Baseline Monitoring Document
and
As-built (MY0) Baseline Report

FINAL

Upper South Hominy Mitigation Site,
South Hominy Creek, French Broad River Basin,
Buncombe County, North Carolina

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Prepared by the North Carolina Wildlife Resources Commission
in Partnership with the

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

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1 Executive Summary

This North Carolina Ecosystem Enhancement Program (NCEEP) project preserved, restored, and enhanced approximately 5,951 ft of perennial stream channel on the mainstem of South Hominy Creek (2,820 ft) and on three unnamed tributaries (3,131 ft) that feed into South Hominy Creek within the project area. Additionally, 1.35 acres of wetland habitat was preserved or enhanced within the project area. The NCEEP contracted with the North Carolina Wildlife Resources Commission (NCWRC) under task order 08FB05-1b-d to prepare a mitigation plan, acquire permits, manage informal contracts, oversee construction, and monitor post-construction channel performance and riparian vegetation. The Upper South Hominy mitigation site aims to provide approximately 3,497 stream mitigation units and 0.60 wetland mitigation units to the NCEEP.

The project site is located in Buncombe County, North Carolina, approximately 5.5 miles southwest of Candler, North Carolina. The Upper South Hominy (USH) mitigation site is located on properties owned by Joe and Molly Bianculli, Lori Bura, James Roberson, and Julia Davis. Combined, a 16.44 acre conservation easement was established. The conservation easements for the four properties were conveyed to the North Carolina State Properties Office between March and June of 2009. The USH mitigation site is located within the French Broad River basin cataloguing unit 06010105 and within the targeted local watershed hydrological unit 06010105060020.

In 2005, the NCEEP developed a Local Watershed Plan for the South Hominy Creek (SHC) watershed. The objective of the plan was to develop a set of management strategies to restore and protect the functional integrity of the watershed, to identify and prioritize stream and wetland project opportunities and to address functional deficits. Specific project sites were identified and prioritized based on a number of factors including the potential for functional improvement, site constraints, potential stream mitigation units, location within the watershed, and the number of landowners per site. The USH mitigation project is located within the SHC Local Watershed Plan area. Coupled with the extensive farm and livestock Best Management Practices, the project will help to address stream and wetland function by targeting aquatic habitat, water quality, and riparian habitat as identified in the LWP study.

Historic land use in the immediate vicinity of the project site has consisted of residential homes and low intensity agricultural operations primarily consisting of livestock grazing and hay production. Stream channels within the project area were historically accessed by livestock, resulting in disturbances to the channel banks and wetland areas. Additional land use practices included removal of large woody riparian vegetation to increase land area for grazing and hay production and mechanized dredging and straightening of stream channels to increase the amount of usable land. These activities have contributed to degraded and unstable stream banks along with compromised water quality due to lack of vegetated buffers, soil erosion, and animal waste.

Construction approaches were assigned with the intent to minimize disturbance to the stream channels and riparian buffers and focus on those reaches that would benefit most from the appropriate level of site work. As such, areas with stable channel conditions and desirable riparian vegetation were placed into preservation. Other reaches were treated with restoration and enhancement level I and II site work to improve stream functions and terrestrial habitats that were compromised under the existing site conditions.

Restoration site work on SHC was assigned to the reaches where dimension, pattern, and profile modifications were necessary to correct areas of instability including incision, eroding banks, and over-widened and homogenous channel segments. All SHC restoration site work was performed using the Priority III approach. The remaining reaches of SHC were treated with enhancement level I and level II site work.

Tributary channels and associated riparian buffers were treated with the appropriate level of site work to restore ecologic functions that had been lost. These tributary reaches were treated with the appropriate amount of site work to preserve, restore, and enhance channel reaches and associated riparian buffers. The upper reaches of the Bianculli tributary north (UT1) and the Davis unnamed tributary (UT3) were preserved. Restoration level site work on the lower portions of the Bianculli UT1 and the Davis UT3 were conducted using a Priority I strategy. Restoration Priority I strategies were applied to the lower portion of the Bianculli tributary south (UT2) and the Roberson abandoned channel (UT2) to reconnect that portion of the channel to the historic floodplain that was abandoned during former roadside ditch construction. The remaining reaches of the tributary channels, including Bianculli UT2 and the middle portion of Davis UT3, were treated with enhancement level II strategies.

In-stream installation of rock and wood structures was utilized throughout the restored and enhanced reaches of SHC. Rock cross vanes and J-hook structures were constructed for grade control to prevent head-cut formation, to promote stable banks on outside of meander bends, and to increase bed form diversity. Log vanes and root wads were installed along selected reaches to reduce near bank stress and increase in-stream habitat. Similar materials and structure types were utilized on the tributary channels, specifically to address grade control, channel slope, and bed form diversity. On-site materials, particularly logs and root wads were salvaged and incorporated into site construction as much as possible. Additional materials such as large rock boulders were purchased from a local quarry and hauled to the construction site.

Site work targeted reconnecting the SHC channel and tributary channels with historic floodplains and creating floodplain benches at the desirable elevations to attenuate high flow events. Periodic out of bank flows along with spring seep hydrology should promote and sustain hydric soil characteristics and wetland vegetation types in those areas supporting jurisdictional wetlands. Areas currently supporting jurisdictional wetlands were enhanced by excluding livestock, removing invasive exotic vegetation, planting wetland vegetation and creating ephemeral pools.

The as-built survey revealed that construction activities at the USH mitigation site in 2011 followed the approaches outlined the in the USH Mitigation Plan (NCWRC 2010). Dimension, pattern, and profile parameters surveyed in monitoring year-1 (MY0) 2011 suggest the restoration, enhancement level II and enhancement level I sections of SHC are performing as designed with little to no variation from design values. Small deviations were found in bankfull width at two riffle cross-sections (XS1 and XS10). Bankfull width at these two cross-sections was slightly below the design value. However, problem areas or instability were not observed at either cross-section. By in large, all other dimensional parameters measured at the 10 cross-sections were within the design values for SHC. Pattern and profile values derived from the as-built survey reveal that the mainstem reaches of SHC are within the design values for these the two morphological parameters. Reach-wide substrate particle size analysis revealed that the D50 value for the as-built channel falls within the coarse gravel category. The median particle size at each of the 6 riffle cross-sections fell within coarse to very coarse gravel categories during the MY0 survey.

As-built morphological results for the three unnamed tributaries revealed that construction activities followed the approaches outlined the in the Upper South Hominy Mitigation Plan. Although small variations from design values were noted in dimensional parameters such as bankfull width (UT3 Upper-XS1 riffle) and bankfull cross-sectional area (UT3 Lower-XS2 riffle), the three unnamed tributaries are stable and performing as designed. Moreover, the significant storm event on 28 November 2011 did not have any observed negative effects on any of the three unnamed tributaries.

Problem areas were noted during the MY0 survey. Following a significant storm event on 28 November 2011, right channel bank sloughing, J-hook arm scour, and bar formation was observed in the Mainstem 1 reach from sta. 1+50 to 2+50. A second problem area was observed on Mainstem 2, sta. 9+25 to 9+75, where a large amount of bed material formed a mid-channel bar below a J-hook stream structure. Overall, SHC was minimally impacted by the severe storm event. The MY0 survey found the majority of the 2,820 ft of mainstem channel was stable and performing as designed. Repair plans and Scope of Work will be developed and presented to NCEEP to address the needed modifications to the problem areas.

A total of 184 planted stems were counted in the ten vegetation plots established during the MY0 survey. The average density of planted woody stems recorded in the ten 100 m^2 vegetation plots combined was 749 stems per acre. Out of the ten vegetation plots, only vegetation plot 8 contained lives stake stems. The planted stems in the remaining nine vegetation plots consisted of both native bare-root whips or containerized stock. All ten vegetation plots exceeded the success criteria for vegetation stem density during the as-built baseline survey.

Although non-native invasive vegetation remains present at the mitigation site, it is less prevalent, compared to before construction. Invasive vegetation treatments were effective during the construction phase of the project and will be routinely continued throughout the monitoring phase.

Overall, the USH mitigation site included 1,093 ft of stream preservation, 1,994 ft of stream restoration, 522 ft of stream enhancement level I, 2,342 ft of stream enhancement level II, 1.11 acres of wetland enhancement, and 0.24 acres of wetland preservation. A total of 16.44 acres of stream channel, riparian buffer, and jurisdictional wetlands are protected by a perpetual conservation easement managed by the NCEEP. It is anticipated that this site should yield 3,498 stream mitigation units and 0.50 wetland mitigation units.

2 Project Background Information

2.1 Project Goals and Objectives

The goals of the USH mitigation project include:

1. Improve water quality in SHC and unnamed tributaries (UT1-3);
2. Stabilize on-site streams so they transport watershed flows and sediment loads in equilibrium;
3. Promote floodwater attenuation and all secondary functions associated with more frequent and extensive floodwater contact times;
4. Improve in-stream habitat by improving the diversity of bed form features;
5. Protect riparian communities, habitats, and wetlands and enhance floodplain community structure; and
6. Enable improved livestock practices which will result in reduced fecal, nutrient, and sediment loads in surface waters.

The objectives of the USH mitigation project include:

1. Preservation of 1,093 linear feet of relatively un-impacted stream channel and forested riparian area by placing them in a conservation easement for perpetuity;
2. Restoration of the pattern, profile, and dimension of 1,148 linear feet of the main stem of SHC;
3. Restoration of channel dimension, pattern, and profile of 846 linear feet of unnamed tributaries to SHC on the Bianculli, Bura/Roberson, and Davis properties;
4. Restoration of dimension and profile (enhancement level I) of the channel on 522 linear feet of SHC along the Davis property;
5. Limited channel work combined with livestock exclusion and invasive species control (enhancement level II) on 2,342 linear feet along SHC and unnamed tributaries;
6. Invasive plant species control measures across the entire project wherever necessary;
7. Preservation or enhancement of approximately 1.35 acres of wetlands across the project site; and
8. Livestock exclusion fencing and other best management practice installations on the Bianculli, Roberson, and Davis properties.

2.2 Locations and Setting

The USH mitigation site is located in southwest Buncombe County, North Carolina, approximately 5.5 miles southwest of the town of Candler, North Carolina (Figure A.1). To access the site from Asheville, North Carolina, take I-40 west to the Enka Candler exit (Exit 44). At the light, turn right onto Smokey Park Highway/US-19S/US-23S and proceed 3.0 miles. Turn left on Pisgah Highway/NC-151S and proceed for 6.0 miles. Turn right on SR1103/S Hominy Road. Proceed 0.2 miles on SR1103/S Hominy Road then turn right on Connie Davis Lane. Connie Davis Lane is a private unpaved driveway that accesses the Bura and Davis properties and the lower end of the project site. A narrow driveway bridge crosses SHC approximately 0.3 miles from the start of Connie Davis Lane. A large fescue pasture to the right of the driveway and bridge, used for parking, is located at a latitude/longitude of 035° 28' 51.10" North and 082° 44' 52.45" West. Access to the upper portion of the reach will be from the second drive to the right past Connie Davis Lane. Turn right off of SR1103/S Hominy Road on to Canter Field Lane, a private drive, 0.25 mile after passing Connie Davis Lane. A fescue pasture located to the left of the private driveway and before the one lane bridge will be used for parking. The pasture is located at a latitude/longitude of 035° 28' 39.35" North and 082° 45' 01.06" West.

The USH mitigation site is located in the upper portion of the SHC watershed (Figure A.2). Most of the first and second order headwater tributaries originate below ridgelines and peaks that range in height from 3,000 to over 4,000 ft in elevation. The southern portion of the watershed drains from the highest peak, Mount Pisgah, at a height of 5,721 ft. The drainage area for SHC at the lower end of the project site is 7.1 mi^2 (4,515 ac). The three tributaries named for the purpose of this project as tributary north (Bianculli property, UT1), tributary south (Bianculli property, UT2) each have drainage areas <0.1 mi^2. The unnamed tributary on the Davis property (UT3) has a drainage area of 0.1 mi^2 (66.7 ac).

The USH mitigation site is located in the Hominy Creek watershed of the French Broad River basin, United States Geological Survey (USGS) 8-digit cataloguing unit 06010105 and 14-digit hydrologic unit 06010105060020 and within the North Carolina Division of Water Quality (NCDWQ) sub-basin 04-03-02. South Hominy Creek has been assigned the Stream Index Number 6-76-5 by the NCDWQ.

2.3 Project Structure, Restoration Type, and Approach

Overall, the project site consists of approximately 5,951 ft of stream channels, as measured from the channel thalweg on the as-built drawings. A total of 16.44 acres of aquatic and riparian habitats are held in a perpetual conservation easement. Channel morphology was modified by implementing multiple restoration levels and construction approaches (Table A.1). Project assets and components are summarized in Figure A.3. Channel restoration was accomplished on 1,148 ft of SHC along with 522 ft of enhancement level I and 1,150 ft enhancement level II mitigation. The Bianculli tributary north (UT1) was preserved (94 ft) in the upper portion; the lower 183 ft was restored to provide stable channel banks and connectivity with a bankfull or floodplain feature. The Bianculli tributary south (UT2), including the portion of the formerly abandoned channel on the Roberson property, was mitigated using enhancement level II (654 ft) and restoration (236 ft) actions. The unnamed tributary on the Davis property (UT3) was preserved on the upper most 777 ft, enhanced through the middle 538 ft, and restored on the lower 427 ft. The two small spring fed channels on the Davis property (spring seep north 144 ft; spring seep south 78 ft) was placed into preservation.

2.4 Project History and Background

Land use in the USH watershed consists largely of forested areas, pasture land, hay fields, and low density residential development (NCWRC 2010). Although land use has resulted in the creation of impermeable surfaces within the watershed, impervious areas are primarily from low density residential development and roads. Low intensity residential and open space land use comprises approximately 3.0% of the watershed, and imperviousness in the watershed is 0.14%

(Yang et al 2002; Homer et al 2004). Future residential development pressures can be expected from the current trend of influx of people to Buncombe County and western North Carolina in general; however, dramatic changes in land use in the SHC watershed are not anticipated in the immediate future.

On-site land uses include livestock grazing, hay production, forested areas, and low density farm and residential developments. Grazing of livestock has occurred over many years and access to the stream channels has not been prohibited. Narrow riparian areas and lack of exclusionary fencing have contributed to the degradation of on-site wetlands and channels banks.

The NCEEP acquired the project site from four landowners (Suzanne Loar, Patrick Roberson, James Roberson, and Julia Davis). Following site acquisition, the Loar property was sold to Joe and Molly Bianculli and the Patrick Roberson property sold to Lorri Bura. The NCWRC performed the initial site assessment, designed the restoration plans, and provided construction oversight (NCWRC 2010). Construction of the USH mitigation project took place between 20 June and 30 November 2011. Stream and riparian impacts were addressed using natural channel design techniques, eliminating livestock access to the riparian areas and stream channels, and removing all foreign materials (old fencing, scrap metals, out buildings, etc.) from within the project footprint. The as-built morphological surveys were completed in February 2012. Vegetation planting was completed in December 2011 through February 2012; the baseline vegetation survey was completed in February 2012. Project reporting history and contact information are presented in Tables A.2 and A.3. Project attributes for SHC, UT1, UT2, and UT3 are presented in Table A.4.

3 Methods and Success Criteria

Post-construction conditions for the USH mitigation site were determined during December 2011 – February 2012 (MY0). Representative cross-sectional dimensions and longitudinal profile data were collected using standard stream channel survey techniques (Harrelson et al. 1994; NCSRI 2003). The geomorphology of the stream was classified using the Rosgen (1994, 1996) stream classification system. Project site, reference reach, and as-built conditions were analyzed and the project design developed using RIVERMorph stream assessment and restoration software, Version 5.0.1 (RSARS 2010). AutoCAD and Carlson engineering software (2012) were used in to develop the project design and generate plan drawings. U.S. Geological Survey 1:24,000 topographical maps were used to determine stream drainage area. Mountain regional hydraulic geometry curve data were used as a field guide and in the design plan (Harman et al. 1999, 2000; Doll et al. 2002). Bed material composition and mobility was assessed pre-project and during the post construction monitoring by doing a reach-wide and riffle cross-section pebble counts (NCSRI 2003). Vegetation surveys and data reduction were completed following established Carolina Vegetation Survey protocols (Lee et al. 2006). Additional project monitoring components were performed following the guidance of the NCEEP Baseline Monitoring Document (NCEEP 2010). References to the left and right channel banks in this document are oriented when viewing the channel in the downstream direction.

Monitoring protocols and performance criteria will follow what is outlined in the NCEEP site specific mitigation plan for the USH mitigation site and the USACE Stream Mitigation

Guidelines (USACE 2003). Site monitoring will consist of data collection, analysis, and reporting on channel stability and survival of riparian vegetation and will be conducted on an annual basis for a minimum of 5 years post construction.

3.1 As-built Plan View

The as-built survey data and plan view sheets provide a means to compare project site conditions following construction to the design specifications and to the projects performance over the five year monitoring period. The as-built plan view sheets not only provide a baseline condition of the project sites channel geomorphology, stability, and riparian vegetation following construction but also reveal the location of all fixed point survey locations for the mitigation site (Figure D.1).

In all, 14 cross-sections were established on SHC, UT2, and UT3 and surveyed per the NCEEP's guidance in the Baseline Monitoring Document (NCEEP 2010). Ten cross-sections were established on SHC, six riffles and four pools. Riffle (XS1, XS3, XS5, XS7, XS8, and XS10) and pool (XS2, XS4, XS6, and XS9) cross sections will be resurveyed in each of following five monitoring years to compare channel morphology and stability over time. One cross-section was established on the restored section of UT2, Roberson property. Three cross-sections (riffles: XS1 and XS2; pool: XS3) were established on restored portion of UT3, Davis property.

The longitudinal profile of the entire mainstem of SHC was surveyed following construction and will be repeated in each of the five monitoring years to evaluate thalweg movement and change in channel slope. Longitudinal profiles also were surveyed on the restored portions of UT1, UT2, and UT3 following construction.

Vegetation monitoring plots were established at 10 locations along the mainstem of SHC and the tributaries. Vegetation plots will be used to determine survival of planted stems over the course of project monitoring.

Fixed photo stations were established at 26 locations on the stream channels and riparian areas and 5 photo stations were established in wetland areas across the project site. In addition to all the established monitoring locations, the as-built plan view reveals site topography, easement boundaries, and other attributes of the project to aid in the long-term monitoring of the mitigation site (Figure D.1).

3.2 Stream Monitoring

Monitoring will include quantification of channel stability including cross-sectional (dimension), pattern, longitudinal profile, and bed material measurements. Fixed station photographic points were established to provide visual comparison of channel banks, in-stream structures, and other morphological features over time. Bankfull flow events will be monitored using a simple crest gauge. A minimum of two bankfull events, occurring in separate calendar years, shall be documented during the 5 year monitoring period. Otherwise, stream monitoring will be continued.

3.3 Vegetation Monitoring

Quantitative vegetation monitoring plots were established in buffer restoration areas following native plant installations in accordance with established NCEEP/CVS protocols (Lee et al. 2006). Vegetation plots will be evaluated to ascertain the performance and density of planted woody stems. Permanent fixed point photo stations were established to provide a visual record of each plot over time. Minimum success criteria, established by USACE (2003), for planted woody vegetation must be 320 stems/acre in year-1 and 260 stems/acre during the year-5 monitoring period.

3.4 Schedule and Reporting

The Baseline Monitoring Document (BMD) was prepared following NCEEP content and guidelines (NCEEP 2010). The BMD includes documentation of the mitigation sites pre-existing morphological values, design values, and a quantitative summary of the post construction (as-built) morphological and vegetative project elements. The BMD also includes photographic documentation of the site in the as-built condition. Yearly monitoring reports will build upon the data tables, graphs, and photographs reported in the BMD.

Future monitoring reports will provide a discussion of any significant deviations from the as-built conditions as well as the potential for the mitigation site to meet the success criteria for channel stability and vegetation survival at the end of the 5-year monitoring period. Monitoring reports will be submitted annually to the NCEEP, no later than March 1.

4 Project Conditions and Monitoring Results

4.1 Stream Assessment

4.1.1 Morphometric Criteria

Channel cross-sectional dimensions, pattern, and longitudinal profile were surveyed in December 2011 to document morphological characteristics of the active channel for the as-built baseline monitoring period (MY0) (Figure D.1). In addition, the locations of all constructed stream features (i.e., rock vanes, log vanes, J-hook vanes, geolifts, wood toe, and root wads) were assessed for stability and structural integrity.

4.1.2 Quantitative Measures Summary

Monitoring year-0 morphological data were obtained by establishing fixed survey locations on the mainstem of SHC and the three unnamed tributaries within the project area. Morphological data from the as-built cross-sectional survey stations were compared with existing, reference, and design data for riffle stream features (Tables B.1 and B.1.1). Mean morphologic and hydraulic data presented in Tables B.1 are from riffle cross-sections 1, 3, 5, 7, 8 and 10 on the mainstem of SHC. Mean values were not derived for the single riffle cross-sections surveyed on UT2 and UT3 Upper and UT3 Lower (Table B.1.1). Morphological data presented in Table B.2 reflect post construction dimensions for each of the 14 individual cross-sections, including both riffles and pools, established on the mainstem of SHC, UT2 and UT3. Channel cross-sectional data plots were used to evaluate the as-built condition and to establish the baseline condition for the visual comparison of channel stability over time (Figures B.1).

Statistical values of the pattern data for each mainstem reach (Mainstem 1 Bianculli Reach, Mainstem 2 Bura/Roberson Reach, and Mainstem 3 Davis Reach) are presented in Table B.1. Insufficient pattern geometry on UT2 and UT3 Upper resulted in a low sample size (n=1) of pattern data parameters (Table B.1.1). Pattern geometry data was more robust for UT3 Lower, and a range of values was calculated for each parameter (Table B.1.1).

Longitudinal profile data, including feature lengths, depths, slopes, and spacing for each of the three SHC mainstem reaches and the unnamed tributaries were evaluated. Statistical values of each profile parameter are presented in Table B.1. Longitudinal profile data for UT2 and UT3 are presented in Table B.1.1. Longitudinal profile data plots were used to establish the as-built condition and for future comparison of morphological data over time (Figures B.2).

Channel bed material was surveyed by performing a reach-wide pebble count consisting of 10 pebble grabs from either a riffle or pool feature along the entire mainstem of SHC. The reach-wide pebble count is used to assign a number to the stream type classification based on median grain size (D50) encountered. Additionally, pebble counts were performed by collecting 100 pebbles from each of the 10 (6 riffles and 4 pools) mainstem cross-sections (Tables B.1 and B.2). Pebble counts were not performed on UT1, UT2 or UT3 due to homogenous (silt) bed material. Pebble count data plots are presented to establish the as-built substrate condition and for visual comparison of bed material data over the course of the monitoring surveys (Figures B.3).

4.1.2.1 Mainstem 1 – Bianculli Reach – 797 feet

The entire length of Mainstem 1 Bianculli reach of SHC within the conservation easement on the Bianculli property is 797 ft. The Bianculli reach was divided into two approach levels (restoration and enhancement II). The channel length of the restoration reach is 630 ft. The channel length of the enhancement II reach is 167 ft.

Dimension.—Channel dimensions data from three cross-sections (XS1 riffle, XS2 pool, XS3 riffle) were collected in the Mainstem 1 Bianculli reach and plotted for visual evaluation (Figure B.1). Channel dimensions from the two riffle cross-sections were compared with the range of design values (Table B.1). Design values for riffle bankfull width ranged from 28.1 to 37.2 ft. Bankfull widths during MY0 ranged from 26.9 to 30.1 ft. Bankfull width at cross-section 1 (26.9 ft) in MY0 was slightly narrower than the minimum design bankfull width. The slight reduction in bankfull width is likely attributed to the proximity of the Bianculli barn to the top of the right bank of SHC (<15ft). Bankfull width at cross-section 3 (30.1 ft) matched the mean design value for bankfull width in MY0. Dimensions of each individual cross-section are presented in Table B.2.

Design values for riffle cross-sectional area ranged from 43.8 to 75.5 ft^2. Bankfull cross-sectional area ranged from 54.8 to 62.9 ft^2 for the as-built channel (Table B.1). Both of the riffle cross-sections surveyed approximated the mean design value (61.3 ft^2) for cross-sectional area during MY0.

Mean depth at bankfull for the two as-built riffle cross-sections ranged from 2.0 to 2.1 ft (Table B.1). Cross-section 1 mean depth (2.0 ft) matched the design value for mean depth in MY0. Mean depth at riffle cross-section 3 (2.1 ft) was within the design mean depth range (1.5 to 2.2) during MY0.

Riffle bankfull maximum depth design values ranged from 2.0 to 3.3 ft (Table B.1). Bankfull maximum depths for the two riffle cross-sections ranged from 2.6 to 3.2 ft during MY0 and were within the design range for riffle maximums depths.

The width/depth ratio design values ranged from 12.0 to 18.6 (Table B.1). Following construction, the width/depth ratio for the two Mainstem 1 reach riffle cross-sections ranged from 13.2 to 14.4.

The post-construction entrenchment ratios, a measure of vertical containment, were similar to the existing range of 6.6 to 13.4. Entrenchment ratios taken from measurements at two riffle cross-sections were found to be 8.8 and 12.0 during MY0 (Table B.1).

Pattern.—Utilizing a Priority III approach during construction resulted in minimal change in pattern geometry on the Mainstem 1 Bianculli reach. Channel sinuosity (1.1) is low due to only a single meander bend located at station 2+50 to 3+50. The MY0 values for channel belt width, radius of curvature, and meander wavelength are similar to the values obtained from the pre-existing site survey (Table B.1).

Profile.—The entire length (804 ft) of the Mainstem 1 Bianculli reach longitudinal profile was surveyed during MY0 (Figure B.2). Channel slope was 0.011 ft/ft. Feature lengths, slopes, depths, and spacing were calculated following the monitoring survey (Table B.1). The MY0 riffle lengths ranged from 32.4 to 62.9 ft and are within the design values (15.8 to 86.9 ft) for riffle length. Riffle slopes ranged from 0.011 ft/ft to 0.016 ft/ft in MY0. All riffle slopes were within the design range of values (0.007 to 0.027 ft/ft). Pool lengths were within the design values (14.7 to 96.7 ft) in MY0, ranging from 20.7 to 34.4 ft. Six in-stream structures (1 rock vane, 1 log vane, and 4 J-hooks) were constructed in the Mainstem 1 reach to provide grade control, channel stability and a heterogeneous bed form for increased habitat. Pool-to-pool spacing ranged from 86.7 to 217.6 ft in MY0 and were within the design range values. The thalweg alignment and edge of water survey points that define the location of the active channel for the existing and as-built channel are presented in the MY0 plan view sheets (Figure D.1).

Substrate Data.—Statistical values for the substrate data are presented in Table B.1. Riffle substrate particle analyses at cross-section 1 and cross-section 3 revealed that the D50 ranged from 22.1 to 28.9 mm during MY0 (Table B.2). The D50 at both cross-sections were in the coarse gravel category (16.0 to 32.0 mm). Riffle substrate data along with field observations suggests the project site stream channel is made up of a gravel and cobble matrix. Plots of the cumulative percent of particles finer than a specific particle size for the riffle pebble counts are summarized in Figure B.3.

4.1.2.2 Mainstem 2 - Bura/Roberson Reach – 1,286 ft

The entire length of Mainstem 2 Bura/Roberson reach of SHC within the conservation easement is 1,286 ft. The Mainstem 2 reach was separated into two distinct approach levels (restoration and enhancement II) based on channel condition prior to construction. The channel length of the restoration reach is 518 ft. The channel length of the enhancement level II reach is 768 ft.

Dimension.—Channel dimensions data from four cross-sections (XS4 pool, XS5 riffle, XS6 pool, XS7 riffle) were collected in the Mainstem 2 Bura/Roberson reach and plotted for visual evaluation (Figure B.1). Channel dimensions from two riffle cross-sections (XS5, XS7) were surveyed during MY0 and compared with the range of design values (Table B.1). Design values for riffle bankfull width ranged from 28.1 to 37.2 ft. Bankfull widths for MY0 ranged from 30.5 to 37.5 ft. Dimensions of each individual cross-section are presented in Table B.2.

Design values for riffle cross-sectional area ranged from 43.8 to 75.5 ft^2. Bankfull cross-sectional area ranged from 62.2 to 65.2 ft^2 for the as-built channel (Table B.1). Both of the riffle cross-sections surveyed approximated the mean design value (61.3 ft^2) for cross-sectional area during MY0.

Mean depth at bankfull for the two as-built riffle cross-sections ranged from 1.7 to 2.0 ft (Table B.1). Cross-section 5 mean depth (2.0 ft) matched the design value for mean depth in MY0. Mean depth at for cross-section 7 (1.7 ft) was within the design mean depth range (1.5 to 2.2) during MY0.

Riffle bankfull maximum depth design values ranged from 2.0 to 3.3 ft (Table B.1). Bankfull maximum depths for the two riffle cross-sections ranged from 2.7 to 3.2 ft during MY0. Both cross-section 5 (3.2 ft) and cross-section 7 (2.7 ft) fell within the design range for riffle maximums depths in MY0.

The width/depth ratio design values ranged from 12.0 to 18.6 (Table B.1). The width/depth ratio for the two Mainstem 2 reach riffle cross-sections ranged from 14.9 to 21.6. The width/depth ratio for cross-section 7 (21.6) is moderate to high for a "C" stream type. Although the channel bed and banks are stable, a bankfull width on the high end of the design range coupled with a mean depth on the low end of the design range resulted in the width/depth ratio at cross-section 7 slightly higher than the maximum design value. A significant inner berm is also present at this location and has likely influenced the width and depth values.

The post-construction entrenchment ratios, a measure of vertical containment, were similar to the existing range of 6.6 to 13.4. Entrenchment ratios taken from measurements at two riffle cross-sections were found to be 7.5 and 11.1 for MY0 (Table B.1).

Pattern.—Utilizing a Priority III approach during construction resulted in minimal to no change in pattern geometry to the Mainstem 2 Bura/Roberson reach, dimension and profile adjustments were made within the existing channel. Sinuosity for the as-built channel was 1.1.

The MY0 values for channel belt width, radius of curvature, and meander wavelength were similar to the values obtained from the pre-existing site survey (Table B.1).

Profile.—The entire length (1,286 ft) of the Mainstem 2 Bura/Roberson reach longitudinal profile was surveyed during MY0 (Figure B.2). Channel slope was 0.008 ft/ft. Feature lengths, slopes, depths, and spacing were calculated following the monitoring survey (Table B.1). The MY0 riffle lengths ranged from 47.6 to 77.8 ft, which were within the range of the design values (15.8 to 86.9 ft) for riffle length. Riffle slopes ranged from 0.011 to 0.016 ft/ft in MY0. All riffle slopes were within the design range of values (0.007 to 0.027 ft/ft). Pool lengths were within the design values (14.7 to 96.7 ft) in MY0, ranging from 32.8 to 78.5 ft. Five in-stream structures (2 log vanes, and 3 J-hooks) were constructed in the Mainstem 2 reach to provide grade control, channel stability and a heterogeneous bed form for increased habitat. Pool-to-pool spacing ranged from 69.1 to 469.9 ft in MY0, exceeding the maximum spacing for pools based on design values. The thalweg alignment and edge of water survey points that define the location of the active channel for the existing and as-built channel are presented in the MY0 plan view sheets (Figure D.1).

Substrate Data.—Statistical values for the substrate data are presented in Table B.1. Riffle substrate particle analyses at cross-section 5 and cross-section 7 revealed that the D50 values were 49.4 mm and 31.4 mm during MY0. These D50 values fall within the coarse to very coarse gravel categories. Riffle substrate data along with field observations suggests the project site stream channel is predominately made up of a gravel and cobble matrix. Plots of the cumulative percent of particles finer than a specific particle size for the riffle cross-section pebble counts are summarized in Figure B.3.

