

FINAL MITIGATION PLAN

**601 East Stream Restoration
Union County, North Carolina
EEP Project Identification Number 95756**

**Yadkin River Basin 03-07-14
Cataloging Unit 03040105
Contract #004925
RFP #16-004110**



Prepared for:



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

January 2014

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Prepared by:

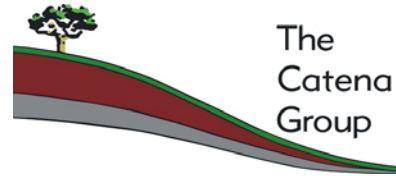


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And:



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January 2014

IRTR PROCESS SUMMARY

The NCIRT Review comments and intent to approve letter for the 601 East Mitigation Site dated January 6, 2014 is included in the following pages to document the IRT Review process for this project. The following is a list of revisions that have been made to the Mitigation Plan in response to these comments:

1. The on-site sediment loss/bank erosion has been quantified for the recent degradation in the upper project reach in Section 7.2.1, page 40.
2. Performance information has been added to the document addressing on site sediment reduction Section 9.0, Page 49.
3. Dense planting of shrubs outside and around the BMP's on the ephemeral section of Reach 1a was added in the document Section 7.2.1, Page 40.
4. The performance standards wording was changed in Section 9, Page 49 to reflect the NCEEP Monitoring Requirements and Performance Standards for Stream and Wetland Mitigation Dated November 7, 2011. (Section IV C.)



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

21 January, 2014

Regulatory Division

Re: NCIRT Review and USACE Approval of the 601 East Draft Mitigation Plan; SAW 2013-00265;
EEP IMS # 95756

Mr. Tim Baumgartner
North Carolina Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Dear Mr. Baumgartner:


The purpose of this letter is to provide the North Carolina Ecosystem Enhancement Program (NCEEP) with all comments generated by the North Carolina Interagency Review Team (NCIRT) during the 30-day comment period for the 601 East Draft Mitigation Plan, which closed on 3 January, 2014. These comments are attached for your review.

Based on our review of these comments, we have determined that no major concerns have been identified with the Draft Mitigation Plan. However, the minor issues with the Draft as discussed in the attached comment memo must be addressed in the Final Mitigation Plan.

The Final Mitigation Plan is to be submitted with the Preconstruction Notification (PCN) Application for Nationwide permit approval of the project along with a copy of this letter and a summation of the addressed comments. If it is determined that the project does not require a Department of the Army permit, you must still provide a copy of the Final Mitigation Plan, along with a copy of this letter, to the appropriate USACE field office at least 30 days in advance of beginning construction of the project. Please note that this approval does not preclude the inclusion of permit conditions in the permit authorization for the project, particularly if issues mentioned above are not satisfactorily addressed. Additionally, this letter provides initial approval for the Mitigation Plan, but this does not guarantee that the project will generate the requested amount of mitigation credit. As you are aware, unforeseen issues may arise during construction or monitoring of the project that may require maintenance or reconstruction that may lead to reduced credit.

Thank you for your attention to this matter, and if you have any questions regarding this letter, the mitigation plan review process, or the requirements of the Mitigation Rule, please call me at 919-846-2564.

Sincerely,

 Digitally signed by
CRUMBLEY.TYLER.AUTR
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Tyler Crumbley
Regulatory Specialist

Enclosures

Electronic Copies Furnished:

NCIRT Distribution List
CESAW-RG/H. Wicker
CESAW-RG-A/S. Kichefski
NCEEP/P. Wiesner



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

CESAW-RG/Crumbley

6 January, 2014

MEMORANDUM FOR RECORD

SUBJECT: 601 East- NCIRT Comments During 30-day Mitigation Plan Review

PURPOSE: The comments listed below were posted to the NCEEP Mitigation Plan Review Portal during the 30-day comment period in accordance with Section 332.8(g) of the 2008 Mitigation Rule.

NCEEP Project Name: 601 East Stream Restoration Project, Union County, NC

USACE AID#: SAW-2013-00265

NCEEP #: 95756

30-Day Comment Deadline: 3 January, 2014

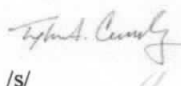
1. Eric Kulz, NCDWR, 19 December, 2013:

- As stated for previous projects, DWR continues to have concerns regarding restoration, particularly P1 restoration, on incised intermittent channels (project proposes 350 LF of P1 on Reach 1a). Our concern remains that constructing an offline channel at a higher elevation can sometimes result in removing the groundwater discharge altogether, converting a jurisdictional intermittent channel into a non-jurisdictional ephemeral feature. It should be noted that credit loss (and the potential need for compensatory mitigation) could result if the proposed work results in the conversion of an intermittent stream to an ephemeral feature. DWR wants to ensure the written record for this project includes our concern.

2. T. Crumbley, USACE, 2 January, 2014:

- The District concurs with the comment provided by NCDWR with regard to Priority 1 restoration on incised intermittent channels. During the field meeting on 29 January, 2013 several issues with the project were discussed:

- a. There was concern from NCIRT on disconnecting the intermittent section of Reach 1a (above cross-section #1) from the groundwater source. It was stated that credits will not be generated on reaches that have been converted from intermittent to ephemeral.
 - b. It was suggested by the NCIRT to quantify the on-site sediment loss/bank erosion prior to restoration and potentially tie a performance standard to incorporate on-site reduction versus watershed input.
 - c. USFWS suggested planting dense shrubs along with trees on the outside/around the BMP on ephemeral section of Reach 1a to prevent additional rill or gully formation. Specifically utilizing species that will attenuate sediment.
 - d. USFWS also suggested that a neotropical migrant bird study be conducted prior to construction.
- A brief discussion on impacts to existing wetlands is presented in the Draft plan, but any impacts (eg. filling, draining, converting) to current waters of the U.S. (streams, wetlands and open waters) must be accounted for and discussed in the Pre-Construction Notification (PCN) and the loss or conversion of those waters must be replaced on-site. (the conversion of ponds to stream is considered an impact, but the functional uplift provided allows for this conversion to be conducted under NWP 27. These impacts do, however need to be accounted for in the PCN).
 - Section 9, pg. 46. Performance Standards: Should reference the "Ecosystem Enhancement Program Monitoring Requirements and Performance Standards for Stream and Wetland Mitigation" Dated November 7, 2011. (Section IV C.) *All monitoring and performance standard requirements need to comply with this EEP/District guidance unless the project was instituted prior to the release of this guidance*


/s/
Tyler Crumbley
Regulatory Specialist,
Regulatory Division

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Environmental Banc & Exchange
Capital • Experience • Expertise

January 13, 2014

Paul Wiesner, Western Program Manager
NC Ecosystem Enhancement Program
5 Ravenscroft Drive, Suite 102
Asheville, NC 28801

Reference: Response to 601 East-NCIRT Comments During 30-day Mitigation Plan Review
Draft Mitigation Plan and Preliminary Plan Set for the
601 East Stream Restoration Project
Yadkin River Basin – CU#03040105-Union County
NCEEP Project ID No. 95756
Contract #004925

Dear Mr. Wiesner:

Please find attached the responses to comments received for the above referenced project. The following responses are listed in the order of the comments received.

1. Eric Kulz, NCDWR, 19, December, 2013:

R: It is understood that credits will not be generated on reaches that have been converted from intermittent to ephemeral. Only the upper portion of Reach 1a will be restored above the present ground elevation. A series of 5 basins have been designed above Reach 1a. These basins will function to trap sediment as well as to provide groundwater recharge areas as the water is stored and allowed to drain into the soils below. We expect Reach 1a to remain intermittent.

2. T. Crumbley, USACE, 2 January, 2014:

a R: See response 1 above.

b R: The on-site sediment loss/bank erosion has been quantified as follows:
Based on surveyed cross sections of the incised channel and an assumed pre-degradation top of bank elevation a sediment loss volume of 167 tons was estimated to have occurred along 335 feet of channel length between 2008 and 2010 at the top of the stream. A series of five (5) stormwater BMP basins have been designed throughout the ephemeral channel reach to detain future sediment moving through the system. The basins have a total capacity to hold 206 tons of sediment. After the initial degradation within this area between 2008 and 2011 occurred, significant sediment loss was not observed in 2012 or 2013. It is anticipated that the due to the continued farming of the land outside of the conservation easement that the draws to the south and east of the restoration project will continue to introduce excess sediment to the stream. It is not anticipated that the sediment loss will be as significant as the degradation that occurred between 2008 and 2010 due to the observations that were made in 2012 and 2013. The designed basins have ample storage capacity to capture sediment and provide ground water recharge as water is stored and allowed to drain into the soils below upstream of the intermittent channel. This change was added to the mitigation plan Section 7.2.1, Page 40.

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The tributaries outside of the conservation easement will be observed yearly and the monitoring report will document the function of the upstream basins in capturing excess sediment produced by observed degradation. The reconstructed stream efficiency for sediment transport will be documented annually through the visual assessment. A specific performance standard will not be added. This change was noted in the mitigation plan Section 9.0, Page 49.

c R: A dense planting of shrubs along with trees on the outside and around the BMP's on the ephemeral section of Reach 1a will be provided. Shrubs will be used to attenuate sediment. This change was noted in the mitigation plan Section 7.2.1 Page 40.

d R: The existing nesting habitat, which consists of primarily privet, will be removed this winter prior to spring. As such, there will no nesting habitat in the construction zone. Further, there will remain extensive habitat along the relic stream channel as well as the riparian buffer along Lanes Creek.

Impacts to existing wetlands:

R: It is understood that the conversion of wetlands will be reported in the PCN. It is anticipated with that raising the stream channel and restoration to the relic channel will create/restore additional wetlands throughout the length of the project. As such, there will not only be a gain of wetlands, but a functional uplift to the entire system.

Section 9, pg 49. Performance Standards:

R: The performance standards wording in this section has been added as requested.

Please call me if you have any questions.

Thanks,

Cara Conde for David Godley

David Godley
Senior Project Manger



EXECUTIVE SUMMARY

Environmental Banc & Exchange (EBX) proposes to restore and enhance Tanyard Branch an unstable stream in Union County. The 601 East Stream Restoration Site is located approximately 1,500 feet east of the intersection of Pageland Highway and Landsford Road at the latitude 34° 50' 21.62" N and longitude 80° 25' 32.26" W. The conservation easement consists of 12.78 acres of existing agricultural land currently in crop production surrounding Tanyard Branch an unstable stream. This mitigation plan describes the details, methods and protocols proposed to generate approximately 3,680 stream mitigation credits, which includes approximately 215 linear feet of ephemeral channel with buffer restoration and best management practices to filter sediment; 2,892 linear feet of Priority I restoration; 480 linear feet of Priority 3 restoration; and 400 linear feet of Stream Enhancement Level I.

General Site Conditions

The historic land use at the project site has consisted primarily of agricultural row crops. Additional land use practices, including the maintenance and removal of riparian vegetation and the relocating, dredging, and straightening of Tanyard Branch have contributed to unstable channel characteristics and degraded water quality. Current conditions at the 601 East Stream Restoration Site contains incised channels with unstable banks and a small to no riparian buffer. Just south of Landsford Road the stream has been impacted by the presence of invasive exotic plants. The uppermost reach of Tanyard Branch is in a confined valley with a steep slope. Recent improvement on Pageland Highway (US 601) has caused significant degradation of the ephemeral and intermittent segments of the stream in recent years. The lower segment of the project is separated by 1,100 feet of stream that is located in a substantially wooded buffer not included in the proposed project. The lower reach consists of a straightened channel that has been diverted from its original location within the floodplain.

Restoration Concept

The stream restoration proposed for this project has been selected to minimize the impact on adjacent land. The stream has been designed to incorporate enhancement practices where it is beneficial to the stream. Where restoration was determined to be warranted, consideration was given to which reaches could best be served by maintaining as much of the existing channel pattern as possible. The ephemeral channel has been designed with protective buffers and BMPs to trap incoming excess sediment within the channel to aid in stabilizing the upper most reach of the project and address existing stressors. Tanyard Branch has been designed with two reaches in both the upper and lower parts of the project. The top of the upper reach from the ephemeral channel to the existing woods at the spring house has been designed as a Type B4 stream. Below the woods to Landsford Road the stream has been designed as a Type C4. The lower reach has been designed as a Type C4 from the wood line for a distance of approximately 1078 feet. The last 480 feet of the stream has been designed as a Priority 3 restoration, Type B4, to transition the stream through a deeply incised reach to Lanes Creek.

The restoration reaches will include the installation of rock, brush, and wood structures. Brush toe structures will be installed within the perennial stream on selected meander

bends to provide bank stability and aquatic habitat. Constructed riffles will be used for grade control to prevent head cut formation. Log vanes with rootwads will be installed in two meander bends in the lower reach to direct the flow away from the outside of the bend and provide toe and bank protection. On-site material including brush, logs, and bed material will be used to the maximum extent possible. In-stream structures will be designed to improve aquatic habitat.

This mitigation plan has been written in conformance with the requirements of the following:

Federal rule for compensatory mitigation project sites as described in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.8 paragraphs (c)(3) through (c)(14).

NCDENR Ecosystem Enhancement Program In-Lieu Fee Instrument signed and dated July 28, 2010

These documents govern NCEEP operations and procedures for the delivery of compensatory mitigation.

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APPENDIX D. PROJECT PLAN SHEETS

APPENDIX E. PRELIMINARY MONITORING PLANS

1.0 RESTORATION PROJECT GOALS AND OBJECTIVES

The North Carolina Ecosystem Enhancement Program (NCEEP) develops River Basin Restoration Priorities (RBRP) to guide its restoration activities within each of the state's 54 cataloging units. RBRP delineate specific watersheds that exhibit both the need and opportunity for wetland, stream, and riparian buffer restoration. These watersheds are called Targeted Local Watersheds (TLWs) and receive priority for NCEEP planning and restoration project funds.

The 2003 Yadkin Pee-Dee River Basin Watershed Restoration Plan first identified HUC 03040105081010 (Upper Lanes Creek) as a TLW (<http://www.nceep.net/services/restplans/yadkinpeedee%202003.pdf>) and was subsequently updated in 2009 (http://www.nceep.net/services/restplans/Yadkin_Pee_De_RBRP_2009_Final.pdf). In 2009 the watershed was characterized by 2 percent impervious surface, 53 percent non-forested buffer, and 44 percent agriculture area with 9 percent of the streams listed as impaired for Aquatic Life by the North Carolina Division of Water Quality (NCDWQ). The 2009 Yadkin Pee-Dee RBRP identified agricultural practices and development impacts as potential stressors within the TLW. The 601 East Stream Restoration Site (hereafter referred to as the "Site") was identified as a stream restoration opportunity to improve water quality and habitat within the Upper Lane's Creek TLW.

The project goals address the stressors identified in the TLW and include the following:

1. Reduce water quality stressors originating in and around the project area affecting the project reaches and downstream watercourses, which includes populations of the Savannah Lilliput (*Toxolasma pullus*) and the Carolina Creekshell (*Vilosa vaughiana*), both listed species of concern. Specifically, this will involve:
 - a. Reducing turbidity and sediment loading
 - b. Input reductions of nutrients and crop protection chemicals
 - c. Improving thermoregulation
2. Improving aquatic habitat quality and diversity within the project reaches
3. Improving recruitment of instream fine organic matter (FOM) in the near term and both FOM and large wood in the long term
4. Improving terrestrial habitat diversity and quality in the vicinity of project reaches
5. Establishing habitat continuity between the reach headwaters and Lanes Creek
6. Improving flood flow attenuation and floodplain interaction

The project goals will be addressed through the following project objectives:

Objectives	Relative Support of Stated Goals		
	High	Mod	Low
Restore or enhance reach pattern, dimension, and profile	6,2		3
Stabilize eroding stream banks	1,2		
Install stream structures to maintain grad and improve bedform complexity	2,6	3	
Implement BMP detention devices on lateral agricultural drainages	6	1	
Install a diverse, native riparian buffer	1-5	6	
Remove invasive and/or exotic plant species	4	5	
Secure a protective conservation easement and establish fencing as needed	1-6		

2.0 SITE SELECTION

2.1 Directions to Site

The 601 East Stream Restoration Site is located approximately 10 miles southeast of Monroe and 0.25 miles east of the intersection of Pageland Highway (US 601) and Landsford Road (NC 1005) in Union County, North Carolina. From Charlotte take US-74 E towards Monroe. After approximately 25 miles turn right onto US 601 S/Pageland Hwy, continue on US 601 S for approximately 10 miles then make a slight right onto Landsford Road (NC 1005). The Site is located at the crossing of Landsford Road and Tanyard Branch at latitude 34° 50' 21.62" N and longitude 80° 25' 32.26" W.

2.2 Site Selection

2.2.1 Description

The project stream on the property is named Tanyard Branch which is a tributary to Lanes Creek. The Site is located on predominately agricultural land. The upper reach of the project is a first order stream. The lower reach of the project begins at the junction of two tributaries. The landowner to the northeast of the lower reach utilizes his land for livestock grazing. The livestock on this property is contained by fencing and does not have access to Tanyard Branch.

Historic land use at the Site has consisted primarily of agriculture crop production. Additional land use practices, including the maintenance and removal of riparian vegetation and the relocating, dredging, and straightening of on-site streams have contributed to unstable channel characteristics and degraded water quality.

2.2.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designations

The project area is located within the United States Geological Survey (USGS) Hydrologic Unit 03040105 (Rocky River Basin) of the greater Yadkin Pee-Dee River Basin. The Rocky River Basin covers 1,417 square miles (3,670 square kilometers) and portions of seven North Carolina counties, in addition to areas of South Carolina. The subject stream is mapped as a UT to Lanes Creek (DWQ Stream Index Number 13-17-40-(1)) – identified as Tanyard Branch in this document based on deed records. Lanes Creek is classified as “WS-V”. The “WS-V” classification indicates waters that are protected as water supplies which are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or as waters formerly used as water supply. These waters are also protected for Class C uses.

Class C waters are protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner (NCDWQ).

Tanyard Branch has no NCDWQ stream impairment rating however Lanes Creek is classified as an impacted stream due turbidity, fecal coliform bacteria, and low-dissolved oxygen due to agriculture and pasture land use practices within the watershed. Impaired streams are those streams not meeting their associated water quality standards in more than 10 percent of the samples taken within the assessment period (January 1, 2002 through December 31, 2006) and impacted streams are those not meeting water quality standards in 7 to 9 percent of the samples.

2.2.3 Watershed Characterization

The Site is characteristic of the Piedmont region with moderate rainfall with annual precipitation averaging 45 to 50 inches per year. Elevations within the Site range from 550 feet at the headwaters extent of Tanyard Branch to 500 feet where Tanyard Branch converges with Lanes Creek. The Site encompasses approximately 3,400 linear feet of Tanyard Branch. The drainage area of Tanyard Branch at the culvert at Landsford Road is 0.27 square miles and to the downstream end of the Site is 0.56 square miles. Land use within the watershed consists of primarily agricultural use with some single family residential. Impervious area covers less than 2 percent of the total watershed. Land use changes are not anticipated in the watershed of this headwater stream in the near future as the watershed consists of primarily active agricultural crop production. Low density residential development is a possibility for the watershed due to the sites proximity to US 601.

2.2.4 Physiography, Geology, and Soils

The Site lies within the Carolina Slate Belt system of the Piedmont Geographical Province and is composed of gently sloping terrain with parent material consisting of a Metamudstone and Meta-Argillic metamorphic rock.

The valleys within the Site headwaters are Type II-colluvial valleys, which are moderately steep, gentle-sloping side-slopes. The valley type changes to a Type VIII, a wide alluvial moderate to gentle sloping valley within a well-developed floodplain adjacent to Lanes Creek.

The Union County Soil Survey identifies seven soil types within the Site (Table 1).

Table 1. Soils in the study area.

Soil Series	Mapping Unit	Drainage Class	Hydric Status
Badin channery silt loam	Ba	Well Drained	Non-Hydric
Badin channery silty clay loam	Bd	Well Drained	Non-Hydric
Chewacla silt loam	Ch	Somewhat Poorly Drained	Hydric*
Cid channery silt loam	Cm	Moderately Well Drained	Non-Hydric
Misenheimer-Cid complex	Mh	Moderately Well Drained	Non-Hydric
Tatum gravelly silt loam	Ta	Well Drained	Non-Hydric
Tatum gravelly silty clay loam	Tb	Well Drained	Non-Hydric

* - Soils which are primarily nonhydric, but which may contain hydric inclusions

2.2.5 Historical Land Use and Development Trends

Historic aerial photographs of the Site from 1938, 1951, 1969, 1998, 2006, and 2011 were examined. In the 1938 photograph (Figure 5), the southern parcel is moderately vegetated and the stream has been diverted into a farm pond. The northern parcel is clear of vegetation and actively being farmed; and it appears the stream is flowing through its current channel. By 1951 (Figure 6), the stream is still impounded on the southern parcel and vegetation has matured; the northern parcel is still clear of vegetation and actively farmed. The 1969 photograph (Figure 7) is of poorer quality, but one is able to discern the absence of the farm pond. Vegetation on the southern parcel looks similar to 1951; however, on the northern parcel, vegetation has increased in relation to actively farmed areas. The 1998 photograph (Figure 8) shows the most area covered with vegetation of the six photographs. The southern parcel has what appears to be a mature forested buffer on the stream; while the northern parcel has also been allowed to revert to a forested state. At some point between the 1998 photograph and the 2006 photograph (Figure 9), the vegetated buffer on both the southern and northern parcels was removed. The 2011 photograph (Figure 10) is very similar to the 2006 photograph; the upstream erosion of the start of the stream channel is evident from the photograph. Aerial photographs are included in Appendix F.

The historic land use at the Site has consisted primarily of agriculture use. Additional land use practices, including the maintenance and removal of riparian vegetation and the relocating and straightening of on-site streams have contributed to unstable channel characteristics and degraded water quality. Historic wetlands were likely drained in order to maximize agricultural production.

2.2.6 Existing Site Conditions

In order to assess the existing geomorphic conditions data was collected on the channel above Landsford Road in 2013 that included the longitudinal profile, cross sections at 27 locations, pebble counts in the intermittent and perennial Type B reaches and the Type C reach, and soil samples for sieve analysis on bank and point bar locations. Data was collected on the existing stream below Landsford Road that included the longitudinal profile, cross sections at 19 locations on the relic channel and 9 locations on the existing active channel, pebble count data, and soil bank and depositional bar samples for sieve analysis.

Cross section information was collected for the project site in 2008 for an earlier proposal submittal. The intermittent and ephemeral streams at the top of the project were observed to have incised significantly when additional data was collected in 2012. Research was completed to determine the stressor that caused the dramatic change in the stream. Improvements were made to Highway 601 during this time frame. The roadway was widened and storm drainage added during the improvements produced higher volumes of stormwater flows from the road system to Tanyard Branch. Due to the additional stormwater amounts and the lack of vegetation present on the stream banks, the stream channel incised for approximately 500 linear feet. Approximately 50 percent of the incision is located within the ephemeral and 50 percent in the intermittent channel. Evidence of excess sediment wash filling in the downstream channel is visible in a 100 foot stream segment immediately downstream of the incision. The ephemeral,

intermittent, and perennial stream origins were identified in the IRT field review meeting held on January 29, 2013. The comparison of the 2008 and 2012 cross sections have been included in Appendix B.

Reach A includes 215 feet of ephemeral channel that is located directly above the intermittent channel at the top of the reach. This area has experienced severe erosion in the past 5 years and has eroded to a "G" Type channel passing extensive sediment downstream. The average valley slope is 2% and the bank heights extend up to 3.8 feet.

Reach 1 is located at the upper most limit of the project and includes 430 feet of intermittent and 1005 feet of perennial stream. This reach extends just into the existing wood line at the spring house. Reach 1 classifies as a Type G4 stream at the top, a degraded Type C4b in the sediment depositional area, and as a degraded Type B4 stream for the majority of its length. The average valley slope is 2 percent. The bank height ratio ranges from 0.4 in the depositional area to 2 in the severely incised stream segments. The landowner has added field stones at locations along the stream length creating a series of check dams within the incised channel. The stones have effectively trapped some of the sediment that has washed through the system during the past 5 years in which observations have been made. The stream throughout this reach, except for a 200 foot segment, is typically disconnected from the floodplain. The present sediment loads are being routed by the incised channel without significant accumulation of depositional material and the overall profile trend is degradation.

Reach 2 begins inside the wooded area at the spring house. The valley slope reduces to 0.84 percent and it widens out throughout this reach. The stream classification changes to a degraded Type C4/E4 in Reach 2. The stream segment through the woods has good pattern however has banks that are eroding and some vertical instability is present. The stream beyond the woods has been severely impacted by sediment and exotic invasive species. A defined channel is not present through much of this reach. The present sediment loads are not effectively being routed through much of this reach and are accumulating as depositional material.

The stream continues below Landsford Road through a wooded buffer for approximately 1,100 linear feet. The buffer extends from 50 to 100 feet on the western side of the stream. The eastern buffer is limited to an existing width of 10 to 20 feet. The topography rises in elevation at a steep rate to the existing agricultural fields to the west. The floodplain to the east is flat. The existing channel has pattern, connection with the floodplain, and is reasonably stable throughout this area. This segment of stream is not included in the restoration project.

Reach 3 begins at the edge of the wooded area just after the junction of two stream tributaries in which the drainage area approximately doubles. Just below the confluence the stream has been impacted by an existing culvert farm crossing, providing access to farm fields east and west of the stream. Beyond the culvert the active channel has been diverted from its original path and flows north to Lanes Creek. This channel is straight, varies in depth from 2 to 6 feet, and borders the existing agricultural field. A relic

channel is located to the west of the existing pipe crossing. Approximately 200 feet of the old channel has been filled in and is currently under crop production. The average valley slope is 0.67 percent. The relic channel is a degraded Type C, for approximately two thirds of its length that has fairly good access to the stream with bank height ratios from 1 to 1.3. The present sediment loads are being routed by the incised channel with some accumulation of depositional material just downstream of the culvert plunge pool where the channel widens out significantly and a portion of the flow is diverted to the floodplain and relic channel. Cross sections taken in the active channel and the relic channel confirm that a portion of flow is currently being diverted to the relic channel through the floodplain during storm events. The floodplain is lower to the west of the active channel allowing for this flow divergence.

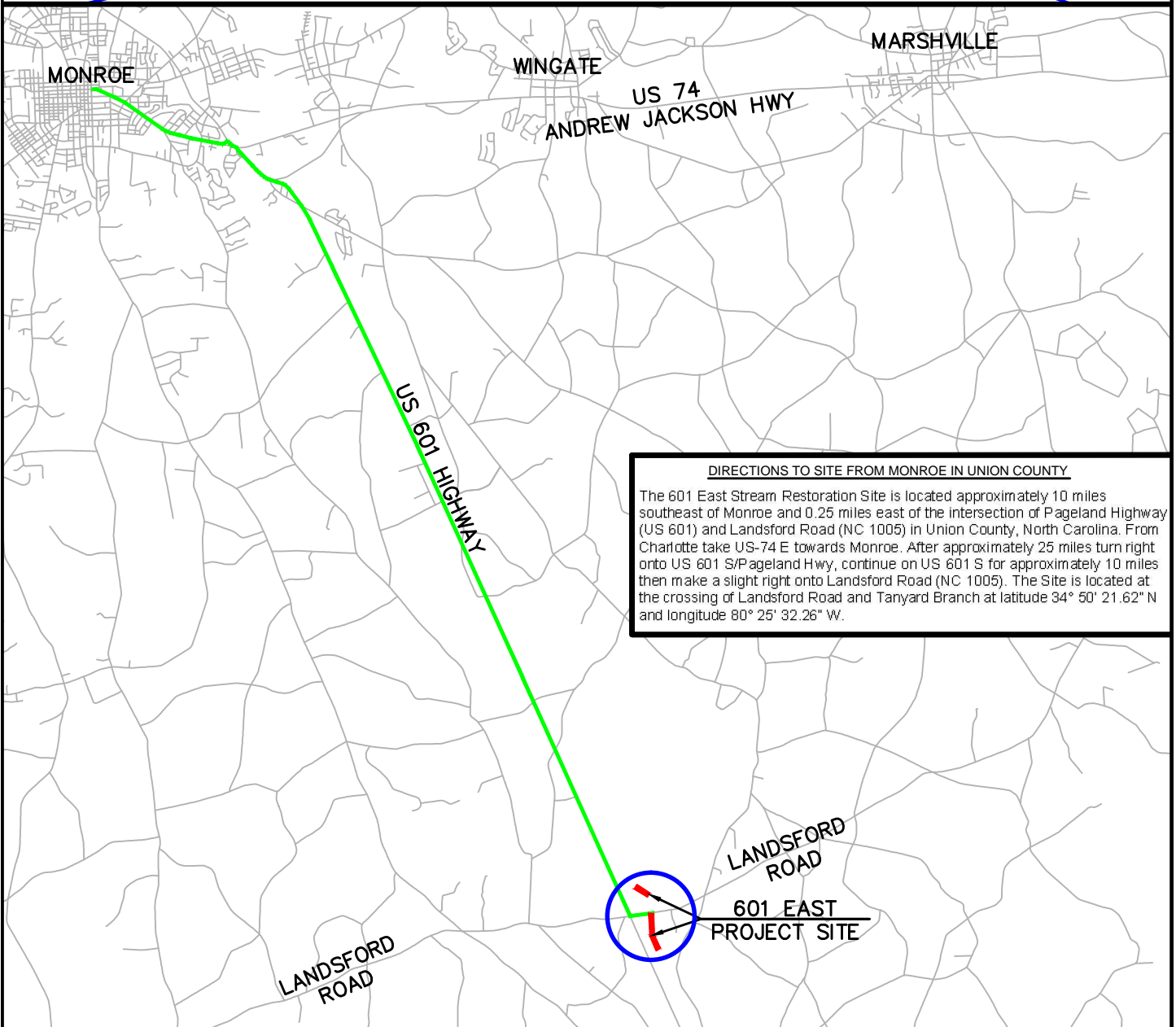
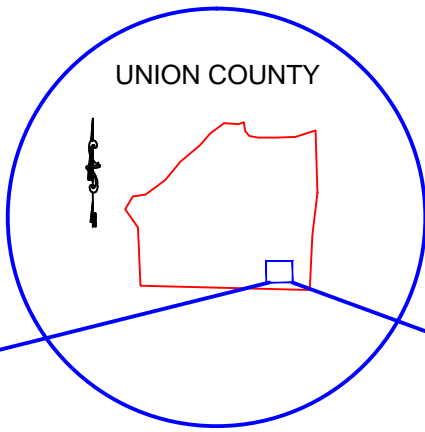
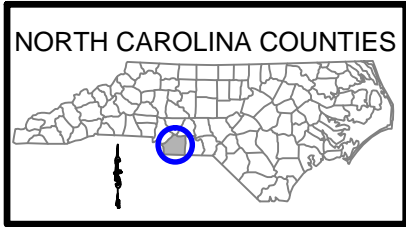
Reach 4 is located in the lower one third of the channel. The valley slope remains at 0.67 percent however the stream becomes increasingly incised, Type G, within this reach until it attains a channel depth of 6 feet at the confluence with Lanes Creek. The deeply incised channel has steep banks with limited vegetation. The overall profile trend of this stream segment is degradational.

Tanyard Branch contains a very narrow buffer throughout the Site consisting of a mixture of tree species typical of a Piedmont Headwater Forest and Piedmont Alluvial Forest community within Reach 1, transitioning to a Piedmont Alluvial Forest within Reach 2, and continuing within Reach 3 and 4. These communities are located along a very narrow and fragmented riparian buffer along Tanyard Branch throughout the Site. Canopy trees are very sparse throughout consisting of green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), willow oak (*Quercus phellos*), sycamore (*Platanus occidentalis*), sweetgum (*Liquidambar styraciflua*), and eastern cottonwood (*Populus deltoides*). The subcanopy and shrub layer consisted of black willow (*Salix nigra*), elderberry (*Sambucus canadensis*), eastern red cedar (*Juniperus virginiana*), silky dogwood (*Cornus amomum*), tag alder (*Alnus serrulata*), silverling (*Baccharis halimifolia*), and Chinese privet (*Ligustrum sinense*). Chinese privet is the dominant woody species within Reach 3 and 4 of the Site.

One wetland, a non-tidal freshwater marsh, occurs along Tanyard Branch. Located within Reach 3, this wetland is a small wetland, approximately 0.43 acre that encompasses Tanyard Branch just upstream of Landsford Rd. This wetland is a linear feature of alluvial deposits resultant of upstream channel degradation. Tanyard Branch becomes a braided stream as it enters this depositional area, and then converges back into a defined channel approximately 70 linear feet upstream of Landsford Rd. Vegetation is mostly herbaceous within the wetland having some small trees, such as Black Willow and Red Maple along the margins. Common Cattail (*Typha latifolia*) dominates the herbaceous layer, with Bulrush (*Scirpus cyperinus*), Common Rush (*Juncus effusus*) and Sedges (*Carex* sp.). Parrot feather (*Myriophyllum aquaticum*) an invasive exotic submerged aquatic plant that grows in slow moving water, was ubiquitous throughout Wetland A.

2.3 Project Site Figures

The following figures Project Site Vicinity Map, Project Site Watershed Map, Project site NRCS Soil Survey Map, Existing Hydrologic Features, and Historical Aerial Photos (1938, 1951, 1969, 1998, and 2006) follow.



DIRECTIONS TO SITE FROM MONROE IN UNION COUNTY

The 601 East Stream Restoration Site is located approximately 10 miles southeast of Monroe and 0.25 miles east of the intersection of Pageland Highway (US 601) and Landsford Road (NC 1005) in Union County, North Carolina. From Charlotte take US-74 E towards Monroe. After approximately 25 miles turn right onto US 601 S/Pageland Hwy, continue on US 601 S for approximately 10 miles then make a slight right onto Landsford Road (NC 1005). The Site is located at the crossing of Landsford Road and Tanyard Branch at latitude 34° 50' 21.62" N and longitude 80° 25' 32.26" W.



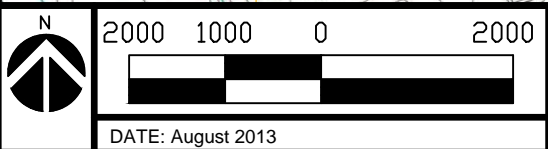
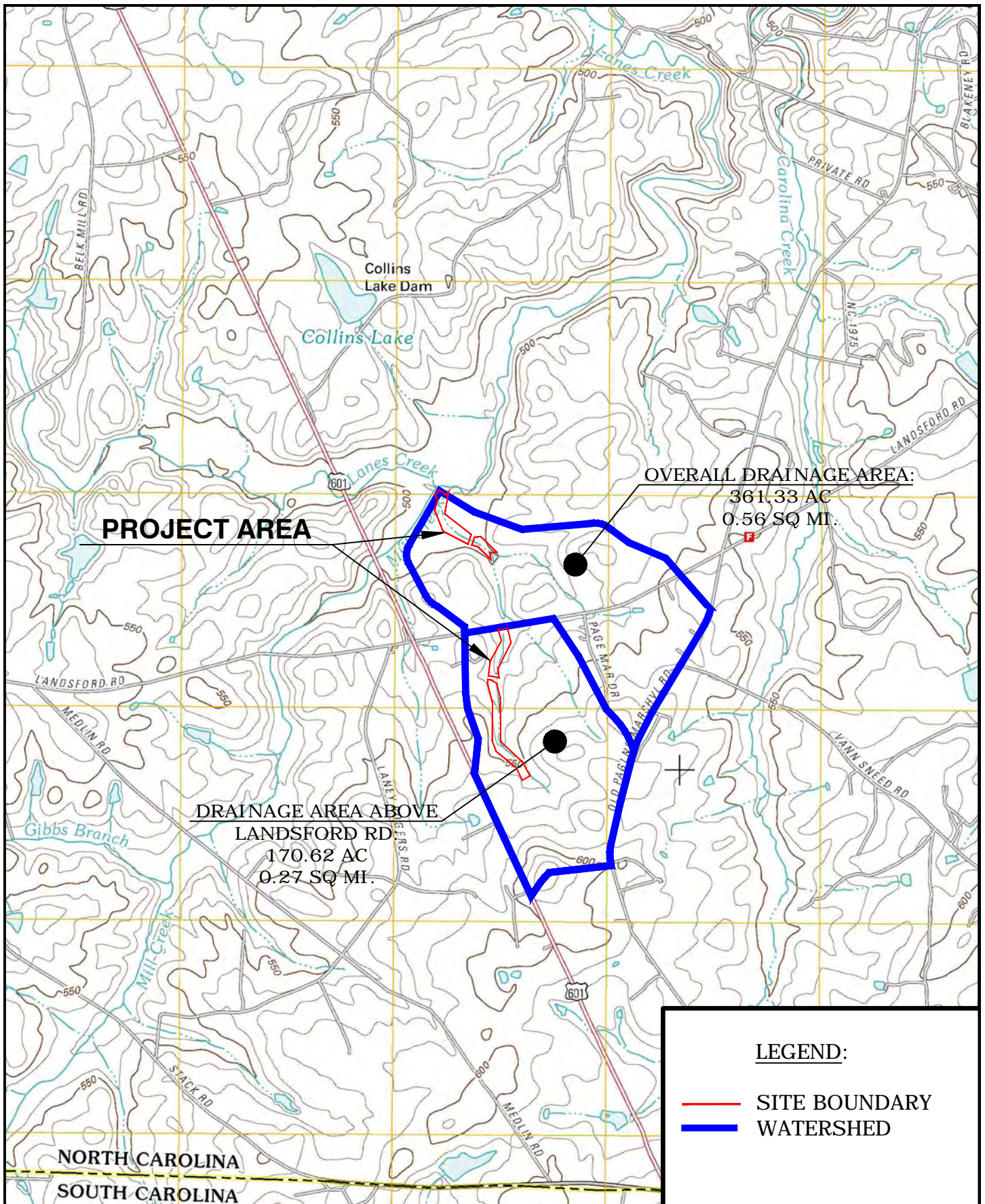
10000 5000 0 10000



DATE: AUGUST 9, 2013

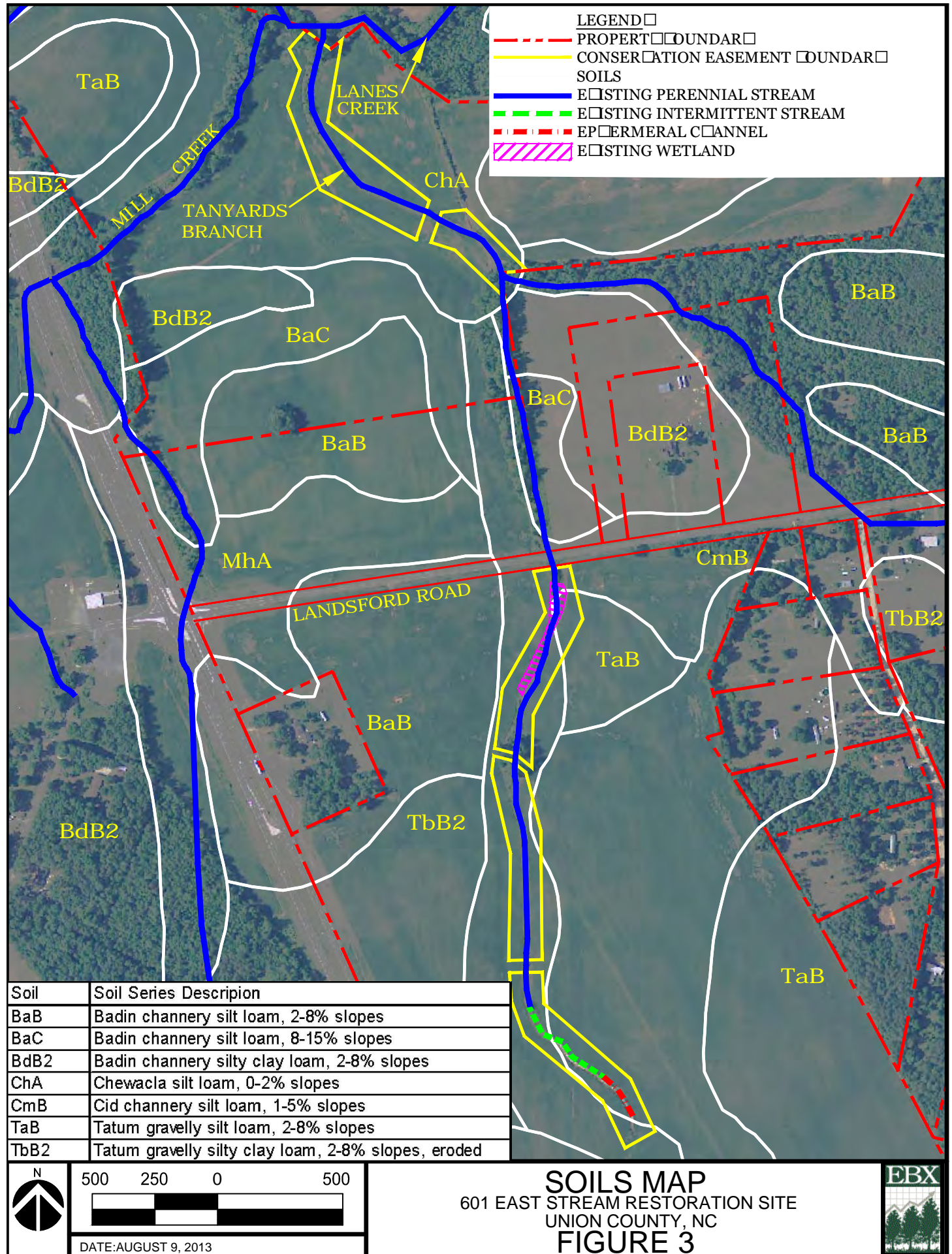
VICINITY MAP
FIGURE 1
SITE LOCATION





WATERSHED MAP
601 EAST STREAM RESTORATION SITE
UNION COUNTY, NC
FIGURE 2





LEGEND






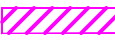
- - - PROPERTY BOUNDARIES
- CONSERVATION EASEMENT BOUNDARIES
- SOILS
- EXISTING PERENNIAL STREAM
- - - EXISTING INTERMITTENT STREAM
- - - EPHEMERAL CHANNEL
- / / / EXISTING WETLAND

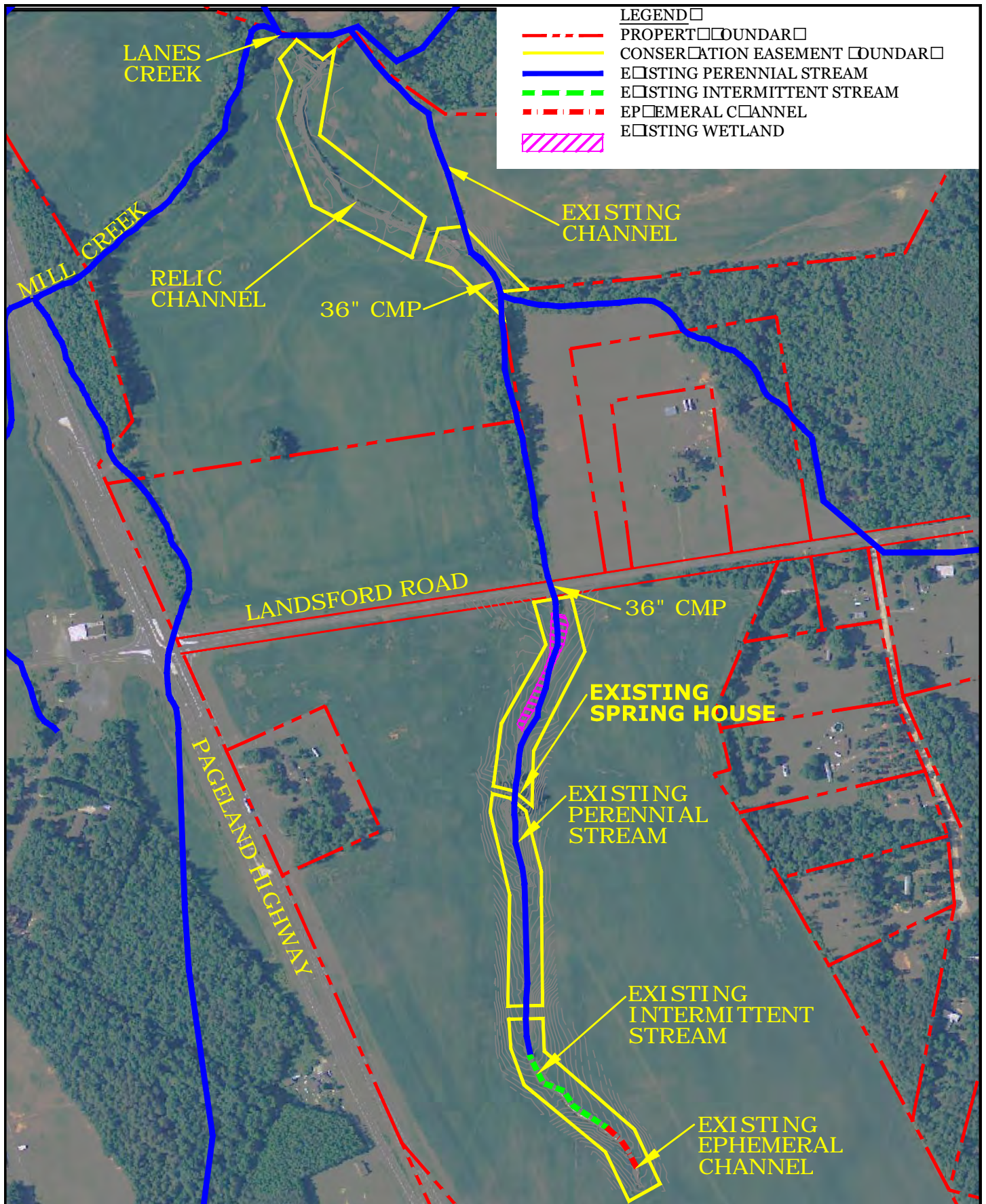
Soil	Soil Series Description
BaB	Badin channery silt loam, 2-8% slopes
BaC	Badin channery silt loam, 8-15% slopes
BdB2	Badin channery silty clay loam, 2-8% slopes
ChA	Chewacla silt loam, 0-2% slopes
CmB	Cid channery silt loam, 1-5% slopes
TaB	Tatum gravelly silt loam, 2-8% slopes
TbB2	Tatum gravelly silty clay loam, 2-8% slopes, eroded

500 250 0 500

SOILS MAP
 601 EAST STREAM RESTORATION SITE
 UNION COUNTY, NC
FIGURE 3


LEGEND

-  PROPERTY BOUNDARY
-  CONSERVATION EASEMENT BOUNDARY
-  EXISTING PERENNIAL STREAM
-  EXISTING INTERMITTENT STREAM
-  EPHEMERAL CHANNEL
-  EXISTING WETLAND



N

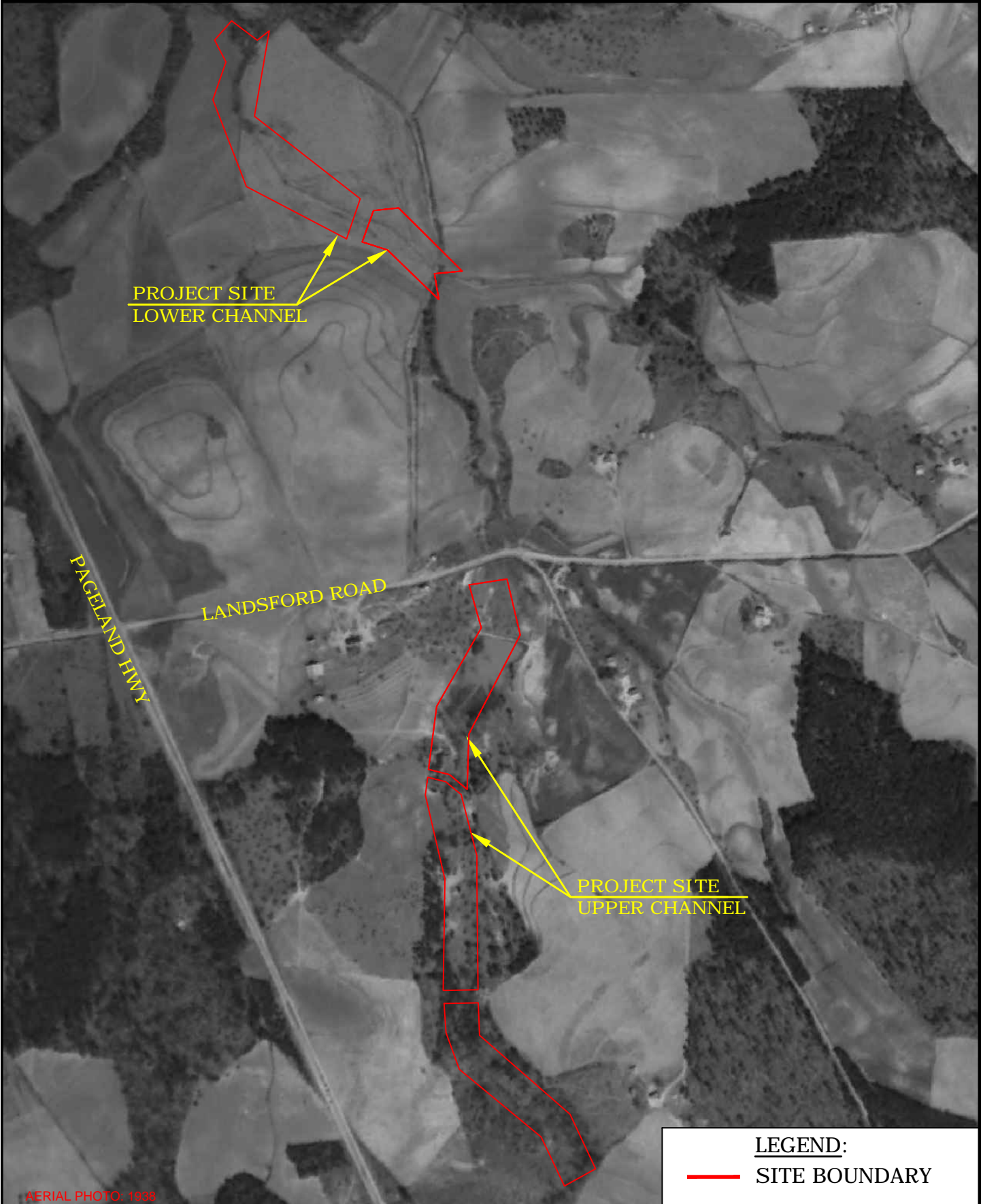
500 250 0 500



DATE: AUGUST 9, 2013

EXISTING HYDROLOGIC FEATURES
 601 EAST STREAM RESTORATION SITE
 UNION COUNTY, NC
FIGURE 4





LEGEND:
— SITE BOUNDARY

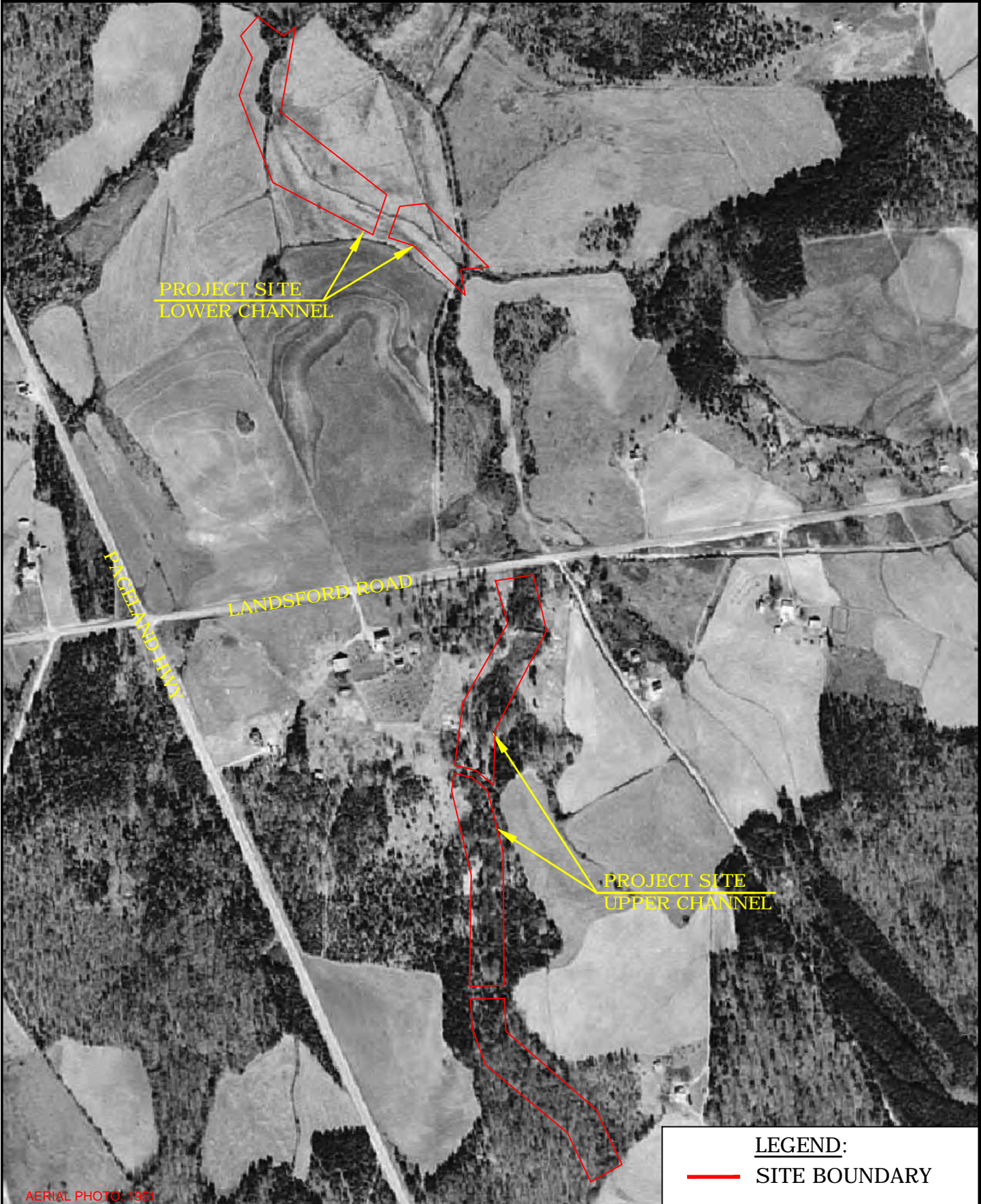
AERIAL PHOTO: 1938

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500 250 0 500

DATE: JUNE 1, 2013



HISTORICAL AERIAL PHOTO 1938
601 EAST STREAM RESTORATION SITE
UNION COUNTY, NC
FIGURE 5





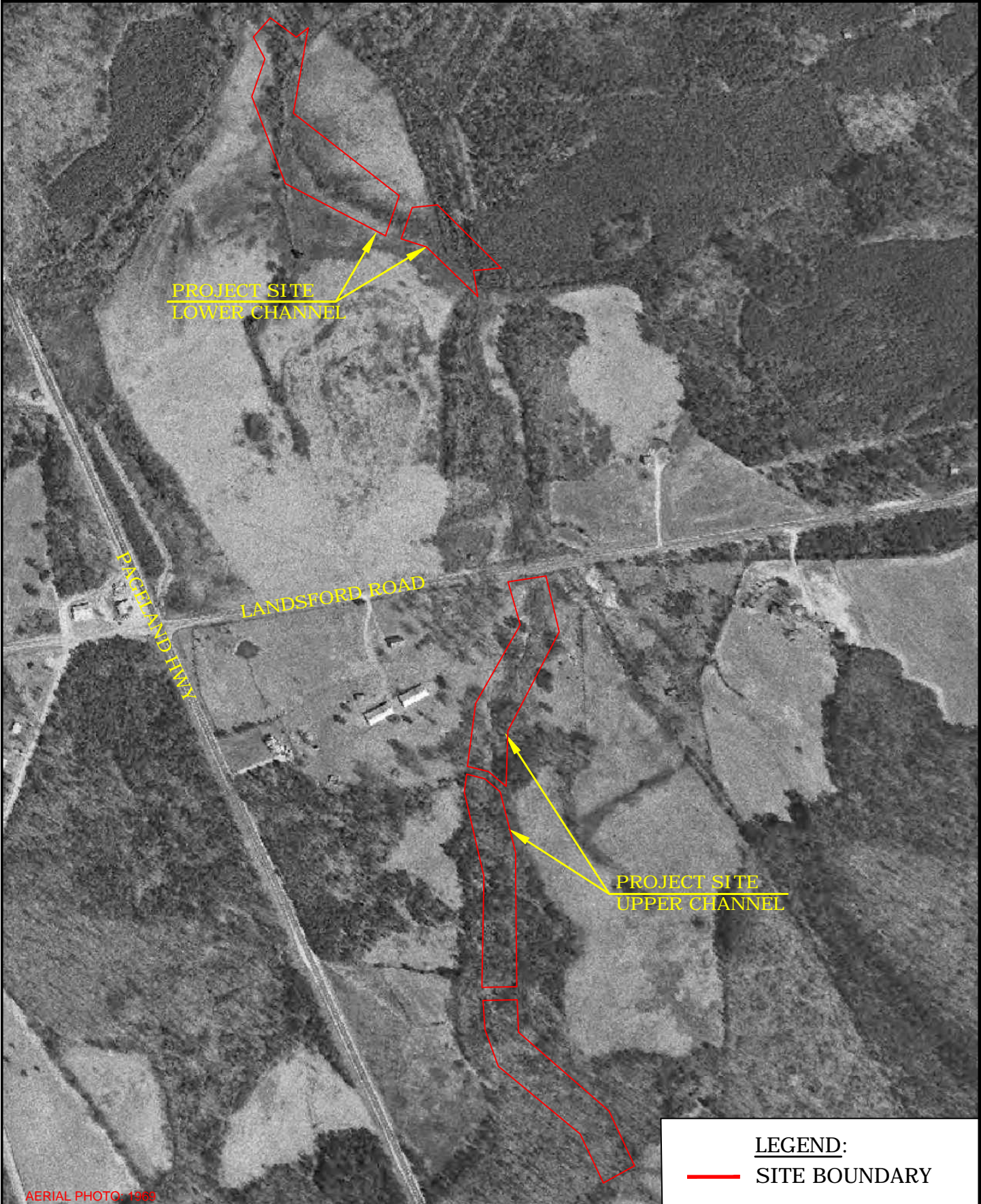
LEGEND:
 SITE BOUNDARY

AERIAL PHOTO: 1951

N

 500 250 0 500

 DATE: JUNE 1, 2013

HISTORICAL AERIAL PHOTO 1951
 601 EAST STREAM RESTORATION SITE
 UNION COUNTY, NC
FIGURE 6





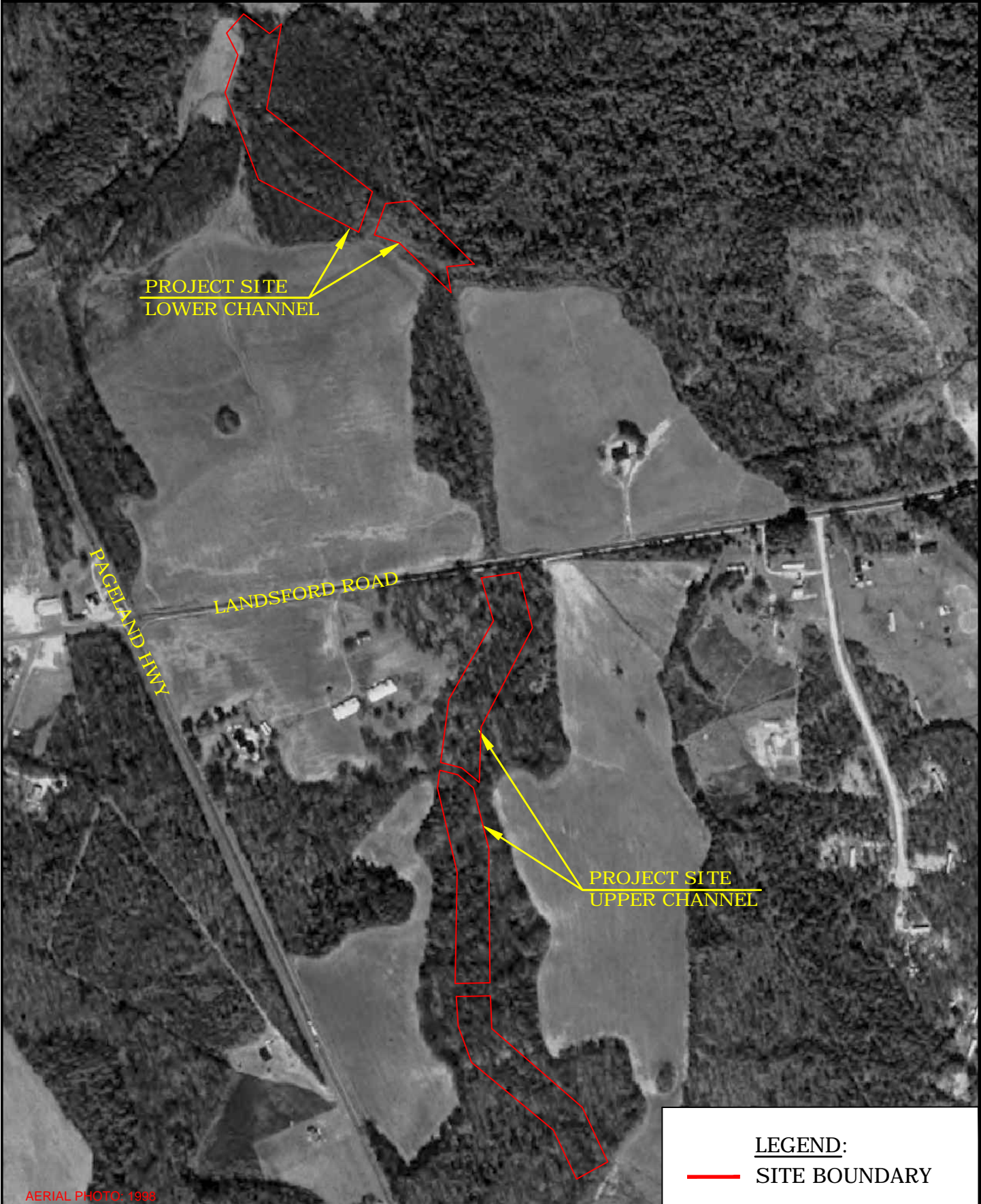
AERIAL PHOTO: 1969

LEGEND:
— SITE BOUNDARY

N
500 250 0 500
DATE: AUGUST 9, 2013

HISTORICAL AERIAL PHOTO 1969
601 EAST STREAM RESTORATION SITE
UNION COUNTY, NC
FIGURE 7





AERIAL PHOTO: 1998

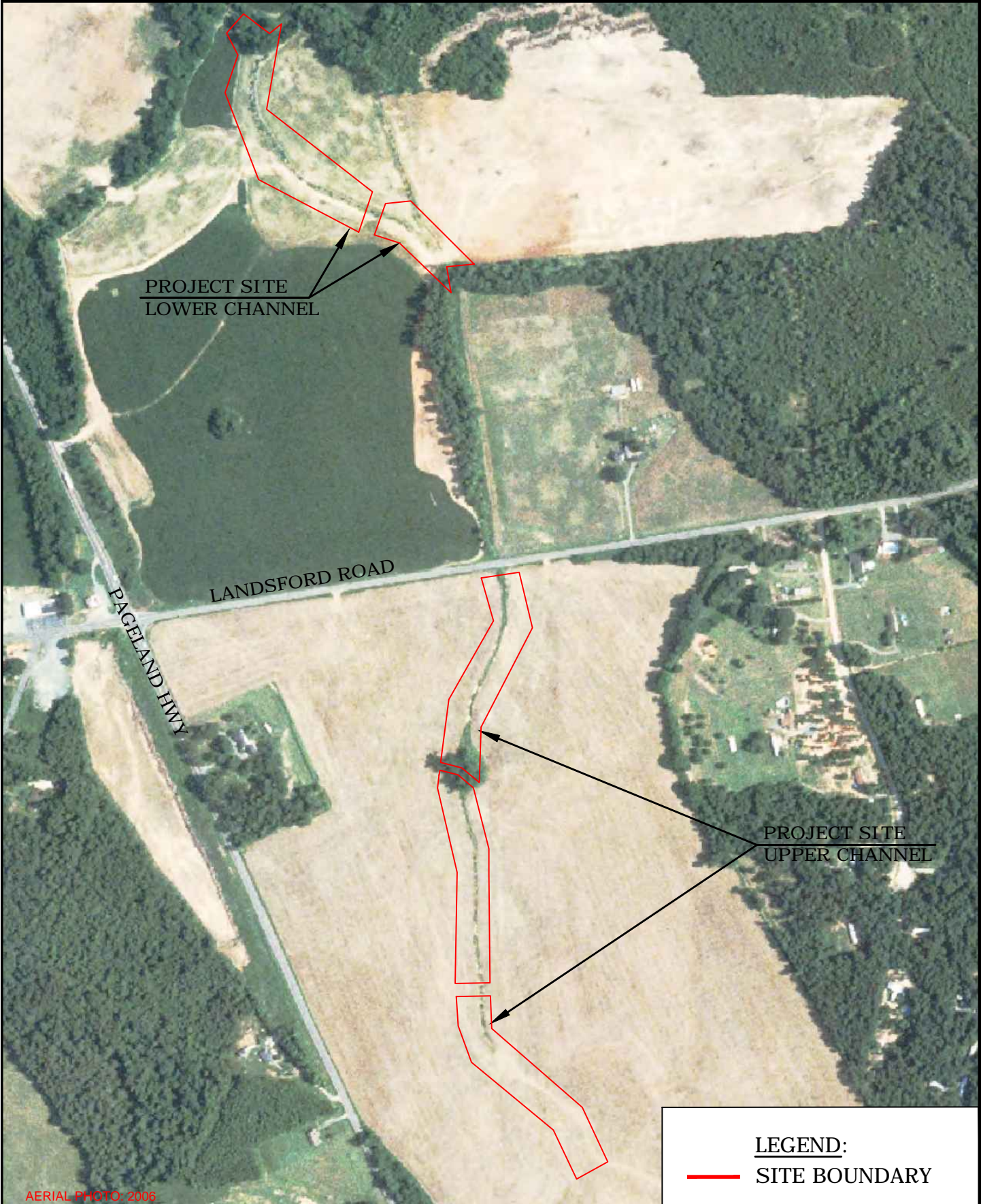


DATE: JUNE 1, 2013

HISTORICAL AERIAL PHOTO 1998
601 EAST STREAM RESTORATION SITE
UNION COUNTY, NC
FIGURE 8

LEGEND:
— SITE BOUNDARY





AERIAL PHOTO: 2006



DATE: JUNE 1, 2013

HISTORICAL AERIAL PHOTO 2006
601 EAST STREAM RESTORATION SITE
UNION COUNTY, NC
FIGURE 9



2.4 Project Site Photos

Site Photographs Nov 12, 2012



Photo Point 1. Uppermost head cut top of project- Ephemeral Channel



Photo Point 2. Ephemeral channel in foreground, intermittent channel origin.



Photo Point 3. Origin of perennial stream



Photo Point 4. Stream in woods by spring house.



Photo Point 5. South facing view of old spring house with Tanyard Branch in the foreground.



Photo Point 6. Wetland area undefined channel by Landsford Road.



Photo Point 7. Channel upstream of Landsford Road at culvert.



Photo Point 8. Pipe at outlet at existing Farm Crossing Lower Reach



Photo Point 9. Existing channel at outlet of plunge pool at farm crossing viewing incised channel downstream



Photo Point 10. Head of Relic Channel as viewed from active channel.



Photo Point 11. Relic Channel with Chinese Privet as the dominant vegetation.

3.0 SITE PROTECTION INSTRUMENT





The land required for the construction, management, and stewardship of this mitigation project includes portions of the following parcels. A copy of the land protection instrument(s) is included in the appendices.

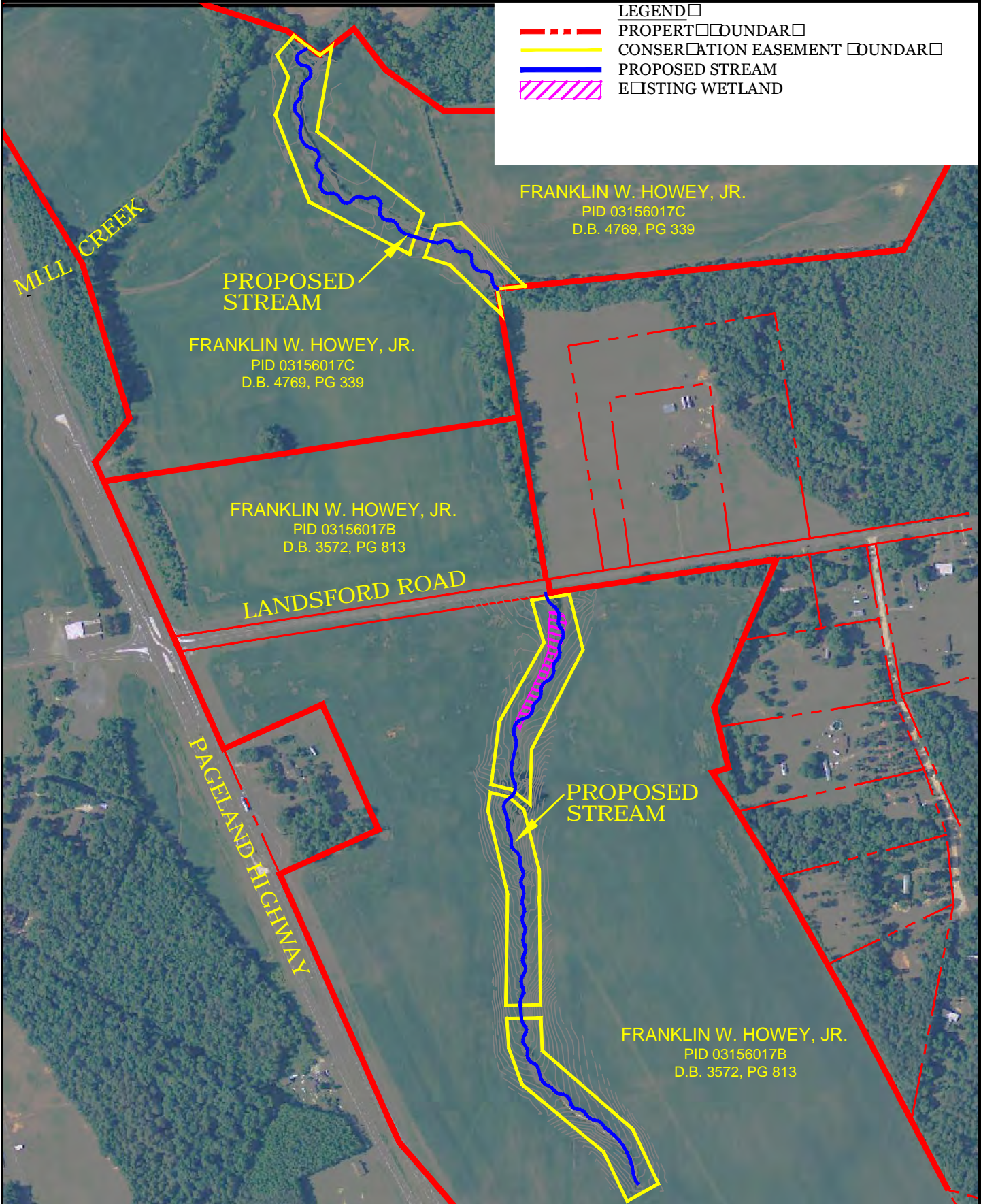
	Landowner	PIN	County	Site Protection Instrument	Deed Book and Page Number	Acreage protected
Parcel A	Franklin W. Howey Jr.	03156017B	Union	Conservation Easement	DB 3572 PG 813	7.76
Parcel B	Franklin W. Howey Jr.	03156017C	Union	Conservation Easement	DB 4769 PG 339	5.02

When available, the recorded document(s) will be provided. If the recorded document(s) are not available, the template documents will be provided.

All site instruments require 60-day advance notification to the Corps and the State prior to any action to void, amend, or modify the document. No such action shall take place unless approved by the State.

LEGEND

-  PROPERTY BOUNDARY
-  CONSERVATION EASEMENT BOUNDARY
-  PROPOSED STREAM
-  EXISTING WETLAND



N

500 250 0 500

DATE: AUGUST 9, 2013

SITE PROTECTION INSTRUMENT
 601 EAST STREAM RESTORATION SITE
 UNION COUNTY, NC
FIGURE 10



4.0 BASELINE INFORMATION

4.1 Project Information

Project Name	601 East Stream Restoration Site		
County	Union County		
Project Area (acres)	12.78		
Project Coordinates (latitude and longitude)	34° 50' 21.62" N, 80° 25' 32.26"N		
Project Watershed Summary Information			
Physiographic Province	Piedmont		
River Basin	Yadkin River Basin		
USGS Hydrologic Unit 8-Digit		USGS Hydrologic Unit 14-digit	03040105081010
DWQ Sub-basin	03-04-14		
Project Drainage Area (acres)	361.33		
Project drainage Area Percentage of Impervious Area	2%		
CGIA Land Use Classification	2.01.01.07 Annual Row Crop Rotation		

4.2 Reach Summary Information

Parameters	Reach 1	Reach 2	Reach 3	Reach 4
Length of reach (LF)	1418	906	1080	Relic Channel
Valley Classification	II	II	VIII	VIII
Drainage area (acres)	109	135	333	359
NCDWQ stream identification score	Intermittent: 19.5 Perennial: 33.5	33.5	33.5	33.5
NCDWQ Water Quality Classification	13-17-40-(1)	13-17-40-(1)	13-17-40-(1)	13-17-40-(1)
Morphological Description (stream type)	G4/B4/C4b	C4/E4/DA	C4/G4	G4
Evolutionary trend (reference channel evolution model used)	G	C/DA	G	G
Underlying mapped soils	Intermittent: Tatum gravelly silty clay loam Perennial: Cid channery silt loam	Cid channery silt loam, Tatum gravelly silt loam	Chewacla silt loam	Chewacla silt loam
Drainage class	Well Drained	Moderately Well Drained	Somewhat Poorly Drained	Somewhat Poorly Drained
Soil Hydric status	Non Hydric	Non Hydric	Non Hydric	Non Hydric
Slope	2%	0.84%	0.67%	1.25%
FEMA classification	N/A	N/A	N/A	N/A
Native vegetation community	Agriculture along upstream portion of Intermittent channel. The remaining stream buffer within this reach is composed of Willow Oak, Red Maple, River Birch, Black Willow, Elderberry, and Blackberry.	Canopy species include Willow Oak, Black Willow, Red Maple, Sweetgum, Eastern Red Cedar, Tag Alder, and Silky Dogwood. Wetland A is composed of Cattails, spike rush arrow-arum, and duckweed.	Canopy species include Red Maple, Hackberry, Willow Oak, and Sweetgum. The presence of Chinese privet outcompete any shrub and herb layer.	Canopy species include Red Maple, Hackberry, Willow oak, and Sweetgum. The presence of Chinese privet outcompete any shrub and herb layer.
Percent composition of exotic invasive vegetation	0%	50% of Parrot feather	5% of Japanese stilt grass, 80% Chinese privet, and kudzu	80% Chinese privet

4.3 Wetland Summary Information

Parameters	Wetland 1
Size of Wetland (acres)	0.43 ac
Wetland Type (non-riparian, riparian riverine, or riparian non-riverine)	Non-Tidal Freshwater Marsh
Mapped Soil Series	Cid channery Silt Loam
Drainage class	Moderately Well Drained to Somewhat Poorly Drained
Soil Hydric Status	Non-Hydric
Source of Hydrology	Tanyard Branch headwaters, groundwater, and adjacent runoff
Hydrologic Impairment	Wetland A formed from accumulating sediments filling the channel resulting in a braided channel system through the wetland.
Native vegetation community	Herbaceous -Vegetation is dominated by herbaceous vegetation such as Cattail (<i>Typha latifolia</i>), Bulrush (<i>Scirpus cyperinus</i>), Common Rush (<i>Juncus effuses</i>). Some tree species such as Black Willow (<i>Salix nigra</i>), and Red Maple (<i>Acer rubrum</i>) are present in the wetland margins.
Percent composition of exotic invasive vegetation	95% -The invasive Parrot Feather (<i>Miriophyllum aquaticum</i>) is dominant throughout the wetland where there is standing water.

4.4 Regulatory Considerations

Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States-Section 404	Yes	To Be Permitted.	
Waters of the United States – Section 401	Yes	To Be Permitted.	
Endangered Species Act	No	Yes	ERTR
Historic Preservation Act	No	Yes	ERTR
Costal Zone Management Act (CZMA)/Costal Area Management Act (CAMA)	No	N/A	
FEMA Floodplain Compliance	No	N/A	
Essential Fisheries Habitat	No	N/A	

5.0 DETERMINATION OF CREDITS

Mitigation credits presented in these tables are projections based upon site design. Upon completion of site construction the project components and credits data will be revised to be consistent with the as-built condition.

601 East Stream Restoration, Union County EEP Project Number 95756									
Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	3680								
Project Components									
Project Component -or- Reach ID	Stationing/Location		Existing Footage/Acreage	Approach (P1, PII etc.)	Restoration -or- Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio		
Reach A Ephemeral	5+45 – 7+60		215		Buffer establishment and BMP sediment import reduction	215	1:5		
Reach 1a Intermittent	7+60 – 11+10		336	P1	R	350	1:1		
Reach 1b Intermittent	11+10 – 11+95		85	Enhancement	E1	85	1:1.5		
Reach 1c Perennial	11+95 – 13+50		136	Enhancement	E1	155	1:1.5		
Reach 1d Perennial	14+00 – 22+00		790	P1	R	800	1:1		
Reach 2a Perennial	22+00 – 22+40		40	Enhancement	E1	40	1:1.5		
Reach 2b Perennial	22+80 – 24+00		125	Enhancement	E1	120	1:1.5		
Reach 2c Perennial	24+00 – 31+24		669	P1	R	724	1:1		
Reach 3a Perennial	43+06 – 46+60		80' active channel 112' relic channel	P1	R	368	1:1		
Reach 3b Perennial	47+20 – 53+70		502' relic channel	P1	R	650	1:1		
Reach 4 Perennial	53+70 – 58+50		470' relic channel	P3	R	480	1:1		

Component Summation						
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non- Riverine			
Restoration	3372					
Enhancement						
Enhancement I	400					
Enhancement II						
Creation						
Preservation/Other	215					
HQ Preservation						
BMP Elements						
Element	Location		Purpose/Function		Notes	
FB, LS, S, FS	Ephemeral Channel 5+45 – 7+60		Slowing the water down for settling and filtering excess sediment		Sediment expected from future degradation upstream	
BMP Elements BR = Bioretention cell; SF = Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP = Dry Detention Pond; FS = Filter Strip; S = Grassed Swale; LS = Level Spread; NI = Natural Infiltration Area; FB = Forested Buffer						

6.0 CREDIT RELEASE SCHEDULE

All credit releases will be based on the total credit generated as reported by the as-built survey of the mitigation site. Under no circumstances shall any mitigation project be debited until the necessary DA authorization has been received for its construction or the District Engineer (DE) has otherwise provided written approval for the project in the case where no DA authorization is required for construction of the mitigation project. The DE, in consultation with the Interagency Review Team (IRT), will determine if performance standards have been satisfied sufficiently to meet the requirements of the release schedules below. In cases where some performance standards have not been met, credits may still be released depending on the specifics of the case. Monitoring may be required to restart or to be extended, depending on the extent to which the site fails to meet the specified performance standard. The release of project credits will be subject to the criteria described as follows:

Stream Credits			
Monitoring Year	Credit Release Activity	Interim Release	Total Released
0	Initial Allocation – see requirements below	30%	30 %
1	First year monitoring report demonstrates performance standards are being met	10%	40%
2	Second year monitoring report demonstrates performance standards are being met	10%	50% (60%*)
3	Third year monitoring report demonstrates performance standards are being met	10%	60% (70%*)
4	Fourth year monitoring report demonstrates performance standards are being met	5%	65% (75%*)
5	Fifth year monitoring report demonstrates performance standards are being met	10%	75% (85%*)
6	Sixth year monitoring report demonstrates performance standards are being met	5%	80% (90*)
7	Seventh year monitoring report demonstrates performance standards are being met and project has received closeout approval	10%	90% (100%*)

Initial Allocation of Released Credits

The initial allocation of released credits, as specified in the mitigation plan can be released by the NCEEP without prior written approval of the DE upon satisfactory completion of the following activities:

- a. Approval of the final Mitigation Plan
- b. Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property
- c. Completion of project construction (the initial physical and biological improvements to the mitigation site) pursuant to the mitigation plan; Per the NCEEP Instruments, construction means that a mitigation site has been construction in its entirety, to include planting, and an as-built report that has

- been produced. As-built reports must be sealed by an engineer prior to project closeout, if appropriate but not prior to the initial allocation of released credits.
- d. Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.

Subsequent Credit Releases

All subsequent credit releases must be approved by the DE, in consultation with the IRT, based on a determination that required performance standards have been achieved. For stream projects a reserve of 15% of a site's total stream credits shall be released after two bank-full events have occurred, in separate years, provided the channel is stable and all other performance standards are met. In the event that less than two bank-full events occur during the monitoring period, release of these reserve credits shall be at the discretion of the IRT. As projects approach milestones associated with credit release, the NCEEP will submit a request for credit release to the DE along with documentation substantiating achievement of criteria required release to occur. This documentation will be included with the annual monitoring report.

7.0 MITIGATION WORK PLAN

7.1 Description of Target Stream and Vegetation Communities

Reference reaches were sought to provide a target for design of the proposed streams. Searches were conducted into surrounding watersheds to find suitable references that contained comparable slope, bed material and valley type. A Type C4 reference was located on Underwood Creek a tributary to Little Twelve Mile Creek in Union County. A type B4 reference was located on UT to Richardson Creek a tributary to Rocky River in Anson County. The reference vegetation community data was also collected at the Cold Springs reference site.

7.1.1 Reference Reach

The reference reach was selected to represent the probable configurations for the proposed stream restoration. Detailed geomorphic survey and Level II Rosgen classifications were conducted on both reference reaches. Reference reach data has been included in Appendix C.

7.1.1.1 UT to Underwood Creek Reference

The reference reach is located in an undisturbed segment of UT to Underwood Creek. This area has remained wooded as far back as 1951 as evidenced by the aerial photography that was obtained. The UT to Underwood creek has many characteristics in common with the 601 East watershed including valley type, valley slope, and drainage area of 0.5 square miles.

The UT to Underwood Creek reach is representative of a C4 channel in a mildly sloped valley with a broad floodplain. Bed material, channel slope and valley form of this stream are consistent with the Site and provide reasonable model for the potential channel forms that can be expected at the site. The UT to Underwood Creek reach has a range of D50 of 20.4 millimeters (mm) to 38.1 mm, D84 of 31.5 mm to 90 mm, channel slope of 0.48 percent, width/depth ratio of 7.7 to 15.6, and sinuosity of 1.2. The channel has a wide bankfull width/depth ratio range and a low bank height that allows floodwater to access the floodplain. The profile consists of a well developed riffle pool sequence located at the appropriate locations within the channel. The stream is located in the same physiographic region, the Carolina Slate Belt, as Tanyard Branch. While UT to Underwood Creek classifies as an "E4/C4" type channel, using the range of numbers from the morphological tables that are more closely associated with a "C" type channel, the proposed restoration channels will be designed to fall into the "C" classification.

Discharge and Bankfull Verification

The drainage area at the downstream limit of the reference reach is approximately 0.43 square miles. The estimated bankfull discharge is approximately 40 cubic feet per second (cfs). The discharge was estimated from eleven field cross sections taken along the channel. Bankfull was located at the top of the existing channel which is at the existing floodplain elevation. Bankfull verification on UT to Underwood Creek was completed with a comparison of field surveyed stream cross sections for typical bankfull

width, area, depth, and discharge relationships. The watershed predicted discharges were compared with the bankfull channel capacities generated from field cross sections for verification. The Rural Piedmont Curves developed by the North Carolina State University (NCSU) Water Quality Group were used to verify acceptable limits of morphological characteristics based on a hydro-physiographic region and drainage area. UT to Underwood Creek's average cross sectional values for bankfull area, width, depth and discharge fell within the confidence limits on the North Carolina Rural Regional Curves

Channel Stability Assessment

Visual observations of UT to Underwood Creek reference show that the stream has adequate root depth and density, moderate bank slopes, low bank heights and good vegetative surface protection. This indicates that the creek has low bank erosion potential degrades slowly and contributes little sediment to the stream waters.

Limited Reference Reach

Through the course of conducting the reference reach searches, several streams were identified as possessing qualities of stability and natural form. However these reaches were determined to not be suitable references for the project due to differences in stream type, valley form, or valley slope.

Reference Vegetation Community

Plant community classifications follow those presented by Schafale and Weakley (1990) where possible. The dominant flora observed, or likely to occur, in each community are described and discussed. Scientific nomenclature and the common names (when applicable) are provided. Plant taxonomy typically follows (Weakley 2008). All subsequent references to the same organism will include the common name only. Published range distributions and habitat analysis are used in estimating flora expected to be present within the project site.

The vegetative community species composition is similar to that of the Piedmont Alluvial Forest located within the conservation easement. The canopy is composed of tree species including but not limited to green ash, sweetgum, red maple, red elm, and southern hackberry. Subcanopy and shrub species observed include ironwood (*Carpinus caroliniana*) saplings of red maple and sweetgum. This community has a dense shrub layer dominated by Chinese privet. Herbaceous species observed in this community include the invasive species, Japanese honeysuckle (*Lonicera japonica*).

7.1.1.2 UT to Richardson Creek

The reference reach is located in an undisturbed segment of UT to Richardson Creek. This area has remained wooded as far back as 1951 as evidenced by the aerial photography that was obtained. The UT to Richardson Creek has many characteristics in common with the 601 East watershed including valley type, valley slope, and drainage area.

The UT to Richardson Creek reach is representative of a B4/C4b channel in a moderately sloped valley with a narrow constrained floodplain. Bed material, channel

slope and valley form of this stream are consistent with the Site and provide reasonable model for the potential channel forms that can be expected at the Site. The UT to Richardson Creek reach has a range of D50 of 18.6 mm to 28.9 mm, D84 of 61.3 mm to 64.8 mm, channel slope of 1.8 percent, width/depth ratio of 8 to 17, and sinuosity of 1.16. The channel has a high bankfull width/depth ratio range and a low bank height that allows floodwater to access the floodplain. The profile consists of a well developed riffle pool sequence located at the appropriate locations within the channel. The stream is located in the same physiographic region, the Carolina Slate Belt, as Tanyard Branch.

Discharge and Bankfull Verification

The drainage area at the downstream limit of the reference reach is approximately 0.15 square miles. The estimated bankfull discharge is approximately 27 cfs. The discharge was estimated from twelve field cross sections taken along the channel. Bankfull was located at the top of the existing channel which is at the existing floodplain elevation. Bankfull verification on UT to Richardson Creek was completed with a comparison of field surveyed stream cross sections for typical bankfull width, area, depth, and discharge relationships. The watershed predicted discharges were compared with the bankfull channel capacities generated from field cross sections for verification. The Rural Piedmont Curves developed by the North Carolina State University (NCSU) Water Quality Group were used to verify acceptable limits of morphological characteristics based on a hydro-physiographic region and drainage area. UT to Underwood Creek's average cross sectional values for bankfull area, width, depth and discharge fell within the confidence limits on the North Carolina Rural Regional Curves.

Channel Stability Assessment

Visual observations of UT to Richardson Creek reference show that the stream has adequate root depth and density, moderate bank slopes, low bank heights and good vegetative surface protection. This indicates that the creek as low bank erosion potential degrades slowly and contributes little sediment to the stream waters.

Limited Reach Reference

Through the course of conducting the reference reach searches, several streams were identified as possessing qualities of stability and natural form. However these reaches were determined to be not suitable references for the project due to differences in stream type, valley form, or valley slope.

Reference Vegetation Community

Plant community classifications follow those presented by Schafale and Weakley (1990) where possible. The dominant flora observed, or likely to occur, in each community are described and discussed. Scientific nomenclature and the common names (when applicable) are provided. Plant taxonomy typically follows (Weakley 2008). All subsequent references to the same organism will include the common name only. Published range distributions and habitat analysis are used in estimating flora expected to be present within the project site.

A plant community survey was performed within the forested community along the Tanyard Branch downstream of Landsford Rd where a stream buffer is present. This

small stream plant community, common to the Piedmont region, is located within what closely resembles a Piedmont Alluvial Forest as described by Schafale and Weakley (Draft May 2012). Canopy species observed included sycamore, hackberry, red maple, river birch, green ash, eastern red cedar, willow oak, and tulip poplar (*Liriodendron tulipifera*). Subcanopy species included American holly (*Ilex opaca*), iron wood, and Chinese privet. Herbaceous species included were sparse consisting mostly of Japanese honeysuckle. The Piedmont Alluvial Forest community proposed for Reach 3 and 4 will be modeled after this community. The Piedmont Headwater Forest community proposed for Reach 1 and 2 will be modeled after typical species expected to occur within these communities and the native woody species already observed along Tanyard Branch within these reaches. Canopy species typical of a Piedmont Headwater Forest consist of willow oak, red maple, sweetgum, common elderberry, ironwood, and white oak, all of which were observed within Reach 1 and 2.

7.2 Design Narrative

7.2.1 Restoration Approach

Tanyard Branch is divided into an ephemeral channel Reach A and four (4) Intermittant or Perennial numbered (1-4) reaches for design with two reaches above Landsford Road and two reaches below. Above Landsford Road the stream valley changes from a Type B to a Type C stream. The ephemeral channel Reach A is located at the top of the project. The ephemeral channel is 215 linear feet in length and improvements include BMPs and buffers to prevent future erosion and sediment input from the existing roadway drainage stressor. Reach 1 is located is the first segment below the ephemeral channel and Reach 2 begins in the woods adjacent to the spring house to Landsford Road. Tanyard Branch below Landsford Road begins as a Type C channel and then changes to a Type B channel in the lower one third of its length with a Priority III restoration approach to transition the stream to the much lower elevation of Lanes Creek.

A concern with the project in the headwater areas was the stability of the ephemeral channel and the extensive erosion that had occurred in the last 5 years due to recent roadway improvements in the watershed. Additionally upstream of the proposed buffers the land will continue in agricultural crop production. The project approach for the ephemeral stream, Reach A, is to stabilize the area from future incision with a series of energy dissipaters to provide vertical stability and as well as provide sediment settling capacity for anticipated future sediment import from continued ephemeral channel erosion outside of the conservation easement. Two hundred and fifteen feet (215') of ephemeral channel has been included in the design. This channel length will have 50 foot vegetative buffers restored along its length and will be included within the conservation easement. A dense planting of shrubs along with trees on the outside and around the BMP's on the ephemeral section of Reach 1a will be provided. Shrubs will be used to attenuate sediment.

Based on surveyed cross sections of the incised channel and an assumed pre-degradation top of bank elevation a sediment loss volume of 167 tons was estimated to

have occurred along 335 feet of channel length between 2008 and 2010 at the top of the stream. A series of five (5) stormwater BMP basins have been designed throughout the ephemeral channel reach to detain future sediment moving through the system. The basins have a total capacity to hold 206 tons of sediment. After the initial degradation within this area between 2008 and 2011 occurred, significant sediment loss was not observed in 2012 or 2013. It is anticipated that due to the continued farming of the land outside of the conservation easement that the draws to the south and east of the restoration project will continue to introduce excess sediment to the stream. It is not anticipated that the sediment loss will be as significant as the degradation that occurred between 2008 and 2010 due to the observations that were made in 2012 and 2013. The designed basins have ample storage capacity to capture sediment and provide ground water recharge as water is stored and allowed to drain into the soils below upstream of the intermittent channel.

A Mitigation ratio of 1:5 has been requested for the 215 linear feet of channel. The improvements in the ephemeral channel add to the functional uplift of the project, provide additional buffer to adjacent agricultural land, and will reduce sediment import to the downstream restored stream. The buffers and sediment reduction will reduce the amount of pesticide and fertilizers entering the stream.

Several draws input drainage from the agricultural fields into the stream along the length. Depressed areas at each draw will be excavated to create diffuse sheet flow over an extended rim of the depression. These draws do not currently support wetlands. The sheet diffused flow will have reduced velocities and aid in preventing rills within the conservation easement to the new channel. The recommended approach is for a combination of restoration and enhancement of reaches 1 & 2 and full restoration of reaches 3 & 4.

Reach 1 will feature Priority 1 restoration and enhancement Level 1. Reach 1 will be reconstructed as a Priority I restoration with a B4 stream. A priority one is appropriate for this design stream type "B" as the proposed design will raise the channel to reconnect the stream with the current floodplain. A "B" type stream is appropriate for this valley slope. This will provide for the construction of the proper cross sectional geometry, reducing stress on the banks and eliminating bank scour. In addition the bed will be stabilized with constructed functional riffles. Riffles constructed from rock materials supplemented with native gravel and cobble materials will provide immediate habitat features and functional lift. The upper 350 feet of Reach 1 is intermittent. The enhancement E1 portion of Reach 1 includes 290 total linear feet of stream that is currently connected to the floodplain and will be enhanced with the correct stream pattern and dimension. Additionally a 50 foot exclusion for a piped farm crossing of the stream is located within Reach 1.

Reach 1 has been broken down into the following components. Reach 1a is a 350 foot segment to be restored as a P1 restoration approach. Reach 1b is an 85 foot segment of intermittent stream that is currently connected to the floodplain where enhancement E1 is proposed. The perennial stream begins at Reach 1c. This reach includes 155 feet of stream which is currently connected to the floodplain where enhancement E1 is

proposed. Reach 1d is an 800 foot segment of perennial channel length with a P1 restoration approach.

Reach 2 begins where the valley flattens out and becomes broad and therefore a C4 stream type is proposed for this reach. The upstream segment of Reach 2 is located in an existing wooded area of the stream. Enhancement E1 is proposed for 200 linear feet through the wooded area in which the stream cross section and vertical alignment will be adjusted within the existing stream pattern. A forty (40) foot easement exclusion is proposed with in the E1 portion of Reach 2 for an existing spring house that is located adjacent to the stream. The spring house provides water to the residence located at 6915 Pageland Hwy owned by Mary C. and Don E. Taylor Pin Number 03156017A, DB 3572, PG 810. Therefore underground electric and water distribution lines are located within this exclusion area. Reach 2a includes 40 feet of stream enhancement E1 below Reach 1d and above the spring house exclusion. Reach 2b includes 120 feet of enhancement E1 below the spring house exclusion. Priority I restoration is proposed for the remaining 724 linear feet of this reach. This reach has been identified as 2c and it extends to Landsford Road. The stream in Reach 2c has been located adjacent to the existing wetlands that have formed in the existing depositional area. The proposed restoration will preserve the majority of the wetlands and improve sediment transport. A 10 foot exclusion has been provided between the conservation easement and right-of-way on Landsford Road for future roadway expansion.

Reach 3 begins below an existing wooded stream segment approximately 1,200 linear feet below Landsford Road. This reach starts just below the confluence of Tanyard Branch and a tributary that approximately doubles the drainage. Reach 3 is proposed as a C4 stream. The stream will be reconnected to the relic channel on the Site. Through this restoration the stream will be placed into its historical location and removed from the agricultural ditch location that was constructed on the property. The issue affecting the ecological function on this reach is the extreme topographic separation of Tanyard Branch from the adjacent floodplain. In order to reconnect Tanyard Branch with the contiguous natural terrain and improve floodplain groundwater hydrology, a Priority I approach is recommended for a distance of 1078 linear feet. A 60 foot easement exclusion is proposed within this stream length for a farm crossing. Reach 3 has been broken into two segments; Reach 3a includes 368 feet above the farm crossing exclusion and Reach 3b 650 feet below. The existing channel below the proposed diversion into the relic channel will be filled for approximately 250 feet to accommodate the new stream alignment and provide farming access to the eastern half of the property. The remaining channel will remain open and in its existing condition.

Reach 4 includes the last 480 linear feet of stream in the lower reach. A Priority 3 restoration approach as a Type B4 stream is proposed for Reach 4. To improve the transition of the stream to the lower elevation of Lanes Creek and overall channel stability the floodplain will be graded to create a confined valley. The restoration will address the degraded conditions of severe channel incision, unstable banks, and improper channel dimensions which are negatively affecting stream function. A Priority 3 approach will be required to convert the existing G channel to a B Type stream.

7.2.2 Restoration Method

Restoration of Type C4 streams will consist of constructing a moderate to high sinuosity stream with a moderate to high width-depth ratio (13 to 14) and a riffle-pool bed profile that will access the floodplain at bankfull flows. Restoration of Type B4 streams will consist of constructing a low to moderate sinuosity (1.1 to 1.17) stream with a moderate width-depth ratio (13 to 16) that accesses the floodplain at greater-than bankfull flows. For streams with average channel slopes from 1.2 to 4 percent the bed profile form is in a range that is transitioning from riffle-pool morphology at the lower slopes to step-pool morphology at the steeper slopes. The profile for Tanyard Branch is at the lower end of the slope range and therefore is proposed as riffle-pool morphology.

Exploration for buried bed material will be conducted in proximity of the channel work to harvest available bed material for reuse in the constructed channel. It is anticipated that the existing bed material is insufficient for the proposed work and therefore will be supplemented with off-site material or material quarried on site of appropriate size.

Constructed riffles will primarily be used to provide vertical stability to the channel, assist in maintaining, riffle, run and pool features and to provide habitat. In an effort to minimize rock used for the project constructed riffles were divided into three groups; Class I, Class II, and Stone & Log riffles. Class II riffles have the largest stone and are used in limited areas that have the highest velocities and shear stresses. Class II riffles are also proposed for Reach 4 that is a Priority 3 Type "B" channel transitioning Tanyard Branch to Lanes Creek. Class I riffles were used primarily in the upper reach Type "B" channel. The stone and log constructed riffles are primarily used in the Type "C" channel where lower velocities and shear stresses were predicted. This stone and log riffle design was used to reduce the rock in the channel and introduce more wood into the design. The "C" Type channels also are adjacent to wetter floodplains that will help in preserving the wood within the riffle structure. The riffle material was selected based on the shear stresses obtained in the HEC-RAS analysis. Within the stream length the shear stress resulted in numbers that required a larger diameter rock to hold the vertical profile at riffle locations than is present in the adjacent medium gravel soils. Additionally material of this size is not readily available as sediment import into the channel in this headwater stream to develop the riffles. Therefore to hold the vertical profile of the restored stream larger stone is required to be added at the riffle locations for long term stability as shown on the plans.

Single wing log vanes will be used to shift the flow away from the outside banks on selected meander bends. Trees will be harvested onsite will be used in the log structures. Brush-toe structures will be installed in the perennial stream outside of selected meander bends to provide bank stability, increase bank roughness, and provide aquatic habitat. Rock toe and grade control structures will be used in the ephemeral channel and intermittent stream segments to provide bank and bed stability. A rock toe is proposed in these reaches due to the concern of wood material rotting away too quickly without continual submergence in water. Small diameter (less than 6") woody plants suitable for transplanting will be harvested on-site where available.

Earthwork activities will include excavation of the proposed channel, partial or complete backfilling of existing channels, and the creation of a wider valley for Priority 3

restoration in Reach 4. Grading work is designed to tie into the natural landscape. During construction, wetland areas will be protected from impact outside of the channel construction area.

Farm crossings will be designed with oversized pipe so that the pipe will be buried below the bed to the channel to allow bed material to pass through the pipe. A boulder grade control structure will be placed downstream of the pipe to hold the low water surface just above the outlet and allow for aquatic passage.

All disturbed areas will be stabilized with temporary and permanent seed and covered with straw or mulch. Live stakes will be installed on the stream banks in accordance with the planting plan and the entire conservation easement will be planted with bare root seedlings. Plantings will be in accordance with the planting plan included in Appendix D.

7.2.3 Data Analysis

Hydraulic and Hydrologic Analysis

A hydrologic analysis was performed to quantify the bankfull flows and flood flows of the watershed for the upper and lower reaches. Field cross sections were taken at 18 locations in Reach 1, 10 locations in Reach 2, 9 locations in Reach 3 and 8 locations in the relic channel. The existing cross sections and the existing stream longitudinal profile of the channel thalweg and water surface slope were evaluated to determine bankfull elevations and discharges at each location based on field indicators. A bankfull elevation and slope was then set based on the field cross section data. The cross sections and slope were then adjusted to obtain a convergence on discharge predictions and morphological parameters.

Table of Bankfull Data from Collected Field Cross Section Data (Selected Sample Data Cross Sections)

Station	Wbkf	Abkf	dbkf	Q (cfs)
Reach 1				
8+66	7.21	4.82	0.67	24.3
9+90	10.56	5.76	0.55	25.0
11+17	19.4	8.1	0.42	21.7
12+11	42.5	14.53	0.32	28.4
12+84	19	12.89	.021	23.7
13+8	20.4	8.8	0.43	21.5
14+50	16.4	9.05	0.55	25.9
16+80	18.9	9.1	0.48	23.3
21+42	6.76	5.91	0.87	24.1
Reach 2				
22+52	8.1	10.7	1.33	26.0
27+96	29.3	22.8	1.78	26.9
30+58	18.89	12.6	0.67	29.6
Reach 3 & 4				
41+39	11.08	15.75	1.42	54.7
43+10	15.64	19.4	1.23	64.8
45+00	15.56	14.53	0.93	59.0
3+80 Relic	11.3	13.5	1.2	50.5

The USGS regional Regression equations for the NC Rural Piedmont hydrologic area were calculated for bankfull data and the Piedmont Regional Curve Data was obtained and compared to the field morphological data. The field discharges were slightly lower than the regional curve average values but compared within 80-90% of the regional curve data and within the confidence limits. The regression equations over predicted the discharges obtained from field data for the watershed.

Design Discharge Analysis Comparisons

Reach 1	Field Morph Data	Regional Curve Data	Regression Equation (1.5- 2yr)	Design Discharge
Q Avg (cfs)	23.67 (18.7–28.4)	23 (8-80)	32-38	24
Reach 2				
Q Avg (cfs)	24 (12-29.6)	29 (9-90)	39-45	26
Reach 3 & 4				
Q Avg (cfs)	54.7	56-60 (18-180)	76-90	55

Discharges were determined at 5 locations in the watershed for the Bankfull, 2xBankfull, 2 year, 5 year, 10 year, and 100 year storm events for input into the HEC-RAS model as shown in the table below.

Table of HEC-RAS Discharges

Upper Reach							
Drainage Area (Acres)	Discharge point of interest location	Bankfull	2 x Bankfull	2- Year	5- Year	10- Year	100- Year
36.2	At beginning of perennial stream	22	44	30	57	81	195
51.44	Above pump house	24	48	38	72	102	242
65.5	At head of Reach 2	26	52	45	84	120	282
84	At Landsford Road	33	66	54	100	140	328
Lower Reach							
175	At end of project	55	110	90	163	227	518

The proposed restored stream conditions were analyzed by creating a HEC-RAS model to reflect the proposed channel geometry, slope, and bed form features. Cross sections were established at all head of riffle, end of riffle, and center of pool locations in the model. The roughness coefficients for the channel were set to reflect anticipated future roughness coefficients. The HEC-RAS model was used to provide assistance in the analysis of sediment transport, verify bankfull flow capacity, determine flood flow conditions for large storm events, and confirm that no hydrologic trespass will occur on adjacent properties. The output files from the proposed HEC-RAS model are included in Appendix C.

7.2.4 *Sediment Competence Analysis*

Data Collection for sediment competence included riffle pebble counts and bulk samples collected on point bars. The bed material consists of a mix of sand and gravel. Pebble counts taken from the top of the stream to the wooded area in the upper reach reflect the sand that has moved out of the incised intermittent stream segment into the perennial stream below. The material in the intermittent stream reflected a 10% sand and 90% gravel mix. The perennial stream below showed a much higher sand

component, 40%, reflecting recent sediment import from the degraded upstream channel.

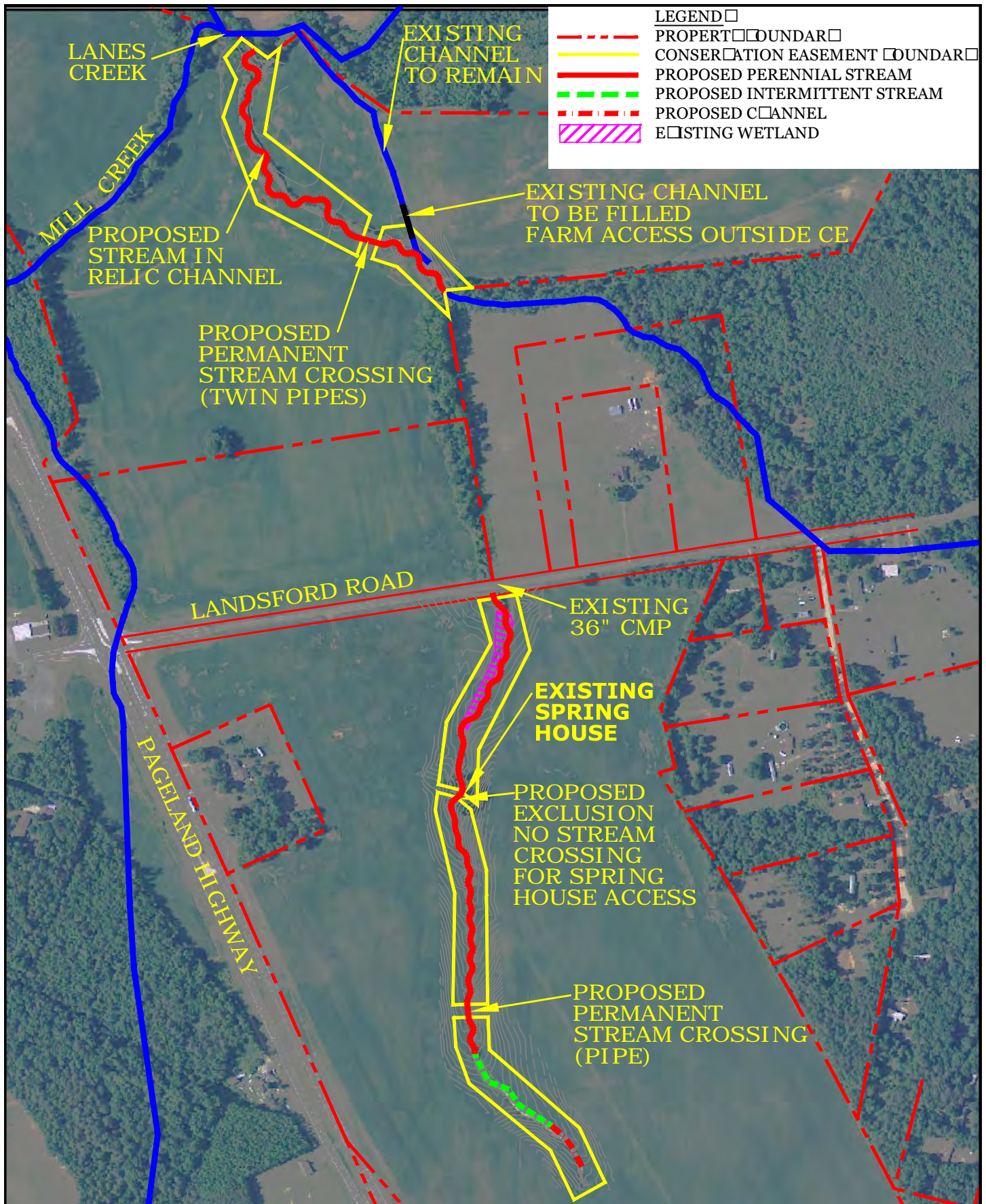
Critical dimensionless shear (T_c^*) of 0.035 was calculated using the Andrew's equation (1984). The threshold particle size based on the maximum particle size collected from field point bar samples was a 2 inch (very coarse gravel) particle. The proposed channel depth of flow and water surface slopes were designed to move the threshold particle based on the calculated dimensionless shear stress.

7.2.5 Sediment Capacity Analysis

Bank bulk samples were collected and analyzed for bank material composition to gain a better understanding of the native soils and particle sizes that may be transported to the stream. The samples were taken at two locations in the upper reach and one location in the lower reach. The samples were consistent with a composition of approximately 10% sand, 30% fine gravel, 40% medium gravel and 10% coarse-very coarse gravel.

Tanyard Branch is located at the top of the watershed, and has a low sediment supply and therefore sediment transport was not a significant concern in the design. The soils in the watershed are primarily silt loam. The major import of soils to the stream is through agricultural use of the adjacent land and the buffers will filter much of these sediments. The ephemeral channel has been designed with components to prevent future erosion as well as to trap sediment that may continue to be imported upstream from the recent highway improvements and agricultural operations.

A HEC-RAS model was built to assess the shear stress and stream power of the design for both the upper and lower reaches. Generally the proposed condition model shows a slight decrease in stream power in the larger storm return periods. The decrease in stream power is to be expected in the larger storm events due to the increase in channel width/depth ratio. The stream power values however are sufficiently high to transport the sand/fine gravel particles which constitute the main wash load component. The model results show that the velocities, shear stresses, and stream power are adequate to transport sand and gravel particles. Shear stress and velocities produced by the model were additionally used to size the proposed constructed riffle materials to resist movement. The riffles were sized typically for the 10 year storm event and at critical locations for the 100 year return period. Reach 4 constructed riffles were sized solely for the 100 year storm event. The HEC-RAS model output is included in Appendix C.

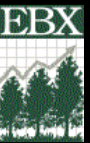


DATE: AUGUST 9, 2013

PROPOSED HYDROLOGIC FEATURES

601 EAST STREAM RESTORATION SITE
UNION COUNTY, NC

FIGURE 11



8.0 MAINTENANCE PLAN

EBX, NCEEP's full delivery provider, shall monitor the site on a regular basis and shall conduct a physical inspection of the site a minimum of once per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include the following:

Component/Feature	Maintenance through project close-out
Stream	Routine channel maintenance and repair activities may include securing of loose coir matting and supplemental installations of live stakes and other target vegetation along the channel. Areas where stormwater and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-cutting
Wetland	Routine wetland maintenance and repair activities may include securing of loose coir matting and supplemental installations of live stakes and other target vegetation along the channel. Areas where stormwater and floodplain flows intercept the channel may also require maintenance to prevent scour.
Vegetation	Vegetation shall be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species shall be controlled by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.
Site Boundary	Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, tree-blazing, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis.
Utility Right-of-Way	Utility rights-of-way within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights of way, or corridor agreements.
Ford Crossing	Ford crossings within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights of way, or corridor agreements.
Road Crossing	Road crossings within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights of way, or corridor agreements.
Beaver Management	Beaver activity will be monitored and removed on an as needed basis.
Stormwater Management Device	Storm water management devices will be monitored and maintained per the protocols and procedures defined by the NC Division of Water Quality Storm Water Best Management Practices Manual.

9.0 PERFORMANCE STANDARDS

Performance standards shall comply with the Ecosystem Enhancement Program Monitoring Requirements and Performance Standards for Stream and Wetland Mitigation Dated November 7, 2011. (Section IV C.)

Morphologic Parameters and Channel Stability

Restored and enhanced streams should demonstrate morphologic stability to be considered successful. Stability does not equate to an absence of change, but rather to sustainable rates of change or stable patterns of variation. Restored streams often demonstrate some level of initial adjustment in the period that follows construction and some subsequent change/variation is also to be expected. However, the observed change should not be unidirectional such that it represents a robust trend. If some trend is evident, it should be modest or indicate migration to another stable form. Annual variation is to be expected, but over time this should demonstrate equilibrium on the reach scale with the maintenance of or even a reduction in the amplitude of variation. Lastly, all of this must be evaluated in the context of hydrologic events to which the system is exposed and the design type/intent (i.e. threshold versus free form alluvial channels).

Dimension

General maintenance of a stable cross-section and hydrologic access to the floodplain features over the course of the monitoring period will generally represent success in dimensional stability. However, some change is natural and expected and can even indicate that the design was successful and appropriate for the hydrologic and sediment regime. Examples include depositional processes resulting in the development of constructive features on the banks and floodplain such as an inner berm, a slightly narrower channel, modest natural levees, and general floodplain deposition.

For stream dimension, cross-sectional overlays and key parameters such as cross-sectional area, and the channel's width to depth ratios should demonstrate modest overall change and patterns of variation that are in keeping with the descriptions in section 3.6.1.

Significant widening of the channel cross-section or trends of increase in the cross sectional area generally represent concern, although some adjustment in this direction is acceptable if the process is arrested after a period of modest adjustment. In the case of riffle cross sections, maintenance of depths that represent small changes to target competence (e.g. consistently low BHRs <1.2) would also reflect stability. Although a pool cross-section may experience periodic infilling due to watershed activity and the timing of events relative to monitoring, the majority of pools within a project stream reach/component should demonstrate maintenance of greater depths and low water surface slopes over time. Rates of lateral migration need to be moderate. Bank pins will be installed to monitor rates of erosion.

Pattern and Profile

Pool depths may vary from year to year, however the majority of pools should maintain depths that are distinct in the profile and are readily observed. Pattern measurement will not be collected unless observations indicate a detectable change based on observations and/or dimension measurements.

Substrate

Generally it is anticipated that the bed materials will coarsen over time. The majority of riffle pebble counts should indicate maintenance or coarsening of the substrate. The D50 and D84 of the substrate should show a coarser distribution of bed materials in riffles and finer size class distribution in pools.

Sediment Transport

Depositional features should be consistent with a stable stream that is effectively managing its sediment load. Point Bar and inner berm features should develop without excessive encroachment of the restored channel. Trends in the development of systemic robust mid-channel or alternating bar features will be considered a destabilizing condition and may require intervention.

The tributaries outside of the conservation easement will be observed yearly and the monitoring report will document the function of the upstream basins in capturing excess sediment produced by observed degradation in the narrative. A specific performance standard has not been added.

Surface Water Hydrology

Monitoring of stream water stages through a staff gauge should show recurrence of bankfull flow on average every 1 to 2 years. Throughout the monitoring period, the surface water stage should achieve bankfull or greater elevations at least twice. The bankfull events must occur during separate monitoring years.

Vegetation

The vegetation monitoring will be conducted according to the Carolina Vegetation Survey (CVS) – EEP protocol Version 4.2 (Lee et al 2008). Vegetation monitoring plots will be 100 square meters in size and will be conducted according to the Level I protocol which has a focus on planted stems only. The purpose of this level of monitoring is to determine the pattern of installation of plant material with respect to species, spacing, density, and to monitor the survival and growth of those installed species. The success criteria for the preferred species in the restoration areas will be based on annual and cumulative survival and growth over seven (7) years. Survival on preferred species must be at a minimum 320 stems/acre at the end of the three years of monitoring and 260 stems/acre after five years. At year 7, density must be no less than 210 seven year-old planted stems/acre. Level II of the CVS protocol, which includes natural stems and planted stems, will be followed for the monitoring year 2 and subsequent years until the project close out year. The number of required plots is based on the mitigation category: stream enhancement, stream restoration, and wetland restoration. A spreadsheet is provided by EEP to calculate to necessary numbers of plots for streams (Lee et al 2008). Ten plots will be required for the restored reach of Tanyard Branch.

10.0 MONITORING REQUIREMENTS

Annual monitoring data will be reported using the EEP monitoring template. The monitoring report shall provide a project data chronology that will facilitate an understanding of project status and trends, population of EEP databases for analysis, research purposes, and assist in decision making regarding project close-out.

Required	Parameter	Quantity	Frequency	Notes
No	Pattern	As per April 2003 WSACE Wilmington District Stream Mitigation Guidelines	Annual	
Yes	Dimension	As per November 2011 NCEEP monitoring requirements	Monitoring Years 1,2,3, 5, and 7	Cross-sections to be monitored over seven (7) years and shall include an assessment of bank height ratio and entrenchment ratio
Yes	Bank Erosion Pins	As per November 2011 NCEEP monitoring requirements	Monitoring Years 1,2,3, 5, and 7	Bank pin arrays shall be installed at pool (bend) monitoring cross-sections; arrays shall be measured at time of cross-section surveys
Yes	Profile	As per April 2003 WSACE Wilmington District Stream Mitigation Guidelines	As-Needed	Longitudinal profile will be collected as a part of the as-built survey, visual monitoring will be conducted thereafter.
Yes	Substrate	As per April 2003 WSACE Wilmington District Stream Mitigation Guidelines	Annual	
Yes	Surface Water Hydrology	As per April 2003 WSACE Wilmington District Stream Mitigation Guidelines	Semi-annual	A Crest Gauge will be installed on site; the device will be inspected on a semi-annual basis to document the occurrence of bankfull events on the project.
No	Ground Water Hydrology	Quantity and location of gauges will be determined in consultation with EEP	Annual	Groundwater monitoring gauges with data recording devices will be installed on site; the data will be downloaded on every three months during the growing season
Yes	Vegetation	Quantity and location of gauges will be determined in consultation with EEP	Monitoring Years 1,2,3,5, and 7	Vegetation will be monitored using the Carolina Vegetation Survey (CVS) protocols
Yes	Exotic and nuisance vegetation and Beaver		Annual	Locations of exotic and nuisance vegetation and the occurrence of beaver dams and approximate inundation limits will be mapped.
Yes	Project boundary		Semi-annual	Location of fence damage, vegetation damage, boundary encroachments, etc. will be mapped.

11.0 LONG-TERM MANAGEMENT PLAN

Upon approval for close-out by the Interagency Review Team (IRT) the site will be transferred to the State of North Carolina. This party shall be responsible for periodic inspection of the site to ensure that restrictions required in the conservation easement of the deed restriction document(s) are upheld. Endowment funds required to uphold easement and deed restrictions shall be negotiated prior to site transfer to the responsible party.

12.0 ADAPTIVE MANAGEMENT PLAN

Upon completion of site construction EBX will implement the post-construction monitoring protocols previously defined in this document. Project maintenance will be preformed as described previously in this document. If, during the course of annual monitoring it is determined the site's ability to achieve site performance standards are jeopardized, EBX will notify the NCEEP of the need to develop a Plan of Correction Action. The Plan of Corrective Action will be prepared by an engineering consultant. Once the Corrective Action Plan is prepared and finalized EBX will:

1. Notify the NCEEP.
2. Revise performance standards, requirements, and monitoring requirements as necessary and/or required by the NCEEP.
3. Obtain other permits as necessary.
4. Implement the Corrective Action Plan.
5. Provide the NCEEP a Record Drawing of Corrective Actions. This document shall depict the extent and nature of the work preformed.

13.0 FINANCIAL ASSURANCES

Pursuant to Section IV H and Appendix III of the Ecosystem Enhancement Program's In-Lieu Fee Instrument dated July 28, 2010, the North Carolina Department of Environment and Natural resources has provided the U.S. Army Corps of Engineers Wilmington District with a formal commitment to fund projects to satisfy mitigation requirements assumed by EEP. This commitment provides financial assurance for all mitigation projects implemented by the program.

14.0 OTHER INFORMATION

14.1 Definitions

Morphological description- the stream type; stream type is determined by quantifying channel entrenchment, dimension, patten, profile, and boundary materials' as described in Rosgen, D. (1996), ***Applied River Morphology, 2nd edition***

Native vegetation community – a distinct and reoccurring assemblage of population of plants, animals, bacteria and fungi naturally associated with each other and their population; as described in Schafale, M.P. and Weakley, A. S. (1990), ***Classification of the Natural Communities of North Carolina, Third Approximation***

Project Area- includes all protected lands associate with the mitigation project

14.2 Reference

Arcement, Jr., G.J., Schneider, V.R. (1989) ***Guide for Selecting Manning's Roughness Coefficients for natural Channels and Flood Plains.*** United States Geological Survey Water-supply Paper: 2339

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North Carolina Division of Water Quality (NCDWQ). **Surface Water Classifications.** <http://portal.ncdenr.org/weg/wq/ps/csu/classifications> Raleigh, NC

North Carolina Ecosystem Enhancement Program (2011), ***Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation.***

North Carolina Floodplain Mapping Program. **Floodplain Mapping Information System.** <http://floodmaps.nc.gov/FMIS/Default.aspx> Raleigh, NC.

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Pope, P.F., Tasker, G.D. 1999, ***Estimating the magnitude and frequency of floods in rural basins of North Carolina.*** U.S. Geological Survey Water Resources Investigations Report 99-4114. U.S. Geological Survey, Raleigh, NC.

Rosgen, D. (1996), ***Applied River Morphology, 2nd edition***, Wildland Hydrology, Pagosa Springs, CO

Rosgen, D. (2006), ***Watershed Assessment of River Stability and Sediment Supply (WARSSS)***, Wildland Hydrology, Fort Collins, CO

Schafale, M.P. and Weakley, A.S. (1990), ***Classification of the Natural Communities of North Carolina, Third Approximation***, NC Natural Heritage Program, Raleigh, NC.

US Army Corps of Engineers Wilmington District (2003), ***Stream Mitigation Guidelines, April 2003***.

Young, T.>F> and Sanzone, S. (editors). (2002), ***A framework for assessing and reporting on ecological condition***. Ecological Reporting Panel, Ecological Processes and Effects Committee. EPA Science Advisory Board. Washington, DC.

Appendix A. Site Protection Instrument(s)

(to be included after completion of Task II)

Appendix B. Baseline Information Data

B1. Wetland Determination Data Form

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Tampana Branch City/County: Union State: NC Sampling Date: Nov 28, 2012
 Applicant/Owner: _____ Sampling Point: WA-2
 Investigator(s): C. Sheets Section, Township, Range: Monroe
 Landform (hillslope, terrace, etc.): depression Local relief (concave, convex, none): concave Slope (%): 1-2%
 Subregion (LRR or MLRA): LRR-P Lat: 34.83899 Long: -80.42561 Datum: NAD83
 Soil Map Unit Name: Cid Channey silt loam NWI classification: NONE
 Are climatic / hydrologic conditions on the site typical for this time of year? Yes No _____ (If no, explain in Remarks.)
 Are Vegetation , Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present? Yes No _____
 Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes <input checked="" type="checkbox"/> No _____ Hydric Soil Present? Yes <input checked="" type="checkbox"/> No _____ Wetland Hydrology Present? Yes <input checked="" type="checkbox"/> No _____	Is the Sampled Area within a Wetland? Yes <input checked="" type="checkbox"/> No _____
Remarks: _____ _____ _____	

HYDROLOGY

Wetland Hydrology Indicators: Primary Indicators (minimum of one is required; check all that apply)	Secondary Indicators (minimum of two required)
<input checked="" type="checkbox"/> Surface Water (A1) _____ <input type="checkbox"/> High Water Table (A2) _____ <input checked="" type="checkbox"/> Saturation (A3) _____ <input type="checkbox"/> Water Marks (B1) _____ <input type="checkbox"/> Sediment Deposits (B2) _____ <input type="checkbox"/> Drift Deposits (B3) _____ <input type="checkbox"/> Algal Mat or Crust (B4) _____ <input type="checkbox"/> Iron Deposits (B5) _____ <input type="checkbox"/> Inundation Visible on Aerial Imagery (B7) _____ <input checked="" type="checkbox"/> Water-Stained Leaves (B9) _____ <input type="checkbox"/> Aquatic Fauna (B13) _____	<input type="checkbox"/> Surface Soil Cracks (B6) _____ <input type="checkbox"/> Sparsely Vegetated Concave Surface (B8) _____ <input type="checkbox"/> Drainage Patterns (B10) _____ <input type="checkbox"/> Moss Trim Lines (B16) _____ <input type="checkbox"/> Dry-Season Water Table (C2) _____ <input type="checkbox"/> Crayfish Burrows (C8) _____ <input type="checkbox"/> Saturation Visible on Aerial Imagery (C8) _____ <input type="checkbox"/> Stunted or Stressed Plants (D1) _____ <input checked="" type="checkbox"/> Geomorphic Position (D2) _____ <input type="checkbox"/> Shallow Aquitard (D3) _____ <input checked="" type="checkbox"/> Microtopographic Relief (D4) _____ <input checked="" type="checkbox"/> FAC-Neutral Test (D5) _____
Field Observations: Surface Water Present? Yes <input checked="" type="checkbox"/> No _____ Depth (inches): _____ Water Table Present? Yes <input checked="" type="checkbox"/> No _____ Depth (inches): _____ Saturation Present? Yes <input checked="" type="checkbox"/> No _____ Depth (inches): <u>0"</u> (includes capillary fringe)	Wetland Hydrology Present? Yes <input checked="" type="checkbox"/> No _____
Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: _____ _____ _____	
Remarks: _____ _____ _____	

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: WA-2

	Absolute % Cover	Dominant Species?	Indicator Status	
Tree Stratum (Plot size: <u>6x5m</u>)				Dominance Test worksheet:
1. <u>Salix nigra</u>	<u>20</u>	<u>yes</u>	<u>OBL</u>	Number of Dominant Species That Are OBL, FACW, or FAC: <u>2</u> (A)
2. _____	_____	_____	_____	Total Number of Dominant Species Across All Strata: <u>2</u> (B)
3. _____	_____	_____	_____	Percent of Dominant Species That Are OBL, FACW, or FAC: <u>100</u> (A/B)
4. _____	_____	_____	_____	Prevalence Index worksheet:
5. _____	_____	_____	_____	Total % Cover of: _____ Multiply by:
6. _____	_____	_____	_____	OBL species _____ x 1 =
7. _____	_____	_____	_____	FACW species _____ x 2 =
8. _____	_____	_____	_____	FAC species _____ x 3 =
9. _____	_____	_____	_____	FACU species _____ x 4 =
10. _____	_____	_____	_____	UPL species _____ x 5 =
Sapling/Shrub Stratum (Plot size: <u>5x5m</u>)				Column Totals: _____ (A) _____ (B)
1. <u>Salix nigra</u>	<u>10</u>	<u>1</u>	<u>OBL</u>	Prevalence Index = B/A =
2. _____	_____	_____	_____	Hydrophytic Vegetation Indicators:
3. _____	_____	_____	_____	<input checked="" type="checkbox"/> 1 - Rapid Test for Hydrophytic Vegetation
4. _____	_____	_____	_____	<input checked="" type="checkbox"/> 2 - Dominance Test is >50%
5. _____	_____	_____	_____	___ 3 - Prevalence index is ≤3.0 ¹
6. _____	_____	_____	_____	___ 4 - Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet)
7. _____	_____	_____	_____	___ Problematic Hydrophytic Vegetation ¹ (Explain)
8. _____	_____	_____	_____	¹ Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.
9. _____	_____	_____	_____	Definitions of Four Vegetation Strata:
10. _____	_____	_____	_____	Tree – Woody plants, excluding vines, 3 in. (7.8 cm) or more in diameter at breast height (DBH), regardless of height.
11. _____	_____	_____	_____	Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.
12. _____	_____	_____	_____	Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.
Herb Stratum (Plot size: <u>5x5</u>)				Woody vine – All woody vines greater than 3.28 ft in height.
1. <u>Typha latifolia</u>	<u>100</u>	<u>yes</u>	<u>DBL</u>	Hydrophytic Vegetation Present? Yes <input checked="" type="checkbox"/> No
2. _____	_____	_____	_____	
3. _____	_____	_____	_____	
4. _____	_____	_____	_____	
5. _____	_____	_____	_____	
6. _____	_____	_____	_____	
Woody Vine Stratum (Plot size: <u>0</u>)				<u>0</u> = Total Cover
1. _____	_____	_____	_____	
2. _____	_____	_____	_____	
3. _____	_____	_____	_____	
4. _____	_____	_____	_____	
5. _____	_____	_____	_____	
6. _____	_____	_____	_____	
Remarks: (Include photo numbers here or on a separate sheet.)				

