Little White Oak Creek Stream Restoration

Polk County, North Carolina

Broad River Basin
Cataloging Unit 03050105

CONTRACT # D06027-B

Prepared For:

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

MITIGATION REPORT

August 2008

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III 08/21/08

Owner

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EXECUTIVE SUMMARY

The Little White Oak Creek Stream Restoration Site (LWOC) is located in Polk County 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. LWOC is located 0.6 mile north of Exit 167 at the intersection of NC Highway 9 and US 74, approximately 78 miles from Charlotte and 47 miles from Asheville. LWOC is situated in the Broad River Basin 8-digit cataloging unit of 03050105 and the 14-digit cataloging unit 03050105030010. Mulkey, Inc. (Mulkey) acquired an easement covering 55.3 acres, which will encompass the streams and associated buffers at LWOC (Figure 1).

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. The overall drainage area for LWOC is 7,124 acres (11.1 square miles). These seven existing reaches totaled approximately 15,487 linear feet (Table 1 and Figure 2).

The existing conditions at LWOC were a result of cattle use for the past 50 years. There are approximately 200 cattle and horses currently utilizing the pastures. These livestock have never been fenced from any of the stream channels within LWOC. This continual livestock access to the streams has 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. Through information from the property owner, we know that many of the streams at the LWOC, particularly the smaller tributaries, were historically maintained through channelization, dredging, and clearing of the riparian buffer.

Restoration of the stream channels was accomplished by using Natural Stream Channel design methods developed by Rosgen (1996). The proposed Rosgen channel type for two of the tributaries (R2A and R2B) was a C4 channel. These tributaries were 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.

To restore the riparian and upland buffer communities along LWOC, a variety of plants that naturally occur in this physiographic province and within a specific hydrologic setting will be used. These plants will comprise a target community which will emulate the Piedmont/Low Mountain Alluvial Forest described by Shafale and Weakley (1990).

A total of 18,290 linear feet of stream channel was restored at LWOC within the 55.3 acre conservation easement (Table 1). Stream restoration activities were accomplished by using Priority Level I and II methodologies as defined by Rosgen (1998).

The restoration of the stream channels and their adjacent buffers combined with the establishment of a fenced conservation easement has provided multiple ecological improvements to LWOC. The primary ecological benefits of these restoration activities include improved water quality, soil stabilization, improved aquatic and terrestrial habitat, and natural flooding capabilities.

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 both hydrologic conditions and vegetation survival. LWOC will follow the success criteria set forth by these agencies.

Yearly monitoring reports will serve as the method for determining success at LWOC. Monitoring will be performed until success criteria are met up to a period of five years. Monitoring is proposed for hydrologic stream stability and vegetation. The monitoring plan will be designed in accordance with Stream Mitigation Guidelines (USACE *et al.,* 2003) and as specified by the EEP's monitoring report requirements (EEP, 2005a). Results will be documented on an annual basis, with the associated reports submitted to EEP as evidence that goals are being achieved. In the event that goals are not being met, Mulkey will coordinate with EEP to develop a plan for ameliorating the areas of concern.

1.0 Introduction

LWOC lies within two parcels that have historically been used for pasture and forest land. Cattle and other land uses over the past 50 years have resulted in substantial degradation to the streams and riparian buffers. In addition, large quantities of fecal matter and several dead cattle were observed in the stream channels during the initial site visits. 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 and began work on the project on May 16, 2007.

1.1 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 will be 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.

1.2 Project Location

LWOC is located in Polk County 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 has acquired an easement covering 55.3 acres, which will encompass the streams and associated buffers at the Site (Figure 2).

1.3 Project Description and Watershed Characterization

The two main streams at LWOC are third order streams, Little White Oak Creek at the north end of the Site and South Branch Little White Oak Creek at the south end. These two streams converge at the center of LWOC as Little White Oak Creek to form a fourth order

stream. LWOC also includes one second order unnamed tributary and five first order unnamed tributaries.

The headwaters of the Little White Oak Creek are located southeast of Lake Adger and north and east of Little White Oak Mountain then flow in an easterly direction through the project site. The drainage area of Little White Oak Creek as it enters the project area is approximately 3,400 acres (5.3 square miles). The headwaters of the South Branch Little White Oak Creek are located north and east of Fox Mountain and flow east to its confluence with Little White Oak Creek. The drainage area of the South Branch of the Little White Oak Creek as it enters the project area is approximately 2,560 acres (4.0 square miles). The overall drainage area of the project is 7,124 acres (11.1 square miles).

It is estimated that 78% of the land cover within the watershed is forest or wetland. Although urbanization is dramatically increasing in the area, it is estimated there is currently 2% of urbanized (impervious) area in the watershed. The remaining land cover is pasture and cultivated cropland. Due to the increase in development in the adjacent properties surrounding LWOC, the property currently encompassing the conservation easement will likely be developed in the next decade.

2.0 Post Construction Site Conditions

2.1 Methods

Mulkey utilized natural channel design methods to restore approximately 18,290 linear feet of stream channel (Rosgen, 1998). Restoration of the stream channels was accomplished by using Natural Stream Channel design methods developed by Rosgen (1996). 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 proposed Rosgen channel type for two of the tributaries (R2A and R2B) was a C4 channel. These tributaries were also implemented using Priority Level I and II methodologies. The remaining reach (R2D) was proposed to be a C6 channel using the same methods previously mentioned.

During construction, modifications are always made to the plans due to various constraints including bedrock, vegetation, soil, etc. The restoration of the reaches proposed installing 191 rock structures (cross vane, j-hook, and rock vanes), 32 constructed riffles, and numerous rootwads throughout the site.

Post construction surveys depicted in Appendix A (Sheets 20 – 33), illustrate the changes to the proposed design. Field changes at the site were typically minor, with most of the changes involving the adjustment of benches and grading to protect vegetation at the site. Bedrock was encountered in several locations and structures were modified or moved to account for its occurrence.

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 or to document baseline conditions for the newly restored stream channels for future monitoring activities. As an industry standard, such surveys are also used for other purposes such as comparing how a proposed design was actually constructed versus what was proposed, including the length of stream actually constructed versus what length of stream was proposed by the design.

Streams are typically measured along their thalweg by surveying the representative points creating the known, repeating sequence of stream features (i.e., head of riffle, head of run, head of pool, max pool, and the head of glide) along with other supplemental points to adequately describe the stream's horizontal geometry (i.e., points on tangents and points on curves) or other site specific stream features. Once these points are surveyed, they are then typically "connected" via straight line segments when the survey is processed to create the drawing describing the alignment of the surveyed stream. Because a representative number of points connected by straight line segments are used to describe a stream alignment that is actually a smooth, continuous curve, accepted total station survey practices can only approximate, albeit closely, the actual length of a stream. The more feet of stream that are measured using this process, the greater the magnitude or difference between the actual stream footage and the measured stream footage, with the measured stream footage being shorter than the actual stream footage. As described above, because of the magnitude of this project, the footage of restored stream measured during the monitoring baseline survey was less than the footage of stream actually restored. To clearly demonstrate that at least 18,200 linear feet of stream were restored within the project easement boundaries, Mulkey conducted supplemental measurements of the project stream reaches using additional, more accurate techniques. These techniques included connecting the surveyed thalweg points in Microstation using smooth curves instead of straight line segments as well as diligently field-measuring the thalweg of the restored stream alignments with a cloth tape. This additional exercise was conducted solely to demonstrate that at least 18,200 linear feet of stream were restored at the Little White Oak Creek Stream Restoration Site. The results of these measurements of restored channel are shown in Table 1. As noted above, the alignments created using the results of the monitoring baseline surveys will be used to establish baseline stationing for as-built and monitoring documentation and activities.

Major grading and channel construction was completed during the last week of November 2007. As-Built Surveys were conducted immediately following the installation of plant material. The following sections describe the conditions of LWOC following construction and follow the guidelines for Mitigation Reports (NCEEP, 2005).

2.2 Streams

The stream reaches at LWOC were surveyed utilizing aerial photography and total station survey equipment and by following the protocols set forth by the 2003 USACE Stream Mitigation guidelines. Stream data included in this report shall serve as the basis for future monitoring reports.

Longitudinal profiles were surveyed along the entire length of all restored 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). A summary of the restored stream channel lengths and their proposed Stream Mitigation Units (SMUs) are outlined in Table 1. A complete set of As-Built Drawings including a plan view, longitudinal profiles for restored channels, and a proposed versus as-built plan view can be found in Appendix A.

2.3 Oxbow Wetlands

Oxbow wetlands were created throughout LWOC where conditions permitted their installation. Most of the oxbow wetlands were created by modifying sections of abandoned channel that were left unfilled. Where feasible, mature vegetation was saved around the oxbow wetland areas to provide shading, seed source, as well as woody detritus input. The oxbow wetlands will provide additional floodplain habitat diversity as well as providing some additional flood storage. It is anticipated that the oxbow wetlands will also trap sediment, woody debris and seeds during flood flows, thereby providing additional habitat benefits. During wet seasons, some of the oxbow wetlands are expected to catch and hold runoff as well as ground water, thus providing a greater diversity of aquatic habitat at the site. These oxbow wetlands are shown on the As-Built Drawings in Appendix A.

Additionally, a treated waste water pipe emanating from the Polk County School property along NC 9 now deposits into an oxbow wetland prior to entering Little White Oak Creek. This reconfiguration of the outfall pipe area provides retention time for the effluent, increased nutrient uptake, and overall water quality improvement.

2.4 Planted Vegetation

All plant material was installed during the months of November and December 2007. A list of vegetation planted within each planting zone can be found in Table 2. Specific vegetation plot information including plot size, species, and species counts can be found in Table 3. A total of 24 vegetation plots were installed in December 2007 to provide long-term monitoring of the plant material. In addition to planted vegetation, great efforts were made during construction to save mature riparian vegetation along the restored and abandoned stream channels.

3.0 Monitoring Plan

Stream channel monitoring will determine the degree of success a mitigation project has achieved in meeting the objectives of providing proper channel function and improved aquatic habitat. Stream monitoring will be performed each year for a 5-year monitoring period. The following sections describe the methods, frequencies, and success criteria for preparing a monitoring report for LWOC. Monitoring guidelines described in this section follow the outline described in the "Content, Format, and Data Requirements for EEP Monitoring Reports, Version 1.1" dated September 16, 2005. 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 both hydrologic

conditions and vegetation survival. LWOC site conditions will be monitored during the latter part of the growing season months (August, September, and October) over the 5-year monitoring period. This monitoring period will allow compliance with the RFP#16-D0627 requirements.

3.1 Dimension

A total of 13 permanent cross sections were established across LWOC to establish baseline data for future monitoring reports. Cross section information and photos for the 13 permanent cross sections can be found in Appendix B and C respectively. The number of cross sections was determined using the sampling rates outlined by the USACE et al. (2003).

These cross sections will be surveyed each year of the 5-year monitoring period. Specific stations for each permanent cross section have been established during the As-Built Surveys and should be recreated during the monitoring years. Cross section stationing always begins on the left side of the channel while facing downstream and continues across to the right side. The left side and right sides of the steam channel are marked with a polyvinyl chloride (PVC) pipes with a rebar pin inside the PVC. An aluminum tag identifies the cross section number on the left side of the channel.

Dimension measurements should remain consistent from year to year and should fall within the proposed design parameter outlined in the restoration plan. It is expected that minor adjustments in dimension will occur such as the development of point bars and the subsequent deepening of pool. As vegetation becomes established and the stream banks are stabilized, it is anticipated that the width depth ratios will decrease and that the entrenchment ratios will likely increase slightly, both within the normal ranges for C and E stream channel types.

3.2 Pattern

Pattern for the constructed channels will be measured using Microstation after completing the yearly monitoring surveys. Three specific measurements will be made for each reach including Radius of Curvature, Meander Wavelength, and Belt Width. These measurements will be made along the specified sampling areas for monitoring which correspond directly to the longitudinal profiles for each reach.

Pattern measurements should remain consistent from year to year and fall within the proposed design parameters outlined in the restoration plan. As vegetation becomes established and the stream banks are stabilized, it is anticipated that the sinuosity of the streams will adjust, likely becoming more sinuous with time.

3.3 Profile

As a part of the As-built Surveys, longitudinal profiles were conducted for the entire lengths of the restored channels (Appendix A). 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 monitoring lengths of each reach 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 during the monitoring period.

Following the sampling rates discussed above, longitudinal profiles should be conducted for monitoring as shown below:

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

Longitudinal profiles should remain relatively consistent (stable) from year to year. Profiles should not show aggrading or degrading conditions during the 5-year monitoring period, however, minor profile adjustments such as deepening of pools is expected. Channels should be indicative of the proposed Rosgen channel type (Rosgen 1994, 1996).

3.4 Hydrology

Hydrology will be assessed throughout the 5-year monitoring period to determine the occurrence of bankfull events at LWOC. A minimum of two bankfull events must be documented within the 5-year monitoring period and these must occur during separate monitoring years. Crest gauges will be used to determine the occurrence of these bankfull events. To further document these events, a rain gauge with a datalogger will be installed at the LWOC, so as to obtain on-site precipitation records.

Eight crest gauges were installed across LWOC, with one at each reach and one at the confluence of R1 and R2. Photos of the crest gauges can be found in Appendix D. These gauges will be checked during each visit to LWOC for the entire 5-year monitoring period.

3.5 Vegetation

Planted vegetation will be evaluated using stem counts and vegetation plots. Mulkey installed 24 vegetation plots were installed throughout LWOC to assess the survival of planted vegetation (Appendix E). Plots were installed randomly throughout the site and have a total area of approximately 100 square meters. An iron pipe was installed at each plot corner and a polyvinyl chloride (PVC) pipe was installed at the corner specified for photo documentation. A label specifying the plot number is attached to each PVC pipe corner. During the establishment of these plots, stems were identified, counted, and flagged on lateral branches. Specific information regarding each vegetation plot can be found in Table 3.

Vegetation success at LWOC will be measured by survivability over a five year monitoring period. Survivability will be based on achieving at least 320 stems per acre after three years and 260 stems per acre after five years. Stem counts will be conducted on annual basis to calculate survivability.

If during any given year, the planted species are not anticipated to meet final criteria established for vegetation; supplemental plantings will be considered. In the event that this occurs, a remedial planting plan will be developed that will achieve the survivability goals established for Years 3 and 5.

3.6 Photo Documentation

Photo documentation is essential to monitoring the success of a restoration site because it provides a visual assessment of the stream and vegetative conditions. A total of 11 permanent reference photo points were installed at the site using rebar and PVC. Photos from these permanent locations can be found Appendix F. In the event that circumstances require, additional photo points may be added during the first year of monitoring to adequately depict the site conditions.

3.7 Bed Material

Bed material will be assessed using the Modified Wolman pebble counts. These pebble counts will be conducted each year of the 5-year monitoring period during the specified monitoring time frame. Large reaches including R1 and R2 will be sampled at each permanent cross section location from bankfull to bankfull. These larger reaches should be sampled at a rate of 25 counts per cross section (Example – R1 has 4 cross sections which will equal 100 counts for the entire reach). The smaller tributary reaches including R1A, R2A, R2B, and R2D should be sampled at a rate of 50 counts per reach. Sampling on the smaller tributaries should be completed from bankfull to bankfull on 3 riffle and 2 pool features with 10 counts being collected at each feature specified. Data collected for each reach is presented in Appendix G.

Success criteria for the bed material will be determined at the end of the 5-year monitoring period when data can be reviewed and compared to the proposed channel material type. Fluctuations in bed material 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.

3.8 BEHI and NBS Assessments

Assessments of BEHI and NBS are currently recommended during monitoring years 3 & 5 following construction. Collection and presentation of the BEHI and NBS information should follow the format outlined by EEP's monitoring report guidelines (NCEEP, 2005a). Data collected during these years will be compared with pre-construction conditions to determine the change in bank erosion hazard indices and sediment export quantities for each reach assessed.

3.9 Reporting

The monitoring reports will follow the methods outlined by the latest version of the EEP Guidance document guidance for monitoring report content, format, and data requirements. Monitoring reports will be submitted to the EEP's designated project representative for coordination with the appropriate regulatory agencies on an annual basis. It is understood that the EEP will coordinate any necessary monitoring report submittals with the regulatory agencies. If monitoring reports indicate any deficiencies in achieving the success criteria on schedule, a remedial action plan will be included in the annual monitoring reports.

4.0 Maintenance and Contingency Plan

Mulkey will reassess the condition of the stream channels, structures, vegetation, and overall bank stability during the next five years of monitoring (2008 - 2012). In the event, there is significant problem or concern at the site, a meeting with EEP will be scheduled to discuss the problem. Mulkey will develop a remediation plan and schedule for addressing the particular problem and submit this to EEP for review and comment. Upon approval, Mulkey will initiate the remediation plan through the appropriate means.

5.0 References

NCEEP. 2005. Mitigation Report DRAFT outline. September 20, 2005. NCDENR, NCEEP. 4 pp.

NCEEP. 2005a. Content, Format, and Data Requirements for EEP Monitoring Reports. Version 1.1, September 16, 2005. NCDENR, NCEEP. 17 pp.

Rosgen, D.L. 1998. The Reference Reach – A Blueprint for Natural Channel Design. From Proceedings of the Wetlands and Restoration Conference, March 1998, Denver CO. Wildland Hydrology, Pagosa Springs, CO.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

Rosgen, D.L. 1994. A Classification of Natural Rivers. Catena, 22:169-199.

Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina, Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, N.C. Department of Environment, Health and Natural Resources.

USACE, USEPA, NCWRC, and NCDWQ. 2003. Stream Mitigation Guidelines. April 2003.

APPENDIX A

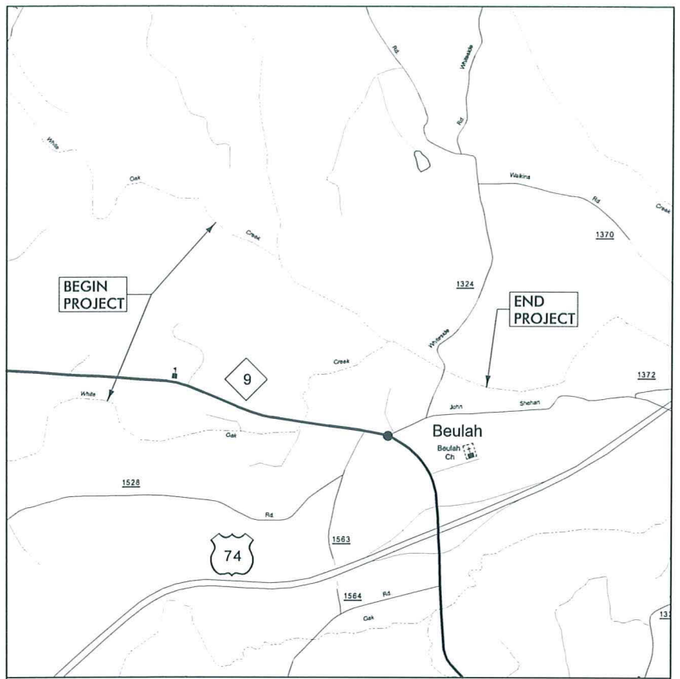
SCO ID NO. D06027-B

POLK COUNTY

LITTLE WHITE OAK CREEK STREAM RESTORATION SITE

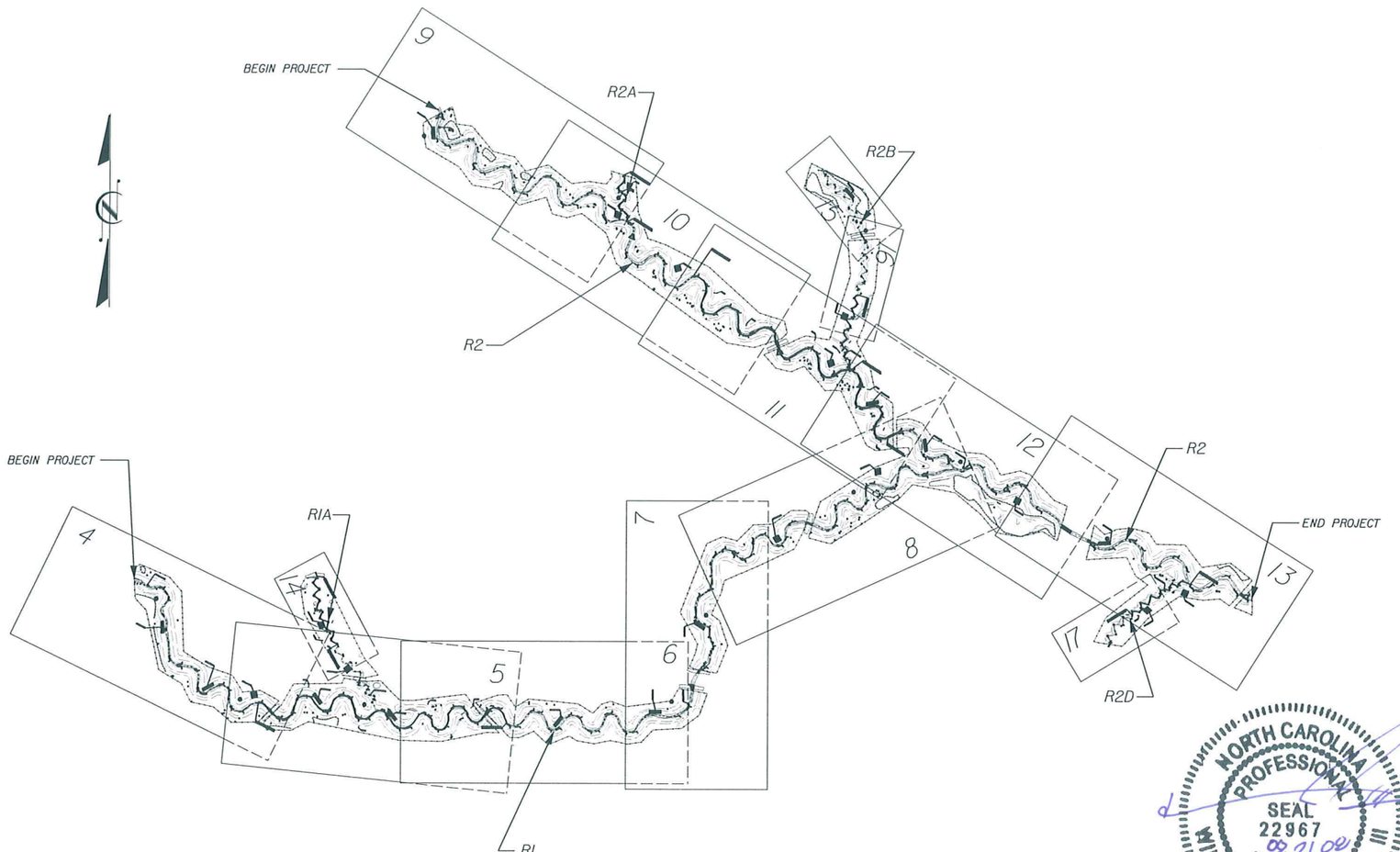
LOCATION: NORTHEAST OF THE INTERSECTION OF NC 9 AND US 74 (EXIT 167)

AS-BUILT DRAWINGS



VICINITY MAP

NOT TO SCALE



NOT TO SCALE

INDEX OF SHEETS

SHEET NUMBER	SHEET
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2	LEGEND
3	PROJECT OVERVIEW
4 – 33	AS-BUILT DRAWINGS

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

REVISIONS

DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

SCALE AS SHOWN

DATE:	3/14/08
DESIGNED:	WSH
DRAWN:	JTL
CHECKED:	WSH
APPROVED:	WSH

MULKEY PROJECT NUMBER 2006237.00

PLANS PREPARED BY:

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TITLE SHEET

NOTE: NOT TO SCALE
Not all symbols used in plans

LEGEND

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III 07.21.08

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

PROJECT ENGINEER

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

LEGEND

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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
- Telephone Pedestal
- 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 #)
- Cross Section
- Crest Gauge

PROJECT ENGINEER	PROJECT REFERENCE NO.	SHEET NO.
	LITTLE WHITE OAK CREEK	3
	AS-BUILT DRAWING	

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Legend

- Easement
- Restored Streams

N

NORTH CAROLINA
PROFESSIONAL
SEAL
22967
03.24.06
ENGINEER
WILLIAM SCOTT HUNT, III

1:2,400
1 inch equals 200 feet

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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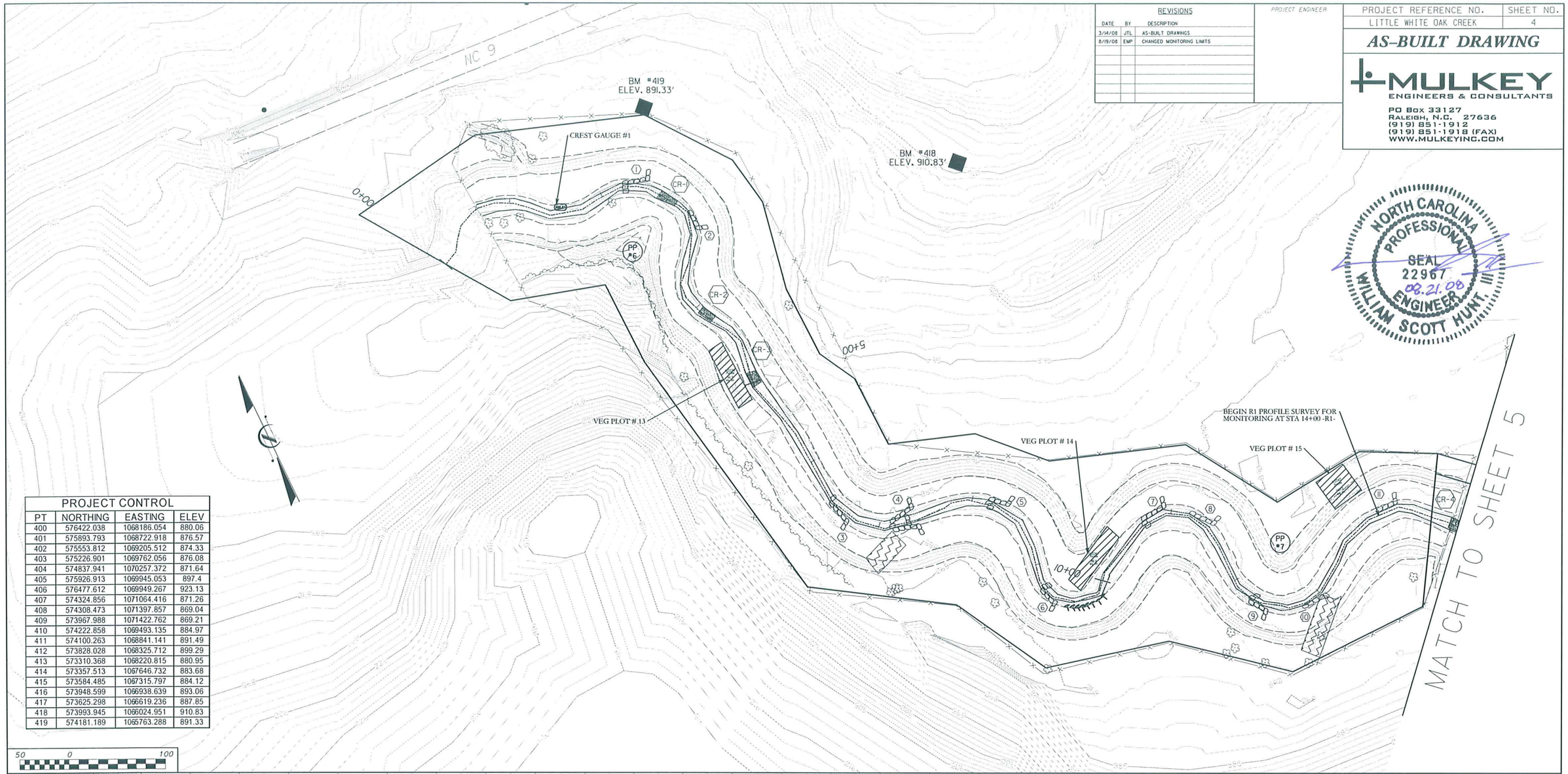
NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08



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

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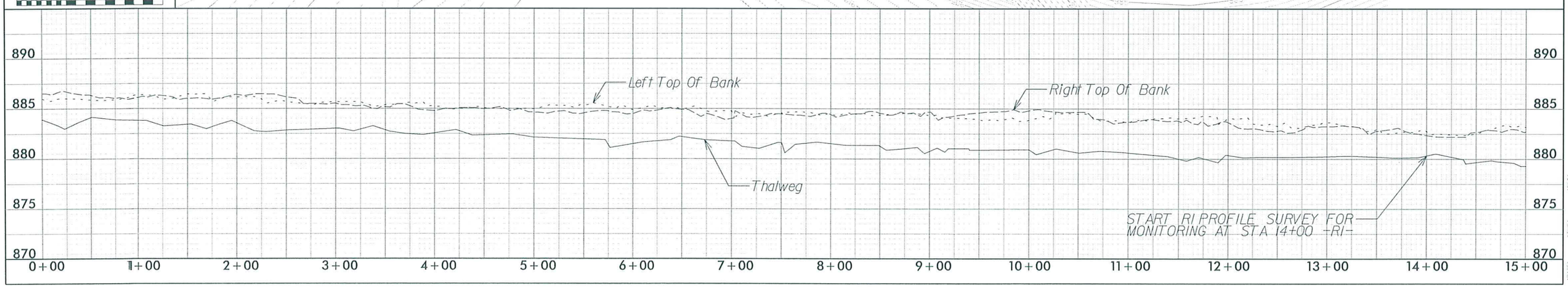

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	ENP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
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401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
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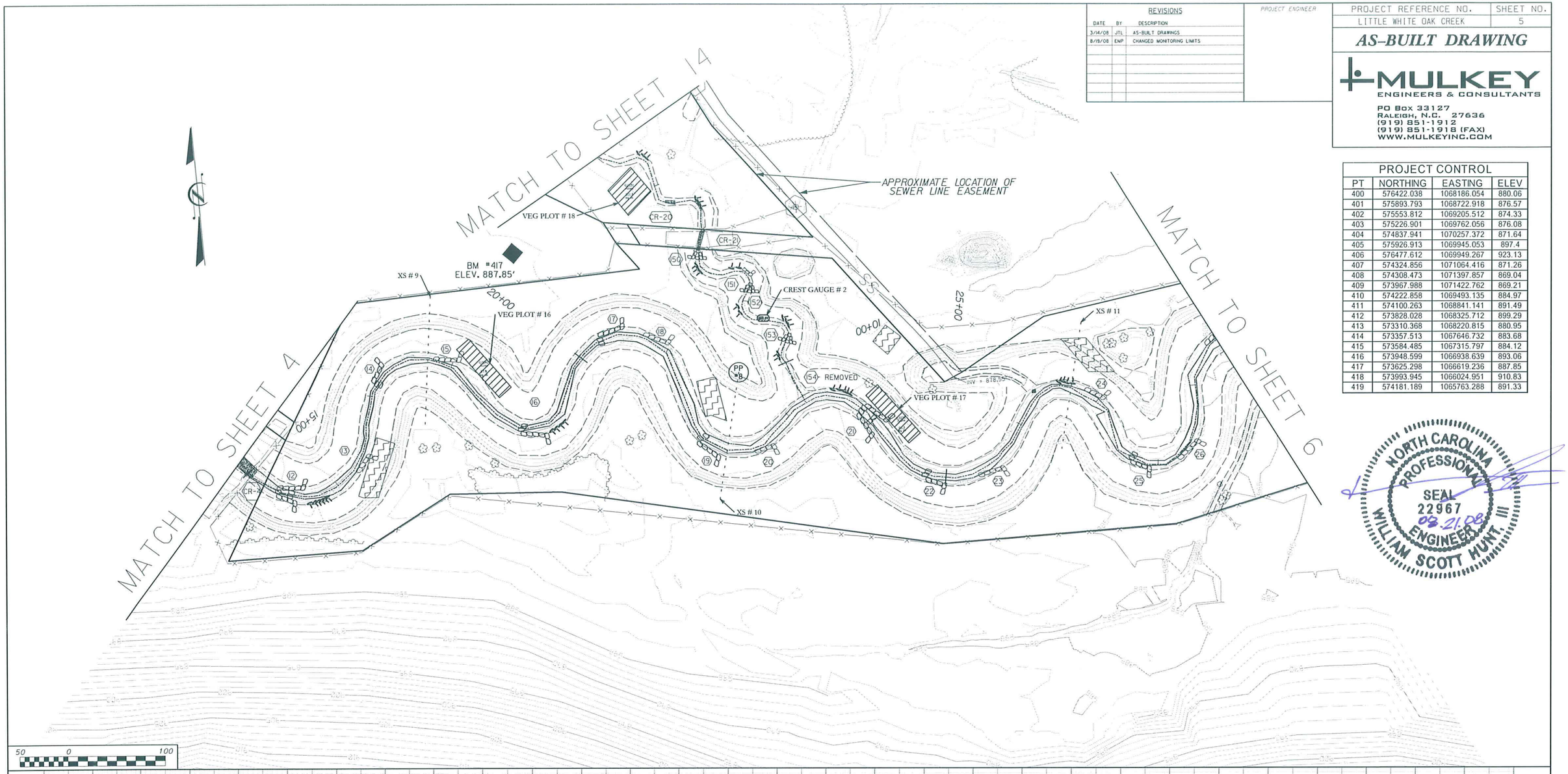

