LITTLE WHITE OAK CREEK STREAM RESTORATION

POLK COUNTY, NORTH CAROLINA

CONTRACT # D06027-B

Prepared For:

Ecosystem Enhancement Program
Department of Environment and Natural Resources
1652 Mail Service Center
Raleigh, NC 27699-1652

ANNUAL MONITORING REPORT (YEAR 3 OF 5)

DECEMBER 2010

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Table of Contents

Appendix D. Cross Section Photos
Appendix E. Raw Data
Appendix F. Year 3 Areas of Concern Photos

1.0 Executive Summary

This annual monitoring report details the third year monitoring activities and their results for the Little White Oak Creek Stream Restoration Site (LWOC). All of the monitoring activities were conducted and the subsequent results are reported in accordance with the approved mitigation plan (Mulkey Engineers and Consultants, 2008) for LWOC. The content and format of this report were developed in accordance with the contract requirements for the Full Delivery RFP 16-D06027 (NCEEP, 2005). Accordingly, this report includes project background information, project monitoring results, and description of the project monitoring methodology.

Mulkey Engineers and Consultants (Mulkey) submitted LWOC for the Full Delivery RFP 16-D06027 to provide 18,200 Stream Mitigation Units (SMUs). Mulkey was awarded the stream restoration contract and began work on the project on May 16, 2007 The primary goals of LWOC were to improve water quality, to reduce bank erosion, to reestablish a floodplain along each of the stream reaches, and to improve the aquatic and terrestrial wildlife habitat. These goals were met through the following objectives:

- By using natural channel design to restore stable pattern, dimension, and profile for 18,290 linear feet of stream channel
- By establishing a conservation easement, which will protect the streams from cattle intrusion and future development activities
- By establishing a floodplain or reconnecting the stream back to its historic floodplain, or a combination of both, for each project stream reach
- By creating or restoring floodplain features such as vernal pools, off channel ponds, or riparian wetlands
- By increasing the amount of aquatic habitat through the addition of rock and wood structures
- By reestablishing native plant communities throughout the conservation easement, whereby reintroducing shading, cover areas, and travel corridors.

LWOC is located in Polk County, North Carolina near the community of Mill Springs and is situated in the Broad River Basin. Past land use practices, including extensive cattle farming, stream channelization and dredging, and clearing of the riparian buffers resulted in substantial degradation of the stream systems at LWOC. LWOC is comprised of seven stream reaches totaling 18,290 feet of restored stream channel. All of the analyses, design, and restoration at LWOC were accomplished using natural stream channel design methods. In addition to stream channel restoration, the restored stream banks and the riparian and upland buffer areas along LWOC were also replanted with native species vegetation.

The survivability of the planted vegetation at LWOC was monitored at representative vegetation plots as well as project-wide. Stem counts, photo documentation and comparison, and visual assessment were utilized. Bare root stock were planted at a density of 680 stems per acre (8 foot by 8 foot spacing) and live stakes were planted on the stream banks at a density of 1,742 stems per acre (5 foot by 5 foot spacing). A total of 24 representative vegetation plots were installed at LWOC based on the recommendations set

forth by EEP regarding the acreage contained in the conservation easement. The survivability of the planted woody vegetation at LWOC was monitored using annual stem counts at each of the plots. In addition to the stem counts, annual photos were taken at each of the plots and also from 14 other permanent photo reference points. The vegetation plot photos were used for photo documentation and comparison of the vegetation growth at each plot. The photo documentation at the reference points were employed to assist in a project-wide visual assessment of the vegetation at LWOC. Survivability will be based on achieving a minimum of 320 stems per acre after Year 3 and 260 stems per acre after Year 5, across the project site. The stem counts were conducted during the latter part of the growing season months (August, September, and October) to insure survival throughout a complete growing season while still allowing for relative ease in identification.

In late August 2008, the vegetation monitoring for Monitoring Year 1 was conducted using the methodologies described above, including stem counts, photo documentation, and visual assessment. The stem counts resulted in the 24 vegetation plots having a survivability of planted woody stems ranging from 438 to 1000 stems per acre, with an average survivability of 713 stems per acre. The results indicated the survivability of the planted woody vegetation at LWOC will meet the success criteria outlined above for Year 3 and Year 5. The comparisons of the baseline and Monitoring Year 1 photos at both the 24 vegetation plot photo reference points and the 14 permanent photo reference points strongly complemented this suggestion, as no concerns, problems, or negative trends were documented. Similarly, the project-wide visual assessment provided further validation, as no vegetation problem areas were observed.

In mid-October 2009, the vegetation monitoring for Monitoring Year 2 was conducted using the methodologies described above, including stem counts, photo documentation, and visual assessment. The stem counts resulted in the 24 vegetation plots having a survivability of planted woody stems ranging from 367 to 1000 stems per acre, with an average survivability of 670 stems per acre. As with the previous year, the results indicated the survivability of the planted woody vegetation at LWOC will meet the success criteria outlined above for Year 3 and Year 5. The comparisons of the baseline and Monitoring Year 2 photos at both the 24 vegetation plot photo reference points and the 14 permanent photo reference indicated the vegetation is moving in a positive direction. The project-wide visual assessment provided validated this positive trend, as no vegetation problem areas were observed.

In early November 2010, the vegetation monitoring for Monitoring Year 3 was conducted using the methodologies described above, including stem counts, photo documentation, and visual assessment. The stem counts resulted in the 24 vegetation plots having a survivability of planted woody stems ranging from 327 to 917 stems per acre, with an average survivability of 557 stems per acre. The results indicated the survivability of the planted woody vegetation at LWOC met the success criteria outlined above for Year 3 and is on track to meet the criteria for Year 5. The comparison of the Monitoring Year 3 photos with all prior photos at both the 24 vegetation plots and the 14 permanent photo reference points indicated the vegetation is growing as expected. The vegetation is becoming well established and is steadily outcompeting many of the pioneer species such as grasses, briers,

and weeds. The project-wide visual assessment also validated this positive trend, as no vegetative problem areas were observed.

Stream dimension, pattern, profile, stream bed material, bank stability, and bankfull hydrology were monitored to evaluate the success of stream restoration at LWOC. The limits of the project stream reaches to be monitored at LWOC were determined using the sampling rates outlined by the USACE *et al*. (2003). The monitoring was conducted using annual field surveys, pebble counts, crest gage recordation, visual assessment and photo documentation. Baseline conditions for comparison of the stream parameters to be monitored were established from data gathered immediately after construction through the as-built survey process. Longitudinal profiles and Modified Wolman pebble counts were conducted for all reaches and a total of 13 permanent cross sections were surveyed and photo documented across LWOC. A total of eight crest gages across LWOC were installed for hydrologic monitoring to verify the occurrence of bankfull storm events. Annual photo documentation was used for stream monitoring to complement and validate the other stream monitoring practices from 14 permanent reference photo points. Annual project wide visual assessment was conducted using field observation and pedestrian surveys to identify any specific problem areas. Since it is only required during Monitoring Year 3 and Monitoring Year 5, the BEHI information was collected during this year. Stream restoration success at LWOC was evaluated by comparison of the annual monitoring results against those same parameters as predicted, specified, and required in the proposed design and as implemented during the construction process represented by the as-built or baseline conditions. Success was achieved when all such comparisons reveal positive trends toward overall stream stability.

In late August 2008, the stream monitoring for Monitoring Year 1 was conducted using the methodologies described above. The results of the stream dimension, pattern, and profile monitoring demonstrated that all of the reaches were experiencing the expected minor adjustments indicative of movement toward increased stream stability and were attributed to vegetation establishment and natural channel adjustments. Fluctuations in bed materials were expected to occur during the early years following construction. Fining of the bed materials was documented by the stream bed material monitoring. The stream systems at LWOC appear to be sand-dominated and therefore coarsening of the bed may not occur. However, the monitoring results suggested on-site sediment supply from LWOC has been reduced as a result of the restoration. Fluctuations in bed materials are likely to continue and several years may be needed to observe a consistent bed material. Data collected at six of the eight on-site crest gauges provided evidence indicating a storm event producing a stage in excess of the bankfull storm occurred at LWOC during Monitoring Year 1. This documented the first of two required bankfull events over the five year monitoring period in order to achieve success with regards to hydrologic monitoring at LWOC. No stream problems were documented through the photo documentation comparison process. However, the project-wide visual assessment conducted along each of the project stream reaches revealed 12 specific stream problem areas which included in-stream structure failures and associated stream bank erosion, areas of floodplain and adjacent stream bank erosion, and an area of stream bank erosion. Mulkey elected to promptly address all of the observed stream problem areas and conducted construction repairs of each in October 2008.

All of the in-stream structures and the areas of floodplain and stream bank erosion were repaired. The repairs to the all of the areas of eroded stream banks included re-grading, re-seeding with appropriate temporary and permanent seed, re-installing coir fiber matting, and re-planting with live stakes. Upon completion of the repair work, LWOC experienced no other stream problem areas and was deemed a success for Year 1 Monitoring.

In mid-October and early November 2009, the stream monitoring for Monitoring Year 2 was conducted using the methodologies described above. The results of the stream dimension, pattern, and profile monitoring demonstrated that all of the reaches were experiencing the expected minor adjustments indicative of movement toward increased stream stability and were attributed to vegetation establishment and natural channel adjustments. Fluctuations in bed materials were expected to occur during the early years following construction. Fining of the bed materials was documented by the stream bed material monitoring. The stream systems at LWOC appear to be sand-dominated and therefore coarsening of the bed may not occur. However, the monitoring results suggested on-site sediment supply from LWOC has been reduced as a result of the restoration, particularly from increased native vegetation and soil stabilization. Fluctuations in bed materials are likely to continue and several years may be needed to observe a consistent bed material. Data collected at seven of the eight on-site crest gauges provided evidence indicating a storm event producing a stage in excess of the bankfull storm occurred at LWOC during Monitoring Year 2. This documented the second of two required bankfull events over the five year monitoring period in order to achieve success with regards to hydrologic monitoring at LWOC. No stream problems were documented through the photo documentation comparison process. However, the project-wide visual assessment conducted along each of the project stream reaches revealed 3 specific stream problem areas, all of which are associated with beaver dams constructed along reaches R1 and R2. Mulkey is actively coordinating with the United States Department of Agriculture (USDA) Wildlife Services under their Beaver Management Assistance Program (BMAP) to have the beavers and beaver dams removed, as well as to have site monitored for future beaver activity.

In early November 2010, the stream monitoring for Monitoring Year 3 was conducted using the methodologies described above. Despite the site suffering a flood event from the remnants of a tropical storm, the overall stability of the six stream reaches has improved. The stream dimension, pattern, and profile remained consistent with the previous years' data and continue to remain within the tolerances of the design parameters. The bed material in the larger streams is beginning to coarsen to the projected design values while the smaller streams remain finer than anticipated. It must be noted that along R1 the visual assessment indicated multiple areas of bank, bench, and terrace scour. The scour was confined to R1 as there was no presence of scour along the other five reaches though they experienced the same event as indicated by the absence of the crest gauge or direct measurement of the crest gauge on each respective reach and apparent deposition of sediment on the benches. Although mostly along the terrace, Mulkey intends to repair the scour areas in early 2011 to ensure an ample amount of time is available for the regrowth of vegetation in the areas where significant disturbance will occur. However, even with this disturbance along R1, the Bank Erosion Hazard Index (BEHI) and Near Bank Shear stress (NBS) evaluation of all

reaches showed a significant reduction in sediment supply throughout the entire stream network.

As a note, Mulkey performed the required fence relocation to encompass a minimum 50 foot buffer as requested by NCEEP in late Spring of 2010. These changes are reflected on the plan sheets in Appendix A.

Therefore, it is the determination of Mulkey, the LWOC has proven to be an overall success in both vegetative and stream monitoring for Year 3 monitoring (2010). Both the vegetative and stream monitoring depict a stable stream system despite being impacted by flood flows. As mentioned, Mulkey intends to correct several areas of scour, however these areas are restricted to the floodplain benches and terraces which did not reflect negative trends under the monitoring guidance.

2.0 Project Background

2.1 Project Location and Setting

The Little White Oak Creek Stream Restoration Site is located in Polk County, North Carolina approximately 2.5 miles east/southeast from the community of Mill Springs along NC Highway 9 South, and approximately 0.5 mile northwest from the intersection of NC Highway 9 South and US Highway 74 (Figure 1). LWOC is situated in the Broad River Basin 8-digit cataloging unit of 03050105 and the 14-digit cataloging unit 03050105030010. Mulkey proposed to provide 18,200 Stream Mitigation Units (SMUs) with LWOC under the Full Delivery RFP 16-D06027 issued by the Ecosystem Enhancement Program Department of Environment and Natural Resources (NCEEP). Mulkey acquired and installed permanent fencing along an easement covering 55.3 acres, which encompasses the restored streams and associated buffers at LWOC.

2.2 Project Goals and Objectives

The primary goals of LWOC were to improve water quality, to reduce bank erosion, to reestablish a floodplain along each of the stream reaches, and to improve the aquatic and terrestrial wildlife habitat.

These goals were met through the following objectives:

- By using natural channel design to restore stable pattern, dimension, and profile for 18,290 linear feet of stream channel
- By establishing a conservation easement, which will protect the streams from cattle intrusion and future development activities
- By establishing a floodplain or reconnecting the stream back to its historic floodplain, or a combination of both, for each project stream reach
- By creating or restoring floodplain features such as vernal pools, off channel ponds, or riparian wetlands

- By increasing the amount of aquatic habitat through the addition of rock and wood structures
- By reestablishing native plant communities throughout the conservation easement, whereby reintroducing shading, cover areas, and travel corridors.

2.3 Project Restoration Approach and Mitigation Type

LWOC is comprised of three main reaches (R1, R2 Upper and R2 Lower) and four tributaries (R1A, R2A, R2B and R2D). Prior to construction, these seven reaches were identified and proposed for restoration due to their distinct stream characteristics and drainage areas. These seven existing reaches totaled approximately 15,487 linear feet. A total of 18,290 linear feet of stream channel was restored at LWOC within the 55.3 acre conservation easement.

Analyses, design, and restoration of the stream channels at LWOC was accomplished using Natural Stream Channel design methods developed by Rosgen (Rosgen, D. L., 1994, 1996, 1998). The proposed Rosgen channel type for two of the tributaries (R2A and R2B) was a C4 channel. The restoration of these tributaries was implemented using Priority Level I and II methodologies. The proposed stream classification for the majority of the reaches (R1, R1A, R2 Upper, and R2 Lower) was a C5 channel. A combination of Priority Level I and II methods were used to construct these reaches. The remaining reach (R2D) was proposed to be a C6 channel using the same methods previously mentioned.

The most significant stream restoration component at LWOC involved the reconstruction of each of the stream reaches such that stream flows greater than bankfull are allowed to access the restored stream's floodplain. Two different approaches were used to insure such floodplain access. The first approach involved relocating and raising the stream bed such that the historic floodplain is accessed by stream flows greater than bankfull (the sections of the project stream reaches that were restored using Priority Level I methodologies). A second approach was used where site constraints prevented such relocation and raising of the stream bed. Therefore the second approach involved building a floodplain at a level lower than the historic floodplain through the construction of bankfull benches (the sections of the project stream reaches that were restored using Priority Level II methodologies). In-stream structures were installed along each of the stream reaches to provide grade control and stream bank protection, and to increase in-stream habitat diversity. The in-stream structures installed included rock cross vanes, j-hook rock vanes, rock vanes, constructed riffles, and root wads. Stream banks were further stabilized through the installation of coir fiber erosion control matting, temporary and permanent seeding, and the installation of native species vegetation in the form of transplants, live stakes, and bare root stock. All areas of the site that were disturbed during construction activities were stabilized using temporary and permanent seeding. The riparian and upland buffer communities along LWOC were also restored with native species vegetation using a target community which will emulate the Piedmont/Low Mountain Alluvial Forest described by Shafale and Weakley (1990). The conservation easement was fenced to permanently protect the restored stream and buffer areas. Information regarding the restoration approach and mitigation type for each of the seven project stream reaches is detailed in Table 1.

2.4 Project History

The existing conditions at LWOC prior to restoration were a result of cattle use for the past 50 years. When Mulkey initially became involved with this project, there were approximately 200 livestock (cattle and horses) utilizing the pastures. The livestock had never been fenced from any of the stream channels within LWOC. This continual livestock access to the streams resulted in substantial erosion along the stream banks, incision of the channels, channel widening in some areas, and heavy siltation throughout LWOC, as well as reduced water quality due to large quantities of fecal matter into the stream system. Based on information gained from the property owner, it was determined that many of the streams at the LWOC, particularly the smaller tributaries, were historically maintained through channelization, dredging, and clearing of the riparian buffer. As a result of these land and water quality issues, Mulkey submitted LWOC for the Full Delivery RFP 16-D06027 to provide 18,200 Stream Mitigation Units (SMUs). Mulkey was awarded the stream restoration contract by the NCEEP and began work on the project on May 16, 2007. The project activity and reporting history are detailed in Table II. Table III lists the contacts for the designer, contractor, relevant suppliers, and monitoring firm for LWOC. Table IV provides a complete listing of project background information.

2.5 Project Monitoring Plan View

Mulkey conducted monitoring baseline surveys along the entire length of each of the restored project stream reaches using total station survey equipment. These surveys were conducted to establish and document baseline conditions for the newly restored stream channels for future monitoring activities. As-built drawings were developed using the results of the monitoring baseline surveys. These drawing depicted the post construction condition of LWOC and are included in Appendix A. The as-built drawings consisted of plan sheets that include the following:

- Title sheet
- Legend sheet
- As-built planimetric drawing developed from aerial photography of LWOC after the completion of construction
- As-built planimetric drawings and profiles developed from the baseline monitoring field surveys

The as-built drawings illustrate the location of all major project elements, including, but not limited to the:

- Restored stream channel thalweg, normal edges of water, constructed bankfull channel limits, and the constructed cut slope limits
- Conservation easement boundaries
- Permanent fencing limits
- Topography
- In-stream structures

- Photo points
- Crest gages
- Vegetation plots locations
- Permanent cross sections
- Project survey control
- Monitoring profile survey limits
- Relevant structures and utilities

3.0 Project Condition and Monitoring Results

3.1 Project Vegetation Monitoring

3.1.1 Vegetation Monitoring Methodology

The survivability of the planted vegetation at LWOC, including both woody and herbaceous species, was monitored at representative vegetation plots as well as project-wide. Monitoring at representative vegetation plots focused primarily on planted woody vegetation and was conducted using stem counts and photo documentation. Project-wide monitoring of planted vegetation included both woody and herbaceous species and was accomplished using visual assessment as well as photo documentation.

Major grading and channel construction was completed during the last week of November 2007. Throughout construction, appropriate temporary and permanent seeding was conducted to stabilize areas disturbed during construction. Appropriate existing native species vegetation was also salvaged, where feasible, in the form of transplants and live stakes, throughout the construction process. Immediately following the completion of the major grading and channel construction activities, all remaining plant material was installed during the months of November and December 2007. These remaining plant materials consisted of native species bare root seedlings and live stakes and were installed, as appropriate, to restore the riparian and upland buffer communities along LWOC within the conservation easement area. A complete listing of the planting zones, their corresponding acreages, and the corresponding vegetation species was included in the approved mitigation report (Mulkey Engineers and Consultants, 2008). The bare root stock were planted at a density of 680 stems per acre (8 foot by 8 foot spacing) and the lives stakes were planted on the stream banks at a density of 1,742 stems per acre (5 foot by 5 foot spacing).

An As-Built Survey was initiated immediately following the installation of plant materials. In December 2007, during the as-built survey and after the completion of planting, a total of 24 representative vegetation plots (vegetation plots 1 through 24) were installed randomly across LWOC. An iron pipe was installed at each plot corner for monumentation and a polyvinyl chloride (PVC) pipe, along with a label specifying the plot number, was also installed at one of the corners of each plot. The plot corners were strategically located such that each plot has a total area of approximately 100 square meters. Between January and February 2008, after the establishment of the plots, all stems contained in the plots were identified and tallied by species and plot, then marked with loosely tied survey flagging (on lateral branches) to facilitate future identification. This data was recorded to provide the

baseline survivability. The survivability of the planted woody vegetation at LWOC for the various monitoring periods was then calculated using annual stem counts at each of the plots and compared to the baseline data. During each of the annual stem counts, the planted stems were re-flagged as required to ensure that all planted stems were accounted for and considered in the survivability calculations. In addition to the stem counts, photos were taken at each of the plots. Where necessary, the corner of each plot was remarked with PVC pipe and the plot number relabeled. This PVC plot corner was used as the reference point from which the annual vegetation plot photos were taken such that the photos at each plot will have the same orientation. The photos were compared to the photos from the previous years to validate and document vegetation success. In addition to the photo reference points established at each of the vegetation plots, a total of 11 additional permanent photo reference points were installed across LWOC. Subsequently, three additional permanent photo reference points (photo points 2.5Y1, 3.5Y1, and 8.5Y1) were added during the Year 1 monitoring period to ensure adequate photo documentation would be conducted within the monitoring limits of the project stream reaches. These additional permanent photo reference points were monumented using steel rebar and PVC pipe. Photos were taken from each of the 14 permanent photo reference points with the same orientation each applicable year and used for photo documentation and annual comparison of the vegetation growth across LWOC. This exercise helped to further validate and document vegetation success at LWOC. Between January and February 2008, after installation of the described 11 permanent photo reference points, photos were taken from each of the permanent photo reference points to document the baseline conditions at LWOC with regards to planted vegetation. Monitoring Year 1 and Monitoring Year 2 photos were taken from all 14 photo points during the visit in August 2008 and October 2009, respectively. Project-wide visual assessment was also used for vegetation monitoring at LWOC. A visual assessment was conducted using annual field observation and pedestrian surveys to identify any specific vegetation problem areas at LWOC during the monitoring period. Any problem areas where vegetation was lacking or exotic vegetation was present, was identified and categorized as bare bank, bare bench, bare floodplain, or invasive population. Such areas were documented using representative photos and their locations were identified on the Monitoring Plan View.

3.1.2 Vegetation Monitoring Success Criteria

Vegetation success at LWOC was determined by stem survivability. Successful survivability is dependent upon achieving at least 320 stems per acre after three years and 260 stems per acre after five years across the project site. Therefore, survivability rates exceeding these requirements in previous years were deemed successful. The stem counts were conducted during the latter part of the growing season months (August, September, and October) to ensure survival throughout a complete growing season while still allowing for relative ease in identification. As described above, photo documentation and visual assessment was used to complement the stem counts as part of the vegetation monitoring protocol at LWOC. If during any given year, the planted species survivability was not anticipated to meet the final criteria established for vegetation; supplemental plantings were considered. In the event this occurred, a remedial planting plan was developed to achieve the survivability goals established for Years 3 and 5.

3.1.3 Vegetation Monitoring Results for Year 1 of 5

In late August 2008, the vegetation monitoring for Monitoring Year 1 was conducted. The methodologies described in the Vegetation Monitoring Methodology Section above were used for the vegetation monitoring at LWOC for Monitoring Year 1. Stem counts were conducted at each of the 24 vegetation plots and the results are summarized in Table V. Photos were taken from the photo reference points at each of the 24 vegetation plots. Appendix B compares these photos with the initial baseline photos taken from the photo reference points at each of the 24 vegetation plots. Photos were also taken from each of the 14 permanent photo reference points. Appendix C compares these photos with the initial baseline photos taken from the original 11 permanent photo reference points and provided the baseline photos for the 3 points installed during the Monitoring Year 1. A project-wide visual assessment was also conducted to identify any specific vegetation problem areas. Table VI summarizes the results of the project-wide vegetation visual assessment. The results of the Monitoring Year 1 stem counts showed that the 24 vegetation plots had successfully achieved the survivability of planted woody vegetation with stem counts ranging from 438 to 1000 stems per acre, with an average survivability of 713 stems per acre. The results indicated the survivability of the planted woody vegetation at LWOC should meet the success criteria defined in Section 3.1.2. During the stem counts, it was noted no significant volunteer woody species were observed at any of the 24 vegetation plots. The comparison of the baseline and Monitoring Year 1 photos at both the 24 vegetation plot photo reference points and the 11 permanent photo reference points strongly complemented this suggestion, as no concerns, problems, or negative trends were documented. The project-wide visual assessment provided further validation, as no vegetation problem areas were observed. Based on the results of the vegetation monitoring for Monitoring Year 1 at LWOC, Mulkey did not propose any additional recommendations or actions other than to proceed with the annual vegetation monitoring.

3.1.4 Vegetation Monitoring Results for Year 2 of 5

In mid-October 2009, the vegetation monitoring for Monitoring Year 2 was conducted. The methodologies described in the Vegetation Monitoring Methodology Section were used for the vegetation monitoring at LWOC for Monitoring Year 2. Stem counts were conducted at each of the 24 vegetation plots. Table V presents the results of these stem counts for each of the plots. This table includes and compares the results of the initial stem counts from the original planting, the previous years, and Monitoring Year 2. Photos were taken from the photo reference points at each of the 24 vegetation plots and are compared to the previously collected photos in Appendix B. Photos were also taken from each of the 14 permanent photo reference points. Appendix C compares these photos with the initial baseline photos taken from the original 11 permanent photo reference points from Year 0 and the photos from the 14 total permanent photo reference points in Monitoring Year 1. A project-wide visual assessment was also conducted to identify any specific vegetation problem areas and is summarized in Table VI. The results of the Monitoring Year 2 stem counts continued to display successful survivability in all 24 vegetation plots with the counts ranging from 367 to 1000 stems per acre and an average survivability of 670 stems per acre. Therefore survivability of the planted woody vegetation at LWOC should meet the success criteria

established in Section 3.1.2. Similar to Monitoring Year 1, no significant volunteer woody species were observed at any of the 24 vegetation plots. The comparison of the Monitoring Year 2 photos to those previously collected at both the 24 vegetation plot photo reference points and the 14 permanent photo reference points suggested the vegetation was growing exceptionally well. Live stake vegetation has exceeded growth expectations and the bare root material is starting to overcome the weedy vegetation. A further review of the vegetation through the project-wide visual assessment validated this positive trend, as no concerns, problems, or negative trends were documented. Based on the results of the vegetation monitoring for Monitoring Year 2 at LWOC, Mulkey did not propose any additional recommendations or actions other than to proceed with the annual vegetation monitoring.

3.1.5 Vegetation Monitoring Results for Year 3 of 5

In early November 2010, the vegetation monitoring for Monitoring Year 3 was conducted. The methodologies described in the Vegetation Monitoring Methodology Section were used for the vegetation monitoring at LWOC for Monitoring Year 3. Stem counts were conducted at each of the 24 vegetation plots. Table V presents the results of these stem counts for each of the plots. This table includes and compares the results of the initial stem counts from the original planting, the previous years, and Monitoring Year 3. Photos were taken from the photo reference points at each of the 24 vegetation plots and are compared to the previously collected 0photos in Appendix B. Photos were also taken from each of the 14 permanent photo reference points. Appendix C compares these photos with the initial baseline photos taken from the original 11 permanent photo reference points from Year 0 and the photos from the 14 total permanent photo reference points in Monitoring Year 1. A project-wide visual assessment was also conducted to identify any specific vegetation problem areas and is summarized in Table VI. The results of the Monitoring Year 3 stem counts continued to display successful survivability in all 24 vegetation plots with the counts ranging from 327 to 917 stems per acre and an average survivability of 557 stems per acre. Therefore survivability of the planted woody vegetation at LWOC meets the success criteria established in Section 3.1.2. for Year 3 and is on track for success in Year 5. Additional uncounted volunteer woody species were observed at all of the 24 vegetation plots. The comparison of the Monitoring Year 2 photos to those previously collected at both the 24 vegetation plot photo reference points and the 14 permanent photo reference points suggested the vegetation was growing exceptionally well. Live stake vegetation has exceeded growth expectations and the bare root material is starting to overcome the weedy vegetation. A further review of the vegetation through the project-wide visual assessment validated this positive trend, as no concerns, problems, or negative trends were documented. Based on the results of the vegetation monitoring for Monitoring Year 3 at LWOC, Mulkey did not propose any additional recommendations or actions other than to proceed with the annual vegetation monitoring. The only additional plantings that will be utilized are associated with the repair work discussed in Section 3.2.5.

3.2 Project Stream Monitoring

3.2.1 Stream Monitoring Methodology

Stream dimension, pattern, profile, stream bed material, bank stability, and bankfull hydrology were monitored to evaluate the success of the stream restoration activities at LWOC. The monitoring of stream dimension, pattern, and profile, or morphometric monitoring, along with the monitoring of stream bed material, were conducted using annual field surveys along with visual assessment. The morphometric, stream bed material, and stream bank stability monitoring were conducted along representative sections of the project stream reaches. Hydrologic monitoring consisted of field measurements of bankfull events using crest gages. Project-wide stream monitoring was accomplished using visual assessment as well as photo documentation.

Major grading and channel construction were completed during the last week of November 2007. Immediately following the completion of the major grading and channel construction activities, all remaining plant material was installed during the months of November and December 2007. The as-built survey of all of the stream reaches at LWOC were initiated immediately following the installation of plant materials and were conducted utilizing aerial photography and total station surveys while following the protocols set forth by the 2003 USACE Stream Mitigation guidelines (USACE *et al*., 2003). In addition to documenting the construction of LWOC for comparison to the proposed design, the results of the as-built survey were also used to establish baseline morphology for the proposed monitoring. This information is presented in Table VII. A summary of the restored stream channel lengths are outlined in Table I. A complete set of As-Built Drawings including a monitoring plan view and longitudinal profile for the as-built conditions of the restored channels can be found in Appendix A. After the completion of the as-built survey, the limits and corresponding lengths of the project stream reaches to be monitored at LWOC were determined using the sampling rates outlined by the USACE *et al*. (2003). A total of 5,893 linear feet (32%) of all restored stream channels will be surveyed annually during the monitoring period. Based on these the sampling rates, the limits of the project stream reaches to be surveyed annually for monitoring are as follows:

Reach R1 – 1,974 Linear Feet Total (Stations 14+00-R1- through 33+74-R1-)
Reach R1A – 500 Linear Feet Total (Stations 0+00-R1A- through 5+00-R1A-)
Reach R2 – 2,047 Linear Feet Total (Stations 25+13-R2- through 45+60-R2-)
Reach R2A – 326 Linear Feet Total (Stations 0+00-R2A- through 3+26-R2A-)
Reach R2B – 551 Linear Feet Total (Stations 9+35-R2B- through 14+86-R2B-)
Reach R2D – 495 Linear Feet Total (Stations 2+84-R2D- through 7+79-R2D-)

The upstream and downstream limits of these reaches were monumented in the field using steel rebar/PVC pins. Each pin was also labeled with an aluminum tag identifying the respective reach and the correct descriptor (“begin” or “end”).

A total of 13 permanent cross sections, consisting of both riffles and pools, were established across LWOC and surveyed during the as-built survey process. The number of cross

sections was determined using the sampling rates outlined by the USACE *et al*. (2003). The left and right ends of each cross section were monumented with a steel rebar pin and PVC pipe. An aluminum tag identifying the cross section number was also installed at the pin on the left side of the channel. In addition to the cross section surveys, photos were taken at each of the 13 cross sections, looking across the stream from left to right, to document the baseline conditions at each respective cross section. Specific stations along each permanent cross section were established during the as-built survey to promote replication and consistency during the subsequent annual cross section surveys. The stationing for each cross section was established to always begin on the left side of the channel, facing downstream, at the left rebar/PVC pin, and to continue across the stream channel to the rebar/PVC pin on the right side. The as-built survey of the 13 cross sections established the baseline conditions with regards to stream dimension. All of the 13 cross sections will be surveyed each year during the five-year monitoring period and the resulting parameters will be compared annually. The parameters to be monitored include bankfull width, floodprone width, bankfull cross sectional area, bankfull mean depth, bankfull max depth, width to depth ratio, entrenchment ratio, wetted perimeter, and hydraulic radius. Annually, photos will be taken at each of the 13 cross sections looking across the stream from left to right and compared to the photos from the previous years to document stream conditions at each respective cross section.

The pattern for all of the stream reaches was surveyed and baseline conditions were established as part of the as-built survey. Monitoring surveys for stream pattern are limited to the project stream reaches specified above for annual monitoring surveys. The stream pattern parameters resulting from the annual monitoring surveys include sinuosity, belt width, radii of curvature, meander wavelength, and meander width ratio. These parameters will be compared annually.

The as-built survey included a longitudinal profile survey along the entire length of all restored stream reaches. Longitudinal profiles were surveyed by identifying each stream feature (riffle, run, pool, or glide) and surveying specific points at each feature. These specific locations included top of bank, bankfull, water's edge or surface, and thalweg. The as-built survey were used to establish the baseline conditions with regards to monitoring the longitudinal profile within the project reaches described above. The longitudinal profiles surveys conducted each year are then limited to the project stream reaches specified above. The parameters resulting from these longitudinal profile surveys are compared on an annual basis to those of the baseline and previous years. The parameters to be monitored include bankfull slope, riffle length, riffle slope, pool length, and pool to pool spacing.

During the as-built survey, Modified Wolman pebble counts were conducted at each of the project stream reaches to classify the stream bed materials. The pebble counts for the larger project stream reaches (R1 and R2) were conducted at each of the permanent cross sections by performing an equal number of counts at each cross section and then combining the results into a reach-wide count. A minimum of 100 counts were made for each of these larger reaches. Reach-wide pebble counts were conducted along the smaller project stream reaches (R1A, R2A, R2B, and R2D). A minimum of 50 counts were made for each of these smaller reaches. The stream bed materials are monitored at LWOC by repeating the same

pebble count procedures on an annual basis. The results of the pebble counts for each specified project stream reach are compared on an annual basis.

BEHI information was collected during the existing condition surveys and sediment transport rates were subsequently developed. The resulting information served as baseline data for stream bank stability at LWOC. Stream bank stability monitoring using these parameters is required in Monitoring Year 3 and 5. Data collected during these years will be compared with pre-construction conditions to determine the change in bank erosion hazard indices and sediment export rates for each reach assessed. Positive change, namely reduction, in both the stream bank erosion rates and sediment transport rates at LWOC are expected as a result of restoration and will be documented as described to demonstrate success.

A total of eight crest gages, one at each reach and one at the confluence of Reaches R1 and R2, were installed across LWOC during the as-built survey. At the base of each crest gage a permanent vertical datum was installed. The locations of each crest gage along with the elevation of the permanent vertical datum were surveyed during the as-built survey. The crest gages were used for the hydrologic monitoring at LWOC to verify the occurrence of bankfull storm events. Each crest gage was set during its initial installation and baseline photos were taken. The crest gages were checked annually and the flood stage(s) recorded by each gage and measured relative to the permanent vertical datum of the respective gage. The results of these measurements were used to document the occurrence of significant storm events, with the goal of specifically documenting the occurrence of bankfull and larger stream flow events.

Photo documentation and project-wide visual assessment was used for stream monitoring at LWOC to complement the other stream monitoring practices. A total of 14 permanent reference photo points were installed across LWOC (11 during the as-built survey and 3 during the Year 1 monitoring period as described above). These photo points were monumented using steel rebar/PVC pins. Photos were taken at that time to provide photo documentation of baseline stream conditions. Photos were taken from each of the 14 permanent photo reference points with the same orientation each year and were used for photo documentation and annual comparison of the stream conditions across LWOC. This exercise helped to further validate and document stream restoration success at LWOC. The visual assessment was conducted using annual field observations and pedestrian surveys to identify any specific problem areas along the streams at LWOC during the monitoring period. Any such problem areas were identified and organized under appropriate categories. Such areas were documented using representative photos, where applicable, and their locations were mapped on the Monitoring Plan View. The suspected cause and appropriate remedial action for each problem was determined. If during any given year, the streams were not anticipated to meet the final established monitoring criteria, corrective actions were considered. Such modifications were documented and discussed with EEP.

3.2.2 Stream Monitoring Success Criteria

Stream dimension, pattern, profile, stream bed material, bank stability, and bankfull hydrology were monitored annually for the project stream reaches as described in detail above. Stream restoration success at LWOC was evaluated by comparison of the annual results against the same parameters as predicted, specified, and required in the proposed design. Success was achieved when all such comparisons reveal positive trends toward overall stream stability. Expectation was the stream monitoring results should confirm the stream channels at LWOC are of the proposed stream channel type (Rosgen 1994).

Stream dimension parameters including bankfull width, floodprone width, bankfull cross sectional area, bankfull mean depth, bankfull max depth, width to depth ratio, entrenchment ratio, wetted perimeter, and hydraulic radius were measured and/or calculated for each of the permanent cross sections. The described dimension parameters were expected to remain consistent from year to year and should fall within the ranges established by the original proposed design parameters. It was expected and acceptable that minor adjustments in dimension will occur such as the development of point bars and the subsequent deepening of pools. As vegetation becomes established and the stream banks are stabilized, the anticipation was that the width depth ratios will decrease and the entrenchment ratios will increase slightly, both within the normal ranges for C and E stream channel types (Rosgen, 1994).

Stream pattern parameters including sinuosity, belt width, radii of curvature, meander wavelength, and meander width ratio were measured and/or calculated. Stream pattern measurements were expected to remain consistent from year to year and to fall within the originally proposed design parameters. As vegetation becomes established and the stream banks are stabilized, it was anticipated that the sinuosity of the streams will also adjust, likely becoming more sinuous with time.

Stream longitudinal profile parameters including bankfull slope, riffle length, riffle slope, pool length, and pool to pool spacing were measured. Longitudinal profiles parameters were expected to remain relatively consistent from year to year. The stream profiles should not show aggrading or degrading conditions during the five-year monitoring period, however, minor profile adjustments such as deepening of pools was expected.

Stream bed material was monitored using the described Modified Wolman pebble counts. The success criteria for the bed material will be determined at the end of the five-year monitoring period when data can be reviewed and compared to the proposed channel material types. Fluctuations in bed materials will likely occur during the early years following construction and several years may be needed to observe a consistent bed material. Bed materials should ultimately reflect the proposed design conditions for each reach at LWOC.

Stream bank stability will be monitored using BEHI and sediment transport estimates during Monitoring Years 3 and 5. Data collected during these years will be compared with pre-construction conditions to determine the change in bank erosion hazard indices and sediment

export rates for each reach assessed. Positive change, namely reduction, in both stream bank erosion rates and sediment transport rates at LWOC are expected as a result of restoration and will be documented as described to demonstrate success.

Hydrologic monitoring success was based on the ability to document the occurrence of bankfull storm events at LWOC. A minimum of two bankfull events, each occurring in two separate monitoring years, are required to be documented within the five-year monitoring period. The described crest gauges were used to determine and document the occurrence of these bankfull events.

As described above, photo documentation and visual assessment was used to complement the other stream monitoring practices as part of the stream monitoring protocol at LWOC. If during any given year, the streams were not anticipated to meet the final established monitoring criteria, corrective actions was considered. Such modifications were documented and discussed with EEP.

3.2.3 Stream Monitoring Results for Year 1 of 5

In late August 2008, the stream monitoring for Monitoring Year 1 was conducted. The methodologies described in the Section 3.2.1 were used for the stream monitoring at LWOC for Monitoring Year 1. Detailed surveys were conducted along the project stream reaches specified to be surveyed for annual monitoring. The results of these surveys were compared to the baseline data for the morphometric monitoring obtained during the as-built survey.

All of the 13 cross sections were surveyed to measure the bankfull width, floodprone width, bankfull cross sectional area, bankfull mean depth, bankfull max depth, width to depth ratio, entrenchment ratio, wetted perimeter, and hydraulic radius. The results of the cross section surveys are presented in Table VIII. Appendix D compares photos taken during Monitoring Year 1 with the initial baseline photos at each of the 13 cross sections. Appendix E provides an overlay of the Monitoring Year 1 and baseline conditions along with the raw data for each cross section. The comparison of the baseline and Monitoring Year 1 stream dimension morphometric data for each of the project stream reaches showed very positive results, all of which were comparable to the originally proposed design parameters. The results showed that all of the reaches were experiencing the expected minor adjustments including decreasing width to depth ratios, increasing entrenchment ratios, and minor increases in depth. Each of these trends was indicative of movement toward increased stream stability and was attributed to vegetation establishment and natural channel adjustments. The comparison of the Year 1 Monitoring cross section photos to the as-built cross section photos strongly complemented these suggestions, as no concerns, problems, or negative trends were documented.

The pattern for all of the stream reaches was surveyed to measure the parameters of sinuosity, belt width, radii of curvature, meander wavelength, and meander width ratio. The results of the pattern surveys are presented in Table VIII. The comparison of the baseline and Monitoring Year 1 stream pattern morphometric data for each of the project stream reaches showed very positive results, all of which were comparable to the originally

proposed design parameters. The results showed that all of the reaches were experiencing the expected minor adjustment attributed to vegetation establishment and natural channel adjustments. This adjustment included slightly increasing radii of curvature, indicative of movement toward increased stream stability. These minor adjustments can be viewed through the overlays included in Appendix A.

Longitudinal profile surveys were conducted along each of the project stream reaches specified for annual monitoring surveys. The surveys were performed to measure the parameters of bankfull slope, riffle length, riffle slope, pool length, and pool to pool spacing. The results of the longitudinal profile surveys are presented in Table VIII. The comparison of the baseline and Monitoring Year 1 longitudinal profiles for each of the monitored project stream reaches showed very positive results, all of which were comparable to the originally proposed design parameters. The results showed that all of the reaches were experiencing the expected minor adjustment attributed to vegetation establishment and natural channel adjustments. This adjustment included deepening of pools. The comparison of the baseline and Monitoring Year 1 longitudinal profiles did not show excessive aggrading or degrading. Overlays can be found in Appendix E along with the raw data from both the baseline and Monitoring Year 1 conditions.

Modified Wolman pebble counts were repeated at each of the project stream reaches to classify the stream bed materials for comparison to the baseline conditions. The results of the pebble counts are presented in Table VIII while the raw data and overlays of the percent accumulation graphs can be viewed in Appendix E. Fluctuations in bed materials were expected to occur during the early years following construction. This expectation was observed in comparing the results of the baseline and Monitoring Year 1 pebble counts. Specifically, the bed material d50 and d84 for each of the stream reaches decreased. This trend may be observed during the five-year monitoring period. At this time it is believed that the original assumption that the stream bed materials would coarsen after restoration may have been incorrect. The stream systems at LWOC appear to be sand-dominated and therefore coarsening of the bed may not occur. The monitoring results do suggest, however that on-site sediment supply from LWOC has been reduced as a result of the restoration. As noted earlier, the success criteria for the bed material will be determined at the end of the five-year monitoring period when data can be reviewed and compared to the proposed channel material types. Fluctuations in bed materials will likely continue to occur and several years may be needed to observe a consistent bed material.

Stream bank stability monitoring was not conducted, as this monitoring practice is scheduled to be performed using BEHI and sediment transport estimates during Monitoring Years 3 and 5. BEHI information was collected during the existing condition surveys and sediment transport rates were subsequently developed. The resulting information will serve as baseline data for stream bank stability at LWOC and is presented in Table IX. The raw data for this table can be viewed in Appendix E.

Each of the eight crest gages were checked during the Monitoring Year 1 surveys to monitor hydrology at LWOC. Six of the eight crest gages recorded flood stages in excess of the bankfull stage. The two crest gages that did not record flood stages in excess of the bankfull

stage were the crest gages at Reaches R2A and R2D. The crest gage at Reach R2A apparently did not record any evidence of a flood stage event, possibly due to problems with the cork or the gage itself. The crest gage at Reach R2D recorded a flood stage that was 0.26 feet below the bankfull stage. Each of the crest gages was reset after checking stage measurements, in order to record future events. Table X lists the information related to the verification of bankfull events at LWOC for Monitoring Year 1 while the raw data can be found in Appendix E. The evidence recorded by the crest gages indicated a storm event producing a stage in excess of the bankfull storm occurred at LWOC during Monitoring Year 1. This documentation of the first bankfull event at LWOC during the monitoring period suggests success with regards to hydrologic monitoring at LWOC.

