

PINCH GUT CREEK STREAM RESTORATION PROJECT

ANNUAL MONITORING REPORT FOR 2011 (YEAR 4)

Contract Number D06043-A



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2728 Capital Blvd, Suite 1H 103
Raleigh, NC 27604



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Prepared by: Michael Baker Engineering, Inc.

Baker

Michael Baker Engineering, Inc.
6500 Regency Parkway
Suite 200
Cary, North Carolina 27516
Phone: 919.463.2400
Fax: 919.463.2400

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1.0 EXECUTIVE SUMMARY

This Annual Monitoring Report details the monitoring activities during the 2011 growing season (Monitoring Year 4) for the Pinch Gut Creek Stream Restoration Site (“Site”). As per the approved Restoration Plan for the Site, this Annual Monitoring Report presents stream geometry data, stem count data from vegetation monitoring stations, and discusses any observed tendencies relating to stream stability and vegetation survival success.

The Site has a recent history of cattle farming and general agricultural usage. Cattle had been allowed to graze on the banks and access the streams in various locations. The streams had been channelized and riparian buffer vegetation was cleared throughout various reaches of the project. A majority of the Site had an early successional, narrow buffer that included several invasive vegetative species and many channel sections were incised and lacked riparian vegetation. As a result, channel degradation was widespread across the Site.

A total of 21 monitoring plots 100 square meters (m²) (10m x 10m) in size were used to predict survivability of the woody vegetation planted on-site. Data from the Year 4 monitoring event of the 21 vegetation plots exhibited a survivability range of 200 to 800 stems per acre. The data showed that the Site had an average survivability of 518 stems per acre.

Approximately ten volunteer tulip poplar (*Liriodendron tulipifera*) stems were noted within the boundaries of Vegetation Plot 1 following Year 4 monitoring. According to the vegetation monitoring data, the density of plot 1 was 200 stems per acre following Year 4. If the ten volunteer stems are included in the stem count for plot 1, then the density increases to over 320 stems per acre. The vegetation data demonstrates that all other plots on the Site met the minimum interim success criteria of 320 trees per acre by the end of Year 3.

According to the Year 4 vegetative monitoring data and the plot 1 observations, the Site is on track to meet the final success criteria of 260 stems per acre by the end of Year 5.

Cross-section monitoring data for stream stability were collected during Year 4 monitoring. A longitudinal profile survey was completed during Year 4 monitoring for approximately 3,589 linear feet (LF) of stream on the Site. The longitudinal profile was completed for reaches UT1_R2 and UT1_R4 only.

In-stream channel repairs on reaches UT1_R2, UT1_R3, UT1_R4, UT5_R1 and UT3 were completed in 2010, following damage from large consecutive storm events. All repairs were functioning properly after completion and will continue to be closely observed during Year 5 monitoring.

According to the on-site crest gauges, the Site experienced at least two bankfull flow events during Year 4 of the post-construction monitoring period. The largest on-site bankfull flow events documented by the UT1 crest gauge during Year 4 monitoring occurred on March 6, 2011. It was estimated that flows at the UT1_R4 crest gauge during this March storm event were approximately 0.30 feet (3.6 inches) above bankfull stage. Inspection of conditions during site visits revealed visual evidence of out-of-bank flows.

The approved Restoration Plan for the Site identified existing wetlands within the project boundaries, however construction activities sought to avoid these marginal wetland areas and wetland mitigation units were not included as part of the monitoring contract.

In summary, the Site is on track to meet the hydrologic, vegetative, and stream success criteria as specified in the Site Restoration Plan.

2.0 PROJECT BACKGROUND

The project involved the restoration and enhancement of unnamed tributaries (UTs) to Pinch Gut Creek. A total of 10,581 linear feet (LF) of stream were restored and 292 LF of stream were enhanced based on the post-construction as-built survey. Table 1 summarizes the restoration areas on the Site. Selected site photographs are shown in Appendix A and B. The recorded conservation easement totaling 31.8 acres is being revised at the time of this report to include an additional 3.5 acres that will protect the streams and riparian buffers in perpetuity.

2.1 Project Objectives

The specific goals for the Pinch Gut Stream Restoration Project were as follows:

- Restore functional stream channels
- Restore and enhance existing riparian wetlands
- Establish native stream bank and floodplain vegetation in the permanent conservation easement
- Improve water quality in the Pinch Gut Creek watershed by reducing sediment and nutrient inputs by fencing cattle out of the stream and reducing bank erosion
- Improve aquatic and riparian habitat by creating deeper pools with in-stream structures.

2.2 Project Structure, Restoration Type and Approach

After examining the assessment data collected at the Site and exploring the potential for restoration, an approach to the Site was developed that addressed restoration of stream functions on the reaches within the agricultural field areas. Topography and soils on the Site indicated that the project area most likely functioned in the past as a headwater tributary stream system with associated wetland areas from hill slope seepage, which fed into the larger Pinch Gut Creek system. Therefore, a design approach was formulated to restore this type of system. First, appropriate stream types for the valley types and slopes were selected and designed to carry bankfull flows. Special consideration was given to minimizing disturbance to existing wetland and wooded areas.

For analysis and design purposes, the on-site streams were divided into 11 reaches (Figure 2). Six tributaries flow directly into a single-thread unnamed tributary (mainstem UT1) from the beginning of the perennial portion of UT1 to Pell Road (SR 1215) and the project limits. The reaches were numbered sequentially from west to east with tributaries carrying a “UT” designation followed by the reach number. The project watershed boundary is confined within nearby roads and divided into sub-watersheds for each corresponding reach. UT1 flows from west to east and ends at a culvert under Pell Road. UT1 is split into four sub-reaches beginning with UT1_R1 at the headwaters and ending at the UT4 confluence. UT1_R2 continues northeast and ends at the northern property line. UT1_R3 starts at the adjoining property lines, and ends at the UT5_R2 confluence. UT1_R4 continues from the UT5_R2 confluence northeast to the confluence with UT7. UT2 flows from the southwest, and ends at the confluence with UT1_R1. UT3 flows from the northwest and ends after a short distance at the confluence with UT1_R1, just downstream of UT2. UT5_R1 flows into the project from the southwest and ends at the confluence with UT6. UT5_R2 continues from that point and ends at the confluence with UT1_R3. UT6 flows into the Site from the south and ends at the confluence with UT5_R2. UT7 begins approximately 300 LF upstream of the UT1_R4 confluence.

The overall restoration approach for the Site allows stream flows larger than bankfull flows to spread onto the floodplain, dissipating flow energies and reducing stress on streambanks. In-stream structures were used throughout all reaches to control streambed grade, reduce streambank stress, and promote bedform sequences and habitat diversity. The in-stream structures consist of root wads, log vanes, log weirs, cross vanes, grade control J-hooks, and constructed riffles, all which promote a diversity of habitat features in the restored channel. Where grade control was a consideration, constructed riffles were installed to provide long term stability. Streambanks were stabilized using a combination of erosion control matting, temporary and permanent seeding, bare root planting, and vegetation transplants. Transplants provide living root mass to increase streambank stability and create holding areas for fish and other aquatic biota.

The approved Restoration Plan for the Site identified existing wetlands within the project boundaries, however construction activities sought to avoid these marginal wetland areas and wetland mitigation units were not proposed. Therefore, no groundwater monitoring stations or rain gauges were installed on the Site. Although, in various locations along the riparian corridor, wetlands were enhanced and/or created as a result of raising the stream profiles, which led to higher water table conditions adjacent to the restored channels and has allowed more out-of-bank flooding to occur.

Table 1. Design Approach for the Pinch Gut Site

Pinch Gut Stream Restoration Site: Project No. D06043-A								
Project Segment or Reach ID	Existing Feet/Acres	Mitigation Type *	Approach**	Linear Footage or Acreage	Mitigation Ratio	Mitigation Units	Stationing	Comment
UT1_R1	1,484	R	P1, P2	1,494	1:1	1,494	10+00 - 29+94	Installed in-stream structures to control grade and reduce bank erosion
UT1_R2	1,952	R	P1, P2	1,506	1:1	1,506	29+94 - 40+30	Installed in-stream structures to control grade and reduce bank erosion
UT1_R3	1,647	R	P1, P2	1,427	1:1	1,427	43+75 - 58+32	Step-pool and riffle-pool design approaches were constructed
UT1_R4	2,677	R	P1, P2	2,302	1:1	2,302	58+32 - 82+59	Installed in-stream structures to control grade and reduce bank erosion
UT2	54	R	P2	45	1:1	45	10+00 - 10+45	Step-pool structures installed, stabilized culvert and crossing
UT3	256	R	P1, P2	428	1:1	428	10+00 - 14+39	Dam crossing re-graded and stabilized, step pool structures and constructed riffle installed
UT4	96	R	P2	60	1:1	60	10+00 - 10+73	Double drop cross-vane, graded bankfull bench
UT5_R1	969	R	P1, P2	953	1:1	953	10+00 - 19.52	Installed in-stream structures and utilized bedrock knickpoints
UT5_R2	842	R	P1, P2	791	1:1	791	19+52 - 27+70	Installed in-stream structures and utilized bedrock knickpoints
UT6	1,648	R	P1, P2	1,575	1:1	1,575	10+00 - 26+03	Installed in-stream structures and utilized bedrock knickpoints
UT7	299	E	EII	292	2.5:1	117	10+00 - 13+69	Installed in-stream structures to reduce near bank stress and bank erosion
Mitigation Unit Summations								
Stream (lf)	Riparian Wetland (Ac)	Non-riparian Wetland (Ac)		Total Wetland (Ac)		Buffer (Ac)		
10,698	0	0		0		35.3		

R =
* Restoration
E = Enhancement

** P1 = Priority I
P2 = Priority II
EII = Enhancement II

2.3 Location and Setting

The Site is located in Stokes County, North Carolina (Figure 1), approximately five miles northeast of the Town of Pilot Mountain. The Site lies in the Roanoke River Basin within North Carolina Division of Water Quality sub-basin 03-02-01 and NCEEP targeted local watershed 03010103170030.

2.4 Project History and Background

The Site has a recent history of cattle farming and general agricultural usage. Cattle had been allowed to graze on the banks and access the stream channels in various locations. The streams had been channelized and riparian buffer vegetation was cleared throughout various reaches of the project. A majority of the Site had an early successional, narrow buffer that included several invasive vegetative species and many sections were incised and lacked riparian vegetation. As a result, channel degradation was widespread across the Site.

The chronology of the Pinch Gut Creek Stream Restoration Project is presented in Table 2. The contact information for the designers, contractors, and relevant suppliers is presented in Table 3. Relevant project background information is provided in Table 4.

2.5 Project Plan

Plans illustrating the as-built conditions of the major project elements, locations of permanent monitoring cross-sections, and locations of permanent vegetation monitoring plots are presented in Figures 2A through 2J of this report.

Table 2. Project Activity and Reporting History

Pinch Gut Creek Stream Restoration Site: Project No. D06043-A			
Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery
Restoration Plan Prepared	N/A	N/A	Jul-07
Restoration Plan Amended	N/A	N/A	Jul-07
Restoration Plan Approved	Mar-07	N/A	Jul-07
Final Design – (at least 90% complete)	N/A	N/A	Jun-07
Construction Begins	Oct-07	N/A	Nov-07
Temporary S&E mix applied to entire project area	NA	N/A	Apr-08
Permanent seed mix applied to entire project area	Dec-07	N/A	Apr-08
Planting of live stakes	Dec-07	N/A	Apr-08
Planting of bare root trees	Dec-07	N/A	Apr-08
End of Construction	Dec-07	N/A	Apr-08
Survey of As-built conditions (Year 0 Monitoring-baseline)	Dec-07	Jul-08	Jul-08
Year 1 Monitoring	Dec-08	Nov-08	Dec-08
Year 2 Monitoring	Dec-09	Oct-09	Dec-09
Year 3 Monitoring	Dec-10	Nov-10	Jan-11
Year 4 Monitoring	Dec-11	Nov-11	Dec-11
Year 5 Monitoring	Scheduled Dec-12	Scheduled Nov-12	Scheduled Dec-12

Table 3. Project Contacts

Pinch Gut Creek Stream Restoration Site: Project No. D06043-A	
Designer Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 <u>Contact:</u> Kevin Tweedy, Tel. 919-463-5488
Construction Contractor River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 <u>Contact:</u> Will Pedersen, Tel. 919-459-9001
Planting Contractor River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 <u>Contact:</u> Will Pedersen, Tel. 919-459-9001
Seeding Contractor River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 <u>Contact:</u> Will Pedersen, Tel. 919-459-9001
Seed Mix Sources Nursery Stock Suppliers	Mellow Marsh Farm, 919-742-1200 International Paper, 1-888-888-7159
Monitoring Performers Michael Baker Engineering, Inc. Stream Monitoring Point of Contact: Vegetation Monitoring Point of Contact:	8000 Regency Parkway, Suite 200 Cary, NC 27518 Dwayne Huneycutt, Tel. 919-463-5488 Dwayne Huneycutt, Tel. 919-463-5488

Table 4. Project Background

Pinch Gut Creek Stream Restoration Site: Project No. D06043-A	
Project County:	Stokes County, NC
Reach:	Drainage Area (sq. mi.):
UT1_R1	0.15
UT1_R2	0.41
UT1_R3	0.48
UT1_R4	1.19
UT2	.02
UT3	.02
UT4	0.10
UT5_R1	0.34
UT5_R2	0.49
UT6	0.12
UT7	0.61
Estimated Drainage % Impervious Cover:	
UT1, UT2, UT3, UT4, UT5, UT6, UT7	<5%
Stream Order:	
UT1_R1, UT2, UT3, UT4, UT5_R1, UT6	1
UT1_R2, UT1_R3, UT5_R2, UT7	2
UT1_R4	3
Physiographic Region	Piedmont
Ecoregion	Northern Inner Piedmont
Rosgen Classification of As-Built:	
UT2, UT3, UT4, UT6, UT7	B
UT1_R3	Bc
UT1_R1, UT5_R1, UT5_R2	B/C
UT1_R2	C
UT1_R4	Cb
Cowardin Classification:	
UT1_R1, UT6, UT5_R1	Riverine, Upper Perennial, Rock Bottom
UT1_R2, UT1_R3, UT1_R4, UT2, UT3, UT4, UT5_R2, UT7	Riverine, Lower Perennial, Unconsolidated Bottom
Dominant Soil Types:	
UT1_R1, UT2, UT3, UT1_R2, UT4, UT1_R3, UT5_R1	PcD2
UT1_R3	PcC2
UT1_R4, UT5_R2, UT6	RpE
UT1_R4, UT7	RtA
Reference site ID	Mickey Reach, Surry County
USGS HUC for Project and Reference sites	03010103170030 (Project); 03040101080010 (Ref.)
NCDWQ Sub-basin for Project and Reference	03-02-01 (Project); 03-07-02 (Ref.)
NCDWQ classification for Project and Reference:	
Reference	B4
UT2, UT3, UT4, UT6, UT7	B
UT1_R3	Bc
UT1_R1, UT5_R1, UT5_R2	B/C

Table 4. Project Background

Pinch Gut Creek Stream Restoration Site: Project No. D06043-A	
Project County:	Stokes County, NC
UT1_R2	C
UT1_R4	B/C
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor?	N/A
% of project easement fenced	100%

3.0 PROJECT CONDITION AND MONITORING RESULTS

3.1 Vegetation Assessment

3.1.1 Description of Vegetative Monitoring

As a final stage of construction, the stream margins and riparian areas of the Site were planted with bare root trees, live stakes, and a seed mixture of temporary and permanent ground cover herbaceous vegetation. The woody vegetation was planted randomly six to eight feet apart from the top of the stream banks to the outer edge of the project's re-vegetation limits. In general, bare-root vegetation was planted at a target density of 436 stems per acre, in a 10-foot by 10-foot grid pattern. Bare root shrubs were planted at a target density of 258 stems per acre, in a 13-foot by 13-foot grid pattern. The tree species planted at the Site are shown in Table 5. The permanent seed mix of herbaceous species applied to the project's riparian area included soft rush (*Juncus effusus*), redtop (*Agrostis alba*), Virginia wild rye (*Elymus virginicus*), switchgrass (*Panicum virgatum*), smartweed (*Polygonum pennsylvanicum*), beggartick (*Bidens frondosa*), lanceleaf tickseed (*Coreopsis lanceolata*), eastern gamma grass (*Tripsacum dactyloides*), little bluestem (*Schizachyrium scoparium*), deertongue (*Panicum clandestinum*), big bluestem (*Andropogon gerardii*) and Indian grass (*Sorghastrum nutans*). This seed mixture was broadcast on the Site at a rate of 15 pounds per acre. All planting was completed in April 2008.

At the time of planting, 21 vegetation plots – labeled 1 through 21 - were established on-site to monitor survival of the planted woody vegetation. Each vegetation plot is 0.025 acre in size, or 10 meters x 10 meters. All of the planted stems inside the plot were flagged to distinguish them from any colonizing individuals and to facilitate locating them in the future. The trees also were marked with aluminum metal tags to ensure that the correct identification is made during future monitoring of the vegetation plots.

On a designated corner within each of the 21 vegetation plots, one herbaceous plot was also established to monitor ground cover establishment. The herbaceous plots measure 1-meter x 1-meter in size. Both vegetation plots and herbaceous plots are photographed throughout the growing season. The locations of the vegetation plots are presented in Figures 2B through 2J.

3.1.2 Vegetative Success Criteria

To characterize vegetation success criteria objectively, specific goals for woody vegetation density have been defined. Data from vegetation monitoring plots should display a surviving tree density of at least 320 trees per acre at the end of the third year of monitoring, and a surviving tree density of at least 260 five-year-old trees per acre at the end of the five-year monitoring period.

Table 5. Vegetation Species Planted Across the Restoration Site			
Scientific Name	Common Name	Percent Planted by Species	Total Number of Stems
Bare Root Tree Species			
<i>Betula nigra</i>	river birch	15%	1,962
<i>Liriodendron tulipifera</i>	tulip poplar	10%	1,308
<i>Quercus phellos</i>	willow oak	20%	2,616
<i>Quercus rubra</i>	southern red oak	15%	1,962
<i>Diospyros virginiana</i>	persimmon	15%	1,962
<i>Juglans nigra</i>	black walnut	15%	1,962
<i>Platanus occidentalis</i>	sycamore	10%	1,308
Shrub species			
<i>Alnus serrulata</i>	tag alder	20%	1,536
<i>Lindera benzoin</i>	spicebush	25%	1,920
<i>Corylus americana</i>	hazelnut	20%	1,536
<i>Carpinus caroliniana</i>	ironwood	15%	1,152
<i>Cornus amomum</i>	silky dogwood	20%	1,536
Native Herbaceous Species			
<i>Agrostis alba</i>	redtop	10%	NA
<i>Elymus virginicus</i>	Virginia wildrye	15%	NA
<i>Panicum virgatum</i>	switch grass	15%	NA
<i>Tripsacum dactyloides</i>	eastern gamma grass	5%	NA
<i>Polygonum pennsylvanicum</i>	Pennsylvania smartweed	5%	NA
<i>Schizachyrium scoparium</i>	little bluestem	5%	NA
<i>Juncus effusus</i>	soft rush	5%	NA
<i>Bidens frondosa (or aristosa)</i>	beggartick	5%	NA
<i>Coreopsis lanceolata</i>	lanceleaf tickseed	10%	NA
<i>Panicum clandestinum</i>	deertongue	15%	NA
<i>Andropogon gerardii</i>	big bluestem	5%	NA
<i>Sorghastrum nutans</i>	Indian grass	5%	NA
Woody Vegetation for Live Stakes			
<i>Cornus amomum</i>	silky dogwood	30%	NA

<i>Salix sericea</i>	silky willow	30%	NA
<i>Sambucus canadensis</i>	elderberry	20%	NA
<i>Physocarpus opulifolius</i>	ninebark	20%	NA

3.1.3 Vegetative Observations and Results

The permanent ground cover seed mixture broadcast on the Site after construction was present during Year 4 monitoring of the Site.

Tables A.1 through A.6 in Appendix A present vegetation metadata, vegetation vigor, vegetation damage and stem count data for the monitoring stations at the end of the Year 4 monitoring period. Data from the Year 4 monitoring event of the 21 vegetation plots exhibited a range of 200 to 800 stems per acre. The data show that the Site had an average survivability of 518 stems per acre.

Trees within each monitoring plot are flagged regularly to prevent planted trees from losing their identifying marks due to flag degradation. It is important for trees within the monitoring plots to remain marked to ensure they are all accounted for during the annual stem counts and calculation of tree survivability. Aluminum tags with wire hangers are used on surviving stems to aid in relocation during future counts. Flags are also used to mark trees because they do not interfere with the growth of the tree.

Approximately ten tulip poplars (*Liriodendron tulipifera*), 1 to 3 feet tall were observed in Vegetation Plot 1 following Year 4 monitoring. These volunteer species are native to the area and were also planted as part of the tree layer for this project. The stems of *Liriodendron tulipifera* did not seem to be posing a threat to the planted stems within the plot. Additionally, these stems have taken root in roughly the same areas within the plot where planted stems of spicebush (*Lindera benzoin*) failed to survive. Including the volunteer stems in the Year 4 count, the density of Plot 1 has a stem density greater than 320 stems per acre.

Six tag alders (*Alnus serrulata*), 1 foot to 3 foot in size were observed in Vegetation Plot 2 following Year 3 monitoring. These volunteer species are native to the area and were also planted as part of the shrub layer for this project. The stems of *Alnus serrulata* do not seem to be posing a threat to the planted stems within the plot and are not included in the density calculation for success.

All plots will continue to be assessed during Year 5 monitoring for occurrence of additional volunteer species.

3.1.4 Vegetative Problem Areas

It was noted during Year 3 monitoring that Vegetation Plot 1 demonstrated a density of 440 stems per acre. However, following Year 4 vegetation monitoring, Plot 1 exhibited a density 200 stems per acre, mainly due to *Lindera benzoin* die off. The seven planted stems of *Lindera benzoin* in plot 1 failed to survive through Year 4.

During Year 3 monitoring, multiflora rose (*Rosa multiflora*) was observed and treated along reaches UT1_R4 and UT6. The *Rosa multiflora* is not scheduled to be treated during Year 5 monitoring in these areas.

There are relatively few weedy species occurring on the Site, and none of the on-site species seem to be posing any problems for the planted woody or herbaceous hydrophytic vegetation at this time. A significant presence of blackberry (*Rubus spp.*) was noted within Vegetation Plot 1. However, the blackberry bushes do not exceed the height of the planted sycamores and do not seem to be posing a threat to the existing planted stems at this time.

3.1.5 Vegetation Photographs

Photographs are used to visually document vegetation plot success. A total of 21 reference stations were established to document tree conditions at each vegetation plot across the Site. Additional photo stations were also established at each of the 21 vegetation plots for herbaceous vegetation monitoring. Reference photos of both tree conditions and herbaceous conditions are taken at least once per year. Photos of the tree plots showing the on-site planted stems are included in Appendix A of this report. Photos of the herbaceous plots are also included in Appendix A.