4.1.2.3 Mainstem 3 - Davis Reach – 737 ft

The entire length of Mainstem 3 Davis reach of SHC within the conservation easement is 737 ft. The Davis reach was separated into two distinct approach levels (enhancement level I and enhancement level II) based on channel condition prior to construction. The channel length of the enhancement level I reach is 522 ft. The channel length of the enhancement level II reach is 215 ft.

Dimension.—Channel dimensions data from three cross-sections (XS8 riffle, XS9 pool, XS10 riffle) were collected in the Mainstem 3 Davis reach and plotted for visual evaluation (Figure B.1). Channel dimensions from the two riffle cross-sections (XS8, XS10) were compared with the range of design values (Table B.1). Design values for riffle bankfull width ranged from 28.1to 37.2 ft. Bankfull widths for MY0 ranged from 25.5 to 30.1 ft. Bankfull width for cross-section 10 was slightly under the minimum design value. Both the right and left banks were shaped at this location and a bench was established on the left bank. The bankfull bench is 6.5 ft wide and is essentially flat, varying in elevation by only 0.15 ft from front to back. Bankfull width was measured at the front edge of the bench. Therefore, additional width is available for flows to expand out onto the bench during bankfull or greater flows. Cross-section 10 appeared stable and performing satisfactorily during the MY0 survey. Dimensions of each individual cross-section are presented in Table B.2.

Design values for riffle cross-sectional area ranged from 43.8 to 75.5 ft^2. Bankfull cross-sectional area ranged from 53.4 to 65.1 ft^2 for the as-built channel (Table B.1). Both of the riffle cross-sections surveyed approximated the mean design value (61.3 ft^2) for cross-sectional area during MY0.

Mean depth at bankfull for the two as-built riffle cross-sections ranged from 2.1 to 2.2 ft (Table B.1). Cross-section 8 mean depth (2.2 ft) matched the maximum design value for mean depth in MY0. Mean depth at cross-section 10 (2.1 ft) was within the design mean depth range (1.5 to 2.2 ft) during MY0.

Riffle bankfull maximum depth design values ranged from 2.0 to 3.3 ft (Table B.1). Bankfull maximum depths for the two riffle cross-sections were 3.1 ft during MY0; both were within the design range for riffle maximums depths.

The width/depth ratio design values ranged from 12.0 to 18.6 (Table B.1). Following construction, the width/depth ratio for the two Mainstem 3 reach riffle cross-sections ranged from 12.1 to 13.9. The width/depth ratios of both cross-sections are typical for a “C” stream type.

The post-construction entrenchment ratios, a measure of vertical containment, were similar to the existing range of 6.6 to 13.4. Entrenchment ratios taken from measurements at two riffle cross-sections were found to be 9.7 and 21.6 for MY0 (Table B.1).

*Pattern.—*Utilizing a Priority III approach during construction resulted in minimal no change in pattern geometry to the Mainstem 3 Davis reach. In large part, dimension and profile adjustments were made within the existing channel. Sinuosity for the as-built channel was 1.1. The MY0 values for channel belt width, radius of curvature, and meander wavelength were similar to the values obtained from the pre-existing site survey (Table B.1).

*Profile.—*The entire length (737 ft) of the Mainstem 3 Davis reach longitudinal profile was surveyed during MY0 (Figure B.2). Channel slope was 0.006 ft/ft. Feature lengths, slopes, depths, and spacing were calculated following the monitoring survey (Table B.1). The MY0 riffle lengths ranged from 22.0 to 60.8 ft, which were within the range of the design values (15.8 to 86.9 ft) for riffle length. Riffle slopes ranged from 0.008 to 0.020 ft/ft in MY0. All riffle slopes were within the design range of values (0.007 to 0.027 ft/ft). Pool lengths were within the design values (14.7 to 96.7 ft) in MY0, ranging from 17.6 to 38.5 ft. Four in-stream structures (3 log vanes, and 1 rock vane) were constructed in the Mainstem 3 reach to provide grade control, channel stability and a heterogeneous bed form for increased habitat. Pool-to-pool spacing ranged from 65.6 to 258.1 ft in MY0 and was within the design value range. The thalweg alignment and edge of water survey points that define the location of the active channel for the existing and as-built channel are presented in the MY0 plan view sheets (Figure D.1).

*Substrate Data.—*Statistical values for the substrate data are presented in Table B.1. Riffle substrate particle analyses at cross-section 8 and cross-section 10 revealed that the D50 values were 47.7 mm and 33.5 mm during MY0. These D50 values fall within the very coarse gravel categories. Riffle substrate data along with field observations suggests the project site stream channel is predominately made up of a gravel and cobble matrix. Plots of the cumulative percent of particles finer than a specific particle size for the riffle pebble counts are summarized in Figure B.3.

4.1.2.4 Unnamed Tributary 1 – Bianculli Reach – 277 ft

The upper most portion of UT1 was mitigated using a preservation (94 ft) approach. The lower portion of UT1 on the Bianculli property was restored (183 ft) during construction using a Priority I approach. The lower two-thirds of UT1 had been ditched by previous property owners in an attempt to quickly drain two small spring areas and the adjacent wooded wetland. The existing channel was severely entrenched and was up to 3 ft below the top of the channel bank and forest floor. A new channel was constructed that is connected to the forest floor and associated wetland. An ephemeral pool was constructed at the outflow of UT1, further enhancing the quality of the adjacent wetlands. The existing ditched channel was filled with compacted material during construction. The banks of the new channel are very low (<12 in.) over much of the reach to allow for the desired connectivity with the floodplain and associated wetlands. Due to its short length and relatively little flow, a cross-sectional survey was not performed. Minimal pattern was added to the new channel when constructed. The entire length of the new channel was surveyed following construction. Pattern and profile data for UT1 are presented in the plan view drawing sheets (Figure D.1).

Substrate Data.—Bed material in UT1 was not collected during the MY0 survey. From observation, it consists of clay, silt, and fine sand materials.

4.1.2.5 Unnamed Tributary 2 – Bianculli and Roberson Reaches – 890 ft

Unnamed Tributary 2 originates on the Bianculli property. The first 654 ft was treated as enhancement level II mitigation; the last 45 ft of UT2 on the Bianculli property was restored. The portion of UT2 on the Roberson property had been abandoned to expand agricultural practices and the flow was routed to a road-side ditch. In order to restore flow back to UT2 and adjacent wetlands, flow was piped under Canterfield Lane during construction. Channel alignment was similar to what it was prior to flow diversion. A new channel (191 ft) with grade control structures and bankfull benches was constructed to carry the re-established flow.

Dimension.—A single riffle cross-section (XS1) was surveyed on the restored portion of UT2 and plotted for visual evaluation (Figure B.1). Therefore, a range of dimensional values are not presented for UT2 (Table B.1.1). Channel dimensions for UT2 cross-section 1 are also presented in Table B.2. Bankfull width during MY0 was 22.6 ft. Bankfull cross-sectional area was 14.2 ft^2. Mean depth at bankfull for the as-built riffle cross-sections was 0.6 ft. Bankfull maximum depth for the riffle cross-section was 1.4 ft during MY0. Following construction, the width/depth ratio for cross-section 1 was 35.8. The entrenchment ratio was found to be 12.5.

Pattern.—Due to short length of the restored channel, insufficient pattern data precluded presentation of a range of pattern data values. Moreover, a Priority III approach during construction resulted in minimal no change in pattern geometry. The MY0 values for channel belt width, radius of curvature, and meander wavelength are presented in Table B.1.1.

Profile.—The entire length (236 ft) of the restored UT2 channel longitudinal profile was surveyed during MY0 (Figure B.2). The total profile length also includes the short (45 ft) section of channel on the adjoining Bianculli property. It does not include the section of channel piped under Canter Field Lane. Two rock seals were constructed to provide grade control and channel stability near the confluence of UT2 and SHC. Feature lengths, slopes, depths, and spacing were calculated following the longitudinal survey (Table B.1.1). The MY0 riffle lengths ranged from 12.3 to 31.8 ft. Riffle slopes ranged from 0.009 to 0.012 ft/ft in MY0. Pool lengths ranged from 10.7 to 23.1 ft. Pool-to-pool spacing ranged from 50.6 to 69.2 ft in MY0. Channel slope was 0.012 ft/ft. The thalweg alignment and edge of water survey points that define the location of the active channel for the existing and as-built channel are presented in the MY0 plan view sheets (Figure D.1).

Substrate Data.—Bed material was not collected in UT2 during the MY0 survey. From observation, it consists of clay, silt, and fine sand materials.

4.1.2.6 Unnamed Tributary 3 – Davis Reach – 1,742 ft

The UT3 channel on the Davis property was approached several different ways during project planning and implementation based on existing condition and need. The upstream most portion of UT3 is bordered by a mature forest and has stable channel features; therefore, it was treated as a preservation (777 ft) reach. The middle portion of UT3 was infested with non-native invasive vegetation and the banks were littered with old farm equipment. The middle portion was treated as enhancement II (538 ft) during construction by removing the invasive vegetation and all foreign materials, excluding livestock from the riparian zone, and performing some targeted bank shaping along the right and left channel banks. The lower portion of UT3, from the wet-ford to the confluence with SHC, was restored during construction using a priority II and priority I restoration approach. Because of the two different restoration types and the significant changes in channel slope, the lower portion of UT3 was divided into the upper (201 ft) and the lower (226 ft) restoration sections. Presented below are the dimension, pattern, and longitudinal profile data for both the upper and lower reaches of the UT3 restoration section.

Unnamed Tributary 3 – Davis Reach – Upper Restoration 201 ft

Dimension.—A single riffle cross-section (XS1) was surveyed on the UT3 Upper restoration section and plotted for visual evaluation (Figure B.1). Therefore, a range of dimensional values are not presented for UT3 Upper. Channel dimensions for UT3 Upper cross-section 1 are also are presented in Table B.2. Comparison of UT3 Upper dimensional values with the design values are presented in Table B.1.1. Bankfull width during MY0 was 12.9 ft, slightly exceeding the design bankfull width of 12.0 ft. Bankfull cross-sectional area was 10.3 ft^2 and exceeded the maximum design cross-sectional area of 7.5 ft^2. Mean depth at bankfull for the as-built riffle cross-sections was 0.8 ft; the design range for mean riffle depth was 0.4 to 0.6 ft. Bankfull maximum depth for the riffle cross-section was 1.3 ft during MY0 and ranged from 1.0 to 1.4 ft in the design plan. Following construction, the width/depth ratio for cross-section 1 was 16.1 and fell within the design range of 16.0 to 20.0.

Pattern.—A range of pattern geometry values are lacking on the UT3 Upper restoration section due in large part to channel type (Ba). This section of UT3 was restored by designing step-pool channel features and employing a priority II approach. Therefore, very little meander is present in this section. The MY0 values for channel belt width, radius of curvature, and meander wavelength are presented in Table B.1.1.

Profile.—The entire length (201 ft) of the UT3 Upper restored channel longitudinal profile was surveyed during MY0 (Figure B.2). The total profile length includes the section of UT3 from the wet-ford downstream to just below the confluence with the Spring Seep South and Wetland C inflow, station 0+00 to 2+01. A series of nine rock step-pool features were constructed to provide grade control and channel stability. Feature lengths, slopes, depths, and spacing were calculated following the as-built survey (Table B.1.1). The MY0 riffle lengths ranged from 13.7 to 26.4 ft. Riffle slopes ranged from 0.054 to 0.102 ft/ft in MY0. The design slopes ranged from 0.950 to 0.120 ft/ft for UT3 Upper. Pool lengths ranged from 2.9 to 5.1 ft for the as-built channel. Pool-to-pool spacing ranged from 21.2 to 24.2 ft in MY0 and was within the design range for UT3 Upper. Channel slope was 0.086 ft/ft. The thalweg alignment and edge of water survey points that define the location of the active channel for the existing and as-built channel are presented in the MY0 plan view sheets (Figure D.1).

Substrate Data.—Bed material in UT3 Upper was not collected during the MY0 survey. From observation it consists of clay, silt, and fine sand materials. Gravel and cobble material was added to the channel following construction to increase roughness and provide benthic organism habitat.

Unnamed Tributary 3 – Davis Reach – Lower Restoration 226 ft

Dimension.—Two cross-sections, XS2 - riffle and XS3 - pool, were surveyed on the UT3 Lower restoration section and plotted for visual evaluation (Figure B.1). Dimensional parameters, for cross-sections 2 and 3, representing the as-built condition of the priority I channel restoration of UT3 Lower are presented in Table B.2. Only the dimensional parameters for the riffle cross-section (XS2) were compared with the design values (Table B.1.1). Bankfull width during MY0 was 9.9 ft, and was within the design bankfull range of 8.0 to 12.0 ft. Bankfull cross-sectional area was 7.6 ft^2, slightly below the minimum design value of 8.6 ft^2. Mean depth at bankfull for the as-built riffle cross-section was 0.8 ft; the design range for mean riffle depth was 0.5 to 0.7 ft. Bankfull maximum depth for the riffle cross-section was 1.4 ft during MY0 and ranged from 0.9 to 2.2 ft in the design plan. Following construction, the width/depth ratio for the UT3 Lower cross-section 1 was 12.8 and fell below the design range of 16.0 to 17.1.

Pattern.—The section of UT3 Lower was restored by constructing a priority I meandering channel with three distinct bends over the course of 226 ft. Therefore, a range of pattern geometry values were determined for UT3 Lower. The MY0 range of values for as-built channel belt widths, radius of curvatures, and meander wavelengths are presented in Table B.1.1.

Profile.—The entire length (226 ft) of the UT3 Lower restored channel longitudinal profile was surveyed during MY0 (Figure B.2). A “C” type channel was constructed with a series of four riffles and three pool features. Feature lengths, slopes, depths, and spacing were calculated following the as-built monitoring survey (Table B.1.1). The MY0 riffle lengths ranged from 10.8 to 28.7 ft. One measured riffle length exceeded the design maximum riffle length value of 18.0 ft. Riffle slopes ranged from 0.013 to 0.065 ft/ft in MY0. The design slopes ranged from 0.018 to 0.056 ft/ft for UT3 Lower. Pool lengths ranged from 16.0 to 19.7 ft for the as-built channel and were within the design range of values. Pool-to-pool spacing ranged from 47.6 to 63.4 ft in MY0, exceeding the maximum design range for pool-to-pool spacing. Channel slope was 0.029 ft/ft. The thalweg alignment and edge of water survey points that define the location of the active channel for the existing and as-built channel are presented in the MY0 plan view sheets (Figure D.1).

Substrate Data.—Bed material in UT3 Lower was not collected during the MY0 survey. From observation it consists of clay, silt, and fine sand materials.

4.1.3 Fixed Station Channel and Riparian Area Photographs

Fixed station photographs document pre- and post-construction conditions and provide a time series view of the USH mitigation site stream channel features and riparian areas (Figure B.4). A total of 26 photo stations were established during the as-built survey.

4.1.4 Bankfull Event Documentation and Verification

One bankfull event (28 November 2011) was documented between the end of construction and completion of the entire as-built survey (Table B.3). A wrack line above the bankfull elevation was observed and photographed for verification on 5 December 2011 (Figure B.5). To monitor additional bankfull events, a simple crest gauge was installed on the right bank (sta. 7+75) downstream of cross-section 6 and adjacent to a large root wad feature.

4.1.5 Stream Feature Visual Stability Assessment

A visual assessment of the project reach was performed to inspect the morphological stability of the channel and to serve as a basis for comparison with future channel stability monitoring. Based on the visual assessment of the channel features, stream structures, and channel banks following the flood event on 28 November 2011 several areas of instability were apparent. The most instability was observed in the Mainstem 1 Bianculli reach (sta. 1+50 to 2+50) and was associated with the large meander bend. Above the meander bend, a structure had failed and 50 ft of the right bank had sloughed into the channel. Below the structure, a large amount of bed material had aggraded and formed a mid-channel bar. A second area of instability was observed in the Mainstem 2 Bura/Roberson reach (sta. 9+25 to 9+75). A large amount of bed material aggraded at this location and formed a mid-channel bar. However, the observed areas of instability make up only a small percentage of the overall stable condition of the SHC mainstem. No areas of instability were observed on the three unnamed tributaries. Table B.4 is only used as a place holder for the MY1 report and is not populated with any data from MY0.

4.1.6 Stream Problem Areas

Several problem areas with regards to channel morphology, structure stability, or bank stability were observed during the MY0 survey. Problem areas observed along the SHC mainstem channel, resulting from the 28 November 2011 storm event, are noted on the as-built plan view sheets (Figure D.1). The problem, likely cause, and location of each observed stream problem area is presented in Table B.5. Issues with the stream channel include aggradation and bar formation, bank scour, and structure stability. Problem areas were most apparent in the Mainstem 1 Bianculli reach in association with the large meander bend. Another obvious problem area, largely due to aggradation and bar formation, was in the Mainstem 2 Bura/Roberson reach. No problem areas were observed in the Mainstem 3 Davis reach or on any of the three unnamed tributaries.

4.1.7 Stream Problem Area Photographs

Channel, stream structure, and banks stability problem areas observed during the MY0 survey were photographed for documentation of the extent of the damage and instability on 5 December 2011 and included in Appendix B of this report (Figure B.6).

4.1.8 Summary of Morphological Results

The as-built survey revealed that construction activities at the USH mitigation site in 2011 followed the approaches outlined the in the USH mitigation plan (NCWRC 2010). Dimension, pattern, and profile parameters surveyed in MY0-2011 suggest the restoration, enhancement level II and enhancement level I sections of SHC are performing as designed with little to no variation from design values. Small deviations were found in bankfull width at two riffle cross-sections (XS1 and XS10). Bankfull width at these two cross-sections was slightly below the design value. However, problem areas or instability was not observed at either cross-section. By in large, all other dimensional parameters measured at the 10 mainstem cross-sections were within the design values for SHC. Pattern and profile values derived from the as-built survey reveal that the mainstem reaches of SHC are within the design values for these the two morphological parameters. Reach-wide substrate particle size analysis revealed that the D50 value for the as-built channel falls within the coarse gravel category. The median particle size at each of the 6 riffle cross-sections fell within coarse to very coarse gravel categories during the MY0 survey.

Problem areas were noted during the MY0 survey. Following a significant storm event on 28 November 2011, right channel bank sloughing, J-hook arm scour, and bar formation was observed in the Mainstem 1 reach from sta. 1+50 to 2+50. A second problem area was observed on Mainstem 2, sta. 9+25 to 9+75, where a large amount of bed material formed a mid-channel bar below a J-hook stream structure. Overall, SHC was minimally impacted by the severe storm event. The MY0 survey found the majority of the 2,820 ft of mainstem channel was stable and performing as designed. Repair plans and Scope of Work will be developed and presented to NCEEP to address the needed modifications to the problem areas. Repair work will likely occur in the summer of 2013.

As-built morphological results for the three unnamed tributaries revealed that construction activities followed the approaches outlined the in the USH mitigation plan. Although small variations from design values were noted in dimensional parameters such as bankfull width (UT3 Upper-XS1 riffle) and bankfull cross-sectional area (UT3 Lower-XS2 riffle), the three unnamed tributaries are stable and performing as designed. Moreover, the significant storm event on 28 November 2011 did not have any observed negative effects on any of the three unnamed tributaries.

4.2 Wetland Enhancement and Preservation

ClearWater Environmental Consultants Inc. identified nine wetlands totaling approximately 1.35 acres in the project area during an October 2009 field investigation of jurisdictional wetlands (Figure B.7).

Wetland C—(Part of Davis Spring Seep South) is approximately 0.01 acres and is adjacent to Davis UT3. There is a hand built rock spring box at the head of this feature. Wetland C was treated as a preservation area during construction and the removal of non-native invasive plants and livestock access were the two management activities directed at this area.

Wetland D—is the largest wetland on site totaling approximately 0.69 acres. This wetland is adjacent to SHC and was greatly impacted by cattle pre-construction. Despite previous impacts from cattle access, Wetland D has the highest diversity of wetland plant species found within the study area. In addition to excluding livestock from Wetland D, the area was enhanced by removing a 4 inch pipe that was installed by the landowner to divert spring flows away from the area. This resulted in replenishing surface water back into the wetland. Wetland D was further enhanced by creating three ephemeral pools to increase wetland plant and amphibian habitat.

Wetland E—is approximately 0.02 acres and is adjacent to SHC and Roberson UT2. This wetland was greatly impacted by cattle. A large pile of scrapped farm machinery, metal, and tree stumps were removed from this feature. Additionally, flow was reconnected to the formerly abandoned UT2 further enhancing the long term viability of the area.

Wetland G—is approximately 0.05 acres and is contiguous with Bianculli UT2 and adjacent to Canter Field Lane. Enhancement to this area included the extensive treatment of for non-native invasive vegetation. Chinese privet *Ligustrum sinense* and multiflora rose *Rosa multiflora* were the dominant non-native vegetation types present pre-construction.

Wetland H—is approximately 0.05 acres and is located adjacent to Bianculli UT2. Enhancement to this area included the extensive treatment of non-native invasive vegetation. Chinese privet *Ligustrum sinense* and multiflora rose *Rosa multiflora* were the dominant non-native vegetation types present pre-construction.

Wetland I—is approximately 0.06 acres and is located between to Bianculli UT2 and was in the border of an actively mowed and grazed pasture. In addition to the removal of the non-native vegetation, easement fencing now encompasses the delineated area removing the livestock access and mechanized encroachment that was occurring pre-construction.

Wetlands J and K—combined are approximately 0.04 acres and are located adjacent to the Bianculli southwestern property line. This area was treated for non-native invasive vegetation and permanently protected with the establishment of the conservation easement and exclusionary fencing.

Wetland L—is approximately 0.44 acres and is the second largest wetland within the project area. Wetland L is located adjacent to SHC and Bianculli UT1. It is a forested wetland with trees and shrubs throughout. Pre-construction UT1 had been deeply channelized in an attempt to direct flow away from the wet area and to quickly move it to SHC. During construction, priority I restoration of UT1 established flow back up to the forest floor elevation and directed the flow into an ephemeral pool that was created. The restoration of UT1 and creation of the ephemeral pool significantly enhanced the wetland feature and amphibian habitat.

4.2.1 Wetland Areas Fixed Station Photographs

Fixed wetland station photographs of pre-and post-construction conditions of the wetland areas for the USH mitigation site were documented during the as-built survey for comparison with future photographs over the course of the monitoring surveys (Figure B.7).

4.3 Vegetation Assessment

The USH mitigation site was revegetated with a variety of annual and perennial native seed mixes during construction to minimize soil erosion immediately following ground disturbing activities and to provide a diversity of herbaceous plant species within the conservation easement (Table C.1). A large number of mature trees and shrubs, representing a variety of species, were not disturbed during construction. Most of these trees and shrubs were located along top of the SHC channel banks and within the established conservation easement. They were retained because they were contributing to bank stability, providing shade to the stream, and would be a seed source that would contribute to natural revegetation of the project area.

Native tree and shrub species, including live stakes, were installed during November and December 2011 and January 2012. Live stakes were used to promote the long term stability of the channel banks, particularly in areas of potential high bank stress. A total of 5,000 livestakes consisting of three different species were installed along SHC and the three unnamed tributaries (Table C.1). A total of 1,492 native tree and shrub species were installed (Table C.2). Woody stems were propagated as either bare-root whips or containerized stock. Woody stems were dispersed across the mitigation site to enhance riparian areas that were lacking woody stems due to past land use practices. Shrub and tree selections ranged from species tolerant (obligate wetland) to weakly tolerant of flooding (facultative upland). Shrubs and trees were matched with one of four planting zones based on a species wetness tolerance. Planting zones typically ranged from wet areas with saturated soils to upland areas where the soils were better drained.

To monitor the performance of the planted woody stems, ten vegetation assessment plots were established following woody stem installation (Figure D.1). Location, orientation, and dimension information for each of the ten vegetation monitoring plots is located in Table C.3.

Stem counts, plant vigor, plant damage, and overall stem density was assessed for each vegetation monitoring plot (Tables C.4 - C.8).

UT2 Vegetation Plot 1.—Thirteen planted stems (526 stems per acre) were documented in vegetation plot 1 (VP1) during the MY0 survey (Table C.8). The 13 planted stems recorded in VP1 represent ten native woody species originating from both containerized and bare-root nursery stock.

SHC Vegetation Plot 2.—Fourteen planted stems were found in vegetation plot 2 (566 stems per acre) in MY0 (Table C.8). The 14 planted stems recorded in VP2 represent 11 native woody species originating from both containerized and bare-root nursery stock.

Vegetation Plot 3.—In vegetation plot 3, 19 planted stems were recorded (769 stems per acre) in MY0 (Table C.8). The 19 planted stems recorded in VP3 represent 14 native woody species originating from both containerized and bare-root nursery stock.

Vegetation Plot 4.—Sixteen planted stems (648 stems per acre) were documented in vegetation plot 4 during the MY0 survey (Table C.8). The 16 planted stems recorded in VP4 represent ten native woody species originating from both containerized and bare-root nursery stock.

Vegetation Plot 5.—In vegetation plot 5, 25 planted stems were recorded (1,012 stems per acre) in MY0 (Table C.8). The 25 planted stems recorded in VP5 represent 14 native tree and shrub species. Planted stems were both container grown and bare-root nursery stock.

Vegetation Plot 6.—Fifteen planted stems (607 stems per acre) were documented in vegetation plot 6 during the MY0 survey (Table C.8). The 15 planted stems recorded in VP6 represent 12 native woody species originating from both containerized and bare-root nursery stock.

Vegetation Plot 7.—In vegetation plot 7, 18 planted stems were recorded (728 stems per acre) in MY0 (Table C.8). The 18 planted stems recorded in VP7 represent 14 native tree and shrub species. Planted stems were both container grown and bare-root nursery stock.

Vegetation Plot 8.—Twenty-seven planted stems (1,093 stems per acre) were documented in vegetation plot 8 during the MY0 survey (Table C.8). The 27 planted stems recorded in VP8 represent 18 native woody species. Seven stems were planted as live stakes in VP8. Live stake species consisted of silky dogwood *Cornus amomum* (4 stems) and silky willow *Salix sericea* (3 stems). VP8 is the only vegetation monitoring plot to include live stakes. The other 20 planted stems were from containerized and bare-root nursery stock.

Vegetation Plot 9.—In vegetation plot 9, 16 planted stems were recorded (648 stems per acre) in MY0 (Table C.8). The 16 planted stems recorded in VP9 represent 13 native tree and shrub species. Planted stems were both container grown and bare-root nursery stock.

Vegetation Plot 10.—Twenty-one planted stems (850 stems per acre) were documented in vegetation plot 10 during the MY0 survey (Table C.8). The 21 planted stems recorded in VP10 represent 13 native woody species originating from both containerized and bare-root nursery stock.

4.3.1 Vegetative Monitoring Plot Photographs

Vegetative monitoring plot photographs were taken during the MY0 vegetation monitoring survey to establish a baseline condition of the plot. Plot photographs will be compared overtime to evaluate the plots performance throughout the monitoring period (Figure C.1).

4.3.2 Vegetation Problem Areas Table Summary

Areas of multiflora rose *Rosa multiflora*, Chinese privet *Ligustrum sinense*, oriental bittersweet *Celastrus orbiculatus*, Japanese honeysuckle *Lonicera japonica*, and pasture fescue *Festuca spp*. along with other less ubiquitous invasive species were chemically treated throughout the project area during the construction period. A follow up treatment of invasive exotic vegetation occurred in the spring of 2012. Areas of high infestation were encountered during the initial treatment phase, particularly adjacent to UT2 (right bank), but the majority of problem invasive areas were observed to have only sparse occurrence during the MY0 survey. Therefore, the vegetation problem areas table (Table C.9) is used only for a place holder in the as-built report and will be populated if problem areas are encountered during on-going monitoring of the mitigation site.

4.3.3 Vegetative Problem Areas Plan View

A vegetation problem areas plan view was not generated for MY0 because herbaceous vegetation and planted stems have performed satisfactorily and because the large areas on invasive vegetation was treated during construction and were satisfactorily controlled by those efforts. Following construction, there were no areas of the conservation easement that were devoid of vegetation, and no areas of heavy non-native infestations were observed.

4.3.4 Vegetative Problem Areas Photographs

Vegetative problem area photographs were not taken in MY0 because of the isolated occurrence of non-native invasive vegetation. Therefore, Figure C.2 will be used as a place holder for future monitoring surveys to provide visual record of the occurrence, size, and dispersal of non-native vegetation.

4.3.5 Summary of Vegetation Assessment Results

A total of 184 planted stems were counted during the MY0 survey. The average density of planted woody stems recorded in the ten 100 m^2 vegetation plots combined was 749 stems per acre in MY0. Only one vegetation plot (VP8) contained live stake stems. The other 9 vegetation plots consisted of both native bare-root whips or containerized stock. All ten vegetation plots exceeded the success criteria for vegetation stem density during the as-built baseline survey.

Although non-native invasive vegetation remains present at the mitigation site, its occurrence is sparse. Invasive vegetation treatments were effective during the construction phase of the project and will be routinely continued throughout the monitoring phase.

5 Farm Management Plan

This mitigation project included livestock best management practices (BMPs) such as livestock exclusionary fencing and developed watering facilities on the Bianculli, Roberson, and Davis properties. The NCEEP funded all livestock BMPs in full through a task order contract with the North Carolina Division of Soil and Water Conservation. The Buncombe County Soil and Water Conservation District designed and managed the installation of the BMPs through a contract independent of the channel and riparian construction contract. Additional details on the locations and quantities of the livestock BMPs are included in the Upper South Hominy Mitigation Plan (NCWRC 2010).

6 Acknowledgements

J. Ferguson, S. Loftis, and B. Burgess of the NCWRC collected and analyzed the field data used in the analysis of the this baseline monitoring document and as-built report. J. Ferguson prepared the as-built construction drawings for the project report. S. Loftis prepared the baseline monitoring document and as-built report. A special thanks goes to the NCWRC staff who improved this document with their thorough review and thoughtful suggestions.

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Appendix A.

General Tables and Figures

Table A.1 Restoration Levels, Mitigation Approaches and Component Summations, Upper South Hominy Mitigation Site.

Upper South Hominy Mitigation Site Project Components							
Project Segment or Reach ID	**Existing Length (lf) or Acres (ac)**	**Mitigation Level[a]**	**Approach[b]**	**Mitigated Length (lf) or Acres (ac)**	**Stationing**	**Mitigation Ratio**	**Mitigation Units**
Bianculli South Hominy Cr.	600	R	P3	630	0+00 to 6+30	1:1	630
Bianculli South Hominy Cr.	169	EII	P3	167	6+30 to 7+97	2.5:1	67
Bianculli Trib North (UT1)	100	P		94	0+00 to 0+94	5:1	19
Bianculli Trib North (UT1)	138	R	P1	183	1+00 to 2+83	1:1	183
Bianculli Trib South (UT2)	44	R	P1	45	6+54 to 6+99	1:1	45
Bianculli Trib South (UT2)	654	EII	SS	654	0+00 to 6+54	2.5:1	262
Bura/Roberson South Hominy Cr	477	R	P3	518	1+00 to 2+25; 7+25 to 10+00; 11+68 to 12+86	1:1	518
Bura/Roberson South Hominy Cr	775	EII	P3	768	0+00 to 1+00; 2+25 to 7+25; 10+00 to 11+68	2.5:1	307
Roberson Abandoned Ch UT2	170	R	P1	191	0+00 to 1+91	1:1	191
Davis South Hominy Cr	500	EI	P3	522	0+00 to 5+22	1.5:1	348
Davis South Hominy Cr	227	EII	P3	215	5+22 to 7+37	2.5:1	86
Davis UT3 upper	775	P		777	0+00 to 7+77	5:1	155
Davis UT3 middle	538	EII	SS	538	7+77 to 13+15	2.5:1	215
Davis UT3 lower	426	R	P1	427	13+15 to 17+42	1:1	427
Davis Springs (north)	144	P		144	0+00 to 1+44	5:1	29
Davis Spring (south)	72	P		78	0+00 to 0+78	5:1	16
Totals	5,809			5,951			3,498

Component Summations						
Mitigation Level	Stream Length(lf)	Steam Mitigation Units		Riparian Wetland (Acre)		Wetland Mitigation Units
				Riverine	Non-Riverine	
Restoration	1,994	1,994				
Enhancement I	522	348				
Enhancement II	2,342	937			1.11	0.44
Creation						
Preservation	1,093	219			0.24	0.05
HQ Preservation						
Totals	**5,951**	**3,498**			**1.35**	**0.49**

R = Restoration P = Preservation C = Creation EI = Enhancement I EII = Enhancement II S = Stabilization
P1 = Priority 1 P2 = Priority 2 P3 = Priority 3 SS = Stream Bank Stabilization
[a]Source: USACE (2003)
[b]Source: Rosgen (2006)

Table A.2 Project Activity and Reporting History, Upper South Hominy Mitigation Site.

