BASELINE MONITORING DOCUMENT AND AS-BUILT BASELINE REPORT

Final

HENRY FORK MITIGATION SITE

Catawba County, NC
DEQ Contract No. 005782
DMS ID No. 96306

Catawba River Basin
HUC 03050103 Expanded Service Area

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EXECUTIVE SUMMARY

Wildlands Engineering (Wildlands) completed a full delivery project at the Henry Fork Mitigation Site (Site) for the North Carolina Department of Environment Quality Division of Mitigation Services (DMS) to restore 3,087 linear feet (LF) of perennial streams and enhance 2,627 LF of intermittent streams, enhance 0.68 acres of existing wetlands, rehabilitate 0.25 acres of existing wetlands, and re-establish 3.71 acres of wetlands in Catawba County, NC. The Site is expected to generate 4,838 stream mitigation units (SMUs) and 4.22 wetland mitigation units (WMUs) (Table 1). The Site is located near the city of Hickory in Catawba County, NC, in the Catawba River Basin; eight-digit Cataloging Unit (CU) 03050102 and the 14-digit Hydrologic Unit Code (HUC) 03050102010030 (Figure 1).

The project's compensatory mitigation credits will be used in accordance with the In-Lieu Fee (ILF) Program Instrument dated July 28, 2010, the expanded service area as defined under the September 12, 2006 PACG memorandum, and/or DMS acceptance and regulatory permit conditions associated with Division of Mitigation Services ILF requirements. Hydrologic Unit Code (HUC) 03050102010030, Lower Henry Fork, was identified as a Targeted Local Watershed (TLW) in DMS' 2007 Catawba River Basin Restoration Priority (RBRP) Plan. The project streams consist of four unnamed tributaries (UTs) to the Henry Fork River on the site of a former golf course, referred to herein as UT1, UT2, UT1A, and UT1B (Figure 2). The adjacent land to the streams and wetlands is primarily residential.

The Site is located in the Lower Henry Fork watershed which was designated as a Targeted Local Watershed (TLW) in the DMS' 2007 Catawba River Basin Restoration Priorities (RBRP) plan. The RBRP identifies a restoration goal for all streams within HUC 03050102 of removing conditions which cause sediment impairments, including mitigating stressors from stormwater runoff. The Henry Fork watershed was also identified in the 2005 North Carolina Wildlife Resource Commission's Wildlife Action Plan as a priority area, which calls for conservation and restoration of streams and riparian zones. In addition, the 2010 NC DWQ Catawba River Basin Plan indicated that the section of Henry Fork that drains the project area is impaired for high turbidity, among other stressors. The intent of this project is to help meet the goals for the watershed outlined in the RBRP and provide numerous ecological benefits within the Catawba River Basin.

The project goals established in the mitigation plan (Wildlands, 2015) were completed with careful consideration of goals and objectives that were described in the RBRP and to meet DMS mitigation needs while maximizing the ecological and water quality uplift within the watershed. The following project goals established include:

- Decommissioning the existing golf course, with the targeted efforts of establishing a permanent conservation easement to buffer the streams and Henry Fork floodplain.
- Improving aquatic and terrestrial habitats, including enhanced connectivity and diversity of habitat.

The Site construction and as-built surveys were completed between November 2015 and March 2016. Some adjustments were made during construction, as needed, based on site conditions and availability of materials. These design adjustments included log steps being replaced by rock steps, brush toe replaced root wads in a few areas, as well as minor grading adjustments. Specific design changes are detailed in Section 5.1 and in the Record Drawings (Appendix 4). Baseline (MY0) profiles and cross-section dimensions closely match the design parameters. Cross-section widths and pool depths occasionally exceed design parameters within a normal range of variability for natural streams; this is not a concern at this time. With overbank events and vegetation growth, it is expected these stream channels will narrow up with time. The Site has been built as designed and is on track to meeting the upcoming monitoring year's success criteria.

TABLE OF CONTENTS

APPENDICES

Section 1: PROJECT GOALS, BACKGROUND AND ATTRIBUTES

1.1 Project Location and Setting

The Henry Fork Mitigation Site (Site) is a stream and wetland project located in western Catawba County approximately one mile southwest of the City of Hickory (Figure 1). The project is located on the old Henry Fork Golf Course. The Site is located on a tract owned by WEI-Henry Fork, LLC (PIN 2791-0888-3819). A conservation easement was recorded on 48.06 acres with the parcel (Deed Book 03247, Page 0476-0488).

The Site is located in the Catawba River Basin; eight-digit Cataloging Unit (CU) 03050102 and the 14-digit Hydrologic Unit Code (HUC) 03050102010030 (Figure 1). The project's compensatory mitigation credits will be used in accordance with the In-Lieu Fee (ILF) Program Instrument dated July 28, 2010, the expanded service area as defined under the September 12, 2006 PACG memorandum, and/or DMS acceptance and regulatory permit conditions associated with Division of Mitigation Services ILF requirements. Hydrologic Unit Code (HUC) 03050102010030, Lower Henry Fork, was identified as a Targeted Local Watershed (TLW) in DMS' 2007 Catawba River Basin Restoration Priority (RBRP) Plan. Located in the Inner Piedmont Belt of the Piedmont Physiographic Province (USGS, 1998), the project watershed consists of mostly residential, herbaceous fields and forest. The drainage area for the project site is approximately 178 acres.

The Henry Fork River and the UTs of this Site are located within the NC Division of Water Resources (NCDWR) subbasin 03-08-35. Henry Fork River (NCDWQ Index No. 11-129-1(12.5)) is classified as C waters. Class C waters are protected for uses such as secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and agriculture. The Site is approximately 15 miles upstream of the South Fork Catawba River (Lincolnton) WS-IV, CA water supply watershed. Lower Henry Fork, was identified as a Targeted Local Watershed (TLW) in DMS' 2007 Catawba River Basin Restoration Priority (RBRP) Plan. The RBRP identifies a restoration goal for all streams within HUC 03050102 of removing conditions which cause sediment impairments, including mitigating stressors from storm water runoff. In addition, the 2010 NC DWQ Catawba River Basin Plan indicated that the section of Henry Fork that drains the project area is impaired for high turbidity and low pH, among other stressors.

1.2 Project Goals and Objectives

This Site is intended to provide numerous ecological benefits within the Catawba River Basin. The Site will help meet the goals for the watershed outlined in the RBRP and provide numerous ecological benefits within the Catawba River Basin. While many of these benefits are limited to the Henry Fork project area, others, such as pollutant removal, reduced sediment loading, and improved aquatic and terrestrial habitat, have farther-reaching effects. Expected improvements to water quality and ecological processes are outlined below as project goals and objectives. These project goals established were completed with careful consideration of goals and objectives that were described in the RBRP and to meet the DMS mitigation needs while maximizing the ecological and water quality uplift within the watershed.

The following project specific goals established in the mitigation plan (Wildlands, 2015) include:

- Permanently protect the project site from harmful uses; and
- Correct modifications to streams, wetlands and buffers;
- Improving and re-establishing hydrology and function of previously cleared wetlands;
- Reducing current erosion and sedimentation;
- Reduce nutrient inputs to streams and wetlands, and to downstream water bodies;

- Improve instream habitat; and
- Provide and improve terrestrial habitat, and native floodplain forest.

The project goals were addressed through the following project objectives:

- Decommissioning the existing golf course and establishing a conservation easement on the Site will eliminate direct chemical fertilizer, pesticide and herbicide inputs;
- To resize and realign channels to address stream dredging and ditching. Plant native woody species in riparian zones which have been maintained through mowing. By correcting these prior modifications, the channels and floodplains will provide a suite of hydrologic and biological function;
- Restoring appropriate stream dimensions and juxtaposition of streams and wetlands on the landscape. Wetlands will be enhanced through more frequent overbank flooding, and also by reducing the drawdown effect that current ditched channels have on wetland hydrology, thereby enhancing wetland connectivity to the local water table. The project will extend existing wetland zones into adjacent areas and support wetland functions;
- Removing historic overburden to uncover relic hydric soils. Roughen wetland re-establishment. Restore streams for wetland benefit. Each of these will bring local water table elevations closer to the ground surface. Create overbank flooding, and depressional storage for overland and overbank flow retention. Decrease direct runoff, and increase infiltration;
- A native vegetation community will be planted on the Site to revegetate the riparian buffers and wetlands. Conduct soil restoration through topsoil harvesting and reapplication, and leaf litter harvesting and application from adjacent forested areas. This will return functions associated with buffers and forested floodplains, as well as enhance soil productivity and bring native biological activity and seed into the disturbed areas;
- By constructing diverse and stable channel form with varied stream bedform and installing habitat features, along with removing culverts. These will allow aquatic habitat quality and connectivity enhancement; and
- Placing a portion of the right bank Henry Fork floodplain under a conservation easement, and planting all stream buffers and wetlands with native species. Creating a 100 foot-wide corridor of wooded riparian buffer along that top right bank area and re-establishing native plant communities, connectivity of habitat within Site and to adjoining natural areas along the river corridor.

1.3 Project Structure, Restoration Type and Approach

The final mitigation plan was submitted and accepted by the DMS in September of 2015. Construction, planting, and as-built survey activities were completed in March 2016 by Land Mechanic Designs, Inc., Bruton Natural Systems, Inc., and Kee Mapping & Surveying, PLLC, respectively. Please refer to Appendix 1 for more detailed project activity, history, contact information, and watershed/site background information.

1.3.1 Project Structure

The project will provide 4,838 stream mitigation units (SMUs) and 4.22 wetland mitigation units (WMUs). Please refer to Figure 2 for the project component/asset map and Table 1 for the project component and mitigation credit information for the Site.

1.3.2 Restoration Type and Approach

The designed streams were restored to the appropriate type based on their topographic setting within the surrounding landscape, hydrologic and climate conditions, and natural vegetation communities. The

project includes stream restoration and enhancement, along with wetland rehabilitation, re-establishment and enhancement.

The stream restoration portion of this project includes:

- UT1 Reaches 1 and 2: This restoration stream enters the Site at the forested southern property boundary and flows north until joining Henry Fork at the downstream property line;
- UT2: This stream enhancement originates from the west of the property and flows due east until joining UT1;
- UT1A: This stream enhancement originates at the confluence of two hillslope seeps located near the steep north facing hillside on the eastern half of the Site. This channel flows northward through the wide floodplain of Henry Fork to its confluence with UT1; and
- UT1B: This restoration stream begins at a groundwater seep and flows westward to its confluence with UT1 Reach 1.

The project design was developed based on reference conditions, representing streams within the Southern Piedmont Belt region with similar drainage areas, valley slopes, morphology, and bed material. The restoration of the streams allows for the re-establishment of stream-wetland complexes that create a unique synergy of aquatic habitats. In addition, the design is tailored towards restoring ecologically beneficial hydrologic conditions in both the streams and the adjacent floodplain wetland resources. The reconstructed channel banks were built with stable side sloped, planted with native materials, matted and seeded for stability. The sinuous plan form of the channel was built to mimic a natural Piedmont stream. Various types of constructed riffles were installed to provide grade control and address excess shear stress.

1.4 Project History, Contacts, and Attribute Data

The Site was restored by Wildlands through a full delivery contract with DMS. Tables 2, 3, and 4 in Appendix 1 provide detailed information regarding the Project Activity and Reporting History, Project Contacts, and Project Baseline Information and Attributes.

Section 2: PERFORMANCE STANDARDS

The stream and wetland performance criteria for the project site will follow approved performance criteria presented in Henry Fork Mitigation Plan (2015). Annual monitoring and semi-annual site visits will be conducted to assess the condition of the finished project. The stream restoration sections of the project will be assigned specific performance criteria components for stream morphology, hydrology, and vegetation. Wetland rehabilitation and re-establishment areas will be assigned specific performance criteria for wetland hydrology and vegetation. Performance criteria will be evaluated throughout the seven-year post-construction monitoring. If all performance criteria have been successfully met and two bankfull events have occurred during separate years, Wildlands may propose to terminate stream and/or vegetation monitoring after year five pending little to no prevalent invasive species issues. An outline of the performance criteria components follows. An outline of the performance criteria components follows.

2.1 Streams

2.1.1 Dimension

Riffle cross-sections on the restoration reaches should be stable and should show little change in bankfull area, maximum depth ratio, and width-to-depth ratio. Per DMS guidance, bank height ratios shall not exceed 1.2 and entrenchment ratios shall be at least 2.2 for restored C- and E- type channels to be considered stable. All riffle cross-sections should fall within the parameters defined for channels of the appropriate stream type. If any changes do occur, these changes will be evaluated to assess whether the stream channel is showing signs of instability. Indicators of instability include a vertically incising thalweg or eroding channel banks. Changes in the channel that indicate a movement toward stability or enhanced habitat include a decrease in the width-to-depth ratio in meandering channels or an increase in pool depth. Remedial action would not be taken if channel changes indicate a movement toward stability. It is important to note that in fine-grained and sand bed channels pools and bed forms (ripples, dunes, etc.) may migrate over time as a natural function of the channel hydraulics. These sorts of bed changes do not constitute a problem or indicate a need for remedial actions.

2.1.2 Pattern and Profile

Visual assessments and photo documentation should indicate that streams are remaining stable and do not indicate a trend toward vertical or lateral instability. As mentioned above, migration of pools and bed forms in fine-grained channels are expected and do not require remedial action.

2.1.3 Substrate

Channel substrate materials will be collected along UT1 Reach 1 and UT1B, which are dominated by cobble and gravel. The remaining streams within the project site are dominated by sand and silt-size particles. Pebble count and/or bulk sampling procedures along these fine-grained streams would not show a significant change in bed material size or distribution over the monitoring period.

UT1 Reach 1 and UT1B restoration reaches should indicate a progression towards or the maintenance of coarser materials in the riffle features and smaller particles in the pool features. A reach-wide pebble count will be performed in each restoration reach each year for classification purposes. A pebble count will be performed at each surveyed riffle to characterize the pavement.

2.1.4 Photo Documentation

Photographs should illustrate the Site's vegetation and morphological stability on an annual basis. Cross-section photos should demonstrate no excessive erosion or degradation of the banks. Longitudinal photos should indicate the absence of persistent bars within the channel or vertical incision. Grade control structures should remain stable. Deposition of sediment on the bank side of vane arms is preferable. Maintenance of scour pools on the channel side of vane arms is expected.

2.1.5 Bankfull Documentation

Two bankfull flow events must be documented on the restoration and enhancement reaches, within the seven-year monitoring period. The two bankfull events must occur in separate years. Stream monitoring will continue until success criteria in the form of two bankfull events in separate years have been documented. Adequate hydrology for intermittent streams must be documented. Direct measurements of continuous interval stream flow data will be made with a gage. The flow regime should indicate sufficient flow to maintain an Ordinary High Water Mark (OHWM), specifically a minimum of 30 consecutive days of flow during periods of normal rainfall. Photographic evidence of streamflow coupled with rainfall gage data from the project site will be used to help support this assessment.

2.2 Vegetation

The final vegetative success criteria will be the survival of 210 planted stems per acre in the planted riparian and wetland areas at the end of the required monitoring period (year seven). The interim measure of vegetative success for the site will be the survival of at least 320 planted stems per acre at the end of the third monitoring year and at least 260 stems per acre at the end of the fifth year of monitoring. Planted vegetation must average 10 feet in height in each plot at the end of the seventh year of monitoring. If this performance standard met by year five and stem density is trending towards success (i.e., no less than 260 five-year-old stems/acre), monitoring of vegetation on the Site may be terminated provided written approval is provided by the USACE in consultation with the NC IRT. Invasive species treatment will be conducted in the mitigation area during the seven-year monitoring period as needed to ensure the hydrologic and ecologic success of the project.

2.3 Wetlands

The preliminary wetland performance standard used to evaluate the Site's hydrology is that the water table must be within 12 inches of the ground surface at each gage for a minimum of 20 consecutive days (8.5%) of the 236 day growing season (March 20 through November 11) for Catawba County. The growing season was determined from the long-term records from the National Weather Service provided in the WETS table for the Hickory Regional Airport and may be evaluated at the project site during the monitoring period using soil temperature loggers in order to base growing season on the measured data.

2.4 Schedule and Reporting

Monitoring reports will be prepared in the fall of each year of monitoring and submitted to DMS. Based on the DMS Monitoring Report Template (version 1.5, 6/8/12), the monitoring reports will include the following:

- Project background which includes project objectives, project structure, restoration type and approach, location and setting, history and background;
- Monitoring plan view map of major project elements including such items as grade control structures, vegetation plots, permanent cross-sections, stream gages, photo points, and groundwater gages;

- Photographs showing views of the restored Stream Site taken from fixed point stations;
- Assessment of the stability of the Stream Site based on visual assessments and cross-section survey;
- Vegetative data as described above including the identification of any invasion by undesirable plant species;
- Groundwater gage attainment;
- Maintenance issues and remediation measures will be detailed and documented as needed; and
- Wildlife observations.

Section 3: MONITORING PLAN

Monitoring will consist of collecting morphological, vegetative, and hydrological data to assess the project success based on the restoration goals and objectives on an annual basis or until success criteria is met. The success of the project will be assessed using measurements of the stream channel's dimension, substrate composition, permanent photographs, vegetation, surface water hydrology, and groundwater hydrology. Any areas with identified high priority problems, such as streambank instability, aggradation/degradation, insufficient groundwater hydroperiod, or lack of vegetation establishment will be evaluated on a case-by-case basis. The problem areas will be visually noted and remedial actions will be discussed with DMS staff as needed.

3.1 Stream

Geomorphic assessments follow guidelines outlined in the Stream Channel Reference Sites: An Illustrated Guide to Field Techniques (Harrelson et al., 1994), methodologies utilized in the Rosgen stream assessment and classification documents (Rosgen, 1994 and 1996), and in the Stream Restoration: A Natural Channel Design Handbook (Doll et al, 2003). Please refer to Figure 3 in Appendix 1 for monitoring locations discussed below.

3.1.1 Dimension

In order to monitor the channel dimension, 14 permanent cross-sections were installed along stream restoration and enhancement I reaches, with riffle and pool sections in proportion to DMS guidance. Two cross-sections were installed per 1,000 linear feet of stream restoration work, with riffle and pool sections in proportion to DMS guidance. Each cross-section is permanently marked with capped rebar installed in concrete and 1/2 inch PVC pipes. Cross-section surveys include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg. If moderate bank erosion is observed at a stream reach during the monitoring period, an array of bank pins will be installed in representative areas where erosion is occurring for reaches with a bankfull width of greater than three feet. Bank pins will be installed in at least three locations (one in upper third of the pool, one at the mid-point of the pool, and one in the lower third of the pool). Bank pins will be monitored by measuring exposed rebar and maintaining pins flush to bank to capture bank erosion progression. Annual cross-section and bank pin survey (if applicable) will be conducted in monitoring years one (MY1), two (MY2), three (MY3), five (MY5), and seven (MY7). Photographs will be taken annually of the cross-sections looking upstream and downstream.

3.1.2 Pattern and Profile

Longitudinal profile surveys will not be conducted during the seven year monitoring period unless other indicators during the annual monitoring indicate a trend toward vertical and lateral instability. If a longitudinal profile is deemed necessary, monitoring will follow standards as described in the 2003 USACE and NCDWR Stream Mitigation Guidance for the necessary reaches. Stream pattern and profile will be assessed visually as described below in section 3.1.6.

3.1.3 Substrate

Since UT1A, UT2 and UT1 Reach 2 are dominated by sand and silt-size particles, sampling procedures were not conducted on these streams. Two reach-wide pebble counts were conducted; one on UT1 and one on UT1B. A wetted pebble count was performed at each surveyed riffle on UT1 Reach 1 Upper and Lower, as well as on UT1B, to characterize the pavement. Substrate analysis will be conducted in monitoring years one (MY1), two (MY2), three (MY3), five (MY5), and seven (MY7).

3.1.4 Photo Reference Points

A total of 29 permanent photograph reference points were established within the project area after construction. Photographs will be taken looking upstream and downstream once a year to visually document stability for seven years following construction. Permanent markers were established so that the same locations and view directions on the Site are monitored each year. Cross-sectional photos will be taken of each permanent cross-section looking upstream and downstream. Reference photos will also be taken for each of the vegetation plots. Representative digital photos of each permanent photo point, cross-section and vegetation plot will be taken on the same day of the stream and vegetation assessments are conducted. The photographer will make every effort to consistently maintain the same area in each photo over time.

3.1.5 Hydrology Documentation

Bankfull events will be documented using crest gages, pressure transducers (stream gages), photographs, and visual assessments such as debris lines. Four stream hydrology monitoring stations were installed each with one crest gage and one pressure transducer (stream gage); one on UT1, one on UT1A, one on UT1B, and one on UT2. The stream hydrology gages were installed within a surveyed riffle cross-section of the restored channels. The stream hydrology gages will be checked at each site visit to determine if a bankfull event has occurred and the intermittent stream channels are demonstrating a flow regime that would be expected to maintain an Ordinary High Water Mark (OHWM). Photographs will be used to document the occurrence of staining and debris and/or sediment deposition on the floodplain.

3.2 Vegetation

Planted woody vegetation will be monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2006) to monitor and assess the planted woody vegetation. A total of 15 vegetation plots were established within the project easement area. All of the plots were established as standard 10 meter by 10 meter squares.

Vegetation plots were randomly established within the planted corridor of the restoration areas to capture the heterogeneity of the designed vegetative communities. The vegetation plot corners have been marked and are recoverable either through field identification or with the use of a GPS unit. Reference photographs at the origin looking diagonally across the plot to the opposite corner were taken during the baseline monitoring in February 2016. Subsequent annual assessments following baseline survey will capture the same reference photograph locations. Species composition, density and survival rates will be evaluated on an annual basis by plot and for the entire Site. Individual plot data will be provided and will include diameter, height, density, vigor, damage (if any), and percent survival. Planted woody stems will be marked annually as needed based off of a known origin so they can be found in succeeding monitoring years. Mortality will be determined from the difference between the baseline year's living planted stems and the current year's living planted stems.

3.3 Wetlands

3.3.1 Hydrology

In order to monitor the wetland rehabilitation and re- establishment areas, wetland hydrology will be monitored using groundwater monitoring gages and installed according to USACE recommended procedures. The gages used for this activity are typically In-situ Level TROLL® 100 or 300 pressure transducers. An additional gage will be established in an adjacent reference wetland and will be utilized to compare the hydrologic response within the restored wetland areas at the Site. The proposed location of monitoring gages and the proposed reference gage are denoted in Figure 3. All gages will be

set to record the ground water level two times per day. An onsite rain gage will be installed to record daily rainfall, and will be utilized to assess whether typical weather conditions occur during the monitoring period. If a particular groundwater gage does not meet the performance standard for a given monitoring year, rainfall patterns will be analyzed and the hydrograph will be compared to that of the reference wetlands to assess whether atypical weather conditions occurred during the monitoring period.

3.4 Visual Assessments

Visual assessments will be performed along all stream, buffer, and wetland areas on a semi-annual basis during the seven-year monitoring period. Problem areas will be noted and included in the Current Condition Plan View Map (CCPV), such as channel instability (i.e. lateral and/or vertical instability, in-stream structure failure/instability and/or piping, headcuts), vegetated health (i.e. low stem density, vegetation mortality, invasive species or encroachment) beaver activity, or easement encroachments. Areas of concern will be mapped and photographed, accompanied by a written description in the annual report. Problem areas will be re-evaluated during each subsequent visual assessment. Should remedial actions be required, remediation approaches will be provided in the annual monitoring report

Section 4: MAINTENANCE AND CONTINGENCY PLAN

Wildlands will perform maintenance as needed on the mitigation project. A physical inspection of the Site shall be conducted a minimum of once per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following construction and may include one or more of the following components.

4.1 Stream

Stream problem areas will be mapped and included in the CCPV as part of the annual stream assessment. Stream problems areas may include bank erosion, structure failure, beaver dams, aggradation/degradation, etc. Routine channel maintenance and repair activities may include chinking of in-stream structures to prevent piping, securing loose coir matting, and supplemental installations of live stakes and other target vegetation along the channel. Areas where storm water runoff flows into the channel may also require maintenance to prevent bank failures and head-cutting.

4.2 Wetlands

Wetland problem areas will be mapped and included in the CCPV as part of the annual wetlands assessment. Wetland problem areas may include supplemental installations of target vegetation within the wetland. Areas where storm water and floodplain flows intercept the wetland may also require maintenance to prevent scour. Routine wetland maintenance will be conducted and repair activities will be implemented on an as-needed basis.

4.3 Vegetation

Vegetative problem areas will be mapped and included in the CCPV as part of the annual vegetation assessment. Vegetation problems areas may include planted vegetation not meeting success criteria, persistent invasive species, barren areas with little to no herbaceous cover, or grass suffocation/crowding of planted stems. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species shall be controlled by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.

4.4 Site Boundary

Site boundary issues will be mapped and included in the CCPV as part of the annual visual assessment. Site boundary issues may include mowing encroachment or boundary markers/fencing disturbed. Routine maintenance will be conducted to address disturbed, damaged, or destroyed easement boundary markers and will be repaired and/or replaced on an as-needed basis.

Section 5: AS-BUILT CONDITION (BASELINE)

The Site construction and as-built surveys were completed in March 2016. The survey included developing an as-built topographic surface and locating the channel boundaries, structures, and cross-sections. For comparison purposes, during the baseline assessments, reaches were divided into assessment reaches in the same way that they were established for design parameters: UT1 Reaches 1 and 2, UT1A, UT1B, and UT2.

5.1 As-Built/Record Drawings

A half-size record drawing is located in Appendix 4 that includes the post-construction survey and alignments for the project including redlines for any significant field adjustments made during construction that were different from the design plans. Several minor adjustments were made during construction, where needed. Specific changes along each stream are detailed below:

5.1.1 UT1 Reach 1 Upper

- The following log steps were converted to rock steps at the following stations:
    - 100+47
    - 100+58
    - 101+50
    - 101+64
    - 101+70
    - 101+76
    - 102+20
    - 103+07;
- Root Wads at Station 101+70 were replaced with Brush Toe;
- Sourwood transplants between UT1 Reach 1 Upper and UT1B were eliminated;
- An ephemeral pool was added in the left floodplain just upstream of the confluence of UT1 Reach 1 Upper and UT1B; and
- Cascade structures were varied in the field based on available materials, a bed rock slide was installed at Station 101+64 and wrapped soil lifts on banks noted in plans were eliminated.

5.1.2 UT1 Reach 1 Lower

- Transplants added in the left floodplain;
- Two pilot channels were eliminated from the design in the left floodplain (see Record Drawings, Sheet 1.2);
- Near station 105+72 the alignment was adjusted because a natural spring was found. The alignment will differ from design in this location;
- Slight grade change made in field on left floodplain;
- Root wads were replaced with brush toe at station 110+88;
- Several log steps were replaced by rock steps along the reach (stations 106+96, 110+35, 111+63, 112+00, and 113+39); and
- A few structure changes were made per engineer's discretion/availability materials (stations 105+89, 106+76, and 110+40).

5.1.3 UT1 Reach 2

- Sod mat added in several locations along UT1 Reach 2;
- A lunker log was added to the pool at Station 122+94;

- Log step angles were modified as needed per engineer's discretion/guidance within the reach;
- Brush toe was carried throughout pool at Station 123+77;
- Root wads at Station 125+20 were replaced with Brush Toe; and
- At the very downstream end of UT1 Reach 2 (near confluence of Henry River), the right bank was graded back. Approximately 35 to 40 LF of boulder toe was added, along with two geolifts to stabilize the bank.

5.1.4 UT1A

- Where the ditch enters UT1A from the right hillside, a log and sod mat was added to the pool to help prevent scour at the confluence;
- Sod mat added in several locations along UT1A; and
- The 24-inch Birch in the right floodplain near Station 185+00 was cut down.

5.1.5 UT1B

- A swale was added at the upstream end of UT1B coming from a small drainage in the right floodplain;
- Ephemeral pool in left floodplain was eliminated during construction;
- A small rock outlet was added coming out of old Pond Bed 1 (ephemeral pool); and
- Riffle at Station 151+20 was converted from a Woody Riffle to a Constructed Riffle.

5.1.6 UT2

- Some rock was added at the upstream end of UT2 (near station 200+15);
- Brush toe was substituted for the root wad at Station 206+25;
- Sod mat added in several locations along UT2;
- Brush toe at Station 209+78 was eliminated; and
- Brush toe was added to pools at Stations 211+03 and 218+00.

5.2 Baseline Data Assessment

Baseline monitoring (MY0) was conducted between March and April 2016. The first annual monitoring assessment (MY1) will be completed in the fall of 2016. The streams and wetlands will be monitored for a total of seven years, with the final monitoring activities conducted in 2021. The close-out for the Site will be conducted in 2022 given the success criteria is met. As part of the closeout process, DMS will evaluate the Site at the end of the fourth year monitoring period to determine whether or not the Site is eligible to closeout following monitoring year five. If the Site is meeting success criteria, DMS will propose to the interagency review team (IRT) to proceed with the closeout process. If the Site is not meeting success criteria, then an additional two years of monitoring will be conducted by Wildlands.

5.2.1 Morphological State of the Channel

Morphological data for the as-built profile was collected in May 2016. Please refer to Appendix 2 for summary data tables, morphological plots, and stream photographs.

Profile and Pattern

The baseline (MY0) profiles closely match the profile design parameters. On the design profiles, riffles were depicted as straight lines with consistent slopes. Additionally, maximum pool depths sometimes exceed design parameters. Variations in pool depths do not constitute a problem or indicate a need for remedial actions. The baseline (MY0) pattern metrics fell within the design parameters for all five reaches.

Dimension

The baseline (MY0) dimension numbers closely match the design parameters with minor variations in all reaches. Minor variations in both the channel depth and width are present and are a function of the small channel size and acceptable deviation within the design range, often times resulting from sod mat installation.

Sediment Transport

As-built shear stresses and velocities are similar to design parameters and should reduce the risk of further erosion along the restoration reaches. The as-built condition for each of these reaches indicates an overall increase in substrate particle size (Tables 6a and 6b). The substrate data for each constructed reach were compared to the design shear stress parameters from the mitigation plan to assess the potential for bed degradation. The shear stresses calculated for the constructed channels are within the allowable range, which indicates that the channel is not at risk to trend toward channel degradation.

5.2.2 Vegetation

The baseline (MY0) planted density is 647 stems/acre, which exceeds the MY5 density requirement. Summary data and photographs of each plot can be found in Appendix 3.

5.2.3 Stream and Wetland Hydrology

Stream and wetland hydrology being recorded on Site is currently being monitored and will be included in the year 1 monitoring report.

Section 6: REFERENCES

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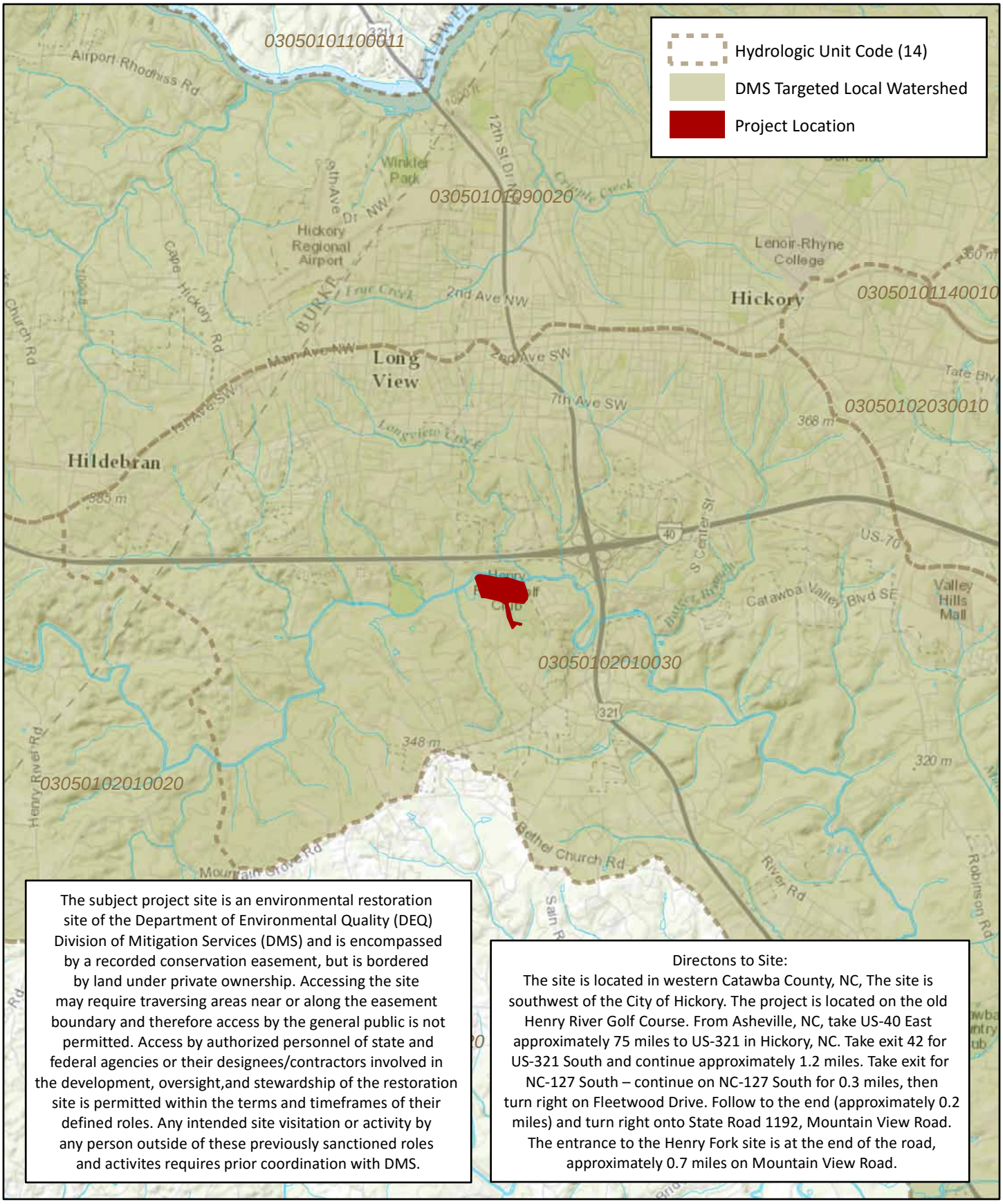
APPENDIX 1. General Tables and Figures



The subject project site is an environmental restoration site of the Department of Environmental Quality (DEQ) Division of Mitigation Services (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 activites requires prior coordination with DMS.

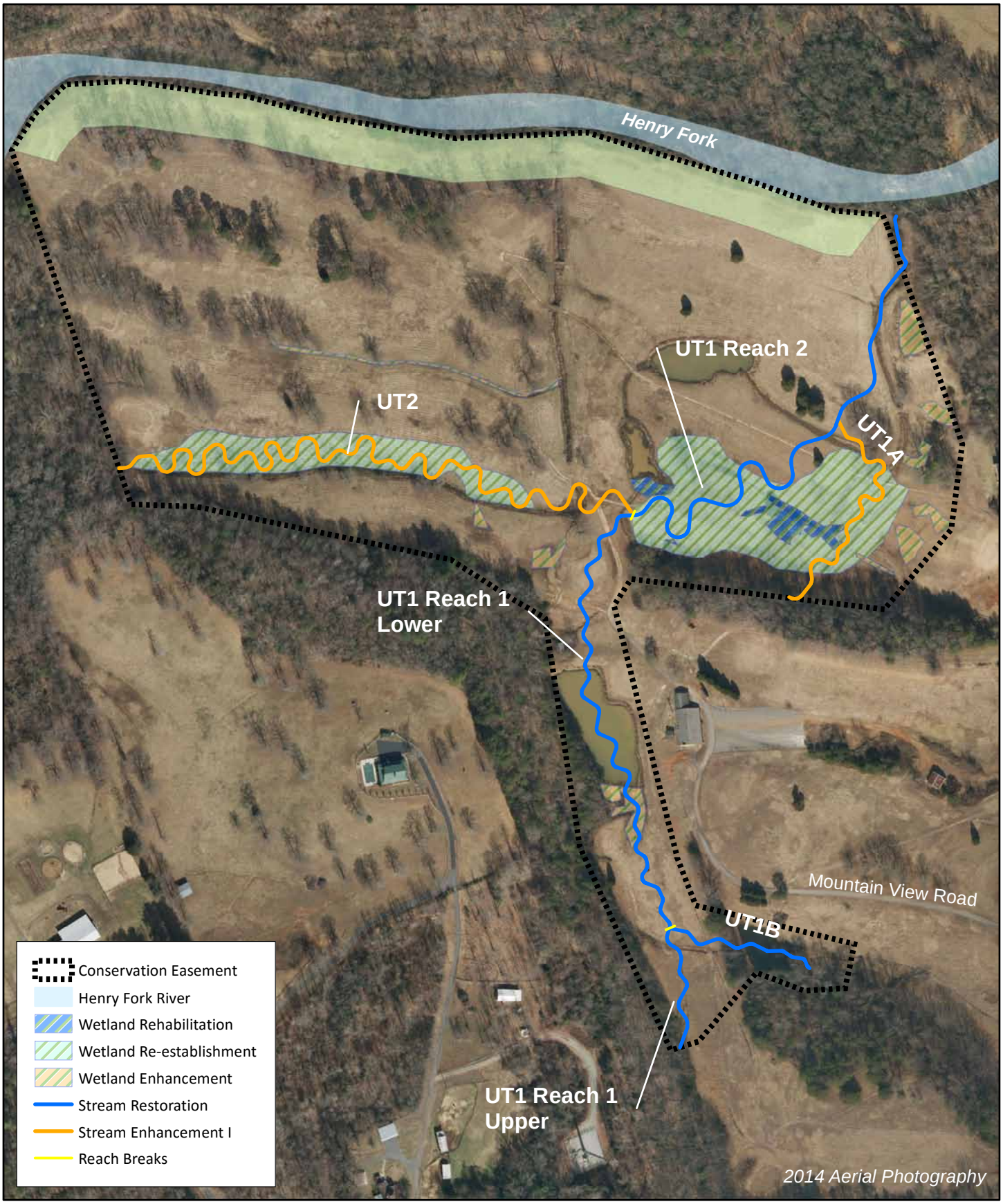
Directons to Site:
The site is located in western Catawba County, NC, The site is southwest of the City of Hickory. The project is located on the old Henry River Golf Course. From Asheville, NC, take US-40 East approximately 75 miles to US-321 in Hickory, NC. Take exit 42 for US-321 South and continue approximately 1.2 miles. Take exit for NC-127 South – continue on NC-127 South for 0.3 miles, then turn right on Fleetwood Drive. Follow to the end (approximately 0.2 miles) and turn right onto State Road 1192, Mountain View Road. The entrance to the Henry Fork site is at the end of the road, approximately 0.7 miles on Mountain View Road.

WILDLANDS ENGINEERING

0 0.5 1 Miles

N

Figure 1 Vicinity Map
Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016
Catawba County, NC



WILDLANDS ENGINEERING

Figure 2 Project Component Map
Henry fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Catawba County, NC

Table 1. Project Components and Mitigation Credits
Henry Fork Mitigation Site
DMS Project No.96306
Monitoring Year 0 - 2016

MITIGATION CREDITS									
	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	4,838	N/A	3.88	0.34	N/A	N/A	N/A	N/A	N/A

PROJECT COMPONENTS							
Reach ID	As-Built Stationing/ Location	Existing Footage/ Acreage	Approach	Restoration (R) or Restoration Equivalent (RE)	Restoration Footage/Acreage	Mitigation Ratio	Credits (SMU/WMU)
STREAMS							
UT1 Reach 1 Upper	100+00 to 103+12	1,497	P1	Restoration	312	1:1	312
UT1 Reach 1 Lower	103+12 to 114+97		P1	Restoration	1,185	1:1	1185
UT1 Reach 2	114+97 to 127+29	1,232	P1/P2	Restoration	1,232	1:1	1232
UT1A	180+00 to 186+58	658	P1	Enhancement	658	1.5:1	439
UT1B	150+00 to 153+58	358	P1	Restoration	358	1:1	358
UT2	200+00 to 219+69	1,969	P1	Enhancement	1,969	1.5:1	1313
WETLANDS							
Wetland 1	Floodplain near UT1 Reach 2	N/A	Planting, hydrologic improvement	Re-establishment	2.48	1:1	2.48
Wetland 2	Floodplain near UT2	N/A	Planting, hydrologic improvement	Re-establishment	1.23	1:1	1.23
Wetland A	Floodplain between UT1 Reach 2 and UT1A	0.182 AC	Planting, hydrologic improvement	Rehabilitation	0.18	1.5:1	0.12
Wetland B	Floodplain between UT1 Reach 2 and UT1A	0.013 AC	Planting, hydrologic improvement	Rehabilitation	0.013	1.5:1	0.01
Wetland C	Floodplain between UT1 Reach 2 and UT1A	0.003 AC	Planting, hydrologic improvement	Rehabilitation	0.003	1.5:1	0.002
Wetland G	Floodplain near UT1A	0.021 AC	Planting	Enhancement	0.018	2:1	0.01
Wetland H	East hillslope near UT1A	0.056 AC	Planting	Enhancement	0.056	2:1	0.03
Wetland I	East hillslope near UT1A	0.078 AC	Planting	Enhancement	0.08	2:1	0.04
Wetland J	East hillslope near UT1 Reach 2	0.036 AC	Planting	Enhancement	0.04	2:1	0.02
Wetland K	East hillslope near UT1 Reach 2	0.062 AC	Planting	Enhancement	0.06	2:1	0.03
Wetland M	East hillslope near UT1 Reach 2	0.131 AC	Planting	Enhancement	0.13	2:1	0.07
Wetland N	Floodplain towards river from UT2	0.084 AC	Planting	Enhancement	0.08	2:1	0.04
Wetland P	Floodplain upslope of UT2	0.023 AC	Planting	Enhancement	0.02	2:1	0.01
Wetland Q	Floodplain upslope of UT2	0.069 AC	Planting	Enhancement	0.07	2:1	0.03
Wetland R	Floodplain in footprint of Pond 3 near head of UT1 Reach 2	0.059 AC	Significant improvement to wetland functions	Rehabilitation	0.06	1.5:1	0.04
Wetland S	UT1 Reach 1 Valley (Pond 1)	0.159 AC	Planting	Enhancement	0.13	2:1	0.07

COMPONENT SUMMATION					
Restoration Level	Stream (LF)	Riparian Wetland (acres)	Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
Restoration	3,087	N/A	N/A	N/A	N/A
Enhancement I	2,627	N/A	N/A	N/A	N/A
Wetland Re-Establishment	N/A	3.71	N/A	N/A	N/A
Wetland Rehabilitation	N/A	0.25	N/A	N/A	N/A
Wetland Enhancement	N/A	0.68	N/A	N/A	N/A
Preservation	N/A	N/A	N/A	N/A	N/A

Table 2. Project Activity and Reporting History
Henry Fork Mitigation Site
DMS Project No.96306
Monitoring Year 0 - 2016

Activity or Report	Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	August 2015	September 2015
Final Design - Construction Plans	October 2015	October 2015
Construction	November 2015 - March 2016	March 2016
Temporary S&E mix applied to entire project area [1]	March 2016	March 2016
Permanent seed mix applied to reach/segments [1]	March 2016	March 2016
Bare root and live stake plantings for reach/segments	March 2016	March 2016
Baseline Monitoring Document (Year 0)	April 2016 -May 2016	May 2016
Year 1 Monitoring	Fall 2016	December 2016
Year 2 Monitoring	2017	December 2017
Year 3 Monitoring	2018	December 2018
Year 4 Monitoring	2019	December 2019
Year 5 Monitoring	2020	December 2020
Year 6 Monitoring	2021	December 2021
Year 7 Monitoring	2022	December 2022

[1]Seed and mulch is added as each section of construction is completed.