3.2 Stream Assessment

3.2.1 Morphometric Success Criteria

To document the stated success criteria, the following monitoring program was instituted following construction completion on the Site:

Cross-sections: Two permanent cross-sections were installed per 1,000 LF of stream restoration work, with one of the locations being a riffle cross-section and one location being a pool cross-section. A total of 22 permanent cross-sections were established across the Site. Each cross-section was marked on both banks with permanent pins to establish the exact transect used. The permanent cross-section pins are surveyed and located relative to a common benchmark to facilitate easy comparison of year-to-year data. The annual cross-section surveys include points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg.

The approved Restoration Plan requires the following criteria be met to achieve stream restoration success. There should be little change in as-built cross-sections. If changes do take place, they will be evaluated to determine if they represent a movement toward a more unstable condition (e.g., down-cutting or erosion) or a movement toward increased stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross-sections will be classified using the Rosgen Stream Classification System, and all monitored cross-sections should fall within the quantitative parameters defined for channels of the design stream type.

Longitudinal Profiles: A complete longitudinal profile was surveyed following construction completion to record as-built conditions and to establish a baseline profile. The profile was conducted for the entire length of each restored channel for all reaches. Measurements included thalweg, water surface, inner berm, bankfull, and top of low bank. Each of these measurements was taken at the head of each feature (e.g., riffle, pool, and glide). In addition, maximum pool depth was recorded. All surveys were tied to a single, permanent benchmark.

The approved Restoration Plan requires the following criteria be met to achieve stream restoration success: The longitudinal profiles should show that the bedform features are remaining stable; i.e., they are not aggrading or degrading. The pools should remain deep, with flat water surface slopes, and the riffles should remain steeper and shallower than the pools. Bedforms observed should be consistent with those observed for channels of the designed stream type.

3.2.2 Morphometric Results

Year 4 cross-section monitoring data for stream stability were completed during August and November 2011. The 22 permanent cross-sections along the restored channels (12 located across riffles and 10 located across pools) were re-surveyed to document stream dimension at the end of monitoring Year 4. Data from each of these cross-sections are presented in Appendix B.

Cross-sections 1, 2, 4, 6, 8, 10, 12, 14, 15, 17, 19, 21 and 22 are situated across riffles that are located between pools. Based on the survey data, cross-sections 1, 14, 15, 17, 19 and 21 showed relatively little change since as-built conditions. Cross-sections 2, 4, 10, 12 and 22 have demonstrated minor fluctuations in riffle dimensions since as-built conditions. Cross-section 6 and 8 has demonstrated moderate fluctuations in channel dimension since as-built conditions. Riffle cross-section 6 has a large amount of sediment deposited near the left bank since Year 3, as shown in Appendix B.

Riffle cross-sections 10 and 12 underwent repairs during Year 3 by adding Class I and B stone and on-site alluvium to raise the bed elevations. The data from Years 3 and 4 for cross-sections 10 and 12 provided in Appendix B show a higher bed elevation than was observed in as-built conditions and Year 1 monitoring. According to the Year 4 data, cross-sections 10 and 12 currently appear to be more stable following repairs, which can be attributed to a better connection with the adjacent floodplain.

Cross-sections 3, 5, 7, 9, 11, 13, 16, 18 and 20 are situated across pools which are located at the apex of meander bends. Based on the survey data, cross-sections 3 and 20 have shown relatively little change since as-built conditions. Cross-sections 3, 5, 7, 11, 13, and 16 have demonstrated minor fluctuations in pool dimensions since as-built conditions. Cross-sections 9 and 18 have demonstrated moderate fluctuations in channel dimension since as-built conditions. Based on the Year 4 survey data, pool cross-sections 3, 7, 13 and 16 show the slow development of point bar features on the inside bank of the meander bends.

Pool cross-section 9 is located over a cross-vane and it is noted that channel dimension has decreased from as-built conditions; however the cross-section has remained stable since Year 1. Pool cross-section 18 has developed minor scour along the right bank (inner berm). These issues are minor and the cross-sections appear to be stable. However, these cross-sections will be closely observed during the 2012 monitoring season and any significant changes will be reported following Year 5 monitoring.

The longitudinal profile for Year 4 was completed in November 2011. The Year 4 data were compared to the data collected during the as-built condition survey in June 2008, Year 1 data collected in November 2008, Year 2 data surveyed in July 2009 and the Year 3 survey data collected in November 2010. During Year 4 of monitoring, the longitudinal profile survey

was only completed for reaches UT1_R2 and UT1_R4. A total stream length of 3,589 LF was surveyed. The longitudinal profiles for these reaches are presented in Appendix B.

Data for the UT1_R2 Year 4 longitudinal profile indicates that the riffles in this reach have essentially maintained the same bed elevations since as-built conditions. Conversely, pools throughout UT1_R2 have continued to increase in depth since as-built conditions. It is noted that increased pool depths were also measured in this reach following Year 1 monitoring. The deeper pools in UT1_R2 are providing increased channel stability while promoting greater habitat diversity. However, two pools at stations 33+18 and 38+38 on UT1_R2 have extended into the downstream riffle sections. These areas have demonstrated deeper thalweg measurements than those which were observed during as-built conditions and previous monitoring years. These two areas will be closely observed during Year 5 monitoring. Any future changes that may demonstrate a movement toward instability within these areas will be noted and whether repairs to these areas are needed. Overall, the longitudinal profile for UT1_R2 demonstrates that the in-stream structures within the reach are stable and functioning as designed.

Data for the UT1_R4 Year 4 longitudinal profile show that the riffles and pools between stations 58+22 to 80+83, have maintained relatively stable riffle elevations and pools have remained deep and are providing well a developed habitat for aquatic wildlife.

Large storm events in early winter 2010 impacted some of the pools along reaches UT1_R4, UT5_R1, and UT1_R2. Moderate bank erosion and floodplain scouring on the outside of the meander bends during the storms also impacted the Site. It was determined that in-stream repairs were needed to ensure channel stability in the future. In-stream repairs were completed between August and December 2010. According to the Year 4 survey, all of the repaired areas were stable and functioning as designed. Detailed information regarding the repaired areas is provided in Section 3.2.5.

In-stream structures installed within the restored stream included constructed riffles, log weirs, log vanes, grade control rock and log j-hooks, rock and log step-pools, rock and rolls, cross vanes, root wads and stream crossings. Visual observations of these structures throughout Year 4 monitoring indicated that all structures are functioning as designed and holding their elevation grade. Structures that were installed to develop deep pools such as cross vanes and step pools are performing their designed functions. Log vanes placed in meander pool areas have provided scour to keep pools deep and provide cover for fish. Log weirs and j-hooks placed in riffle areas have maintained riffle elevations and provided downstream scour holes that provides aquatic habitat. Root wads placed on the outside of meander bends have provided bank stability and in-stream cover for fish and other aquatic organisms. Project problem areas relating to in-stream stability and structures are described in Section 3.2.5.

3.2.3 Hydrologic Criteria

Two crest gauges were installed on the Site to document bankfull events. The gauges are checked during each site visit and record the highest out-of-bank flow between site visits. The gauges are located on the downstream portion of UT1_R4 at station 75+50 and UT5_R2 at station 23+50.

The approved Restoration Plan requires the following criteria be met to achieve stream restoration success: Two bankfull flow events must be documented within the five-year monitoring period. The two bankfull events must occur in separate years, otherwise, the stream monitoring will continue until two bankfull events have been documented in separate years.

3.2.4 Hydrologic Monitoring Results

According to the on-site crest gauges, the Site experienced at least two bankfull flow events during Year 4 of the post-construction monitoring period. The largest on-site bankfull flow events documented by the UT1 crest gauge during Year 4 of monitoring occurred on March 6, 2011. It was estimated that flows at the UT1_R4 crest gauge during the December 1, 2011 storm event were approximately 0.35 feet (4.2 inches) above bankfull stage, but this storm fell under Year 3 monitoring. To approximate the amount of precipitation that fell on the Site during these events, rain data from the USGS Ararat river weather station (02113850) in Ararat, NC were used. According to the Ararat station, approximately 2.10 inches of rain fell in the Pilot Mountain region between November 30 and December 1 of 2011.

According to the Ararat station, approximately 5.17 inches of rain fell in the Pilot Mountain region between February 28 and March 6 of 2011.

Following the March 6, 2011 storm, the crest gauge on UT5 was not read. However, the UT5 crest did document out of channel bankfull flows during Year 4 monitoring. The largest flow documented by the UT5 crest gauge during Year 4 of monitoring was 0.22 feet (2.6 inches) above bankfull stage. Inspection of conditions during site visits revealed visual evidence of out-of-bank flows.

Crest gauge readings are presented in Table 6 and photos of the crest gauges and out-of-bank evidence are presented in Appendix B.

Table 6. Verification of Bankfull Events				
Pinch Gut Creek Stream Restoration Site: EEP Contract No. D06043-A				
Date of Data Collection	Estimated Occurrence of Bankfull Event	Method of Data Collection	UT1 Reach 4 – Crest (feet)	UT5 Reach 2 – Crest (feet)
2/1/2011	December 1, 2010	Crest Gauge	0.35	0.22
6/9/2011	March 6, 2011	Crest Gauge	0.30	No reading

3.2.5 Stream Problem Areas

During Year 3 monitoring, pools located on reaches UT1_R2, UT1_R4, UT5_R1, and UT5_R2 experienced isolated bank erosion along the outer meander bends. Most problems that were identified during Year 3 of monitoring were caused by extensive storm damage in the winter/spring of 2010, primarily due to saturated soil conditions and poor vegetation establishment in some areas. Repair work to these problem areas was necessary to correct the damage incurred from the storm. Repairs to the concerned areas were completed

between August and December of 2010. Visual observations of the repaired areas during Year 4 monitoring indicated the repairs were successful and did not indicate any other issues.

As noted in Section 3.2.2, in-stream repairs were mostly concentrated within the pool areas. The work completed between August and December 2010 included adding geolifts to protect the outside of meander bends, adding a cross vane structure for increased bed stability, and adding additional Class I and B stone to constructed riffles and/or problem areas. Other repairs in the UT1_R4 area included re-grading channel bottoms/banks and re-centering of the thalweg. The areas of disturbance were matted and seeded following the repairs.

During Year 3, in-stream repairs on UT5_R1 and UT5_R2 were also completed. On UT5_R1, a brush mattress was installed along the right bank to increase bank stability near station 12+00. In-stream repairs on UT5_R1 were also completed on a J-Hook structure that experienced minor piping at station 18+25.

The planting of 3-year old containerized trees and shrubs, and live stakes occurred winter/spring 2011 in areas that were repaired and/or areas on the floodplain that experienced erosional scour from the large storm event.

The repairs completed during 2010 will be closely observed during Year 5 monitoring.

3.2.6 Stream Photographs

Photographs are used to document restoration success visually. A total of 144 reference stations were installed and photographed after construction. Photographs of these reference stations will be collected for at least five years following construction. Reference photos are taken at least twice per year, and are taken in enough locations to document the condition of the restored system. Permanent markers were established to ensure that the same locations (and view directions) on the Site are documented in each monitoring period.

The stream systems are photographed longitudinally beginning at the downstream portion of the restoration reaches and moving upstream to the beginning of the reaches. Photographs are taken looking upstream at designated locations. Reference photo locations are marked and described for future reference. Points are spaced sufficiently close enough together to provide an overall view of the reach. The angle of the shot depends on which angle provides the best view and is noted and continued in future photos. When modifications to photo position are made due to obstructions or other reasons, the position is noted along with any landmarks and the same position is used in the future.

Additional photographs are taken to document any observed evidence of flooding patterns such as debris, wrack lines, water marks, channel features, etc.

Both stream banks are photographed at all permanent cross-section photo stations. For each stream bank photo, the photo view line follows a survey tape placed across the channel, perpendicular to flow (representing the cross-section line). The photograph is framed so that the survey tape is centered in the photo (appears as a vertical line at the center of the photograph), keeping the channel water surface line horizontal and near the lower edge of the frame.

A photo log of the restored channel is presented in the attached CD of this report. Photos for each of the 22 permanent cross-sections are included in Appendix B.

Photographs of the restored channel were taken in November 2011 to document the evolution of the stream geometry. Herbaceous vegetation and shrubs were dense along the banks of UT1_R3, UT3, UT5 and UT6, making the photography of some of the stream channel areas difficult.

3.2.7 Stream Stability Assessment

Table B.1 provides a summary of the results obtained from the visual inspection of in-stream structures performed during Year 4 of post-construction monitoring. The percentages noted are a general, overall field evaluation of the how the features were performing at the time of the photo point survey. According to the visual stability assessment following Year 4 monitoring and after a visual evaluation of the August 2009 repairs and the fall 2010 repairs, all features on the Site are currently performing as designed.

3.2.8 Quantitative Measures Summary Tables

The quantitative pre-construction, reference reach, and design data used to determine restoration approach, as well as the as-built baseline data used during the project's post construction monitoring period are summarized in Appendix B.

4.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

Stream Monitoring - The total length of stream channel restored on the Site was 10,581 LF. This entire length was inspected during Year 4 of the monitoring period to assess stream performance. Although additional repairs were completed in 2010, Year 4 monitoring did not reveal any other significant problem areas within the boundaries of the Site.

A longitudinal profile survey was completed during Year 4 of monitoring for 3,589 LF of stream on the Site.

Data for the UT1_R2 Year 4 longitudinal profile show that the riffles in this reach have maintained relatively the same bed elevations since as-built conditions, with the exceptions of stations 33+18 and 38+38 as stated in Section 3.2.2. The longitudinal profile demonstrates that the in-stream structures within UT1_R4 are stable and functioning as designed.

Data for the UT1_R4 Year 4 longitudinal profile show that between stations 58+22 to 82+53, riffles have maintained relatively stable riffle elevations and pools have remained deep after the 2010 repairs. The visual assessment demonstrated that some of the pools had experienced moderate bank erosion and in-stream structure damage during the winter of 2010. It was determined that in-stream repairs were needed to ensure channel stability in the future. In-stream repairs within UT1_R4 were completed in August and December 2010. According to the Year 4 survey and monitoring, all of the repaired areas were stable and functioning as designed.

Year 4 cross-section monitoring data for stream stability were collected during September and November 2011. Cross-sections 1, 2, 4, 6, 8, 10, 12, 14, 15, 17, 19, 21 and 22 are situated across riffles, which are located between pools. Cross-sections 3, 5, 7, 9, 11, 13, 16, 18 and 20 are situated across pools which are located at the apex of meander bends. Based on the Year 4 survey data, the cross-sections demonstrate low to moderate fluctuations in channel dimension since as-built conditions. Overall, the cross-sections appear to be stable and are functioning as designed.

In-stream repairs on UT1_R3, UT1_R4, UT5_R1, and UT5_R2 were completed in 2010. All repairs were functioning properly after completion and will continue to be closely observed during Year 5 of monitoring.

According to the on-site crest gauges, the Site experienced at least two bankfull flow events during Year 4 of the post-construction monitoring period. The largest on-site bankfull flow events documented by the UT1 crest gauge during Year 4 of monitoring occurred approximately on March 6, 2011. It was estimated that flows at the UT1_R4 crest gauge during the March storm event were approximately 0.30 feet (3.6 inches) above bankfull stage. Inspection of conditions during site visits revealed visual evidence of out-of-bank flows.

Vegetation Monitoring - Data from the Year 4 monitoring event of the 21 vegetation plots exhibited a range of 200 to 800 stems per acre. The data showed that the Site had an average of survivability of 518 stems per acre. Density within Plots 1, 2, and 6 will be closely observed during Year 5 monitoring.

Approximately ten volunteer tulip poplar (*Liriodendron tulipifera*) stems were noted within the boundaries of Vegetation Plot 1 following Year 4 monitoring. According to the vegetation monitoring data, the density of Plot 1 was 200 stems per acre, following Year 4. If the approximated ten volunteer stems of *Liriodendron tulipifera* are included in the stem count for

plot 1, then the stem density exceeds 320 stems per acre. The monitoring data demonstrate that all other plots on the Site have met the minimum interim success criteria of 320 trees per acre by the end of Year 3.

According to the Year 4 vegetative monitoring data, the Site is on track to meet the final success criteria of 260 stems per acre by the end of Year 5.

5.0 WILDLIFE OBSERVATIONS

Observations of deer and raccoon tracks are common on the Site. During the Year 4 of monitoring season, many small animals such as snakes and frogs were periodically observed. Various birds were observed on the Site throughout the monitoring season.

6.0 REFERENCES

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

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

USDA, NC Agricultural Experiment Station, *Soil Survey of Stokes County, North Carolina*, 1995.

FIGURES

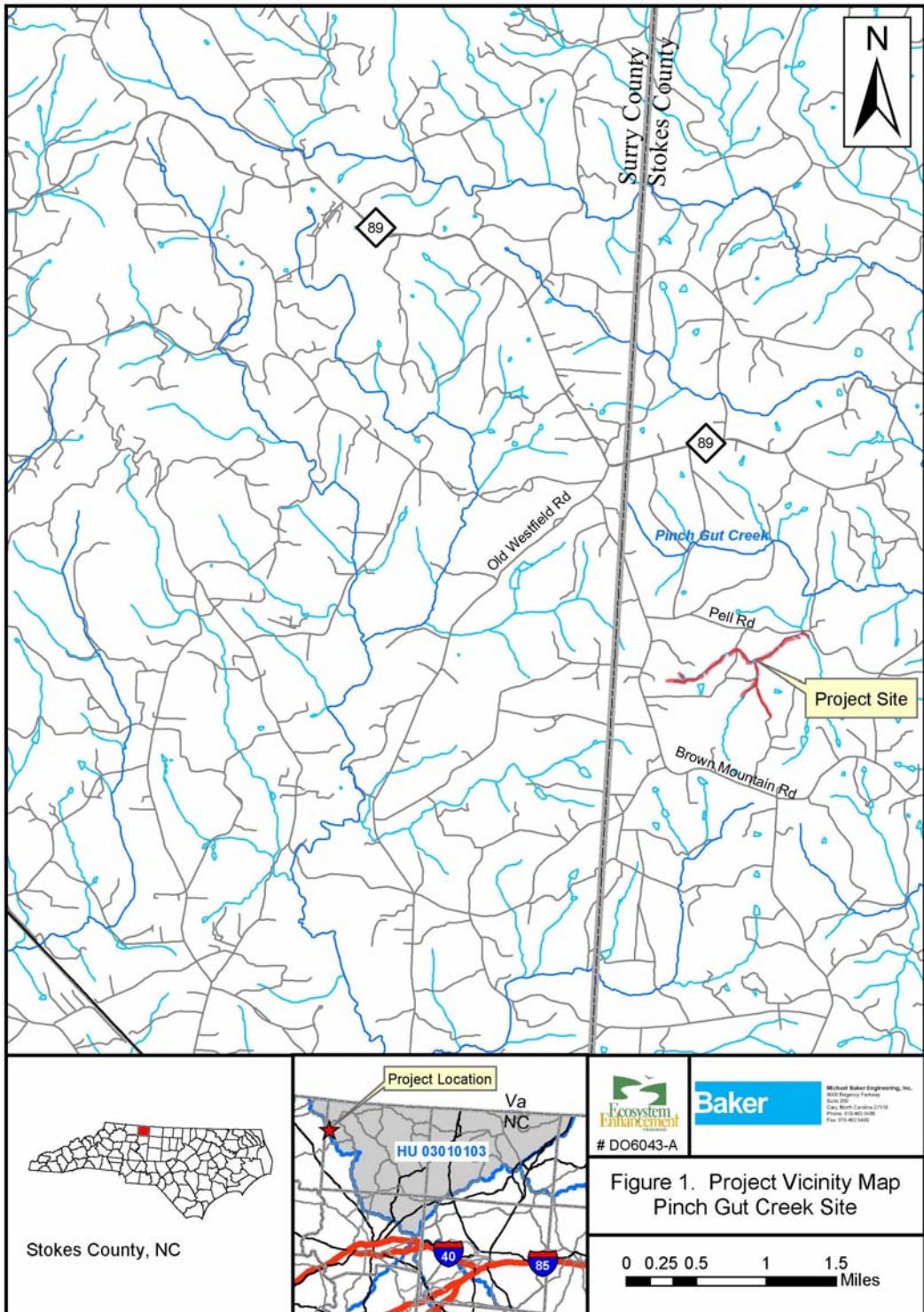


Figure 1. Location of Pinch Gut Creek Stream Restoration Site.