Photo documentation and project-wide visual assessment were used to complement the other Monitoring Year 1 stream monitoring practices. Photos were taken from each of the original 11 permanent photo reference points. Three additional photo points (photo points 2.5Y1, 3.5Y1, and 8.5Y1) were also added to ensure that adequate photo documentation would be conducted within the monitoring limits of the project stream reaches. Photo point 2.5Y1 was added for Reach R2, photo point 3.5Y1 for Reach R2B, and photo point 8.5Y1 for Reach R1A. After installation, photos were taken at each of the three added photo points. Appendix C includes all of the described photos and provides comparison of the photos with the initial baseline photos taken from the 11 permanent photo reference points. The new photos taken at three additional photo points will serve as supplemental baseline condition photos and subsequent photos at these same locations will be compared in Monitoring Years 2 through 5. No stream problems were documented through the photo comparison process. A project-wide visual assessment was conducted along each of the project stream reaches to identify any specific stream problem areas. Table XI presents the results of the project-wide visual assessment. The project-wide visual assessment revealed 12 specific stream problem areas. Each of these stream problem areas, including their description, location, and suspected cause, are listed in Table XII. The stream problem areas included eight in-stream structure failures and associated stream bank erosion, three areas of floodplain and adjacent stream bank erosion, and one area of stream bank erosion. Mulkey elected to promptly address all of the stream problem areas and conducted construction repairs of each in October 2008. The eight stream problem areas categorized as failures of in-stream structures and were determined to be caused by incorrect construction of the given in-stream structure. The failed in-stream structures included j-hook rock vanes and rock cross vanes. All eight of the structures and the associated areas of stream bank erosion were repaired. Several of the j-hook rock vanes were converted to rock vanes during the repairs to prevent future point bar erosion. The three stream problem areas categorized as floodplain and adjacent stream bank erosion were determined to be attributed to the incorrect installation of floodplain interceptors. All three of the eroded areas were repaired and floodplain interceptors were installed using both rock and log materials. The remaining stream problem area categorized as stream bank erosion was determined to be caused by a minor field adjustment made to the stream alignment in order to save an existing mature tree at the request of the landowner. This area of stream bank erosion was also repaired. The repairs to the all of the areas of eroded stream banks included re-grading, re-seeding with appropriate temporary and permanent seed, and re-installing coir fiber matting. Black willow (*Salix nigra*) and/or silky dogwood (*Cornus amomum*) live stakes were harvested on-

site and were installed at the repaired stream banks. Please note that the results shown in Table XI were updated such that the repairs to the stream problem areas described above are included. Based on the results of the stream monitoring for Monitoring Year 1 at LWOC, as well as the subsequent corrective actions taken, Mulkey did not propose any additional recommendations or actions other than to proceed with the annual stream monitoring.

3.2.4 Stream Monitoring Results for Year 2 of 5

In mid-October and the beginning of November 2009, the stream monitoring for Monitoring Year 2 was conducted. The methodologies described in the Section 3.2.1 were used for the stream monitoring at LWOC for Monitoring Year 2. Detailed surveys were conducted along the project stream reaches specified to be surveyed for annual monitoring. The results of these surveys were compared to the previous data collected during prior monitoring periods, baseline conditions established through the as-built survey, and to the proposed design parameters calculated prior to construction.

All of the 13 cross sections were surveyed to measure the bankfull width, floodprone width, bankfull cross sectional area, bankfull mean depth, bankfull max depth, width to depth ratio, entrenchment ratio, wetted perimeter, and hydraulic radius. The results of the cross section surveys are presented in Table VIII. Appendix D compares photos taken during Monitoring Year 2 with the initial baseline photos and the previous monitoring photos taken at each of the 13 cross sections. Appendix E provides an overlay of the Monitoring Year 2, the previous monitoring periods, and baseline conditions along with the raw data for each cross section. The comparison of Monitoring Year 2 to the previous surveys for stream dimension data for each of the project stream reaches showed very positive results, all of which were comparable to the originally proposed design parameters. Throughout all the cross sections, the bankfull cross sectional area and entrenchment ratios remained consistent indicating the channels were able to contain and convey all the flows experienced during Monitoring Year 2. However, the main channels R1 and R2 displayed typical signs of adjustment in their channel geometries. Both of these reaches have recently been impacted by beavers and some of these adjustments can be attributed to this recent development. In particular on R1, cross section 11 had a significant increase in the width to depth ratio due to the backwater of a downstream beaver dam causing the pool to experience siltation. On the other end, cross section 12 experienced the reverse because a beaver dam was located directly upstream and the cascading water created scour ultimately decreasing the width to depth ratio. Similarly, cross sections along R2 exhibited localized changes in channel geometries, some attributable to beaver activity and others to natural fluctuations, but all within the acceptable ranges of the design parameters. The one exception was cross section 1, with a width to depth ratio climbing up to 22 and the bankfull cross sectional area remaining consistent, a cursory analysis raised concern. However, the overlay of cross section 1 clearly demonstrated the channel developing opposing inner berms to better accommodate the low flow capacity. This effectively allowed the channel to deepen without creating a change in the cross sectional area causing the width to depth ratio to increase instead of decrease due to the derivation being based on the calculated value of mean depth. The results of the smaller tributaries R1A, R2A, R2B, and R2D consistently exhibited minor natural adjustments typical of stable C type streams. The comparisons of the Monitoring Year 2 overlays and

cross sectional photos to the previous year's strongly substantiated these findings, as no concerns, problems, or negative trends were documented.

The pattern for all of the stream reaches was surveyed to measure the parameters of sinuosity, belt width, radii of curvature, meander wavelength, and meander width ratio. The results of the pattern surveys are presented in Table VIII. The comparison of the Year 2 monitoring data to previous years stream pattern data for each of the project stream reaches showed very positive results, all of which were comparable to the originally proposed design parameters. The results showed that all of the reaches remained consistent to the design parameters with minor variations attributed to vegetation establishment, natural channel adjustments, and variance in measuring techniques. These minor variations can be viewed through the overlays included in Appendix A.

Longitudinal profile surveys were conducted along each of the project stream reaches specified for annual monitoring surveys. The surveys were performed to measure the parameters of bankfull slope, riffle length, riffle slope, pool length, and pool to pool spacing. The results of the longitudinal profile surveys are presented in Table VIII. In comparing the data collected from Monitoring Year 2 to the previously collected data, the results followed the previous analysis. All reaches showed acceptable minor variations in all parameters monitored. These variations are within the design tolerances and are attributable to vegetation establishment, natural channel adjustments, and variance in measuring techniques. Overall, none of the longitudinal profiles showed excessive aggrading or degrading. Overlays of the longitudinal profiles can be found in Appendix E.

Modified Wolman pebble counts were repeated at each of the project stream reaches to classify the stream bed materials and for comparison to the previous years' conditions. The results of the pebble counts are presented in Table VIII while the raw data and overlays of the percent accumulation graphs can be viewed in Appendix E. Fluctuations in bed materials were expected to occur during the early years following construction. Over time the expectation was for the stream to eventually coarsen, however, Monitoring Year 1 and Year 2 have shown the opposite to be true. Specifically, the bed material d50 and d84 for each of the stream reaches decreased. Therefore it is believed that the original assumption that the stream bed materials would coarsen after restoration may have been incorrect. The stream systems at LWOC appear to be sand-dominated and therefore coarsening of the bed may not occur. Nonetheless, the monitoring results do suggest on-site sediment supply from LWOC was reduced as a result of the restoration. As noted earlier, the success criteria for the bed material will be determined at the end of the five-year monitoring period when data can be reviewed and compared to the proposed channel material types. Fluctuations in bed materials will likely continue to occur and several years may be needed to observe a consistent bed material.

Stream bank stability monitoring was not conducted, as this monitoring practice is scheduled to be performed using BEHI and sediment transport estimates during Monitoring Years 3 and 5. BEHI information was collected during the existing condition surveys and sediment transport rates were subsequently developed. The resulting information will serve as

baseline data for stream bank stability at LWOC and is presented in Table IX. The raw data for this table can be viewed in Appendix E.

Each of the eight crest gages were checked during the Monitoring Year 2 surveys to monitor hydrology at LWOC. Seven of the eight crest gages recorded flood stages in excess of the bankfull stage. The one crest gage that did not record a flood stage in excess of the bankfull stage was at Reach R2D. Although, the region has seen a significant drought, the site has received large quantities of rain this monitoring year. Additionally, the R2D reach has a constant flow of water throughout its course. The crest gage at Reach R2D recorded a flood stage that was 0.10 feet below the bankfull stage this monitoring year. This information coupled with the other seven gauges having recorded a bankfull event during this monitoring year suggested that Mulkey needs to recheck the R2D crest gage in 2010 for elevation discrepancies with regard to its zero elevation. All of the crest gages were reset after checking stage measurements, in order to record future events. Table X lists the information related to the verification of bankfull events at LWOC for Monitoring Year 2 while the raw data can be found in Appendix E. The evidence recorded by the crest gages indicated a storm event producing a stage in excess of the bankfull storm occurred at LWOC during Monitoring Year 2. This documented the second and final required bankfull event at LWOC and therefore demonstrated success with regards to hydrologic monitoring per Section 3.2.2.

Photo documentation and project-wide visual assessment were used to complement the other Monitoring Year 2 stream monitoring practices. Photos were taken from each of the 14 permanent photo reference points. Appendix C includes all of the described photos and provides comparison of the photos between the baseline conditions, Monitoring Year 1 and Monitoring Year 2 photos taken from the 14 permanent photo reference points. No stream problems were documented through the photo comparison process. A project-wide visual assessment was conducted along each of the project stream reaches to identify any specific stream problem areas (Table XI). During the project-wide visual assessment, along with the other Monitoring Year 2 field work activities, Mulkey noticed a significant increase in beaver activity at the site. Specifically, beaver dams have been constructed along Reaches R1, R2 Upper, and R2 Lower in several locations. Please note that Table XI and Table XII have been updated to reflect these observations. Mulkey is currently coordinating with the USDA Wildlife Services under BMAP to have the beavers and beaver dams removed, as well as to have the site monitored for future beaver activity. Mulkey has also observed cattle intrusion into the fenced buffers at LWOC. Mulkey is working with the landowner to prevent future cattle trespass from occurring. Other field observations made during the Monitoring Year 2 include the observation of the apparent restoration of wetland hydrology adjacent to Reach R1A. The restoration of Reach R1A appears to have reconnected the stream to its historic floodplain, as well as raise the groundwater table in the buffer areas adjacent to the reach. These observations are evidenced by the increase of wetland vegetation species and the saturation of the soils in the buffer areas adjacent to Reach R1A. The waste treatment outfall located on R1 reach and emanating from the nearby school appears to be functioning extremely well. Vegetation around the outfall is growing rapidly and helping to create a highly stable secondary treatment area.

Based on the results of the stream monitoring for Monitoring Year 2 at LWOC, as well as the subsequent corrective actions being taken, Mulkey does not propose any additional recommendations or actions other than to proceed with the annual stream monitoring.

NCEEP expressed concerns regarding the fencing of the conservation easement at LWOC to Mulkey in a letter dated May 26, 2009. Mulkey responded to NCEEP in a June 1, 2009 letter, urging NCEEP to consider several key exceptions for this particular case. These exceptions are explained in the referenced June 1, 2009 letter. Mulkey awaits response from NCEEP regarding the July 2009 letter before further addressing the concerns raised by NCEEP.

3.2.5 Stream Monitoring Results for Year 3 of 5

In early November 2010, the stream monitoring for Monitoring Year 3 was conducted using the methodologies described above. Despite the site suffering a flood event from the remnants of a tropical storm, the overall stability of the six stream reaches has improved. The stream dimension, pattern, and profile remained consistent with the previous years' data and continue to remain within the tolerances of the design parameters which is explained in detail below. However the visual assessment did reveal areas of scour along the banks, benches, and terraces confined mostly to reach R1. Mulkey intends to repair these areas in early 2011 to ensure ample time for the project to recover. Nonetheless, per the monitoring guidance, the overall stability of LWOC is within acceptable tolerances.

LWOC experienced several storm events over the Year 3 monitoring period, the most extensive occurring from the remnants of a tropical storm occurring in late September of 2010. This event created storm flows well in excess of the bankfull stage evidenced by wrack lines along the terrace slopes. These lines were often above the measurable extent of the crest gages. In fact, the flows destroyed four of the eight crest gages across the site. The four destroyed crest gages existed on reaches which have achieved the two bankfull events in two separate years' hydrological monitoring success criteria. Overall, five of the six reaches on LWOC have achieved the hydrological success criteria for monitoring; therefore Mulkey intends to only continue monitoring R2D.

The visual assessment of LWOC supported the crest gage data with several areas of scour occurring along reach R1, vegetative matts being forced down, wrack lines along the terrace slopes, silt dispersed on the vegetation on the bench, deposition of sand/silt on the benches, and minor washing out of the fence. Most of this evidence can be viewed through the photo logs of the vegetation plots (Appendix B), photo points (Appendix C), and cross sections (Appendix D); however photos of the scour along R1 can be found in Appendix F as no existing photo points could capture the areas of concern. The scour occurred because back eddies were formed from the terrace slopes following the creek. In these areas the back eddies essentially drilled a hole in the bench and deposited the materials downstream. Areas of bank scour were located in the vicinity of these scour holes as heavy flows began re-entering the channel. There are also areas of scour around the structure tie-ins with the bench where unforeseen eddies began to develop downstream of structure arms. Due to the location of this disturbance occurring up on the bench or terraces, the monitoring does not

reflect any instability from these areas of concern. Nonetheless, Mulkey perceived these areas of concern as detracting from the overall positive trends developing across LWOC and therefore intends to repair these areas in early 2011. The repairs will consist of a combination of grading and vegetative activities to minimize the effects of future excessive flows.

Contrary to the visual assessment, the comparison of the 13 cross sections to previous monitoring data indicated stability across the site (Appendix E). The cross sections along R2 (1-5) not only show signs of a stable channel, but they depict the expected tightening of the channel due to vegetation taking hold with aggradation along the banks occurring in all but 1 cross section. The cross section on R2A (6) also depicts this phenomenon while the cross sections for R1A (13), R2B (7) and R2D (8) show no significant change in shape or form. The cross sections along R1 (9-12) show slight variation in shape and form that is indicative of a recent excessive storm event. However, upon comparison of all cross sections with past monitoring data and design tolerances, every measured variable is either varying within the design tolerance or migrating back towards an acceptable value. Therefore in terms of channel dimension, LWOC has been determined to be stable and meeting all monitoring success criteria.

Similarly, the stream pattern for all reaches across LWOC portrayed a stable stream network. The meander length, belt width, and radius of curvature measurements for each reach remained within the design tolerances and showed no significant deviations from the previously collected monitoring data.

The longitudinal profiles, found in Appendix E, depicted slight variations in each stream reach. Reaches R1 and R2B were consistent with previously collected data while R2 and R2A displayed degradation and R1A and R2D aggradation. These differences can be attributed to the dynamic nature of the stream system coupled with the system experiencing an intense storm event. Typically, the bed materials would correlate and support stream bed fluctuation with aggrading streams displaying an influx of finer materials and vice versa for degrading streams. This correlation is displayed in R1A and R2D where the finer sediments upstream are being slowed by the vegetation and aggrading the channel. Similarly, R2 is displaying the correlation in reverse with the bed material coarsening while the bed degrades exposing the larger substrate materials. R1 has a consistent longitudinal profile and is beginning to coarsen indicating the reach still moving towards an equilibrium between stream power and sediment transport. R2A with degradation in the longitudinal profile and fining of the bed materials is still trying to accommodate the sediment supply exposed upstream during the construction process. R2B displayed consistent bed slope and bed form thus indicating a balance reached between stream power and sediment transport. Therefore all of the reaches except R2B are still showing the expected signs of stream fluctuation indicative of a system trying to establish equilibrium. None of the described trends are representative of trends toward instability, rather they depict the natural development of a young stream network striking a balance between stream power and sediment transport.

As detailed by the monitoring guidance, data was collected and analyzed for the Bank Erosion Hazard Index (BEHI) and Near Bank Shear Stress (NBS) in an effort to quantify the

sediment transport rate in tons/year for each reach in LWOC (See Table IX). The results of this process indicated a significant decrease across LWOC. Pre-construction data determined the sediment transport rate to be 1853 tons/year. Data collected in Monitoring Year 3 revealed a sediment transport rate of 342 tons/year or an 82% reduction in sediment in the system. Reach R1, the reach most affected by the storm event, showed a reduction in sediment transport from 455 tons/year to 189 tons/year or a 58% reduction. These individual reach trends and cumulative system wide trends show extremely positive results and are indicative of stream stability across the entire stream network at LWOC.

In Spring of 2010, Mulkey relocated portions of the fence surrounding the easement around LWOC. This was performed at the request of NCEEP to ensure the entire easement was protected from cattle and to include the required 50 foot buffer established by the United States Army Corps of Engineers. The new fence locations have been incorporated and accurately depicted on the plan sheets found in Appendix B.

In conclusion, Mulkey has determined that all monitoring aspects have met the monitoring success criteria established for LWOC. Mulkey does intend to perform some minor corrections to LWOC in early 2011 so as not to detract from the overall success of the project. These corrections are minor in scope and do not affect the overall stability of LWOC. Given the overall success and the prior fence relocation, Mulkey does not recommend any action except to proceed with the annual stream monitoring.

4.0 Project Monitoring Methodology

Success criteria for stream mitigation sites are based on guidelines established by the USACE, US Environmental Protection Agency (USEPA), NC Wildlife Resources Commission (NCWRC) and the NCDWQ (USACE et. al, 2003). These guidelines establish criteria for monitoring both hydrologic conditions and vegetation survival. These same guidelines were used to develop the monitoring methods, frequencies, and success criteria discussed herein for LWOC and further described in detail in the approved mitigation report (Mulkey Engineers and Consultants, 2008). LWOC site conditions will be monitored annually during the latter part of the growing season months (August, September, and October) over the five-year monitoring period. This monitoring period complies with the requirements set forth in the Full Delivery RFP 16-D06027. Monitoring results will be documented on an annual basis, with the associated reports submitted to the NCEEP as evidence that the established project goals and objectives are being achieved. The results of annual monitoring will be used to evaluate the degree of success LWOC has achieved in meeting the said goals and objectives. In the event that goals are not being met, Mulkey will coordinate with the NCEEP to develop a plan for ameliorating the areas of concern.

5.0 References

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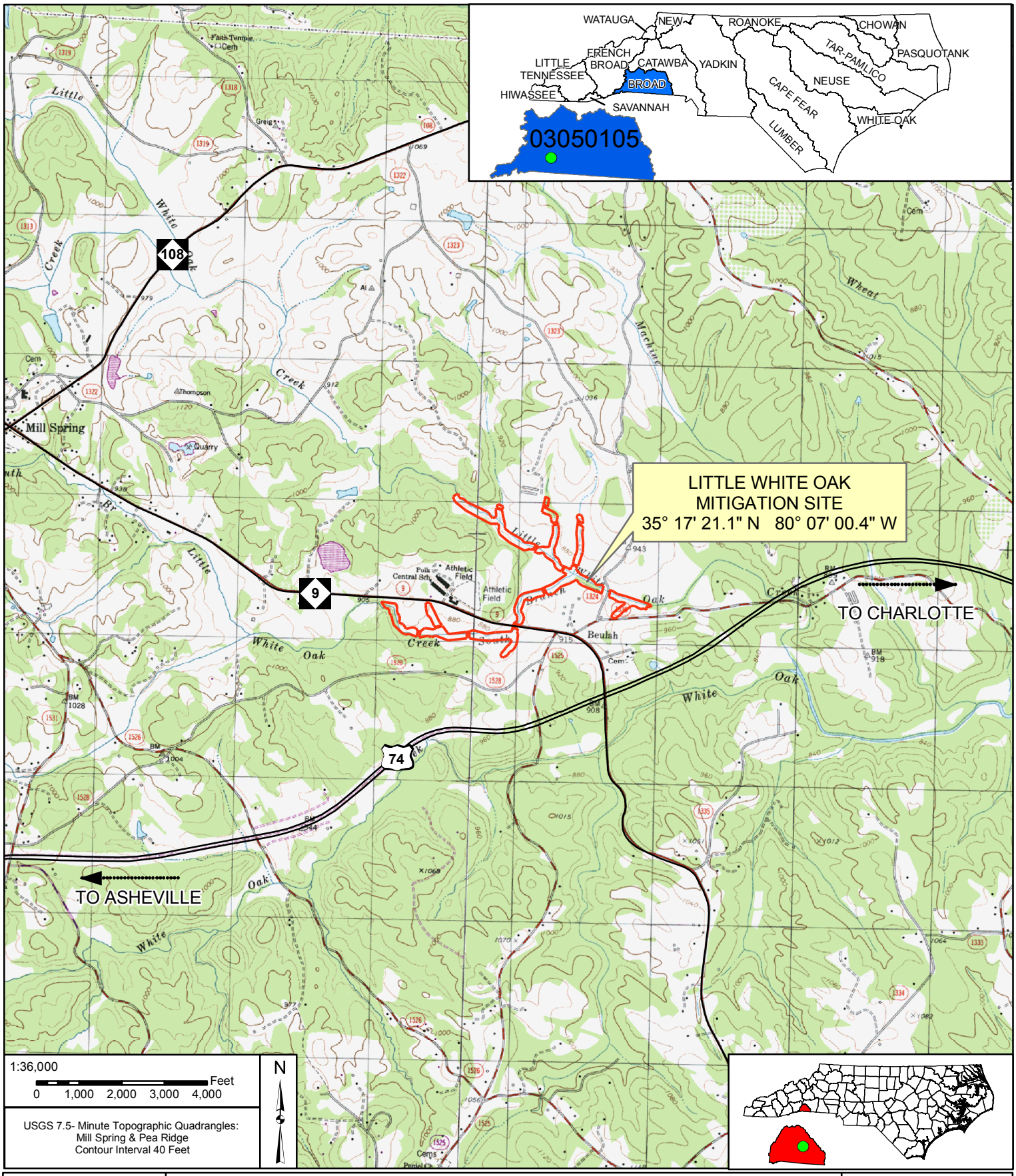


LOCATION MAP

LITTLE WHITE OAK STREAM RESTORATION

POLK COUNTY, NORTH CAROLINA

March 20, 2008

Figure 1

Ecosystem Enhancement Program

MULKEY ENGINEERS & CONSULTANTS

PROJECT NO. D06027-B

Table I. Project Restoration Approach and Mitigation Type Little White Oak Creek Stream Restoration / D06027-B					
Stream Reach ID	**Restoration Approach**	**Mitigation Type**	**Linear Footage**	**Stationing**	**Comments**
R1	P2	R	7,543	0+00 – 75+43	Channel relocation with floodplain excavation
R1A	P1/P2	R	1,040	0+00 – 10+40	Includes 850 feet of P1 and 190 feet of P2 channel relocation
R2 (Upper and Lower)	P2	R	7,107	0+00 – 71+07	Channel relocation with floodplain excavation
R2A	P2	R	336	0+00 – 3+36	Channel relocation with floodplain excavation
R2B	P1/P2	R	1,474	0+00 – 14+74	Includes 250 feet of P1 and 1224 feet of P2 channel relocation
R2D	P1/P2	R	790	0+00 – 7+90	Includes 100 feet of P1 and 690 feet of P2 channel relocation

R = Restoration
EI = Enhancement I
EII = Enhancement II
S = Stabilization
P1 = Priority I
P2 = Priority II
P3 = Priority III
SS = Stream Banks Stabilization

Table II. Project Activity and Reporting History Little White Oak Creek Stream Restoration / D06027-B			
Activity or Report	**Scheduled Completion**	**Data Collection Completion**	**Actual Completion or Delivery**
Restoration Plan Prepared	Oct-06	Aug-06	12-Feb-07
Restoration Plan Approved	Nov-06	N/A	30-Mar-07
Final Design - 90%	Dec-06	N/A	16-May-07
Construction	Jun-07	N/A	13-Nov-07
Temporary S&E mix applied to entire project area	Jun-07	N/A	13-Nov-07
Permanent seed mix applied to entire project area	Jun-07	N/A	13-Nov-07
Planting live stakes	Dec-07	N/A	11-Jan-08
Planting bare roots	Dec-07	N/A	11-Jan-08
End of Construction	Dec-07	N/A	11-Jan-08
Survey of As-built conditions (Year 0 Monitoring - Baseline)	Jan-08	Jan-08	9-Jan-08
Monitoring			
Year 1 - 2008	Dec-08	Sep-08	Dec-08
Year 2 - 2009	Dec-09	Oct-09	Dec-09
Year 3 - 2010	Dec-10	Nov-10	Dec-10
Year 4 - 2011	Dec-11	N/A	N/A
Year 5 - 2012	Dec-12	N/A	N/A

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

Table III. Project Contacts Little White Oak Creek Stream Restoration / D06027-B		
Designer		
	Mulkey Engineers and Consultants	6750 Tryon Road Cary, NC 27518 Contact: Emmett Perdue, PE Tel. 919.858.1874
Construction Contractor		
	Vaughan Contracting, LLC	P.O. Box 796 Wadesboro, NC 28170 Contact: Tommy Vaughan Tel. 704.694.6450
Planting Coordinator		
	Bruton Nurseries and Landscapes	150 Black Creek Road Fremont, NC 27830 Contact: Charles Bruton, Jr. Tel. 919.242.6555
Seeding Contractor		
	Vaughan Contracting, LLC	P.O. Box 796 Wadesboro, NC 28170 Contact: Tommy Vaughan Tel. 704.694.6450
Seed Mix Sources		
	Evergreen Seed	P.O. Box 669 Willow Spring, NC 27592 Contact: Wister Heald Tel. 919.567.1333
Nursery Stock Suppliers		
	International Paper South Carolina SuperTree Nursery	5594 Highway 38 South Blenheim, SC 29516 Contact: Geoffrey Hill Tel. 803.528.3203
	North Carolina Forestry Service Claridge Nursery	762 Claridge Nursery Road Goldsboro, NC 27530 Contact: James West Tel. 919.731.7988
Monitoring Performers		
	Mulkey Engineers and Consultants	6750 Tryon Road Cary, NC 27518 Contact: Emmett Perdue Tel. 919.858.1874

Table IV. Project Background Little White Oak Creek Stream Restoration / D06027-B	
Project County	Polk County, North Carolina
Drainage Area [sq. mi(acres)]	
R1	4.46 (2854)
R1A	0.11 (70)
R2	10.85 (6944)
R2A	0.54 (355)
R2B	0.12 (77)
R2D	0.05 (32)
Drainage Impervious cover estimate (%)	
R1	2
R1A	2
R2	2
R2A	2
R2B	2
R2D	2
Stream Order	
R1	3
R1A	1
R2	3,4
R2A	2
R2B	1
R2D	1
Physiographic Region	Piedmont
Ecoregion	Southern Inner Piedmont
Rosgen Classification (As-built)	
R1, R1A, R2	C5
R2A, R2B	C4
R2D	C6
Cowardin Classification	R3UB2*
Dominat Soil Types	Riverview-Chewacla-Buncombe
Reference Site ID	UT to Ostin Creek
USGS HUC for Project and Reference	
Project	03050105
Reference	03050105
NCDWQ Sub-basin for Project and Reference	
Project	03-08-02 (Broad)
Reference	03-08-03 (Borad)
NCDWQ Classification for Project and Reference	
Project	C
Reference	C,Tr
Any portion of any project segement 303d?	No
Any portion of any project segement upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	N/A
Percent of project easement fenced	100

*(R) Riverine (3) Upper Perennial (UB) Unconsolidated Bottom (2) Sand

Table V. Stem Counts Monitoring Year 3 for Each Species Arranged by Plot
Little White Oak Creek Stream Restoration / D06027-B

Species	Plots																								Year 0 Totals	Year 0 Totals (Adjusted) [A]	Year 1 Totals	Year 2 Totals	Year 3 Totals	Survival %
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24						
Shrubs																														
Cephalanthus occidentalis																3			1						9	9	8	7	4	44%
Cornus amomum		1					4	2		1		1		3											15	18	18	18	12	67%
Sambucus canadensis																									2	2	2	0	0	0%
Trees																														
Betula nigra	1	8				2	5	5		1				2				1		2			6		41	40	37	35	33	83%
Cornus florida															1						1				2	2	2	2	2	100%
Corylus americana														1											17	5	4	3	1	20%
Diospyros virginiana											3	2					2							7	19	19	16	17	14	74%
Fraxinus pennsylvanica								2		2			7	1				4	2			5	1		37	35	35	31	24	69%
Juglans nigra			2								1										1			2	7	7	6	6	6	86%
Pinus echinata			2	1	1				1			1					2								28	26	15	11	8	31%
Pinus strobus									2		1				4									1	20	21	18	11	8	38%
Pinus virginiana					3				2						2										12	13	9	8	7	54%
Prunus serotina			1		2						1	1			1						1				6	7	7	7	7	100%
Plantanus occidentalis							2	2		5		7				4		2	5	16			1		45	45	45	45	44	98%
Quercus alba			5	7	3				3		1	1		1	1		7		1		1			7	35	43	39	41	38	88%
Quercus falcata									3	1	5				6		2				7				41	36	30	28	24	67%
Quercus michauxii	7	2								1			4	2		2		1		4		4	3		47	46	45	40	30	65%
Quercus nigra	8					9																			34	23	21	21	17	74%
Quercus phellos	2	2			2	4																			9	19	19	19	10	53%
Salix nigra																									1	1	1	1	0	0%
Ulmus americana								4		4				1		4		3	9			9	4		26	43	42	41	38	88%
Totals	18	13	10	8	11	15	11	15	11	15	12	13	11	11	15	13	13	11	18	22	11	18	15	17	453	460	419	392	327	71%

	Stems/Acre																								Min	Ave	Max
Year 0	996	823	735	653	741	950	748	763	683	694	656	705	795	615	850	868	757	518	854	1000	645	924	776	939	518	779	1000
Year 1	996	823	571	571	576	826	709	763	562	694	615	581	795	615	729	826	598	438	813	1000	484	924	776	816	438	713	1000
Year 2	996	823	490	367	535	744	669	643	522	694	615	581	711	615	729	702	558	438	772	1000	444	843	776	776	367	668	1000
Year 3	747	563	408	327	453	620	433	602	442	612	492	539	460	451	607	537	518	438	732	917	444	723	612	694	327	557	917
Plot Acreage	0.024	0.023	0.025	0.025	0.024	0.024	0.025	0.025	0.025	0.025	0.024	0.024	0.024	0.024	0.025	0.024	0.025	0.025	0.025	0.024	0.025	0.025	0.025	0.025			

Notes: [A] Year 0 Totals (Adjusted) represents the most accurate species occurrence, following corrections for misidentification and other issues during the initial counting process.

Table VI. Vegetative Problem Areas Little White Oak Creek Stream Restoration / D06027-B			
Feature/Issue	**Station / Range**	**Probable Cause**	**Photo No. (If Available)**
No vegetative problem areas observed (Year 1, 2008)	All project reaches	N/A	N/A
No vegetative problem areas observed (Year 2, 2009)	All project reaches	N/A	N/A
No vegetative problem areas observed (Year 3, 2010)	All project reaches	N/A	N/A

Table VII. Baseline Morphology and Hydraulic Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R1 (7543 ft)

PARAMETERS	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension - Riffle	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BKF Width (ft)	--	--	--	15	43	25	16.6	20.3	18.4	16.0	20.6	18.5	--	--	25.7	22.9	24.1	23.5
Floodprone Width (ft)	--	--	--	--	--	--	69.6	118.6	94.1	67.2	72.8	67.2	90.8	113.6	98.4	73.5	79.5	76.5
BKF Cross Sectional Area (sq. ft.)	--	--	--	30	110	60	52.9	69.7	61.3	27.4	33.4	30.3	--	--	52.0	39.5	49.1	44.3
BKF Mean Depth (ft)	--	--	--	1.5	3.8	2.5	3.20	3.43	3.32	1.57	1.72	1.64	--	--	2.02	1.6	2.1	1.89
BKF Max Depth (ft)	--	--	--	--	--	--	2.37	5.00	3.69	1.54	2.36	1.90	1.90	2.91	2.34	2.8	3.0	2.89
Width/Depth Ratio	--	--	--	--	--	--	5.2	5.9	5.6	9.3	12.7	11.3	--	--	12.7	10.7	14.7	12.7
Entrenchment Ratio	--	--	--	--	--	--	4.2	5.8	5.0	3.5	4.4	3.8	3.5	4.4	3.8	3.2	3.3	3.3
Wetted Perimeter (ft)	--	--	--	--	--	--	--	--	25.4	--	--	20.8	--	--	29.7	24.3	25.2	24.7
Hydraulic Radius (ft)	--	--	--	--	--	--	--	--	2.8	--	--	1.4	--	--	1.8	1.57	2.03	1.8
Pattern	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	--	--	--	--	--	--	22.0	61.6	39.8	36.0	150.0	67.0	77.1	208.1	92.9	40.6	135.8	87.7
Radius of Curvature (ft)	--	--	--	--	--	--	23.4	63.8	37.7	19.0	115.0	49.0	38.5	159.5	68.0	35.5	108.4	58.1
Meander Wavelength (ft)	--	--	--	--	--	--	107.0	189.3	135.7	33.0	155.0	94.0	45.8	215.0	130.4	178.0	258.9	210.9
Meander Width Ratio	--	--	--	--	--	--	1.2	3.3	2.2	1.9	8.1	3.6	1.9	8.1	3.6	1.7	5.8	3.7
Profile	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14.3	43.1	27.5
Riffle Slope (ft/ft)	--	--	--	--	--	--	0.001	0.117	0.010	0.006	0.066	0.028	0.002	0.021	0.009	0.003	0.027	0.010
Pool Length (ft)	--	--	--	--	--	--	11.4	87.9	39.3	18.3	62.9	35.1	25.4	87.2	48.7	22.4	53.7	40.7
Pool Spacing (ft)	--	--	--	--	--	--	50.6	402.6	140.9	50.3	105.8	78.9	69.8	146.8	109.4	113.3	323.8	193.5
Substrate																		
d50 (mm)	--			--			8			3			8			0.5		
d84 (mm)	--			--			19			105			19			4.4		
Additional Reach Parameters																		
Bankfull Slope (ft/ft)	--			--			0.0028			0.0090			0.0028			0.0025		
Channel Length(ft)	--			--			6530			590			7643			7543		
Valley Length (ft)	--			--			5717			404			5717			5717		
Sinuosity	--			--			1.14			1.46			1.34			1.32		
Rosgen Classification	--			--			Degraded E5			C4/1			C5			C5		

Table VII. cont. Baseline Morphology and Hydraulic Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R1A (1040 ft)

PARAMETERS	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BKF Width (ft)	--	--	--	6	21	12	4.5	10.9	7.7	16.0	20.6	18.5	--	--	8.0	--	--	7.8
Floodprone Width (ft)	--	--	--	--	--	--	8.6	19.1	13.8	67.2	72.8	67.2	28.2	35.2	30.5	--	--	125.0
BKF Cross Sectional Area (sq. ft.)	--	--	--	9	37	19	1.6	5.9	3.7	27.4	33.4	30.3	--	--	5.0	--	--	3.5
BKF Mean Depth (ft)	--	--	--	0.9	2.1	1.6	0.36	0.54	0.45	1.57	1.72	1.64	--	--	0.63	--	--	0.45
BKF Max Depth (ft)	--	--	--	--	--	--	0.54	1.18	0.86	1.54	2.36	1.90	0.59	0.90	0.73	--	--	0.79
Width/Depth Ratio	--	--	--	--	--	--	12.5	20.2	16.4	9.3	12.7	11.3	--	--	12.7	--	--	17.2
Entrenchment Ratio	--	--	--	--	--	--	1.7	1.9	1.8	3.5	4.4	3.8	3.5	4.4	3.8	--	--	16.1
Wetted Perimeter (ft)	--	--	--	--	--	--	--	--	4.7	--	--	20.8	--	--	9.3	--	--	8.1
Hydraulic Radius (ft)	--	--	--	--	--	--	--	--	0.3	--	--	1.4	--	--	0.5	--	--	0.4
Pattern	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	--	--	--	--	--	--	--	--	--	36.0	150.0	67.0	23.8	64.5	28.8	16.4	39.7	24.4
Radius of Curvature (ft)	--	--	--	--	--	--	--	--	--	19.0	115.0	49.0	12.0	49.5	21.1	10.0	21.0	14.7
Meander Wavelength (ft)	--	--	--	--	--	--	--	--	--	33.0	155.0	94.0	14.2	66.7	40.4	61.5	85.7	68.8
Meander Width Ratio	--	--	--	--	--	--	--	--	--	1.9	8.1	3.6	1.9	8.1	3.6	2.1	5.1	3.1
Profile	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.0	26.0	14.5
Riffle Slope (ft/ft)	--	--	--	--	--	--	--	--	--	0.006	0.066	0.028	0.007	0.070	0.030	0.004	0.046	0.019
Pool Length (ft)	--	--	--	--	--	--	--	--	--	18.3	62.9	35.1	7.9	27.1	15.1	7.5	30.7	18.5
Pool Spacing (ft)	--	--	--	--	--	--	--	--	--	50.3	105.8	78.9	21.6	45.5	33.9	15.0	52.3	32.0
Substrate																		
d50 (mm)	--			--			0			3			0			0.28		
d84 (mm)	--			--			6			105			6			1		
Additional Reach Parameters																		
Bankfull Slope (ft/ft)	--			--			0.0122			0.0090			0.0096			0.0115		
Channel Length(ft)	--			--			906			590			1225			1040		
Valley Length (ft)	--			--			854			404			854			854		
Sinuosity	--			--			1.06			1.46			1.43			1.22		
Rosgen Classification	--			--			Degraded B6c			C4/1			C5			C5		

Table VII. cont. Baseline Morphology and Hydraulic Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R2 (7107 ft)

PARAMETERS	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BKF Width (ft)	--	--	--	18	50	29	24.3	24.5	24.4	16.0	20.6	18.5	--	--	31.1	26.7	33.1	30.2
Floodprone Width (ft)	--	--	--	--	--	--	77.1	251.0	164.0	67.2	72.8	67.2	109.8	137.4	119.0	92.0	120.0	108.1
BKF Cross Sectional Area (sq. ft.)	--	--	--	40	150	85	76.1	76.7	76.4	27.4	33.4	30.3	--	--	76.0	61.9	73.5	66.0
BKF Mean Depth (ft)	--	--	--	1.8	4	2.9	3.13	3.14	3.14	1.57	1.72	1.64	--	--	2.45	1.89	2.38	2.20
BKF Max Depth (ft)	--	--	--	--	--	--	3.61	4.94	4.10	1.54	2.36	1.90	2.30	3.52	2.83	2.95	4.40	3.68
Width/Depth Ratio	--	--	--	--	--	--	7.7	7.8	7.8	9.3	12.7	11.3	--	--	12.7	11.5	17.5	14.0
Entrenchment Ratio	--	--	--	--	--	--	3.1	10.3	6.7	3.5	4.4	3.8	3.5	4.4	3.8	2.8	4.5	3.6
Wetted Perimeter (ft)	--	--	--	--	--	--	--	--	28.0	--	--	20.8	--	--	35.9	28.0	34.0	31.5
Hydraulic Radius (ft)	--	--	--	--	--	--	--	--	2.7	--	--	1.4	--	--	2.1	1.8	2.3	2.1
Pattern	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	--	--	--	--	--	--	15.2	48.7	32.8	36.0	150.0	67.0	60.4	251.6	112.4	40.6	169.2	105.1
Radius of Curvature (ft)	--	--	--	--	--	--	19.7	124.4	45.8	19.0	115.0	49.0	31.9	192.9	82.2	38.1	155.1	61.8
Meander Wavelength (ft)	--	--	--	--	--	--	85.8	165.1	118.2	33.0	155.0	94.0	55.4	260.0	157.7	179.3	296.1	248.4
Meander Width Ratio	--	--	--	--	--	--	3.5	6.8	4.9	1.9	8.1	3.6	1.9	8.1	3.6	1.3	5.6	3.5
Profile	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23.6	66.1	44.2
Riffle Slope (ft/ft)	--	--	--	--	--	--	0.001	0.008	0.003	0.006	0.066	0.028	0.001	0.014	0.006	0.001	0.002	0.001
Pool Length (ft)	--	--	--	--	--	--	8.5	137.1	42.0	18.3	62.9	35.1	30.8	105.5	58.9	18.9	84.9	52.3
Pool Spacing (ft)	--	--	--	--	--	--	38.7	442.4	205.7	50.3	105.8	78.9	84.4	177.5	132.3	132.2	264.4	183.0
Substrate																		
d50 (mm)	--			--			0.8			3			0.8			0.6		
d84 (mm)	--			--			5.4			105			5.4			4.7		
Additional Reach Parameters																		
Bankfull Slope (ft/ft)	--			--			0.0021			0.0090			0.0019			0.0017		
Channel Length(ft)	--			--			5978			590			7337			7107		
Valley Length (ft)	--			--			5255			404			5255			5255		
Sinuosity	--			--			1.14			1.46			1.40			1.35		
Rosgen Classification	--			--			Degraded E5			C4/1			C5			C5		

Table VII. cont. Baseline Morphology and Hydraulic Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R2A (336 ft)

PARAMETERS	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BKF Width (ft)	--	--	--	5.5	20	11	11.2	11.2	11.2	16.0	20.6	18.5	--	--	11.7	--	--	13.9
Floodprone Width (ft)	--	--	--	--	--	--	16.0	19.1	17.5	67.2	72.8	67.2	42.4	51.9	44.9	--	--	40.5
BKF Cross Sectional Area (sq. ft.)	--	--	--	6.5	28	16	10.8	16.8	13.8	27.4	33.4	30.3	--	--	11.0	--	--	15.8
BKF Mean Depth (ft)	--	--	--	0.65	1.9	1.3	0.97	1.50	1.24	1.57	1.72	1.64	--	--	0.94	--	--	1.14
BKF Max Depth (ft)	--	--	--	--	--	--	0.95	2.23	1.48	1.54	2.36	1.90	0.88	1.35	1.09	--	--	1.80
Width/Depth Ratio	--	--	--	--	--	--	7.5	11.5	9.5	9.3	12.7	11.3	--	--	12.5	--	--	12.2
Entrenchment Ratio	--	--	--	--	--	--	1.4	1.7	1.6	3.5	4.4	3.8	3.5	4.4	3.7	--	--	2.9
Wetted Perimeter (ft)	--	--	--	--	--	--	--	--	13.2	--	--	20.8	--	--	13.6	--	--	14.7
Hydraulic Radius (ft)	--	--	--	--	--	--	--	--	1.3	--	--	1.4	--	--	0.8	--	--	1.1
Pattern	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	--	--	--	--	--	--	20.2	20.2	20.2	36.0	150.0	67.0	22.8	95.0	42.4	32.2	49.3	40.0
Radius of Curvature (ft)	--	--	--	--	--	--	8.8	31.4	21.1	19.0	115.0	49.0	12.0	72.8	31.0	17.6	27.2	22.9
Meander Wavelength (ft)	--	--	--	--	--	--	76.7	76.7	76.7	33.0	155.0	94.0	20.9	98.1	59.5	99.4	107.1	102.9
Meander Width Ratio	--	--	--	--	--	--	1.8	1.8	1.8	1.9	8.1	3.6	1.9	8.1	3.6	2.3	3.6	2.9
Profile	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.8	46.8	23.1
Riffle Slope (ft/ft)	--	--	--	--	--	--	0.004	0.024	0.011	0.006	0.066	0.028	0.006	0.066	0.029	0.011	0.131	0.046
Pool Length (ft)	--	--	--	--	--	--	17.2	65.4	31.8	18.3	62.9	35.1	11.6	39.8	22.2	16.6	42.1	29.5
Pool Spacing (ft)	--	--	--	--	--	--	83.1	165.7	113.2	50.3	105.8	78.9	31.8	67.0	49.9	61.7	72.9	65.7
Substrate																		
d50 (mm)	--			--			20			3			20			0.5		
d84 (mm)	--			--			50			105			50			27.5		
Additional Reach Parameters																		
Bankfull Slope (ft/ft)	--			--			0.0107			0.0090			0.0091			0.0150		
Channel Length(ft)	--			--			377			590			379			336		
Valley Length (ft)	--			--			319			404			246			246		
Sinuosity	--			--			1.18			1.46			1.54			1.36		
Rosgen Classification	--			--			Degraded E4			C4/1			C4			C5		

