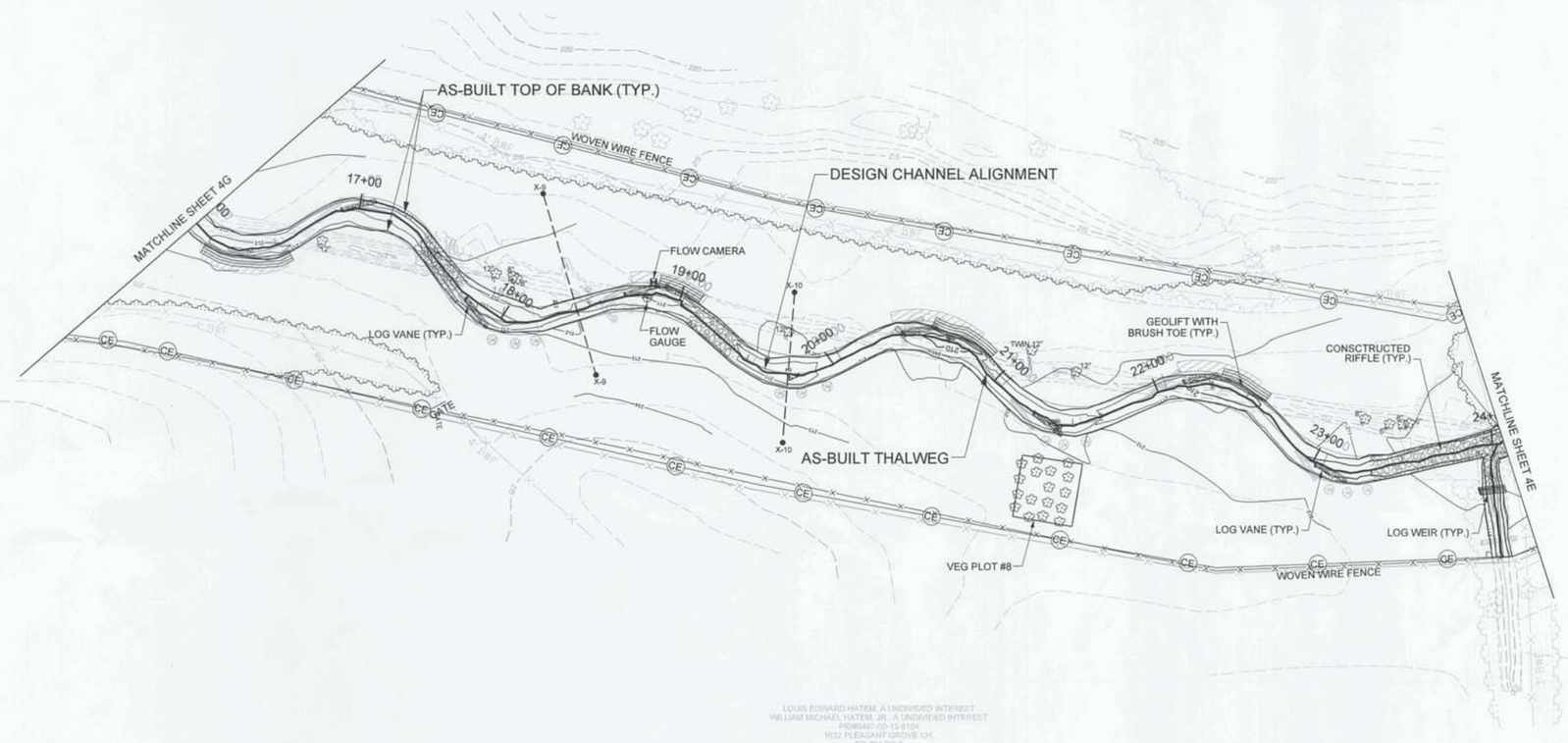

RECORD DRAWING
UT4
PLAN VIEW

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SCALE (FT)

11/16/2016
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mcgray
BrownCreekTribs_95351_AB_12/15/2015_Final

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	4G

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M BYERS

APPROVED BY:

4/10/16
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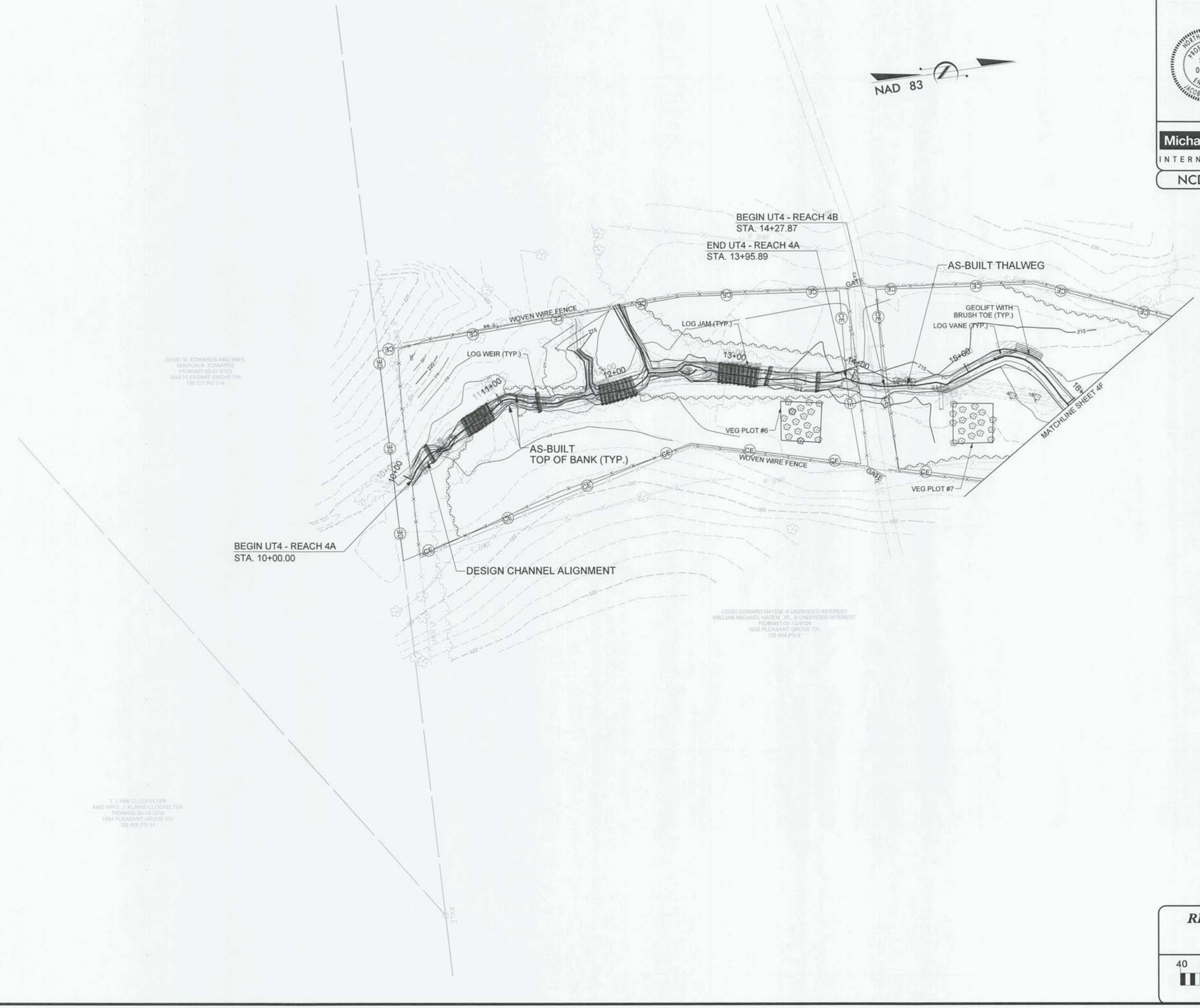
License #: F-1084

NCDMS ID NO. 95351



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UT4
PLAN VIEW

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SCALE (FT)

2/26/03

11/9/2016
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mcarey
BrownCreekTribs_95351_AB_12/15/2015_Final

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	4H

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

APPROVED BY:

11/23/16

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Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCDMS ID NO. 95351

NAD 83

TERRY MARSHALL DENNIS
AND WIFE, MARTHA HENSLEY DENNIS
PID#0497-00-31-5725
NC 109
DB 211 PG 482

DESIGN CHANNEL ALIGNMENT

AS-BUILT THALWEG

LOG JAM (TYP.)