PROJECT: 109294 PINCH GUT CREEK

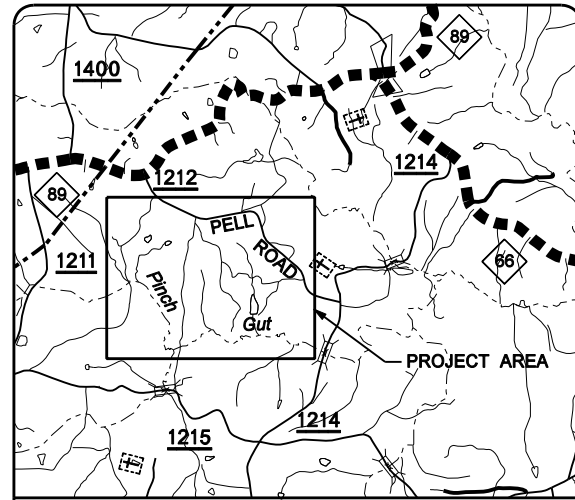
**STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM**

STOKES COUNTY

**LOCATION: 5 MILES NORTHEAST OF PILOT MOUNTAIN
OFF PELL ROAD SR 1215**

**TYPE OF WORK: AS-BUILT DRAWINGS FOR MITIGATION REPORT
STREAM RESTORATION PROJECT
NCEP PROJECT# D06043-A**

STATE	BAKER PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	109294	1	24
NO.	DATE	CHECKED BY	APPROVED BY
1	06/19/08	KV	KLT



VICINITY MAP

INDEX OF SHEETS

- 1 TITLE SHEET
- 1-A STREAM CONVENTIONAL SYMBOLS, GENERAL NOTES, STANDARD SPECIFICATIONS, AND VEGETATION SELECTION
- 1-B CONVENTIONAL SYMBOLS
- 2 TO 6 TYPICAL POOL AND RIFFLE CROSS SECTIONS, STRUCTURE DETAILS
- 7 TO 15 AS-BUILT PLAN VIEW
- 16 TO 22 AS-BUILT PROFILES

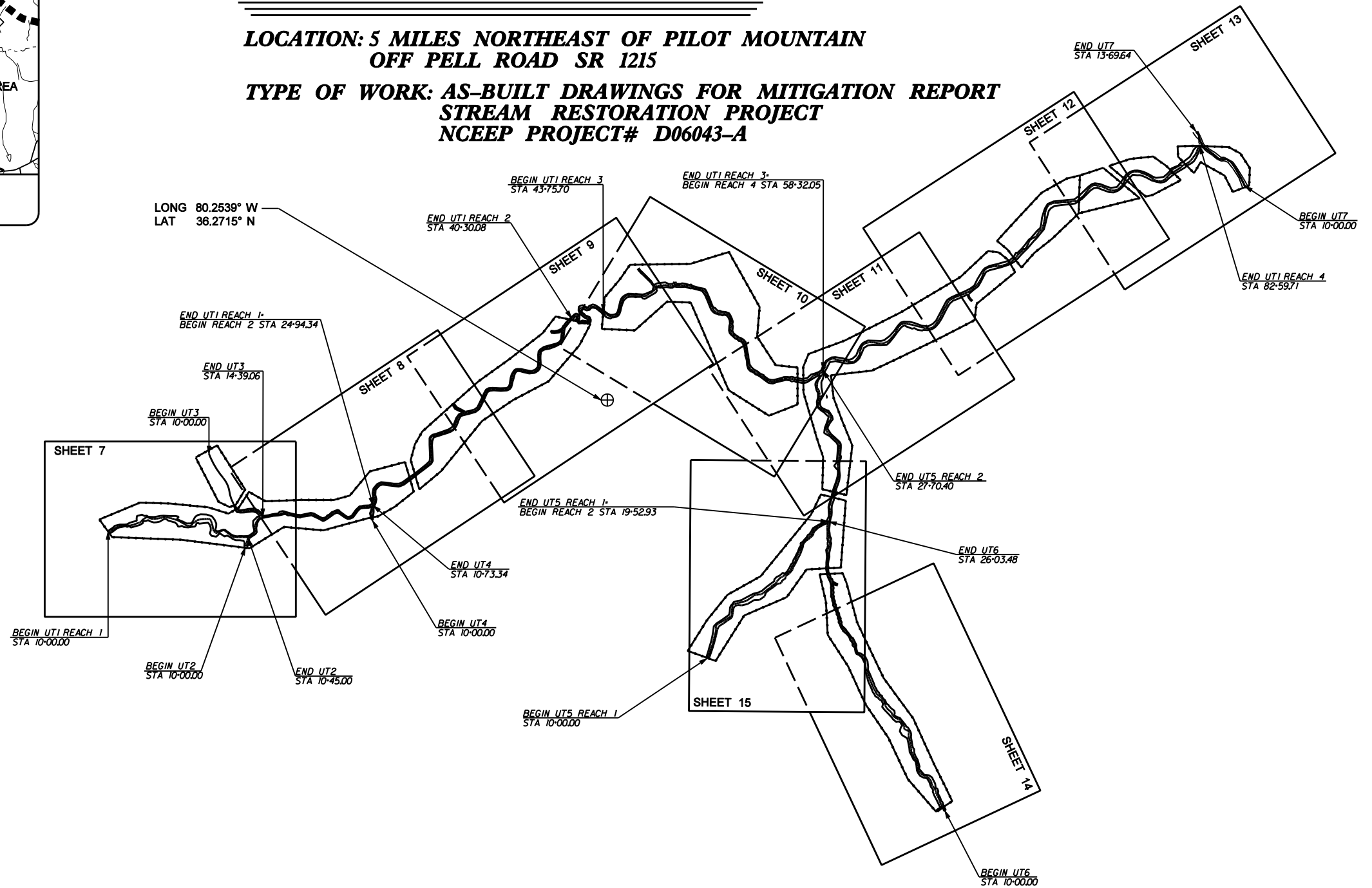
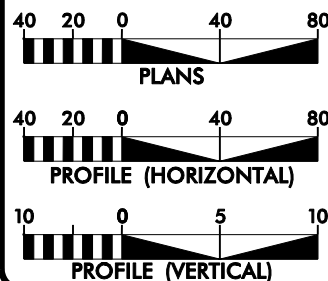


FIGURE 2A

GRAPHIC SCALES



AS-BUILT SUMMARY (YEAR 0-BASELINE DATA)

Project Reach	Existing Length (ft)	As-built Length (ft)	Restoration Approach
UT1_R1	1,484	1,494	Restoration - Priority Level I & II approaches
UT1_R2	1,952	1,506	Restoration - Priority Level I & II approaches
UT1_R3	1,647	1,427	Restoration - Priority Level I & II approaches
UT1_R4	2,677	2,302	Restoration - Priority Level I & II approaches
UT2	54	45	Restoration - Priority Level II approach
UT3	256	428	Restoration - Priority Level I & II approaches
UT4	96	60	Restoration - Priority Level II approach
UT5_R1	969	953	Restoration - Priority Level I & II approaches
UT5_R2	842	791	Restoration - Priority Level I & II approaches
UT6	1,648	1,575	Restoration - Priority Level I & II approaches
UT7	299	292	Enhancement - Level II approach
TOTAL	11,924	10,873	

PREPARED FOR THE OFFICE OF:
 NCDENR - ECOSYSTEM ENHANCEMENT PROGRAM
 2728 CAPITAL BLVD, SUITE 1H 103
 RALEIGH, NC 27604



NCEP CONTACT: GUY PEARCE
 PROJECT CONTACT

PREPARED IN THE OFFICE OF:

Baker

Michael Baker Engineering, Inc.
 6000 Regency Parkway
 Suite 200
 Cary, NORTH CAROLINA 27518
 Phone: 919.463.5488
 Fax: 919.463.5490

MAY 2008
 COMPLETION DATE:

KEVIN TWEEDY, PE
 PROJECT ENGINEER

KAYNE VAN STELL
 PROJECT MANAGER

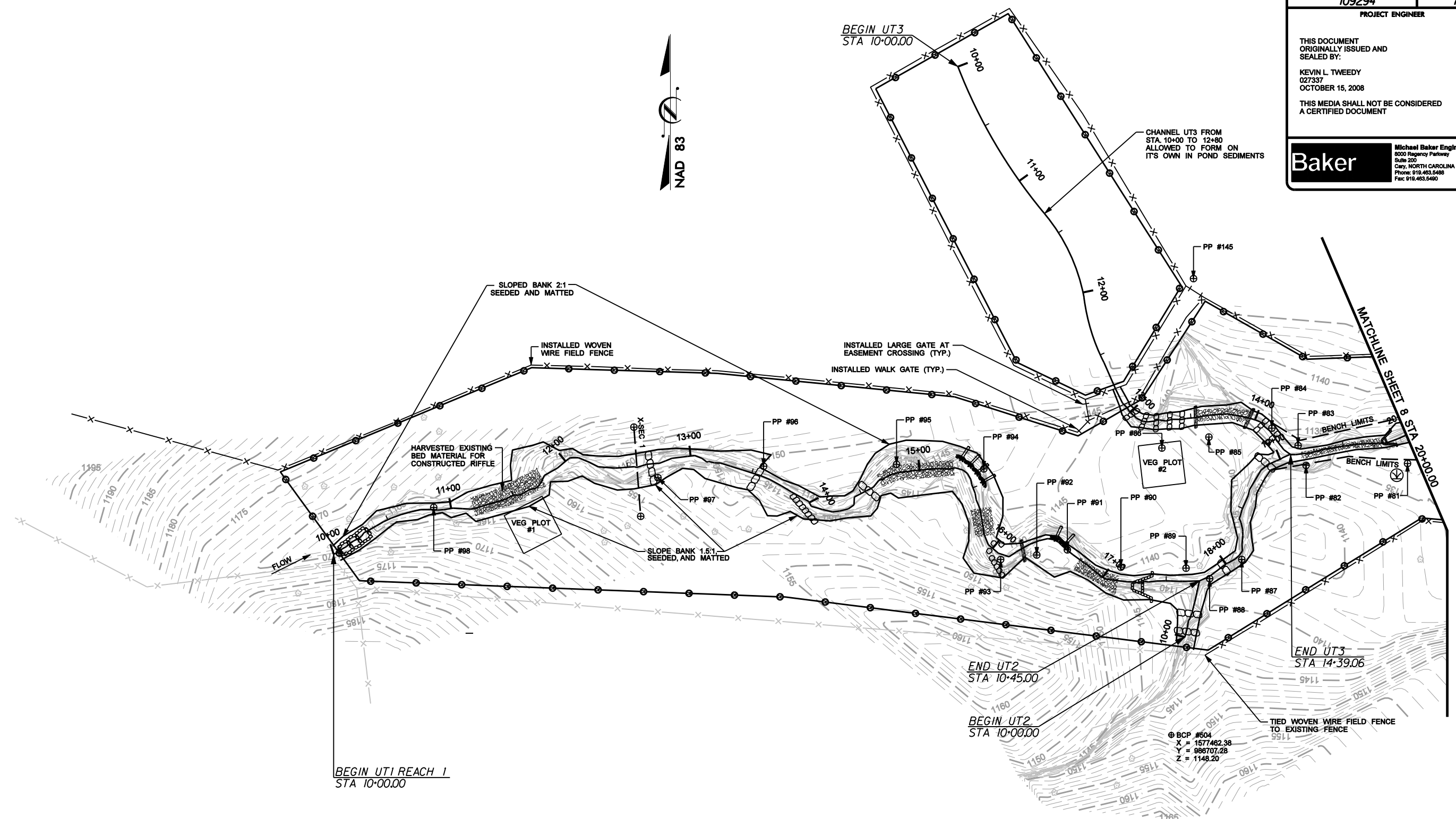
PROJECT ENGINEER

THIS DOCUMENT
 ORIGINALLY ISSUED AND
 SEALED BY:

KEVIN L. TWEEDY
 027337
 OCTOBER 15, 2008

THIS MEDIA SHALL NOT BE CONSIDERED
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SIGNATURE: P.E.



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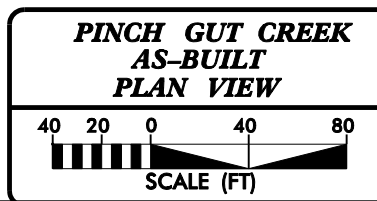
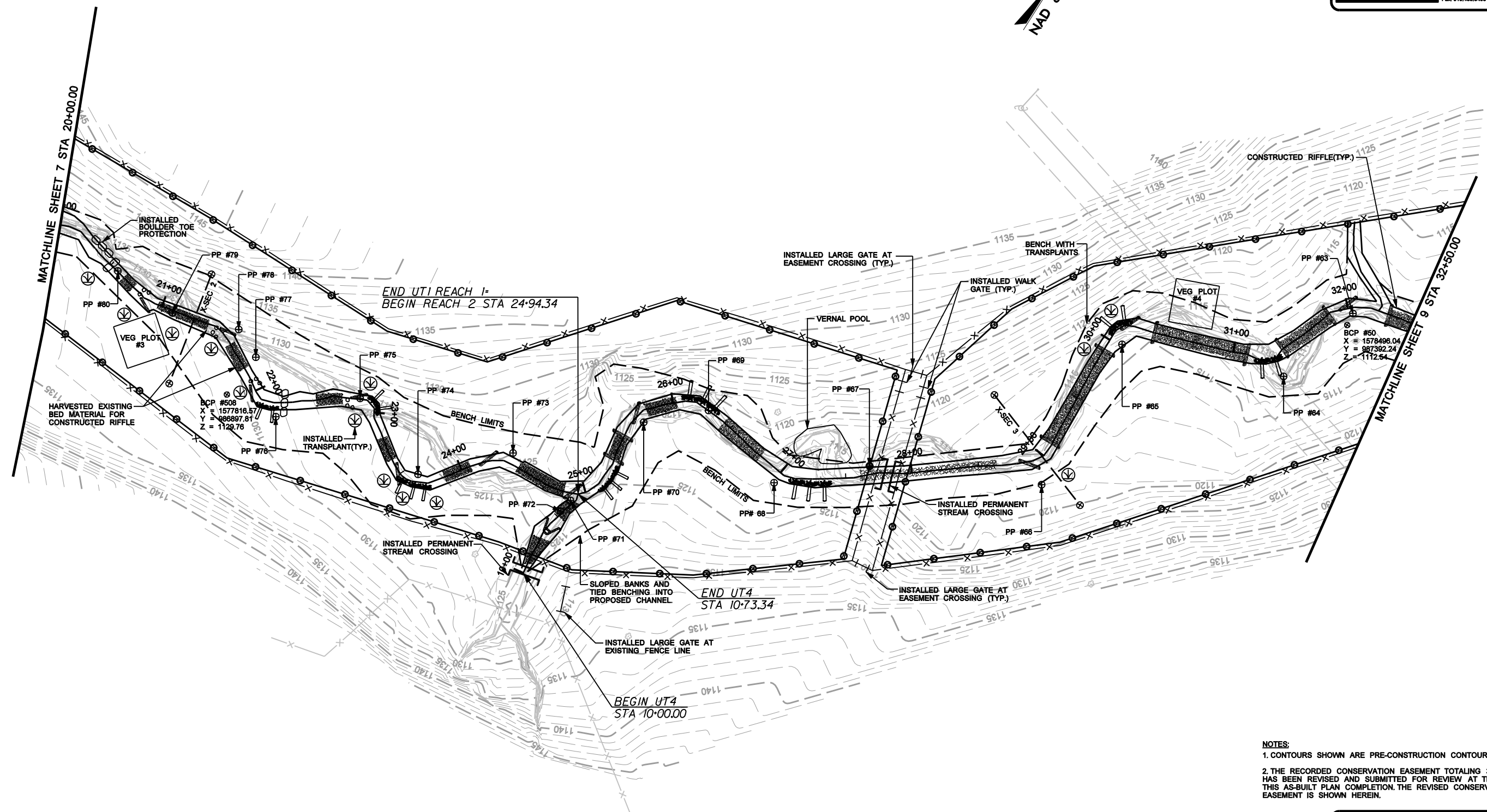
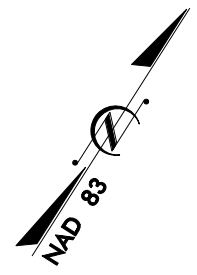


FIGURE 2B

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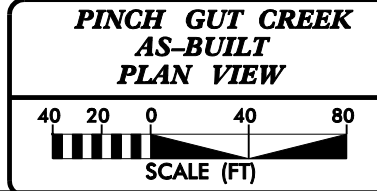
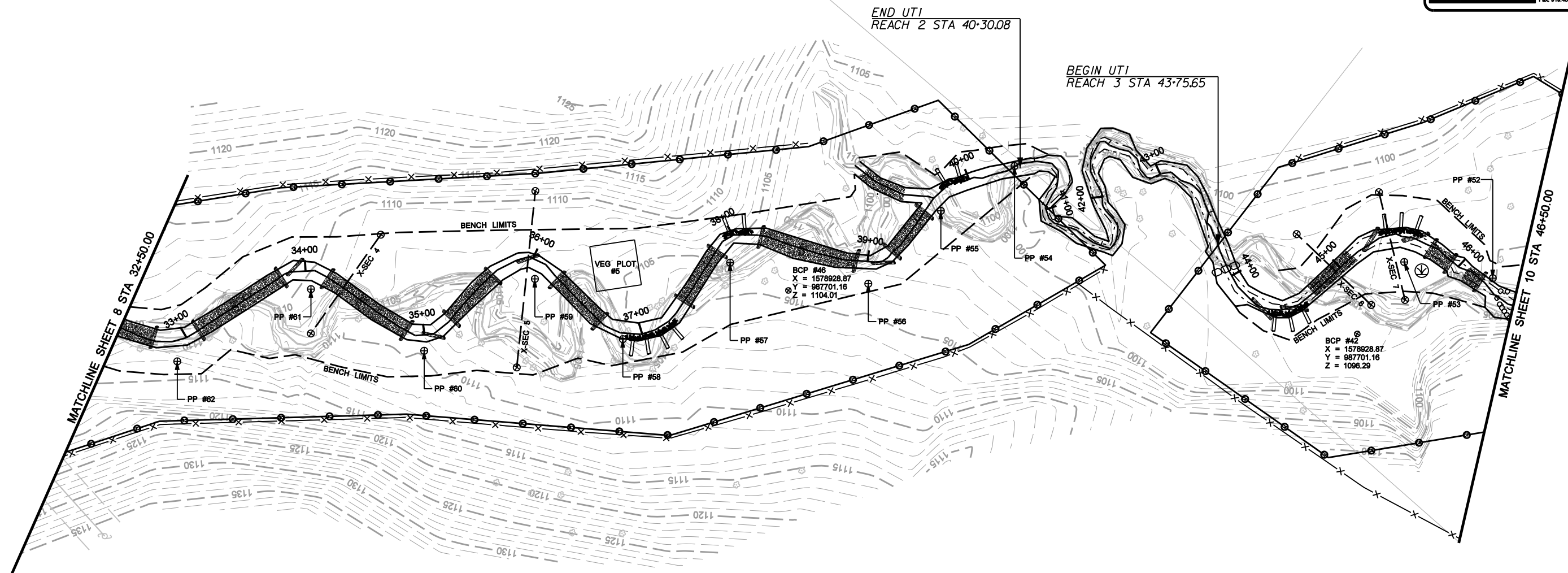
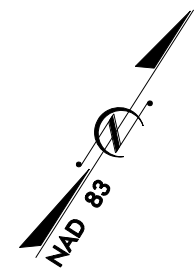


FIGURE 2C

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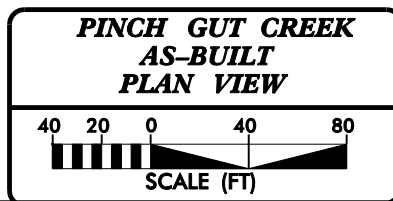
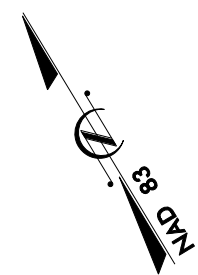
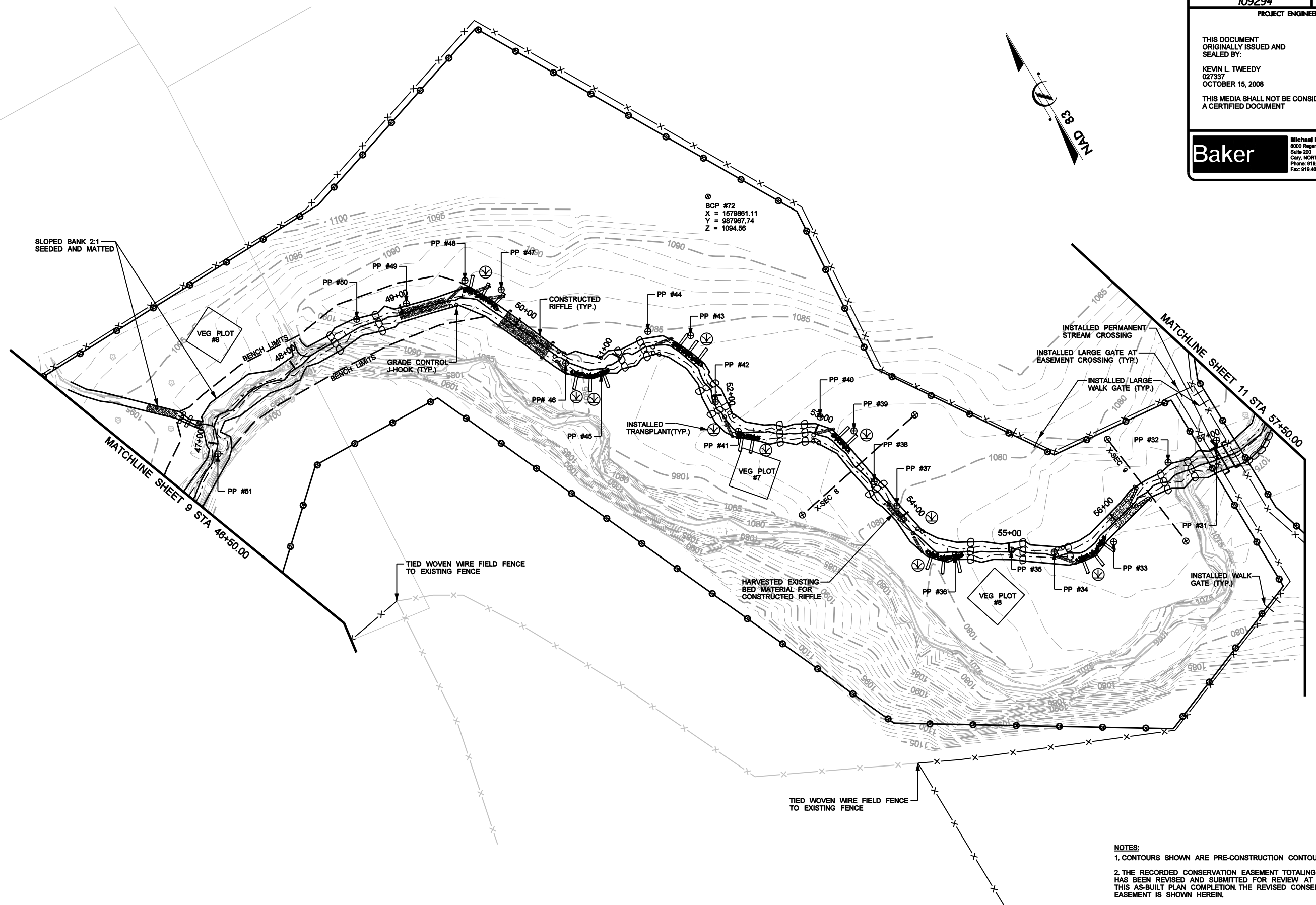


FIGURE 2D

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BCP #72
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Z = 1094.56

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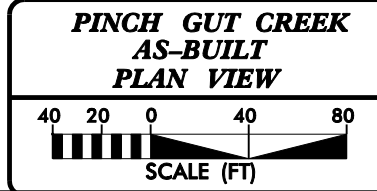
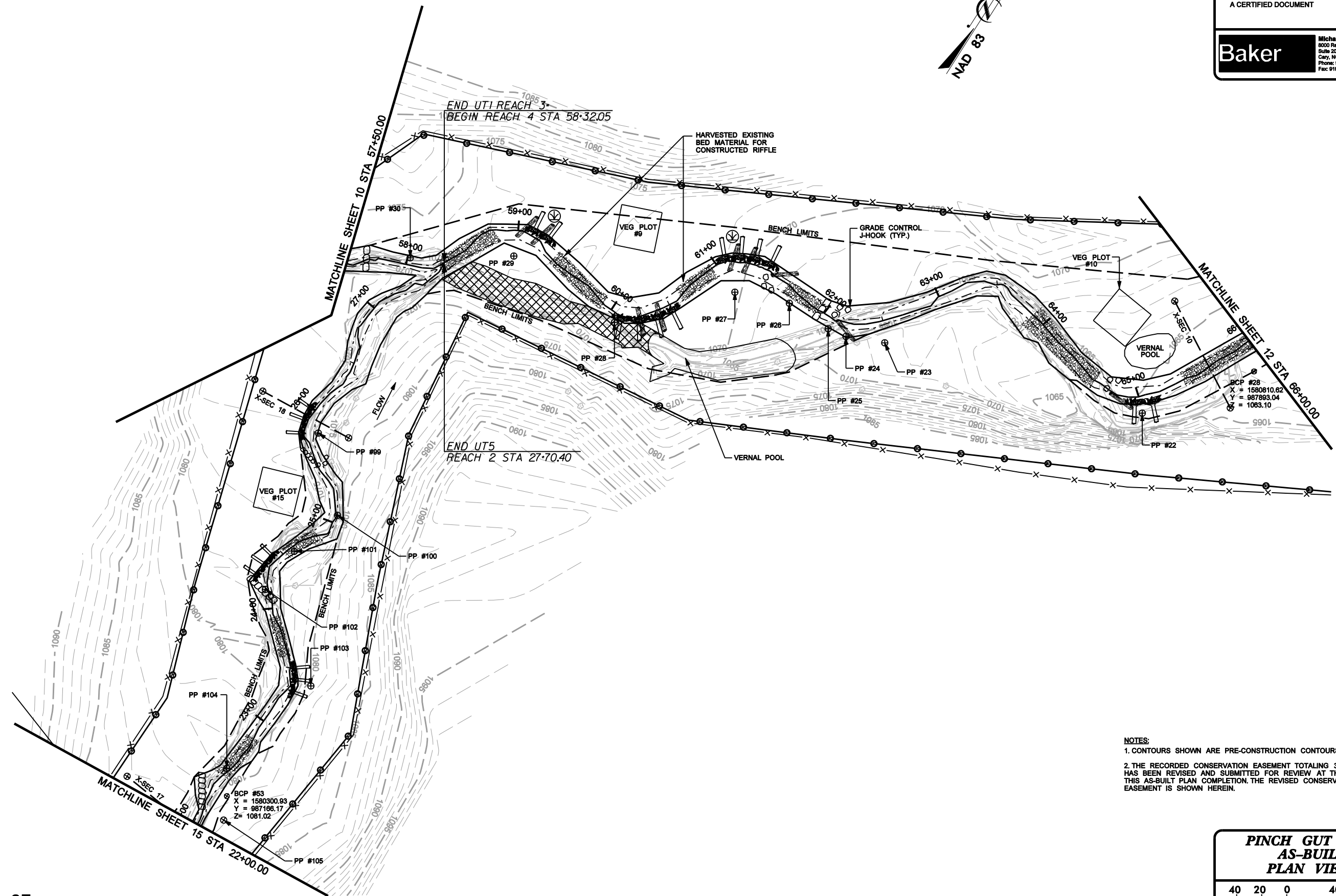
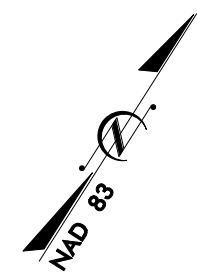