Table VII. cont. Baseline Morphology and Hydraulic Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R2B (1474 ft)

PARAMETERS	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BKF Width (ft)	--	--	--	3	11	6	4.5	6.4	5.5	16.0	20.6	18.5	--	--	8.0	8.8	8.9	8.8
Floodprone Width (ft)	--	--	--	--	--	--	5.4	195.3	100.4	67.2	72.8	67.2	28.2	35.2	30.5	26.0	75.0	49.1
BKF Cross Sectional Area (sq. ft.)	--	--	--	2	9	4.5	5.9	8.7	7.3	27.4	33.4	30.3	--	--	5.0	4.9	8.7	6.3
BKF Mean Depth (ft)	--	--	--	0.45	1.2	0.8	1.31	1.35	1.33	1.57	1.72	1.64	--	--	0.63	0.56	0.98	0.72
BKF Max Depth (ft)	--	--	--	--	--	--	1.70	1.80	1.75	1.54	2.36	1.90	0.59	0.90	0.73	0.93	1.48	1.13
Width/Depth Ratio	--	--	--	--	--	--	3.4	4.8	4.1	9.3	12.7	11.3	--	--	12.7	9.0	15.7	13.0
Entrenchment Ratio	--	--	--	--	--	--	1.2	30.3	15.8	3.5	4.4	3.8	3.5	4.4	3.8	3.0	8.5	5.6
Wetted Perimeter (ft)	--	--	--	--	--	--	--	--	6.4	--	--	20.8	--	--	9.3	9.1	9.7	9.3
Hydraulic Radius (ft)	--	--	--	--	--	--	--	--	0.9	--	--	1.4	--	--	0.5	0.5	0.9	0.7
Pattern	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	--	--	--	--	--	--	--	--	--	36.0	150.0	67.0	15.5	64.5	28.8	8.0	37.1	22.6
Radius of Curvature (ft)	--	--	--	--	--	--	--	--	--	19.0	115.0	49.0	8.2	49.5	21.1	7.9	31.0	15.3
Meander Wavelength (ft)	--	--	--	--	--	--	--	--	--	33.0	155.0	94.0	14.2	66.7	40.4	56.1	70.8	63.6
Meander Width Ratio	--	--	--	--	--	--	--	--	--	1.9	8.1	3.6	1.9	8.1	3.6	0.9	4.2	2.6
Profile	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.7	17.0	10.1
Riffle Slope (ft/ft)	--	--	--	--	--	--	--	--	--	0.006	0.066	0.028	0.008	0.083	0.036	--	--	--
Pool Length (ft)	--	--	--	--	--	--	--	--	--	18.3	62.9	35.1	7.9	27.1	15.1	10.5	31.5	16.6
Pool Spacing (ft)	--	--	--	--	--	--	--	--	--	50.3	105.8	78.9	21.6	45.5	33.9	15.5	105.3	35.6
Substrate																		
d50 (mm)	--			--			4.9			3			4.9			0.1		
d84 (mm)	--			--			28			105			28			6.2		
Additional Reach Parameters																		
Bankfull Slope (ft/ft)	--			--			0.0145			0.0090			0.0113			0.0139		
Channel Length(ft)	--			--			1385			590			1654			1474		
Valley Length (ft)	--			--			1264			404			1091			1091		
Sinuosity	--			--			1.10			1.46			1.52			1.35		
Rosgen Classification	--			--			G5c			C4/1			C4			C5		

Table VII. cont. Baseline Morphology and Hydraulic Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R2D (790 ft)

PARAMETERS	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension - Riffle	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BKF Width (ft)	--	--	--	--	--	3.3	3.8	7.2	5.5	16.0	20.6	18.5	--	--	8.0	--	--	8.8
Floodprone Width (ft)	--	--	--	--	--	--	8.4	12.6	10.5	67.2	72.8	67.2	28.2	35.2	30.5	--	--	70.0
BKF Cross Sectional Area (sq. ft.)	--	--	--	--	--	2.7	2.7	5.8	4.3	27.4	33.4	30.3	--	--	5.0	--	--	6.0
BKF Mean Depth (ft)	--	--	--	--	--	0.6	0.70	0.80	0.75	1.57	1.72	1.64	--	--	0.63	--	--	0.68
BKF Max Depth (ft)	--	--	--	--	--	--	1.12	1.65	1.40	1.54	2.36	1.90	0.59	0.90	0.73	--	--	1.02
Width/Depth Ratio	--	--	--	--	--	--	5.3	8.8	7.1	9.3	12.7	11.3	--	--	12.7	--	--	13.0
Entrenchment Ratio	--	--	--	--	--	--	1.8	2.2	2.0	3.5	4.4	3.8	3.5	4.4	3.8	--	--	7.9
Wetted Perimeter (ft)	--	--	--	--	--	--	--	--	--	--	--	20.8	--	--	9.3	--	--	9.3
Hydraulic Radius (ft)	--	--	--	--	--	--	--	--	--	--	--	1.4	--	--	0.5	--	--	0.7
Pattern	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	--	--	--	--	--	--	--	--	--	36.0	150.0	67.0	15.5	64.5	28.8	8.6	42.0	24.8
Radius of Curvature (ft)	--	--	--	--	--	--	--	--	--	19.0	115.0	49.0	8.2	49.5	21.1	8.2	20.1	13.3
Meander Wavelength (ft)	--	--	--	--	--	--	--	--	--	33.0	155.0	94.0	14.2	66.7	40.4	47.7	68.6	61.8
Meander Width Ratio	--	--	--	--	--	--	--	--	--	1.9	8.1	3.6	1.9	8.1	3.6	1.0	4.8	2.8
Profile	Min	Max	Med	LL	UL	Eq	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.2	26.4	13.4
Riffle Slope (ft/ft)	--	--	--	--	--	--	--	--	--	0.006	0.066	0.028	0.008	0.083	0.036	0.008	0.062	0.028
Pool Length (ft)	--	--	--	--	--	--	--	--	--	18.3	62.9	35.1	7.9	27.1	15.1	10.1	23.3	15.9
Pool Spacing (ft)	--	--	--	--	--	--	--	--	--	50.3	105.8	78.9	21.6	45.5	33.9	31.8	90.7	51.9
Substrate																		
d50 (mm)	--			--			0.06			3			0.06			0.32		
d84 (mm)	--			--			0.21			105			0.21			0.5		
Additional Reach Parameters																		
Bankfull Slope (ft/ft)	--			--			0.0111			0.0090			0.0079			0.0105		
Channel Length(ft)	--			--			549			590			860			790		
Valley Length (ft)	--			--			486			404			571			571		
Sinuosity	--			--			1.13			1.46			1.51			1.38		
Rosgen Classification	--			--			Degraded E6			C4/1			C6			C5		

Table VIII. Morphology and Hydraulic Monitoring Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R1 (7543 ft)

PARAMETERS	Cross Section 9 Pool					Cross Section 10 Pool					Cross Section 11 Pool					Cross Section 12 Riffle														
Dimension	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
BKF Width (ft)	23.1	23.6	19.5			18.9	26.0	16.7			21.2	20.5	26.7			22.7	23.7	23.1													
Floodprone Width (ft)	80.3	87.7	77.3			104.9	105.7	109.1			129.3	83.3	87.7			74.9	96.5	80.3													
BKF Cross Sectional Area (sq. ft.)	45.9	45.1	35.4			40.7	42.6	34.7			61.1	44.4	60.5			48.9	59.2	44.0													
BKF Mean Depth (ft)	1.99	1.91	1.82			2.15	1.64	2.08			2.88	2.16	2.27			2.16	2.50	1.91													
BKF Max Depth (ft)	3.95	4.38	3.69			3.70	3.48	3.94			6.32	3.59	4.02			3.22	5.01	4.04													
Width/Depth Ratio	11.6	12.4	10.7			8.8	15.9	8.0			7.4	9.5	11.7			10.5	9.5	12.1													
Entrenchment Ratio	3.47	3.59	3.97			5.55	4.06	6.53			6.10	4.06	3.29			3.31	4.08	3.48													
Wetted Perimeter (ft)	25.1	26.2	22.0			22.5	27.9	20.5			25.7	23.6	29.5			25.0	27.2	25.4													
Hydraulic Radius (ft)	1.83	1.72	1.61			1.81	1.53	1.69			2.37	1.88	2.05			1.95	2.18	1.73													

PARAMETERS	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	50.2	134.8	95.3	38.7	121.8	90.9	50.6	133.0	95.2						
Radius of Curvature (ft)	44.9	73.6	54.0	37.4	87.0	55.2	38.4	74.4	53.8						
Meander Wavelength (ft)	186.6	240.2	210.4	189.0	240.1	209.5	190.4	238.6	210.4						
Meander Width Ratio	2.2	6.0	4.2	1.6	5.1	3.8	2.2	5.8	4.1						
Profile	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	21.8	47.5	29.3	13.1	30.0	22.5	12.3	29.1	19.7						
Riffle Slope (ft/ft)	0.001	0.015	0.006	0.002	0.028	0.018	0.001	0.018	0.008						
Pool Length (ft)	25.7	85.0	43.0	37.5	88.1	54.7	14.3	69.4	33.6						
Pool Spacing (ft)	49.4	138.4	85.7	33.7	168.7	89.6	49.0	149.0	87.5						
Substrate															
d50 (mm)	0.23			0.15			0.62								
d84 (mm)	0.73			0.65			6.73								
Additional Reach Parameters															
Bankfull Slope (ft/ft)	0.0020			0.0021			0.0018								
Monitored Channel Length (ft)	2022			2053			2073								
Monitored Valley Length (ft)	1277			1414			1375								
Sinuosity	1.58			1.45			1.51								
Total Channel Length (ft)	7543			7543			7543								
Rosgen Classification	C5			C5			C5								

Table VIII. Morphology and Hydraulic Monitoring Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R1A (1040 ft)

PARAMETERS	Cross Section 13 Riffle																													
Dimension	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
BKF Width (ft)	7.8	9.2	7.6																											
Floodprone Width (ft)	124.2	125.0	125.0																											
BKF Cross Sectional Area (sq. ft.)	4.2	4.4	3.5																											
BKF Mean Depth (ft)	0.54	0.48	0.46																											
BKF Max Depth (ft)	0.82	0.77	0.85																											
Width/Depth Ratio	14.5	19.2	16.4																											
Entrenchment Ratio	15.85	13.54	16.56																											
Wetted Perimeter (ft)	8.1	9.8	7.8																											
Hydraulic Radius (ft)	0.52	0.45	0.45																											

PARAMETERS	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	16.7	28.1	23.4	13.7	25.5	20.3	14.9	26.2	19.6						
Radius of Curvature (ft)	8.1	20.1	13.8	12.9	21.2	17.0	13.4	22.1	17.8						
Meander Wavelength (ft)	60.6	70.0	66.1	52.6	78.9	66.3	61.0	70.0	65.8						
Meander Width Ratio	2.1	3.6	3.0	1.5	2.8	2.2	2.0	3.5	2.6						
Profile	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	6.8	23.7	15.8	11.6	19.4	14.9	5.3	9.7	7.5						
Riffle Slope (ft/ft)	0.012	0.050	0.023	0.013	0.033	0.022	0.008	0.052	0.033						
Pool Length (ft)	12.1	29.1	15.9	11.1	24.7	16.6	6.8	12.6	9.4						
Pool Spacing (ft)	32.5	55.2	43.1	25.7	73.6	50.6	20.3	52.8	34.2						
Substrate															
d50 (mm)	0.14			0.05			0.04								
d84 (mm)	0.44			0.79			0.20								
Additional Reach Parameters															
Bankfull Slope (ft/ft)	0.0114			0.0106			0.0107								
Monitored Channel Length (ft)	501			499			500								
Monitored Valley Length (ft)	380			402			405								
Sinuosity	1.32			1.24			1.23								
Total Channel Length (ft)	1040			1040			1040								
Rosgen Classification	C6			C6			C6								

Table VIII. Morphology and Hydraulic Monitoring Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R2 (7107 ft)

PARAMETERS	Cross Section 1 Riffle					Cross Section 2 Pool					Cross Section 3 Pool					Cross Section 4 Riffle					Cross Section 5 Pool									
Dimension	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
BKF Width (ft)	34.0	37.5	23.5			25.7	25.2	23.5			27.6	26.2	25.7			26.1	26.0	26.1			28.0	27.7	27.3							
Floodprone Width (ft)	99.7	110.0	91.3			118.8	116.5	116.7			150.2	155.3	164.0			120.4	120.0	120.0			104.6	105.0	105.0							
BKF Cross Sectional Area (sq. ft.)	64.1	64.2	44.1			49.7	44.2	36.7			48.7	46.9	40.8			52.1	55.4	51.8			45.4	46.2	46.8							
BKF Mean Depth (ft)	1.89	1.71	1.88			1.94	1.75	1.56			1.77	1.79	1.59			1.99	2.13	1.99			1.62	1.67	1.71							
BKF Max Depth (ft)	3.23	3.95	3.21			4.23	3.48	3.51			3.49	3.79	3.96			3.25	3.74	3.53			3.11	3.09	3.22							
Width/Depth Ratio	18.0	21.9	12.5			13.2	14.4	15.1			15.6	14.6	16.2			13.1	12.2	13.1			17.3	16.6	16.0							
Entrenchment Ratio	2.94	2.93	3.89			4.63	4.63	4.96			5.45	5.93	6.38			4.61	4.62	4.61			3.73	3.79	3.84							
Wetted Perimeter (ft)	34.9	39.3	25.0			28.6	27.1	26.3			30.0	29.0	28.1			27.5	27.6	27.9			29.4	28.9	28.8							
Hydraulic Radius (ft)	1.84	1.64	1.77			1.74	1.63	1.39			1.62	1.62	1.45			1.90	2.01	1.86			1.54	1.60	1.62							

PARAMETERS	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	62.5	141.1	110.6	57.5	139.1	105.8	62.3	139.0	105.2						
Radius of Curvature (ft)	41.9	79.3	54.7	37.3	77.6	59.4	48.0	82.1	56.4						
Meander Wavelength (ft)	183.6	258.7	236.1	177.2	263.4	236.7	176.1	259.7	236.5						
Meander Width Ratio	2.1	4.7	3.7	1.8	4.4	3.3	2.5	5.6	4.2						
Profile	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	29.7	79.1	44.7	20.4	34.7	28.1	22.5	38.8	32.3						
Riffle Slope (ft/ft)	0.002	0.013	0.005	0.002	0.006	0.004	0.003	0.012	0.006						
Pool Length (ft)	35.6	94.9	57.7	30.6	91.9	50.3	20.4	65.3	35.2						
Pool Spacing (ft)	108.7	264.9	176.3	79.6	228.7	147.0	61.3	200.1	129.4						
Substrate															
d50 (mm)	0.25			0.11			0.45								
d84 (mm)	0.76			0.38			5.70								
Additional Reach Parameters															
Bankfull Slope (ft/ft)	0.0014			0.0014			0.0012								
Monitored Channel Length (ft)	2093			2112			2103								
Monitored Valley Length (ft)	1392			1390			1392								
Sinuosity	1.50			1.52			1.51								
Total Channel Length (ft)	7107			7107			7107								
Rosgen Classification	C5			C5			C5								

Table VIII. Morphology and Hydraulic Monitoring Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R2A (336 ft)

PARAMETERS	Cross Section 6 Riffle																													
Dimension	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
BKF Width (ft)	16.1	16.1	13.4																											
Floodprone Width (ft)	40.4	40.6	41.6																											
BKF Cross Sectional Area (sq. ft.)	16.2	15.1	9.4																											
BKF Mean Depth (ft)	1.01	0.94	0.70																											
BKF Max Depth (ft)	1.89	1.90	2.09																											
Width/Depth Ratio	15.9	17.1	19.2																											
Entrenchment Ratio	2.51	2.52	3.10																											
Wetted Perimeter (ft)	16.7	16.9	15.1																											
Hydraulic Radius (ft)	0.97	0.90	0.62																											

PARAMETERS	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	33.9	47.2	39.4	35.0	48.3	40.5	34.9	48.2	40.1						
Radius of Curvature (ft)	21.3	26.8	23.7	20.1	27.1	22.9	19.1	28.5	23.4						
Meander Wavelength (ft)	98.3	105.2	100.6	99.6	103.3	101.0	98.4	108.1	101.8						
Meander Width Ratio	2.1	2.9	2.4	2.2	3.0	2.5	2.6	3.6	3.0						
Profile	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	19.2	24.6	22.0	18.2	26.3	21.4	6.6	12.4	9.2						
Riffle Slope (ft/ft)	0.007	0.020	0.013	0.005	0.020	0.012	0.005	0.025	0.013						
Pool Length (ft)	18.3	45.0	31.7	13.2	22.1	18.3	7.8	20.2	13.8						
Pool Spacing (ft)	71.8	133.0	102.4	47.7	93.0	72.7	46.5	90.3	67.3						
Substrate															
d50 (mm)	0.24			0.68			0.05								
d84 (mm)	11.30			11.30			11.30								
Additional Reach Parameters															
Bankfull Slope (ft/ft)	0.0108			0.0115			0.0143								
Monitored Channel Length (ft)	320			321			319								
Monitored Valley Length (ft)	246			248			244								
Sinuosity	1.30			1.30			1.30								
Total Channel Length (ft)	336			336			336								
Rosgen Classification	C5			C5			C6								

Table VIII. Morphology and Hydraulic Monitoring Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R2B (1474 ft)

PARAMETERS	Cross Section 7 Riffle																													
Dimension	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
BKF Width (ft)	8.7	8.3	8.5																											
Floodprone Width (ft)	25.5	24.9	25.1																											
BKF Cross Sectional Area (sq. ft.)	4.5	4.2	4.4																											
BKF Mean Depth (ft)	0.52	0.51	0.51																											
BKF Max Depth (ft)	0.89	0.85	0.84																											
Width/Depth Ratio	16.7	16.2	16.6																											
Entrenchment Ratio	2.93	3.01	2.96																											
Wetted Perimeter (ft)	9.0	8.5	8.9																											
Hydraulic Radius (ft)	0.50	0.50	0.49																											

PARAMETERS	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	16.9	31.6	22.8	15.1	28.7	21.1	16.4	29.1	21.5						
Radius of Curvature (ft)	9.4	22.2	16.7	11.5	23.1	18.0	9.5	22.6	16.9						
Meander Wavelength (ft)	59.4	68.7	64.2	60.1	69.8	64.6	58.5	79.1	65.5						
Meander Width Ratio	1.9	3.6	2.6	1.8	3.5	2.6	1.9	3.4	2.5						
Profile	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	--	--	--	5.1	10.7	7.8	5.1	10.7	7.8						
Riffle Slope (ft/ft)	--	--	--	0.013	0.048	0.035	0.013	0.048	0.035						
Pool Length (ft)	9.6	18.6	15.0	13.5	23.6	17.5	13.5	23.6	17.5						
Pool Spacing (ft)	24.8	60.2	44.0	30.4	55.1	42.2	30.4	55.1	42.2						
Substrate															
d50 (mm)	0.04			0.03			0.03								
d84 (mm)	0.38			0.06			0.05								
Additional Reach Parameters															
Bankfull Slope (ft/ft)	0.0165			0.0164			0.0163								
Monitored Channel Length (ft)	528			553			517								
Monitored Valley Length (ft)	387			433			405								
Sinuosity	1.36			1.28			1.28								
Total Channel Length (ft)	1474			1474			1474								
Rosgen Classification	C6			C6			C6								

Table VIII. Morphology and Hydraulic Monitoring Summary
Little White Oak Creek Stream Restoration / D06027-B
Reach R2D (790 ft)

PARAMETERS	Cross Section 8 Riffle																													
Dimension	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
BKF Width (ft)	11.7	10.9	11.1																											
Floodprone Width (ft)	69.6	70.0	70.0																											
BKF Cross Sectional Area (sq. ft.)	6.7	7.1	6.5																											
BKF Mean Depth (ft)	0.57	0.65	0.59																											
BKF Max Depth (ft)	1.04	1.05	1.03																											
Width/Depth Ratio	20.6	16.8	18.8																											
Entrenchment Ratio	5.94	6.40	6.31																											
Wetted Perimeter (ft)	12.1	11.3	1.5																											
Hydraulic Radius (ft)	0.55	0.63	0.57																											

PARAMETERS	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	12.0	30.9	23.7	6.7	28.7	21.4	11.7	27.8	21.8						
Radius of Curvature (ft)	12.4	20.4	15.1	10.8	23.8	15.7	12.0	20.2	15.8						
Meander Wavelength (ft)	49.7	67.7	61.6	50.1	69.4	61.5	49.5	67.8	61.7						
Meander Width Ratio	1.0	2.6	2.0	0.6	2.6	2.0	1.1	2.5	2.0						
Profile	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Riffle Length (ft)	7.0	14.9	11.4	5.8	12.2	8.1	5.8	15.7	10.5						
Riffle Slope (ft/ft)	--	--	--	0.011	0.044	0.025	0.002	0.095	0.027						
Pool Length (ft)	12.2	19.7	16.3	8.1	24.4	16.8	7.0	20.9	13.6						
Pool Spacing (ft)	42.2	51.1	44.6	27.9	66.3	49.4	27.3	54.1	42.3						
Substrate															
d50 (mm)	0.14			0.16			0.03								
d84 (mm)	0.41			0.42			0.06								
Additional Reach Parameters															
Bankfull Slope (ft/ft)	0.0124			0.0125			0.0138								
Monitored Channel Length (ft)	463			464			466								
Monitored Valley Length (ft)	346			345			346								
Sinuosity	1.34			1.35			1.35								
Total Channel Length (ft)	790			790			790								
Rosgen Classification	C5			C5			C6								

Exhibit Table IX. BEHI and Sediment Export Estimates
Little White Oak Creek Stream Restoration / D06027-B

Time Point	Segment / Reach	Linear Footage or Acreage	Extreme		Very High		High		Moderate		Low		Very Low		Sediment Export
			ft	%	ft	%	ft	%	ft	%	ft	%	ft	%	tons/yr
Preconstruction 2006	R1	6530			5877	90									455
	R1A	906	906	100											229
	R2	5979	5381	90											767
	R2A	625			625	100									32
	R2B	1713					1713	100							120
	R2D	526	526	100											250
	TOTAL	16279	6813	42	6502	40	1713	11	0	0	0	0	0	0	1853
Monitoring Y3 2010	R1	7543							5280	70	2263	30			189
	R1A	1040									1040	100			1
	R2	7107							7107	100					123
	R2A	336									336	100			3
	R2B	1474									1474	100			4
	R2D	790									790	100			22
	TOTAL	18290	0	0	0	0	0	0	12387	68	5903	32	0	0	342
Monitoring Y5 2012 **(NOT APPLICABLE)**	R1	7543													
	R1A	1040													
	R2	7107													
	R2A	336													
	R2B	1474													
	R2D	790													
	TOTAL	18290	0	0	0	0	0	0	0	0	0	0	0	0	0

Exhibit Table X. Verification of Bankfull Events Little White Oak Creek Stream Restoration / D06027-B			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo No. (If Available)**
8/25/08-8/27/08	Unknown	Crest Guage	N/A
10/13/09 - 10/14/09	Unknown	Crest Guage	N/A
11/01/10 - 11/03/10	Unknown	Crest Guage	N/A

Table XI. Categorical Stream Feature Visual Stability Assessment Little White Oak Creek Stream Restoration / D06027-B						
Reach R1 (7543ft)						
Feature	**Initial**	**MY-01**	**MY-02[A]**	**MY-03[B]**	**MY-04**	**MY-05**
Riffles	100%	100%	100%	91%		
Pools	100%	100%	100%	84%		
Thalwegs	100%	100%	100%	100%		
Meanders	100%	100%	95%	95%		
Bed General	100%	100%	100%	100%		
Structures	100%	100%	95%	88%		
Rootwads	100%	100%	95%	98%		
Reach R1A (1040ft)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%	100%	100%	100%		
Pools	100%	100%	100%	100%		
Thalwegs	100%	100%	100%	100%		
Meanders	100%	100%	100%	100%		
Bed General	100%	100%	100%	100%		
Structures	100%	100%	100%	100%		
Rootwads	100%	100%	100%	100%		
Reach R2 (7107ft)						
Feature	**Initial**	**MY-01**	**MY-02[A]**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%	100%	100%	100%		
Pools	100%	100%	100%	100%		
Thalwegs	100%	100%	100%	100%		
Meanders	100%	100%	95%	95%		
Bed General	100%	100%	100%	100%		
Structures	100%	100%	95%	95%		
Rootwads	100%	100%	95%	95%		
Reach R2A (336ft)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%	100%	100%	100%		
Pools	100%	100%	100%	100%		
Thalwegs	100%	100%	100%	100%		
Meanders	100%	100%	100%	100%		
Bed General	100%	100%	100%	100%		
Structures	100%	100%	100%	100%		
Rootwads	100%	100%	100%	100%		
Reach R2B (1474ft)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%	100%	100%	100%		
Pools	100%	100%	100%	100%		
Thalwegs	100%	100%	100%	100%		
Meanders	100%	100%	100%	100%		
Bed General	100%	100%	100%	100%		
Structures	100%	100%	100%	100%		
Rootwads	100%	100%	100%	100%		
Reach R2D (790ft)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%	100%	100%	100%		
Pools	100%	100%	100%	100%		
Thalwegs	100%	100%	100%	100%		
Meanders	100%	100%	100%	100%		
Bed General	100%	100%	100%	100%		
Structures	100%	100%	100%	100%		
Rootwads	100%	100%	100%	100%		

Notes:

[A]The results shown above as less than 100% percent, reflect the construction of beaver dams on the respective reaches during MY-02 (2009).

[B]The entire project suffered a flood event during MY-03 (2010) causing damage along R1.

Table XII. Stream Problem Areas (Year 3 of 5) Little White Oak Creek Stream Restoration / D06027-B			
Feature/Issue	**Station / Range**	**Probable Cause**	**Photo No. (If Available)**
Right bench erosion	Approximate station 2+10 -R1-	Flood Event	N/A
Left terrace erosion	Approximate station 3+75 -R1-	Flood Event	Appendix F Photo 1
Left bench and terrace erosion	Approximate station 8+75 -R1-	Flood Event	Appendix F Photo 2
Right bench and terrace erosion	Approximate station 10+96 -R1-	Flood Event	N/A
Left bench and terrace erosion	Approximate station 12+10 -R1-	Flood Event	Appendix F Photo 3
Right terrace and streambank erosion	Approximate station 16+75 to 18+00 -R1-	Flood Event	Appendix F Photo 4
Left bench and terrace erosion	Approximate station 19+10 -R1-	Flood Event	N/A
Left streambank erosion	Approximate station 20+05 to 20+50 -R1-	Flood Event	Appendix F Photo 5
Right bench and terrace erosion	Approximate station 20+25 -R1-	Flood Event	N/A
Right bench, terrace, and streambank erosion	Approximate station 23+90 -R1-	Flood Event	Appendix F Photo 6
Right streambank erosion	Approximate station 25+10 to 25+35 -R1-	Flood Event	Appendix F Photo 7
Left streambank erosion	Approximate station 26+45 to 26+55 -R1-	Flood Event	N/A
Right streambank erosion	Approximate station 26+75 to 27+45 -R1-	Flood Event	Appendix F Photo 8
Right streambank scour	Single Arm Vane Structure Number 26 Approximate station 28+35 -R1-	Flood Event	N/A
Right bench erosion	Approximate station 29+75 -R1-	Flood Event	Appendix F Photo 9
Left streambank scour	Single Arm Vane Structure Number 28 Approximate station 30+25 -R1-	Flood Event	N/A
Left bench and terrace erosion	Approximate station 31+35 -R1-	Flood Event	Appendix F Photo 10
Right streambank erosion	Approximate station 31+15 to 31+75 -R1-	Flood Event	N/A
Right streambank erosion	Approximate station 34+00 to 34+50 -R1-	Flood Event	N/A
Left bench erosion	Approximate station 34+40 -R1-	Flood Event	N/A
Left terrace erosion	Approximate station 36+70 -R1-	Flood Event	N/A
Left bench erosion	Approximate station 39+70 -R1-	Flood Event	Appendix F Photo 11
Right terrace erosion	Approximate station 41+60 -R1-	Flood Event	N/A
Left bench erosion	Approximate station 42+30 -R1-	Flood Event	N/A
Right streambank erosion	Approximate station 43+50 to 44+00 -R1-	Flood Event	N/A
Right bench erosion	Approximate station 44+35 -R1-	Flood Event	N/A
Right streambank erosion	Approximate station 46+95 to 47+30 -R1-	Flood Event	N/A
Right streambank erosion	Approximate station 58+30 to 58+70 -R1-	Flood Event	N/A
Right bench and streambank erosion	Approximate station 61+85 to 62+75 -R1-	Flood Event	Appendix F Photo 12
Right streambank erosion	Approximate station 54+60 to 55+40 -R2-	Flood Event	N/A
Left streambank erosion	Approximate station 56+10 to 57+00 -R2-	Flood Event	Appendix F Photo 13

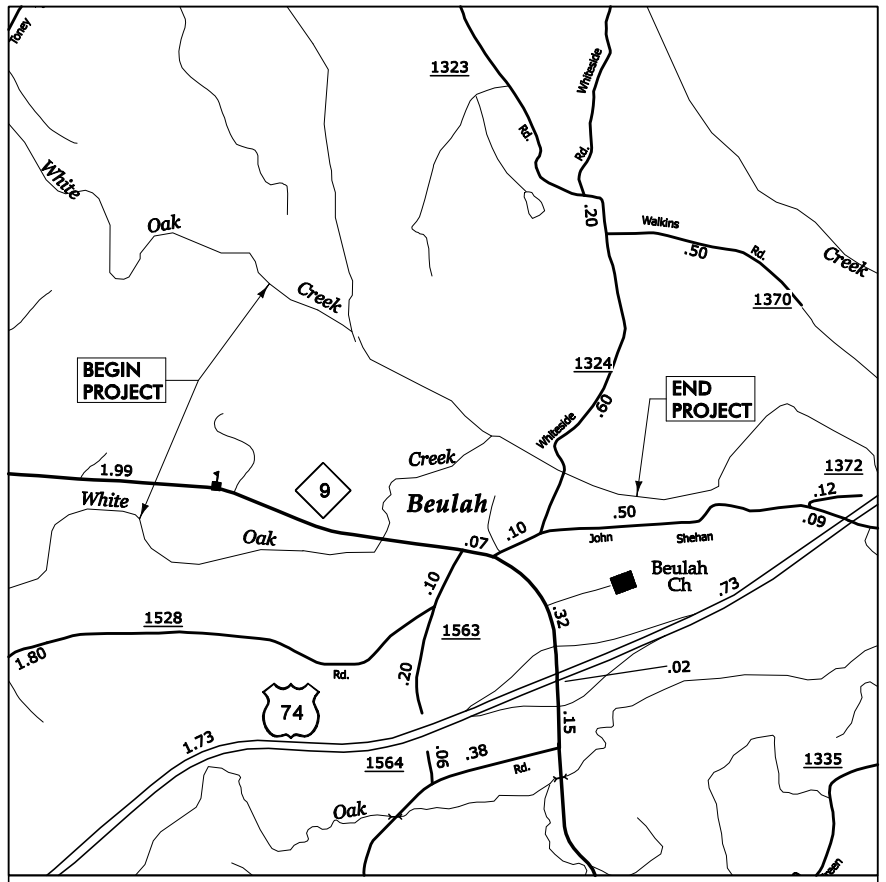
SCO ID NO. D06027–B

POLK COUNTY

LITTLE WHITE OAK CREEK STREAM RESTORATION SITE

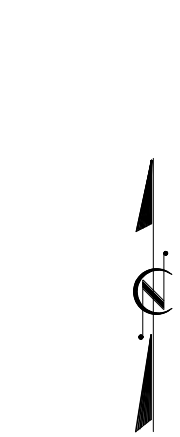
LOCATION: NORTHEAST OF THE INTERSECTION OF NC 9 AND US 74 (EXIT 167)

YEAR 3 MONITORING



VICINITY MAP

NOT TO SCALE



NOT TO SCALE

INDEX OF SHEETS

SHEET NUMBER	SHEET
1	TITLE SHEET
2	LEGEND
3	PROJECT OVERVIEW
4 – 19	YEAR 1 MONITORING OVERLAY

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

SCALE AS SHOWN	
DATE:	12/10/10
DESIGNED:	WSH
DRAWN:	MLM
CHECKED:	EMP
APPROVED:	EMP

MULKEY PROJECT NUMBER
2006237.00

PLANS PREPARED BY:

MULKEY
ENGINEERS & CONSULTANTS
PO Box 33127
Raleigh, N.C. 27636
(919) 851-1912
(919) 851-1918 (FAX)
WWW.MULKEYINC.COM

MULKEY PROJECT MANAGER
WENDEE B. SMITH

MULKEY ENGINEER
EMMETT PERDUE, PE

MULKEY SENIOR SCIENTIST
THOMAS BARRETT, RF

PROJECT ENGINEER

TITLE SHEET

SHEET 1 OF 19

NOTE: NOT TO SCALE
Not all symbols used in plans

LEGEND

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	2

LEGEND

MULKEY
ENGINEERS & CONSULTANTS
PO Box 33127
Raleigh, N.C. 27636
(919) 851-1912
(919) 851-1918 (FAX)
WWW.MULKEYINC.COM

BOUNDARIES AND PROPERTY:

- State Line
- County Line
- Township Line
- City Line
- Reservation Line
- Property Line
- Existing Iron Pin (EIP)
- Property Corner
- Property Monument (ECM)
- Existing Fence
- Temporary Fence
- Proposed Woven Wire Fence
- Proposed Chain Link Fence
- Proposed Barbed Wire Fence
- Tree Protection Fence
- Wetland Boundary
- Proposed Oxbow Wetland Boundary (WLB)
- Conservation Easement
- Construction Limits
- Limits Of Disturbance
- Proposed Gate (G)
- Bench Mark
- Control Point

BUILDINGS AND OTHER CULTURE:

- Sign (S)
- Foundation
- Area Outline
- Building
- School
- Church

HYDROLOGY:

- Hydro, Pool or Reservoir
- River Basin Buffer (RBB)
- Flow Arrow
- Disappearing Stream
- Spring
- Thalweg
- Top Of Bank
- Swamp Marsh
- Proposed Lateral, Tail, Head Ditch (FLOW)
- Bedrock

RAILROADS:

- Standard Guage (CSX TRANSPORTATION)
- RR Signal Milepost (MILEPOST 35)
- Switch (SWITCH)
- RR Abandoned

ROADS AND RELATED FEATURES:

- Existing Edge of Pavement
- Existing Curb
- Existing Soil Road
- Existing Metal Guardrail
- Existing Cable Guiderail

VEGETATION:

- Single Tree
- Single Shrub
- Hedge
- Woods Line
- Orchard
- Vineyard (Vineyard)

EXISTING STRUCTURES:

MAJOR:

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

MINOR:

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

UTILITIES:

POWER:

- Existing Power Pole
- Existing Joint Use Pole
- Power Manhole (P)
- Power Line Tower
- Power Transformer
- U/G Power Cable Hand Hole (HH)
- H-Frame Pole
- Recorded U/G Power Line (P)

GAS:

- Gas Meter
- Recorded U/G Gas Line (G)
- Above Ground Gas Line (A/G Gas)

TELEPHONE:

- Existing Telephone Pole
- Telephone Manhole (T)
- Telephone Booth (T)
- Telephone Pedestal (T)
- Telephone Cell Tower
- U/G Telephone Cable Hand Hole (HH)
- Recorded U/G Telephone Cable (T)
- Recorded U/G Telephone Conduit (TC)
- Recorded U/G Fiber Optics Cable (T FO)

WATER:

- Water Manhole (W)
- Water Valve
- Water Hydrant
- Recorded U/G Water Line (W)
- Above Ground Water Line (A/G Water)

TV:

- TV Satellite Dish
- TV Pedestal (C)
- TV Tower
- U/G TV Cable Hand Hole (HH)
- Recorded U/G TV Cable (TV)
- Recorded U/G Fiber Optic Cable (TV FO)

MISCELLANEOUS:

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

SANITARY SEWER:

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

PROPOSED STREAM WORK:

STREAM STRUCTURES:

- Rock Crossvane
- Rock Vane
- J Hook Rock Vane
- Flood Plane Interceptor
- Constructed Riffle
- Root Wad
- Structure Number
- Constructed Flood Plane Interceptor

STREAM FEATURES:

- Constructed Bankfull/Top Of Bank
- Old Top Of Bank
- Constructed Thalweg
- Proposed Thalweg
- Waters Edge
- Old Waters Edge
- Vernal Pool
- Surface Water
- Staging Area
- Impervious Dike
- Permanent Improved Gravel Road
- Temporary Gravel Road
- Stone Outlet Sediment Trap
- Impervious Stream Channel Plug
- Fill Existing Stream Channel
- Vegetation Plot

MISCELLANEOUS:

- Photo Point (PP #1)
- Cross Section
- Crest Gauge

Easement
Restored Streams
Monitored Sections

R2
R2A
R2B
R2
R2
R2
R1
R2
R2D
R1A
R1
R1

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

1" = 400'

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	3

YEAR 3 MONITORING

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PO Box 33127
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(919) 851-1918 (FAX)
www.mulkeyinc.com

$FILE$ $TIME$ $DATE$

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	4

YEAR 3 MONITORING

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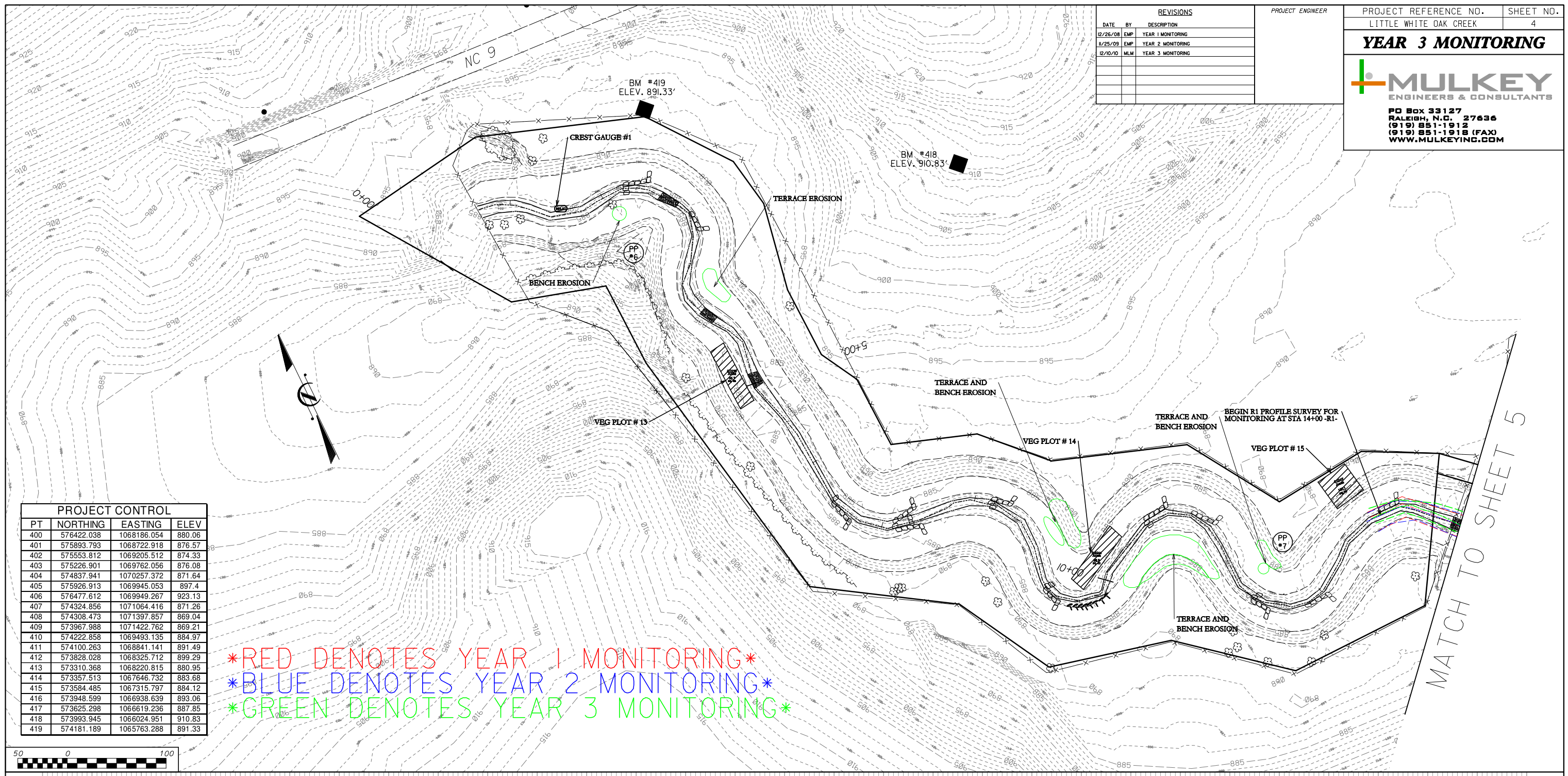
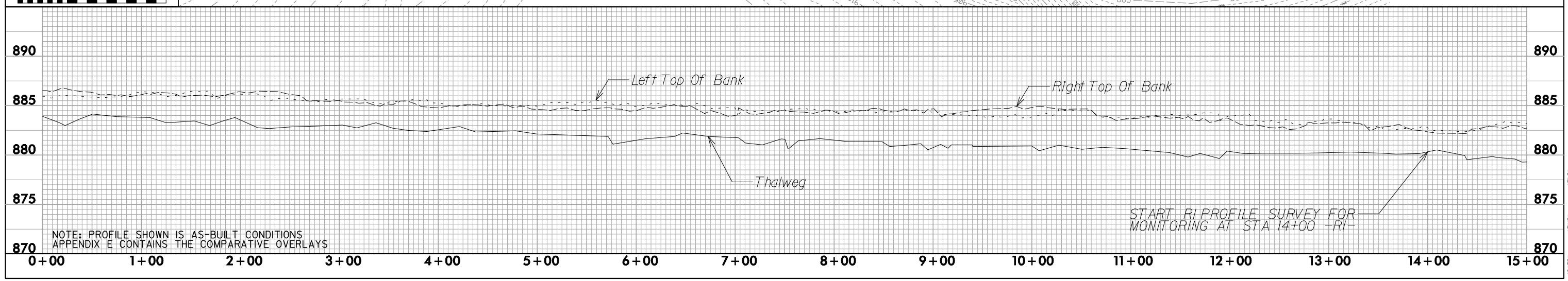


PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
403	575226.901	1069762.056	876.08
404	574837.941	1070257.372	871.64
405	575926.913	1069945.053	897.4
406	576477.612	1069949.267	923.13
407	574324.856	1071064.416	871.26
408	574308.473	1071397.857	869.04
409	573967.988	1071422.762	869.21
410	574222.858	1069493.135	884.97
411	574100.263	1068841.141	891.49
412	573828.028	1068325.712	899.29
413	573310.368	1068220.815	880.95
414	573357.513	1067646.732	883.68
415	573584.485	1067315.797	884.12
416	573948.599	1066938.639	893.06
417	573625.298	1066619.236	887.85
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