Table 3. Project Contact Table
Henry Fork Stream Mitigation Site
DMS Project No.96306
Monitoring Year 0 - 2016

Designer Jake McLean, PE	**Wildlands Engineering, Inc.** 167-B Haywood Rd. Asheville, NC 28806 828.774.5547
Construction Contractor	**Land Mechanics Designs, Inc.** 780 Landmark road Willow Spring, NC 27592
Planting Contractor	**Bruton Natural Systems, Inc** P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	**Land Mechanics Designs, Inc.** 780 Landmark road Willow Spring, NC 27592
Seed Mix Sources	**Green Resource, LLC**
Nursery Stock Suppliers **Bare Roots** **Live Stakes** **Plugs**	 **Dykes and Son Nursery** **Bruton Natural Systems, Inc** **Wetland Plants, Inc.**
Monitoring Performers	**Wildlands Engineering, Inc.**
Monitoring, POC	Kirsten Gimbert 704.332.7754, ext. 110

Table 4. Project Information and Attributes
Henry Fork Mitigation Site
DMS Project No.96306
Monitoring Year 0 - 2016

PROJECT INFORMATION	
Project Name	Henry Fork Mitigation Site
County	Catawba County
Project Area (acres)	48.06
Project Coordinates (latitude and longitude)	35°42'12.98"N, 81°21'53.20"W
PROJECT WATERSHED SUMMARY INFORMATION	
Physiographic Province	Inner Piedmont
River Basin	Catawba
USGS Hydrologic Unit 8-digit	03050102 (Expanded Service Area for 03050103)
USGS Hydrologic Unit 14-digit	03050102010030
DWR Sub-basin	03-08-35
Project Drainiage Area (acres)	178
Project Drainage Area Percentage of Impervious Area	5%
CGIA Land Use Classification	39% - Herbaceous/Pasture, 36% - Forested, 25% - Developed, >1% - Water

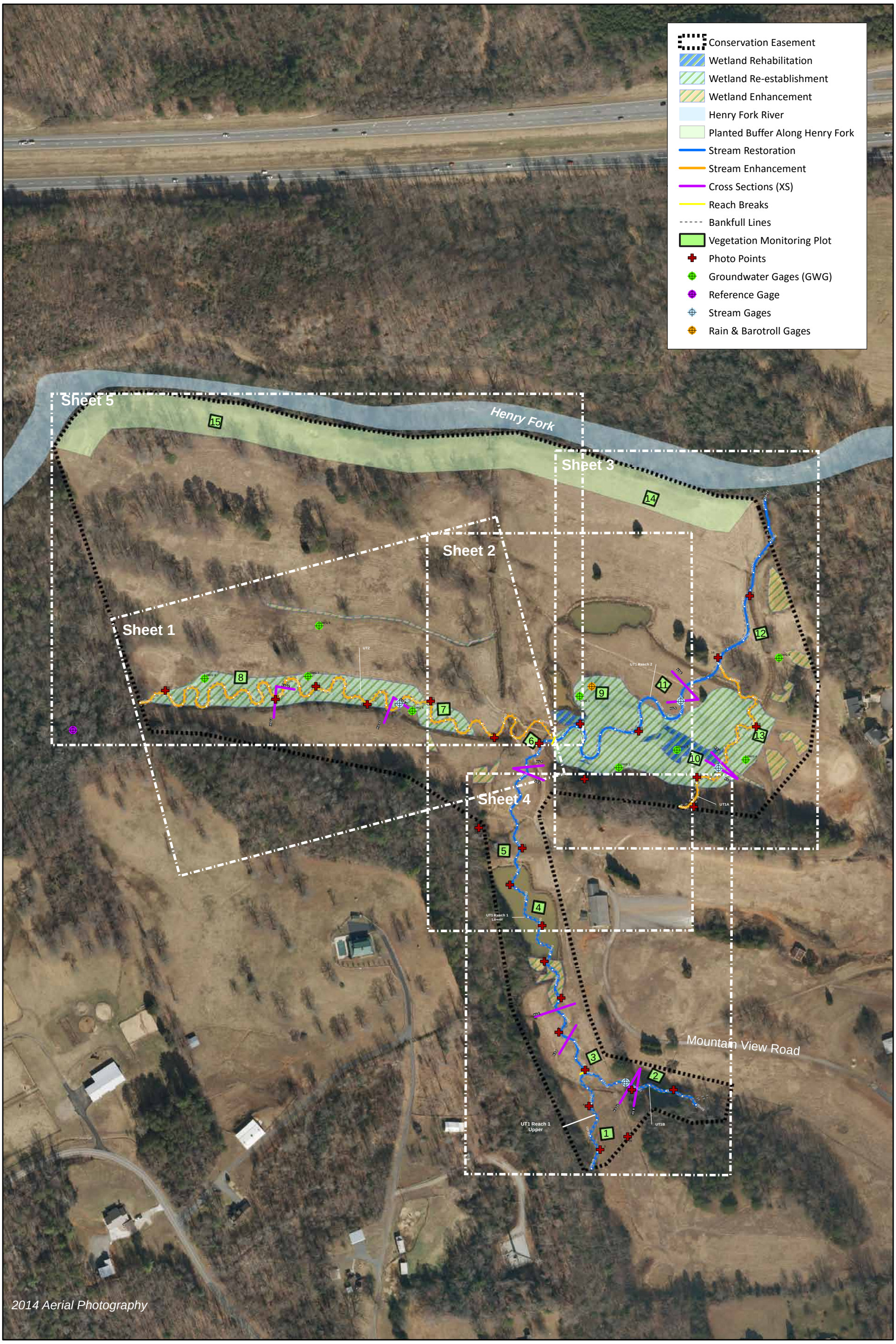
REACH SUMMARY INFORMATION					
Parameters	**UT1 Reach 1**	**UT1 Reach 2**	**UT1A**	**UT1B**	**UT2**
Length of Reach (linear feet) - Post-Restoration	1,497	1,232	658	358	1,969
Drainage Area (acres)	106	129	23	31	49
NCDWR Stream Identification Score	39.5	32.5	27.25	31.25	27
NCDWR Water Quality Classification	C				
Morphological Desription (stream type)	P	P	I	P	I
Evolutionary Trend (Simon's Model) - Pre-Restoration	III	IV/V	IV/V	III	IV/V
Underlying Mapped Soils	Codorus loam, Dan River loam, Hatboro Loam, Poplar Forest gravelly sandy loam 2-6% slopes, and Woolwine-Fairview complex				
Drainage Class	---	---	---	---	---
Soil Hydric Status	---	---	---	---	---
Slope	0.024-0.056	0.0043-0.017	0.0095-0.016	0.015-0.077	0.0032
FEMA Classification	N/A*				
Native Vegetation Community	Piedmont Alluvial Forest				
Percent Composition Exotic Invasive Vegetation -Post-Restoration	0%				

REGULATORY CONSIDERATIONS			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States - Section 404	Yes	PCN prepared	USACE Nationwide Permit No.27 and DWQ 401 Water Quality Certification No. 3885.
Waters of the United States - Section 401	Yes	PCN prepared	
Division of Land Quality (Dam Safety)	N/A	N/A	N/A
Endangered Species Act	Yes	Yes	Henry Fork Mitigation Plan; Wildlands determined "no effect" on Catawba County listed endangered species. June 5, 2015 email correspondence from USFWS stated "not likely to adversely affect" northern long-eared bat.
Historic Preservation Act	Yes	Yes	No historic resources were found to be impacted (letter from SHPO dated 3/24/2014)
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes*	No impact application was prepared for local review. No post-project activities required.	Floodplain development permit issued by Catawba County.
Essential Fisheries Habitat	No	N/A	N/A

*The project site reaches do not have regulated floodplain mapping, but are located within the Henry Fork floodplain.

Table 5. Monitoring Component Summary
Henry Fork Mitigation Site
DMS Project No.96306
Monitoring Year 0 - 2016

Parameter	Monitoring Feature	Quantity/ Length by Reach					Frequency
		UT1	UT1A	UT1B	UT2	Wetlands 1 & 2	
Dimension	Riffle Cross Sections	3	1	1	2	N/A	Years 1, 2, 3, 5, and 7
	Pool Cross Section	3	1	1	2	N/A	
Pattern	Pattern	N/A	N/A	N/A	N/A	N/A	N/A
Profile	Longitudinal Profile	N/A	N/A	N/A	N/A	N/A	N/A
Substrate	Reach Wide / Shallow 100 Pebble Count	RW-2, RF-2	N/A	RW-1, RF-1	N/A	N/A	N/A
Stream Hydrology	Crest Gage	1	1	1	1	N/A	Quarterly
Wetland Hydrology	Groundwater Gages	N/A	N/A	N/A	N/A	7	Quarterly
Vegetation	CVS Level 2	15					Years 1, 2, 3, 5, and 7
Visual Assessment	All Streams	Y	Y	Y	Y	Y	Semi-Annual
Exotic and nuisance vegetation							Annual
Project Boundary							Annual
Reference Photos	Photographs	29					Annual



WILDLANDS ENGINEERING

0 250 500 Feet

N

Figure 3.0 Monitoring Plan View (KEY)
Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Catawba County, NC

Conservation Easement
Wetland Rehabilitation
Wetland Re-establishment
Wetland Enhancement
Henry Fork River
Planted Buffer Along Henry Fork
Stream Restoration
Stream Enhancement
Cross Sections (XS)
Reach Breaks
Bankfull Lines
Vegetation Monitoring Plot
Photo Points
Groundwater Gages (GWG)
Reference Gage
Stream Gages
Rain & Barotroll Gages

UT1 Reach 1 Lower
UT2
XS 4
XS 14
XS 13
XS 12
XS 11
GWG 6
GWG 7
GWG 8
GWG 9
6
7
8
13
20
21
22
23
24
25
219+00
218+00
217+00
216+00
215+00
214+00
213+00
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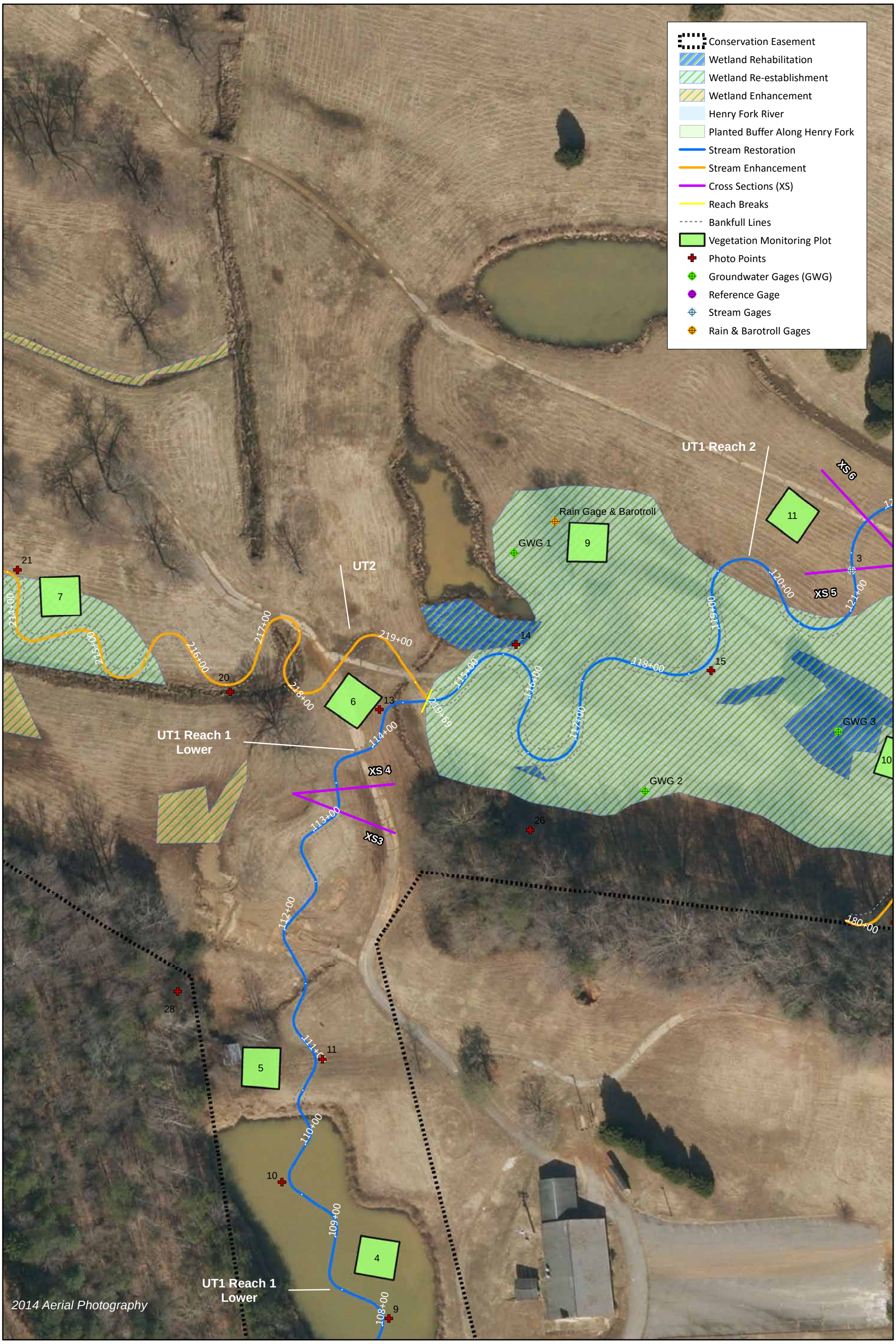
204+00
203+00
202+00
201+00
200+00
2014 Aerial Photography

WILDLANDS ENGINEERING

0 75 150 Feet

Figure 3.1 Monitoring Plan View (Sheet 1)
Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Catawba County, NC



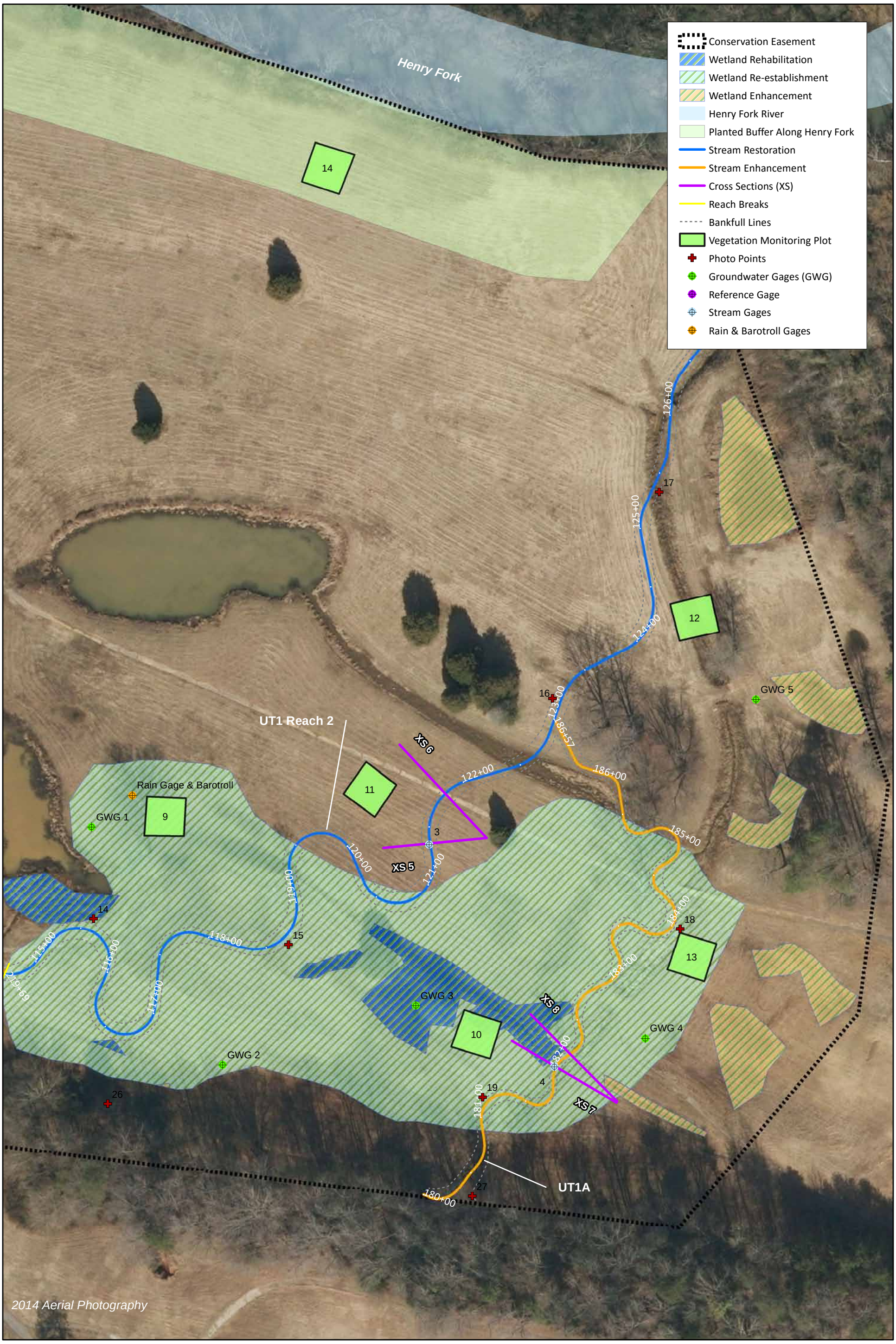
WILDLANDS ENGINEERING

0 75 150 Feet

N

Figure 3.2 Monitoring Plan View (Sheet 2)
Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Catawba County, NC



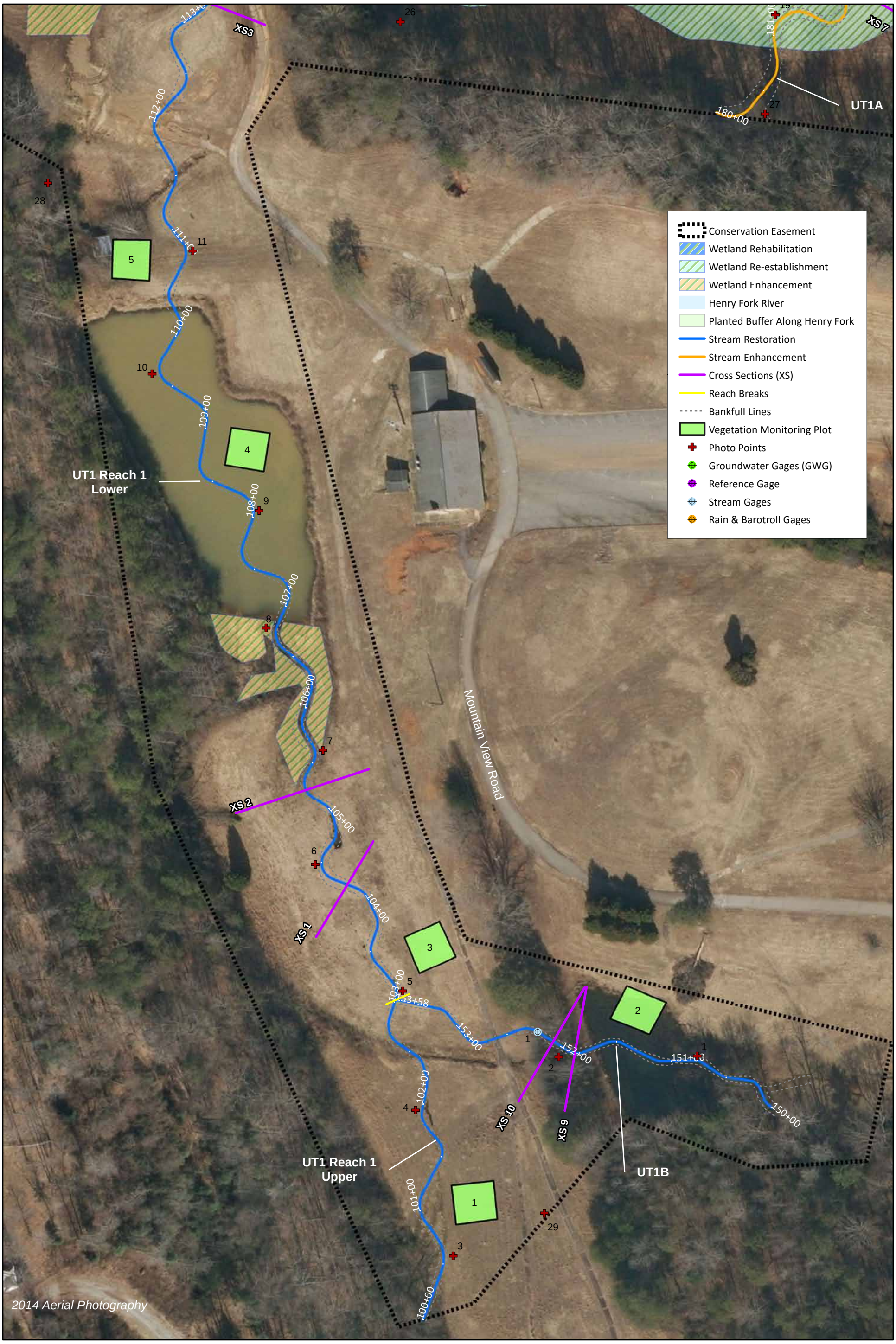
WILDLANDS ENGINEERING

0 75 150 Feet

N

Figure 3.3 Monitoring Plan View (Sheet 3)
Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

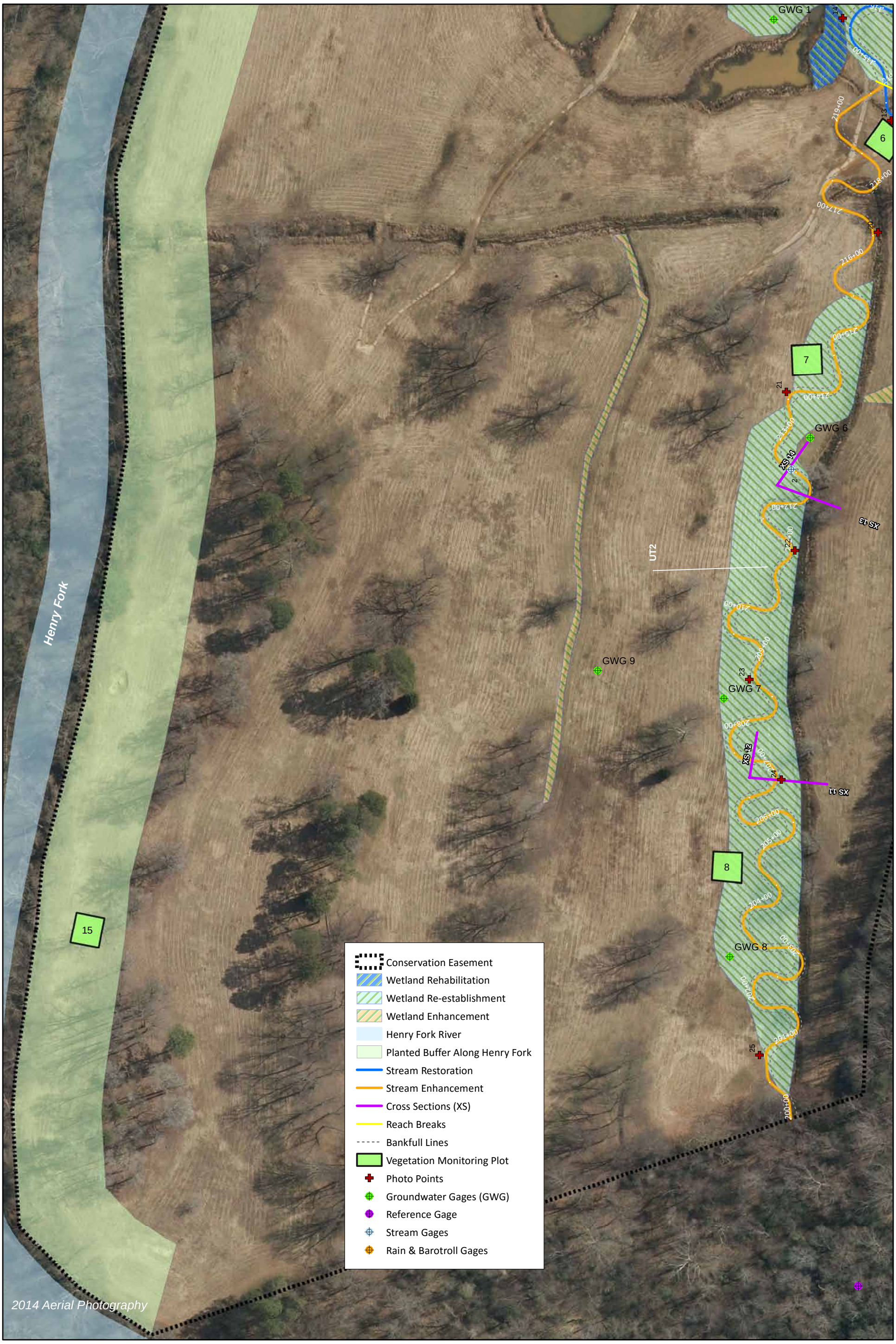
Catawba County, NC



0 75 150 Feet

Figure 3.4 Monitoring Plan View (Sheet 4)
Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Catawba County, NC



WILDLANDS ENGINEERING

0 100 200 Feet

Figure 3.5 Monitoring Plan View (Sheet 5)
Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Catawba County, NC

APPENDIX 2. Morphological Summary Data and Plots

Table 6a. Baseline Stream Data Summary
Henry Fork Mitigation Site
DMS Project No.96306
Monitoring Year 0 - 2016

Henry Fork-UT1 Reach 2, UT1A and UT2

		PRE-RESTORATION CONDITION						REFERENCE REACH DATA								DESIGN						AS-BUILT/BASELINE					
Parameter	Gage	UT1 Reach 2		UT1A		UT2		UT to Catawba River Reach 1		UT to Catawba River Reach 2		UT to Lyle Creek		Vile Preserve		UT1 Reach 2		UT1A		UT2		UT1 Reach 2		UT1A		UT2	
		Min	Max	Min	Max	Min	Max	Min[1]	Max[1]	Min[1]	Max[1]	Min[1]	Max[1]	Min[1]	Max[1]	Upper	Lower	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Reference Cross Section Number		XS9		XS8		XS5,XS6		XS2	XS3	XS4		XS1	XS3	XS1	XS3												
Dimension and Substrate - Riffle																											
Bankfull Width (ft)	N/A	9.4		12.5		15.2	16.3	12.4	9.7	12.3		8.6	7.0	6.2	5.7	10.1		6.2		7.5		10.5		6.6		5.65	
Floodprone Width (ft)		17.9		23.1		18	19.8	79	52	53		48.9	45.2	200+	200+	23	46	150	200	60	110	96.7+		31.4		81.3	149.8+
Bankfull Mean Depth		0.7		0.2		0.5	0.5	1.4	1.2	1.1		0.5	0.5	0.8	0.8	0.82		0.51		0.58		0.9		0.40		0.85	
Bankfull Max Depth		1.4		0.7		0.6	0.6	1.7	1.7	1.7		1.1	1.0	1.3	1.4	1.30		0.85		0.95		1.5		0.80		1.2	
Bankfull Cross-sectional Area (ft^2)		6.1		2.8		7.5	7.8	17.6	11.4	13.2		4.1	3.5	5.3	4.5	8.3		3.2		4.4		9.7		2.5		4.6	
Width/Depth Ratio		14.4		56.0		30.7	34.4	8.7	8.2	11.5		18.3	13.9	7.4	7.2	12.3		12.1		12.9		11.4		17.0		7.2	
Entrenchment Ratio		1.9		1.8		1.2	1.2	5.8+		5.8+		2.5+		30+		2.3	4.6	24.2	32.37	8.0	14.7	9.2+		4.8		15.9	20.3
Bank Height Ratio		2.7		1.9		2.9	7.5	1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.1	
D50 (mm)		5.3/N/A		0.28/0.34		SC/0.04		1.8		75.9		0.2		0.4		N/A		0.34		0.04		Silt/Clay					
Riffle Length (ft)	N/A							---		---		---		---		---		---		---		23.3	51.9	10.8	32.9	3.45	52.29
Riffle Slope (ft/ft)		0.4	1.7	6.7		N/A[2]		0.0114	0.0605	0.0142	0.3451	0.0055	0.0597	0.0063		0.002	0.0080	0.005	0.0210	0.0020	0.0080	0.0000	0.0230	0.0010	0.0395	0.0000	0.0144
Pool Length (ft)								---		---		---		---		---		---		---		15.4	83.1	10.2	47.5	10.28	60.9
Pool Max Depth (ft)		N/A[2]		N/A[2]		N/A[2]		2.5		N/A		1.3		1.4		1.3	2.5	0.8	1.5	0.0	1.8	2.2	3.5	0.9	2.6	1.6	2.6
Pool Spacing (ft)		38.1		N/A[2]		N/A[2]		31	60	19	46	15	28	44.8		20	86	12	53	15	68	49	136	29	53	28	87
Pool Volume (ft^3)								---		---		----		----													
Pattern																											
Channel Beltwidth (ft)	N/A	N/A[2]		N/A[2]		N/A[2]		55		23		21		19		8	83	8	37	9	58	7	84	7	36	8	59
Radius of Curvature (ft)		N/A[2]		N/A[2]		N/A[2]		31	56	29	52	19	32	27	50	25	51	13	25	14	24	25	58	9	25	13	24
Rc:Bankfull Width (ft/ft)		N/A[2]		N/A[2]		N/A[2]		2.8	5.1	2.4	4.2	2.2	4.6	4.4	8.8	19.2	39.2	15.3	29.4	14.7	25.3	2.4	5.5	1.4	3.8	2.3	4.2
Meander Length (ft)		N/A[2]		N/A[2]		N/A[2]		65	107	52	79	39	44	29	45	120	210	63	100	65	156	123	210	61	100	63	158
Meander Width Ratio		N/A[2]		N/A[2]		N/A[2]		4.4	5.7	1.8		2.4	3.0	3.1	4.2	92.3	161.5	74.1	117.6	68.4	164.2	11.7	20.0	9.2	15.2	11.2	28.0
Substrate, Bed and Transport Parameters																											
Ri%/Ru%/P%/G%/S%	N/A																										
SC%/Sa%/G%/C%/B%/Be%																											
d16/d35/d50/d84/d95/d100		SC/0.18/2.8/38/62/128-180		SC/SC/SC/SC/0.25/4.0/11.3-16		SC/SC/SC/SC/SC/8.0/45-64		0.3/0.4/1.8/12.8/25/90		0.5/29.8/75.9/170.8/332.0/>2048.0		-/0.1/0.2/0.5/4.0/8.0		0.2/0.3/0.4/0.9/2/-													
Reach Shear Stress (Competency) lb/ft^2		0.8-1.6		0.7		0.18-0.25+[4]										0.06		0.13		0.05		0.00	0.11	0.13		0.07	
Max part size (mm) mobilized at bankfull																											
Stream Power (Capacity) W/m^2																											
Additional Reach Parameters																											
Drainage Area (SM)	N/A	0.2		0.036		0.077		1.60		1.60		0.25		1.09		0.24-0.28		0.04		0.08		0.24-0.28		0.04		0.08	
Watershed Impervious Cover Estimate (%)		5.3%		6.1%		2.4%		---		---		---		---		5.3%		6.1%		2.4%		5.3%		6.1%		2.4%	
Rosgen Classification		Modified B4c[3]		Modified B6c[3]		Modified F6[3]		E5		E3b/C3b		C5		E5		C6		C6		C6		C6		C6		C6	
Bankfull Velocity (fps)		3.0		2.2		1.3	1.5	3.9	3.5	6.3		2	2.1	3.3	3.2	1.7		2.0		1.2		1		1.4		0.8	1.0
Bankfull Discharge (cfs)		18.3		6.1		10.2		58		83		8		16		14		6		5		13		4		4.0	6.7
Q-NFF regression (2-yr)		---		---		---																					
Q-USGS extrapolation (1.2-yr)		61		19		29																					
Q-Mannings		18.3		6.1		10.2										14		6		5		13		4		4.0	6.7
Valley Length (ft)		---		---		---		---		---		---		---		---		---		---		922		415		1174	
Channel Thalweg Length (ft)		1499*		353		1,915		---		---		---		---		1,228		657		1,969		1,232		658		1,969	
Sinuosity		1.5[5]		1.05		1.03		1.2		1.1		1.1		1.1		1.39		1.06		1.65		1.3		1.6		1.7	
Water Surface Slope (ft/ft^2)		---		---		---		---		---		---		---		0.0016	0.0018	0.0037	0.0043	0.0016	0.0019	0.0023		0.0063		0.0018	
Bankfull Slope (ft/ft)		---		---		---		---		---		---		---		0.0016	0.0018	0.0037	0.0043	0.0016	0.0019	0.0037		0.0060		0.0015	

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable
[1] Min and max values may appear backwards for ratios. When this is the case, ratio values have been left in the column associated with a particular cross section.
[2] Due to the highly manipulated condition of the streams resulting in ditched streams with little profile diversity, no profile or pattern data was assessed on UT1A, UT2, UT1 Reach 2, and UT1B.
[3]The Rosgen classification system is for natural streams and project streams have been heavily manipulated. These classifications are for illustrative purposes only.
[4]The 25-year event was the largest event modeled; it does not fill the channel
[5]Sinuosity on UT1 Reach 2 is calculated by drawing a valley length line that follows the proposed valley; the existing valley is poorly defined
*Does not include last 150' to tie-in to Henry Fork.

Table 6b. Baseline Stream Data Summary
Henry Fork Mitigation Site
DMS Project No.96306
Monitoring Year 0 - 2016

Henry Fork-UT1 Reach 1 and UT1B

Parameter	Gage	PRE-RESTORATION CONDITION				REFERENCE REACH DATA																DESIGN				AS-BUILT/BASELINE			
		UT1 Reach 1		UT1B		UT to Catawba River Reach 1		UT to Catawba River Reach 2		UT to Lyle Creek		Vile Preserve		UT to South Crowders		Group Camp Tributary		UT to Gap Branch		Upstream UT1 to Henry Fork		UT1 Reach 1		UT1B		UT1 Reach 1		UT1B	
		Min	Max	Min	Max	Min[1]	Max[1]	Min[1]	Max[1]	Min[1]	Max[1]	Min[1]	Max[1]	Min[1]	Max[1]	Min[1]	Max[1]	Min[1]	Max[1]	Min[1]	Max[1]	Upper	Lower	Min	Max	Min	Max	Min	Max
Reference Cross Section Number		XS3,XS4		XS1,XS2		XS2	XS3	XS4		XS1	XS3	XS1	XS3	XS1	XS2	XS3	XS4	XS2		XS1	XS2								
Dimension and Substrate - Riffle																													
Bankfull Width (ft)		3.2	3.3	2.7	3.1	12.4	9.7	12.3		8.6	7.0	6.2	5.7	6.1	8.4	4.4	4.2	6.2		3.2	7.7	6.0	7.0	5.5		6.9	7.3	5.4	
Floodprone Width (ft)		6.7	11.4	17.5	19.8	79	52	53		48.9	45.2	200+	200+	25.5	31.2	8.6	10.6	20.9		6.3	13	15	20(40[3])	10	15	51.3	118.3+	13.2	
Bankfull Mean Depth		0.6	0.7	0.6	0.7	1.4	1.2	1.1		0.5	0.5	0.8	0.8	1.1	1.0	0.8	0.8	0.6		0.6	0.5	0.40	0.49	0.4		0.4	0.5	0.4	
Bankfull Max Depth		0.7	1.0	0.7	0.9	1.7	1.7	1.7		1.1	1.0	1.3	1.4	1.4	1.4	1.0	1.2	1.0		0.8	0.7	1.3		0.55		0.75		0.6	
Bankfull Cross-sectional Area (ft^2)	N/A	1.8	2.1	1.9	2	17.6	11.4	13.2		4.1	3.5	5.3	4.5	6.4	8.7	3.6	3.4	3.8		1.9	3.6	2.4	3.4	2.1		2.9	3.5	2.2	
Width/Depth Ratio		5.1	5.7	3.7	5.1	8.7	8.2	11.5		18.3	13.9	7.4	7.2	5.7	8.2	5.5	5.2	10.1		5.2	16.4	12.3		14.7		15.8		13.2	
Entrenchment Ratio		2.0	3.6	1.7	2.5	5.8+		5.8+		2.5+		30+		4.2	3.7	1.9	2.5	3.4		2.0	1.7	2.5	2.9 (5.7[3])	1.8	2.7	7.0	17.1+	6.9	
Bank Height Ratio		1.0	3.1	1.7	2.2	1.0		1.0		1.0		1.0		1.6	1.0	1.0	1.0	1.0		1.0	1.3	1.0		1.0		1.0		1.0	
D50 (mm)		16/8.3		6.9/5.3		1.8		75.9		0.2		0.4		19.7		0.3		19.0		34.0		8.3		5.3		17.1		11.0	
Profile																													
Riffle Length (ft)						---		---		---		---		---		---		---		---		---		---		8.0	47.3	11.3	41.2
Riffle Slope (ft/ft)		0.041	0.21	N/A[2]		0.0114	0.0605	0.0142	0.3451	0.0055	0.0597	0.0063		0.0202	0.0664	0.0105	0.1218	0.0110	0.1400	0.0500	0.0700	0.056	0.092	0.067	0.110	0.0142	0.0987	0.0259	0.0978
Pool Length (ft)						---		---		---		---		---		---		---		---		---		---		4.3	33.4	5.6	20.0
Pool Max Depth (ft)	N/A	N/A[2]		N/A[2]		2.5		N/A		1.3		1.4		1.3	3.0	1.8	2.8	1.5		N/A		0.6	1.5	0.7	1.3	0.9	2.8	0.5	2.2
Pool Spacing (ft)		10.4	20.5	N/A[2]		31	60	19	46	15	28	44.8		28	63	9	58	18	27	14	25	12	35	11	28	10	60	7	43
Pool Volume (ft^3)						---		---		----		----		----		----		----		----									
Pattern																													
Channel Beltwidth (ft)		N/A[2]		N/A[2]		55		23		21		19		81		15.5	16.5	N/A		N/A		6	28	5	21	10	26	4	19
Radius of Curvature (ft)		N/A[2]		N/A[2]		31	56	29	52	19	32	27	50	9	20	8.0	11.8	N/A		N/A		14	30	10	18	8	31	8	32
Rc:Bankfull Width (ft/ft)	N/A	N/A[2]		N/A[2]		2.8	5.1	2.4	4.2	2.2	4.6	4.4	8.8	1.5	2.4	1.9	2.7	N/A		N/A		2.3	4.3	1.8	3.3	1.2	4.5	1.5	5.9
Meander Length (ft)		N/A[2]		N/A[2]		65	107	52	79	39	44	29	45	45	72	31	34	N/A		N/A		52	104	46	92	56	104	48	90
Meander Width Ratio		N/A[2]		N/A[2]		4.4	5.7	1.8		2.4	3.0	3.1	4.2	9.6	13.3	3.6	3.8	N/A		N/A		9	15	8	17	8	15	9	17
Substrate, Bed and Transport Parameters																													
Ri%/Ru%/P%/G%/S%																													
SC%/Sa%/G%/C%/B%/Be%																													
d16/d35/d50/d84/d95/d100		SC/0.18/2.80/38/62/128-180		FS/SC/SC/0.14/8.9/45/128-180		0.3/0.4/1.8/12.8/25/90		0.5/29.8/75.9/170.8/332.0/>2048.0		-/0.1/0.2/0.5/4.0/8.0		0.2/0.3/0.4/0.9/2/-		0.8/12.1/19.7/49.5/75.9/180.0		SC/0.1/0.3/16.0/55.6/128.0		0.4/8/19.0/102.3/256.0/>2048		2.8/16/34/64/101/128-180									
Reach Shear Stress (Competency) lb/ft^2	N/A	2.3-3.1		1.3-2.4																		1.0-1.2		0.91		0.87		1.32	
Max part size (mm) mobilized at bankfull																													
Stream Power (Capacity) W/m^2																													
Additional Reach Parameters																													
Drainage Area (SM)		0.17		0.048		1.60		1.60		0.25		1.09		0.22		0.10		0.04		0.05		0.07-0.17		0.048		0.07-0.17		0.048	
Watershed Impervious Cover Estimate (%)		5.9%		7.9%		---		---		---		---		---		---		---		---		5.9%		7.9%		5.9%		7.9%	
Rosgen Classification		Modified Low W/D B4a / E4b[4]		Modified B5a / E5b[4]		E5		E3b/C3b		C5		E5		E4		E5b		Slightly entrenched B4a/A4		B4a		B4a	B4a (C4b[5])	B4a[6]		B4a		B4a	
Bankfull Velocity (fps)		4.8	5.3	3.8	4.1	3.9	3.5	6.3		2	2.1	3.3	3.2	3.3	4.4	3.6	3.4	5.0		5.4	3.8	4.6	4.1	4.3		2.6	3.9	3.9	
Bankfull Discharge (cfs)		8.5	11.4	8		58		83		8		16		25		12		19		12		10	15	9		7.6	12.6	8.7	
Q-NFF regression (2-yr)		---		---																									
Q-USGS extrapolation (1.2-yr)	N/A	30		24																									
Q-Mannings		8.5	11.4	8																		10	15	9		7.6	12.6	8.7	
Valley Length (ft)		---		---		---		---		---		---		---		---		---		---		---		---		1,271		338	
Channel Thalweg Length (ft)		1,392		478		---		---		---		---		---		---		---		---		1,471		358		1,497		358	
Sinuosity		1.0		1.1		1.2		1.1		1.1		1.1		2.2		1.6		N/A		1.1		1.11	1.16	1.30		1.2		1.1	
Water Surface Slope (ft/ft)[2]		---		---		---		---		---		---		---		---		---		---		---		0.0477	0.0527	0.0500	0.0565	0.0369		0.0598	
Bankfull Slope (ft/ft)		---		---		---		---		---		---		---		---		---		---		---		0.0477	0.0527	0.0500	0.0565	0.0241	0.0612	0.0602	

SC: Silt/Clay <0.062 mm diameter particles
FS: Fine Sand 0.125-0.250mm diameter particles
(---): Data was not provided
N/A: Not Applicable

[1] Min and max values may appear backwards for ratios. When this is the case, ratio values have been left in the column associated with a particular cross section.