FIGURE 2E

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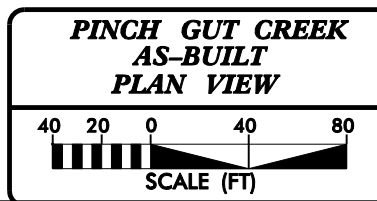
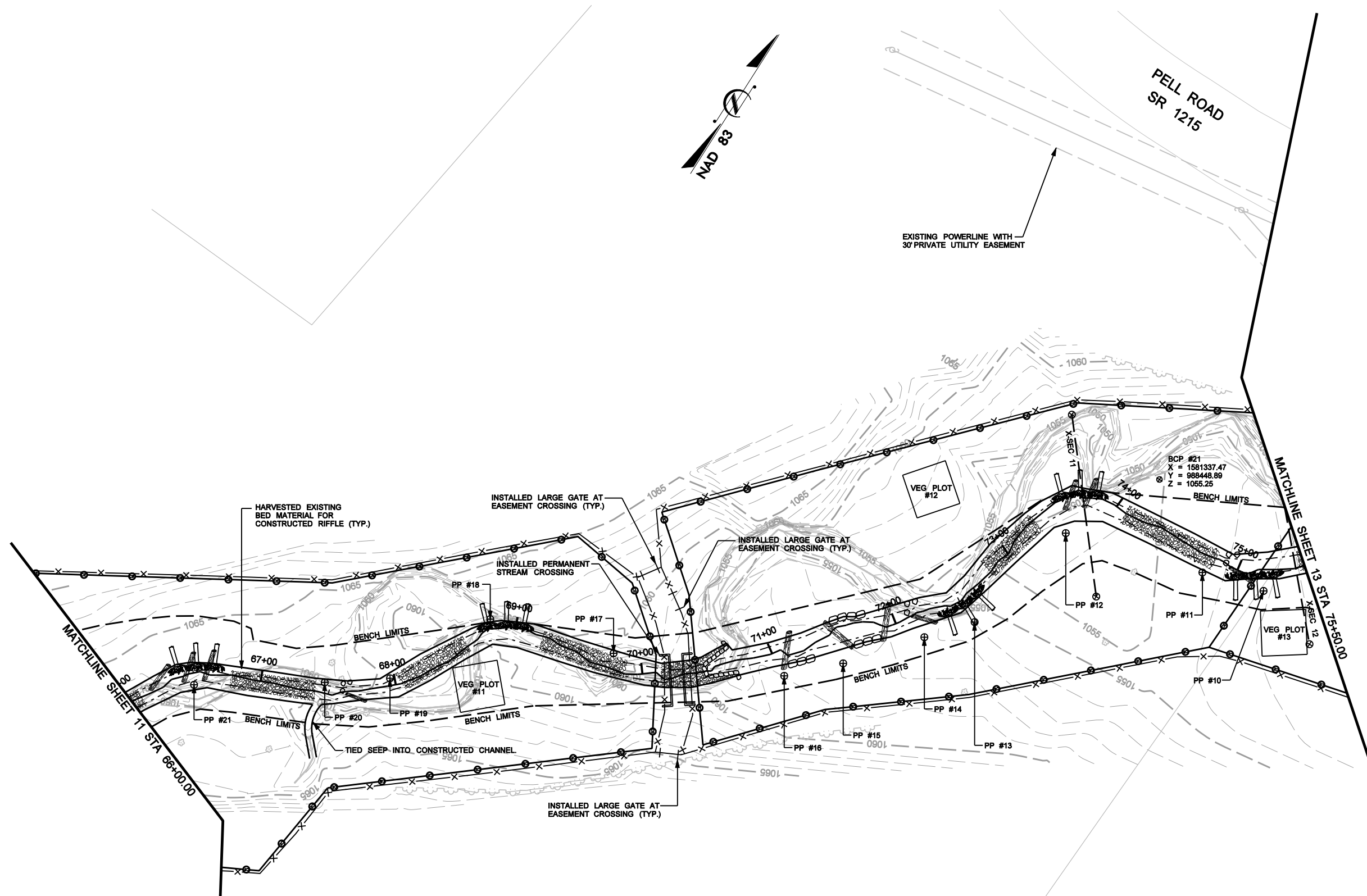


FIGURE 2F

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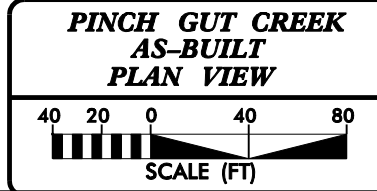
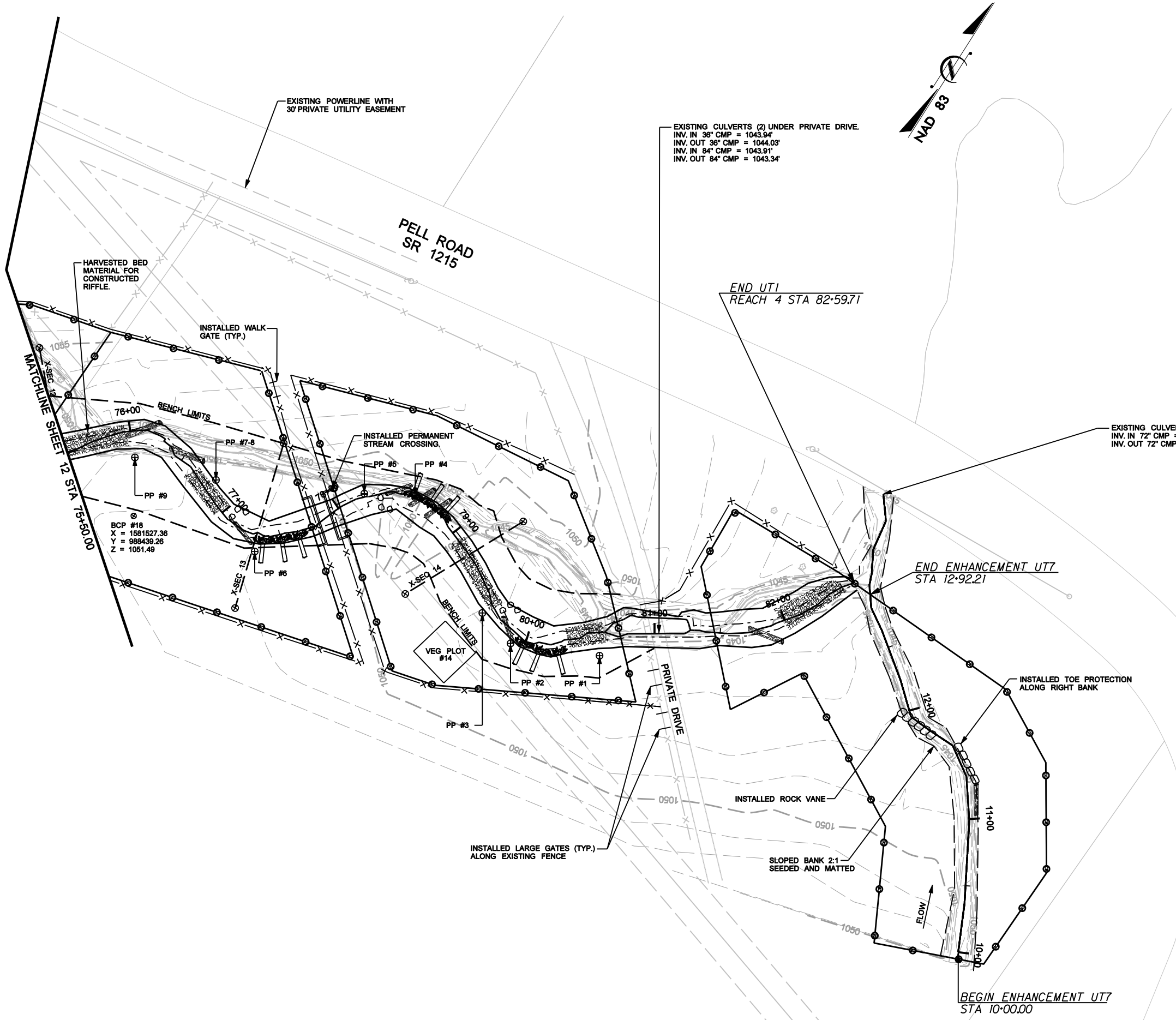


FIGURE 2G

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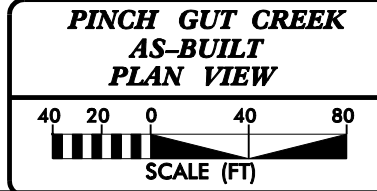
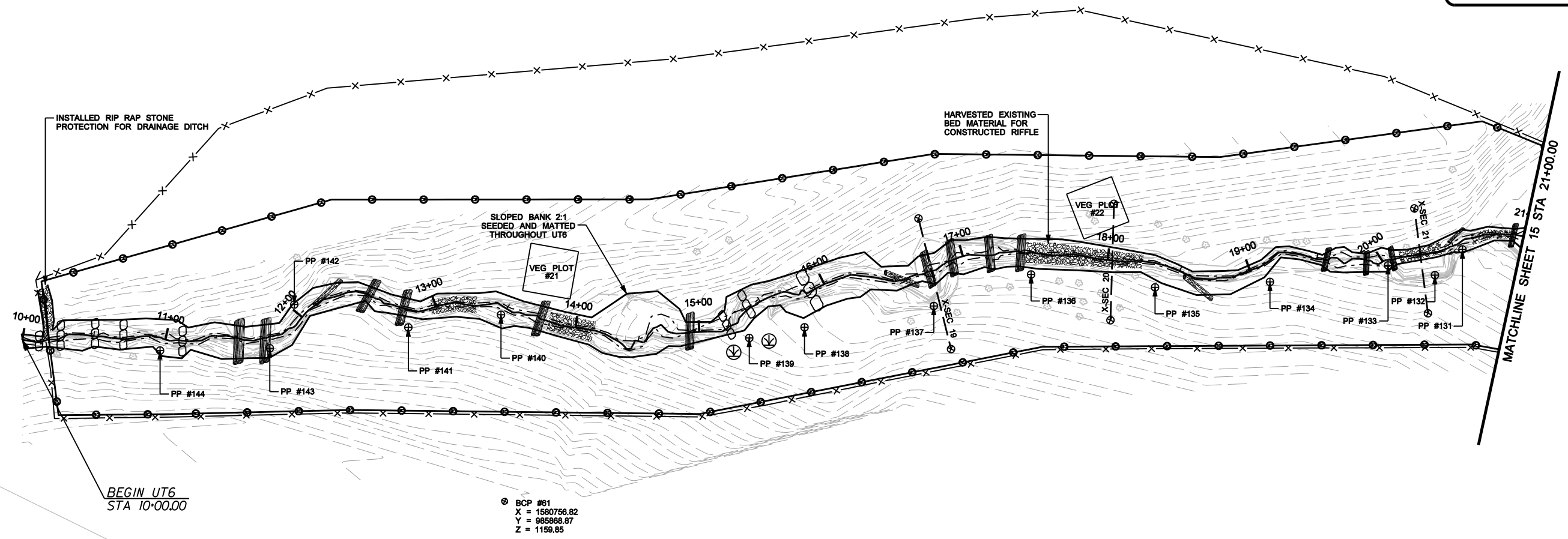
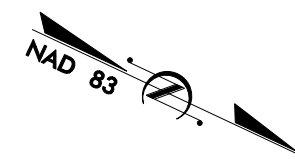


FIGURE 2H

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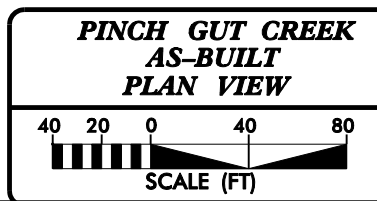
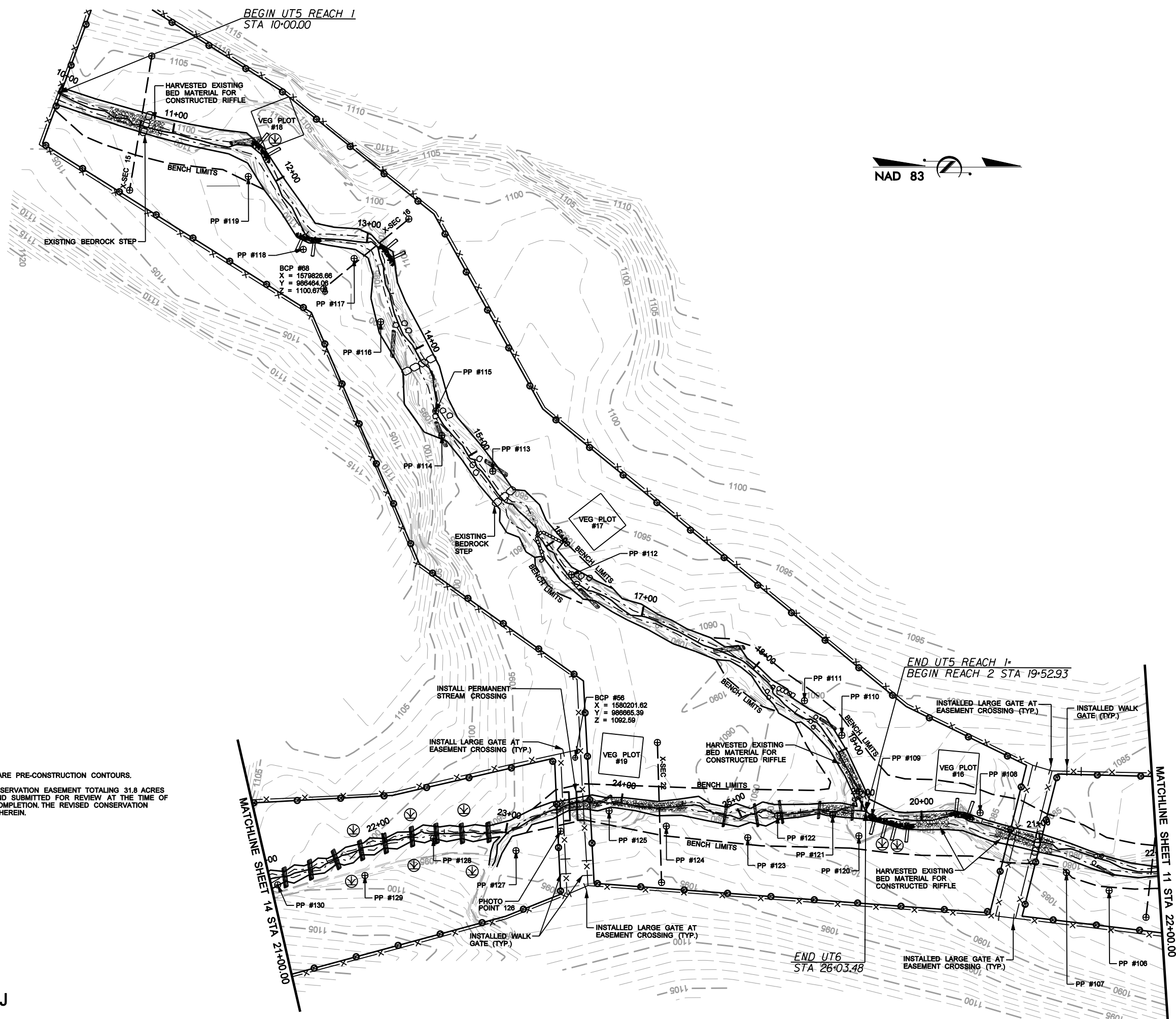


FIGURE 21

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 2/26/08



NOTES:
 1. CONTOURS SHOWN ARE PRE-CONSTRUCTION CONTOURS.
 2. THE RECORDED CONSERVATION EASEMENT TOTALING 31.8 ACRES HAS BEEN REVISED AND SUBMITTED FOR REVIEW AT THE TIME OF THIS AS-BUILT PLAN COMPLETION. THE REVISED CONSERVATION EASEMENT IS SHOWN HEREIN.

FIGURE 2J

**PINCH GUT CREEK
AS-BUILT
PLAN VIEW**

SCALE (FT)

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 2/26/08

APPENDIX A

VEGETATION DATA

VEGETATION TABLES

Table A.1. Vegetation Metadata

Pinch Gut Restoration Site: Project No. D06043-A	
Report Prepared By	Dwayne Huneycutt
Date Prepared	10/20/2011 14:37
database name	Baker-2010-B-PinchGut_DukeSwamp.mdb
database location	L:\Monitoring\Veg Plot Info\CVS Data Tool\2010
computer name	CARYWDHUNEYCU2
file size	36540416
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY-----	
Project Code	PG
project Name	Pinch Gut
Description	The Pinch Gut Creek Restoration Site was restored through a full delivery contract with the North Carolina Ecosystem Enhancement Program (NCEEP).
River Basin	Roanoke
length(ft)	10873
stream-to-edge width (ft)	50
area (sq m)	101003.25
Required Plots (calculated)	20
Sampled Plots	21

Table A.2. Vegetation Vigor by Species

Pinch Gut Restoration Site: Project No. D06043-A									
	Species	CommonName	4	3	2	1	0	Missing	Unknown
	<i>Alnus serrulata</i>	hazel alder			3				
	<i>Betula nigra</i>	river birch	49	13	2	1			
	<i>Cornus amomum</i>	silky dogwood	14	11	3				
	<i>Corylus americana</i>	American hazelnut	5	16	2		1		
	<i>Diospyros virginiana</i>	common persimmon	8	10	8		2		
	<i>Quercus phellos</i>	willow oak	12	7	3				
	<i>Carpinus caroliniana</i>	American hornbeam	7	4	1		1		
	<i>Quercus rubra</i>	northern red oak	1	11	4		2		
	<i>Lindera benzoin</i>	northern spicebush		7	4	2	7		
	<i>Liriodendron tulipifera</i>	tuliptree	10	7	8		2		
	<i>Platanus occidentalis</i>	American sycamore	27	8	4		1		
TOT:	11	11	133	94	42	3	16		

Table A.3. Vegetation Damage by Species

Pinch Gut Restoration Site: Project No. D06043-A							
Species	CommonName	Count of Damage Categories					
		No Damage	Deer	Unknown	Vine Strangulation		
<i>Alnus serrulata</i>	hazel alder	2	1	1	1		
<i>Betula nigra</i>	river birch	0	65				
<i>Carpinus caroliniana</i>	American hornbeam	0	13				
<i>Cornus amomum</i>	silky dogwood	2	26	1		1	
<i>Corylus americana</i>	American hazelnut	0	24				
<i>Diospyros virginiana</i>	common persimmon	2	26	1		1	
<i>Lindera benzoin</i>	northern spicebush	1	19	1			
<i>Liriodendron tulipifera</i>	tuliptree	1	26			1	
<i>Platanus occidentalis</i>	American sycamore	0	40				
<i>Quercus phellos</i>	willow oak	1	21			1	
<i>Quercus rubra</i>	northern red oak	2	16	1	1		
TOT:	11	11	277	5	2	4	

Table A.4. Vegetation Damage by Plot

Pinch Gut Restoration Site: Project No. D06043-A						
<i>Plot</i>	<i>Count of Damage Categories</i>	<i>No Damage</i>	<i>Deer</i>	<i>Unknown</i>	<i>Vine Strangulation</i>	
PG-01-VP1-year:4	0	11				
PG-01-VP2-year:4	1	7	1			
PG-01-VP3-year:4	0	10				
PG-01-VP4-year:4	0	11				
PG-01-VP5-year:4	0	10				
PG-01-VP6-year:4	0	9				
PG-01-VP7-year:4	0	13				
PG-01-VP8-year:4	2	12	1		1	
PG-01-VP9-year:4	3	11	2		1	
PG-01-VP10-year:4	1	16			1	
PG-01-VP11-year:4	1	8			1	
PG-01-VP12-year:4	0	19				
PG-01-VP13-year:4	2	18	1	1		
PG-01-VP14-year:4	0	14				
PG-01-VP15-year:4	0	18				
PG-01-VP16-year:4	0	18				
PG-01-VP17-year:4	0	12				
PG-01-VP18-year:4	0	13				
PG-01-VP19-year:4	1	17		1		
PG-01-VP20-year:4	0	17				
PG-01-VP21-year:4	0	13				
TOT:	21	277	5	2	4	