RED DENOTES YEAR 1 MONITORING
BLUE DENOTES YEAR 2 MONITORING
GREEN DENOTES YEAR 3 MONITORING



NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

$DATE$ $TIME$ $FILE$

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	5

YEAR 3 MONITORING

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PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
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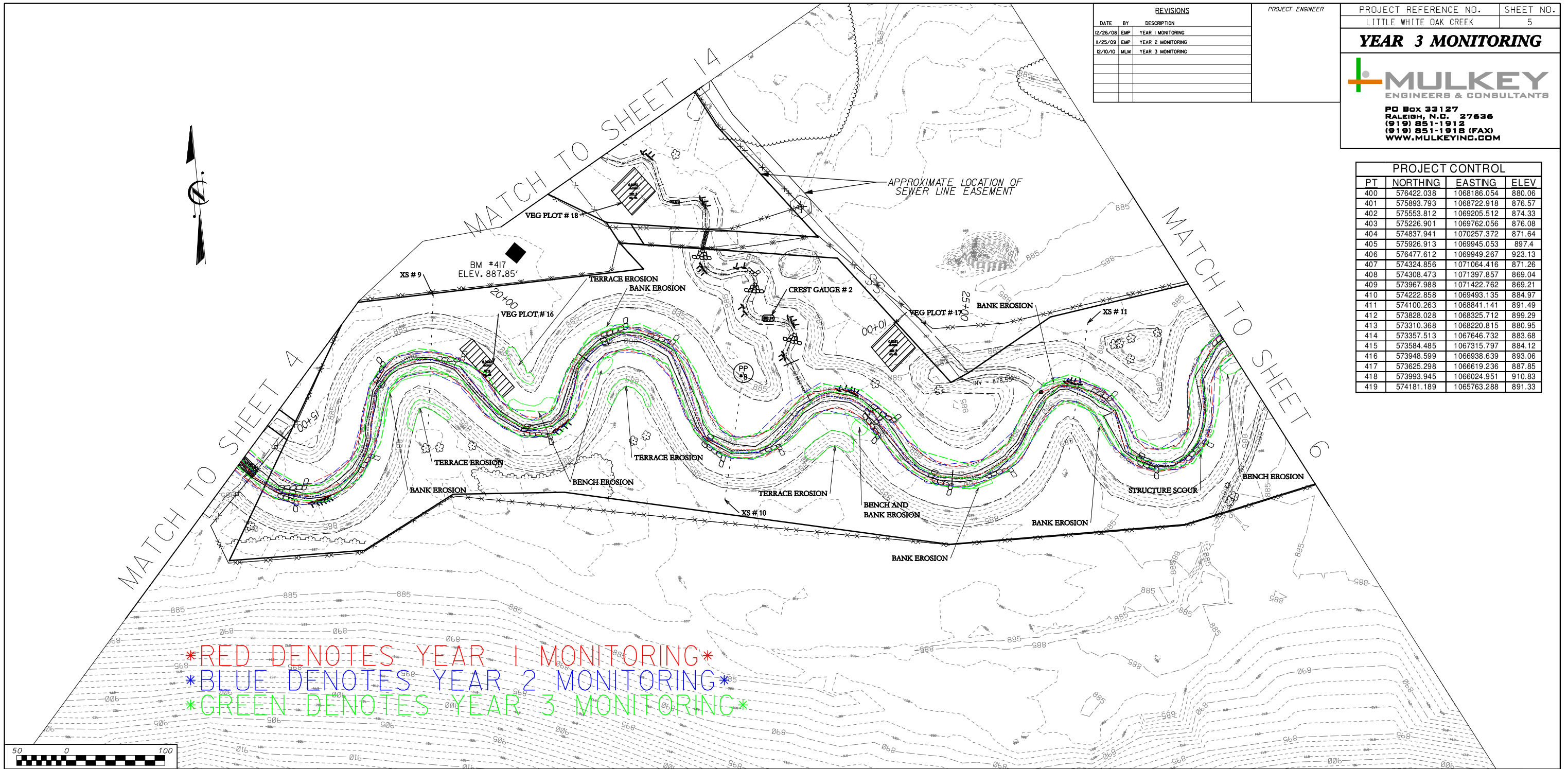

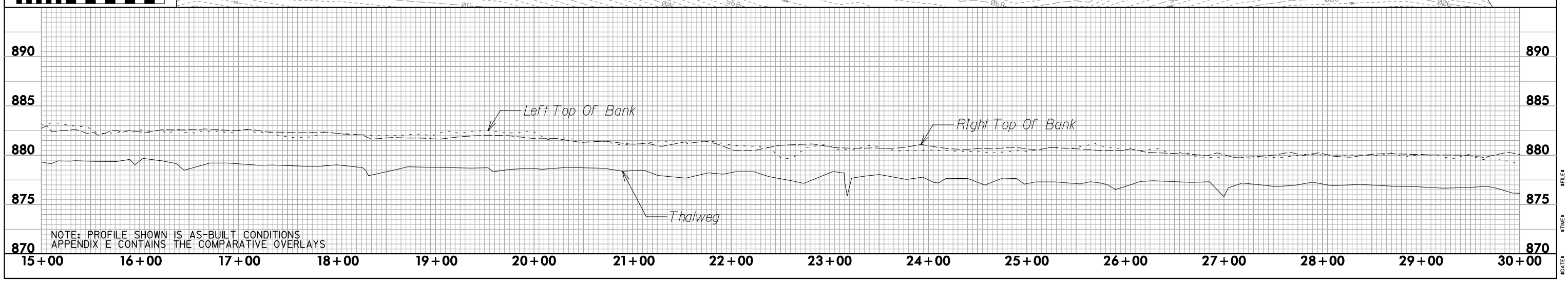

NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

$FILE$
$TIME$
$DATE$

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	6

YEAR 3 MONITORING

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PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
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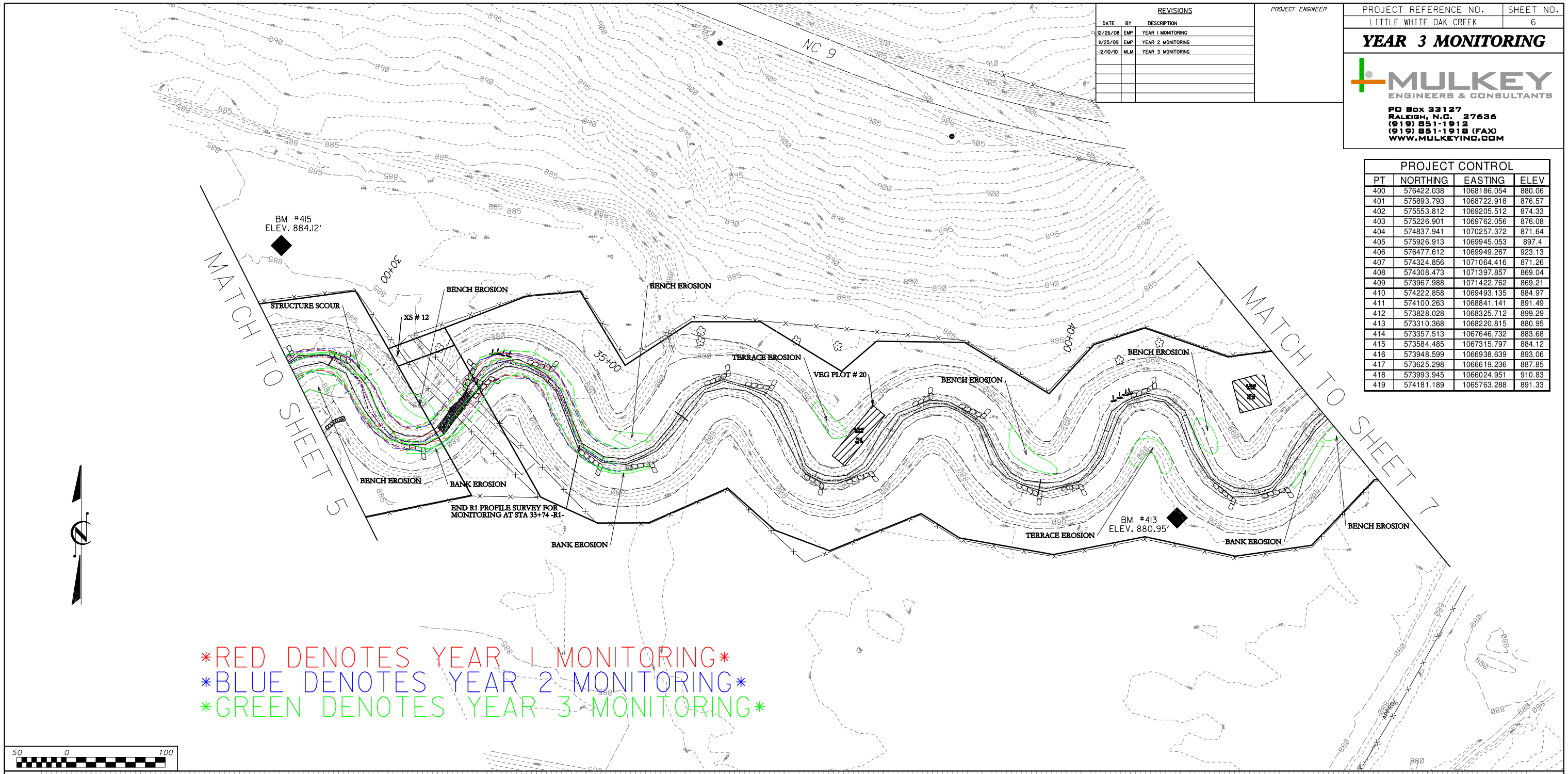
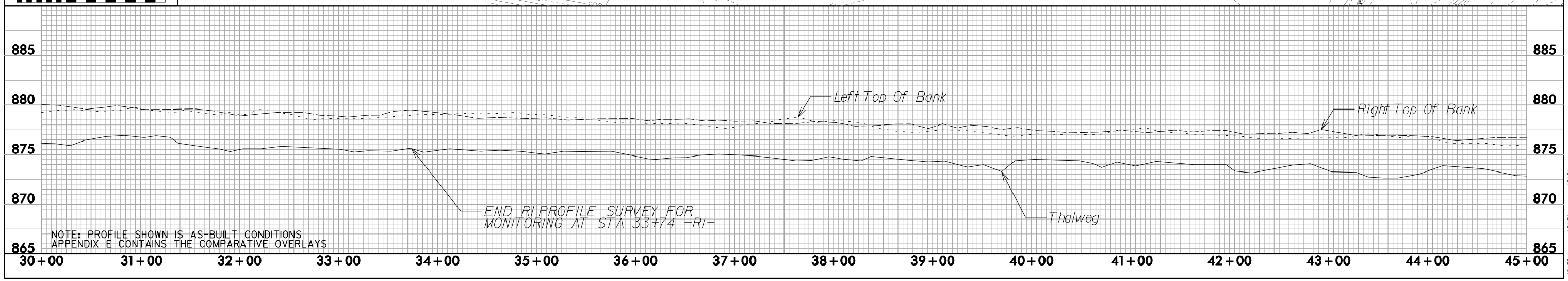
419	574181.189	1065763.288	891.33





NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

$FILE$ $TIME$ $DATE$

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	7

YEAR 3 MONITORING

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MATCH TO SHEET 6

MATCH TO SHEET 8

BM #412
ELEV. 899.29'

BM #411
ELEV. 891.49'

BENCH EROSION

BANK EROSION

BANK EROSION

CREST GAUGE #3

APPROX

VEG PLOT #22

PP #9

PP #10

45+00

50+00

55+00

UNC 9

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
403	575226.901	1069762.056	876.08
404	574837.941	1070257.372	871.64
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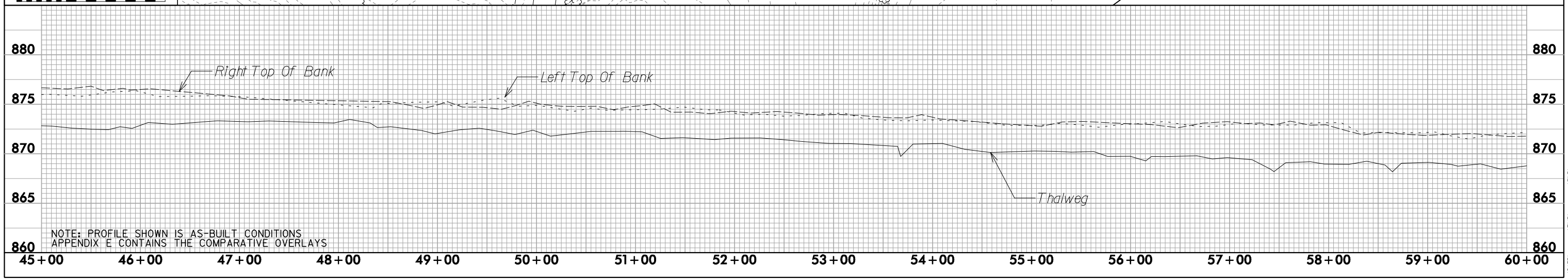
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

RED DENOTES YEAR 1 MONITORING
BLUE DENOTES YEAR 2 MONITORING
GREEN DENOTES YEAR 3 MONITORING

50 0 100



NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

$FILE$ $TIME$ $DATE$

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	8

YEAR 3 MONITORING

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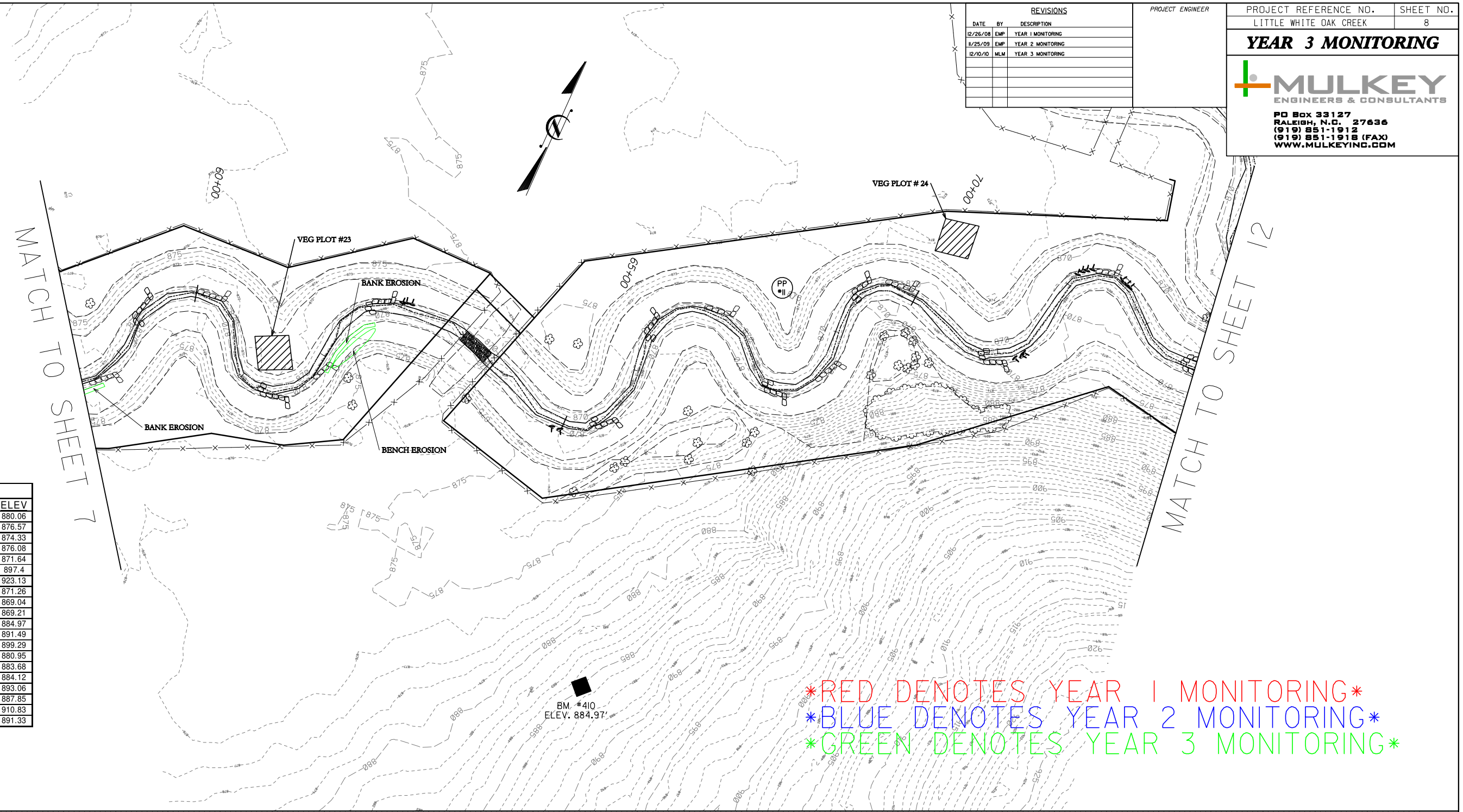

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
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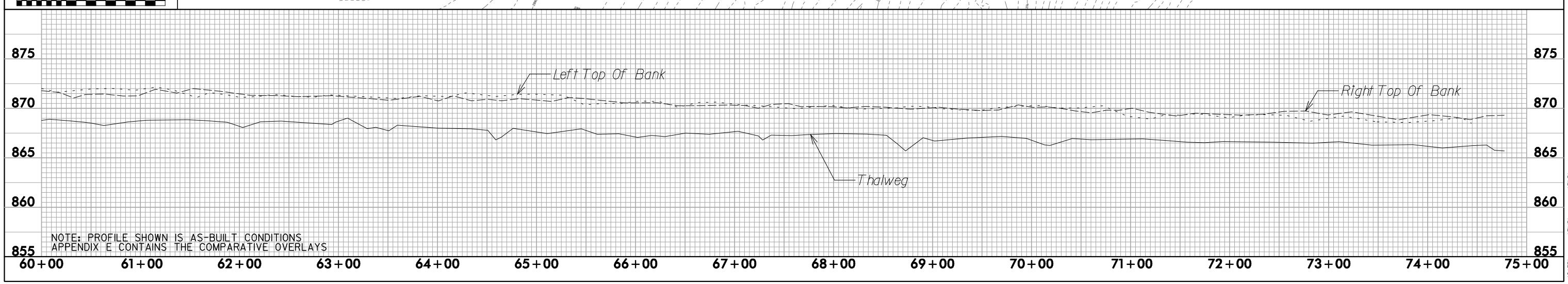

RED DENOTES YEAR 1 MONITORING
BLUE DENOTES YEAR 2 MONITORING
GREEN DENOTES YEAR 3 MONITORING

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	9

YEAR 3 MONITORING

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MATCH TO SHEET 10

0+00
5+00
10+00

CREST GAUGE # 4
VEG PLOT #1
RP #1

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
403	575226.901	1069762.056	876.08
404	574837.941	1070257.372	871.64
405	575926.913	1069945.053	897.4
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413	573310.368	1068220.815	880.95
414	573357.513	1067646.732	883.68
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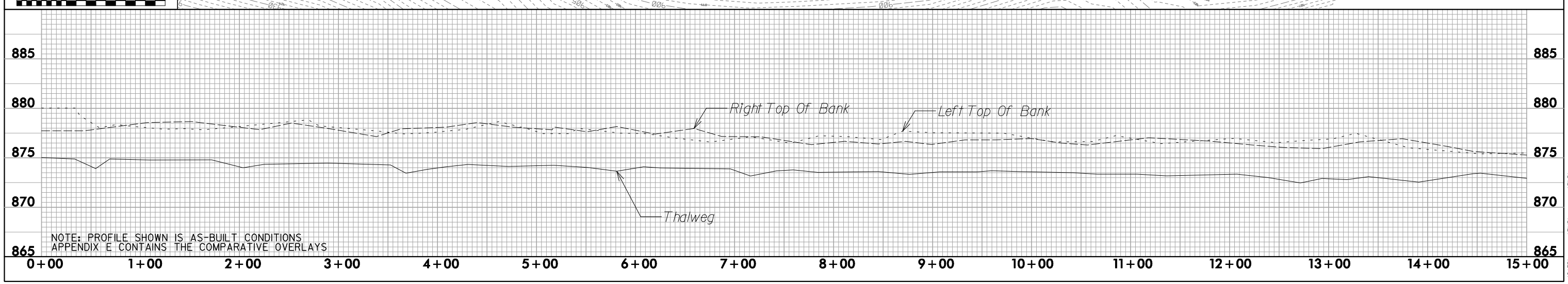
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

50 0 100



NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

$FILE$ $TIME$ $DATE$

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	10

YEAR 3 MONITORING

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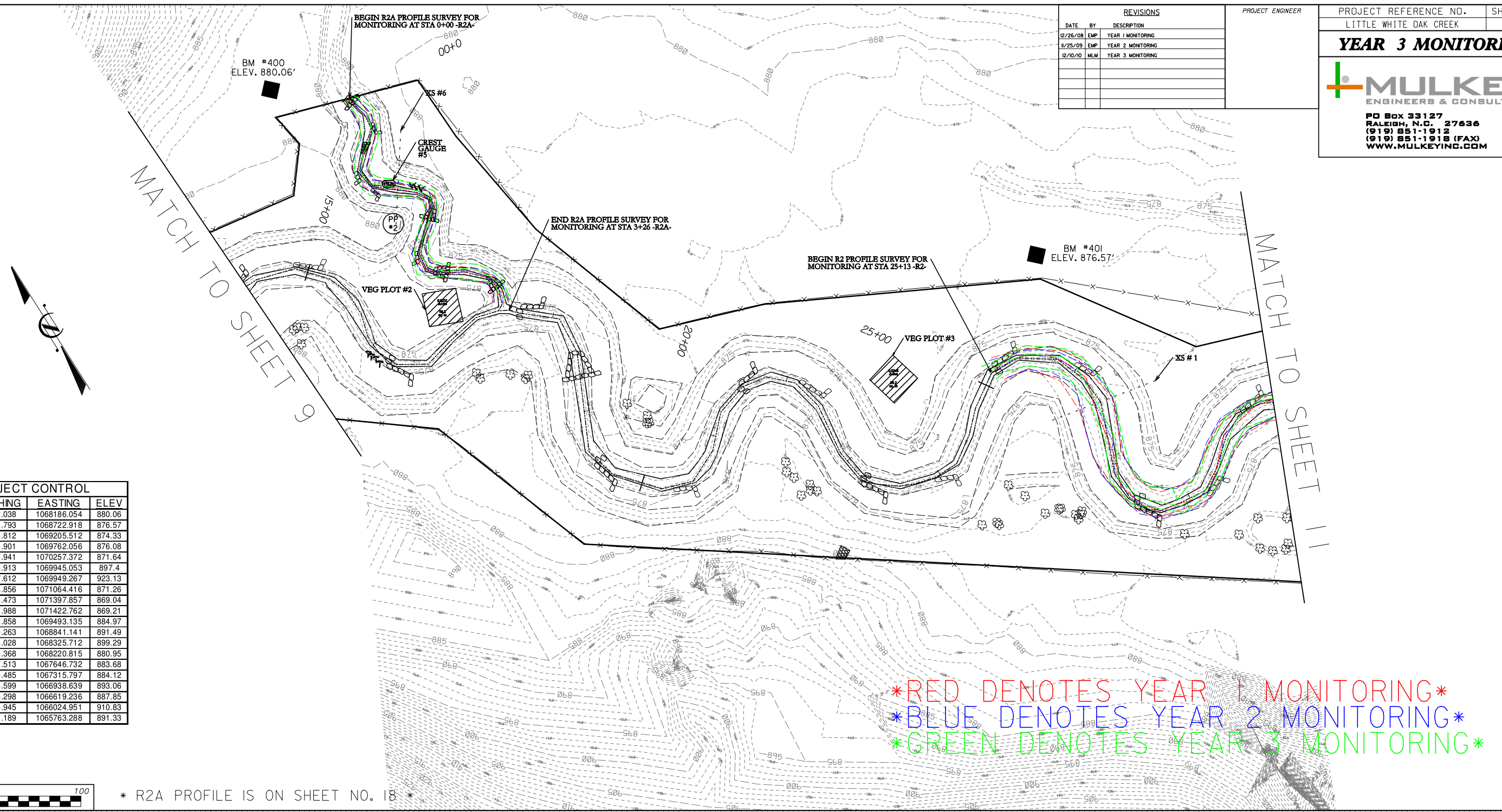

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
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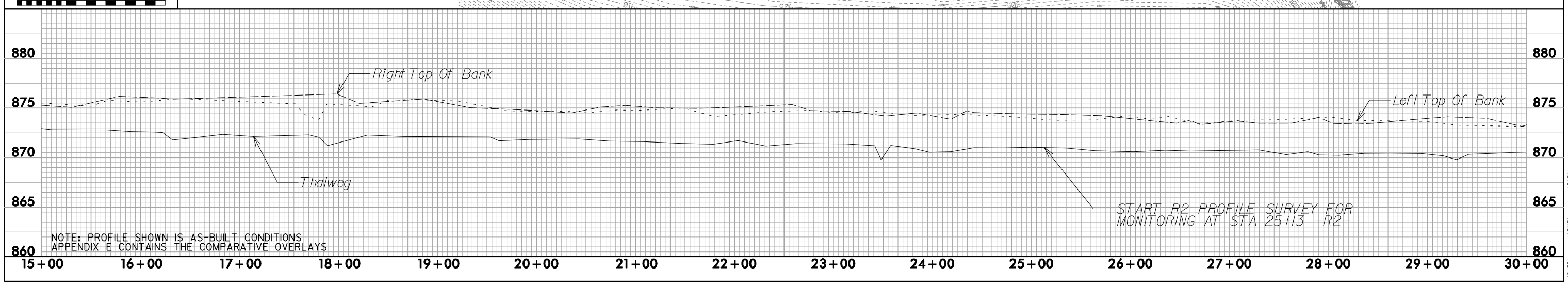
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

50 0 100

* R2A PROFILE IS ON SHEET NO. 18 *



REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	11

YEAR 3 MONITORING

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MATCH TO SHEET 16

MATCH TO SHEET 10

MATCH TO SHEET 12

BM #402
ELEV. 874.33'

BM #403
ELEV. 876.08'

XS # 2

XS # 3

XS # 4

XS # 7

CREST GAUGE #6

END R2B PROFILE SURVEY FOR MONITORING AT STA 14+86 -R2B-

VEG PLOT # 4

VEG PLOT # 7

PP +2.5Y

PP +3.5Y

30+00

35+00

40+00

RED DENOTES YEAR 1 MONITORING
BLUE DENOTES YEAR 2 MONITORING
GREEN DENOTES YEAR 3 MONITORING

PROJECT CONTROL			
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400	576422.038	1068186.054	880.06
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415	573584.485	1067315.797	884.12
416	573948.599	1066938.639	893.06
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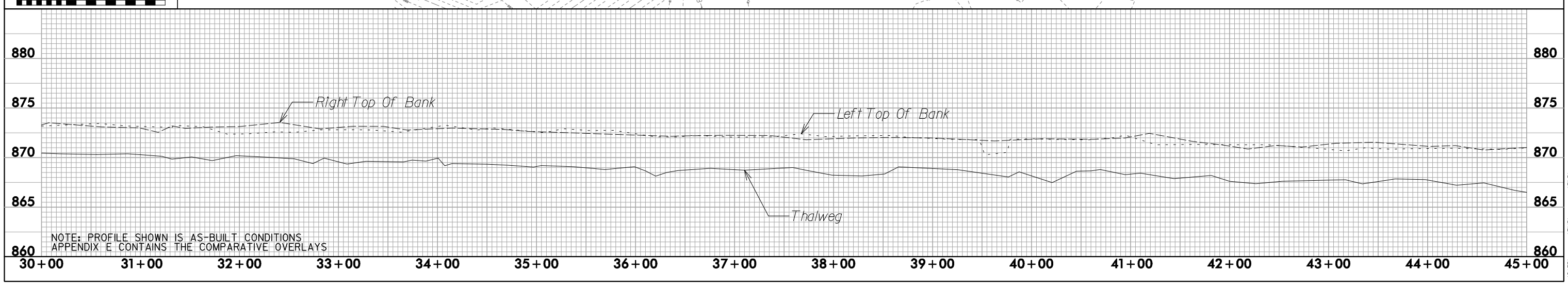
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

50 0 100



NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

&FILE&
&TIME&
&DATE&

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
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414	573357.513	1067646.732	883.68
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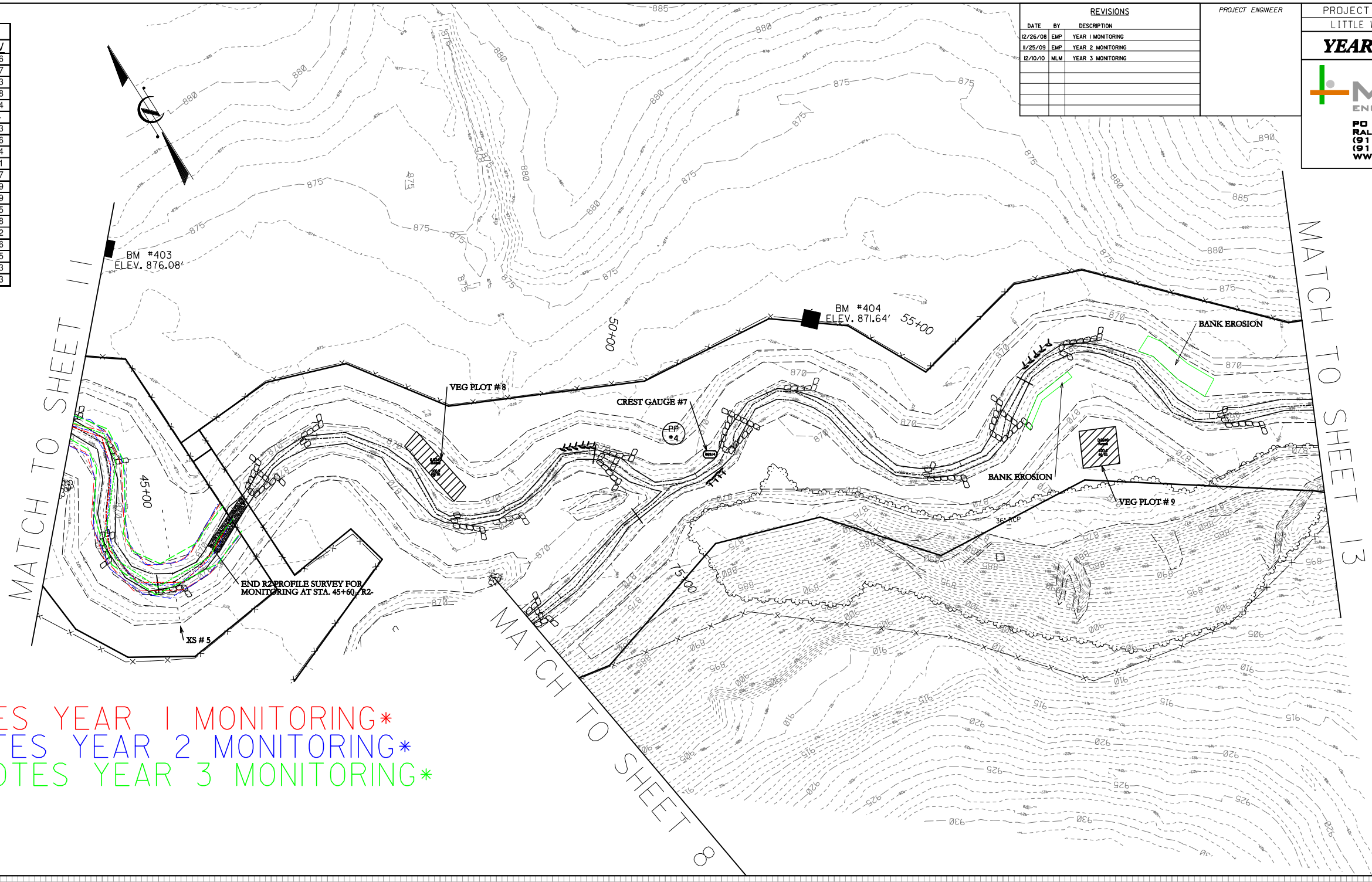
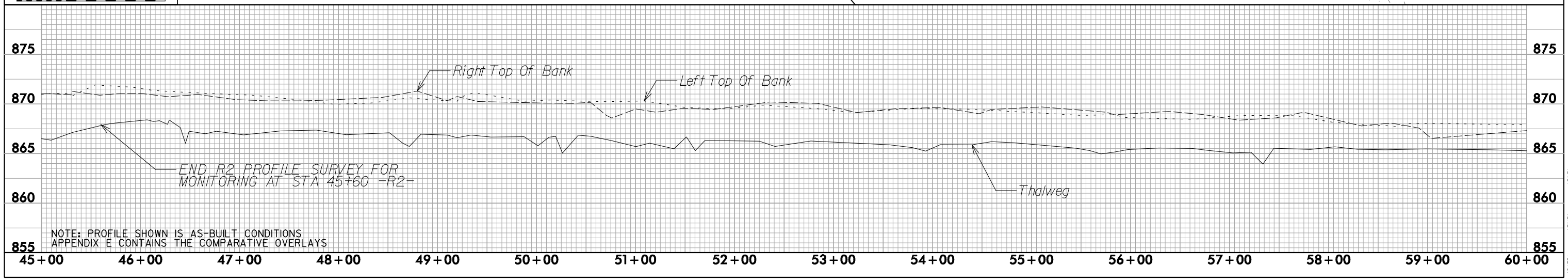


RED DENOTES YEAR 1 MONITORING
BLUE DENOTES YEAR 2 MONITORING
GREEN DENOTES YEAR 3 MONITORING

50 0 100



REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	12

YEAR 3 MONITORING

MULKEY
ENGINEERS & CONSULTANTS
PO Box 33127
Raleigh, N.C. 27636
(919) 851-1912
(919) 851-1918 (FAX)
WWW.MULKEYINC.COM

$FILE$
$TIME$
$DATE$

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
403	575226.901	1069762.056	876.08
404	574837.941	1070257.372	871.64
405	575926.913	1069945.053	897.4
406	576477.612	1069949.267	923.13
407	574324.856	1071064.416	871.26
408	574308.473	1071397.857	869.04
409	573967.988	1071422.762	869.21
410	574222.858	1069493.135	884.97
411	574100.263	1068841.141	891.49
412	573828.028	1068325.712	899.29
413	573310.368	1068220.815	880.95
414	573357.513	1067646.732	883.68
415	573584.485	1067315.797	884.12
416	573948.599	1066938.639	893.06
417	573625.298	1066619.236	887.85
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	13

YEAR 3 MONITORING

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SR 1324 (Whiteside Rd.)

BM #408
ELEV. 869.04'

BM #409
ELEV. 869.21'

VEG PLOT # 10

VEG PLOT # 11

PP #5

CREST GAUGE #8

END R2D PROFILE SURVEY FOR MONITORING AT STA 7+79 -R2D-

60+00

65+00

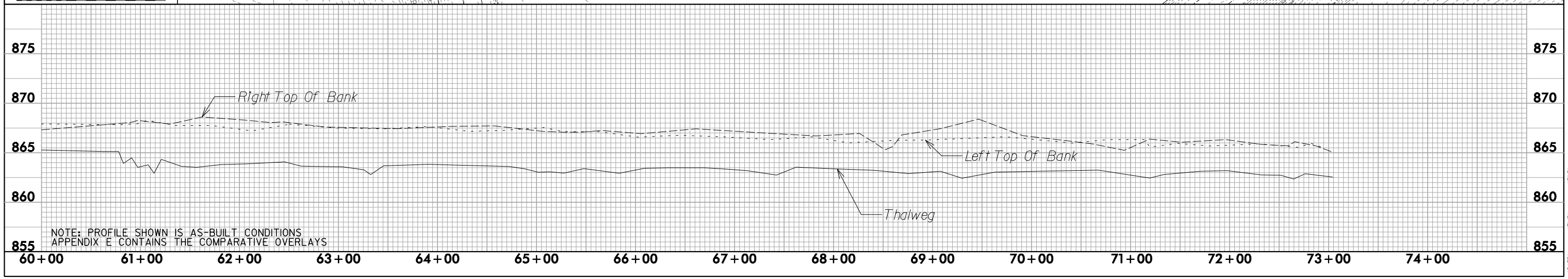
70+00

MATCH TO SHEET 12

MATCH TO SHEET 17

RED DENOTES YEAR 1 MONITORING
BLUE DENOTES YEAR 2 MONITORING
GREEN DENOTES YEAR 3 MONITORING

50 0 100



NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

$FILE$
$TIME$
$DATE$

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	14

YEAR 3 MONITORING

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BEGIN R1A PROFILE SURVEY FOR MONITORING AT STA 0+00 -R1A-

APPROXIMATE LOCATION OF SEWER LINE EASEMENT

0+00

5+00

30" CMP

NC 9

PP #8.5YI

0.0246 Acres 99.6 sq. m

VEG PLOT # 19

XS # 13

END R1A PROFILE SURVEY FOR MONITORING AT STA 5+00 -R1A-

MATCH TO SHEET 5

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
403	575226.901	1069762.056	876.08
404	574837.941	1070257.372	871.64
405	575926.913	1069945.053	897.4
406	576477.612	1069949.267	923.13
407	574324.856	1071064.416	871.26
408	574308.473	1071397.857	869.04
409	573967.988	1071422.762	869.21
410	574222.858	1069493.135	884.97
411	574100.263	1068841.141	891.49
412	573828.028	1068325.712	899.29
413	573310.368	1068220.815	880.95
414	573357.513	1067646.732	883.68
415	573584.485	1067315.797	884.12
416	573948.599	1066938.639	893.06
417	573625.298	1066619.236	887.85
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

NOTE: THE HORIZONTAL SCALE FOR THIS SHEET IS DIFFERENT FROM SHEET NO. 5

RED DENOTES YEAR 1 MONITORING
BLUE DENOTES YEAR 2 MONITORING
GREEN DENOTES YEAR 3 MONITORING

20 0 40

SEE SHEET NO. 18 FOR -R1A- PROFILE

NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

$FILE$ $TIME$ $DATE$

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	15

YEAR 3 MONITORING

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APPROXIMATE LOCATION OF GAS LINE EASEMENT

00+0

00+6

VEG PLOT # 6

0.0242 Acres
98.0 sq. m

RP #3

MATCH TO SHEET 16

RED DENOTES YEAR 1 MONITORING
BLUE DENOTES YEAR 2 MONITORING
GREEN DENOTES YEAR 3 MONITORING

NOTE: THE HORIZONTAL SCALE FOR THIS SHEET IS DIFFERENT FROM SHEET NO. 11

20 0 40

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
403	575226.901	1069762.056	876.08
404	574837.941	1070257.372	871.64
405	575926.913	1069945.053	897.4
406	576477.612	1069949.267	923.13
407	574324.856	1071064.416	871.26
408	574308.473	1071397.857	869.04
409	573967.988	1071422.762	869.21
410	574222.858	1069493.135	884.97
411	574100.263	1068841.141	891.49
412	573828.028	1068325.712	899.29
413	573310.368	1068220.815	880.95
414	573357.513	1067646.732	883.68
415	573584.485	1067315.797	884.12
416	573948.599	1066938.639	893.06
417	573625.298	1066619.236	887.85
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

SEE SHEET NO. 19 FOR -R2B- PROFILE

NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

$FILE$ $TIME$ $DATE$

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
403	575226.901	1069762.056	876.08
404	574837.941	1070257.372	871.64
405	575926.913	1069945.053	897.4
406	576477.612	1069949.267	923.13
407	574324.856	1071064.416	871.26
408	574308.473	1071397.857	869.04
409	573967.988	1071422.762	869.21
410	574222.858	1069493.135	884.97
411	574100.263	1068841.141	891.49
412	573828.028	1068325.712	899.29
413	573310.368	1068220.815	880.95
414	573357.513	1067646.732	883.68
415	573584.485	1067315.797	884.12
416	573948.599	1066938.639	893.06
417	573625.298	1066619.236	887.85
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	16

YEAR 3 MONITORING

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BEGIN R2B PROFILE SURVEY FOR MONTIORING STA. 9+35

0.0243 Acres 98.6 sq. m

VEG PLOT # 5

MATCH TO SHEET 15

MATCH TO SHEET 11

RED DENOTES YEAR 1 MONITORING
BLUE DENOTES YEAR 2 MONITORING
GREEN DENOTES YEAR 3 MONITORING

NOTE: THE HORIZONTAL SCALE FOR THIS SHEET IS DIFFERENT FROM SHEET NO. 11

20 0 40

SEE SHEET NO. 19 FOR -R2B- PROFILE

NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

$FILE$ $TIME$ $DATE$

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
403	575226.901	1069762.056	876.08
404	574837.941	1070257.372	871.64
405	575926.913	1069945.053	897.4
406	576477.612	1069949.267	923.13
407	574324.856	1071064.416	871.26
408	574308.473	1071397.857	869.04
409	573967.988	1071422.762	869.21
410	574222.858	1069493.135	884.97
411	574100.263	1068841.141	891.49
412	573828.028	1068325.712	899.29
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414	573357.513	1067646.732	883.68
415	573584.485	1067315.797	884.12
416	573948.599	1066938.639	893.06
417	573625.298	1066619.236	887.85
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	17

YEAR 3 MONITORING

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www.mulkeyinc.com

BEGIN R2D PROFILE SURVEY FOR MONITORING AT STA 2+84 -R2D-

MATCH TO SHEET 13

XS # 8

0.0241 Acres 97.6 sq.m

VEG PLOT # 12

RED DENOTES YEAR 1 MONITORING
BLUE DENOTES YEAR 2 MONITORING
GREEN DENOTES YEAR 3 MONITORING

NOTE: THE HORIZONTAL SCALE FOR THIS SHEET IS DIFFERENT FROM SHEET NO. 13

20 0 40

SEE SHEET NO. 19 FOR -R2D- PROFILE

NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

$FILE$ $TIME$ $DATE$

AS-BUILT PROFILES

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	18

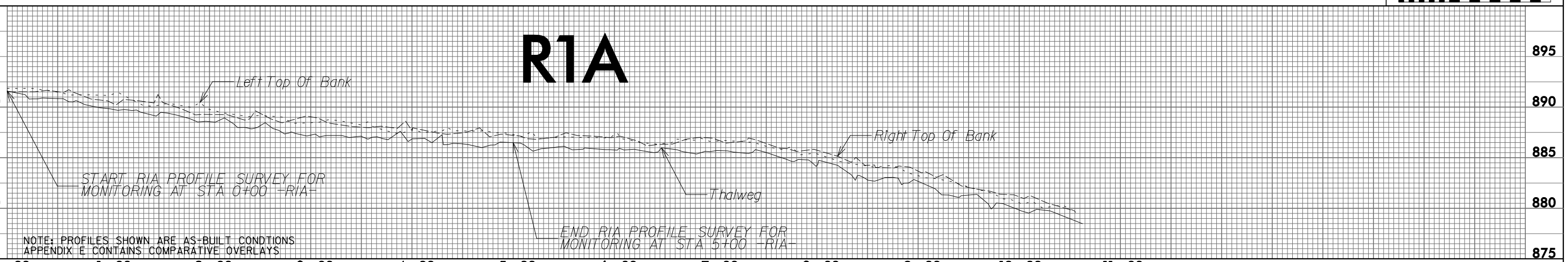
YEAR 3 MONITORING

MULKEY ENGINEERS & CONSULTANTS

HORIZONTAL SCALE 50 0 100

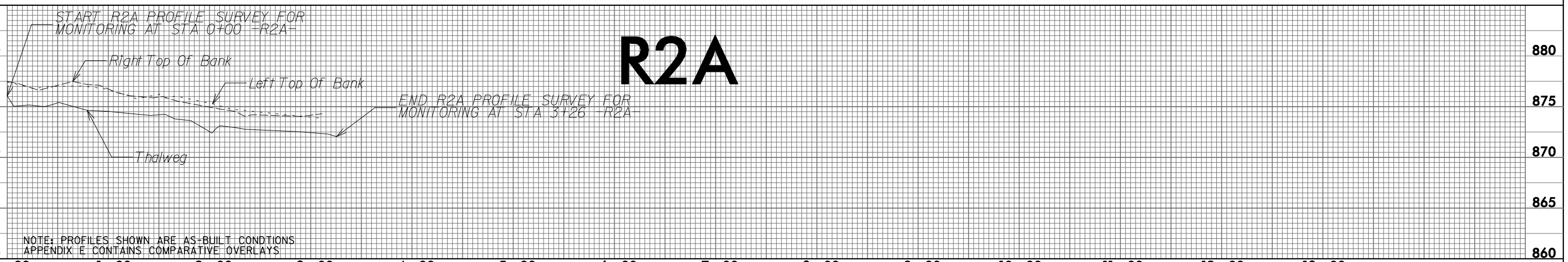
VERTICAL SCALE 5 0 10

R1A



NOTE: PROFILES SHOWN ARE AS-BUILT CONDTIONS
APPENDIX E CONTAINS COMPARATIVE OVERLAYS

R2A



NOTE: PROFILES SHOWN ARE AS-BUILT CONDTIONS
APPENDIX E CONTAINS COMPARATIVE OVERLAYS

$FILE$
$TIME$
$DATE$

AS-BUILT PROFILES

REVISIONS		
DATE	BY	DESCRIPTION
12/26/08	EMP	YEAR 1 MONITORING
11/25/09	EMP	YEAR 2 MONITORING
12/10/10	MLM	YEAR 3 MONITORING

