

Cane Creek Stream Restoration Site

EEP Project #92325

Contract # D06002

USACE Action ID #SAW-200703012

DWQ 404 #08-0358

Monitoring Year 05/Closeout

Project Type: Stream Restoration



Submitted: January 2014

Table 1a. Project Setting and Classifications Cane Creek Stream Restoration Site	
County	Person
General Location	Semora
Basin	Roanoke River
Physiographic Region	Piedmont
USGS Hydro Unit	03010104061040
NCDWQ Sub-basin	03-02-05
Trout Water	No
Project Performers	
Source Agency	NCEEP
Provider	KCI Technologies
Designer	KCI Technologies
Monitoring Firm	KCI Technologies
Planting	Bruton Nurseries & Landscapes
Property Interest Holder	NCEEP

Table 1b. Project Activity and Reporting History Cane Creek Stream Restoration Site		
Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	2007	Dec 07
Final Design	2007	Dec 07
Construction	N/A	Dec 08
Planting - Stream	N/A	Dec 08
Mitigation Plan / As-Built (Year 0 Monitoring - Baseline)	Jan 09	May 09
Monitoring Year 01	Dec 09	Dec 09
Maintenance on pools on T4-1, T4-2, & T-6		2009
Installed rock and stabilized swale on T4-1, T4-2, & T7-3		2009
Bank repair on T1-3		2009
Monitoring Year 02	Jan 11	Jan 11
Supplemental Planting		2010/2011
Monitoring Year 03	Nov 11	Jan 12
Monitoring Year 04	Jul 12	Dec 12
Supplemental Planting		Mar 12
Maintenance was conducted to stabilize most of the areas of slope erosion		2012
Monitoring Year 05	Sep 13	Dec 13
Beaver dam removal		Jan 13

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1.0 PROJECT SETTING AND BACKGROUND SUMMARY

The Cane Creek Tributary Site (CCTS) is a full-delivery project that was developed for the North Carolina Ecosystem Enhancement Program (EEP). The project restored, enhanced, and preserved 19,059 linear feet on an Unnamed Tributary to Cane Creek and other associated tributaries, and included planting a functional Piedmont Alluvial Forest floodplain community along with Mesic Mixed Hardwood Forest to develop an effective riparian buffer.

Prior to restoration, the project streams had been impacted by livestock and land clearing. These impacts resulted in bank erosion on all of the tributaries and severe incision on selected tributaries. There were also spoil piles remaining from land clearing, which disrupted overland flow paths. The streams had experienced bank erosion, which led to excessive sediment throughout the site. Overall the CCTS contained a series of tributaries in varying degrees of instability.

Since construction, supplemental planting has occurred on portions of the site to address poor vigor and survivability in the buffer. Supplemental planting was conducted at the site during the 2010/2011, and 2012 dormant season. Stream maintenance was conducted at the site in 2009 and 2012. The maintenance involved, isolated terrace slope stabilization, bank stabilization, and other small areas of maintenance. These areas were generally isolated and caused by local issues associated with overland flow or concentrated runoff from outside of the easement. They were not indicative of any widespread instability at the site. Overall the site is stable and well vegetated.

2.0 PROJECT GOALS AND OBJECTIVES

The goals and objectives of the restoration project are as follows:

Project Goals:

- Restore the stream's riparian buffer.
- Create a stable network of headwater streams.

Project Objectives:

- Plant a functional Piedmont Alluvial Forest floodplain community along with a Mesic Mixed Hardwood Forest to create an effective riparian buffer.
- Arrest bed elevation lowering and stabilize seep outlets.
- Stop bank erosion by developing the appropriate channel dimension and stabilizing with vegetation.
- Remove relic spoil piles that disrupt overland flow paths.
- Exclude livestock from the riparian areas with fencing.

3.0 SUCCESS CRITERIA

Table 2. Success Criteria Cane Creek Stream Restoration Site	
Feature	Success Criteria
Stream	Minimal changes to the measured stream characteristics, demonstrating system stability. At least two bankfull events occurring in separate years over the course of the monitoring period.
Vegetation	Average of 260 stems/acre, as indicated by permanent vegetation plots after 5 years of monitoring.

Table 3. Project Assets Cane Creek Stream Restoration Site				
Project Segment / Reach ID	Pre-Restoration (linear feet)	Mitigation Approach	As - Built Linear Fottage	Stream Mitigation Units
T1-1 and T1-2	1,087	EI	1,150	725 SMU*
T1-3, T1-4 and T1-5	1,688	R	1,617	1,617 SMU
T2-1	305	EII	305	122 SMU
T2-2	227	R	195	195 SMU
T2-3	160	EI	150	100 SMU
T2-4	151	R	200	180 SMU*
T3-1	107	EI	85	57 SMU
T3-2	1,457	R	1,612	1,592 SMU*
T4-1 and T4-2	1,979	R	2,281	2,261 SMU*
T5-1	244	EII	264	97 SMU*
T5-2	118	R	132	132 SMU
T6A	89	P	90	36 SMU
T6B-1	162	EII	162	32 SMU
T6B	103	R	104	42 SMU
T6AB	30	P	31	31 SMU
T6C-1	297	P	297	59 SMU
T6C-2	80	P	80	16 SMU
T6C-3	82	R	82	16 SMU
T6C and T6	1,455	P	1,425	1,405 SMU*
T7A-1	62	EII	62	12 SMU
T7A	136	P	136	54 SMU
T7B	125	EII	125	25 SMU
T7C	42	EII	42	17 SMU
T7-1	469	EI	525	210 SMU
T7-2	331	R	332	221 SMU
T7-3	2,023	R	2,129	2,109 SMU*
T7-4	1,246	EI	1,242	828 SMU
T7-5	185	R	147	147 SMU
T7-6 and T7-7	1,365	EI	1,438	945 SMU*
T8A-1	25	P	25	5 SMU
T8A	110	EII	123	49 SMU
T8B	59	P	59	12 SMU
T8-1	94	P	94	19 SMU
T8	449	EI	438	292 SMU
T9	369	EI	368	245 SMU
T10-1	1,300	EII	1,300	520 SMU
T10-2	282	EI	294	196 SMU

Table 3. Project Assets Continued				
Cane Creek Stream Restoration Site				
Project Segment / Reach ID	Pre-Restoration (linear feet)	Mitigation Approach	As - Built Linear Fottage	Stream Mitigation Units
Preservation Total			986	196 SMU*
Enhancement II Total			2,889	1,147 SMU*
Enhancement I Total			5,497	3,609 SMU*
Restoration Total			9,769	9,669 SMU*
Total of All Reaches			19,141	14,621 SMU*
Mitigation Unit Summations				
Stream (lf)	Riparian Wetland (Ac)	Nonriparian Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)
14,621	0	0	0	0

R = Restoration

EI = Enhancement I

EII = Enhancement II

P = Preservation

* These SMUs have been calculated by excluding the easement exceptions, which include ford crossings for the landowner

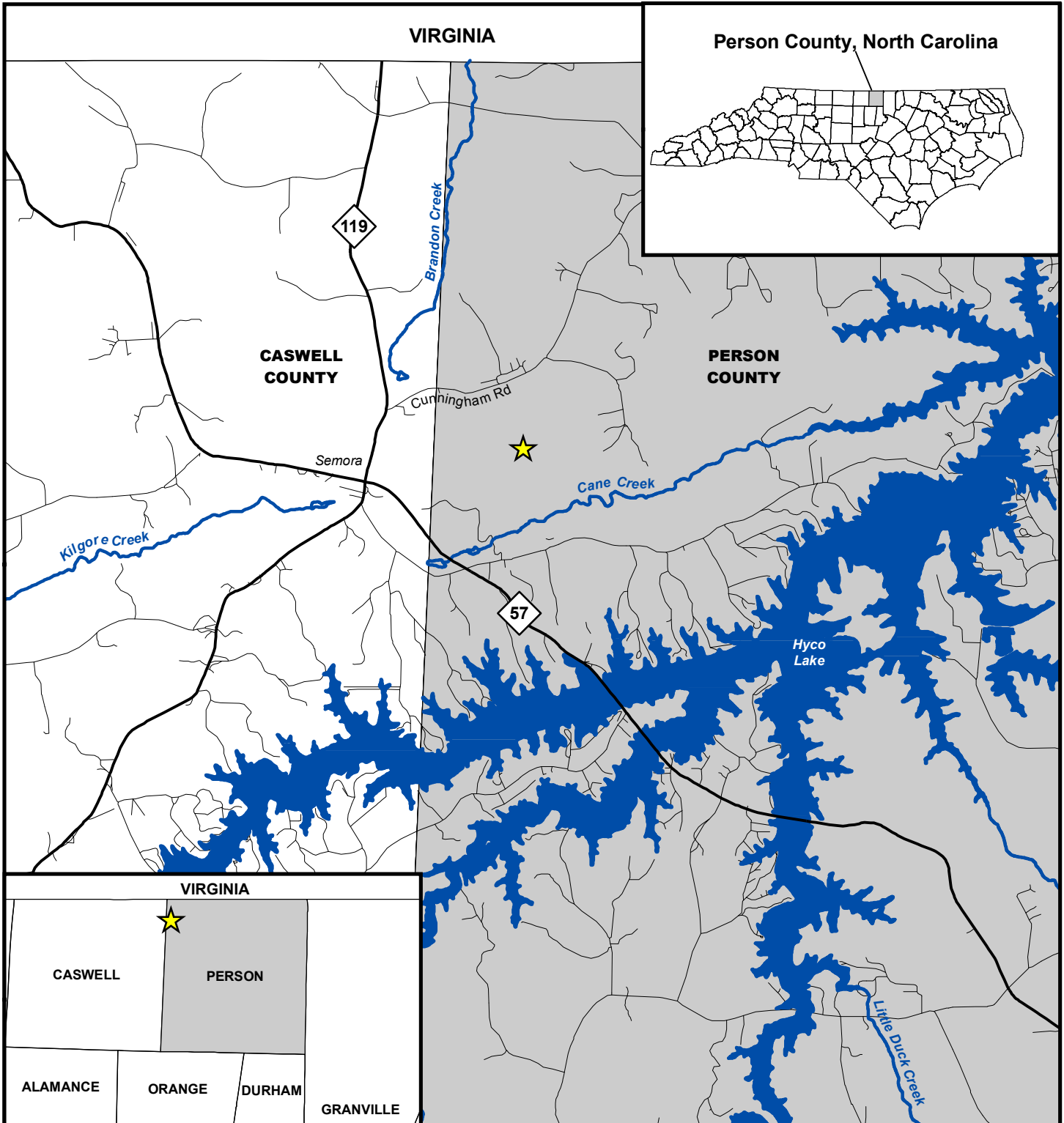






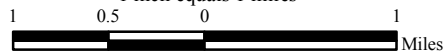


Figure 1. Vicinity Map

-  Project Site Location
-  Major Roads
-  Other Roads
-  Major Streams and Rivers
-  Major Lakes and Reservoirs
-  County Boundaries



1:63,360
1 inch equals 1 miles



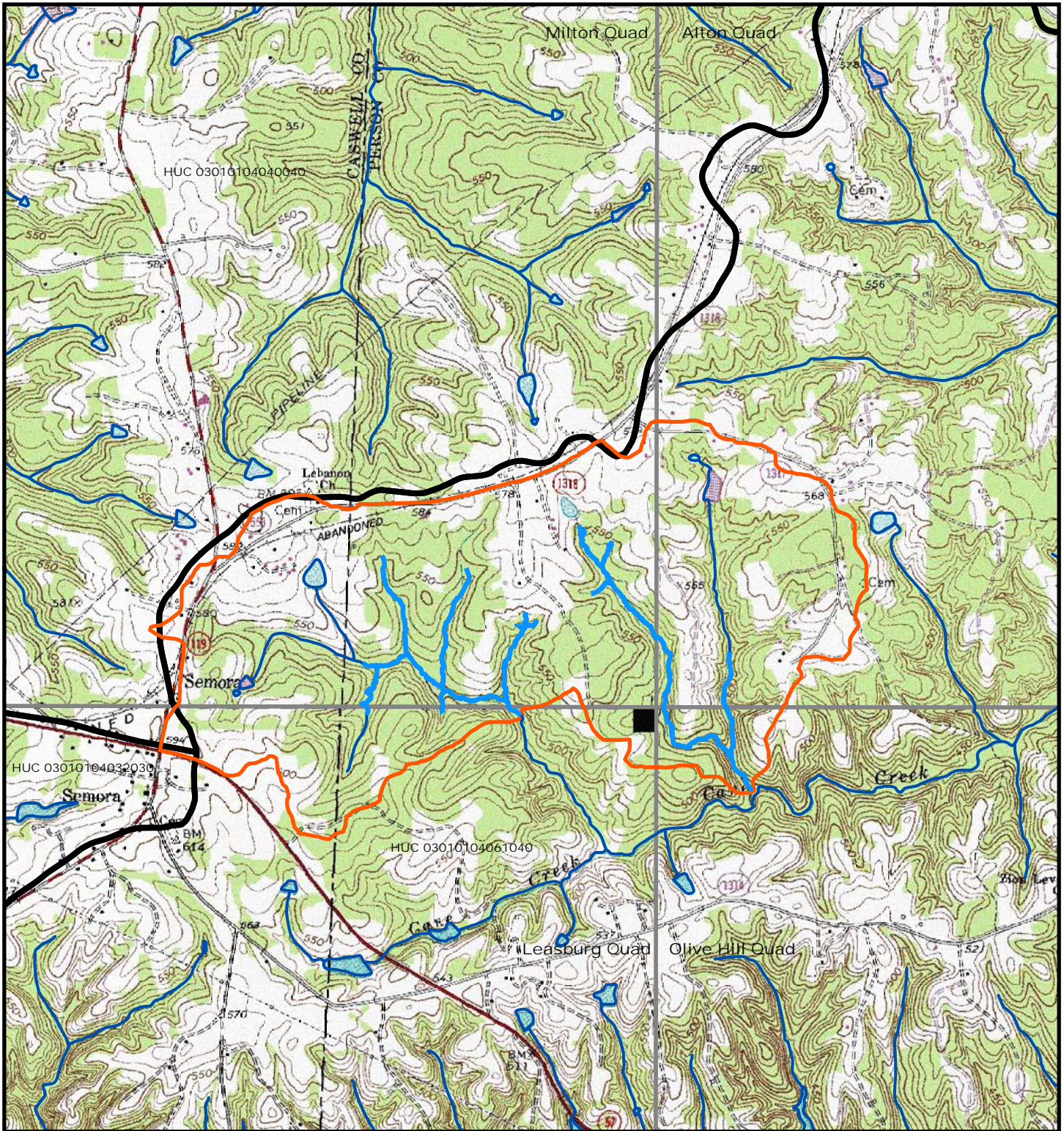





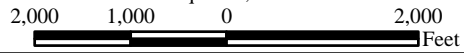


Figure 2. Project Watershed

-  Project Streams
-  Other Streams
-  Project Watershed (1.32 sq. miles)
-  14-digit HUC Boundaries
-  USGS Quadrangle Boundaries