[2] Due to the highly manipulated condition of the streams resulting in ditched streams with little profile diversity, no profile or pattern data was assessed on UT1A, UT2, UT1 Reach 2, and UT1B.

[3] UT1 Reach 1 (Lower) is a hybrid reach that goes through what is presently a pond and then drops rapidly down what is presently a dam embankment and drop to master stream floodplain. Through the pond, slopes and floodprone width is more typical of a C.

[4] The Rosgen classification system is for natural streams and project streams have been heavily manipulated. These classifications are for illustrative purposes only.

[5] UT1 Reach 1 (Lower) is a hybrid reach that goes through what is presently a pond and then drops rapidly down what is presently a dam embankment and drop to master stream floodplain. Through the pond, slopes and floodprone width is more typical of a C.

[6] UT1B is classified in existing conditions as a sand bed stream. This is thought to be reflective of manipulation (impoundment and channelization resulting in a less steep stream). The restored stream, with slopes exceeding 2% grade throughout the reach, will be a gravel dominated stream, and is classified as such.

Table 7a. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)

Henry Fork Mitigation Site

DMS Project No.96306

Monitoring Year 0 - 2016

	Cross-Section 1, UT1 Reach 1 (Riffle)						Cross-Section 2, UT1 Reach 1 (Pool)						Cross-Section 3, UT1 Reach 1 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	906.1						901.9						878.3					
Bankfull Width (ft)	7.3						8.8						7.8					
Floodprone Width (ft)	51.3						---						---					
Bankfull Mean Depth (ft)	0.5						1.2						1.2					
Bankfull Max Depth (ft)	0.7						2.2						2.2					
Bankfull Cross-Sectional Area (ft^2)	3.5						10.7						9.1					
Bankfull Width/Depth Ratio	15.4						---						---					
Bankfull Entrenchment Ratio	7.0						---						---					
Bankfull Bank Height Ratio	1.0						---						---					
	Cross-Section 4, UT1 Reach 1 (Riffle)						**Cross-Section 5, UT1 Reach 2 (Riffle)**						**Cross-Section 6, UT1 Reach 2 (Pool)**					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	877.6						873.5						872.7					
Bankfull Width (ft)	6.9						10.5						8.8					
Floodprone Width (ft)	118.3+						96.7+						---					
Bankfull Mean Depth (ft)	0.4						0.9						1.0					
Bankfull Max Depth (ft)	0.8						1.5						1.8					
Bankfull Cross-Sectional Area (ft^2)	2.9						9.7						8.8					
Bankfull Width/Depth Ratio	16.2						11.4						---					
Bankfull Entrenchment Ratio	17.1+						9.2+						---					
Bankfull Bank Height Ratio	1.0						1.0						---					

Table 7b. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)

Henry Fork Mitigation Site

DMS Project No.96306

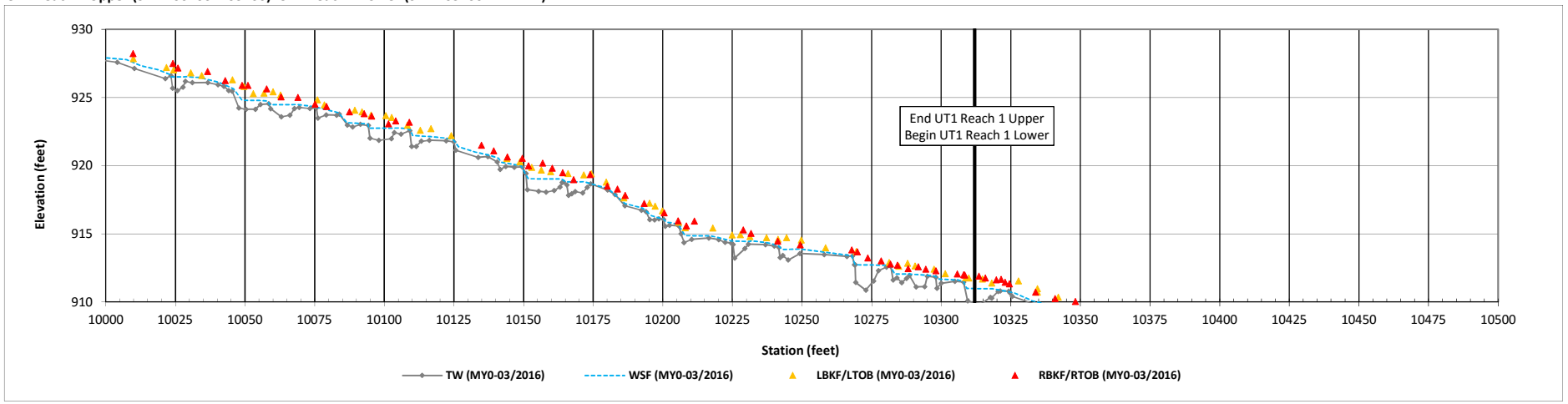
Monitoring Year 0 - 2016

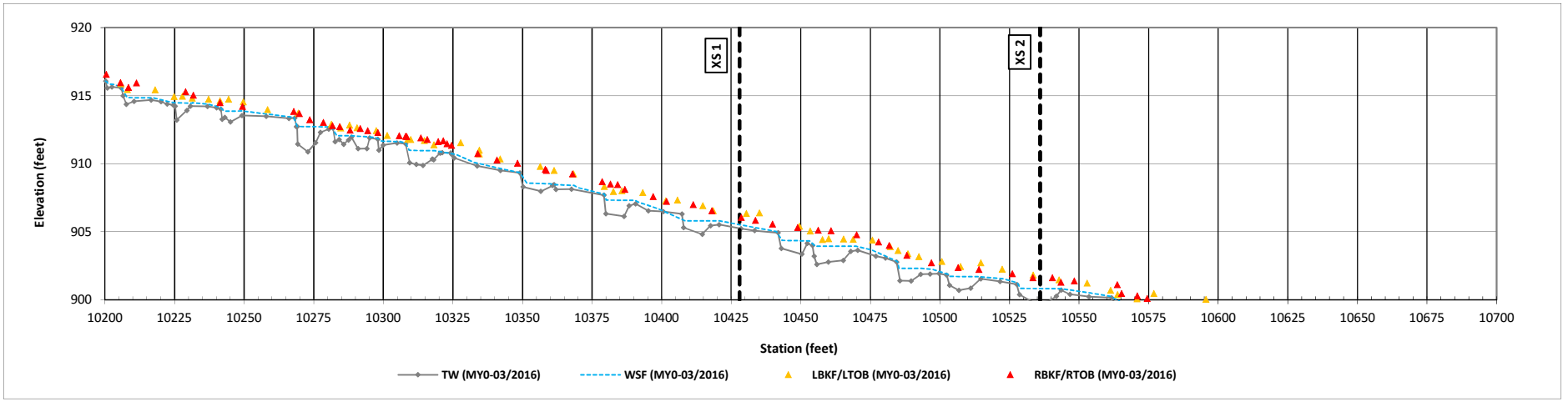
	Cross-Section 7, UT1A (Pool)						Cross-Section 8, UT1A (Riffle)						Cross-Section 9, UT1B (Pool)						Cross-Section 10, UT1B (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	874.9						875.0						922.9						922.1					
Bankfull Width (ft)	5.6						6.6						5.5						5.4					
Floodprone Width (ft)	---						31.4						---						37.7					
Bankfull Mean Depth (ft)	0.4						0.4						0.9						0.4					
Bankfull Max Depth (ft)	0.7						0.8						1.4						0.6					
Bankfull Cross-Sectional Area (ft^2)	2.0						2.5						5.0						2.2					
Bankfull Width/Depth Ratio	---						17.0						---						13.2					
Bankfull Entrenchment Ratio	---						4.8						---						6.9					
Bankfull Bank Height Ratio	---						1.0						---						1.0					
	Cross-Section 11, UT2 (Pool)						**Cross-Section 12, UT2 (Riffle)**						**Cross-Section 13, UT2 (Pool)**						**Cross-Section 14, UT2 (Riffle)**					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	876.0						876.0						875.1						875.2					
Bankfull Width (ft)	8.5						5.1						7.8						7.4					
Floodprone Width (ft)	---						81.3						---						149.8+					
Bankfull Mean Depth (ft)	1.0						1.0						1.1						0.6					
Bankfull Max Depth (ft)	1.9						1.4						1.9						1.0					
Bankfull Cross-Sectional Area (ft^2)	8.4						5.1						8.8						4.2					
Bankfull Width/Depth Ratio	---						5.1						---						12.9					
Bankfull Entrenchment Ratio	---						15.9						---						20.2					
Bankfull Bank Height Ratio	---						1.09						---						1.09					

Longitudinal Profile Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

UT1 Reach 1 Upper (STA 100+00 -103+00) UT1 Reach 1 Lower (STA 103+00 - 114+71)

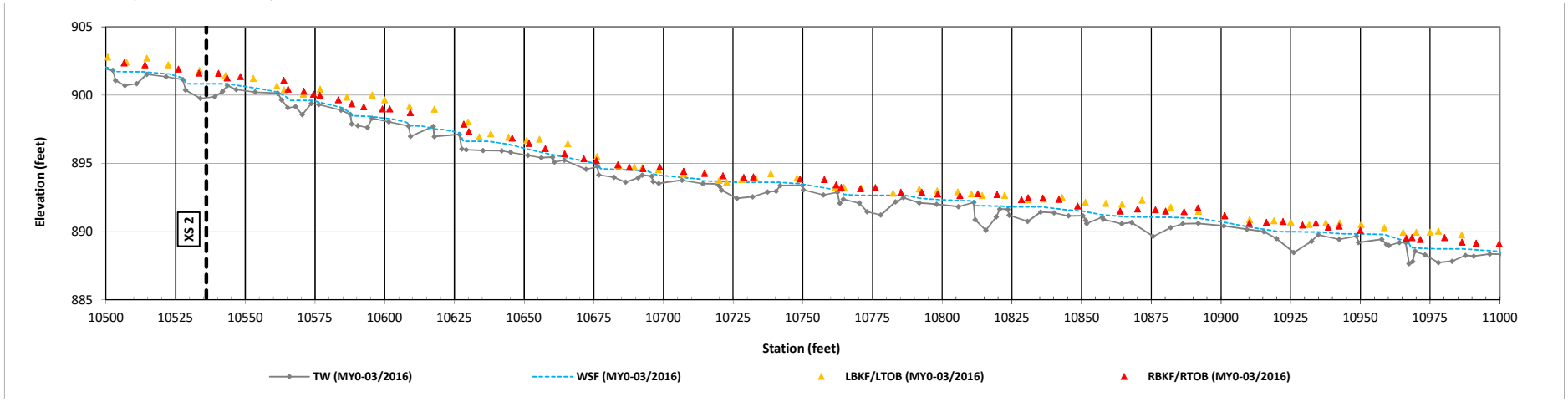


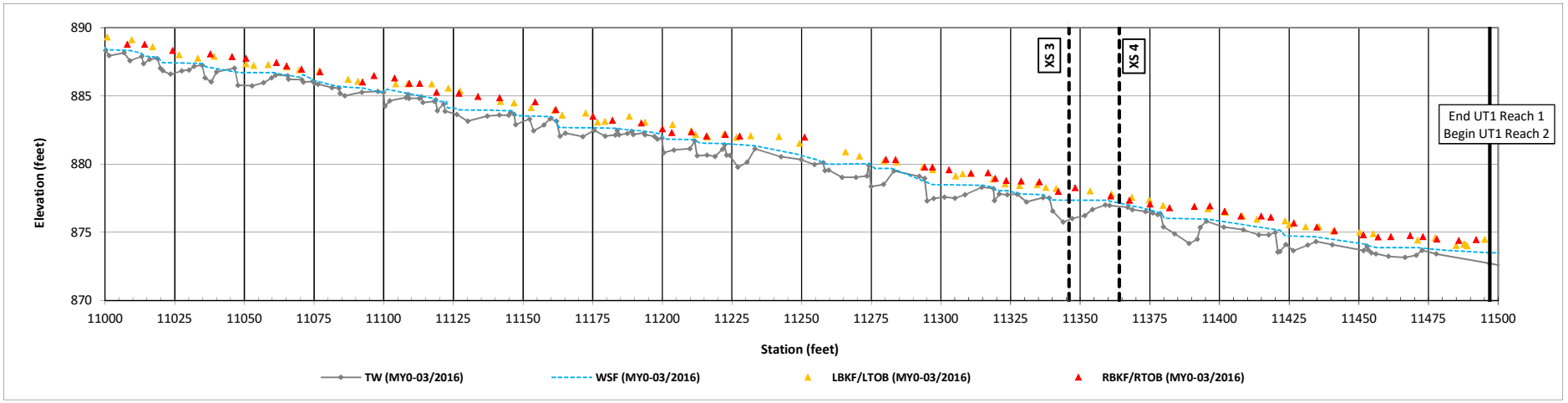


Longitudinal Profile Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

UT1 Reach 1 Lower (STA 103+00 - 114+71)





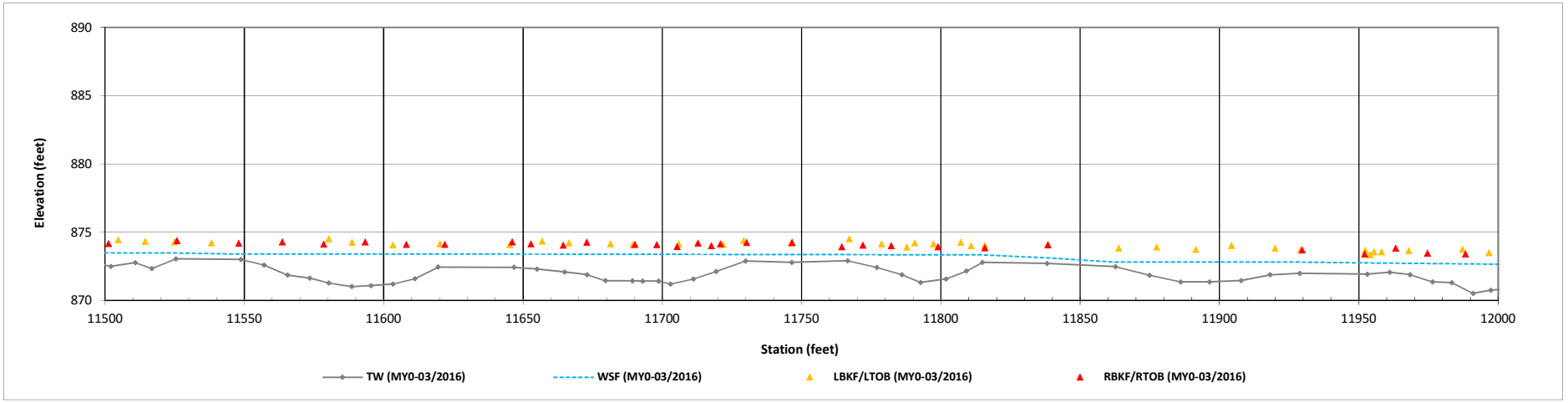
Longitudinal Profile Plots

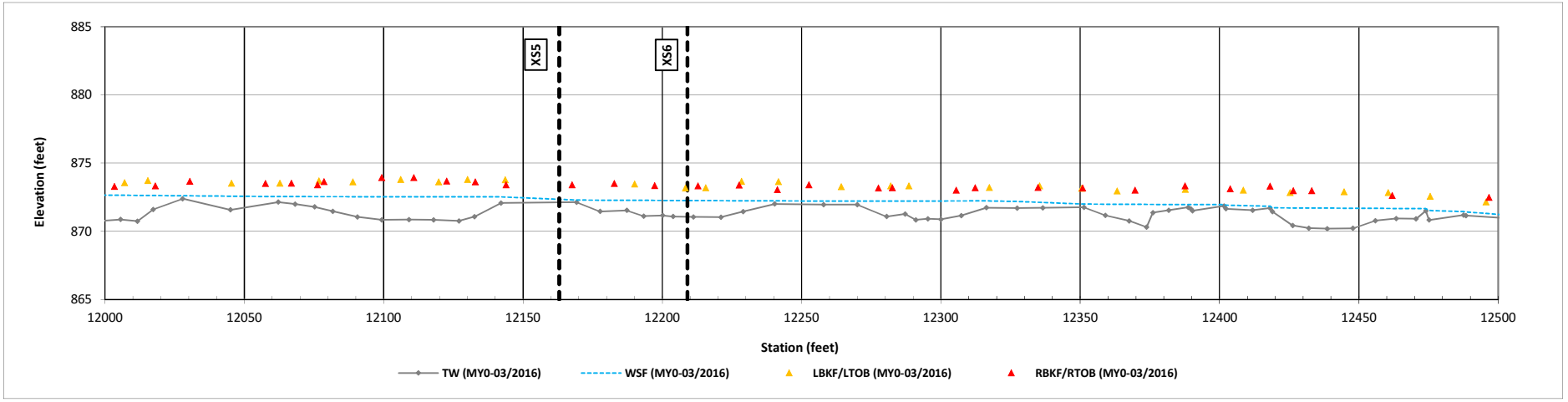
Henry Fork Mitigation Site

DMS Project No. 96306

Monitoring Year 0 - 2016

UT1 Reach 2 (STA 114+71 - 127+29)

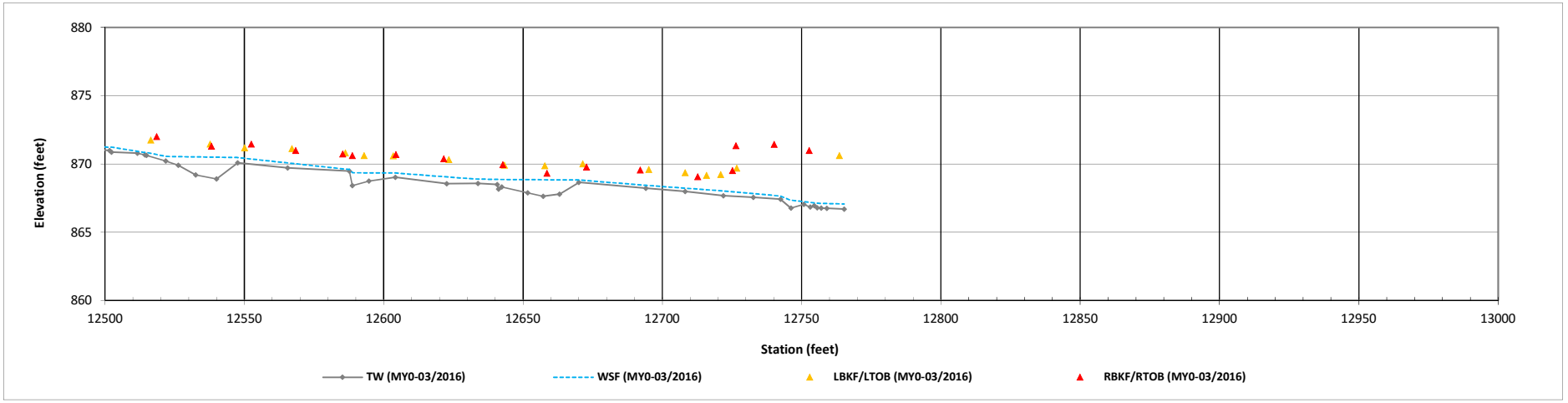




Longitudinal Profile Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

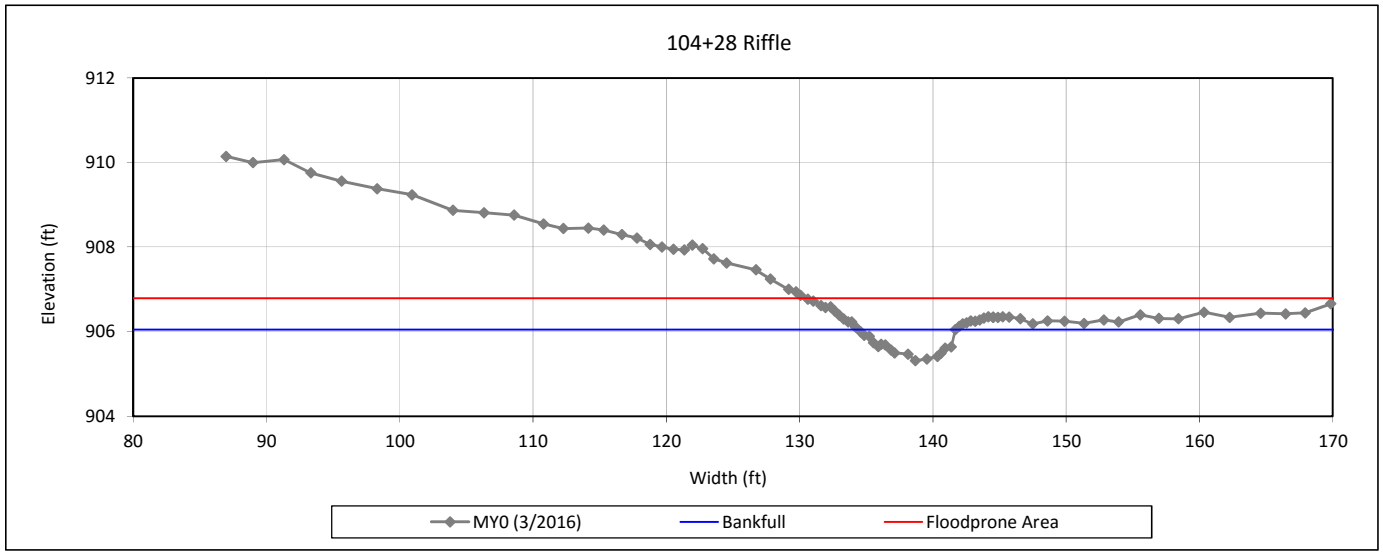
UT1 Reach 2 (STA 114+71 - 127+29)



Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 1-UT1 R1



Bankfull Dimensions	
3.5	x-section area (ft.sq.)
7.3	width (ft)
0.5	mean depth (ft)
0.7	max depth (ft)
7.6	wetted perimeter (ft)
0.5	hydraulic radius (ft)
15.4	width-depth ratio
51.3	W flood prone area (ft)
7.0	entrenchment ratio
1.0	low bank height ratio

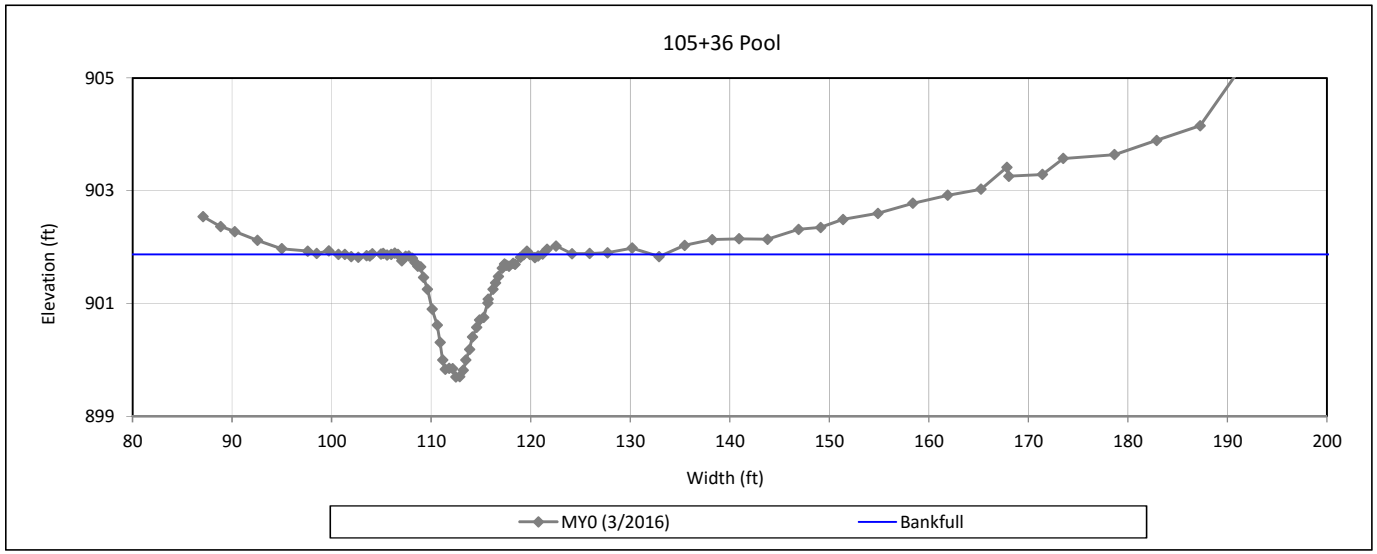
Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 2-UT1 R1



Bankfull Dimensions	
10.7	x-section area (ft.sq.)
8.8	width (ft)
1.2	mean depth (ft)
2.2	max depth (ft)
9.9	wetted perimeter (ft)
1.1	hydraulic radius (ft)
7.2	width-depth ratio

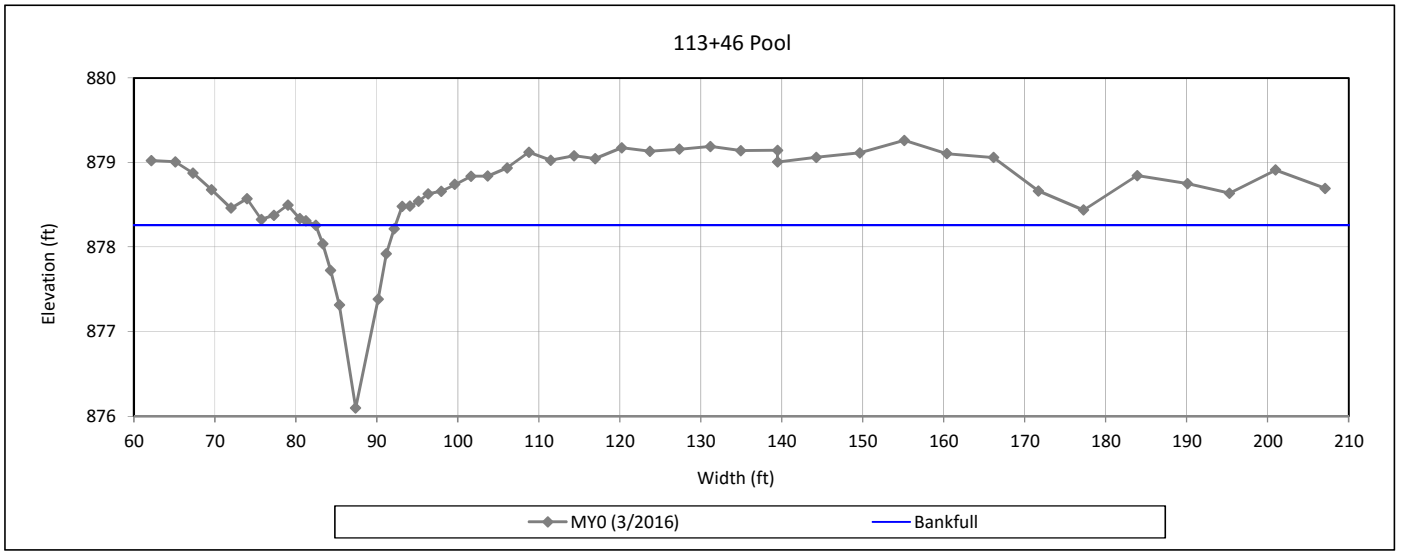
Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 3-UT1 R1



Bankfull Dimensions	
9.1	x-section area (ft.sq.)
7.8	width (ft)
1.2	mean depth (ft)
2.2	max depth (ft)
8.7	wetted perimeter (ft)
1.0	hydraulic radius (ft)
6.7	width-depth ratio

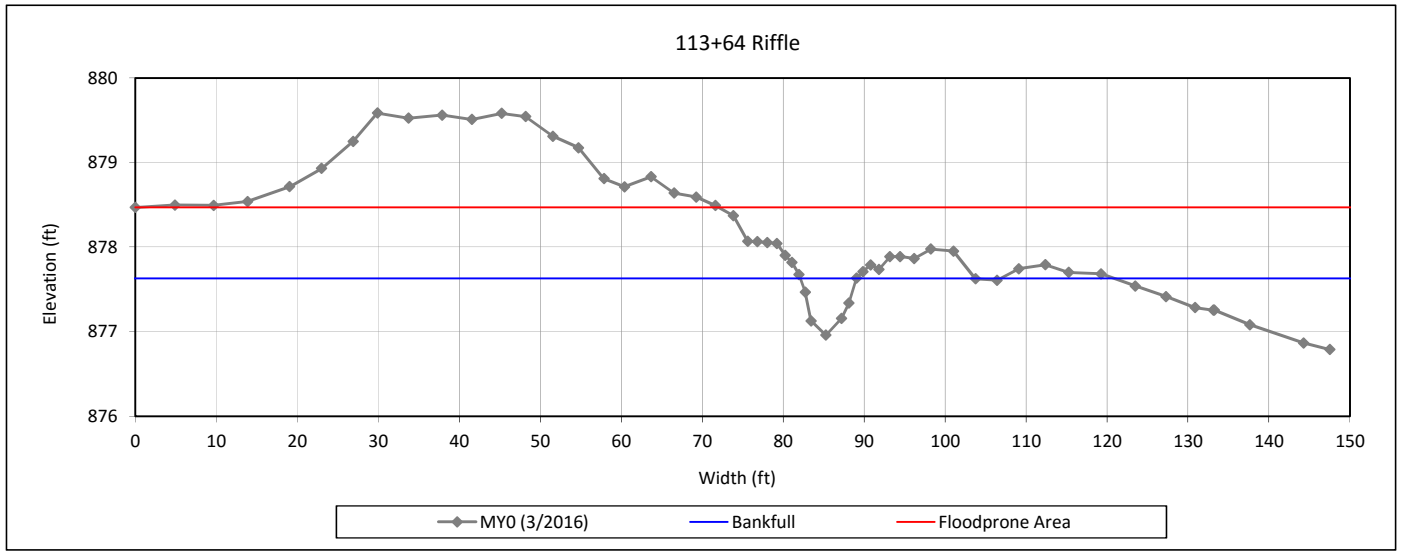
Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 4-UT1 R1



Bankfull Dimensions	
2.9	x-section area (ft.sq.)
6.9	width (ft)
0.4	mean depth (ft)
0.8	max depth (ft)
7.1	wetted perimeter (ft)
0.4	hydraulic radius (ft)
16.2	width-depth ratio
118.3+	W flood prone area (ft)
17.1+	entrenchment ratio
1.0	low bank height ratio

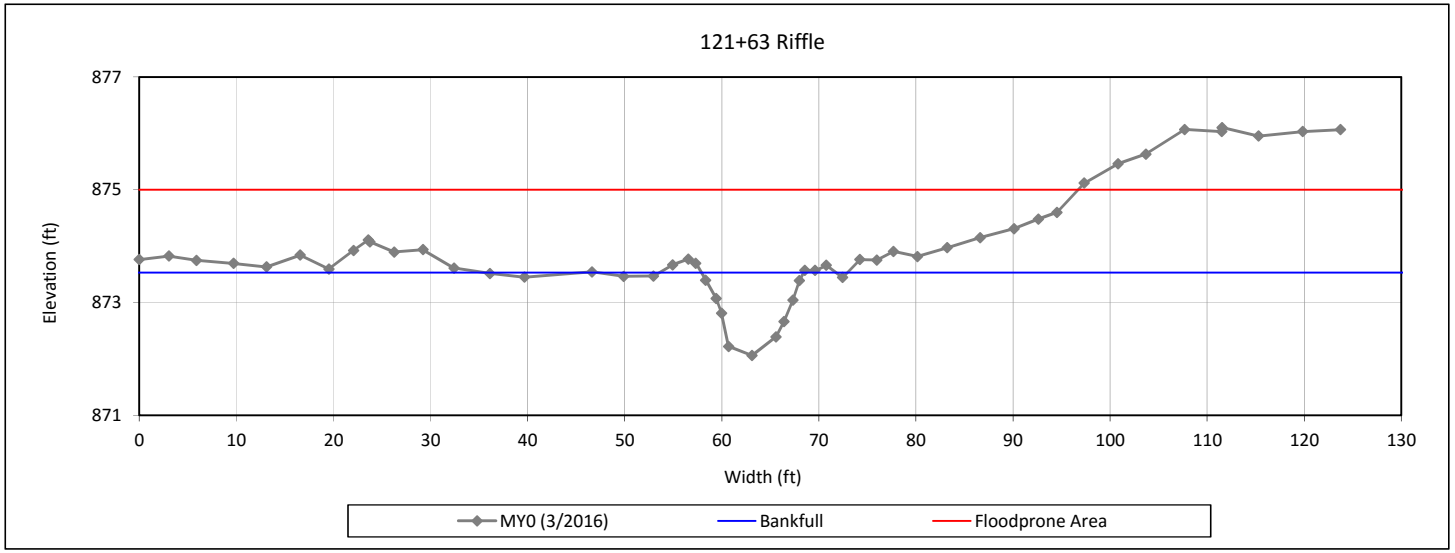
Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 5-UT1 R2



Bankfull Dimensions	
9.7	x-section area (ft.sq.)
10.5	width (ft)
0.9	mean depth (ft)
1.5	max depth (ft)
11.1	wetted perimeter (ft)
0.9	hydraulic radius (ft)
11.4	width-depth ratio
96.7+	W flood prone area (ft)
9.2+	entrenchment ratio
1.0	low bank height ratio

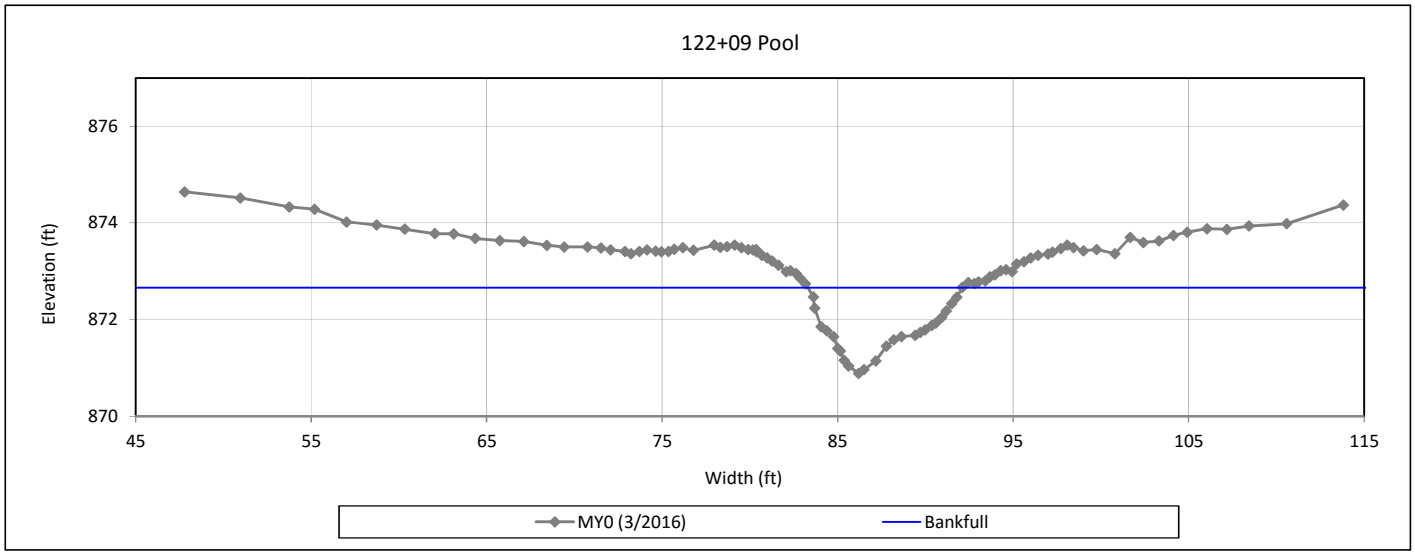
Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 6-UT1 R2



Bankfull Dimensions	
8.8	x-section area (ft.sq.)
8.8	width (ft)
1.0	mean depth (ft)
1.8	max depth (ft)
9.8	wetted perimeter (ft)
0.9	hydraulic radius (ft)
8.7	width-depth ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Reachwide and Cross Section Pebble Count Plots

Henry Fork Stream Mitigation

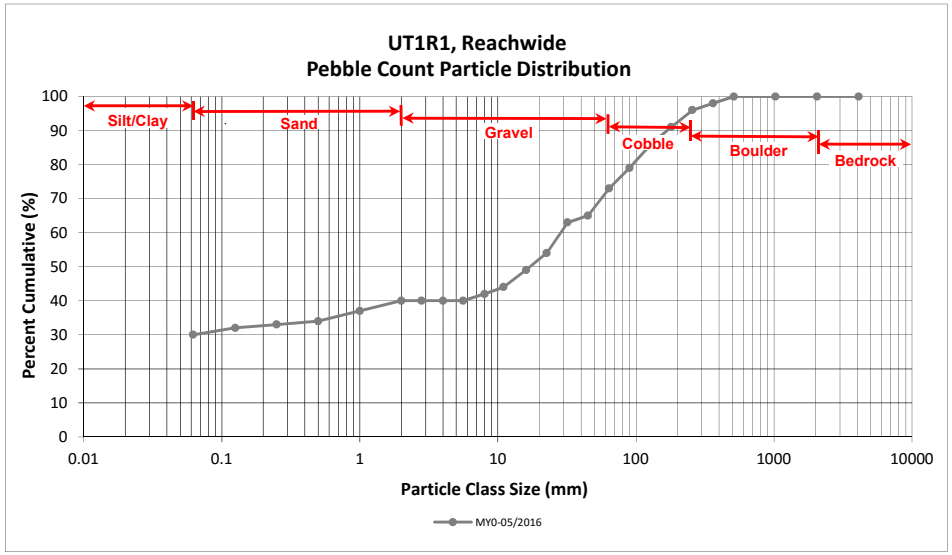
DMS Project No. 96306

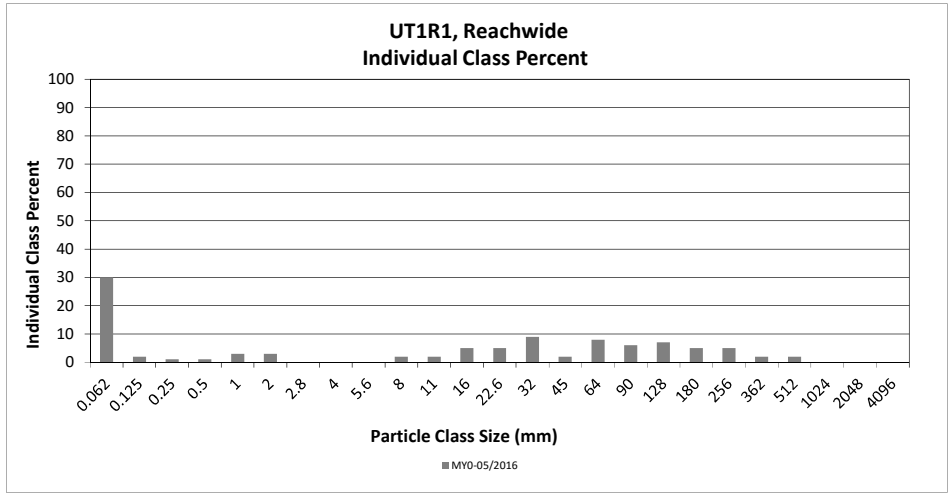
Monitoring Year 0 - 2016

UT1R1, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	3	27	30	30	30
SAND	Very fine	0.062	0.125		2	2	2	32
	Fine	0.125	0.250		1	1	1	33
	Medium	0.25	0.50		1	1	1	34
	Coarse	0.5	1.0	3		3	3	37
	Very Coarse	1.0	2.0		3	3	3	40
GRAVEL	Very Fine	2.0	2.8					40
	Very Fine	2.8	4.0					40
	Fine	4.0	5.6					40
	Fine	5.6	8.0		2	2	2	42
	Medium	8.0	11.0	2		2	2	44
	Medium	11.0	16.0	2	3	5	5	49
	Coarse	16.0	22.6	1	4	5	5	54
	Coarse	22.6	32	8	1	9	9	63
	Very Coarse	32	45	2		2	2	65
	Very Coarse	45	64	7	1	8	8	73
COBBLE	Small	64	90	5	1	6	6	79
	Small	90	128	4	3	7	7	86
	Large	128	180	4	1	5	5	91
	Large	180	256	5		5	5	96
BOULDER	Small	256	362	2		2	2	98
	Small	362	512	2		2	2	100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.63
D_{50} =	17.1
D_{84} =	115.7
D_{95} =	238.6
D_{100} =	512.0