END UT4 - REACH 5A
STA. 13+35.32

BEGIN UT4 - REACH 5A
STA. 9+44.40

AS-BUILT THALWEG

LOG WEIR (TYP.)

LOG VANE (TYP.)

CONSTRUCTED RIFFLE (TYP.)

DESIGN CHANNEL ALIGNMENT

BEGIN UT4 - REACH 5B
STA. 14+40.25

AS-BUILT TOP OF BANK (TYP.)

VEG PLOT #15

MATCHLINE SHEET 4I

10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00

RECORD DRAWING
UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

11/16/2016
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mcarey
BrownCreekTribs_95351_AB_12/15/2015_Final

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	41

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

APPROVED BY:

4/14/16
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License #: F-1084

NCDMS ID NO. 95351

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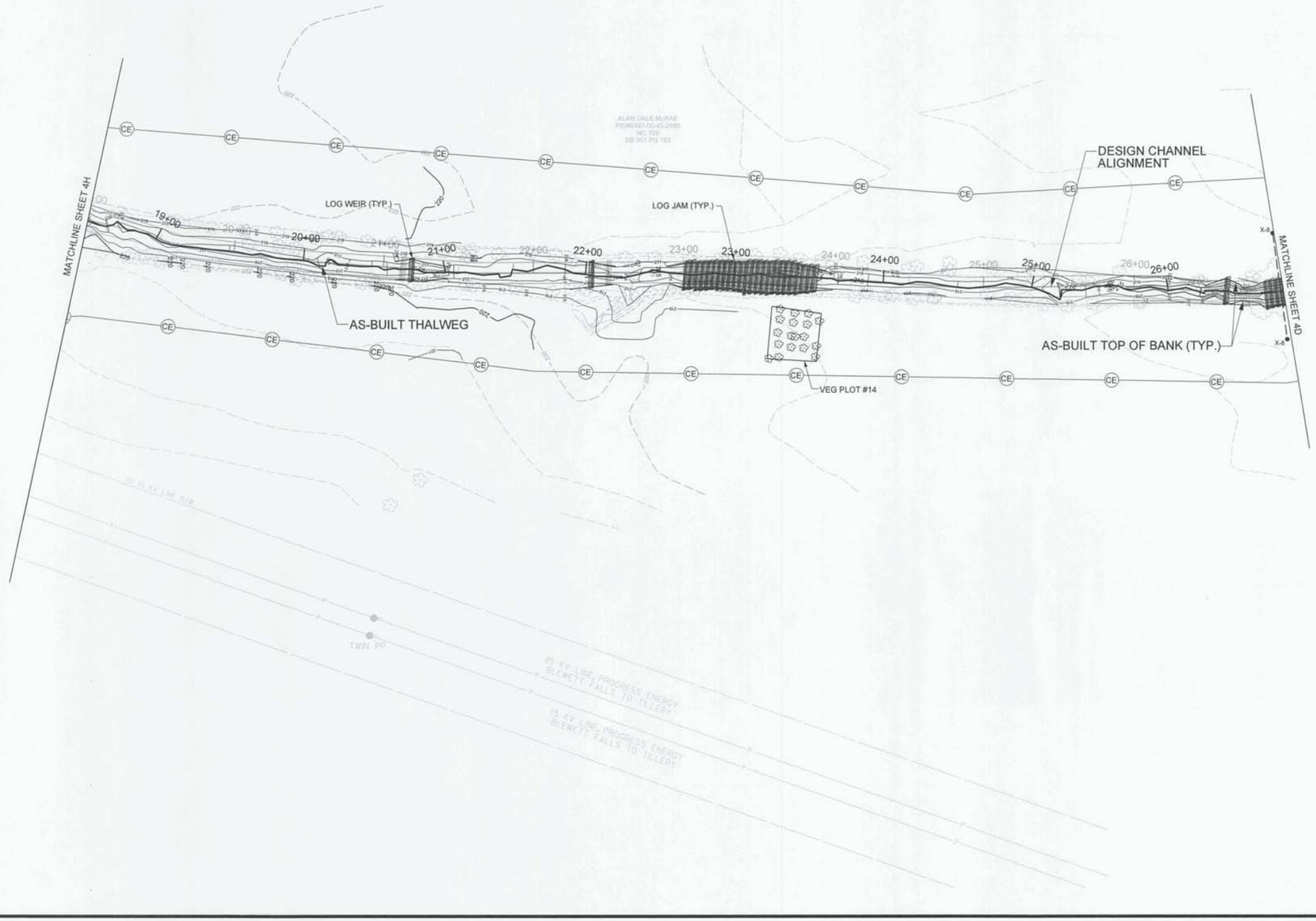

RECORD DRAWING
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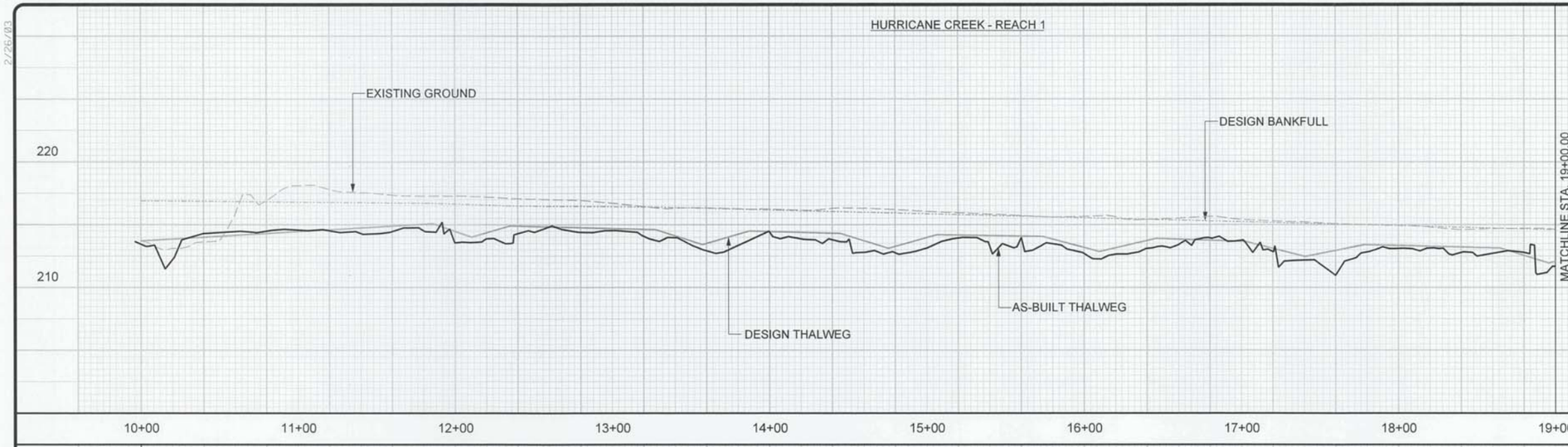
2/26/03