Table A.5. Planted Stems by Plot and Species

Pinch Gut Restoration Site: Project No. D06043-A																										
Comment	Species	Common Name	Total Planted Stems	# Plots	avg# stems	Plots																				
						Plot PG-01-Vp1-year:4	Plot PG-01-Vp2-year:4	Plot PG-01-Vp3-year:4	Plot PG-01-Vp4-year:4	Plot PG-01-Vp5-year:4	Plot PG-01-Vp6-year:4	Plot PG-01-Vp7-year:4	Plot PG-01-Vp8-year:4	Plot PG-01-Vp9-year:4	Plot PG-01-Vp10-year:4	Plot PG-01-Vp11-year:4	Plot PG-01-Vp12-year:4	Plot PG-01-Vp13-year:4	Plot PG-01-Vp14-year:4	Plot PG-01-Vp15-year:4	Plot PG-01-Vp16-year:4	Plot PG-01-Vp17-year:4	Plot PG-01-Vp18-year:4	Plot PG-01-Vp19-year:4	Plot PG-01-Vp20-year:4	Plot PG-01-Vp21-year:4
	<i>Alnus serrulata</i>	hazel alder	3	1	3																					3
	<i>Betula nigra</i>	river birch	65	18	3.61		5	3		4	4	3	4	3	2	3	1	4	3	2	2	9	5	3	5	
	<i>Carpinus caroliniana</i>	American hornbeam	12	4	3										3	2							5			2
	<i>Cornus amomum</i>	silky dogwood	28	5	5.6			2			4	10	10	2												
	<i>Corylus americana</i>	American hazelnut	23	5	4.6									1			5							3	7	7
	<i>Diospyros virginiana</i>	common persimmon	26	9	2.89		3	2		4				2		4	2	4	4			1				
	<i>Lindera benzoin</i>	northern spicebush	13	7	1.86	1		2						1	1			3	4				1			
	<i>Liriodendron tulipifera</i>	tuliptree	25	8	3.12				2	2					7		3			5	3		1			2
	<i>Platanus occidentalis</i>	American sycamore	39	9	4.33	4			8					4	2		3	5		5	4			4		
	<i>Quercus phellos</i>	willow oak	22	10	2.2			1							1	2	3		3	4			1	1	5	1
	<i>Quercus rubra</i>	northern red oak	16	5	3.2									1				1		2	6			6		
TOT:	0	11	272	11		5	8	10	10	10	8	13	14	14	16	9	19	20	14	18	15	10	13	17	17	12

Table A.6. Plot Species and Densities

Pinch Gut Restoration Site Contract No. D06043-A

Tree Species	Plots																					Year 4 Totals	Yearly Average Stems/acre
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		
<i>Betula nigra</i>		5	3		4	4	3	4	3	2	3	1	4	3	2	2	9	5	3	5		65	
<i>Liriodendron tulipifera</i>				2	2					7		3			5	3		1			2	25	
<i>Quercus phellos</i>			1							1	2	3		3	4			1	1	5	1	22	
<i>Quercus rubra</i>									1				2		2	6			6			17	
<i>Diospyros virginiana</i>		3	2		4				2		4	2	5	4			1					27	
<i>Juglans nigra</i>																						0	
<i>Platanus occidentalis</i>	4			8					4	2		2	4		5	4				4		37	
<i>Quercus michauxii</i>																						0	
<i>Unknown</i>																						0	
Shrub Species																							
<i>Alnus serrulata</i>													2									2	
<i>Lindera benzoin</i>	1		2						1	1		1	3	4				1				14	
<i>Corylus americana</i>									1			5							3	7	7	23	
<i>Carpinus caroliniana</i>										3		2						5			2	12	
<i>Cornus amomum</i>			2			4	10	10	2													28	
Number of stems/plot	5	8	10	10	10	8	13	14	14	16	9	19	20	14	18	15	10	13	17	17	12	272	
Stems/acre Year 4	200	320	400	400	400	320	520	560	560	640	360	760	800	560	720	600	400	520	680	680	480	518	
Stems/acre Year 3	440	320	400	440	400	360	520	560	560	680	360	760	800	560	720	720	480	520	720	640	520		
Stems/acre Year 2	440	320	480	480	400	360	520	560	600	680	400	760	840	640	720	720	520	600	760	680	520		
Stems/acre Year 1	520	480	480	520	400	520	560	560	720	680	360	720	880	640	760	720	640	640	760	680	600		
Stems/acre Initial	520	520	560	560	450	600	560	560	720	760	400	800	800	640	760	720	680	680	760	840	680		

VEGETATION PHOTOS



Vegetation Plot 1



Herbaceous Plot 1



Vegetation Plot 2



Herbaceous Plot 2



Vegetation Plot 3



Herbaceous Plot 3



Vegetation Plot 4



Herbaceous Plot 4



Vegetation Plot 5



Herbaceous Plot 5



Vegetation Plot 6



Herbaceous Plot 6



Vegetation Plot 7



Herbaceous Plot 7



Vegetation Plot 8



Herbaceous Plot 8



Vegetation Plot 9



Herbaceous Plot 9



Vegetation Plot 10



Herbaceous Plot 10



Vegetation Plot 11



Herbaceous Plot 11



Vegetation Plot 12



Herbaceous Plot 12



Vegetation Plot 13



Herbaceous Plot 13



Vegetation Plot 14



Herbaceous Plot 14



Vegetation Plot 15



Herbaceous Plot 15



Vegetation Plot 16



Herbaceous Plot 16



Vegetation Plot 17



Herbaceous Plot 17



Vegetation Plot 18



Herbaceous Plot 18



Vegetation Plot 19



Herbaceous Plot 19



Vegetation Plot 20



Herbaceous Plot 20



Vegetation Plot 21



Herbaceous Plot 21

APPENDIX B

GEOMORPHIC DATA

STREAM TABLES

Table B.1. Categorical Stream Feature Visual Stability Assessment

Pinch Gut Restoration Site: Project No. D06043-A						
Performance Percentage						
Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	100%	100%	95%	95%	97%	
B. Pools	100%	95%	95%	95%	97%	
C. Thalweg	100%	100%	95%	95%	95%	
D. Meanders	100%	100%	100%	98%	98%	
E. Bed General	100%	100%	100%	100%	100%	
F. Bank Condition	100%	100%	100%	98%	98%	
G. Wads	100%	100%	100%	100%	100%	

Table B.2. Baseline Stream Summary

Pinch Gut Restoration Site Contract No. D06043-A

Pinch Gut - UT1 Reach 1

Parameter	USGS Gauge		Regional Curve Interval			Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
Dimension - Riffle																	
BF Width (ft)	----	----	----	----	----	----	7.9	----	8.8	14.25	19.7	9.2	9.2	9.2	9.2	10.3	11.3
Floodprone Width (ft)	----	----	----	----	----	----	10.8	----	35	37.5	40	----	----	----	16.81	28.0	39.13
BF Mean Depth (ft)	----	----	----	----	----	----	1.1	----	0.5	0.8	1.1	0.7	0.7	0.7	0.7	0.7	0.74
BF Max Depth (ft)	----	----	----	----	----	----	1.5	----	1.1	1.5	1.9	0.8	0.8	0.8	1.1	1.1	1.1
BF Cross Sectional Area (ft²)	----	----	----	----	----	----	8.9	----	9.1	10.7	12.2	6.0	6.0	6.0	6.4	7.4	8.4
Width/Depth Ratio	----	----	----	----	----	----	7.0	----	7.7	21.0	34.3	----	14.0	----	13.2	14.2	15.3
Entrenchment Ratio	----	----	----	----	----	----	1.4	----	2.0	3.0	4.0	----	----	----	1.5	2.9	4.3
Bank Height Ratio	----	----	----	----	----	----	2.0	----	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.2	5.3
BF Velocity (fps)	----	----	----	----	----	----	3.8	----	----	----	----	5.7	----	5.7	----	----	----
Pattern																	
Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	32	52.5	73	----	----	----
Radius of Curvature (ft)	----	----	----	----	----	----	----	----	28	37.5	47	23	25	27	----	----	----
Meander Wavelength (ft)	----	----	----	----	----	----	----	----	70	175.0	280	73	91.5	110	----	----	----
Meander Width Ratio	----	----	----	----	----	----	----	----	1	2.5	4	3.5	5.75	8	----	----	----
Profile																	
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	0.0271	0.04435	0.0616	----	----	----
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Spacing (ft)	----	----	----	----	----	----	----	----	8	----	82	22.9	34.35	45.8	----	----	----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	----	----	----	----	----	1.7/12.3/21.4/49.4/65.9			.97/26.72/40.56/87.24/127.72			----			----	----	----
Reach Shear Stress (competency) lb/ft²	----	----	----	----	----	----	1.29	----	----	----	----	----	0.88	----	----	----	----
Stream Power (transport capacity) W/m²	----	----	----	----	----	----	92.4	----	----	----	----	----	83.2	----	----	----	----
Additional Reach Parameters																	
Channel length (ft)	----	----	----	----	----	----	1,484	----	----	----	----	----	1,494	----	----	1,494	----
Drainage Area (SM)	----	----	----	----	----	----	0.15	----	0.45	----	0.45	----	0.15	----	----	0.15	----
Rosgen Classification	----	----	----	----	----	----	B4	----	----	B4	----	----	B4	----	----	B4	----
BF Discharge (cfs)	----	----	----	----	----	----	34.1	----	----	----	----	----	34.1	----	----	----	----
Sinuosity	----	----	----	----	----	----	1.2	----	----	1.13	----	----	1.16	----	----	1.2	----
BF slope (ft/ft)	----	----	----	----	----	----	0.024	----	----	0.0350	----	----	0.0247	----	----	0.023	----

Pinch Gut - UT1 Reach 2

Parameter	USGS Gauge		Regional Curve Interval			Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Dimension - Riffle																	
BF Width (ft)	----	----	----	----	----	----	11.0	----	----	----	----	12.4	13	13.5	----	12.03	----
Floodprone Width (ft)	----	----	----	----	----	----	53.8	----	----	----	----	54.0	65.0	76.0	----	82.4	----
BF Mean Depth (ft)	----	----	----	----	----	----	11.0	----	----	----	----	0.9	1.0	1.0	----	0.85	----
BF Max Depth (ft)	----	----	----	----	----	----	2.1	----	----	----	----	1.1	1.2	1.2	----	1.39	----
BF Cross Sectional Area (ft ²)	----	----	----	----	----	----	17.4	----	----	----	----	11.0	12.0	13.0	----	10.2	----
Width/Depth Ratio	----	----	----	----	----	----	6.9	----	----	----	----	----	14.0	----	----	14.6	----
Entrenchment Ratio	----	----	----	----	----	----	4.9	----	----	----	----	4.3	5.0	5.6	----	6.9	----
Bank Height Ratio	----	----	----	----	----	----	1.3	----	----	----	----	1.0	1.0	1.0	----	1.0	----
BF Velocity (fps)	----	----	----	----	----	----	3.3	----	----	----	----	4.5	4.9	5.3	----	----	----
Pattern																	
Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	45	76.5	108	----	----	----
Radius of Curvature (ft)	----	----	----	----	----	----	----	----	----	----	----	31	35.5	40	----	----	----
Meander Wavelength (ft)	----	----	----	----	----	----	----	----	----	----	----	99	130.5	162	----	----	----
Meander Width Ratio	----	----	----	----	----	----	----	----	----	----	----	3.5	5.75	8	----	----	----
Profile																	
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Spacing (ft)	----	----	----	----	----	----	----	----	----	----	----	31	49	68	----	----	----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	----	----	----	----	----	1.5/10.9/21.8/51.6/85.3			----	----	----	----	----	----	----	----	----
Reach Shear Stress (competency) lb/ft ²	----	----	----	----	----	----	0.88	----	----	----	----	----	0.67	----	----	----	----
Stream Power (transport capacity) W/m ²	----	----	----	----	----	----	55.5	----	----	----	----	----	54.4	----	----	----	----
Additional Reach Parameters																	
Channel length (ft)	----	----	----	----	----	----	2242	----	----	----	----	----	1519	----	----	1569	----
Drainage Area (SM)	----	----	----	----	----	----	0.4	----	----	----	----	----	0.4	----	----	0.4	----
Rosgen Classification	----	----	----	----	----	----	C4	----	----	----	----	----	C4	----	----	C4	----
BF Discharge (cfs)	----	----	----	----	----	----	58.2	----	----	----	----	----	58.2	----	----	----	----
Sinuosity	----	----	----	----	----	----	1.40	----	----	----	----	----	1.3	----	----	1.19	----
BF slope (ft/ft)	----	----	----	----	----	----	0.012	----	----	----	----	----	0.013	----	----	0.015	----

Pinch Gut - UT1 Reach 3

Parameter	USGS Gauge		Regional Curve Interval			Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Dimension - Riffle																	
BF Width (ft)	----	----	----	----	----	----	14.5	----	----	----	----	12.4	13	13.5	11.1	11.94	12.8
Floodprone Width (ft)	----	----	----	----	----	----	48.6	----	----	----	----	25.0	32.5	40.0	49.3	85.65	122.0
BF Mean Depth (ft)	----	----	----	----	----	----	1.3	----	----	----	----	0.9	1.0	1.0	0.9	0.94	1.0
BF Max Depth (ft)	----	----	----	----	----	----	2.2	----	----	----	----	1.1	1.2	1.2	1.4	1.38	1.4
BF Cross Sectional Area (ft²)	----	----	----	----	----	----	48.6	----	----	----	----	11.0	12.0	13.0	10.2	11.20	12.2
Width/Depth Ratio	----	----	----	----	----	----	11.4	----	----	----	----	----	14.0	----	12.1	12.75	13.4
Entrenchment Ratio	----	----	----	----	----	----	3.4	----	----	----	----	2.0	2.5	3.0	3.9	7.45	11.0
Bank Height Ratio	----	----	----	----	----	----	1.8	----	----	----	----	1.0	1.0	1.0	1.0	1.00	1.0
BF Velocity (fps)	----	----	----	----	----	----	3.3	----	----	----	----	4.1	4.5	4.9	4.4	4.82	5.2
Pattern																	
Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	43	75.5	108	----	----	----
Radius of Curvature (ft)	----	----	----	----	----	----	----	----	----	----	----	31	35.5	40	----	----	----
Meander Wavelength (ft)	----	----	----	----	----	----	----	----	----	----	----	99	130.5	162	----	----	----
Meander Width Ratio	----	----	----	----	----	----	----	----	----	----	----	3.5	5.75	8	----	----	----
Profile																	
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Spacing (ft)	----	----	----	----	----	----	----	----	----	----	----	25	46	68	----	----	----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	----	----	----	----	----	1.59/13.59/25.91/66.78/71.66			----			----			----	----	----
Reach Shear Stress (competency) lb/ft²	----	----	----	----	----	----	0.81	----	----	----	----	----	0.52	----	----	----	----
Stream Power (transport capacity) W/m²	----	----	----	----	----	----	45.1	----	----	----	----	----	37	----	----	----	----
Additional Reach Parameters																	
Channel length (ft)	----	----	----	----	----	----	1647	----	----	----	----	----	1414	----	----	1427	----
Drainage Area (SM)	----	----	----	----	----	----	0.47	----	----	----	----	----	0.47	----	----	0.47	----
Rosgen Classification	----	----	----	----	----	----	C4	----	----	----	----	----	C4	----	----	C4	----
BF Discharge (cfs)	----	----	----	----	----	----	53.5	----	----	----	----	----	53.5	----	----	----	----
Sinuosity	----	----	----	----	----	----	1.11	----	----	----	----	1.25	1.3	1.4	----	1.34	----
BF slope (ft/ft)	----	----	----	----	----	----	0.012	----	----	----	----	----	0.098	----	----	0.017	----

Pinch Gut - UT1 Reach 4

Parameter	USGS Gauge		Regional Curve Interval			Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Dimension - Riffle																	
BF Width (ft)	----	----	----	----	----	----	16.2	----	----	----	----	20.8	----	17.8	18.81	19.6	
Floodprone Width (ft)	----	----	----	----	----	----	43.0	----	----	----	54.0	65.0	76.0	93.4	107.60	133.3	
BF Mean Depth (ft)	----	----	----	----	----	----	1.4	----	----	----	----	1.5	----	1.4	1.54	1.7	
BF Max Depth (ft)	----	----	----	----	----	----	1.9	----	----	----	----	1.8	----	2.4	2.58	2.7	
BF Cross Sectional Area (ft ²)	----	----	----	----	----	----	22.5	----	----	----	----	31.0	----	25.3	29.04	31.6	
Width/Depth Ratio	----	----	----	----	----	----	11.7	----	----	----	----	14.0	----	11.5	12.20	12.7	
Entrenchment Ratio	----	----	----	----	----	----	2.7	----	----	----	2.6	3.1	3.6	5.1	5.70	6.8	
Bank Height Ratio	----	----	----	----	----	----	1.2	----	----	----	----	1.0	----	1.0	1.00	1.0	
BF Velocity (fps)	----	----	----	----	----	----	4.2	----	----	----	----	3.0	----	----	----	----	
Pattern																	
Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	73	120	167	----	----	----	
Radius of Curvature (ft)	----	----	----	----	----	----	----	----	----	----	52	57	62	----	----	----	
Meander Wavelength (ft)	----	----	----	----	----	----	----	----	----	----	167	208.5	250	----	----	----	
Meander Width Ratio	----	----	----	----	----	----	----	----	----	----	3.5	5.75	8	----	----	----	
Profile																	
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	0.0123	0.0153	0.0183	----	----	----	
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
Pool Spacing (ft)	----	----	----	----	----	----	----	----	----	----	52.1	78.15	104.2	----	----	----	
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	----	----	----	----	----	4.9/12.4/17.4/31.3/49.8			----	----	----	----	----	----	----	----	
Reach Shear Stress (competency) lb/ft ²	----	----	----	----	----	----	0.74	----	----	----	----	0.79	----	----	----	----	
Stream Power (transport capacity) W/m ²	----	----	----	----	----	----	52.4	----	----	----	----	39.6	----	----	----	----	
Additional Reach Parameters																	
Channel length (ft)	----	----	----	----	----	----	2765	----	----	----	----	2361	----	----	2429	----	
Drainage Area (SM)	----	----	----	----	----	----	1.67	----	----	----	----	1.67	----	----	1.67	----	
Rosgen Classification	----	----	----	----	----	----	C4	----	----	----	----	C4	----	----	C4	----	
BF Discharge (cfs)	----	----	----	----	----	----	93.7	----	----	----	----	93.7	----	----	93.7	----	
Sinuosity	----	----	----	----	----	----	1.20	----	----	----	1.25	1.325	1.4	----	1.17	----	
BF slope (ft/ft)	----	----	----	----	----	----	0.010	----	----	----	0.012	0.010	0.009	----	0.011	----	

Pinch Gut - UT5 Reach 1

Parameter	USGS Gauge		Regional Curve Interval			Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
Dimension - Riffle																	
BF Width (ft)	----	----	----	----	----	----	9.43	----	----	----	----	11.8	14.5	13.2	----	11.7	----
Floodprone Width (ft)	----	----	----	----	----	----	22.39	----	----	----	----	15	20	25	----	74.1	----
BF Mean Depth (ft)	----	----	----	----	----	----	1.28	----	----	----	----	0.8	0.9	1	----	1.8	----
BF Max Depth (ft)	----	----	----	----	----	----	1.68	----	----	----	----	1	1.1	1.2	----	2.8	----
BF Cross Sectional Area (ft²)	----	----	----	----	----	----	12.09	----	----	----	----	10	12.5	15	----	20.3	----
Width/Depth Ratio	----	----	----	----	----	----	7.35	----	----	----	----	----	14	----	----	6.2	----
Entrenchment Ratio	----	----	----	----	----	----	2.38	----	----	----	----	1.3	1.5	1.7	----	6.6	----
Bank Height Ratio	----	----	----	----	----	----	1.75	----	----	----	----	----	1	----	----	1.0	----
BF Velocity (fps)	----	----	----	----	----	----	4.9	----	----	----	----	----	----	----	----	----	----
Pattern																	
Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	41	78.5	116	----	----	----
Radius of Curvature (ft)	----	----	----	----	----	----	----	----	----	----	----	30	36.5	43	----	----	----
Meander Wavelength (ft)	----	----	----	----	----	----	----	----	----	----	----	95	134.5	174	----	----	----
Meander Width Ratio	----	----	----	----	----	----	----	----	----	----	----	3.5	8.75	8	----	----	----
Profile																	
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	0.0167	0.0208	0.0249	----	----	----
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Spacing (ft)	----	----	----	----	----	----	----	----	----	----	----	29.6	51.05	72.5	----	----	----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	----	----	----	----	----	1.4/9.4/20.1/45/66			----	----	----	----	----	----	----	----	----
Reach Shear Stress (competency) lb/ft²	----	----	----	----	----	----	0.97	----	----	----	----	----	0.61	----	----	----	----
Stream Power (transport capacity) W/m²	----	----	----	----	----	----	83.4	----	----	----	----	----	51.1	----	----	----	----
Additional Reach Parameters																	
Channel length (ft)	----	----	----	----	----	----	980	----	----	----	----	----	934	----	----	----	----
Drainage Area (SM)	----	----	----	----	----	----	0.33	----	----	----	----	----	0.33	----	----	0.33	----
Rosgen Classification	----	----	----	----	----	----	C4	----	----	----	----	----	C4	----	----	E4	----
BF Discharge (cfs)	----	----	----	----	----	----	56.2	----	----	----	----	----	56.2	----	----	56.2	----
Sinuosity	----	----	----	----	----	----	1.13	----	----	----	----	1.25	1.3	1.4	----	1.2	----
BF slope (ft/ft)	----	----	----	----	----	----	0.015	----	----	----	----	0.014	0.0130	0.012	----	0.018	----

Pinch Gut - UT5 Reach 2

Parameter	USGS Gauge		Regional Curve Interval			Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
Dimension - Riffle																	
BF Width (ft)	----	----	----	----	----	----	15.66	----	----	----	----	----	----	----	8.7	----	----
Floodprone Width (ft)	----	----	----	----	----	----	18.4	----	----	----	----	----	----	----	24.1	----	----
BF Mean Depth (ft)	----	----	----	----	----	----	1.24	----	----	----	----	----	----	----	0.9	----	----
BF Max Depth (ft)	----	----	----	----	----	----	1.82	----	----	----	----	----	----	----	1.7	----	----
BF Cross Sectional Area (ft ²)	----	----	----	----	----	----	19.47	----	----	----	----	----	----	----	----	----	----
Width/Depth Ratio	----	----	----	----	----	----	12.6	----	----	----	----	----	----	----	10.2	----	----
Entrenchment Ratio	----	----	----	----	----	----	1.2	----	----	----	----	----	----	----	2.8	----	----
Bank Height Ratio	----	----	----	----	----	----	2.2	----	----	----	----	----	----	----	1.0	----	----
BF Velocity (fps)	----	----	----	----	----	----	4	----	----	----	----	----	----	----	----	----	----
Pattern																	
Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Radius of Curvature (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Meander Wavelength (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Meander Width Ratio	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Profile																	
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Spacing (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	----	----	----	----	----	3.5/11/23.1/96.3/118.9			----	----	----	----	----	----	----	----	----
Reach Shear Stress (competency) lb/ft ²	----	----	----	----	----	----	1.11	----	----	----	----	0.81	----	----	----	----	----
Stream Power (transport capacity) W/m ²	----	----	----	----	----	----	81.4	----	----	----	----	72.8	----	----	----	----	----
Additional Reach Parameters																	
Channel length (ft)	----	----	----	----	----	----	842	----	----	----	----	----	----	----	----	----	----
Drainage Area (SM)	----	----	----	----	----	----	0.48	----	----	----	----	----	----	----	0.33	----	----
Rosgen Classification	----	----	----	----	----	----	C4	----	----	----	----	----	----	----	E4	----	----
BF Discharge (cfs)	----	----	----	----	----	----	77.1	----	----	----	----	----	----	----	77.1	----	----
Sinuosity	----	----	----	----	----	----	1.3	----	----	----	----	----	----	----	1.2	----	----
BF slope (ft/ft)	----	----	----	----	----	----	0.015	----	----	----	----	----	----	----	0.018	----	----