Reachwide and Cross Section Pebble Count Plots

Henry Fork Stream Mitigation

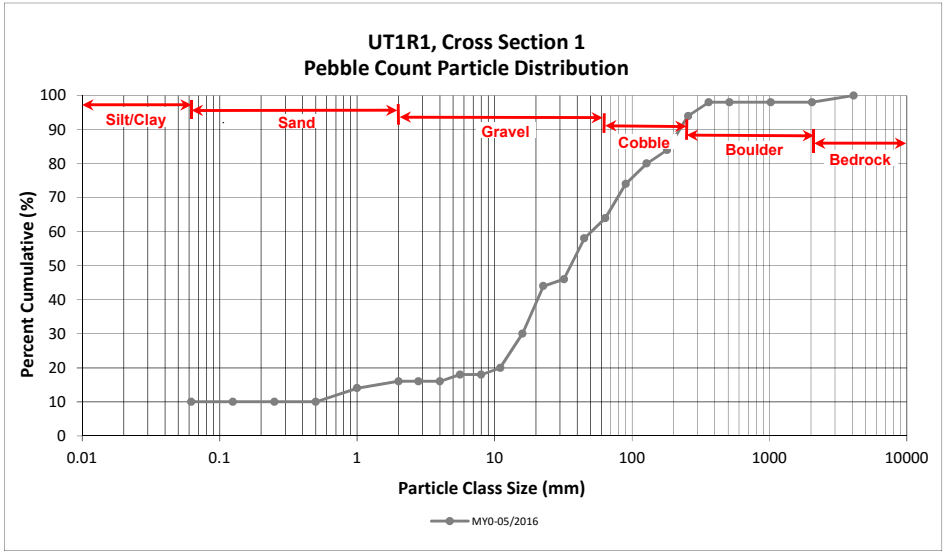
DMS Project No. 96306

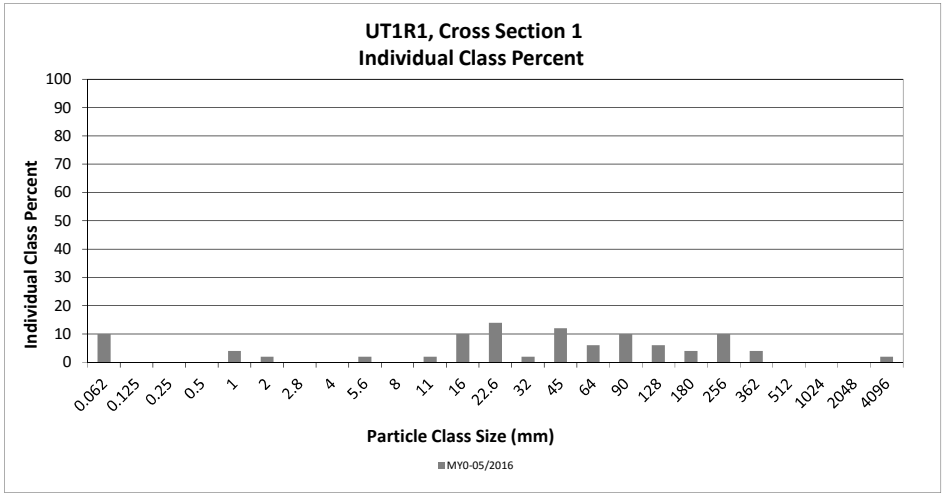
Monitoring Year 0 - 2016

UT1R1, Cross Section 1

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	10	10	10
SAND	Very fine	0.062	0.125			10
	Fine	0.125	0.250			10
	Medium	0.25	0.50			10
	Coarse	0.5	1.0	4	4	14
	Very Coarse	1.0	2.0	2	2	16
GRAVEL	Very Fine	2.0	2.8			16
	Very Fine	2.8	4.0			16
	Fine	4.0	5.6	2	2	18
	Fine	5.6	8.0			18
	Medium	8.0	11.0	2	2	20
	Medium	11.0	16.0	10	10	30
	Coarse	16.0	22.6	14	14	44
	Coarse	22.6	32	2	2	46
	Very Coarse	32	45	12	12	58
	Very Coarse	45	64	6	6	64
COBBLE	Small	64	90	10	10	74
	Small	90	128	6	6	80
	Large	128	180	4	4	84
	Large	180	256	10	10	94
BOULDER	Small	256	362	4	4	98
	Small	362	512			98
	Medium	512	1024			98
	Large/Very Large	1024	2048			98
BEDROCK	Bedrock	2048	>2048	2	2	100
			Total	**100**	**100**	**100**

Cross Section	
Channel materials (mm)	
D_{16} =	2.00
D_{35} =	18.10
D_{50} =	35.9
D_{84} =	180.0
D_{95} =	279.2
D_{100} =	>2048





Reachwide and Cross Section Pebble Count Plots

Henry Fork Stream Mitigation

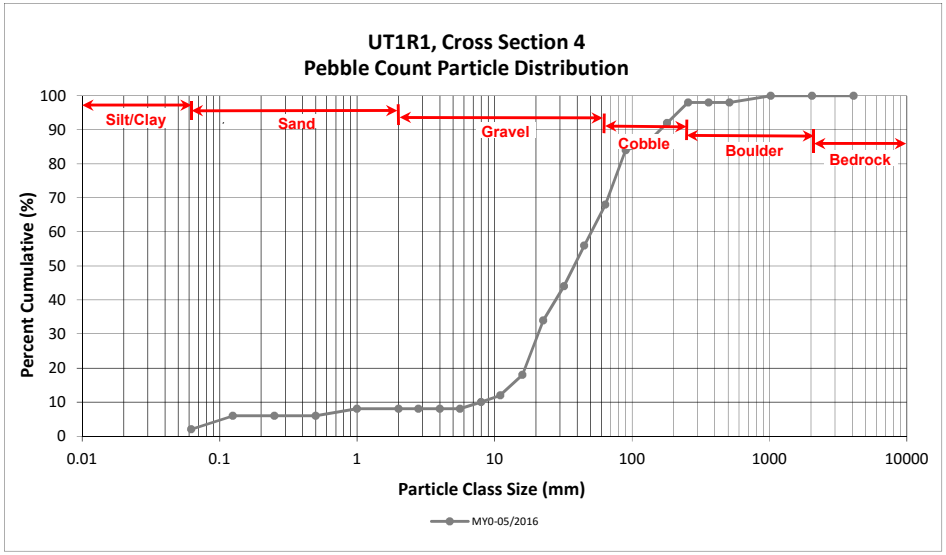
DMS Project No. 96306

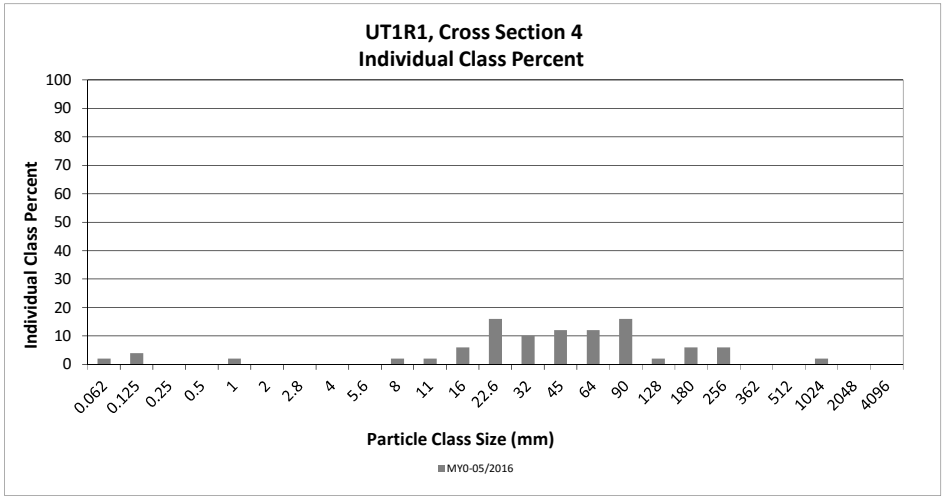
Monitoring Year 0 - 2016

UT1R1, Cross Section 4

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	2	2	2
SAND	Very fine	0.062	0.125	4	4	6
	Fine	0.125	0.250			6
	Medium	0.25	0.50			6
	Coarse	0.5	1.0	2	2	8
	Very Coarse	1.0	2.0			8
GRAVEL	Very Fine	2.0	2.8			8
	Very Fine	2.8	4.0			8
	Fine	4.0	5.6			8
	Fine	5.6	8.0	2	2	10
	Medium	8.0	11.0	2	2	12
	Medium	11.0	16.0	6	6	18
	Coarse	16.0	22.6	16	16	34
	Coarse	22.6	32	10	10	44
	Very Coarse	32	45	12	12	56
	Very Coarse	45	64	12	12	68
COBBLE	Small	64	90	16	16	84
	Small	90	128	2	2	86
	Large	128	180	6	6	92
	Large	180	256	6	6	98
BOULDER	Small	256	362			98
	Small	362	512			98
	Medium	512	1024	2	2	100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 4	
Channel materials (mm)	
D_{16} =	14.12
D_{35} =	23.40
D_{50} =	37.9
D_{84} =	90.0
D_{95} =	214.7
D_{100} =	1024.0

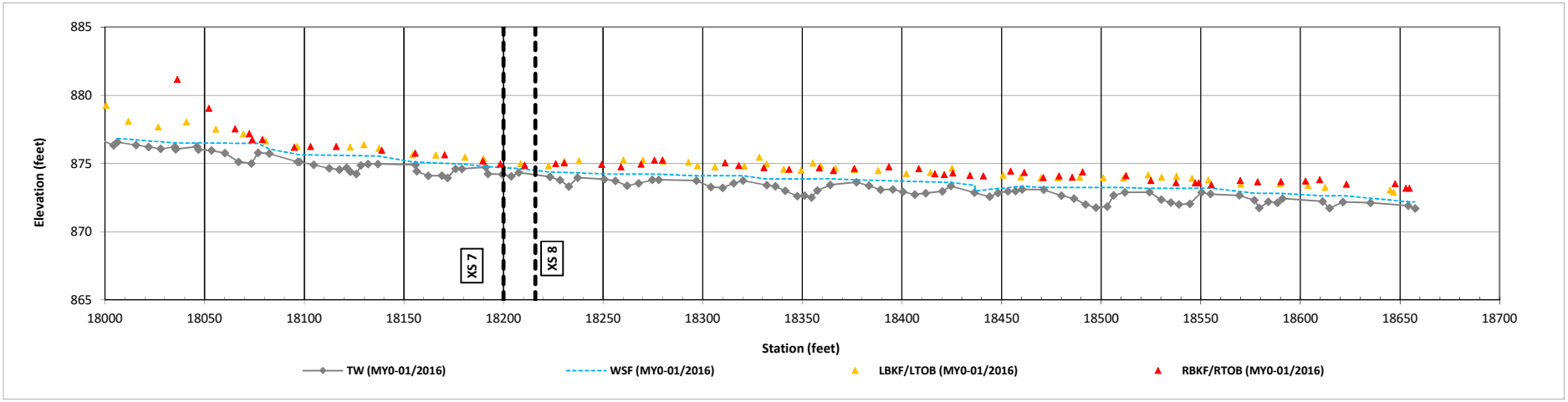




Longitudinal Profile Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

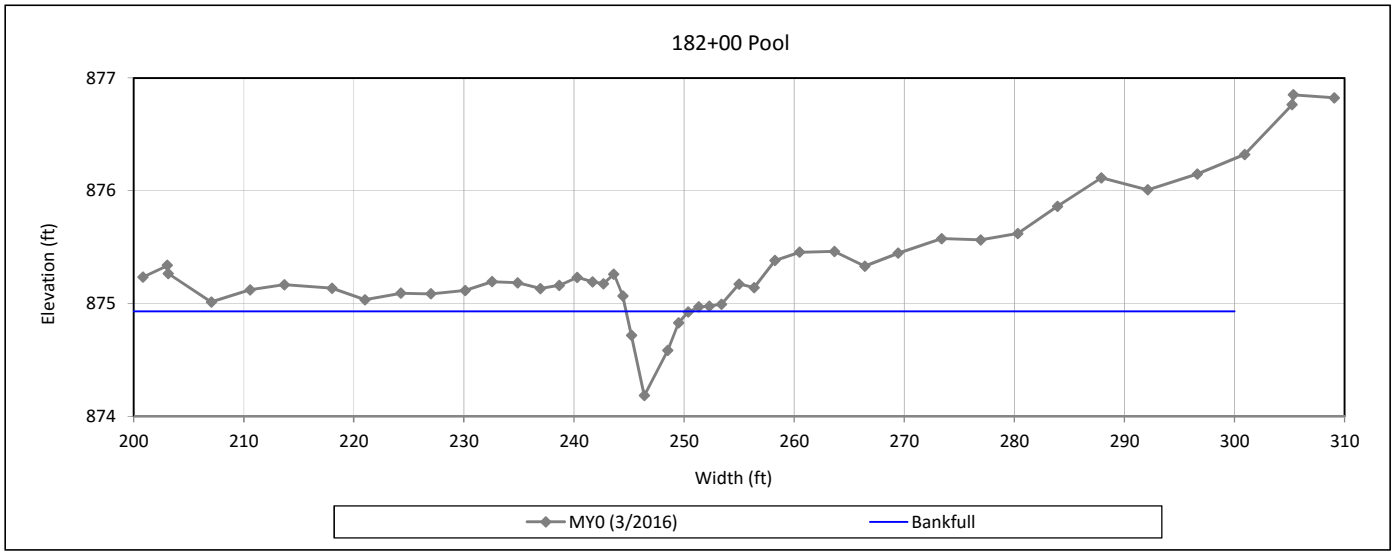
UT1A (STA 180+00 - 186+58)



Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 7-UT1A



Bankfull Dimensions	
2.0	x-section area (ft.sq.)
5.6	width (ft)
0.4	mean depth (ft)
0.7	max depth (ft)
5.9	wetted perimeter (ft)
0.3	hydraulic radius (ft)
15.6	width-depth ratio

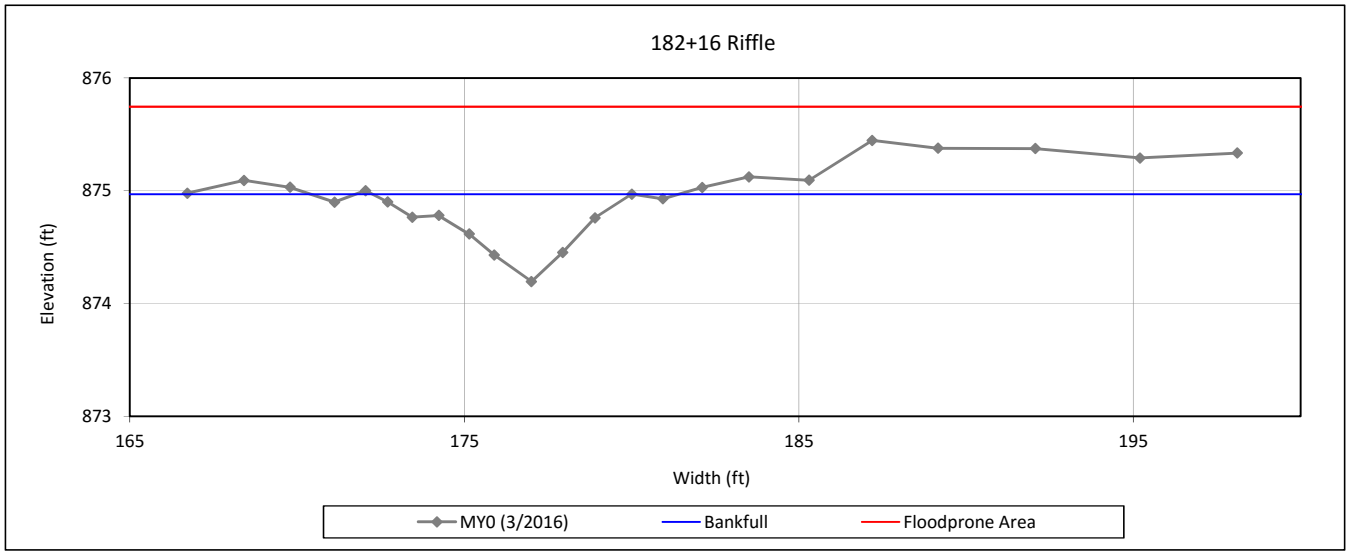
Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 8-UT1A



Bankfull Dimensions	
2.5	x-section area (ft.sq.)
6.6	width (ft)
0.4	mean depth (ft)
0.8	max depth (ft)
6.7	wetted perimeter (ft)
0.4	hydraulic radius (ft)
17.0	width-depth ratio
31.4	W flood prone area (ft)
4.8	entrenchment ratio
1.0	low bank height ratio

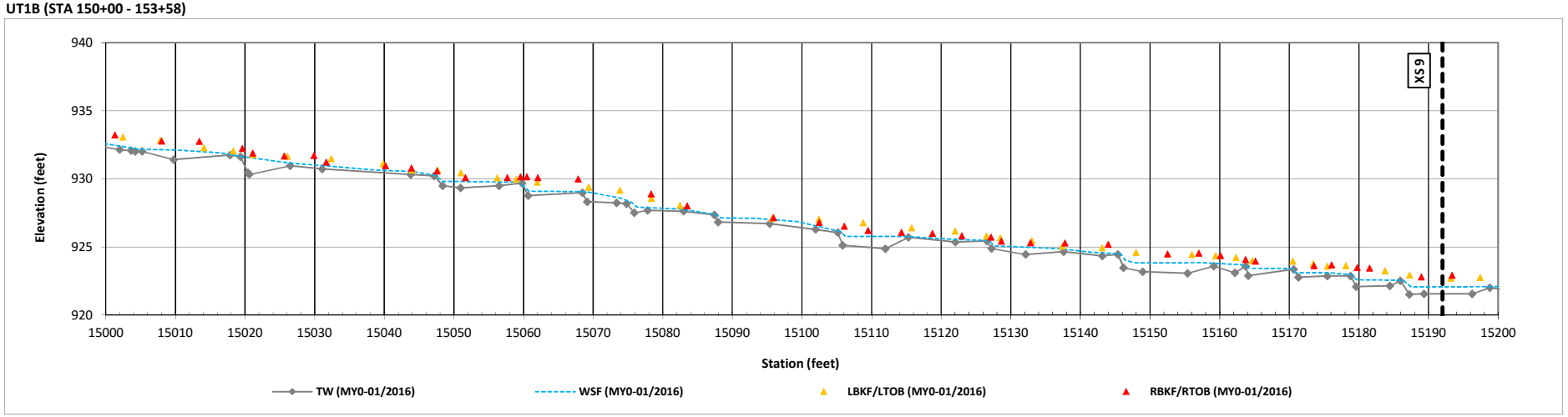
Survey Date: 3/2016
Field Crew: Kee Surveying

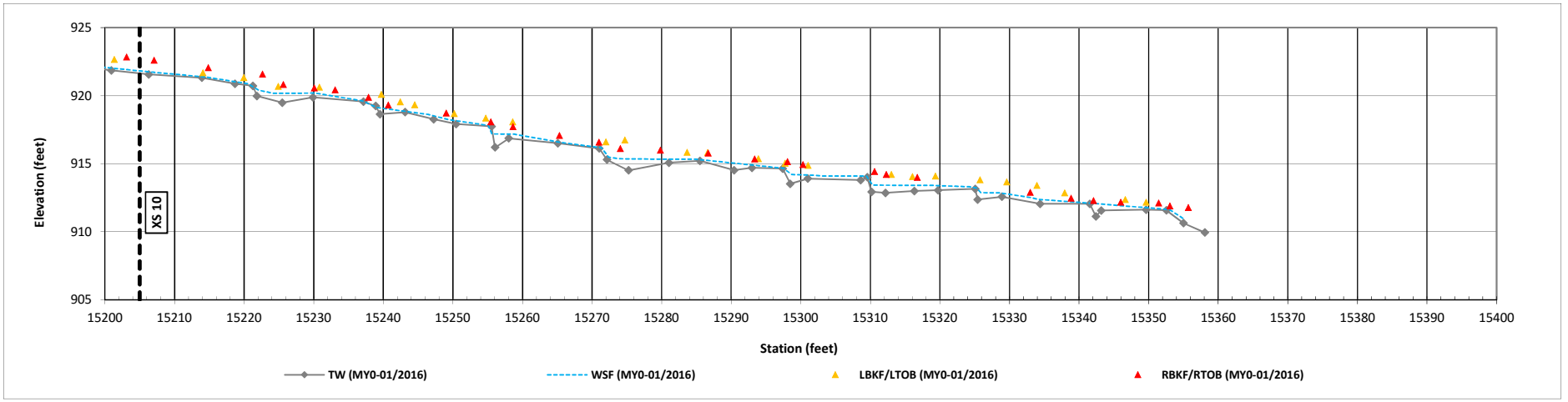
View Downstream (5/6/2016)

Longitudinal Profile Plots

Henry Fork Mitigatin Site
DMS Project No. 96306
Monitoring Year 0 - 2016

UT1B (STA 150+00 - 153+58)

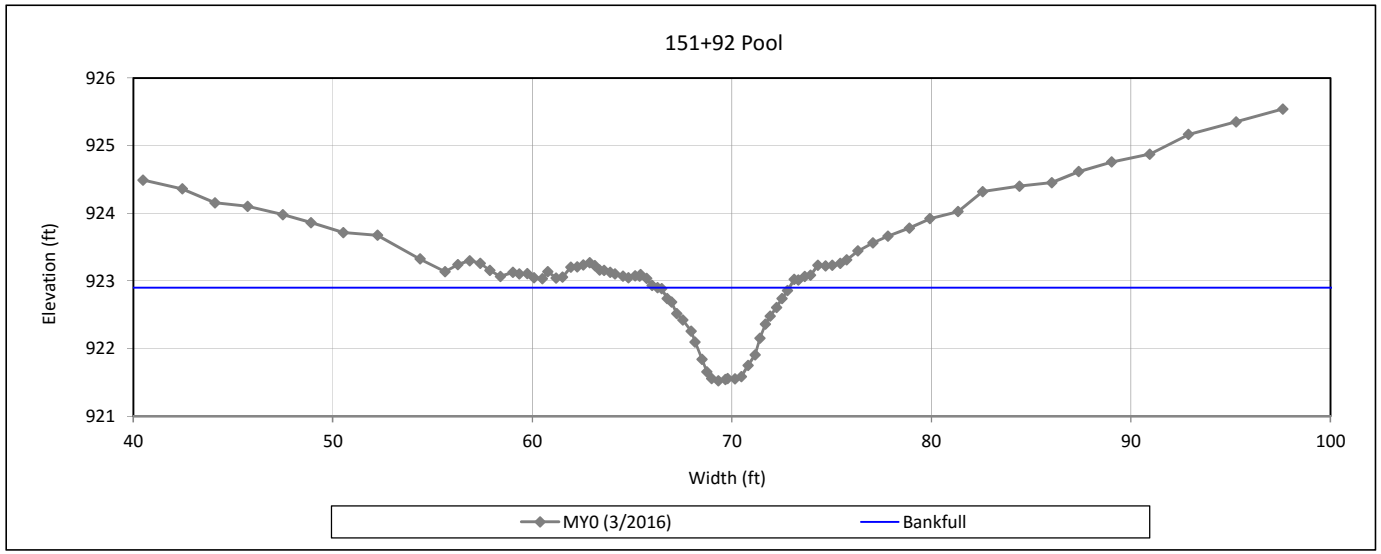




Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 9-UT1B



Bankfull Dimensions	
5.0	x-section area (ft.sq.)
5.5	width (ft)
0.9	mean depth (ft)
1.4	max depth (ft)
6.1	wetted perimeter (ft)
0.8	hydraulic radius (ft)
6.1	width-depth ratio

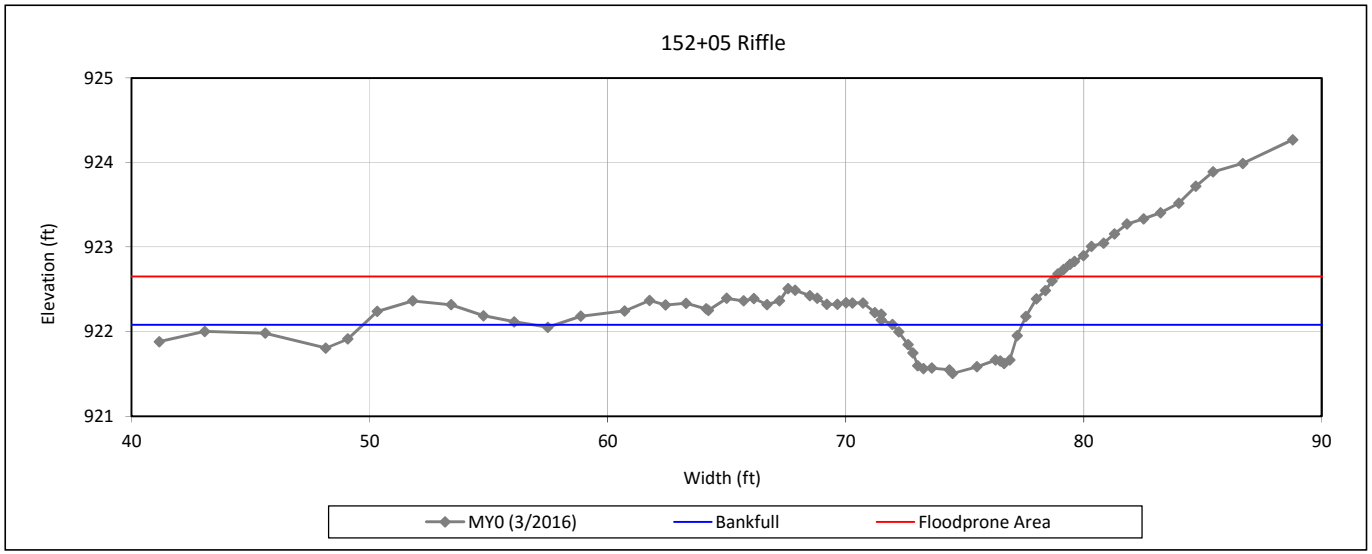
Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 10-UT1B



Bankfull Dimensions	
2.2	x-section area (ft.sq.)
5.4	width (ft)
0.4	mean depth (ft)
0.6	max depth (ft)
5.7	wetted perimeter (ft)
0.4	hydraulic radius (ft)
13.2	width-depth ratio
37.7	W flood prone area (ft)
6.9	entrenchment ratio
1.0	low bank height ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Reachwide and Cross Section Pebble Count Plots

Henry Fork Stream Mitigation

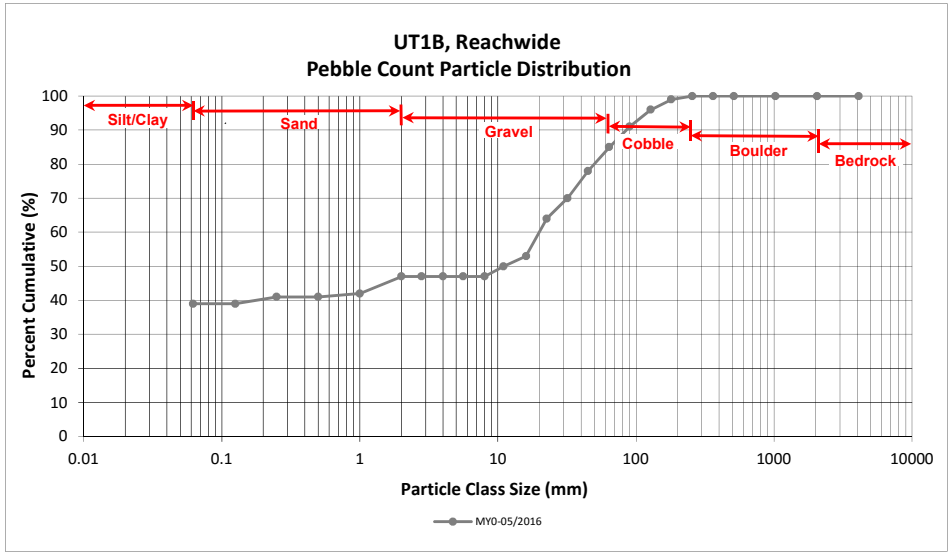
DMS Project No. 96306

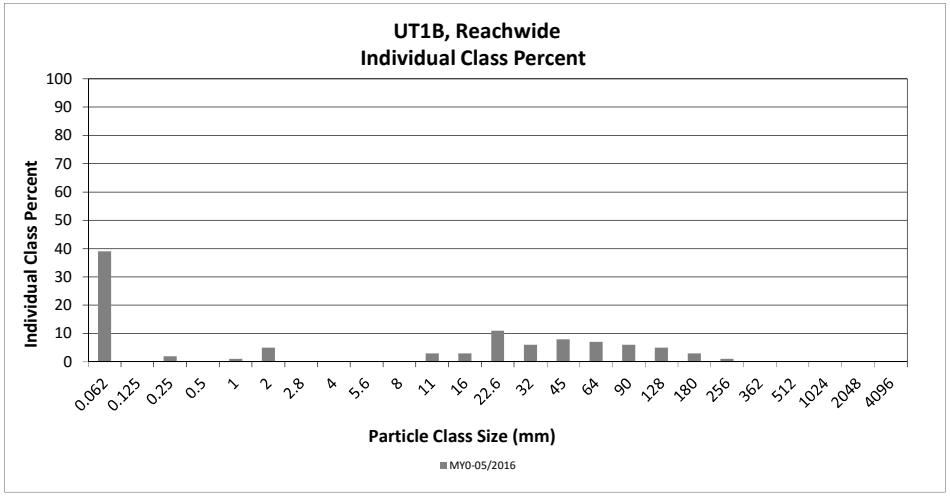
Monitoring Year 0 - 2016

UT1B, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	8	31	39	39	39
SAND	Very fine	0.062	0.125					39
	Fine	0.125	0.250	1	1	2	2	41
	Medium	0.25	0.50					41
	Coarse	0.5	1.0		1	1	1	42
	Very Coarse	1.0	2.0	3	2	5	5	47
GRAVEL	Very Fine	2.0	2.8					47
	Very Fine	2.8	4.0					47
	Fine	4.0	5.6					47
	Fine	5.6	8.0					47
	Medium	8.0	11.0	1	2	3	3	50
	Medium	11.0	16.0	2	1	3	3	53
	Coarse	16.0	22.6	3	8	11	11	64
	Coarse	22.6	32	4	2	6	6	70
	Very Coarse	32	45	7	1	8	8	78
	Very Coarse	45	64	7		7	7	85
COBBLE	Small	64	90	5	1	6	6	91
	Small	90	128	5		5	5	96
	Large	128	180	3		3	3	99
	Large	180	256	1		1	1	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	Silt/Clay
D_{50} =	11.0
D_{84} =	60.9
D_{95} =	119.3
D_{100} =	256.0





Reachwide and Cross Section Pebble Count Plots

Henry Fork Stream Mitigation

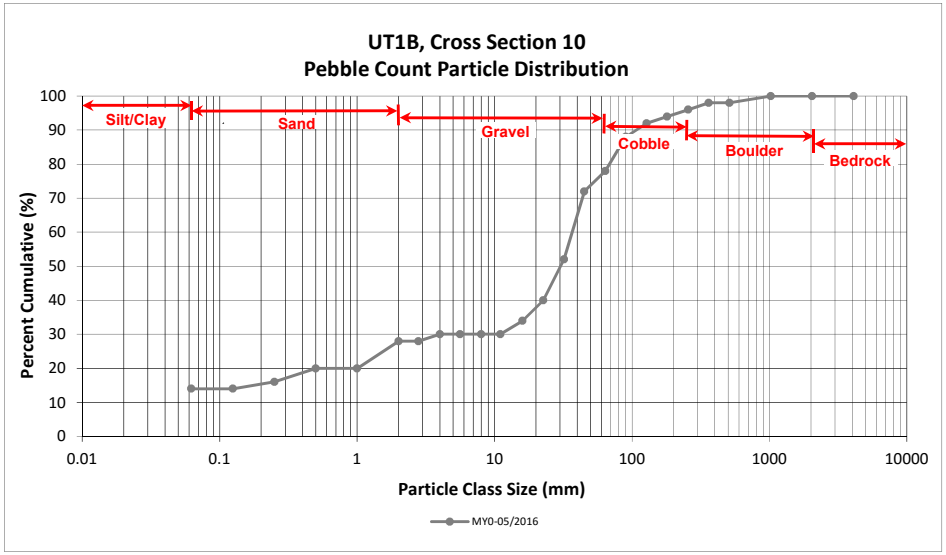
DMS Project No. 96306

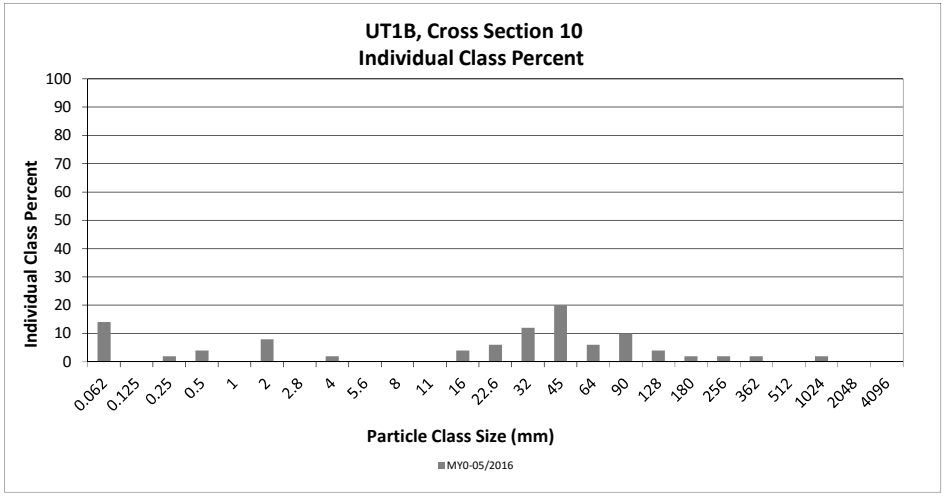
Monitoring Year 0 - 2016

UT1B, Cross Section 10

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	14	14	14
SAND	Very fine	0.062	0.125			14
	Fine	0.125	0.250	2	2	16
	Medium	0.25	0.50	4	4	20
	Coarse	0.5	1.0			20
	Very Coarse	1.0	2.0	8	8	28
GRAVEL	Very Fine	2.0	2.8			28
	Very Fine	2.8	4.0	2	2	30
	Fine	4.0	5.6			30
	Fine	5.6	8.0			30
	Medium	8.0	11.0			30
	Medium	11.0	16.0	4	4	34
	Coarse	16.0	22.6	6	6	40
	Coarse	22.6	32	12	12	52
	Very Coarse	32	45	20	20	72
	Very Coarse	45	64	6	6	78
COBBLE	Small	64	90	10	10	88
	Small	90	128	4	4	92
	Large	128	180	2	2	94
	Large	180	256	2	2	96
BOULDER	Small	256	362	2	2	98
	Small	362	512			98
	Medium	512	1024	2	2	100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section	
Channel materials (mm)	
D_{16} =	0.25
D_{35} =	16.95
D_{50} =	30.2
D_{84} =	78.5
D_{95} =	214.7
D_{100} =	1024.0

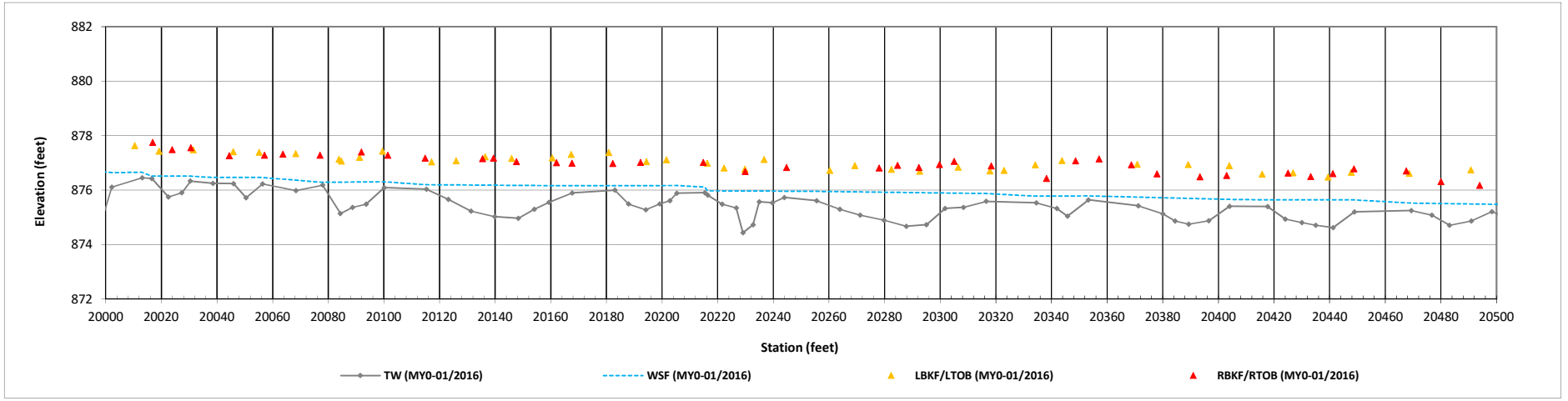


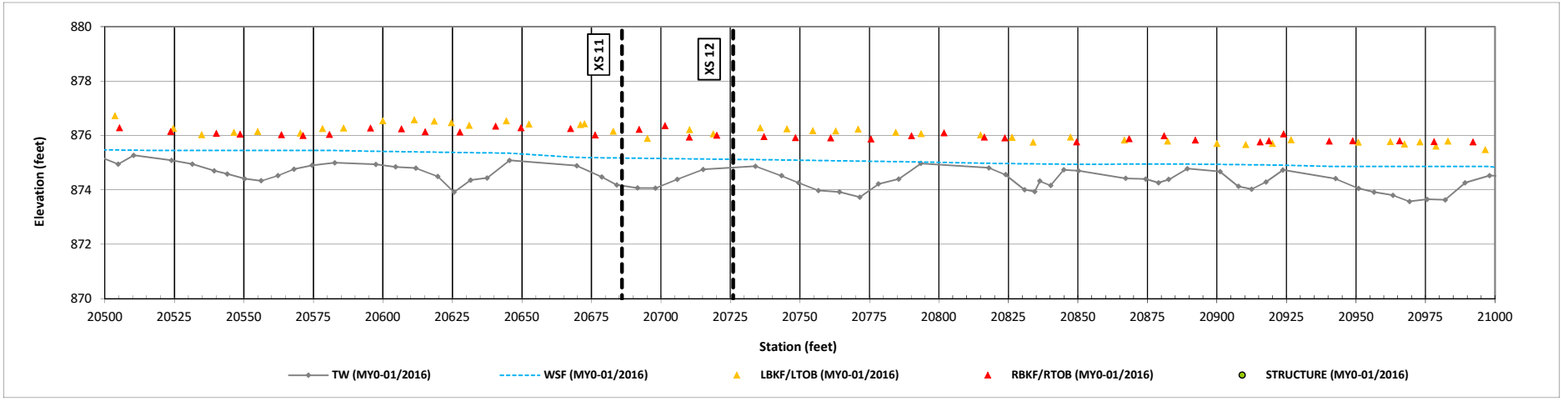


Longitudinal Profile Plots

Henry Fork Stream Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

UT2 (STA 200+00 - 219+69)