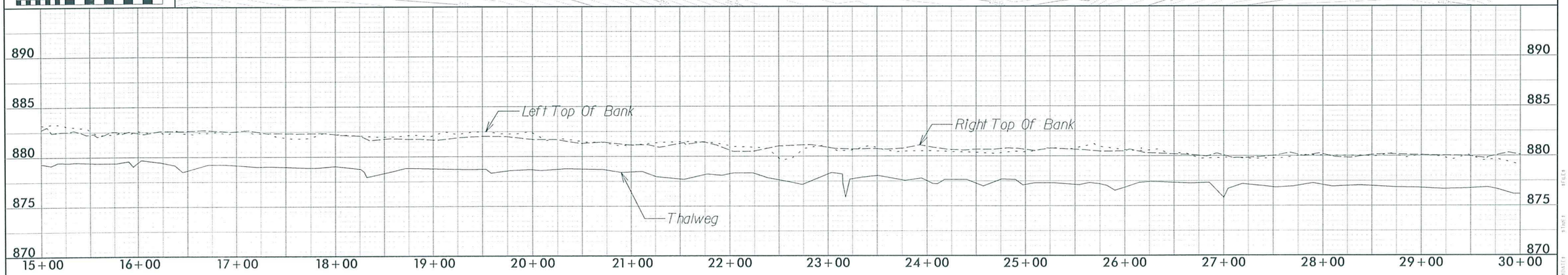

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08.21.08

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	ENP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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08.21.08

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
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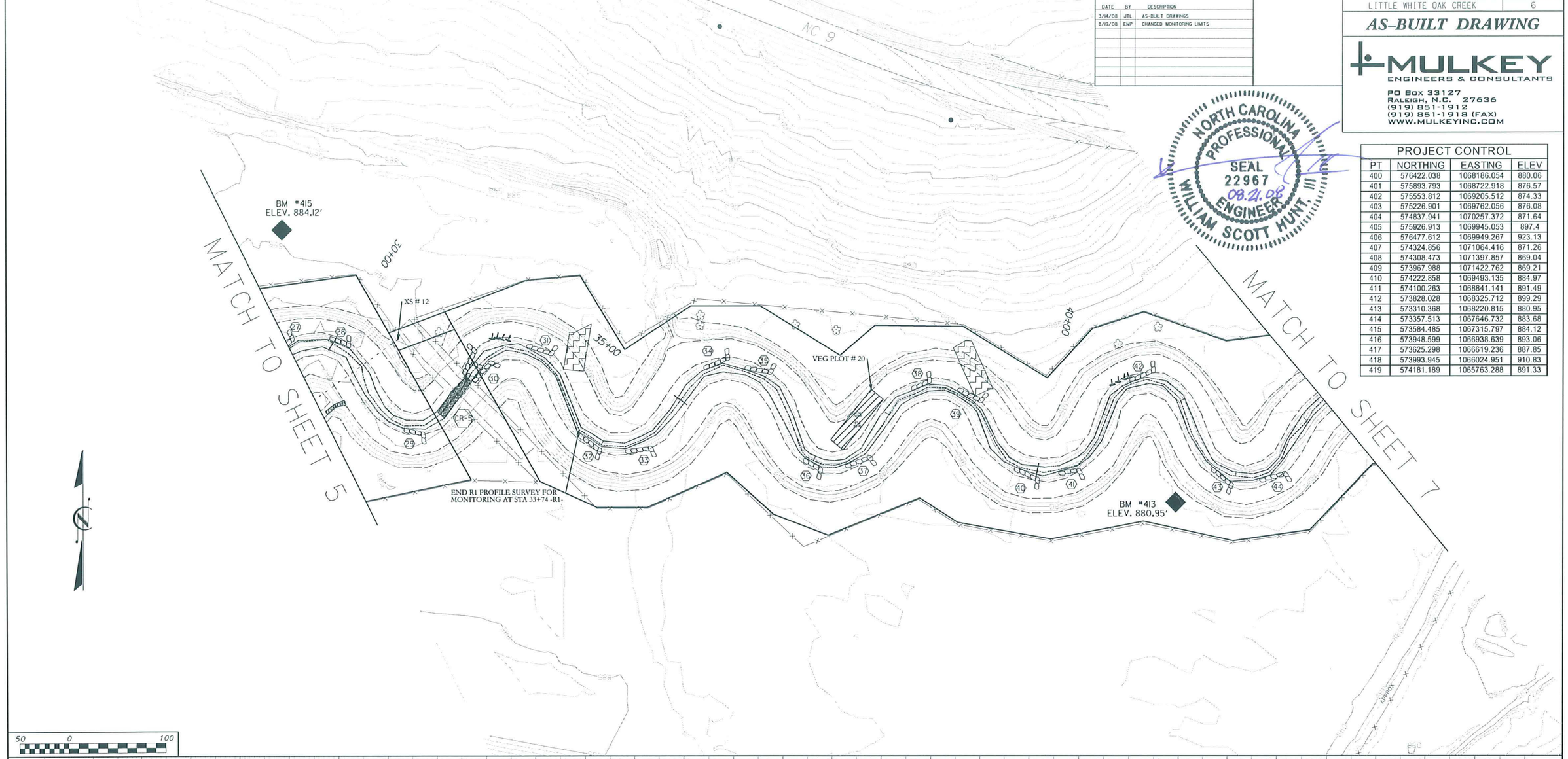

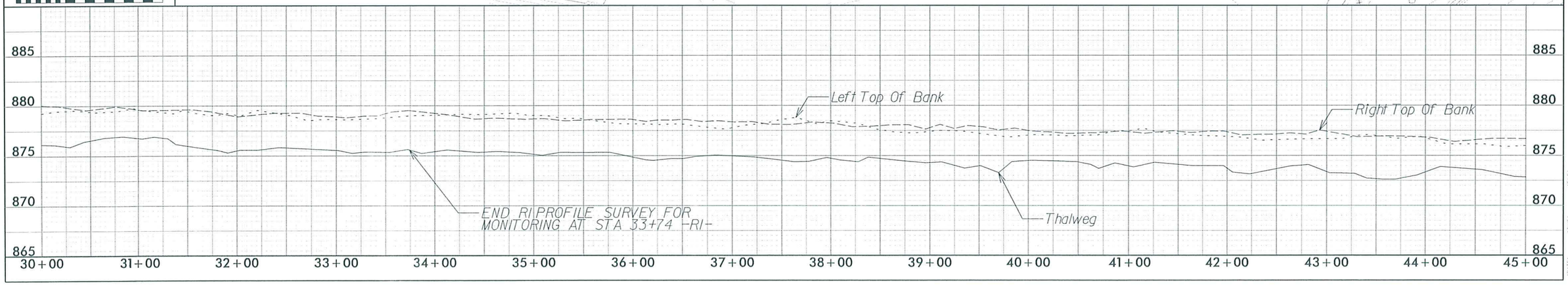

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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MATCH TO SHEET 6

MATCH TO SHEET 8

BM #412
ELEV. 899.29'

BM #411
ELEV. 891.49'

VEG PLOT # 21

VEG PLOT #22

CREST GAUGE #3

PP #9

PP #10

CR-6

CR-6 REMOVED

CR-7

CR-9

CR-10

NC 9

45+00

50+00

55+00

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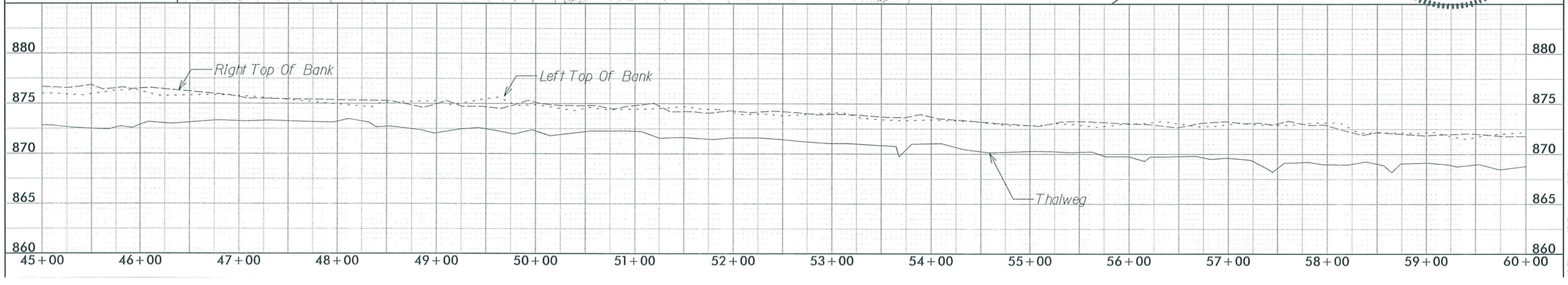

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
03.24.08

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

PROJECT ENGINEER

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

AS-BUILT DRAWING

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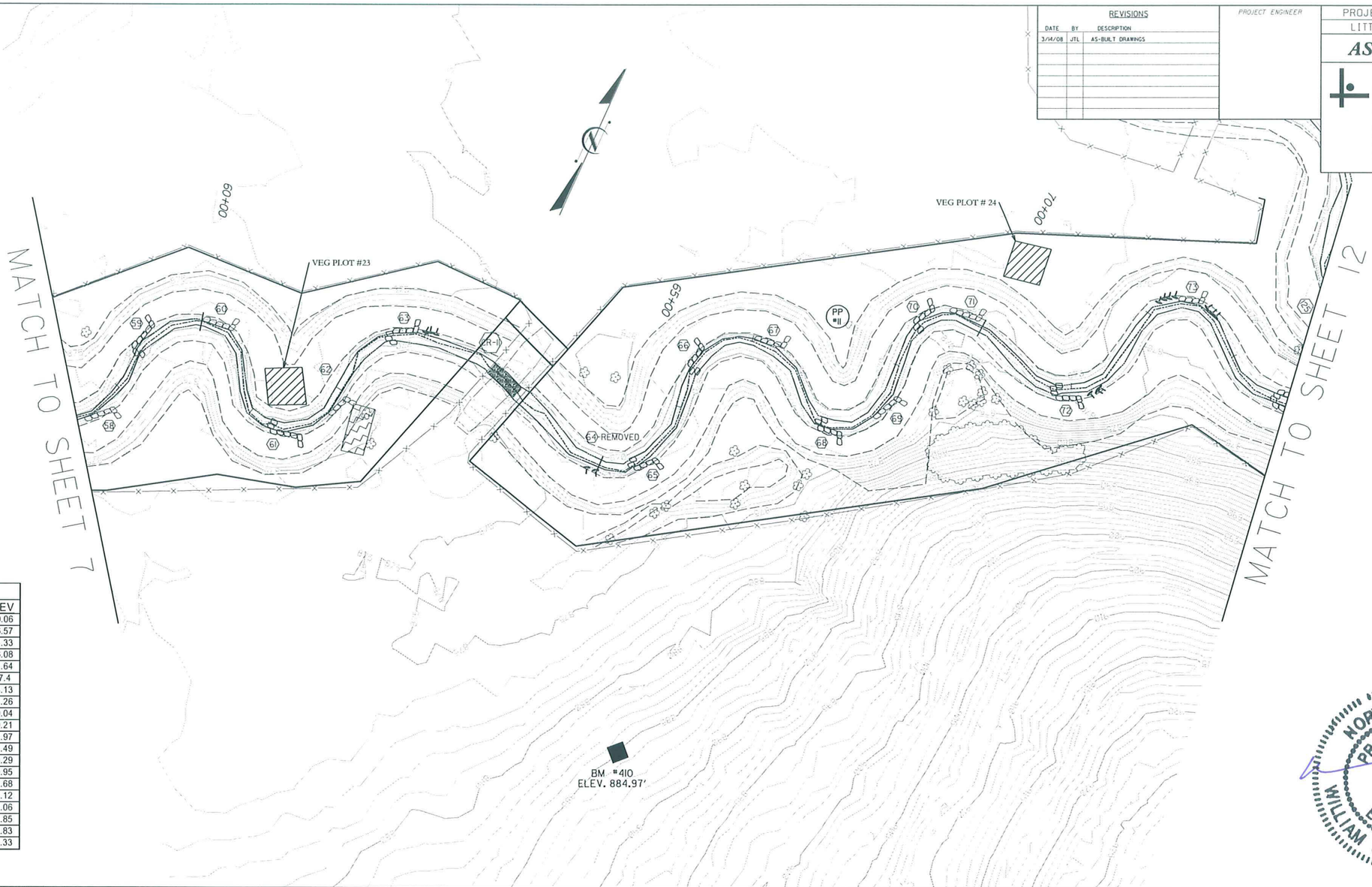

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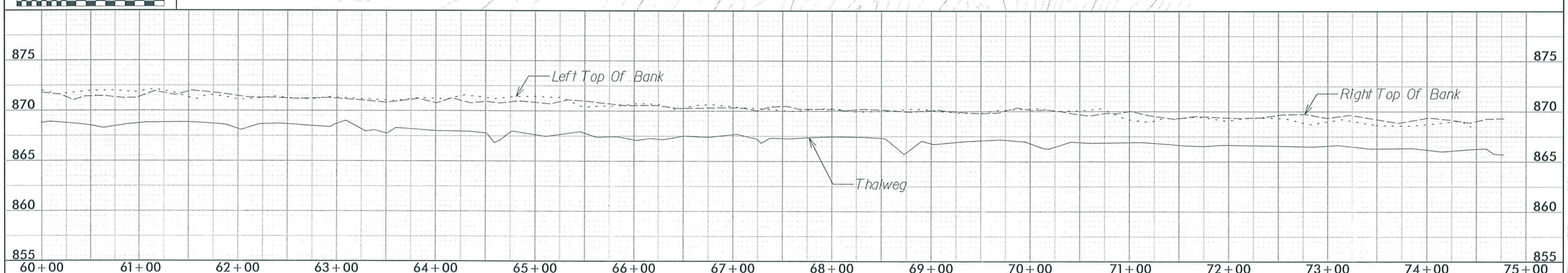

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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3/21/08

MATCH TO SHEET 10

00+0

10+00

5+00

CREST GAUGE # 4

VEG PLOT #1

CP #1

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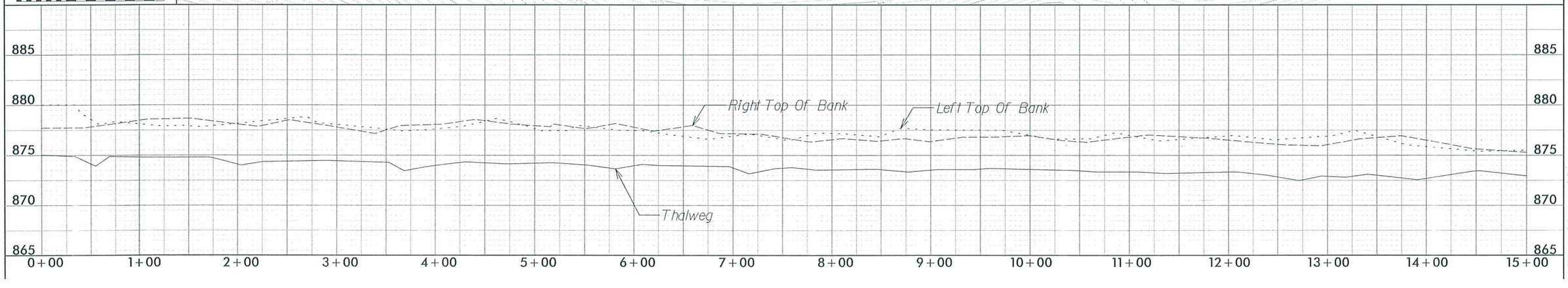

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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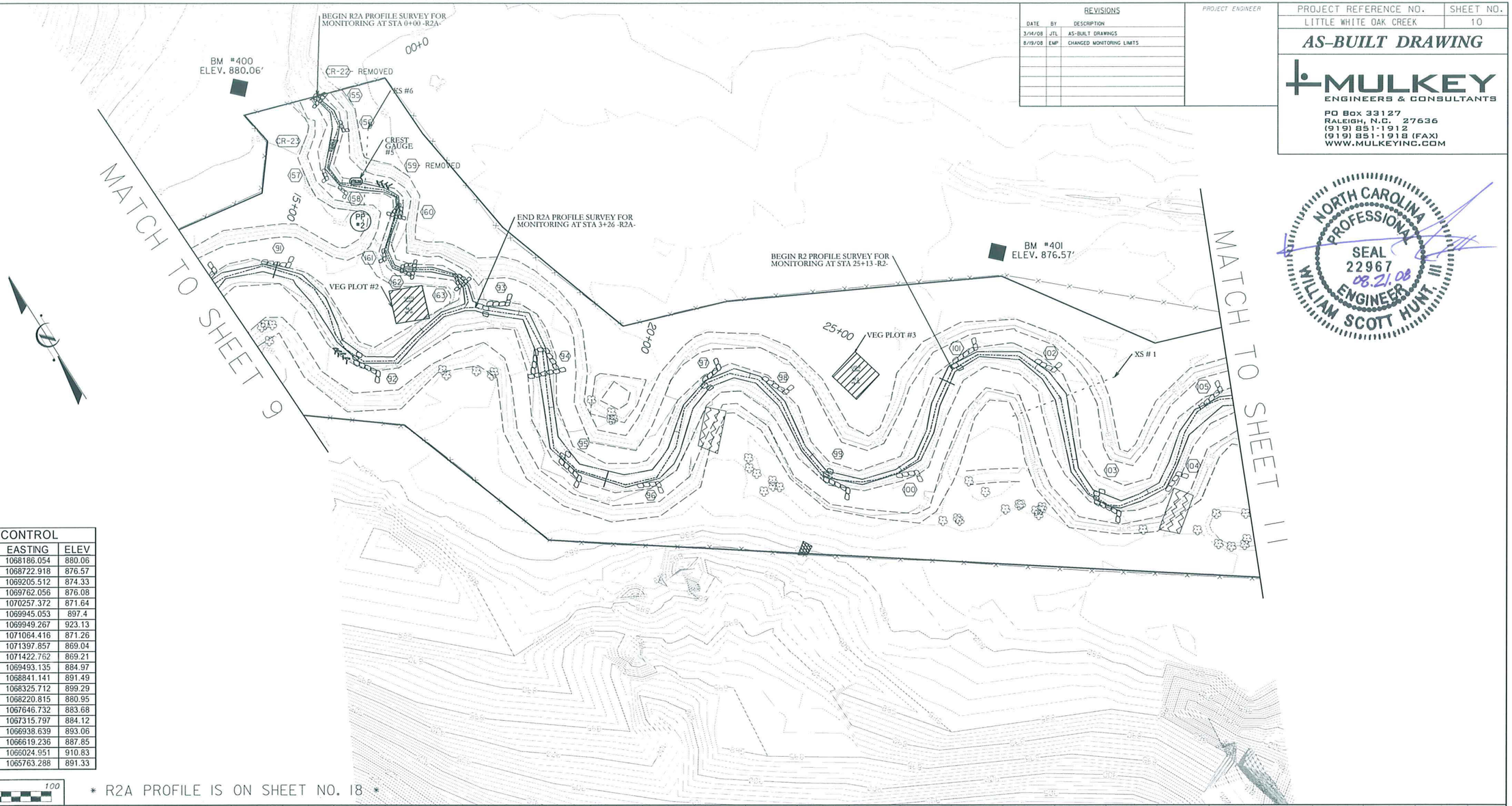

PROJECT CONTROL			
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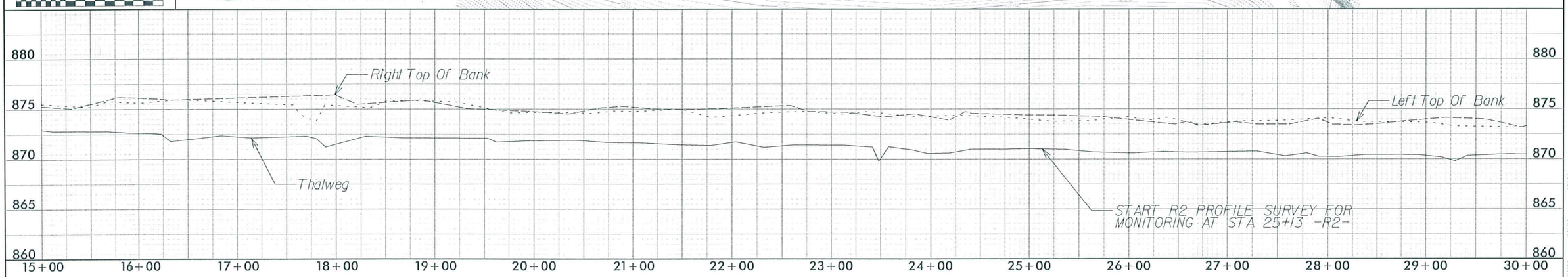
50 0 100

* R2A PROFILE IS ON SHEET NO. 18 *



REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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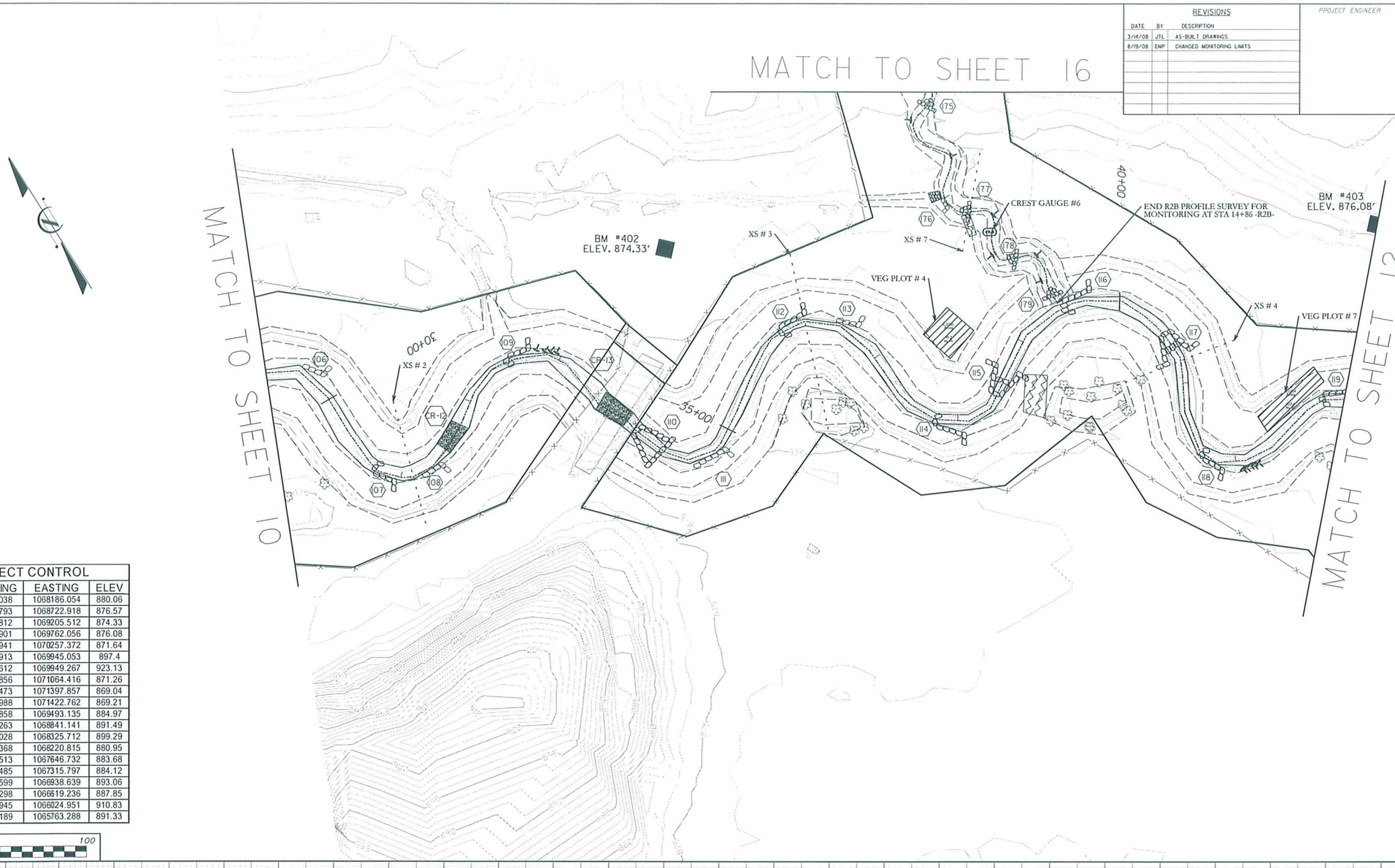

PROJECT CONTROL			
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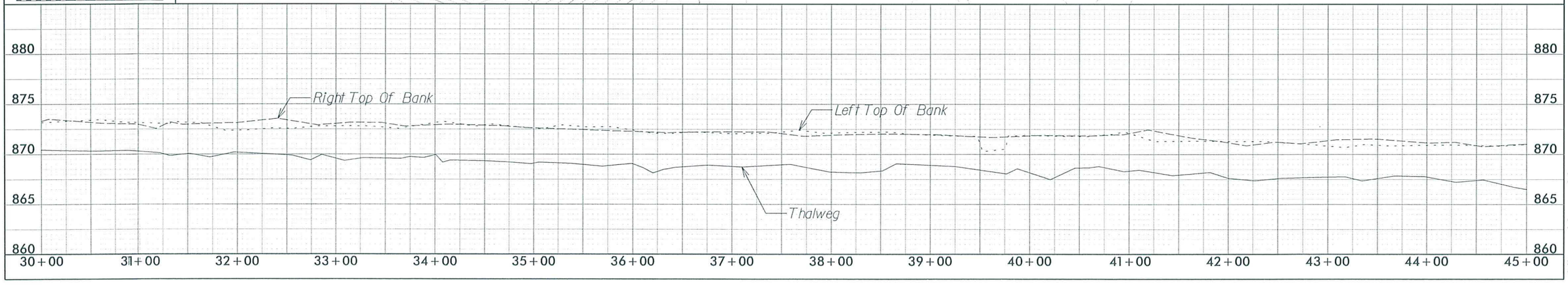

PROJECT CONTROL			
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REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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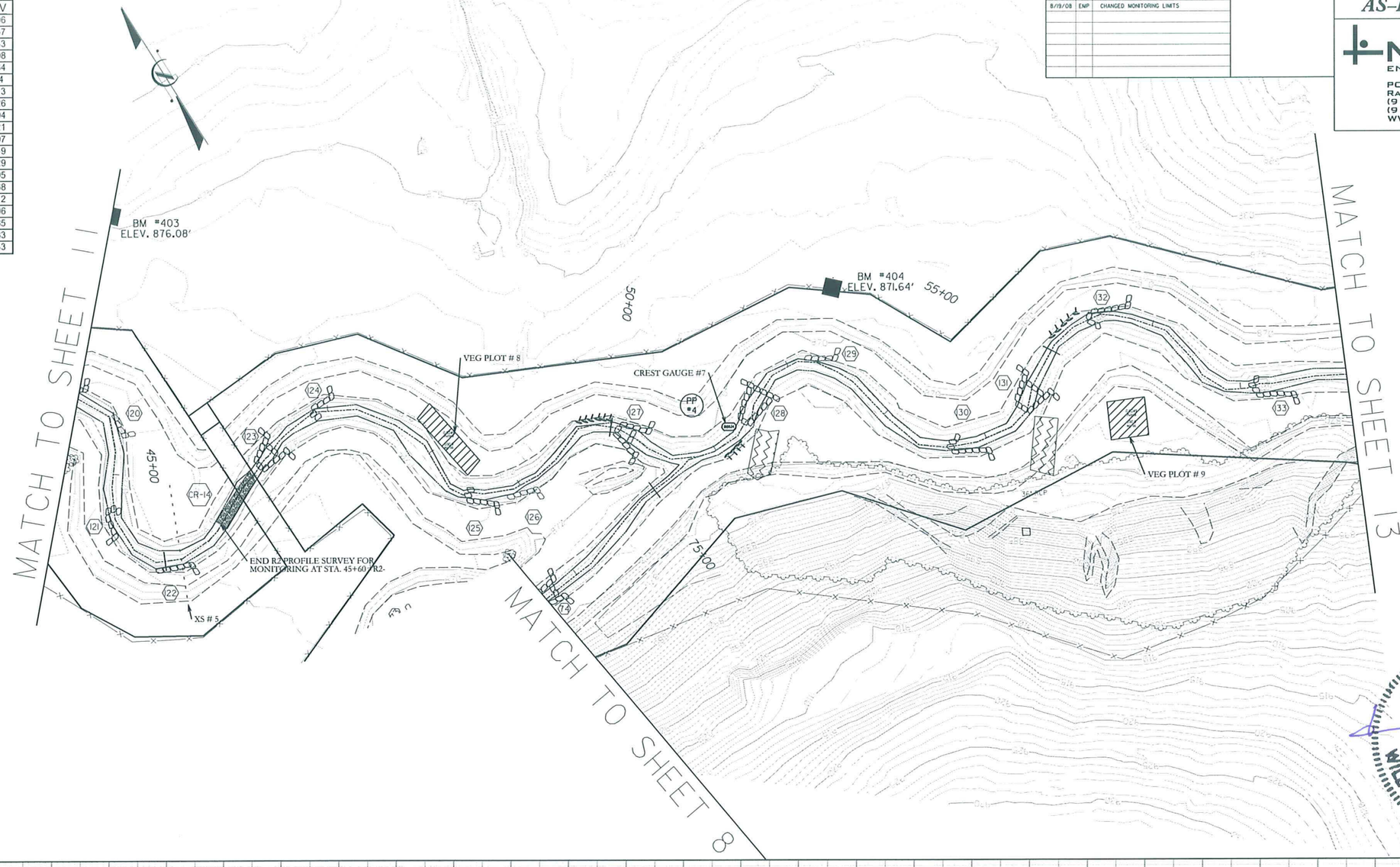

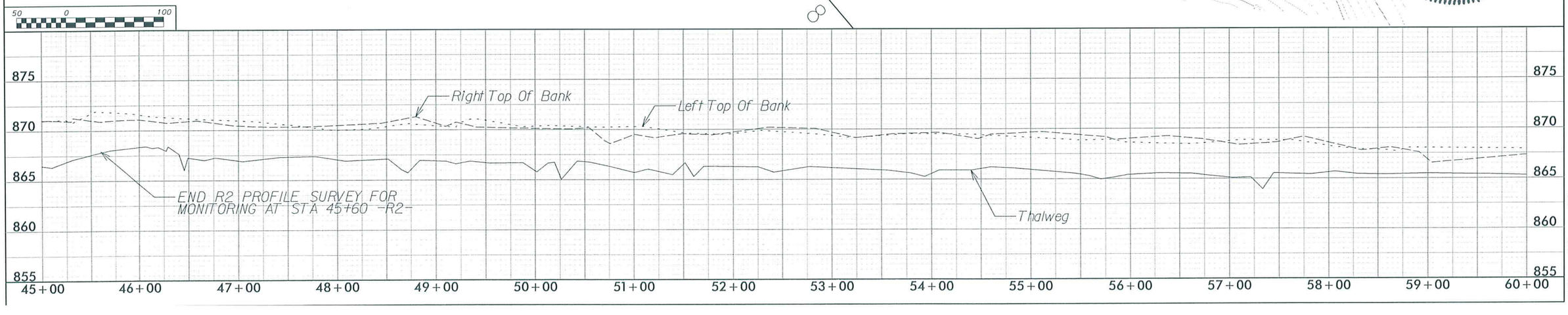

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

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DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	ENP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III
08.21.08

SR 1324 (Whiteside Rd.)

