BASELINE MONITORING DOCUMENT AND AS-BUILT BASELINE REPORT

Final

OWL'S DEN MITIGATION SITE
Lincoln County, NC
NCDEQ Contract 005150
NCDMS Project Number 95808

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EXECUTIVE SUMMARY

Wildlands Engineering (Wildlands) implemented a full delivery project at the Owl's Den Mitigation Site (Site) for the North Carolina Division of Mitigation Services (NCDMS) to restore 2,468 linear feet (LF) of perennial streams, rehabilitate 2.82 acres of existing wetlands, and re-establish 6.77 acres of wetlands in Lincoln County, NC. The Site is expected to generate 2,468 stream mitigation units (SMUs) and 8.9 wetland mitigation units (WMUs) (Table 1).

The Site is located near the City of Lincolnton in Lincoln County, NC within the NCDMS targeted watershed for the Catawba River Basin Hydrologic Unit Code (HUC) 03050102040040 and NCDWR Subbasin 03-08-35 (Figure 1) and is being submitted for mitigation credit in the Catawba River Basin HUC 03050103 within the expanded service area of this HUC. Hydrologic Unit Code (HUC) 03050102040040 was identified as a Targeted Local Watershed (TLW) in EEP's 2007 Catawba River Basin Restoration Priority (RBRP) Plan. The project streams consist of two unnamed tributaries to Howards Creek, HC1 and HC2 (Figure 2). Howards Creek eventually flows into the South Fork Catawba River near the City of Lincolnton in Lincoln County. The adjacent land to the streams and wetlands is maintained for agricultural purposes.

The Site is located in the Howards Creek watershed and is within a Targeted Local Watershed (TLW) identified in NCDMS 2007 Catawba River Basin Restoration Priority Plan (RBRP). The Site is also identified in the Indian Creek and Howards Creek Local Watershed Plan (LWP) Project Atlas. The Indian and Howards Creek LWP identified stream channelization and dredging, incised channels and unstable stream banks, deforested riparian buffers, drained and cleared wetlands, and nutrient inputs to streams and wetlands as major stressors within this watershed. The LWP Project Atlas identified the Owl's Den Mitigation Site as a restoration opportunity with the potential to improve water quality, habitat, and hydrology within the Howards Creek watershed.

The project goals established in the mitigation plan (Wildlands, 2014) were completed with careful consideration of goals and objectives that were described in the RBRP and to address stressors identified in the LWP. The following project goals established include:

- Correct hydrologic modifications to streams including stream incision and dredging, bank erosion, lowering of the local water table, sedimentation, and loss of riparian buffer and floodplain functions;
- Improve hydrology and function of previously drained and cleared wetlands;
- Re-establish riparian buffer and wetland vegetation communities; and
- Reduce nutrient loads to downstream waters by improving wetlands and buffers to treat runoff.

Secondary project goals include:

- Improve instream habitat by diversifying the stream bedform and introducing habitat structures and wood debris and
- Reduce agricultural pollution form pesticides and herbicides used on adjacent fields by improving wetland and buffers to treat runoff.

Following the mitigation plan approval by the IRT, the conservation easement and wetland re-establishment boundary were revised to accommodate the relocation of a power line utility from inside the project area to outside of the project area. This change to the conservation easement and wetland re-establishment boundary resulted in the reduction of approximately 0.53 acres of wetland re-

establishment area. This reduction in re-establishment acreage and WMUs is included in Table 1 of this report.

The Site construction and as-built surveys were completed between May 2015 and August 2015. Planting and baseline vegetation data collection occurred in January 2016. Minimal adjustments were made during construction and specific changes are detailed in Section 5.1. Baseline (MY0) profiles and cross-section dimensions closely match the design parameters. Cross section widths and pool depths occasionally exceed design parameters within a normal range of variability for natural streams. The Site has been built as designed and is expected to meet the upcoming monitoring year's success criteria.

OWL'S DEN MITIGATION SITE

Baseline Monitoring Document and As-Built Baseline Report

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APPENDICES

Section 1: PROJECT GOALS, BACKGROUND AND ATTRIBUTES

1.1 Project Location and Setting

The Site is located in central Lincoln County 3.4 miles northwest of Lincolnton off of Owl's Den Road (Figure 1). The Site is located on a tract owned by Owl's Den Farm, LLC (PIN 83614135713). A conservation easement was recorded on 12.87 acres of the parcel (Deed Book 2455, Page Number 864).

The Site is located in the Catawba River Basin; eight-digit Cataloging Unit (CU) 03050102 and within the NCDMS targeted watershed for the Catawba River Basin 14-digit Hydrologic Unit Code (HUC) 03050102040040 (Figure 1) and is being submitted for mitigation credit in the Catawba River Basin HUC 03050103 within the expanded service area of this HUC.

Located in the Inner Piedmont Belt of the Piedmont Physiographic Province (USGS, 1998), the project watershed is dominated by agricultural and forested land. The drainage area for the project site is 152 acres. From Charlotte, NC, take US-85 South approximately 18 miles to US-321 in Gastonia, NC. Take exit 17 for US-321 North and continue approximately 14 miles. Take exit 24 for NC 27 North / NC 150 toward Lincolnton. Continue onto Main Street in downtown Lincolnton, which will go through a roundabout at the Lincoln County Civil Court. Continue on US 27 N/ Main Street by taking the 3rd exit on the roundabout. Main Street becomes Riverside Drive. In approximately 3 miles, turn right onto Rock Dam Road at St. Dorothy's Catholic Church and Kid's Dome. After 0.6 miles, turn right onto Owl's Den Road. The entrance to the Owl's Den Farm is on the left in approximately 2 miles.

The unnamed tributaries to Howards Creek (HC1 and HC2) are located within the NC Division of Water Resources (NCDWR) subbasin 03-08-35. The Site drains to Howards Creek (NCDWR Index No. 11-129-4) which is classified as C waters. Class C waters are protected for uses such as secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and agriculture. Howards Creek eventually drains to the South Fork Catawba River. The Site is located in the Howards Creek watershed and is within a Targeted Local Watershed (TLW) identified in NCDMS 2007 Catawba River Basin Restoration Priority Plan (RBRP). The Site is also identified in the Indian Creek and Howards Creek Local Watershed Plan (LWP) Project Atlas. The Indian and Howards Creek LWP identified stream channelization and dredging, incised channels and unstable stream banks, deforested riparian buffers, drained and cleared wetlands, and nutrient inputs to streams and wetlands as major stressors within this watershed. The LWP Project Atlas identified the Owl's Den Mitigation Site as a restoration opportunity with the potential to improve water quality, habitat, and hydrology within the Howards Creek watershed.

Prior to construction activities, the streams on the Site had been straightened, widened, and deepened to provide drainage for surrounding cropland. The adjacent floodplain areas had been cleared and maintained to support agricultural activities. Table 4 in Appendix 1 and Tables 6a-b in Appendix 2 present the pre-restoration conditions in more detail.

1.2 Project Goals and Objectives

This mitigation site is intended to provide numerous ecological benefits within the Catawba River Basin. The Site will help address stressors identified in the LWP and provide numerous ecological benefits within the Catawba River Basin. While many of these benefits are limited to the Owl's Den project area, others, such as pollutant removal, reduced sediment loading, and improved aquatic and terrestrial habitat, have farther-reaching effects. Expected improvements to water quality and ecological processes are outlined below as project goals and objectives. These project goals established were completed with careful

consideration of goals and objectives that were described in the RBRP and to address stressors identified in the LWP while also meeting the NCDMS mitigation needs.

The primary objectives of the Owl's Den Mitigation Site address stressors identified in the LWP and included the following:

- *Correct hydrologic modifications to streams including stream incision and dredging, bank erosion, lowering of the local water table, sedimentation, and loss of riparian buffer and floodplain functions.* The project re-connected streams with a stable floodplain using Priority 1 restoration techniques. The Priority 1 restoration eliminated vertically incised channels on site. Stream banks were stabilized with grading, in-stream structures, and planting. By stabilizing stream banks on site, sediment loading should be reduced in the receiving watershed.
- *Improve hydrology and function of previously drained and cleared wetlands.* The project restored hydrologic connections to existing wetlands using Priority 1 stream restoration to raise the local water table and increase overbank flooding. The project extended existing wetland zones into adjacent areas and established wetland vegetation throughout the site.
- *Re-establish wetland hydrology and function in relic wetland areas.* Removal of historic overburden uncovered relic hydric soils and should bring local water table elevations closer to the ground surface. Disking and roughening of wetland re-establishment areas should increase retention times and improve natural infiltrative processes.
- *Re-establish riparian buffer and wetland vegetation communities.* A native vegetation community was planted on the site to revegetate the riparian buffers and wetlands and return the functions associated with these wooded areas.
- *Reduce excess sediment to downstream waters by stabilizing streams and revegetating site.* Stream banks were stabilized on all project reaches. The site was also revegetated with a native forest community to prevent erosion and sedimentation from overland runoff of agricultural lands and filter runoff from adjacent fields.
- *Reduce nutrient and agricultural pollutant inputs to streams and wetlands.* Increased retention times along with reestablished vegetation in restored wetland areas will reduce fertilizers used in blackberry and soybean agricultural production before runoff enters the streams.

Secondary project goal includes:

- *Improve instream habitat by diversifying the stream bedform and introducing habitat structures and woody debris.* Large woody debris, brush toe meander bends, other woody structures, and native stream bank vegetation were installed to improve both instream and terrestrial habitat value throughout the riparian corridor.

1.3 Project Structure, Restoration Type and Approach

The final mitigation plan was submitted and accepted by the NCDMS in April of 2014.

Following the mitigation plan approval by the IRT, the conservation easement and wetland re-establishment boundary were revised to accommodate the relocation of a power line utility from inside the project area to outside of the project area. This change to the conservation easement and wetland re-establishment boundary resulted in the reduction of approximately 0.53 acres of wetland re-establishment area. This reduction in re-establishment acreage and WMUs is included in Table 1 of this report.

Construction activities were completed in July 2015 by Land Mechanic Designs, Inc. Key Mapping and Surveying, P.A. completed the as-built survey activities in August 2015 and planting was completed by Bruton Natural Systems, Inc. in January 2016. Minimal adjustments were made during construction and field adjustments made during construction are described in further detail in section 5.1. Please refer to Appendix 1 for detailed project activity, history, contact information, and watershed/site background information.

1.3.1 Project Structure

The project is expected to provide 2,468 SMUs and 8.9 WMUs. Please refer to Figure 2 for the project component/asset map for the stream and wetland feature exhibits and Table 1 for the project component and mitigation credit information for the Site.

1.3.2 Restoration Type and Approach

The design streams were restored to the appropriate type based on the surrounding landscape, climate, and natural vegetation communities but also with thorough consideration to existing watershed conditions and trajectory. The project includes stream restoration as well as wetland rehabilitation and re-establishment. The specific proposed stream and wetland types are described below.

The stream restoration portion of this project includes three reaches on two streams:

- HC1 (Reaches 1 and 2): This restoration reach enters the Site from a forested wetland complex within the western portion of the property and extends to the confluence with Howards Creek along the southern property boundary. This reach includes one easement break for a culvert farm road crossing and the stream within this break is not included in the restoration credit total. The design includes one reach upstream of the confluence with HC2 and one downstream of the confluence with HC2; and
- HC2: This reach originates from a wetland complex and groundwater seeps within the northern portion of the Site and extends to the confluence with HC1.

The project design was developed based on reference conditions, representing streams within the Southern Piedmont Belt region with similar drainage areas, valley slopes, morphology, and bed material. The restoration reaches were designed as threshold channels. This design approach was determined to be appropriate due to the low bedload supply and the desire to establish an immobile channel boundary. The channels were not intended to be fully alluvial and are not expected to migrate laterally over time. Various types of constructed riffles were installed to provide grade control and address excess shear stress. Riffles at the Site are low-sloped, fine-grained systems and are hereafter referred to as shallows.

1.4 Project History, Contacts and Attribute Data

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

Section 2: PERFORMANCE STANDARDS

The stream and wetland performance criteria for the Site follow approved performance criteria presented in the Owl's Den Mitigation Plan (2014). Annual monitoring and semi-annual site visits will be conducted to assess the condition of the finished project. The stream restoration reaches (HC1 Reach 1, HC1 Reach 2, and HC2) of the project were assigned specific performance criteria components for stream morphology, hydrology, and vegetation. Wetland rehabilitation and re-establishment areas were assigned specific performance criteria for wetland hydrology and vegetation. Performance criteria will be evaluated throughout the seven year post-construction monitoring. If all performance criteria have been successfully met and two bankfull events have occurred during separate years, Wildlands may propose to terminate stream and/or vegetation monitoring after year five pending little to no prevalent invasive species issues. An outline of the performance criteria components follows.

2.1 Dimension

Shallow cross-sections on the restoration reaches should be stable and should show little change in bankfull area, maximum depth ratio, and width-to-depth ratio. Per NCDMS guidance, bank height ratios shall not exceed 1.2 and entrenchment ratios shall be at least 2.2 for restored channels to be considered stable. Shallow cross-sections should fall within the parameters defined for channels of the appropriate Rosgen stream type. If any changes do occur, these changes will be evaluated to assess whether the stream channel is showing signs of instability. Indicators of instability include trends in vertical incision or bank erosion. Changes in the channel that indicate a movement toward stability or enhanced habitat include a decrease in the width-to-depth ratio in meandering channels or an increase in pool depth. Remedial action would not be taken if channel changes indicate a movement toward stability.

2.1.1 Pattern and Profile

Annual longitudinal profile surveys will not be conducted during the seven year monitoring period unless other indicators during the annual monitoring indicate a trend toward vertical and lateral instability. If a longitudinal profile is deemed necessary, monitoring will follow standards as described in the NCDMS Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation (11/7/2011) and the 2003 USACE and NCDWR Stream Mitigation Guidance for the necessary reaches. A longitudinal profile was conducted as part of the as-built survey to provide a baseline for comparison should it become necessary to perform longitudinal profile surveys later during monitoring and to insure accordance with design plans.

2.1.2 Substrate

Because the streams through the project site are dominated by sand and silt-size particles, pebble count and/or bulk sampling procedures would not show a significant change in bed material size or distribution over the monitoring period; therefore, bed material analyses will not be conducted for this project. Channel substrate distribution will not be a component of project success criteria.

2.1.3 Photo Documentation

Photographs should illustrate the Site's vegetation and morphological stability on an annual basis. Cross-section photos should demonstrate no excessive erosion or degradation of the banks. Longitudinal photos should indicate the absence of persistent bars within the channel or vertical incision. Grade control

structures should remain stable. Deposition of sediment on the bank side of vane arms is preferable. Maintenance of scour pools on the channel side of vane arms is expected.

2.1.4 Bankfull Documentation

Two bankfull flow events must be documented on the restoration reaches within the seven-year monitoring period. The two bankfull events must occur in separate years. Stream monitoring will continue until success criteria in the form of two bankfull events in separate years have been documented. Bankfull events will be documented using submerged pressure transducers, crest gages, photographs, and visual assessments such as debris lines.

2.2 Vegetation

The final vegetative success criteria will be the survival of 210 planted stems per acre in the planted riparian and wetland corridor at the end of the required monitoring period (MY7). The interim measure of vegetative success for the Site will be the survival of at least 320 planted stems per acre at the end of the third monitoring year and at least 260 stems per acre at the end of the fifth year of monitoring. Planted vegetation must average 10 feet in height in each plot at the end of the seventh year of monitoring. If this performance standard is met by MY5 and stem density is trending towards success (i.e., vigor), monitoring of vegetation on the Site may be terminated provided written approval is provided by the USACE in consultation with the NC Interagency Review Team. The extent of invasive species coverage will also be monitored and controlled as necessary throughout the required monitoring period (seven years).

2.3 Wetlands

The final performance standard for wetland hydrology will be a free groundwater surface within 12 inches of the ground surface for 18 consecutive days (8.1 percent) of the defined 222 day growing season for Lincoln County (March 28 through November 4) under typical precipitation conditions. This performance standard was determined through model simulations of post restoration conditions and comparison to reference wetland systems. If a particular gage does not meet the performance standard for a given monitoring year, rainfall patterns will be analyzed and the hydrograph will be compared to that of the reference wetlands to assess whether atypical weather conditions occurred during the monitoring period.

2.4 Schedule and Reporting

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

- Project background which includes project objectives, project structure, restoration type and approach, location and setting, history and background;
- As-built topographic plans of major project elements including such items as grade control structures, vegetation plots, permanent cross-sections, crest gages, and pressure transducers;
- Photographs showing views of the restored Site taken from fixed point stations;
- Assessment of the stability of the stream based on the cross-sections;
- Vegetative data as described above including the identification of any invasion by undesirable plant species;

- Groundwater gage attainment;
- A description of damage by animals or vandalism;
- Maintenance issues and recommended remediation measures will be detailed and documented; and
- Wildlife observations.

Section 3: MONITORING PLAN

Monitoring will consist of collecting morphological, vegetative, and hydrological data to assess the project success based on the restoration goals and objectives on an annual basis or until success criteria is met. The success of the project will be assessed using measurements of the stream channel's dimension, substrate composition, permanent photographs, vegetation, surface water hydrology, and groundwater hydrology. Any areas with identified high priority problems, such as streambank instability, aggradation/degradation, insufficient groundwater hydroperiod, or lack of vegetation establishment will be evaluated on a case-by-case basis. The problem areas will be visually noted and remedial actions will be discussed with NCDMS staff to determine a plan of action. Refer to Table 5 in Appendix 1 for monitoring component summary.

3.1 Stream

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

3.1.1 Dimension

In order to monitor the channel dimension, 13 permanent cross-sections were installed along the stream restoration reaches. One cross section was installed per 20 bankfull widths along the stream restoration reaches, with shallow and pool sections in proportion to NCDMS guidance. Each cross-section is permanently marked with rebar installed in concrete and 1/2 inch PVC pipes. Cross-section surveys include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg. If moderate bank erosion is observed at a stream reach during the monitoring period, an array of bank pins will be installed in representative areas where erosion is occurring for reaches with a bankfull width of greater than three feet. Bank pins will be installed in at least three locations (one in upper third of the pool, one at the mid-point of the pool, and one in the lower third of the pool). Bank pins will be monitored by measuring exposed rebar and maintaining pins flush to bank to capture bank erosion progression. Annual cross section and bank pin survey (if applicable) will be conducted in monitoring years one (MY1), two (MY2), three (MY3), five (MY5), and seven (MY7). Photographs will be taken annually of the cross sections looking upstream and downstream.

3.1.2 Pattern and Profile

Longitudinal profile surveys will not be conducted during the seven year monitoring period unless other indicators during the annual monitoring indicate a trend toward vertical and lateral instability. If a longitudinal profile is deemed necessary, monitoring will follow standards as described in the NCDMS Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation (11/7/2011) and the 2003 USACE and NCDWR Stream Mitigation Guidance for the necessary reaches. Stream pattern and profile will be assessed visually as described below in Section 3.1.6.

3.1.3 Substrate

Because the streams through the project site are dominated by sand and silt-size particles, pebble count and/or bulk sampling procedures would not show a significant change in bed material size or distribution over the monitoring period; therefore, bed material analyses will not be conducted for this project.

3.1.4 Photo Reference Points

A total of 14 permanent photograph reference points were established along the stream reaches after construction. Permanent markers were established so that the same locations and view directions on the Site are photographed each year. Longitudinal stream photographs will be taken looking upstream and downstream once a year to visually document stability. Cross-sectional photos will be taken at each permanent cross-section looking upstream and downstream. Representative digital photos of each permanent photo point will be taken on the same day the stream assessments are conducted. The photographer will make every effort to consistently maintain the same area in each photo over time.

3.1.5 Hydrology Documentation

Bankfull events will be documented using crest gages, pressure transducers, photographs, and visual assessments such as debris lines. Two hydrology monitoring stations with crest gages and pressure transducers were installed; one on HC1 Reach 2 and one on HC2. The gages were installed within a surveyed shallow cross-section of the restored channels. The gages will be checked at each site visit to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition. Additionally, the pressure transducer data will be plotted and included in the annual monitoring reports.

3.1.6 Visual Assessment

Visual assessments will be performed along all stream and wetland areas on a semi-annual basis during the seven year monitoring period. Problem areas will be noted such as channel instability (i.e. lateral and/or vertical instability, in-stream structure failure/instability and/or piping, headcuts), vegetated health (i.e. low stem density, vegetation mortality, invasive species or encroachment), beaver activity, or livestock access. Areas of concern will be mapped, photographed, and described through a written description in the annual report. Problem areas will be re-evaluated during each subsequent visual assessment. Should remedial actions be required, recommendations will be provided in the annual monitoring report.

3.2 Vegetation

Planted woody vegetation will be monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2006) to monitor and assess the planted woody vegetation. A total of 13 vegetation plots were established within the project easement area. All of the plots were established as standard 10 meter by 10 meter squares. Please refer to Figure 3 in Appendix 1 for the vegetation monitoring locations.

Vegetation plots were randomly established within the planted stream and wetland restoration areas to capture the heterogeneity of the designed vegetative communities. The vegetation plot corners have been marked and are recoverable either through field identification or with the use of a GPS unit. Reference photographs at the origin looking diagonally across the plot to the opposite corner were taken during the baseline monitoring in January 2016. Subsequent annual assessments following baseline survey will capture the same reference photograph locations. Species composition, density and survival rates will

be evaluated on an annual basis by plot and for the entire Site. Individual plot data will be provided and will include diameter, height, density, vigor, damage (if any), and percent survival. Planted woody stems will be marked annually as needed based off of a known origin so they can be found in succeeding monitoring years. Mortality will be determined from the difference between the baseline year's living planted stems and the current year's living planted stems.

3.3 Wetland

In order to monitor the wetland rehabilitation and re-establish areas, 13 groundwater hydrology pressure transducers were established at the Site. An additional gage was established in an adjacent reference wetland and will be utilized to compare the hydrologic response within the restored wetland areas at the Site. All gages were set to record the ground water level two times per day. An onsite rain gage will record daily rainfall and will be utilized to assess whether typical weather conditions occurred during the monitoring period. If a particular gage does not meet the performance standard for a given monitoring year, rainfall patterns will be analyzed and the hydrograph will be compared to that of the reference wetlands to assess whether atypical weather conditions occurred during the monitoring period. Permanent photograph reference points were established at 6 locations within the wetland areas. Permanent markers were established so that the same locations and view directions on the Site are photographed each year. Please refer to Figure 3 in Appendix 1 for the hydrological monitoring and photo station locations.

Section 4: MAINTENANCE AND CONTINGENCY PLAN

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

4.1 Stream

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

4.2 Vegetation

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

4.3 Wetlands

Wetland problem areas will be mapped and included in the CCPV as part of the annual wetland assessment. Wetland problems areas may include planted vegetation not meeting success criteria, persistent invasive species, barren areas with little to no herbaceous cover, grass suffocation/crowding of planted stems, or wetland hydrology not meeting success criteria. Routine wetland maintenance and repair activities may include supplemental installations of target vegetation within the wetland. Areas where storm water and floodplain flows intercept the wetland may also require maintenance to prevent scour.

4.4 Site Boundary

Site boundary issues will be mapped and included in the CCPV as part of the annual visual assessment. Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, tree-blazing, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis.

Section 5: AS-BUILT CONDITION (BASELINE)

The Site construction and as-built surveys were completed in August 2015. The survey included developing an as-built topographic surface, locating the channel boundaries, structures, and cross-sections. For comparison purposes, during the baseline assessments, reaches were divided into assessment reaches in the same way that they were established for design parameters: HC1 Reaches 1 and 2 and HC2.

5.1 Record Drawings

A sealed half-size record drawing is located in Appendix 5 that includes redlines for any significant field adjustments made during construction that were different from the design plans. Minor stream adjustments made during construction were associated with instream habitat improvement and erosion prevention measures. Plantings within the already vegetated wetland rehabilitation areas were limited to those areas with insufficient native woody trees. Specific changes are detailed below:

5.1.1 HC1 Reach 1

- Station 106+35 to Station 106+50 brush added to shallow.