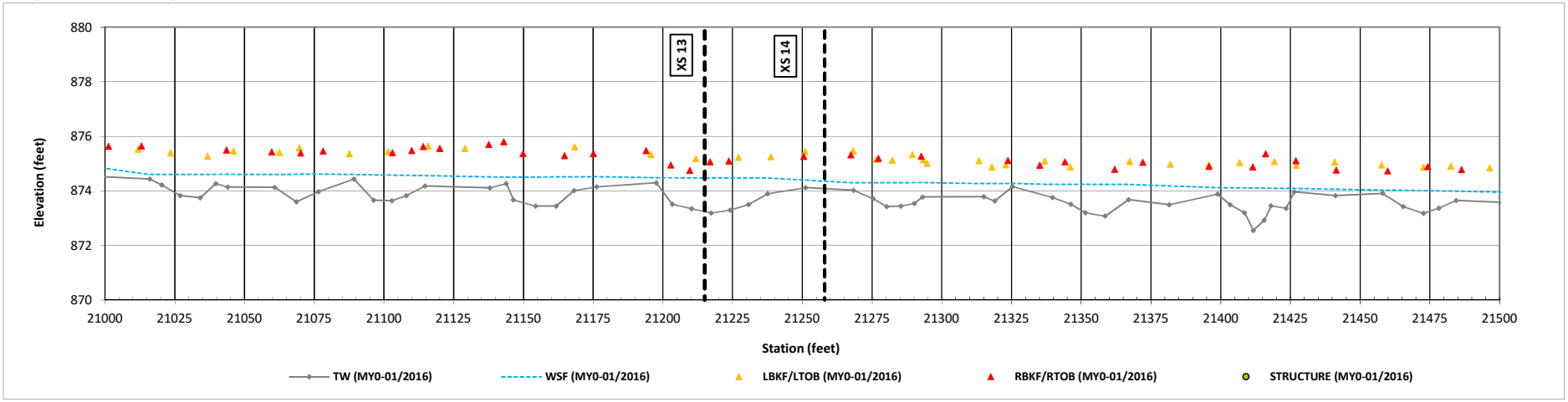


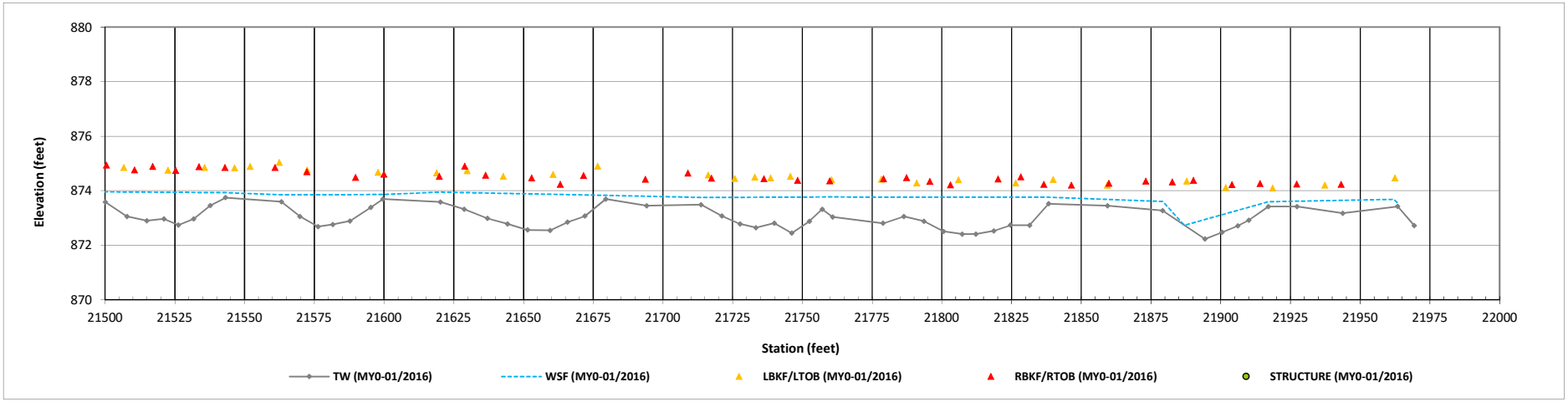
Longitudinal Profile Plots

Henry Fork Stream Mitigatin Site (NCDMS Project No. 96306)

Monitoring Year 0 - 2016

UT2 (STA 200+00 - 219+69)

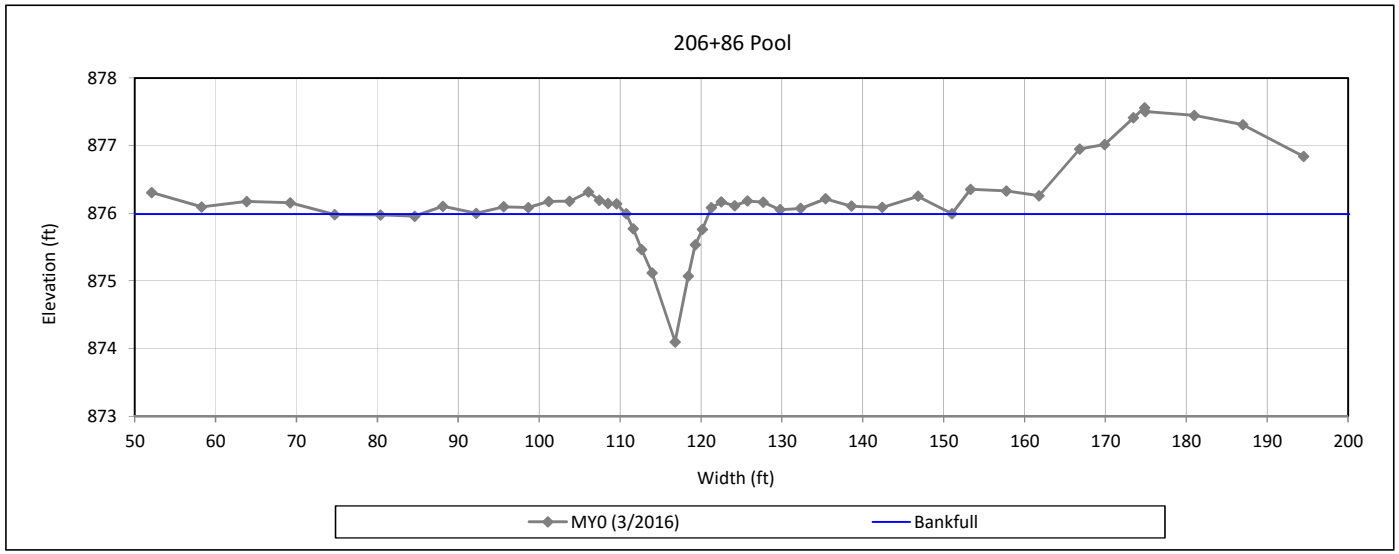




Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 11-UT2



Bankfull Dimensions	
8.4	x-section area (ft.sq.)
8.5	width (ft)
1.0	mean depth (ft)
1.9	max depth (ft)
9.2	wetted perimeter (ft)
0.9	hydraulic radius (ft)
8.7	width-depth ratio

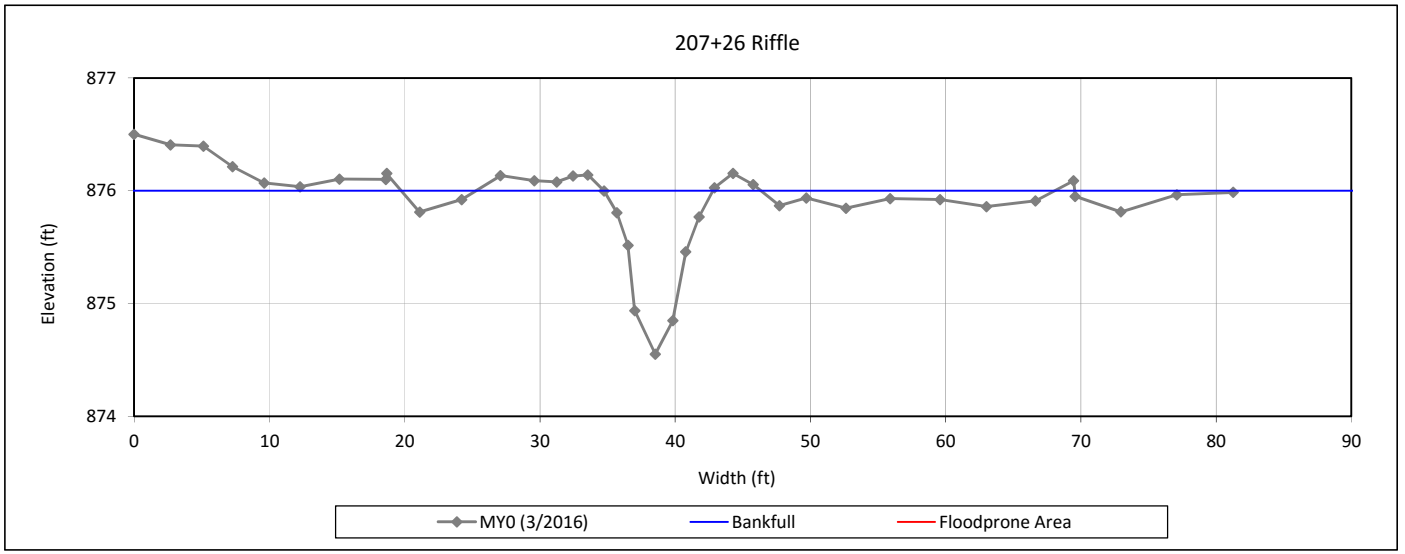
Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 12-UT2



Bankfull Dimensions	
5.1	x-section area (ft.sq.)
5.1	width (ft)
1.0	mean depth (ft)
1.4	max depth (ft)
5.7	wetted perimeter (ft)
0.9	hydraulic radius (ft)
5.1	width-depth ratio
81.3	W flood prone area (ft)
15.9	entrenchment ratio
1.1	low bank height ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

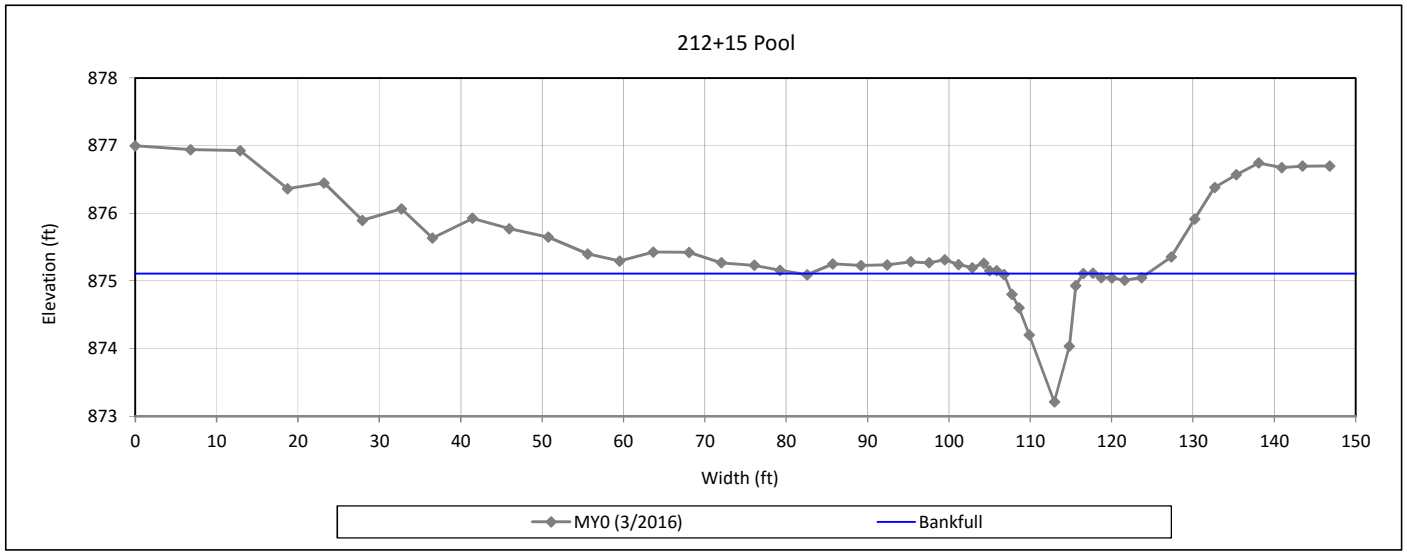
Cross Section Plots

Henry Fork Mitigation Site

DMS Project No. 96306

Monitoring Year 0 - 2016

Cross Section 13-UT2



Bankfull Dimensions	
8.8	x-section area (ft.sq.)
7.8	width (ft)
1.1	mean depth (ft)
1.9	max depth (ft)
8.7	wetted perimeter (ft)
1.0	hydraulic radius (ft)
7.0	width-depth ratio

Survey Date: 3/2016

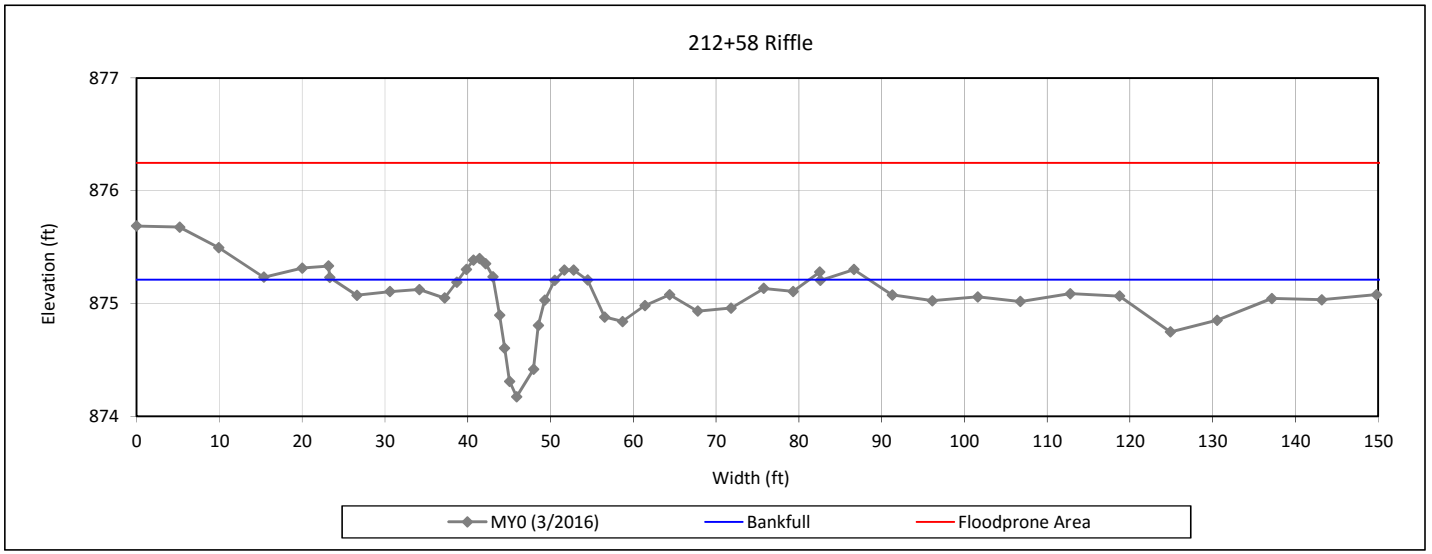
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Cross Section Plots

Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

Cross Section 14-UT2



Bankfull Dimensions	
4.2	x-section area (ft.sq.)
7.4	width (ft)
0.6	mean depth (ft)
1.0	max depth (ft)
7.8	wetted perimeter (ft)
0.5	hydraulic radius (ft)
12.9	width-depth ratio
149.8+	W flood prone area (ft)
20.2	entrenchment ratio
1.09	low bank height ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream (5/6/2016)

Stream Photographs

	
Photo Point 1 – looking upstream UT1B *(03/16/2016)*	**Photo Point 1** – looking downstream UT1B *(03/16/2016)*
	
Photo Point 2 – looking upstream UT1B *(03/16/2016)*	**Photo Point 2** – looking downstream UT1B *(03/16/2016)*
	
Photo Point 3 – looking upstream UT1 R1 Upper *(03/16/2016)*	**Photo Point 3** – looking downstream UT1 R1 Upper (*03/16/2016)*

Photo Point 4 – looking upstream UT1 R1 Upper *(03/16/2016)*

Photo Point 4 – looking downstream UT1 R1 Upper *(03/16/2016)*

Photo Point 5 – looking upstream UT1 R1 Lower *(03/16/2016)*

Photo Point 5 – looking downstream UT1 R1 Lower *(03/16/2016)*

Photo Point 5 – looking upstream of UT1B *(03/16/2016)*

	
Photo Point 6 – looking upstream UT1 R1 Lower *(03/16/2016)*	**Photo Point 6** – looking downstream UT1 R1 Lower *(03/16/2016)*
	
Photo Point 7 – looking upstream UT1 R1 Lower *(03/16/2016)*	**Photo Point 7** – looking downstream UT1 R1 Lower *(03/16/2016)*
	
Photo Point 8 – looking upstream UT1 R1 Lower *(03/16/2016)*	**Photo Point 8** – looking downstream UT1 R1 Lower *(03/16/2016)*

	
Photo Point 9 – looking upstream UT1 R1 Lower *(03/16/2016)*	**Photo Point 9** – looking downstream UT1 R1 Lower *(03/16/2016)*
	
Photo Point 10 – looking upstream UT1 R1 Lower *(03/16/2016)*	**Photo Point 10** –looking downstream UT1 R1 Lower (*03/16/2016)*
	
Photo Point 11 – looking upstream UT1 R1 Lower *(03/16/2016)*	**Photo Point 11** –looking downstream UT1 R1 Lower *(03/16/2016)*

	
Photo Point 12 – looking upstream UT1 R1 Lower *(03/16/2016)*	**Photo Point 12** –looking downstream UT1 R1 Lower *(03/16/2016)*
	
Photo Point 13 – looking upstream UT1 R1 Lower *(03/16/2016)*	**Photo Point 13** –looking downstream UT1 R1 Lower *(03/16/2016)*
	
Photo Point 14 – looking upstream UT1 R2 *(03/16/2016)*	**Photo Point 14** – looking downstream UT1 R2 *(03/16/2016)*

	
Photo Point 15 – looking upstream UT1 R2 *(03/16/2016)*	**Photo Point 15** – looking downstream UT1 R2 *(03/16/2016)*
	
Photo Point 16 – looking upstream UT1 R2 *(03/16/2016)*	**Photo Point 16** – looking downstream UT1 R2 *(03/16/2016)*
	
Photo Point 17 – looking upstream UT1 R2 *(03/16/2016)*	**Photo Point 17** – looking downstream UT1 R2 *(03/16/2016)*

	
Photo Point 18 – looking upstream UT1A *(03/16/2016)*	**Photo Point 18** – looking downstream UT1A *(03/16/2016)*
	
Photo Point 19 – looking upstream UT1A *(03/16/2016)*	**Photo Point 19** – looking downstream UT1A *(03/16/2016)*
	
Photo Point 20 – looking upstream UT2 *(03/16/2016)*	**Photo Point 20** – looking downstream UT2 *(03/16/2016)*

	
Photo Point 21 – looking upstream UT2 *(03/16/2016)*	**Photo Point 21** – looking downstream UT2 *(03/16/2016)*
	
Photo Point 22 – looking upstream UT2 *(03/16/2016)*	**Photo Point 22** – looking downstream UT2 *(03/16/2016)*
	
Photo Point 23 – looking upstream UT2 *(03/16/2016)*	**Photo Point 23** – looking downstream UT2 *(03/16/2016)*

	
Photo Point 24 – looking upstream UT2 *(03/16/2016)*	**Photo Point 24** – looking downstream UT2 *(03/16/2016)*
	
Photo Point 25 – looking upstream UT2 *(03/16/2016)*	**Photo Point 25** – looking downstream UT2 *(03/16/2016)*
	
Photo Point 26 – looking upstream UT1 R2 *(03/16/2016)*	**Photo Point 26** – looking downstream UT1 R2 *(03/16/2016)*

Photo Point 26 – looking UT1 R2 floodplain *(03/16/2016)*

Photo Point 27 – looking upstream UT1 R2 floodplain *(03/16/2016)*

Photo Point 27 – looking downstream UT1 R2 floodplain (*3/16/2016)*

Photo Point 28 – UT1 R1 Lower floodplain overview *(03/16/2016)*

Photo Point 28 – UT2 floodplain overview *(03/16/2016)*

Photo Point 28 – UT1 R1 Lower floodplain overview *(03/16/2016)*

Photo Point 29 – UT1 R1 Upper floodplain overview *(03/16/2016)*

APPENDIX 3. Vegetation Plot Data

Table 8. Planted and Total Stem Counts
Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

			Current Plot Data (MY0 2016)																								
			96306-WEI-0001			96306-WEI-0002			96306-WEI-0003			96306-WEI-0004			96306-WEI-0005			96306-WEI-0006			96306-WEI-0007			96306-WEI-0008		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer negundo		Tree																								
Acer rubrum		Tree				1	1	1										3	3	3						
Betula nigra	River Birch, Red Birch	Tree	1	1	1				4	4	4	4	4	4	4	4	4	1	1	1	2	2	2	2	2	2
Diospyros virginiana	American Persimmon, Possumwood	Tree	6	6	6	4	4	4	1	1	1	2	2	2	3	3	3							1	1	1
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	2	2	2	7	7	7	4	4	4	6	6	6	4	4	4	4	4	4	6	6	6	6	6	6
Liquidambar styraciflua	Sweet Gum, Red Gum	Tree																								
Liriodendron tulipifera		Tree																								
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree																								
Platanus occidentalis	Sycamore, Plane-tree	Tree	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	3	3	3	4	4	4
Quercus michauxii	Basket Oak, Swamp Chestnut Oak	Tree																4	4	4	3	3	3	1	1	1
Quercus phellos	Willow Oak	Tree	5	5	5	4	4	4	5	5	5				1	1	1				1	1	1	2	2	2
		Stem count	16	16	16	18	18	18	16	16	16	16	16	16	16	16	16	16	16	16	15	15	15	16	16	16
		size (ares)	1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	5	5	5	5	5	5	5	5	5	4	4	4	5	5	5	5	5	5	5	5	5	6	6	6
		Stems per ACRE	647	647	647	728	728	728	647	647	647	647	647	647	647	647	647	647	647	647	607	607	607	647	647	647

Color For Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 8. Planted and Total Stem Counts
Henry Fork Mitigation Site
DMS Project No. 96306
Monitoring Year 0 - 2016

			Current Plot Data (MY0 2016)																						Annual Means		
			96306-WEI-0009			96306-WEI-0010			96306-WEI-0011			96306-WEI-0012			96306-WEI-0013			96306-WEI-0014			96306-WEI-0015			MY0 (2016)		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer negundo		Tree																					12			12
Acer rubrum		Tree	4	4	4				4	4	4							1	1	1				13	13	13
Betula nigra	River Birch, Red Birch	Tree	3	3	3	4	4	4	3	3	3	2	2	2	1	1	1	3	3	3	3	3	3	37	37	37
Diospyros virginiana	American Persimmon, Possumwood	Tree				1	1	1	1	1	1	3	3	3	5	5	5	1	1	1	4	4	4	32	32	32
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree				3	3	3	4	4	4	5	5	5	1	1	1	4	4	4	1	1	1	57	57	57
Liquidambar styraciflua	Sweet Gum, Red Gum	Tree																					5			5
Liriodendron tulipifera		Tree																					2			2
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree																					2			2
Platanus occidentalis	Sycamore, Plane-tree	Tree	4	4	4	3	3	3	2	2	2	5	5	5	4	4	4	6	6	6	8	8	8	57	57	57
Quercus michauxii	Basket Oak, Swamp Chestnut Oak	Tree	3	3	3	4	4	4	3	3	3				1	1	1	1	1	1				20	20	20
Quercus phellos	Willow Oak	Tree	2	2	2	2	2	2				1	1	1	4	4	4							27	27	27
		Stem count	16	16	16	17	17	17	17	17	17	16	16	16	16	16	16	16	16	16	16	16	37	243	243	264
		size (ares)	1			1			1			1			1			1			1			15		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.37		
		Species count	5	5	5	6	6	6	6	6	6	5	5	5	6	6	6	6	6	6	4	4	8	7	7	11
		Stems per ACRE	647	647	647	688	688	688	688	688	688	647	647	647	647	647	647	647	647	647	647	647	1497	656	656	712

Color For Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Vegetation Photographs

Vegetation Plot 1 - *(03/31/2016)*

Vegetation Plot 2 - *(03/31/2016)*

Vegetation Plot 3 - *(03/31/2016)*

Vegetation Plot 4 - *(03/31/2016)*

Vegetation Plot 5 - *(03/31/2016)*

Vegetation Plot 6 - *(03/31/2016)*

Vegetation Plot 7 - *(03/31/2016)*

Vegetation Plot 8 - *(03/31/2016)*

Vegetation Plot 9 - *(04/01/2016)*

Vegetation Plot 10 - *(04/01/2016)*

Vegetation Plot 11 - *(04/01/2016)*

Vegetation Plot 12 - *(04/01/2016)*

Vegetation Plot 13 - *(04/01/2016)*

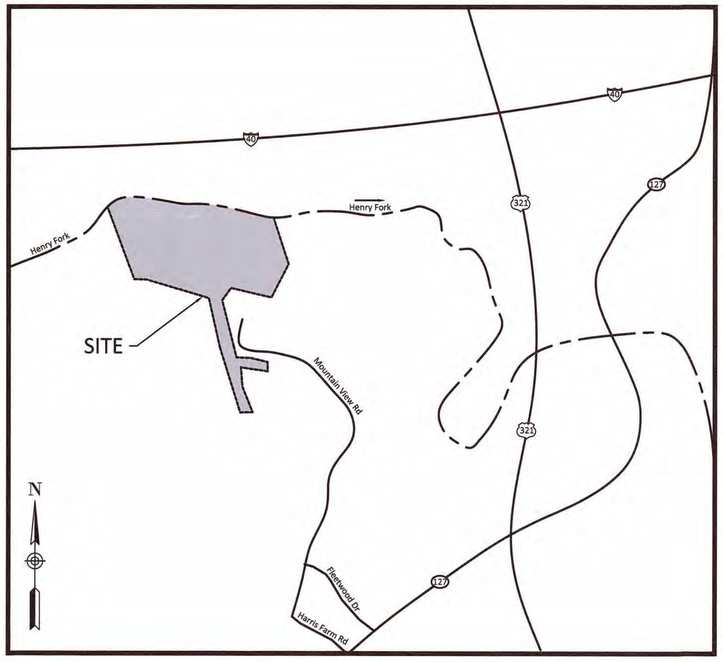
Vegetation Plot 14 - *(03/31/2016)*

Vegetation Plot 15 - *(03/31/2016)*

APPENDIX 4. Record Drawings

Henry Fork Mitigation Site Record Drawings

Catawba County, North Carolina
for
NCDEQ -
Division of Mitigation Services



Vicinity Map
Not to Scale

RECORD DRAWINGS
ISSUED JUNE 21, 2016

CERTIFICATE OF SURVEY AND ACCURACY

I, NOLAN R. CARMACK, CERTIFY THAT THE GROUND TOPOGRAPHIC SURVEY PORTION OF THIS PROJECT WAS COMPLETED UNDER MY DIRECT SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY DIRECT SUPERVISION, THAT THE RECORD DRAWINGS WERE PREPARED BY WILDLANDS ENGINEERING, INC FROM DIGITAL FILES PROVIDED BY KEY MAPPING AND SURVEYING, PA AS SHOWN ON AN AS-BUILT SURVEY FOR "THE STATE OF NC, DIVISION OF MITIGATION SERVICES" DATED APRIL 22, 2016 ; THAT THIS SURVEY WAS PERFORMED AT THE 95% CONFIDENCE LEVEL TO MEET THE FEDERAL GEOGRAPHIC DATA COMMITTEE STANDARDS; THAT THIS SURVEY WAS PERFORMED TO MEET THE REQUIREMENTS FOR A TOPOGRAPHIC SURVEY TO THE ACCURACY OF CLASS A HORIZONTAL AND CLASS C VERTICAL WHERE APPLICABLE; THAT THE ORIGINAL DATA WAS OBTAIN BETWEEN THE DATES OF 3/18/16 - 4/20/16 ; THAT THE CONTOURS SHOWN AS BROKEN LINES MAY NOT MEET THE STATED STANDARD AND ALL COORDINATES ARE BASED ON NAD 83 (NSRS 2011) AND ALL ELEVATIONS ARE BASE ON NAVD 88; THAT THIS MAP MEETS THE SPECIFICATIONS FOR TOPOGRAPHIC SURVEYS AS STATED IN TITLE 21, CHAPTER 56, SECTION .1606; THAT THIS MAP WAS NOT PREPARED IN ACCORDANCE WITH G.S. 47-30, AS AMENDED AND DOES NOT REPRESENT AN OFFICIAL BOUNDARY SURVEY.

WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS THE 21st DAY OF June, 2016.

OFFICIAL SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-5076 LAND SURVEYOR NOLAN R. CARMACK

NOLAN R. CARMACK, PLS L-5076

Sheet Index

Project Directory

Engineering:
Wildlands Engineering, Inc
License No. F-0831
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Jake McLean, PE, CFM
828-774-5547

Surveying:
Kee Mapping and Surveying
88 Central Avenue
Asheville, NC 28801
Nolan Carmack, PLS
828-575-9021

Owner:
NCDEQ
Division of Mitigation Services
5 Ravenscroft Dr, Suite 102
Asheville, NC 28801
DMS Project Manager:
Matthew Reid
828-231-7912

NCDEQ Contract No. 5782

DMS ID No. 96306

WILDLANDS ENGINEERING
167-B Haywood Road
Asheville, NC 28806
Tel: 828.774.5547
Fax: 704.332.3306
Firm License No. F-0831

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 033578 JAKE R. McLEAN

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

Title Sheet

Revisions:

Date: May 25, 2016
Job Number: 005-02143
Project Engineer: JPM
Drawn By: RCP
Checked By: JPM

Sheet 0.1

June 21, 2016

T:\ACTIVE PROJECTS (NC\005-02143 Henry Fork\Monitoring \Baseline Monitoring \Plans \02143-Alt-CoverNotes.dwg

Existing & Design Features

- Property Line (GIS/Unsurveyed)
- Right of Way
- FEMA Floodplain
- FEMA Floodway
- Conservation Easement
- Property Line
- Conservation Easement/Property Line
- Design Thalweg Alignment
- Design Floodplain Pilot Channel
- Design Bankfull
- Design Major Contour
- Design Minor Contour
- Existing Wetland
- Tree Saved During Construction
- Henry Fork (Open Water)
- Existing Building

As-Built Features

- As-Built Bankfull
- As-Built Thalweg Alignment
- As-Built Pilot Channel
- As-Built Major Contour (5' Interval)
- As-Built Minor Contour
- As-Built Wetland Re-establishment
- As-Built Wetland Rehabilitation
- As-Built Wetland Enhancement

Design Stream Features (NTS)

- Design Rock Step
- Design Log Step
- Design Root Wad
- Design Brush Toe
- Design Ephemeral Pool
- Design Lunker Log
- CR-CR Constructed Riffle
- CR-WR Woody Riffle
- CR-JZ Jazz Riffle
- CR-CH Chunky Riffle
- CASC Log-Rock Cascade Riffle

Design Constructed Riffle Varies

- Design Sod Mat
- Design Geo-Lift

As-Built Stream Features (NTS)

- As-Built Rock Step
- As-Built Log Step
- As-Built Root Wad
- As-Built Brush Toe
- As-Built Ephemeral Pool
- As-Built Lunker Log
- CR-CR Constructed Riffle
- CR-WR Woody Riffle
- CR-JZ Jazz Riffle
- CR-CH Chunky Riffle
- CASC Log-Rock Cascade Riffle

As-Built Constructed Riffle Varies

- As-Built Sod Mat
- As-Built Geo-Lift

*Deviation from design shown in red.

WILDLANDS ENGINEERING
167-B Haywood Road
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Fax: 704.332.3306
Firm License No. F-0831

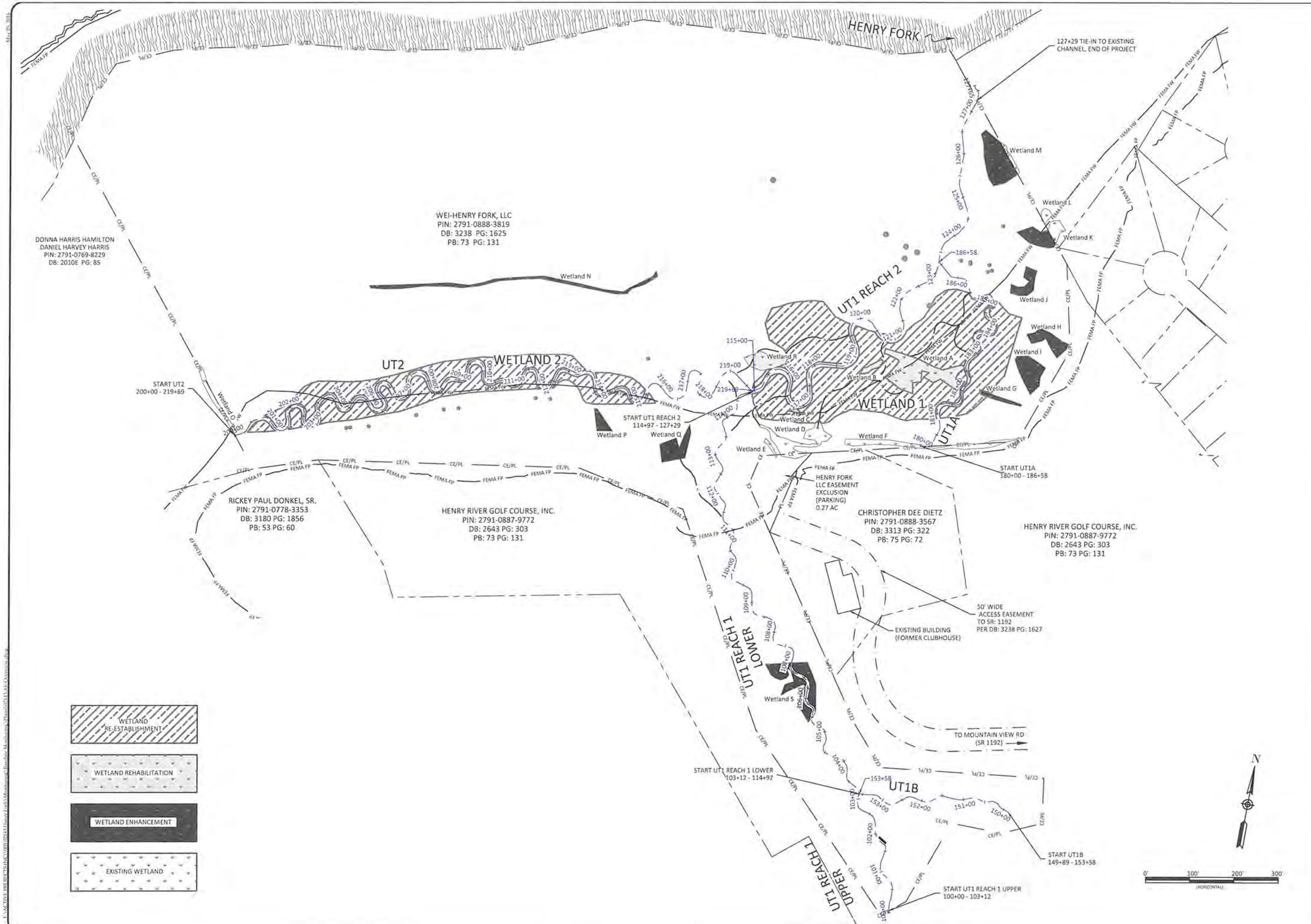
Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

General Notes and Symbols

Revisions:

Date: May 25, 2016
Job Number: 005-02143
Project Engineer: JPM
Drawn By: RCT
Checked By: JPM

Sheet 0.2


HENRY FORK
127+29 TIE-IN TO EXISTING CHANNEL, END OF PROJECT
WEI-HENRY FORK, LLC
PIN: 2791-0888-3819
DB: 3238 PG: 1625
PB: 73 PG: 131
DONNA HARRIS HAMILTON
DANIEL HARVEY HARRIS
PIN: 2791-0769-8229
DB: 2010E PG: 85
Wetland N
Wetland M
Wetland L
Wetland K
Wetland J
Wetland H
Wetland I
Wetland G
UT1 REACH 2
UT2
WETLAND 2
WETLAND 1
UT1A
START UT2
200+00 - 219+69
START UT1 REACH 2
114+97 - 127+29
Wetland P
Wetland Q
Wetland R
Wetland A
Wetland B
Wetland C
Wetland D
Wetland E
Wetland F
START UT1A
180+00 - 186+58
HENRY FORK LLC EASEMENT EXCLUSION (PARKING) 0.27 AC
RICKEY PAUL DONKEL, SR.
PIN: 2791-0778-3353
DB: 3180 PG: 1856
PB: 53 PG: 60
HENRY RIVER GOLF COURSE, INC.
PIN: 2791-0887-9772
DB: 2643 PG: 303
PB: 73 PG: 131
CHRISTOPHER DEE DIETZ
PIN: 2791-0888-3567
DB: 3313 PG: 322
PB: 75 PG: 72
HENRY RIVER GOLF COURSE, INC.
PIN: 2791-0887-9772
DB: 2643 PG: 303
PB: 73 PG: 131
50' WIDE ACCESS EASEMENT TO SR: 1192 PER DB: 3238 PG: 1627
EXISTING BUILDING (FORMER CLUBHOUSE)
UT1 REACH 1 LOWER
Wetland S
TO MOUNTAIN VIEW RD (SR 1192)
START UT1 REACH 1 LOWER
103+12 - 114+97
UT1B
START UT1B
149+89 - 153+58
UT1 REACH 1 UPPER
START UT1 REACH 1 UPPER
100+00 - 103+12
WETLAND RE-ESTABLISHMENT
WETLAND REHABILITATION
WETLAND ENHANCEMENT
EXISTING WETLAND
N
0' 100' 200' 300'
(HORIZONTAL)

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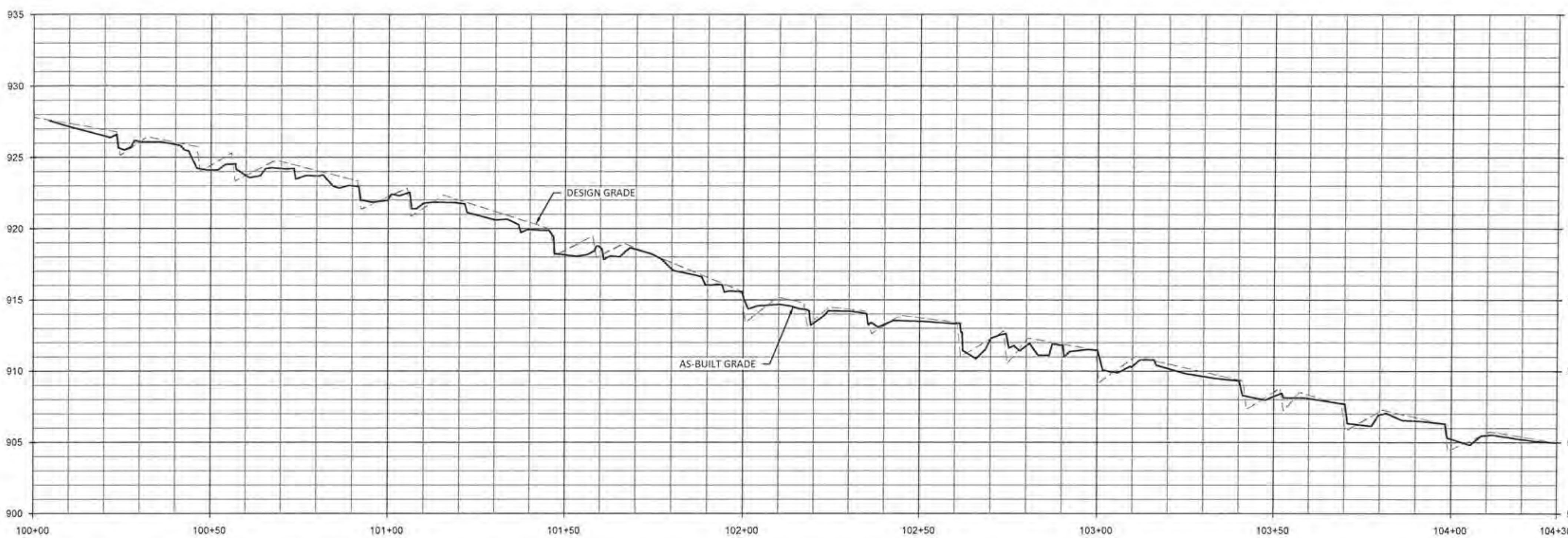
Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

Project Overview

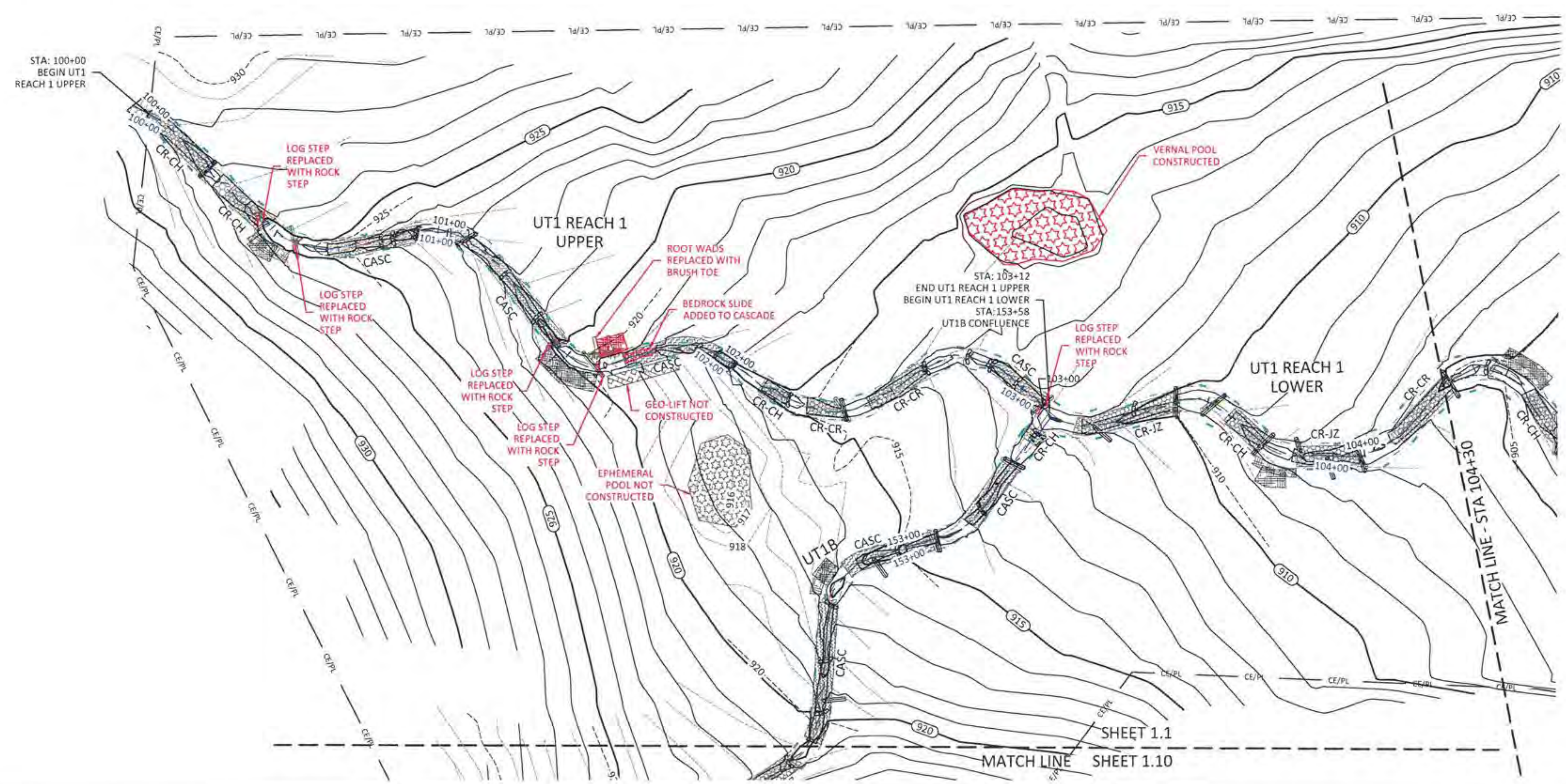
Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:

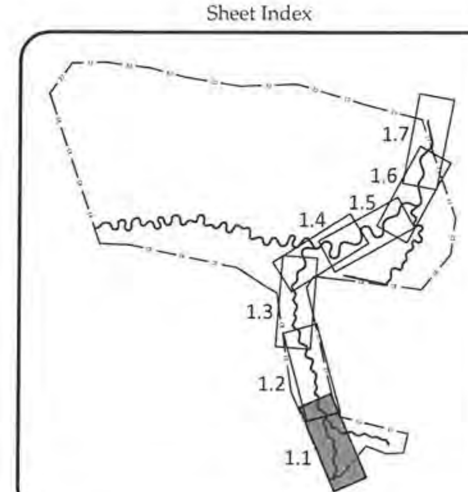
Sheet 0.3



Note: Profile stations and match lines based on design alignment.