MATCH TO SHEET 12

MATCH TO SHEET 17

BM #408
ELEV. 869.04'

BM #409
ELEV. 869.21'

VEG PLOT # 10

VEG PLOT # 11

CREST GAUGE #8

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

CR-15

CR-16

CR-32

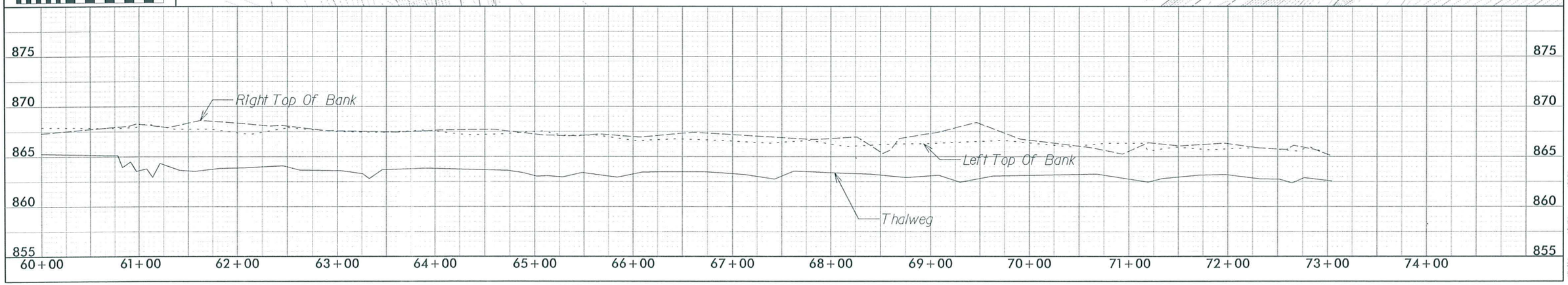
60+00

65+00

70+00

APPROX

50 0 100



REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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

0+00

5+00

SS

30" CMP

CR-17

147

NC 9

CR-18

148

149

CR-19

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

20 0 40

NORTH CAROLINA PROFESSIONAL SEAL 22987 ENGINEER WILLIAM SCOTT HUNT, III 08.21.08

SEE SHEET NO. 18 FOR -R1A- PROFILE

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

APPROXIMATE LOCATION OF GAS LINE EASEMENT

00+0

VEG PLOT # 6

0.0242 Acres
98.0 sq.m

CR-24

164

165

CR-25

166

167

RP #3

CR-26

5+00

MATCH TO SHEET 16

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
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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

SEE SHEET NO. 19 FOR -R2B- PROFILE

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
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
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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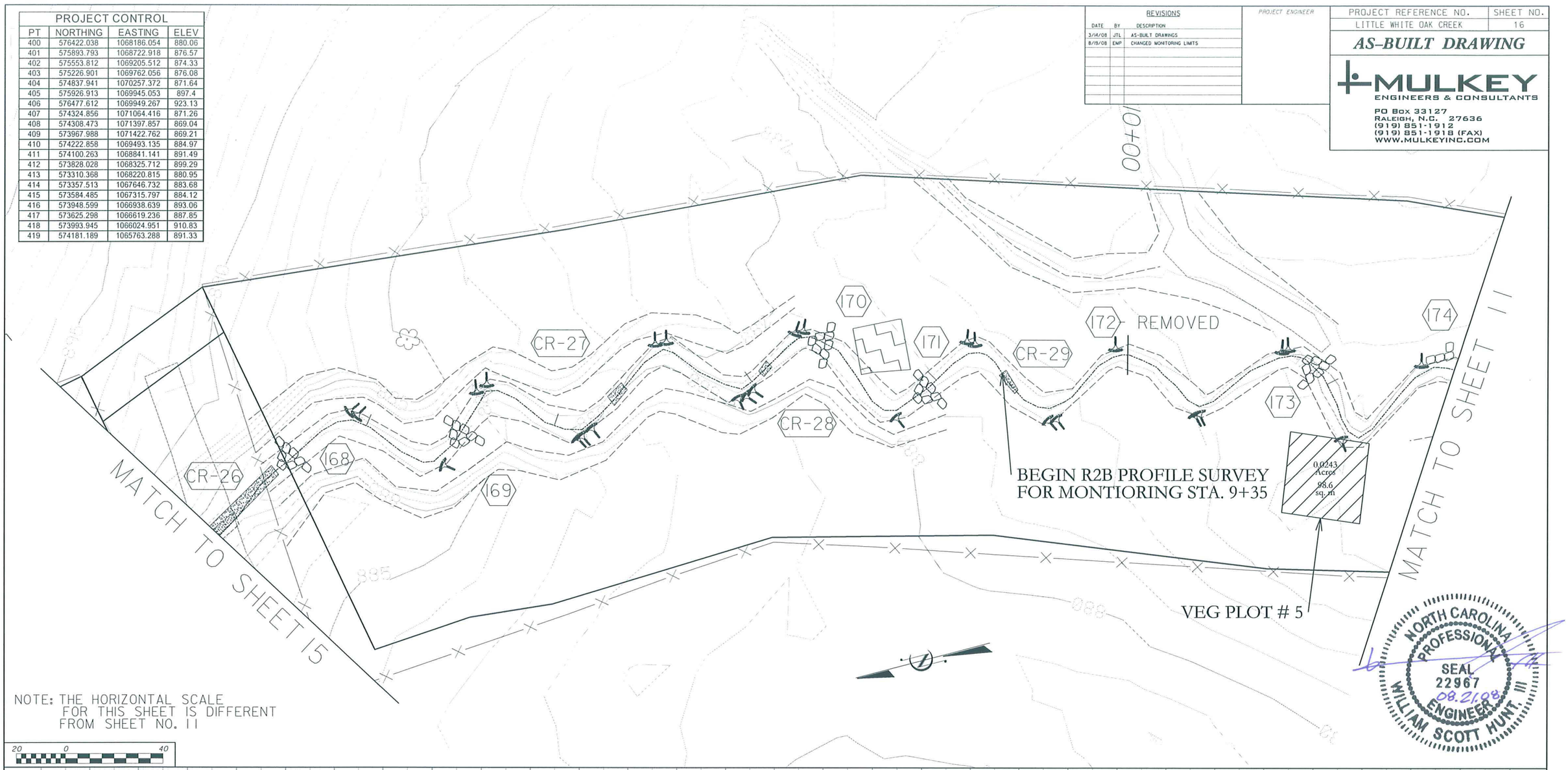

NOTE: THE HORIZONTAL SCALE
FOR THIS SHEET IS DIFFERENT
FROM SHEET NO. 11

20 0 40

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

SEE SHEET NO. 19 FOR -R2B- PROFILE

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
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419	574181.189	1065763.288	891.33

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	ENP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

AS-BUILT DRAWING

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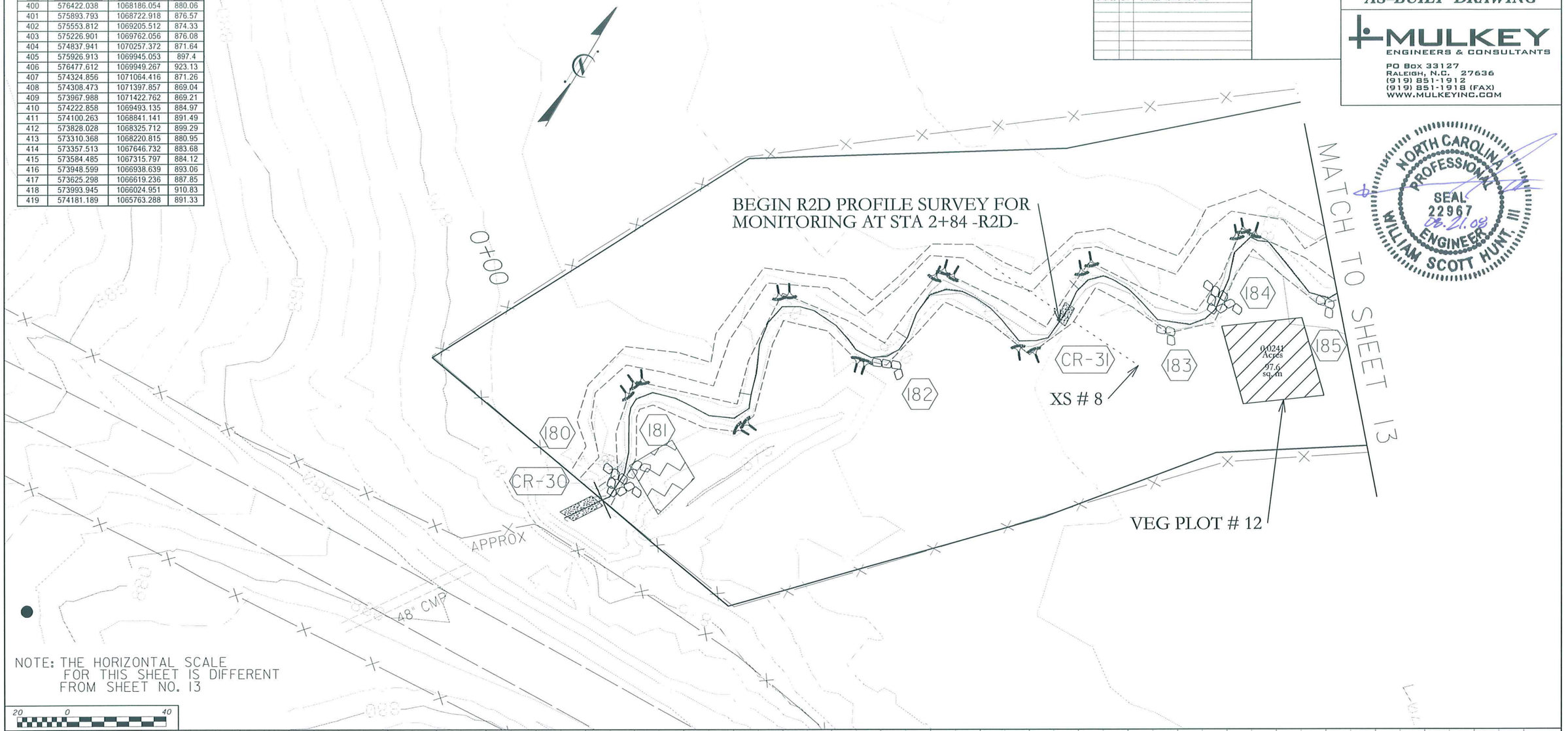
08.21.08



SEE SHEET NO. 19 FOR -R2D- PROFILE

PROPOSED PROFILES

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWING
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

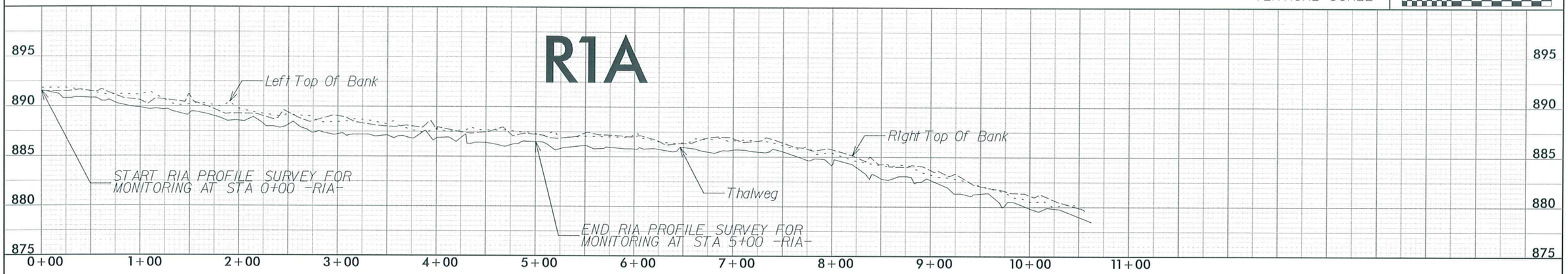
AS-BUILT DRAWING

MULKEY ENGINEERS & CONSULTANTS

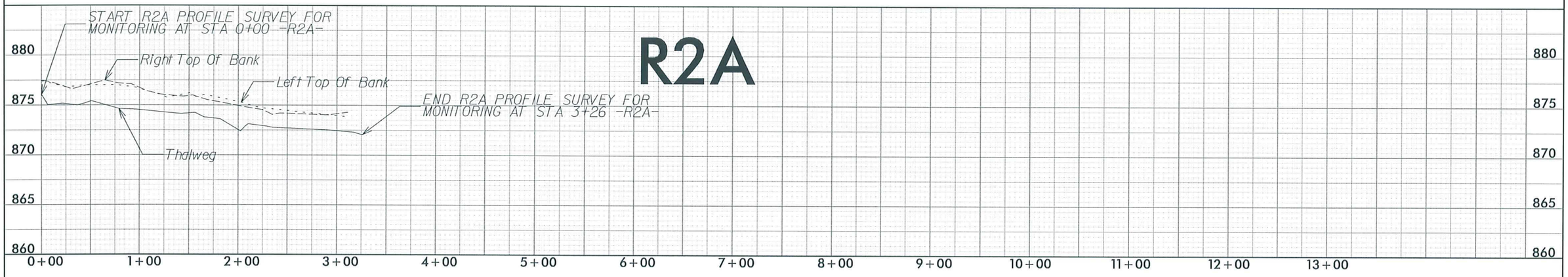
HORIZONTAL SCALE 50 0 100

VERTICAL SCALE 5 0 10

R1A



R2A



NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III 08.21.08

PROPOSED PROFILES

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWING
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

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

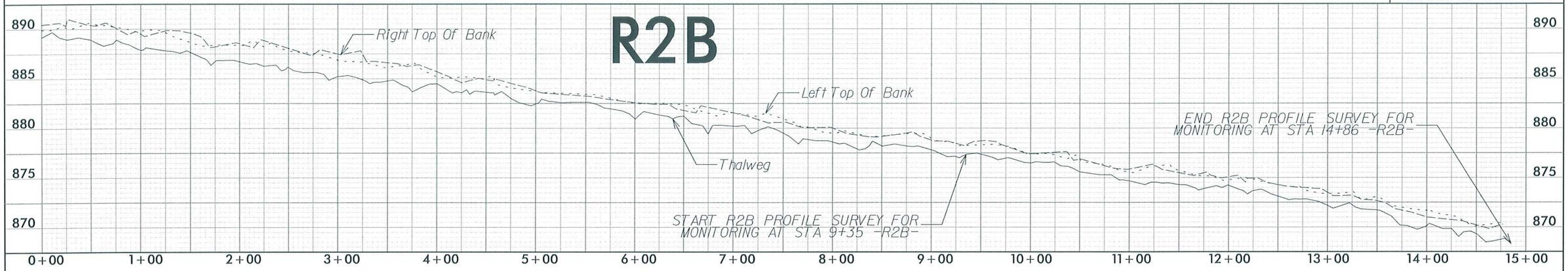
AS-BUILT DRAWING

MULKEY ENGINEERS & CONSULTANTS

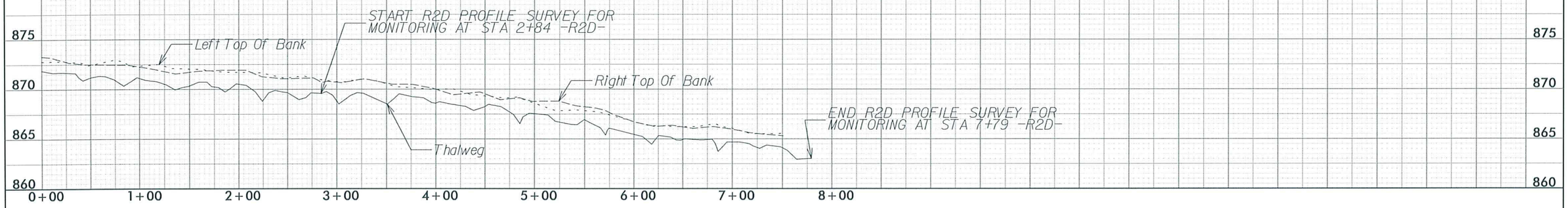
HORIZONTAL SCALE 50 0 100

VERTICAL SCALE 5 0 10

R2B



R2D



NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III 08.21.08

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	20

AS-BUILT DRAWING

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NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

NC 9

BM #419
ELEV. 891.33'

BM #418
ELEV. 910.83'

CREST GAUGE #1

0+00

5+00

10+00

PP #6

PP #7

VEG PLOT # 13

VEG PLOT # 14

VEG PLOT # 15

BEGIN R1 PROFILE SURVEY FOR MONITORING AT STA 14+00 -R1-

MATCH TO SHEET 21

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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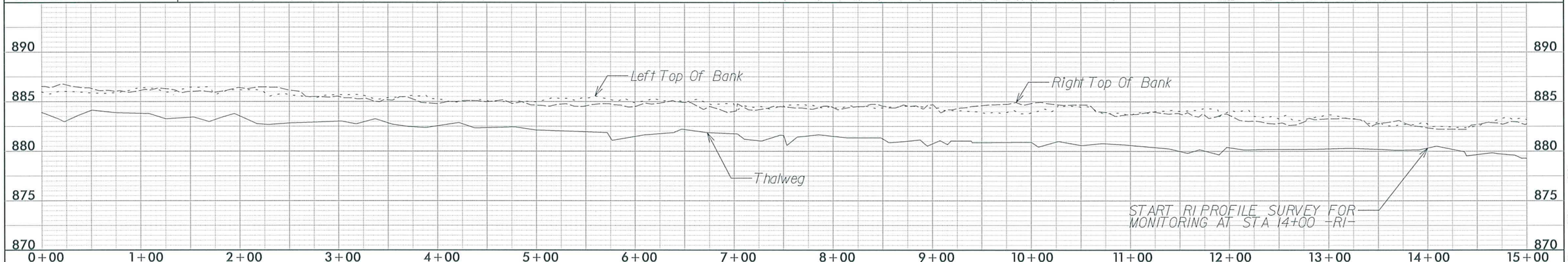
411	574100.263	1068841.141	891.49
412	573828.028	1068325.712	899.29
413	573310.368	1068220.815	880.95
414	573357.513	1067646.732	883.68
415	573584.485	1067315.797	884.12
416	573948.599	1066938.639	893.06
417	573625.298	1066619.236	887.85
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

RED DENOTES PROPOSED DESIGN

50 0 100



RED DENOTES PROPOSED DESIGN

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	21

AS-BUILT DRAWING

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PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
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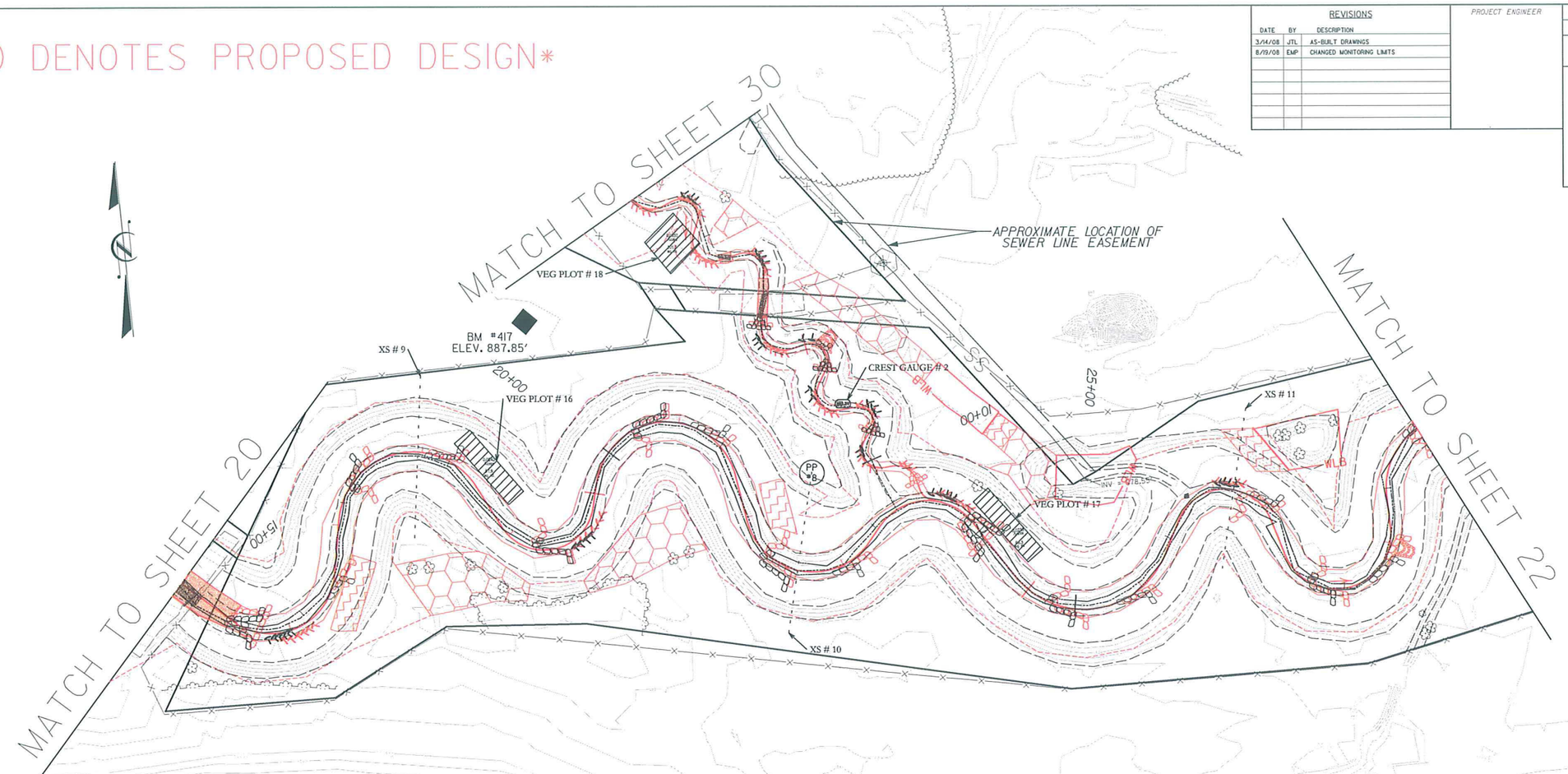

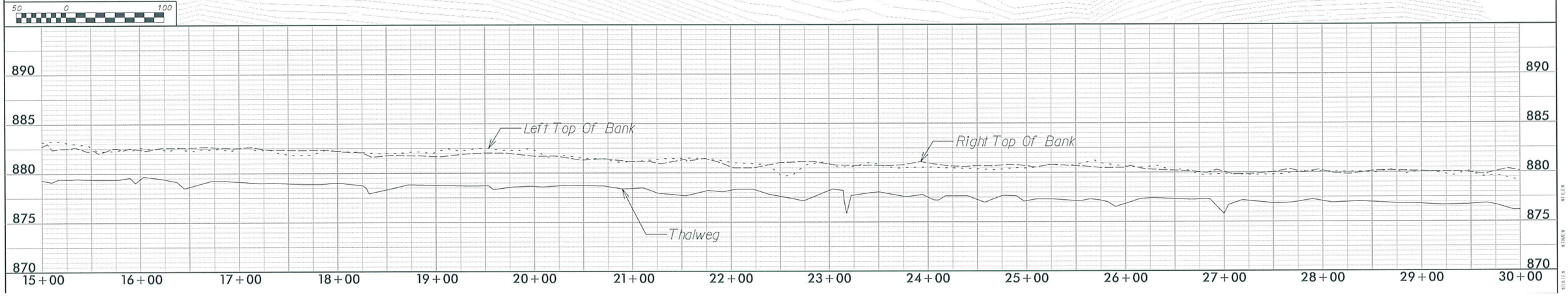

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	22

AS-BUILT DRAWING

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PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
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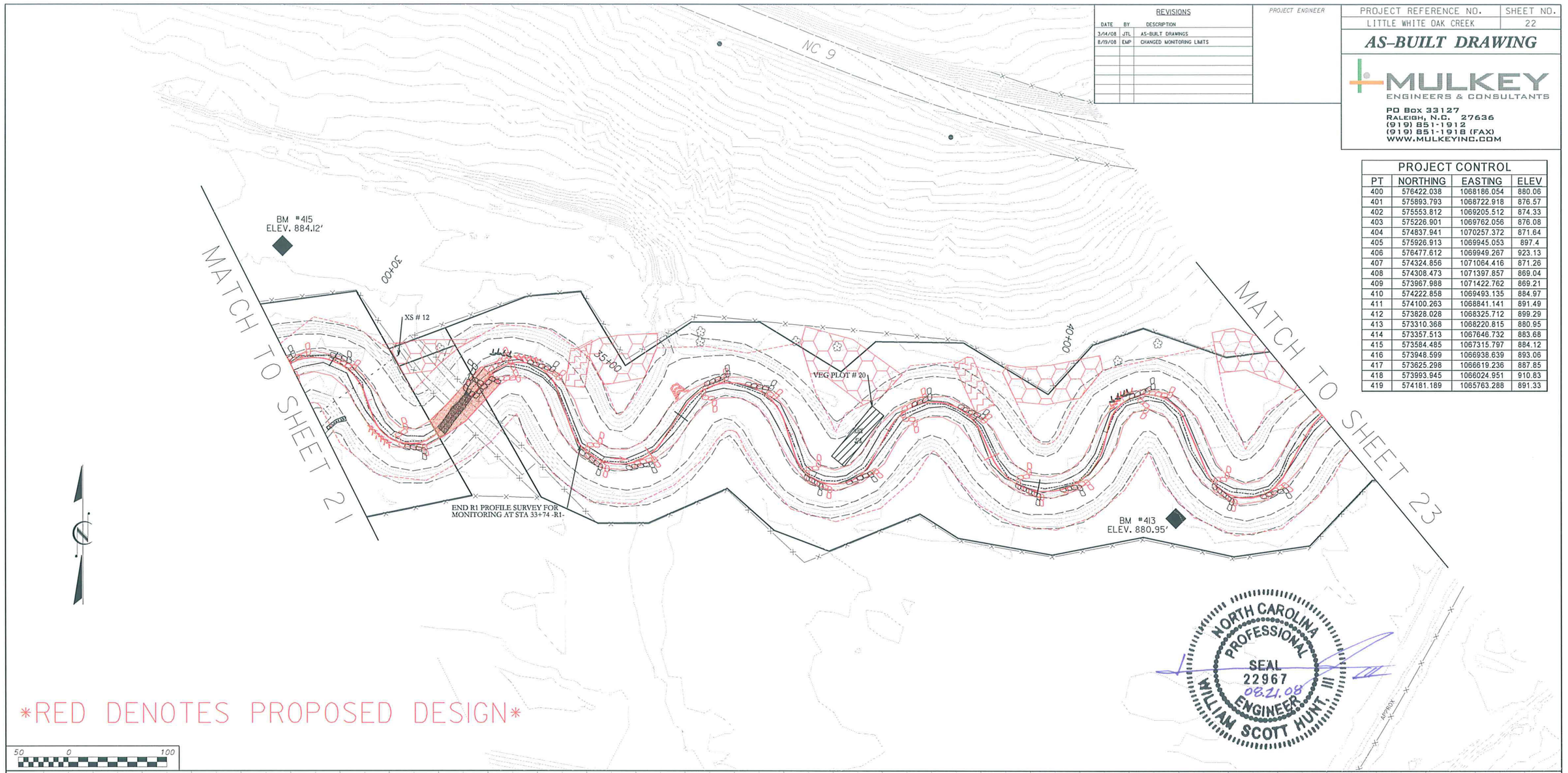
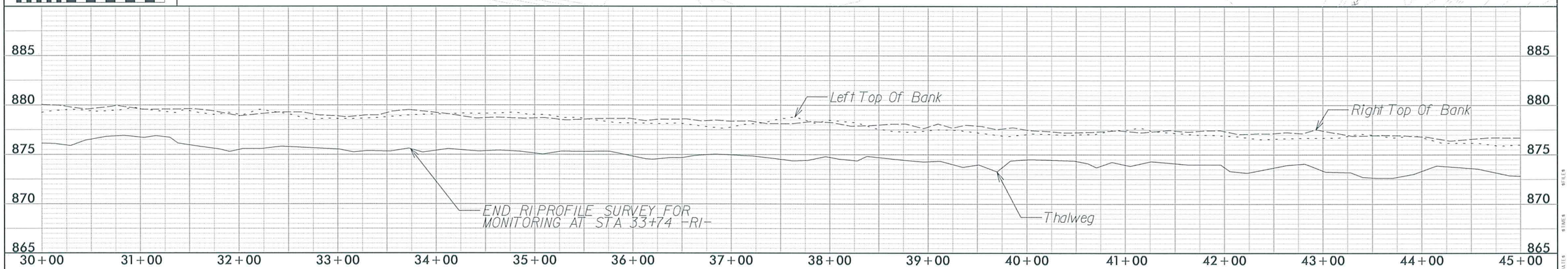


RED DENOTES PROPOSED DESIGN

50 0 100



NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

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

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	23

AS-BUILT DRAWING

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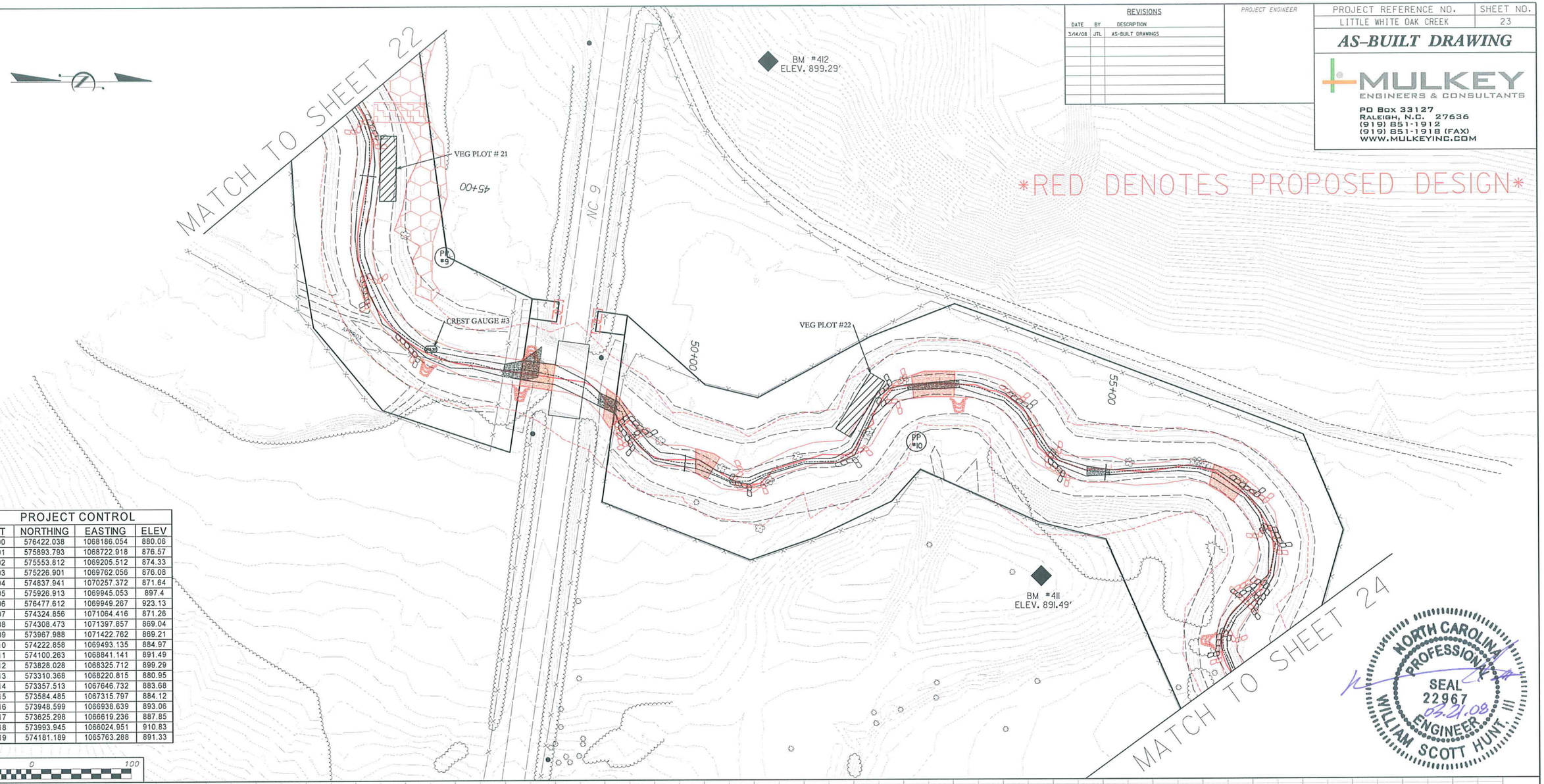
RED DENOTES PROPOSED DESIGN



PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
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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
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409	573967.988	1071422.762	869.21
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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
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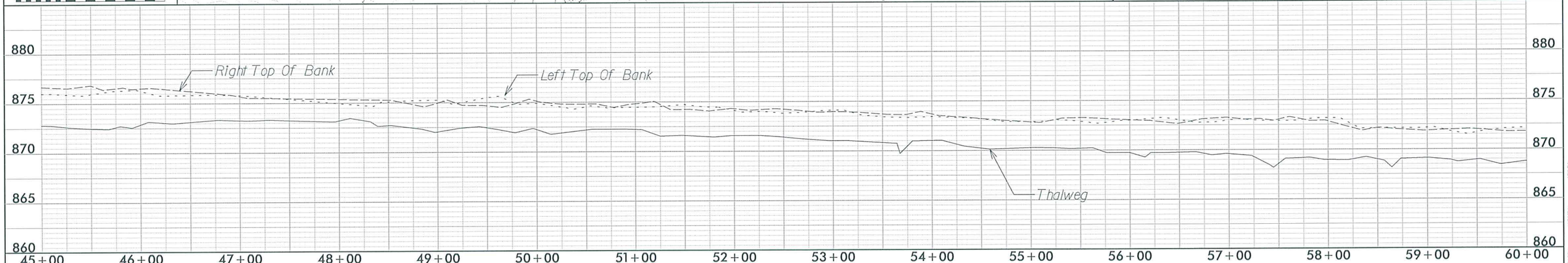
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33



NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
03.21.08

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

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	24

AS-BUILT DRAWING

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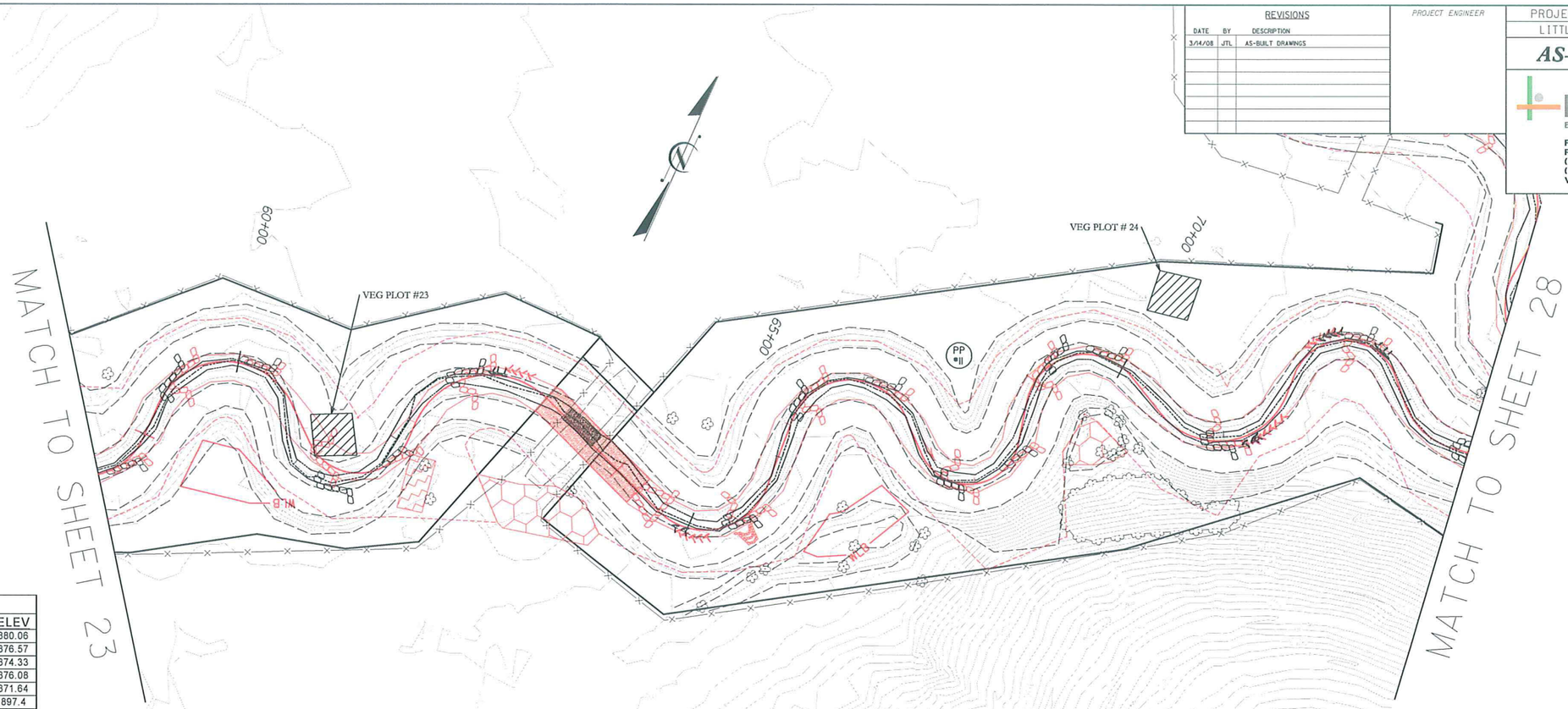
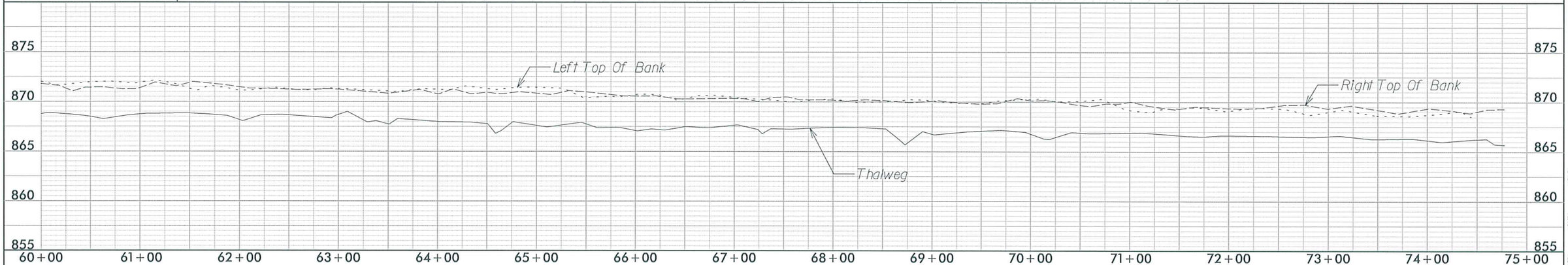


PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
403	575226.901	1069762.056	876.08
404	574837.941	1070257.372	871.64
405	575926.913	1069945.053	897.4
406	576477.612	1069949.267	923.13
407	574324.856	1071064.416	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	883.66
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 PROPOSED DESIGN

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
03.21.08

50 0 100



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

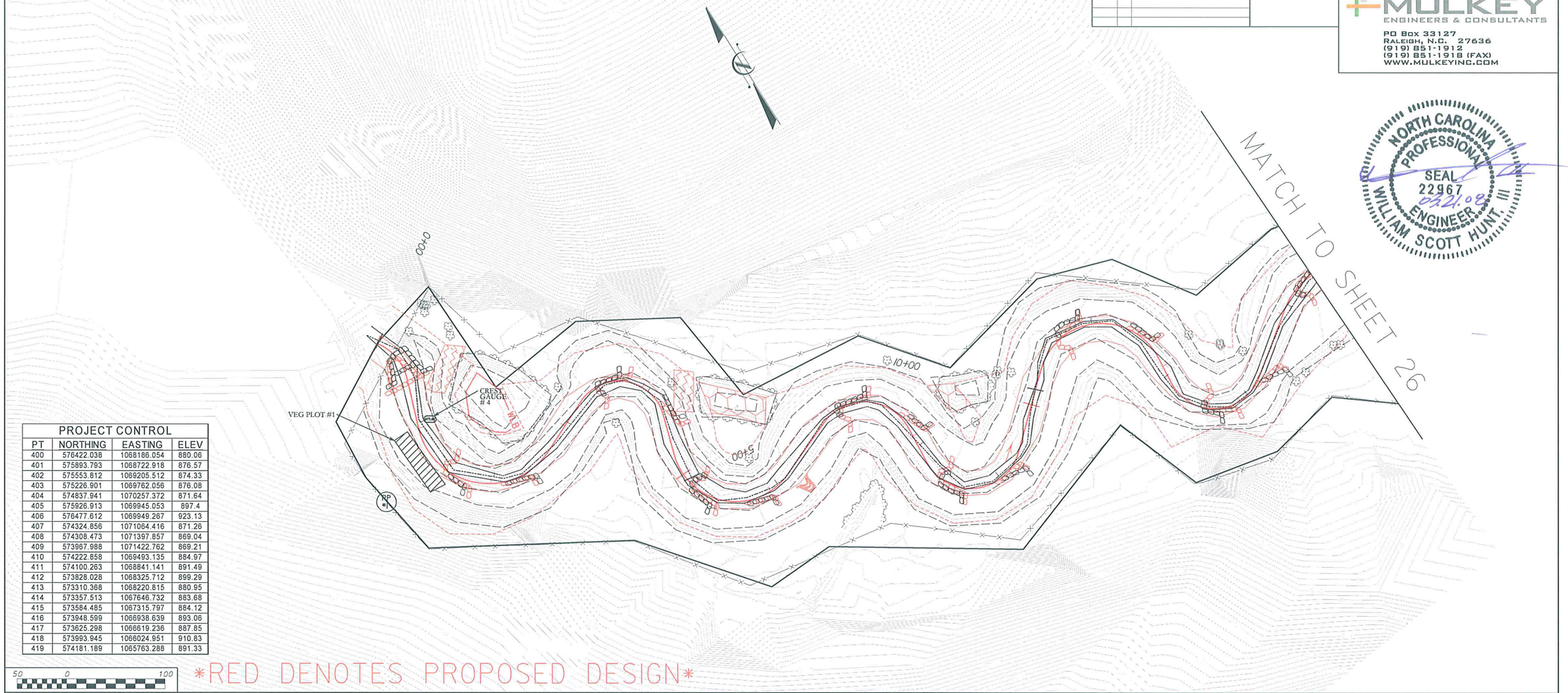
PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	25

AS-BUILT DRAWING

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

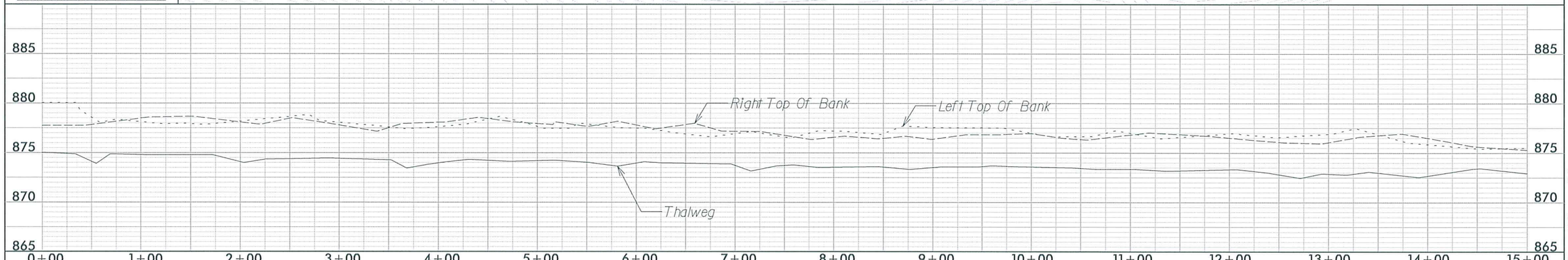
NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
03.21.08



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

50 0 100

RED DENOTES PROPOSED DESIGN



REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	26

AS-BUILT DRAWING

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PO Box 33127
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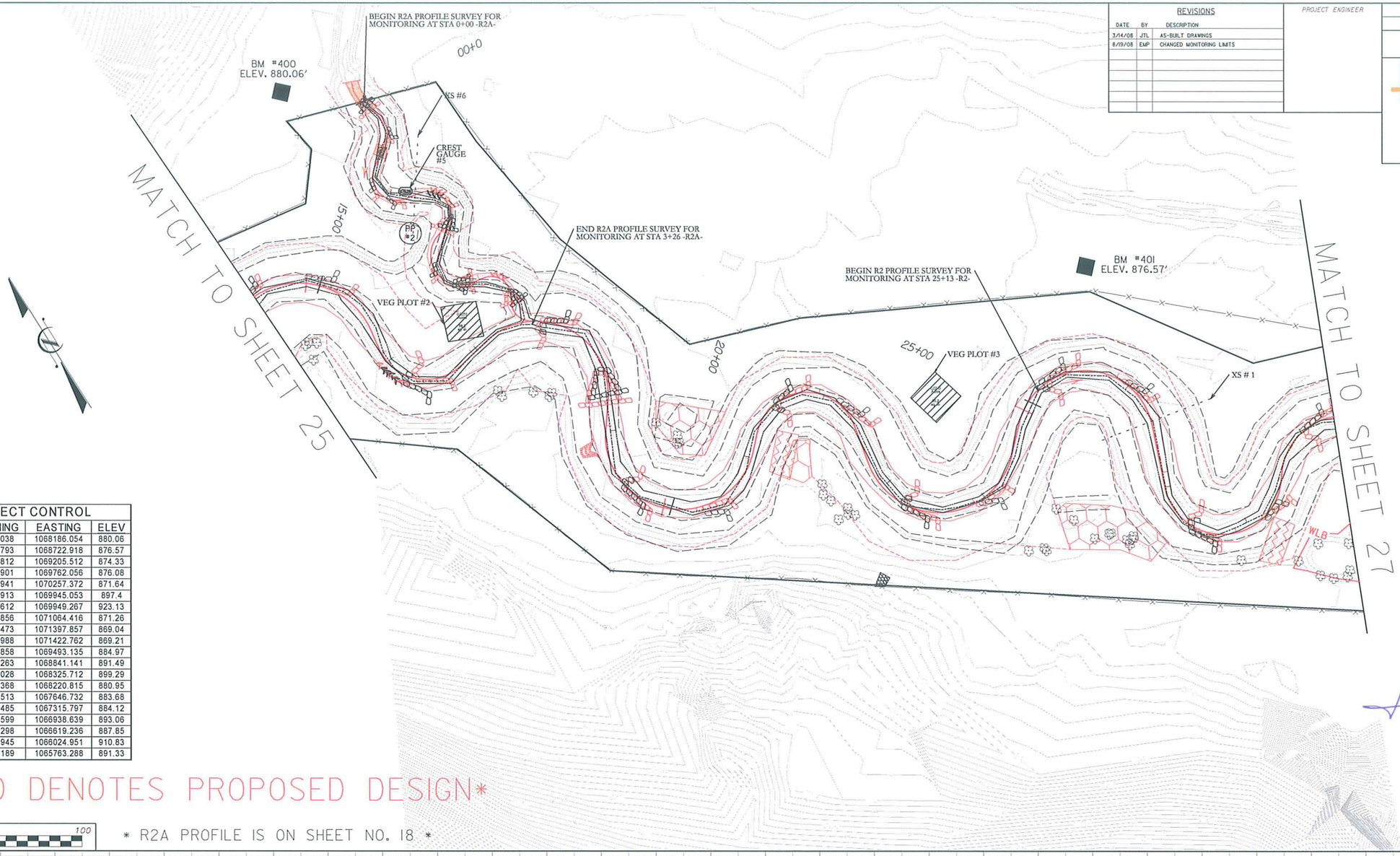

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
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403	575226.901	1069762.056	876.08
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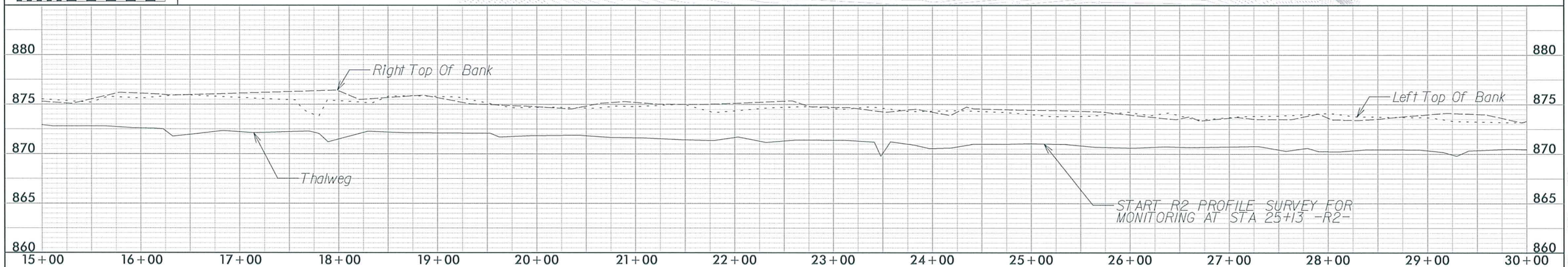
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

RED DENOTES PROPOSED DESIGN

50 0 100

* R2A PROFILE IS ON SHEET NO. 18 *



NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	27

AS-BUILT DRAWING

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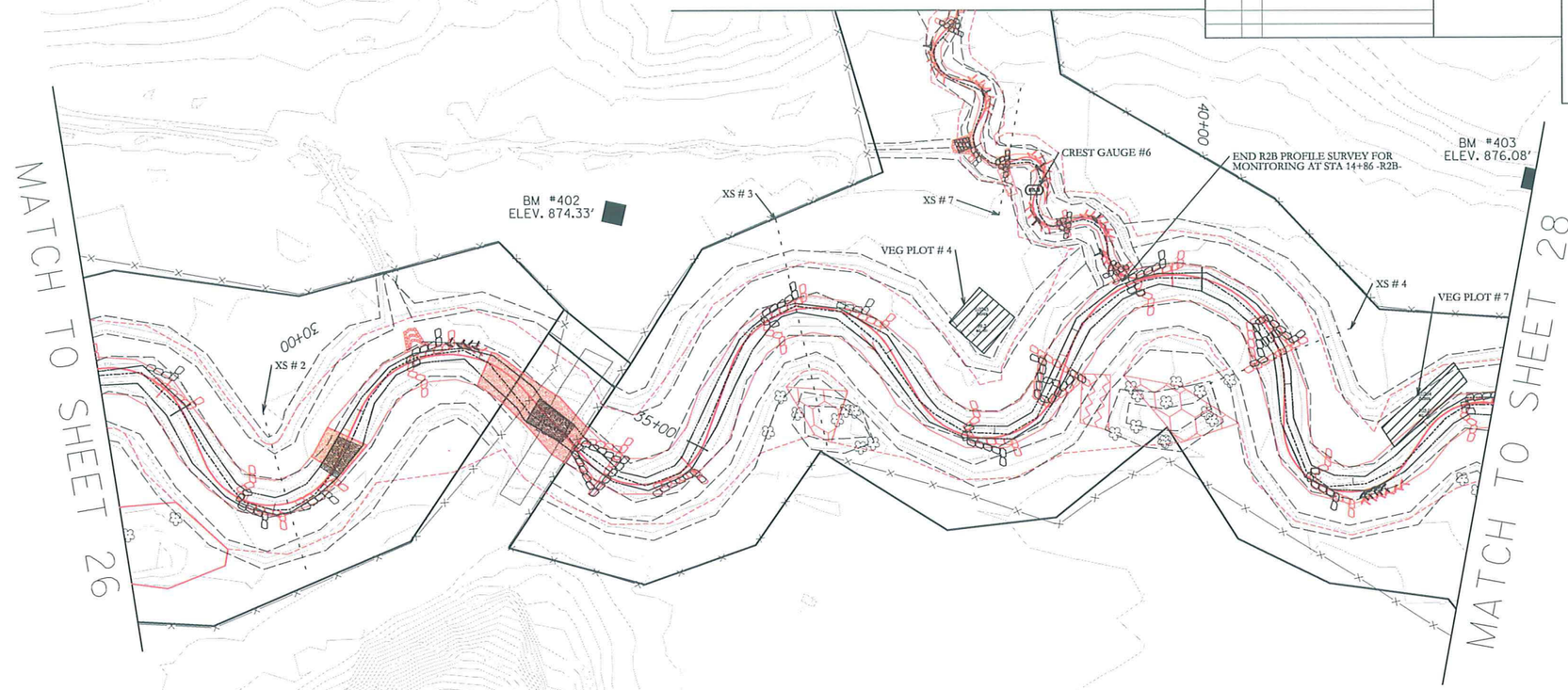

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
403	575226.901	1069762.056	876.08
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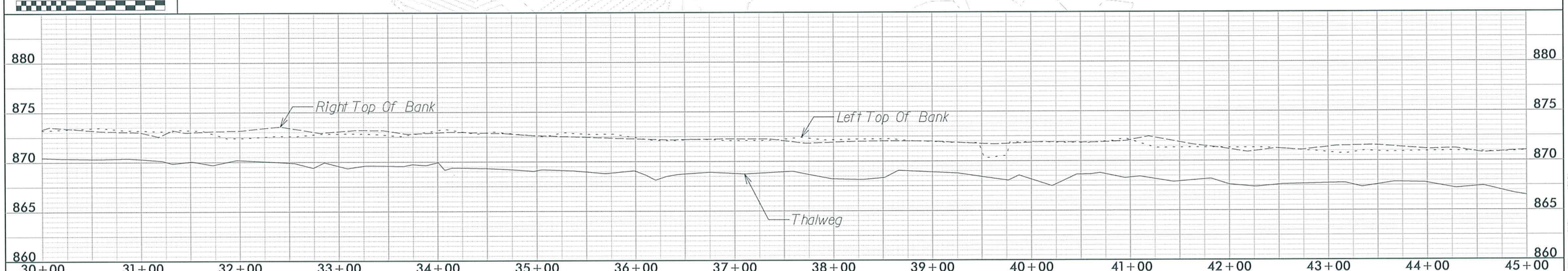
418	573993.945	1066024.951	910.83
419	574181.189	1065763.288	891.33

RED DENOTES PROPOSED DESIGN



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

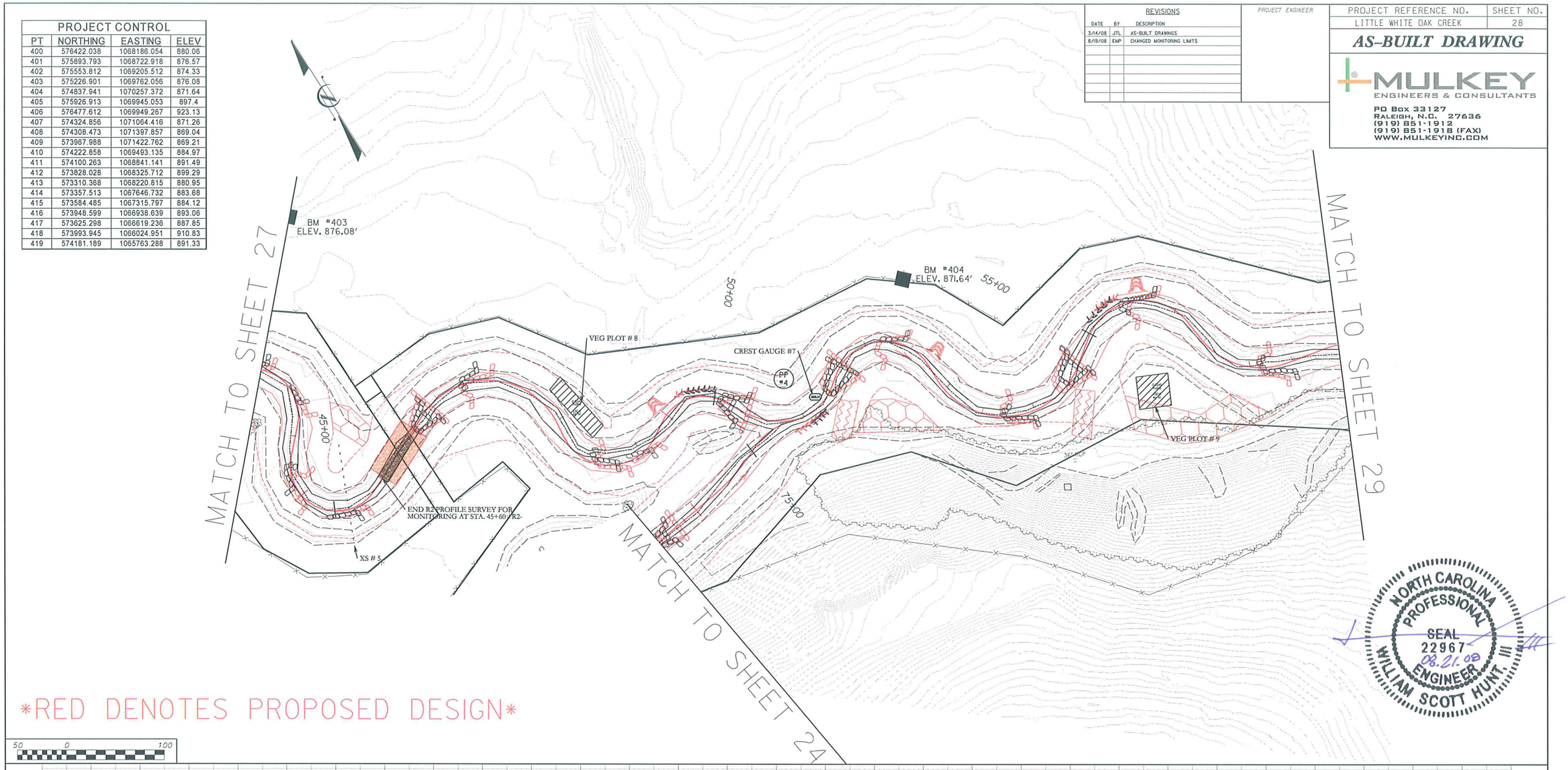
REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

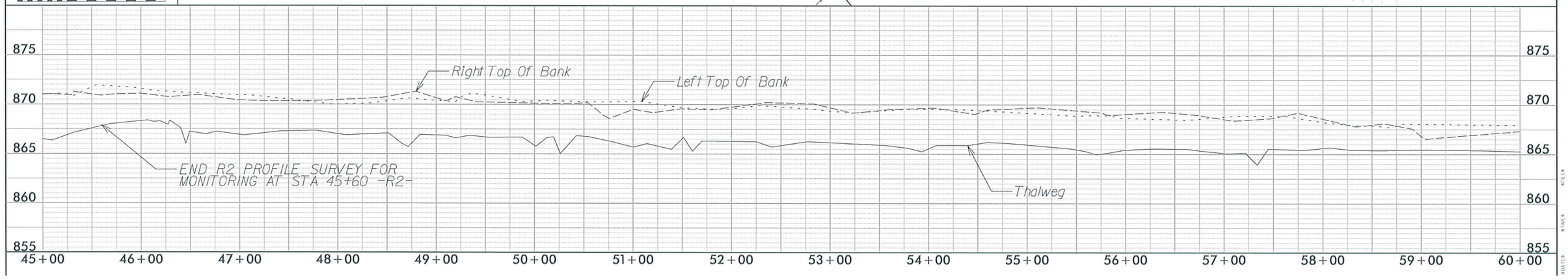
PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	28

AS-BUILT DRAWING

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



RED DENOTES PROPOSED DESIGN



NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
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REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	29

AS-BUILT DRAWING

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WWW.MULKEYINC.COM

SR 1324 (Whiteside Rd.)

60+00

65+00

70+00

MATCH TO SHEET 28

MATCH TO SHEET 33

VEG PLOT # 10

PP #5

CREST GAUGE #8

VEG PLOT # 11

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

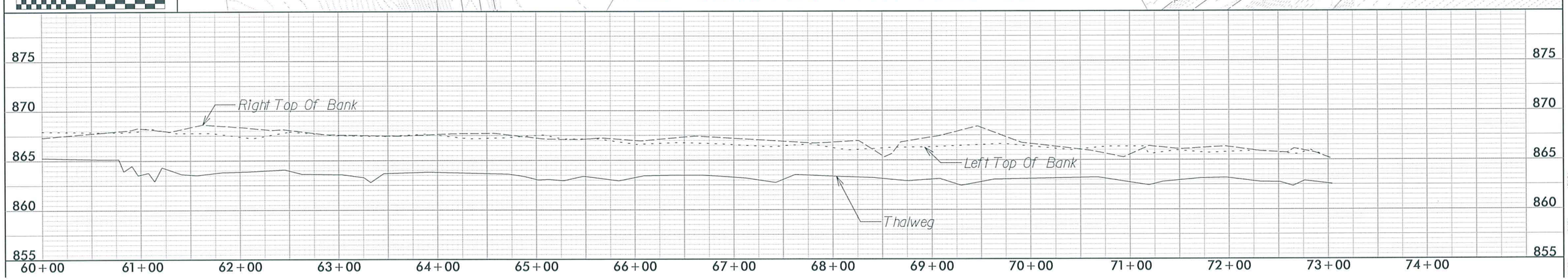
BM #408
ELEV. 869.04'

BM #409
ELEV. 869.21'

APPROX

50 0 100

RED DENOTES PROPOSED DESIGN



NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III 08.21.08

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	30

AS-BUILT DRAWING

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PO Box 33127
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(919) 851-1912
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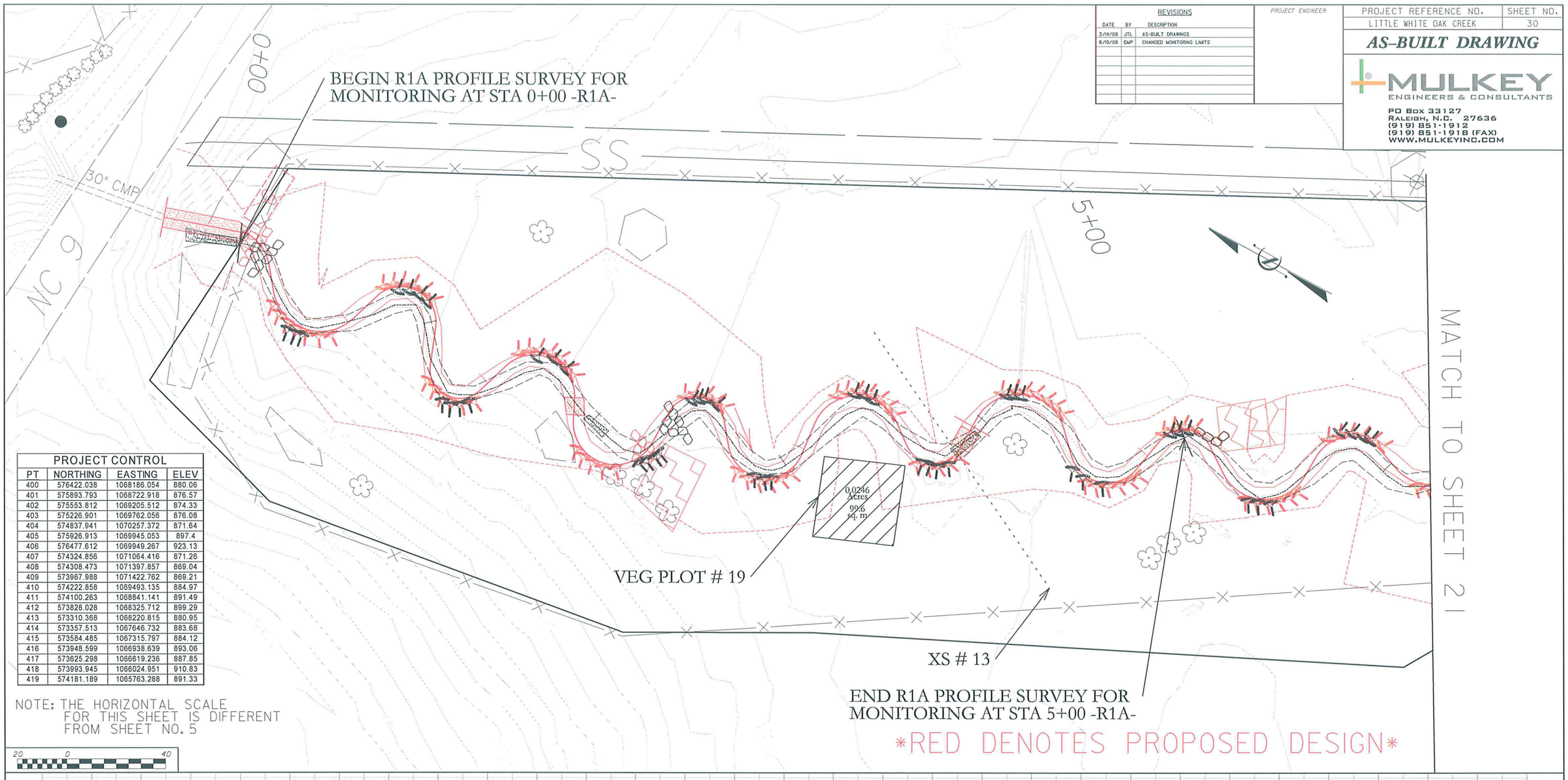

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
400	576422.038	1068186.054	880.06
401	575893.793	1068722.918	876.57
402	575553.812	1069205.512	874.33
403	575226.901	1069762.056	876.08
404	574837.941	1070257.372	871.64
405	575926.913	1069945.053	897.4
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408	574308.473	1071397.857	869.04
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413	573310.368	1068220.815	880.95
414	573357.513	1067646.732	883.68
415	573584.485	1067315.797	884.12
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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

20 0 40

SEE SHEET NO. 18 FOR -R1A- PROFILE

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
8.21.08

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	31

AS-BUILT DRAWING

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APPROXIMATE LOCATION OF GAS LINE EASEMENT

00+0

VEG PLOT # 6

0.0242 Acres
98.0 sq.m

00+5

RP #3

MATCH TO SHEET 32

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

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
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406	576477.612	1069949.267	923.13
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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. 11