Pinch Gut - UT6																	
Parameter	USGS Gauge		Regional Curve Interval			Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
Dimension - Riffle																	
BF Width (ft)	----	----	----	----	----	----	10.15	----	8.8	14.25	19.7	----	8.5	----	----	8.9	----
Floodprone Width (ft)	----	----	----	----	----	----	13.06	----	35	37.5	40	----	18	----	----	33.0	----
BF Mean Depth (ft)	----	----	----	----	----	----	0.7	----	0.5	0.8	1.1	----	0.7	----	----	0.8	----
BF Max Depth (ft)	----	----	----	----	----	----	0.98	----	1.1	1.5	1.9	----	1	----	----	1.6	----
BF Cross Sectional Area (ft ²)	----	----	----	----	----	----	7.06	----	9.1	10.7	12.2	----	6	----	----	7.0	----
Width/Depth Ratio	----	----	----	----	----	----	14.6	----	7.7	21.0	34.3	----	12	----	----	11.4	----
Entrenchment Ratio	----	----	----	----	----	----	1.29	----	2.0	3.0	4.0	----	2.1	----	----	3.6	----
Bank Height Ratio	----	----	----	----	----	----	3.06	----	1.0	1.0	1.0	----	1	----	----	1.8	----
BF Velocity (fps)	----	----	----	----	----	----	2.9	----	----	----	----	----	4.5	----	----	----	----
Pattern																	
Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	30	49	68	----	----	----
Radius of Curvature (ft)	----	----	----	----	----	----	----	----	28	37.5	47	21	23	25	----	----	----
Meander Wavelength (ft)	----	----	----	----	----	----	----	----	70	175.0	280	68	85	102	----	----	----
Meander Width Ratio	----	----	----	----	----	----	----	----	1	2.5	4	3.5	5.75	8	----	----	----
Profile																	
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	0.0409	0.0669	0.0929	----	----	----
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Spacing (ft)	----	----	----	----	----	----	----	----	8	----	82	21.2	31.8	42.4	----	----	----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	----	----	----	----	----	1.2/5.6/12.2/32.6/55.1/76.2			.97/26.72/40.56/87.24/127.72			----			----	----	----
Reach Shear Stress (competency) lb/ft ²	----	----	----	----	----	1.46			----	----	----	----	1.28	----	----	----	----
Stream Power (transport capacity) W/m ²	----	----	----	----	----	92.4			----	----	----	----	107.3	----	----	----	----
Additional Reach Parameters																	
Channel length (ft)	----	----	----	----	----	1,650			----	----	----	----	1,250	----	----	1,604	----
Drainage Area (SM)	----	----	----	----	----	0.12			0.45	----	0.45	----	0.12	----	----	0.12	----
Rosgen Classification	----	----	----	----	----	B4			----	B4	----	----	B4	----	----	B4a	----
BF Discharge (cfs)	----	----	----	----	----	27			----	----	----	----	27	----	----	27	----
Sinuosity	----	----	----	----	----	1.1			----	1.13	----	----	1.16	----	----	1.1	----
BF slope (ft/ft)	----	----	----	----	----	0.038			----	0.0350	----	----	0.0372	----	----	0.040	----

Table B.3. Morphology and Hydraulic Monitoring Summary

Pinch Gut Restoration Site: Project No. D06043-A															
Reach: UT1_R1															
Parameter	Cross-section 1 Riffle					Cross-section 2 Riffle									
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5					
Dimension															
BF Width (ft)	12.18	11.88	12.10	12.11		12.21	14.96	9.80	10.84						
BF Mean Depth (ft)	0.83	0.89	0.73	0.75		0.57	0.41	0.42	0.37						
Width/Depth Ratio	14.64	13.35	16.57	16.25		21.56	36.45	23.26	29.14						
BF Cross-sectional Area (ft²)	10.10	10.60	8.80	9.00		6.90	6.10	4.10	4.00						
BF Max Depth (ft)	1.46	1.39	1.15	1.27		1.40	0.97	0.80	1.00						
Width of Floodprone Area (ft)	18.53	18.39	17.47	18.28		47.83	43.19	40.57	42.86						
Entrenchment Ratio	1.50	1.50	1.40	1.50		3.90	2.90	4.10	4.00						
Bank Height Ratio	2.40	2.50	2.90	2.80		1.00	0.80	1.10	1.30						
Wetted Perimeter (ft)	13.84	13.66	13.56	13.61		13.35	15.78	10.64	11.58						
Hydraulic Radius (ft)	0.73	0.78	0.65	0.66		0.52	0.39	0.39	0.35						
Substrate															
d50 (mm)															
d84 (mm)															
Parameter	MY-1 (2008)			MY-2 (2009)			MY-3 (2010)			MY-4 (2011)			MY-5 (2012)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)															
Radius of Curvature (ft)															
Meander Wavelength (ft)															
Meander Width Ratio															
Profile															
Riffle length (ft)															
Riffle Slope (ft/ft)															
Pool Length (ft)															
Pool Spacing (ft)															
Additional Reach Parameters															
Valley Length (ft)				No			No			No			No		
Channel Length (ft)				Data			Data			Data			Data		
Sinuosity				Collected			Collected			Collected			Collected		
Water Surface Slope (ft/ft)															
BF Slope (ft/ft)															
Rosgen Classification															

Reach: UT1_R2															
Parameter	Cross-section 3 Pool					Cross-section 4 Riffle					Cross-section 5 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension															
BF Width (ft)	18.41	19.09	18.01	16.99		12.05	14.71	11.66	12.52		23.25	23.82	25.87	25.03	
BF Mean Depth (ft)	3.02	0.98	1.17	1.20		0.86	0.65	0.64	0.55		0.87	1.17	1.04	1.01	
Width/Depth Ratio	16.66	19.40	15.40	14.17		14.03	22.72	18.15	22.78		26.65	20.29	24.94	24.90	
BF Cross-sectional Area (ft²)	20.30	18.80	21.10	20.40		10.40	9.50	7.50	6.90		20.30	28.00	26.80	25.20	
BF Max Depth (ft)	3.02	2.92	3.06	3.06		1.51	1.32	1.29	1.26		2.77	4.03	4.01	4.02	
Width of Floodprone Area (ft)	84.82	80.64	85.37	83.91		82.65	80.66	81.23	80.94		99.45	108.81	109.62	109.85	
Entrenchment Ratio	4.60	4.20	4.70	4.90		6.90	5.50	7.00	6.50		4.30	4.60	4.20	4.40	
Bank Height Ratio	1.00	0.90	1.00	1.00		1.00	1.00	1.00	1.00		0.90	0.90	1.00	1.00	
Wetted Perimeter (ft)	24.45	21.05	20.35	19.39		13.77	16.01	12.94	13.62		24.99	26.16	27.95	27.05	
Hydraulic Radius (ft)	0.83	0.89	1.04	1.05		0.76	0.59	0.58	0.51		0.81	1.07	0.96	0.93	
Substrate															
d50 (mm)															
d84 (mm)															
Parameter	MY-1 (2008)			MY-2 (2009)			MY-3 (2010)			MY-4 (2011)			MY-5 (2012)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)															
Radius of Curvature (ft)															
Meander Wavelength (ft)															
Meander Width Ratio															
Profile															
Riffle length (ft)															
Riffle Slope (ft/ft)															
Pool Length (ft)															
Pool Spacing (ft)															
Additional Reach Parameters															
Valley Length (ft)	1320.42			1320.42			1320.42			1320.42			1320.42		
Channel Length (ft)	1569			1569			1569			1569			1569		
Sinuosity	1.19			1.19			1.19			1.19			1.19		
Water Surface Slope (ft/ft)	0.0154			0.0156			0.0158			0.0160			0.0160		
BF Slope (ft/ft)	0.0184			0.0184			0.0188			0.0188			0.0190		
Rosgen Classification															

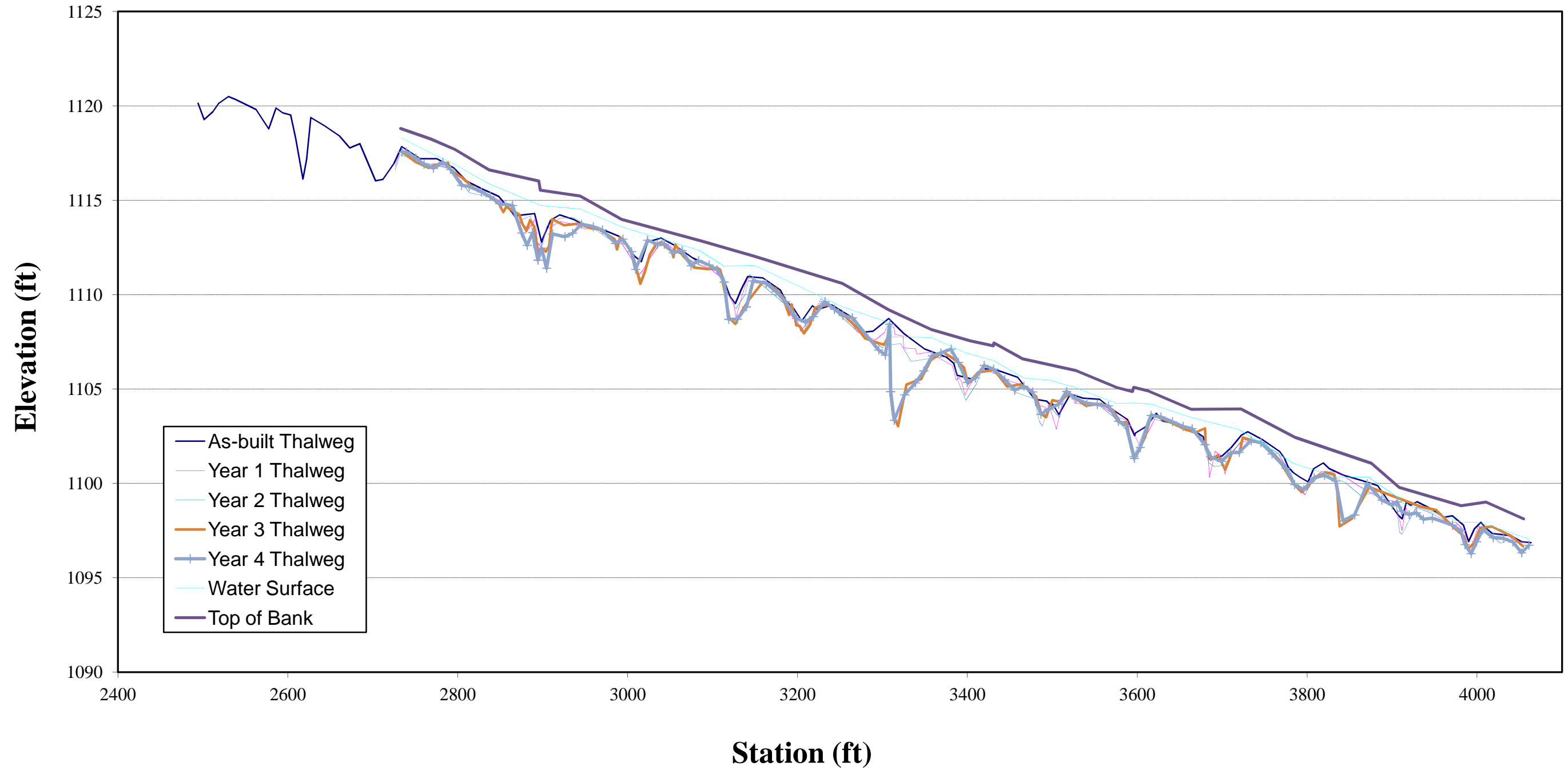
Reach: UT1_R4																				
Parameter	Cross-section 10 Riffle					Cross-section 11 Pool					Cross-section 12 Riffle					Cross-section 13 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	23.27	19.28	18.21	17.26		44.84	44.61	43.79	41.97		19.31	20.40	20.10	18.83		37.32	37.86	34.59	25.78	
BF Mean Depth (ft)	1.36	1.32	1.44	1.36		1.57	1.55	1.52	1.57		1.51	1.24	1.20	1.19		1.25	1.09	0.99	1.04	
Width/Depth Ratio	17.14	14.58	12.67	12.66		28.57	28.87	28.90	26.76		12.75	16.49	16.76	15.84		29.95	34.80	35.04	24.79	
BF Cross-sectional Area (ft²)	31.60	25.50	26.20	23.50		70.40	68.90	66.40	65.80		29.20	25.20	24.11	22.40		46.50	41.20	34.15	26.80	
BF Max Depth (ft)	2.70	2.02	2.25	2.00		4.25	4.70	4.84	4.96		2.18	1.83	1.89	1.88		3.87	4.02	3.26	2.78	
Width of Floodprone Area (ft)	96.18	96.25	96.22	96.20		133.42	133.36	133.46	133.38		137.73	137.73	137.75	137.75		128.61	128.59	128.65	128.61	
Entrenchment Ratio	4.10	5.00	5.30	5.60		3.00	3.00	3.00	3.20		6.60	5.70	5.84	6.20		3.40	3.40	3.72	5.00	
Bank Height Ratio	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.04	1.10		1.00	1.00	0.93	1.00	
Wetted Perimeter (ft)	25.99	21.92	21.09	19.98		47.98	47.71	46.83	45.11		22.33	22.88	22.50	21.21		39.82	40.04	36.57	27.86	
Hydraulic Radius (ft)	1.22	1.16	1.24	1.18		1.47	1.44	1.42	1.46		1.31	1.10	1.07	1.06		1.17	1.03	0.93	0.96	
Substrate																				
d50 (mm)																				
d84 (mm)																				
Parameter	Cross-section 14 Riffle																			
	MY1	MY2	MY3	MY4	MY5															
Dimension																				
BF Width (ft)	21.86	21.82	17.58	18.06																
BF Mean Depth (ft)	1.31	1.29	1.54	1.49																
Width/Depth Ratio	16.69	16.88	11.43	12.14																
BF Cross-sectional Area (ft²)	28.60	28.20	27.02	26.90																
BF Max Depth (ft)	2.47	2.51	2.60	2.46																
Width of Floodprone Area (ft)	103.62	103.63	103.68	103.68																
Entrenchment Ratio	4.70	4.70	5.90	5.70																
Bank Height Ratio	1.00	1.00	1.14	1.00																
Wetted Perimeter (ft)	24.48	24.40	20.66	21.04																
Hydraulic Radius (ft)	1.17	1.16	1.31	1.28																
Substrate																				
d50 (mm)																				
d84 (mm)																				

Reach: UT5																				
Parameter	Cross-section 15 Riffle				Cross-section 16 Pool				Cross-section 17 Riffle				Cross-section 18 Pool							
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	11.37	11.88	12.10	12.19		15.86	15.57	17.53	18.53		15.66	15.94	15.16	13.82		13.32	12.05	17.03	15.76	
BF Mean Depth (ft)	1.75	1.89	1.95	1.88		1.67	1.26	1.03	1.05		0.86	0.82	0.95	0.98		1.93	1.62	1.28	1.06	
Width/Depth Ratio	6.51	6.28	6.20	6.49		9.52	12.32	17.08	17.68		18.24	19.48	16.02	14.09		6.90	7.42	13.28	14.87	
BF Cross-sectional Area (ft²)	19.90	22.50	23.60	22.90		26.40	19.70	18.00	19.40		13.40	13.10	14.35	13.60		25.70	19.60	21.83	16.70	
BF Max Depth (ft)	2.88	3.10	3.18	3.06		3.63	3.26	2.35	2.63		2.13	2.45	2.49	2.39		3.75	3.73	2.87	1.88	
Width of Floodprone Area (ft)	84.46	95.71	97.65	97.49		81.21	77.34	56.04	70.61		29.01	30.99	32.02	30.03		68.36	68.75	55.17	35.43	
Entrenchment Ratio	7.40	8.10	8.10	8.00		5.10	5.00	3.20	3.00		1.90	1.90	2.11	2.20		5.10	5.70	3.24	2.20	
Bank Height Ratio	1.00	1.00	1.00	1.10		1.00	1.00	0.97	1.10		0.80	0.80	0.88	2.20		1.00	1.10	1.22	2.60	
Wetted Perimeter (ft)	14.87	15.66	16.00	15.95		19.20	18.09	19.59	20.64		17.38	17.58	17.06	15.78		17.18	15.29	19.59	17.88	
Hydraulic Radius (ft)	1.34	1.44	1.48	1.44		1.38	1.09	0.92	0.94		0.77	0.75	0.84	0.86		1.50	1.28	1.11	0.93	
Substrate																				
d50 (mm)																				
d84 (mm)																				
Parameter	MY-1 (2008)			MY-2 (2009)			MY-3 (2010)			MY-4 (2011)			MY-5 (2012)							
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med					
Pattern																				
Channel Beltwidth (ft)																				
Radius of Curvature (ft)																				
Meander Wavelength (ft)																				
Meander Width Ratio																				
Profile																				
Riffle length (ft)																				
Riffle Slope (ft/ft)																				
Pool Length (ft)																				
Pool Spacing (ft)																				
Additional Reach Parameters																				
Valley Length (ft)	No			No			No			No			No							
Channel Length (ft)	Data			Data			Data			Data			Data							
Sinuosity	Collected			Collected			Collected			Collected			Collected							
Water Surface Slope (ft/ft)																				
BF Slope (ft/ft)																				
Rosgen Classification																				

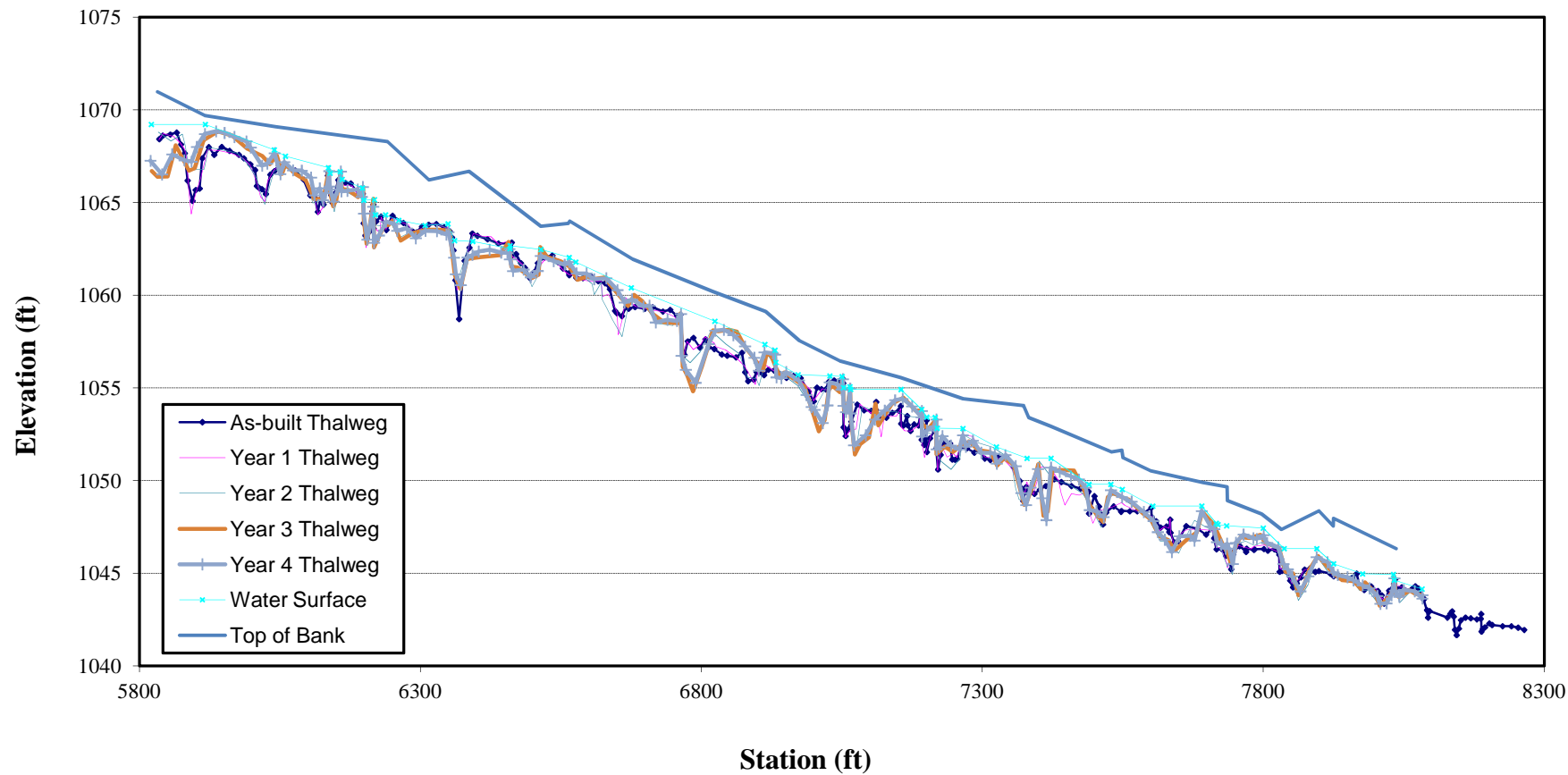
Reach: UT6																				
Parameter	Cross-section 19 Riffle				Cross-section 20 Pool				Cross-section 21 Riffle				Cross-section 22 Pool							
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	8.54	8.25	8.66	8.26	8.35	8.85	8.60	8.53	8.88	9.17	10.07	9.76	11.21	12.08	13.56	12.14				
BF Mean Depth (ft)	0.80	0.84	0.73	0.80	0.88	0.86	0.84	0.83	0.70	0.70	0.69	0.70	0.90	0.85	0.98	0.86				
Width/Depth Ratio	10.74	9.81	11.90	10.28	9.47	10.34	10.28	10.29	12.74	13.15	14.66	13.90	12.52	14.13	13.86	14.07				
BF Cross-sectional Area (ft²)	6.80	6.90	6.30	6.60	7.40	7.60	7.20	7.1	6.20	6.40	6.90	6.80	10.00	10.30	13.30	10.50				
BF Max Depth (ft)	1.80	1.50	1.08	1.18	1.32	1.36	1.26	1.38	1.45	1.51	1.50	1.59	1.77	2.05	2.67	2.29				
Width of Floodprone Area (ft)	15.88	14.31	13.37	12.95	13.54	13.33	13.32	13.9	49.95	51.04	49.78	51.15	70.08	75.34	85.48	76.16				
Entrenchment Ratio	1.90	1.70	1.50	1.60	1.60	1.50	1.50	1.60	5.60	5.60	4.90	5.20	6.30	6.20	6.30	6.30				
Bank Height Ratio	2.30	2.90	3.40	3.40	2.20	2.20	2.30	2.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Wetted Perimeter (ft)	10.14	9.93	10.12	9.86	10.11	10.57	10.28	10.19	10.28	10.57	11.45	11.16	13.01	13.78	15.52	13.86				
Hydraulic Radius (ft)	0.67	0.69	0.62	0.67	0.73	0.72	0.70	0.70	0.60	0.61	0.60	0.61	0.77	0.75	0.86	0.76				
Substrate																				
d50 (mm)																				
d84 (mm)																				
Parameter	MY-1 (2008)			MY-2 (2009)			MY-3 (2010)			MY-4 (2011)			MY-5 (2012)							
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med					
Pattern																				
Channel Beltwidth (ft)																				
Radius of Curvature (ft)																				
Meander Wavelength (ft)																				
Meander Width Ratio																				
Profile																				
Riffle length (ft)																				
Riffle Slope (ft/ft)																				
Pool Length (ft)																				
Pool Spacing (ft)																				
Additional Reach Parameters																				
Valley Length (ft)	No			No			No			No			No							
Channel Length (ft)	Data			Data			Data			Data			Data							
Sinuosity	Collected			Collected			Collected			Collected			Collected							
Water Surface Slope (ft/ft)																				
BF Slope (ft/ft)																				
Rosgen Classification																				