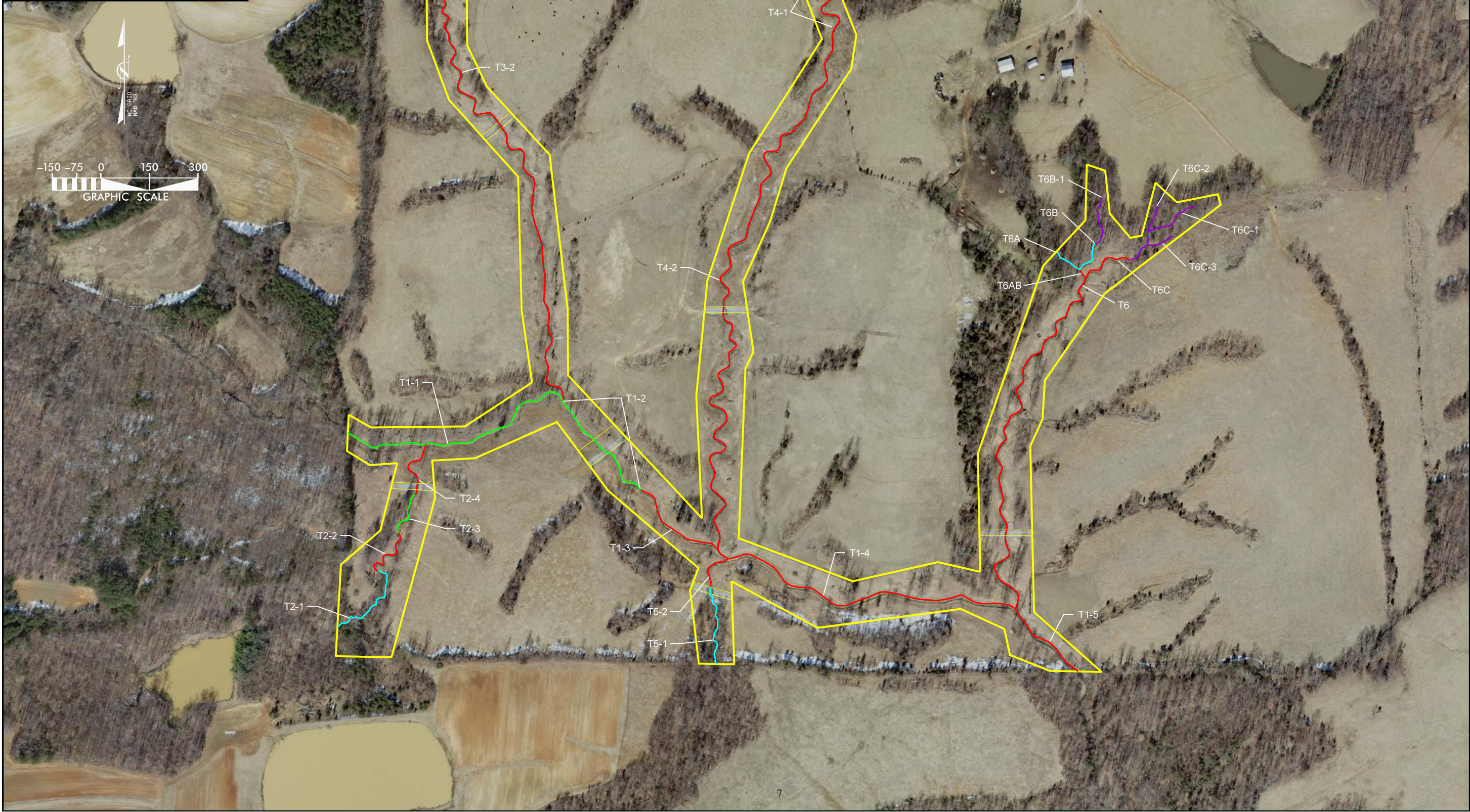
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1 inch equals 2,000 feet








*Source: USGS Topographic Quadrangles
Alton (1968), Leasburg (1968), Milton (1983),
and Olive Hill (1968)*

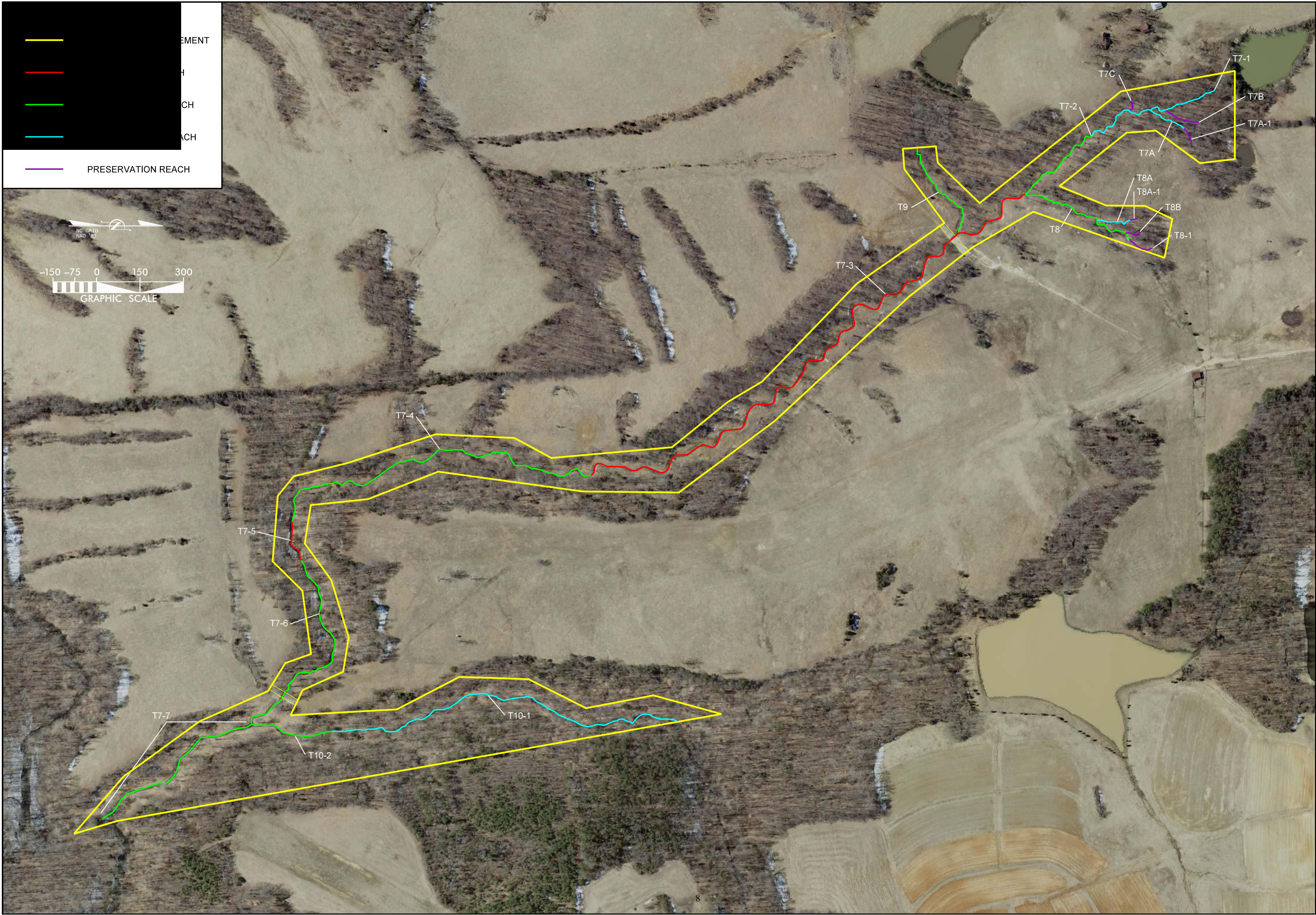
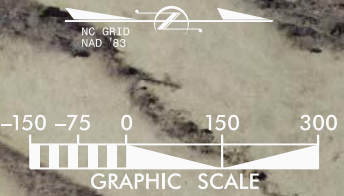


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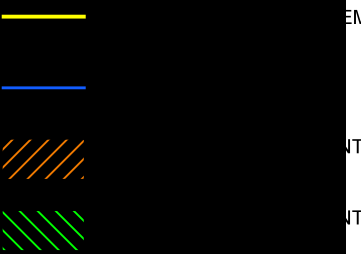


 <small>ENGINEERS • PLANNERS • SCIENTISTS</small>
CANE CREEK STREAM RESTORATION PROJECT
<small>DATE: JAN 2014 SCALE: GRAPHIC</small>
<small>CURRENT CONDITION PLAN VIEW</small>
<small>SHEET 1 OF 2</small>

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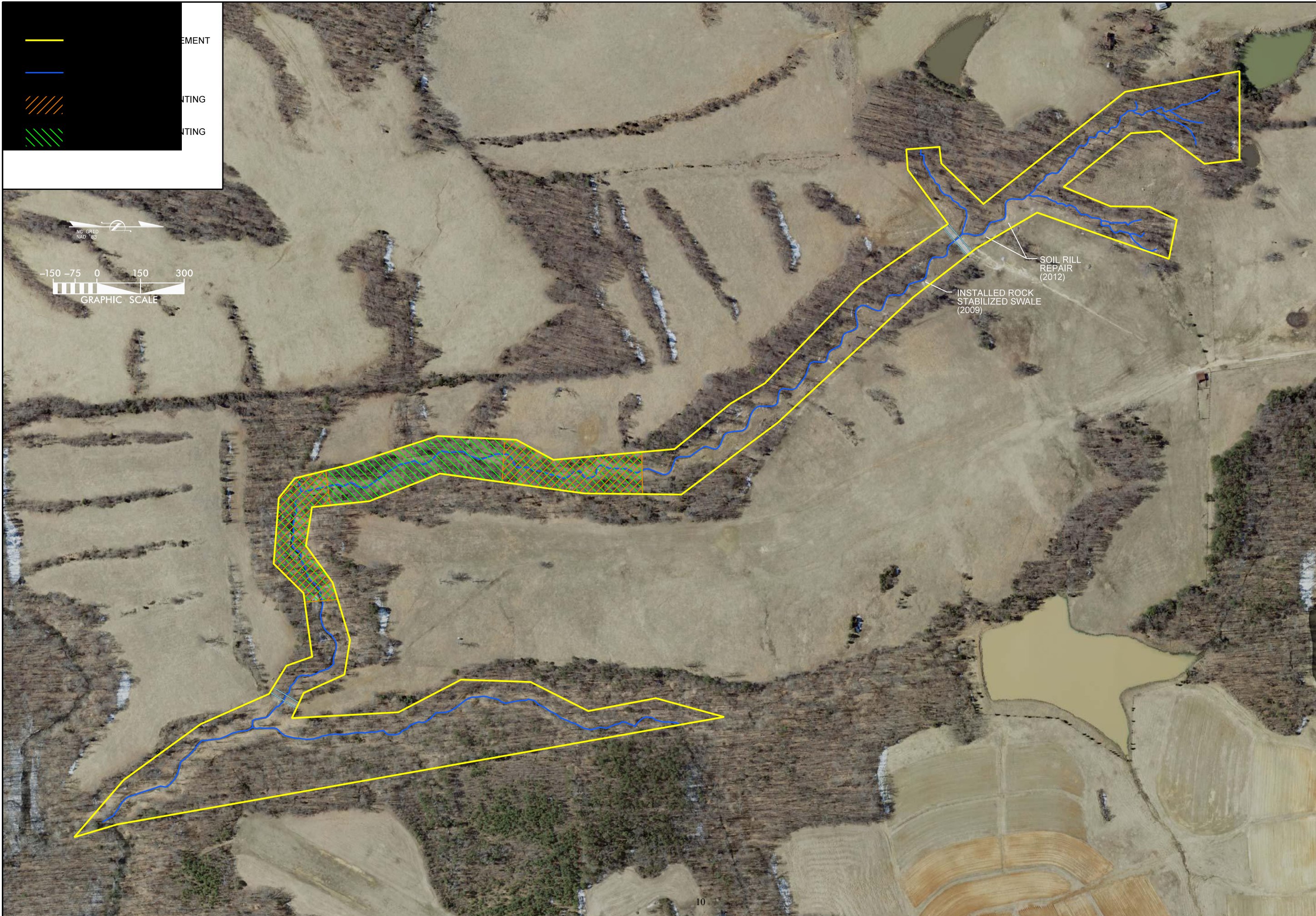
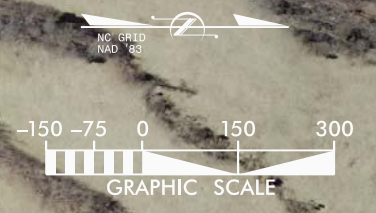


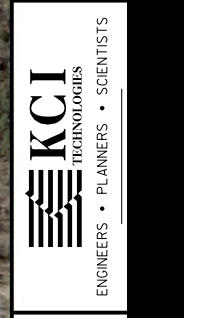
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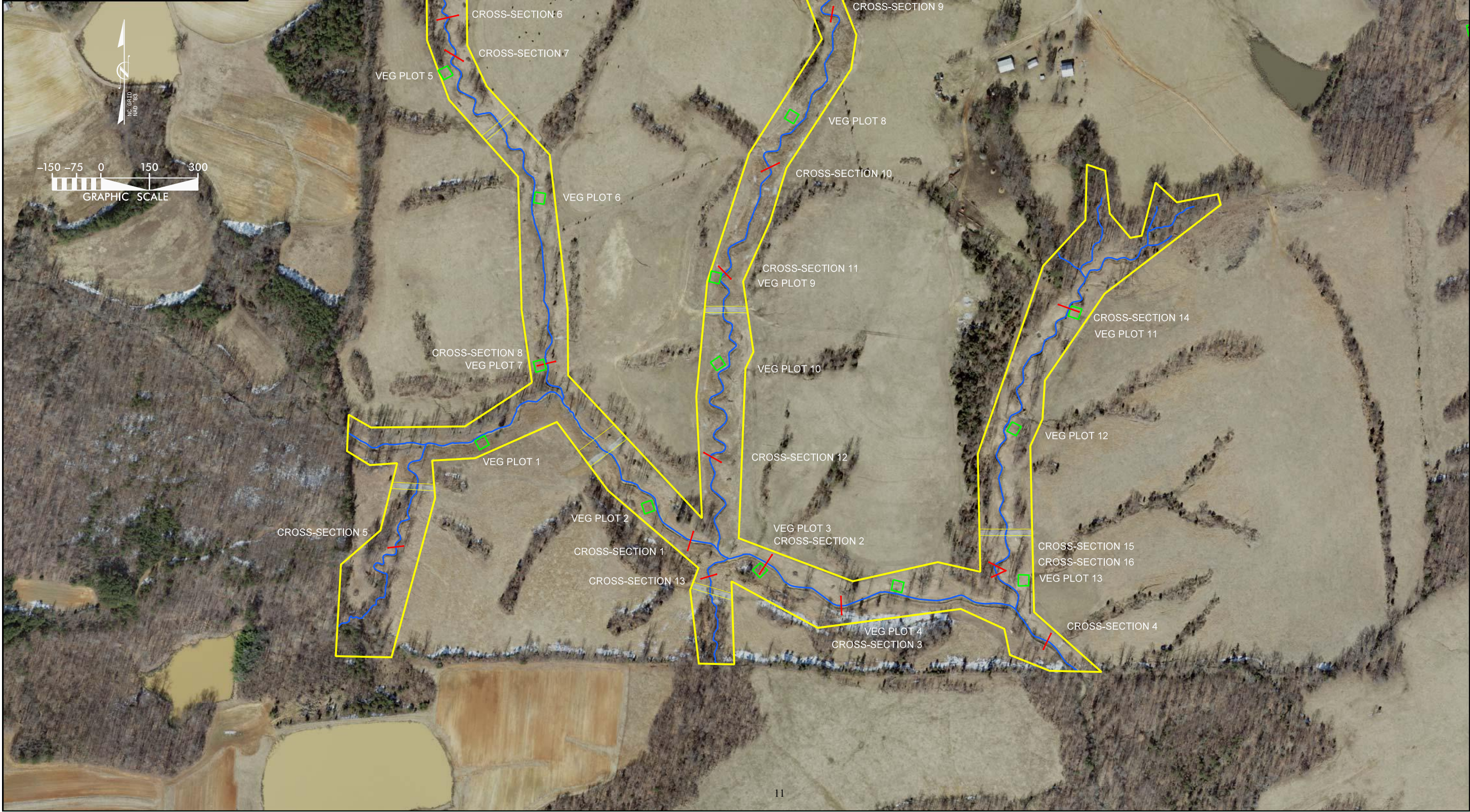




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 SEMORA, PERSON COUNTY, NORTH CAROLINA