SOIL

Sampling Point: WA-2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)								
Depth (inches)	Matrix		Redox Features		Type ¹	Loc ²	Texture	Remarks
	Color (moist)	%	Color (moist)	%				
0-5	10YR 5/2	85	10YR 7/6	15	C	M		clay loam
5-12	10YR 5/2	75	10YR 5/6	25	C	M		clay

¹Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. ²Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: <input type="checkbox"/> Histosol (A1) <input type="checkbox"/> Histic Epipedon (A2) <input type="checkbox"/> Black Histic (A3) <input type="checkbox"/> Hydrogen Sulfide (A4) <input type="checkbox"/> Stratified Layers (A5) <input type="checkbox"/> 2 cm Muck (A10) (LRR N) <input type="checkbox"/> Depleted Below Dark Surface (A11) <input type="checkbox"/> Thick Dark Surface (A12) <input type="checkbox"/> Sandy Mucky Mineral (S1) (LRR N, MLRA 147, 148) <input type="checkbox"/> Sandy Gleyed Matrix (S4) <input type="checkbox"/> Sandy Redox (S5) <input type="checkbox"/> Stripped Matrix (S6)	<input type="checkbox"/> Dark Surface (S7) <input type="checkbox"/> Polyvalue Below Surface (S8) (MLRA 147, 148) <input type="checkbox"/> Thin Dark Surface (S9) (MLRA 147, 148) <input checked="" type="checkbox"/> Loamy Gleyed Matrix (F2) <input type="checkbox"/> Depleted Matrix (F3) <input type="checkbox"/> Redox Dark Surface (F6) <input type="checkbox"/> Depleted Dark Surface (F7) <input type="checkbox"/> Redox Depressions (F8) <input type="checkbox"/> Iron-Manganese Masses (F12) (LRR N, MLRA 136) <input type="checkbox"/> Umbric Surface (F13) (MLRA 136, 122) <input type="checkbox"/> Piedmont Floodplain Soils (F19) (MLRA 148) <input type="checkbox"/> Red Parent Material (F21) (MLRA 127, 147)	Indicators for Problematic Hydric Soils³: <input type="checkbox"/> 2 cm Muck (A10) (MLRA 147) <input type="checkbox"/> Coast Prairie Redox (A16) (MLRA 147, 148) <input type="checkbox"/> Piedmont Floodplain Soils (F19) (MLRA 136, 147) <input type="checkbox"/> Very Shallow Dark Surface (TF12) <input type="checkbox"/> Other (Explain in Remarks)
--	---	--

³Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed): Type: Depth (inches):	Hydric Soil Present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
---	---

Remarks:

B2. NCWAM Stream Identification Forms

NC DWQ Stream Identification Form Version 4.11

Date: Nov 18, 2012	Project/Site: Tanager Branch	Latitude: 34.83382
Evaluator: C. Shick, K. Martich	County: Union	Longitude: -80.4249
Total Points: Stream is at least intermittent if ≥ 19 or perennial if $\geq 30^*$ 19.5	Stream Determination (circle one) Ephemeral Intermittent Perennial	Other e.g. Quad Name: Pageland

A. Geomorphology (Subtotal = 13)	Absent	Weak	Moderate	Strong
1 ^a Continuity of channel bed and bank	0	1	(2)	3
2. Sinuosity of channel along thalweg	0	1	(2)	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	0	1	(2)	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = 0		Yes = 3	

^a artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 2.5)	Absent	Weak	Moderate	Strong
12. Presence of Baseflow	(0)	1	2	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 4)	Absent	Weak	Moderate	Strong
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	3	(2)	1	0
20. Macroinvertebrates (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:

Bank Height (ft) 2'

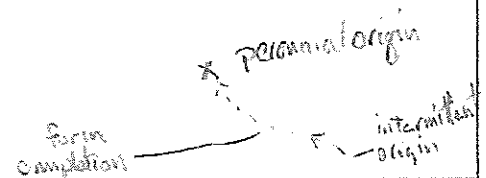
Bankfull width (ft) 2'

Water depth (in) 0"

Channel substrate Clay, Silt, Sand, Gravel, Cobble, Bedrock

Velocity - fast, moderate, slow None

Clarity - clear, slightly turbid, turbid None



North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: <u>7/15/08</u>	Project: <u>EBX</u>	Latitude:
Evaluator: <u>Kate Montieth</u>	Site: <u>601 East</u>	Longitude:
Total Points: Stream is at least intermittent if ≥ 19 or perennial if ≥ 30 <u>33.5</u>	County: <u>Union</u>	Other e.g. Quad Name:

A. Geomorphology (Subtotal = <u>13.5</u>)		Absent	Weak	Moderate	Strong
1 ^a . Continuous bed and bank		0	1	2	(3)
* 2. Sinuosity		0	(1)	2	3
** 3. In-channel structure: riffle-pool sequence		0	1	(2)	3
4. Soil texture or stream substrate sorting		0	1	(2)	3
5. Active/relic floodplain		0	1	(2)	3
6. Depositional bars or benches		0	(1)	2	3
7. Braided channel		(0)	1	2	3
8. Recent alluvial deposits		(0)	1	2	3
9 ^a Natural levees		(0)	1	2	3
10. Headcuts		0	(1)	2	3
** 11. Grade controls		0	0.5	(1)	1.5
12. Natural valley or drainageway		0	(0.5)	1	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.		No = (0)		Yes = 3	

^a Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = <u>7.5</u>)		Absent	Weak	Moderate	Strong
14. Groundwater flow/discharge		0	1	(2)	3
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season		0	1	(2)	3
16. Leaf litter		(1.5)	1	0.5	0
17. Sediment on plants or debris		(0)	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)		0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?		No = 0		Yes = (1.5)	

C. Biology (Subtotal = <u>12.5</u>)		Absent	Weak	Moderate	Strong
20 ^b . Fibrous roots in channel		(3)	2	1	0
21 ^b . Rooted plants in channel		3	(2)	1	0
22. Crayfish		(0)	0.5	1	1.5
23. Bivalves		(0)	1	2	3
24. Fish		(0)	0.5	1	1.5
25. Amphibians		0	0.5	(1)	1.5
26. Macroinvertebrates (note diversity and abundance)		0	0.5	(1)	1.5
27. Filamentous algae; periphyton		0	1	2	(3)
28. Iron oxidizing bacteria/fungus		0	0.5	(1)	1.5
29 ^b . Wetland plants in streambed		FAC = 0.5; FACW = 0.75; OBL = (1.5) SAV = 2.0; Other = 0			

^b Items 20 and 21 focus on the presence of upland plants, item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes)

Sketch:

- * Stream has been straightened
- ** Farmer has added rock piles to stream creating riffles and pools and grade control

Collected right-handed snails; Observed green frog tadpoles and adults; Adult salamander (escaped before ID-ed)

Perennial origin at what appears to be an old headcut – farmer has added pile of rocks to streambed, probably to stop erosion at headcut. No water above headcut; water below headcut

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 7/15/08	Project: EBX	Latitude:
Evaluator: Kate Montieth	Site: 601 East	Longitude:
Total Points: Stream is at least intermittent if ≥ 19 or perennial if ≥ 30 19.5	County: Union	Other e.g. Quad Name:

A. Geomorphology (Subtotal = 10.5)	Absent	Weak	Moderate	Strong
1 ^a . Continuous bed and bank	0	1	2	3
2. Sinuosity	0	1	2	3
3. In-channel structure: riffle-pool sequence	0	1	2	3
4. Soil texture or stream substrate sorting	0	1	2	3
5. Active/relic floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Braided channel	0	1	2	3
8. Recent alluvial deposits	0	1	2	3
9 ^a . Natural levees	0	1	2	3
10. Headcuts	0	1	2	3
11. Grade controls	0	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence	No = 0		Yes = 3	

^a Man-made ditches are not rated, see discussions in manual

B. Hydrology (Subtotal = 3)	Absent	Weak	Moderate	Strong
14. Groundwater flow/discharge	0	1	2	3
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3
16. Leaf/litter	1.5	1	0.5	0
17. Sediment on plants or debris	0	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5	

C. Biology (Subtotal = 3)	Absent	Weak	Moderate	Strong
20 ^b . Fibrous roots in channel	3	2	1	0
21 ^b . Rooted plants in channel	3	2	1	0
22. Crayfish	0	0.5	1	1.5
23. Bivalves	0	1	2	3
24. Fish	0	0.5	1	1.5
25. Amphibians	0	0.5	1	1.5
26. Macroinvertebrates (note diversity and abundance)	0	0.5	1	1.5
27. Filamentous algae; periphyton	0	1	2	3
28. Iron oxidizing bacteria/fungus.	0	0.5	1	1.5
29 ^b . Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

^b Items 20 and 21 focus on the presence of upland plants. Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)




Sketch:

The stream is in the middle of a corn field. There is no vegetation or biology – just a channel

B3. Categorical Exclusion Form

Appendix A
Categorical Exclusion Form for Ecosystem Enhancement
Program Projects
Version 1.4

Note: Only Appendix A should be submitted (along with any supporting documentation) as the environmental document.

Project Name: 601 East	
County Name: Union County	
EEP Number: RFP#16-004110 / Project # 95756	
Project Sponsor: NCEEP	
Project Contact Name: Paul Wiesner	
Project Contact Address: 5 Ravenscroft Dr., #102, Asheville, NC 28801	
Project Contact E-mail: Paul.Wiesner@ncdenr.gov	
EEP Project Manager: Paul Wiesner	
Project Description	
<p>The project will include 688 linear feet of existing intermittent stream and 3510 linear feet of perennial stream for a total restored stream length of 4198 linear feet. The project will be broken down into three project components: the restored stream will be constructed as a Rosgen type "B" in the upper reach above the spring house, Rosgen type "I" will be in the existing wooded area, and Rosgen type "C" below the spring house to the end of the project. Forty (50) foot buffers will be constructed on both sides of the stream. The existing channel at the bottom of the site will be restored and the water is diverted from the excavated ditch to the channel.</p>	
For Official Use Only	
Reviewed By: 5/7/13	 EEP Project Manager
Date	
Conditional Approved By: 5-2-13	 For Division Administrator FHWA
Date	
Check this box if there are outstanding issues <u>ESA Un. Form Act</u>	
Final Approval By: 9-18-13	 For Division Administrator FHWA
Date	

Part 2: All Projects Regulation/Question		Response
<u>Coastal Zone Management Act (CZMA)</u>		
1. Is the project located in a CAMA county?		Yes No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?		Yes No N/A
3. Has a CAMA permit been secured?		Yes No N/A
4. Has NCDCM agreed that the project is consistent with the NC Coastal Management Program?		Yes No N/A
<u>Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)</u>		
1. Is this a "full-delivery" project?		Yes No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?		Yes No N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?		Yes No N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?		Yes No N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?		Yes No N/A
6. Is there an approved hazardous mitigation plan?		Yes No N/A
<u>National Historic Preservation Act (Section 106)</u>		
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?		Yes No
2. Does the project affect such properties and does the SHPO/THPO concur?		Yes No N/A
3. If the effects are adverse, have they been resolved?		Yes No N/A
<u>Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)</u>		

1. Is this a "full-delivery" project?	Yes No
2. Does the project require the acquisition of real estate?	Yes No N/A
3. Was the property acquisition completed prior to the intent to use federal funds?	Yes No N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?	Yes No N/A
The landowner was notified in writing on January 31, 2013.	

Part 3: Ground-Disturbing Activities Regulation/Question		Response
American Indian Religious Freedom Act (AIRFA)		
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	Yes No	
2. Is the site of religious importance to American Indians?	Yes No N/A	
3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	Yes No N/A	
4. Have the effects of the project on this site been considered?	Yes No N/A	
Antiquities Act (AA)		
1. Is the project located on Federal lands?	Yes No	
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	Yes No N/A	
3. Will a permit from the appropriate Federal agency be required?	Yes No N/A	
4. Has a permit been obtained?	Yes No N/A	
Archaeological Resources Protection Act (ARPA)		
1. Is the project located on federal or Indian lands (reservation)?	Yes No	

2. Will there be a loss or destruction of archaeological resources?	Yes No N/A
3. Will a permit from the appropriate Federal agency be required?	Yes No N/A
4. Has a permit been obtained?	Yes No N/A
Endangered Species Act (ESA)	
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	Yes No
2. Is Designated Critical Habitat or suitable habitat present for listed species?	Yes No N/A
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	Yes No N/A
4. Is the project "likely to adversely affect" the species and/or "likely to adversely modify" Designated Critical Habitat?	Yes No N/A
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	Yes No N/A
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	Yes No N/A

Executive Order 13007 (Indian Sacred Sites)	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	Yes No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	Yes No N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	Yes No N/A

Farmland Protection Policy Act (FPPA)	
1. Will real estate be acquired?	Yes No
2. Has NRCS determined that the project contains prime, unique, statewide or locally important farmland?	Yes No N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	Yes No

	N/A
<u>Fish and Wildlife Coordination Act (FWCA)</u>	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	Yes No
2. Have the USFWS and the NCWRC been consulted?	Yes No N/A
<u>Land and Water Conservation Fund Act (Section 6(f))</u>	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	Yes No
2. Has the NPS approved of the conversion?	Yes No N/A
<u>Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)</u>	
1. Is the project located in an estuarine system?	Yes No
2. Is suitable habitat present for EFH-protected species?	Yes No N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	Yes No N/A
4. Will the project adversely affect EFH?	Yes No N/A
5. Has consultation with NOAA-Fisheries occurred?	Yes No N/A
<u>Migratory Bird Treaty Act (MBTA)</u>	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	Yes No
2. Have the USFWS recommendations been incorporated?	Yes No N/A
<u>Wilderness Act</u>	
1. Is the project in a Wilderness area?	Yes No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	Yes No N/A

B4. Floodplain Requirement Checklist



EEP Floodplain Requirements Checklist

This form was developed by the National Flood Insurance program, NC Floodplain Mapping program and Ecosystem Enhancement Program to be filled for all EEP projects. The form is intended to summarize the floodplain requirements during the design phase of the projects. The form should be submitted to the Local Floodplain Administrator with three copies submitted to NFIP (attn. State NFIP Engineer), NC Floodplain Mapping Unit (attn. State NFIP Coordinator) and NC Ecosystem Enhancement Program.

Project Location

Name of project:	601 East Stream Restoration
Name if stream or feature:	Tanyard Branch
County:	Union County
Name of river basin:	Yadkin River Basin
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Union County
DFIRM panel number for entire site:	371053900J, 3710546000
Consultant name:	Ward Consulting Engineers, P.C.
Phone number:	919-870-0526
Address:	4805 Green Road, Suite 100 Raleigh, NC 27616-2848

Design Information

Provide a general description of project (one paragraph). Include project limits on a reference orthophotograph at a scale of 1" = 500".

Summarize stream reaches or wetland areas according to their restoration priority.

Reach	Length	Priority
<i>Reach 1a & 1d</i>	<i>1150</i>	<i>P1</i>
<i>Reach 1b & 1c</i>	<i>240</i>	<i>E1</i>
<i>Reach 2a & 2b</i>	<i>160</i>	<i>E1</i>
<i>Reach 2c</i>	<i>724</i>	<i>P1</i>
<i>Reach 3a & 3b</i>	<i>1018</i>	<i>P1</i>
<i>Reach 4</i>	<i>480</i>	<i>P3</i>

Floodplain Information

<p>Is project located in a Special Flood Hazard Area (SFHA)?</p> <p><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>
<p>If project is located in a SFHA, check how it was determined:</p> <p><input type="checkbox"/> Redelineation</p> <p><input type="checkbox"/> Detailed Study</p> <p><input checked="" type="checkbox"/> Limited Detail Study (Lanes Creek & Mill Creek South)</p> <p><input type="checkbox"/> Approximate Study</p> <p><input type="checkbox"/> Don't know</p>
<p>List flood zone designation:</p> <p>Check if applies:</p> <p><input checked="" type="checkbox"/> AE Zone</p> <p style="padding-left: 20px;"><input type="checkbox"/> Floodway</p> <p style="padding-left: 20px;"><input checked="" type="checkbox"/> Non-Encroachment (Lanes Creek)</p> <p style="padding-left: 20px;"><input type="checkbox"/> None</p> <p><input type="checkbox"/> A Zone</p> <p style="padding-left: 20px;"><input type="checkbox"/> Local Setbacks Required</p> <p style="padding-left: 20px;"><input type="checkbox"/> No Local Setbacks Required</p>
<p>If local setbacks are required, list how many feet:</p>
<p>Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks?</p>

<input checked="" type="radio"/> Yes <input type="radio"/> No
Land Acquisition (Check) <input type="checkbox"/> State owned (fee simple) <input type="checkbox"/> Conservation easment (Design Bid Build) <input checked="" type="checkbox"/> Conservation Easement (Full Delivery Project) Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)
Is community/county participating in the NFIP program? <input checked="" type="radio"/> Yes <input type="radio"/> No Note: if community is not participating, then all requirements should be addressed to NFIP (attn: State NFIP Engineer, (919) 715-8000)
Name of Local Floodplain Administrator: Lee Jenson Phone Number: 704-283-3605

Floodplain Requirements

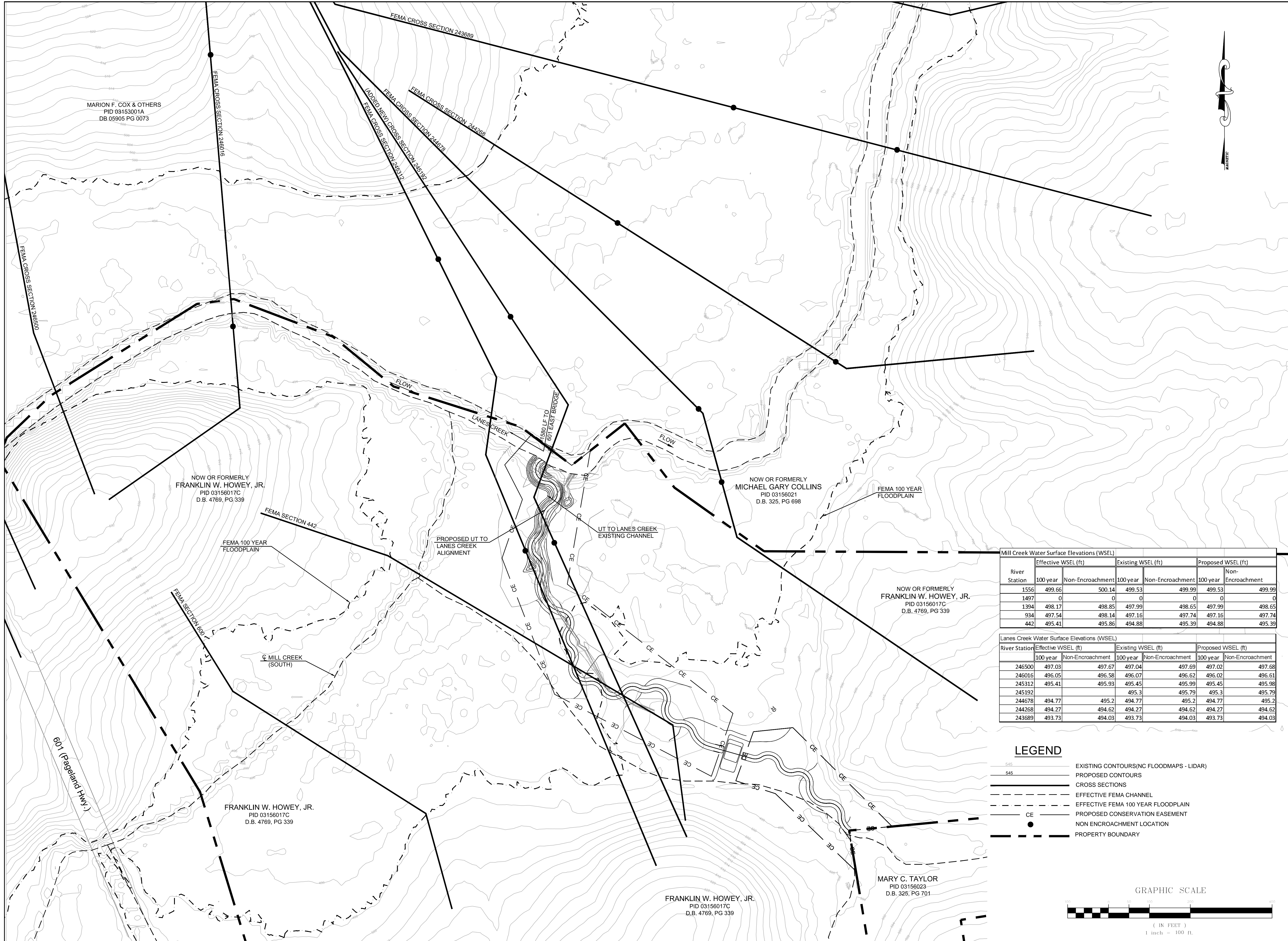
This section to be filled by designer/applicant following verification with the LFPA

- No Action
- No Rise (Lanes Creek)
- Letter of Map Revision
- Conditional Letter of Map Revision
- Other Requirements

List other requirements:

Comments:

Name: Becky L. Ward, P.E. Signature: Becky L. Ward
 Title: President Date: 11-14-2013



MARION F. COX & OTHERS
PID 03153001A
DB 05905 PG 0073

NOW OR FORMERLY
FRANKLIN W. HOWEY, JR.
PID 03156017C
D.B. 4769, PG 339

NOW OR FORMERLY
MICHAEL GARY COLLINS
PID 03156021
D.B. 325, PG 698

NOW OR FORMERLY
FRANKLIN W. HOWEY, JR.
PID 03156017C
D.B. 4769, PG 339

FRANKLIN W. HOWEY, JR.
PID 03156017C
D.B. 4769, PG 339

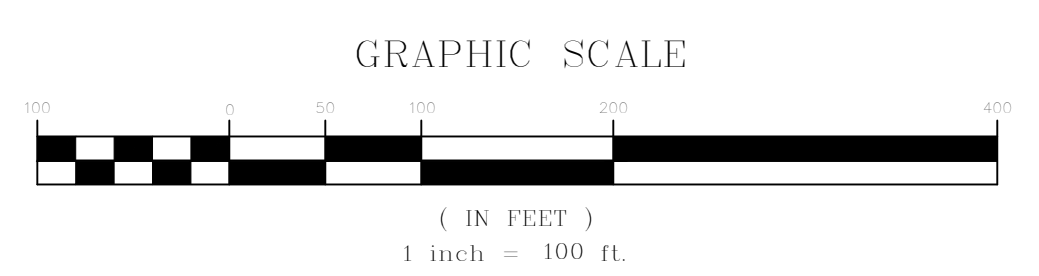
FRANKLIN W. HOWEY, JR.
PID 03156017C
D.B. 4769, PG 339

MARY C. TAYLOR
PID 03156023
D.B. 325, PG 701

River Station	Effective WSEL (ft)		Existing WSEL (ft)		Proposed WSEL (ft)	
	100 year	Non-Encroachment	100 year	Non-Encroachment	100 year	Non-Encroachment
1556	499.66	500.14	499.53	499.99	499.53	499.99
1497	0	0	0	0	0	0
1394	498.17	498.85	497.99	498.65	497.99	498.65
934	497.54	498.14	497.16	497.74	497.16	497.74
442	495.41	495.86	494.88	495.39	494.88	495.39

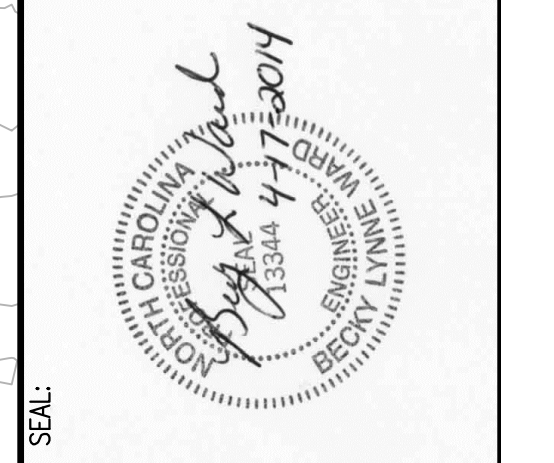
River Station	Effective WSEL (ft)		Existing WSEL (ft)		Proposed WSEL (ft)	
	100 year	Non-Encroachment	100 year	Non-Encroachment	100 year	Non-Encroachment
246500	497.03	497.67	497.04	497.69	497.02	497.68
246016	496.05	496.58	496.07	496.62	496.02	496.61
245312	495.41	495.93	495.45	495.99	495.45	495.98
245192		495.3	495.79	495.3	495.79	495.79
244678	494.77	495.2	494.77	495.2	494.77	495.2
244268	494.27	494.62	494.27	494.62	494.27	494.62
243689	493.73	494.03	493.73	494.03	493.73	494.03

- LEGEND**
- EXISTING CONTOURS (NC FLOODMAPS - LIDAR)
 - PROPOSED CONTOURS
 - CROSS SECTIONS
 - EFFECTIVE FEMA CHANNEL
 - EFFECTIVE FEMA 100 YEAR FLOODPLAIN
 - PROPOSED CONSERVATION EASEMENT
 - NON ENCROACHMENT LOCATION
 - PROPERTY BOUNDARY



Ward Consulting Engineers, P.C.
4805 Green Rd, Suite 100 (919) 870-0526
Raleigh, NC 27616-2848 FAX (919) 870-5559

Environmental Banc & Exchange
909 Capability Drive, Suite 3100
Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913



**601 EAST STREAM RESTORATION
FLOOD STUDY MAP**

UNION COUNTY, NORTH CAROLINA

DATE: 10-30-2013

REVISIONS:
4-17-2014

PROJECT NAME:
601 East

DWG NAME:
Flood Study

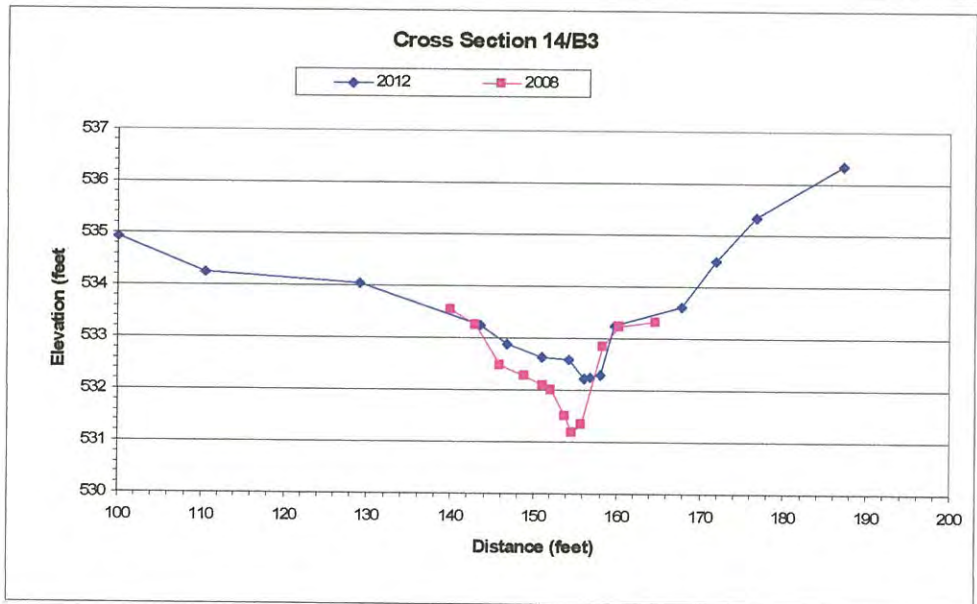
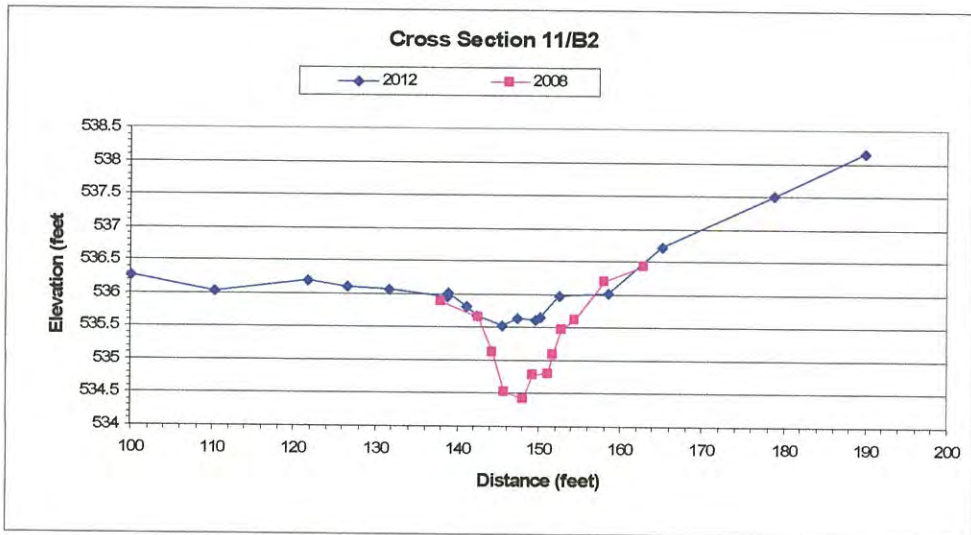
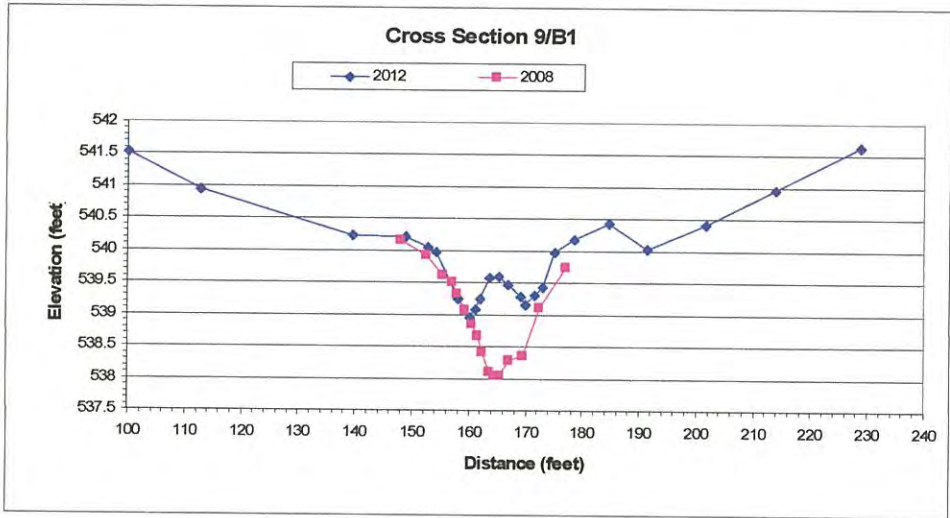
SCALE:
1" = 100'

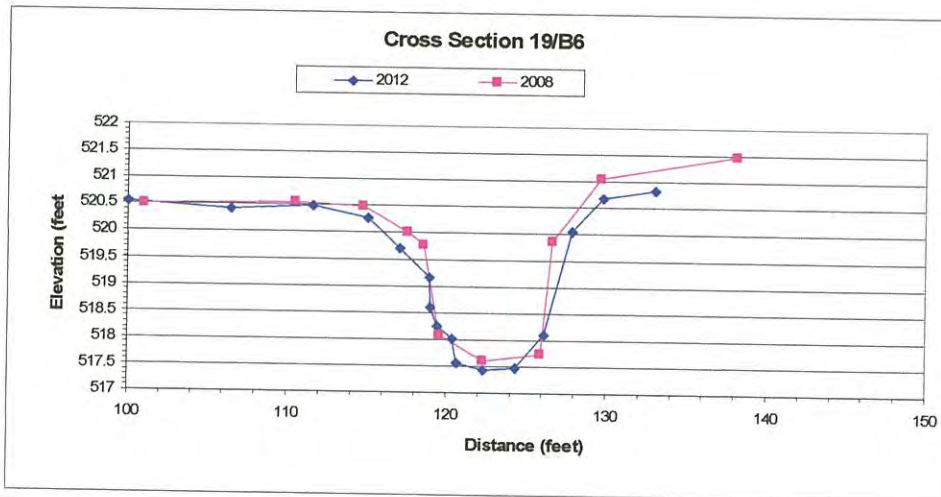
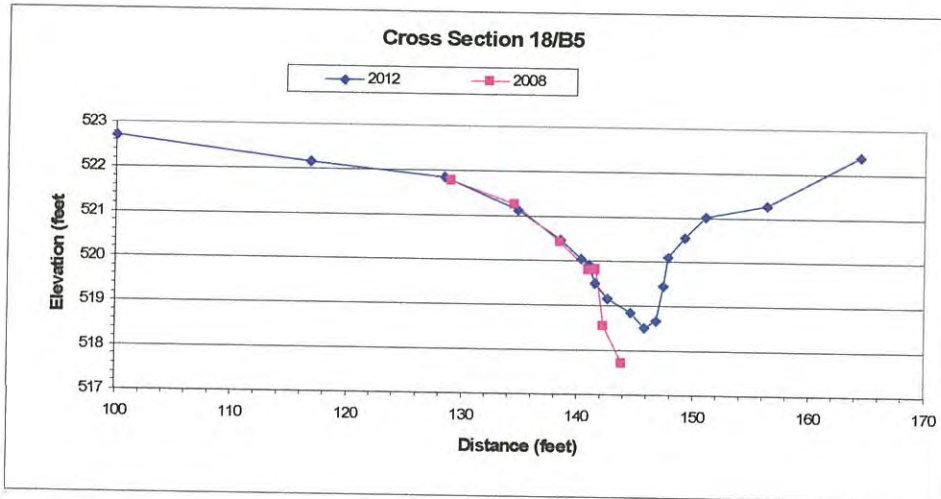
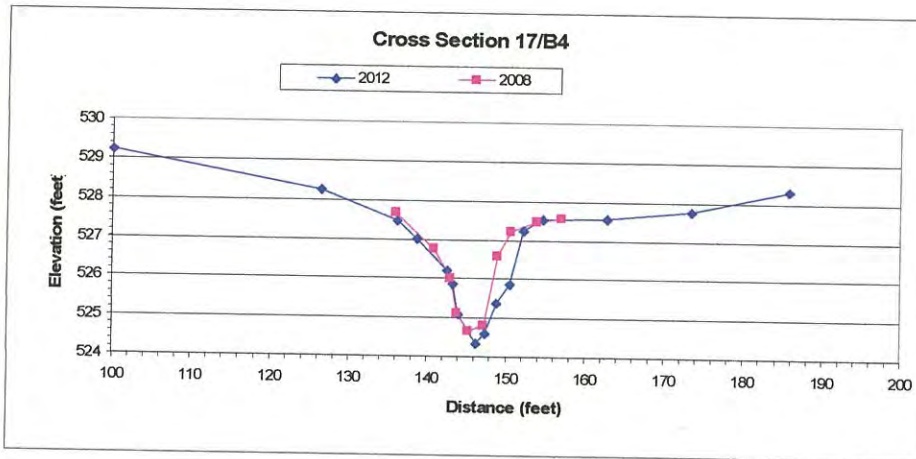
SHEET NO.
1 OF **1**

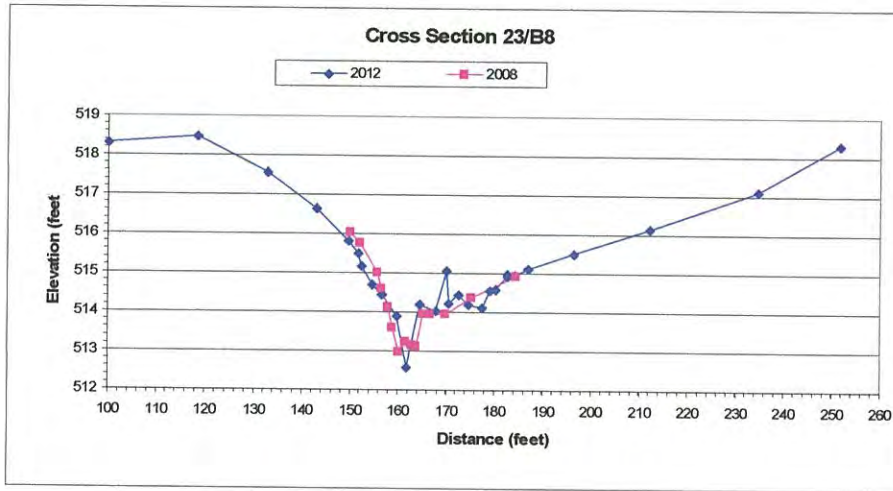
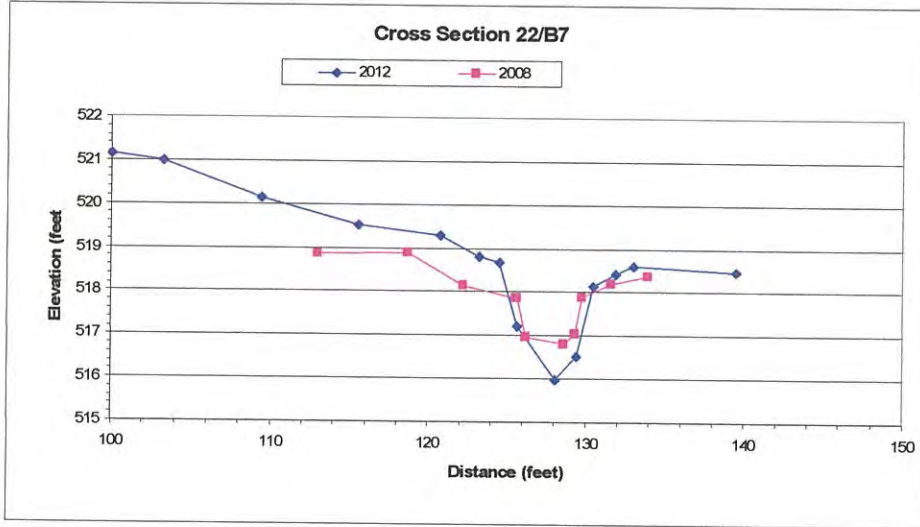
EEP Floodplain Requirements Checklist Project General Description

The 601 East project will be constructed on Tanyard Branch which is not a FEMA regulated stream. The project below Landsford Road ties into Lanes Creek which is a FEMA regulated stream. Lanes Creek is a limited detail study with non encroachment limits set at cross section 2465 approximately 1600 feet upstream and cross section 2443 approximately 800 feet downstream of the tie in location. A floodway is not delineated on Firm Panel 5460 because of the nature of the limited detail study. The restoration of the channel extends into the non-encroachment limit of Lanes Creek. A no-rise study was submitted to Mr. Lee Jenson Union County Floodplain Manager for Lanes Creek. The proposed project is not within the non encroachment limits of Mill Creek South and no impacts to the floodplain of Mill Creek South will occur due to the proposed project as no fill is proposed within this area.

B5. Channel Cross Section Comparison 2008-2012







Appendix C. Mitigation Work Plan Data and Analyses

C1. Channel Morphology Tables

Tanyard Branch Reach 1
Union County, North Carolina

Variables	Existing Channel Tanyard Branch Reach 1	Proposed Tanyard Branch Reach 1	Reference Reach UT Richardson Creek
Stream type	G4/B4/C4b	B4/C4b	B4/C4b
Drainage Area (Sq. Mile)	0.166	0.166	0.144
Bankfull width (Wbkf) feet	21 (7-60)	10	9.88 (7.42-11.61)
Bankfull mean depth (dbkf) feet	0.5 (0.2-0.9)	0.72	0.79 (0.68-0.97)
Width/depth ratio (Wbkf/dbkf)	27 (8-47)	13.9	12.95 (8.14-16.89)
Bankfull Cross Sectional Area (Abkf) (sq ft)	8.3 (4-14.5)	7.2	7.68 (6.02-10.27)
Bankfull Mean Velocity (Vbkf) feet/second	3.2 (2-5)	3.2	3.27 (2.71-3.83)
Bankfull Discharge, cfs (Qbkf) cfs	24	24	27
Bankfull Maximum depth (dmax) feet	1 (0.7-1.4)	1.2	1.39 (0.97-1.82)
Max dmax/dbkf ratio	2.2 (1.5-3.4)	1.67	1.78 (1.28-2.16)
Low Bank Height feet	0.34 (2-0.86)	1.2	1.39 (0.97-1.82)
Ratio of Low bank Height to max dbkf	0.84 (0.4-2)	1.0	1.0 (0.84-1.18)
Width of flood prone area (Wfpa) feet	60 (8-101)	28 (22-35)	26.43 (18.51-33.59)
Entrenchment ratio (Wfpa/Wbkf)	2.4 (1.1-9.5)	2.8 (2.2 – 3.5)	2.4 (2.02-3.24)
Meander length (Lm) feet	96 (36-240)	61 (43-89)	59.67 (43-88)
Ratio of meander length to bankfull width (Lm/Wbkf)	4.6 (1.7-11.5)	6.1 (4.3-8.9)	6.04 (4.35-8.9)
Radius of Curvature (Rc) feet	84 (14.5-118)	33 (16-53)	32.1 (16-52)

Tanyard Branch Reach 1
Union County, North Carolina

Ratio of radius of curvature to bankfull width (Rc/Wbkf)	4 (.7-5.6)	3.3 (1.6-5.3)	3.25 (1.62-5.27)
Belt width (Wblt) feet	19.6 (10-35)	18 (13-21)	17.33 (13-20)
Meander width ratio (Wblt/Wbkf)	0.94 (0.5-1.7)	1.8 (1.3-2.1)	1.76 (1.32-2.03)
Sinuosity (stream length /valley distance) (k)	1.04	1.17	1.16
Valley slope (ft/ft)	0.02	0.02	0.021
Average slope $S_{avg} = (S_{valley} / k)$	0.0196	0.017	0.018
Pool Slope (Spool) (ft/ft)	0.005 (0-.015)	0.0006	0.0011 (0.0003-0.0024)
Ratio of pool slope to average slope (Spool/Sbkf)	0.26 (0.01-0.76)	.035	0.06 (0.02—0.13)
Maximum pool depth (dpool) feet	2.4 (1-3.9)	2.2	1.83 (1.4-2.2)
Ratio of pool depth to average bankfull depth (dpool/dbkf)	4.6 (2-7.8)	3.0	2.33 (1.78-2.8)
Pool width (Wpool) Feet	9.2 (7.1-12.5)	10	8.75 (7.46-9.79)
Ratio of pool width to bankfull width (Wpool/Wbkf)	0.44 (0.24-0.60)	1.0	0.89 (0.76-0.99)
Pool Cross Sectional Area (sq ft)	6.6 (4.3-8.1)	14.1	7.77 (5.88-12.10)
Ratio of pool area to bankfull area A_{pool}/A_{bkf}	0.8 (0.5-0.97)	1.9	1.01 (0.77-1.58)
Pool to pool spacing (p-p) feet	50 (15.5-128)	36.7 (24-58)	36.2 (23.5-57.4)
Ratio of p-p spacing to bankfull width (p-p/Wbkf)	2.4 (0.74-6.1)	3.6 (2.4-5.8)	3.67 (2.38-5.81)

Tanyard Branch Reach 2
Union County, North Carolina

Variables	Existing Channel Tanyard Branch Reach 2	Existing Channel Tanyard Branch Reach 2	Reference Reach UT to Underwood Creek
Stream type	C4/E4/DA	C4	C4/E4
Drainage Area (Sq. Mile)	0.212	0.212	0.5
Bankfull width (Wbkf)	13 (7-19)	12	12.2 (10.0-14.3)
Bankfull mean depth (dbkf)	0.9 (0.5-1.33)	0.9	1.12 (0.92-1.34)
Width/depth ratio (Wbkf/dbkf)	20.4 (6.1-39)	13.3	11.3 (7.7-15.6)
Bankfull Cross Sectional Area (Abkf)	12 (6-21)	10.7	13 (12.2-13.4)
Bankfull Mean Velocity (Vbkf)	2.1 (1-4)	2.6	3.0 (2.8-3.2)
Bankfull Discharge, cfs (Qbkf)	27	27	40
Bankfull Maximum depth (dmax)	1.4 (0.7-1.9)	1.5	1.6 (1.2-2.2)
Max driff/dbkf ratio	1.8 (1.3-2.8)	1.7	1.52 (1.0-1.9)
Low Bank Height	1.5 (0.9-1.7)	1.5	1.5 (1.1-1.7)
Low bank Height to max dbkf	0.9 (.5-1.1)	1.0	1.0 (0.9-1.2)
Width of flood prone area (Wfpa)	107 (40-214)	91.5 (48-135)	77 (42-110)
Entrenchment ratio (Wfpa/Wbkf)	6 (2.2-10)	7.6 (3.6 - 10)	6.5 (2.9-8.6)
Meander length (Lm)	70 (46-97)	84 (61-97)	85.5 (62-99)
Ratio of meander length to bankfull width (Lm/Wbkf)	5.3 (3.5-7.4)	7.0 (5.1-8.0)	7.0 (5.1-8.1)
Radius of Curvature (Rc)	75 (68-77)	47 (38-58)	31 (20-65)
Ratio of radius of curvature to bankfull width (Rc/Wbkf)	5.7 (5.2-5.9)	3.9 (3.2-4.8)	2.55 (1.6-5.3)

Tanyard Branch Reach 2
Union County, North Carolina

Belt width (Wblt)	32 (12-42)	40 (25-65)	40 (25-65)
Meander width ratio (Wblt/Wbkf)	2.4 (0.9-3.2)	3.3 (2.1-5.4)	3.3 (2.1-5.4)
Sinuosity (stream length /valley distance) (k)	1.01	1.1	1.34
Valley slope (ft/ft)	0.0084	0.0084	0.0065
Average slope $S_{avg} = (S_{valley} / k)$	0.0083	0.0069	0.0048
Pool Slope (Spool)	0.006 (0-0.014)	0.0009	0.0007 (.0006 - .0009)
Ratio of pool slope to average slope (spool/Sbkf)	0.65 (0-1.6)	0.125	0.146 (0.125 -0.188)
Maximum pool depth (dpool)	2.8 (1.9-4.2)	2.5	2.47 (1.7-3.1)
Ratio of pool depth to average bankfull depth (dpool/dbkf)	3.3 (2.3-5)	2.8	2.20 (1.5-2.8)
Pool width (Wpool)	10 (7.2-12.4)	12	15.5 (11.8-18.0)
Ratio of pool width to bankfull width (Wpool/Wbkf)	0.8 (0.55-0.94)	1.0	1.2 (1.0-1.5)
Pool Cross Sectional Area	8 (4.6-11)	20	21.4 (20.6-22.9)
Ratio of pool area to bankfull area	0.68 (0.4-0.9)	1.8	1.6 (1.54-1.71)
Pool to pool spacing (p-p)	56 (20-512)	49 (38-84)	48 (29-84)
Ratio of p-p spacing to bankfull width (p-p/Wbkf)	4.3 (1.4-38)	4.1 (3.2-6.9)	3.9 (2.3-6.9)

Tanyard Branch Reach 3
Union County, North Carolina

Variables	Existing Channel Tanyard Branch Reach 3	Proposed Channel Tanyard Branch Reach 3	Reference Reach UT to Underwood Creek
Stream type	C4-G4	C4	E4/C4
Drainage Area (Sq. Mile)	0.52	0.52	0.5
Bankfull width (Wbkf)	15.7 (6.5-29)	17	12.2 (10.0-14.3)
Bankfull mean depth (dbkf)	0.9 (0.5-1.23)	1.18	1.12 (0.92-1.34)
Width/depth ratio (Wbkf/dbkf)	17.5 (12.8-31)	14.4	11.3 (7.7-15.6)
Bankfull Cross Sectional Area (Abkf)	14.5 (10.5-19.4)	21	13 (12.2-13.4)
Bankfull Mean Velocity (Vbkf)	3.2 (2.1-4.3)	2.81	3.0 (2.8-3.2)
Bankfull Discharge, cfs (Qbkf)	55	55	40 (38-42)
Bankfull Maximum depth (dmax)	1.7 (1.28-2.1)	2.0	1.6 (1.2-2.2)
Max drift/dbkf ratio	1.89 (1.4-2.3)	1.69	1.52 (1.0-1.9)
Low Bank Height	2.2 (1.3-4)	2.0	1.5 (1.1-1.7)
Low bank Height to max dbkf	2.4 (1.4-4.4)	1.0	1.0 (0.9-1.2)
Width of flood prone area (Wfpa)	200 (150-260)	200 (150-300)	77 (42-110)
Entrenchment ratio (Wfpa/Wbkf)	12.7 (9.6-16.5)	11.8 (8.8-17.6)	6.5 (2.9-8.6)
Meander length (Lm)	57 (32-89)	119 (87-134)	85.5 (62-99)
Ratio of meander length to bankfull width (Lm/Wbkf)	3.6 (2-5.7)	7.0 (5.1-8.1)	7.0 (5.1-8.1)
Radius of Curvature (Rc)	49.7 (22.5-78)	43 (27-63)	31 (20-122)
Ratio of radius of curvature to bankfull width (Rc/Wbkf)	3.2 (1.4-4.9)	2.5 (1.6-3.7)	2.55 (1.6-3.7)

Tanyard Branch Reach 3
Union County, North Carolina

Belt width (Wblt)	41 (13-58)	56 (35-92)	40 (25-65)
Meander width ratio (Wblt/Wbkf)	2.6 (1.3-3.7)	3.3 (2.1-5.4)	3.3 (2.1-5.4)
Sinuosity (stream length /valley distance) (k)	1.05	1.2	1.20
Valley slope (ft/ft)	0.0067	0.0067	0.0065
Average slope $S_{avg} = (S_{valley} / k)$	0.0064	0.0056	0.0048
Pool Slope (Spool)	0.0016 (0.0004-0.0026)	0.0007	0.0007 (.0006 - .0009)
Ratio of pool slope to average slope (spool/Sbkf)	0.25 (0.063-0.41)	0.125	0.146 (0.125 -0.188)
Maximum pool depth (dpool)	2.7 (1.8-3.4)	3.4	2.47 (1.7-3.1)
Ratio of pool depth to average bankfull depth (dpool/dbkf)	3 (2-3.8)	2.8	2.20 (1.5-2.8)
Pool width (Wpool)	16.8 (11-42)	17	15.5 (11.8-18.0)
Ratio of pool width to bankfull width (Wpool/Wbkf)	1.1 (0.7-2.7)	1.0	1.2 (1.0-1.5)
Pool Cross Sectional Area	16.6 (15.8-17.6)	32.3	21.4 (20.6-22.9)
Ratio of pool area to bankfull area	1.14 (1.1-1.2)	1.53	1.6 (1.54-1.71)
Pool to pool spacing (p-p)	48 (8-125)	66 (39-117)	48 (29-84)
Ratio of p-p spacing to bankfull width (p-p/Wbkf)	3.06 (1.5-7.9)	3.9 (2.3-6.9)	3.9 (2.3-6.9)

Tanyard Branch Reach 4
Union County, North Carolina

Variables	Relic Channel Tanyard Branch Reach 4	Proposed Tanyard Branch Reach 4	Reference Reach UT Richardson Creek
Stream type	G4	B4	B4/C4b
Drainage Area (Sq. Mile)	0.56	0.56	0.144
Bankfull width (Wbkf) feet	11.6 (5.2-20)	16	9.88 (7.42-11.61)
Bankfull mean depth (dbkf) feet	0.9 (0.76-1.1)	0.98	0.79 (0.68-0.97)
Width/depth ratio (Wbkf/dbkf)	12.9 (7-18)	16.3	12.95 (8.14-16.89)
Bankfull Cross Sectional Area (Abkf) (sq ft)	15 (12.3-16)	15.7	7.68 (6.02-10.27)
Bankfull Mean Velocity (Vbkf) feet/second	4 (3.6-4.7)	3.6	3.27 (2.71-3.83)
Bankfull Discharge, cfs (Qbkf) cfs	55	55	27
Bankfull Maximum depth (dmax) feet	1.2 (0.8-1.4)	1.8	1.39 (0.97-1.82)
Max dmax/dbkf ratio	1.2 (1.05-1.33)	1.84	1.78 (1.28-2.16)
Low Bank Height feet	3.5 (3.3-4.2)	1.8	1.39 (0.97-1.82)
Ratio of Low bank Height to max dbkf	3.0 (2.9-3.3)	1.0	1.0 (0.84-1.18)
Width of flood prone area (Wfpa) feet	20 (16-25)	35 (30-40)	26.43 (18.51-33.59)
Entrenchment ratio (Wfpa/Wbkf)	1.7 (1.4-2.2)	2.2 (1.9-2.5)	2.4 (2.02-3.24)
Meander length (Lm) feet	56 (30-113)	97 (69-142)	59.67 (43-88)
Ratio of meander length to bankfull width (Lm/Wbkf)	4.8 (2.6-5.6)	6.04 (4.35-8.9)	6.04 (4.35-8.9)
Radius of Curvature (Rc) feet	34.9 (18-61)	52 (26-84)	32.1 (16-52)

Tanyard Branch Reach 4
Union County, North Carolina

Ratio of radius of curvature to bankfull width (Rc/Wbkf)	3 (1.6-5.3)	3.25 (1.62-5.25)	3.25 (1.62-5.27)
Belt width (Wblt) feet	32 (12-83)	28 (21-32)	17.33 (13-20)
Meander width ratio (Wblt/Wbkf)	2.8 (1.1-7.2)	1.75 (1.31-2.0)	1.76 (1.32-2.03)
Sinuosity (stream length /valley distance) (k)	1.04	1.13	1.16
Valley slope (ft/ft)	0.0125	0.0125	0.021
Average slope $S_{avg} = (S_{valley} / k)$	0.0144	0.0114	0.018
Pool Slope (Spool) (ft/ft)	--	0.0009	0.0011 (0.0003-0.0024)
Ratio of pool slope to average slope (Spool/Sbkf)	--	0.16	0.06 (0.02—0.13)
Maximum pool depth (dpool) feet	2.5 (2-3.2)	3.0	1.83 (1.4-2.2)
Ratio of pool depth to average bankfull depth (dpool/dbkf)	2.1 (1.7-2.7)	1.8	2.33 (1.78-2.8)
Pool width (Wpool) Feet	11 (10-16)	16	8.75 (7.46-9.79)
Ratio of pool width to bankfull width (Wpool/Wbkf)	0.95 (0.9-1.4)	1.0	0.89 (0.76-0.99)
Pool Cross Sectional Area (sq ft)	20 (14-33)	26.3	7.77 (5.88-12.10)
Ratio of pool area to bankfull area A_{pool}/A_{bkf}	1.3 (0.9-2.2)	1.6	1.01 (0.77-1.58)
Pool to pool spacing (p-p) feet	29 (15-55)	59 (38-93)	36.2 (23.5-57.4)
Ratio of p-p spacing to bankfull width (p-p/Wbkf)	2.5 (1.3-4.7)	3.68 (2.4-5.8)	3.67 (2.38-5.81)

C2. Hydraulic Modeling

Above Lansford Road

Upper Design Stream

Reach 1 and 2

HEC RAS River Station	Design Stream CL Station	Stream Feature	Comment
25+59	07+62		
25+42	07+79	ER	
25+31	07+90	CP	
25+19	08+02	HR	
25+00	08+21	ER	
24+92	08+29	CP	
24+76	08+45	HR	
24+57	08+64	ER	
24+46	08+75	CP	
24+32	08+89	HR	
24+15	09+06	ER	
24+06	09+15	CP	
23+95	09+26	HR	
23+73	09+48	ER	
23+61	09+80	CP	
23+44	09+77	HR	
23+29	09+92	ER	
23+21	10+00	CP	
23+11	10+10	HR	
22+97	10+24	ER	
22+89	10+32	CP	
22+77	10+44	HR	
22+56	10+65	ER	
22+43	10+78	CP	
22+31	10+90	HR	
21+96	11+25	ER	
21+83	11+38	CP	
21+71	11+50	HR	
21+49	11+72	ER	
21+38	11+83	CP	
21+25	11+96	HR	
21+10	12+11	ER	
20+99	12+22	CP	
20+96	12+25	HR	
20+71	12+50	ER	
20+59	12+62	CP	
20+46	12+75	HR	
20+26	12+95	ER	
20+17	13+04	CP	
20+01	13+20	HR	
19+88	13+53		Upstream Culvert
19+63	13+58		Farm Crossing Culvert
19+11	14+10	ER	
19+01	14+20	CP	
18+91	14+30	HR	
18+74	14+47	ER	
18+66	14+55	CP	
18+56	14+65	HR	
18+31	14+90	ER	
18+21	15+00	CP	
18+10	15+11	HR	
17+84	15+37	ER	
17+76	15+45	CP	
17+64	15+57	HR	
17+46	15+75	ER	

HEC RAS River Station	Design Stream CL Station	Stream Feature	Comment
17+36	15+85	CP	
17+24	15+97	HR	
17+07	16+14	ER	
16+98	16+23	CP	
16+86	16+35	HR	
16+67	16+54	ER	
16+57	16+64	CP	
16+45	16+76	HR	
16+28	16+93	ER	
16+18	17+03	CP	
16+06	17+15	HR	
15+89	17+32	ER	
15+78	17+43	CP	
15+68	17+53	HR	
15+48	17+73	ER	
15+39	17+82	CP	
15+27	17+94	HR	
15+11	18+10	ER	
15+03	18+18	CP	
14+93	18+28	HR	
14+76	18+45	ER	
14+66	18+55	CP	
14+55	18+66	HR	
14+39	18+82	ER	
14+30	18+91	CP	
14+18	19+03	HR	
14+02	19+19	ER	
13+93	19+28	CP	
13+81	19+40	HR	
13+68	19+53	ER	
13+58	19+63	CP	
13+51	19+70	HR	
13+26	19+95	ER	
13+18	20+03	CP	
13+06	20+15	HR	
12+91	20+30	ER	
12+81	20+40	CP	
12+71	20+50	HR	
12+54	20+67	ER	
12+45	20+76	CP	
12+33	20+88	HR	
12+13	21+08	ER	
12+04	21+17	CP	
11+96	21+25	HR	
11+81	21+40	ER	
11+71	21+50	CP	
11+57	21+64	HR	
11+21	22+00	ER	Begin Reach 2
11+06	22+15	CP	
10+86	22+35	HR	
10+51	22+70	ER	
10+31	22+90	CP	
10+06	23+15	HR	
09+66	23+55	ER	
09+48	23+73	CP	

HEC RAS River Station	Design Stream CL Station	Stream Feature	Comment
09+26	23+95	HR	
08+88	24+33	ER	
08+63	24+58	CP	
08+32	24+89	HR	
08+06	25+15	ER	
07+81	25+40	CP	
07+56	25+65	HR	
07+29	25+92	ER	
07+13	26+08	CP	
06+93	26+28	HR	
06+79	26+42	ER	
06+70	26+51	CP	
06+59	26+62	HR	
06+46	26+75	ER	
06+32	26+89	CP	
06+16	27+05	HR	
06+01	27+20	ER	
05+85	27+36	CP	
05+66	27+55	HR	
05+46	27+75	ER	
05+29	27+92	CP	
05+09	28+12	HR	
04+93	28+28	ER	
04+82	28+39	CP	
04+69	28+52	HR	
04+56	28+65	ER	
04+44	28+77	CP	
04+29	28+92	HR	
04+15	29+06	ER	
04+04	29+17	CP	
03+91	29+30	HR	
03+77	29+44	ER	
03+62	29+59	CP	
03+43	29+78	HR	
03+26	29+96	ER	
03+14	30+07	CP	
03+00	30+21	HR	
02+86	30+35	ER	
02+70	30+51	CP	
02+51	30+70	HR	
02+25	30+96	ER	
02+08	31+13	CP	
01+86	31+35	HR	
01+76	31+45	ER	
01+56	31+65		Lansford Road Culvert
01+30	31+91		Lansford Road Downstream
00+00	33+21		Woods North of Lansford Rd

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	2815	22.00	551.00	551.86	0.75	0.75	2.59	2.59		3.45		6.37	10.86
Upper	2815	44.00	551.00	552.17	1.06	0.82	4.59	2.48	0.41	4.35	0.41	10.94	22.62
Upper	2815	30.00	551.00	552.00	0.86	0.86	3.24	3.24		3.77		7.95	11.97
Upper	2815	57.00	551.00	552.31	1.17	0.57	5.47	2.17	0.60	4.69	0.60	14.83	31.59
Upper	2815	81.00	551.00	552.52	1.35	0.59	7.00	2.10	0.82	5.20	0.82	22.67	44.47
Upper	2815	195.00	551.00	553.18	1.63	0.69	10.06	2.05	1.28	6.17	1.36	65.72	85.44
Upper	2767	22.00	550.00	550.77	0.78	0.78	2.67	2.67		3.44		6.40	12.52
Upper	2767	44.00	550.00	551.04	1.13	1.05	4.89	4.54	0.19	4.34	0.19	10.16	16.19
Upper	2767	30.00	550.00	550.90	0.89	0.89	3.33	3.33		3.75		7.99	13.85
Upper	2767	57.00	550.00	551.14	1.38	1.12	6.77	5.39	0.43	4.91	0.43	11.86	18.90
Upper	2767	81.00	550.00	551.36	1.51	1.02	8.10	4.96	0.74	5.36	0.74	16.66	25.02
Upper	2767	195.00	550.00	552.08	1.99	1.06	13.45	4.92	1.28	6.74	1.34	42.10	46.38
Upper	2728	22.00	549.00	549.76	0.83	0.83	2.97	2.97		3.56		6.19	12.33
Upper	2728	44.00	549.00	550.07	1.03	0.82	4.33	3.41	0.24	4.18	0.24	10.65	19.10
Upper	2728	30.00	549.00	549.88	0.93	0.93	3.58	3.58		3.84		7.82	13.71
Upper	2728	57.00	549.00	550.20	1.13	0.89	5.11	2.86	0.48	4.51	0.48	13.74	27.25
Upper	2728	81.00	549.00	550.38	1.37	0.70	6.98	2.87	0.73	5.11	0.73	19.64	38.24
Upper	2728	195.00	549.00	551.05	1.62	0.74	9.82	2.43	1.20	6.06	1.24	59.17	77.73
Upper	2687	22.00	548.00	548.78	0.70	0.70	2.28	2.28		3.26		6.75	13.34
Upper	2687	44.00	548.00	549.02	1.09	1.02	4.61	4.32	0.13	4.24	0.13	10.39	17.10
Upper	2687	30.00	548.00	548.89	0.81	0.81	2.90	2.90		3.58		8.38	14.74
Upper	2687	57.00	548.00	549.12	1.34	1.03	6.43	4.85	0.38	4.80	0.38	12.15	21.30
Upper	2687	81.00	548.00	549.33	1.42	0.85	7.34	3.85	0.70	5.17	0.70	17.88	31.33
Upper	2687	195.00	548.00	550.03	1.72	0.85	10.71	3.24	1.23	6.23	1.25	50.78	62.96
Upper	2648	22.00	547.00	547.74	0.90	0.90	3.29	3.29		3.67		5.99	12.16
Upper	2648	44.00	547.00	548.08	1.00	0.88	4.10	3.56	0.26	4.12	0.26	10.77	17.21
Upper	2648	30.00	547.00	547.87	0.96	0.96	3.74	3.74		3.89		7.71	13.62
Upper	2648	57.00	547.00	548.25	0.99	0.72	4.23	2.91	0.50	4.26	0.50	14.16	22.04
Upper	2648	81.00	547.00	548.50	1.07	0.67	4.93	2.64	0.73	4.61	0.73	20.54	29.04
Upper	2648	195.00	547.00	549.23	1.56	0.79	9.46	3.13	1.13	6.05	1.22	49.52	52.66
Upper	2609	22.00	546.00	546.96	0.63	0.63	2.09	2.09		3.31		6.64	9.78
Upper	2609	44.00	546.00	547.29	0.99	0.67	4.36	2.73	0.52	4.42	0.52	10.76	16.29
Upper	2609	30.00	546.00	547.10	0.75	0.62	2.80	2.29	0.26	3.72	0.26	8.17	12.30
Upper	2609	57.00	546.00	547.39	1.28	0.80	6.52	3.61	0.70	5.11	0.70	12.63	18.65
Upper	2609	81.00	546.00	547.61	1.59	0.91	9.37	4.27	0.95	5.88	0.95	17.21	23.44
Upper	2609	195.00	546.00	548.51	1.97	0.87	14.10	3.45	1.43	7.14	1.30	49.35	51.65

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	2561	22.00	544.80	545.75	1.25	1.25	5.62	5.62		4.48		4.91	8.01
Upper	2561	44.00	544.80	546.14	1.47	1.07	7.58	5.30	0.43	5.14	0.43	8.85	14.51
Upper	2561	30.00	544.80	545.92	1.34	1.34	6.31	6.31		4.71		6.37	9.35
Upper	2561	57.00	544.80	546.33	1.48	0.85	7.91	3.98	0.69	5.33	0.69	12.25	20.77
Upper	2561	81.00	544.80	546.61	1.57	0.79	8.97	3.34	0.94	5.71	0.94	19.18	29.69
Upper	2561	195.00	544.80	547.39	2.04	0.95	14.32	3.51	1.57	7.02	1.41	52.69	55.49
Upper	2543	22.00	544.13	545.39	0.47	0.43	1.34	1.22	0.14	2.85	0.14	7.74	11.08
Upper	2543	44.00	544.13	545.85	0.59	0.36	2.03	1.06	0.54	3.45	0.53	14.97	20.09
Upper	2543	30.00	544.13	545.58	0.51	0.37	1.58	1.09	0.35	3.09	0.34	10.24	14.83
Upper	2543	57.00	544.13	546.06	0.65	0.37	2.43	1.08	0.66	3.73	0.58	19.53	24.48
Upper	2543	81.00	544.13	546.36	0.76	0.39	3.14	1.10	0.85	4.15	0.64	28.29	32.61
Upper	2543	195.00	544.13	547.19	1.26	0.59	7.20	1.79	1.35	5.71	1.06	64.51	54.98
Upper	2533	22.00	543.08	545.42	0.10	0.09	0.15	0.13	0.07	1.46	0.07	15.17	13.05
Upper	2533	44.00	543.08	545.89	0.20	0.11	0.42	0.21	0.28	2.12	0.28	23.78	23.59
Upper	2533	30.00	543.08	545.62	0.14	0.10	0.24	0.16	0.16	1.73	0.16	18.16	17.44
Upper	2533	57.00	543.08	546.10	0.25	0.13	0.60	0.26	0.37	2.42	0.34	29.17	28.39
Upper	2533	81.00	543.08	546.41	0.34	0.17	0.97	0.34	0.51	2.88	0.44	39.02	35.77
Upper	2533	195.00	543.08	547.23	0.74	0.34	3.33	0.87	1.00	4.50	0.80	76.58	56.38
Upper	2521	22.00	544.12	545.07	1.24	1.24	5.52	5.52		4.46		4.94	8.04
Upper	2521	44.00	544.12	545.45	1.49	1.16	7.72	5.84	0.42	5.17	0.42	8.72	13.37
Upper	2521	30.00	544.12	545.24	1.34	1.34	6.30	6.30		4.71		6.37	9.35
Upper	2521	57.00	544.12	545.64	1.54	0.89	8.33	4.77	0.69	5.42	0.69	11.65	18.02
Upper	2521	81.00	544.12	545.92	1.65	0.91	9.66	4.19	0.96	5.84	0.96	17.59	24.94
Upper	2521	195.00	544.12	546.79	1.94	0.82	13.39	2.94	1.50	6.89	1.23	54.48	60.97
Upper	2502	22.00	543.37	544.64	0.45	0.38	1.27	1.07	0.15	2.80	0.15	7.91	11.93
Upper	2502	44.00	543.37	545.10	0.55	0.31	1.85	0.84	0.56	3.35	0.55	16.42	23.67
Upper	2502	30.00	543.37	544.83	0.49	0.31	1.48	0.88	0.35	3.03	0.35	10.77	17.38
Upper	2502	57.00	543.37	545.29	0.62	0.35	2.27	0.95	0.71	3.64	0.68	21.14	26.67
Upper	2502	81.00	543.37	545.54	0.80	0.45	3.36	1.28	0.92	4.22	0.86	28.13	30.58
Upper	2502	195.00	543.37	546.29	1.51	0.77	9.32	2.85	1.48	6.18	1.32	56.46	46.79
Upper	2490	22.00	542.31	544.67	0.10	0.07	0.14	0.10	0.08	1.44	0.08	15.58	16.93
Upper	2490	44.00	542.31	545.14	0.18	0.07	0.37	0.11	0.29	2.03	0.27	29.54	41.46
Upper	2490	30.00	542.31	544.87	0.13	0.06	0.23	0.10	0.16	1.70	0.16	19.99	27.72
Upper	2490	57.00	542.31	545.33	0.22	0.09	0.50	0.13	0.39	2.28	0.34	38.41	50.34
Upper	2490	81.00	542.31	545.59	0.29	0.12	0.78	0.18	0.52	2.68	0.45	53.15	62.37
Upper	2490	195.00	542.31	546.48	0.44	0.20	1.55	0.31	0.77	3.48	0.82	124.70	95.90

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	2476	22.00	543.36	544.31	1.25	1.25	5.57	5.57	4.47			4.92	8.02
Upper	2476	44.00	543.36	544.71	1.43	0.90	7.23	4.31	0.44		0.44	9.18	17.13
Upper	2476	30.00	543.36	544.48	1.34	1.34	6.31	6.31	4.71			6.37	9.35
Upper	2476	57.00	543.36	544.91	1.40	0.68	7.23	2.89	0.68		0.68	13.50	26.57
Upper	2476	81.00	543.36	545.17	1.46	0.74	8.03	2.81	0.99		1.05	21.43	32.81
Upper	2476	195.00	543.36	545.86	2.18	1.29	15.71	5.33	1.69		1.95	47.09	40.51
Upper	2456	22.00	542.65	543.91	0.47	0.35	1.33	0.97	0.14		0.14	7.84	13.85
Upper	2456	44.00	542.65	544.37	0.54	0.31	1.77	0.78	0.63		0.64	17.71	25.32
Upper	2456	30.00	542.65	544.11	0.48	0.27	1.46	0.71	0.40		0.41	11.61	21.54
Upper	2456	57.00	542.65	544.54	0.62	0.36	2.25	0.93	0.75		0.77	22.23	27.79
Upper	2456	81.00	542.65	544.79	0.76	0.45	3.16	1.21	0.93		0.96	29.85	31.51
Upper	2456	195.00	542.65	545.63	1.29	0.66	7.41	2.03	1.42		1.21	63.72	51.23
Upper	2448	22.00	541.60	543.95	0.10	0.06	0.15	0.09	0.07		0.07	15.55	18.94
Upper	2448	44.00	541.60	544.41	0.19	0.10	0.39	0.17	0.34		0.34	27.08	28.67
Upper	2448	30.00	541.60	544.15	0.13	0.07	0.23	0.11	0.20		0.20	20.14	25.06
Upper	2448	57.00	541.60	544.58	0.24	0.13	0.58	0.23	0.44		0.43	32.23	31.09
Upper	2448	81.00	541.60	544.84	0.34	0.19	0.98	0.37	0.58		0.58	40.78	34.72
Upper	2448	195.00	541.60	545.68	0.74	0.34	3.31	0.85	1.02		0.83	79.16	58.76
Upper	2434	22.00	542.64	543.59	1.25	1.25	5.60	5.60				4.92	8.02
Upper	2434	44.00	542.64	544.03	1.25	0.61	5.99	2.55	0.51		0.51	10.58	24.49
Upper	2434	30.00	542.64	543.76	1.34	1.34	6.32	6.32				6.36	9.35
Upper	2434	57.00	542.64	544.19	1.32	0.69	6.67	2.67	0.81		0.82	14.70	27.21
Upper	2434	81.00	542.64	544.40	1.54	0.84	8.64	3.24	1.11		1.13	20.96	30.87
Upper	2434	195.00	542.64	545.06	2.51	1.36	19.29	6.03	1.84		1.82	44.80	43.31
Upper	2417	22.00	542.01	543.26	0.48	0.43	1.37	1.23	0.13		0.13	7.70	11.12
Upper	2417	44.00	542.01	543.69	0.64	0.39	2.30	1.19	0.53		0.54	14.36	20.25
Upper	2417	30.00	542.01	543.46	0.52	0.37	1.60	1.07	0.34		0.35	10.25	15.28
Upper	2417	57.00	542.01	543.79	0.87	0.50	3.65	1.73	0.68		0.69	16.53	22.44
Upper	2417	81.00	542.01	543.81	1.66	0.96	9.72	4.53	0.96		0.97	17.10	22.98
Upper	2417	195.00	542.01	544.68	2.14	1.03	15.46	4.32	1.36		1.54	46.52	45.45
Upper	2409	22.00	540.95	543.31	0.10	0.09	0.15	0.12	0.07		0.07	15.34	13.24
Upper	2409	44.00	540.95	543.74	0.21	0.12	0.44	0.23	0.27		0.28	23.14	22.51
Upper	2409	30.00	540.95	543.50	0.14	0.09	0.23	0.15	0.16		0.16	18.35	17.41
Upper	2409	57.00	540.95	543.86	0.29	0.16	0.75	0.36	0.36		0.36	25.99	25.06
Upper	2409	81.00	540.95	543.97	0.51	0.27	1.75	0.77	0.51		0.52	28.82	27.35
Upper	2409	195.00	540.95	544.17	2.26	1.08	16.71	6.02	0.96		1.21	35.00	34.50

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	2396	22.00	542.00	542.95	1.25	1.25	5.61	5.61		4.48		4.91	8.01
Upper	2396	44.00	542.00	543.42	1.12	1.34	5.11	1.39	0.48	4.55	0.48	12.52	39.15
Upper	2396	30.00	542.00	543.12	1.34	1.34	6.33	6.33		4.72		6.36	9.35
Upper	2396	57.00	542.00	543.61	0.99	0.32	4.39	0.80	0.63	4.42	0.63	22.87	65.12
Upper	2396	81.00	542.00	543.80	1.03	0.34	4.78	0.74	0.87	4.62	0.76	36.95	89.83
Upper	2396	195.00	542.00	544.20	1.46	0.60	8.35	1.43	1.55	5.73	1.12	81.78	120.42
Upper	2374	22.00	541.16	542.44	0.44	0.27	1.22	0.73	0.16	2.77	0.16	8.19	17.06
Upper	2374	44.00	541.16	542.94	0.40	0.14	1.13	0.22	0.46	2.85	0.46	28.31	63.26
Upper	2374	30.00	541.16	542.64	0.44	0.17	1.28	0.38	0.35	2.89	0.35	13.60	35.89
Upper	2374	57.00	541.16	543.16	0.34	0.13	0.94	0.17	0.55	2.73	0.49	44.12	79.40
Upper	2374	81.00	541.16	543.47	0.30	0.12	0.78	0.14	0.65	2.62	0.51	71.95	99.89
Upper	2374	195.00	541.16	544.12	0.37	0.17	1.14	0.22	0.97	3.08	0.67	155.28	137.75
Upper	2361	22.00	540.10	542.46	0.10	0.06	0.14	0.08	0.08	1.44	0.08	15.81	20.28
Upper	2361	44.00	540.10	542.94	0.17	0.06	0.33	0.07	0.26	1.96	0.26	34.96	59.94
Upper	2361	30.00	540.10	542.66	0.13	0.05	0.22	0.07	0.16	1.68	0.16	21.48	36.78
Upper	2361	57.00	540.10	543.15	0.19	0.06	0.39	0.07	0.35	2.10	0.25	49.09	76.93
Upper	2361	81.00	540.10	543.45	0.20	0.07	0.46	0.07	0.48	2.25	0.30	76.04	101.68
Upper	2361	195.00	540.10	544.12	0.32	0.12	0.94	0.15	0.82	2.94	0.52	162.44	151.38
Upper	2346	22.00	541.15	542.10	1.24	1.24	5.52	5.52		4.45		4.94	8.04
Upper	2346	44.00	541.15	542.49	1.46	1.00	7.45	4.90	0.43	5.11	0.43	8.97	15.49
Upper	2346	30.00	541.15	542.27	1.34	1.34	6.31	6.31		4.71		6.37	9.35
Upper	2346	57.00	541.15	542.69	1.44	0.78	7.60	3.47	0.69	5.26	0.69	12.75	23.04
Upper	2346	81.00	541.15	542.96	1.54	0.73	8.65	2.91	0.93	5.64	0.93	20.25	33.29
Upper	2346	195.00	541.15	543.74	1.46	0.47	8.70	1.14	1.21	5.95	1.11	80.55	123.34
Upper	2331	22.00	540.56	541.81	0.48	0.39	1.38	1.12	0.13	2.88	0.13	7.70	12.45
Upper	2331	44.00	540.56	542.29	0.51	0.19	1.66	0.42	0.39	3.23	0.53	20.62	45.42
Upper	2331	30.00	540.56	542.00	0.51	0.27	1.56	0.73	0.33	3.08	0.34	11.08	22.33
Upper	2331	57.00	540.56	542.48	0.51	0.19	1.70	0.34	0.48	3.31	0.60	31.27	61.73
Upper	2331	81.00	540.56	542.76	0.53	0.20	1.84	0.31	0.58	3.46	0.69	50.98	83.92
Upper	2331	195.00	540.56	543.54	0.48	0.21	1.76	0.30	0.89	3.55	0.94	141.74	136.01
Upper	2322	22.00	539.51	541.85	0.10	0.07	0.15	0.10	0.07	1.46	0.07	15.30	16.91
Upper	2322	44.00	539.51	542.32	0.19	0.08	0.38	0.12	0.32	2.05	0.29	28.90	38.06
Upper	2322	30.00	539.51	542.04	0.14	0.06	0.24	0.10	0.17	1.72	0.16	19.86	28.56
Upper	2322	57.00	539.51	542.50	0.23	0.10	0.53	0.16	0.41	2.32	0.37	36.55	44.54
Upper	2322	81.00	539.51	542.75	0.32	0.14	0.88	0.23	0.55	2.77	0.49	48.62	53.19
Upper	2322	195.00	539.51	543.40	0.65	0.23	2.69	0.43	0.62	4.15	0.96	105.26	110.08

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	2311	22.00	540.55	541.50	1.26	1.26	5.63	5.63		4.48		4.91	8.01
Upper	2311	44.00	540.55	541.90	1.42	0.86	7.17	4.11	0.43	5.05	0.44	9.25	17.85
Upper	2311	30.00	540.55	541.67	1.34	1.34	6.31	6.31		4.71		6.37	9.35
Upper	2311	57.00	540.55	542.11	1.35	0.62	6.88	2.50	0.43	5.10	0.73	14.07	29.41
Upper	2311	81.00	540.55	542.37	1.39	0.57	7.43	1.93	0.68	5.36	0.99	23.82	45.10
Upper	2311	195.00	540.55	543.07	1.69	0.69	10.70	1.91	1.16	6.35	1.44	70.31	87.91
Upper	2298	22.00	540.00	541.25	0.48	0.43	1.39	1.24	0.13	2.88	0.13	7.67	11.27
Upper	2298	44.00	540.00	541.70	0.60	0.34	2.10	0.97	0.53	3.48	0.54	15.40	23.09
Upper	2298	30.00	540.00	541.44	0.52	0.35	1.62	1.02	0.34	3.11	0.35	10.32	16.33
Upper	2298	57.00	540.00	541.86	0.72	0.38	2.80	1.13	0.66	3.88	0.66	19.36	27.23
Upper	2298	81.00	540.00	542.03	1.06	0.30	5.11	0.96	0.34	4.81	0.87	25.22	60.12
Upper	2298	195.00	540.00	542.63	1.67	0.66	10.62	1.87	1.25	6.37	1.24	68.95	84.05
Upper	2289	22.00	538.95	541.29	0.10	0.08	0.15	0.11	0.07	1.46	0.07	15.21	14.98
Upper	2289	44.00	538.95	541.75	0.19	0.09	0.41	0.14	0.27	2.10	0.27	26.81	35.62
Upper	2289	30.00	538.95	541.48	0.14	0.07	0.24	0.12	0.16	1.73	0.16	19.00	23.79
Upper	2289	57.00	538.95	541.91	0.25	0.10	0.61	0.18	0.35	2.42	0.35	33.37	43.11
Upper	2289	81.00	538.95	542.13	0.36	0.14	1.07	0.26	0.42	2.96	0.48	44.15	55.83
Upper	2289	195.00	538.95	542.53	1.12	0.47	6.03	1.33	1.07	5.36	1.01	68.97	67.87
Upper	2278	22.00	539.99	540.94	1.25	1.25	5.60	5.60		4.48		4.91	8.01
Upper	2278	44.00	539.99	541.36	1.34	0.88	6.57	3.01	0.46	4.92	0.46	9.92	22.58
Upper	2278	30.00	539.99	541.11	1.34	1.34	6.31	6.31		4.71		6.36	9.35
Upper	2278	57.00	539.99	541.56	1.25	0.51	6.18	1.81	0.67	4.93	0.67	15.98	37.52
Upper	2278	81.00	539.99	541.80	1.30	0.50	6.77	1.49	0.86	5.20	0.86	27.17	55.37
Upper	2278	195.00	539.99	542.38	1.69	0.76	10.63	2.12	1.38	6.29	1.52	69.61	84.26
Upper	2257	22.00	539.21	540.47	0.47	0.40	1.33	1.13	0.14	2.84	0.14	7.79	11.79
Upper	2257	44.00	539.21	540.94	0.56	0.29	1.88	0.78	0.53	3.36	0.53	16.65	26.07
Upper	2257	30.00	539.21	540.66	0.50	0.32	1.53	0.89	0.35	3.06	0.35	10.69	17.77
Upper	2257	57.00	539.21	541.13	0.63	0.29	2.28	0.75	0.64	3.65	0.57	22.26	34.27
Upper	2257	81.00	539.21	541.39	0.74	0.32	3.04	0.77	0.80	4.09	0.67	33.01	47.42
Upper	2257	195.00	539.21	542.06	1.27	0.53	7.17	1.35	1.24	5.65	1.13	76.11	80.64
Upper	2245	22.00	538.15	540.50	0.10	0.08	0.15	0.12	0.07	1.45	0.07	15.32	14.31
Upper	2245	44.00	538.15	540.97	0.19	0.09	0.40	0.16	0.27	2.10	0.27	25.66	29.90
Upper	2245	30.00	538.15	540.70	0.14	0.08	0.24	0.13	0.16	1.72	0.16	18.78	20.87
Upper	2245	57.00	538.15	541.15	0.25	0.10	0.59	0.18	0.34	2.41	0.32	32.24	41.20
Upper	2245	81.00	538.15	541.41	0.34	0.12	0.97	0.22	0.44	2.88	0.41	45.12	58.29
Upper	2245	195.00	538.15	542.07	0.73	0.26	3.19	0.52	0.81	4.40	0.80	97.67	100.13

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chml (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	2231	22.00	539.19	540.14	1.25	1.25	5.60	5.60	0.44	4.48	0.44	4.92	8.02
Upper	2231	44.00	539.19	540.54	1.42	0.88	7.18	4.22	0.44	5.05	0.44	9.22	17.41
Upper	2231	30.00	539.19	540.31	1.34	1.34	6.31	6.31	0.68	4.71	0.68	6.37	9.35
Upper	2231	57.00	539.19	540.74	1.39	0.67	7.19	2.82	0.91	5.17	0.91	13.60	27.11
Upper	2231	81.00	539.19	540.99	1.47	0.64	8.11	2.34	1.30	5.51	1.24	22.20	39.75
Upper	2231	195.00	539.19	541.71	1.77	0.68	11.52	1.90	1.30	6.51	1.24	69.63	92.68
Upper	2199	22.00	538.19	539.46	0.46	0.35	1.28	0.98	0.15	2.81	0.15	7.92	13.25
Upper	2199	44.00	538.19	539.93	0.51	0.23	1.65	0.51	0.51	3.23	0.51	19.60	36.39
Upper	2199	30.00	538.19	539.65	0.48	0.25	1.45	0.66	0.35	3.00	0.35	11.50	22.99
Upper	2199	57.00	538.19	540.11	0.56	0.24	1.93	0.52	0.62	3.45	0.61	26.86	44.43
Upper	2199	81.00	538.19	540.34	0.67	0.30	2.62	0.63	0.77	3.88	0.75	38.29	54.18
Upper	2199	195.00	538.19	540.99	1.14	0.52	6.10	1.22	1.21	5.34	1.17	82.91	81.75
Upper	2186	22.00	537.13	539.48	0.10	0.06	0.15	0.09	0.07	1.45	0.07	15.59	18.78
Upper	2186	44.00	537.13	539.95	0.18	0.06	0.35	0.08	0.26	2.00	0.26	32.66	54.22
Upper	2186	30.00	537.13	539.68	0.13	0.06	0.23	0.08	0.16	1.70	0.16	20.79	33.79
Upper	2186	57.00	537.13	540.13	0.21	0.08	0.47	0.10	0.35	2.23	0.35	43.23	62.89
Upper	2186	81.00	537.13	540.36	0.28	0.11	0.73	0.15	0.48	2.61	0.47	58.93	71.75
Upper	2186	195.00	537.13	541.02	0.57	0.25	2.23	0.43	0.86	3.99	0.84	114.36	96.83
Upper	2171	22.00	538.17	539.12	1.25	1.25	5.60	5.60	0.45	4.48	0.45	4.91	8.01
Upper	2171	44.00	538.17	539.54	1.36	0.72	6.71	3.25	0.45	4.95	0.45	9.74	21.29
Upper	2171	30.00	538.17	539.29	1.34	1.34	6.31	6.31	0.67	4.71	0.67	6.36	9.35
Upper	2171	57.00	538.17	539.74	1.28	0.54	6.39	1.99	0.67	4.98	0.67	15.41	35.04
Upper	2171	81.00	538.17	540.01	1.22	0.48	6.19	1.41	0.87	5.06	0.86	27.76	53.36
Upper	2171	195.00	538.17	540.56	1.96	0.96	13.22	3.09	1.74	6.76	1.45	60.66	67.02
Upper	2151	22.00	537.42	538.69	0.45	0.23	1.27	0.63	0.15	2.81	0.15	8.18	20.76
Upper	2151	44.00	537.42	538.13	0.39	0.14	1.10	0.19	0.46	2.81	0.50	31.85	75.45
Upper	2151	30.00	537.42	538.90	0.42	0.13	1.20	0.25	0.34	2.82	0.34	15.99	54.20
Upper	2151	57.00	537.42	539.23	0.46	0.18	1.40	0.26	0.55	3.07	0.63	39.90	79.09
Upper	2151	81.00	537.42	539.36	0.61	0.26	2.18	0.42	0.70	3.60	0.83	50.45	83.63
Upper	2151	195.00	537.42	540.34	0.40	0.21	1.25	0.28	0.75	3.17	1.03	149.35	119.59
Upper	2140	22.00	536.36	538.72	0.10	0.04	0.14	0.05	0.08	1.44	0.08	16.60	35.57
Upper	2140	44.00	536.36	539.14	0.15	0.04	0.27	0.04	0.27	1.82	0.27	49.32	103.63
Upper	2140	30.00	536.36	538.92	0.12	0.03	0.20	0.03	0.16	1.62	0.16	28.18	80.56
Upper	2140	57.00	536.36	539.24	0.19	0.06	0.39	0.06	0.35	2.07	0.35	59.93	107.06
Upper	2140	81.00	536.36	539.36	0.27	0.10	0.68	0.10	0.48	2.51	0.48	73.71	111.35
Upper	2140	195.00	536.36	540.34	0.21	0.10	0.50	0.10	0.70	2.38	0.70	198.98	144.95

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	2126	22.00	537.41	538.36	1.25	1.25	5.62	5.62	0.48	4.48	0.48	4.91	8.01
Upper	2126	44.00	537.41	538.88	0.88	0.23	3.57	0.56	0.48	4.06	0.48	18.24	72.23
Upper	2126	30.00	537.41	538.53	1.35	1.35	6.35	6.35	0.48	4.72	0.48	6.35	9.34
Upper	2126	57.00	537.41	539.03	0.80	0.23	3.18	0.41	0.59	3.97	0.60	31.49	101.01
Upper	2126	81.00	537.41	539.18	0.83	0.30	3.43	0.51	0.80	4.13	0.80	47.51	106.41
Upper	2126	195.00	537.41	540.32	0.24	0.13	0.60	0.14	0.81	2.47	0.80	191.92	147.64
Upper	2111	22.00	536.82	538.07	0.48	0.34	1.38	0.97	0.13	2.88	0.13	7.75	14.51
Upper	2111	44.00	536.82	538.57	0.43	0.16	1.28	0.26	0.47	2.97	0.47	26.42	60.33
Upper	2111	30.00	536.82	538.27	0.49	0.20	1.47	0.48	0.34	3.02	0.34	12.45	32.77
Upper	2111	57.00	536.82	538.81	0.36	0.13	1.02	0.17	0.51	2.81	0.51	43.91	82.78
Upper	2111	81.00	536.82	539.20	0.26	0.11	0.64	0.11	0.55	2.46	0.55	81.40	103.40
Upper	2111	195.00	536.82	540.31	0.20	0.11	0.45	0.10	0.71	2.31	0.72	206.74	126.47
Upper	2102	22.00	535.77	538.11	0.10	0.06	0.15	0.08	0.07	1.46	0.16	15.47	20.77
Upper	2102	44.00	535.77	538.60	0.15	0.04	0.27	0.05	0.24	1.82	0.56	36.62	74.39
Upper	2102	30.00	535.77	538.31	0.13	0.05	0.22	0.06	0.16	1.68	0.36	21.71	42.50
Upper	2102	57.00	535.77	538.83	0.14	0.04	0.25	0.04	0.28	1.80	0.64	59.33	100.50
Upper	2102	81.00	535.77	539.21	0.10	0.04	0.16	0.03	0.32	1.61	0.73	103.67	125.98
Upper	2102	195.00	535.77	540.31	0.08	0.04	0.11	0.03	0.42	1.47	0.87	262.32	161.39
Upper	2091	22.00	536.81	537.76	1.25	1.25	5.60	5.60	0.41	4.48	0.41	4.91	8.01
Upper	2091	44.00	536.81	538.14	1.53	1.36	8.01	7.05	0.41	5.23	0.40	8.50	11.40
Upper	2091	30.00	536.81	537.93	1.34	1.34	6.30	6.30	0.41	4.71	0.41	6.37	9.35
Upper	2091	57.00	536.81	538.31	1.64	1.30	9.14	6.93	0.69	5.57	0.68	10.67	13.35
Upper	2091	81.00	536.81	538.58	1.84	1.30	11.32	7.14	0.99	6.15	0.98	14.71	16.37
Upper	2091	195.00	536.81	539.74	1.64	0.50	10.61	1.57	1.00	6.46	0.95	62.26	86.71
Upper	2071	22.00	536.14	537.40	0.46	0.23	1.29	0.61	0.15	2.82	0.15	8.17	21.53
Upper	2071	44.00	536.14	538.28	0.08	0.03	0.11	0.02	0.30	1.33	0.30	89.50	136.36
Upper	2071	30.00	536.14	537.62	0.42	0.12	1.16	0.22	0.33	2.79	0.33	16.77	59.51
Upper	2071	57.00	536.14	538.42	0.09	0.04	0.12	0.02	0.35	1.41	0.35	109.41	140.67
Upper	2071	81.00	536.14	538.59	0.11	0.05	0.18	0.03	0.43	1.63	0.43	132.91	145.59
Upper	2071	195.00	536.14	539.05	0.25	0.13	0.61	0.13	0.75	2.49	0.75	203.03	159.43
Upper	2059	22.00	535.09	537.43	0.10	0.05	0.15	0.07	0.07	1.46	0.07	15.69	24.41
Upper	2059	44.00	535.09	538.27	0.06	0.02	0.08	0.01	0.24	1.24	0.24	82.66	114.24
Upper	2059	30.00	535.09	537.63	0.13	0.04	0.22	0.05	0.16	1.68	0.16	23.40	53.26
Upper	2059	57.00	535.09	538.41	0.08	0.03	0.11	0.02	0.29	1.38	0.29	99.02	118.04
Upper	2059	81.00	535.09	538.57	0.11	0.05	0.19	0.03	0.38	1.68	0.38	118.03	122.31
Upper	2059	195.00	535.09	539.00	0.29	0.14	0.81	0.16	0.75	2.78	0.75	173.33	133.97

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	2047	22.00	536.13	537.08	1.25	1.25	5.60	5.60		4.48		4.91	8.01
Upper	2047	44.00	536.13	538.25	0.13	0.05	0.22	0.04	0.38	1.71	0.32	60.85	95.16
Upper	2047	30.00	536.13	537.34	1.02	0.94	4.22	3.88	0.06	4.15	0.06	7.24	10.91
Upper	2047	57.00	536.13	538.38	0.15	0.07	0.28	0.09	0.45	1.86	0.37	74.55	101.19
Upper	2047	81.00	536.13	538.54	0.21	0.10	0.47	0.05	0.58	2.22	0.45	90.32	107.72
Upper	2047	195.00	536.13	538.93	0.54	0.26	1.96	0.38	1.07	3.66	0.80	135.68	124.59
Upper	2032	22.00	535.43	536.93	0.20	0.06	0.40	0.07	0.24	1.97	0.24	18.27	63.30
Upper	2032	44.00	535.43	538.26	0.02	0.01	0.01	0.00	0.22	0.69	0.19	158.75	124.97
Upper	2032	30.00	535.43	537.49	0.05	0.02	0.05	0.01	0.25	1.04	0.24	71.09	104.33
Upper	2032	57.00	535.43	538.40	0.03	0.01	0.02	0.00	0.26	0.80	0.22	176.48	128.75
Upper	2032	81.00	535.43	538.55	0.04	0.02	0.04	0.01	0.34	1.02	0.28	196.66	132.91
Upper	2032	195.00	535.43	538.96	0.13	0.08	0.25	0.06	0.66	1.89	0.54	253.03	143.91
Upper	2017	22.00	534.37	536.94	0.06	0.02	0.07	0.01	0.11	1.16	0.27	26.09	64.59
Upper	2017	44.00	534.37	538.26	0.01	0.01	0.01	0.00	0.15	0.52	0.29	168.94	125.83
Upper	2017	30.00	534.37	537.49	0.02	0.01	0.02	0.00	0.15	0.75	0.35	78.56	104.78
Upper	2017	57.00	534.37	538.40	0.01	0.01	0.01	0.00	0.18	0.61	0.35	184.76	129.53
Upper	2017	81.00	534.37	538.55	0.02	0.01	0.02	0.00	0.23	0.78	0.45	205.01	133.60
Upper	2017	195.00	534.37	538.96	0.07	0.04	0.11	0.03	0.47	1.46	0.85	261.27	144.33
Upper	2001	22.00	535.31	536.88	0.19	0.09	0.37	0.13	0.26	1.93	0.26	14.88	31.87
Upper	2001	44.00	535.31	538.25	0.04	0.02	0.04	0.01	0.23	0.97	0.21	113.45	107.35
Upper	2001	30.00	535.31	537.47	0.08	0.03	0.11	0.02	0.26	1.37	0.26	43.93	66.77
Upper	2001	57.00	535.31	538.39	0.05	0.02	0.05	0.01	0.28	1.12	0.25	128.54	112.35
Upper	2001	81.00	535.31	538.53	0.08	0.04	0.11	0.02	0.38	1.42	0.32	146.62	117.74
Upper	2001	195.00	535.31	538.91	0.25	0.12	0.67	0.13	0.76	2.64	0.62	191.97	131.28
Upper	1968	22.00	534.72	536.81	0.13	0.04	0.22	0.05	0.18	1.63	0.18	16.72	48.54
Upper	1968	44.00	534.72	538.25	0.02	0.01	0.02	0.00	0.23	0.74	0.20	137.35	99.92
Upper	1968	30.00	534.72	537.46	0.04	0.02	0.04	0.01	0.24	1.01	0.22	65.26	82.53
Upper	1968	57.00	534.72	538.38	0.03	0.02	0.03	0.01	0.28	0.87	0.24	151.16	102.64
Upper	1968	81.00	534.72	538.53	0.05	0.03	0.05	0.01	0.37	1.13	0.31	166.34	105.56
Upper	1968	195.00	534.72	538.88	0.17	0.10	0.38	0.10	0.77	2.20	0.63	205.01	112.65
Upper	1963												
Upper	1911	22.00	533.46	534.70	0.50	0.47	1.47	1.36	0.11	2.93	0.11	7.52	10.80
Upper	1911	44.00	533.46	535.15	0.62	0.37	2.19	1.10	0.54	3.53	0.54	14.76	20.99
Upper	1911	30.00	533.46	534.89	0.54	0.39	1.71	1.16	0.34	3.16	0.34	10.00	15.09
Upper	1911	57.00	533.46	535.33	0.71	0.40	2.76	1.20	0.66	3.87	0.66	18.90	25.02
Upper	1911	81.00	533.46	535.57	0.92	0.49	4.12	1.54	0.85	4.50	0.85	25.48	30.34

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	1911	195.00	533.46	536.05	2.42	1.19	18.52	5.44	1.55	7.65	1.59	42.71	42.50
Upper	1901	22.00	532.40	534.73	0.10	0.08	0.15	0.12	0.07	1.47	0.07	15.13	14.21
Upper	1901	44.00	532.40	535.20	0.20	0.09	0.42	0.16	0.27	2.11	0.27	25.79	31.73
Upper	1901	30.00	532.40	534.93	0.14	0.08	0.24	0.13	0.16	1.74	0.16	18.62	21.57
Upper	1901	57.00	532.40	535.39	0.25	0.11	0.60	0.19	0.35	2.41	0.35	32.38	38.79
Upper	1901	81.00	532.40	535.64	0.34	0.15	0.99	0.27	0.48	2.89	0.48	43.47	48.40
Upper	1901	195.00	532.40	536.29	0.81	0.34	3.75	0.81	0.94	4.63	0.88	82.67	72.09
Upper	1891	22.00	533.44	534.39	1.25	1.25	5.60	5.60		4.48		4.92	8.02
Upper	1891	44.00	533.44	534.79	1.43	0.89	7.21	4.25	0.44	5.06	0.44	9.20	17.38
Upper	1891	30.00	533.44	534.56	1.34	1.34	6.31	6.31		4.71		6.37	9.35
Upper	1891	57.00	533.44	534.99	1.39	0.67	7.17	2.81	0.68	5.17	0.68	13.63	27.17
Upper	1891	81.00	533.44	535.25	1.44	0.62	7.83	2.24	0.91	5.46	0.91	22.60	40.28
Upper	1891	195.00	533.44	535.98	1.78	0.77	11.64	2.30	1.37	6.54	1.37	64.85	76.06
Upper	1874	22.00	532.86	534.10	0.50	0.41	1.44	1.18	0.11	2.92	0.11	7.59	12.35
Upper	1874	44.00	532.86	534.59	0.51	0.21	1.64	0.45	0.50	3.21	0.50	20.62	41.29
Upper	1874	30.00	532.86	534.30	0.52	0.26	1.60	0.70	0.34	3.10	0.34	11.16	24.04
Upper	1874	57.00	532.86	534.81	0.49	0.20	1.57	0.36	0.58	3.23	0.58	31.42	54.70
Upper	1874	81.00	532.86	535.15	0.45	0.18	1.45	0.26	0.61	3.21	0.67	54.37	79.84
Upper	1874	195.00	532.86	536.05	0.44	0.22	1.47	0.32	0.97	3.38	0.89	137.16	102.88
Upper	1866	22.00	531.80	534.14	0.10	0.09	0.15	0.12	0.07	1.46	0.16	15.22	13.56
Upper	1866	44.00	531.80	534.61	0.19	0.10	0.40	0.18	0.27	2.06	0.63	24.60	26.31
Upper	1866	30.00	531.80	534.34	0.14	0.09	0.24	0.15	0.16	1.72	0.37	18.39	18.85
Upper	1866	57.00	531.80	534.82	0.23	0.12	0.54	0.21	0.35	2.34	0.82	30.69	31.98
Upper	1866	81.00	531.80	535.13	0.30	0.10	0.81	0.19	0.34	2.71	1.08	44.27	58.24
Upper	1866	195.00	531.80	535.98	0.48	0.20	1.72	0.38	0.73	3.61	1.72	103.82	83.27
Upper	1851	22.00	532.85	533.80	1.24	1.24	5.53	5.53		4.46		4.94	8.04
Upper	1851	44.00	532.85	534.18	1.49	1.14	7.72	5.76	0.42	5.17	0.42	8.74	13.58
Upper	1851	30.00	532.85	533.97	1.34	1.34	6.30	6.30		4.71		6.37	9.35
Upper	1851	57.00	532.85	534.37	1.53	0.95	8.23	4.58	0.69	5.40	0.69	11.77	18.60
Upper	1851	81.00	532.85	534.65	1.63	0.88	9.49	3.97	0.96	5.81	0.96	17.94	25.97
Upper	1851	195.00	532.85	535.53	1.76	0.73	11.60	2.35	1.27	6.58	1.40	60.90	69.19
Upper	1831	22.00	531.81	533.06	0.45	0.21	1.30	0.57	0.19	2.86	0.20	8.31	23.64
Upper	1831	44.00	531.81	533.37	0.68	0.31	2.50	0.76	0.59	3.70	0.62	17.78	37.58
Upper	1831	30.00	531.81	533.27	0.43	0.19	1.23	0.41	0.41	2.89	0.43	14.22	33.03
Upper	1831	57.00	531.81	533.45	0.91	0.41	3.94	1.13	0.73	4.34	0.77	20.81	41.04
Upper	1831	81.00	531.81	533.56	1.34	0.61	7.18	1.92	0.97	5.36	1.02	25.81	46.20

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	1831	195.00	531.81	534.18	1.88	0.89	12.76	2.76	1.35	6.78	1.58	63.05	73.21
Upper	1821	22.00	530.76	533.10	0.10	0.04	0.14	0.05	0.10	1.45	0.10	16.90	32.81
Upper	1821	44.00	530.76	533.41	0.21	0.10	0.46	0.15	0.32	2.20	0.36	28.26	38.84
Upper	1821	30.00	530.76	533.30	0.12	0.05	0.20	0.07	0.21	1.66	0.23	23.86	36.62
Upper	1821	57.00	530.76	533.50	0.30	0.14	0.79	0.25	0.42	2.64	0.47	31.76	40.52
Upper	1821	81.00	530.76	533.62	0.48	0.23	1.64	0.51	0.59	3.40	0.67	36.88	42.85
Upper	1821	195.00	530.76	533.92	1.71	0.87	11.27	3.37	1.28	6.58	1.47	50.49	48.51
Upper	1811	22.00	531.80	532.76	1.79	1.79	7.96	7.96		4.45		4.94	8.04
Upper	1811	44.00	531.80	533.21	1.46	0.53	5.74	1.28	0.79	3.94	0.83	18.33	55.83
Upper	1811	30.00	531.80	532.91	2.26	2.26	10.80	10.80		4.79		6.27	9.27
Upper	1811	57.00	531.80	533.31	1.63	0.66	6.91	1.60	0.99	6.91	1.05	23.60	58.77
Upper	1811	81.00	531.80	533.43	1.97	0.89	9.38	2.29	1.25	4.76	1.35	31.48	62.91
Upper	1811	195.00	531.80	533.83	3.39	1.77	22.18	5.87	2.03	6.55	2.24	58.81	75.55
Upper	1784	22.00	530.60	531.84	0.49	0.36	1.42	1.03	0.12	2.90	0.12	7.67	13.89
Upper	1784	44.00	530.60	532.31	0.50	0.23	1.58	0.46	0.57	3.17	0.53	21.48	40.06
Upper	1784	30.00	530.60	532.04	0.49	0.22	1.50	0.53	0.36	3.03	0.35	12.22	29.71
Upper	1784	57.00	530.60	532.47	0.56	0.26	1.91	0.51	0.68	3.42	0.63	28.36	46.28
Upper	1784	81.00	530.60	532.70	0.65	0.30	2.49	0.61	0.82	3.80	0.77	40.37	55.49
Upper	1784	195.00	530.60	533.44	0.96	0.47	4.72	1.02	1.22	4.91	1.13	90.78	81.38
Upper	1776	22.00	529.50	531.89	0.09	0.05	0.13	0.06	0.09	1.40	0.09	16.56	24.49
Upper	1776	44.00	529.50	532.34	0.16	0.07	0.32	0.09	0.32	1.94	0.29	33.90	46.72
Upper	1776	30.00	529.50	532.09	0.12	0.05	0.20	0.06	0.19	1.63	0.18	23.05	38.01
Upper	1776	57.00	529.50	532.50	0.21	0.09	0.47	0.12	0.41	2.22	0.36	41.66	52.07
Upper	1776	81.00	529.50	532.73	0.29	0.13	0.76	0.19	0.54	2.65	0.47	54.61	59.93
Upper	1776	195.00	529.50	533.44	0.60	0.28	2.40	0.51	0.91	4.00	0.86	105.29	83.49
Upper	1764	22.00	530.59	531.54	1.25	1.25	5.59	5.59		4.47		4.92	8.02
Upper	1764	44.00	530.59	532.00	1.16	0.47	5.33	1.75	0.49	4.61	0.49	11.69	32.12
Upper	1764	30.00	530.59	531.71	1.34	1.34	6.32	6.32		4.72		6.36	9.35
Upper	1764	57.00	530.59	532.16	1.21	0.53	5.88	1.80	0.79	4.85	0.71	16.89	36.66
Upper	1764	81.00	530.59	532.36	1.40	0.66	7.49	2.14	1.09	5.35	0.95	24.83	42.67
Upper	1764	195.00	530.59	533.04	1.86	0.94	12.28	3.02	1.68	6.62	1.46	60.79	63.17
Upper	1746	22.00	529.92	531.18	0.47	0.40	1.34	1.14	0.14	2.85	0.14	7.76	11.85
Upper	1746	44.00	529.92	531.65	0.55	0.28	1.85	0.73	0.53	3.35	0.53	17.00	27.37
Upper	1746	30.00	529.92	531.37	0.51	0.31	1.55	0.88	0.35	3.07	0.35	10.69	18.26
Upper	1746	57.00	529.92	531.85	0.59	0.29	2.09	0.70	0.63	3.55	0.63	23.37	34.19
Upper	1746	81.00	529.92	532.16	0.66	0.31	2.53	0.71	0.78	3.86	0.74	35.18	44.13

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	1746	195.00	529.92	533.01	0.95	0.44	4.69	1.01	1.18	4.96	1.07	85.10	72.55
Upper	1736	22.00	528.87	531.21	0.10	0.08	0.15	0.12	0.07	1.46	0.07	15.21	13.93
Upper	1736	44.00	528.87	531.68	0.20	0.10	0.41	0.17	0.27	2.11	0.27	25.26	28.87
Upper	1736	30.00	528.87	531.41	0.14	0.08	0.24	0.14	0.16	1.73	0.16	18.55	20.16
Upper	1736	57.00	528.87	531.88	0.24	0.11	0.58	0.20	0.36	2.39	0.36	31.75	35.31
Upper	1736	81.00	528.87	532.18	0.32	0.14	0.91	0.27	0.49	2.82	0.46	43.45	44.82
Upper	1736	195.00	528.87	533.00	0.65	0.28	2.74	0.60	0.91	4.21	0.81	91.64	72.05
Upper	1724	22.00	529.91	530.86	1.25	1.25	5.58	5.58		4.47		4.92	8.02
Upper	1724	44.00	529.91	531.25	1.47	1.07	7.58	5.30	0.43	5.14	0.43	8.85	14.53
Upper	1724	30.00	529.91	531.03	1.34	1.34	6.31	6.31		4.71		6.37	9.35
Upper	1724	57.00	529.91	531.44	1.48	0.85	7.91	3.97	0.69	5.33	0.69	12.25	20.80
Upper	1724	81.00	529.91	531.72	1.57	0.79	8.96	3.32	0.94	5.70	0.94	19.20	29.76
Upper	1724	195.00	529.91	532.50	2.04	0.95	14.37	3.52	1.56	7.03	1.42	52.66	55.55
Upper	1707	22.00	529.28	530.52	0.49	0.43	1.44	1.23	0.12	2.91	0.12	7.59	11.71
Upper	1707	44.00	529.28	530.99	0.56	0.26	1.87	0.65	0.52	3.35	0.52	17.79	31.63
Upper	1707	30.00	529.28	530.72	0.52	0.30	1.63	0.84	0.34	3.11	0.34	10.68	19.96
Upper	1707	57.00	529.28	531.19	0.59	0.27	2.11	0.61	0.62	3.55	0.62	24.79	40.03
Upper	1707	81.00	529.28	531.45	0.68	0.30	2.67	0.66	0.76	3.91	0.75	36.98	51.40
Upper	1707	195.00	529.28	532.24	0.95	0.43	4.71	0.92	1.09	4.94	1.10	91.04	84.98
Upper	1698	22.00	528.22	530.56	0.10	0.08	0.15	0.11	0.07	1.46	0.07	15.25	14.83
Upper	1698	44.00	528.22	531.03	0.19	0.09	0.40	0.14	0.27	2.09	0.27	26.70	34.33
Upper	1698	30.00	528.22	530.76	0.14	0.08	0.24	0.12	0.16	1.72	0.16	18.96	22.96
Upper	1698	57.00	528.22	531.22	0.24	0.10	0.57	0.17	0.35	2.37	0.35	34.04	43.06
Upper	1698	81.00	528.22	531.47	0.33	0.13	0.93	0.23	0.46	2.83	0.46	46.57	54.84
Upper	1698	195.00	528.22	532.24	0.64	0.26	2.64	0.50	0.81	4.14	0.84	101.49	88.22
Upper	1686	22.00	529.26	530.21	1.25	1.25	5.60	5.60		4.48		4.91	8.01
Upper	1686	44.00	529.26	530.61	1.42	0.89	7.21	4.28	0.44	5.06	0.44	9.19	17.22
Upper	1686	30.00	529.26	530.38	1.34	1.34	6.31	6.31		4.71		6.37	9.35
Upper	1686	57.00	529.26	530.81	1.40	0.68	7.23	2.88	0.68	5.18	0.68	13.51	26.70
Upper	1686	81.00	529.26	531.08	1.42	0.65	7.71	2.33	0.93	5.43	0.94	22.50	38.21
Upper	1686	195.00	529.26	531.76	2.04	1.01	14.25	3.56	1.55	6.97	1.61	54.81	57.18
Upper	1667	22.00	528.58	529.84	0.47	0.35	1.35	0.99	0.14	2.85	0.14	7.81	13.77
Upper	1667	44.00	528.58	530.31	0.49	0.22	1.55	0.47	0.56	3.16	0.52	20.95	38.22
Upper	1667	30.00	528.58	530.03	0.49	0.23	1.47	0.59	0.36	3.02	0.35	11.86	26.40
Upper	1667	57.00	528.58	530.50	0.52	0.23	1.74	0.46	0.65	3.33	0.61	28.83	46.08
Upper	1667	81.00	528.58	530.75	0.61	0.27	2.24	0.53	0.78	3.69	0.74	41.68	56.59

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper: (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	1667	195.00	528.58	531.40	1.04	0.50	5.34	1.12	1.22	5.11	1.18	86.70	80.68
Upper	1657	22.00	527.52	529.87	0.10	0.06	0.15	0.08	0.07	1.45	0.07	15.63	19.86
Upper	1657	44.00	527.52	530.34	0.17	0.07	0.35	0.09	0.28	1.99	0.29	32.53	48.78
Upper	1657	30.00	527.52	530.07	0.13	0.05	0.22	0.08	0.17	1.69	0.17	21.15	34.57
Upper	1657	57.00	527.52	530.53	0.21	0.08	0.47	0.11	0.36	2.23	0.36	42.34	58.30
Upper	1657	81.00	527.52	530.77	0.28	0.11	0.73	0.15	0.46	2.61	0.47	58.32	71.14
Upper	1657	195.00	527.52	531.43	0.55	0.24	2.11	0.41	0.84	3.83	0.90	114.68	97.61
Upper	1645	22.00	528.57	529.52	1.25	1.25	5.61	5.61		4.48		4.91	8.01
Upper	1645	44.00	528.57	529.92	1.41	0.83	7.11	3.91	0.43	5.04	0.44	9.33	18.63
Upper	1645	30.00	528.57	529.69	1.34	1.34	6.31	6.31		4.71		6.36	9.35
Upper	1645	57.00	528.57	530.13	1.32	0.68	6.67	2.29	0.44	5.05	0.75	14.52	31.41
Upper	1645	81.00	528.57	530.39	1.36	0.54	7.23	1.79	0.69	5.31	1.00	24.65	47.78
Upper	1645	195.00	528.57	531.04	1.75	0.72	11.29	2.02	1.21	6.45	1.46	69.61	88.46
Upper	1628	22.00	527.92	529.14	0.53	0.51	1.61	1.54	0.07	3.01	0.07	7.31	10.47
Upper	1628	44.00	527.92	529.52	0.76	0.43	2.91	1.41	0.54	3.84	0.54	13.44	21.72
Upper	1628	30.00	527.92	529.33	0.56	0.37	1.79	1.13	0.33	3.21	0.33	9.95	16.30
Upper	1628	57.00	527.92	529.66	0.92	0.49	3.99	1.67	0.68	4.33	0.68	16.73	25.81
Upper	1628	81.00	527.92	529.85	1.23	0.62	6.28	2.24	0.90	5.12	0.90	22.31	31.55
Upper	1628	195.00	527.92	530.54	2.03	0.92	14.25	3.46	1.61	7.02	1.26	52.09	55.45
Upper	1618	22.00	525.52	529.20	0.07	0.06	0.08	0.07	0.05	1.20	0.05	18.50	13.67
Upper	1618	44.00	525.52	529.60	0.16	0.09	0.30	0.14	0.22	1.89	0.22	26.50	25.92
Upper	1618	30.00	525.52	529.40	0.10	0.06	0.14	0.08	0.13	1.45	0.13	21.84	19.72
Upper	1618	57.00	525.52	529.75	0.22	0.11	0.49	0.21	0.30	2.25	0.30	30.73	30.45
Upper	1618	81.00	525.52	529.97	0.33	0.16	0.94	0.34	0.44	2.83	0.44	38.14	37.10
Upper	1618	195.00	525.52	530.57	0.93	0.38	4.55	1.09	0.93	4.91	0.80	68.41	63.81
Upper	1606	22.00	527.90	528.85	1.24	1.24	5.55	5.55		4.46		4.93	8.03
Upper	1606	44.00	527.90	529.29	0.92	0.64	4.08	2.61	0.57	4.44	0.38	10.78	23.93
Upper	1606	30.00	527.90	529.01	1.36	1.36	6.46	6.46		4.75		6.32	9.31
Upper	1606	57.00	527.90	529.41	1.11	0.71	5.22	2.86	0.79	4.71	0.59	14.14	28.60
Upper	1606	81.00	527.90	529.61	1.38	0.82	7.07	3.23	1.06	5.12	0.85	20.52	35.82
Upper	1606	195.00	527.90	530.25	2.14	1.13	13.52	4.30	1.63	6.32	1.43	51.21	61.10
Upper	1589	22.00	527.27	528.52	0.48	0.41	1.38	1.16	0.13	2.87	0.13	7.70	11.90
Upper	1589	44.00	527.27	528.98	0.56	0.28	1.90	0.71	0.52	3.37	0.52	17.23	29.33
Upper	1589	30.00	527.27	528.71	0.51	0.30	1.58	0.85	0.34	3.09	0.35	10.72	19.21
Upper	1589	57.00	527.27	529.16	0.63	0.29	2.30	0.72	0.65	3.65	0.61	23.13	36.77
Upper	1589	81.00	527.27	529.40	0.78	0.34	3.22	0.85	0.81	4.15	0.76	32.94	46.65

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chml (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	1589	195.00	527.27	530.03	1.41	0.63	8.37	1.73	1.30	5.92	1.25	70.56	72.58
Upper	1578	22.00	526.21	528.55	0.10	0.07	0.15	0.10	0.07	1.46	0.07	15.35	16.25
Upper	1578	44.00	526.21	529.02	0.19	0.08	0.39	0.11	0.27	2.06	0.27	28.85	41.92
Upper	1578	30.00	526.21	528.75	0.14	0.07	0.23	0.10	0.16	1.72	0.16	19.59	27.11
Upper	1578	57.00	526.21	529.20	0.23	0.09	0.54	0.14	0.36	2.33	0.33	37.23	51.11
Upper	1578	81.00	526.21	529.44	0.32	0.12	0.88	0.19	0.49	2.77	0.43	50.89	63.29
Upper	1578	195.00	526.21	530.09	0.67	0.27	2.79	0.52	0.89	4.20	0.82	103.02	93.72
Upper	1568	22.00	527.26	528.21	1.24	1.24	5.55	5.55		4.46		4.93	8.03
Upper	1568	44.00	527.26	528.62	1.38	0.78	6.91	3.60	0.45	4.99	0.45	9.52	19.73
Upper	1568	30.00	527.26	528.38	1.34	1.34	6.31	6.31		4.71		6.36	9.35
Upper	1568	57.00	527.26	528.82	1.32	0.58	6.67	2.25	0.68	5.05	0.68	14.72	32.01
Upper	1568	81.00	527.26	529.08	1.35	0.56	7.18	1.81	0.91	5.30	0.87	24.93	47.01
Upper	1568	195.00	527.26	529.71	1.88	0.81	12.55	2.43	1.50	6.87	1.32	64.90	79.79
Upper	1548	22.00	526.57	527.82	0.47	0.39	1.36	1.11	0.13	2.86	0.13	7.74	12.30
Upper	1548	44.00	526.57	528.23	0.63	0.30	2.21	0.82	0.53	3.53	0.54	16.34	29.31
Upper	1548	30.00	526.57	528.02	0.51	0.28	1.55	0.78	0.35	3.07	0.35	10.96	20.71
Upper	1548	57.00	526.57	528.33	0.83	0.39	3.42	1.15	0.67	4.12	0.68	19.40	33.22
Upper	1548	81.00	526.57	528.46	1.25	0.58	6.46	1.95	0.90	5.15	0.91	23.88	38.24
Upper	1548	195.00	526.57	529.11	1.97	0.87	13.59	2.96	1.48	6.88	1.34	57.66	65.51
Upper	1539	22.00	525.52	527.86	0.10	0.07	0.15	0.09	0.07	1.46	0.07	15.41	18.21
Upper	1539	44.00	525.52	528.28	0.20	0.09	0.42	0.13	0.30	2.11	0.30	28.15	38.55
Upper	1539	30.00	525.52	528.06	0.14	0.06	0.23	0.09	0.17	1.71	0.17	20.43	31.00
Upper	1539	57.00	525.52	528.40	0.27	0.12	0.68	0.20	0.39	2.50	0.39	32.86	42.50
Upper	1539	81.00	525.52	528.56	0.42	0.18	1.33	0.37	0.54	3.15	0.54	40.13	47.97
Upper	1539	195.00	525.52	529.20	0.94	0.41	4.66	1.02	1.03	4.94	0.92	77.99	72.08
Upper	1527	22.00	526.56	527.51	1.25	1.25	5.60	5.60		4.48		4.92	8.02
Upper	1527	44.00	526.56	528.03	0.92	0.29	3.85	0.81	0.50	4.16	0.51	15.97	52.97
Upper	1527	30.00	526.56	527.68	1.34	1.34	6.34	6.34		4.72		6.36	9.34
Upper	1527	57.00	526.56	528.14	1.03	0.38	4.62	0.98	0.67	4.48	0.74	22.13	57.11
Upper	1527	81.00	526.56	528.30	1.23	0.51	6.14	1.31	0.87	5.00	1.01	31.58	62.94
Upper	1527	195.00	526.56	529.21	0.82	0.44	3.66	0.82	1.04	4.47	1.29	104.13	93.18
Upper	1511	22.00	525.99	527.23	0.49	0.44	1.43	1.26	0.11	2.91	0.12	7.59	11.42
Upper	1511	44.00	525.99	527.70	0.58	0.29	1.96	0.77	0.52	3.41	0.53	16.68	27.55
Upper	1511	30.00	525.99	527.42	0.53	0.33	1.65	0.94	0.34	3.13	0.34	10.43	18.07
Upper	1511	57.00	525.99	527.90	0.61	0.28	2.22	0.73	0.62	3.61	0.63	22.98	34.56
Upper	1511	81.00	525.99	528.19	0.69	0.31	2.74	0.72	0.57	3.95	0.79	34.61	46.71

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	1511	195.00	525.99	529.00	0.99	0.42	4.91	0.93	0.87	5.02	1.18	87.73	84.06
Upper	1503	22.00	524.94	527.27	0.10	0.09	0.15	0.13	0.06	1.47	0.07	15.11	13.73
Upper	1503	44.00	524.94	527.74	0.20	0.10	0.42	0.18	0.27	2.12	0.27	25.00	28.69
Upper	1503	30.00	524.94	527.47	0.14	0.09	0.24	0.14	0.16	1.74	0.16	18.39	19.97
Upper	1503	57.00	524.94	527.94	0.25	0.12	0.60	0.21	0.35	2.41	0.36	31.31	35.05
Upper	1503	81.00	524.94	528.22	0.34	0.14	0.96	0.27	0.32	2.87	0.50	42.75	47.31
Upper	1503	195.00	524.94	528.99	0.68	0.27	2.92	0.56	0.65	4.29	0.91	93.44	83.68
Upper	1493	22.00	525.98	526.93	1.25	1.25	5.61	5.61		4.48		4.91	8.01
Upper	1493	44.00	525.98	527.32	1.46	1.02	7.47	5.00	0.43	5.12	0.43	8.94	15.20
Upper	1493	30.00	525.98	527.10	1.34	1.34	6.31	6.31		4.71		6.37	9.35
Upper	1493	57.00	525.98	527.51	1.47	0.81	7.81	3.69	0.68	5.31	0.69	12.50	22.17
Upper	1493	81.00	525.98	527.79	1.53	0.74	8.65	2.99	0.93	5.64	0.94	20.04	32.29
Upper	1493	195.00	525.98	528.56	1.96	0.85	13.45	2.93	1.16	6.87	1.52	56.79	64.53
Upper	1476	22.00	525.32	526.57	0.48	0.43	1.39	1.24	0.13	2.88	0.13	7.66	11.29
Upper	1476	44.00	525.32	527.03	0.58	0.32	2.00	0.90	0.54	3.43	0.52	15.82	23.90
Upper	1476	30.00	525.32	526.76	0.52	0.34	1.61	1.00	0.35	3.11	0.35	10.37	16.56
Upper	1476	57.00	525.32	527.22	0.65	0.34	2.44	0.93	0.70	3.72	0.59	20.81	29.16
Upper	1476	81.00	525.32	527.46	0.82	0.41	3.51	1.14	0.90	4.28	0.74	28.77	36.00
Upper	1476	195.00	525.32	528.20	1.45	0.66	8.80	2.02	1.31	6.06	1.23	63.32	60.49
Upper	1466	22.00	524.26	526.61	0.10	0.09	0.15	0.13	0.07	1.46	0.07	15.22	13.34
Upper	1466	44.00	524.26	527.07	0.20	0.11	0.42	0.20	0.28	2.12	0.26	24.11	25.01
Upper	1466	30.00	524.26	526.80	0.14	0.09	0.24	0.15	0.16	1.73	0.16	18.32	18.15
Upper	1466	57.00	524.26	527.26	0.25	0.13	0.62	0.25	0.38	2.44	0.32	29.27	30.24
Upper	1466	81.00	524.26	527.50	0.37	0.17	1.11	0.38	0.53	3.00	0.45	37.47	37.06
Upper	1466	195.00	524.26	528.22	0.89	0.37	4.32	1.02	0.92	4.87	0.89	71.66	61.27
Upper	1453	22.00	525.30	526.25	1.24	1.24	5.55	5.55		4.46		4.93	8.03
Upper	1453	44.00	525.30	526.65	1.43	0.90	7.22	4.30	0.44	5.06	0.44	9.18	17.18
Upper	1453	30.00	525.30	526.42	1.34	1.34	6.31	6.31		4.71		6.37	9.35
Upper	1453	57.00	525.30	526.85	1.40	0.69	7.26	2.90	0.68	5.19	0.68	13.48	26.60
Upper	1453	81.00	525.30	527.12	1.43	0.68	7.76	2.49	0.95	5.44	0.98	22.19	35.96
Upper	1453	195.00	525.30	527.80	2.11	1.15	14.98	4.44	1.61	7.09	1.78	50.62	47.54
Upper	1439	22.00	524.72	525.97	0.48	0.30	1.37	0.85	0.13	2.87	0.13	7.83	16.44
Upper	1439	44.00	524.72	526.30	0.72	0.34	2.69	0.92	0.62	3.74	0.57	16.16	32.26
Upper	1439	30.00	524.72	526.17	0.48	0.23	1.44	0.57	0.41	3.00	0.39	12.35	26.98
Upper	1439	57.00	524.72	526.37	1.01	0.47	4.49	1.45	0.78	4.46	0.73	18.45	35.04
Upper	1439	81.00	524.72	526.50	1.44	0.67	7.85	2.30	1.04	5.44	0.97	23.48	40.50

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	1439	195.00	524.72	527.17	1.93	0.95	13.03	3.10	1.53	6.75	1.58	59.58	63.75
Upper	1430	22.00	523.66	526.01	0.10	0.03	0.14	0.04	0.08	1.44	0.08	17.24	47.29
Upper	1430	44.00	523.66	526.37	0.18	0.07	0.37	0.09	0.32	2.02	0.33	35.57	55.82
Upper	1430	30.00	523.66	526.21	0.12	0.04	0.19	0.05	0.21	1.61	0.21	27.19	52.09
Upper	1430	57.00	523.66	526.47	0.25	0.10	0.59	0.14	0.41	2.38	0.43	41.28	58.23
Upper	1430	81.00	523.66	526.61	0.38	0.17	1.13	0.27	0.57	2.97	0.59	49.86	61.66
Upper	1430	195.00	523.66	527.29	0.71	0.36	3.05	0.73	1.00	4.28	1.06	97.00	77.60
Upper	1418	22.00	524.71	525.66	1.25	1.25	5.61	5.61		4.48		4.91	8.01
Upper	1418	44.00	524.71	526.15	0.86	0.28	3.41	0.61	0.58	3.98	0.59	19.94	67.23
Upper	1418	30.00	524.71	525.82	1.36	1.36	6.46	6.46		4.75		6.32	9.31
Upper	1418	57.00	524.71	526.24	0.98	0.36	4.23	0.80	0.76	4.33	0.77	26.10	69.84
Upper	1418	81.00	524.71	526.38	1.14	0.49	5.47	1.10	0.99	4.78	1.01	36.37	73.98
Upper	1418	195.00	524.71	527.27	0.70	0.41	2.89	0.70	1.18	4.11	1.19	113.31	97.36
Upper	1402	22.00	524.09	525.34	0.48	0.40	1.36	1.15	0.13	2.87	0.13	7.73	11.99
Upper	1402	44.00	524.09	525.81	0.56	0.27	1.87	0.69	0.52	3.35	0.52	17.42	29.68
Upper	1402	30.00	524.09	525.54	0.51	0.30	1.56	0.83	0.35	3.07	0.35	10.80	19.43
Upper	1402	57.00	524.09	525.99	0.62	0.29	2.26	0.71	0.63	3.63	0.63	23.32	36.46
Upper	1402	81.00	524.09	526.22	0.76	0.36	3.14	0.90	0.81	4.12	0.82	32.65	42.75
Upper	1402	195.00	524.09	526.77	1.67	0.83	10.64	2.69	1.44	6.39	1.47	59.85	56.93
Upper	1393	22.00	523.04	525.38	0.10	0.09	0.15	0.12	0.07	1.46	0.07	15.20	13.71
Upper	1393	44.00	523.04	525.84	0.20	0.10	0.42	0.18	0.28	2.12	0.27	24.68	27.37
Upper	1393	30.00	523.04	525.58	0.14	0.09	0.24	0.14	0.16	1.73	0.16	18.46	19.52
Upper	1393	57.00	523.04	526.02	0.26	0.13	0.63	0.24	0.36	2.46	0.36	29.88	32.57
Upper	1393	81.00	523.04	526.24	0.38	0.17	1.15	0.37	0.48	3.03	0.51	38.03	39.98
Upper	1393	195.00	523.04	526.73	1.15	0.50	6.27	1.58	0.99	5.46	1.06	61.47	56.08
Upper	1381	22.00	524.08	525.04	1.24	1.24	5.49	5.49		4.45		4.95	8.05
Upper	1381	44.00	524.08	525.44	1.38	0.77	6.85	3.52	0.45	4.98	0.45	9.57	20.05
Upper	1381	30.00	524.08	525.20	1.34	1.34	6.31	6.31		4.71		6.36	9.35
Upper	1381	57.00	524.08	525.64	1.31	0.57	6.60	2.19	0.68	5.04	0.68	14.86	32.62
Upper	1381	81.00	524.08	525.90	1.35	0.54	7.15	1.75	0.88	5.29	0.88	25.21	48.56
Upper	1381	195.00	524.08	526.49	1.94	0.94	13.11	3.02	1.45	6.75	1.66	60.78	67.36
Upper	1368	22.00	523.58	524.81	0.50	0.40	1.47	1.16	0.11	2.93	0.11	7.55	12.83
Upper	1368	44.00	523.58	525.26	0.54	0.25	1.77	0.58	0.44	3.29	0.65	19.78	36.40
Upper	1368	30.00	523.58	525.01	0.52	0.23	1.60	0.59	0.32	3.09	0.35	11.65	28.36
Upper	1368	57.00	523.58	525.40	0.63	0.30	2.30	0.88	0.54	3.63	0.82	25.08	40.79
Upper	1368	81.00	523.58	525.60	0.80	0.39	3.34	0.92	0.70	4.17	1.05	33.89	47.20