Sheet Index



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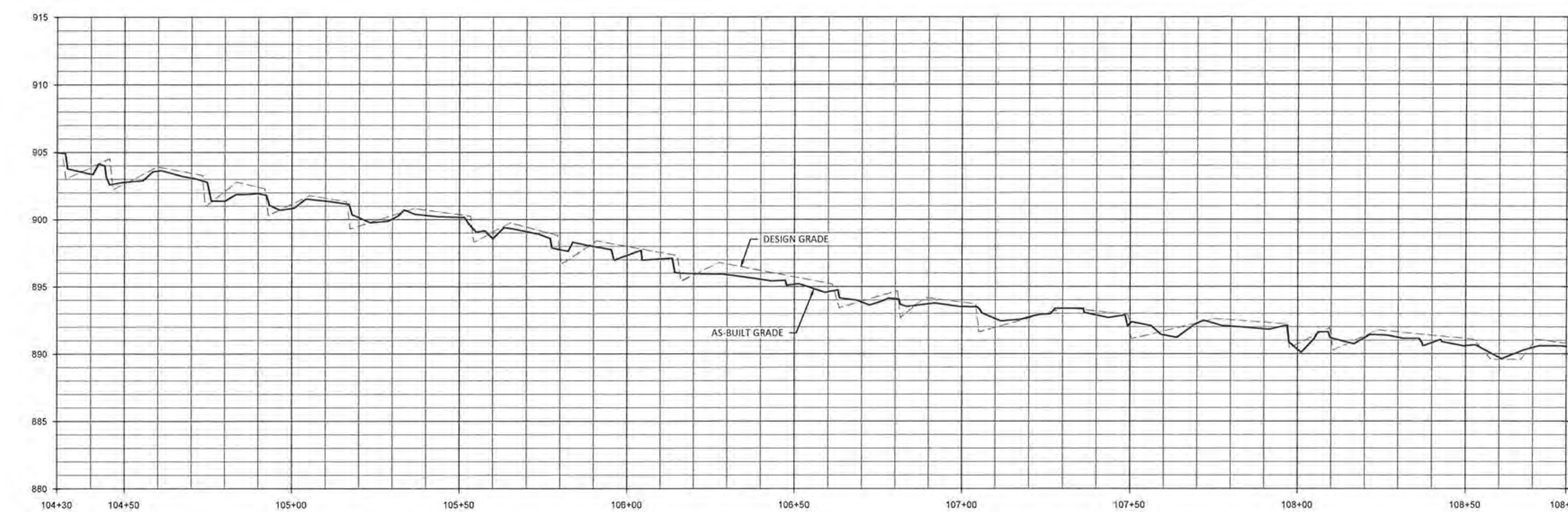
Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT1 Reach 1 Upper & Lower
Stream Plan and Profile

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCT
Checked By:	JPM

Revisions:

Sheet 1.1



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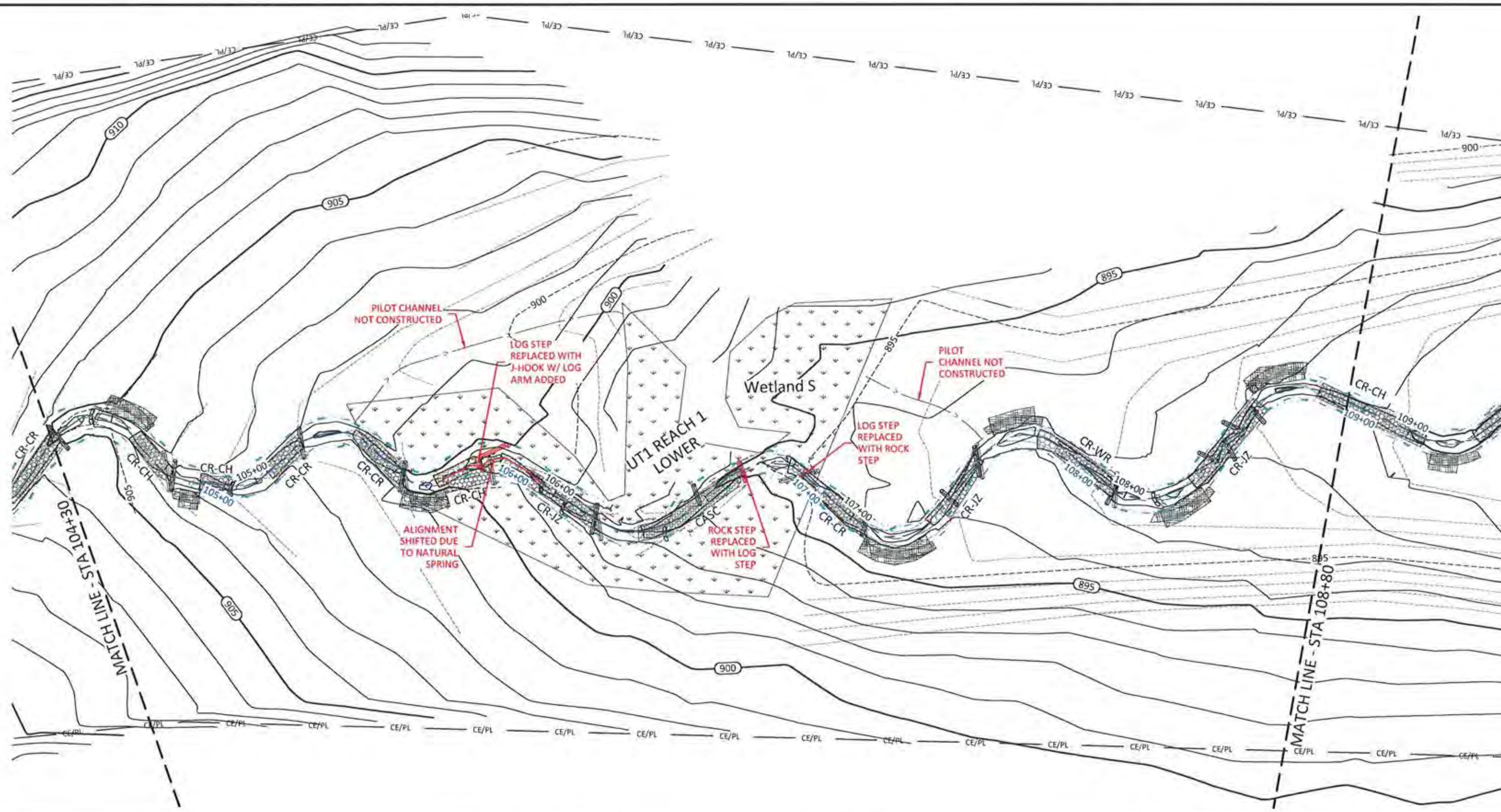
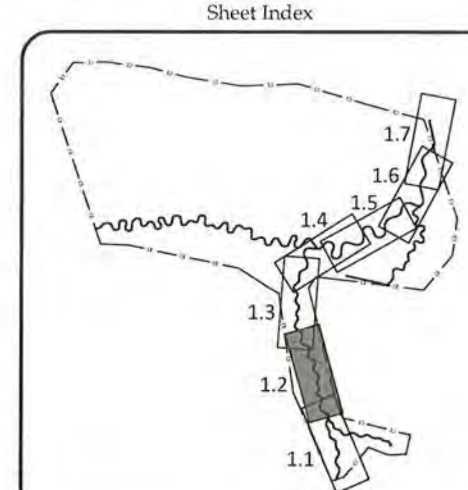


Sheet Index



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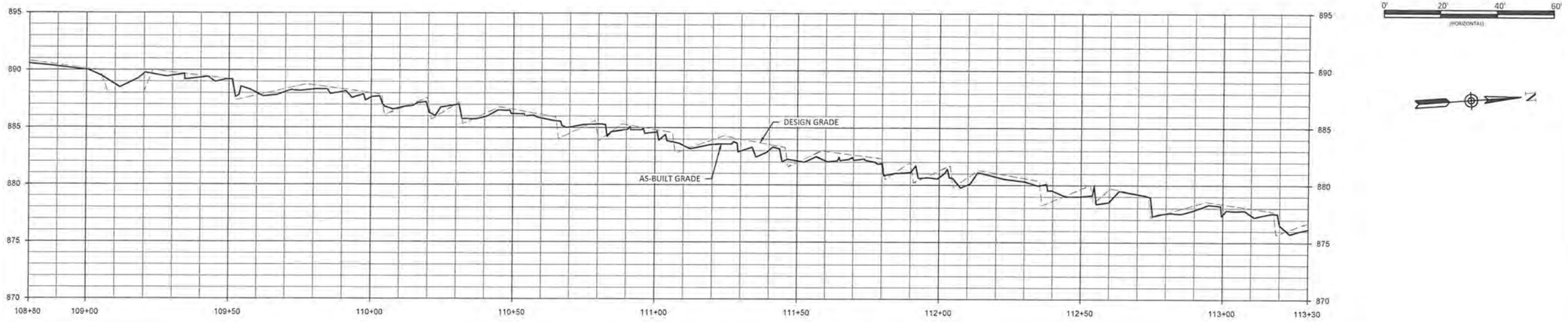
Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

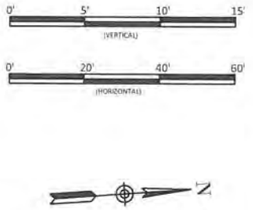
UT1 Reach 1 Lower
Stream Plan and Profile

Revisions:

Date: May 25, 2016
Job Number: 005-02143
Project Engineer: JPM
Drawn By: RCP
Checked By: JPM

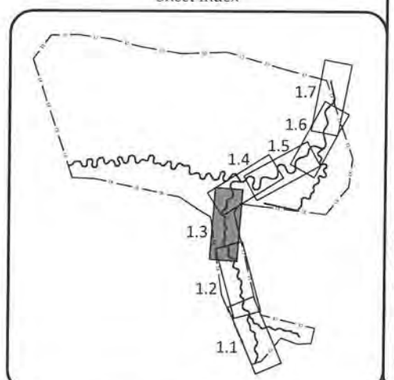
Sheet 1.2





Note: Profile stations and match lines based on design alignment.

Sheet Index



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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 033578 JOHN T. MORGAN

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT1 Reach 1 Lower
Stream Plan and Profile

Revisions:

Date: May 25, 2016
Job Number: 005-02143
Project Engineer: JTM
Drawn By: RCP
Checked By: JTM

Sheet: 1.3

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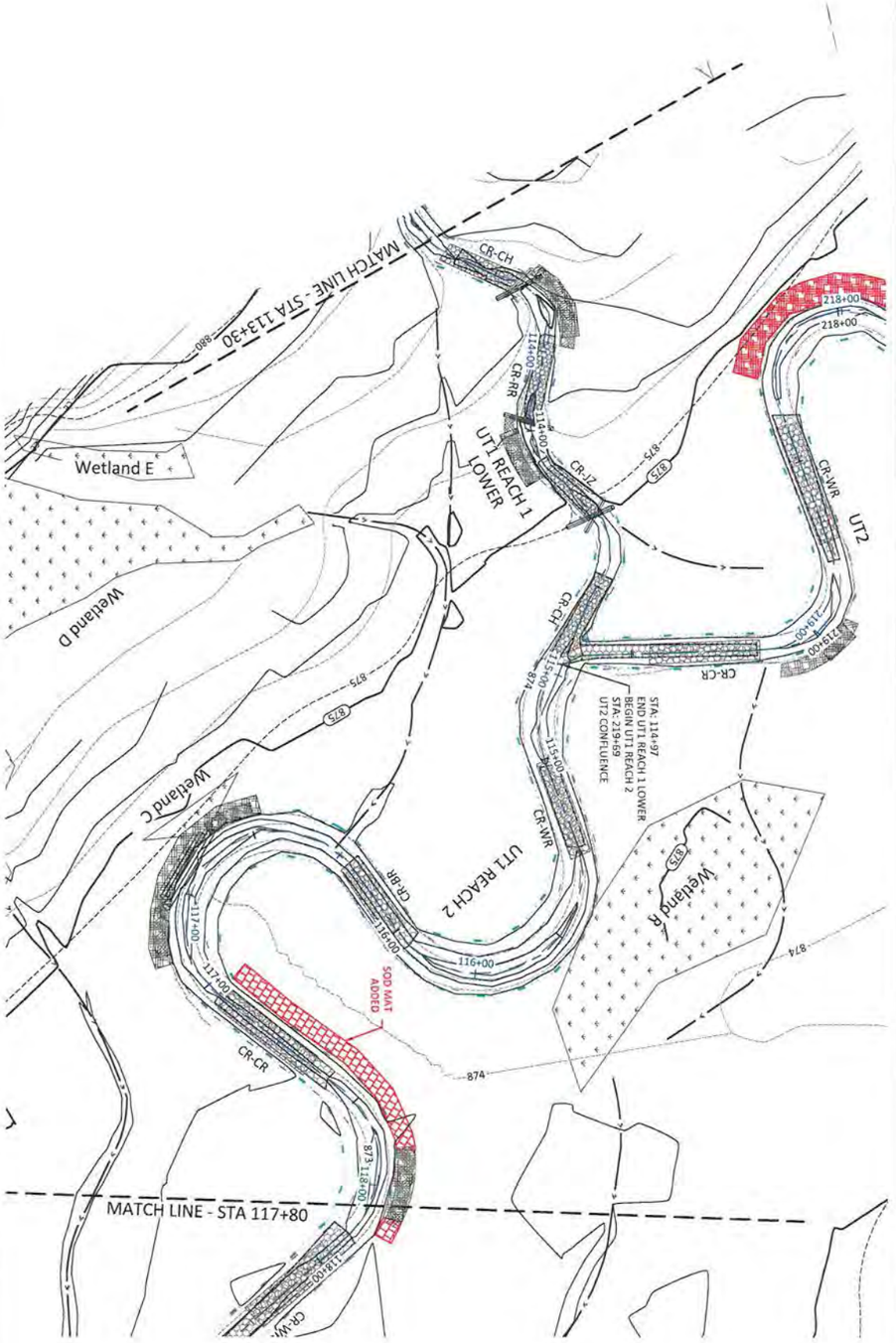
May 25, 2016



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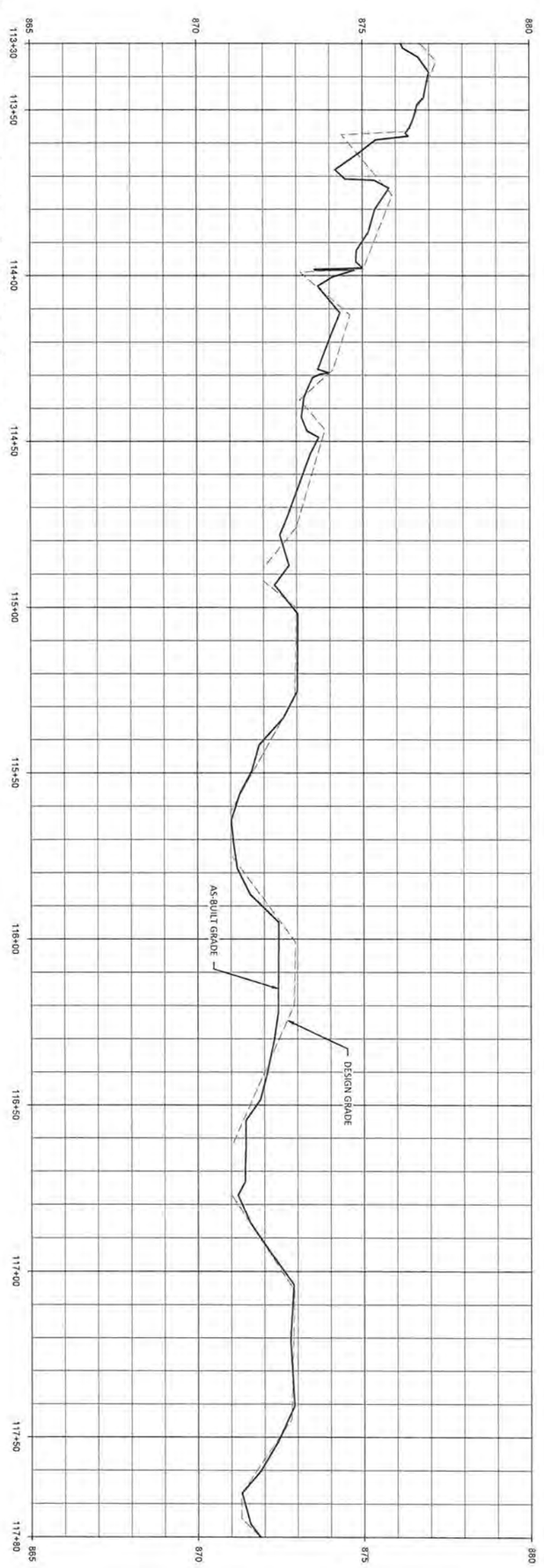

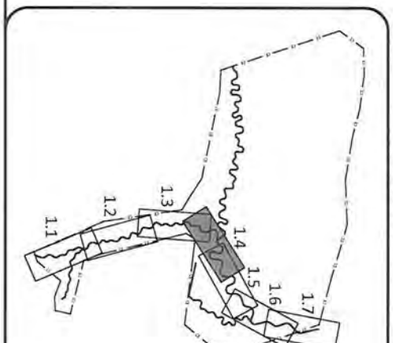

Sheet Index

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

1.4

Sheet

Revisions:

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT1 Reach 1 Lower & UT1 Reach 2
Stream Plan and Profile

NORTH CAROLINA PROFESSIONAL SEAL 033578 ENGINEER JOHN M. LEE

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157-B Haywood Road
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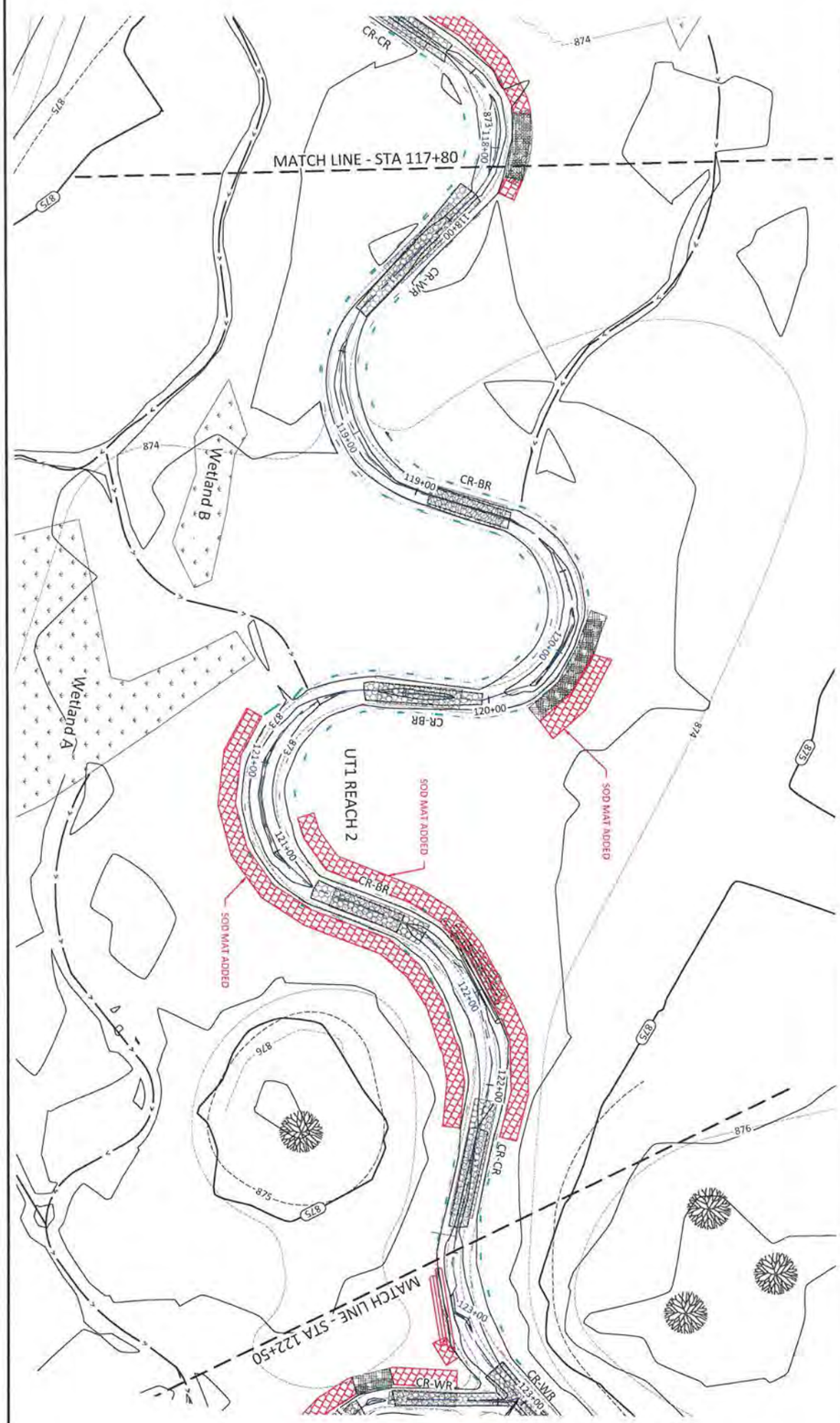

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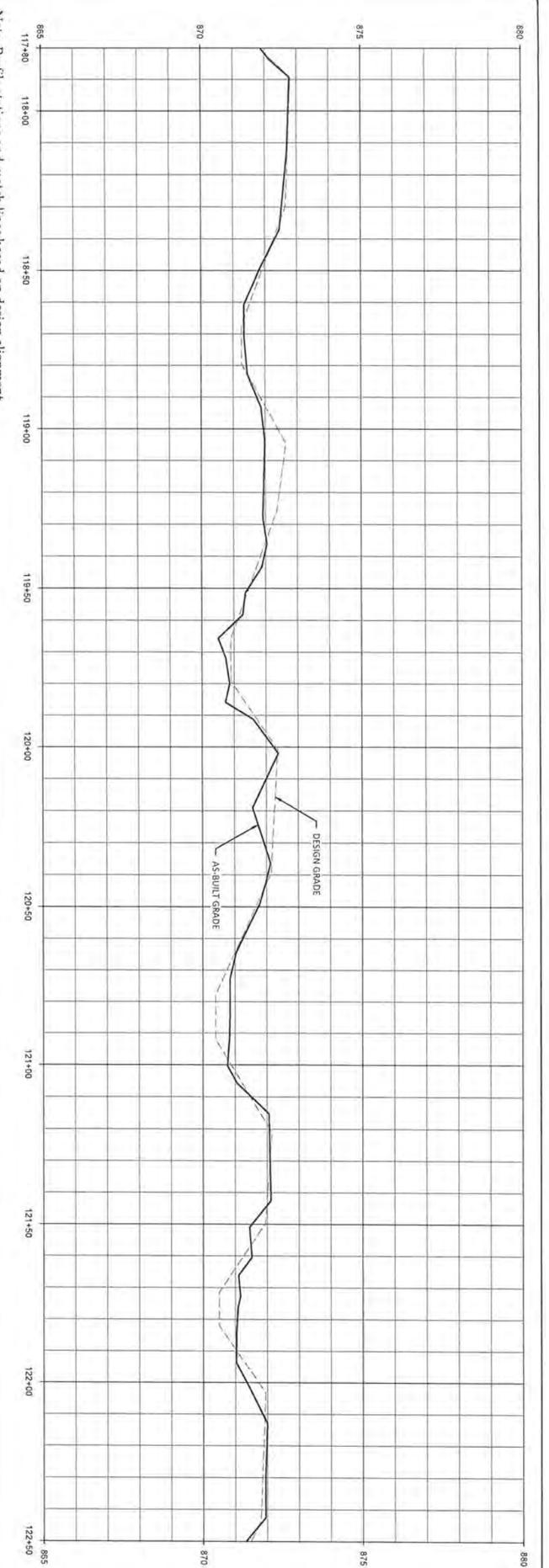

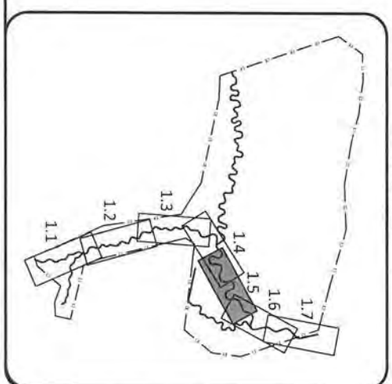

Sheet Index

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:

1.5
Sheet

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT1 Reach 2
Stream Plan and Profile

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 033578 JASON M. LEE

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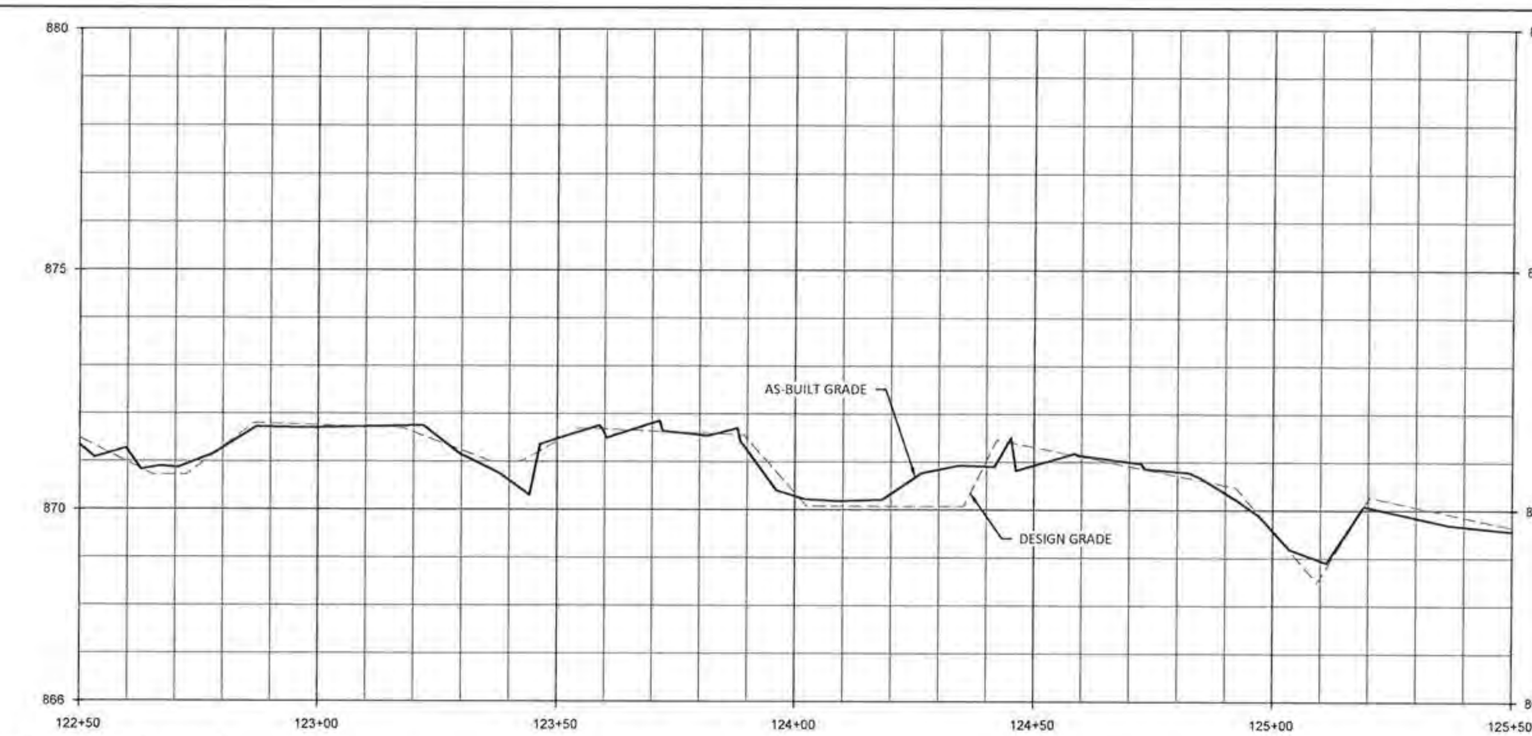

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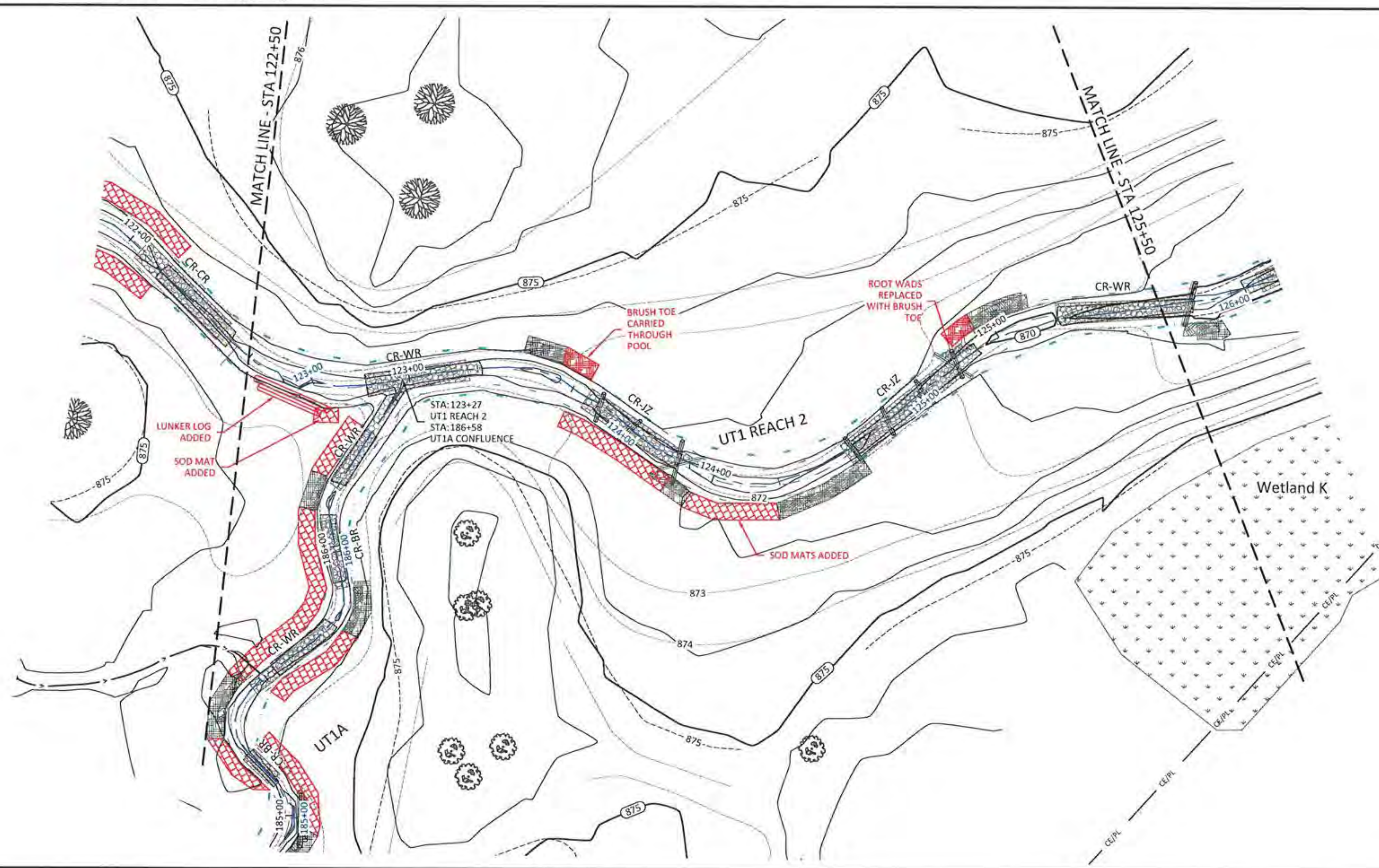
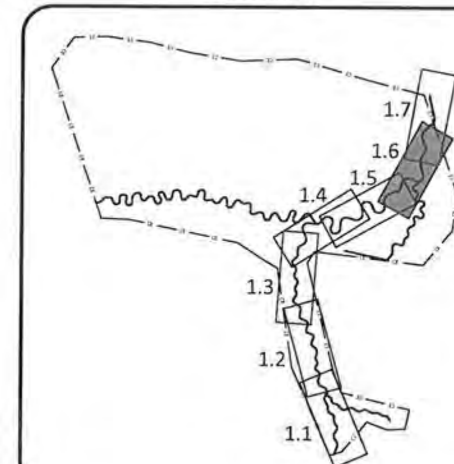


Sheet Index



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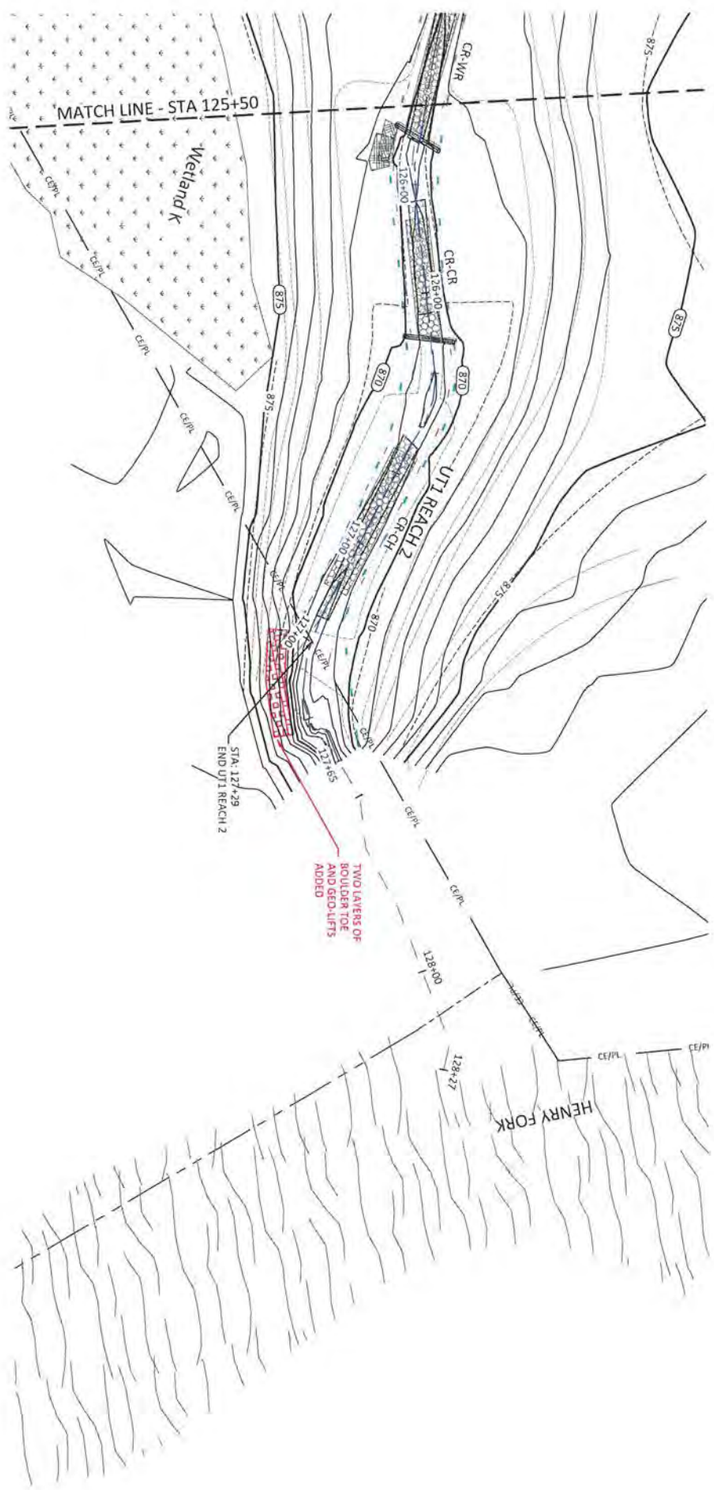
Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT1 Reach 2
Stream Plan and Profile

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:

Sheet 1.6



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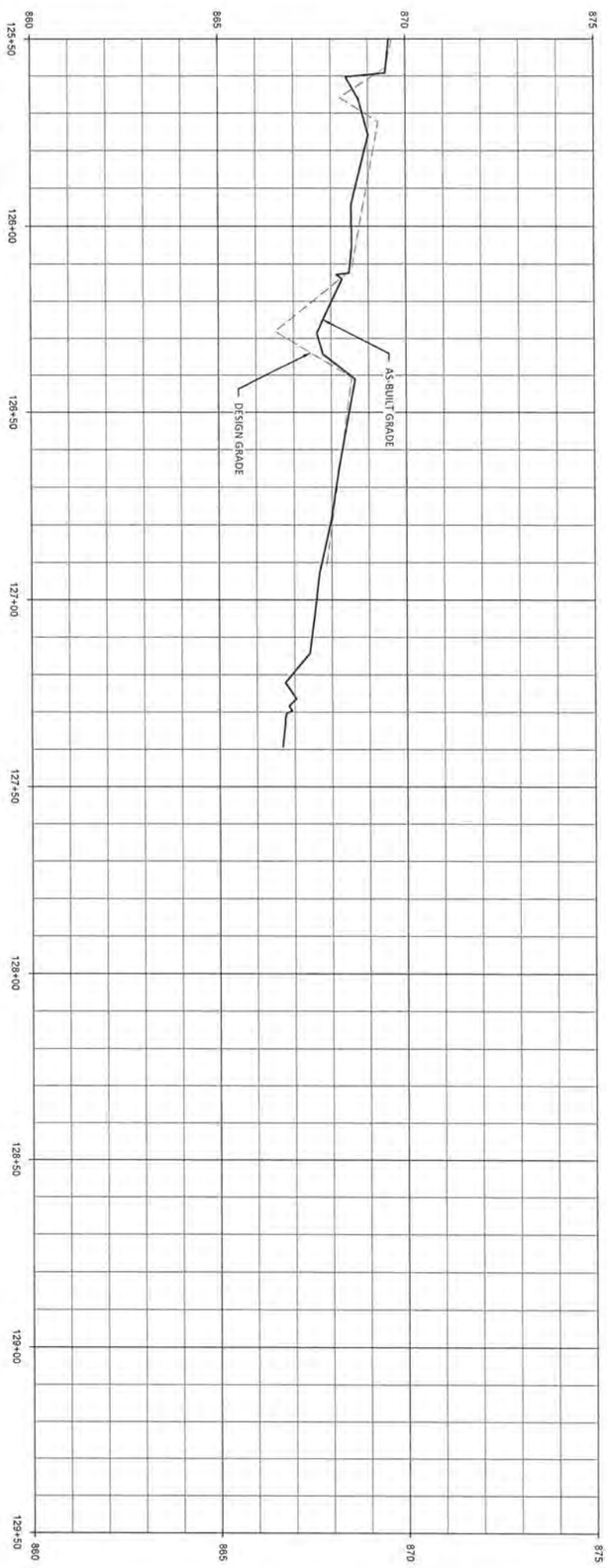

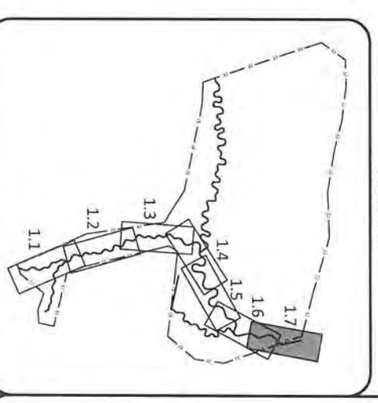

Sheet Index

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:

1.7
Sheet

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT1 Reach 2
Stream Plan and Profile

NORTH CAROLINA PROFESSIONAL SEAL 033578 ENGINEER JACOB McLEAN

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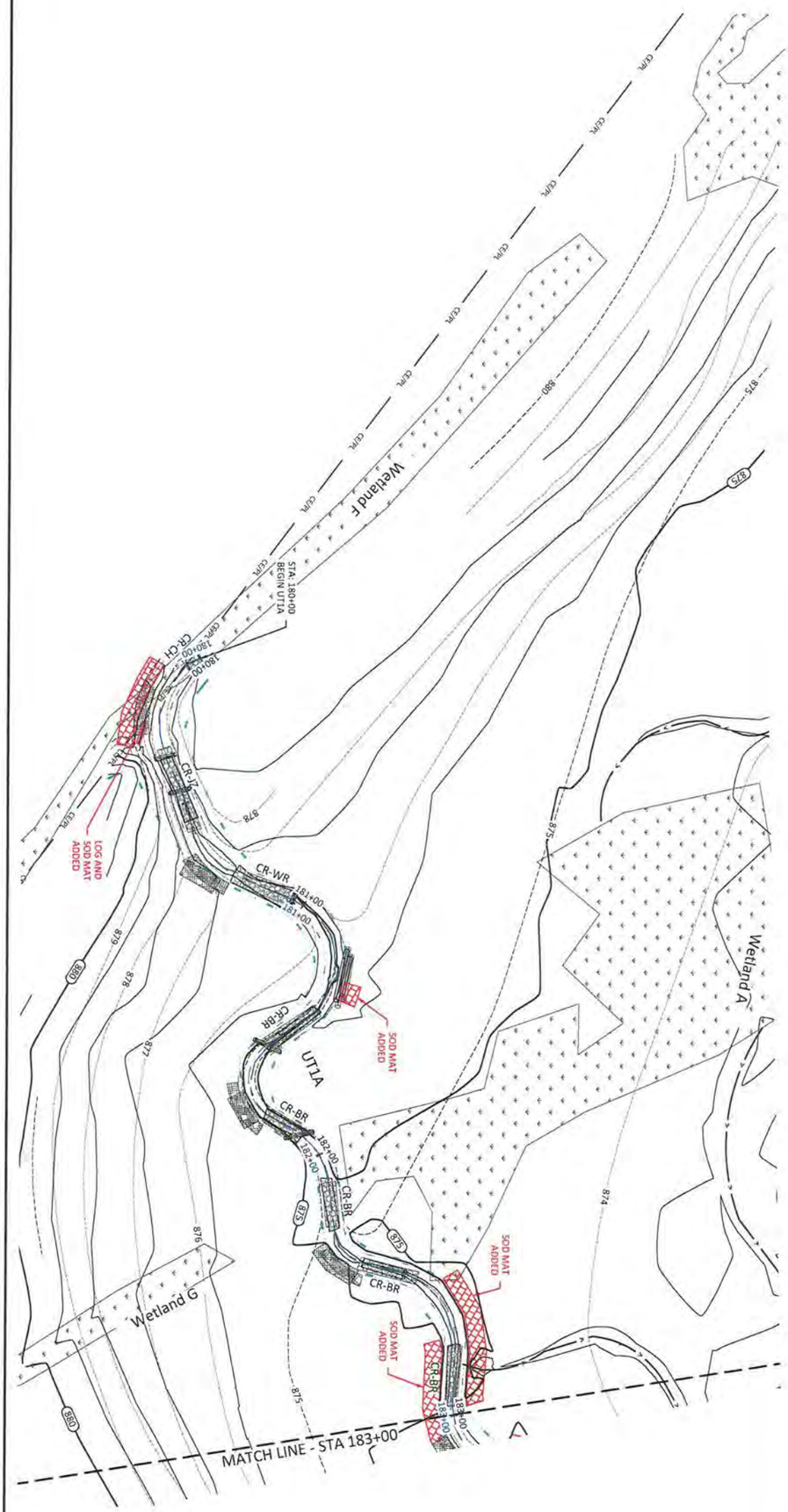
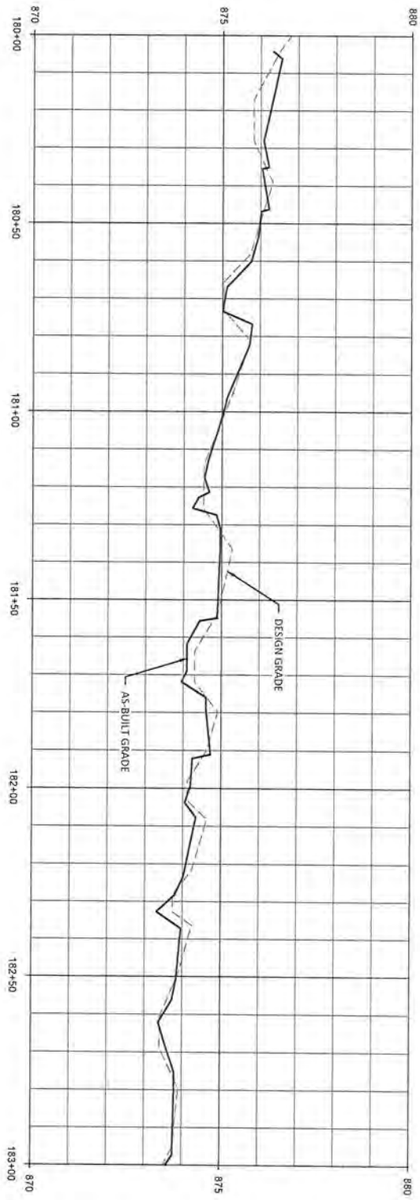
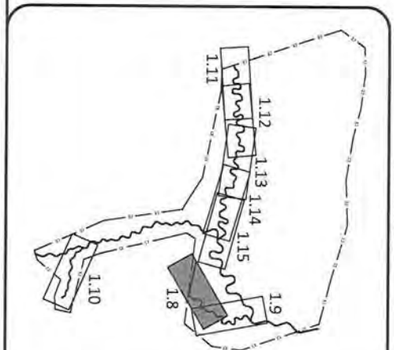
Note: Profile stations and match lines based on design alignment.