5.1.2 HC1 Reach 2

- Station 109+85 a grassed swale was added to improve hydrologic connectivity with the stream channel;
- Station 111+00 to 111+73 bed was raised to accommodate log vane placement;
- Station 112+25 added a constructed shallow;
- Station 114+50 lunker log moved downstream;
- Station 115+25 riprap material added to culvert inlet to prevent scour;
- Station 115+50 additional riprap added to end of stream crossing to prevent bank scour in the event of overflow events; and
- Station 116+00 installed log vane and toe vane to protect bank at culvert outlet.

5.1.3 HC2

- Station 200+10 added a constructed shallow;
- Station 202+50 rock substrate added to constructed shallow;
- Station 203+40 lunker log moved downstream;
- Station 205+05 rock substrate added to constructed shallow; and
- Station 205+25 brush toe added to provide bank protection and improve habitat.

5.2 Baseline Data Assessment

Baseline monitoring (MY0) was conducted in July and August 2015 with the vegetation data collection occurring in January 2016 immediately following planting. The first annual monitoring assessment (MY1)

will be completed in the fall of 2016. The streams and wetlands will be monitored for a total of seven years, with the final monitoring activities to be conducted in 2022. The close-out for the Site will be conducted in 2023 given the success criteria is met. As part of the closeout process, NCDMS will evaluate the Site at the end of the fourth year monitoring period to determine whether or not the site is eligible to closeout following MY5. If the Site is meeting success criteria, NCDMS will propose to the Interagency Review Team (IRT) to proceed with the closeout process. If the Site is not meeting success criteria, then an additional two years of monitoring will be conducted by Wildlands.

5.2.1 Morphological State of the Channel

Morphological data for the as-built profile was collected in July and August 2015. Please refer to Appendix 2 for summary data tables, morphological plots, and stream photographs.

Profile

The baseline (MY0) profiles closely match the profile design parameters. On the design profiles, shallows were depicted as straight lines with consistent slopes. However, at some locations the as-built survey shallow profiles are not consistent in slope due to natural deposition and scour within some shallow reaches. Additionally, maximum pool depths typically exceed design parameters and are expected to trend towards the design depths as a result of natural deposition over time. These variations in shallow slope and pool depths do not constitute a problem or indicate a need for remedial actions and will be assessed visually during the CCPV site walks.

Dimension

The baseline (MY0) dimension numbers closely match the design parameters with minor variations in all reaches. These occasional variations are primarily due to a larger as-built bankfull width constructed on HC1 and larger as-built max depths on HC2 as reflected in the cross sections. Bankfull widths were increased to accommodate sod mat plantings and the effect of channel narrowing over time. An inner berm feature was designed on HC1 Reach 2 which resulted in a width to depth ratio in the upper range. A width to depth ratio in the 10 to 14 range is the delineating line between the C and E stream type. We expect that over time as vegetation is established, the channels may narrow more toward dimensions characteristic of an E channel. This narrowing over time would not be seen as an indicator of instability in and of itself.

Pattern

The baseline (MY0) pattern metrics fell within acceptable ranges of the design parameters for all three reaches. Pattern data will be evaluated in MY5 if there are any indicators through the profile or dimension assessments that significant geomorphic adjustments have occurred.

Sediment Transport

While a sediment transport analysis was performed for the restoration reaches, bed particles are easily mobilized at flows near and often well below bankfull in sand bed channels (Knighton, 1998) so competence is assumed and only capacity was analyzed. Based on the watershed assessments conducted and the grade control structures implemented during construction, the stream channel aggradation and degradation is not expected.

Visual assessments will be conducted during the annual monitoring efforts and areas of aggradation and/or degradation will be reported in the annual monitoring reports.

Bankfull Events

Bankfull events recorded following completion of constructions will be reported in the Year 1 monitoring report.

5.2.2 Vegetation

The baseline (MY0) planted density is 647 stems/acre, which exceeds the interim measure of vegetative success of at least 320 planted stems per acre at the end of the third monitoring year. Summary data and photographs of each plot can be found in Appendix 3.

5.2.3 Wetlands

Wetland photos collected at the permanent photo points during the baseline (MY0) data collection efforts can be found in Appendix 5. Groundwater gage data will be reported in the annual monitoring reports.

Section 6: REFERENCES

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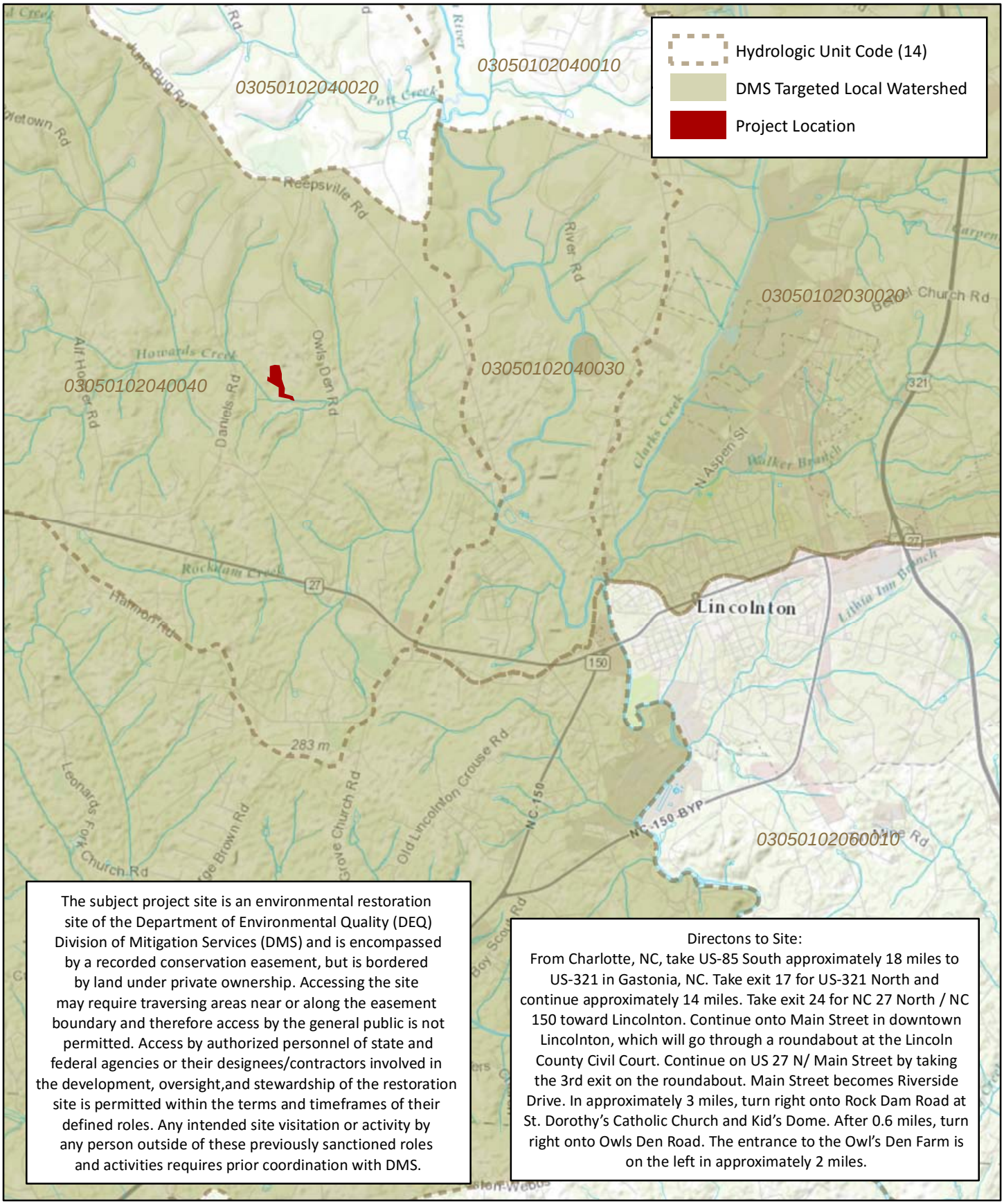
APPENDIX 1. General Figures and Tables



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

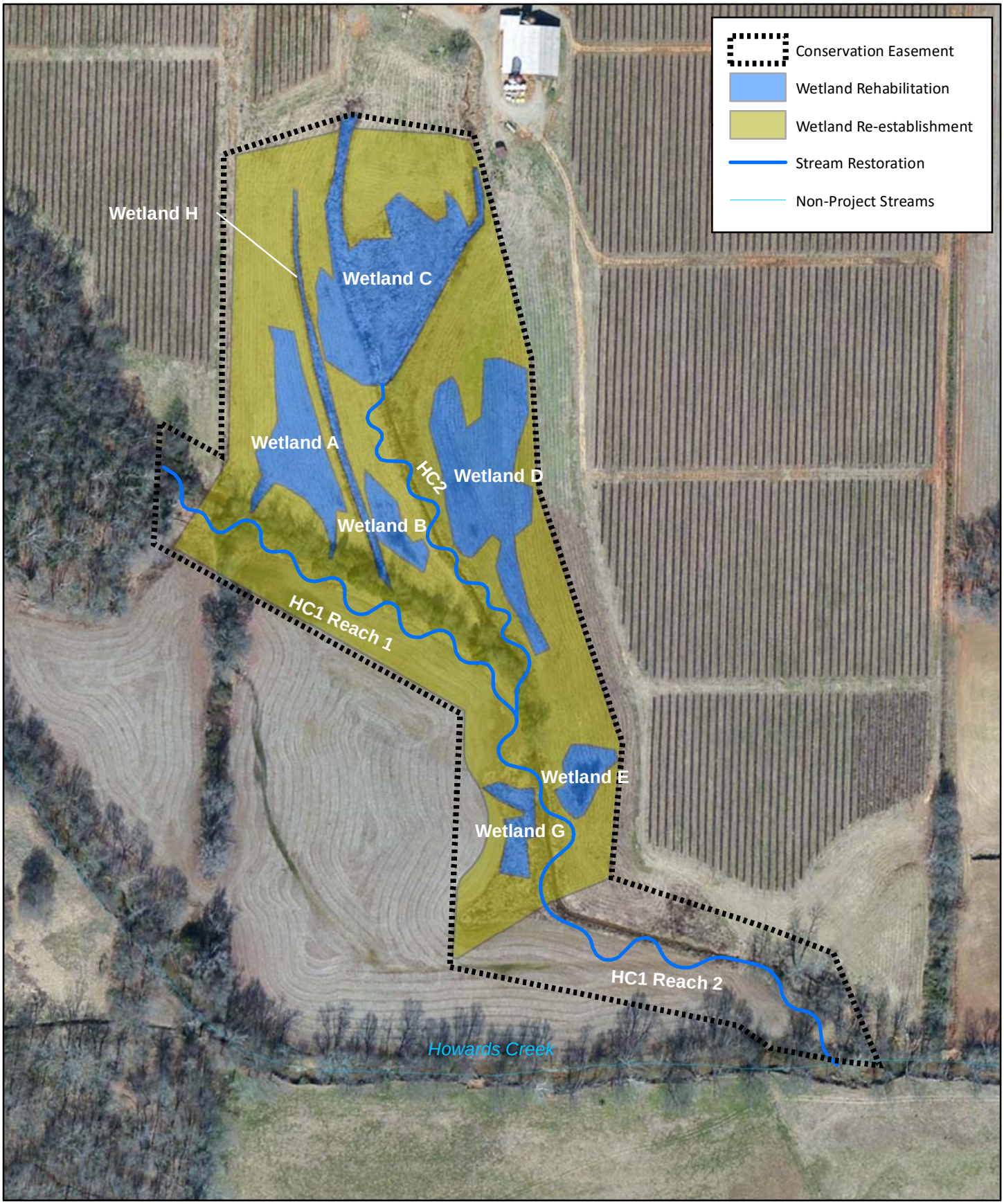
Directons to Site:
From Charlotte, NC, take US-85 South approximately 18 miles to US-321 in Gastonia, NC. Take exit 17 for US-321 North and continue approximately 14 miles. Take exit 24 for NC 27 North / NC 150 toward Lincolnton. Continue onto Main Street in downtown Lincolnton, which will go through a roundabout at the Lincoln County Civil Court. Continue on US 27 N/ Main Street by taking the 3rd exit on the roundabout. Main Street becomes Riverside Drive. In approximately 3 miles, turn right onto Rock Dam Road at St. Dorothy's Catholic Church and Kid's Dome. After 0.6 miles, turn right onto Owls Den Road. The entrance to the Owl's Den Farm is on the left in approximately 2 miles.

WILDLANDS ENGINEERING

0 0.5 1 Miles

N

Figure 1 Project Vicinity Map
Owl's Den Mitigation Site
DMS Project No. 95808
Monitoring Year 0 - 2015
Lincoln County, NC



WILDLANDS ENGINEERING

0 100 200 Feet

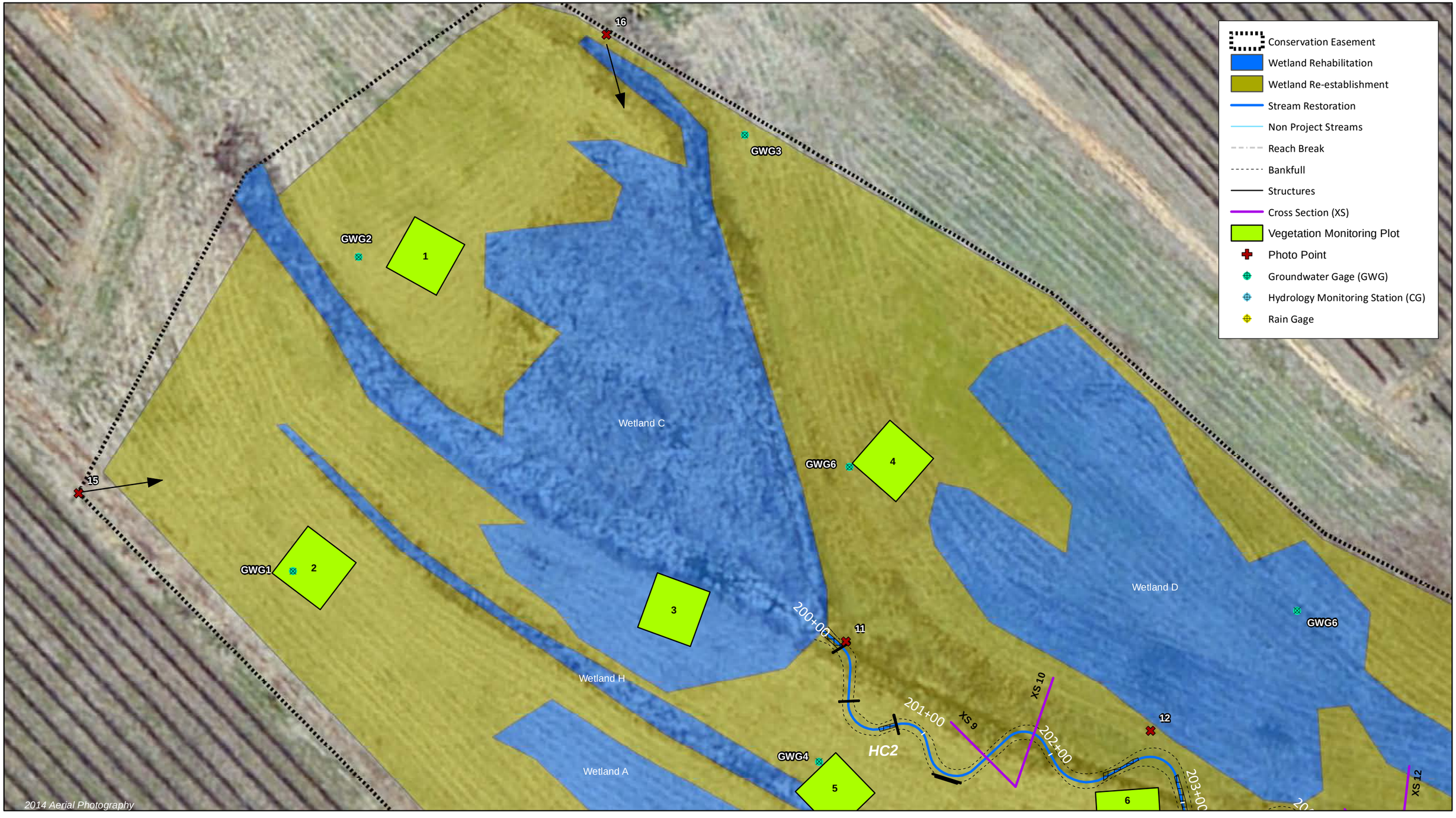
N

Figure 2 Project Component/Asset Map
Owl's Den Mitigation Site
DMS Project No. 95808
Monitoring Year 0 - 2015
Lincoln County, NC

WILDLANDS ENGINEERING

0 75 150 Feet

Figure 3.0 Monitoring Plan View (Key)
Owl's Den Mitigation Site
DMS Project No. 95808
Monitoring Year 0 - 2015
Lincoln County, NC



WILDLANDS ENGINEERING

0 25 50 Feet

Figure 3.1 Monitoring Plan View (Sheet 1 of 3)
Owl's Den Mitigation Site
DMS Project No. 95808
Monitoring Year 0 - 2015
Lincoln County, NC

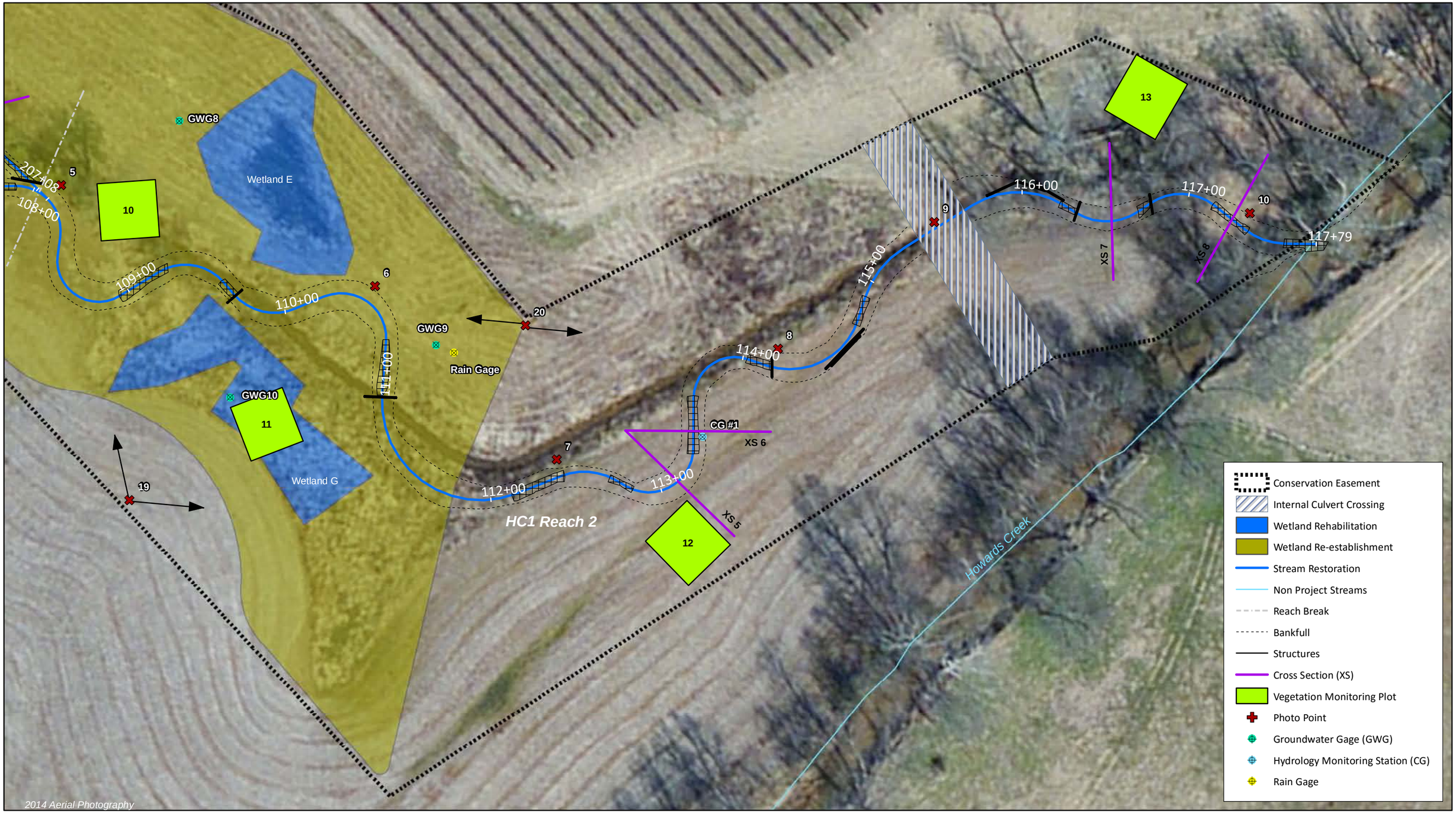
Conservation Easement
Wetland Rehabilitation
Wetland Re-establishment
Stream Restoration
Non Project Streams
Reach Break
Bankfull
Structures
Cross Section (XS)
Vegetation Monitoring Plot
Photo Point
Groundwater Gage (GWG)
Reference Gage
Hydrology Monitoring Station (CG)
Rain Gage

HC1 Reach 1
HC1 Reach 2
HC2
Wetland A
Wetland B
Wetland D
Wetland E
Wetland G
Wetland H
GWG4
GWG6
GWG7
GWG8
GWG10
GWG11
GWG12
GWG13
CG #2
Reference Gage
100+00
101+00
102+00
103+00
104+00
105+00
106+00
107+00
108+00
109+00
200+00
201+00
202+00
203+00
204+00
205+00
206+00
207+00
XS 1
XS 2
XS 3
XS 4
XS 9
XS 10
XS 11
XS 12
XS 13
1
2
3
4
5
10
11
12
13
14
17
18
19
2014 Aerial Photography

WILDLANDS ENGINEERING

0 25 50 Feet

Figure 3.2 Monitoring Plan View (Sheet 2 of 3)
Owl's Den Mitigation Site
DMS Project No. 95808
Monitoring Year 0 - 2015
Lincoln County, NC



WILDLANDS ENGINEERING

0 25 50 Feet

Figure 3.3 Monitoring Plan View (Sheet 3 of 3)
Owl's Den Mitigation Site
DMS Project No. 95808
Monitoring Year 0 - 2015
Lincoln County, NC

Table 1. Project Components and Mitigation Credits
Owl's Den Mitigation Site (NCDMS Project No.95808)
Monitoring Year 0 - 2015

MITIGATION CREDITS

	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	2,468	0	8.94	0	N/A	N/A	N/A	N/A	N/A

PROJECT COMPONENTS

Reach ID	As-Built Stationing/ Location	Existing Footage/ Acreage	Approach	Restoration or Restoration Equivalent	Restoration Footage/ Acreage	Mitigation Ratio	Credits (SMU/ WMU)
STREAMS							
HC1 Reach 1	99+89 - 108+09	609	P1	Restoration	820	1:1	820
HC1 Reach 2	108+09 - 115+36	994	P1	Restoration	727	1:1	727
	115+66 - 117+79		P1	Restoration	213	1:1	213
HC2	200+00 - 207+08	444	P1	Restoration	708	1:1	708
WETLANDS							
Wetland A	N/A	0.44	Significant improvement to wetland functions	Rehabilitation	0.44	1.3:1	0.34
Wetland B	N/A	0.13	Significant improvement to wetland functions	Rehabilitation	0.13	1.3:1	0.10
Wetland C	N/A	1.03	Significant improvement to wetland functions	Rehabilitation	1.03	1.3:1	0.79
Wetland D	N/A	0.81	Significant improvement to wetland functions	Rehabilitation	0.81	1.3:1	0.62
Wetland E	N/A	0.13	Significant improvement to wetland functions	Rehabilitation	0.13	1.3:1	0.10
Wetland G	N/A	0.13	Significant improvement to wetland functions	Rehabilitation	0.13	1.3:1	0.10
Wetland H	N/A	0.15	Significant improvement to wetland functions	Rehabilitation	0.15	1.3:1	0.11
Wetland Re-Establishment Area	N/A	n/a	Planting, hydrologic improvement	Re-Establishment	6.77	1:1	6.77

COMPONENT SUMMATION

Restoration Level	Stream (LF)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	2,468	-	-	-	-	-
Enhancement		-	-	-	-	-
Enhancement I	-					
Enhancement II	-					
Wetland Re-Establishment		6.77	-	-		
Wetland Rehabilitation	-	2.82	-	-		-

The 30 linear feet associated with the stream crossing on HC1 Reach 2 were excluded from the computations.