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	1368	195.00	523.58	526.23	1.40	0.71	8.17	2.01	1.25	5.84	1.66	69.40	64.96
Upper	1358	22.00	522.52	524.85	0.10	0.06	0.15	0.09	0.07	1.47	0.07	15.35	19.74
Upper	1358	44.00	522.52	525.29	0.19	0.08	0.38	0.11	0.29	2.05	0.33	30.73	43.16
Upper	1358	30.00	522.52	525.05	0.14	0.05	0.23	0.08	0.17	1.71	0.17	21.08	36.36
Upper	1358	57.00	522.52	525.43	0.25	0.11	0.58	0.16	0.38	2.38	0.44	36.87	46.97
Upper	1358	81.00	522.52	525.62	0.35	0.16	1.03	0.28	0.51	2.91	0.60	46.88	52.49
Upper	1358	195.00	522.52	526.23	0.81	0.38	3.73	0.88	1.02	4.59	1.10	83.91	70.90
Upper	1351	22.00	523.57	524.52	1.25	1.25	5.61	5.61		4.48		4.91	8.01
Upper	1351	44.00	523.57	525.01	1.04	0.37	4.59	1.23	0.50	4.40	0.50	13.36	40.31
Upper	1351	30.00	523.57	524.69	1.34	1.34	6.33	6.33		4.72		6.36	9.35
Upper	1351	57.00	523.57	525.14	1.14	0.46	5.33	1.40	0.75	4.69	0.76	18.85	43.83
Upper	1351	81.00	523.57	525.32	1.33	0.61	6.97	1.81	1.02	5.22	1.04	27.18	48.69
Upper	1351	195.00	523.57	525.88	2.09	1.09	14.47	3.62	1.67	6.93	1.74	58.61	63.78
Upper	1326	22.00	522.40	523.65	0.48	0.39	1.38	1.12	0.13	2.88	0.13	7.70	12.47
Upper	1326	44.00	522.40	524.12	0.54	0.25	1.76	0.58	0.53	3.29	0.53	18.85	33.93
Upper	1326	30.00	522.40	523.85	0.51	0.27	1.56	0.73	0.34	3.07	0.34	11.10	22.26
Upper	1326	57.00	522.40	524.29	0.60	0.28	2.13	0.63	0.65	3.56	0.64	25.09	39.70
Upper	1326	81.00	522.40	524.51	0.75	0.35	3.04	0.82	0.82	4.07	0.81	34.67	47.20
Upper	1326	195.00	522.40	525.19	1.24	0.61	6.88	1.59	1.29	5.56	1.31	74.69	68.36
Upper	1318	22.00	521.35	523.69	0.10	0.07	0.15	0.10	0.07	1.46	0.07	15.33	16.52
Upper	1318	44.00	521.35	524.15	0.19	0.08	0.38	0.12	0.29	2.06	0.29	28.95	38.85
Upper	1318	30.00	521.35	523.89	0.14	0.06	0.24	0.10	0.16	1.72	0.16	19.73	28.31
Upper	1318	57.00	521.35	524.32	0.24	0.10	0.55	0.17	0.39	2.35	0.39	35.82	43.04
Upper	1318	81.00	521.35	524.54	0.34	0.15	0.96	0.27	0.53	2.85	0.53	45.87	48.53
Upper	1318	195.00	521.35	525.19	0.79	0.37	3.61	0.88	1.00	4.57	0.96	82.89	65.60
Upper	1306	22.00	522.39	523.34	1.25	1.25	5.56	5.56		4.47		4.93	8.03
Upper	1306	44.00	522.39	523.76	1.34	0.68	6.59	3.05	0.46	4.92	0.46	9.89	22.38
Upper	1306	30.00	522.39	523.51	1.34	1.34	6.31	6.31		4.71		6.36	9.35
Upper	1306	57.00	522.39	523.98	1.20	0.48	5.82	1.68	0.67	4.84	0.67	16.49	38.30
Upper	1306	81.00	522.39	524.19	1.35	0.60	7.12	1.90	0.97	5.28	0.94	25.36	45.23
Upper	1306	195.00	522.39	524.79	2.04	1.03	14.11	3.46	1.65	6.91	1.56	57.73	62.12
Upper	1291	22.00	521.77	523.03	0.47	0.33	1.33	0.92	0.16	2.85	0.17	7.89	14.73
Upper	1291	44.00	521.77	523.43	0.63	0.34	2.21	0.93	0.56	3.53	0.60	16.05	25.80
Upper	1291	30.00	521.77	523.22	0.49	0.29	1.49	0.77	0.38	3.03	0.42	11.31	20.13
Upper	1291	57.00	521.77	523.57	0.77	0.40	3.06	1.16	0.69	3.98	0.73	19.81	29.54
Upper	1291	81.00	521.77	523.76	1.02	0.52	4.79	1.61	0.89	4.70	0.93	26.18	34.97

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	1281	195.00	521.77	524.40	1.89	0.98	12.81	3.58	1.48	6.78	1.61	53.33	49.63
Upper	1281	22.00	520.72	523.06	0.10	0.05	0.15	0.07	0.09	1.45	0.10	16.16	25.67
Upper	1281	44.00	520.72	523.48	0.19	0.10	0.40	0.15	0.33	2.09	0.35	28.36	33.41
Upper	1281	30.00	520.72	523.26	0.13	0.07	0.22	0.09	0.21	1.68	0.22	21.61	29.38
Upper	1281	57.00	520.72	523.62	0.28	0.13	0.62	0.22	0.43	2.43	0.45	33.40	36.13
Upper	1281	81.00	520.72	523.84	0.37	0.19	1.11	0.37	0.57	2.98	0.61	41.63	40.17
Upper	1281	195.00	520.72	524.49	0.90	0.47	4.38	1.29	1.07	4.86	1.14	71.81	52.40
Upper	1289	22.00	521.76	522.71	1.26	1.26	5.63	5.63		4.48		4.91	8.01
Upper	1289	44.00	521.76	523.17	1.10	0.48	4.96	1.61	0.64	4.50	0.65	13.23	33.73
Upper	1289	30.00	521.76	522.88	1.36	1.36	6.42	6.42		4.74		6.33	9.32
Upper	1289	57.00	521.76	523.29	1.22	0.58	5.89	1.86	0.86	4.83	0.88	17.74	36.62
Upper	1289	81.00	521.76	523.48	1.44	0.73	7.77	2.39	1.13	5.40	1.15	24.93	40.80
Upper	1289	195.00	521.76	524.10	2.15	1.19	15.20	4.28	1.77	7.06	1.81	54.44	54.70
Upper	1254	22.00	521.16	522.41	0.47	0.37	1.36	1.05	0.13	2.86	0.13	7.77	13.01
Upper	1254	44.00	521.16	522.89	0.51	0.22	1.65	0.47	0.51	3.22	0.51	20.28	39.71
Upper	1254	30.00	521.16	522.61	0.50	0.25	1.52	0.66	0.34	3.05	0.34	11.41	24.07
Upper	1254	57.00	521.16	523.08	0.53	0.23	1.78	0.45	0.62	3.36	0.60	28.79	47.90
Upper	1254	81.00	521.16	523.33	0.60	0.28	2.19	0.55	0.79	3.66	0.75	41.59	53.94
Upper	1254	195.00	521.16	524.12	0.86	0.45	4.00	0.95	1.21	4.87	1.11	91.96	73.11
Upper	1245	22.00	520.11	522.45	0.10	0.07	0.15	0.11	0.07	1.46	0.07	15.31	16.06
Upper	1245	44.00	520.11	522.92	0.19	0.08	0.39	0.12	0.27	2.07	0.27	28.68	41.47
Upper	1245	30.00	520.11	522.65	0.14	0.07	0.24	0.10	0.16	1.72	0.16	19.51	26.77
Upper	1245	57.00	520.11	523.10	0.23	0.09	0.54	0.15	0.36	2.33	0.35	36.97	48.37
Upper	1245	81.00	520.11	523.34	0.31	0.14	0.87	0.22	0.51	2.77	0.48	49.26	54.13
Upper	1245	195.00	520.11	524.10	0.62	0.30	2.54	0.60	0.94	4.08	0.87	97.58	72.55
Upper	1233	22.00	521.15	522.10	1.25	1.25	5.61	5.61		4.48		4.91	8.01
Upper	1233	44.00	521.15	522.51	1.39	0.79	6.92	3.65	0.45	5.00	0.45	9.49	19.52
Upper	1233	30.00	521.15	522.27	1.34	1.34	6.32	6.32		4.71		6.36	9.35
Upper	1233	57.00	521.15	522.71	1.33	0.59	6.71	2.29	0.68	5.06	0.68	14.61	31.55
Upper	1233	81.00	521.15	522.99	1.28	0.52	6.60	1.62	0.87	5.17	0.87	25.98	48.58
Upper	1233	195.00	521.15	523.97	1.01	0.54	5.08	1.26	1.28	5.03	1.28	84.00	69.45
Upper	1213	24.00	520.20	521.51	1.21	1.06	3.53	3.05	0.33	2.91	0.33	8.33	11.63
Upper	1213	48.00	520.20	522.00	1.47	0.95	5.11	2.88	0.90	3.47	0.91	15.83	18.99
Upper	1213	38.00	520.20	521.81	1.39	0.96	4.55	2.91	0.74	3.28	0.74	12.58	16.22
Upper	1213	72.00	520.20	522.37	1.60	0.83	6.02	2.40	0.88	3.77	1.21	24.80	29.05
Upper	1213	102.00	520.20	522.76	1.61	0.77	6.32	2.07	1.05	3.92	1.38	37.97	39.44

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	1213	242.00	520.20	523.84	1.79	0.93	7.94	2.45	1.66	4.43	1.72	92.11	57.80
Upper	1204	24.00	519.15	521.54	0.11	0.10	0.17	0.15	0.09	1.54	0.09	15.74	12.77
Upper	1204	48.00	519.15	522.03	0.22	0.15	0.50	0.30	0.28	2.26	0.31	23.42	19.24
Upper	1204	38.00	519.15	521.86	0.18	0.13	0.35	0.24	0.23	1.99	0.23	20.22	16.58
Upper	1204	72.00	519.15	522.38	0.32	0.16	0.88	0.37	0.35	2.78	0.46	32.01	29.03
Upper	1204	102.00	519.15	522.74	0.42	0.19	1.35	0.44	0.48	3.26	0.60	44.11	38.84
Upper	1204	242.00	519.15	523.69	0.83	0.40	4.00	1.08	1.02	4.84	1.04	90.01	55.60
Upper	1193	24.00	520.19	521.19	1.27	1.27	5.76	5.76		4.53		5.90	8.39
Upper	1193	48.00	520.19	521.57	1.55	1.24	8.26	6.42	0.51	5.32	0.51	9.28	13.01
Upper	1193	38.00	520.19	521.44	1.43	1.34	7.13	6.62	0.22	4.97	0.22	7.66	10.80
Upper	1193	72.00	520.19	521.88	1.70	1.12	9.92	5.75	0.89	5.84	0.89	13.98	17.95
Upper	1193	102.00	520.19	522.19	1.85	1.02	11.72	5.01	1.00	6.33	1.15	20.65	25.35
Upper	1193	242.00	520.19	523.20	2.12	1.03	15.66	4.15	1.55	7.38	1.65	60.13	50.41
Upper	1181	24.00	519.61	520.92	0.47	0.32	1.38	0.88	0.21	2.90	0.21	8.58	15.83
Upper	1181	48.00	519.61	521.42	0.51	0.26	1.68	0.61	0.57	3.27	0.64	20.92	31.46
Upper	1181	38.00	519.61	521.23	0.51	0.27	1.60	0.66	0.48	3.16	0.54	15.40	26.30
Upper	1181	72.00	519.61	521.81	0.53	0.26	1.81	0.54	0.69	3.44	0.77	35.04	41.86
Upper	1181	102.00	519.61	522.20	0.54	0.27	1.94	0.52	0.81	3.60	0.83	53.20	51.72
Upper	1181	242.00	519.61	523.38	0.63	0.33	2.64	0.60	1.08	4.20	1.02	131.44	79.83
Upper	1169	24.00	518.55	520.95	0.11	0.07	0.17	0.11	0.10	1.52	0.10	16.24	17.81
Upper	1169	48.00	518.55	521.44	0.20	0.10	0.43	0.17	0.30	2.15	0.35	28.68	31.97
Upper	1169	38.00	518.55	521.26	0.17	0.09	0.32	0.14	0.23	1.93	0.27	23.23	26.98
Upper	1169	72.00	518.55	521.82	0.26	0.12	0.67	0.21	0.43	2.54	0.49	42.49	42.04
Upper	1169	102.00	518.55	522.19	0.32	0.15	0.92	0.26	0.56	2.88	0.59	60.18	51.63
Upper	1169	242.00	518.55	523.36	0.49	0.24	1.85	0.42	0.89	3.77	0.85	136.83	79.31
Upper	1158	24.00	519.60	520.60	1.27	1.27	5.78	5.78		4.54		5.29	8.38
Upper	1158	48.00	519.60	520.98	1.56	1.26	8.30	6.57	0.51	5.33	0.51	9.24	12.76
Upper	1158	38.00	519.60	520.85	1.44	1.34	7.14	6.67	0.22	4.97	0.22	7.66	10.73
Upper	1158	72.00	519.60	521.28	1.73	1.17	10.19	6.13	0.89	5.89	0.88	13.71	17.22
Upper	1158	102.00	519.60	521.59	1.90	1.16	12.20	6.00	1.16	6.41	1.15	19.75	21.87
Upper	1158	242.00	519.60	522.68	2.19	0.90	16.53	3.67	1.44	7.54	1.30	69.14	57.40
Upper	1121	26.00	518.01	519.48	0.37	0.32	0.98	0.82	0.31	2.64	0.26	10.09	12.02
Upper	1121	52.00	518.01	519.97	0.55	0.40	1.90	1.23	0.61	3.44	0.52	16.91	15.75
Upper	1121	45.00	518.01	519.86	0.50	0.37	1.62	1.10	0.55	3.24	0.47	15.24	14.93
Upper	1121	84.00	518.01	520.38	0.76	0.47	3.23	1.60	0.82	4.22	0.59	24.53	21.34
Upper	1121	120.00	518.01	520.74	0.97	0.55	4.78	2.00	1.01	4.90	0.78	33.02	26.32

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	1121	282.00	518.01	521.82	1.64	0.65	11.10	2.36	1.45	6.79	1.03	77.53	60.38
Upper	1106	26.00	517.26	519.48	0.13	0.13	0.20	0.20		1.60		16.27	12.66
Upper	1106	52.00	517.26	519.99	0.23	0.12	0.50	0.25	0.17	2.23	0.17	24.84	29.01
Upper	1106	45.00	517.26	519.87	0.20	0.14	0.42	0.28	0.10	2.09	0.10	21.96	21.40
Upper	1106	84.00	517.26	520.43	0.31	0.17	0.83	0.37	0.42	2.71	0.47	39.24	34.74
Upper	1106	120.00	517.26	520.82	0.38	0.22	1.18	0.49	0.58	3.10	0.67	53.61	39.03
Upper	1106	282.00	517.26	521.98	0.67	0.33	2.91	0.81	0.95	4.38	0.91	113.74	66.59
Upper	1086	26.00	518.00	519.23	0.73	0.73	2.60	2.60		3.54		7.35	9.90
Upper	1086	52.00	518.00	519.67	0.94	0.79	3.95	3.28	0.35	4.22	0.35	12.52	14.54
Upper	1086	45.00	518.00	519.57	0.89	0.83	3.61	3.33	0.20	4.05	0.20	11.15	13.05
Upper	1086	84.00	518.00	520.06	1.12	0.73	5.42	3.18	0.66	4.86	0.73	19.31	21.18
Upper	1086	120.00	518.00	520.40	1.28	0.68	7.00	2.90	0.81	5.42	1.00	28.16	31.16
Upper	1086	282.00	518.00	521.75	1.15	0.54	6.47	1.56	1.27	5.63	1.01	96.75	68.93
Upper	1051	26.00	517.43	518.88	0.41	0.41	1.10	1.10		2.69		9.67	11.59
Upper	1051	52.00	517.43	519.39	0.52	0.41	1.69	1.29	0.45	3.27	0.42	16.70	15.90
Upper	1051	45.00	517.43	519.28	0.48	0.40	1.50	1.21	0.38	3.11	0.35	14.93	14.93
Upper	1051	84.00	517.43	519.80	0.69	0.50	2.73	1.75	0.70	3.95	0.64	23.89	19.31
Upper	1051	120.00	517.43	520.12	0.91	0.62	4.27	2.42	0.92	4.67	0.76	30.51	22.19
Upper	1051	282.00	517.43	520.87	2.18	1.33	16.64	7.49	1.77	7.62	1.30	49.93	29.67
Upper	1031	26.00	516.42	518.87	0.09	0.09	0.12	0.12		1.34		19.37	13.78
Upper	1031	52.00	516.42	519.39	0.16	0.13	0.32	0.25	0.21	1.94	0.28	27.92	18.29
Upper	1031	45.00	516.42	519.27	0.14	0.12	0.26	0.21	0.17	1.80	0.23	26.84	17.69
Upper	1031	84.00	516.42	519.80	0.26	0.20	0.67	0.47	0.37	2.55	0.47	35.91	20.46
Upper	1031	120.00	516.42	520.12	0.39	0.25	1.24	0.71	0.41	3.17	0.56	43.00	25.52
Upper	1031	282.00	516.42	520.90	1.06	0.46	5.80	1.80	0.78	5.46	0.91	72.78	50.87
Upper	1006	26.00	517.40	518.65	0.71	0.71	2.46	2.46		3.48		7.47	10.00
Upper	1006	52.00	517.40	519.11	0.86	0.58	3.49	2.26	0.46	4.06	0.31	13.40	18.88
Upper	1006	45.00	517.40	519.00	0.82	0.67	3.21	2.58	0.25	3.91	0.24	11.66	15.09
Upper	1006	84.00	517.40	519.49	1.00	0.50	4.62	1.81	0.85	4.62	0.65	23.25	32.95
Upper	1006	120.00	517.40	519.82	1.10	0.51	5.49	1.69	1.04	5.00	0.85	36.31	45.29
Upper	1006	282.00	517.40	520.80	1.35	0.62	8.06	1.81	1.11	5.97	1.37	97.34	79.09
Upper	966	26.00	516.99	518.37	0.49	0.49	1.42	1.42		2.92		8.91	11.07
Upper	966	52.00	516.99	518.89	0.58	0.58	1.94	1.94		3.35		15.53	14.35
Upper	966	45.00	516.99	518.77	0.55	0.55	1.79	1.79		3.24		13.90	13.66
Upper	966	84.00	516.99	519.31	0.68	0.42	2.60	1.51	0.37	3.81	0.38	23.64	26.54
Upper	966	120.00	516.99	519.66	0.79	0.40	3.39	1.38	0.60	4.26	0.61	34.97	39.28

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	966	282.00	516.99	520.60	1.18	0.54	6.60	1.74	0.84	5.58	1.17	87.87	72.95
Upper	948	26.00	515.97	518.40	0.09	0.09	0.12	0.12		1.37		19.01	13.66
Upper	948	52.00	515.97	518.92	0.16	0.08	0.32	0.15	0.21	1.95	0.21	30.34	32.47
Upper	948	45.00	515.97	518.80	0.15	0.08	0.27	0.14	0.16	1.82	0.17	26.81	27.60
Upper	948	84.00	515.97	519.35	0.24	0.12	0.57	0.21	0.30	2.41	0.41	47.25	43.73
Upper	948	120.00	515.97	519.71	0.31	0.15	0.87	0.28	0.41	2.83	0.56	64.18	51.54
Upper	948	282.00	515.97	520.64	0.64	0.29	2.72	0.67	0.74	4.27	0.96	124.28	79.18
Upper	926	26.00	516.95	517.99	1.33	1.33	6.21	6.21		4.67		5.56	8.36
Upper	926	52.00	516.95	518.42	1.55	1.55	8.13	8.13		5.25		9.90	11.75
Upper	926	45.00	516.95	518.32	1.48	1.48	7.55	7.55		5.10		8.83	11.01
Upper	926	84.00	516.95	518.79	1.67	1.01	9.69	5.24	0.69	5.79	0.69	16.14	22.98
Upper	926	120.00	516.95	519.12	1.73	0.87	10.60	4.02	1.05	6.13	0.76	25.84	34.60
Upper	926	282.00	516.95	519.99	2.28	1.03	17.28	4.18	1.76	7.58	1.30	69.37	66.47
Upper	888	26.00	515.50	516.99	0.37	0.37	0.95	0.95		2.57		10.13	11.90
Upper	888	52.00	515.50	517.50	0.48	0.38	1.53	1.13	0.44	3.17	0.45	17.33	16.46
Upper	888	45.00	515.50	517.38	0.45	0.37	1.35	1.06	0.37	3.01	0.38	15.50	15.43
Upper	888	84.00	515.50	517.93	0.63	0.44	2.39	1.46	0.66	3.79	0.82	25.35	20.38
Upper	888	120.00	515.50	518.30	0.79	0.37	3.48	1.25	0.49	4.39	0.88	35.29	35.95
Upper	888	282.00	515.50	519.42	1.04	0.40	5.62	1.07	1.06	5.40	1.04	105.79	86.89
Upper	863	26.00	514.50	516.99	0.08	0.08	0.11	0.11		1.31		19.83	13.94
Upper	863	52.00	514.50	517.50	0.16	0.12	0.30	0.21	0.22	1.91	0.22	28.65	20.52
Upper	863	45.00	514.50	517.38	0.14	0.11	0.24	0.18	0.18	1.77	0.18	26.35	19.00
Upper	863	84.00	514.50	517.94	0.24	0.16	0.60	0.34	0.38	2.46	0.37	39.03	26.28
Upper	863	120.00	514.50	518.32	0.34	0.16	1.00	0.39	0.39	2.97	0.50	51.38	40.53
Upper	863	282.00	514.50	519.40	0.63	0.25	2.68	0.60	0.82	4.28	0.76	118.77	81.84
Upper	832	26.00	515.50	516.71	0.79	0.79	2.88	2.88		3.66		7.11	9.71
Upper	832	52.00	515.50	517.13	1.03	0.86	4.54	3.74	0.31	4.40	0.31	11.98	14.68
Upper	832	45.00	515.50	517.04	0.98	0.82	4.10	3.87	0.14	4.21	0.14	10.71	12.74
Upper	832	84.00	515.50	517.50	1.23	0.78	6.23	3.47	0.72	5.08	0.72	18.80	22.41
Upper	832	120.00	515.50	517.82	1.42	0.80	7.97	3.55	0.97	5.63	0.97	27.15	29.20
Upper	832	282.00	515.50	518.72	2.13	0.86	15.86	3.47	1.24	7.43	1.50	69.65	69.64
Upper	806	26.00	515.02	516.48	0.40	0.40	1.06	1.06		2.66		9.78	11.67
Upper	806	52.00	515.02	516.95	0.53	0.33	1.76	0.97	0.44	3.31	0.44	17.72	22.72
Upper	806	45.00	515.02	516.84	0.50	0.33	1.58	0.97	0.37	3.16	0.37	15.38	19.98
Upper	806	84.00	515.02	517.39	0.63	0.37	2.35	1.06	0.71	3.76	0.72	29.28	29.43
Upper	806	120.00	515.02	517.74	0.75	0.44	3.20	1.29	0.89	4.25	0.91	40.49	34.36

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	806	282.00	515.02	518.54	1.61	0.75	10.60	2.77	1.20	6.58	1.40	75.99	58.98
Upper	781	26.00	514.00	516.48	0.08	0.08	0.11	0.11		1.32		19.75	13.91
Upper	781	52.00	514.00	516.95	0.17	0.11	0.32	0.20	0.21	1.96	0.21	28.40	23.07
Upper	781	45.00	514.00	516.84	0.14	0.10	0.26	0.18	0.17	1.81	0.17	26.00	20.88
Upper	781	84.00	514.00	517.39	0.25	0.14	0.63	0.29	0.34	2.50	0.39	40.42	32.33
Upper	781	120.00	514.00	517.73	0.35	0.18	1.05	0.41	0.47	3.01	0.53	52.88	39.77
Upper	781	282.00	514.00	518.54	0.87	0.40	4.33	1.20	0.94	4.96	0.91	93.14	62.37
Upper	756	26.00	514.98	516.26	0.64	0.64	2.12	2.12		3.32		7.83	10.28
Upper	756	52.00	514.98	516.55	1.19	1.00	5.56	4.65	0.23	4.67	0.23	11.21	14.44
Upper	756	45.00	514.98	516.50	1.02	0.97	4.38	4.17	0.09	4.29	0.09	10.50	12.63
Upper	756	84.00	514.98	516.82	1.66	0.98	9.59	5.04	0.69	5.77	0.69	16.31	23.70
Upper	756	120.00	514.98	517.15	1.72	0.82	10.51	3.73	0.90	6.11	1.04	26.39	37.13
Upper	756	282.00	514.98	518.07	1.99	0.86	14.11	3.03	1.41	7.10	1.56	79.72	78.15
Upper	729	26.00	514.57	516.02	0.41	0.16	1.10	0.41	0.08	2.69		9.97	31.84
Upper	729	52.00	514.57	516.49	0.36	0.18	0.92	0.27	0.59	2.71	0.36	33.63	55.51
Upper	729	45.00	514.57	516.40	0.35	0.16	0.97	0.25	0.53	2.64	0.31	28.67	53.83
Upper	729	84.00	514.57	516.81	0.42	0.23	1.28	0.37	0.79	3.05	0.51	52.48	61.48
Upper	729	120.00	514.57	517.11	0.47	0.27	1.54	0.45	0.94	3.30	0.60	72.09	68.31
Upper	729	282.00	514.57	517.99	0.66	0.37	2.73	0.74	1.37	4.17	0.86	143.12	93.73
Upper	713	26.00	513.56	516.04	0.08	0.03	0.11	0.04	0.05	1.31		20.63	41.84
Upper	713	52.00	513.56	516.48	0.14	0.06	0.25	0.07	0.31	1.80	0.19	43.52	56.38
Upper	713	45.00	513.56	516.40	0.12	0.05	0.21	0.06	0.26	1.67	0.16	38.72	54.61
Upper	713	84.00	513.56	516.79	0.22	0.10	0.49	0.14	0.48	2.28	0.31	61.94	62.75
Upper	713	120.00	513.56	517.09	0.28	0.14	0.74	0.21	0.63	2.65	0.42	81.40	69.57
Upper	713	282.00	513.56	517.95	0.50	0.26	1.87	0.48	1.10	3.73	0.72	151.62	94.41
Upper	693	26.00	514.54	515.85	0.60	0.60	1.91	1.91		3.21		8.10	10.48
Upper	693	52.00	514.54	516.31	0.57	0.24	1.89	0.51	0.60	3.34	0.36	25.03	53.02
Upper	693	45.00	514.54	516.21	0.59	0.23	1.99	0.53	0.49	3.36	0.28	19.70	50.93
Upper	693	84.00	514.54	516.64	0.59	0.31	2.11	0.59	0.85	3.56	0.55	43.57	59.72
Upper	693	120.00	514.54	516.96	0.61	0.34	2.26	0.64	1.00	3.72	0.67	63.38	66.13
Upper	693	282.00	514.54	517.88	0.66	0.36	2.74	0.66	1.35	4.16	0.92	152.01	108.11
Upper	679	26.00	514.32	515.71	0.47	0.47	1.37	1.37		2.88		9.02	11.14
Upper	679	52.00	514.32	516.24	0.43	0.16	1.28	0.28	0.45	2.97	0.52	29.21	64.85
Upper	679	45.00	514.32	516.11	0.48	0.14	1.47	0.31	0.31	3.07	0.42	21.14	62.83
Upper	679	84.00	514.32	516.60	0.42	0.20	1.30	0.32	0.71	3.07	0.71	53.33	70.55
Upper	679	120.00	514.32	516.93	0.42	0.23	1.32	0.35	0.86	3.14	0.81	77.62	75.86

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	679	282.00	514.32	517.87	0.43	0.21	1.49	0.30	1.14	3.42	0.82	198.20	146.69
Upper	670	26.00	513.32	515.76	0.09	0.09	0.12	0.12		1.36		19.15	13.70
Upper	670	52.00	513.32	516.27	0.15	0.05	0.27	0.07	0.23	1.85	0.26	40.80	65.27
Upper	670	46.00	513.32	516.15	0.14	0.04	0.24	0.06	0.16	1.76	0.21	33.46	63.44
Upper	670	84.00	513.32	516.60	0.21	0.09	0.48	0.12	0.41	2.27	0.43	63.52	70.62
Upper	670	120.00	513.32	516.92	0.26	0.13	0.68	0.17	0.55	2.58	0.56	86.86	75.72
Upper	670	282.00	513.32	517.84	0.37	0.16	1.21	0.22	0.90	3.24	0.69	203.83	145.70
Upper	659	26.00	514.31	515.55	0.72	0.72	2.52	2.52		3.51		7.42	9.93
Upper	659	52.00	514.31	516.01	0.86	0.20	3.52	0.72	0.11	4.07	0.38	14.64	61.11
Upper	659	45.00	514.31	515.90	0.84	0.51	3.30	1.94	0.22	3.94	0.24	11.80	20.82
Upper	659	84.00	514.31	516.48	0.56	0.26	2.04	0.48	0.70	3.53	0.77	45.19	68.64
Upper	659	120.00	514.31	516.84	0.52	0.27	1.81	0.46	0.84	3.46	0.88	71.04	74.42
Upper	659	282.00	514.31	517.61	0.51	0.24	1.87	0.36	1.13	3.68	0.86	189.08	144.52
Upper	646	26.00	514.04	515.43	0.47	0.47	1.36	1.36		2.88		9.03	11.16
Upper	646	52.00	514.04	515.93	0.58	0.36	1.99	1.12	0.44	3.43	0.44	16.87	22.09
Upper	646	45.00	514.04	515.82	0.54	0.37	1.78	1.14	0.36	3.27	0.36	14.85	19.30
Upper	646	84.00	514.04	516.28	0.77	0.34	3.18	1.03	0.52	4.12	0.74	27.53	40.65
Upper	646	120.00	514.04	516.59	0.90	0.35	4.11	0.99	0.69	4.58	0.94	43.00	59.24
Upper	646	282.00	514.04	517.67	0.75	0.30	3.40	0.54	1.10	4.52	0.84	154.92	136.10
Upper	632	26.00	513.02	515.47	0.09	0.09	0.12	0.12		1.35		19.29	13.75
Upper	632	52.00	513.02	515.97	0.16	0.06	0.30	0.09	0.21	1.91	0.21	34.30	49.00
Upper	632	45.00	513.02	515.86	0.14	0.06	0.25	0.09	0.17	1.78	0.17	29.32	40.41
Upper	632	84.00	513.02	516.35	0.23	0.09	0.54	0.14	0.39	2.37	0.34	56.03	65.70
Upper	632	120.00	513.02	516.67	0.29	0.12	0.80	0.18	0.51	2.73	0.45	79.12	79.10
Upper	632	282.00	513.02	517.68	0.42	0.18	1.47	0.28	0.89	3.48	0.64	181.36	124.83
Upper	616	26.00	514.01	515.24	0.74	0.74	2.61	2.61		3.54		7.34	9.89
Upper	616	52.00	514.01	515.69	0.90	0.46	3.72	1.75	0.36	4.14	0.36	13.74	26.37
Upper	616	45.00	514.01	515.59	0.86	0.58	3.43	2.25	0.22	3.99	0.22	11.55	18.61
Upper	616	84.00	514.01	516.10	0.87	0.35	3.76	0.95	0.70	4.31	0.66	30.84	55.06
Upper	616	120.00	514.01	516.50	0.74	0.32	3.05	0.69	0.86	4.13	0.75	56.25	71.88
Upper	616	282.00	514.01	517.61	0.63	0.30	2.59	0.51	1.15	4.12	0.84	162.94	121.57
Upper	601	26.00	513.70	515.11	0.45	0.45	1.28	1.28		2.82		9.21	11.28
Upper	601	52.00	513.70	515.61	0.53	0.27	1.76	0.72	0.44	3.30	0.43	19.20	31.15
Upper	601	45.00	513.70	515.50	0.51	0.28	1.62	0.78	0.36	3.18	0.36	16.03	26.01
Upper	601	84.00	513.70	516.04	0.58	0.26	2.10	0.59	0.64	3.61	0.63	36.71	50.31
Upper	601	120.00	513.70	516.44	0.58	0.27	2.15	0.54	0.77	3.73	0.75	59.24	63.03

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	601	282.00	513.70	517.53	0.65	0.32	2.78	0.62	1.13	4.26	0.91	146.75	97.36
Upper	585	26.00	512.68	515.14	0.09	0.09	0.11	0.11		1.34		19.41	13.80
Upper	585	52.00	512.68	515.64	0.16	0.09	0.31	0.16	0.22	1.94	0.21	29.75	28.12
Upper	585	45.00	512.68	515.53	0.14	0.09	0.26	0.15	0.17	1.79	0.17	26.85	24.77
Upper	585	84.00	512.68	516.05	0.25	0.12	0.61	0.23	0.36	2.48	0.35	43.89	41.26
Upper	585	120.00	512.68	516.43	0.32	0.14	0.93	0.27	0.47	2.89	0.46	62.26	56.97
Upper	585	282.00	512.68	517.48	0.53	0.23	2.08	0.44	0.87	3.92	0.70	143.74	95.74
Upper	566	26.00	513.66	514.92	0.68	0.68	2.32	2.32		3.42		7.61	10.11
Upper	566	52.00	513.66	515.36	0.88	0.66	3.62	2.64	0.37	4.11	0.37	13.07	16.65
Upper	566	45.00	513.66	515.27	0.80	0.67	3.11	2.57	0.26	3.87	0.25	11.76	14.66
Upper	566	84.00	513.66	515.63	1.29	0.79	6.65	3.59	0.72	5.16	0.71	18.52	23.17
Upper	566	120.00	513.66	515.85	1.73	0.98	10.67	4.83	1.00	6.15	0.99	24.28	28.48
Upper	566	282.00	513.66	516.84	2.09	0.85	15.35	3.28	1.33	7.34	1.58	73.05	73.25
Upper	546	26.00	513.30	514.75	0.40	0.40	1.08	1.08		2.68		9.70	11.62
Upper	546	52.00	513.30	515.29	0.40	0.20	1.19	0.40	0.51	2.92	0.50	25.55	40.24
Upper	546	45.00	513.30	515.19	0.41	0.18	1.12	0.38	0.41	2.83	0.43	21.38	39.08
Upper	546	84.00	513.30	515.64	0.51	0.28	1.71	0.58	0.78	3.37	0.70	40.31	44.09
Upper	546	120.00	513.30	515.94	0.61	0.36	2.34	0.80	0.98	3.81	0.86	53.92	47.36
Upper	546	282.00	513.30	516.88	1.02	0.57	5.34	1.48	1.39	5.24	1.21	107.70	68.20
Upper	529	26.00	512.29	514.77	0.08	0.08	0.11	0.11		1.32		19.76	13.92
Upper	529	52.00	512.29	515.31	0.14	0.07	0.26	0.10	0.25	1.83	0.26	35.68	40.35
Upper	529	45.00	512.29	515.20	0.13	0.06	0.22	0.08	0.19	1.70	0.21	31.63	39.24
Upper	529	84.00	512.29	515.64	0.23	0.12	0.55	0.20	0.45	2.38	0.42	50.01	44.09
Upper	529	120.00	512.29	515.93	0.32	0.18	0.93	0.33	0.62	2.88	0.56	63.18	47.26
Upper	529	282.00	512.29	516.84	0.69	0.36	3.06	0.88	1.03	4.43	0.92	114.89	67.34
Upper	509	26.00	513.27	514.58	0.59	0.59	1.89	1.89		3.20		8.13	10.50
Upper	509	52.00	513.27	515.09	0.64	0.26	2.28	0.76	0.36	3.57	0.47	17.84	38.04
Upper	509	45.00	513.27	515.00	0.61	0.22	2.08	0.70	0.17	3.43	0.34	14.33	37.01
Upper	509	84.00	513.27	515.40	0.81	0.41	3.38	1.14	0.79	4.18	0.78	29.97	41.40
Upper	509	120.00	513.27	515.66	0.98	0.53	4.60	1.56	1.07	4.71	0.99	41.18	44.28
Upper	509	282.00	513.27	516.47	1.63	0.90	10.60	3.09	1.68	6.49	1.40	82.15	60.18
Upper	493	26.00	513.02	514.43	0.45	0.45	1.26	1.26		2.81		9.26	11.32
Upper	493	52.00	513.02	515.01	0.48	0.17	1.50	0.45	0.16	3.15	0.45	19.51	42.21
Upper	493	45.00	513.02	514.92	0.42	0.26	1.23	0.67	0.38	2.92	0.38	17.32	22.92
Upper	493	84.00	513.02	515.30	0.68	0.28	2.61	0.73	0.56	3.87	0.71	32.68	49.40
Upper	493	120.00	513.02	515.55	0.84	0.38	3.68	0.98	0.81	4.41	0.90	46.24	55.84

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	493	282.00	513.02	516.42	1.23	0.59	7.00	1.61	1.37	5.70	1.21	104.41	81.12
Upper	482	26.00	512.01	514.47	0.08	0.08	0.11	0.11		1.33		19.49	13.82
Upper	482	52.00	512.01	515.05	0.14	0.06	0.26	0.09	0.23	1.82	0.22	35.99	43.44
Upper	482	45.00	512.01	514.96	0.12	0.05	0.20	0.08	0.18	1.67	0.18	32.14	39.79
Upper	482	84.00	512.01	515.35	0.24	0.11	0.58	0.18	0.40	2.42	0.37	50.00	51.41
Upper	482	120.00	512.01	515.60	0.34	0.16	1.02	0.30	0.55	2.96	0.51	64.02	58.31
Upper	482	282.00	512.01	516.44	0.71	0.33	3.15	0.76	1.03	4.45	0.82	122.46	82.59
Upper	469	26.00	513.00	514.28	0.63	0.63	2.10	2.10		3.31		7.86	10.30
Upper	469	52.00	513.00	514.91	0.50	0.19	1.60	0.43	0.42	3.20	0.42	23.04	49.94
Upper	469	45.00	513.00	514.83	0.47	0.18	1.42	0.43	0.36	3.05	0.36	19.09	42.03
Upper	469	84.00	513.00	515.21	0.62	0.27	2.30	0.56	0.70	3.69	0.63	40.17	62.13
Upper	469	120.00	513.00	515.49	0.69	0.33	2.73	0.68	0.91	3.98	0.77	58.35	67.73
Upper	469	282.00	513.00	516.40	0.85	0.45	4.06	0.98	1.39	4.75	0.99	129.90	92.79
Upper	456	26.00	512.74	514.19	0.41	0.41	1.11	1.11		2.70		9.64	11.58
Upper	456	52.00	512.74	514.88	0.34	0.16	0.90	0.31	0.43	2.69	0.42	26.60	36.97
Upper	456	45.00	512.74	514.80	0.30	0.14	0.74	0.27	0.38	2.51	0.37	23.52	35.49
Upper	456	84.00	512.74	515.14	0.54	0.24	1.88	0.54	0.63	3.49	0.62	37.92	49.58
Upper	456	120.00	512.74	515.36	0.74	0.33	3.09	0.79	0.80	4.18	0.79	49.93	58.67
Upper	456	282.00	512.74	516.24	1.05	0.48	5.59	1.17	1.26	5.31	1.08	116.94	92.53
Upper	444	26.00	511.73	514.22	0.08	0.08	0.11	0.11		1.31		19.86	13.95
Upper	444	52.00	511.73	514.91	0.12	0.05	0.19	0.06	0.22	1.66	0.22	43.06	54.33
Upper	444	45.00	511.73	514.82	0.10	0.04	0.15	0.05	0.19	1.52	0.19	38.67	49.26
Upper	444	84.00	511.73	515.17	0.20	0.08	0.45	0.12	0.38	2.24	0.33	59.23	63.48
Upper	444	120.00	511.73	515.41	0.29	0.13	0.81	0.21	0.53	2.75	0.43	74.61	68.15
Upper	444	282.00	511.73	516.27	0.56	0.28	2.25	0.55	1.01	3.99	0.69	140.93	88.01
Upper	429	26.00	512.72	514.05	0.56	0.56	1.76	1.76		3.13		8.31	10.64
Upper	429	52.00	512.72	514.80	0.36	0.16	1.01	0.30	0.42	2.78	0.42	26.80	44.81
Upper	429	45.00	512.72	514.73	0.32	0.14	0.83	0.27	0.37	2.59	0.37	23.62	40.61
Upper	429	84.00	512.72	515.01	0.62	0.26	2.28	0.58	0.63	3.70	0.63	37.13	56.14
Upper	429	120.00	512.72	515.18	0.87	0.39	3.90	0.98	0.88	4.48	0.78	47.41	60.38
Upper	429	282.00	512.72	516.07	1.13	0.58	6.13	1.48	1.41	5.44	1.07	110.29	82.03
Upper	415	26.00	512.48	513.94	0.39	0.39	1.04	1.04		2.65		9.82	11.70
Upper	415	52.00	512.48	514.79	0.22	0.10	0.48	0.13	0.41	2.21	0.40	39.08	55.01
Upper	415	45.00	512.48	514.72	0.19	0.08	0.39	0.11	0.37	2.05	0.36	35.11	51.43
Upper	415	84.00	512.48	514.99	0.39	0.17	1.17	0.28	0.59	3.00	0.58	51.02	64.59
Upper	415	120.00	512.48	515.16	0.58	0.26	2.15	0.50	0.79	3.72	0.69	62.38	70.89

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	415	282.00	512.48	516.06	0.79	0.38	3.66	0.76	1.23	4.62	0.92	141.05	104.09
Upper	404	26.00	511.47	513.98	0.08	0.07	0.10	0.09	0.01	1.29	0.01	20.09	16.07
Upper	404	52.00	511.47	514.80	0.09	0.04	0.13	0.04	0.24	1.48	0.27	53.10	56.95
Upper	404	45.00	511.47	514.73	0.07	0.03	0.10	0.03	0.21	1.34	0.23	48.93	53.87
Upper	404	84.00	511.47	515.01	0.17	0.07	0.37	0.10	0.36	2.10	0.40	65.59	65.29
Upper	404	120.00	511.47	515.18	0.28	0.12	0.77	0.19	0.51	2.70	0.47	77.15	71.54
Upper	404	282.00	511.47	516.05	0.54	0.24	2.09	0.44	0.94	3.90	0.71	153.30	103.65
Upper	391	26.00	512.46	513.82	0.51	0.51	1.52	1.52	2.99	2.99		8.71	10.92
Upper	391	52.00	512.46	514.75	0.21	0.10	0.47	0.13	0.44	2.19	0.39	40.28	54.68
Upper	391	45.00	512.46	514.68	0.19	0.09	0.37	0.11	0.39	2.02	0.35	36.57	51.76
Upper	391	84.00	512.46	514.92	0.40	0.19	1.23	0.31	0.64	3.05	0.57	49.93	61.65
Upper	391	120.00	512.46	515.04	0.67	0.31	2.84	0.65	0.85	3.96	0.75	57.28	66.30
Upper	391	282.00	512.46	515.93	0.90	0.43	4.37	0.93	1.30	4.88	0.95	131.40	99.40
Upper	377	26.00	512.16	513.77	0.27	0.18	0.60	0.38	0.15	2.24	0.15	12.00	19.16
Upper	377	52.00	512.16	514.76	0.10	0.04	0.15	0.03	0.41	1.52	0.34	64.63	88.12
Upper	377	45.00	512.16	514.69	0.09	0.03	0.12	0.03	0.37	1.42	0.31	58.48	83.01
Upper	377	84.00	512.16	514.94	0.17	0.07	0.35	0.07	0.59	2.03	0.47	81.65	100.90
Upper	377	120.00	512.16	515.08	0.25	0.10	0.64	0.13	0.79	2.51	0.56	96.16	108.05
Upper	377	282.00	512.16	516.02	0.26	0.13	0.71	0.17	1.14	2.70	0.54	213.92	143.82
Upper	362	26.00	511.14	513.79	0.06	0.04	0.07	0.05	0.07	1.18	0.07	22.65	21.82
Upper	362	52.00	511.14	514.76	0.05	0.02	0.06	0.01	0.27	1.18	0.23	73.44	85.42
Upper	362	45.00	511.14	514.69	0.05	0.02	0.05	0.01	0.24	1.08	0.21	67.55	80.52
Upper	362	84.00	511.14	514.93	0.11	0.04	0.17	0.04	0.42	1.66	0.35	89.46	97.51
Upper	362	120.00	511.14	515.07	0.17	0.06	0.37	0.07	0.58	2.13	0.42	102.76	104.70
Upper	362	282.00	511.14	515.99	0.23	0.10	0.59	0.13	1.00	2.58	0.43	217.54	142.74
Upper	343	26.00	512.13	513.69	0.31	0.25	0.73	0.58	0.10	2.37	0.10	11.05	15.23
Upper	343	52.00	512.13	514.74	0.08	0.03	0.14	0.02	0.39	1.48	0.25	72.96	113.27
Upper	343	45.00	512.13	514.67	0.08	0.03	0.12	0.02	0.36	1.39	0.23	65.24	105.66
Upper	343	84.00	512.13	514.91	0.16	0.06	0.32	0.05	0.57	1.98	0.35	93.62	131.51
Upper	343	120.00	512.13	515.04	0.24	0.09	0.59	0.09	0.74	2.45	0.46	110.93	142.35
Upper	343	282.00	512.13	515.99	0.20	0.10	0.47	0.10	0.99	2.36	0.64	262.44	176.56
Upper	326	26.00	511.85	513.66	0.16	0.05	0.28	0.06	0.20	1.76	0.20	20.79	56.15
Upper	326	52.00	511.85	514.75	0.03	0.02	0.03	0.01	0.24	0.91	0.24	140.89	142.42
Upper	326	45.00	511.85	514.68	0.03	0.01	0.02	0.00	0.22	0.84	0.22	130.93	138.88
Upper	326	84.00	511.85	514.92	0.06	0.03	0.08	0.01	0.35	1.24	0.36	165.98	150.97
Upper	326	120.00	511.85	515.05	0.10	0.05	0.16	0.03	0.46	1.59	0.46	185.49	156.71

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	326	282.00	511.85	515.99	0.13	0.07	0.24	0.06	0.65	1.91	0.67	349.00	191.46
Upper	314	26.00	510.84	513.67	0.05	0.02	0.05	0.01	0.10	1.03	0.10	32.06	59.34
Upper	314	52.00	510.84	514.75	0.02	0.01	0.02	0.00	0.19	0.79	0.18	151.59	142.33
Upper	314	45.00	510.84	514.68	0.02	0.01	0.01	0.00	0.17	0.73	0.16	141.68	138.80
Upper	314	84.00	510.84	514.92	0.05	0.02	0.05	0.01	0.28	1.11	0.28	176.36	150.78
Upper	314	120.00	510.84	515.04	0.08	0.03	0.11	0.02	0.37	1.45	0.37	195.40	156.46
Upper	314	282.00	510.84	515.98	0.11	0.06	0.21	0.04	0.58	1.85	0.59	358.22	191.12
Upper	300	26.00	511.83	513.62	0.16	0.05	0.29	0.07	0.20	1.79	0.20	20.54	58.25
Upper	300	52.00	511.83	514.74	0.03	0.01	0.02	0.00	0.22	0.84	0.22	158.90	164.17
Upper	300	45.00	511.83	514.67	0.02	0.01	0.02	0.00	0.20	0.78	0.20	147.49	159.81
Upper	300	84.00	511.83	514.91	0.05	0.02	0.06	0.01	0.32	1.14	0.32	187.39	174.60
Upper	300	120.00	511.83	515.04	0.08	0.04	0.12	0.02	0.42	1.46	0.42	209.27	182.38
Upper	300	282.00	511.83	515.98	0.10	0.05	0.17	0.03	0.56	1.69	0.59	410.19	245.33
Upper	286	26.00	511.53	513.62	0.08	0.03	0.10	0.02	0.20	1.27	0.20	37.36	79.65
Upper	286	52.00	511.53	514.74	0.02	0.01	0.02	0.00	0.19	0.73	0.19	182.93	165.37
Upper	286	45.00	511.53	514.67	0.02	0.01	0.01	0.00	0.18	0.67	0.17	171.45	161.37
Upper	286	84.00	511.53	514.91	0.04	0.02	0.04	0.01	0.28	1.02	0.28	211.32	174.88
Upper	286	120.00	511.53	515.03	0.07	0.03	0.09	0.02	0.38	1.32	0.38	232.86	182.08
Upper	286	282.00	511.53	515.97	0.09	0.04	0.15	0.03	0.53	1.63	0.54	433.27	244.96
Upper	270	26.00	510.52	513.63	0.02	0.01	0.01	0.00	0.15	0.69	0.14	73.04	153.73
Upper	270	52.00	510.52	514.74	0.00	0.00	0.00	0.00	0.12	0.37	0.14	310.70	214.47
Upper	270	45.00	510.52	514.67	0.00	0.00	0.00	0.00	0.11	0.33	0.13	295.72	210.74
Upper	270	84.00	510.52	514.91	0.01	0.00	0.01	0.00	0.18	0.53	0.21	347.44	223.36
Upper	270	120.00	510.52	515.03	0.02	0.01	0.01	0.00	0.24	0.69	0.28	375.09	230.21
Upper	270	282.00	510.52	515.97	0.03	0.02	0.03	0.01	0.36	0.97	0.43	619.25	290.26
Upper	251	26.00	511.50	513.61	0.06	0.03	0.06	0.01	0.23	1.09	0.25	46.43	137.43
Upper	251	52.00	511.50	514.74	0.01	0.01	0.01	0.00	0.15	0.51	0.14	288.09	225.67
Upper	251	45.00	511.50	514.67	0.01	0.00	0.00	0.00	0.14	0.47	0.12	272.30	223.53
Upper	251	84.00	511.50	514.91	0.02	0.01	0.01	0.00	0.22	0.72	0.20	326.11	230.75
Upper	251	120.00	511.50	515.03	0.03	0.02	0.03	0.01	0.29	0.94	0.26	354.11	234.33
Upper	251	282.00	511.50	515.97	0.06	0.03	0.07	0.02	0.44	1.28	0.40	585.69	260.09
Upper	225	26.00	510.50	513.61	0.02	0.01	0.01	0.00	0.08	0.67	0.17	72.16	77.32
Upper	225	52.00	510.50	514.74	0.02	0.00	0.01	0.00	0.15	0.68	0.11	221.44	209.55
Upper	225	45.00	510.50	514.67	0.01	0.00	0.01	0.00	0.13	0.62	0.10	207.22	199.33
Upper	225	84.00	510.50	514.90	0.03	0.01	0.03	0.00	0.22	0.99	0.16	257.33	233.38
Upper	225	120.00	510.50	515.01	0.06	0.02	0.07	0.01	0.31	1.30	0.21	284.91	248.25

HEC-RAS Plan: UpReachRev7-14 River: Tanyard Branch Reach: Upper (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Upper	225	282.00	510.50	515.95	0.08	0.04	0.13	0.02	0.46	1.62	0.37	524.94	264.18
Upper	208	26.00	509.52	513.61	0.01	0.00	0.00	0.00	0.09	0.49	0.11	96.36	81.27
Upper	208	52.00	509.52	514.74	0.01	0.00	0.01	0.00	0.13	0.56	0.08	244.58	208.22
Upper	208	45.00	509.52	514.67	0.01	0.00	0.00	0.00	0.12	0.50	0.07	230.48	197.66
Upper	208	84.00	509.52	514.90	0.02	0.01	0.02	0.00	0.20	0.82	0.12	280.22	232.79
Upper	208	120.00	509.52	515.01	0.04	0.01	0.04	0.00	0.27	1.10	0.16	307.58	248.23
Upper	208	282.00	509.52	515.95	0.07	0.03	0.10	0.01	0.43	1.48	0.32	546.93	284.11
Upper	186	33.00	510.50	513.60	0.03	0.03	0.03	0.02	0.29	0.90	0.28	52.67	106.85
Upper	186	66.00	510.50	514.74	0.01	0.00	0.01	0.00	0.20	0.61	0.10	293.34	225.69
Upper	186	54.00	510.50	514.67	0.01	0.00	0.01	0.00	0.17	0.52	0.08	278.08	215.58
Upper	186	100.00	510.50	514.90	0.02	0.01	0.02	0.00	0.28	0.84	0.14	331.74	249.93
Upper	186	140.00	510.50	515.01	0.04	0.01	0.05	0.01	0.37	1.10	0.18	360.92	265.51
Upper	186	328.00	510.50	515.94	0.07	0.03	0.10	0.02	0.51	1.49	0.34	627.37	305.63
Upper	176	33.00	510.43	513.56	0.09	0.09	0.14	0.14		1.55		21.23	151.35
Upper	176	66.00	510.43	514.74	0.01	0.01	0.01	0.00		0.64	0.22	231.65	274.99
Upper	176	54.00	510.43	514.67	0.01	0.00	0.01	0.00		0.56	0.18	220.66	271.06
Upper	176	100.00	510.43	514.90	0.01	0.00	0.01	0.00	0.17	0.57	0.20	435.55	284.28
Upper	176	140.00	510.43	515.01	0.02	0.01	0.01	0.00	0.23	0.73	0.27	468.19	290.87
Upper	176	328.00	510.43	515.95	0.03	0.01	0.03	0.01	0.34	0.97	0.42	762.48	333.14
Upper	156	Culvert											
Upper	130	33.00	508.67	510.28	0.67	0.67	2.65	2.65		3.93		8.39	15.63
Upper	130	66.00	508.67	510.83	1.32	1.32	7.62	7.62		5.79		11.40	20.96
Upper	130	54.00	508.67	510.67	1.06	1.06	5.43	5.43		5.13		10.54	19.48
Upper	130	100.00	508.67	511.11	2.24	2.24	17.23	17.23		7.71		12.98	23.65
Upper	130	140.00	508.67	511.48	3.13	3.13	29.27	29.27		9.34		14.98	27.08
Upper	130	328.00	508.67	513.54	4.62	4.62	57.65	57.65		12.47		26.30	361.56
Upper	0	33.00	507.19	509.42	0.41	0.19	1.21	0.49		2.92	0.26	12.84	27.88
Upper	0	66.00	507.19	509.93	0.55	0.26	1.79	0.51		3.27	0.67	33.70	54.35
Upper	0	54.00	507.19	509.79	0.51	0.24	1.61	0.48		3.17	0.58	26.27	46.67
Upper	0	100.00	507.19	510.22	0.64	0.33	2.30	0.65	0.24	3.58	0.92	50.74	64.73
Upper	0	140.00	507.19	510.47	0.74	0.38	2.87	0.79	0.34	3.89	1.13	67.89	74.46
Upper	0	328.00	507.19	511.20	1.02	0.48	4.83	1.08	0.94	4.75	1.69	146.07	129.26

Below Lansford Road

Lower Design Stream

Reach 3 and 4

HEC RAS River Station	Design Stream CL Station	Stream Feature	Comment
15+54	43+06	Tie in	
15+30	43+30	ER	
15+05	43+55	CP	
14+80	43+80	HR	
14+60	44+00	ER	
14+40	44+20	CP	
14+15	44+45	HR	
13+95	44+65	ER	
13+78	44+82	CP	
13+55	45+05	HR	
13+38	45+22	ER	
13+25	45+35	CP	
13+05	45+55	HR	
12+90	45+70	ER	
12+75	45+85	CP	
12+55	46+05	HR	
12+40	46+20	ER	
12+27	46+33	CP	
12+10	46+50	HR	
11+93	46+67		Upstream Culvert
11+53	47+07		Culvert
11+39	47+21		Downstream Culvert
11+07	47+53	ER	
10+90	47+70	CP	
10+70	47+90	HR	
10+55	48+05	ER	
10+40	48+20	CP	
10+20	48+40	HR	
10+00	48+60	ER	
09+85	48+75	CP	
09+60	49+00	HR	
09+35	49+25	ER	
09+15	49+45	CP	
08+90	49+70	HR	
08+75	49+85	ER	
08+65	49+95	CP	
08+50	50+10	HR	
08+35	50+25	ER	
08+20	50+40	CP	
08+00	50+60	HR	
07+80	50+80	ER	
07+68	50+92	CP	
07+50	51+10	HR	
07+30	51+30	ER	
07+15	51+45	CP	
06+95	51+65	HR	
06+73	51+87	ER	
06+58	52+02	CP	
06+37	52+23	HR	
06+20	52+40	ER	
06+05	52+55	CP	
05+85	52+75	HR	
05+70	52+90	ER	
05+58	53+02	CP	
05+42	53+18	HR	
05+25	53+35	ER	
05+08	53+52	CP	
04+90	53+70	HR	End of Reach 3

HEC RAS River Station	Design Stream CL Station	Stream Feature	Comment
04+85	53+95	ER	
04+50	54+10	CP	
04+35	54+25	HR	
04+15	54+45	ER	
04+00	54+60	CP	
03+85	54+75	HR	
03+65	54+95	ER	
03+47	55+13	CP	
03+30	55+30	HR	
03+10	55+50	ER	
02+95	55+65	CP	
02+80	55+80	HR	
02+60	56+00	ER	
02+45	56+15	CP	
02+30	56+30	HR	
02+00	56+60	ER	
07+80	50+80	ER	
07+68	50+92	CP	
07+50	51+10	HR	
07+30	51+30	ER	
07+15	51+45	CP	
06+95	51+65	HR	
06+73	51+87	ER	
06+58	52+02	CP	
06+37	52+23	HR	
06+20	52+40	ER	
06+05	52+55	CP	
05+85	52+75	HR	
05+70	52+90	ER	
05+58	53+02	CP	
05+42	53+18	HR	
05+25	53+35	ER	
05+08	53+52	CP	
04+90	53+70	HR	
04+65	53+95	ER	
04+50	54+10	CP	
04+35	54+25	HR	
04+15	54+45	ER	
04+00	54+60	CP	
03+85	54+75	HR	
03+65	54+95	ER	
03+47	55+13	CP	
03+30	55+30	HR	
03+10	55+50	ER	
02+95	55+65	CP	
02+80	55+80	HR	
02+60	56+00	ER	
02+45	56+15	CP	
02+30	56+30	HR	
02+00	56+60	ER	
01+85	56+75	CP	
01+70	56+90	HR	
01+45	57+15	ER	
01+30	57+30	CP	
01+10	57+50	HR	
00+80	57+80	ER	
00+60	58+00	CP	
00+40	58+20	HR	
00+00	58+60	ER	

HEC-RAS Plan: Prop lower ineff River: Tanyard Branch Reach: Lower

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	1554	55.00	497.10	498.73	0.72	0.72	2.62	2.62		3.66		15.05	15.54
Lower	1554	110.00	497.10	498.90	1.98	1.98	12.30	12.30		6.21		17.72	16.21
Lower	1554	90.00	497.10	498.78	1.74	1.74	10.00	10.00		5.74		15.69	15.70
Lower	1554	163.00	497.10	499.39	1.03	0.36	4.87	0.96	1.18	4.73	0.43	61.43	119.27
Lower	1554	227.00	497.10	499.54	1.26	0.49	6.68	1.40	1.54	5.31	0.61	80.04	126.85
Lower	1554	518.00	497.10	500.01	2.06	0.97	14.59	3.46	2.60	7.08	1.12	144.98	150.16
Lower	1530	55.00	496.72	498.57	0.45	0.45	1.34	1.34		2.97		18.51	115.92
Lower	1530	110.00	496.72	498.96	0.16	0.07	0.29	0.07	0.75	1.84	0.15	110.82	167.84
Lower	1530	90.00	496.72	498.97	0.10	0.05	0.15	0.04	0.61	1.49	0.13	112.47	169.18
Lower	1530	163.00	496.72	499.19	0.18	0.09	0.35	0.10	0.89	1.98	0.27	150.18	178.25
Lower	1530	227.00	496.72	499.40	0.20	0.11	0.43	0.13	1.04	2.16	0.35	189.30	184.29
Lower	1530	518.00	496.72	500.07	0.31	0.20	0.88	0.32	1.53	2.84	0.59	318.00	202.63
Lower	1505	55.00	495.30	498.58	0.12	0.12	0.20	0.20		1.65		33.38	117.54
Lower	1505	110.00	495.30	498.93	0.12	0.05	0.20	0.04	0.55	1.67	0.11	118.87	157.27
Lower	1505	90.00	495.30	498.95	0.07	0.03	0.10	0.02	0.44	1.33	0.09	122.47	159.72
Lower	1505	163.00	495.30	499.15	0.15	0.06	0.29	0.07	0.71	1.93	0.20	154.98	168.40
Lower	1505	227.00	495.30	499.36	0.19	0.09	0.40	0.10	0.87	2.17	0.28	191.12	173.26
Lower	1505	518.00	495.30	500.01	0.32	0.18	0.97	0.30	1.41	2.98	0.51	308.42	188.19
Lower	1480	55.00	496.69	498.33	0.70	0.70	2.52	2.52		3.62		15.21	55.16
Lower	1480	110.00	496.69	498.69	0.79	0.33	3.14	0.74	0.92	3.99	0.26	49.31	98.77
Lower	1480	90.00	496.69	498.43	1.51	1.51	8.10	8.10		5.37		16.75	67.05
Lower	1480	163.00	496.69	498.88	0.95	0.40	4.24	0.94	1.21	4.48	0.33	70.20	119.97
Lower	1480	227.00	496.69	499.08	1.07	0.47	5.17	1.12	1.43	4.86	0.58	95.94	138.62
Lower	1480	518.00	496.69	499.72	1.33	0.66	7.61	1.72	1.96	5.73	1.22	199.21	183.60
Lower	1460	55.00	496.35	498.21	0.44	0.44	1.30	1.30		2.95		18.66	80.22
Lower	1460	110.00	496.35	498.66	0.33	0.13	0.90	0.18	0.78	2.69	0.26	78.86	140.04
Lower	1460	90.00	496.35	498.53	0.34	0.12	0.90	0.18	0.71	2.67	0.19	61.48	125.78
Lower	1460	163.00	496.35	498.84	0.43	0.17	1.35	0.27	0.99	3.13	0.38	106.38	160.04
Lower	1460	227.00	496.35	499.04	0.50	0.21	1.73	0.35	1.17	3.44	0.50	140.14	179.29
Lower	1460	518.00	496.35	499.68	0.70	0.36	2.97	0.70	1.65	4.25	1.00	264.61	209.69
Lower	1440	55.00	494.94	498.23	0.12	0.12	0.19	0.19		1.64		33.58	88.56
Lower	1440	110.00	494.94	498.63	0.17	0.06	0.36	0.07	0.52	2.05	0.15	91.65	137.35
Lower	1440	90.00	494.94	498.51	0.15	0.05	0.29	0.06	0.44	1.91	0.10	75.43	123.85
Lower	1440	163.00	494.94	498.80	0.27	0.09	0.69	0.13	0.73	2.58	0.25	115.74	155.25
Lower	1440	227.00	494.94	498.98	0.36	0.13	1.09	0.20	0.92	3.02	0.35	145.63	174.94
Lower	1440	518.00	494.94	499.57	0.65	0.28	2.72	0.57	1.50	4.20	0.79	258.58	204.55

HEC-RAS Plan: Prop lower ineff. River: Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	1415	55.00	496.32	498.01	0.64	0.64	2.21	2.21		3.47		15.85	80.16
Lower	1415	110.00	496.32	498.51	0.45	0.18	1.39	0.29	0.83	3.09	0.23	67.51	125.75
Lower	1415	90.00	496.32	498.35	0.51	0.19	1.66	0.35	0.74	3.23	0.08	49.08	109.13
Lower	1415	163.00	496.32	498.61	0.72	0.29	2.86	0.59	1.14	3.96	0.37	80.66	136.37
Lower	1415	227.00	496.32	498.76	0.90	0.38	4.07	0.83	1.41	4.50	0.52	102.71	152.53
Lower	1415	518.00	496.32	499.37	1.16	0.57	6.19	1.40	2.00	5.35	1.05	210.13	194.97
Lower	1395	55.00	496.01	497.88	0.43	0.43	1.25	1.25		2.91		18.89	16.50
Lower	1395	110.00	496.01	498.07	1.15	0.21	5.56	0.79	0.43	4.85	0.17	29.46	127.86
Lower	1395	90.00	496.01	498.26	0.40	0.11	1.18	0.18	0.57	2.93	0.25	54.50	140.80
Lower	1395	163.00	496.01	498.38	0.87	0.27	3.79	0.62	1.03	4.37	0.46	71.85	149.12
Lower	1395	227.00	496.01	498.59	0.85	0.31	3.74	0.67	1.28	4.41	0.58	106.04	164.28
Lower	1395	518.00	496.01	499.25	0.95	0.45	4.66	1.03	1.86	4.91	0.95	226.70	200.47
Lower	1378	55.00	494.60	497.91	0.12	0.12	0.19	0.19		1.62		33.97	19.02
Lower	1378	110.00	494.60	498.15	0.31	0.06	0.94	0.12	0.31	2.70	0.21	58.30	152.88
Lower	1378	90.00	494.60	498.26	0.16	0.04	0.32	0.05	0.31	1.97	0.21	74.50	156.29
Lower	1378	163.00	494.60	498.34	0.43	0.12	1.40	0.22	0.60	3.24	0.41	88.35	159.14
Lower	1378	227.00	494.60	498.52	0.55	0.18	2.05	0.34	0.85	3.71	0.57	117.38	164.97
Lower	1378	518.00	494.60	499.09	0.93	0.40	4.65	0.96	1.58	4.99	1.04	215.95	183.36
Lower	1355	55.00	495.99	497.70	0.60	0.60	2.02	2.02		3.38		16.28	73.60
Lower	1355	110.00	495.99	498.08	0.42	0.16	1.25	0.24	0.21	2.36	0.89	74.64	154.76
Lower	1355	90.00	495.99	497.81	1.27	1.27	6.35	6.35		4.98		18.05	82.91
Lower	1355	163.00	495.99	498.27	0.50	0.22	1.67	0.34	0.48	3.31	1.10	105.50	166.30
Lower	1355	227.00	495.99	498.45	0.60	0.28	2.18	0.47	0.69	3.66	1.30	135.66	176.85
Lower	1355	518.00	495.99	499.01	0.88	0.47	4.11	1.01	1.27	4.67	1.88	243.79	210.36
Lower	1398	55.00	495.73	497.60	0.43	0.43	1.26	1.26		2.91		18.87	76.39
Lower	1398	110.00	495.73	498.02	0.32	0.09	0.85	0.11	0.32	2.64	0.72	92.50	215.82
Lower	1398	90.00	495.73	497.91	0.32	0.10	0.82	0.12	0.21	2.59	0.66	70.37	171.31
Lower	1398	163.00	495.73	498.22	0.34	0.13	0.96	0.15	0.56	2.79	0.86	137.40	225.09
Lower	1398	227.00	495.73	498.40	0.38	0.16	1.13	0.20	0.75	2.98	0.99	179.03	233.35
Lower	1398	518.00	495.73	498.97	0.52	0.27	1.67	0.43	1.24	3.63	1.38	319.43	259.29
Lower	1325	55.00	494.32	497.64	0.11	0.11	0.18	0.18		1.61		34.12	83.19
Lower	1325	110.00	494.32	498.00	0.18	0.04	0.36	0.05	0.20	2.06	0.45	105.34	215.13
Lower	1325	90.00	494.32	497.90	0.15	0.04	0.28	0.04	0.12	1.89	0.38	85.08	170.42
Lower	1325	163.00	494.32	498.19	0.24	0.07	0.57	0.08	0.39	2.42	0.61	147.02	223.77
Lower	1325	227.00	494.32	498.36	0.30	0.10	0.84	0.13	0.57	2.77	0.76	185.36	231.43
Lower	1325	518.00	494.32	498.91	0.50	0.22	1.86	0.36	1.09	3.70	1.21	318.78	256.32

HEC-RAS Plan: Prop lower ineff River: Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	1305	55.00	495.71	497.45	0.57	0.57	1.86	1.86	1.86	3.29	0.82	16.71	60.96
Lower	1305	110.00	495.71	497.88	0.51	0.16	1.66	0.26	0.26	3.27	0.72	66.79	160.53
Lower	1305	90.00	495.71	497.77	0.47	0.17	1.46	0.28	0.12	3.10	0.99	52.66	115.75
Lower	1305	163.00	495.71	498.07	0.57	0.18	1.99	0.29	0.53	3.53	1.13	105.65	218.25
Lower	1305	227.00	495.71	498.26	0.57	0.22	2.07	0.33	0.78	3.61	1.53	148.04	226.91
Lower	1305	518.00	495.71	498.83	0.69	0.34	2.84	0.62	1.34	4.14	1.48	283.73	252.66
Lower	1290	55.00	495.45	497.48	0.17	0.07	0.32	0.08	0.04	1.86	0.49	52.46	100.67
Lower	1290	110.00	495.45	497.88	0.21	0.08	0.45	0.09	0.25	2.16	0.71	104.68	167.25
Lower	1290	90.00	495.45	497.78	0.18	0.08	0.37	0.08	0.20	2.01	0.63	89.26	145.70
Lower	1290	163.00	495.45	498.06	0.28	0.10	0.71	0.12	0.40	2.54	0.89	140.84	217.67
Lower	1290	227.00	495.45	498.24	0.34	0.14	0.97	0.18	0.58	2.85	1.04	180.04	225.71
Lower	1290	518.00	495.45	498.78	0.54	0.27	2.03	0.46	1.13	3.74	1.48	309.53	250.46
Lower	1275	55.00	494.04	497.48	0.07	0.03	0.09	0.02	0.25	1.26	0.27	70.48	107.16
Lower	1275	110.00	494.04	497.88	0.07	0.02	0.10	0.02	1.37	1.36	0.38	130.03	189.13
Lower	1275	90.00	494.04	497.78	0.07	0.02	0.10	0.02	1.19	1.34	0.36	111.81	168.52
Lower	1275	163.00	494.04	498.06	0.08	0.03	0.12	0.03	1.58	1.46	0.44	167.91	216.83
Lower	1275	227.00	494.04	498.24	0.09	0.03	0.14	0.04	1.80	1.55	0.49	206.79	225.01
Lower	1275	518.00	494.04	498.77	0.13	0.06	0.25	0.09	2.57	1.90	0.67	333.29	249.79
Lower	1255	55.00	495.43	497.33	0.41	0.41	1.16	1.16	0.31	2.84	0.66	19.35	16.61
Lower	1255	110.00	495.43	497.66	0.66	0.15	2.51	0.33	0.31	3.77	0.86	52.04	58.83
Lower	1255	90.00	495.43	497.54	0.67	0.13	2.53	0.36	0.20	3.75	0.41	34.01	37.54
Lower	1255	163.00	495.43	497.89	0.65	0.18	2.46	0.31	0.56	3.81	0.96	93.76	607.19
Lower	1255	227.00	495.43	498.12	0.57	0.19	2.10	0.30	0.76	3.66	1.11	145.03	631.80
Lower	1255	518.00	495.43	498.70	0.65	0.32	2.68	0.59	1.32	4.09	1.56	281.97	640.50
Lower	1240	55.00	495.19	497.30	0.25	0.05	0.57	0.09	0.12	2.29	0.25	33.79	321.45
Lower	1240	110.00	495.19	497.68	0.28	0.09	0.72	0.11	0.35	2.54	0.66	91.63	579.31
Lower	1240	90.00	495.19	497.56	0.28	0.08	0.71	0.10	0.27	2.50	0.56	71.02	561.86
Lower	1240	163.00	495.19	497.89	0.34	0.11	0.94	0.14	0.50	2.80	0.85	130.73	608.44
Lower	1240	227.00	495.19	498.10	0.36	0.14	1.05	0.17	0.64	2.94	0.99	177.68	626.71
Lower	1240	518.00	495.19	498.66	0.53	0.26	1.97	0.45	1.16	3.72	1.49	307.20	636.50
Lower	1227	55.00	493.78	497.32	0.08	0.02	0.11	0.02	0.07	1.38	0.14	52.10	368.26
Lower	1227	110.00	493.78	497.68	0.15	0.04	0.29	0.04	0.22	1.93	0.41	107.17	578.47
Lower	1227	90.00	493.78	497.56	0.13	0.03	0.23	0.03	0.16	1.78	0.33	87.81	562.05
Lower	1227	163.00	493.78	497.87	0.21	0.06	0.50	0.07	0.34	2.34	0.59	143.58	605.84
Lower	1227	227.00	493.78	498.07	0.27	0.08	0.70	0.10	0.47	2.64	0.76	188.96	640.70
Lower	1227	518.00	493.78	498.61	0.47	0.20	1.69	0.32	0.99	3.61	1.26	319.97	646.08

HEC-RAS Plan: Prop lower ineff River; Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	1210	55.00	495.17	497.22	0.30	0.06	0.74	0.11	0.08	2.48	0.16	26.65	179.29
Lower	1210	110.00	495.17	497.60	0.35	0.11	0.99	0.15	0.34	2.81	0.68	79.65	567.11
Lower	1210	90.00	495.17	497.47	0.36	0.10	1.02	0.15	0.26	2.81	0.56	59.21	549.14
Lower	1210	163.00	495.17	497.79	0.42	0.14	1.33	0.20	0.51	3.13	0.90	114.41	594.86
Lower	1210	227.00	495.17	498.01	0.44	0.16	1.43	0.22	0.65	3.25	1.06	159.97	625.12
Lower	1210	518.00	495.17	498.54	0.64	0.31	2.63	0.57	1.22	4.09	1.60	282.32	633.13
Lower	1193	55.00	495.17	497.19	0.21	0.04	0.47	0.08		2.20	0.04	25.92	96.60
Lower	1193	110.00	495.17	497.47	0.45	0.12	1.47	0.24		3.27	0.57	55.50	548.68
Lower	1193	90.00	495.17	497.39	0.37	0.09	1.08	0.17		2.94	0.42	46.96	537.79
Lower	1193	163.00	495.17	497.72	0.41	0.12	1.27	0.18	0.42	3.13	0.81	106.29	584.16
Lower	1193	227.00	495.17	497.92	0.46	0.14	1.54	0.22	0.57	3.37	1.02	147.10	613.79
Lower	1193	518.00	495.17	498.42	0.74	0.31	3.26	0.62	1.15	4.42	1.66	260.78	631.35
Lower	1153	Culvert											
Lower	1139	55.00	494.32	496.35	0.23	0.03	0.53	0.07		2.29	0.08	26.10	129.38
Lower	1139	110.00	494.32	496.90	0.24	0.09	0.60	0.12		2.46	0.62	83.72	560.90
Lower	1139	90.00	494.32	496.77	0.22	0.07	0.52	0.09		2.34	0.51	69.87	549.02
Lower	1139	163.00	494.32	497.12	0.23	0.08	0.55	0.09	0.36	2.39	0.75	142.70	576.20
Lower	1139	227.00	494.32	497.32	0.29	0.12	0.80	0.15	0.49	2.74	0.94	177.32	585.77
Lower	1139	518.00	494.32	497.88	0.54	0.25	2.09	0.44	0.91	3.85	1.57	291.09	614.21
Lower	1107	55.00	494.32	496.16	0.46	0.46	1.38	1.38		3.00		18.31	16.35
Lower	1107	110.00	494.32	496.76	0.41	0.12	1.23	0.18	0.35	3.02	0.53	77.74	283.14
Lower	1107	90.00	494.32	496.60	0.44	0.11	1.34	0.19	0.28	3.07	0.42	53.61	204.58
Lower	1107	163.00	494.32	496.94	0.54	0.18	1.90	0.28	0.54	3.53	0.73	107.80	369.03
Lower	1107	227.00	494.32	497.10	0.67	0.25	2.67	0.42	0.74	3.99	0.92	138.47	441.19
Lower	1107	518.00	494.32	497.57	1.23	0.58	6.93	1.31	1.43	5.61	1.55	229.21	604.80
Lower	1090	55.00	492.91	496.19	0.12	0.12	0.20	0.20		1.65		33.94	18.85
Lower	1090	110.00	492.91	496.76	0.17	0.05	0.36	0.06	0.20	2.07	0.40	94.65	286.12
Lower	1090	90.00	492.91	496.61	0.16	0.04	0.32	0.05	0.15	1.97	0.29	71.83	214.38
Lower	1090	163.00	492.91	496.93	0.27	0.07	0.69	0.10	0.32	2.59	0.60	123.46	378.70
Lower	1090	227.00	492.91	497.08	0.37	0.10	1.12	0.15	0.45	3.07	0.80	156.15	475.11
Lower	1090	518.00	492.91	497.51	0.75	0.28	3.36	0.57	1.06	4.50	1.44	257.46	635.14
Lower	1070	55.00	494.30	495.97	0.66	0.66	2.34	2.34		3.53		15.56	15.67
Lower	1070	110.00	494.30	496.43	0.98	0.20	4.45	0.65	0.48	4.53	0.45	33.99	133.81
Lower	1070	90.00	494.30	496.30	0.91	0.91	3.93	3.93		4.30		20.94	16.99
Lower	1070	163.00	494.30	496.68	0.91	0.25	4.05	0.59	0.87	4.48	0.95	70.37	281.55
Lower	1070	227.00	494.30	496.83	1.06	0.33	5.20	0.78	1.12	4.91	1.25	95.68	335.73

HEC-RAS Plan; Prop lower ineff River; Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	1070	518.00	494.30	497.40	1.00	0.42	5.00	0.99	1.74	5.00	1.77	221.45	597.23
Lower	1055	55.00	494.04	495.87	0.47	0.47	1.41	1.41		3.02		18.22	16.33
Lower	1055	110.00	494.04	496.49	0.34	0.11	0.93	0.15	0.32	2.75	0.68	79.97	554.08
Lower	1055	90.00	494.04	496.31	0.40	0.11	1.17	0.18	0.26	2.93	0.56	54.15	536.11
Lower	1055	163.00	494.04	496.63	0.49	0.17	1.62	0.27	0.47	3.34	0.94	102.55	568.15
Lower	1055	227.00	494.04	496.80	0.59	0.22	2.21	0.38	0.64	3.74	1.18	132.11	584.90
Lower	1055	518.00	494.04	497.31	0.91	0.40	4.42	0.85	1.19	4.83	1.84	241.96	633.05
Lower	1040	55.00	492.63	495.91	0.12	0.12	0.20	0.20		1.65		33.34	18.85
Lower	1040	110.00	492.63	496.49	0.15	0.04	0.29	0.04	0.28	1.93	0.40	111.59	588.61
Lower	1040	90.00	492.63	496.32	0.15	0.04	0.29	0.04	0.20	1.91	0.31	80.99	574.91
Lower	1040	163.00	492.63	496.62	0.24	0.07	0.60	0.09	0.41	2.47	0.58	137.17	599.34
Lower	1040	227.00	492.63	496.78	0.33	0.11	0.95	0.14	0.56	2.90	0.77	169.55	612.15
Lower	1040	518.00	492.63	497.25	0.64	0.26	2.66	0.49	1.10	4.17	1.37	276.94	632.55
Lower	1020	55.00	494.02	495.69	0.66	0.66	2.35	2.35		3.54		15.55	15.67
Lower	1020	110.00	494.02	496.06	1.24	0.19	6.22	0.79	0.24	5.03	0.26	26.26	194.05
Lower	1020	90.00	494.02	495.99	0.95	0.95	4.18	4.18		4.38		20.54	16.89
Lower	1020	163.00	494.02	496.37	0.92	0.26	4.12	0.57	0.65	4.49	0.98	75.27	572.14
Lower	1020	227.00	494.02	496.52	1.08	0.35	5.34	0.79	0.87	4.94	1.28	101.50	586.75
Lower	1020	518.00	494.02	496.91	1.77	0.70	11.61	1.99	1.56	6.55	2.20	183.10	626.27
Lower	1000	55.00	493.71	495.55	0.46	0.46	1.36	1.36		2.99		18.39	16.37
Lower	1000	110.00	493.71	496.17	0.29	0.07	0.74	0.08	0.38	2.55	0.63	97.78	663.32
Lower	1000	90.00	493.71	495.97	0.42	0.11	1.28	0.20	0.26	3.00	0.55	51.83	532.18
Lower	1000	163.00	493.71	496.32	0.35	0.11	1.00	0.13	0.59	2.84	0.81	135.96	656.32
Lower	1000	227.00	493.71	496.43	0.45	0.15	1.44	0.21	0.79	3.24	1.00	166.32	686.68
Lower	1000	518.00	493.71	496.90	0.64	0.30	2.56	0.53	1.36	4.02	1.50	289.33	688.02
Lower	985	55.00	492.30	495.59	0.12	0.12	0.19	0.19		1.64		33.52	18.90
Lower	985	110.00	492.30	496.16	0.13	0.03	0.24	0.03	0.30	1.81	0.37	131.09	653.27
Lower	985	90.00	492.30	495.99	0.15	0.03	0.29	0.03	0.20	1.90	0.30	86.55	643.88
Lower	985	163.00	492.30	496.30	0.19	0.05	0.43	0.05	0.46	2.21	0.52	166.03	656.02
Lower	985	227.00	492.30	496.41	0.28	0.09	0.76	0.10	0.63	2.69	0.69	192.84	686.10
Lower	985	518.00	492.30	496.84	0.54	0.22	2.07	0.38	1.18	3.82	1.22	305.99	666.73
Lower	960	55.00	493.68	495.36	0.65	0.65	2.25	2.25		3.49		15.75	15.72
Lower	960	110.00	493.68	495.63	1.48	1.48	8.08	8.08		5.45		20.19	16.81
Lower	960	90.00	493.68	495.62	1.01	1.01	4.52	4.52		4.49		20.05	16.78
Lower	960	163.00	493.68	496.12	0.65	0.12	2.49	0.19	0.50	3.82	0.93	102.37	752.44
Lower	960	227.00	493.68	496.22	0.78	0.18	3.28	0.29	0.77	4.21	1.14	136.96	754.40

HEC-RAS Plan: Prop lower ineff River: Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	960	518.00	493.68	496.78	0.52	0.21	1.87	0.33	1.24	3.60	1.30	337.15	765.52
Lower	935	55.00	493.32	495.20	0.42	0.42	1.23	1.23		2.89		19.01	16.53
Lower	935	110.00	493.32	495.78	0.26	0.07	0.62	0.08	0.45	2.41	0.60	105.52	624.85
Lower	935	90.00	493.32	495.65	0.28	0.07	0.69	0.08	0.37	2.47	0.52	78.97	611.21
Lower	935	163.00	493.32	495.94	0.32	0.10	0.85	0.12	0.61	2.70	0.78	143.88	643.21
Lower	935	227.00	493.32	496.11	0.35	0.13	1.00	0.16	0.76	2.88	0.92	186.89	652.24
Lower	935	518.00	493.32	496.70	0.43	0.22	1.46	0.34	1.21	3.35	1.31	338.63	663.99
Lower	915	55.00	491.91	495.22	0.12	0.12	0.19	0.19		1.62		33.96	19.02
Lower	915	110.00	491.91	495.75	0.15	0.04	0.29	0.04	0.29	1.93	0.39	115.48	620.18
Lower	915	90.00	491.91	495.64	0.14	0.03	0.25	0.03	0.21	1.82	0.31	91.20	606.53
Lower	915	163.00	491.91	495.90	0.23	0.08	0.54	0.07	0.43	2.38	0.56	148.93	637.71
Lower	915	227.00	491.91	496.05	0.29	0.09	0.81	0.11	0.58	2.75	0.73	186.84	651.03
Lower	915	518.00	491.91	496.63	0.44	0.19	1.52	0.29	1.07	3.47	1.18	334.15	662.51
Lower	890	55.00	493.29	495.01	0.59	0.59	1.97	1.97		3.35		16.41	15.88
Lower	890	110.00	493.29	495.44	0.89	0.17	3.88	0.45	0.28	4.33	0.55	40.19	429.01
Lower	890	90.00	493.29	495.35	0.78	0.13	3.13	0.43	0.15	4.01	0.27	27.78	212.83
Lower	890	163.00	493.29	495.67	0.79	0.21	3.31	0.39	0.65	4.18	0.94	85.91	610.89
Lower	890	227.00	493.29	495.90	0.87	0.22	2.81	0.36	0.84	3.92	1.11	137.95	638.37
Lower	890	518.00	493.29	496.54	0.59	0.28	2.28	0.49	1.30	3.88	1.46	289.78	660.86
Lower	875	55.00	493.09	494.91	0.48	0.48	1.48	1.48		3.06		17.95	16.27
Lower	875	110.00	493.09	495.41	0.51	0.16	1.72	0.30	0.33	3.35	0.69	58.73	527.61
Lower	875	90.00	493.09	495.33	0.45	0.12	1.39	0.23	0.26	3.10	0.54	48.38	522.72
Lower	875	163.00	493.09	495.55	0.73	0.26	2.97	0.54	0.48	4.06	1.02	77.35	535.97
Lower	875	227.00	493.09	495.68	1.00	0.38	4.80	0.91	0.63	4.80	1.35	94.59	543.28
Lower	875	518.00	493.09	496.10	1.91	0.84	13.11	2.74	1.21	6.86	2.41	159.55	567.94
Lower	865	55.00	491.68	494.95	0.12	0.12	0.20	0.20		1.65		33.29	18.84
Lower	865	110.00	491.68	495.44	0.21	0.05	0.46	0.07	0.19	2.23	0.40	84.05	563.28
Lower	865	90.00	491.68	495.36	0.16	0.04	0.32	0.05	0.15	1.98	0.31	71.79	550.15
Lower	865	163.00	491.68	495.58	0.33	0.08	0.93	0.12	0.33	2.85	0.61	109.85	599.12
Lower	865	227.00	491.68	495.70	0.47	0.13	1.62	0.22	0.49	3.45	0.83	135.36	613.94
Lower	865	518.00	491.68	496.14	0.89	0.31	4.33	0.67	1.09	4.87	1.51	241.25	652.88
Lower	850	55.00	493.07	494.76	0.63	0.63	2.20	2.20		3.47		15.87	15.75
Lower	850	110.00	493.07	495.23	0.75	0.16	2.99	0.34	0.54	3.98	0.56	52.22	580.84
Lower	850	90.00	493.07	495.07	0.89	0.14	3.76	0.51	0.26	4.23	0.02	24.66	132.66
Lower	850	163.00	493.07	495.40	0.83	0.24	3.53	0.46	0.79	4.26	0.91	84.85	596.41
Lower	850	227.00	493.07	495.56	0.89	0.30	4.02	0.58	0.98	4.50	1.17	117.34	610.77

HEC-RAS Plan: Prop lower ineff. River: Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	850	518.00	493.07	496.07	1.07	0.47	5.47	1.03	1.51	5.13	1.80	234.79	651.36
Lower	835	55.00	492.81	494.67	0.44	0.44	1.30	1.30		2.95		18.44	18.44
Lower	835	110.00	492.81	495.27	0.26	0.07	0.64	0.08	0.45	2.43	0.61	102.57	632.14
Lower	835	90.00	492.81	495.11	0.33	0.07	0.90	0.10	0.33	2.70	0.55	67.62	613.31
Lower	835	163.00	492.81	495.42	0.33	0.10	0.90	0.12	0.63	2.75	0.79	138.89	650.21
Lower	835	227.00	492.81	495.57	0.38	0.13	1.12	0.17	0.78	2.99	0.95	179.48	668.97
Lower	835	518.00	492.81	496.06	0.53	0.22	1.95	0.36	1.21	3.68	1.41	323.22	721.16
Lower	820	55.00	491.40	494.70	0.12	0.12	0.19	0.19		1.63		33.81	18.98
Lower	820	110.00	491.40	495.25	0.15	0.04	0.30	0.03	0.29	1.94	0.36	115.30	630.23
Lower	820	90.00	491.40	495.11	0.15	0.03	0.29	0.03	0.19	1.91	0.28	83.21	612.85
Lower	820	163.00	491.40	495.38	0.24	0.06	0.57	0.07	0.45	2.43	0.52	146.91	646.16
Lower	820	227.00	491.40	495.52	0.32	0.09	0.92	0.12	0.61	2.87	0.67	181.25	662.37
Lower	820	518.00	491.40	495.95	0.61	0.21	2.45	0.36	1.11	4.04	1.18	306.77	714.58
Lower	800	55.00	492.79	494.50	0.60	0.60	2.03	2.03		3.38		16.27	15.85
Lower	800	110.00	492.79	494.88	1.07	0.21	5.06	0.75	0.22	4.71	0.45	31.18	274.45
Lower	800	90.00	492.79	494.80	0.90	0.20	3.84	0.84	0.03	4.27	0.05	21.40	80.62
Lower	800	163.00	492.79	495.17	0.80	0.20	3.37	0.38	0.64	4.21	0.96	83.95	620.93
Lower	800	227.00	492.79	495.29	0.98	0.26	4.61	0.57	0.91	4.71	1.22	110.56	634.94
Lower	800	518.00	492.79	495.84	0.89	0.35	4.21	0.70	1.41	4.71	1.68	258.25	701.07
Lower	780	55.00	492.53	494.36	0.47	0.47	1.41	1.41		3.02		18.22	16.33
Lower	780	110.00	492.53	494.95	0.29	0.09	0.74	0.10	0.47	2.54	0.61	98.01	605.99
Lower	780	90.00	492.53	494.81	0.34	0.09	0.92	0.11	0.40	2.71	0.52	69.18	590.14
Lower	780	163.00	492.53	495.10	0.39	0.13	1.14	0.16	0.64	2.97	0.82	128.60	621.56
Lower	780	227.00	492.53	495.25	0.45	0.17	1.48	0.23	0.79	3.27	1.01	164.86	638.71
Lower	780	518.00	492.53	495.77	0.63	0.27	2.51	0.47	1.21	4.00	1.51	302.63	694.92
Lower	768	55.00	491.12	494.40	0.12	0.12	0.20	0.20		1.64		33.48	18.89
Lower	768	110.00	491.12	494.95	0.16	0.04	0.30	0.04	0.30	1.95	0.39	113.15	605.95
Lower	768	90.00	491.12	494.81	0.15	0.03	0.28	0.03	0.23	1.88	0.30	86.44	591.42
Lower	768	163.00	491.12	495.07	0.25	0.07	0.61	0.08	0.44	2.48	0.56	140.54	619.86
Lower	768	227.00	491.12	495.21	0.34	0.10	0.98	0.14	0.59	2.93	0.75	172.64	635.12
Lower	768	518.00	491.12	495.69	0.62	0.23	2.52	0.40	1.06	4.09	1.32	295.96	686.26
Lower	750	55.00	492.51	494.20	0.63	0.63	2.18	2.18		3.45		15.92	15.76
Lower	750	110.00	492.51	494.61	1.00	0.17	4.57	0.50	0.37	4.56	0.47	37.48	366.47
Lower	750	90.00	492.51	494.49	0.95	0.95	4.14	4.14		4.37		20.61	16.91
Lower	750	163.00	492.51	494.85	0.86	0.24	3.75	0.47	0.72	4.35	0.93	81.84	596.82
Lower	750	227.00	492.51	494.99	1.01	0.32	4.83	0.66	0.95	4.78	1.22	109.51	611.38

HEC-RAS Plan: Prop lower ineff River: Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	750	518.00	492.51	495.58	0.94	0.39	4.56	0.81	1.38	4.84	1.74	252.01	674.39
Lower	730	55.00	492.22	494.07	0.45	0.45	1.35	1.35		2.98		18.46	16.39
Lower	730	110.00	492.22	494.69	0.25	0.08	0.60	0.08	0.46	2.38	0.60	105.32	602.03
Lower	730	90.00	492.22	494.52	0.31	0.08	0.82	0.10	0.40	2.61	0.52	72.75	586.98
Lower	730	163.00	492.22	494.80	0.38	0.13	1.11	0.17	0.64	2.94	0.82	128.73	612.19
Lower	730	227.00	492.22	494.96	0.44	0.17	1.43	0.23	0.79	3.24	1.01	164.42	626.81
Lower	730	518.00	492.22	495.51	0.60	0.27	2.38	0.47	1.20	3.94	1.51	302.68	676.22
Lower	715	55.00	490.81	494.10	0.12	0.12	0.19	0.19		1.64		33.59	18.92
Lower	715	110.00	490.81	494.67	0.14	0.04	0.26	0.04	0.30	1.87	0.39	119.72	601.54
Lower	715	90.00	490.81	494.52	0.14	0.03	0.26	0.03	0.23	1.84	0.31	88.91	587.38
Lower	715	163.00	490.81	494.77	0.24	0.07	0.60	0.08	0.44	2.47	0.57	139.65	610.20
Lower	715	227.00	490.81	494.92	0.33	0.11	0.97	0.14	0.59	2.92	0.76	171.12	623.18
Lower	715	518.00	490.81	495.43	0.59	0.23	2.38	0.40	1.05	4.01	1.32	296.33	668.69
Lower	695	55.00	492.20	493.89	0.63	0.63	2.17	2.17		3.45		15.95	15.77
Lower	695	110.00	492.20	494.22	1.28	0.16	6.53	0.72	0.16	5.10	0.22	24.96	255.18
Lower	695	90.00	492.20	494.20	0.91	0.91	3.91	3.91		4.29		20.97	16.99
Lower	695	163.00	492.20	494.54	0.87	0.24	3.78	0.49	0.72	4.36	0.95	80.90	590.39
Lower	695	227.00	492.20	494.74	0.82	0.28	3.57	0.53	0.91	4.33	1.18	120.85	608.21
Lower	695	518.00	492.20	495.31	0.90	0.39	4.30	0.81	1.37	4.75	1.74	252.65	656.42
Lower	673	55.00	491.90	493.74	0.46	0.46	1.38	1.38		3.00		18.32	16.36
Lower	673	110.00	491.90	494.31	0.32	0.09	0.87	0.11	0.44	2.68	0.64	90.56	611.03
Lower	673	90.00	491.90	494.21	0.31	0.08	0.82	0.10	0.35	2.62	0.54	70.79	592.71
Lower	673	163.00	491.90	494.53	0.32	0.10	0.89	0.12	0.58	2.74	0.80	141.18	651.92
Lower	673	227.00	491.90	494.73	0.33	0.11	0.93	0.13	0.69	2.81	0.92	195.51	689.46
Lower	673	518.00	491.90	495.29	0.38	0.16	1.22	0.22	1.04	3.16	1.25	381.47	754.53
Lower	658	55.00	490.49	493.77		0.12	0.20	0.20		1.64		33.45	18.88
Lower	658	110.00	490.49	494.30	0.16	0.04	0.32	0.04	0.28	1.98	0.39	112.23	628.28
Lower	658	90.00	490.49	494.21	0.14	0.03	0.25	0.03	0.22	1.82	0.31	92.27	613.83
Lower	658	163.00	490.49	494.51	0.20	0.05	0.45	0.05	0.42	2.25	0.55	162.79	661.32
Lower	658	227.00	490.49	494.70	0.24	0.07	0.58	0.07	0.54	2.47	0.68	216.49	692.36
Lower	658	518.00	490.49	495.25	0.35	0.13	1.09	0.17	0.91	3.11	1.07	396.85	752.45
Lower	637	55.00	491.88	493.55		0.65	2.30	2.30		3.51		15.65	15.69
Lower	637	110.00	491.88	494.12	0.60	0.13	2.18	0.24	0.41	3.60	0.65	60.11	599.40
Lower	637	90.00	491.88	493.93	0.79	0.13	3.21	0.44	0.14	4.04	0.29	27.49	339.24
Lower	637	163.00	491.88	494.43	0.40	0.12	1.19	0.15	0.62	3.01	0.83	129.46	648.90
Lower	637	227.00	491.88	494.64	0.37	0.13	1.11	0.16	0.73	2.97	0.94	186.35	683.12

HEC-RAS Plan: Prop lower ineff River: Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	637	518.00	491.88	495.20	0.43	0.18	1.41	0.26	1.08	3.31	1.29	367.25	750.16
Lower	620	55.00	491.61	493.44	0.47	0.47	1.42	1.42		3.03		18.16	16.32
Lower	620	110.00	491.61	494.03	0.51	0.14	1.71	0.26	0.38	3.37	0.60	57.94	584.93
Lower	620	90.00	491.61	493.87	0.50	0.15	1.65	0.34	0.29	3.29	0.46	40.82	543.04
Lower	620	163.00	491.61	494.29	0.56	0.17	2.01	0.28	0.63	3.61	0.80	97.64	625.81
Lower	620	227.00	491.61	494.49	0.62	0.20	2.39	0.33	0.82	3.86	0.96	137.03	658.60
Lower	620	518.00	491.61	495.04	0.83	0.31	3.88	0.58	1.32	4.66	1.36	275.29	741.96
Lower	605	55.00	490.20	493.47	0.12	0.12	0.20	0.20		1.65		33.28	18.83
Lower	605	110.00	490.20	494.06	0.19	0.05	0.40	0.06	0.30	2.15	0.33	89.75	605.28
Lower	605	90.00	490.20	493.90	0.17	0.04	0.35	0.06	0.20	2.03	0.25	67.15	582.87
Lower	605	163.00	490.20	494.29	0.25	0.07	0.64	0.09	0.46	2.54	0.48	130.71	639.25
Lower	605	227.00	490.20	494.48	0.33	0.10	0.98	0.14	0.61	2.95	0.63	168.08	665.62
Lower	605	518.00	490.20	494.98	0.64	0.22	2.69	0.38	1.11	4.21	1.08	294.05	737.20
Lower	585	55.00	491.58	493.26	0.65	0.65	2.25	2.25		3.49		15.75	15.72
Lower	585	110.00	491.58	493.72	1.00	0.24	4.59	0.82	0.27	4.58	0.43	31.92	418.49
Lower	585	90.00	491.58	493.61	0.86	0.24	3.61	0.95	0.09	4.19	0.14	22.64	208.47
Lower	585	163.00	491.58	493.99	1.03	0.30	4.95	0.74	0.72	4.79	0.84	65.94	595.22
Lower	585	227.00	491.58	494.18	1.15	0.37	5.94	0.86	0.99	5.15	1.08	96.05	622.31
Lower	585	518.00	491.58	494.64	1.71	0.62	11.15	1.68	1.71	6.52	1.73	192.25	689.12
Lower	570	55.00	491.36	493.15	0.51	0.51	1.62	1.62		3.15		17.45	16.14
Lower	570	110.00	491.36	493.80	0.32	0.08	0.86	0.10	0.52	2.67	0.48	94.72	677.29
Lower	570	90.00	491.36	493.59	0.45	0.10	1.41	0.17	0.43	3.11	0.41	54.06	622.73
Lower	570	163.00	491.36	493.96	0.38	0.11	1.13	0.13	0.88	2.96	0.63	136.49	722.15
Lower	570	227.00	491.36	494.12	0.43	0.13	1.36	0.16	0.81	3.18	0.74	182.82	764.53
Lower	570	518.00	491.36	494.58	0.57	0.20	2.16	0.29	1.17	3.80	1.06	353.21	896.30
Lower	558	55.00	489.95	493.19	0.13	0.13	0.21	0.21		1.68		32.68	18.66
Lower	558	110.00	489.95	493.79	0.16	0.04	0.33	0.04	0.33	2.00	0.30	110.50	678.03
Lower	558	90.00	489.95	493.62	0.17	0.03	0.34	0.04	0.24	2.01	0.23	74.44	631.00
Lower	558	163.00	489.95	493.94	0.24	0.06	0.60	0.06	0.47	2.47	0.43	147.90	718.21
Lower	558	227.00	489.95	494.08	0.32	0.08	0.93	0.10	0.61	2.88	0.56	187.99	755.48
Lower	558	518.00	489.95	494.49	0.60	0.17	2.39	0.27	1.05	4.01	0.95	334.27	863.93
Lower	542	55.00	491.34	492.96	0.74	0.74	2.75	2.75		3.71		14.82	15.48
Lower	542	110.00	491.34	493.28	1.52	1.52	8.36	8.36		5.51		19.97	16.76
Lower	542	90.00	491.34	493.28	1.01	1.01	4.51	4.51		4.49		20.06	16.78
Lower	542	163.00	491.34	493.72	0.86	0.22	3.74	0.42	0.79	4.36	0.74	82.87	661.89
Lower	542	227.00	491.34	493.87	0.99	0.27	4.67	0.53	1.02	4.74	0.94	115.43	699.32

HEC-RAS Plan: Prop lower ineff River: Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	542	518.00	491.34	494.40	0.90	0.30	4.24	0.54	1.38	4.72	1.25	284.82	839.81
Lower	525	55.00	491.03	492.84	0.48	0.48	1.49	1.49		3.07		17.91	16.26
Lower	525	110.00	491.03	493.36	0.49	0.12	1.60	0.19	0.55	3.27	0.51	69.59	633.87
Lower	525	90.00	491.03	493.29	0.42	0.10	1.24	0.15	0.44	2.99	0.42	57.60	618.67
Lower	525	163.00	491.03	493.62	0.43	0.13	1.37	0.17	0.71	3.16	0.66	124.07	691.12
Lower	525	227.00	491.03	493.78	0.49	0.15	1.68	0.21	0.86	3.41	0.79	166.22	727.43
Lower	525	518.00	491.03	494.37	0.50	0.18	1.78	0.26	1.14	3.58	1.03	367.18	858.33
Lower	508	55.00	489.64	492.87	0.13	0.13	0.22	0.22		1.69		32.50	18.61
Lower	508	110.00	489.64	493.39	0.14	0.03	0.25	0.03	0.42	1.83	0.25	125.46	718.56
Lower	508	90.00	489.64	493.32	0.12	0.02	0.20	0.02	0.35	1.67	0.20	106.90	706.18
Lower	508	163.00	489.64	493.63	0.14	0.04	0.27	0.03	0.53	1.90	0.34	194.21	760.14
Lower	508	227.00	489.64	493.79	0.18	0.05	0.38	0.05	0.65	2.14	0.43	245.00	787.58
Lower	508	518.00	489.64	494.36	0.24	0.09	0.63	0.10	0.93	2.58	0.65	465.50	887.19
Lower	490	55.00	491.00	492.65	0.69	0.69	2.49	2.49		3.60		15.27	15.59
Lower	490	110.00	491.00	493.31	0.36	0.09	1.02	0.11	0.60	2.81	0.42	90.73	703.78
Lower	490	90.00	491.00	493.01	0.89	0.08	3.78	0.33	0.11	4.25	0.07	22.82	317.45
Lower	490	163.00	491.00	493.59	0.25	0.08	0.59	0.08	0.67	2.38	0.50	169.84	753.47
Lower	490	227.00	491.00	493.75	0.28	0.10	0.71	0.10	0.79	2.56	0.59	219.74	781.00
Lower	490	518.00	491.00	494.33	0.31	0.13	0.87	0.15	1.03	2.81	0.80	439.71	881.91
Lower	465	55.00	490.51	492.49	0.44	0.31	1.30	0.90	0.23	2.96	0.23	19.20	23.97
Lower	465	110.00	490.51	493.06	0.60	0.08	2.24	0.19	0.33	3.71	0.33	49.11	415.49
Lower	465	90.00	490.51	492.87	0.57	0.30	1.99	0.85	0.49	3.52	0.49	31.18	39.41
Lower	465	163.00	490.51	493.52	0.26	0.07	0.66	0.07	0.59	2.53	0.48	165.59	741.68
Lower	465	227.00	490.51	493.67	0.31	0.09	0.88	0.10	0.73	2.81	0.59	211.03	767.78
Lower	465	518.00	490.51	494.26	0.36	0.13	1.11	0.15	1.00	3.11	0.82	428.47	870.82
Lower	450	55.00	490.45	492.37	0.50	0.39	1.56	1.21	0.19	3.12	0.19	17.86	20.75
Lower	450	110.00	490.45	492.93	0.68	0.34	2.66	1.04	0.60	3.91	0.60	36.28	44.20
Lower	450	90.00	490.45	492.75	0.63	0.34	2.34	1.07	0.49	3.69	0.49	28.76	36.51
Lower	450	163.00	490.45	493.48	0.29	0.07	0.76	0.08	0.59	2.65	0.49	156.55	734.63
Lower	450	227.00	490.45	493.62	0.35	0.10	1.05	0.11	0.74	2.88	0.61	198.43	759.31
Lower	450	518.00	490.45	494.22	0.38	0.13	1.24	0.17	1.02	3.23	0.84	415.05	864.11
Lower	435	55.00	490.43	491.88	1.49	1.49	7.68	7.68		5.15		10.68	12.88
Lower	435	110.00	490.43	492.40	1.79	1.43	10.66	8.36	0.45	5.96	0.46	18.82	20.57
Lower	435	90.00	490.43	492.25	1.66	1.61	9.33	9.06	0.11	5.61	0.11	16.04	16.49
Lower	435	163.00	490.43	492.78	1.93	1.18	12.53	6.71	0.90	6.49	0.90	28.65	30.98
Lower	435	227.00	490.43	493.55	0.46	0.12	1.54	0.16	0.78	3.38	0.66	172.77	746.34

HEC-RAS Plan: Prop lower ineff River: Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	435	518.00	490.43	494.18	0.43	0.15	1.49	0.19	1.06	3.43	0.88	393.48	856.28
Lower	415	55.00	489.88	491.76	0.54	0.50	1.74	1.59	0.16	3.23	0.16	17.10	17.49
Lower	415	110.00	489.88	492.36	0.72	0.47	2.89	1.88	0.62	4.02	0.61	31.01	28.51
Lower	415	90.00	489.88	492.17	0.65	0.46	2.46	1.60	0.50	3.76	0.50	25.92	25.07
Lower	415	163.00	489.88	492.76	0.90	0.54	4.18	2.01	0.84	4.65	0.83	43.85	35.74
Lower	415	227.00	489.88	493.09	1.18	0.18	6.48	0.57	0.51	5.48	0.57	70.75	457.90
Lower	415	518.00	489.88	493.99	0.80	0.31	3.82	0.62	1.41	4.75	1.05	255.40	659.89
Lower	400	55.00	488.97	491.77	0.21	0.18	0.45	0.37	0.09	2.14	0.09	25.82	19.48
Lower	400	110.00	488.97	492.36	0.37	0.17	1.09	0.40	0.34	2.99	0.45	45.67	47.03
Lower	400	90.00	488.97	492.18	0.32	0.16	0.86	0.39	0.27	2.74	0.34	37.37	37.19
Lower	400	163.00	488.97	492.80	0.48	0.19	1.67	0.45	0.51	3.51	0.63	69.70	67.94
Lower	400	227.00	488.97	493.19	0.53	0.10	2.01	0.19	0.60	3.79	0.49	124.39	854.70
Lower	400	518.00	488.97	493.99	0.51	0.15	1.96	0.22	0.99	3.86	0.86	352.05	789.04
Lower	385	55.00	489.86	491.31	1.49	1.49	7.66	7.66		5.15		10.69	12.89
Lower	385	110.00	489.86	491.83	1.80	1.36	10.71	7.93	0.45	5.97	0.45	18.88	21.84
Lower	385	90.00	489.86	491.67	1.68	1.63	9.45	9.17	0.09	5.63	0.09	15.98	16.50
Lower	385	163.00	489.86	492.23	1.82	0.93	11.51	4.88	0.77	6.32	1.00	31.15	39.70
Lower	385	227.00	489.86	492.61	1.88	0.84	12.47	3.83	1.01	6.65	1.29	49.81	58.67
Lower	385	518.00	489.86	493.95	0.60	0.19	2.49	0.30	1.13	4.12	0.97	328.21	782.50
Lower	365	55.00	489.26	491.15	0.52	0.49	1.67	1.54	0.17	3.19	0.17	17.30	17.38
Lower	365	110.00	489.26	491.76	0.71	0.49	2.85	1.78	0.61	4.00	0.61	30.56	26.40
Lower	365	90.00	489.26	491.57	0.64	0.47	2.38	1.65	0.50	3.72	0.50	25.85	23.60
Lower	365	163.00	489.26	492.13	0.94	0.54	4.45	2.10	0.69	4.75	0.87	41.71	35.80
Lower	365	227.00	489.26	492.44	1.24	0.60	6.97	2.47	0.79	5.60	1.13	54.67	49.22
Lower	365	518.00	489.26	493.83	0.68	0.18	3.05	0.31	1.06	4.48	0.86	304.13	766.44
Lower	347	55.00	488.34	491.15	0.21	0.17	0.44	0.37	0.10	2.13	0.10	25.99	19.20
Lower	347	110.00	488.34	491.76	0.37	0.20	1.11	0.50	0.40	3.00	0.39	43.35	37.65
Lower	347	90.00	488.34	491.57	0.31	0.18	0.85	0.45	0.31	2.73	0.31	36.70	31.87
Lower	347	163.00	488.34	492.14	0.52	0.25	1.88	0.69	0.58	3.65	0.57	60.11	48.86
Lower	347	227.00	488.34	492.47	0.70	0.33	3.03	0.98	0.77	4.33	0.75	77.51	57.68
Lower	347	518.00	488.34	493.79	0.59	0.15	2.53	0.25	0.98	4.25	0.71	312.69	760.20
Lower	330	55.00	489.23	490.68	1.48	1.48	7.61	7.61		5.13		10.71	12.90
Lower	330	110.00	489.23	491.21	1.72	1.19	10.10	6.71	0.47	5.86	0.47	19.48	24.38
Lower	330	90.00	489.23	491.05	1.67	1.61	9.41	9.03	0.10	5.63	0.10	16.00	16.69
Lower	330	163.00	489.23	491.66	1.63	0.80	9.77	3.76	0.89	6.01	0.88	34.77	44.52
Lower	330	227.00	489.23	492.15	1.39	0.67	8.11	2.46	1.12	5.82	1.04	61.77	62.54

HEC-RAS Plan: Prop lower ineff River: Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	330	518.00	489.23	493.75	0.62	0.18	2.67	0.29	1.10	4.28	0.81	311.20	755.33
Lower	310	55.00	488.69	490.56	0.55	0.52	1.80	1.69	0.15	3.26	0.15	16.89	17.08
Lower	310	110.00	488.69	491.16	0.74	0.50	2.99	1.81	0.60	4.06	0.59	30.18	27.30
Lower	310	90.00	488.69	490.97	0.67	0.49	2.54	1.76	0.50	3.80	0.50	25.30	23.57
Lower	310	163.00	488.69	491.61	0.87	0.51	3.98	1.88	0.81	4.59	0.78	44.34	36.22
Lower	310	227.00	488.69	492.05	1.00	0.54	5.09	1.98	0.94	5.08	0.97	62.00	45.96
Lower	310	518.00	488.69	493.61	0.77	0.18	3.69	0.35	0.97	4.82	0.99	273.01	735.16
Lower	295	55.00	487.77	490.57	0.21	0.19	0.45	0.41	0.09	2.14	0.09	25.72	17.44
Lower	295	110.00	487.77	491.17	0.39	0.26	1.18	0.73	0.31	3.07	0.42	39.11	26.60
Lower	295	90.00	487.77	490.98	0.32	0.24	0.90	0.62	0.29	2.77	0.31	34.27	23.71
Lower	295	163.00	487.77	491.61	0.53	0.32	1.96	1.01	0.48	3.70	0.63	52.23	33.18
Lower	295	227.00	487.77	492.04	0.69	0.38	2.98	1.27	0.57	4.33	0.93	67.65	41.40
Lower	295	518.00	487.77	493.56	0.70	0.16	3.26	0.30	0.85	4.67	0.92	273.87	728.78
Lower	280	55.00	488.66	490.11	1.49	1.49	7.63	7.63		5.14		10.70	12.90
Lower	280	110.00	488.66	490.64	1.73	1.50	10.17	8.72	0.46	5.87	0.47	18.96	18.74
Lower	280	90.00	488.66	490.48	1.67	1.64	9.35	9.21	0.10	5.62	0.10	16.03	16.25
Lower	280	163.00	488.66	491.04	1.88	1.31	12.04	7.74	0.73	6.42	0.93	27.58	25.41
Lower	280	227.00	488.66	491.47	1.94	1.30	13.19	7.46	1.19	6.80	1.28	39.55	29.75
Lower	280	518.00	488.66	493.46	0.91	0.21	4.76	0.46	1.00	5.23	1.16	241.20	714.77
Lower	260	55.00	488.12	489.99	0.56	0.53	1.82	1.71	0.14	3.27	0.14	16.84	17.01
Lower	260	110.00	488.12	490.59	0.76	0.60	3.11	2.32	0.60	4.11	0.67	28.51	21.78
Lower	260	90.00	488.12	490.40	0.68	0.56	2.59	2.06	0.48	3.82	0.55	24.56	20.32
Lower	260	163.00	488.12	491.01	0.94	0.70	4.50	2.95	0.83	4.77	0.90	38.45	25.10
Lower	260	227.00	488.12	491.44	1.13	0.77	6.10	3.48	1.02	5.39	1.06	50.26	29.44
Lower	260	518.00	488.12	493.32	0.95	0.20	5.13	0.47	0.88	5.42	1.08	216.90	695.04
Lower	245	55.00	487.20	489.99	0.21	0.17	0.45	0.37	0.09	2.15	0.09	25.78	19.71
Lower	245	110.00	487.20	490.60	0.39	0.30	1.18	0.84	0.53	3.06	0.45	38.81	23.00
Lower	245	90.00	487.20	490.41	0.32	0.25	0.89	0.66	0.42	2.76	0.35	34.54	22.05
Lower	245	163.00	487.20	491.03	0.54	0.40	2.04	1.34	0.76	3.75	0.64	49.09	25.21
Lower	245	227.00	487.20	491.46	0.72	0.50	3.16	1.87	0.92	4.42	0.80	60.81	28.69
Lower	245	518.00	487.20	493.38	0.60	0.12	2.60	0.21	0.72	4.37	0.84	298.47	702.50
Lower	230	55.00	488.09	489.57	1.37	1.37	6.79	6.79		4.95		11.11	13.17
Lower	230	110.00	488.09	490.09	1.69	1.37	9.79	7.73	0.60	5.81	0.55	19.47	20.43
Lower	230	90.00	488.09	489.92	1.61	1.51	8.92	8.34	0.15	5.54	0.15	16.27	17.15
Lower	230	163.00	488.09	490.48	1.84	1.46	11.73	8.55	1.21	6.37	1.02	27.80	22.38
Lower	230	227.00	488.09	490.88	2.02	1.55	13.96	9.47	1.55	6.92	1.30	37.28	24.40

HEC-RAS Plan: Prep_lower_ineff River: Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	230	518.00	488.09	492.09	3.25	1.66	30.91	11.82	1.65	9.51	1.47	72.57	45.08
Lower	200	55.00	487.43	489.30	0.55	0.52	1.78	1.70	0.15	3.25	0.15	16.94	16.85
Lower	200	110.00	487.43	489.91	0.74	0.54	2.99	2.03	0.61	4.06	0.62	28.39	23.98
Lower	200	90.00	487.43	489.72	0.67	0.53	2.54	1.90	0.49	3.80	0.50	24.90	21.68
Lower	200	163.00	487.43	490.35	0.89	0.63	4.13	2.51	0.88	4.64	0.89	40.83	27.48
Lower	200	227.00	487.43	490.80	1.05	0.72	5.44	3.04	1.10	5.20	1.11	53.81	30.61
Lower	200	518.00	487.43	492.13	1.87	0.83	13.96	4.13	1.00	7.46	1.45	104.15	61.22
Lower	185	55.00	486.52	489.31	0.21	0.20	0.46	0.42	0.09	2.15	0.09	25.59	17.35
Lower	185	110.00	486.52	489.92	0.39	0.26	1.19	0.74	0.40	3.07	0.40	39.08	26.76
Lower	185	90.00	486.52	489.72	0.33	0.24	0.91	0.63	0.31	2.78	0.31	34.13	23.75
Lower	185	163.00	486.52	490.36	0.53	0.34	1.95	1.07	0.65	3.70	0.63	52.03	30.92
Lower	185	227.00	486.52	490.82	0.67	0.43	2.86	1.45	0.87	4.28	0.82	66.83	34.54
Lower	185	518.00	486.52	492.17	1.36	0.57	8.84	2.39	0.97	6.48	1.15	123.80	68.98
Lower	170	55.00	487.40	488.84	1.53	1.53	7.96	7.96		5.21		10.56	12.80
Lower	170	110.00	487.40	489.35	1.87	1.73	11.38	10.44	0.41	6.08	0.43	18.20	17.46
Lower	170	90.00	487.40	489.20	1.73	1.72	9.85	9.83		5.70		15.78	16.02
Lower	170	163.00	487.40	489.75	2.00	1.58	13.16	9.91	0.87	6.60	0.91	26.00	21.47
Lower	170	227.00	487.40	490.16	2.14	1.50	15.23	9.49	0.96	7.11	1.26	35.82	26.42
Lower	170	518.00	487.40	491.74	2.22	1.20	17.78	6.42	1.51	8.00	1.79	96.79	51.59
Lower	145	55.00	486.75	488.66	0.50	0.47	1.57	1.47	0.19	3.13	0.18	17.64	17.02
Lower	145	110.00	486.75	489.28	0.70	0.56	2.76	2.09	0.68	3.97	0.59	29.56	21.38
Lower	145	90.00	486.75	489.08	0.63	0.51	2.30	1.82	0.53	3.69	0.48	25.48	20.40
Lower	145	163.00	486.75	489.71	0.87	0.67	4.02	2.79	0.94	4.61	0.80	39.36	23.56
Lower	145	227.00	486.75	490.14	1.07	0.80	5.63	3.62	1.16	5.27	1.00	50.01	25.72
Lower	145	518.00	486.75	491.61	1.75	1.16	12.69	6.43	1.76	7.26	1.45	93.60	34.30
Lower	130	55.00	485.90	488.66	0.22	0.21	0.49	0.47	0.07	2.19	0.07	25.07	16.98
Lower	130	110.00	485.90	489.27	0.40	0.32	1.26	0.96	0.45	3.13	0.39	36.95	21.96
Lower	130	90.00	485.90	489.08	0.34	0.28	0.98	0.76	0.32	2.82	0.30	32.86	20.38
Lower	130	163.00	485.90	489.71	0.56	0.43	2.15	1.50	0.68	3.82	0.59	46.75	23.54
Lower	130	227.00	485.90	490.14	0.75	0.55	3.36	2.17	0.90	4.50	0.78	57.42	25.71
Lower	130	518.00	485.90	491.61	1.41	0.92	9.30	4.73	1.52	6.60	1.25	100.93	34.27
Lower	110	55.00	486.72	488.16	1.53	1.53	7.97	7.97		5.21		10.56	12.79
Lower	110	110.00	486.72	488.67	1.88	1.70	11.40	10.26	0.43	6.08	0.43	18.21	17.82
Lower	110	90.00	486.72	488.52	1.73	1.73	9.85	9.84		5.70		15.78	16.02
Lower	110	163.00	486.72	489.03	2.10	1.63	14.15	10.37	0.92	6.74	0.93	25.59	22.13
Lower	110	227.00	486.72	489.39	2.39	1.84	17.79	12.36	1.36	7.45	1.45	33.79	23.57

HEC-RAS Plan: Prop lower ineff River: Tanyard Branch Reach: Lower (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)	Power Chan (lb/ft s)	Power Total (lb/ft s)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Flow Area (sq ft)	Top Width (ft)
Lower	110	518.00	486.72	490.65	3.35	2.45	32.24	19.07	2.21	9.62	2.37	66.64	28.60
Lower	80	55.00	485.96	487.87	0.51	0.46	1.59	1.43	0.19	3.14	0.19	17.61	17.80
Lower	80	110.00	485.96	488.49	0.68	0.49	2.67	1.73	0.70	3.93	0.61	31.13	25.34
Lower	80	90.00	485.96	488.29	0.62	0.47	2.27	1.59	0.57	3.67	0.50	26.33	23.16
Lower	80	163.00	485.96	488.92	0.84	0.56	3.78	2.12	0.92	4.52	0.83	43.21	30.16
Lower	80	227.00	485.96	489.37	0.98	0.65	4.98	2.59	1.14	5.06	1.06	57.34	33.56
Lower	80	518.00	485.96	490.83	1.50	0.94	10.12	4.23	1.57	6.73	1.65	114.76	45.49
Lower	60	55.00	485.04	487.85	0.20	0.18	0.43	0.37	0.10	2.12	0.10	26.09	18.62
Lower	60	110.00	485.04	488.47	0.37	0.27	1.11	0.73	0.46	3.01	0.48	40.25	25.31
Lower	60	90.00	485.04	488.28	0.31	0.23	0.85	0.58	0.36	2.72	0.37	35.39	23.93
Lower	60	163.00	485.04	488.91	0.52	0.36	1.89	1.13	0.66	3.67	0.70	51.85	28.34
Lower	60	227.00	485.04	489.34	0.68	0.46	2.91	1.62	0.87	4.30	0.90	64.74	31.03
Lower	60	518.00	485.04	490.77	1.27	0.81	7.96	3.65	1.37	6.27	1.53	115.44	40.36
Lower	40	55.00	485.92	487.36	1.53	1.53	7.96	7.96		5.21		10.56	12.80
Lower	40	110.00	485.92	487.87	1.86	1.58	11.31	9.48	0.43	6.06	0.43	18.36	19.18
Lower	40	90.00	485.92	487.72	1.73	1.72	9.86	9.84		5.71		15.77	16.03
Lower	40	163.00	485.92	488.23	2.07	1.55	13.82	9.56	1.01	6.69	1.06	26.43	23.64
Lower	40	227.00	485.92	488.59	2.34	1.71	17.25	11.00	1.37	7.38	1.46	35.30	26.14
Lower	40	518.00	485.92	489.93	3.22	2.23	30.35	15.89	2.23	9.42	2.27	72.55	33.95
Lower	0	55.00	484.00	485.78	0.67	0.67	2.40	2.40		3.56		15.46	15.84
Lower	0	110.00	484.00	486.28	1.01	0.91	4.73	4.18	0.58	4.67	0.56	23.98	17.98
Lower	0	90.00	484.00	486.12	0.90	0.83	3.88	3.57	0.44	4.31	0.43	21.06	17.31
Lower	0	163.00	484.00	486.67	1.28	1.08	6.97	5.67	0.66	5.45	0.83	31.20	19.56
Lower	0	227.00	484.00	487.07	1.55	1.26	9.64	7.26	1.10	6.21	1.07	39.27	21.18
Lower	0	518.00	484.00	488.43	2.50	1.76	21.30	12.61	1.81	8.52	1.61	72.24	27.60

C3. Channel Stability (BEHD)

Soil Bulk Density (g/cm ³)		Left Bank	13.461	Total Soil	23.387
Soil Bulk Density (lb/ft ³)	81.16	Soil Loss (tons/yr)		Loss (tons/yr)	

(g/cm³) = 81.16 (lb/ft³) Based on ChA and CmB soils

Loc From Sta	Loc to Sta	Bank Height (ft)	Bankfull Height (ft)	Root Depth (feet)	Root Density %	Bank Angle (deg)	Surface Prot %	Near Bank Stress Index	Comments	Location Sta to Station	Stream Length	Bank Height/ Bankfull Height	Root Depth/ Bank Ht.	Bank Height/ Bankfull Height	Root Depth/ Bank Ht.	Root Density	Bank Angle	Surface Protection	Bank Matl Adjustment	Stratification Adjustment	Total Value	Bank Eros Potential	Bank Erosion Rate (ft/yr)	Bank Erosion Volume (ft ³ /yr)	Bank Erosion (tons/year)
0	17	1	1.00	0.25	95	60	90	1		0	17	1.00	0.25	1.00	6.54	1.23	3.90	1.45			14.12	Low	0	0	0
17	33	1	1.00	0.25	85	65	70	1		17	16	1.00	0.25	1.00	6.54	1.68	4.40	2.71			16.33	Low	0	0	0
33	50	1	1.00	0.25	50	70	10	1		33	17	1.00	0.25	1.00	6.54	4.32	4.90	9.00			25.76	Moderate	0.066	1.12	0.045
50	63	3	1.00	0.25	10	80	0	1		50	13	3.00	0.08	10.00	8.67	8.44	5.90	10.00			43.01	Very High	0.5	19.5	0.791
63	80	3	1.00	0.25	30	85	0	2		63	17	3.00	0.08	10.00	8.67	5.90	6.84	10.00			41.41	Very High	0.6	30.6	1.242
80	105	3	1.00	0.25	10	80	0	1		80	25	3.00	0.08	10.00	8.67	8.44	5.90	10.00			43.01	Very High	0.5	37.5	1.522
105	160	1	1.00	0.25	90	45	80	1		105	55	1.00	0.25	1.00	6.54	1.45	3.17	1.90			14.06	Low	0	0	0
160	195	3	1.00	0.25	10	45	10	1		160	35	3.00	0.08	10.00	8.67	8.44	3.17	9.00			39.28	High	0.08	8.4	0.341
195	225	1	1.00	0.25	90	45	80	1		195	30	1.00	0.25	1.00	6.54	1.45	3.17	1.90			14.06	Low	0	0	0
195	262	1	1.00	0.25	90	60	20	1		195	67	1.00	0.25	1.00	6.54	1.45	3.90	7.22			20.11	Moderate	0.066	4.42	0.179
262	290	2	1.00	0	0	60	10	1		262	28	2.00	0.00	7.90	10.00	10.00	3.90	9.00			40.80	Very High	0.5	28	1.136
290	375	3	1.00	0	0	45	0	2		290	85	3.00	0.00	10.00	10.00	10.00	3.17	10.00			43.17	Very High	0.6	153	6.209
375	475	2	1.00	0.25	30	65	10	1		375	100	2.00	0.13	7.90	8.11	5.90	4.40	9.00			35.31	High	0.08	16	0.649
475	529	1.5	1.50	0.5	90	30	90	4		475	54	1.00	0.33	1.00	5.60	1.45	2.44	1.45			11.94	Low	0	0	0
529	595	1	1.00	0.5	95	10	95	1		529	66	1.00	0.50	1.00	3.90	1.23	1.45	1.23			8.80	Very Low	0	0	0
595	700	1	1.00	0.5	95	10	95	1		595	105	1.00	0.50	1.00	3.90	1.23	1.45	1.23			8.80	Very Low	0	0	0
700	750	1	1.00	1	95	5	95	1		700	50	1.00	1.00	1.00	1.00	1.23	1.23	1.23			5.68	Very Low	0	0	0
750	825	1	1.00	0.5	95	8	95	1		750	75	1.00	0.50	1.00	3.90	1.23	1.36	1.23			8.71	Very Low	0	0	0
825	847	0.5	0.50	0.25	80	80	15	1		825	22	1.00	0.50	1.00	3.90	1.90	5.90	7.90			20.60	Moderate	0.066	0.73	0.03
847	881	1	1.00	0.75	75	45	75	1		847	34	1.00	0.75	1.00	2.68	2.32	3.17	2.32			11.48	Low	0	0	0
881	895	1	1.00	0.25	50	60	50	1	inside pool	881	14	1.00	0.25	1.00	6.54	4.32	3.90	4.32			20.08	Moderate	0.066	0.92	0.037
895	906	2	1.00	0.33	40	45	25	4	outside bend	895	11	2.00	0.17	7.90	7.63	5.11	3.17	6.54			30.35	High	0.2	4.4	0.179
906	987	0.5	0.50	0.75	75	45	50	1		906	81	1.00	1.50	1.00	1.00	2.32	3.17	4.32			11.80	Low	0	0	0
987	1013	2	1.00	0.33	40	20	20	1		987	26	2.00	0.17	7.90	7.63	5.11	1.90	7.22			29.76	Moderate	0.066	3.43	0.139
1013	1029	1	1.00	0.5	60	10	15	1		1013	16	1.00	0.50	1.00	3.90	3.50	1.45	7.90			17.75	Low	0	0	0
1029	1060	1.5	1.00	0.5	75	10	15	1		1029	31	1.50	0.33	5.90	5.60	2.32	1.45	7.90			23.17	Moderate	0.066	3.07	0.125
1060	1188	1.5	1.00	0.75	80	45	50	1		1060	128	1.50	0.50	5.90	3.90	1.90	3.17	4.32			19.19	Low	0	0	0
1188	1216	2	1.00	0.75	80	30	70	1		1188	28	2.00	0.38	7.90	5.10	1.90	2.44	2.71			20.05	Moderate	0.066	3.7	0.15
1216	1263	1	1.00	0.5	85	45	50	1		1216	47	1.00	0.50	1.00	3.90	1.68	3.17	4.32			14.06	Low	0	0	0
1263	1319	0.5	0.50	0.25	85	40	70	1		1263	56	1.00	0.50	1.00	3.90	1.68	2.93	2.71			12.21	Low	0	0	0
1319	1394	1	1.00	0.3	95	30	50	1		1319	75	1.00	0.30	1.00	5.90	1.23	2.44	4.32			14.88	Low	0	0	0
1394	1425	1.5	1.00	0.3	95	37	85	1	B4 at 590	1394	31	1.50	0.20	5.90	7.22	1.23	2.78	1.68			18.80	Low	0	0	0
1425	1445	1	1.00	0.4	95	40	95	1		1425	20	1.00	0.40	1.00	4.90	1.23	2.93	1.23			11.28	Low	0	0	0
1445	1481	1.25	1.00	0.4	90	30	90	1		1445	36	1.25	0.32	4.32	5.70	1.45	2.44	1.45			15.36	Low	0	0	0
1481	1487	3	1.00	0.4	40	15	10	4		1481	6	3.00	0.13	10.00	8.11	5.11	1.68	9.00			33.89	High	0.2	3.6	0.146
1487	1498	1	1.00	0.5	65	15	50	3		1487	11	1.00	0.50	1.00	3.90	3.11	1.68	4.32			14.00	Low	0	0	0
1498	1554	1.5	1.00	0.75	75	45	75	1		1498	56	1.50	0.50	5.90	3.90	2.32	3.17	2.32			17.60	Low	0	0	0
1554	1675	1	1.00	0.75	85	45	90	1		1554	121	1.00	0.75	1.00	2.68	1.68	3.17	1.45			9.98	Very Low	0	0	0
1675	1685	1	1.00	0.5	75	15	10	3		1675	10	1.00	0.50	1.00	3.90	2.32	1.68	9.00			17.89	Low	0	0	0
1685	1718	1	1.00	0.75	90	35	80	1	cross section #5	1685	33	1.00	0.75	1.00	2.68	1.45	2.68	1.90			9.71	Very Low	0	0	0
1718	1755	1.5	1.00	0.75	85	30	40	1		1718	37	1.50	0.50	5.90	3.90	1.68	2.44	5.11			19.02	Low	0	0	0
1755	1792	2.5	1.00	0.75	80	10	30	4	outside bend	1755	37	2.50	0.30	8.62	5.90	1.90	1.45	5.90			23.77	Moderate	0.1	9.25	0.375
1792	1836	1	1.00	0.3	80	45	75	1		1792	44	1.00	0.30	1.00	5.90	1.90	3.17	2.32			14.29	Low	0	0	0
1836	1867	2	1.00	1.5	75	40	30	1	inside	1836	31	2.00	0.75	7.90	2.68	2.32	2.93	5.90			21.72	Moderate	0.066	4.09	0.166
1867	1895	1	1.00	0.75	75	45	80	3	outside bend	1867	28	1.00	0.75	1.00	2.68	2.32	3.17	1.90			11.07	Low	0	0	0
1895	2015	0.5	0.50	0.75	87	35	40	1	from woods to muddy area	1895	120	1.00	1.50	1.00	1.00	1.59	2.68	5.11			11.38	Low	0	0	0
		0.75	1.00	1.25	85	40	50	1	wooded area near field	0	240	0.75	1.67	1.00	1.00	1.68	2.93	4.32			10.92	Low	0	0	0