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	19

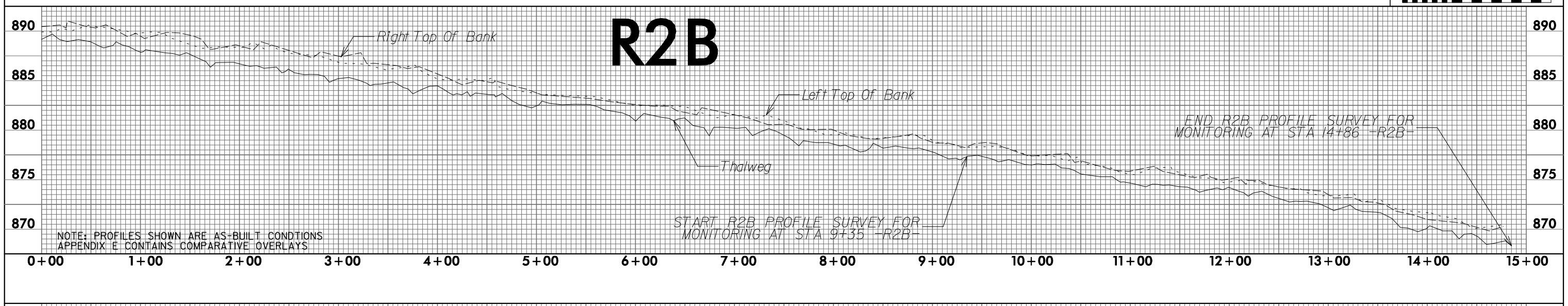
YEAR 3 MONITORING

MULKEY ENGINEERS & CONSULTANTS

HORIZONTAL SCALE 50 0 100

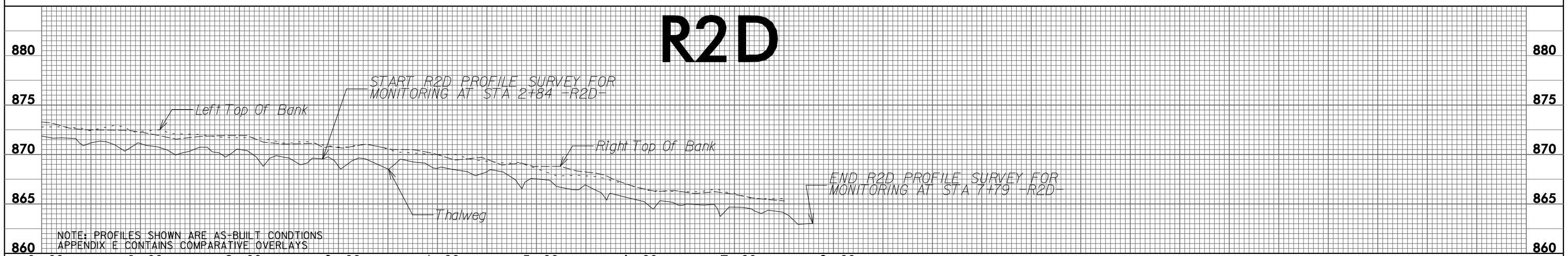
VERTICAL SCALE 5 0 10

R2B



NOTE: PROFILES SHOWN ARE AS-BUILT CONDTIONS
APPENDIX E CONTAINS COMPARATIVE OVERLAYS

R2D



NOTE: PROFILES SHOWN ARE AS-BUILT CONDTIONS
APPENDIX E CONTAINS COMPARATIVE OVERLAYS

$DATE$ $TIME$ $FILE$

Vegetation Plot 1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 2

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 3

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 4

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

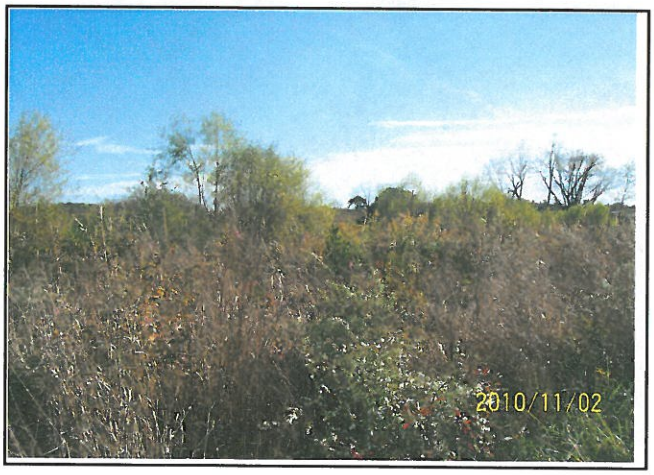
Year 5 Monitoring:

Vegetation Plot 5

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009



Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 6

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 7

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 8

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 9

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

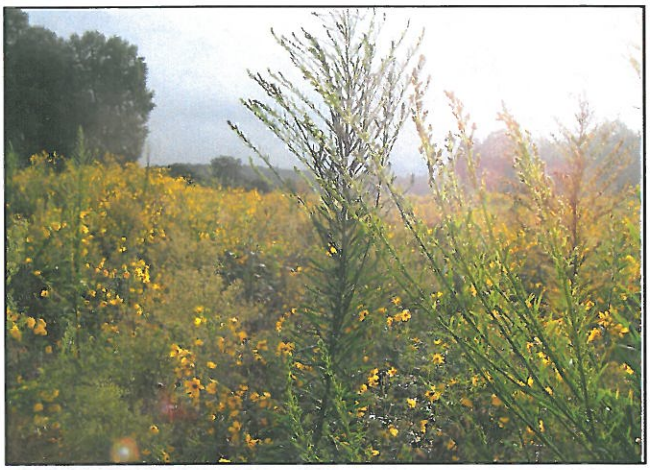
Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 10

As-built Survey: January 2008



Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 11

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 12

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 13

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegeation Plot 14

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 15

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 16

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

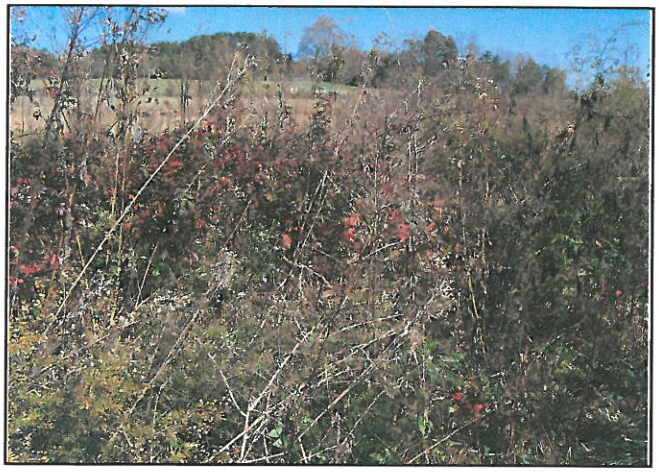
Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 17

As-built Survey: January 2008

Year 1 Monitoring: September 2008



Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 18

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 19

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 20

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 21

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 22

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 23

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Vegetation Plot 24

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 1; Looking Downstream on Reach R2

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 2; Looking Downstream on Reach R2

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 2; Looking Upstream on Reach R2

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 2; Looking upstream on Reach R2A

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 2.5Y1; Looking Downstream Along R2

Not Applicable

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 2.5Y1; Looking Upstream Along Reach R2

Not Applicable

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 3; Looking Downstream Along Reach R2B

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 3; Looking Upstream Along Reach R2B

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 3.5Y1; Looking Downstream Along R2&R2B

Not Applicable

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 3.5Y1; Looking Upstream Along R2

Not Applicable

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 3.5Y1; Looking Upstream Along R2B

Not Applicable

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 4; Looking Downstream Along R2

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 4; Looking Upstream at Confluence of R1&R2

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 5; Looking Downstream Along R2

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 5; Looking Upstream Along R2

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 6; Looking Downstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 6; Looking Upstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 7; Looking Downstream Along R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 7; Looking Upstream Along R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 8; Looking Downstream Along R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 8; Looking Upstream Along R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 8; Looking Upstream Along R1A

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: November 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 8.5Y1; Looking Downstream Along R1A

Not Applicable

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 8.5Y1; Looking Upstream Along R1A

Not Applicable

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 9; Looking Across Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 9; Looking Downstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 9; Looking Upstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 10; Looking Across Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 10; Looking Downstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 10; Looking Upstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 11; Looking Across Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 11; Looking Downstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Photo Point 11; Looking Upstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 2

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 3

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 4

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 5

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 6

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 7

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 8

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 9

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: November 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 10

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: November 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 11

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: November 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

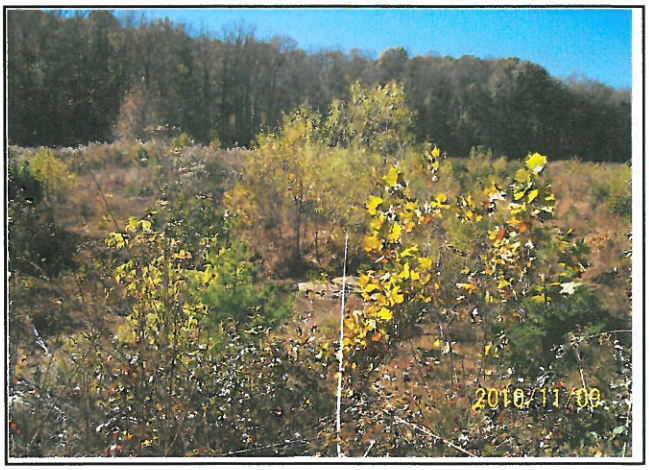
Year 5 Monitoring:

Permanent Cross Section 12

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: November 2009



Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:

Permanent Cross Section 13

As-built Survey: January 2008

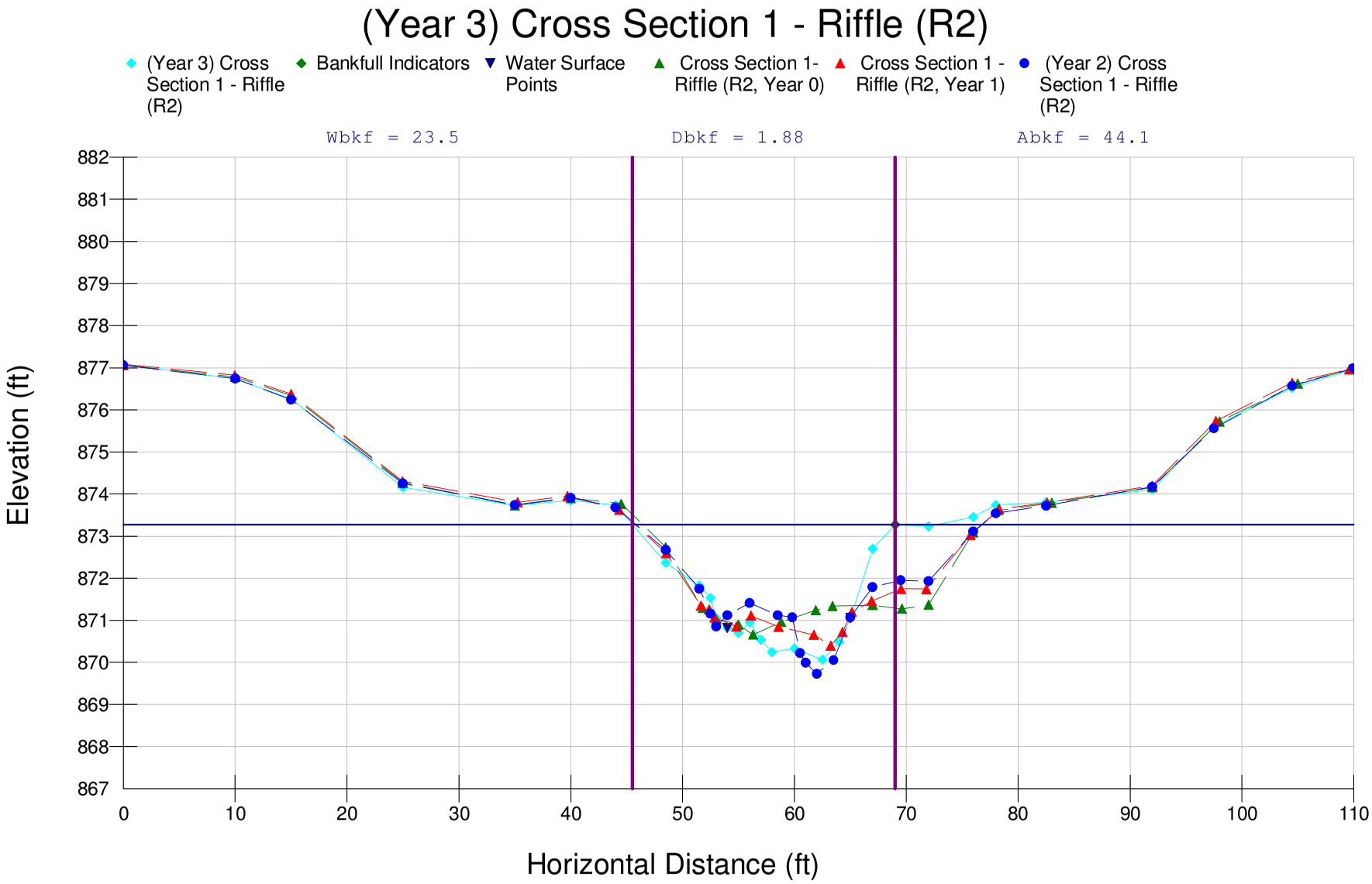
Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring:

Year 5 Monitoring:


(Year 3) Cross Section 1 - Riffle (R2)
(Year 3) Cross Section 1 - Riffle (R2)
Bankfull Indicators
Water Surface Points
Cross Section 1- Riffle (R2, Year 0)
Cross Section 1 - Riffle (R2, Year 1)
(Year 2) Cross Section 1 - Riffle (R2)
Wbkf = 23.5
Dbkf = 1.88
Abkf = 44.1
Elevation (ft)
882
881
880
879
878
877
876
875
874
873
872
871
870
869
868
867
0
10
20
30
40
50
60
70
80
90
100
110
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2
Cross Section Name: (Year 3) Cross Section 1 - Riffle (R2)
Survey Date: 11/09/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	877.077938	GS
10	0	876.741741	GS
15	0	876.262877	GS
25	0	874.161063	GS
35	0	873.72517	GS
40	0	873.850267	GS
44	0	873.734995	LB
48.5	0	872.36849	GS
51.5	0	871.827762	GS
52.5	0	871.531669	GS
53	0	871.050844	GS
54	0	870.820353	LEW
55	0	870.699815	GS
56	0	870.949956	GS
57	0	870.536388	GS
58	0	870.244861	GS
60	0	870.330971	GS
62.5	0	870.064136	TW
64	0	870.490847	GS
65	0	871.045931	REW
67	0	872.702281	GS
69	0	873.271399	BKF
72	0	873.232246	GS
76	0	873.452167	GS
78	0	873.742915	GS
82.5	0	873.802471	GS
92	0	874.10567	GS
97.5	0	875.60042	GS
104.5	0	876.528036	GS
110	0	876.95486	GS

Cross Sectional Geometry

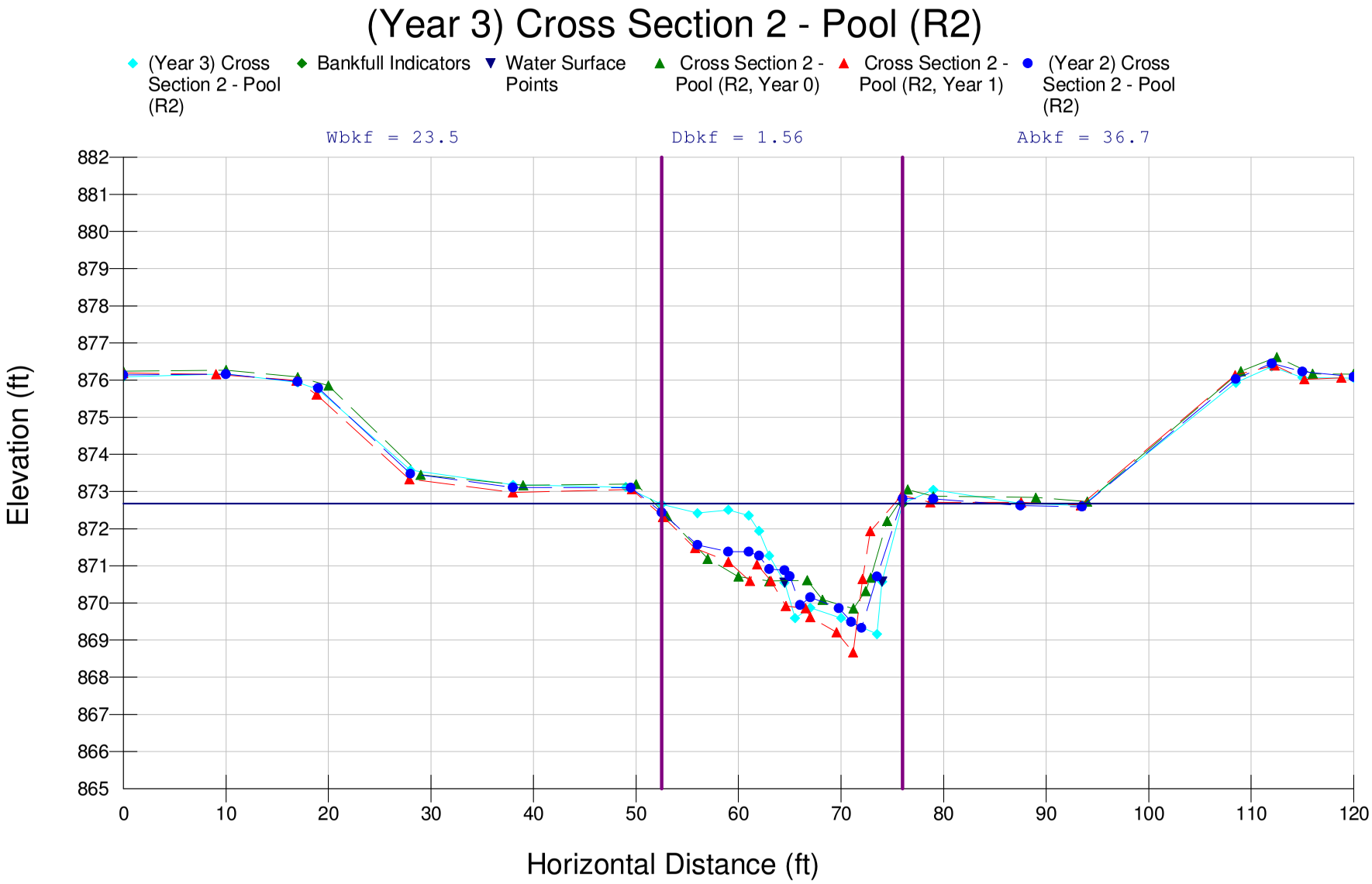
	Channel	Left	Right
Floodprone Elevation (ft)	876.48	876.48	876.48
Bankfull Elevation (ft)	873.27	873.27	873.27
Floodprone Width (ft)	91.33	-----	-----
Bankfull Width (ft)	23.46	11.73	11.74
Entrenchment Ratio	3.89	-----	-----
Mean Depth (ft)	1.88	1.53	2.23
Maximum Depth (ft)	3.21	2.81	3.21
Width/Depth Ratio	12.48	7.67	5.26
Bankfull Area (sq ft)	44.12	17.97	26.15
Wetted Perimeter (ft)	24.97	15.11	15.47
Hydraulic Radius (ft)	1.77	1.19	1.69
Begin BKF Station	45.53	45.53	57.26

End BKF Station	69	57.26	69

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


(Year 3) Cross Section 2 - Pool (R2)
(Year 3) Cross Section 2 - Pool (R2)
Bankfull Indicators
Water Surface Points
Cross Section 2 - Pool (R2, Year 0)
Cross Section 2 - Pool (R2, Year 1)
(Year 2) Cross Section 2 - Pool (R2)
Wbkf = 23.5
Dbkf = 1.56
Abkf = 36.7
Elevation (ft)
Horizontal Distance (ft)
882
881
880
879
878
877
876
875
874
873
872
871
870
869
868
867
866
865
0
10
20
30
40
50
60
70
80
90
100
110
120

RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2
Cross Section Name: (Year 3) Cross Section 2 - Pool (R2)
Survey Date: 11/09/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	876.084001	GS
10	0	876.164913	GS
17	0	875.941231	GS
19	0	875.744862	GS
28	0	873.577713	GS
38	0	873.177689	GS
49	0	873.121267	LB
52.5	0	872.659279	GS
56	0	872.417024	GS
59	0	872.506682	GS
61	0	872.355958	GS
62	0	871.936833	GS
63	0	871.268923	GS
64.5	0	870.546761	LEW
65.5	0	869.589694	GS
67	0	869.866881	GS
70	0	869.593597	GS
73.5	0	869.159368	TW
74	0	870.573002	LEW
76	0	872.66945	BKF
79	0	873.048082	GS
87.5	0	872.679629	GS
93.5	0	872.616596	GS
108.5	0	875.929642	GS
112	0	876.360059	GS
115	0	876.072211	GS
120	0	876.054147	GS

Cross Sectional Geometry

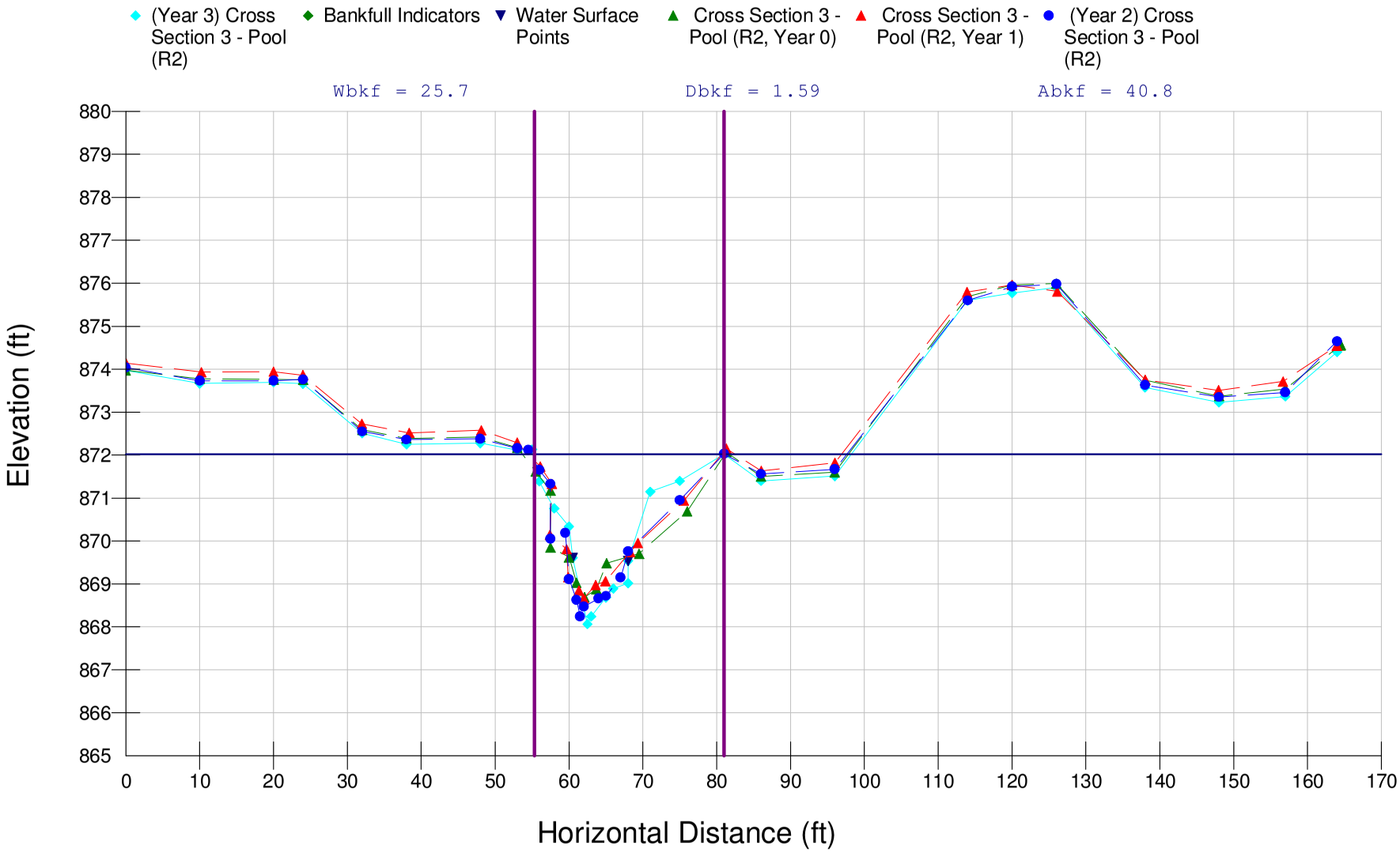
	Channel	Left	Right
Floodprone Elevation (ft)	876.18	876.18	876.18
Bankfull Elevation (ft)	872.67	872.67	872.67
Floodprone Width (ft)	116.67	-----	-----
Bankfull Width (ft)	23.5	11.75	11.75
Entrenchment Ratio	4.96	-----	-----
Mean Depth (ft)	1.56	0.45	2.67
Maximum Depth (ft)	3.51	2	3.51
Width/Depth Ratio	15.06	26.11	4.4
Bankfull Area (sq ft)	36.66	5.28	31.38
Wetted Perimeter (ft)	26.32	14.2	16.13
Hydraulic Radius (ft)	1.39	0.37	1.95
Begin BKF Station	52.5	52.5	64.25
End BKF Station	76	64.25	76

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

(Year 3) Cross Section 3 - Pool (R2)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2
Cross Section Name: (Year 3) Cross Section 3 - Pool (R2)
Survey Date: 11/09/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	873.969054	GS
10	0	873.666259	GS
20	0	873.696899	GS
24	0	873.658087	GS
32	0	872.506864	GS
38	0	872.248624	GS
48	0	872.277731	GS
53	0	872.117464	GS
55	0	872.127393	LB
56	0	871.387219	GS
58	0	870.754577	GS
60	0	870.335641	GS
60.5	0	869.607094	LEW
62.5	0	868.063405	TW
63	0	868.241002	GS
65	0	868.685863	GS
66	0	868.892668	GS
68	0	869.016849	GS
68	0	869.537405	REW
71	0	871.144944	GS
75	0	871.397353	GS
81	0	872.017843	BKF
86	0	871.398239	GS
96	0	871.509783	GS
114	0	875.59945	GS
120	0	875.771219	GS
126	0	875.900292	GS
138	0	873.576144	GS
148	0	873.224619	GS
157	0	873.365697	GS
164	0	874.397008	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	875.98	875.98	875.98
Bankfull Elevation (ft)	872.02	872.02	872.02
Floodprone Width (ft)	164	-----	-----
Bankfull Width (ft)	25.7	12.85	12.85
Entrenchment Ratio	6.38	-----	-----
Mean Depth (ft)	1.59	2.43	0.74
Maximum Depth (ft)	3.96	3.96	2.4
Width/Depth Ratio	16.16	5.29	17.36
Bankfull Area (sq ft)	40.82	31.28	9.54
Wetted Perimeter (ft)	28.11	17.23	15.68
Hydraulic Radius (ft)	1.45	1.81	0.61

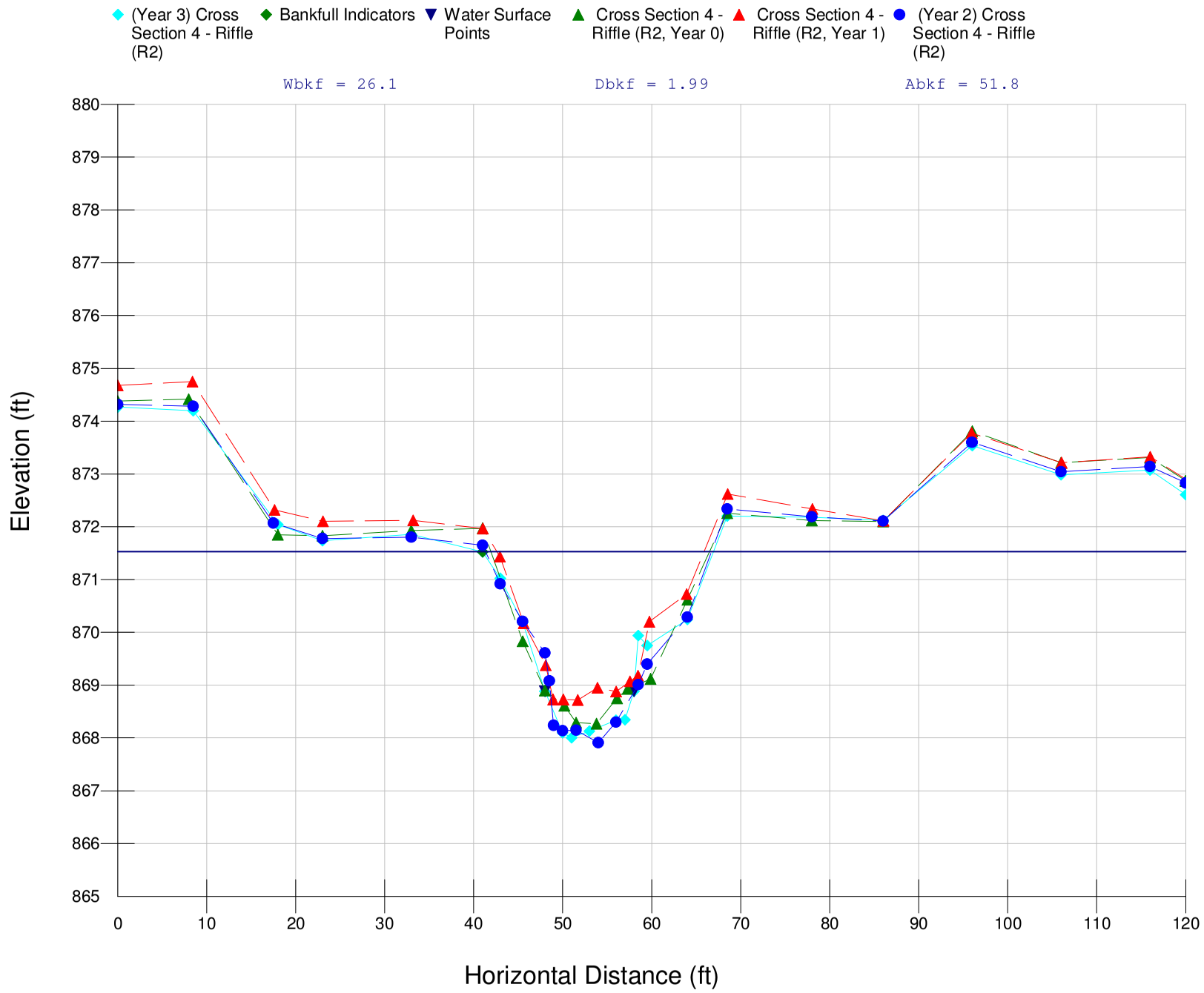
Begin BKF Station	55.3	55.3	68.15
End BKF Station	81	68.15	81

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

(Year 3) Cross Section 4 - Riffle (R2)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2
Cross Section Name: (Year 3) Cross Section 4 - Riffle (R2)
Survey Date: 11/09/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	874.265195	GS
8.5	0	874.195697	GS
18	0	872.042921	GS
23	0	871.733904	GS
33	0	871.859033	GS
41	0	871.525668	BKF
43	0	871.023839	GS
45.5	0	870.190093	GS
48	0	868.885601	LEW
50	0	868.095984	GS
51	0	868.000976	TW
53	0	868.129993	GS
56	0	868.335711	GS
57	0	868.346019	GS
58	0	868.881521	LEW
58.5	0	869.938739	GS
59.5	0	869.751997	GS
64	0	870.245416	GS
68.5	0	872.203095	RB
78	0	872.179994	GS
86	0	872.123873	GS
96	0	873.537267	GS
106	0	872.987295	GS
116	0	873.07339	GS
120	0	872.609835	GS

Cross Sectional Geometry

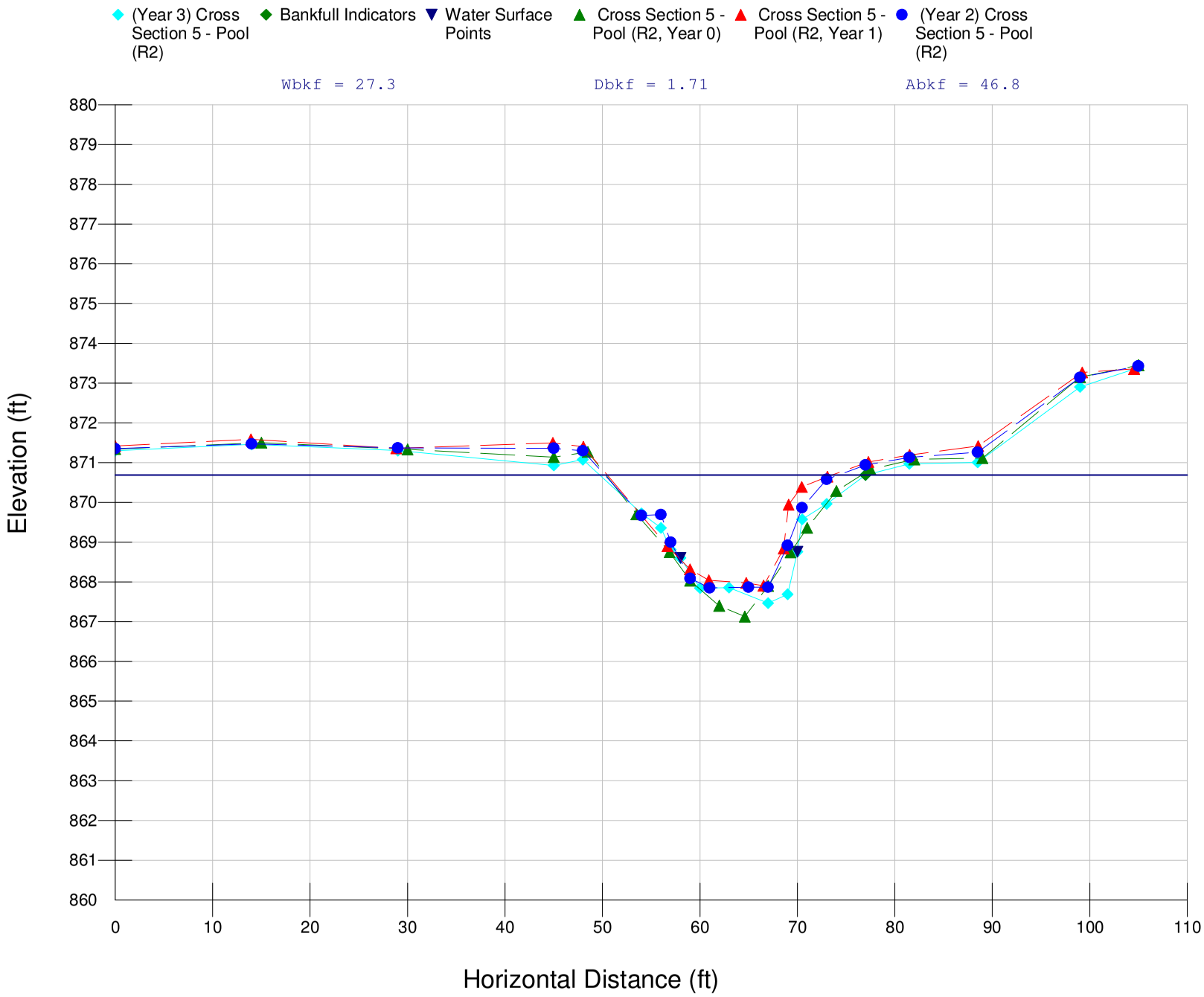
	Channel	Left	Right
Floodprone Elevation (ft)	875.06	875.06	875.06
Bankfull Elevation (ft)	871.53	871.53	871.53
Floodprone Width (ft)	120	-----	-----
Bankfull Width (ft)	26.06	13.12	12.93
Entrenchment Ratio	4.61	-----	-----
Mean Depth (ft)	1.99	2.11	1.86
Maximum Depth (ft)	3.53	3.53	3.33
Width/Depth Ratio	13.1	6.22	6.95
Bankfull Area (sq ft)	51.82	27.72	24.1
Wetted Perimeter (ft)	27.86	17.13	17.38
Hydraulic Radius (ft)	1.86	1.62	1.39
Begin BKF Station	40.9	40.9	54.02
End BKF Station	66.95	54.02	66.95

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

(Year 3) Cross Section 5 - Pool (R2)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2
Cross Section Name: (Year 3) Cross Section 5 - Pool (R2)
Survey Date: 11/09/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	871.298724	GS
14	0	871.454868	GS
29	0	871.303848	GS
45	0	870.929709	GS
48	0	871.075395	LB
54	0	869.723203	GS
56	0	869.355633	GS
57	0	868.808855	GS
58	0	868.606455	LEW
60	0	867.840918	GS
63	0	867.854936	GS
67	0	867.467667	TW
69	0	867.689128	GS
70	0	868.760152	LEW
70.5	0	869.571849	GS
73	0	869.962148	GS
77	0	870.688772	BKF
81.5	0	870.968285	GS
88.5	0	871.00457	GS
99	0	872.904581	GS
105	0	873.387886	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	873.91	873.91	873.91
Bankfull Elevation (ft)	870.69	870.69	870.69
Floodprone Width (ft)	105	-----	-----
Bankfull Width (ft)	27.31	13.65	13.66
Entrenchment Ratio	3.84	-----	-----
Mean Depth (ft)	1.71	1.64	1.78
Maximum Depth (ft)	3.22	2.87	3.22
Width/Depth Ratio	15.97	8.32	7.67
Bankfull Area (sq ft)	46.75	22.45	24.3
Wetted Perimeter (ft)	28.8	16.96	17.57
Hydraulic Radius (ft)	1.62	1.32	1.38
Begin BKF Station	49.71	49.71	63.36
End BKF Station	77.02	63.36	77.02

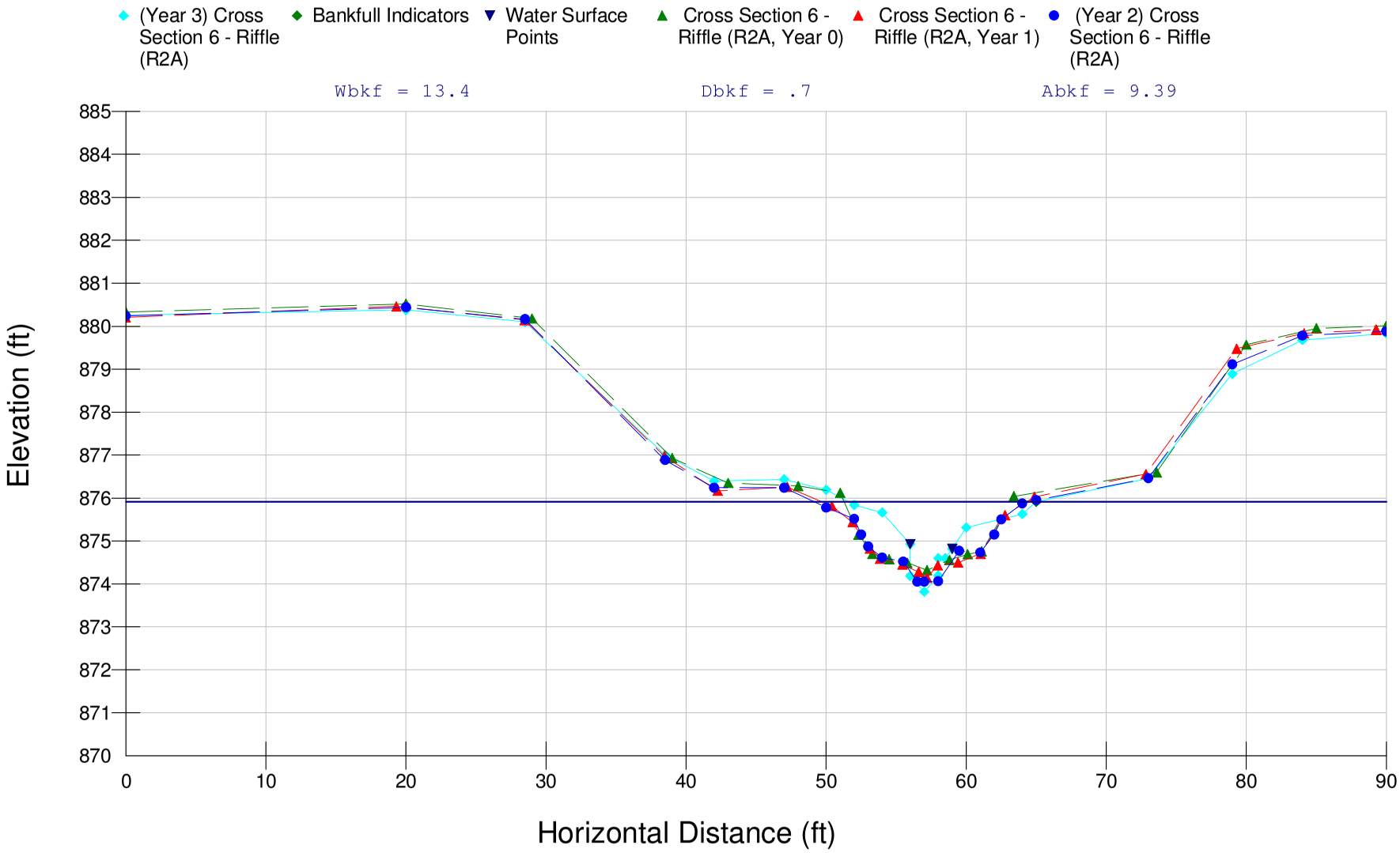
Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side

Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

(Year 3) Cross Section 6 - Riffle (R2A)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2A
Cross Section Name: (Year 3) Cross Section 6 - Riffle (R2A)
Survey Date: 11/08/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	880.257537	GS
20	0	880.380444	GS
20	0	880.380462	GS
28.5	0	880.097987	GS
38.5	0	876.998672	GS
42	0	876.395067	GS
47	0	876.432554	GS
50	0	876.191129	LB
52	0	875.836549	GS
54	0	875.660304	GS
56	0	874.926806	LEW
56	0	874.18215	GS
57	0	873.818284	TW
58	0	874.19652	GS
58	0	874.597959	GS
58.5	0	874.601007	GS
59	0	874.816608	LEW
60	0	875.313228	GS
64	0	875.625679	GS
65	0	875.911569	BKF
73	0	876.452247	GS
79	0	878.889882	GS
84	0	879.680163	GS
90	0	879.83018	GS

