MITIGATION PLAN ADDENDUM - FINAL

Shadrick Creek Restoration Project
McDowell County, North Carolina
EEP Project No. 92916
SCO Project ID 08-0739102

Catawba River Basin
Cataloging Unit 03050101

Prepared for:

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

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Prepared by:

Confluence Engineering, PC
16 Broad Street
Asheville, NC 28801
828.255.5530

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EXECUTIVE SUMMARY

This Mitigation Plan Addendum is being submitted as a follow up to the Mitigation Plan dated May 18, 2010 by Kimley-Horn and Associates, Inc. (KHA). The Mitigation Plan was reviewed by the Interagency Review Team and a §404 permit (Action ID SAW-2010-00764) was issued on August 27, 2010. The purpose of this addendum is to document our analyses and revised design approach in support of an amended 404/401 permit application.

The Shadrick Creek Restoration Project (project) will be used to fulfill stream mitigation requirements accepted by the EEP for the Catawba River Basin (CU 03050101). Through this project, EEP proposes to restore and enhance approximately 5,324 linear feet (LF) of Shadrick Creek and approximately 3,179 LF of three unnamed tributaries (UT) to Shadrick Creek. The project will also preserve 3,835 LF of five UTs, enhance 0.53 acre of existing wetland, remove invasive plant species across the project, establish native riparian buffers, install over 8,000 LF of livestock fencing, and construct alternative watering devices.

The project is located within an EEP Targeted Local Watershed (Shadrick Creek, lower Muddy Creek, HUC 03050101030060), as documented within the 2009 River Basin Restoration Priorities (RBRP) for the Upper Catawba River Basin. Furthermore, the project site is within a priority subwatershed for stream and wetland restoration as identified within the RBRP. Primary stressors within the subwatershed include habitat and riparian buffer degradation.

The purpose of this addendum is to document a revised design approach. Project background and non-design elements of the KHA Mitigation Plan are unchanged and the recorded conservation easements will not change. The revised design will use more of the existing channels and will incorporate bio-engineering measures and in-stream structures to address instability and habitat degradation. The revised design is expected to result in greater benefit and less impact to the natural resources at the site.

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1.0 PROJECT GOALS AND OBJECTIVES

The EEP develops River Basin Restoration Priorities (RBRP) to guide its restoration activities within each of the state's 54 cataloging units. RBRPs 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 EEP planning and restoration project funds.

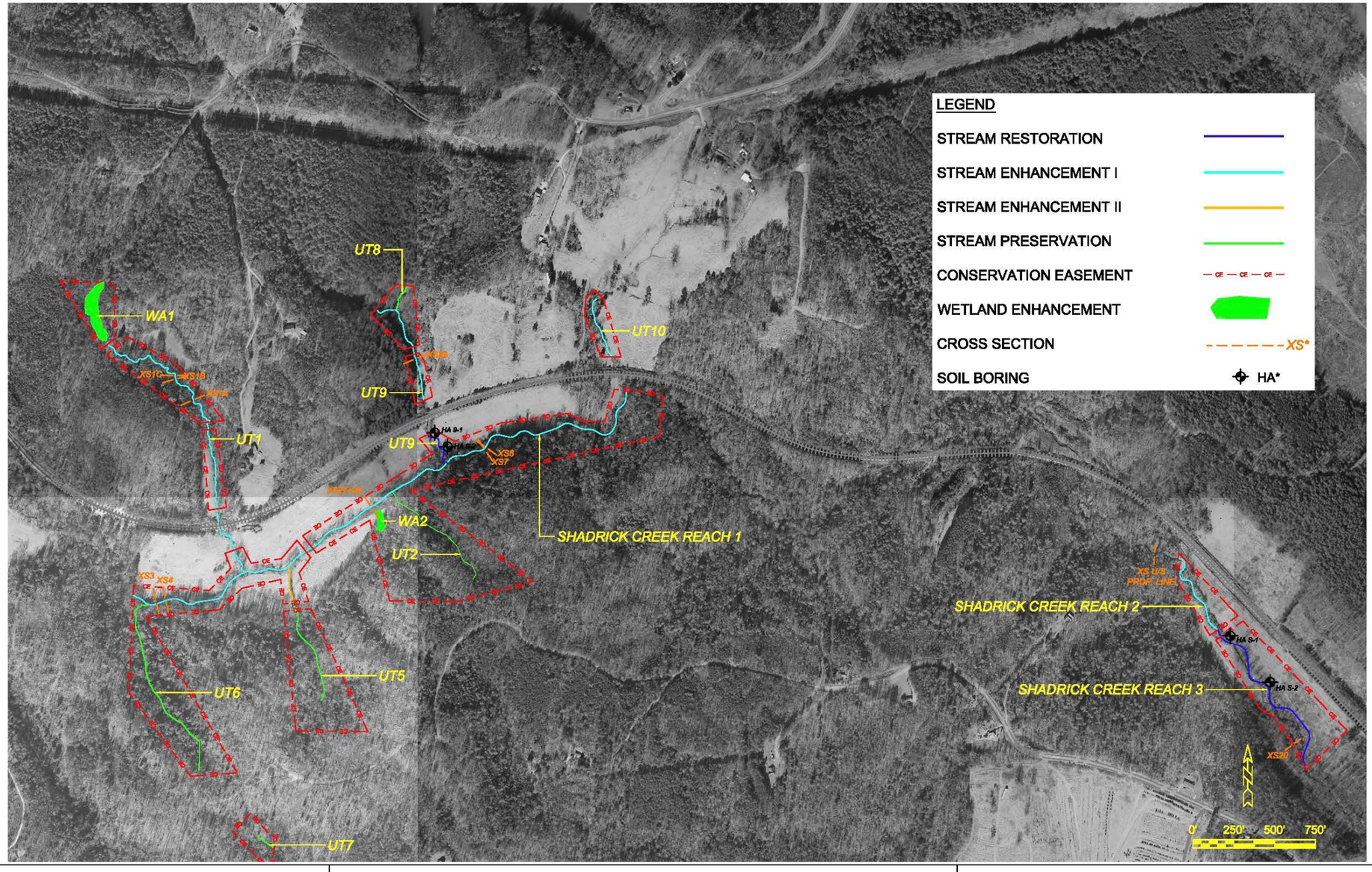
The project goals address stressors identified in the TLW and priority subwatershed, and include the following:

- Improve water quality by repairing eroding stream banks, establishing riparian buffers and implementing agricultural best management practices;
- Improve the community structure of the buffers;
- Improve stream function and habitat by re-establishing stream-to-floodplain connections;
- Restore long-term stability through the restoration of channel dimension, pattern and profile;
- Improve in-stream habitat using in-stream structures; and
- Remove exotic invasive plant species.

Specific project objectives include:

- Restoration and enhancement of approximately 5,276 LF of Shadrick Creek;
- Restoration and enhancement of 3,179 LF of UT's 1, 5, 9 and 10;
- Preservation of 3,835 LF of UT's 2, 5, 6, 7 and 8;
- Enhancement of 0.53 acre of wetland by improving hydrologic connections and vegetation communities;
- Installing over 8,000 LF of livestock fence, three wells and six watering tanks; and
- Establishment of riparian buffers by removing exotic invasive plants and installing a variety of native vegetation.

2.0 UPDATED BASELINE INFORMATION



Scale: As Shown	Shadrick Creek Restoration McDowell County, NC	Figure 1: Project Site Map

2.1 General Observations

The initial topographic survey of the project site was performed by W.K. Dickson & Co., Inc. (WKD) in 2009. KHA staff supplemented this topographic survey with a detailed geomorphic survey, including several cross sections and longitudinal profiles. Based on our review of these data and our observations of current site conditions, we believe the WKD and KHA data are still valid. While several areas of active erosion identified during the initial survey are still actively eroding, the erosion does not appear to have affected stream patterns and profiles significantly.

Cattle continue to have unrestricted access to Shadrick Reach 1 (upstream of the Norfolk Southern Railway right-of-way) and UTs 5, 8, 9 and 10. Floodplain and bank vegetation along UT1 and Shadrick Reach 2 appears to have matured somewhat since the KHA study, but the riparian buffers are still sparse.

2.2 Data Review and Additional Data Collection

As a starting point for our site assessment, we reviewed the following data collected by KHA during their site assessment and imported these data into the RIVERMorph software:

- Nine cross sections and five longitudinal profiles on Shadrick Creek;
- Eight cross sections and four longitudinal profiles on UT1;
- Four cross sections and one longitudinal profile on UT9
- One cross section each on UTs 2, 5 and 10;
- Eight pebble counts and one bulk sample on Shadrick Creek;
- Three pebble counts on UT1;
- One pebble count on UT5;
- The 2009 WKD topographic survey; and
- Several photographs

In order to check the validity of the WKD and KHA data sets and to supplement these data with geomorphic and sediment data we deemed necessary for our analysis, we collected the following additional data:

- One cross section each on Shadrick Creek Reaches 1 and 2;
- One cross section about 200 LF upstream of Shadrick Reach 2;
- Three cross sections on UT1;
- One cross section on UT9;
- Five pebble counts and six bulk samples on Shadrick Creek, UT1 and UT9; and
- Several photographs.

We also performed the qualitative evaluations of the current conditions, including:

- Identification of desirable native woody species;
- Location of non-native species infestations;
- Bank and bed stability; and
- Site constraints, including rights-of-way, fences and the proposed ford crossings.

A comparison of our surveyed cross sections indicated that, while our judgments of bankfull indicators may be somewhat different, the channel cross sectional areas we surveyed are in close agreement to those surveyed in 2009. Our sediment data are also similar to the KHA data set. For example, in Shadrick Reach 1, the D_{50} of the KHA "entrainment" pebble counts ranged from 14 mm to 57 mm (an average of 23 mm) while our riffle pebble counts indicated a D_{50} ranging from 23 mm to 40 mm (an average of 29 mm). These comparisons give us confidence that the KHA data, when combined with our data, provide a complete baseline data set from which to develop the revised design.

The additional geomorphic data are summarized in Appendix A. The KHA data set is not repeated herein. Recent site photographs are included in Section 2.3 below.

2.3 **Current Site Photographs**

Shadrick Creek Reach 1, looking downstream near station 12+00; 10/29/12

Shadrick Creek Reach 1, looking south at UT5 confluence near station 20+50; 4/9/13

Shadrick Creek Reach 1, looking downstream near at 26+50; 4/9/13

Shadrick Creek Reach 1, looking downstream at station 43+00; 5/30/13

Shadrick Creek Reach 2, looking downstream at station 101+50, 11/9/12

Shadrick Creek Reach 3, looking upstream from station 111+00; 11/9/12

UT1, looking downstream near station 13+50; 4/10/13

UT1, looking downstream near station 18+00; 4/10/13

UT1, looking upstream near station 22+00; 4/10/13

UT1, looking downstream at reach 2 from NS railway; 4/10/13

UT9, looking downstream near station 12+50, 5/30/13

UT10, looking downstream near station 12+00; 5/30/13

UT2, looking west; 10/29/12

UT5 Enhancement Reach, looking upstream; 5/30/13

UT6, looking downstream near Shadrick confluence; 4/9/13

UT8, looking downstream from near upstream end of preservation reach; 4/10/13

WA1, looking north, 4/10/13

WA2, looking north; 10/29/12

3.0 MITIGATION APPROACH

Descriptions of each project component with proposed treatments are presented in Table 1 below. Buffer mitigation credits are proposed for stream reaches where the planted buffer within the conservation easements will extend at least 50 feet from the top of the bank. The projected mitigation credits are presented in Table 2. Mitigation credits presented in Table 2 are projections based on the proposed design. Upon completion of site construction, the mitigation credit for each project component will be revised as needed to be consistent with the as-built conditions.

Table 1. Component Descriptions

Reach	Characteristics and Uplift Discussion
Shadrick Creek Reach 1	Impacted by livestock access, agricultural practices, and vegetation removal; widespread bank erosion and mid-channel deposition; some mature trees and shrubs worthy of protection; privet infestation; bedrock visible in profile multiple locations; 0.09 acre wetland on right floodplain; planned ford crossing at 22+20.
	Uplift gained by a combination of on-line bank sloping, floodplain benching, bioengineering and in-stream structures. Buffers will be planted with native trees and shrubs. Existing wetland will be protected during construction.
Shadrick Creek Reaches 2 and 3	Impacts due to historic agricultural practices, including recent tree farming; bank erosion at outside meander bends and mid-channel deposition; planned ford crossing at 106+00; small pocket wetlands on right floodplain.
	Uplift gained by bank sloping, floodplain benching, off-line channel construction, bioengineering, in-stream structures, and planted buffers. Existing wetlands will be protected during construction.
UT1	Impacted by historic livestock access, buffer vegetation removal and channel incision; bank erosion common at outside meander bends. Work reaches bisected by railroad right-of-way; some mature trees in downstream reach.
	Uplift gained by on-line bank sloping and benching, bioengineering and in-stream structures. Buffers will be planted with native trees and shrubs. Planned ford crossings in both upstream and downstream reaches.
UT5	Impacted by livestock access and buffer vegetation removal; abundant alder and sycamore on banks; privet infestation. Upstream wooded reach is stable and will be preserved.
	Uplift gained by privet removal and establishment of wider and more diverse buffers. Planned ford crossing at break between enhancement and preservation reaches.
UT9	Impacted by livestock access and buffer vegetation removal; dam and pond at headwaters. Wooded UT8 is functioning well and will be preserved.
	Uplift gained by on-line bank sloping and benching, bioengineering and in-stream structures. Buffers will be planted with native trees and shrubs. Planned ford crossing will replace culvert mid-reach.
UT10	Impacted by livestock access and buffer vegetation removal; large headcut at headwaters has been filled with debris.
	Uplift gained by on-line bank sloping and benching, bioengineering and in-stream structures. Buffers will be planted with native trees and shrubs.
Wetland A	Wetland is located at headwaters of UT1. Impacted by vegetation removal and minor infestation of non-native species. Hydrology appears largely intact but is threatened by headcut at upstream end of UT1.
	Uplift gained by stabilization of UT1 headwaters, removal of non-native species and supplemental planting.
Wetland B	Impacted by vegetation clearing and livestock access.
	Uplift gained by supplemental planting.

Table 2: Projected Mitigation Credits

Shadrick Creek Restoration Project
McDowell County, North Carolina
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Mitigation Credits *

Stream SMUs					Wetland WMUs	Buffer SF
Type	**R**	**EI**	**EII**	**P**	**E**	**527,000**
Totals	**1,353**	**4,615**	**91**	**767**	**0.27**	

Project Components *

Project Component - or- Reach ID	Stationing/Location	Existing Thalweg LF or AC	Approach	Restoration - or- Restoration Equivalent	Proposed LF or AC *	Mitigation Ratio	Buffer SF
Shadrick Reach 1	STA 10+00-46+86	3,686	P3	EI	3,641	1.5:1	199,000
Shadrick Reach 2	STA 100+00-105+75	595	P3	EI	575	1.5:1	226,000
Shadrick Reach 3	STA 105+75-117+29	1,168	P2	R	1,108	1:1	
UT1	STA 10+00-30+68	1,637	P3	EI	1,637	1.5:1	46,000
UT5	STA 1665-1893	228	Buffer	EII	228	2.5:1	Incl. in Shadrick R1
UT's 2, 5, 6, 7 & 8**	-	3,835	Preservation	P	3,835	5:1	-
UT9 Reach 1	10+00-17+23	678	P3	EI	678	1.5:1	34,000
UT9 Reach 2	19+59-22+04	237	P2	R	245	1:1	
UT10	10+00-13+91	391	P3	EI	391	1.5:1	21,000
Wetland A	-	0.44	Stab./Buffer	E	0.44	2:1	-
Wetland B	-	0.09	Buffer	E	0.09	2:1	-

Component Summary

Restoration Level	Proposed Amount
Streams	
Restoration	1,353 LF
Enhancement I	6,922 LF
Enhancement II	228 LF
Preservation	3,835 LF
Buffer : 527,000 SF	
Wetlands	
Enhancement	0.53 AC

* Mitigation credits and stream lengths account for breaks in conservation easements.
** UT3 and UT4 were determined to be non-jurisdictional.

4.0 MITIGATION WORK PLAN

4.1 Channel Evolution Discussion

As discussed in the KHA Mitigation Plan, streams at the project site have been impacted by buffer vegetation removal and livestock trampling. It appears that some sections of Shadrick Creek have been straightened and channelized, particularly between stations 20+00 and 31+00. The channel in this reach is considerably straighter than adjacent reaches, and the low point of the valley is to the left of the existing channel. Elsewhere along Shadrick Creek, levees are present, mainly on the left bank and likely consisting of dredge spoils.

The combination of bank vegetation removal, trampling and levee placement has led to incised conditions and bank erosion. Near station 43+00, the former stream bed materials are visible on the bank roughly 1 to 2 feet above the current thalweg, giving a general indication of the level of incision. Bedrock is common throughout the Shadrick Creek profile; this bedrock has prevented even deeper incision. In response to the vertical constraint, the channel has widened, which in turn has led to mid-channel sediment deposition in areas where the sediment transport competence and/or capacity has been reduced. Bank erosion is further accelerated in areas of mid-channel deposition where flow energies are directed toward already raw banks. This is the main problem in Shadrick Creek Reaches 2 and 3.

The tributaries flow through valleys that are steeper and more confined than the Shadrick Creek valley. The same impacts that have left Shadrick Creek in a degraded state have impacted the tributaries, chiefly UTs 1, 5, 9 and 10. Other than UT5 Reach 2, the tributary channels do not appear to have been straightened or moved from the low point of their valleys. The preservation reaches of UTs 2, 5, 6, 7 and 8 were either impacted to a lesser degree or have recovered from past impacts to the point where intervention is not warranted.

4.2 Target Streams

The project addresses the primary water quality stressors described in the Upper Catawba River Basin Restoration Priorities Plan (2009). The project design will restore, enhance and protect where appropriate threatened ecological services in the project area. The proposed designs will address channel incision by promoting more frequent stream-to-floodplain interaction and the associated energy dissipation effects a functioning floodplain will provide. The conservation easement boundaries will encompass riparian buffers and two wetlands at the site.

Table 3 below summarizes the links between each design objective and the ecological service improvements that can be achieved on a reach-by-reach basis.

Table 3: Design Objectives and Ecological Services						
Design Objective	**Enhanced Ecological Services**	**Project Reach**				
		Shadrick Reaches 1 and 2	**Shadrick Reach 3**	**UT's 1, 9 (R1) and 10**	**UT9 Reach 2**	**UT5**
Create bankfull benches; restore stream to floodplain interaction.	a. Reduction in channel shear stresses will protect in-stream habitats b. Flood attenuation c. Fine sediment storage	✓	✓	✓	✓	
Create new channel dimension, pattern and profile	a. Maintenance of stable channel bed and banks. b. Equilibrium sediment transport c. Maintenance of in-stream riffle and pool habitats		✓		✓	
Use in-stream structures and bank grading to promote stability, riffle and pool formation and sediment transport continuity for on-line reaches.	a. Maintenance of stable channel bed and banks. b. Equilibrium sediment transport c. Maintenance of in-stream riffle and pool habitats	✓	✓	✓	✓	
Establish riparian buffers with diverse group of native species.	a. Filtration of runoff b. Thermal regulation c. Input of organic matter	✓	✓	✓	✓	✓
Remove invasive exotic vegetation and seed source; replant buffer areas with native vegetation.	a. Riparian buffer habitat b. Robust species diversity	✓	✓	✓	✓	✓

4.3 Design Methodology and Data Analyses

The design methodology incorporated both form-based and analytical approaches, using a combination of reference reach data, reference cross sections within the project reaches, statistical relationships and hydraulic analyses to arrive at a design discharge for each reach. We then used the design discharges to develop riffle and pool typical sections, profiles and pattern through an iterative process. The following sections summarize each phase of the methodology; supporting calculations and data are included in Appendix A.

4.3.1 Reference Reaches and Reference Sections

The primary reference for Shadrick Creek Reach 1 is the short reach of Shadrick Creek between stations 10+00 and 11+60. KHA surveyed a riffle and a pool cross section in this reach, and aside from some bank erosion and a bank height greater than bankfull, both cross sections are stable and appear to be functioning. These cross sections serve primarily as dimension and design discharge references. For Shadrick Creek Reaches 2 and 3, Confluence surveyed a relatively stable cross section upstream of the Reach 2 limits. As with the Reach 1 reference sections, this section serves primarily as a dimension and design discharge reference. Sediment samples collected near each reference site provided information about critical discharge values required to mobilize pavement materials (Andrews and Nankervis, Bathurst, et al). We also considered the dimensions and bank slopes of cross sections within the project reach where bankfull indicators were evident. These include two cross sections surveyed by Confluence (at 27+00 and 115+00 as well as KHA cross sections 7 and 9.

For UT1, Reach 1 of UT9, and UT10, the design approach is to excavate bankfull benches where space allows and grade unstable banks where appropriate. The primary reference for these reaches is the bankfull stage that guides the stage at which to excavate the benches and the bankfull discharge.

Surveyed cross sections within relatively stable project reaches provide indications of bankfull stage and discharge.

For Reach 2 of UT9, we consulted the stable cross sections for a discharge reference and typical dimensionless ratios from past projects for morphological parameters such as width-depth ratio and radius of curvature ratio.

Morphological data comparisons between the existing, design and reference data sets are included in Appendix A.

4.3.2 Design Discharge

In order to evaluate a range of design discharges, we evaluated regional regression equations, analyzed field bankfull indicators using hydraulic modeling (HEC-RAS and RIVERMorph), and considered sediment transport competence using critical discharge for initiation of bed material mobility. We also developed effective discharge predictions based on sediment transport estimates at varying discharges. For the effective discharge calculations, we used daily streamflow data from a USGS stream gauge on Jacobs Fork, scaled down to the Shadrick Creek drainage area, coupled with predicted sediment transport rates. (Jacobs Fork is a 26-square mile drainage in Burke County and is the closest gauge to the site.)

Our selected design values are based primarily on hydraulic models using cross sections with reliable bankfull indicators, in each case a well-defined bench or break in slope. We built a reach-wide HEC-RAS model of Shadrick Creek from surveyed cross sections and extracted channel geometry from the base topographic mapping. This existing conditions model accounts not only for geometry, but also for varying floodplain and channel roughness, which allowed us to adjust discharge until the stage matched the stable bankfull indicators. For the tributaries, we used the RIVERMorph stage-discharge function to estimate discharge at stages corresponding to field bankfull indicators. In general, of the discharge predictions, we are most confident in the modeled values because they are based on site-specific, reach-wide measurements rather than average regional conditions or empirical formulae.

As indicated in Table 4, there is reasonable agreement in the predicted design discharge values. The USGS 2-year estimate typically provides an upper bound on the bankfull discharge.

Table 4: Design Discharge Estimates (cfs)

Reach	NC Mountain/ Piedmont Regional Curves	USGS 2-year NC HR1	Hydraulic Model using Field Indicators	Critical Discharge (Pavement Samples)	Effective Discharge Scaled from Jacobs Fork Gauge	Selected Design Value
Shadrick Creek Reach 1	220 / 187	308	200-250	176-291	253	230
Shadrick Creek Reaches 2 & 3	248 / 209	341	270-320	n/a	n/a	300
UT1	17 / 18	37	20-30	n/a	n/a	24
UT9	18 / 19	37	23	n/a	n/a	18
UT10	7 / 7	17	25	n/a	n/a	7

4.3.3 Sediment Transport

A qualitative sediment transport assessment of project site reveals the following general conditions:

- The culverts beneath the railroad tracks on UTs 1, 9 and 10 disrupt sediment transport through these streams, but bankfull discharges appear to pass through the culverts and sediment supply is low; the consequences of this disruption do not appear to have greatly affected channel morphology.
- On Shadrick Creek, particularly in Reaches 2 and 3, excess fine sediment is being supplied to the reach from widespread bank erosion and modest backwater effects from a railroad crossing about ½ mile downstream appear to promote deposition. Much of the fine sediment is being deposited on bench features during flood events, but some of the fines are settling in riffles.
- Gravel and small cobble sized bed materials appear to be moving through Shadrick Creek and bars of fresh coarse sediment are visible throughout.
- Bedrock in the Shadrick Creek bed has fixed the longitudinal slope and prevented channel incision beyond what is evident today.

Our detailed sediment transport evaluation is focused on Shadrick Creek and much of the following discussion deals with Shadrick Creek in particular. As part of our sediment transport evaluations, we considered landscape position and the connections between the supply, project and downstream reaches. The primary sediment transport issue for Shadrick Creek relates to bank erosion and mid-channel deposition: in areas where the channel has become overly wide due to bank erosion or livestock trampling, the transport capacity has been diminished. The design attempts to create sediment transport continuity with less impacted supply reaches upstream of Reaches 1 and 2. On the tributaries, incised conditions have created greater shear stress on the bed and banks, resulting in greater transport competence and capacity than is healthy for the streams.

In terms of sediment transport *competence*, our analyses indicate the design streams will transport the size of the large bed materials sampled at the site. We attempted to mimic the discharge-shear profiles for the relatively stable existing cross sections up to the bankfull stage, with a shear break at the bankfull stage where bankfull benches are planned. The benches will effectively reduce boundary shear at discharges greater than bankfull, thereby addressing excess shear that is leading to bank erosion. When compared to an overly wide cross section at station 106+30, the design discharge-shear profile is greater up to and beyond the bankfull discharge, indicating that the potential for mid-channel deposition is reduced. When compared to an incised cross section at station 113+00, the design indicates lower shear stress throughout the discharge-shear profile.

We also evaluated sediment transport *capacity* using unit stream power as the indicator parameter. We compared existing and design stream power over a range of stages up to and above the bankfull stage. Hydraulic models (HEC-RAS and RIVERMorph) of the existing and design conditions were used to support the sediment transport analyses by providing hydraulic parameters such as hydraulic radius, slope, shear stress, and power.

Slope and cross section size and shape are the factors that determine stream power. Because the project will involve primarily on-line enhancement, slope is essentially unchanged and cross section shape and size become the design focus. As discussed in Section 4.3.4, there are geotechnical stability constraints for cross section design; the design attempts to optimize sediment transport capacity and bank stability within these constraints. Analyses indicate that the design unit stream power in the Shadrick Creek reaches is very similar to that in the relatively stable existing project reaches, up to the bankfull stage. Excess stream power will be dissipated on bankfull benches, thereby addressing channel incision and bank erosion problems. When compared to the overly wide, unstable section at station 106+30, the design unit stream power is slightly greater, indicating a reduction in the potential for mid-channel deposition. We anticipate the unit stream power profile in Shadrick Reaches 2 and 3 will more closely match that in the supply reach as bank vegetation becomes established and the width-to-depth ratio decreases. As with the competence comparison, stream power is reduced when compared to the existing incised section at station 113+00. Graphical output of these analyses is included in Appendix A.

At the tributaries, sediment supply is low and velocities are high. The main concern in the steep upstream reaches is down-cutting and the key design parameter is boundary shear. Comparisons of existing versus design boundary shear indicate reductions in the design shear beyond the bankfull stage. Shield's curve predictions indicate that the D_{50} of the planned constructed riffle materials will not be mobile during events up to twice the bankfull discharge and that an armor layer will remain to protect subgrade soils and the overall bed profile.

4.3.4 Cross Section

Design discharge and sediment transport analyses inform the design of cross section dimensions and shapes; cross section dimensions and shapes along with slope govern hydraulic parameters that are relevant to design. Past experience also informs the cross section design. For example, project monitoring over the past several years has indicated that a newly constructed E or C-type channel with a width-depth ratio less than about 10 can lead to stability problems. We evaluated reference cross sections as indications of bankfull area and general shape, but the design bank slopes are also governed by geotechnical stability needs during the monitoring period in areas where little or no deep-rooted vegetation will be present for the first few growing seasons. Ratios of pool-to-riffle depth and top width are based in part on reference reach data and in part on past experience.

4.3.5 Pattern and Profile

The proposed restorations of Shadrick Creek Reach 3 and UT9 Reach 2 include pattern changes in locations where existing meander bends are unstable and the opportunity exists to relocate the channel to the low point of the valley. At these pattern changes, the design meander geometry is based on a range of dimensionless ratios that have proven to be effective in meeting design objectives while promoting stability. The prime example for plan geometry is radius of curvature ratio; well-vegetated reference reaches suggest a radius of curvature ratio of 1.0 or less would be desirable, but experience indicates that a ratio less than about 1.8 places undue stresses on newly constructed banks that lack deep rooted vegetation. For the re-aligned portions of Shadrick Creek Reach 3 and UT9 Reach 2, the design radius of curvature ratio ranges from to 1.9 to 2.6.

4.3.6 In-Stream Structures

In-stream structure types and locations were selected based on design stability, habitat enhancement and sediment transport objectives within each reach. Table 5 below provides a summary of specific objectives for the proposed structures. Data and analyses supporting the sizing of stone for in-stream structures are provided in Appendix A.

Table 5. In-Stream Structures

Structure	Objectives
Geolifts and Brush Mattresses	a. Bank stability at channel plugs or sloped banks b. Quickly establish deep rooted bank vegetation c. Offers alternative to extensive bank sloping where space is limited
Log Vane	a. Direct flow toward center of channel and away from banks b. Promote sediment storage upstream and pool formation downstream
Constructed Riffle	a. Set grade in profile b. Provide roughness in bed c. Initiate riffle habitat and sediment transport equilibrium
Step Structure	a. Set grade in profile b. Provide roughness in bed c. Direct cascading flow to center and downstream plunge pool
Root Wad Cluster	a. Enhance bank stability b. Provide bank roughness c. Establish near-bank cover and pool habitat

4.4 Wetlands

KHA identified two jurisdictional wetlands at the site, WA1 and WA2, which combined measure ½ acre. KHA describes WA1 as having been recently impacted by logging activities. Recent observations indicate the vegetation communities have recovered somewhat after the logging in 2009, with a variety of pioneer tree species and abundant sedges (*carex spp*.) and rushes (*juncus spp.*) visible. The hydrology of wetland WA1 will be stabilized by addressing a headcut at the headwaters of UT1, which is the outlet of WA1. The hydrology of WA2 appears to be fairly stable, the source of which is a spring.

The conservation easement will protect both WA1 and WA2 and supplemental plating in the wetlands and along the adjacent riparian buffers will enhance their function. The supplemental planting plans will be developed based on appropriate wetland plant communities. Desirable species will be protected and non-native plants will be removed.

5.0 DEFINITIONS

D_x – with respect to sediment grain size distribution, the grain mean diameter which is larger than x% of the sample distribution

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

Native vegetation community – a distinct and reoccurring assemblage of populations 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 associated with the mitigation project

Priority Levels of Restoration – 1: convert incised stream to new stream at original floodplain elevation; 2: establish new stream and floodplain at existing stream elevation; 3: convert incised stream to new stream type without establishing an active floodplain but providing flood-prone area; 4: stabilize incised stream in place.

6.0 REFERENCES

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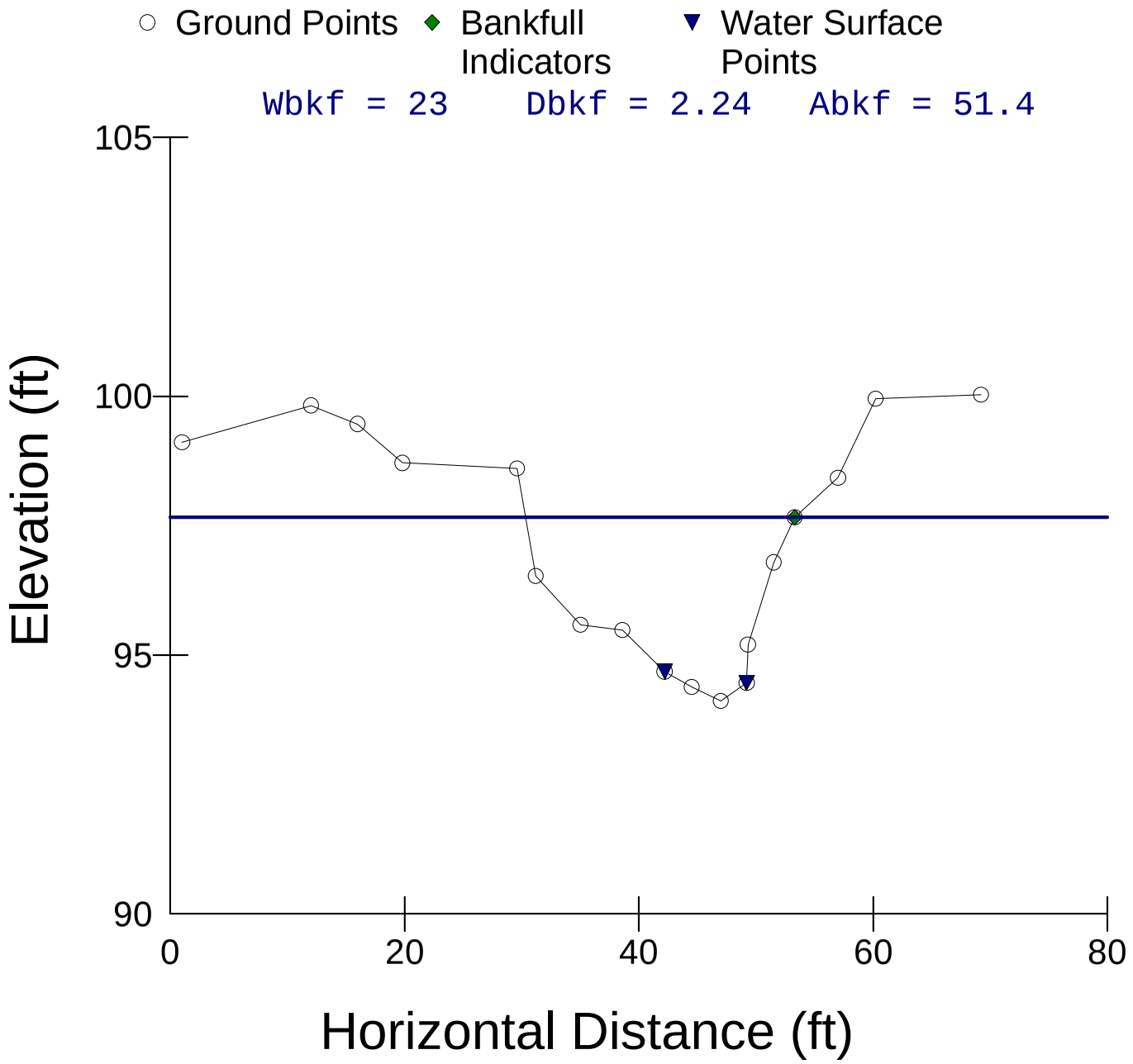
APPENDIX A

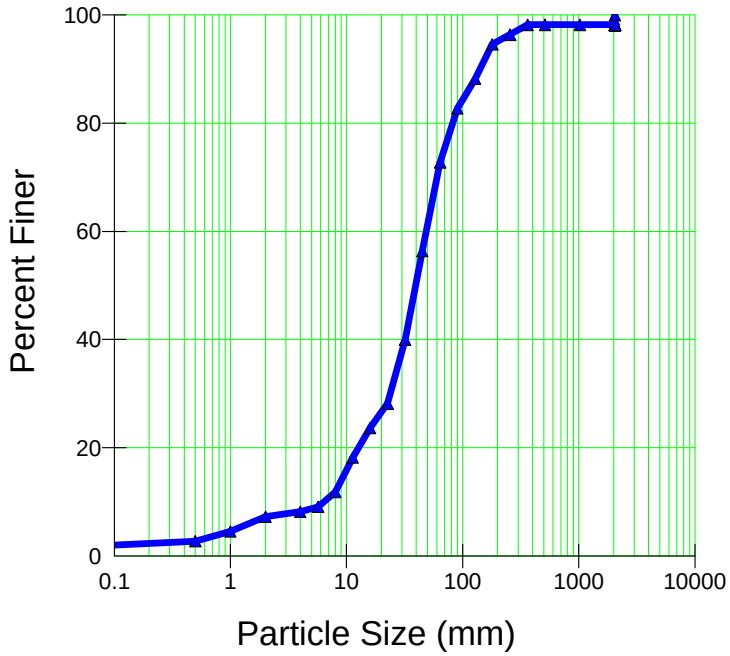
MITIGATION WORK PLAN DATA AND ANALYSES

Parameter	Existing Stream			Design Stream			Reference Stream		
	Min	Median	Max	Min	Median	Max	Min	Median	Max
Stream name	Shadrick Creek R1			Shadrick Creek R1			Shadrick Ck. Upstream		
Stream type	E4			C4			E4		
Drainage area, DA (sq mi)	2.8			2.8			2.5		
Mean riffle depth, d_{bkf} (ft)	2.4	2.6	2.8	2.2				1.8	
Riffle width, W_{bkf} (ft)	21.0	22.0	23.0	27.0				19.0	
Width-to-depth ratio, [W_{bkf}/d_{bkf}]	6.9	8.6	10.3	12.4				10.4	
Riffle cross-section area, A_{bkf} (sq ft)	51.4	57.5	63.5	58.5				34.5	
Max riffle depth, d_{mbkf} (ft)	3.6	3.6	3.7	3.0				2.1	
Max riffle depth ratio, [d_{mbkf}/d_{bkf}]	1.5	1.4	1.3	1.4				1.2	
Pool width, W_{bkfp} (ft)	19.4	21.2	23.0	38.5				19.4	
Pool width ratio, [W_{bkfp}/W_{bkf}]	0.9	1.0	1.0	1.4				1.0	
Pool cross-section area, A_{bkfp} (sq ft)	60.6	65.7	70.7	111.0				60.7	
Pool area ratio, [A_{bkfp}/A_{bkf}]	1.2	1.7	2.0	1.9				1.8	
Max pool depth, d_{mbkfp} (ft)	3.9	4.4	4.8	5.0				3.9	
Max pool depth ratio, [d_{mbkfp}/d_{bkf}]	1.6	1.7	1.7	2.3				2.2	
Low bank height, LBH (ft)	4.5	4.8	5.1	3.0				2.1	
Low bank height ratio, [LBH/d_{mbkf}]	1.3	1.3	1.4	1.0				1.0	
Width flood-prone area, W_{fpa} (ft)	68	74	80	100				32	
Entrenchment ratio, ER [W_{fpa}/W_{bkf}]	3.0	3.4	3.8	3.7				1.7	
Radius of curvature, Rc (ft)	34	61	149	34	61	149		60	
Radius of curvature ratio [Rc/W_{bkf}]	1.6	2.8	6.5	1.6	2.8	6.5		3.2	
Belt width, W_{blt} (ft)	66	70	162	66	70	162		65	
Meander width ratio [W_{blt}/W_{bkf}]	3.1	3.2	7.0	3.1	3.2	7.0		3.4	
Valley slope, VS (ft/ft)	0.0070			0.0070			0.0160		
Average water surface slope, S (ft/ft)	0.0053			0.0053			0.0089		
Sinuosity, k = VS/S (ft/ft)	1.32			1.32			1.80		
Bankfull discharge, Q_{bkf} (cfs)	220	273	326	220	230	240	127		
Bankfull mean velocity, u_{bkf} = Q/A (ft/s)	4.3	4.8	5.1	3.8	3.9	4.1		3.7	
D_{50} riffle (mm)	23	25	40	23	25	40		40	
D_{84} bar (mm)	10	35	135	10	35	135		106	
D_{100} bar (mm)	22	62	140	22	62	140		106	

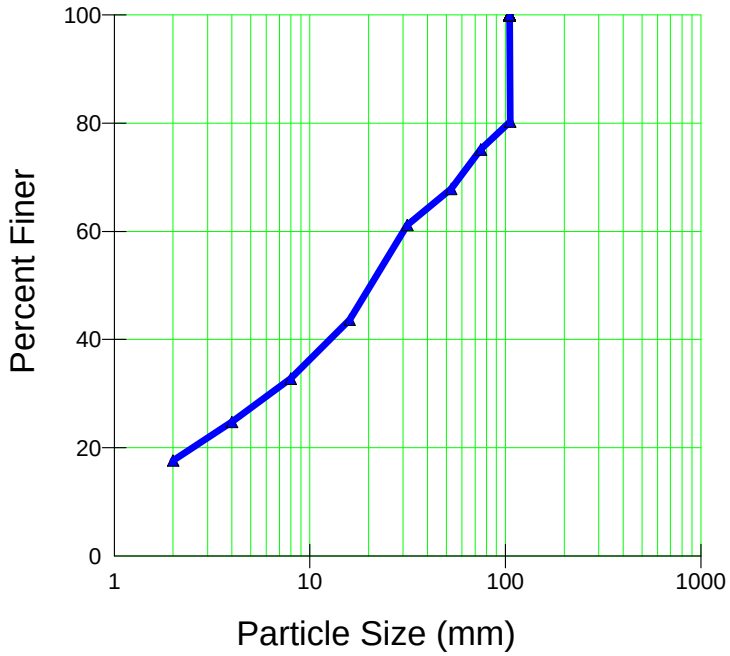
Shadrick XS near 27+00



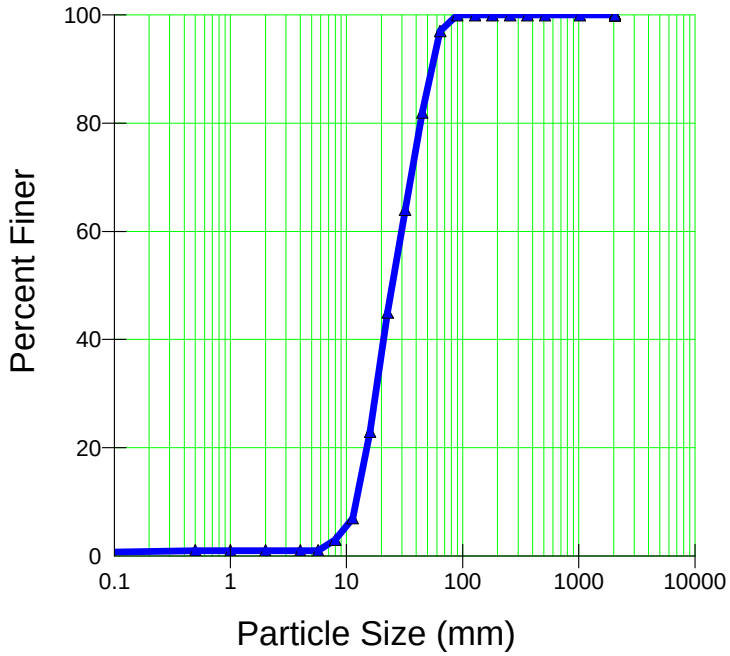
Shadrick Zigzag Riffle 12+00



Shadrick Bulk Sample 12+00



Shadrick Zigzag Riffle 26+00



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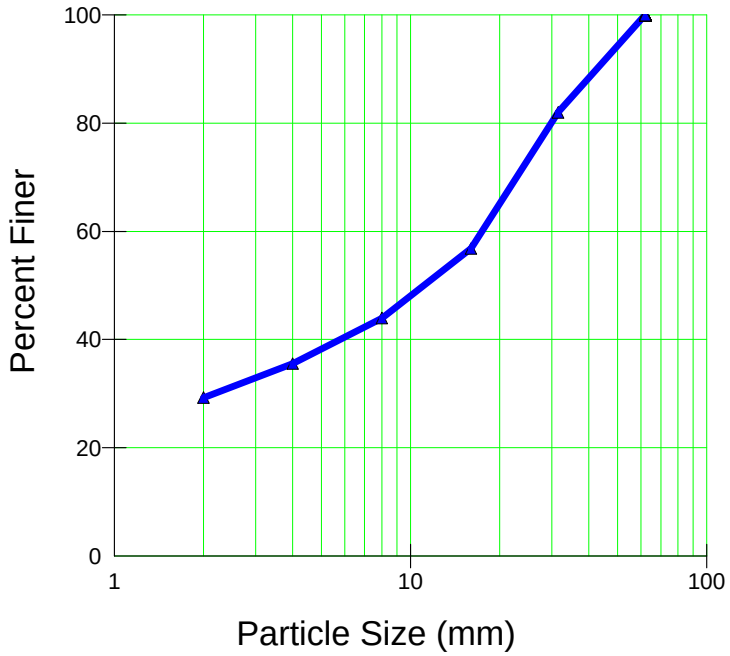
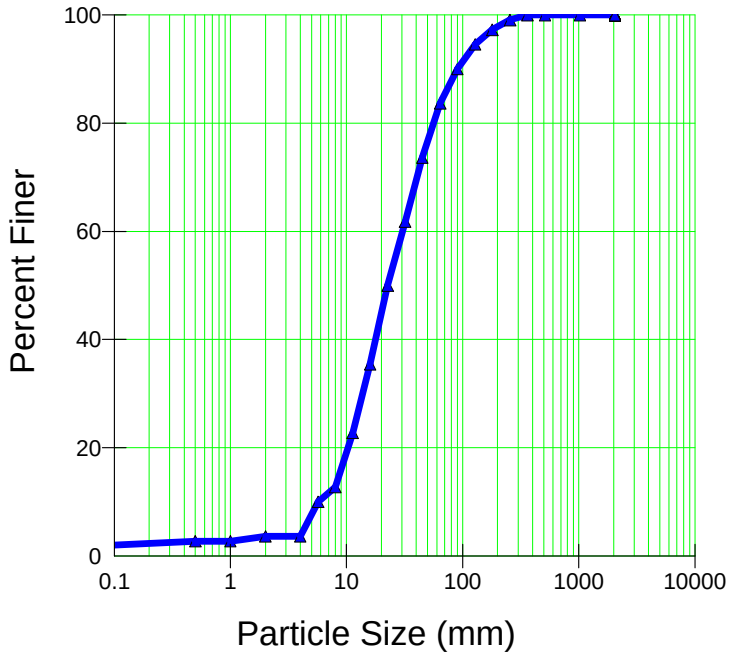


Shadrick Zigzag Riffle 35+00



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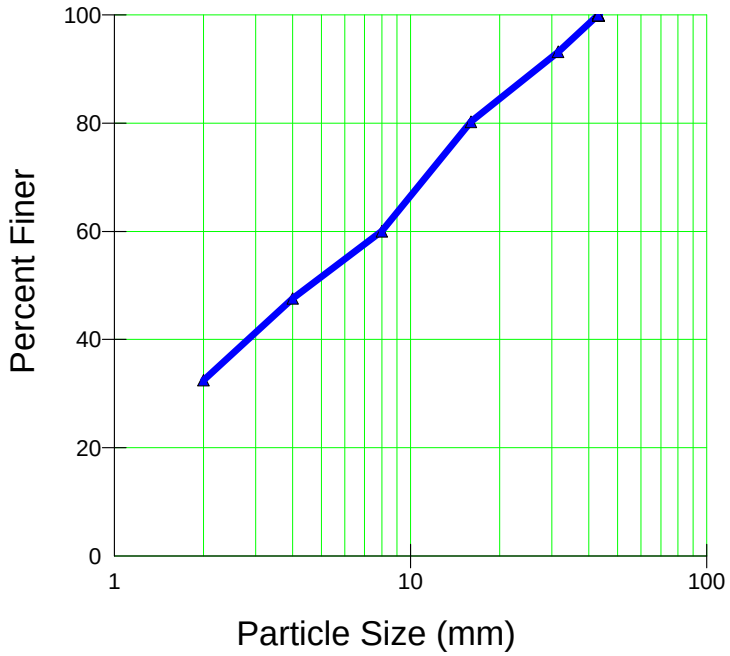
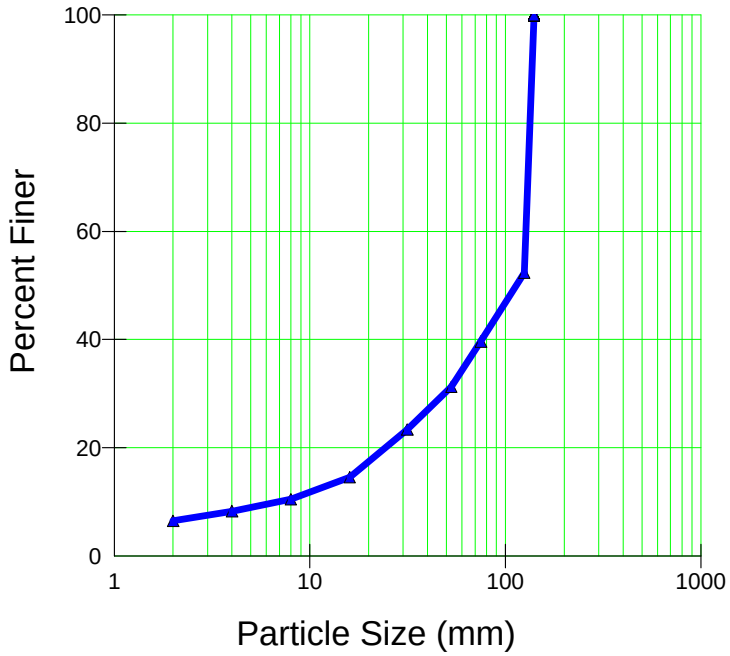
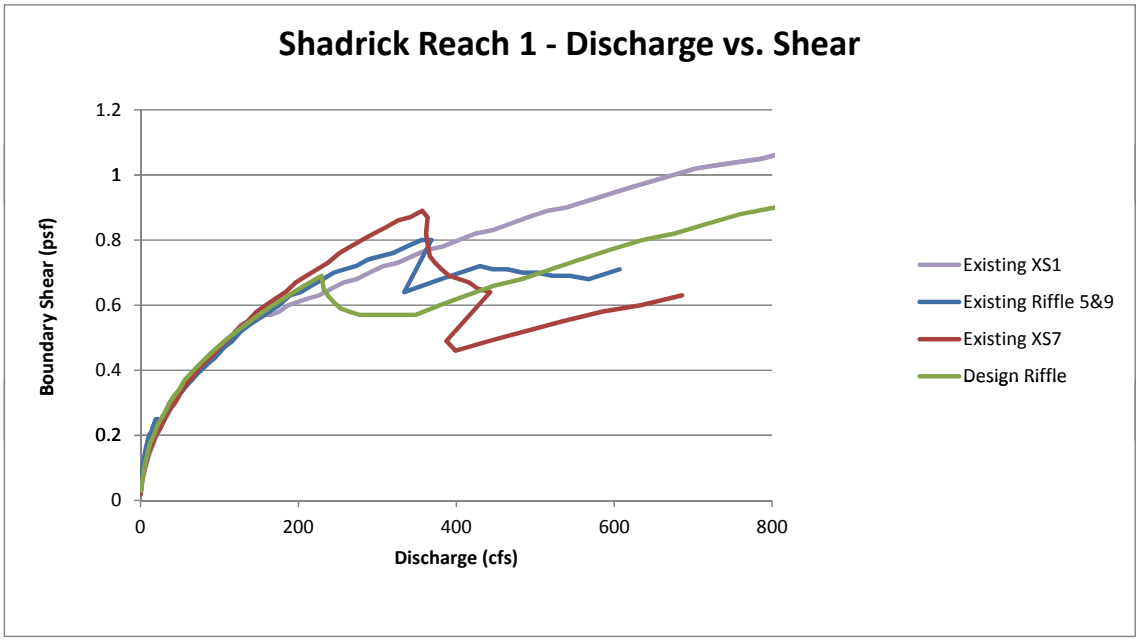
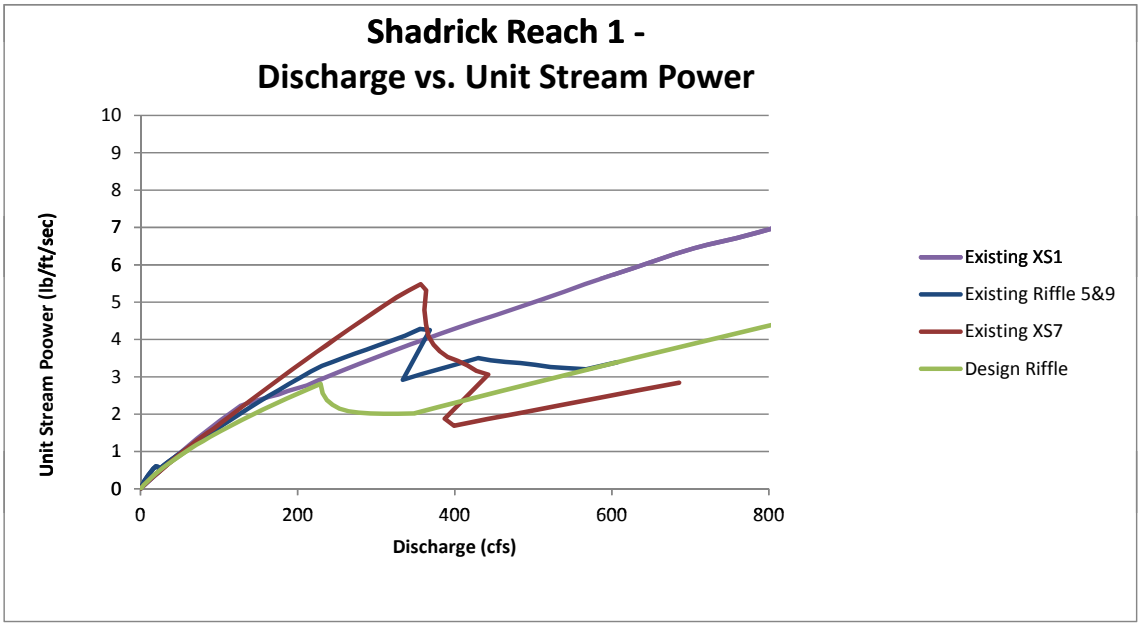


Shadrick bar near 32+00

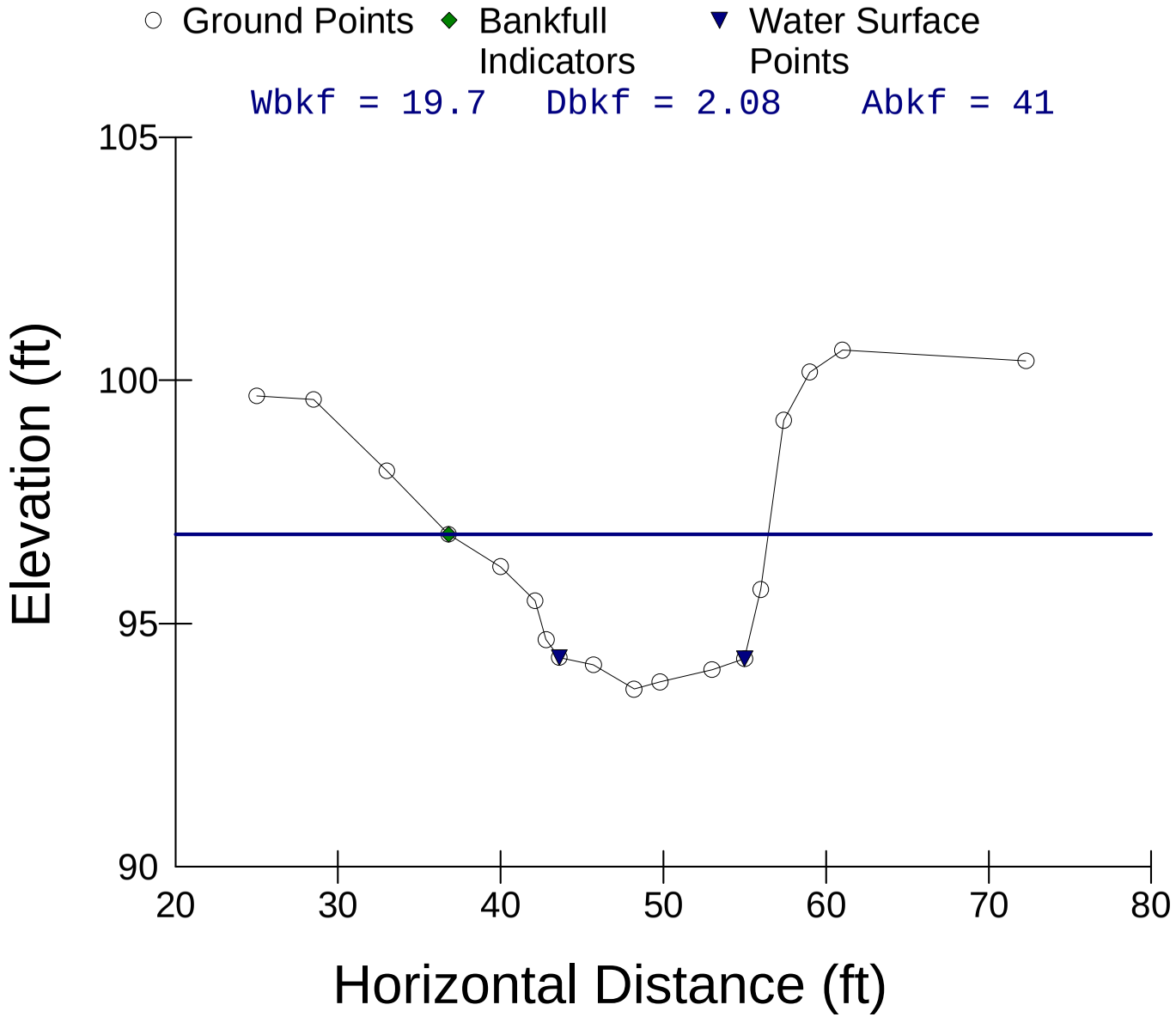



Shadrick Reach 1 - Discharge vs. Shear
Boundary Shear (psf)
1.2
1
0.8
0.6
0.4
0.2
0
0
200
400
600
800
Discharge (cfs)
Existing XS1
Existing Riffle 5&9
Existing XS7
Design Riffle