Field Data Collected Right Bank
 Project: 601 East Bank soils D50= 10-11 mm Medium Gravel

Soil Bulk Density (g/cm ³)		Right Bank	9.926
Soil Bulk Density (lb/ft ³)	81.6	Soil Loss (tons/yr)	

1 (g/cm³) = 81.16 (lb/ft³) Based on ChA and CmB soils

Loc From Sta	Loc to Sta	Bank Height (ft)	Bankfull Height (ft)	Root Depth (feet)	Root Density %	Bank Angle (deg)	Surface Prot %	Near Bank Stress Index	Comments	Location Sta to Station	Stream Length	Bnk Height/ Bankfull Height	Root Depth/ Bank Ht.	Bnk Height/ Bankfull Height	Root Depth/ Bank Ht.	Root Density	Bank Angle	Surface Protection	Bank Matl Adjustment	Stratification Adjustment	Total Value	Bank Eros Potential	Bank Erosion Rate (ft/yr)	Bank Erosion Volume (ft ³ /yr)	Bank Erosion (tons/year)
0	17	1	1.00	0.25	95	65	90	1		0	17	1.00	0.25	1.00	6.54	1.23	4.40	1.45			14.62	Low	0	0	0
17	33	1.5	1.00	0.25	80	65	70	1		17	16	1.50	0.17	5.90	7.63	1.90	4.40	2.71			22.54	Moderate	0.066	1.58	0.064
33	50	2	1.00	0.25	50	30	10	1	sta 46 headcut	33	17	2.00	0.13	7.90	8.11	4.32	2.44	9.00			31.77	High	0.08	2.72	0.111
50	63	3	1.00	0.25	20	60	0	1		50	13	3.00	0.08	10.00	8.67	7.22	3.90	10.00			39.79	High	0.08	3.12	0.127
63	80	1.5	1.00	0	0	75	0	2		63	17	1.50	0.00	5.90	10.00	10.00	5.40	10.00			41.30	Very High	0.6	15.3	0.624
80	105	3	1.00	0	0	80	0	1		80	25	3.00	0.00	10.00	10.00	10.00	5.90	10.00			45.90	Very High	0.5	37.5	1.53
105	160	2	1.00	0	0	30	0	1		105	55	2.00	0.00	7.90	10.00	10.00	2.44	10.00			40.34	Very High	0.5	55	2.244
160	195	2	1.00	0.25	10	45	10	1		160	35	2.00	0.13	7.90	8.11	8.44	3.17	9.00			36.62	High	0.08	5.6	0.228
195	225	2	1.00	0	0	45	0	1	sta 225 headcut	195	30	2.00	0.00	7.90	10.00	10.00	3.17	10.00			41.07	Very High	0.5	30	1.224
225	262	2.5	1.00	0.25	50	70	0	1	sta 262 headcut	225	37	2.50	0.10	8.62	8.44	4.32	4.90	10.00			36.28	High	0.08	7.4	0.302
262	290	3	1.00	0	0	45	0	1		262	28	3.00	0.00	10.00	10.00	10.00	3.17	10.00			43.17	Very High	0.5	42	1.714
290	375	3	1.00	0.25	30	45	0	2		290	85	3.00	0.08	10.00	8.67	5.90	3.17	10.00			37.74	High	0.1	25.5	1.04
375	487	1	1.00	0.25	80	45	70	1		375	112	1.00	0.25	1.00	6.54	1.90	3.17	2.71			15.32	Low	0	0	0
487	512	1.5	1.50	0.25	30	60	10	4		487	25	1.00	0.17	1.00	7.63	5.90	3.90	9.00			27.43	Moderate	0.1	3.75	0.153
512	595	1	1.00	0.25	90	15	90	1		512	83	1.00	0.25	1.00	6.54	1.45	1.68	1.45			12.12	Low	0	0	0
595	700	1	1.00	0.75	95	10	95	1	sta 614 xsection 1	595	105	1.00	0.75	1.00	2.68	1.23	1.45	1.23			7.58	Very Low	0	0	0
700	750	1	1.00	0.75	95	8	95	1		700	50	1.00	0.75	1.00	2.68	1.23	1.36	1.23			7.49	Very Low	0	0	0
750	825	1	1.00	0.5	95	10	95	1	sta 770 xsection 2	750	75	1.00	0.50	1.00	3.90	1.23	1.45	1.23			8.80	Very Low	0	0	0
825	837	0.5	0.50	0.25	75	80	45	1		825	12	1.00	0.50	1.00	3.90	2.32	5.90	4.71			17.83	Low	0	0	0
837	881	0.5	0.50	0.2	40	80	40	1		837	44	1.00	0.40	1.00	4.90	5.11	5.90	5.11			22.02	Moderate	0.066	1.45	0.059
881	895	1	0.67	0.33	65	45	60	1	outside pool	881	14	1.49	0.33	5.84	5.60	3.11	3.17	3.50			21.22	Moderate	0.066	0.92	0.038
895	905	2	1.00	0.25	65	50	80	1	inside bend	895	10	2.00	0.13	7.90	8.11	3.11	3.41	1.90			24.43	Moderate	0.066	1.32	0.054
905	987	0.5	0.50	0.5	70	40	85	1		905	82	1.00	1.00	1.00	2.71	2.93	1.68				9.31	Very Low	0	0	0
987	1013	2	1.00	0.33	45	10	75	1		987	26	2.00	0.17	7.90	7.63	4.71	1.45	2.32			24.01	Moderate	0.066	3.43	0.14
1013	1029	0.67	0.67	0.25	40	10	75	1		1013	16	1.00	0.37	1.00	5.20	5.11	1.45	2.32			15.08	Low	0	0	0
1029	1060	1.5	1.00	0.5	80	10	85	1		1029	31	1.50	0.33	5.90	5.60	1.90	1.45	1.68			16.53	Low	0	0	0
1060	1211	1	1.00	0.5	80	15	80	3		1060	151	1.00	0.50	1.00	3.90	1.90	1.68	1.90			10.38	Low	0	0	0
1211	1263	1.5	1.50	0.75	70	20	70	1		1211	52	1.00	0.50	1.00	3.90	2.71	1.90	2.71			12.23	Low	0	0	0
1263	1319	0.33	0.33	0.5	80	55	70	1		1263	56	1.00	1.52	1.00	1.00	1.90	3.66	2.71			10.27	Low	0	0	0
1319	1394	1.25	1.00	1	75	20	70	1		1319	75	1.25	0.80	4.32	2.44	2.32	1.90	2.71			13.68	Low	0	0	0
1394	1425	2.5	1.00	1.25	75	25	80	1		1394	31	2.50	0.50	8.62	3.90	2.32	2.19	1.90			18.93	Low	0	0	0
1425	1445	2	1.00	1.25	75	35	70	1		1425	20	2.00	0.63	7.90	3.27	2.32	2.68	2.71			18.88	Low	0	0	0
1445	1481	1.5	1.00	1.75	80	45	80	1		1445	36	1.50	1.17	5.90	1.00	1.90	3.17	1.90			13.87	Low	0	0	0
1481	1498	1.75	0.75	1	75	40	75	1		1481	17	2.33	0.57	8.41	3.56	2.32	2.93	2.32			19.52	Low	0	0	0
1498	1547	2	1.00	1	75	32	75	1		1498	49	2.00	0.50	7.90	3.90	2.32	2.54	2.32			18.97	Low	0	0	0
1547	1558	1.5	1.00	0.33	60	45	80	4		1547	11	1.50	0.22	5.90	6.95	3.50	3.17	1.90			21.42	Moderate	0.1	1.65	0.067
1558	1650	0.75	0.75	0.75	75	30	85	1		1558	92	1.00	1.00	1.00	1.00	2.32	2.44	1.68			8.43	Very Low	0	0	0
1650	1685	1	1.00	0.75	85	12	80	1		1650	35	1.00	0.75	1.00	2.68	1.68	1.54	1.90			8.80	Very Low	0	0	0
1685	1718	1	1.00	2	85	35	85	1	Ben's xsection 4	1685	33	1.00	2.00	1.00	1.00	1.68	2.68	1.68			8.03	Very Low	0	0	0
1718	1755	2.75	1.00	1.75	85	12	75	1		1718	37	2.75	0.64	8.94	3.22	1.68	1.54	2.32			17.69	Low	0	0	0
1755	1792	2	1.00	1	75	45	80	1		1755	37	2.00	0.50	7.90	3.90	2.32	3.17	1.90			19.19	Low	0	0	0
1792	1809	2	1.00	1	65	5	65	3	eroding outer bank	1792	17	2.00	0.50	7.90	3.90	3.11	1.23	3.11			19.24	Low	0	0	0
1809	1830	2.25	0.75	0.45	65	29	55	1	near pump house	1809	21	3.00	0.20	10.00	7.22	3.11	2.39	3.90			26.62	Moderate	0.066	3.1185	0.127
1830	1845	3.25	0.50	1	75	5	80	3	slight erosion	1830	15	6.50	0.31	10.00	5.80	2.32	1.23	1.90			21.24	Moderate	0.04	1.95	0.08
1845	1867	3.25	1.00	2.25	80	5	85	4	erosion outer bend	1845	22	3.25	0.69	10.00	2.97	1.90	1.23	1.68			17.77	Low	0	0	0
1867	1895	1	0.50	1.25	75	45	75	1	inner bend	1867	28	2.00	1.25	7.90	1.00	2.32	3.17	2.32			16.70	Low	0	0	0
1895	2015	0.5	0.50	0.75	85	35	45	1	to the mucky area	1895	120	1.00	1.50	1.00	1.00	1.68	2.68	4.71			11.07	Low	0	0	0
near road		0.75	1.00	1.5	85	40	50	1		near road	50	0.75	2.00	1.00	1.00	1.68	2.93	4.32			10.92	Low	0	0	0

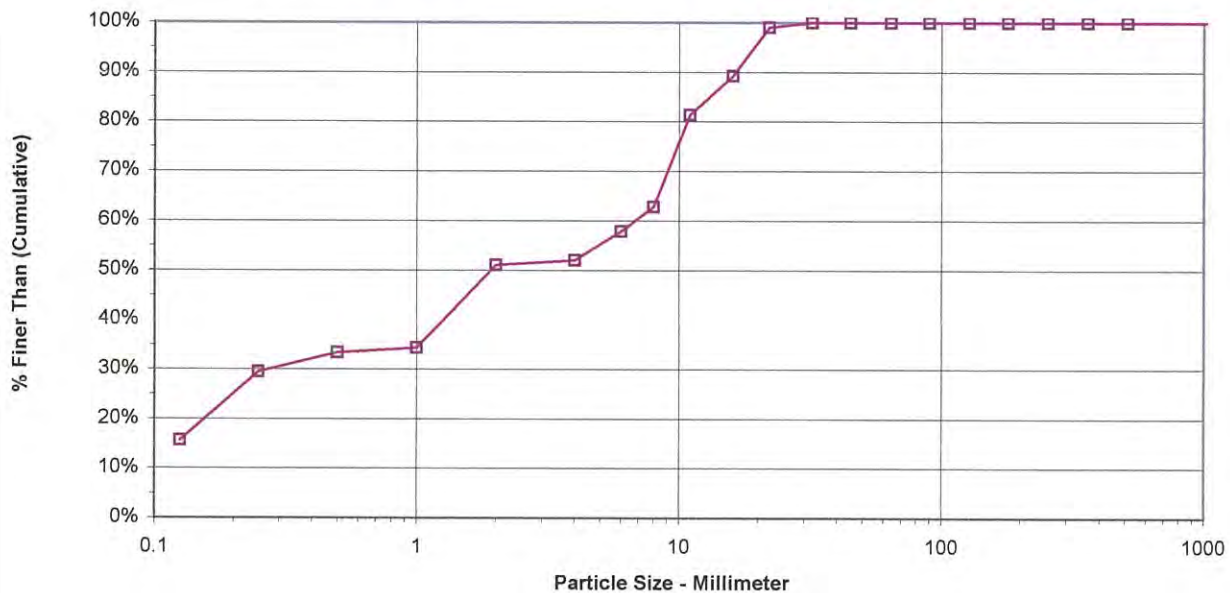
C4. Assessment Data

PEBBLE COUNT

Project: 601 East				Date: 1/3/2013				
Location: 50' Upstream Cross Section 18/B5 (Bankfull)								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	8	0	8	8%	8%
.04 - .08	Very Fine	.062 - .125	S	8	0	8	8%	16%
	Fine	.125 - .25	A	14	0	14	14%	29%
	Medium	.25 - .50	N	4	0	4	4%	33%
	Coarse	.50 - 1.0	D	1	0	1	1%	34%
	Very Coarse	1.0 - 2.0	S	17	0	17	17%	51%
.08 - .16	Very Fine	2.0 - 4.0		1	0	1	1%	52%
.16 - .22	Fine	4.0 - 5.7	G	6	0	6	6%	58%
.22 - .31	Fine	5.7 - 8.0	R	5	0	5	5%	63%
.31 - .44	Medium	8.0 - 11.3	A	19	0	19	19%	81%
.44 - .63	Medium	11.3 - 16.0	V	8	0	8	8%	89%
.63 - .89	Coarse	16.0 - 22.6	E	10	0	10	10%	99%
.89 - 1.26	Coarse	22.6 - 32.0	L	1	0	1	1%	100%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	0	0	0	0%	100%
1.77 - 2.5	Very Coarse	45.0 - 64.0		0	0	0	0%	100%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	100%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	100%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
Totals				102	0	102	100%	100%

d16	d35	d50	d84	d95
0.1	1.0	1.9	12.7	19.5

601-E Particle Size Distribution Sample #1- 50' US CS#5(Bankfull)

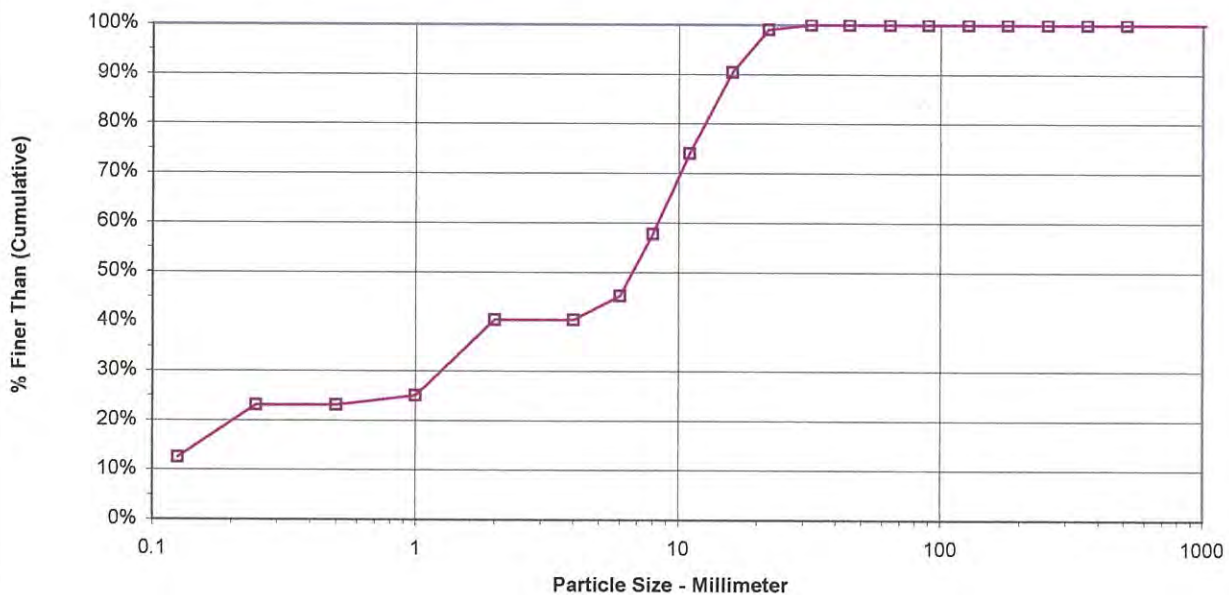


PEBBLE COUNT

Project: 601 East				Date: 1/3/2013				
Location: 50' Upstream Cross Section 18/B5 (Wetted Perimeter)								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	9	0	9	9%	9%
.04 - .08	Very Fine	.062 - .125	S	4	0	4	4%	13%
	Fine	.125 - .25	A	11	0	11	11%	23%
	Medium	.25 - .50	N	0	0	0	0%	23%
	Coarse	.50 - 1.0	D	2	0	2	2%	25%
	Very Coarse	1.0 - 2.0	S	16	0	16	15%	40%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	40%
.16 - .22	Fine	4.0 - 5.7	G	5	0	5	5%	45%
.22 - .31	Fine	5.7 - 8.0	R	13	0	13	13%	58%
.31 - .44	Medium	8.0 - 11.3	A	17	0	17	16%	74%
.44 - .63	Medium	11.3 - 16.0	V	17	0	17	16%	90%
.63 - .89	Coarse	16.0 - 22.6	E	9	0	9	9%	99%
.89 - 1.26	Coarse	22.6 - 32.0	L	1	0	1	1%	100%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	0	0	0	0%	100%
1.77 - 2.5	Very Coarse	45.0 - 64.0		0	0	0	0%	100%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	100%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	100%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
Totals				104	0	104	100%	100%

d16	d35	d50	d84	d95
0.2	1.7	6.8	14.0	19.2

601-E Particle Size Distribution Sample #2-50' US CS#5 (Wetted)

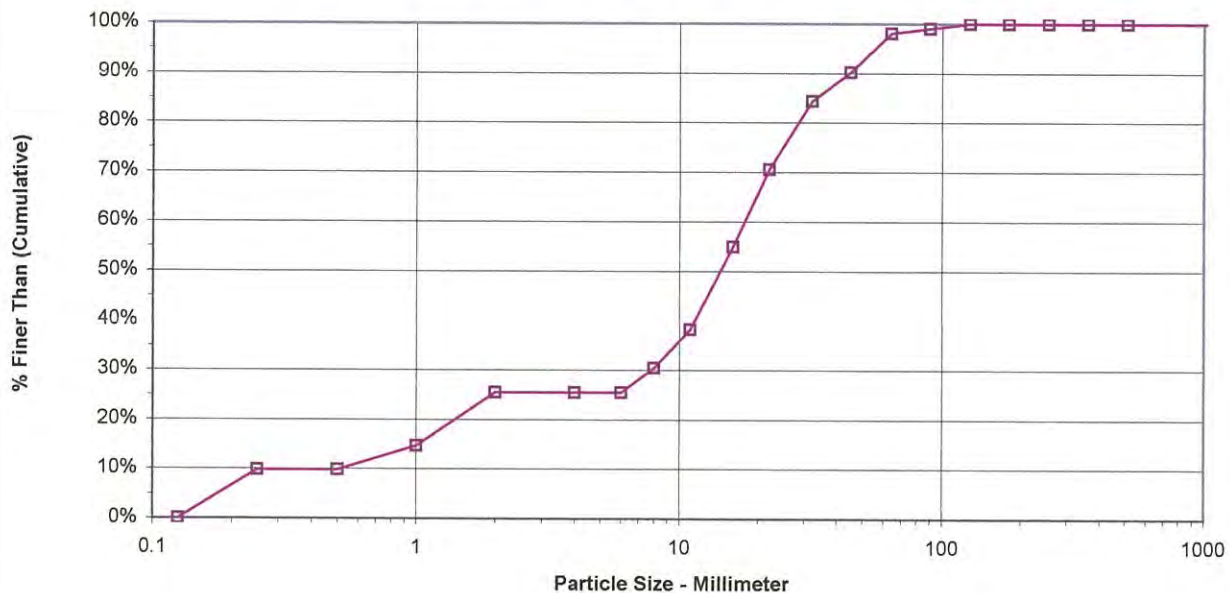


PEBBLE COUNT

Project: 601 East				Date: 1-3-2013				
Location: Top (Intermittant) Bankfull								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
.04 - .08	Very Fine	.062 - .125	S	0	0	0	0%	0%
	Fine	.125 - .25	A	10	0	10	10%	10%
	Medium	.25 - .50	N	0	0	0	0%	10%
	Coarse	.50 - 1.0	D	5	0	5	5%	15%
	Very Coarse	1.0 - 2.0	S	11	0	11	11%	25%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	25%
.16 - .22	Fine	4.0 - 5.7	G	0	0	0	0%	25%
.22 - .31	Fine	5.7 - 8.0	R	5	0	5	5%	30%
.31 - .44	Medium	8.0 - 11.3	A	8	0	8	8%	38%
.44 - .63	Medium	11.3 - 16.0	V	17	0	17	17%	55%
.63 - .89	Coarse	16.0 - 22.6	E	16	0	16	16%	71%
.89 - 1.26	Coarse	22.6 - 32.0	L	14	0	14	14%	84%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	6	0	6	6%	90%
1.77 - 2.5	Very Coarse	45.0 - 64.0		8	0	8	8%	98%
2.5 - 3.5	Small	64 - 90	C	1	0	1	1%	99%
3.5 - 5.0	Small	90 - 128	O	1	0	1	1%	100%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
Totals				102	0	102	100%	100%

d16	d35	d50	d84	d95
1.1	9.8	14.5	31.8	56.6

601 E Particle Size Distribution Sample #3-Top Intermittant (Bankfull)

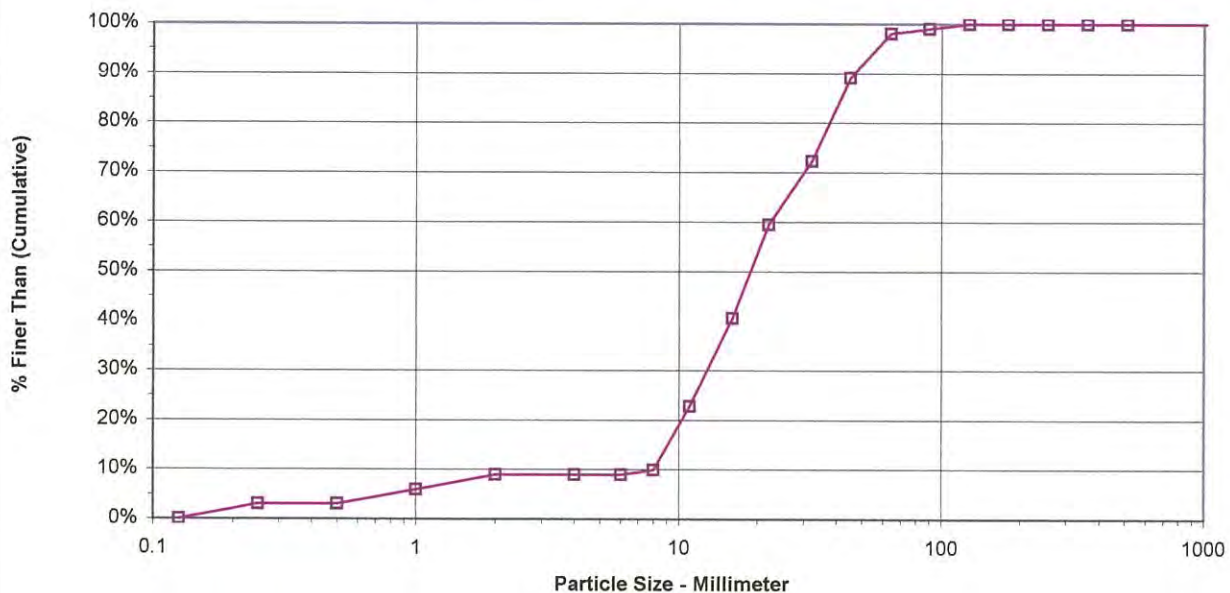


PEBBLE COUNT

Project: 601 East				Date: 1-3-2013				
Location: Top (Intermittant) (Wetted)								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
.04 - .08	Very Fine	.062 - .125	S	0	0	0	0%	0%
	Fine	.125 - .25	A	3	0	3	3%	3%
	Medium	.25 - .50	N	0	0	0	0%	3%
	Coarse	.50 - 1.0	D	3	0	3	3%	6%
	Very Coarse	1.0 - 2.0	S	3	0	3	3%	9%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	9%
.16 - .22	Fine	4.0 - 5.7	G	0	0	0	0%	9%
.22 - .31	Fine	5.7 - 8.0	R	1	0	1	1%	10%
.31 - .44	Medium	8.0 - 11.3	A	13	0	13	13%	23%
.44 - .63	Medium	11.3 - 16.0	V	18	0	18	18%	41%
.63 - .89	Coarse	16.0 - 22.6	E	19	0	19	19%	59%
.89 - 1.26	Coarse	22.6 - 32.0	L	13	0	13	13%	72%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	17	0	17	17%	89%
1.77 - 2.5	Very Coarse	45.0 - 64.0		9	0	9	9%	98%
2.5 - 3.5	Small	64 - 90	C	1	0	1	1%	99%
3.5 - 5.0	Small	90 - 128	O	1	0	1	1%	100%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
Totals				101	0	101	100%	100%

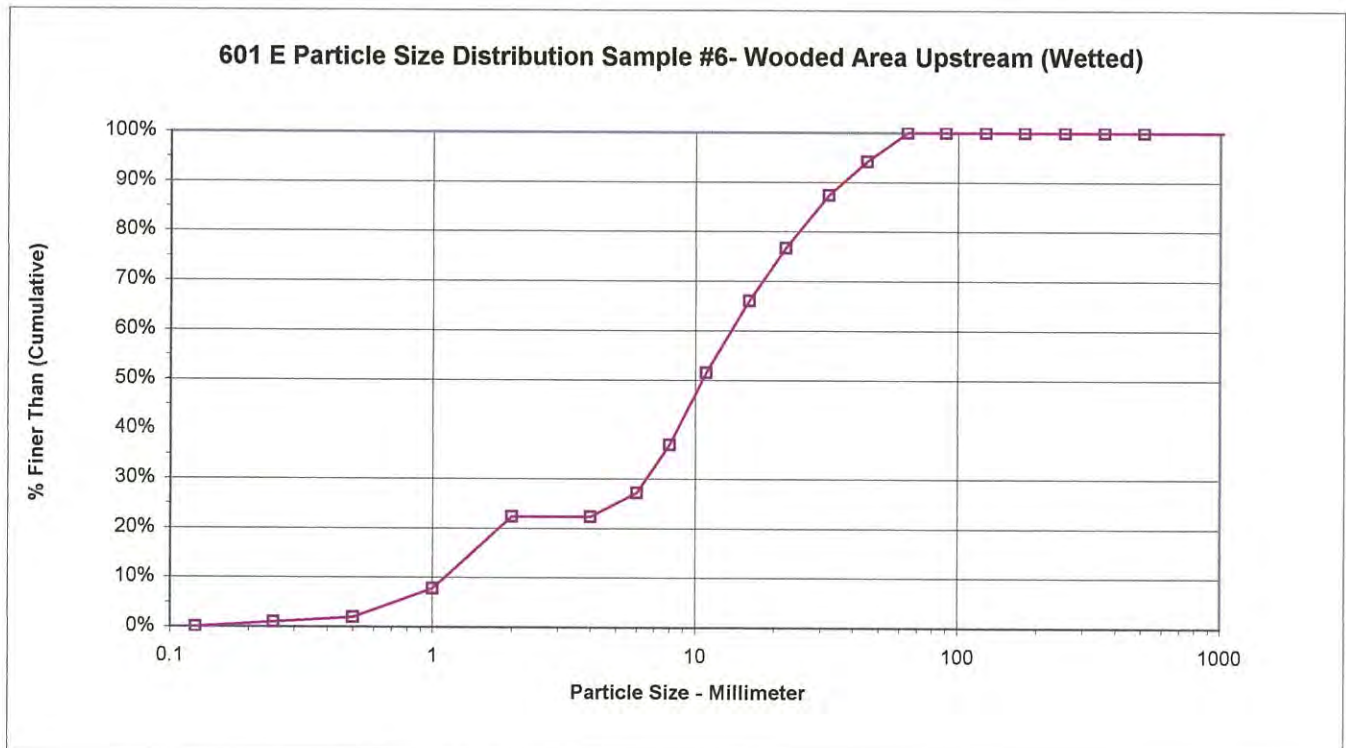
d16	d35	d50	d84	d95
9.4	14.4	19.0	41.1	57.6

601 E Particle Size Distribution Sample #4-Top Intermittant (Wetted)



PEBBLE COUNT								
Project: 601 East						Date: 1-3-2013		
Location: (Wooded Area) Pump House (Wetted)								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
.04 - .08	Very Fine	.062 - .125	S	0	0	0	0%	0%
	Fine	.125 - .25	A	1	0	1	1%	1%
	Medium	.25 - .50	N	1	0	1	1%	2%
	Coarse	.50 - 1.0	D	6	0	6	6%	8%
	Very Coarse	1.0 - 2.0	S	15	0	15	15%	22%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	22%
.16 - .22	Fine	4.0 - 5.7	G	5	0	5	5%	27%
.22 - .31	Fine	5.7 - 8.0	R	10	0	10	10%	37%
.31 - .44	Medium	8.0 - 11.3	A	15	0	15	15%	51%
.44 - .63	Medium	11.3 - 16.0	V	15	0	15	15%	66%
.63 - .89	Coarse	16.0 - 22.6	E	11	0	11	11%	77%
.89 - 1.26	Coarse	22.6 - 32.0	L	11	0	11	11%	87%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	7	0	7	7%	94%
1.77 - 2.5	Very Coarse	45.0 - 64.0		6	0	6	6%	100%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	100%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	100%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
Totals				103	0	103	100%	100%

d16	d35	d50	d84	d95
1.6	7.6	10.7	28.8	47.7

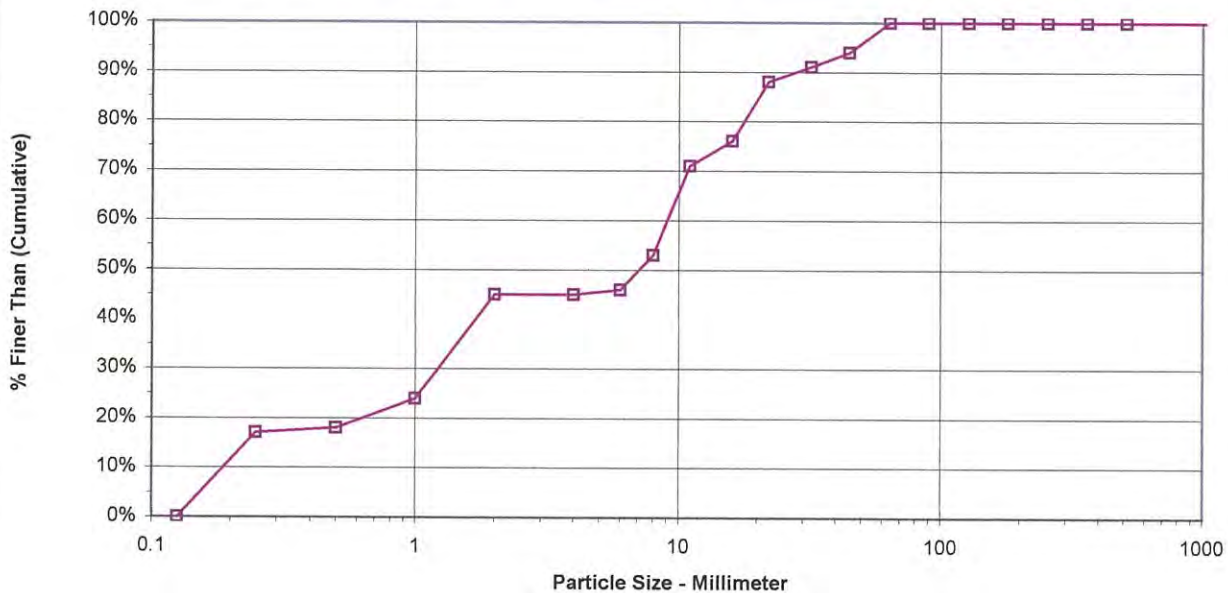


PEBBLE COUNT

Project: 601 East				Date: 1-3-2013				
Location: (Wooded Area) Pump House (Bankfull)								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
.04 - .08	Very Fine	.062 - .125	S	0	0	0	0%	0%
	Fine	.125 - .25	A	17	0	17	17%	17%
	Medium	.25 - .50	N	1	0	1	1%	18%
	Coarse	.50 - 1.0	D	6	0	6	6%	24%
	Very Coarse	1.0 - 2.0	S	21	0	21	21%	45%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	45%
.16 - .22	Fine	4.0 - 5.7	G	1	0	1	1%	46%
.22 - .31	Fine	5.7 - 8.0	R	7	0	7	7%	53%
.31 - .44	Medium	8.0 - 11.3	A	18	0	18	18%	71%
.44 - .63	Medium	11.3 - 16.0	V	5	0	5	5%	76%
.63 - .89	Coarse	16.0 - 22.6	E	12	0	12	12%	88%
.89 - 1.26	Coarse	22.6 - 32.0	L	3	0	3	3%	91%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	3	0	3	3%	94%
1.77 - 2.5	Very Coarse	45.0 - 64.0		6	0	6	6%	100%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	100%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	100%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
Totals				100	0	100	100%	100%

d16	d35	d50	d84	d95
0.2	1.5	7.1	20.0	48.2

601 E Particle Size Distribution Sample #5- Wooded Area Upper (Bankfull)

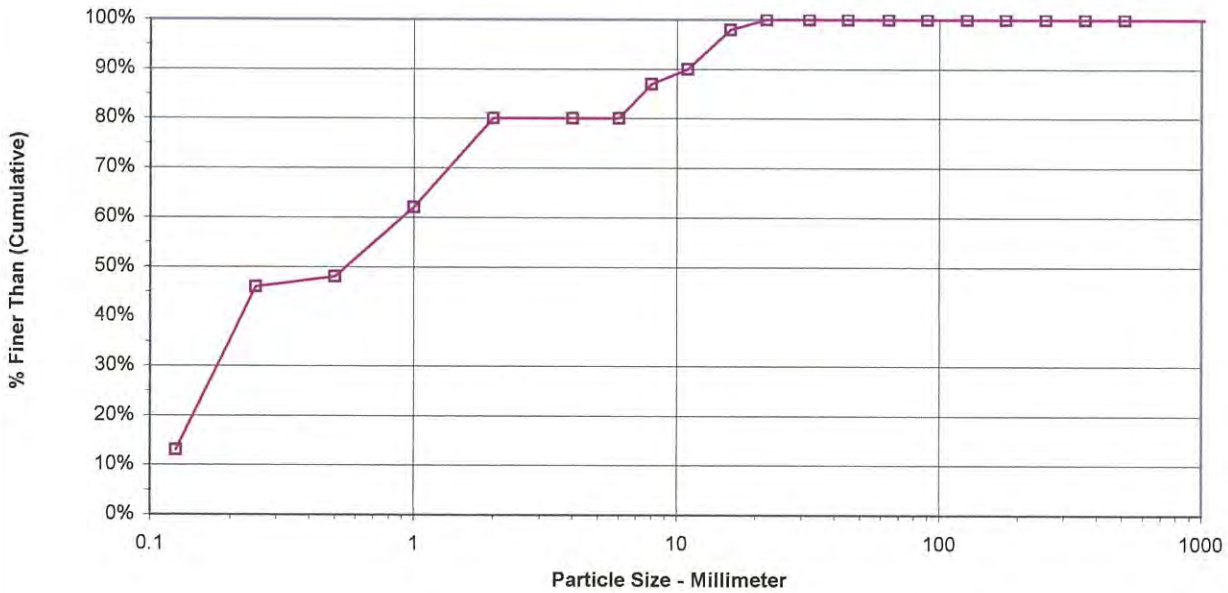


PEBBLE COUNT

Project: 601 East				Date: 1-3-2013				
Location: Downstream Below Pipe (Bankfull)								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	8	0	8	8%	8%
.04 - .08	Very Fine	.062 - .125	S	5	0	5	5%	13%
	Fine	.125 - .25	A	33	0	33	33%	46%
	Medium	.25 - .50	N	2	0	2	2%	48%
	Coarse	.50 - 1.0	D	14	0	14	14%	62%
	Very Coarse	1.0 - 2.0	S	18	0	18	18%	80%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	80%
.16 - .22	Fine	4.0 - 5.7	G	0	0	0	0%	80%
.22 - .31	Fine	5.7 - 8.0	R	7	0	7	7%	87%
.31 - .44	Medium	8.0 - 11.3	A	3	0	3	3%	90%
.44 - .63	Medium	11.3 - 16.0	V	8	0	8	8%	98%
.63 - .89	Coarse	16.0 - 22.6	E	2	0	2	2%	100%
.89 - 1.26	Coarse	22.6 - 32.0	L	0	0	0	0%	100%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	0	0	0	0%	100%
1.77 - 2.5	Very Coarse	45.0 - 64.0		0	0	0	0%	100%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	100%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	100%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
Totals				100	0	100	100%	100%

d16	d35	d50	d84	d95
0.1	0.2	0.6	7.1	14.1

601 E Particle Size Distribution Sample #7- Downstream Below Pipe (Bankfull)

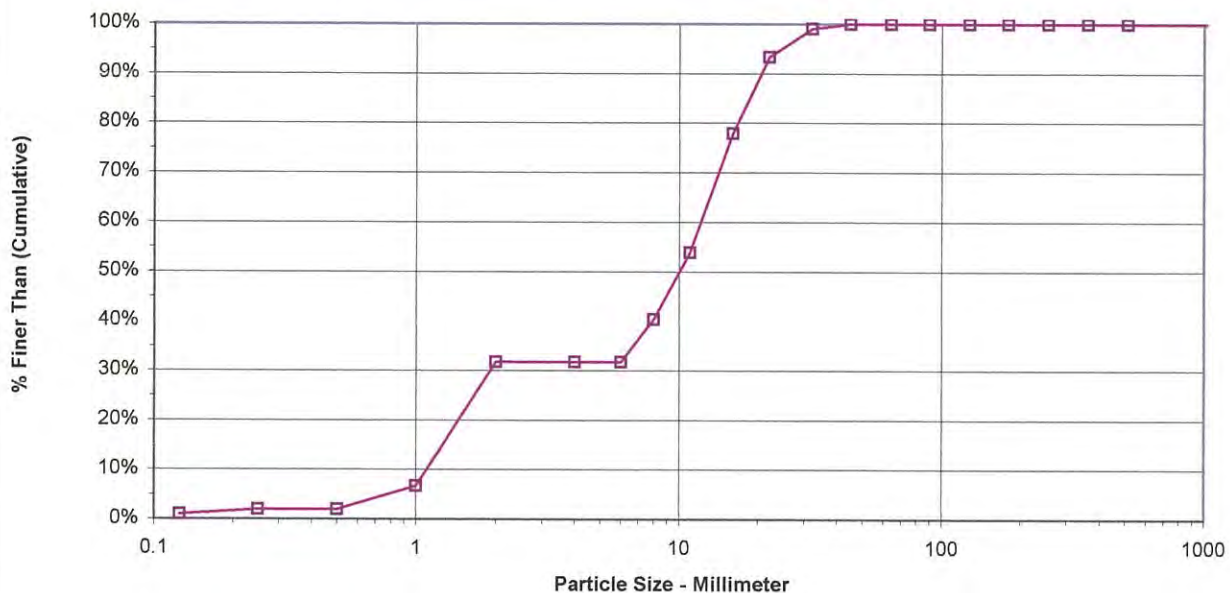


PEBBLE COUNT

Project: 601 East			Date: 1-3-2013					
Location: Downstream Below Pipe (wetted perimeter)								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
.04 - .08	Very Fine	.062 - .125	S	1	0	1	1%	1%
	Fine	.125 - .25	A	1	0	1	1%	2%
	Medium	.25 - .50	N	0	0	0	0%	2%
	Coarse	.50 - 1.0	D	5	0	5	5%	7%
	Very Coarse	1.0 - 2.0	S	26	0	26	25%	32%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	32%
.16 - .22	Fine	4.0 - 5.7	G	0	0	0	0%	32%
.22 - .31	Fine	5.7 - 8.0	R	9	0	9	9%	40%
.31 - .44	Medium	8.0 - 11.3	A	14	0	14	13%	54%
.44 - .63	Medium	11.3 - 16.0	V	25	0	25	24%	78%
.63 - .89	Coarse	16.0 - 22.6	E	16	0	16	15%	93%
.89 - 1.26	Coarse	22.6 - 32.0	L	6	0	6	6%	99%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	1	0	1	1%	100%
1.77 - 2.5	Very Coarse	45.0 - 64.0		0	0	0	0%	100%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	100%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	100%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
Totals				104	0	104	100%	100%

d16	d35	d50	d84	d95
1.4	6.8	10.1	18.4	25.0

601 E Particle Size Distribution Sample #8- Downstream Below Pipe (Wetted)



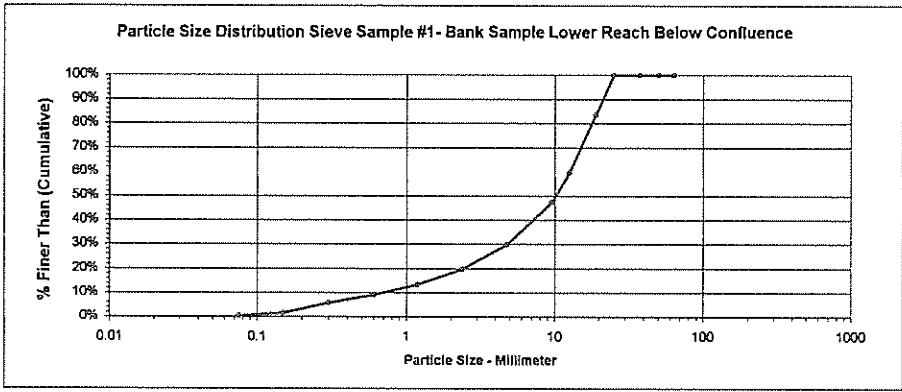
Sieve Sample #1

Pavement Type: Bank Soil Sample
 Sample Date: 1/4/2013
 Project: 801 East Existing Conditions
 Location: Below confluence of 2 tributaries in lower reach
 Largest Particle on bar =====> N/A

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175					0
2 inch	50	1.195					0
1 1/2 inch	37.5	1.25					0
1 inch	25	1.23					0
3/4 inch	19	1.245	1.98				0.715
1/2 inch	12.5	1.21	2.27				1.08
3/8 inch	9.5	1.225	1.78				0.535
No. 4	4.75	1.145	1.82				0.775
No. 8	2.38	1.07	1.51				0.44
No. 16	1.18	0.955	1.24				0.285
No. 30	0.6	0.9	1.09				0.19
No. 50	0.3	0.815	0.95				0.145
No. 100	0.15	0.775	0.98				0.185
No. 200	0.075	0.765	0.81				0.045
Passing 200	<0.075	1.08	1.1				0.02

Total Sample Weight =====> 4.395

Sieve Sample #1						
Inches	Sieve Size	Millimeter < #200	S/C	Wt. Retained (lbs)	% Passing	% Cumulative
0.0029	#200	0.0750	S	0.045	1.02%	1.48%
0.0059	#100	0.150	A	0.185	4.21%	5.69%
0.0117	#50	0.30	H	0.145	3.30%	8.90%
0.0234	#30	0.60	F	0.19	4.32%	13.31%
0.0469	#16	1.18	S	0.285	6.48%	19.80%
0.0937	#8	2.36	G	0.44	10.01%	29.81%
0.187	#4	4.75	R	0.775	17.63%	47.44%
0.374	3/8"	9.50	A	0.535	12.17%	59.61%
0.5	1/2"	12.50	V	1.06	24.12%	83.73%
0.748	3/4"	19.0	E	0.715	16.27%	100.00%
0.9843	1"	25.0	L	0	0.00%	100.00%
1.4764	1 1/2"	37.5	S	0	0.00%	100.00%
1.9885	2"	50.0		0	0.00%	100.00%
2.5	2 1/2"	63.0		0	0.00%	100.00%
			C	0	0.00%	100.00%
			O	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			I	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
Totals				4.395	100%	100%



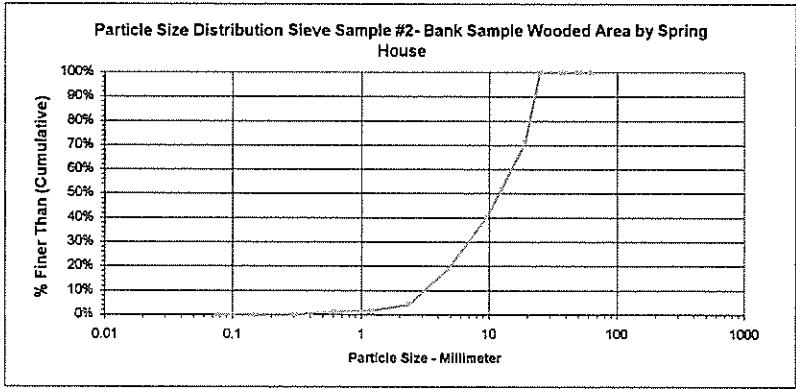
Sieve Sample #2

Pavement Type: Bank Sample
 Sample Date: 1/3/2013
 Project: 601 East Existing Conditions
 Location: Upper Wooded Area by Spring House
 Largest Particle on bar ==> N/A

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175					0
2 inch	50	1.195					0
1 1/2 inch	37.5	1.25					0
1 inch	25	1.23					0
3/4 inch	19	1.245	1.94				0.695
1/2 inch	12.5	1.21	1.67				0.46
3/8 inch	9.5	1.225	1.51				0.285
No. 4	4.75	1.145	1.09				0.515
No. 8	2.36	1.07	1.42				0.35
No. 16	1.18	0.955	1.02				0.065
No. 30	0.6	0.9	0.91				0.01
No. 50	0.3	0.815	0.84				0.025
No. 100	0.15	0.775					0
No. 200	0.075	0.765					0
Passing 200	<0.075	1.08					0

Total Sample Weight =====> 2.405

Sieve Sample #2						
Location:	0					
Project:	0					
Inches	Sieve Size	Millimeter		Wt. Retained (lbs)	% Passing	% Cumulative
	< #200		S/C	0	0.00%	0.00%
0.0029	#200	0.0750	S	0	0.00%	0.00%
0.0059	#100	0.150	A	0	0.00%	0.00%
0.0117	#50	0.30	N	0.025	1.04%	1.04%
0.0234	#30	0.60	D	0.01	0.42%	1.46%
0.0460	#16	1.18	S	0.065	2.70%	4.16%
0.0937	#8	2.36	G	0.35	14.55%	18.71%
0.187	#4	4.75	R	0.515	21.41%	40.12%
0.374	3/8"	9.50	A	0.285	11.85%	51.98%
0.5	1/2"	12.50	V	0.46	19.13%	71.10%
0.748	3/4"	19.0	E	0.695	28.80%	100.00%
0.9843	1"	25.0	L	0	0.00%	100.00%
1.4764	1 1/2"	37.5	S	0	0.00%	100.00%
1.9885	2"	50.0		0	0.00%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			O	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
Totals				2.405	100%	100%



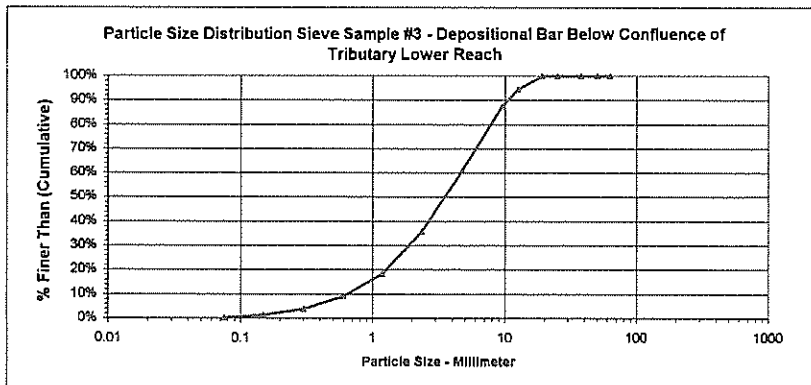
Sieve Sample #3

Pavement Type: Depositional Bar
Sample Date: 1/4/2013
Project: 601 East
Location: Depositional Bar in channel below confluence of 2 tributaries at lower stream segment below road
Largest Particle on bar =====> N/A

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175					0
2 inch	50	1.195					0
1 1/2 inch	37.5	1.25					0
1 inch	25	1.23					0
3/4 inch	18	1.245					0
1/2 inch	12.5	1.21	1.49	1.45			0.52
3/8 inch	9.5	1.225	1.52	1.59			0.65
No. 4	4.75	1.145	2.54	2.23			2.48
No. 8	2.36	1.07	2.36	2.15			2.37
No. 16	1.18	0.955	1.83	1.72			1.84
No. 30	0.6	0.9	1.35	1.31			0.88
No. 50	0.3	0.815	1.07	1.05			0.49
No. 100	0.15	0.775	0.89	0.89			0.23
No. 200	0.075	0.765	0.81	0.83			0.11
Passing 200	<0.075	1.08	1.1	1			0.02

Total Sample Weight =====> **9.38**

Sieve Sample #3						
Inches	Sieve Size	Millimeter	SIC	Wt. Retained (lbs)	% Passing	% Cumulative
		< #200		0.02	0.21%	0.21%
0.0029	#200	0.0750	S	0.11	1.17%	1.39%
0.0059	#100	0.150	A	0.23	2.45%	3.84%
0.0117	#50	0.30	N	0.49	5.22%	9.06%
0.0234	#30	0.60	D	0.86	9.17%	18.23%
0.0460	#16	1.18	S	1.64	17.45%	35.71%
0.0937	#8	2.36	G	2.37	25.27%	60.98%
0.187	#4	4.75	R	2.48	26.44%	87.42%
0.374	3/8"	9.50	A	0.66	7.04%	94.46%
0.5	1/2"	12.50	V	0.52	5.54%	100.00%
0.748	3/4"	19.0	E	0	0.00%	100.00%
0.9843	1"	25.0	L	0	0.00%	100.00%
1.4764	1 1/2"	37.5	S	0	0.00%	100.00%
1.9685	2"	50.0		0	0.00%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			G	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			C	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
Totals				9.38	100%	100%



Sieve Sample #4

Pavement Type:

Sample Date:

Project:

Location:

Largest Particle on bar =====>

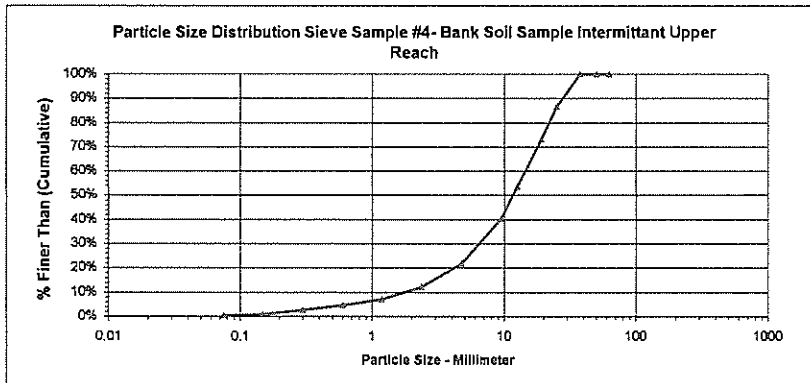
Bank Soil Sample
1/3/2013
601 East Existing Conditions
Intermittant upper reach

N/A

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175					0
2 inch	50	1.195					0
1 1/2 inch	37.5	1.25					0
1 inch	25	1.23	2.03				0.8
3/4 inch	19	1.245	2.05				0.805
1/2 inch	12.5	1.21	2.37				1.16
3/8 inch	9.5	1.225	2.01				0.785
No. 4	4.75	1.145	2.25				1.105
No. 8	2.38	1.07	1.65				0.58
No. 16	1.18	0.955	1.25				0.295
No. 30	0.6	0.9	1.05				0.15
No. 50	0.3	0.815	0.93				0.115
No. 100	0.15	0.775	0.88				0.105
No. 200	0.075	0.785	0.8				0.035
Passing 200	<0.075	1.08	1.1				0.02

Total Sample Weight =====> **5.955**

Inches	Sieve Size	Millimeter	S/C	Wt. Retained (lbs)	% Passing	% Cumulative
0.0029	#200	0.0750	S	0.035	0.34%	0.34%
0.0059	#100	0.150	A	0.105	1.76%	2.69%
0.0117	#50	0.30	N	0.115	1.93%	4.82%
0.0234	#30	0.60	D	0.15	2.52%	7.14%
0.0468	#15	1.18	S	0.205	4.95%	12.05%
0.0937	#8	2.38	G	0.58	9.74%	21.83%
0.187	#4	4.75	R	1.105	18.56%	40.39%
0.374	3/8"	9.50	A	0.785	13.18%	53.57%
0.5	1/2"	12.50	V	1.16	19.48%	73.05%
0.748	3/4"	19.0	E	0.805	13.52%	86.57%
0.9843	1"	25.0	L	0.8	13.43%	100.00%
1.4764	1 1/2"	37.5	S	0	0.00%	100.00%
1.9685	2"	50.0		0	0.00%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			O	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
Totals				5.955	100%	100%



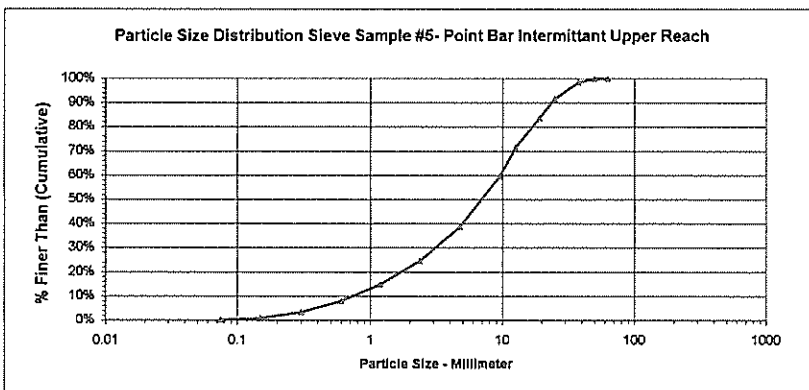
Sieve Sample #5

Pavement Type:	Point Bar Sample
Sample Date:	1/3/2013
Project:	601 East Existing Conditions
Location:	Intermittant upper reach
Largest Particle on bar =====>	2.5 inches

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175					0
2 inch	50	1.195					0
1 1/2 inch	37.5	1.25		1.6			0.35
1 inch	25	1.23	1.74	1.79	1.79		1.63
3/4 inch	19	1.245	1.77	1.92	1.93		1.885
1/2 inch	12.5	1.21	2.07	2.37	2.08		2.89
3/8 inch	9.5	1.225	2.25	1.94	2.3		2.815
No. 4	4.75	1.145	2.48	2.83	1.84	2.58	4.93
No. 8	2.36	1.07	1.82	2.11	1.37	2.3	3.32
No. 16	1.18	0.955	1.34	1.68	1.39	1.7	2.29
No. 30	0.6	0.9	1.18	1.33	1.29	1.41	1.61
No. 50	0.3	0.815	0.95	1.13	1.12	1.19	1.13
No. 100	0.15	0.775	0.88	0.92	0.95	0.95	0.58
No. 200	0.075	0.765	0.79	0.81	0.8	0.8	0.14
Passing 200	<0.075	1.08	1.09	1.09	1.09	1.1	0.05

Total Sample Weight =====> **23.62**

Sieve Sample #4						
Location:	0					
Project:						
Inches	Sieve Size	Millimeter	S/C	Wt. Retained (lbs)	% Passing	% Cumulative
		< #200		0.05	0.21%	0.21%
0.0029	#200	0.0750	S	0.14	0.56%	0.80%
0.0059	#100	0.150	A	0.58	2.40%	3.28%
0.0117	#50	0.30	N	1.13	4.78%	8.04%
0.0234	#30	0.60	D	1.61	6.82%	14.86%
0.0462	#15	1.18	S	2.29	9.70%	24.56%
0.0937	#8	2.36	G	3.32	14.06%	38.61%
0.187	#4	4.75	R	4.93	20.87%	59.48%
0.374	3/8"	9.50	A	2.815	11.92%	71.40%
0.5	1/2"	12.50	V	2.89	12.24%	83.64%
0.746	3/4"	19.0	E	1.085	7.66%	91.30%
0.9843	1"	25.0	L	1.63	6.90%	98.20%
1.4784	1 1/2"	37.5	S	0.35	1.48%	100.00%
1.9685	2"	50.0		0	0.00%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			O	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
Totals				23.62	100%	100%



Sieve Sample #6

Pavement Type:

Sample Date:

Project:

Location:

Largest Particle on bar =====>

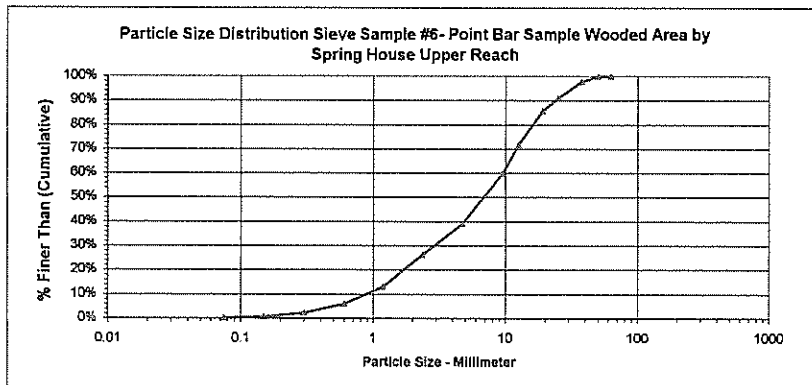
Bank Soil Sample
1/3/2013
601 East Existing Conditions
Intermittent upper reach

2.3 inches

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Sieve + Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175	1.175				0
2 inch	50	1.195	1.195				0
1 1/2 inch	37.5	1.25	1.25	1.65			0.4
1 inch	25	1.23	1.89	1.72			1.15
3/4 inch	19	1.245	1.89	1.53			0.93
1/2 inch	12.5	1.21	2.85	1.98			2.41
3/8 inch	9.5	1.225	2.5	2			2.05
No. 4	4.75	1.145	3.42	2.47			3.8
No. 8	2.36	1.07	2.64	1.7			2.2
No. 16	1.18	0.955	2.3	1.89			2.28
No. 30	0.6	0.9	1.46	1.57			1.23
No. 50	0.3	0.815	1.09	1.17			0.63
No. 100	0.15	0.775	0.91	0.9			0.26
No. 200	0.075	0.765	0.81	0.82			0.1
Passing 200	<0.075	1.08	1.09	1.1			0.03

Total Sample Weight =====> 17.27

Inches	Sieve Size	Millimeter	S/C	Wt. Retained (lbs)	% Passing	% Cumulative
0.0029	#200	0.0750	S	0.03	0.17%	0.17%
0.0059	#100	0.150	A	0.1	0.58%	0.75%
0.0117	#50	0.30	N	0.26	1.51%	2.26%
0.0234	#30	0.60	D	0.63	3.65%	5.91%
0.0469	#16	1.18	S	1.23	7.12%	13.03%
0.0937	#8	2.36	S	2.29	13.20%	26.23%
0.187	#4	4.75	G	2.2	12.74%	38.97%
0.374	3/8"	0.50	R	3.8	20.85%	59.81%
0.5	1/2"	12.50	A	2.05	11.87%	71.69%
0.748	3/4"	19.0	V	2.41	13.95%	85.64%
0.9843	1"	25.0	E	0.93	5.39%	91.02%
1.4764	1 1/2"	37.5	L	1.15	6.68%	97.68%
1.9885	2"	50.0	S	0.4	2.32%	100.00%
				0	0.00%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			G	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
Totals				17.27	100%	100%

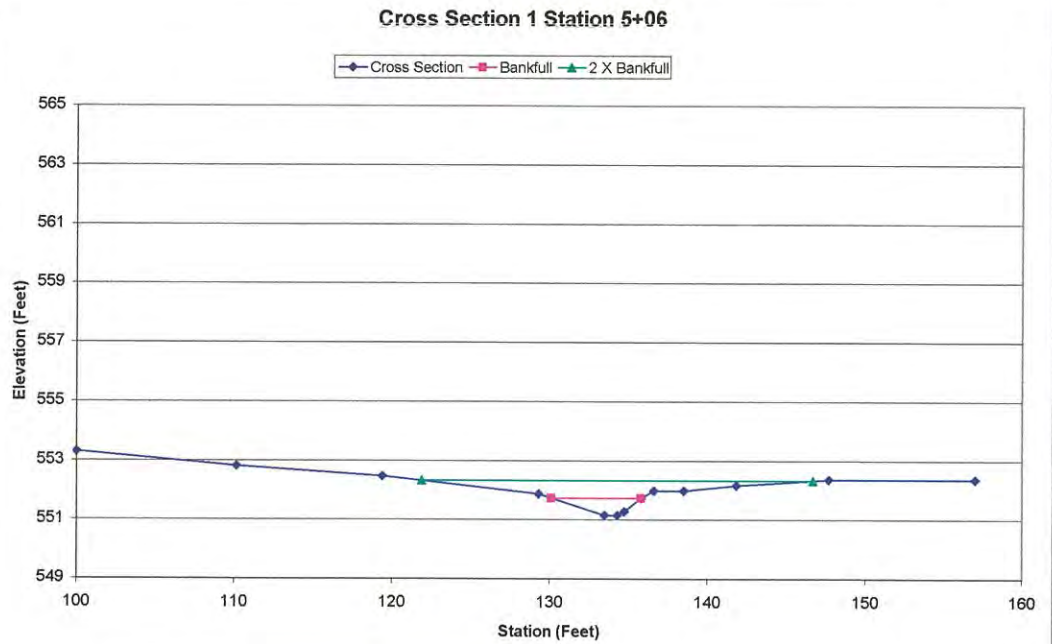


Above Lansford Road

Project: 601 East
 Cross Section 1
 Feature
 Station: 5+06
 Date: 15-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	1.7
W (BKF)	5.7
Max d	0.6
Mean d	0.3
W/D	18.9

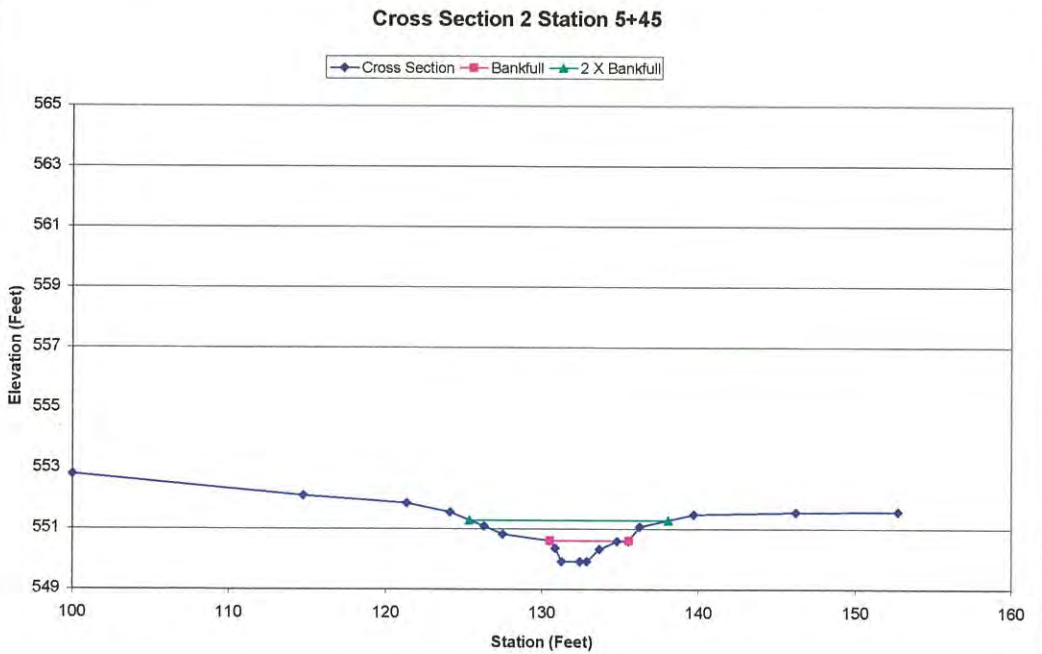
Station	Elevation	Surveyed Notes
100.00	553.30	
110.16	552.81	
119.38	552.47	
129.29	551.88	
133.50	551.14	TOE L
134.30	551.14	TW
134.74	551.28	TOE R
135.81	551.73	TOBR Bankfull right
136.63	551.98	
138.51	551.97	
141.82	552.17	
147.68	552.36	
157.02	552.35	



Project: 601 East
 Cross Section 2
 Feature
 Station: 5+45
 Date: 15-Jan-13
 Crew: BW,SV

Summary (bankfull)	
A (BKF)	1.9
W (BKF)	5.0
Max d	0.7
Mean d	0.4
W/D	13.3

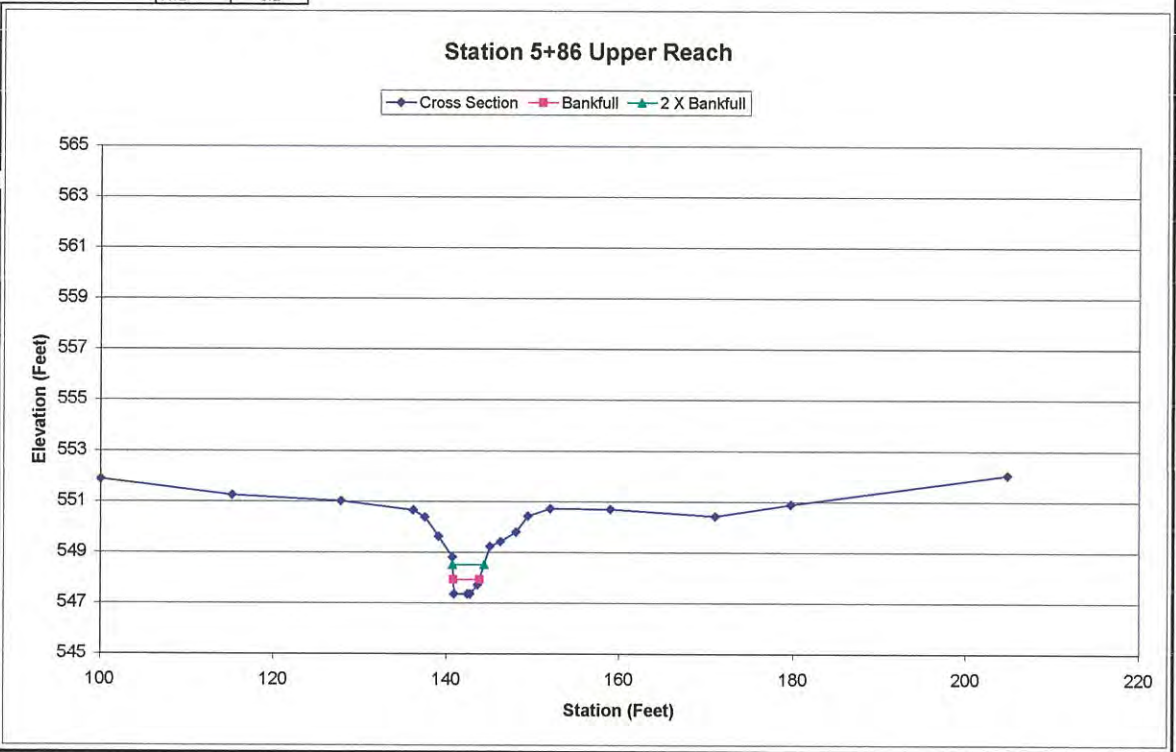
Station	Elevation	Surveyed Notes
3.62	470.32	RIFFLE
4.61	469.02	
8.41	468.74	
12.81	468.63	
14.12	468.42	
14.67	468.29	TOBL
15.35	468.11	bankfull left
16.57	468.01	
17.42	467.57	
18.41	467.09	TOE L
19.71	467.19	TW
20.57	467.24	
21.37	467.36	TOE R
22.90	467.81	
24.58	468.07	bankfull right
26.59	468.63	
30.67	469.38	TOBR
37.59	469.80	
42.92	470.65	
	472.01	



Project: 601 East
 Cross Section 3
 Feature
 Station: 5+86
 Date: 15-Jan-13
 Crew: BW,SV

Summary (bankfull)	
A (BKF)	1.5
W (BKF)	3.0
Max d	0.6
Mean d	0.5
W/D	6.2

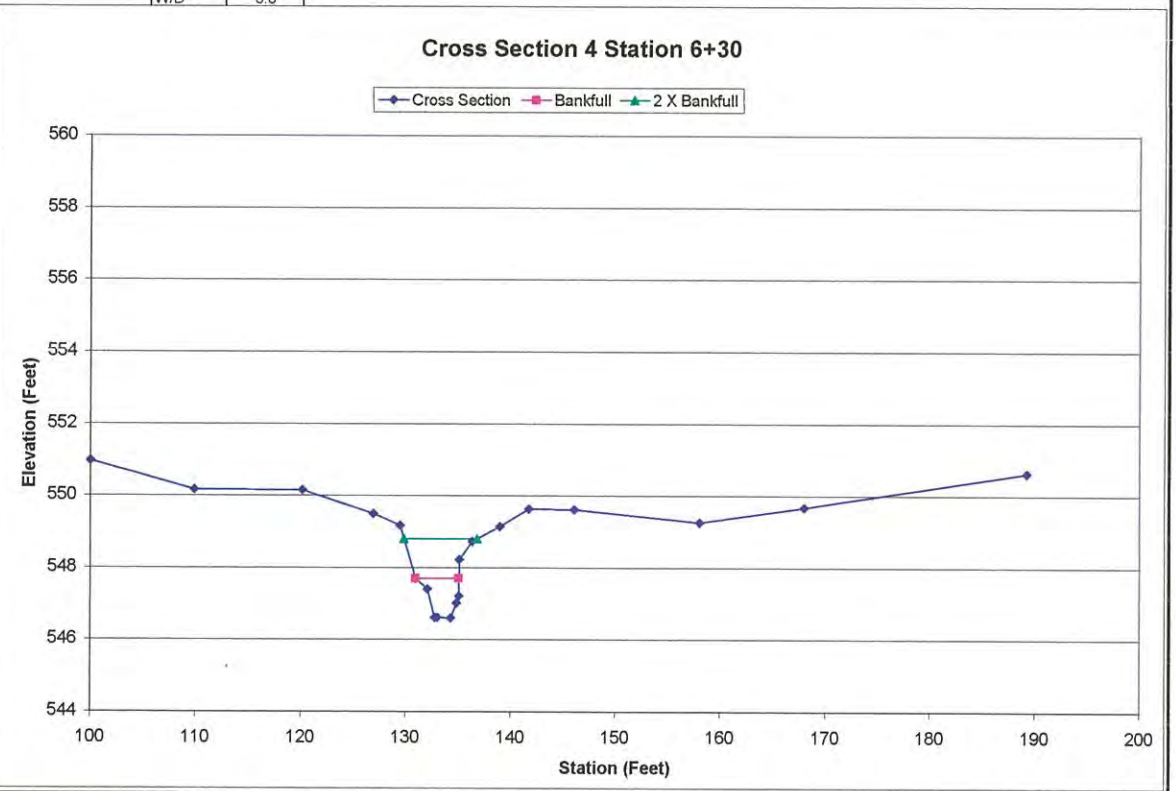
Surveyed		
Station	Elevation	Notes
100.00	551.89	
115.17	551.26	
127.77	551.02	
136.07	550.65	
137.46	550.39	
139.08	549.62	
140.64	548.80	TOBL
140.77	547.93	Bankfull left
140.82	547.36	TOE L
142.41	547.35	TW
142.69	547.35	
143.58	547.71	TOE R
144.95	549.23	TOBR
146.20	549.42	
147.98	549.80	
149.33	550.42	



Project: 601 East
 Cross Section 4
 Feature Riffle
 Station: 6+30
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	2.9
W (BKF)	4.1
Max d	1.1
Mean d	0.7
W/D	5.8

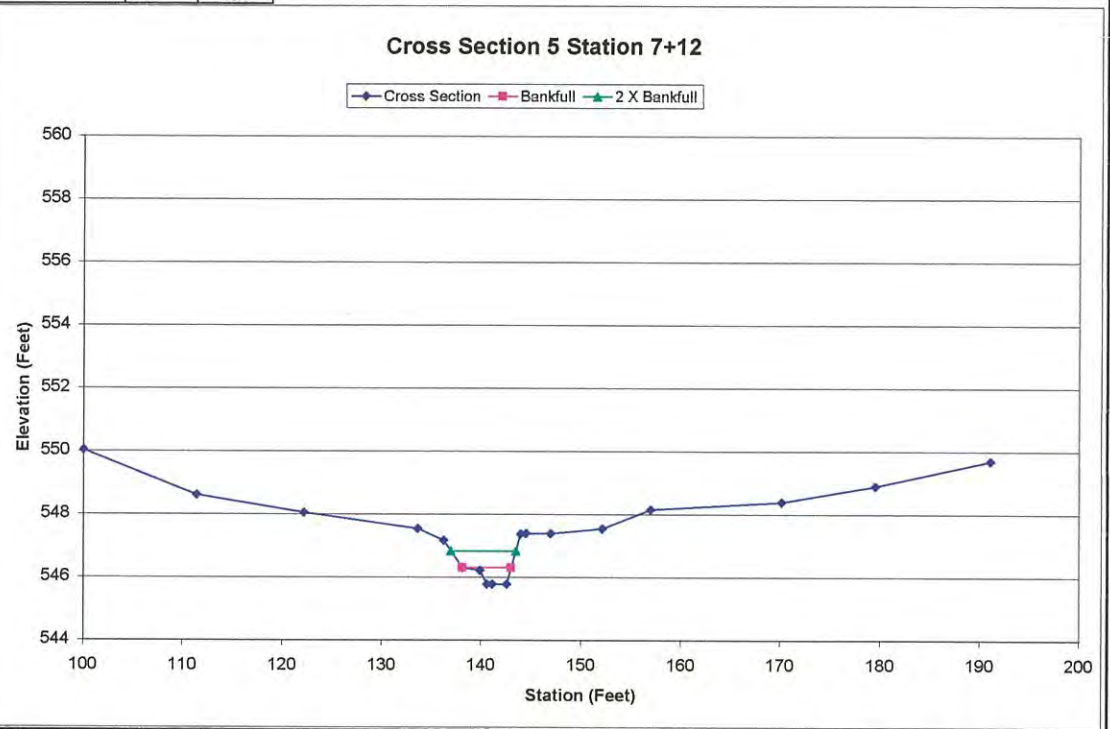
Surveyed		
Station	Elevation	Notes
100.00	550.96	
109.88	550.16	
120.15	550.15	
126.95	549.50	
129.47	549.16	TOBL
130.98	547.70	Bankfull left
132.07	547.40	
132.81	546.61	TOE L
133.04	546.61	TW
134.34	546.61	TOE R
134.86	547.01	
135.06	547.22	
135.14	548.22	TOBR
136.33	548.72	
138.98	549.15	
141.77	549.63	
146.06	549.62	
158.06	549.25	



Project: 601 East
 Cross Section 5
 Feature
 Station: 7+12
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	1.4
W (BKF)	4.9
Max d	0.5
Mean d	0.3
W/D	16.7

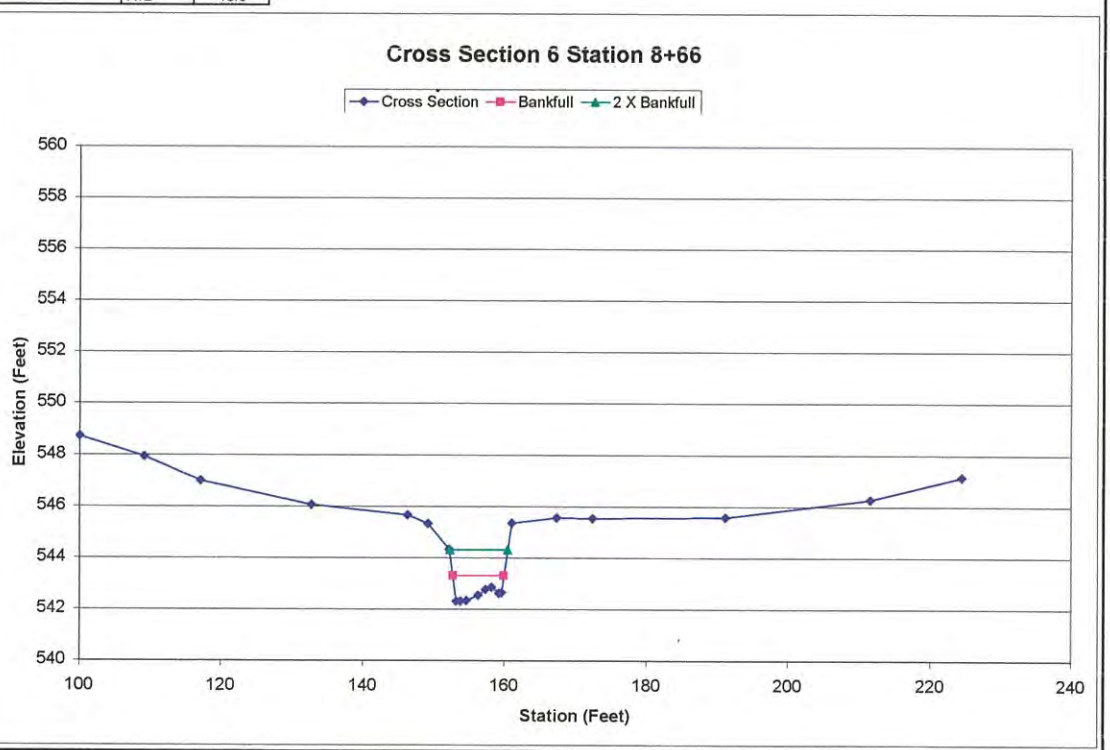
Surveyed		
Station	Elevation	Notes
	466.48	
2.75	464.95	
6.75	463.32	
8.66	462.95	
11.12	462.56	TOBL bankfull left
11.90	462.11	TOE L
13.65	461.93	TW
15.05	461.93	TOE R
16.66	462.47	
18.27	462.98	
21.75	463.30	
27.36	463.70	
30.01	464.52	STEP



Project: 601 East
 Cross Section 6
 Feature
 Station: 8+66
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	4.8
W (BKF)	7.2
Max d	1.0
Mean d	0.7
W/D	10.8

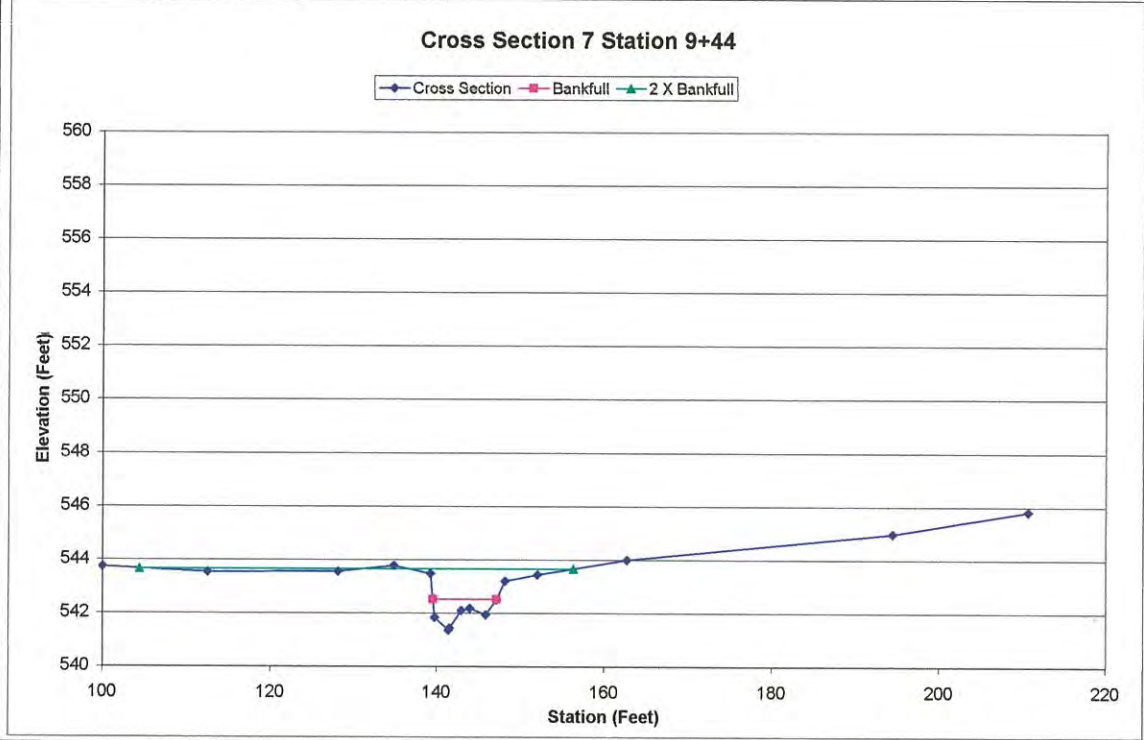
Surveyed		
Station	Elevation	Notes
100.00	546.72	
109.18	547.92	
117.07	546.99	
132.70	546.05	
146.36	545.66	
149.18	545.33	
152.25	544.33	TOBL
153.17	542.30	TOE L
153.77	542.31	
154.62	542.33	TW
156.26	542.54	
157.33	542.77	
158.15	542.86	Bankfull right



Project: 601 East
 Cross Section 7
 Feature
 Station: 9+44
 Date: 15-Jan-13
 Crew: BW,SV

Summary (bankfull)	
A (BKF)	3.9
W (BKF)	7.6
Max d	1.2
Mean d	0.5
W/D	14.8

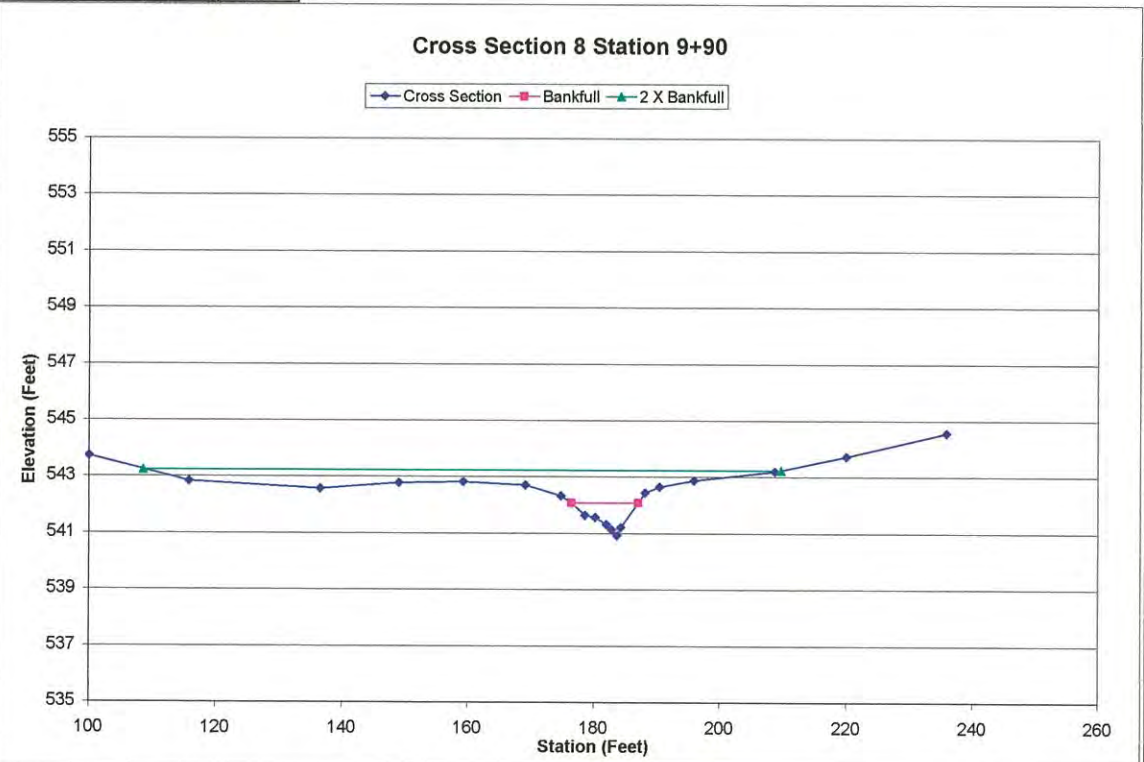
Surveyed		
Station	Elevation	Notes
100.00	543.73	
112.54	543.54	
128.13	543.57	
134.79	543.77	
139.23	543.48	TOBL
139.74	541.83	TOE L
141.41	541.36	TW
141.53	541.44	TOE R
142.94	542.09	TOBR
143.95	542.17	Bankfull right
145.86	541.94	
147.10	542.51	



Project: 601 East
 Cross Section 8
 Feature
 Station: 9+90
 Date: 15-Jan-13
 Crew: BW,SV

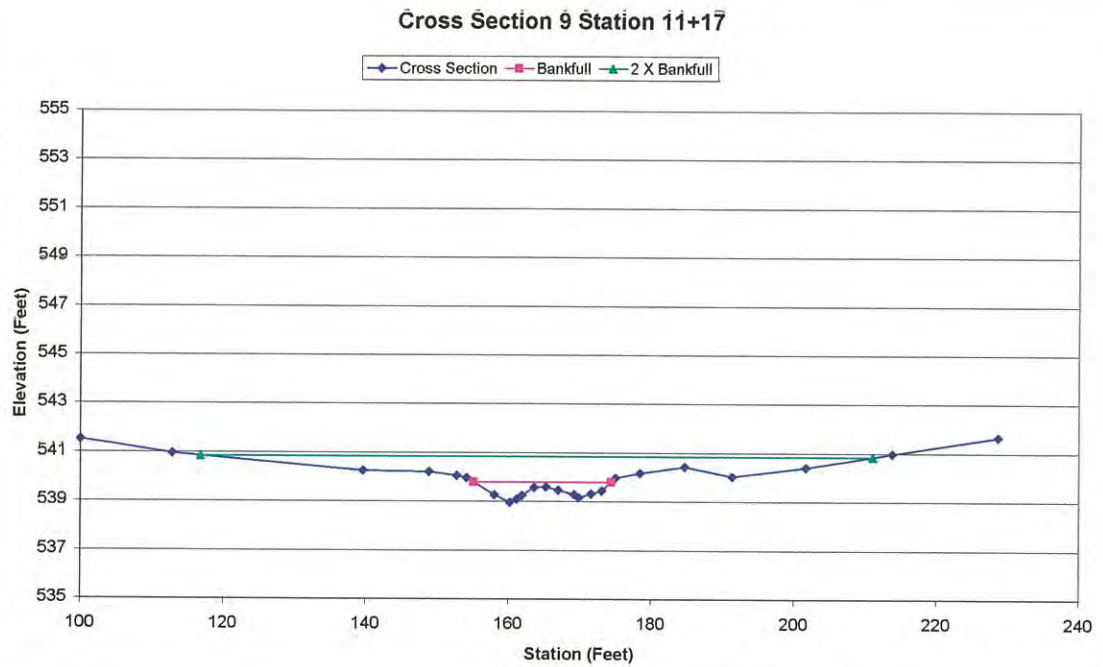
Summary (bankfull)	
A (BKF)	5.8
W (BKF)	10.6
Max d	1.2
Mean d	0.5
W/D	19.4

Surveyed		
Station	Elevation	Notes
100.00	543.77	
115.83	542.84	
136.53	542.56	
149.06	542.78	
159.31	542.81	
169.17	542.70	
174.71	542.32	
176.46	542.08	TOBL
178.58	541.65	Bankfull left
180.17	541.57	
181.92	541.33	



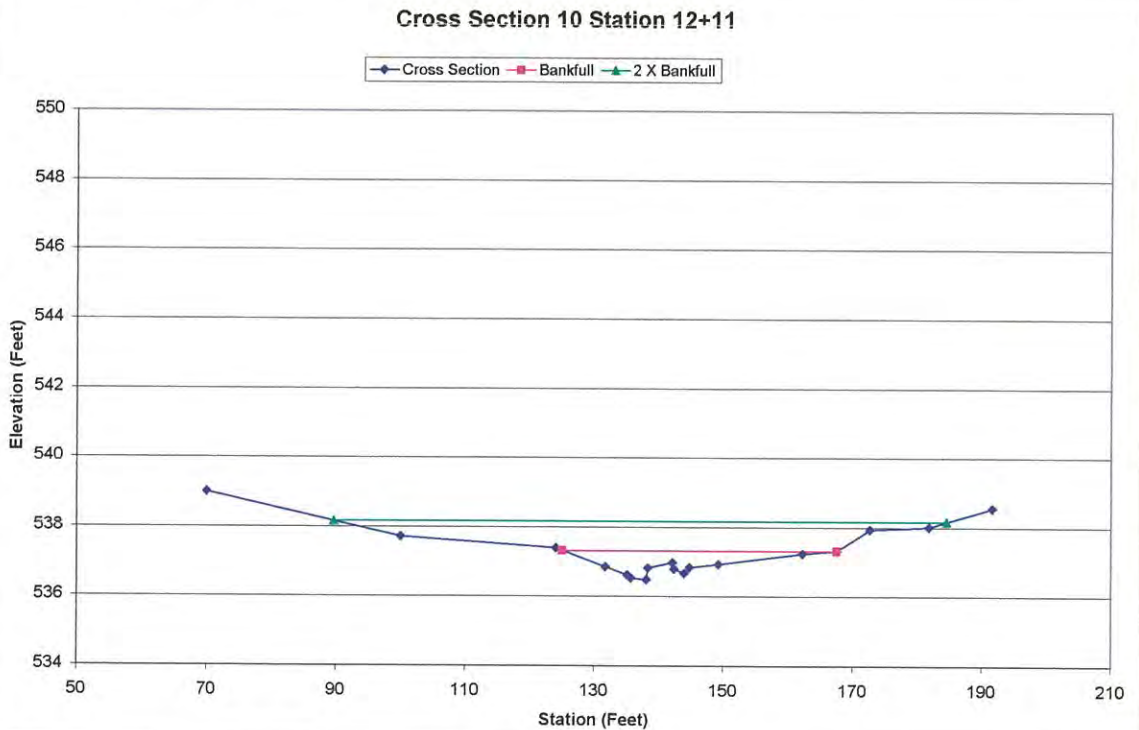
Project: 601 East	Summary (bankfull)	
Cross Section 9	A (BKF)	8.1
Feature	W (BKF)	19.4
Station: 11+17	Max d	0.8
Date: 15-Jan-13	Mean d	0.4
Crew: BW,SV	W/D	46.5

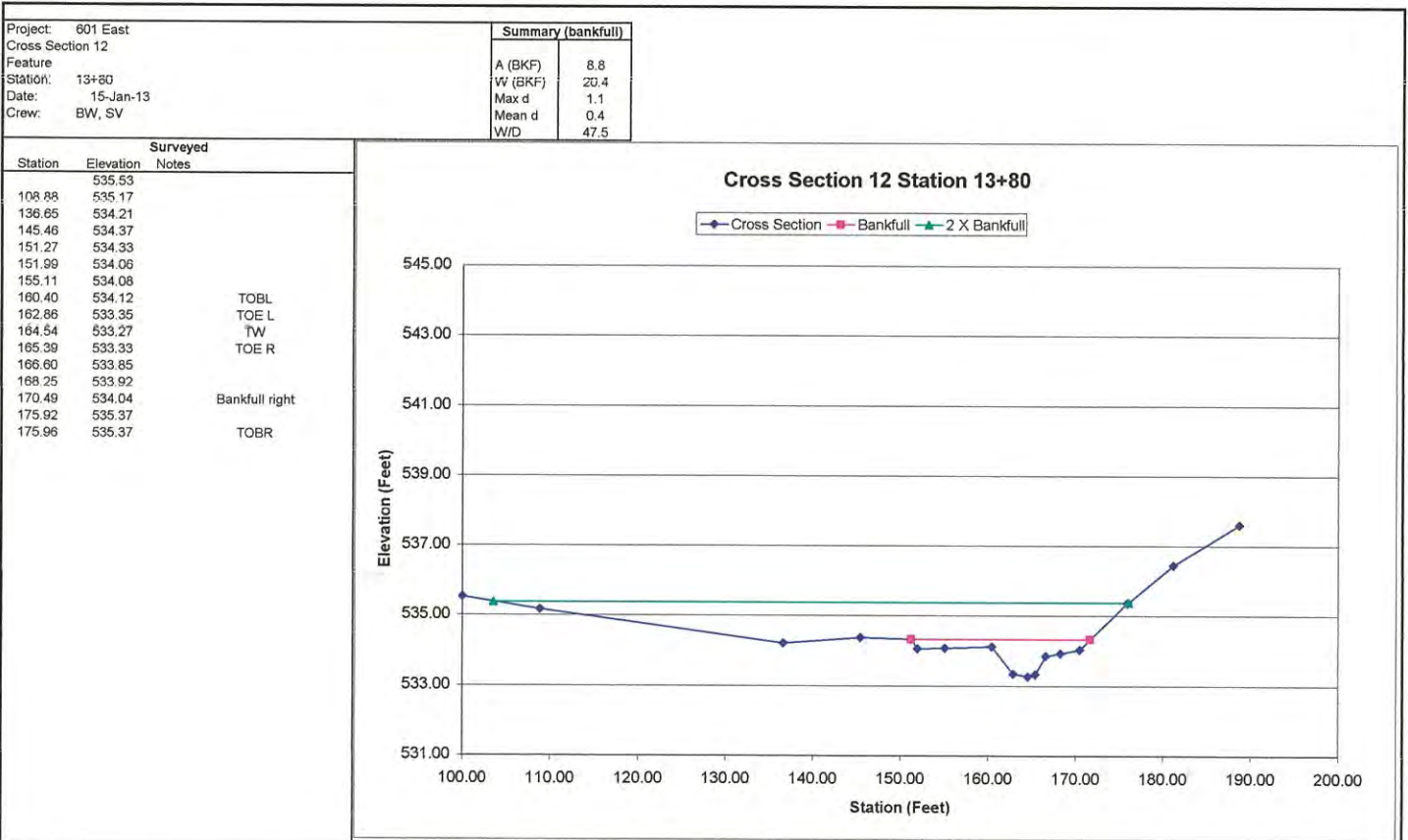
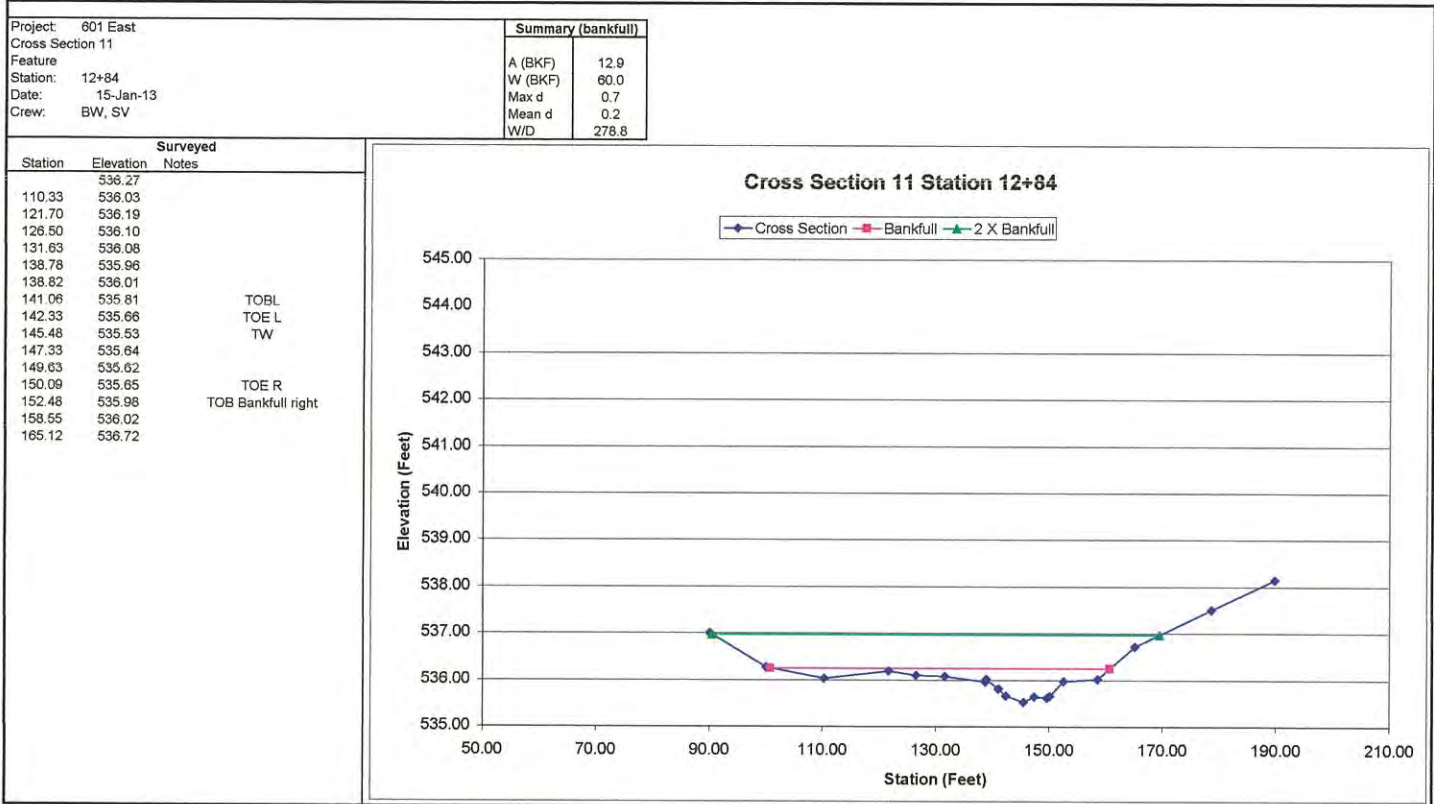
Surveyed		
Station	Elevation	Notes
	463.55	RIFFLE
8.11	461.23	
8.92	461.01	bankfull left
10.51	460.40	TOE L
12.00	460.28	TW
13.34	460.25	
14.10	460.32	TOE R
14.24	461.59	bankfull right
15.86	462.37	TOBR
18.81	462.69	
24.75	463.64	
30.86	465.60	



Project: 601 East	Summary (bankfull)	
Cross Section 10	A (BKF)	14.5
Feature	W (BKF)	42.5
Station: 12+11	Max d	0.8
Date: 15-Jan-13	Mean d	0.3
Crew: BW, SV	W/D	124.1

Surveyed		
Station	Elevation	Notes
	537.72	
124.05	537.39	TOBL
131.74	536.86	
135.15	536.62	
135.68	536.53	Toe L
138.08	536.49	TW
138.38	536.83	
142.17	536.98	
142.42	536.79	
143.99	536.67	
144.79	536.84	
149.26	536.93	TOBR
162.27	537.24	
167.53	537.32	Bankfull Right
172.64	537.94	
181.84	538.01	

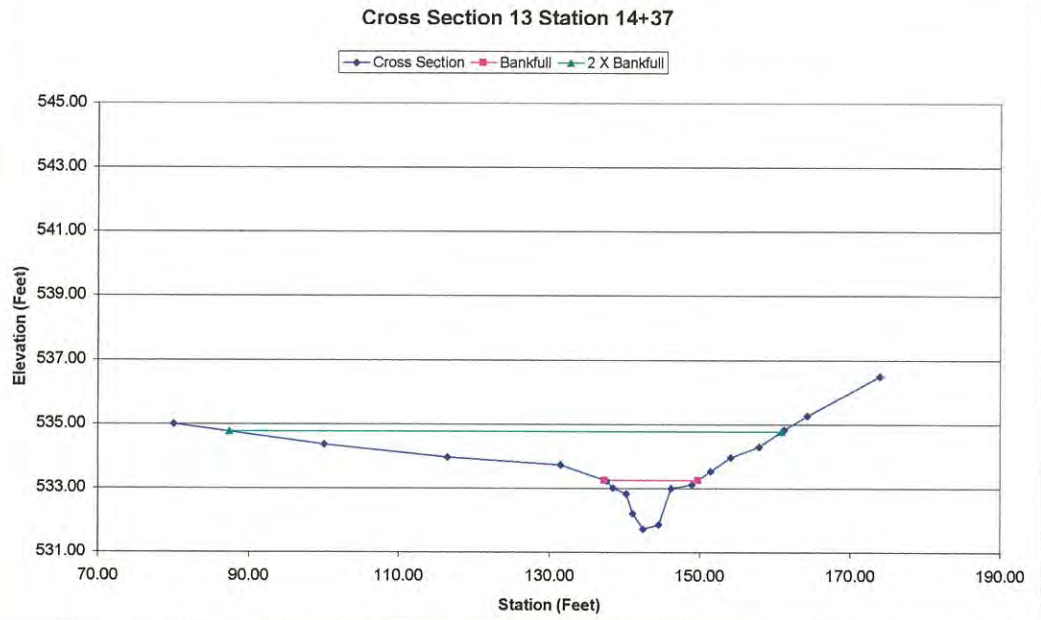




Project: 601 East
 Cross Section 13
 Feature
 Station: 14+37
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
MY0	
A (BKF)	8.1
W (BKF)	12.5
Max d	1.5
Mean d	0.6
W/D	19.3

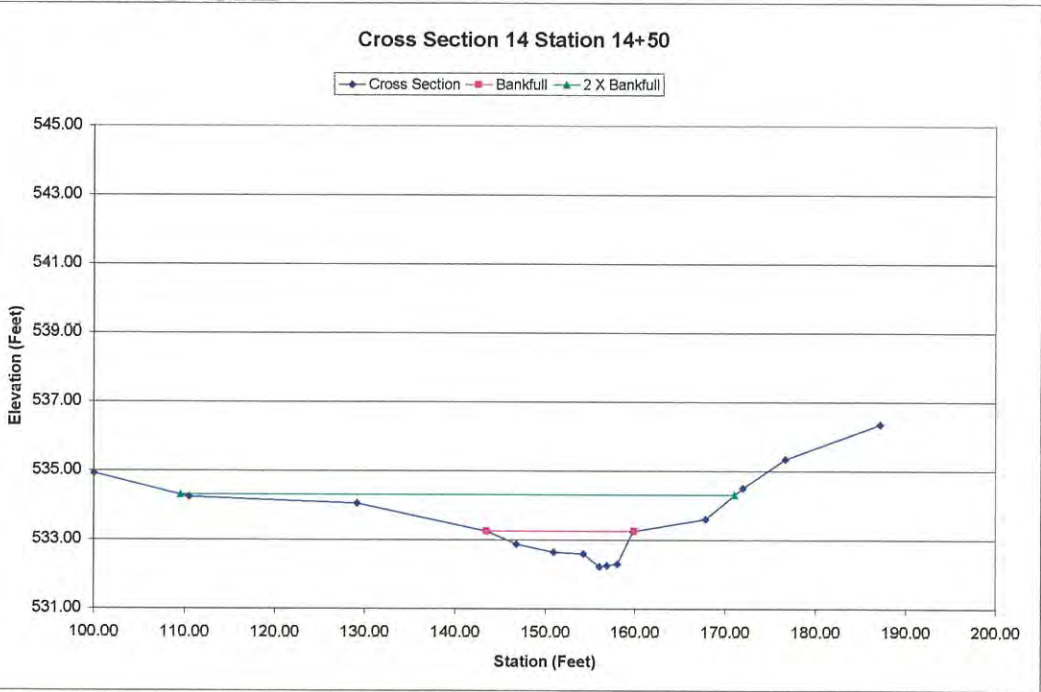
Surveyed		
Station	Elevation	Notes
	534.36	
116.42	533.96	
131.43	533.74	
137.61	533.22	
138.45	533.01	Bankfull left
140.20	532.84	TOBL
141.06	532.22	TOE L
142.49	531.74	TW
144.53	531.88	TOE R
146.19	533.00	TOBR
148.98	533.11	Bankfull right
151.41	533.53	
154.16	533.96	
157.82	534.29	
161.23	534.82	
164.28	535.25	



Project: 601 East
 Cross Section 14
 Feature
 Station: 14+50
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
MY0	
A (BKF)	9.1
W (BKF)	16.4
Max d	1.0
Mean d	0.6
W/D	29.8

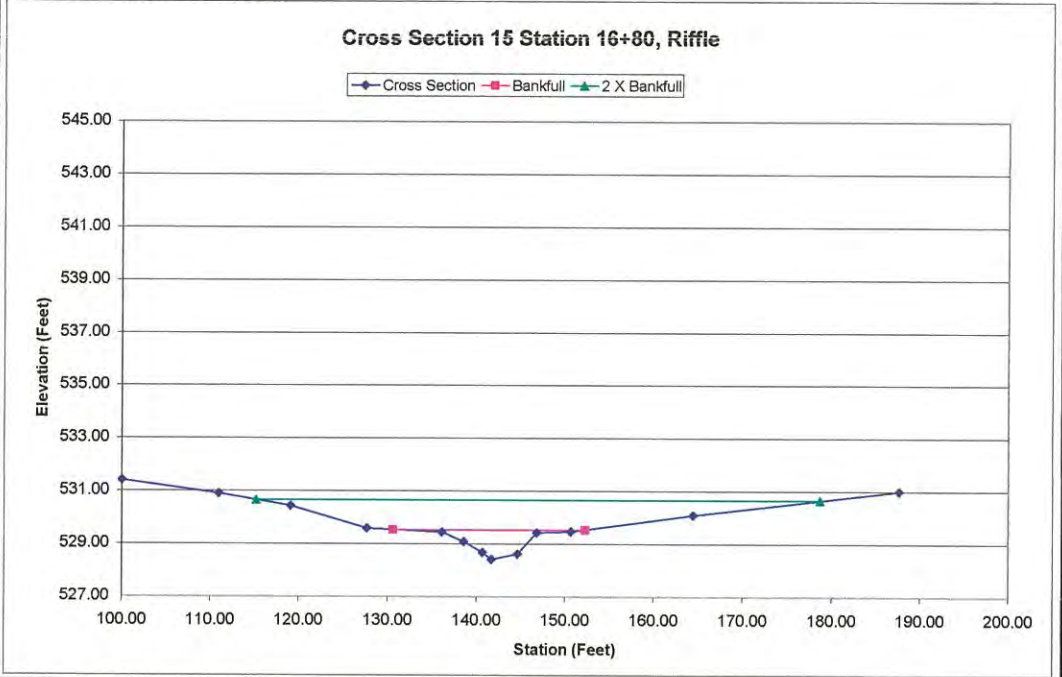
Surveyed		
Station	Elevation	Notes
	534.93	
110.50	534.24	
129.14	534.05	
143.50	533.25	
146.75	532.88	
150.93	532.64	Bankfull left
154.24	532.59	TOBL
156.01	532.23	TOE L
156.82	532.25	TW
158.00	532.30	TOE R
159.76	533.24	TOBR
167.78	533.61	Bankfull right
171.93	534.51	
176.64	535.34	
187.10	536.35	



Project: 601 East
 Cross Section 15
 Feature: Riffle
 Station: 16+80
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	8.8
W (BKF)	21.7
Max d	1.1
Mean d	0.4
W/D	53.6

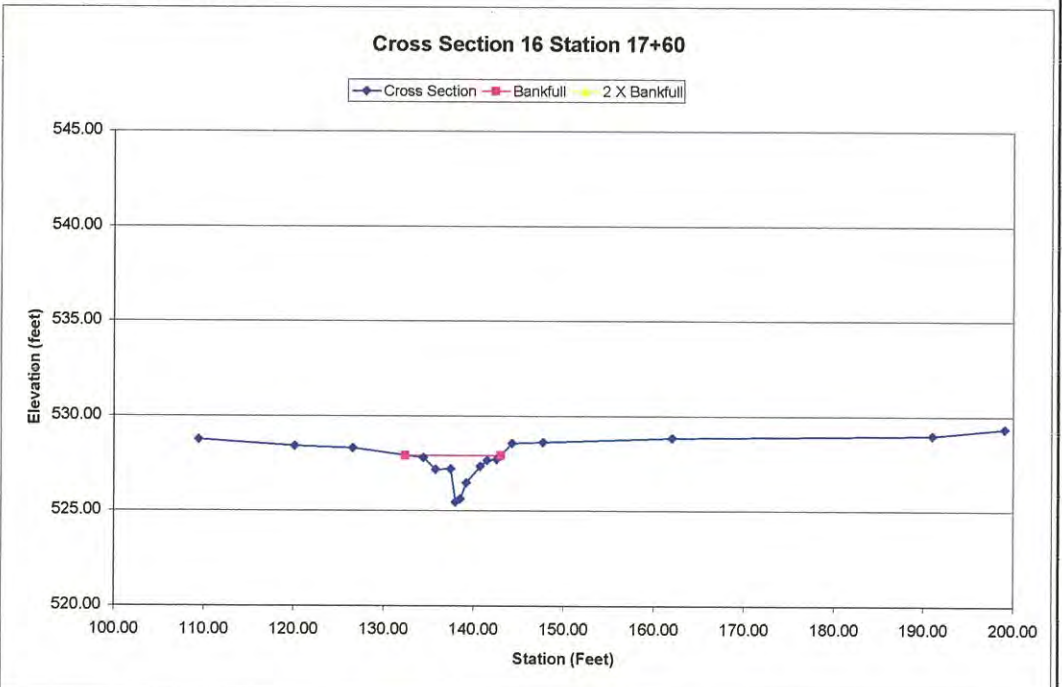
Station	Elevation	Notes
	531.41	
110.96	530.90	
119.10	530.43	
127.68	529.59	
136.08	529.45	TOBL
138.57	529.08	Bankfull left
140.66	528.68	TOE L
141.68	528.42	TW
144.66	528.61	TOE R
146.80	529.44	
150.66	529.46	
164.42	530.10	
187.64	531.01	



Project: 601 East
 Cross Section 16
 Feature: Riffle
 Station: 17+60
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	8.0
W (BKF)	10.6
Max d	2.5
Mean d	0.8
W/D	14.0

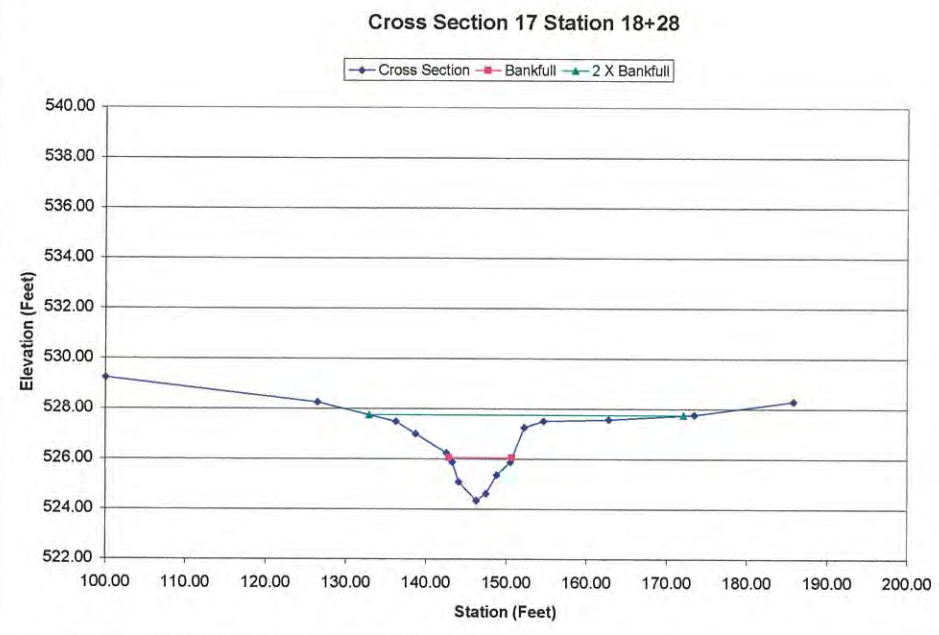
Station	Elevation	Notes
	528.76	
120.13	528.43	
126.60	528.32	
134.38	527.79	TOBL
135.76	527.17	Bankfull left
137.41	527.20	
137.97	525.47	TOE L
138.48	525.64	TW
139.17	526.48	TOE R
140.71	527.36	Bankfull right
141.46	527.65	
142.55	527.71	
144.25	528.55	TOBR
147.71	528.62	
162.02	528.84	
191.01	528.97	



Project: 601 East
 Cross Section 17
 Feature
 Station: 18+28
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	7.5
W (BKF)	7.8
Max d	1.7
Mean d	1.0
W/D	8.2

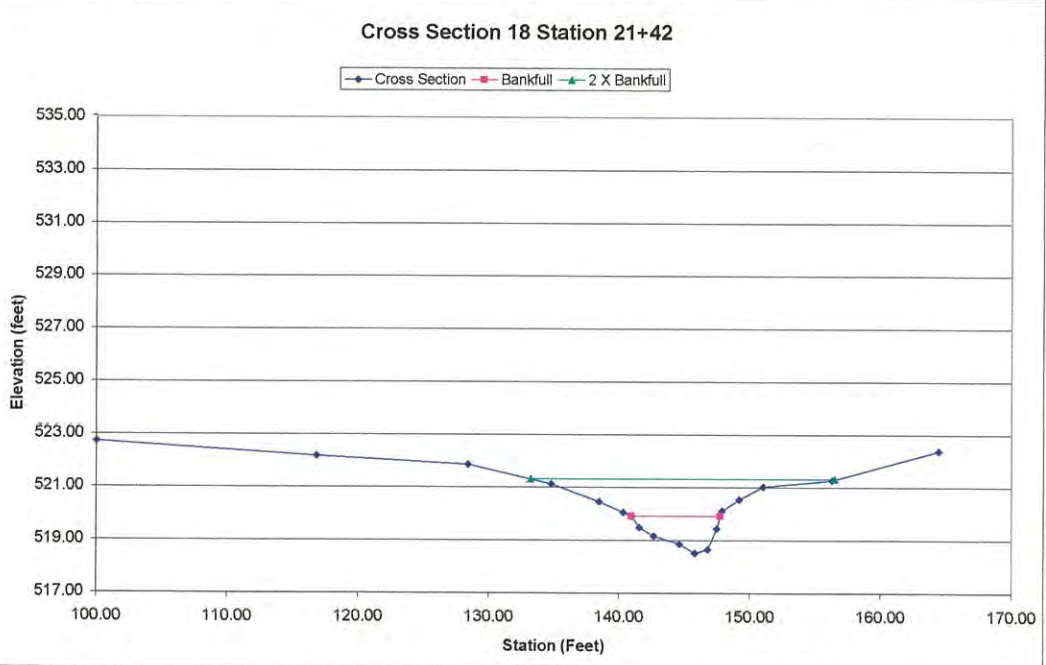
Station	Elevation	Notes
	529.23	
126.43	528.25	
136.19	527.49	
138.63	527.00	
142.53	526.22	TOBL Bankfull left
143.22	525.87	
144.02	525.09	TOE L
146.22	524.35	TW
147.41	524.62	TOE R
148.75	525.37	
150.48	525.87	Bankfull right
152.25	527.25	TOBR
154.65	527.52	
162.77	527.57	
173.38	527.77	
185.76	528.30	



Project: 601 East
 Cross Section 18
 Feature
 Station: 21+42
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	5.9
W (BKF)	6.8
Max d	1.4
Mean d	0.9
W/D	7.7

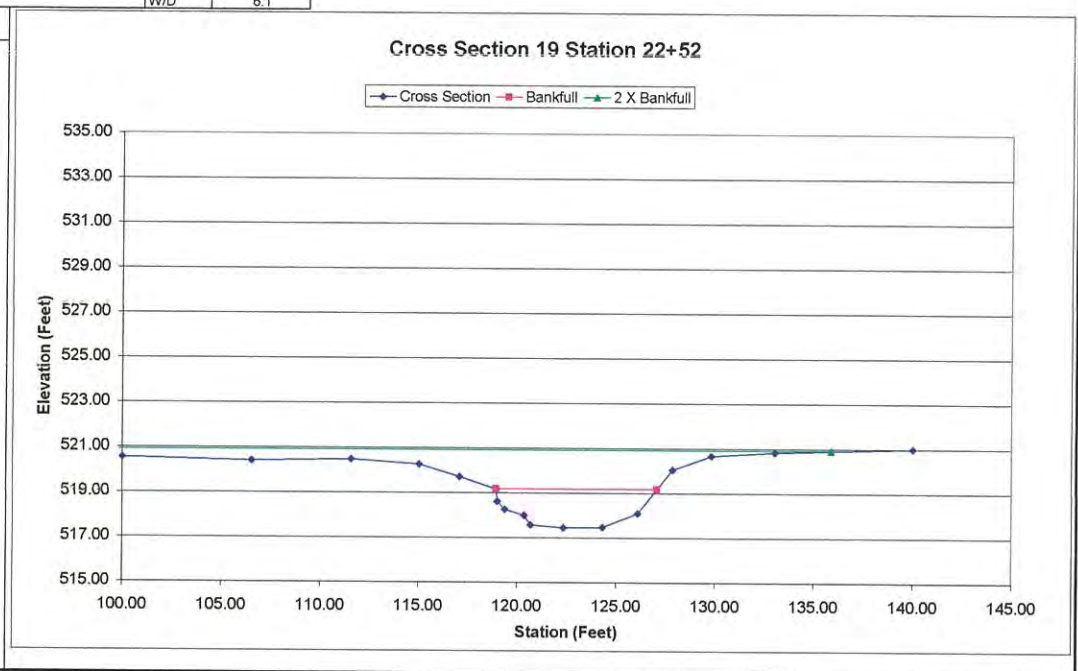
Station	Elevation	Notes
118.83	522.72	
128.44	521.86	
134.78	521.13	
138.49	520.46	Bankfull left
140.31	520.06	
140.97	519.91	
141.53	519.50	
142.64	519.17	TOE L
144.60	518.86	
145.77	518.51	TW
146.75	518.66	TOE R
147.45	519.45	Bankfull right
147.85	520.11	
149.19	520.54	TOBR
151.01	521.03	



Project: 801 East
 Cross Section 19
 Feature
 Station: 22+52
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	10.7
W (BKF)	8.1
Max d	1.7
Mean d	1.3
W/D	6.1

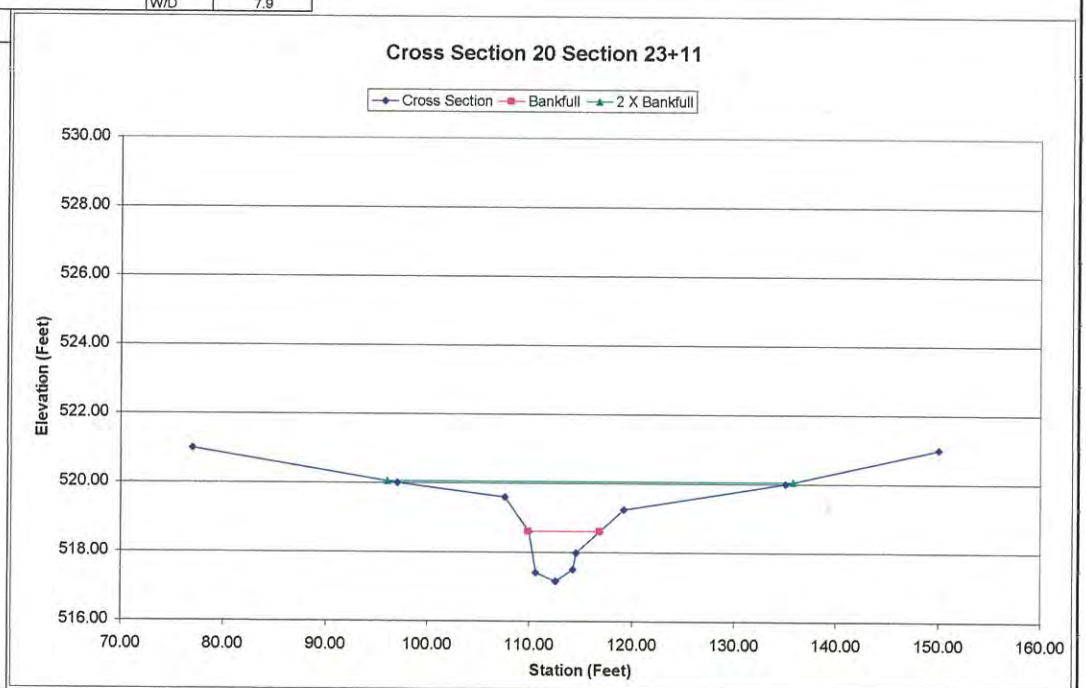
Station	Elevation	Notes
	520.55	
106.50	520.41	
111.58	520.49	
115.03	520.27	
117.08	519.70	
118.95	519.17	TOBL
119.01	518.61	Bankfull left
119.39	518.26	
120.34	518.01	
120.68	517.56	TOE L
122.33	517.44	TW
124.29	517.49	
126.08	518.10	TOE R
127.85	520.05	TOBR
129.81	520.68	
133.04	520.83	



Project: 801 East
 Cross Section 20
 Feature
 Station: 23+11
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	6.1
W (BKF)	6.9
Max d	1.4
Mean d	0.9
W/D	7.9

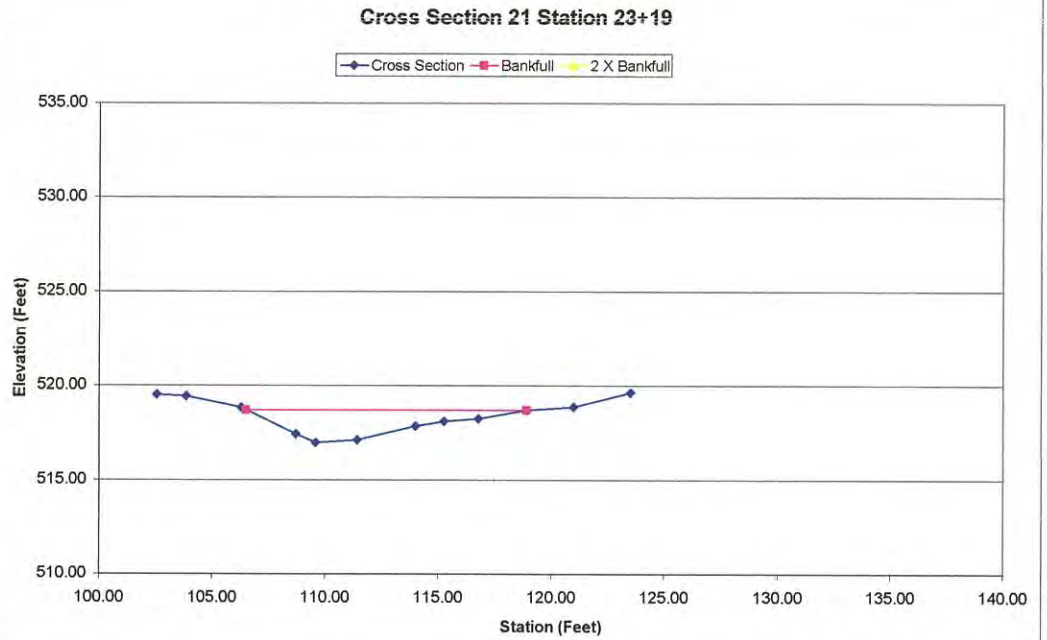
Station	Elevation	Notes
107.59	519.60	TOBL
109.91	519.60	bankfull left
110.63	517.42	TOE L
112.52	517.16	TW
114.20	517.50	TOE R
114.54	517.98	Bankfull right
116.83	518.61	TOBR
119.17	519.25	
135.00	520.00	
150.00	521.00	



Project: 601 East
 Cross Section 21
 Feature
 Station: 23+19
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	11.2
W (BKF)	12.4
Max d	1.7
Mean d	0.9
W/D	13.7

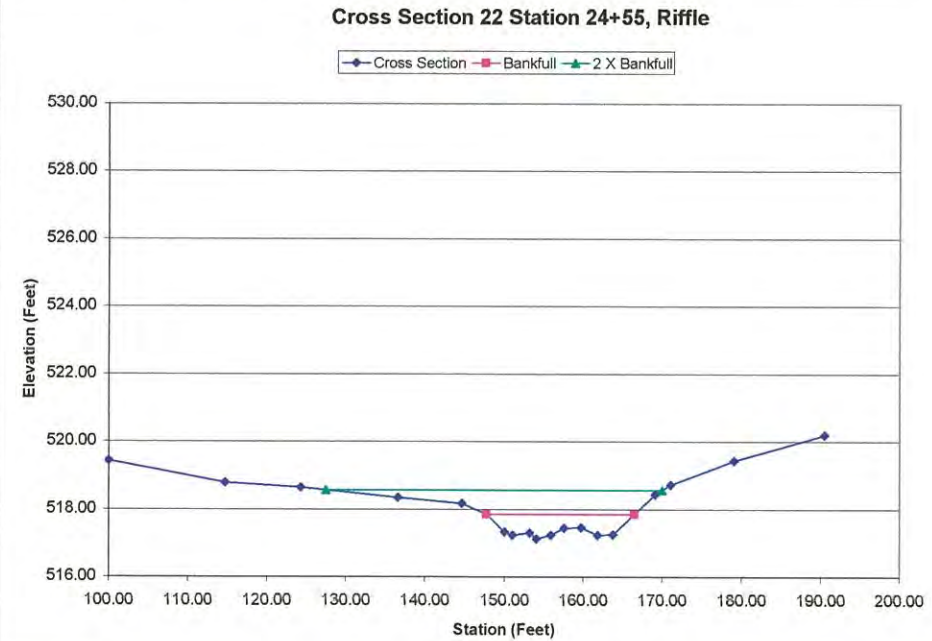
Surveyed		
Station	Elevation	Notes
	518.54	
103.84	519.44	
106.27	518.85	TOBL
108.72	517.42	TOE L
109.59	516.97	TW
111.43	517.12	TOE R
114.00	517.84	TOBR
115.25	518.10	
116.77	518.24	Bankfull right
118.91	518.71	
120.99	518.88	
123.51	519.65	



Project: 601 East
 Cross Section 22
 Feature Riffle
 Station: 24+55
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	9.0
W (BKF)	18.8
Max d	0.7
Mean d	0.5
W/D	39.2

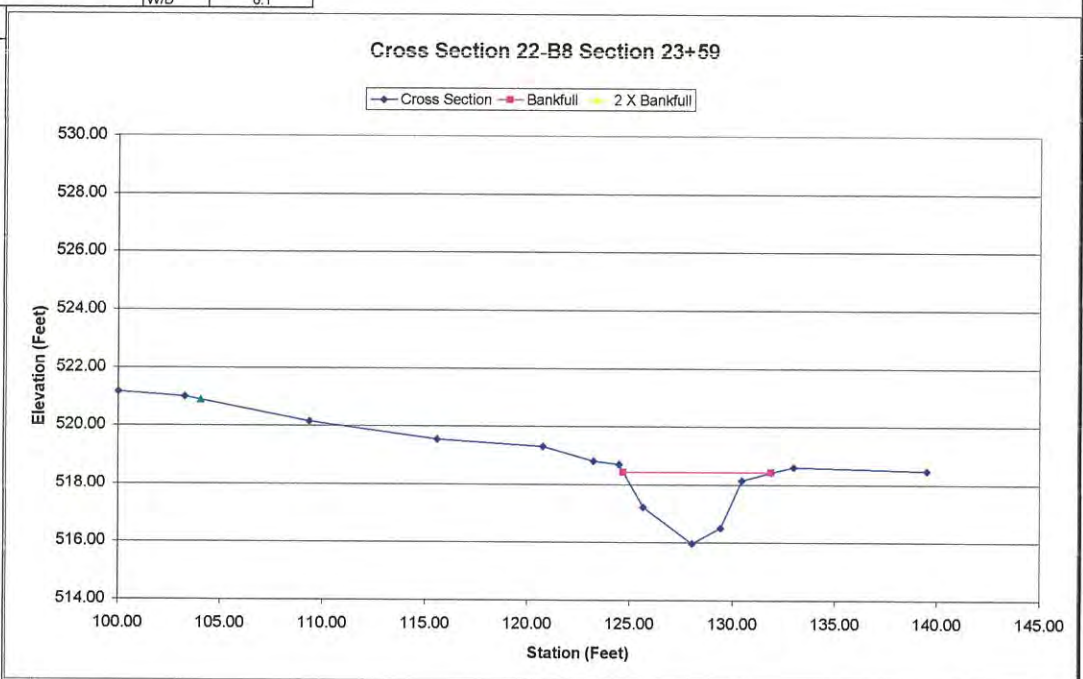
Surveyed		
Station	Elevation	Notes
	519.43	
114.72	518.78	
124.30	518.64	
136.57	518.34	
144.61	518.16	
147.74	517.85	TOBL Bankfull Left
150.01	517.32	TOE L
151.04	517.23	
153.18	517.30	
154.11	517.13	TW
155.92	517.24	
157.61	517.44	
159.79	517.46	
161.88	517.23	
163.79	517.24	TOE R
169.12	518.43	TOBR