Upper South Hominy Mitigation Site Project Activity and Reporting History		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Conservation easement acquired (by NCEEP)	11 June 2009	11 June 2009
Mitigation Plan	23 January 2009	30 November 2010
Final Design - 90%	28 February 2010	30 November 2010
Construction	29 June 2011	31 October 2011
Temporary S&E seed mix applied to entire project area	29 June 2011	31 October 2011
Permanent seed mix applied to entire project area	29 June 2011	31 October 2011
As-built physical survey	16 December 2011	1 February 2012
Containerized and bare root plantings installed over entire project area	9 November 2011	20 February 2012
As-built vegetation survey	2 February 2012	22 February 2012
Mitigation Plan/As-built (Year 0 Monitoring - baseline)	22 February 2012	28 February 2013
Year 1 Monitoring	16 November 2012	
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5+ Monitoring		

Bolded items represent those events or deliverables that are variable. Non-bolded items represent events that are standard components over the course of a typical project

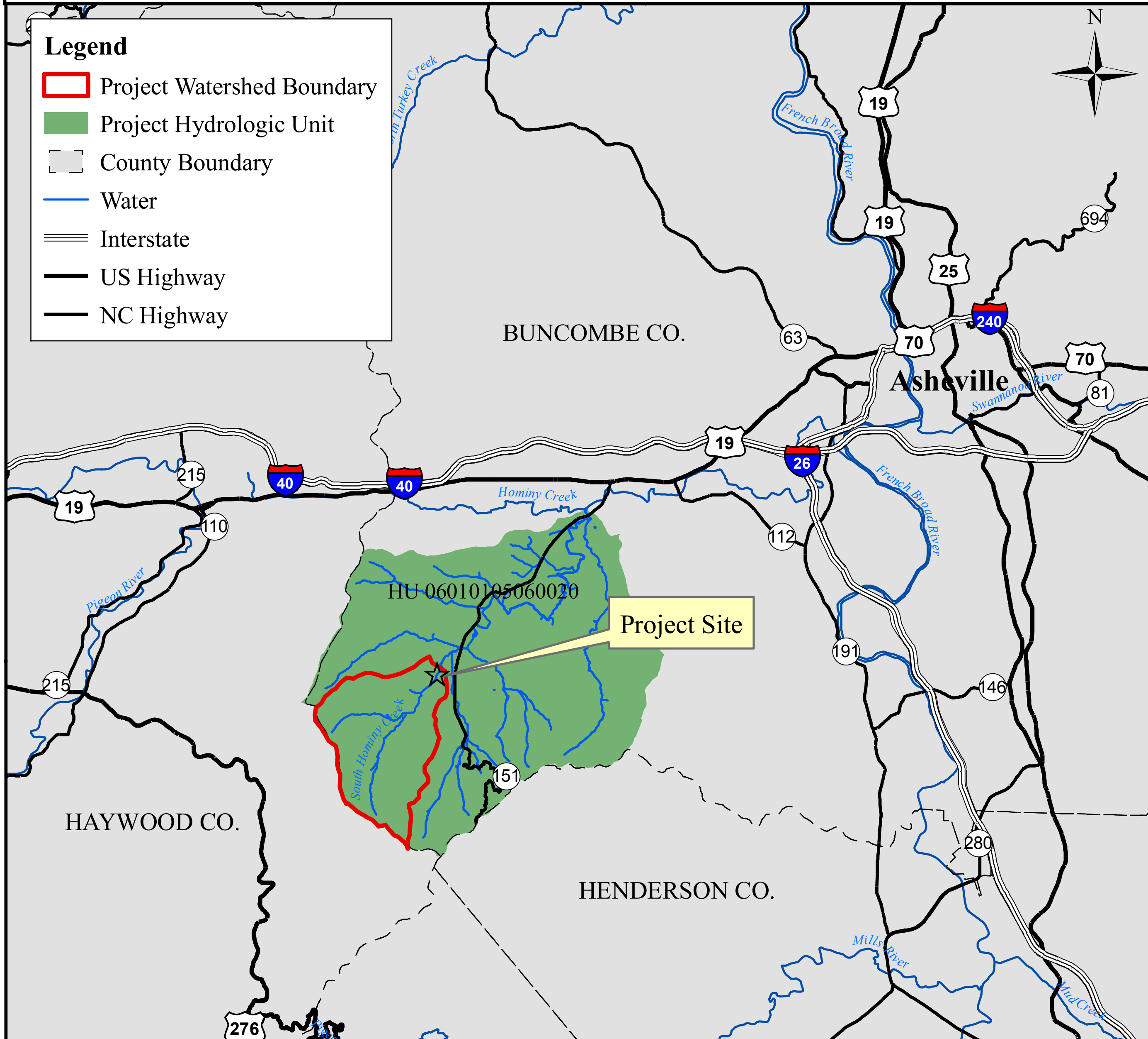
Table A.3 Project Contacts, Upper South Hominy Mitigation Site.

Upper South Hominy Mitigation Site Project Contacts	
Project Owner NC Ecosystem Enhancement Program	**Contact Information** NC Ecosystem Enhancement Program Harry Tsomides 5 Ravenscroft Dr. Asheville, NC 28801
Designer(s): NC Wildlife Resources Commission Jeff Ferguson Shannon Deaton	**Firm Information/Address:** North Carolina Wildlife Resources Commission 1751Varsity Drive NCSU Centennial Campus Raleigh, NC 27695
Construction Contractor: Suttles Trucking and Grading, Inc.	**Firm Information/Address:** Suttles Trucking and Grading, Inc. 10 Edwards Drive Nebo, NC 28761 (828-659-2104)
Planting Contractor: Suttles Trucking and Grading, Inc.	**Company Information/Address:** Same as above
Seeding Contractor: NC Wildlife Resources Commission **Native Seed Mix Sources** Ernst Conservation Seeds, LLP **Nursery Stock Suppliers** NC Wildlife Resources Commission NC Forest Service	**Company Information/Address:** Same as above **Company and Contact Phone:** 1-800-873-3321 **Company and Contact Phone:** Dan River Prison Farm, Same as above Carolyn Jernigan 919-731-7988
Monitoring Performers: Stream Monitoring POC Vegetation Monitoring POC	**Firm Information/Address:** NCWRC, same as above NCWRC, same as above

Table A.4 Project Attributes, Upper South Hominy Mitigation Site.

Upper South Hominy Mitigation Site Project Attributes				
Project County	Buncombe			
Physiographic Region	Blue Ridge Mountains			
Ecoregion (Reference: USACE 2003)	Southern Crystalline Ridges and Mountains			
Project River Basin	French Broad River			
USGS HUC for Project (14 digit)	06010105060020			
NCDWQ Sub-basin for Project	04-03-02			
Within Extent of EEP Watershed Plan?	Yes			
NCWRC Class (Warm, Cool, Cold)	Cold			
Percent of project Easement Fenced or Demarcated	100%			
Beaver activity Observed During Design Phase?	Yes			
	SHC	UT3 Davis	UT2 Bianculli/Roberson	UT1 Bianculli
Drainage Area (mi^2)	7.1	0.1	<0.1	<0.1
Stream Order	4	1	1	1
Restored Length (ft)	2,820	1,742	890	277
Perennial or Intermittent	Perennial	Perennial	Perennial	Perennial
Watershed Type (Rural, Urban, Developing, etc.)	Developing	Developing	Developing	Developing
Watershed LULC Distribution (e.g.) (percent)				
Residential	<3.0	Included in total	Included in total	Included in total
Ag-Row Crop	0.2	Included in total	Included in total	Included in total
Ag-Livestock	7.2	Included in total	Included in total	Included in total
Forested	89.7	Included in total	Included in total	Included in total
Etc.				
Watershed Impervious Cover (percent)	<1.0	Included in total	Included in total	Included in total
NCDWQ AU/Index Number	6-76-5	N/A	N/A	N/A
NCDWQ Classification	C, Tr	C, Tr	C, Tr	C, Tr
303d Listed?	No	No	No	No
Upstream 303d Listed Segment?	No	No	No	No
Reasons for 303d Listing or Stressor	N/A	N/A	N/A	N/A
NCDWQ 401 Water Quality Certification Number	Buncombe Co. 20110118		Same	Same
USACE 404 Action ID Number	SAW-2011-00076		Same	Same
Total Acreage of Conservation Easement (including stream channel)	16.44	Included in total	Included in total	Included in total
Total (undisturbed) Vegetated Acreage Within Easement	7.5	Included in total	Included in total	Included in total
Total Riparian Buffer Acreage as Part of the Restoration	7.0	Included in total	Included in total	Included in total
Rosgen Stream Classification of Pre-Existing	C4	G5	abandoned	G5
Rosgen Stream Classification of As-built (Design)	C4	B5/C5	C5	E5
Valley Type	VIII	VII	VIII	VIII
Valley Slope	0.00973	0.10480		
Valley Side Slope Range (e.g. 2-3%)	0.09-0.24	0.07-0.29		
Valley Toe Slope Range (e.g. 2-3%)	0.003-0.026	0.02-0.19		
Cowardin Classification (Reference: Cowardin 1979)	N/A	N/A	N/A	N/A
Trout Waters Designation (NCWRC)	No	No	No	No
Species of Concern, Endangered, Etc.? (Y/N)	No	No	No	No
Dominant Soil Series and Characteristics				
Series (dominant)	Iotla Loam	Included in total	Included in total	Included in total
Depth (in)	80			
Clay (%)	15.5			
K	0.15			
T	5			

Figure A.1 Vicinity Map, Upper South Hominy Mitigation Site.



From Asheville, NC, head west on I-40 turn. Take exit 44 and go south on US 19/US 23/Smokey Park Highway for 3.0 miles. Turn left on to NC 151/Pisgah Highway and travel for 6.0 miles before turning right on to Davis Creek Road/S. Hominy Road (SR 1103).

The subject project site is an environmental restoration site of the NCDENR Ecosystem Enhancement Program (EEP) 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 or the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activities by any person outside of these previously sanctioned roles and activities requires prior coordination with EEP.

0 1 2 4 6 8 Miles

Ecosystem Enhancement PROGRAM

Project Vicinity Map

Upper South Hominy Mitigation Site
EEP Project Number: 92632
Buncombe County, North Carolina

Map Insert

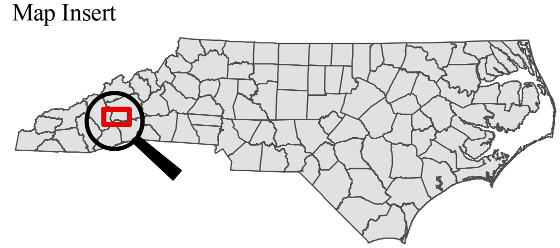
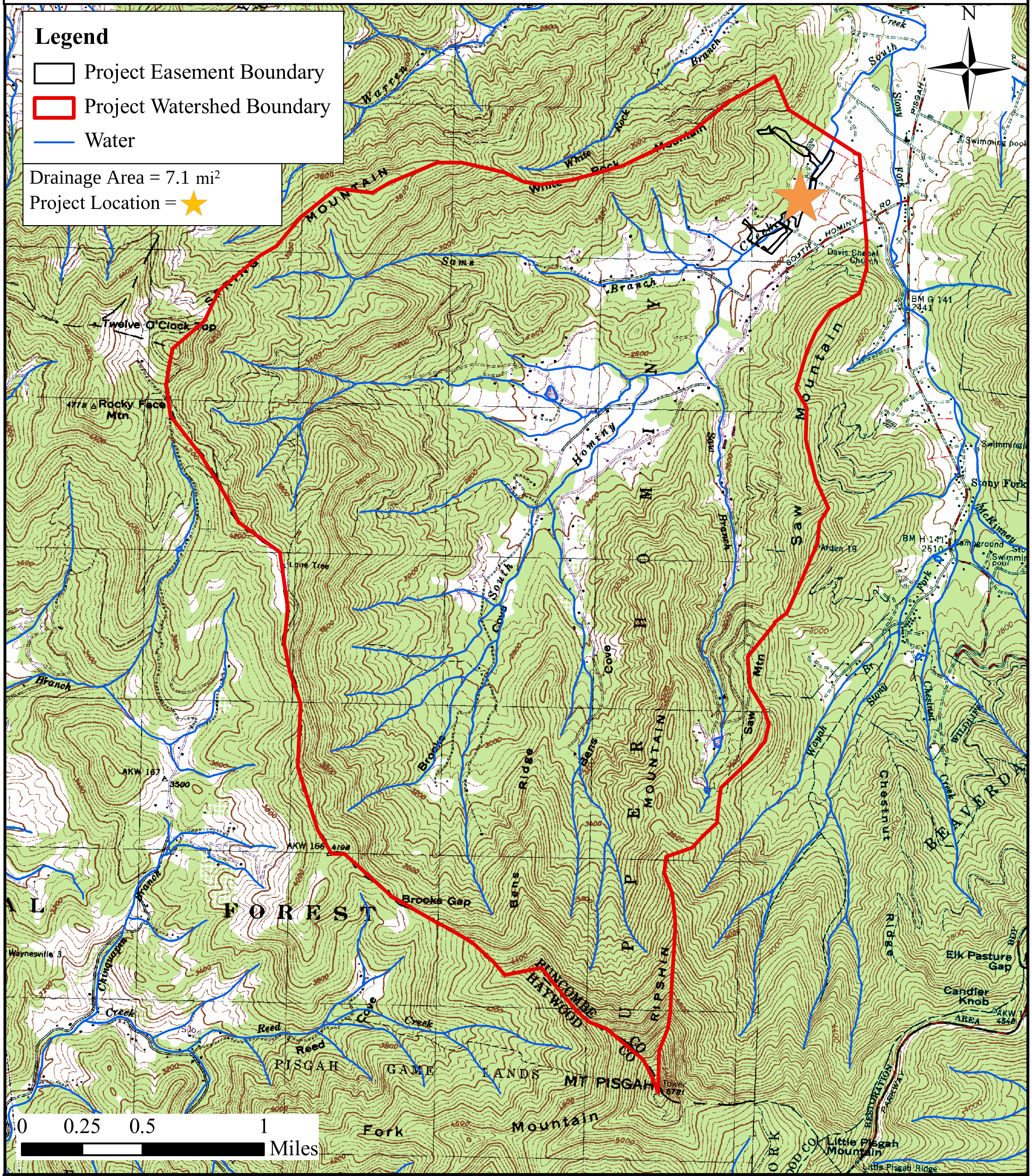


Figure A.2 South Hominy Creek Watershed Boundary and Project Area Map.



Project Watershed Boundary Map

Upper South Hominy Mitigation Site
EEP Project Number: 92632
Buncombe County, North Carolina

Map Insert

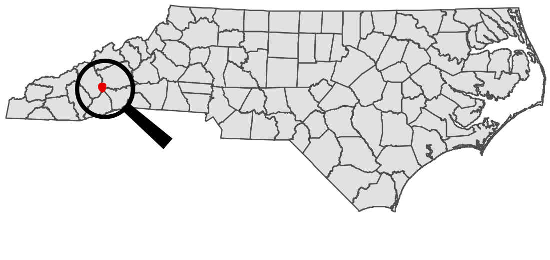
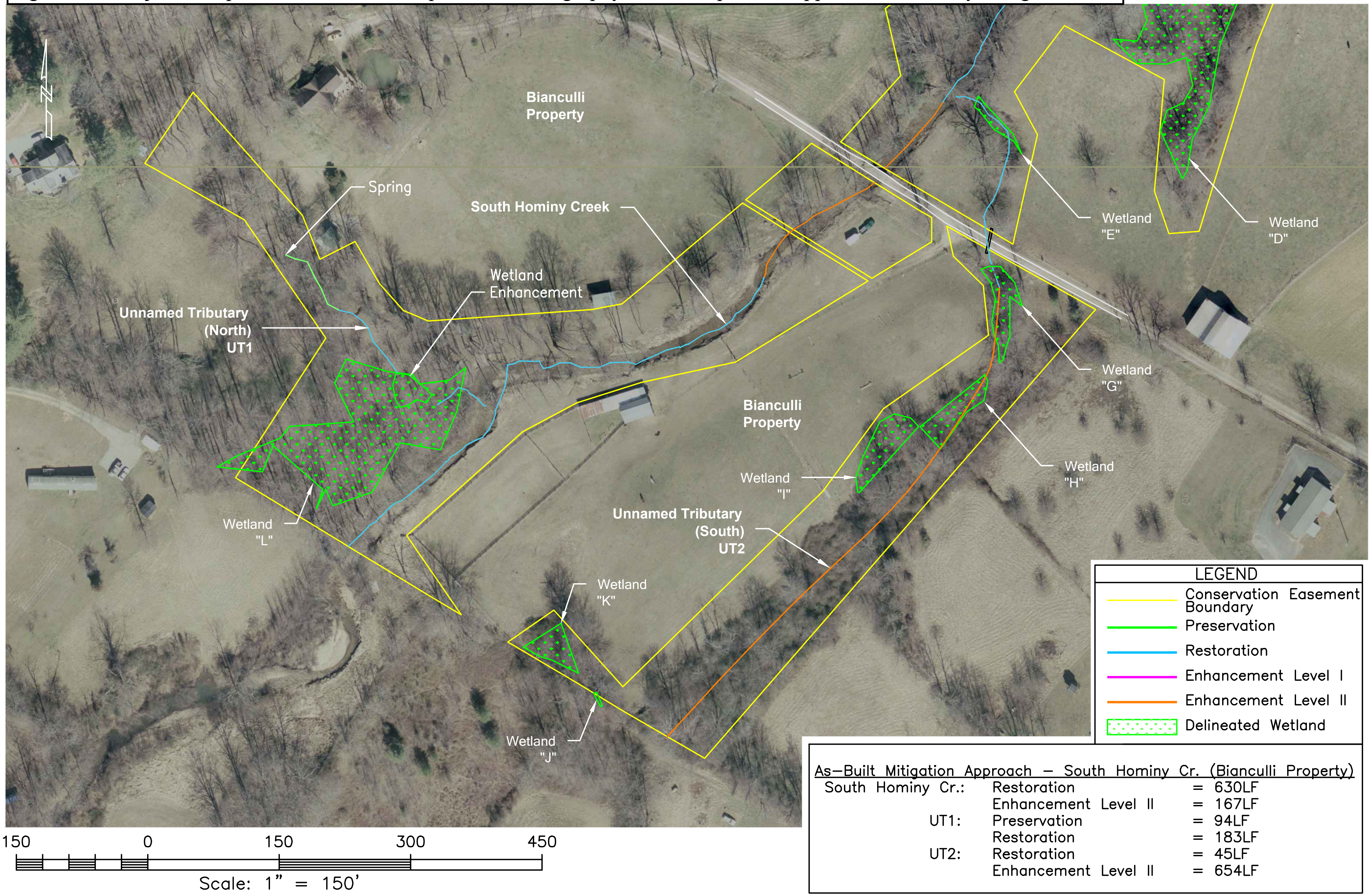


Figure A.3 Project Components and Assets Map, Aerial Photography NConemap 2006, Upper South Hominy Mitigation Site.

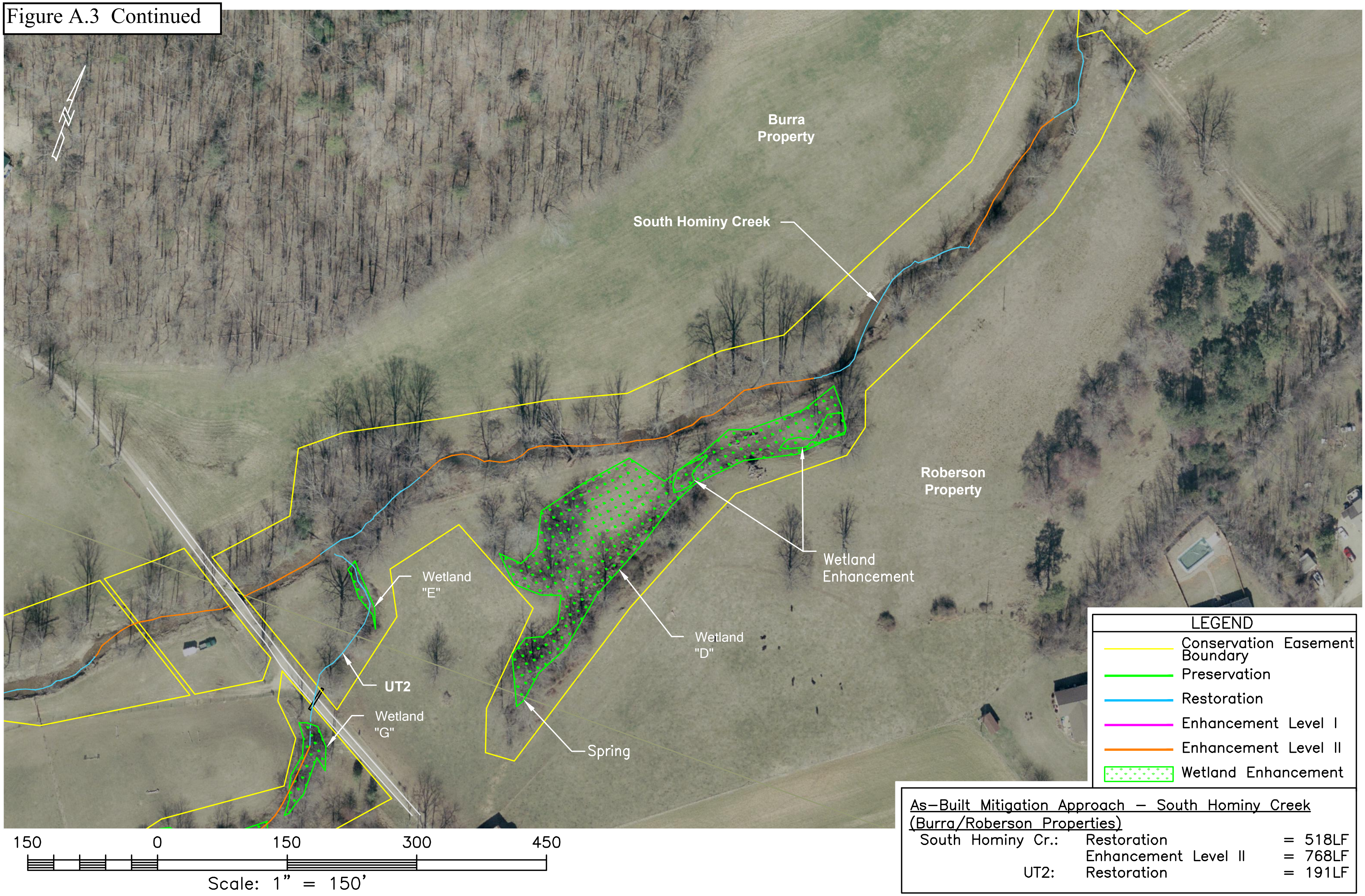


As-Built Mitigation Approach – South Hominy Cr. (Bianculli Property)

South Hominy Cr.:	Restoration	=	630LF
	Enhancement Level II	=	167LF
UT1:	Preservation	=	94LF
	Restoration	=	183LF
UT2:	Restoration	=	45LF
	Enhancement Level II	=	654LF

South Hominy Creek Mitigation Components (As-Built)
EEP Project No.: 92632 Buncombe County, NC
Bianculli Property Reach

Figure A.3 Continued



LEGEND

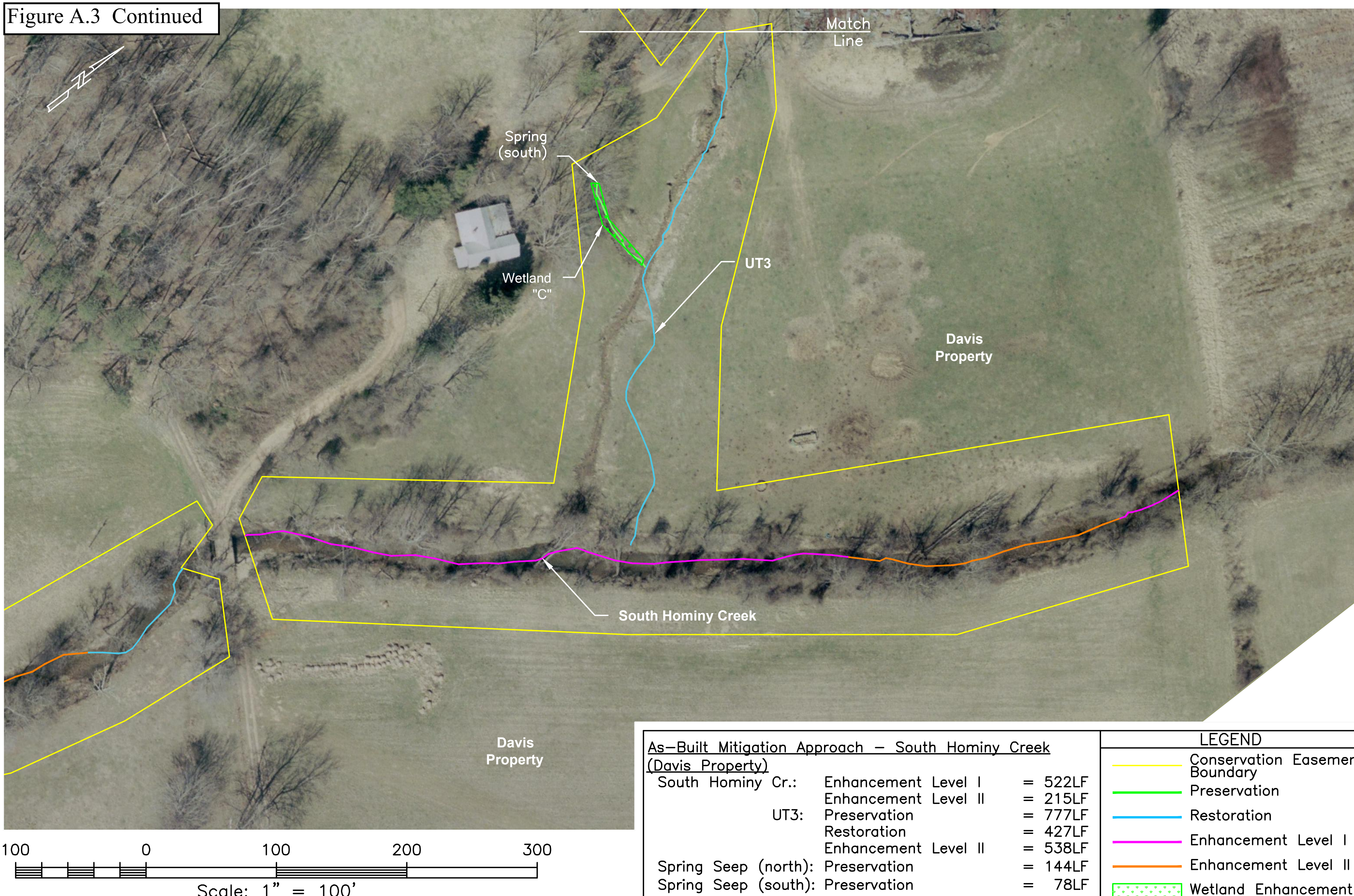
- Conservation Easement Boundary
- Preservation
- Restoration
- Enhancement Level I
- Enhancement Level II
- Wetland Enhancement

As–Built Mitigation Approach – South Hominy Creek (Burra/Roberson Properties)

South Hominy Cr.:	Restoration	= 518LF
	Enhancement Level II	= 768LF
UT2:	Restoration	= 191LF

South Hominy Creek Mitigation Components (As-Built)
EEP Project No.: 92632 Buncombe County, NC
Burra/Roberson Properties Reach

Figure A.3 Continued



As–Built Mitigation Approach – South Hominy Creek (Davis Property)

South Hominy Cr.:	Enhancement Level I	=	522LF
	Enhancement Level II	=	215LF
UT3:	Preservation	=	777LF
	Restoration	=	427LF
	Enhancement Level II	=	538LF
Spring Seep (north):	Preservation	=	144LF
Spring Seep (south):	Preservation	=	78LF

LEGEND

- Conservation Easement Boundary
- Preservation
- Restoration
- Enhancement Level I
- Enhancement Level II
- Wetland Enhancement

Ecosystem Enhancement PROGRAM

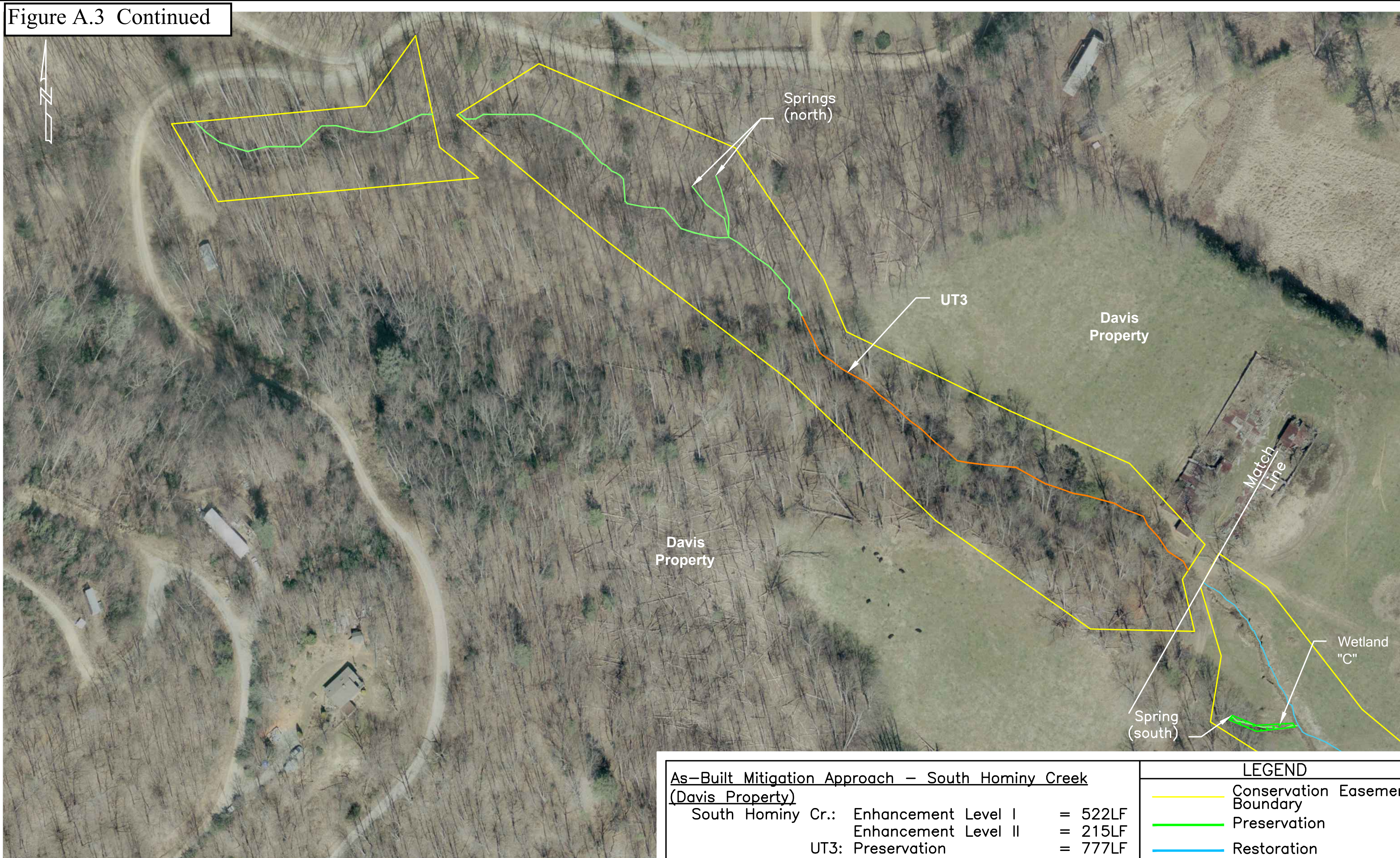
South Hominy Creek Mitigation Components (As-Built)

EEP Project No.: 92632 Buncombe County, NC

Davis Property Reach

NORTH CAROLINA Wildlife RESOURCES COMMISSION

Figure A.3 Continued



As–Built Mitigation Approach – South Hominy Creek (Davis Property)

South Hominy Cr.:	Enhancement Level I	=	522LF
	Enhancement Level II	=	215LF
UT3:	Preservation	=	777LF
	Restoration	=	427LF
	Enhancement Level II	=	538LF
Spring Seep (north):	Preservation	=	144LF
Spring Seep (south):	Preservation	=	78LF

LEGEND

- Conservation Easement Boundary
- Preservation
- Restoration
- Enhancement Level I
- Enhancement Level II
- Wetland Enhancement

Ecosystem Enhancement PROGRAM

South Hominy Creek Mitigation Components (As-Built)
EEP Project No.: 92632 Buncombe County, NC
Davis Property Reach

NORTH CAROLINA Wildlife RESOURCES COMMISSION

Appendix B.