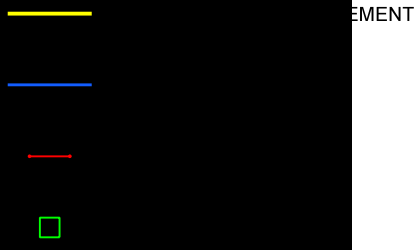
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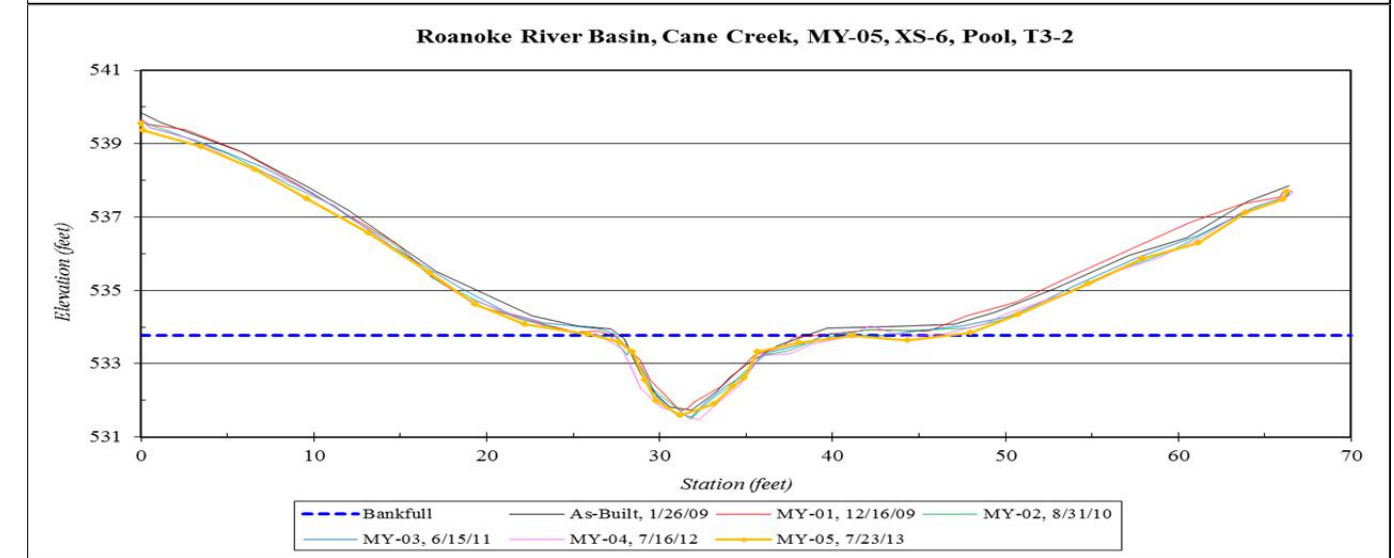
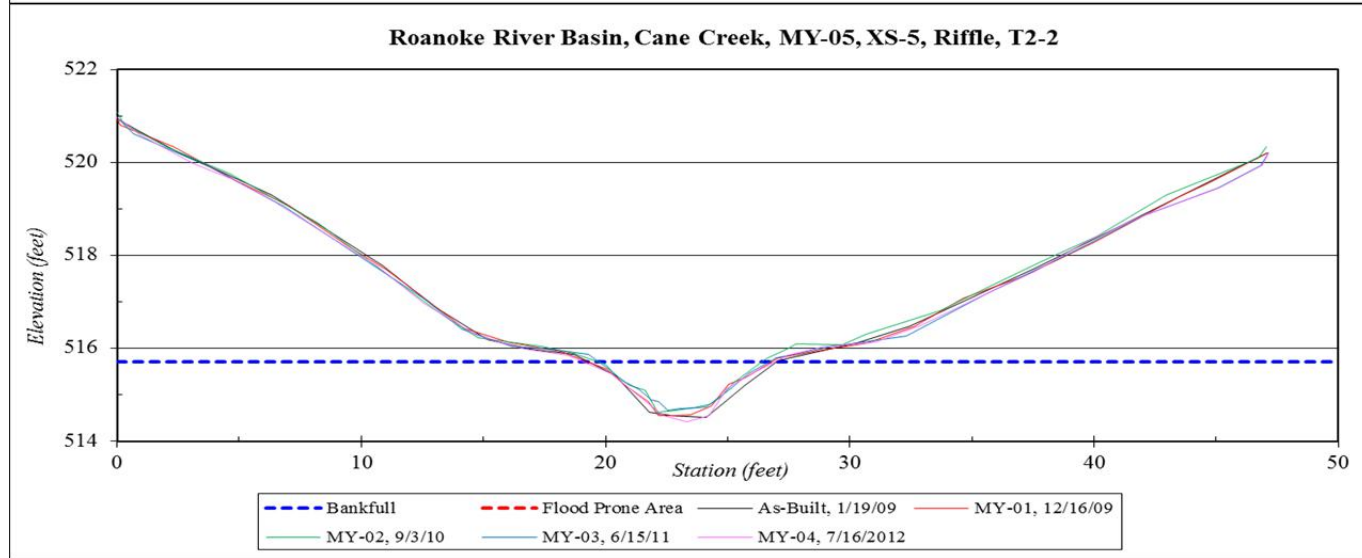
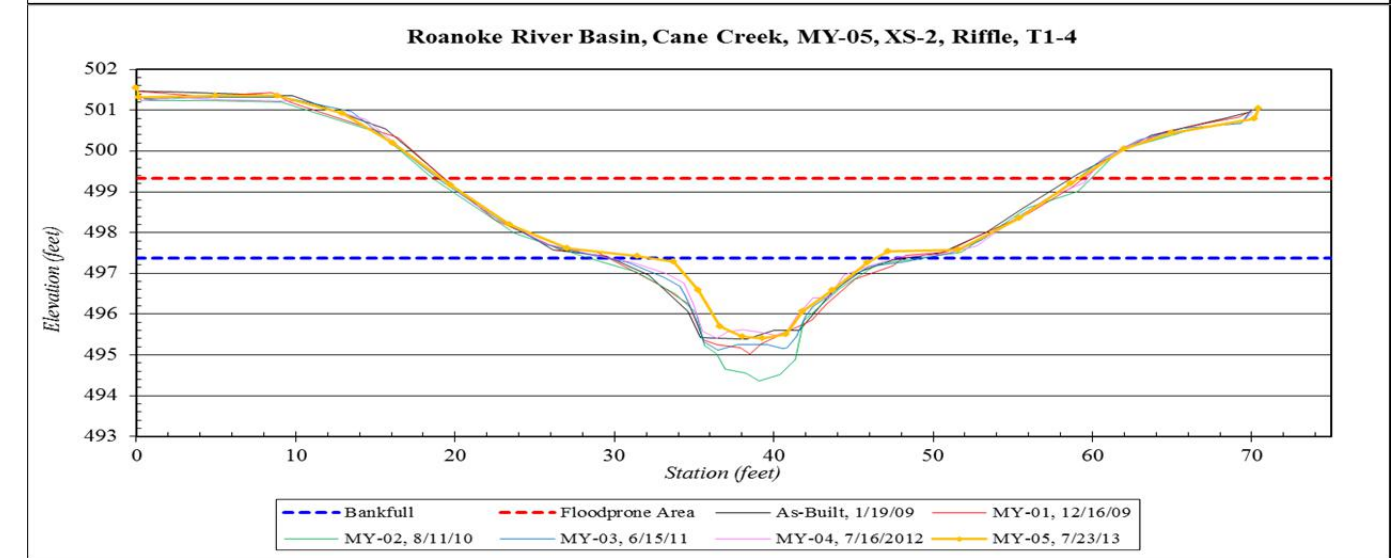
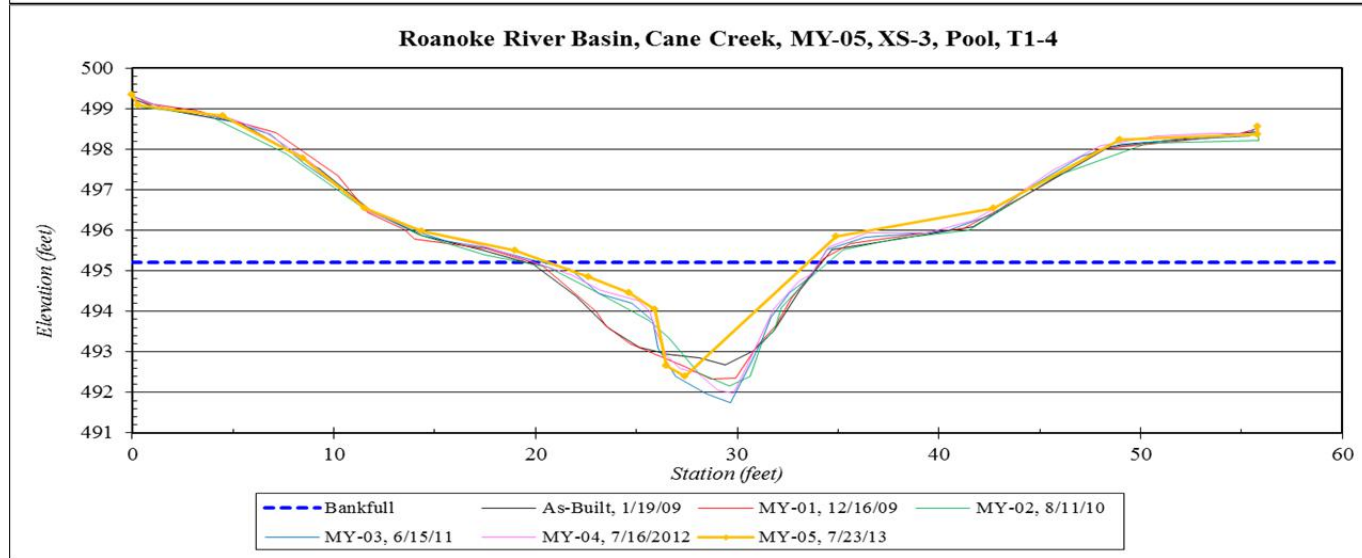
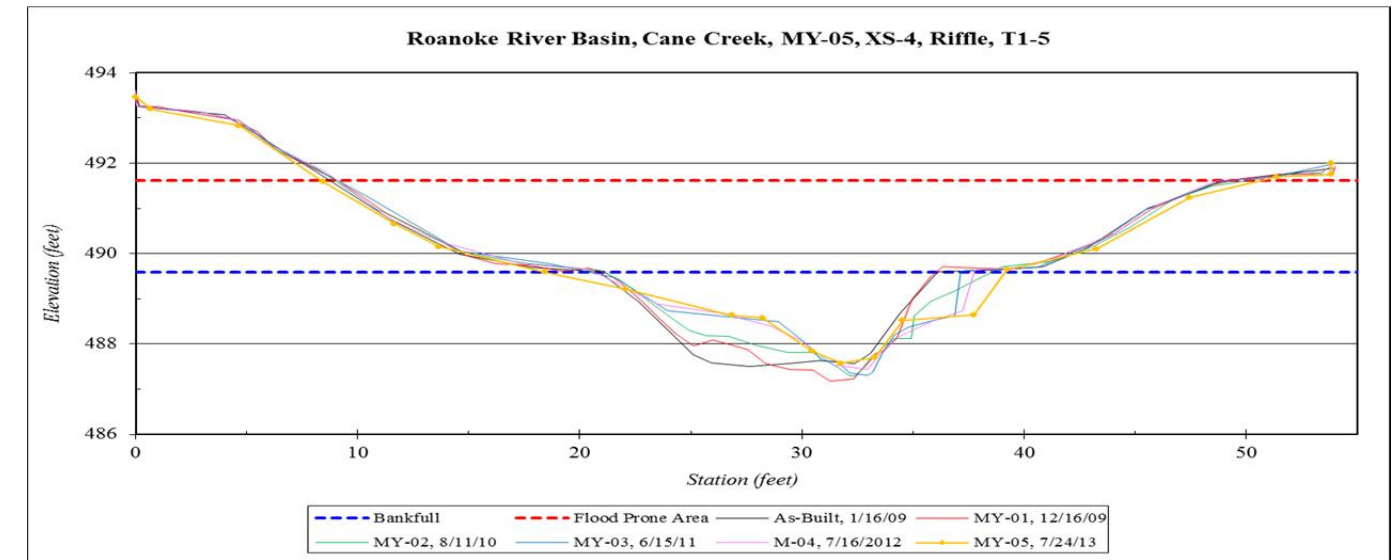
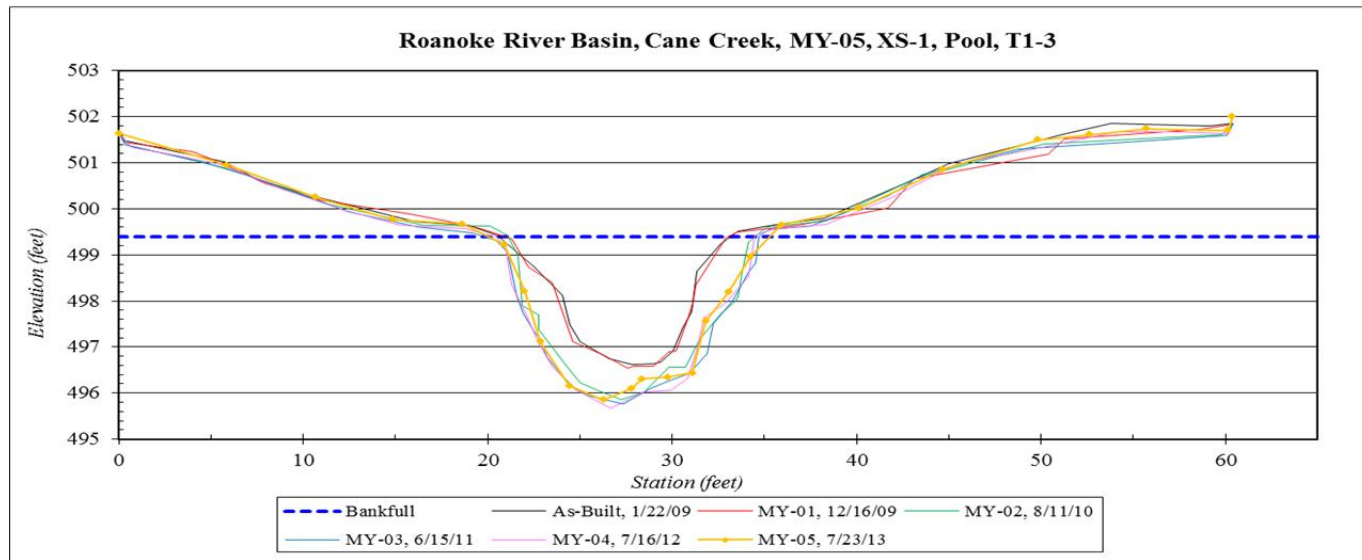