Project: 601 East
 Cross Section 1
 Feature
 Station: 23+59
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	8.4
W (BKF)	7.2
Max d	2.5
Mean d	1.2
W/D	6.1

Station	Elevation	Surveyed Notes
	521.18	
103.26	520.99	
109.36	520.15	
115.57	519.54	
120.76	519.31	TOBL
123.24	518.80	
124.48	518.69	
125.64	517.22	TOE L
126.02	515.97	TW
129.39	516.51	TOE R
130.43	518.14	
131.88	518.42	Bankfull right
132.97	518.60	TOBR
139.50	518.47	

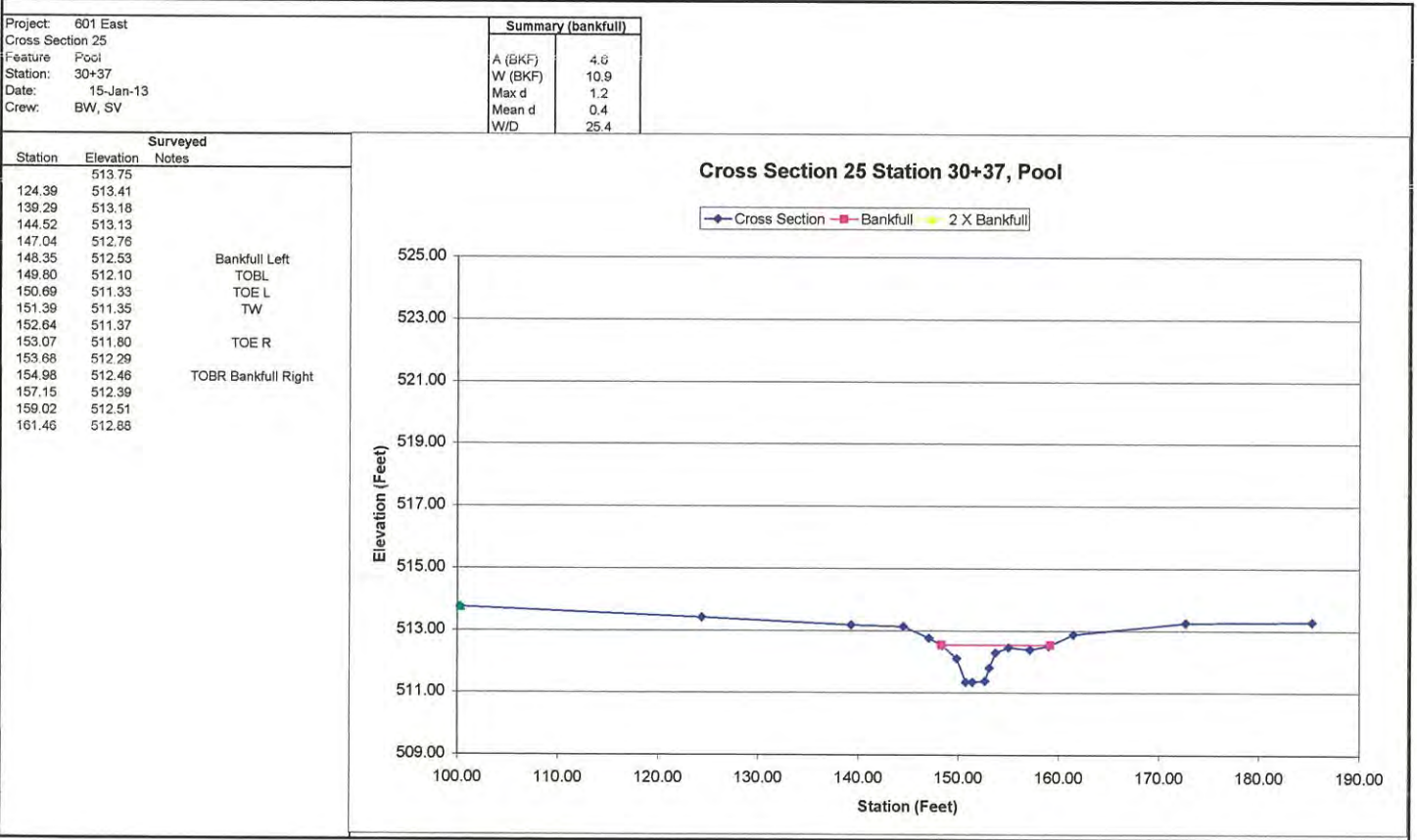
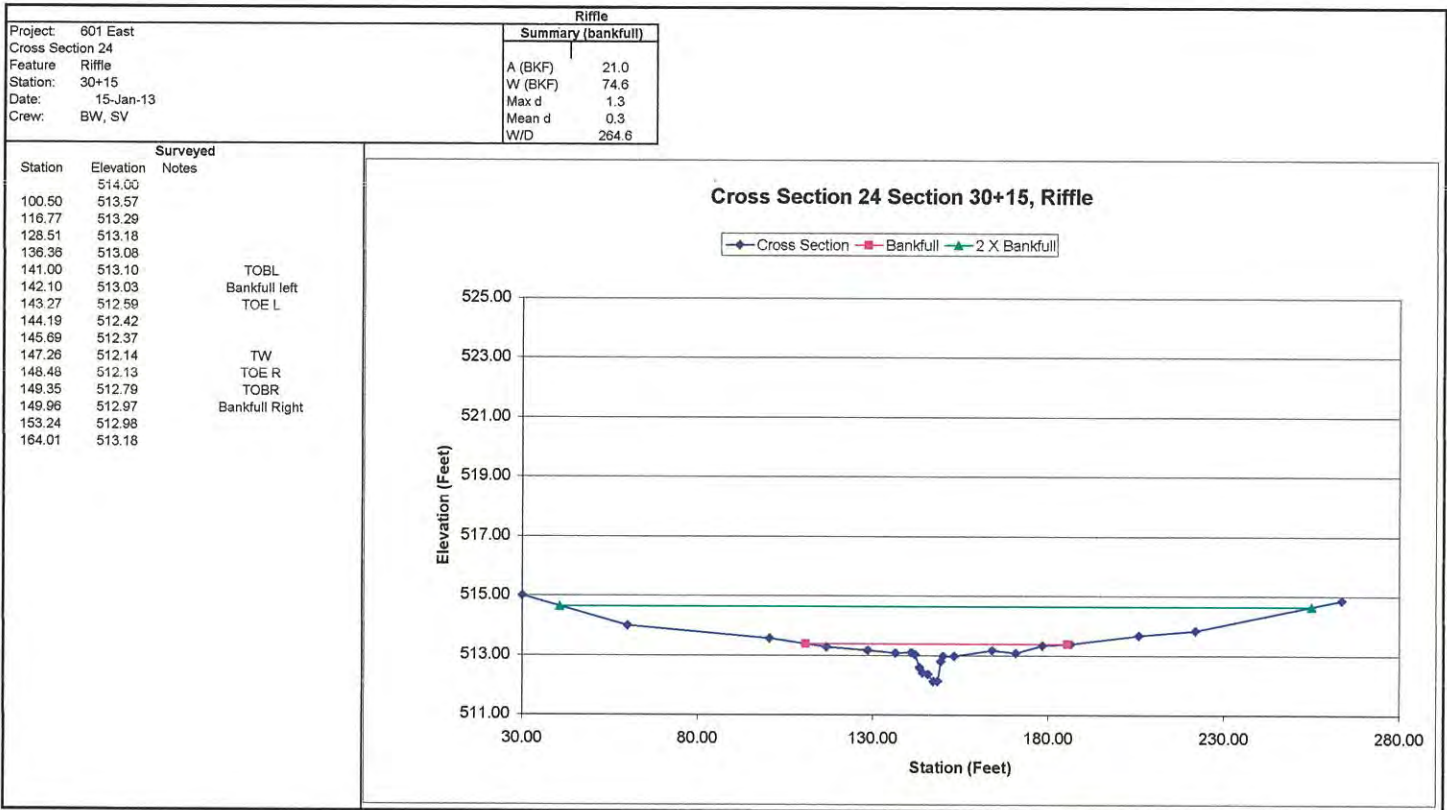


Project: 601 East
 Cross Section 23-B8
 Feature
 Station: 27+96
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	22.9
W (BKF)	29.3
Max d	2.4
Mean d	0.8
W/D	37.5

Station	Elevation	Surveyed Notes
	518.30	
118.33	518.48	
132.80	517.55	
142.90	516.64	TOBL
149.75	515.82	bankfull left
151.63	515.51	
152.34	515.15	
154.60	514.71	
156.68	514.43	
159.70	513.89	
161.90	512.59	TW
164.44	514.21	
167.82	514.02	
170.50	514.22	
172.55	514.44	
174.70	514.20	



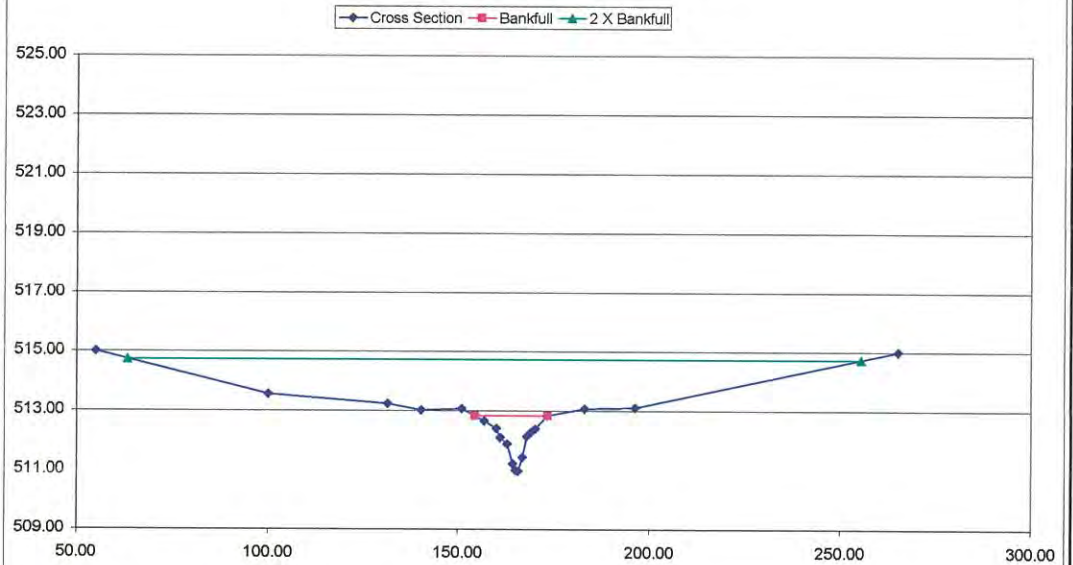


Project: 601 East
 Cross Section 26
 Feature: Pool
 Station: 30+58
 Date: 15-Jan-13
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	12.6
W (BKF)	18.9
Max d	1.9
Mean d	0.7
W/D	28.3

Surveyed		
Station	Elevation	Notes
	513.55	
131.51	513.24	
140.37	513.02	
150.99	513.08	
156.82	512.67	
159.98	512.41	TOBR Bankfull Left
161.04	512.11	
162.84	511.88	
164.22	511.22	TOE L
164.97	511.01	TW
165.63	510.98	
166.80	511.44	TOE R
167.83	512.14	
168.92	512.28	TOBR Bankfull Right
170.16	512.39	
173.17	512.84	

Cross Section 26 Section 30+58, Pool

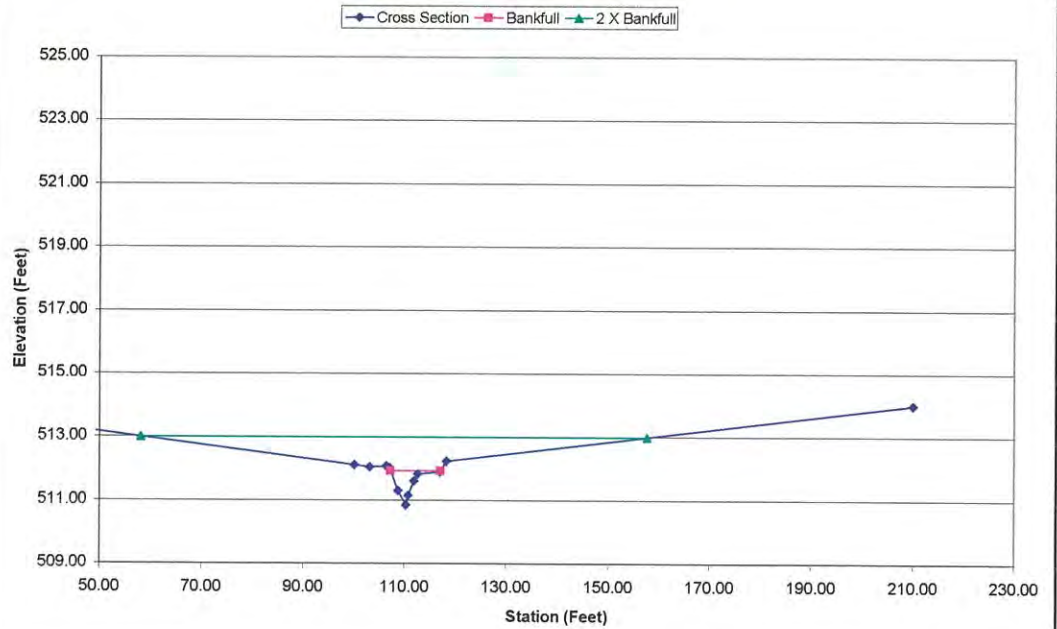


Project: 601 East
 Cross Section 27
 Feature: Riffle
 Station: 30+88
 Date: 15-Jan-13
 Crew: BW, SV

Summary (Bankfull)	
A (BKF)	3.1
W (BKF)	9.9
Max d	1.1
Mean d	0.3
W/D	31.5

Surveyed		
Station	Elevation	Notes
	512.11	
103.22	512.04	
106.47	512.07	
107.02	512.02	TOBL Bankfull Left
108.74	511.29	TOE L
110.30	510.85	TW
110.70	511.14	TOE R
111.91	511.61	
112.66	511.82	TOBR Bankfull Right
117.01	511.89	
118.35	512.23	
210.00	514.00	

Cross Section 27 Station 30+88 Upper Reach

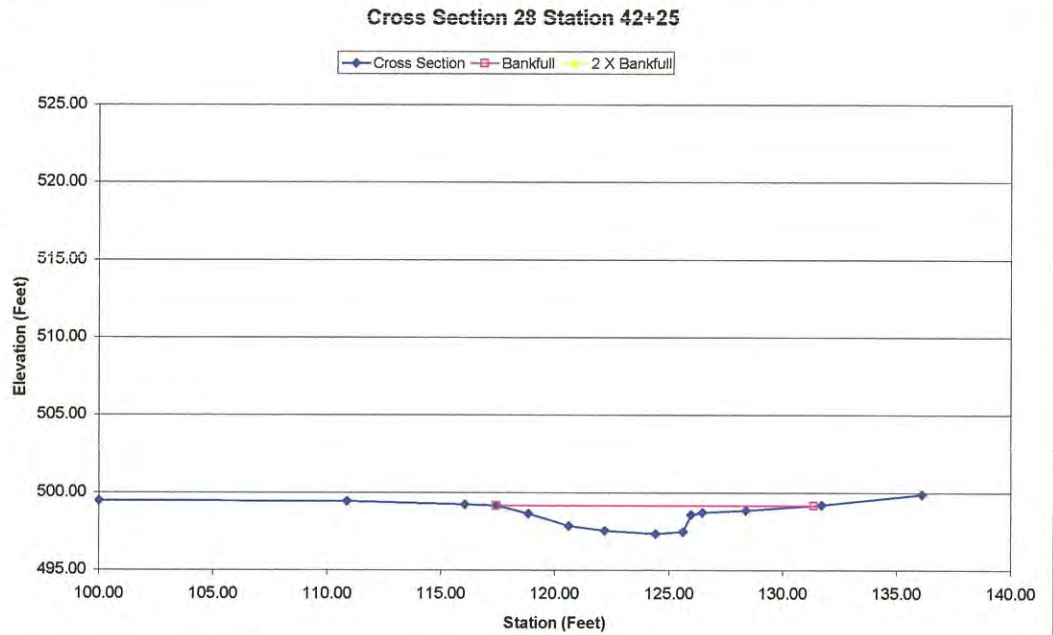


Below Lansford Road, Active Channel

Project: 601 East
 Cross Section 28
 Feature
 Station: 42+25
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	13.9
W (BKF)	28.6
Max d	1.3
Mean d	0.5
W/D	58.9

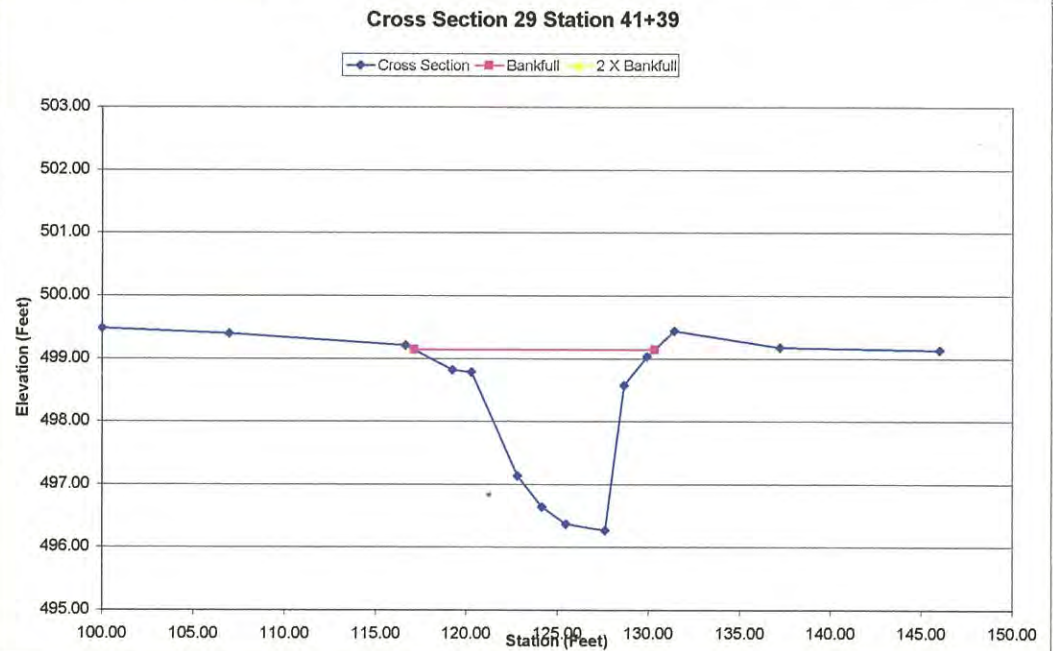
Surveyed		
Station	Elevation	Notes
100.00	496.53	
113.25	496.74	
120.84	497.45	
122.53	497.13	TOBL
124.11	496.76	
125.73	495.55	bankfull left
125.95	495.18	
126.32	494.53	TOE L
127.40	494.23	
127.84	494.21	TW
128.66	494.37	
129.93	494.88	TOE R
130.45	495.82	bankfull right
131.62	497.43	TOBR
136.00	497.24	FOUL



Project: 601 East
 Cross Section 29
 Feature
 Station: 41+39
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	13.9
W (BKF)	28.6
Max d	1.3
Mean d	0.5
W/D	58.9

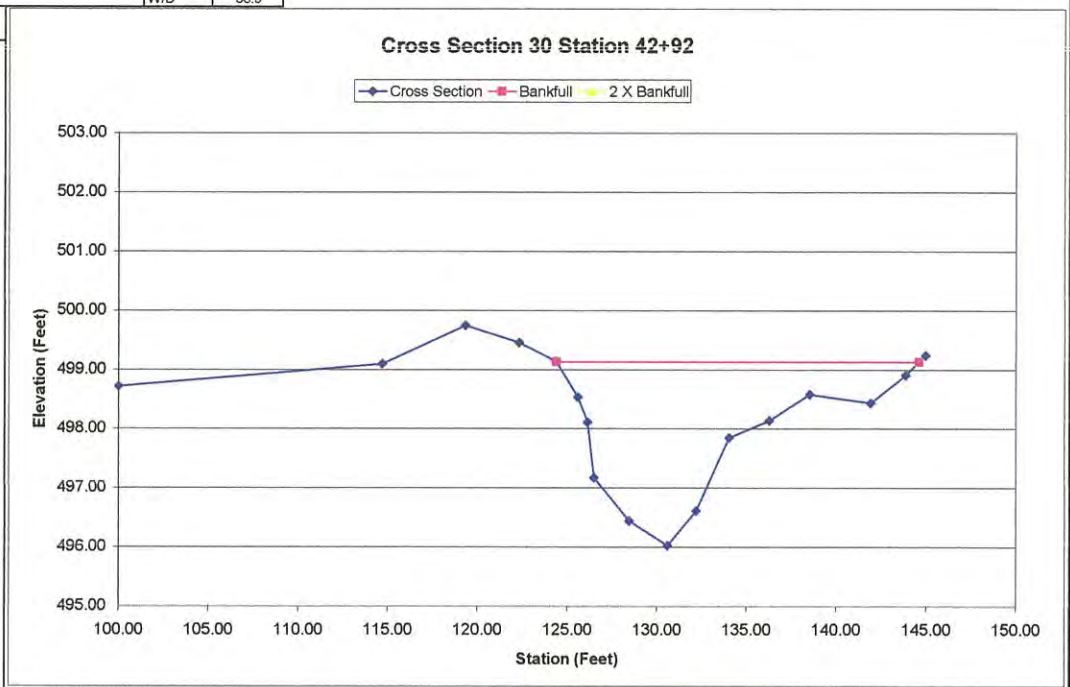
Surveyed		
Station	Elevation	Notes
100.00	499.48	
106.97	499.40	
116.65	499.21	bankfull left
119.24	498.82	TOBL
120.30	498.78	TOE L
122.82	497.14	
124.17	496.64	
125.48	496.37	TW
127.61	496.27	TOE R
128.64	498.57	
129.91	499.03	bankfull right
131.41	499.44	TOBR
137.21	499.18	
146.03	499.13	



Project: 601 East
 Cross Section 30
 Feature
 Station: 42+92
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	13.9
W (BKF)	28.6
Max d	1.3
Mean d	0.5
W/D	58.9

Surveyed		
Station	Elevation	Notes
100.00	498.72	
114.69	499.10	
119.35	499.75	
122.32	499.45	
124.38	499.14	TOBL
125.60	498.53	bankfull left
126.13	498.11	
126.49	497.17	TOE L
128.44	496.45	
130.59	496.03	TW
132.21	496.62	TOE R
134.06	497.85	TOBR
136.29	498.14	
138.55	498.58	bankfull right
141.93	498.43	
143.87	498.90	
144.96	499.24	



Project: 601 East
 Cross Section 31
 Feature
 Station: 43+10
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	13.9
W (BKF)	28.6
Max d	1.3
Mean d	0.5
W/D	58.9

Surveyed		
Station	Elevation	Notes
100.00	498.45	
112.93	498.03	
141.04	498.88	
154.51	499.61	
156.77	499.13	bankfull left
156.88	499.15	TOBL
158.07	497.53	TOE L
160.14	497.33	
161.53	497.25	
163.43	497.01	TW
165.21	497.40	
166.28	497.63	
168.54	498.03	
169.91	498.53	bankfull right
172.55	498.61	
176.47	498.62	
187.40	499.15	
199.78	499.71	

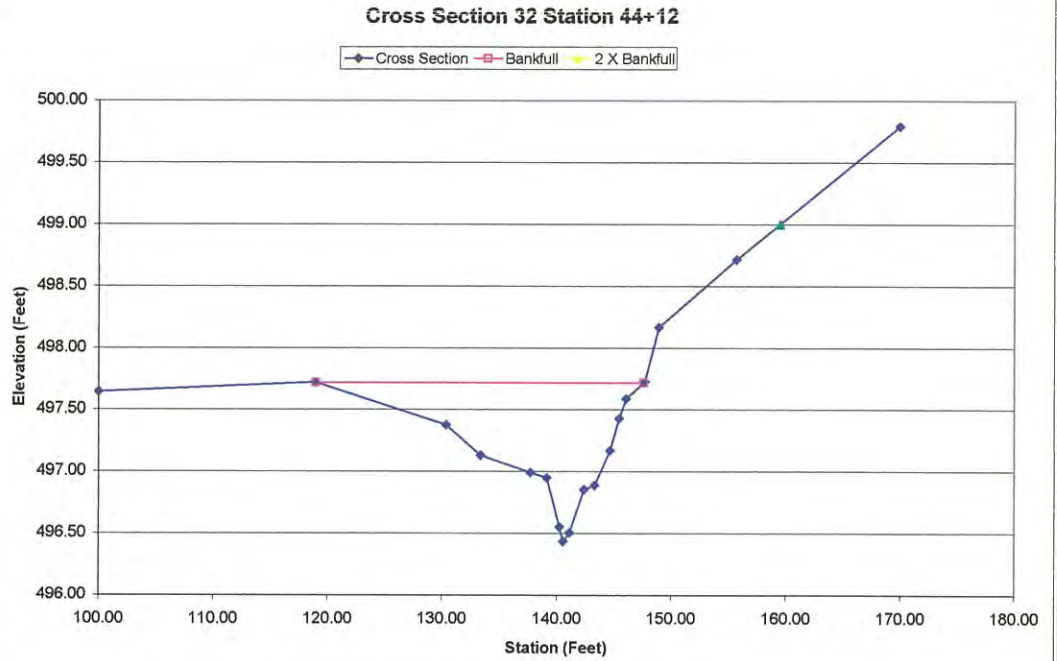


Project: 601 East
 Cross Section 32
 Feature
 Station: 44+12
 Date: 30-Jan-13
 Crew:

Summary (bankfull)

A (BKF)	13.9
W (BKF)	28.6
Max d	1.3
Mean d	0.5
W/D	58.9

Station	Elevation	Notes
100.00	497.64	
118.89	497.60	
130.38	497.38	TOBL Bankfull left
133.33	497.13	
137.71	496.99	
139.13	496.95	
140.25	496.55	
140.80	496.44	
141.15	496.51	TW TOE R
142.41	496.86	
143.35	496.89	
144.70	497.17	
145.50	497.43	Bankfull Right
146.11	497.59	TOBR
147.70	497.72	
148.91	498.16	
155.72	498.71	
169.91	499.79	

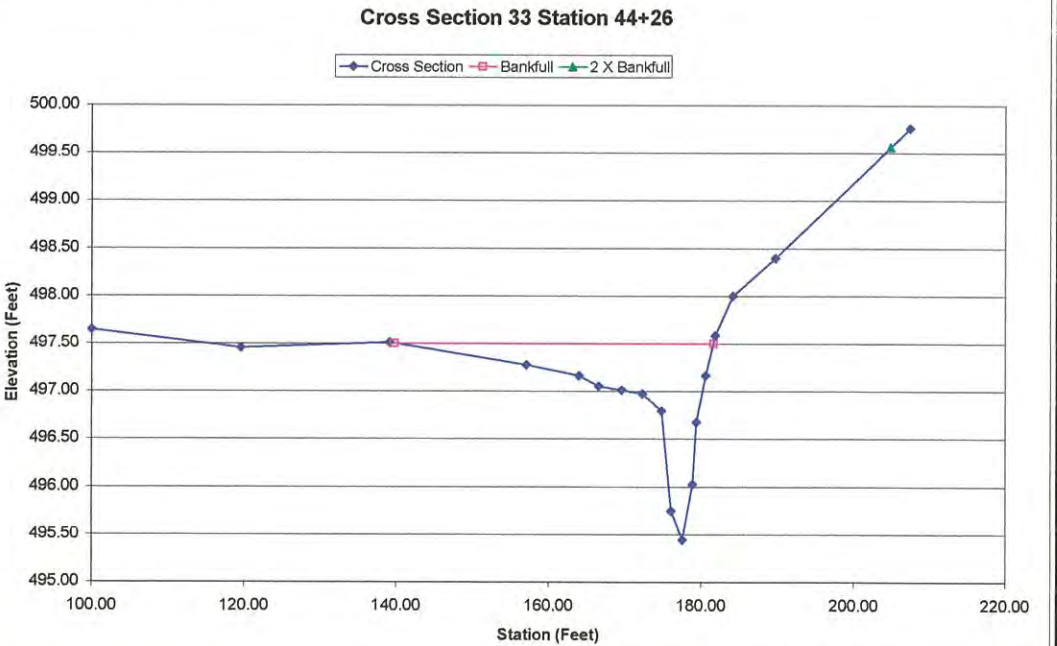


Project: 601 East
 Cross Section 33
 Feature
 Station: 44+26
 Date: 30-Jan-13
 Crew:

Summary (bankfull)

A (BKF)	13.9
W (BKF)	28.6
Max d	1.3
Mean d	0.5
W/D	58.9

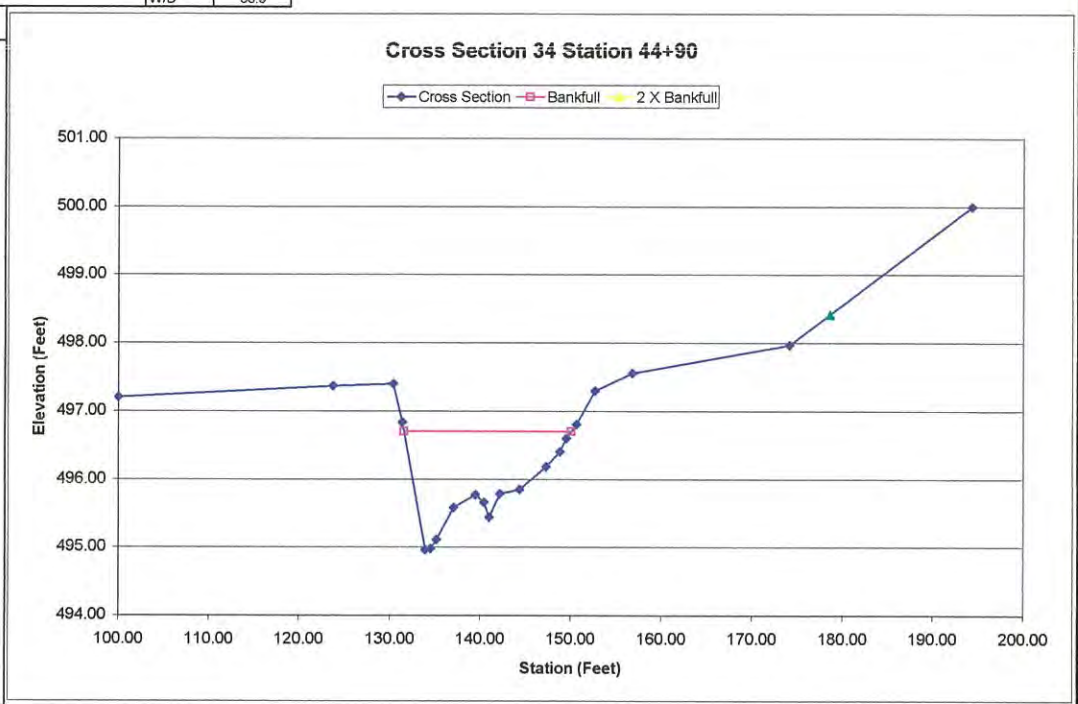
Station	Elevation	Notes
100.00	497.64	
119.54	497.45	
139.16	497.51	
157.00	497.28	
163.93	497.17	TOBL Bankfull Left
166.54	497.05	
169.54	497.01	
172.33	496.97	
174.80	496.79	TOBL
176.08	495.75	TOE L
177.55	495.44	TW
178.89	496.03	TOER
179.36	496.68	
180.58	497.16	Bankfull Right
181.86	497.58	
184.15	498.00	
189.70	498.40	
207.42	499.76	



Project: 601 East
 Cross Section 34
 Feature:
 Station: 44+90
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	13.9
W (BKF)	28.6
Max d	1.3
Mean d	0.5
W/D	58.9

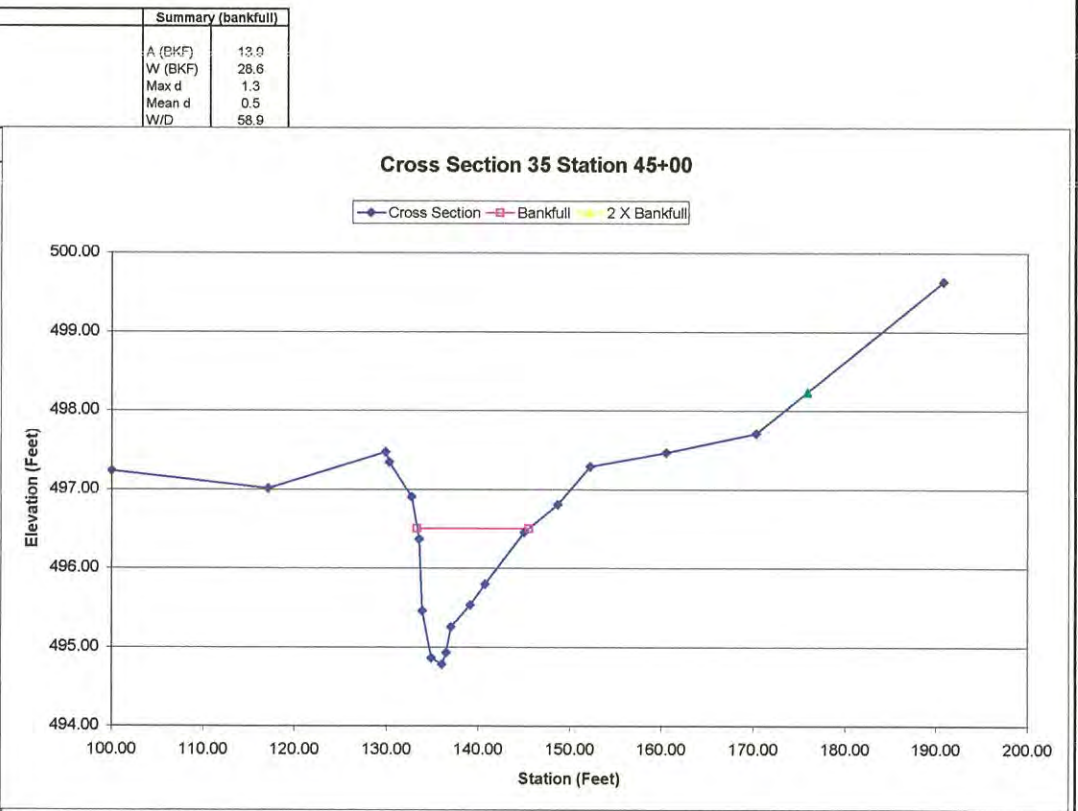
Surveyed		
Station	Elevation	Notes
100.00	497.21	
123.79	497.36	
130.36	497.40	TOBL
131.39	496.83	bankfull left
133.89	494.97	TOE L
134.47	494.98	TW
135.15	495.11	TOE R
137.01	495.58	TOBR
139.45	495.77	
140.37	495.66	
141.00	495.44	
142.15	495.79	
144.36	495.85	
147.26	496.19	bankfull right
148.80	496.41	
149.51	496.60	
150.65	496.80	
152.74	497.30	
156.83	497.55	
174.14	497.97	
194.32	500.00	



Project: 601 East
 Cross Section 35
 Feature:
 Station: 45+00
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	13.9
W (BKF)	28.6
Max d	1.3
Mean d	0.5
W/D	58.9

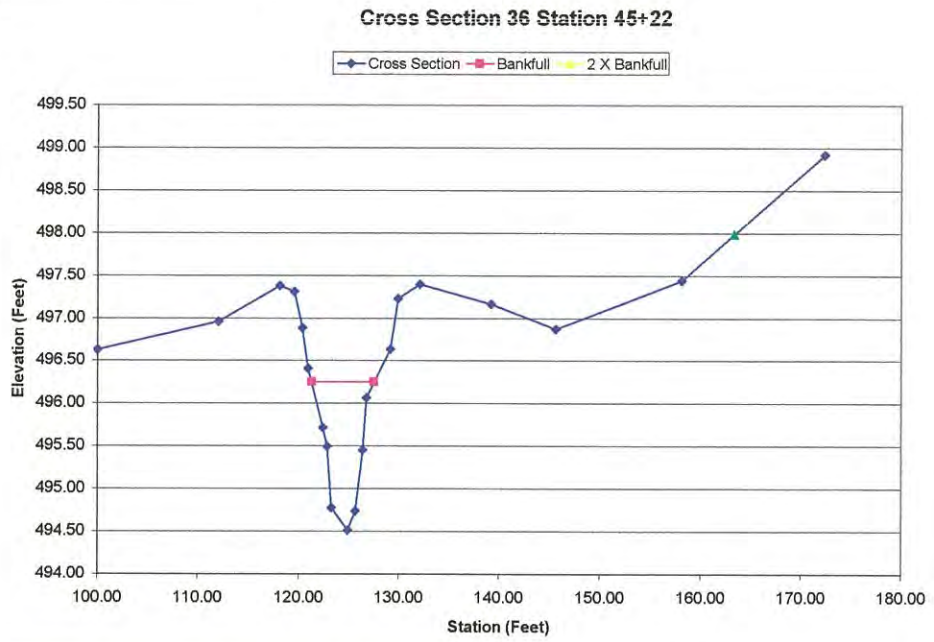
Surveyed		
Station	Elevation	Notes
100.00	497.24	
117.13	497.01	
129.89	497.47	
130.26	497.34	TOBL
132.75	496.90	bankfull left
133.53	496.37	
133.91	495.46	
134.89	494.86	TOE L
136.08	494.78	TW
136.53	494.93	TOE R
137.07	495.26	TOBR
139.13	495.53	
140.79	495.80	
145.01	496.45	
148.89	496.81	bankfull right
152.22	497.29	
160.53	497.46	
170.29	497.71	
190.82	499.64	



Project: 601 East
 Cross Section 36
 Feature
 Station: 45+22
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	13.9
W (BKF)	28.6
Max d	1.3
Mean d	0.5
W/D	58.9

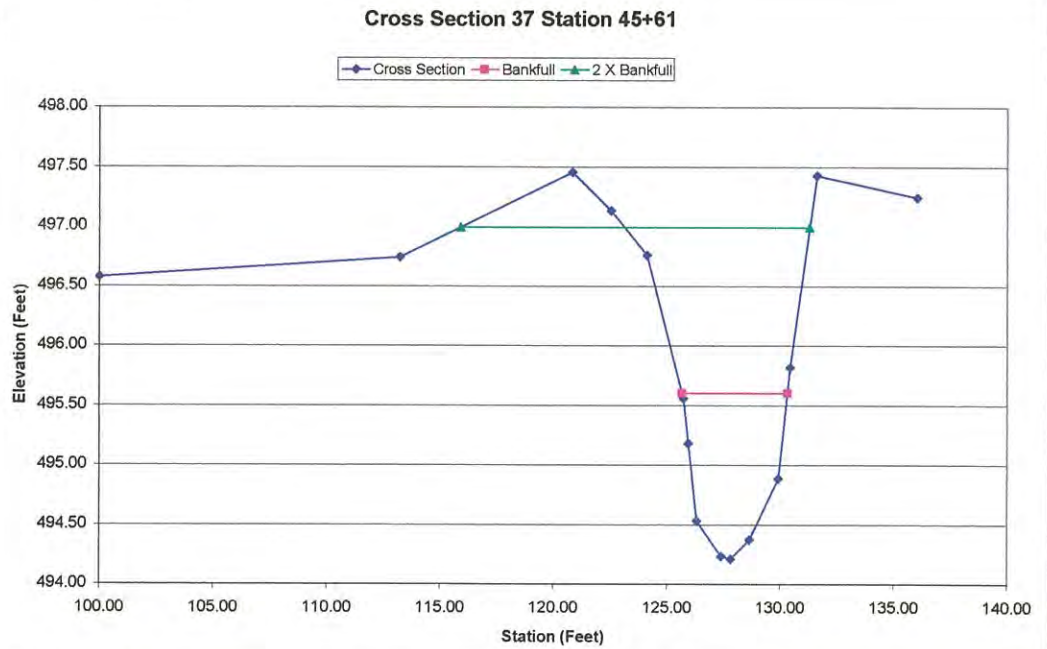
Surveyed		
Station	Elevation	Notes
100.00	496.63	
112.05	498.96	
118.10	497.38	
119.53	497.31	TOBL
120.37	496.88	
120.95	496.41	bankfull left
122.43	495.72	
122.84	495.50	
123.29	494.78	TOE L
124.90	494.51	TW
125.67	494.74	TOE R
126.39	495.45	
126.75	496.07	bankfull right
129.15	496.63	
129.89	497.23	TOBR
132.06	497.40	
139.21	497.17	
145.61	496.87	
158.09	497.44	
172.41	498.92	



Project: 601 East
 Cross Section 37
 Feature
 Station: 45+61
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	13.9
W (BKF)	28.6
Max d	1.3
Mean d	0.5
W/D	58.9

Surveyed		
Station	Elevation	Notes
100.00	496.58	
113.25	496.74	
120.84	497.45	
122.53	497.13	TOBL
124.11	496.76	
125.73	495.55	bankfull left
125.95	495.18	
126.32	494.53	TOE L
127.40	494.23	
127.84	494.21	TW
128.68	494.37	
129.93	494.88	TOE R
130.45	495.82	bankfull right
131.62	497.43	TOBR
136.05	497.24	



Below Lansford Road, Relic Channel

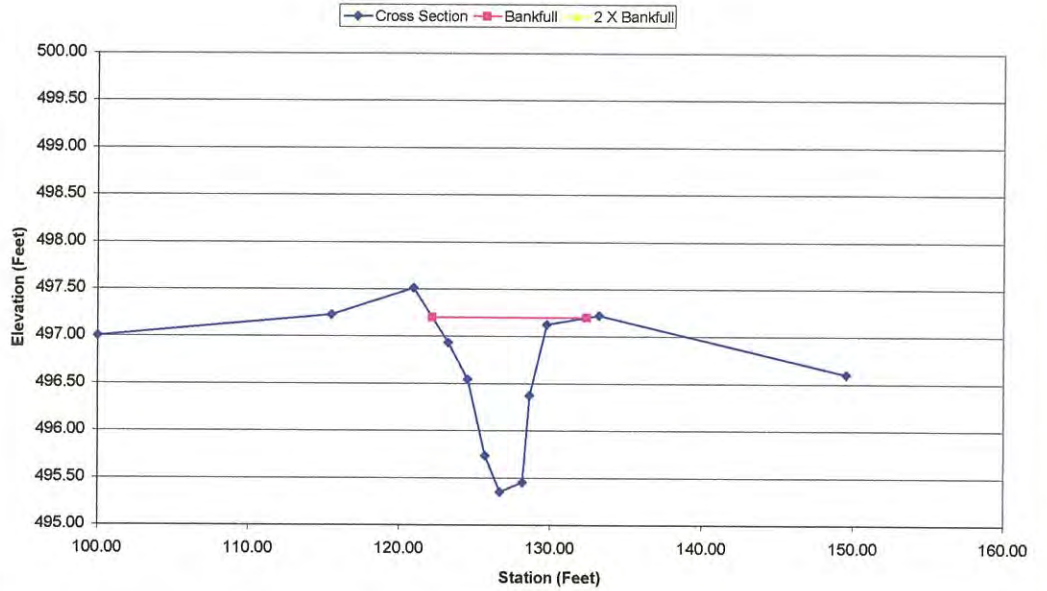
Project: 601 East
 Cross Section 38
 Feature
 Station: 1+34
 Date: 30-Jan-13
 Crew:

Summary (bankfull)

A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

Station	Elevation	Notes
100.00	497.00	
115.51	497.23	
120.91	497.51	TOBL
123.19	496.93	
124.50	496.55	bankfull left
125.67	495.73	TOE L
126.67	495.35	TW
128.15	495.45	TOE R
128.59	496.38	bankfull right
129.75	497.13	TOBR
133.21	497.22	
149.56	496.60	

Cross Section 38, Station 1+34



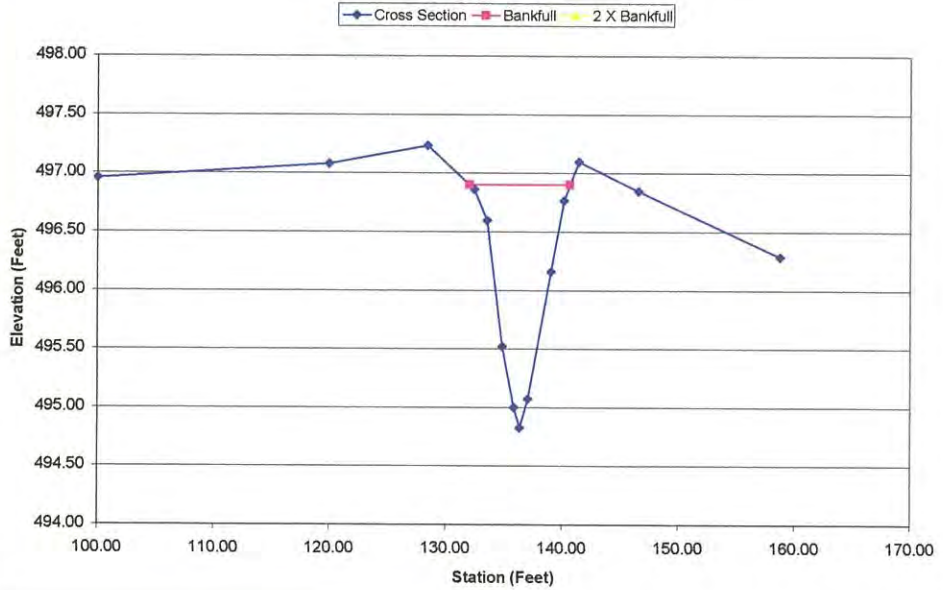
Project: 601 East
 Cross Section 39
 Feature
 Station: 1+71
 Date: 30-Jan-13
 Crew:

Summary (bankfull)

A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

Station	Elevation	Notes
100.00	496.96	
119.93	497.08	
128.40	497.24	
132.44	496.86	
133.54	496.60	TOBL bankfull left
134.85	495.52	
135.86	495.00	TOE L
136.40	494.82	TW
137.08	495.07	TOE R
139.02	496.16	bankfull right
140.13	496.76	TOBR
141.42	497.10	
146.59	496.85	
158.75	496.28	

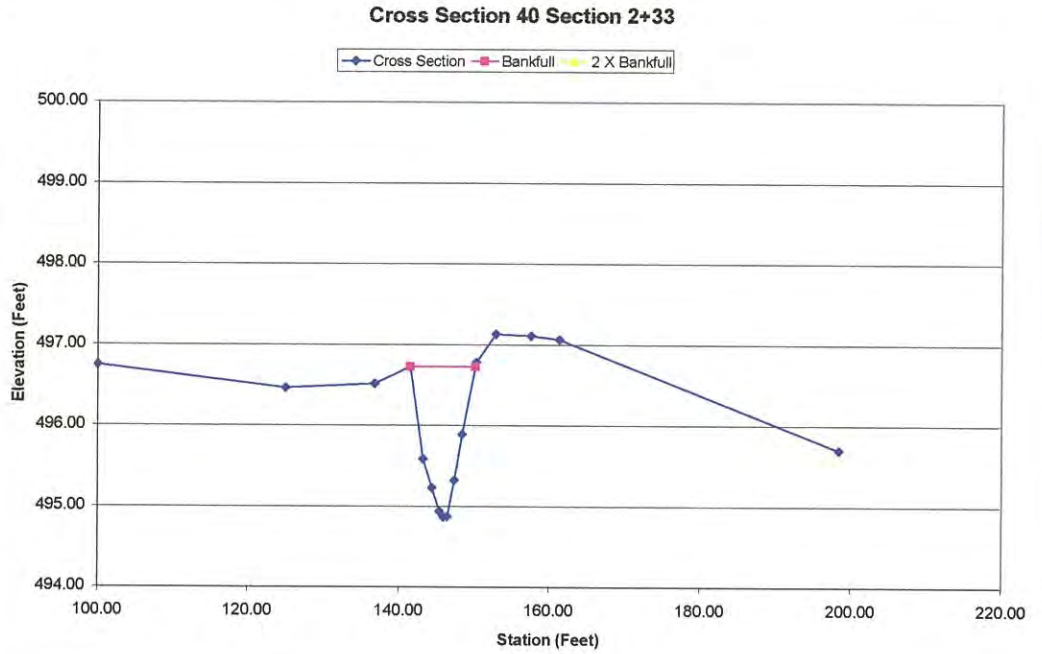
Cross Section 39 Station 1+71



Project: 601 East
 Cross Section 40
 Feature
 Station: 2+33
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
	MY0
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

Surveyed		
Station	Elevation	Notes
100.00	496.74	
125.02	496.46	
136.78	496.51	
141.52	496.73	TOBL bankfull left
143.18	495.59	
144.45	495.23	
145.43	494.94	TOE L
146.00	494.87	TW
148.45	494.87	TOE R
147.41	495.32	
148.46	495.89	bankfull Right
150.30	496.78	TOBR
152.94	497.13	
157.58	497.11	
161.37	497.07	
198.50	495.70	



Project: 601 East
 Cross Section 41
 Feature
 Station: 2+45
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
	MY0
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

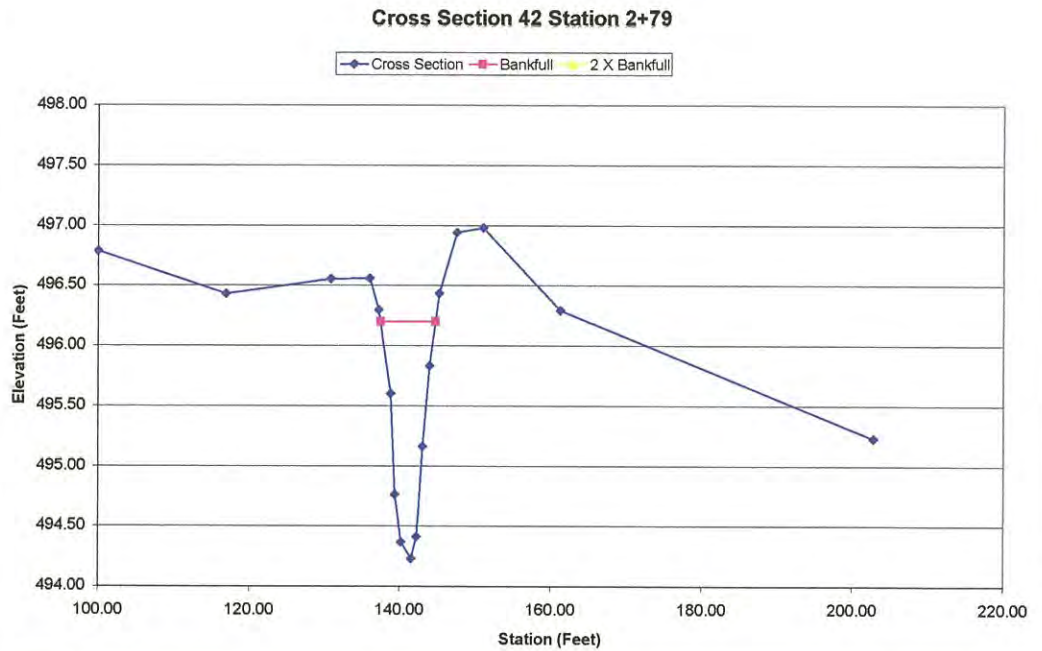
Surveyed		
Station	Elevation	Notes
100.00	496.43	
108.31	496.40	
114.02	496.25	
116.85	496.20	
119.49	496.16	TOBL
119.68	495.62	bankfull left
120.42	495.09	
121.60	494.63	TOE L
122.13	494.49	TW
122.71	494.76	TOE R
124.23	494.97	
124.76	495.47	
125.96	495.99	bankfull right
127.19	496.40	TOBR
130.11	496.81	
130.95	496.95	
133.12	496.95	
138.24	496.98	
146.51	496.42	
156.63	496.02	



Project: 601 East
 Cross Section 42
 Feature:
 Station: 2+79
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

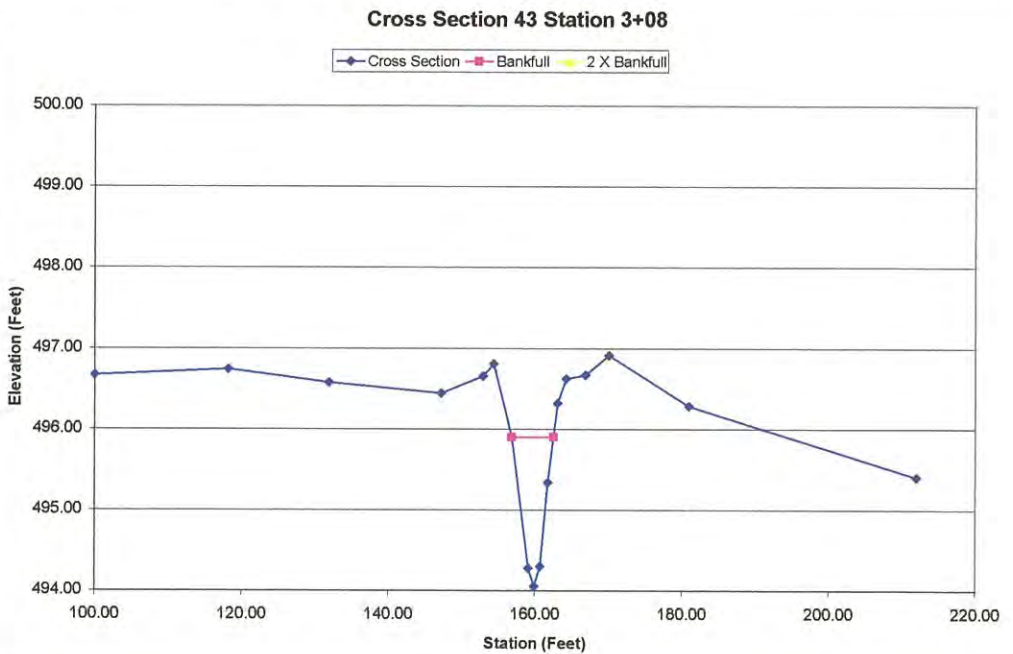
Station	Elevation	Notes
100.00	496.79	
116.89	496.43	
130.75	496.56	
135.96	496.56	TOBL
137.18	496.30	
138.76	495.60	bankfull left
139.37	494.76	
140.22	494.37	TOE L
141.53	494.23	TW
142.27	494.41	TOE R
143.05	495.18	
143.94	495.83	bankfull right
145.22	496.43	TOBR
147.58	496.94	
151.05	496.98	
161.30	496.29	
202.80	495.23	



Project: 601 East
 Cross Section 43
 Feature:
 Station: 3+08
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

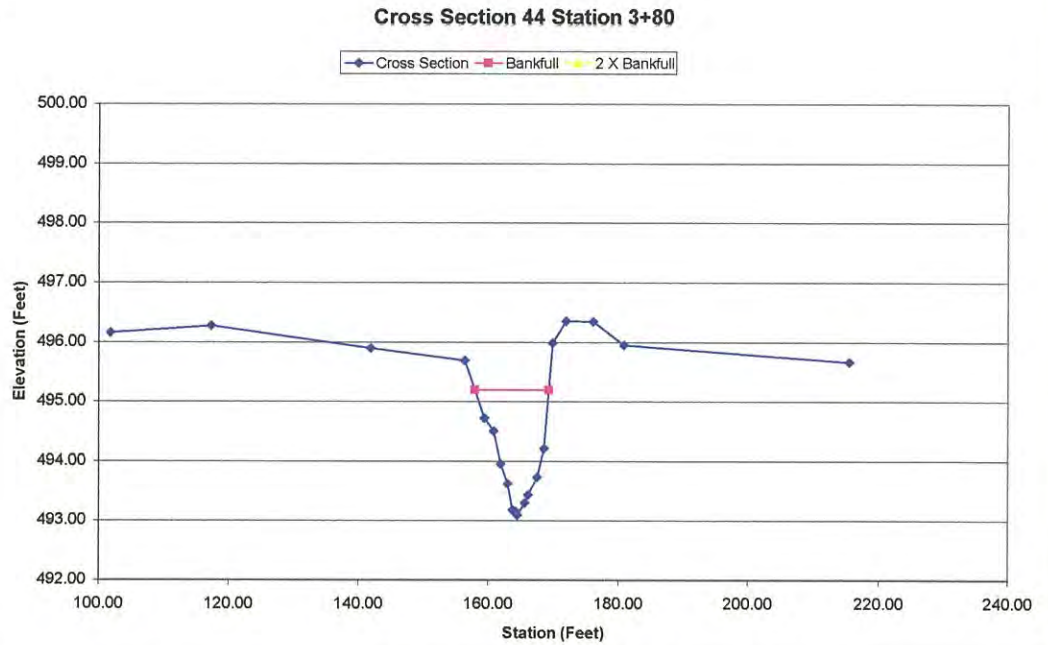
Station	Elevation	Notes
100.00	496.67	
118.17	496.74	
131.89	496.58	
147.22	496.44	
152.97	496.65	
154.40	496.80	TOBL
156.86	495.90	bankfull left
159.11	494.28	TOE L
159.96	494.06	TW
160.72	494.30	TOE R
161.74	495.34	bankfull right
163.08	496.31	TOBR
164.20	496.62	
166.84	496.67	
170.05	496.91	
180.97	496.28	
212.01	495.40	



Project: 601 East
 Cross Section 44
 Feature
 Station: 3+80
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

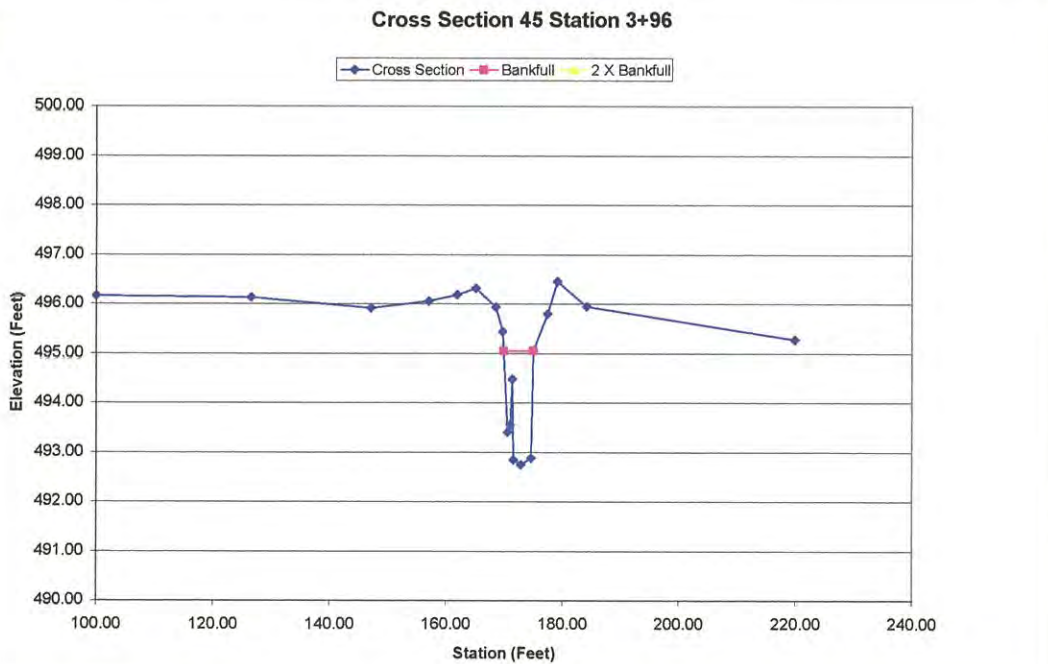
Surveyed		
Station	Elevation	Notes
101.77	496.16	
117.24	496.27	
141.93	495.89	
156.40	495.70	
159.37	494.73	
160.78	494.51	TOBL
161.90	493.96	bankfull left
162.90	493.62	
163.65	493.19	TOE L
164.16	493.15	TW
164.39	493.09	TOE R
165.54	493.30	
166.04	493.43	
167.47	493.73	
168.54	494.21	bankfull right
169.81	495.99	TOBR
171.88	496.36	
176.06	496.34	
180.81	495.95	
215.52	495.67	



Project: 601 East
 Cross Section 45
 Feature
 Station: 3+96
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

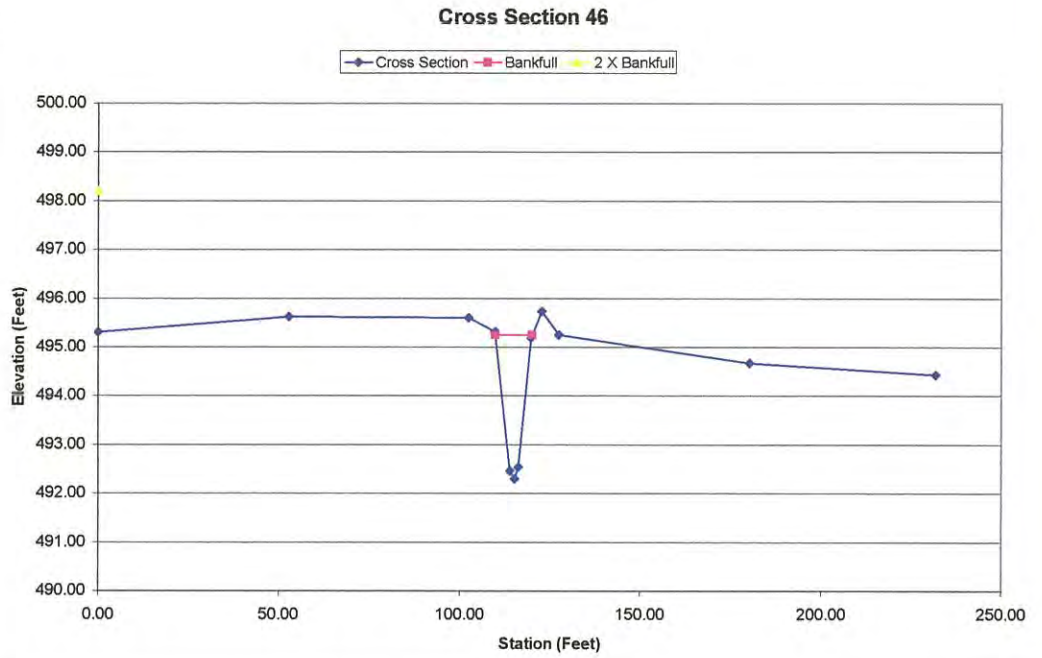
Surveyed		
Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.56	492.84	TW
172.87	492.75	TOE R
174.55	492.87	bankfull right
174.93	495.05	
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



Project: 601 East
 Cross Section 46
 Feature:
 Station:
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

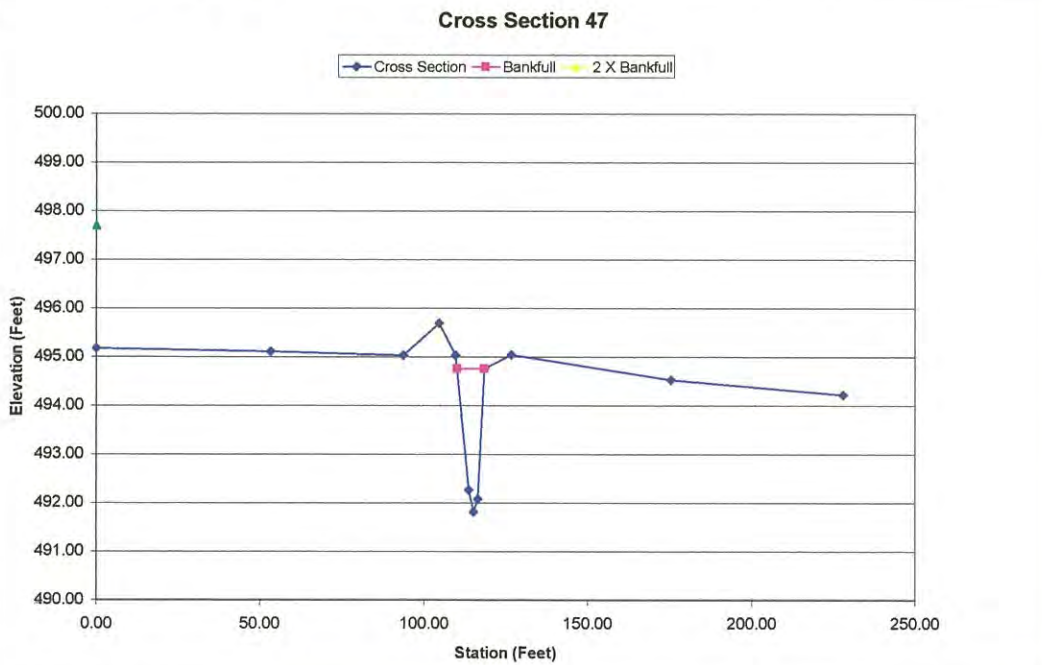
Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.58	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



Project: 601 East
 Cross Section 47
 Feature:
 Station:
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	MYO 8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

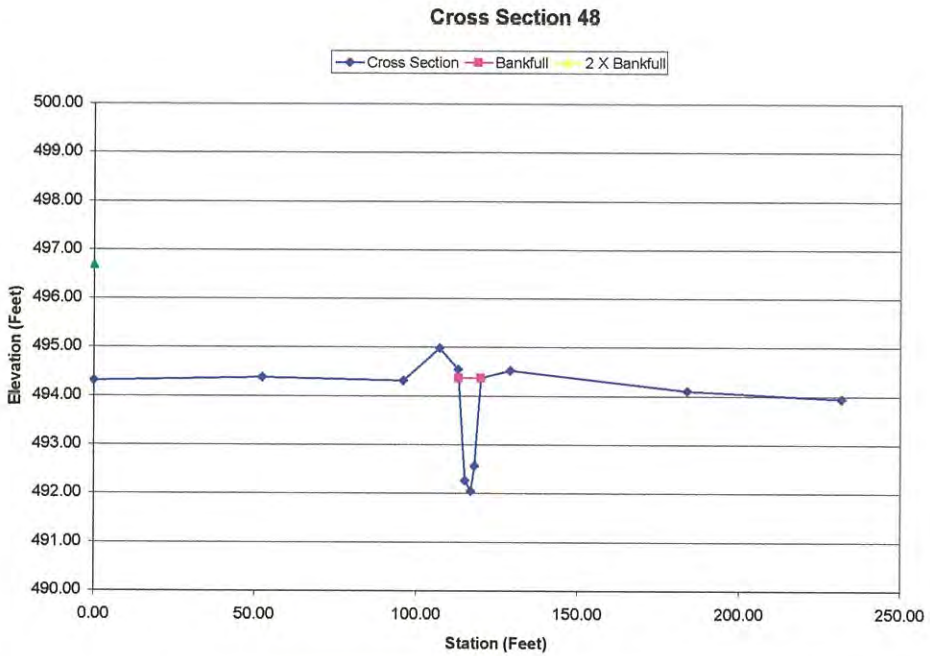
Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.56	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



Project: 601 East
 Cross Section 48
 Feature:
 Station:
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

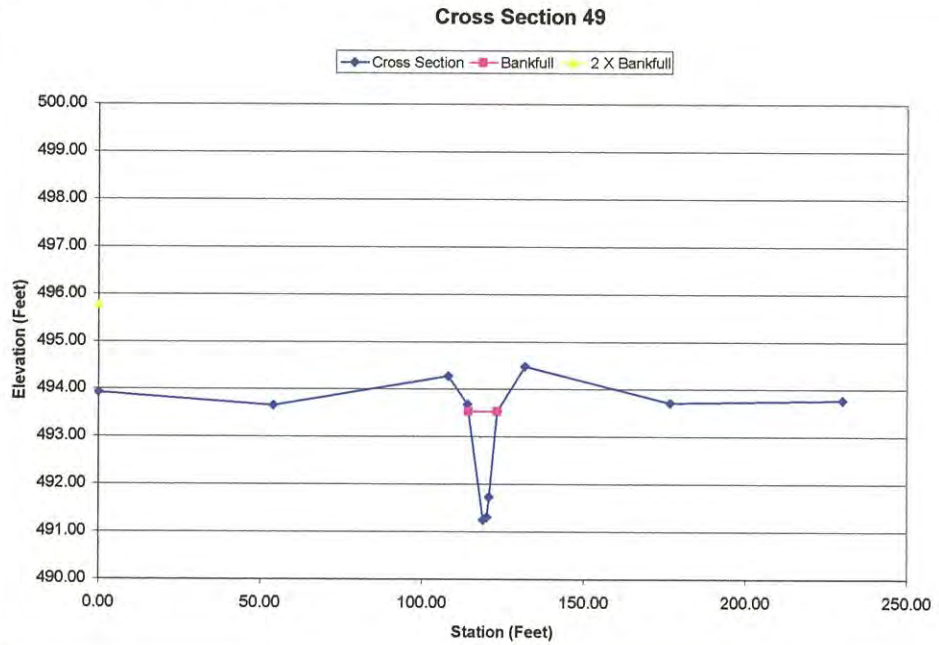
Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.56	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



Project: 601 East
 Cross Section 49
 Feature:
 Station:
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

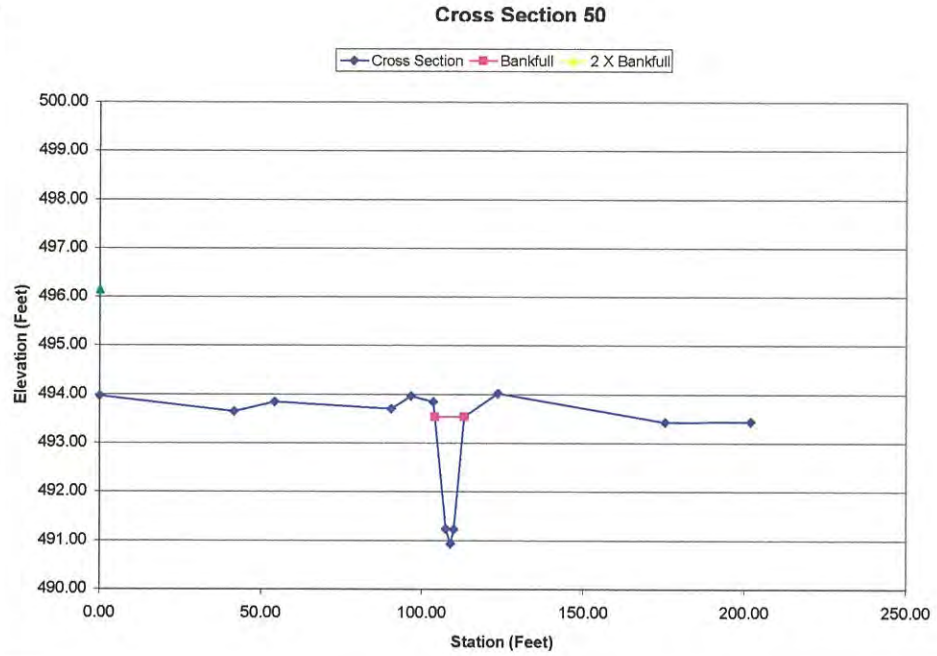
Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.56	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



Project: 601 East
 Cross Section 50
 Feature
 Station:
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

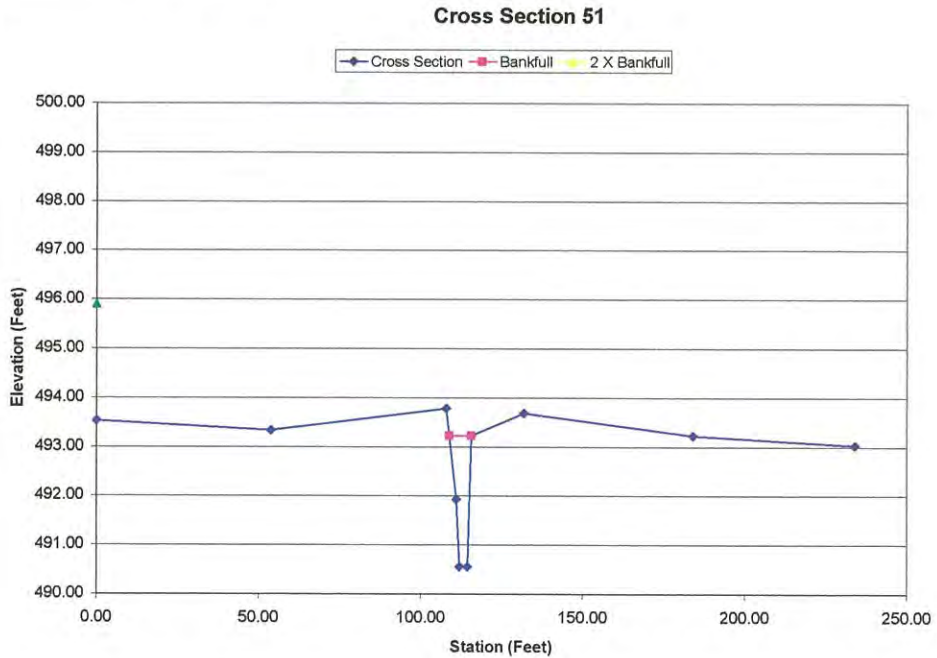
Surveyed		
Station	Elevation	Notes
100.00	495.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.56	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



Project: 601 East
 Cross Section 51
 Feature
 Station:
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

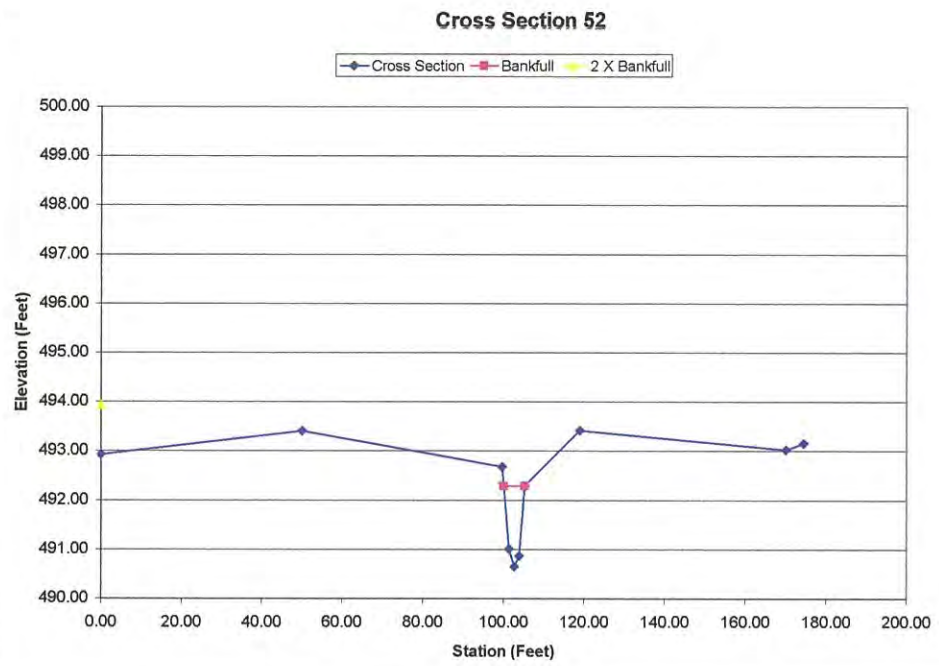
Surveyed		
Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.56	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



Project: 601 East
 Cross Section 52
 Feature
 Station:
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

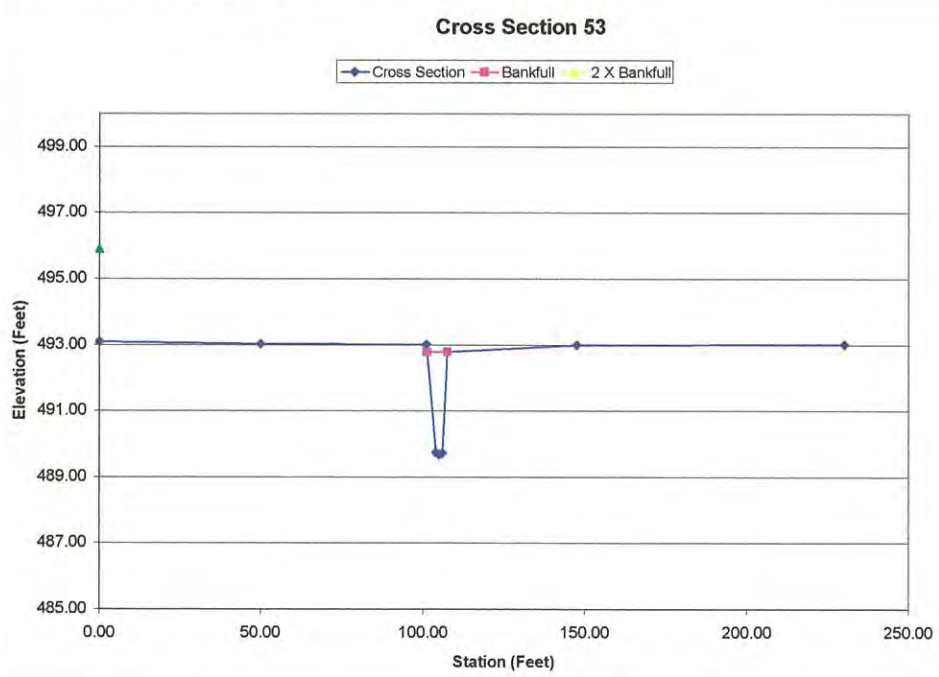
Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.66	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



Project: 601 East
 Cross Section 53
 Feature
 Station:
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

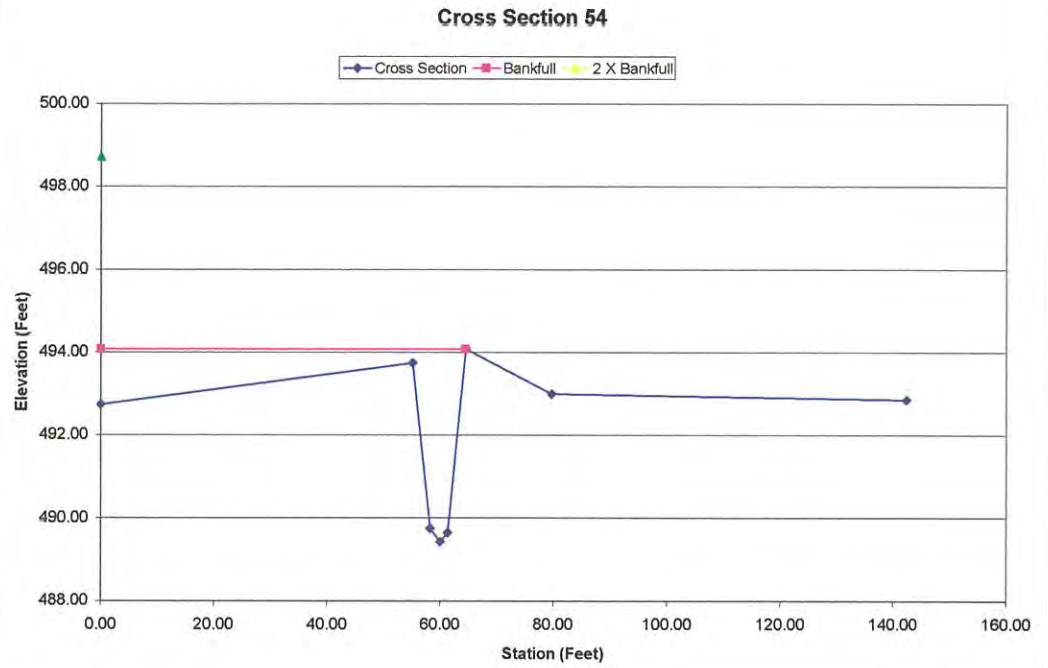
Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.56	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



Project: 601 East
 Cross Section 54
 Feature
 Station:
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

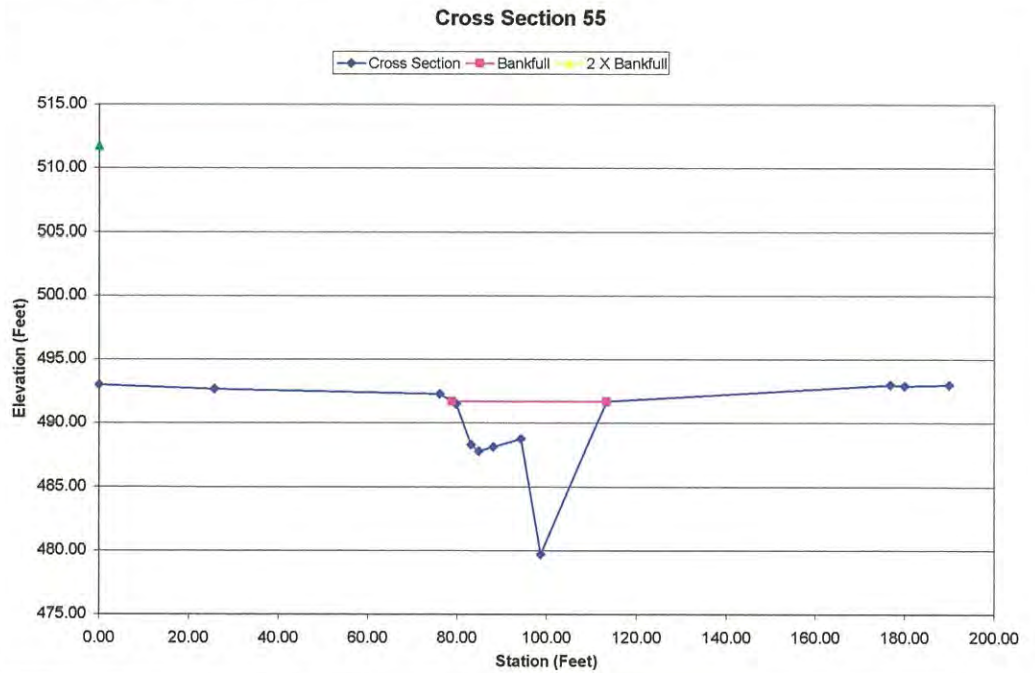
Surveyed		
Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.56	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



Project: 601 East
 Cross Section 55
 Feature
 Station:
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

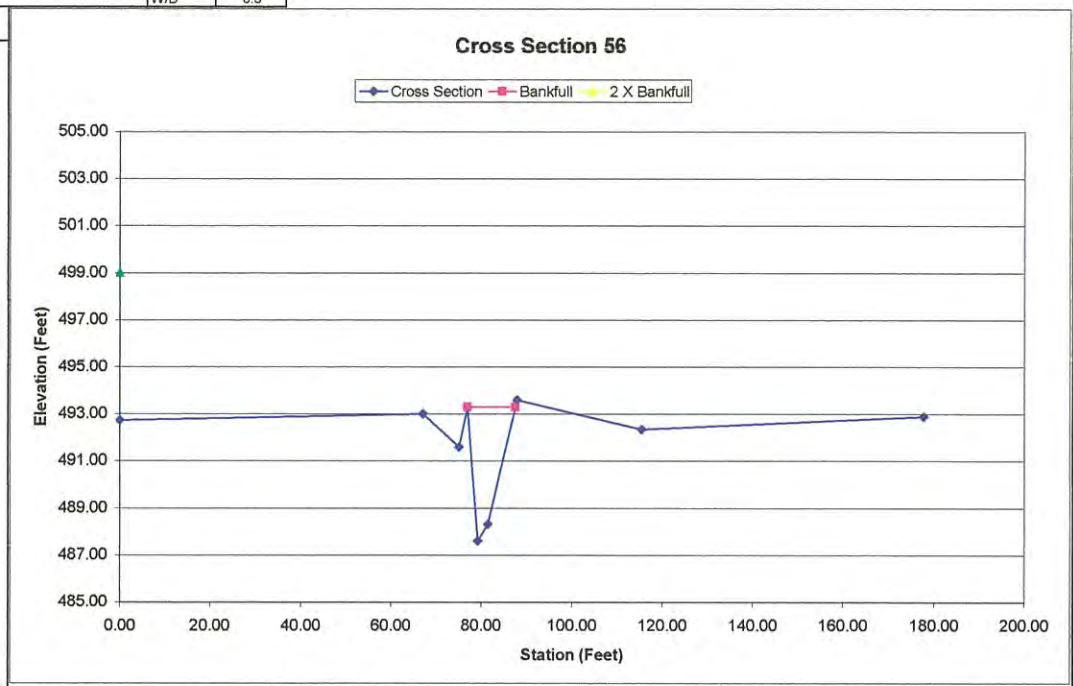
Surveyed		
Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.56	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



Project: 601 East
 Cross Section 1
 Feature
 Station: 3+96
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

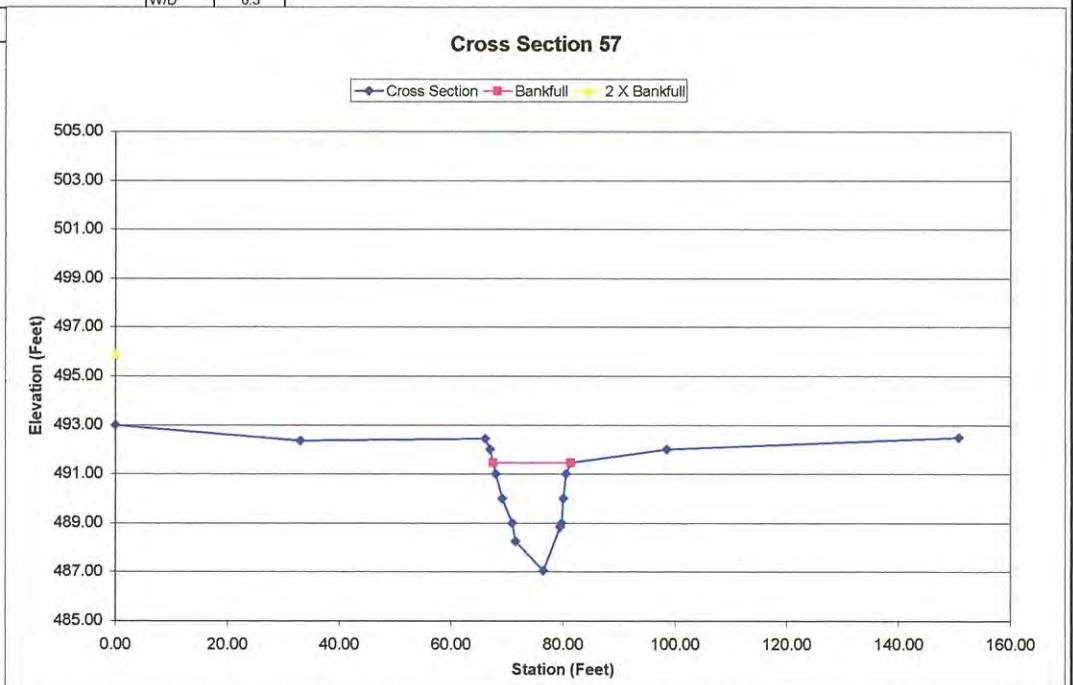
Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.56	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	



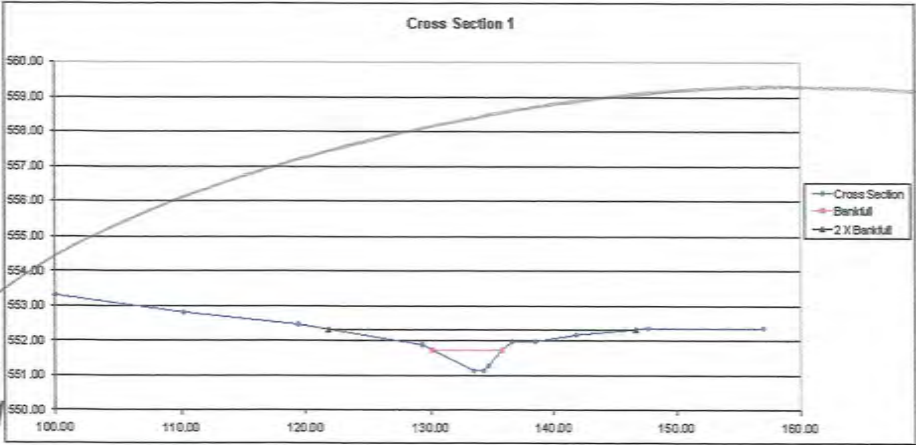
Project: 601 East
 Cross Section 57
 Feature
 Station:
 Date: 30-Jan-13
 Crew:

Summary (bankfull)	
A (BKF)	8.6
W (BKF)	7.3
Max d	2.0
Mean d	1.2
W/D	6.3

Station	Elevation	Notes
100.00	496.16	
126.57	496.13	
147.22	495.91	
157.08	496.05	
161.91	496.18	
165.12	496.32	
168.55	495.94	
169.73	495.44	TOBL
170.53	493.40	TOE L
170.99	493.55	
171.38	494.47	
171.56	492.84	
172.87	492.75	TW
174.55	492.87	TOE R
174.93	495.05	bankfull right
177.46	495.79	
179.05	496.45	
184.14	495.94	
219.93	495.28	

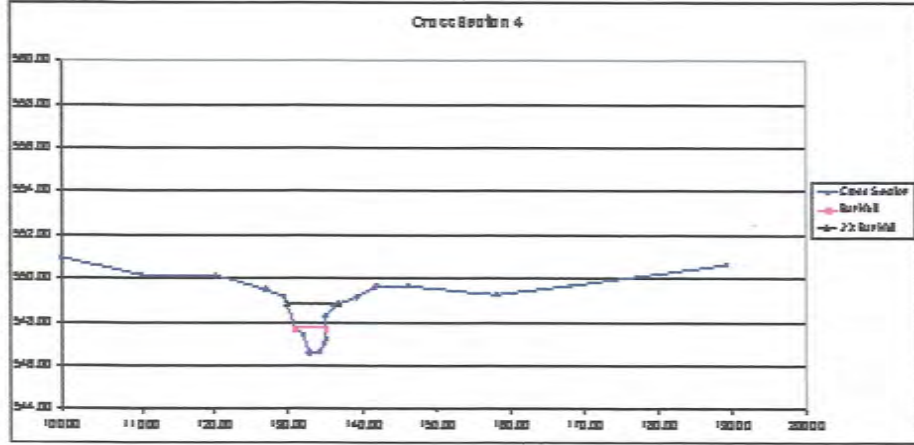
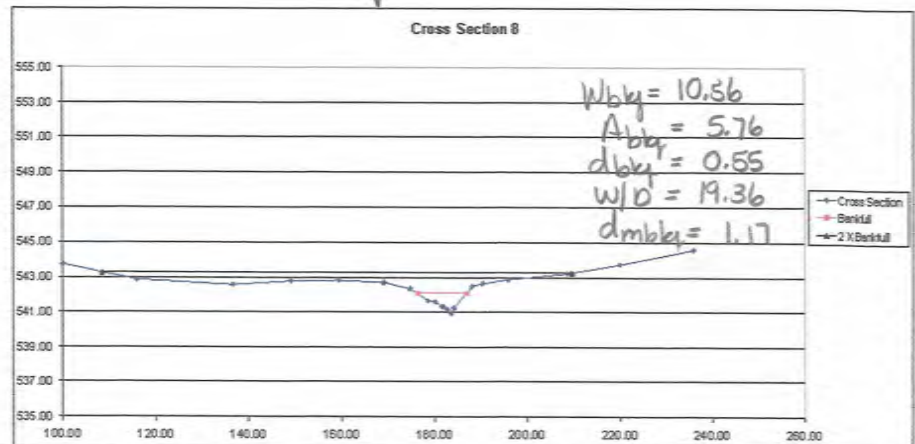
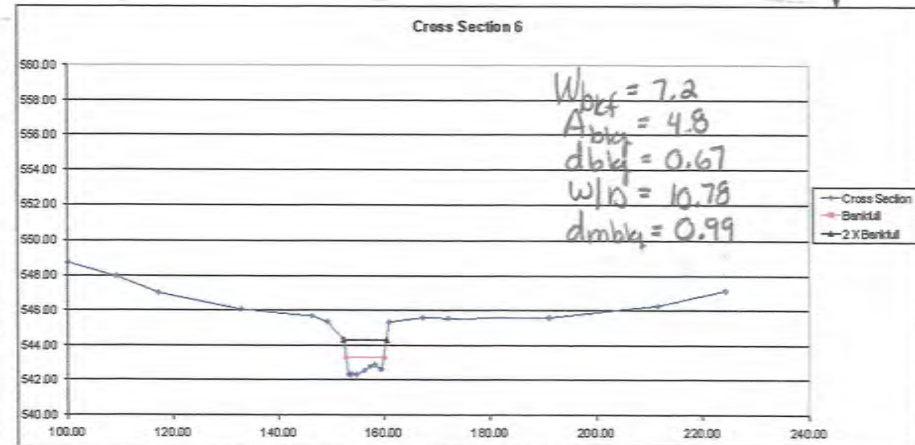


C5. Existing Conditions Plan Sheets



Draw from Hwy 601 Cause of Ephemeral & Intermittent Channel Erosion Hwy Improvements in 2009 (approximately) changed drainage patterns of Hwy 601 sending more runoff to Tanyards Branch changes documented in cross section changes 2005 - 2010 comparison in Appendix

FRANKLIN W. HOWEY, JR.
PIN 031580178
D.B. 3572, PG 813



LOCATION KEY LEGEND

MATCHLINE SHEET EC1
SHEET EC2

Ward Consulting Engineers, P.C.
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Raleigh, NC 27616-2948
FAX (919) 870-5359
Environmental Banc & Exchange
909 Capability Drive, Suite 3100
Raleigh NC 27606 Phone: (919) 829-9609
Fax: (919) 229-9913

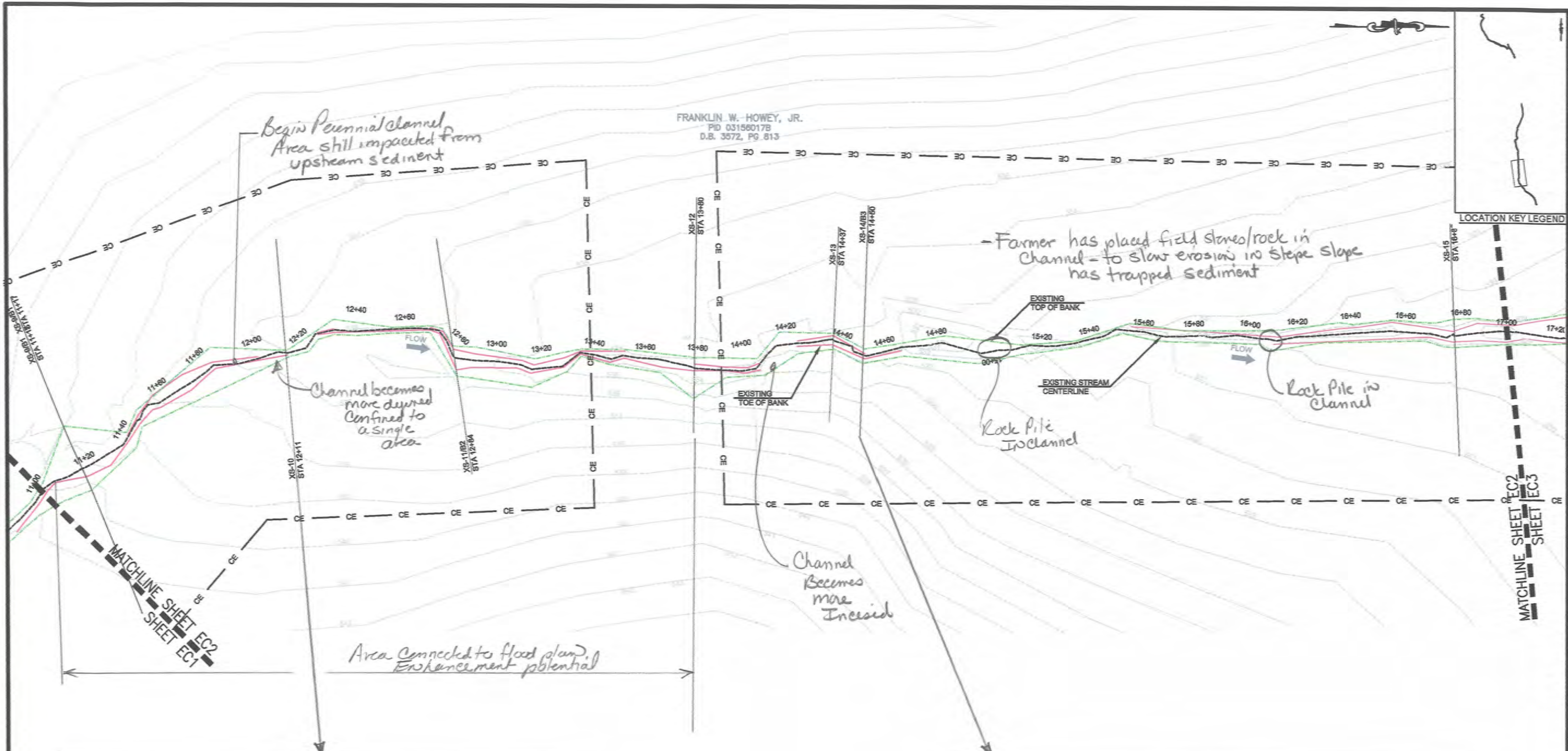


601 EAST
EXISTING CONDITIONS
STATION 5+00 TO 11+00
UNION COUNTY, NORTH CAROLINA

DATE: 8 AUGUST 2013
REVISIONS:
PROJECT NAME: 601 East
DWG NAME: Existing Conditions
SCALE: 1"=20'
MITIGATION PLAN SET
SHEET NO.

EC1





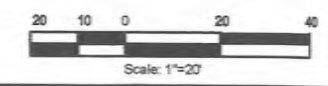
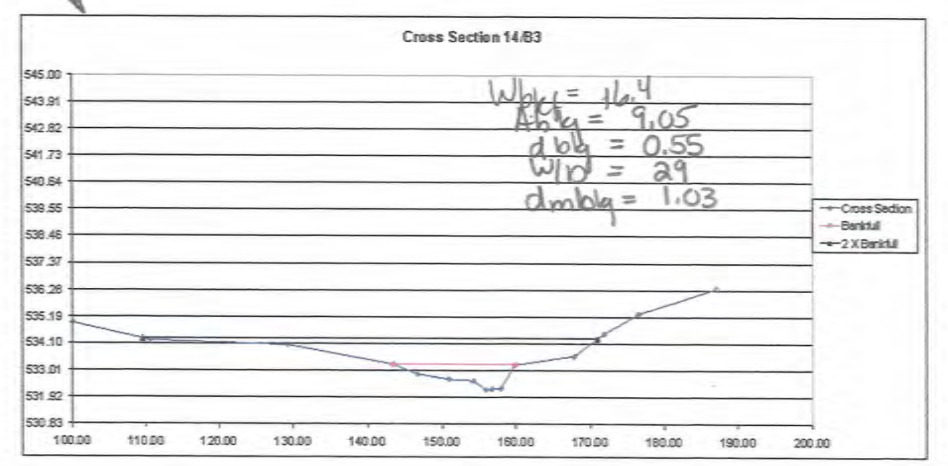
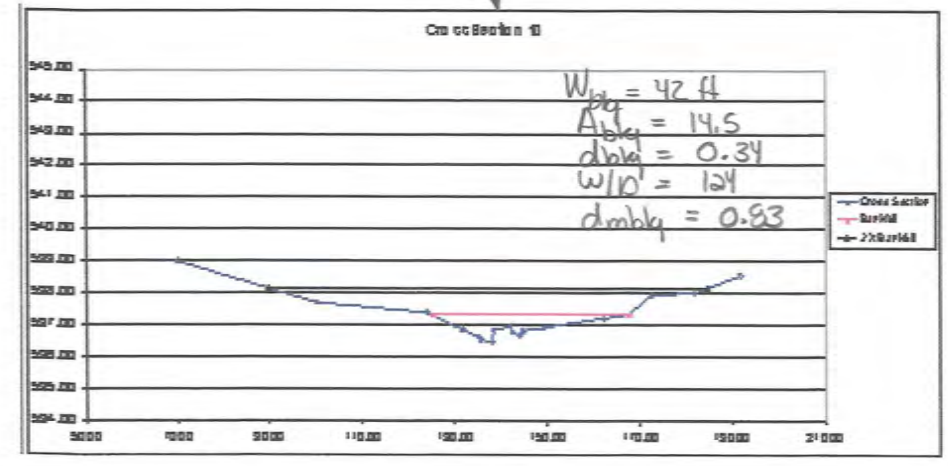
FRANKLIN W. HOWEY, JR.
 PID 031560178
 D.B. 3572, PG. 813

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 Environmental Bank & Exchange
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 Fax: (919) 229-9913

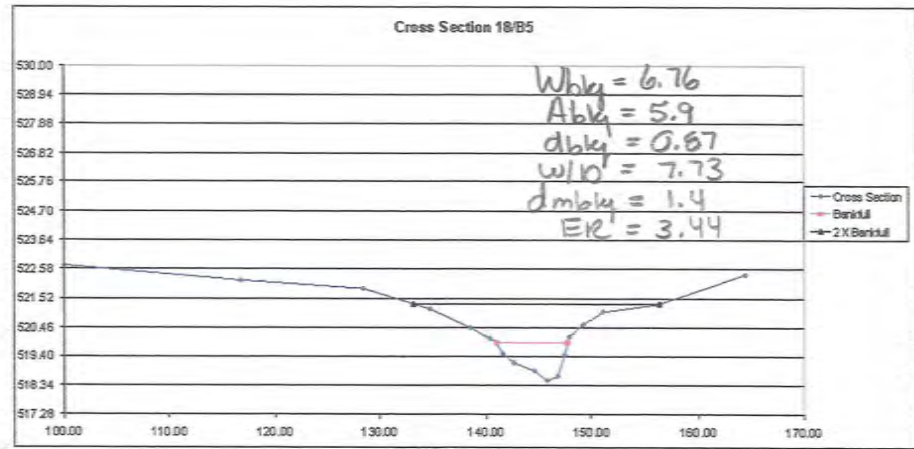


601 EAST
 EXISTING CONDITIONS
 STATION 11+00 TO 17+00
 UNION COUNTY, NORTH CAROLINA

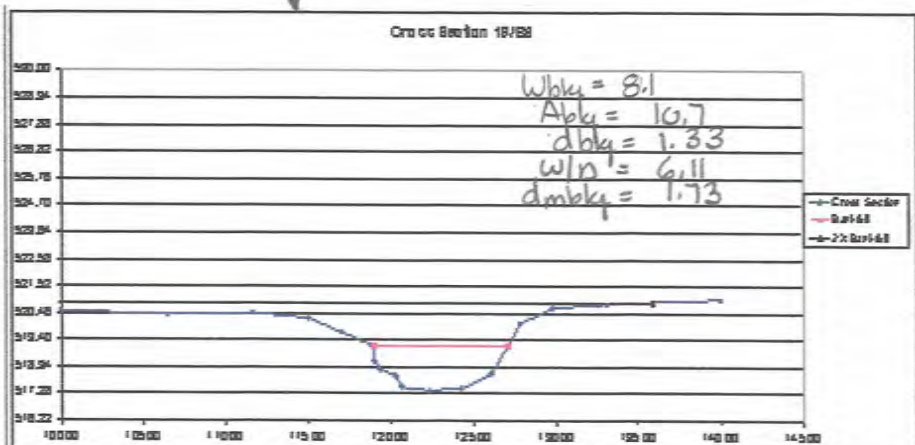
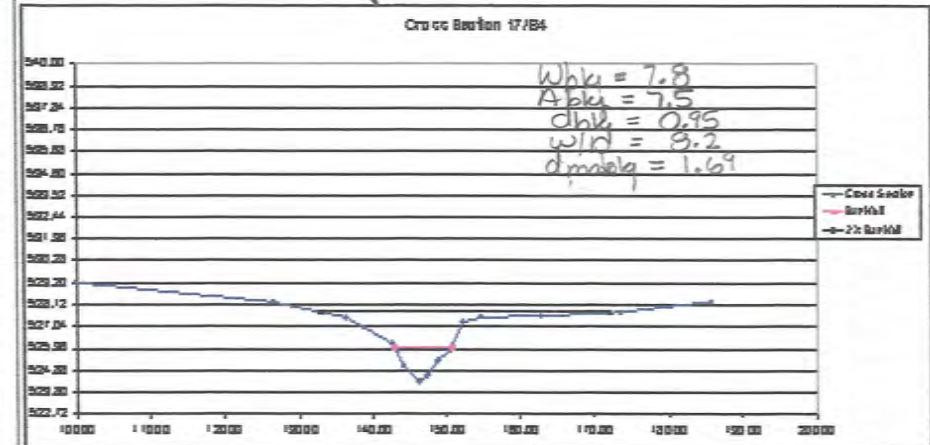
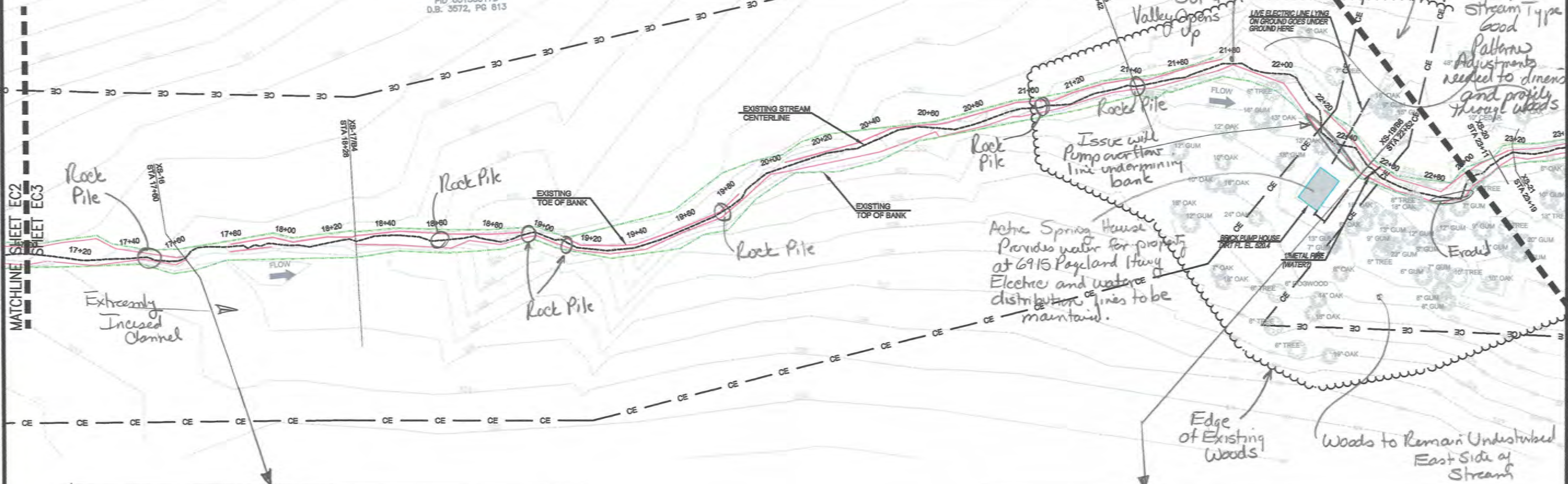
DATE: 5 AUGUST 2013
 REVISIONS:
 PROJECT NAME:
 601 East
 DWG NAME:
 Existing Conditions
 SCALE:
 1"=20'
 MITIGATION
 PLAN SET
 SHEET NO.



EC2



FRANKLIN W. HOWEY, JR.
 PID 031560178
 D.B. 3572, PG 813



LOCATION KEY LEGEND



Ward Consulting Engineers, P.C.
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 Raleigh, NC 27616-2848
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 (919) 870-5359
 FAX (919) 870-5359
 Environmental Banc & Exchange
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 Fax: (919) 229-9913

601 EAST
 EXISTING CONDITIONS
 STATION 17+00 TO 23+00
 UNION COUNTY, NORTH CAROLINA

DATE: 8 AUGUST 2013

REVISIONS:

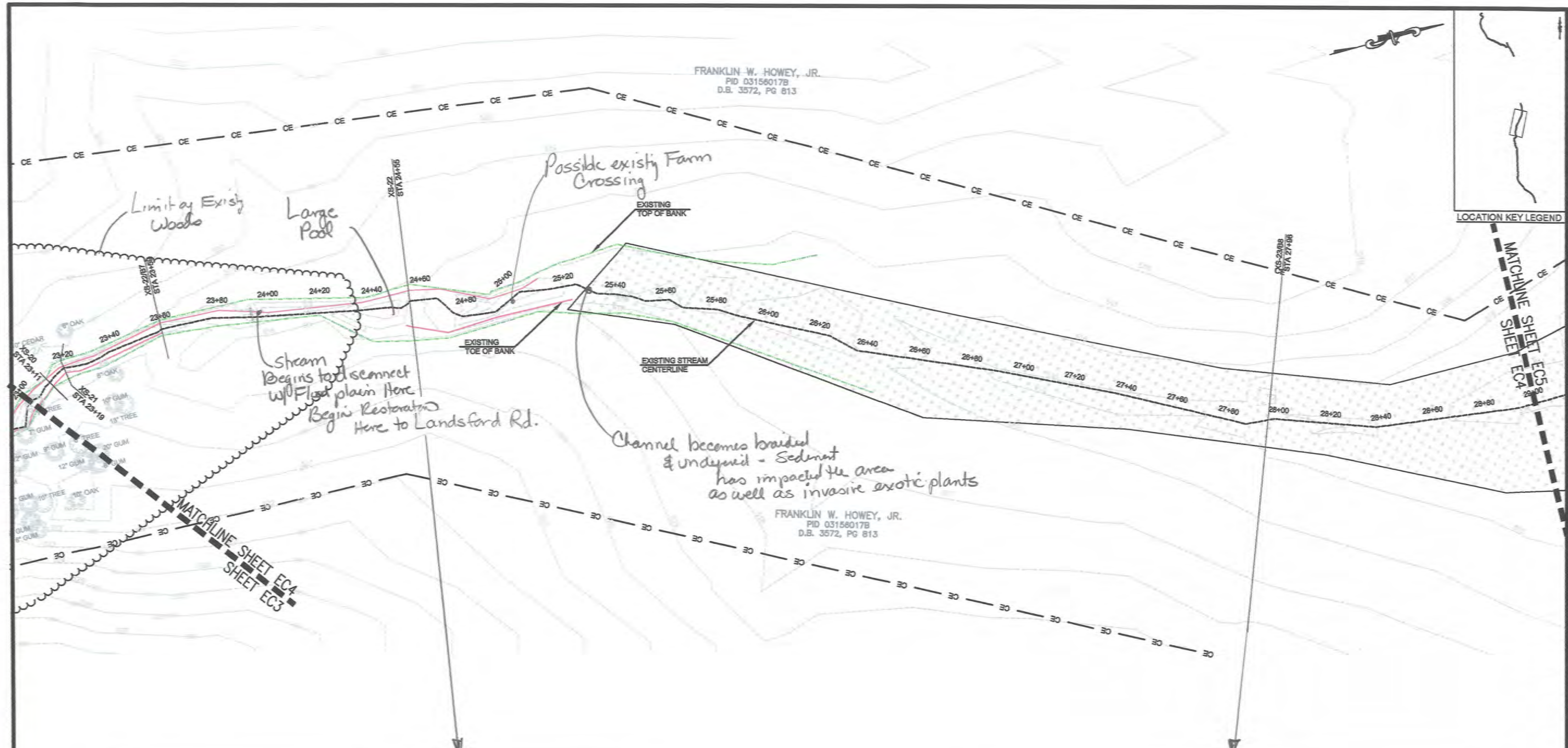
PROJECT NAME:
601 East

DWG NAME:
Existing Conditions

SCALE:
1"=20'

MITIGATION
PLAN SET

SHEET NO.
EC3



LOCATION KEY LEGEND

MATCHLINE SHEET EC3
MATCHLINE SHEET EC4
MATCHLINE SHEET EC5

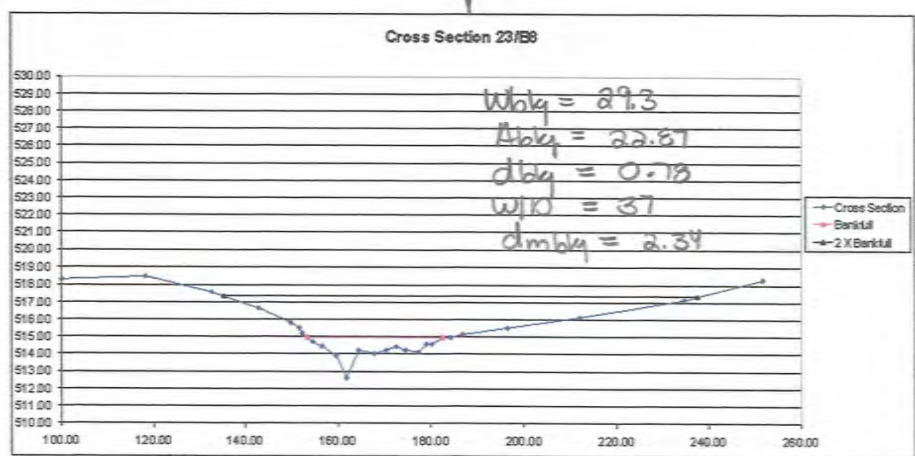
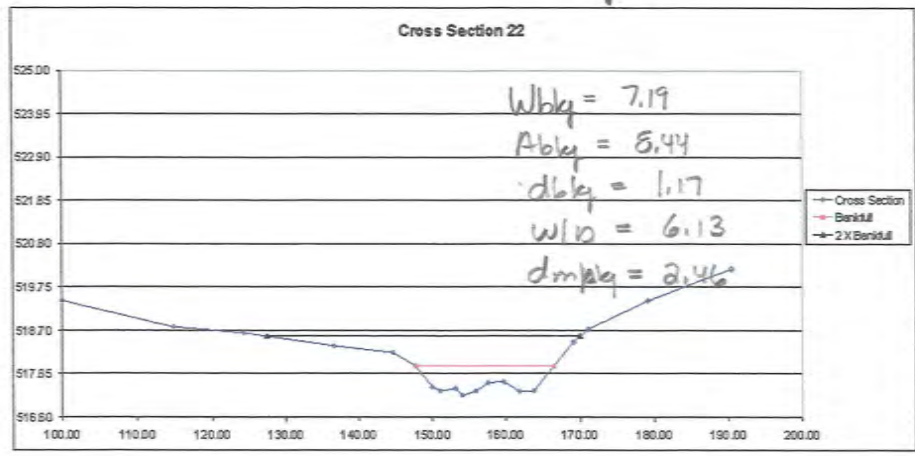
Ward Consulting Engineers, P.C.
 FIRM LICENSE NO C-2810
 4805 Green Rd, Suite 100
 Raleigh, NC 27616-2948
 (919) 870-0526
 (919) 870-5359
 FAX (919) 870-5359

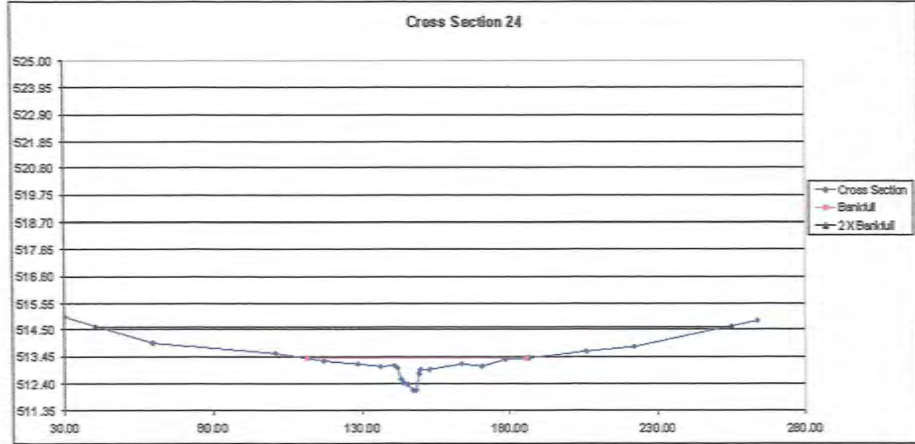
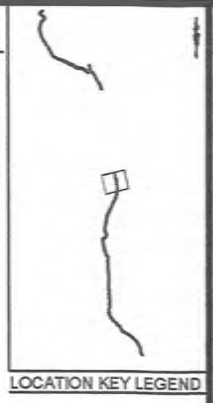
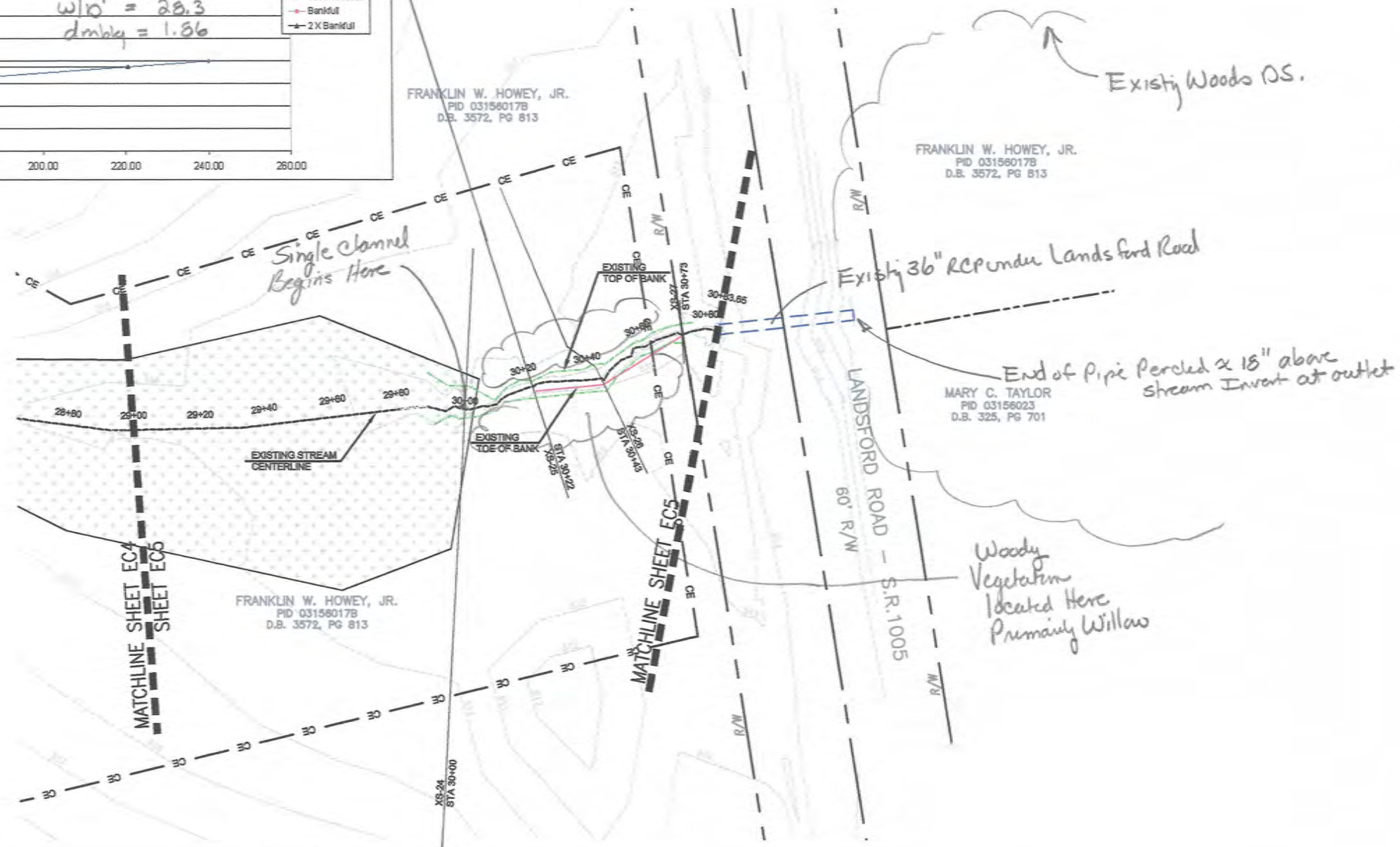
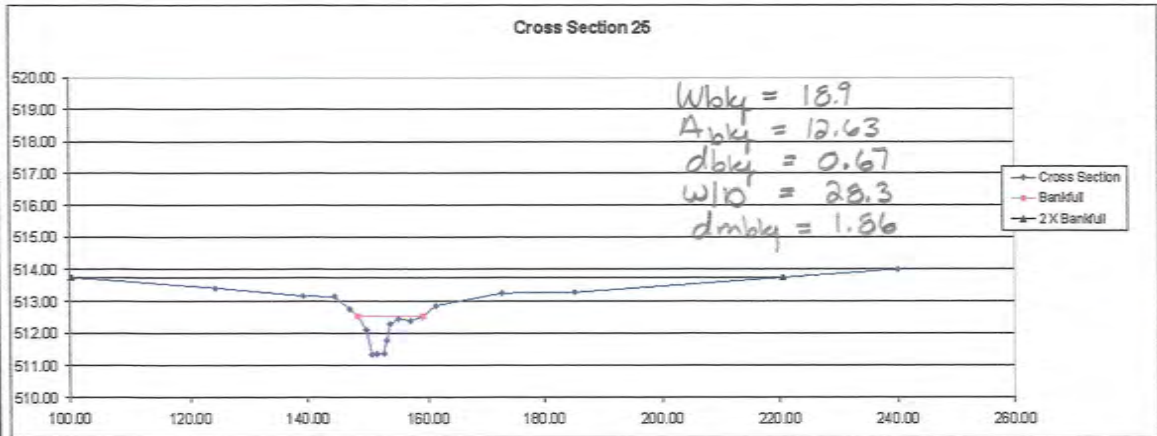


601 EAST
 EXISTING CONDITIONS
 STATION 23+00 TO 29+00
 UNION COUNTY, NORTH CAROLINA

DATE: 9 AUGUST 2013
 REVISIONS:
 PROJECT NAME:
 601 East
 DWG NAME:
 Existing Conditions
 SCALE:
 1"=20'
 MITIGATION
 PLAN SET
 SHEET NO.

EC4





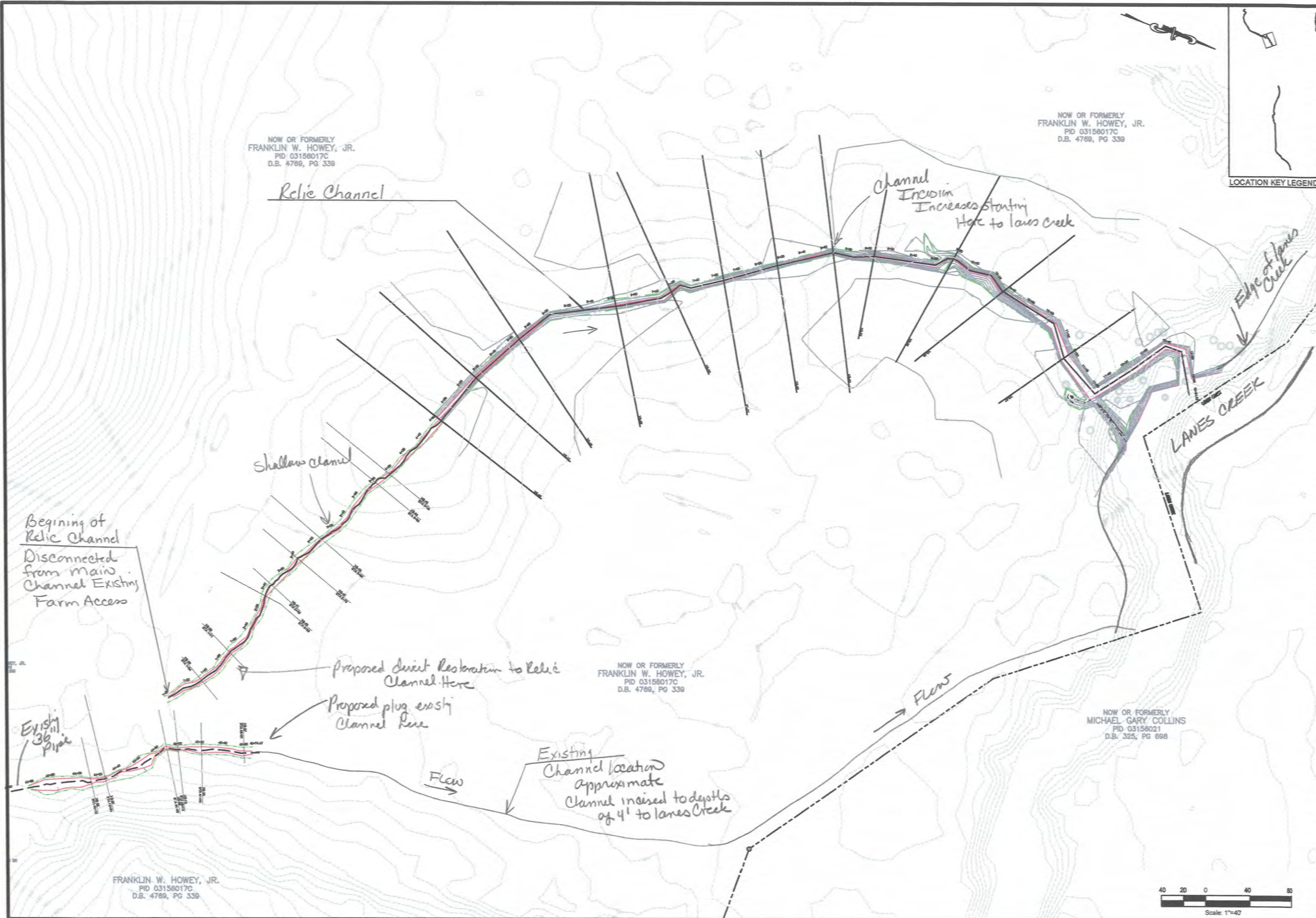
Ward Consulting Engineers, P.C.
 FIRM LICENSE NO C-2819
 4805 Green Rd, Suite 100
 Raleigh, NC 27616-2848
 (919) 870-0528
 (919) 870-5389
 FAX (919) 870-5389

Environmental Banc & Exchange
 909 Capabilities Drive, Suite 3100
 Raleigh NC 27606
 Phone: (919) 829-9808
 Fax: (919) 229-9913



601 EAST
 EXISTING CONDITIONS
 STATION 29+00 TO 30+83.65
 UNION COUNTY, NORTH CAROLINA

DATE:	9 AUGUST 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Existing Conditions
SCALE:	1"=20'
MITIGATION PLAN SET	
SHEET NO.	EC5



NOW OR FORMERLY
FRANKLIN W. HOWEY, JR.
PID 03156017C
D.B. 4789, PG 339

NOW OR FORMERLY
FRANKLIN W. HOWEY, JR.
PID 03156017C
D.B. 4789, PG 339

NOW OR FORMERLY
FRANKLIN W. HOWEY, JR.
PID 03156017C
D.B. 4789, PG 339

NOW OR FORMERLY
MICHAEL GARY COLLINS
PID 03156021
D.B. 325, PG 698

FRANKLIN W. HOWEY, JR.
PID 03156017C
D.B. 4789, PG 339

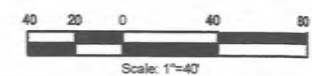
LOCATION KEY LEGEND

Ward Consulting Engineers, P.C.
FIRM LICENSE NO C-2819
4805 Green Rd, Suite 100
Raleigh, NC 27616-2848
Environmental Banc & Exchange
909 Capability Drive, Suite 3100
Raleigh NC 27606 Phone: (919) 829-6609
Fax: (919) 229-6613

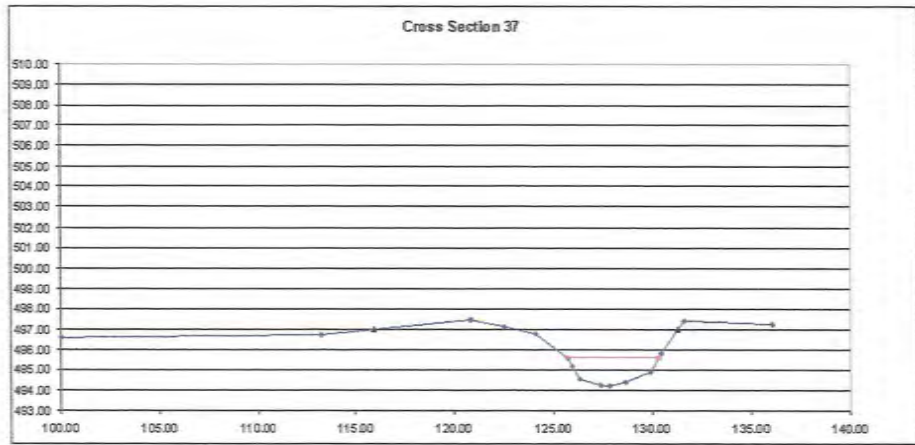


601 EAST
EXISTING CONDITIONS
OVERALL EXISTING LOWER REACH
UNION COUNTY, NORTH CAROLINA

DATE	9 AUGUST 2013
REVISIONS	
PROJECT NAME	601 East
DWG NAME	Overall Existing Lower Reach
SCALE	1"=40'
MITIGATION PLAN SET	
SHEET NO.	