Morphological Summary Data Tables and Plots

Table B.1 Existing, Reference, Design, and As-built Stream Channel Morphology Data Summary for South Hominy Creek (SHC).

Upper South Hominy Mitigation Site Channel Morphology Data Summary																			
Parameter (Riffles Only)	**Gauge**	**Regional Curve Interval**			**(SHC) Pre-Existing Condition**						**Reference Reach(es) Data**						**(SHC) Design**		
Dimension and Substrate		LL	UL	Eq.	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n	Min	Mean	Max
Bankfull Width (ft)				30	27.2	37.3	31.1	32.0	3.6	7	28.1	37.2	30.3	31.2	3.5	5	28.1	30.7	37.2
Floodprone Width (ft)					203.0	370.0	320.0	311.3	55.6	7	64.0	329.0	104.0	146.4	106.9	5	68.4	182.2	296
Bankfull Cross-Sectional Area (ft^2)				70	50.8	81.4	70.2	69.7	9.9	7	43.8	75.5	62.0	60.7	11.6	5	43.8	61.3	75.5
Bankfull Mean Depth (ft)				2.5	1.7	2.6	2.2	2.2	0.4	7	1.5	2.2	2.0	2.0	0.3	5	1.5	2.0	2.2
Bankfull Max Depth (ft)					2.5	3.8	3.2	3.2	0.4	7	2.3	3.3	3.0	2.8	0.4	5	2.0	2.7	3.3
Width/Depth Ratio					10.5	20.1	15.0	15.0	3.5	7	12.7	20.9	16.4	16.3	3.4	5	12.0	15.4	18.6
Entrenchment Ratio					6.6	13.4	9.9	9.8	2.0	7	2.3	11.2	3.4	4.7	3.6	5	2.4	5.9	8.0
Bank Height Ratio					1.1	2.0	1.4	1.5	0.3	7	1.0	2.0	1.0	1.3	0.4	5	1.0	1.3	1.5
Bankfull Wetted Perimeter (ft)					30.0	38.7	32.8	33.8	3.3	7	30.5	38.2	31.6	32.8	3.1	5	30.5	32.8	38.15
Hydraulic Radius (ft)					1.6	2.4	2.1	2.1	0.3	7	1.4	2.1	2.0	1.8	0.3	5	1.4	1.9	2.1
D50 (mm)					17.3	39.2	24.5	26.9	8.1	7	15.2	62.3	46.5	42.6	20.8	4	15.2	42.6	62.3
Pattern																			
Channel Belt Width (ft)					28.2	97.4	46.0	56.8	26.1	6	64.7	240.0	88.0	120.2	81.8	4	53.1	154.7	256.2
Radius of Curvature (ft)					29.7	545.1	294.3	295.8	209.7	6	12.7	105.0	49.6	54.2	38.1	4	10.7	70.7	256.2
Rc:Bankfull Width (ft/ft)					0.9	17.0	9.2	9.2	6.6	6	0.5	3.4	1.6	1.8	1.2	4	0.4	2.3	6.9
Meander Wavelength (ft)					140.0	561.5	307.5	307.0	148.3	6	131.0	350.0	342.5	291.5	107.2	4	108.0	288.9	469.8
Meander Width Ratio					0.9	3.0	1.4	1.8	0.8	6	1.9	11.9	7.9	7.4	5.0	4	1.9	5.0	6.9
Profile																			
Riffle Length (ft)					12.6	85.9	53.7	53.5	21.9	14	27.7	65.0	57.5	51.9	16.8	4	15.8	52.3	86.9
Riffle Slope (ft/ft)					0.01177	0.03597	0.01733	0.01967	0.00709	14	0.01128	0.02103	0.01329	0.01472	0.00433	4	0.00737	0.01703	0.02669
Pool Length (ft)					16.0	84.1	42.2	42.7	19.6	11	27.1	41.0	30.9	32.5	6.2	4	14.7	55.7	96.7
Pool Max Depth (ft)					2.9	7.7	4.4	4.5	1.3	11	3.8	5.3	4.3	4.4	0.7	4	3.6	6.2	8.8
Pool to Pool Spacing (ft)					28.4	537.8	184.4	220.9	173.1	8	41.4	307.9	77.0	125.9	123.0	4	44.2	176.8	309.4

Table B.1 Continued

Upper South Hominy Mitigation Site Channel Morphology Data Summary													
Substrate, Bed and Transport Parameters	**Gauge**	**Regional Curve Interval**			**(SHC) Pre-Existing Condition**							**Reference Reach(es) Data**	**(SHC) Design**
[a]Ri % / Ru % / P % / G % / S %						30		30	20	20			
[a]SC % / Sa % / G % / C % / B % / Be %						7.6	16.1	29.7	45.4	1.3	0.0		
[a]D_{16} / D_{35} / D_{50} / D_{84} / D_{95} / Di^p / Di^{sp}					0.23	23.9	56.6	144.4	211.0	98.0	90.0		
Reach Shear Stress (competency) lb/ft[b]					1.0 to 1.3								0.5 to1.2
Max part size (mm) mobilized at bankfull					98								71 to 160
Stream Power (transport capacity) W/m[b]													
Additional Reach Parameters													
Drainage Area (mi^2)					7.1								
Impervious cover estimate (%)					<1.0								
Rosgen Classification					C4								C4
Bankfull Velocity (fps)					4.6								4.6
Bankfull Discharge (cfs)		250		350	322								
Valley Length (ft)					2604.1								
Channel Thalweg Length (ft)					2893.7								2893.7
Sinuosity					1.11								1.11
Water Surface Slope (Channel) (ft/ft)					0.009								0.009
Bankfull Slope (ft/ft)					0.009								0.009
Bankfull Floodplain Area (acres)					0.66								1.26
Proportion Over Wide (%)					5								
Entrenchment Class (ER Range)					Low (>2.2)								
Incision Class (BHR)					Moderately Unstable (1.06-1.3) to Highly Unstable (>1.5)								
BEHI VL% / L% /M% / H% / VH% / E %					NA								
Channel Stability or Habitat Metric					NA								
Biological or Other					NA								

[a] Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock, (values derived from reach-wide pebble counts). Di^p = max pavement, Di^{sp} = max sub-pavement. Shaded cells indicate that these will typically not be filled in

[b] Methodology should be cited and described either here or in text

= Non-Applicable; NA = Not Available

Table B.1 Continued

Upper South Hominy Mitigation Site Channel Morphology Data Summary (EEP Project Number 92632)																		
Mainstem 1 – Bianculli Reach – 797 feet																		
Parameter (Riffles 1 & 3)	**MYO**						**MY1**						**MY2**					
Dimension and Substrate	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n
Bankfull Width (ft)	26.9	30.1	28.5	28.5	2.3	2												
Floodprone Width (ft)	236.0	362.0	299.0	299.0	89.1	2												
Bankfull Cross-Sectional Area (ft^2)	54.8	62.9	58.8	58.8	5.7	2												
Bankfull Mean Depth (ft)	2.0	2.1	2.1	2.1	0.0	2												
Bankfull Max Depth (ft)	2.6	3.2	2.9	2.9	0.4	2												
Width/Depth Ratio	13.2	14.4	13.8	13.8	0.9	2												
Entrenchment Ratio	8.8	12.0	10.4	10.4	2.3	2												
Bank Height Ratio	1.6	1.7	1.7	1.7	0.1	2												
Bankfull Wetted Perimeter (ft)	28.8	32.0	30.4	30.4	2.3	2												
Hydraulic Radius (ft)	1.9	2.0	1.9	1.9	0.0	2												
D50 (mm)	22.1	28.9	25.5	25.5	4.8	2												
Pattern																		
Channel Belt Width (ft)			121.0			1												
Radius of Curvature (ft)	97.0	247.0	212.0	185.3	106.1	3												
Rc:Bankfull Width (ft/ft)	3.2	8.2	7.1	6.2	3.5	3												
Meander Wavelength (ft)	315.0	329.0	322.0	322.0	9.9	2												
Meander Width Ratio			4.0			1												
Profile																		
Riffle Length (ft)	32.4	62.9	60.1	52.6	12.9	5												
Riffle Slope (ft/ft)	0.01107	0.01581	0.01258	0.01334	0.00208	5												
Pool Length (ft)	20.7	34.4	29.1	28.5	5.0	5												
Pool Max Depth (ft)	4.7	5.9	5.4	5.3	0.5	5												
Pool to Pool Spacing (ft)	86.7	217.6	114.3	133.2	59.6	4												

Table B.1 Continued

Upper South Hominy Mitigation Site Channel Morphology Data Summary (EEP Project Number 92632)																		
Mainstem 2 – Bura/Roberson Reach – 1,286 feet																		
Parameter (Riffles 5 & 7)	**MY0**						**MY1**						**MY2**					
Dimension and Substrate	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n
Bankfull Width (ft)	30.5	37.5	34.0	34.0	5.0	2												
Floodprone Width (ft)	282.0	337.0	309.5	309.5	38.9	2												
Bankfull Cross-Sectional Area (ft^2)	62.2	65.2	63.7	63.7	2.1	2												
Bankfull Mean Depth (ft)	1.7	2.0	1.9	1.9	0.2	2												
Bankfull Max Depth (ft)	2.7	3.2	3.0	3.0	0.3	2												
Width/Depth Ratio	14.9	21.6	18.3	18.3	4.7	2												
Entrenchment Ratio	7.5	11.1	9.3	9.3	2.5	2												
Bank Height Ratio	1.2	1.2	1.2	1.2	0.0	2												
Bankfull Wetted Perimeter (ft)	31.8	38.3	35.0	35.0	4.6	2												
Hydraulic Radius (ft)	1.7	2.0	1.8	1.8	0.2	2												
D50 (mm)	31.4	49.4	40.4	40.4	12.7	2												
Pattern																		
Channel Belt Width (ft)	93.0	193.0	143.0	143.0	70.7	2												
Radius of Curvature (ft)	90.0	137.0	114.0	113.7	23.5	3												
Rc:Bankfull Width (ft/ft)	3.0	4.6	3.8	3.8	0.8	3												
Meander Wavelength (ft)	214.0	343.0	229.0	262.0	70.5	3												
Meander Width Ratio	3.1	6.4	4.8	4.8	2.3	2												
Profile																		
Riffle Length (ft)	47.6	77.8	70.9	68.8	12.3	5												
Riffle Slope (ft/ft)	0.00719	0.01452	0.01287	0.01192	0.00280	5												
Pool Length (ft)	32.8	78.5	56.3	54.1	17.5	5												
Pool Max Depth (ft)	3.5	4.4	5.9	4.7	4.5	5												
Pool to Pool Spacing (ft)	69.1	469.9	271.8	270.7	218.4	4												

Table B.1 Continued

Upper South Hominy Mitigation Site Channel Morphology Data Summary (EEP Project Number 92632)																		
Mainstem 3 – Davis Reach – 737 feet																		
Parameter (Riffles 8 & 10)	**MY0**						**MY1**						**MY2**					
Dimension and Substrate	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n
Bankfull Width (ft)	25.5	30.1	27.8	27.8	3.3	2												
Floodprone Width (ft)	292.0	549.0	420.5	420.5	181.7	2												
Bankfull Cross-Sectional Area (ft^2)	53.4	65.1	59.2	59.2	8.2	2												
Bankfull Mean Depth (ft)	2.1	2.2	2.1	2.1	0.0	2												
Bankfull Max Depth (ft)	3.1	3.1	3.1	3.1	0.0	2												
Width/Depth Ratio	12.1	13.9	13.0	13.0	1.3	2												
Entrenchment Ratio	9.7	21.6	15.6	15.6	8.4	2												
Bank Height Ratio	1.2	1.4	1.3	1.3	0.1	2												
Bankfull Wetted Perimeter (ft)	26.6	31.3	29.0	29.0	3.3	2												
Hydraulic Radius (ft)	2.0	2.1	2.0	2.0	0.1	2												
D50 (mm)	33.5	47.7	40.6	40.6	10.0	2												
Pattern																		
Channel Belt Width (ft)	39.0	50.0	47.0	45.3	5.7	3												
Radius of Curvature (ft)	102.0	187.0	144.5	144.5	60.1	2												
Rc:Bankfull Width (ft/ft)	3.4	6.2	4.8	4.8	2.0	2												
Meander Wavelength (ft)	188.0	382.0	268.0	279.3	97.5	3												
Meander Width Ratio	1.6	1.7	1.6	1.6	0.1	3												
Profile																		
Riffle Length (ft)	22.0	60.8	37.2	40.4	17.0	5												
Riffle Slope (ft/ft)	0.00856	0.02029	0.01368	0.01399	0.00501	5												
Pool Length (ft)	17.6	38.5	27.6	28.1	8.6	5												
Pool Max Depth (ft)	3.9	5.1	4.4	4.5	0.5	5												
Pool to Pool Spacing (ft)	65.6	258.1	174.8	168.3	94.7	4												

Table B.1.1 Existing, Reference, Design, and As-built Stream Channel Morphology Data Summary for Roberson UT2 and Davis UT3, Riffles Only.

Upper South Hominy Mitigation Site Channel Morphology Data Summary (EEP Project Number 92632)														
Parameter (Riffles Only)	**(UT3 Davis) Pre-Existing Condition**						**Reference Reach Basin Cr (C)**	**Reference Reach North Br (Ba)[c]**	**(UT3-upper, Ba) Design**			**(UT3-lower, C) Design**		
Dimension and Substrate	Min	Max	Med	Mean	SD	n	Mean	Mean	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	3.9	10.0	4.4	6.1	3.4	3	30.7	8.0	8.0	10.0	12.0	8.0	10.0	12.0
Floodprone Width (ft)	6.0	15.3	14.0	11.8	5.0	3	85.0	11.6	15.0	20.0	25.0	27.7	40.0	54.0
Bankfull Cross-Sectional Area (ft^2)	4.5	7.4	6.5	6.1	1.5	3	57.4	4.2	6.0	6.9	7.5	8.6	9.2	9.9
Bankfull Mean Depth (ft)	0.7	1.5	1.2	1.1	0.4	3	1.87	0.5	0.4	0.5	0.6	0.5	0.6	0.7
Bankfull Max Depth (ft)	1.1	1.8	1.4	1.4	0.4	3	2.4	0.8	1.0	1.2	1.4	0.9	1.6	2.2
Width/Depth Ratio	3.0	13.8	3.3	6.7	6.1	3	16.4	15.4	16.0	18.0	20.0	16.0	16.6	17.1
Entrenchment Ratio	1.5	3.1	1.6	2.1	0.9	3	2.8	1.5	1.9	2.2	2.5	3.5	4.0	4.5
Bank Height Ratio	3.4	3.7	3.6	3.6	0.1	3	1.0	1.0		1.0			1.0	
Bankfull Wetted Perimeter (ft)	6.0	10.4	6.7	7.7	2.4	3	32.6	N/A	10.4	10.7	10.9	10.6	11.1	11.6
Hydraulic Radius (ft)	0.7	1.0	0.8	0.8	0.2	3	1.76	N/A	0.8	1.0	1.1	0.9	1.0	1.1
D50 (mm)	N/A						38.5	27.0		20-30			10-20	
Pattern														
Channel Belt Width (ft)	6.8	39.5	23.8	24.7	14.5	7	105.0	17.0	13.8	16.8	22.3	23.6	26.8	29.7
Radius of Curvature (ft)	45.5	146.8	81.6	86.4	39.2	7	106.0	13.0	33.0	56.4	71.9	30.1	38.4	43.6
Rc:Bankfull Width (ft/ft)	5.4	17.4	9.7	10.2	4.7	7	3.5	1.6	4.1	5.6	6.0	3.0	3.8	4.4
Meander Wavelength (ft)	8.5	180.3	37.6	52.8	58.1	7	350	29.0	70.0	76.9	89.7	97.6	102.1	106.8
Meander Width Ratio	0.8	4.7	2.8	2.9	1.7	7	3.4	2.1	1.7	1.9	1.2	2.5	2.7	2.9
Profile[b]														
Riffle Length (ft)							65.0	N/A	1.8	2.0	2.2	10.0	14.0	18.0
Riffle Slope (ft/ft)							0.02103	0.14200	0.09500	0.10000	0.12000	0.01861	0.03747	0.05634
Pool Length (ft)							70.0	N/A	4.0	4.4	4.8	13.4	22.8	32.3
Pool Max Depth (ft)							5.3	0.95	1.8	2.0	2.2	1.0	1.6	2.2
Pool to Pool Spacing (ft)							90.1	68.0	22.8	23.0	23.2	22.3	27.7	33.1

a Only a single riffle was surveyed for the Basin Creek (6.8 mi^2) reference reach, 1998.

b Channel impacts and low flow precluded meaningful channel feature evaluation.

c Only a single riffle was surveyed for the North Branch reference reach, Wolf Creek Engineering, PLLC, 2008..

Table B.1.1 Continued.

Upper South Hominy Mitigation Site Channel Morphology Data Summary (EEP Project Number 92632)																		
UT2 – Roberson Reach – 236 feet																		
Parameter (Riffle UT2 XS1)	**MY0**						**MY1**						**MY2**					
Dimension and Substrate	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n
Bankfull Width (ft)			22.6			1												
Floodprone Width (ft)			2354.0			1												
Bankfull Cross-Sectional Area (ft^2)			14.2			1												
Bankfull Mean Depth (ft)			0.6			1												
Bankfull Max Depth (ft)			1.4			1												
Width/Depth Ratio			35.8			1												
Entrenchment Ratio			12.5			1												
Bank Height Ratio			1.2			1												
Bankfull Wetted Perimeter (ft)			22.9			1												
Hydraulic Radius (ft)			0.6			1												
D50 (mm)			NA															
Pattern																		
Channel Belt Width (ft)			45.0			1												
Radius of Curvature (ft)			46.0			1												
Rc:Bankfull Width (ft/ft)			4.6			1												
Meander Wavelength (ft)			134.0			1												
Meander Width Ratio			4.5			1												
Profile																		
Riffle Length (ft)	12.3	31.8	27.5	23.9	10.2	3												
Riffle Slope (ft/ft)	0.00857	0.01177	0.01119	0.01051	0.00171	3												
Pool Length (ft)	10.7	23.1	21.7	18.5	6.8	3												
Pool Max Depth (ft)	0.8	1.3	1.2	1.1	0.3	3												
Pool to Pool Spacing (ft)	50.6	69.2	59.9	59.9	13.1	2												

Table B.1.1 Continued.

Upper South Hominy Mitigation Site Channel Morphology Data Summary (EEP Project Number 92632)																		
UT3 Upper – Davis – 201 feet																		
Parameter (Riffles UT3 XS1)	**MY0**						**MY1**						**MY2**					
Dimension and Substrate	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n
Bankfull Width (ft)			12.9			1												
Floodprone Width (ft)			2352.8			1												
Bankfull Cross-Sectional Area (ft^2)			10.3			1												
Bankfull Mean Depth (ft)			0.8			1												
Bankfull Max Depth (ft)			1.3			1												
Width/Depth Ratio			16.1			1												
Entrenchment Ratio			38.8			1												
Bank Height Ratio			1.0			1												
Bankfull Wetted Perimeter (ft)			13.2			1												
Hydraulic Radius (ft)			0.8			1												
D50 (mm)			NA															
Pattern																		
Channel Belt Width (ft)			47.0			1												
Radius of Curvature (ft)			133.0			1												
Rc:Bankfull Width (ft/ft)			11.1			1												
Meander Wavelength (ft)			138.0			1												
Meander Width Ratio			3.9			1												
Profile																		
Riffle Length (ft)	13.7	26.4	15.9	17.8	5.0	5												
Riffle Slope (ft/ft)	0.05368	0.10273	0.09392	0.08727	0.01924	5												
Pool Length (ft)	2.9	5.1	4.6	4.3	0.9	5												
Pool Max Depth (ft)	1.5	2.0	1.8	1.8	0.2	5												
Pool to Pool Spacing (ft)	21.2	24.2	23.1	22.9	1.2	4												

Table B.1.1 Continued.

Upper South Hominy Mitigation Site Channel Morphology Data Summary (EEP Project Number 92632)																		
UT3 Lower – Davis Reach – 226 feet																		
Parameter (Riffle UT3 XS2)	**MY0**						**MY1**						**MY2**					
Dimension and Substrate	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n	Min	Max	Med	Mean	SD	n
Bankfull Width (ft)			9.9			1												
Floodprone Width (ft)			2346.7			1												
Bankfull Cross-Sectional Area (ft^2)			7.6			1												
Bankfull Mean Depth (ft)			0.8			1												
Bankfull Max Depth (ft)			1.4			1												
Width/Depth Ratio			12.8			1												
Entrenchment Ratio			23.5			1												
Bank Height Ratio			1.0			1												
Bankfull Wetted Perimeter (ft)			10.3			1												
Hydraulic Radius (ft)			0.7			1												
D50 (mm)			NA															
Pattern																		
Channel Belt Width (ft)	23.0	42.0	27.0	30.7	10.0	3												
Radius of Curvature (ft)	20.0	39.0	30.0	29.8	8.1	4												
Rc:Bankfull Width (ft/ft)	1.7	3.3	2.6	2.5	0.7	4												
Meander Wavelength (ft)	87.0	113.0	104.0	101.3	13.2	3												
Meander Width Ratio	1.9	3.5	2.3	2.6	0.8	3												
Profile																		
Riffle Length (ft)	10.8	28.7	27.3	23.5	8.6	4												
Riffle Slope (ft/ft)	0.01319	0.06560	0.03791	0.03865	0.02231	4												
Pool Length (ft)	16.0	19.7	19.0	18.2	1.9	3												
Pool Max Depth (ft)	1.3	1.8	1.8	1.7	0.3	3												
Pool to Pool Spacing (ft)	47.6	63.4	55.5	55.5	11.2	2												

Table B.2 Riffle and Pool Morphology Summary for South Hominy Creek (SHC) and Tributaries (UT2, UT3), Dimensional Parameters Only.

	Upper South Hominy Mitigation Site. Riffle and Pool Morphology Summary																	
	SHC Bianculli Cross-Section 1 (Riffle)						**SHC Bianculli Cross-Section 2 (Pool)**						**SHC Bianculli Cross-Section 3 (Riffle)**					
Dimension and Substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																		
Bankfull Width (ft)	26.9						28.2						30.1					
Floodprone Width (ft)	236.0						299.0						362.0					
Bankfull Cross-sectional Area (ft^2)	54.8						58.8						62.9					
Bankfull Mean Depth (ft)	2.0						2.1						2.1					
Bankfull Max Depth (ft)	2.6						3.8						3.2					
Bankfull Width/Depth Ratio	13.2						13.5						14.4					
Bankfull Entrenchment Ratio	8.8						10.6						12.0					
Bankfull Bank Height Ratio	1.6						1.4						1.7					
Based on current/developing bankfull feature																		
Bankfull Width (ft)																		
Floodprone Width (ft)																		
Bankfull Cross-sectional Area (ft^2)																		
Bankfull Mean Depth (ft)																		
Bankfull Max Depth (ft)																		
Bankfull Width/Depth Ratio																		
Bankfull Entrenchment Ratio																		
Bankfull Bank Height Ratio																		
Cross-sectional Area between end pins (ft^2)																		
D50(mm)	22.1						33.1						28.9					
	SHC Bura Cross-Section 4 (Pool)						**SHC Bura Cross-Section 5 (Riffle)**						**SHC Bura Cross-Section 6 (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 baseline bankfull elevation																		
Bankfull Width (ft)	31.4						30.5						37.8					
Floodprone Width (ft)	350.0						337.0						310.0					
Bankfull Cross-sectional Area (ft^2)	73.3						62.2						69.7					
Bankfull Mean Depth (ft)	2.3						2.0						1.8					
Bankfull Max Depth (ft)	3.8						3.2						4.5					
Bankfull Width/Depth Ratio	13.4						14.9						20.6					
Bankfull Entrenchment Ratio	11.2						11.1						8.2					
Bankfull Bank Height Ratio	1.6						1.2						1.4					
Based on current/developing bankfull feature																		
Bankfull Width (ft)																		
Floodprone Width (ft)																		
Bankfull Cross-sectional Area (ft^2)																		
Bankfull Mean Depth (ft)																		
Bankfull Max Depth (ft)																		
Bankfull Width/Depth Ratio																		
Bankfull Entrenchment Ratio																		
Bankfull Bank Height Ratio																		
Cross-sectional Area between end pins (ft^2)																		
D50(mm)	36.6						49.4						19.3					

Table B.2 Continued

Upper South Hominy Mitigation Site. Riffle and Pool Morphology Summary																		
	SHC Bura Cross-Section 7 (Riffle)						SHC Davis Cross-Section 8 (Riffle)						SHC Davis Cross-Section 9 (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 baseline bankfull elevation																		
Bankfull Width (ft)	37.5						30.1						37.86					
Floodprone Width (ft)	282.0						292.0						421					
Bankfull Cross-sectional Area (ft^2)	65.2						65.1						76.23					
Bankfull Mean Depth (ft)	1.7						2.2						2.01					
Bankfull Max Depth (ft)	2.7						3.1						4.37					
Bankfull Width/Depth Ratio	21.6						13.9						18.84					
Bankfull Entrenchment Ratio	7.5						9.7						11.12					
Bankfull Bank Height Ratio	1.2						1.4						1.3					
Based on current/developing bankfull feature																		
Bankfull Width (ft)																		
Floodprone Width (ft)																		
Bankfull Cross-sectional Area (ft^2)																		
Bankfull Mean Depth (ft)																		
Bankfull Max Depth (ft)																		
Bankfull Width/Depth Ratio																		
Bankfull Entrenchment Ratio																		
Bankfull Bank Height Ratio																		
Cross-sectional Area between end pins (ft^2)																		
D50(mm)	31.4						47.7						14.7					
	SHC Davis Cross-Section 10 (Riffle)						UT2 Cross-Section 1 Roberson (Riffle)						Upper UT3 Cross-Section 1 Davis (Riffle)					
Dimension and Substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																		
Bankfull Width (ft)	25.5						22.6						12.9					
Floodprone Width (ft)	549.0						2354.0						2352.8					
Bankfull Cross-sectional Area (ft^2)	53.4						14.2						10.3					
Bankfull Mean Depth (ft)	2.1						0.6						0.8					
Bankfull Max Depth (ft)	3.1						1.4						1.3					
Bankfull Width/Depth Ratio	12.1						35.8						16.1					
Bankfull Entrenchment Ratio	21.6						12.5						38.8					
Bankfull Bank Height Ratio	1.2						1.2						1.0					
Based on current/developing bankfull feature																		
Bankfull Width (ft)																		
Floodprone Width (ft)																		
Bankfull Cross-sectional Area (ft^2)																		
Bankfull Mean Depth (ft)																		
Bankfull Max Depth (ft)																		
Bankfull Width/Depth Ratio																		
Bankfull Entrenchment Ratio																		
Bankfull Bank Height Ratio																		
Cross-sectional Area between end pins (ft^2)																		
D50(mm)	33.5						NA						NA					

Table B.2 Continued

Upper South Hominy Mitigation Site. Riffle and Pool Morphology Summary																		
	Lower UT3 Davis Cross-Section 2 (Riffle)						Lower UT3 Davis Cross-Section 3 (Pool)						Cross-Section ()					
Dimension and Substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																		
Bankfull Width (ft)	9.9						12.9											
Floodprone Width (ft)	2346.7						2337.4											
Bankfull Cross-sectional Area (ft^2)	7.6						11.0											
Bankfull Mean Depth (ft)	0.8						0.9											
Bankfull Max Depth (ft)	1.4						1.6											
Bankfull Width/Depth Ratio	12.8						15.2											
Bankfull Entrenchment Ratio	23.5						38.7											
Bankfull Bank Height Ratio	1.0						1.1											
Based on current/developing bankfull feature																		
Bankfull Width (ft)																		
Floodprone Width (ft)																		
Bankfull Cross-sectional Area (ft^2)																		
Bankfull Mean Depth (ft)																		
Bankfull Max Depth (ft)																		
Bankfull Width/Depth Ratio																		
Bankfull Entrenchment Ratio																		
Bankfull Bank Height Ratio																		
Cross-sectional Area between end pins (ft^2)																		
D50(mm)	NA						NA											
	Cross-Section ()						Cross-Section ()						Cross-Section ()					
Dimension and Substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																		
Bankfull Width (ft)																		
Floodprone Width (ft)																		
Bankfull Cross-sectional Area (ft^2)																		
Bankfull Mean Depth (ft)																		
Bankfull Max Depth (ft)																		
Bankfull Width/Depth Ratio																		
Bankfull Entrenchment Ratio																		
Bankfull Bank Height Ratio																		
Based on current/developing bankfull feature																		
Bankfull Width (ft)																		
Floodprone Width (ft)																		
Bankfull Cross-sectional Area (ft^2)																		
Bankfull Mean Depth (ft)																		
Bankfull Max Depth (ft)																		
Bankfull Width/Depth Ratio																		
Bankfull Entrenchment Ratio																		
Bankfull Bank Height Ratio																		
Cross-sectional Area between end pins (ft^2)																		
D50(mm)																		

Table B.3 Verification of Bankfull Events, Upper South Hominy Mitigation Site.