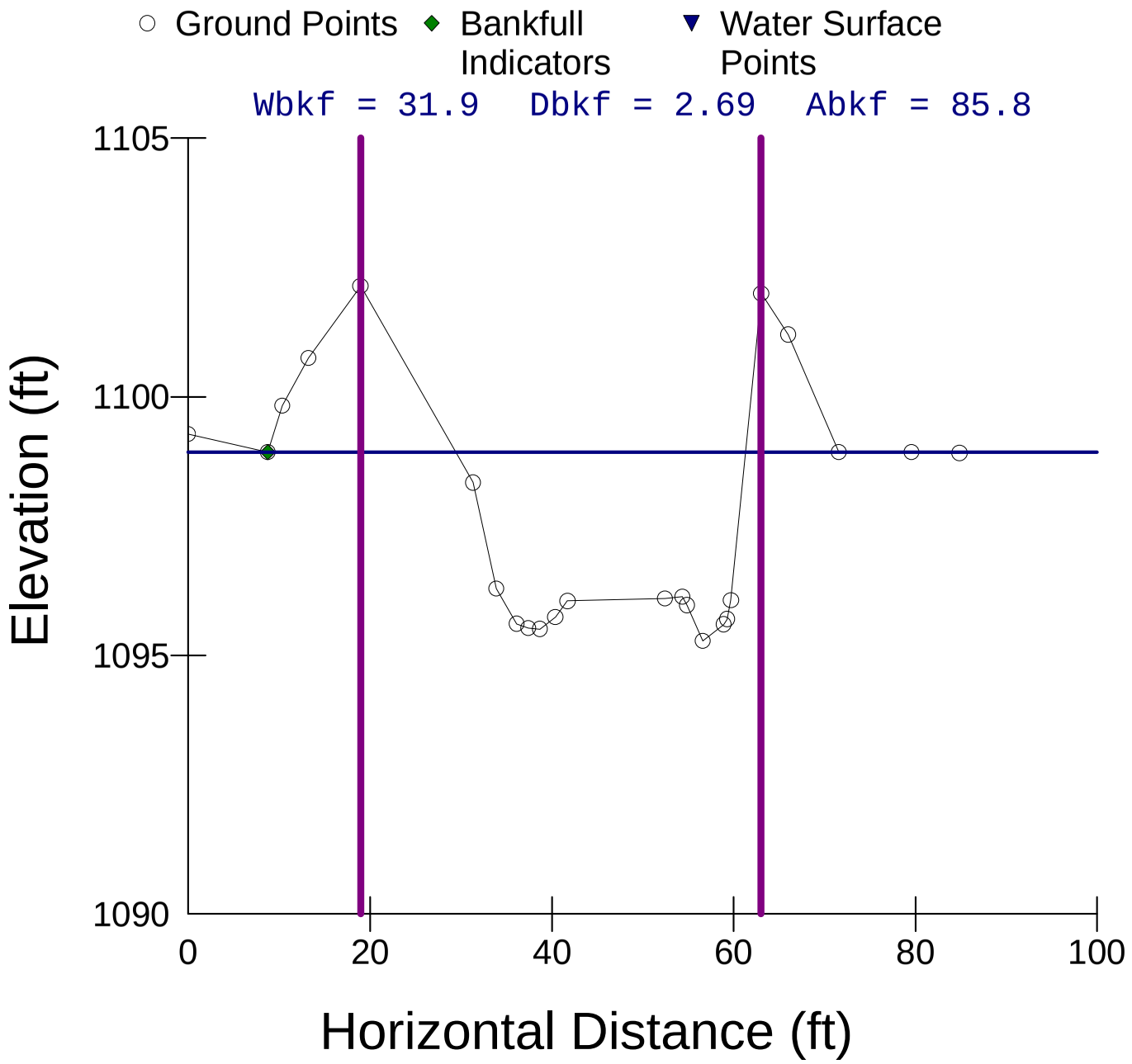

Shadrick Reach 1 -
Discharge vs. Unit Stream Power
Unit Stream Poower (lb/ft/sec)
10
9
8
7
6
5
4
3
2
1
0
0
200
400
600
800
Discharge (cfs)
Existing XS1
Existing Riffle 5&9
Existing XS7
Design Riffle

Parameter	Existing Stream			Design Stream			Reference Stream		
	Min	Median	Max	Min	Median	Max	Min	Median	Max
Stream name	Shadrick Creek R2&3			Shadrick Creek R2&3			Shadrick Supply Rch		
Stream type	E4			C4			E4		
Drainage area, DA (sq mi)	3.3			3.3			3.2		
Mean riffle depth, d_{bkf} (ft)	2.3	2.4	2.5	2.4				2.1	
Riffle width, W_{bkf} (ft)	19.9	20.6	21.3	29.0				19.7	
Width-to-depth ratio, [W_{bkf}/d_{bkf}]	8.5	8.6	8.6	12.1				9.5	
Riffle cross-section area, A_{bkf} (sq ft)	46.4	49.4	52.3	69.7				41.0	
Max riffle depth, d_{mbkf} (ft)	3.4	3.7	4.0	3.4				3.2	
Max riffle depth ratio, [d_{mbkf}/d_{bkf}]	1.5	1.5	1.6	1.4				1.5	
Pool width, W_{bkfp} (ft)		21.2		41.8					
Pool width ratio, [W_{bkfp}/W_{bkf}]		1.0		1.4					
Pool cross-section area, A_{bkfp} (sq ft)		75.4		131.0					
Pool area ratio, [A_{bkfp}/A_{bkf}]		1.7		1.9					
Max pool depth, d_{mbkfp} (ft)		5.1		5.5					
Max pool depth ratio, [d_{mbkfp}/d_{bkf}]		2.1		2.3					
Low bank height, LBH (ft)	5.6	6.1	6.7	3.4				6.0	
Low bank height ratio, [LBH/d_{mbkf}]	1.6	1.7	1.7	1.0				1.9	
Width flood-prone area, W_{fpa} (ft)	44	58	71	87	116	145		34	
Entrenchment ratio, ER [W_{fpa}/W_{bkf}]	2.2	2.8	3.3	3.0	4.0	5.0		1.7	
Radius of curvature, Rc (ft)	20	43	118	30	60	75	30	40	50
Radius of curvature ratio [Rc/W_{bkf}]	1.0	2.1	5.5	1.1	2.1	2.6	1.5	2.0	2.5
Belt width, W_{blt} (ft)	60	80	100	90	116	160	60	80	100
Meander width ratio [W_{blt}/W_{bkf}]	3.0	3.9	4.7	3.1	4.0	5.5	3.1	4.1	5.1
Valley slope, VS (ft/ft)	0.0063			0.0063			0.0063		
Average water surface slope, S (ft/ft)	0.0050			0.0048			0.0050		
Sinuosity, k = VS/S (ft/ft)	1.26			1.31			1.26		
Bankfull discharge, Q_{bkf} (cfs)	205	225	244	260	280	300	173	217	260
Bankfull mean velocity, u_{bkf} = Q/A (ft/s)	4.4	4.5	4.7	3.7	4.0	4.3	4.2	5.3	6.3
D_{50} riffle (mm)	10	12	32	10	12	32	10	12	32
D_{50} bar (mm)		12			12			12	
D_{100} bar (mm)		45			45			45	

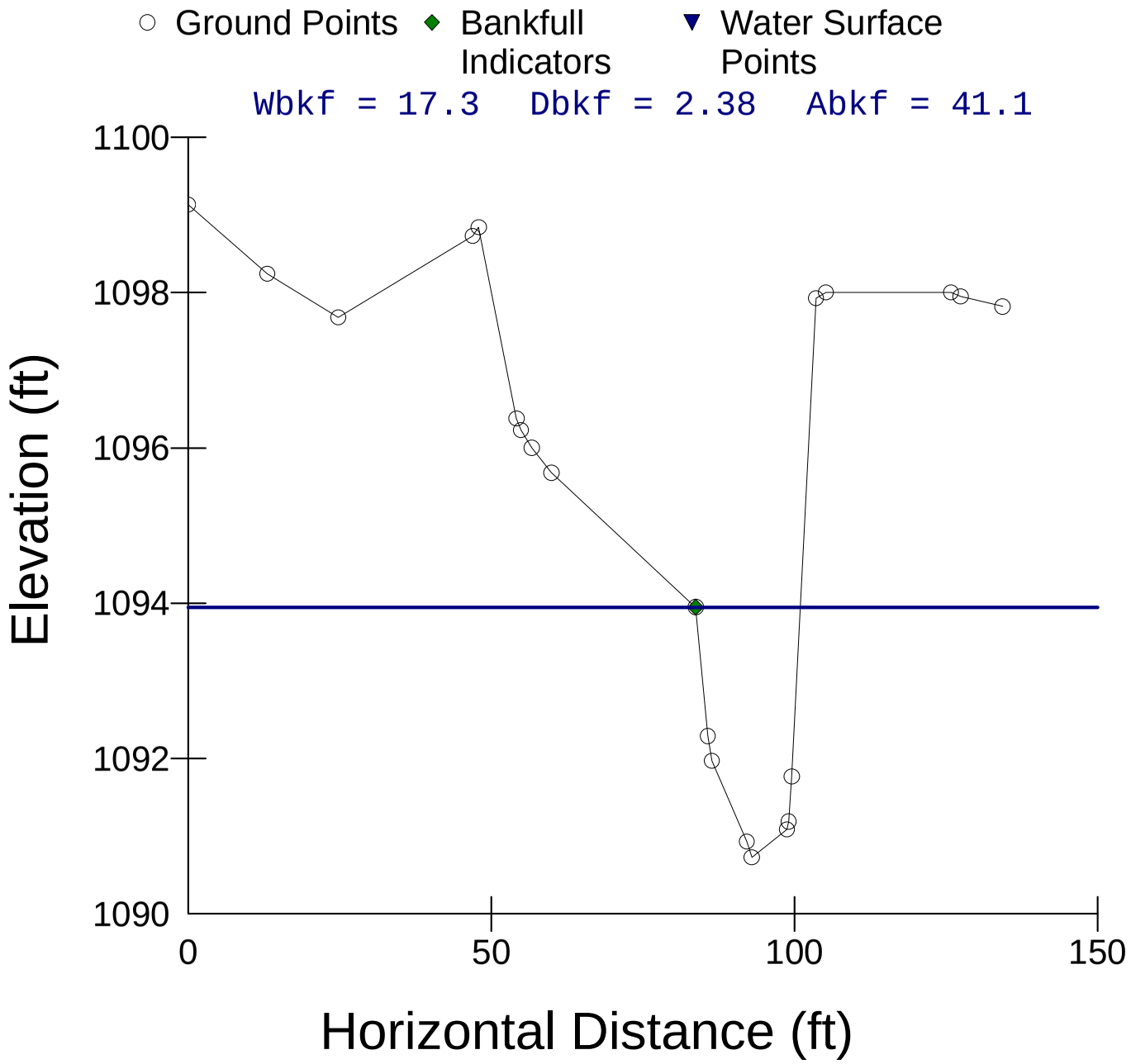
Lower Shadrick 200' upstream property line



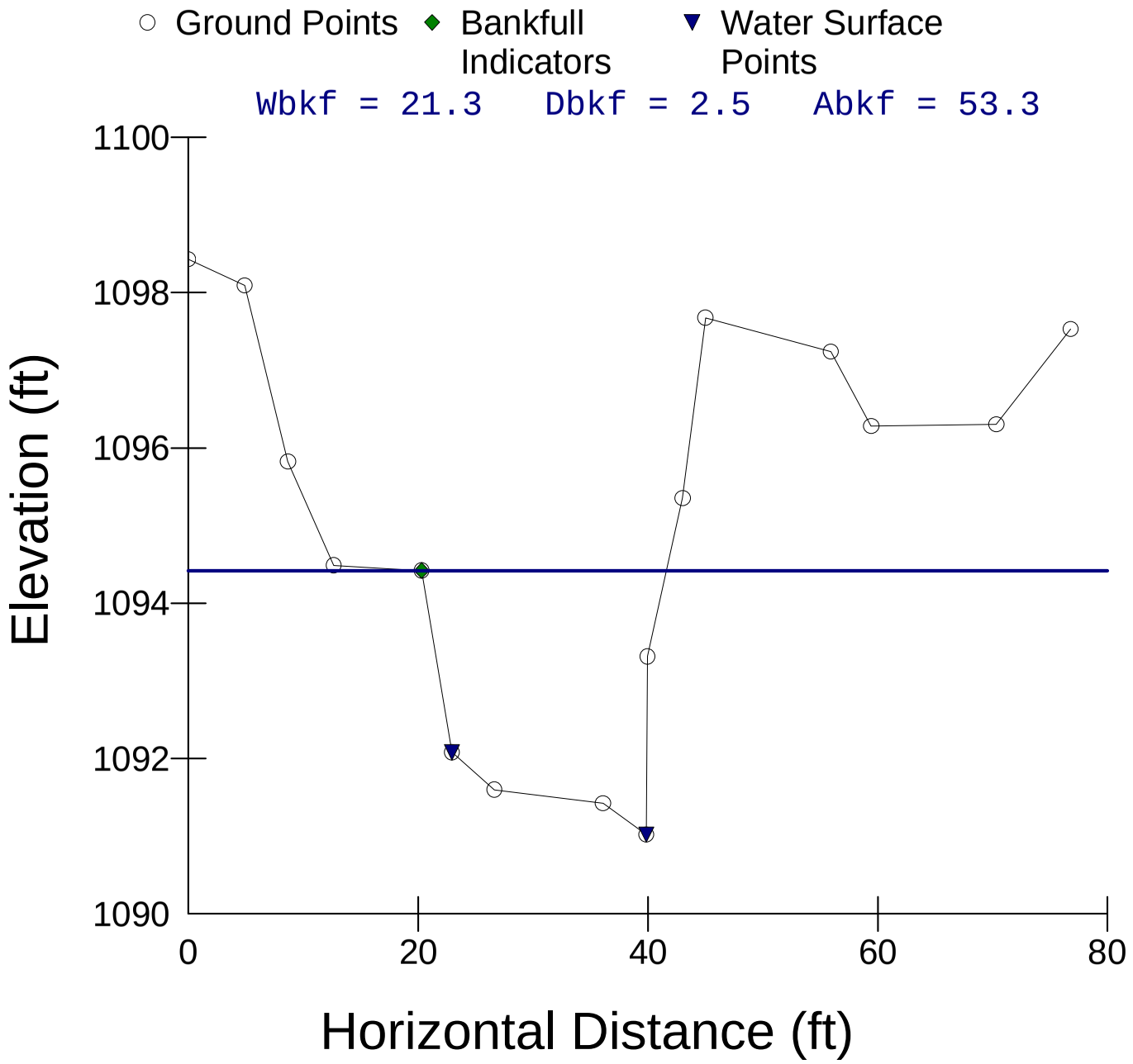
Extracted XS at 106+30



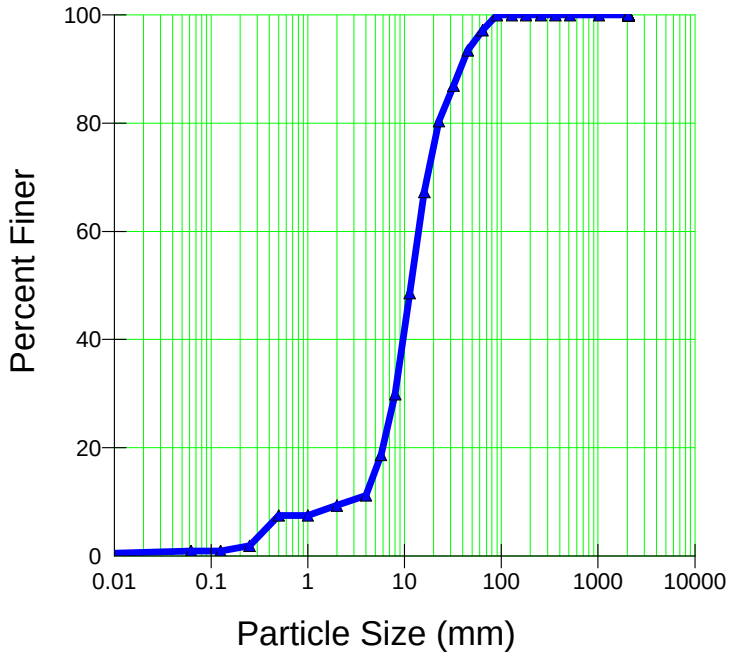
Extracted XS at 113+00



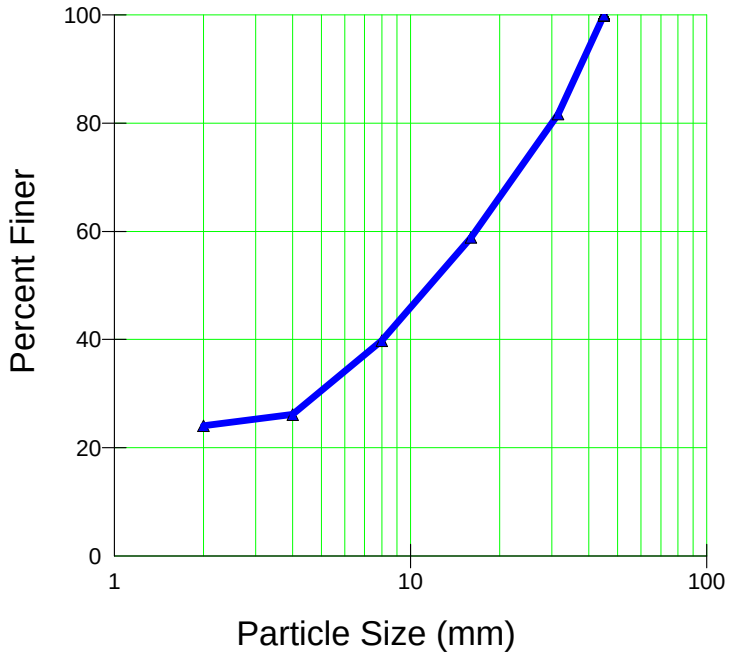
Shadrick XS20, near 115+00

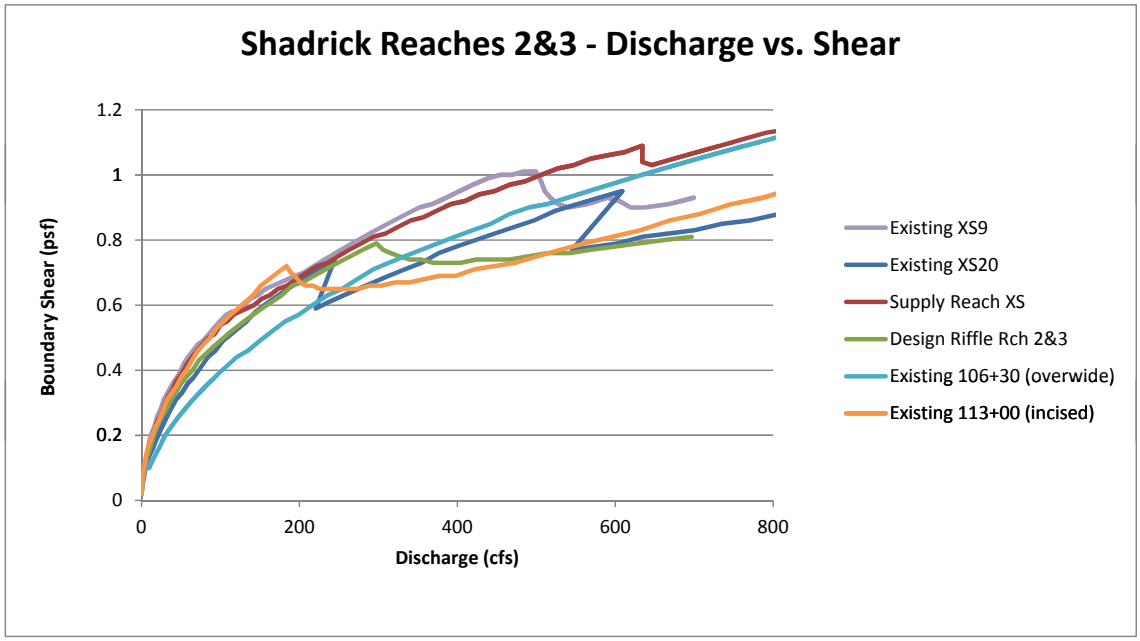


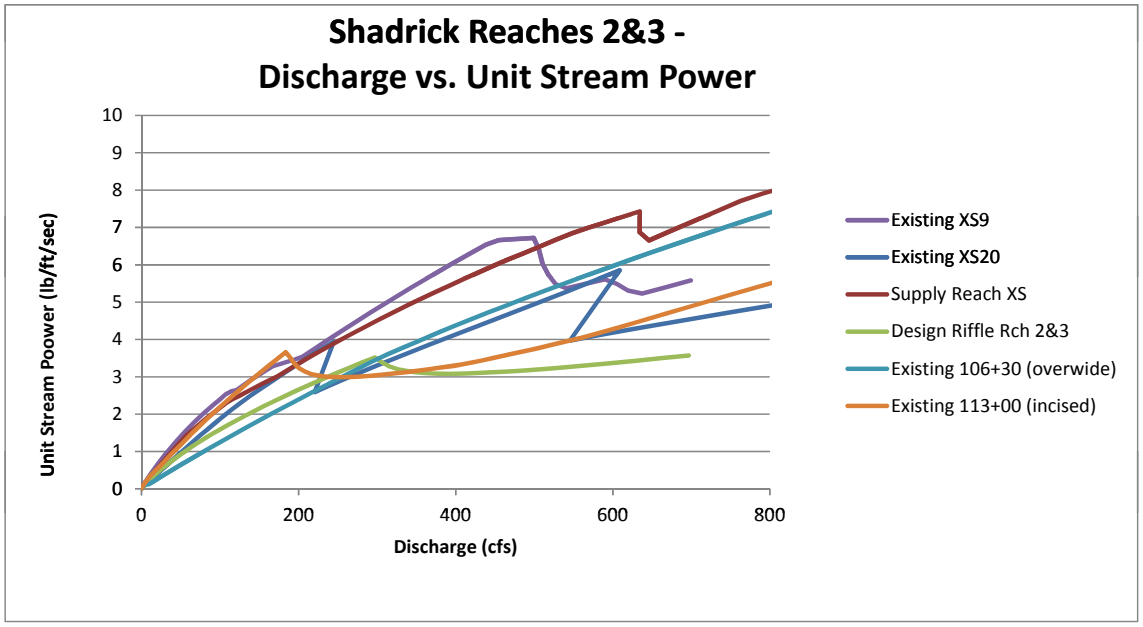
Shadrick Zigzag Riffle 113+00

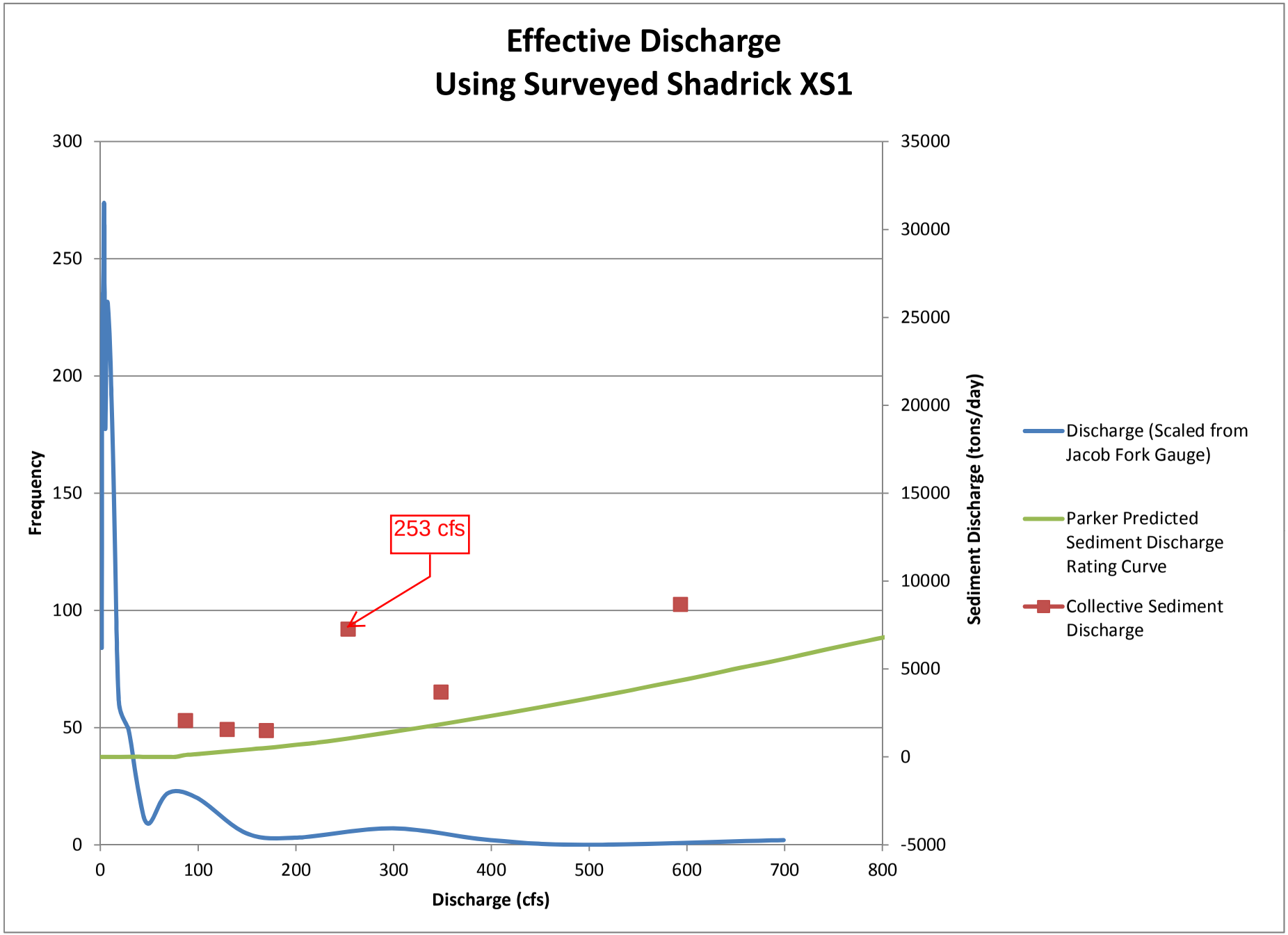


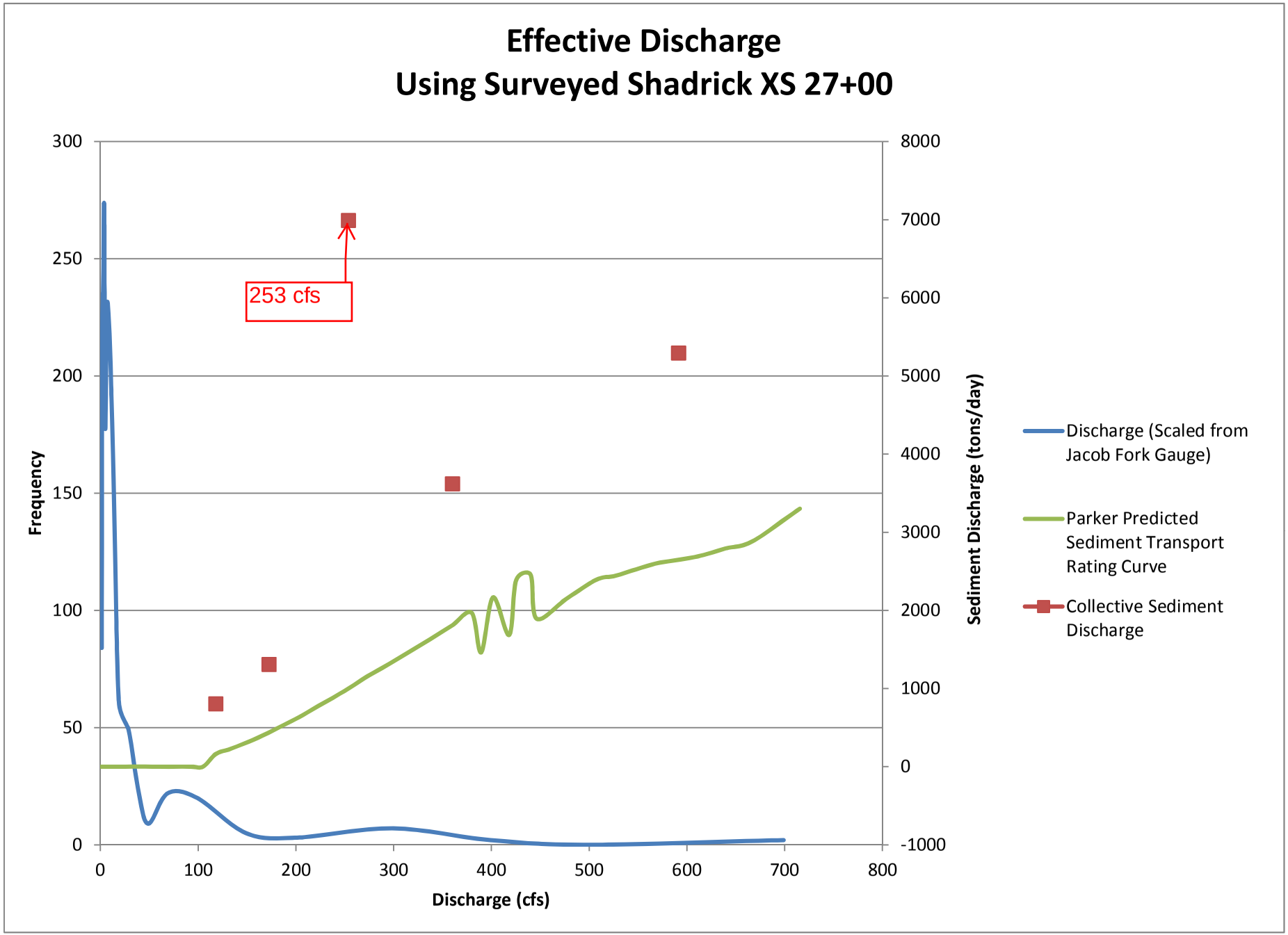
Shadrick Bar Sample at 113+00




Shadrick Reaches 2&3 - Discharge vs. Shear
Boundary Shear (psf)
1.2
1
0.8
0.6
0.4
0.2
0
0
200
400
600
800
Discharge (cfs)
Existing XS9
Existing XS20
Supply Reach XS
Design Riffle Rch 2&3
Existing 106+30 (overwide)
Existing 113+00 (incised)


Shadrick Reaches 2&3 -
Discharge vs. Unit Stream Power
Unit Stream Poower (lb/ft/sec)
10
9
8
7
6
5
4
3
2
1
0
0
200
400
600
800
Discharge (cfs)
Existing XS9
Existing XS20
Supply Reach XS
Design Riffle Rch 2&3
Existing 106+30 (overwide)
Existing 113+00 (incised)


Effective Discharge
Using Surveyed Shadrick XS1
Frequency
Sediment Discharge (tons/day)
Discharge (cfs)
253 cfs
Discharge (Scaled from Jacob Fork Gauge)
Parker Predicted Sediment Discharge Rating Curve
Collective Sediment Discharge
300
250
200
150
100
50
0
35000
30000
25000
20000
15000
10000
5000
0
-5000
0
100
200
300
400
500
600
700
800


Effective Discharge
Using Surveyed Shadrick XS 27+00
253 cfs
Frequency
Sediment Discharge (tons/day)
Discharge (cfs)
300
250
200
150
100
50
0
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
0
100
200
300
400
500
600
700
800
Discharge (Scaled from Jacob Fork Gauge)
Parker Predicted Sediment Transport Rating Curve
Collective Sediment Discharge

CRITICAL DISCHARGE ESTIMATE 1

Andrews (1984) and Andrews and Nankervis (1995)

tci* = 0.0834(di/d'50)-0.872 applies if di/d'50 ranges from 3 to 7
tci* = 0.0384(di/d'50)-0.887 if di/d'50 is 1.3 to 3.0

di = d50 of riffle pavement (from zigzag), mm
d'50 = d50 of sub-pavement (bar sample), mm

d = tci*((rsand-rh20)/rh20)*Di)/s

d = mean bankfull depth of water (ft) needed to move largest particle
rsand = 2.65 g/cc specific gravity of sand
rh20 = 1.00 g/cc specific gravity of water
Di = largest particle found in bar or subpavement sample (ft)
s = average (bankfull) water surface slope

SHADRICK REACH 1

For samples near 12+00

di	40	mm		
d'50	22	mm		
di/d'50	1.818182			
tci* =	0.022596			
Di	105	mm	=	0.34 ft
s	0.0050	ft/ft		
d =	2.57	ft		

from stage report for XS1 in RM w/ d_{bkf} = d, q_{ci} ~ 176 cfs

CRITICAL DISCHARGE ESTIMATE 2

Bathurst et al (1987)

$q_{cD50} = (0.15g^{0.5}D_{50}^{1.5})/(s^{1.12})$ D in ft

$q_{ci} = q_{cD50}(D_i/D_{50})^b$

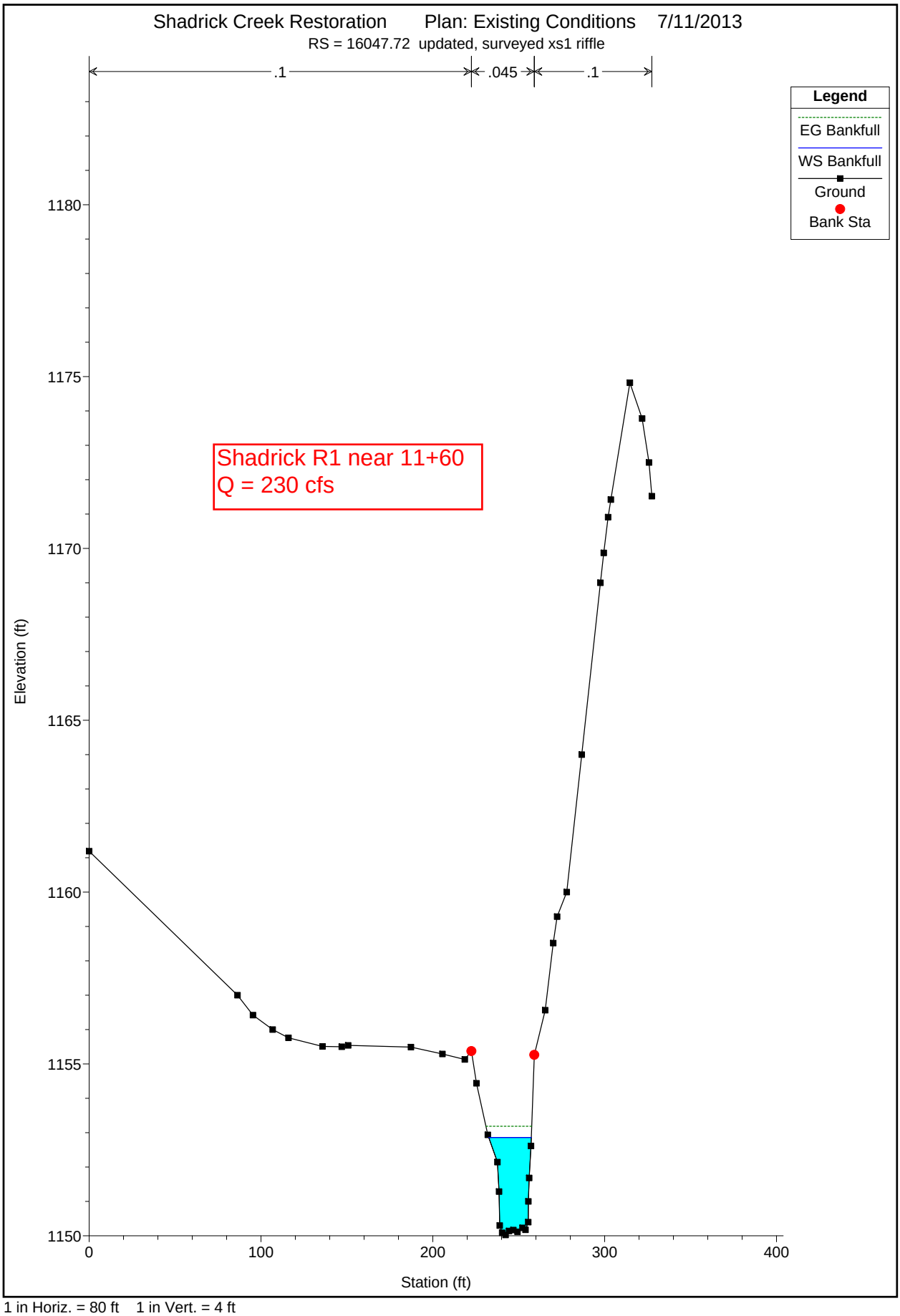
$b = 1.5(D_{84}/D_{16})^{-1}$

SHADRICK REACH 1

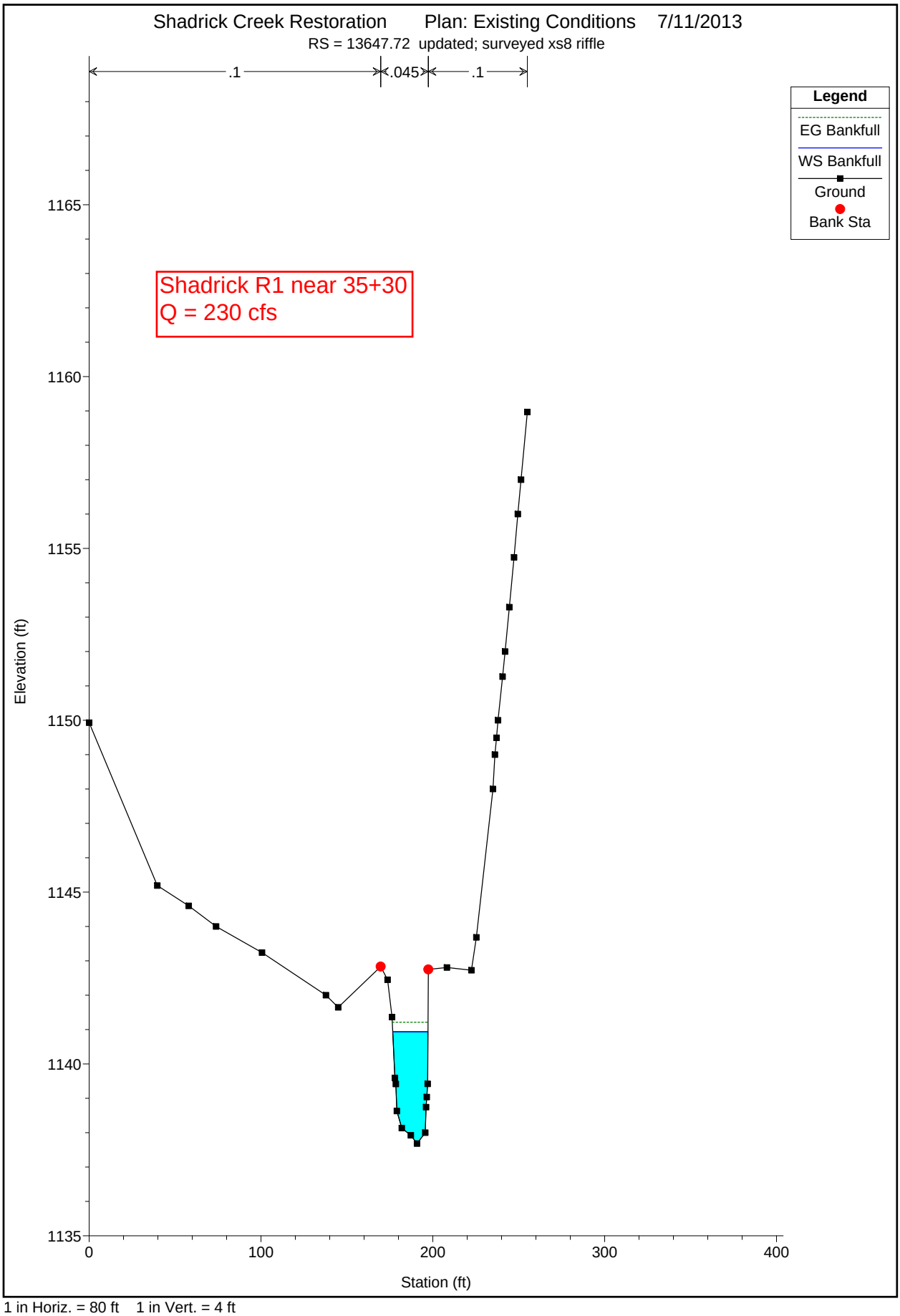
Shadrick Pebble Count 12+00

D_{50} =	0.04	m	0.1312 ft
D_{84} =	0.099	m	0.32472 ft
D_{16} =	0.01	m	0.0328 ft
s =	0.005		
q_{cD50} =	15.27825	cfs	
b =	0.151515		
q_{ci} =	17.52694	cfs/ft	

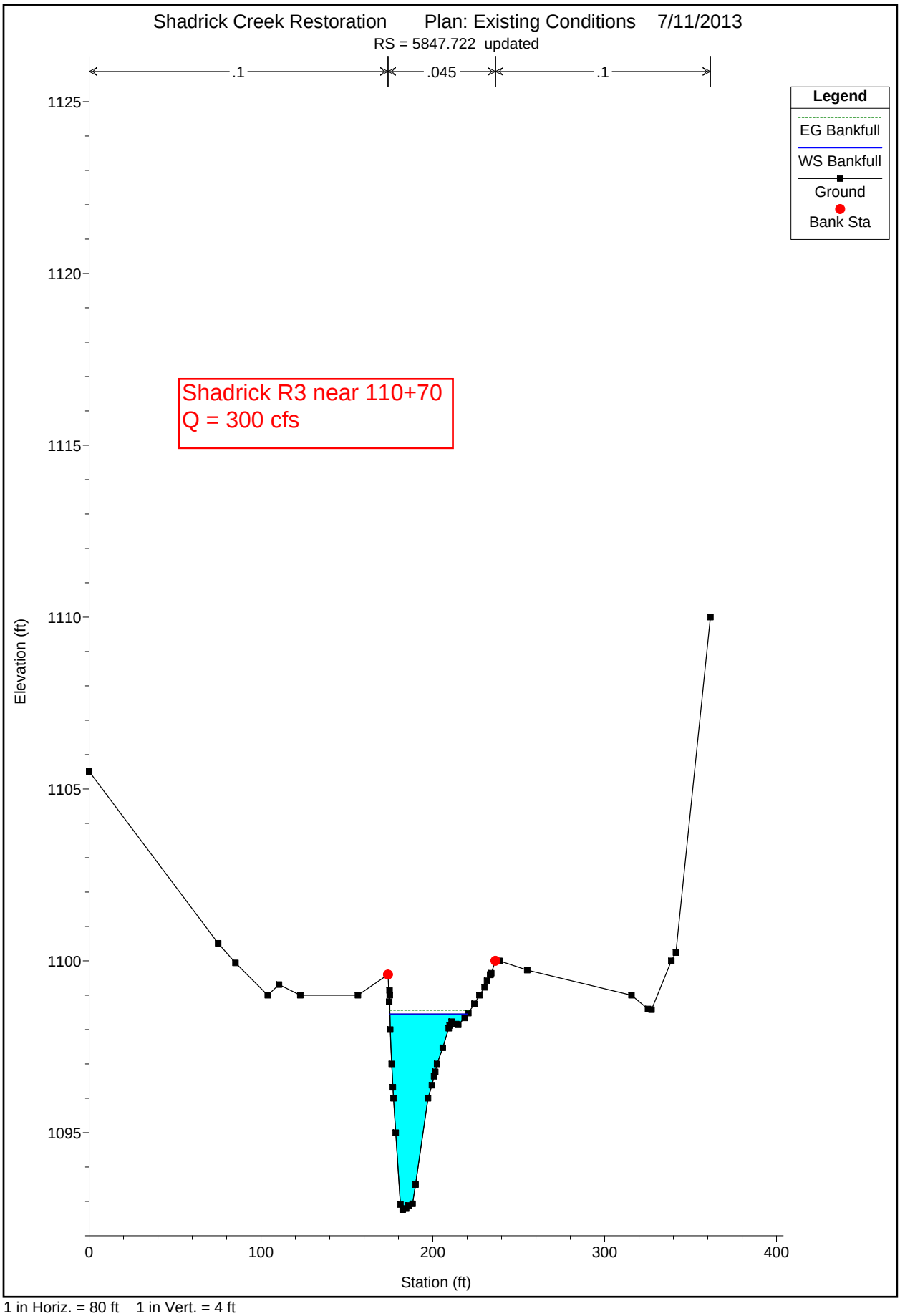
Section	Active Channel Width (ft)	q_{ci} (cfs) =
XS1	16.6	291



1 in Horiz. = 80 ft 1 in Vert. = 4 ft



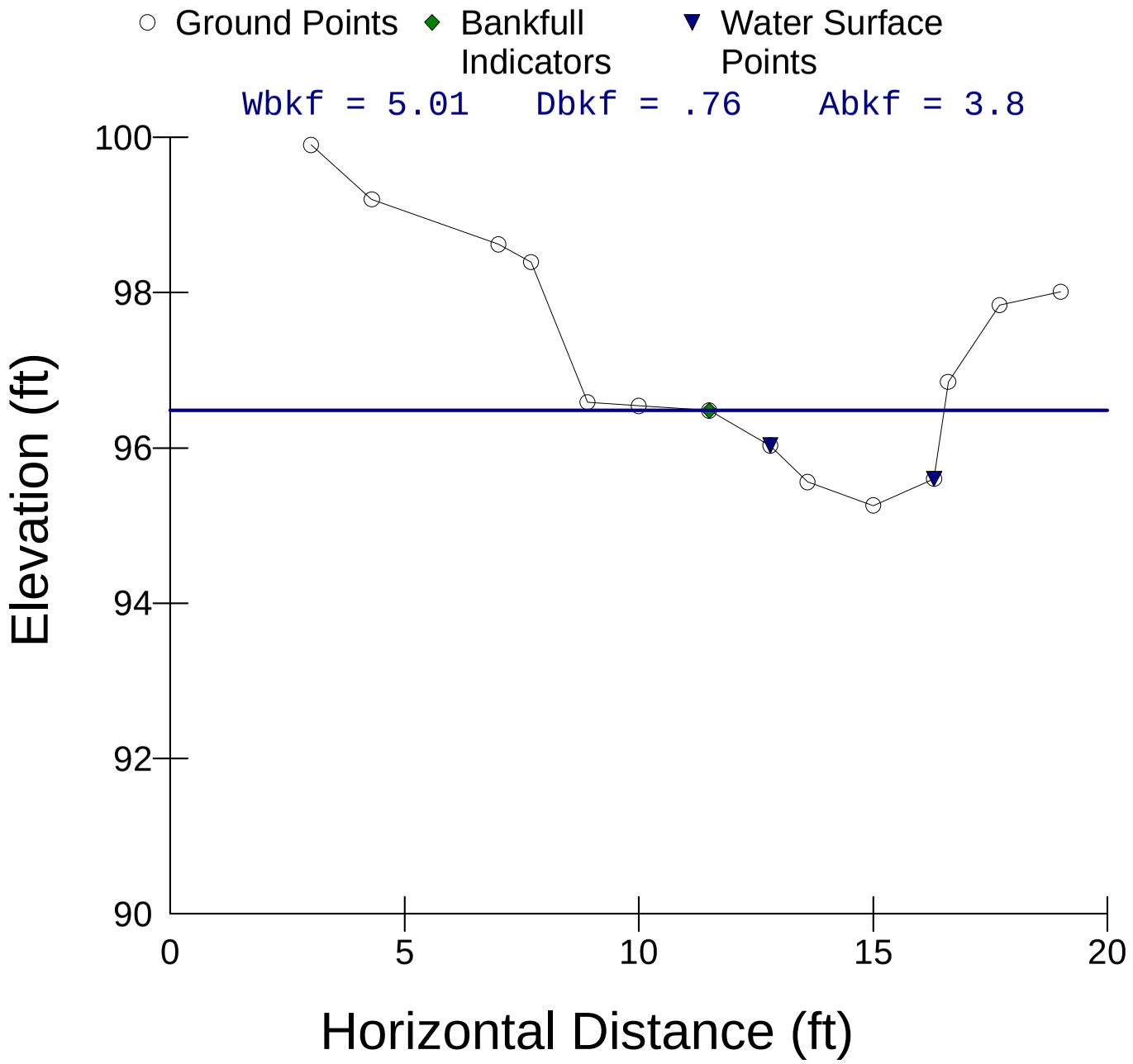
1 in Horiz. = 80 ft 1 in Vert. = 4 ft



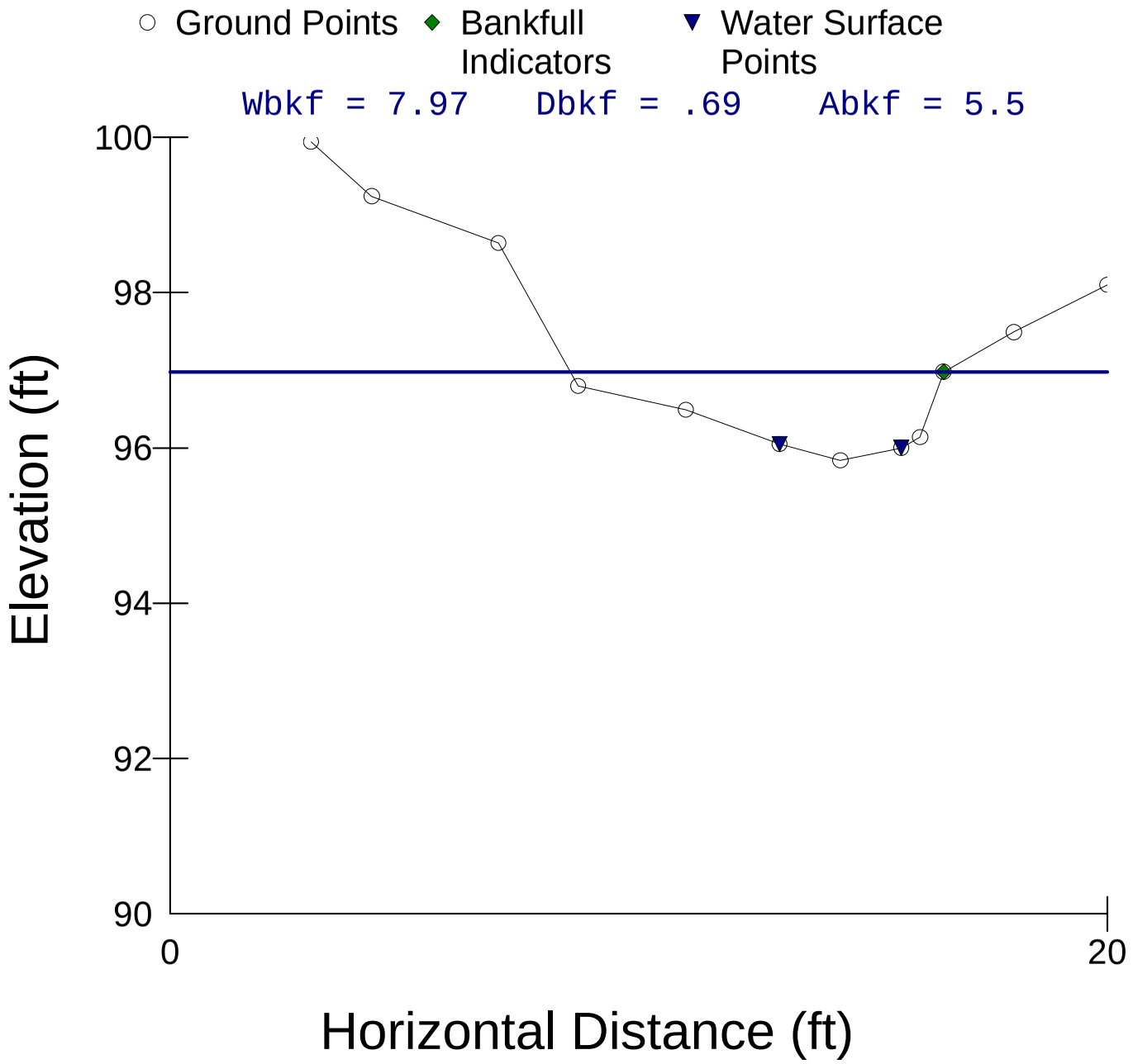
1 in Horiz. = 80 ft 1 in Vert. = 4 ft

Parameter	Existing Stream			Design Stream			Reference Stream		
	Min	Median	Max	Min	Median	Max	Min	Median	Max
Stream name	UT1			UT1			UT1 near STA. 18+00		
Stream type	G4			B4			B4		
Drainage area, DA (sq mi)	0.1			0.1			0.1		
Mean riffle depth, d_{bkf} (ft)	0.3	0.7	1.0	0.7			0.6	0.6	0.7
Riffle width, W_{bkf} (ft)	3.3	3.9	5.3	8.0			5.4	6.7	8.0
Width-to-depth ratio, [W_{bkf}/d_{bkf}]	4.2	6.1	12.6	11.6			9.4	10.5	11.6
Riffle cross-section area, A_{bkf} (sq ft)	1.2	2.8	4.6	5.5			3.1	4.3	5.5
Max riffle depth, d_{mbkf} (ft)	0.5	0.9	1.2	1.0			1.1	1.1	1.2
Max riffle depth ratio, [d_{mbkf}/d_{bkf}]	1.3	1.3	1.6	1.4			1.7	1.8	2.0
Pool width, W_{bkfp} (ft)	3.6	4.1	6.0	11.0				5.0	
Pool width ratio, [W_{bkfp}/W_{bkf}]	0.9	1.0	1.5	1.4				0.7	
Pool cross-section area, A_{bkfp} (sq ft)	2.5	2.9	7.2	11.2				3.8	
Pool area ratio, [A_{bkfp}/A_{bkf}]	0.9	1.7	2.6	2.0				0.9	
Max pool depth, d_{mbkfp} (ft)	0.9	1.3	1.9	1.6				1.2	
Max pool depth ratio, [d_{mbkfp}/d_{bkf}]	1.3	1.8	2.7	2.3				1.9	
Low bank height, LBH (ft)	0.45	1.2	3.67	1.0			1.1	1.1	1.2
Low bank height ratio, [LBH/d_{mbkf}]	1.0	1.5	3.0	1.0				1.0	
Width flood-prone area, W_{fpa} (ft)	4.5	13	21	24			13	16.5	20
Entrenchment ratio, ER [W_{fpa}/W_{bkf}]	1.1	2.8	5.2	3.0				2.5	
Radius of curvature, Rc (ft)	7	20	70	7	20	70	21	22	23
Radius of curvature ratio [Rc/W_{bkf}]	2.1	5.1	13.2	2.1	5.1	13.2	3.1	3.3	3.4
Belt width, W_{blt} (ft)	16	35	50	16	35	50		40	
Meander width ratio [W_{blt}/W_{bkf}]	4.8	8.9	9.5	4.8	8.9	9.5		6.0	
Valley slope, VS (ft/ft)	0.0260			0.0260			0.0260		
Average water surface slope, S (ft/ft)	0.0230			0.0230			0.0230		
Sinuosity, k = VS/S (ft/ft)	1.13			1.13			1.13		
Bankfull discharge, Q_{bkf} (cfs)	20	24	27		25		30		
Bankfull mean velocity, u_{bkf} = Q/A (ft/s)	5.3	5.5	5.8		4.5			7.0	
D_{50} riffle (mm)	3	6	9	3	6	9	3	6	9
D_{84} bar (mm)		130			130			130	
D_{100} bar (mm)		132			132			132	