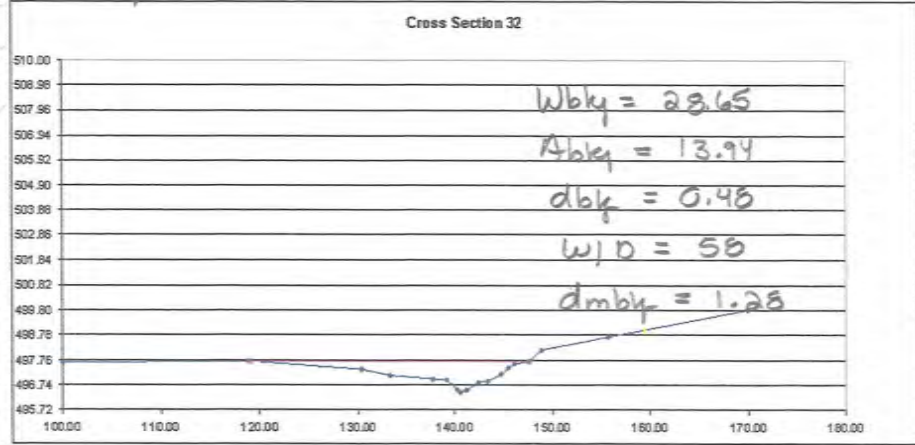
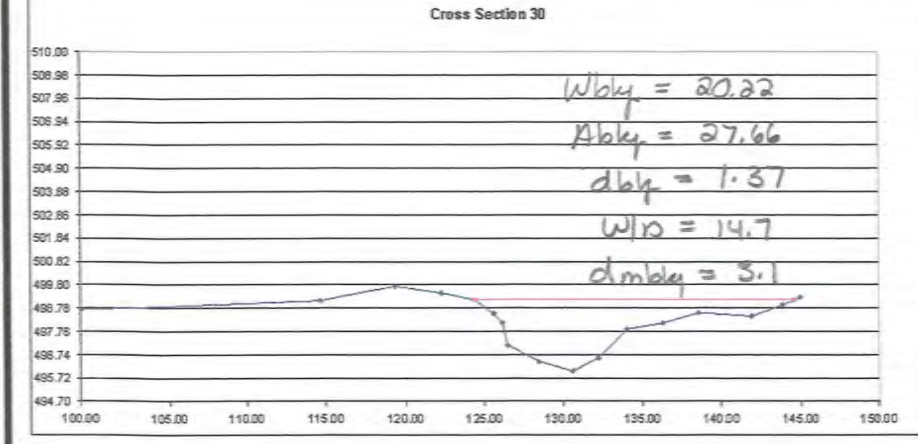
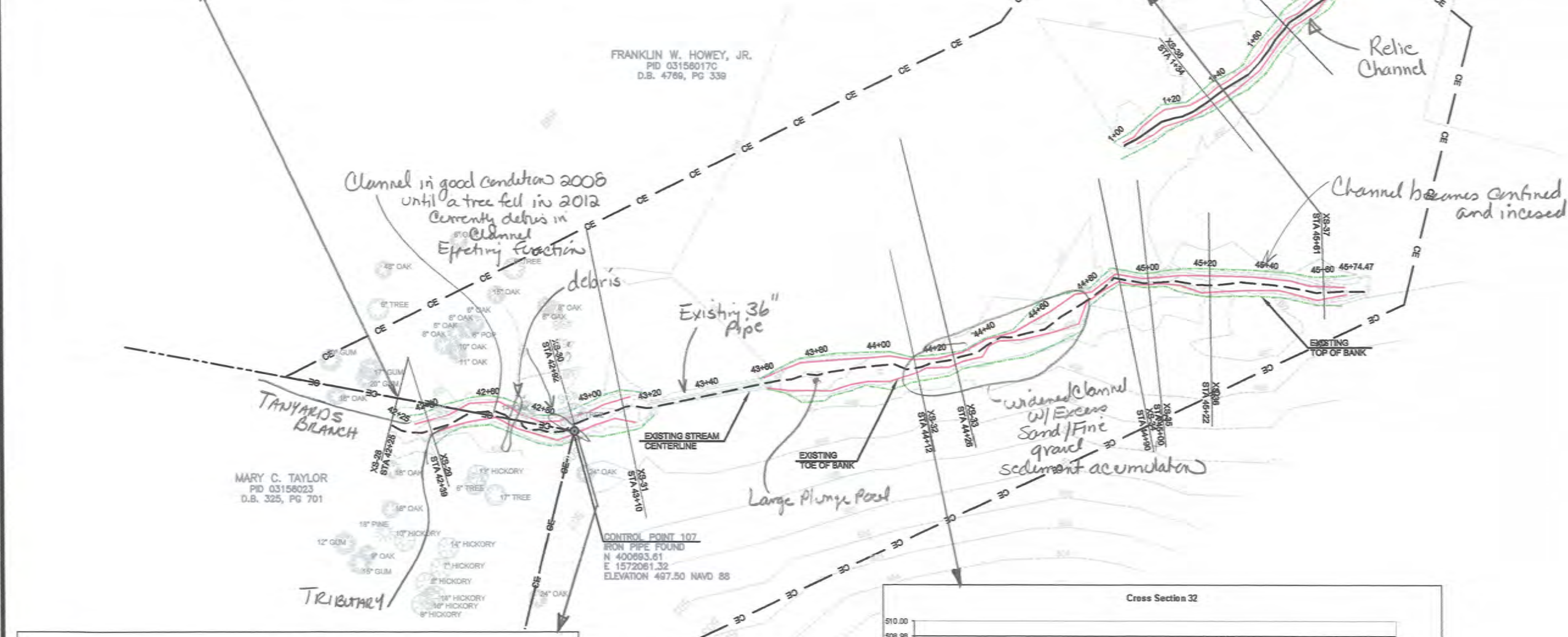
EC6



LOCATION KEY LEGEND

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 FIRM LICENSE NO C-2819
 4805 Green Rd, Suite 100
 Raleigh, NC 27616-2848
 (919) 870-0528
 FAX (919) 870-5369

Environmental Banc & Exchange
 909 Capability Drive, Suite 3100
 Raleigh NC 27606
 Phone: (919) 829-9808
 Fax: (919) 229-9913



601 EAST
 EXISTING CONDITIONS
 STATION 42+25 TO 45+74.47
 UNION COUNTY, NORTH CAROLINA

DATE: 9 AUGUST 2013

REVISIONS:

PROJECT NAME:
601 East

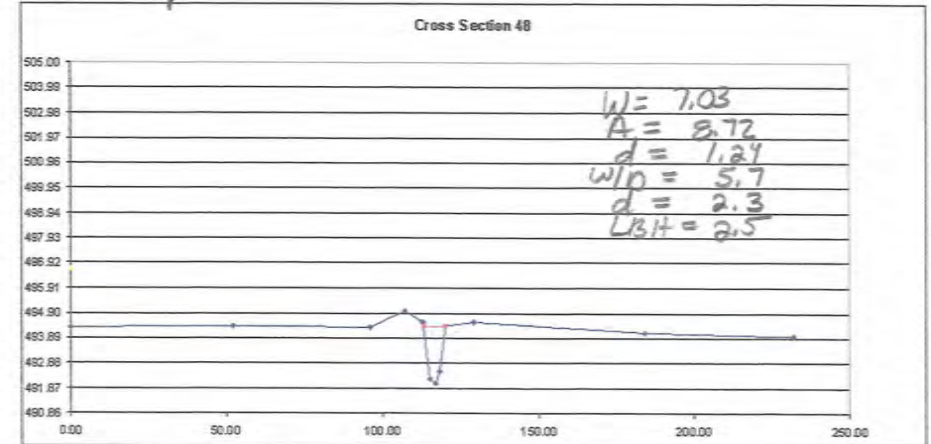
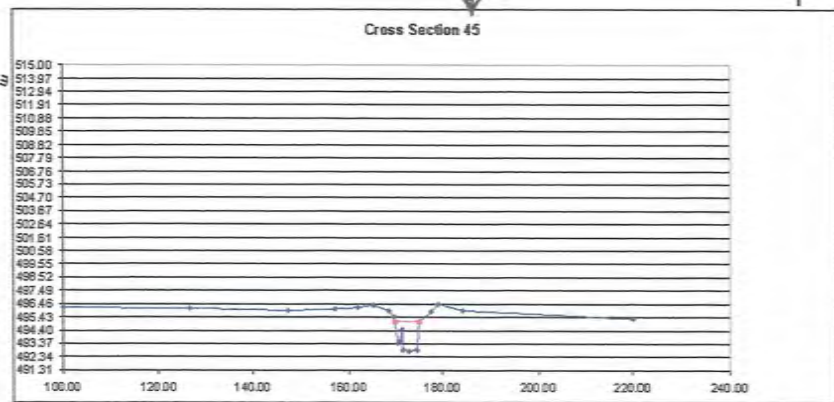
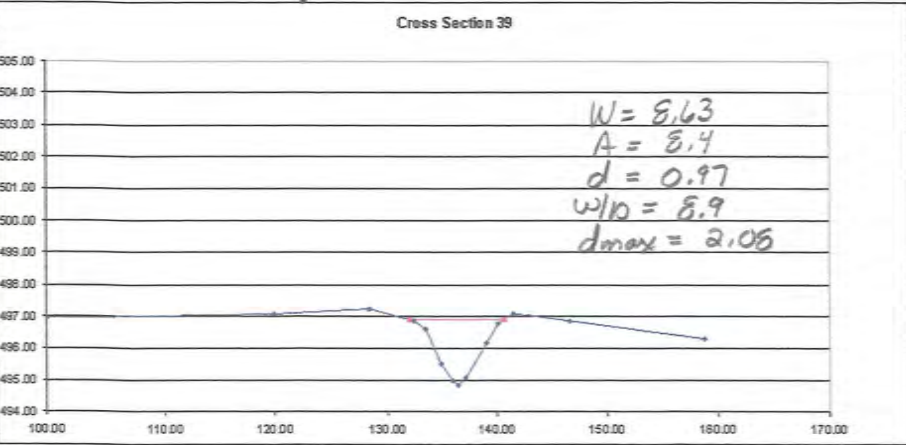
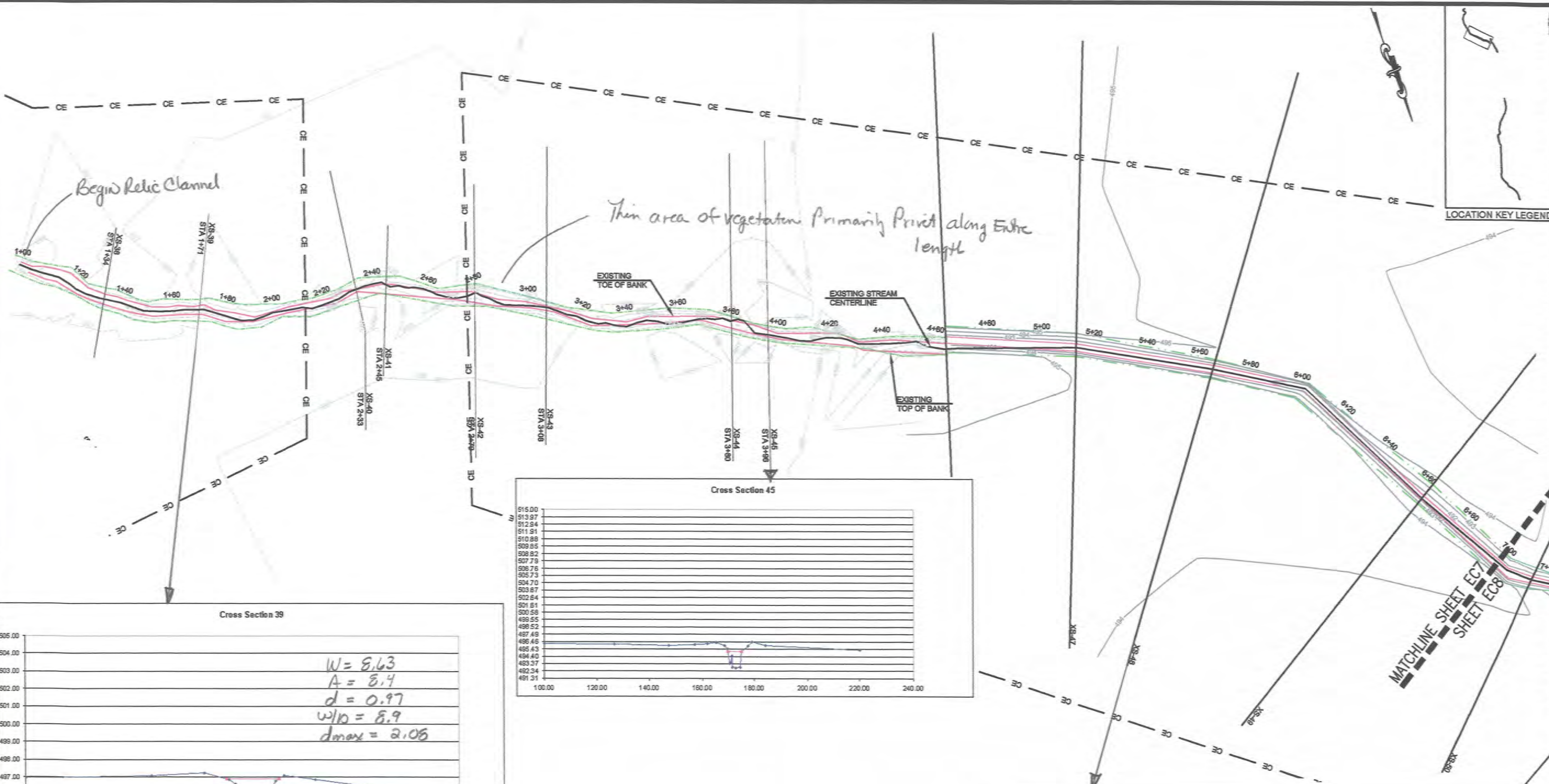
DWG NAME:
Existing Conditions

SCALE:
1"=20'

MITIGATION PLAN SET

SHEET NO.

EC7



Ward Consulting Engineers, P.C.
 FIRM LICENSE NO C-2819
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 Raleigh, NC 27616-2848
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 (919) 870-5359
 FAX (919) 870-5359



601 EAST
EXISTING CONDITIONS (RELIC CHANNEL)
 STATION 1+00 TO 7+00
 UNION COUNTY, NORTH CAROLINA

DATE: 5 AUGUST 2013

REVISIONS:

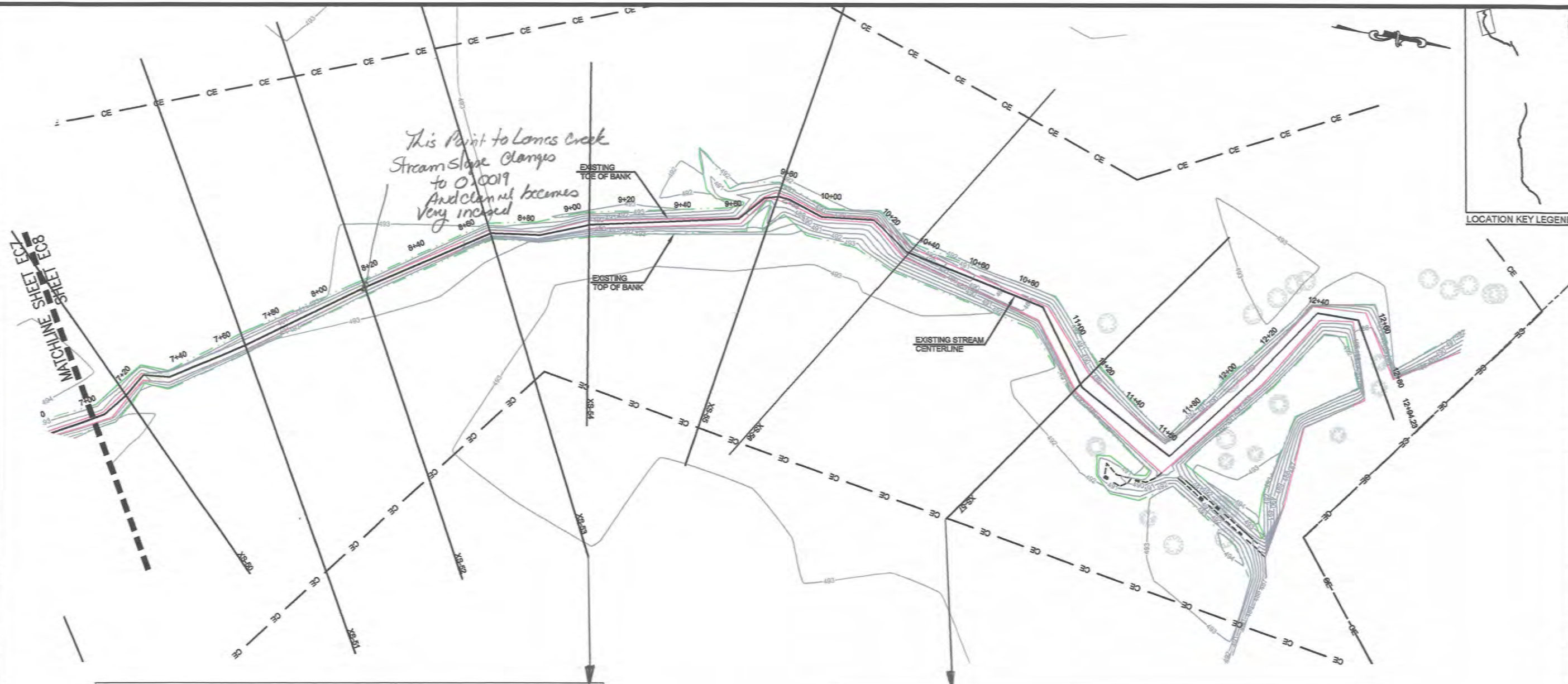
PROJECT NAME:
601 East

DWG NAME:
Existing Conditions (Relic Channel)

SCALE:
1"=20'

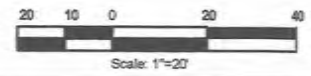
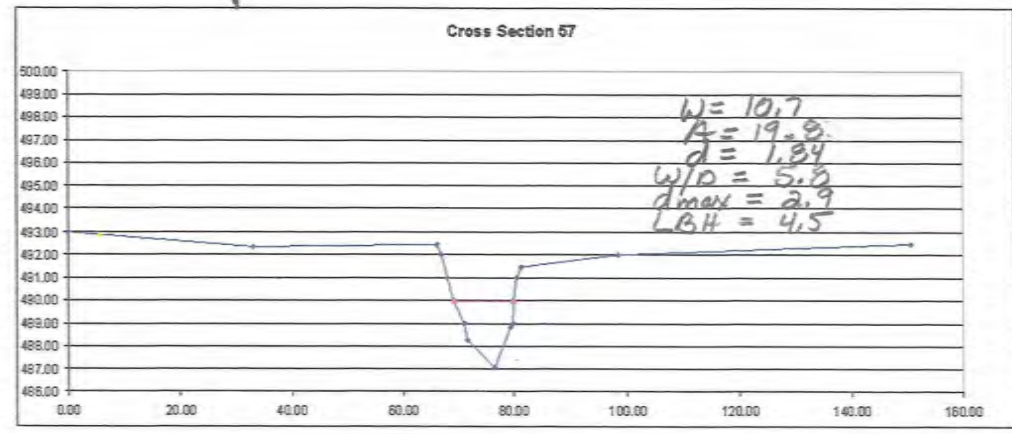
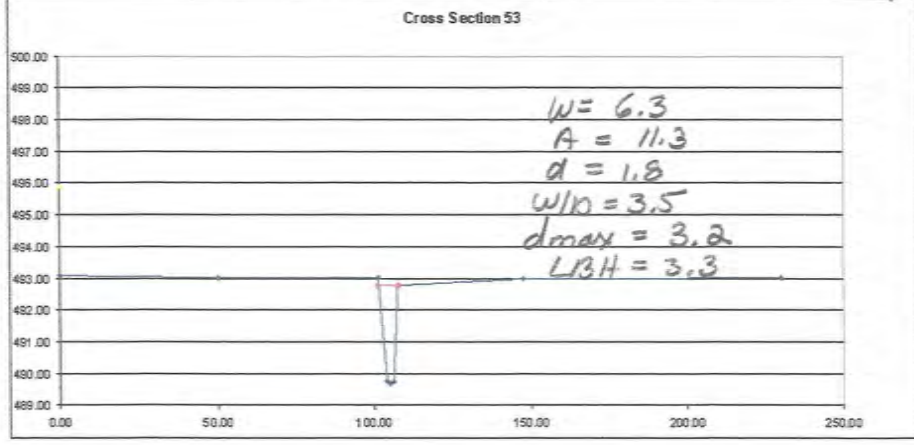
**MITIGATION
PLAN SET**

SHEET NO. **EC18**



LOCATION KEY LEGEND

MATCHLINE SHEET EC7



Ward Consulting Engineers, P.C.
 FIRM LICENSE NO C-2619
 4805 Green Rd, Suite 100
 Raleigh, NC 27616-2848
 (919) 870-0528
 (919) 870-6369
 FAX (919) 870-6369



601 EAST
EXISTING CONDITIONS (RELIC CHANNEL)
STATION 7+00 TO 12+94.23
UNION COUNTY, NORTH CAROLINA

DATE:	9 AUGUST 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Existing Conditions (Relic Channel)
SCALE:	1"=20'
MITIGATION PLAN SET	
SHEET NO.:	

EC 9

C6. Design Calculations

Regional Cunes - NC Rural Piedmont

3-10-13

No. 937811E
Engineering Co.
Consultation Pad

601 East

Drainage Area (Sq. mi)	Bankfull X-sect Area (ft ²)	Discharge (cfs)	Bankfull Width (ft)	Bankfull Depth (ft)	Regression Equation (1.5yr - 2yr)
① - 0.117	4.89	(Range) 18 (65-85)	5.7	0.75	(24-30)
Reach 1 "B" channel ② - 0.166	6.32	23 (8-80)	6.4	0.84	(32-38)
Reach 2 "C" channel ③ - 0.212	7.46	29 (9-90)	7.1	0.91	(39-45)
④ - 0.52	13.74	56 (18-170)	9.0	1.22	(76-85)
Reach 3 "E" channel ⑤ - 0.56	14.45	60 (20-180)	12	1.25	(79-90)
Reach 4 "B" channel					

X-sectional Area $y = 21.43 x^{0.68}$
 Discharge $y = 66.57 x^{0.89}$
 Width $y = 11.89 x^{0.43}$
 Depth $y = 1.5 x^{0.32}$

Reach 1 - Field Morph Data -

$Q_{Avg} = 23.67 (18.73 - 28.44)$
 $W_{bkt} = 20.97 (6.76 - 59.9)$
 $d_{bkt} = 0.50 (.22 - .87)$
 $A_{bkt} = 8.3 (3.9 - 14.5)$

Regional Cune Data -

$Q_{Avg} = 23 (8-80)$
 $W_{bkt} = 6.5$
 $d_{bkt} = 0.84$
 $A_{bkt} = 6.3$

Regression Equns

$\approx 32 cfs.$
 = Design $Q = 24 cfs$

Reach 2

$Q_{Avg} = 23.96 (12.1 - 29.6)$
 $W_{bkt} = 25.3 (6.9 - 74)$
 $d_{bkt} = 0.73 (.28 - 1.33)$
 $A_{bkt} = 11.9 (6.1 - 21)$

Regional Cune Data -

$Q_{Avg} = 29 (9-90)$
 $W_{bkt} = 7.1$
 $d_{bkt} = 0.91$
 $A_{bkt} = 7.5$

Regression Equns

$\approx 29 cfs.$
 = Design $Q = 26 cfs.$

Reach 3

Relic Channel still seen a portion of bankfull flow due to the topography - when water gets above elev 447 it can spread out and is directed to old channel -
 Q - combined by split from xs. 31 = 64.8 cfs

Avg. Q - sect. 32-37

$\frac{29.66 + 36.83 + 25.57}{3} = 30.7 cfs.$

Avg. Q - sect. (38-45) Relic Channel

$\frac{18 \cdot 27.2 + 24.7 \cdot 16.46 + 27.6 \cdot 26.1}{3} = 23.67$

Regression Equns

76-79 cfs
 Design $Q = 55 cfs$
 lower reach -

TOTAL $Q = 30.7 + 24 = 54.7$

Determine N-values for Existing Channel
Intermittent Channel

Point Bar Sample #5 Intermittent upper $D_{50} = 7\text{mm}$ Fine Gravel

Bank Sample #4 Intermittent upper $D_{50} = 11\text{mm}$ medium Gravel

$N = 0.028 - 0.030$

Intermittent Channel - Sample #3 #4

Bankfull = 14.5 medium gravel = 0.028

Wetted = 19.0 Coarse gravel = 0.030

N Adjustments from
USGS Water Supply
Paper 2339

$N = 0.028$ for Intermittent channel

$(N_1) = .001$

$(N_2) = 0$

$(N_3) = 0$

$N = 0.029$ - use

Perennial Channel Upper $N_4 = 0$

50' US. XS 18/35 Samples 1 & 2

Bankfull = 1.9 mm

Wetted = 6.8 mm

} fine gravel area meshy
collect fine deposits
sediment may flow
by stem from
upper reach

In wooded area Sample 5 & 6

Bankfull = 7.1 mm

Wetted = 10.7 mm

} medium gravel

Bank Soil Sample # 2 $D_{50} = 11\text{mm}$

Point Bar Sample # 6 $D_{50} = 7\text{mm}$

} Fine to medium gravel

use $N = 0.028$
Adjustments $(N_1) = .001$
 $(N_2) = .001$
 $(N_3) = .001$
 $(N_4) \frac{.01}{0.041}$

meander - slight N value adj = $1.05(0.041) = 0.043$

use for Perennial channel - more vegetation

Overbanks of FP - adj. procedure

Sediment Competance -

Depth of flow/water surface slope required to move largest particle

Determine Critical Dimensionless Shear Stress

$$\tau_c^* = 0.0834 \left(\frac{d_i}{d_{50}} \right)^{-0.872}$$

 $d_i =$ bed material $d_{50} = 19.0 \text{ mm}$ $\hat{d}_{50} =$ bar sample $d_{50} = 7.0 \text{ mm}$

$$\tau_c^* = 0.0834 \left(\frac{19}{7} \right)^{-0.872}$$

$$\tau_c^* = 0.035$$

Upper ReachsLower Reachs"B" Type Stream $S = 0.017 \text{ ft/ft}$ $S = 0.0114 \text{ ft/ft}$ "C" Type Stream $S = 0.0069 \text{ ft/ft}$ $S = 0.0056 \text{ ft/ft}$ Max Size Particle moving $2'' = 0.167 \text{ ft} = D$

$$d = \frac{\tau_c^* (1.65) (D)}{S}$$

Upper ReachsLower Reachs

$$d = \frac{0.035 (1.65) (0.167)}{0.017}$$

$$d = \frac{0.035 (1.65) (0.167)}{0.0114}$$

$$d = 0.57 \text{ ft} \quad \text{ok - 1' design}$$

$$d = 0.85 \text{ ft} \quad \text{ok 1.2 design}$$

$$d = \frac{0.035 (1.65) (0.167)}{0.0069}$$

$$d = \frac{0.035 (1.65) (0.167)}{0.0056}$$

$$d = 1.39 \text{ ft} \quad \text{ok 1.4' design}$$

$$d = 1.72 \quad \text{ok 1.7 design}$$

"B" Channel Velocities & Shear stresses for design

Intermittant 7+60 to 11+81

Perennial 11+81 to 22+43

Velocity Ranges -

	max Channel	max Shear Channel
bankfull	4.5	1.25
2x bankfull	5.2	1.36 - 1.53
10 year	5.3 - 6.2	1.6 - 2.0
100 year	7 - 7.5	2 - 2.3

allowable velocity for silt ≈ 3.0

Rypts will not hold w/ out armorng -

Shear in channel -

design for shear stress in channel = 2.0

Stulds diagram Shear of 2.0 \Rightarrow 350 mm threshold of motion

$$350 \text{ mm} \times \frac{1 \text{ in}}{25.4 \text{ mm}} = 13.77 \text{ " } \approx 14 \text{ " stone will max -}$$

100 year Storm Design -

Class II Rip Rap 9" - 23" - avg 14" (24" deep)

Bankfull Design -

$\gamma = 1.25$ Stulds diagram \Rightarrow 200 mm

$$200 \text{ mm} \times \frac{1 \text{ in}}{25.4 \text{ mm}} = 8 \text{ " diameter}$$

Class B - 5 - 12" Avg 8" (12" deep)

Upper Reach -

Design For $\gamma = 1.5$ \approx 10 year design storm

Stulds diagram \Rightarrow 250 mm

$$\frac{250 \text{ mm}}{25.4} = 9.8 \text{ in } \approx 10 \text{ "}$$

Class I Rip Rap = 5 - 17" Avg 10" (18" deep)

Increase Rypts to Class II for - Stations

7+88

8+00

15+10

15+97

20+88

22+91

Lower Reach Shear Stress - Channel "B"

5-5-2013

AMPAD

RAS STATION	STREAM STA	FEATURE	Highest Shear	Stream Event
4+80	53+80	HR	1.20	2 year
4+35	54+35	HR	1.95	5 year
3+80	54+80	HR	1.89	10 year
3+65	54+95	ER	1.32	10 year
3+27	55+33	HR	1.66	2x bankfull
2+73	55+87	HR	1.96	100 year
2+60	56+00	ER	1.11	10 year
2+30	56+30	HR	3.47 (1.53 blk)	100 yr
2+10	56+50	ER	1.83	100 yr
1+90	56+70	CP	1.36	100 yr
1+70	56+90	HR	2.35	10 yr
1+50	57+10	ER	1.70	100 yr
1+30	57+30	CP	1.36	100 yr
1+10	57+50	HR	3.35 (1.53 blk)	100 yr
80	57+80	ER	1.50	100 yr
60	58+00	CP	1.27	100 yr
40	58+20	HR	3.23 (1.53 blk)	100 yr
0	58+60	ER	2.50 (1.35 yr)	100 yr

Shields Curve Threshold of Motion {

Average = $1.95 \text{ #/sf} = 340 / 25.4 = 13.5 \text{ inches}$

Highest 10 year Event = $2.35 \text{ #/sf} = \frac{375 \text{ mm}}{25.4 \text{ mm}} = 15 \text{ inches}$

Highest Shear 100 year = $3.47 \text{ #/sf} = \frac{200 \text{ mm}}{25.4 \text{ mm}} = 24 \text{ inches}$

Construct Riprap of Boulders & Class II Riprap -

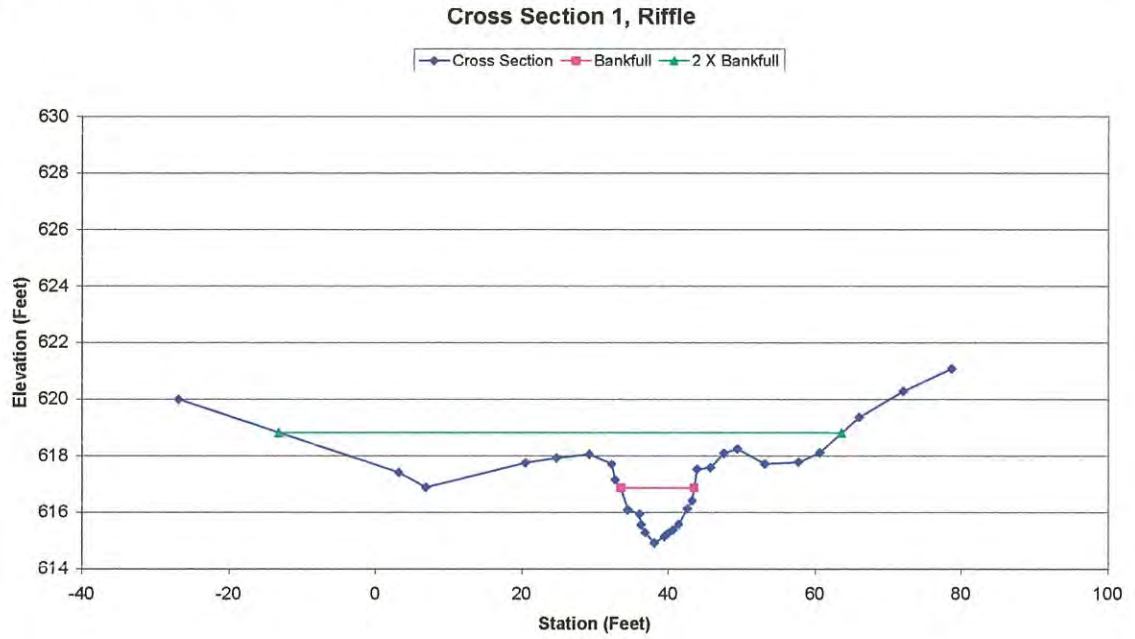
C7. Reference Reach Data

Reference Reach 1-Underwood Creek

Project: 601 E-Reference
 Cross Section 1
 Feature: Riffle
 Station:
 Date: 3-Feb-10
 Crew: BW, RL, SV

Bankfull Summary	
A (BKF)	12.1
W (BKF)	10.0
Max d	2.0
Mean d	1.2
W/D	8.3

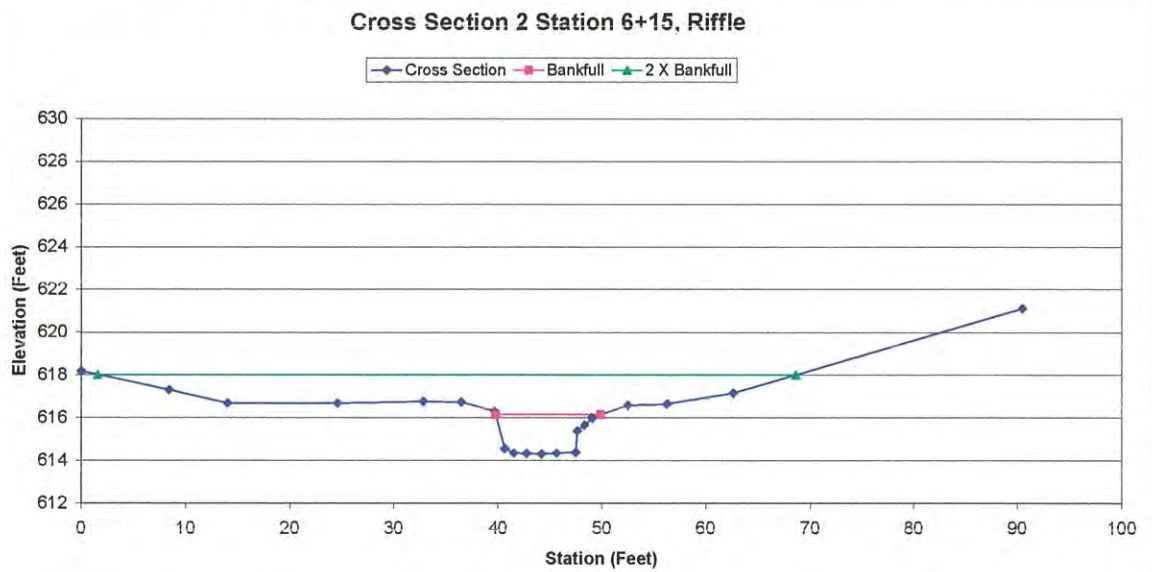
Baseline Section		
Station	Elevation	Notes
-26.92	620.00	TOPO
3.16	617.41	X1
6.87	616.89	X1
20.45	617.75	X1
24.67	617.93	X1
29.19	618.05	X1
32.23	617.71	TOBL
32.70	617.16	X1
33.51	616.87	Bankfull left
34.46	616.09	X1BED
36.05	615.94	X1BED
36.26	615.56	X1BED
36.84	615.29	X1BED
38.08	614.92	X11W
39.49	615.15	X1BED
39.89	615.24	X1BED
40.65	615.37	X1BED
41.42	615.59	X1
42.62	616.13	X1
43.23	616.42	X1
43.95	617.53	TOBR
45.78	617.59	X1
47.59	618.10	X1
49.42	618.24	X1
53.10	617.72	X1
57.70	617.78	X1
60.58	618.11	X1
66.00	619.37	X1
72.07	620.28	X1
78.67	621.08	X1



Project: 601 E-Reference
 Cross Section 2
 Feature: Riffle
 Station: 6+15
 Date: 3-Feb-10
 Crew: BW, RL, SV

Bankfull Summary	
A (BKF)	13.4
W (BKF)	10.1
Max d	1.9
Mean d	1.3
W/D	7.6

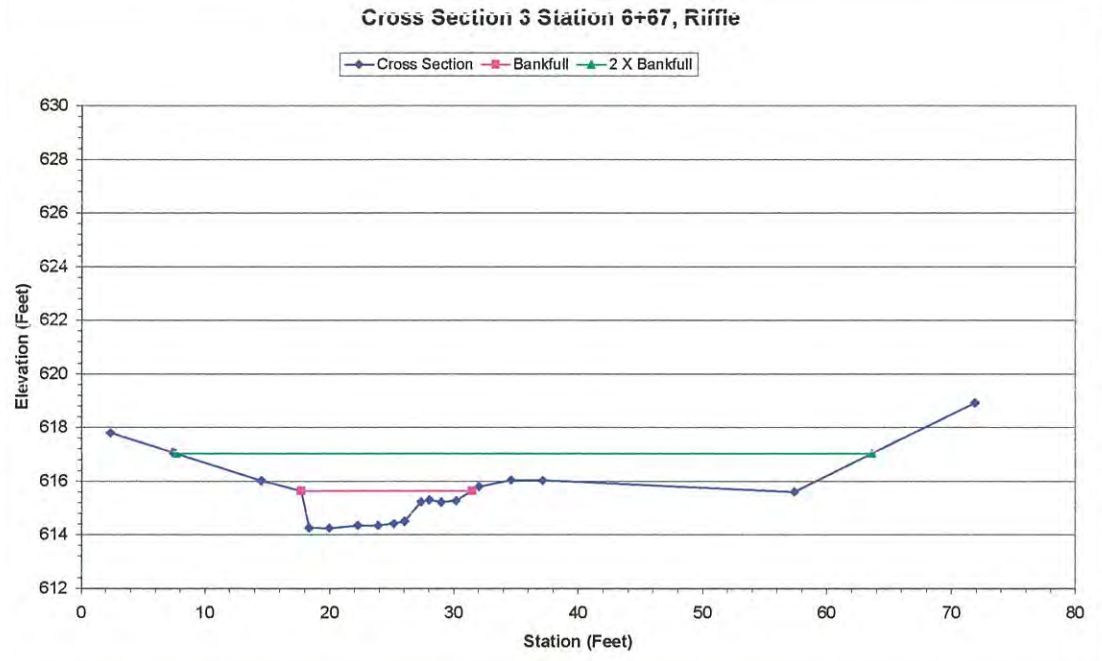
Baseline Section		
Station	Elevation	Notes
0.00	618.17	X2
8.36	617.32	X2
14.05	616.68	X2
24.59	616.68	X2
32.80	616.16	X2
36.47	616.74	TOBL
39.70	616.30	Bankfull Left
40.65	614.55	X2TOE
41.55	614.34	X2
42.76	614.33	X2
44.20	614.30	X2TW
45.65	614.34	X2
47.49	614.38	X2TOE
47.66	615.37	X2
48.33	615.65	X2
49.10	615.99	0.00
49.03	616.01	Bankfull Right
52.49	616.59	TOBR
56.28	616.63	X2
56.32	616.65	X2
62.63	617.16	X2
90.45	621.12	X2



Project: New Town Reference Reach
 Cross Section 3
 Feature: Riffle
 Station: 6+67
 Date: 3-Feb-10
 Crew: BW, RL, SV

Bankfull Summary	
A (BKF)	12.8
W (BKF)	13.8
Max d	1.4
Mean d	0.9
W/D	14.7

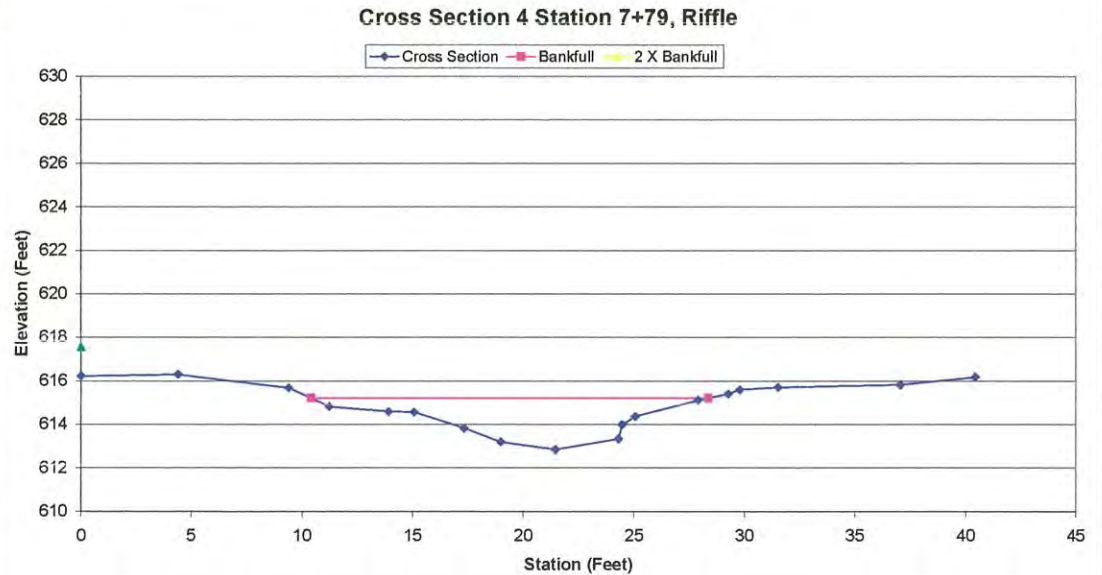
Baseline Section		
Station	Elevation	Notes
2.36	617.80	X3
7.41	617.07	X3
14.53	616.01	X3
17.70	615.64	Bankfull Left TOBL
18.34	614.26	X3TOE
19.96	614.25	X3TW
22.25	614.35	X3
23.89	614.35	X3
25.16	614.42	X3
26.03	614.50	X3TOE
27.35	615.23	X3
28.01	615.30	X3
28.97	615.22	X3
30.18	615.27	X3
32.00	615.80	Bankfull Right
34.59	616.04	TOBR
37.14	616.03	X3
57.37	615.60	X3
71.87	618.92	X3

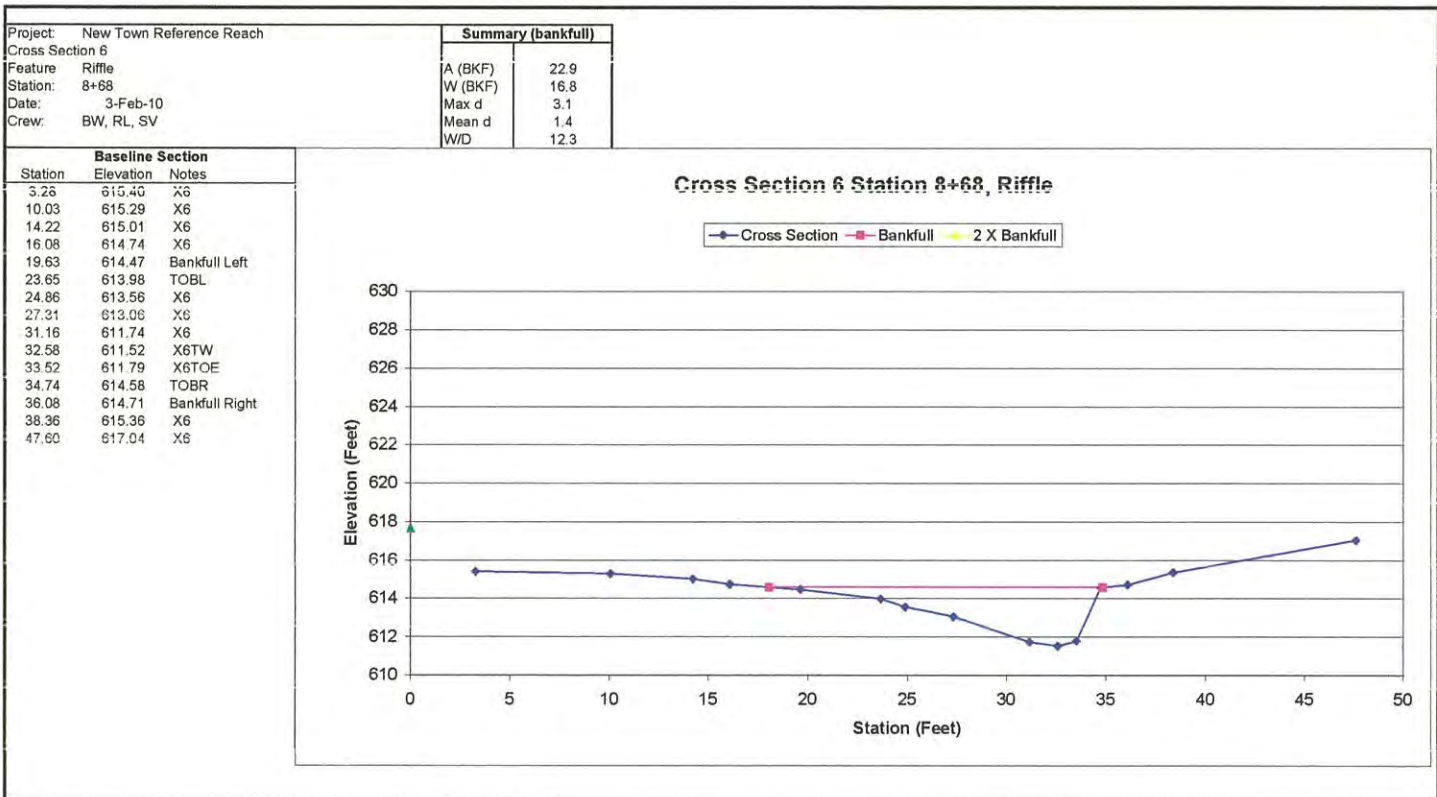
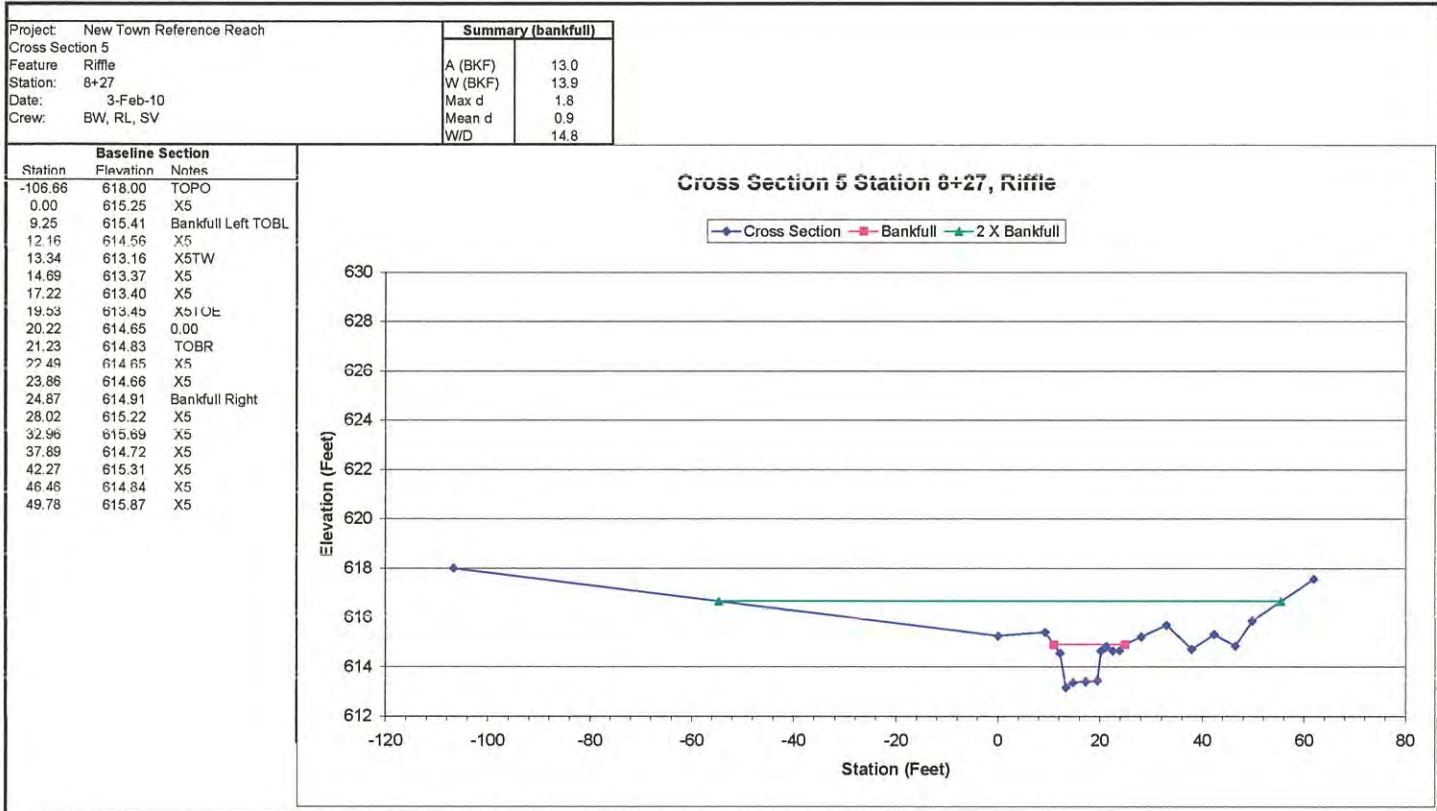


Project: New Town Reference Reach
 Cross Section 4
 Feature: Riffle
 Station: 7+79
 Date: 3-Feb-10
 Crew: BW, RL, SV

Summary (bankfull)	
A (BKF)	20.6
W (BKF)	18.0
Max d	2.4
Mean d	1.1
W/D	15.7

Baseline Section		
Station	Elevation	Notes
0.00	616.22	X4
4.41	616.29	X4
9.40	615.68	TOBL
11.23	614.82	Bankfull Left
13.92	614.58	X4
15.08	614.56	X4
17.34	613.82	X4
18.99	613.19	X4
21.46	612.85	X4TW
24.31	613.33	X4TOE
24.46	613.98	X4
25.06	614.36	X4
27.90	615.11	X4
29.27	615.39	X4
29.78	615.59	Bankfull Right
31.52	615.71	TOBR
37.05	615.82	X4
40.42	616.17	X4

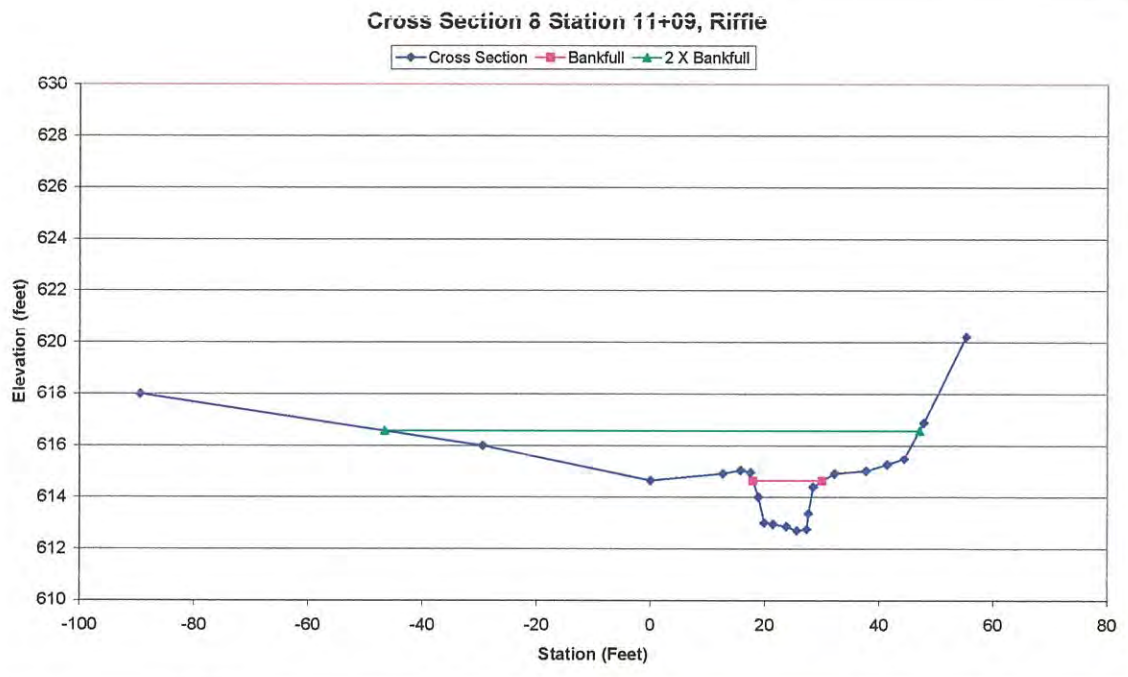




Project: 601 E
 Cross Section 8
 Feature: Riffle
 Station: 11+09
 Date: 3-Feb-10
 Crew: BW, RL, SV

Summary (bankfull)	
A (BKF)	16.0
W (BKF)	12.0
Max d	1.9
Mean d	1.3
WD	9.0

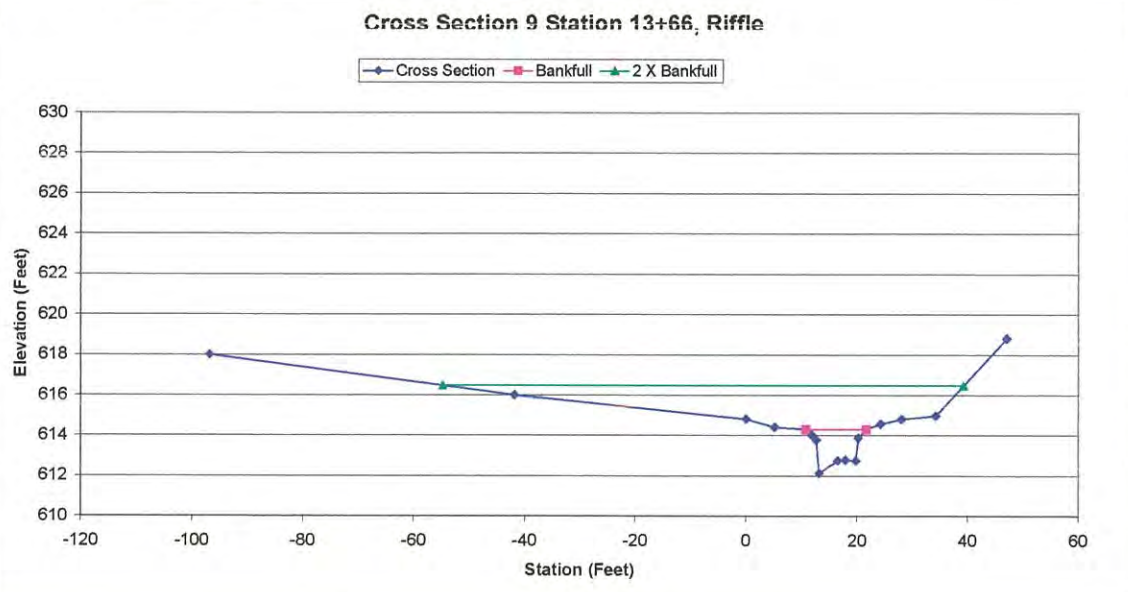
Baseline Section		
Station	Elevation	Notes
-89.44	618.00	X8
-29.44	616.00	X8
0.00	614.66	X8
12.67	614.91	X8
15.81	615.05	TOBL
17.44	614.96	Bankfull Left
18.91	614.01	X8
19.92	613.01	X8TOE
21.37	612.95	X8
23.73	612.88	X8
25.55	612.71	X8TW
27.33	612.76	X8TOE
27.54	613.37	X8
28.45	614.41	TOBR
29.94	614.64	Bankfull Right
32.14	614.91	X8
37.70	615.02	X8
41.38	615.28	X8
44.41	615.49	X8



Project: 601 E
 Cross Section 9
 Feature: Riffle
 Station: 13+66
 Date: 3-Feb-10
 Crew: BW, RL, SV

Summary (bankfull)	
A (BKF)	13.2
W (BKF)	11.0
Max d	2.2
Mean d	1.2
WD	9.2

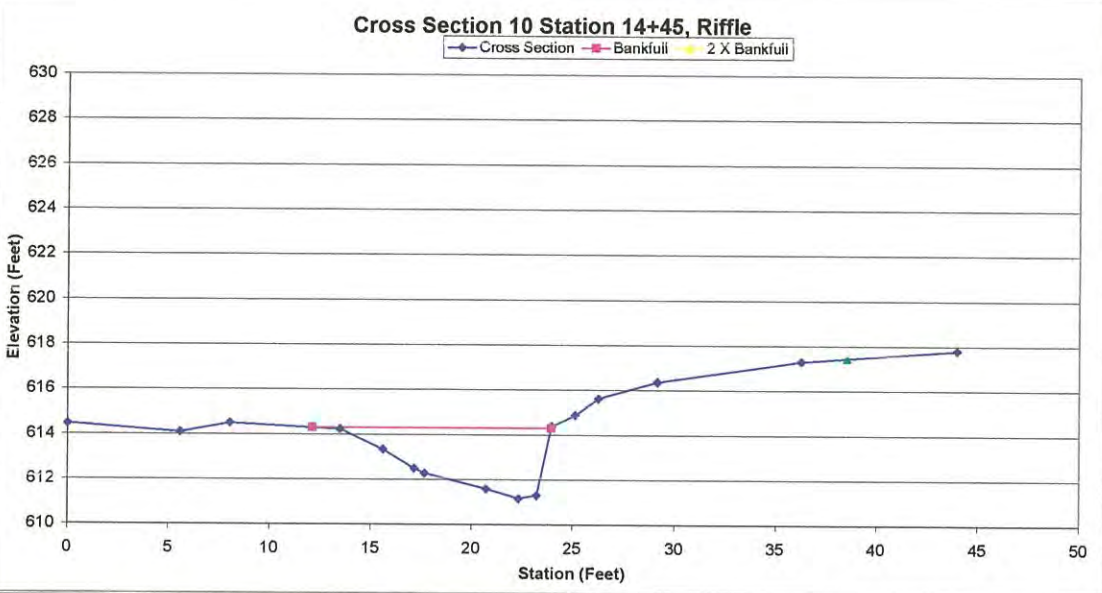
Baseline Section		
Station	Elevation	Notes
-55.55	615.00	TOPO
-41.85	616.00	TOPO
0.00	614.82	X9
5.14	614.41	X9
10.67	614.31	Bankfull Left TO
11.75	614.04	X9
12.63	613.77	X9
13.15	612.14	TW
16.47	612.75	X9
17.90	612.80	X9
19.78	612.75	X9TOE
20.21	613.89	0.00
21.62	614.30	X9 TOBR
24.32	614.56	Bankfull Right
28.07	614.81	X9



Project: 601 E
 Cross Section 10
 Feature: Riffle
 Station: 14+45
 Date: 3-Feb-10
 Crew: BW, RL, SV

Summary (bankfull)	
A (BKF)	20.6
W (BKF)	11.8
Max d	3.1
Mean d	1.7
W/D	6.8

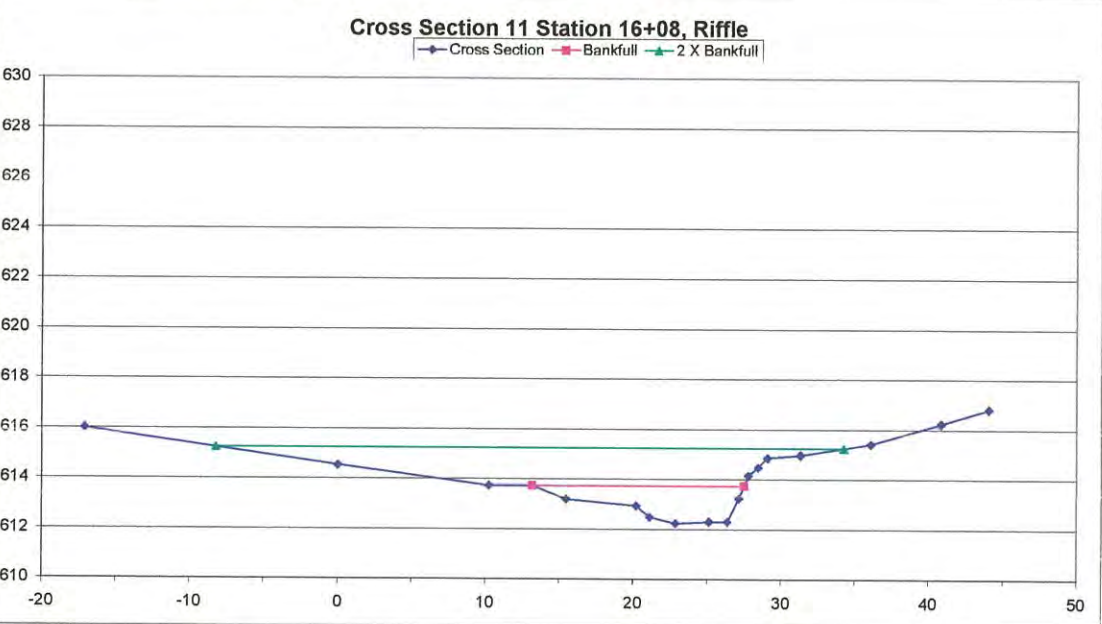
Baseline Section		
Station	Elevation	Notes
0.00	614.46	X10
5.58	614.09	X10
8.05	614.50	X10
13.47	614.24	Bankfull Left TOBL
15.59	613.34	X10
17.13	612.49	X10TOE
17.65	612.28	X10
20.73	611.59	X10
22.32	611.17	TW
23.21	611.30	X10TOE
23.95	614.37	Bankfull Right TOBR
25.11	614.88	X10
26.25	615.62	X10
29.15	616.36	X10
36.26	617.29	X10
43.98	617.80	X10



Project: 601 E
 Cross Section 11
 Feature: Riffle
 Station: 16+08
 Date: 3-Feb-10
 Crew: BW, RL, SV

Summary (bankfull)	
A (BKF)	13.1
W (BKF)	14.3
Max d	1.5
Mean d	0.9
W/D	15.6

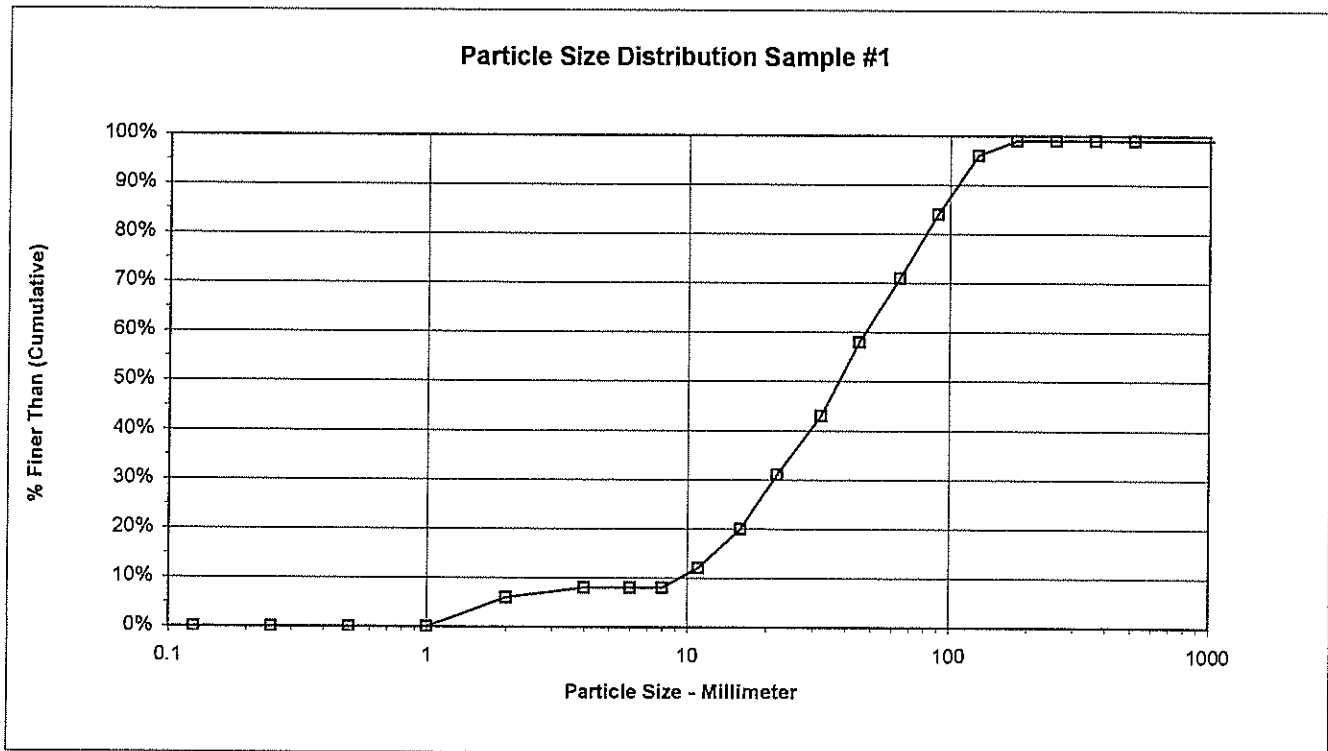
Baseline Section		
Station	Elevation	Notes
-17.14	616.00	TOPO
0.00	614.54	X11
10.25	613.74	X11
13.18	613.74	Bankfull Left TOBL
15.47	613.20	X11
20.20	612.93	X11
21.11	612.48	X11TOE
22.86	612.24	X11TW
25.12	612.31	X11
26.36	612.31	X11TOE
27.14	613.23	X11
27.77	614.15	X11
28.44	614.47	Bankfull Right
29.07	614.86	TOBR
31.32	614.97	X11
36.09	615.41	X11
40.65	616.23	X11



PEBBLE COUNT

Project: 601 East Underwood Creek Reference Reach (Wetted Perimeter)				Date: 2/2/2010				
Location: XS-3								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
.04 - .08	Very Fine	.062 - .125	S	0	0	0	0%	0%
	Fine	.125 - .25	A	0	0	0	0%	0%
	Medium	.25 - .50	N	0	0	0	0%	0%
	Coarse	.50 - 1.0	D	0	0	0	0%	0%
	Very Coarse	1.0 - 2.0	S	6	0	6	6%	6%
.08 - .16	Very Fine	2.0 - 4.0		2	0	2	2%	8%
.16 - .22	Fine	4.0 - 5.7	G	0	0	0	0%	8%
.22 - .31	Fine	5.7 - 8.0	R	0	0	0	0%	8%
.31 - .44	Medium	8.0 - 11.3	A	4	0	4	4%	12%
.44 - .63	Medium	11.3 - 16.0	V	8	0	8	8%	20%
.63 - .89	Coarse	16.0 - 22.6	E	11	0	11	11%	31%
.89 - 1.26	Coarse	22.6 - 32.0	L	12	0	12	12%	43%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	15	0	15	15%	58%
1.77 - 2.5	Very Coarse	45.0 - 64.0		13	0	13	13%	71%
2.5 - 3.5	Small	64 - 90	C	13	0	13	13%	84%
3.5 - 5.0	Small	90 - 128	O	12	0	12	12%	96%
5.0 - 7.1	Large	128 - 180	B	3	0	3	3%	99%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	99%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	99%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	99%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	99%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	99%
	Bedrock		BDRK	1	0	1	1%	100%
Totals				100	0	100	100%	100%

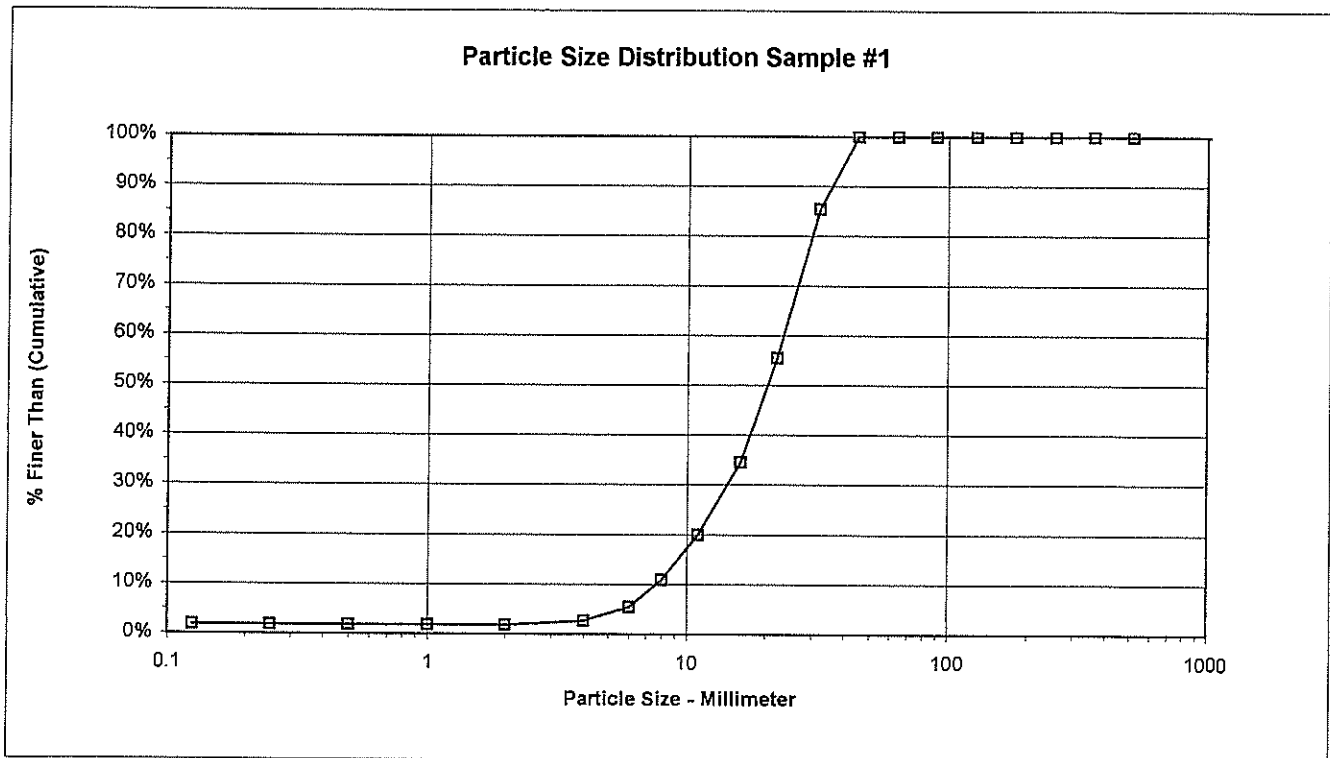
d16	d35	d50	d84	d95
13.5	25.3	38.1	90.0	124.8



PEBBLE COUNT

Project: 601 East, Underwood Creek Reference Reach (Wetted)				Date: 2/2/2010				
Location: Between XS-6 and XS-8								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	2	0	2	2%	2%
.04 - .08	Very Fine	.062 - .125	S	0	0	0	0%	2%
	Fine	.125 - .25	A	0	0	0	0%	2%
	Medium	.25 - .50	N	0	0	0	0%	2%
	Coarse	.50 - 1.0	D	0	0	0	0%	2%
	Very Coarse	1.0 - 2.0	S	0	0	0	0%	2%
.08 - .16	Very Fine	2.0 - 4.0		1	0	1	1%	3%
.16 - .22	Fine	4.0 - 5.7	G	3	0	3	3%	5%
.22 - .31	Fine	5.7 - 8.0	R	6	0	6	5%	11%
.31 - .44	Medium	8.0 - 11.3	A	10	0	10	9%	20%
.44 - .63	Medium	11.3 - 16.0	V	16	0	16	15%	35%
.63 - .89	Coarse	16.0 - 22.6	E	23	0	23	21%	55%
.89 - 1.26	Coarse	22.6 - 32.0	L	33	0	33	30%	85%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	16	0	16	15%	100%
1.77 - 2.5	Very Coarse	45.0 - 64.0		0	0	0	0%	100%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	100%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	100%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
Totals				110	0	110	100%	100%

d16	d35	d50	d84	d95
9.7	16.1	20.4	31.5	40.5



Sieve Sample #1

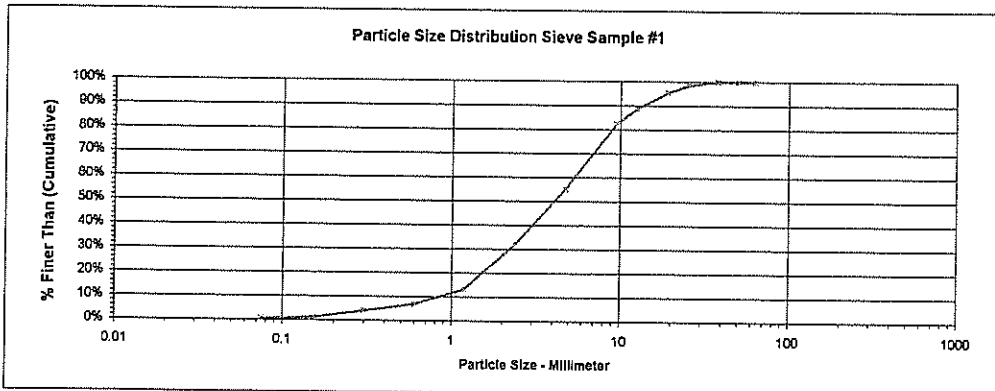
Pavement Type: _____
 Sample Date: _____
 Project: 601 East
 Location: Upper Reach
 Largest Particle on bar ==> inches: 1.8; 1.6; 1.7; 1.7; 1.2; 1.3; 1.4; 1.4; 1.0; 1.1; 1.7

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175							0
2 inch	50	1.195							0
1 1/2 inch	37.5	1.25							0
1 inch	25	1.23		1.42	1.25				0.21
3/4 inch	19	1.245	1.31	1.54	1.29				0.405
1/2 inch	12.5	1.21	1.43	1.61	1.465				0.875
3/8 inch	9.5	1.225	1.5	1.58	1.44				0.845
No. 4	4.75	1.145	2.29	2.47	2.2				3.525
No. 8	2.38	1.07	1.62	2.475	2.175				3.06
No. 16	1.18	0.955	2	1.74	1.57				2.445
No. 30	0.6	0.9	1.29	1.15	1.05				0.79
No. 50	0.3	0.815	0.98	0.92	0.92				0.375
No. 100	0.15	0.775	0.95	0.92	0.84				0.385
No. 200	0.075	0.765	0.79	0.79	0.77				0.055
Passing 200	<0.075	1.08	1.095	1.09	1.15				0.095

Total Sample Weight =====>

13.065

Sieve Sample #1						
Inches	Sieve Size	Millimeter		Wt. Retained (lbs)	% Passing	% Cumulative
	#200	0.0750	S/C	0.095	0.73%	0.73%
0.0029	#200	0.0750	S	0.055	0.42%	1.15%
0.0059	#100	0.150	A	0.385	2.95%	4.09%
0.0117	#50	0.30	N	0.375	2.07%	6.97%
0.0234	#30	0.60	D	0.79	6.05%	13.01%
0.0469	#16	1.18	S	2.445	18.71%	31.73%
0.0937	#8	2.36	G	3.06	23.42%	55.15%
0.187	#4	4.75	R	3.525	26.98%	82.13%
0.374	3/8"	9.50	A	0.845	6.47%	88.60%
0.5	1/2"	12.50	V	0.875	6.70%	95.29%
0.748	3/4"	19.0	E	0.405	3.10%	98.39%
0.843	1"	25.0	L	0.21	1.61%	100.00%
1.4784	1 1/2"	37.5	S	0	0.00%	100.00%
1.9685	2"	50.0	S	0	0.00%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			D	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
Totals				13.065	100%	100%



Sieve Sample #2

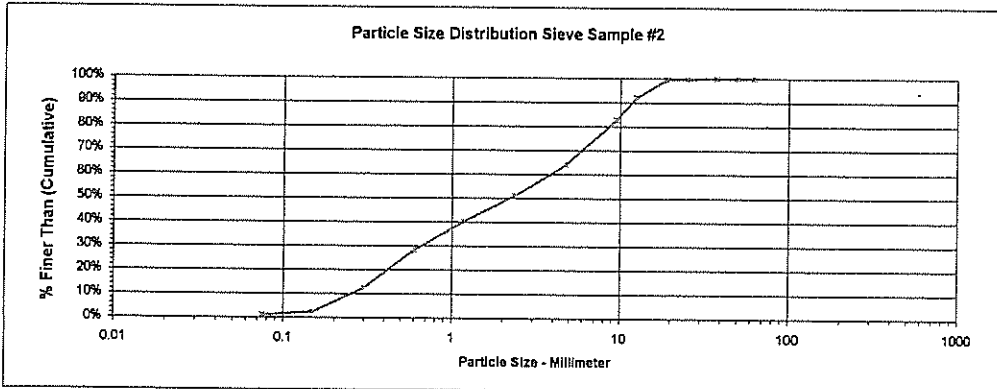
Pavement Type: _____
 Sample Date: _____
 Project: _____
 Location: 601 East
 Smaller Trib
 Largest Particle on bar ==>>> Inches: 2.0; 1.8; 1.6; 1.2; 1.1; 0.8; 1.2; 1.1

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175								0
2 inch	50	1.195								0
1 1/2 inch	37.5	1.25								0
1 inch	25	1.23			1.265					0.035
3/4 inch	19	1.245			1.26	1.27				0.04
1/2 inch	12.5	1.21	1.525		1.79	1.41	1.29			1.175
3/8 inch	9.5	1.225	1.59		1.765	1.59	1.465			1.5
No. 4	4.75	1.145	1.905		1.97	2.01	1.63			2.935
No. 8	2.38	1.07	1.587		1.475	1.78	1.51			2.072
No. 16	1.18	0.955	1.355		1.215	1.625	1.34			1.715
No. 30	0.6	0.9	1.26		1.09	1.78	1.35			1.88
No. 50	0.3	0.815	1.273		1.07	1.98	1.45			2.513
No. 100	0.15	0.775	1.34		1.07	1.138	1.13			1.578
No. 200	0.075	0.765	0.875		0.81	0.8	0.6			0.225
Passing 200	<0.075	1.08	1.193		1.11	1.065	1.09			0.188

Total Sample Weight =====>

15.836

Sieve Sample #2						
Inches	Sieve Size	Millimeter	S/C	Wt. Retained (lbs)	% Passing	% Cumulative
		< #200		0.168	1.06%	1.06%
0.0029	#200	0.0750	S	0.225	1.42%	2.48%
0.0059	#100	0.150	A	1.578	9.96%	12.45%
0.0117	#50	0.30	N	2.513	15.87%	28.32%
0.0234	#30	0.60	D	1.88	11.87%	40.19%
0.0469	#16	1.18	S	1.715	10.83%	51.02%
0.0937	#8	2.38	G	2.072	13.08%	64.10%
0.187	#4	4.75	R	2.935	18.53%	82.63%
0.374	3/8"	9.50	A	1.5	9.47%	92.11%
0.5	1/2"	12.50	V	1.175	7.42%	99.53%
0.748	3/4"	19.0	E	0.04	0.25%	99.78%
0.9943	1"	25.0	L	0.035	0.22%	100.00%
1.4784	1 1/2"	37.5	S	0	0.00%	100.00%
1.9885	2"	50.0	S	0	0.00%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			O	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
Totals				15.836	100%	100%



Sieve Sample #3

Pavement Type:

Sample Date:

Project:

Location:

Largest Particle on bar =====>

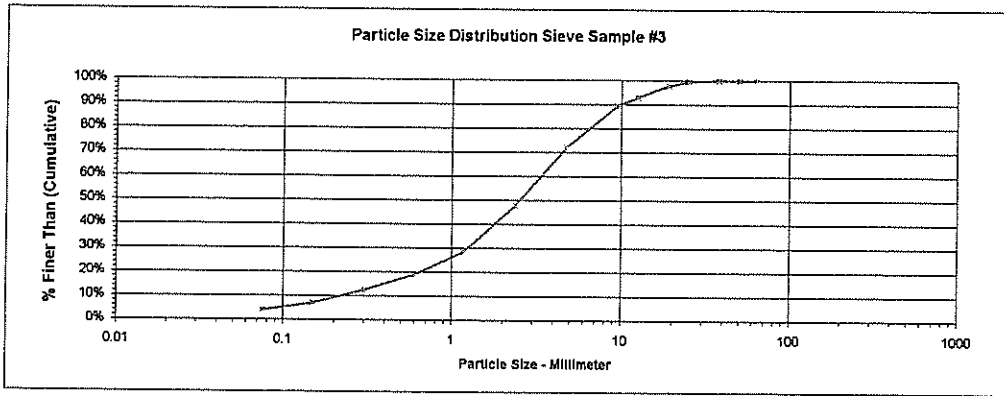
601 East
Reference Reach
Inches: 2.0; 0.9; 1.2; 1.3; 1.3; 1.9; 2.0; 1.5; 1.4; 1.4; 1.5

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175							0
2 inch	50	1.195							0
1 1/2 inch	37.5	1.25							0
1 inch	25	1.23					1.3		0.07
3/4 inch	19	1.245	1.39				1.44		0.34
1/2 inch	12.5	1.21	1.43	1.4	1.63	1.24			0.88
3/8 inch	9.5	1.225	1.35	1.39	1.55	1.28			0.67
No. 4	4.75	1.145	1.97	2.02	2.19	1.52			3.12
No. 8	2.36	1.07	2.37	2.31	2.17	1.85			4.42
No. 16	1.18	0.955	1.98	1.97	1.73	1.67			3.51
No. 30	0.6	0.9	1.31	1.37	1.24	1.4			1.72
No. 50	0.3	0.815	1.05	1.19	1.01	1.19			1.18
No. 100	0.15	0.775	1.15	0.99	0.91	1.05			1
No. 200	0.075	0.785	0.82	0.81	0.87	0.98			0.52
Passing 200	<0.075	1.08	1.25	1.33	1.27	1.19			0.72

Total Sample Weight =====>

18.13

Sieve Sample #3						
Location:	0					
Project:	0					
Inches	Sieve Size	Millimeter < #200	S/C	Wt. Retained (lbs)	% Passing	% Cumulative
0.0029	#200	0.0750	S	0.52	2.87%	6.84%
0.0059	#100	0.150	A	1	5.52%	12.30%
0.0117	#50	0.30	N	1.18	0.51%	18.88%
0.0234	#30	0.60	D	1.72	9.49%	28.35%
0.0469	#16	1.18	S	3.51	19.36%	47.71%
0.0837	#8	2.36	G	4.42	24.38%	72.09%
0.167	#4	4.75	R	3.12	17.21%	89.30%
0.374	3/8"	9.50	A	0.67	3.70%	93.00%
0.5	1/2"	12.50	V	0.88	4.74%	97.74%
0.748	3/4"	19.0	E	0.34	1.88%	99.61%
0.9843	1"	25.0	L	0.07	0.38%	100.00%
1.4764	1 1/2"	37.5	S	0	0.00%	100.00%
1.9685	2"	50.0	O	0	0.00%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			O	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
			BDRK	0	0.00%	100.00%
			Totals	18.13	100%	100%

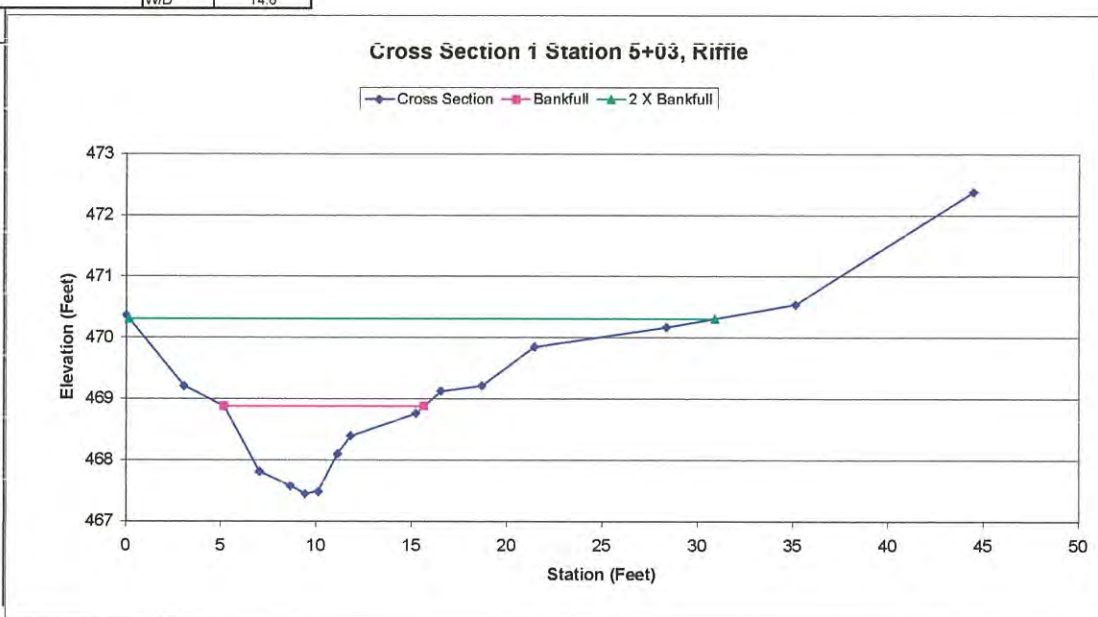


Reference Reach 2-Richardson Creek

Project: 601 East
 Cross Section 1
 Feature: Riffle
 Station: 5+03
 Date: 5-Dec-12
 Crew: BW, ZP

Summary (bankfull)	
A (BKF)	7.5
W (BKF)	10.5
Max d	1.4
Mean d	0.7
WD	14.6

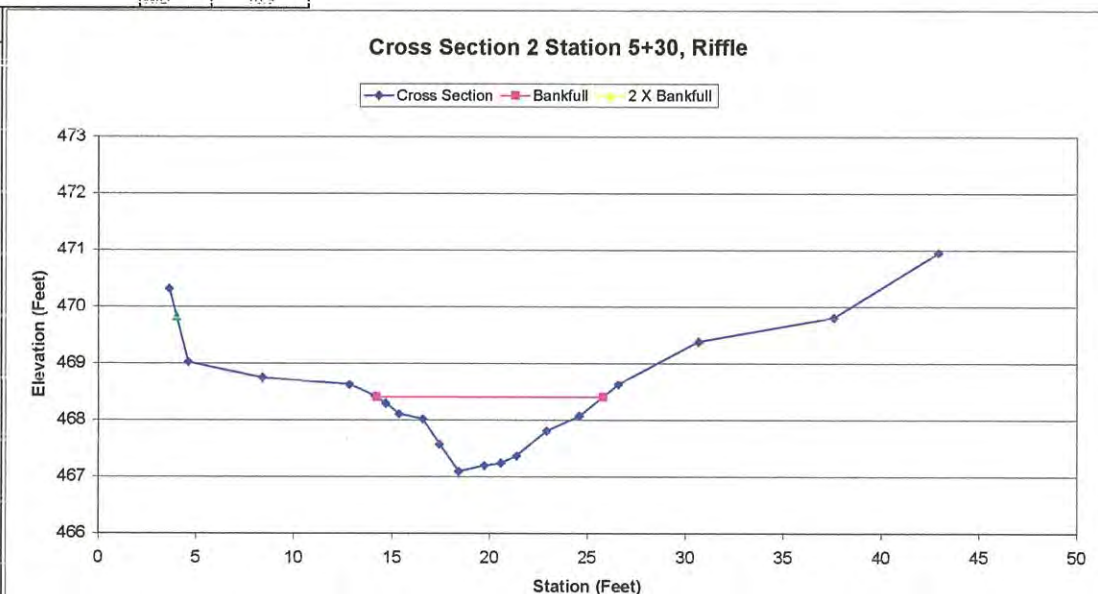
Baseline Section		
Station	Elevation	Notes
	470.36	RIFFLE
3.05	469.21	
5.16	468.88	TOBL bankfull left
7.03	467.81	TOE L
8.65	467.58	
9.42	467.45	TW
10.10	467.49	TOE R
11.10	468.10	
11.79	468.40	TOBR bankfull right
15.20	468.76	
16.52	469.13	
18.68	469.21	
21.43	469.85	
28.36	470.17	
35.12	470.54	
44.48	472.38	



Project: 601 East
 Cross Section 2
 Feature: Riffle
 Station: 5+30
 Date: 5-Dec-12
 Crew: BW, SV

Summary (bankfull)	
A (BKF)	8.0
W (BKF)	11.6
Max d	1.3
Mean d	0.7
WD	16.9

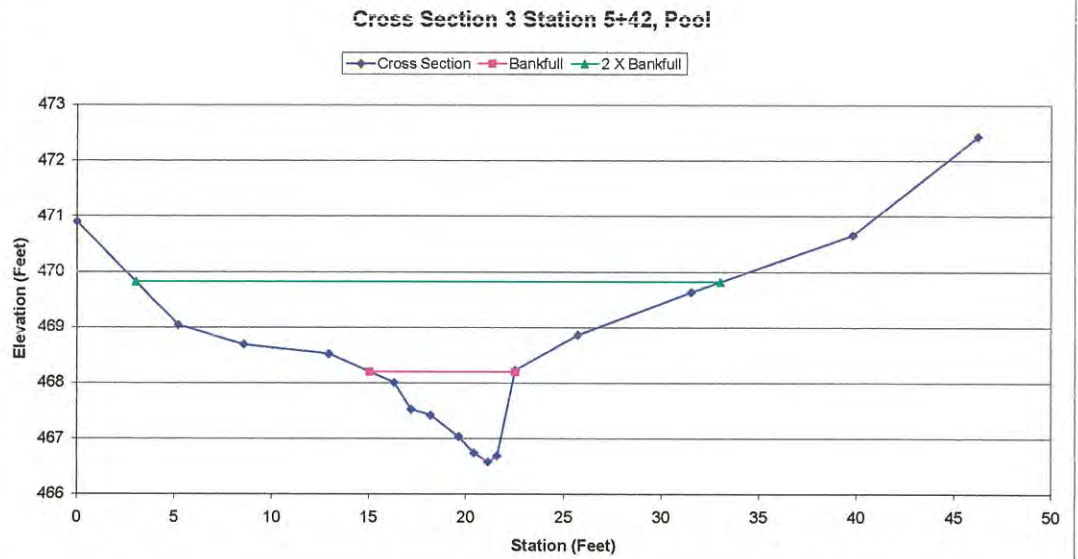
Baseline Section		
Station	Elevation	Notes
3.62	470.32	RIFFLE
4.61	469.02	
8.41	468.74	
12.81	468.63	
14.12	468.42	
14.67	468.29	TOBL
15.35	468.11	bankfull left
16.57	468.01	
17.42	467.57	
18.41	467.09	TOE L
19.71	467.19	TW
20.57	467.24	
21.37	467.36	TOE R
22.90	467.81	
24.58	468.07	bankfull right
26.59	468.63	
30.67	469.38	TOBR
37.59	469.80	
42.92	470.95	
	472.01	



Project: 601 East
 Cross Section 3
 Feature: Pool
 Station: 5+42
 Date: 5-Dec-12
 Crew: BW,ZP

Summary (bankfull)	
A (BKF)	6.4
W (BKF)	7.5
Max d	1.6
Mean d	0.9
W/D	8.7

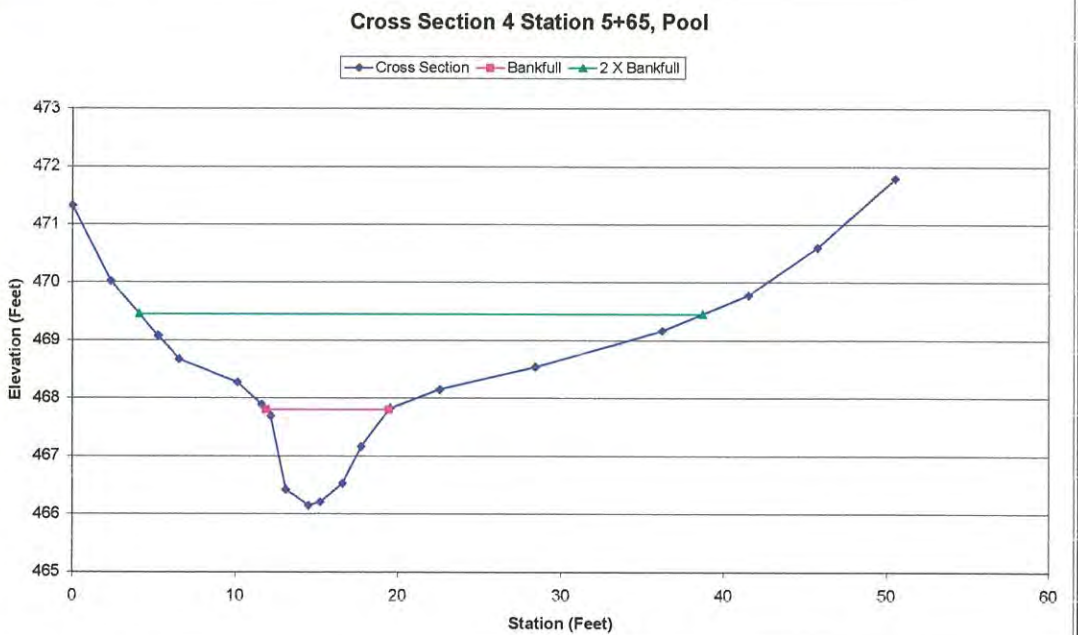
Baseline Section		
Station	Elevation	Notes
0.01	470.90	FOCL
5.21	469.04	
8.56	468.69	
12.92	468.52	
16.30	468.01	TOBL bankfull left
17.18	467.53	TOE L TOP POINT BAR
18.17	467.42	
19.62	467.03	
20.41	466.74	
21.13	466.58	TW
21.59	466.69	TOE R
22.52	466.23	TOBR bankfull right
25.69	468.86	
31.52	469.63	
39.82	470.66	
46.21	472.43	



Project: 601 East
 Cross Section 4
 Feature: Pool
 Station: 5+65
 Date: 5-Dec-12
 Crew: BW, ZP

Summary (bankfull)	
A (BKF)	7.7
W (BKF)	7.6
Max d	1.7
Mean d	1.0
W/D	7.4

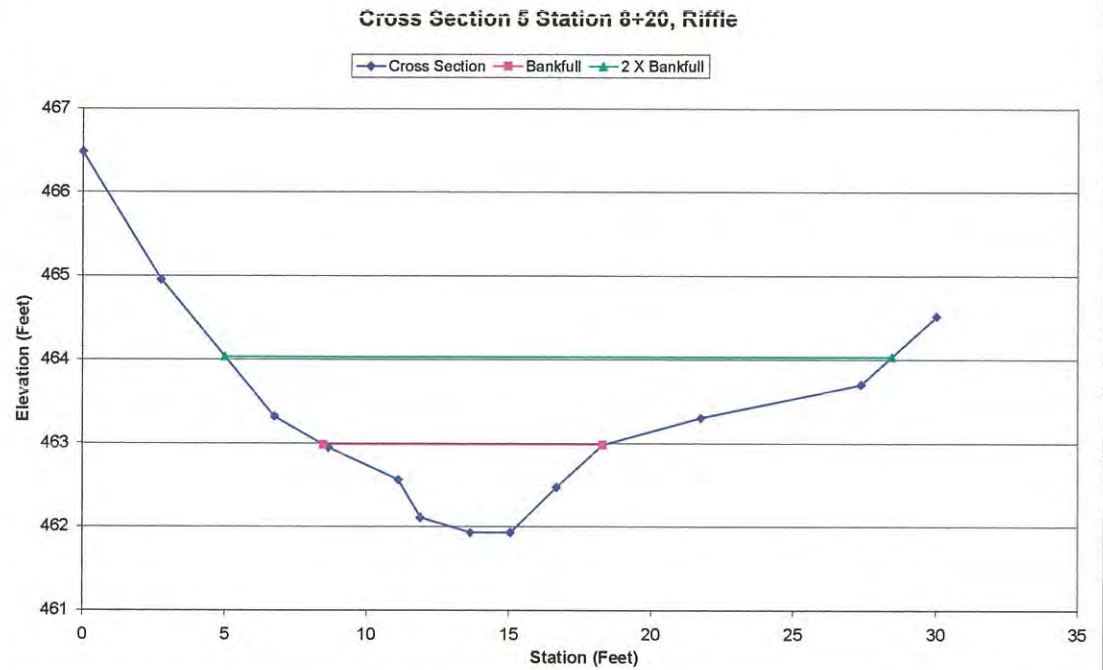
Baseline Section		
Station	Elevation	Notes
0.01	471.32	POOL
2.36	470.02	
5.28	469.08	
6.57	468.67	
10.11	468.27	
11.60	467.89	TOBL
12.17	467.69	bankfull left
13.09	466.42	TOE L
14.49	466.15	TW
15.20	466.21	
16.58	466.52	TOE R
17.72	467.16	bankfull right
19.51	467.82	TOBR
22.56	468.15	
28.43	468.54	
38.21	469.17	
41.54	469.78	
45.77	470.60	



Project: 601 East
 Cross Section 5
 Feature: Riffle
 Station: 8+20
 Date: 5-Dec-12
 Crew: BW, ZP

Summary (bankfull)	
A (BKF)	5.9
W (BKF)	9.8
Max d	1.1
Mean d	0.6
W/D	16.3

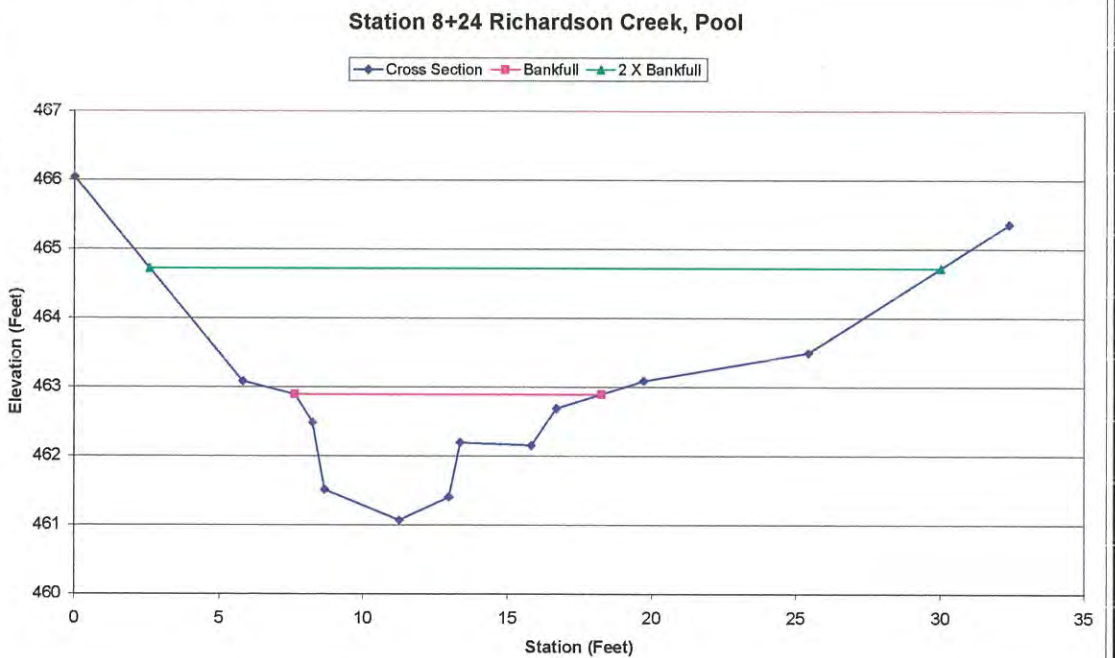
Baseline Section		
Station	Elevation	Notes
	466.48	
2.75	464.95	
6.75	463.32	
8.66	462.95	
11.12	462.56	TOBL bankfull left
11.90	462.11	TOE L
13.65	461.93	TW
15.05	461.93	TOE R
16.66	462.47	
18.27	462.98	
21.75	463.30	
27.36	463.70	
30.01	464.52	STEP



Project: 601 East
 Cross Section 6
 Feature: Pool
 Station: 8+24
 Date: 5-Dec-12
 Crew: BW, ZP

Summary (bankfull)	
A (BKF)	10.3
W (BKF)	10.0
Max d	1.8
Mean d	1.0
W/D	11.0

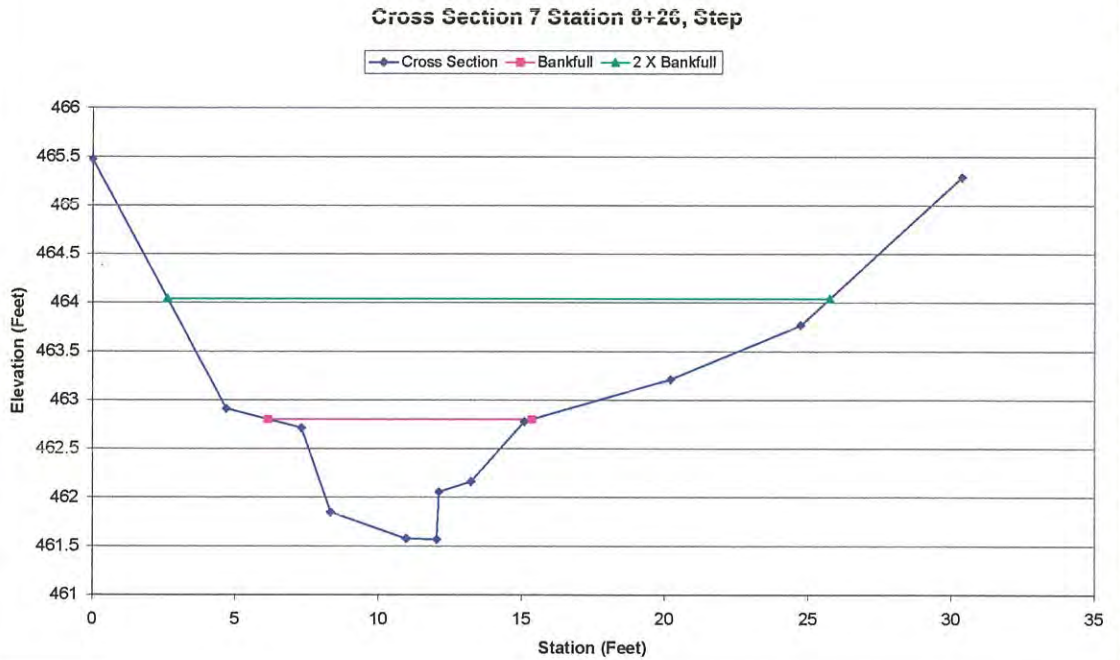
Baseline Section		
Station	Elevation	Notes
	466.04	STEP POOL
5.81	463.08	
7.63	462.89	TOBL bankfull left
8.25	462.48	
8.67	461.51	TOE L
11.26	461.07	TW
12.98	461.40	TOE R
13.36	462.19	TOBR bankfull right
15.82	462.15	
16.68	462.69	
19.71	463.09	
25.43	463.49	
32.36	465.36	



Project: 601 East
 Cross Section 7
 Feature: Step
 Station: 8+26
 Date: 5-Dec-12
 Crew: BW,ZP

Summary (bankfull)	
A (BKF)	6.7
W (BKF)	9.2
Max d	1.2
Mean d	0.7
W/D	12.7

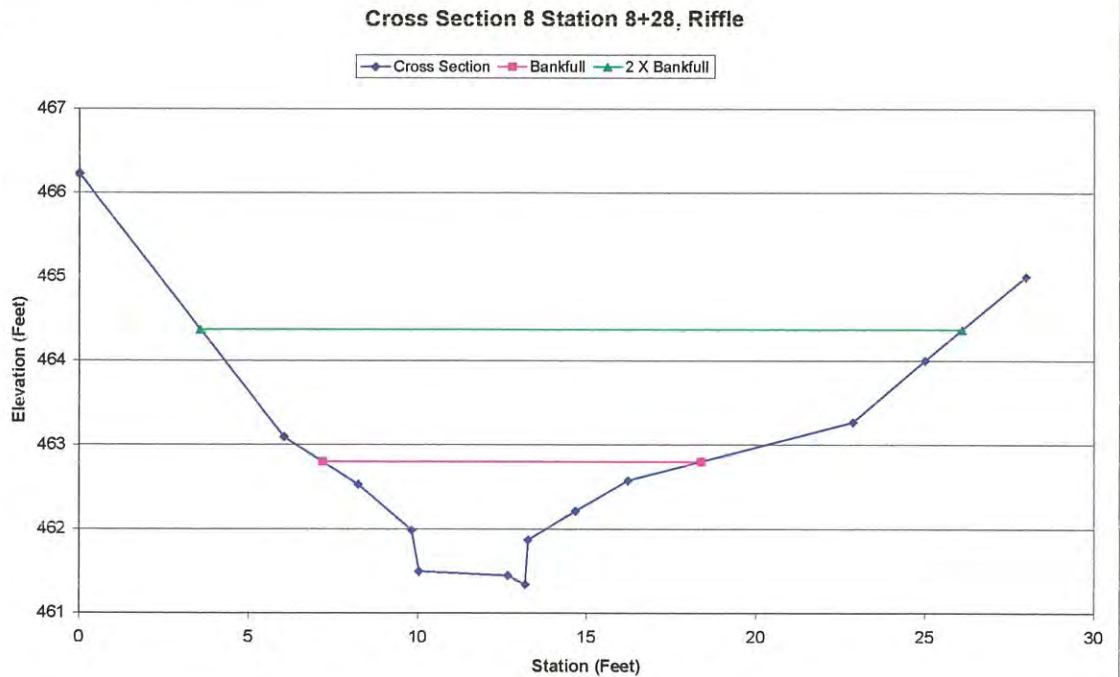
Baseline Section		
Station	Elevation	Notes
	465.47	
4.69	462.91	
7.32	462.71	TOBL bankfull left
8.33	461.85	TOE L
10.96	461.58	TW
12.03	461.57	TOE R
12.10	462.06	
13.22	462.16	TOBR bankfull right
15.10	462.78	
20.21	463.21	
24.73	463.77	
30.38	465.29	STEP

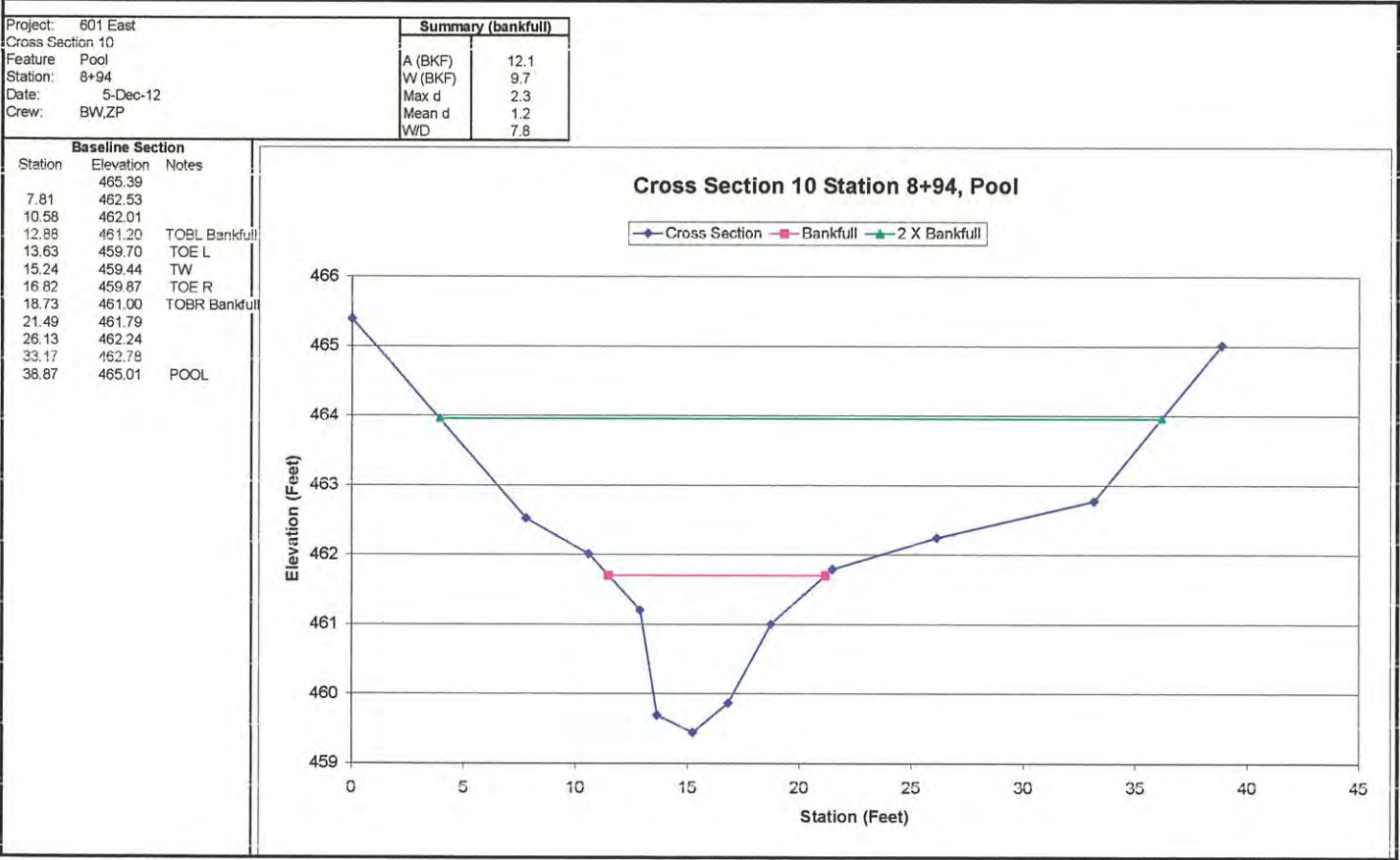
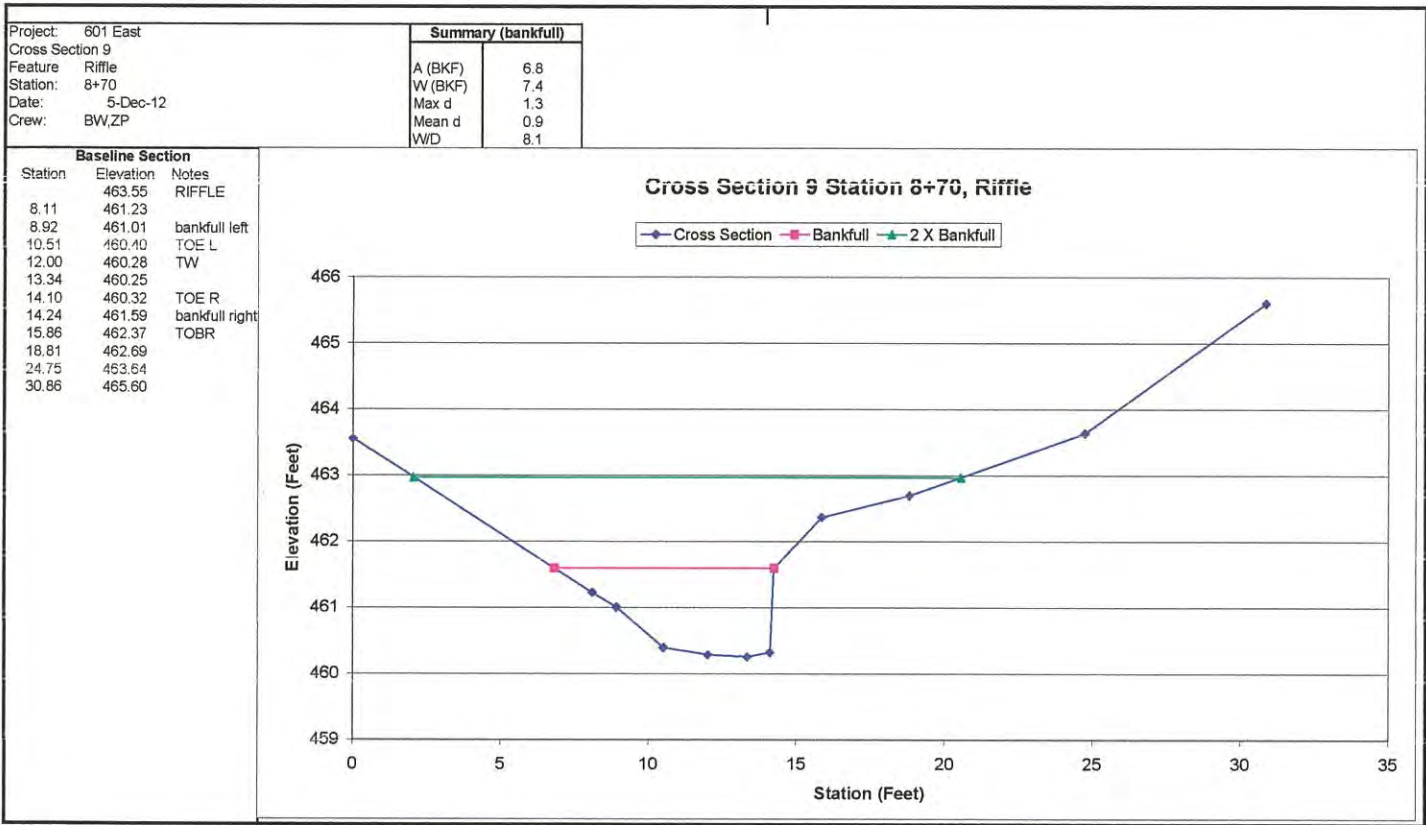


Project: 601 East
 Cross Section 8
 Feature: Riffle
 Station: 8+28
 Date: 5-Dec-12
 Crew: BW,ZP

Summary (bankfull)	
A (BKF)	7.8
W (BKF)	11.2
Max d	1.5
Mean d	0.7
W/D	16.5

Baseline Section		
Station	Elevation	Notes
	466.22	STEP
6.06	463.09	
8.25	462.53	TOBL bankfull left
9.82	461.99	
10.03	461.49	TOE L
12.67	461.45	TW
13.18	461.34	TOE R
13.27	461.87	
14.67	462.21	TOBR bankfull right
16.23	462.57	
22.87	463.27	

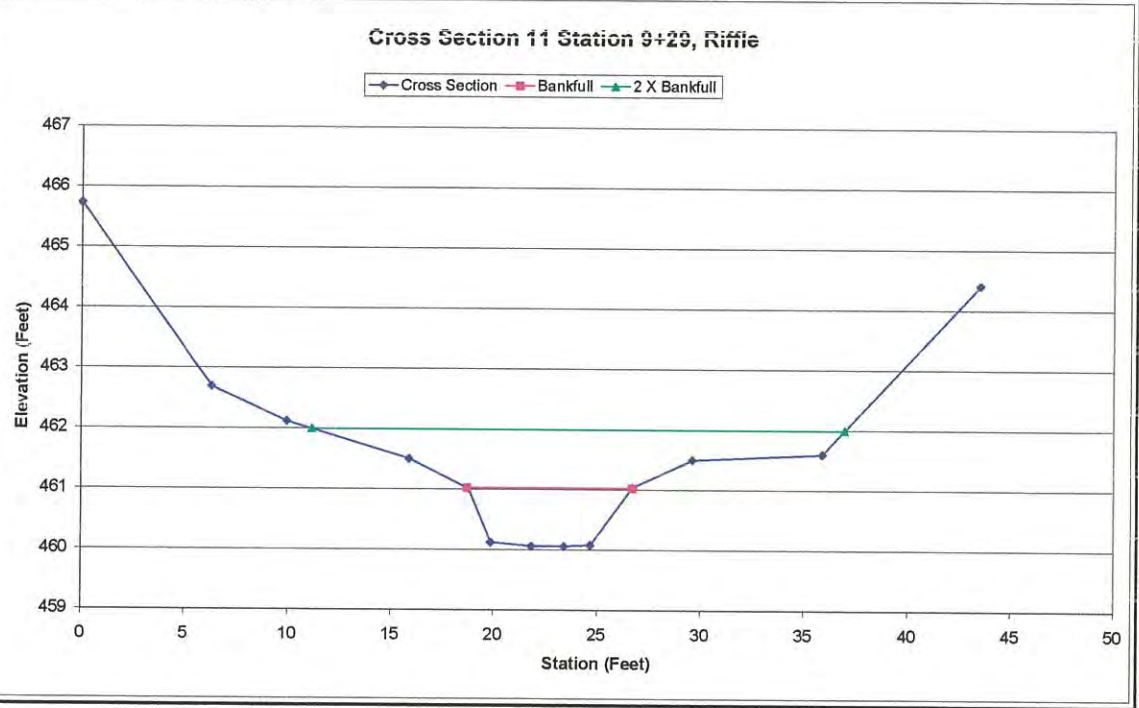




Project: 601 East
 Cross Section 11
 Feature: Riffle
 Station: 9+29
 Date: 5-Dec-12
 Crew: BW,ZP

Summary (bankfull)	
A (BKF)	6.0
W (BKF)	8.0
Max d	1.0
Mean d	0.8
W/D	10.5

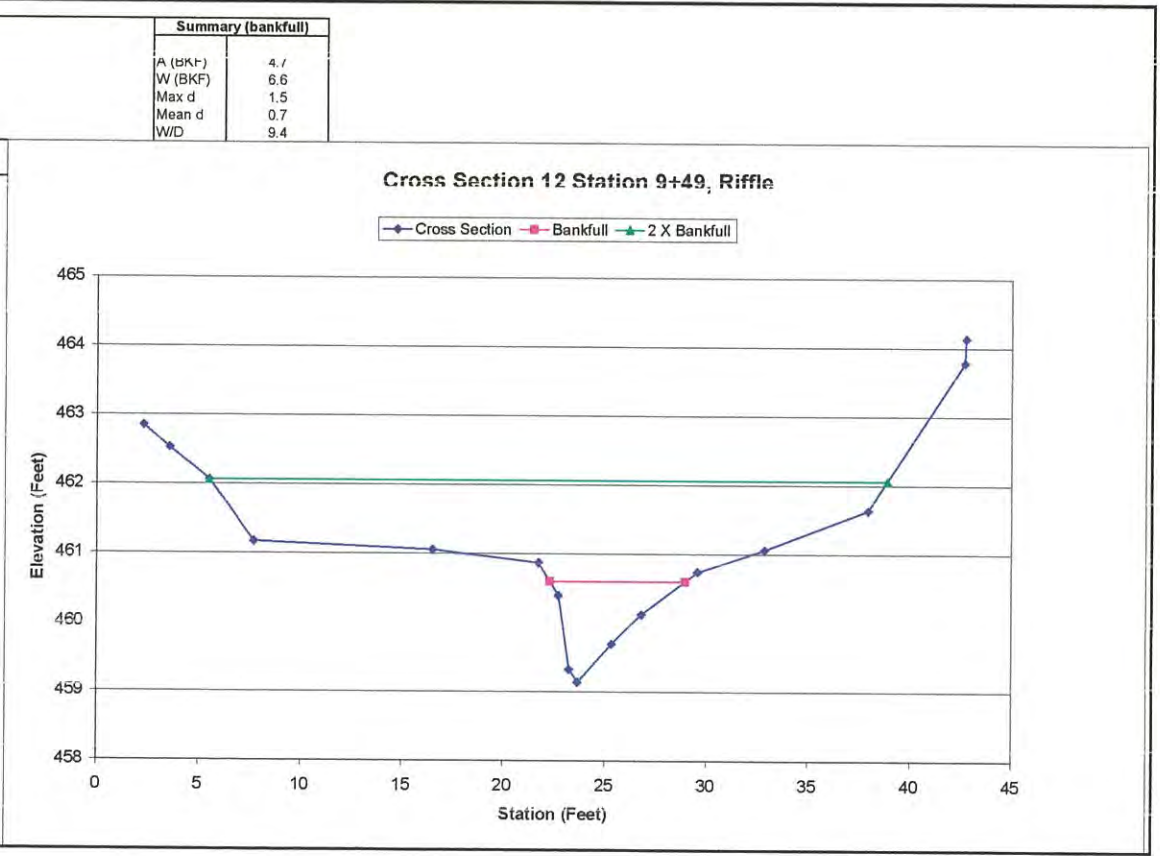
Baseline Section		
Station	Elevation	Notes
	465.73	RIFFLE
6.29	462.70	
9.94	462.12	
15.89	461.50	
18.78	461.01	TOBL bankfull left
19.86	460.12	TOE L
21.82	460.06	TW
23.40	460.08	
24.67	460.08	TOE R
26.70	461.03	TOBR bankfull right
29.60	461.50	
35.89	461.60	
43.50	464.41	



Project: 601 East
 Cross Section 12
 Feature: Riffle
 Station: 9+49
 Date: 5-Dec-12
 Crew: BW,ZP

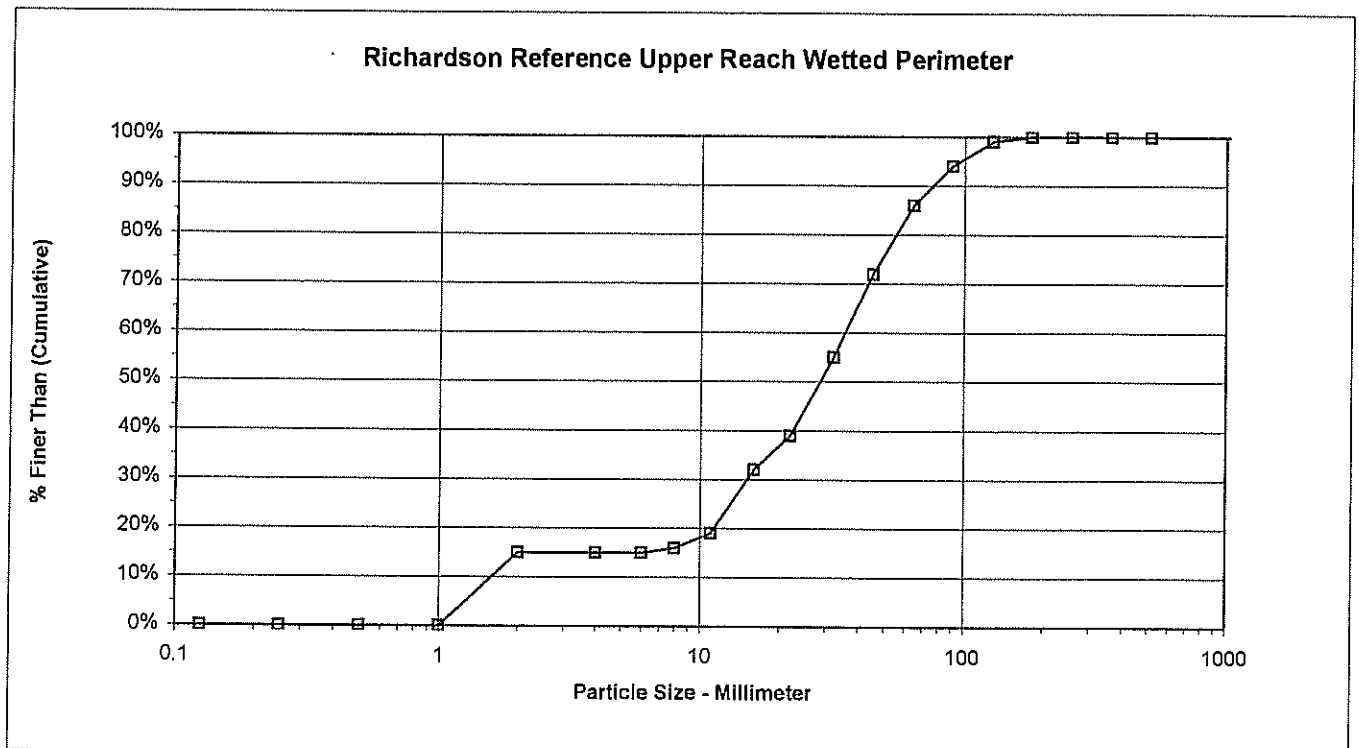
Summary (bankfull)	
A (BKF)	4.7
W (BKF)	6.6
Max d	1.5
Mean d	0.7
W/D	9.4

Baseline Section		
Station	Elevation	Notes
2.23	462.55	
3.58	462.53	POOL
5.54	462.06	
7.71	461.17	
16.52	461.05	
21.74	460.87	TOBL bankfull left
22.72	460.40	
23.25	459.32	TOE L
23.66	459.14	TW
25.34	459.69	
26.80	460.12	
29.56	460.74	TOBR
32.86	461.06	
37.95	461.63	
42.68	463.78	
42.73	464.13	



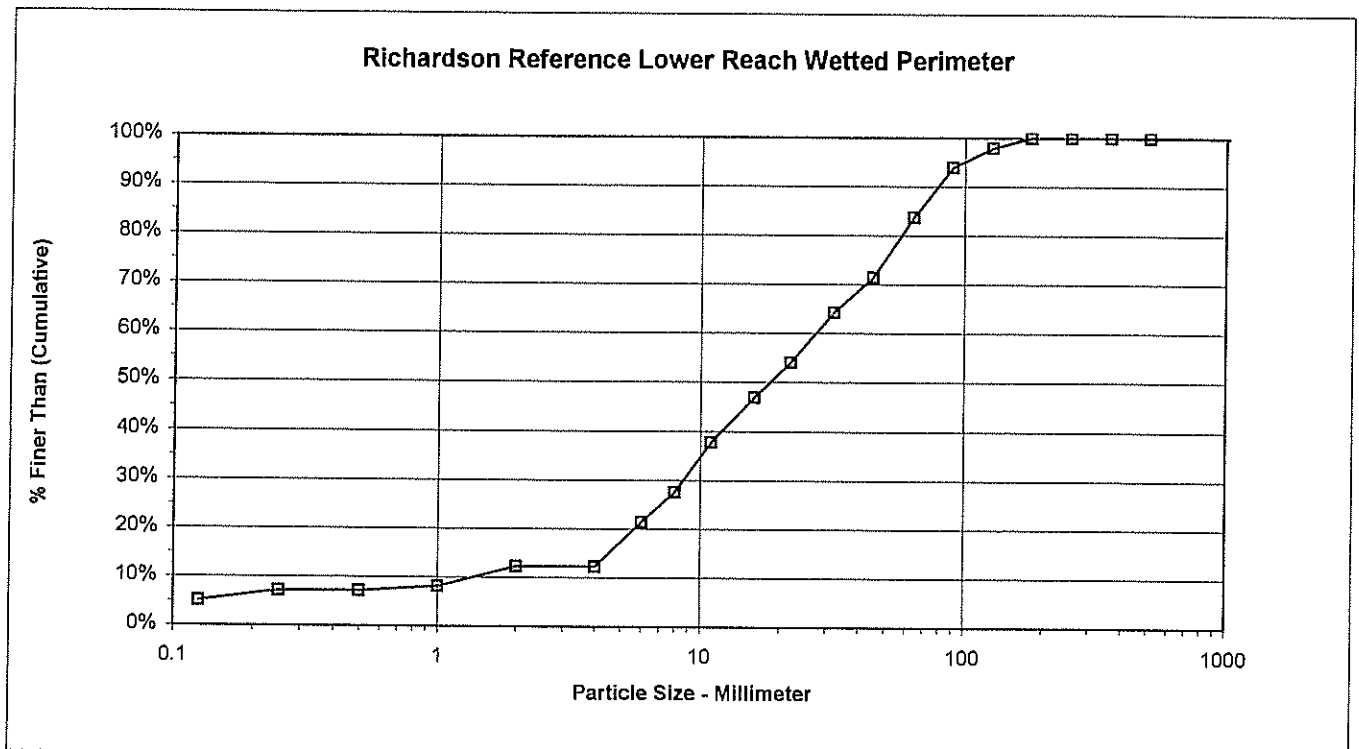
PEBBLE COUNT								
Project: REF Richardson					Date: 12/6/2012			
Location: Upper Reach Wetted Perimeter								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0		0	0%	0%
.04 - .08	Very Fine	.062 - .125	S	0		0	0%	0%
	Fine	.125 - .25	A	0		0	0%	0%
	Medium	.25 - .50	N	0		0	0%	0%
	Coarse	.50 - 1.0	D	0		0	0%	0%
	Very Coarse	1.0 - 2.0	S	15		15	15%	15%
.08 - .16	Very Fine	2.0 - 4.0		0		0	0%	15%
.16 - .22	Fine	4.0 - 5.7	G	0		0	0%	15%
.22 - .31	Fine	5.7 - 8.0	R	1		1	1%	16%
.31 - .44	Medium	8.0 - 11.3	A	3		3	3%	19%
.44 - .63	Medium	11.3 - 16.0	V	13		13	13%	32%
.63 - .89	Coarse	16.0 - 22.6	E	7		7	7%	39%
.89 - 1.26	Coarse	22.6 - 32.0	L	16		16	16%	55%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	17		17	17%	72%
1.77 - 2.5	Very Coarse	45.0 - 64.0		14		14	14%	86%
2.5 - 3.5	Small	64 - 90	C	8		8	8%	94%
3.5 - 5.0	Small	90 - 128	O	5		5	5%	99%
5.0 - 7.1	Large	128 - 180	B	1		1	1%	100%
7.1 - 10.1	Large	180 - 256	L	0		0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0		0	0%	100%
14.3 - 20	Small	362 - 512	L	0		0	0%	100%
20 - 40	Medium	512 - 1024	D	0		0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0		0	0%	100%
	Bedrock		BDRK	0		0	0%	100%
Totals				100	0	100	100%	100%

d16	d35	d50	d84	d95
8.0	18.6	28.9	61.3	97.6



PEBBLE COUNT								
Project: REF Richardson						Date: 12/6/2012		
Location: Lower Reach Wetted Perimeter								
Particle Counts								
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	2		2	2%	2%
.04 - .08	Very Fine	.062 - .125	S	3		3	3%	5%
	Fine	.125 - .25	A	2		2	2%	7%
	Medium	.25 - .50	N	0		0	0%	7%
	Coarse	.50 - 1.0	D	1		1	1%	8%
	Very Coarse	1.0 - 2.0	S	4		4	4%	12%
.08 - .16	Very Fine	2.0 - 4.0		0		0	0%	12%
.16 - .22	Fine	4.0 - 5.7	G	9		9	9%	21%
.22 - .31	Fine	5.7 - 8.0	R	6		6	6%	28%
.31 - .44	Medium	8.0 - 11.3	A	10		10	10%	38%
.44 - .63	Medium	11.3 - 16.0	V	9		9	9%	47%
.63 - .89	Coarse	16.0 - 22.6	E	7		7	7%	54%
.89 - 1.26	Coarse	22.6 - 32.0	L	10		10	10%	64%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	7		7	7%	71%
1.77 - 2.5	Very Coarse	45.0 - 64.0		12		12	12%	84%
2.5 - 3.5	Small	64 - 90	C	10		10	10%	94%
3.5 - 5.0	Small	90 - 128	O	4		4	4%	98%
5.0 - 7.1	Large	128 - 180	B	2		2	2%	100%
7.1 - 10.1	Large	180 - 256	L	0		0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0		0	0%	100%
14.3 - 20	Small	362 - 512	L	0		0	0%	100%
20 - 40	Medium	512 - 1024	D	0		0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0		0	0%	100%
	Bedrock		BDRK	0		0	0%	100%
Totals				98	0	98	100%	100%

d16	d35	d50	d84	d95
4.8	10.2	18.6	64.8	100.5



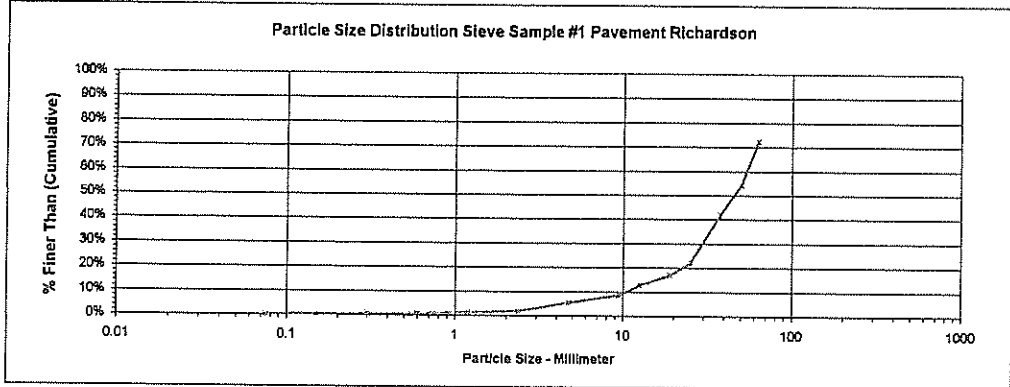
Sieve Sample #1

Pavement Type: Pavement Sample
 Sample Date: 12/8/2012
 Project: For 601 East Project
 Location: Reference Reach Richardson
 Largest Particle on bar =====> N/A