20 0 40

RED DENOTES PROPOSED DESIGN

SEE SHEET NO. 19 FOR -R2B- PROFILE

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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407	574324.856	1071064.416	871.26
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413	573310.368	1068220.815	880.95
414	573357.513	1067646.732	883.68
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419	574181.189	1065763.288	891.33

REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	32

AS-BUILT DRAWING

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PO Box 33127
Raleigh, N.C. 27636
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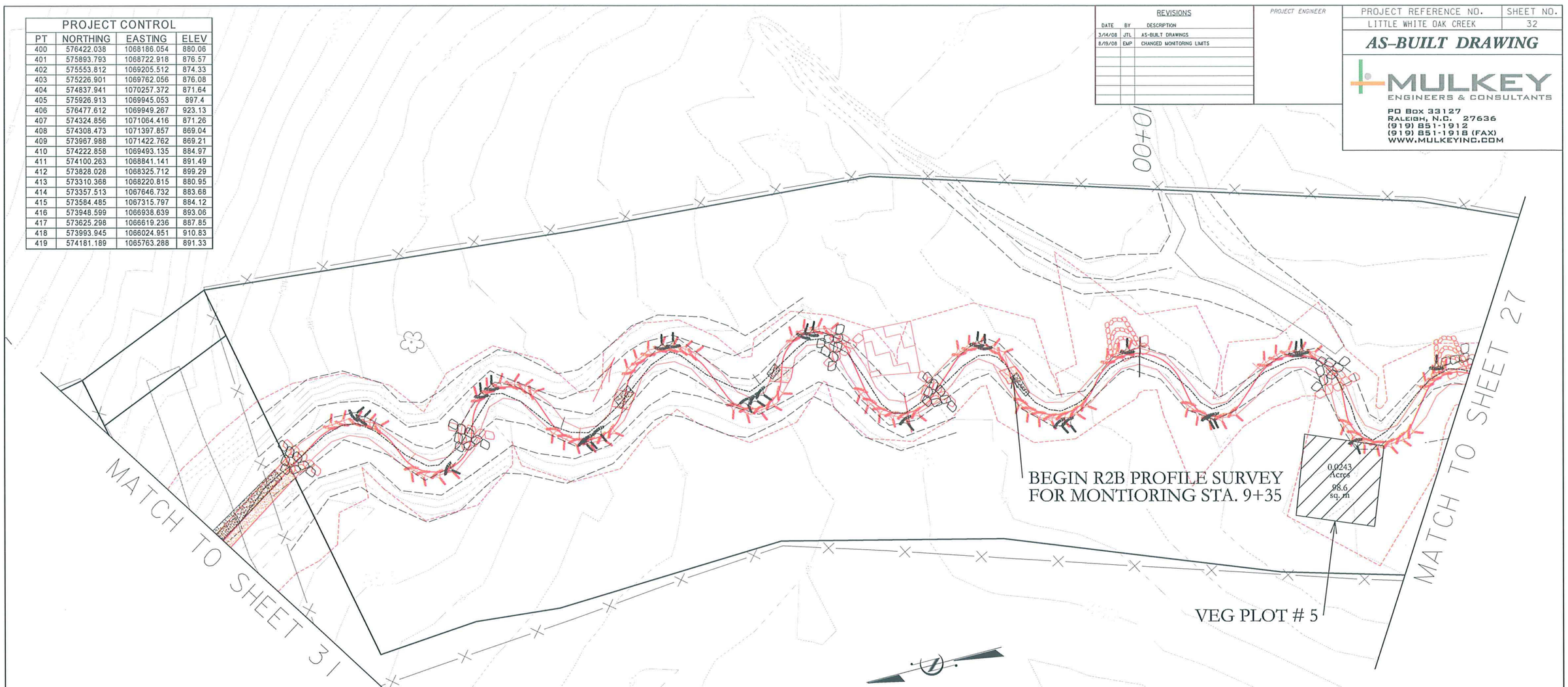

NOTE: THE HORIZONTAL SCALE FOR THIS SHEET IS DIFFERENT FROM SHEET NO. 11

20 0 40

RED DENOTES PROPOSED DESIGN

SEE SHEET NO. 19 FOR -R2B- PROFILE

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

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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REVISIONS		
DATE	BY	DESCRIPTION
3/14/08	JTL	AS-BUILT DRAWINGS
8/19/08	EMP	CHANGED MONITORING LIMITS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
LITTLE WHITE OAK CREEK	33

AS-BUILT DRAWING

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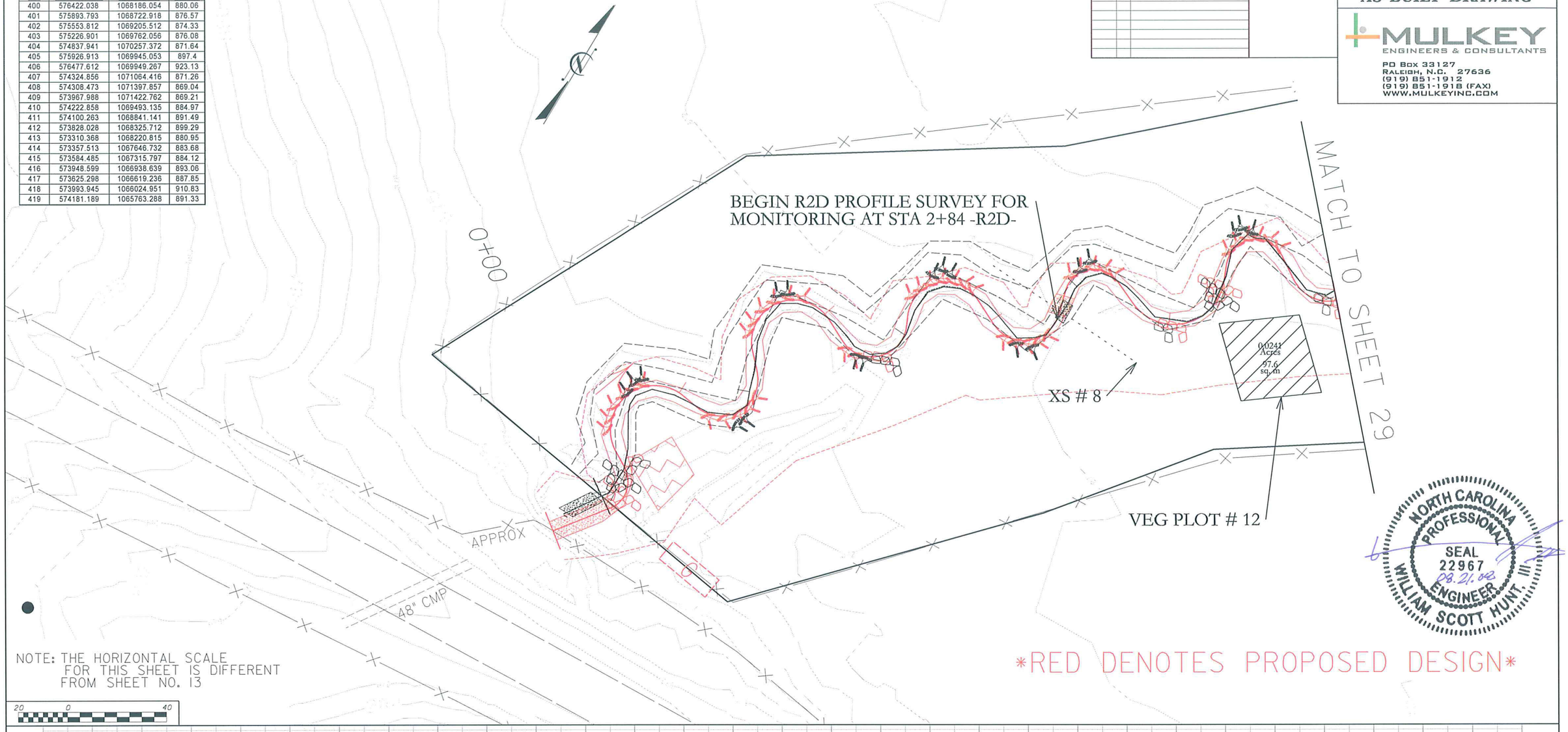


NOTE: THE HORIZONTAL SCALE FOR THIS SHEET IS DIFFERENT FROM SHEET NO. 13

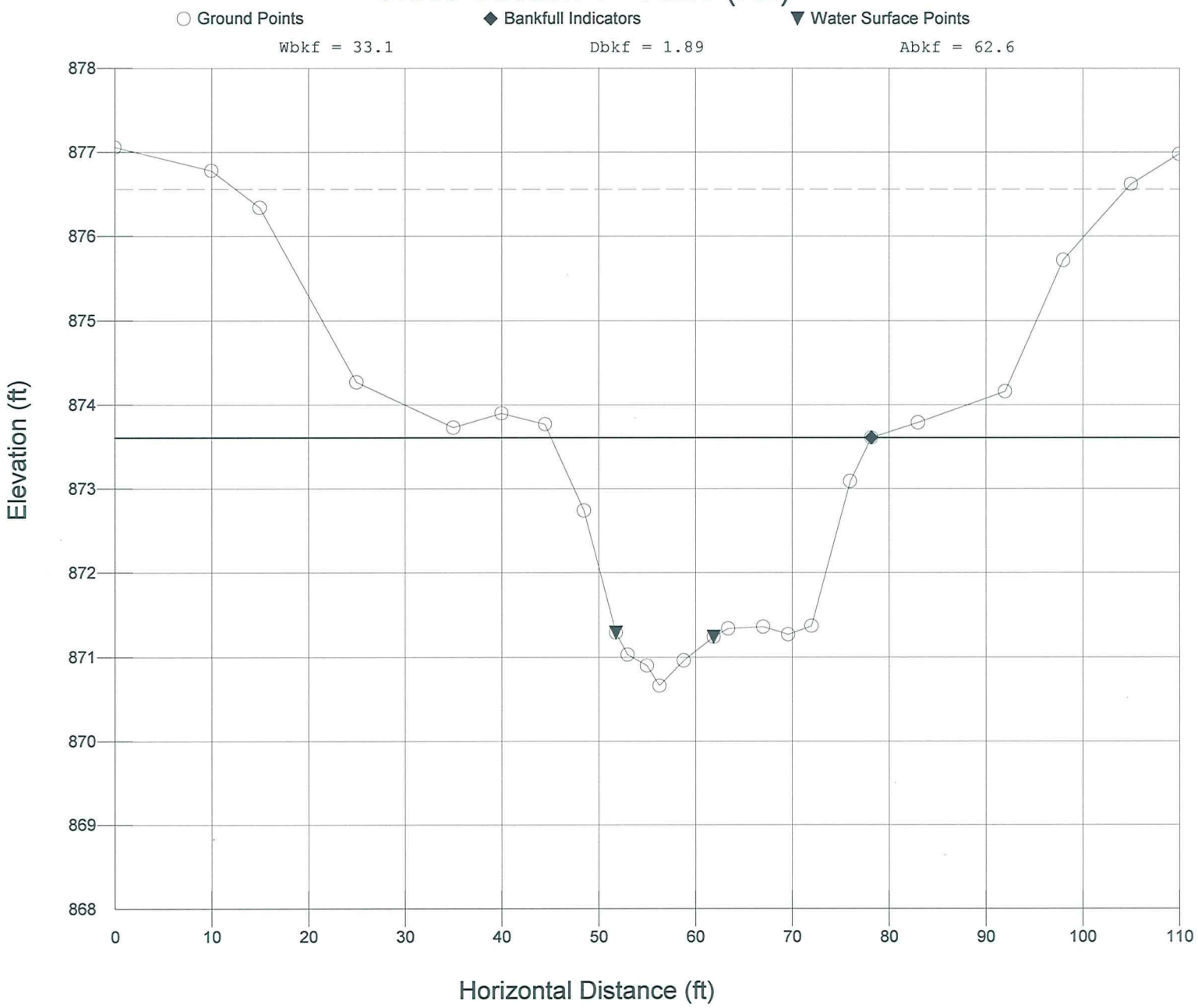
RED DENOTES PROPOSED DESIGN

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
08.21.08

SEE SHEET NO. 19 FOR -R2D- PROFILE

APPENDIX B

Cross Section 1 - Riffle (R2)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R2
Cross Section Name: XS1 Riffle
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	877.06	GS
10	0	876.78	GS
15	0	876.34	GS
25	0	874.27	GS
35	0	873.73	GS
40	0	873.9	GS
44.5	0	873.77	LB
48.5	0	872.74	GS
51.8	0	871.29	LEW
53	0	871.03	SB
55	0	870.9	SB
56.3	0	870.66	TW
58.8	0	870.96	SB
61.9	0	871.24	REW
63.4	0	871.34	GS
67	0	871.36	GS
69.6	0	871.27	GS
72	0	871.37	GS
76	0	873.09	GS
78.2	0	873.61	BKF
83	0	873.79	GS
92	0	874.16	GS
98	0	875.72	GS
105	0	876.62	GS
110	0	876.98	GS

Cross Sectional Geometry

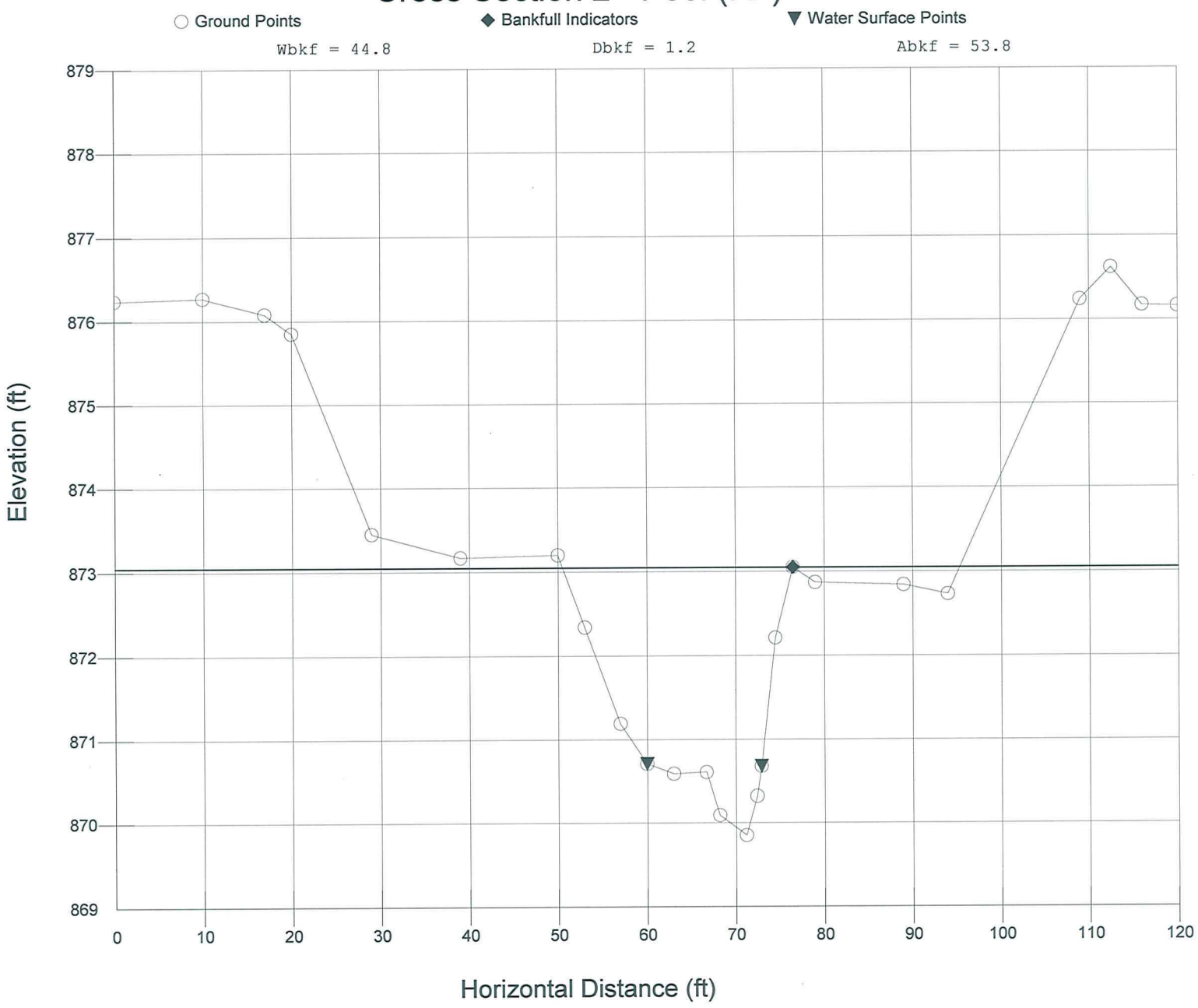
	Channel	Left	Right
Floodprone Elevation (ft)	876.56	876.56	876.56
Bankfull Elevation (ft)	873.61	873.61	873.61
Floodprone Width (ft)	92.03	-----	-----
Bankfull Width (ft)	33.08	16.54	16.54
Entrenchment Ratio	2.78	-----	-----
Mean Depth (ft)	1.89	1.99	1.8
Maximum Depth (ft)	2.95	2.95	2.39
Width/Depth Ratio	17.5	8.31	9.19
Bankfull Area (sq ft)	62.59	32.85	29.74
Wetted Perimeter (ft)	34	19.43	19.35
Hydraulic Radius (ft)	1.84	1.69	1.54
Begin BKF Station	45.12	45.12	61.66
End BKF Station	78.2	61.66	78.2

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)			

Cross Section 2 - Pool (R2)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R2
Cross Section Name: XS2 Pool
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	876.24	GS
10	0	876.27	GS
17	0	876.08	GS
20	0	875.85	GS
29	0	873.45	GS
39	0	873.17	GS
50	0	873.2	LB
53	0	872.34	GS
57	0	871.19	GS
60	0	870.71	LEW
63	0	870.59	SB
66.7	0	870.61	SB
68.2	0	870.09	SB
71.2	0	869.85	TW
72.4	0	870.32	SB
72.9	0	870.68	REW
74.5	0	872.21	GS
76.5	0	873.05	BKF
79	0	872.87	GS
89	0	872.84	GS
94	0	872.73	GS
109	0	876.24	GS
112.5	0	876.62	GS
116	0	876.17	GS
120	0	876.16	GS

Cross Sectional Geometry

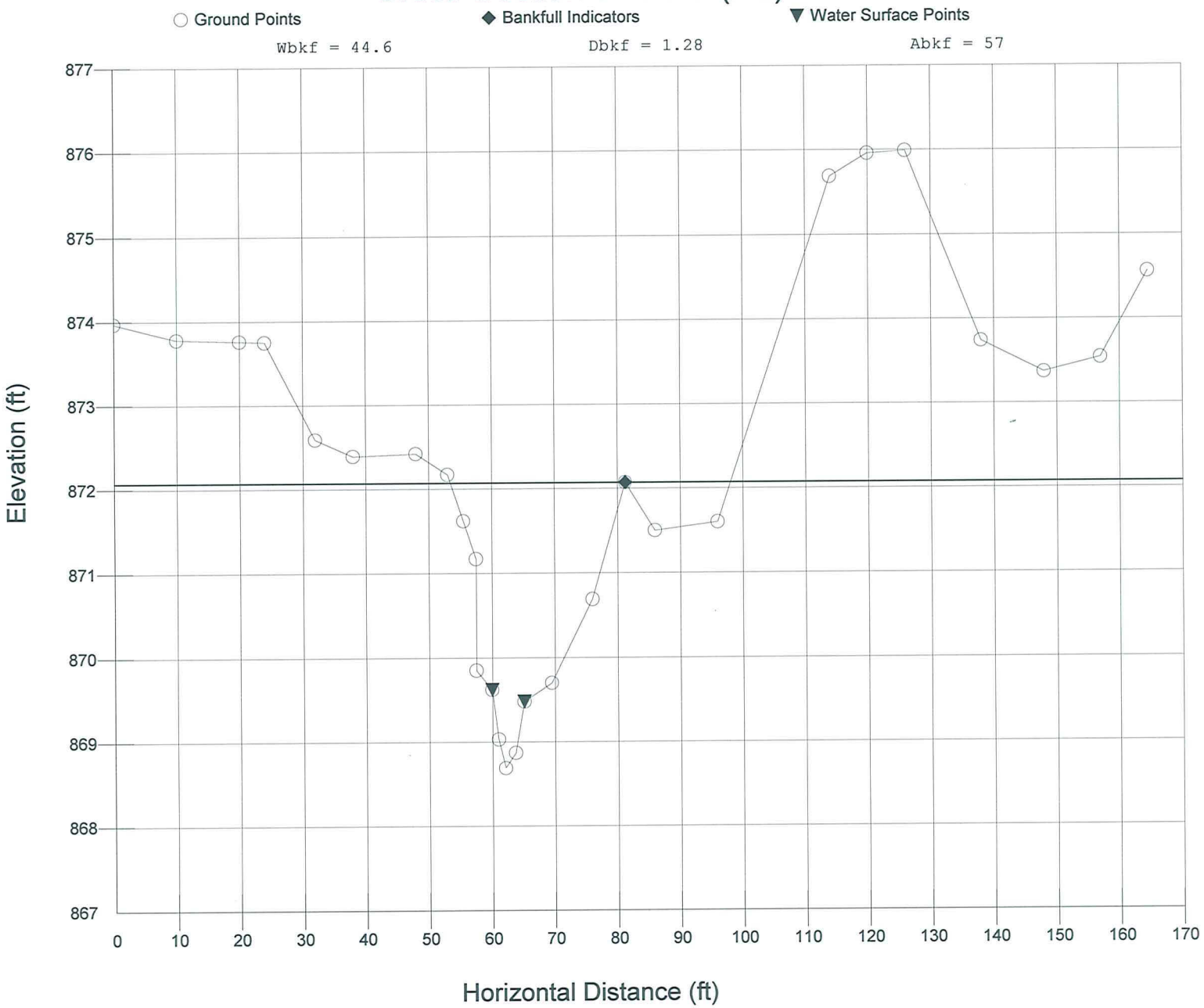
	Channel	Left	Right
Floodprone Elevation (ft)	876.25	876.25	876.25
Bankfull Elevation (ft)	873.05	873.05	873.05
Floodprone Width (ft)	106.31	-----	-----
Bankfull Width (ft)	44.84	22.43	22.42
Entrenchment Ratio	2.37	-----	-----
Mean Depth (ft)	1.2	2.09	0.31
Maximum Depth (ft)	3.2	3.2	2.32
Width/Depth Ratio	37.37	10.73	72.32
Bankfull Area (sq ft)	53.83	46.82	7.01
Wetted Perimeter (ft)	46.28	25.37	25.55
Hydraulic Radius (ft)	1.16	1.85	0.27
Begin BKF Station	50.52	50.52	72.95
End BKF Station	95.37	72.95	95.37

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)			

Cross Section 3 - Pool (R2)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R2
Cross Section Name: XS3 Pool
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	873.97	GS
10	0	873.78	GS
20	0	873.76	GS
24	0	873.75	GS
32	0	872.59	GS
38	0	872.39	GS
48	0	872.42	GS
53	0	872.17	LB
55.5	0	871.62	GS
57.5	0	871.17	GS
57.5	0	869.85	GS
60	0	869.62	LEW
61	0	869.03	SB
62.1	0	868.69	TW
63.7	0	868.87	SB
65.1	0	869.48	REW
69.5	0	869.7	GS
76	0	870.69	GS
81.3	0	872.07	BKF
86	0	871.5	GS
96	0	871.6	GS
114	0	875.69	GS
120	0	875.96	GS
126	0	875.99	GS
138	0	873.74	GS
148	0	873.37	GS
157	0	873.54	GS
164.5	0	874.56	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	875.45	875.45	875.45
Bankfull Elevation (ft)	872.07	872.07	872.07
Floodprone Width (ft)	148.56	-----	-----
Bankfull Width (ft)	44.61	22.31	22.31
Entrenchment Ratio	3.33	-----	-----
Mean Depth (ft)	1.28	2.06	0.49
Maximum Depth (ft)	3.38	3.38	1.42
Width/Depth Ratio	34.85	10.83	45.53
Bankfull Area (sq ft)	57.02	46	11.02
Wetted Perimeter (ft)	46.74	25.58	23.99
Hydraulic Radius (ft)	1.22	1.8	0.46
Begin BKF Station	53.45	53.45	75.76

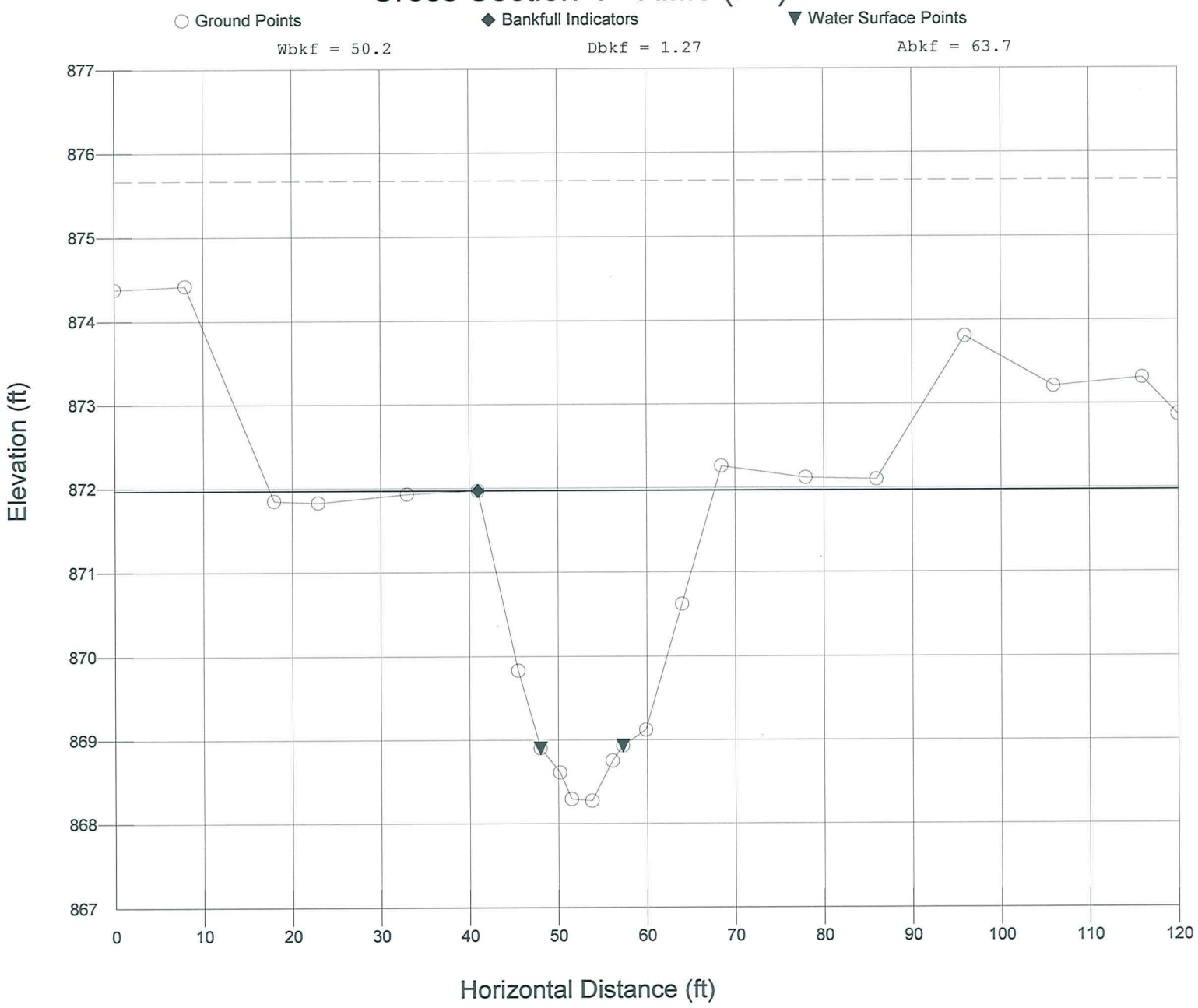
End BKF Station	98.07	75.76	98.07

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)			

Cross Section 4 - Riffle (R2)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R2
Cross Section Name: XS4 Riffle
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	874.38	GS
8	0	874.42	GS
18	0	871.85	GS
23	0	871.83	GS
33	0	871.93	GS
41	0	871.97	BKF
45.5	0	869.83	GS
48	0	868.9	LEW
50.2	0	868.61	SB
51.5	0	868.29	TW
53.8	0	868.27	SB
56.1	0	868.75	SB
57.3	0	868.93	REW
59.9	0	869.12	GS
64	0	870.62	GS
68.5	0	872.26	RB
78	0	872.12	GS
86	0	872.1	GS
96	0	873.81	GS
106	0	873.21	GS
116	0	873.31	GS
120	0	872.87	GS

Cross Sectional Geometry

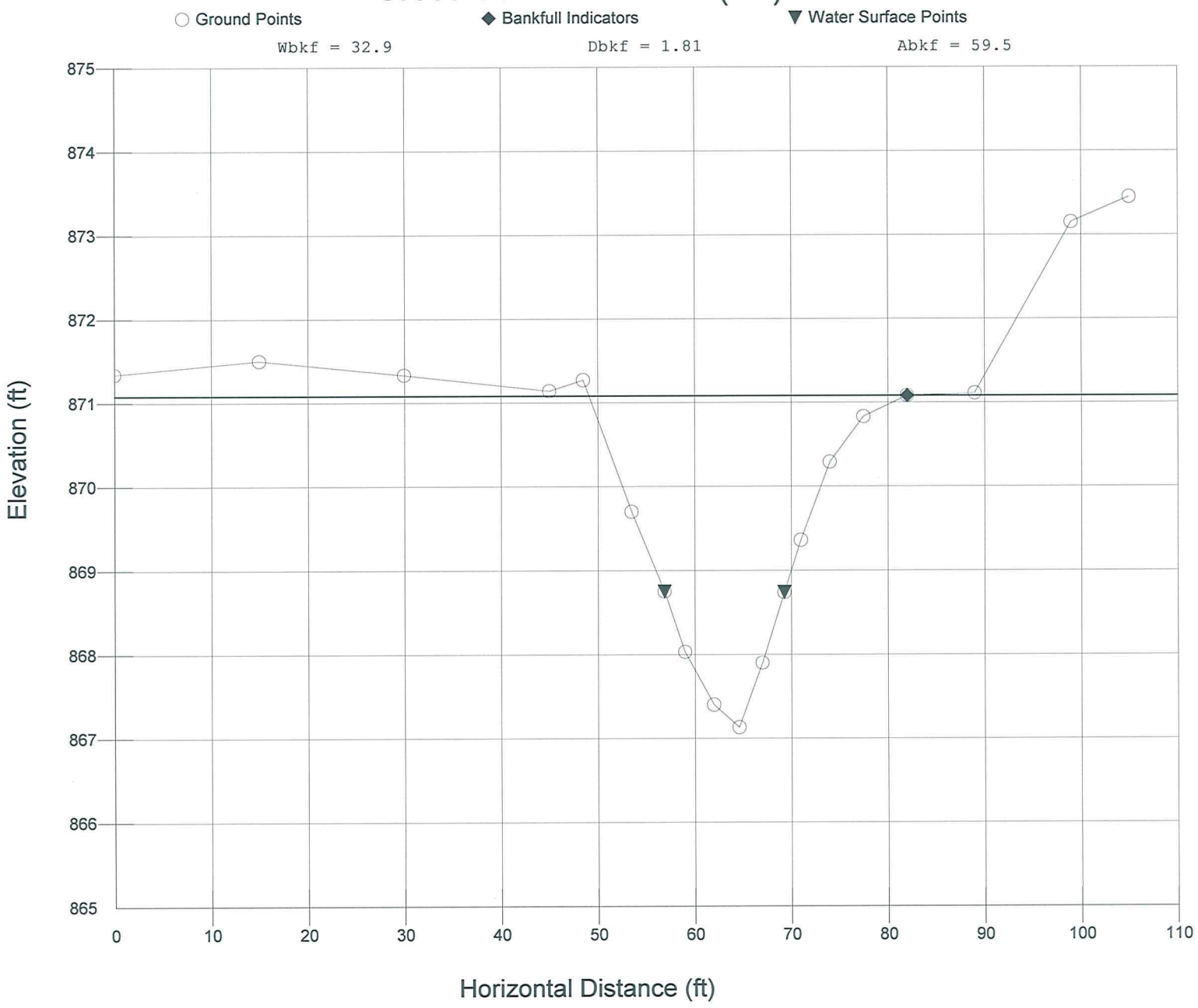
	Channel	Left	Right
Floodprone Elevation (ft)	875.67	875.67	875.67
Bankfull Elevation (ft)	871.97	871.97	871.97
Floodprone Width (ft)	120	-----	-----
Bankfull Width (ft)	50.17	25.09	25.08
Entrenchment Ratio	2.39	-----	-----
Mean Depth (ft)	1.27	0.09	2.45
Maximum Depth (ft)	3.7	0.77	3.7
Width/Depth Ratio	39.5	278.78	10.24
Bankfull Area (sq ft)	63.68	2.36	61.32
Wetted Perimeter (ft)	51.47	26.05	26.96
Hydraulic Radius (ft)	1.24	0.09	2.27
Begin BKF Station	17.53	17.53	42.62
End BKF Station	67.7	42.62	67.7