Cross Sectional Geometry

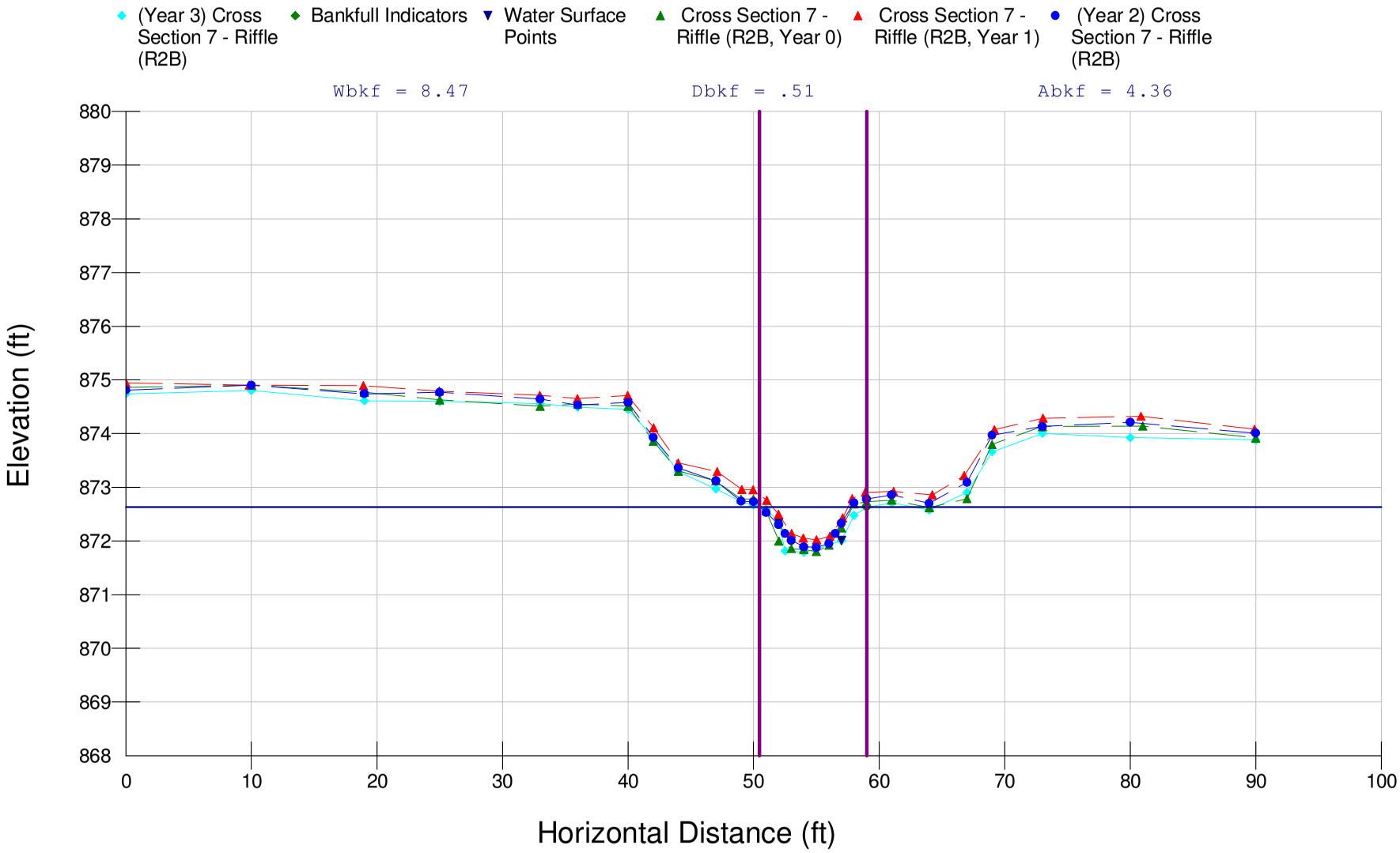
	Channel	Left	Right
Floodprone Elevation (ft)	878	878	878
Bankfull Elevation (ft)	875.91	875.91	875.91
Floodprone Width (ft)	41.55	-----	-----
Bankfull Width (ft)	13.41	6.7	6.7
Entrenchment Ratio	3.1	-----	-----
Mean Depth (ft)	0.7	0.86	0.54
Maximum Depth (ft)	2.09	2.09	1.31
Width/Depth Ratio	19.16	7.79	12.41
Bankfull Area (sq ft)	9.39	5.76	3.62
Wetted Perimeter (ft)	15.05	9.44	8.22
Hydraulic Radius (ft)	0.62	0.61	0.44
Begin BKF Station	51.59	51.59	58.29
End BKF Station	64.99	58.29	64.99

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

(Year 3) Cross Section 7 - Riffle (R2B)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2B
Cross Section Name: (Year 3) Cross Section 7 - Riffle (R2B)
Survey Date: 11/09/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	874.740362	GS
10	0	874.803279	GS
19	0	874.61007	GS
25	0	874.597095	GS
33	0	874.560587	GS
36	0	874.491044	GS
40	0	874.454251	GS
42	0	873.927287	GS
44	0	873.293239	GS
47	0	872.96995	GS
49	0	872.731264	GS
50	0	872.668255	GS
51	0	872.596297	LB
52	0	872.344637	LEW
52.5	0	871.815305	GS
54	0	871.790267	TW
55	0	871.849961	GS
57	0	872.008623	REW
58	0	872.47748	GS
59	0	872.625695	BKF
61	0	872.713116	GS
64	0	872.577514	GS
67	0	872.904667	GS
69	0	873.662504	GS
73	0	874.004544	GS
80	0	873.923606	GS
90	0	873.881421	GS

Cross Sectional Geometry

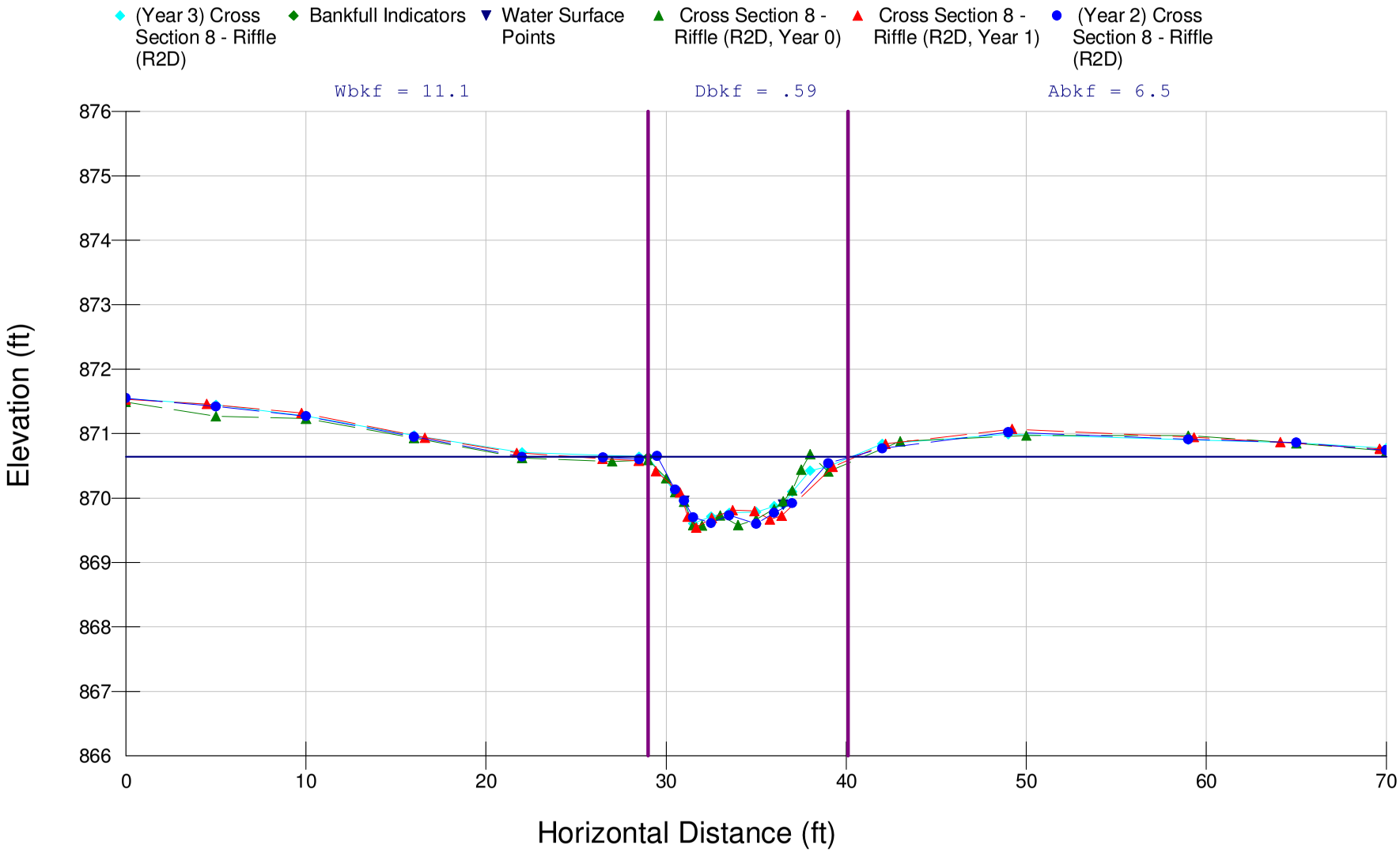
	Channel	Left	Right
Floodprone Elevation (ft)	873.47	873.47	873.47
Bankfull Elevation (ft)	872.63	872.63	872.63
Floodprone Width (ft)	25.05	-----	-----
Bankfull Width (ft)	8.47	3.97	4.5
Entrenchment Ratio	2.96	-----	-----
Mean Depth (ft)	0.51	0.53	0.5
Maximum Depth (ft)	0.84	0.84	0.81
Width/Depth Ratio	16.61	7.49	9
Bankfull Area (sq ft)	4.36	2.1	2.26
Wetted Perimeter (ft)	8.86	5.04	5.44
Hydraulic Radius (ft)	0.49	0.42	0.42
Begin BKF Station	50.53	50.53	54.5
End BKF Station	59	54.5	59

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

(Year 3) Cross Section 8 - Riffle (R2D)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2D
Cross Section Name: (Year 3) Cross Section 8 - Riffle (R2D)
Survey Date: 11/10/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	871.542239	GS
5	0	871.444674	GS
10	0	871.273228	GS
16	0	870.972042	GS
22	0	870.70704	GS
28.5	0	870.642531	GS
29	0	870.635602	BKF
30.5	0	870.088088	GS
31	0	869.955404	LEW
31.5	0	869.606895	GS
32.5	0	869.712753	GS
33.5	0	869.770743	GS
35	0	869.783584	TW
36	0	869.87344	GS
36.5	0	869.897699	REW
37	0	870.095923	GS
38	0	870.425439	GS
39	0	870.487743	RB
42	0	870.840767	GS
49	0	870.988172	GS
59	0	870.904198	GS
65	0	870.856729	GS
70	0	870.774037	GS

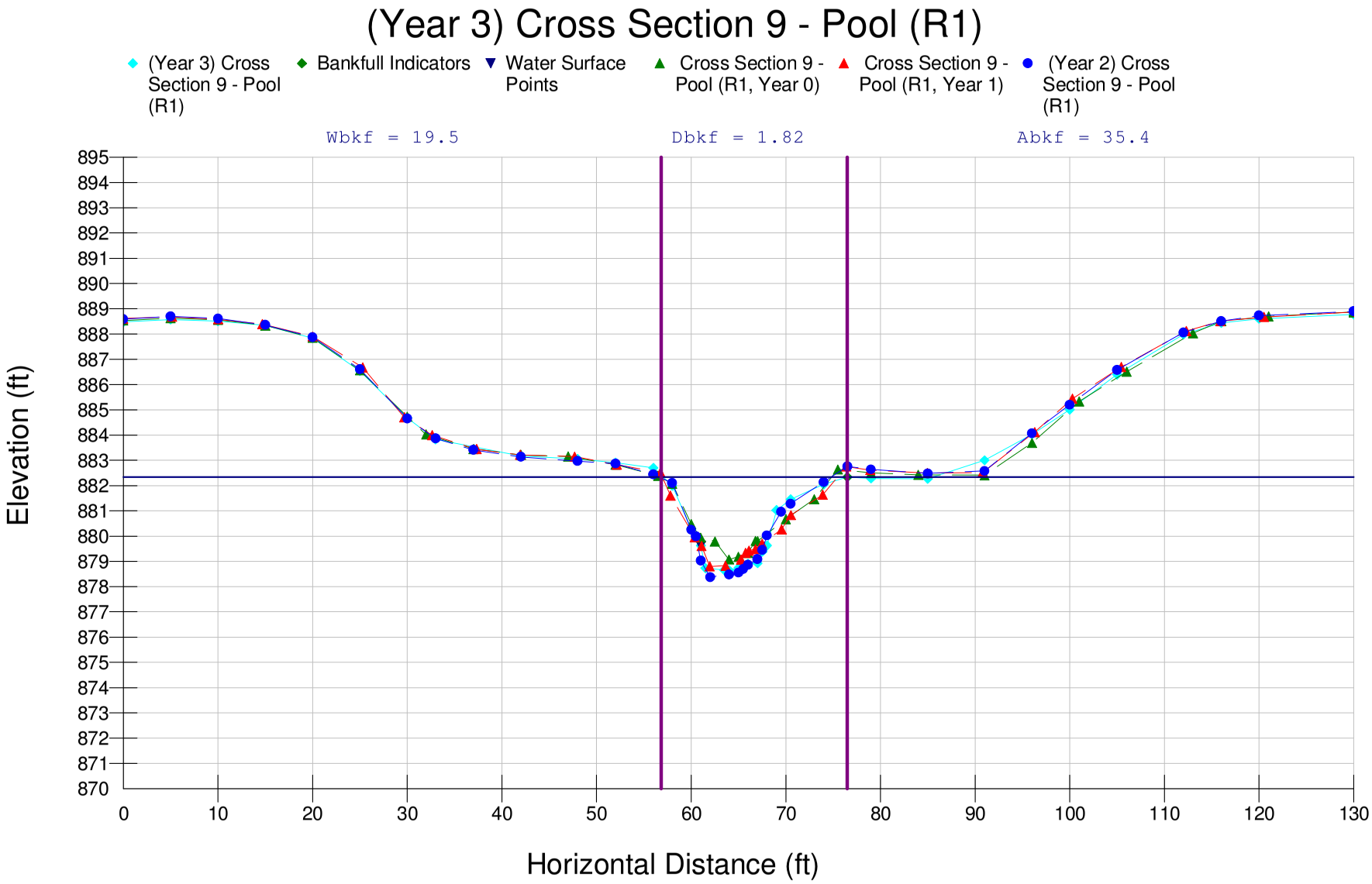
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	871.67	871.67	871.67
Bankfull Elevation (ft)	870.64	870.64	870.64
Floodprone Width (ft)	70	-----	-----
Bankfull Width (ft)	11.1	5.23	5.87
Entrenchment Ratio	6.31	-----	-----
Mean Depth (ft)	0.59	0.7	0.48
Maximum Depth (ft)	1.03	1.03	0.86
Width/Depth Ratio	18.81	7.47	12.23
Bankfull Area (sq ft)	6.5	3.67	2.83
Wetted Perimeter (ft)	11.46	6.33	6.86
Hydraulic Radius (ft)	0.57	0.58	0.41
Begin BKF Station	29	29	34.23
End BKF Station	40.1	34.23	40.1

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


(Year 3) Cross Section 9 - Pool (R1)
(Year 3) Cross Section 9 - Pool (R1)
Bankfull Indicators
Water Surface Points
Cross Section 9 - Pool (R1, Year 0)
Cross Section 9 - Pool (R1, Year 1)
(Year 2) Cross Section 9 - Pool (R1)
Wbkf = 19.5
Dbkf = 1.82
Abkf = 35.4
Elevation (ft)
Horizontal Distance (ft)
895
894
893
892
891
890
889
888
887
886
885
884
883
882
881
880
879
878
877
876
875
874
873
872
871
870
0
10
20
30
40
50
60
70
80
90
100
110
120
130

RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R1
Cross Section Name: (Year 3) Cross Section 9 - Pool (R1)
Survey Date: 11/09/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	888.47913	GS
5	0	888.572354	GS
10	0	888.511825	GS
15	0	888.34598	GS
20	0	887.836966	GS
25	0	886.538971	GS
30	0	884.6788	GS
33	0	883.826213	GS
42	0	883.175455	GS
48	0	883.05673	GS
52	0	882.910264	GS
56	0	882.700029	LB
58	0	881.991422	GS
60	0	880.269024	GS
61	0	879.618628	LEW
61.5	0	878.725333	GS
63.5	0	878.651034	GS
64	0	878.647769	TW
65	0	878.736895	GS
66	0	878.907932	GS
67	0	878.928064	GS
67.5	0	879.382256	GS
68	0	879.625813	GS
69	0	881.029214	GS
70.5	0	881.454256	GS
74	0	882.05077	GS
76.5	0	882.335479	BKF
79	0	882.279817	GS
85	0	882.269851	GS
91	0	883.001258	GS
96	0	884.033747	GS
100	0	885.011109	GS
105	0	886.397563	GS
112	0	887.980946	GS
116	0	888.442301	GS
120	0	888.609257	GS
130	0	888.778565	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	886.03	886.03	886.03
Bankfull Elevation (ft)	882.34	882.34	882.34
Floodprone Width (ft)	77.32	-----	-----
Bankfull Width (ft)	19.48	14.82	4.66
Entrenchment Ratio	3.97	-----	-----

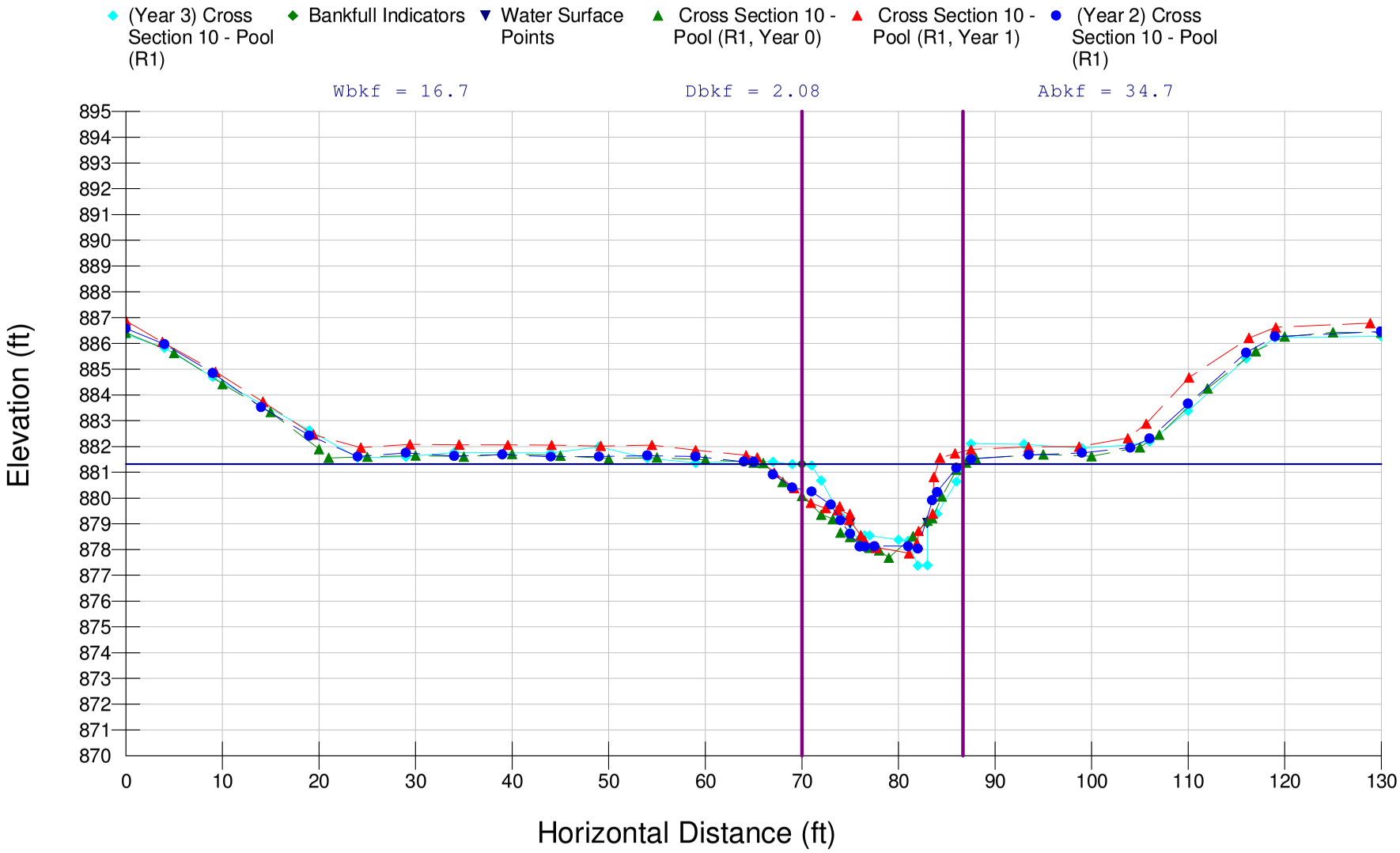
Mean Depth (ft)	1.82	2.29	0.3
Maximum Depth (ft)	3.69	3.69	0.66
Width/Depth Ratio	10.7	6.47	15.53
Bankfull Area (sq ft)	35.4	34.01	1.39
Wetted Perimeter (ft)	22	17.95	5.37
Hydraulic Radius (ft)	1.61	1.89	0.26
Begin BKF Station	57.02	57.02	71.84
End BKF Station	76.5	71.84	76.5

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

(Year 3) Cross Section 10 - Pool (R1)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R1
Cross Section Name: (Year 3) Cross Section 10 - Pool (R1)
Survey Date: 11/09/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	886.345723	GS
4	0	885.824	GS
9	0	884.698386	GS
19	0	882.626846	GS
24	0	881.565434	GS
29	0	881.595007	GS
34	0	881.767258	GS
44	0	881.749858	GS
49	0	881.985365	GS
54	0	881.538707	GS
59	0	881.359276	GS
64	0	881.435774	GS
67	0	881.404951	GS
69	0	881.308515	GS
70	0	881.315598	BKF
71	0	881.261262	GS
72	0	880.676991	GS
74	0	879.31185	GS
75	0	879.027186	LEW
75	0	878.680899	GS
76	0	878.405048	GS
76.5	0	878.54975	GS
77	0	878.539544	GS
80	0	878.386016	GS
81	0	878.334285	GS
82	0	877.376296	TW
83	0	877.387325	GS
83	0	879.033263	REW
84	0	879.391491	GS
86	0	880.639867	GS
87.5	0	882.106927	RB
93	0	882.088673	GS
99	0	881.939318	GS
104	0	882.057804	GS
106	0	882.187411	GS
110	0	883.379207	GS
116	0	885.415107	GS
119	0	886.222416	GS
130	0	886.276029	GS

Cross Sectional Geometry

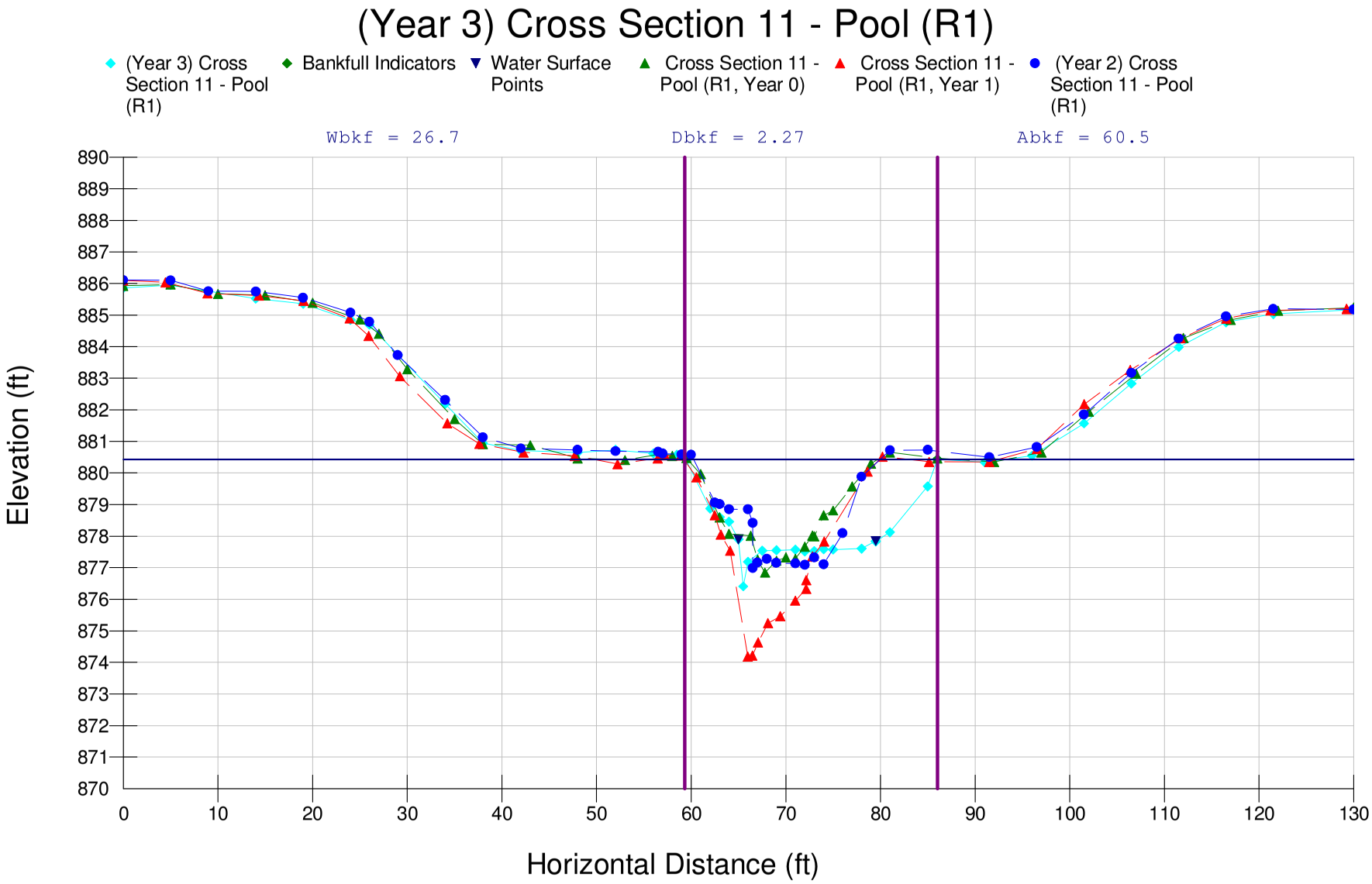
	Channel	Left	Right
Floodprone Elevation (ft)	885.26	885.26	885.26
Bankfull Elevation (ft)	881.32	881.32	881.32
Floodprone Width (ft)	109.06	-----	-----

Bankfull Width (ft)	16.69	7.41	9.28
Entrenchment Ratio	6.53	-----	-----
Mean Depth (ft)	2.08	1.61	2.45
Maximum Depth (ft)	3.94	2.91	3.94
Width/Depth Ratio	8.02	4.6	3.79
Bankfull Area (sq ft)	34.66	11.91	22.74
Wetted Perimeter (ft)	20.46	11.24	14.82
Hydraulic Radius (ft)	1.69	1.06	1.53
Begin BKF Station	70	70	77.41
End BKF Station	86.69	77.41	86.69

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


(Year 3) Cross Section 11 - Pool (R1)
(Year 3) Cross Section 11 - Pool (R1)
Bankfull Indicators
Water Surface Points
Cross Section 11 - Pool (R1, Year 0)
Cross Section 11 - Pool (R1, Year 1)
(Year 2) Cross Section 11 - Pool (R1)
Wbkf = 26.7
Dbkf = 2.27
Abkf = 60.5
Elevation (ft)
Horizontal Distance (ft)
890
889
888
887
886
885
884
883
882
881
880
879
878
877
876
875
874
873
872
871
870
0
10
20
30
40
50
60
70
80
90
100
110
120
130

RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R1
Cross Section Name: (Year 3) Cross Section 11 - Pool (R1)
Survey Date: 11/09/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	885.860499	GS
5	0	885.954149	GS
14	0	885.523811	GS
19	0	885.360982	GS
24	0	884.850953	GS
26	0	884.695566	GS
29	0	883.740645	GS
34	0	882.187127	GS
38	0	880.940862	GS
42	0	880.705761	GS
48	0	880.642966	GS
52	0	880.729534	GS
56	0	880.617989	GS
58.5	0	880.575273	LB
59.5	0	880.401963	GS
62	0	878.871729	GS
63	0	878.601415	GS
64	0	878.455667	GS
65	0	877.898983	LEW
65.5	0	876.40614	TW
66	0	877.185615	GS
67.5	0	877.538002	GS
69	0	877.546547	GS
71	0	877.570611	GS
72	0	877.517195	GS
73	0	877.52271	GS
74	0	877.585256	GS
75	0	877.574535	GS
78	0	877.605742	GS
79.5	0	877.843412	REW
79.5	0	877.826467	GS
81	0	878.12024	GS
85	0	879.574055	GS
86	0	880.434286	BKF
91	0	880.337327	GS
96	0	880.545149	GS
101.5	0	881.569489	GS
106.5	0	882.827563	GS
111.5	0	883.988447	GS
116.5	0	884.77074	GS
121.5	0	885.034564	GS
130	0	885.176403	GS

Cross Sectional Geometry

	Channel	Left	Right

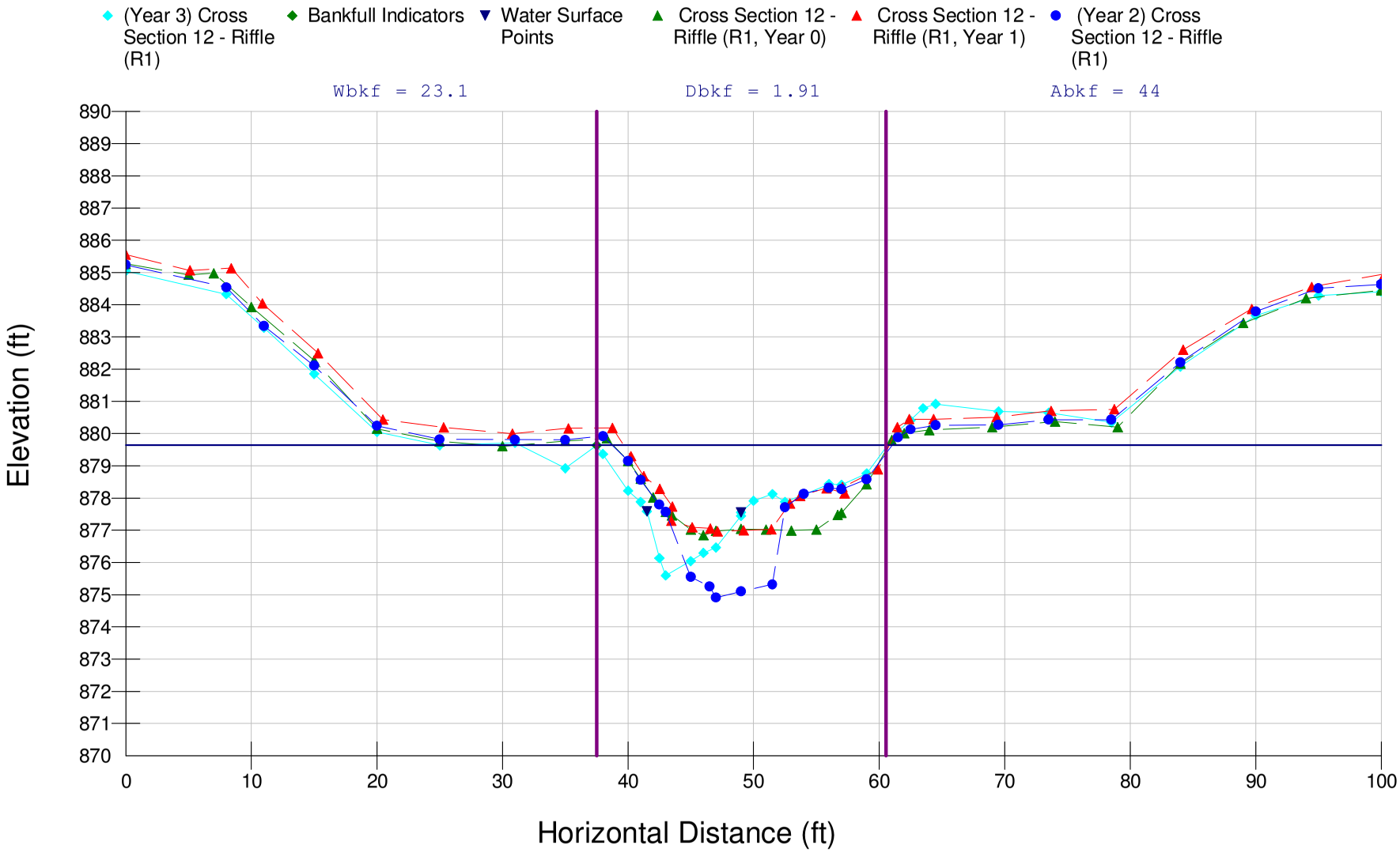
Floodprone Elevation (ft)	884.45	884.45	884.45
Bankfull Elevation (ft)	880.43	880.43	880.43
Floodprone Width (ft)	87.72	-----	-----
Bankfull Width (ft)	26.66	16.8	9.86
Entrenchment Ratio	3.29	-----	-----
Mean Depth (ft)	2.27	2.42	2.01
Maximum Depth (ft)	4.02	4.02	2.84
Width/Depth Ratio	11.74	6.94	4.91
Bankfull Area (sq ft)	60.51	40.74	19.77
Wetted Perimeter (ft)	29.46	21.81	13.34
Hydraulic Radius (ft)	2.05	1.87	1.48
Begin BKF Station	59.34	59.34	76.14
End BKF Station	86	76.14	86

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

(Year 3) Cross Section 12 - Riffle (R1)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R1
Cross Section Name: (Year 3) Cross Section 12 - Riffle (R1)
Survey Date: 11/09/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	885.050579	GS
8	0	884.326429	GS
11	0	883.283706	GS
15	0	881.855269	GS
20	0	880.051583	GS
25	0	879.638414	GS
31	0	879.710466	GS
35	0	878.925684	GS
37.5	0	879.637126	BKF
38	0	879.364497	GS
40	0	878.227061	GS
41	0	877.87767	GS
41.5	0	877.585521	LEW
42.5	0	876.131511	GS
43	0	875.595617	TW
45	0	876.041597	GS
46	0	876.29106	GS
47	0	876.463696	GS
49	0	877.444476	GS
49	0	877.549631	REW
50	0	877.910347	GS
51.5	0	878.122473	GS
52.5	0	877.875294	GS
54	0	878.103052	GS
56	0	878.434225	GS
57	0	878.40966	GS
59	0	878.764094	GS
61.5	0	880.078619	GS
62.5	0	880.406568	GS
63.5	0	880.787485	RB
64.5	0	880.917988	GS
69.5	0	880.687149	GS
73.5	0	880.646076	GS
78.5	0	880.342149	GS
84	0	882.081119	GS
90	0	883.66376	GS
95	0	884.28379	GS
100	0	884.406182	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	883.68	883.68	883.68
Bankfull Elevation (ft)	879.64	879.64	879.64
Floodprone Width (ft)	80.32	-----	-----
Bankfull Width (ft)	23.05	11.29	11.76

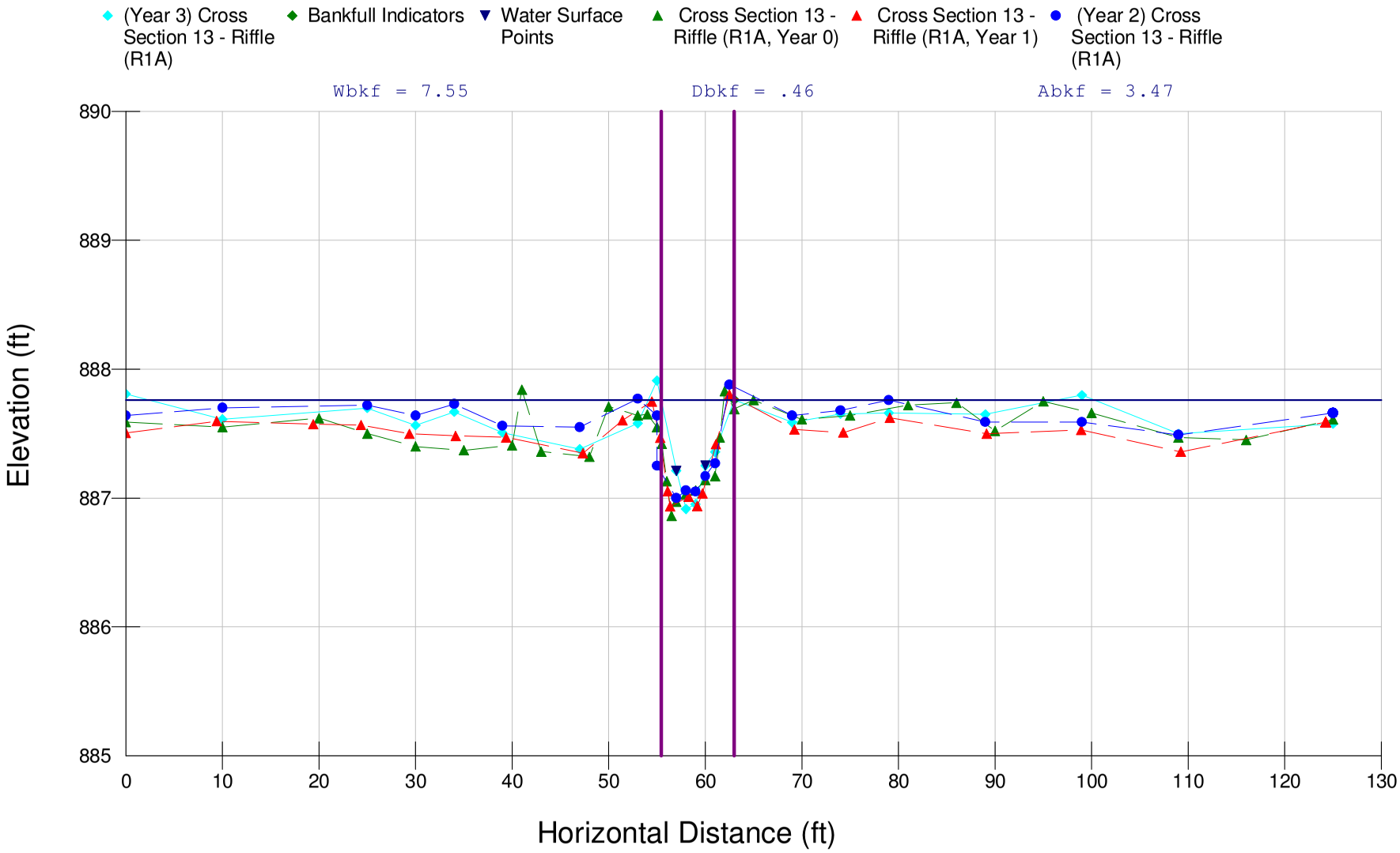
Entrenchment Ratio	3.48	-----	-----
Mean Depth (ft)	1.91	2.5	1.34
Maximum Depth (ft)	4.04	4.04	2.3
Width/Depth Ratio	12.07	4.52	8.78
Bankfull Area (sq ft)	43.98	28.25	15.73
Wetted Perimeter (ft)	25.43	15.4	14.63
Hydraulic Radius (ft)	1.73	1.83	1.07
Begin BKF Station	37.5	37.5	48.79
End BKF Station	60.55	48.79	60.55

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

(Year 3) Cross Section 13 - Riffle (R1A)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R1A
Cross Section Name: (Year 3) Cross Section 13 - Riffle (R1A)
Survey Date: 11/08/2010

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	887.807646	GS
10	0	887.610973	GS
25	0	887.697326	GS
30	0	887.564138	GS
34	0	887.668765	GS
39	0	887.5075	GS
47	0	887.379413	GS
53	0	887.578973	GS
55	0	887.911016	LB
57	0	887.211508	LEW
58	0	886.914573	GS
59	0	886.951896	TW
60	0	887.251344	REW
61	0	887.3577	GS
63	0	887.762267	BKF
69	0	887.585651	GS
74	0	887.652452	GS
79	0	887.659217	GS
89	0	887.648803	GS
99	0	887.798802	GS
109	0	887.49785	GS
125	0	887.576212	GS

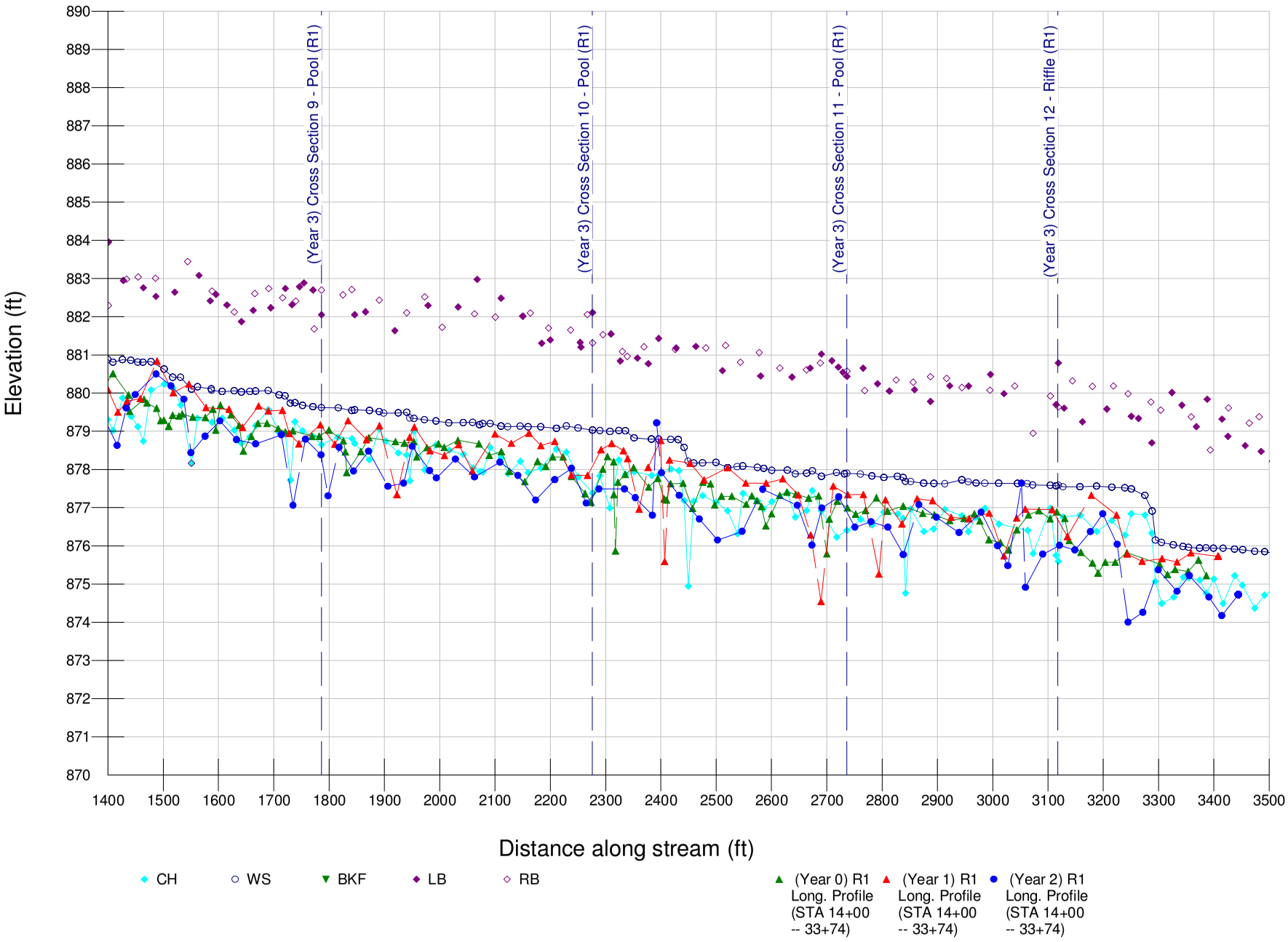
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	888.61	888.61	888.61
Bankfull Elevation (ft)	887.76	887.76	887.76
Floodprone Width (ft)	125	-----	-----
Bankfull Width (ft)	7.55	7.02	0.53
Entrenchment Ratio	16.56	-----	-----
Mean Depth (ft)	0.46	0.49	0.05
Maximum Depth (ft)	0.85	0.85	0.11
Width/Depth Ratio	16.41	14.33	10.6
Bankfull Area (sq ft)	3.47	3.44	0.03
Wetted Perimeter (ft)	7.78	7.35	0.65
Hydraulic Radius (ft)	0.45	0.47	0.04
Begin BKF Station	55.44	55.44	62.46
End BKF Station	62.99	62.46	62.99

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


(Year 3) R1 Longitudinal Profile (STA 14+00 -- 33+74)
Elevation (ft)
890
889
888
887
886
885
884
883
882
881
880
879
878
877
876
875
874
873
872
871
870
(Year 3) Cross Section 9 - Pool (R1)
(Year 3) Cross Section 10 - Pool (R1)
(Year 3) Cross Section 11 - Pool (R1)
(Year 3) Cross Section 12 - Riffle (R1)
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
Distance along stream (ft)
CH
WS
BKF
LB
RB
(Year 0) R1 Long. Profile (STA 14+00 -- 33+74)
(Year 1) R1 Long. Profile (STA 14+00 -- 33+74)
(Year 2) R1 Long. Profile (STA 14+00 -- 33+74)

RIVERMORPH PROFILE SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R1
Profile Name: (Year 3) R1 Long. Profile (STA 14+00 -- 33+74)
Survey Date: 11/19/2010

Survey Data

DIST	CH	WS	BKF	LB	RB
1400	879.305				
1400		880.875			
1400.69					882.297
1401.113				883.956	
1409.081		880.805			
1409.332	879.022				
1426.471	879.874				
1426.577		880.875			
1427.864				882.949	
1433.57					882.983
1441.8		880.857			
1441.985	879.386				
1454.112		880.809			
1454.254	879.12				
1454.686					883.042
1463.477		880.806			
1463.922	878.738				
1463.922				882.759	
1478.154		880.821			
1478.289	880.083				
1486.026					883.006
1486.879				882.531	
1501.822		880.629			
1501.951	880.234				
1517.192	880.133				
1517.25		880.415			
1520.837				882.642	
1531.374		880.414			
1531.652	879.69				
1544.071					883.444
1551.119					878.163
1551.287		880.102			
1551.287	878.163				
1562.002	879.34				
1562.238		880.162			
1564.77				883.08	
1585.017				882.414	
1587.148		880.109			
1587.487		880.073			
1588.157					882.67
1588.157	879.238				
1595.411				882.583	
1606.783		880.043			
1606.783	879.342				
1615.292				882.306	
1628.557		880.061			
1628.564	879.028				
1628.564					882.126
1641.237	878.694				
1641.507				881.874	

1641.646 880.028
1656.86 878.853
1657.008 880.043
1662.626 882.166
1665.433 882.606
1667.12 880.051
1667.228 879.152
1690.123 880.066
1690.199 879.564
1690.894 882.74
1694.633 882.234
1709.874 879.952
1710.052 878.961
1716.208 882.498
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1720.902 882.741
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1738.425 879.745
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1746.444 882.788
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1754.423 882.887
1770.815 878.862
1770.815 882.702
1770.968 879.645
1772.94 881.679
1786.062 878.648 879.619 882.051 882.7
1815.892 878.842
1816.845 879.612
1824.917 882.571
1841.048 882.71
1841.052 879.546
1841.442 878.807
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1846.375 879.559
1846.375 878.682
1865.826 882.129
1872.617 878.253
1873.174 879.545
1890.649 882.431
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1890.9 879.513
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1918.921 881.634
1925.352 878.431
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1953.66 879.338
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1972.436 879.303
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1978.982 882.296
1993.181 879.269
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2016.603 879.222
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2395.99 881.431
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2418.336  878.008
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2441.897  877.19
2441.909           878.576
2449.112           878.214
2449.665  874.949
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2459.405           878.167
2463.285                        881.224
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2475.773  877.314
2481.146                                  881.185
2499.742           878.183
2499.852  877.142
2511.414                        880.587
2516.866                                  881.249
2520.462  876.914
2520.676           878.042
2537.988           878.072
2538.706  876.313
2543.768                                  880.807
2548.291           878.088
2548.6    877.374
2574.479           878.053
2574.491  877.177
2577.835                                  881.059
2580.252                        880.448
2585.5    876.971
2586.154           878.028
2600.602  877.156
2600.769           877.973
2615.1                                    880.658
2628.76   877.385
2628.862           877.983
2637.08                         880.421
2643.118           877.881
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2663.683           877.901
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2673.994           877.966
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2688.513                                  880.791
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2690.513                        881.023
2690.533           877.817
2709.315                        880.846
2717.576           877.918
2717.99   876.229
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2729.238                        880.548
2731.92            877.885
2736.244  876.406 877.899         880.434 880.575
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2858.773   880.09
2875.263 876.375
2875.263   877.638
2887.482   879.782
2887.606   880.431
2893.154 876.44
2893.745   877.632
2913.325   877.625
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2916.853   880.382
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3062.681   877.629
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3073.097   878.949
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Cross Section / Bank Profile Locations

Name	Type	Profile Station
(Year 3) Cross Section 9 - Pool (R1)	Pool XS	1786
(Year 3) Cross Section 10 - Pool (R1)	Pool XS	2276
(Year 3) Cross Section 11 - Pool (R1)	Pool XS	2736

(Year 3) Cross Section 12 - Riffle (R1)Riffle XS 3118

Measurements from Graph

Bankfull Slope: 0.00183

Variable	Min	Avg	Max
S riffle	0.00093	0.00797	0.01777
S pool	0	0	0
S run	0	0	0
S glide	0	0	0
P - P	49	87.47	149.04
Pool length	14.29	33.57	69.42
Riffle length	12.25	19.69	29.05
Dmax riffle	0	0	0
Dmax pool	0	0	0
Dmax run	0	0	0
Dmax glide	0	0	0
Low bank ht	0	0	0

Length and depth measurements in feet, slopes in ft/ft.