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175	1.96	2.45					2.06
2 inch	50	1.195	1.69	2.02					1.32
1 1/2 inch	37.5	1.25	2.16	1.27					0.93
1 inch	25	1.23	2.58	1.35					1.47
3/4 inch	19	1.245	1.81	1.25					0.37
1/2 inch	12.5	1.21	1.45	1.29					0.32
3/8 inch	9.5	1.225	1.35	1.4					0.3
No. 4	4.75	1.145	1.29	1.23					0.23
No. 8	2.39	1.07	1.11	1.3					0.27
No. 16	1.18	0.955	0.86	1					0.05
No. 30	0.6	0.9	0.92	0.915					0.035
No. 50	0.3	0.815	0.817	0.818					0.005
No. 100	0.15	0.775	0.6	0.779					0.029
No. 200	0.075	0.765	0.77	0.77					0.01
Passing 200	<0.075	1.08	1.09	1.085					0.015

Total Sample Weight =====> 7.414

Richardson Sieve Sample #1- Pavement						
Inches	Sieve Size	Millimeter	S/C	Wt. Retained (lbs)	% Passing	% Cumulative
		< #200	S/C	0.015	0.20%	0.20%
0.0029	#200	0.0750	S	0.01	0.13%	0.34%
0.0059	#100	0.150	A	0.029	0.39%	0.73%
0.0117	#50	0.30	N	0.005	0.07%	0.80%
0.0234	#30	0.60	D	0.035	0.47%	1.27%
0.0469	#16	1.18	S	0.05	0.67%	1.94%
0.0937	#8	2.36	G	0.27	3.64%	5.58%
0.187	#4	4.75	R	0.23	3.10%	8.69%
0.374	3/8"	9.50	A	0.3	4.05%	12.73%
0.5	1/2"	12.50	V	0.32	4.32%	17.05%
0.748	3/4"	19.0	E	0.37	4.99%	22.04%
0.9843	1"	25.0	L	1.47	19.83%	41.87%
1.4764	1 1/2"	37.5	S	0.93	12.54%	54.41%
1.9885	2"	50.0	L	1.32	17.80%	72.21%
2.5	2 1/2"	63.0	C	2.06	27.79%	100.00%
			O	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
			Totals	7.414	100%	100%



Sieve Sample #2

Pavement Type:

Sample Date:

Project:

Location:

Largest Particle on bar ==>>>

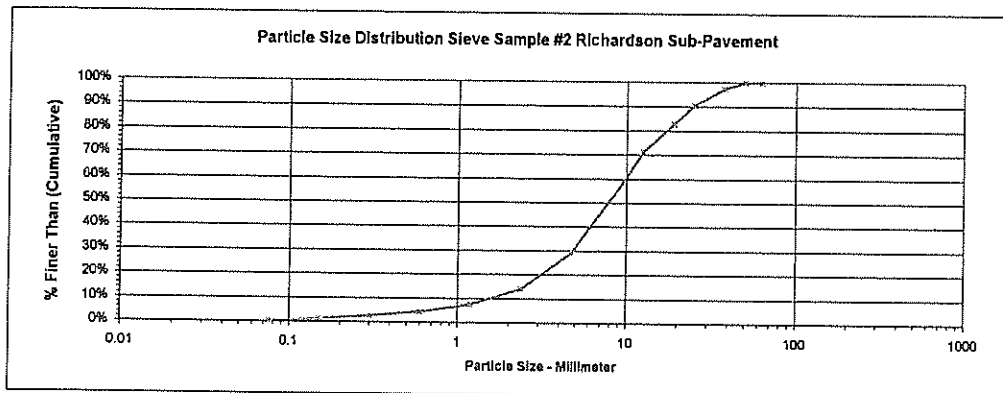
Sub-Pavement Sample
12/8/2013
For 801 East
Richardson Reference Reach
N/A

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175	1.175	1.175	1.175				0
2 inch	50	1.195	1.193	1.195	1.195				0
1 1/2 inch	37.5	1.25	1.47	1.63	1.25				0.8
1 inch	25	1.23	1.76	2.21	1.23				1.51
3/4 inch	19	1.245	2.44	1.78	1.245				1.73
1/2 inch	12.5	1.21	2.39	2.6	1.21				2.57
3/8 inch	9.5	1.225	2.41	1.99	2.11				2.835
No. 4	4.75	1.145	3.61	2.68	3.42				6.455
No. 8	2.38	1.07	2.32	2.01	2.27				3.39
No. 16	1.18	0.955	1.42	1.61	1.3				1.465
No. 30	0.6	0.9	1.08	1.28	1.02				0.68
No. 50	0.3	0.815	0.91	1.08	0.88				0.425
No. 100	0.15	0.775	0.835	0.93	0.85				0.29
No. 200	0.075	0.765	0.815	0.85	0.83				0.2
Passing 200	<0.075	1.08	1.12	1.11	1.09				0.08

Total Sample Weight ==>>>>>>>

22.23

Inches	Sieve Size	Millimeter	SAC	Wt. Retained (lbs)	% Passing	% Cumulative
	< #200			0.08	0.36%	0.36%
0.0029	#200	0.0750	S	0.2	0.90%	1.26%
0.0059	#100	0.150	A	0.29	1.30%	2.56%
0.0117	#50	0.30	N	0.425	1.91%	4.48%
0.0234	#30	0.60	D	0.69	3.06%	7.53%
0.0460	#18	1.18	S	1.465	6.59%	14.13%
0.0937	#8	2.38	G	3.39	15.25%	29.37%
0.187	#4	4.75	R	6.455	29.04%	58.41%
0.374	3/8"	9.50	A	2.835	12.75%	71.17%
0.5	1/2"	12.50	V	2.57	11.58%	82.73%
0.748	3/4"	19.0	E	1.73	7.70%	90.51%
0.9843	1"	25.0	L	1.61	6.79%	97.30%
1.4784	1 1/2"	37.5	S	0.6	2.70%	100.00%
1.9955	2"	50.0	0	0	0.00%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			D	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
			Totals	22.23	100%	100%



Sieve Sample #3

Pavement Type:

Sample Date:

Project:

Location:

Point Bar Sample
12/6/2013
For 801 East
Richardson Reference

Largest Particle on bar ==>>>

2.5

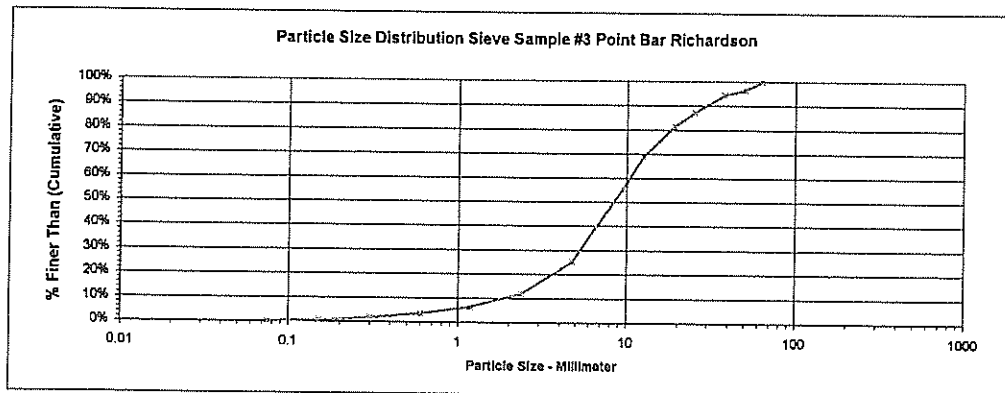
Samples 2.0,2.5,1.8

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175							0
2 inch	50	1.195					2.14		0.945
1 1/2 inch	37.5	1.25				1.38	1.88		0.54
1 inch	25	1.23	1.43	1.68	1.59	2.17			1.95
3/4 inch	19	1.245	1.49	1.61	1.64	1.77			1.53
1/2 inch	12.5	1.21	1.78	2.23	2.18	2.05			3.4
3/8 inch	9.5	1.225	1.91	2.21	2.22	2.13			3.57
No. 4	4.75	1.145	2.53	3.31	3.45	3.42			8.13
No. 8	2.36	1.07	1.67	1.93	2.1	2.17			3.59
No. 16	1.18	0.955	1.19	1.31	1.35	1.49			1.52
No. 30	0.6	0.9	1.01	1.04	1.08	1.21			0.72
No. 50	0.3	0.815	0.87	0.91	0.92	1.04			0.48
No. 100	0.15	0.775	0.81	0.83	0.84	0.91			0.29
No. 200	0.075	0.765	0.79	0.8	0.8	0.81			0.14
Passing 200	<0.075	1.08	1.09	1.08	1.1	1.11			0.08

Total Sample Weight ==>>>>>>>>

26.865

Inches	Sieve Size	Millimeter < #200	S/C	Wt. Retained (lbs)	% Passing	% Cumulative
0.0029			S/C	0.08	0.22%	0.22%
0.0059	#200	0.0750	S	0.14	0.52%	0.74%
0.0117	#100	0.150	A	0.20	1.08%	1.82%
0.0234	#50	0.30	N	0.48	1.79%	3.61%
0.0469	#30	0.60	D	0.72	2.68%	6.29%
0.0937	#16	1.18	S	1.52	5.66%	11.95%
0.187	#8	2.36	G	3.59	13.36%	25.31%
0.374	#4	4.75	R	8.13	30.26%	55.57%
0.748	3/8"	9.50	A	3.57	13.28%	68.86%
1.496	1/2"	12.50	V	3.4	12.66%	81.52%
2.992	3/4"	19.0	E	1.53	5.70%	87.21%
5.984	1"	25.0	L	1.95	7.26%	94.47%
11.968	1 1/2"	37.5	S	0.54	2.01%	96.48%
23.936	2"	50.0	L	0.945	3.52%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			O	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
			Totals	26.865	100%	100%



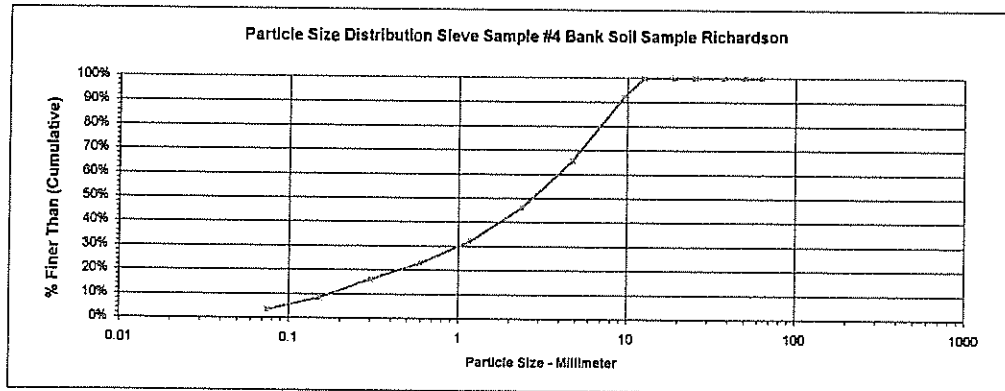
Sieve Sample #4

Pavement Type:	Bank Soil Sample
Sample Date:	12/6/2012
Project:	For 601 East
Location:	Richardson Reference Reach
Largest Particle on bar ==>>>	N/A

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175	1.175						0
2 inch	50	1.195	1.195						0
1 1/2 inch	37.5	1.25	1.25						0
1 inch	25	1.23	1.23						0
3/4 inch	19	1.245	1.245						0
1/2 inch	12.5	1.21	1.21						0
3/8 inch	9.5	1.225	1.37						0.145
No. 4	4.75	1.145	1.83						0.485
No. 8	2.36	1.07	1.43						0.36
No. 16	1.18	0.955	1.21						0.255
No. 30	0.6	0.9	1.07						0.17
No. 50	0.3	0.815	0.94						0.125
No. 100	0.15	0.775	0.815						0.14
No. 200	0.075	0.765	0.85						0.095
Passing 200	<0.075	1.08	1.14						0.08

Total Sample Weight =====>>> 1.835

Sieve Sample #4 Bank Soil Sample Richardson						
Location:	0					
Project:	0					
Inches	Sieve Size	Millimeter		Wt. Retained (lbs)	% Passing	% Cumulative
		< #200	S/C	0.00	3.27%	3.27%
0.0029	#200	0.0750	S	0.005	5.18%	8.45%
0.0059	#100	0.150	A	0.14	7.63%	18.08%
0.0117	#50	0.30	N	0.125	6.81%	22.89%
0.0234	#30	0.60	D	0.17	9.26%	32.15%
0.0469	#16	1.18	S	0.255	13.90%	46.05%
0.0937	#8	2.36	G	0.36	19.62%	65.67%
0.187	#4	4.75	R	0.485	26.43%	92.10%
0.374	3/8"	9.50	A	0.145	7.90%	100.00%
0.5	1/2"	12.50	V	0	0.00%	100.00%
0.748	3/4"	19.0	E	0	0.00%	100.00%
0.9843	1"	25.0	L	0	0.00%	100.00%
1.4764	1 1/2"	37.5	S	0	0.00%	100.00%
1.9685	2"	50.0	O	0	0.00%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			O	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
Totals				1.835	100%	100%



Sieve Sample #5

Pavement Type:

Sample Date:

Project:

Location:

Largest Particle on bar ==>>>>

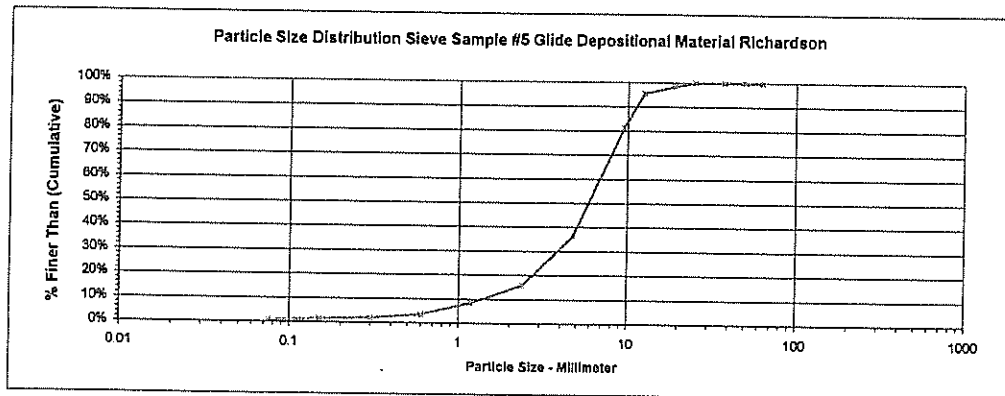
Material on Glide being deposited
12/8/2012
For 601 East
Richardson Reference Reach
N/A

Sieve Size	Sieve Size (mm)	Sieve Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Sieve +Sample Weight (Lbs)	Total Weight (Lbs)
2 1/2 inch	63	1.175	1.175							0
2 inch	50	1.195	1.195							0
1 1/2 inch	37.5	1.25	1.25							0
1 inch	25	1.23	1.23							0
3/4 inch	19	1.245	1.26							0.015
1/2 inch	12.5	1.21	1.24							0.03
3/8 inch	9.5	1.225	1.37							0.145
No. 4	4.75	1.145	1.8							0.455
No. 8	2.38	1.07	1.28							0.21
No. 16	1.18	0.955	1.03							0.075
No. 30	0.6	0.9	0.95							0.05
No. 50	0.3	0.815	0.83							0.015
No. 100	0.15	0.775	0.78							0.005
No. 200	0.075	0.765	0.77							0.005
Passing 200	<0.075	1.08	1.09							0.01

Total Sample Weight =====>

1.015

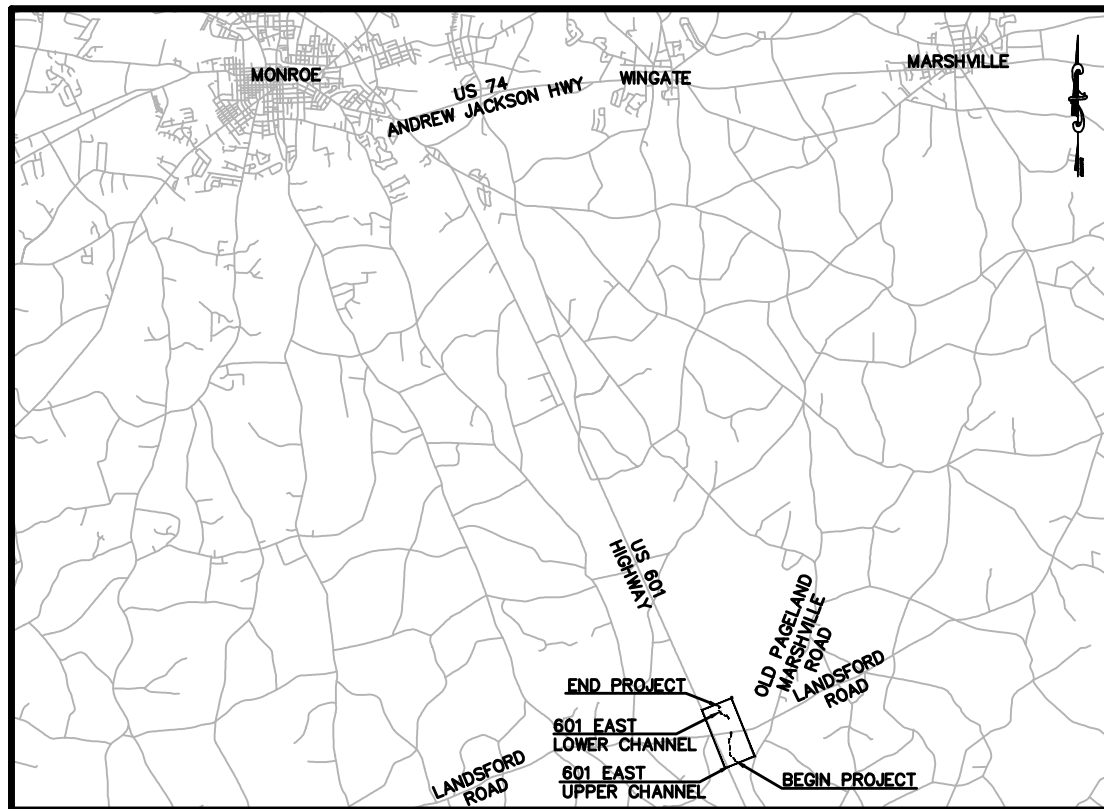
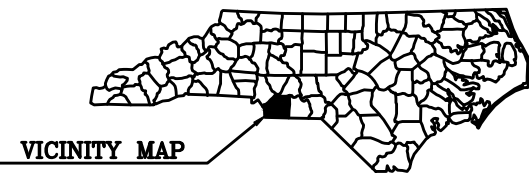
Sieve Sample #5 Glide Material Deposition Richardson						
Location:	0					
Project:	0					
Inches	Sieve Size	Millimeter < #200	S/C	Wt. Retained (lbs)	% Passing	% Cumulative
0.0029	#200	0.0750	S	0.005	0.49%	1.48%
0.0059	#100	0.150	A	0.005	0.49%	1.97%
0.0117	#50	0.30	N	0.015	1.48%	3.45%
0.0234	#30	0.60	D	0.05	4.93%	8.37%
0.0469	#18	1.18	E	0.075	7.30%	15.78%
0.0937	#8	2.38	G	0.21	20.66%	38.45%
0.187	#4	4.75	R	0.455	44.83%	81.28%
0.374	3/8"	0.50	A	0.145	14.29%	95.57%
0.5	1/2"	12.50	U	0.03	2.96%	98.52%
0.748	3/4"	19.0	E	0.015	1.48%	100.00%
0.9843	1"	25.0	L	0	0.00%	100.00%
1.4764	1 1/2"	37.5	S	0	0.00%	100.00%
1.9685	2"	50.0	O	0	0.00%	100.00%
2.5	2 1/2"	63.0	C	0	0.00%	100.00%
			O	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			B	0	0.00%	100.00%
			L	0	0.00%	100.00%
			D	0	0.00%	100.00%
			R	0	0.00%	100.00%
	Bedrock		BDRK	0	0.00%	100.00%
Totals				1.015	100%	100%



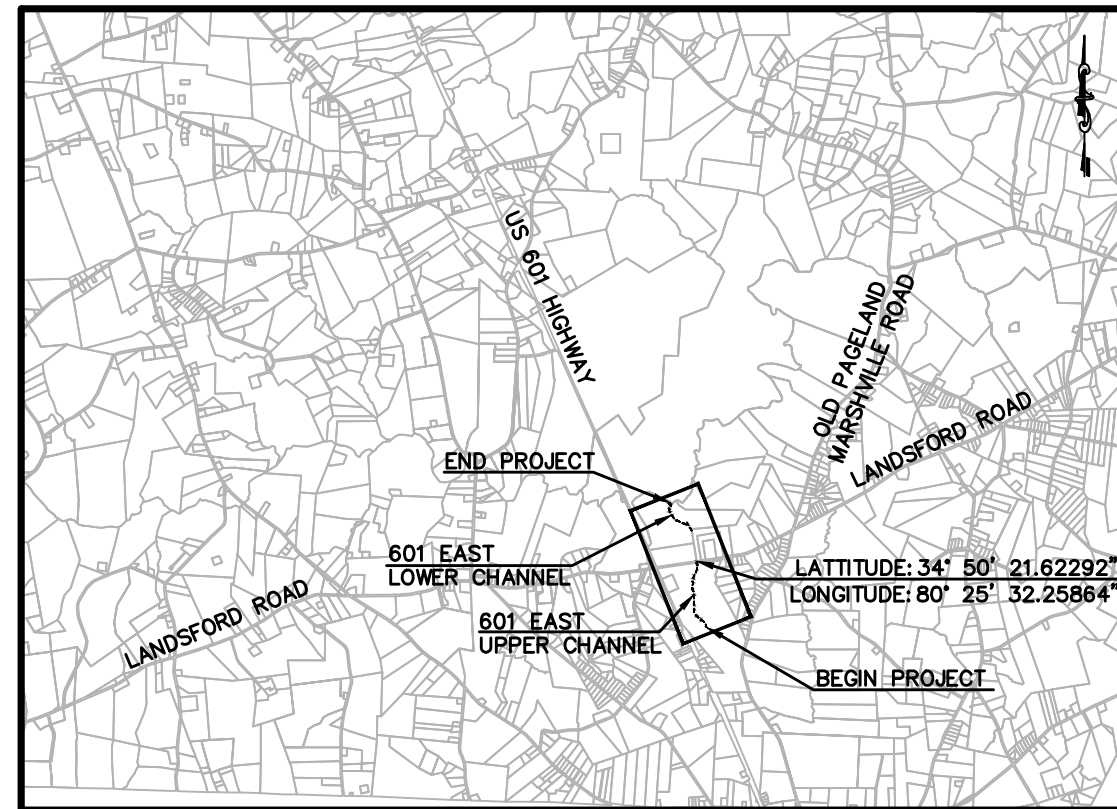
Appendix D. Project Plan Sheets

CONSTRUCTION PLANS FOR 601 EAST STREAM AND WETLAND RESTORATION PROJECT

UNION COUNTY, NORTH CAROLINA
EEP CONTRACT DENR NO:004925
EEP PROJECT NO:95756
RFP 16-004110



VICINITY MAP



LOCATION MAP

INDEX OF SHEETS

SHEET NO.	DESCRIPTION
T1	TITLE SHEET
L1	LEGENDS SYMBOLS AND SHEET KEY
TCS1-TCS2	TYPICAL CONSTRUCTED CROSS SECTIONS
GNI	GENERAL NOTES AND CONSTRUCTION SEQUENCE
D1-D5	DETAILS
PP1-PP8	PLAN AND PROFILE
VP1-VP12	PLANTING PLANS
CEM1-CEM2	CONSERVATION EASEMENT MARKING PLAN

SURVEY DATA PROVIDED BY:



909 MARKET STREET
WILMINGTON, NC 28401
(910) 762-4200
NC LICENSE NO. F-0374



STREAM DESIGNER:

Ward Consulting Engineers
4805 Green Road
Raleigh, NC 27616
NC LICENSE NO: C-2619
PH: 919-870-0526
FAX: 919-870-5359

NATURAL SYSTEMS INVESTIGATION:



The Catena Group Inc.
410-B Millstone Drive
Hillsborough, NC 27278
PH: 919-732-1300
FAX: 919-732-1303



FULL DELIVERY PROVIDER:

Environmental Banc & Exchange
909 Capability Drive, Suite 3100
Raleigh, NC 27606
PH: 919-829-9909
FAX: 919-229-9913

NCEP CONTACT: PAUL WESNER (828) 273-1673
WARD CONSULTING ENGINEERS CONTACT: BECKY WARD, PE (919) 870-0526
ENVIRONMENTAL BANC AND EXCHANGE CONTACT: (919) 829-9909

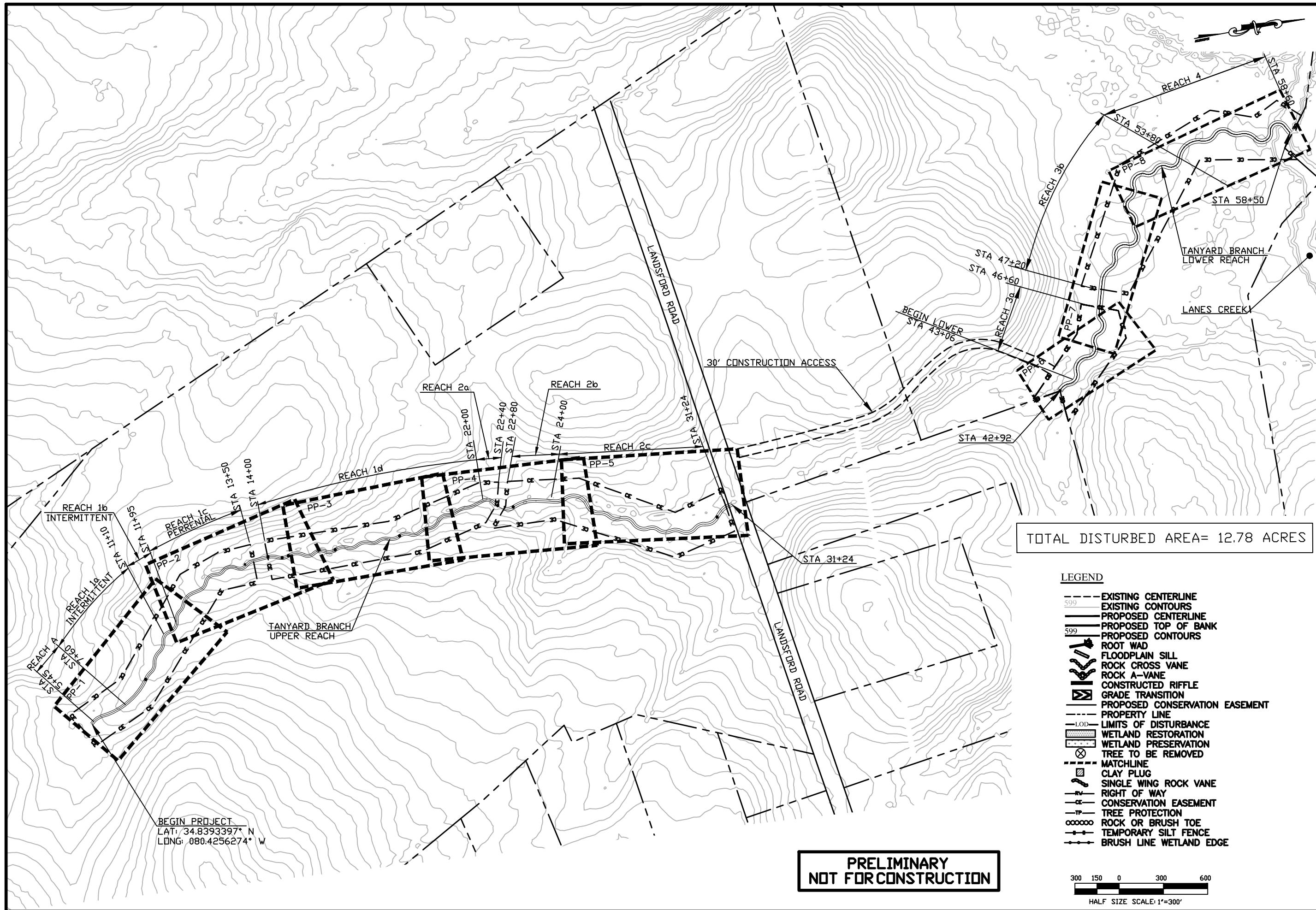
**PRELIMINARY
NOT FOR CONSTRUCTION**

Ward Consulting Engineers, P.C.
 FIRM LICENSE NO C-2619
 4805 Green Rd, Suite 100 (919) 870-0526
 Raleigh, NC 27616-2848 FAX (919) 870-5359
 Environmental Banc & Exchange
 909 Capability Drive, Suite 3100
 Raleigh NC 27606 Phone: (919) 829-9909
 Fax: (919) 229-9913



**601 EAST
TITLE SHEET
UNION COUNTY, NORTH CAROLINA**

DATE: 5 SEPT 2013
REVISIONS:
PROJECT NAME: 601 East
DWG NAME: Construction Title Sheet
SCALE: NTS
MITIGATION PLAN SET
SHEET NO.



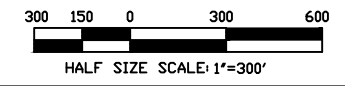
BEGIN PROJECT
 LAT: 34.8393397° N
 LONG: 080.4256274° W

**PRELIMINARY
 NOT FOR CONSTRUCTION**

TOTAL DISTURBED AREA= 12.78 ACRES

LEGEND

- EXISTING CENTERLINE
- EXISTING CONTOURS
- PROPOSED CENTERLINE
- PROPOSED TOP OF BANK
- PROPOSED CONTOURS
- ROOT WAD
- FLOODPLAIN SILL
- ROCK CROSS VANE
- ROCK A-VANE
- CONSTRUCTED RIFFLE
- GRADE TRANSITION
- PROPOSED CONSERVATION EASEMENT
- PROPERTY LINE
- LIMITS OF DISTURBANCE
- WETLAND RESTORATION
- WETLAND PRESERVATION
- TREE TO BE REMOVED
- MATCHLINE
- CLAY PLUG
- SINGLE WING ROCK VANE
- RIGHT OF WAY
- CONSERVATION EASEMENT
- TREE PROTECTION
- ROCK OR BRUSH TOE
- TEMPORARY SILT FENCE
- BRUSH LINE WETLAND EDGE



Ward Consulting Engineers, P.C.
 FIRM LICENSE NO C-2619
 4805 Green Rd, Suite 100 (919) 870-0626
 Raleigh, NC 27616-2848 FAX (919) 870-6369
 Environmental Banc & Exchange
 909 Capability Drive, Suite 3100
 Raleigh NC 27606 Phone: (919) 829-9909
 Fax: (919) 229-9913

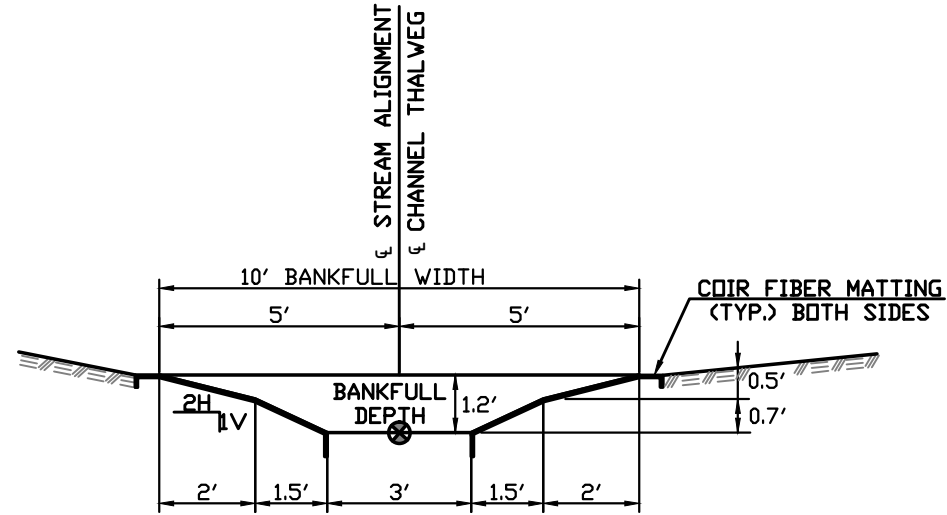


LEGENDS, SYMBOLS AND SHEET KEY
601 EAST
UNION COUNTY, NORTH CAROLINA

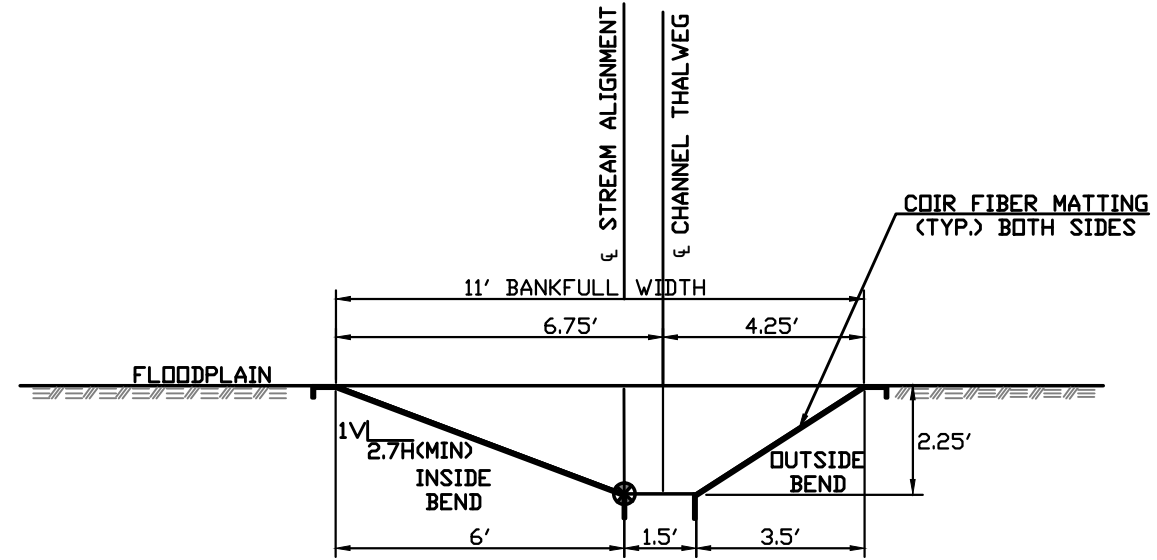
DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Legends and Symbols Sheet
SCALE:	1"=300'
	MITIGATION PLAN SET
SHEET NO.	L1

NOTES:

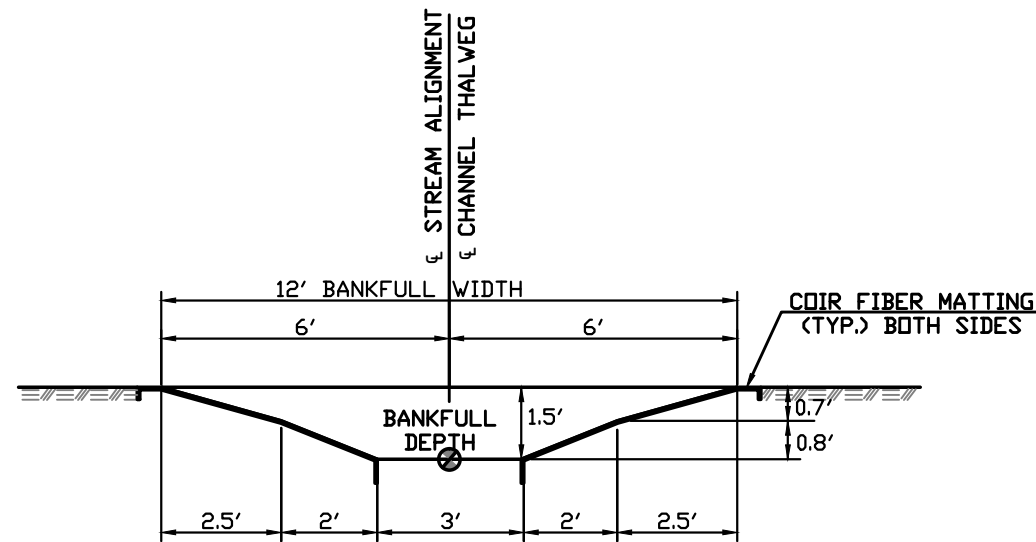
1. CONTRACTOR TO PROVIDE A SMOOTH TRANSITION BETWEEN THE RIFFLE AND POOL SECTIONS SHOWN BELOW.
2. ○ INDICATES THE STREAM CENTERLINE ALIGNMENT AS IDENTIFIED ON THE PLAN AND PROFILE SHEETS.
3. € OF STREAM FOR HORIZONTAL LAYOUT AND € OF THALWEG MAYBE AT DIFFERENT LOCATIONS IN POOL SECTIONS.
4. USE 700 GRAM COIR FIBER MATTING BLANKET WESTERN EXCELSIOR CORPORATION COIR MAT 700 OR APPROVED EQUAL.



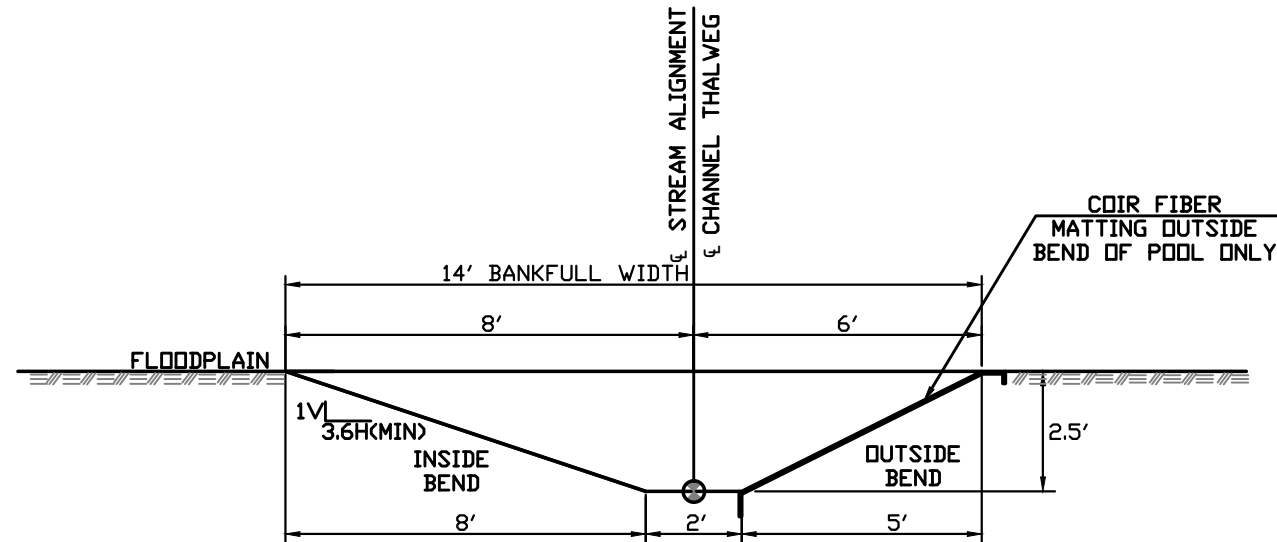
1 PROPOSED RIFFLE SECTION (REACH 1)
SCALE: NOT TO SCALE



2 PROPOSED POOL SECTION (REACH 1)
SCALE: NOT TO SCALE



3 PROPOSED RIFFLE SECTION (REACH 2)
SCALE: NOT TO SCALE



4 PROPOSED POOL SECTION (REACH 2)
SCALE: NOT TO SCALE

**PRELIMINARY
NOT FOR CONSTRUCTION**

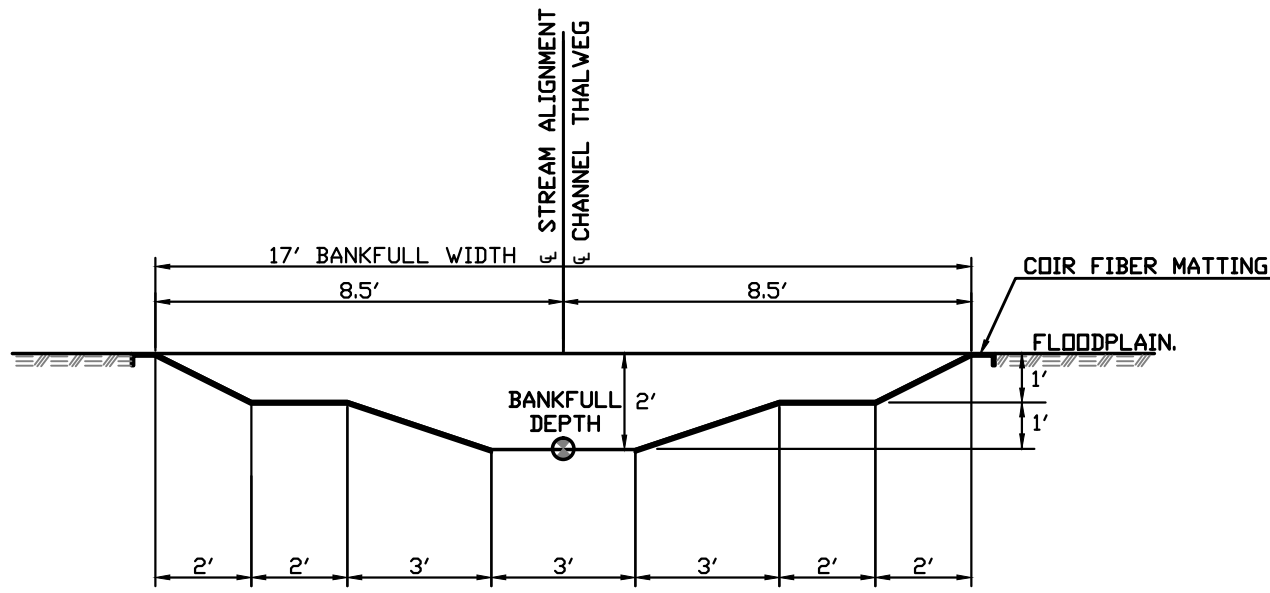
Ward Consulting Engineers, P.C.
FIRM LICENSE NO. C-2619
4805 Green Rd, Suite 100 (919) 870-0526
Raleigh, NC 27616 FAX (919) 870-5359
Environmental Banc & Exchange
909 Capability Drive, Suite 3100
Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913



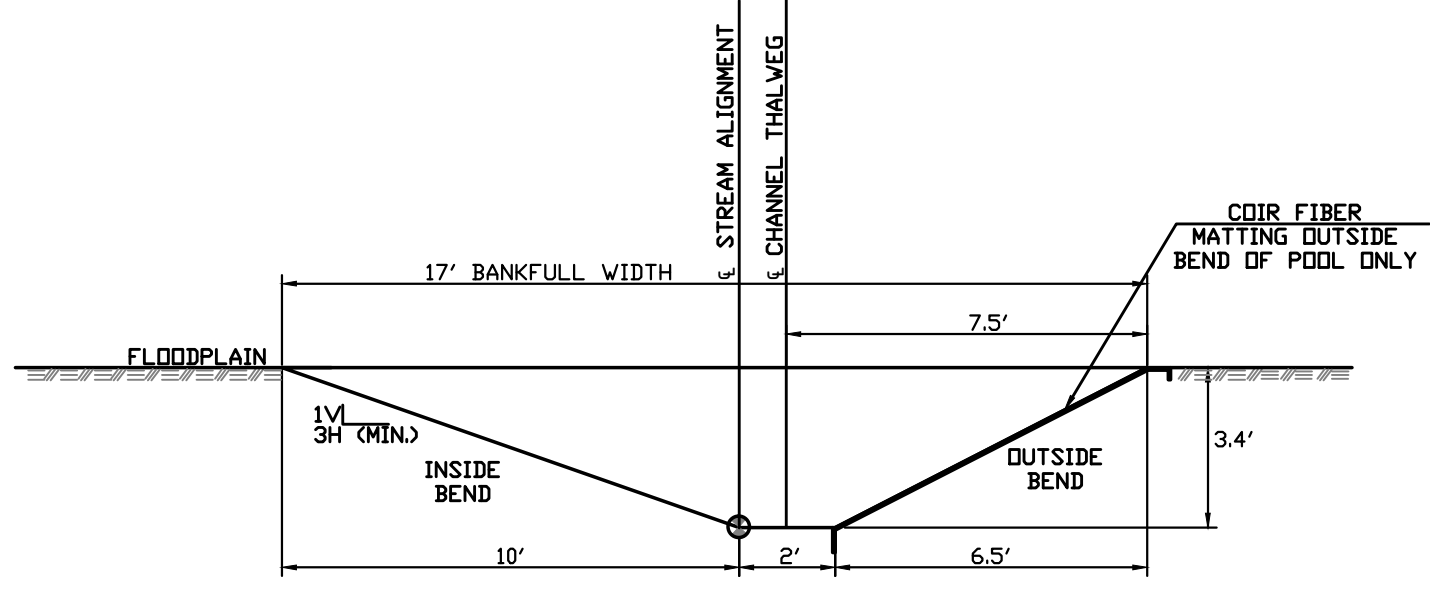
**601 EAST
TYPICAL CONSTRUCTED
CROSS SECTIONS WITH LEGENDS
UNION COUNTY, NORTH CAROLINA**

DATE: 5 SEPT 2013
REVISIONS:
PROJECT NAME: 601 East Creek
DWG NAME: Typical Cross Sections
SCALE: NTS
MITIGATION PLAN SET
SHEET NO.

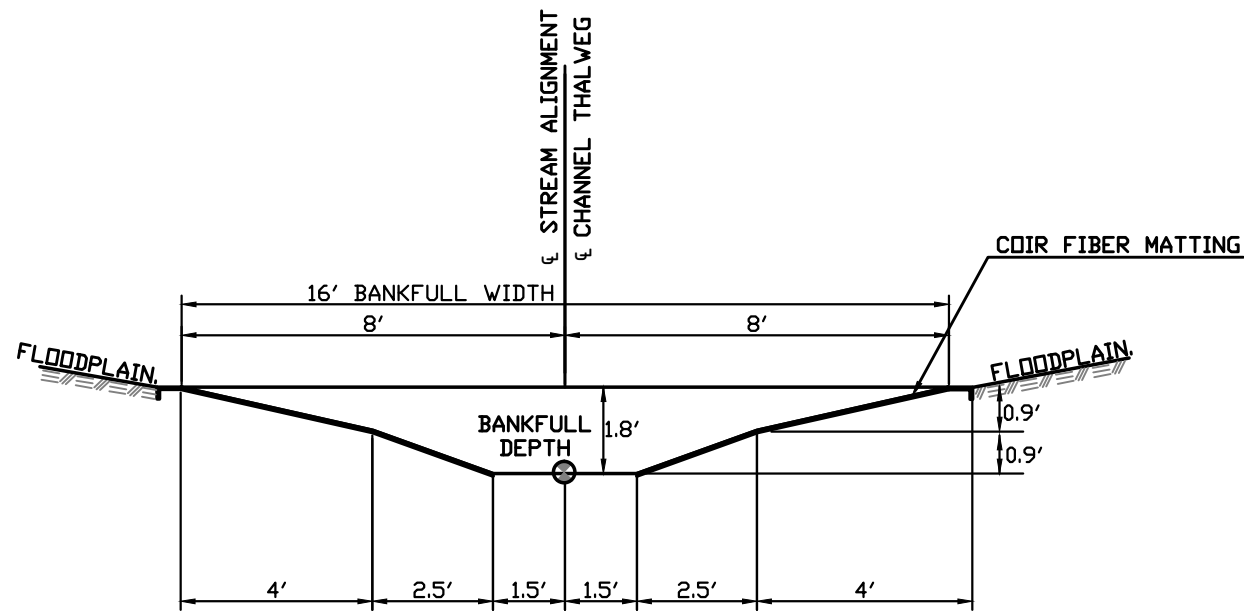
TCS1



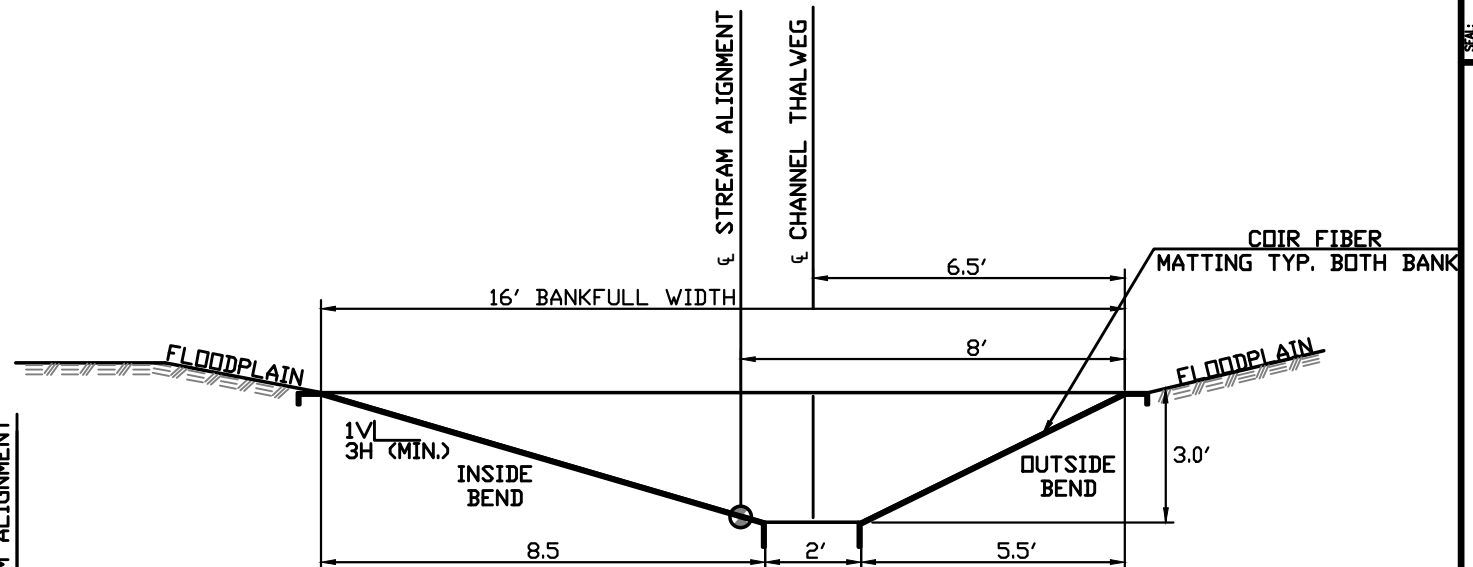
5 PROPOSED RIFFLE SECTION (REACH 3)
SCALE: NOT TO SCALE



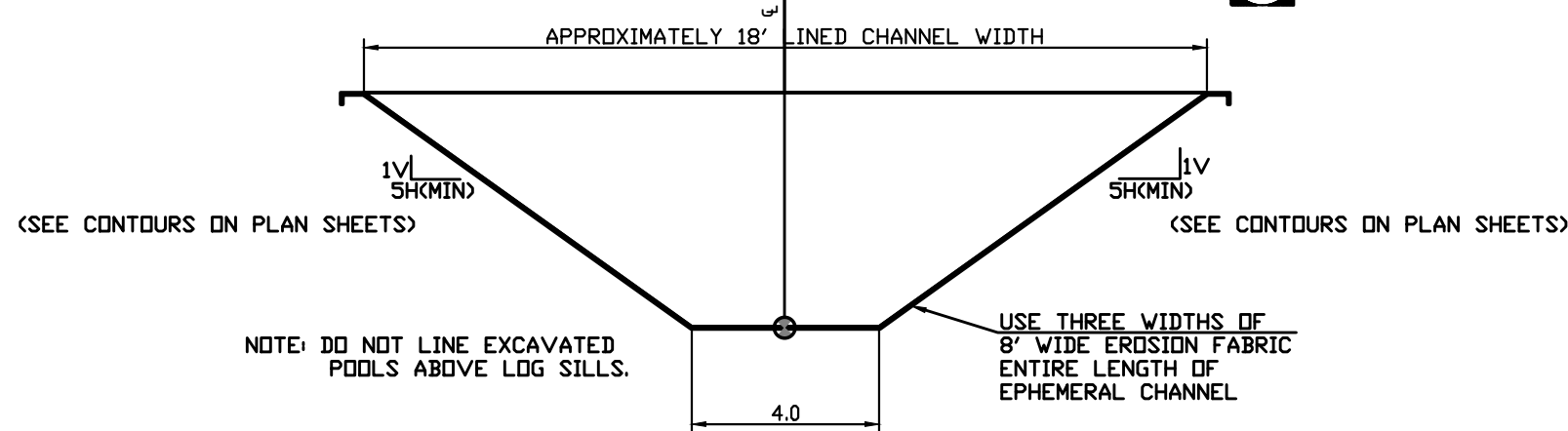
6 PROPOSED POOL SECTION (REACH 3)
SCALE: NOT TO SCALE



7 PROPOSED RIFFLE SECTION (REACH 4)
SCALE: NOT TO SCALE



8 PROPOSED POOL SECTION (REACH 4)
SCALE: NOT TO SCALE



9 TYPICAL EPHEMERAL CROSS SECTION
SCALE: NOT TO SCALE

**PRELIMINARY
NOT FOR CONSTRUCTION**

Ward Consulting Engineers, P.C.
FIRM LICENSE NO. C-2619
4805 Green Rd, Suite 100
Raleigh, NC 27616
Phone: (919) 870-0526
Fax: (919) 870-5359
Environmental Banc & Exchange
909 Capabilities Drive, Suite 3100
Raleigh NC 27606
Phone: (919) 829-9909
Fax: (919) 229-9913



**601 EAST
TYPICAL CONSTRUCTED
CROSS SECTIONS WITH LEGENDS
UNION COUNTY, NORTH CAROLINA**

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East Creek
DWG NAME:	Typical Cross Sections
SCALE:	NTS
	MITIGATION PLAN SET
SHEET NO.:	TCS2

GENERAL NOTES:

- Contractor shall verify locations and elevations of all existing utilities inside the construction corridor. The contractor is responsible for having all utilities located 48 hours prior to mobilization to the site. "Call before you dig." Toll free number (811)
- The Contractor shall follow OSHA guidelines and utility owner guidelines when working near utilities.
- All construction and materials shall be constructed to standards provided on the plans.
- Contractors shall verify all dimensions in field. Any discrepancies thereof shall be reported to the owner and designer, prior to proceeding with the work.
- No trees not shown for removal on the plans shall be removed without the Designer's approval unless they are in the new channel alignment. All trees and debris to be mulched onsite or properly disposed of offsite. Remaining tree stumps to be no more than 12" from existing ground.
- Base topographic and planimetric information generated from Union County GIS data and field surveys.
- No subsurface data is made available to the Contractor for this project. The Contractor shall be responsible for making his own subsurface investigations as they relate to this project.
- Benchmark controls are shown on the Staking Plan. The Contractor is responsible for performing the construction survey. The Designer will coordinate available auto-cad drawing files to the surveyor for the proposed design and base survey data obtained in the design phase of the project.
- Plan Vertical Datum: NAVD 1988
- Plan Horizontal Datum: NC State Plane Coordinates NAD 83
- No Flood Hazard zones exist on this project according to FEMA Floodway map for Tanyard Branch. Lanes Creek and Mills Creek South are FEMA regulated.
- In the event of a storm, the owner will not accept any liability for damaged equipment, tools, materials, or other items needed to complete the work. The contractor will be responsible for removal or protection of any equipment that could be affected by storm flows.
- Temporary construction access to the site to be improved only as necessary in areas unsuitable for construction equipment passage by the Contractor. All access improvements to the roadway, gates, and fences required for construction to remain for future use by landowner. Existing farm fields used for construction access will be repaired to original conditions or better by the contractor.
- The Contractor shall be responsible for repairing any damaged items during construction including but not limited to, existing roads, gates, fences, etc.
- The Contractor shall make every effort to prevent damage to trees within the tree protection area. In the event of damage, repair any damage to the crown, trunk, or root system immediately.
 - Roots: Repair roots by cutting off damage areas and painting them with tree paint. Spread peat moss or moist topsoil over exposed roots.
 - Tree Bark: Repair damage to bark by trimming around damaged area, taper the cut to provide drainage, and paint the tree paint.
 - Tree Limbs: Cut off all damaged tree limbs above the tree collar at the trunk or main branch. Use a separate cut to avoid peeling bark from healthy area of the tree.

ACCESS, STAGING AND STOCKPILE AREA NOTES:

- Construction equipment limited to only areas within the limits of disturbance as shown on the plans. All parking and staging to be limited to areas shown on plan.
- All areas outside the shown disturbance limit or conservation easement to remain in their natural condition.
- All construction to be performed from the top of bank, no equipment will be permitted to work from the channel bed or cross the streams except at designated locations as shown on the plans.
- Every effort shall be taken to minimize disturbance in the stream channel and in gaining access to and from the work area.
- Access and staging areas have been shown on the plans. Staking of the access areas shall be approved by the Designer before construction commences.
- The contractor shall establish stockpile areas along the project, as necessary, to carry out the work. All stockpile areas must be inside the limits of construction and approved by the Designer. Stockpile areas should not be located within forested areas. Silt fence shall be

required in areas where loose soil has been placed in the staging and stockpiling areas. The contractor is responsible for the temporary protection and permanent stabilization of all soil stockpiles on site as well as soil internally transported within the project site.

7. Temporary access areas which go through agricultural fields are to be planted with temporary seed mix.

MATERIALS NOTES:

- The Contractor is responsible for stockpiling all materials as stated above.
- Topsoil: the upper 6 inches of topsoil shall be saved from areas that will be disturbed by excavation, fill, access areas, or compaction equipment. Topsoil shall be kept separate from any site spoil. Upon completion of construction, topsoil will be spread at a depth of 4 to 6 inches over areas to be planted. See planting plans.
- Stream Bed Material: Stream bed material deemed suitable by the designer. Shall be saved from areas of the exiting stream that will be impacted by construction. Excavated bed materials will be utilized in close proximity to their location of excavation, and will not require extensive hauling. This excavated bed material will be used to seed the newly constructed stream riffles.
- Site Spoil: All remaining excavated materials other than topsoil and stream bed material shall be considered site spoil. The site spoil shall be stockpiled separately. Suitable site spoil shall be saved for later use as backfill of the abandoned channel. All excess soil shall be wasted on site in designated areas or hauled off site.

EROSION CONTROL NOTES:

Total Disturbed Area = 12.78 Ac.

Project Soil Types Carolina Slate Belt: Badin, Chewacla, Cid, Mecklenburg, and Tarrus.

- The contractor shall exercise precautions throughout the construction sequence to prevent erosion and siltation. Erosion control measures shall be installed and maintained in accordance with the project plans, North Carolina Sedimentation and Erosion Control Guidelines, and as directed by the designer. All sedimentation and erosion
- The owner and financially responsible party for this project is Environmental Banc and Exchange.
- Construction work shall be in compliance with regulations of the National Pollutant discharge Elimination System (NPDES) stormwater general permit. The Contractor shall be responsible for installing a RAIN GAUGE on the project site & for recording daily rainfall amounts during construction.
- The contractor shall be responsible for maintenance of all erosion control measures during construction. The measures shall be maintained continuously, relocated when and as necessary, and shall be checked for maintenance issues after every rainfall.
- All disturbed areas to be seeded to specifications unless otherwise noted on the planting plan. Seeded areas shall be checked regularly and shall be watered, fertilized, reseeded and mulched as necessary to obtain a dense stand of grass. All disturbed areas that are not otherwise stabilized shall be topsoiled and seeded, temporarily or permanently in accordance with the North Carolina sediment control regulations. Permanent seeding and grass establishment is required prior to project completion and acceptance.
- The Contractor shall provide ground cover as soon as practicable but in the event within 14 days on disturbed flat areas and 7 days on all perimeter dikes, swales, ditches perimeter slopes and slopes steeper than 3 horizontal to 1 vertical. Permanent ground cover shall be established within 15 working days or 90 calendar days (whichever is shorter) following completion of construction.
- All temporary erosion and sediment control measures shall be removed within 21 days after final site stabilization or after the temporary measures are no longer needed. Trapped sediment and the disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation.
- The Contractor shall only conduct bank and stream bed work, including all in-stream, grading bank stabilization, and in-stream structures on a section of stream that can be entirely stabilized before turning flow into the newly constructed channel.
- If any soil is transported offsite, it is the contractor's responsibility to ensure that this action is conducted in a manner that is consistent with the approved erosion control permit.

- Construction entrances shall be installed at all access locations as shown on the plans. When a crushed stone construction entrance has been covered with soil or has been pushed into the soil by construction traffic, it shall be replaced with a depth of stone equal to that of the original application.
- The Contractor shall keep all surrounding public roadways and drainage systems free from dirt, mud and construction debris at all times. Where sediment is transported onto a paved or public road surface, the road surface shall be cleaned thoroughly at the end of each day. Sediment shall be removed from the roads by shoveling or sweeping and transported to a sediment control disposal area. Street washing shall be allowed only after excess sediment is removed.
- During construction the Contractor shall be responsible for installing additional erosion control measures not shown on the plans but necessary to control excess sediment, if determined to be necessary by the Designer. Additional soil stockpile areas will be pre-approved by the engineer and will have appropriate silt fencing installed around it.

SEQUENCE OF CONSTRUCTION EVENTS

A General Initial Site Preparation

- Perform all utility identification and marking/flagging as necessary.
- The contractor shall set up a pre-construction meeting with the local erosion control inspector, and the project engineer. The contractor shall schedule this meeting a minimum of 48 hours prior to any land disturbing activity.
- Install construction entrance(s) and access road. The construction entrance(s) and staging area(s) identified on the plans provide the only access points in to the limits of disturbance. No additional access points shall be used without approval of the designer and modifications of the erosion control permit.
- Stake and mark sensitive areas and trees/vegetation to be saved. (Coordinate with Designer).
- Stake construction limits, clearing limits and stream access locations as shown on the plans or as directed by the designer.
- Install sediment/erosion control fencing as shown on the plans and all other erosion control measures as necessary to begin clearing and grading operations in accordance with the approved erosion control plan. Erosion control measures shall be installed and maintained in accordance with the project plans and special provisions, North Carolina sediment and erosion control guidelines and as directed by the designer. The contractor shall exercise every reasonable precaution throughout the construction of the project to prevent erosion and siltation. When the measures are complete call for an inspection by the local erosion control inspector.
- Identify staging and stockpile areas as shown on plans. (Coordinate with Designer) All excavated material shall be stockpiled within the limits of disturbance for later use as embankment material or disposal. The contractor is responsible for installing appropriate stabilization measures around the stockpile area(s) to prevent erosion and sedimentation.
- Perform clearing and selective vegetation removal operations. All woody vegetation on site smaller than 6" to be shredded to mulch and stockpiled to be used to amend the soil in the floodplain or disposed of offsite.
- Clear any debris from the stream. Dispose of according to the plans and specifications or as directed by the Designer.
- Install temporary crossings as shown on the plans. The permanent stream crossings will not be installed until the channel construction in that area is completed in conjunction with the crossing. The culvert permanent crossings and temporary crossings as shown on the plans will serve as the only stream crossing locations for Tanyard Branch.

B Stream Restoration Area Construction

- It is up to the discretion of the contractor to determine the length of daily work areas in accordance with the following provisions:
 - All excavation shall be performed in dry or isolated sections of the channel.
 - The contractor shall only conduct stream work, including all in-stream structures, grading, stabilization measures, seeding, mulching, and matting work, on a section of stream that can be completed within a single day. Each section of completed stream must be stabilized and matted before flow can be returned into the channel.

C General Site Completion

- Complete site cleanup and stabilization as called for on the plans and specifications.
- Erosion control devices shall be removed from their respective locations only when the stabilization of the adjacent ground has been established. The removal of the construction entrance will occur when all of the construction equipment has been removed from the project site. Construction entrance stone will only be left on the project site upon the request of the land owner. Upon removal of the entrance the area will be seeded and mulched.
- Obtain Final approvals.
- Complete as-built survey.

- Temporary pumps shall be utilized by the contractor in portions of the stream to divert normal flow from and dewater the work area. The pumps and bypass or dewatering layouts used by the contractor shall meet all requirements specified in these plans. The temporary pump shall be installed and removed in accordance with the manufacturer's guidelines. The contractor shall be responsible for utilizing pump(s) sufficient to bypass the normal flow and dewater the work area.
- All disturbed soils will be seeded for vegetative stabilization in accordance with the temporary and permanent seeding specifications in the special provisions and as listed on the planting plan notes sheet VP 1 -2 of the construction set.

- The Contractor shall work from upstream to downstream when doing work in the existing channel. The Contractor shall maintain a temporary rock silt screen downstream of any work in the live stream.
- Amend soils; stabilize with erosion control matting, and seed daily as construction proceeds downstream.
- Construct ephemeral channel improvements at the top of the project to station 7+60 the beginning of the intermittent channel.
- Pump around Tanyard Branch from station 7+60 to 13+50 as needed and construct the channel and floodplain grading stabilizing the channel daily as work progresses.
- Pump around to construct permanent stream crossing at Station 13+75. Install pipe to the lines and grades as called for on the plans.
- Pump around Tanyard Branch from 14+00 to 22+50 to construct the channel and floodplain basins at concentrated overland flow locations. Stabilize all work areas daily as work progresses.
- Pump around Tanyard Branch from 22+50 to 25+80. Construct channel and floodplain improvements.
- Construct the channel from 25+80 to 30+80 adjacent to the existing channel. Contractor to minimize construction impacts to the existing wetland areas.
- Pump around from 30+80 to Landsford Road. Complete the channel construction and tie into the existing culvert at Landsford Road.
- Contractor to finish seeding and stabilization of project upstream of Landsford Road.
- Mobilize equipment and materials to lower end of the stream.
- Construct the channel in the dry from station 44+20 to 58+50. Stabilize with seed and matting.
- Construct the permanent crossing at station 46+92.
- Pump around the stream from station 42+90 and divert flow into the newly constructed channel.
- Construct the channel from 42+92 and tie into the newly constructed channel at 44+20.
- Contractor to stockpile materials in only the locations shown on the plans unless otherwise approved by the engineer or owner. Fill abandoned channel as construction proceeds downstream and the stream flow is diverted to the new channel. Seed floodplain, ephemeral pool(s) and wetland enhancement area(s) as final grading is completed.
- Complete re-vegetation of the woody species for the project within the conservation easement as shown on the plans.
- Repair areas used for construction access.
- Seed and mulch staging areas, stockpile areas, access areas and any remaining non-vegetated areas within the project.

PRELIMINARY NOT FOR CONSTRUCTION

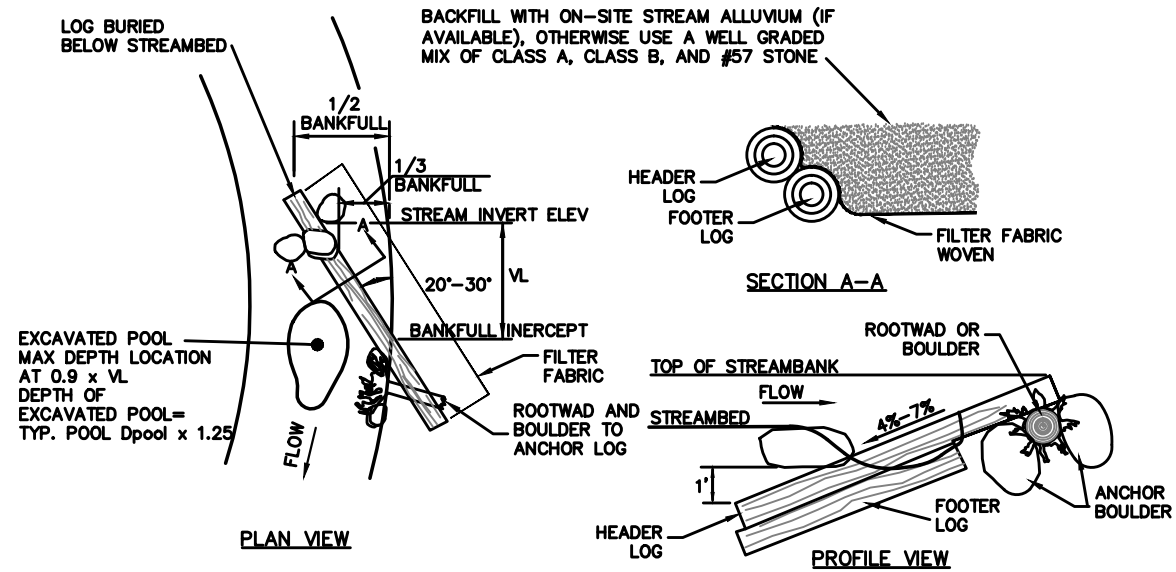
Ward Consulting Engineers, P.C.
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 Environmental Banc & Exchange
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**601 EAST
 GENERAL NOTES AND
 CONSTRUCTION SEQUENCE
 UNION COUNTY, NORTH CAROLINA**

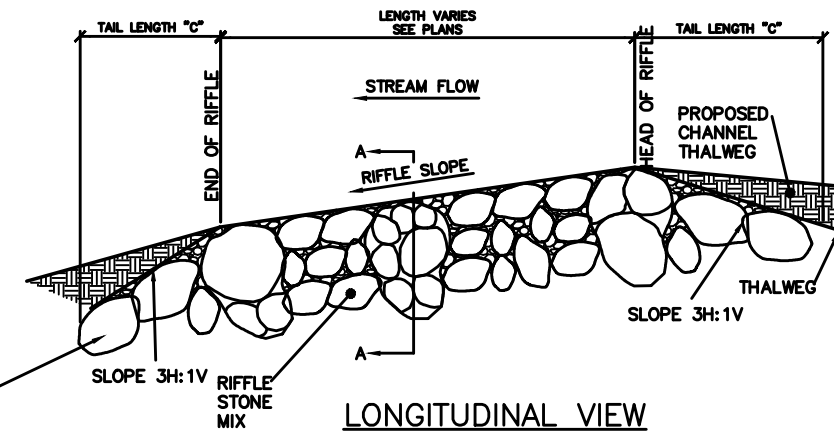
DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Construction Sequence
SCALE:	NTS
	MITIGATION PLAN SET
SHEET NO.	

GN1



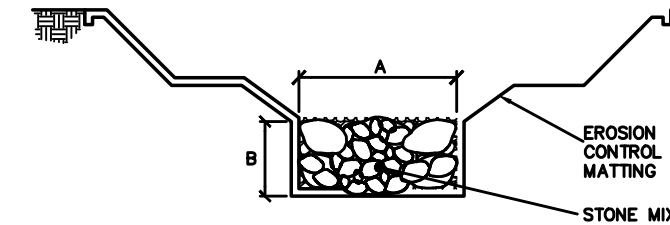
- NOTES:
1. HEADER LOG SHALL BE AT LEAST 18" IN DIAMETER AND THE FOOTER LOG AT LEAST 12" IN DIAMETER; RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
 2. BOULDERS MUST BE AT LEAST 2'X2'X3'.
 3. SOIL SHOULD BE WELL COMPACTED AROUND BURIED PORTIONS OF LOG.
 4. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT LOCKS THE HEADER LOG INTO THE BANK.
 5. BOULDERS SHOULD BE PLACED ON TOP OF HEADER LOG FOR ANCHORING.
 6. FILTER FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.

- NOTES:
1. EROSION CONTROL MATTING TO BE INSTALLED IN EXCAVATED TRENCH AS SHOWN
 2. CONTRACTOR TO PACK VOIDS WITH STONE MIX THEN ADD A FINE LAYER OF SOIL TO FILL SMALLER VOIDS AS RIFFLE IS CONSTRUCTED FROM BOTTOM UP
 3. THE RIFFLE TAIL LENGTHS "C" ARE 5' MINIMUM.
 4. PLACE STONE MIX AS SHOWN IN CHART BELOW.
 5. CONTRACTOR TO UTILIZE EXISTING RIFFLE STONE IN OLD CHANNEL FOR CONSTRUCTION OF NEW RIFFLES WHERE POSSIBLE.



PERCENT OF MIX					
STONE MIX	15%	30%	50%	5%	TRENCH DEPTH
CLASS I MIX	#57STONE	CLASS A	CLASS I	SOIL	18"
CLASS II MIX	#57STONE	CLASS B	CLASS II	SOIL	24"

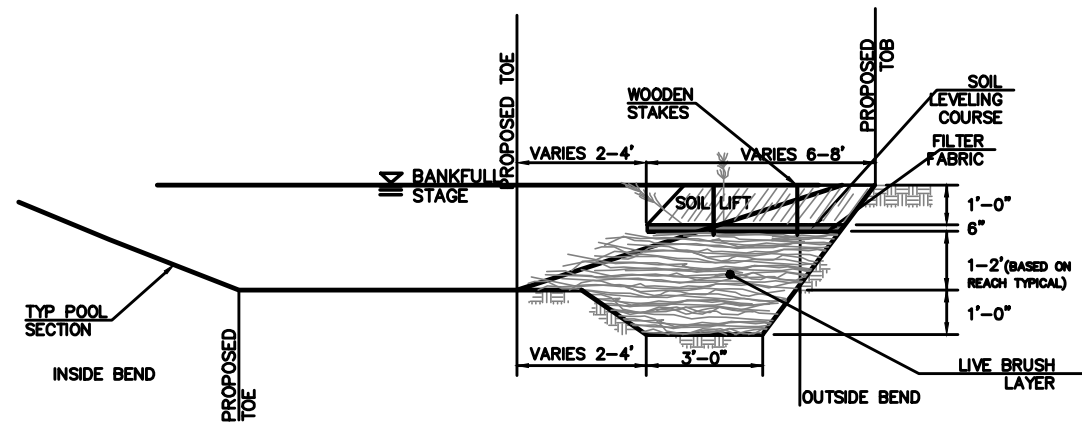
- NOTE:
- CLASS A - RIP RAP 2"-6" AVG 4"
 - CLASS B - RIP RAP 5"-12" AVG 8"
 - CLASS I - RIP RAP 5"-17" AVG 10"
 - CLASS II - RIP RAP 9"-23" AVG 14"



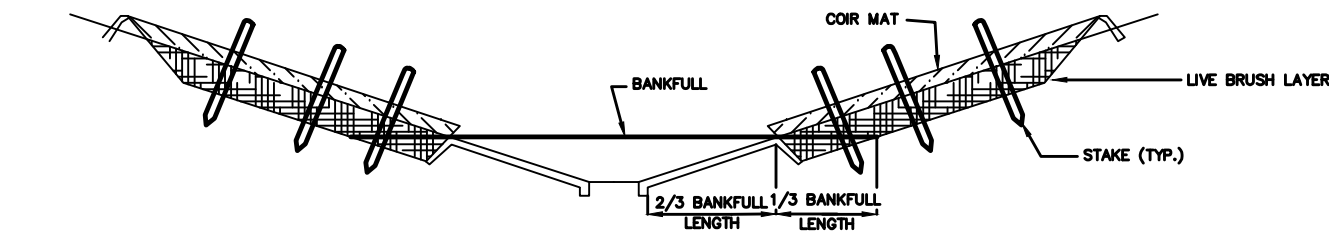
SEE VERTICAL ALIGNMENT TABLES FOR CONSTRUCTED RIFFLE LENGTHS, SLOPES, ELEVATIONS AND COORDINATES

1 LOG VANE
SCALE: NOT TO SCALE

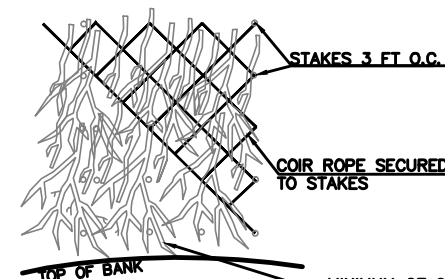
2 CONSTRUCTED RIFFLE
SCALE: NOT TO SCALE



- NOTES:
1. WRAP SOIL FOR LIFT IN DUAL LAYERS OF WOVEN C-700 FABRIC, SEED AND STRAW FACE & TOP OF LIFT.
 2. LIVE STAKE VERTICAL FACE & TOP OF LIFT 3' SPACING.
 3. PLACE FILTER FABRIC AND SOIL LEVELING COURSE ON TOP OF BRUSH LAYER.

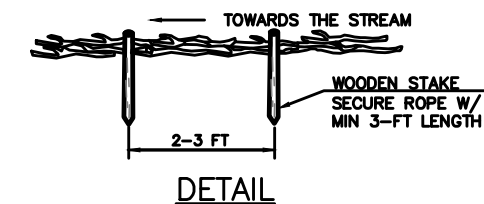


- BRUSH MATTRESS:
1. BEGIN BRUSH MATTRESS IN UPPER 1/3 OF BANKFULL CHANNEL BOTH SIDES OF THE STREAM.
 2. BACKFILL 3" OF ONSITE ALLUVIUM OVER BRUSH LAYER.
 3. COVER WITH EROSION CONTROL MAT.
 4. STAKE AND TIE DOWN WITH ROPE SECURED TO STAKES.



PLAN VIEW

CROSS SECTION VIEW



PRELIMINARY
NOT FOR CONSTRUCTION

- NOTES:
1. BRUSH MATTRESS SHOULD BE INSTALLED DURING VEGETATION DORMANCY.
 2. ONLY USE SPECIES SPECIFIED UNDER LIVE STAKES SECTION OF VEGETATION SELECTION.

3 BRUSH TOE DETAIL
SCALE: NOT TO SCALE

4 BRUSH MATTRESS
SCALE: NOT TO SCALE

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601 EAST
DETAILS
UNION COUNTY, NORTH CAROLINA

DATE: 5 SEPT 2013

REVISIONS:

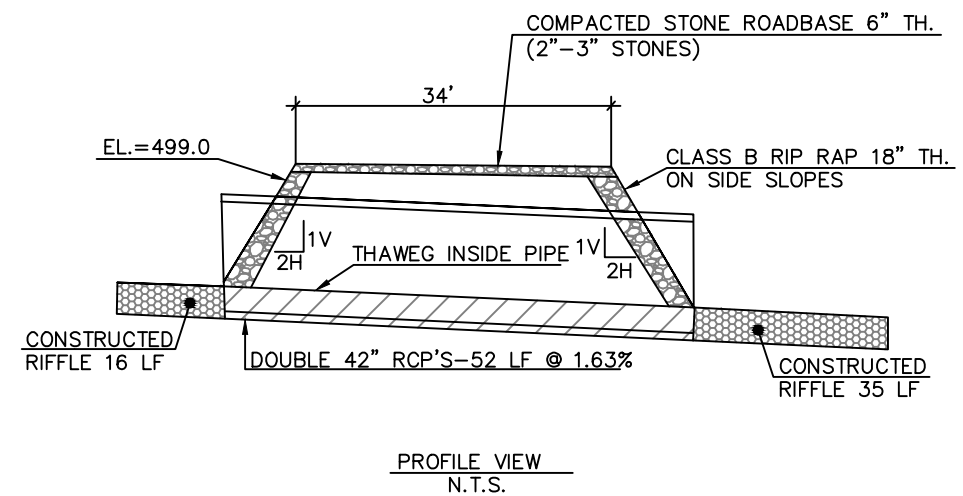
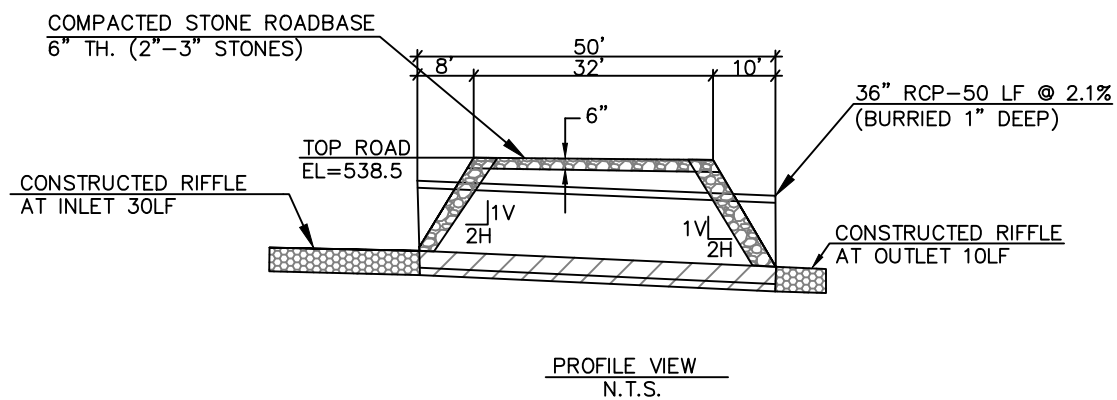
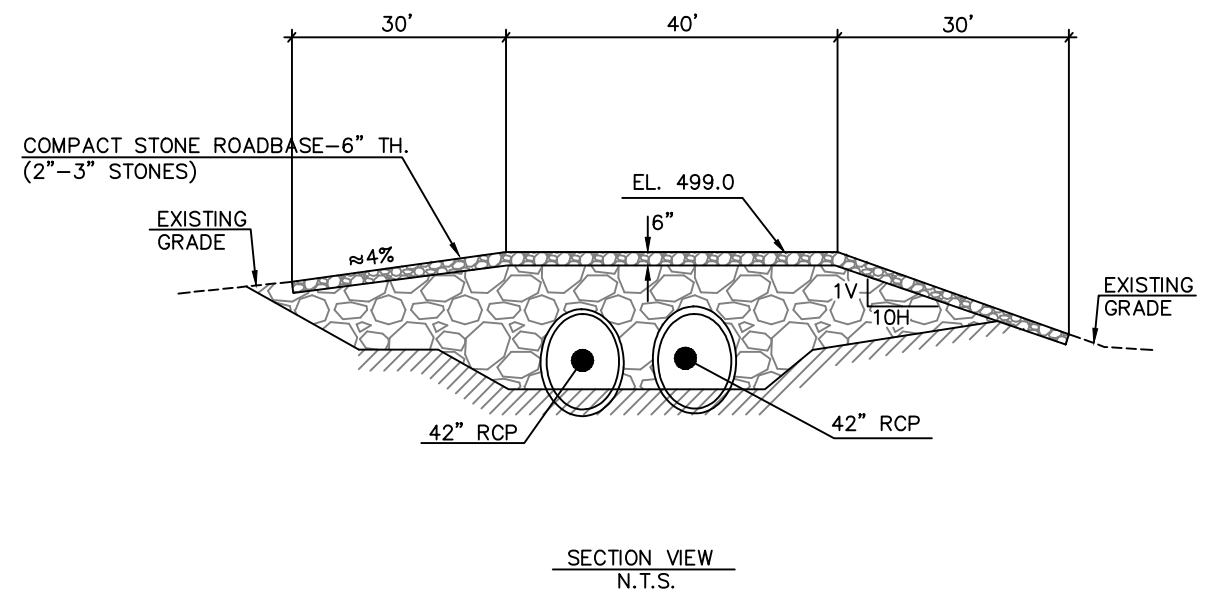
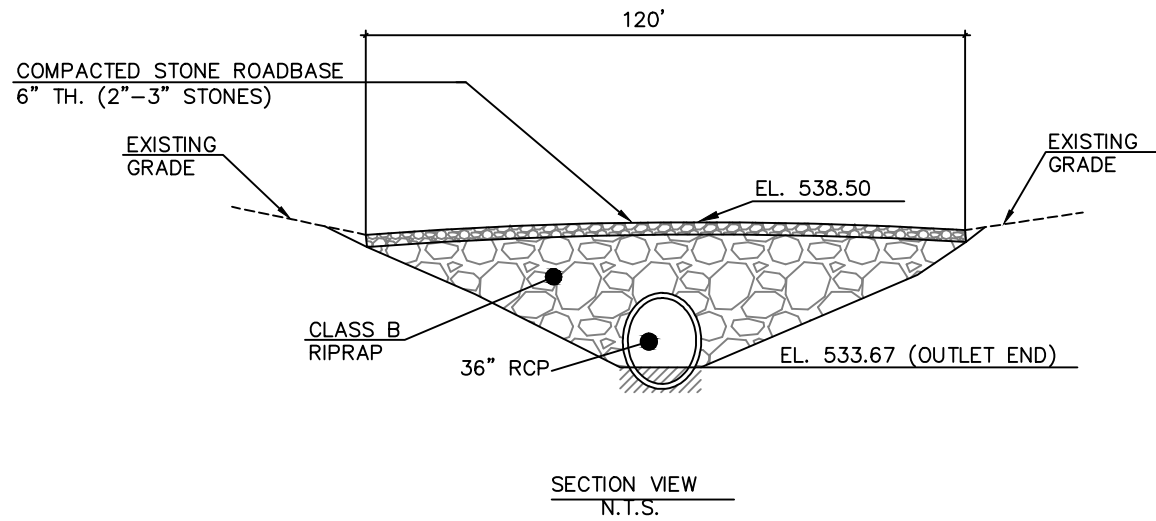
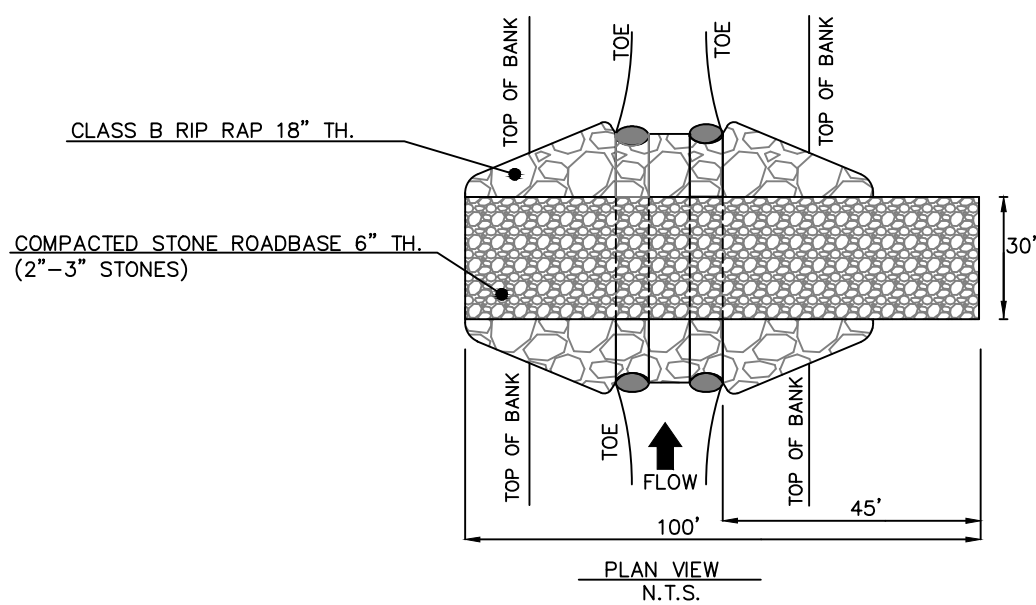
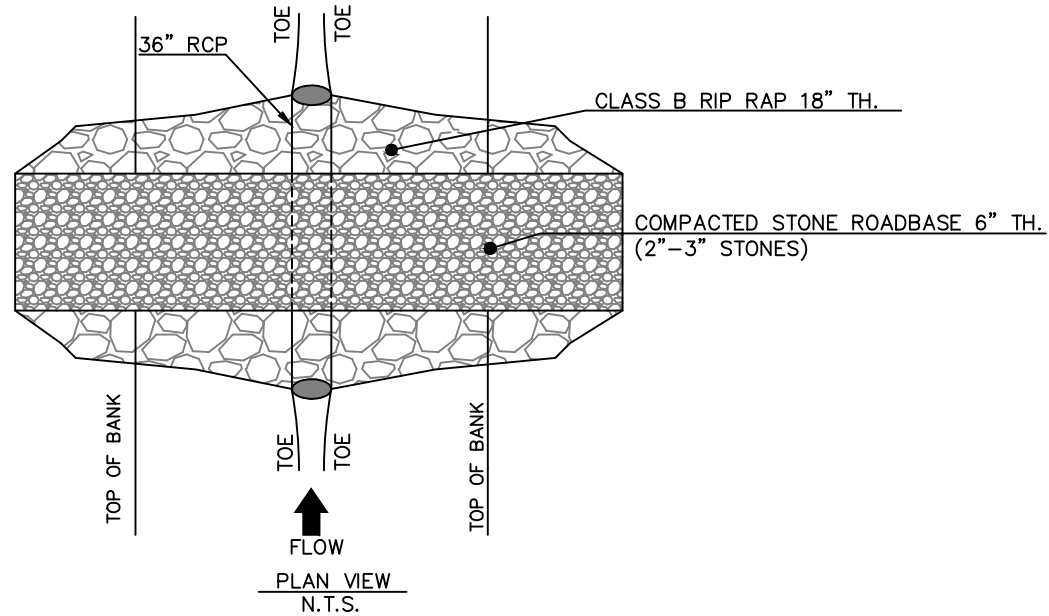
PROJECT NAME:
601 East

DWG NAME:
Details

SCALE:
NTS

MITIGATION
PLAN SET

SHEET NO.



NOTES:

1. CONSTRUCT TEMPORARY DIVERSION OR SET-UP PUMP AROUND PER THE DETAIL
2. BEGIN EXCAVATION OF THE CHANNEL TO INSTALL THE CULVERT PER THE PLAN SHEETS. INSTALL THE CENTER OR BASEFLOW CULVERT(S).
3. PLACE AND COMPACT FILL FOR CROSSING TO THE CONTOUR ELEVATIONS SPECIFIED ON THE PLAN SHEETS.
4. PLACE AND COMPACT THE FILL AND GRADE THE UPSTREAM AND DOWNSTREAM FACE WITH 2:1 SLOPES.
5. PLACE A 18" THICK WELL GRADED MIX OF 5"-12" CLASS B RIP RAP ON THE UPSTREAM AND DOWNSTREAM FACES. PLACE A GRADATION OF 2" AND 3" STONE ON THE SURFACE OF THE CROSSING AND COMPACT TO FINAL GRADE.

1 FARM CROSSING DETAIL STA 13+75
SCALE: NOT TO SCALE

2 FARM CROSSING DETAIL STA 46+85
SCALE: NOT TO SCALE

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**601 EAST
DETAILS
UNION COUNTY, NORTH CAROLINA**

DATE: 5 SEPT 2013
REVISIONS:
PROJECT NAME:
601 East
DWG NAME:
Details
SCALE:
NTS
MITIGATION
PLAN SET
SHEET NO.

D2



DATE: 5 SEPT 2013

REVISIONS:

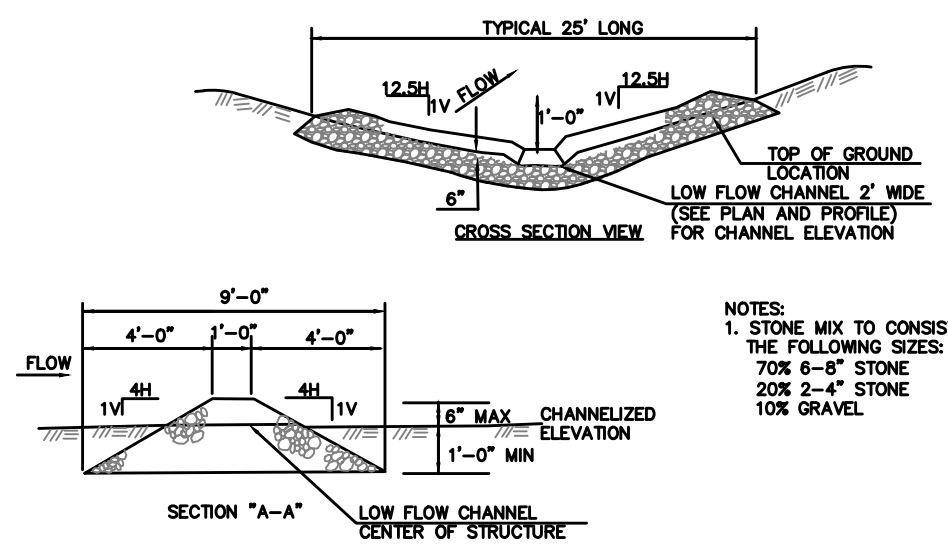
PROJECT NAME:
601 East

DWG NAME:

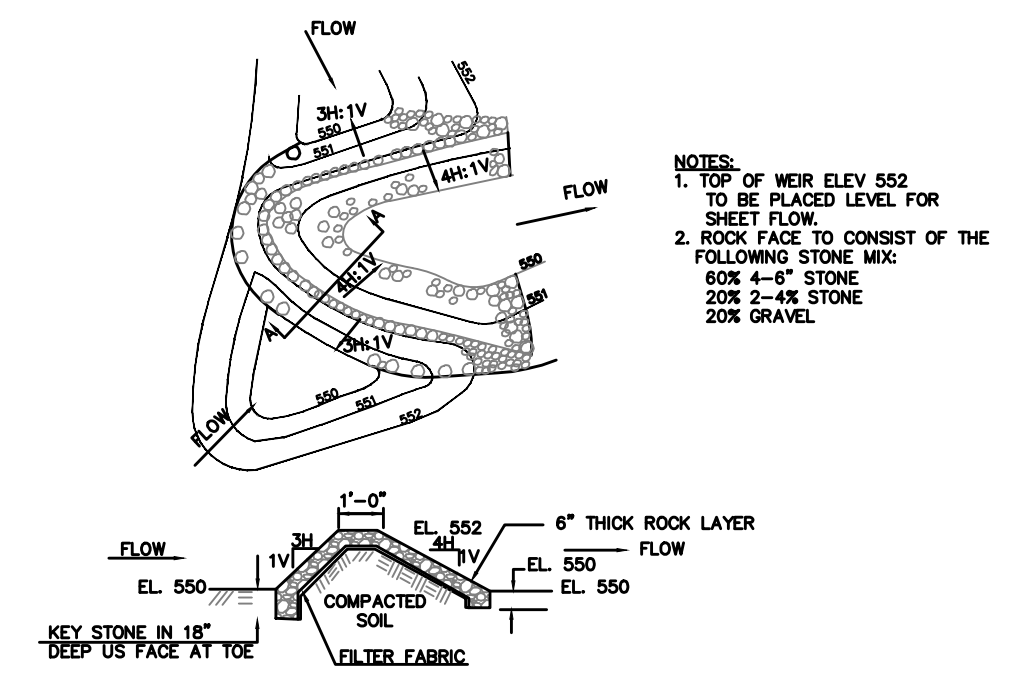
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MITIGATION
PLAN SET

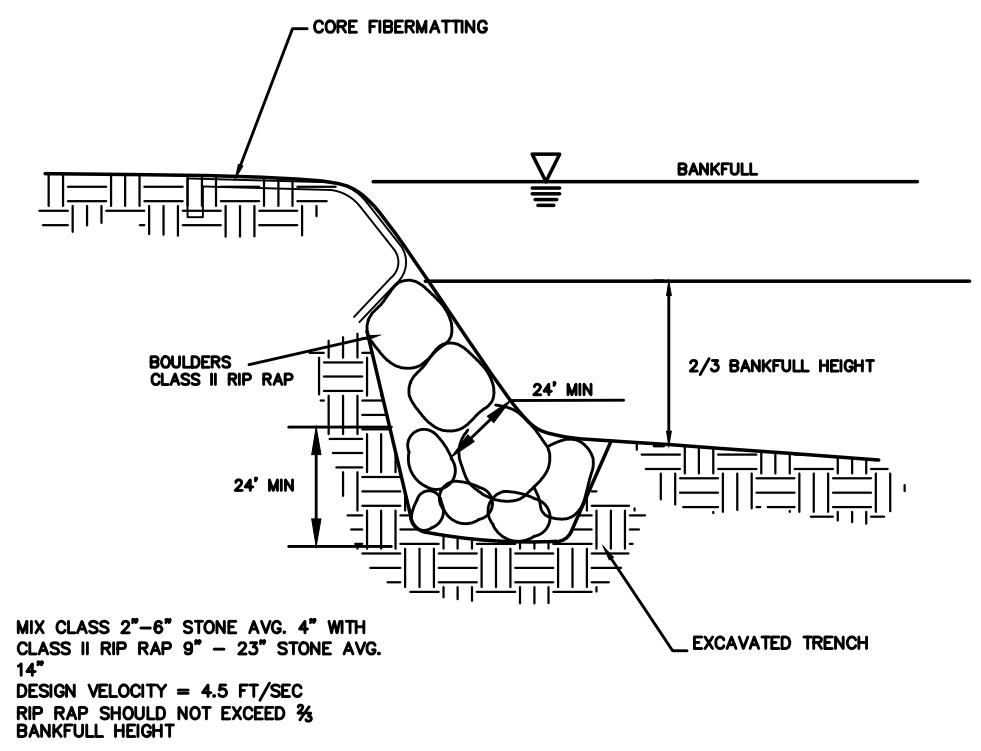
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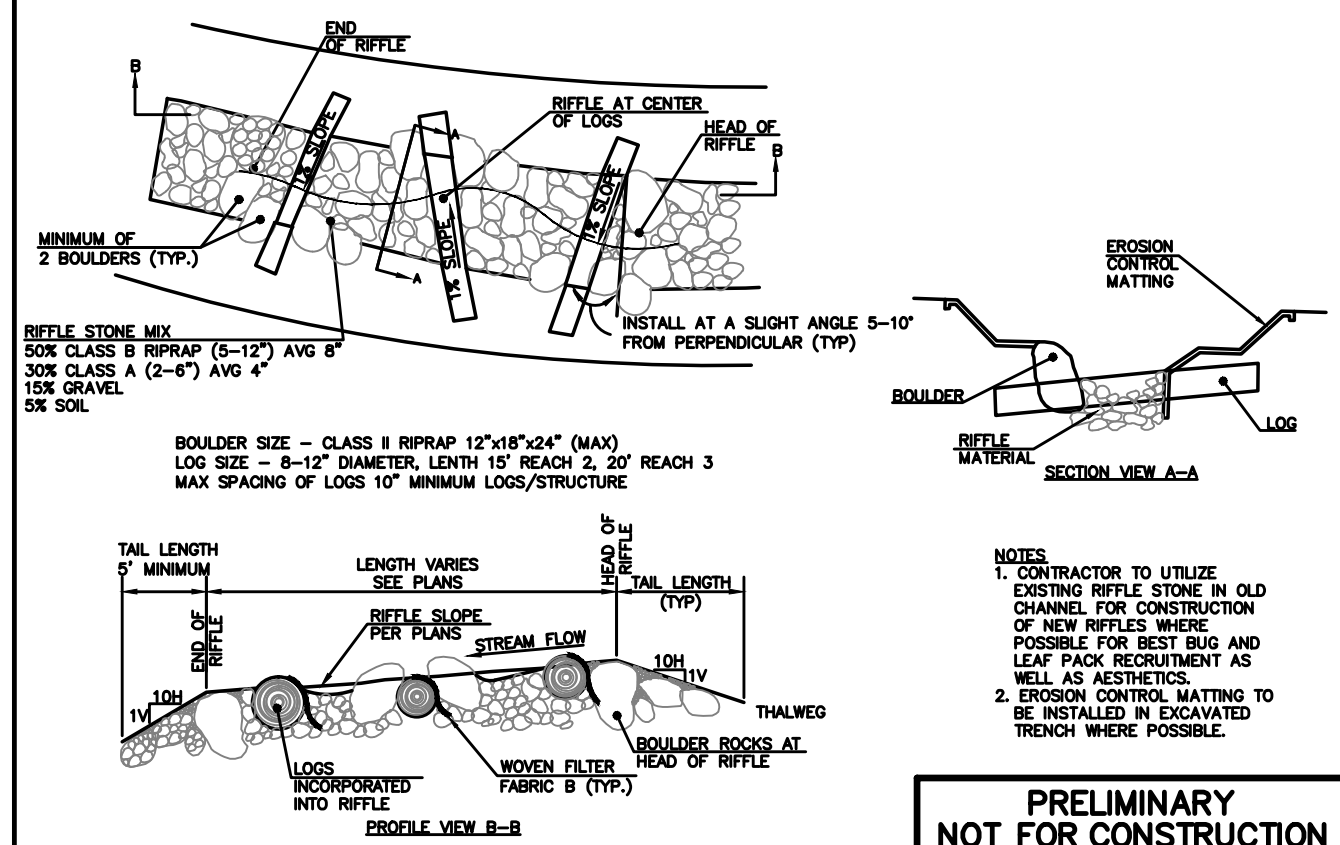
1 EPHEMERAL CHANNEL ROCK GRADE CONTROL (REACH A)
 SCALE: NOT TO SCALE



2 EPHEMERAL CHANNEL ROCK WEIR (REACH A)
 SCALE: NOT TO SCALE

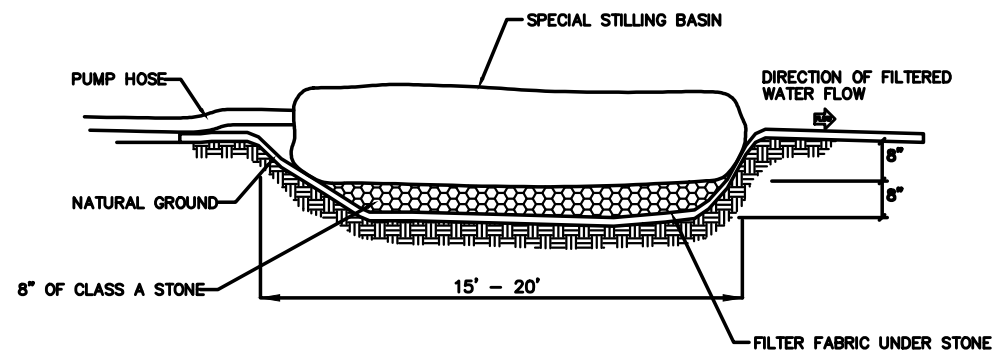


3 ROCK TOE STABILIZATION
 SCALE: NOT TO SCALE



4 STONE AND LOG CONSTRUCTED RIFFLE
 SCALE: NOT TO SCALE

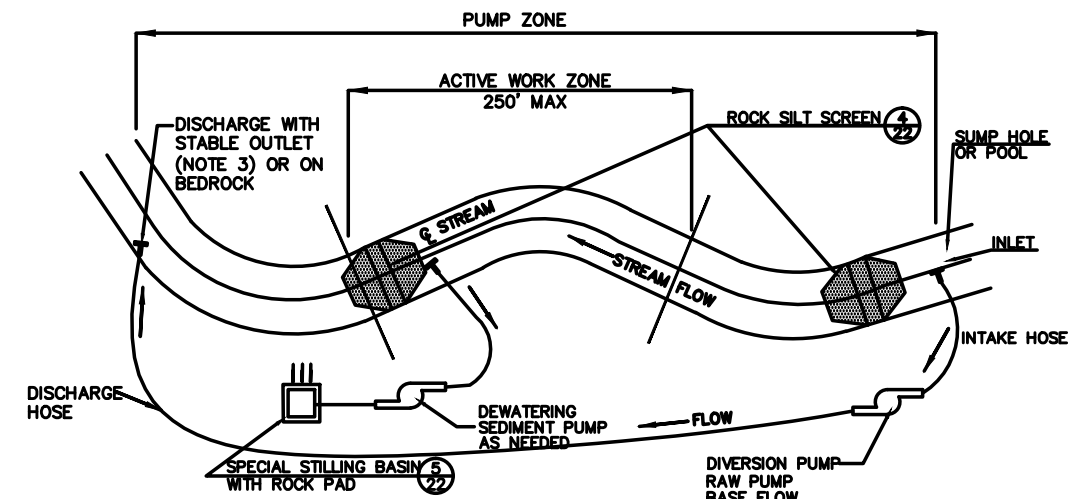
**PRELIMINARY
 NOT FOR CONSTRUCTION**



- NOTE: 1. SPECIAL STILLING BASIN LOCATION TO BE APPROVED BY THE ENGINEER PRIOR TO INSTALLATION.
 2. PROVIDE STABILIZED OUTLET TO DRAIN TOWARDS STREAM.
 3. THE SILT BAG SHOULD BE REPLACED AND DISPOSED OF WHEN IT IS 75% FULL OR WHEN IT IS IMPRACTICABLE TO MOVE OR OTHERWISE NOT FILTERING WATER AT A REASONABLE FLOW RATE.
 4. THE SILT BAG SHOULD BE REMOVED TO AN UPLAND AREA AND DISPOSED OF WITH OTHER WASTE MATERIAL IN AN AREA PROTECTED BY SEDIMENT AND EROSION CONTROL MEASURES. THE CONTENTS OF THE SILT BAG SHOULD BE DISPOSED OF IN THIS AREA AND THE BAG ITSELF TAKEN OFF-SITE FOR DISPOSAL.

1 SPECIAL STILLING BASIN WITH ROCK PAD

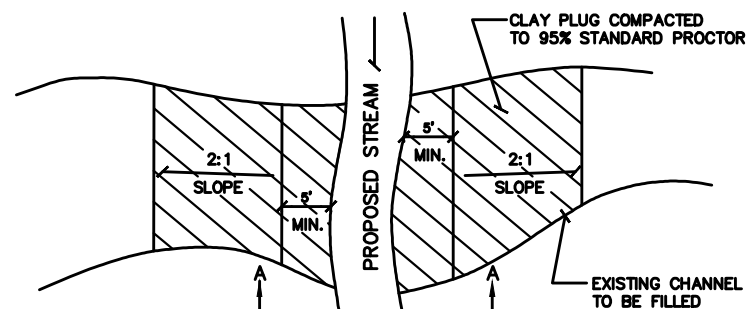
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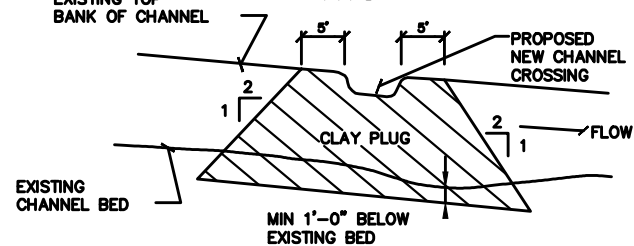
- NOTE: 1. WORK AREA TO BE STABILIZED AT THE END OF EACH WORK DAY.
 2. ROCK SILT SCREENS REQUIRED FOR PUMP AROUND OPERATIONS ARE CONSIDERED INCIDENTAL TO PUMPING.
 3. STABLE OUTLET TO CONSIST OF ROCK PLACED IN CHANNEL FOR ENERGY DISSIPATION AND 45° ELBOW INSTALLATION AT THE END OF THE PIPING SO THAT THE WATER DISCHARGES VERTICALLY UP IN THE AIR. THE OUTLET WILL BE APPROVED BY THE DESIGNER PRIOR TO PUMPING.

2 TYPICAL PUMP AROUND OPERATION

SCALE: NOT TO SCALE



PLAN VIEW
NTS



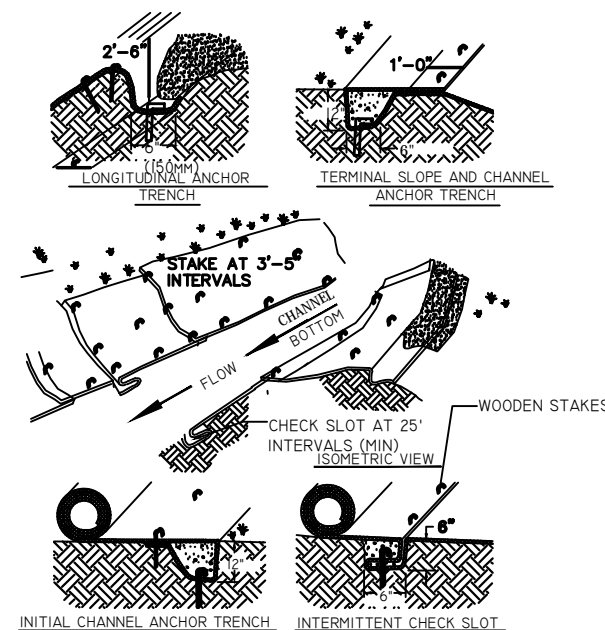
SECTION VIEW A-A
NTS

CLAY PLUG DETAIL
(FOR STREAM CROSSING OVER AN EXISTING CHANNEL AT A HIGHER ELEVATION)

- NOTE:
 USE MINIMUM TOP WIDTH OF 10' WHERE CHANNEL IS TO THE SIDE OF THE CLAY PLUG AS SHOWN ON PLANS.

3 CLAY PLUG

SCALE: NOT TO SCALE



NOTES:

- CHECK SLOTS TO BE CONSTRUCTED AT 25' INTERVALS.
- ALL MATTING TO BE SECURED WITH WOODEN STAKES ACCORDING TO THE SPECIFICATIONS AT 5' INTERVALS.
- FABRIC OVERLAP WHEN 2 ROWS OF MATERIAL ARE USED SHALL BE PLACED WITH THE UPPER ROW OF MATERIAL PLACED OVER THE LOWER ROW OF MATERIAL.
- TRENCH MATTING AT TOP AND BOTTOM OF MAT AS SHOWN IN DETAIL.
- OVERLAP FABRIC IN DIRECTION OF FLOW WITH MATTING UPSTREAM ON TOP OF DOWNSTREAM MAT.
- MATTING WILL BE INSTALLED ACCORDING TO THE SPECIFICATIONS.

4 COIR MATS-CHANNEL INSTALLATION

SCALE: NOT TO SCALE

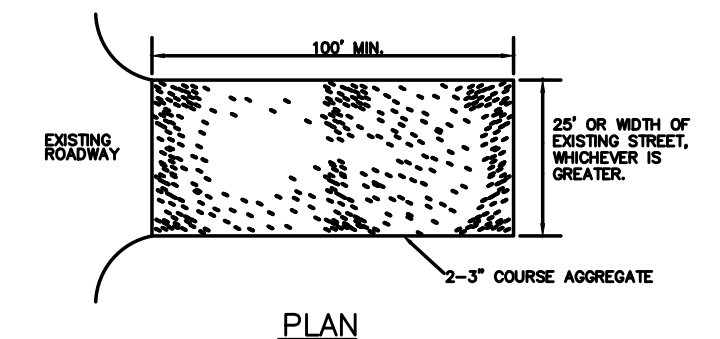
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 Fax: (919) 229-9913

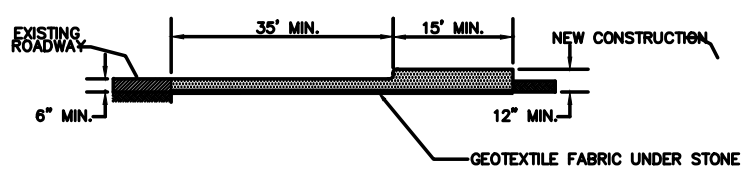


601 EAST
 DETAILS
 UNION COUNTY, NORTH CAROLINA

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Details
SCALE:	NTS
	MITIGATION PLAN SET
SHEET NO.	



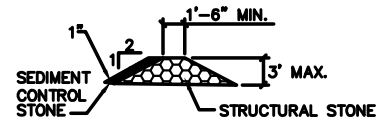
- NOTES:
1. GEOTEXTILE FABRIC TO BE ADDED UNDER THE STONE AS SHOWN.
 2. PLACE STONE OVER A STABLE FOUNDATION AT LOCATIONS SHOWN ON THE PLANS.
 3. INSTALL PIPE UNDER PAD IF NEEDED TO MAINTAIN PROPER PUBLIC ROAD DRAINAGE.



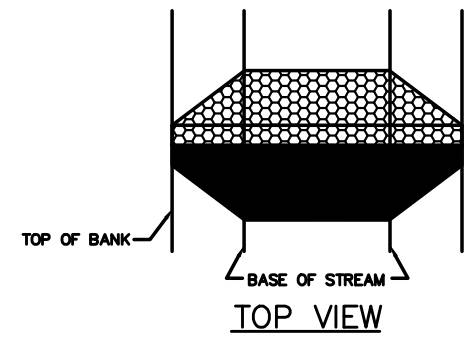
CROSS SECTION

1 CONSTRUCTION ENTRANCE
SCALE: NOT TO SCALE

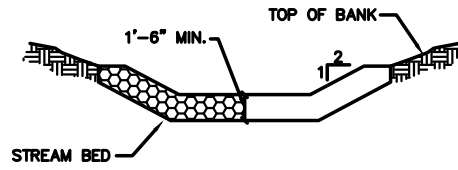
- NOTES:
- USE CLASS B STONE FOR STRUCTURAL STONE AND PAY FOR AT THE CONTRACT UNIT PRICE PER TON STONE FOR EROSION CONTROL. CLASS B. USE NO. 5 OR NO. 57 STONE FOR SEDIMENT CONTROL AND PAY FOR AT THE CONTRACT UNIT PRICE PER TON SEDIMENT CONTROL STONE. CONSTRUCT DAM A MAXIMUM OF 1 FOOT ABOVE NORMAL FLOW DEPTH.



CROSS SECTION



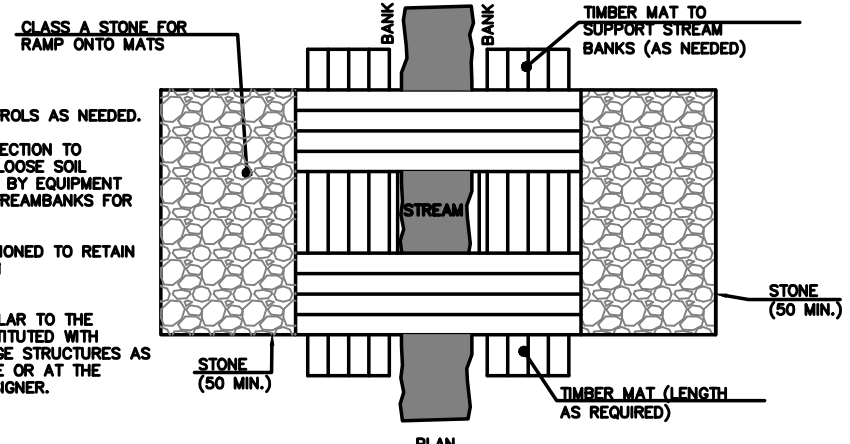
TOP VIEW



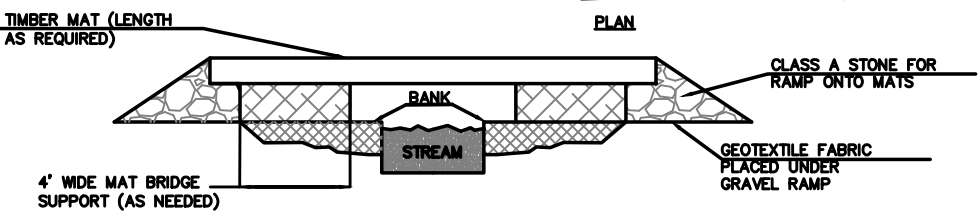
FRONT VIEW

2 ROCK SILT SCREEN
SCALE: NOT TO SCALE

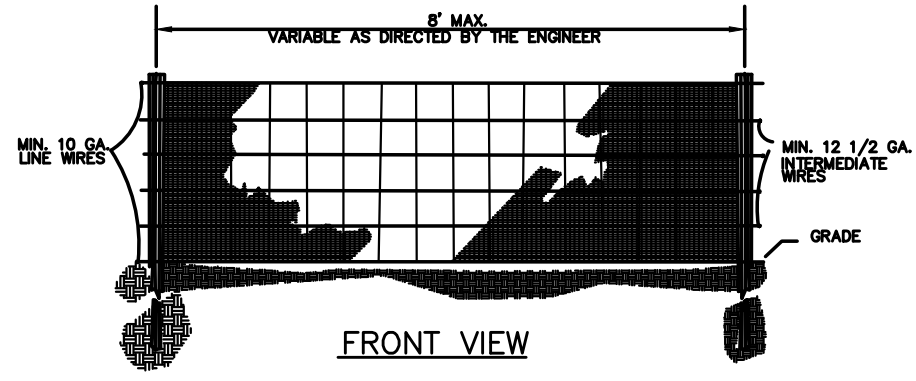
- NOTES:
1. DEPLOY EROSION CONTROLS AS NEEDED.
 2. PERFORM ROUTINE INSPECTION TO INCLUDE REMOVAL OF LOOSE SOIL TRACKED ONTO BRIDGE BY EQUIPMENT AND INSPECTION OF STREAMBANKS FOR STABILITY.
 3. MATS SHALL BE POSITIONED TO RETAIN THE NATURAL STREAM CHARACTERISTICS.
 4. MATS LAID PERPENDICULAR TO THE STREAM CAN BE SUBSTITUTED WITH PRE-FABRICATED BRIDGE STRUCTURES AS SPAN LENGTHS DICTATE OR AT THE APPROVAL OF THE DESIGNER.



PLAN

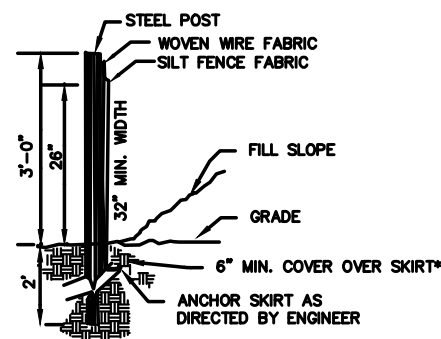


3 BRIDGE MAT DETAIL
SCALE: NOT TO SCALE



FRONT VIEW

- NOTES:
- USE SILT FENCE ONLY WHEN DRAINAGE AREA DOES NOT EXCEED 1/4 ACRE AND NEVER IN AREAS OF CONCENTRATED FLOW
 - * FOR REPAIR OF SILT FENCE FAILURES, USE NO. 57 WASHED STONE



SIDE VIEW

4 STANDARD TEMPORARY SILT FENCE
SCALE: NOT TO SCALE

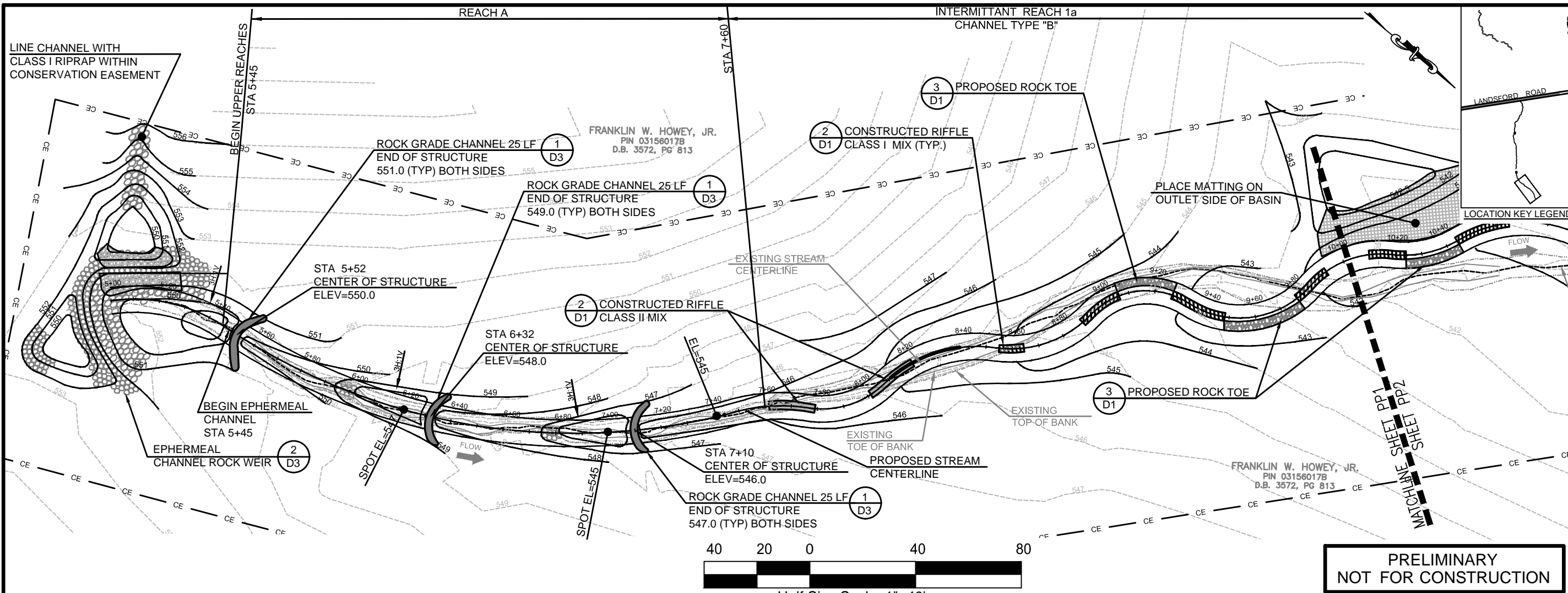
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Fax: (919) 229-9913

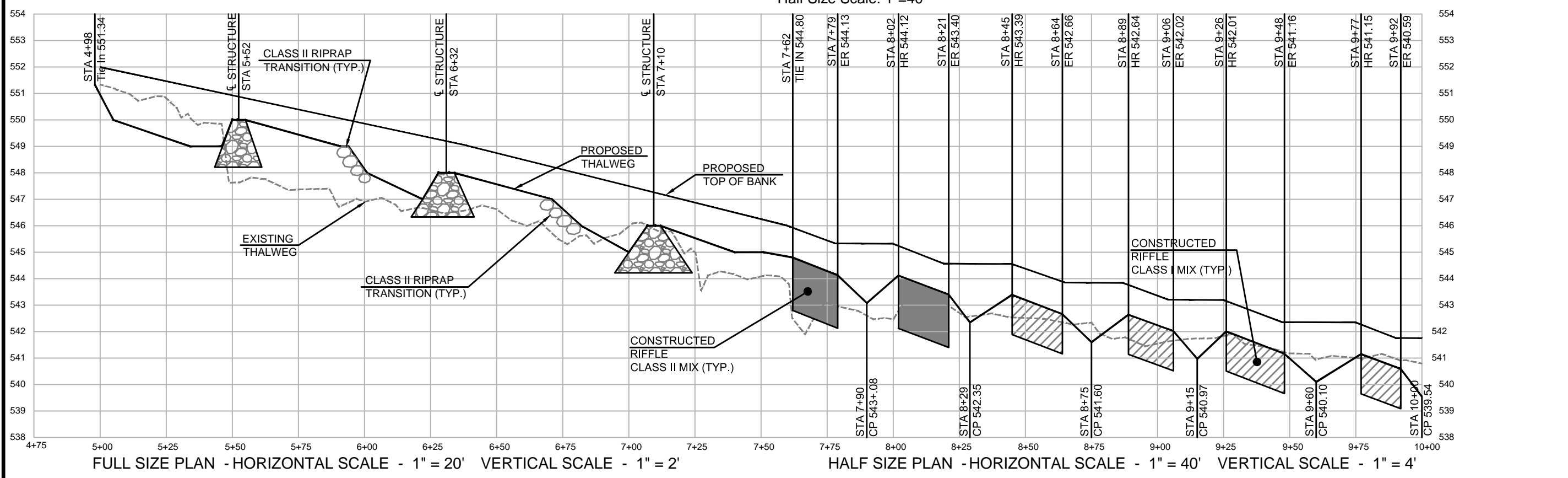


**601 EAST
DETAILS
UNION COUNTY, NORTH CAROLINA**

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Planting Details
SCALE:	NTS
	MITIGATION PLAN SET
SHEET NO.	



**PRELIMINARY
NOT FOR CONSTRUCTION**



FULL SIZE PLAN - HORIZONTAL SCALE - 1" = 20' VERTICAL SCALE - 1" = 2'

HALF SIZE PLAN - HORIZONTAL SCALE - 1" = 40' VERTICAL SCALE - 1" = 4'

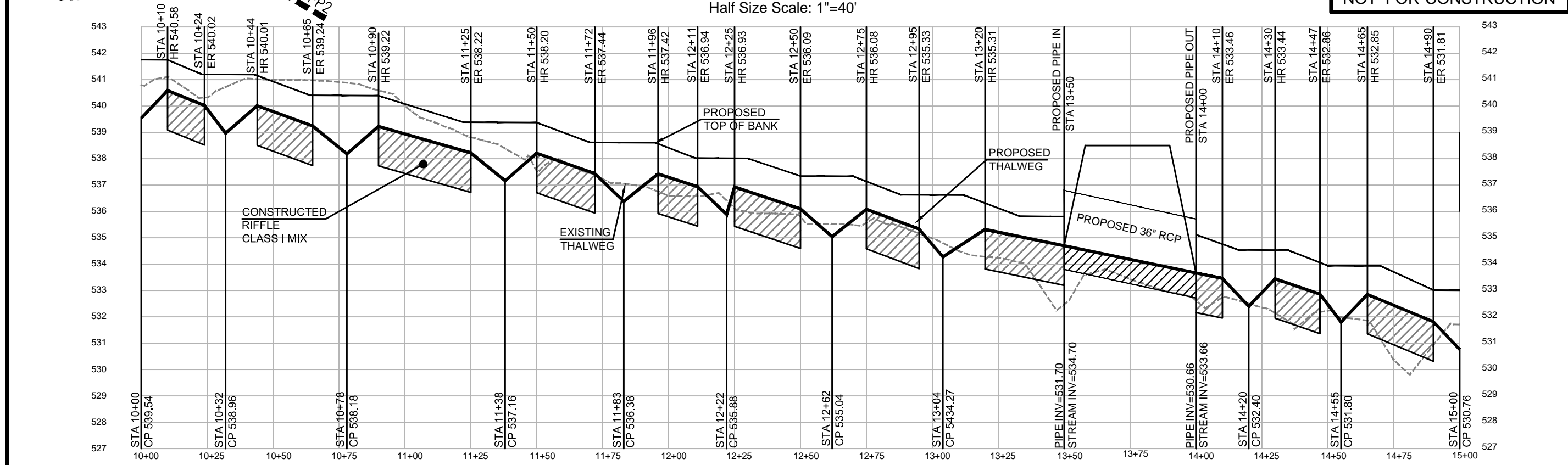
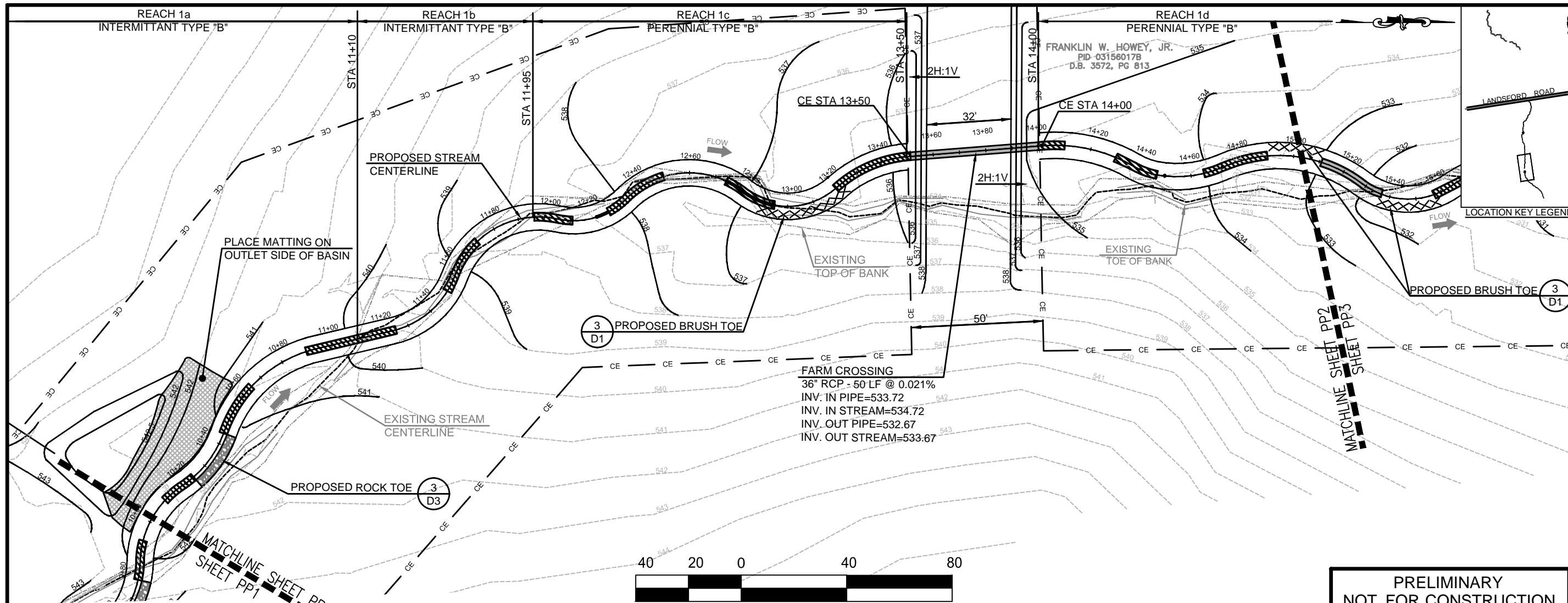
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601 EAST
PLAN AND PROFILE
STATION 5+00 TO 10+00
UNION COUNTY, NORTH CAROLINA

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Construction Plan and Profile
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.	