2/26/03



BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	5

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

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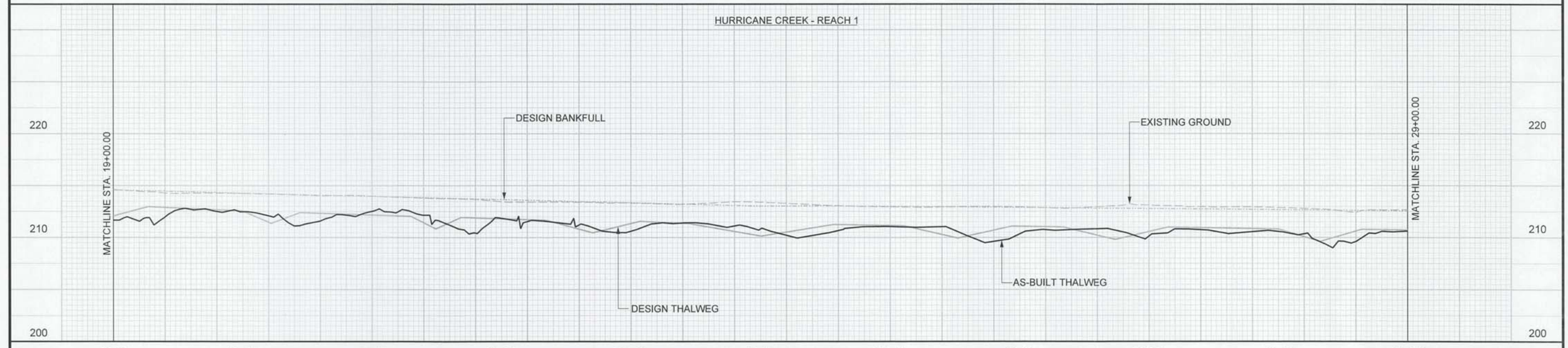
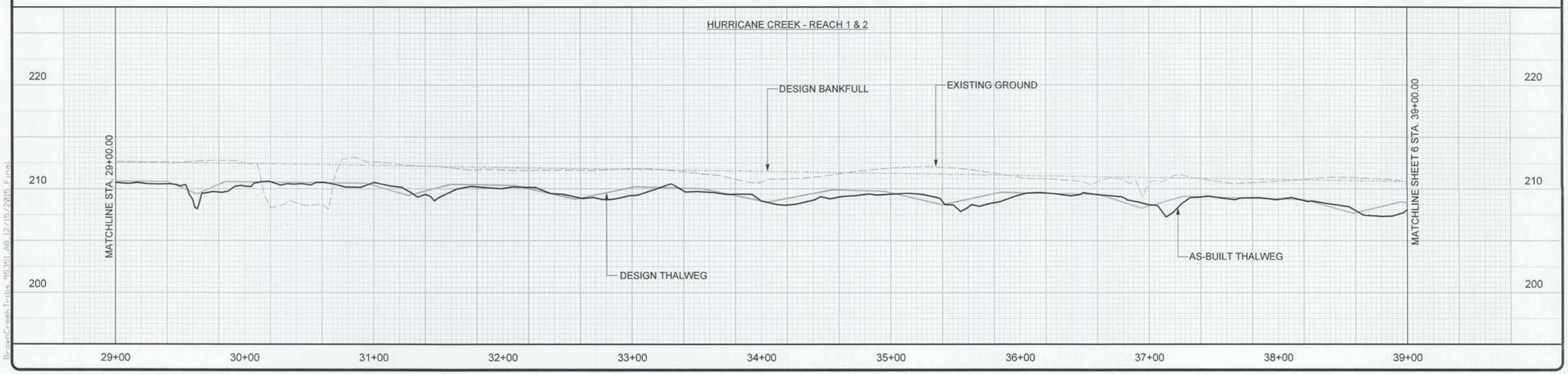
NCDMS ID NO. 95351

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

12-7-16





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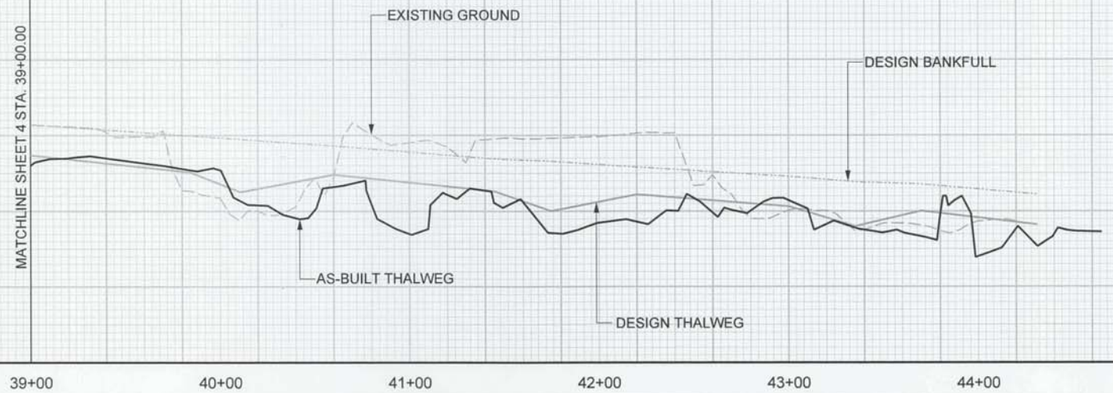
HURRICANE CREEK - REACH 2



BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	6

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

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11/10/16
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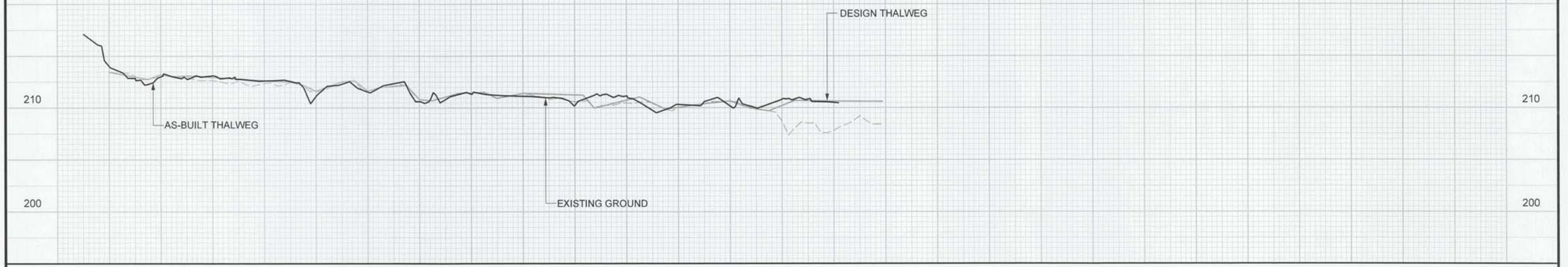
License #: P-1084

NCDMS ID NO. 95351

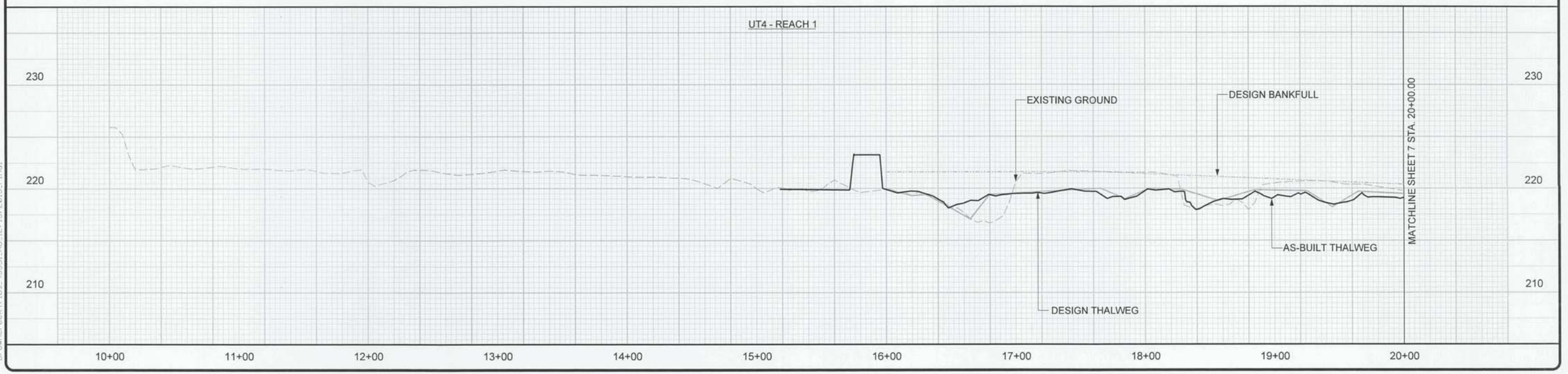
NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR DAVID LEER