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)			

Cross Section 5 - Pool (R2)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R2
Cross Section Name: XS5 Pool
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	871.34	GS
15	0	871.5	GS
30	0	871.33	GS
45	0	871.14	GS
48.5	0	871.27	LB
53.5	0	869.7	GS
56.9	0	868.75	LEW
59	0	868.03	SB
62	0	867.4	SB
64.6	0	867.13	TW
67	0	867.9	SB
69.3	0	868.74	REW
71	0	869.36	GS
74	0	870.29	GS
77.5	0	870.83	RB
82	0	871.08	BKF
89	0	871.11	GS
99	0	873.15	GS
105	0	873.45	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	875.03	875.03	875.03
Bankfull Elevation (ft)	871.08	871.08	871.08
Floodprone Width (ft)	105	-----	-----
Bankfull Width (ft)	32.89	16.44	16.45
Entrenchment Ratio	3.19	-----	-----
Mean Depth (ft)	1.81	2.35	1.27
Maximum Depth (ft)	3.95	3.95	3.65
Width/Depth Ratio	18.17	7	12.95
Bankfull Area (sq ft)	59.5	38.61	20.89
Wetted Perimeter (ft)	34	20.68	20.62
Hydraulic Radius (ft)	1.75	1.87	1.01
Begin BKF Station	49.11	49.11	65.55
End BKF Station	82	65.55	82

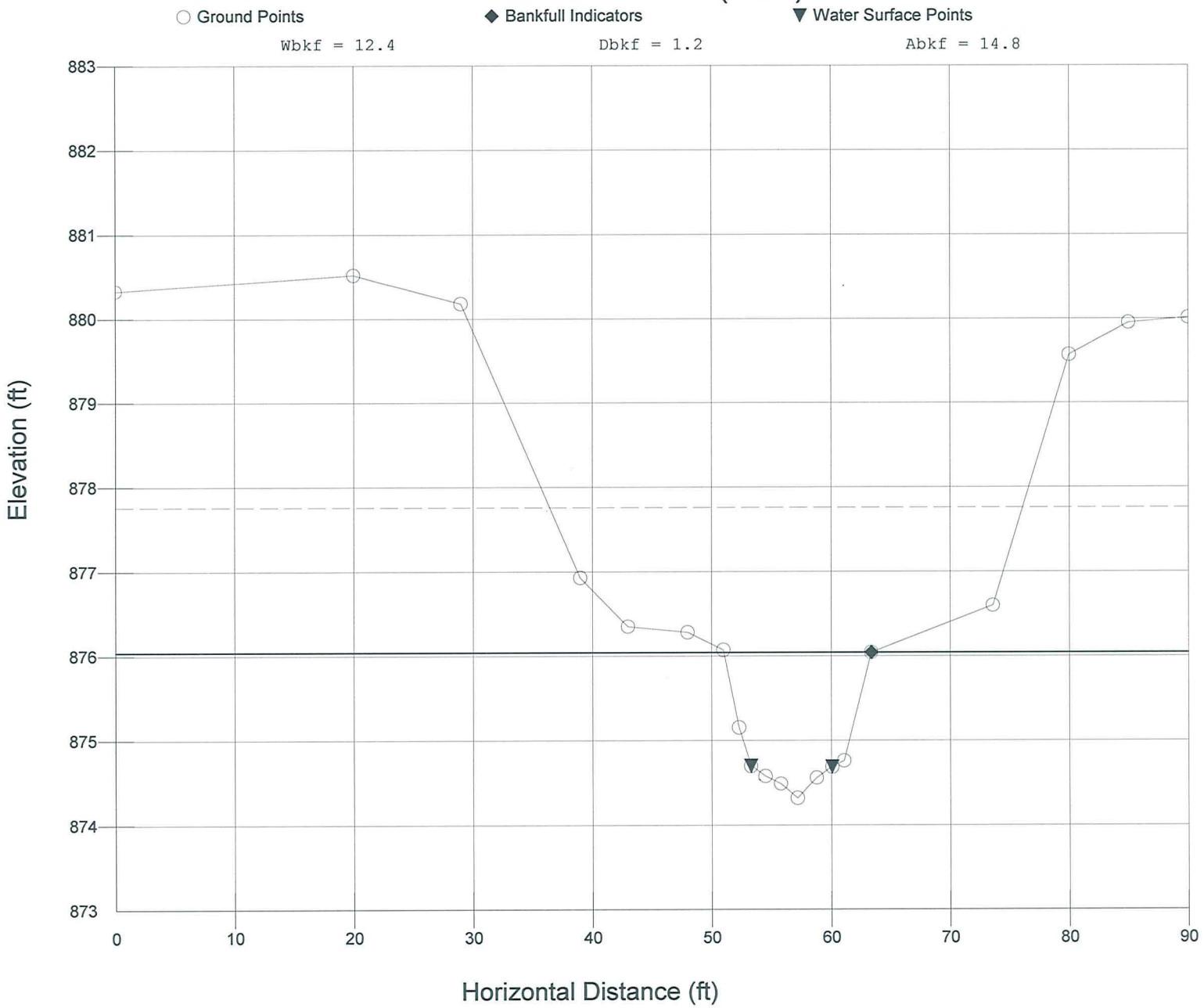
Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side

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

Cross Section 6 - Riffle (R2A)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R2A
Cross Section Name: XS6 Riffle
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	880.33	GS
20	0	880.52	GS
29	0	880.18	GS
39	0	876.93	GS
43	0	876.35	GS
48	0	876.28	GS
51	0	876.07	LB
52.3	0	875.15	GS
53.3	0	874.7	LEW
54.5	0	874.58	SB
55.8	0	874.49	SB
57.2	0	874.32	TW
58.8	0	874.56	SB
60.1	0	874.69	REW
61.1	0	874.76	GS
63.4	0	876.04	BKF
73.6	0	876.6	GS
80	0	879.57	GS
85	0	879.95	GS
90	0	880.01	GS

Cross Sectional Geometry

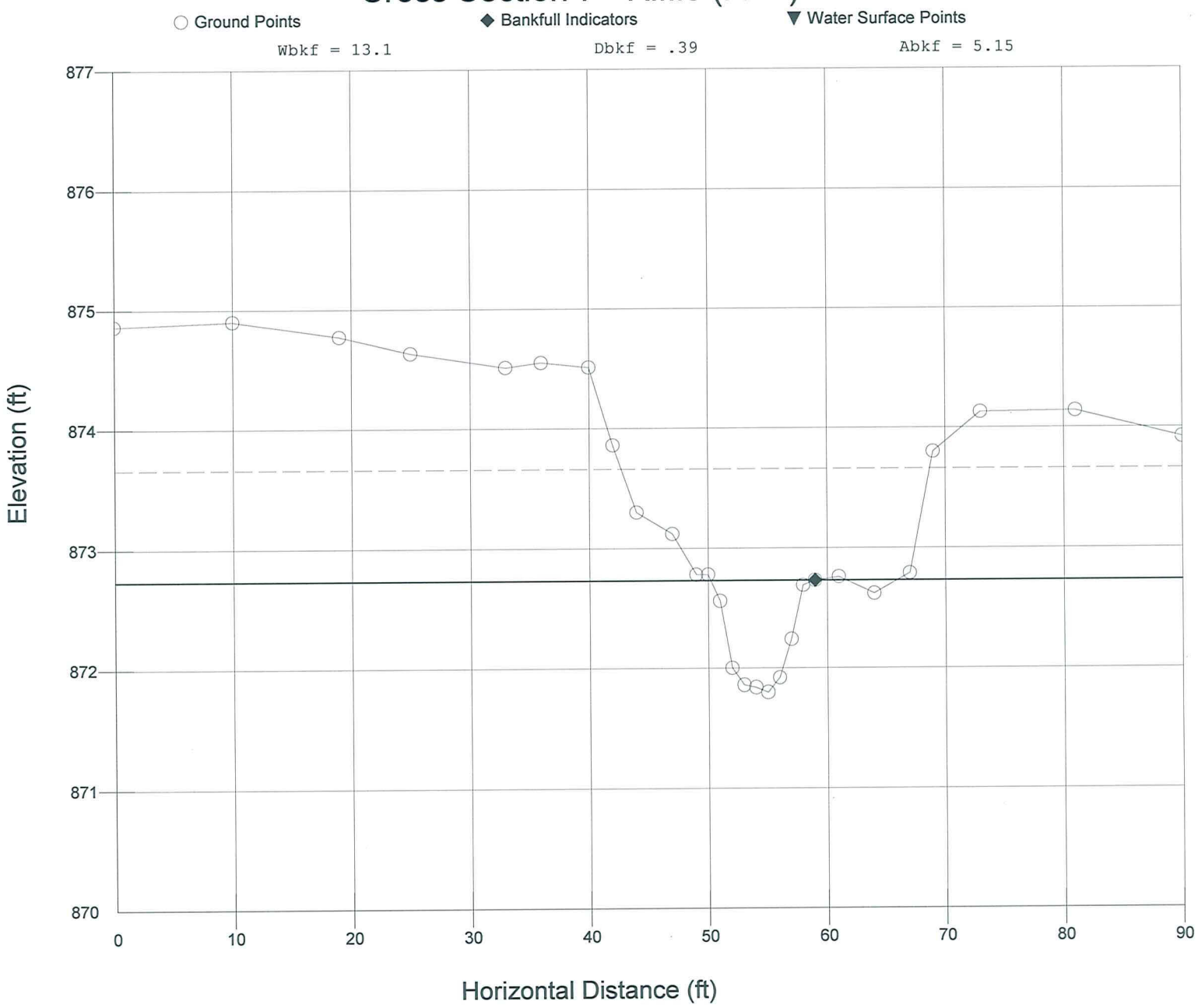
	Channel	Left	Right
Floodprone Elevation (ft)	877.76	877.76	877.76
Bankfull Elevation (ft)	876.04	876.04	876.04
Floodprone Width (ft)	39.65	-----	-----
Bankfull Width (ft)	12.36	6.18	6.18
Entrenchment Ratio	3.21	-----	-----
Mean Depth (ft)	1.2	1.24	1.16
Maximum Depth (ft)	1.72	1.72	1.72
Width/Depth Ratio	10.3	4.98	5.33
Bankfull Area (sq ft)	14.79	7.63	7.15
Wetted Perimeter (ft)	13.12	8.29	8.26
Hydraulic Radius (ft)	1.13	0.92	0.87
Begin BKF Station	51.04	51.04	57.22
End BKF Station	63.4	57.22	63.4

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)			

Cross Section 7 - Riffle (R2B)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R2B
Cross Section Name: XS7 Riffle
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	874.86	GS
10	0	874.9	GS
19	0	874.77	GS
25	0	874.63	GS
33	0	874.51	GS
36	0	874.55	GS
40	0	874.51	GS
42	0	873.86	GS
44	0	873.3	GS
47	0	873.12	GS
49	0	872.78	GS
50	0	872.78	LB
51	0	872.56	GS
52	0	872	GS
53	0	871.86	GS
54	0	871.84	TW
55	0	871.8	GS
56	0	871.92	GS
57	0	872.24	GS
58	0	872.69	RB
59	0	872.73	BKF
61	0	872.76	GS
64	0	872.62	GS
67	0	872.79	GS
69	0	873.8	GS
73	0	874.13	GS
81	0	874.14	GS
90	0	873.92	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	873.66	873.66	873.66
Bankfull Elevation (ft)	872.73	872.73	872.73
Floodprone Width (ft)	26.01	-----	-----
Bankfull Width (ft)	13.07	6.53	9.18
Entrenchment Ratio	1.99	-----	-----
Mean Depth (ft)	0.39	0.69	0.1
Maximum Depth (ft)	0.93	0.93	0.57
Width/Depth Ratio	33.51	9.46	91.8
Bankfull Area (sq ft)	5.15	4.5	0.65
Wetted Perimeter (ft)	13.41	7.32	7.22
Hydraulic Radius (ft)	0.38	0.61	0.09
Begin BKF Station	50.23	50.23	56.76

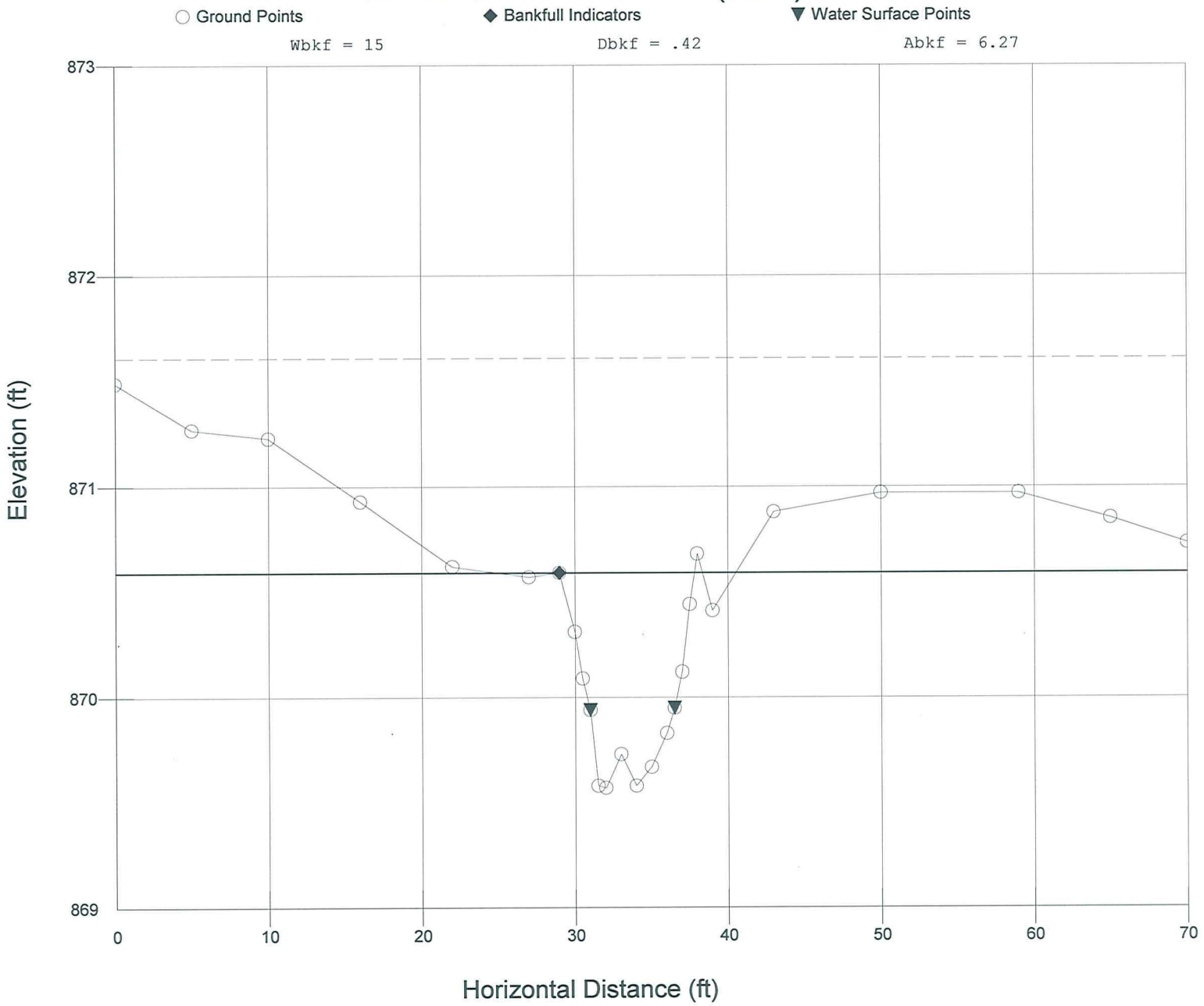
End BKF Station	65.94	56.76	65.94

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)			

Cross Section 8 - Riffle (R2D)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R2
Cross Section Name: XS8 Pool
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	871.34	GS
15	0	871.5	GS
30	0	871.33	GS
45	0	871.14	GS
48.5	0	871.27	LB
53.5	0	869.7	GS
56.9	0	868.75	LEW
59	0	868.03	SB
62	0	867.4	SB
64.6	0	867.13	TW
67	0	867.9	SB
69.3	0	868.74	REW
71	0	869.36	GS
74	0	870.29	GS
77.5	0	870.83	RB
82	0	871.08	BKF
89	0	871.11	GS
99	0	873.15	GS
105	0	873.45	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	875.03	875.03	875.03
Bankfull Elevation (ft)	871.08	871.08	871.08
Floodprone Width (ft)	105	-----	-----
Bankfull Width (ft)	32.89	16.44	16.45
Entrenchment Ratio	3.19	-----	-----
Mean Depth (ft)	1.81	2.35	1.27
Maximum Depth (ft)	3.95	3.95	3.65
Width/Depth Ratio	18.17	7	12.95
Bankfull Area (sq ft)	59.5	38.61	20.89
Wetted Perimeter (ft)	34	20.68	20.62
Hydraulic Radius (ft)	1.75	1.87	1.01
Begin BKF Station	49.11	49.11	65.55
End BKF Station	82	65.55	82

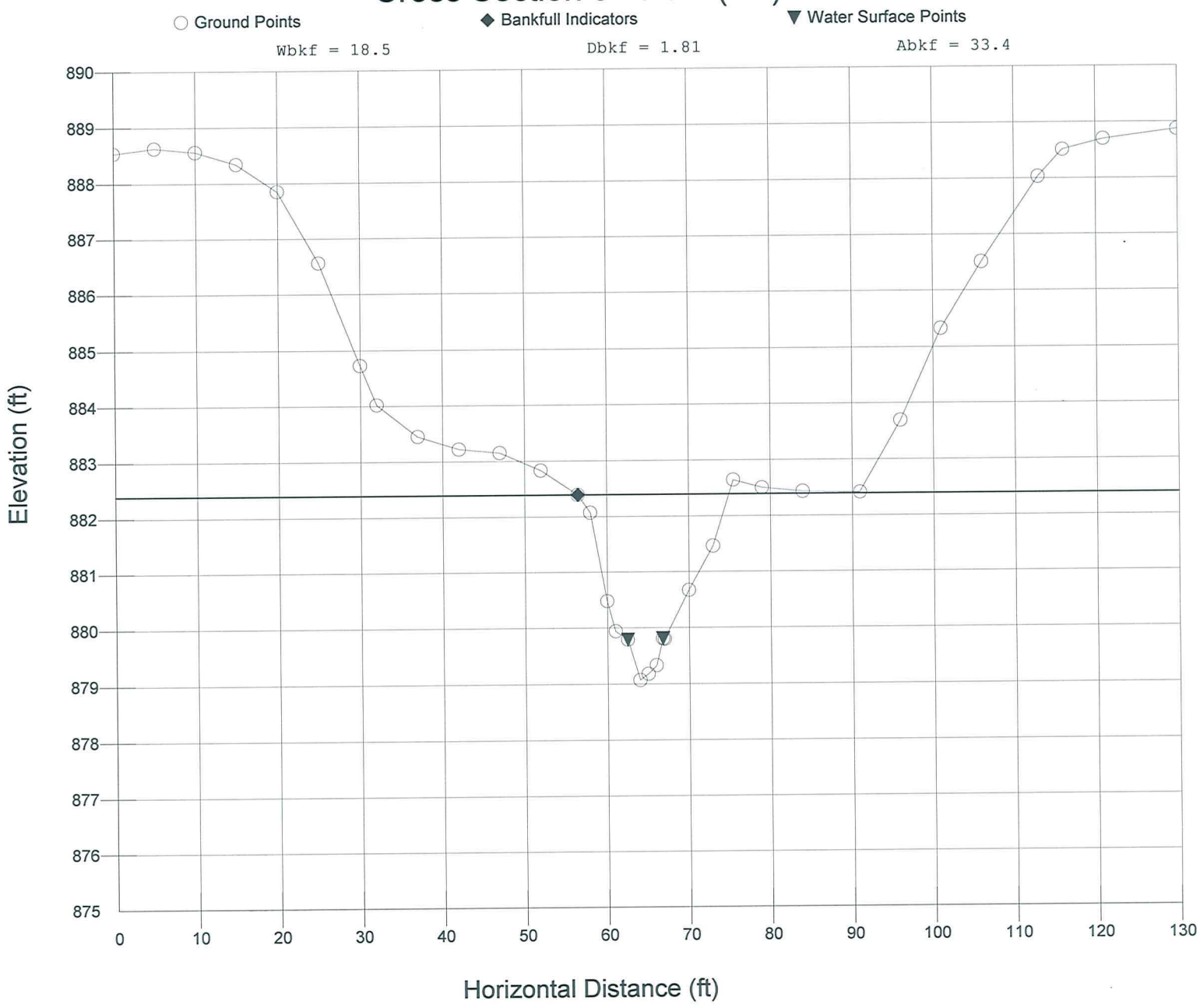
Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side

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

Cross Section 9 - Pool (R1)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R1
Cross Section Name: XS9 - Pool
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	888.54	GS
5	0	888.63	GS
10	0	888.56	GS
15	0	888.34	GS
20	0	887.85	GS
25	0	886.56	GS
30	0	884.73	GS
32	0	884.02	GS
37	0	883.45	GS
42	0	883.22	GS
47	0	883.15	GS
52	0	882.83	GS
56.5	0	882.39	BKF
58	0	882.07	GS
60	0	880.48	GS
61	0	879.94	GS
62.5	0	879.79	LEW
64	0	879.07	TW
65	0	879.18	SB
66	0	879.33	SB
66.8	0	879.81	REW
67	0	879.8	GS
70	0	880.67	GS
73	0	881.46	GS
75.5	0	882.64	RB
79	0	882.5	GS
84	0	882.43	GS
91	0	882.41	GS
96	0	883.69	GS
101	0	885.33	GS
106	0	886.51	GS
113	0	888.03	GS
116	0	888.51	GS
121	0	888.7	GS
130	0	888.87	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	885.71	885.71	885.71
Bankfull Elevation (ft)	882.39	882.39	882.39
Floodprone Width (ft)	75.29	-----	-----
Bankfull Width (ft)	18.47	9.32	9.15
Entrenchment Ratio	4.08	-----	-----

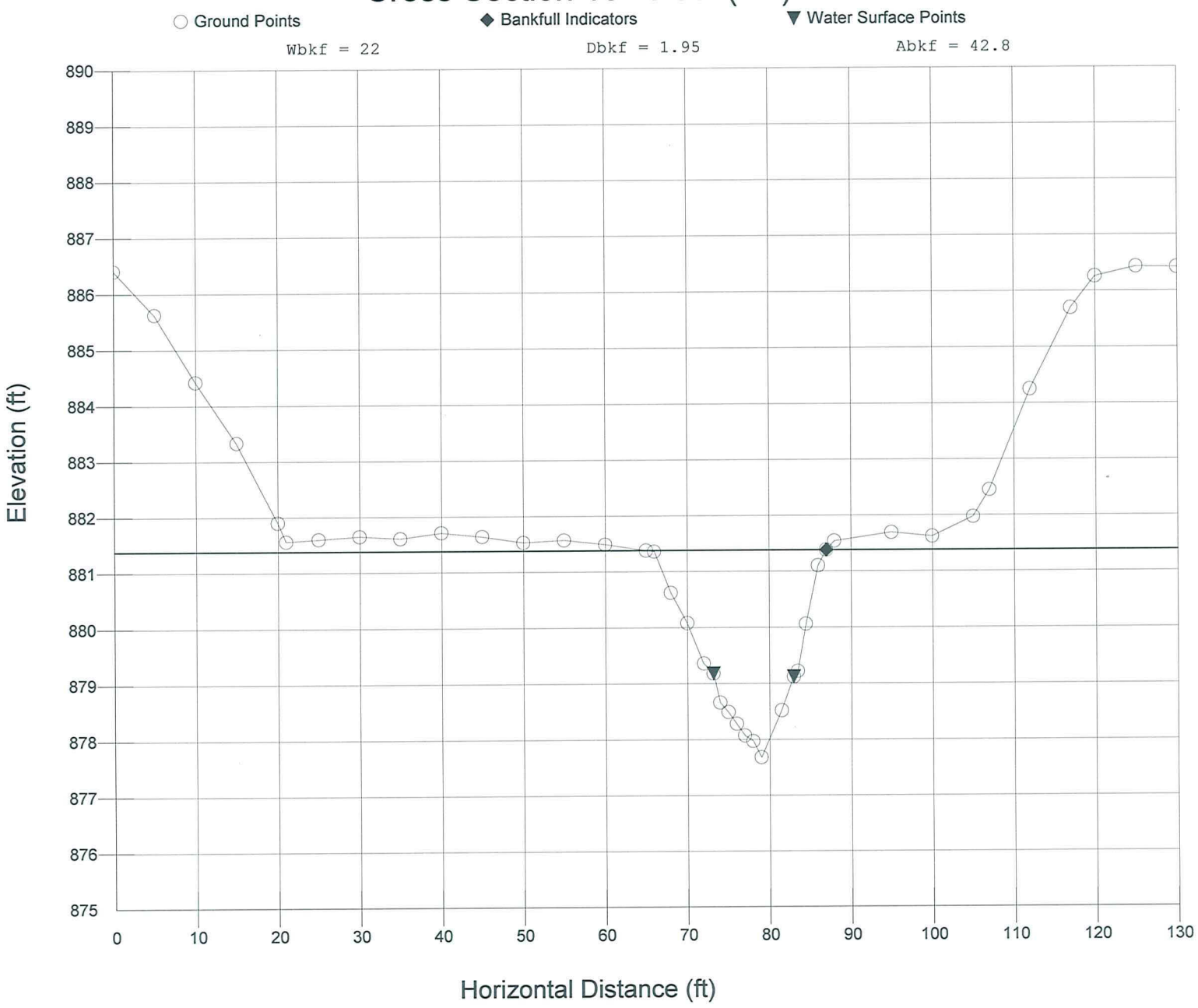
Mean Depth (ft)	1.81	2.01	1.6
Maximum Depth (ft)	3.32	3.32	3.09
Width/Depth Ratio	10.2	4.64	5.72
Bankfull Area (sq ft)	33.41	18.72	14.68
Wetted Perimeter (ft)	19.95	13.32	12.81
Hydraulic Radius (ft)	1.67	1.41	1.15
Begin BKF Station	56.5	56.5	65.82
End BKF Station	74.97	65.82	74.97

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)			

Cross Section 10 - Pool (R1)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R1
Cross Section Name: XS10 - Pool
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	886.41	GS
5	0	885.63	GS
10	0	884.42	GS
15	0	883.33	GS
20	0	881.9	GS
21	0	881.56	GS
25	0	881.6	GS
30	0	881.65	GS
35	0	881.61	GS
40	0	881.71	GS
45	0	881.64	GS
50	0	881.53	GS
55	0	881.57	GS
60	0	881.49	GS
65	0	881.38	GS
66	0	881.36	LB
68	0	880.62	GS
70	0	880.08	GS
72	0	879.36	GS
73.2	0	879.18	LEW
74	0	878.66	SB
75	0	878.49	SB
76	0	878.28	SB
77	0	878.07	SB
78	0	877.97	SB
79	0	877.68	TW
81.5	0	878.52	SB
83	0	879.12	REW
83.5	0	879.22	GS
84.5	0	880.06	GS
86	0	881.1	GS
87	0	881.38	BKF
88	0	881.54	GS
95	0	881.69	GS
100	0	881.62	GS
105	0	881.97	GS
107	0	882.45	GS
112	0	884.25	GS
117	0	885.7	GS
120	0	886.26	GS
125	0	886.43	GS
130	0	886.42	GS

Cross Sectional Geometry

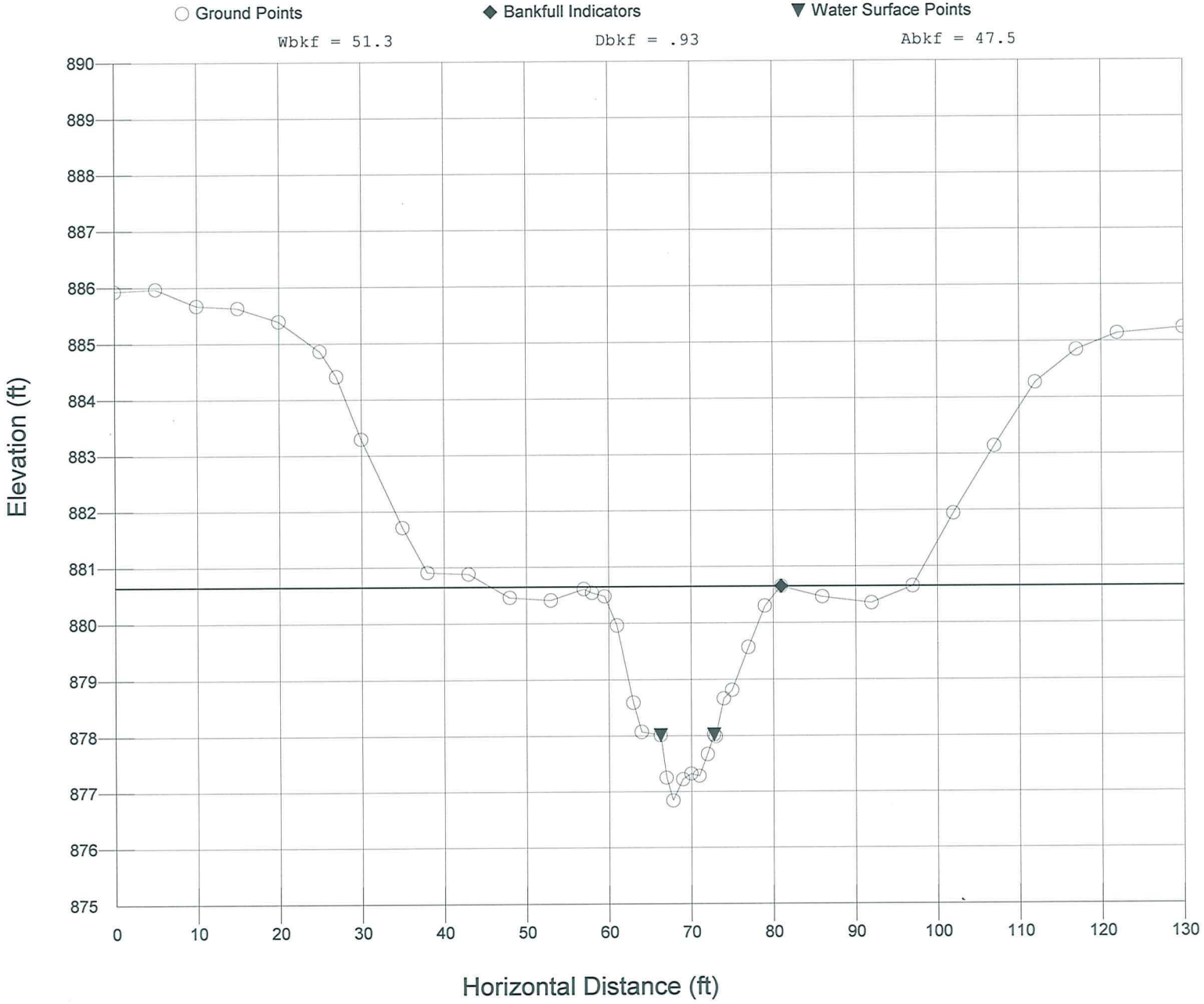
	Channel	Left	Right
Floodprone Elevation (ft)	885.08	885.08	885.08
Bankfull Elevation (ft)	881.38	881.38	881.38
Floodprone Width (ft)	107.59	-----	-----
Bankfull Width (ft)	22	10.82	11.18
Entrenchment Ratio	4.89	-----	-----
Mean Depth (ft)	1.95	1.47	2.41
Maximum Depth (ft)	3.7	3.06	3.7
Width/Depth Ratio	11.28	7.36	4.64
Bankfull Area (sq ft)	42.81	15.92	26.9
Wetted Perimeter (ft)	23.53	14.41	15.25
Hydraulic Radius (ft)	1.82	1.1	1.76
Begin BKF Station	65	65	75.82
End BKF Station	87	75.82	87

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)			

Cross Section 11 - Pool (R1)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R1
Cross Section Name: XS11 - Pool
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	885.93	GS
5	0	885.97	GS
10	0	885.67	GS
15	0	885.63	GS
20	0	885.39	GS
25	0	884.86	GS
27	0	884.41	GS
30	0	883.29	GS
35	0	881.71	GS
38	0	880.91	GS
43	0	880.88	GS
48	0	880.46	GS
53	0	880.41	GS
57	0	880.61	GS
58	0	880.54	GS
59.5	0	880.48	LB
61	0	879.96	GS
63	0	878.59	GS
64	0	878.07	GS
66.3	0	878.01	LEW
67	0	877.25	SB
67.8	0	876.84	TW
69	0	877.22	SB
70	0	877.32	SB
71	0	877.28	SB
72	0	877.67	SB
72.8	0	878.02	REW
73	0	877.99	GS
74	0	878.66	GS
75	0	878.81	GS
77	0	879.57	GS
79	0	880.3	GS
81	0	880.65	BKF
86	0	880.46	GS
92	0	880.35	GS
97	0	880.65	GS
102	0	881.94	GS
107	0	883.14	GS
112	0	884.27	GS
117	0	884.85	GS
122	0	885.14	GS
130	0	885.24	GS