Upper South Hominy (EEP project number 92632)			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo Number (if available)**
5 Dec 2011	28 Nov 2011	Wrack line observation	Figure B.5, Photo 1
5 Dec 2011	28 Nov 2011	Wrack line observation	Figure B.5, Photo 2
5 Dec 2011	28 Nov 2011	Wrack line observation	Figure B.5, Photo 3

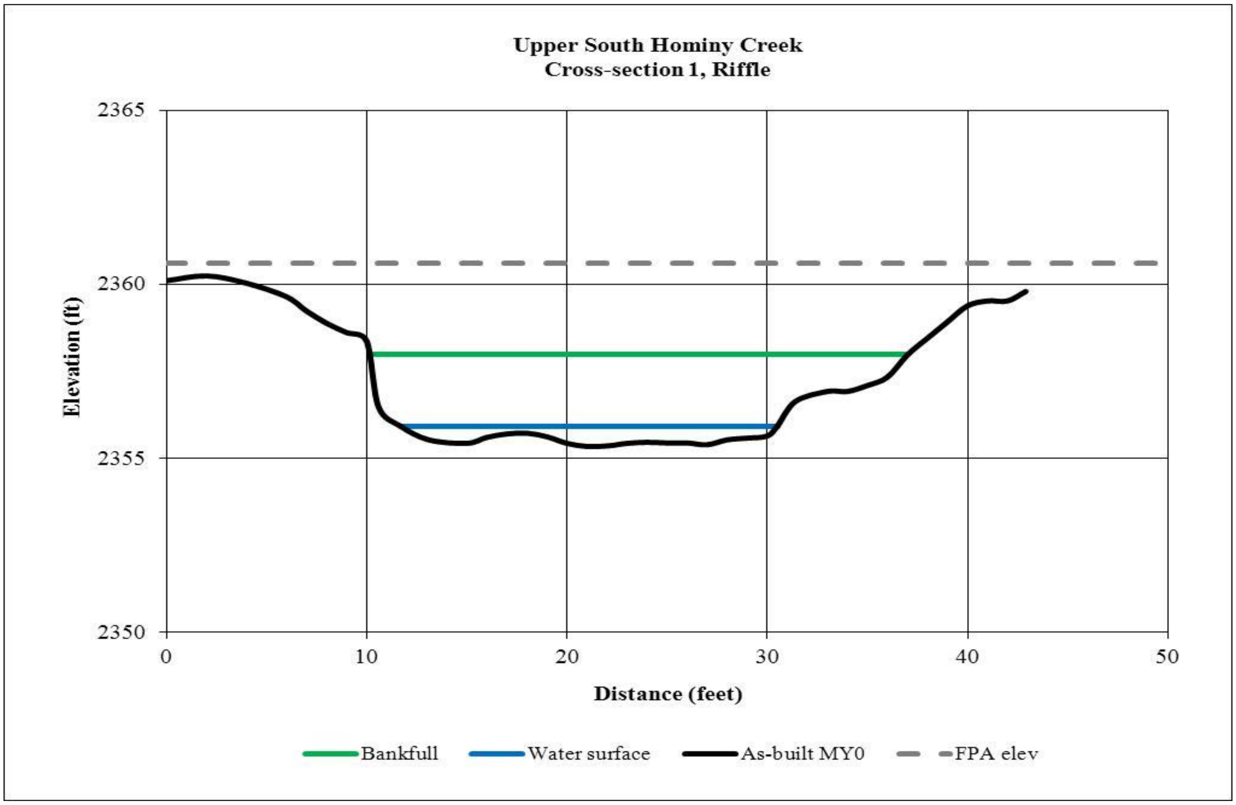
Table B.4 Categorical Stream Feature Visual Stability Assessment. (*__Used as a place holder for the MY01 report*__)

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle & Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)								
		2. Degradation - Evidence of down cutting								
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate								
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Pool Depth $\geq$ 1.6)								
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)								
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)								
		2. Thalweg centering at downstream of meander (Glide)								
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion								
	2. Undercut	Bank undercut/overhanging to the extent that mass wasting appears likely. Does not include undercuts that are modest, appear sustainable and are providing habitat								
	3. Mass Wasting	Bank slumping, calving, or collapsing								
				Totals						
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs								
	2. Grade Control	Grade control structures exhibiting maintenance of grade across sill								
	2a. Piping	Structures lacking any substantial flow underneath sills or arms								
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15% (see guidance for this table in EEP monitoring guidance document)								
	4. Habitat	Pool forming structures maintaining - Max Pool Depth : Mean Pool Depth ratio $\geq$ 1.6 Rootwads/logs providing some cover at base-flow								

Table B.5 Stream Problem Areas, Upper South Hominy Mitigation Site.

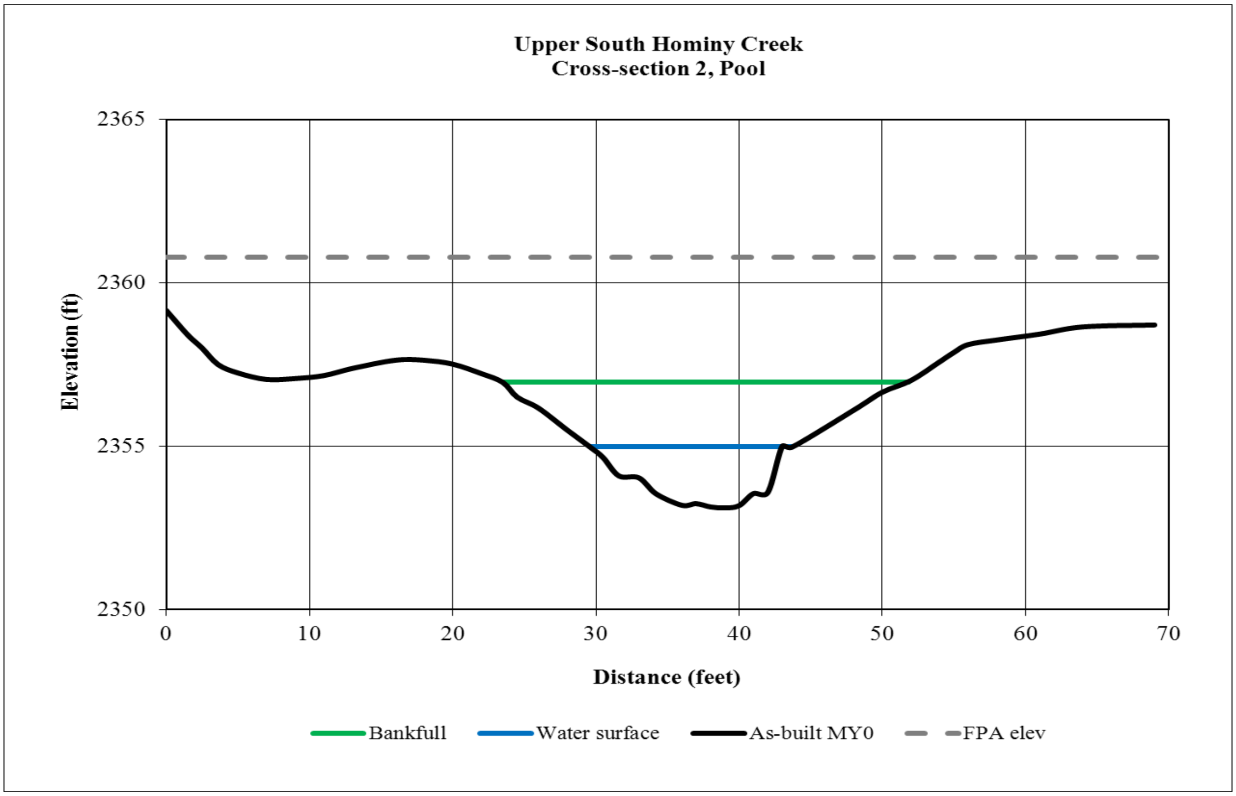
Stream Problem Areas Upper South Hominy (EEP project number 92632)			
Feature/Issue	**Reach / Station**	**Suspected Cause**	**Photo Number**
Aggradation/Bar Formation	Mainstem 1 - 2+25 to 2+75	flood event	Figure B.6, PA3
	Mainstem 2 – 9+00 to 9+50	flood event	Figure B.6, PA4
Bank Scour	Mainstem 1 – 1+75 to 2+25	flood event	Figure B.6, PA2
Engineered structures	Mainstem 1 - 1+50	flood event	Figure B.6, PA1

Figure B.1 As-built Cross-Section Plots, Upper South Hominy Mitigation Site.



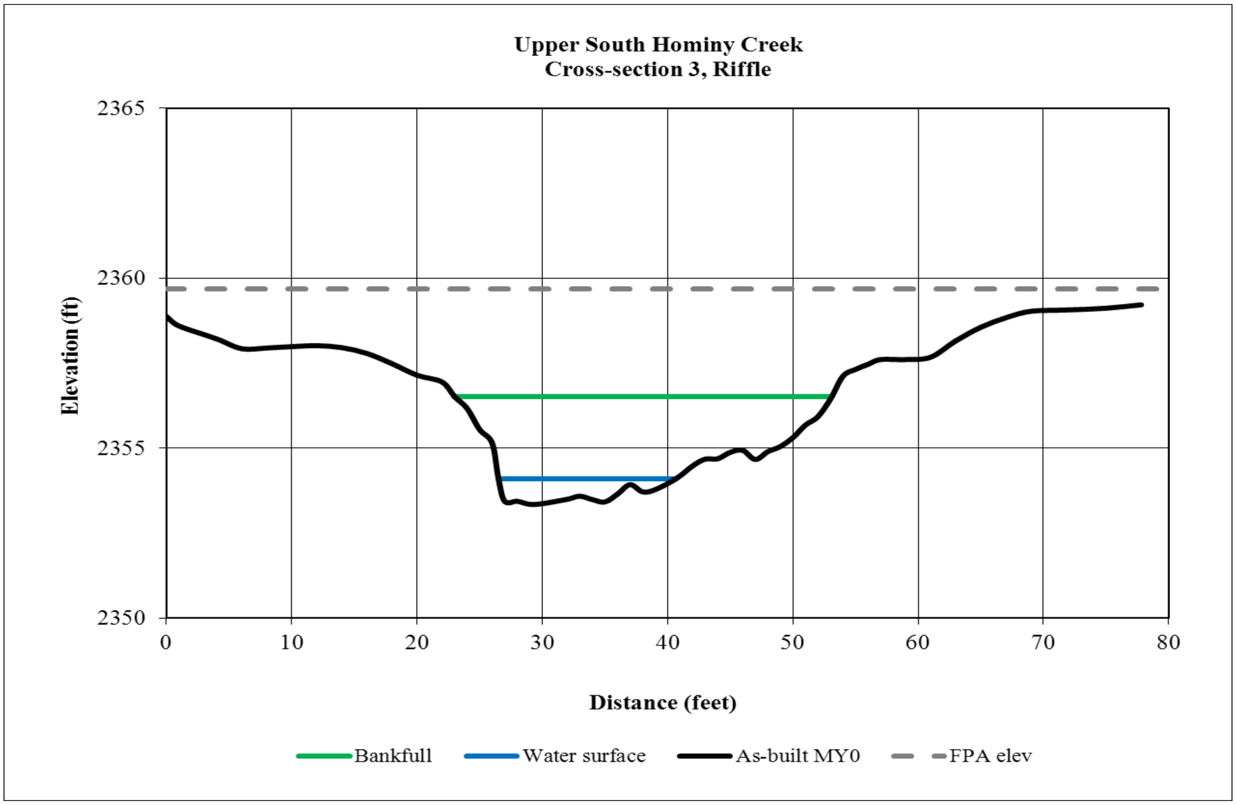
Cross-section 1, facing downstream, 31 January 2012, MY0.

Figure B.1 Continued.



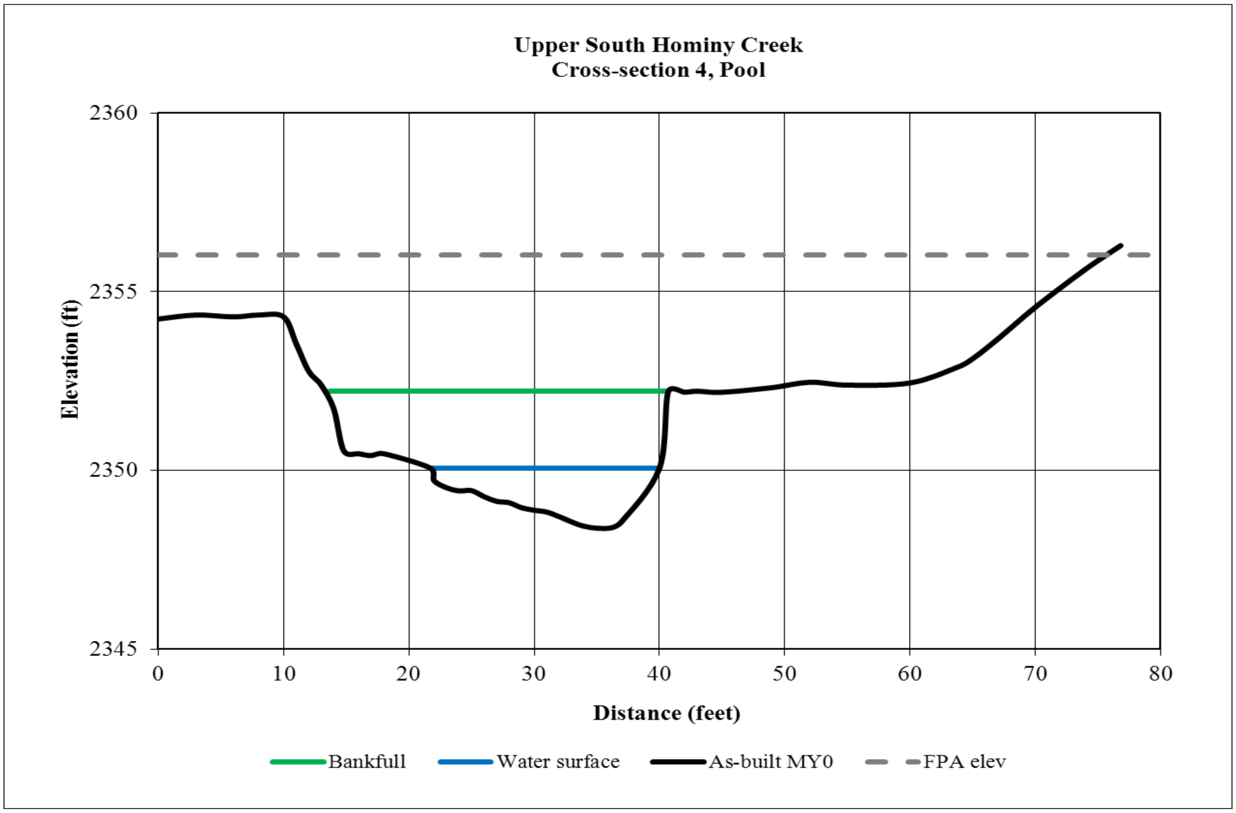
Cross-section 2, facing downstream, 31 January 2012, MY0.

Figure B.1 Continued.



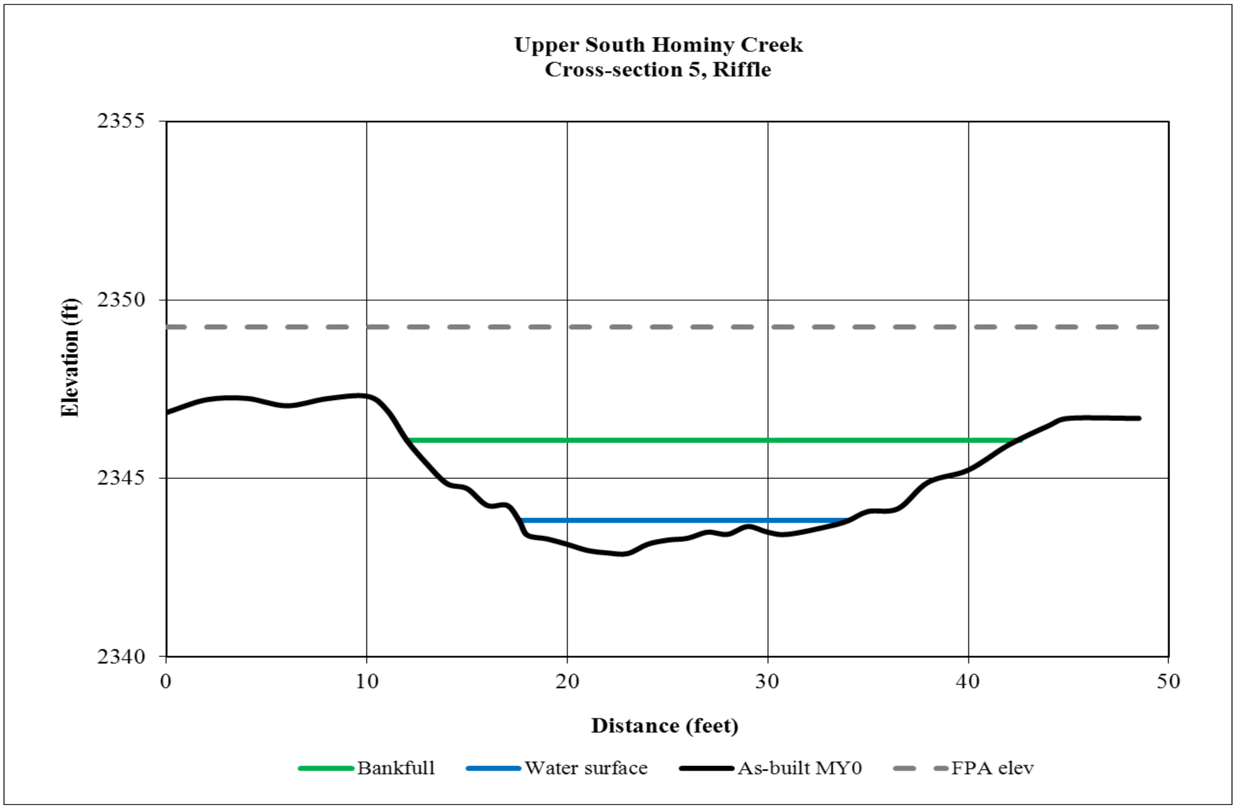
Cross-section 3, facing downstream, 31 January 2012, MY0.

Figure B.1 Continued.



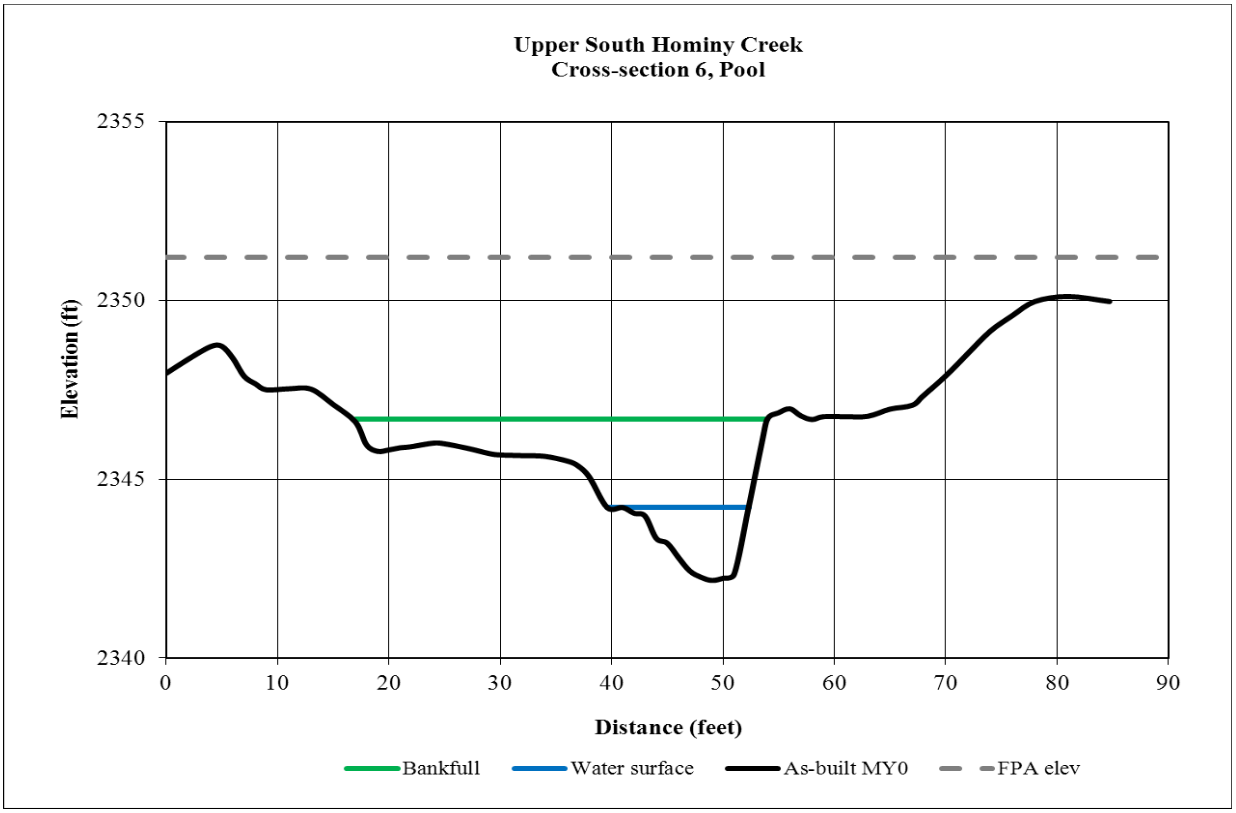
Cross-section 4, facing downstream, 31 January 2012, MY0.

Figure B.1 Continued.



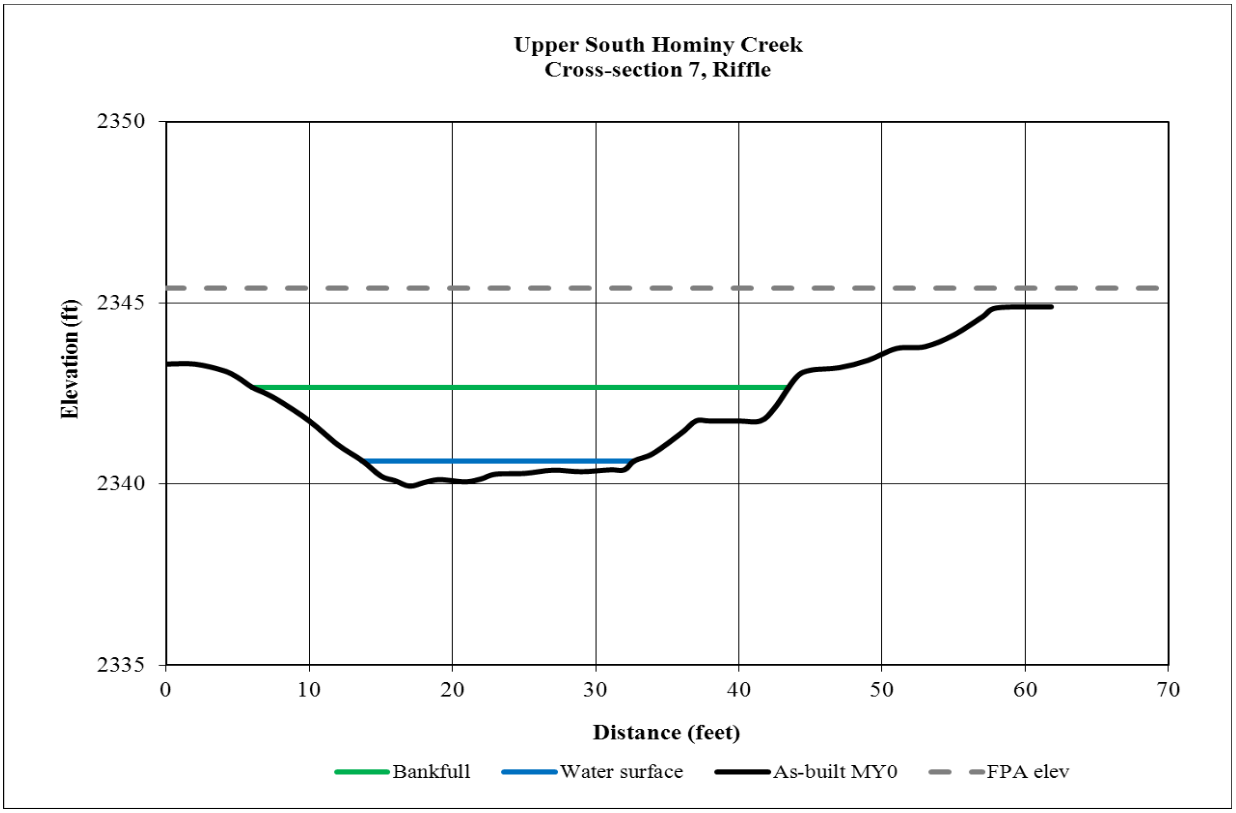
Cross-section 5, facing downstream, 31 January 2012, MY0.

Figure B.1 Continued.



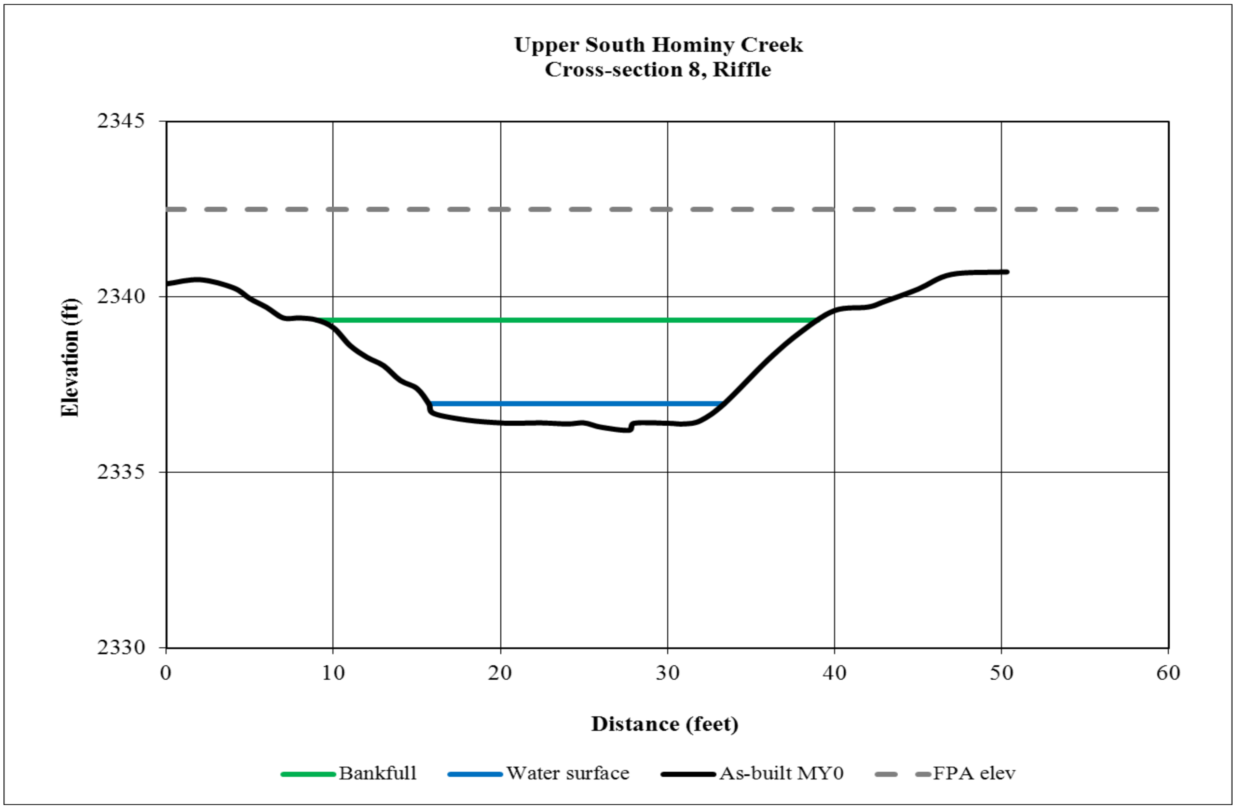
Cross-section 6, facing downstream, 31 January 2012, MY0.

Figure B.1 Continued.



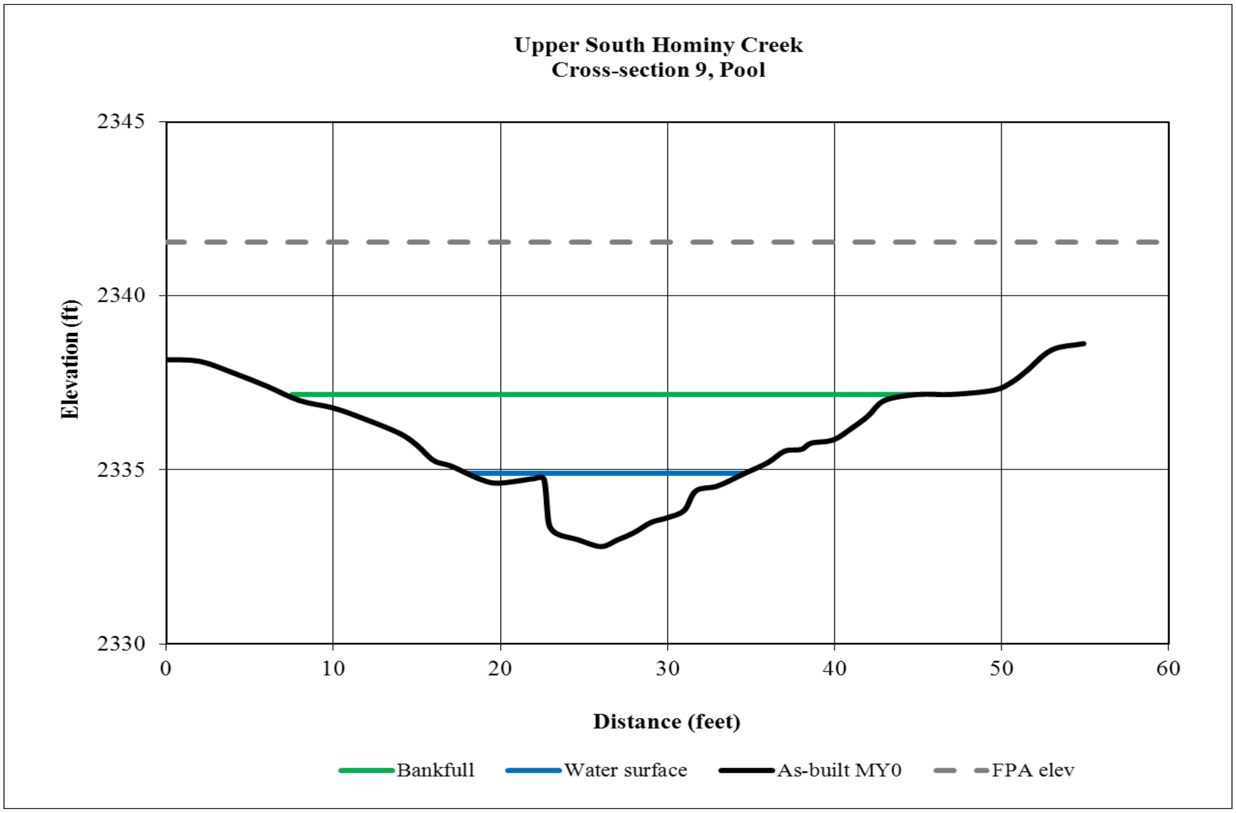
Cross-section 7, facing downstream, 31 January 2012, MY0.

Figure B.1 Continued.