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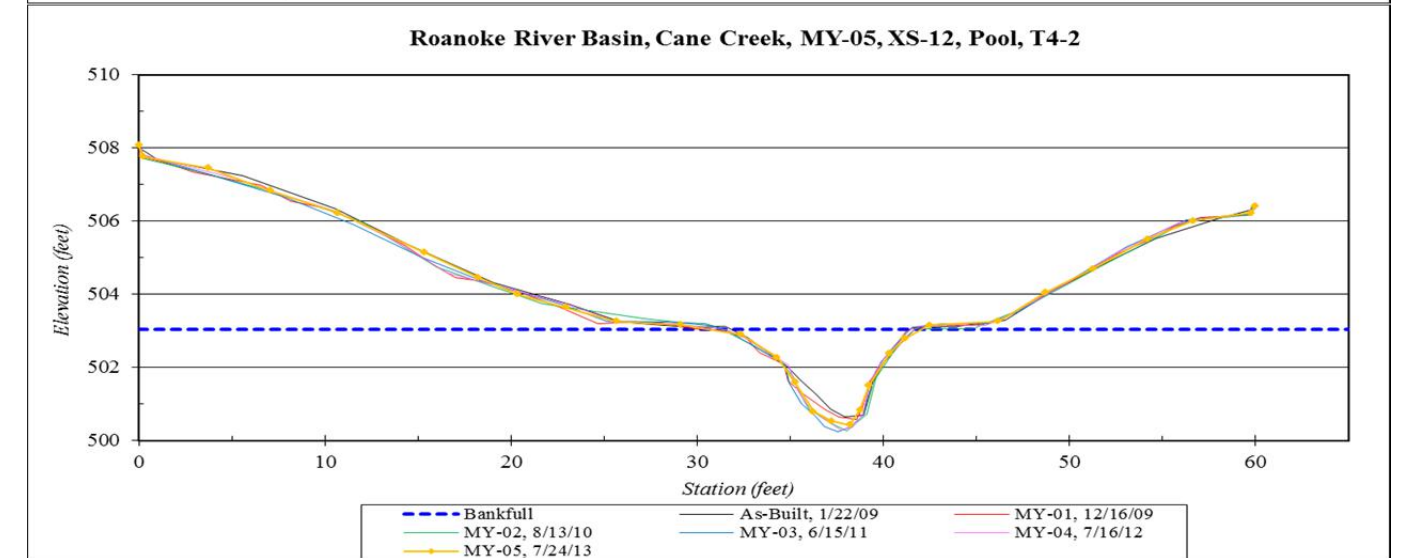
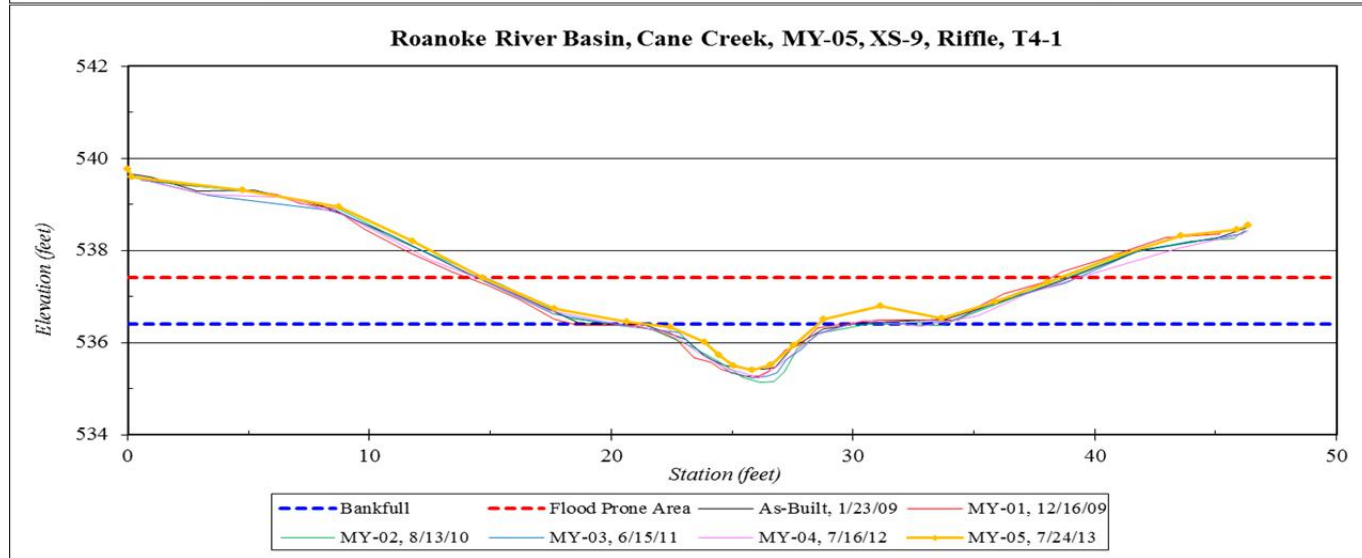
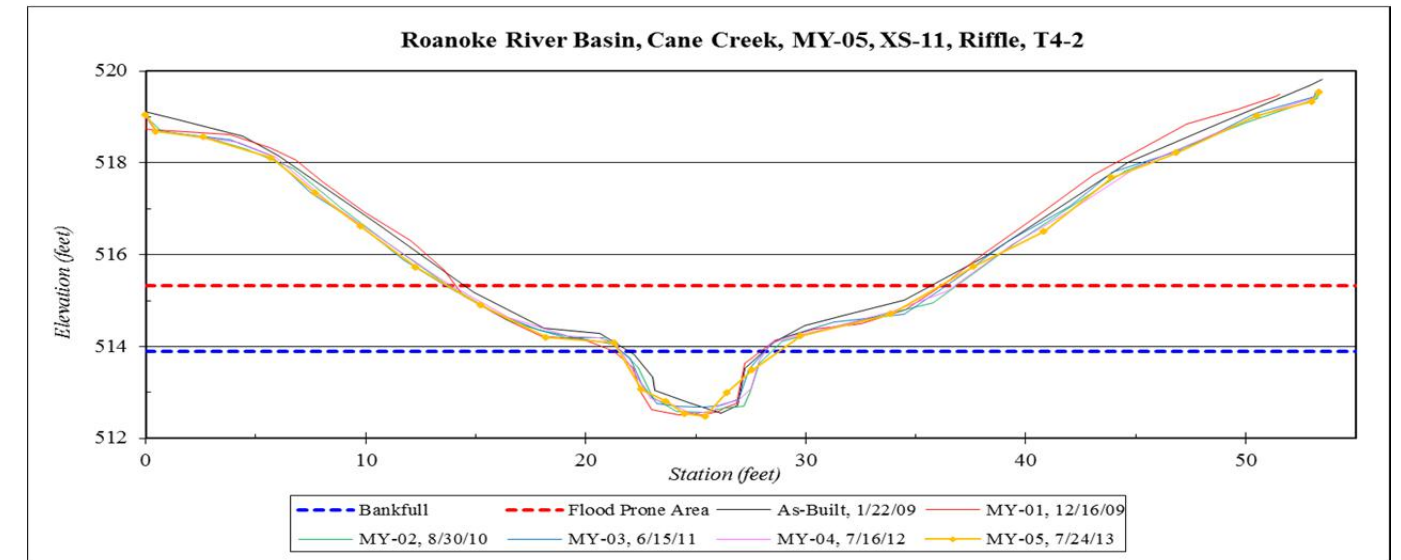
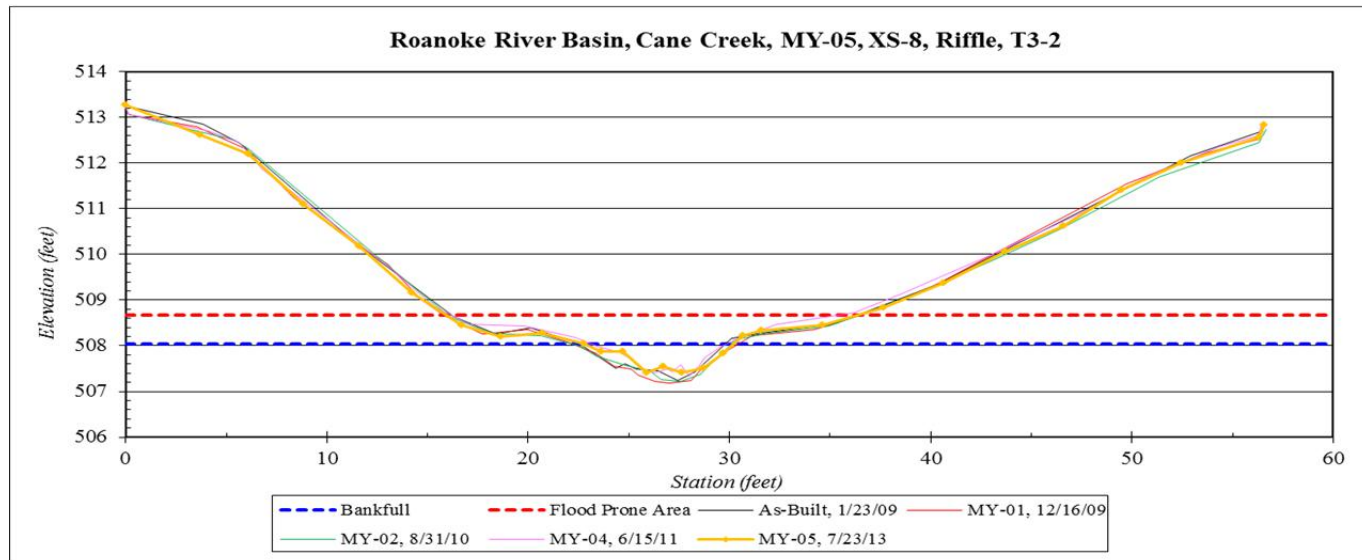
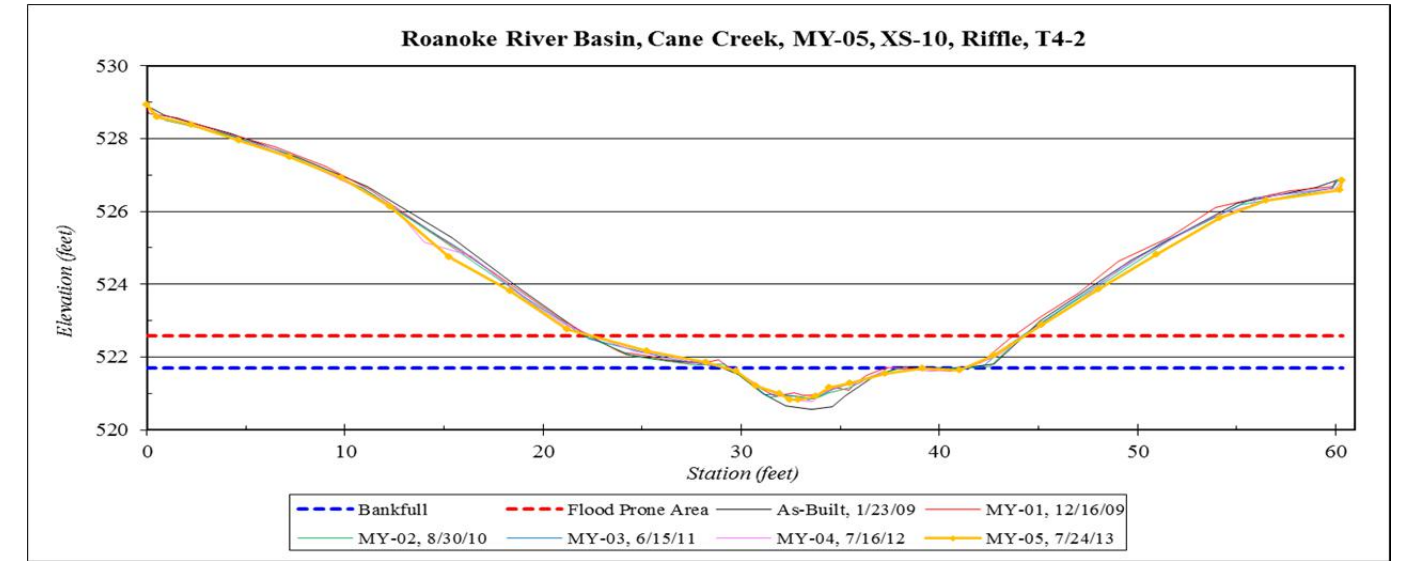
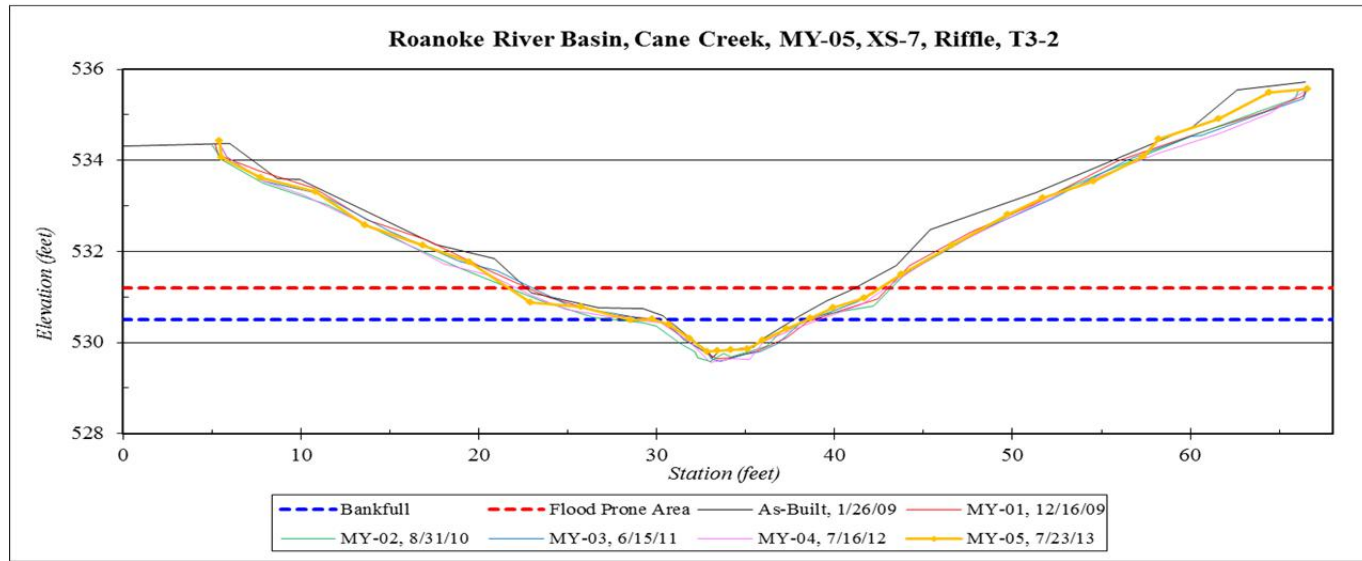