12-7-16

HURRICANE CREEK - REACH 3



UT4 - REACH 1



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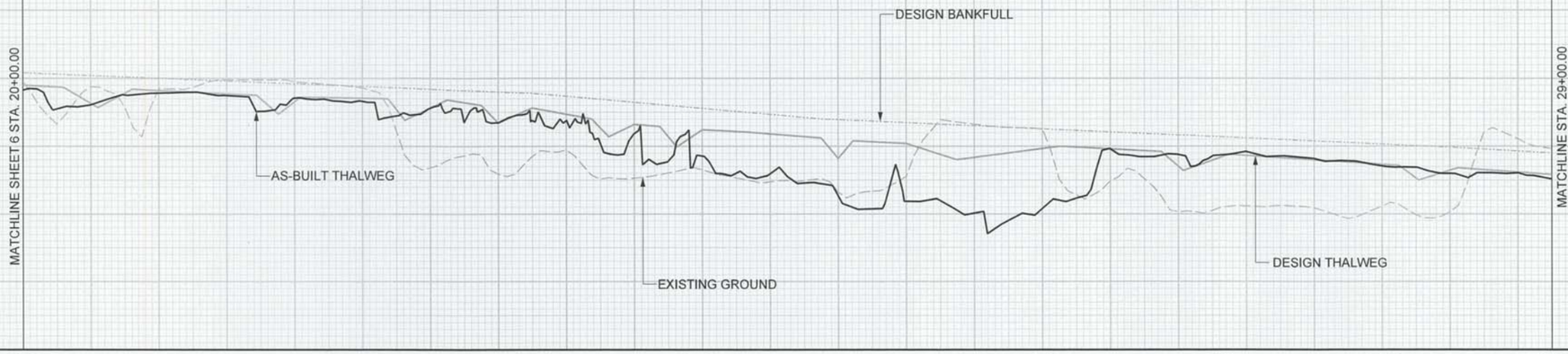
UT4 - REACH 1 / REACH 2



BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	7

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

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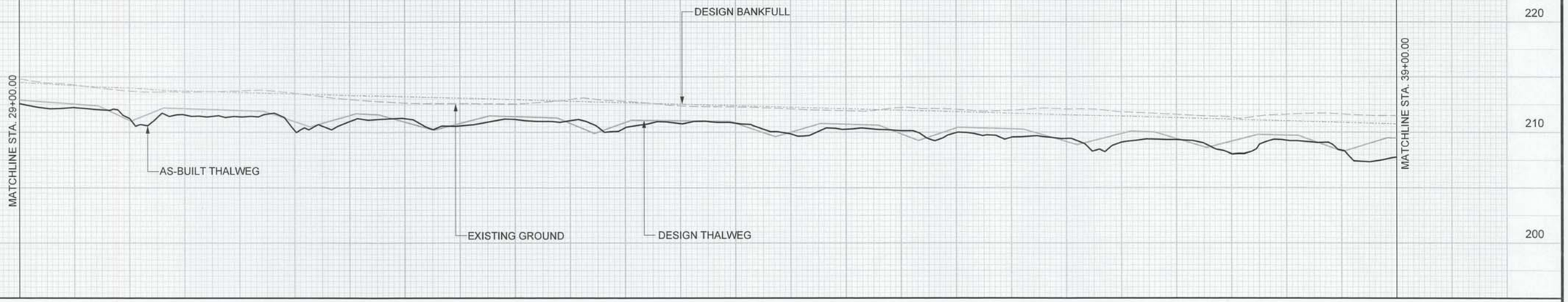
License #: F-1084

NCDMS ID NO. 95351

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

12-7-14

UT4 - REACH 2



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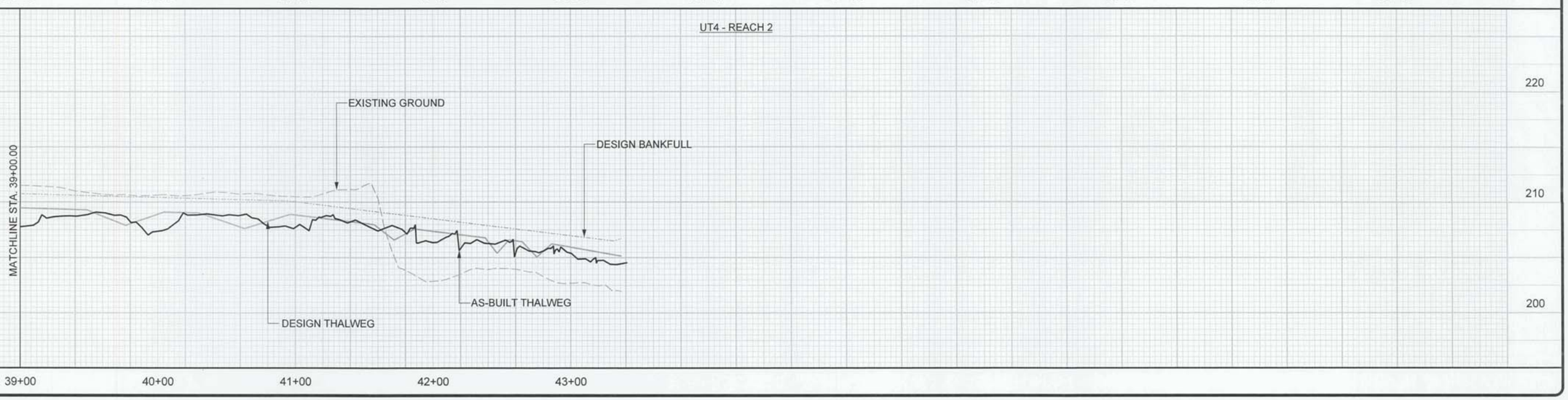

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BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	8