RIVERMORPH PROFILE SUMMARY

Notes

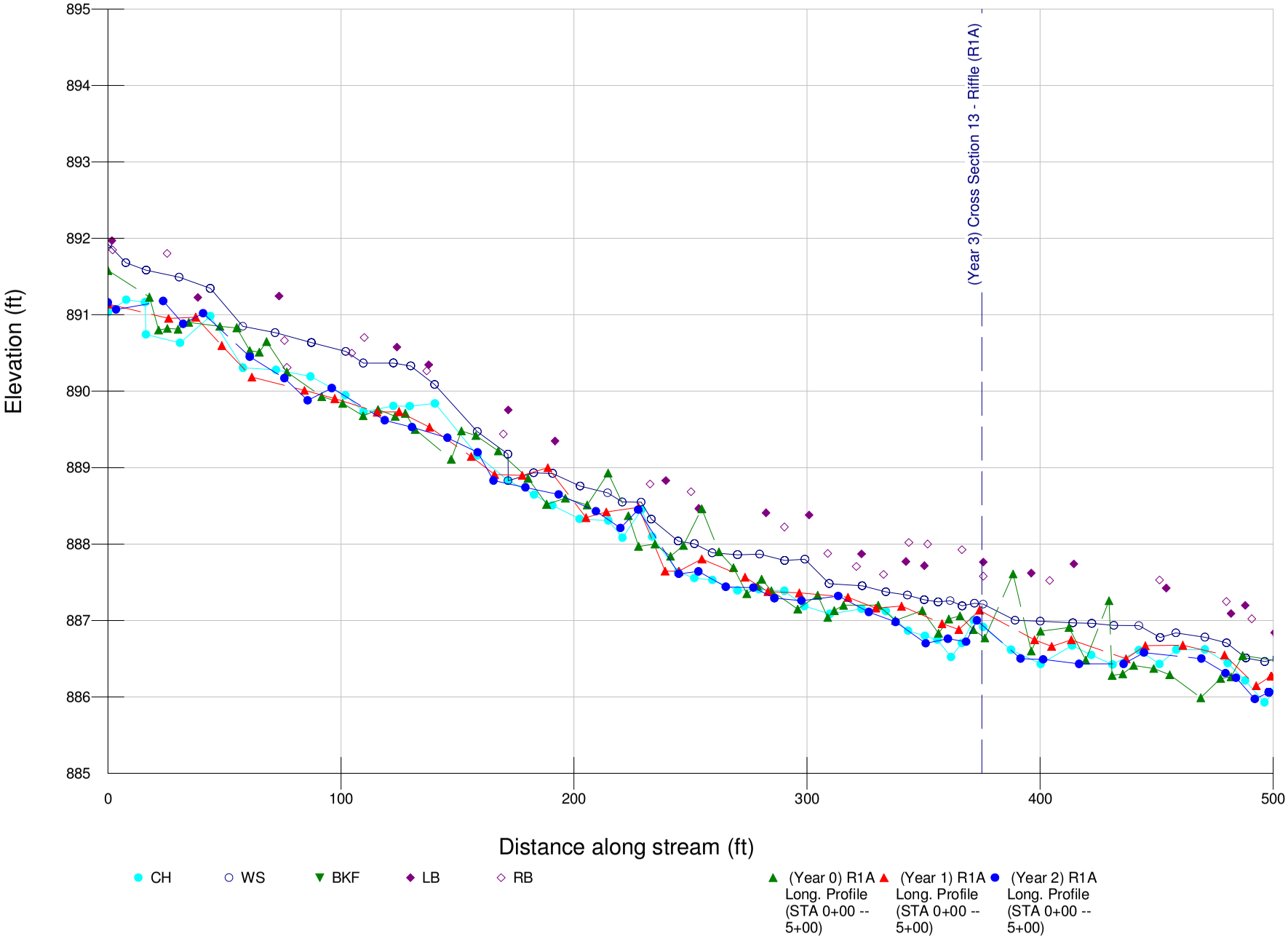
River Name: Little White Oak Creek (Year 3)
Reach Name: R1
Profile Name: (Year 3) R1 Long. Profile (STA 14+00 -- 33+74)
Survey Date: 11/19/2010

DIST	Note
1400	LEW
1409.081	LEW
1426.577	LEW
1441.8	LEW
1454.112	LEW
1463.477	LEW
1478.154	LEW
1501.822	LEW
1517.25	LEW
1531.374	LEW
1551.287	LEW
1562.238	LEW
1587.148	LEW
1587.487	LEW
1606.783	LEW
1628.557	LEW
1641.646	LEW
1657.008	LEW
1667.12	LEW
1690.123	LEW
1709.874	LEW
1720.27	LEW
1730.16	LEW
1738.425	LEW
1752.195	LEW
1770.968	LEW
1786.062	XS9 - TW Intersect @ station 1786.062
1816.845	LEW
1841.052	LEW
1846.375	LEW

1873.174 LEW
1890.9 LEW
1898.914 LEW
1925.352 LEW
1940.585 LEW
1945.861 LEW
1953.66 LEW
1972.436 LEW
1993.181 LEW
2016.603 LEW
2042.614 LEW
2059.702 LEW
2072.424 LEW
2078.022 LEW
2091.385 LEW
2110.951 LEW
2123.214 LEW
2145.681 LEW
2159.859 LEW
2182.713 LEW
2211.234 LEW
2229.283 LEW
2250.308 LEW
2276.365 XS10 - TW Intersect @ station 2276.365
2289.696 LEW
2307.942 LEW
2324.089 LEW
2335.793 LEW
2351.644 LEW
2383.071 LEW
2383.244 LEW
2396.464 LEW
2418.047 LEW
2431.466 LEW
2441.909 LEW
2449.112 LEW
2459.405 LEW
2475.421 LEW
2499.742 LEW
2520.676 LEW
2537.988 LEW
2548.291 LEW
2574.479 LEW
2586.154 LEW
2600.769 LEW
2628.862 LEW
2643.118 LEW
2663.683 LEW
2673.994 LEW
2690.533 LEW
2717.576 LEW
2731.92 LEW
2736.244 XS11 - TW Intersect @ station 2736.244
2760.776 LEW
2781.803 LEW
2803.375 LEW
2827.604 LEW
2838.229 LEW
2842.274 LEW
2851.658 LEW
2875.263 LEW
2893.745 LEW
2913.325 LEW
2944.446 LEW
2955.818 LEW
2969.978 LEW

2985.795 LEW
3010.951 LEW
3045.08 LEW
3062.681 LEW
3072.627 LEW
3104.016 LEW
3114.565 LEW
3118.732 XS12 - TW Intersect @ station 3118.732
3127.227 LEW
3157.894 LEW
3187.889 LEW
3215.466 LEW
3239.237 LEW
3250.73 LEW
3275.28 LEW
3288.604 LEW
3294.277 LEW
3305.386 LEW
3326.752 LEW
3344.049 LEW
3354.153 LEW
3374.329 LEW
3385.978 LEW
3399.487 LEW
3416.719 LEW
3437.443 LEW
3452.102 LEW
3473.861 LEW
3491.885 LEW
3509.476 LEW

(Year 3) R1A Longitudinal Profile (STA 0+00 -- 5+00)



RIVERMORPH PROFILE SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R1A
Profile Name: (Year 3) R1A Long. Profile (STA 0+00 -- 5+00)
Survey Date: 11/19/2010

Survey Data

DIST	CH	WS	BKF	LB	RB
0	891.031				
0		891.923			
1.708				891.969	
1.981					891.848
7.68		891.679			
7.914	891.196				
15.958	891.163				
16.377	890.742				
16.413		891.585			
25.373					891.802
30.573		891.491			
31.022	890.633				
38.612				891.226	
43.97	890.983				
43.97		891.344			
57.889		890.848			
57.99	890.306				
71.795		890.764			
72.169	890.278				
73.443				891.246	
75.74					890.665
76.85					890.311
86.944	890.193				
87.342		890.634			
101.945	889.945				
102.077		890.52			
104.65					890.499
109.576		890.367			
109.718	889.73				
110.019					890.701
122.553	889.806				
122.553		890.369			
124.074				890.576	
129.57	889.805				
129.996		890.33			
136.799					890.267
137.654				890.346	
140.204		890.088			
140.369	889.839				
158.516		889.471			
158.516	889.16				
169.72					889.439
171.677		889.175			
171.734		888.828			
171.812	888.832				
171.812				889.755	
182.697		888.932			
182.929	888.646				
190.749	888.504				
190.909		888.923			

191.852 889.348
202.444 888.327
202.658 888.759
214.484 888.669
214.788 888.308
220.703 888.549
220.809 888.083
228.791 888.547
228.992 888.448
232.645 888.785
233.196 888.324
233.551 888.095
239.423 888.832
244.691 887.633
244.691 888.038
250.239 888.684
251.685 887.554
251.752 888.003
253.563 888.465
259.325 887.884
259.455 887.529
270.227 887.392
270.227 887.86
279.427 887.408
279.681 887.867
282.454 888.41
290.354 888.222
290.354 887.388
290.422 887.785
298.923 887.188
299.12 887.8
300.881 888.379
308.888 887.877
309.553 887.482
309.868 887.087
321.172 887.705
323.408 887.153
323.408 887.871
323.663 887.454
332.817 887.603
333.892 887.122
333.892 887.376
342.382 887.771
343.13 887.331
343.41 886.866
343.704 888.02
350.321 887.716
350.339 887.272
350.592 886.8
351.735 888.001
355.896 886.748
356.269 887.243
361.464 887.259
361.855 886.521
366.475 886.704
366.475 887.924
366.619 887.189
371.55 887.004
371.921 887.225
375.594 886.915 887.212 887.762 887.579
387.527 886.617
389.255 887.001
396.265 887.62
400.128 886.989
400.306 886.43
404.088 887.523

413.779	886.671			
414.072		886.97		
414.512			887.739	
422.017	886.547			
422.232		886.962		
431.165	886.423			
431.681		886.936		
442.419		886.931		
442.419	886.611			
451.303				887.529
451.303	886.428			
451.535		886.776		
454.111			887.424	
458.29		886.836		
458.514	886.618			
470.75		886.78		
470.794	886.621			
479.978				887.247
480.054		886.706		
480.582	886.444			
481.969			887.091	
488.069	886.214			
488.069			887.198	
488.369		886.51		
490.847				887.023
496.328	885.927			
496.393		886.462		
500.621			886.84	
501.622		886.499		
501.747				886.795
501.747	886.105			

Cross Section / Bank Profile Locations

Name	Type	Profile Station
(Year 3) Cross Section 13 - Riffle (R1A)	Riffle XS	375

Measurements from Graph

Bankfull Slope: 0

Variable	Min	Avg	Max
S riffle	0	0	0
S pool	0	0	0
S run	0	0	0
S glide	0	0	0
P - P	0	0	0
Pool length	0	0	0
Riffle length	0	0	0
Dmax riffle	0	0	0
Dmax pool	0	0	0
Dmax run	0	0	0
Dmax glide	0	0	0
Low bank ht	0	0	0

Length and depth measurements in feet, slopes in ft/ft.

RIVERMORPH PROFILE SUMMARY

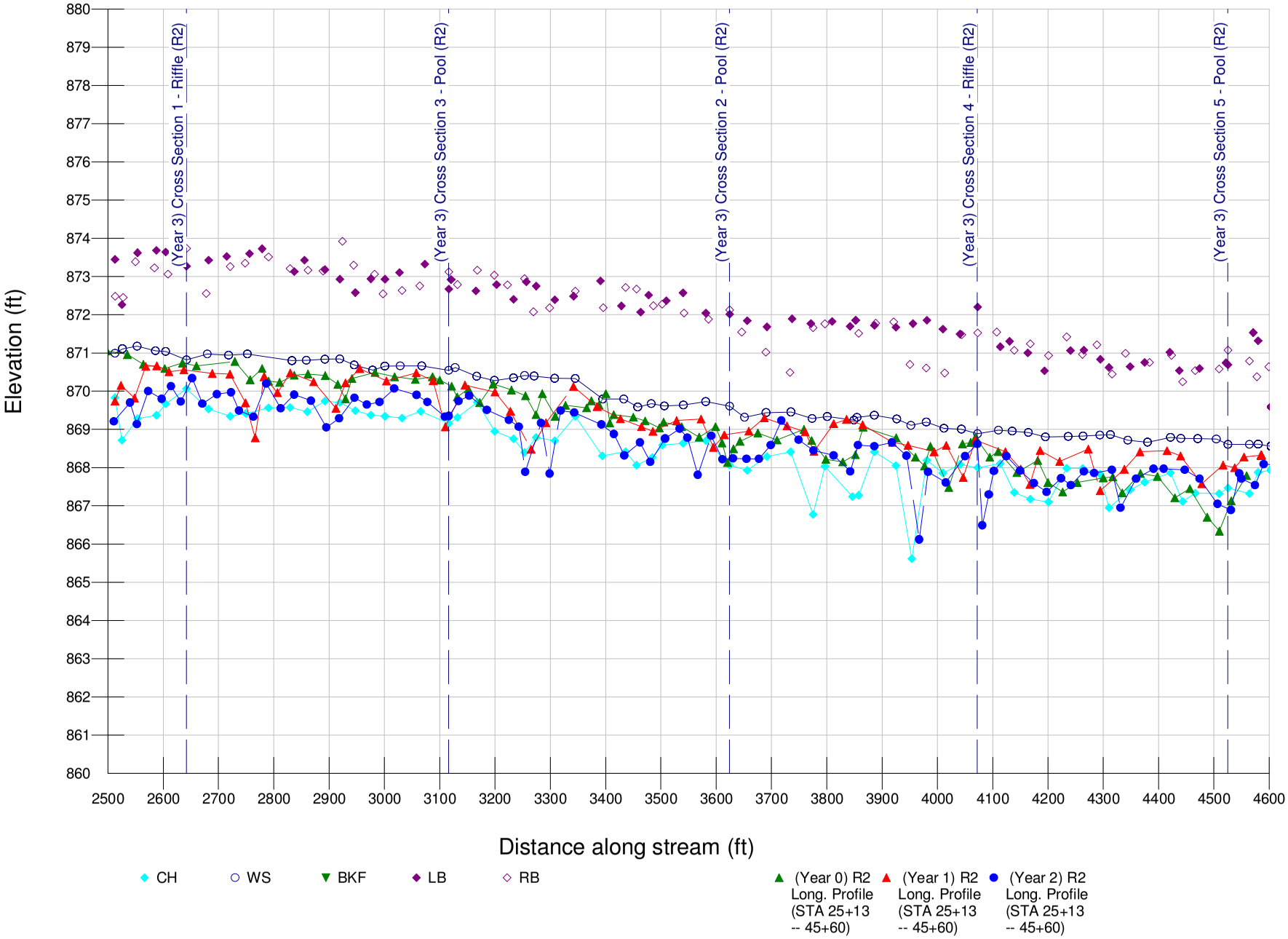
Notes

River Name: Little White Oak Creek (Year 3)

Reach Name: R1A
Profile Name: (Year 3) R1A Long. Profile (STA 0+00 -- 5+00)
Survey Date: 11/19/2010

DIST	Note
0	LEW
7.68	LEW
16.413	LEW
30.573	LEW
43.97	LEW
57.889	LEW
71.795	LEW
87.342	LEW
102.077	LEW
109.576	LEW
122.553	LEW
129.996	LEW
140.204	LEW
158.516	LEW
171.677	LEW
171.734	LEW
182.697	LEW
190.909	LEW
202.658	LEW
214.484	LEW
220.703	LEW
228.791	LEW
233.196	LEW
244.691	LEW
251.752	LEW
259.325	LEW
270.227	LEW
279.681	LEW
290.422	LEW
299.12	LEW
309.553	LEW
323.663	LEW
333.892	LEW
343.13	LEW
350.339	LEW
356.269	LEW
361.464	LEW
366.619	LEW
371.921	LEW
375.594	XS13 - TW Intersect @ station 375.594
389.255	LEW
400.128	LEW
414.072	LEW
422.232	LEW
431.681	LEW
442.419	LEW
451.535	LEW
458.29	LEW
470.75	LEW
480.054	LEW
488.369	LEW
496.393	LEW
501.622	LEW

(Year 3) R2 Longitudinal Profile (STA 25+13 -- 45+60)



RIVERMORPH PROFILE SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2
Profile Name: (Year 3) R2 Long. Profile (STA 25+13 -- 45+60)
Survey Date: 11/19/2010

Survey Data

DIST	CH	WS	BKF	LB	RB
2513	869.834				
2513		870.991			
2513				873.449	
2513.334					872.486
2525.359	868.714				
2525.359				872.267	
2526.388		871.11			
2527.778					872.452
2549.761					873.389
2552.838		871.178			
2553.774				873.623	
2553.774	869.284				
2583.918					873.226
2586.041		871.057			
2587.715				873.685	
2587.715	869.373				
2604.391	869.666				
2604.391		871.036			
2604.391				873.645	
2608.619					873.063
2642.347	870.064	870.82		873.271	873.735
2677.993					872.553
2679.808		870.972			
2682.045	869.531				
2682.045				873.427	
2714.73				873.528	
2718.491		870.939			
2721.168	869.34				
2721.168					873.262
2747.834					873.35
2749.053	869.418				
2752.321		870.974			
2756.056				873.597	
2778.865				873.727	
2790.25	869.56				
2790.25					873.515
2829.386	869.573				
2829.386					873.211
2833.032		870.798			
2837.068				873.13	
2855.351				873.431	
2858.942		870.805			
2860.518	869.463				
2861.693					873.168
2888.819					873.148
2892.536		870.836			
2892.536	869.742				
2892.536				873.183	
2919.333		870.84			
2919.333				872.932	