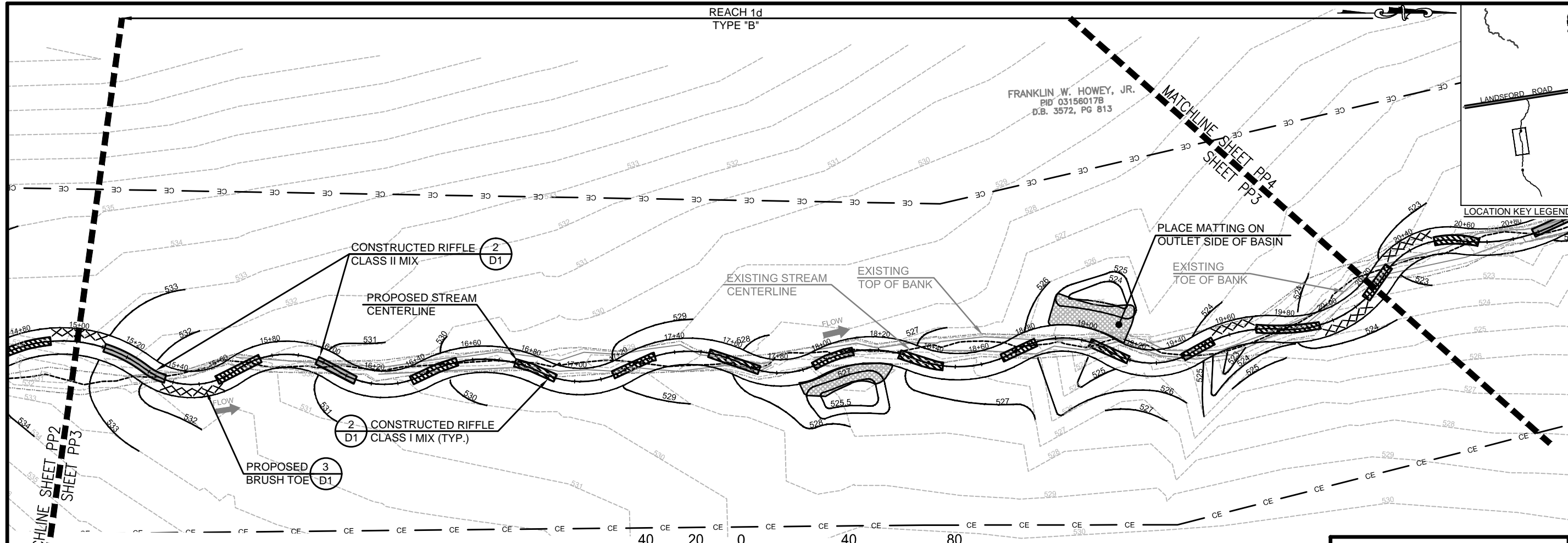
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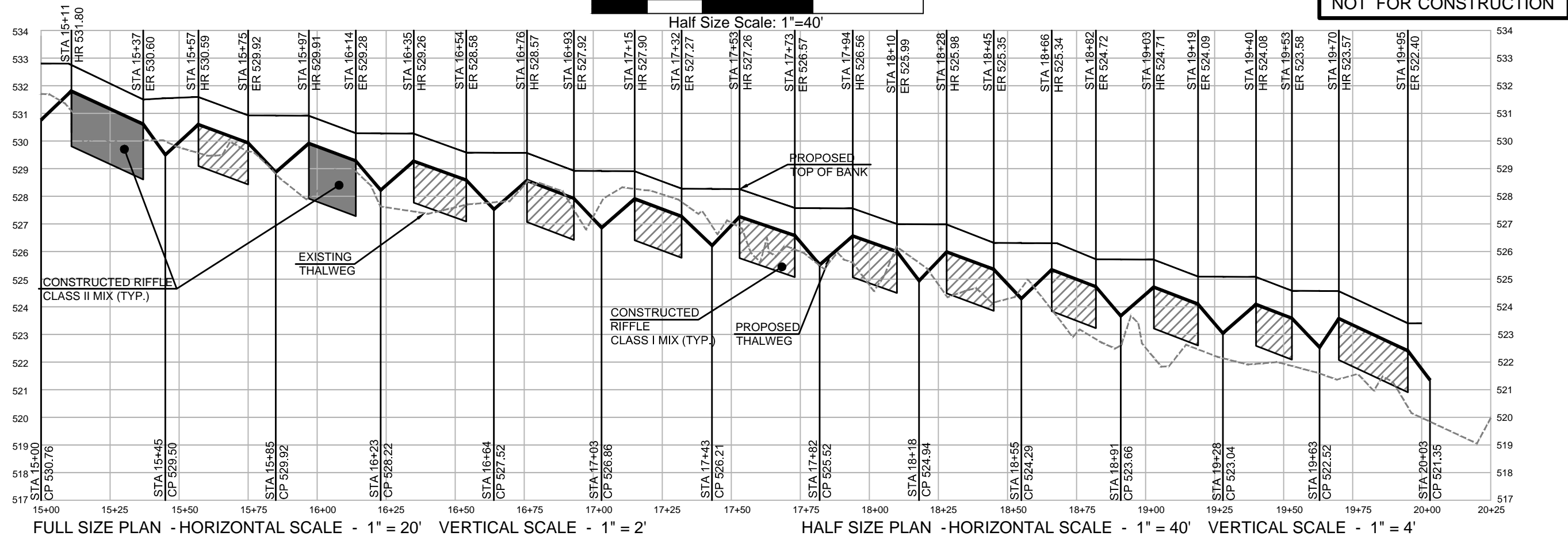


**601 EAST
 PLAN AND PROFILE
 STATION 10+00 TO 15+00
 UNION COUNTY, NORTH CAROLINA**

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Construction Plan and Profile
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.	PP2



**PRELIMINARY
NOT FOR CONSTRUCTION**



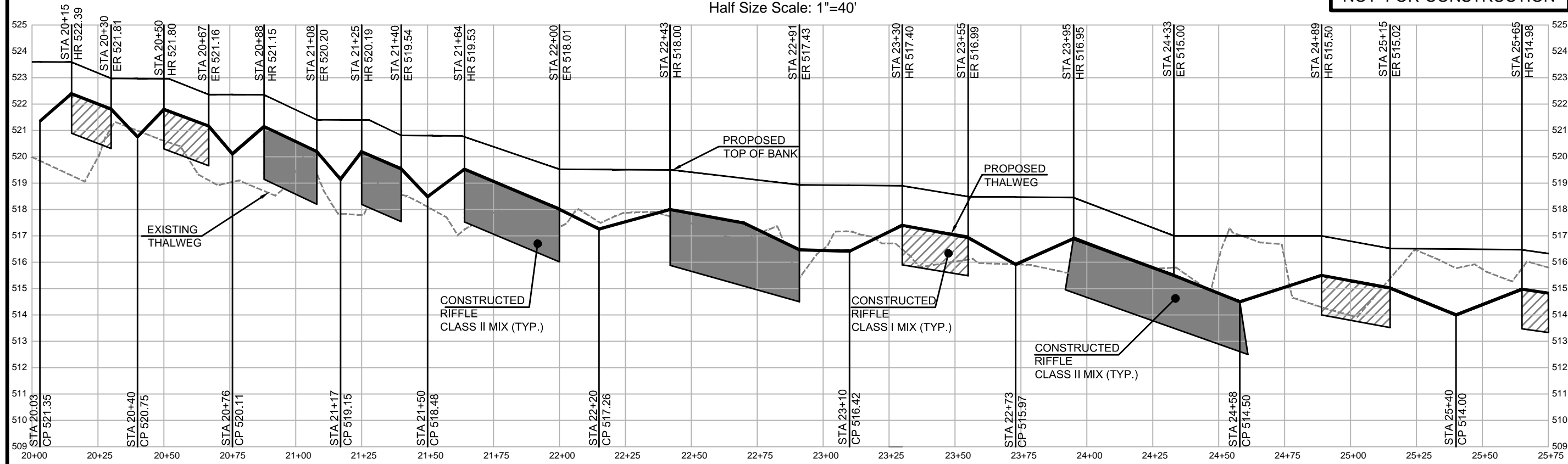
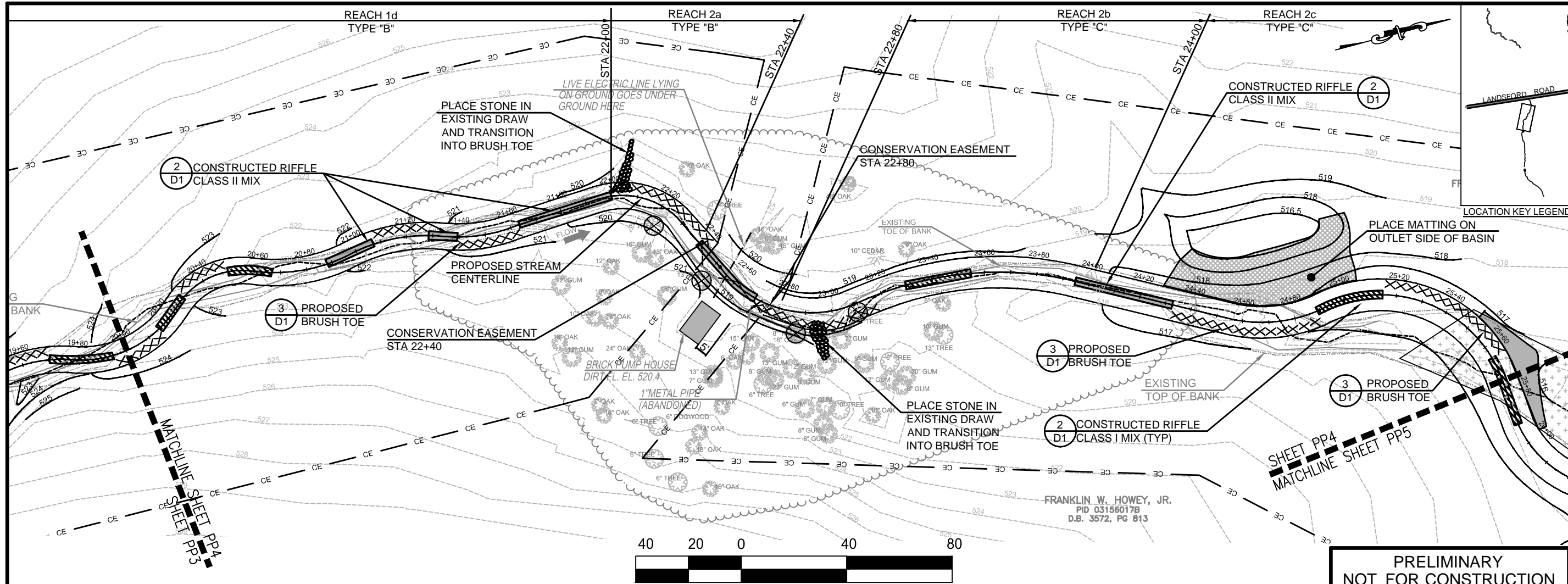
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601 EAST
PLAN AND PROFILE
STATION 15+00 TO 20+00
UNION COUNTY, NORTH CAROLINA

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Construction Plan and Profile
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.	PP3



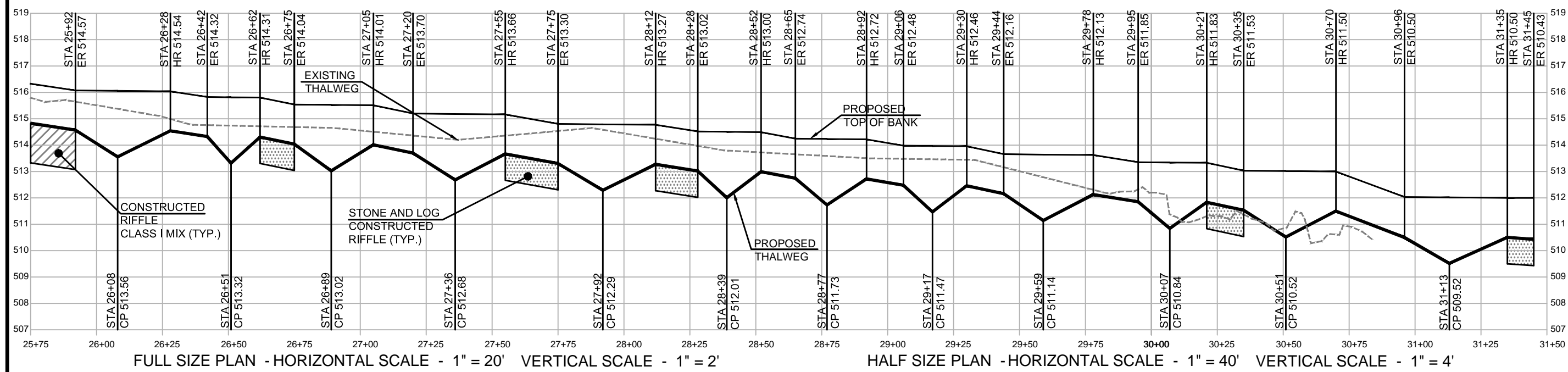
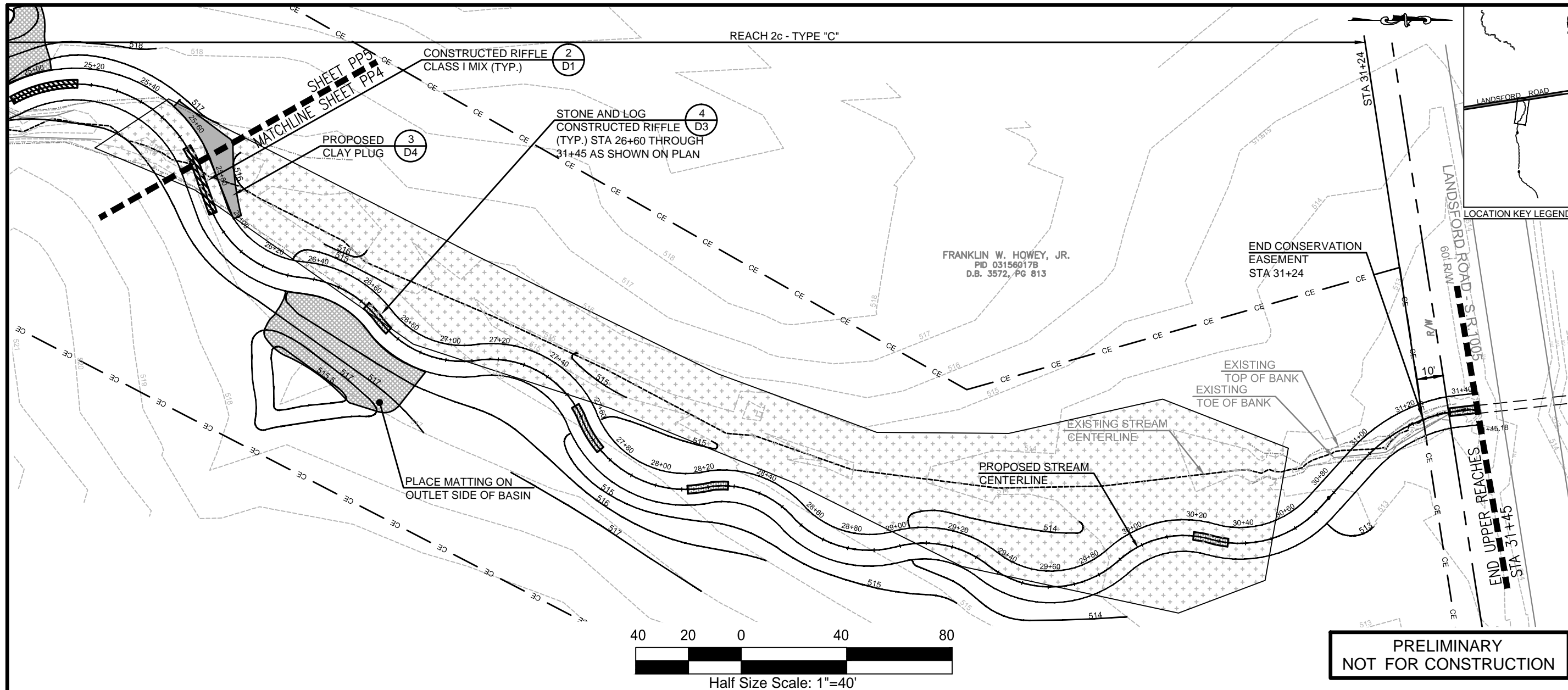
FULL SIZE PLAN - HORIZONTAL SCALE - 1" = 20' VERTICAL SCALE - 1" = 2'
 HALF SIZE PLAN - HORIZONTAL SCALE - 1" = 40' VERTICAL SCALE - 1" = 4'

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601 EAST
PLAN AND PROFILE
STATION 20+00 TO 25+75
UNION COUNTY, NORTH CAROLINA

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Construction Plan and Profile
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.	



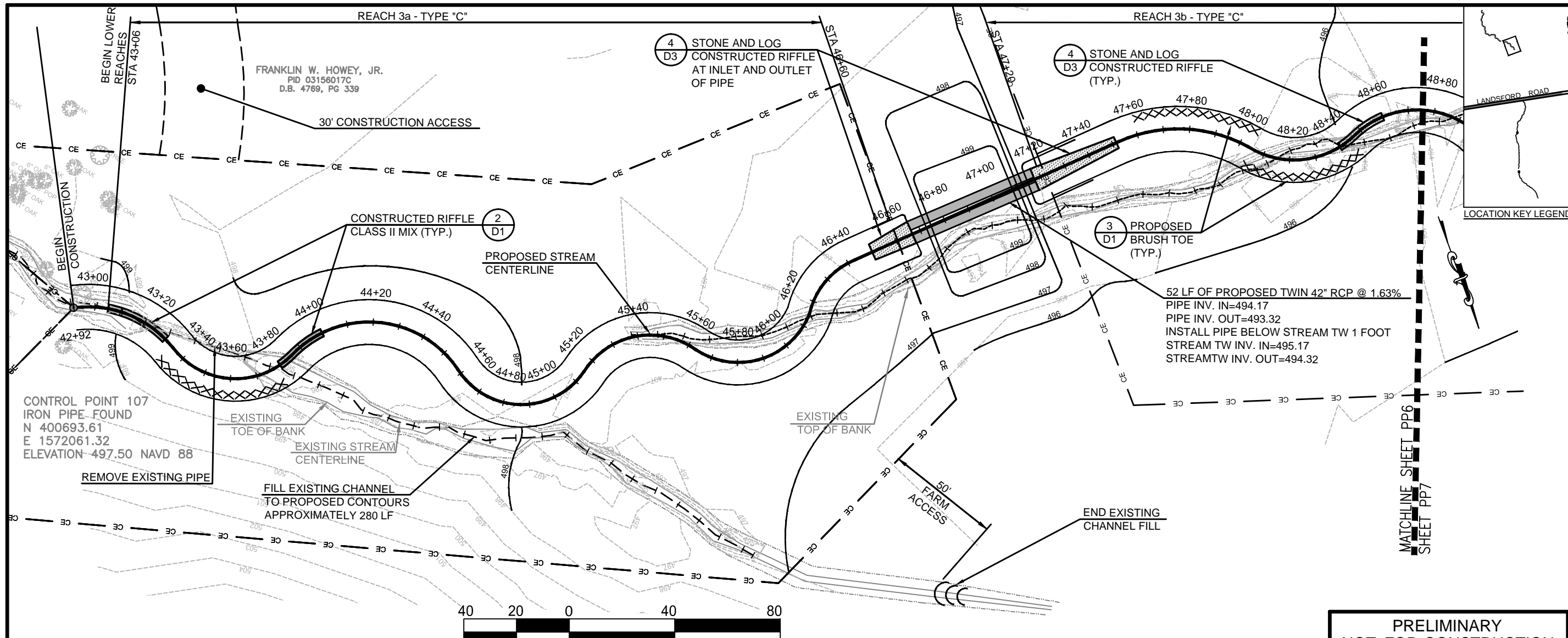
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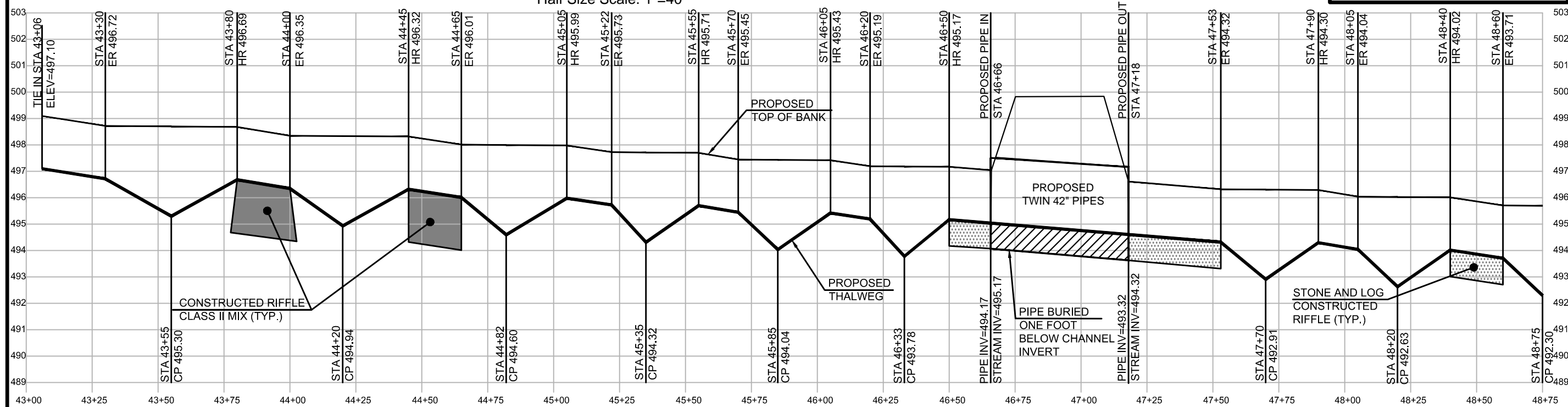


601 EAST
 PLAN AND PROFILE
 STATION 25+75 TO 31+45.18
 UNION COUNTY, NORTH CAROLINA

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Construction Plan and Profile
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.	PP5



**PRELIMINARY
NOT FOR CONSTRUCTION**



FULL SIZE PLAN - HORIZONTAL SCALE - 1" = 20' VERTICAL SCALE - 1" = 2'

HALF SIZE PLAN - HORIZONTAL SCALE - 1" = 40' VERTICAL SCALE - 1" = 4'

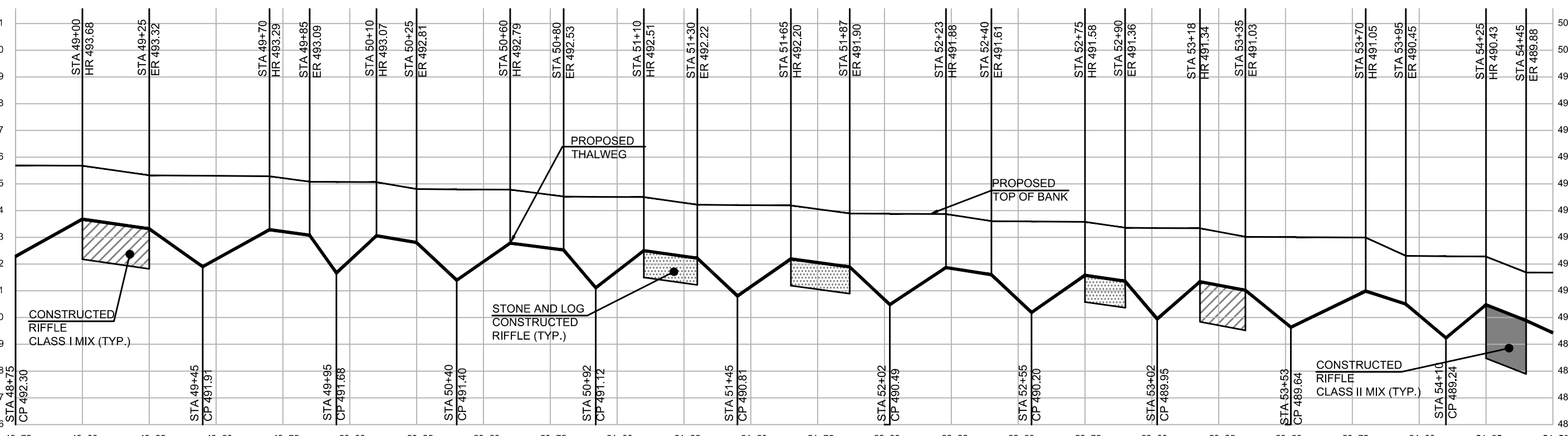
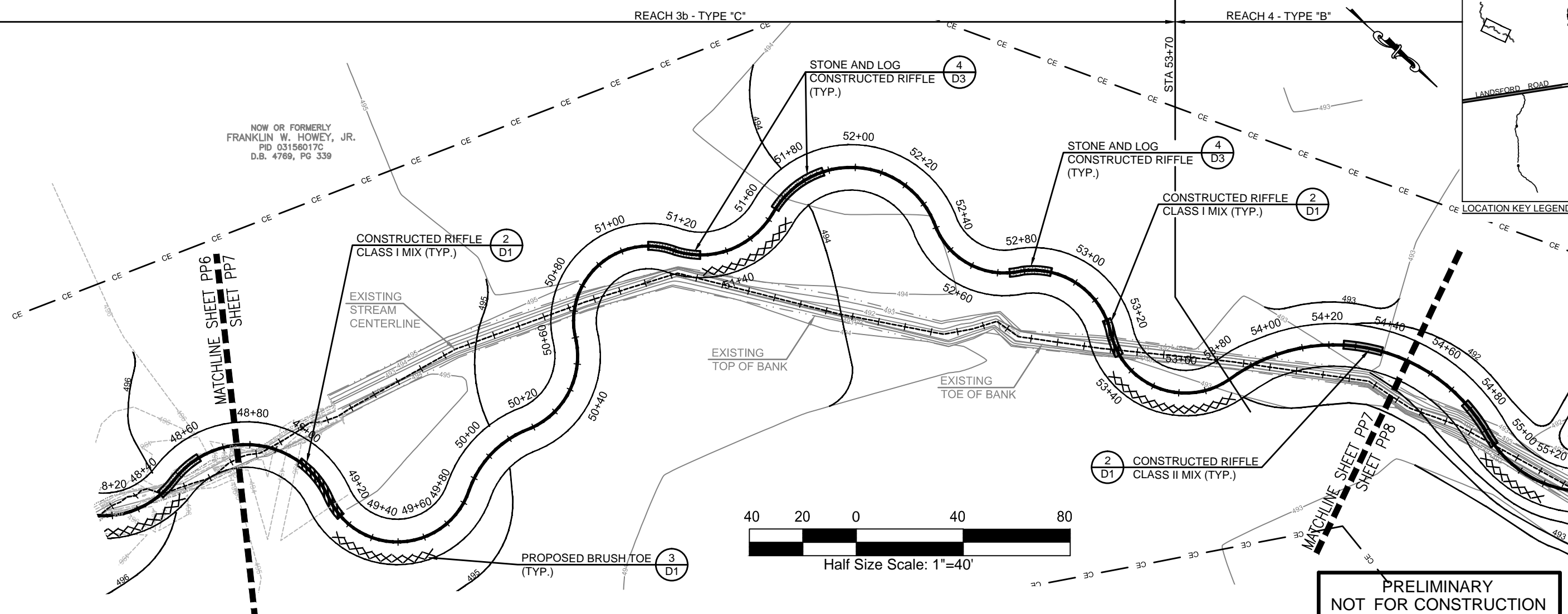
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**601 EAST
PLAN AND PROFILE
STATION 42+92 TO 48+75
UNION COUNTY, NORTH CAROLINA**

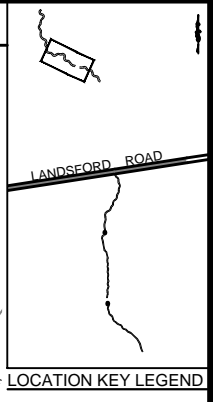
DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Construction Plan and Profile
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.	PP6



FULL SIZE PLAN - HORIZONTAL SCALE - 1" = 20' VERTICAL SCALE - 1" = 2'

HALF SIZE PLAN - HORIZONTAL SCALE - 1" = 40' VERTICAL SCALE - 1" = 4'

NOW OR FORMERLY
FRANKLIN W. HOWEY, JR.
PID 03156017C
D.B. 4769, PG 339



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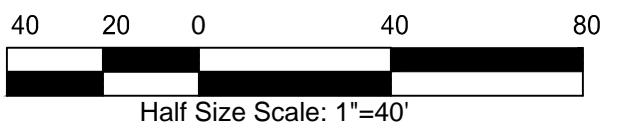
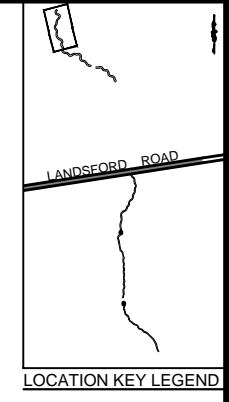
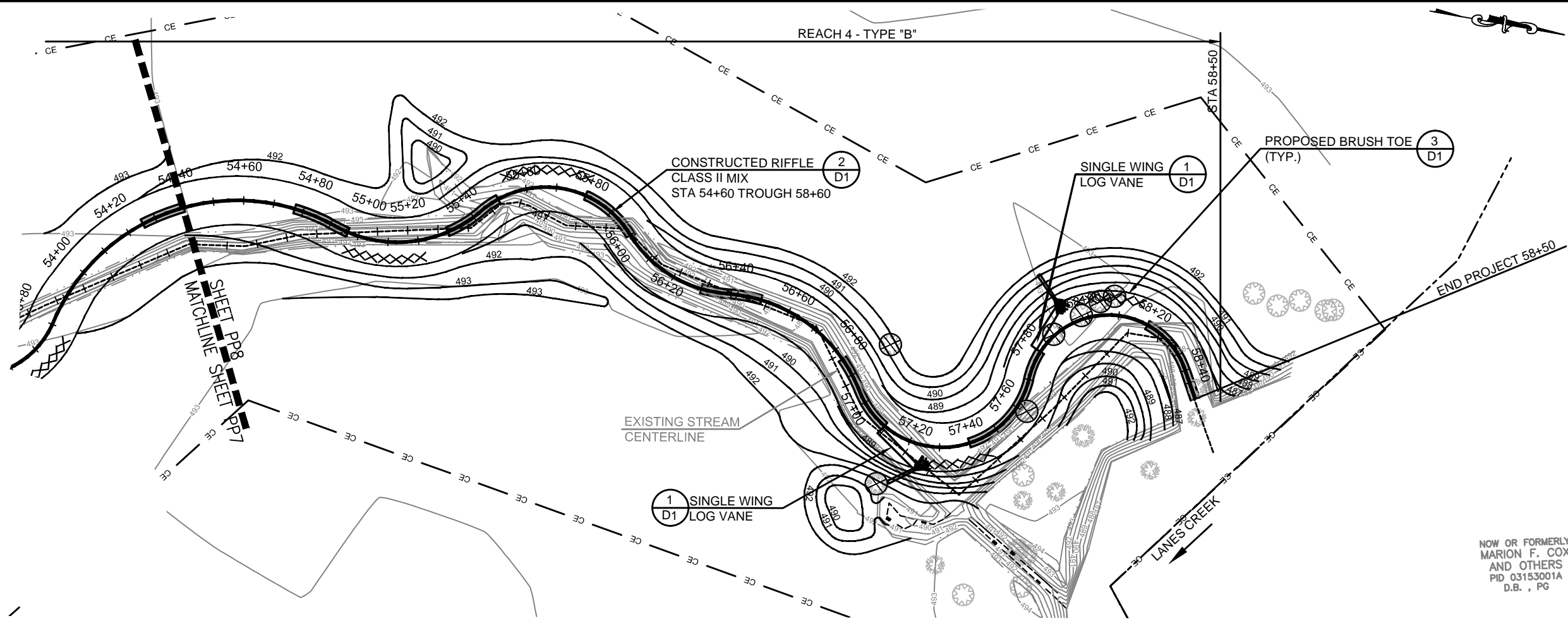
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**601 EAST
PLAN AND PROFILE (RELIC CHANNEL)
STATION 48+75 TO 54+50
UNION COUNTY, NORTH CAROLINA**

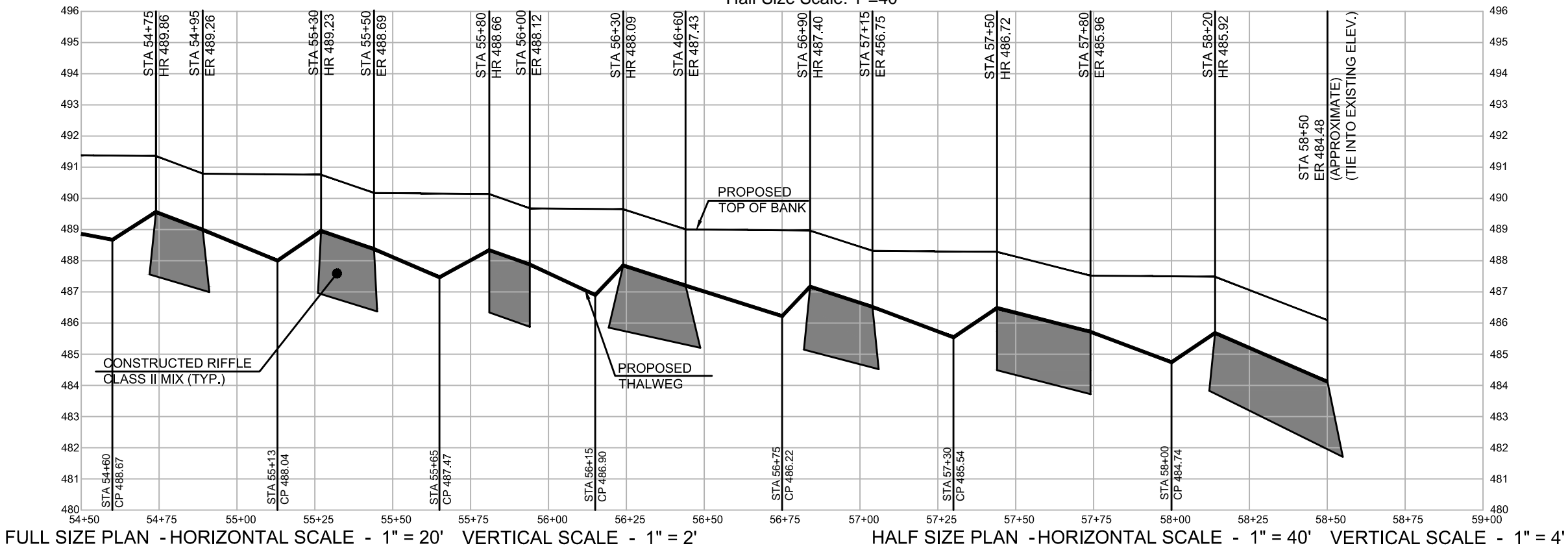
DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Construction Plan & Profile(Relic Channel)
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.	PP7

**PRELIMINARY
NOT FOR CONSTRUCTION**



**PRELIMINARY
NOT FOR CONSTRUCTION**

NOW OR FORMERLY
MARION F. COX
AND OTHERS
PID 03153001A
D.B., PG



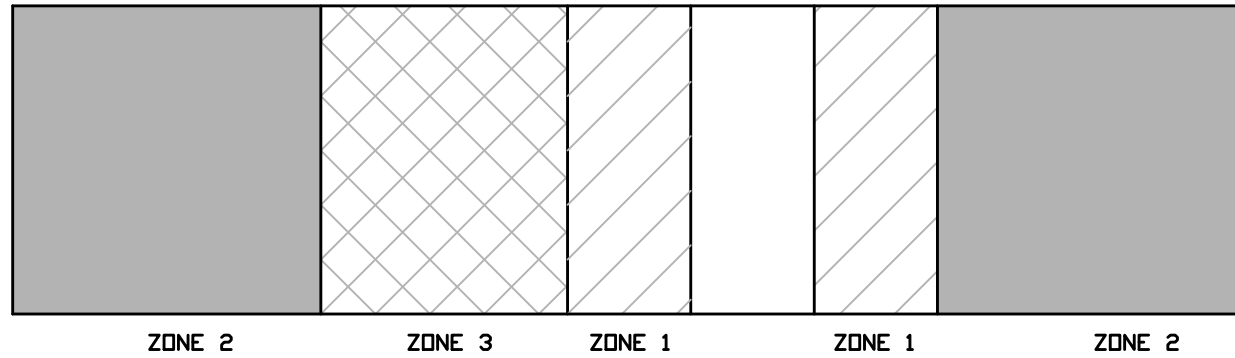
FULL SIZE PLAN - HORIZONTAL SCALE - 1" = 20' VERTICAL SCALE - 1" = 2' HALF SIZE PLAN - HORIZONTAL SCALE - 1" = 40' VERTICAL SCALE - 1" = 4'

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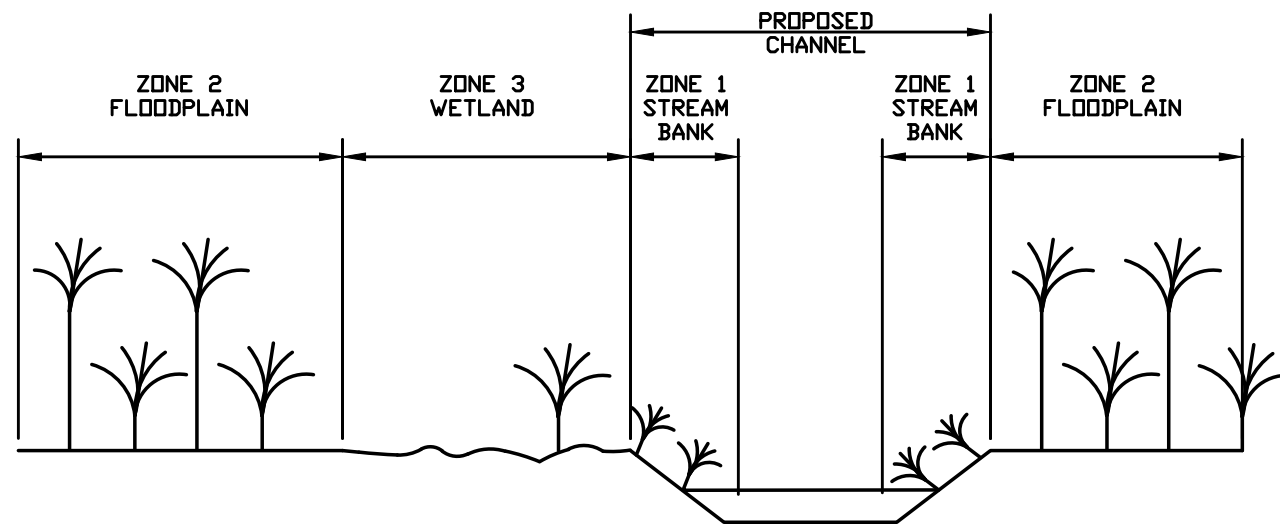


601 EAST
PLAN AND PROFILE (RELIC CHANNEL)
STATION 54+50 TO 58+68.63
UNION COUNTY, NORTH CAROLINA

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Construction Plan & Profile(Relic Channel)
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.	



PLAN VIEW



PLANTING ZONE PROFILE SCHEMATIC
NOT TO SCALE

GENERAL NOTES:

1. TEMPORARY PLANTING WILL OCCUR IMMEDIATELY AFTER CONSTRUCTION TO STABILIZE AREAS OF BARE SOIL. PERMANENT PLANTING AND SEEDINGS SHALL BEGIN IN SEASON OPTIMALLY BETWEEN NOVEMBER 15 AND APRIL 15.
2. PRIOR TO PERMANENT PLANTINGS AND SEEDINGS, THE SITE SOILS SHALL BE PREPARED FOR PLANTING. WHERE NEEDED THE SOILS SHOULD BE PLOWED OR RIPPED TO IMPROVE COMPACTED SOILS AND ELIMINATE CHANNELIZED FLOW FROM NON-TARGET AREAS. IF NECESSARY SOILS SHALL BE AMENDED WITH STORED SITE TOPSOIL TO FACILITATE VIGOROUS PLANT GROWTH. EXOTIC AND INVASIVE PLANTS SHALL BE TREATED AND REMOVED.
3. SUMMARY OF PLANT QUANTITIES CHART SIZE REFERS TO THE SIZE OF THE PLANTS AT INSTALLATION.
4. THE SPACING OF THE PLANTS SHALL BE 3' ON CENTER FOR SMALL PLANTS, WETLAND FORBES, AND ON STREAM BANK ZONES FOR TREES AND SHRUBS. SPACING SHALL BE 10 FEET ALONG ROWS WITH 10 FOOT ROW SPACING. FOR TREES AND SHRUBS PLANTING DENSITY IS TO BE 640 PLANTS /ACRE.
5. PLANTS WILL BE KEPT SHADED AND WELL WATERED TO MAINTAIN HEALTHY, VIGOROUS CONDITION PRIOR TO PLANTING.
6. PERMANENT SEED MIX REQUIRES ADVANCE PRE-ORDER AND SHIPMENT.
7. ALL PLANT MATERIAL SHALL CONFORM TO OR EXCEED THE AMERICAN STANDARD FOR NURSERY STOCK (LATEST EDITION) AS PUBLISHED BY THE AMERICAN ASSOCIATION OF NURSERYMEN.
8. THE SITE SHALL BE PLANTED BY THE ZONES DEPICTED IN THE PLANTING PLAN SHEETS WITH SPECIES LISTED IN THE PLANTING TABLES.
9. PLANTING ZONE DESCRIPTIONS:

- ZONE 1 - STREAM BANK
THE STREAM BANK ZONE INCLUDED THE STREAM CHANNEL FROM BASE FLOW TO THE BANKFULL ELEVATION.
- ZONE 2&3 - STREAM BUFFER
THE STREAM BUFFER INCLUDES THE AREA FROM THE BANKFULL ELEVATION TO THE CONSERVATION EASEMENT LIMIT.
- ZONE 4 - WETLAND
THE WETLAND ZONES INCLUDE POCKETS OF ENHANCED EXISTING WETLAND AREAS WITHIN ZONE 2.
- ZONE 5- TEMPORARY ACCESS AREA TO BE STABILIZED WITH TEMPORARY SEED ONLY WITHIN CROP PRODUCTION AREAS.

Wetland Planting Zones - Permanent Seed Mix		
Species	Common Name	Percent
Recommended application rate: 20 lbs. per acre		
Agrostis stolonifera	Creeping bentgrass	35
Carex vulpinoidea	Fox sedge	25
Elymus virginicus	Virginia wild rye	25
Juncus effusus	Soft Rush	5
Rudbeckia hirta	Black-eyed susan	5
Verbena hastata	Blue vervain	5
Total:		100
0.37 Total Acres		
20 lbs./acre		
8 Total lbs.		

Stream Buffer and Stream Banks Planting Zones-Permanent Seed Mix		
Scientific Name	Common Name	Percent
Recommended application rate: 20 lbs. per acre		
Elymus virginicus	Virginia wild rye	20
Panicum virgatum	Switchgrass	20
Agrostis stolonifera	Creeping bentgrass	15
Coreopsis lanceolata	Coreopsis	10
Panicum clandestinum	Deer tongue	10
Andropogon gerardii	Big bluestem	5
Juncus effusus	Soft rush	5
Polygonum pennsylvanicum	Penn. Smartweed	5
Schizachyrium scoparium	Little bluestem	5
Sorghastrum nutans	Indian grass	5
Total:		100
10.37 Total Acres		
20 lbs./acre		
208 Total lbs.		

Plant Table				
Bare Roots	Zone 1 (Streambank)	Zone 2 (Stream Buffer)	Zone 3 (Stream Buffer)	Zone 4 (Wetlands)
Black gum (Nyssa sylvatica)		350		
Red Oak (Quercus rubra)		350		
White oak (Quercus alba)		350		
Tulip poplar (Liriodendron tulipifera)		500	400	
River birch (Betula nigra)		300	400	
American persimmon (Diospyros virginiana)		100	100	
Tag Alder (Alnus serrulata)		100	100	50
Willow oak (Quercus phellos)		500	250	
Chestnut oak (Quercus mi chauxii)		500	250	
Ironwood (Carpinus caroliniana)		350	250	
Green Ash (Fraxinus pennsylvanica)			250	
Black Willow (Salix nigra)			250	
Sycamore (Platanus occidentalis)			250	50
Hackberry (Celtis laevigata)			250	
Buttonbush (Cephalanthus occidentalis)				100
Elderberry (Sambucus canadensis)				100
Bare Root Total =	0	3400	2750	300
Live Stakes				
Black Willow (Salix nigra)	1000			
Cottonwood	900			
Silky dogwood (Cornus amomum)	1000			
Silky willow (Salix sericea)	600			
Live Stake Total =	3500	0	0	0

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601 EAST
 PLANTING NOTES
 UNION COUNTY, NORTH CAROLINA

DATE: AUG 9 2013
 REVISIONS:
 PROJECT NAME:
 601 East
 DWG NAME:
 Planting Notes
 SCALE:
 NTS
 MITIGATION
 PLAN SET
 SHEET NO.

GENERAL

The vegetation plan for the Newtown Project was developed using a 3 Zone planting scheme. The planting zones are as follows:

- Zone 1- Streambank (1.87 Acres)
- Zone 2- Stream Buffer (11.99 Acres Piedmont Aluvial Forest)
- Zone 3- Wetland Restoration (3.38 Acres Piedmont Alluvial Forest)

The planting plan zones are shown on the construction plans planting plan sheets. Substitutions of specified plant materials may be made with the approval of the owner and the Designer and shall be compatible with the specified planting scheme. The various species of bare root plants and live stakes specified on the plans is to be at spacing called for on the plans in the appropriate zone.

The planting stock should be grown by restoration nurseries within the same physiographic region (Piedmont) and within 200 miles of the project site. The seed sources for the plant material should be obtained from the Piedmont, and genetically improved seedlings should be used when available. Plant stock or seed mixes may be obtained from nurseries beyond the 200-mile limit with approval of the Designer. Only the highest quality plant material should be planted. The seedlings should have well-developed fibrous root systems and healthy buds. Seedling should be packaged and stored prior to planting to protect against damage or extreme temperatures.

Installation should occur during the dormant season, i.e., late fall or winter, if the ground is not frozen, to early spring before growth begins. No planting shall be done when the temperature is below 32 degree F, the soil is frozen, when the sides or bottom of the plant hole are frozen, or when the soil to be used for backfilling is frozen or too wet.

The contractor installing the vegetation on the project site shall have the following qualification/certifications: Certified Landscape Technician, or Certified Plant Professional, or Registered Forester, or Registered Landscape Contractor, or Certified Nurserymen, or otherwise approved by the owner.

Survival of Plantings

The Contractor shall be responsible for maintaining a survival rate of 80% on all permanent plantings for the duration of twelve months following the Date of Project Acceptance by the owner. The Date of Project Acceptance is defined by the Project Acceptance Letter issued by the State Construction Office. The 80% survival rate shall apply additionally to each species planted. The contractor shall incur the cost of replacing any permanent plantings that do not survive through the one-year warranty period. One year after project acceptance, an on-site inspection will be conducted and the Contractor will be directed accordingly on replacement of any mortality.

PERMANENT SEEDING

General:

Permanent seeding will be required in all planting zones specified on the plans and prior to demobilization from the site on all remaining disturbed areas. Contractor shall install temporary cover suitable for that season in conjunction with the permanent seed in all areas as shown on the planting plan to receive permanent seeding as construction and stabilization progresses. Temporary seed mixture and schedule is shown on the Erosion Control Key & Site Access plan sheet EROS 1. Areas fertilized for temporary seeding shall be sufficiently fertilized for permanent seeding; additional fertilizer is not required for permanent seeding. Seed mixes at the rates shown in the tables on Planting Plan VP1 shall be used for seeding. Ideally, permanent seeding shall occur during the growing season for all listed seed species. Soil amendments are shown on VP1.

Materials:

The tables on VP1 list herbaceous, permanent seed mixtures. The contractor shall provide detailed information including but not limited to germination rates, noxious weed seeds and date and location of harvest on seed mix. The designer must approve the seed mix prior to application.

Installation:

The Contractor is to limit sub-grade and finish grade preparation to areas that will be planted immediately. Preparation areas are to be moistened prior to seeding when soil is dry but care shall be taken not to create muddy conditions. The seedbed shall be non compacted loose soil. Prepared areas are to be restored if eroded or disturbed after fine grading and before planting. Soil amendments should follow the fertilizer and liming description in the amendment table included on the planting plan.

Seed is to be sown with a spreader or a seeding machine. Seed is not to be broadcast or dropped when wind velocity exceeds 5 mph. Seed is to be evenly distributed by sowing in two directions at right angles to each other. Wet seed or seed that is moldy or otherwise damaged in transit or storage is not to be used. After being sown, the seed is to be raked into the top 1/8 inch of the topsoil, lightly rolled, and watered with fine spray. Seeded areas on stream banks shall be protected with coir fiber matting as shown on the plans. Other seeded areas are to be protected by spreading straw mulch uniformly to form a continuous blanket over the seeded areas (75% coverage = 2 tons/acre). Straw mulch is to be spread by hand, blower or other suitable equipment. Alternative seeding methods must be pre-approved by the Designer prior to installation.

LIVE STAKES

General:

Stages required by the Contractor to complete for successful implementation of the planting plan include soil bed preparation, initial planting, plant establishment, and replacement planting. The Contractor shall perform the operations provided for in these specifications in a careful, workmanlike manner that will promote the continued life and healthy growth of all plants in their location. Live stakes shall be handled in accordance with the Pocket guide to Seedling Care and Planting Standards, 5th Edition, July 2003 or most recent edition or similar guide with designer approval.

Materials

Live stakes are to be planted in the appropriate zone as indicated on the planting plans. The Plant Quantity Summary Table on the planting plan lists the species, minimum stem caliper, plant height/length, and spacing guidelines. A minimum stake caliper is 0.5 inches to 2 inch diameter with a length of 2 to 3 feet, appropriate for driving into the ground. See the standards described in The Pocket Guide to Seedling Care and Planting, July 2003.

Live stakes are to be dormant (cut fall or winter) and gathered locally or purchased from a commercial supplier. Stakes must be freshly cut with side branches removed, but with bark intact (ensure that the bark is not stripped during the cutting, preparation or installation of the stake). Cuttings are to be collected using a saw or sharpened clippers (not an axe).

One end of the live stake must be cut at an angle for insertion into the soil and the other end must be cut square for tamping. Cutting must be kept fresh and moist prior to installation.

Installation

In digging, loading, transporting, unloading, planting or otherwise handling plants, the Contractor shall exercise utmost care and use adequate precautions to prevent injury to or drying out of the plant. The live stakes shall be installed the same day they are prepared. The installation should start nearest to the stream and work up the bank/floodplain. Cutting must be installed right side up with the buds pointing upward. Cuttings should be tamped into the ground at right angles to the slope and angled downstream. They are to be tamped into the ground for approximately 4/5 of their length. Cuttings that split or become "mushroomed" must be replaced. Stakes should be installed in a random configuration to prevent gullies and promote a natural effect in the re-vegetated area.

BARE ROOT PLANTS

General:

The work of planting includes planting bed preparation, initial planting, plant establishment, and replacement planting. The Contractor shall perform the operations provided for in these specifications in a careful, workmanlike manner that will promote the continued life and healthy growth of all plants in their location. Seedlings shall be handled in accordance with the Pocket guide to Seedling Care and Planting Standards, 5th Edition, July 2003.

Materials:

Bare root plants are to be planted in the appropriate zone as indicated on the planting plans. The Summary of Plant Quantity table on the planting plan lists the species, plant size, spacing guidelines and placement of bare root vegetation. An assortment of bare root plants are required as indicated in this table on the plans

Installation:

In digging, loading, transporting, unloading, planting or otherwise handling plants, the contractor shall exercise utmost care and use adequate precautions to prevent injury to or drying out of the trunk, branches, or roots: and to prevent freezing of the plant roots. Immediately following delivery to the project, all plants with bare roots, if not promptly planted, shall be heeled-in in constantly moist soil or sawdust in an acceptable manner corresponding to generally accepted horticultural practices.

While plant with bare roots are being transported to and from heeling-in beds, or are being distributed in planting beds, or are awaiting planting after distribution, the Contractor shall protect the plants from drying out by means of wet canvas, burlap or straw or by other means acceptable to the Designer and appropriate to weather conditions and the length of time the roots will remain out of the ground.

Installation of bare root vegetation shall be located in designated areas along the stream bank above and below bankfull elevation as described in the plans or a directed by the Designer and in the wetland areas. Soil in the

permit roots to spread out and down without J-rooting. After planting, the soil shall be tamped around the shrub or tree firmly to eliminate air pockets. Straw mulch shall be placed around the base of each plant at least 4-6 inches thick. Straw bails may be torn into segments and placed around the base of each plant.

SHRUB AND TREE TRANSPLANTS

General:

Existing site vegetation may be used to augment plantings. Transplants may only be taken from disturbed areas.

Materials:

Vegetation to be transplanted will be identified by the Contractor and approved by the Designer. Shrub and trees less than 3 inches in diameter shall be salvaged onsite in areas designated for construction access and disturbed areas.

Installation:

Transplanted vegetation shall be carefully excavated with root balls with intact and surrounding soils. Care shall be taken to prevent damage to limbs or bark. Vegetation shall be transplanted immediately, if possible. Otherwise the vegetation shall be transported to designated stockpile areas and heeled into moist soil or sawdust in an acceptable manner appropriate to weather or seasonal conditions.

Installation of the transplant shall be located in areas approved by the designer. Compacted soils in the transplant area shall be loosened to a depth of at least 1 foot. Transplants shall be replanted to the same depth as they were originally growing. The planting trench or hole shall be deep and wide enough to permit the roots to spread out and down. The plant stem shall remain upright. Soil shall be replaced around the transplanted vegetation and tamped around the shrub or tree firmly to eliminate air pockets, and watered in.

Transplant spacing should be at least 10 ft. x 10 ft. for canopy and 5 ft. x 5 ft. for understory plants.

TOPSOIL

General:

Topsoil will be preserved and spread where necessary to provide a suitable growth medium for vegetation growth. Topsoil will be used throughout the site to reduce the amount of fertilizers and soil amendments needed for vegetation growth.

Spreading:

Uniformly distribute topsoil to a minimum compacted depth of 2 inches on 3:1 slopes and 4 inches on flatter slopes. Do not spread topsoil while it is frozen or muddy, or when the sub-grade is wet or frozen. Compact the topsoil enough to ensure good contact with the underlying soil, but avoid excessive compaction. The volume of topsoil required for application to various depths is included in the chart below.

Volume of Topsoil Required For Application to Various Depths		
Depth (inches)	Cubic Yards Per 1000 Sq. Feet	Cubic Yards Per Acre
1	3.1	134
2	6.2	269
3	9.3	403
4	12.4	538
5	15.4	672
6	18.5	806

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601 EAST
 PLANTING NOTES
 UNION COUNTY, NORTH CAROLINA

DATE: AUG 9 2013

REVISIONS:

PROJECT NAME:
601 East

DWG NAME:
Planting Notes

SCALE:
NTS

MITIGATION
PLAN SET

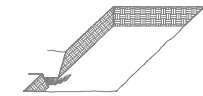
SHEET NO.

PLANTING DETAILS

SEEDLING / LINER BAREROOT PLANTING DETAIL DIBBLE PLANTING METHOD USING THE KBC PLANTING BAR

HEALING IN

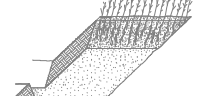
1. Locate a healing-in site in a shady, well protected area.
2. Excavate a flat bottom trench 12" deep and provide drainage.



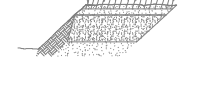
3. Backfill the trench with 2" well rotted sawdust. Place a 2" layer of well rotted sawdust at a sloping angle at one end of the trench.



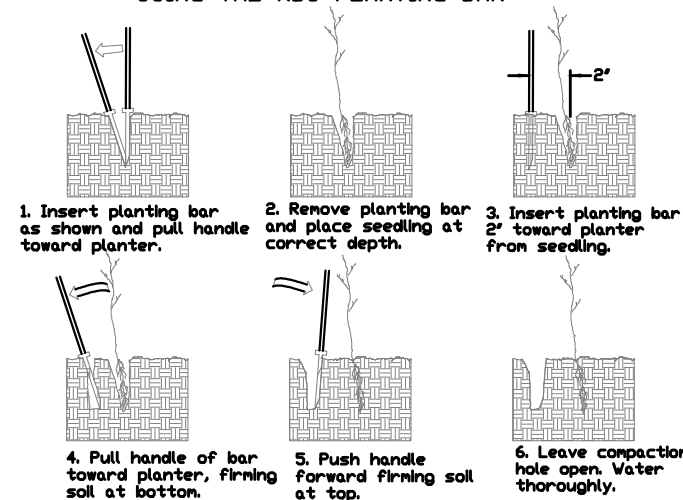
4. Place a single layer of plants against the sloping end so that the root collar is at ground level.



5. Place a 2" layer of well rotted sawdust over the roots maintaining a sloping angle.



6. Repeat layers of plants and sawdust as necessary and water thoroughly.



PLANTING NOTES:

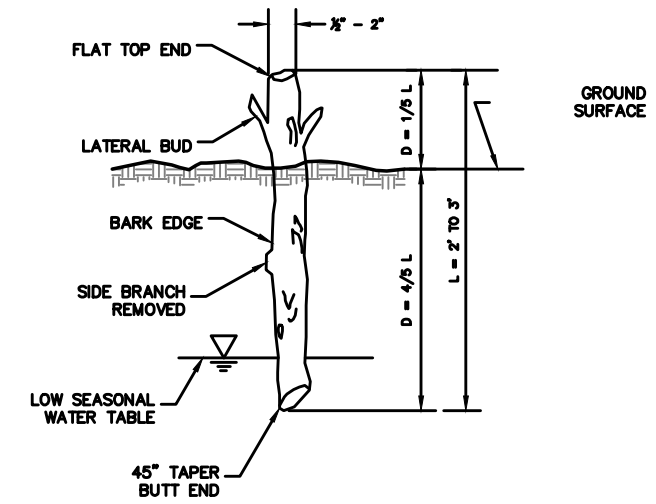
PLANTING BAG
During planting, seedlings shall be kept in a moist



KBC PLANTING BAR
Planting bar shall have a blade with a triangular cross section, and shall be 12" long, 4" wide and 1" thick at center.



ROOT PRUNING
All seedlings shall be root pruned, if necessary, so that no roots extend more than 10 inches (10") below the root collar.

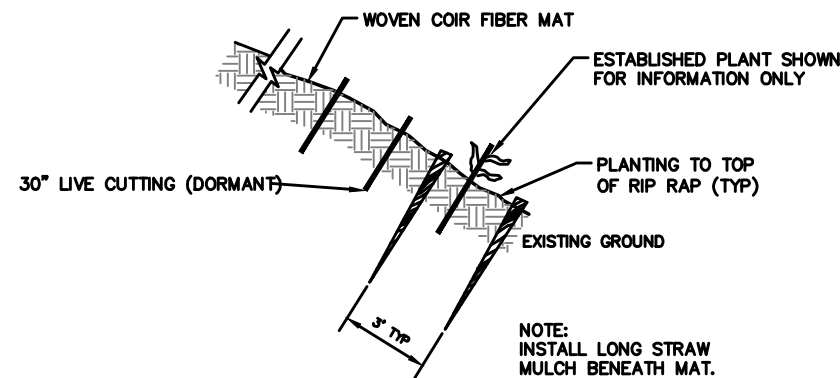


1 REFORESTATION DETAIL

SCALE: NOT TO SCALE

2 LIVE STAKE DETAIL

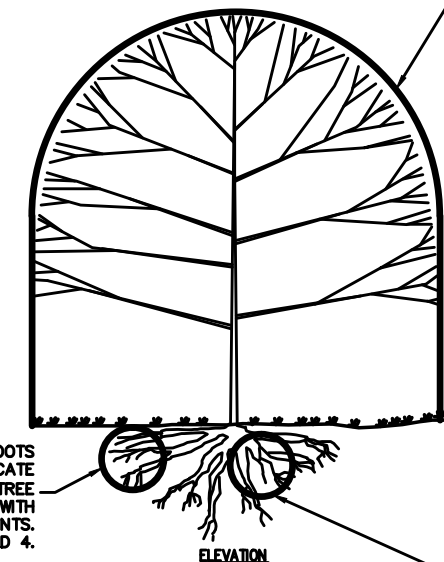
SCALE: NOT TO SCALE



3 REFORESTATION DETAIL

SCALE: NOT TO SCALE

- TREE PROTECTION DURING CONSTRUCTION**
1. DO NOT COMPACT SOIL BENEATH TREES. NO VEHICLE SHALL BE ALLOWED TO PARK UNDER TREES. NO HEAVY MATERIALS SHALL BE STORED BENEATH TREES. RESULTS OF COMPACTION CAUSE WATER AND AIR NOT TO REACH THE ROOTS AND THE TREE WILL DIE. THESE FEEDING ROOTS OCCUR WELL AWAY FROM THE BASE OF THE TREE TO THE EDGE OF THE OVERHEAD BRANCH CANOPY. DAMAGING THE BARK WITH LAWNMOWERS, CONSTRUCTION EQUIPMENT, OR ANYTHING ELSE IS PROHIBITED. A PROTECTIVE BARRIER SHOULD PREVENT DAMAGE FROM OCCURRING DURING CONSTRUCTION.
 2. NO CUTTING OF LARGE STRUCTURAL ROOTS LOCATED NEAR THE BASE OF THE TRUNK. THESE ARE ESSENTIAL IN SUPPORTING THE TREE AND HOLDING IT UPRIGHT IN HIGH WINDS. REMOVAL OF THE ROOTS ALONG ONE SIDE IS OFTEN DONE BECAUSE OF A WALK, PAVING OR BUILDING WHICH IS BEING CONSTRUCTED.
 3. AVOID CUT AND FILL WITHIN DIAMETER OF TREE CROWN DURING EXCAVATION.



4 METHOD OF TREE PROTECTION DURING CONSTRUCTION

SCALE: NOT TO SCALE

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Fax: (919) 229-9913



601 EAST
PLANTING DETAILS
UNION COUNTY, NORTH CAROLINA

DATE: 9 AUG 2013

REVISIONS:

PROJECT NAME:
601 East

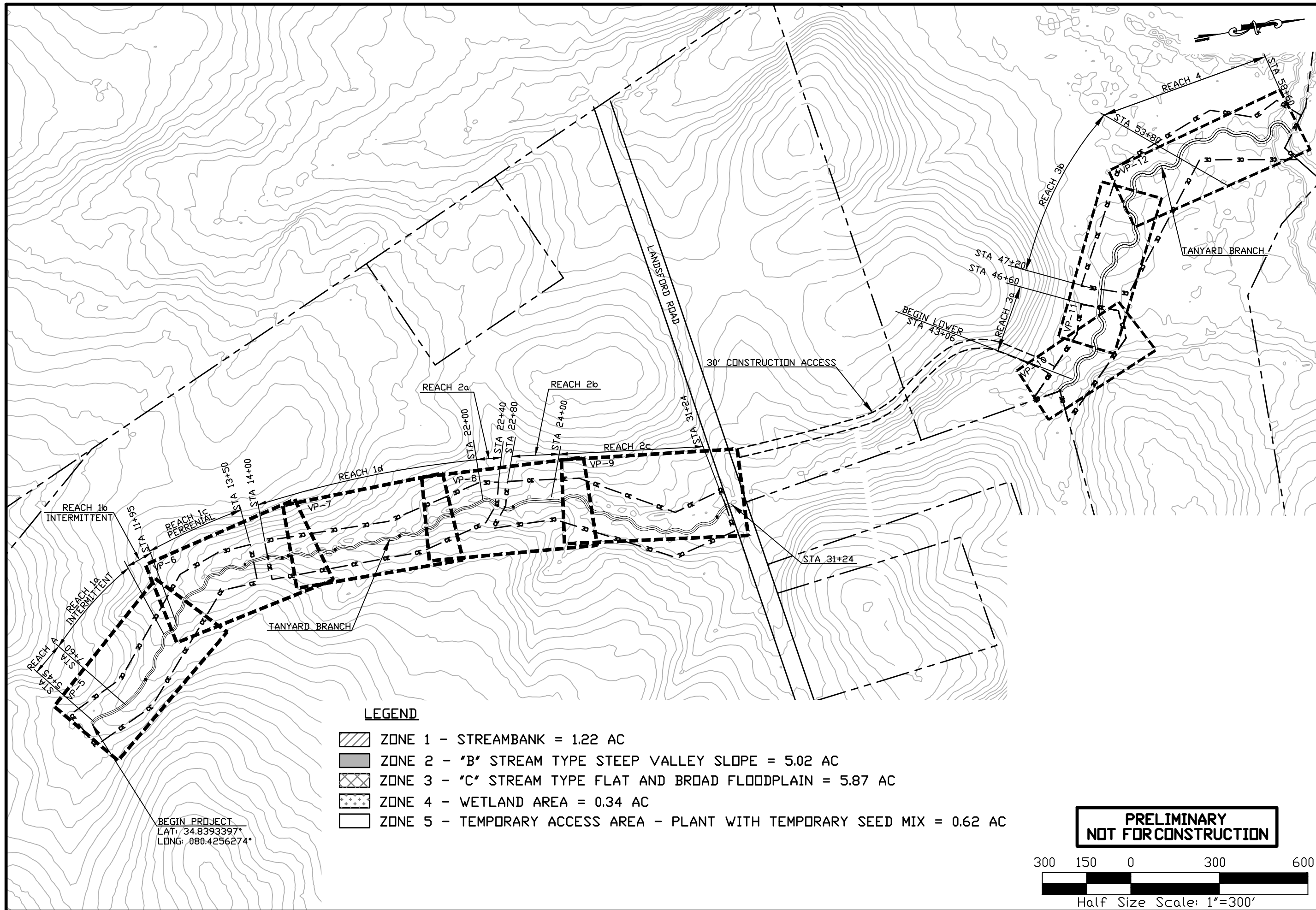
DWG NAME:
Planting Details

SCALE:
NTS

MITIGATION
PLAN SET

SHEET NO.

VP3



BEGIN PROJECT
 LAT: 34.8393397°
 LONG: 080.4256274°

LEGEND

- ZONE 1 - STREAMBANK = 1.22 AC
- ZONE 2 - "B" STREAM TYPE STEEP VALLEY SLOPE = 5.02 AC
- ZONE 3 - "C" STREAM TYPE FLAT AND BROAD FLOODPLAIN = 5.87 AC
- ZONE 4 - WETLAND AREA = 0.34 AC
- ZONE 5 - TEMPORARY ACCESS AREA - PLANT WITH TEMPORARY SEED MIX = 0.62 AC

**PRELIMINARY
NOT FOR CONSTRUCTION**

Half Size Scale: 1"=300'

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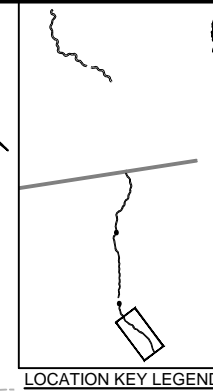
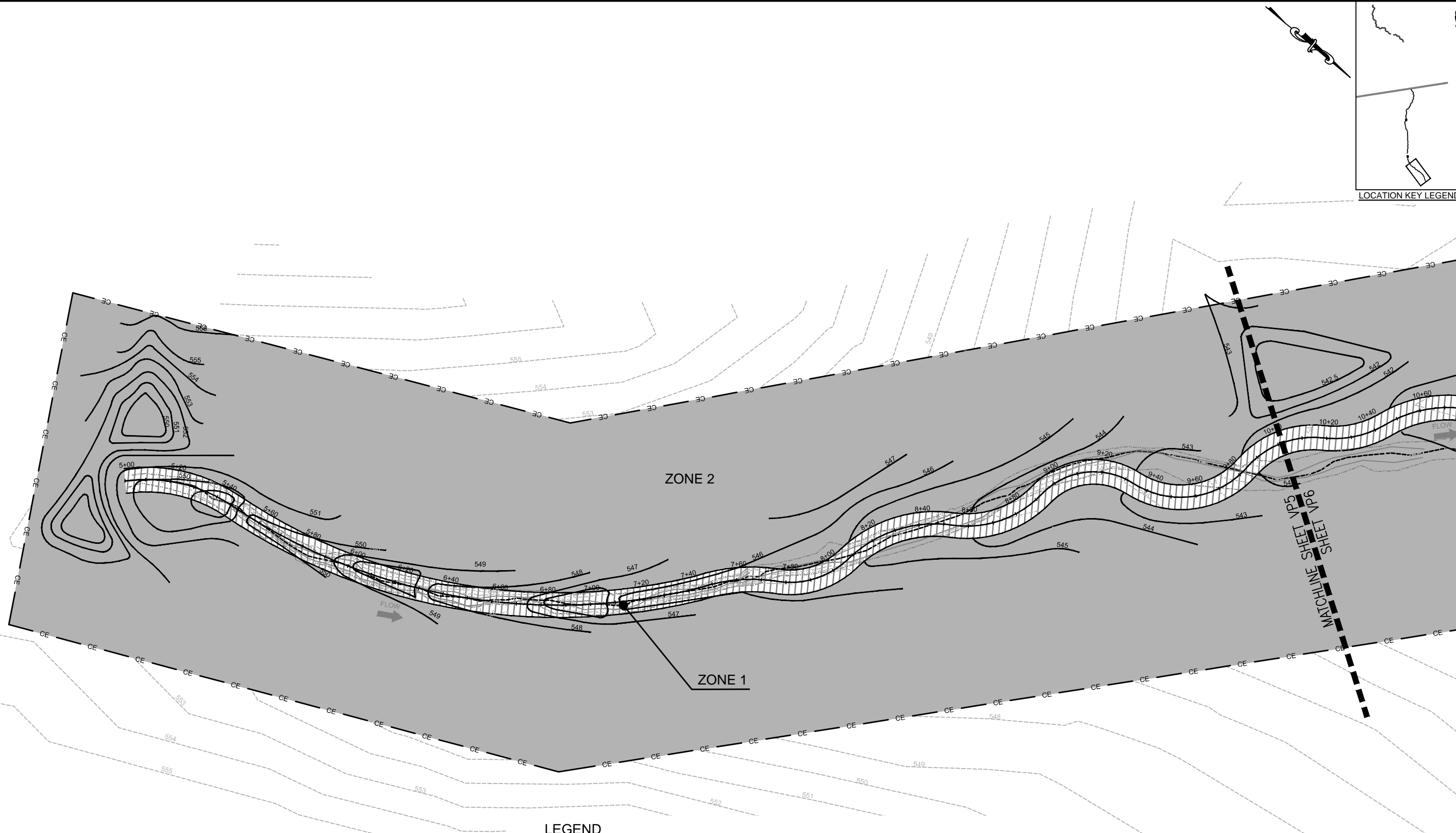


**PLANTING PLAN LEGEND
AND SHEET KEY**

601 EAST

UNION COUNTY, NORTH CAROLINA

DATE: 5 SEPT 2013
REVISIONS:
PROJECT NAME: 601 East
DWG NAME: Legends and Symbols Sheet
SCALE: 1"=300'
MITIGATION PLAN SET
SHEET NO. VP4



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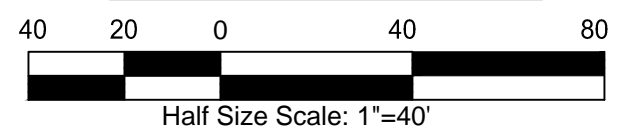
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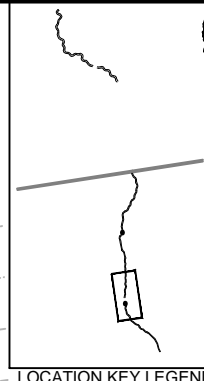
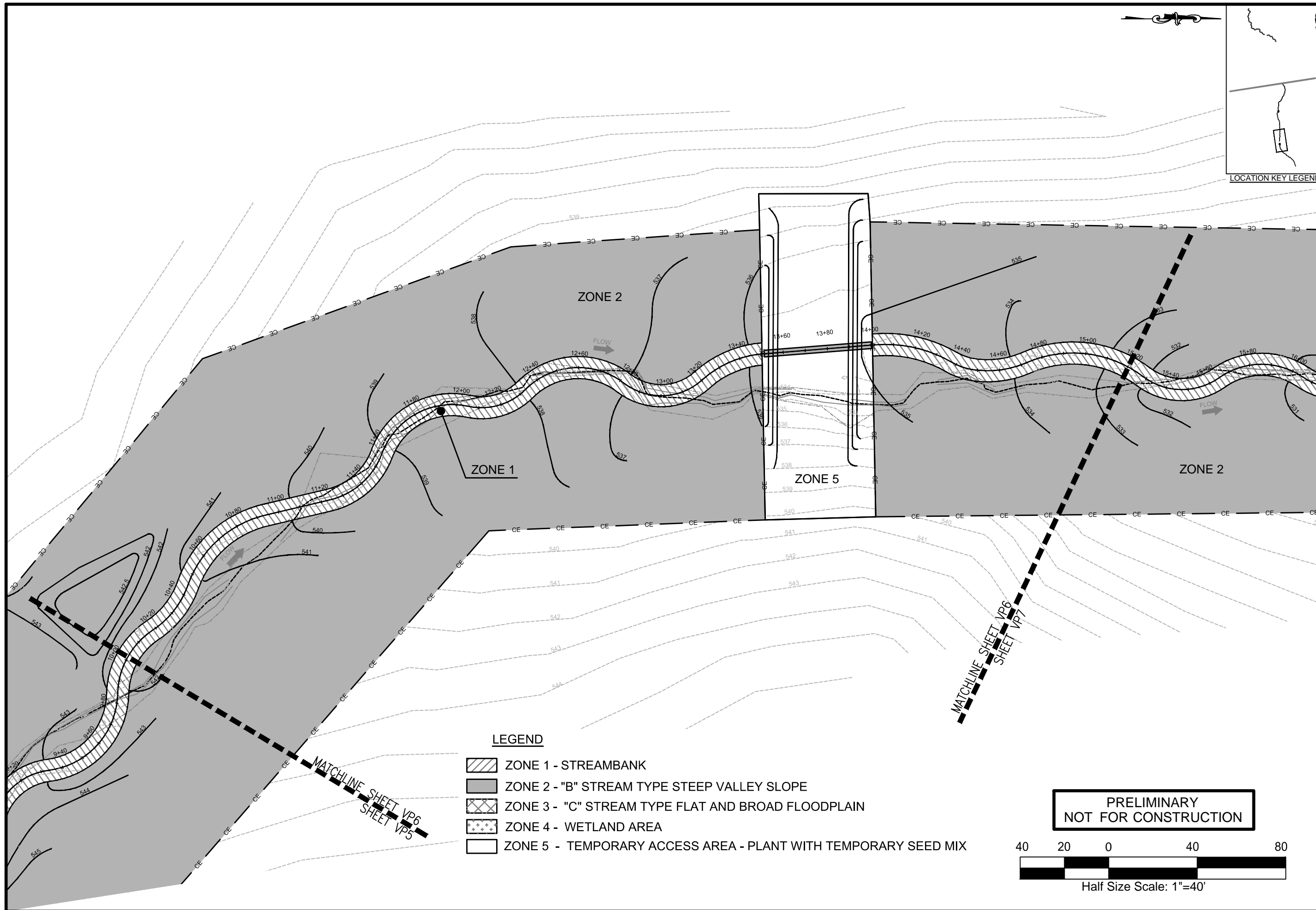
**601 EAST
 PLANTING PLAN
 STATION 5+00 TO 10+00
 UNION COUNTY, NORTH CAROLINA**

- LEGEND**
- ZONE 1 - STREAMBANK
 - ZONE 2 - "B" STREAM TYPE STEEP VALLEY SLOPE
 - ZONE 3 - "C" STREAM TYPE FLAT AND BROAD FLOODPLAIN
 - ZONE 4 - WETLAND AREA
 - ZONE 5 - TEMPORARY ACCESS AREA - PLANT WITH TEMPORARY SEED MIX

**PRELIMINARY
 NOT FOR CONSTRUCTION**



DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Planting Plan
SCALE:	As Noted
	MITIGATION PLAN SET
SHEET NO.	VP5



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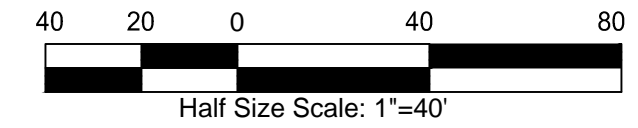
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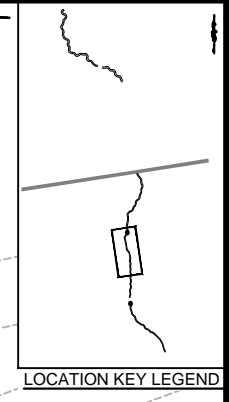
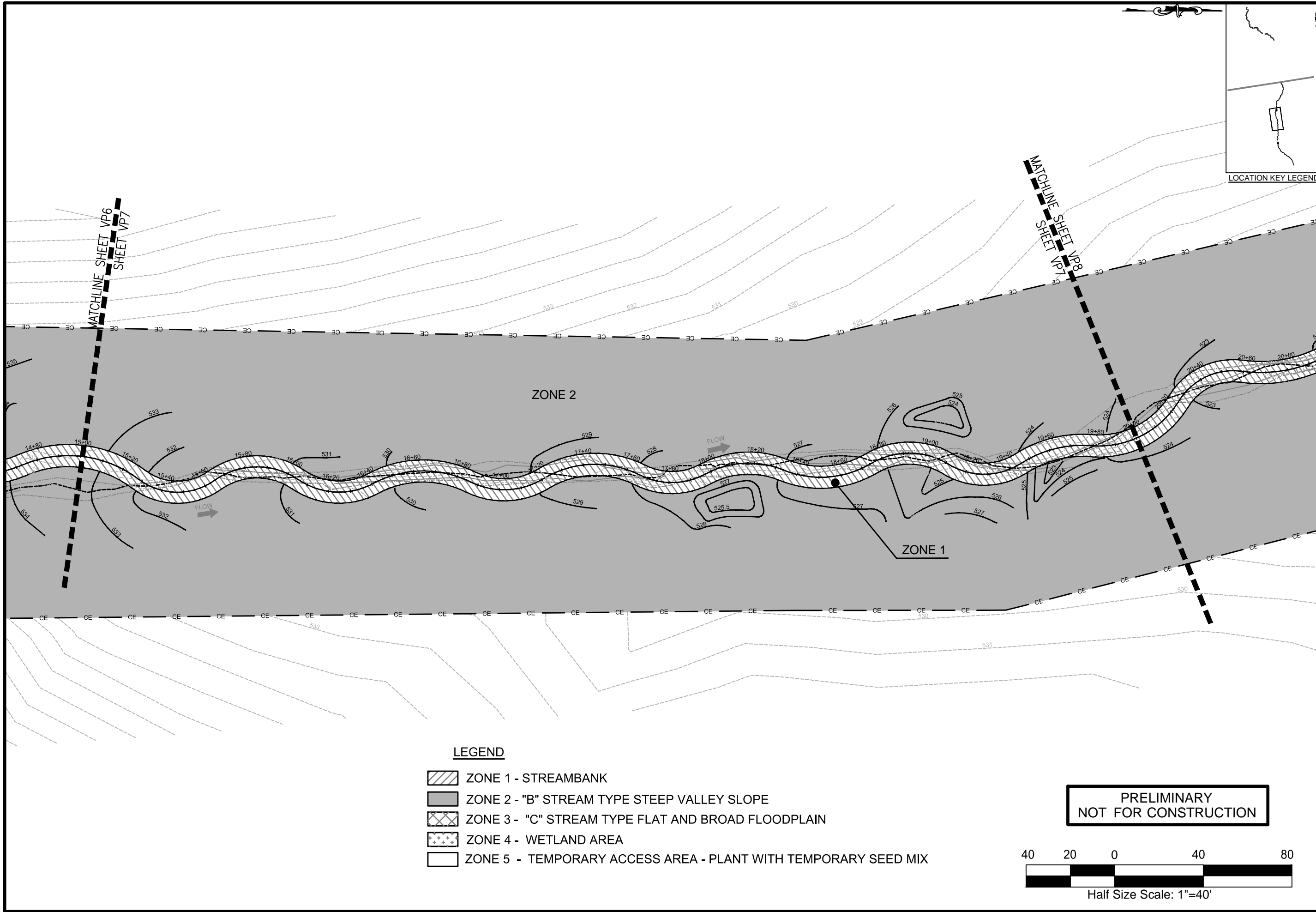
**601 EAST
 PLANTING PLAN
 STATION 10+00 TO 15+00
 UNION COUNTY, NORTH CAROLINA**

- LEGEND**
- ZONE 1 - STREAMBANK
 - ZONE 2 - "B" STREAM TYPE STEEP VALLEY SLOPE
 - ZONE 3 - "C" STREAM TYPE FLAT AND BROAD FLOODPLAIN
 - ZONE 4 - WETLAND AREA
 - ZONE 5 - TEMPORARY ACCESS AREA - PLANT WITH TEMPORARY SEED MIX

**PRELIMINARY
 NOT FOR CONSTRUCTION**



DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Planting Plan
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.	VP6



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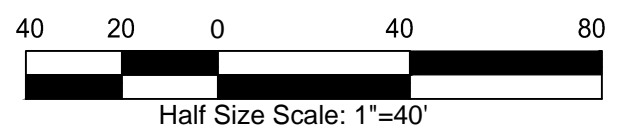


**601 EAST
 PLANTING PLAN
 STATION 15+00 TO 20+00
 UNION COUNTY, NORTH CAROLINA**

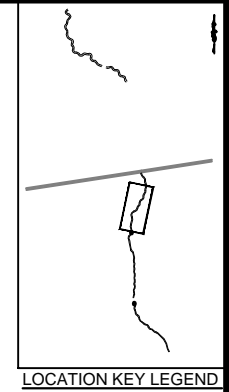
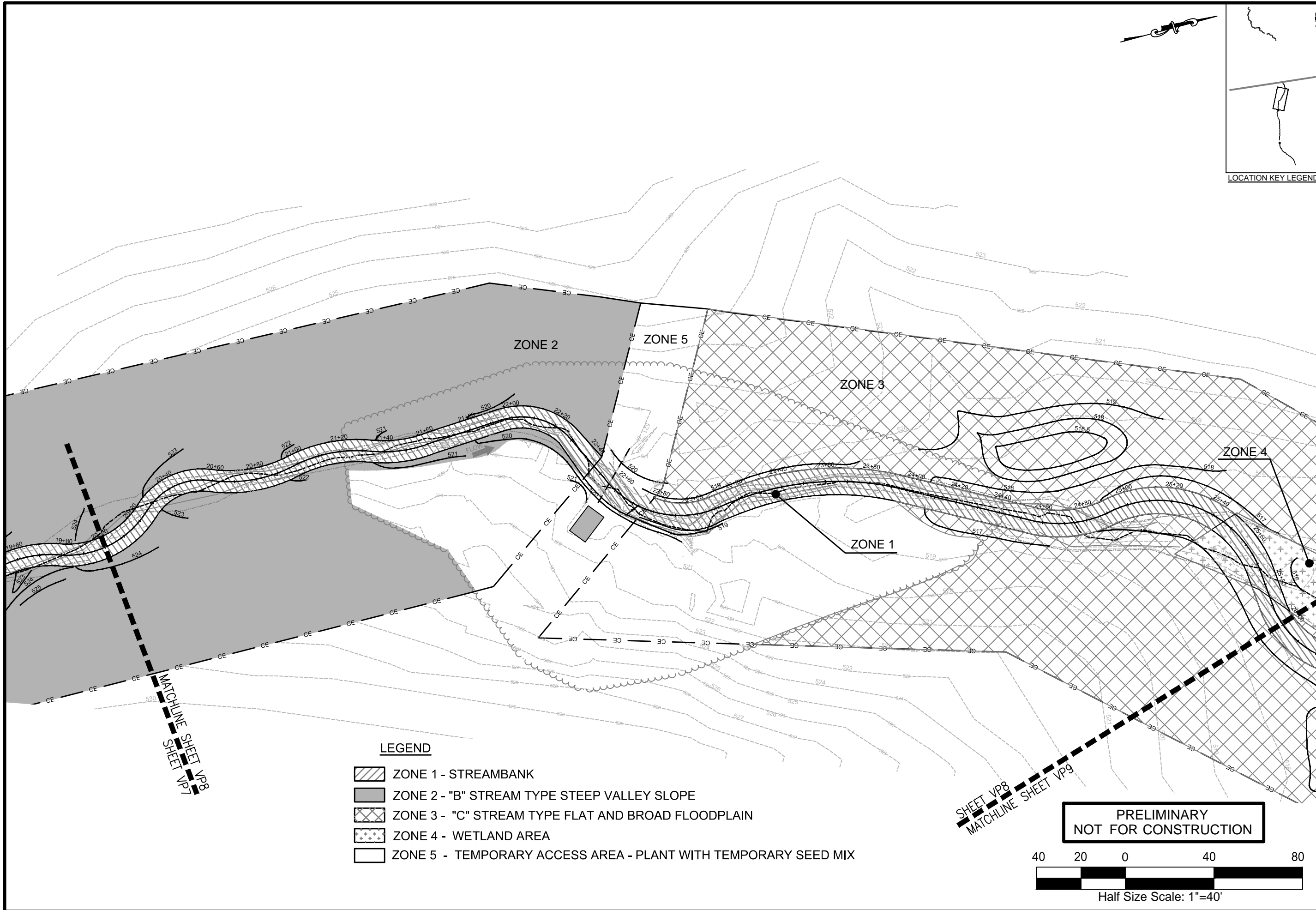
LEGEND

- ZONE 1 - STREAMBANK
- ZONE 2 - "B" STREAM TYPE STEEP VALLEY SLOPE
- ZONE 3 - "C" STREAM TYPE FLAT AND BROAD FLOODPLAIN
- ZONE 4 - WETLAND AREA
- ZONE 5 - TEMPORARY ACCESS AREA - PLANT WITH TEMPORARY SEED MIX






**PRELIMINARY
 NOT FOR CONSTRUCTION**



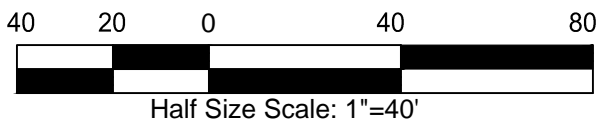
DATE: 5 SEPT 2013
REVISIONS:
PROJECT NAME: 601 East
DWG NAME: Planting Plan
SCALE: As Noted
MITIGATION PLAN SET
SHEET NO. VP7



LEGEND

-  ZONE 1 - STREAMBANK
-  ZONE 2 - "B" STREAM TYPE STEEP VALLEY SLOPE
-  ZONE 3 - "C" STREAM TYPE FLAT AND BROAD FLOODPLAIN
-  ZONE 4 - WETLAND AREA
-  ZONE 5 - TEMPORARY ACCESS AREA - PLANT WITH TEMPORARY SEED MIX

**PRELIMINARY
NOT FOR CONSTRUCTION**



MATCHLINE SHEET VP7
MATCHLINE SHEET VP8

MATCHLINE SHEET VP9
MATCHLINE SHEET VP8

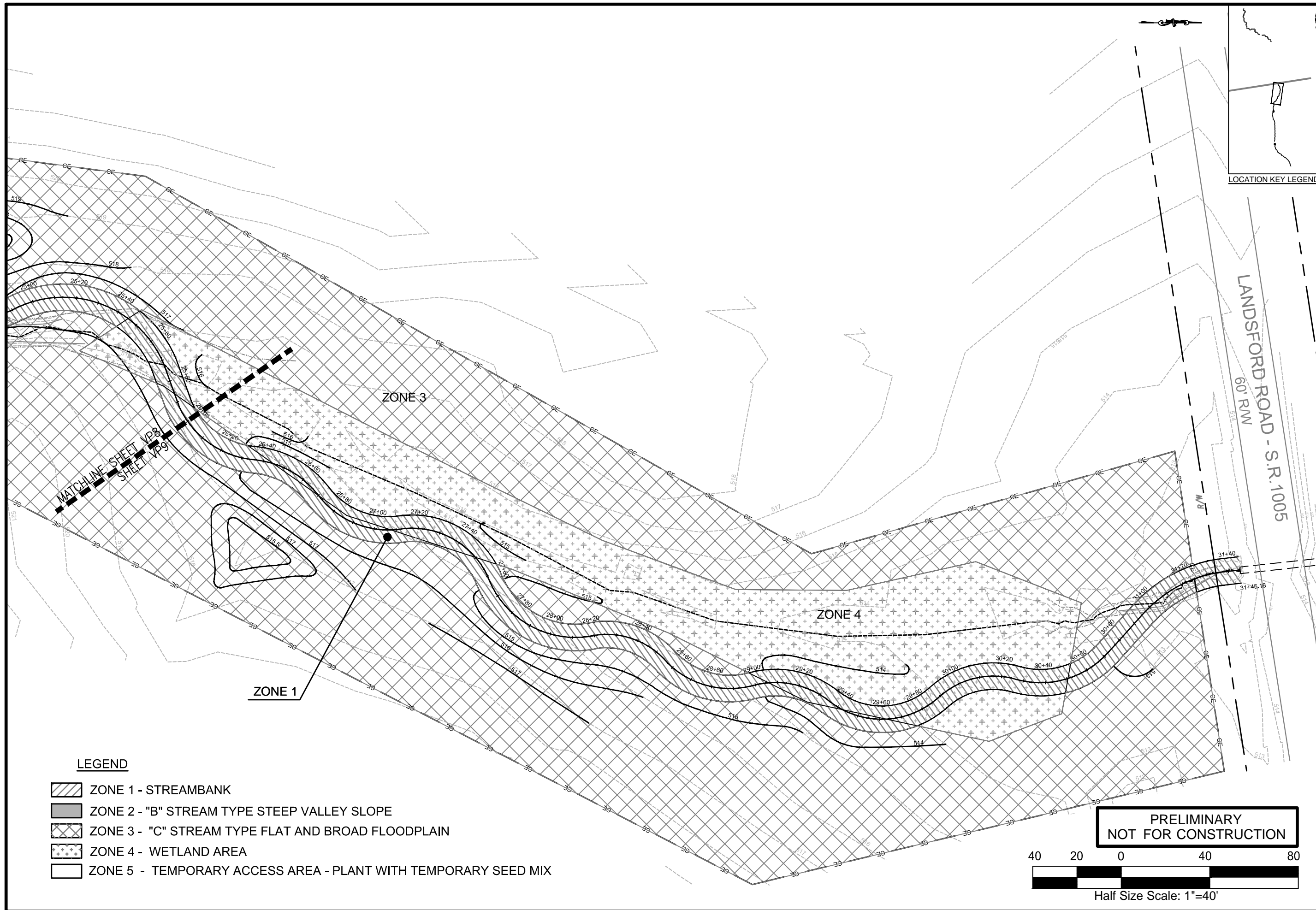
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
**601 EAST
PLANTING PLAN
STATION 20+00 TO 26+00
UNION COUNTY, NORTH CAROLINA**

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Planting Plan
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.	VP8

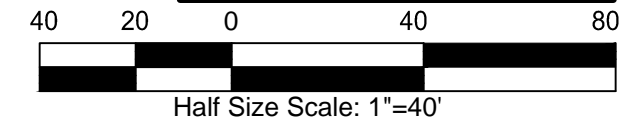


LOCATION KEY LEGEND

LEGEND

-  ZONE 1 - STREAMBANK
-  ZONE 2 - "B" STREAM TYPE STEEP VALLEY SLOPE
-  ZONE 3 - "C" STREAM TYPE FLAT AND BROAD FLOODPLAIN
-  ZONE 4 - WETLAND AREA
-  ZONE 5 - TEMPORARY ACCESS AREA - PLANT WITH TEMPORARY SEED MIX

**PRELIMINARY
NOT FOR CONSTRUCTION**

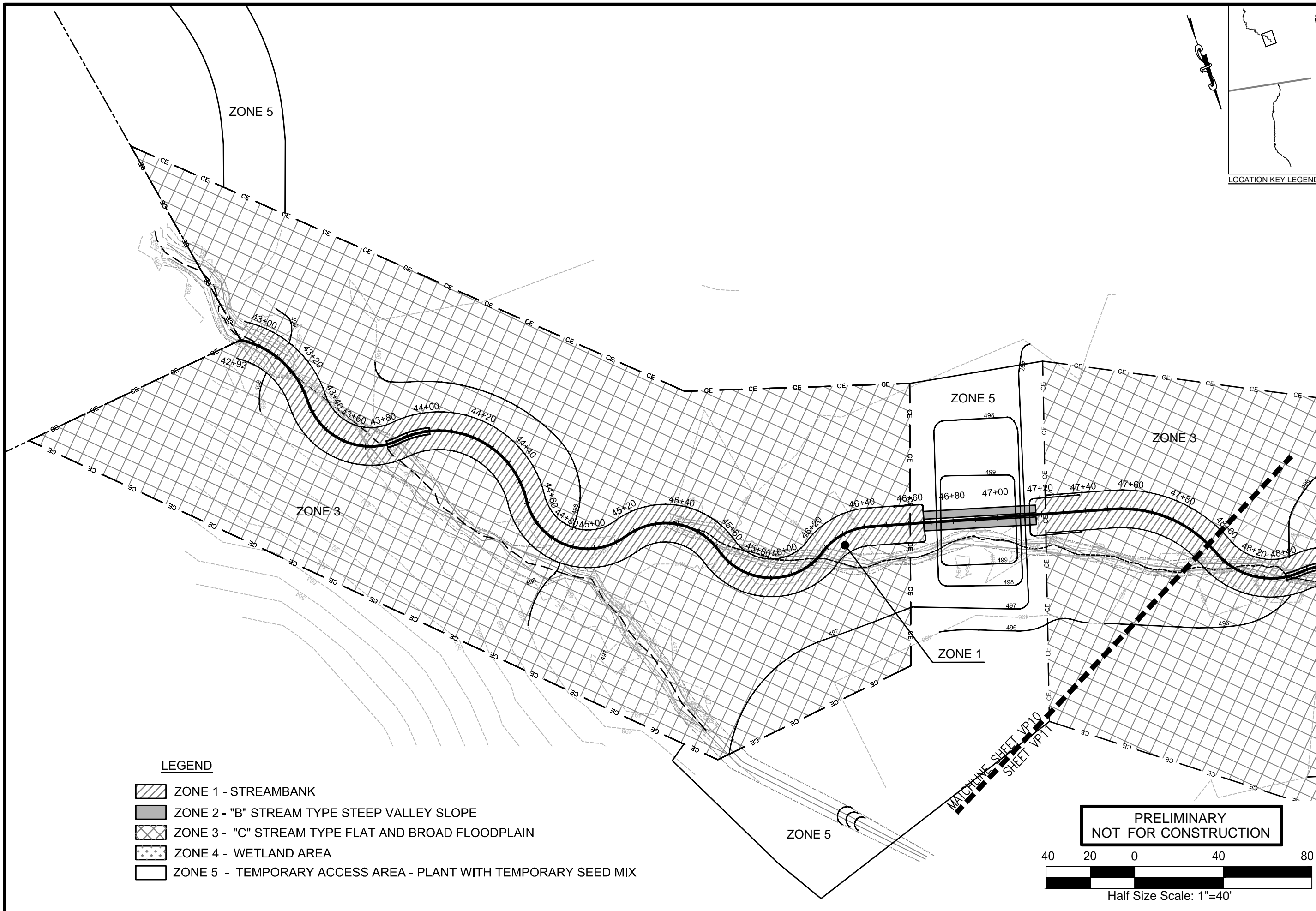


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


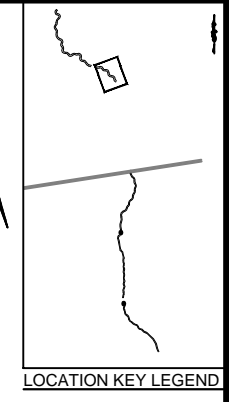
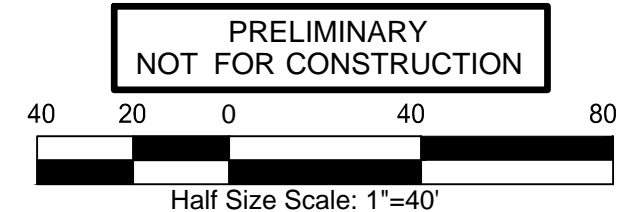
**601 EAST
PLANTING PLAN
STATION 26+00 TO 31+45.18
UNION COUNTY, NORTH CAROLINA**

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Planting Plan
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.	VP9



LEGEND

-  ZONE 1 - STREAMBANK
-  ZONE 2 - "B" STREAM TYPE STEEP VALLEY SLOPE
-  ZONE 3 - "C" STREAM TYPE FLAT AND BROAD FLOODPLAIN
-  ZONE 4 - WETLAND AREA
-  ZONE 5 - TEMPORARY ACCESS AREA - PLANT WITH TEMPORARY SEED MIX



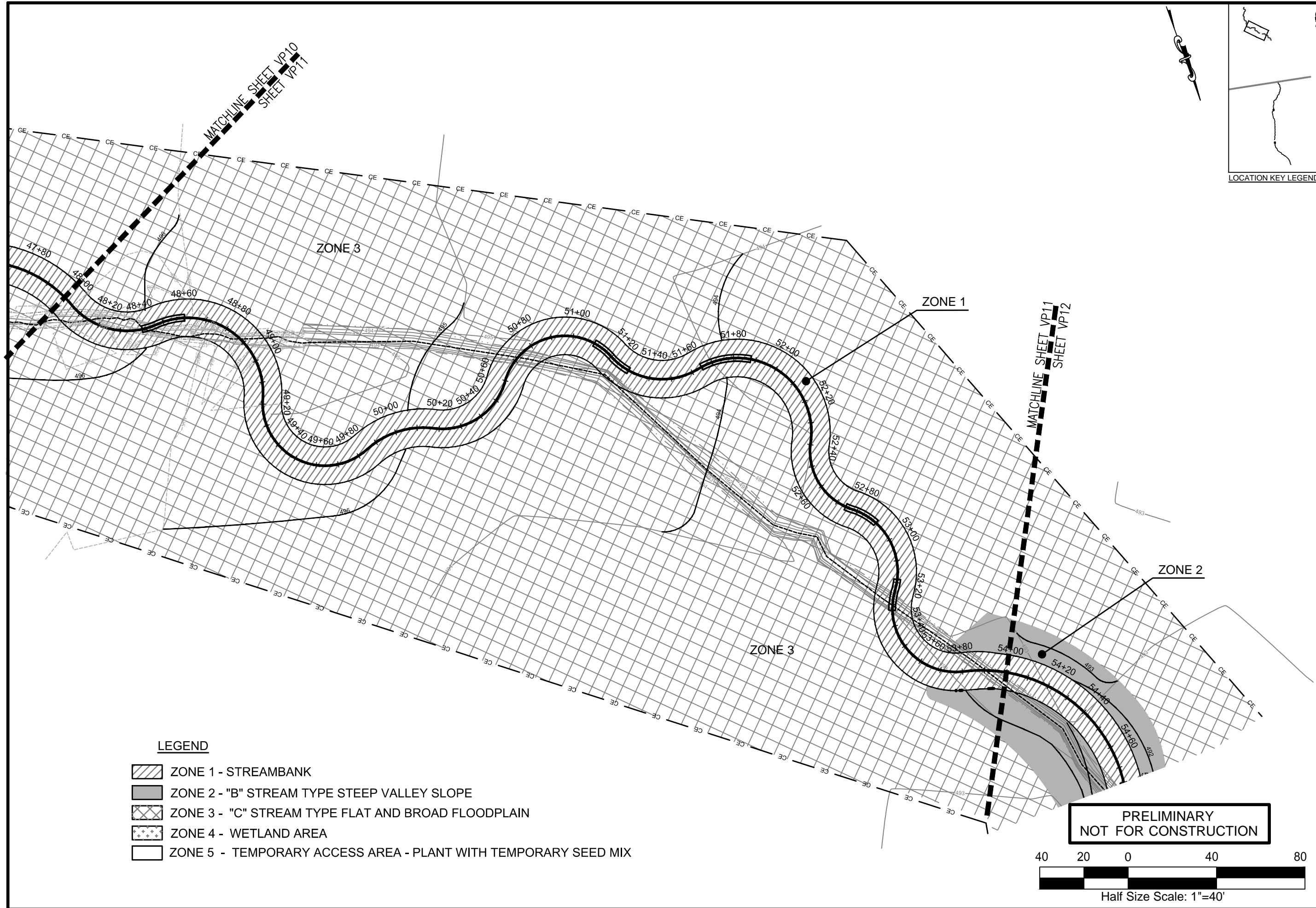
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


**601 EAST
 PLANTING PLAN
 STATION 42+92 TO 48+00
 UNION COUNTY, NORTH CAROLINA**

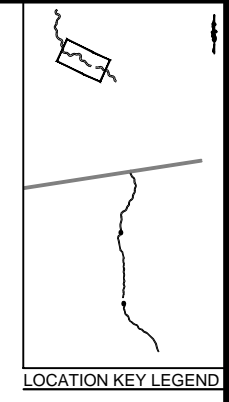
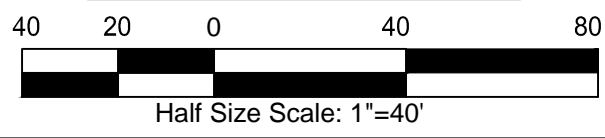
DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Planting Plan
SCALE:	As Noted
MITIGATION PLAN SET	
SHEET NO.:	VP10



LEGEND

-  ZONE 1 - STREAMBANK
-  ZONE 2 - "B" STREAM TYPE STEEP VALLEY SLOPE
-  ZONE 3 - "C" STREAM TYPE FLAT AND BROAD FLOODPLAIN
-  ZONE 4 - WETLAND AREA
-  ZONE 5 - TEMPORARY ACCESS AREA - PLANT WITH TEMPORARY SEED MIX

**PRELIMINARY
NOT FOR CONSTRUCTION**

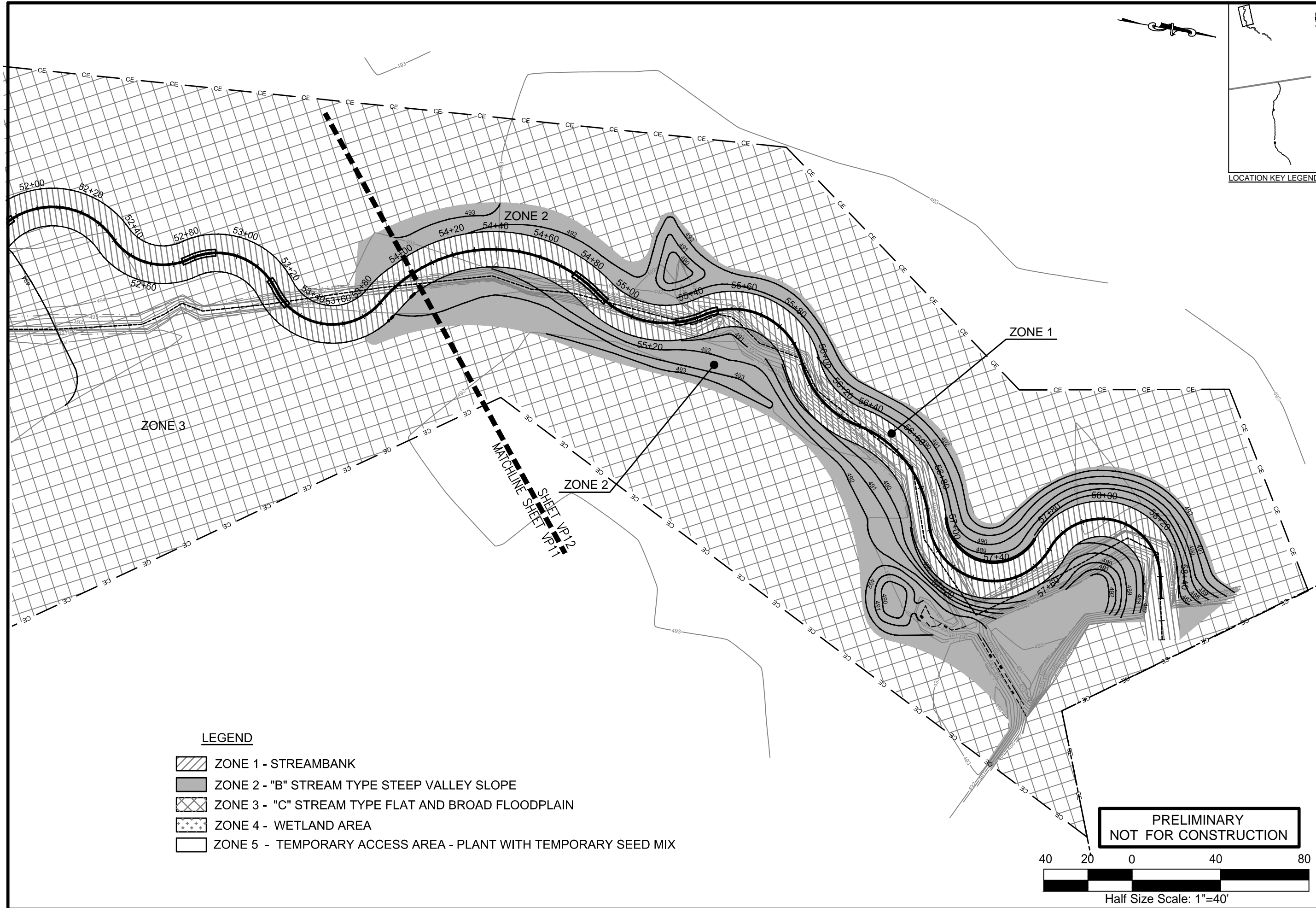


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


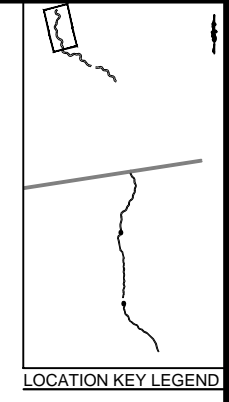
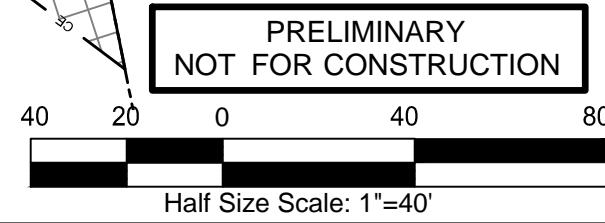
**601 EAST
 PLANTING PLAN (RELIC CHANNEL)
 STATION 48+00 TO 54+00
 UNION COUNTY, NORTH CAROLINA**

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Planting Plan
SCALE:	1"=20'
MITIGATION PLAN SET	
SHEET NO.	VP11



LEGEND

-  ZONE 1 - STREAMBANK
-  ZONE 2 - "B" STREAM TYPE STEEP VALLEY SLOPE
-  ZONE 3 - "C" STREAM TYPE FLAT AND BROAD FLOODPLAIN
-  ZONE 4 - WETLAND AREA
-  ZONE 5 - TEMPORARY ACCESS AREA - PLANT WITH TEMPORARY SEED MIX



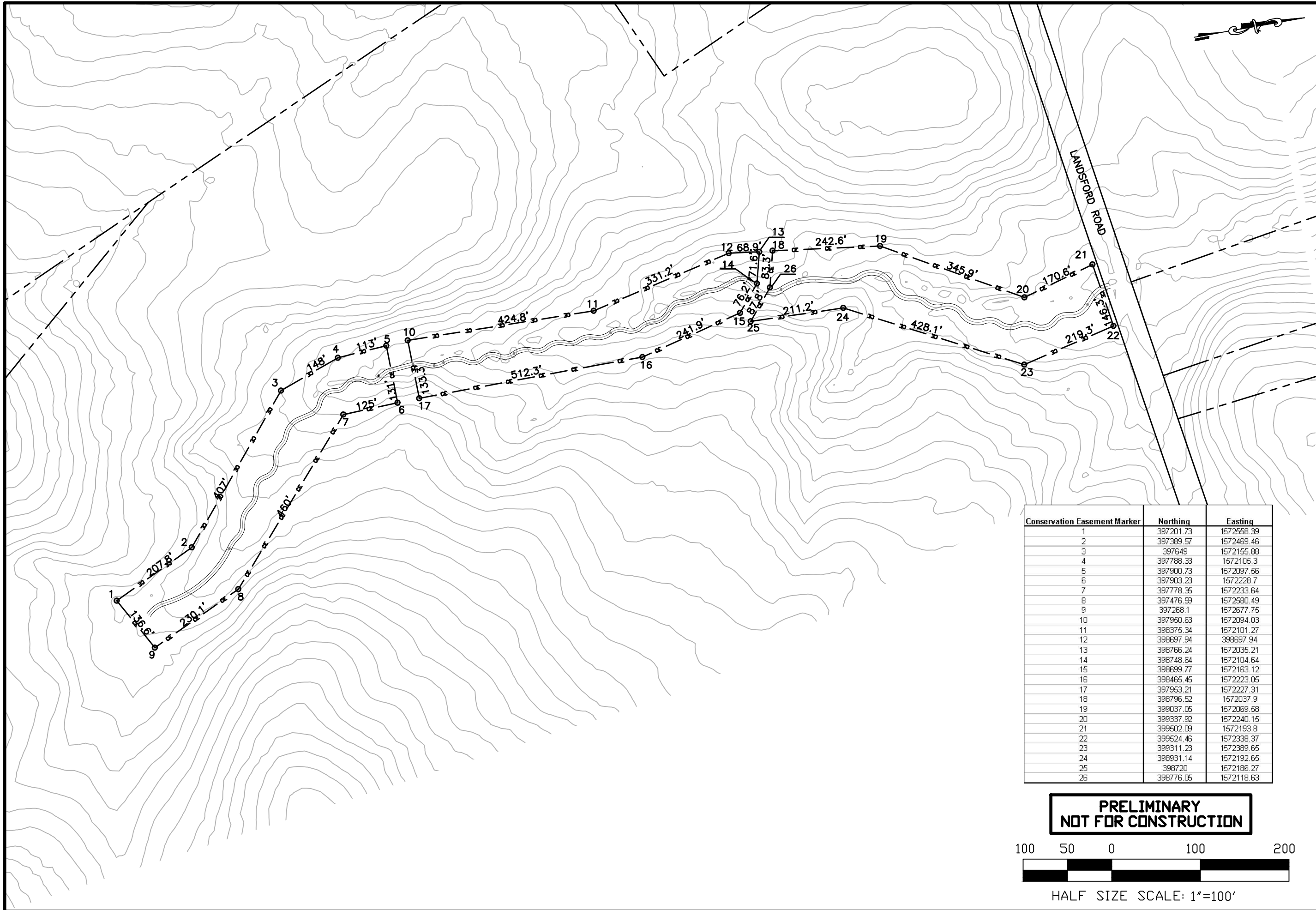
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601 EAST
 PLANTING PLAN (RELIC CHANNEL)
 STATION 54+00 TO 58+68.63
 UNION COUNTY, NORTH CAROLINA

DATE:	5 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Planting Plan
SCALE:	1"=20'
MITIGATION PLAN SET	
SHEET NO.	VP12



Conservation Easement Marker	Northing	Easting
1	397201.73	1572558.39
2	397389.57	1572469.46
3	397649	1572155.88
4	397788.33	1572105.3
5	397900.73	1572097.56
6	397903.23	1572228.7
7	397778.35	1572233.64
8	397476.59	1572580.49
9	397268.1	1572677.75
10	397950.63	1572094.03
11	398375.34	1572101.27
12	398697.94	398697.94
13	398766.24	1572035.21
14	398748.64	1572104.64
15	398699.77	1572163.12
16	398465.45	1572223.05
17	397953.21	1572227.31
18	398796.52	1572037.9
19	399037.05	1572069.58
20	399337.92	1572240.15
21	399502.09	1572193.8
22	399524.46	1572338.37
23	399311.23	1572389.65
24	398931.14	1572192.65
25	398720	1572186.27
26	398776.05	1572118.63

**PRELIMINARY
NOT FOR CONSTRUCTION**



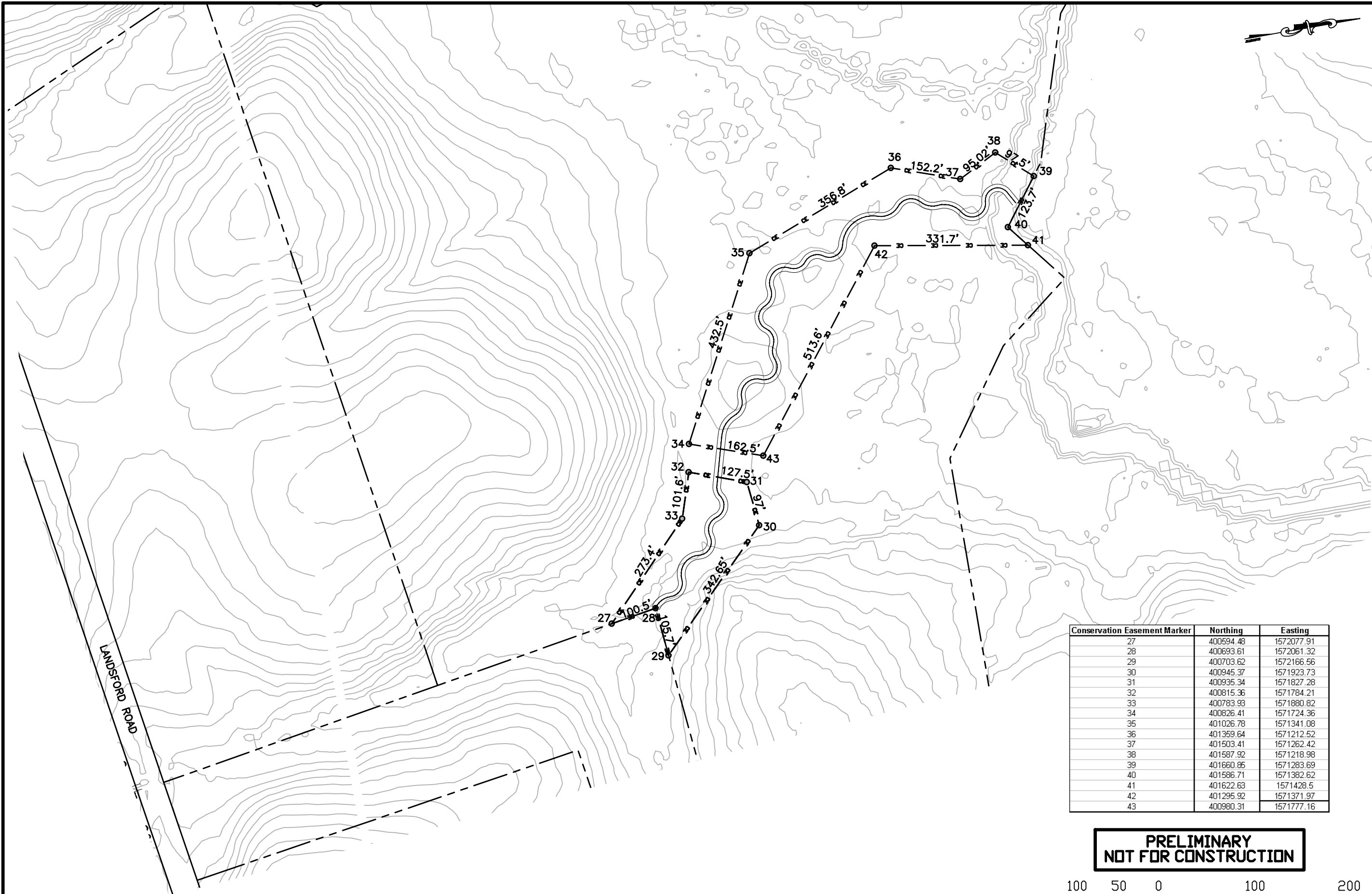
HALF SIZE SCALE: 1"=100'

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**CONSERVATION EASEMENT
MARKING PLAN ABOVE
LANDSFORD ROAD
601 EAST
UNION COUNTY, NORTH CAROLINA**

DATE: 5 SEPT 2013
 REVISIONS:
 PROJECT NAME:
 601 East
 DWG NAME:
 Conservation Marking Plan
 SCALE:
 1"=100'
 MITIGATION
 PLAN SET
 SHEET NO.
CEM1



Conservation Easement Marker	Northing	Easting
27	400594.48	1572077.91
28	400693.61	1572061.32
29	400703.62	1572166.56
30	400945.37	1571923.73
31	400935.34	1571827.28
32	400815.36	1571784.21
33	400783.93	1571880.82
34	400826.41	1571724.36
35	401026.78	1571341.08
36	401359.64	1571212.52
37	401503.41	1571262.42
38	401587.92	1571218.98
39	401660.86	1571283.69
40	401586.71	1571382.62
41	401622.63	1571428.5
42	401295.92	1571371.97
43	400980.31	1571777.16

**PRELIMINARY
NOT FOR CONSTRUCTION**



HALF SIZE SCALE: 1"=100'

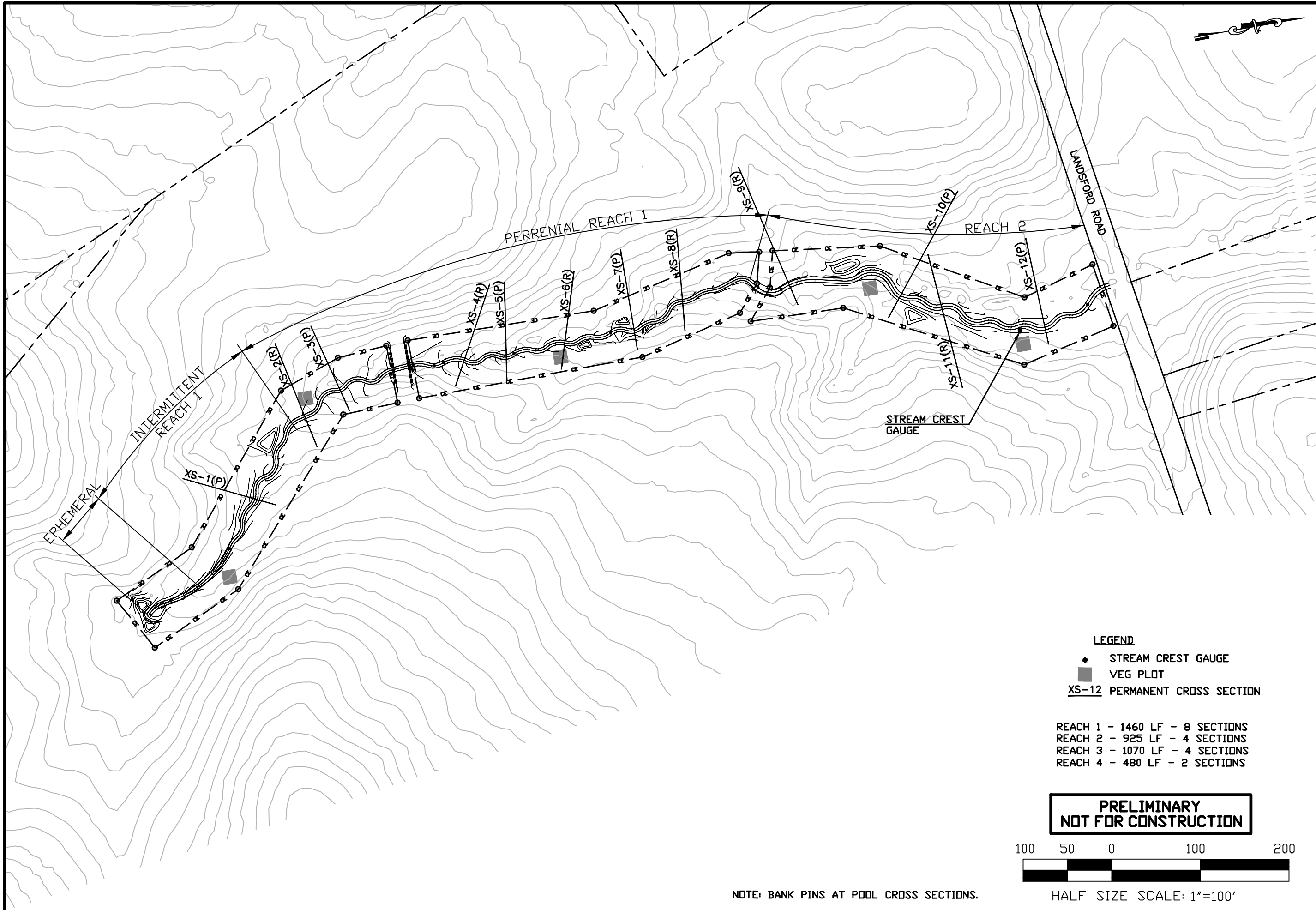
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**CONSERVATION EASEMENT
 MARKING PLAN BELOW
 LANDSFORD ROAD
 601 EAST
 UNION COUNTY, NORTH CAROLINA**

DATE: 5 SEPT 2013
 REVISIONS:
 PROJECT NAME:
 601 East
 DWG NAME:
 Conservation Marking Plan
 SCALE:
 1"=100'
 MITIGATION
 PLAN SET
 SHEET NO.
CEM2

Appendix E. Preliminary Monitoring Plans



LEGEND

- STREAM CREST GAUGE
- VEG PLOT
- XS-12 PERMANENT CROSS SECTION

REACH 1 - 1460 LF - 8 SECTIONS
 REACH 2 - 925 LF - 4 SECTIONS
 REACH 3 - 1070 LF - 4 SECTIONS
 REACH 4 - 480 LF - 2 SECTIONS

**PRELIMINARY
 NOT FOR CONSTRUCTION**



HALF SIZE SCALE: 1"=100'

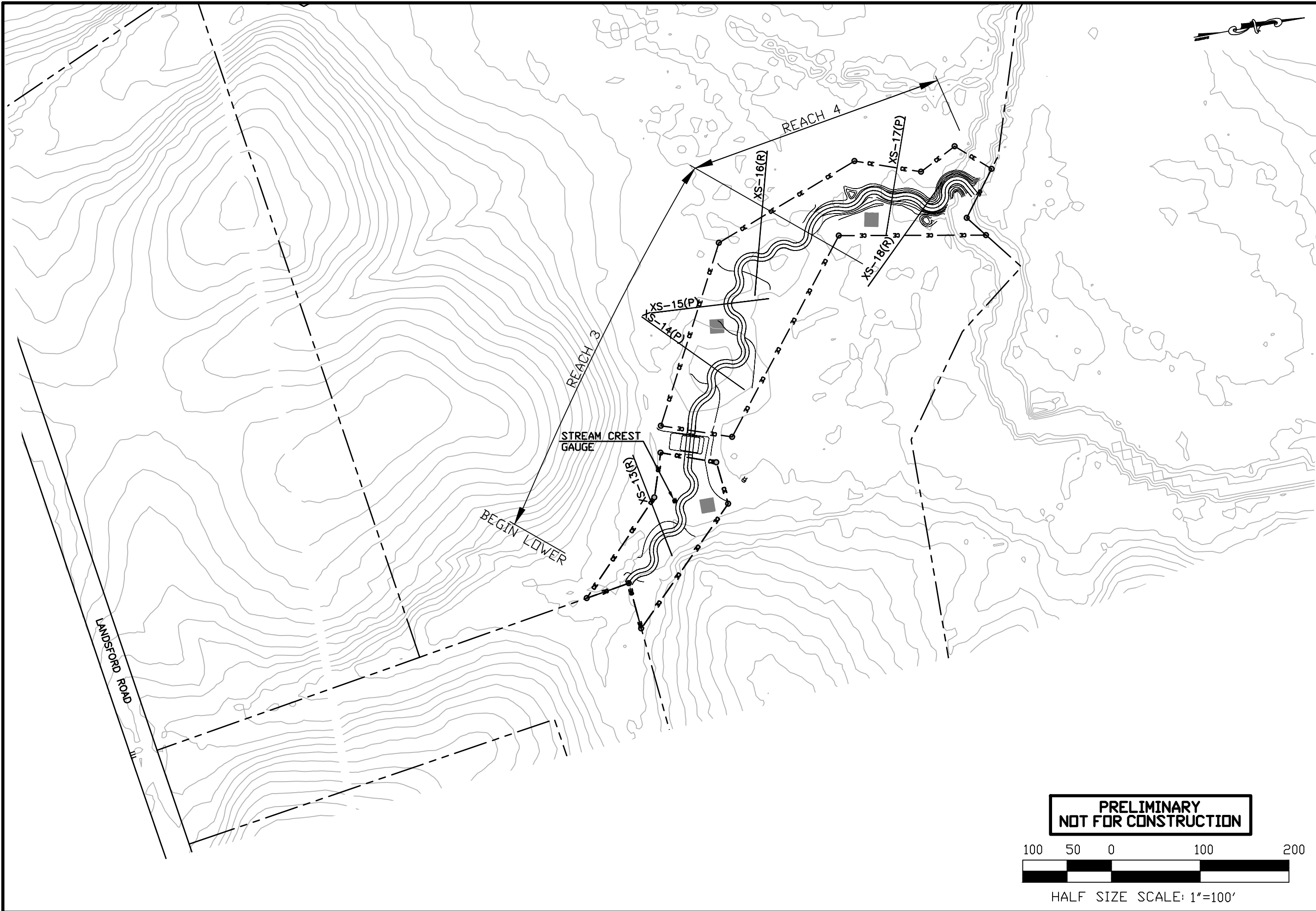
NOTE: BANK PINS AT POOL CROSS SECTIONS.

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**PRELIMINARY MONITORING PLAN
 ABOVE LANDSFORD ROAD
 601 EAST
 UNION COUNTY, NORTH CAROLINA**

DATE:	25 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Preliminary Monitoring Plan
SCALE:	1"=100'
MITIGATION PLAN SET	
SHEET NO.	PM1



**PRELIMINARY
NOT FOR CONSTRUCTION**



HALF SIZE SCALE: 1"=100'

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**PRELIMINARY MONITORING PLAN
 BELOW LANDSFORD ROAD
 601 EAST
 UNION COUNTY, NORTH CAROLINA**

DATE:	25 SEPT 2013
REVISIONS:	
PROJECT NAME:	601 East
DWG NAME:	Preliminary Marking Plan
SCALE:	1"=100'
MITIGATION PLAN SET	
SHEET NO.	PM2