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

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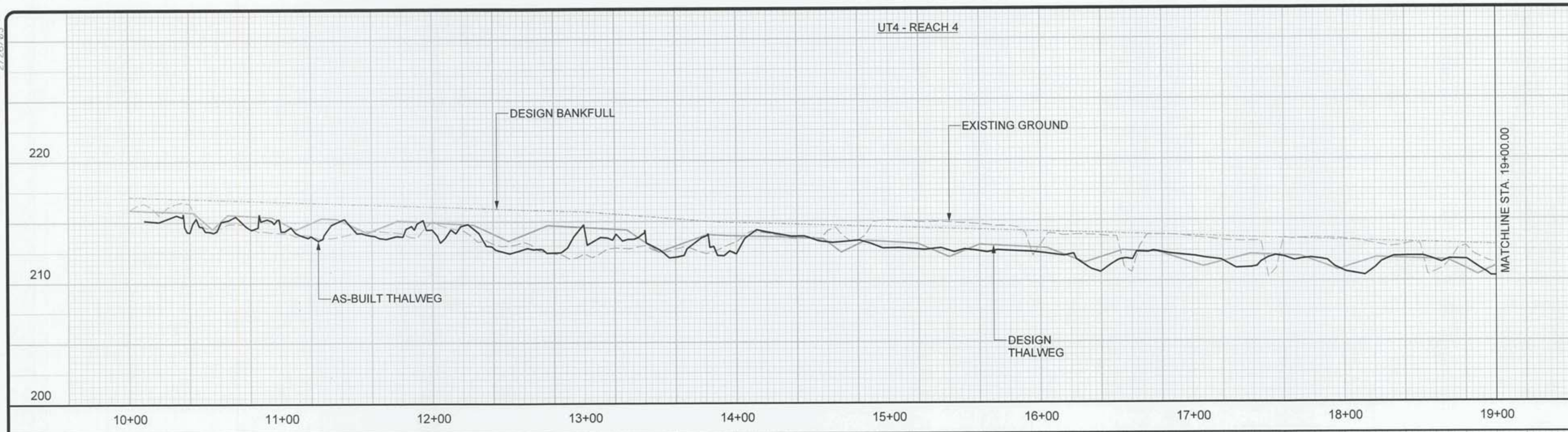
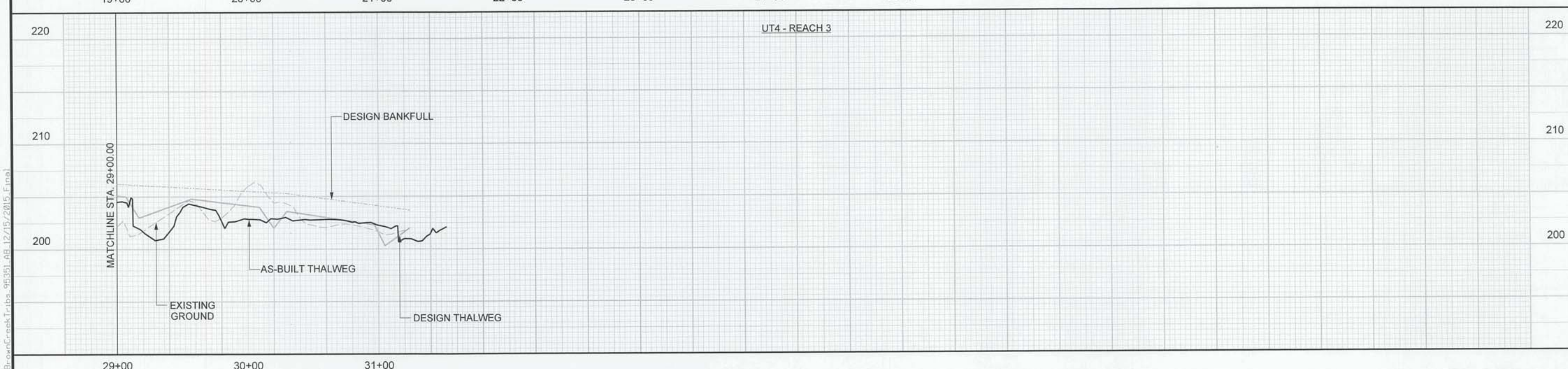
License #: F-1084

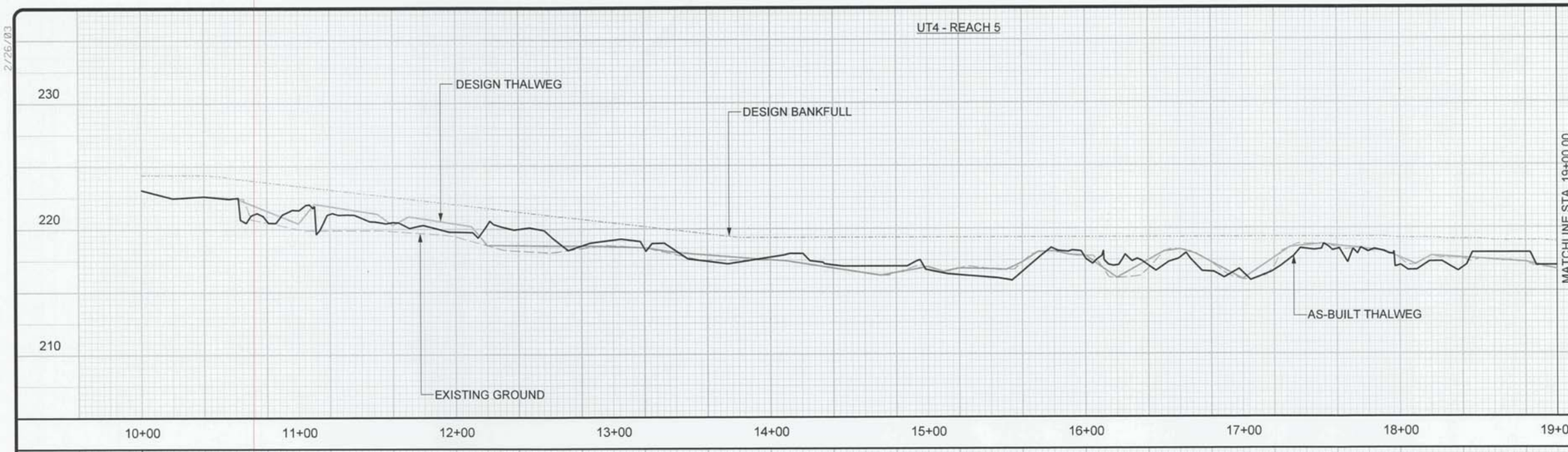
NCDMS ID NO. 95351

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

12-7-14







BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	9

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M BYERS

APPROVED BY:

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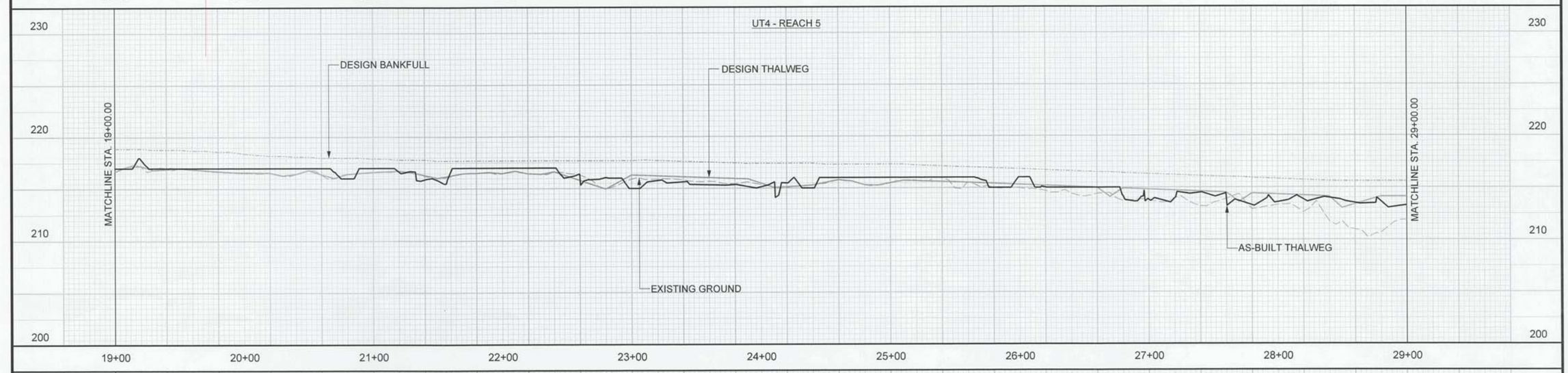
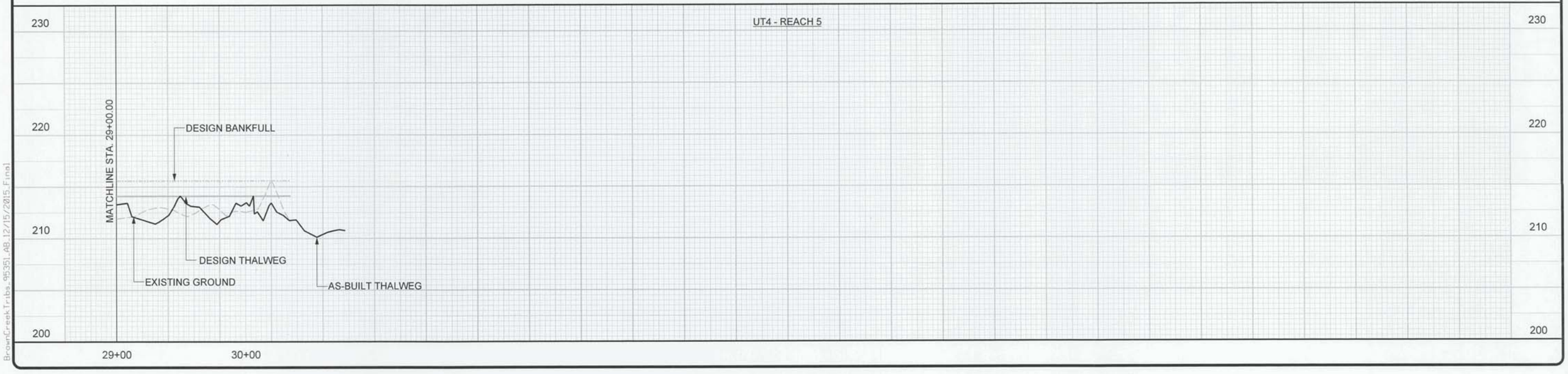
Fax: 919.463.5490
License #: F-1084