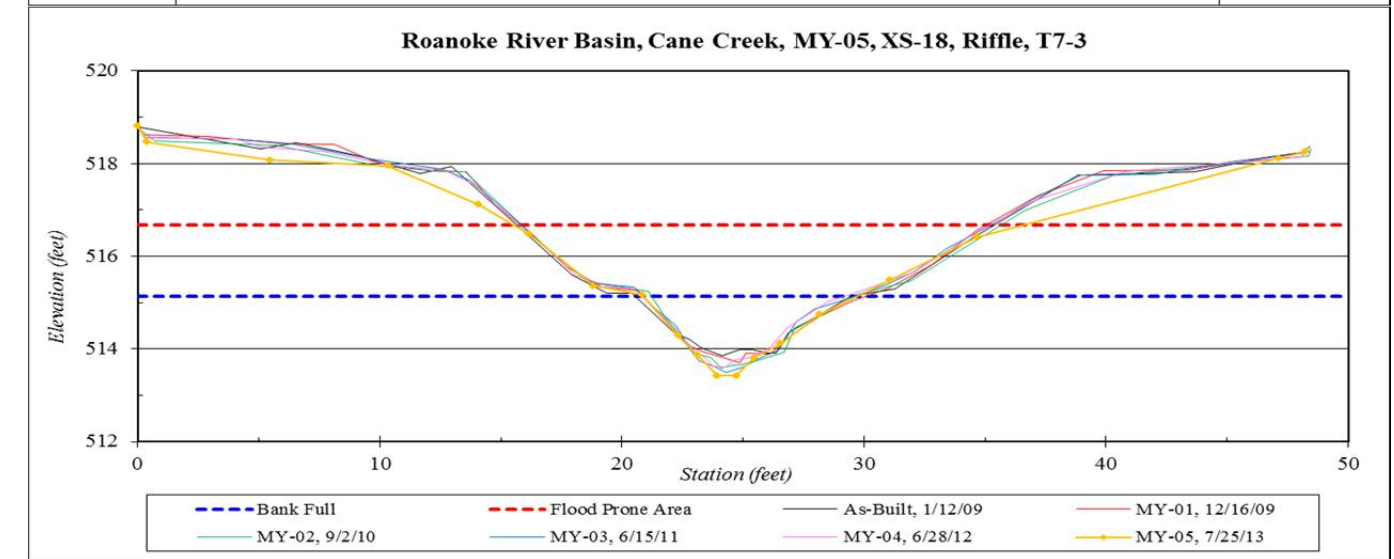
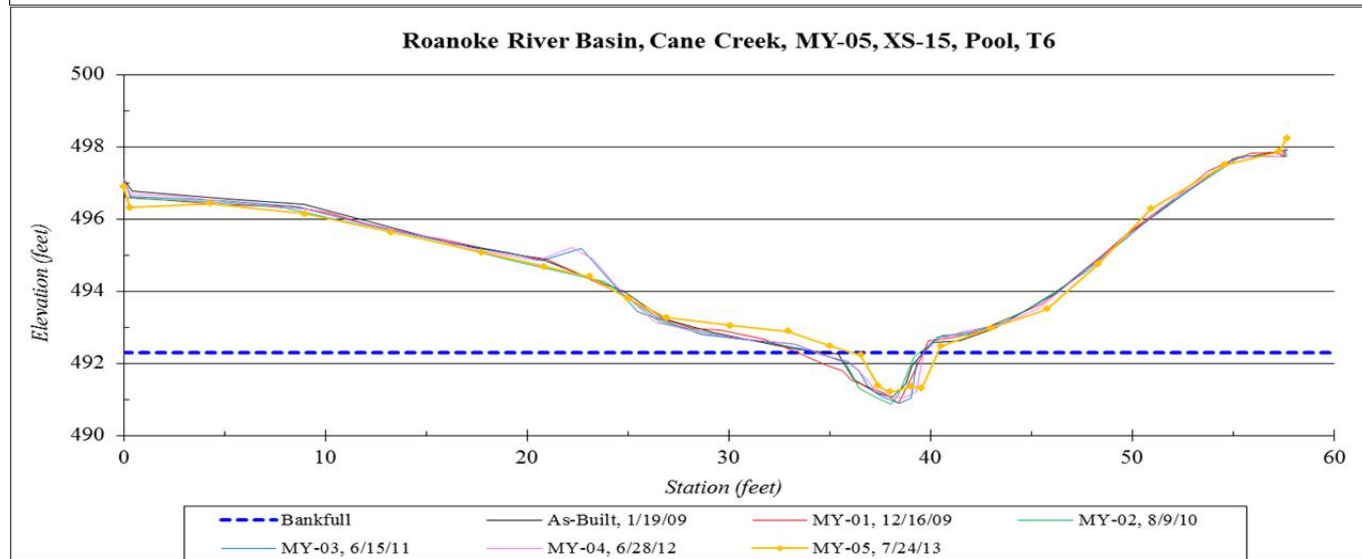
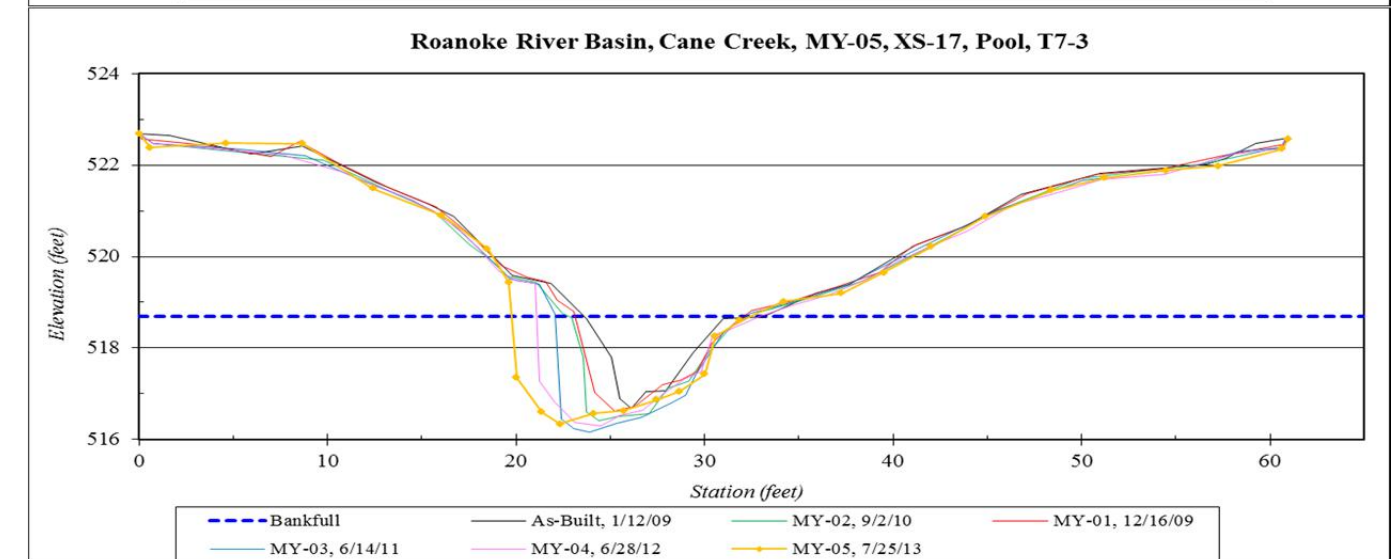
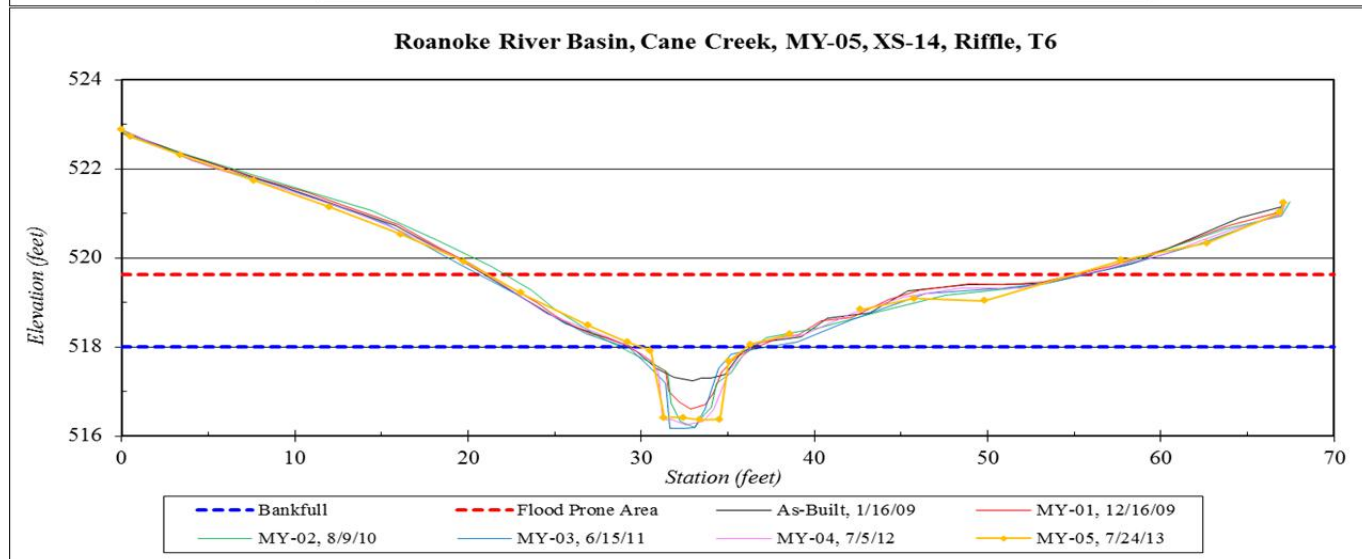
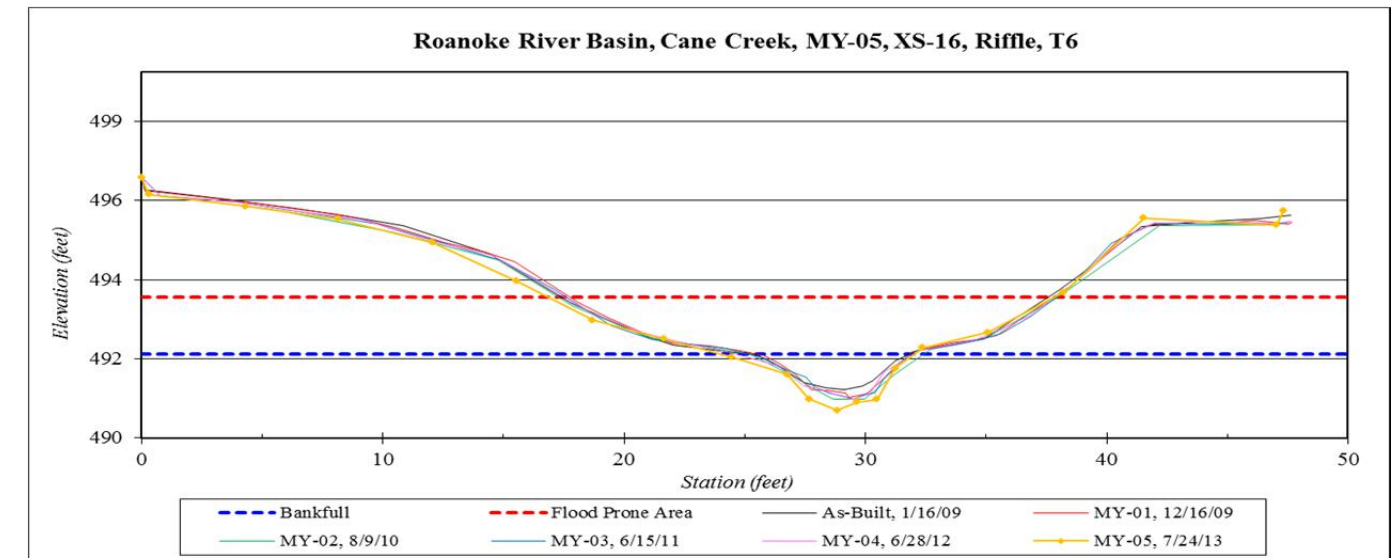
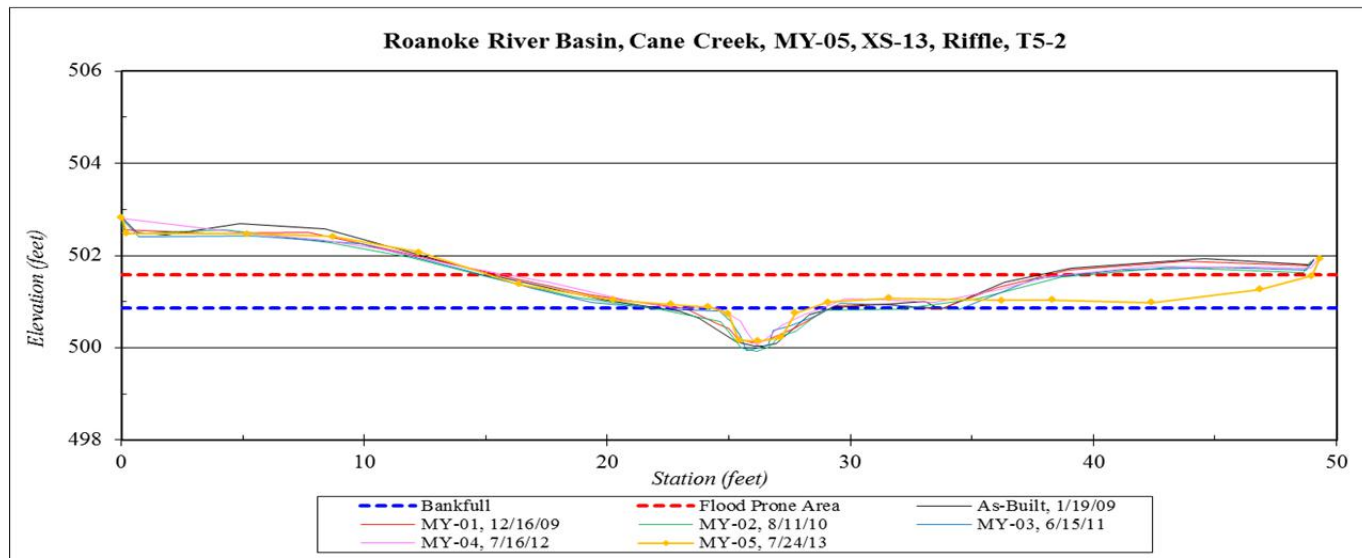
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STREAM RESTORATION PROJECT
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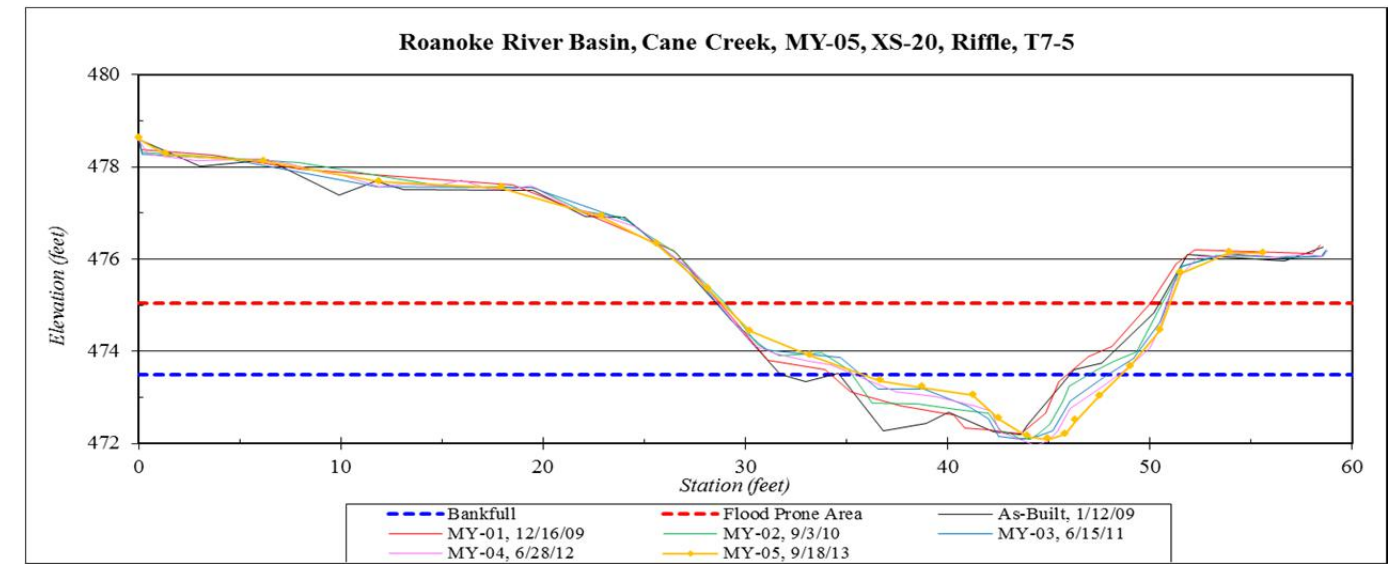
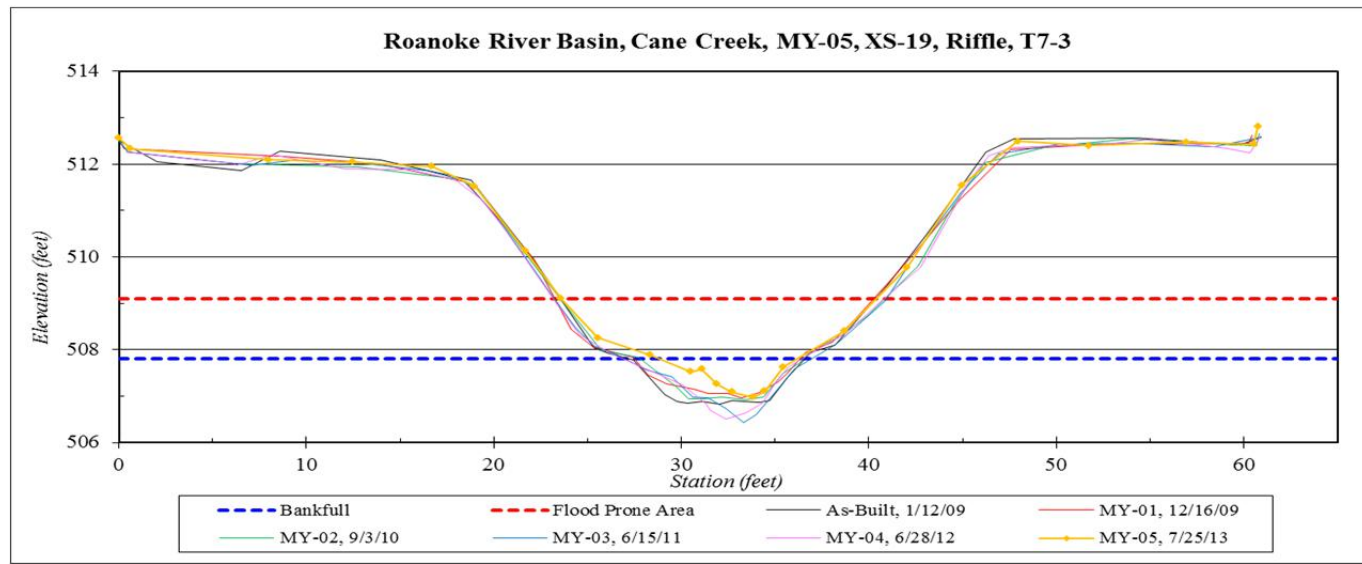
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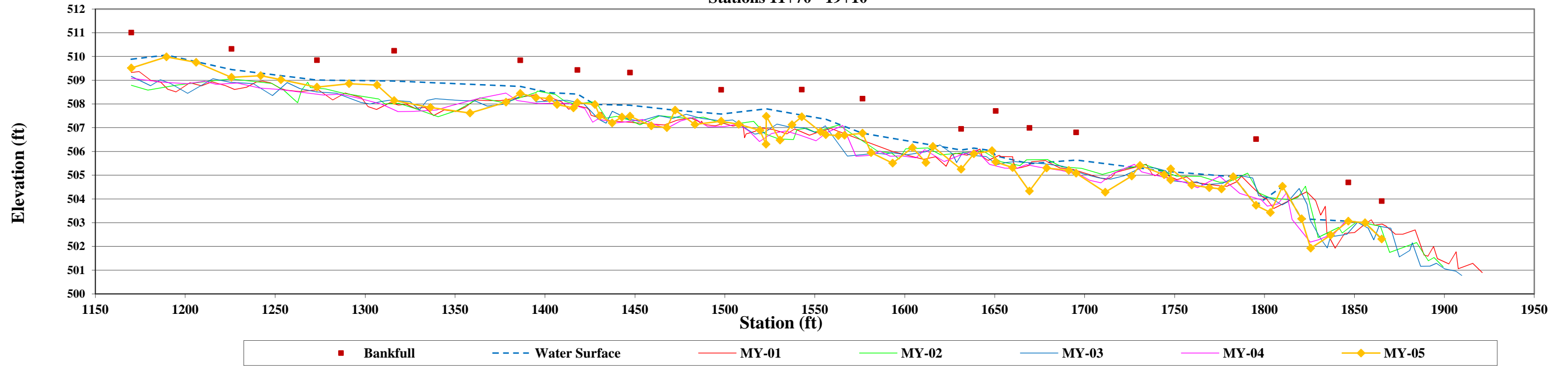