Cross Sectional Geometry

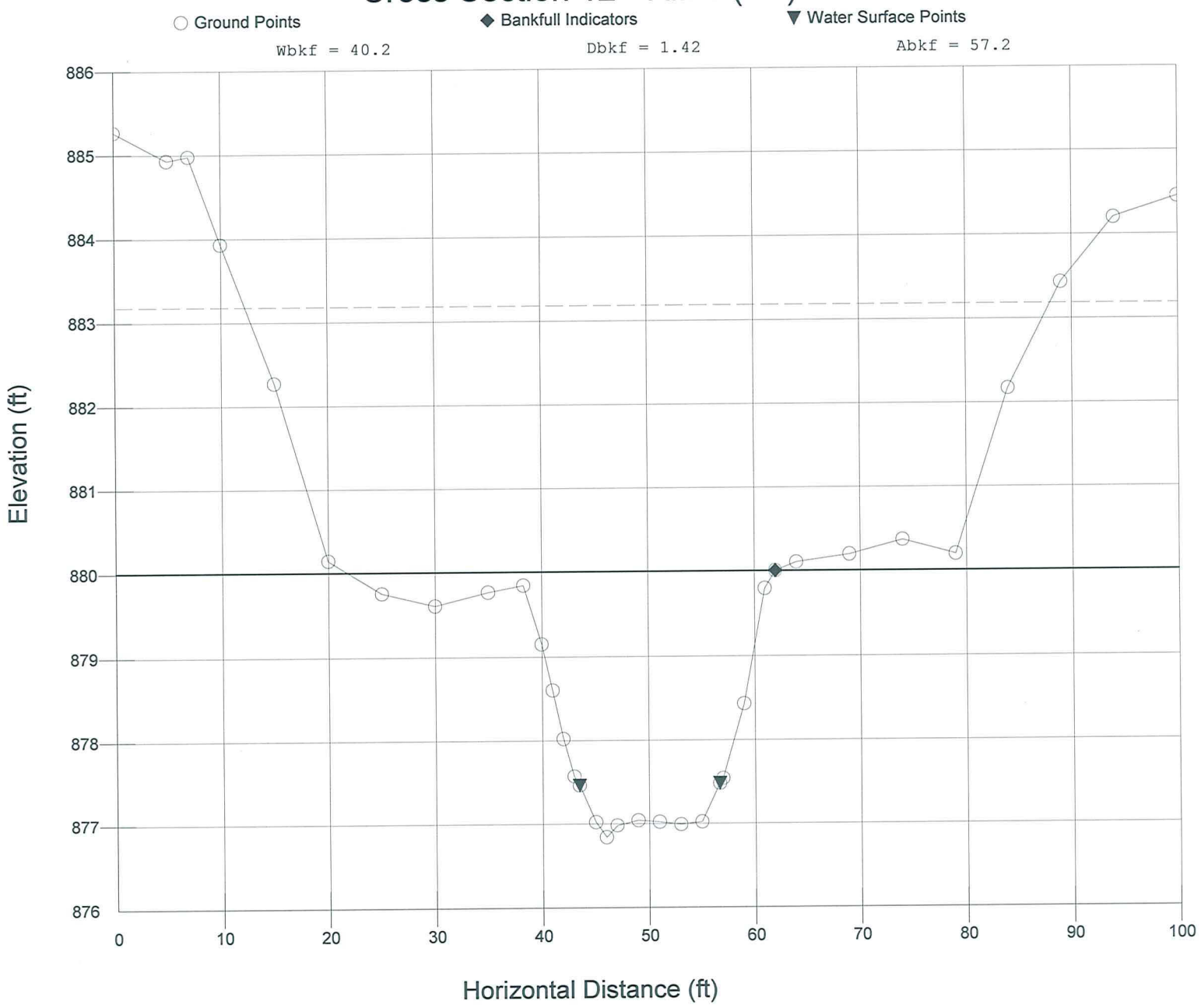
	Channel	Left	Right
Floodprone Elevation (ft)	884.46	884.46	884.46
Bankfull Elevation (ft)	880.65	880.65	880.65
Floodprone Width (ft)	86.86	-----	-----
Bankfull Width (ft)	51.26	25.48	25.78
Entrenchment Ratio	1.69	-----	-----
Mean Depth (ft)	0.93	1.2	0.65
Maximum Depth (ft)	3.81	3.81	3.28
Width/Depth Ratio	55.12	21.23	39.66
Bankfull Area (sq ft)	47.51	30.66	16.85
Wetted Perimeter (ft)	53.09	29.94	29.72
Hydraulic Radius (ft)	0.89	1.02	0.57
Begin BKF Station	45.74	45.74	71.22
End BKF Station	97	71.22	97

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)			

Cross Section 12 - Riffle (R1)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R1
Cross Section Name: XS12 - Riffle
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	885.27	GS
5	0	884.93	GS
7	0	884.98	GS
10	0	883.93	GS
15	0	882.27	GS
20	0	880.15	GS
25	0	879.76	GS
30	0	879.61	GS
35	0	879.77	GS
38.3	0	879.85	LB
40	0	879.15	GS
41	0	878.6	GS
42	0	878.02	GS
43	0	877.57	GS
43.5	0	877.46	LEW
45	0	877.02	SB
46	0	876.84	TW
47	0	876.98	SB
49	0	877.04	SB
51	0	877.02	SB
53	0	876.99	SB
55	0	877.02	SB
56.7	0	877.48	REW
57	0	877.54	GS
59	0	878.43	GS
61	0	879.8	GS
62	0	880.01	BKF
64	0	880.11	GS
69	0	880.2	GS
74	0	880.37	GS
79	0	880.2	GS
84	0	882.17	GS
89	0	883.43	GS
94	0	884.2	GS
100	0	884.45	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	883.18	883.18	883.18
Bankfull Elevation (ft)	880.01	880.01	880.01
Floodprone Width (ft)	75.75	-----	-----
Bankfull Width (ft)	40.21	19.81	20.4
Entrenchment Ratio	1.88	-----	-----

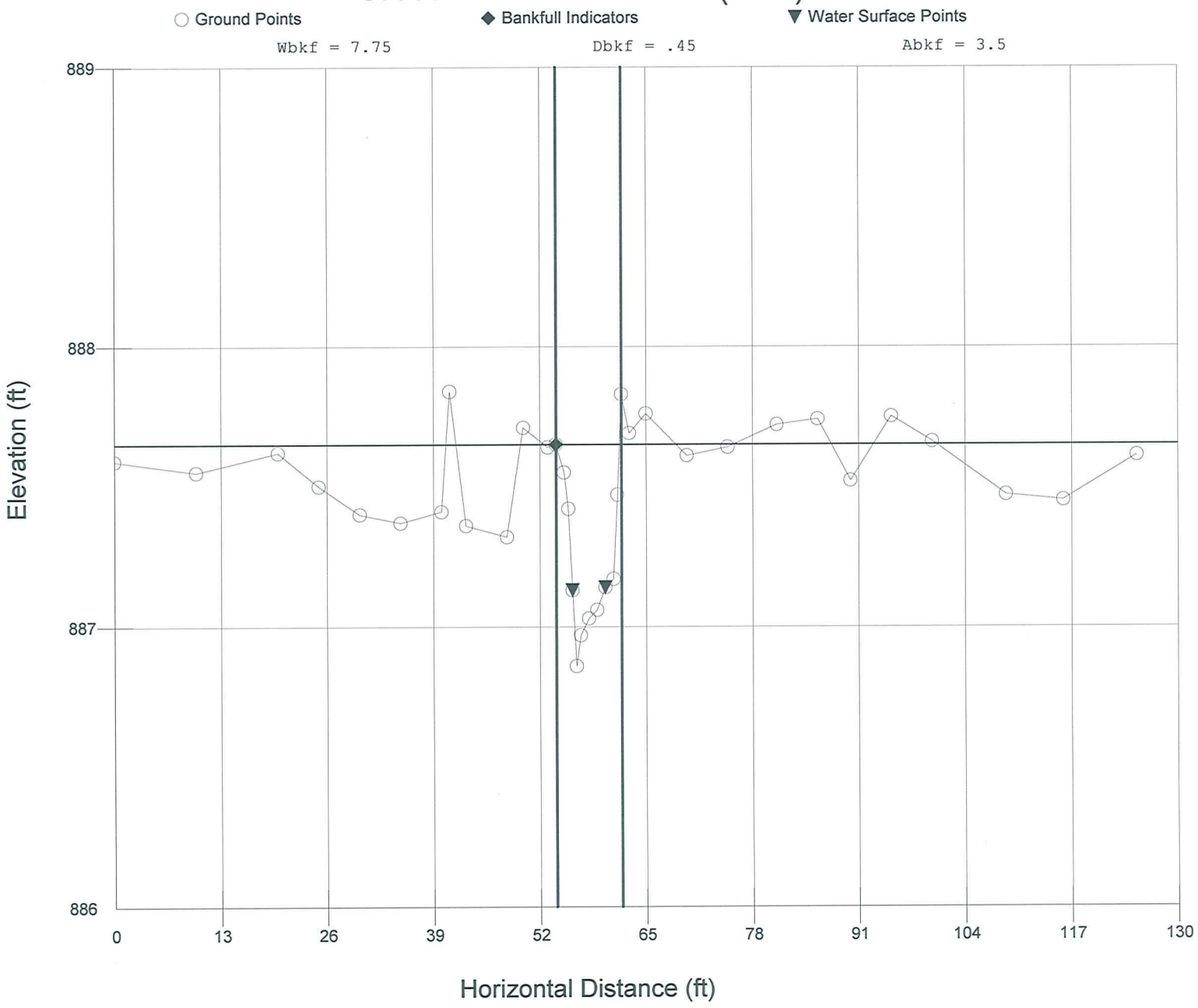
Mean Depth (ft)	1.42	0.37	2.45
Maximum Depth (ft)	3.17	1.76	3.17
Width/Depth Ratio	28.32	53.54	8.33
Bankfull Area (sq ft)	57.15	7.24	49.91
Wetted Perimeter (ft)	41.56	21.95	23.12
Hydraulic Radius (ft)	1.38	0.33	2.16
Begin BKF Station	21.79	21.79	41.6
End BKF Station	62	41.6	62

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)			

Cross Section 13 - Pool (R1A)



RIVERMORPH CROSS SECTION SUMMARY

River Name: Little White Oak Creek
Reach Name: R1A
Cross Section Name: XS13 - Pool
Survey Date: 03/14/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	887.59	GS
10	0	887.55	GS
20	0	887.62	GS
25	0	887.5	GS
30	0	887.4	GS
35	0	887.37	GS
40	0	887.41	GS
41	0	887.84	GS
43	0	887.36	GS
48	0	887.32	GS
50	0	887.71	GS
53	0	887.64	LB
54	0	887.65	BKF
55	0	887.55	GS
55.5	0	887.42	GS
56	0	887.13	LEW
56.5	0	886.86	SB
57	0	886.97	TW
58	0	887.03	SB
59	0	887.06	SB
60	0	887.14	REW
61	0	887.17	GS
61.5	0	887.47	GS
62	0	887.83	RB
62.963	0	887.69	GS
65	0	887.76	GS
70	0	887.61	GS
75	0	887.64	GS
81	0	887.72	GS
86	0	887.74	GS
90	0	887.52	GS
95	0	887.75	GS
100	0	887.66	GS
109	0	887.47	GS
116	0	887.45	GS
125	0	887.61	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	888.44	888.44	888.44
Bankfull Elevation (ft)	887.65	887.65	887.65
Floodprone Width (ft)	125	-----	-----
Bankfull Width (ft)	94.44	47.06	77.94

Entrenchment Ratio	1.32	-----	-----
Mean Depth (ft)	0.16	0.15	0.16
Maximum Depth (ft)	0.79	0.32	0.79
Width/Depth Ratio	590.25	313.73	487.13
Bankfull Area (sq ft)	14.78	7.01	7.77
Wetted Perimeter (ft)	94.99	46.3	49.34
Hydraulic Radius (ft)	0.16	0.15	0.16
Begin BKF Station	0	0	47.06
End BKF Station	125	47.06	125

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)			

APPENDIX C

PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix C:**
EEP	Little White Oak Creek Stream Restoration	Cross Section Photographs

Photo No.	**Date:**
1	1/30/08

Perspective:

Looking left to right

Description:

Cross Section 1 on Reach R2.

Photo No.	**Date:**
2	1/30/08

Perspective:

Looking left to right

Description:

Cross Section 2 on Reach R2.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix C:**
EEP	Little White Oak Creek Stream Restoration	Cross Section Photographs

Photo No. 3	**Date:** 1/30/08

Perspective:

Looking left to right

Description:

Cross Section 3 on Reach R2.

Photo No. 4	**Date:** 1/31/08

Perspective:

Looking left to right

Description:

Cross Section 4 on Reach R2.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix C:**
EEP	Little White Oak Creek Stream Restoration	Cross Section Photographs

Photo No.	**Date:**
5	1/31/08

Perspective:

Looking left to right

Description:

Cross Section 5 on Reach R2.

Photo No.	**Date:**
6	2/13/08

Perspective:

Looking left to right

Description:

Cross Section 6 on Reach R2A.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix C:**
EEP	Little White Oak Creek Stream Restoration	Cross Section Photographs

Photo No.	**Date:**
7	1/30/08

Perspective:

Looking left to right

Description:

Cross Section 7 on Reach R2B.

Photo No.	**Date:**
8	1/31/08

Perspective:

Looking left to right

Description:

Cross Section 8 on Reach R2D.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix C:**
EEP	Little White Oak Creek Stream Restoration	Cross Section Photographs

Photo No.	**Date:**
9	1/31/08

Perspective:

Looking left to right

Description:

Cross Section 9 on Reach R1.

Photo No.	**Date:**
10	1/31/08

Perspective:

Looking left to right

Description:

Cross Section 10 on Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix C:**
EEP	Little White Oak Creek Stream Restoration	Cross Section Photographs

Photo No.	**Date:**
11	1/31/08

Perspective:

Looking left to right

Description:

Cross Section 11 on Reach R1.

Photo No.	**Date:**
12	2/28/08

Perspective:

Looking left to right

Description:

Cross Section 12 on Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix C:**
EEP	Little White Oak Creek Stream Restoration	Cross Section Photographs

Photo No.	**Date:**
13	1/13/08

Perspective:

Looking left to right

Description:

Cross Section 13 on Reach R1A.

APPENDIX D

APPENDIX E

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
1	1/30/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 1 on Reach R2 Upper.

Photo No.	**Date:**
2	1/30/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 2 on Reach R2 Upper/R2A.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
3	1/30/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 3 on Reach R2 Upper.

Photo No.	**Date:**
4	1/30/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 4 on Reach R2 Upper.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
5	1/30/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 5 on Reach R2B.

Photo No.	**Date:**
6	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 6 on Reach R2B.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
7	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 7 on Reach R2 Upper.

Photo No.	**Date:**
8	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 8 on Reach R2 Upper.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
9	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 9 on Reach R2 Upper.

Photo No.	**Date:**
10	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 10 on Reach R2 Lower.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
11	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 11 on Reach R2 Lower.

Photo No.	**Date:**
12	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 12 on Reach R2D.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
13	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 13 on Reach R1.

Photo No.	**Date:**
14	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 14 on Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
15	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 15 on Reach R1.

Photo No.	**Date:**
16	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 16 on Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
17	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 17 on Reach R1.

Photo No.	**Date:**
18	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 18 on Reach R1A.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
19	1/31/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 19 on Reach R1A.

Photo No.	**Date:**
20	2/28/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 20 on Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
21	2/28/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 21 on Reach R1.

Photo No.	**Date:**
22	2/28/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 22 on Reach R1 below bridge.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix E:**
EEP	Little White Oak Creek Stream Restoration	Vegetation Plot Photographs

Photo No.	**Date:**
23	2/28/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 23 on Reach R1.

Photo No.	**Date:**
24	2/28/08

Perspective:

Facing downstream, right to left diagonal view across plot.

Description:

Veg Plot 24 on Reach R1.

APPENDIX F

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
1	1/30/08

Perspective:

Facing downstream

Description:

Photo Point 1 located on Reach R2 Upper.

Photo No.	**Date:**
2	1/30/08

Perspective:

Facing upstream

Description:

Photo Point 2 view upstream on Reach R2 Upper.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
3	1/30/08

Perspective:

Facing downstream

Description:

Photo Point 2 view downstream on Reach R2A.

Photo No.	**Date:**
4	1/30/08

Perspective:

Facing upstream

Description:

Photo Point 2 view upstream on Reach R2A.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
5	1/31/08

Perspective:

Facing downstream

Description:

Photo Point 3 view downstream on Reach R2B.

Photo No.	**Date:**
6	1/31/08

Perspective:

Looking left to right

Description:

Photo Point 3 view upstream on Reach R2B.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
7	1/31/08

Perspective:

Facing downstream

Description:

Photo Point 4 view downstream on Reach R2 Upper.

Photo No.	**Date:**
8	1/31/08

Perspective:

Facing upstream

Description:

Photo Point 4 view upstream on Reach R2 Upper.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
9	1/31/08

Perspective:

Facing upstream

Description:

Photo Point 4 view upstream on Reach R1.

Photo No.	**Date:**
10	1/31/08

Perspective:

Facing downstream

Description:

Photo Point 5 view downstream on Reach R2 Lower.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
11	1/31/08

Perspective:

Facing upstream

Description:

Photo Point 5 view upstream on Reach R2 Lower.

Photo No.	**Date:**
12	1/31/08

Perspective:

Facing downstream

Description:

Photo Point 6 view downstream on Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
13	1/31/08

Perspective:

Facing upstream

Description:

Photo Point 6 view upstream on Reach R1.

Photo No.	**Date:**
14	1/31/08

Perspective:

Facing downstream

Description:

Photo Point 7 view downstream on Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
15	1/31/08

Perspective:

Facing upstream

Description:

Photo Point 7 view upstream on Reach R1.

Photo No.	**Date:**
16	1/31/08

Perspective:

Facing downstream

Description:

Photo Point 8 view downstream on Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
17	1/31/08

Perspective:

Facing upstream

Description:

Photo Point 8 view upstream on Reach R1.

Photo No.	**Date:**
18	1/31/08

Perspective:

Facing upstream

Description:

Photo Point 8 view upstream on Reach R1A.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
19	2/28/08

Perspective:

Facing downstream

Description:

Photo Point 9 view downstream on Reach R1.

Photo No.	**Date:**
20	2/28/08

Perspective:

Facing across

Description:

Photo Point 9 view across Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
21	2/28/08

Perspective:

Facing upstream

Description:

Photo Point 9 view upstream on Reach R1.

Photo No.	**Date:**
22	2/28/08

Perspective:

Facing downstream

Description:

Photo Point 10 view downstream on Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
23	2/28/08

Perspective:

Facing across

Description:

Photo Point 10 view across Reach R1.

Photo No.	**Date:**
24	2/28/08

Perspective:

Facing upstream

Description:

Photo Point 10 view upstream on Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No. 25	**Date:** 2/28/08

Perspective:

Facing downstream

Description:

Photo Point 11 view downstream on Reach R1.

Photo No. 26	**Date:** 2/28/08

Perspective:

Facing across

Description:

Photo Point 11 view across Reach R1.

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PHOTOGRAPHIC LOG – YEAR 0, 2008

Client Name:	**Project Name:**	**Appendix F:**
EEP	Little White Oak Creek Stream Restoration	Reference Photo Points

Photo No.	**Date:**
27	2/28/08

Perspective:

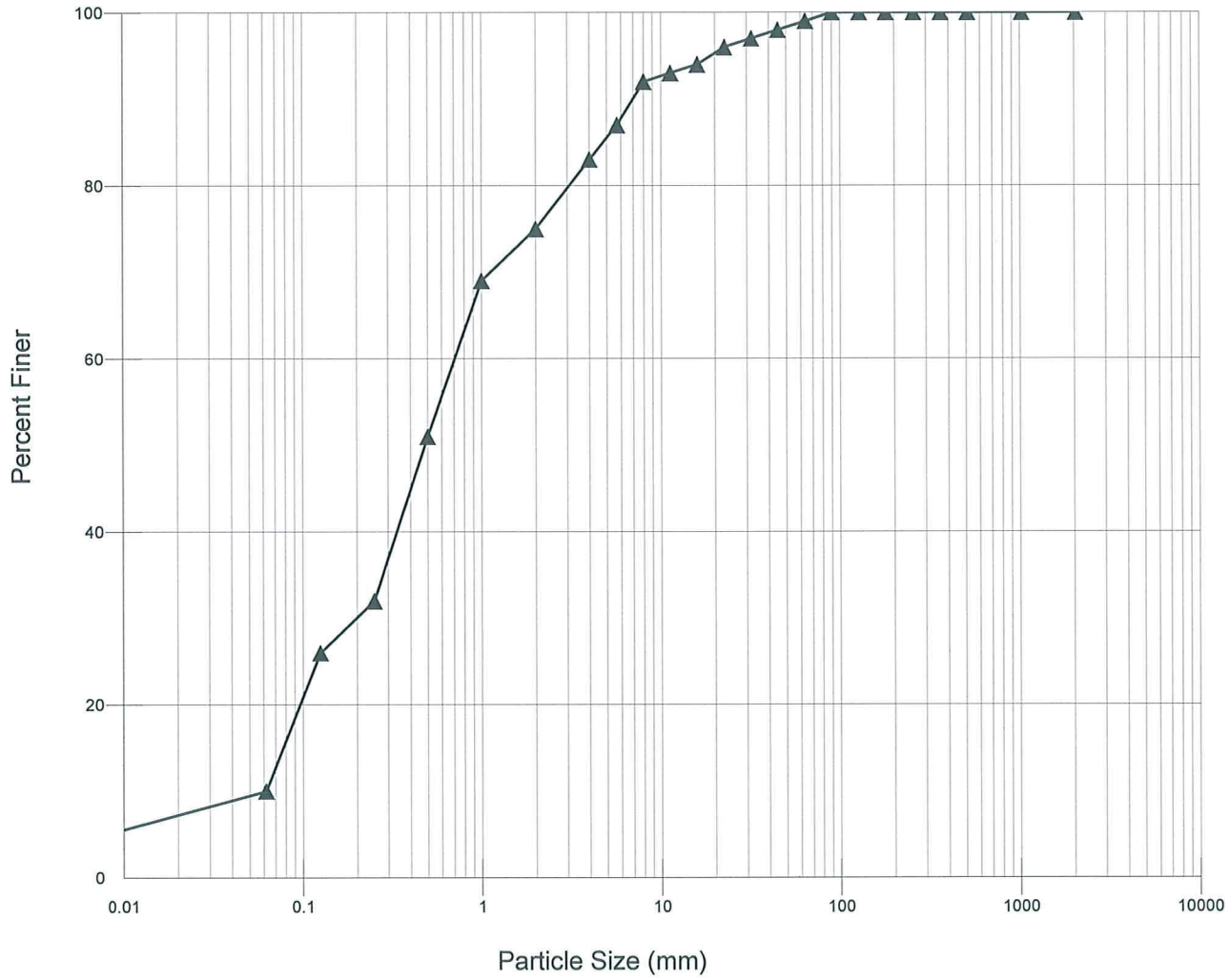
Facing upstream

Description:

Photo Point 11 view upstream on Reach R1.

APPENDIX G

R1 Reachwide Pebble Count



RIVERMORPH PARTICLE SUMMARY

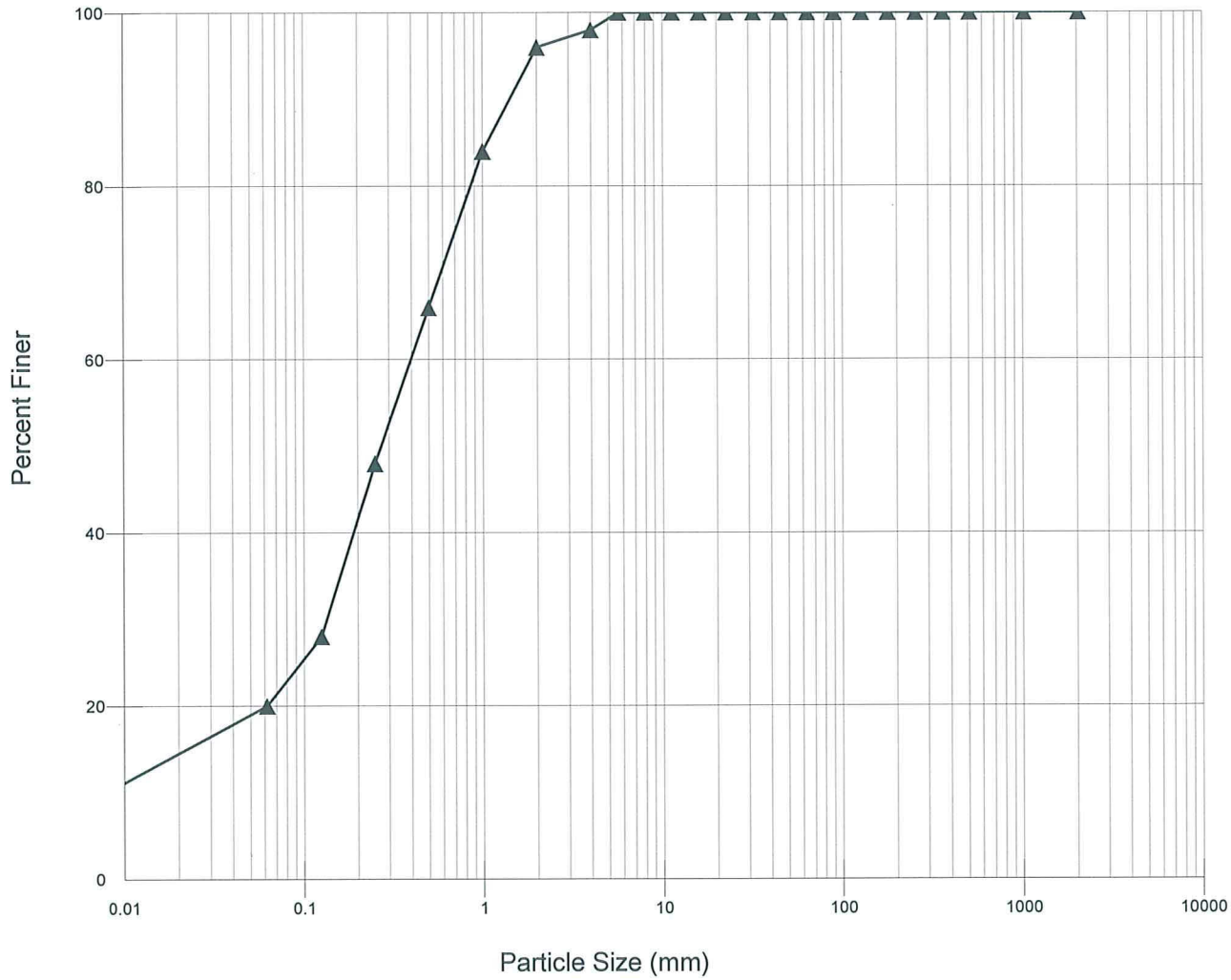
River Name: Little White Oak Creek
Reach Name: R1
Sample Name: R1 Reachwide Pebble Count
Survey Date: 03/04/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	10	10.00	10.00
0.062 - 0.125	16	16.00	26.00
0.125 - 0.25	6	6.00	32.00
0.25 - 0.50	19	19.00	51.00
0.50 - 1.0	18	18.00	69.00
1.0 - 2.0	6	6.00	75.00
2.0 - 4.0	8	8.00	83.00
4.0 - 5.7	4	4.00	87.00
5.7 - 8.0	5	5.00	92.00
8.0 - 11.3	1	1.00	93.00
11.3 - 16.0	1	1.00	94.00
16.0 - 22.6	2	2.00	96.00
22.6 - 32.0	1	1.00	97.00
32 - 45	1	1.00	98.00
45 - 64	1	1.00	99.00
64 - 90	1	1.00	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)	0.09
D35 (mm)	0.29
D50 (mm)	0.49
D84 (mm)	4.42
D95 (mm)	19.3
D100 (mm)	90
Silt/Clay (%)	10
Sand (%)	65
Gravel (%)	24
Cobble (%)	1
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

Reachwide Pebble Count (R1A)



RIVERMORPH PARTICLE SUMMARY

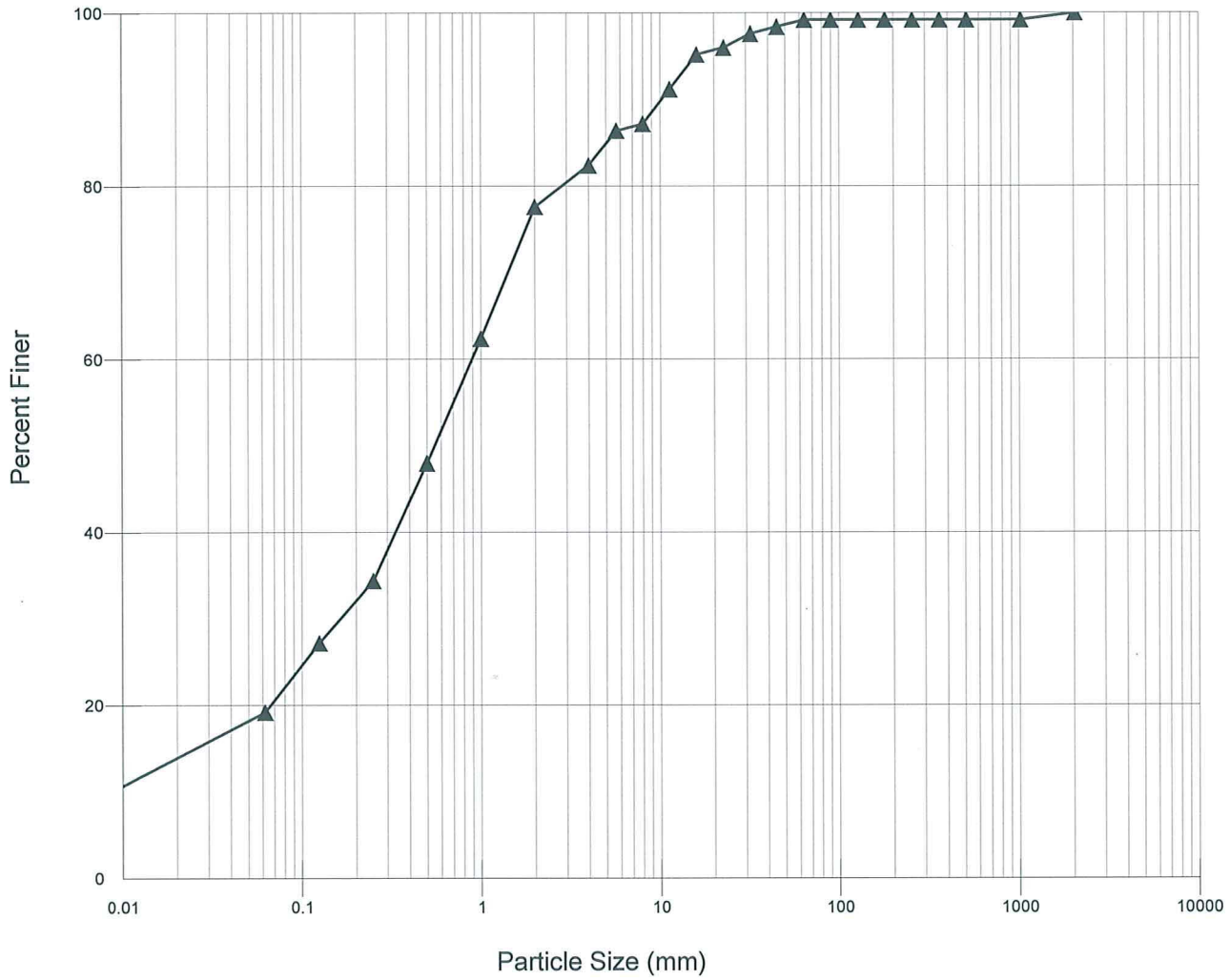
River Name: Little White Oak Creek
Reach Name: R1A
Sample Name: R1A Reachwide Pebble Count
Survey Date: 03/04/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	10	20.00	20.00
0.062 - 0.125	4	8.00	28.00
0.125 - 0.25	10	20.00	48.00
0.25 - 0.50	9	18.00	66.00
0.50 - 1.0	9	18.00	84.00
1.0 - 2.0	6	12.00	96.00
2.0 - 4.0	1	2.00	98.00
4.0 - 5.7	1	2.00	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)	0.05
D35 (mm)	0.17
D50 (mm)	0.28
D84 (mm)	1
D95 (mm)	1.92
D100 (mm)	5.7
Silt/Clay (%)	20
Sand (%)	76
Gravel (%)	4
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 50 (need at least 60).