STREAM DATA

UT1 Reach 2 - Year 4 Longitudinal Profile, Stations 27+34 to 40+61



UT1 Reach 4 - Year 4 Longitudinal Profile, Stations 58+19 to 80+83



Permanent Cross-section 2, Station 21+26
 (Year 4 Data - Collected November 2011)

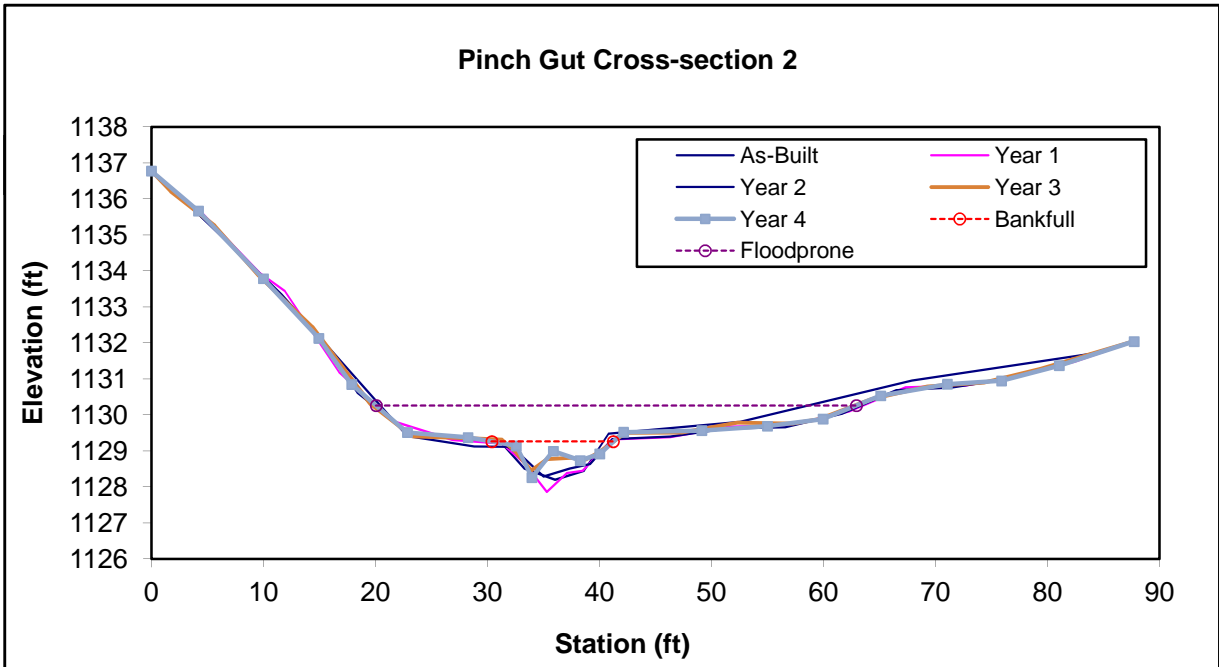


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Cc	4	10.84	0.37	1	29.14	1.3	4	1129.26	1129.52



Permanent Cross-section 3, Station 28+99
 (Year 4 Data - Collected November 2011)

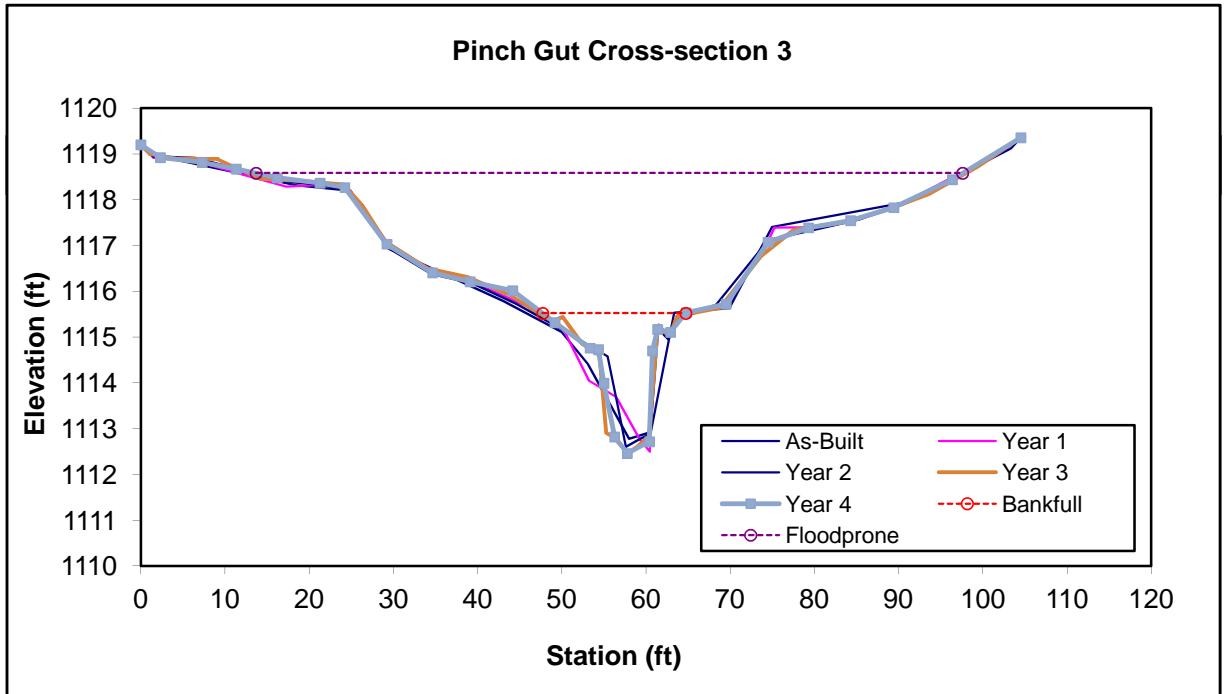


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		20.4	16.99	1.2	3.06	14.17	1	4.9	1115.52	1115.53



Permanent Cross-section 4, Station 31+34
 (Year 4 Data - Collected November 2011)

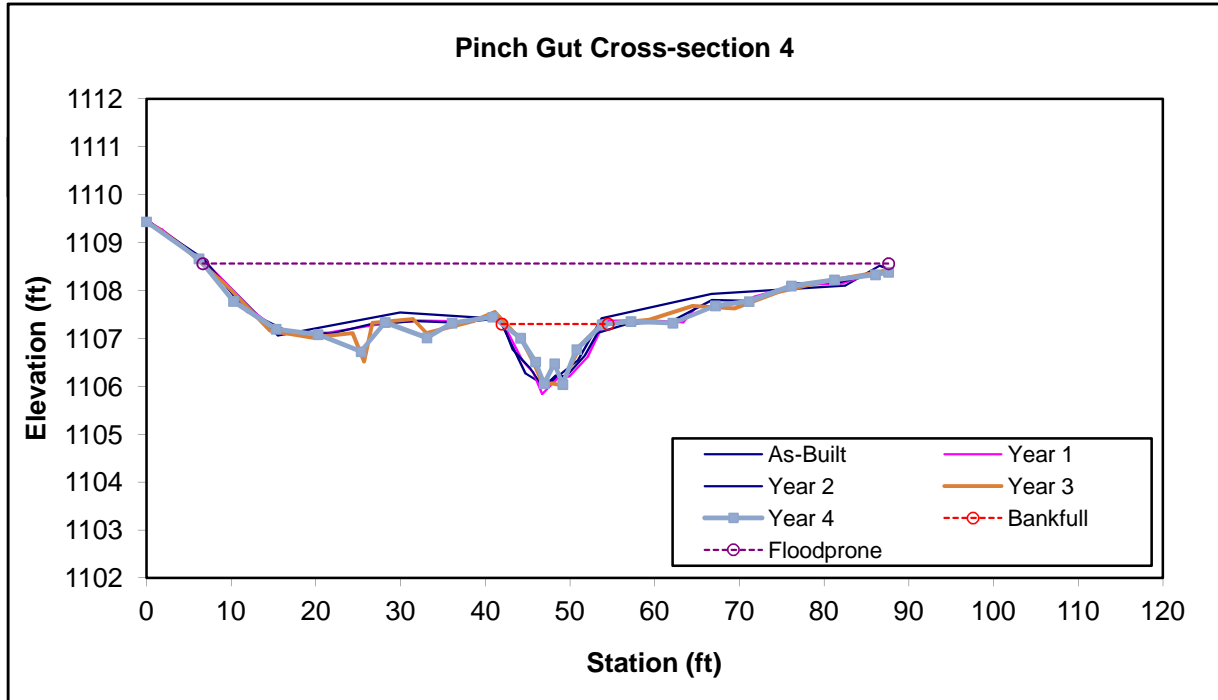


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	6.9	12.52	0.55	1.26	22.78	1	6.5	1107.3	1107.29



Permanent Cross-section 5, Station 35+97
 (Year 4 Data - Collected November 2011)

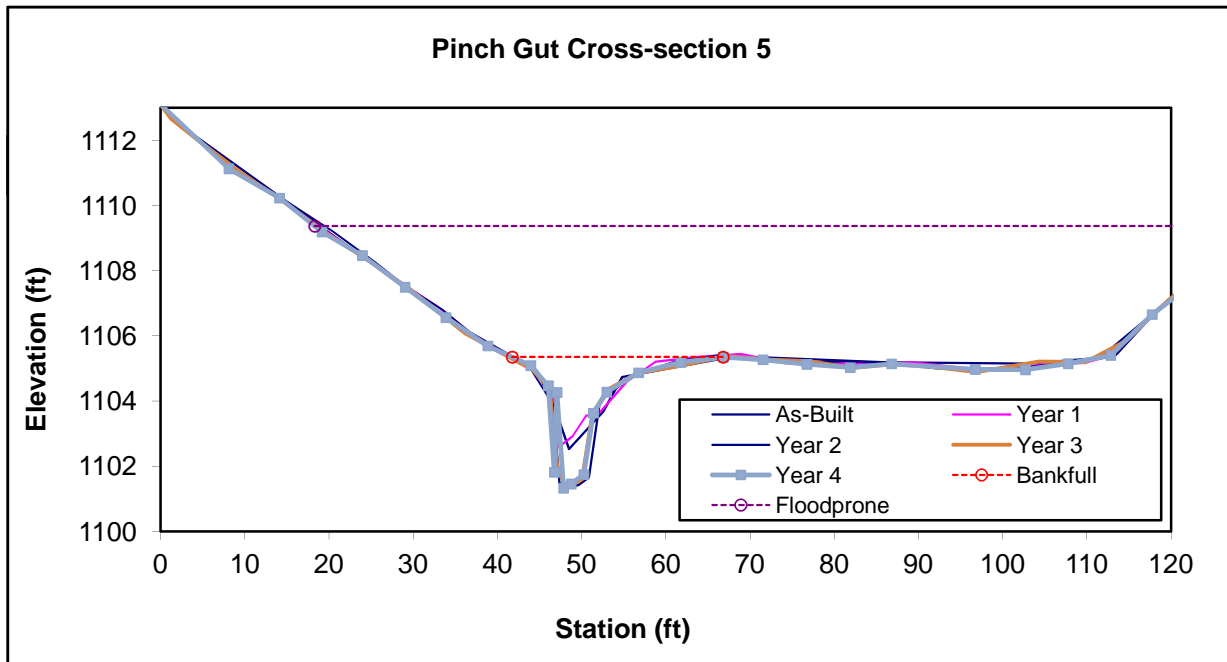


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		25.2	25.03	1.01	4.02	24.9	1	4.4	1105.35	1105.35



Permanent Cross-section 7, Station 45+44
 (Year 4 Data - Collected November 2011)

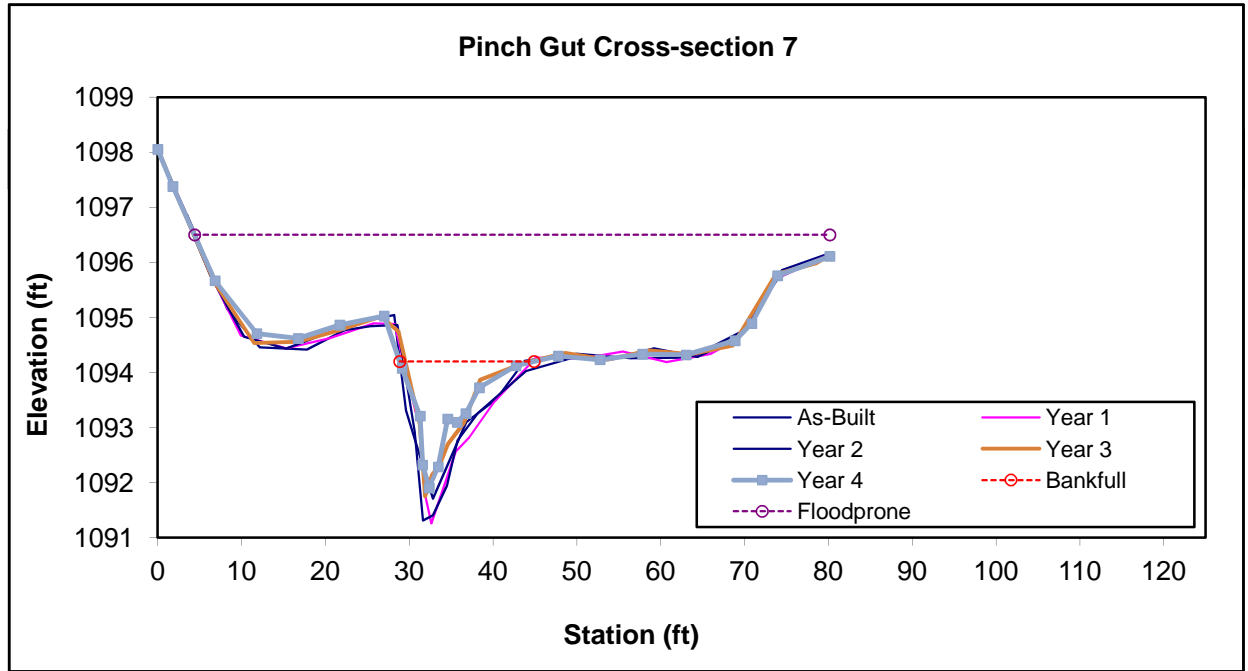


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		11.9	16.02	0.74	2.3	21.52	1	4.7	1094.2	1094.3



Permanent Cross-section 8, Station 53+47
 (Year 4 Data - Collected November 2011)

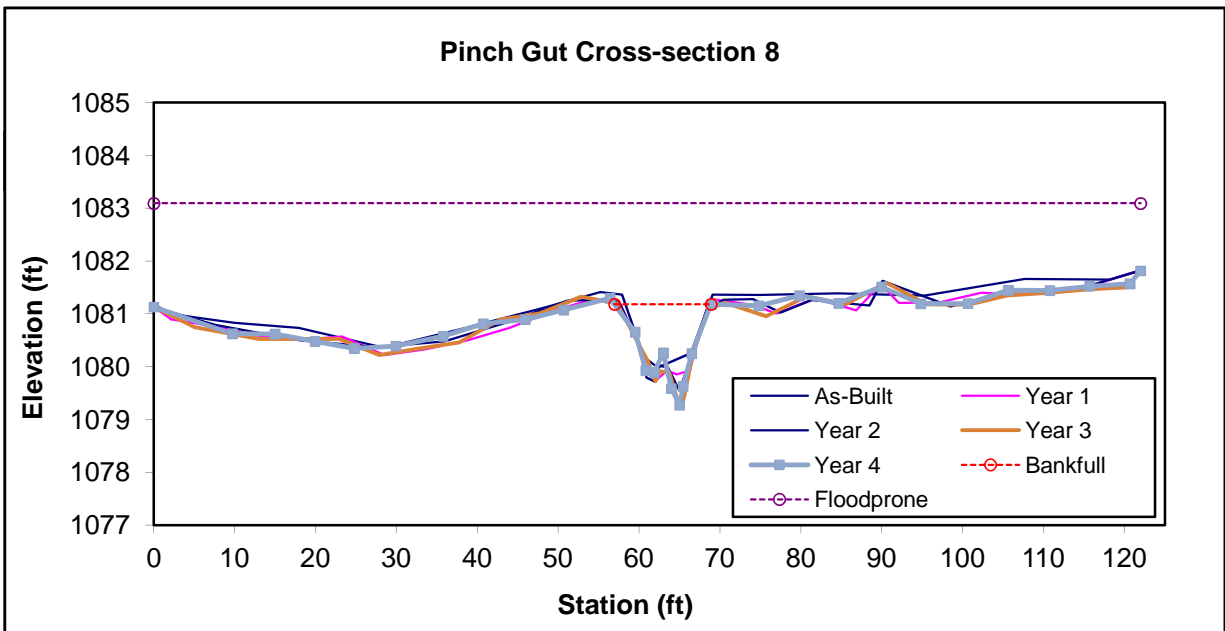


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Cc	10.6	11.94	0.89	1.91	13.41	1	10.2	1081.18	1081.18



Permanent Cross-section 9, Station 56+39
 (Year 4 Data - Collected November 2011)

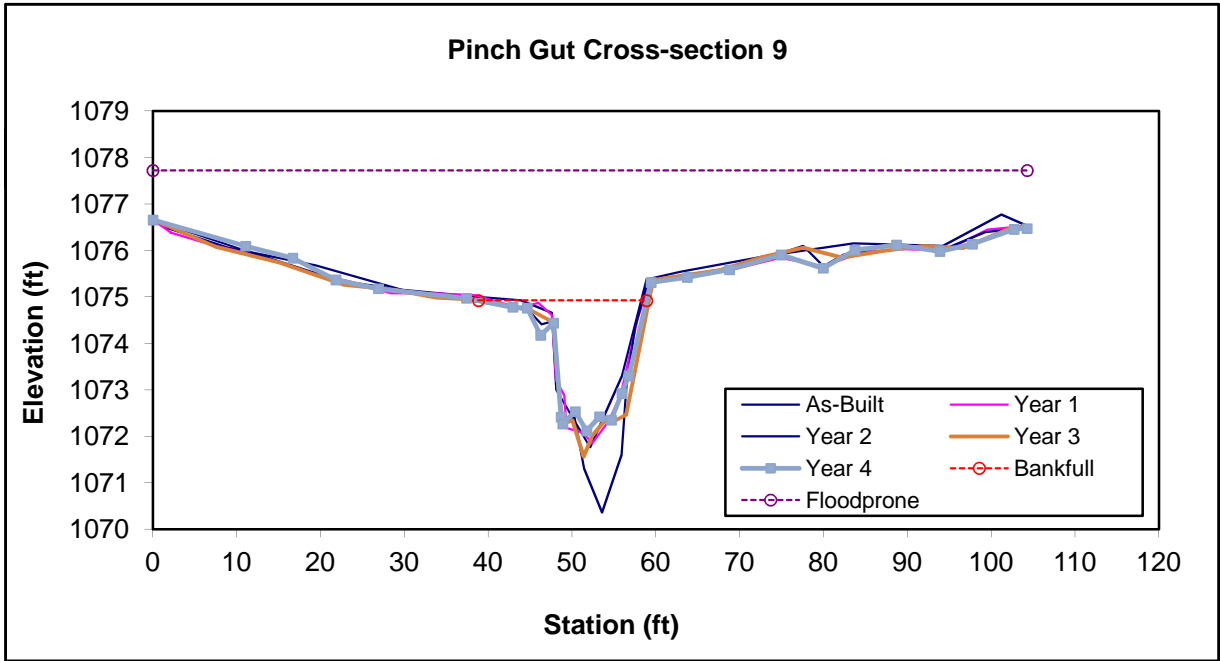


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		25.1	20.07	1.25	2.8	16.04	1	5.2	1074.92	1074.97



Permanent Cross-section 11, Station 73+68
 (Year 4 Data - Collected November 2011)

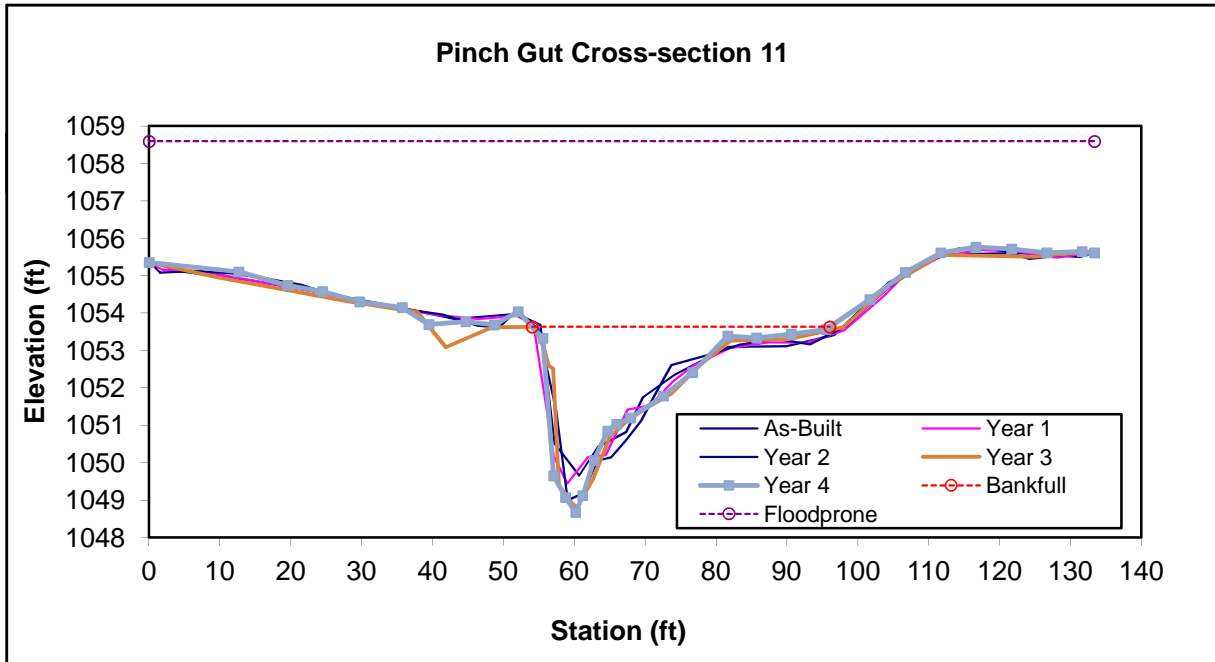


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		65.8	41.97	1.57	4.96	26.76	1	3.2	1053.63	1053.39