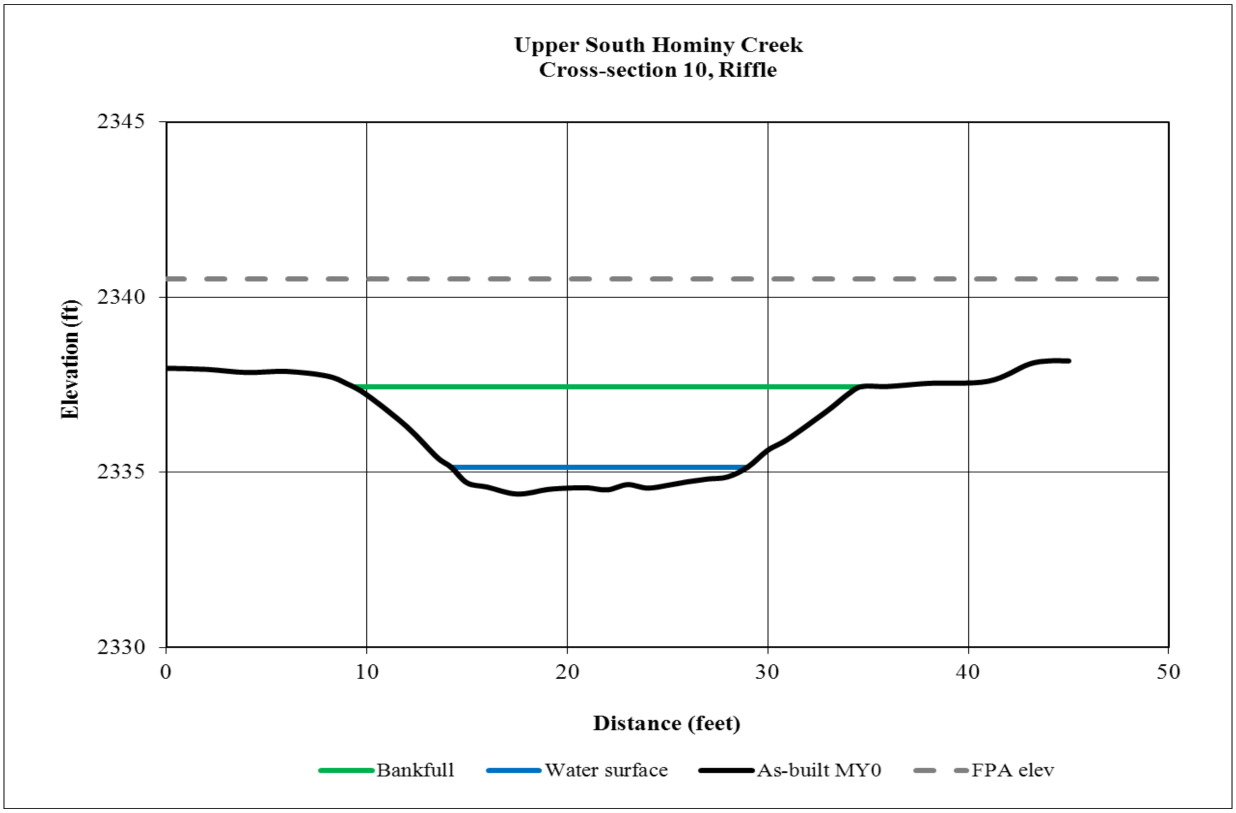
Cross-section 8, facing downstream, 31 January 2012, MY0.

Figure B.1 Continued.



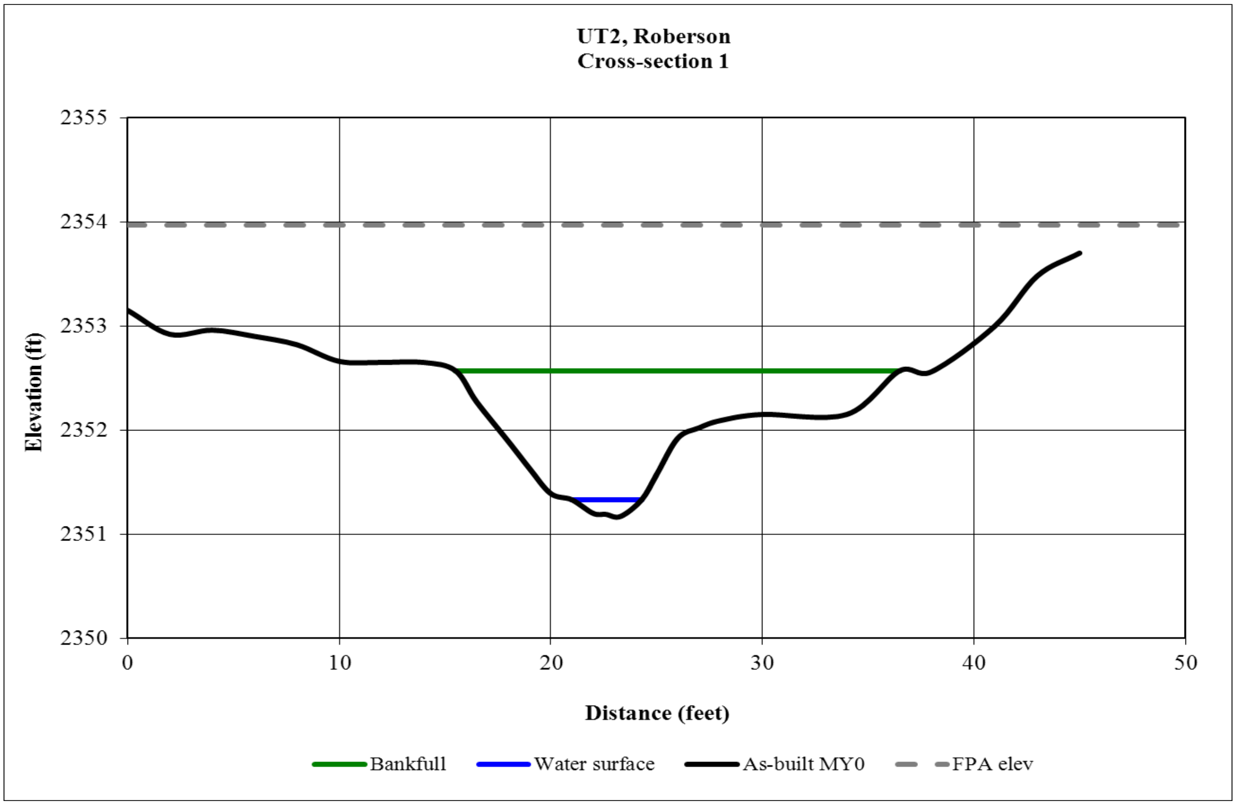
Cross-section 9, facing downstream, 31 January 2012, MY0.

Figure B.1 Continued.



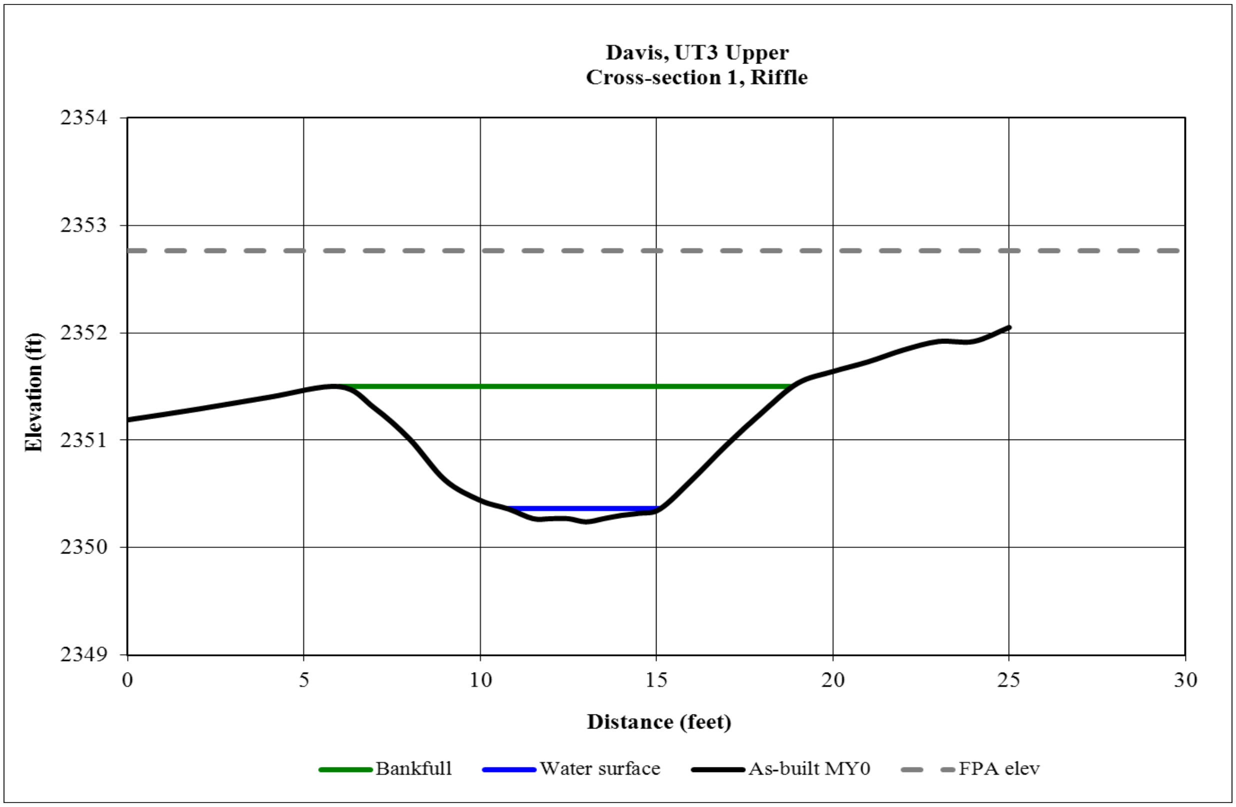
Cross-section 10, facing downstream, 31 January 2012, MY0.

Figure B.1 Continued.



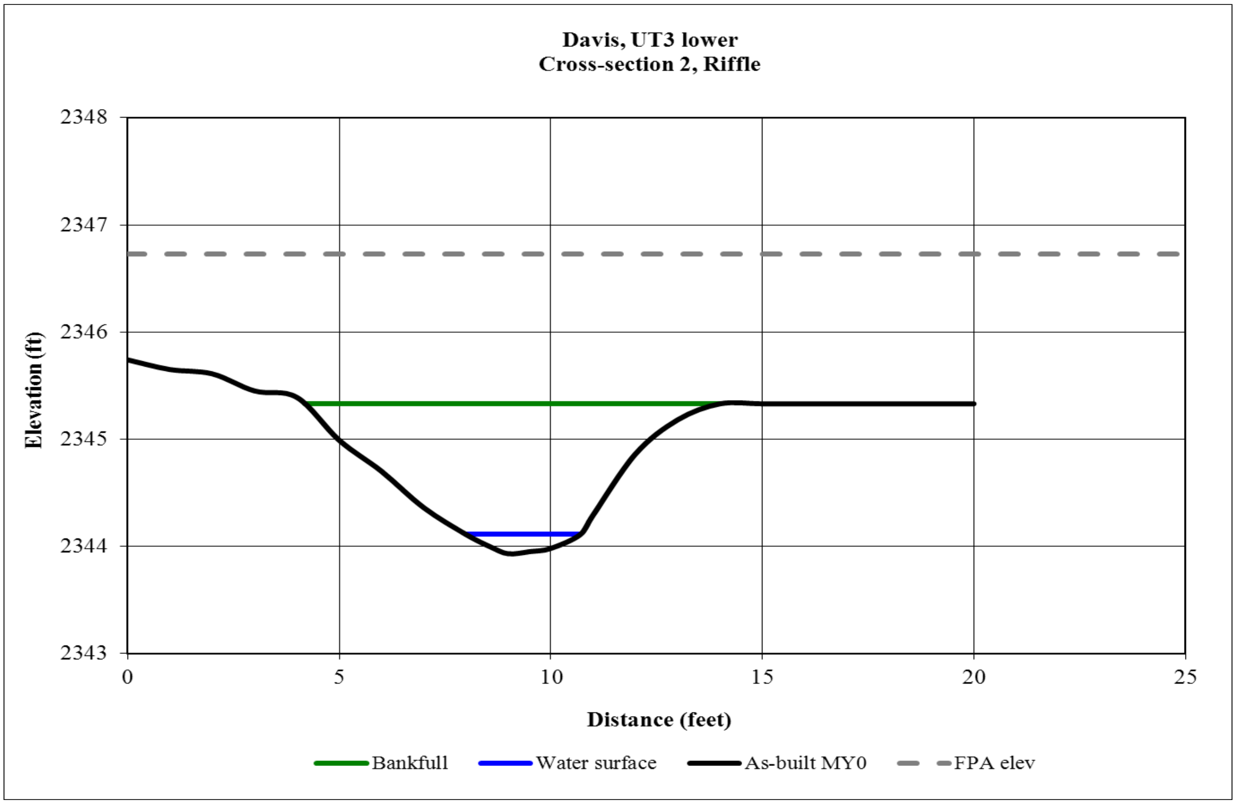
Cross-section 1, UT2 facing downstream, 2 February 2012, MY0.

Figure B.1 Continued.



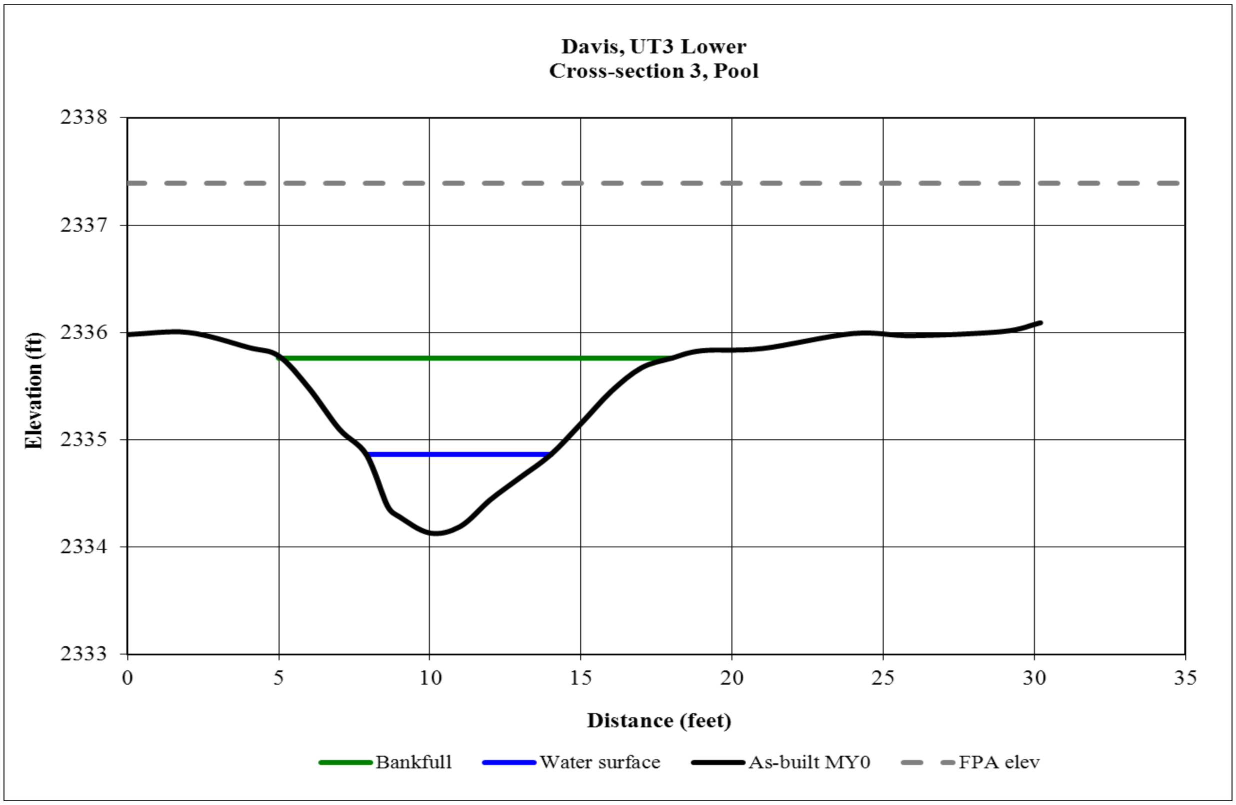
Cross-section 1, UT3 facing downstream, 2 February 2012, MY0.

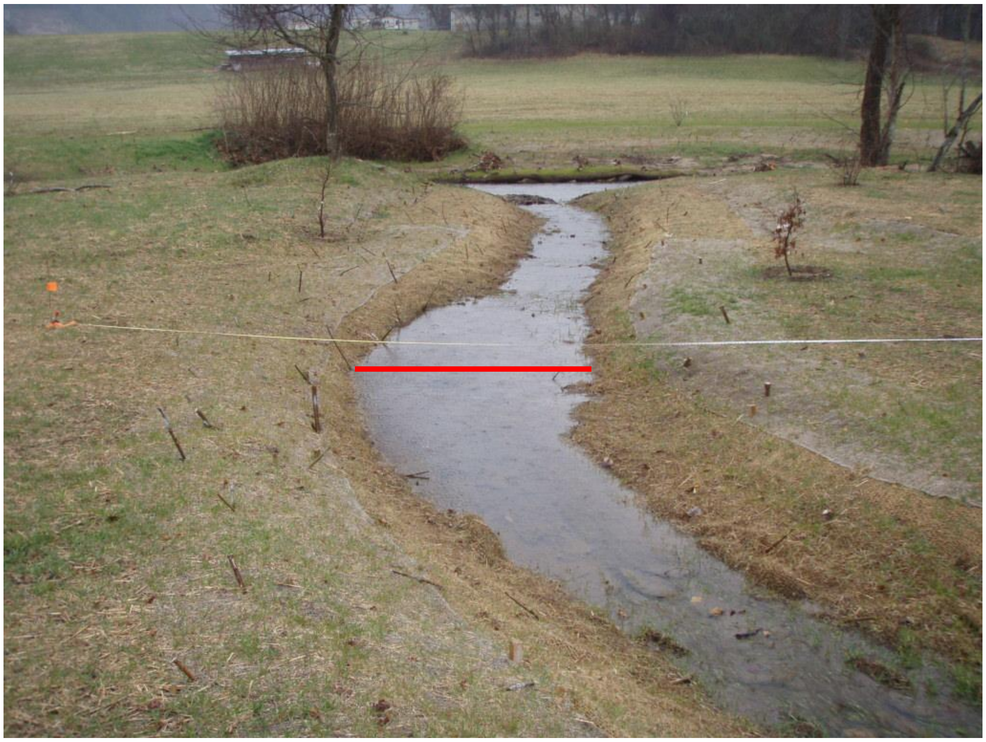
Figure B.1 Continued.



Cross-section 2, UT3 facing downstream, 2 February 2012, MY0.

Figure B.1 Continued.





Cross-section 3, UT3 facing downstream, 2 February 2012, MY0.

Figure B.2 As-built Longitudinal Profile Data, Upper South Hominy Mitigation Site.