Table 2. Project Activity and Reporting History
Owl's Den Mitigation Site (NCDMS Project No.95808)
Monitoring Year 0 - 2015

Activity or Report	Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	July 2013	April 2014
Final Design - Construction Plans	March 2015	April 2015
Construction	May 2015 - July 2015	July 2015
Temporary S&E mix applied to entire project area [1]	May 2015 - July 2015	July 2015
Permanent seed mix applied to reach/segments	June 2015	July 2015
Bare root and live stake plantings for reach/segments	January 2016	January 2016
Baseline Monitoring Document (Year 0)	July 2015 - January 2016	February 2016
Year 1 Monitoring	2016	December 2016
Year 2 Monitoring	2017	December 2017
Year 3 Monitoring	2018	December 2018
Year 4 Monitoring	2019	December 2019
Year 5 Monitoring	2020	December 2020
Year 6 Monitoring	2021	December 2021
Year 7 Monitoring	2022	December 2022

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

Table 3. Project Contact Table
Owl's Den Mitigation Site (NCDMS Project No.95808)
Monitoring Year 0 - 2015

Designer Emily Reinicker, PE	**Wildlands Engineering, Inc.** 1430 South Mint Street, Suite 104 Charlotte, NC 28203 704.332.7754
Construction Contractor	**Land Mechanic Designs, Inc.** 126 Circle G Lane Willow Spring, NC 27592
Planting Contractor	**Bruton Natural Systems, Inc** P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	**Land Mechanic Designs, Inc.** 126 Circle G Lane Willow Spring, NC 27592
Seed Mix Sources	**Green Resource, LLC**
Nursery Stock Suppliers **Bare Roots** **Live Stakes**	**Bruton Natural Systems, Inc**
Monitoring Performers	**Wildlands Engineering, Inc.**
Monitoring, POC	Kirsten Gimbert 704.332.7754, ext. 110

Table 4. Project Information and Attributes
Owl's Den Mitigation Site (NCDMS Project No.95808)
Monitoring Year 0 - 2015

PROJECT INFORMATION			
Project Name	Owl's Den Mitigation Site		
County	Lincoln County		
Project Area (acres)	12.87		
Project Coordinates (latitude and longitude)	35°29'33.22" N, 81° 18'45.95" W		
PROJECT WATERSHED SUMMARY INFORMATION			
Physiographic Province	Inner Piedmont Belt of the Piedmont Physiographic Province		
River Basin	Catawba		
USGS Hydrologic Unit 8-digit	03050102		
USGS Hydrologic Unit 14-digit	03050102040040		
DWR Sub-basin	03-08-35		
Project Drainiage Area (acres)	152		
Project Drainage Area Percentage of Impervious Area	<1%		
CGIA Land Use Classification	93% – Agriculture/Managed Herbaceous; 7% – Forested/Scrubland		
REACH SUMMARY INFORMATION			
Parameters	**HC1 Reach 1**	**HC1 Reach 2**	**HC2**
Length of reach (linear feet) - Post-Restoration	820	940	708
Drainage area (acres)	62	152	27
NCDWR stream identification score	31.5	37.5	31.5
NCDWR Water Quality Classification	C		
Morphological Desription (stream type)	P	P	P
Evolutionary trend (Simon's Model) - Pre- Restoration	IV	IV	IV
Underlying mapped soils	Chewacla Loam, Helena sandy loam, Riverview loam, Worsham fine sandy loam		
Drainage class	---	---	---
Soil hydric status	---	---	---
Slope	0.0061	0.0075	0.0059
FEMA classification	AE*		
Native vegetation community	Piedmont Bottomland Forest		
Percent composition exotic invasive vegetation -Post-Restoration	0%		
REGULATORY CONSIDERATIONS			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States - Section 404	X	X	USACE Nationwide Permit No.27 (Action ID# SAW-2013-00717) and DWQ 401 Water Quality Certification No. 3885.
Waters of the United States - Section 401	X	X	
Division of Land Quality (Dam Safety)	N/A	N/A	N/A
Endangered Species Act	X	X	Owl's Den Mitigation Plan; Wildlands determined "no effect" on Lincoln County listed endangered species. May 18, 2015 email correspondence from USFWS indicating no effect on the northern long-eared bat.
Historic Preservation Act	X	X	No historic resources were found to be impacted (letter from SHPO dated 4/30/2013).
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A
FEMA Floodplain Compliance	X	X	Floodplain development permit issued by Lincoln County.
Essential Fisheries Habitat	No	N/A	N/A

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

Table 5. Monitoring Component Summary
Owl's Den Mitigation Site (NCDMS Project No.95808)
Monitoring Year 0 - 2015

Parameter	Monitoring Feature	Quantity/ Length by Reach					Frequency
		HC1 Reach 1	HC1 Reach 2	HC2	Wetland Rehabilitation	Wetland Re-Establishment	
Dimension	Riffle Cross Sections	2	2	3	N/A	N/A	Years 1, 2, 3, 5, and 7
	Pool Cross Section	2	2	2	N/A	N/A	
Pattern	Pattern	N/A	N/A	N/A	N/A	N/A	N/A
Profile	Longitudinal Profile	N/A	N/A	N/A	N/A	N/A	N/A
Substrate	Reach Wide / Shallow 100 Pebble Count	N/A	N/A	N/A	N/A	N/A	N/A
Hydrology	Crest Gage	1		1	N/A	N/A	Quarterly
Hydrology	Groundwater Gages	N/A	N/A	N/A	3	10	Quarterly
Vegetation	Vegetation Plots	13					Years 1, 2, 3, 5, and 7
Visual Assessment	All Streams	Y	Y	Y	Y	Y	Semi-Annual
Exotic and nuisance vegetation							Annual
Project Boundary							Annual
Reference Photos	Photos	14			6		Annual

APPENDIX 2. Morphological Summary Data and Plots

Table 6a. Baseline Stream Data Summary
Owl's Den Mitigation Site (NCDMS Project No.95808)
Monitoring Year 0 - 2015

Owl's Den-HC1 Reaches 1 and 2

		PRE-RESTORATION CONDITION				REFERENCE REACH DATA										DESIGN				AS-BUILT/BASELINE			
Parameter	**Gage**	**HC1 Reach 1**		**HC1 Reach 2**		**Vile Preserve**		**UT to Lyle Creek**		**UT to Catawba River**		**UT to Lake Wheeler**		**Westbrook Lowlands**		**HC1 Reach 1**		**HC1 Reach 2**		**HC1 Reach 1**		**HC1 Reach 2**	
		Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Shallow																							
Bankfull Width (ft)		8.9	10.4	5.4	12.7	4.5	6.2	15.2		13.8		10.6		9.7		9.0		13.0		8.9	10.7	11.8	13.9
Floodprone Width (ft)		11	25	15	181	200+		38+		53+		N/A[1]		100+		23	46	31	130	200+		60	200+
Bankfull Mean Depth		0.5	0.8	0.8	1.5	0.9		0.5		1.5		1.6		0.8		0.7		0.8		0.6	0.7	0.8	0.9
Bankfull Max Depth		0.9	1.3	1.0	2.4	1.4		1.4		2.0		2.2		1.1		1.1		1.2		1.2	1.3	1.3	1.6
Bankfull Cross-sectional Area (ft^2)	N/A	2.7	7.2	7.9	9.7	4.5	5.3	7.3		20.8		17.4		8.0		6.2		9.8		6.1		10.3	10.5
Width/Depth Ratio		10.9	19.1	3.7	16.6	4.5	7.4	31.7		9.1		6.5		12.0		13.2		17.2		13.0	19.0	13.4	18.5
Entrenchment Ratio		1.1	2.8	1.2	16.1	30+		2.5+		5.8+		15.7		2.2+		2.6	5.1	2.4	10.0	19+		4.4	17+
Bank Height Ratio		1.9	2.2	1.7	5.1	1.0		1.0		1.0		N/A[1]		1.0		1.0		1.0		1.0		1.0	
D50 (mm)		0.206																					
Shallow Length (ft)						---		---		---		---		---		---		---		8.2	25.4	7.9	32.5
Shallow Slope (ft/ft)		0.0094		0.0005	0.0053	0.0063		0.0055	0.0597	0.0110	0.0600	0.0430		N/A[2]		0.0022	0.0130	0.0022	0.0130	0.0004	0.0193	0.0023	0.0227
Pool Length (ft)	N/A					---		---		---		---		---		---		---		18.8	62.2	21.5	69.9
Pool Max Depth (ft)		1.3		1.3		1.4		1.7		2.9		1.4		1.5		1.0	1.4	1.1	1.5	1.2	2.2	2.0	3.4
Pool Spacing (ft)		83	165	100	215	45		15	28	31	60	42		16	59	14	90	21	130	32	74	36	91
Pool Volume (ft^3)																							
Pattern																							
Channel Beltwidth (ft)		N/A		N/A		19		21		55		26	64	14	20	16	38	23	55	21	45	17	62
Radius of Curvature (ft)		N/A		N/A		27	50	19	32	31	56	8	34	15	27	16	41	23	59	16	27	22	50
Rc:Bankfull Width (ft/ft)	N/A	N/A		N/A		4.5	8.1	1.3	2.1	2.2	4.1	0.8	3.2	1.5	2.8	1.8	4.5	1.8	4.5	1.5	3.0	1.6	4.2
Meander Length (ft)		N/A		N/A		29	45	39	44	65	107	40	191	50		38	66	55	95	58	92	82	155
Meander Width Ratio		N/A		N/A		3.1	4.2	1.3		4.0		6.0	11.0	1.4	2.1	1.8	4.2	1.8	4.2	1.9	5.1	1.2	5.3
Substrate, Bed and Transport Parameters																							
Ri%/Ru%/P%/G%/S%																							
SC%/Sa%/G%/C%/B%/Be%																							
d16/d35/d50/d84/d95/d100	N/A	0.0062 / 0.089 / 0.206 / 0.790 / 1.5 / 4.8				0.2/0.3/0.4/0.9/2.0/9.0		-/0.1/0.2/0.5/4.0/8.0		0.3/0.4/1.8/12.8/25/90		d_{50} : 2.6		d_{50} : 0.7						N/A		N/A	
Reach Shear Stress (Competency) lb/ft^2		0.11	0.18	0.14	0.15											---		---		0.07	0.09	0.13	0.15
Max part size (mm) mobilized at bankfull																							
Stream Power (Capacity) W/m^2																1.8		2.6		1.8		2.6	
Additional Reach Parameters																							
Drainage Area (SM)		0.10		0.24		1.09		0.25		1.60		0.40		0.90		0.10		0.24		0.10		0.24	
Watershed Impervious Cover Estimate (%)		<1%		<1%		---		---		---		---		---		<1%		<1%		<1%		<1%	
Rosgen Classification		Modified G5c		Modified C5		E5		C5		E5		E4		E/C5		C/E		C/E		C5		C5	
Bankfull Velocity (fps)		1.3	1.6	1.5	1.8	2.5		1.9		3.5		N/A[1]		N/A[2]		1.4		1.6		1.3		1.3	1.4
Bankfull Discharge (cfs)		8		14		12		14		73		N/A[3]		N/A[2]		8		14		8		14	
Q-NFF regression (2-yr)		35		62																			
Q-USGS extrapolation (1.2-yr)	N/A	4		8																			
Q-Mannings		---		---																			
Valley Length (ft)		---		---		---		---		---		---		---		---		---		601		797	
Channel Thalweg Length (ft)		609		994		---		---		---		---		---		815		940		820		940	
Sinuosity		1.0		1.0		1.1		1.7		1.3		1.6		1.2		1.1	1.3	1.1	1.3	1.4		1.2	
Water Surface Slope ($ft/ft)^2$		---		---		---		---		---		---		---		0.0020		0.0020		0.0023		0.0031	
Bankfull Slope (ft/ft)		---		---		---		---		---		---		---		0.0020		0.0020		0.0021	0.0026	0.0026	0.0029

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable
N/A[1]: Data not provided in reference reach report (Lowther, 2008)
N/A[2]: Data not provided in Neu-Con Umbrella Wetland and Stream Mitigation Bank Westbrook Lowgrounds Site Specific Mitigation Plan (Environmental Banc Exchange, 2002)
N/A[3]: Lowther reported a range of possible discharges from 46.8 to 108.9 cfs based on different Mannings 'n' estimation techniques (Lowther, 2008)

Table 6b. Baseline Stream Data Summary
Owl's Den Mitigation Site (NCDMS Project No.95808)
Monitoring Year 0 - 2015

Owl's Den-HC2

		PRE-RESTORATION CONDITION		REFERENCE REACH DATA	DESIGN		AS-BUILT/BASELINE	
Parameter	**Gage**	**HC2**		**See Table 5a.**	**HC2**		**HC2**	
		Min	**Max**		**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle								
Bankfull Width (ft)	N/A	5.4	8.9	See Table 6a.	6.5		6.8	8.8
Floodprone Width (ft)		9	14		35	110	200+	
Bankfull Mean Depth		0.4	0.5		0.5		0.3	0.5
Bankfull Max Depth		0.8	0.9		0.8		0.8	1.0
Bankfull Cross-sectional Area (ft^2)		2.9	3.5		3.3		2.1	3.8
Width/Depth Ratio		10.0	22.3		13.2		16.1	21.5
Entrenchment Ratio		1.6			5.4	16.9	23+	30+
Bank Height Ratio		3.3	4.1		1.0		1.0	
D50 (mm)		0.047						
Profile								
Shallow Length (ft)	N/A			See Table 6a.	---		8.5	26.7
Shallow Slope (ft/ft)		0.0046	0.0120		0.0053	0.0160	0.0044	0.0294
Pool Length (ft)					---		10.6	48.7
Pool Max Depth (ft)		N/A			0.7	1.0	1.0	2.0
Pool Spacing (ft)		90	148		10	65	29	72
Pool Volume (ft^3)								
Pattern								
Channel Beltwidth (ft)	N/A	N/A		See Table 6a.	12	27	16	41
Radius of Curvature (ft)		N/A			12	29	11	26
Rc:Bankfull Width (ft/ft)		N/A			1.8	4.5	1.3	3.8
Meander Length (ft)		N/A			27	48	46	80
Meander Width Ratio		N/A			1.8	4.2	1.8	6.0
Substrate, Bed and Transport Parameters								
Ri%/Ru%/P%/G%/S%	N/A			See Table 6a.				
SC%/Sa%/G%/C%/B%/Be%								
d16/d35/d50/d84/d95/d100		0.002/0.012/0.05/0.26/0.43/5					N/A	
Reach Shear Stress (Competency) lb/ft^2		---			---		0.11	0.15
Max part size (mm) mobilized at bankfull								
Stream Power (Capacity) W/m^2					3.6		3.6	
Additional Reach Parameters								
Drainage Area (SM)	N/A	0.04		See Table 6a.	0.04		0.04	
Watershed Impervious Cover Estimate (%)		<1%			<1%		<1%	
Rosgen Classification		Modified G6c			C/E		C5	
Bankfull Velocity (fps)		1.4	1.7		1.6		1.3	2.4
Bankfull Discharge (cfs)		5			5		5	
Q-NFF regression (2-yr)		20						
Q-USGS extrapolation (1.2-yr)		2						
Q-Mannings		---						
Valley Length (ft)		---			---		574	
Channel Thalweg Length (ft)		444			698		708	
Sinuosity		1.0			1.1	1.3	1.2	
Water Surface Slope (ft/ft)[2]		---			0.0043	0.0098	0.0061	
Bankfull Slope (ft/ft)		---			0.0043	0.0098	0.0059	0.0062

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable
N/A[4]: No pool cross section taken on HC2

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

Owl's Den Mitigation Site (NCDMS Project No.95808)

Monitoring Year 0 - 2015

	Cross-Section 1, HC1 Reach 1 (Pool)						Cross-Section 2, HC1 Reach 1 (Shallow)						Cross-Section 3, HC1 Reach 1 (Pool)						Cross-Section 4, HC1 Reach 1 (Shallow)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	765.9						765.9						765.5						765.0					
Bankfull Width (ft)	15.5						10.7						16.4						8.9					
Floodprone Width (ft)	---						200+						---						200+					
Bankfull Mean Depth (ft)	0.8						0.6						0.9						0.7					
Bankfull Max Depth (ft)	1.9						1.2						2.4						1.3					
Bankfull Cross-Sectional Area (ft^2)	11.6						6.1						14.8						6.1					
Bankfull Width/Depth Ratio	20.6						19.0						18.2						17.9					
Bankfull Entrenchment Ratio	---						19+						---						19+					
Bankfull Bank Height Ratio	1.0						1.0						1.0						1.0					
	Cross-Section 5, HC1 Reach 2 (Pool)						**Cross-Section 6, HC1 Reach 2 (Shallow)**						**Cross-Section 7, HC1 Reach 2 (Pool)**						**Cross-Section 8, HC1 Reach 2 (Shallow)**					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	763.7						763.6						762.4						762.1					
Bankfull Width (ft)	17.0						11.8						14.7						13.9					
Floodprone Width (ft)	---						200+						---						61.0					
Bankfull Mean Depth (ft)	1.5						0.9						0.9						0.8					
Bankfull Max Depth (ft)	2.6						1.6						2.2						1.3					
Bankfull Cross-Sectional Area (ft^2)	24.9						10.3						13.9						10.5					
Bankfull Width/Depth Ratio	11.6						13.4						15.6						18.5					
Bankfull Entrenchment Ratio	---						17+						---						4.4					
Bankfull Bank Height Ratio	1.0						1.0						1.0						1.0					

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

Owl's Den Mitigation Site (NCDMS Project No.95808)

Monitoring Year 0 - 2015

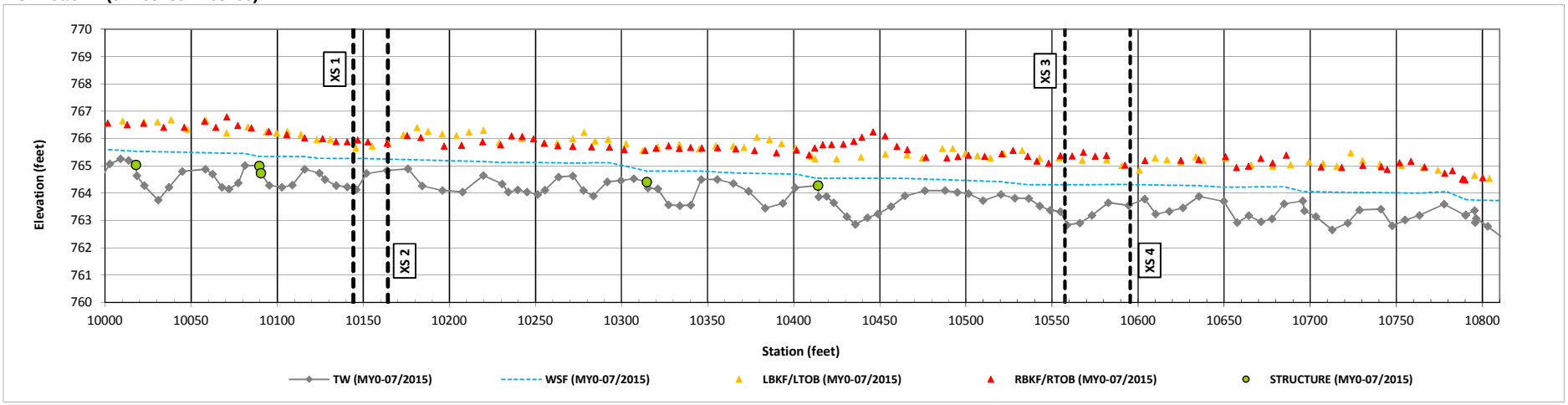
	Cross-Section 9, HC2 (Shallow)						Cross-Section 10, HC2 (Pool)						Cross-Section 11, HC2 (Shallow)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	767.8						767.5						766.6					
Bankfull Width (ft)	6.8						12.2						7.5					
Floodprone Width (ft)	200+						---						200+					
Bankfull Mean Depth (ft)	0.3						0.6						0.5					
Bankfull Max Depth (ft)	0.8						1.6						1.0					
Bankfull Cross-Sectional Area (ft^2)	2.1						7.0						3.4					
Bankfull Width/Depth Ratio	21.5						21.0						16.1					
Bankfull Entrenchment Ratio	30+						---						27+					
Bankfull Bank Height Ratio	1.0						1.0						1.0					
	Cross-Section 12, HC2 (Pool)						**Cross-Section 13, HC2 (Shallow)**											
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**						
based on fixed bankfull elevation	766.7						765.1											
Bankfull Width (ft)	12.1						8.8											
Floodprone Width (ft)	---						200+											
Bankfull Mean Depth (ft)	0.7						0.4											
Bankfull Max Depth (ft)	1.8						1.0											
Bankfull Cross-Sectional Area (ft^2)	8.9						3.8											
Bankfull Width/Depth Ratio	16.4						20.7											
Bankfull Entrenchment Ratio	---						23+											
Bankfull Bank Height Ratio	1.0						1.0											

Longitudinal Profile Plots

Owl's Den Mitigation Site (NCDMS Project No. 95808)

Monitoring Year 0 - 2015

HC1 Reach 1 (STA 99+89 - 108+09)

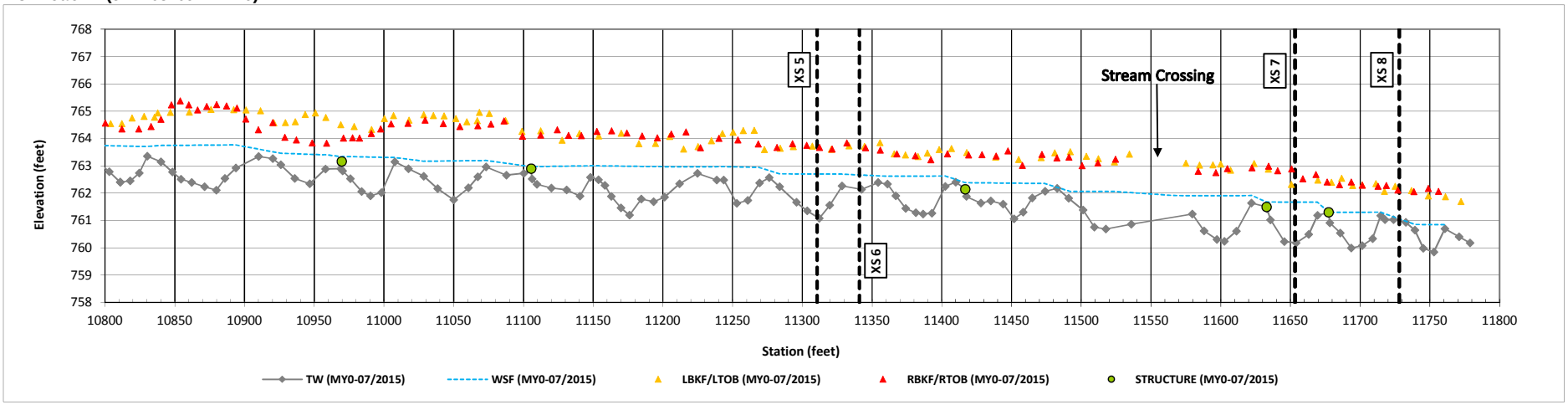


Longitudinal Profile Plots

Owl's Den Mitigation Site (NCDMS Project No. 95808)

Monitoring Year 0 - 2015

HC1 Reach 2 (STA 108+09-117+79)