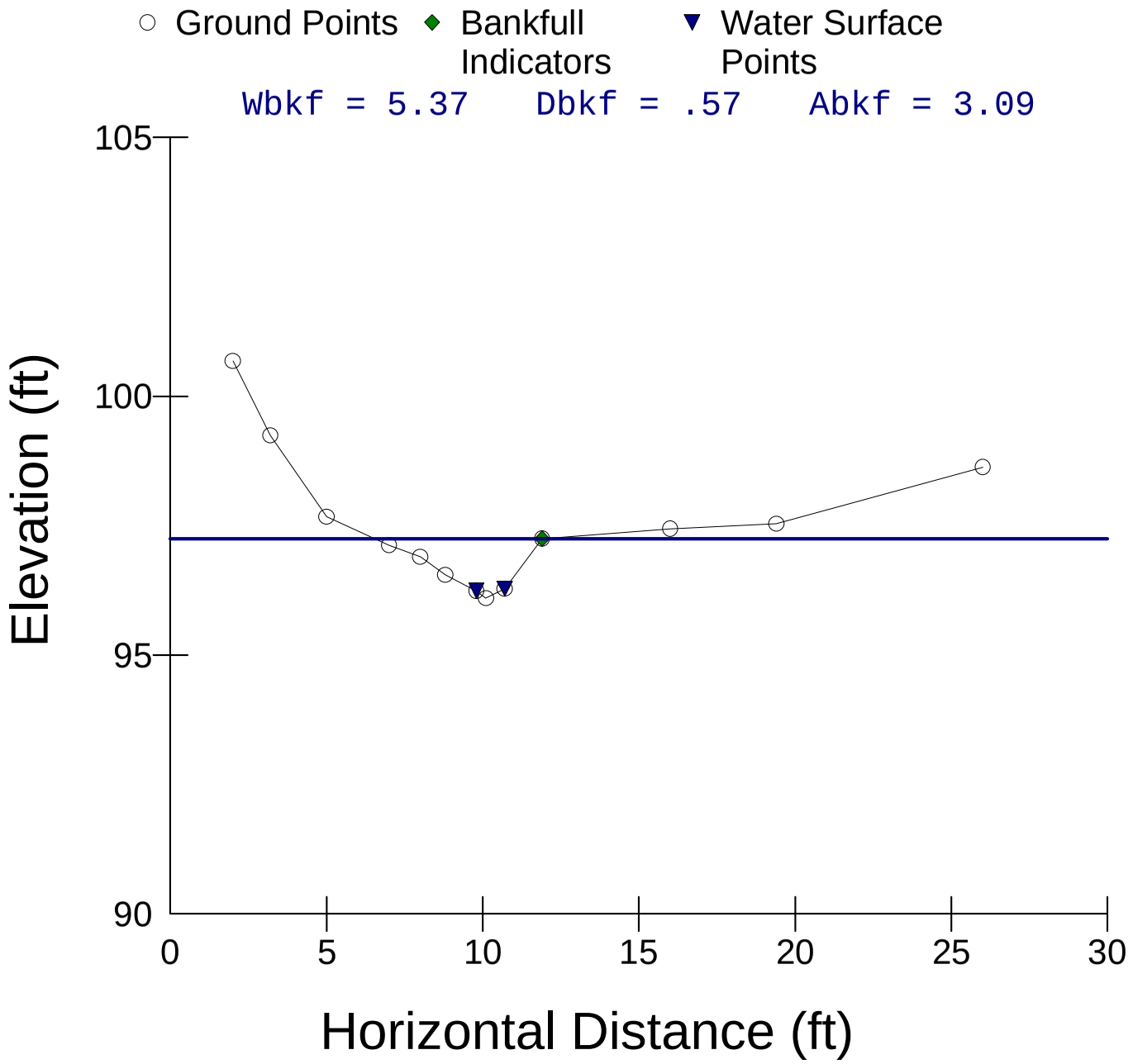
UT1 - XS1C 16+00



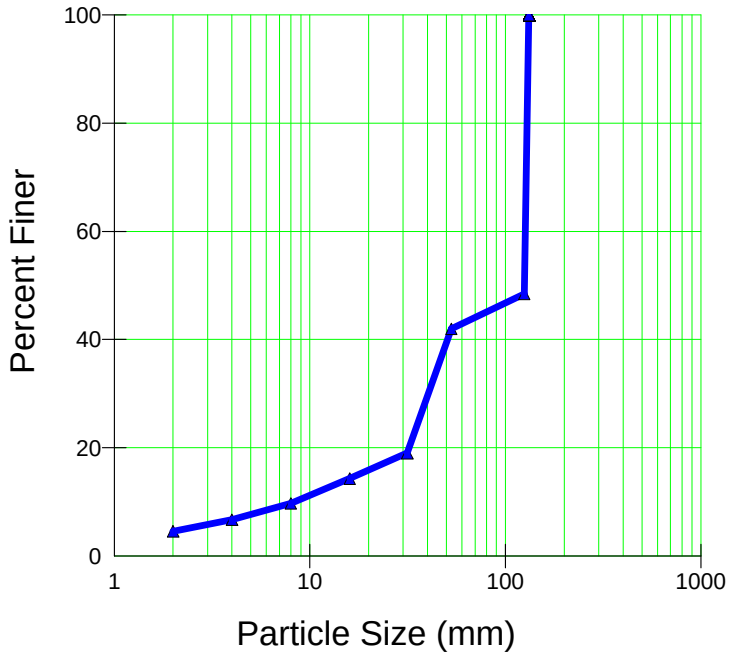
UT1 - XS1B 16+20

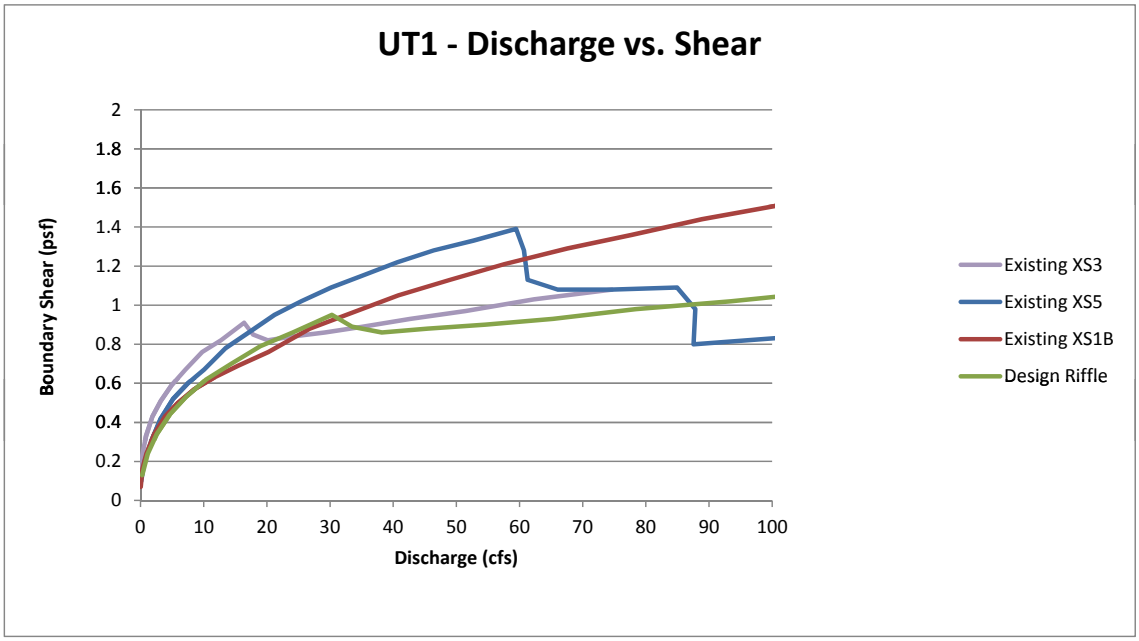


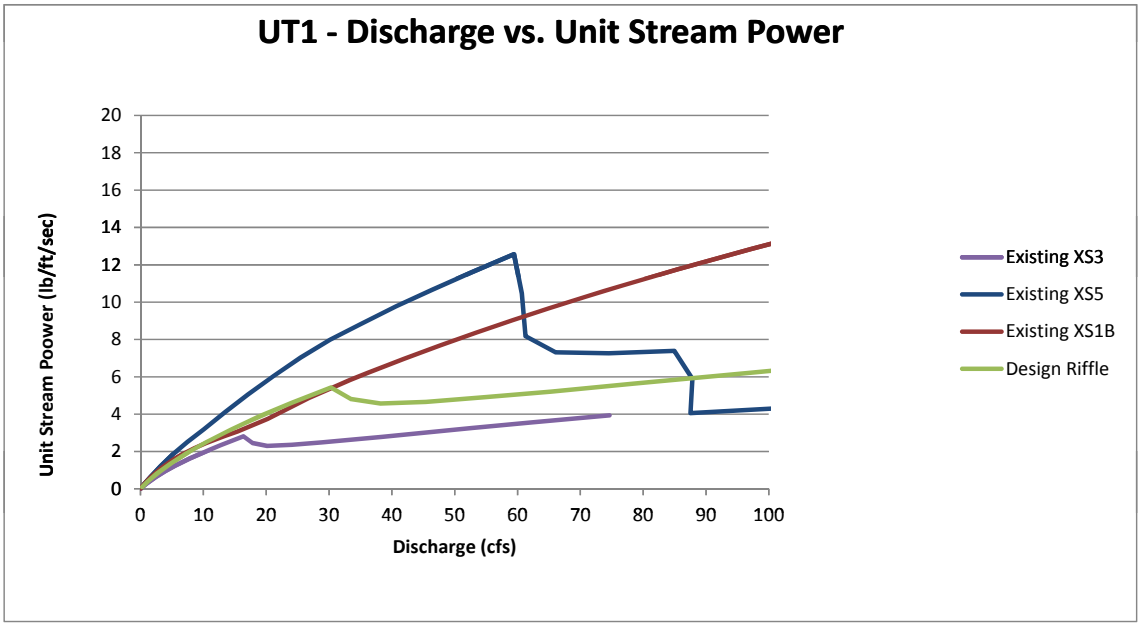
UT1 XS1A, 18+20



Bulk Sample UT1 Riffle 20+00



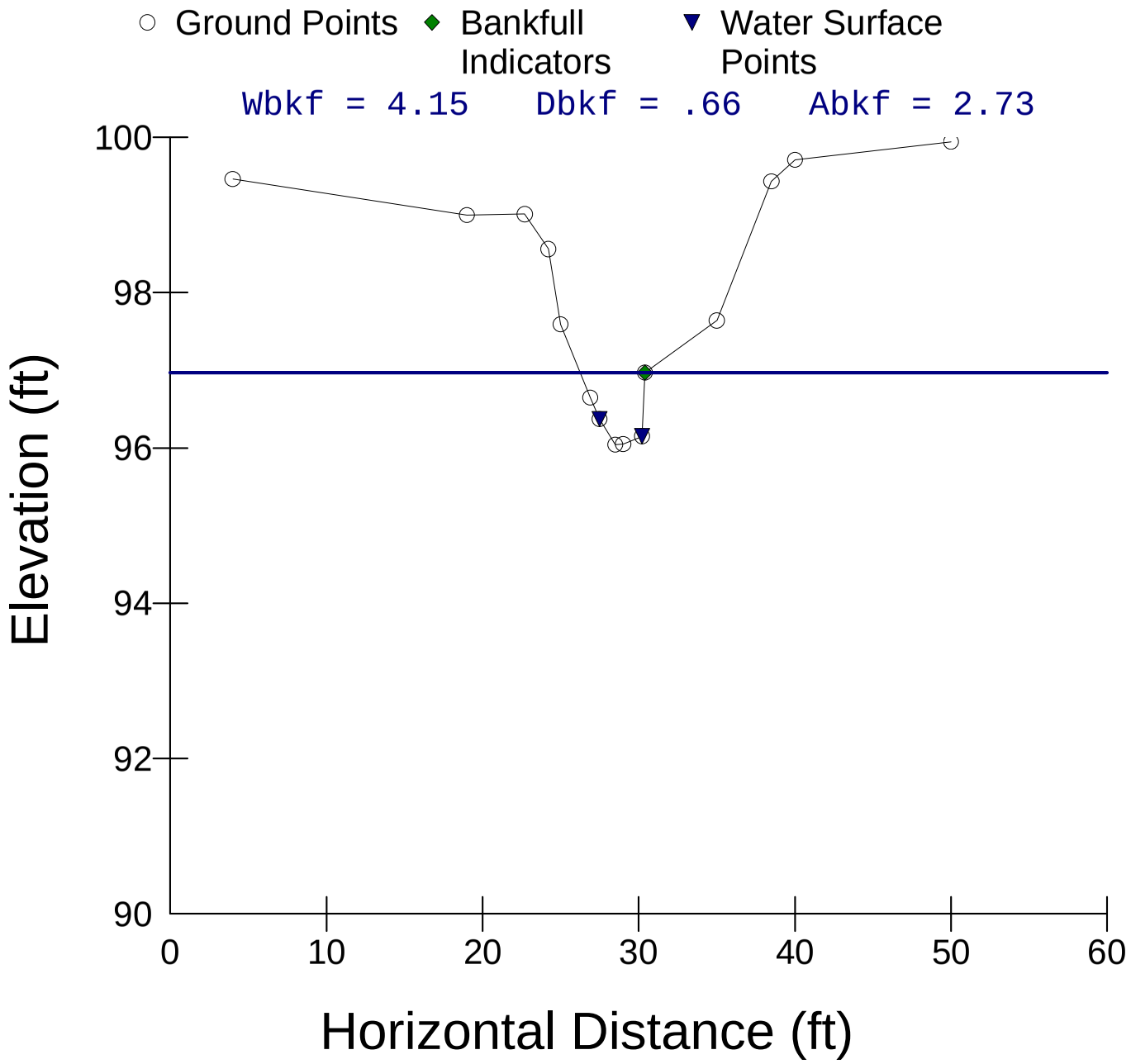

UT1 - Discharge vs. Shear
Boundary Shear (psf)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40
50
60
70
80
90
100
Discharge (cfs)
Existing XS3
Existing XS5
Existing XS1B
Design Riffle


UT1 - Discharge vs. Unit Stream Power
Unit Stream Poower (lb/ft/sec)
20
18
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
90
100
Discharge (cfs)
Existing XS3
Existing XS5
Existing XS1B
Design Riffle

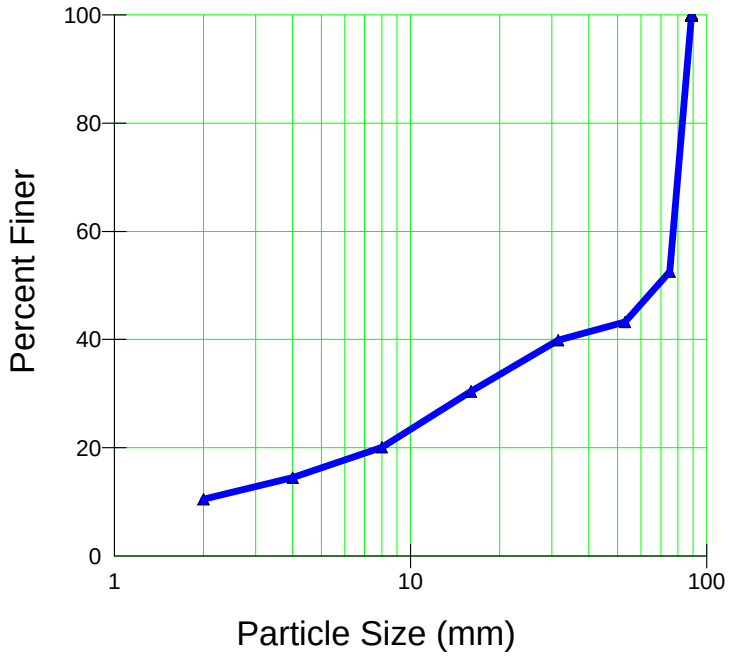
Parameter	Existing Stream			Design Stream			Reference Stream		
	Min	Median	Max	Min	Median	Max	Min	Median	Max
Stream name	UT9 Reach 1			UT9 Reach 1			UT1 near STA. 18+00		
Stream type	B4, G4			B4			B4		
Drainage area, DA (sq mi)	0.1			0.1			0.1		
Mean riffle depth, d_{bkf} (ft)	0.5	0.7	1.1	0.7			0.6	0.6	0.7
Riffle width, W_{bkf} (ft)	4.2	5.7	6.0	8.0			5.4	6.7	8.0
Width-to-depth ratio, [W_{bkf}/d_{bkf}]	5.7	6.3	12.7	11.6			9.4	10.5	11.6
Riffle cross-section area, A_{bkf} (sq ft)	2.6	2.7	6.3	5.5			3.1	4.3	5.5
Max riffle depth, d_{mbkf} (ft)	0.6	0.9	1.5	1.0			1.1	1.1	1.2
Max riffle depth ratio, [d_{mbkf}/d_{bkf}]	1.4	1.4	1.5	1.4			1.7	1.8	2.0
Pool width, W_{bkfp} (ft)	4.1	6.3	8.6	11.0				5.0	
Pool width ratio, [W_{bkfp}/W_{bkf}]	1.0	1.1	1.4	1.4				0.7	
Pool cross-section area, A_{bkfp} (sq ft)	2.8	3.3	3.9	11.2				3.8	
Pool area ratio, [A_{bkfp}/A_{bkf}]	1.0	1.2	1.4	2.0				0.9	
Max pool depth, d_{mbkfp} (ft)	1.0	1.2	1.4	1.6				1.2	
Max pool depth ratio, [d_{mbkfp}/d_{bkf}]	1.5	1.8	2.1	2.3				1.9	
Low bank height, LBH (ft)	2.5	2.7	3.6	1.0			1.1	1.1	1.2
Low bank height ratio, [LBH/d_{mbkf}]	2.3	2.7	4.4	1.0				1.0	
Width flood-prone area, W_{fpa} (ft)	8	10	11	24			13	17	20
Entrenchment ratio, ER [W_{fpa}/W_{bkf}]	1.4	1.7	2.7	3.0				2.5	
Radius of curvature, Rc (ft)	36	47	62	36	47	62	21	22	23
Radius of curvature ratio [Rc/W_{bkf}]	6.0	8.2	14.9	6.0	8.2	14.9	3.1	3.3	3.4
Belt width, W_{blt} (ft)	20	26	31	20	26	31		40	
Meander width ratio [W_{blt}/W_{bkf}]	4.8	4.5	5.1	4.8	4.5	5.1		6.0	
Valley slope, VS (ft/ft)	0.0360			0.0360			0.0260		
Average water surface slope, S (ft/ft)	0.0350			0.0350			0.0230		
Sinuosity, k = VS/S (ft/ft)	1.03			1.03			1.13		
Bankfull discharge, Q_{bkf} (cfs)	24	48	72		25		30		
Bankfull mean velocity, u_{bkf} = Q/A (ft/s)	8.8	10.1	11.4		4.5			7.0	
D_{50} riffle (mm)		0.3			0.3		3	6	9
D_{84} bar (mm)		84			84			130	
D_{100} bar (mm)		89			89			132	

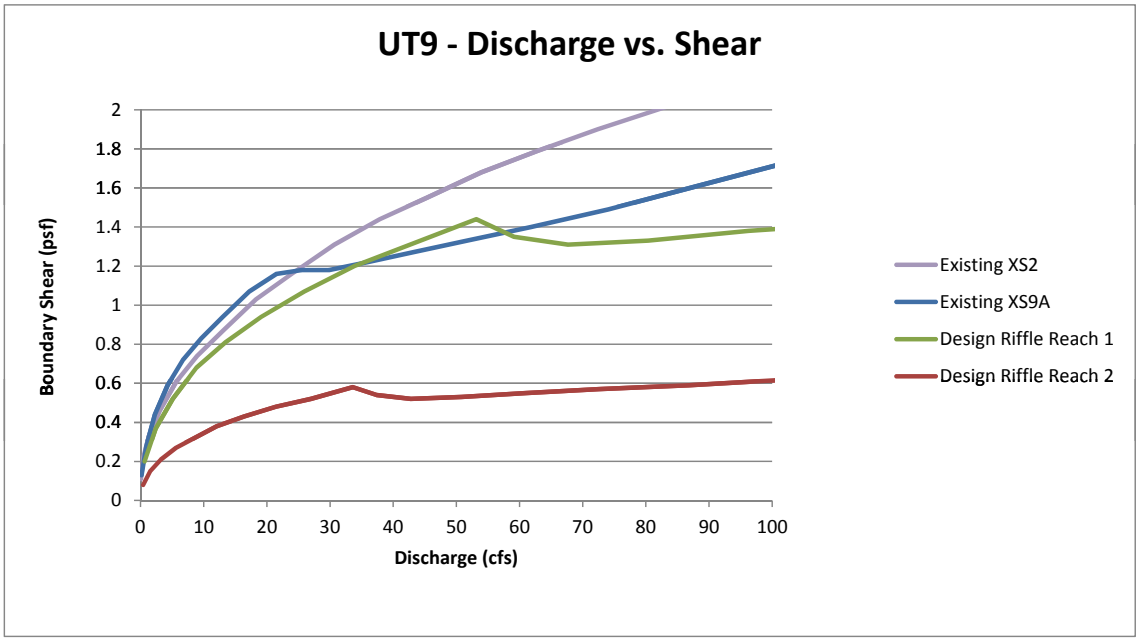
Parameter	Existing Stream			Design Stream			Reference Stream		
	Min	Median	Max	Min	Median	Max	Min	Median	Max
Stream name	UT9 Reach 1			UT9 Reach 2			UT1 near STA. 18+00		
Stream type	B4, G4			E4			B4		
Drainage area, DA (sq mi)	0.1			0.1			0.1		
Mean riffle depth, d_{bkf} (ft)	0.5	0.7	1.1	0.7			0.6	0.6	0.7
Riffle width, W_{bkf} (ft)	4.2	5.7	6.0	8.0			5.4	6.7	8.0
Width-to-depth ratio, [W_{bkf}/d_{bkf}]	5.7	6.3	12.7	11.6			9.4	10.5	11.6
Riffle cross-section area, A_{bkf} (sq ft)	2.6	2.7	6.3	5.5			3.1	4.3	5.5
Max riffle depth, d_{mbkf} (ft)	0.6	0.9	1.5	1.0			1.1	1.1	1.2
Max riffle depth ratio, [d_{mbkf}/d_{bkf}]	1.4	1.4	1.5	1.4			1.7	1.8	2.0
Pool width, W_{bkfp} (ft)	4.1	6.3	8.6	13.7				5.0	
Pool width ratio, [W_{bkfp}/W_{bkf}]	1.0	1.1	1.4	1.7				0.7	
Pool cross-section area, A_{bkfp} (sq ft)	2.8	3.3	3.9	14.1				3.8	
Pool area ratio, [A_{bkfp}/A_{bkf}]	1.0	1.2	1.4	2.6				0.9	
Max pool depth, d_{mbkfp} (ft)	1.0	1.2	1.4	1.8				1.2	
Max pool depth ratio, [d_{mbkfp}/d_{bkf}]	1.5	1.8	2.1	2.6				1.9	
Low bank height, LBH (ft)	2.5	2.7	3.6	1.0			1.1	1.1	1.2
Low bank height ratio, [LBH/d_{mbkf}]	2.3	2.7	4.4	1.0				1.0	
Width flood-prone area, W_{fpa} (ft)	8	10	11	24			13	17.0	20
Entrenchment ratio, ER [W_{fpa}/W_{bkf}]	1.4	1.7	2.7	3.0				2.5	
Radius of curvature, Rc (ft)	36	47	62		15		21	22	23
Radius of curvature ratio [Rc/W_{bkf}]	6.0	8.2	14.9		1.9		3.1	3.3	3.4
Belt width, W_{blt} (ft)	20	26	31	28	42	60		40	
Meander width ratio [W_{blt}/W_{bkf}]	4.8	4.5	5.1	3.5	5.3	7.5		6.0	
Valley slope, VS (ft/ft)	0.0360			0.0240			0.0260		
Average water surface slope, S (ft/ft)	0.0350			0.0140			0.0230		
Sinuosity, k = VS/S (ft/ft)	1.03			1.71			1.13		
Bankfull discharge, Q_{bkf} (cfs)	24	48	72		18		30		
Bankfull mean velocity, u_{bkf} = Q/A (ft/s)	8.8	10.1	11.4		3.3			7.0	
D_{50} riffle (mm)		0.3			0.3		3	6	9
D_{84} bar (mm)		84			84			130	
D_{100} bar (mm)		89			89			132	

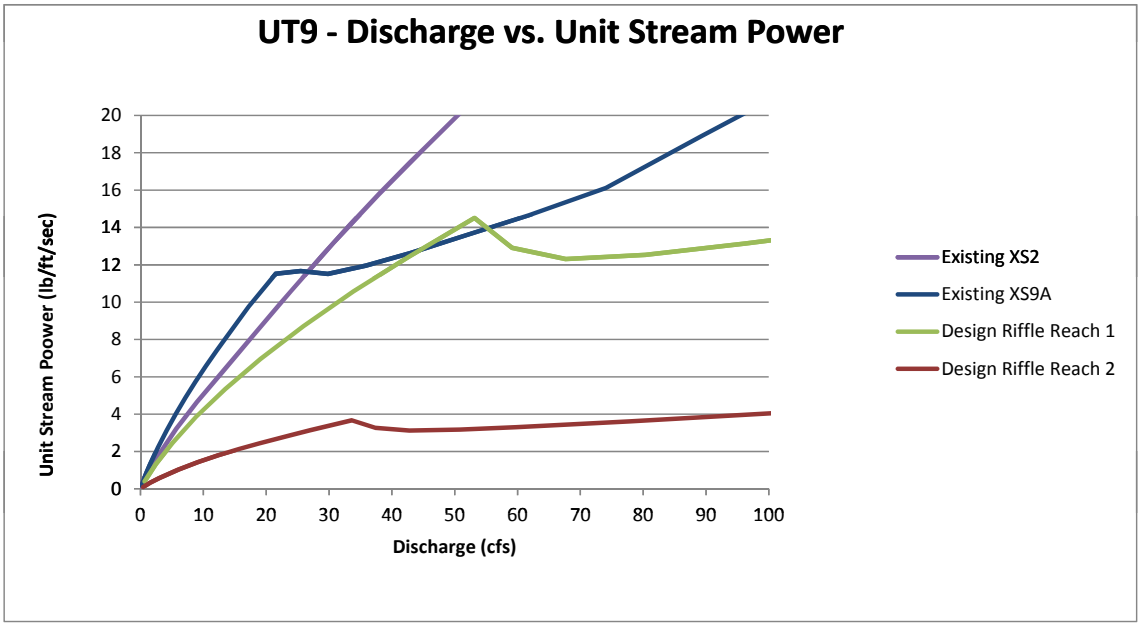
UT9 - XS9A 14+50



UT9 Bulk Sample 15+00



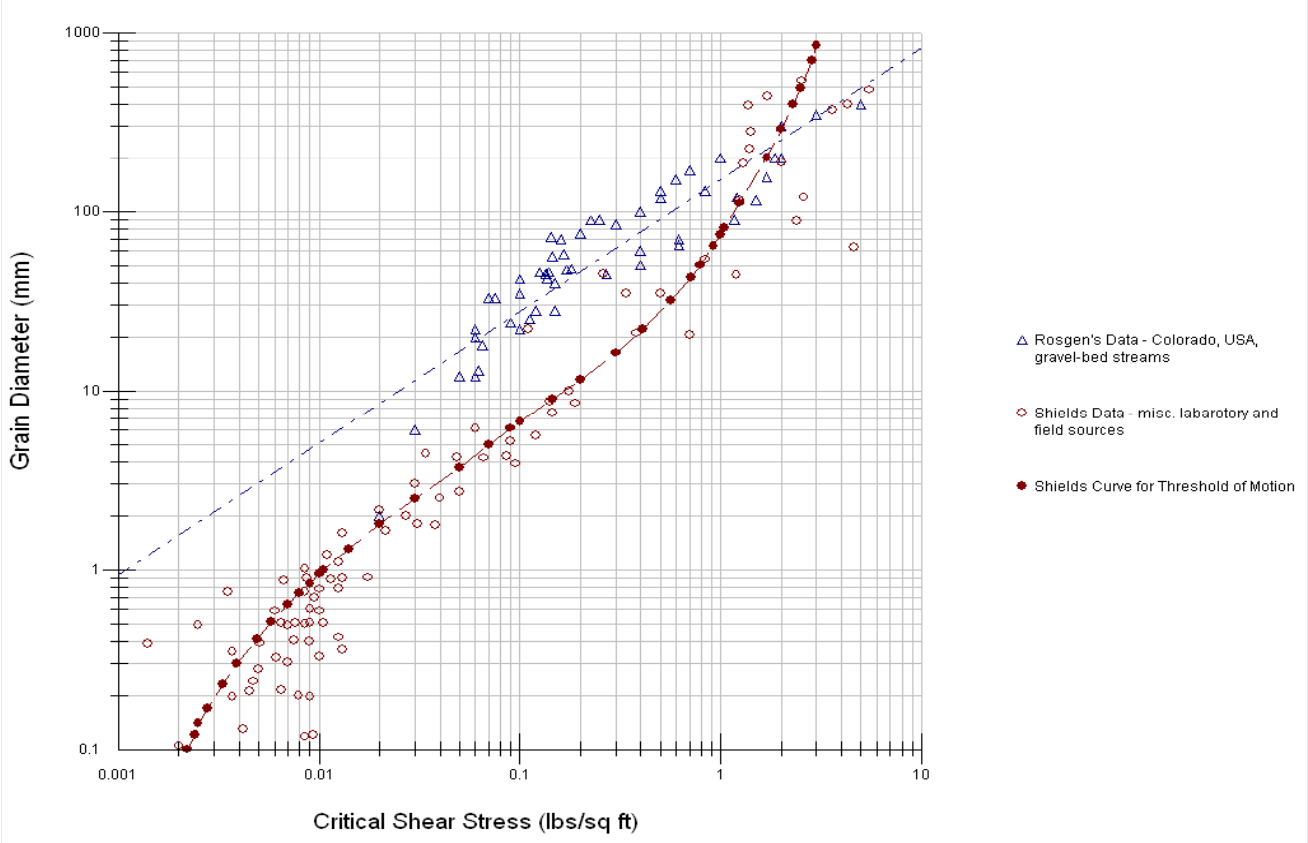

UT9 - Discharge vs. Shear
Boundary Shear (psf)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40
50
60
70
80
90
100
Discharge (cfs)
Existing XS2
Existing XS9A
Design Riffle Reach 1
Design Riffle Reach 2


UT9 - Discharge vs. Unit Stream Power
Unit Stream Poower (lb/ft/sec)
20
18
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
90
100
Discharge (cfs)
Existing XS2
Existing XS9A
Design Riffle Reach 1
Design Riffle Reach 2

Parameter	Existing Stream			Design Stream			Reference Stream		
	Min	Median	Max	Min	Median	Max	Min	Median	Max
Stream name	UT10			UT10			UT1 near STA. 18+00		
Stream type	F4			B4			B4		
Drainage area, DA (sq mi)	0.03			0.03			0.1		
Mean riffle depth, d_{bkf} (ft)		0.5		0.6			0.6	0.6	0.7
Riffle width, W_{bkf} (ft)		7.0		7.0			5.4	6.7	8.0
Width-to-depth ratio, [W_{bkf}/d_{bkf}]		13.0		12.3			9.4	10.5	11.6
Riffle cross-section area, A_{bkf} (sq ft)		3.8		4.0			3.1	4.3	5.5
Max riffle depth, d_{mbkf} (ft)		0.8		0.8			1.1	1.1	1.2
Max riffle depth ratio, [d_{mbkf}/d_{bkf}]		1.5		1.4			1.7	1.8	2.0
Pool width, W_{bkfp} (ft)		n/a		9.5				5.0	
Pool width ratio, [W_{bkfp}/W_{bkf}]				1.4				0.7	
Pool cross-section area, A_{bkfp} (sq ft)		n/a		8.1				3.8	
Pool area ratio, [A_{bkfp}/A_{bkf}]				2.0				0.9	
Max pool depth, d_{mbkfp} (ft)		n/a		1.3				1.2	
Max pool depth ratio, [d_{mbkfp}/d_{bkf}]				2.3				1.9	
Low bank height, LBH (ft)		2.0		0.8			1.1	1.1	1.2
Low bank height ratio, [LBH/d_{mbkf}]		2.5		1.0				1.0	
Width flood-prone area, W_{fpa} (ft)		9		24			13	16.5	20
Entrenchment ratio, ER [W_{fpa}/W_{bkf}]		1.3		3.4				2.5	
Radius of curvature, Rc (ft)	36	66	67	36	66	67	21	22	23
Radius of curvature ratio [Rc/W_{bkf}]	5.1	9.4	9.6	5.1	9.4	9.6	3.1	3.3	3.4
Belt width, W_{blt} (ft)		30			30			40	
Meander width ratio [W_{blt}/W_{bkf}]		4.3			4.3			6.0	
Valley slope, VS (ft/ft)	0.0260			0.0260			0.0260		
Average water surface slope, S (ft/ft)	0.0249			0.0249			0.0230		
Sinuosity, k = VS/S (ft/ft)	1.04			1.04			1.13		
Bankfull discharge, Q_{bkf} (cfs)		7			7		30		
Bankfull mean velocity, u_{bkf} = Q/A (ft/s)		1.9			1.8			7.0	
D_{50} riffle (mm)		0.3			0.3		3	6	9
D_{84} bar (mm)		84			84			130	
D_{100} bar (mm)		89			89			132	

Check of in-stream structure particle mobility				7/10/2013			
Reach	**Discharge or Stage**	**Shear (psf) ***	**Particle Diam. Shield's Curve, Rosgen data (mm)**	**Particle Diam. Shield's Curve, Rosgen data (in)**	**Constructed Riffle D_{50} (in)**	**Rock Vane or Boulder Step Med. Boulder Size (in)**	**Ford Crossing D_{50} (in)**
Shadrick R1 & R2	bankfull	0.75	120	4.7			
	2xbankfull	0.96	145	5.7			
Shadrick R3	bankfull	0.84	130	5.1			
	2xbankfull	1.28	180	7.1			
UT1	bankfull	0.95	145	5.7			
	2xbankfull	1.13	165	6.5			
					10	24	10 to 24
UT9 R1	bankfull	1.44	200	7.9			
	2xbankfull	1.73	225	8.9			
UT9 R2	bankfull	0.58	100	3.9			
	2xbankfull	0.69	115	4.5			
UT10	bankfull	0.86	135	5.3			
	2xbankfull	1.06	160	6.3			

* From stage shear calcs (RAS and RIVERMorph)



Hand Auger Boring Summary
Shadrick Creek Restoration
3/26/2013

HA 9-1	left floodplain of UT9 near upstream CE line Reach 2
0-2.5'	brown to tan and brown sandy clay
2.5'-4.2'	mottled brown, tan and lt. gray sandy clay
4.2'-4.5'	blue-gray silty, sandy clay
4.5'-5.0'	blue-gray sandy gravel, wet at 4.5'
5.0'	terminated
N:	730391.86
E:	1140102.94
Z:	1145.5' +/-

HA 9-2	left floodplain UT9, midway along Reach 2
0-2.0'	brown sandy clay
2.0'-2.5'	mottled brown, tan and lt. gray clayey sand; wet at 2.2'
2.5'-4.8'	blue-gray clayey sand, becoming silty then gravelly below 3.0'
4.8'	Refusal on gravel, water at 3.0'
N:	730310.71
E:	1140168.65
Z:	1143.8' +/-

HA S-1	left floodplain Shadrick Reach 3; 2.5' +/- below LB
0-0.5'	Topsoil
0.5'-2.0'	tan clayey sand
2.0'-3.5'	mottled tan and lt. gray clayey sand; wet and more clay at 3.0'
3.5'-4.5'	blue-gray sandy clay/clayey sand with gravel
4.5'	terminated; water at 2.8'
N:	729159.58
E:	1144983.12
Z:	1100' +/-

HA S-2	left floodplain Shadrick Reach 3; same elev. as LB
0-3.0'	red-brown sandy clay
3.0'-5.0'	red-brown to gray sandy clay/clayey sand with gravel below 3.5'
5.0'	refusal on gravel, wet at 3.5'
N:	728865.88
E:	1145221.19
Z:	1101' +/-

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. Edward Curtis), NC Floodplain Mapping Unit (attn. John Gerber) and NC Ecosystem Enhancement Program.

Project Location

Name of project:	Shadrick Creek Restoration
Name if stream or feature:	Shadrick Creek
County:	McDowell
Name of river basin:	Catawba
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	McDowell County
DFIRM panel number for entire site:	1732, 1733, 1742
Consultant name:	Confluence Engineering, PC
Phone number:	828-255-5530
Address:	16 Broad Street, Asheville, NC 28801

Design Information

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

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

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)?

☑ Yes ☐ No

If project is located in a SFHA, check how it was determined:

☐ Redelineation

☐ Detailed Study

☑ Limited Detail Study

☐ Approximate Study

☐ Don't know

List flood zone designation: AE, with non-encroachment area

Check if applies:

☑ AE Zone

- ☐ Floodway
- ☑ Non-Encroachment
- ☐ None

☐ A Zone

- ☐ Local Setbacks Required
- ☐ No Local Setbacks Required

If local setbacks are required, list how many feet: not known

Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks? Not known

☐ Yes ☑ No

Land Acquisition (Check)

☐ State owned (fee simple)

☑ Conservation easment (Design Bid Build)

☐ 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?

◉ Yes ○ No

Note: if community is not participating, then all requirements should be addressed to NFIP (attn: Edward Curtis, (919) 715-8000 x369)

Name of Local Floodplain Administrator: Jerry Silvers
Phone Number: 828-652-7030 ext. 2

Floodplain Requirements

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

☐ No Action

☑ No Rise

☐ Letter of Map Revision

☐ Conditional Letter of Map Revision

☐ Other Requirements

List other requirements:

Comments:
We submitted a so-rise report to McDowell County on 9/20/13. I spoke by phone with Jerry Silvers on September 16 and he indicated that he might send the report and models to NCFMP for review and approval, but that he'd need to review the package first. I have not heard back from Mr. Silvers.

Name: __Andrew Bick_____ Signature:
Title: _____Principal_____ Date: _____10/31/13_____

Shadrick Creek Flood Study

3 messages

Andrew Bick <andrew@confluence-eng.com> Fri, Jan 10, 2014 at 9:59 AM
To: Jerry Silvers <buildinginspections@mcdowellgov.com>, Julie Cahill <julie.cahill@ncdenr.gov>

Jerry - this is a follow up to our conversation on December 9th regarding the flood study for the Shadrick Creek restoration project. You had mentioned that you were going to look at it that week but we have not heard back from you. Have you had a chance to review this yet? We are trying to get the floodplain permit as soon as possible.

If you have any questions, I'd be glad to talk on the phone or come to your office.

--
Andrew Bick, PE
Confluence Engineering
16 Broad Street
Asheville, NC 28804
o: 828.255.5530 ext. 19
c: 828.606.0306
www.confluence-eng.com

Building Inspections <buildinginspections@mcdowellgov.com> Fri, Jan 10, 2014 at 3:04 PM
To: Andrew Bick <andrew@confluence-eng.com>

Good Afternoon Andrew,

First off I apologise for the delay in my response to this matter, however I now have reviewed your no rise study and found everything acceptable,therefore this E-mail can stand for your approved flood plain development permit for the Shadrick creek project as described in your flood study documents.

There will be no charge for this permit as we will not be making any field inspections, however we do request documentation supported by pictures when this project is complete.

If you need any thing more please advise

Jerry Silvers
McDowell County
Flood Plain Administrator

cc Ron Harmon McDowell County Planning
File

[Quoted text hidden]

--
Jerry Silvers
McDowell County Building Inspections
60 East Court Street
Marion, NC 28752
P. 828-652-7030
F. 828-659-3484
buildinginspections@mcdowellgov.com

APPENDIX B

PRELIMINARY PLANS

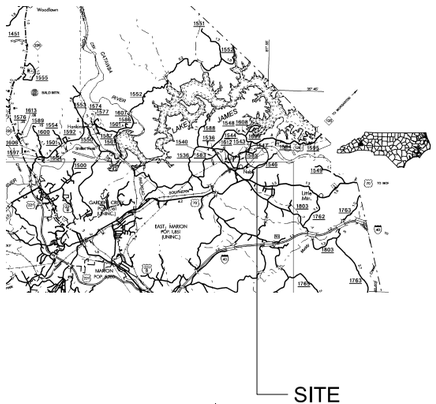
SCO PROJECT NUMBER	SHEET	TOTAL
08-07391-02	T1	36

A	PRELIM. FOR MIT. PLAN	12/13	AB
B	DRAFT CD'S	09/14	AB
C	FINAL MIT. PLAN	02/15	AB
D			
E			
SYM	DESCRIPTION	DATE	APPROVED
	REVISIONS		

CONSTRUCTION PLANS

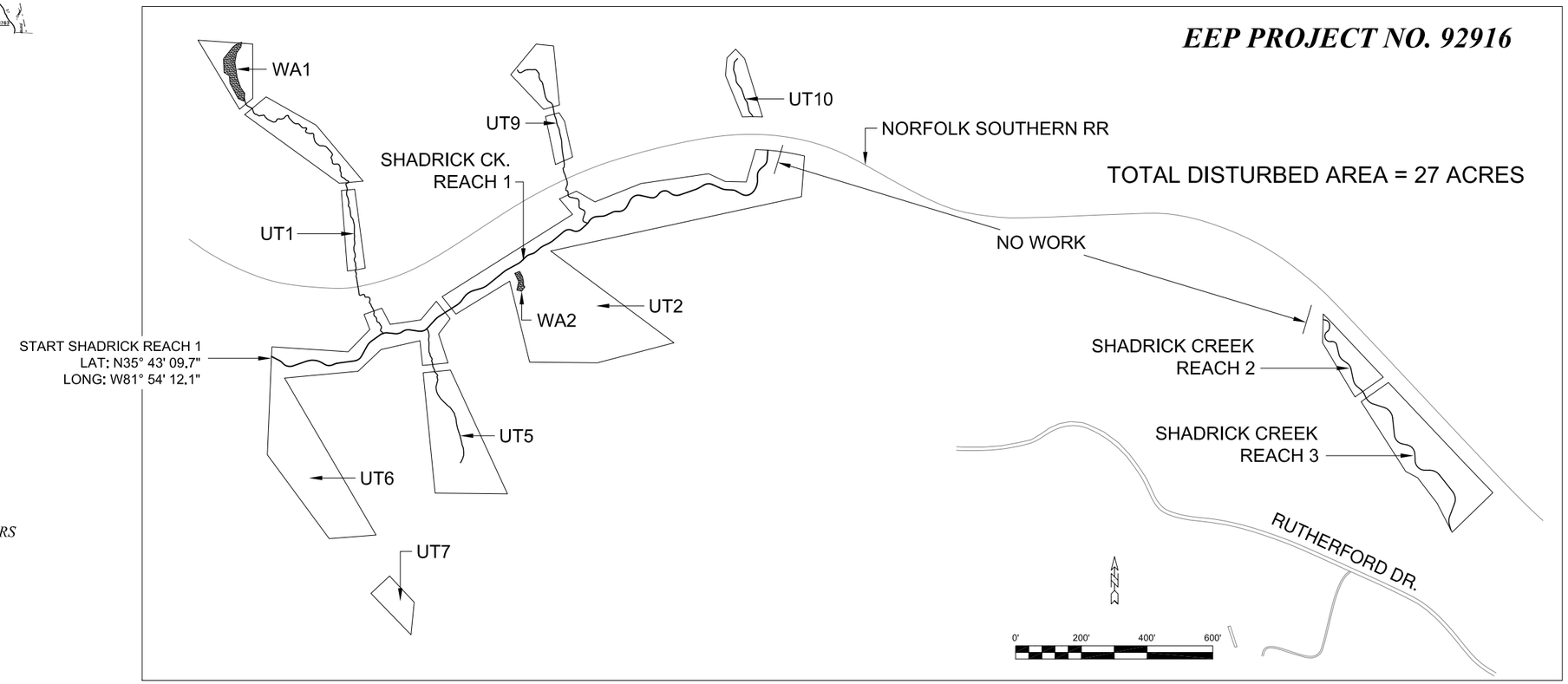
SHADRICK CREEK RESTORATION PROJECT

STREAM NAMES: SHADRICK CREEK AND UNNAMED TRIBUTARIES
LOCATION: McDOWELL COUNTY, NORTH CAROLINA



VICINITY MAP
NOT TO SCALE

EEP PROJECT NO. 92916



INDEX OF SHEETS

SCO PROJECT NO. 08-07391-02

GRAPHIC SCALES

40 20 0 40 80
PLAN (EXCEPT AS NOTED)

40 20 0 40 80
PROFILE (HORZ.)

4 2 0 4 8
PROFILE (VERT.)

CONFLUENCE ENGINEERING

Prepared By:
CONFLUENCE
ENGINEERING, PC
16 Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

DESIGN

APPROVAL

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22209 ENGINEER ANDREW DAVID BICK
NOT FOR CONSTRUCTION

SIGNATURE

Prepared for:
Ecosystem Enhancement PROGRAM

EEP PROJECT MANAGER: MATTHEW REID

PRELIMINARY PLANS
NOT FOR CONSTRUCTION

GENERAL NOTES:
SURVEY DATA ARE NAD 83 (HORIZONTAL) AND NGVD 88 (VERTICAL).

BASE TOPOGRAPHY (1-FOOT CONTOURS) PROVIDED BY W.K. DICKSON & CO., INC.

EROSION AND SEDIMENT CONTROLS SHALL BE INSTALLED, INSPECTED AND MAINTAINED IN ACCORDANCE WITH THE APPROVED PLAN AND FEDERAL, STATE AND LOCAL REGULATIONS.

ALL EQUIPMENT SHALL BE CLEANED REGULARLY AND MAINTAINED TO BE FREE OF FUEL, OIL AND LUBRICANT LEAKS.

SUBSURFACE CONDITIONS:
LOGS OF HAND AUGER BORINGS CAN BE MADE AVAILABLE UPON REQUEST.

CLEARING AND STOCKPILING:
PRIOR TO CLEARING AND TREE REMOVAL, THE CONTRACTOR SHALL CONSULT WITH THE DESIGNER TO DETERMINE WHICH TREES ARE SUITABLE FOR SALVAGE AS ROOT WADS AND LOGS IN THE PROJECT.

STAGING AND STOCKPILE AREAS SHOWN ON THE PLANS ARE APPROXIMATE. THE CONTRACTOR MAY ADJUST LOCATIONS PROVIDED THEY ARE CONTAINED WITHIN THE LIMITS OF DISTURBANCE AND TEMPORARY CONSTRUCTION EASEMENT BOUNDARIES.

TOPSOIL GENERATED FROM CLEARING IN NEW OFF-LINE CHANNEL SEGMENTS SHALL BE SHALL BE STOCKPILED SEPARATELY FROM OTHER EXCAVATED MATERIALS AND RE-USED ON CHANNEL BANKS.

SOD MATS SHALL BE HARVESTED AND TRANSPLANTED TO NEW CHANNEL BANKS IN AREAS WHERE NEW OFF-LINE CHANNEL WILL BE CONSTRUCTED AND SOD IS PRESENT.

UTILITIES:
THE CONTRACTOR SHALL SHALL REQUEST A UTILITY LOCATION SURVEY PRIOR TO BEGINNING CONSTRUCTION. THE CONTRACTOR IS FULLY RESPONSIBLE FOR DAMAGE TO ANY UTILITY CAUSED BY HIS FORCES.

EXISTING

- MAJOR CONTOUR (5')
- MINOR CONTOUR (1')
- PARCEL
- FENCE
- BEDROCK
- WETLAND
- CONSERVATION EASEMENT (CE — CE — CE)
- TEMP. CONST. EASEMENT
- MATURE TREES
- BEDROCK OUTCROP

PROPOSED

- STREAM ALIGNMENT (10+00)
- TOP OF BANK
- APPROX. GRADING LIMITS
- LIMITS OF DISTURBANCE (LOD — LOD)
- SILT FENCE (SF — SF — SF — SF)
- TEMP. CONST. ENTRANCE — 3 / D3
- TEMP. STREAM CROSSING — 1 / D3
- PERM. FORD CROSSING — 4 / D4
- GEOLIFTS — 1 / D4
- BRUSH MATTRESS — 1 / D1
- CONSTRUCTED RIFFLE — 3 / D4
- STEP STRUCTURE — 2 / D1
- LOG VANE — 3 / D2
- TREE REMOVAL — 2 / D2
- TREE PROTECTION
- LIVESTOCK FENCE
- FENCE REMOVAL
- GULLY STABILIZATION — 1 / D2

A	MIT. PLAN	12/13					
B	DRAFT CD'S.	09/14					
C	FINAL MP	02/15					
					DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22205 ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

DATE: FEB. 2015
SCALE: NTS

NOTES AND SYMBOLS

PRELIMINARY PLANS
NOT FOR CONSTRUCTION

CONSTRUCTION SEQUENCE OF EVENTS

GENERAL CONSTRUCTION NOTES FOR ALL REACHES

1. ALL EROSION AND SEDIMENT CONTROL PRACTICES SHALL COMPLY WITH THE NORTH CAROLINA EROSION AND SEDIMENT CONTROL DESIGN MANUAL.
2. CONTRACTOR SHALL INSTALL PUMP-AROUND SYSTEMS TO DIVERT FLOW WHILE WORKING IN LIVE, FLOWING CHANNELS. THE CONTRACTOR SHALL OPERATE AND MAINTAIN THE PUMP-AROUND SYSTEMS 24 HOURS A DAY UNLESS ALL DISTURBED AREAS WITHIN THE PUMP-AROUND AREA CAN BE STABILIZED BY THE END OF THE WORK DAY. THE CONTRACTOR SHALL NOT REMOVE PUMP-AROUND SYSTEMS AND ADVANCE TO THE NEXT WORK AREA UNTIL THE CURRENT WORK AREA IS COMPLETED AND STABILIZED.
3. NO MATERIAL FROM THE OFF-LINE CHANNEL EXCAVATION MAY BE BACKFILLED INTO ADJACENT, ABANDONED CHANNEL SEGMENTS UNTIL THE NEWLY CONSTRUCTED CHANNEL SECTION IS COMPLETED AND STABILIZED, AND THE STREAM FLOW HAS BEEN DIVERTED INTO THE NEWLY CONSTRUCTED CHANNEL SECTION, EVEN IF WATER IN THAT SECTION OF ABANDONED CHANNEL IS BEING DIVERTED.
4. IN AREAS WITHOUT A PUMP-AROUND SYSTEM, THE CONTRACTOR SHALL DISTURB ONLY AS MUCH CHANNEL AS CAN BE STABILIZED WITH SEEDING, MULCH AND EROSION CONTROL MATTING BY THE END OF EACH WORK DAY.
5. CLEARING AND GRUBBING ACTIVITIES SHALL NOT EXTEND MORE THAN 150 LINEAR FEET AHEAD OF IN-STREAM WORK.
6. WHEN CROSSING AN ACTIVE SECTION OF CHANNEL, A TEMPORARY STREAM CROSSING SHALL BE INSTALLED ACCORDING TO THE PLANS AND SPECIFICATIONS.
7. ALL GRADED AREAS WITH SLOPES STEEPER THAN 3:1 SHALL BE STABILIZED WITHIN SEVEN DAYS OF REACHING FINAL GRADES. ALL OTHER AREAS SHALL BE STABILIZED WITHIN 14 DAYS.
8. LOCATIONS FOR STAGING AND STOCKPILE AREAS AND STREAM CROSSINGS HAVE BEEN PROVIDED ON THE PLANS. ADDITIONAL OR ALTERNATIVE STAGING AND/OR STOCKPILE AREAS AND STREAM CROSSINGS MAY BE USED BY THE CONTRACTOR PROVIDED THAT ALL PRACTICES ARE APPROVED BY THE DESIGNER PRIOR TO IMPLEMENTATION.
9. THE CONTRACTOR SHALL MAKE EVERY EFFORT TO AVOID DAMAGING OR REMOVING EXISTING TREES THAT ARE BEYOND THE LIMITS OF DISTURBANCE.
10. UNDER NO CIRCUMSTANCES SHALL THE CONTRACTOR EXCEED THE LIMITS OF DISTURBANCE SHOWN ON THE PLANS.

PHASE 1: MOBILIZATION AND GENERAL SITE PREPARATION

1. MOBILIZE EQUIPMENT AND MATERIALS TO THE SITE. LOCATE LIMITS OF DISTURBANCE. CLEARLY MARK AND PROTECT EXISTING EASEMENT MONUMENTS; CONTRACTOR IS RESPONSIBLE FOR RE-SURVEYING AND REPLACING ANY MONUMENTS THAT ARE DISTURBED.
2. ESTABLISH CONSTRUCTION ENTRANCES/EXITS AND STAGING AREAS AS SHOWN ON THE PLANS. ACCESS TO THE SITE WILL BE VIA EXISTING FARM PATHS. THE EXISTING CROSSINGS AT UT1 AND UT9 MAY BE USED DURING CONSTRUCTION. INSTALL OTHER TEMPORARY STREAM CROSSINGS AS INDICATED ON THE PLANS.
3. INSTALL TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES.
4. ESTABLISH CONSTRUCTION HAUL ROUTES USING EXISTING FARM PATHS TO THE EXTENT FEASIBLE. MINIMIZE DISTURBANCE BEYOND IMMEDIATE HAUL ROUTES AND GRADING LIMITS. STABILIZE HAUL ROUTE SURFACES WITH STONE AND GEOGRID AS SITE CONDITIONS DICTATE.
5. HARDWOOD TREES 12 INCHES DBH AND LARGER THAT REQUIRE REMOVAL PER THE PLANS SHALL BE SALVAGED FOR USE AS IN-STREAM STRUCTURES. ATTENTION SHALL BE PAID TO THE SPECIFIED TRUNK LENGTHS OF LOGS AND ROOT WADS SHOWN ON THE PLANS.
6. THE STEMS AND ROOT MASSES OF NON-NATIVE SPECIES (HONEYUCKLE, CHINESE PRIVET, ETC.) GENERATED DURING GRADING OPERATIONS SHALL BE BURNED OR DISPOSED IN APPROVED OFF-SITE LOCATIONS.
7. STOCKPILED MATERIALS NOT USED FOR BACKFILL WITHIN 7 DAYS OF PLACEMENT SHALL BE STABILIZED WITH TEMPORARY SEED AND STRAW MULCH.

PHASE 2: OFF-LINE CHANNEL CONSTRUCTION (SHADRICK CREEK REACH 3, UT9 REACH 2)

1. PERFORM SOD MAT CUTTING WITHIN GRADING LIMITS AND TRANSPLANT OR STORE SEPARATELY FOR LATER USE ON STREAM BANKS AND PLANTING AREAS. LIMIT SOD MAT CUTTING AND STRIPPING TO THOSE AREAS THAT WILL BE GRADED WITHIN 3 DAYS IN ORDER TO MINIMIZE SOFTENING AND DEGRADATION OF SUBGRADE SOILS UNDER CONSTRUCTION TRAFFIC.
2. WHEN EXCAVATING NEW OFF-LINE CHANNEL, LEAVE PLUGS OF EXISTING BANK MATERIAL IN PLACE AT UPSTREAM AND DOWNSTREAM ENDS. BASE FLOW SHALL BE MAINTAINED IN THE EXISTING CHANNEL UNTIL THE NEW CHANNEL IS FULLY STABILIZED WITH SOD MATS, SEEDING AND STRUCTURES.
3. COMPLETE IN-STREAM STRUCTURE INSTALLATION AND BANK STABILIZATION ON THE NEW CHANNEL. TRANSPLANT SOD MATS OR SEED AND MAT BANKS (WHERE SOD MAT TRANSPLANTING IS NOT FEASIBLE). STOCKPILE EXCAVATED SOILS BETWEEN THE NEW CHANNEL AND EXISTING CHANNEL FOR LATER BACKFILLING. SILT FENCE SHALL BE INSTALLED ON THE CREEK SIDE OF ALL STOCKPILES.
4. WORKING FROM THE TOP OF THE EXITING STREAM BANKS, EXCAVATE GRAVEL AND COBBLE SEDIMENT AND STOCKPILE SEPARATELY FOR USE IN CONSTRUCTED RIFFLES AND OTHER STRUCTURES.
5. ONCE THE NEW CHANNEL IS STABILIZED, COMPLETE TIE-INS FROM EXISTING TO NEW CHANNEL, TAKING PRECAUTIONS TO PREVENT SOIL FROM REACHING THE LIVE STREAM. DIVERTING WATER INTO THE NEW CHANNEL SHALL PROCEED ACCORDING TO THE FOLLOWING STEPS:

- REMOVE PLUG AT DOWNSTREAM END OF NEW CHANNEL
- SET UP PUMP-AROUND DIVERSION UPSTREAM OF UPSTREAM TIE-IN
- GRADE ON-LINE STREAM CHANNEL THROUGH THE PLUGS TO THE DESIGN DIMENSIONS AND PROFILE AND CONFORM TO NEW CHANNEL SEGMENT
- BACKFILL ABANDONED CHANNEL, WORKING UPSTREAM TO DOWNSTREAM AND USING STOCKPILED SOIL COMPACTED IN HORIZONTAL LIFTS NOT EXCEEDING 12 INCHES IN THICKNESS. STABILIZE NEWLY GRADED AREAS WITH SEED, STRAW MULCH AND MATTING.

PHASE 3: ON-LINE CHANNEL CONSTRUCTION

1. BASE FLOW SHALL BE DIVERTED IN STAGES, GENERALLY BETWEEN TWO EXISTING POOLS. INSTALL TEMPORARY SAND BAG COFFER DAMS UPSTREAM AND DOWNSTREAM OF THE WORK AREA. INSTALL PUMP, SUCTION AND DISCHARGE LINES AND DIVERT FLOW AROUND TIE-IN AREA. INSTALL DEWATERING PUMP AS NECESSARY TO MAINTAIN SUITABLE WORKING CONDITIONS; DISCHARGE DEWATERED FLOW THROUGH A SILT BAG.
2. PERFORM EARTHWORK, INSTALL IN-STREAM STRUCTURES, PLACE BRUSH MATTRESSES AND GEOLIFTS, SEED, MULCH AND MAT PER THE PLANS. SALVAGE GRAVEL AND COBBLE SEDIMENT FOR USE IN CONSTRUCTED RIFFLES AND OTHER STRUCTURES.
3. PERMANENTLY DISPOSE OF EXCAVATED MATERIALS IN APPROVED UPLAND OR OFF-SITE AREAS. SILT FENCE SHALL BE INSTALLED ON THE CREEK SIDE OF ALL TEMPORARY STOCKPILES.
4. ONCE RESTORED CHANNEL IS FULLY STABILIZED, DISMANTLE PUMPS, DISCHARGE LINES AND COFFER DAMS, AND RETURN FLOW TO THE RESTORED CHANNEL.