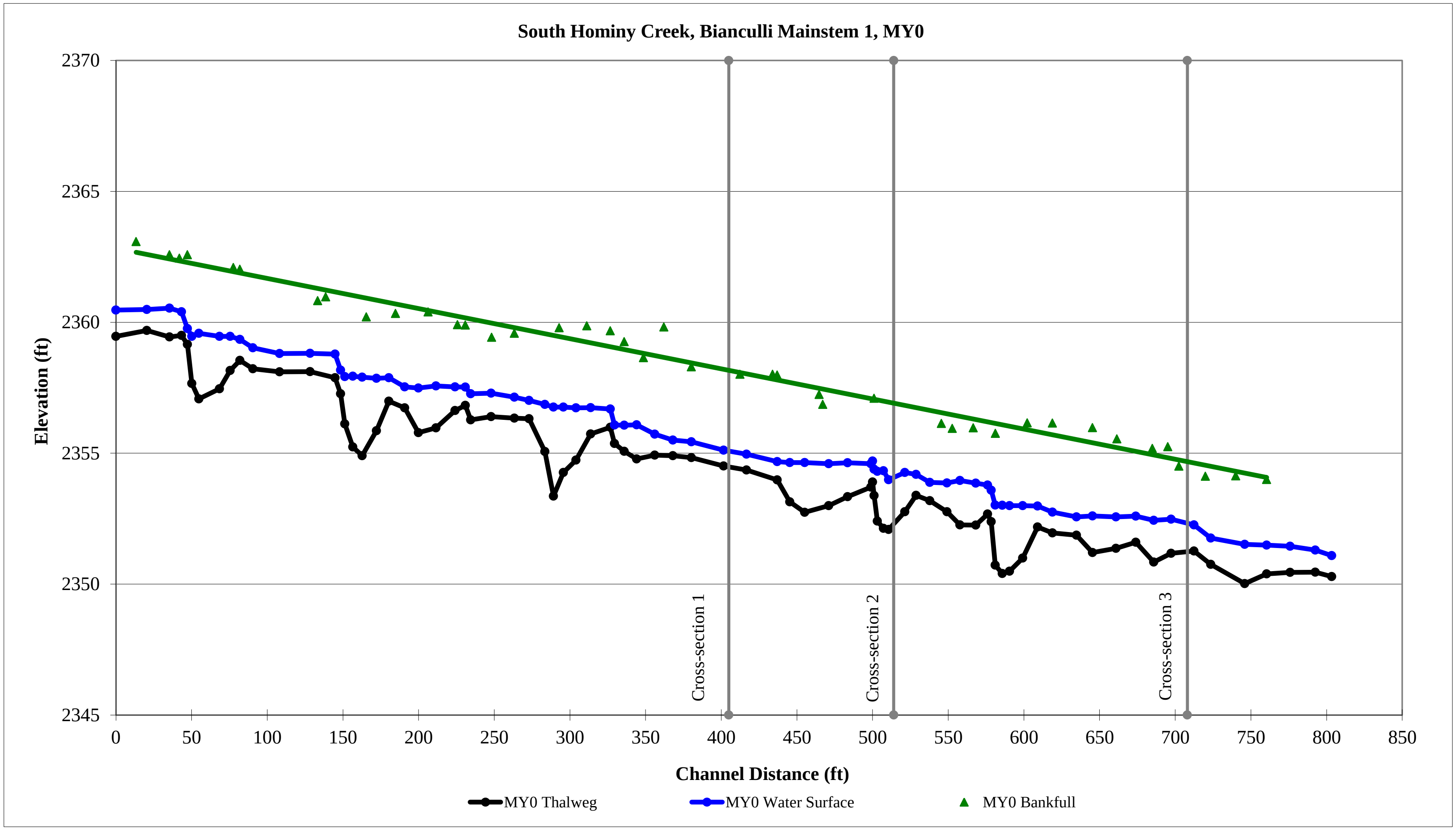


Figure B.2 Continued

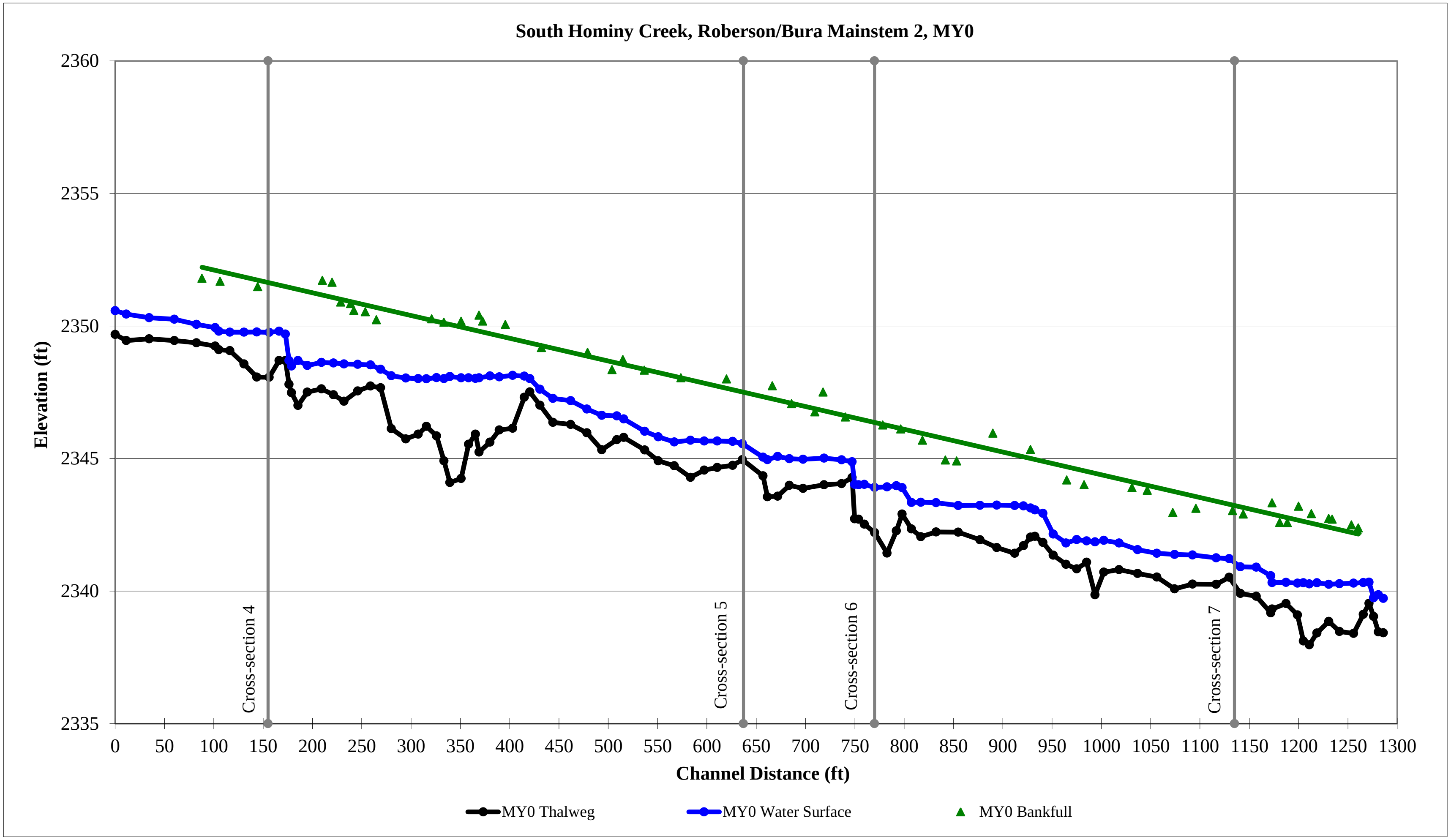


Figure B.2 Continued

Figure B.2 Continued

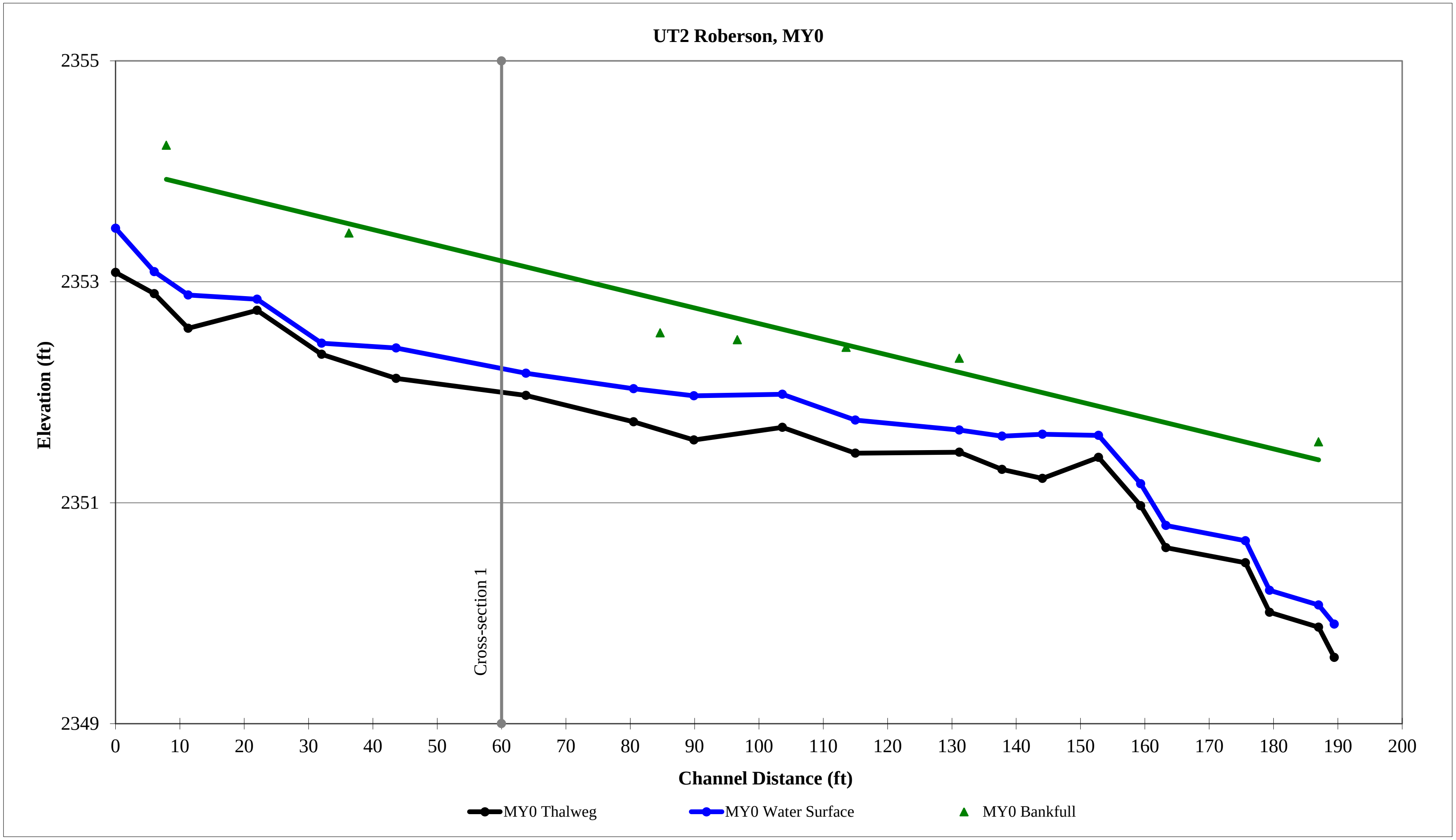


Figure B.2 Continued

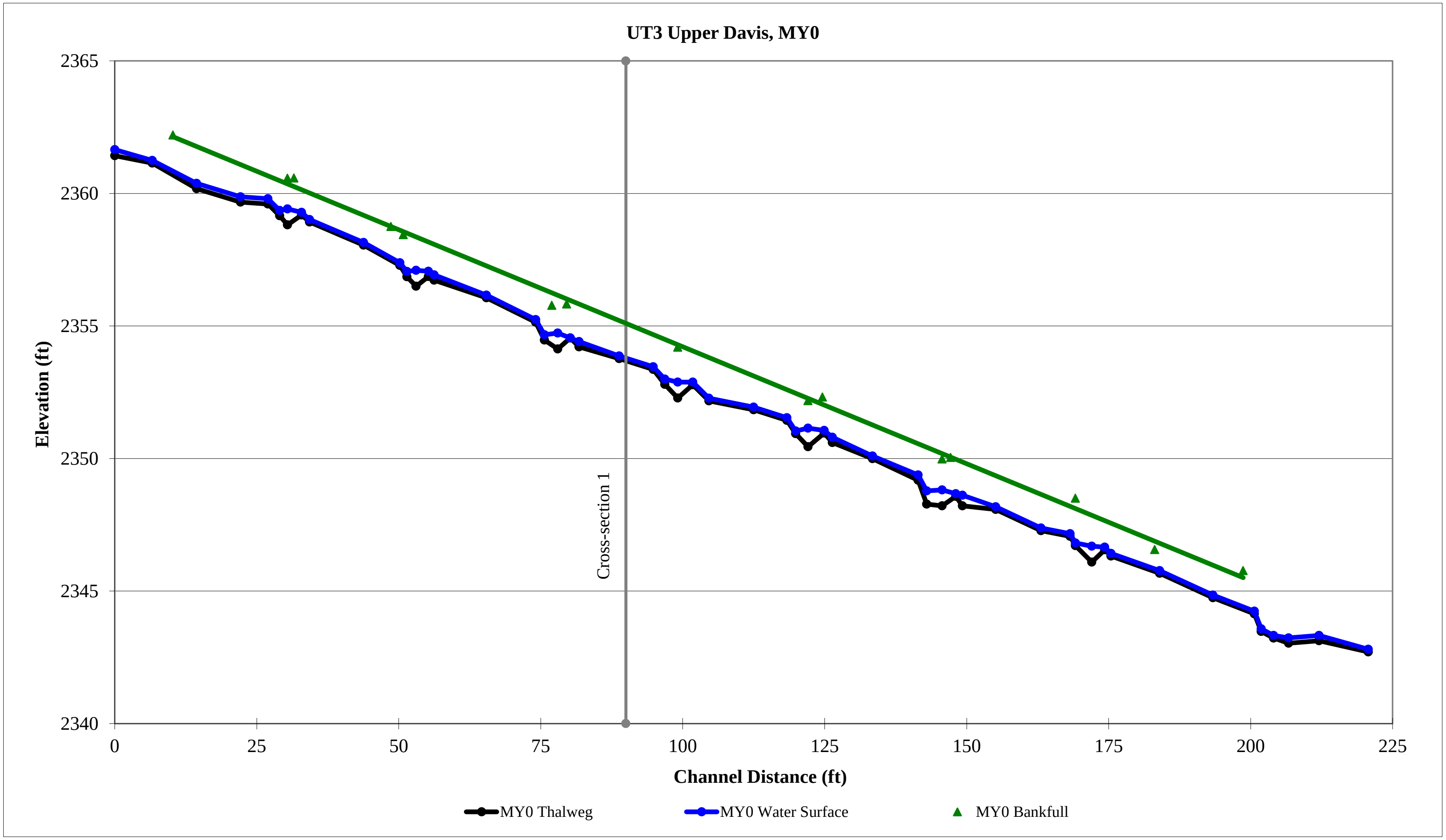


Figure B.2 Continued

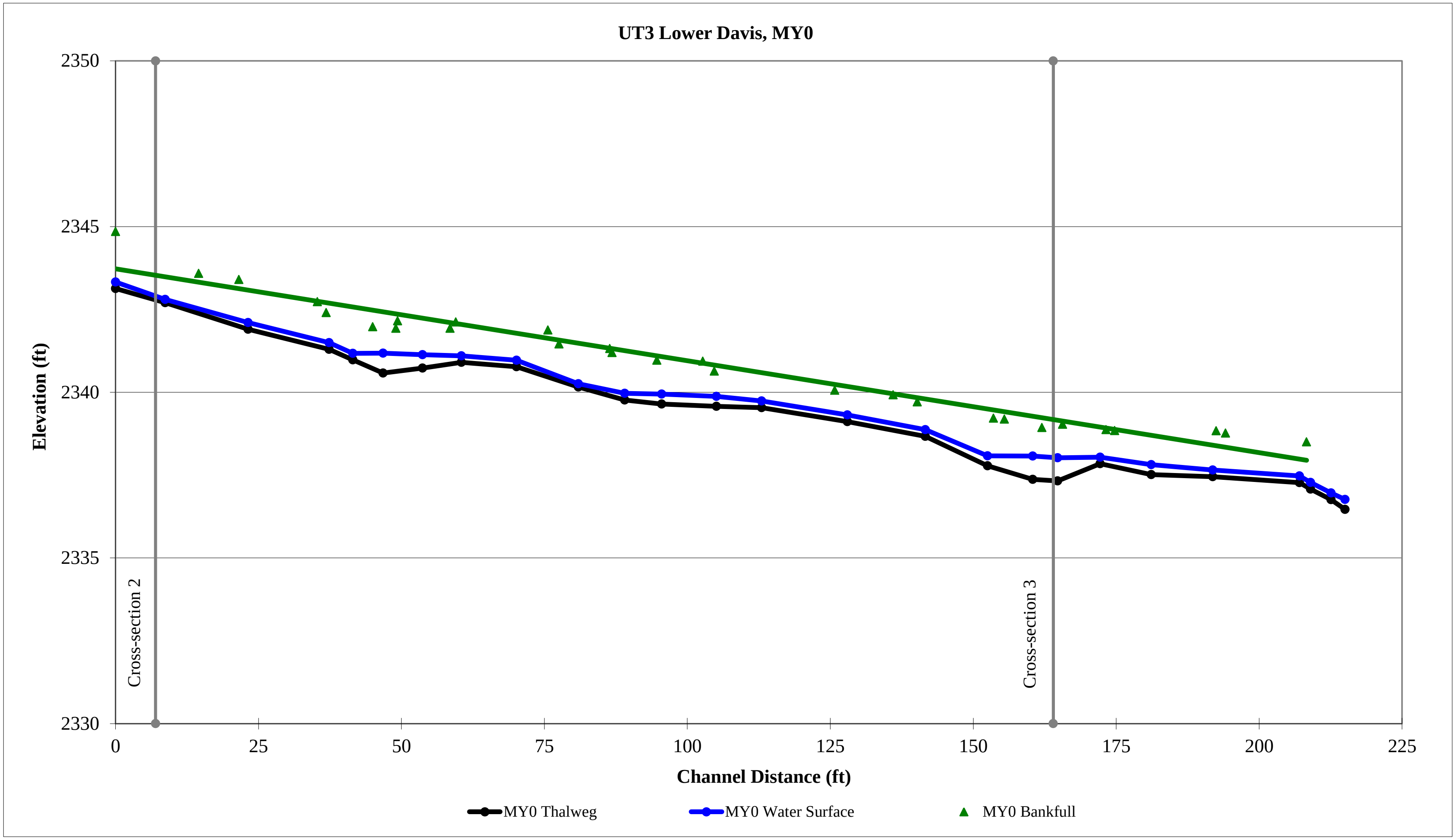
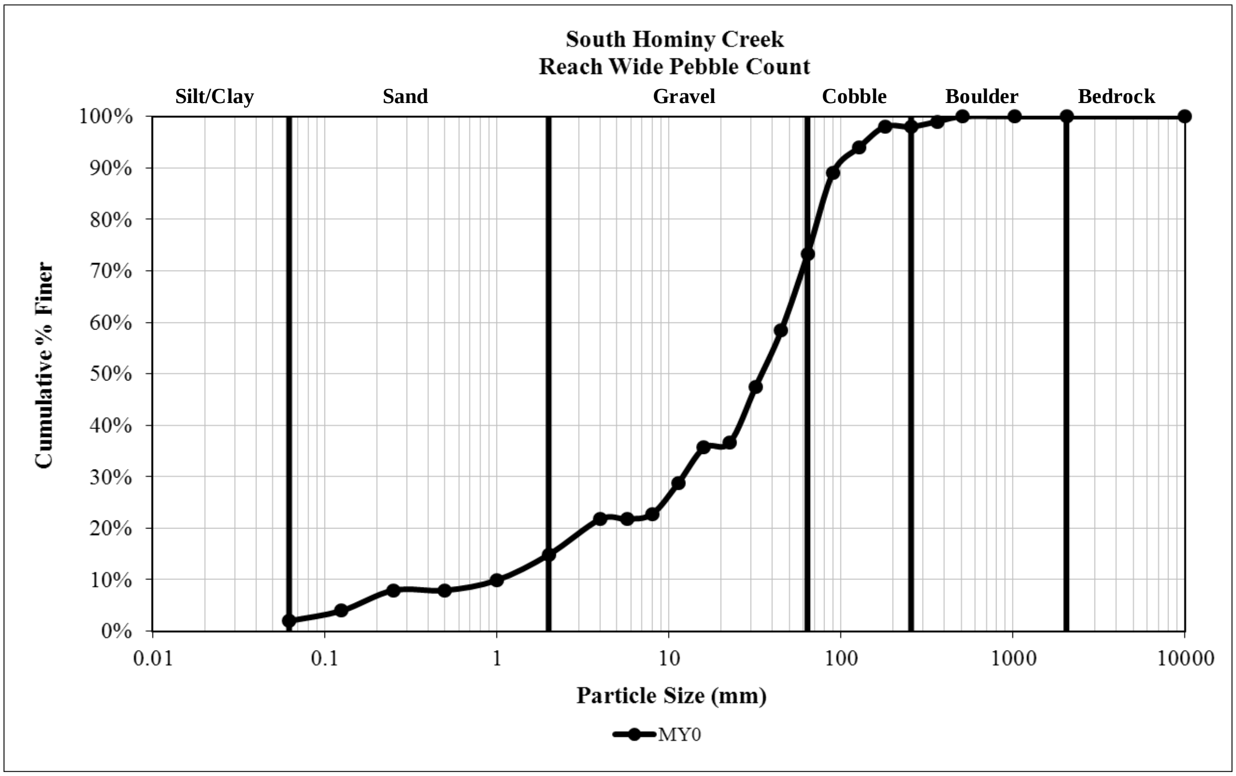
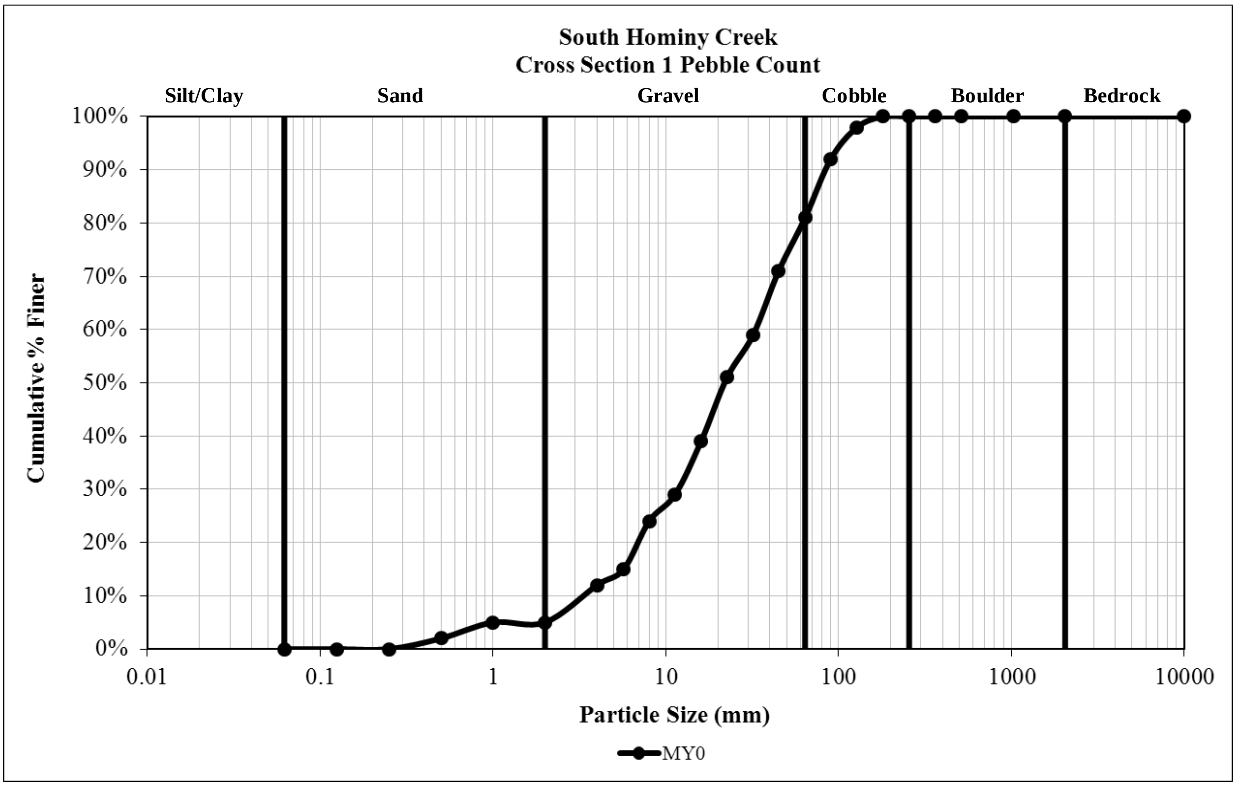


Figure B.3 As-built and Existing Pebble Count Cumulative Frequency Distribution Plots, Particle Sizes by Category, and Percent Bed Material by Category, Upper South Hominy Mitigation Site.



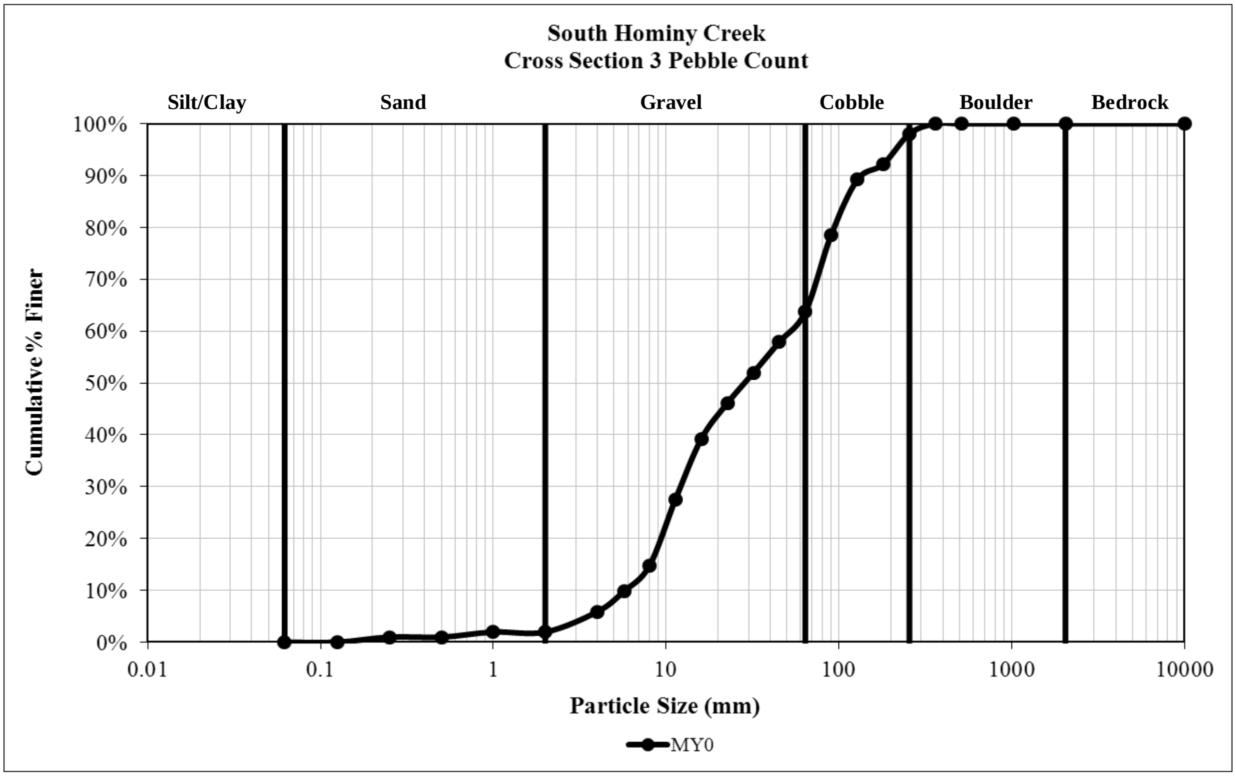
USH Reach-Wide Pebble Count			
	Particle Size by Category		
Category	**Existing**	**MY0**	**MY1**
D16 (mm)	0.2	2.3	
D35 (mm)	23.9	15.6	
D50 (mm)	56.6	35.0	
D84 (mm)	144.4	81.6	
D95 (mm)	211.0	140.3	
	Percent Bed Material by Category		
Category	**Existing**	**MY0**	**MY1**
Silt/Clay	8.0	2.0	
Sand	16.0	13.0	
Gravel	30.0	58.0	
Cobble	45.0	25.0	
Boulder	1.0	2.0	
Bedrock	0.0	0.0	

Figure B.3 Continued



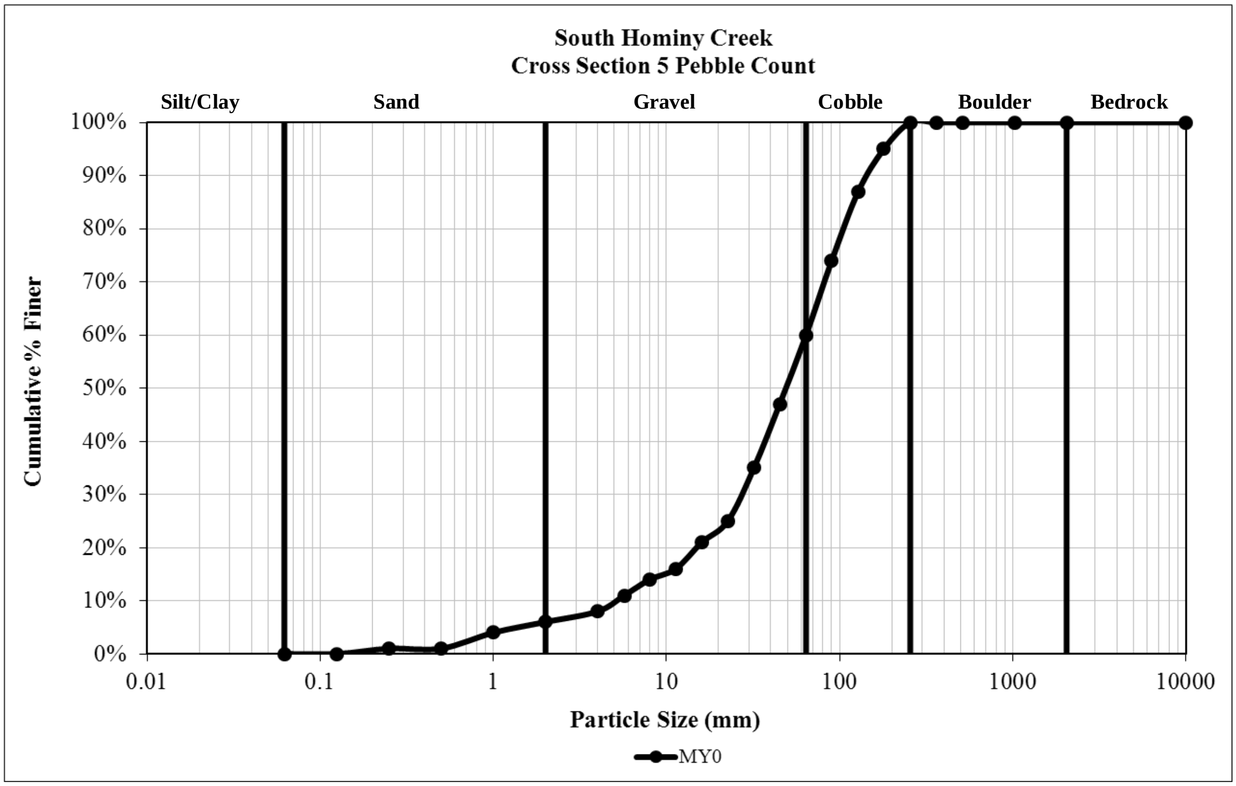
USH Bianculli Cross Section 1 Riffle Pebble Count			
	Particle Size by Category		
Category	**Existing**	**MY0**	**MY1**
D16 (mm)	6.6	6.0	
D35 (mm)	11.4	14.1	
D50 (mm)	21.2	22.1	
D84 (mm)	89.7	71.1	
D95 (mm)	124.2	109.0	
	Percent Bed Material by Category		
Category	**Existing**	**MY0**	**MY1**
Silt/Clay	2.0	0.0	
Sand	8.0	5.0	
Gravel	66.0	76.0	
Cobble	23.0	19.0	
Boulder	1.0	0.0	
Bedrock	0.0	0.0	

Figure B.3 Continued



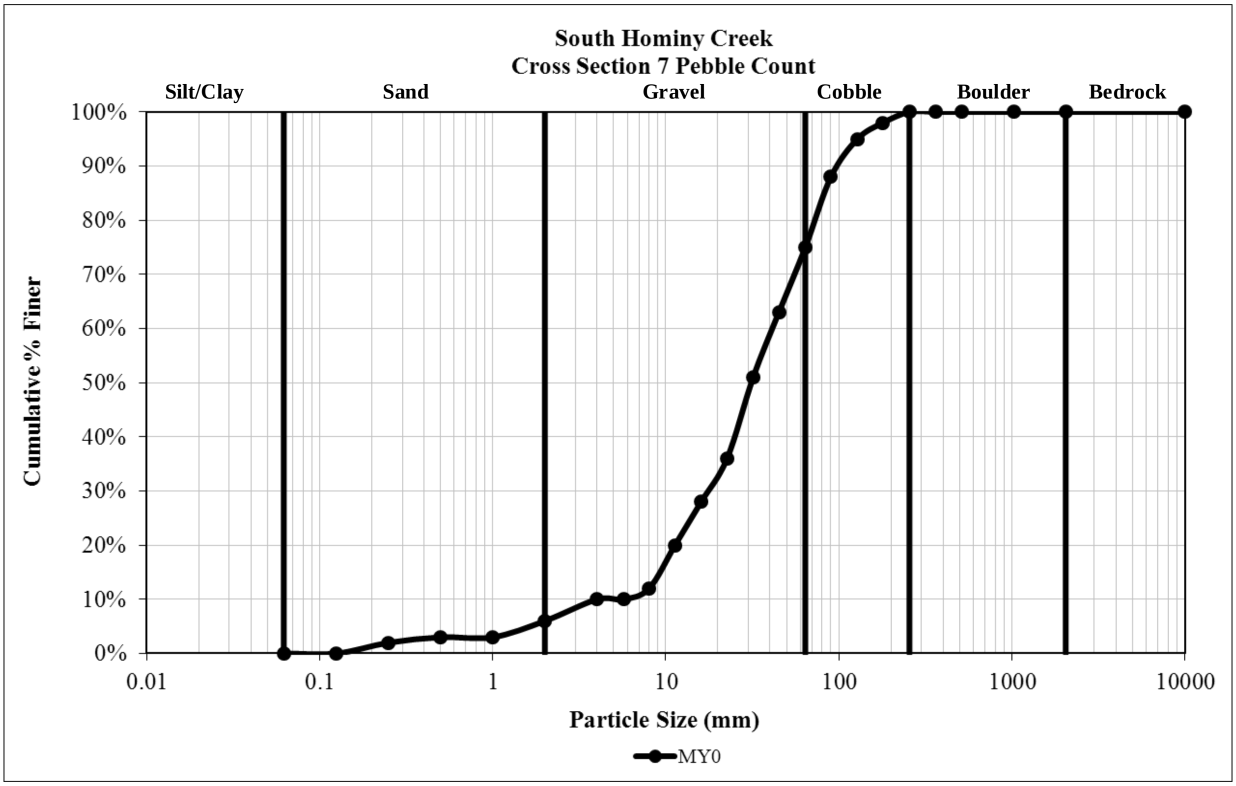
USH Bianculli Cross Section 3 Riffle Pebble Count			
	Particle Size by Category		
Category	Existing	MY0	MY1
D16 (mm)	5.1	8.3	
D35 (mm)	11.0	14.3	
D50 (mm)	21.0	28.9	
D84 (mm)	80.9	109.6	
D95 (mm)	120.2	216.7	
	Percent Bed Material by Category		
Category	Existing	MY0	MY1
Silt/Clay	0.0	0.0	
Sand	11.0	2.0	
Gravel	67.0	62.0	
Cobble	22.0	34.0	
Boulder	0.0	2.0	
Bedrock	0.0	0.0	

Figure B.3 Continued



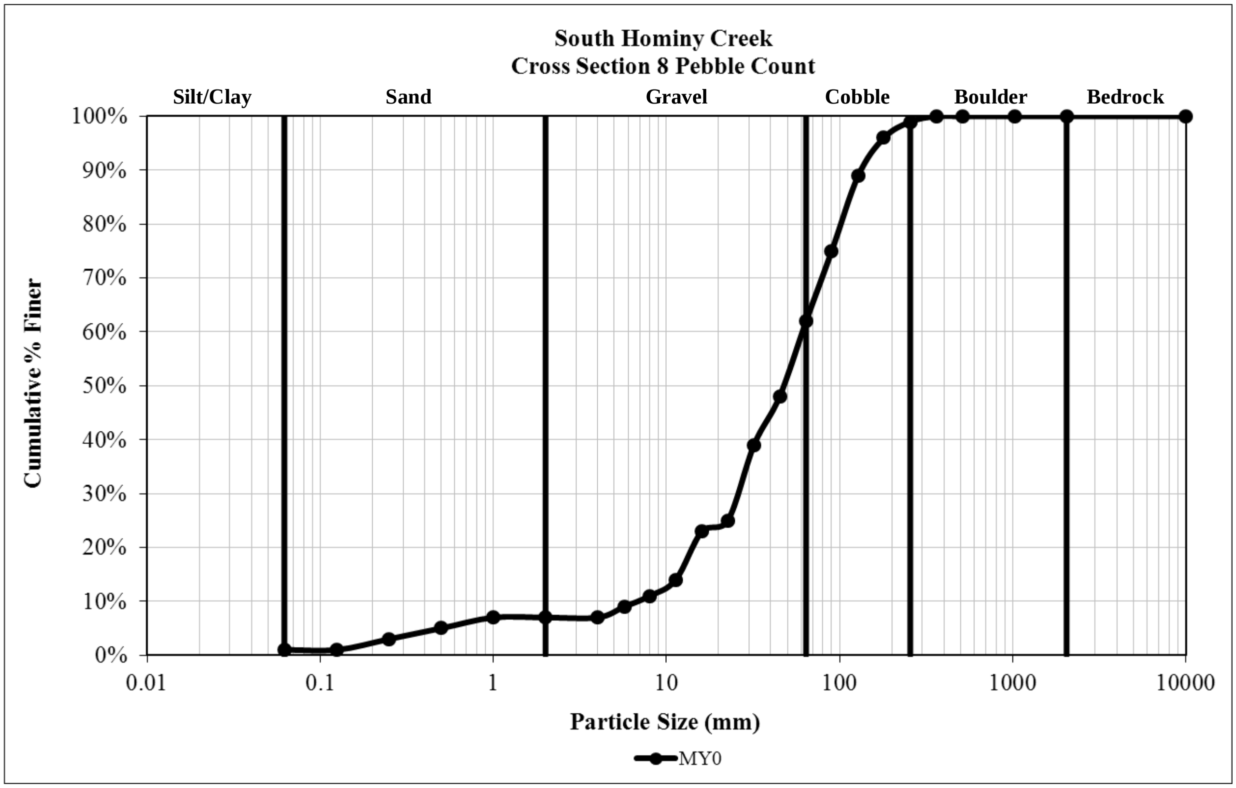
USH Bura Cross Section 5 Riffle Pebble Count			
	Particle Size by Category		
Category	Existing	MY0	MY1
D16 (mm)	6.1	11.3	
D35 (mm)	14.6	32.0	
D50 (mm)	30.0	49.4	
D84 (mm)	106.2	119.2	
D95 (mm)	179.6	180.0	
	Percent Bed Material by Category		
Category	Existing	MY0	MY1
Silt/Clay	0.0	0.0	
Sand	15.0	6.0	
Gravel	55.0	54.0	
Cobble	30.0	40.0	
Boulder	1.0	0.0	
Bedrock	0.0	0.0	

Figure B.3 Continued



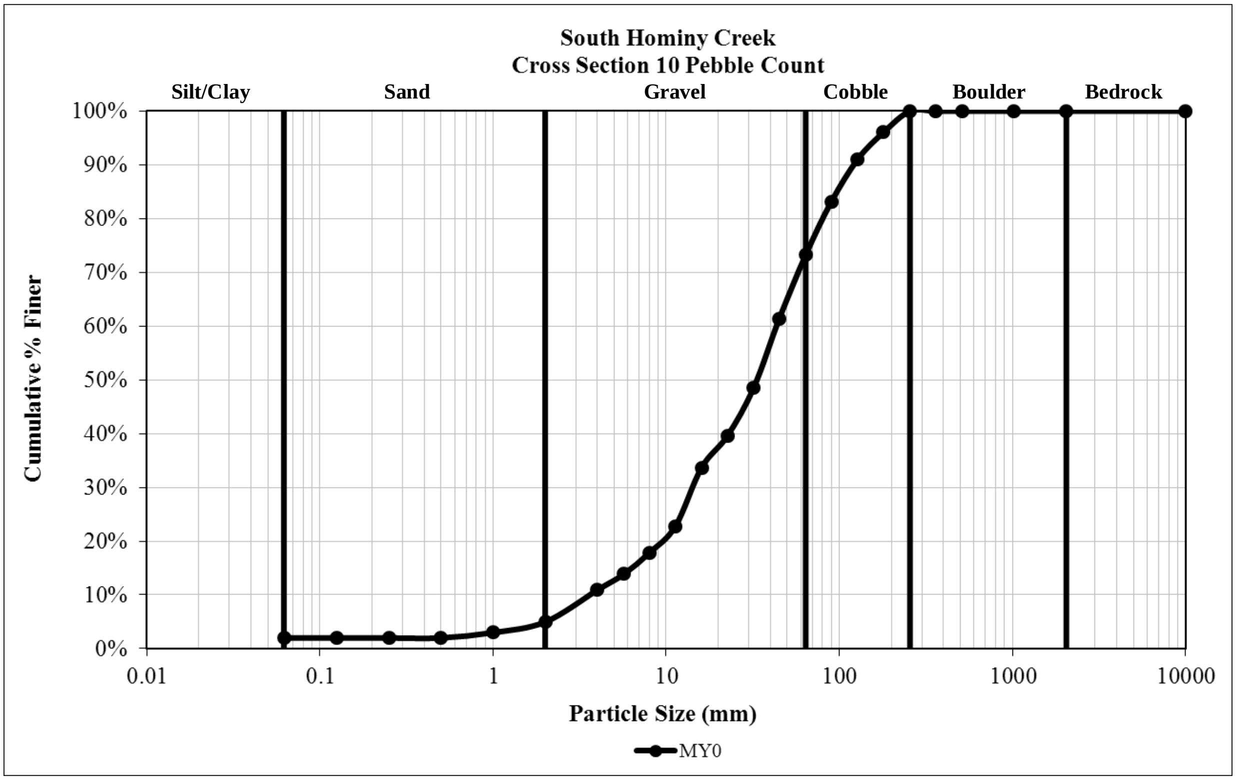
USH Bura Cross Section 7 Riffle Pebble Count			
	Particle Size by Category		
Category	Existing	MY0	MY1
D16 (mm)	5.5	9.7	
D35 (mm)	12.9	21.8	
D50 (mm)	24.5	31.4	
D84 (mm)	104.0	82.0	
D95 (mm)	164.4	128.0	
	Percent Bed Material by Category		
Category	Existing	MY0	MY1
Silt/Clay	0.0	0.0	
Sand	12.0	6.0	
Gravel	64.0	69.0	
Cobble	24.0	25.0	
Boulder	1.0	0.0	
Bedrock	0.0	0.0	

Figure B.3 Continued



USH Bura Cross Section 8 Riffle Pebble Count			
	Particle Size by Category		
Category	**Existing**	**MY0**	**MY1**
D16 (mm)	1.0	12.3	
D35 (mm)	22.6	29.3	
D50 (mm)	35.3	47.7	
D84 (mm)	96.3	114.4	
D95 (mm)	245.1	172.6	
	Percent Bed Material by Category		
Category	**Existing**	**MY0**	**MY1**
Silt/Clay	0.0	1.0	
Sand	16.0	6.0	
Gravel	58.0	55.0	
Cobble	22.0	37.0	
Boulder	4.0	1.0	
Bedrock	0.0	0.0	

Figure B.3 Continued



USH Bura Cross Section 10 Riffle Pebble Count			
	Particle Size by Category		
Category	Existing	MY0	MY1
D16 (mm)	0.6	6.9	
D35 (mm)	6.9	17.5	
D50 (mm)	17.3	33.5	
D84 (mm)	79.4	94.0	
D95 (mm)	118.0	169.1	
	Percent Bed Material by Category		
Category	Existing	MY0	MY1
Silt/Clay	10.0	2.0	
Sand	17.0	3.0	
Gravel	50.0	68.0	
Cobble	24.0	27.0	
Boulder	0.0	0.0	
Bedrock	0.0	0.0	

Figure B.4 Photographic Stations Log, Upper South Hominy Mitigation Site.

Bianculli Property, South Hominy Creek – (Restoration)

Photo Station 1

Mid channel bar, sta. 0+50, facing downstream, pre-construction. 30 September 2008.

Cross vane, sta. 0+50, facing downstream, 14 August 2011.

Photo Station 2

Channel blockage, sta.2+50, facing downstream, pre-construction, 30 September 2008.

J-hook, sta. 2+50, facing downstream, 5 September 2011.

Figure B.4 Continued

Bianculli Property, South Hominy Creek – (Restoration)

Photo Station 3

Right bank erosion, sta. 5+50, pre-construction, 30 September 2008.

J-hook, sta. 5+00, facing downstream, 5 December 2011.

Figure B.4 Continued

Bianculli Property, South Hominy Creek – (Enhancement II)

Photo Station 4

Sta. 6+50 to 8+00, right bank facing upstream, 5 December 2011.