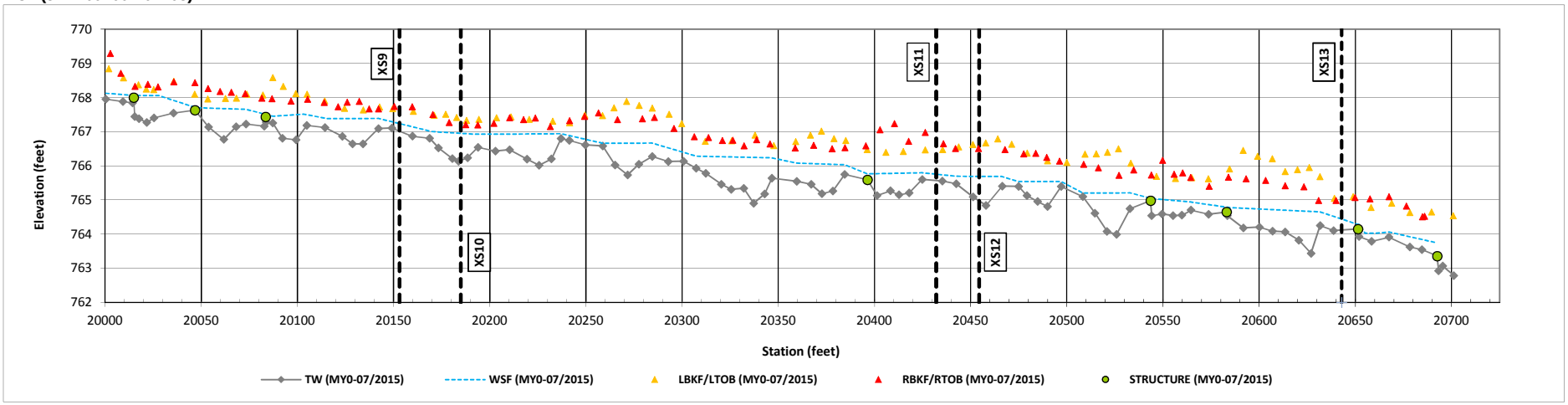


Longitudinal Profile Plots

Owl's Den Mitigation Site (NCDMS Project No. 95808)

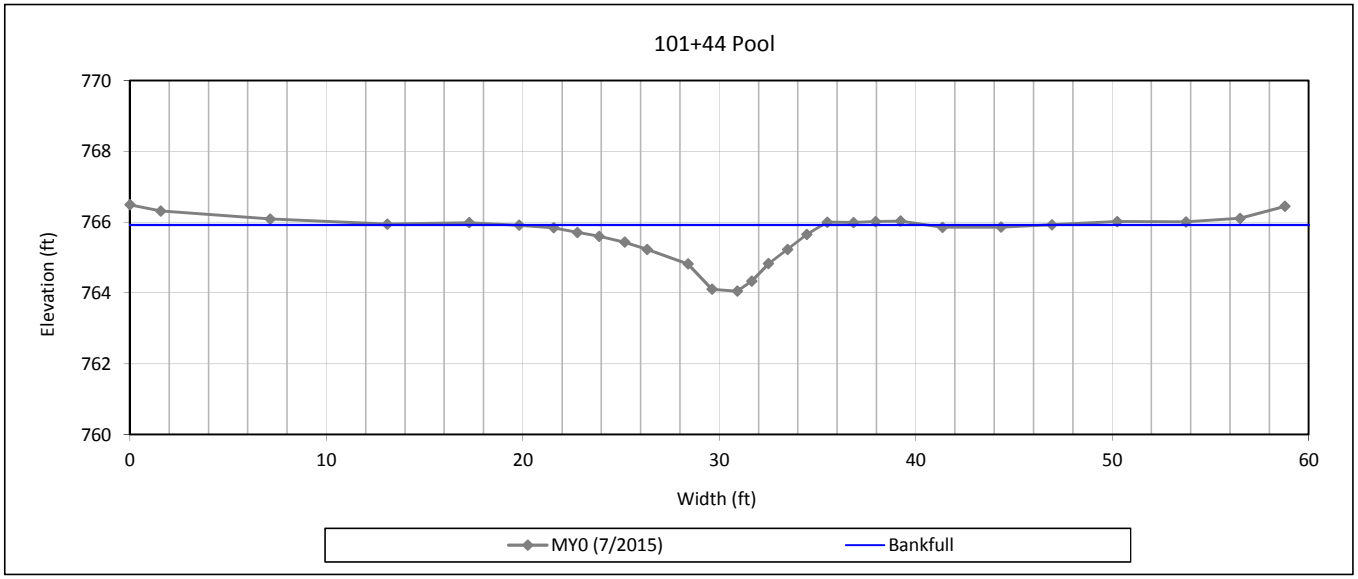
Monitoring Year 0 - 2015

HC2 (STA 200+00-207+08)



Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 1, HC1 Reach 1



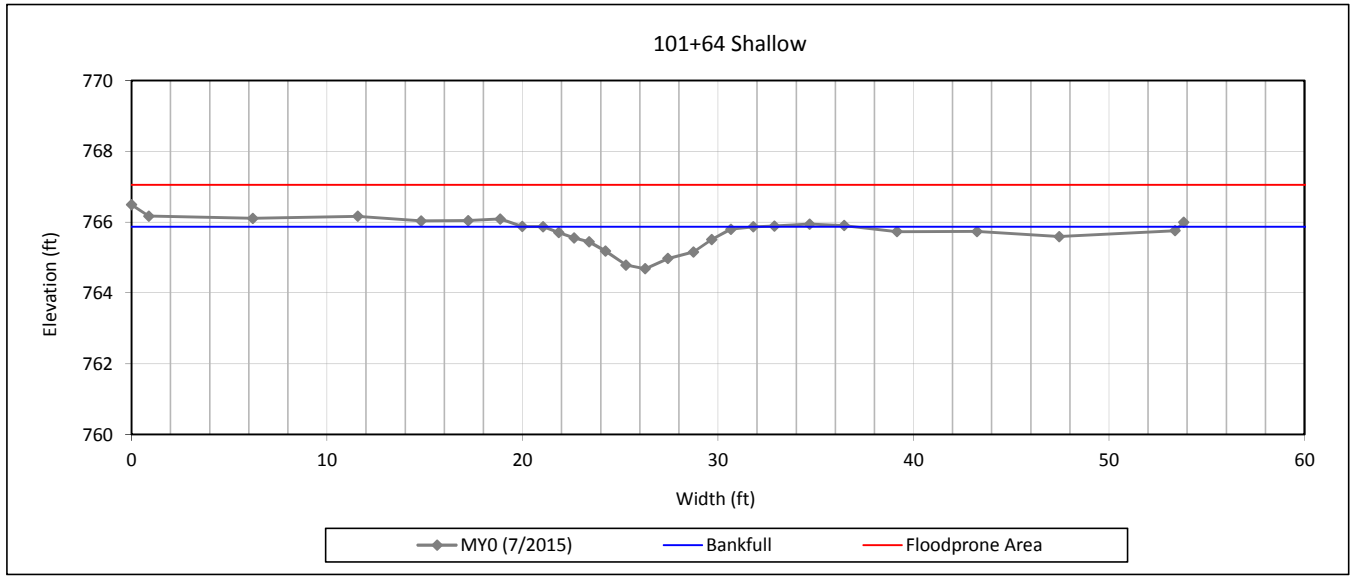
Bankfull Dimensions	
11.6	x-section area (ft.sq.)
15.5	width (ft)
0.8	mean depth (ft)
1.9	max depth (ft)
16.1	wetted parimeter (ft)
0.7	hydraulic radius (ft)
20.6	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 2, HC1 Reach 1



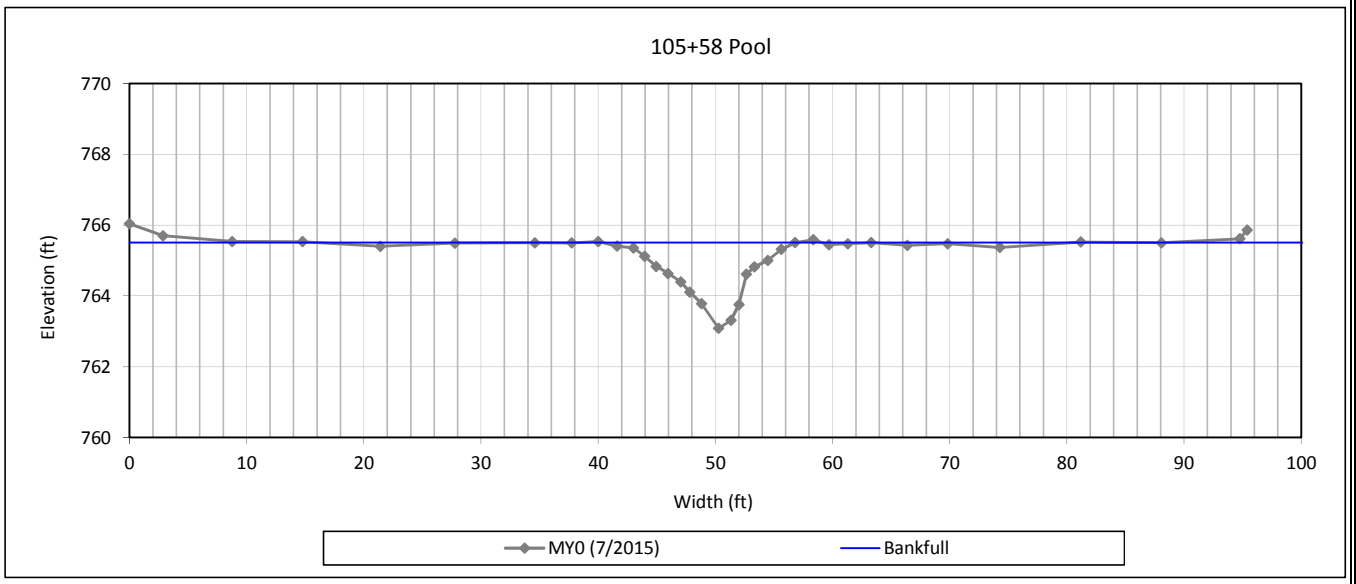
Bankfull Dimensions	
6.1	x-section area (ft.sq.)
10.7	width (ft)
0.6	mean depth (ft)
1.2	max depth (ft)
11.0	wetted parimeter (ft)
0.5	hydraulic radius (ft)
19.0	width-depth ratio
200.0	W flood prone area (ft)
18.6	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 3, HC1 Reach 1



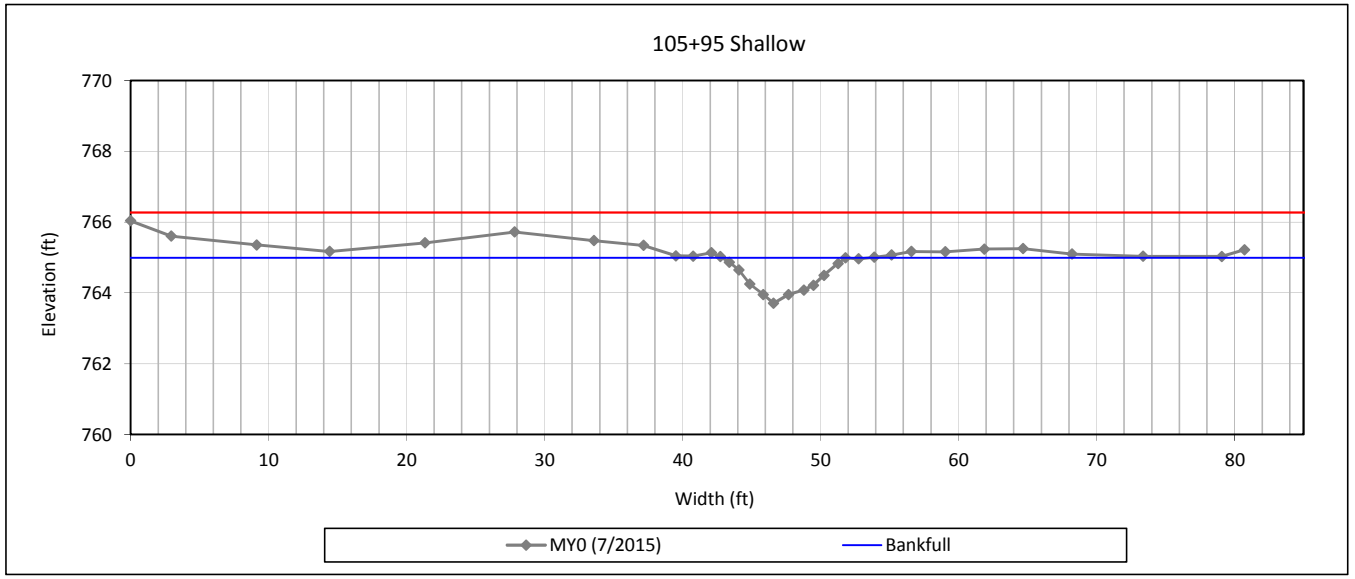
Bankfull Dimensions	
14.8	x-section area (ft.sq.)
16.4	width (ft)
0.9	mean depth (ft)
2.4	max depth (ft)
17.5	wetted parimeter (ft)
0.8	hydraulic radius (ft)
18.2	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 4, HC1 Reach 1



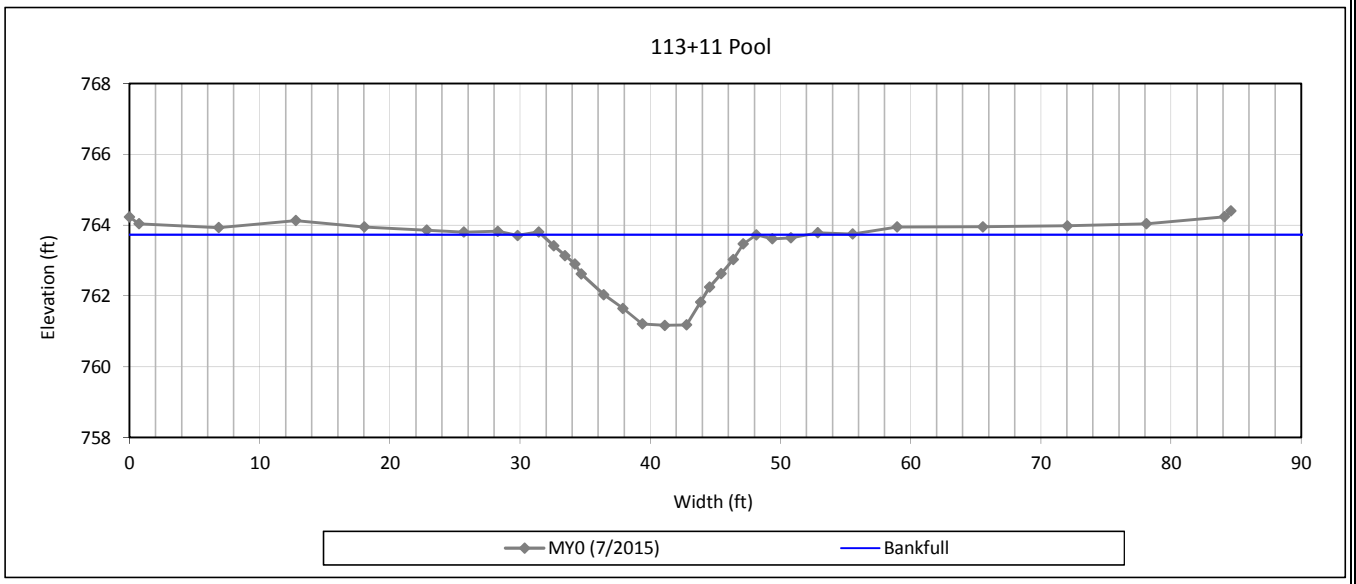
Bankfull Dimensions	
6.1	x-section area (ft.sq.)
8.9	width (ft)
0.7	mean depth (ft)
1.3	max depth (ft)
9.3	wetted parimeter (ft)
0.7	hydraulic radius (ft)
13.0	width-depth ratio
200.0	W flood prone area (ft)
22.4	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 5, HC1 Reach 2



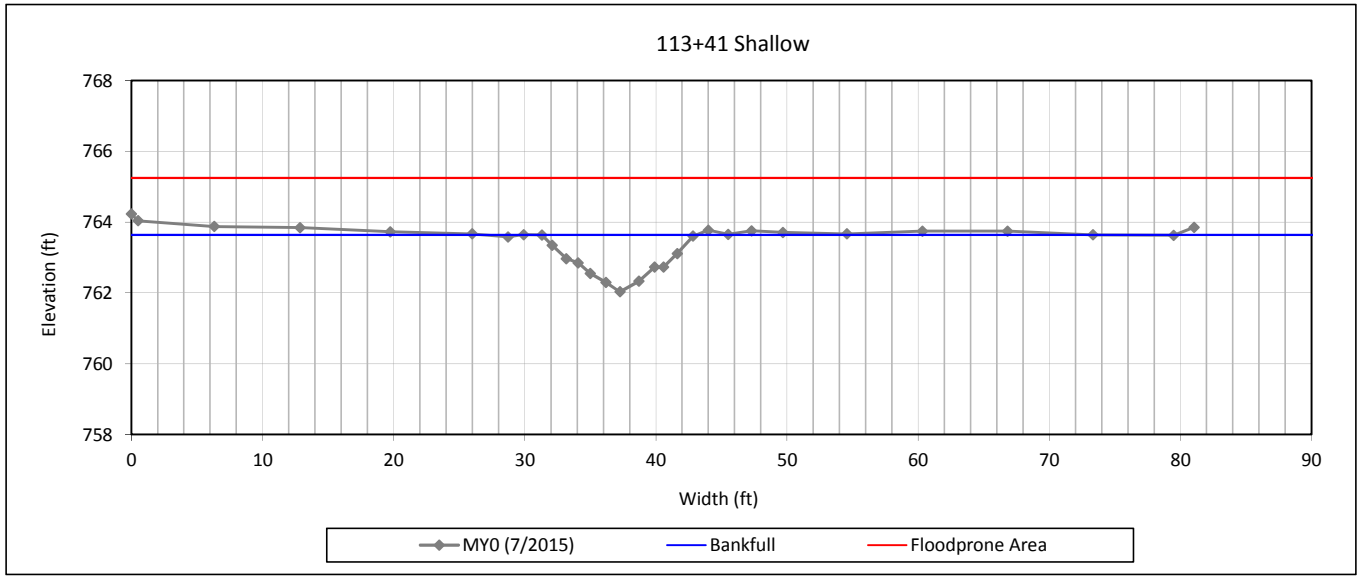
Bankfull Dimensions	
24.9	x-section area (ft.sq.)
17.0	width (ft)
1.5	mean depth (ft)
2.6	max depth (ft)
18.0	wetted parimeter (ft)
1.4	hydraulic radius (ft)
11.6	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 6, HC1 Reach 2



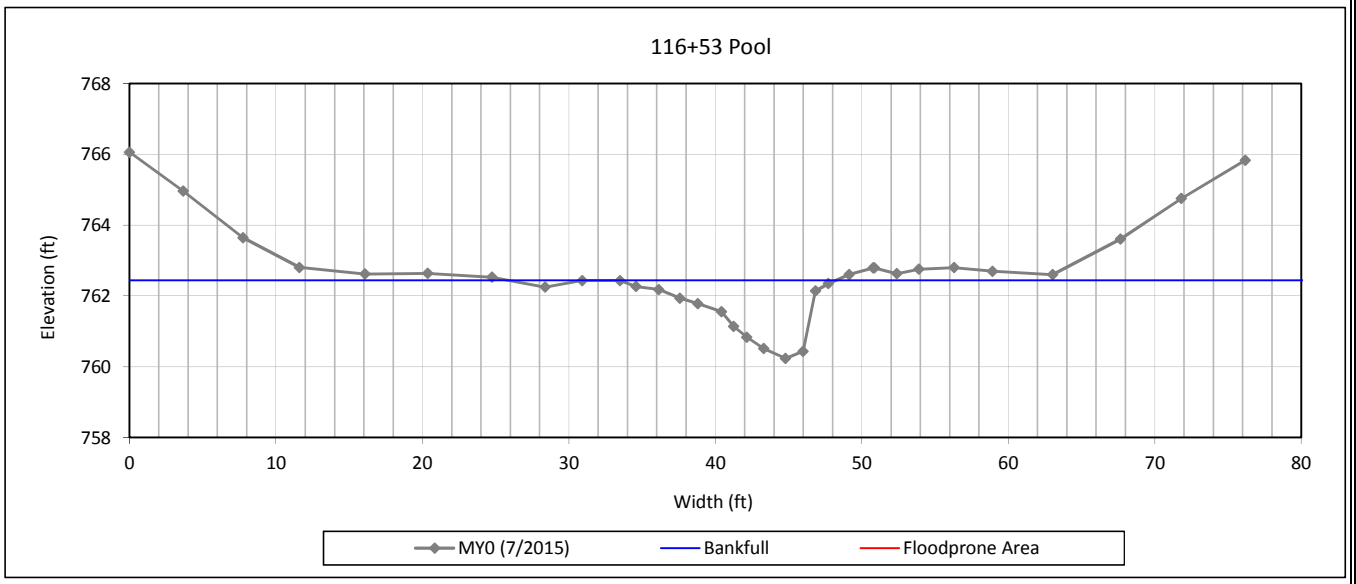
Bankfull Dimensions	
10.3	x-section area (ft.sq.)
11.8	width (ft)
0.9	mean depth (ft)
1.6	max depth (ft)
12.3	wetted parimeter (ft)
0.8	hydraulic radius (ft)
13.4	width-depth ratio
200.0	W flood prone area (ft)
17.0	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 7, HC1 Reach 2



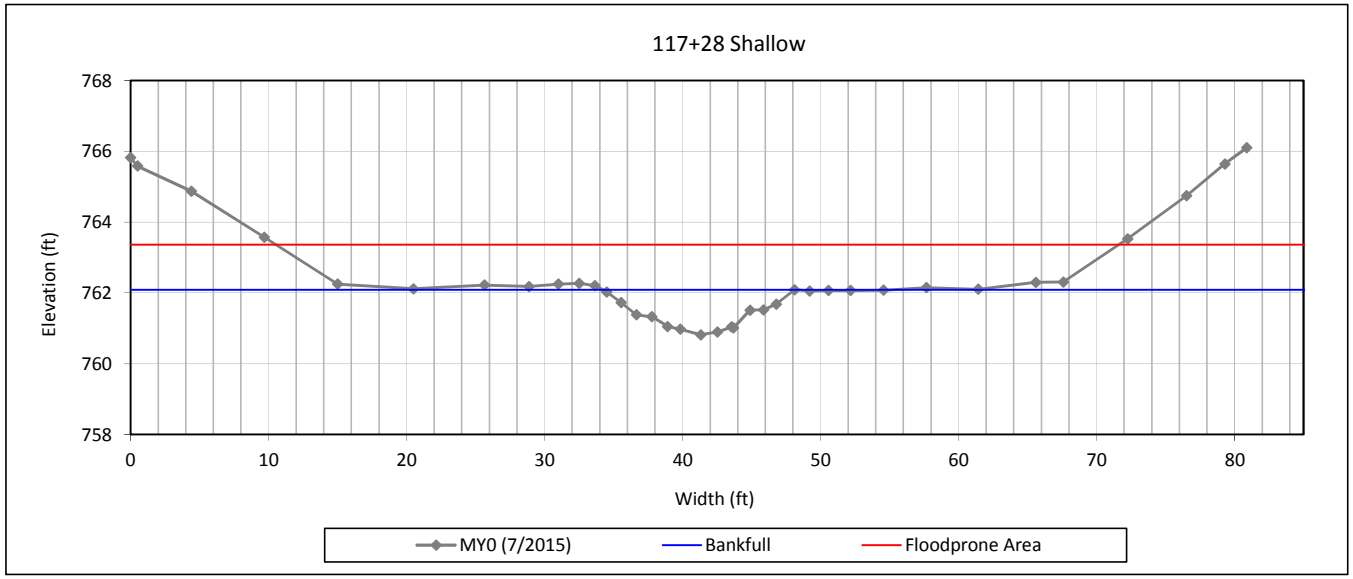
Bankfull Dimensions	
13.9	x-section area (ft.sq.)
14.7	width (ft)
0.9	mean depth (ft)
2.2	max depth (ft)
16.1	wetted parimeter (ft)
0.9	hydraulic radius (ft)
15.6	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Upstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 8, HC1 Reach 2