Permanent Cross-section 12, Station 75+37
 (Year 4 Data - Collected November 2011)

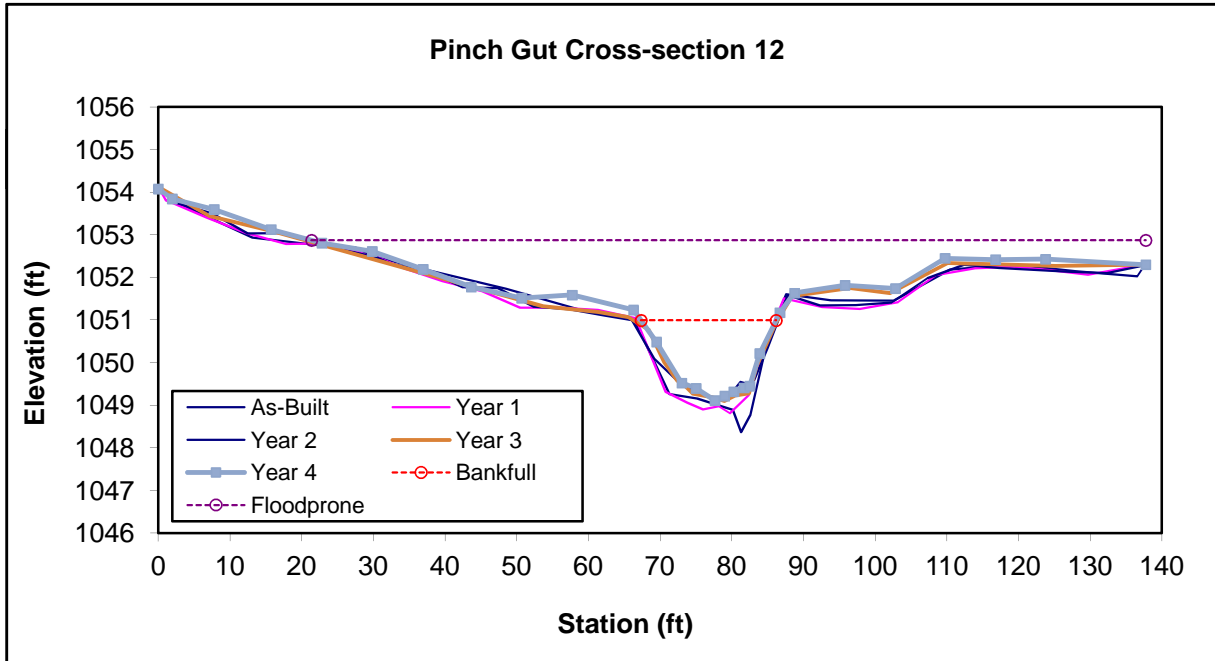


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	22.4	18.83	1.19	1.88	15.84	1.1	6.2	1050.99	1051.24



Permanent Cross-section 13, Station 77+25
 (Year 4 Data - Collected November 2011)

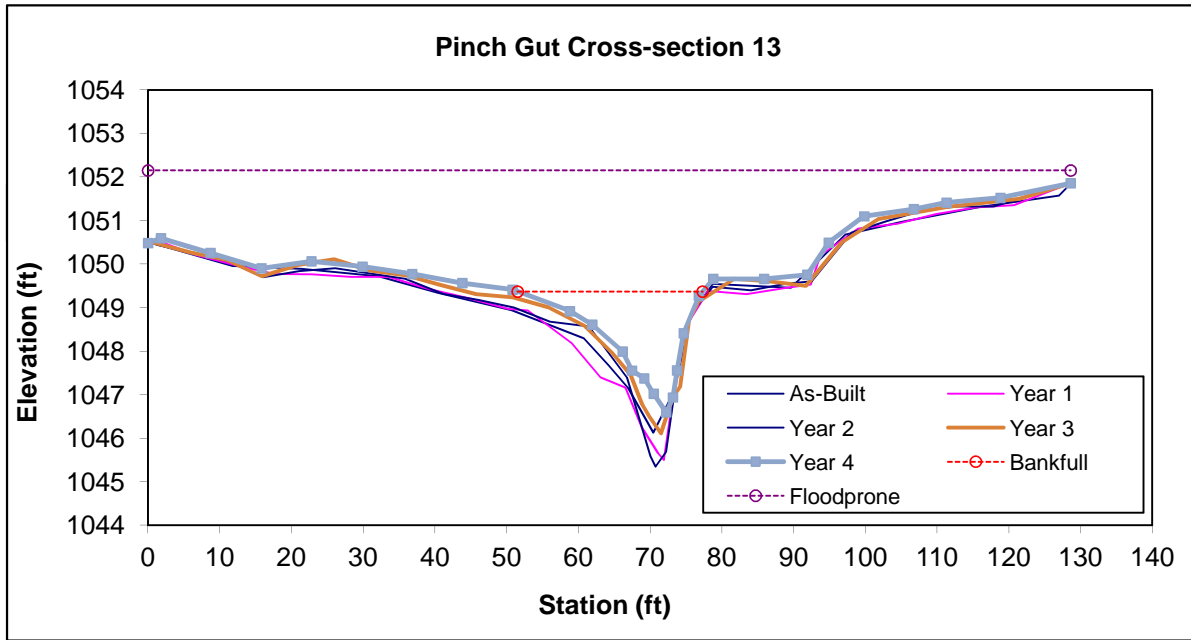


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		26.8	25.78	1.04	2.78	24.79	1	5	1049.37	1049.41



Permanent Cross-section 14, Station 79+15
 (Year 4 Data - Collected November 2011)

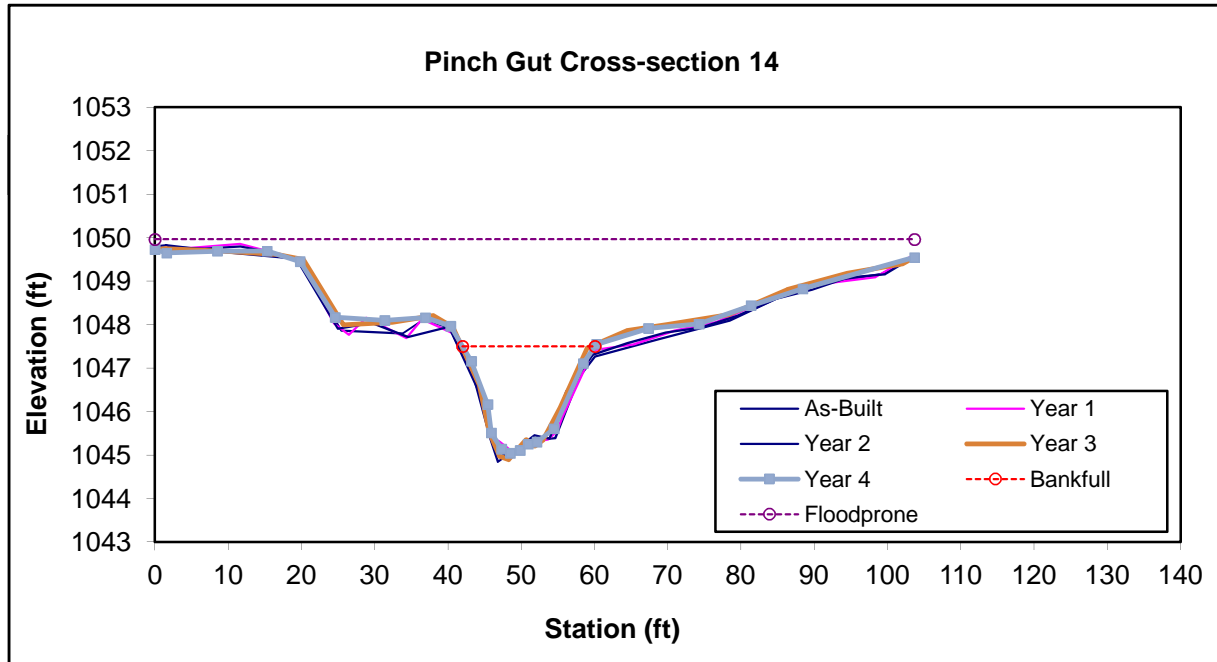


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	26.9	18.06	1.49	2.46	12.14	1	5.7	1047.5	1047.55



Permanent Cross-section 15, Station 10+73
 (Year 4 Data - Collected November 2011)

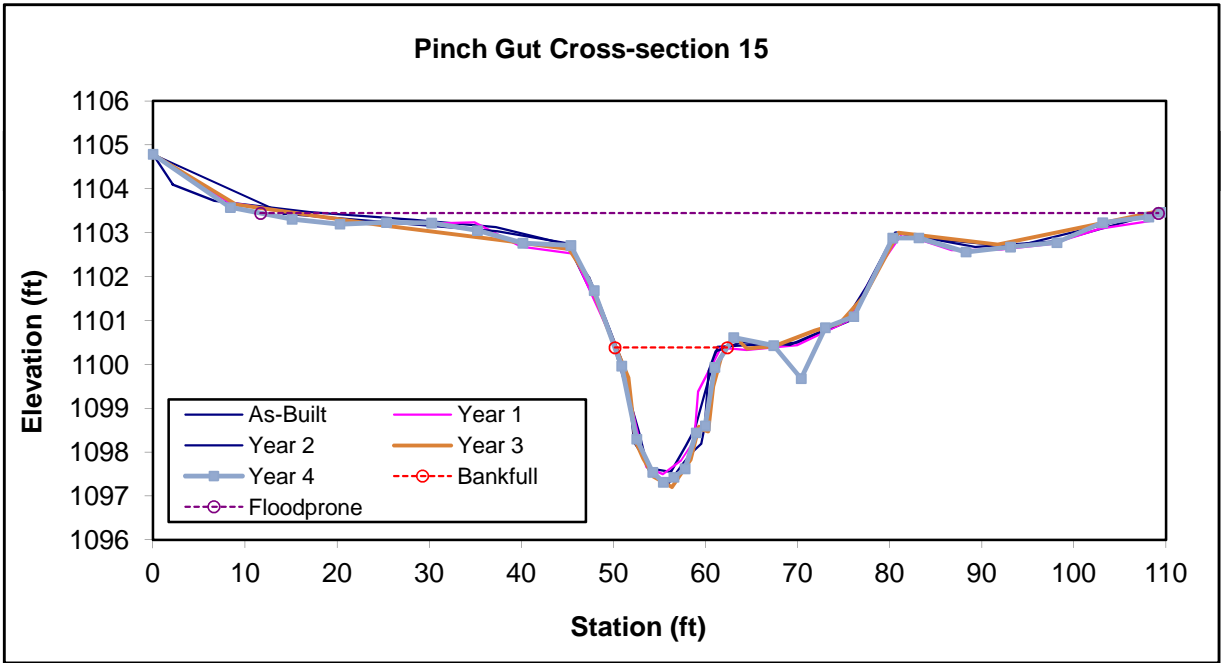


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	22.9	12.19	1.88	3.06	6.49	1.1	8	1100.38	1100.61



Permanent Cross-section 17, Station 21+96
 (Year 4 Data - Collected November 2011)

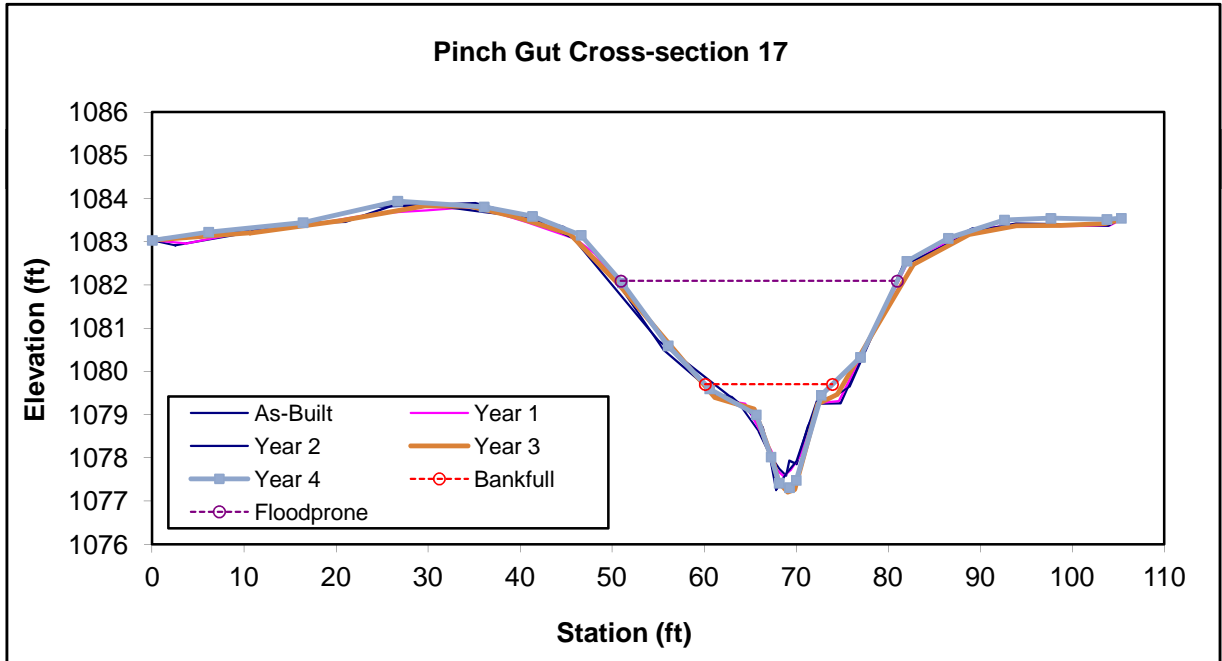


Looking at the Left Bank



Looking at the Right Bank

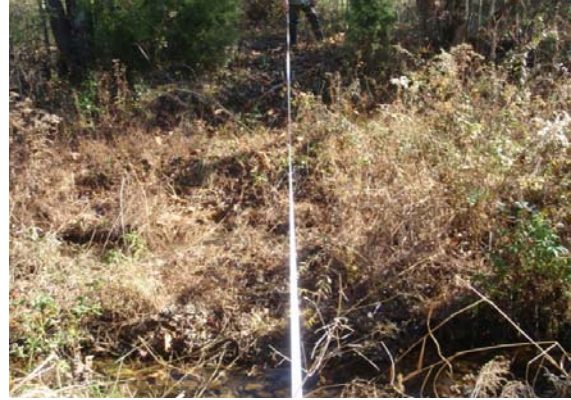
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	13.6	13.82	0.98	2.39	14.09	2.2	2.2	1079.7	1082.55



Permanent Cross-section 18, Station 25+95
 (Year 4 Data - Collected November 2011)

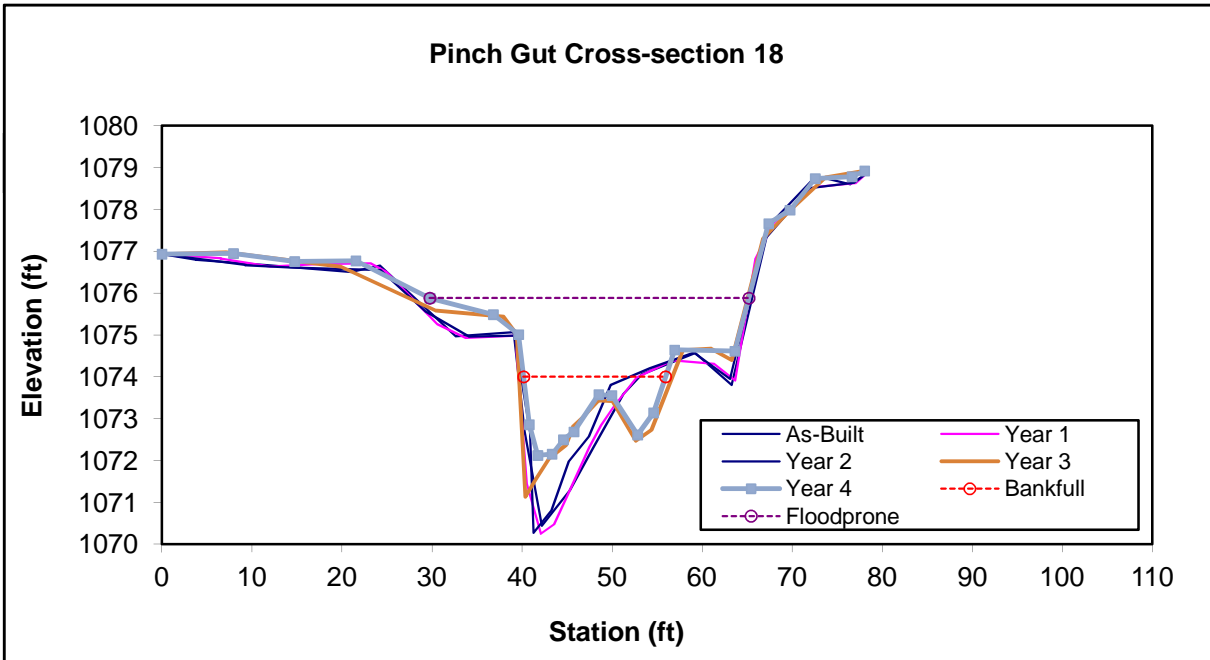


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		16.7	15.76	1.06	1.88	14.87	2.6	2.2	1074	1076.95



Permanent Cross-section 20, Station 18+03
 (Year 4 Data - Collected November 2011)

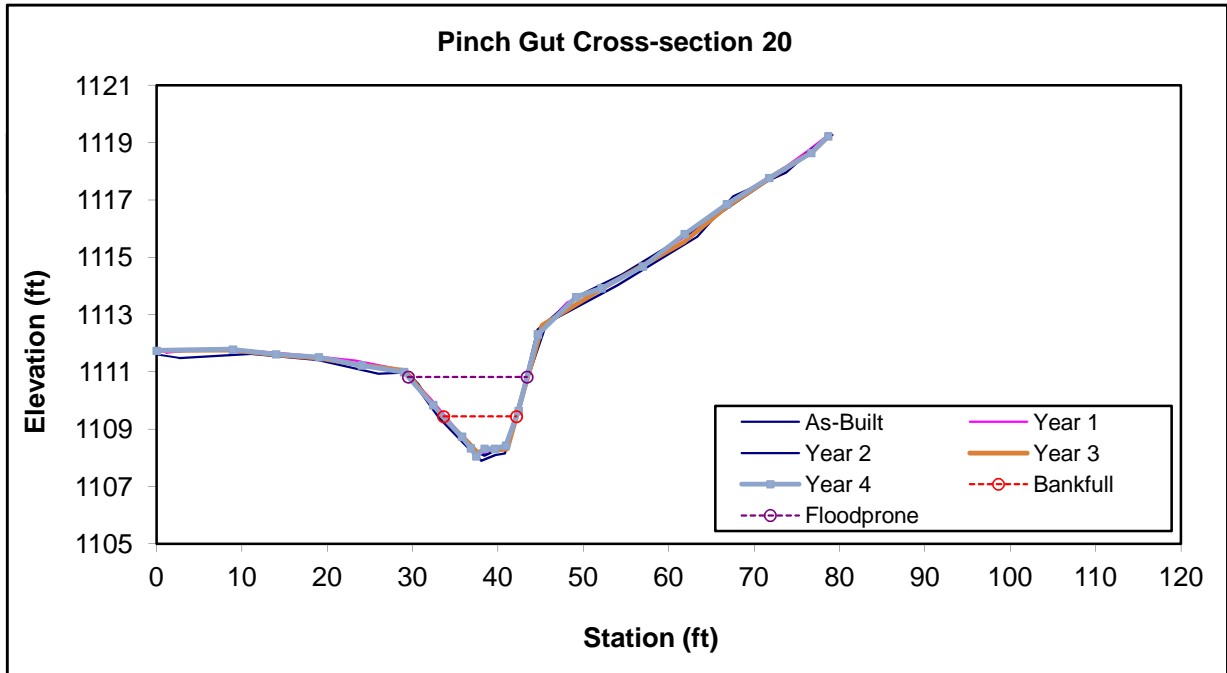


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		7.1	8.53	0.83	1.38	10.29	2.1	1.6	1109.44	1110.99



Permanent Cross-section 21, Station 20+27
 (Year 4 Data - Collected November 2011)

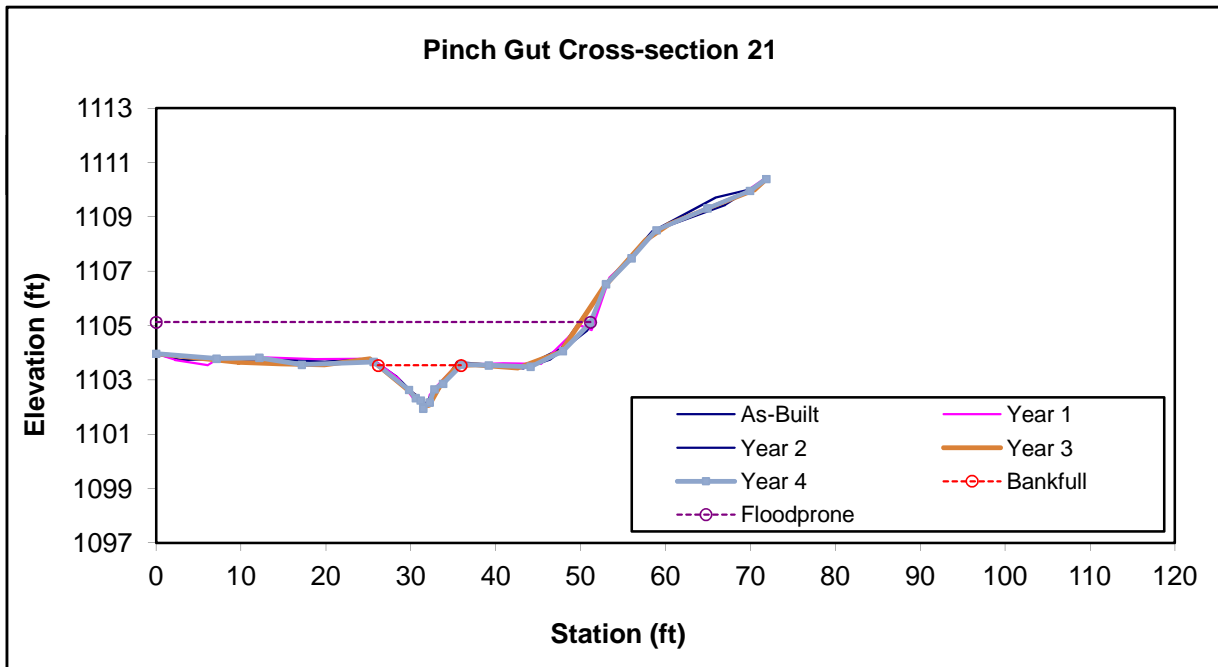


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Cc	6.8	9.76	0.7	1.59	13.9	1	5.2	1103.53	1103.56



Permanent Cross-section 22, Station 24+32
 (Year 4 Data - Collected November 2011)



Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Cc	10.5	12.14	0.86	2.29	14.07	1	6.3	1090.46	1090.42