PHASE 4: DEMOBILIZATION

1. UPON COMPLETION OF STREAM AND FLOODPLAIN GRADING OPERATIONS, STOCKPILED MATERIALS AND SILT FENCES SHALL BE REMOVED, CONSTRUCTION ENTRANCES/EXITS AND TEMPORARY STREAM CROSSINGS SHALL BE REMOVED, AND THE CONSTRUCTION HAUL ROUTES SHALL BE GRADED, SEEDED AND MULCHED AS NEEDED TO RESTORE THEM TO THEIR PRE-PROJECT CONDITIONS.
2. THE CONTRACTOR SHALL ENSURE THAT THE SITE IS FREE FROM TRASH AND EXCESS CONSTRUCTION MATERIALS PRIOR TO DEMOBILIZATION OF EQUIPMENT FROM THE SITE.
3. THE STAGING AREAS SHALL BE RESTORED TO THEIR PRE-PROJECT CONDITIONS.

PHASE 4A: BIOENGINEERING AND PLANTING

1. BIOENGINEERING (BRUSH MATTRESSES AND GEOLIFTS) AND LIVE STAKING SHALL BE COMPLETED AFTER GRADING AND IN-STREAM STRUCTURE OPERATIONS ARE COMPLETE AND DURING THE DORMANT SEASON (NOVEMBER TO APRIL).
2. BUFFER AND WETLAND PLANTING SHALL BE COMPLETED AFTER GRADING OPERATIONS ARE COMPLETE AND DURING THE DORMANT SEASON (NOVEMBER TO APRIL).

DESIGN PARAMETERS BY REACH

Reach	Shadrick Reach 1	Shadrick Reaches 2 & 3	UT1	UT9 Reach 1	UT9 Reach 2	UT10
Riffle Max. Depth (ft)	3.0	3.4	1.0	1.0	1.0	0.8
Riffle Width (ft)	27.0	29.0	8.0	8.0	8.0	7.0
Riffle W/D Ratio	12.5	12.1	11.6	11.6	11.6	12.2
Pool Max. Depth (ft)	5.0	5.5	1.6	1.6	1.8	1.3
Pool Width (ft)	38.5	41.8	11.0	11.0	13.7	9.5
Riffle Area (ft^2)	58.5	69.7	5.5	5.5	5.5	4.0
Pool Area (ft^2)	111.3	131.3	11.2	11.2	14.1	8.1
Slope (ft/ft)	0.005	0.005	0.025	0.035	0.014	0.025

	DESCRIPTION	DATE	APP.
A	MIT. PLAN	12/13	
B	DRAFT CD'S.	09/14	
C	FINAL MP	02/15	
D			

REVISIONS

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22209 ANDREW DAVID B
NOT FOR CONSTRUCTION

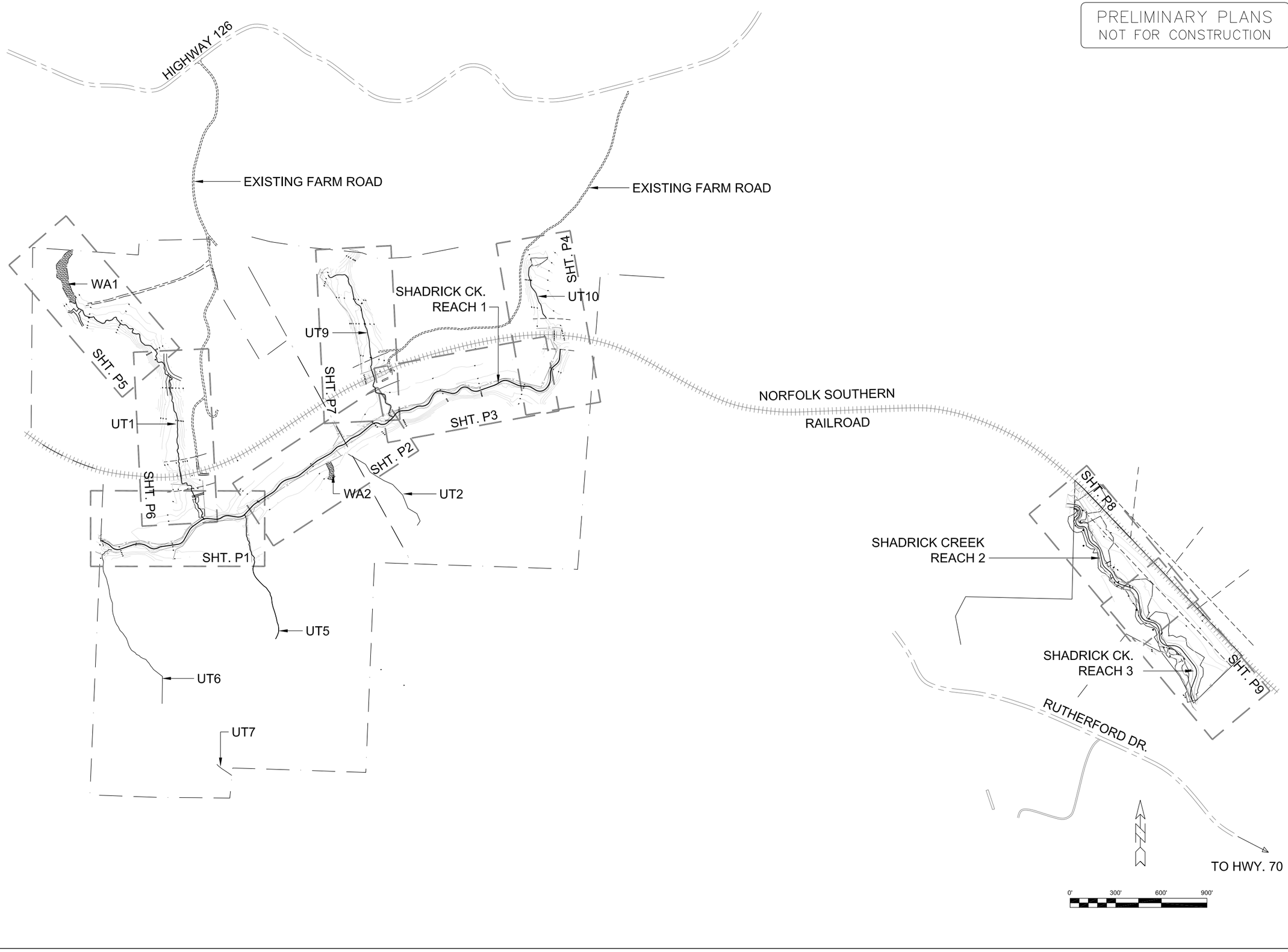
CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

DATE: FEB. 2015
SCALE: NTS

SEQUENCE & DESIGN PARAMETERS

PRELIMINARY PLANS
NOT FOR CONSTRUCTION



A	MIT. PLAN	12/13		
B	DRAFT CD'S.	09/14		
C	FINAL MP	02/15		
			DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA
PROFESSIONAL
SEAL
22209
ENGINEER
ANDREW DAVID
2nd

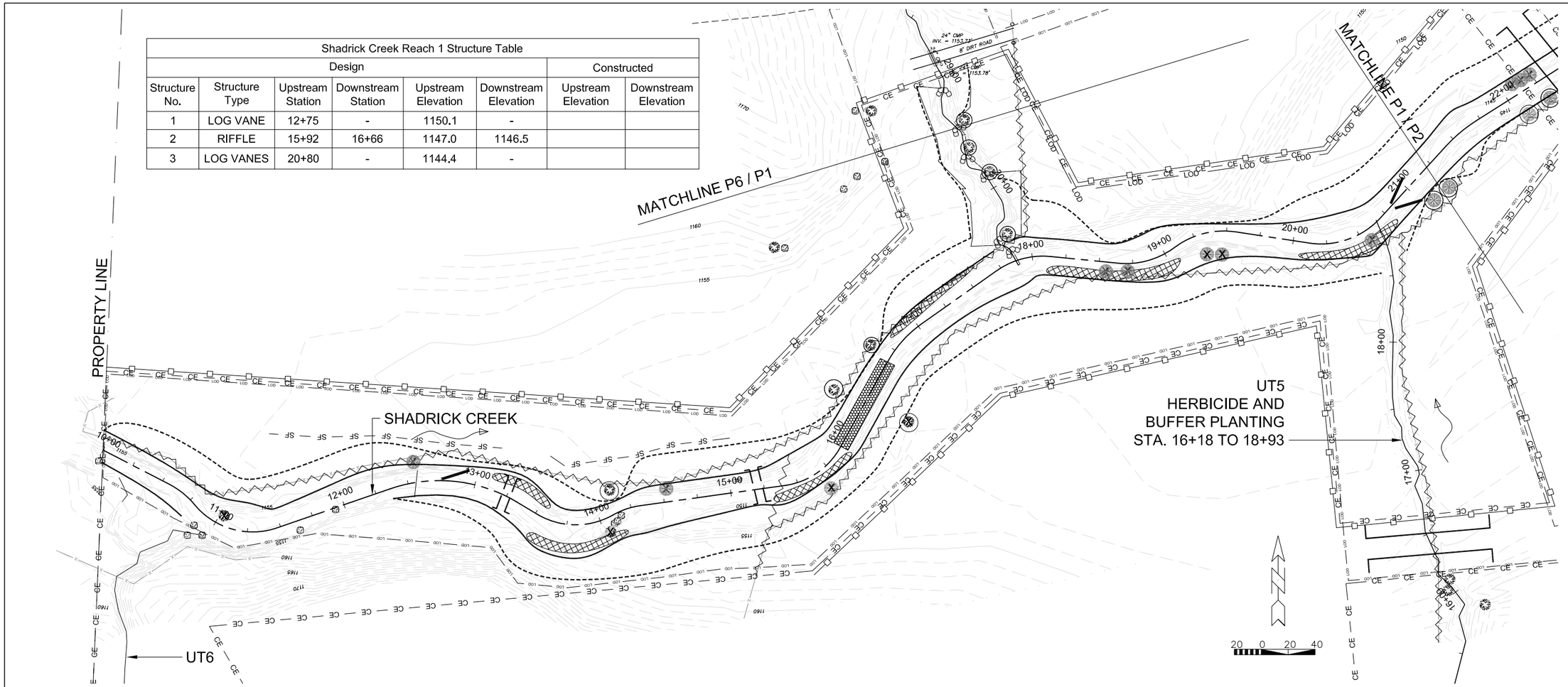
CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

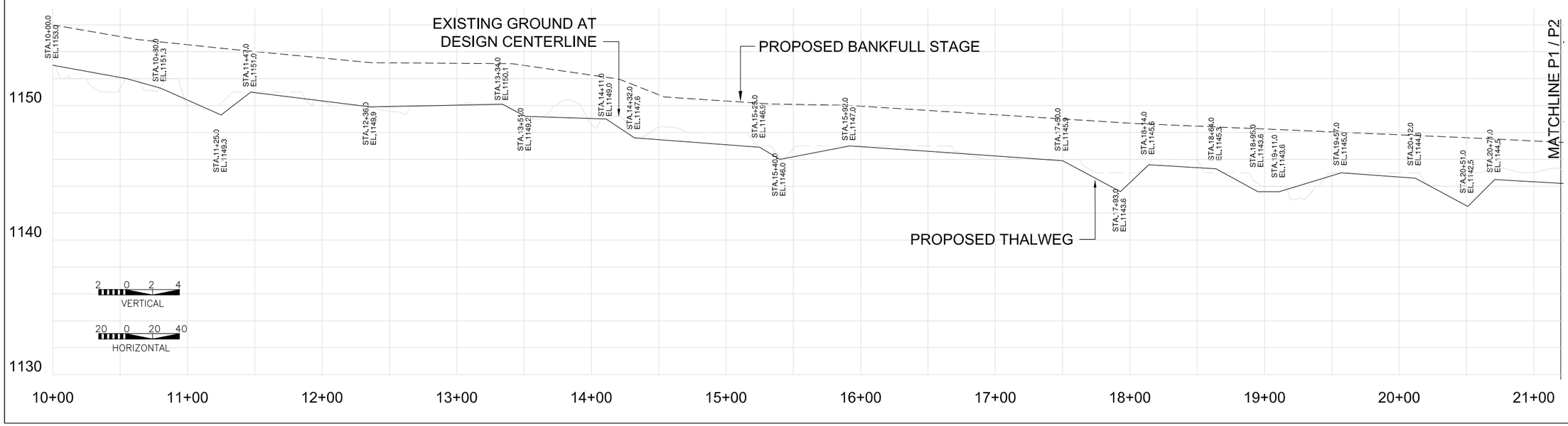
SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

DATE: FEB. 2015
SCALE: AS SHOWN

SHEET INDEX

Shadrick Creek Reach 1 Structure Table							
Design						Constructed	
Structure No.	Structure Type	Upstream Station	Downstream Station	Upstream Elevation	Downstream Elevation	Upstream Elevation	Downstream Elevation
1	LOG VANE	12+75	-	1150.1	-		
2	RIFFLE	15+92	16+66	1147.0	1146.5		
3	LOG VANES	20+80	-	1144.4	-		





A	MIT. PLAN	12/13	
B	DRAFT CD'S.	09/14	
C	FINAL MP	02/15	
D			
	DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION

NORTH CAROLINA
PROFESSIONAL
SEAL
22203
ENGINEER
ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

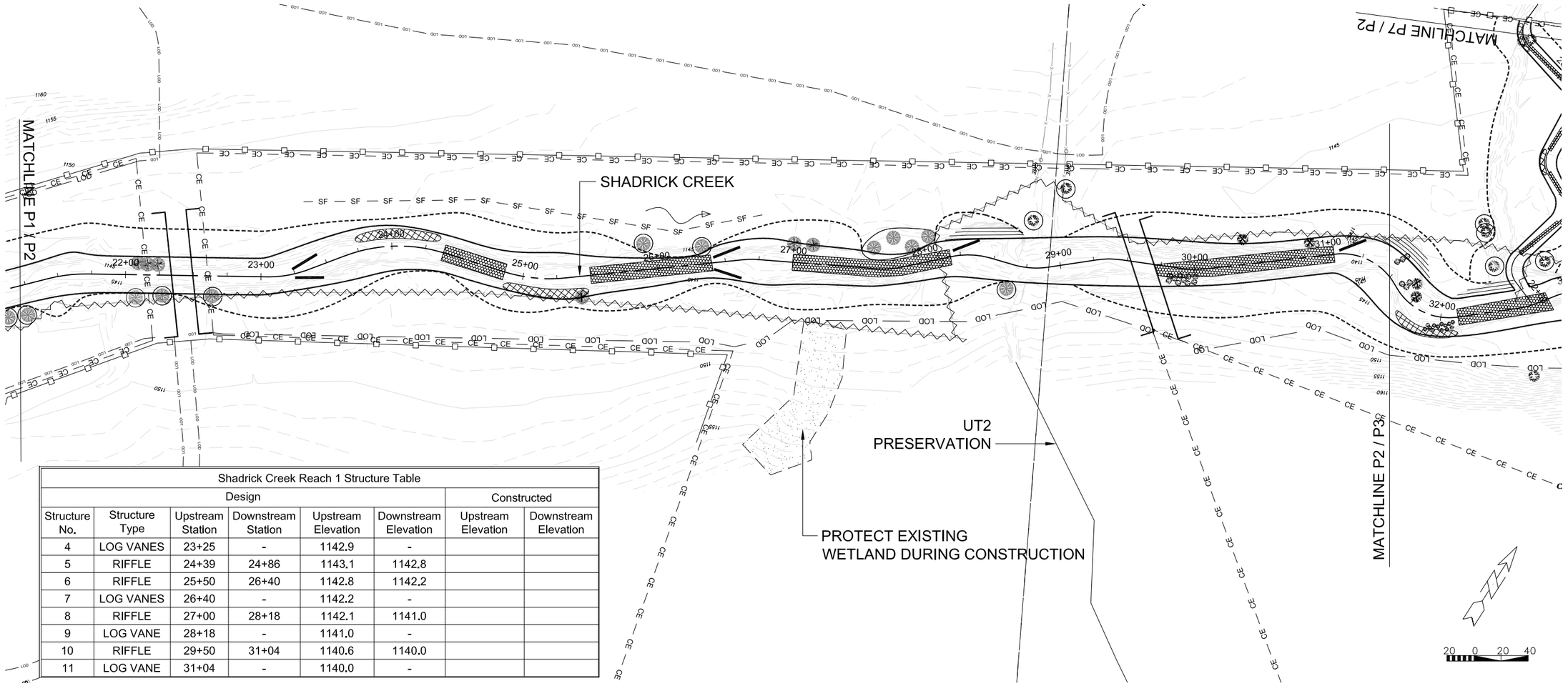
STA. 10+00 TO 21+20

DATE: FEB. 2015

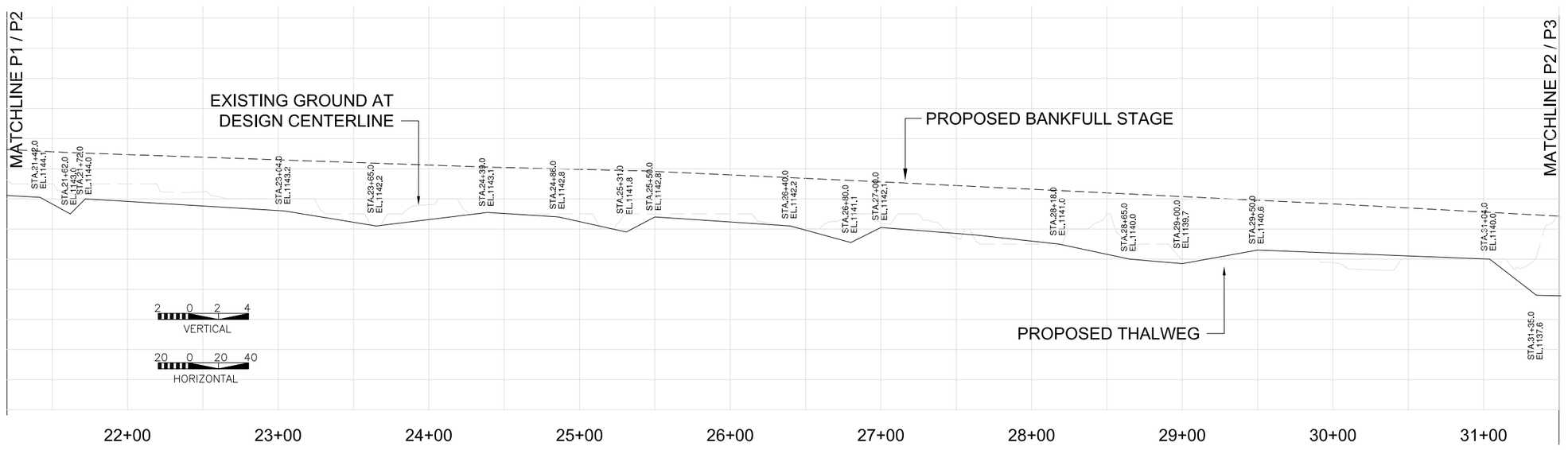
SCALE: AS SHOWN

SHADRICK CK.
REACH 1
PLAN & PROFILE

SHEET P1 OF 36



Shadrick Creek Reach 1 Structure Table							
		Design				Constructed	
Structure No.	Structure Type	Upstream Station	Downstream Station	Upstream Elevation	Downstream Elevation	Upstream Elevation	Downstream Elevation
4	LOG VANES	23+25	-	1142.9	-		
5	RIFFLE	24+39	24+86	1143.1	1142.8		
6	RIFFLE	25+50	26+40	1142.8	1142.2		
7	LOG VANES	26+40	-	1142.2	-		
8	RIFFLE	27+00	28+18	1142.1	1141.0		
9	LOG VANE	28+18	-	1141.0	-		
10	RIFFLE	29+50	31+04	1140.6	1140.0		
11	LOG VANE	31+04	-	1140.0	-		



A	MIT. PLAN	12/13		
B	DRAFT CD'S.	09/14		
C	FINAL MP	02/15		
D				
	DESCRIPTION	DATE	APP.	

REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA
PROFESSIONAL
SEAL
22206
ENGINEER
ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

STA. 21+20 TO 31+50

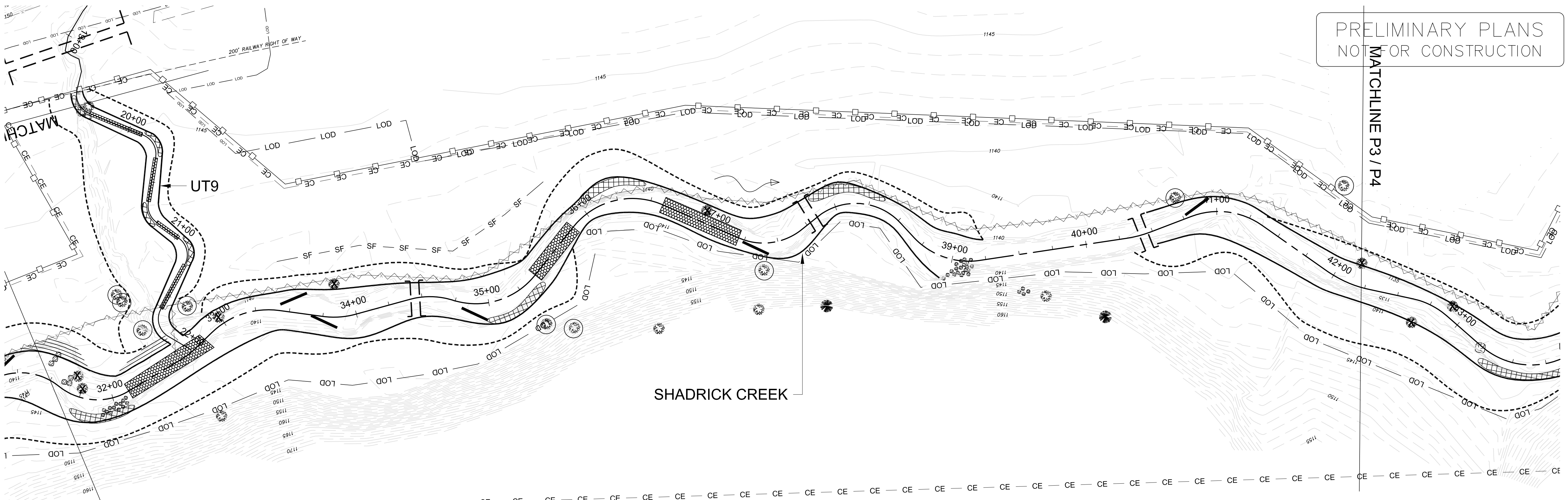
DATE: FEB. 2015

SCALE: AS SHOWN

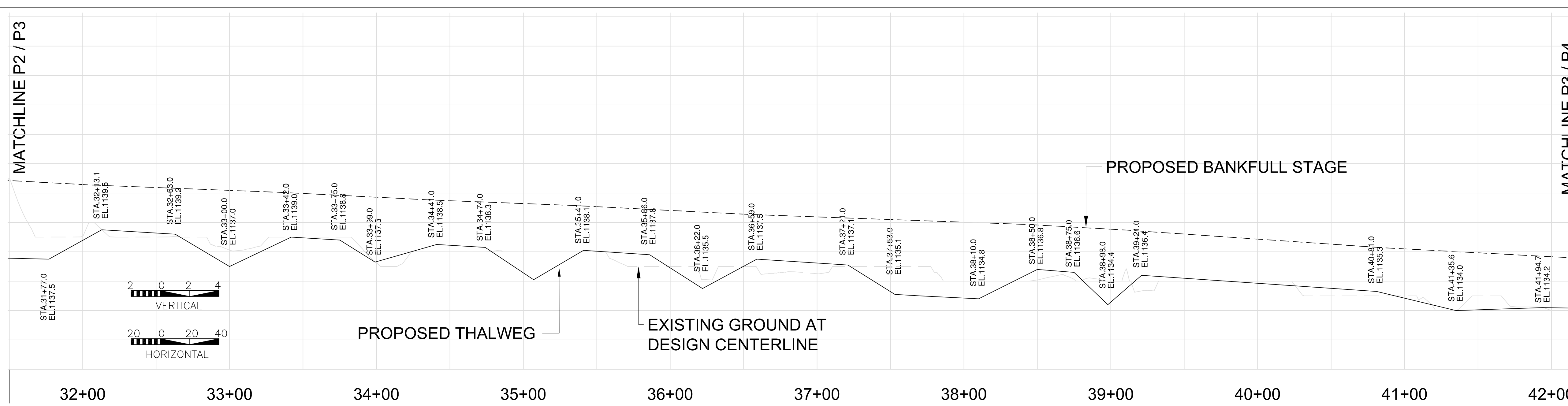
SHADRICK CK.
REACH 1
PLAN & PROFILE

SHEET P2 OF 36

PRELIMINARY PLANS
NOT FOR CONSTRUCTION



Shadrick Creek Reach 1 Structure Table							
Design						Constructed	
Structure No.	Structure Type	Upstream Station	Downstream Station	Upstream Elevation	Downstream Elevation	Upstream Elevation	Downstream Elevation
12	RIFFLE	32+13	32+63	1139.5	1139.2		
13	LOG VANE	33+42	-	1139.0	-		
14	LOG VANE	33+66	-	1138.9	-		
15	LOG VANE	34+75	-	1138.2	-		
16	RIFFLE	35+41	35+86	1138.1	1137.8		
17	RIFFLE	36+59	37+21	1137.5	1137.1		
18	LOG VANE	37+21	-	1137.1	-		
19	LOG VANE	40+75	-	1135.4	-		



A	MIT. PLAN	12/13	
B	DRAFT CD'S.	09/14	
C	FINAL MP	02/15	
D			
	DESCRIPTION	DATE	APP.

REVISIONS

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22209 ANDREW DAVID
NOT FOR CONSTRUCTION

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

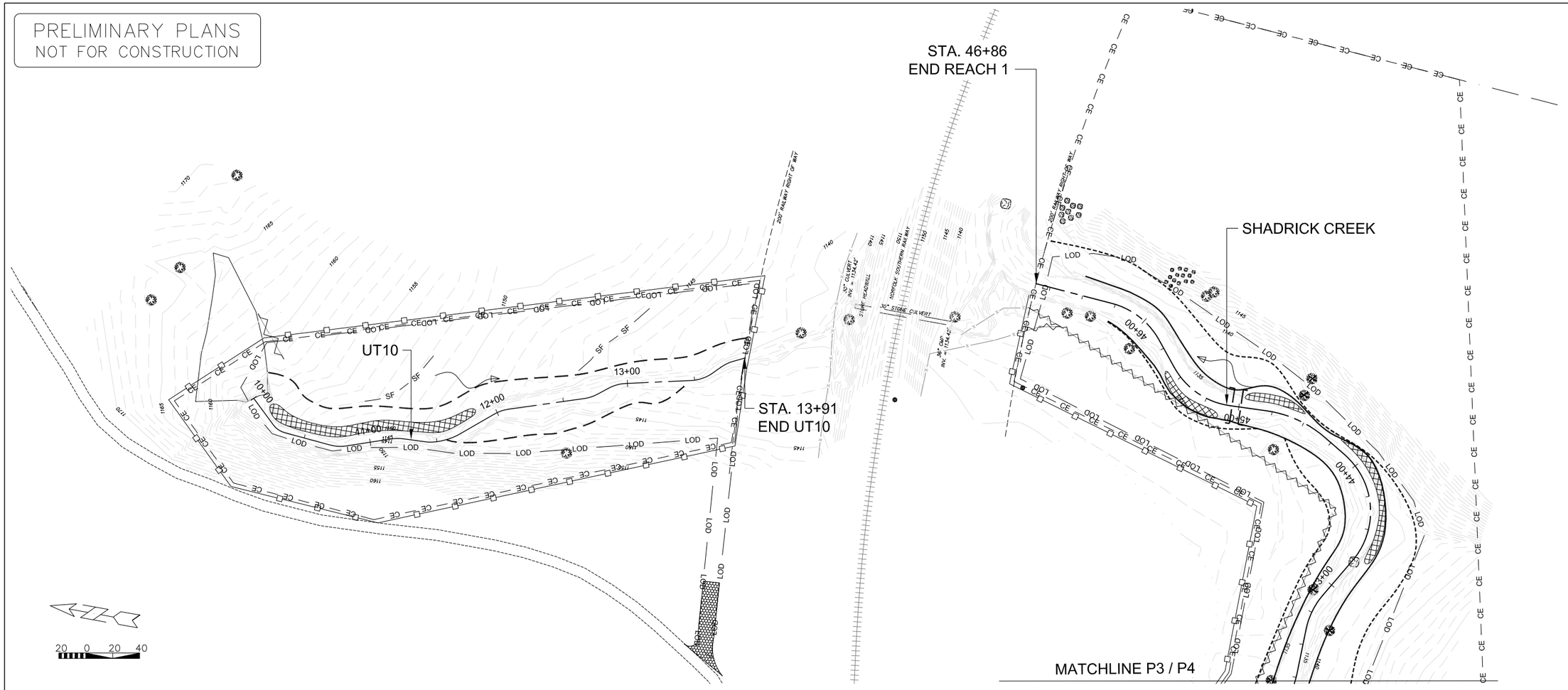
SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

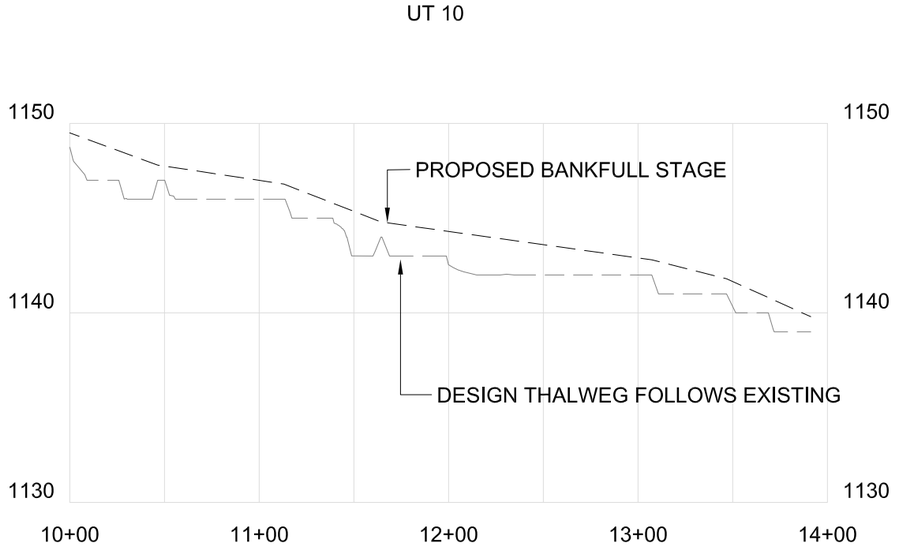
STA. 31+50 TO 42+20

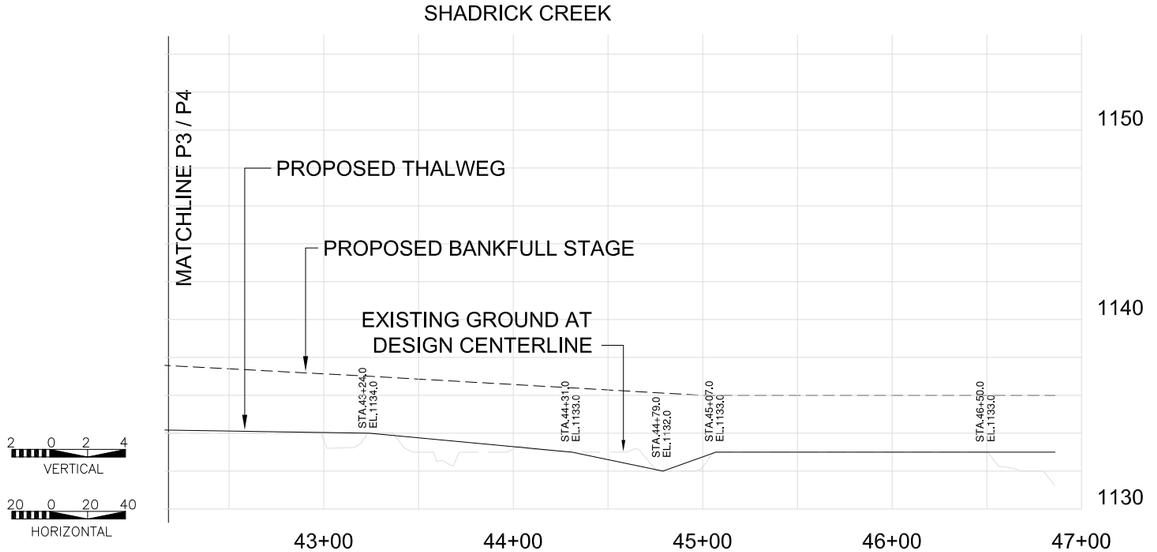
DATE: FEB. 2015
SCALE: AS SHOWN

SHADRICK CK.
REACH 1
PLAN & PROFILE

PRELIMINARY PLANS
NOT FOR CONSTRUCTION







2 0 2 4
VERTICAL
20 0 20 40
HORIZONTAL

A	MIT. PLAN	12/13			
B	DRAFT CD'S.	09/14			
C	FINAL MP	02/15			
D					
			DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA
PROFESSIONAL
SEAL
22206
ENGINEER
ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

STA. 42+20 TO 46+86; UT10

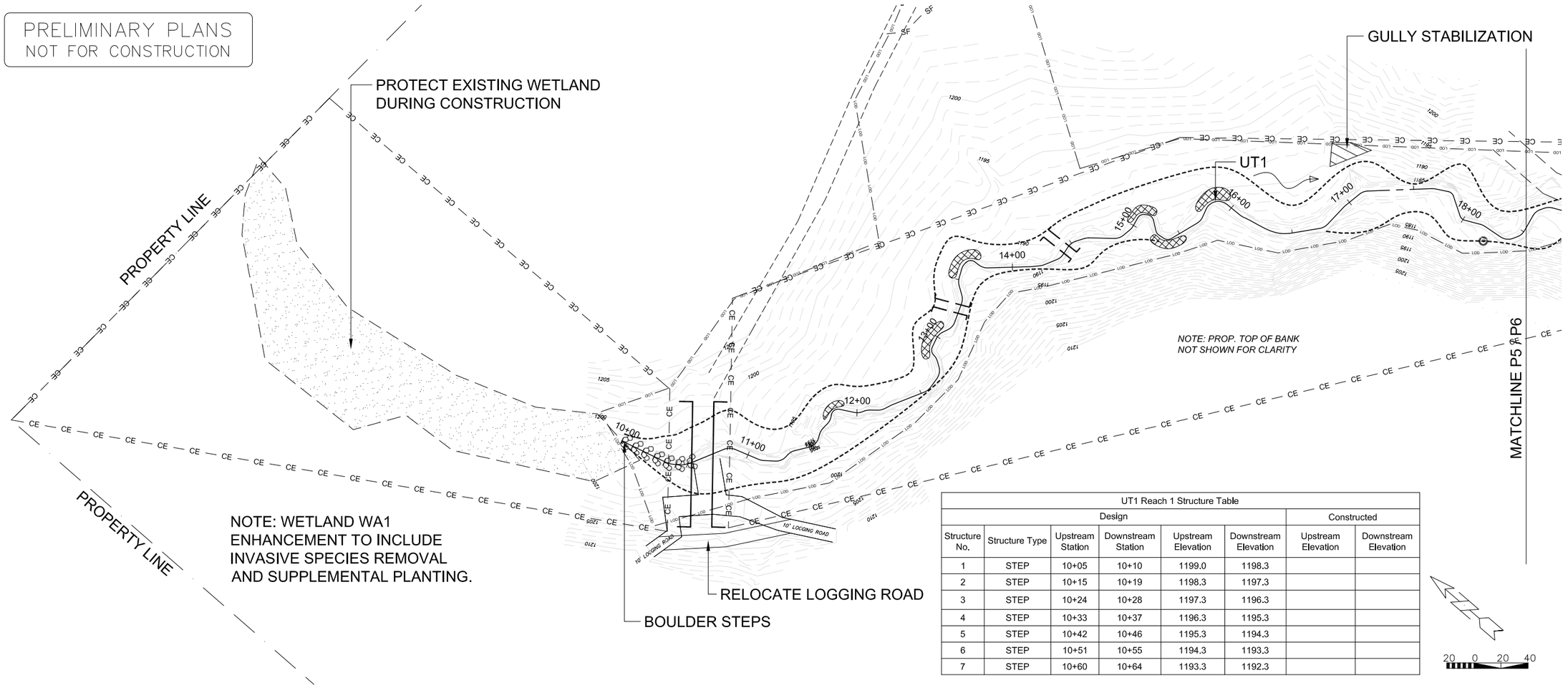
DATE: FEB. 2015

SCALE: AS SHOWN

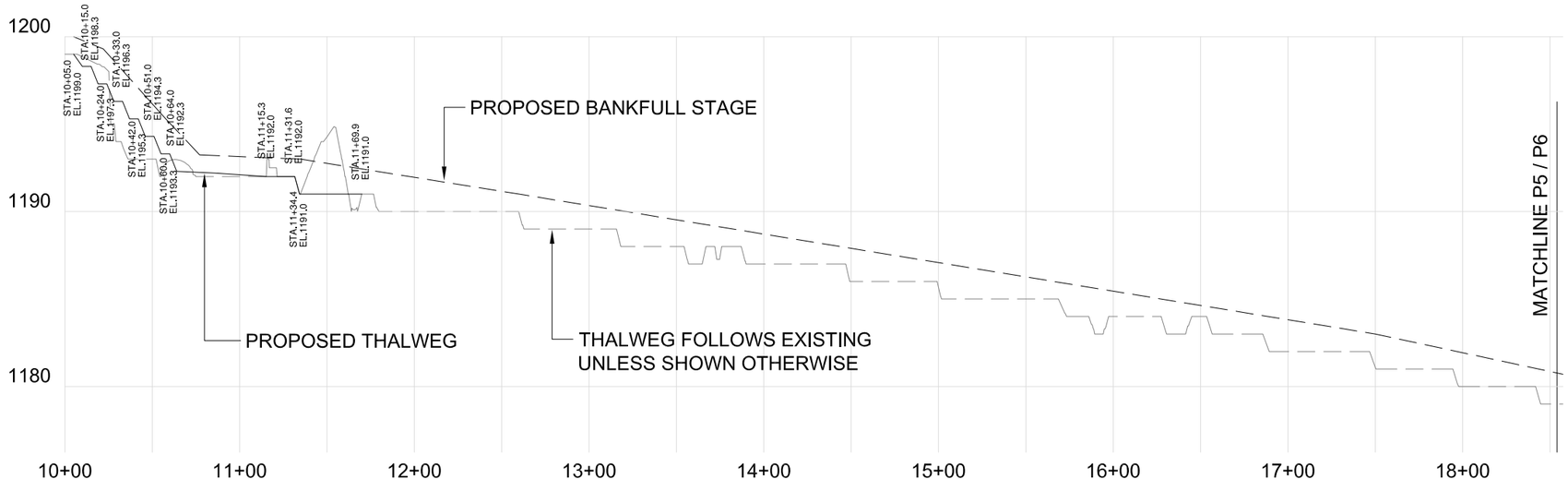
SHADRICK
REACH 1 & UT10
PLAN & PROFILE

SHEET P4 OF 36

PRELIMINARY PLANS
NOT FOR CONSTRUCTION



UT1 Reach 1 Structure Table							
		Design				Constructed	
Structure No.	Structure Type	Upstream Station	Downstream Station	Upstream Elevation	Downstream Elevation	Upstream Elevation	Downstream Elevation
1	STEP	10+05	10+10	1199.0	1198.3		
2	STEP	10+15	10+19	1198.3	1197.3		
3	STEP	10+24	10+28	1197.3	1196.3		
4	STEP	10+33	10+37	1196.3	1195.3		
5	STEP	10+42	10+46	1195.3	1194.3		
6	STEP	10+51	10+55	1194.3	1193.3		
7	STEP	10+60	10+64	1193.3	1192.3		



2 0 2 4
VERTICAL

20 0 20 40
HORIZONTAL

A	MIT. PLAN	12/13	
B	DRAFT CD'S.	09/14	
C	FINAL MP	02/15	
D			
	DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA
PROFESSIONAL
SEAL
22206
ENGINEER
ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

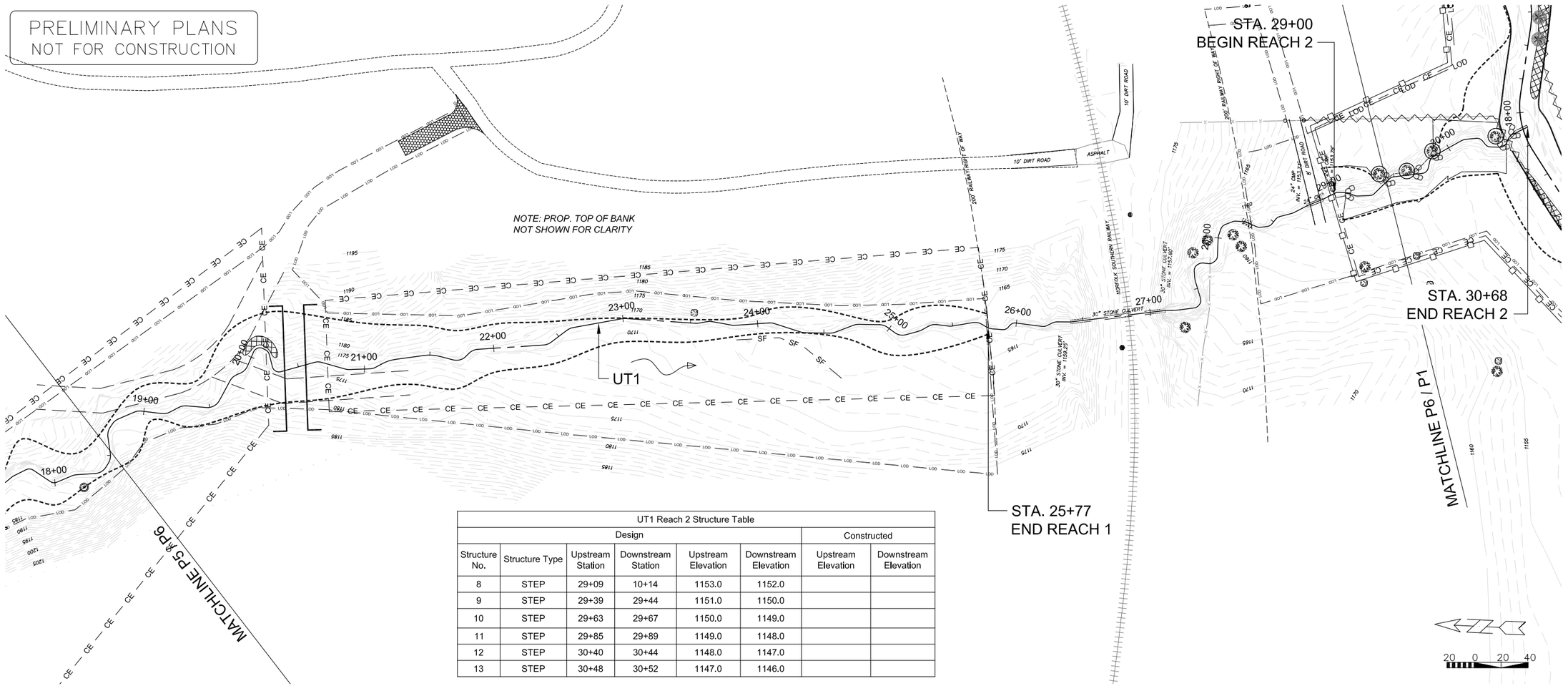
STA. 10+00 TO 18+54

DATE: FEB. 2015
SCALE: AS SHOWN

UT1
PLAN & PROFILE

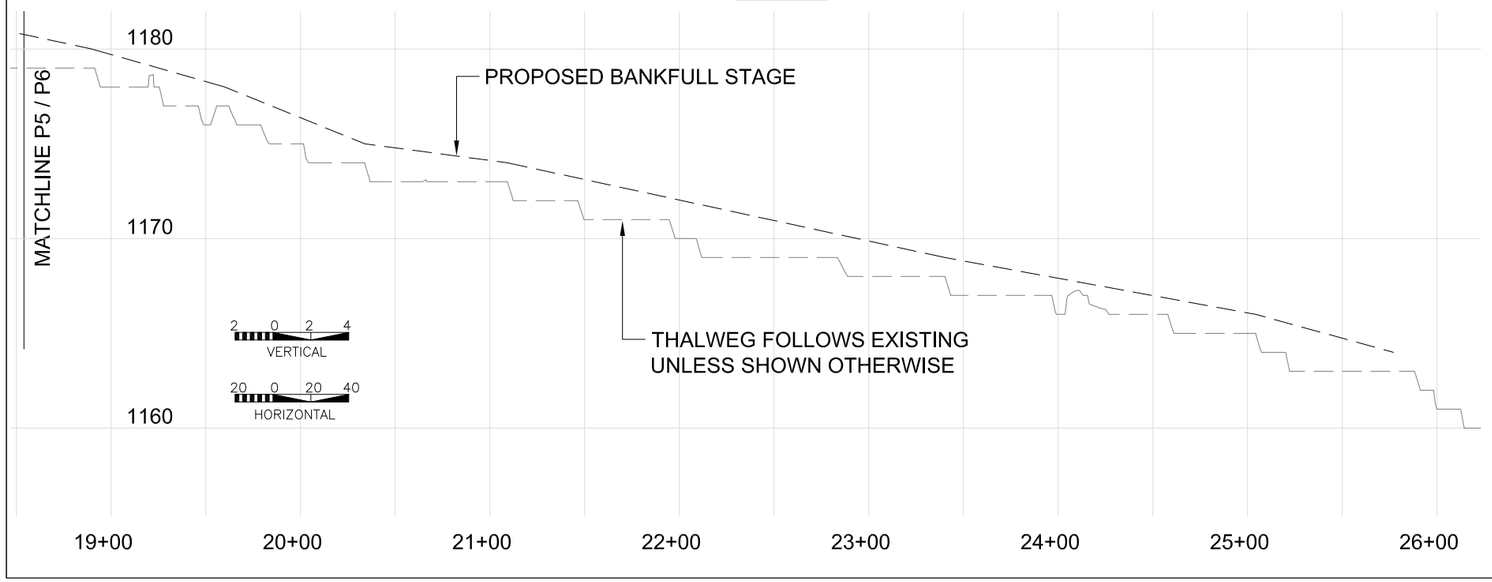
SHEET P5 OF 36

PRELIMINARY PLANS
NOT FOR CONSTRUCTION

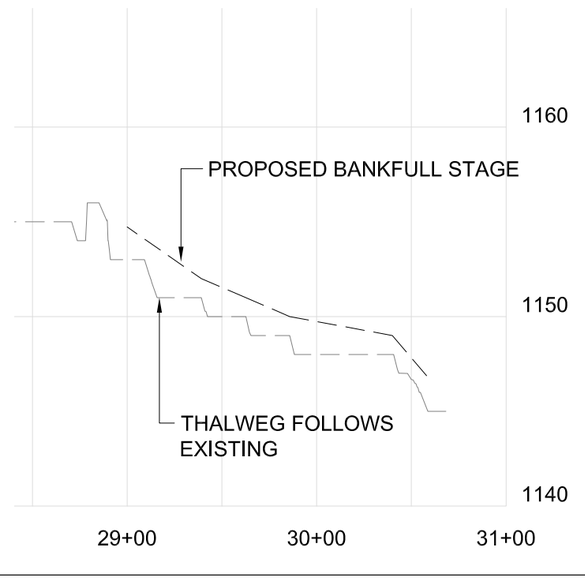


UT1 Reach 2 Structure Table							
		Design				Constructed	
Structure No.	Structure Type	Upstream Station	Downstream Station	Upstream Elevation	Downstream Elevation	Upstream Elevation	Downstream Elevation
8	STEP	29+09	10+14	1153.0	1152.0		
9	STEP	29+39	29+44	1151.0	1150.0		
10	STEP	29+63	29+67	1150.0	1149.0		
11	STEP	29+85	29+89	1149.0	1148.0		
12	STEP	30+40	30+44	1148.0	1147.0		
13	STEP	30+48	30+52	1147.0	1146.0		

REACH 1



REACH 2



A	MIT. PLAN	12/13	
B	DRAFT CD'S.	09/14	
C	FINAL MP	02/15	
D			
	DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA
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ANDREW DAVID

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Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

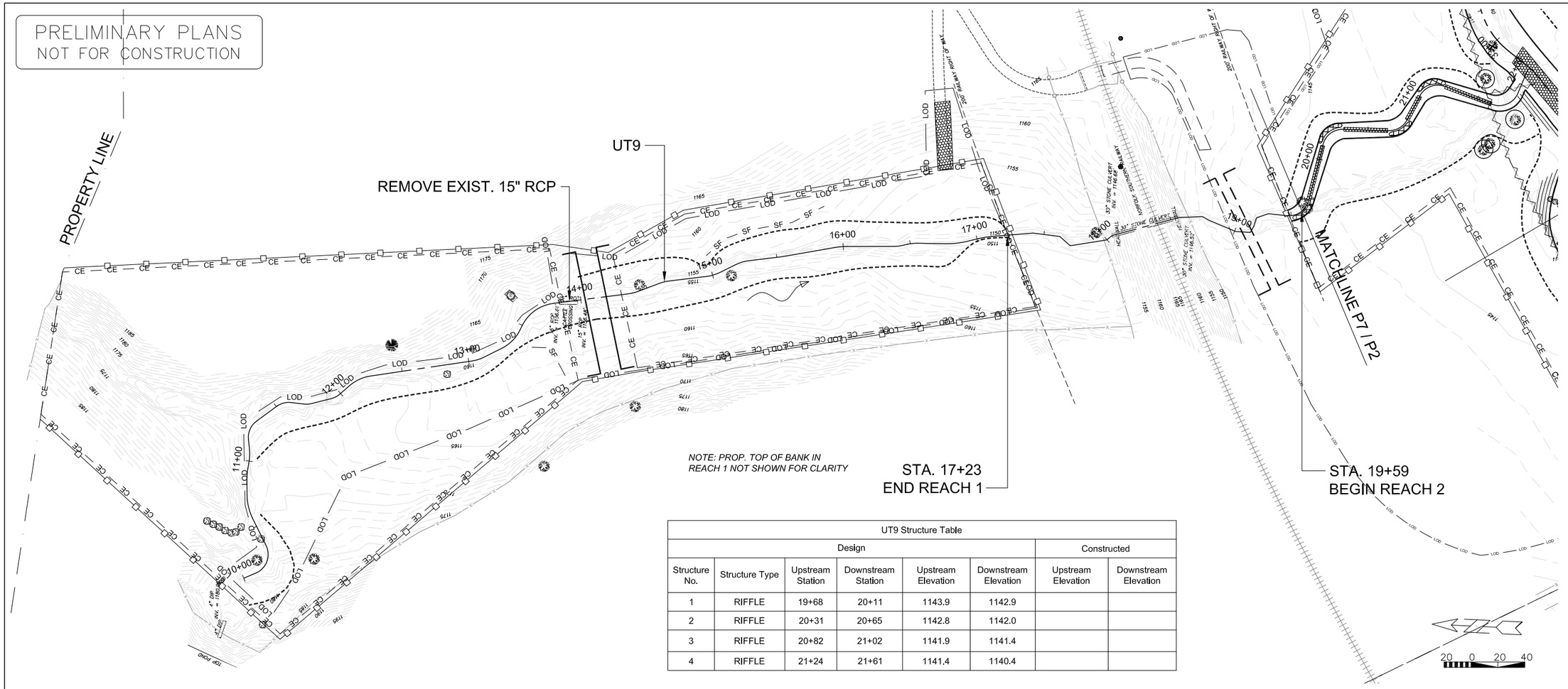
STA. 18+54 TO 30+68

DATE: FEB. 2015
SCALE: AS SHOWN

UT1
PLAN & PROFILE

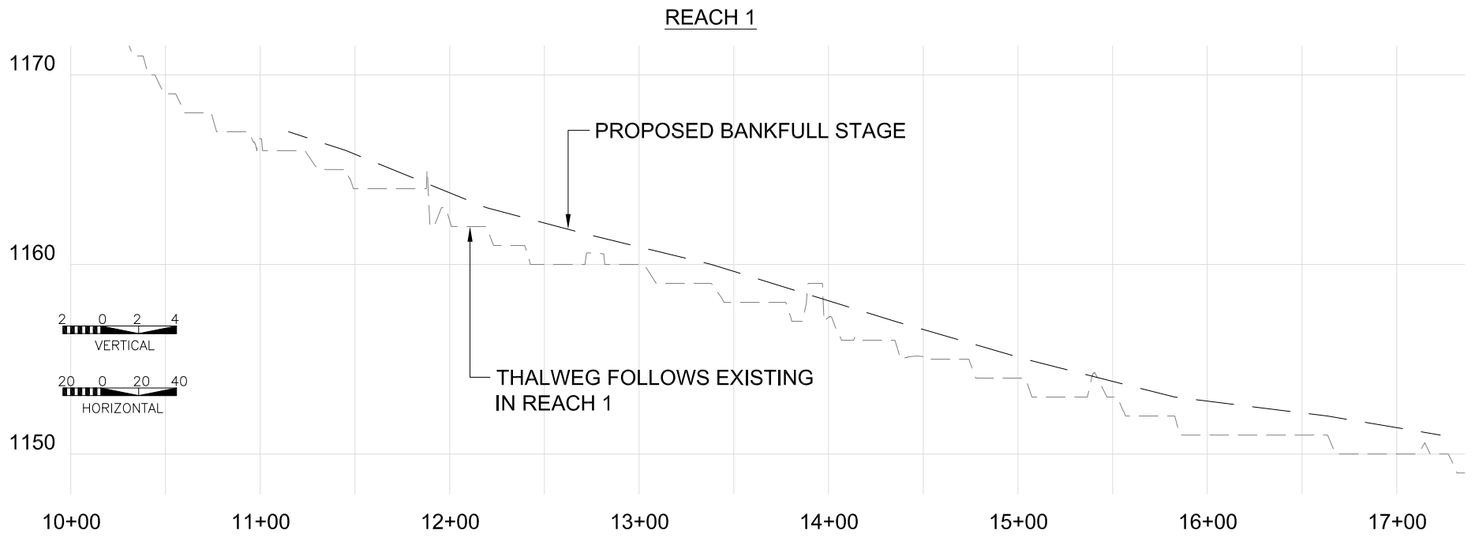
SHEET P6 OF 36

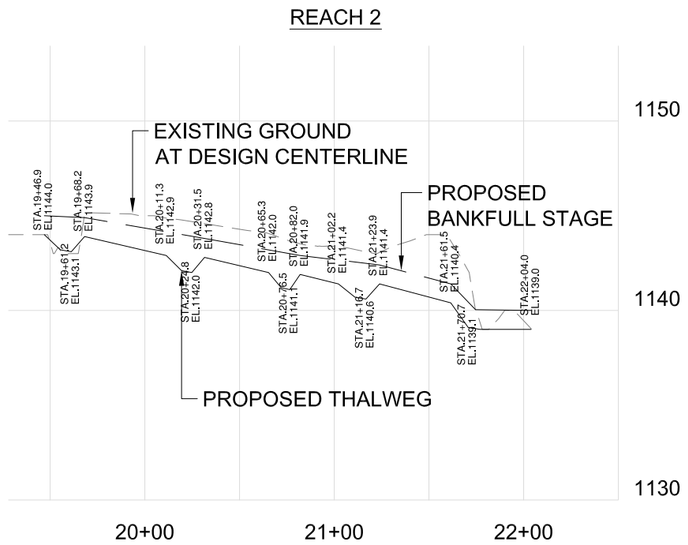
PRELIMINARY PLANS
NOT FOR CONSTRUCTION



UT9 Structure Table

		Design				Constructed	
Structure No.	Structure Type	Upstream Station	Downstream Station	Upstream Elevation	Downstream Elevation	Upstream Elevation	Downstream Elevation
1	RIFFLE	19+68	20+11	1143.9	1142.9		
2	RIFFLE	20+31	20+65	1142.8	1142.0		
3	RIFFLE	20+82	21+02	1141.9	1141.4		
4	RIFFLE	21+24	21+61	1141.4	1140.4		





REVISIONS

	DESCRIPTION	DATE	APP.
A	MIT. PLAN	12/13	
B	DRAFT CD'S.	09/14	
C	FINAL MP	02/15	
D			

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NORTH CAROLINA
PROFESSIONAL
SEAL
22206
ENGINEER
ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

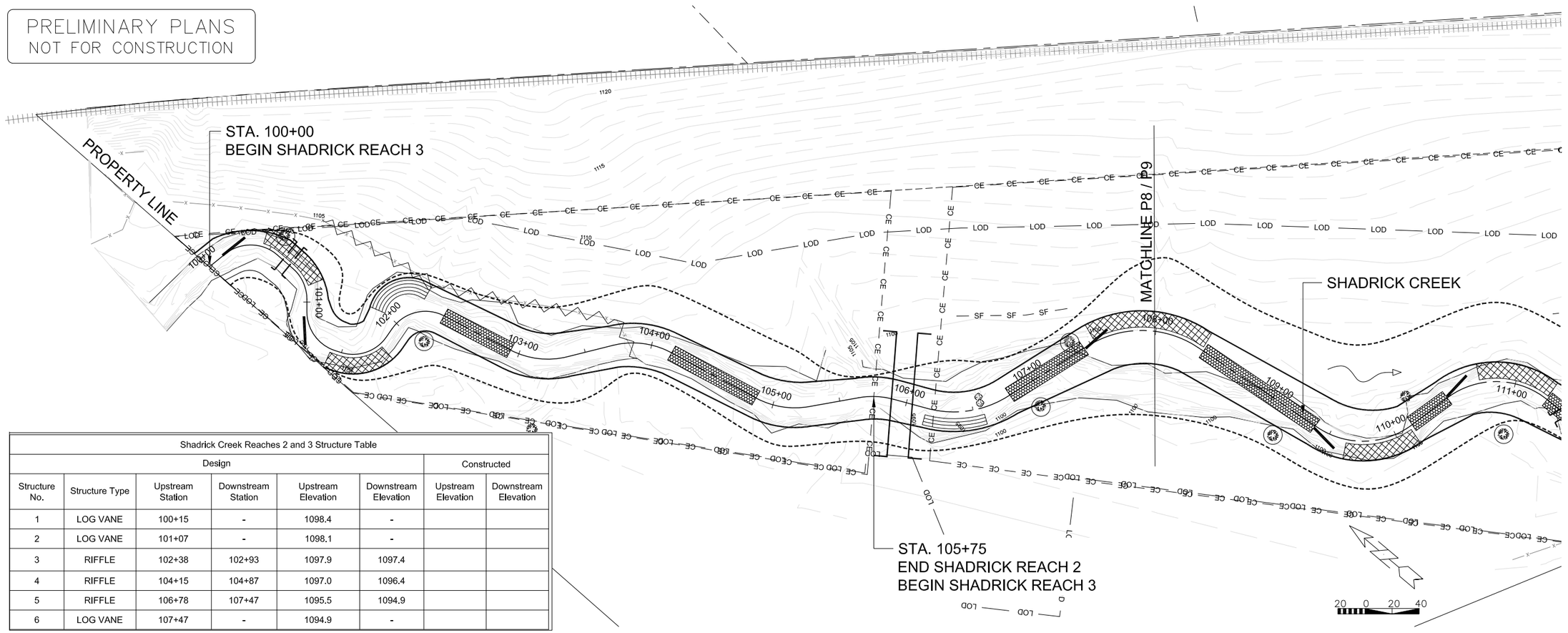
STA. 10+00 TO 22+04

DATE: FEB. 2015
SCALE: AS SHOWN

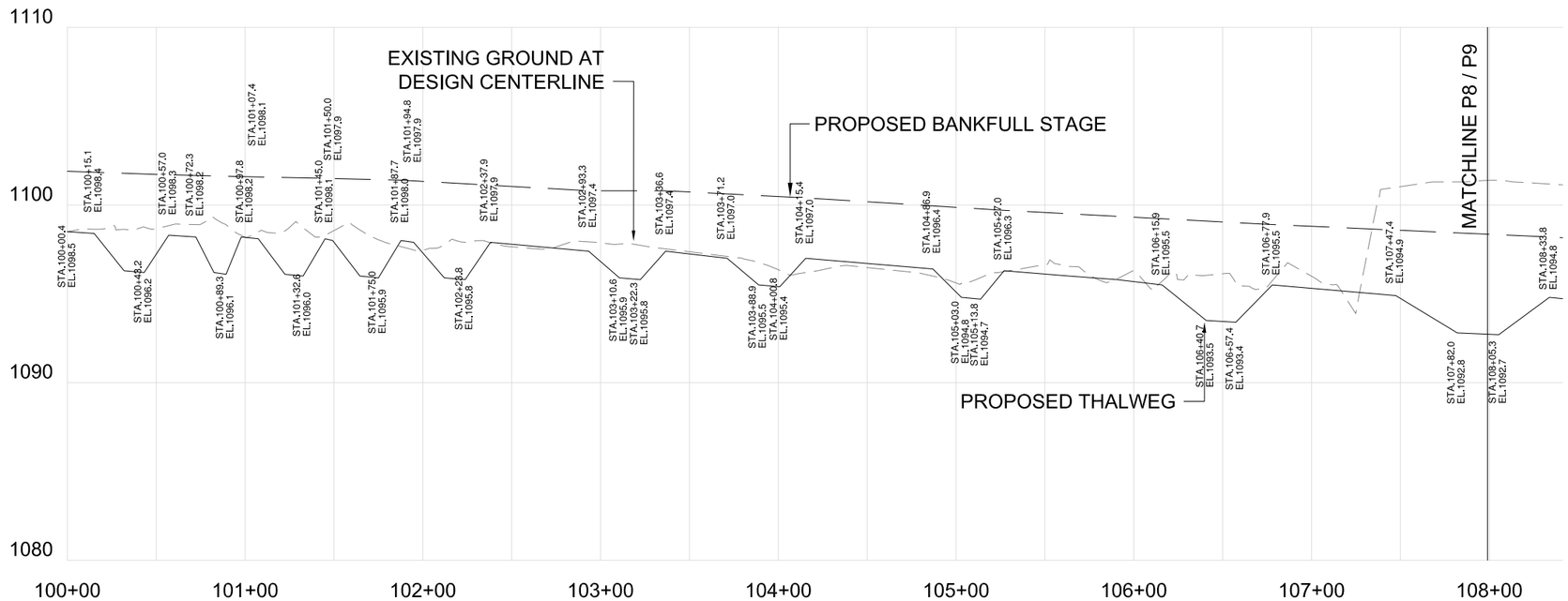
UT9
PLAN & PROFILE

SHEET P7 OF 36

PRELIMINARY PLANS
NOT FOR CONSTRUCTION



Shadrick Creek Reaches 2 and 3 Structure Table							
Design						Constructed	
Structure No.	Structure Type	Upstream Station	Downstream Station	Upstream Elevation	Downstream Elevation	Upstream Elevation	Downstream Elevation
1	LOG VANE	100+15	-	1098.4	-		
2	LOG VANE	101+07	-	1098.1	-		
3	RIFFLE	102+38	102+93	1097.9	1097.4		
4	RIFFLE	104+15	104+87	1097.0	1096.4		
5	RIFFLE	106+78	107+47	1095.5	1094.9		
6	LOG VANE	107+47	-	1094.9	-		



2 0 2 4
VERTICAL

20 0 20 40
HORIZONTAL

A	MIT. PLAN	12/13
B	DRAFT CD'S.	09/14
C	FINAL MP	02/15
D		

REVISIONS

DESCRIPTION | DATE | APP.