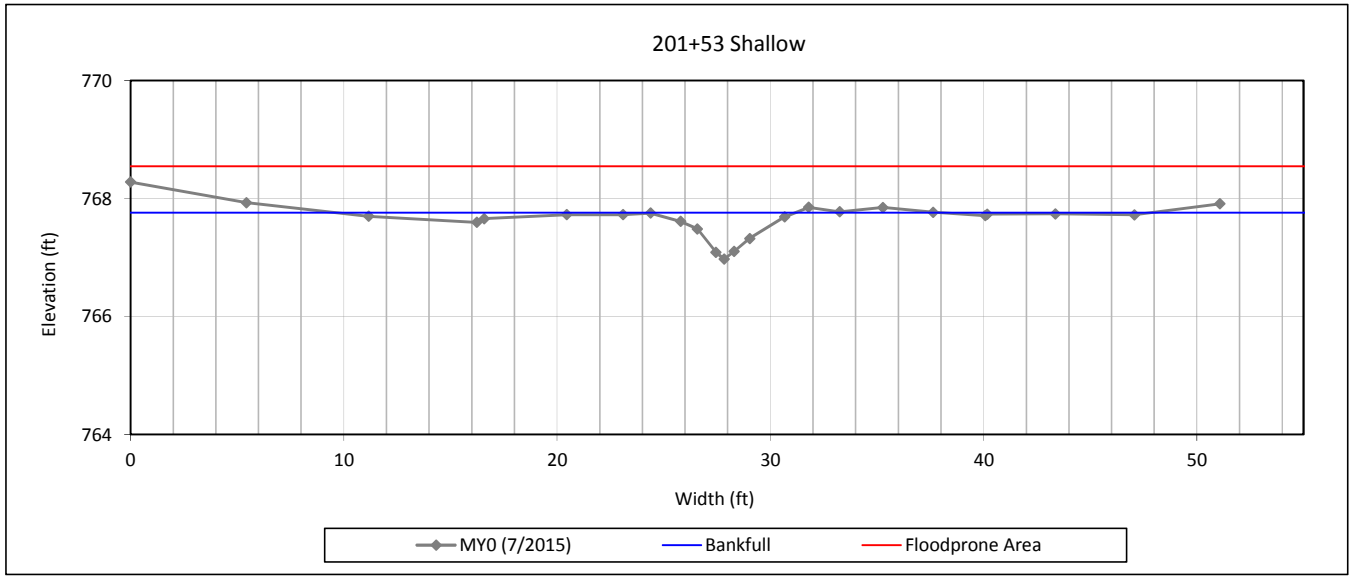
Bankfull Dimensions	
10.5	x-section area (ft.sq.)
13.9	width (ft)
0.8	mean depth (ft)
1.3	max depth (ft)
14.2	wetted parimeter (ft)
0.7	hydraulic radius (ft)
18.5	width-depth ratio
61.0	W flood prone area (ft)
4.4	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 9, HC2



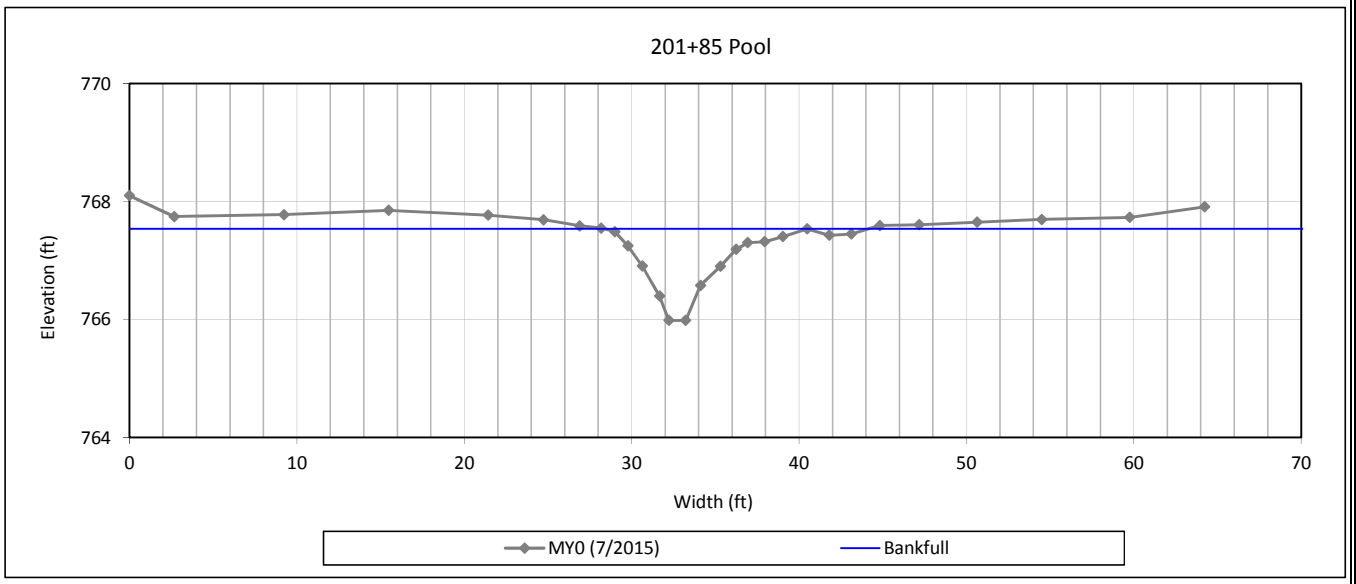
Bankfull Dimensions	
2.1	x-section area (ft.sq.)
6.8	width (ft)
0.3	mean depth (ft)
0.8	max depth (ft)
7.0	wetted parimeter (ft)
0.3	hydraulic radius (ft)
21.5	width-depth ratio
200.0	W flood prone area (ft)
29.5	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 10, HC2



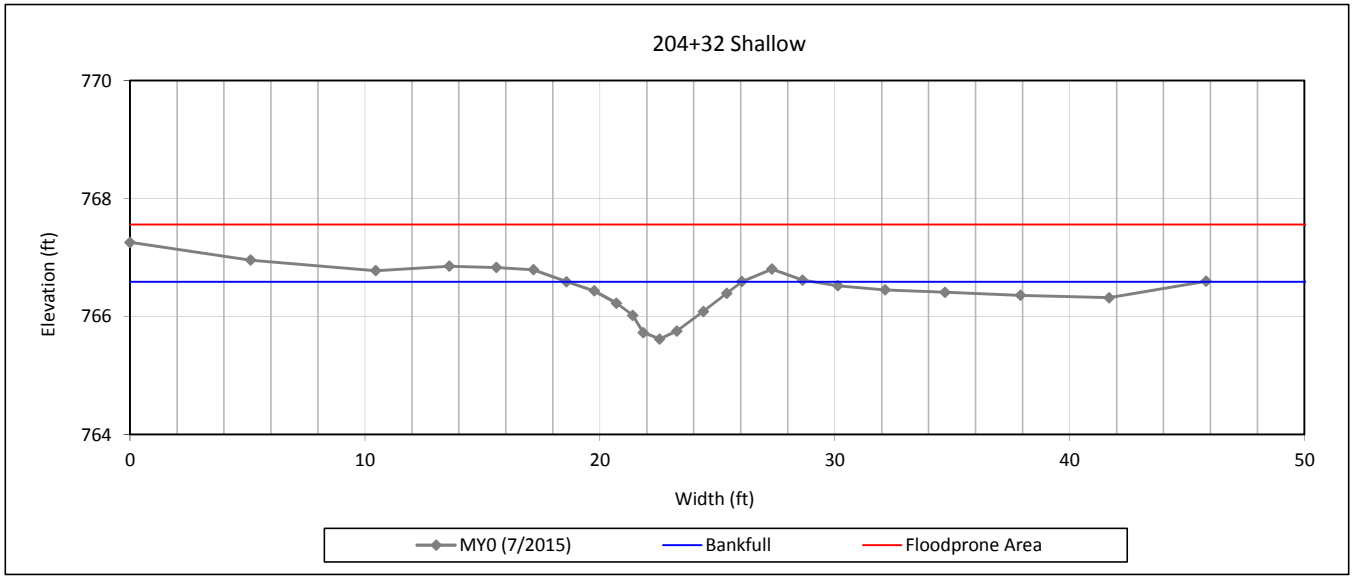
Bankfull Dimensions	
7.0	x-section area (ft.sq.)
12.2	width (ft)
0.6	mean depth (ft)
1.6	max depth (ft)
12.8	wetted parimeter (ft)
0.5	hydraulic radius (ft)
21.0	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 11, HC2



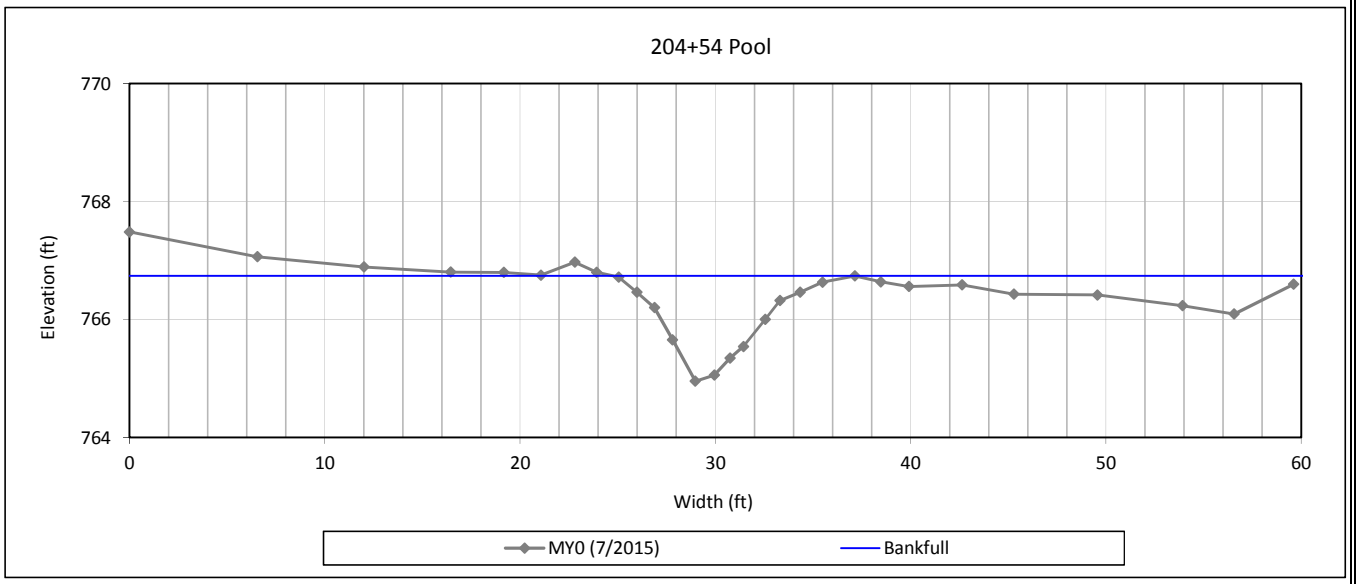
Bankfull Dimensions	
3.4	x-section area (ft.sq.)
7.5	width (ft)
0.5	mean depth (ft)
1.0	max depth (ft)
7.8	wetted parimeter (ft)
0.4	hydraulic radius (ft)
16.1	width-depth ratio
200.0	W flood prone area (ft)
26.8	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 12, HC2



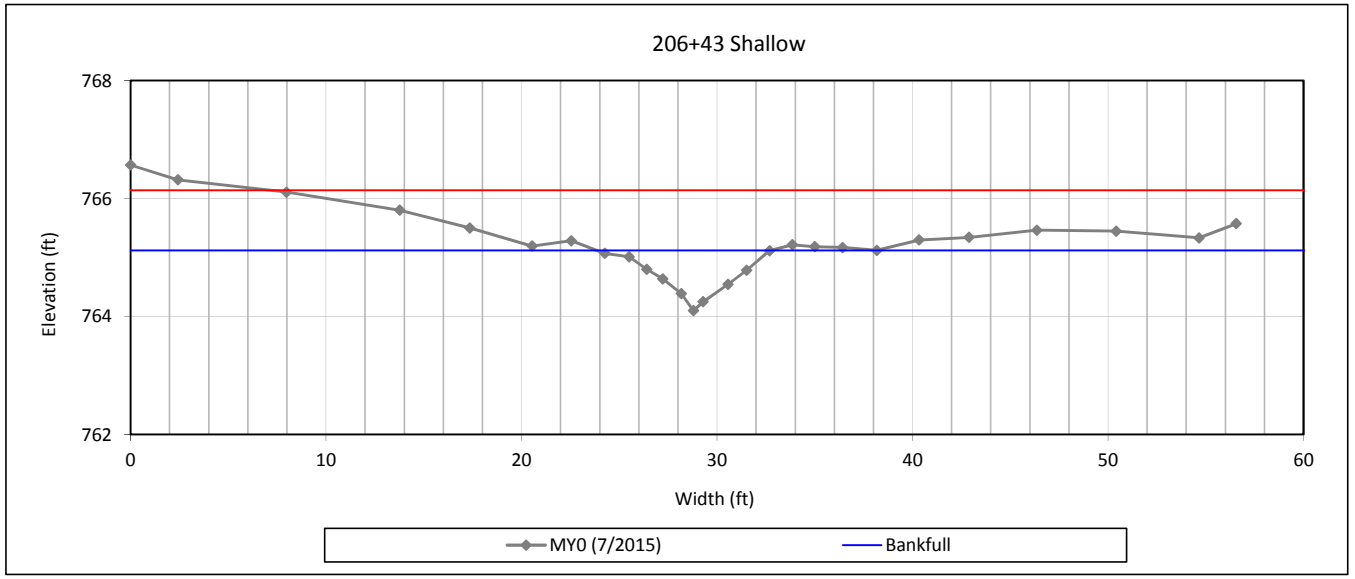
Bankfull Dimensions	
8.9	x-section area (ft.sq.)
12.1	width (ft)
0.7	mean depth (ft)
1.8	max depth (ft)
12.8	wetted parimeter (ft)
0.7	hydraulic radius (ft)
16.4	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Cross Section Plots
Owl's Den Mitigation Site (NCDMS Project No. 95808)
Monitoring Year 0

Cross Section 13, HC2



Bankfull Dimensions	
3.8	x-section area (ft.sq.)
8.8	width (ft)
0.4	mean depth (ft)
1.0	max depth (ft)
9.1	wetted parimeter (ft)
0.4	hydraulic radius (ft)
20.7	width-depth ratio
200.0	W flood prone area (ft)
22.7	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2015
Field Crew: Kee Mapping & Surveying

View Downstream

Stream Photographs

	
Photo Point 1 – looking upstream (07/09/2015)	Photo Point 1 – looking downstream (07/09/2015)
	
Photo Point 2 – looking upstream (07/09/2015)	Photo Point 2 – looking downstream (07/09/2015)
	
Photo Point 3 – looking upstream (07/09/2015)	Photo Point 3 – looking downstream (07/09/2015)

Photo Point 4 – looking upstream (07/09/2015)

Photo Point 4 – looking downstream (07/09/2015)

Photo Point 5 – looking upstream HC1 (07/09/2015)

Photo Point 5 – looking upstream HC2 (07/09/2015)

Photo Point 5 – looking downstream (01/19/2015)

	
Photo Point 6 – looking upstream (07/09/2015)	Photo Point 6 – looking downstream (07/09/2015)
	
Photo Point 7 – looking upstream (07/09/2015)	Photo Point 7 – looking downstream (07/09/2015)
	
Photo Point 8 – looking upstream (07/09/2015)	Photo Point 8 – looking downstream (07/09/2015)

	
Photo Point 9 – looking upstream (07/09/2015)	Photo Point 9 – looking downstream (07/09/2015)
	
Photo Point 10 – looking upstream (07/09/2015)	Photo Point 10 – looking downstream (07/09/2015)
	
Photo Point 11 – looking upstream (07/09/2015)	Photo Point 11 – looking downstream (07/09/2015)

	
Photo Point 12 – looking upstream (07/09/2015)	Photo Point 12 – looking downstream (07/09/2015)
	
Photo Point 13 – looking upstream (07/09/2015)	Photo Point 13 – looking downstream (07/09/2015)
	
Photo Point 14 – looking upstream (07/09/2015)	Photo Point 14 – looking downstream (07/09/2015)

APPENDIX 3. Vegetation Plot Data

Table 8. Planted and Total Stems

Owl's Den Mitigation Site (NCDMS Project No.95808)

Monitoring Year 0 - 2015

			Current Plot Data (MY0 2015)																				
			Vegetation Plot 1			Vegetation Plot 2			Vegetation Plot 3			Vegetation Plot 4			Vegetation Plot 5			Vegetation Plot 6			Vegetation Plot 7		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red maple	Tree	1	1	1	1	1	1	2	2	2												1
Betula nigra	River birch	Tree	1	1	1	3	3	3	2	2	2	5	5	5				2	2	2	3	3	3
Diospyros virginiana	Common persimmon	Tree	1	1	1				1	1	1	4	4	4	1	1	1				3	3	3
Fraxinus pennsylvanica	Green ash	Tree	4	4	4	4	4	4	2	2	2	2	2	2	8	8	8	4	4	4	2	2	2
Platanus occidentalis	American sycamore	Tree	5	5	5	3	3	3	6	6	6				4	4	4	9	9	9	1	1	1
Quercus michauxii	Swamp chestnut oak	Tree	3	3	3	3	3	3	1	1	1				2	2	2	1	1	1			
Quercus phellos	Willow oak	Tree	1	1	1	2	2	2	3	3	3	5	5	5	1	1	1				6	6	6
Sambucus canadensis	Common Elderberry	Shrub																					
		Stem count	16	16	16	16	16	16	17	17	17	16	16	16	16	16	16	16	16	16	15	15	16
		Size (ares)	1			1			1			1			1			1			1		
		Size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	7	7	7	6	6	6	7	7	7	4	4	4	5	5	5	4	4	4	5	5	6
		Stems per ACRE	647	647	647	647	647	647	688	688	688	647	647	647	647	647	647	647	647	647	607	607	647

			Current Plot Data (MY0 2015)																		Annual Summary		
			Vegetation Plot 8			Vegetation Plot 9			Vegetation Plot 10			Vegetation Plot 11			Vegetation Plot 12			Vegetation Plot 13			MY0		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red maple	Tree				2	2	2				2	2	2	1	1	1				9	9	10
Betula nigra	River birch	Tree	3	3	3	4	4	4	5	5	5	1	1	1	2	2	2	2	2	2	33	33	33
Diospyros virginiana	Common persimmon	Tree	1	1	1	1	1	1	4	4	4	1	1	1	2	2	2	2	2	2	21	21	21
Fraxinus pennsylvanica	Green ash	Tree	7	7	7	4	4	4	3	3	3	2	2	7	4	4	4	5	5	5	51	51	56
Platanus occidentalis	American sycamore	Tree	4	4	4	4	4	4	2	2	2	3	3	3	2	2	2	1	1	1	44	44	44
Quercus michauxii	Swamp chestnut oak	Tree				1	1	1				5	5	5	1	1	1				17	17	17
Quercus phellos	Willow oak	Tree	1	1	1				2	2	2	2	2	2	4	4	4	6	6	6	33	33	33
Sambucus canadensis	Common Elderberry	Shrub																		2			2
		Stem count	16	16	16	16	16	16	16	16	16	16	16	21	16	16	16	16	16	18	208	208	216
		Size (ares)	1			1			1			1			1			1			13		
		Size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.32		
		Species count	5	5	5	6	6	6	5	5	5	7	7	7	7	7	7	5	5	6	7	7	8
		Stems per ACRE	647	647	647	647	647	647	647	647	647	647	647	850	647	647	647	647	647	728	647	647	672

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Vegetation Photographs

	
Vegetation Plot 1 – (01/14/2016)	Vegetation Plot 2 – (01/14/2016)
	
Vegetation Plot 3 – (01/14/2016)	Vegetation Plot 4 – (01/14/2016)
	
Vegetation Plot 5 – (01/14/2016)	Vegetation Plot 6 – (01/14/2016)

	
Vegetation Plot 7 – (01/14/2016)	Vegetation Plot 8 – (01/14/2016)
	
Vegetation Plot 9 – (01/14/2016)	Vegetation Plot 10 – (01/14/2016)
	
Vegetation Plot 11 – (01/14/2016)	Vegetation Plot 12 – (01/14/2016)

Vegetation Plot 13 – (01/14/2016)

APPENDIX 4. Baseline Wetland Photo Documentation

Wetland Photographs

Photo Point 15 – looking southeast (08/17/2015)

Photo Point 16 – looking southwest (08/17/2015)

Photo Point 17 – looking north(08/17/2015)

Photo Point 18 – looking northwest (08/17/2015)

Photo Point 18 – looking southwest (08/17/2015)

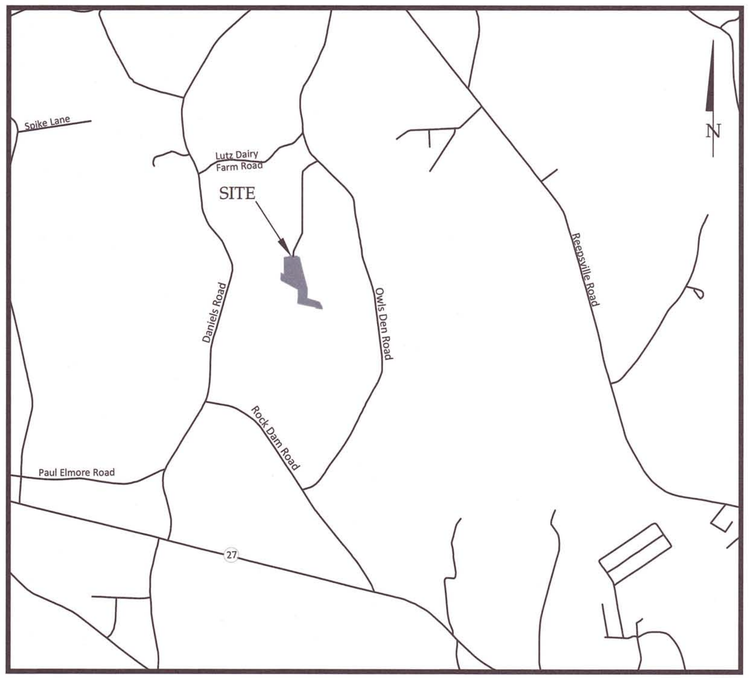
	
Photo Point 19 – looking northeast (08/17/2015)	Photo Point 19 – looking southeast (08/17/2015)
	
Photo Point 20 – looking northwest (08/17/2015)	Photo Point 20 – looking southeast (08/17/2015)

APPENDIX 5. Record Drawings

February 12, 2016

Owl's Den Mitigation Site Record Drawings

Catawba River Basin 03050103 Expanded Service Area
Lincoln County, North Carolina
for
NCDEQ -
Division of Mitigation Services



Vicinity Map
Not to Scale

BEFORE YOU DIG!
CALL 1-800-632-4949
N.C. ONE-CALL CENTER
IT'S THE LAW!

RECORD DRAWINGS
FEBRUARY 17, 2016

CERTIFICATE OF SURVEY
AND
ACCURACY

I, PHILLIP B. KEE, CERTIFY THAT THE GROUND TOPOGRAPHIC SURVEY PORTION OF THIS PROJECT WAS COMPLETED UNDER MY DIRECT SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY DIRECT SUPERVISION, THAT THE RECORD DRAWINGS WERE PREPARED BY WILDLANDS ENGINEERING, INC FROM DIGITAL FILES PROVIDED BY KEE MAPPING AND SURVEYING, PA AS SHOWN ON AN AS-BUILT SURVEY FOR "THE STATE OF NC, DIVISION OF MITIGATION SERVICES", JOB #150798-AB, DATED SEPTEMBER 21ST, 2015; THAT THIS SURVEY WAS PERFORMED AT THE 95% CONFIDENCE LEVEL TO MEET THE FEDERAL GEOGRAPHIC DATA COMMITTEE STANDARDS; THAT THIS SURVEY WAS PERFORMED TO MEET THE REQUIREMENTS FOR A TOPOGRAPHIC SURVEY TO THE ACCURACY OF CLASS A HORIZONTAL AND CLASS C VERTICAL WHERE APPLICABLE; THAT THE ORIGINAL DATA WAS OBTAIN BETWEEN THE DATES OF 07/20/15 - 08/17/15 ; THAT THE CONTOURS SHOWN AS BROKEN LINES MAY NOT MEET THE STATED STANDARD AND ALL COORDINATES ARE BASED ON NAD 83 (NSRS 2011) AND ALL ELEVATIONS ARE BASE ON NAVD 88; THAT THIS MAP MEETS THE SPECIFICATIONS FOR TOPOGRAPHIC SURVEYS AS STATED IN TITLE 21, CHAPTER 56, SECTION .1606; THAT THIS MAP WAS NOT PREPARED IN ACCORDANCE WITH G.S. 47-30, AS AMENDED AND DOES NOT REPRESENT AN OFFICIAL BOUNDARY SURVEY.

WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS THE 18TH DAY OF FEBRUARY, 2016.

OFFICIAL SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-4647 LAND SURVEYOR PHILLIP B. KEE

PHILLIP B. KEE, PLS L-4647

Sheet Index

Project Directory

Engineering:
Wildlands Engineering, Inc
License No. F-0831
1430 South Mint Street, Suite 104
Charlotte, NC 28203
Eric Neuhaus, PE
704-332-7754 x112

Surveying:
Kee Mapping and Survey
111 Central Avenue,
Asheville, NC 28801
Brad Kee, PLS
828-645-8275

Owner:
NCDEQ
Division of Mitigation Services
1652 Mail Service Center
Raleigh, North Carolina 27699-1652
Project Manager: Paul Wiesner

DMS Project ID: 95808

NCDEQ Contract No. 005150

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NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

Title Sheet

Revisions:

Date:	February 17, 2016
Job Number:	005-02140
Project Engineer:	EPN
Drawn By:	RCP
Checked By:	KYG & EGR

Sheet 0.1

T:\ACTIVE PROJECTS (NC)\005-02140 Owls Den Monitoring \Baseline\ Plans \02140-Ab-CoverNotes.dwg

February 17, 2016

EXISTING GRAVEL
ACCESS ROAD
CONTINUES TO OWLS
DEN ROAD (SR 1202)

OHE

FEMA FLOODPLAIN FOR
HOWARDS CREEK

J SEAGLE III
3614235707

OWLS DEN FARM LLC
3614135713

RELOCATED OVERHEAD ELECTRIC LINE. BURIED BY RUTHERFORD ELECTRIC. AN ELECTRIC LINE RIGHT-OF-WAY EASEMENT INCLUDING 20 FEET ON EACH SIDE OF THE CONSTRUCTED LINE IS TO BE RECORDED BY RUTHERFORD ELECTRIC.

WETLAND
REHABILITATION
BOUNDARY (TYP)

WETLAND
RE-ESTABLISHMENT
BOUNDARY (TYP)

2.1

2.2

2.3

2.4

2.5

2.6

HC1 REACH 1

HC1 REACH 2

HC2

99+89
100+00
101+00
102+00
103+00
104+00
105+00
106+00
107+00
108+20
109+00
110+00
111+00
112+00
113+00
114+00
115+00
116+00
117+00
117+79
200+00
201+00
202+00
203+00
204+00
205+00
206+00

HOWARDS CREEK

MELINDA R AVERY
3614117207

N

0' 60' 120' 180'
(HORIZONTAL)

T:\ACTIVE PROJECTS\NC\08-02410\Owls Den Mitigation\Baseline\Plans\02410-Ab-Project Overview.dgn

WILDLANDS ENGINEERING
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Fax: 704.332.3306
Firm License No. F-0831

NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

Project Overview

Revisions:

Date: February 17, 2016
Job Number: 08-02410
Project Engineer: EPN
Drawn By: RCP
Checked By: KYG & EGR

Sheet 0.2

February 17, 2016

Property Line
Underground Electric Power
Overhead Electric Power
FEMA Floodplain
Conservation Easement
Design Minor Contour
Design Minor Contour
Design Bankfull
Trees Saved During Construction
Power Pole
Power Pole Guy Wire
Electrical Box (Transformer)
Pump Station
As-Built Thalweg Alignment
As-Built Bankfull
As-Built Major Contour
As-Built Minor Contour

Jurisdictional Wetland
Farm Road and Gravel Parking
Design Wetland Re-establishment
Design Wetland Rehabilitation

Design Angled Log Drop
Design Constructed Shallow
Design Woody Shallow
Design Jazz Shallow
Design Brush Shallow
Design Log Vane
Design Transplanted Sod Mats
Design Brush Toe
Design Lunker Log

As-Built Angled Log Drop
As-Built Constructed Shallow
As-Built Woody Shallow
As-Built Jazz Shallow
As-Built Brush Shallow
As-Built Log Vane
As-Built Transplanted Sod Mats
As-Built Brush Toe
As-Built Lunker Log

*Deviation from design shown in red.

T:\ACTIVE PROJECTS\NC\005-0910\Owls Den\Monitoring\Baseline\Plans\0910-Ab-GeneNotes.dgn

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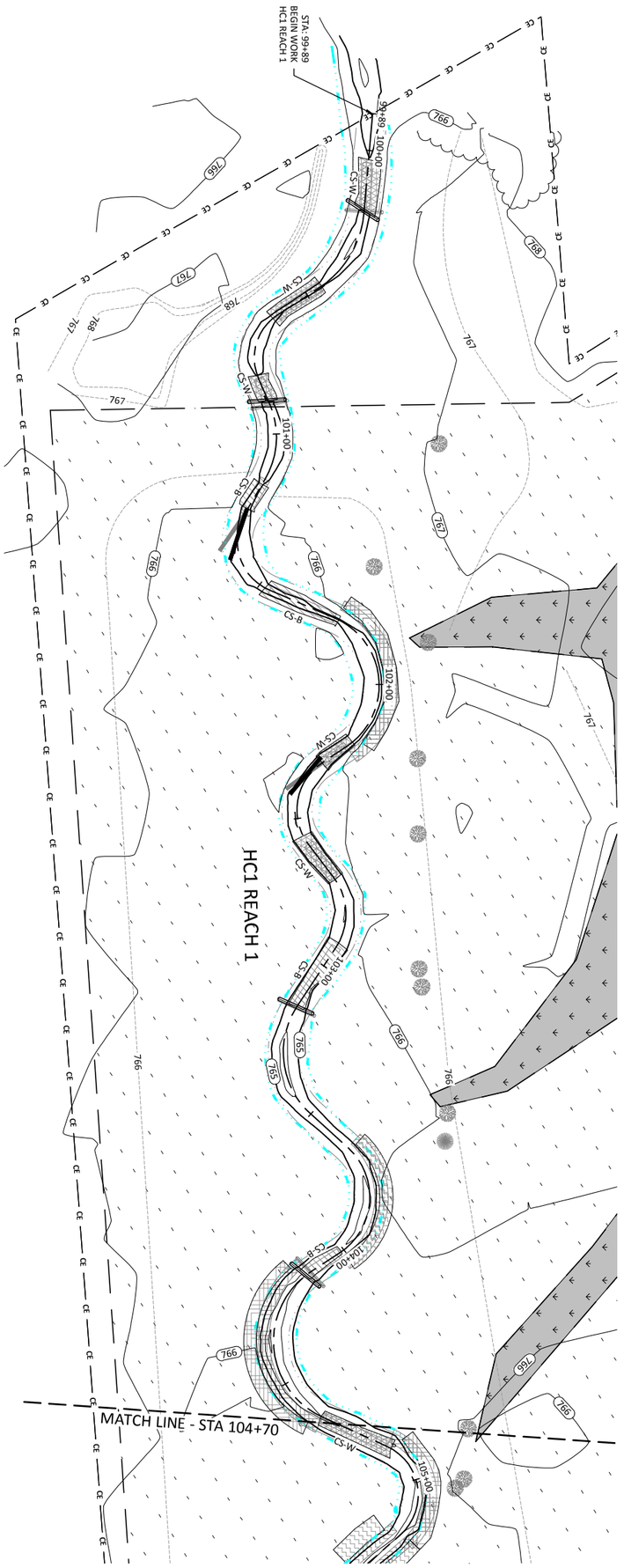
NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

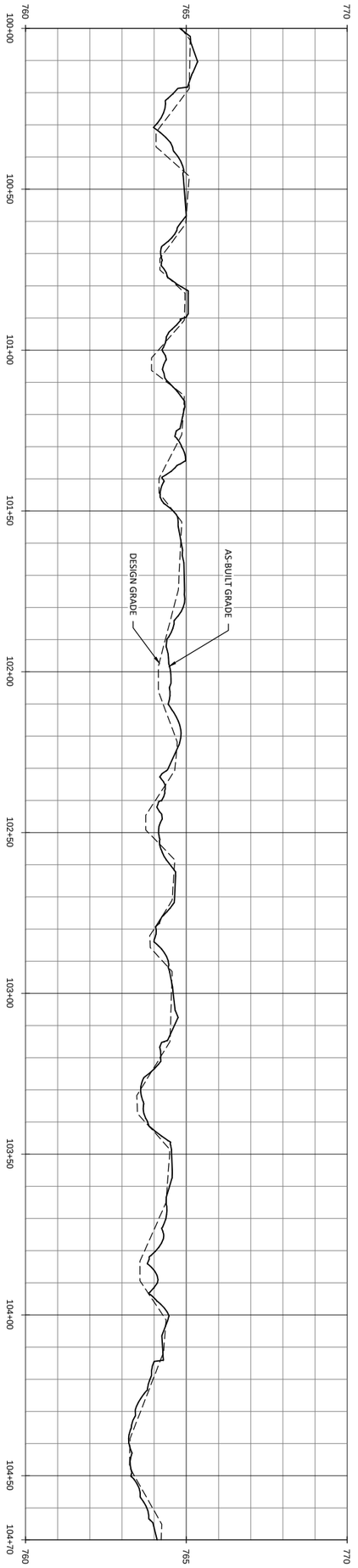
Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina
General Note and Symbols

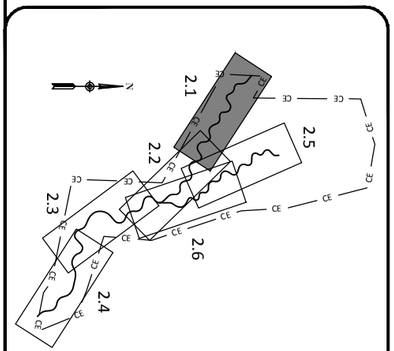
Revisions:

Date: February 17, 2016
Job Number: 015-02140
Project Engineer: EPN
Drawn by: BKT
Checked By: KYG & EGR

Sheet 0.3







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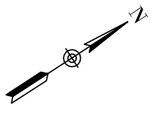

Date:	February 17, 2016
Job Number:	005-02140
Project Engineer:	EPN
Drawn By:	RCP
Checked By:	KYG & EGR

Revisions:

2.1
Sheet

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

HC1
Stream Plan and Profile

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 042660

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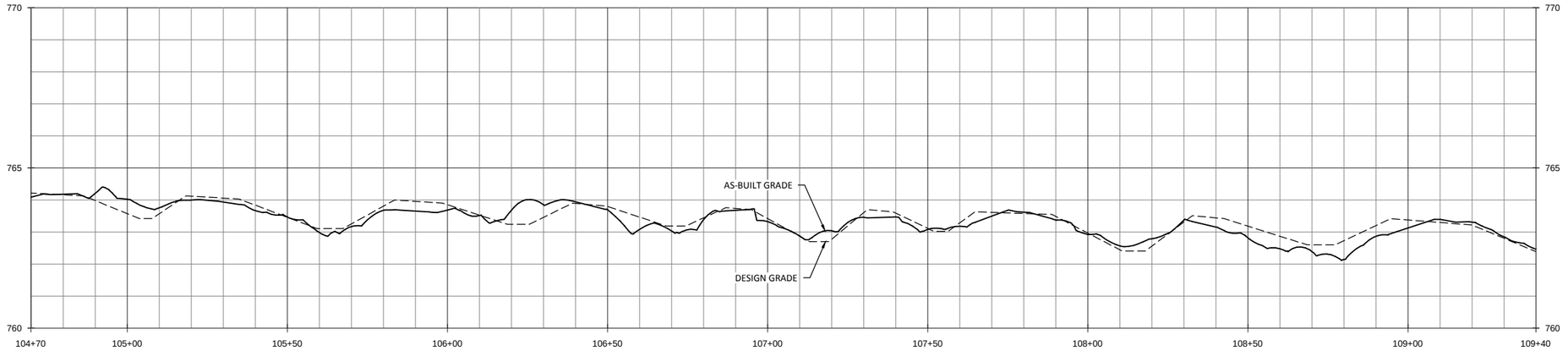
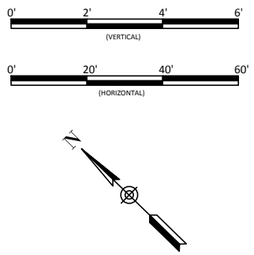
February 17, 2016





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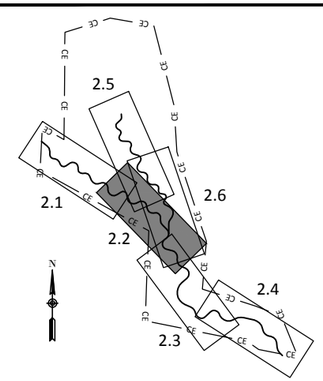

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NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

HC1
Stream Plan and Profile

Revisions:

Date: February 17, 2016
Job Number: 005-02140
Project Engineer: EPN
Drawn by: RCP
Checked by: KYG & EGR

Sheet 2.2

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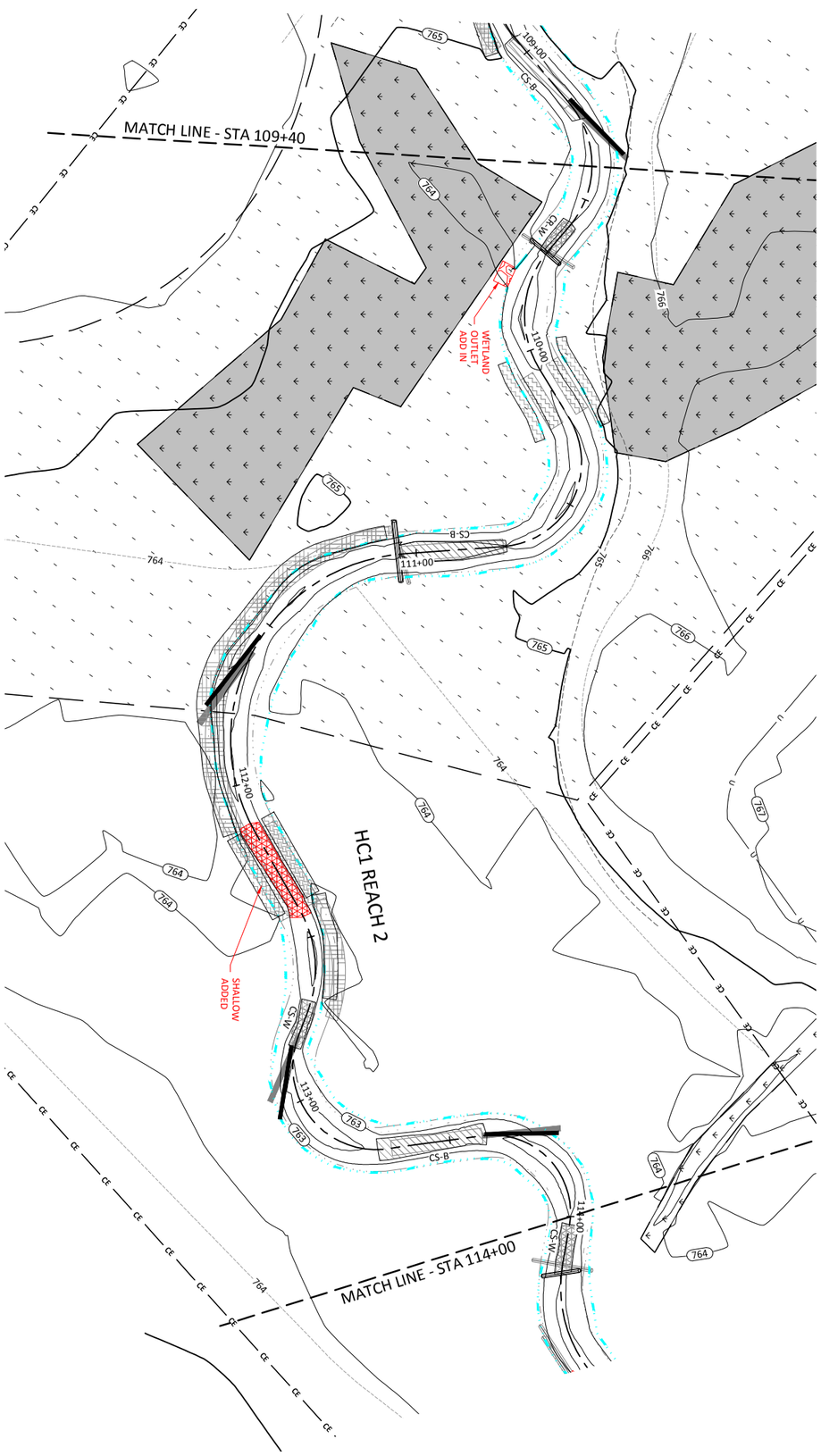

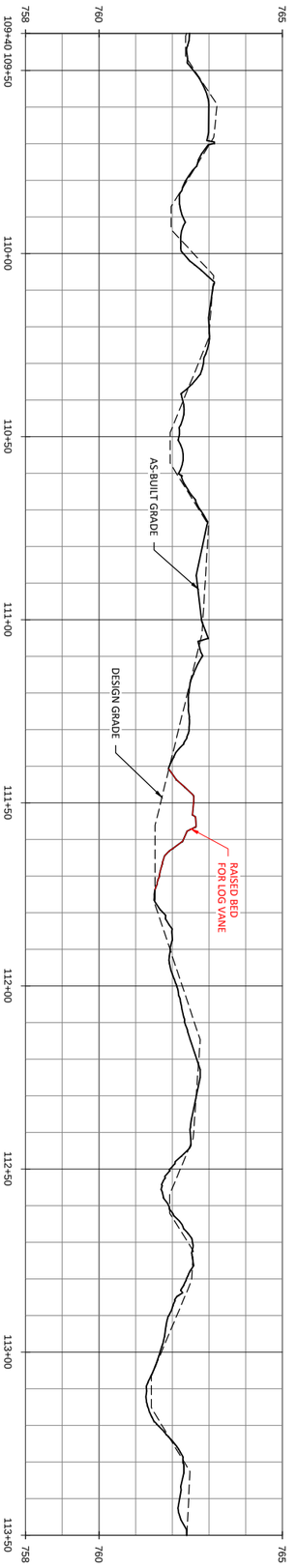

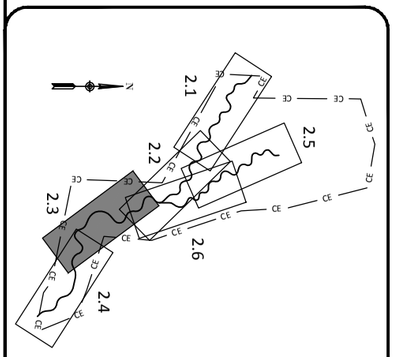

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Job Number:	005-02140
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Revisions:

2.3
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Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

HC1
Stream Plan and Profile

PROFESSIONAL ENGINEER SEAL 042660 NORTH CAROLINA

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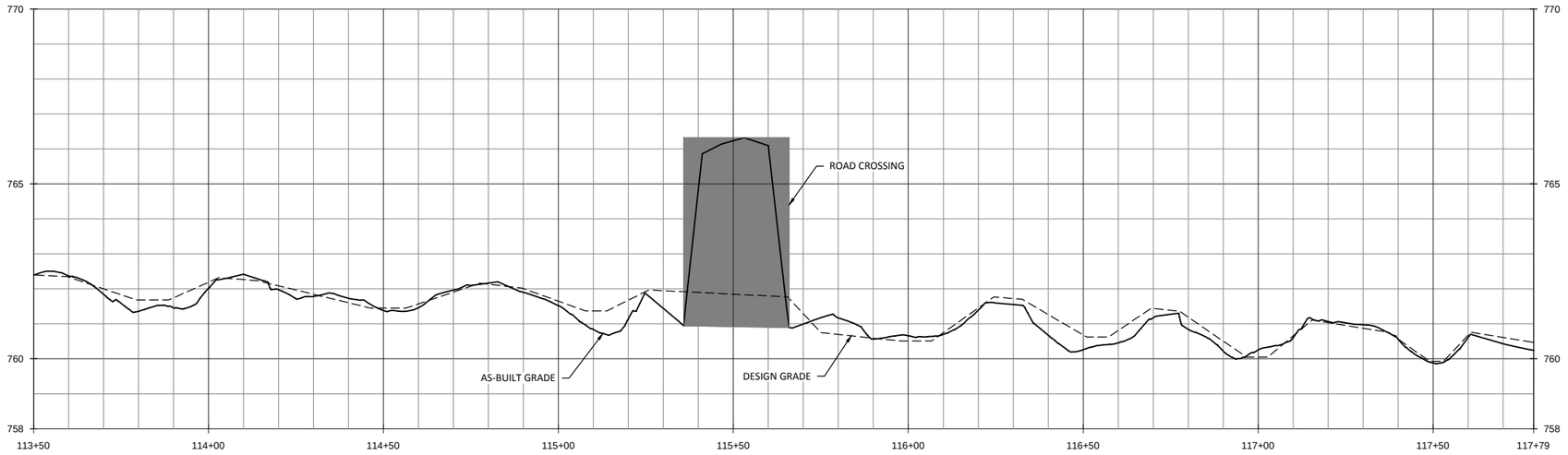
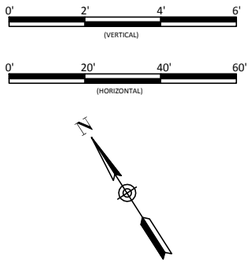
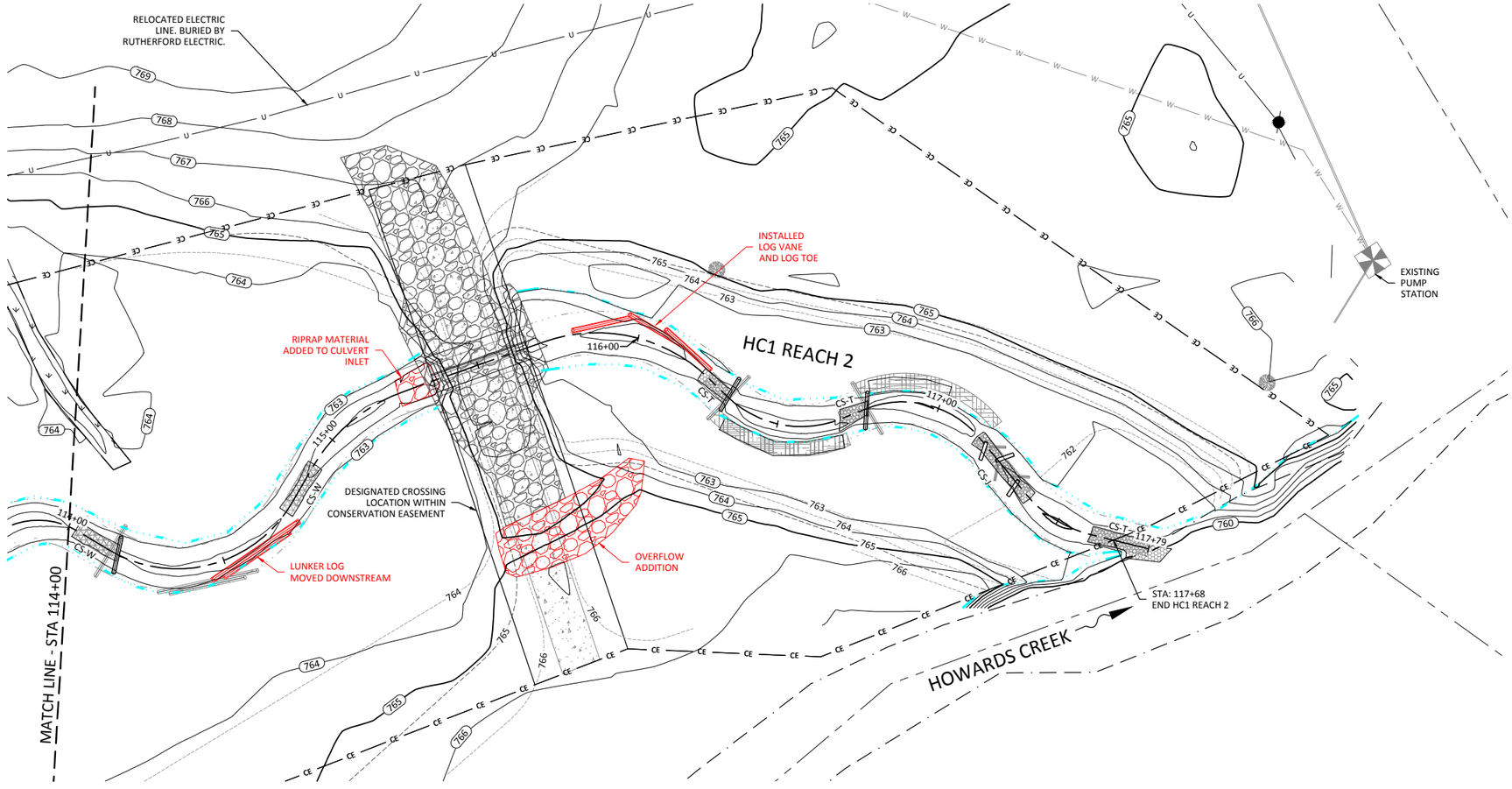
February 17, 2016