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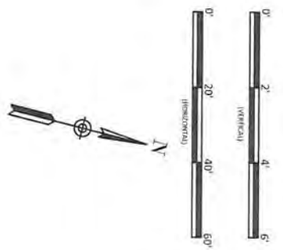

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:

1.8
Sheet

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT1A
Stream Plan and Profile

NORTH CAROLINA PROFESSIONAL SEAL 033578 ENGINEER JASON McCAIN

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167-B Haywood Road
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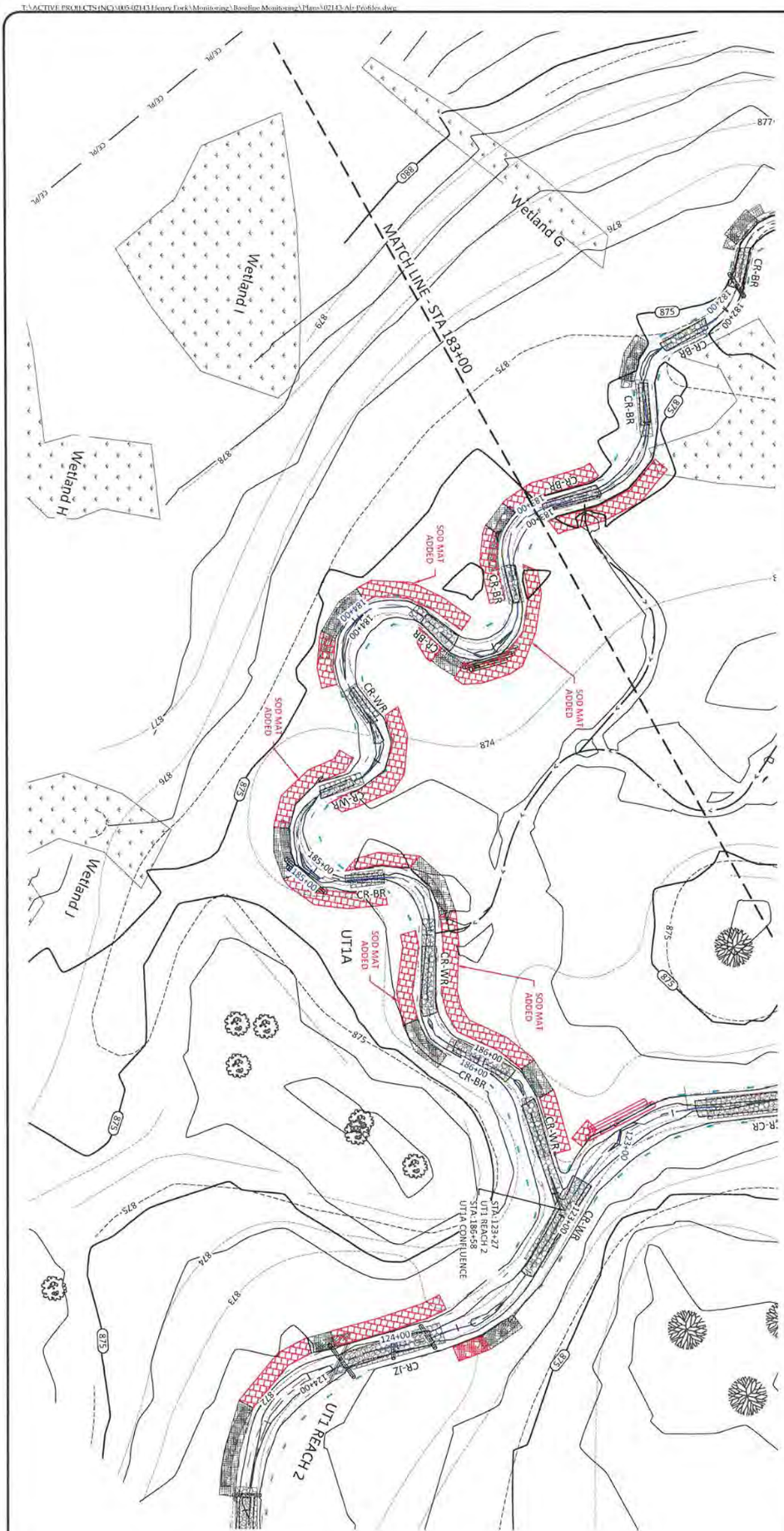

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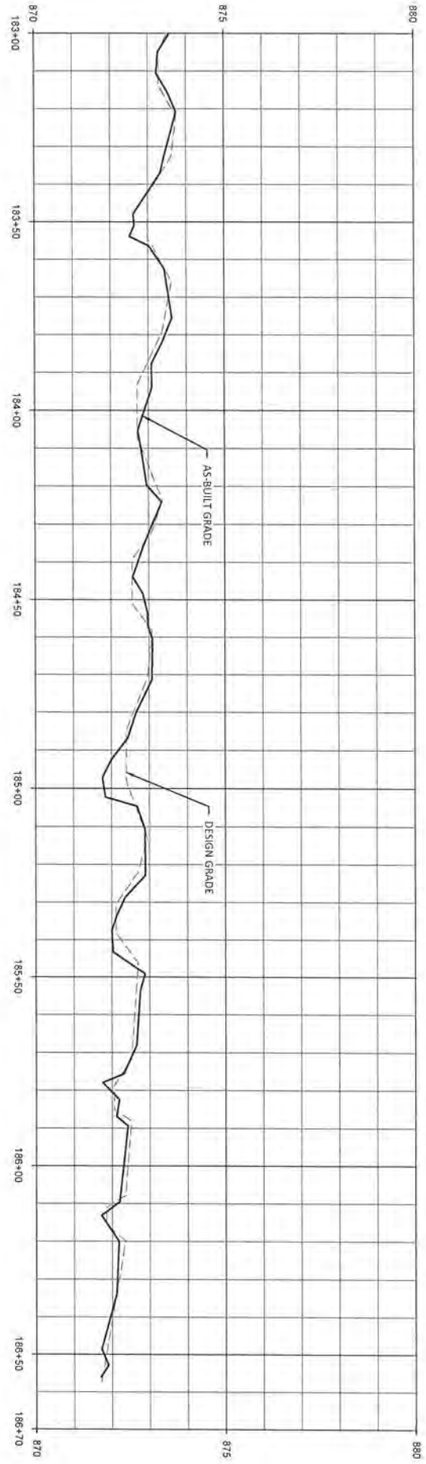

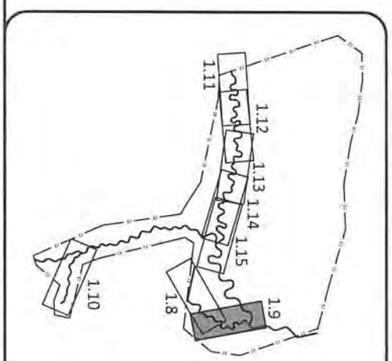

Sheet Index

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

1.9
Sheet

Revisions:

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT1A
Stream Plan and Profile

NORTH CAROLINA PROFESSIONAL SEAL 033781 ENGINEER JACOB M. LEES

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167-B Haywood Road
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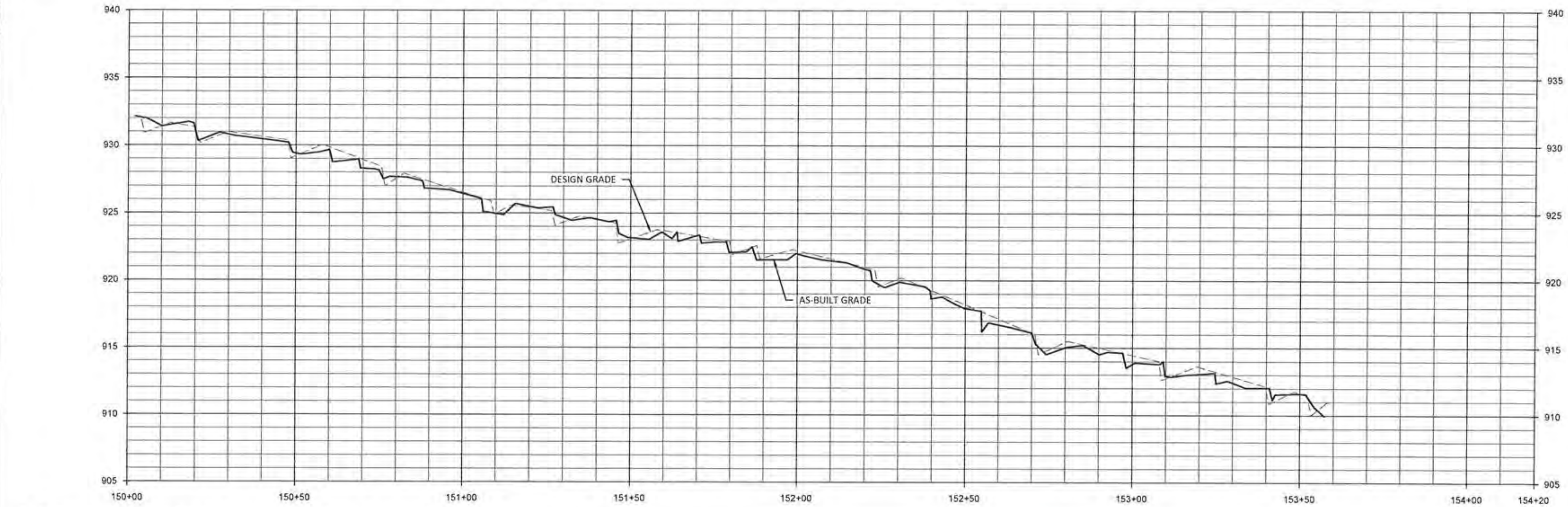

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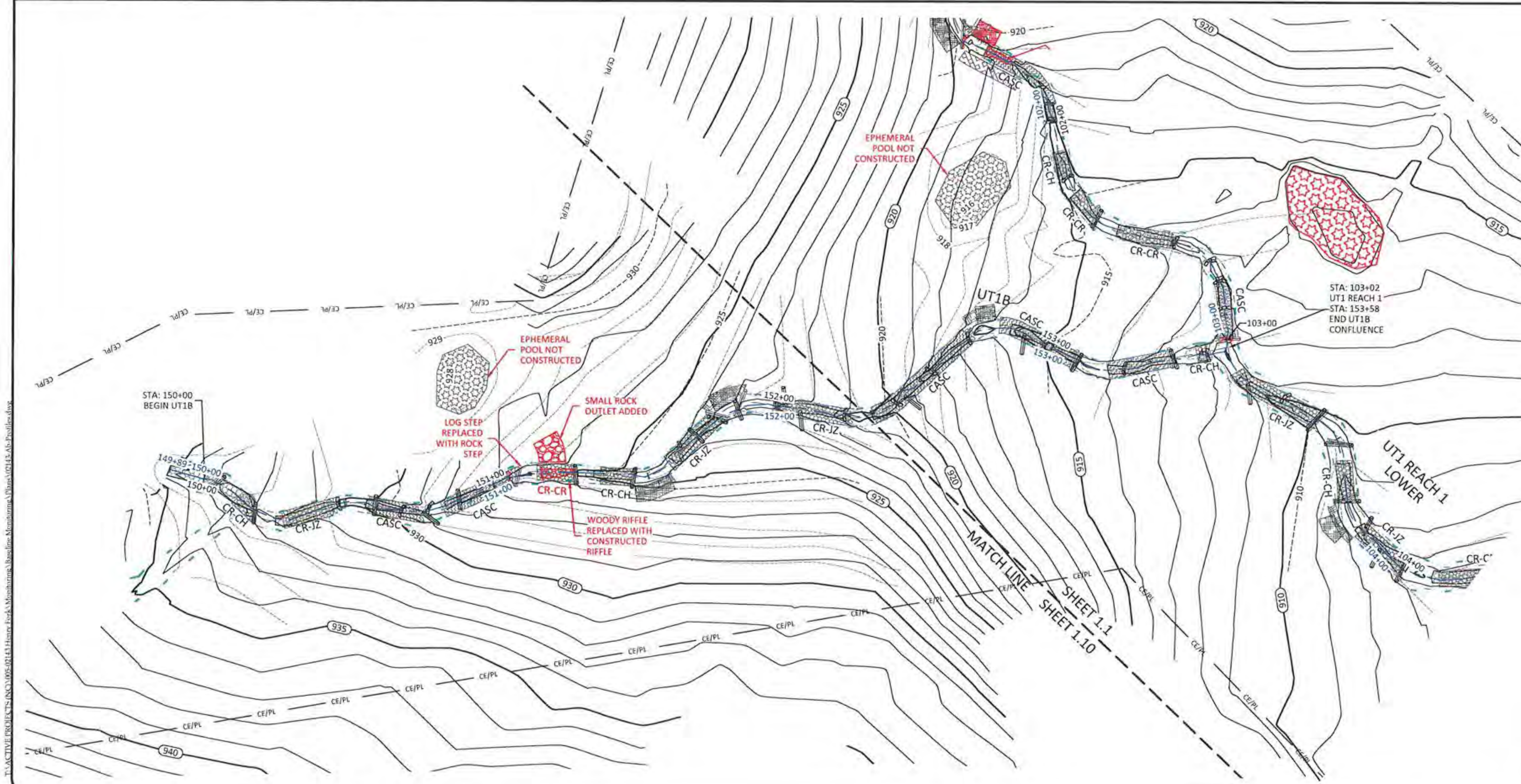

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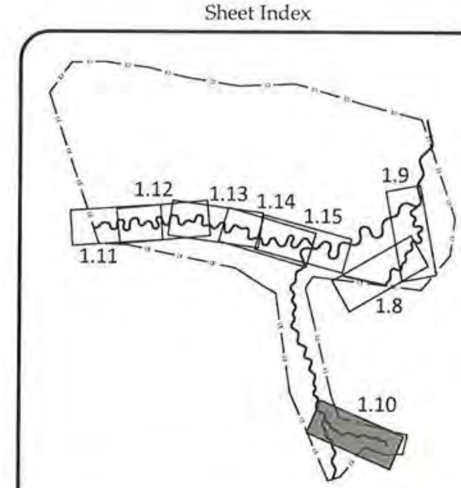

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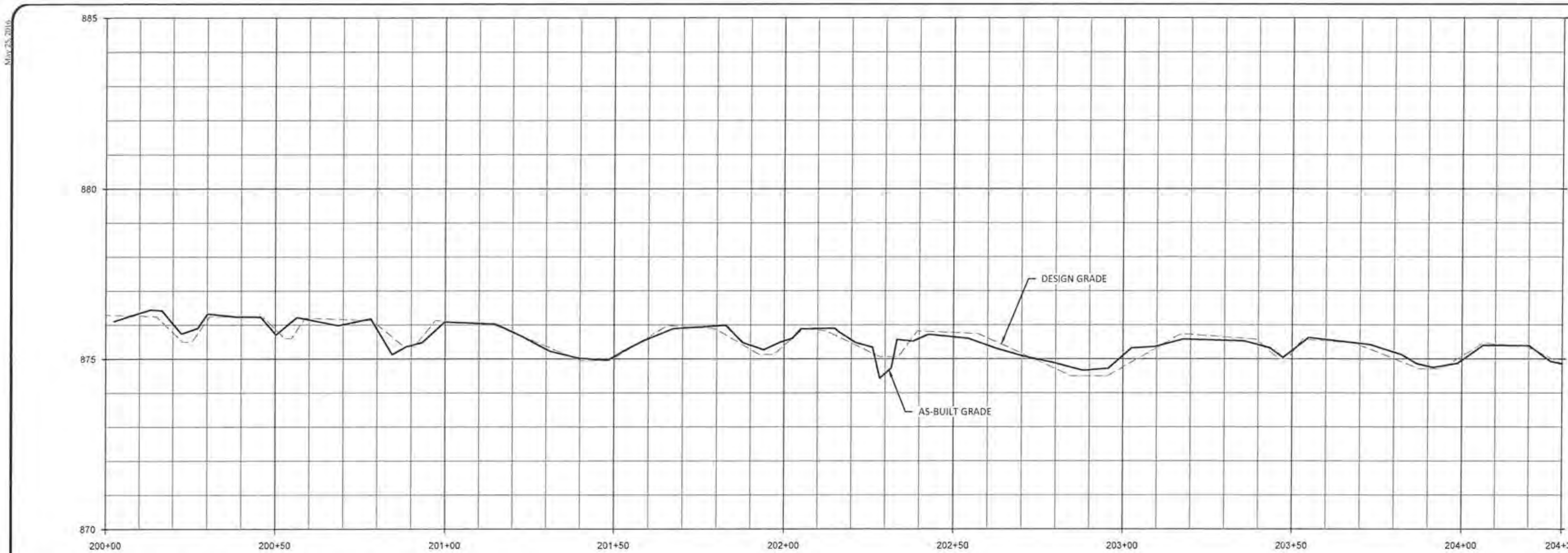
Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT1B
Stream Plan and Profile

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:

Sheet 1.10



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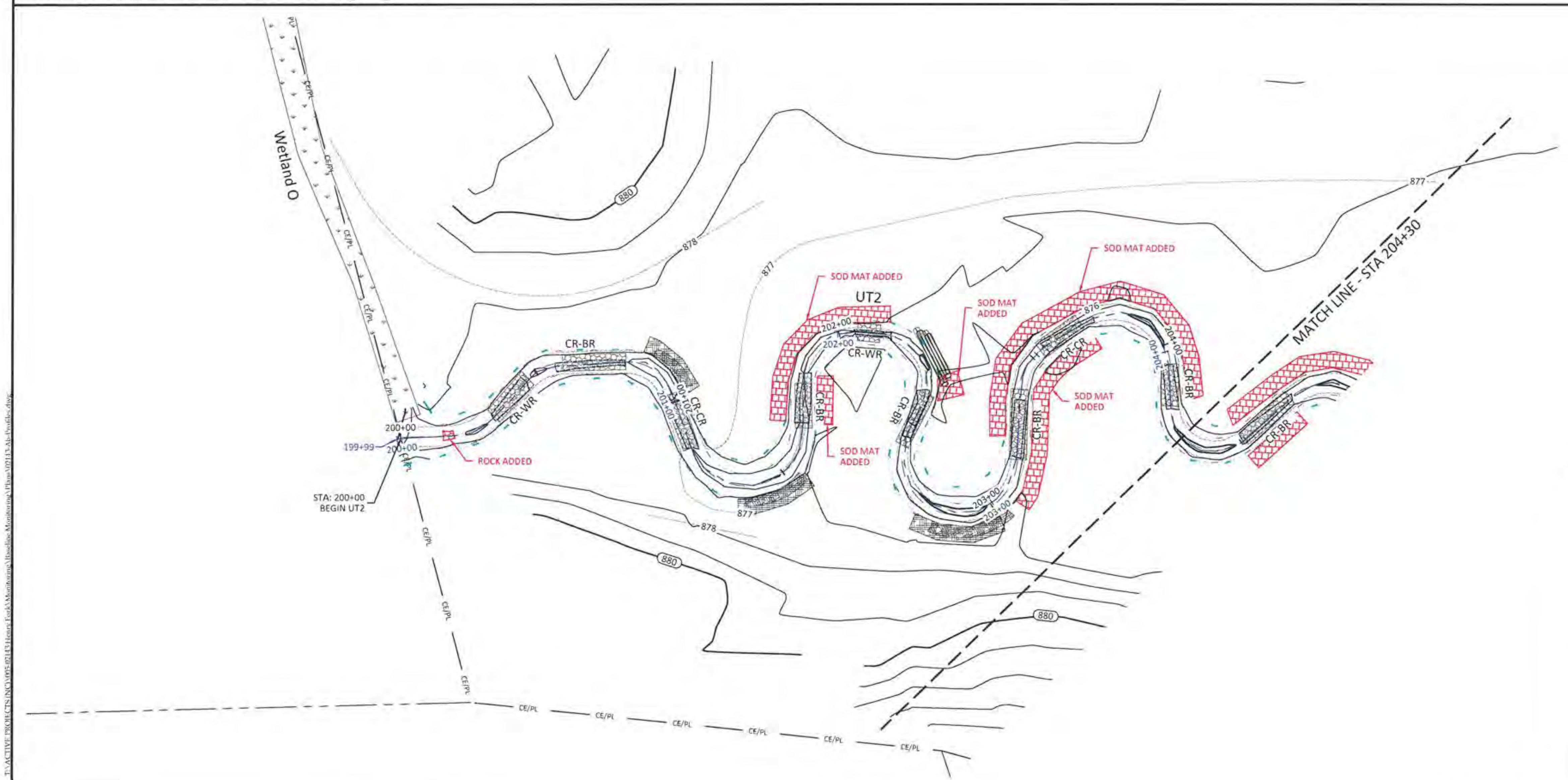
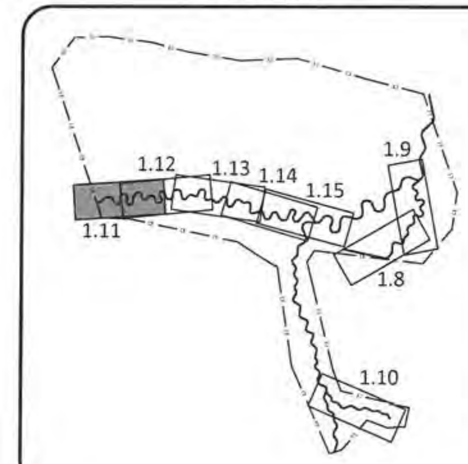


Sheet Index



0' 2' 4' 6' (VERTICAL)

0' 20' 40' 60' (HORIZONTAL)

N

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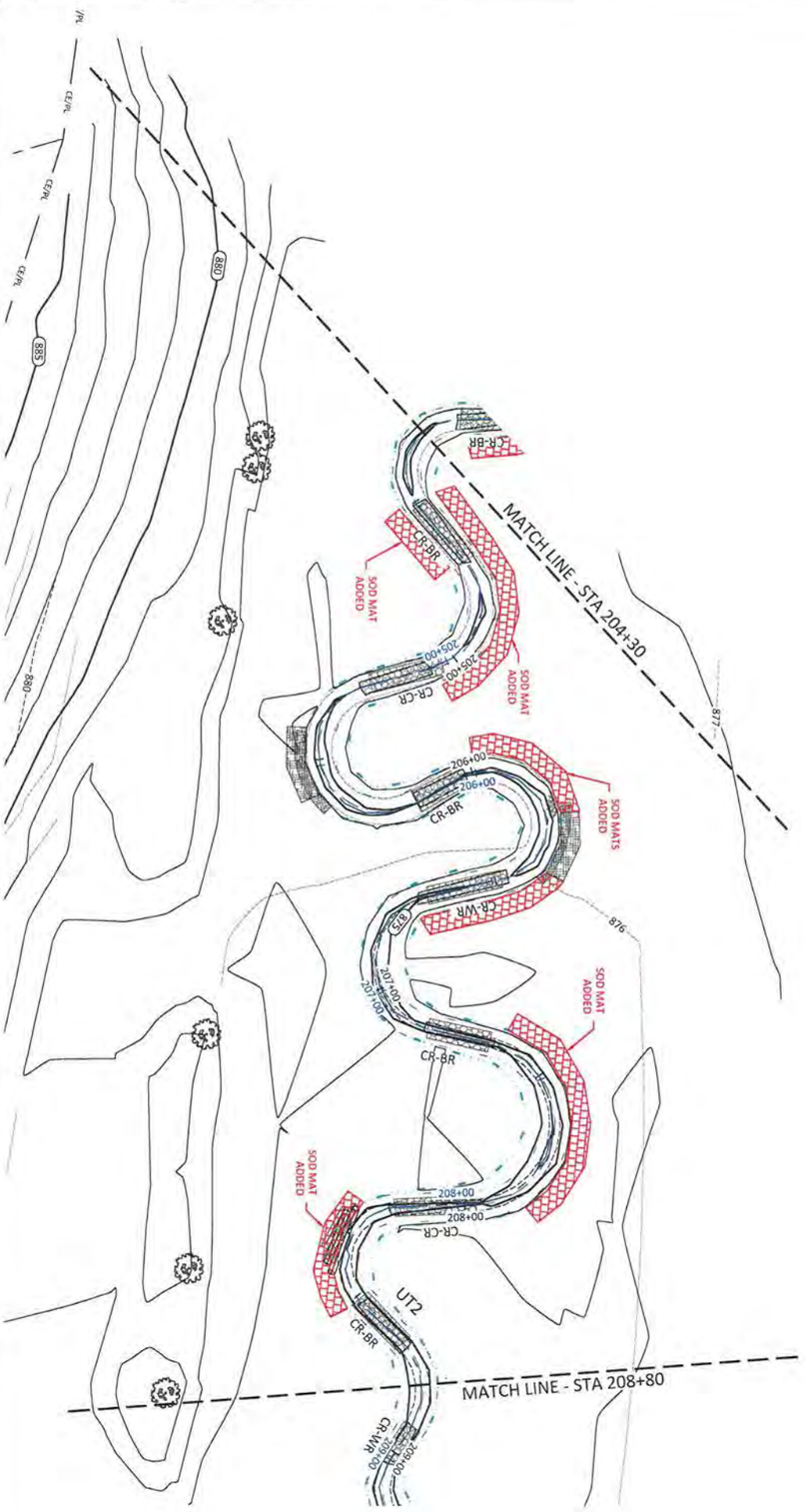
Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT2
Stream Plan and Profile

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:

Sheet 1.11



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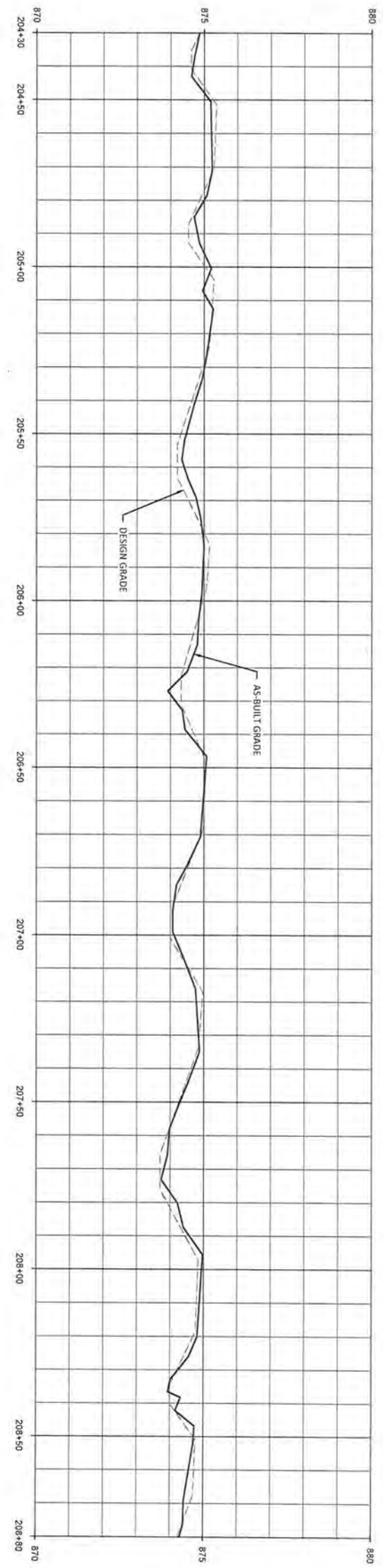

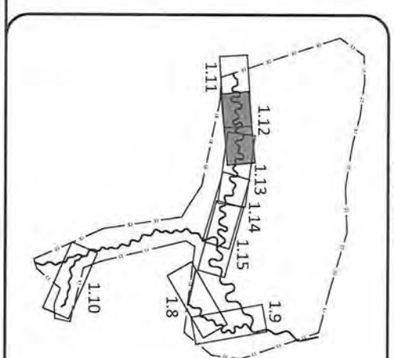

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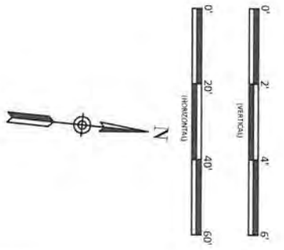

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:

1.12
Sheet

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT2
Stream Plan and Profile

NORTH CAROLINA SEAL 033578 JASON M. PATTERSON ENGINEER

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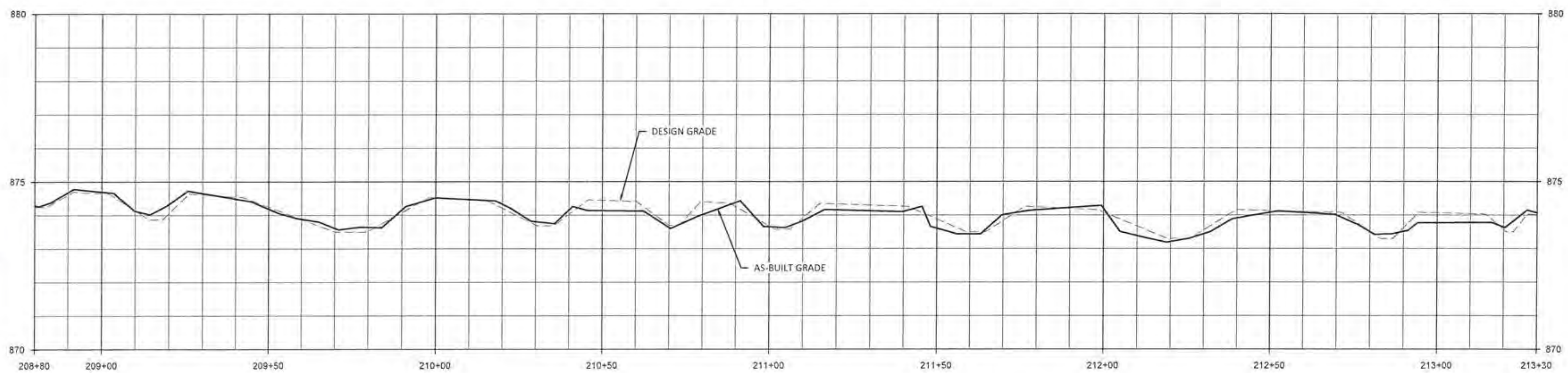
Fax: 704.332.3306
Firm License No. F-0831



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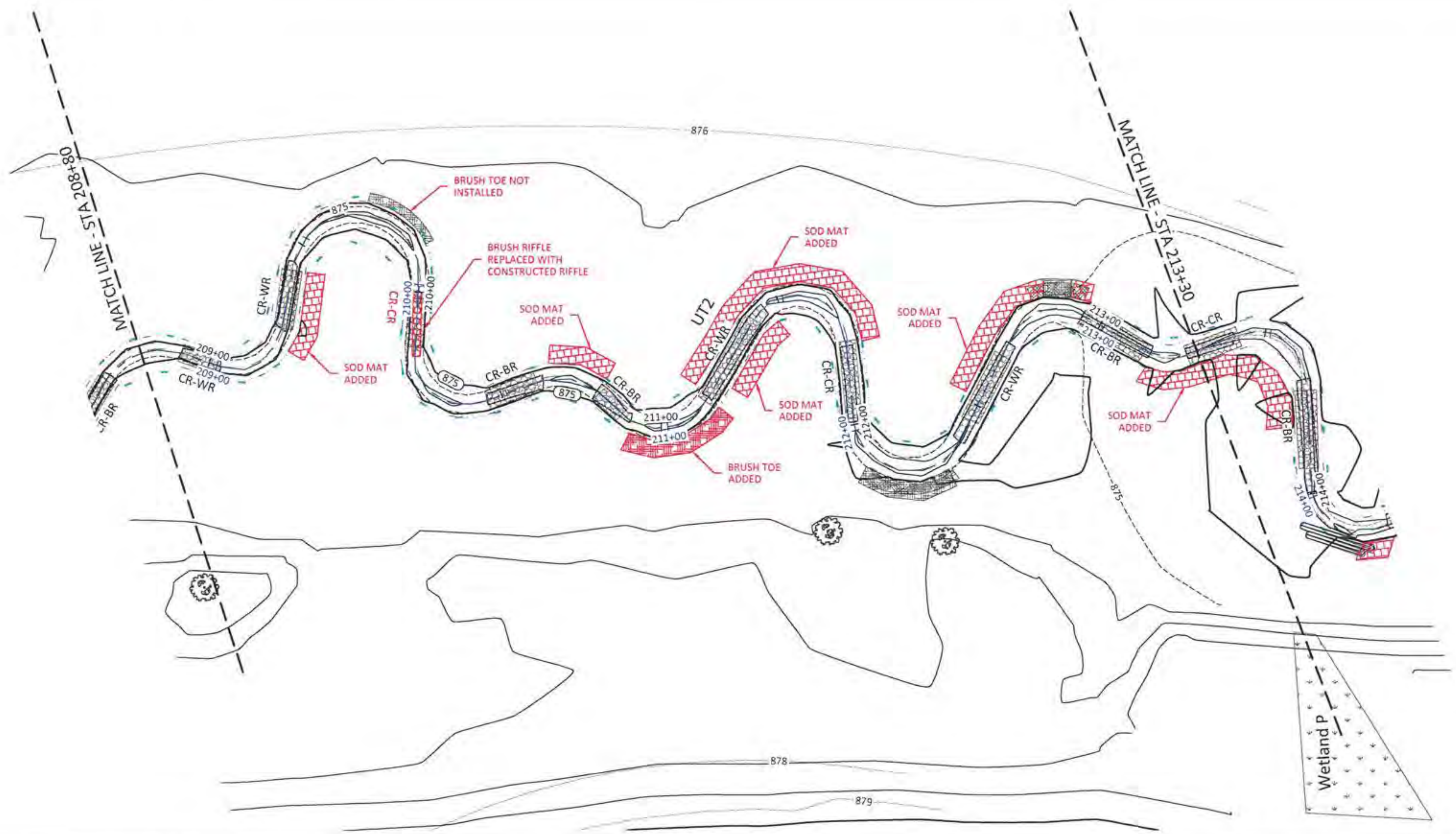
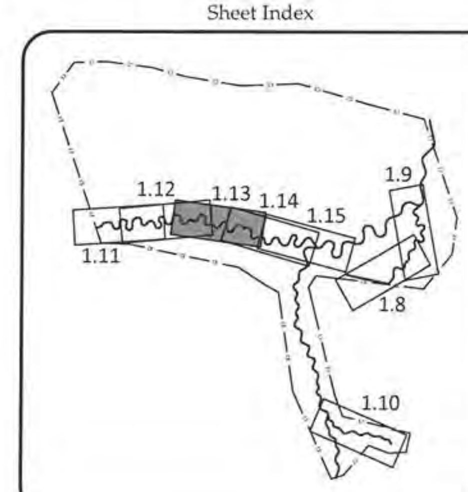


Sheet Index



Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT2
Stream Plan and Profile

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Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:
10/2/15 Fill area revision

Sheet 1.13

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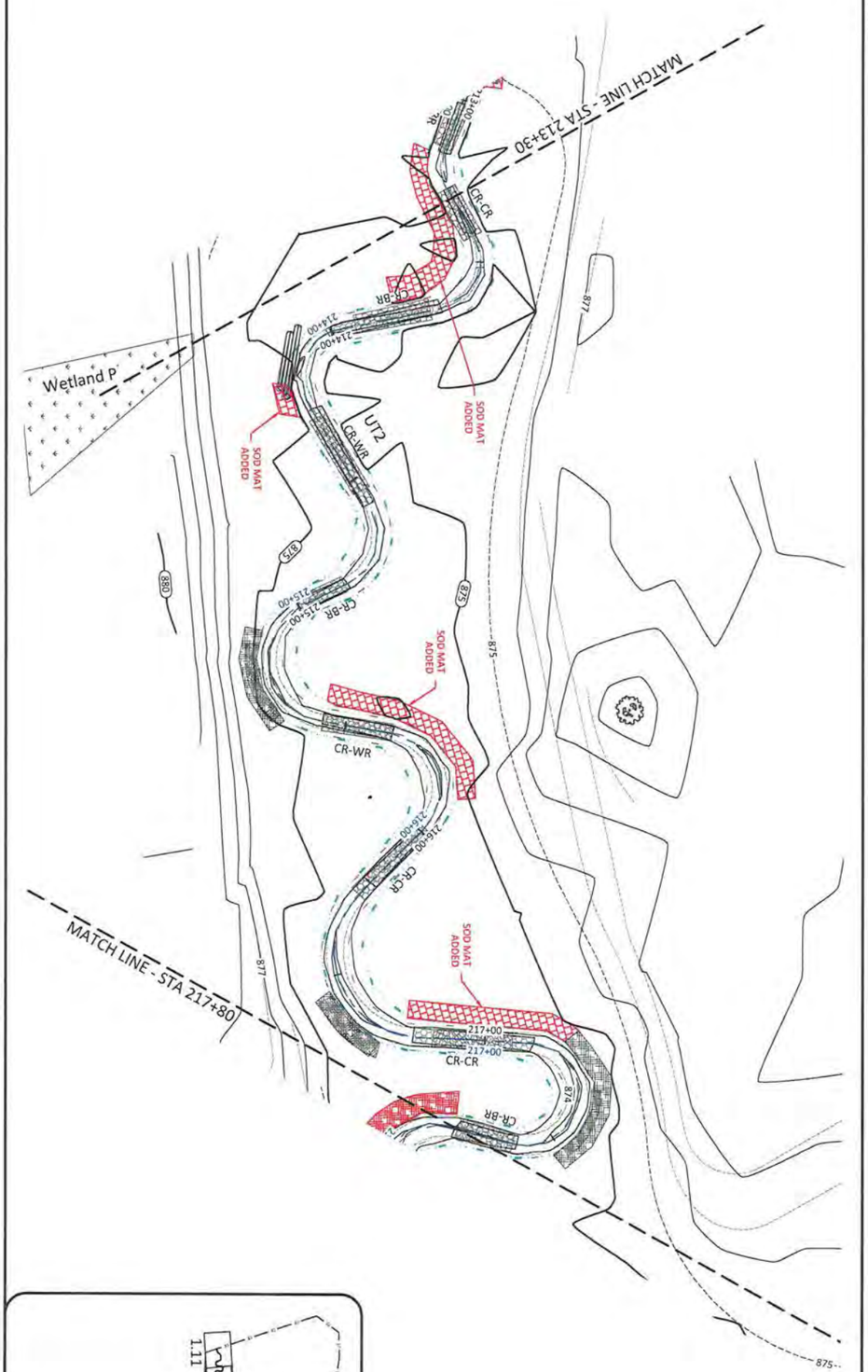
May 25, 2016