NCDMS ID NO. 95351

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR DAVID LEE II

J. Rizzo
12-7-16





APPENDIX E

Photo Log

Hurricane Creek Reach 1, view downstream at Station 10+00

Hurricane Creek Reach 1, view downstream at Station 11+80

Hurricane Creek Reach 1, view downstream at Station 14+50

Hurricane Creek Reach 1, view upstream at Station 16+90

Hurricane Creek Reach 1, view upstream at Station 17+50

Hurricane Creek Reach 1, view upstream at Station 19+25

Hurricane Creek Reach 1, view downstream at Station 19+75

Hurricane Creek Reach 1, view downstream at Station 22+40

Hurricane Creek Reach 1, view downstream at Station 24+00

Hurricane Creek Reach 1, vernal pool at Station 26+25

Hurricane Creek Reach 1, view downstream at Station 29+30

Hurricane Creek Reach 2, view upstream at Station 31+40

Hurricane Creek Reach 2, view upstream at Station 32+75

Hurricane Creek Reach 2, view downstream at Station 33+00

Hurricane Creek Reach 2, view upstream at Station 35+70

Hurricane Creek Reach 2, view downstream at Station 36+00

Hurricane Creek Reach 2, view downstream at Station 39+10

Hurricane Creek Reach 2, view downstream at Station 40+75

Hurricane Creek Reach 2, view upstream at Station 43+75

Hurricane Creek Reach 2, view downstream at Station 44+25

Hurricane Creek Reach 3, view upstream at Station 11+40

Hurricane Creek Reach 3, view downstream at Station 14+00

Hurricane Creek Reach 3, view downstream at Station 15+50

Hurricane Creek Reach 3, view upstream at Station 15+90

UT4 Reach 1, view downstream at Station 11+00

UT4 Reach 1, view downstream at Station 12+75

UT4 Reach 1, view upstream at Station 14+15

UT4 Reach 1, view downstream at Station 14+25

UT4 Reach 1, view downstream at Station 15+40

UT4 Reach 1, view downstream at Station 17+20

UT4 Reach 1, view upstream at Station 19+00

UT4 Reach 2, view of crossing at Station 21+25

UT4 Reach 2, view downstream at Station 21+50

UT4 Reach 2, view at Station 26+00

UT4 Reach 2, view downstream at Station 28+75

UT4 Reach 2, view upstream at Station 31+75

UT4 Reach 3, view upstream at Station 29+50

UT4 Reach 4, view upstream at Station 13+40

UT4 Reach 4, view upstream at Station 18+20

UT4 Reach 4, view upstream at Station 20+50

UT4 Reach 4, view downstream at Station 21+25

UT4 Reach 4, view upstream at Station 22+50

UT4 Reach 5, view upstream at Station 11+00

UT4 Reach 5, view upstream at Station 13+10

UT4 Reach 5, view upstream at Station 22+20

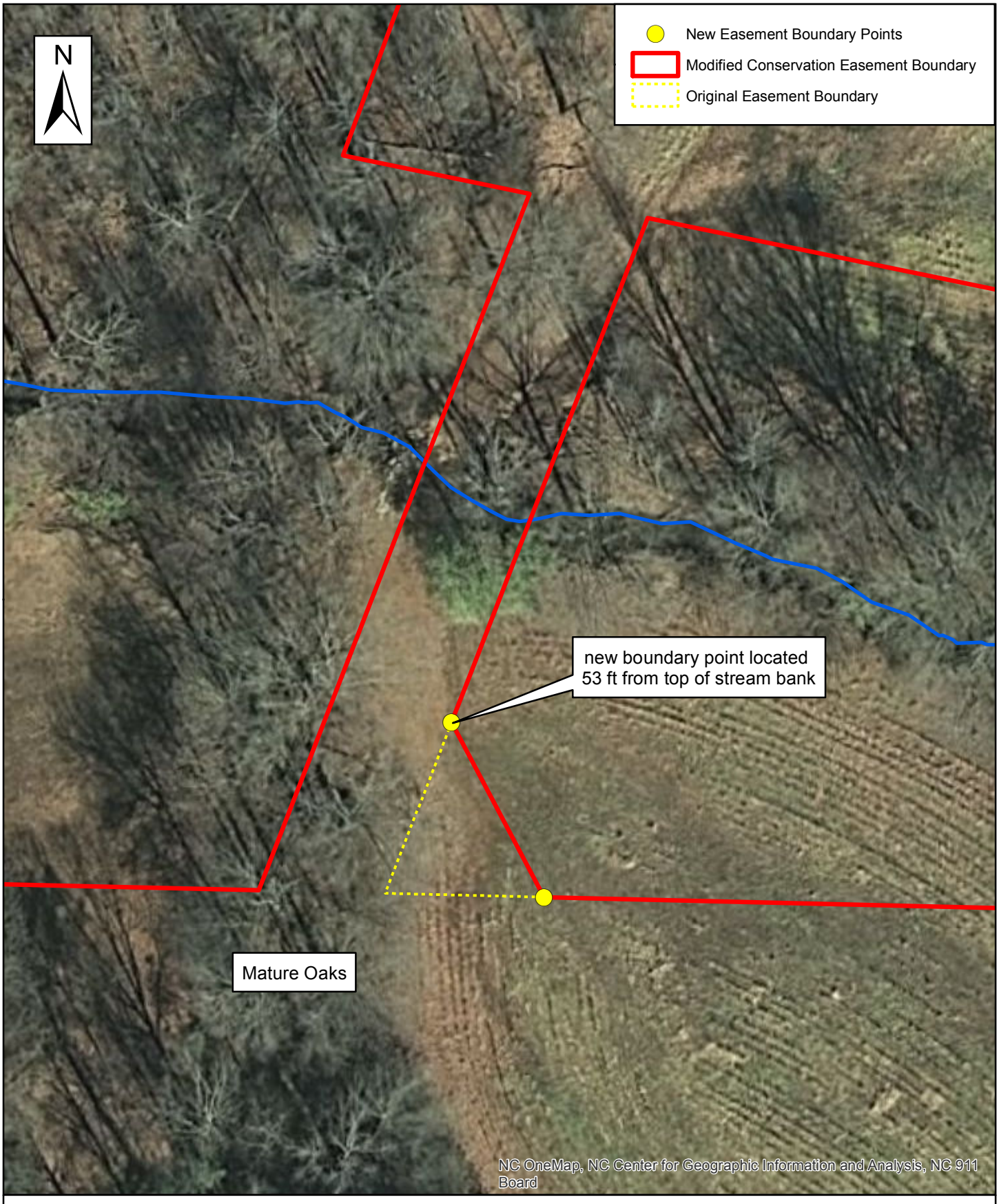
UT4 Reach 5, view upstream at Station 23+75