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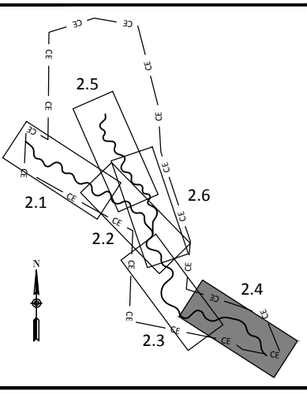

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NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

HC1
Stream Plan and Profile

Revisions:

Date: February 17, 2016
Job Number: 005-02140
Project Engineer: EPN
Drawn By: RCP
Checked By: KYG & EGR

Sheet: 2.4

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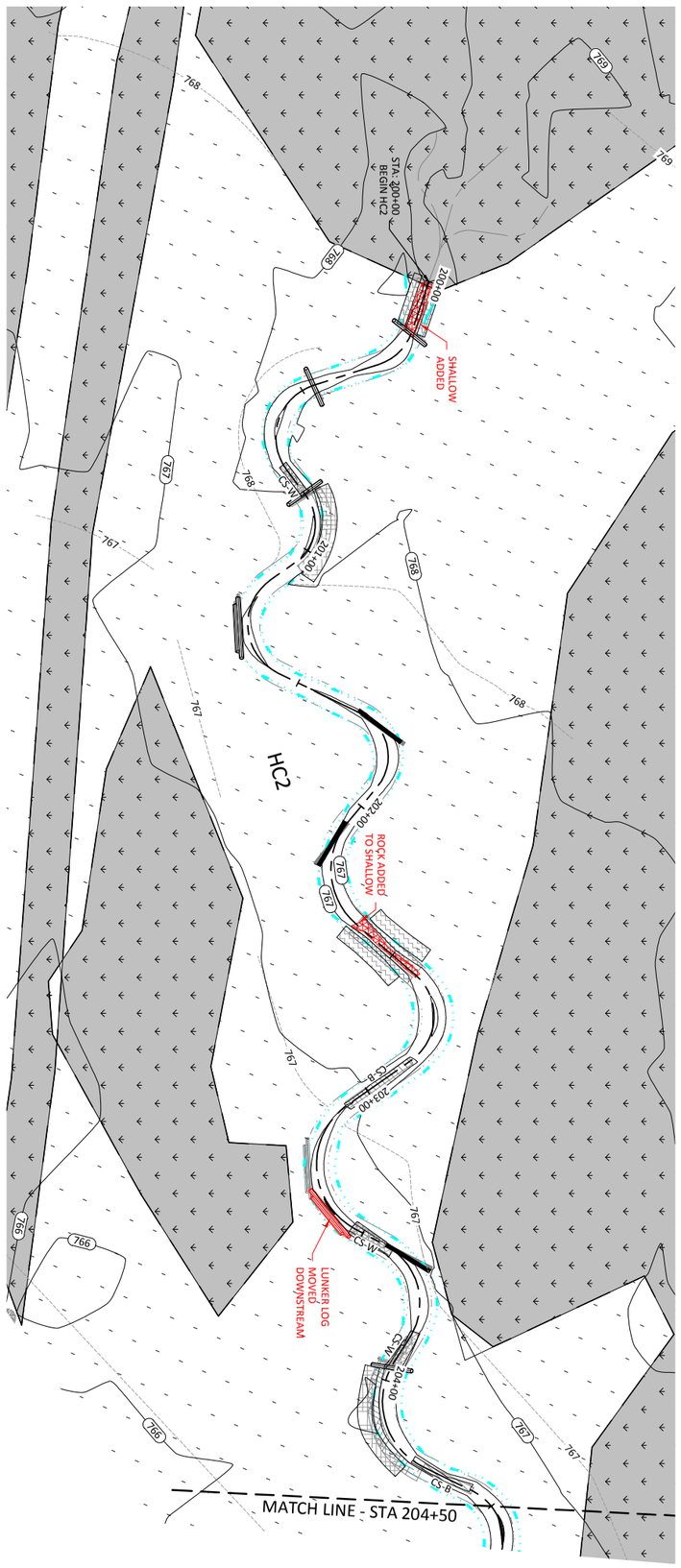

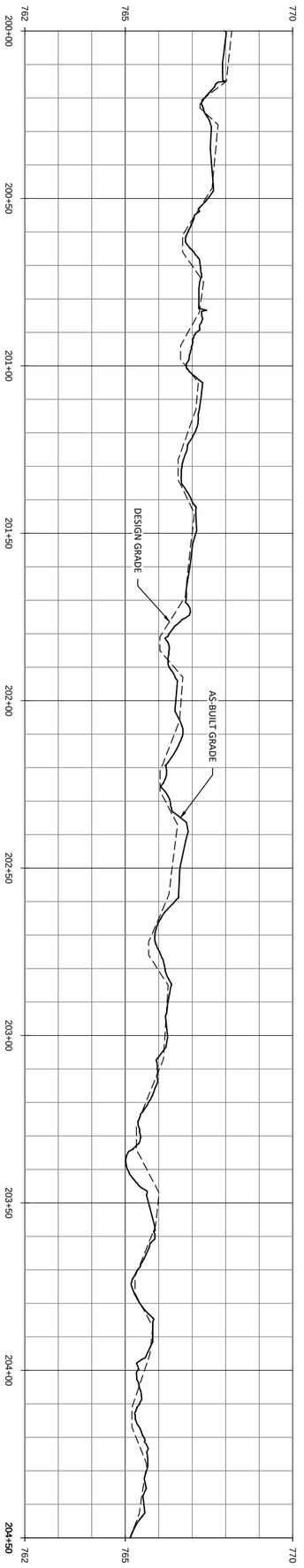

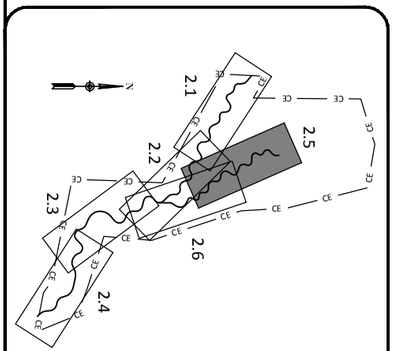

Sheet Index

Date:	February 17, 2016
Job Number:	005-02140
Project Engineer:	EPN
Drawn By:	RCP
Checked By:	KYG & EGR

Revisions:

2.5
Sheet

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

HC2
Stream Plan and Profile

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Charlotte, NC 28203
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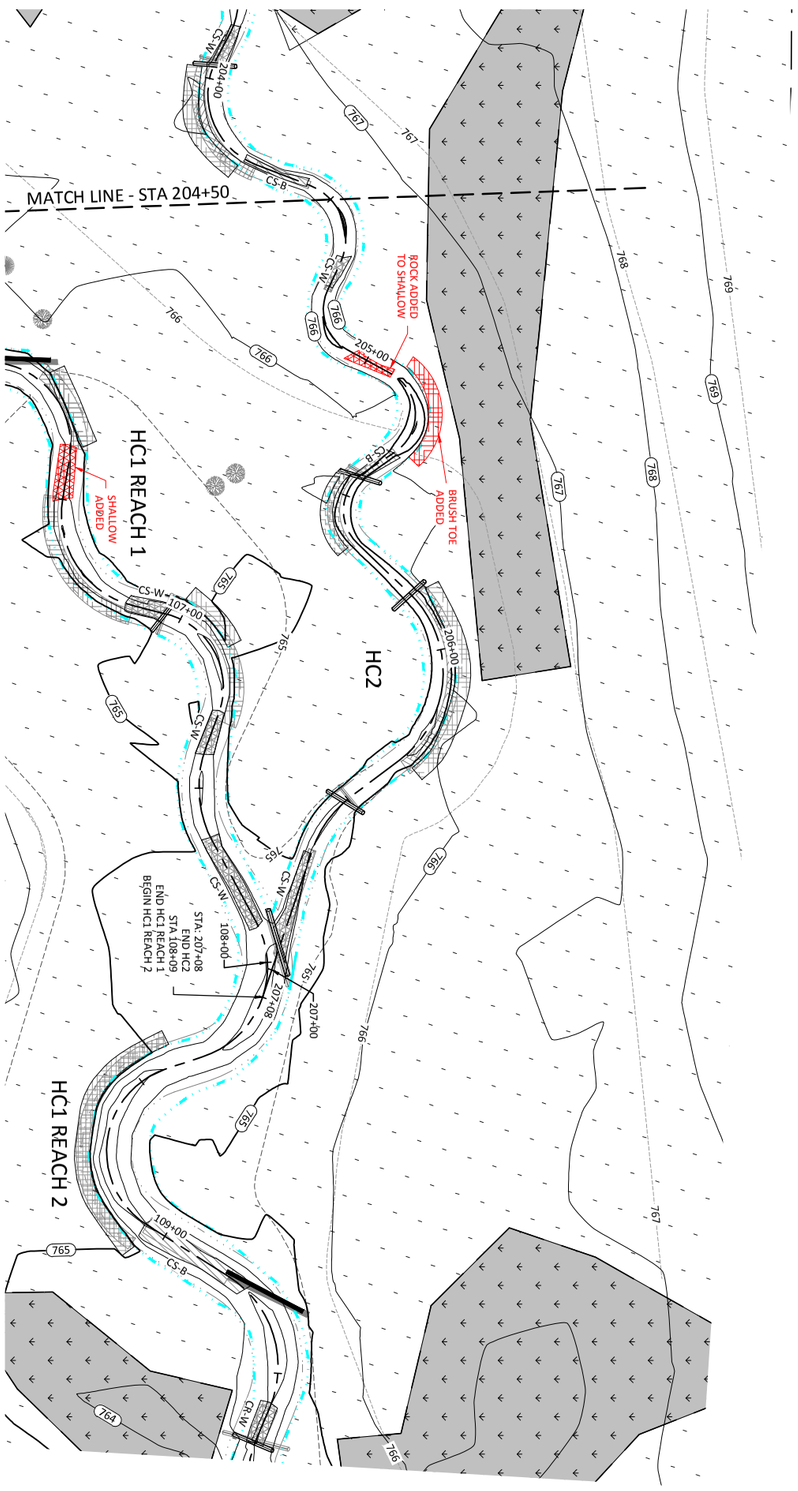

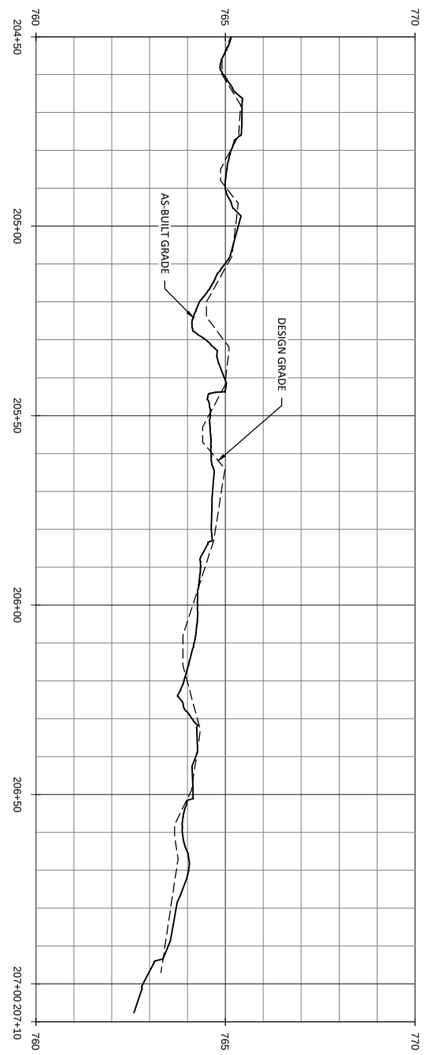

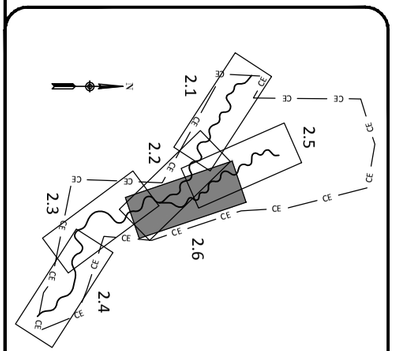

Sheet Index

Date:	February 17, 2016
Job Number:	005-02140
Project Engineer:	EPN
Drawn By:	RCP
Checked By:	KYG & EGR

Revisions:

2.6
Sheet

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

HC2
Stream Plan and Profile

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February 12, 2016

WETLAND RE-ESTABLISHMENT BOUNDARY (TYP)

WETLAND REHABILITATION BOUNDARY (TYP)

EXISTING FARM ROAD

RELOCATED OVERHEAD ELECTRIC LINE. BURIED BY RUTHERFORD ELECTRIC.

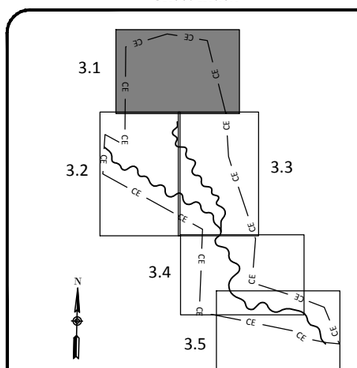
MATCHLINE - SHEET 3.2

MATCHLINE - SHEET 3.3

N

0' 20' 40' 60'
(HORIZONTAL)

Sheet Index



T:\ACTIVE PROJECTS (NC)\005.01\Owls Den Monitoring\Baseline Plans\2016\Owls Den Wetland Grading.dwg

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Charlotte, NC 28203
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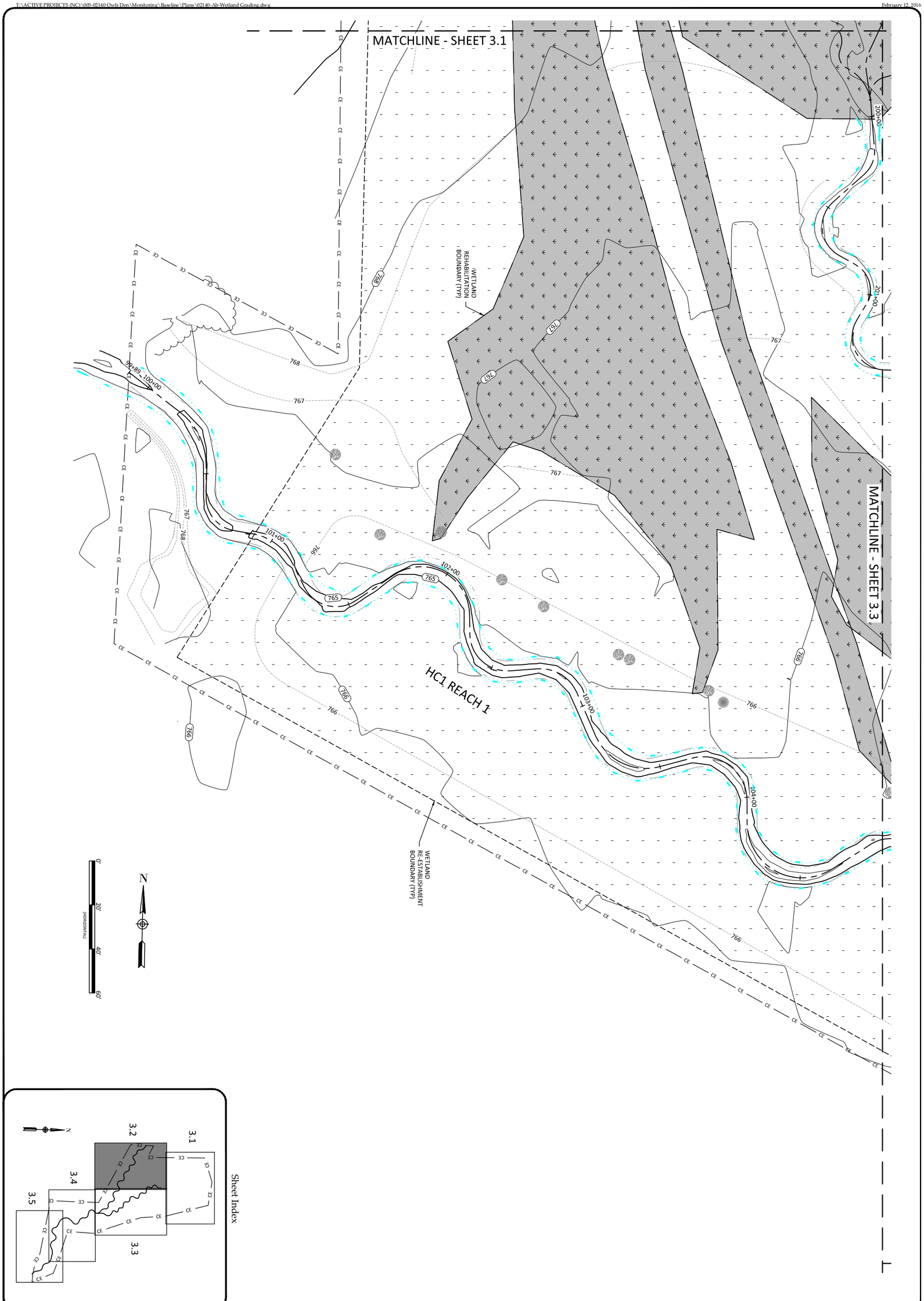
NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina
Wetland Grading

Revisions:

Date: February 2, 2016
Job Number: 005-021-lw
Project Engineer: EPN
Drawn By: KCP
Checked By: KYG

Sheet 3.1



Sheet Index

Date:	February 2, 2016
Job Number:	005-02140
Project Engineer:	EPN
Drawn By:	RCP
Checked By:	KYG

3.2
Sheet

Revisions:

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

Wetland Grading

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 042660

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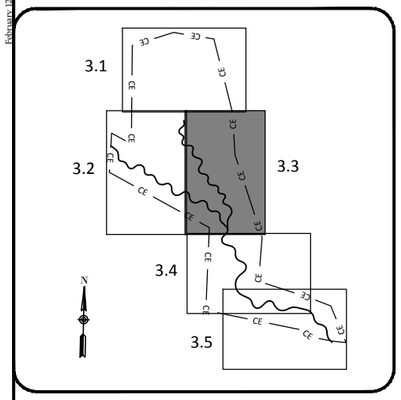
February 12, 2016

Sheet Index



N

0' 20' 40' 60'
(HORIZONTAL)

NEW GROUNDING CABINET INSTALLED BY RUTHERFORD ELECTRIC

RELOCATED ELECTRIC LINE. BURIED BY RUTHERFORD ELECTRIC.

WETLAND RE-ESTABLISHMENT BOUNDARY (TYP)

WETLAND REHABILITATION BOUNDARY (TYP)

HC2

HC1 REACH 1

MATCHLINE - SHEET 3.1

MATCHLINE - SHEET 3.2

MATCHLINE - SHEET 3.4

WILDLANDS ENGINEERING
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Fax: 704.332.3306
Firm License No. F-0831

NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUMANN

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina
Wetland Grading

Revisions:

Date:	February 2, 2016
Job Number:	055-021-16
Project Engineer:	EPN
Drawn by:	RCT
Checked By:	KYG

Sheet 3.3

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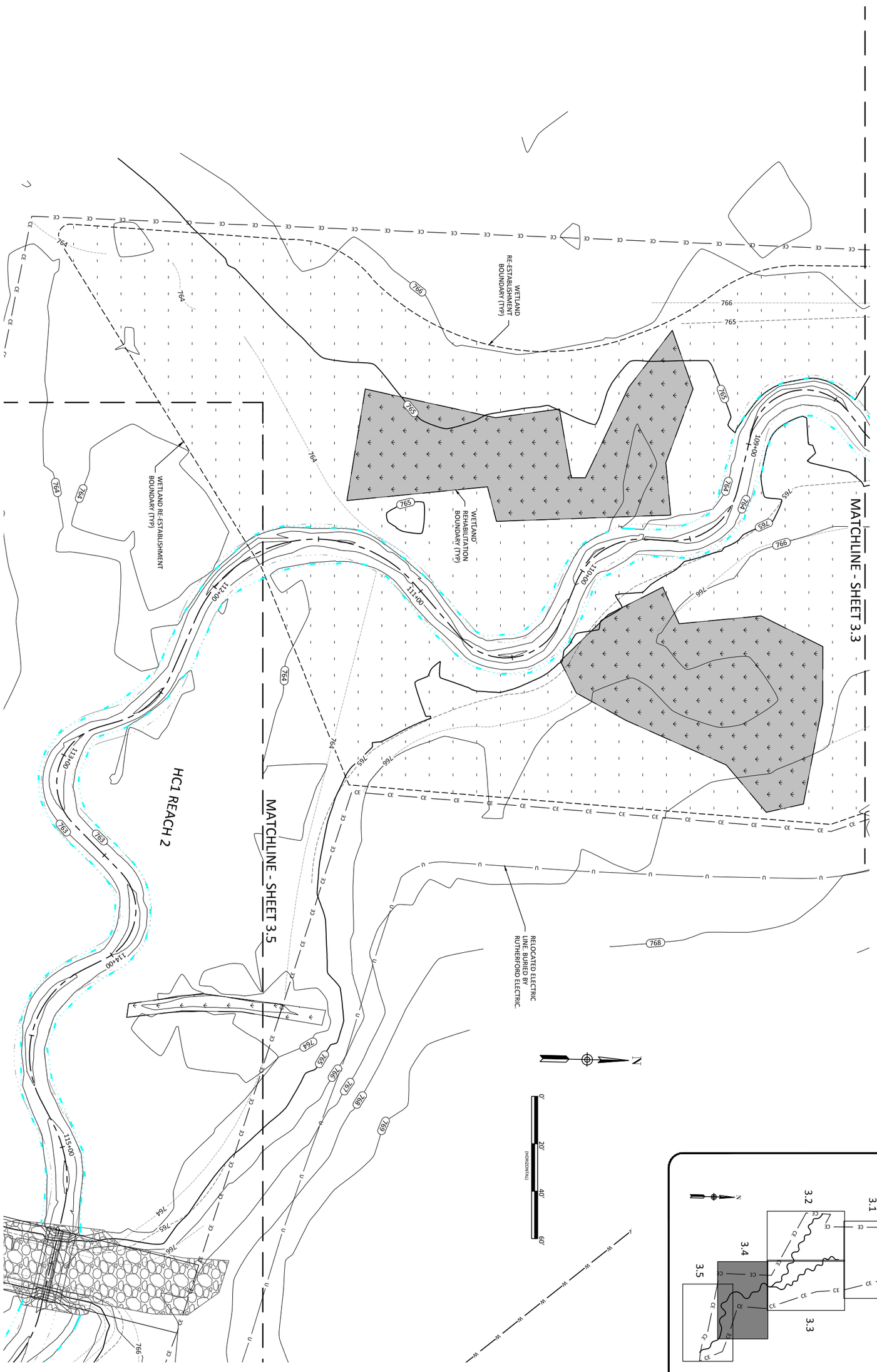

Sheet Index

Date:	February 2, 2016
Job Number:	005-02140
Project Engineer:	EPN
Drawn By:	RCP
Checked By:	KYG

Revisions:

3.4
Sheet

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

Wetland Grading

PROFESSIONAL ENGINEER SEAL 042660 NORTH CAROLINA

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Firm License No. F-0831

February 12, 2016

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WETLAND RE-ESTABLISHMENT BOUNDARY (TYP)

HC1 REACH 2

MATCHLINE - SHEET 3.4

DESIGNATED CROSSING LOCATION WITHIN CONSERVATION EASEMENT

OVERFLOW ADDITION

RELOCATED ELECTRIC LINE. BURIED BY RUTHERFORD ELECTRIC.