NOT FOR CONSTRUCTION
NORTH CAROLINA
PROFESSIONAL
SEAL
22208
ENGINEER
ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

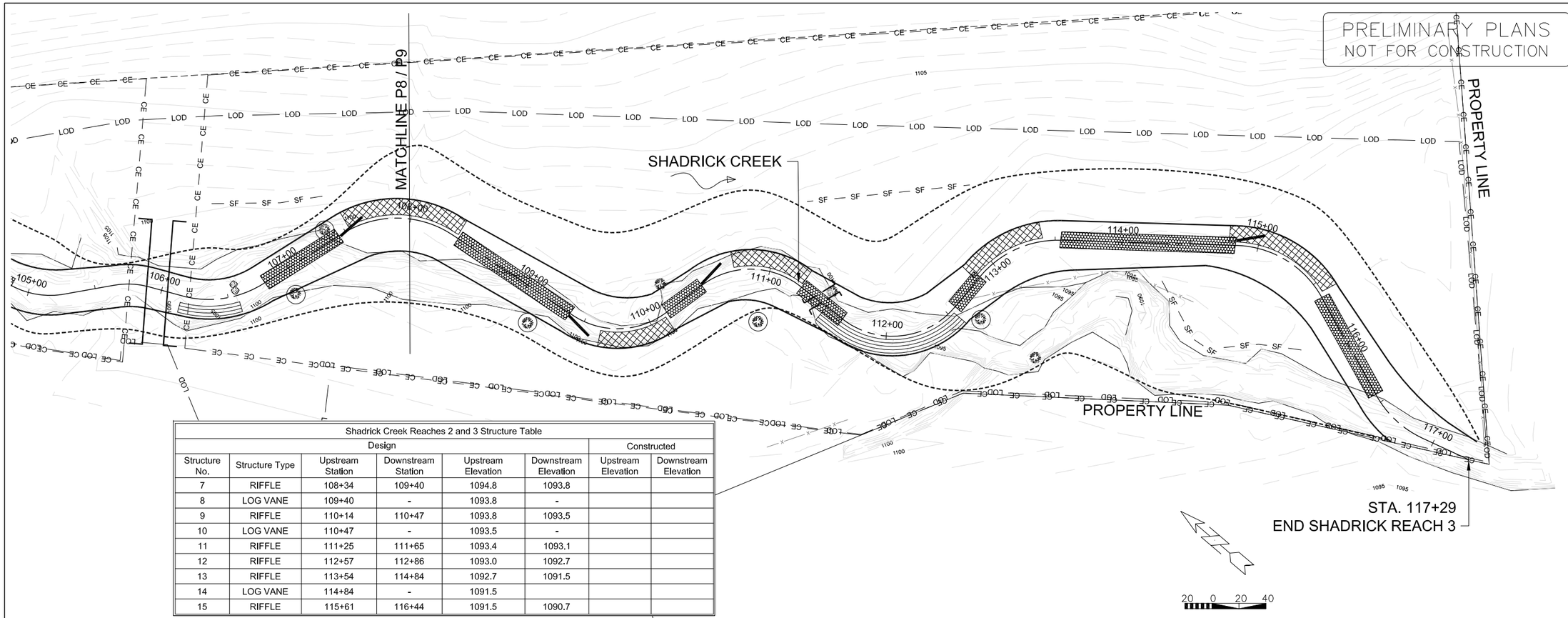
STA. 100+00 TO 108+00

DATE: FEB. 2015

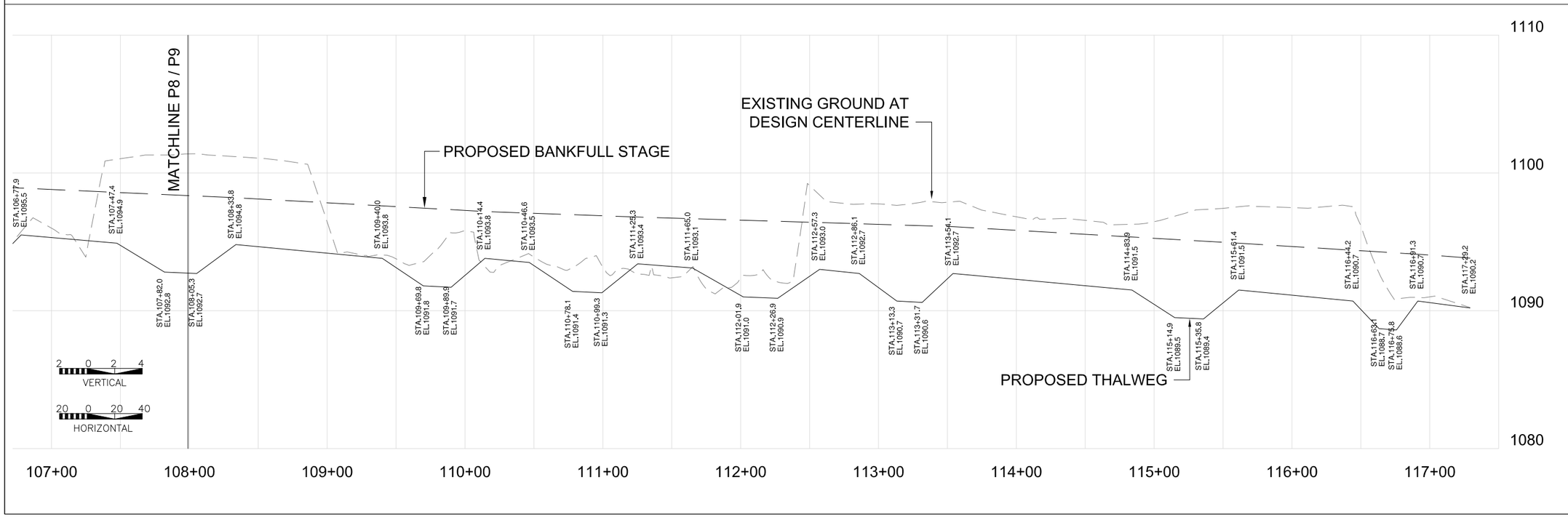
SCALE: AS SHOWN

SHADRICK CK.
REACHES 2&3
PLAN & PROFILE

SHEET P8 OF 36



Shadrick Creek Reaches 2 and 3 Structure Table							
		Design				Constructed	
Structure No.	Structure Type	Upstream Station	Downstream Station	Upstream Elevation	Downstream Elevation	Upstream Elevation	Downstream Elevation
7	RIFFLE	108+34	109+40	1094.8	1093.8		
8	LOG VANE	109+40	-	1093.8	-		
9	RIFFLE	110+14	110+47	1093.8	1093.5		
10	LOG VANE	110+47	-	1093.5	-		
11	RIFFLE	111+25	111+65	1093.4	1093.1		
12	RIFFLE	112+57	112+86	1093.0	1092.7		
13	RIFFLE	113+54	114+84	1092.7	1091.5		
14	LOG VANE	114+84	-	1091.5			
15	RIFFLE	115+61	116+44	1091.5	1090.7		



PRELIMINARY PLANS
NOT FOR CONSTRUCTION

A	MIT. PLAN	12/13
B	DRAFT CD'S.	09/14
C	FINAL MP	02/15
D		
	DESCRIPTION	DATE APP.

REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA
PROFESSIONAL
SEAL
22206
ENGINEER
ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

STA. 108+00 TO 117+29

DATE: FEB. 2015

SCALE: AS SHOWN

SHADRICK CK.
REACHES 2&3
PLAN & PROFILE

SHEET P9 OF 36

UT1

Station Northing Easting Bearing Distance
10+00.0 730977.2 1138092.8
S 14°39'46" E 36.7'
10+36.7 730941.7 1138102.0 PC
RADIUS: 730944.2 1138111.7 RADIUS LENGTH: 10.0'
PI: 730940.0 1138102.5 10+38.4 TANGENT: 1.7'
DELTA: -19°22'39" ARC LEN: 3.4'
CHORD LEN: 3.4' CHORD BRG: S 24°21'06" E
10+40.1 730938.6 1138103.4 PT
S 34°02'25" E 6.0'
10+46.1 730933.6 1138106.8 PC
RADIUS: 730939.2 1138115.1 RADIUS LENGTH: 10.0'
PI: 730932.1 1138107.8 10+48.0 TANGENT: 1.9'
DELTA: -21°09'40" ARC LEN: 3.7'
CHORD LEN: 3.7' CHORD BRG: S 44°37'15" E
10+49.8 730931.0 1138109.4 PT
S 55°12'05" E 4.4'
10+54.2 730928.5 1138113.0 PC
RADIUS: 730936.7 1138118.7 RADIUS LENGTH: 10.0'
PI: 730928.1 1138113.6 10+54.9 TANGENT: 0.7'
DELTA: -7°42'16" ARC LEN: 1.3'
CHORD LEN: 1.3' CHORD BRG: S 59°03'13" E
10+55.5 730927.8 1138114.2 PT
S 62°54'21" E 26.0'
10+81.5 730916.0 1138137.3 PC
RADIUS: 730907.1 1138132.7 RADIUS LENGTH: 10.0'
PI: 730914.1 1138141.0 10+85.7 TANGENT: 4.1'
DELTA: 45°03'13" ARC LEN: 7.9'
CHORD LEN: 7.7' CHORD BRG: S 40°22'45" E
10+89.4 730910.1 1138142.3 PT
S 17°51'08" E 19.5'
11+08.9 730891.5 1138148.2 PC
RADIUS: 730894.6 1138157.8 RADIUS LENGTH: 10.0'
PI: 730889.8 1138148.8 11+10.7 TANGENT: 1.8'
DELTA: -20°07'04" ARC LEN: 3.5'
CHORD LEN: 3.5' CHORD BRG: S 27°54'40" E
11+12.4 730888.4 1138149.9 PT
S 37°58'12" E 8.5'
11+20.9 730881.8 1138155.1 PC
RADIUS: 730887.9 1138163.0 RADIUS LENGTH: 10.0'
PI: 730878.1 1138158.0 11+25.6 TANGENT: 4.7'
DELTA: -49°53'59" ARC LEN: 8.7'
CHORD LEN: 8.4' CHORD BRG: S 62°55'12" E
11+29.7 730877.9 1138162.6 PT
S 87°52'11" E 2.2'
11+31.8 730877.8 1138164.8 PC
RADIUS: 730867.8 1138164.4 RADIUS LENGTH: 10.0'
PI: 730877.7 1138167.8 11+34.8 TANGENT: 3.0'
DELTA: 33°18'52" ARC LEN: 5.8'
CHORD LEN: 5.7' CHORD BRG: S 71°12'45" E
11+37.7 730876.0 1138170.2 PT
S 54°33'19" E 10.8'
11+48.5 730869.7 1138179.0 PC
RADIUS: 730877.9 1138184.8 RADIUS LENGTH: 10.0'
PI: 730866.3 1138183.8 11+54.3 TANGENT: 5.8'
DELTA: -60°36'46" ARC LEN: 10.6'
CHORD LEN: 10.1' CHORD BRG: S 84°51'42" E
11+59.0 730868.8 1138189.1 PT
N 64°49'54" E 2.7'
11+61.7 730870.0 1138191.5 PC
RADIUS: 730860.9 1138195.8 RADIUS LENGTH: 10.0'
PI: 730871.1 1138193.9 11+64.3 TANGENT: 2.6'
DELTA: 29°12'02" ARC LEN: 5.1'
CHORD LEN: 5.0' CHORD BRG: N 79°25'55" E
11+66.8 730870.9 1138196.5 PT
S 85°58'04" E 4.6'
11+71.4 730870.6 1138201.0 PC
RADIUS: 730880.5 1138201.7 RADIUS LENGTH: 10.0'
PI: 730870.3 1138204.5 11+74.8 TANGENT: 3.4'
DELTA: -37°51'38" ARC LEN: 6.6'
CHORD LEN: 6.5' CHORD BRG: N 75°06'08" E
11+78.0 730872.2 1138207.3 PT
N 56°10'19" E 0.5'
11+78.5 730872.5 1138207.7 PC
RADIUS: 730868.4 1138210.5 RADIUS LENGTH: 5.0'
PI: 730875.5 1138212.3 11+84.0 TANGENT: 5.4'
DELTA: 94°53'55" ARC LEN: 8.3'
CHORD LEN: 7.4' CHORD BRG: S 76°22'44" E
11+86.8 730870.8 1138214.9 PT
S 28°55'47" E 11.3'
11+98.1 730860.9 1138220.4 PC
RADIUS: 730865.7 1138229.1 RADIUS LENGTH: 10.0'
PI: 730858.3 1138221.8 12+01.1 TANGENT: 2.9'
DELTA: -32°26'01" ARC LEN: 5.7'
CHORD LEN: 5.6' CHORD BRG: S 45°08'47" E
12+03.8 730856.9 1138224.3 PT
S 61°21'48" E 2.0'
12+05.8 730856.0 1138226.1 PC
RADIUS: 730847.2 1138221.3 RADIUS LENGTH: 10.0'
PI: 730855.0 1138227.8 12+07.7 TANGENT: 1.9'
DELTA: 21°28'23" ARC LEN: 3.7'
CHORD LEN: 3.7' CHORD BRG: S 50°37'36" E
12+09.6 730853.6 1138229.0 PT
S 39°53'25" E 6.3'
12+15.9 730848.7 1138233.0 PC
RADIUS: 730855.2 1138240.7 RADIUS LENGTH: 10.0'
PI: 730846.8 1138234.6 12+18.4 TANGENT: 2.5'
DELTA: -27°59'21" ARC LEN: 4.9'
CHORD LEN: 4.8' CHORD BRG: S 53°53'05" E
12+20.8 730845.9 1138236.9 PT
S 67°52'46" E 5.6'
12+26.3 730843.8 1138242.1 PC
RADIUS: 730834.5 1138238.3 RADIUS LENGTH: 10.0'
PI: 730843.6 1138242.6 12+26.8 TANGENT: 0.5'
DELTA: 5°38'38" ARC LEN: 1.0'
CHORD LEN: 1.0' CHORD BRG: S 65°03'27" E
12+27.3 730843.4 1138243.0 PT
S 62°14'08" E 25.4'
12+52.7 730831.5 1138265.5 PC
RADIUS: 730840.4 1138270.2 RADIUS LENGTH: 10.0'
PI: 730830.2 1138268.0 12+55.6 TANGENT: 2.9'
DELTA: -32°08'24" ARC LEN: 5.6'
CHORD LEN: 5.5' CHORD BRG: S 78°18'20" E
12+58.3 730830.4 1138270.9 PT
N 85°37'28" E 8.0'
12+66.4 730831.0 1138278.9 PC
RADIUS: 730841.0 1138278.2 RADIUS LENGTH: 10.0'
PI: 730831.4 1138283.8 12+71.3 TANGENT: 4.9'
DELTA: -52°30'49" ARC LEN: 9.2'
CHORD LEN: 8.8' CHORD BRG: N 59°22'03" E
12+75.5 730835.5 1138286.5 PT
N 33°06'38" E 4.4'
12+79.9 730839.2 1138288.9 PC
RADIUS: 730844.7 1138280.6 RADIUS LENGTH: 10.0'
PI: 730841.1 1138290.1 12+82.2 TANGENT: 2.2'
DELTA: -25°08'17" ARC LEN: 4.4'
CHORD LEN: 4.4' CHORD BRG: N 20°32'30" E
12+84.3 730843.3 1138290.5 PT
N 07°58'21" E 1.3'
12+85.6 730844.6 1138290.6 PC
RADIUS: 730843.9 1138295.6 RADIUS LENGTH: 5.0'
PI: 730847.9 1138291.1 12+89.0 TANGENT: 3.3'
DELTA: 66°59'23" ARC LEN: 5.8'
CHORD LEN: 5.5' CHORD BRG: N 41°28'03" E
12+91.5 730848.7 1138294.3 PT
N 74°57'45" E 7.1'
12+98.6 730850.6 1138301.2 PC
RADIUS: 730840.9 1138303.8 RADIUS LENGTH: 10.0'
PI: 730851.5 1138304.6 13+02.2 TANGENT: 3.6'
DELTA: 39°13'40" ARC LEN: 6.8'
CHORD LEN: 6.7' CHORD BRG: S 85°25'25" E
13+05.5 730850.1 1138307.9 PT
S 65°48'35" E 3.9'
13+09.4 730848.4 1138311.4 PC
RADIUS: 730857.6 1138315.5 RADIUS LENGTH: 10.0'
PI: 730846.8 1138315.2 13+13.5 TANGENT: 4.1'
DELTA: -44°43'10" ARC LEN: 7.8'
CHORD LEN: 7.6' CHORD BRG: S 88°10'10" E
13+17.2 730848.2 1138319.1 PT
N 69°28'15" E 14.6'
13+31.8 730853.3 1138332.7 PC
RADIUS: 730862.7 1138329.2 RADIUS LENGTH: 10.0'
PI: 730854.5 1138335.8 13+35.0 TANGENT: 3.2'
DELTA: -35°57'52" ARC LEN: 6.3'
CHORD LEN: 6.2' CHORD BRG: N 51°29'19" E
13+38.1 730857.2 1138337.6 PT
N 33°30'23" E 7.4'
13+45.5 730863.4 1138341.7 PC
RADIUS: 730857.8 1138350.0 RADIUS LENGTH: 10.0'
PI: 730865.7 1138343.2 13+48.3 TANGENT: 2.8'
DELTA: 31°41'16" ARC LEN: 5.5'
CHORD LEN: 5.5' CHORD BRG: N 49°21'01" E
13+51.0 730866.9 1138345.8 PT
N 65°11'39" E 6.9'
13+57.9 730869.8 1138352.0 PC
RADIUS: 730860.7 1138356.2 RADIUS LENGTH: 10.0'
PI: 730871.0 1138354.7 13+60.8 TANGENT: 2.9'
DELTA: 32°30'31" ARC LEN: 5.7'
CHORD LEN: 5.6' CHORD BRG: N 81°26'55" E
13+63.6 730870.6 1138357.6 PT
S 82°17'50" E 0.6'
13+64.1 730870.6 1138358.1 PC
RADIUS: 730865.6 1138357.4 RADIUS LENGTH: 5.0'
PI: 730870.0 1138362.2 13+68.2 TANGENT: 4.1'
DELTA: 79°02'10" ARC LEN: 6.9'
CHORD LEN: 6.4' CHORD BRG: S 42°46'45" E
13+71.0 730865.9 1138362.4 PT
S 03°15'40" E 3.9'
13+74.9 730862.0 1138362.6 PC
RADIUS: 730862.6 1138372.6 RADIUS LENGTH: 10.0'
PI: 730858.4 1138362.9 13+78.5 TANGENT: 3.6'
DELTA: -39°09'23" ARC LEN: 6.8'
CHORD LEN: 6.7' CHORD BRG: S 22°50'22" E
13+81.7 730855.8 1138365.2 PT
S 42°25'03" E 32.5'
14+14.2 730831.8 1138387.2 PC
RADIUS: 730838.6 1138394.5 RADIUS LENGTH: 10.0'
PI: 730831.5 1138387.4 14+14.6 TANGENT: 0.4'
DELTA: -4°16'38" ARC LEN: 0.7'
CHORD LEN: 0.7' CHORD BRG: S 44°33'22" E
14+15.0 730831.3 1138387.7 PT
S 46°41'41" E 5.6'
14+20.6 730827.4 1138391.8 PC
RADIUS: 730834.7 1138398.6 RADIUS LENGTH: 10.0'
PI: 730826.5 1138392.8 14+22.0 TANGENT: 1.4'
DELTA: -16°06'28" ARC LEN: 2.8'
CHORD LEN: 2.8' CHORD BRG: S 54°44'55" E
14+23.4 730825.8 1138394.1 PT
S 62°48'09" E 10.3'
14+33.7 730821.1 1138403.2 PC
RADIUS: 730830.0 1138407.8 RADIUS LENGTH: 10.0'
PI: 730819.7 1138406.0 14+36.9 TANGENT: 3.1'
DELTA: -34°46'55" ARC LEN: 6.1'
CHORD LEN: 6.0' CHORD BRG: S 80°11'36" E
14+39.8 730820.1 1138409.1 PT
N 82°24'56" E 6.6'
14+46.4 730821.0 1138415.7 PC
RADIUS: 730811.0 1138417.0 RADIUS LENGTH: 10.0'
PI: 730821.4 1138419.3 14+50.0 TANGENT: 3.6'
DELTA: 39°30'16" ARC LEN: 6.9'
CHORD LEN: 6.8' CHORD BRG: S 77°49'56" E
14+53.3 730819.5 1138422.3 PT
S 58°04'48" E 6.9'
14+60.2 730815.9 1138428.1 PC
RADIUS: 730807.4 1138422.8 RADIUS LENGTH: 10.0'
PI: 730815.0 1138429.5 14+61.8 TANGENT: 1.6'
DELTA: 18°32'55" ARC LEN: 3.2'
CHORD LEN: 3.2' CHORD BRG: S 48°48'20" E
14+63.4 730813.8 1138430.6 PT
S 39°31'53" E 18.9'
14+82.4 730799.2 1138442.6 PC
RADIUS: 730805.5 1138450.3 RADIUS LENGTH: 10.0'
PI: 730796.3 1138445.0 14+86.1 TANGENT: 3.7'
DELTA: -40°40'50" ARC LEN: 7.1'
CHORD LEN: 7.0' CHORD BRG: S 59°52'18" E
14+89.5 730795.7 1138448.6 PT
S 80°12'43" E 6.4'
14+95.9 730794.6 1138454.9 PC
RADIUS: 730804.4 1138456.6 RADIUS LENGTH: 10.0'
PI: 730794.3 1138456.7 14+97.7 TANGENT: 1.8'
DELTA: -20°47'51" ARC LEN: 3.6'
CHORD LEN: 3.6' CHORD BRG: N 89°23'21" E
14+99.5 730794.6 1138458.5 PT
N 78°59'26" E 7.0'
15+06.5 730796.0 1138465.4 PC
RADIUS: 730791.1 1138466.4 RADIUS LENGTH: 5.0'
PI: 730796.6 1138468.7 15+09.8 TANGENT: 3.4'
DELTA: 67°51'25" ARC LEN: 5.9'
CHORD LEN: 5.6' CHORD BRG: S 67°04'52" E
15+12.4 730793.8 1138470.5 PT
S 33°09'10" E 2.3'
15+14.7 730791.9 1138471.8 PC
RADIUS: 730789.2 1138467.6 RADIUS LENGTH: 5.0'
PI: 730789.0 1138473.7 15+18.1 TANGENT: 3.5'
DELTA: 69°16'53" ARC LEN: 6.0'
CHORD LEN: 5.7' CHORD BRG: S 01°29'17" W
15+20.7 730786.2 1138471.6 PT
S 36°07'44" W 8.2'
15+28.9 730779.6 1138466.8 PC
RADIUS: 730776.6 1138470.8 RADIUS LENGTH: 5.0'
PI: 730778.0 1138465.6 15+30.9 TANGENT: 2.0'
DELTA: -43°32'59" ARC LEN: 3.8'
CHORD LEN: 3.7' CHORD BRG: S 14°21'14" W
15+32.7 730776.0 1138465.9 PT
S 07°25'16" E 4.6'
15+37.3 730771.4 1138466.5 PC
RADIUS: 730772.1 1138471.4 RADIUS LENGTH: 5.0'
PI: 730768.3 1138466.9 15+40.5 TANGENT: 3.1'
DELTA: -63°59'02" ARC LEN: 5.6'
CHORD LEN: 5.3' CHORD BRG: S 39°24'47" E
15+42.9 730767.3 1138469.8 PT
S 71°24'17" E 22.3'
15+65.2 730760.2 1138490.9 PC
RADIUS: 730769.7 1138494.1 RADIUS LENGTH: 10.0'
PI: 730759.2 1138493.9 15+68.3 TANGENT: 3.2'
DELTA: -35°09'33" ARC LEN: 6.1'
CHORD LEN: 6.0' CHORD BRG: S 88°59'04" E
15+71.3 730760.1 1138497.0 PT
N 73°26'10" E 6.2'
15+77.5 730761.9 1138502.9 PC
RADIUS: 730752.3 1138505.8 RADIUS LENGTH: 10.0'
PI: 730765.6 1138515.4 15+90.6 TANGENT: 13.1'
DELTA: 105°11'06" ARC LEN: 18.4'
CHORD LEN: 15.9' CHORD BRG: S 53°58'17" E
15+95.9 730752.5 1138515.8 PT
S 01°22'44" E 12.8'
16+08.7 730739.7 1138516.1 PC
RADIUS: 730739.9 1138526.1 RADIUS LENGTH: 10.0'
PI: 730738.7 1138516.1 16+09.8 TANGENT: 1.1'
DELTA: -12°01'49" ARC LEN: 2.1'
CHORD LEN: 2.1' CHORD BRG: S 07°23'39" E
16+10.8 730737.6 1138516.3 PT
S 13°24'33" E 19.5'
16+30.3 730718.6 1138520.9 PC
RADIUS: 730725.6 1138550.0 RADIUS LENGTH: 30.0'
PI: 730708.9 1138523.2 16+40.3 TANGENT: 10.0'
DELTA: -36°48'00" ARC LEN: 19.3'
CHORD LEN: 18.9' CHORD BRG: S 31°48'33" E
16+49.6 730702.5 1138530.8 PT
S 50°12'33" E 21.1'
16+70.7 730689.1 1138547.0 PC
RADIUS: 730696.7 1138553.4 RADIUS LENGTH: 10.0'
PI: 730686.9 1138549.6 16+74.0 TANGENT: 3.4'
DELTA: -37°04'08" ARC LEN: 6.5'
CHORD LEN: 6.4' CHORD BRG: S 68°44'37" E
16+77.1 730686.8 1138553.0 PT
S 87°16'41" E 17.8'
16+95.0 730685.9 1138570.8 PC
RADIUS: 730675.9 1138570.3 RADIUS LENGTH: 10.0'
PI: 730685.9 1138571.5 16+95.6 TANGENT: 0.7'
DELTA: 7°35'11" ARC LEN: 1.3'
CHORD LEN: 1.3' CHORD BRG: S 83°29'05" E
16+96.3 730685.8 1138572.1 PT
S 79°41'30" E 13.4'
17+09.7 730683.4 1138585.2 PC
RADIUS: 730673.5 1138583.4 RADIUS LENGTH: 10.0'
PI: 730682.8 1138588.5 17+13.0 TANGENT: 3.3'
DELTA: 36°49'04" ARC LEN: 6.4'
CHORD LEN: 6.3' CHORD BRG: S 61°16'58" E
17+16.1 730680.3 1138590.8 PT
S 42°52'26" E 47.4'
17+63.5 730645.6 1138623.0 PC
RADIUS: 730638.8 1138615.7 RADIUS LENGTH: 10.0'
PI: 730644.7 1138623.9 17+64.7 TANGENT: 1.2'
DELTA: 13°40'21" ARC LEN: 2.4'
CHORD LEN: 2.4' CHORD BRG: S 36°02'15" E
17+65.9 730643.7 1138624.4 PT
S 29°12'04" E 10.0'
17+75.9 730634.9 1138629.3 PC
RADIUS: 730632.5 1138624.9 RADIUS LENGTH: 5.0'
PI: 730632.4 1138630.7 17+78.8 TANGENT: 2.9'
DELTA: 59°53'25" ARC LEN: 5.2'
CHORD LEN: 5.0' CHORD BRG: S 00°44'38" W
17+81.1 730629.9 1138629.2 PT
S 30°41'21" W 15.4'
17+96.5 730616.7 1138621.4 PC
RADIUS: 730614.1 1138625.7 RADIUS LENGTH: 5.0'
PI: 730614.4 1138620.0 17+99.2 TANGENT: 2.7'
DELTA: -56°43'59" ARC LEN: 5.0'
CHORD LEN: 4.8' CHORD BRG: S 02°19'21" W
18+01.5 730611.9 1138621.2 PT
S 26°02'38" E 12.1'
18+13.6 730601.0 1138626.5 PC
RADIUS: 730596.6 1138617.5 RADIUS LENGTH: 10.0'
PI: 730599.5 1138627.3 18+15.3 TANGENT: 1.7'
DELTA: 19°27'31" ARC LEN: 3.4'
CHORD LEN: 3.4' CHORD BRG: S 16°18'53" E
18+17.0 730597.8 1138627.4 PT
S 06°35'07" E 14.0'
18+31.0 730583.9 1138629.1 PC
RADIUS: 730585.1 1138639.0 RADIUS LENGTH: 10.0'
PI: 730578.8 1138629.6 18+36.1 TANGENT: 5.2'
DELTA: -54°35'31" ARC LEN: 9.5'
CHORD LEN: 9.2' CHORD BRG: S 33°52'53" E
18+40.5 730576.3 1138634.2 PT
S 61°10'38" E 3.5'
18+44.0 730574.6 1138637.3 PC
RADIUS: 730583.4 1138642.1 RADIUS LENGTH: 10.0'
PI: 730572.8 1138640.4 18+47.7 TANGENT: 3.6'
DELTA: -39°56'30" ARC LEN: 7.0'
CHORD LEN: 6.8' CHORD BRG: S 81°08'53" E
18+51.0 730573.5 1138644.0 PT
N 78°52'52" E 12.7'
18+63.7 730576.0 1138656.5 PC
RADIUS: 730566.2 1138658.4 RADIUS LENGTH: 10.0'
PI: 730576.7 1138660.1 18+67.4 TANGENT: 3.8'
DELTA: 41°09'01" ARC LEN: 7.2'
CHORD LEN: 7.0' CHORD BRG: S 80°32'38" E
18+70.9 730574.8 1138663.4 PT
S 59°58'07" E 3.2'
18+74.1 730573.2 1138666.2 PC
RADIUS: 730564.6 1138661.1 RADIUS LENGTH: 10.0'
PI: 730571.7 1138668.8 18+77.1 TANGENT: 3.0'
DELTA: 33°51'11" ARC LEN: 5.9'
CHORD LEN: 5.8' CHORD BRG: S 43°02'32" E
18+80.0 730569.0 1138670.1 PT
S 26°06'56" E 12.9'
18+92.9 730557.4 1138675.8 PC
RADIUS: 730553.0 1138666.8 RADIUS LENGTH: 10.0'
PI: 730555.0 1138677.0 18+95.5 TANGENT: 2.7'
DELTA: 29°59'32" ARC LEN: 5.2'
CHORD LEN: 5.2' CHORD BRG: S 11°07'10" E
18+98.1 730552.3 1138676.8 PT
S 03°52'36" W 15.4'
19+13.5 730537.0 1138675.8 PC
RADIUS: 730536.3 1138685.7 RADIUS LENGTH: 10.0'
PI: 730533.9 1138675.5 19+16.6 TANGENT: 3.1'
DELTA: -34°30'22" ARC LEN: 6.0'
CHORD LEN: 5.9' CHORD BRG: S 13°22'35" E
19+19.5 730531.2 1138677.1 PT
S 30°37'46" E 7.5'
19+26.9 730524.8 1138680.9 PC
RADIUS: 730519.7 1138672.3 RADIUS LENGTH: 10.0'
PI: 730522.3 1138682.4 19+29.8 TANGENT: 2.9'
DELTA: 32°11'34" ARC LEN: 5.6'
CHORD LEN: 5.5' CHORD BRG: S 14°31'59" E
19+32.6 730519.5 1138682.3 PT
S 01°33'48" W 15.0'
19+47.6 730504.4 1138681.9 PC
RADIUS: 730504.2 1138691.9 RADIUS LENGTH: 10.0'
PI: 730497.9 1138681.7 19+54.1 TANGENT: 6.5'
DELTA: -66°05'32" ARC LEN: 11.5'
CHORD LEN: 10.9' CHORD BRG: S 31°28'58" E
19+59.1 730495.1 1138687.6 PT
S 64°31'44" E 16.5'
19+75.7 730488.0 1138702.5 PC
RADIUS: 730479.0 1138698.2 RADIUS LENGTH: 10.0'
PI: 730486.5 1138705.7 19+79.1 TANGENT: 3.5'
DELTA: 38°20'37" ARC LEN: 6.7'
CHORD LEN: 6.6' CHORD BRG: S 45°21'26" E
19+82.3 730483.4 1138707.2 PT
S 26°11'07" E 3.0'
19+85.3 730480.7 1138708.5 PC
RADIUS: 730485.1 1138717.5 RADIUS LENGTH: 10.0'
PI: 730477.2 1138710.3 19+89.3 TANGENT: 4.0'
DELTA: -43°20'37" ARC LEN: 7.6'
CHORD LEN: 7.4' CHORD BRG: S 47°51'26" E
19+92.9 730475.8 1138714.0 PT
S 69°31'45" E 11.4'
20+04.3 730471.8 1138724.7 PC
RADIUS: 730467.1 1138722.9 RADIUS LENGTH: 5.0'
PI: 730469.9 1138729.6 20+09.6 TANGENT: 5.3'
DELTA: 93°20'08" ARC LEN: 8.1'
CHORD LEN: 7.3' CHORD BRG: S 22°51'41" E
20+12.4 730465.1 1138727.5 PT
S 23°48'23" W 2.4'
20+14.8 730462.9 1138726.5 PC
RADIUS: 730464.9 1138721.9 RADIUS LENGTH: 5.0'
PI: 730460.8 1138725.6 20+17.1 TANGENT: 2.3'
DELTA: 48°47'41" ARC LEN: 4.3'
CHORD LEN: 4.1' CHORD BRG: S 48°12'13" W
20+19.0 730460.2 1138723.4 PT
S 72°36'03" W 9.6'
20+28.6 730457.3 1138714.3 PC
RADIUS: 730452.5 1138715.8 RADIUS LENGTH: 5.0'
PI: 730455.8 1138709.5 20+33.7 TANGENT: 5.1'
DELTA: -91°03'09" ARC LEN: 7.9'
CHORD LEN: 7.1' CHORD BRG: S 27°04'29" W
20+36.5 730451.0 1138711.1 PT
S 18°27'05" E 25.8'
20+62.3 730426.5 1138719.2 PC
RADIUS: 730423.3 1138709.8 RADIUS LENGTH: 10.0'
PI: 730423.8 1138720.1 20+65.1 TANGENT: 2.8'
DELTA: 31°23'57" ARC LEN: 5.5'
CHORD LEN: 5.4' CHORD BRG: S 02°45'07" E
20+67.8 730421.1 1138719.5 PT
S 12°56'52" W 17.9'
20+85.7 730403.6 1138715.5 PC
RADIUS: 730401.4 1138725.2 RADIUS LENGTH: 10.0'
PI: 730402.1 1138715.1 20+87.3 TANGENT: 1.6'
DELTA: -17°45'19" ARC LEN: 3.1'
CHORD LEN: 3.1' CHORD BRG: S 04°04'12" W
20+88.8 730400.5 1138715.3 PT
S 04°48'27" E 15.0'
21+03.9 730385.6 1138716.5 PC
RADIUS: 730386.4 1138726.5 RADIUS LENGTH: 10.0'
PI: 730383.2 1138716.7 21+06.3 TANGENT: 2.4'
DELTA: -26°56'57" ARC LEN: 4.7'
CHORD LEN: 4.7' CHORD BRG: S 18°16'56" E
21+08.6 730381.1 1138718.0 PT
S 31°45'25" E 4.8'
21+13.4 730377.0 1138720.5 PC
RADIUS: 730361.2 1138695.0 RADIUS LENGTH: 30.0'
PI: 730372.3 1138723.5 21+19.0 TANGENT: 5.6'
DELTA: 21°01'27" ARC LEN: 11.0'
CHORD LEN: 10.9' CHORD BRG: S 21°14'41" E
21+24.4 730366.8 1138724.5 PT
S 10°43'57" E 21.3'
21+45.7 730345.9 1138728.5 PC
RADIUS: 730340.3 1138699.0 RADIUS LENGTH: 30.0'
PI: 730340.0 1138729.6 21+51.7 TANGENT: 6.0'
DELTA: 22°37'40" ARC LEN: 11.8'
CHORD LEN: 11.8' CHORD BRG: S 00°34'53" W
21+57.6 730334.1 1138728.4 PT
S 11°53'43" W 9.8'
21+67.4 730324.5 1138726.3 PC
RADIUS: 730322.5 1138736.1 RADIUS LENGTH: 10.0'
PI: 730318.9 1138725.2 21+73.2 TANGENT: 5.8'
DELTA: -60°03'51" ARC LEN: 10.5'
CHORD LEN: 10.0' CHORD BRG: S 18°08'13" E
21+77.9 730315.0 1138729.5 PT
S 48°10'08" E 3.0'
21+80.9 730313.0 1138731.7 PC
RADIUS: 730305.5 1138725.1 RADIUS LENGTH: 10.0'
PI: 730310.5 1138734.5 21+84.7 TANGENT: 3.8'
DELTA: 41°25'21" ARC LEN: 7.2'
CHORD LEN: 7.1' CHORD BRG: S 27°27'28" E
21+88.1 730306.7 1138735.0 PT
S 06°44'47" E 49.1'
22+37.2 730258.0 1138740.8 PC
RADIUS: 730259.2 1138750.7 RADIUS LENGTH: 10.0'
PI: 730255.0 1138741.1 22+40.2 TANGENT: 3.0'
DELTA: -33°20'42" ARC LEN: 5.8'
CHORD LEN: 5.7' CHORD BRG: S 23°25'08" E
22+43.0 730252.7 1138743.0 PT
S 40°05'29" E 14.7'
22+57.7 730241.5 1138752.5 PC
RADIUS: 730235.0 1138744.8 RADIUS LENGTH: 10.0'
PI: 730239.7 1138754.0 22+60.1 TANGENT: 2.4'
DELTA: 26°47'32" ARC LEN: 4.7'
CHORD LEN: 4.6' CHORD BRG: S 26°41'43" E
22+62.4 730237.3 1138754.6 PT
S 13°17'57" E 36.9'
22+99.3 730201.4 1138763.1 PC
RADIUS: 730199.1 1138753.3 RADIUS LENGTH: 10.0'
PI: 730200.2 1138763.4 23+00.6 TANGENT: 1.3'
DELTA: 14°16'25" ARC LEN: 2.5'
CHORD LEN: 2.5' CHORD BRG: S 06°09'44" E
23+01.8 730198.9 1138763.3 PT
S 00°58'28" W 51.9'
23+53.7 730147.0 1138762.5 PC
RADIUS: 730146.8 1138772.5 RADIUS LENGTH: 10.0'
PI: 730145.8 1138762.4 23+54.9 TANGENT: 1.2'
DELTA: -13°46'21" ARC LEN: 2.4'
CHORD LEN: 2.4' CHORD BRG: S 05°54'42" E
23+56.1 730144.6 1138762.7 PT
S 12°47'53" E 6.4'
23+62.6 730138.3 1138764.1 PC
RADIUS: 730136.1 1138754.4 RADIUS LENGTH: 10.0'
PI: 730136.6 1138764.5 23+64.3 TANGENT: 1.8'
DELTA: 19°52'54" ARC LEN: 3.5'
CHORD LEN: 3.5' CHORD BRG: S 02°51'26" E
23+66.0 730134.9 1138764.3 PT
S 07°05'01" W 15.0'
23+81.1 730120.0 1138762.4 PC
RADIUS: 730118.7 1138772.4 RADIUS LENGTH: 10.0'
PI: 730118.7 1138762.3 23+82.3 TANGENT: 1.2'
DELTA: -14°06'49" ARC LEN: 2.5'
CHORD LEN: 2.5' CHORD BRG: S 00°01'36" W
23+83.5 730117.5 1138762.4 PT
S 07°01'48" E 24.9'
24+08.4 730092.8 1138765.5 PC
RADIUS: 730091.6 1138755.6 RADIUS LENGTH: 10.0'
PI: 730090.9 1138765.7 24+10.4 TANGENT: 1.9'
DELTA: 21°43'12" ARC LEN: 3.8'
CHORD LEN: 3.8' CHORD BRG: S 03°49'48" W
24+12.2 730089.0 1138765.2 PT
S 14°41'24" W 20.8'
24+33.0 730069.0 1138760.0 PC
RADIUS: 730066.4 1138769.6 RADIUS LENGTH: 10.0'
PI: 730067.5 1138759.6 24+34.5 TANGENT: 1.5'
DELTA: -16°38'52" ARC LEN: 2.9'
CHORD LEN: 2.9' CHORD BRG: S 06°21'58" W
24+35.9 730066.1 1138759.7 PT
S 01°57'27" E 18.6'
24+54.5 730047.4 1138760.3 PC
RADIUS: 730047.8 1138770.3 RADIUS LENGTH: 10.0'
PI: 730045.5 1138760.4 24+56.5 TANGENT: 1.9'
DELTA: -21°53'54" ARC LEN: 3.8'
CHORD LEN: 3.8' CHORD BRG: S 12°54'25" E
24+58.4 730043.7 1138761.1 PT
S 23°51'22" E 14.5'
24+72.9 730030.4 1138767.0 PC
RADIUS: 730026.4 1138757.9 RADIUS LENGTH: 10.0'
PI: 730028.7 1138767.8 24+74.8 TANGENT: 1.9'
DELTA: 22°01'03" ARC LEN: 3.8'
CHORD LEN: 3.8' CHORD BRG: S 12°50'50" E
24+76.7 730026.7 1138767.9 PT
S 01°50'19" E 15.6'
24+92.4 730011.1 1138768.4 PC
RADIUS: 730010.8 1138758.4 RADIUS LENGTH: 10.0'
PI: 730007.9 1138768.5 24+95.6 TANGENT: 3.2'
DELTA: 35°40'52" ARC LEN: 6.2'
CHORD LEN: 6.1' CHORD BRG: S 16°00'07" W
24+98.6 730005.2 1138766.7 PT
S 33°50'33" W 6.2'
25+04.8 730000.0 1138763.2 PC
RADIUS: 729994.5 1138771.5 RADIUS LENGTH: 10.0'
PI: 729996.0 1138760.5 25+09.7 TANGENT: 4.9'
DELTA: -51°59'31" ARC LEN: 9.1'
CHORD LEN: 8.8' CHORD BRG: S 07°50'48" W
25+13.9 729991.3 1138762.0 PT
S 18°08'58" E 9.6'
25+23.5 729982.3 1138765.0 PC
RADIUS: 729985.4 1138774.5 RADIUS LENGTH: 10.0'
PI: 729981.1 1138765.4 25+24.7 TANGENT: 1.2'
DELTA: -13°27'44" ARC LEN: 2.3'
CHORD LEN: 2.3' CHORD BRG: S 24°52'50" E
25+25.8 729980.1 1138766.0 PT
S 31°36'42" E 6.1'
25+31.9 729974.9 1138769.2 PC
RADIUS: 729969.7 1138760.7 RADIUS LENGTH: 10.0'
PI: 729972.2 1138770.9 25+35.2 TANGENT: 3.2'
DELTA: 35°55'12" ARC LEN: 6.3'
CHORD LEN: 6.2' CHORD BRG: S 13°39'06" E
25+38.2 729969.0 1138770.6 PT
S 04°18'30" W 8.7'
25+46.9 729960.2 1138770.0 PC
RADIUS: 729959.5 1138779.9 RADIUS LENGTH: 10.0'
PI: 729958.8 1138769.9 25+48.4 TANGENT: 1.5'
DELTA: -16°45'52" ARC LEN: 2.9'
CHORD LEN: 2.9' CHORD BRG: S 04°04'26" E
25+49.9 729957.3 1138770.2 PT
S 12°27'22" E 15.1'
25+65.0 729942.5 1138773.4 PC
RADIUS: 729940.4 1138763.7 RADIUS LENGTH: 10.0'
PI: 729938.9 1138774.2 25+68.7 TANGENT: 3.7'
DELTA: 40°51'13" ARC LEN: 7.1'
CHORD LEN: 7.0' CHORD BRG: S 07°58'14" W
25+72.1 729935.6 1138772.5 PT
S 28°23'51" W 3.5'
25+75.6 729932.5 1138770.8 PC
RADIUS: 729927.8 1138779.6 RADIUS LENGTH: 10.0'
PI: 729930.5 1138769.7 25+78.0 TANGENT: 2.4'
DELTA: -26°40'52" ARC LEN: 4.7'
CHORD LEN: 4.6' CHORD BRG: S 15°03'25" W
25+80.3 729928.1 1138769.6 PT
S 01°42'59" W 7.7'
25+88.0 729920.4 1138769.4 PC
RADIUS: 729920.2 1138774.4 RADIUS LENGTH: 5.0'
PI: 729917.8 1138769.3 25+90.6 TANGENT: 2.6'
DELTA: -54°22'07" ARC LEN: 4.7'
CHORD LEN: 4.6' CHORD BRG: S 25°28'05" E
25+92.7 729916.3 1138771.3 PT
S 52°39'08" E 1.9'
25+94.6 729915.1 1138772.8 PC
RADIUS: 729911.1 1138769.8 RADIUS LENGTH: 5.0'
PI: 729913.5 1138775.0 25+97.3 TANGENT: 2.7'
DELTA: 57°08'04" ARC LEN: 5.0'
CHORD LEN: 4.8' CHORD BRG: S 24°05'06" E
25+99.6 729910.8 1138774.8 PT
S 04°28'56" W 19.9'
26+19.5 729890.9 1138773.2 PC
RADIUS: 729890.6 1138778.2 RADIUS LENGTH: 5.0'
PI: 729889.4 1138773.1 26+21.0 TANGENT: 1.5'
DELTA: -33°34'53" ARC LEN: 2.9'
CHORD LEN: 2.9' CHORD BRG: S 12°18'31" E
26+22.4 729888.1 1138773.8 PT
S 29°05'57" E 4.4'
26+26.8 729884.3 1138776.0 PC
RADIUS: 729879.5 1138767.2 RADIUS LENGTH: 10.0'
PI: 729882.2 1138777.1 26+29.1 TANGENT: 2.4'
DELTA: 26°38'00" ARC LEN: 4.6'
CHORD LEN: 4.6' CHORD BRG: S 15°46'57" E
26+31.4 729879.9 1138777.2 PT
S 02°27'57" E 9.4'
26+40.8 729870.5 1138777.6 Deflection: 7°21'26" Left
S 09°49'23" E 70.4'
27+11.2 729801.1 1138789.6 Deflection: 5°24'17" Right
S 04°25'06" E 8.0'
27+19.2 729793.1 1138790.3 PC
RADIUS: 729793.9 1138800.2 RADIUS LENGTH: 10.0'
PI: 729792.6 1138790.3 27+19.8 TANGENT: 0.5'
DELTA: -5°49'54" ARC LEN: 1.0'
CHORD LEN: 1.0' CHORD BRG: S 07°23'23" E
27+20.3 729792.1 1138790.4 PT
S 10°18'20" E 12.5'
27+32.7 729779.8 1138792.6 PC
RADIUS: 729780.7 1138797.5 RADIUS LENGTH: 5.0'
PI: 729778.0 1138792.9 27+34.6 TANGENT: 1.9'
DELTA: -40°42'40" ARC LEN: 3.6'
CHORD LEN: 3.5' CHORD BRG: S 30°39'40" E
27+36.3 729776.8 1138794.4 PT
S 51°00'59" E 0.8'
27+37.1 729776.3 1138795.0 PC
RADIUS: 729780.2 1138798.2 RADIUS LENGTH: 5.0'
PI: 729774.5 1138797.2 27+39.9 TANGENT: 2.8'
DELTA: -58°44'02" ARC LEN: 5.1'
CHORD LEN: 4.9' CHORD BRG: S 80°23'00" E
27+42.3 729775.5 1138799.9 PT
N 70°14'59" E 13.6'
27+55.8 729780.1 1138812.6 PC
RADIUS: 729770.7 1138816.0 RADIUS LENGTH: 10.0'
PI: 729780.5 1138813.7 27+56.9 TANGENT: 1.1'
DELTA: 12°38'27" ARC LEN: 2.2'
CHORD LEN: 2.2' CHORD BRG: N 76°34'12" E
27+58.0 729780.6 1138814.8 PT
N 82°53'25" E 5.1'
27+63.1 729781.2 1138819.9 PC
RADIUS: 729776.3 1138820.5 RADIUS LENGTH: 5.0'
PI: 729781.6 1138822.9 27+66.2 TANGENT: 3.1'
DELTA: 62°59'50" ARC LEN: 5.5'
CHORD LEN: 5.2' CHORD BRG: S 65°36'40" E
27+68.6 729779.1 1138824.6 PT
S 34°06'45" E 1.1'
27+69.7 729778.2 1138825.2 PC
RADIUS: 729775.4 1138821.1 RADIUS LENGTH: 5.0'
PI: 729776.8 1138826.2 27+71.4 TANGENT: 1.7'
DELTA: 37°15'51" ARC LEN: 3.3'
CHORD LEN: 3.2' CHORD BRG: S 15°28'50" E
27+72.9 729775.1 1138826.1 PT
S 03°09'06" W 4.2'
27+77.2 729770.9 1138825.8 PC
RADIUS: 729770.6 1138830.8 RADIUS LENGTH: 5.0'
PI: 729768.9 1138825.7 27+79.1 TANGENT: 2.0'
DELTA: -43°16'19" ARC LEN: 3.8'
CHORD LEN: 3.7' CHORD BRG: S 18°29'04" E
27+80.9 729767.4 1138827.0 PT
S 40°07'14" E 1.3'
27+82.2 729766.5 1138827.8 PC
RADIUS: 729769.7 1138831.6 RADIUS LENGTH: 5.0'
PI: 729764.6 1138829.3 27+84.6 TANGENT: 2.4'
DELTA: -50°47'05" ARC LEN: 4.4'
CHORD LEN: 4.3' CHORD BRG: S 65°30'46" E
27+86.6 729764.7 1138831.7 PT
N 89°05'41" E 12.7'
27+99.3 729764.9 1138844.4 PC
RADIUS: 729754.9 1138844.5 RADIUS LENGTH: 10.0'
PI: 729764.9 1138845.9 28+00.8 TANGENT: 1.5'
DELTA: 17°17'00" ARC LEN: 3.0'
CHORD LEN: 3.0' CHORD BRG: S 82°15'49" E
28+02.3 729764.5 1138847.4 PT
S 73°37'19" E 4.8'
28+07.1 729763.1 1138852.0 PC
RADIUS: 729758.3 1138850.6 RADIUS LENGTH: 5.0'
PI: 729762.5 1138854.2 28+09.4 TANGENT: 2.3'
DELTA: 49°10'21" ARC LEN: 4.3'
CHORD LEN: 4.2' CHORD BRG: S 49°02'08" E
28+11.4 729760.4 1138855.1 PT
S 24°26'58" E 6.1'
28+17.6 729754.8 1138857.7 PC
RADIUS: 729752.7 1138853.1 RADIUS LENGTH: 5.0'
PI: 729753.8 1138858.1 28+18.7 TANGENT: 1.1'
DELTA: 25°30'37" ARC LEN: 2.2'
CHORD LEN: 2.2' CHORD BRG: S 11°41'40" E
28+19.8 729752.6 1138858.1 PT
S 01°03'39" W 6.6'
28+26.4 729746.1 1138858.0 PC
RADIUS: 729746.2 1138853.0 RADIUS LENGTH: 5.0'
PI: 729745.2 1138858.0 28+27.2 TANGENT: 0.9'
DELTA: 19°35'44" ARC LEN: 1.7'
CHORD LEN: 1.7' CHORD BRG: S 10°51'31" W
28+28.1 729744.4 1138857.7 PT
S 20°39'23" W 8.2'
28+36.3 729736.7 1138854.8 PC
RADIUS: 729735.0 1138859.5 RADIUS LENGTH: 5.0'
PI: 729735.4 1138854.3 28+37.6 TANGENT: 1.4'
DELTA: -30°26'11" ARC LEN: 2.7'
CHORD LEN: 2.6' CHORD BRG: S 05°26'17" W
28+38.9 729734.1 1138854.5 PT
S 09°46'49" E 5.2'
28+44.1 729729.0 1138855.4 PC
RADIUS: 729729.9 1138860.3 RADIUS LENGTH: 5.0'
PI: 729727.0 1138855.8 28+46.1 TANGENT: 2.0'
DELTA: -44°18'24" ARC LEN: 3.9'
CHORD LEN: 3.8' CHORD BRG: S 31°56'01" E
28+48.0 729725.8 1138857.4 PT
S 54°05'13" E 4.8'
28+52.8 729723.0 1138861.3 PC
RADIUS: 729718.9 1138858.4 RADIUS LENGTH: 5.0'
PI: 729722.0 1138862.6 28+54.4 TANGENT: 1.7'
DELTA: 36°36'54" ARC LEN: 3.2'
CHORD LEN: 3.1' CHORD BRG: S 35°46'46" E
28+56.0 729720.4 1138863.1 PT
S 17°28'19" E 9.7'
28+65.7 729711.2 1138866.0 PC
RADIUS: 729712.7 1138870.8 RADIUS LENGTH: 5.0'
PI: 729710.7 1138866.2 28+66.2 TANGENT: 0.6'
DELTA: -12°53'08" ARC LEN: 1.1'
CHORD LEN: 1.1' CHORD BRG: S 23°54'53" E
28+66.8 729710.2 1138866.5 PT
S 30°21'27" E 11.0'
28+77.8 729700.7 1138872.0 PC
RADIUS: 729698.2 1138867.7 RADIUS LENGTH: 5.0'
PI: 729700.5 1138872.2 28+78.0 TANGENT: 0.2'
DELTA: 5°09'52" ARC LEN: 0.5'
CHORD LEN: 0.5' CHORD BRG: S 27°46'31" E
28+78.2 729700.3 1138872.3 PT
S 25°11'34" E 12.4'
28+90.6 729689.1 1138877.5 PC
RADIUS: 729691.2 1138882.1 RADIUS LENGTH: 5.0'
PI: 729688.9 1138877.6 28+90.8 TANGENT: 0.2'
DELTA: -4°48'33" ARC LEN: 0.4'
CHORD LEN: 0.4' CHORD BRG: S 27°35'51" E
28+91.0 729688.7 1138877.7 PT
S 30°00'08" E 9.8'
29+00.8 729680.2 1138882.6 PC
RADIUS: 729677.7 1138878.3 RADIUS LENGTH: 5.0'
PI: 729679.0 1138883.3 29+02.2 TANGENT: 1.4'
DELTA: 30°33'28" ARC LEN: 2.7'
CHORD LEN: 2.6' CHORD BRG: S 14°43'24" E
29+03.5 729677.7 1138883.3 PT
S 00°33'20" W 6.4'
29+09.9 729671.2 1138883.2 PC
RADIUS: 729671.3 1138878.2 RADIUS LENGTH: 5.0'
PI: 729670.3 1138883.2 29+10.9 TANGENT: 0.9'
DELTA: 20°42'38" ARC LEN: 1.8'
CHORD LEN: 1.8' CHORD BRG: S 10°54'39" W
29+11.7 729669.5 1138882.9 PT
S 21°15'58" W 3.6'
29+15.4 729666.1 1138881.6 PC
RADIUS: 729664.3 1138886.3 RADIUS LENGTH: 5.0'
PI: 729665.0 1138881.2 29+16.5 TANGENT: 1.2'
DELTA: -26°12'09" ARC LEN: 2.3'
CHORD LEN: 2.3' CHORD BRG: S 08°09'53" W
29+17.6 729663.9 1138881.3 PT
S 04°56'12" E 9.3'
29+26.9 729654.6 1138882.1 PC
RADIUS: 729655.0 1138887.1 RADIUS LENGTH: 5.0'
PI: 729652.7 1138882.2 29+28.9 TANGENT: 1.9'
DELTA: -42°20'43" ARC LEN: 3.7'
CHORD LEN: 3.6' CHORD BRG: S 26°06'33" E
29+30.6 729651.4 1138883.7 PT
S 47°16'54" E 15.7'
29+46.4 729640.7 1138895.2 PC
RADIUS: 729637.0 1138891.8 RADIUS LENGTH: 5.0'
PI: 729639.5 1138896.5 29+48.1 TANGENT: 1.7'
DELTA: 37°30'56" ARC LEN: 3.3'
CHORD LEN: 3.2' CHORD BRG: S 28°31'27" E
29+49.6 729637.9 1138896.8 PT
S 09°45'59" E 21.5'
29+71.1 729616.7 1138900.4 PC
RADIUS: 729617.5 1138905.3 RADIUS LENGTH: 5.0'
PI: 729613.2 1138901.0 29+74.6 TANGENT: 3.5'
DELTA: -69°46'19" ARC LEN: 6.1'
CHORD LEN: 5.7' CHORD BRG: S 44°39'08" E
29+77.2 729612.6 1138904.4 PT
S 79°32'17" E 5.6'
29+82.8 729611.6 1138909.9 PC
RADIUS: 729606.7 1138909.0 RADIUS LENGTH: 5.0'
PI: 729611.2 1138912.1 29+85.0 TANGENT: 2.2'
DELTA: 47°24'49" ARC LEN: 4.1'
CHORD LEN: 4.0' CHORD BRG: S 55°49'53" E
29+87.0 729609.3 1138913.3 PT
S 32°07'28" E 23.6'
30+10.6 729589.3 1138925.8 PC
RADIUS: 729584.0 1138917.4 RADIUS LENGTH: 10.0'
PI: 729587.5 1138927.0 30+12.8 TANGENT: 2.2'
DELTA: 24°18'21" ARC LEN: 4.2'
CHORD LEN: 4.2' CHORD BRG: S 19°58'17" E
30+14.8 729585.4 1138927.3 PT
S 07°49'07" E 7.4'
30+22.2 729578.0 1138928.3 PC
RADIUS: 729577.4 1138923.3 RADIUS LENGTH: 5.0'
PI: 729575.4 1138928.6 30+24.9 TANGENT: 2.7'
DELTA: 56°17'00" ARC LEN: 4.9'
CHORD LEN: 4.7' CHORD BRG: S 20°19'23" W
30+27.2 729573.6 1138926.6 PT
S 48°27'54" W 3.3'
30+30.5 729571.4 1138924.2 PC
RADIUS: 729567.7 1138927.5 RADIUS LENGTH: 5.0'
PI: 729569.8 1138922.4 30+32.8 TANGENT: 2.3'
DELTA: -50°18'33" ARC LEN: 4.4'
CHORD LEN: 4.3' CHORD BRG: S 23°18'37" W
30+34.9 729567.5 1138922.5 PT
S 01°50'39" E 7.2'
30+42.0 729560.4 1138922.7 PC
RADIUS: 729560.5 1138927.7 RADIUS LENGTH: 5.0'
PI: 729557.1 1138922.8 30+45.3 TANGENT: 3.3'
DELTA: -66°25'28" ARC LEN: 5.8'
CHORD LEN: 5.5' CHORD BRG: S 35°03'23" E
30+47.8 729555.9 1138925.8 PT
S 68°16'07" E 4.3'
30+52.1 729554.3 1138929.8 PC
RADIUS: 729549.6 1138927.9 RADIUS LENGTH: 5.0'
PI: 729553.6 1138931.5 30+53.9 TANGENT: 1.8'
DELTA: 39°14'22" ARC LEN: 3.4'
CHORD LEN: 3.4' CHORD BRG: S 48°38'56" E
30+55.5 729552.1 1138932.3 PT
S 29°01'45" E 12.9'
30+68.4 729540.8 1138938.6