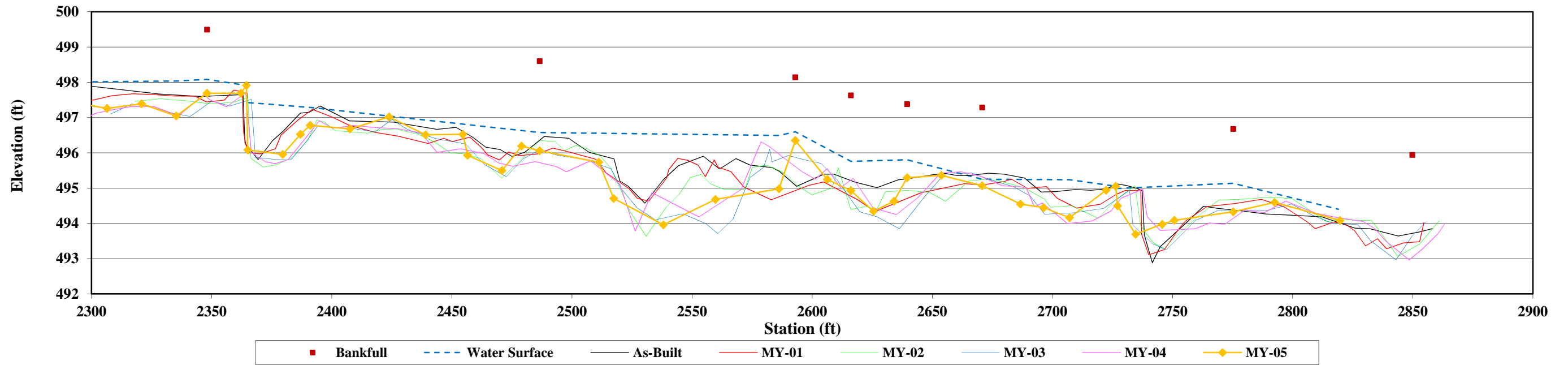




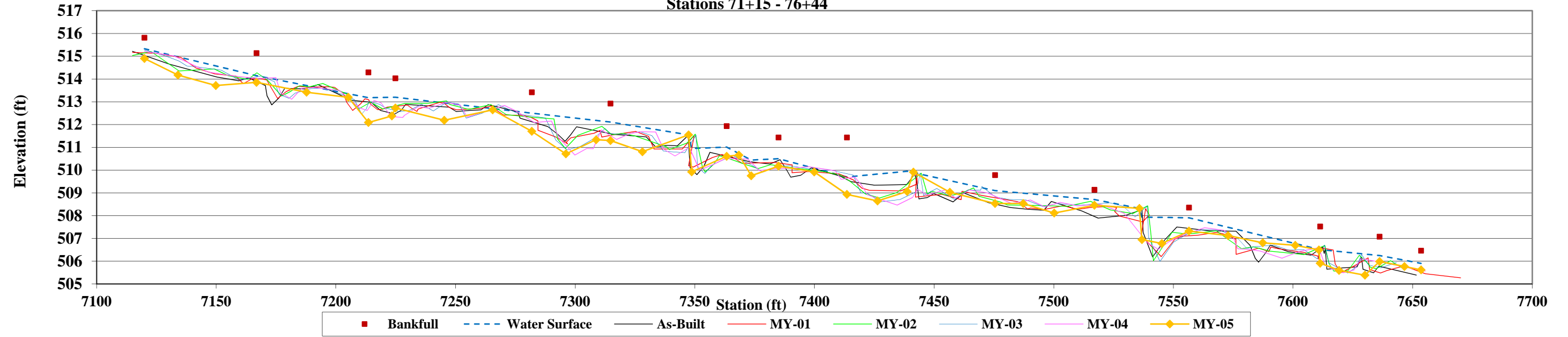
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 Longitudinal Profile 1
 Tributary 1, MY-05
 Stations 11+70 - 19+10**



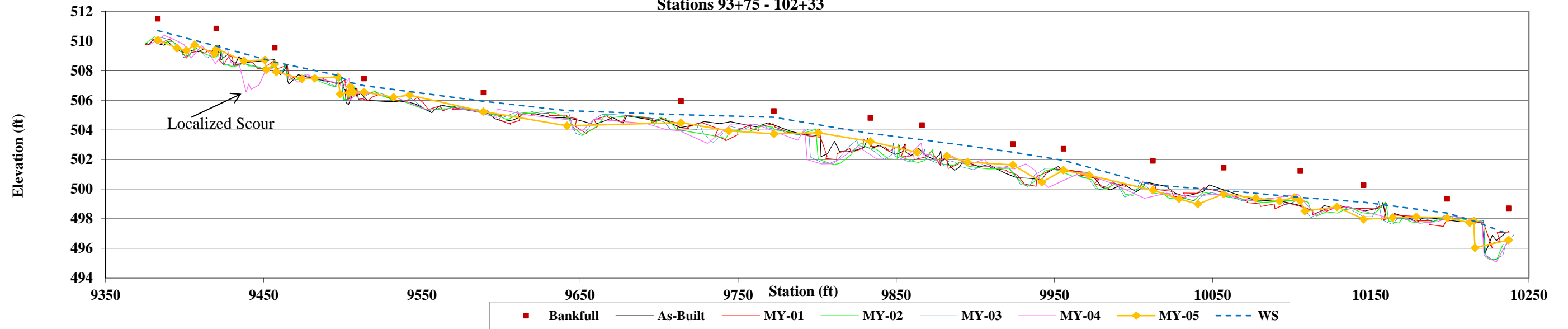
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 Longitudinal Profile 2
 Tributary 1, MY-05
 Stations 23+18 - 28+66**



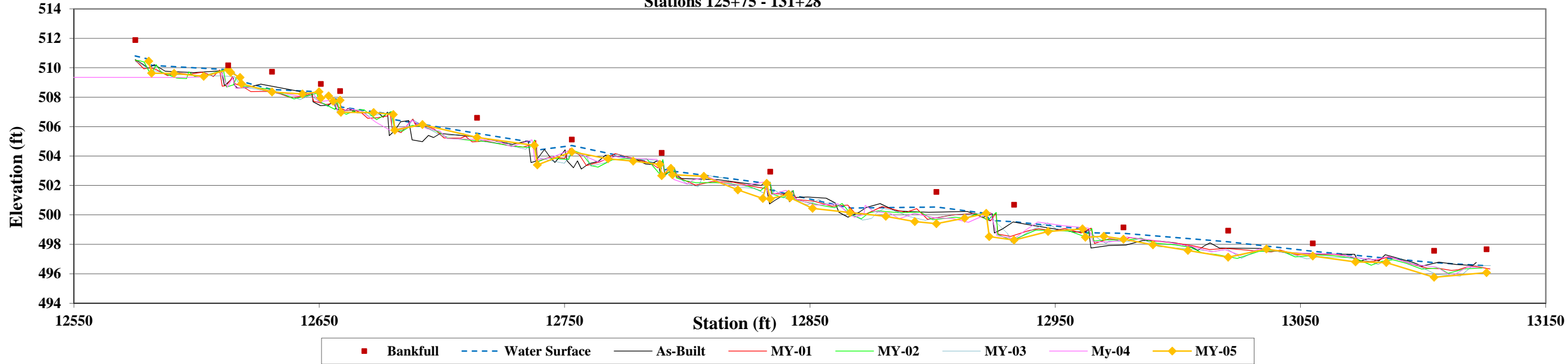
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 Longitudinal Profile
 Tributary 3, MY-05
 Stations 71+15 - 76+44



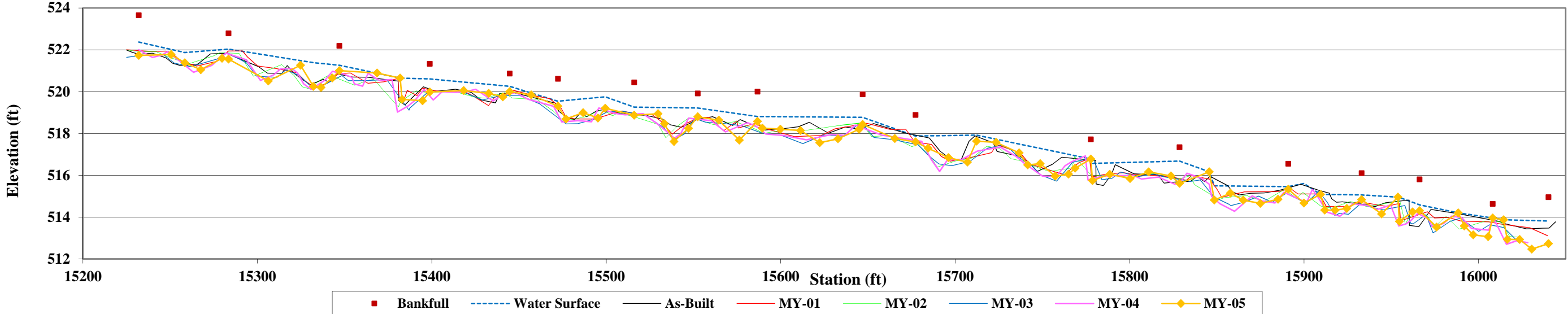
Cane Creek Tributary Site
 Longitudinal Profile
 Tributary 4, MY-05
 Stations 93+75 - 102+33



**Cane Creek Tributary Site
 Longitudinal Profile
 Tributary 6, MY-05
 Stations 125+75 - 131+28**



**Cane Creek Stream Restoration Site
 Longitudinal Profile 1
 Tributary 7, MY-05
 Stations 152+25 - 160+25**



**Cane Creek Tributary Site
 Longitudinal Profile 2
 Tributary 7, MY-05
 Stations 180+00 - 187+37**

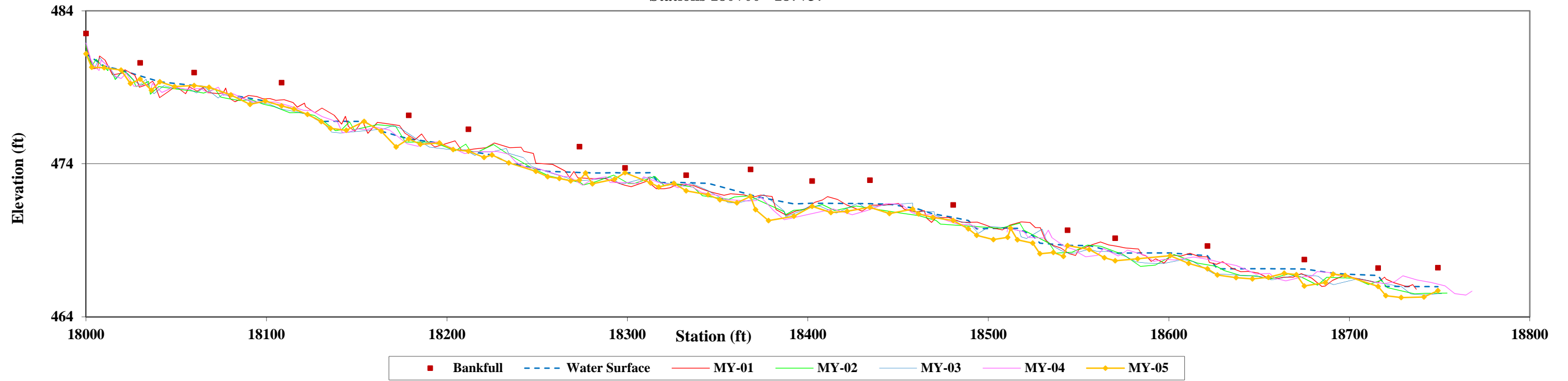


Table 4a. Morphology and Hydraulic Monitoring Summary																		
Cane Creek Stream Restoration Site																		
Parameter	Cross-Section 1						Cross-Section 2						Cross-Section 3					
	Pool						Riffle						Pool					
Reach	T1-3						T1-4						T1-4					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	12.6	12.2	13.4	14.9	14.0	15.3	17.4	17.8	18.8	18.0	18.2	14.1	14.2	14.3	14.4	13.2	14.0	12.8
Floodprone Width (ft)	-	-	-	-	-	-	39	42	42	41	40	40	-	-	-	-	-	-
Bankfull Mean Depth (ft)	1.6	1.7	2.4	2.4	2.5	2.2	1.1	1.1	1.2	1.0	0.9	1.0	1.5	1.6	1.4	1.6	1.4	1.1
Bankfull Max Depth (ft)	2.8	2.9	3.5	3.6	3.7	3.5	1.9	2.3	2.9	2.2	2.0	2.0	2.5	2.9	3.0	3.4	3.2	2.8
Bankfull Cross-Sectional Area (ft ²)	20.2	20.9	32.2	35.5	35.2	33.1	18.9	19.9	23.3	18.7	17.0	14.8	21.9	23.5	19.7	20.5	19.6	14.7
Width/Depth Ratio	-	-	-	-	-	-	16.0	15.9	15.2	17.3	19.5	13.4	-	-	-	-	-	-
Entrenchment Ratio	-	-	-	-	-	-	2.2	2.4	2.2	2.3	2.6	2.8	-	-	-	-	-	-
Bank Height Ratio	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-
Substrate																		
d50 (mm)	5		2	2	12	8	15	8	8	23	10	19	2	9	9	3	22	6
d84 (mm)	15		15	34	54	19	40	43	43	38	21	36	12	30	30	35	64	38