HOWARDS CREEK

112+00 113+00 114+00 115+00 116+00 117+00 117+79

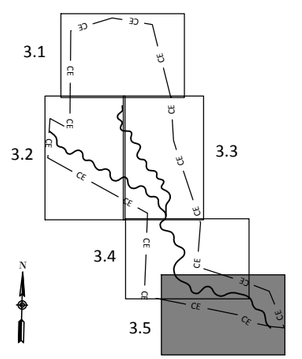
763 764 765 766 767 768 762

CE U W

N

0' 20' 40' 60'
(HORIZONTAL)

Sheet Index



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Firm License No. F-0831

NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

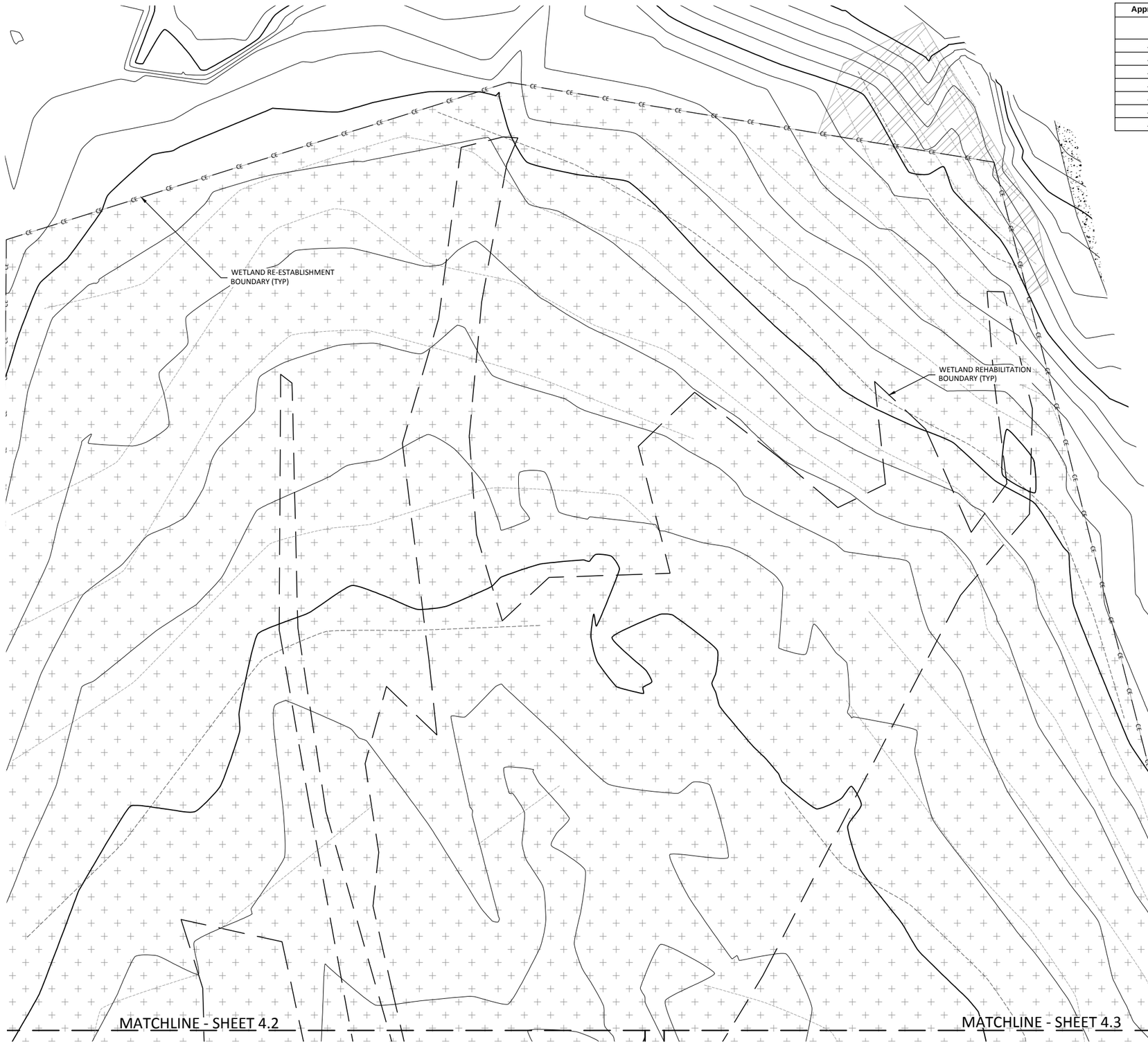
Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina
Wetland Grading

Revisions:

Date:	February 2, 2016
Job Number:	005-021-H
Project Engineer:	EPN
Drawn By:	KGP
Checked By:	KYG

Sheet 3.5

February 12, 2016



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

Bare Root Planting		
Scientific Name	**Common Name**	**%**
Platanus occidentalis	Sycamore	20%
Quercus phellos	Willow Oak	15%
Betula nigra	River Birch	15%
Fraxinus pennsylvanica	Green Ash	25%
Quercus michauxii	Swamp Chestnut Oak	10%
Acer rubrum	Red Maple	5%
Diospyros virginiana	Persimmon	10%

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

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

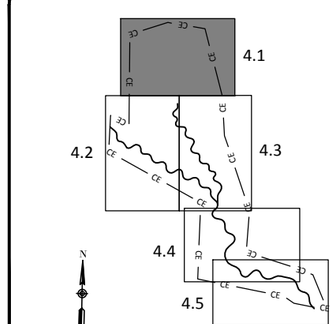
NOTE:
GROUND STABILIZATION SHALL BE ESTABLISHED WITHIN 7 DAYS OF GRADING COMPLETION FOR SLOPES STEEPER THAN 4:1 AND WITHIN 14 DAYS FOR SLOPES 4:1 OR FLATTER. PERMANENT GROUND COVER SHALL BE ESTABLISHED FOR ALL DISTURBED AREAS WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER IS SHORTER) FOLLOWING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

Live Stake		
Scientific Name	**Common Name**	**%**
Salix serecia	Silky Willow	30%
Cornus amomum	Silky Dogwood	30%
Physocarpus opulifolius	Ninebark	15%
Sambucus canadensis	Elderberry	15%
Cephalanthus occidentalis	Button Bush	10%

N

0' 20' 40' 60'
(HORIZONTAL)

Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina
Planting

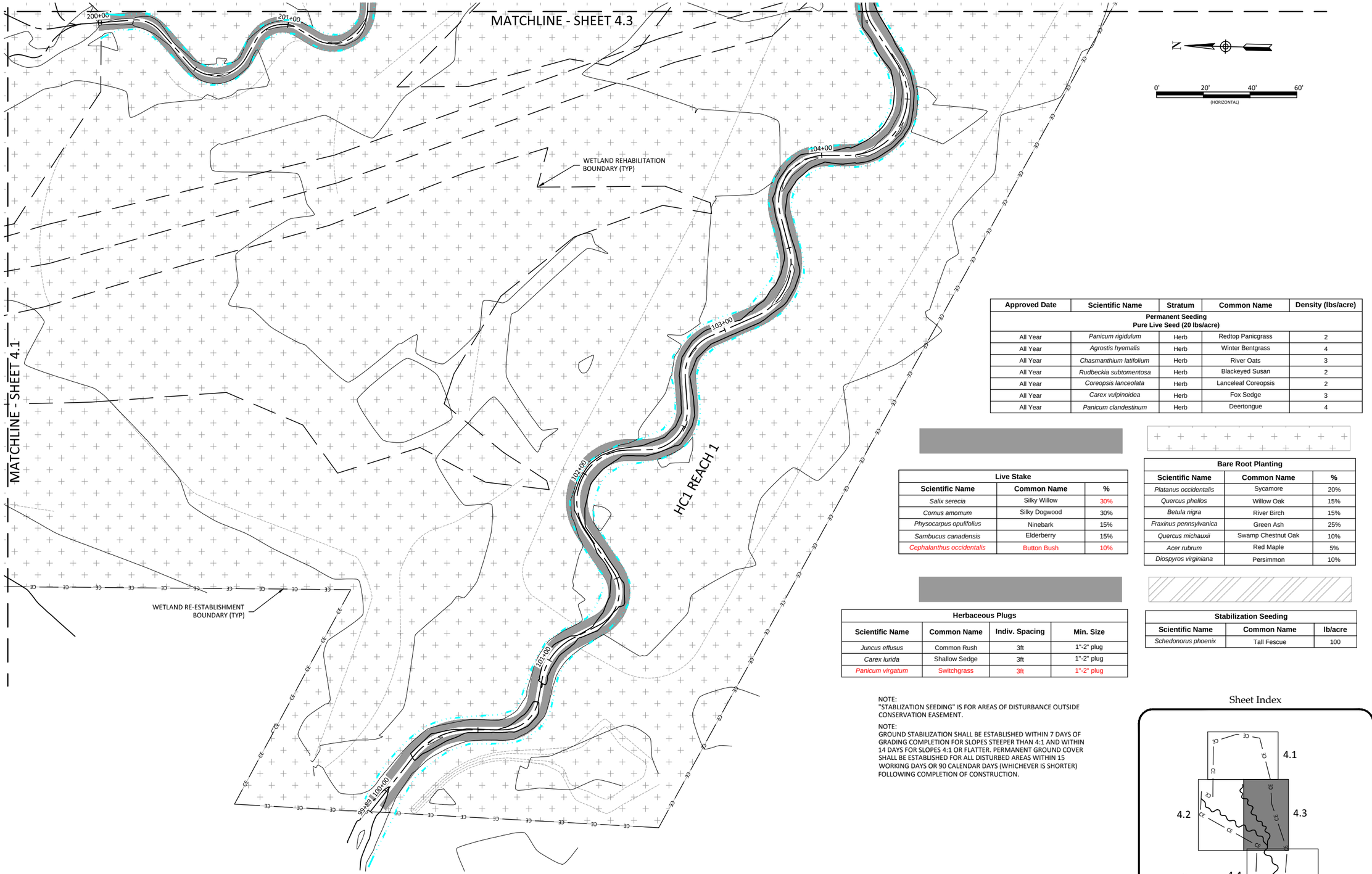
Revisions:

Date: February 2, 2016
JOB Number: 053-02140
Project Engineer: EPN
Drawn By: RCP
Checked By: KVG

Sheet 4.1

T:\ACTIVE PROJECTS\NC\053-02140 Owls Den Monitoring\Baseline\Plans\02140-Ab-Planting.dwg

February 12, 2016



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

Live Stake

Scientific Name	Common Name	%
Salix serecia	Silky Willow	30%
Cornus amomum	Silky Dogwood	30%
Physocarpus opulifolius	Ninebark	15%
Sambucus canadensis	Elderberry	15%
Cephalanthus occidentalis	Button Bush	10%

Bare Root Planting

Scientific Name	Common Name	%
Platanus occidentalis	Sycamore	20%
Quercus phellos	Willow Oak	15%
Betula nigra	River Birch	15%
Fraxinus pennsylvanica	Green Ash	25%
Quercus michauxii	Swamp Chestnut Oak	10%
Acer rubrum	Red Maple	5%
Diospyros virginiana	Persimmon	10%

Herbaceous Plugs

Scientific Name	Common Name	Indiv. Spacing	Min. Size
Juncus effusus	Common Rush	3ft	1"-2" plug
Carex lurida	Shallow Sedge	3ft	1"-2" plug
Panicum virgatum	Switchgrass	3ft	1"-2" plug

Stabilization Seeding

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

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

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

Sheet Index

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NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina
Planting

Revisions:

Date: February 2, 2016
Job Number: 085-021-10
Project Engineer: EPN
Drawn By: KCP
Checked By: KYG

Sheet 4.2

T:\ACTIVE PROJECTS (NC)\085-021\Owls Den Monitoring\Baseline Plans\2016-As-Planted.dwg

February 12, 2016

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

Bare Root Planting

Scientific Name	Common Name	%
Platanus occidentalis	Sycamore	20%
Quercus phellos	Willow Oak	15%
Betula nigra	River Birch	15%
Fraxinus pennsylvanica	Green Ash	25%
Quercus michauxii	Swamp Chestnut Oak	10%
Acer rubrum	Red Maple	5%
Diospyros virginiana	Persimmon	10%

Live Stake

Scientific Name	Common Name	%
Salix serecia	Silky Willow	30%
Cornus amomum	Silky Dogwood	30%
Physocarpus opulifolius	Ninebark	15%
Sambucus canadensis	Elderberry	15%
Cephalanthus occidentalis	Button Bush	10%

Stabilization Seeding

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

Herbaceous Plugs

Scientific Name	Common Name	Indiv. Spacing	Min. Size
Juncus effusus	Common Rush	3ft	1"-2" plug
Carex lurida	Shallow Sedge	3ft	1"-2" plug
Panicum virgatum	Switchgrass	3ft	1"-2" plug

NOTE:
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NOTE:
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N

0' 20' 40' 60'
(HORIZONTAL)

RELOCATED ELECTRIC LINE. BURIED BY RUTHERFORD ELECTRIC.

WETLAND RE-ESTABLISHMENT BOUNDARY (TYP)

WETLAND REHABILITATION BOUNDARY (TYP)

HC2

HC1 REACH 1

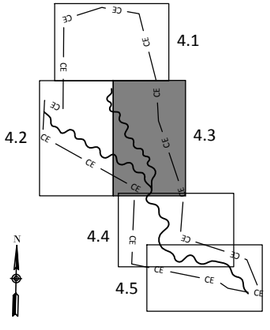
202+00 203+00 204+00 205+00 206+00 207+(207+08 107+00 106+00 105+00

MATCHLINE - SHEET 4.1

MATCHLINE - SHEET 4.2

MATCHLINE - SHEET 4.2

Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

Planting

Revisions:

Date: February 2, 2016
Job Number: 015-02140
Project Engineer: EPN
Drawn By: BCP
Checked By: KYG

Sheet 4.3

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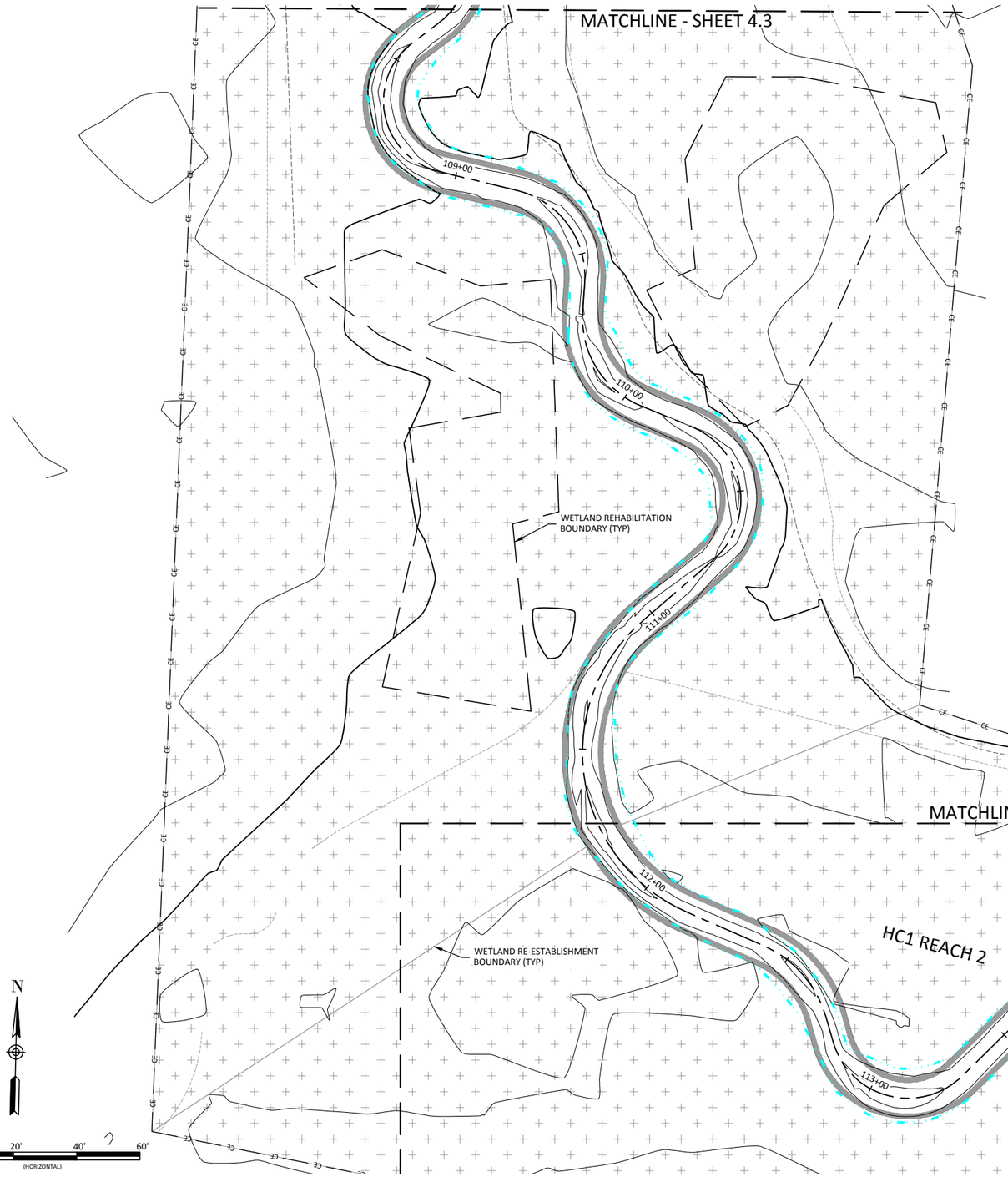
February 10, 2016



Approved Date	Scientific Name	Stratum	Common Name	Density (lbs/acre)
Permanent Seeding Pure Live Seed (20 lbs/acre)				
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All Year	*Coreopsis lanceolata*	Herb	Lanceleaf Coreopsis	2
All Year	*Carex vulpinoidea*	Herb	Fox Sedge	3
All Year	*Panicum clandestinum*	Herb	Deertongue	4

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

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

Live Stake		
Scientific Name	**Common Name**	**%**
Salix serecia	Silky Willow	30%
Cornus amomum	Silky Dogwood	30%
Physocarpus opulifolius	Ninebark	15%
Sambucus canadensis	Elderberry	15%
Cephalanthus occidentalis	Button Bush	10%

Bare Root Planting		
Scientific Name	**Common Name**	**%**
Platanus occidentalis	Sycamore	20%
Quercus phellos	Willow Oak	15%
Betula nigra	River Birch	15%
Fraxinus pennsylvanica	Green Ash	25%
Quercus michauxii	Swamp Chestnut Oak	10%
Acer rubrum	Red Maple	5%
Diospyros virginiana	Persimmon	10%

NOTE:
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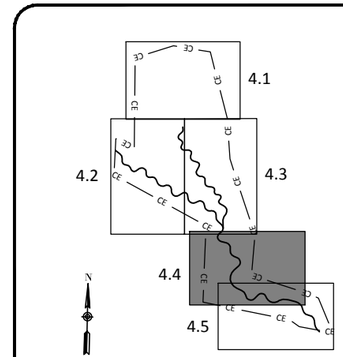
Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina
Planting

Revisions:

Date: February 2, 2016
Job Number: 015-02140
Project Engineer: EPN
Drawn By: RCP
Checked By: KYC

Sheet 4.4

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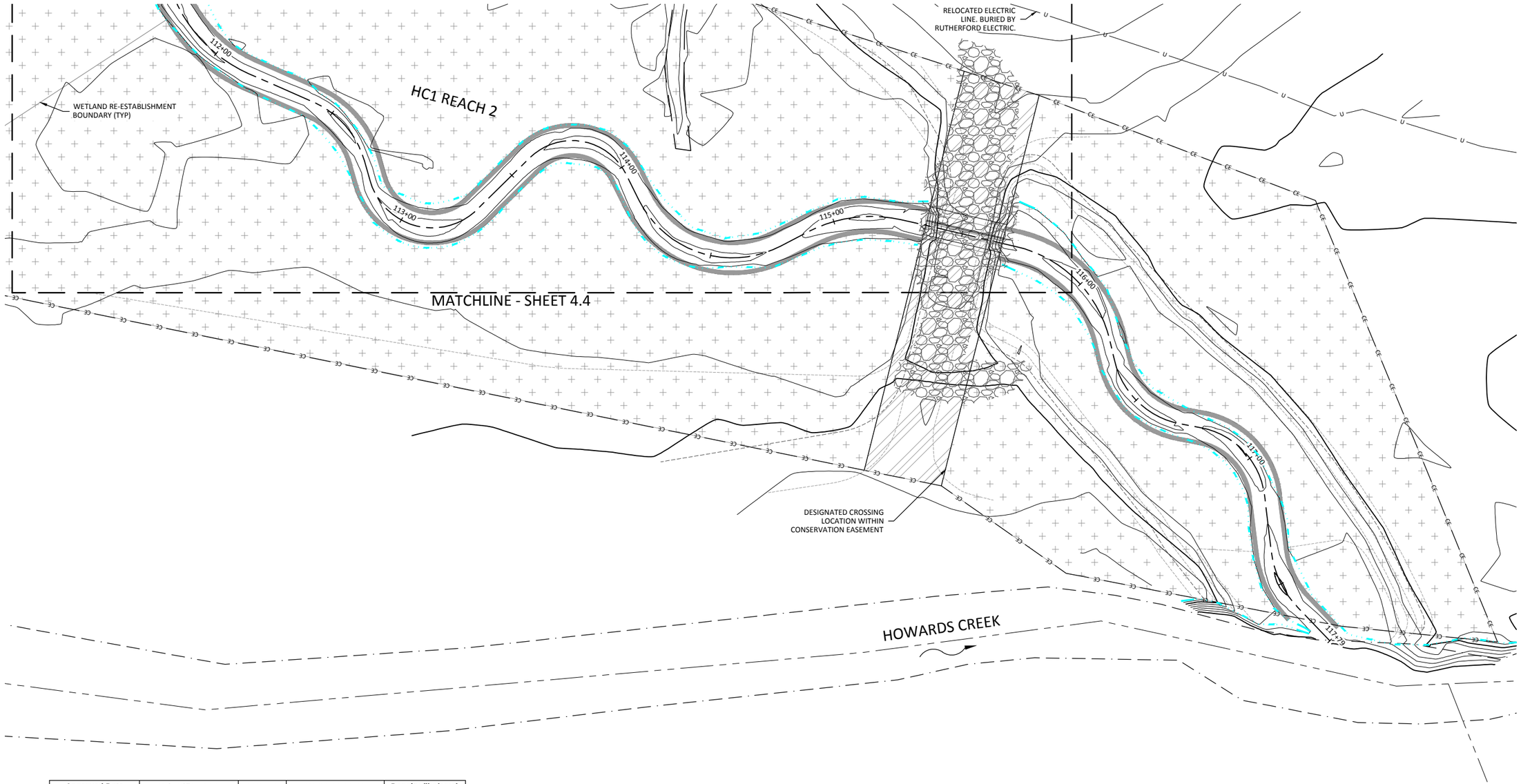

Approved Date	Scientific Name	Stratum	Common Name	Density (lbs/acre)
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Herbaceous Plugs			
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Stabilization Seeding		
Scientific Name	**Common Name**	**lb/acre**
Schedonorus phoenix	Tall Fescue	100

Bare Root Planting		
Scientific Name	**Common Name**	**%**
Platanus occidentalis	Sycamore	20%
Quercus phellos	Willow Oak	15%
Betula nigra	River Birch	15%
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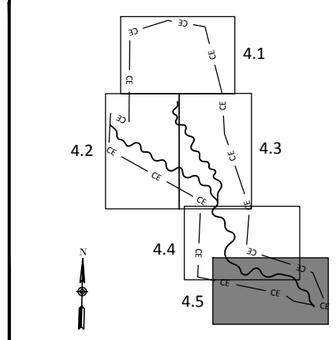
(HORIZONTAL)

Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 042660 ENGINEER ERIC P. NEUHAUS

Owl's Den Mitigation Site Record Drawings
Lincoln County, North Carolina

Planting

Revisions:

Date: February 2, 2016
Job Number: 035-021-(R)
Project Engineer: EPN
Drawn by: RKT
Checked by: KYG

Sheet 4.5