A	MIT. PLAN	12/13	
B	DRAFT CD'S.	09/14	
C	FINAL MP	02/15	
D			
	DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22209 ANDREW DAVID B

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

DATE: FEB. 2015
SCALE: NTS

UT1
CENTERLINE
DATA

SHADRICK REACH 1

Station Northing Easting Bearing Distance
10+00.0 729403.5 1138258.8
S 62°41'59" E 55.4'
10+55.4 729378.1 1138308.0 PC
RADIUS: 729324.7 1138280.4 RADIUS LENGTH: 60.0'
PI: 729372.4 1138318.9 10+67.6 TANGENT: 12.3'
DELTA: 23°06'35" ARC LEN: 24.2'
CHORD LEN: 24.0' CHORD BRG: S 51°08'41" E
10+79.6 729363.0 1138326.7 PT
10+79.6 729363.0 1138326.7 PC
RADIUS: 729398.7 1138369.8 RADIUS LENGTH: 56.0'
PI: 729333.1 1138351.4 11+18.4 TANGENT: 38.8'
DELTA: -69°27'03" ARC LEN: 67.9'
CHORD LEN: 63.8' CHORD BRG: S 74°18'55" E
11+47.4 729345.7 1138388.1 PT
N 70°57'33" E 88.7'
12+36.2 729374.7 1138472.0 PC
RADIUS: 729268.8 1138508.5 RADIUS LENGTH: 112.0'
PI: 729391.7 1138521.4 12+88.5 TANGENT: 52.3'
DELTA: 50°04'27" ARC LEN: 97.9'
CHORD LEN: 94.8' CHORD BRG: S 84°00'14" E
13+34.1 729364.8 1138566.2 PT
S 58°58'00" E 17.1'
13+51.2 729355.9 1138580.9 PC
RADIUS: 729403.9 1138609.8 RADIUS LENGTH: 56.0'
PI: 729339.0 1138609.1 13+84.0 TANGENT: 32.8'
DELTA: -60°46'23" ARC LEN: 59.4'
CHORD LEN: 56.7' CHORD BRG: S 89°21'11" E
14+10.6 729355.3 1138637.6 PT
14+10.6 729355.3 1138637.6 PC
RADIUS: 729306.7 1138665.4 RADIUS LENGTH: 56.0'
PI: 729360.7 1138646.9 14+21.4 TANGENT: 10.8'
DELTA: 21°47'25" ARC LEN: 21.3'
CHORD LEN: 21.2' CHORD BRG: N 71°09'20" E
14+31.9 729362.1 1138657.6 PT
N 82°03'02" E 108.5'
15+40.3 729377.1 1138765.0 PC
RADIUS: 729432.6 1138757.3 RADIUS LENGTH: 56.0'
PI: 729381.0 1138792.7 15+68.3 TANGENT: 28.0'
DELTA: -53°05'17" ARC LEN: 51.9'
CHORD LEN: 50.1' CHORD BRG: N 55°30'24" E
15+92.2 729405.5 1138806.3 PT
N 28°57'46" E 72.9'
16+65.1 729469.3 1138841.6 PC
RADIUS: 729428.6 1138915.1 RADIUS LENGTH: 84.0'
PI: 729486.0 1138850.9 16+84.3 TANGENT: 19.2'
DELTA: 25°42'37" ARC LEN: 37.7'
CHORD LEN: 37.4' CHORD BRG: N 41°49'04" E
17+02.8 729497.1 1138866.5 PT
N 54°40'22" E 68.2'
17+71.0 729536.5 1138922.1 PC
RADIUS: 729487.6 1138956.8 RADIUS LENGTH: 60.0'
PI: 729549.5 1138940.4 17+93.4 TANGENT: 22.4'
DELTA: 40°58'32" ARC LEN: 42.9'
CHORD LEN: 42.0' CHORD BRG: N 75°09'38" E
18+13.9 729547.3 1138962.7 PT
S 84°21'06" E 50.2'
18+64.1 729542.3 1139012.7 PC
RADIUS: 729602.1 1139018.6 RADIUS LENGTH: 60.0'
PI: 729540.2 1139034.9 18+86.4 TANGENT: 22.3'
DELTA: -40°45'21" ARC LEN: 42.7'
CHORD LEN: 41.8' CHORD BRG: N 75°16'13" E
19+06.8 729553.0 1139053.1 PT
N 54°53'33" E 4.1'
19+10.9 729555.3 1139056.5 PC
RADIUS: 729506.3 1139091.0 RADIUS LENGTH: 60.0'
PI: 729569.2 1139076.2 19+35.0 TANGENT: 24.1'
DELTA: 43°46'17" ARC LEN: 45.8'
CHORD LEN: 44.7' CHORD BRG: N 76°46'42" E
19+56.8 729565.6 1139100.0 PT
S 81°20'10" E 54.9'
20+11.7 729557.3 1139154.3 PC
RADIUS: 729616.6 1139163.3 RADIUS LENGTH: 60.0'
PI: 729552.5 1139186.0 20+43.7 TANGENT: 32.1'
DELTA: -56°16'22" ARC LEN: 58.9'
CHORD LEN: 56.6' CHORD BRG: N 70°31'39" E
20+70.6 729576.2 1139207.7 PT
N 42°23'28" E 71.8'
21+42.4 729629.2 1139256.1 PC
RADIUS: 729553.7 1139338.8 RADIUS LENGTH: 112.0'
PI: 729640.3 1139266.2 21+57.4 TANGENT: 15.0'
DELTA: 15°15'17" ARC LEN: 29.8'
CHORD LEN: 29.7' CHORD BRG: N 50°01'07" E
21+72.3 729648.3 1139278.9 PT
N 57°38'45" E 131.8'
23+04.1 729718.9 1139390.2 PC
RADIUS: 729789.8 1139345.3 RADIUS LENGTH: 84.0'
PI: 729727.4 1139403.7 23+20.1 TANGENT: 16.0'
DELTA: -21°34'06" ARC LEN: 31.6'
CHORD LEN: 31.4' CHORD BRG: N 46°51'42" E
23+35.7 729740.4 1139413.2 PT
N 36°04'38" E 28.9'
23+64.6 729763.7 1139430.2 PC
RADIUS: 729697.8 1139520.7 RADIUS LENGTH: 112.0'
PI: 729794.9 1139452.9 24+03.1 TANGENT: 38.5'
DELTA: 37°59'04" ARC LEN: 74.3'
CHORD LEN: 72.9' CHORD BRG: N 55°04'11" E
24+38.9 729805.5 1139490.0 PT
N 74°03'43" E 47.0'
24+85.8 729818.4 1139535.1 PC
RADIUS: 729926.1 1139504.4 RADIUS LENGTH: 112.0'
PI: 729824.7 1139557.2 25+08.8 TANGENT: 23.0'
DELTA: -23°11'33" ARC LEN: 45.3'
CHORD LEN: 45.0' CHORD BRG: N 62°27'56" E
25+31.2 729839.2 1139575.1 PT
N 50°52'10" E 132.2'
26+63.3 729922.6 1139677.6 PC
RADIUS: 729876.1 1139715.5 RADIUS LENGTH: 60.0'
PI: 729926.0 1139681.8 26+68.7 TANGENT: 5.4'
DELTA: 10°16'47" ARC LEN: 10.8'
CHORD LEN: 10.8' CHORD BRG: N 56°00'34" E
26+74.1 729928.6 1139686.5 PT
N 61°08'57" E 88.9'
27+63.0 729971.5 1139764.4 PC
RADIUS: 730024.1 1139735.4 RADIUS LENGTH: 60.0'
PI: 729975.7 1139771.9 27+71.7 TANGENT: 8.6'
DELTA: -16°23'35" ARC LEN: 17.2'
CHORD LEN: 17.1' CHORD BRG: N 52°57'10" E
27+80.2 729981.8 1139778.0 PT
N 44°45'23" E 37.9'
28+18.1 730008.7 1139804.7 PC
RADIUS: 729966.5 1139847.3 RADIUS LENGTH: 60.0'
PI: 730019.4 1139815.3 28+33.1 TANGENT: 15.0'
DELTA: 28°09'07" ARC LEN: 29.5'
CHORD LEN: 29.2' CHORD BRG: N 58°49'56" E
28+47.5 730023.8 1139829.7 PT
N 72°54'29" E 17.8'
28+65.3 730029.1 1139846.7 PC
RADIUS: 730086.4 1139829.1 RADIUS LENGTH: 60.0'
PI: 730032.9 1139859.3 28+78.5 TANGENT: 13.2'
DELTA: -24°44'17" ARC LEN: 25.9'
CHORD LEN: 25.7' CHORD BRG: N 60°32'21" E
28+91.3 730041.7 1139869.1 PT
N 48°10'12" E 36.4'
29+27.6 730065.9 1139896.2 PC
RADIUS: 730021.2 1139936.2 RADIUS LENGTH: 60.0'
PI: 730071.8 1139902.7 29+36.4 TANGENT: 8.8'
DELTA: 16°40'35" ARC LEN: 17.5'
CHORD LEN: 17.4' CHORD BRG: N 56°30'30" E
29+45.1 730075.5 1139910.7 PT
N 64°50'47" E 43.0'
29+88.1 730093.8 1139949.6 PC
RADIUS: 730175.3 1139911.4 RADIUS LENGTH: 90.0'
PI: 730098.8 1139960.1 29+99.7 TANGENT: 11.6'
DELTA: -14°39'27" ARC LEN: 23.0'
CHORD LEN: 23.0' CHORD BRG: N 57°31'04" E
30+11.1 730106.2 1139969.0 PT
N 50°11'20" E 93.1'
31+04.2 730165.8 1140040.5 PC
RADIUS: 730131.2 1140069.3 RADIUS LENGTH: 45.0'
PI: 730185.3 1140063.9 31+34.7 TANGENT: 30.5'
DELTA: 68°12'45" ARC LEN: 53.6'
CHORD LEN: 50.5' CHORD BRG: N 84°17'43" E
31+57.8 730170.8 1140090.7 PT
31+57.8 730170.8 1140090.7 PC
RADIUS: 730210.4 1140112.1 RADIUS LENGTH: 45.0'
PI: 730155.8 1140118.4 31+89.3 TANGENT: 31.5'
DELTA: -69°59'41" ARC LEN: 55.0'
CHORD LEN: 51.6' CHORD BRG: N 83°24'15" E
32+12.8 730176.7 1140142.0 PT
N 48°24'24" E 45.0'
32+57.8 730206.6 1140175.7 PC
RADIUS: 730251.5 1140135.8 RADIUS LENGTH: 60.0'
PI: 730211.1 1140180.8 32+64.6 TANGENT: 6.8'
DELTA: -13°00'02" ARC LEN: 13.6'
CHORD LEN: 13.6' CHORD BRG: N 41°54'23" E
32+71.4 730216.7 1140184.7 PT
N 35°24'22" E 16.8'
32+88.2 730230.4 1140194.5 PC
RADIUS: 730195.6 1140243.4 RADIUS LENGTH: 60.0'
PI: 730254.1 1140211.3 33+17.3 TANGENT: 29.1'
DELTA: 51°46'46" ARC LEN: 54.2'
CHORD LEN: 52.4' CHORD BRG: N 61°17'46" E
33+42.4 730255.5 1140240.4 PT
N 87°11'09" E 32.7'
33+75.1 730257.1 1140273.1 PC
RADIUS: 730317.1 1140270.1 RADIUS LENGTH: 60.0'
PI: 730257.8 1140285.3 33+87.4 TANGENT: 12.3'
DELTA: -23°06'21" ARC LEN: 24.2'
CHORD LEN: 24.0' CHORD BRG: N 75°37'58" E
33+99.3 730263.1 1140296.3 PT
N 64°04'48" E 41.6'
34+40.9 730281.3 1140333.8 PC
RADIUS: 730230.9 1140358.3 RADIUS LENGTH: 56.0'
PI: 730288.4 1140348.4 34+57.1 TANGENT: 16.2'
DELTA: 32°19'40" ARC LEN: 31.6'
CHORD LEN: 31.2' CHORD BRG: N 80°14'38" E
34+72.5 730286.6 1140364.5 PT
S 83°35'32" E 1.3'
34+73.8 730286.4 1140365.8 PC
RADIUS: 730342.1 1140372.0 RADIUS LENGTH: 56.0'
PI: 730282.2 1140403.7 35+11.9 TANGENT: 38.1'
DELTA: -68°31'28" ARC LEN: 67.0'
CHORD LEN: 63.1' CHORD BRG: N 62°08'44" E
35+40.7 730315.9 1140421.5 PT
N 27°53'00" E 45.1'
35+85.8 730355.7 1140442.6 PC
RADIUS: 730329.5 1140492.1 RADIUS LENGTH: 56.0'
PI: 730393.8 1140462.7 36+28.8 TANGENT: 43.0'
DELTA: 75°03'38" ARC LEN: 73.4'
CHORD LEN: 68.2' CHORD BRG: N 65°24'49" E
36+59.2 730384.1 1140504.6 PT
S 77°03'22" E 61.6'
37+20.8 730370.3 1140564.7 PC
RADIUS: 730414.2 1140574.7 RADIUS LENGTH: 45.0'
PI: 730364.2 1140591.1 37+47.9 TANGENT: 27.1'
DELTA: -62°11'33" ARC LEN: 48.8'
CHORD LEN: 46.5' CHORD BRG: N 71°50'51" E
37+69.6 730384.8 1140608.8 PT
N 40°45'05" E 15.3'
37+84.9 730396.4 1140618.8 PC
RADIUS: 730367.0 1140652.9 RADIUS LENGTH: 45.0'
PI: 730428.2 1140646.2 38+26.9 TANGENT: 42.0'
DELTA: 86°01'10" ARC LEN: 67.6'
CHORD LEN: 61.4' CHORD BRG: N 83°45'40" E
38+52.4 730403.1 1140679.8 PT
S 53°13'45" E 13.8'
38+66.3 730394.8 1140690.9 PC
RADIUS: 730439.6 1140724.4 RADIUS LENGTH: 56.0'
PI: 730377.0 1140714.7 38+96.0 TANGENT: 29.7'
DELTA: -55°53'36" ARC LEN: 54.6'
CHORD LEN: 52.5' CHORD BRG: S 81°10'32" E
39+20.9 730386.7 1140742.8 PT
N 70°52'40" E 109.4'
40+30.2 730422.6 1140846.1 PC
RADIUS: 730501.9 1140818.6 RADIUS LENGTH: 84.0'
PI: 730425.5 1140854.6 40+39.3 TANGENT: 9.0'
DELTA: -12°16'39" ARC LEN: 18.0'
CHORD LEN: 18.0' CHORD BRG: N 64°44'20" E
40+48.2 730430.2 1140862.3 PT
N 58°36'01" E 32.6'
40+80.8 730447.2 1140890.1 PC
RADIUS: 730399.4 1140919.3 RADIUS LENGTH: 56.0'
PI: 730462.7 1140915.5 41+10.5 TANGENT: 29.7'
DELTA: 55°55'18" ARC LEN: 54.7'
CHORD LEN: 52.5' CHORD BRG: N 86°33'40" E
41+35.5 730450.3 1140942.5 PT
S 65°28'41" E 59.0'
41+94.4 730425.8 1140996.2 PC
RADIUS: 730502.3 1141031.1 RADIUS LENGTH: 84.0'
PI: 730418.8 1141011.7 42+11.4 TANGENT: 17.0'
DELTA: -22°53'10" ARC LEN: 33.6'
CHORD LEN: 33.3' CHORD BRG: S 76°55'16" E
42+28.0 730418.3 1141028.7 PT
S 88°21'51" E 33.5'
42+61.5 730417.3 1141062.2 PC
RADIUS: 730361.4 1141060.6 RADIUS LENGTH: 56.0'
PI: 730416.9 1141076.7 42+76.0 TANGENT: 14.5'
DELTA: 29°00'44" ARC LEN: 28.4'
CHORD LEN: 28.1' CHORD BRG: S 73°51'29" E
42+89.9 730409.5 1141089.2 PT
S 59°21'07" E 33.9'
43+23.8 730392.3 1141118.3 PC
RADIUS: 730440.4 1141146.9 RADIUS LENGTH: 56.0'
PI: 730364.0 1141166.1 43+79.3 TANGENT: 55.5'
DELTA: -89°27'37" ARC LEN: 87.4'
CHORD LEN: 78.8' CHORD BRG: N 75°55'05" E
44+11.2 730411.4 1141194.8 PT
N 31°11'16" E 19.4'
44+30.7 730428.1 1141204.9 PC
RADIUS: 730471.6 1141133.0 RADIUS LENGTH: 84.0'
PI: 730449.5 1141217.8 44+55.7 TANGENT: 25.0'
DELTA: -33°09'50" ARC LEN: 48.6'
CHORD LEN: 47.9' CHORD BRG: N 14°36'22" E
44+79.3 730474.5 1141216.9 PT
N 01°58'33" W 27.4'
45+06.7 730501.9 1141216.0 PC
RADIUS: 730503.8 1141272.0 RADIUS LENGTH: 56.0'
PI: 730529.7 1141215.0 45+34.6 TANGENT: 27.9'
DELTA: 52°56'10" ARC LEN: 51.7'
CHORD LEN: 49.9' CHORD BRG: N 24°29'32" E
45+58.5 730547.3 1141236.7 PT
N 50°57'37" E 23.7'
45+82.2 730562.2 1141255.1 PC
RADIUS: 730605.7 1141219.8 RADIUS LENGTH: 56.0'
PI: 730577.3 1141273.7 46+06.1 TANGENT: 24.0'
DELTA: -46°19'19" ARC LEN: 45.3'
CHORD LEN: 44.1' CHORD BRG: N 27°47'58" E
46+27.4 730601.2 1141275.6 PT
N 04°38'19" E 58.5'
46+85.9 730659.5 1141280.4

SHADRICK REACHES 2 & 3

Station Northing Easting Bearing Distance
100+00.0 729628.0 1144660.0
S 78°52'32" E 15.1'
100+15.1 729625.1 1144674.8 PC
RADIUS: 729595.6 1144669.0 RADIUS LENGTH: 30.0'
PI: 729620.2 1144699.5 100+40.3 TANGENT: 25.2'
DELTA: 80°04'10" ARC LEN: 41.9'
CHORD LEN: 38.6' CHORD BRG: S 38°50'26" E
100+57.0 729595.0 1144699.0 PT
S 01°11'39" W 15.2'
100+72.3 729579.8 1144698.7 PC
RADIUS: 729580.4 1144668.7 RADIUS LENGTH: 30.0'
PI: 729566.2 1144698.4 100+85.8 TANGENT: 13.6'
DELTA: 48°42'17" ARC LEN: 25.5'
CHORD LEN: 24.7' CHORD BRG: S 25°32'47" W
100+97.8 729557.4 1144688.0 PT
S 49°53'55" W 9.6'
101+07.4 729551.3 1144680.7 PC
RADIUS: 729528.3 1144700.0 RADIUS LENGTH: 30.0'
PI: 729537.3 1144664.1 101+29.1 TANGENT: 21.7'
DELTA: -71°50'48" ARC LEN: 37.6'
CHORD LEN: 35.2' CHORD BRG: S 13°58'31" W
101+45.0 729517.1 1144672.2 PT
S 21°56'53" E 4.3'
101+49.3 729513.1 1144673.8 PC
RADIUS: 729524.3 1144701.6 RADIUS LENGTH: 30.0'
PI: 729492.4 1144682.1 101+71.6 TANGENT: 22.3'
DELTA: -73°21'50" ARC LEN: 38.4'
CHORD LEN: 35.8' CHORD BRG: S 58°37'48" E
101+87.7 729494.5 1144704.4 PT
N 84°41'17" E 7.1'
101+94.8 729495.1 1144711.4 PC
RADIUS: 729465.3 1144714.2 RADIUS LENGTH: 30.0'
PI: 729497.6 1144737.7 102+21.2 TANGENT: 26.4'
DELTA: 82°39'20" ARC LEN: 43.3'
CHORD LEN: 39.6' CHORD BRG: S 53°59'03" E
102+38.0 729471.8 1144743.5 PT
S 12°39'23" E 55.3'
102+93.3 729417.9 1144755.6 PC
RADIUS: 729431.0 1144814.1 RADIUS LENGTH: 60.0'
PI: 729395.8 1144760.6 103+15.9 TANGENT: 22.6'
DELTA: -41°17'14" ARC LEN: 43.2'
CHORD LEN: 42.3' CHORD BRG: S 33°18'00" E
103+36.6 729382.5 1144778.8 PT
S 53°56'37" E 34.6'
103+71.2 729362.1 1144806.8 PC
RADIUS: 729313.6 1144771.5 RADIUS LENGTH: 60.0'
PI: 729348.5 1144825.5 103+94.3 TANGENT: 23.1'
DELTA: 42°10'59" ARC LEN: 44.2'
CHORD LEN: 43.2' CHORD BRG: S 32°51'08" E
104+15.4 729325.9 1144830.2 PT
S 11°45'38" E 71.5'
104+86.9 729255.8 1144844.8 PC
RADIUS: 729268.1 1144903.6 RADIUS LENGTH: 60.0'
PI: 729235.4 1144849.1 105+07.7 TANGENT: 20.8'
DELTA: -38°18'31" ARC LEN: 40.1'
CHORD LEN: 39.4' CHORD BRG: S 30°54'53" E
105+27.0 729222.0 1144865.1 PT
S 50°04'09" E 36.8'
105+63.8 729198.4 1144893.3 PC
RADIUS: 729152.4 1144854.8 RADIUS LENGTH: 60.0'
PI: 729189.8 1144903.6 105+77.3 TANGENT: 13.5'
DELTA: 25°20'58" ARC LEN: 26.5'
CHORD LEN: 26.3' CHORD BRG: S 37°23'39" E
105+90.4 729177.5 1144909.3 PT
S 24°43'10" E 25.5'
106+15.9 729154.3 1144919.9 PC
RADIUS: 729185.7 1144988.1 RADIUS LENGTH: 75.0'
PI: 729124.4 1144933.7 106+48.8 TANGENT: 32.9'
DELTA: -47°23'33" ARC LEN: 62.0'
CHORD LEN: 60.3' CHORD BRG: S 48°24'57" E
106+77.9 729114.3 1144965.0 PT
S 72°06'43" E 69.5'
107+47.4 729093.0 1145031.2 PC
RADIUS: 729021.6 1145008.2 RADIUS LENGTH: 75.0'
PI: 729078.0 1145077.5 107+96.1 TANGENT: 48.7'
DELTA: 65°57'14" ARC LEN: 86.3'
CHORD LEN: 81.6' CHORD BRG: S 39°08'06" E
108+33.8 729029.6 1145082.7 PT
S 06°09'29" E 106.2'
109+40.0 728924.0 1145094.1 PC
RADIUS: 728930.5 1145153.8 RADIUS LENGTH: 60.0'
PI: 728881.4 1145098.7 109+82.8 TANGENT: 42.8'
DELTA: -71°02'37" ARC LEN: 74.4'
CHORD LEN: 69.7' CHORD BRG: S 41°40'48" E
110+14.4 728871.9 1145140.5 PT
S 77°12'06" E 32.2'
110+46.6 728864.8 1145171.9 PC
RADIUS: 728806.3 1145158.6 RADIUS LENGTH: 60.0'
PI: 728854.6 1145216.9 110+92.8 TANGENT: 46.2'
DELTA: 75°08'44" ARC LEN: 78.7'
CHORD LEN: 73.2' CHORD BRG: S 39°37'44" E
111+25.3 728808.5 1145218.5 PT
S 02°03'22" E 39.7'
111+65.0 728768.8 1145220.0 PC
RADIUS: 728770.9 1145279.9 RADIUS LENGTH: 60.0'
PI: 728710.7 1145222.1 112+23.1 TANGENT: 58.1'
DELTA: -88°11'23" ARC LEN: 92.4'
CHORD LEN: 83.5' CHORD BRG: S 46°09'03" E
112+57.3 728710.9 1145280.2 PT
N 89°45'15" E 28.7'
112+86.1 728711.1 1145308.9 PC
RADIUS: 728636.1 1145309.2 RADIUS LENGTH: 75.0'
PI: 728711.2 1145345.5 113+22.6 TANGENT: 36.6'
DELTA: 52°00'23" ARC LEN: 68.1'
CHORD LEN: 65.8' CHORD BRG: S 64°14'33" E
113+54.1 728682.5 1145368.1 PT
S 38°14'22" E 129.7'
114+83.9 728580.6 1145448.4 PC
RADIUS: 728534.2 1145389.5 RADIUS LENGTH: 75.0'
PI: 728547.1 1145474.8 115+26.5 TANGENT: 42.6'
DELTA: 59°13'19" ARC LEN: 77.5'
CHORD LEN: 74.1' CHORD BRG: S 08°37'42" E
115+61.4 728507.3 1145459.6 PT
S 20°58'58" W 82.8'
116+44.2 728430.0 1145429.9 PC
RADIUS: 728403.1 1145499.9 RADIUS LENGTH: 75.0'
PI: 728407.2 1145421.2 116+68.6 TANGENT: 24.3'
DELTA: -35°57'53" ARC LEN: 47.1'
CHORD LEN: 46.3' CHORD BRG: S 03°00'01" W
116+91.3 728383.7 1145427.5 PT
S 14°58'56" E 37.9'
117+29.2 728347.1 1145437.3

UT9

Station Northing Easting Bearing Distance
10+00.0 731148.4 1139755.1
S 25°56'14" E 9.7'
10+09.7 731139.6 1139759.4 PC
RADIUS: 731146.2 1139772.8 RADIUS LENGTH: 15.0'
PI: 731125.3 1139766.3 10+25.6 TANGENT: 15.9'
DELTA: -93°21'31" ARC LEN: 24.4'
CHORD LEN: 21.8' CHORD BRG: S 72°37'00" E
10+34.2 731133.1 1139780.2 PT
N 60°42'15" E 22.5'
10+56.7 731144.1 1139799.8 PC
RADIUS: 731109.2 1139819.4 RADIUS LENGTH: 40.0'
PI: 731148.6 1139807.9 10+65.9 TANGENT: 9.2'
DELTA: 26°02'03" ARC LEN: 18.2'
CHORD LEN: 18.0' CHORD BRG: N 73°43'16" E
10+74.8 731149.2 1139817.1 PT
N 86°44'18" E 12.0'
10+86.8 731149.8 1139829.0 PC
RADIUS: 731109.9 1139831.3 RADIUS LENGTH: 40.0'
PI: 731150.1 1139832.9 10+90.7 TANGENT: 3.9'
DELTA: 11°11'49" ARC LEN: 7.8'
CHORD LEN: 7.8' CHORD BRG: S 87°39'48" E
10+94.6 731149.5 1139836.8 PT
S 82°03'53" E 3.2'
10+97.8 731149.1 1139840.0 PC
RADIUS: 731188.7 1139845.5 RADIUS LENGTH: 40.0'
PI: 731148.3 1139845.9 11+03.8 TANGENT: 6.0'
DELTA: -17°07'28" ARC LEN: 12.0'
CHORD LEN: 11.9' CHORD BRG: N 89°22'23" E
11+09.7 731149.2 1139851.9 PT
N 80°48'39" E 6.3'
11+16.1 731150.2 1139858.1 PC
RADIUS: 731135.4 1139860.5 RADIUS LENGTH: 15.0'
PI: 731151.6 1139866.7 11+24.7 TANGENT: 8.6'
DELTA: 59°55'49" ARC LEN: 15.7'
CHORD LEN: 15.0' CHORD BRG: S 69°13'27" E
11+31.8 731144.9 1139872.1 PT
S 39°15'32" E 18.6'
11+50.3 731130.5 1139883.9 PC
RADIUS: 731121.0 1139872.3 RADIUS LENGTH: 15.0'
PI: 731125.9 1139887.6 11+56.3 TANGENT: 5.9'
DELTA: 43°02'14" ARC LEN: 11.3'
CHORD LEN: 11.0' CHORD BRG: S 17°44'25" E
11+61.6 731120.0 1139887.2 PT
S 03°46'42" W 9.8'
11+71.4 731110.3 1139886.6 PC
RADIUS: 731109.3 1139901.6 RADIUS LENGTH: 15.0'
PI: 731107.5 1139886.4 11+74.2 TANGENT: 2.8'
DELTA: -20°56'26" ARC LEN: 5.5'
CHORD LEN: 5.5' CHORD BRG: S 06°41'31" E
11+76.9 731104.9 1139887.2 PT
S 17°09'44" E 15.4'
11+92.2 731090.2 1139891.8 PC
RADIUS: 731094.6 1139906.1 RADIUS LENGTH: 15.0'
PI: 731086.8 1139892.8 11+95.8 TANGENT: 3.6'
DELTA: -26°46'52" ARC LEN: 7.0'
CHORD LEN: 6.9' CHORD BRG: S 30°33'10" E
11+99.3 731084.2 1139895.3 PT
S 43°56'36" E 9.8'
12+09.0 731077.1 1139902.1 PC
RADIUS: 731056.3 1139880.5 RADIUS LENGTH: 30.0'
PI: 731070.8 1139908.2 12+17.8 TANGENT: 8.8'
DELTA: 32°34'16" ARC LEN: 17.1'
CHORD LEN: 16.8' CHORD BRG: S 27°39'28" E
12+26.1 731062.2 1139909.9 PT
S 11°22'20" E 76.2'
13+02.3 730987.5 1139924.9 PC
RADIUS: 730993.4 1139954.4 RADIUS LENGTH: 30.0'
PI: 730982.8 1139925.9 13+07.1 TANGENT: 4.8'
DELTA: -18°03'11" ARC LEN: 9.5'
CHORD LEN: 9.4' CHORD BRG: S 20°23'56" E
13+11.8 730978.7 1139928.2 PT
S 29°25'32" E 14.8'
13+26.6 730965.8 1139935.5 PC
RADIUS: 730980.5 1139961.6 RADIUS LENGTH: 30.0'
PI: 730956.9 1139940.5 13+36.8 TANGENT: 10.2'
DELTA: -37°23'09" ARC LEN: 19.6'
CHORD LEN: 19.2' CHORD BRG: S 48°07'06" E
13+46.2 730952.9 1139949.8 PT
S 66°48'41" E 3.5'
13+49.7 730951.6 1139953.1 PC
RADIUS: 730924.0 1139941.2 RADIUS LENGTH: 30.0'
PI: 730945.2 1139967.9 13+65.8 TANGENT: 16.1'
DELTA: 56°31'50" ARC LEN: 29.6'
CHORD LEN: 28.4' CHORD BRG: S 38°32'46" E
13+79.3 730929.3 1139970.8 PT
S 10°16'51" E 56.7'
14+36.0 730873.5 1139980.9 PC
RADIUS: 730878.9 1140010.4 RADIUS LENGTH: 30.0'
PI: 730870.1 1139981.5 14+39.5 TANGENT: 3.5'
DELTA: -13°17'15" ARC LEN: 7.0'
CHORD LEN: 6.9' CHORD BRG: S 16°55'28" E
14+43.0 730866.9 1139982.9 PT
S 23°34'05" E 17.2'
14+60.2 730851.1 1139989.8 PC
RADIUS: 730839.1 1139962.3 RADIUS LENGTH: 30.0'
PI: 730847.8 1139991.2 14+63.8 TANGENT: 3.6'
DELTA: 13°41'52" ARC LEN: 7.2'
CHORD LEN: 7.2' CHORD BRG: S 16°43'09" E
14+67.4 730844.2 1139991.9 PT
S 09°52'14" E 28.1'
14+95.5 730816.5 1139996.7 PC
RADIUS: 730821.7 1140026.2 RADIUS LENGTH: 30.0'
PI: 730811.5 1139997.5 15+00.6 TANGENT: 5.1'
DELTA: -19°18'54" ARC LEN: 10.1'
CHORD LEN: 10.1' CHORD BRG: S 19°31'41" E
15+05.6 730807.0 1140000.0 PT
S 29°11'08" E 13.4'
15+19.0 730795.4 1140006.6 PC
RADIUS: 730780.7 1139980.4 RADIUS LENGTH: 30.0'
PI: 730790.9 1140009.0 15+24.1 TANGENT: 5.1'
DELTA: 19°21'40" ARC LEN: 10.1'
CHORD LEN: 10.1' CHORD BRG: S 19°30'18" E
15+29.1 730785.9 1140009.9 PT
S 09°49'28" E 23.7'
15+52.8 730762.5 1140014.0 PC
RADIUS: 730772.7 1140073.1 RADIUS LENGTH: 60.0'
PI: 730760.9 1140014.2 15+54.4 TANGENT: 1.6'
DELTA: -3°03'26" ARC LEN: 3.2'
CHORD LEN: 3.2' CHORD BRG: S 11°21'11" E
15+56.0 730759.4 1140014.6 PT
S 12°52'54" E 36.8'
15+92.8 730723.5 1140022.8 PC
RADIUS: 730710.1 1139964.3 RADIUS LENGTH: 60.0'
PI: 730718.4 1140024.0 15+98.0 TANGENT: 5.2'
DELTA: 9°51'36" ARC LEN: 10.3'
CHORD LEN: 10.3' CHORD BRG: S 07°57'06" E
16+03.2 730713.3 1140024.2 PT
S 03°01'18" E 34.3'
16+37.5 730679.0 1140026.0 PC
RADIUS: 730680.6 1140056.0 RADIUS LENGTH: 30.0'
PI: 730675.6 1140026.2 16+40.9 TANGENT: 3.4'
DELTA: -12°55'51" ARC LEN: 6.8'
CHORD LEN: 6.8' CHORD BRG: S 09°29'14" E
16+44.3 730672.3 1140027.2 PT
S 15°57'10" E 3.7'
16+48.0 730668.8 1140028.2 PC
RADIUS: 730660.5 1139999.3 RADIUS LENGTH: 30.0'
PI: 730665.2 1140029.2 16+51.6 TANGENT: 3.7'
DELTA: 14°02'12" ARC LEN: 7.3'
CHORD LEN: 7.3' CHORD BRG: S 08°56'04" E
16+55.3 730661.5 1140029.3 PT
S 01°54'58" E 21.4'
16+76.7 730640.1 1140030.0 PC
RADIUS: 730642.1 1140090.0 RADIUS LENGTH: 60.0'
PI: 730632.4 1140030.3 16+84.5 TANGENT: 7.8'
DELTA: -14°44'46" ARC LEN: 15.4'
CHORD LEN: 15.4' CHORD BRG: S 09°17'21" E
16+92.2 730624.9 1140032.5 PT
S 16°39'44" E 9.2'
17+01.4 730616.1 1140035.2 PC
RADIUS: 730598.9 1139977.7 RADIUS LENGTH: 60.0'
PI: 730611.4 1140036.5 17+06.3 TANGENT: 4.9'
DELTA: 9°15'10" ARC LEN: 9.7'
CHORD LEN: 9.7' CHORD BRG: S 12°02'09" E
17+11.1 730606.6 1140037.2 PT
S 07°24'34" E 11.8'
17+22.9 730594.9 1140038.7 Deflection: 0°13'17" Left
S 07°37'51" E 19.0'
17+41.9 730576.0 1140041.2 Deflection: 11°55'53" Right
S 04°18'01" W 20.0'
17+61.9 730556.1 1140039.7 Deflection: 34°22'03" Right
S 38°40'04" W 10.4'
17+72.3 730548.0 1140033.2 Deflection: 50°41'24" Left
S 12°01'20" E 27.5'
17+99.8 730521.1 1140038.9 Deflection: 30°58'55" Left
S 43°00'15" E 5.2'
18+04.9 730517.3 1140042.5 Deflection: 25°02'43" Right
S 17°57'32" E 51.5'
18+56.5 730468.3 1140058.4 Deflection: 12°43'42" Right
S 05°13'50" E 17.3'
18+73.8 730451.1 1140059.9 Deflection: 32°18'11" Right
S 27°04'20" W 5.6'
18+79.5 730446.0 1140057.4 Deflection: 7°18'26" Left
S 19°45'55" W 21.4'
19+00.9 730425.9 1140050.1 Deflection: 19°04'33" Left
S 00°41'21" W 10.9'
19+11.8 730414.9 1140050.0 Deflection: 63°26'09" Left
S 62°44'48" E 5.3'
19+17.1 730412.5 1140054.7 Deflection: 13°05'15" Left
S 75°50'03" E 6.7'
19+23.7 730410.9 1140061.1 Deflection: 54°17'16" Right
S 21°32'47" E 9.3'
19+33.0 730402.3 1140064.5 Deflection: 24°32'50" Right
S 03°00'03" W 13.8'
19+46.9 730388.4 1140063.8 PC
RADIUS: 730387.7 1140078.8 RADIUS LENGTH: 15.0'
PI: 730375.5 1140063.1 19+59.8 TANGENT: 12.9'
DELTA: -81°30'52" ARC LEN: 21.3'
CHORD LEN: 19.6' CHORD BRG: S 37°45'23" E
19+68.2 730373.0 1140075.8 PT
S 78°30'49" E 43.1'
20+11.3 730364.4 1140118.0 PC
RADIUS: 730349.7 1140115.0 RADIUS LENGTH: 15.0'
PI: 730362.0 1140129.8 20+23.3 TANGENT: 12.0'
DELTA: 77°13'15" ARC LEN: 20.2'
CHORD LEN: 18.7' CHORD BRG: S 39°54'12" E
20+31.5 730350.0 1140130.0 PT
S 01°17'34" E 33.8'
20+65.3 730316.2 1140130.8 PC
RADIUS: 730316.5 1140145.8 RADIUS LENGTH: 15.0'
PI: 730306.9 1140131.0 20+74.6 TANGENT: 9.3'
DELTA: -63°40'18" ARC LEN: 16.7'
CHORD LEN: 15.8' CHORD BRG: S 33°07'43" E
20+82.0 730303.0 1140139.5 PT
S 64°57'52" E 20.2'
21+02.2 730294.4 1140157.8 PC
RADIUS: 730280.8 1140151.4 RADIUS LENGTH: 15.0'
PI: 730288.8 1140169.7 21+15.4 TANGENT: 13.2'
DELTA: 82°40'22" ARC LEN: 21.6'
CHORD LEN: 19.8' CHORD BRG: S 23°37'41" E
21+23.8 730276.2 1140165.7 PT
S 17°42'30" W 37.6'
21+61.5 730240.4 1140154.3 PC
RADIUS: 730235.9 1140168.6 RADIUS LENGTH: 15.0'
PI: 730226.6 1140149.9 21+75.9 TANGENT: 14.5'
DELTA: -87°56'02" ARC LEN: 23.0'
CHORD LEN: 20.8' CHORD BRG: S 26°15'31" E
21+84.5 730221.7 1140163.5 PT
S 70°13'32" E 19.4'
22+03.9 730215.2 1140181.8

UT10

Station Northing Easting Bearing Distance
10+00.0 731216.9 1141095.7
S 43°33'55" W 24.7'
10+24.7 731199.0 1141078.7 PC
RADIUS: 731188.6 1141089.6 RADIUS LENGTH: 15.0'
PI: 731195.2 1141075.1 10+29.9 TANGENT: 5.2'
DELTA: -38°17'05" ARC LEN: 10.0'
CHORD LEN: 9.8' CHORD BRG: S 24°25'23" W
10+34.7 731190.0 1141074.7 PT
S 05°16'50" W 35.0'
10+69.7 731155.2 1141071.4 PC
RADIUS: 731152.4 1141101.3 RADIUS LENGTH: 30.0'
PI: 731148.8 1141070.8 10+76.1 TANGENT: 6.4'
DELTA: -24°08'33" ARC LEN: 12.6'
CHORD LEN: 12.5' CHORD BRG: S 06°47'26" E
10+82.4 731142.7 1141072.9 PT
S 18°51'43" E 33.7'
11+16.1 731110.8 1141083.8 PC
RADIUS: 731101.1 1141055.4 RADIUS LENGTH: 30.0'
PI: 731106.7 1141085.2 11+20.4 TANGENT: 4.4'
DELTA: 16°30'27" ARC LEN: 8.6'
CHORD LEN: 8.6' CHORD BRG: S 10°36'29" E
11+24.7 731102.3 1141085.4 PT
S 02°21'16" E 17.0'
11+41.7 731085.3 1141086.1 PC
RADIUS: 731086.6 1141116.1 RADIUS LENGTH: 30.0'
PI: 731079.2 1141086.4 11+47.9 TANGENT: 6.2'
DELTA: -23°15'09" ARC LEN: 12.2'
CHORD LEN: 12.1' CHORD BRG: S 13°58'51" E
11+53.9 731073.6 1141089.0 PT
S 25°36'25" E 5.3'
11+59.3 731068.8 1141091.3 PC
RADIUS: 731081.7 1141118.4 RADIUS LENGTH: 30.0'
PI: 731065.4 1141093.0 11+63.0 TANGENT: 3.8'
DELTA: -14°21'45" ARC LEN: 7.5'
CHORD LEN: 7.5' CHORD BRG: S 32°47'18" E
11+66.8 731062.5 1141095.4 PT
S 39°58'10" E 30.7'
11+97.5 731039.0 1141115.1 PC
RADIUS: 731019.7 1141092.1 RADIUS LENGTH: 30.0'
PI: 731034.5 1141118.9 12+03.3 TANGENT: 5.8'
DELTA: 22°00'40" ARC LEN: 11.5'
CHORD LEN: 11.5' CHORD BRG: S 28°57'50" E
12+09.0 731028.9 1141120.7 PT
S 17°57'30" E 56.5'
12+65.5 730975.2 1141138.1 PC
RADIUS: 730984.5 1141166.6 RADIUS LENGTH: 30.0'
PI: 730970.1 1141139.7 12+70.8 TANGENT: 5.4'
DELTA: -20°18'05" ARC LEN: 10.6'
CHORD LEN: 10.6' CHORD BRG: S 28°06'33" E
12+76.1 730965.9 1141143.0 PT
S 38°15'35" E 9.3'
12+85.4 730958.6 1141148.8 PC
RADIUS: 730940.0 1141125.2 RADIUS LENGTH: 30.0'
PI: 730953.2 1141153.0 12+92.2 TANGENT: 6.8'
DELTA: 25°41'45" ARC LEN: 13.5'
CHORD LEN: 13.3' CHORD BRG: S 25°24'43" E
12+98.8 730946.6 1141154.5 PT
S 12°33'50" E 48.4'
13+47.3 730899.3 1141165.1 PC
RADIUS: 730905.8 1141194.3 RADIUS LENGTH: 30.0'
PI: 730890.7 1141167.0 13+56.0 TANGENT: 8.7'
DELTA: -32°26'59" ARC LEN: 17.0'
CHORD LEN: 16.8' CHORD BRG: S 28°47'20" E
13+64.3 730884.6 1141173.1 PT
S 45°00'49" E 8.0'
13+72.3 730878.9 1141178.8 PC
RADIUS: 730857.7 1141157.6 RADIUS LENGTH: 30.0'
PI: 730875.3 1141182.4 13+77.4 TANGENT: 5.1'
DELTA: 19°21'40" ARC LEN: 10.1'
CHORD LEN: 10.1' CHORD BRG: S 35°19'59" E
13+82.4 730870.7 1141184.6 PT
S 25°39'09" E 8.7'
13+91.1 730862.8 1141188.4

A	MIT. PLAN	12/13		
B	DRAFT CD'S.	09/14		
C	FINAL MP	02/15		
D				
	DESCRIPTION	DATE	APP.	