Table 4b. Morphology and Hydraulic Monitoring Summary continued																		
Cane Creek Stream Restoration Site																		
Parameter	Cross-Section 4						Cross-Section 5						Cross-Section 6					
	Riffle						Riffle						Pool					
Reach	T1-5						T2-2						T3-2					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	15.3	15.0	17.5	15.6	17.1	20.7	7.7	7.5	6.7	6.5	7.8		12.3	12.6	13.5	12.3	14.4	15.1
Floodprone Width (ft)	42	37	37	45	42	42	21	21	21	21	23		-	-	-	-	-	-
Bankfull Mean Depth (ft)	1.5	1.5	1.2	1.2	1.1	0.9	0.7	0.6	0.6	0.6	0.7		1.1	0.9	1.1	1.1	1.0	0.9
Bankfull Max Depth (ft)	2.1	2.4	2.3	2.3	2.2	2.0	1.2	1.2	1.1	1.0	1.3		2.2	2.1	2.3	2.3	2.3	2.2
Bankfull Cross-Sectional Area (ft ²)	22.2	22.1	21.2	18.8	19.3	19.4	5.4	4.7	4.2	4.2	5.1		13.3	11.0	13.3	12.9	15.0	13.0
Width/Depth Ratio	10.5	10.2	14.4	12.9	15.2	22.1	11.0	12.0	10.7	10.1	11.9		-	-	-	-	-	-
Entrenchment Ratio	2.7	2.5	2.1	2.9	2.5	2.0	2.7	2.8	3.1	3.2	2.9		-	-	-	-	-	-
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		-	-	-	-	-	-
Substrate																		
d50 (mm)	24	27	17	27	26	14	10	14	14	1	11	5	1.10		0.62	0.06	0.08	0.06
d84 (mm)	44	Bdrk	Bdrk	59	76	31	30	31	41	12	32	21	10.00		0.62	1.20	0.76	0.06

**Table 4c. Morphology and Hydraulic Monitoring Summary continued
Cane Creek Stream Restoration Site**

Parameter	Cross-Section 7						Cross-Section 8						Cross-Section 9					
	Riffle						Riffle						Riffle					
Reach	T3-2						T3-2						T4-1					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	7.8	8.8	9.4	7.9	8.9	8.8	8.3	10.3	9.3	8.2	7.8	7.4	8.5	8.3	10.4	10.1	9.7	7.1
Floodprone Width (ft)	21	22	22	22	24	23	24	26	26	23	24	21	24	25	25	26	29	29
Bankfull Mean Depth (ft)	0.5	0.5	0.5	0.6	0.5	0.4	0.5	0.6	0.5	0.4	0.4	0.4	0.5	0.6	0.5	0.5	0.5	0.5
Bankfull Max Depth (ft)	0.9	0.9	0.9	0.9	0.9	0.7	0.9	1.0	1.0	0.9	0.8	0.6	1.0	1.1	1.3	1.2	1.2	1.0
Bankfull Cross-Sectional Area (ft ²)	3.9	4.4	4.7	4.5	4.5	3.4	4.2	5.8	4.7	3.6	3.5	2.7	4.1	4.6	5.3	4.9	4.9	3.5
Width/Depth Ratio	15.6	17.6	18.8	13.9	17.7	22.8	16.4	18.3	18.4	18.7	17.4	20.3	17.6	15.0	20.4	20.8	19.2	14.4
Entrenchment Ratio	2.7	2.5	2.3	2.7	2.7	2.6	2.9	2.5	2.8	2.8	3.0	2.8	2.8	3.0	2.4	2.6	3.0	4.1
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Substrate																		
d50 (mm)	0.30	1.30	1.30	0.33	0.41	0.06	26	18	18	16	6	9	0	2	7	19	7	7
d84 (mm)	7	41	41	33	18	2	42	50	50	58	41	20	13	35	17	45	22	38

**Table 4d. Morphology and Hydraulic Monitoring Summary continued
Cane Creek Stream Restoration Site**

Parameter	Cross-Section 10						Cross-Section 11						Cross-Section 12					
	Riffle						Riffle						Pool					
Reach	T4-2						T4-2						T5-2					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	9.1	9.5	8.3	9.3	8.0	8.1	8.6	6.7	6.8	6.1	6.6	7.3	10.7	10.3	10.5	9.9	10.1	9.8
Floodprone Width (ft)	24	21	21	22	22	22	26	22	22	21	21	22	-	-	-	-	-	-
Bankfull Mean Depth (ft)	0.6	0.5	0.5	0.4	0.5	0.4	0.9	1.0	0.9	0.9	1.0	0.8	1.1	1.1	1.3	1.4	1.3	1.3
Bankfull Max Depth (ft)	1.2	0.8	0.8	0.8	0.9	0.9	1.7	1.4	1.6	1.2	1.4	1.4	2.5	2.5	2.8	2.8	2.8	2.6
Bankfull Cross-Sectional Area (ft ²)	5.9	4.3	4.1	3.9	4.2	4.0	7.9	6.4	6.4	5.7	6.3	6.0	12.3	11.2	13.6	13.4	12.9	12.5
Width/Depth Ratio	14.0	21.0	16.8	22.2	15.2	16.4	9.4	7.0	7.2	6.5	6.9	8.9	-	-	-	-	-	-
Entrenchment Ratio	2.6	2.2	2.6	2.3	2.8	2.7	3.0	3.3	3.2	3.5	3.2	3.0	-	-	-	-	-	-
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-
Substrate																		
d50 (mm)	8	20	35	17	12	8	1	35	10	1	3	2	0	5	25	10	29	23
d84 (mm)	39	43	59	39	26	11	16	Bdrk	25	19	10	6	1	22	43	41	84	39

Table 4e. Morphology and Hydraulic Monitoring Summary continued																		
Cane Creek Stream Restoration Site																		
Parameter	Cross-Section 13						Cross-Section 14						Cross-Section 15					
	Riffle						Riffle						Pool					
Reach	T5-2						T6						T6					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	5.9	6.0	6.9	5.9	5.6	4.0	7.1	7.4	7.7	6.9	7.0	6.1	4.1	6.0	5.0	5.1	5.2	4.2
Floodprone Width (ft)	21	23	23	27	24	23	19	26	26	38	35	36	-	-	-	-	-	-
Bankfull Mean Depth (ft)	0.4	0.4	0.4	0.3	0.3	0.4	0.5	0.6	0.8	0.8	0.9	1.1	0.8	0.7	0.7	0.7	0.7	0.7
Bankfull Max Depth (ft)	0.8	0.7	0.9	0.9	0.8	0.7	0.8	1.4	1.8	1.8	1.7	1.6	1.2	1.4	1.4	1.4	1.3	1.1
Bankfull Cross-Sectional Area (ft ²)	2.4	2.4	2.6	1.8	1.4	1.7	3.4	4.7	5.9	5.8	6.6	6.5	3.1	3.9	3.6	3.7	3.6	3.0
Width/Depth Ratio	14.5	15.0	18.3	19.3	22.4	9.4	14.8	11.7	10.0	8.2	7.4	5.7	-	-	-	-	-	-
Entrenchment Ratio	3.6	3.8	3.3	4.6	4.3	5.8	2.6	3.5	3.4	5.5	5.0	5.9	-	-	-	-	-	-
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-
Substrate																		
d50 (mm)	0.20	0.68	2.80	1.30	0.62	0.52	44	7	10	2	4	13	4	10	23	25	30	2
d84 (mm)	4	2	28	42	1	2	57	30	26	17	13	31	20	35	44	54	59	20

Table 4f. Morphology and Hydraulic Monitoring Summary continued																		
Cane Creek Stream Restoration Site																		
Parameter	Cross-Section 16						Cross-Section 17						Cross-Section 18					
	Riffle						Pool						Riffle					
Reach	T6						T7-3						T7-3					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	6.3	6.0	7.4	6.9	7.5	8.1	7.3	8.8	9.8	10.1	9.4	12.7	9.0	9.2	8.2	8.1	8.4	8.9
Floodprone Width (ft)	17	18	18	19	19	21	-	-	-	-	-	-	18	19	19	19	21	21
Bankfull Mean Depth (ft)	0.6	0.7	0.7	0.6	0.6	0.8	1.1	1.2	1.4	1.7	1.8	1.6	0.8	0.8	0.9	0.9	0.8	0.9
Bankfull Max Depth (ft)	0.9	1.2	1.2	1.2	1.2	1.5	2.0	2.0	2.3	2.6	2.4	2.4	1.3	1.4	1.5	1.7	1.5	1.7
Bankfull Cross-Sectional Area (ft ²)	3.6	4.1	5.2	4.4	4.6	6.2	7.7	10.8	13.3	17.3	17.3	20.4	7.2	7.3	7.2	7.4	6.8	7.9
Width/Depth Ratio	11.0	8.8	10.5	10.8	12.2	10.6	-	-	-	-	-	-	11.6	11.6	9.3	8.9	10.4	10.0
Entrenchment Ratio	2.7	3.0	2.4	2.7	2.5	2.6	-	-	-	-	-	-	2.0	2.0	2.3	2.3	2.5	2.4
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0
Substrate																		
d50 (mm)	35	45	22	19	10	9	0.30	0.39	0.57	0.12	0.46	0.13	21.00	32.00	7.30	0.56	0.82	0.76
d84 (mm)	56	Bdrk	45	52	34	29	1	7	4	13	23	16	58	100	63	20	20	25

Table 4g. Morphology and Hydraulic Monitoring Summary Cane Creek Stream Restoration Site												
Parameter	Cross-Section 19						Cross-Section 20					
	Riffle						Riffle					
Reach	T7-3						T7-5					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	9.1	8.7	8.7	9.9	9.6	7.3	11.5	11.9	11.8	12.0	13.1	12.8
Floodprone Width (ft)	15	15	15	18	18	18	21	21	21	21	23	23
Bankfull Mean Depth (ft)	0.7	0.6	0.6	0.6	0.6	0.4	0.9	0.8	0.8	0.7	0.7	0.6
Bankfull Max Depth (ft)	0.9	0.8	0.9	1.4	1.3	0.8	1.3	1.3	1.5	1.5	1.5	1.5
Bankfull Cross-Sectional Area (ft ²)	6.4	4.8	5.2	6.4	6.1	3.0	10.7	9.6	8.9	8.3	8.9	8.2
Width/Depth Ratio	12.9	15.8	14.6	15.3	15.1	17.8	12.4	14.8	15.6	17.3	19.3	20.0
Entrenchment Ratio	1.7	1.7	1.7	1.8	1.9	2.5	1.9	1.7	1.7	1.7	1.8	1.8
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Substrate												
d50 (mm)	2	25	33	2	9	9	11	41	33	38	34	71
d84 (mm)	19	42	74	51	59	60	34	Bdrk	75	160	150	150

**Table 5. Verification of Bankfull Events
Cane Creek Stream Restoration Site**

Date of Data Collection	Date of Occurrence	Method
8/4/2009	5/28/2009	Stream Gauge
8/4/2009	6/5/2009	Stream Gauge
10/13/2009	9/21/2009	Stream Gauge
10/13/2009	9/28/2009	Stream Gauge
10/13/2009	10/9/2009	Stream Gauge
7/22/2010	3/22/2010	Stream Gauge
7/22/2010	5/28/2010	Stream Gauge
5/27/2011	4/16/2011	Stream Gauge
7/25/2012	7/14/2012	Stream Gauge
7/25/2012	7/22/2012	Stream Gauge
7/23/2013	1/14/2013	Stream Gauge
7/23/2013	5/6/2013	Stream Gauge
7/23/2013	7/31/2013	Stream Gauge



Photo taken July 24, 2013, depicting wrack lines on T7 floodplain near Stream Gauge 2.

**Cane Creek Stream Restoration Site
Yanceyville 4 SE, NC Weather Station
2013 Monthly Rainfall**

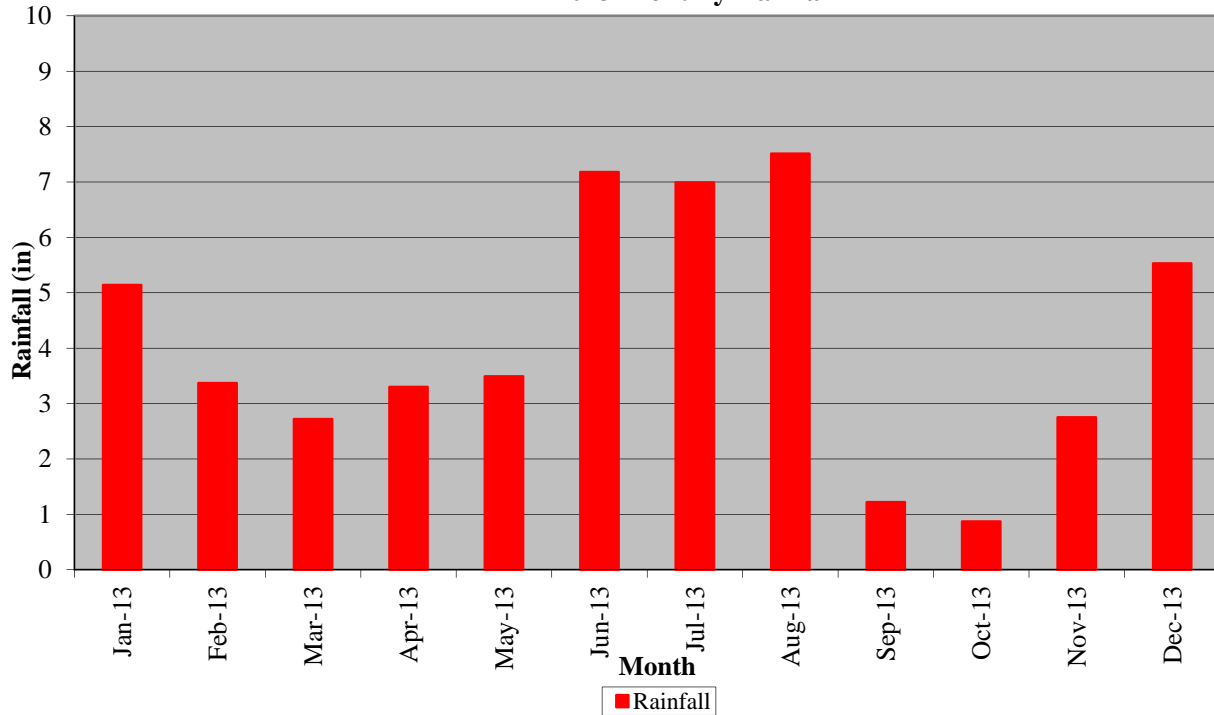


Table 6. Stream Riparian Buffer Stem Density and Species Count by Plot																					
Cane Creek Stream Restoration Site																					
Species	Plots																				Total Year 5
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
<i>Asimina triloba</i>			1							1		3									5
<i>Betula nigra</i>	1															5					6
<i>Carya ovata*</i>				2	2														2		6
<i>Cornus amomum</i>	1	1	3	5		4	6		6	4	1			14		3	2		1	5	56
<i>Diospyros virginiana</i>	1	2	2	2	1			2			4	3	1	1	1						20
<i>Fraxinus pennsylvanica</i>		3	1																		4
<i>Juglans nigra</i>	2	1					1		1	1											6
<i>Liriodendron tulipifera</i>						1			2												3
<i>Platanus occidentalis</i>	1	1	3				1										1	2			9
<i>Quercus falcata</i>	1			1	2		1					6	4						3	1	19
<i>Quercus lyrata</i>																			1		1
<i>Quercus michauxii</i>								2							7	1					10
<i>Quercus pagoda</i>	1																				1
<i>Quercus phellos*</i>		1	3															3			7
<i>Salix nigra</i>				1												2					3
<i>Salix sericea</i>	2			5		3			1		6			1		1			1		20
Total (Year 5)	10	9	13	16	5	8	9	4	10	6	11	12	5	16	8	12	3	5	8	6	176
Average Density (Stems/Acre)	405	364	526	647	202	324	364	162	405	243	445	486	202	647	324	486	121	202	324	243	
Average Total Density (Stems/Acre)																				356	

*Percentages greater than 100% are due to previously unknown species being positively identified.