Figure B.4 Continued

Bianculli Property, Tributary North, UT1 - (Preservation)

Photo Station 5

UT1 facing downstream on, area adjacent to small barn 28 July 2009.

Figure B.4 Continued

Bianculli Property, Tributary North, UT1 – (Restoration)

Photo Station 6

UT1 facing downstream, pre-construction 28 July 2009.

UT1 Priority I channel construction, above vernal pond, 5 September 2011.

Figure B.4 Continued

Bianculli Property, Tributary South, UT2 – (Enhancement II)

Photo Station 7

UT2 facing downstream, pre-construction, 30 November 2007.

UT2 facing downstream, post invasive removal, 5 December 2011.

Figure B.4 Continued

Bianculli Property, Tributary South, UT2 – (Restoration)

Photo Station 8

UT2 routed from original channel to a ditch, pre-construction, 30 November 2007.

UT2 re-connected under Canterfield Lane to abandoned channel, sta. 0+00 to 0+50, 5 December 2011.

Figure B.4 Continued

Roberson Property, Tributary South Abandoned Channel, UT2 – (Restoration)

Photo Station 9

Upper portion of the UT2 abandoned channel east of Canterfield Lane, 26 April 2010.

UT2 restored portion, east of Canterfield Lane, 5 December 2011.

Photo Station 10

Lower portion of UT2 abandoned channel at confluence with SHC, Pre-construction, facing downstream, 26 April 2010.

Lower portion of UT2 at confluence with SHC, facing upstream, 5 September 2011.

Figure B.4 Continued

Bura Property Left Bank, Roberson Property Right Bank, South Hominy Creek – (Restoration)

Photo Staton 11

Livestock access right bank, sta. 1+00 to 1+50, facing downstream.
22 January 2009.

Log vane at sta. 1+00 to 1+50, facing downstream
5 December. 2011.

Photo Station 12

Mid channel aggradation, sta. 1+50 to 2+50, facing downstream.
22 January 2009.

Log vane at sta. 1+50 to 2+50, facing downstream,
5 December 2011.

Figure B.4 Continued

Bura Left Bank, Roberson Right Bank, South Hominy Creek – (Enhancement II)

Photo Station 13

Typical features along channel in enhancement II reach, downstream, 22 January 2009.

Fence and invasive removal, bank sloping, sta. 5+00, facing 22 September 2011.

Figure B.4 Continued

Bura Left Bank, Roberson Right Bank, South Hominy Creek – (Restoration)

Photo Station 14

Outside meander bend bank stress, sta. 7+25 to 8+00, facing downstream, 22 January 2009.

Log vane, root wad, and bank shaping, sta. 7+25 to 8+00, 22 September 2011.

Photo Station 15

Bed aggradation and transverse bar, sta. 9+50 to 10+00, facing downstream, 22 January 2009.

Bank sloping and J-hook, sta. 9+25 to 10+00, 22 September 2011.

Figure B.4 Continued

Bura Left Bank, Roberson Right Bank, South Hominy Creek – (Enhancement II)

Photo Station 16

Lower portion of enhancement II, sta. 11+50 to 12+00, facing downstream, 22 January 2009.

Bank shaping, root wads, and toe-wood, sta. 11+50 to 12+00, 22 September 2011.

Photo Station 17

Driveway bridge at lower end of Bura/Roberson properties, sta. 12+50, facing downstream, 22 January 2009.

J-hook at sta. 12+75, lower end of Bura/Roberson properties, 22 September 2011.

Figure B.4 Continued

Davis Property, South Hominy Creek – (Enhancement I)

Photo Station 18

J-hook proposed, sta. 0+50, facing downstream, 25 July 2008, pre-construction.

Bank shaping, log vane, and riffle construction, sta. 0+25, 22 September 2011.

Figure B.4 Continued

Davis Property, South Hominy Creek – (Enhancement I)

Photo Station 19

In-stream structures proposed to enhance habitat features, sta. 2+00 3+50, facing downstream, 25 July 2008.

Log vane, root wads, and bank shaping, sta. 2+25 to 3+50, facing downstream, 7 December 2011.

Photo Station 20

Lower end of Enhancement I, sta. 3+50 to 4+50, facing downstream. 25 July 2008.

Log vane, root wads, and bank shaping, sta. 4+50, facing upstream, 19 October 2011.

Figure B.4 Continued

Davis Property, South Hominy Creek – (Enhancement II)

Photo Station 21

Cross vane, riffle construction, and bank shaping, sta. 6+75,
4 October 2011.

Photo Station 22

Left bank of Davis property, sta. 7+37, lower project boundary,
facing upstream, 15 November 2011.

Figure B.4 Continued

Davis Property, Unnamed Tributary, UT3 – (Preservation)

Photo Station 23

Upper portion of UT3 preservation, facing downstream,
25 July 2008.

Figure B.4 Continued

Davis Property, Unnamed Tributary, UT3 – (Enhancement II)

Photo Station 24

UT3 above ford, channel incision, facing downstream, 25 July 2008.

UT3 above ford, invasive removal, cattle exclusion, and bank shaping, facing upstream, 9 November 2011.

Figure B.4 Continued

Davis Property, Unnamed Tributary, UT3 Upper – (Restoration)

Photo Station 25

UT3 below ford, severe entrenchment and head cutting, 25 July 2008.

UT3 below ford, Priority I channel restoration, facing downstream, sta. 0+00, 15 November 2011.

Figure B.4 Continued

Davis Property, Unnamed Tributary, UT3 Lower – (Restoration)

Photo Station 26

UT3 lower at confluence with SHC, Priority I restoration, facing upstream, 15 November 2011.

Figure B.5 Bankfull Verification Photographs, Upper South Hominy Mitigation Site.

Photo 1 bankfull event on SHC, Bianculli property, 28 November 2011.

Photo 2 bankfull event on SHC, Roberson property, 28 November 2011.

Photo 3 bankfull event on SHC, Davis property, 28 November 2011.

Figure B.6 Stream Problem Area Photographs, Upper South Hominy Mitigation Site.

Bianculli Property, South Hominy Creek

Problem Area 1

Rock vane after construction, sta. 1+50, facing upstream, 5 September 2011.

Rock vane after flood damage, sta. 1+50, 5 December 2012.

Problem Area 2

Left channel bank under stable condition, sta. 2+00, facing upstream, 5 September 2011.

Left channel bank instability after flood damage, sta. 1+75 to 2+25, 5 December 2012.

Figure B.6 Continued

Bianculli Property, South Hominy Creek

Problem Area 3

J-hook and meander post construction, sta. 2+50, facing downstream, 5 September 2011.

Aggradation and bar formation in meander below J-hook after flood event, 5 December 2012.

Bura Property Left Bank, Roberson Property Right Bank, South Hominy Creek

Problem Area 4

J-hook vane after construction, sta. 9+25, facing upstream, 5 September 2011.

Aggradation and bar formation in below J-hook after flood event, 5 December 2012.

Figure B.7 Wetland Delineations Map and Wetland Station Pictures. Map Prepared by Confluence Engineering, PC and ClearWater Environmental Consultants, Inc. Pre-construction Wetland Photos Courtesy of ClearWater Environmental Consultants, Inc.

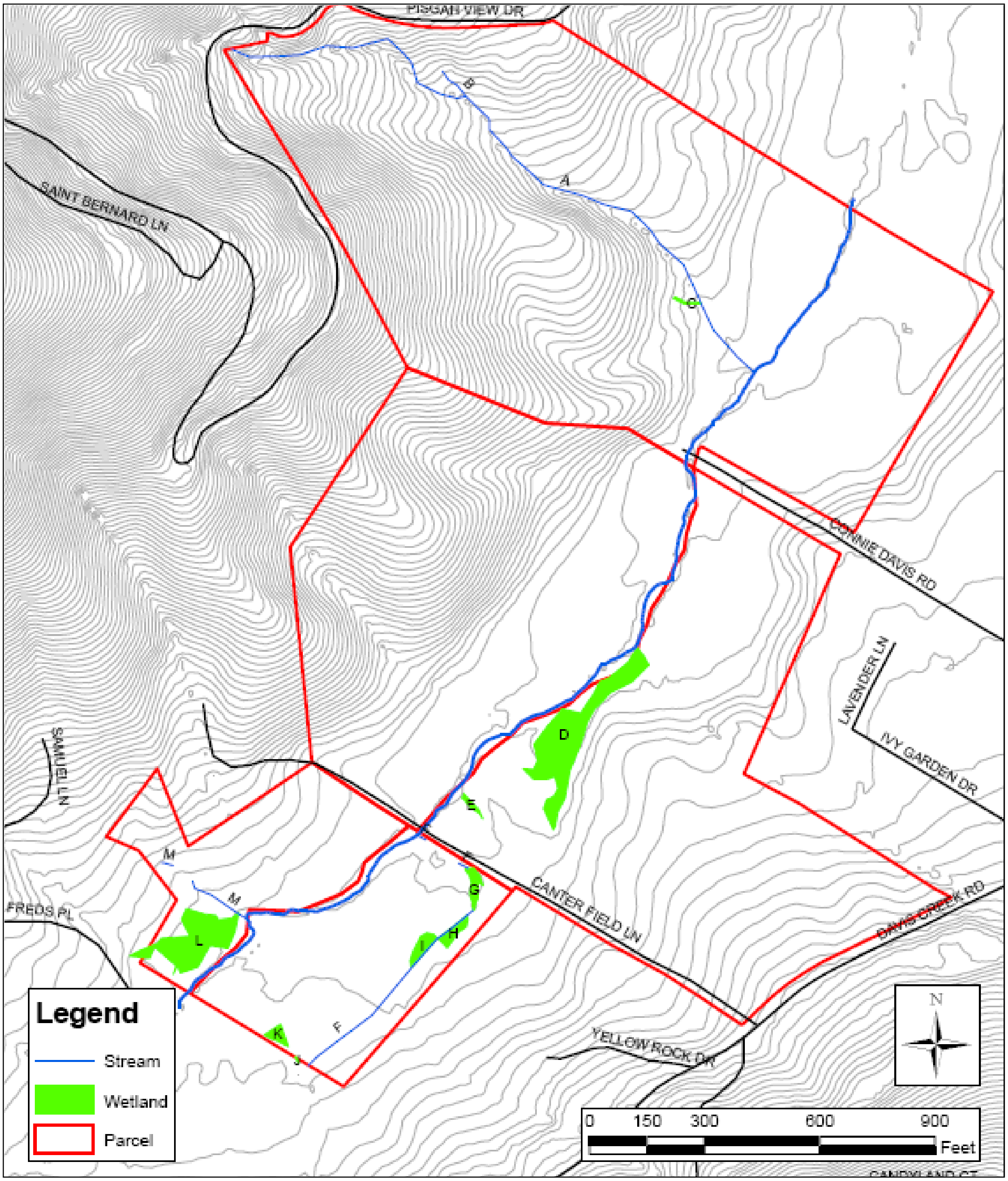


Figure B.7 Continued

Bianculli Property, Wetland L

Wetland Station 1


Wetland L, pre-construction, 2009.


Wetland L constructed ephemeral pool, facing upstream, 5 December 2011.

Figure B.7 Continued

Roberson Property, Wetland E and UT2

Wetland Station 2

Wetland E, UT2 facing upstream, pre-construction, 2009.

Wetland E reconnected with spring flow from UT2, 5 September 2011.

Figure B.7 Continued

Roberson Property, Wetland D

Wetland Station 3


Wetland D, facing downstream, pre-construction, 2009.


Enhancement to Wetland D, facing downstream, 22 September 2011.

Figure B.7 Continued

Roberson Property, Wetland D

Wetland Station 4

Wetland D, area of livestock access, facing upstream, 2009.

Enhancement to lower portion of Wetland D, 22 Sept 2011.

Wetland Station 5

Lower portion of Wetland D, livestock impacts, facing upstream, 2009.

Lower portion of Wetland D, at SHC confluence, 22 September 2011.

Appendix C.

Vegetation Data, CVS Output Tables, and Vegetation Plot Photographs

Table C.1 Annual Seed Mix, Perennial Native Seed Mix, and Live Stake Species used to stabilize and revegetate the Upper South Hominy Mitigation Site.

Type	Common Name	Scientific Name	Rate	Zone [a]	Number
Annual seed	Browntop millet	*Panicum ramosum*	10 lb/ac	1,2,3	
	Buckwheat	*Eriogonum spp.*	15 lb/ac	1,2	
	Winter rye	*Lolium spp.*	30 lb/ac	1,2	
	Winter wheat	*Triticum spp.*	15 lb/ac	1,2	
Perennial native seed	Arrowleaf tearthumb	*Polygonum sagittatum*		1,2	
	Big bluestem	*Andropogon gerardii*		1,2	
	Blackeyed Susan	*Rudbeckia hirta*		1,2	
	Blue vervain	*Verbena hastata*		1,2	
	Deer tongue	*Panicum clandestinum*		1,2	
	Eastern bur reed	*Sparganium americanum*		1,3	
	Green bulrush	*Scirpus atrovirens*		1,3	
	Grey headed cone flower	*Ratibida pinnata*		1,2	
	Hop sedge	*Carex lupulina*		1,3	
	Indian wood oats	*Chasmanthium latifolium*		1,2	
	Indiangrass	*Sorghastrum nutans*		1,2	
	Lanceleaf coreopsis	*Coreopsis lanceolata*		1,2	
	Little bluestem	*Schizachyrium scoparium*		1,2	
	Many leaved bulrush	*Scirpus polyphyllus*		1,3	
	Nodding bur-marigold	*Bidens cernua*		1,2	
	Oxeye sunflower	*Heliopsis helianthoides*		1,2	
	Partridge pea	*Chamaecrista fasciculata*		1,2	
	Pennsylvania smartweed	*Polygonum pensylvanicum*		1,2	
	Purple cone flower	*Echinacea purpurea*		1,2	
	River oats	*Chasmanthium latifolium*		1,2	
	Showy evening primrose	*Oenothera speciosa*		1,2	
	Showy tickseed sunflower	*Bidens aristosa*		1,2	
	Smooth panic grass	*Panicum dichotomiflorum*		1,2	
	Soft rush	*Juncus effusus*		1,3	
	Softstem bulrush			1,3	
	Switch grass	*Panicum virgatum*		1,2	
	Virginia wild rye	*Elymus virginicus*		1,2	
		Combined Total	15 lb/ac		
Live stakes	Elderberry	*Sambucus canadensis*		1,3	250
	Silky dogwood	*Cornus amomum*		1,3	3,250
	Silky willow	*Salix sericea*		1,3	1,500
		Total		1,3	5,000

[a] Planting zone refer to stream bank & floodplain areas (1), transition & upland areas (2), or wetland areas (3).

Table C.2 Shrub and tree species installed at the Upper South Hominy Mitigation Site. Plant source was either bare root (B) or containerized (C) nursery stock.

Type	Common Name	Scientific Name	Wetness Indicator	Zone[a]	Number Installed	Plant Source[b,c]
Shrubs and small trees	American beauty berry	*Callicarpa americana*	FACU	2	20	C
	Arrowwood viburnum	*Viburnum dentatum*	FAC	2	30	C
	Button bush	*Cephalanthus occidentalis*	OBL	1,2,3	30	C
	Elderberry	*Sambucus canadensis*	FACW	1,2,3	25	C
	Possum haw	*Ilex decidua*	FACW	2	30	C
	Red chokeberry	*Aronia arbutifolia*	FACW	2	20	C
Totals	6				155	
Medium trees	Black cherry	*Prunus serotina*	FACU	2	100	B
	Black willow	*Salix nigra*	OBL	1,2,3	50	C
	Carolina ash	*Fraxinus caroliniana*	OBL	2	15	C
	Dogwood	*Cornus florida*	FACU	2	200	B
	Eastern redbud	*Cercis canadensis*	FACU	2	100	B
	Ironwood	*Carpinus caroliniana*	FAC	2	23	C
	Persimmon	*Diospyros virginiana*	FACU	2	25, 100	C,B
	River birch	*Betula nigra*	FACW	2	20, 200	C,B
	Southern crabapple	*Malus angustifolia*	FACU	2	100	B
Totals	9				933	
Large trees	Black gum	*Nyssa sylvatica*	FAC	2	100	B
	Bitternut hickory	*Carya cordiformis*	FAC	2	100	B
	Cherrybark oak	*Quercus pagoda*	FAC	2	100	B
	Chestnut oak	*Quercus prinus*	FAQU	2	100	B
	Mockernut hickory	*Carya alba*	FACU	2	100	B
	Northern red oak	*Quercus rubra*	FACU	2	30, 100	C,B
	Pin oak	*Quercus palustris*	FACW	2	100	B
	Scarlet oak	*Quercus coccinea*	FACU	2	2, 200	C, B
	Shagbark hickory	*Carya ovata*	FACU	2	100	B
	Shumard's oak	*Quercus shumardii*	FACW	2	10, 100	C,B
	Sycamore	*Platanus occidentalis*	FACW	2	200	B
	White oak	*Quercus alba*	FACU	2	30, 100	C,B
	Yellow buckeye	*Aesculus flava*	FAC	2	20	C
Totals	13				1,492	

[a] Planting zone refer to stream bank & floodplain areas (1), transition & upland areas (2), or wetland areas (3).
[b] Bare root whips ranged from 1 to 2 feet in height; hickory species were less averaging 6 inches in height.
[c] Container sizes ranged from 5 to 7 gallon; the majority of the plants were in 5 gallon containers.

Table C.3 Vegetation Monitoring Plot Location, Orientation, and Dimension, Upper South Hominy Mitigation Site.

Vegetation Monitoring Plots Photographs Upper South Hominy Mitigation Site (EEP project number 92632)			
Stream	**Location**	**Bearing (Degrees from North)**	**Plot Dimensions (m)**
UT2	Plot 1 left bank sta. 2+00	Plot origin (x,y) 140^{o}	10 X 10
SHC	Plot 2 right bank sta. 7+50	Plot origin (x,y) 160^{o}	10 X 10
SHC	Plot 3 left bank sta. 7+25	Plot origin (x,y) 140^{o}	10 X 10
SHC	Plot 4 right bank sta. 0+50	Plot origin (x,y) 140^{o}	10 X 10
SHC	Plot 5 left bank sta. 9+50	Plot origin (x,y) 125^{o}	10 X 10
SHC	Plot 6 right bank sta.10+50	Plot origin (x,y) 120^{o}	5 X 20
SHC	Plot 7 right bank sta. 0+75	Plot origin (x,y) 140^{o}	10 X 10
SHC	Plot 8 left bank sta. 2+50	Plot origin (x,y) 150^{o}	10 X 10
SHC	Plot 9 right bank sta. 5+75	Plot origin (x,y) 140^{o}	5 X 20
UT3 Lower	Plot 10 left bank sta. 1+00	Plot origin (x,y) 130^{o}	10 X 10

Table C.4 Vegetation Metadata, Upper South Hominy Mitigation Site.

MY0 Vegetation Metadata Upper South Hominy Mitigation Site (EEP project number 92632)	
Report Prepared By	C. Scott Loftis, A. Brent Burgess
Date Prepared	29 May 2012
Database Name	USH MY0 cvs-eep-entrytool-v2.2.7.mdb
Database Location	C:\Documents and Settings\Brent Burgess\My Documents\MY DATA\Word\Restoration\USH\As Built Data 2011
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Project, Planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Project, Total Stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp.	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp.	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp.	Count of living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY	
Project Code/Number	92632
Project Name	Upper South Hominy Mitigation Site
Description	NCEEP Mitigation Site, Buncombe County, N.C.
Length (ft)	5,804
Stream-to-Edge Width (ft)	30
Area (m^2/acres)	32,349.28 m^2 / 8.0acres
Required Plots (calculated)	9
Sampled Plots	10

Table C.5 Vegetation Vigor by Species, Upper South Hominy Mitigation Site.

MY0 Vegetation Vigor by Species								
Upper South Hominy Mitigation Site (EEP project number 92632)								
Species	**Common Name**	**4**	**3**	**2**	**1**	**0**	**Missing**	**Unknown**
Aesculus flava	Yellow buckeye	2	1					
Aronia arbutifolia	Red Chokeberry	1	2					
Betula nigra	River birch		6					
Callicarpa americana	American beautyberry	6						
Carpinus caroliniana	American hornbeam	1						
Carya alba	Mockernut hickory		5					
Carya cordiformis	Bitternut hickory		5					
Carya ovata	Shagbark hickory	1	4					
Cephalanthus occidentalis	Buttonbush		2					
Cercis canadensis	Eastern redbud		8					
Cornus amomum	Silky dogwood		4					
Cornus florida	Flowering dogwood		16					
Diospyros virginiana	Persimmon	1	14					
Fraxinus caroliniana	Carolina ash	1						
Ilex decidua	Possumhaw	1	1					
Liriodendron tulipifera	Tuliptree		8					
Malus angustifolia	Southern crabapple	1						
Nyssa sylvatica	Blackgum		3					
Platanus occidentalis	Sycamore		7					
Prunus serotina	Black cherry		15					
Quercus alba	White oak		7					
Quercus coccinea	Scarlet oak		7					
Quercus pagoda	Cherrybark oak		7					
Quercus palustris	Pin oak	1	7					
Quercus prinus	Chestnut oak		5					
Quercus rubra	Northern red oak	2	6					
Quercus shumardii	Shumard's oak		9					
Salix nigra	Black willow	3	1					
Salix sericea	Silky willow		3					
Sambucus canadensis	Elderberry	4	2					
Viburnum dentatum	Southern arrowwood	2	2					
Total Species	**31**	**27**	**157**					

Table C.6 Vegetation Damage by Species, Upper South Hominy Mitigation Site.

MY0 Vegetation Damage by Species			
Upper South Hominy Mitigation Site (EEP project number 92632)			
Species	**Common Name**	**Count of Damage Categories**	**(no damage)**
Aesculus flava	Yellow buckeye	0	3
Aronia arbutifolia	Red Chokeberry	0	3
Betula nigra	River birch	0	6
Callicarpa americana	American beautyberry	0	6
Carpinus caroliniana	American hornbeam	0	1
Carya alba	Mockernut hickory	0	5
Carya cordiformis	Bitternut hickory	0	5
Carya ovata	Shagbark hickory	0	5
Cephalanthus occidentalis	Buttonbush	0	2
Cercis canadensis	Eastern redbud	0	8
Cornus amomum	Silky dogwood	0	4
Cornus florida	Flowering dogwood	0	16
Diospyros virginiana	Persimmon	0	15
Fraxinus caroliniana	Carolina ash	0	1
Ilex decidua	Possumhaw	0	2
Liriodendron tulipifera	Tuliptree	0	8
Malus angustifolia	Southern crabapple	0	1
Nyssa sylvatica	Blackgum	0	3
Platanus occidentalis	Sycamore	0	7
Prunus serotina	Black cherry	0	15
Quercus alba	White oak	0	7
Quercus coccinea	Scarlet oak	0	7
Quercus pagoda	Cherrybark oak	0	7
Quercus palustris	Pin oak	0	8
Quercus prinus	Chestnut oak	0	5
Quercus rubra	Northern red oak	0	8
Quercus shumardii	Shumard's oak	0	9
Salix nigra	Black willow	0	4
Salix sericea	Silky willow	0	3
Sambucus canadensis	Elderberry	0	6
Viburnum dentatum	Southern arrowwood	0	4
Total Species	**31**	**0**	**184**

Table C.7 Vegetation Damage by Plot, Upper South Hominy Mitigation Site.

MY0 Vegetation Damage by Plot		
Upper South Hominy Mitigation Site (EEP project number 92632)		
Plot	**Count of Damage Categories**	**No Damage**
92632-NCWRC-VP1-MY0	0	13
92632-NCWRC-VP2-MY0	0	14
92632-NCWRC-VP3-MY0	0	19
92632-NCWRC-VP4-MY0	0	16
92632-NCWRC-VP5-MY0	0	25
92632-NCWRC-VP6-MY0	0	15
92632-NCWRC-VP7-MY0	0	18
92632-NCWRC-VP8-MY0	0	27
92632-NCWRC-VP9-MY0	0	16
92632-NCWRC-VP10-MY0	0	21
Total: 10	**0**	**184**

Table C.8 Planted Stem Count by Plot and Species, Upper South Hominy Mitigation Site.

MY0 Planted Stem Count by Plot and Species									
Upper South Hominy Mitigation Site (EEP project number 92632)									
Species	**Common Name**	**Total Stems**	**Number of Plots**	**Average Number of Stems**	**VP1**	**VP2**	**VP3**	**VP4**	**VP5**
Aesculus flava	Yellow buckeye	3	3	1			1		1
Aronia arbutifolia	Red Chokeberry	3	2	1.5					
Betula nigra	River birch	6	4	1.5	1	3		1	1
Callicarpa americana	American beautyberry	6	5	1.2					
Carpinus caroliniana	American hornbeam	1	1	1					
Carya alba	Mockernut hickory	5	4	1.25			2		1
Carya cordiformis	Bitternut hickory	5	5	1	1		1		1
Carya ovata	Shagbark hickory	5	3	1.67					2
Cephalanthus occidentalis	Buttonbush	2	2	1		1	1		
Cercis canadensis	Eastern redbud	8	3	2.67					
Cornus amomum	Silky dogwood	4	1	4					
Cornus florida	Flowering dogwood	16	8	2	3	1	3	2	
Diospyros virginiana	Persimmon	15	8	1.88		1	2	1	6
Fraxinus caroliniana	Carolina ash	1	1	1				1	
Ilex decidua	Possumhaw	2	2	1	1				
Liriodendron tulipifera	Tuliptree	8	4	2			2		3
Malus angustifolia	Southern crabapple	1	1	1					
Nyssa sylvatica	Blackgum	3	2	1.5			1		2
Platanus occidentalis	Sycamore	7	3	2.33			1	5	
Prunus serotina	Black cherry	15	8	1.88	2	2		1	2
Quercus alba	White oak	7	6	1.17	1		1		1
Quercus coccinea	Scarlet oak	7	6	1.17	1	1			
Quercus pagoda	Cherrybark oak	7	7	1	1	1		1	1
Quercus palustris	Pin oak	8	7	1.14	1		1	1	
Quercus prinus	Chestnut oak	5	4	1.25					1
Quercus rubra	Northern red oak	8	8	1		1	1	1	1
Quercus shumardii	Shumard's oak	9	8	1.12	1		1	2	
Salix nigra	Black willow	4	4	1		1			
Salix sericea	Silky willow	3	1	3					
Sambucus canadensis	Elderberry	6	4	1.5		1			2
Viburnum dentatum	Southern arrowwood	4	4	1		1	1		
Totals:	**31**	**184**			**13**	**14**	**19**	**16**	**25**
Density (stem/acre):		**749**			**526**	**566**	**769**	**648**	**1012**

Table C.8 Continued

MY0 Planted Stem Count by Plot and Species									
Upper South Hominy Mitigation Site (EEP project number 92632)									
Species	**Common Name**	**Total Stems**	**Number of Plots**	**Average Number of Stems**	**VP6**	**VP7**	**VP8**	**VP9**	**VP10**
Aesculus flava	Yellow buckeye	3	3	1					1
Aronia arbutifolia	Red Chokeberry	3	2	1.5		2	1		
Betula nigra	River birch	6	4	1.5					
Callicarpa americana	American beautyberry	6	5	1.2	1	1	1	2	1
Carpinus caroliniana	American hornbeam	1	1	1				1	
Carya alba	Mockernut hickory	5	4	1.25				1	1
Carya cordiformis	Bitternut hickory	5	5	1			1		1
Carya ovata	Shagbark hickory	5	3	1.67			1		2
Cephalanthus occidentalis	Buttonbush	2	2	1					
Cercis canadensis	Eastern redbud	8	3	2.67		2	1		5
Cornus amomum	Silky dogwood	4	1	4			4		
Cornus florida	Flowering dogwood	16	8	2	3		1	1	2
Diospyros virginiana	Persimmon	15	8	1.88		1	2	1	1
Fraxinus caroliniana	Carolina ash	1	1	1					
Ilex decidua	Possumhaw	2	2	1				1	
Liriodendron tulipifera	Tuliptree	8	4	2			1		2
Malus angustifolia	Southern crabapple	1	1	1				1	
Nyssa sylvatica	Blackgum	3	2	1.5					
Platanus occidentalis	Sycamore	7	3	2.33		1			
Prunus serotina	Black cherry	15	8	1.88	1	1	3	3	
Quercus alba	White oak	7	6	1.17	1	2	1		
Quercus coccinea	Scarlet oak	7	6	1.17	1	2	1	1	
Quercus pagoda	Cherrybark oak	7	7	1	1	1		1	
Quercus palustris	Pin oak	8	7	1.14	1	1	2	1	
Quercus prinus	Chestnut oak	5	4	1.25	2	1			1
Quercus rubra	Northern red oak	8	8	1	1		1	1	1
Quercus shumardii	Shumard's oak	9	8	1.12	1	1	1	1	1
Salix nigra	Black willow	4	4	1	1	1	1		
Salix sericea	Silky willow	3	1	3			3		
Sambucus canadensis	Elderberry	6	4	1.5			1		2
Viburnum dentatum	Southern arrowwood	4	4	1	1	1			
Totals:	**31**	**184**			**15**	**18**	**27**	**16**	**21**
Density (stems/acre):		**749**			**607**	**728**	**1093**	**648**	**850**

Table C.9 Vegetation Problem Areas, Upper South Hominy Mitigation Site.

MY0 Vegetation Problem Areas Upper South Hominy Mitigation Site (EEP project number 92632)			
Feature/Issue	**Station Number/Range**	**Probable Cause**	**Photo Number**

** No vegetation problem areas were observed during MY0. Table C.9 is only a place holder for future monitoring reports.

Figure C.1 Vegetation Monitoring Plot Photographs, Upper South Hominy Mitigation Site.


Vegetation plot 1, UT2 facing downstream (0,0), 2 Feb 2012, MY0.


Vegetation plot 1, UT2 facing downstream (10,10), 2 Feb 2012, MY0.

Figure C.1 Continued

Vegetation plot 2, SHC facing downstream (0,0), 2 Feb 2012, MY0.

Vegetation plot 2, SHC facing upstream (10,10), 2 Feb 2012, MY0.

Figure C.1 Continued

Vegetation plot 3, SHC facing downstream (0,0), 2 Feb 2012, MY0.

Vegetation plot 3, SHC facing upstream (0,0), 2 Feb 2012, MY0.

Figure C.1 Continued

Vegetation Plot 4 No Pictures, MY0

Figure C.1 Continued

Vegetation plot 5, SHC facing downstream (0,0), 2 Feb 2012, MY0.

Vegetation plot 5, SHC facing upstream (10,10), 2 Feb 2012, MY0.

Figure C.1 Continued

Vegetation plot 6, SHC facing downstream (0,0), 2 Feb 2012, MY0.

Vegetation plot 6, SHC facing upstream (20,5), 2 Feb 2012, MY0.

Figure C.1 Continued

Vegetation plot 7, SHC facing downstream (0,0), 2 Feb 2012, MY0.

Vegetation plot 7, SHC facing upstream (10,10), 2 Feb 2012, MY0.

Figure C.1 Continued

Vegetation plot 8, SHC facing downstream (0,0), 2 Feb 2012, MY0.

Vegetation plot 8, SHC facing upstream (10,10), 2 Feb 2012, MY0.

Figure C.1 Continued

Vegetation plot 9, SHC facing downstream (20,0), 2 Feb 2012, MY0.

Vegetation plot 9, SHC facing upstream (20,5), 2 Feb 2012, MY0.

Figure C.1 Continued

Vegetation plot 10, UT3 facing downstream (0,0), 2 Feb 2012, MY0.

Vegetation plot 10, UT3 facing upstream (10,10), 2 Feb 2012, MY0.

Figure C.2 Vegetation Problem Area Photographs, Upper South Hominy Mitigation Site.

**No vegetation problem area photographs were taken during MY0. Figure C.2 is only a place holder for future monitoring reports.

Appendix D.

As-built Plan Sheets

Figure D.1 As-built Plan Sheets, Upper South Hominy Mitigation Site.