UT4 Reach 5, view downstream at Station 26+50

UT4 Reach 5, view upstream at Station 28+25

APPENDIX F

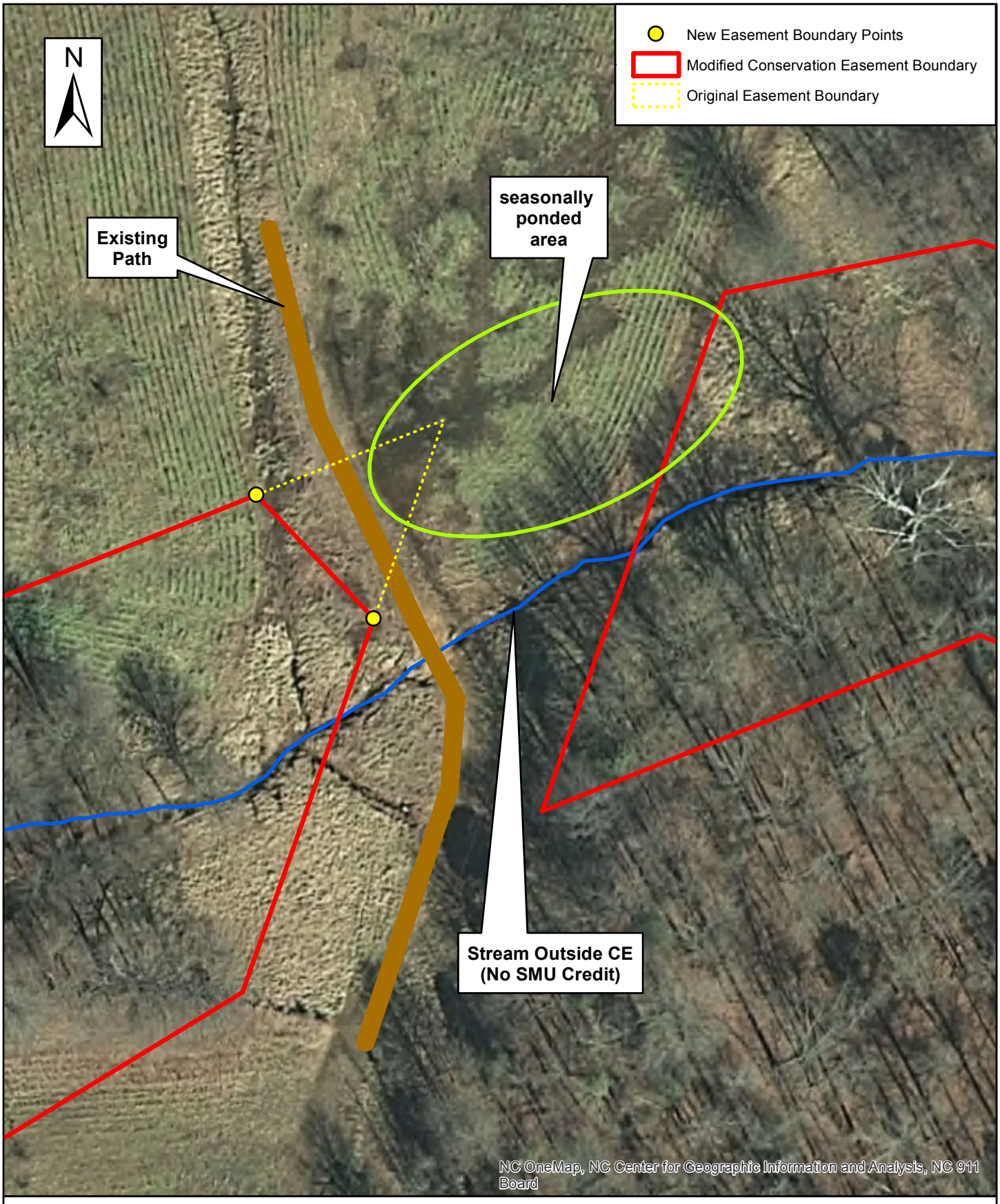
Conservation Easement
Boundary Adjustment Documents



Michael Baker
INTERNATIONAL

0 50 Feet

Figure 1: Crossing #1
Easement Boundary Adjustment
Brown Creek Tribs Project (UT4 Site)



Michael Baker INTERNATIONAL

0 50 Feet

Figure 2: Crossing #2
Easement Boundary Adjustment
Brown Creek Tribs Project (UT4 Site)

FILED
ANSON COUNTY, NC
JOANNE S. HUNTLEY
REGISTER OF DEEDS

FILED	Sep 14, 2016
AT	10:45 am
BOOK	01128
START PAGE	0206
END PAGE	0208
INSTRUMENT #	01579
RECORDING	$26.00
EXCISE TAX	(None)

STATE OF NORTH CAROLINA
COUNTY OF ANSON
SPO 04-C
DMS SITE 95351

PARTIAL RELEASE OF A 0.04 ACRE AND A 0.02 ACRE SECTION OF A CONSERVATION EASEMENT
(Deed Book 01054, Page 155)

THIS PARTIAL RELEASE OF EASEMENT, is made as of the date set forth in the notary acknowledgement below, by the STATE OF NORTH CAROLINA through the Department of Administration, State Property Office, 116 W. Jones Street, Raleigh. NC 276603-8003, hereinafter party of the first part and Alan Dale McRae, (unmarried), whose address is 151 Bailey Road, Wadesboro, NC 28170, hereinafter party of the second part,

WITNESSETH:

THAT, WHEREAS Alan Dale McRae conveyed a conservation Easement to the State of NC covering 8.97+/- acres for the Brown Creek Tributaries Restoration Project in an instrument executed on December 19th, 2013, and recorded in Deed Book 01054, Page 155, Anson County Registry, and;

WHEREAS, the State of NC has agreed to release two small sections of the property described herein from said Conservation Easement as conveyed in Deed Book 01054, Page 155 that were not intended to be included and to remedy management issues for the described areas as shown on attached **"Exhibit A"**.

NOW, THEREFORE, the party of the first part in consideration of TEN DOLLARS ($10.00) and other good and valuable consideration, the receipt of which is hereby acknowledged, hereby releases and forever quitclaims unto the party of the second part, their heirs and assigns, all right, title, claim and interest of the party of the first part in and to those two sections of land identified as "Abandoned Existing Conservation Easement 0.04 Acres and Abandoned Existing Conservation Easement 0.02 Acres on a Map of Survey by J. David Lee, III PLS, and attached as Exhibit "A".

See attached **"Exhibit A"** for above referenced map and legal description of the areas to be released.

TO HAVE AND TO HOLD, the aforesaid tract of land, together with all privileges and appurtenances thereunto belonging, to it, the said party of the second part, its heirs, successors and assigns free, and discharged from the aforementioned Conservation Easement.

IN TESTIMONY WHEREOF, the STATE OF NORTH CAROLINA has caused this instrument to be executed in its name by Tim Walton, State Property Office Director, NC Department of Administration.