REVISIONS

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22209 ANDREW DAVID B

NOT FOR CONSTRUCTION

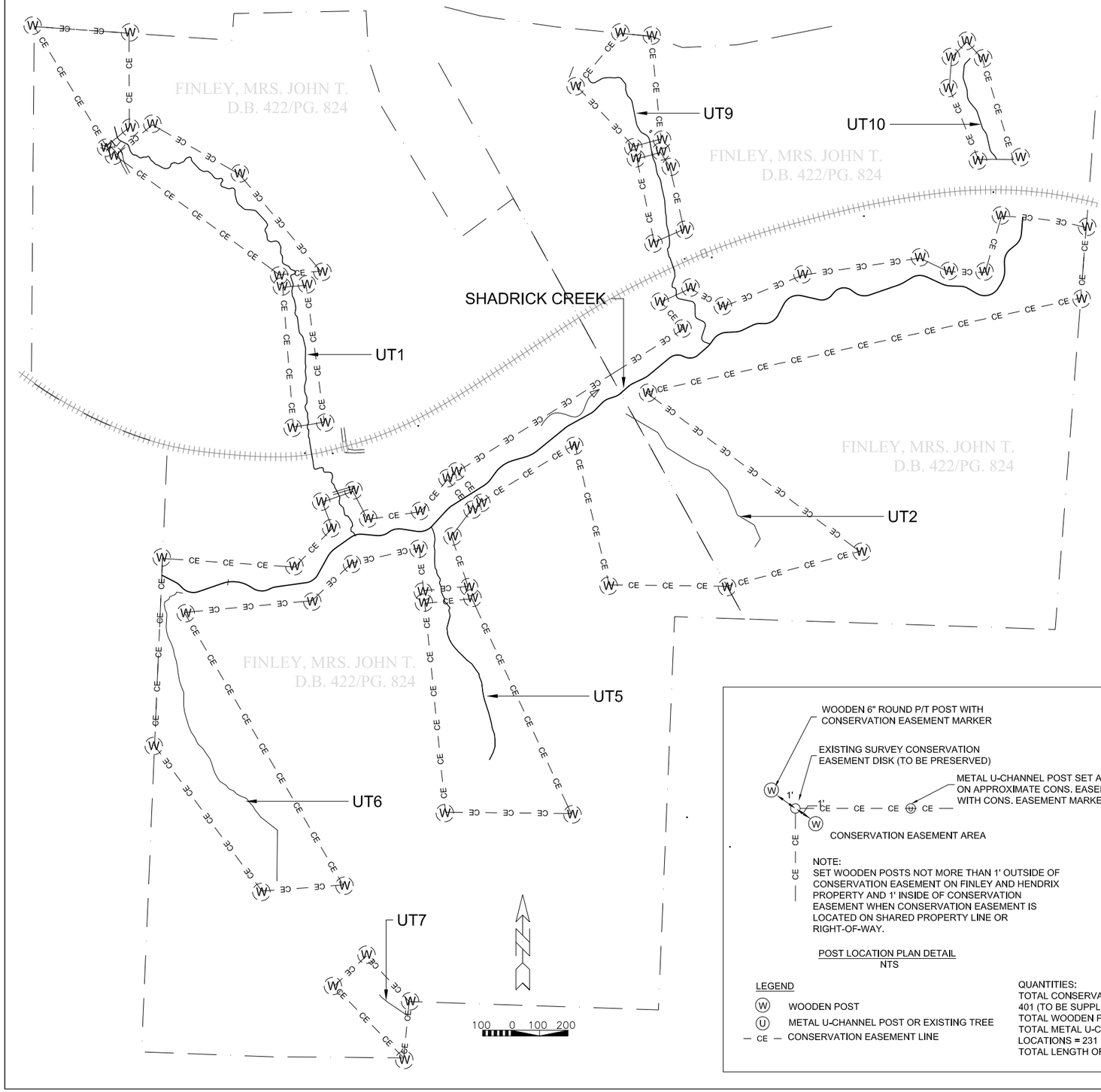
CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

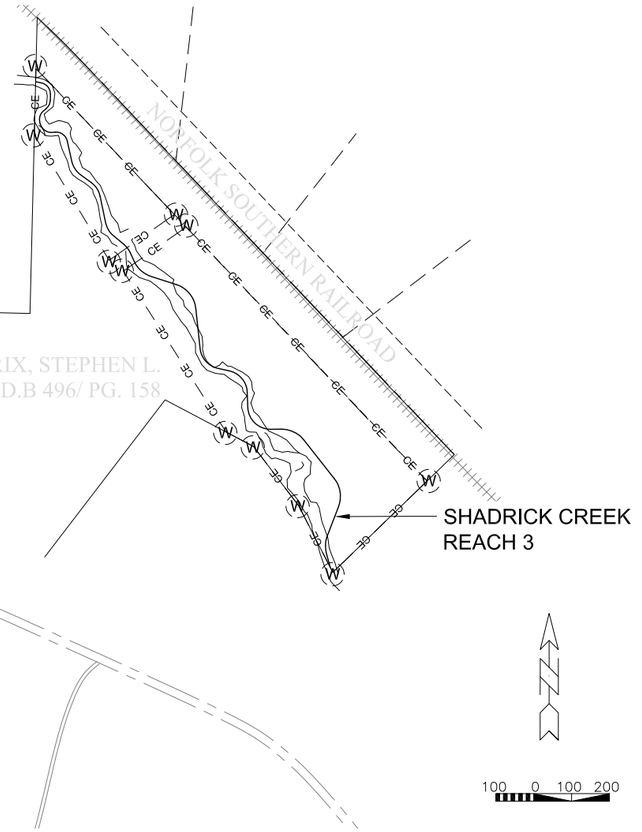
SHADRICK CREEK RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

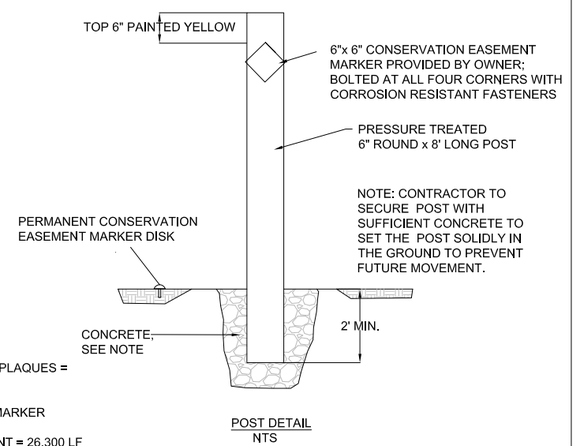
DATE: FEB. 2015
SCALE: NTS

CENTERLINE DATA

PRELIMINARY PLANS
NOT FOR CONSTRUCTION







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CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

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EASEMENT MARKING PLAN

PRELIMINARY PLANS
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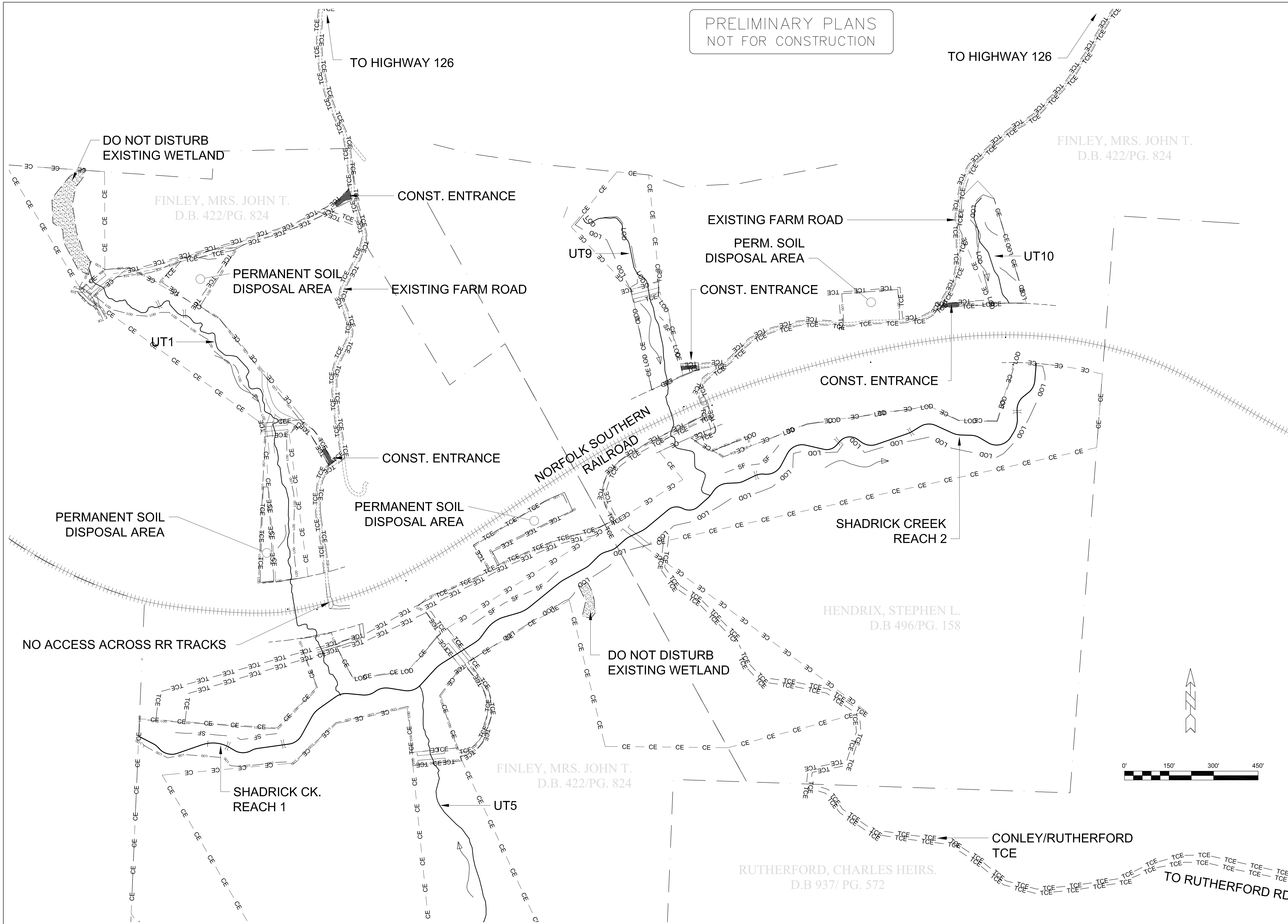

	DESCRIPTION	DATE	APP.
A	MIT. PLAN	12/13	
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SEAL 22209
ANDREW DAVID B

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
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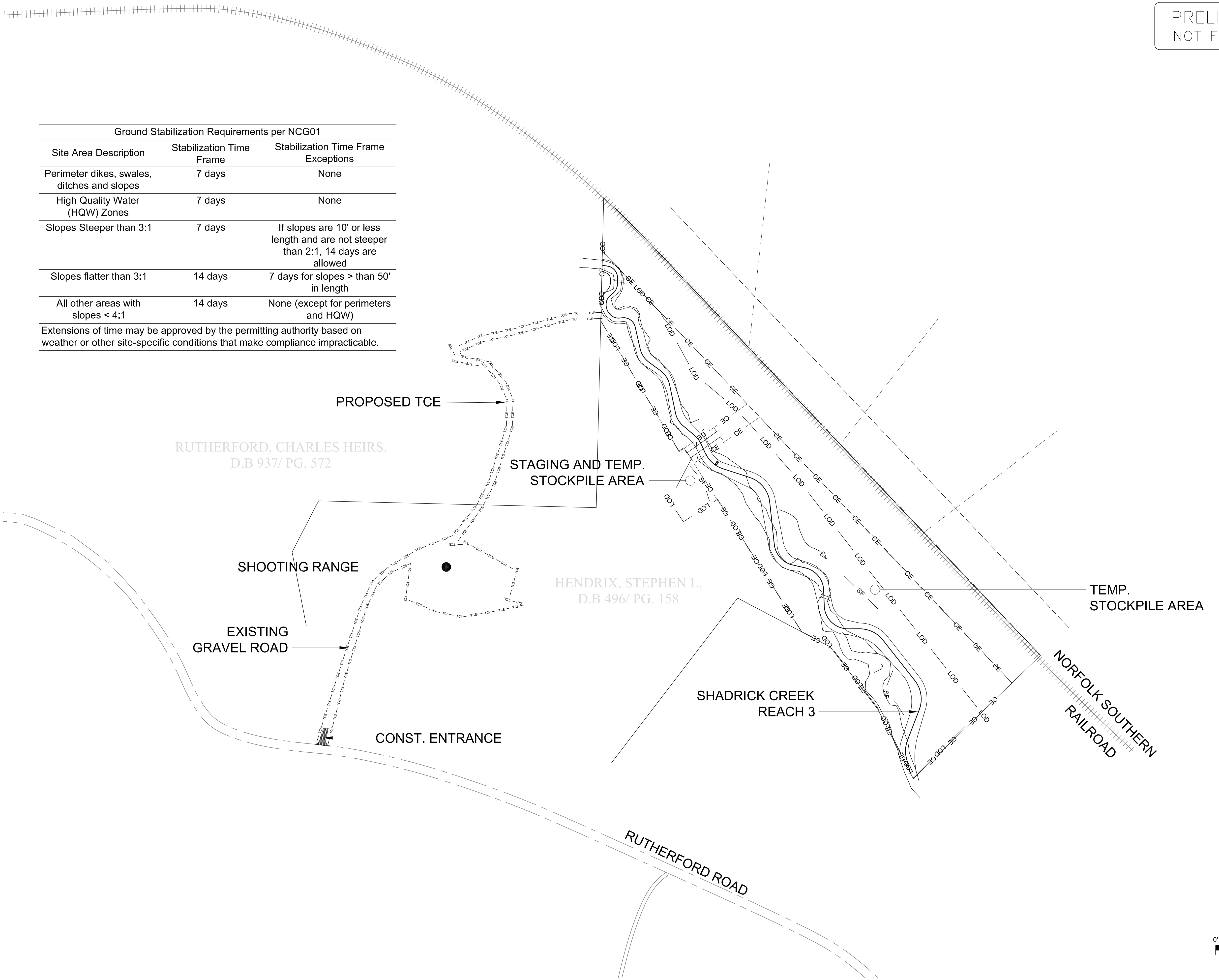
SEDIMENTATION AND EROSION CONTROL PLAN

SHEET P13 OF 36

PRELIMINARY PLANS
NOT FOR CONSTRUCTION

Ground Stabilization Requirements per NCG01		
Site Area Description	Stabilization Time Frame	Stabilization Time Frame Exceptions
Perimeter dikes, swales, ditches and slopes	7 days	None
High Quality Water (HQW) Zones	7 days	None
Slopes Steeper than 3:1	7 days	If slopes are 10' or less length and are not steeper than 2:1, 14 days are allowed
Slopes flatter than 3:1	14 days	7 days for slopes > than 50' in length
All other areas with slopes < 4:1	14 days	None (except for perimeters and HQW)
Extensions of time may be approved by the permitting authority based on weather or other site-specific conditions that make compliance impracticable.		



	DESCRIPTION	DATE	APP.
A	MIT. PLAN	12/13	
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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22209 ANDREW DAVID B

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

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McDOWELL COUNTY, NC
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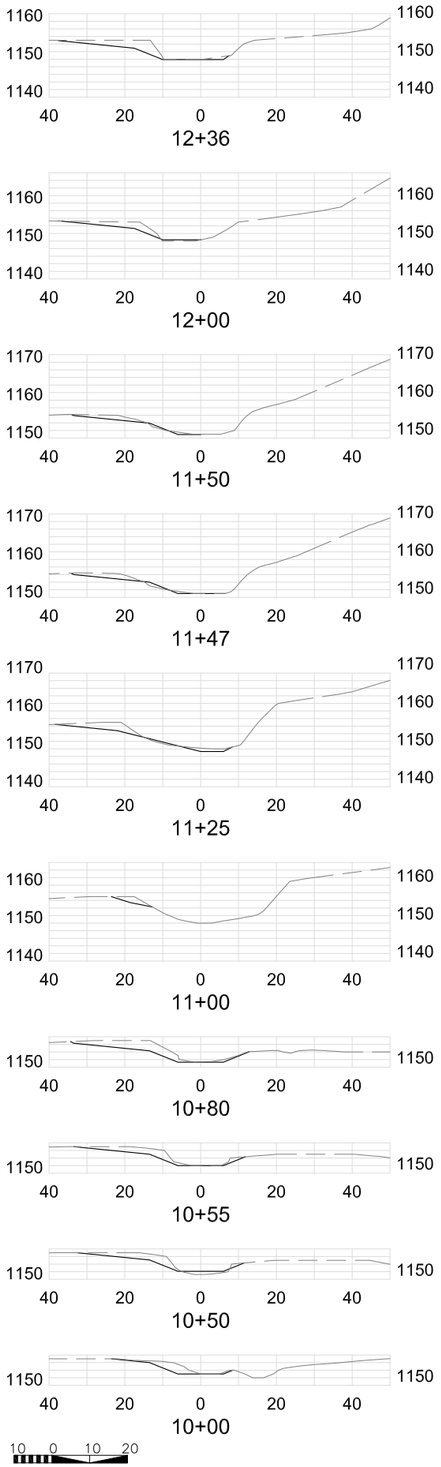
SEDIMENTATION AND EROSION CONTROL PLAN



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D				DESCRIPTION	DATE	APP.

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NORTH CAROLINA
PROFESSIONAL
SEAL
22206
ENGINEER
ANDREW DAVID X

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
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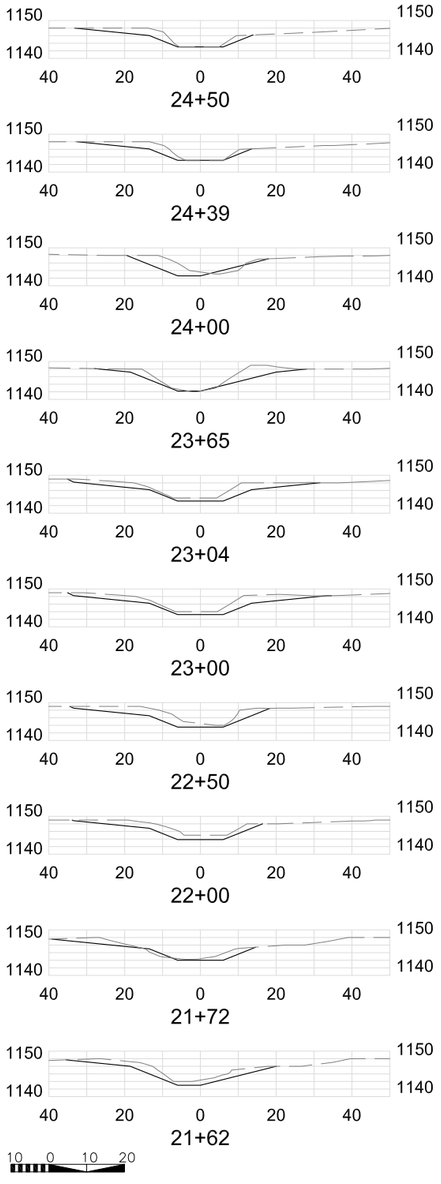
SHADRICK REACH 1 CROSS SECTIONS

SHEET XS1 OF 36



	MIT. PLAN	12/13
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D		

	DESCRIPTION	DATE	APP.

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22206 ANDREW DAVID BOX

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
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McDOWELL COUNTY, NC
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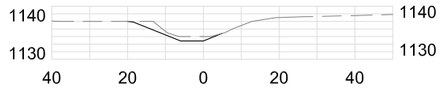
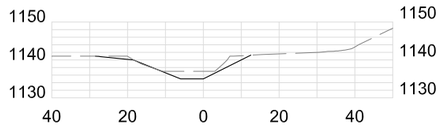
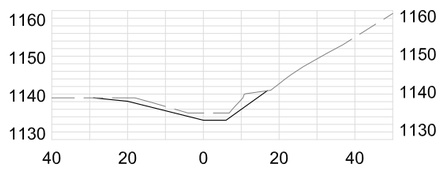
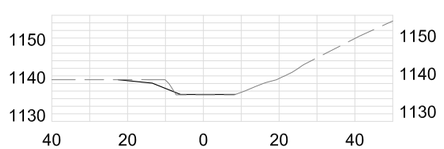
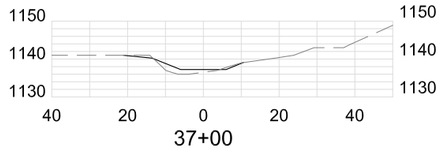
SHADRICK
REACH 1
CROSS SECTIONS

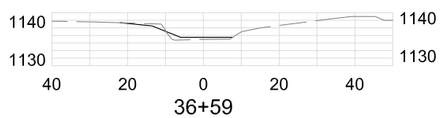


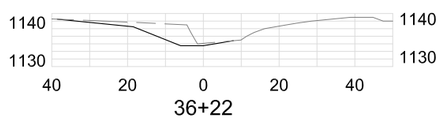


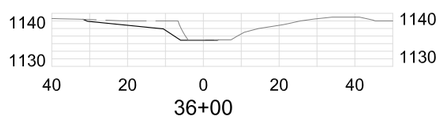


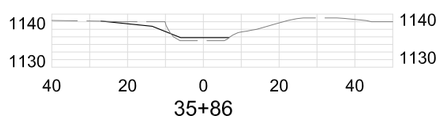


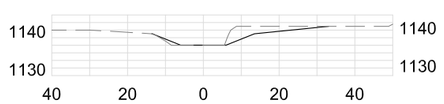


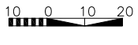


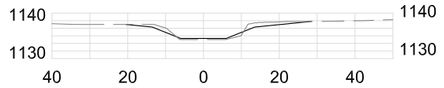


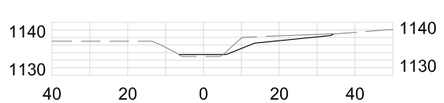


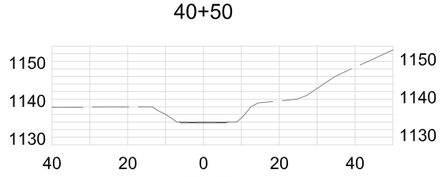


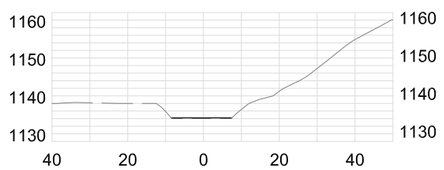


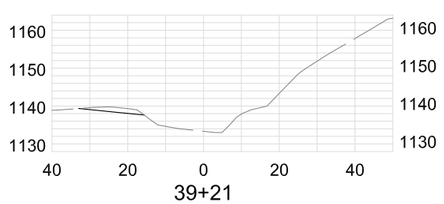


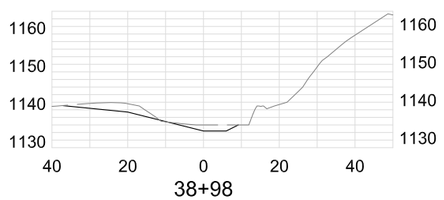


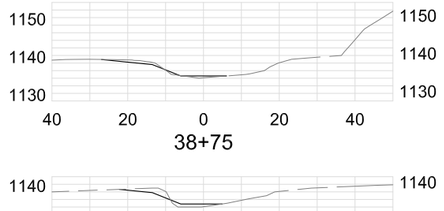


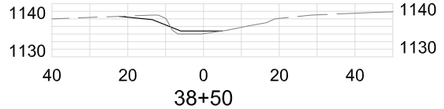


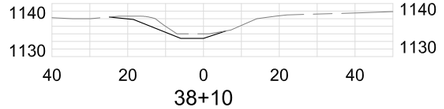


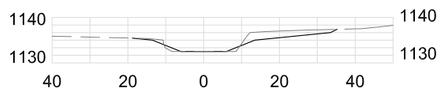


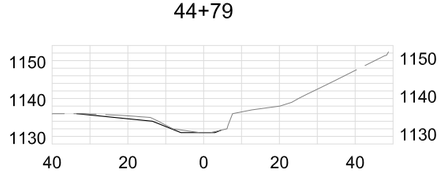


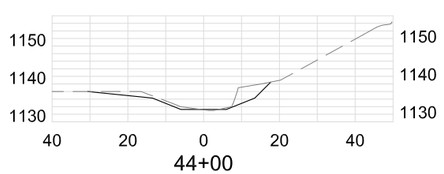


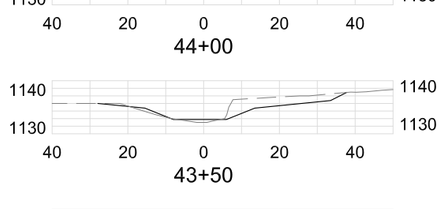


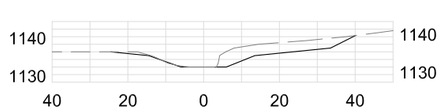


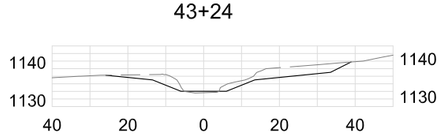


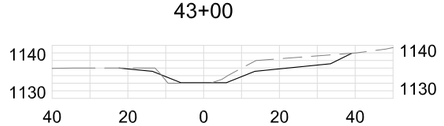


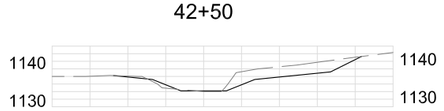


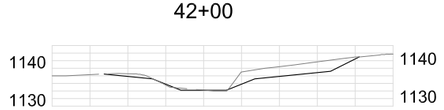


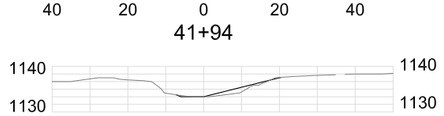


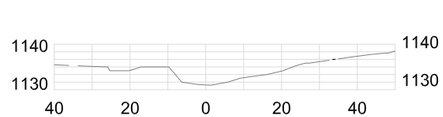


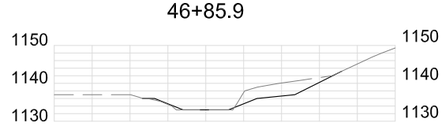


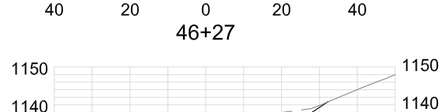


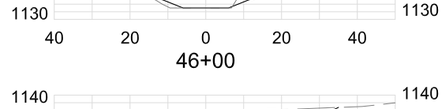












A	MIT. PLAN	12/13				
B	DRAFT CD'S.	09/14				
C	FINAL MP	02/15				
D						
				DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION

NORTH CAROLINA
PROFESSIONAL
SEAL
22200
ENGINEER
ANDREW DAVID X

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

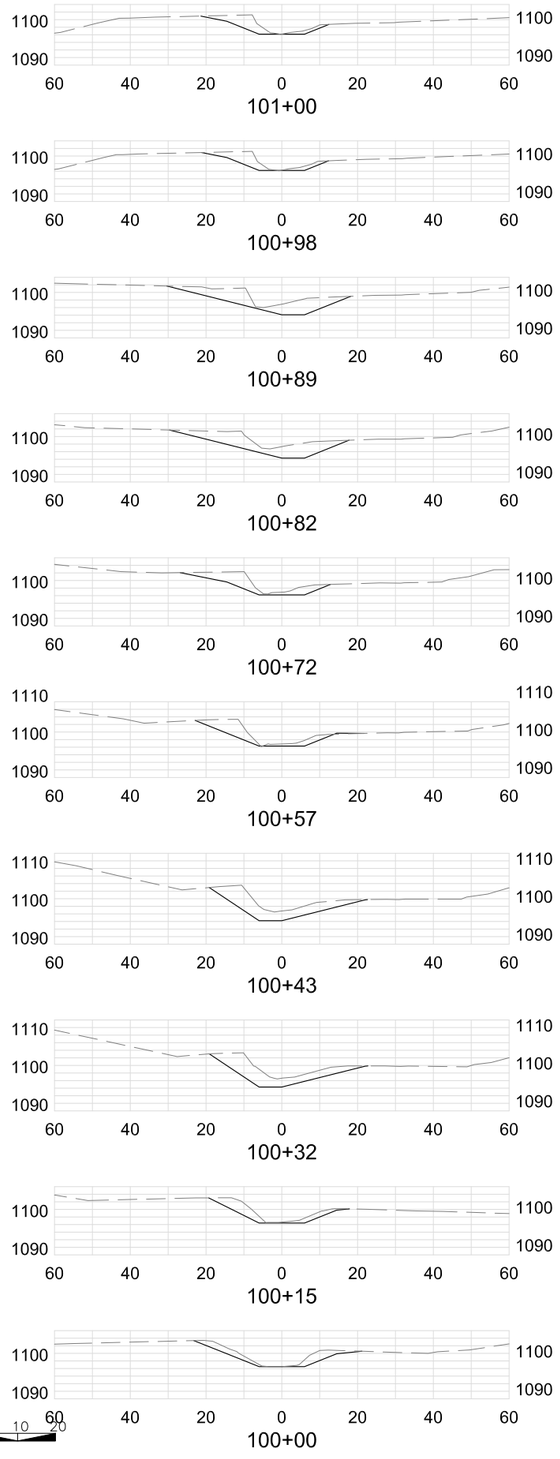
SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

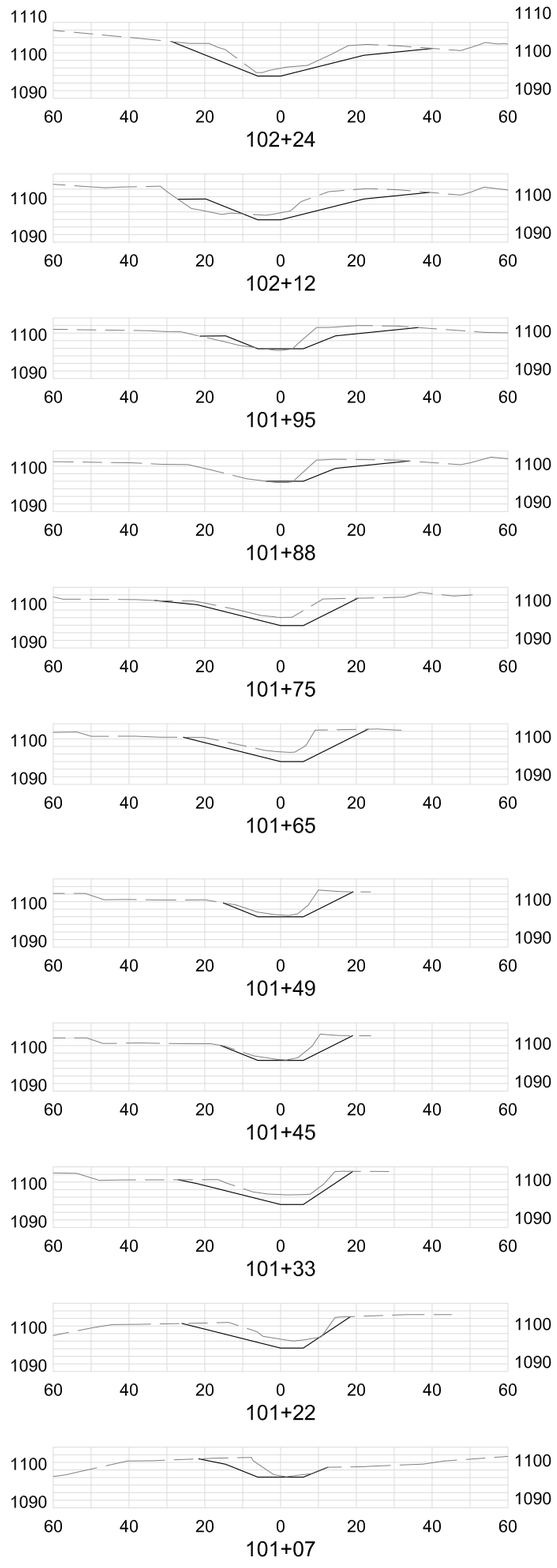
DATE: FEB. 2015

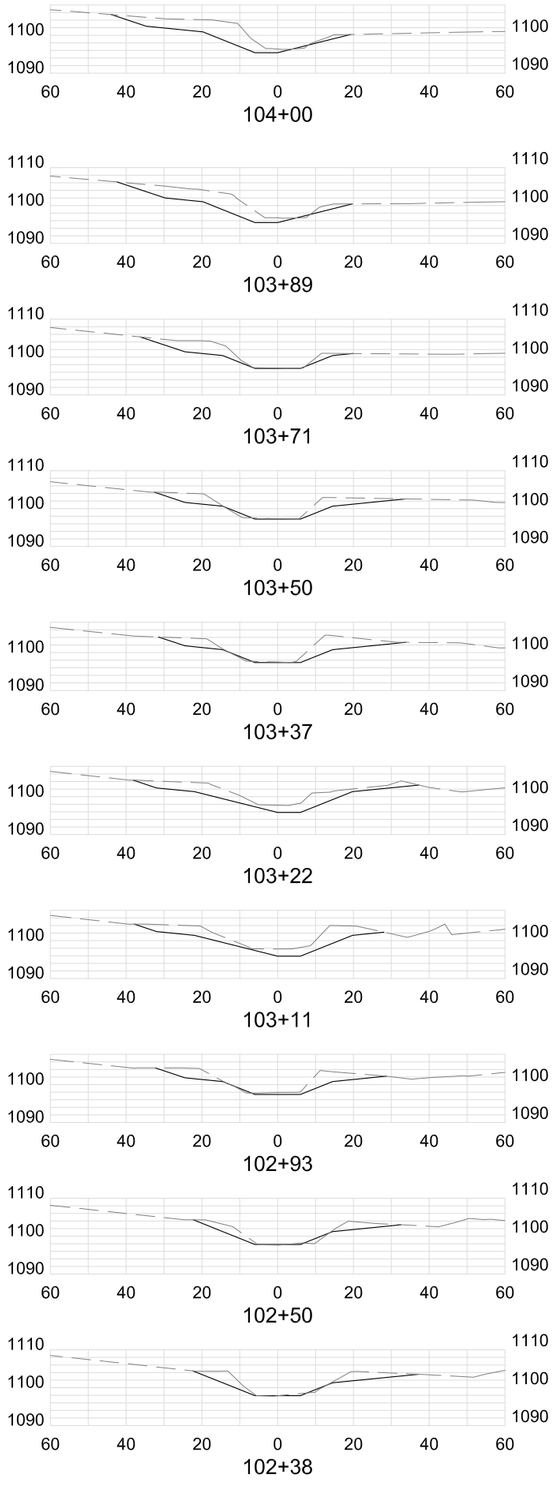
SCALE: AS SHOWN

SHADRICK
REACH1
CROSS SECTIONS

SHEET XS3 OF 36







A	MIT. PLAN	12/13				
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C	FINAL MP	02/15				
D						
				DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION

NORTH CAROLINA
PROFESSIONAL
SEAL
22208
ENGINEER
ANDREW DAVID

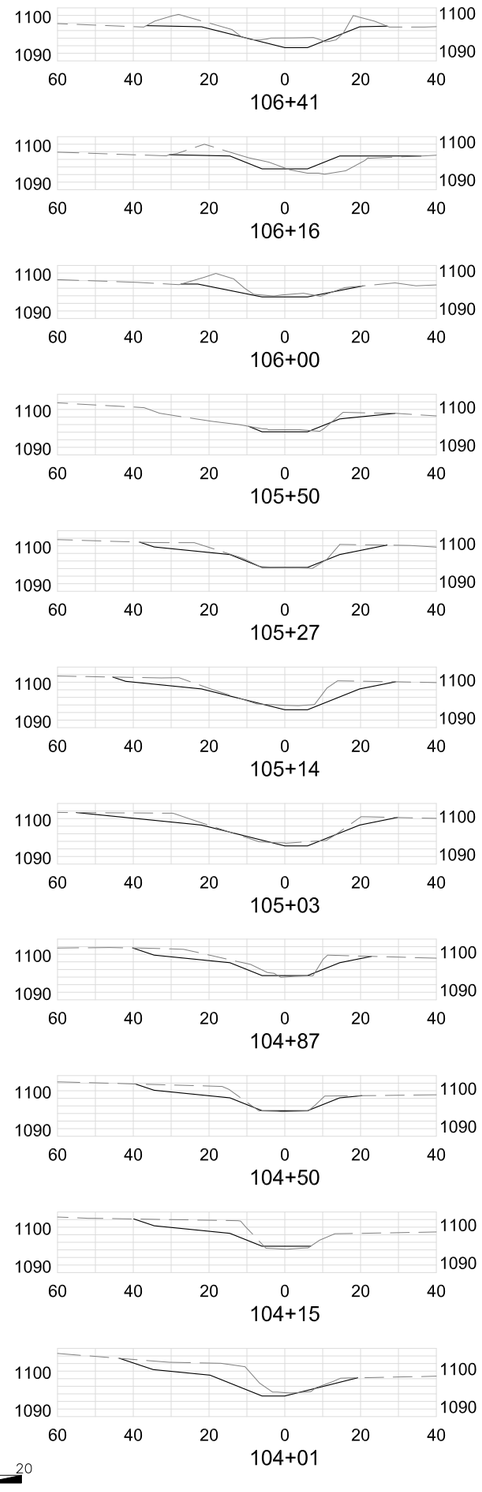
CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

DATE: FEB. 2015

SCALE: AS SHOWN

SHADRICK REACHES 2&3 CROSS SECTIONS



A	MIT. PLAN	12/13			
B	DRAFT CD'S.	09/14			
C	FINAL MP	02/15			
D					
			DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22206 ANDREW DAVID BOX

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

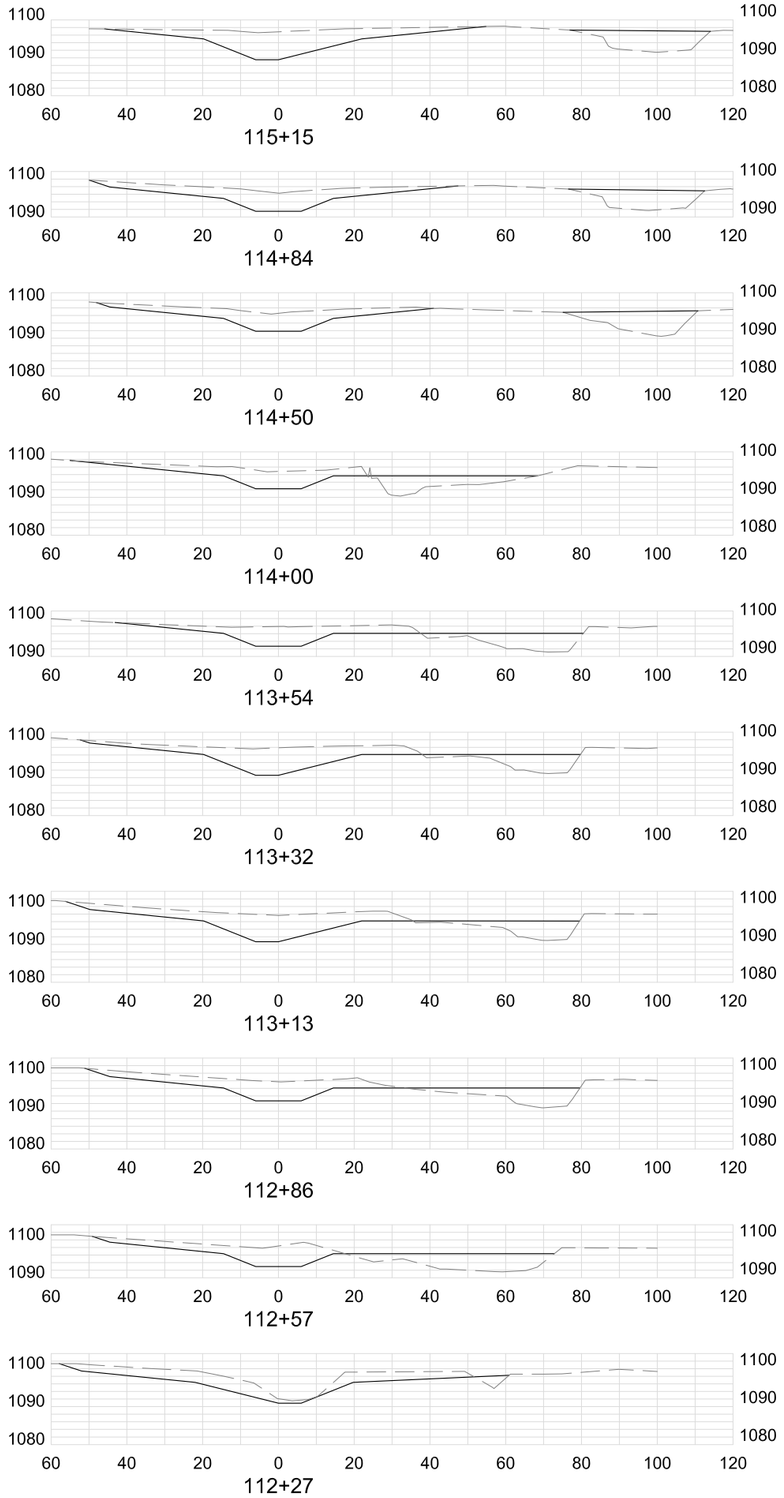
SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

DATE: FEB. 2015

SCALE: AS SHOWN

SHADRICK
REACHES 2&3
CROSS SECTIONS

SHEET XS5 OF 36



10 0 10 20

	MIT. PLAN	12/13
B	DRAFT CD'S.	09/14
C	FINAL MP	02/15
D		

	DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22206 ANDREW DAVID X

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

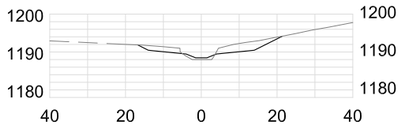
SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

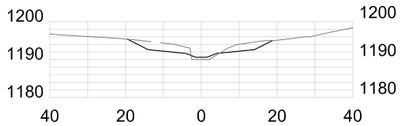
DATE: FEB. 2015

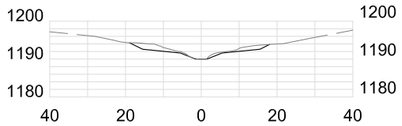
SCALE: AS SHOWN

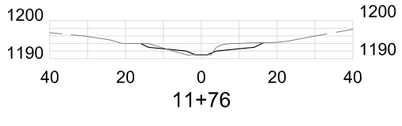
SHADRICK REACHES 2&3 CROSS SECTIONS

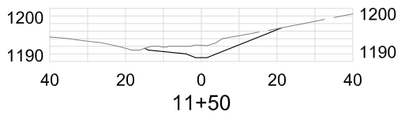
SHEET XS6 OF 36

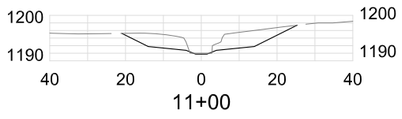


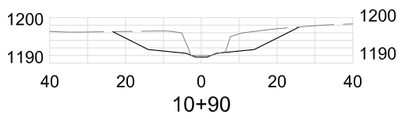


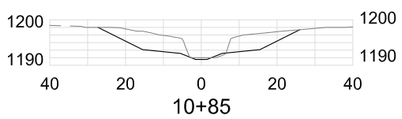


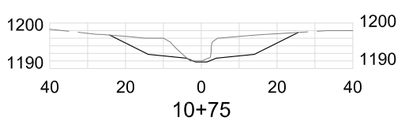


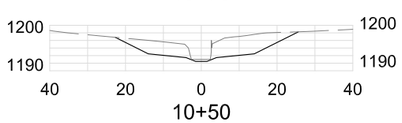


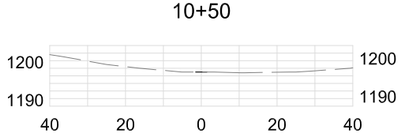


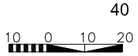


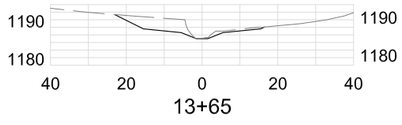


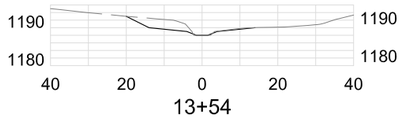


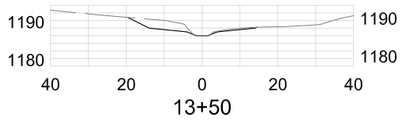


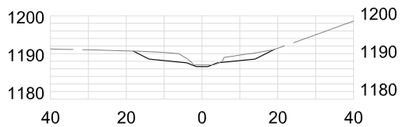


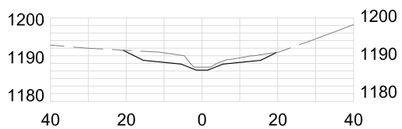


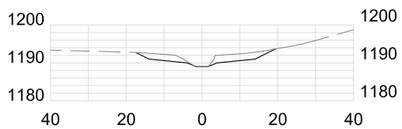


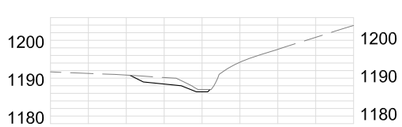


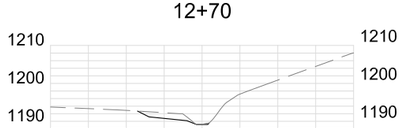


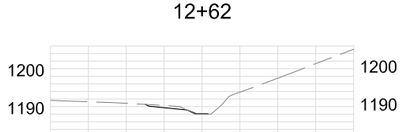


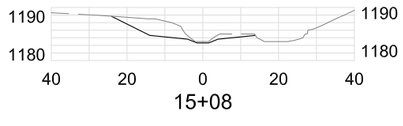


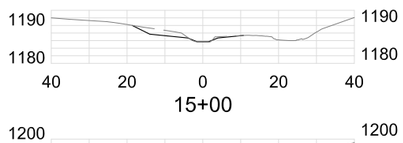


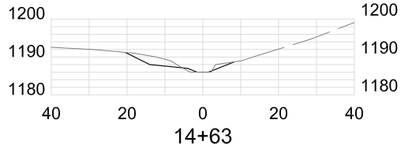


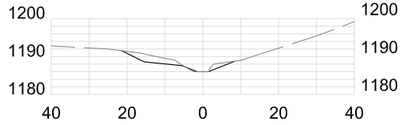


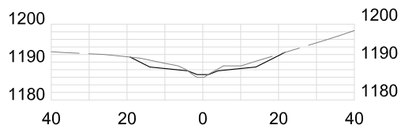


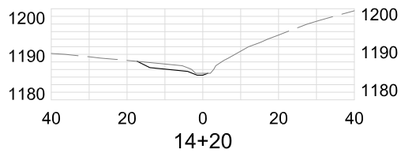


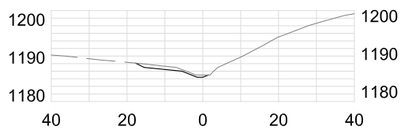


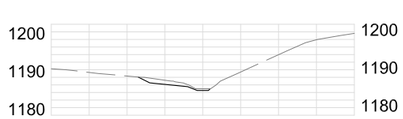


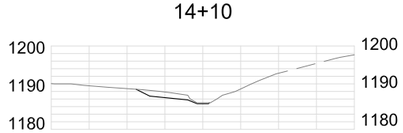


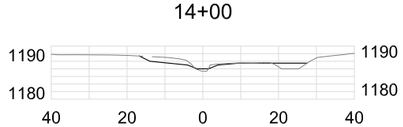


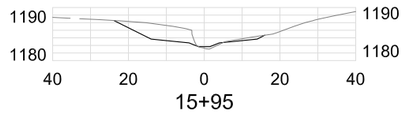


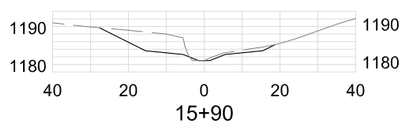


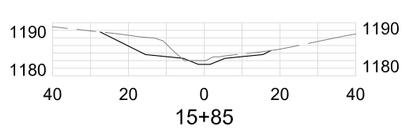


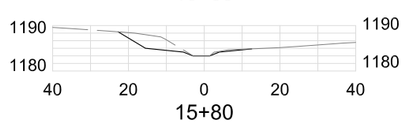


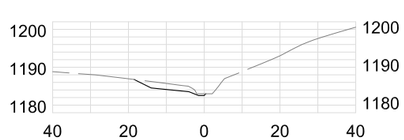


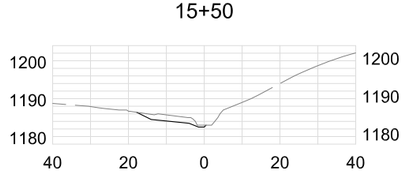


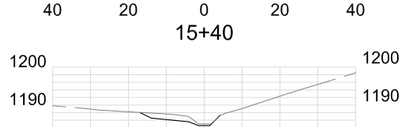


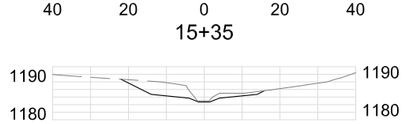












REVISIONS

	DESCRIPTION	DATE	APP.
A	MIT. PLAN	12/13	
B	DRAFT CD'S.	09/14	
C	FINAL MP	02/15	
D			

NOT FOR CONSTRUCTION
NORTH CAROLINA
PROFESSIONAL
SEAL
22208
ENGINEER
ANDREW DAVID X

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

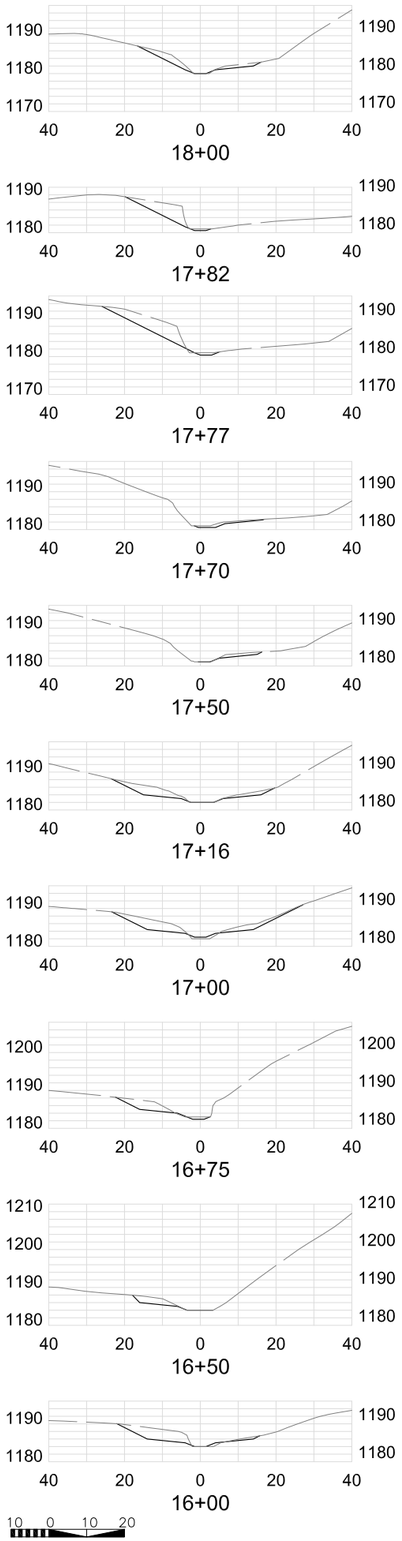
DATE: FEB. 2015

SCALE: AS SHOWN

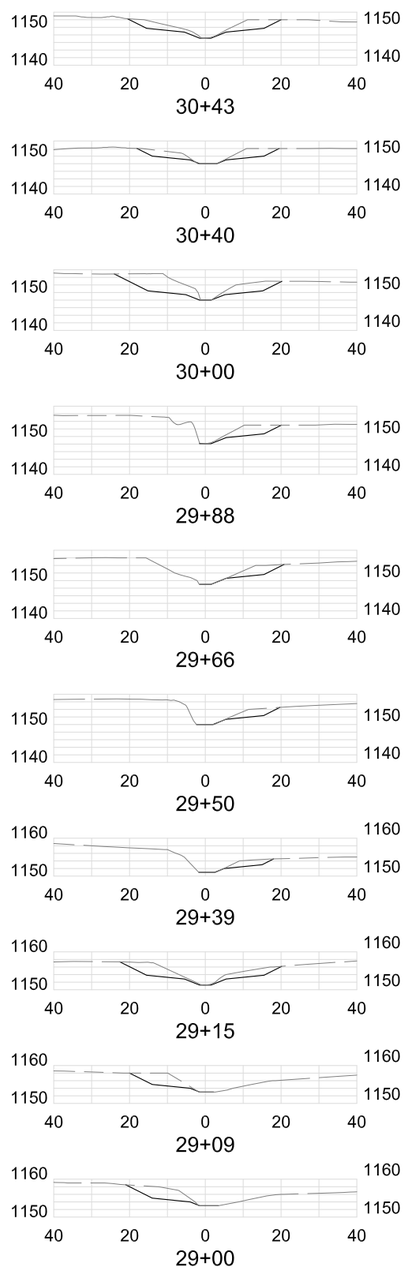
UT1
REACH 1
CROSS SECTIONS

SHEET XS7 OF 36

UT1 - REACH 1



UT1 - REACH 2



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REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA
PROFESSIONAL
SEAL
22203
ENGINEER
ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

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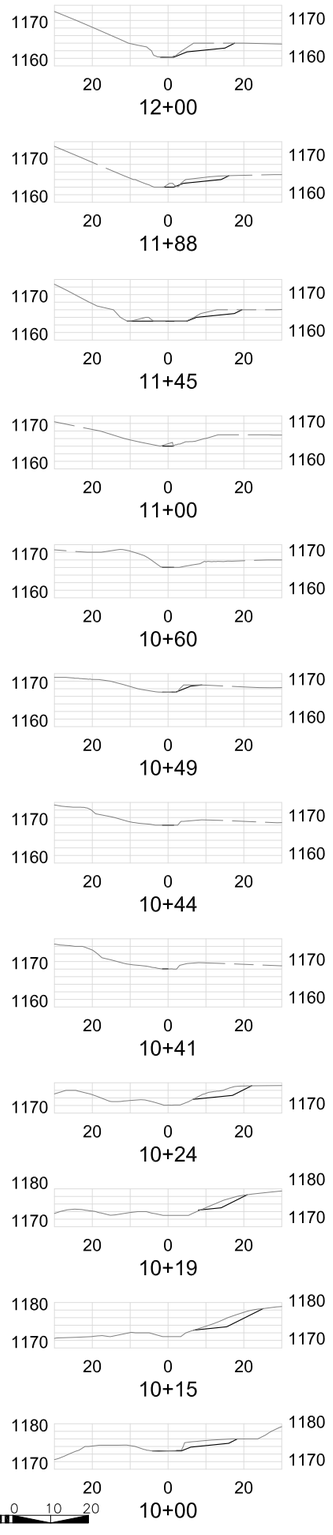
UT1
REACHES 1&2
CROSS SECTIONS

SHEET XS8 OF 36

REACH 1



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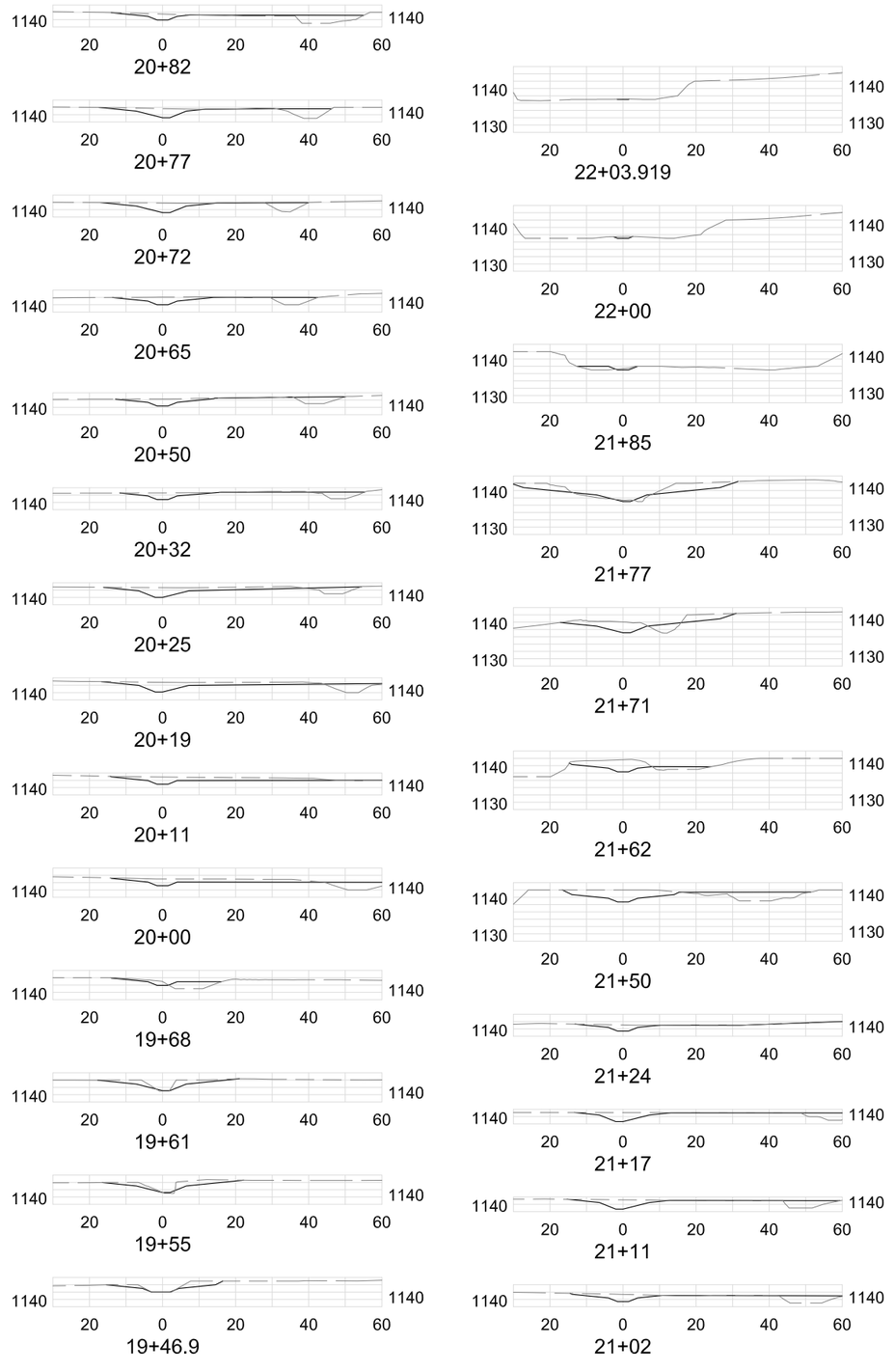

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REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22206 ANDREW DAVID X

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

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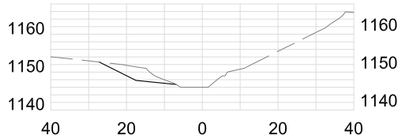
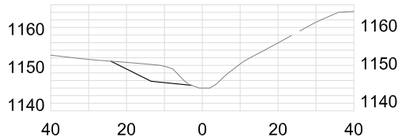
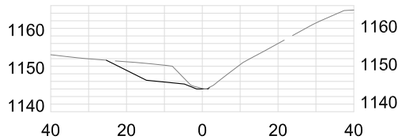
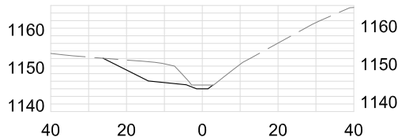
UT9
CROSS SECTIONS

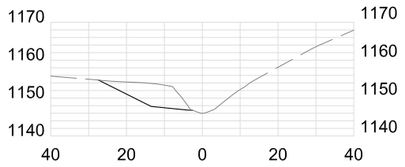
SHEET XS9 OF 36

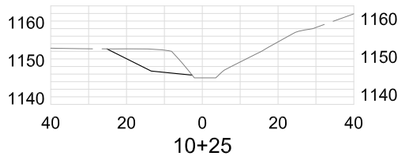


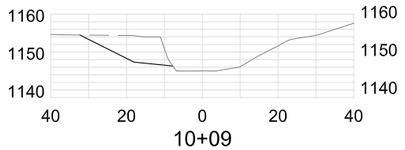


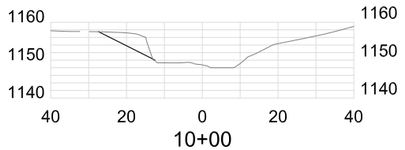


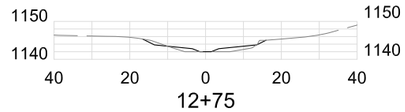


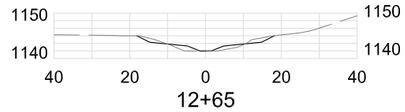


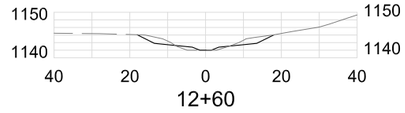


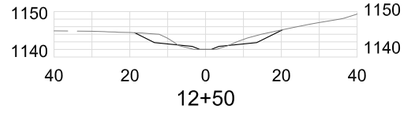


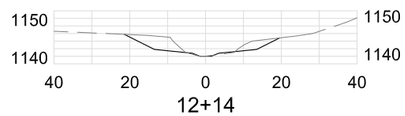


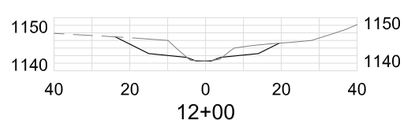


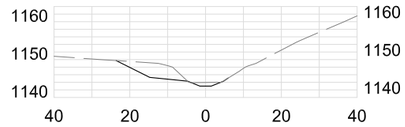


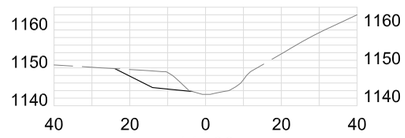


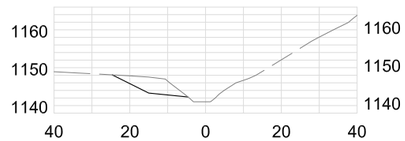


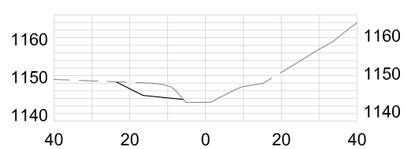


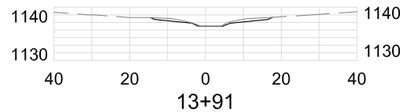


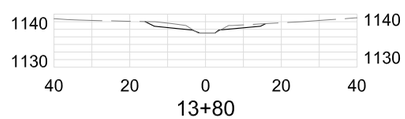


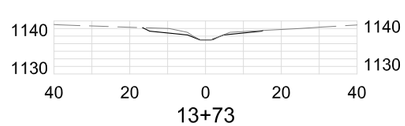


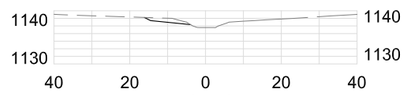


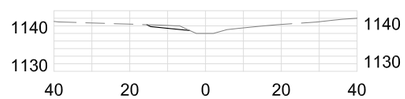


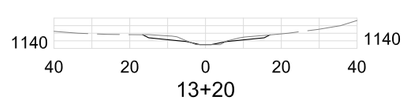


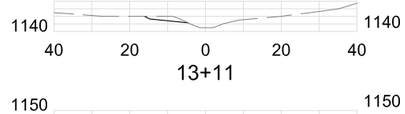


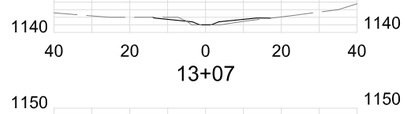


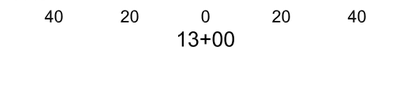












10 0 10 20

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REVISIONS

NOT FOR CONSTRUCTION

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22208 ANDREW DAVID X

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

DATE: FEB. 2015

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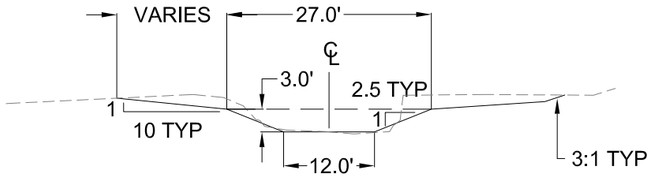
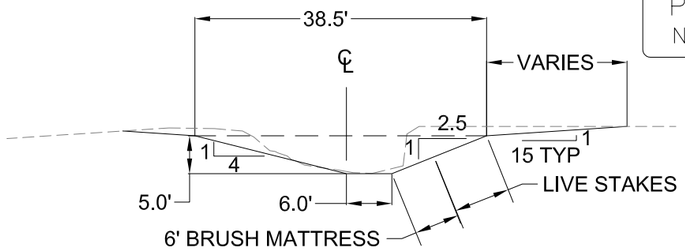
UT10
CROSS SECTIONS

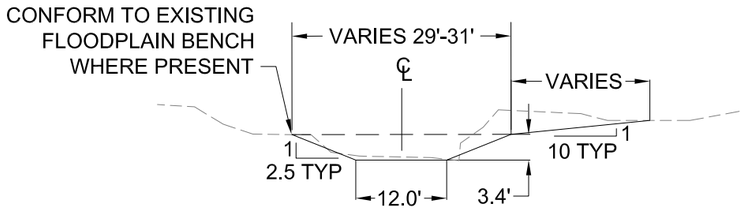
PRELIMINARY PLANS
NOT FOR CONSTRUCTION



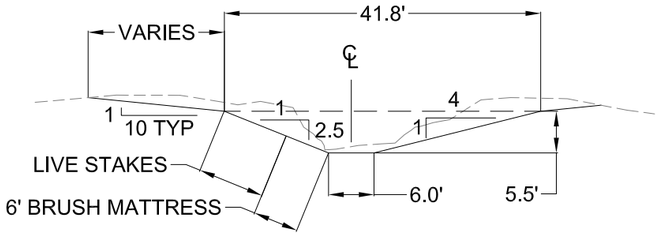
1 / TS1 TYPICAL SHADRICK RIFFLE REACH 1



2 / TS1 TYPICAL SHADRICK POOL REACH 1



3 / TS1 TYPICAL SHADRICK RIFFLE REACH 2



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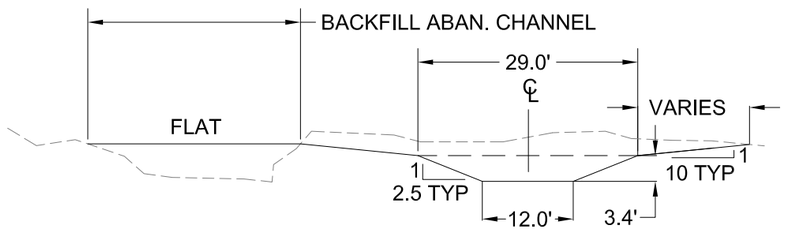
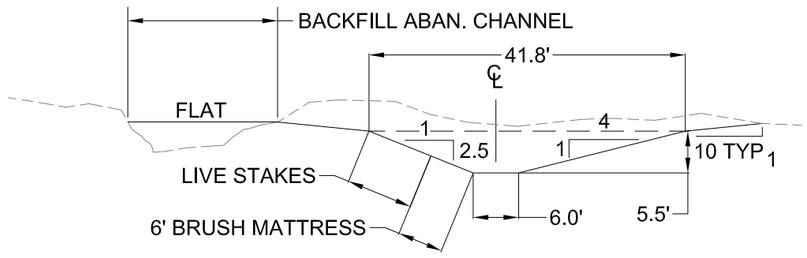


5 / TS1 TYPICAL SHADRICK RIFFLE REACH 3



6 / TS1 TYPICAL SHADRICK POOL REACH 3

LEGEND

EXISTING

PROPOSED

BANKFULL STAGE

10 0 10 20

NOTES:

1. TYPICAL SECTION DIMENSIONS, CENTERLINE OFFSETS AND SLOPES DO NOT APPLY AT ALL STATIONS. REFER TO CROSS SECTIONS FOR ADJUSTMENTS TO GRADING LIMITS.
2. BANKS OF ON-LINE REACHES SHALL BE ROUGHENED PERPENDICULAR TO SLOPE, COVERED WITH 3" LAYER OF TOPSOIL, SEEDED, MULCHED AND MATTED WITH 780 G/SM COIR FIBER MATTING.
3. BANKS OF OFF-LINE REACH SHALL BE ROUGHENED PERPENDICULAR TO SLOPE AND COVERED WITH SOD MATS. APPLY TOPSOIL, SEED AND MATTING IF ON-SITE SOD MAT INSUFFICIENT.
4. TERRACE SLOPES SHALL BE ROUGHENED PERPENDICULAR TO SLOPE, SEEDED AND MULCHED.
5. OVER-EXCAVATE BANKFULL BENCHES TO 3" DEPTH AND PLACE TOPSOIL TO FINISHED GRADE.
6. SEE GROUND STABILIZATION NOTES, SHEET T2, FOR NPDES CONSTRUCTION STORMWATER PERMIT REQUIREMENTS.
7. TYPICAL SECTIONS DRAWN LOOKING DOWNSTREAM; APPLY POOL TYPICALS AS MIRROR IMAGES OF THESE DRAWINGS DEPENDING ON WHICH WAY THE STREAM IS MEANDERING.