R2 Reachwide Pebble Count



RIVERMORPH PARTICLE SUMMARY

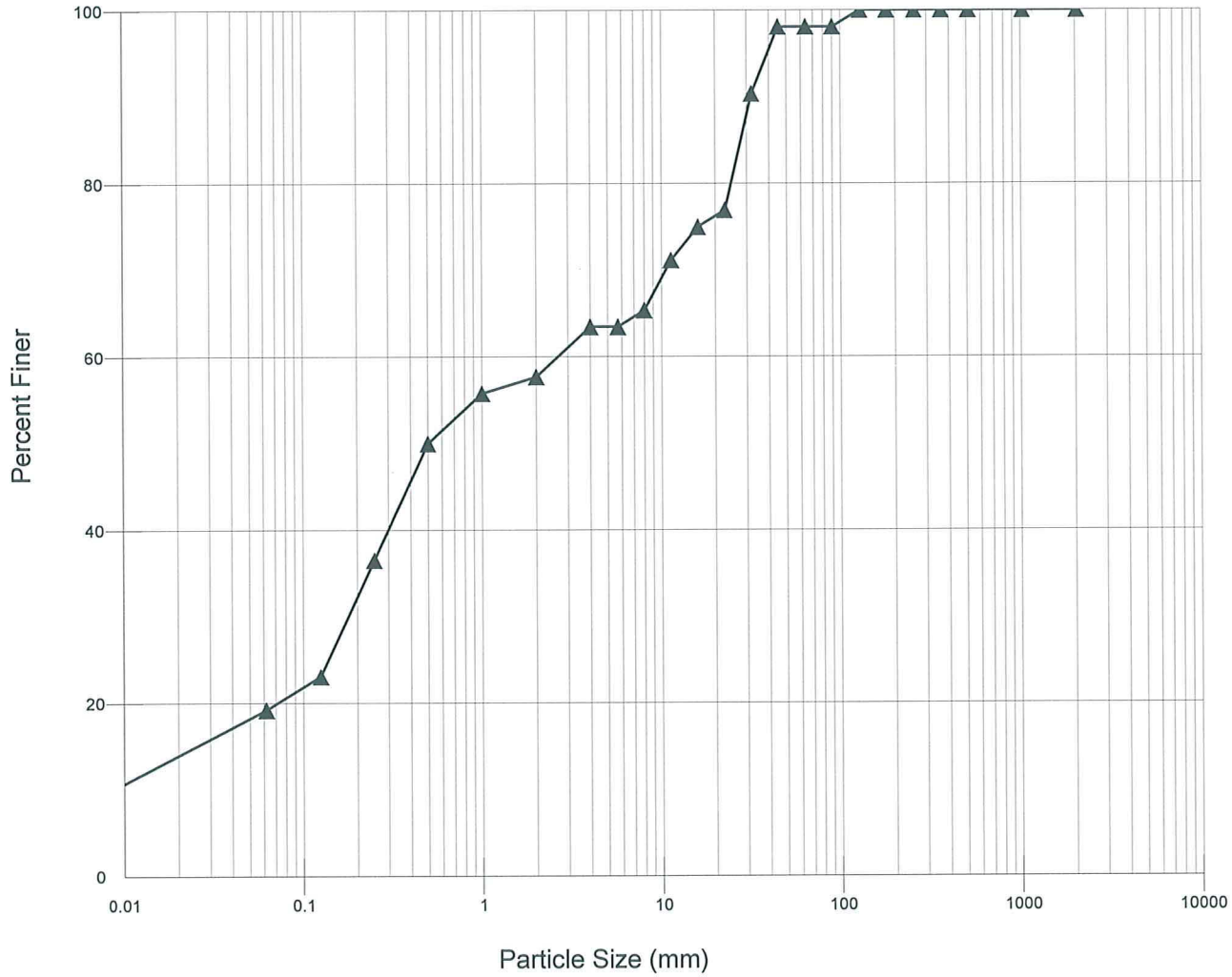
River Name: Little White Oak Creek
Reach Name: R2
Sample Name: R2 Reachwide Pebble Count
Survey Date: 08/20/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	24	19.20	19.20
0.062 - 0.125	10	8.00	27.20
0.125 - 0.25	9	7.20	34.40
0.25 - 0.50	17	13.60	48.00
0.50 - 1.0	18	14.40	62.40
1.0 - 2.0	19	15.20	77.60
2.0 - 4.0	6	4.80	82.40
4.0 - 5.7	5	4.00	86.40
5.7 - 8.0	1	0.80	87.20
8.0 - 11.3	5	4.00	91.20
11.3 - 16.0	5	4.00	95.20
16.0 - 22.6	1	0.80	96.00
22.6 - 32.0	2	1.60	97.60
32 - 45	1	0.80	98.40
45 - 64	1	0.80	99.20
64 - 90	0	0.00	99.20
90 - 128	0	0.00	99.20
128 - 180	0	0.00	99.20
180 - 256	0	0.00	99.20
256 - 362	0	0.00	99.20
362 - 512	0	0.00	99.20
512 - 1024	0	0.00	99.20
1024 - 2048	1	0.80	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.05
D35 (mm)	0.26
D50 (mm)	0.57
D84 (mm)	4.68
D95 (mm)	15.77
D100 (mm)	2047.87
Silt/Clay (%)	19.2
Sand (%)	58.4
Gravel (%)	21.6
Cobble (%)	0
Boulder (%)	0.8
Bedrock (%)	0

Total Particles = 125.

Reachwide Pebble Count (R2A)



RIVERMORPH PARTICLE SUMMARY

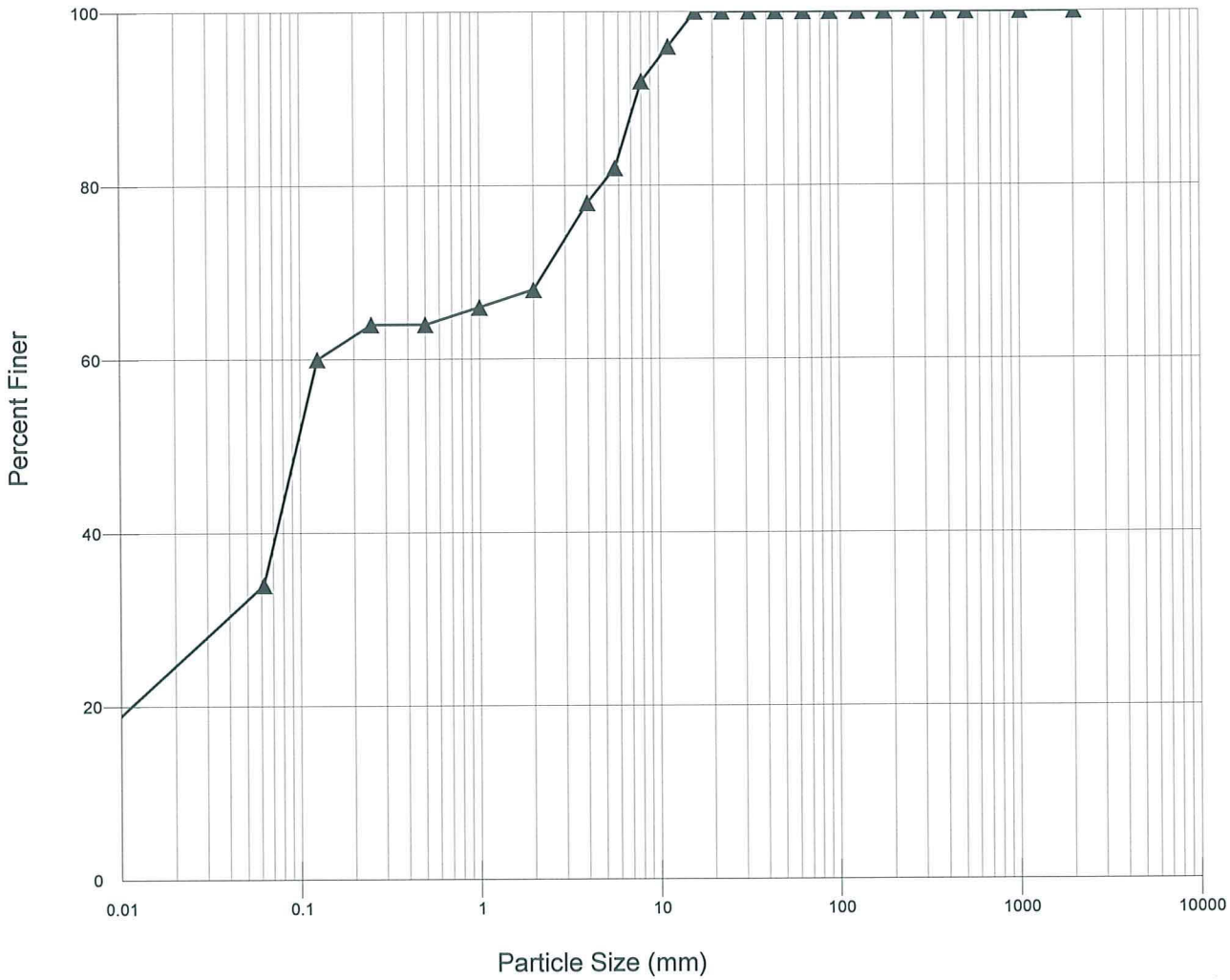
River Name: Little White Oak Creek
Reach Name: R2A
Sample Name: R2A Reachwide Pebble Count
Survey Date: 03/04/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	10	19.23	19.23
0.062 - 0.125	2	3.85	23.08
0.125 - 0.25	7	13.46	36.54
0.25 - 0.50	7	13.46	50.00
0.50 - 1.0	3	5.77	55.77
1.0 - 2.0	1	1.92	57.69
2.0 - 4.0	3	5.77	63.46
4.0 - 5.7	0	0.00	63.46
5.7 - 8.0	1	1.92	65.38
8.0 - 11.3	3	5.77	71.15
11.3 - 16.0	2	3.85	75.00
16.0 - 22.6	1	1.92	76.92
22.6 - 32.0	7	13.46	90.38
32 - 45	4	7.69	98.08
45 - 64	0	0.00	98.08
64 - 90	0	0.00	98.08
90 - 128	1	1.92	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)	0.24
D50 (mm)	0.5
D84 (mm)	27.54
D95 (mm)	39.8
D100 (mm)	128
Silt/Clay (%)	19.23
Sand (%)	38.46
Gravel (%)	40.39
Cobble (%)	1.92
Boulder (%)	0
Bedrock (%)	0

Total Particles = 52 (need at least 60).

Reachwide Pebble Count (R2B)



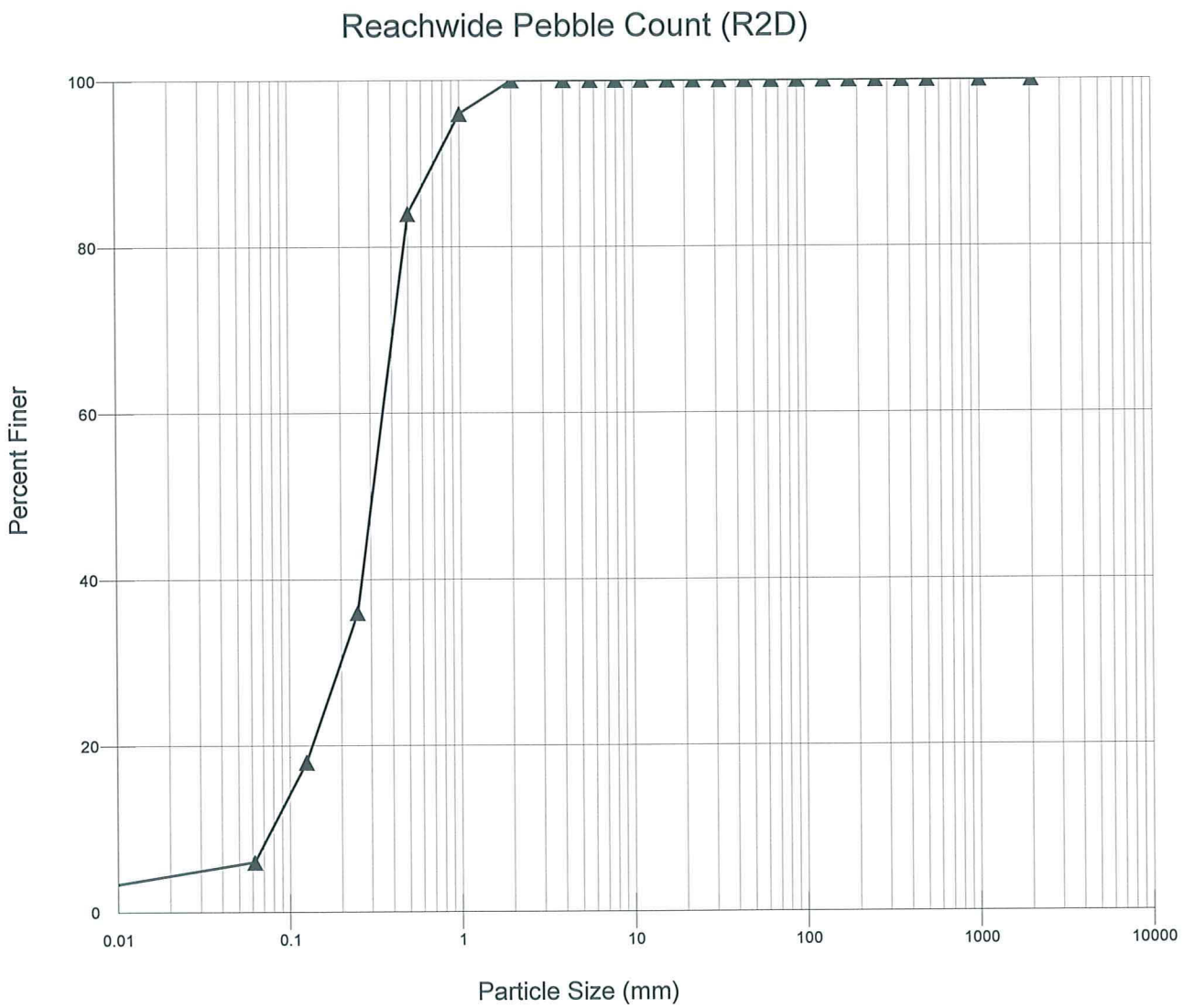
RIVERMORPH PARTICLE SUMMARY

River Name: Little White Oak Creek
Reach Name: R2B
Sample Name: R2B Reachwide Pebble Count
Survey Date: 03/04/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	17	34.00	34.00
0.062 - 0.125	13	26.00	60.00
0.125 - 0.25	2	4.00	64.00
0.25 - 0.50	0	0.00	64.00
0.50 - 1.0	1	2.00	66.00
1.0 - 2.0	1	2.00	68.00
2.0 - 4.0	5	10.00	78.00
4.0 - 5.7	2	4.00	82.00
5.7 - 8.0	5	10.00	92.00
8.0 - 11.3	2	4.00	96.00
11.3 - 16.0	2	4.00	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)	0.03
D35 (mm)	0.06
D50 (mm)	0.1
D84 (mm)	6.16
D95 (mm)	10.48
D100 (mm)	16
Silt/Clay (%)	34
Sand (%)	34
Gravel (%)	32
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 50 (need at least 60).


Reachwide Pebble Count (R2D)
Percent Finer
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)

RIVERMORPH PARTICLE SUMMARY

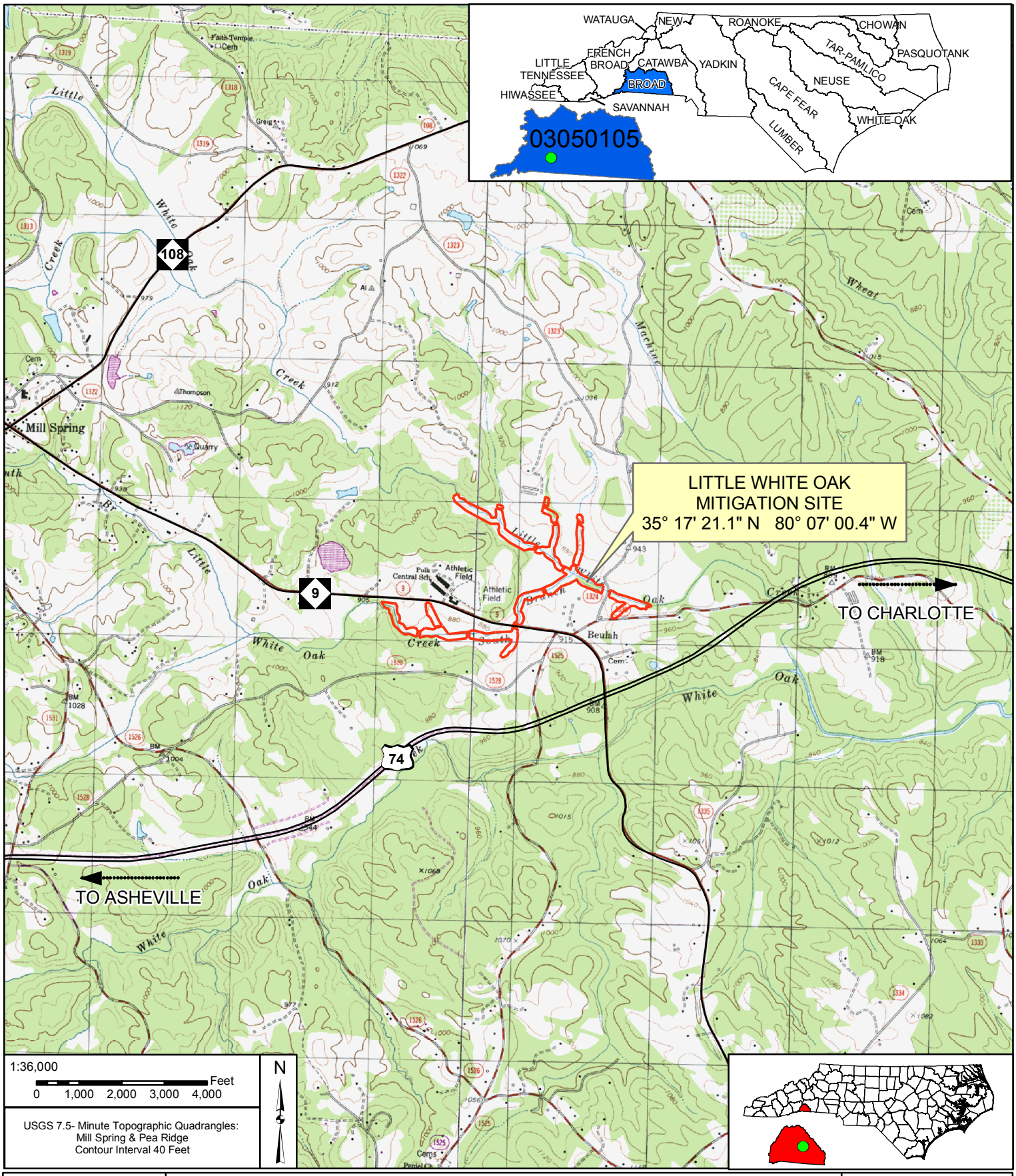
River Name: Little White Oak Creek
Reach Name: R2D
Sample Name: R2D Reachwide Pebble Count
Survey Date: 03/04/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	3	6.00	6.00
0.062 - 0.125	6	12.00	18.00
0.125 - 0.25	9	18.00	36.00
0.25 - 0.50	24	48.00	84.00
0.50 - 1.0	6	12.00	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)	0.11
D35 (mm)	0.24
D50 (mm)	0.32
D84 (mm)	0.5
D95 (mm)	0.96
D100 (mm)	2
Silt/Clay (%)	6
Sand (%)	94
Gravel (%)	0
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 50 (need at least 60).

FIGURES



LOCATION MAP

LITTLE WHITE OAK STREAM RESTORATION

POLK COUNTY, NORTH CAROLINA

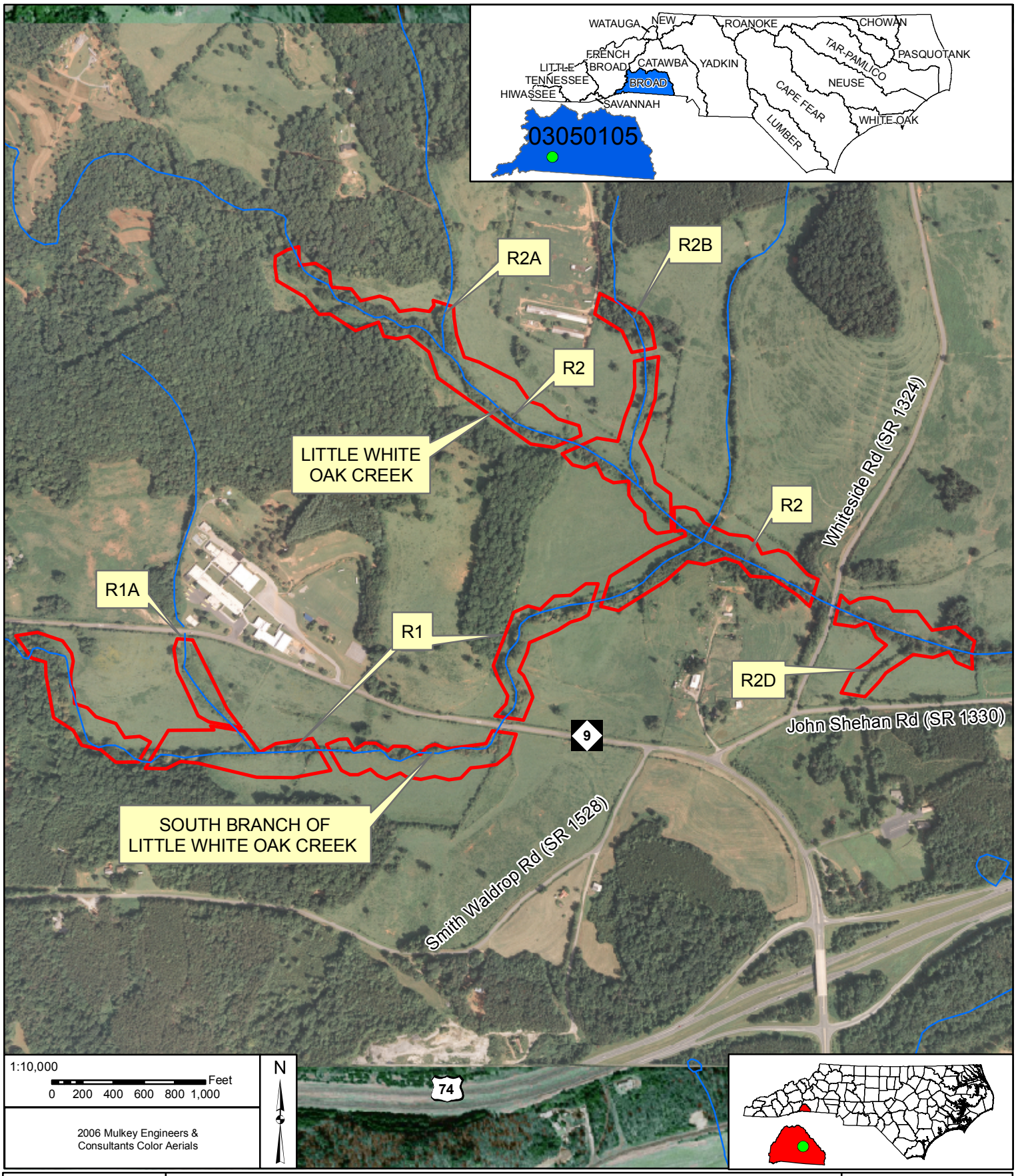
March 20, 2008

Figure 1

Ecosystem Enhancement Program

MULKEY ENGINEERS & CONSULTANTS

PROJECT NO. D06027-B



Ecosystem Enhancement Program

MULKEY ENGINEERS & CONSULTANTS

PROJECT NO. D06027-B

PROJECT MAP

LITTLE WHITE OAK STREAM RESTORATION

POLK COUNTY, NORTH CAROLINA

March 20, 2008

Figure 2

TABLES

Table 1. Stream Restoration Summary

Project Number D06027-B (Little White Oak Creek Stream Restoration)

Stream Channel Summary					
Stream Reach ID	**Approach**	**Mitigation Type**	**Original Channel Length (lf)**	**Restored Channel Length (lf)**	**Stream Mitigation Units (SMU)**
R1	P2	R	6,530	7,543	7,543
R1A	P1/P2	R	906	1,040	1,040
R2 (Upper and Lower)	P2	R	5,978	7,107	7,107
R2A	P2	R	287	336	336
R2B	P1/P2	R	1,237	1,474	1,474
R2D	P1/P2	R	549	790	790
		Totals	15,487	18,290	18,290

Table 2. Designed Vegetative Communities

Project Number D06027-B (Little White Oak Creek Stream Restoration)

Planting Zone	Acres	Zone Description	Recommended Plant Species	
			Scientific Name	**Common Name**
1	5.26	Stream Banks	*Alnus serrulata*	Tag alder
			Cornus amomum	Silky dogwood
			Salix nigra	Black willow
			Sambucus canadensis	Elderberry
2	14.30	Riparian Buffer	*Betula nigra*	River birch
			Cephalanthus occidentalis	Buttonbush
			Cornus amomum	Silky dogwood
			Corylus americana	American hazelnut
			Fraxinus americana	White ash
			Fraxinus pennsylvanica	Green ash
			Plantanus occidentalis	Sycamore
			Quercus michauxii	Swamp chestnut oak
			Quercus nigra	Water oak
			Quercus phellos	Willow oak
			Sambucus canadensis	Elderberry
			Ulmus americana	American elm
3	0.35	Wetland Pockets/Oxbows	*Alnus serrulata*	Tag alder
			Betula nigra	River birch
			Cephalanthus occidentalis	Buttonbush
			Cornus amomum	Silky dogwood
			Fraxinus americana	White ash
			Sambucus canadensis	Elderberry
4	32.50	Upland Buffer	*Cornus florida*	Flowering dogwood
			Diospyros virginiana	Persimmon
			Juglans nigra	Black walnut
			Pinus echinata	Shortleaf pine
			Pinus strobus	Eastern white pine
			Pinus virginiana	Virginia Pine
			Prunus serotina	Black cherry
			Quercus alba	White oak
			Quercus falcata	Southern red oak

Table 3. Vegetation Sampling Plot Information.

Vegetation Plot	Zone Description	Actual Plot Size, sq. meters (sq. feet)	Identified Species Common Name
1	Riparian	97.7 (1,051.6)	River birch (1) Swamp chestnut oak (6) Water oak (14) Willow oak (3) **Total - 24**
2	Riparian	98.2 (1,057.0)	River birch (9) Silky dogwood (2) Swamp chestnut oak (2) Water oak (6) **Total - 19**
3	Upland	99.2 (1,067.8)	Black cherry (1) Black walnut (3) Persimmon (1) Shortleaf pine (3) Southern red oak (1) Virginia pine (2) White pine (2) White oak (5) **Total - 18**
4	Upland	99.2 (1,067.8)	Shortleaf pine (6) Southern red oak (5) White pine (1) White oak (4) **Total - 16**
5	Upland	98.6 (1,061.3)	Black cherry (2) Shortleaf pine (7) Southern red oak (2) Virginia pine (2) Water oak (2) White oak (3) **Total - 18**
6	Riparian	98.0 (1,054.9)	American hazelnut (1) River birch (4) Water oak (12) Willow oak (6) **Total - 23**

( ) Denotes the number of species found within a particular vegetation plot (bareroot or live stake)
[A] Species designated for live staking at 1,742 stakes/acre, which is a 5' x 5' spacing.
Note: All bareroot species were planted at 680 stems/acre, which is an 8' x 8' spacing.

Table 3 contd. Vegetation Sampling Plot Information.

Vegetation Plot	Zone Description	Actual Plot Size, sq. meters (sq. feet)	Identified Species Common Name
7	Riparian	103.0 (1,108.7)	Black willow [A] (1) River birch (8) Silky dogwood (4) Silky dogwood [A] (4) Sycamore (2) **Total - 19**
8	Riparian	100.9 (1,086.1)	American elm (1) American hazelnut (3) Green ash (4) River birch (5) Silky dogwood (1) Swamp chestnut oak (2) Sycamore (2) **Total - 18**
9	Upland	100.6 (1,082.8)	Shortleaf pine (3) White pine (4) Virginia pine (3) White oak (2) Southern red oak (5) Total - 17
10	Riparian/Upland	99.2 (1,067.8)	American elm (3) American hazelnut (2) Green ash (2) River birch (1) Silky dogwood (1) Southern red oak (1) Swamp chestnut oak (2) Sycamore (5) **Total - 17**
11	Upland	98.7 (1,062.4)	Persimmon (4) Black walnut (1) Shortleaf pine (2) White pine (1) Virginia pine (1) Black cherry (1) White oak (1) Southern red oak (5) **Total - 16**

( ) Denotes the number of species found within a particular vegetation plot (bareroot or live stake)
[A] Species designated for live staking at 1,742 stakes/acre, which is a 5' x 5' spacing.
Note: All bareroot species were planted at 680 stems/acre, which is an 8' x 8' spacing.

Table 3 contd. Vegetation Sampling Plot Information.

Vegetation Plot	Zone Description	Actual Plot Size, sq. meters (sq. feet)	Identified Species Common Name
12	Riparian/Upland	97.6 (1,050.6)	Persimmon (2) River birch (1) Shortleaf pine (3) Silky dogwood (1) Southern red oak (1) Swamp chestnut oak (1) Sycamore (7) White oak (1) **Total - 17**
13	Riparian	96.7 (1,040.9)	Elderberry (2) Green ash (7) Swamp chestnut oak (10) **Total - 18**
14	Riparian	98.9 (1,064.6)	American elm (2) American hazelnut (4) Green ash (2) River birch (1) Silky dogwood (2) Swamp chestnut oak (4) **Total - 15**
15	Upland	100.1 (1077.5)	Flowering dogwood (1) Persimmon (1) Shortleaf pine (2) White pine (5) Virginia pine (1) Black cherry (1) White oak (1) Southern red oak (9) **Total - 21**
16	Riparian	97.9 (1,053.8)	American elm (4) Buttonbush (5) Green ash (3) Swamp chestnut oak (4) Sycamore (5) **Total - 21**
17	Upland	96.3 (1036.6)	Persimmon (2) Shortleaf pine (1) White pine (1) Virginia pine (3) White oak (9) Southern red oak (3) **Total - 19**

( ) Denotes the number of species found within a particular vegetation plot (bareroot or live stake)
[A] Species designated for live staking at 1,742 stakes/acre, which is a 5' x 5' spacing.
Note: All bareroot species were planted at 680 stems/acre, which is an 8' x 8' spacing.

Table 3 contd. Vegetation Sampling Plot Information.

Vegetation Plot	Zone Description	Actual Plot Size, sq. meters (sq. feet)	Identified Species Common Name
18	Riparian	101.5 (1,092.5)	American elm (2) Buttonbush (1) Green ash (3) River birch (3) Swamp chestnut oak (1) Sycamore (3) **Total - 13**
19	Riparian	99.6 (1,072.1)	American elm (9) American hazelnut (1) Buttonbush (1) Green ash (3) Swamp chestnut oak (3) Sycamore (4) **Total - 21**
20	Riparian	97.2 (1,046.3)	Green ash (2) River birch (2) Swamp chestnut oak (3) Sycamore (15) **Total - 23**
21	Upland	98.6 (1,061.3)	Flowering dogwood (1) Black walnut (1) White pine (2) Black cherry (1) White oak (4) Southern red oak (7) **Total - 16**
22	Riparian	101.1 (1,088.2)	American elm (3) American hazelnut (5) Green ash (9) Swamp chestnut oak (6) **Total - 23**
23	Riparian	99.3 (1,068.9)	American elm (2) American hazelnut (1) Buttonbush (2) Green ash (2) River birch (6) Swamp chestnut oak (3) Sycamore (2) **Total - 18**

( ) Denotes the number of species found within a vegetation plot (bareroot or live stake)
[A] Species designated for live staking at 1,742 stakes/acre, which is a 5' x 5' spacing.
Note: All bareroot species were planted at 680 stems/acre, which is an 8' x 8' spacing.

Table 3 contd. Vegetation Sampling Plot Information.

24	Upland	99.2 (1,067.8)	Persimmon (9) Black walnut (2) Shortleaf pine (1) White pine (4) White oak (5) Southern red oak (2) **Total - 23**

( ) Denotes the number of species found within a vegetation plot (bareroot or live stake)
A Species designated for live staking at 1,742 stakes/acre, which is a 5' x 5' spacing.
Note: All bareroot species were planted at 680 stems/acre, which is an 8' x 8' spacing.