2919.333 869.708
2924.183   873.921
2944.19   873.299
2945.328   870.686
2947.401   872.579
2947.401 869.494
2975.615   872.94
2975.615 869.375
2978.878   870.55
2982.37   873.064
2997.657   872.546
3000.958 869.341
3000.958   872.929
3000.958   870.655
3027.106   873.106
3028.587   870.662
3031.836   872.635
3031.836 869.294
3064.177   872.755
3065.68   869.473
3067.691   870.664
3073.355   873.324
3116.413 869.159 870.547   872.669 873.121
3120.726   872.921
3127.972   870.617
3132.029 869.311
3132.029   872.789
3165.554   872.625
3166.929   870.388
3168.003 869.715
3168.003   873.17
3198.711   873.036
3199.076   870.282
3199.606 868.949
3202.861   872.787
3222.49   872.781
3233.357   872.403
3233.357 868.752
3233.443   870.351
3253.525   872.948
3253.525   870.41
3253.525 868.395
3256.577   872.862
3269.67   872.077
3270.945   870.397
3274.526 868.79
3274.526   872.749
3298.641   872.181
3308.111 868.707
3308.111   870.335
3308.111   872.391
3342.062   872.488
3345.168   872.619
3345.168   870.332
3345.168 869.341
3390.501   872.885
3394.136 868.305
3394.888   869.795
3395.849   872.185
3428.742   872.231
3432.977   869.792
3436.213   872.716
3436.213 868.416
3455.756   872.669
3455.756 868.06
3458.349   869.584

```
3463.281                          872.069
3477.905                          872.516
3482.549          869.67
3484.654  868.265
3486.48                                   872.236
3502.164                                  872.278
3502.837  868.591
3506.463          869.613
3509.923                          872.371
3540.131  868.637
3540.131                          872.574
3540.774          869.636
3541.816                                  872.046
3581.253                          872.043
3581.253  868.705
3581.253          869.727
3585.959                                  871.885
3624.362  868.063 869.607          872.018 872.127
3645.959                                  871.547
3651.414          869.315
3656.305                          871.843
3656.305  867.927
3689.642                                  871.02
3690.402          869.437
3691.864                          871.684
3691.864  868.289
3733.507                                  870.489
3734.503  868.412
3735.27           869.454
3736.937                          871.895
3771.204                          871.766
3773.433          869.284
3775.022  866.773
3775.022                                  871.661
3796.58                                   871.764
3796.58   868.033
3800.99           869.334
3809.61                           871.827
3842.045                          871.697
3846.422  867.239
3849.396          869.245
3851.776                                  871.856
3852.542                          871.853
3854.614          869.314
3857.782                                  871.512
3857.782  867.277
3886.202                          871.72
3886.202  868.41
3886.202          869.371
3888.625                                  871.782
3921.127                                  871.815
3924.98                           871.673
3924.98   868.049
3926.432          869.274
3950.133                                  870.699
3952.234          869.105
3953.942  865.614
3955.797                          871.768
3979.903                                  870.605
3980.057          869.19
3981.014  868.189
3981.014                          871.853
4009.738  867.862
4009.738                          871.625
4011.842          869.03
4013.261                                  870.474
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4040.612 871.493
4040.612 868.084
4043.542 869.006
4043.822 871.477
4072.772 868.001 868.886 872.203 871.526
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4110.32 868.977
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4163.484 871.002
4164.621 868.919
4168.007 871.24
4168.097 867.176
4193.703 870.536
4195.382 868.802
4201.098 870.931
4201.098 867.098
4233.983 871.422
4233.983 867.989
4236.78 868.816
4240.742 871.06
4262.379 870.961
4262.532 867.981
4263.523 868.825
4264.793 871.074
4288.229 871.215
4294.065 868.85
4294.065 867.828
4294.754 870.832
4310.311 866.952
4310.311 870.62
4312.926 868.862
4315.98 870.448
4340.014 870.991
4344.36 868.716
4348.44 870.645
4348.44 867.422
4374.905 867.622
4374.905 870.753
4379.912 868.662
4383.567 870.753
4420.003 871.019
4421.208 867.867
4421.478 868.792
4423.441 870.937
4437.49 870.54
4440.355 868.764
4443.529 870.246
4443.529 867.111
4466.365 867.33
4466.365 870.541
4470.793 868.758
4474.168 870.59
4504.463 868.743
4509.442 870.582
4509.442 867.319
4521.913 870.741
4525.447 867.468 868.606 870.689 871.075
4564.219 867.323
4564.219 868.605
4564.219 870.789
4571.201 871.533

4577.503			870.379	
4580.146	867.877			
4580.146			871.322	
4580.146		868.61		
4599.377			870.641	
4602.905	867.937	868.561	869.592	

Cross Section / Bank Profile Locations

Name	Type	Profile Station
(Year 3) Cross Section 1 - Riffle (R2)	Riffle XS	2642
(Year 3) Cross Section 3 - Pool (R2)	Pool XS	3116
(Year 3) Cross Section 2 - Pool (R2)	Pool XS	3624
(Year 3) Cross Section 4 - Riffle (R2)	Riffle XS	4072
(Year 3) Cross Section 5 - Pool (R2)	Pool XS	4525

Measurements from Graph

Bankfull Slope: 0.00116

Variable	Min	Avg	Max
S riffle	0.00314	0.00568	0.01194
S pool	0	0	0
S run	0	0	0
S glide	0	0	0
P - P	61.25	129.41	200.08
Pool length	20.42	35.18	65.33
Riffle length	22.46	32.26	38.79
Dmax riffle	0	0	0
Dmax pool	0	0	0
Dmax run	0	0	0
Dmax glide	0	0	0
Low bank ht	0	0	0

Length and depth measurements in feet, slopes in ft/ft.

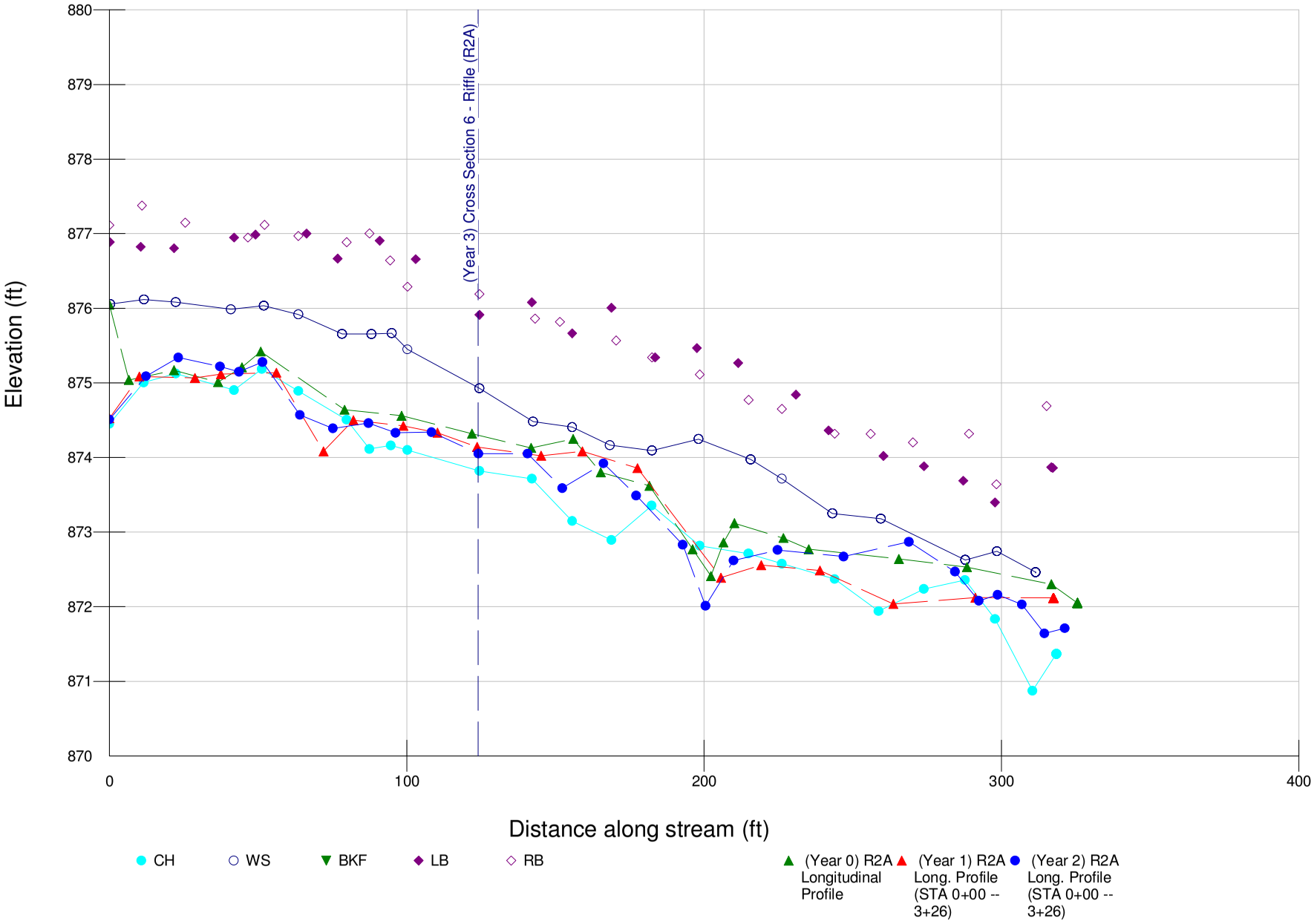
RIVERMORPH PROFILE SUMMARY

Notes

River Name: Little White Oak Creek (Year 3)
Reach Name: R2
Profile Name: (Year 3) R2 Long. Profile (STA 25+13 -- 45+60)
Survey Date: 11/19/2010

DIST	Note
2513	LEW
2526.388	LEW
2552.838	LEW
2586.041	LEW
2604.391	LEW
2642.347	XS1 - TW Intersect @ station 2642
2679.808	LEW
2718.491	LEW
2752.321	LEW
2833.032	LEW
2858.942	LEW
2892.536	LEW
2919.333	LEW
2945.328	LEW
2978.878	LEW

3000.958 LEW
3028.587 LEW
3067.691 LEW
3116.413 XS2 - TW Intersect @ station 3116
3127.972 LEW
3166.929 LEW
3199.076 LEW
3233.443 LEW
3253.525 LEW
3270.945 LEW
3308.111 LEW
3345.168 LEW
3394.888 LEW
3432.977 LEW
3458.349 LEW
3482.549 LEW
3506.463 LEW
3540.774 LEW
3581.253 LEW
3624.362 XS3 - TW Intersect @ station 3624
3651.414 LEW
3690.402 LEW
3735.27 LEW
3773.433 LEW
3800.99 LEW
3849.396 LEW
3854.614 LEW
3886.202 LEW
3926.432 LEW
3952.234 LEW
3980.057 LEW
4011.842 LEW
4043.542 LEW
4072.772 XS4 - TW Intersect @ station 4072
4110.32 LEW
4135.158 LEW
4164.621 LEW
4195.382 LEW
4236.78 LEW
4263.523 LEW
4294.065 LEW
4312.926 LEW
4344.36 LEW
4379.912 LEW
4421.478 LEW
4440.355 LEW
4470.793 LEW
4504.463 LEW
4525.447 XS5 - TW Intersect @ station 4525
4564.219 LEW
4580.146 LEW


(Year 3) R2A Long. Profile (STA 0+00 -- 3+26)
Elevation (ft)
880
879
878
877
876
875
874
873
872
871
870
0
100
200
300
400
(Year 3) Cross Section 6 - Riffle (R2A)
Distance along stream (ft)
CH
WS
BKF
LB
RB
(Year 0) R2A Longitudinal Profile
(Year 1) R2A Long. Profile (STA 0+00 -- 3+26)
(Year 2) R2A Long. Profile (STA 0+00 -- 3+26)

RIVERMORPH PROFILE SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2A
Profile Name: (Year 3) R2A Long. Profile (STA 0+00 -- 3+26)
Survey Date: 01/19/2011

Survey Data

DIST	CH	WS	BKF	LB	RB
0	874.449				
0					877.113
0.157				876.887	
0.295		876.057			
10.55				876.823	
10.946					877.378
11.503	875.005				
11.661		876.118			
21.753				876.805	
22.299	875.125				
22.299		876.082			
25.484					877.149
40.891		875.987			
41.93				876.948	
41.93	874.902				
46.612					876.948
49.095				876.987	
51.277	875.185				
51.943		876.034			
52.155					877.117
63.589		875.917			
63.589	874.891				
63.589					876.97
66.304				877	
76.745				876.667	
78.276		875.656			
79.771	874.507				
79.8					876.884
87.47	874.113				
87.47					877.002
88.148		875.655			
90.897				876.906	
94.397					876.641
94.698	874.161				
94.981		875.666			
100.241		875.45			
100.241					876.291
100.241	874.1				
103.015				876.66	
124.478	873.818	874.927		875.912	876.191
142.082	873.715				
142.082				876.08	
142.505		874.481			
143.171					875.86
151.53					875.819
155.677	873.147				
155.677		874.406			
155.677				875.664	
168.355		874.164			
168.842				876.007	

168.842	872.893			
170.417				875.569
182.4	873.356			
182.497		874.093		
182.515				875.342
183.511			875.342	
197.549			875.467	
198.161		874.248		
198.534	872.818			
198.534				875.112
211.425			875.268	
214.915	872.712			
215.015				874.771
215.667		873.974		
226.177		873.716		
226.177				874.65
226.177	872.577			
230.893			874.84	
241.876			874.365	
243.176		873.25		
243.912				874.319
243.912	872.369			
256.015				874.317
258.712	871.94			
259.488		873.179		
260.368			874.021	
270.245				874.202
273.906	872.237			
273.906			873.882	
274.558				
287.185			873.687	
287.745	872.357			
287.856		872.627		
289.079				874.319
297.85	871.834			
297.85			873.396	
298.306				873.641
298.484		872.744		
310.486	870.873			
311.484		872.462		
315.204				874.69
316.786			873.868	
317.284			873.861	
318.497	871.367			

Cross Section / Bank Profile Locations

Name	Type	Profile Station
(Year 3) Cross Section 6 - Riffle	(R2A)Riffle XS	124

Measurements from Graph

Bankfull Slope: 0

Variable	Min	Avg	Max
S riffle	0	0	0
S pool	0	0	0
S run	0	0	0
S glide	0	0	0
P - P	0	0	0
Pool length	0	0	0
Riffle length	0	0	0
Dmax riffle	0	0	0

Dmax pool	0	0	0
Dmax run	0	0	0
Dmax glide	0	0	0
Low bank ht	0	0	0

Length and depth measurements in feet, slopes in ft/ft.

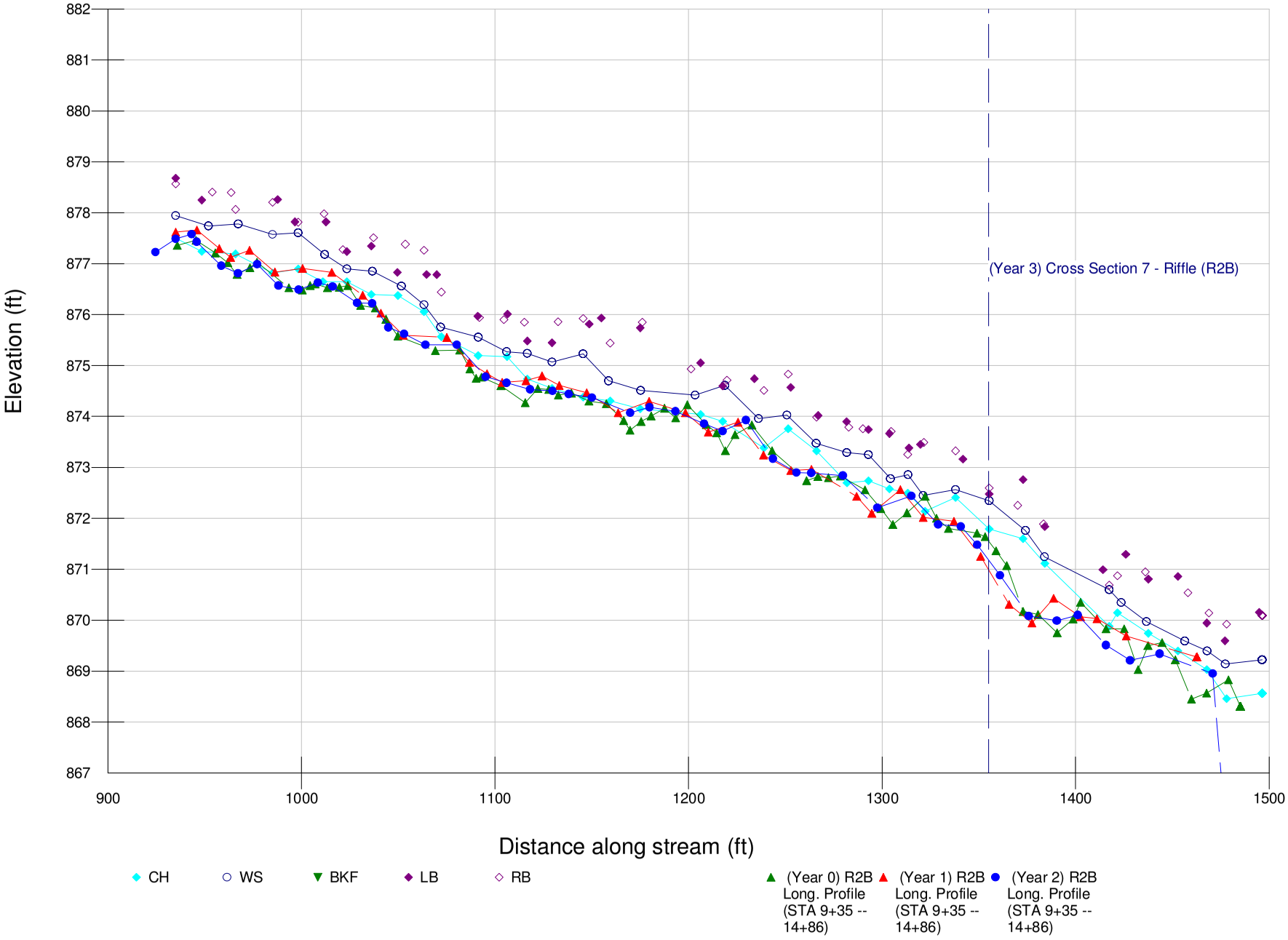
RIVERMORPH PROFILE SUMMARY

Notes

River Name: Little White Oak Creek (Year 3)
Reach Name: R2A
Profile Name: (Year 3) R2A Long. Profile (STA 0+00 -- 3+26)
Survey Date: 01/19/2011

DIST	Note
0.295	LEW
11.661	LEW
22.299	LEW
40.891	LEW
51.943	LEW
63.589	LEW
78.276	LEW
88.148	LEW
94.981	LEW
100.241	LEW
124.478	XS6 - TW Intersect @ station 124.478
142.505	LEW
155.677	LEW
168.355	LEW
182.497	LEW
198.161	LEW
215.667	LEW
226.177	LEW
243.176	LEW
259.488	LEW
274.558	LEW
287.856	LEW
298.484	LEW
311.484	LEW

(Year 3) R2B Longitudinal Profile (STA 9+35 -- 14+86)



RIVERMORPH PROFILE SUMMARY

River Name: Little White Oak Creek (Year 2)
Reach Name: R2B
Profile Name: (Year 2) R2B Long. Profile (STA 9+35 -- 14+86)
Survey Date: 11/18/2009

Survey Data

DIST	CH	WS	BKF	LB	RB	P3	P4
924.61	877.23						
924.61				878.28			
924.61		877.98					
925.679					878.11		
933.761		877.87					
935.004	877.49						
935.004				878.13			
936.758					878.45		
941.173				878.31			
943.268	877.58						
943.795		877.79					
945.385		877.7					
945.857	877.43						
953.135					878.64		
955.511				878.3			
958.117		877.31					
958.58	876.96						
965.379					878.43		
967.252	876.81						
968.21		877.26					
972.1				878.17			
973.197					878.17		
976.199		877.17					
977.147	876.99						
981.288				878.19			
987.126					877.99		
988.087		877.06					
988.183	876.57						
990.685				877.66			
998.28		877					
998.579	876.49						
998.862				877.44			
1002.065					877.58		
1007.894				877.52			
1008.257		876.98					
1008.503	876.63						
1015.368		876.87					
1016.127	876.55						
1016.51				877.37			
1017.003					877.59		
1028.669		876.51					
1028.721	876.23						
1028.721				876.96			
1034.535					877.52		
1035.896		876.34					
1036.589	876.22						
1042.318				876.98			
1044.857					876.84		
1044.857	875.75						
1045.16		875.98					

1051.886 876.43
1052.112 875.8
1053.059 875.62
1054.044 876.51
1064.07 876.46
1064.07 875.41
1064.171 875.77
1065.01 876.91
1076.668 876
1080.245 875.41
1080.245 876.07
1080.245 875.59
1092.231 876.05
1095.112 874.78
1095.112 875.79
1095.191 875.25
1104.18 876.21
1104.557 875.11
1106.005 874.66
1106.005 875.65
1118.173 875.13
1118.173 876.46
1118.173 874.53
1121.504 876.08
1125.567 876.12
1129.724 876.07
1129.724 874.5
1129.724 875
1137.277 876.03
1138.117 874.82
1138.117 874.44
1139.334 875.92
1149.049 875.7
1150.107 874.37
1151.385 874.71
1151.478 875.74
1163.11 875.23
1164.93 874.67
1169.904 874.07
1169.904 875.28
1177.929 874.63
1179.61 875.21
1179.841 874.18
1183.142 875.2
1192.223 874.81
1192.323 874.52
1193.25 874.1
1193.729 875.01
1206.618 874.93
1207.98 873.86
1208.38 875.04
1209.471 874.23
1217.616 873.71
1217.616 875.11
1217.616 874.18
1219.635 874.8
1229.62 874.12
1229.62 874.4
1229.62 873.93
1230.876 874.46
1242.49 874.17
1243.605 873.43
1243.605 873.17
1243.605 874.12
1254.865 873.36
1255.71 873.95

1255.71 872.9
1256.951   873.96
1263.43   873.97
1263.43 872.89
1265.268   873.26
1268.413   873.9
1269.283   873.99
1278.311   873.7
1279.697   873.1
1279.798   873.67
1279.798 872.84
1295.728   872.79
1297.505   873.28
1297.505 872.21
1301.036   873.64
1311.743   873.3
1315.122   873.37
1315.122 872.44
1315.142   872.73
1328.975 871.88 872.14 872.73   872.71
1340.098   872.87
1340.623 871.84
1341.215   872.04
1342.305   872.59
1349.141   872.9
1349.141 871.48
1349.81   871.64
1352.01   872.45
1360.588   871.05
1360.958 870.88
1361.215   871.76
1361.74   871.94
1375.751 870.08
1375.751   871.29
1376.583   870.45
1377.717   871.61
1386.652   871.49
1389.809   870.9
1390.288   870.56
1390.288 869.99
1401.083 870.1
1401.288   870.95
1401.304   870.26
1404.106   871.14
1413.858   870.78
1415.061   870.09
1415.603 869.51
1415.603   870.87
1425.579   870.98
1428.077 869.21
1433.106   870.54
1433.565   869.92
1442.854   870
1443.387 869.34
1446.568   870.34
1448.881   870.02
1468.562   870.52
1470.06   870.02
1470.809 868.95   870.15
1476.969 866.12

Cross Section / Bank Profile Locations

Name	Type	Profile Station
(Year 2) Cross Section 7 - Riffle (R2B)	Riffle XS	1328

Measurements from Graph

Bankfull Slope: 0.01641

Variable	Min	Avg	Max
S riffle	0.01252	0.03485	0.04758
S pool	0	0	0
S run	0	0	0
S glide	0	0	0
P - P	30.37	42.24	55.12
Pool length	13.5	17.51	23.62
Riffle length	5.06	7.76	10.69
Dmax riffle	0	0	0
Dmax pool	0	0	0
Dmax run	0	0	0
Dmax glide	0	0	0
Low bank ht	0	0	0

Length and depth measurements in feet, slopes in ft/ft.

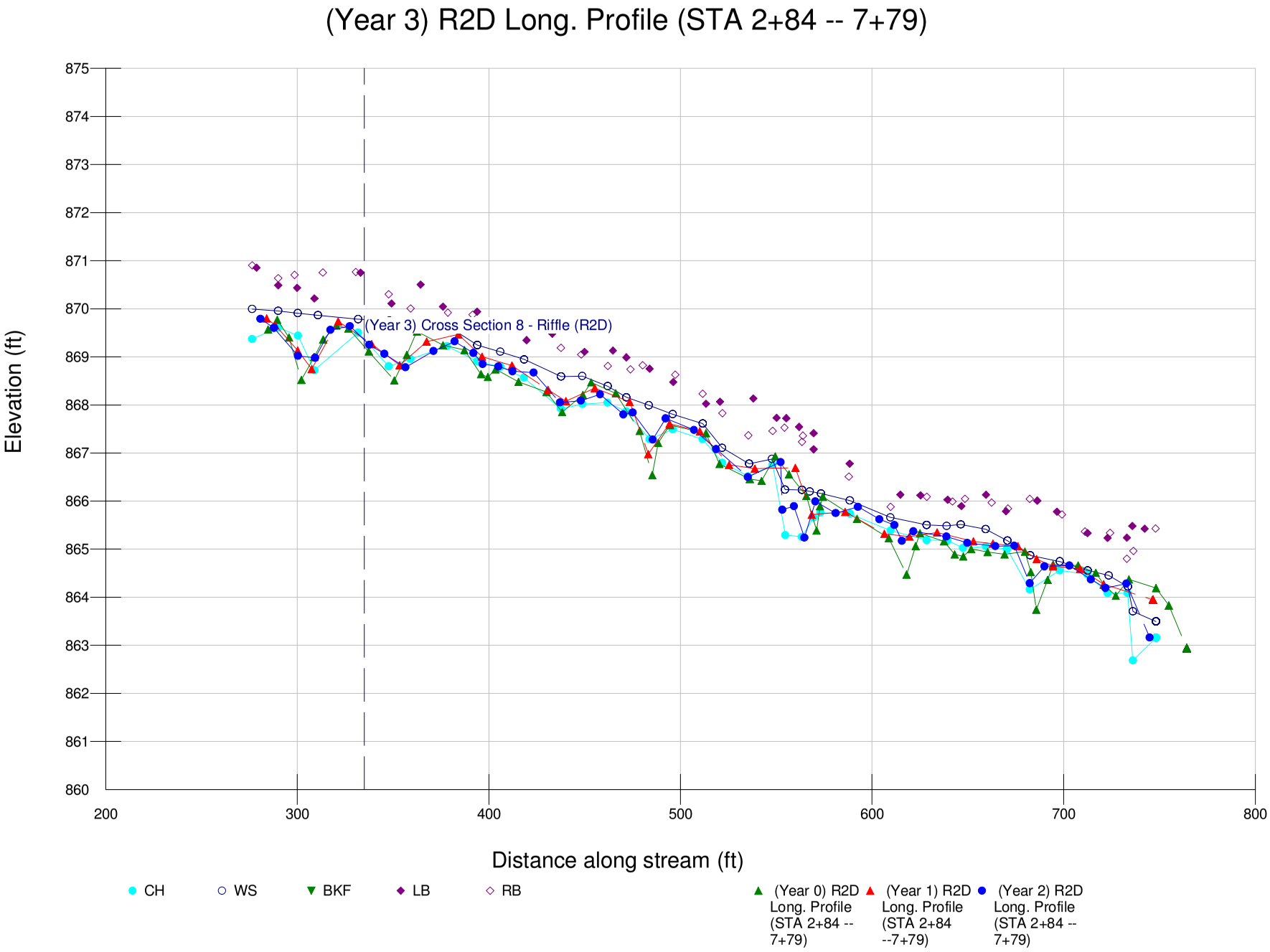
RIVERMORPH PROFILE SUMMARY

Notes

River Name: Little White Oak Creek (Year 2)
Reach Name: R2B
Profile Name: (Year 2) R2B Long. Profile (STA 9+35 -- 14+86)
Survey Date: 11/18/2009

DIST	Note
924.61	REW
933.761	REW
943.795	REW
945.385	REW
958.117	REW
968.21	REW
976.199	REW
988.087	REW
998.28	REW
1008.257	REW
1015.368	REW
1028.669	REW
1035.896	REW
1045.16	REW
1052.112	REW
1064.171	REW
1080.245	REW
1095.191	REW
1104.557	REW
1118.173	REW
1129.724	REW
1138.117	REW
1151.385	REW
1164.93	REW
1177.929	REW
1192.323	REW
1209.471	REW
1217.616	REW
1229.62	REW
1243.605	REW
1254.865	REW

1265.268 REW
1279.697 REW
1295.728 REW
1315.142 REW
1328.975 XS7 - TW Intersect @ station 1328
1341.215 REW
1349.81 REW
1360.588 REW
1376.583 REW
1390.288 REW
1401.304 REW
1415.061 REW
1433.565 REW
1448.881 REW
1470.06 REW


(Year 3) R2D Long. Profile (STA 2+84 -- 7+79)
Elevation (ft)
875
874
873
872
871
870
869
868
867
866
865
864
863
862
861
860
200
300
400
500
600
700
800
Distance along stream (ft)
(Year 3) Cross Section 8 - Riffle (R2D)
CH
WS
BKF
LB
RB
(Year 0) R2D Long. Profile (STA 2+84 -- 7+79)
(Year 1) R2D Long. Profile (STA 2+84 --7+79)
(Year 2) R2D Long. Profile (STA 2+84 -- 7+79)

RIVERMORPH PROFILE SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2D
Profile Name: (Year 3) R2D Long. Profile (STA 2+84 -- 7+79)
Survey Date: 11/19/2010

Survey Data

DIST	CH	WS	BKF	LB	RB
276.5	869.371				
276.5		869.996			
276.5					870.904
278.759				870.852	
290.016	869.607	869.955		870.488	870.636
298.559					870.704
299.905				870.437	
300.239		869.908			
300.403	869.442				
308.902	868.723				
308.902				870.213	
310.758		869.863			
313.312					870.753
330.559					870.763
331.716		869.782			
331.788	869.502				
333.038				870.751	
347.678					870.301
347.678	868.804				
348.118		869.751			
349.219				870.109	
359.131	868.952				
359.131					870.006
359.331		869.696			
364.333				870.502	
376.003				870.043	
378.023		869.656			
378.144	869.222				
378.555					869.92
391.534					869.874
393.84	868.909				
393.84				869.938	
394.041		869.243			
404.799					869.688
405.936		869.106			
406.049				869.602	
406.049	868.794				
418.274	868.567				
418.274					869.637
418.416		868.946			
419.683				869.346	
433.053				869.48	
437.601	867.923				
437.601					869.187
437.673		868.59			
448.187					869.046
448.761		868.599			
448.889	868.017				
449.95				869.105	
461.898	868.048				

462.023 868.389
462.084 868.811
464.746 869.129
471.737 868.989
471.737 867.863
471.799 868.157
473.926 868.74
480.264 868.824
483.534 867.992
483.878 868.753
483.878 867.287
495.885 867.808
495.885 867.491
496.197 868.475
497.293 868.629
511.558 868.23
511.558 867.287
511.634 867.61
513.324 868.024
520.661 868.066
521.71 867.108
521.856 867.829
521.856 866.796
535.383 866.514
535.383 867.367
535.797 866.774
537.972 868.134
547.702 866.875
548.054 867.459
548.054 866.755
550.099 867.733
554.242 867.526
554.557 866.237
554.665 865.293
555.219 867.722
561.849 867.544
563.333 865.254
563.375 866.231
563.415 867.23
563.834 867.36
567.536 866.2
569.477 865.658
569.477 867.41
569.477 867.076
573.034 865.76
573.317 866.155
587.857 866.507
588.3 866.777
588.409 866.013
588.608 865.736
609.591 865.662
609.695 865.878
609.695 865.387
614.734 866.132
625.257 866.12
628.543 866.089
628.543 865.502
628.543 865.186
638.94 865.484
639.359 866.028
639.366 865.176
641.905 865.989
646.268 865.513
646.588 865.894
647.413 865.026
648.452 866.046

659.331 865.415
659.44 865.057
659.44 866.13
662.366 865.968
669.849 865.786
670.5 865.002
670.708 865.173
670.894 865.845
682.312 866.044
682.312 864.159
682.611 864.87
686.193 866.009
696.493 865.779
697.906 864.556
698.017 864.744
699.132 865.719
711.112 865.364
712.439 864.477
712.439 865.333
712.511 864.554
722.905 865.233
722.905 864.083
723.453 864.45
724.203 865.338
732.937 864.799
732.954 865.237
733.409 864.081
733.508 864.222
735.848 865.483
736.136 862.683
736.201 863.704
736.419 864.963
742.222 865.424
747.982 865.428
748.193 863.155 863.496

Cross Section / Bank Profile Locations

Name	Type	Profile Station
(Year 3) Cross Section 8 - Riffle (R2D)	Riffle XS	335

Measurements from Graph

Bankfull Slope: 0

Variable	Min	Avg	Max
S riffle	0	0	0
S pool	0	0	0
S run	0	0	0
S glide	0	0	0
P - P	0	0	0
Pool length	0	0	0
Riffle length	0	0	0
Dmax riffle	0	0	0
Dmax pool	0	0	0
Dmax run	0	0	0
Dmax glide	0	0	0
Low bank ht	0	0	0

Length and depth measurements in feet, slopes in ft/ft.

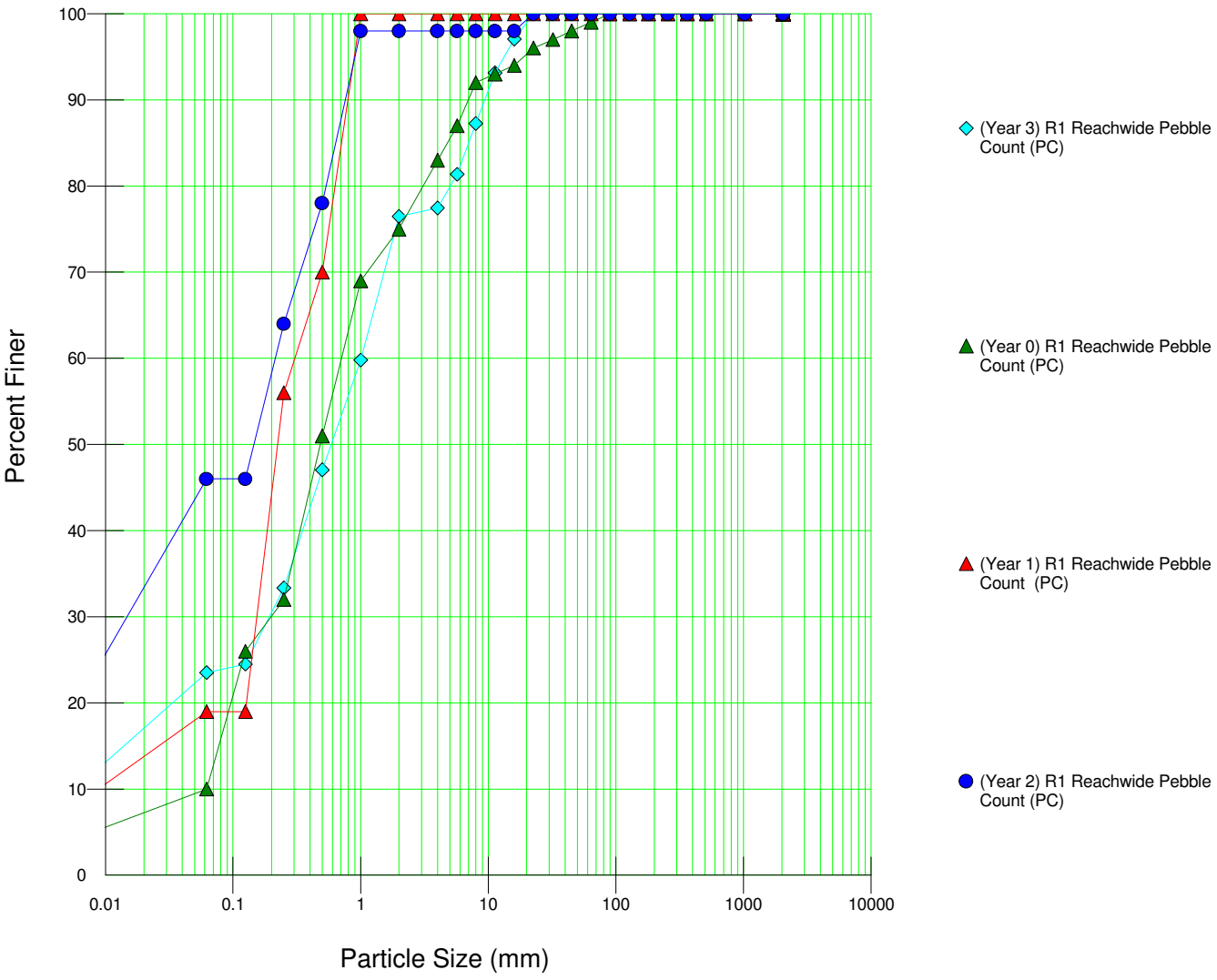
RIVERMORPH PROFILE SUMMARY

Notes

River Name: Little White Oak Creek (Year 3)
Reach Name: R2D
Profile Name: (Year 3) R2D Long. Profile (STA 2+84 -- 7+79)
Survey Date: 11/19/2010

DIST	Note
276.5	LEW
290.016	XS8 - TW Intersect @ station 290
300.239	LEW
310.758	LEW
331.716	LEW
348.118	LEW
359.331	LEW
378.023	LEW
394.041	LEW
405.936	LEW
418.416	LEW
437.673	LEW
448.761	LEW
462.023	LEW
471.799	LEW
483.534	LEW
495.885	LEW
511.634	LEW
521.71	LEW
535.797	LEW
547.702	LEW
554.557	LEW
563.375	LEW
567.536	LEW
573.317	LEW
588.409	LEW
609.591	LEW
628.543	LEW
638.94	LEW
646.268	LEW
659.331	LEW
670.708	LEW
682.611	LEW
698.017	LEW
712.511	LEW
723.453	LEW
733.508	LEW
736.201	LEW

(Year 3) R1 Reachwide Pebble Count



RIVERMORPH PARTICLE SUMMARY

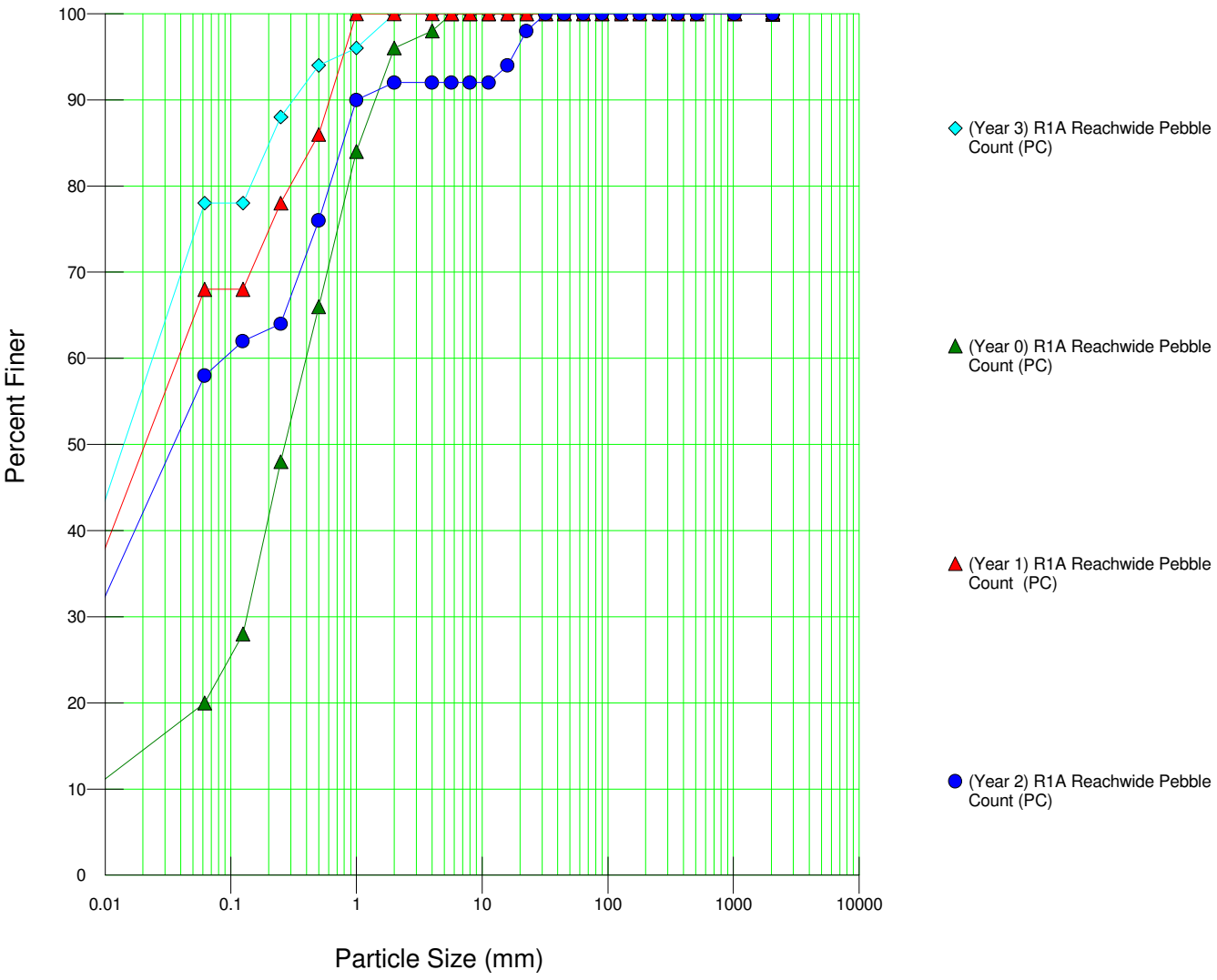
River Name: Little White Oak Creek (Year 3)
Reach Name: R1
Sample Name: (Year 3) R1 Reachwide Pebble Count
Survey Date: 11/03/2010

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	24	23.53	23.53
0.062 - 0.125	1	0.98	24.51
0.125 - 0.25	9	8.82	33.33
0.25 - 0.50	14	13.73	47.06
0.50 - 1.0	13	12.75	59.80
1.0 - 2.0	17	16.67	76.47
2.0 - 4.0	1	0.98	77.45
4.0 - 5.7	4	3.92	81.37
5.7 - 8.0	6	5.88	87.25
8.0 - 11.3	6	5.88	93.14
11.3 - 16.0	4	3.92	97.06
16.0 - 22.6	3	2.94	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.04
D35 (mm)	0.28
D50 (mm)	0.62
D84 (mm)	6.73
D95 (mm)	13.53
D100 (mm)	22.6
Silt/Clay (%)	23.53
Sand (%)	52.94
Gravel (%)	23.53
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 102.

(Year 3) R1A Reachwide Pebble Count



RIVERMORPH PARTICLE SUMMARY

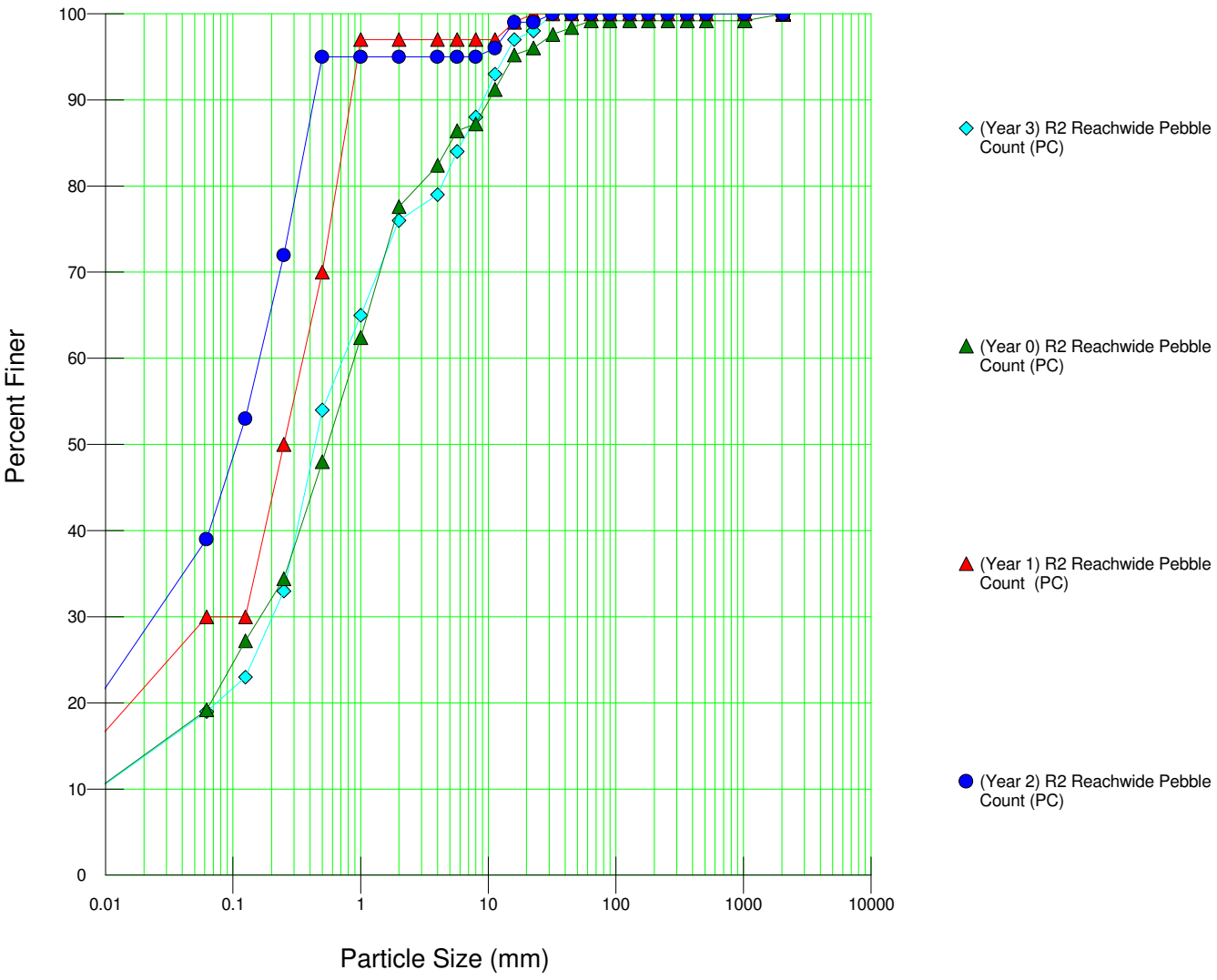
River Name: Little White Oak Creek (Year 3)
Reach Name: R1A
Sample Name: (Year 3) R1A Reachwide Pebble Count
Survey Date: 11/03/2010

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	39	78.00	78.00
0.062 - 0.125	0	0.00	78.00
0.125 - 0.25	5	10.00	88.00
0.25 - 0.50	3	6.00	94.00
0.50 - 1.0	1	2.00	96.00
1.0 - 2.0	2	4.00	100.00
2.0 - 4.0	0	0.00	100.00
4.0 - 5.7	0	0.00	100.00
5.7 - 8.0	0	0.00	100.00
8.0 - 11.3	0	0.00	100.00
11.3 - 16.0	0	0.00	100.00
16.0 - 22.6	0	0.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.01
D35 (mm)	0.03
D50 (mm)	0.04
D84 (mm)	0.2
D95 (mm)	0.75
D100 (mm)	2
Silt/Clay (%)	78
Sand (%)	22
Gravel (%)	0
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 50 (need at least 60).

(Year 3) R2 Reachwide Pebble Count



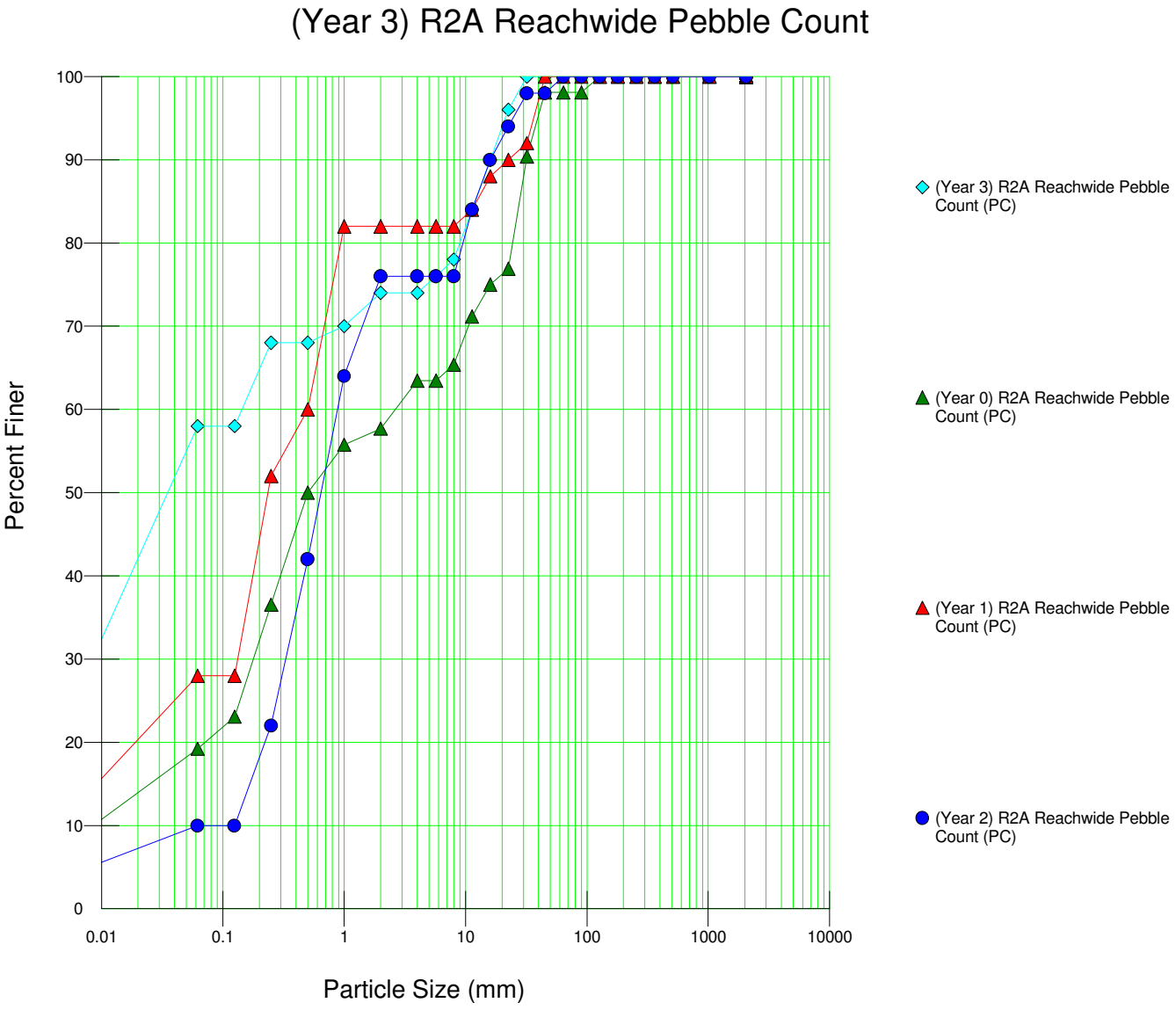
RIVERMORPH PARTICLE SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2
Sample Name: (Year 3) R2 Reachwide Pebble Count
Survey Date: 11/03/2010

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	19	19.00	19.00
0.062 - 0.125	4	4.00	23.00
0.125 - 0.25	10	10.00	33.00
0.25 - 0.50	21	21.00	54.00
0.50 - 1.0	11	11.00	65.00
1.0 - 2.0	11	11.00	76.00
2.0 - 4.0	3	3.00	79.00
4.0 - 5.7	5	5.00	84.00
5.7 - 8.0	4	4.00	88.00
8.0 - 11.3	5	5.00	93.00
11.3 - 16.0	4	4.00	97.00
16.0 - 22.6	1	1.00	98.00
22.6 - 32.0	2	2.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.05
D35 (mm)	0.27
D50 (mm)	0.45
D84 (mm)	5.7
D95 (mm)	13.65
D100 (mm)	32
Silt/Clay (%)	19
Sand (%)	57
Gravel (%)	24
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.


(Year 3) R2A Reachwide Pebble Count
Percent Finer
Particle Size (mm)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
(Year 3) R2A Reachwide Pebble Count (PC)
(Year 0) R2A Reachwide Pebble Count (PC)
(Year 1) R2A Reachwide Pebble Count (PC)
(Year 2) R2A Reachwide Pebble Count (PC)

RIVERMORPH PARTICLE SUMMARY

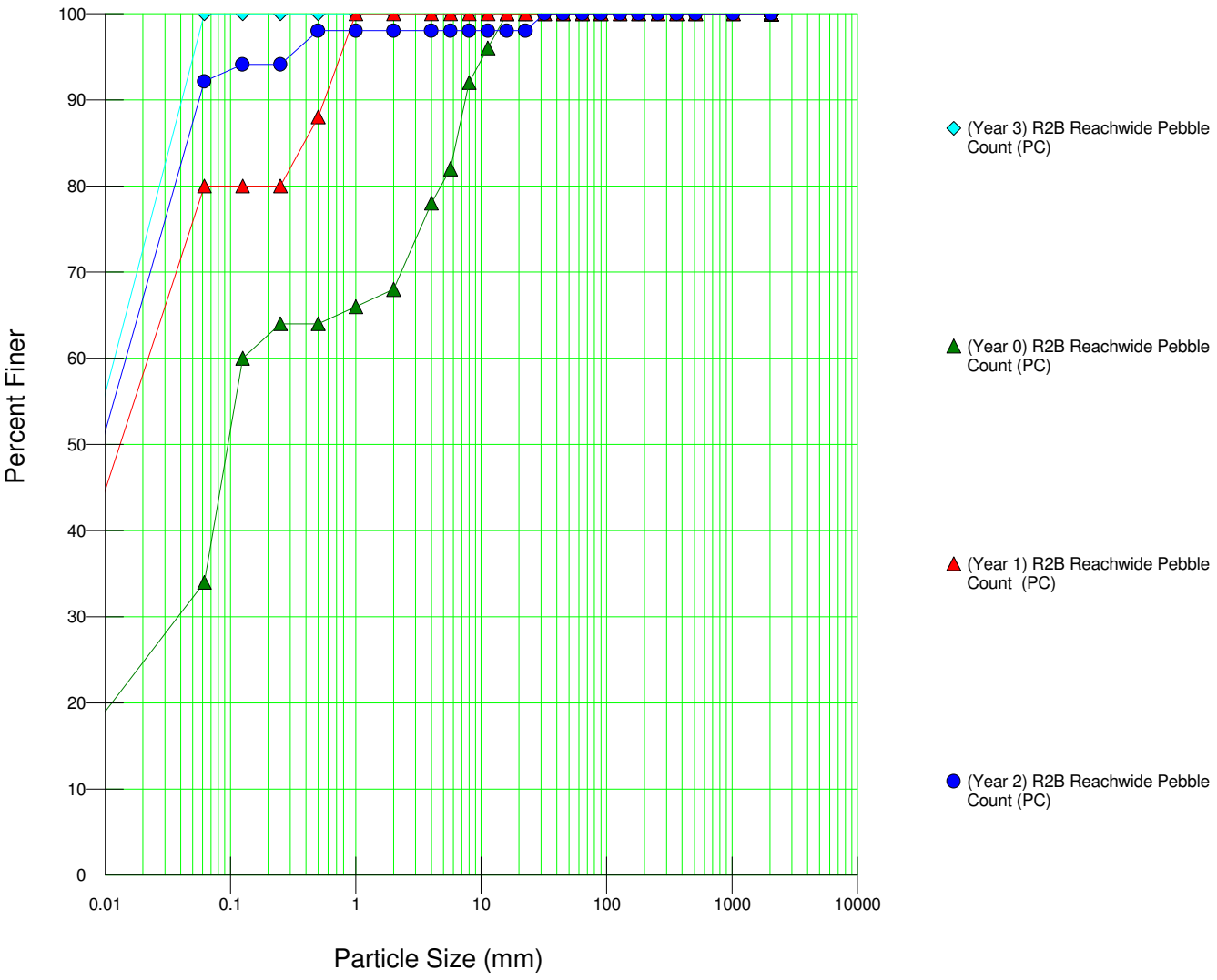
River Name: Little White Oak Creek (Year 3)
Reach Name: R2A
Sample Name: (Year 3) R2A Reachwide Pebble Count
Survey Date: 11/03/2010

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	29	58.00	58.00
0.062 - 0.125	0	0.00	58.00
0.125 - 0.25	5	10.00	68.00
0.25 - 0.50	0	0.00	68.00
0.50 - 1.0	1	2.00	70.00
1.0 - 2.0	2	4.00	74.00
2.0 - 4.0	0	0.00	74.00
4.0 - 5.7	1	2.00	76.00
5.7 - 8.0	1	2.00	78.00
8.0 - 11.3	3	6.00	84.00
11.3 - 16.0	3	6.00	90.00
16.0 - 22.6	3	6.00	96.00
22.6 - 32.0	2	4.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.02
D35 (mm)	0.04
D50 (mm)	0.05
D84 (mm)	11.3
D95 (mm)	21.5
D100 (mm)	32
Silt/Clay (%)	58
Sand (%)	16
Gravel (%)	26
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 50 (need at least 60).

(Year 3) R2B Reachwide Pebble Count



RIVERMORPH PARTICLE SUMMARY

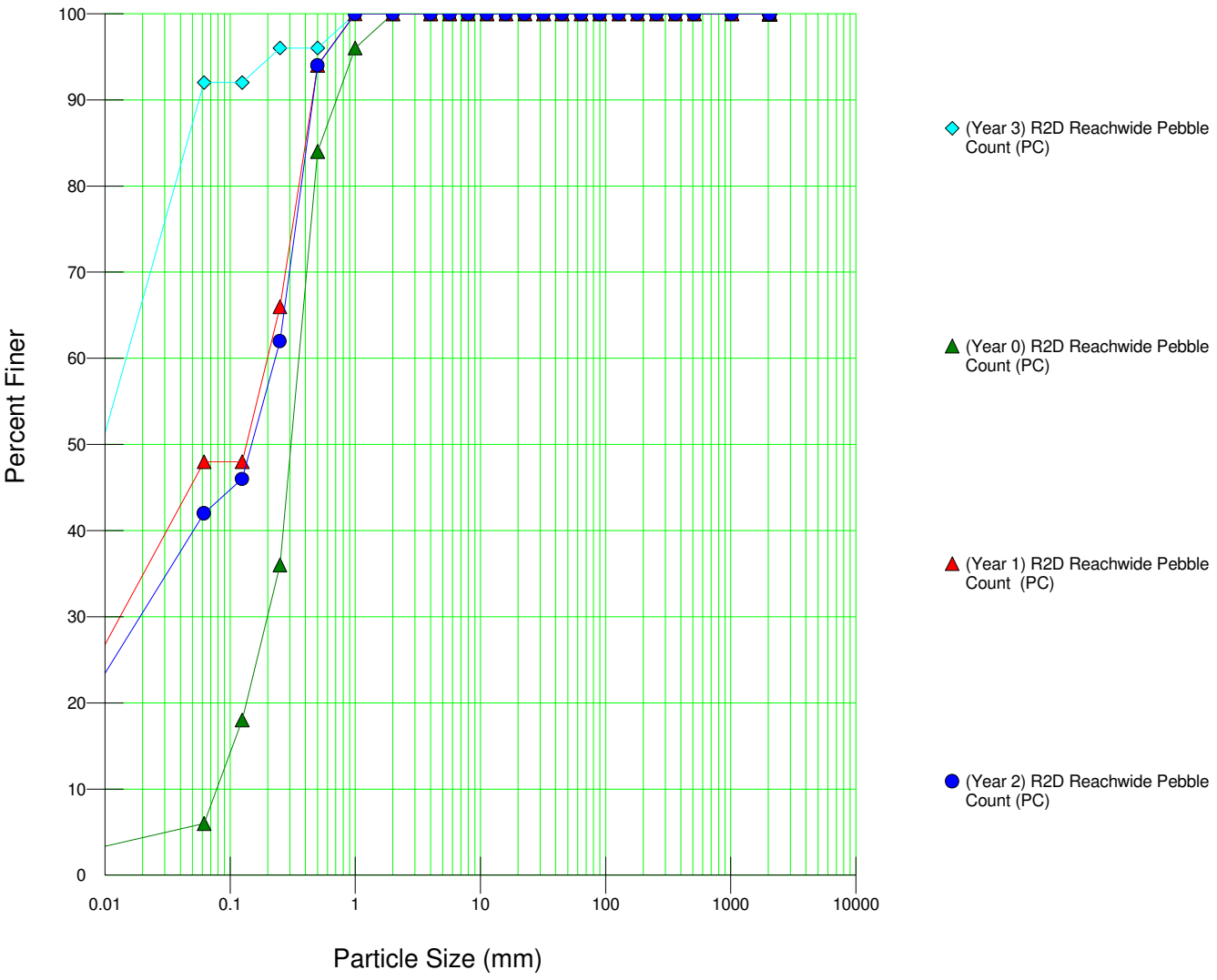
River Name: Little White Oak Creek (Year 3)
Reach Name: R2B
Sample Name: (Year 3) R2B Reachwide Pebble Count
Survey Date: 11/03/2010

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	50	100.00	100.00
0.062 - 0.125	0	0.00	100.00
0.125 - 0.25	0	0.00	100.00
0.25 - 0.50	0	0.00	100.00
0.50 - 1.0	0	0.00	100.00
1.0 - 2.0	0	0.00	100.00
2.0 - 4.0	0	0.00	100.00
4.0 - 5.7	0	0.00	100.00
5.7 - 8.0	0	0.00	100.00
8.0 - 11.3	0	0.00	100.00
11.3 - 16.0	0	0.00	100.00
16.0 - 22.6	0	0.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.01
D35 (mm)	0.02
D50 (mm)	0.03
D84 (mm)	0.05
D95 (mm)	0.06
D100 (mm)	0.06
Silt/Clay (%)	100
Sand (%)	0
Gravel (%)	0
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 50 (need at least 60).

(Year 3) R2D Reachwide Pebble Count



RIVERMORPH PARTICLE SUMMARY

River Name: Little White Oak Creek (Year 3)
Reach Name: R2D
Sample Name: (Year 3) R2D Reachwide Pebble Count
Survey Date: 11/03/2010

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	46	92.00	92.00
0.062 - 0.125	0	0.00	92.00
0.125 - 0.25	2	4.00	96.00
0.25 - 0.50	0	0.00	96.00
0.50 - 1.0	2	4.00	100.00
1.0 - 2.0	0	0.00	100.00
2.0 - 4.0	0	0.00	100.00
4.0 - 5.7	0	0.00	100.00
5.7 - 8.0	0	0.00	100.00
8.0 - 11.3	0	0.00	100.00
11.3 - 16.0	0	0.00	100.00
16.0 - 22.6	0	0.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.01
D35 (mm)	0.02
D50 (mm)	0.03
D84 (mm)	0.06
D95 (mm)	0.22
D100 (mm)	1
Silt/Clay (%)	92
Sand (%)	8
Gravel (%)	0
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 50 (need at least 60).

Project Name: Little White Oak Creek **Installation Date:** 12/4/2007

County, State: Polk County, North Carolina

Year of Sampling

Crest Gauge Information			2008	2008	2009	2010	2011	2012		
Gauge ID	**Bankfull Elevation (ft)**	**Zero Elevation (ft)**	**Year 0**	**Year 1**	**Year 2**	**Year 3[a]**	**Year 4**	**Year 5**	**Total Exceedance by Gauge**	**Reach**
1[b]	886.12	885.87	N/A	1	1	1	0	0	3	R1 (U/S End)
2	882.04	882.04	N/A	1	1	1	0	0	3	R1A (D/S End)
3[b]	875.80	875.30	N/A	1	1	1	0	0	3	R1 (U/S NC 9)
4[b]	878.10	877.96	N/A	1	1	1	0	0	3	R2 (U/S End)
5	876.30	876.26	N/A	0	1	1	0	0	2	R2A (Middle)
6	871.70	871.51	N/A	1	1	1	0	0	3	R2B (D/S End)
7[b]	869.90	869.14	N/A	1	1	1	0	0	3	R2 (Confluence)
8	866.93	866.67	N/A	0	0	1	0	0	1	R2D (D/S End)

[a] A bankfull occurrence is documented for each gauge location during Year 3 due to evidence of extreme flooding at the Site. Evidence of flooding indicated that crest gauges were completed submerged by flood waters.

[b] Gauge was either damaged or missing following Year 3 flood event. These gauge locations will not be replaced or monitored in future years as they have already met the minimum requirement of two bankful occurrences over the 5-year monitoring period.