STATE OF NORTH CAROLINA

By: _____

Tim Walton,
State Property Office Director

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I, R. Michael Moser, a Notary Public in and for the aforesaid County of Wake and the State of North Carolina, do certify that Tim Walton, personally came before me this day and acknowledged that he is Director, State Property Office, Department of Administration, State of North Carolina, and that by authority duly given and as the act of the State, has signed the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notarial Seal, this the 18th day of August, 2016.

_____

Notary Public

Print name: R. Michael Moser

My Commission Expires: 9/30/17

R. Michael Moser NOTARY PUBLIC Wake County, NC

"Exhibit A"

LEGEND

- EASEMENT MONUMENT SET (EEP STANDARD ALUMINUM CAP AND REBAR)
- PROPERTY CORNER
- GPS (OPUS) ESTABLISHED POINT
- GPS (VRS) ESTABLISHED POINT
- SURVEYED BOUNDARY LINE
- NON SURVEYED LINE
- EASEMENT LINE
- CENTER OF CREEK
- TIE LINE
- ABANDONED EASEMENT LINE

DB = DEED BOOK
PG = PAGE
R/W = RIGHT OF WAY

I, J. David Lee, II, NCPLS L- 4175, certify that this plat was drawn under my supervision from an actual survey made under my supervision; that the boundaries not surveyed are clearly indicated as drawn from information found in Deed Book (See References); that the ratio of precision as calculated is 1:116,072; that this plat was prepared in accordance with G. S. 47-30 as amended. Witness my original signature, registration number and seal this 11th day of May, A.D., 2016.

J. David Lee, II, NCPLS L- 4175

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

I, J. David Lee, II, NCPLS L-4175, certify to one or more of the following as indicated thus (X):

(X) That this plat is of a survey of another category, such as the recombination of parcels, a court-ordered survey or other exception to the definition of subdivision.

J. David Lee, II, NCPLS L-4175

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

THIS MAP IS NOT A CERTIFIED SURVEY AND HAS NOT BEEN REVIEWED BY A LOCAL GOVERNMENT AGENCY FOR COMPLIANCE WITH ANY APPLICABLE LAND DEVELOPMENT REGULATIONS.

NOTES:

1. All lines traversed with an ratio of precision of 1:116,072.
2. North Carolina Geodetic Monuments were not found within 2000'.
3. Easements and Right-of-Ways not surveyed unless shown on the plat.
4. If this map does not have an original signature and seal, this map is not valid.
5. This map is for RECORDATION.
6. Underground utilities, tanks, and or lines not surveyed unless noted otherwise.
7. Boundary corners not occupied unless noted otherwise.
8. It is understood that the lines not surveyed are checked with adjoining deed and as traversed.
9. All curves by chord unless noted otherwise.
10. Area computed by coordinate method.
11. The right(s) of non-exclusive ingress, egress, and regress over and along any and all existing paths/roads transecting the subject property are reserved by the Grantor(s) and the Grantee(s) of the Conservation Easements for the uses and purposes not inconsistent with the uses of Conservation Easement Area 1 thru 8, described hereon for Conservation Easement purposes.

NGS OPUS SOLUTION

MEC #1
LAT: 35 2 43.28072 0.013(m)
E LON: 279 58 40.02849 0.020(m)
W LON: 80 1 19.97151 0.020(m)
EL HGT: 37.841(m) 0.056(m)
ORTHO HGT: 68.556(m) 0.096(m)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DG7402	NCPO POLKTON CORS ARP	N345933.172	W0801037.857	15309.1
DM3995	NCRO ROCKINGHAM CORS ARP	N345751.987	W0794747.740	22466.8
DK4045	NCTR TROY CORS ARP	N352201.845	W0795212.770	38294.0

NEAREST NGS PUBLISHED CONTROL POINT
AG9799 38 WSM N350350.592 W0800131.994 2103.6

MEC #2
UNABLE TO OBTAIN OPUS SOLUTION. VRS WAS USED TO OBTAIN POSITION.

LINE TABLE		
LINE	BEARING	DISTANCE
L1	N43°26'44"W	53.68'

EASEMENT CORNERS		
POINT NUMBER	NORTHING	EASTING
72	473976.1213	1694388.2526
73	473937.1494	1694425.1654
74	473635.3129	1693521.5399
75	473591.2863	1693544.7764

AMERICAN TIMBERLAND II, LLC
C/O POWELL, GOLDSTEIN, FRAZER & MURPHY LLP
PID#6497-00-25-5531
NC 109
DB 507 PG 190

LOUIS EDWARD HATEM,
A 1/2 UNDIVIDED INTEREST
WILLIAM MICHAEL HATEM, JR.,
A 1/2 UNDIVIDED INTEREST
PID#6497-00-13-8104
1632 PLEASANT GROVE CH.
DB 404 PG 8

ALAN DALE McRAE
PID#6497-00-45-2885
NC 109
DB 951 PG 182

EXISTING CONSERVATION EASEMENT AREA 3
DB 1054 PG 155

ABANDONED EXISTING CONSERVATION EASEMENT AREA 2 = 0.02 ACRES

EXISTING CONSERVATION EASEMENT AREA 2
DB 1054 PG 155

ABANDONED EXISTING CONSERVATION EASEMENT AREA 2 = 0.04 ACRES

EXISTING MONUMENT REMOVED

EXISTING MONUMENT

EXISTING MONUMENT REMOVED

S21°15'22"W 136.32'

NEW LINE S27°49'28"E 49.25'

46.21'

40.00'

N88°37'15"W 129.71'

N68°12'50"E 152.38'

63.44'

L1 NEW LINE

66.27'

S10°23'02"W 124.58'

N21°27'15"E 585.02' GROUND 584.95' GRID

N75°46'10"W 649.43' GROUND 649.35' GRID

436.91' GROUND 436.85' GRID N15°34'31"E

115 KV LINE, PROGRESS ENERGY BLEWETT FALLS TO TILLERY 70' R/W

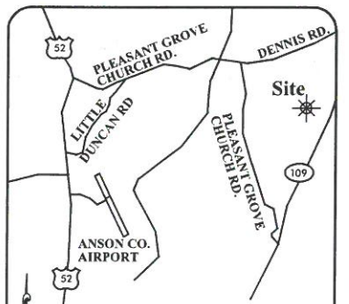
MEC #2
N=473431.6389'
E=1694174.2790'
COMBINED FACTOR 0.99987311
ELEV=228.02' NAVD88 (GEOID 12A)

MEC #1
N=473010.7731'
E=1694056.9660'
COMBINED FACTOR 0.99987311
ELEV=224.92' NAVD88 (GEOID 12A)

NAD 83/2011

125' 0 125'
SCALE

"BROWN CREEK TRIBUTARIES PROJECT - UT4"
CONSERVATION EASEMENT SURVEY
FOR
THE STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM
ON THE PROPERTY OF
ALAN DALE McRAE
ANSONVILLE & WADESBORO TOWNSHIP
ANSON COUNTY, NORTH CAROLINA



VICINITY MAP
NTS

EEP Site ID	95351
SPO Number	04-B, 04-C & 04-G
Mulkey Job Number	2012070.00
Survey Dates	09/09/2012 - 04/19/2015
Scale	1" = 125'

Deed References:	
DB 951; PG 182	DB 404; PG 8
DB 507; PG 190	

No.	Revision/Issue	Date

CALYX ENGINEERS + CONSULTANTS
7500 EAST INDEPENDENCE BOULEVARD, SUITE 100
CHARLOTTE, NC 28227
phone: 704.537.7300 CALYXengineers.com
NC License # F-1333
Formerly Mulkey Engineers & Consultants

SHEET 1 of 1

DULY RECORDED & PROCESSED
BY JOANNE S. HUNTLEY, REG. OF DEEDS
ANSON COUNTY NC