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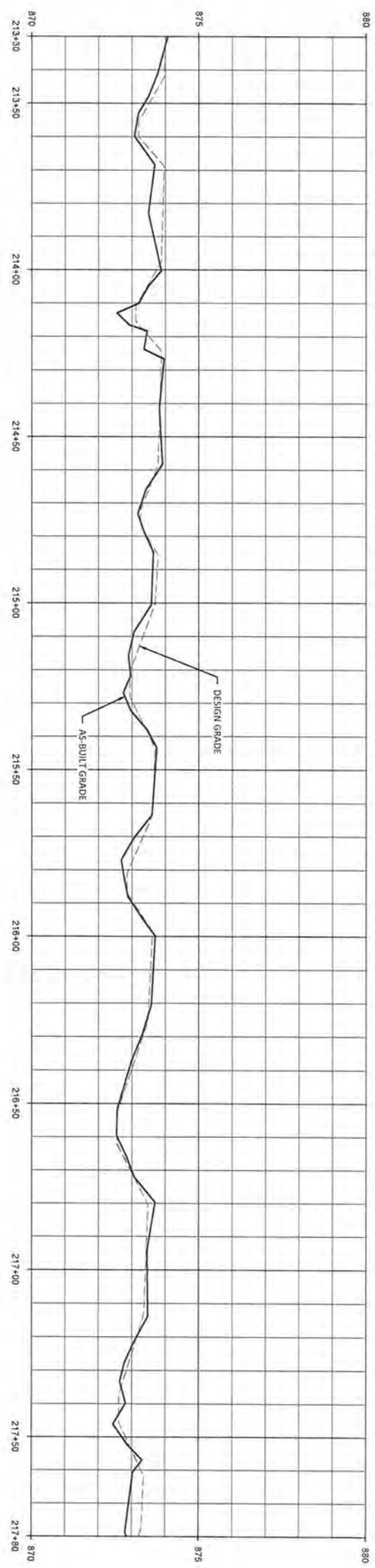

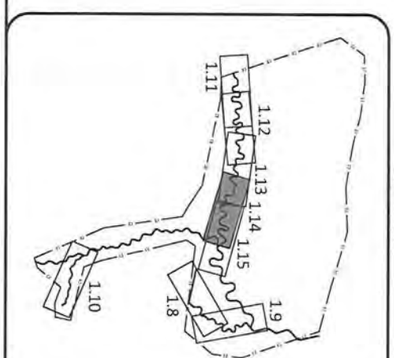

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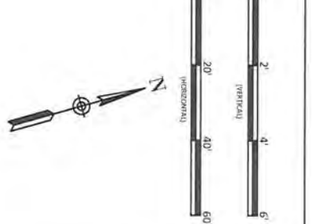


Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

1.14
Sheet

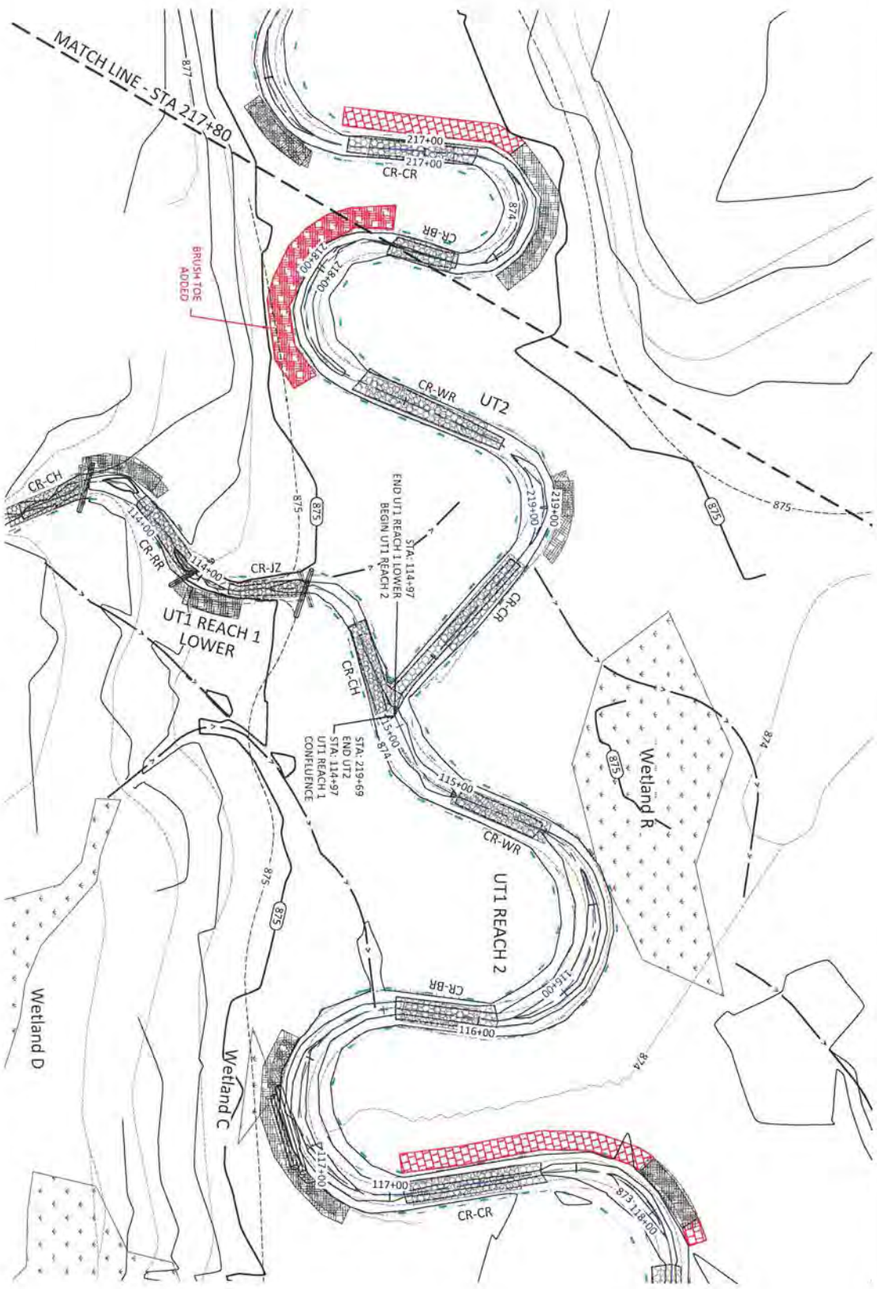
Revisions:

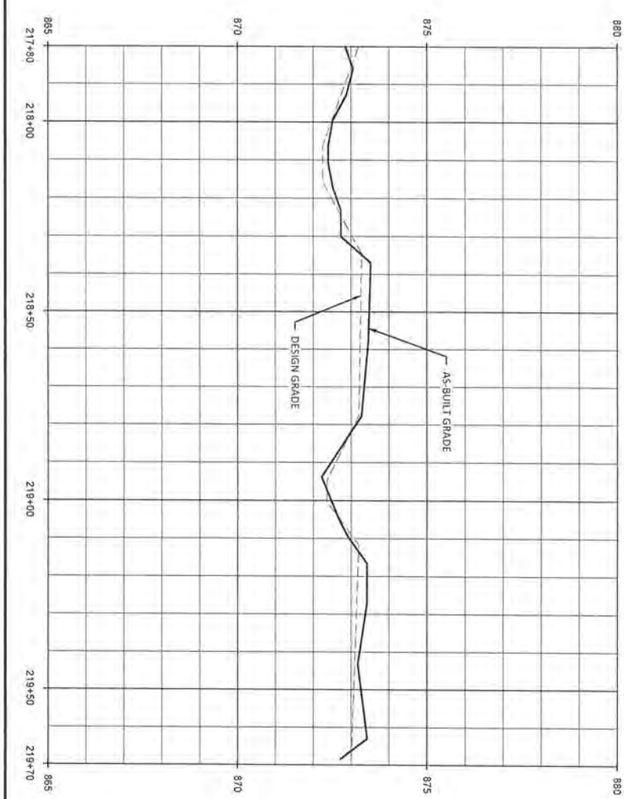
Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

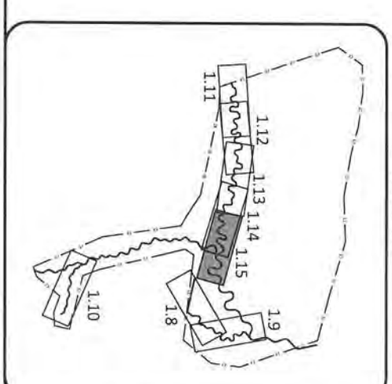
UT2
Stream Plan and Profile

WILDLANDS
ENGINEERING
167-B Haywood Road
Asheville, NC 28806
Tel: 828.774.5547
Fax: 704.332.3306
Firm License No. F-0831

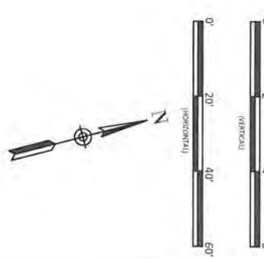
Note: Profile stations and match lines based on design alignment.







Sheet Index



Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

1.15
Sheet

Revisions:

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

UT2
Stream Plan and Profile

NORTH CAROLINA
JACOB McLEAN
SEAL
033578
ENGINEER

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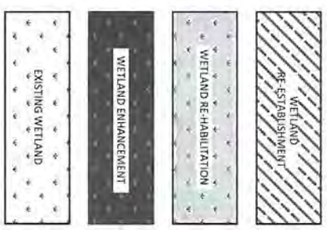

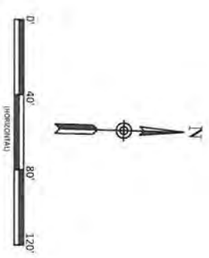

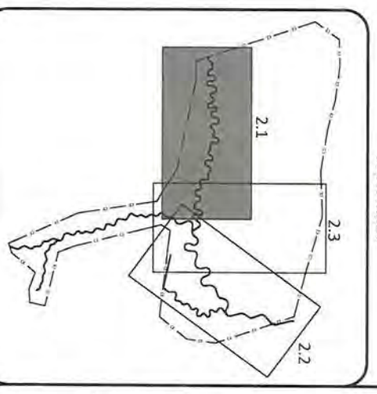

Sheet Index

Date:	May 25, 2016
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Drawn By:	RCP
Checked By:	JPM

Revisions:

2.1

Sheet

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

Wetland Grading

NORTH CAROLINA PROFESSIONAL SEAL 033578 ENGINEER JAMES M. HEATH

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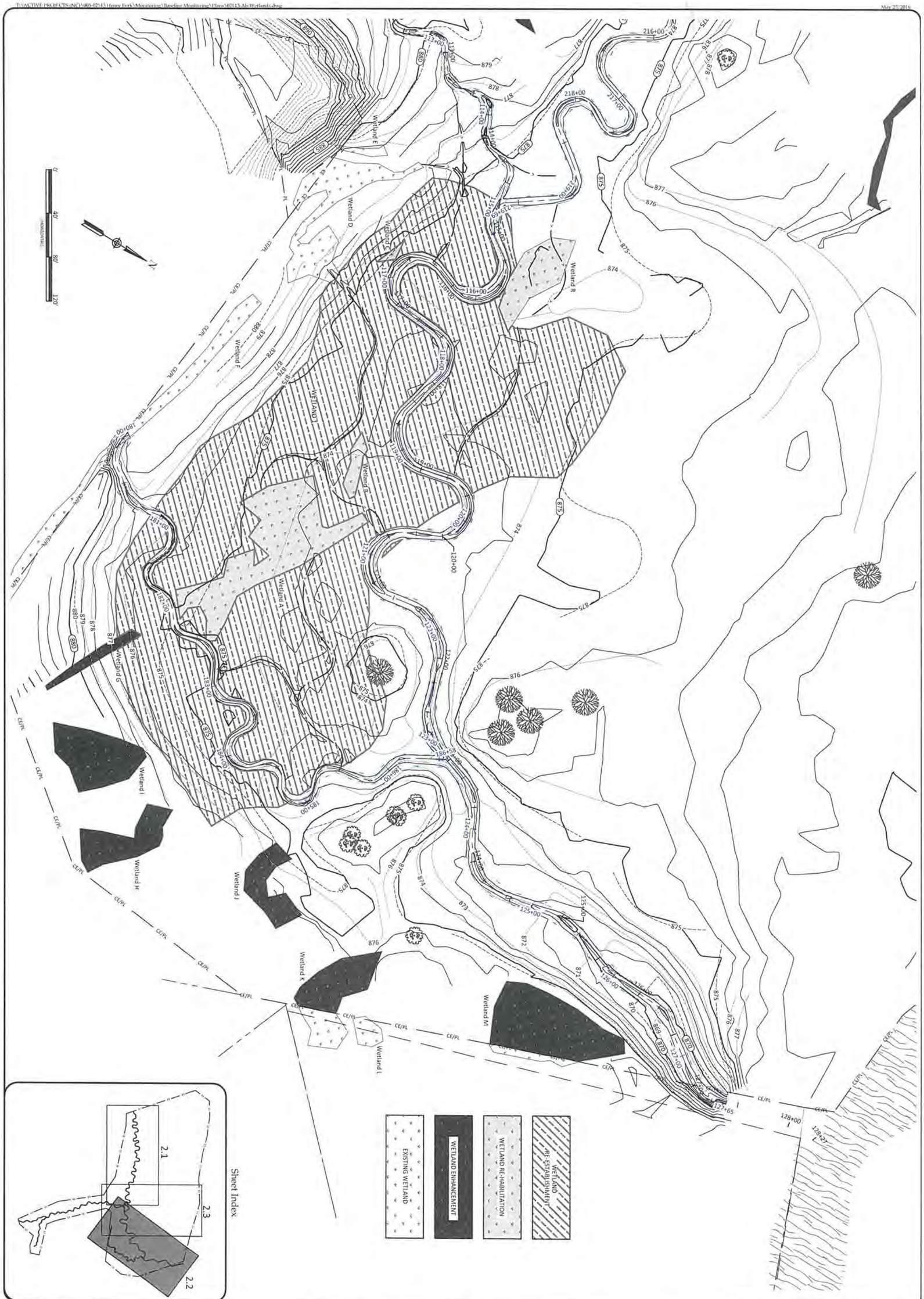

Sheet Index

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:

2.2
Sheet

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

Wetland Grading

NORTH CAROLINA SEAL 033578 ENGINEER JAMES P. MARTIN

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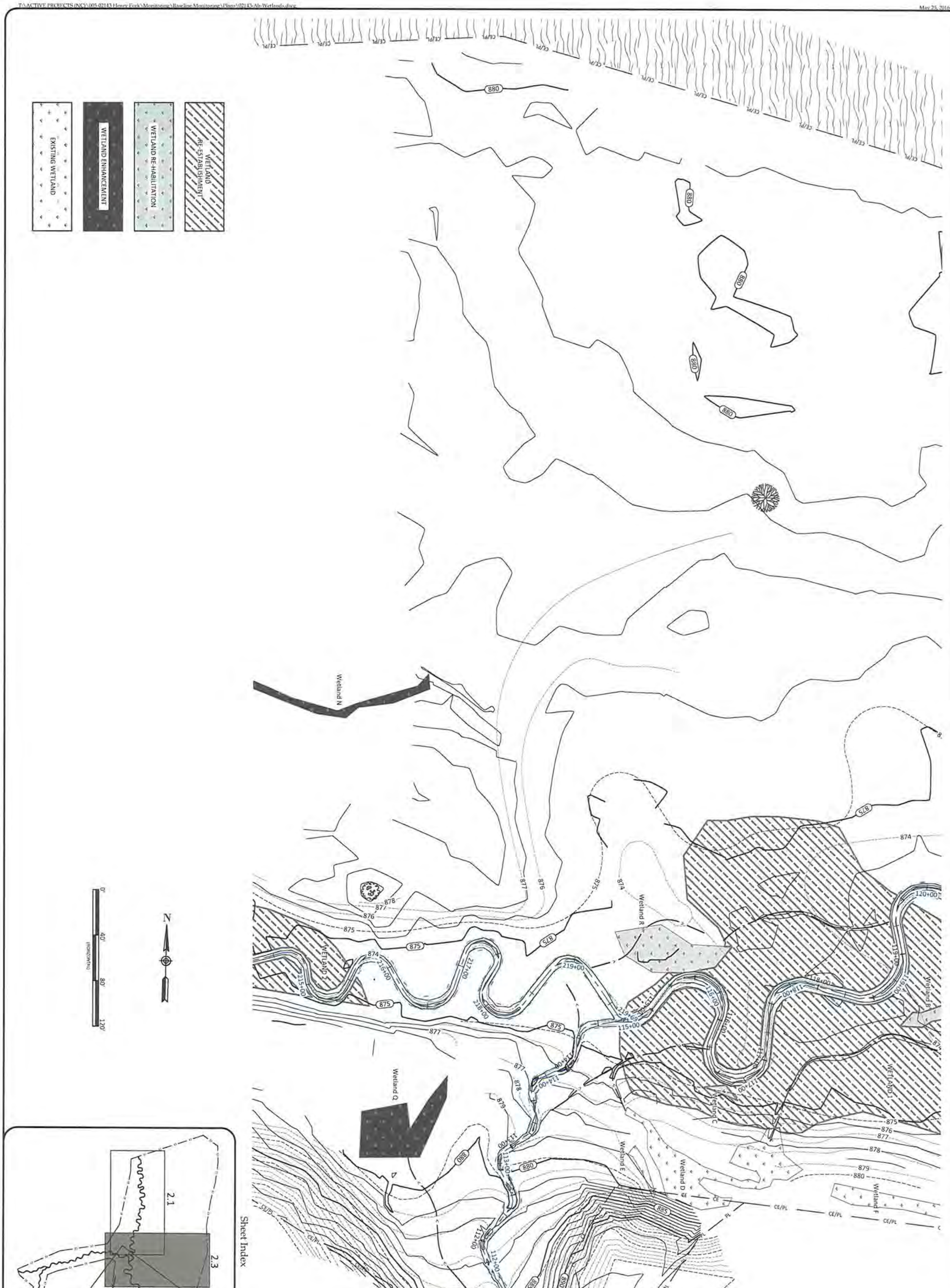
May 25, 2016



Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:

2.3

Sheet

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

Wetland Grading

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 033578 JACOB McLEAN

WILDLANDS ENGINEERING
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NOTE:
"PERMANENT SEEDING" IS FOR ALL DISTURBED AREAS WITHIN CONSERVATION EASEMENT. ALL DISTURBED AREAS SHALL RECEIVE TEMPORARY SEEDING AND MULCHING PER DETAIL 3/6.6 IN ADDITION TO PERMANENT SEEDING.

Approved Date	Scientific Name	Stratum	Common Name	Density (lbs/acre)
Permanent Seeding Pure Live Seed (20 lbs/acre)				
All Year	*Panicum rigidulum*	Herb	Redtop Panicgrass	2
All Year	*Agrostis hyemalis*	Herb	Winter Bentgrass	4
All Year	*Chasmanthium latifolium*	Herb	River Oats	3
All Year	*Rudbeckia subtomentosa*	Herb	Blackeyed Susan	2
All Year	*Coreopsis lanceolata*	Herb	Lanceleaf Coreopsis	2
All Year	*Carex vulpinoidea*	Herb	Fox Sedge	3
All Year	*Panicum clandestinum*	Herb	Deertongue	4

Wetland Bare Root Planting		
Scientific Name	Common Name	%
Platanus occidentalis	Sycamore	20%
Quercus phellos	Willow Oak	15%
Betula nigra	River Birch	15%
Fraxinus pennsylvanica	Green Ash	20%
Quercus michauxii	Swamp Chestnut Oak	15%
Acer rubrum	Red Maple	5%
Diospyros virginiana	Persimmon	10%
Populus deltoides	Eastern Cottonwood	10%

Riparian Root Planting		
Scientific Name	Common Name	%
Platanus occidentalis	Sycamore	20%
Quercus phellos	Willow Oak	15%
Betula nigra	River Birch	15%
Fraxinus pennsylvanica	Green Ash	20%
Quercus michauxii	Swamp Chestnut Oak	15%
Acer rubrum	Red Maple	5%
Diospyros virginiana	Persimmon	10%
Populus deltoides	Eastern Cottonwood	10%

NOTE:
ON SLOPING UPLANDS, PLANTING CONTRACTOR SHALL REDUCE ALL RIPARIAN BARE ROOT SPECIES PERCENTAGE, AND SUBSTITUTE AS 50% UPLAND SPECIES SUCH AS WHITE OAK, SOURWOOD, AMERICAN BEECH AND OTHER AVAILABLE UPLAND SPECIES APPROVED BY DESIGNER. THIS APPLICABLE FOR UT1 REACH 1, UT1B, AND ALSO UPSLOPE OF UT2. APPLICABLE AREAS REPRESENT 1 ACRE ON THIS SHEET.

Herbaceous Plugs				
Scientific Name	Common Name	Max Spacing	Indiv. Spacing	Min. Size
Juncus effusus	Common Rush	3ft	3ft	1"-2" plug
Carex lurida	Shallow Sedge	3ft	3ft	1"-2" plug

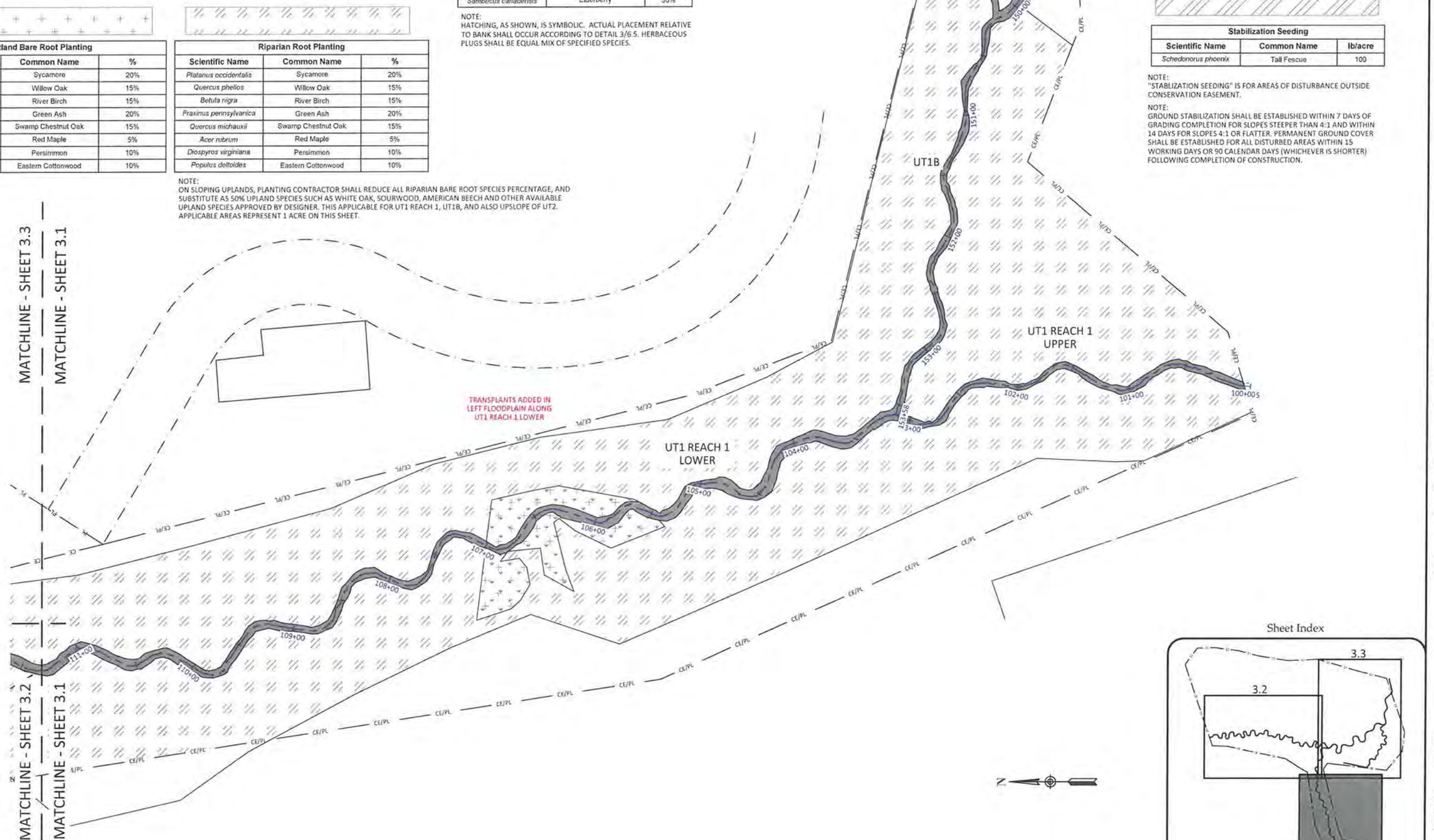
Live Stake		
Scientific Name	Common Name	%
Salix serecia	Silky Willow	40%
Cornus amomum	Silky Dogwood	30%
Sambucus canadensis	Elderberry	30%

NOTE:
HATCHING, AS SHOWN, IS SYMBOLIC. ACTUAL PLACEMENT RELATIVE TO BANK SHALL OCCUR ACCORDING TO DETAIL 3/6.5. HERBACEOUS PLUGS SHALL BE EQUAL MIX OF SPECIFIED SPECIES.

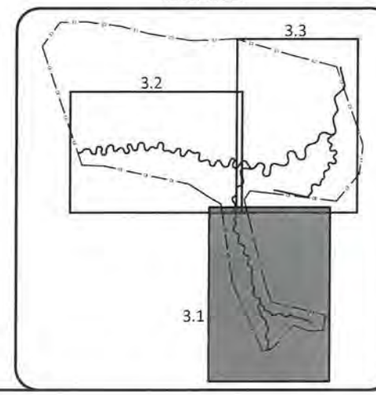
Stabilization Seeding		
Scientific Name	Common Name	lb/acre
Schedonorus phoenix	Tall Fescue	100

NOTE:
"STABLIZATION SEEDING" IS FOR AREAS OF DISTURBANCE OUTSIDE CONSERVATION EASEMENT.

NOTE:
GROUND STABILIZATION SHALL BE ESTABLISHED WITHIN 7 DAYS OF GRADING COMPLETION FOR SLOPES STEEPER THAN 4:1 AND WITHIN 14 DAYS FOR SLOPES 4:1 OR FLATTER. PERMANENT GROUND COVER SHALL BE ESTABLISHED FOR ALL DISTURBED AREAS WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER IS SHORTER) FOLLOWING COMPLETION OF CONSTRUCTION.



Sheet Index



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NORTH CAROLINA SEAL 033578 ENGINEER JAMES P. MCKEE

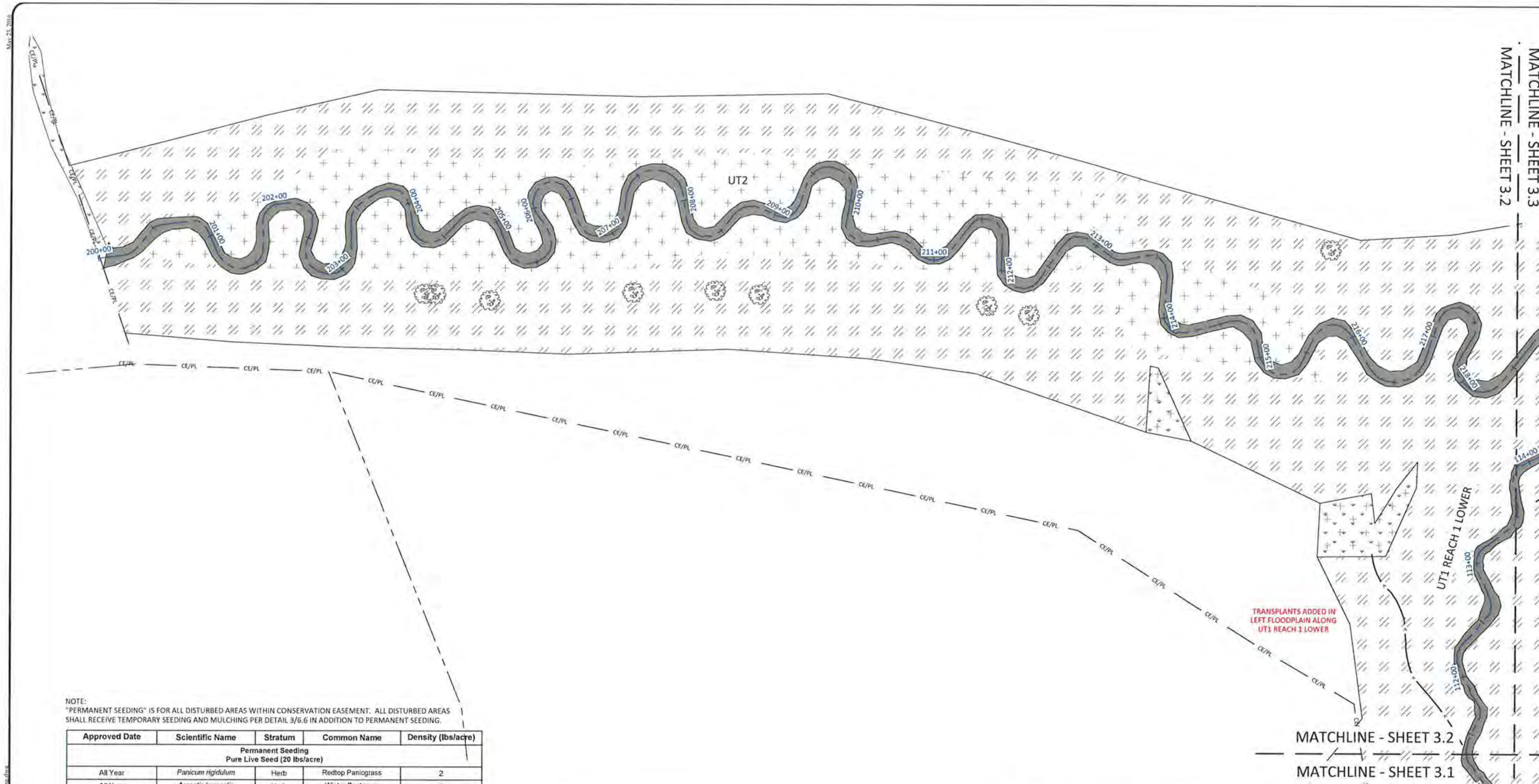
Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

Planting Plan

Revisions	

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Sheet 3.1



NOTE:
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Approved Date	Scientific Name	Stratum	Common Name	Density (lbs/acre)
Permanent Seeding Pure Live Seed (20 lbs/acre)				
All Year	*Panicum rigidulum*	Herb	Redtop Panicgrass	2
All Year	*Agrostis hyemalis*	Herb	Winter Bentgrass	4
All Year	*Chasmanthium latifolium*	Herb	River Oats	3
All Year	*Rudbeckia subtomentosa*	Herb	Blackeyed Susan	2
All Year	*Coreopsis lanceolata*	Herb	Lanceleaf Coreopsis	2
All Year	*Carex vulpinoidea*	Herb	Fox Sedge	3
All Year	*Panicum clandestinum*	Herb	Deertongue	4

Wetland Bare Root Planting		
Scientific Name	Common Name	%
Platanus occidentalis	Sycamore	20%
Quercus phellos	Willow Oak	15%
Betula nigra	River Birch	15%
Fraxinus pennsylvanica	Green Ash	20%
Quercus michauxii	Swamp Chestnut Oak	15%
Acer rubrum	Red Maple	5%
Diospyros virginiana	Persimmon	10%
Populus deltoides	Eastern Cottonwood	10%

Riparian Root Planting		
Scientific Name	Common Name	%
Platanus occidentalis	Sycamore	20%
Quercus phellos	Willow Oak	15%
Betula nigra	River Birch	15%
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NOTE:
ON SLOPING UPLANDS, PLANTING CONTRACTOR SHALL REDUCE ALL RIPARIAN BARE ROOT SPECIES PERCENTAGE, AND SUBSTITUTE AS 50% UPLAND SPECIES SUCH AS WHITE OAK, SOURWOOD, AMERICAN BEECH AND OTHER AVAILABLE UPLAND SPECIES APPROVED BY DESIGNER. THIS APPLICABLE FOR UT1 REACH 1, UT1B, AND ALSO UPSLOPE OF UT2. APPLICABLE AREAS REPRESENT 2/3 ACRE ON THIS SHEET.

Herbaceous Plugs				
Scientific Name	Common Name	Max Spacing	Indiv. Spacing	Min. Size
Juncus effusus	Common Rush	3ft	3ft	1"-2" plug
Carex lurida	Shallow Sedge	3ft	3ft	1"-2" plug

Live Stake		
Scientific Name	Common Name	%
Salix serecia	Silky Willow	40%
Cornus amomum	Silky Dogwood	30%
Sambucus canadensis	Elderberry	30%

NOTE:
HATCHING, AS SHOWN, IS SYMBOLIC. ACTUAL PLACEMENT RELATIVE TO BANK SHALL OCCUR ACCORDING TO DETAIL 3/6.5. HERBACEOUS PLUGS SHALL BE EQUAL MIX OF SPECIFIED SPECIES.

Stabilization Seeding		
Scientific Name	Common Name	lb/acre
Schedonorus phoenix	Tall Fescue	100

NOTE:
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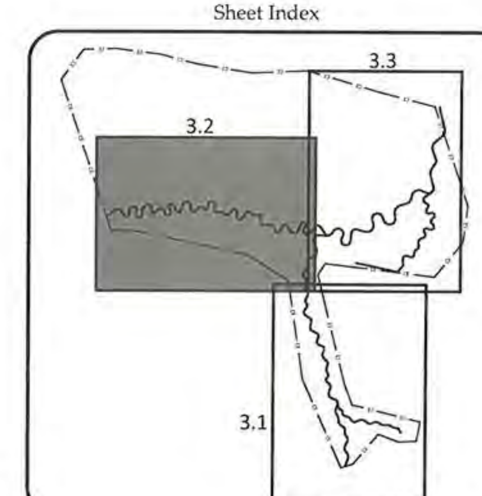
(HORIZONTAL)

Sheet Index



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Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

Planting Plan

Revisions:

Date: May 25, 2016
Job Number: 003-02143
Project Engineer: JPM
Drawn By: RCP
Checked By: JPM

Sheet 3.2

Approved Date	Scientific Name	Stratum	Common Name	Density (lbs/acre)
Permanent Seeding Pure Live Seed (20 lbs/acre)				
All Year	*Panicum rigidulum*	Herb	Redtop Panicgrass	2
All Year	*Agrostis hyemalis*	Herb	Winter Bentgrass	4
All Year	*Chasmanthium latifolium*	Herb	River Oats	3
All Year	*Rudbeckia subtomentosa*	Herb	Blackeyed Susan	2
All Year	*Coreopsis lanceolata*	Herb	Lanceleaf Coreopsis	2
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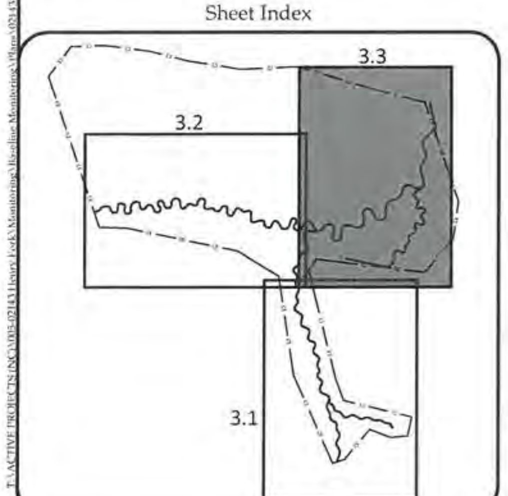

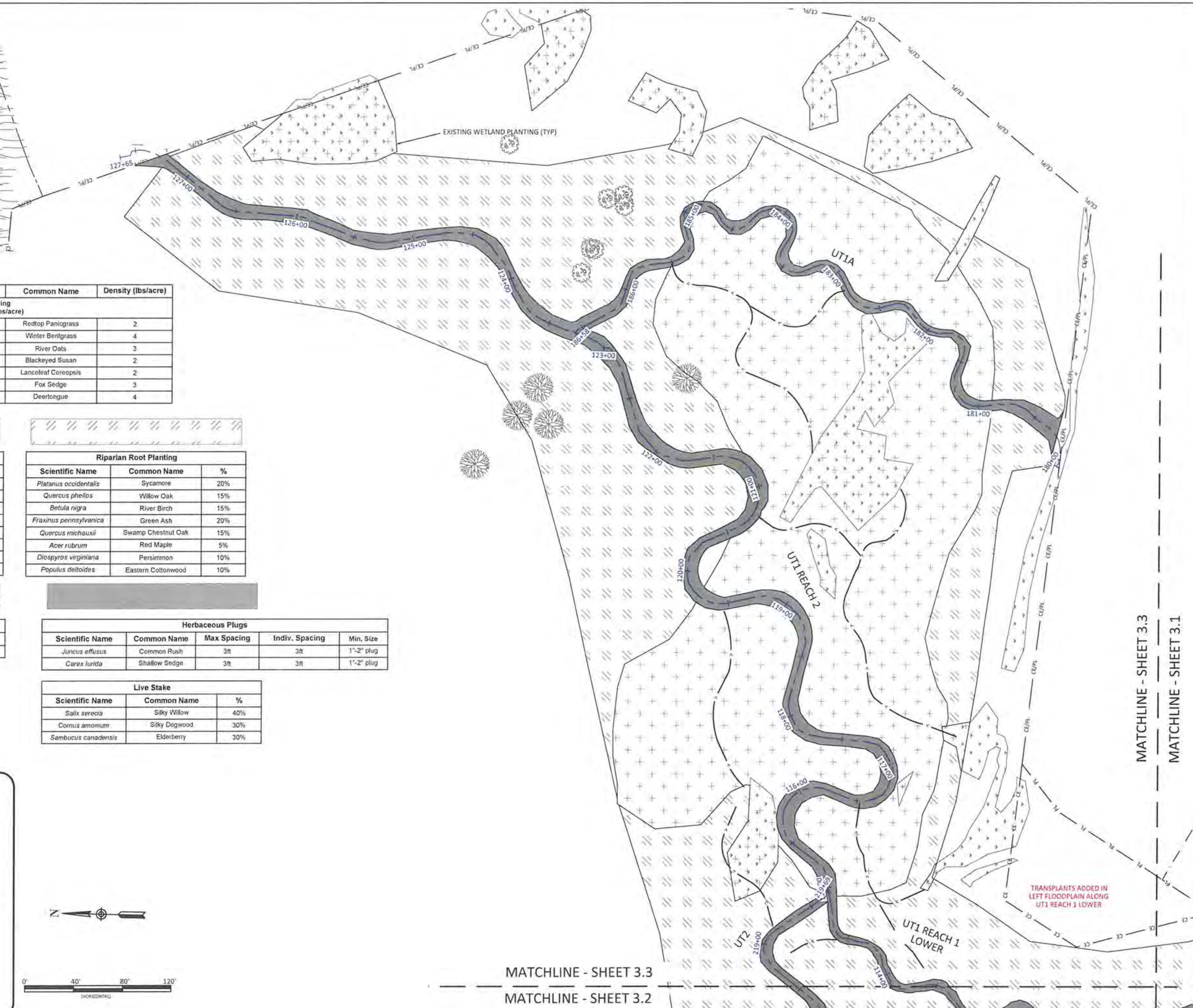

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Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

Planting Plan

Date:	May 25, 2016
Job Number:	005-02143
Project Engineer:	JPM
Drawn By:	RCP
Checked By:	JPM

Revisions:

Sheet 3.3

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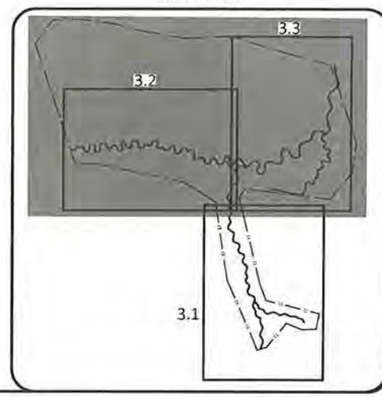

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 033578 JAMES P. MCKEE

Henry Fork Mitigation Site Record Drawings
Catawba County, North Carolina

Planting Plan

Revisions:

Date: May 25, 2016
Job Number: 005-02143
Project Engineer: JPM
Drawn By: RCP
Checked By: JPM

Sheet 3.4

Mar 25, 2016
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