REVISIONS

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Sixteen Broad Street
Asheville, North Carolina 28801
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confluence-eng.com

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TYPICAL SECTIONS

PRELIMINARY PLANS
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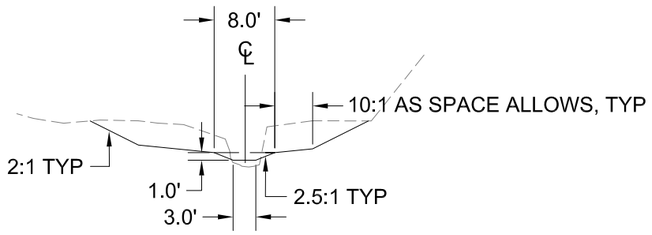
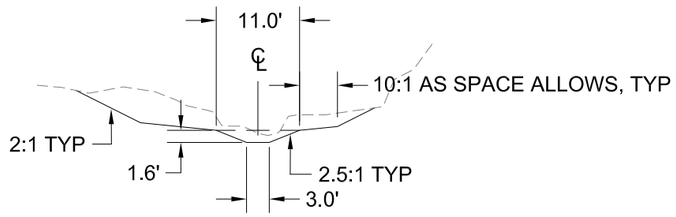
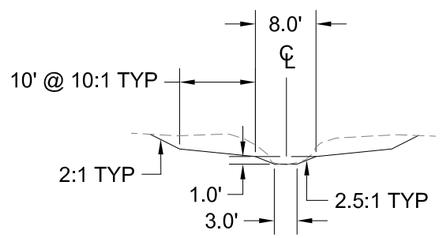


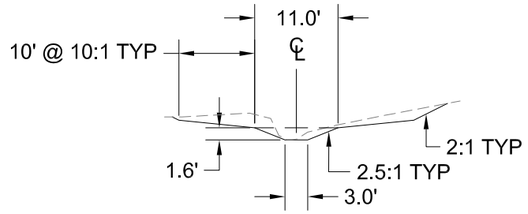
1 / TS2 TYPICAL UT 1 RIFFLE REACHES 1&2



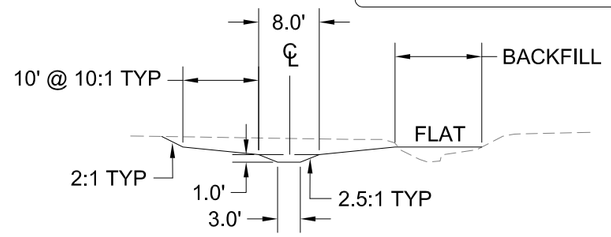
2 / TS2 TYPICAL UT1 POOL REACHES 1&2



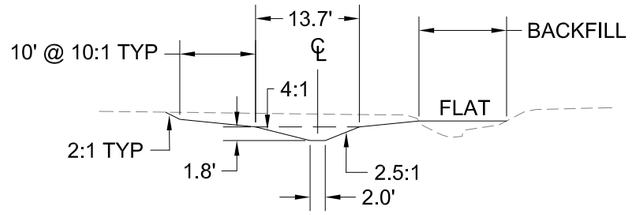
3 / TS2 TYPICAL UT9 RIFFLE REACH 1



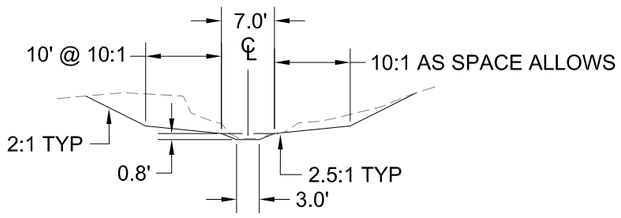
4 / TS2 TYPICAL UT9 POOL REACH 1



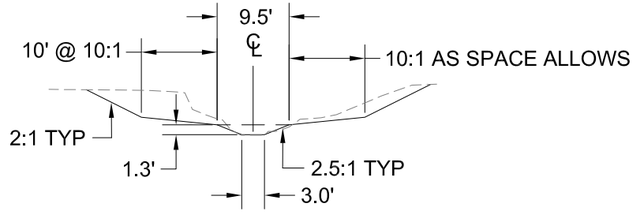
5 / TS2 TYPICAL UT9 RIFFLE REACH 2



6 / TS2 TYPICAL UT9 POOL REACH 2



7 / TS2 TYPICAL UT10 RIFFLE



8 / TS2 TYPICAL UT10 POOL

LEGEND

EXISTING

PROPOSED

BANKFULL STAGE

10 0 10 20

NOTES:

1. TYPICAL SECTION DIMENSIONS, CENTERLINE OFFSETS AND SLOPES DO NOT APPLY AT ALL STATIONS. REFER TO CROSS SECTIONS FOR ADJUSTMENTS TO GRADING LIMITS.
2. BANKS OF ON-LINE REACHES SHALL BE ROUGHENED PERPENDICULAR TO SLOPE, COVERED WITH 3" LAYER OF TOPSOIL, SEEDED, MULCHED AND MATTED WITH 780 G/SM COIR FIBER MATTING.
3. BANKS OF OFF-LINE REACH SHALL BE ROUGHENED PERPENDICULAR TO SLOPE AND COVERED WITH SOD MATS. APPLY TOPSOIL, SEED AND MATTING IF ON-SITE SOD MAT INSUFFICIENT.
4. TERRACE SLOPES SHALL BE ROUGHENED PERPENDICULAR TO SLOPE, SEEDED AND MULCHED.
5. OVER-EXCAVATE BANKFULL BENCHES TO 3" DEPTH AND PLACE TOPSOIL TO FINISHED GRADE.
6. SEE GROUND STABILIZATION NOTES, SHEET T2, FOR NPDES CONSTRUCTION STORMWATER PERMIT REQUIREMENTS.
7. TYPICAL SECTIONS DRAWN LOOKING DOWNSTREAM; APPLY POOL TYPICALS AS MIRROR IMAGES OF THESE DRAWINGS DEPENDING ON WHICH WAY THE STREAM IS MEANDERING.

A	MIT. PLAN	12/13				APP.
B	DRAFT CD'S.	09/14				DATE
C	FINAL MP	02/15				DESCRIPTION

REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22203 ANDREW DAVID X

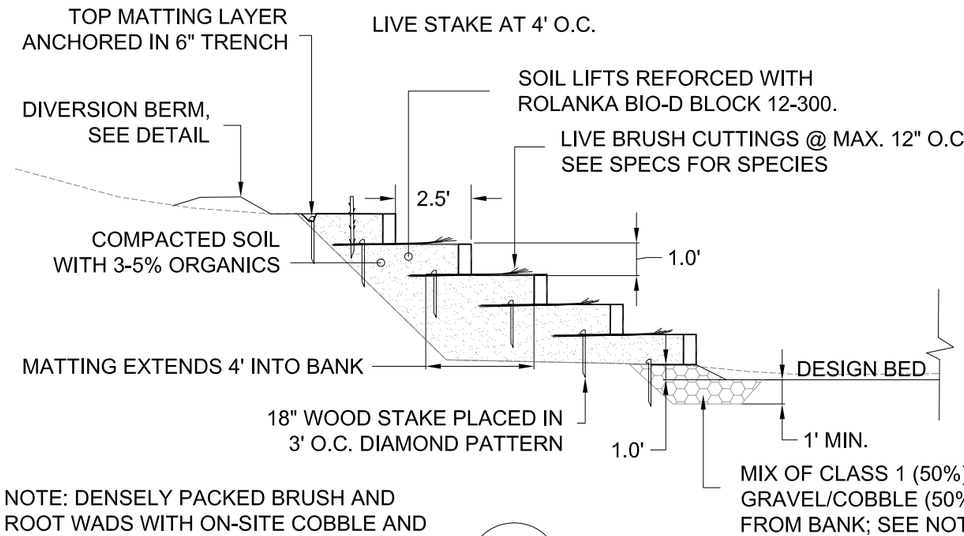
CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

DATE: FEB. 2015

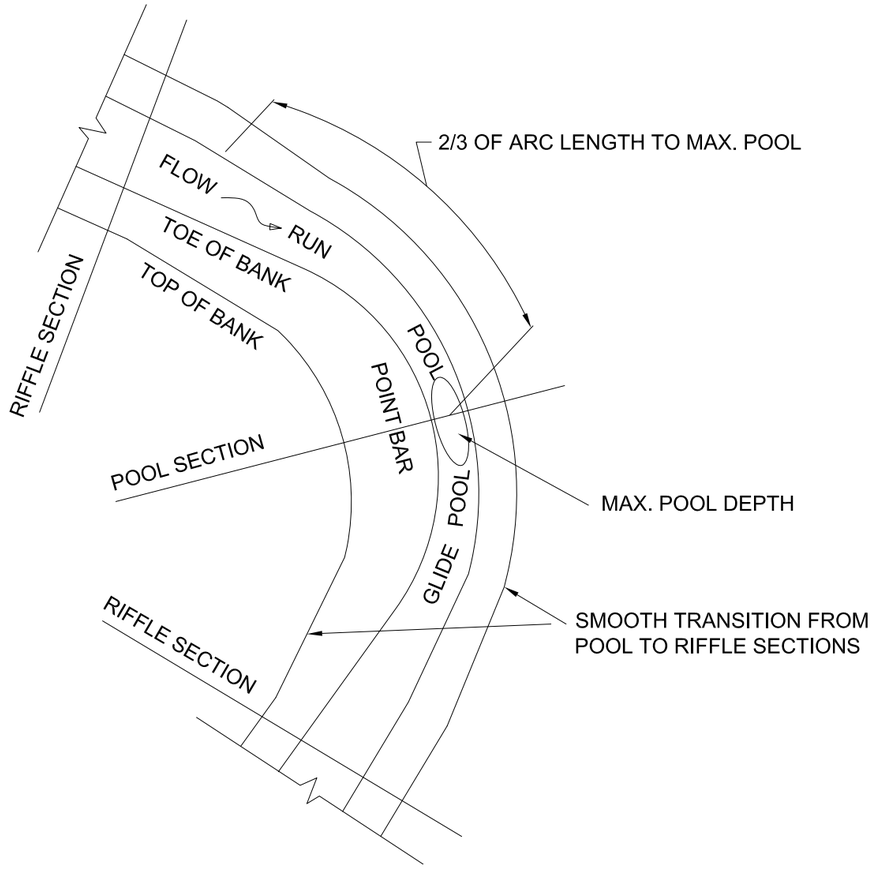
SCALE: AS SHOWN

TYPICAL SECTIONS

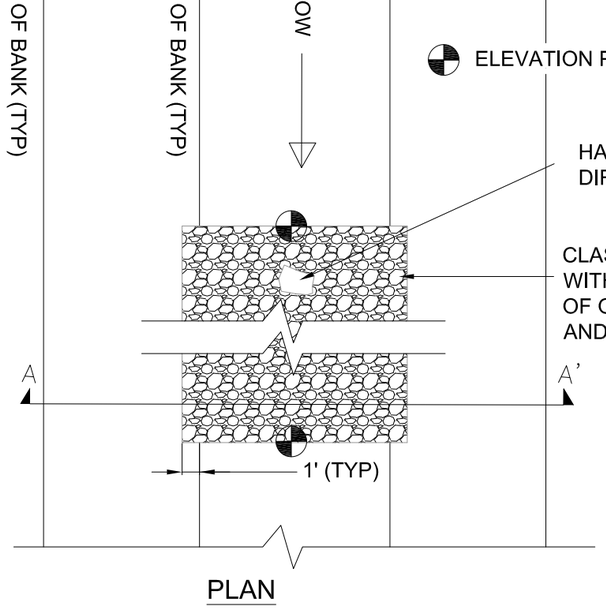


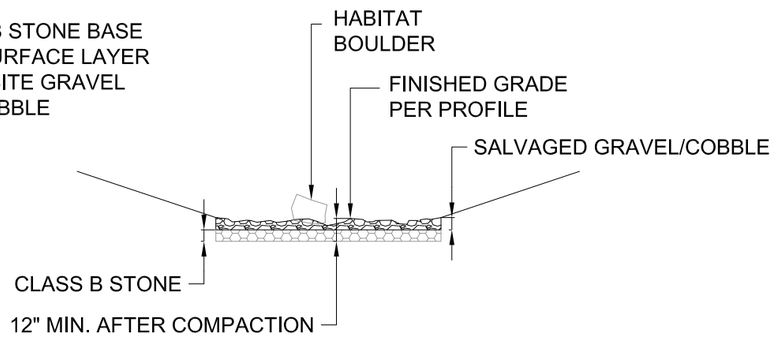
NOTE: Ddensely packed brush and root wads with on-site cobble and gravel backfill installed to design dimensions may be substituted for stone per direction of designer.

1 / D1 GEOLIFTS
NTS

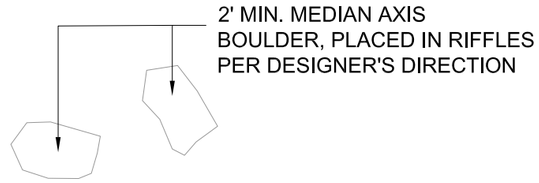


3 / D1 RIFFLE-POOL TRANSITIONS
NTS





2 / D1 CONSTRUCTED RIFFLE
NTS



4 / D1 HABITAT BOULDER
NTS

PRELIMINARY PLANS
NOT FOR CONSTRUCTION

REVISIONS

A	MIT. PLAN	12/13		
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C	FINAL MP	02/15		
			DESCRIPTION	DATE	APP.

NOT FOR CONSTRUCTION
NORTH CAROLINA
PROFESSIONAL
ENGINEER
ANDREW DAVID
22203

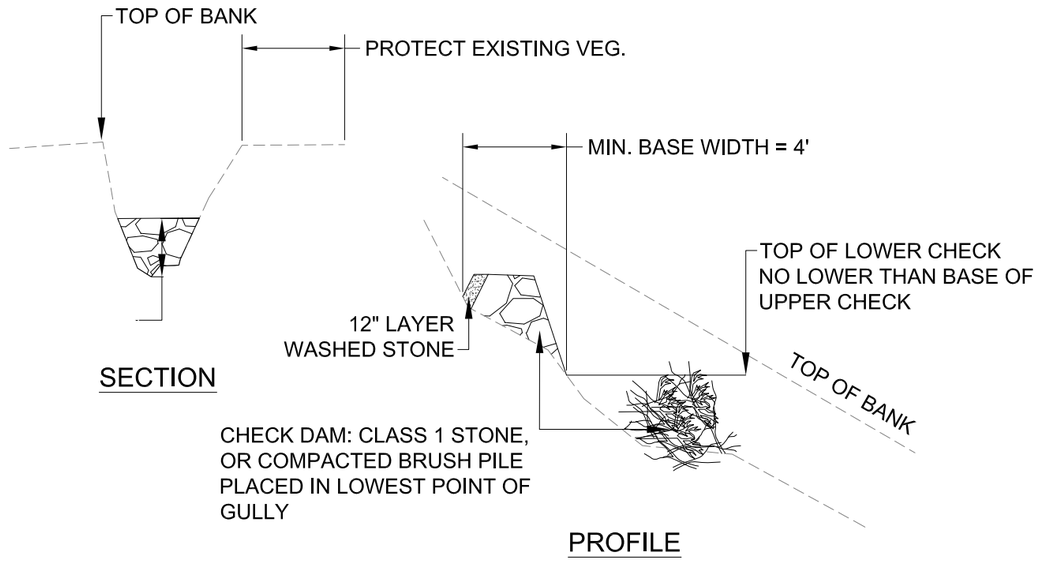
CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

DATE: FEB. 2015
SCALE: NTS

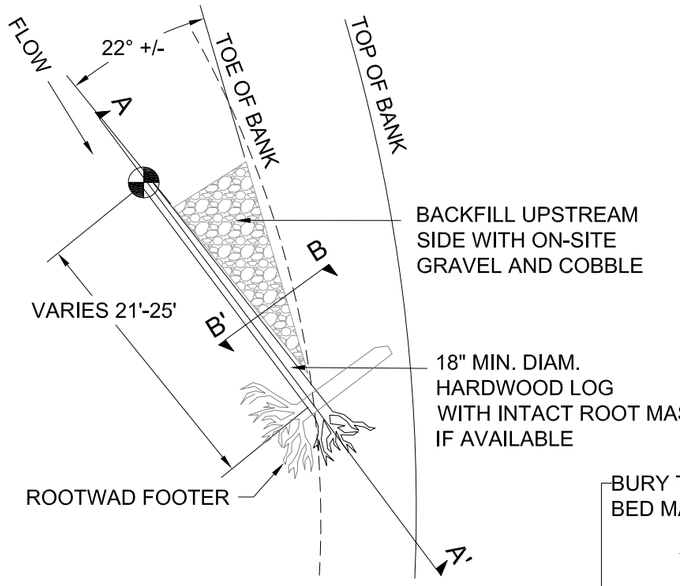
STRUCTURE DETAILS

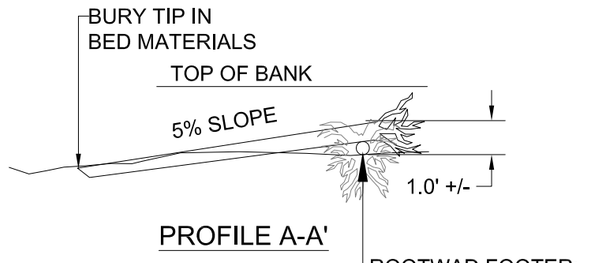
ELEVATION POINT IN STRUCTURE TABLE

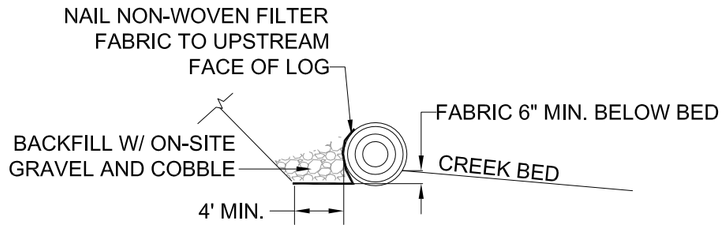


1 / D2 GULLY STABILIZATION NTS

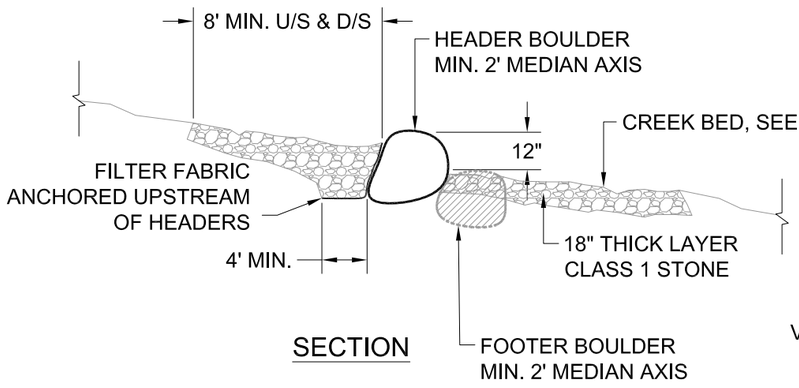
NOTES:
1. BRUSH MUST BE FROM NATIVE, NON-INVASIVE SPECIES.
2. NO MORE THAN 25% OF CHECK DAMS SHALL BE FROM BRUSH.

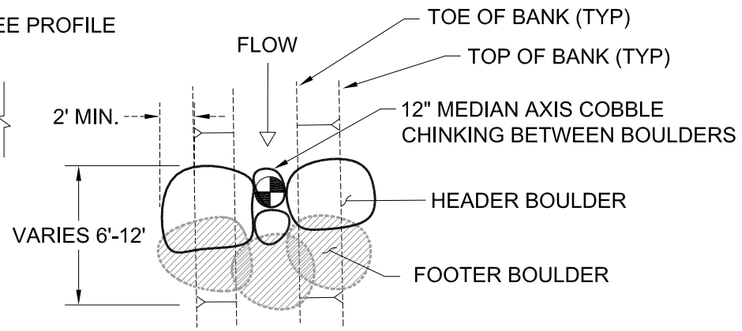






2 / D2 LOG VANE NTS





3 / D2 BOULDER STEP NTS

PRELIMINARY PLANS
NOT FOR CONSTRUCTION

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					DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22200 ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

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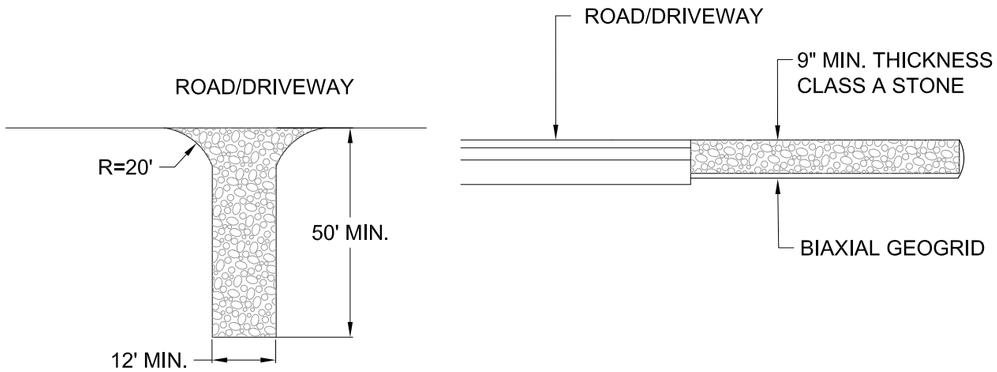
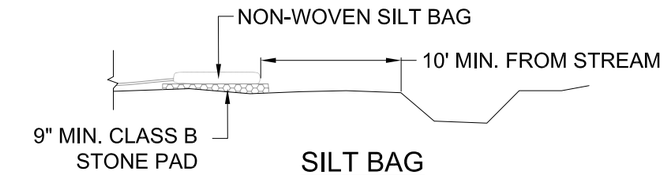
DATE: FEB. 2015
SCALE: NTS

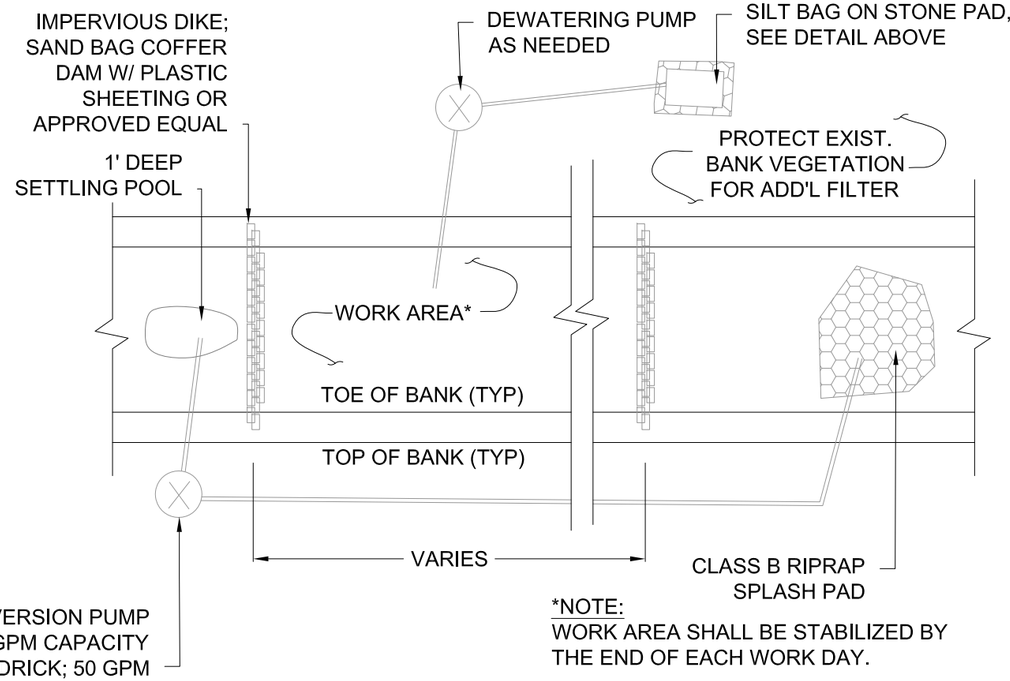
STRUCTURE DETAILS



1 / D3 CONSTRUCTION ENTRANCE/EXIT
NTS



SILT BAG



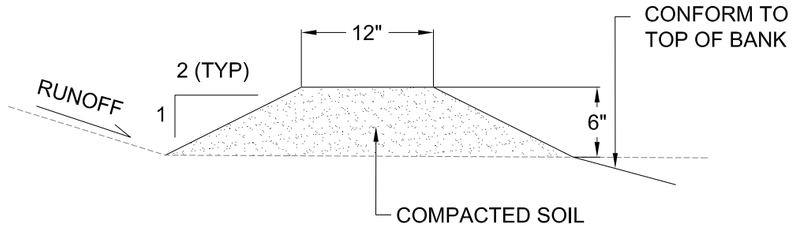
*NOTE:
WORK AREA SHALL BE STABILIZED BY THE END OF EACH WORK DAY.

2 / D3 PUMP-AROUND SCHEMATIC
NTS

SECTION PROFILE

3 / D3 SILT FENCE
NTS

NOTES:
1. SILT FENCE SHALL BE PLACED ON STREAM SIDE OF ALL STOCKPILES.
2. SILT FENCE SHALL BE REMOVED UPON COMPLETION OF EARTHWORK.



4 / D3 DIVERSION BERM
NTS

PRELIMINARY PLANS
NOT FOR CONSTRUCTION

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					DESCRIPTION	DATE	APP.

REVISIONS

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22203 ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

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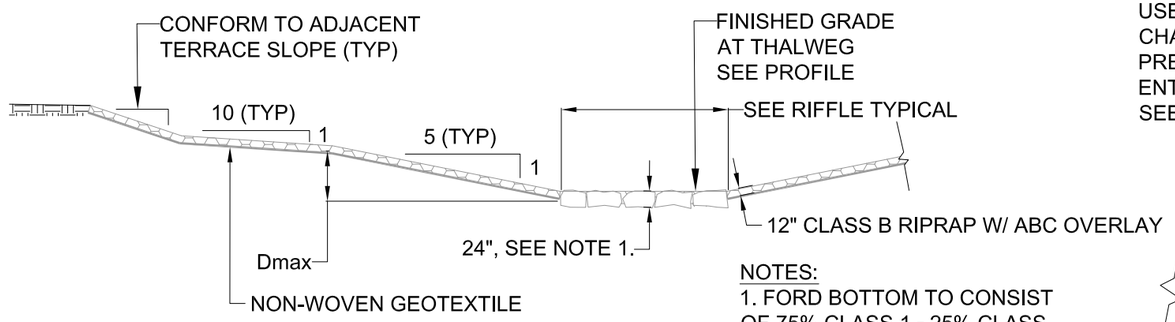
E&S
DETAILS

SHEET D3 OF 36

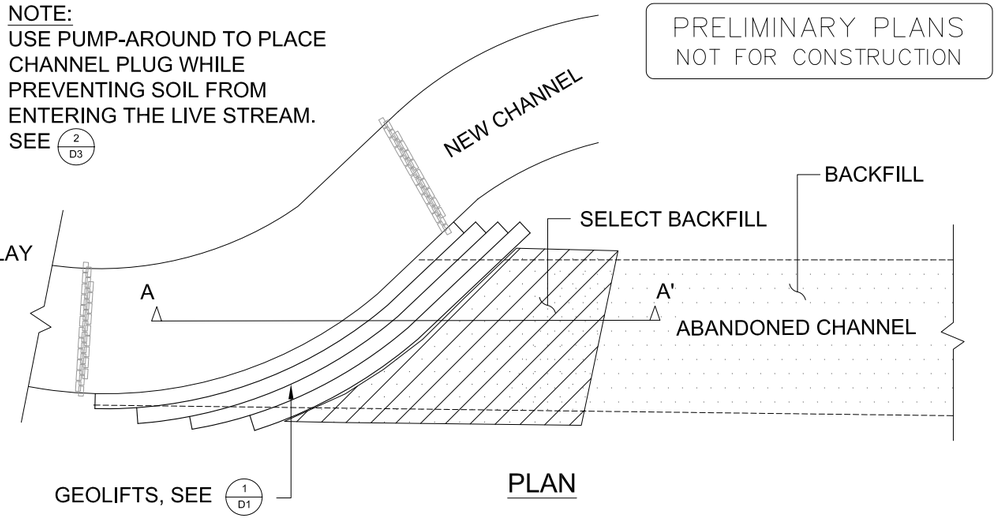


1 / D4 FORD CROSSING

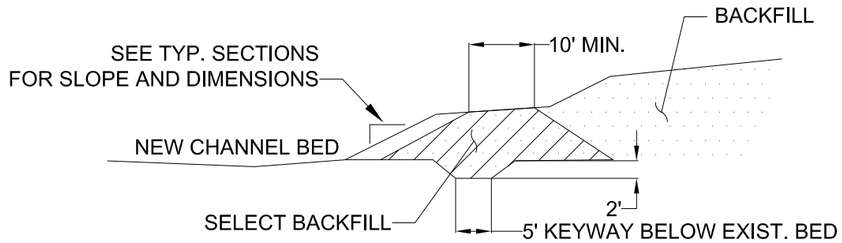
NTS

NOTES:
1. FORD BOTTOM TO CONSIST OF 75% CLASS 1 - 25% CLASS A STONE MIX.
2. FORD WIDTH = 15'.

NOTE:
USE PUMP-AROUND TO PLACE CHANNEL PLUG WHILE PREVENTING SOIL FROM ENTERING THE LIVE STREAM. SEE 2/D3



PLAN

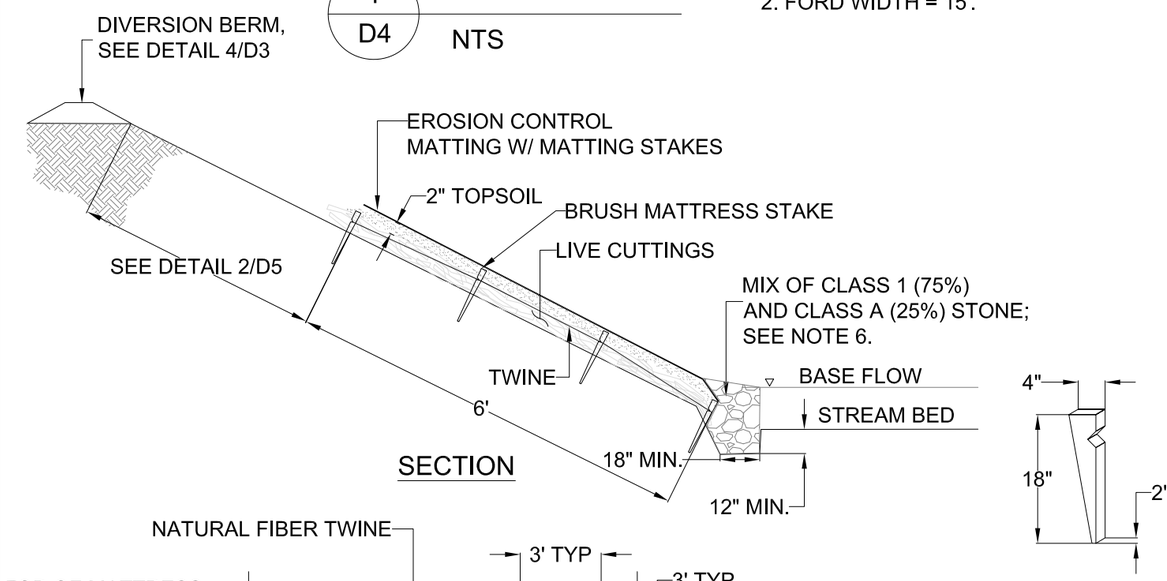


SECTION A-A'

NOTE:
NEW CHANNEL BANK TO BE FORMED BY OVERFILLING SELECT BACKFILL IN HORIZONTAL LIFTS AND TRIMMING TO FINAL GRADE.

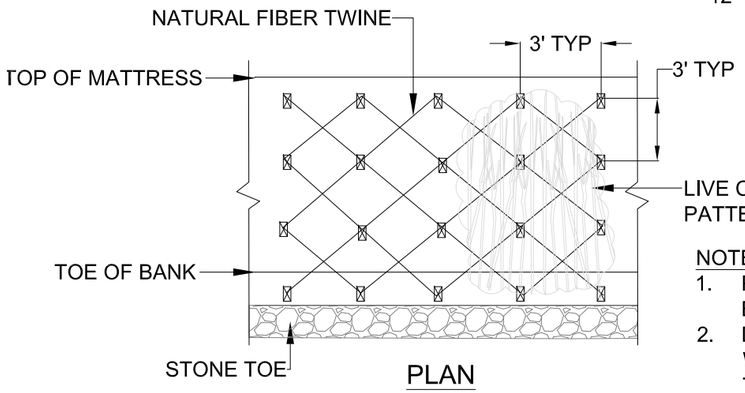
2 / D4 CHANNEL PLUG

NTS



SECTION

BRUSH MATTRESS STAKE

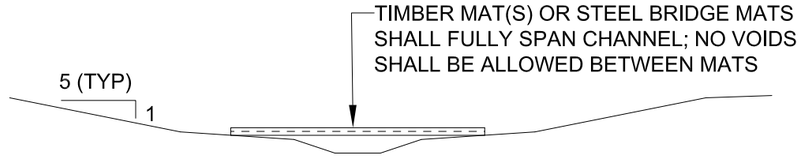


PLAN

NOTES:
1. PLACE LIVE CUTTINGS ON GRADED BANK WITH BUTT ENDS EXTENDING TO BASE FLOW WATER SURFACE.
2. DRIVE STAKES HALFWAY INTO BANK BETWEEN CUTTINGS. WRAP TWINE AROUND STAKES AND OVER CUTTINGS TIGHTLY. DRIVE STAKES FURTHER TO TIGHTEN TWINE AND SECURE CUTTINGS TO SLOPE.
3. FILL VOIDS BETWEEN CUTTINGS WITH LOOSE TOPSOIL. SEED AND MULCH SURFACE.
4. INSTALL EROSION CONTROL MATTING OVER TOPSOIL, USING 18" LONG MATTING STAKES.
5. PLACE STONE TOE OVER END OF MATTRESS AND MATTING.
6. ON-SITE COBBLE AND GRAVEL MEETING STONE SPECS MAY BE SUBSTITUTED FOR IMPORTED STONE .

3 / D4 BRUSH MATTRESS

NTS



SECTION

4 / D4 TEMPORARY STREAM CROSSING - MAT

NTS

PRELIMINARY PLANS
NOT FOR CONSTRUCTION

REVISIONS

	DESCRIPTION	DATE	APP.
A	MIT. PLAN	12/13	
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NORTH CAROLINA
PROFESSIONAL
SEAL
22203
ENGINEER
ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
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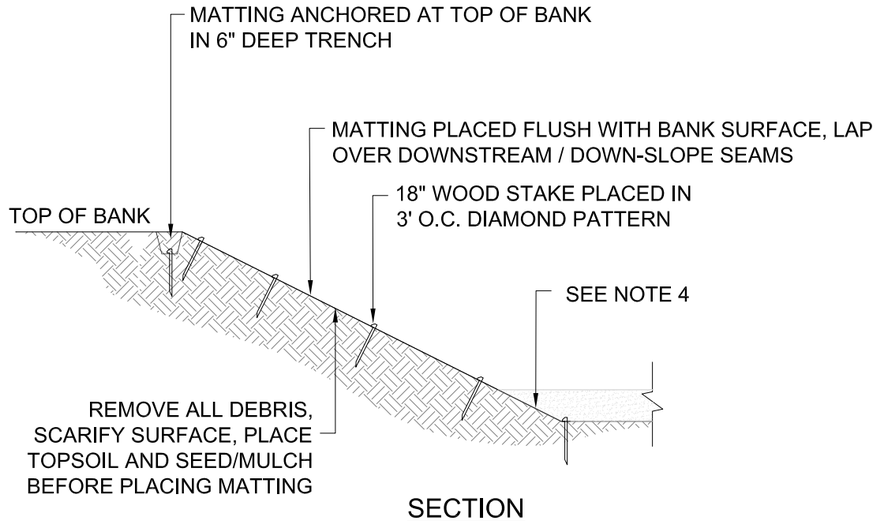
DETAILS

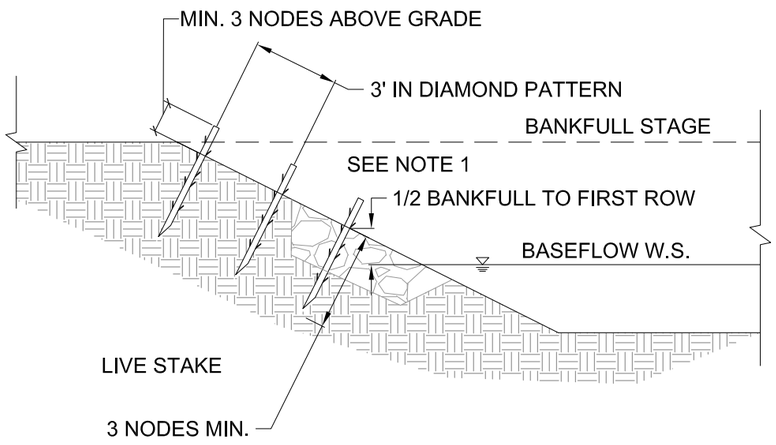
PRELIMINARY PLANS
NOT FOR CONSTRUCTION



SECTION

NOTES:
1. MATTING SHALL BE COIR FIBER, 780 G/M^2 WITH NOMINAL 0.50 INCH OPENING SIZE.
2. STAKES SHALL BE HARDWOOD, 2"X2"X18" LONG WITH 1" NOTCH OR NAIL 2" BELOW THE TOP TO CATCH MATTING.
3. SEE SPECS FOR SEED MIXES.
4. ANCHOR MATTING 6" BELOW STREAM BED FOR OFF-LINE REACHES AT AT BANK TOE FOR ON-LINE REACHES.

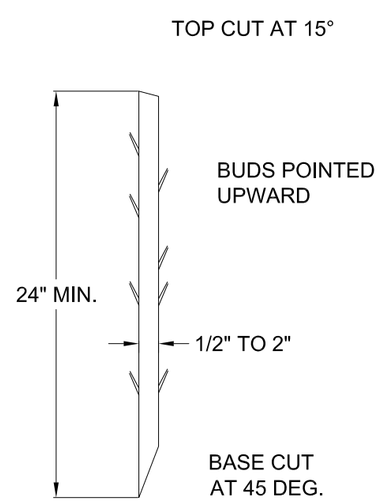
1 / D5 — EROSION CONTROL MATTING — NTS



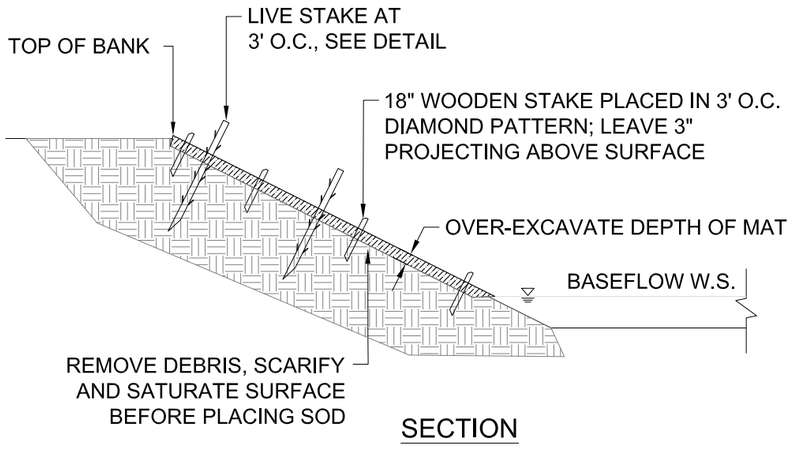
SECTION

NOTES:
1. FORM PILOT HOLE THROUGH HARD SOIL OR STONE TO PREVENT DAMAGE TO STAKE.
2. LIVE STAKE MIX TO INCLUDE AT LEAST TWO OF THE FOLLOWING SPECIES: SILKY DOGWOOD, SILKY WILLOW, ELDERBERRY, NINEBARK, BUTTONBUSH.

2 / D5 — LIVE STAKING — NTS



LIVE STAKE DETAIL



SECTION

3 / D5 — SOD MAT TRANSPLANT — NTS

Permanent Seed Mix - Disturbed Areas Beyond Conservation Easement		
Seeding Rate = 30 lb/acre		
Mulching: wheat or oat straw mulch applied at 2 tons/acre		
Soil Amendments: 0.3 tons/acre 20-10-10 fertilizer; 0.5 ton/acre lime		
Common Name	Scientific Name	Percentage
Orchardgrass	Dactylis glomerata	50
Perennial Ryegrass	Lolium perenne	40
Red Clover	Trifolium pratense	5
White Clover	Trifolium repens	5

Permanent Seed Mix - Conservation Easement Disturbed Areas		
Seeding Rate = 20 lb/acre		
Mulching: wheat or oat straw mulch applied at 2 tons/acre		
Soil Amendments*: 0.3 ton/acre 20-10-10 fertilizer; 0.5 ton/acre lime * DO NOT APPLY AMENDMENTS TO STREAM BANKS		
Common Name	Scientific Name	Percentage
Deer Tongue	Panicum clandestinum	20
Big Bluestem	Andropogon gerardii	20
Virginia Wildrye	Elymus virginicus	20
Indiangrass	Sorghastrum nutans	20
Redtop	Panicum rigidulum	20

Temporary Seed Mix				
Application Dates	Common Name	Scientific Name	Rate (lb/acre) Applied Separately	Rate (lb/acre) Applied w/ Permanent Mix
August 15 to May 1	Rye Grain	Secale cereale	120	60
May 1 to August 15	Browntop Millet	Panicum ramosum	40	20

REVISIONS

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NOT FOR CONSTRUCTION
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22200 ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

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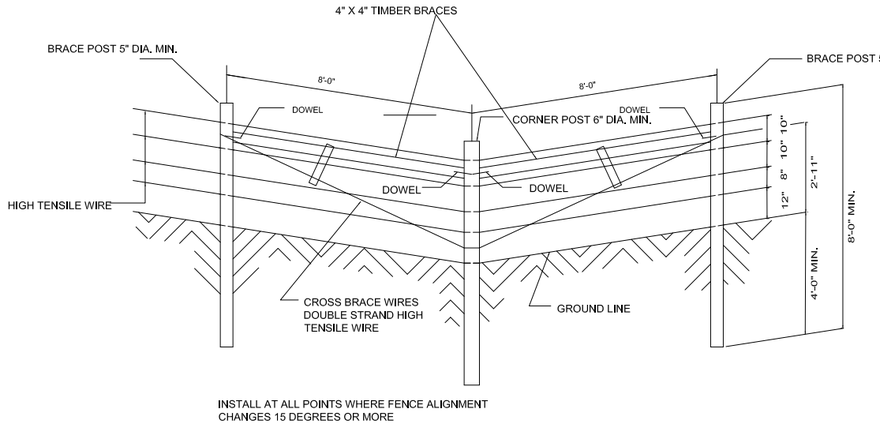
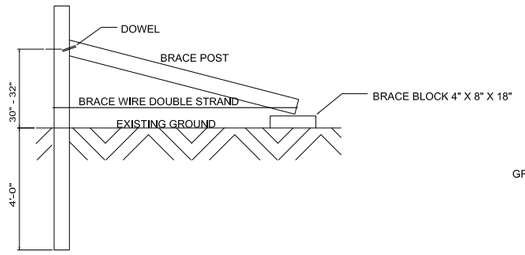
MISC. DETAILS
SEED MIXES

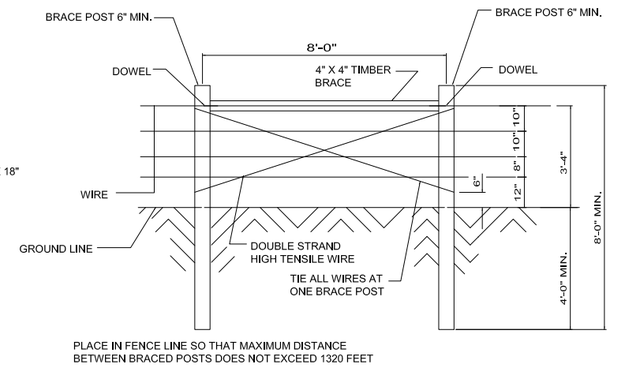
PRELIMINARY PLANS
NOT FOR CONSTRUCTION



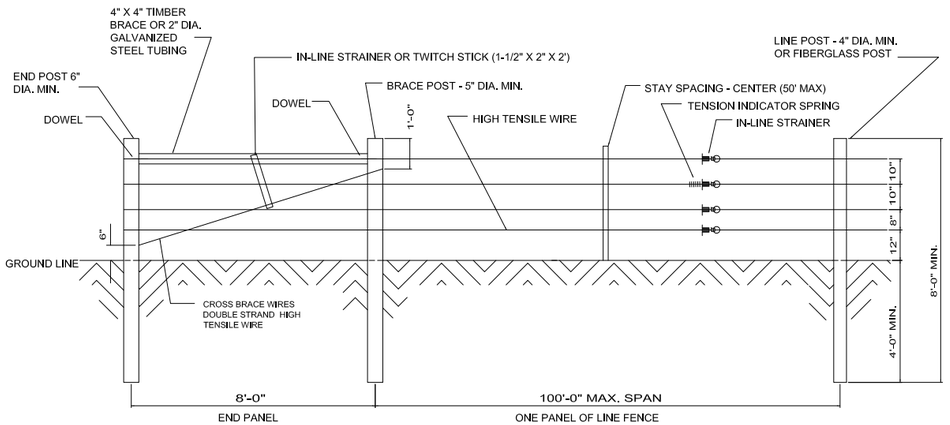
1 / D6 CORNER AND VERTICAL CHANGE BRACING
NTS



3 / D6 OPTIONAL CORNER OR END BRACE ASSEMBLY
NTS



4 / D6 PULL POST ASSEMBLY
NTS



2 / D6 END ASSEMBLY AND LINE FENCE SECTION
NTS

NOTES:

1. NOTCH POSTS 3/4" FOR 4" X 4" TIMBER BRACES.

2. DOWELS TO BE 1/2" DIA. X 5" PLAIN STEEL RODS. DRIVE DOWELS IN 7/16" DIA. HOLES, 2-1/2" INTO EACH POST AND TIMBER BRACE.

3. STAPLE CROSS-BRACE WIRES TO BRACE AND CORNER POSTS AT QUARTER POINTS OF THE POSTS.

4. HIGH TENSILE WIRE WILL BE NEW AND SMOOTH AND WILL MEET THE FOLLOWING 1) TENSILE STRENGTH - 110,000 PSI 2) GALVANIZING - TYPE III 3) GAGE - 12-1/2.

5. ALL CORNER POSTS, BRACE POSTS, BRACES, AND STAY SPACERS SHALL BE PRESSURE TREATED. PRESSURE TREATMENT SHALL CONFORM TO FEDERAL SPECIFICATION TT-W-571.

6. STAPLES TO BE NO. 9 GAUGE, GALVANIZED, 1-3/4" LONG (1-1/4" LONG FOR HARD WOODS).

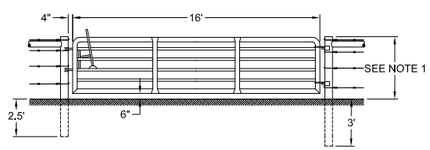
7. AT CORNER POSTS, STAPLE EACH WIRE AT QUARTER POINTS OF POSTS. AT BRACE POSTS, DOUBLE STAPLE EACH WIRE. AT LINE POSTS, SECURE EACH WIRE WITH STANDARD CLAMPS.

8. FIBERGLASS MAY BE USED FOR LINE POSTS. THESE WILL CONSIST OF MARBLE, FIBERGLASS, AND POLYMER RESINS WHICH HAVE BEEN TREATED BY THERMOSETTINGS (HEAT TREATMENT). POSTS MUST BE DRIVEN IN THE SOIL AT LEAST 18 INCHES.

9. 2" DIAMETER PIPE DIAGONAL BRACE MAY BE USED IN PLACE OF HORIZONTAL TIMBER BRACE AND DIAGONAL WIRES.

10. MINIMUM NET RETENTION OF CHROMATED COPPER ARSENATE (CCA) FOR WOOD SHALL BE 0.40 POUNDS PER CUBIC FOOT.

11. A SINGLE 12 FOOT LONG, 6 INCH MINIMUM DIAMETER POST MAY BE SUBSTITUTED FOR END PANEL, CORNER AND VERTICAL CHANGE BRACING, AND PULL POST ASSEMBLY. THE 12 FOOT LONG POSTS SHALL EXTEND A MINIMUM OF 7.5 FEET INTO THE GROUND AND BE BACKFILLED WITH GRAVEL.



5 / D6 STEEL GATE
NTS

SOURCES:
FENCING DETAILS: USDA, NRCS MI-0245.DWG
GATE DETAILS: USDOI, BLM, BLM28347.DWG

A	MIT. PLAN	12/13					
B	DRAFT CD'S.	09/14					
C	FINAL MP	02/15					
					DESCRIPTION	DATE	APP.

REVISIONS

NOT FOR CONSTRUCTION
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22206 ANDREW DAVID

CONFLUENCE ENGINEERING
Sixteen Broad Street
Asheville, North Carolina 28801
Phone: 828.255.5530
confluence-eng.com

SHADRICK CREEK
RESTORATION PROJECT
McDOWELL COUNTY, NC
SCO NO. 08-07391-02

DATE: FEB. 2015
SCALE: NTS

FENCING DETAILS