**Table 7. Vegetation History: Stems/Acre Planted and Total with Volunteers
Cane Creek Stream Restoration Site**

Plot Number	MY-00	MY-01	MY-02	MY-03		MY-04		MY-05	
	Planted	Planted	Planted	Planted	Total	Planted	Total	Planted	Total
1	1,133	840	526	526	2,630	445	2,064	405	3,359
2	526	440	364	364	4,452	364	7,001	364	8,620
3	647	520	526	526	3,440	526	10,927	526	11,291
4	850	680	607	647	8,013	647	14,973	647	13,517
5	607	440	243	243	1,295	202	1,295	202	2,104
6	931	680	486	486	769	324	728	324	1,093
7	809	720	647	647	3,925	486	4,128	364	4,937
8	445	320	202	162	526	162	688	162	1,538
9	809	640	486	486	2,509	445	1,942	405	2,469
10	567	440	405	364	890	364	1,052	243	931
11	850	720	526	526	1,255	486	1,295	445	1,902
12	607	560	526	526	3,116	486	2,792	486	2,995
13	445	240	202	202	1,052	202	931	202	1,093
14	971	800	688	647	7,891	647	14,326	647	12,829
15	486	400	364	324	7,365	324	11,695	324	11,331
16	931	760	769	486	1,659	486	1,295	486	1,133
17	486	320	243	202	1,052	121	971	121	1,416
18	567	320	324	283	8,701	243	18,454	202	18,049
19	647	600	324	364	4,168	324	5,949	324	5,301
20	486	480	324	283	931	283	1,457	243	1,578
Site Average	690	546	439	415	3,282	378	5,198	356	5,374

4.0 EEP RECOMMENDATIONS AND CONCLUSIONS

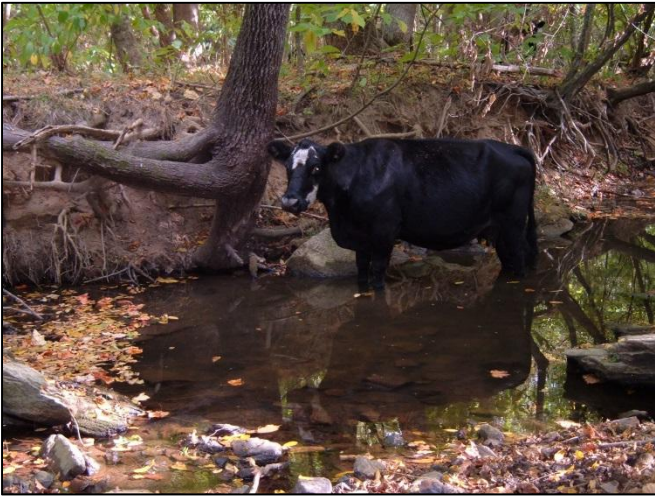
The stream assessment found the stream to be stable overall. There are isolated areas of erosion on the stream banks and the side slopes, but there are no systematic problems that indicate that the project streams are becoming unstable. It is also important to note that all of the streams across the site have grade control from in-stream structures, and in some instances significant bedrock. With multiple bankfull events since construction, the stream has met the success criterion of at least two bankfull events occurring in separate years over the course of the monitoring period.

There are some plots with low planted stem densities, including five plots with planted stem densities below 260 stems/acre: plots 5, 8, 13, 17, and 18. When including volunteers in these five plots, all plots are above the 260 total stems/acre density. The monitored vegetation plots within the stream buffer revealed that the planted vegetation is growing well with an average of 356 stems/acre. The overall vegetation assessment found the site has met the vegetative success criteria for monitoring year 5.

Overall the stream and the site's vegetation condition indicate that it is on a path to success. The EEP recommends that this site be closed out.

Pre-Construction Photos (2007)





Post-Construction Photos MY-05



PP#05d – MY05 – 12/11/13



PP#5d – MY05 – 12/11/13



PP#09d – MY05 – 12/11/13



PP#15u – MY05 – 12/11/13



PP#17u – MY05 – 12/11/13



PP#28u – MY05 – 12/11/13



PP#30d – MY05 – 12/11/13



PP#33d – MY05 – 12/11/13



PP#40d – MY05 – 12/11/13



PP#49d – MY05 – 12/11/13



PP trib 1.2 upstream – MY05 – 12/11/13



PP trib 2 downstream – MY05 – 12/11/13

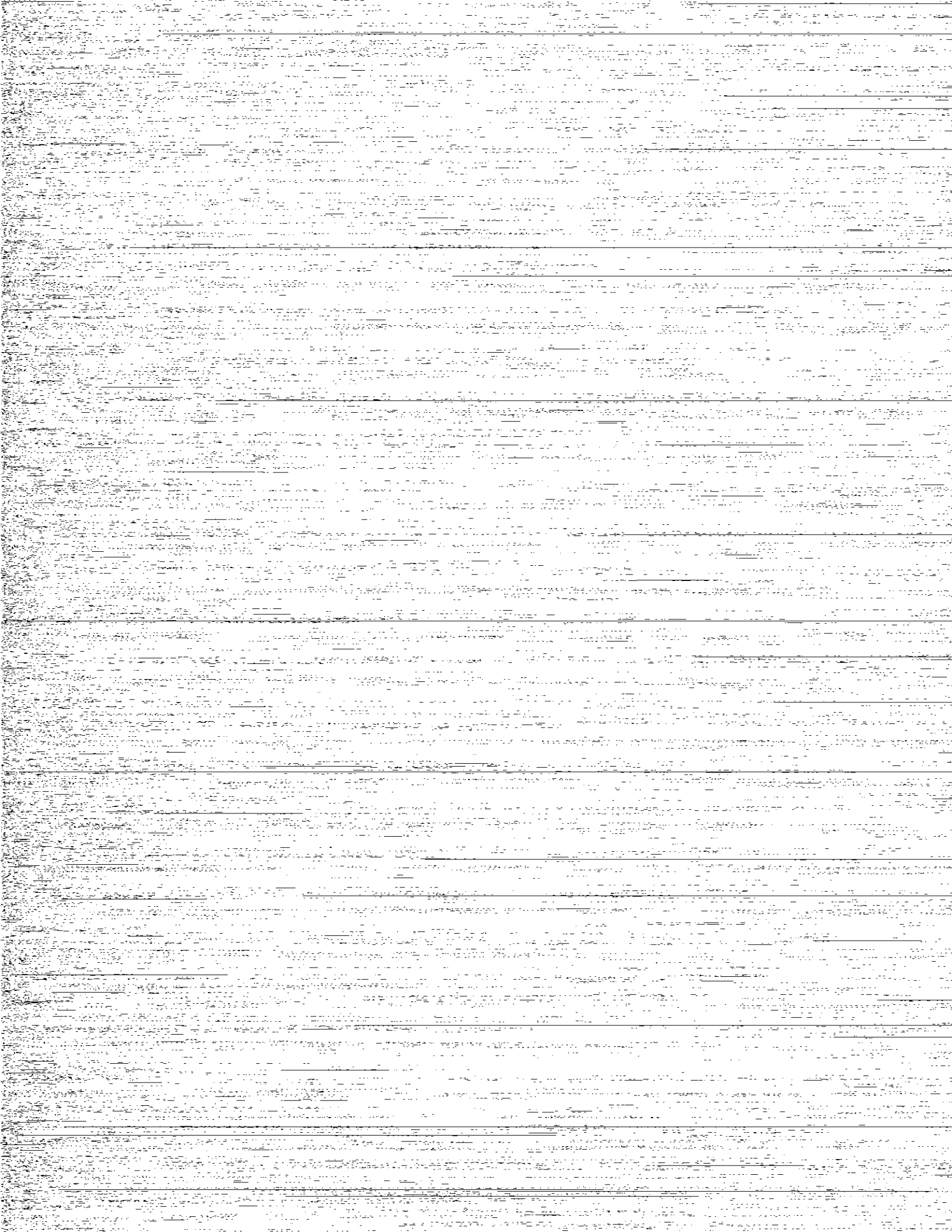
Appendix A

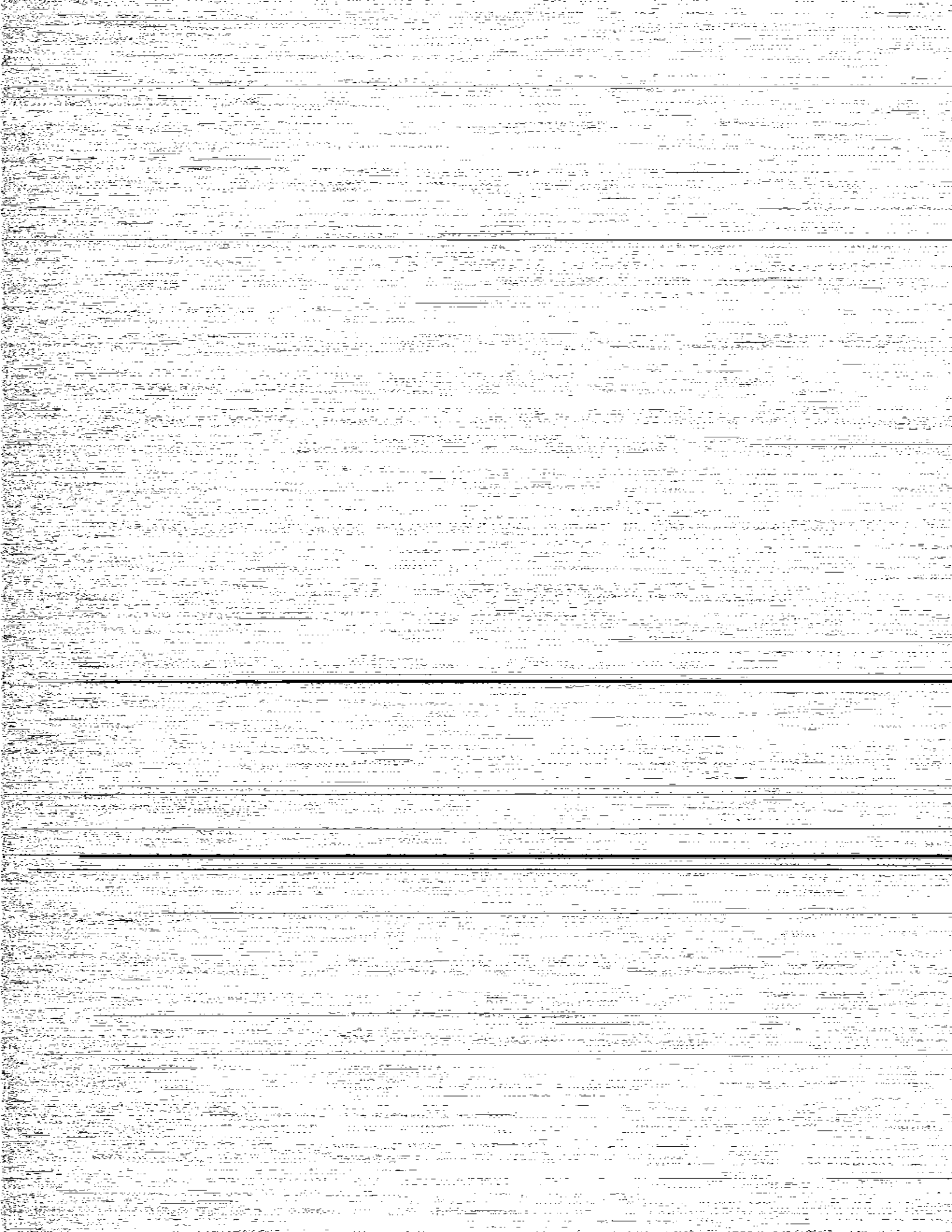
Watershed Planning Summary

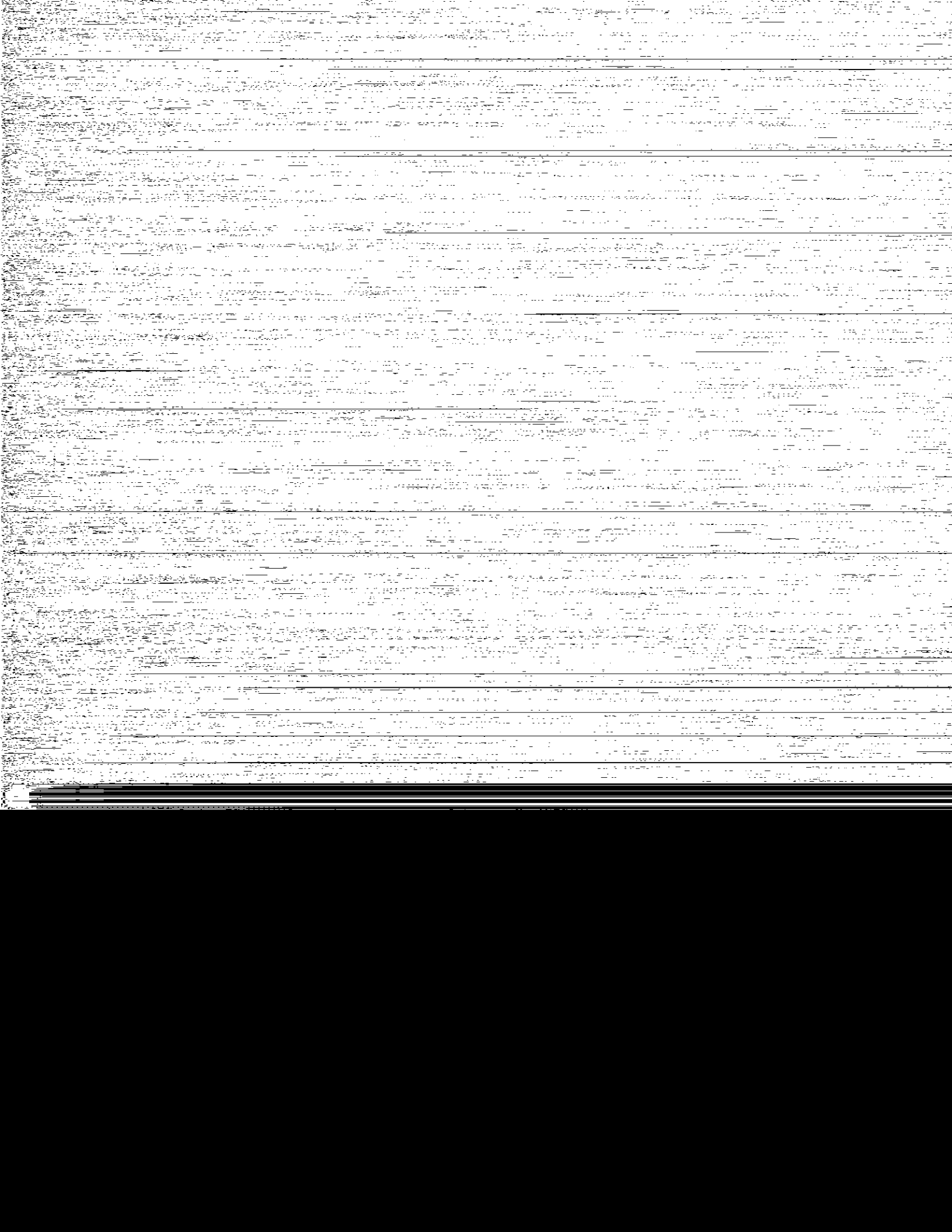
To be completed by the EEP Watershed Planner.

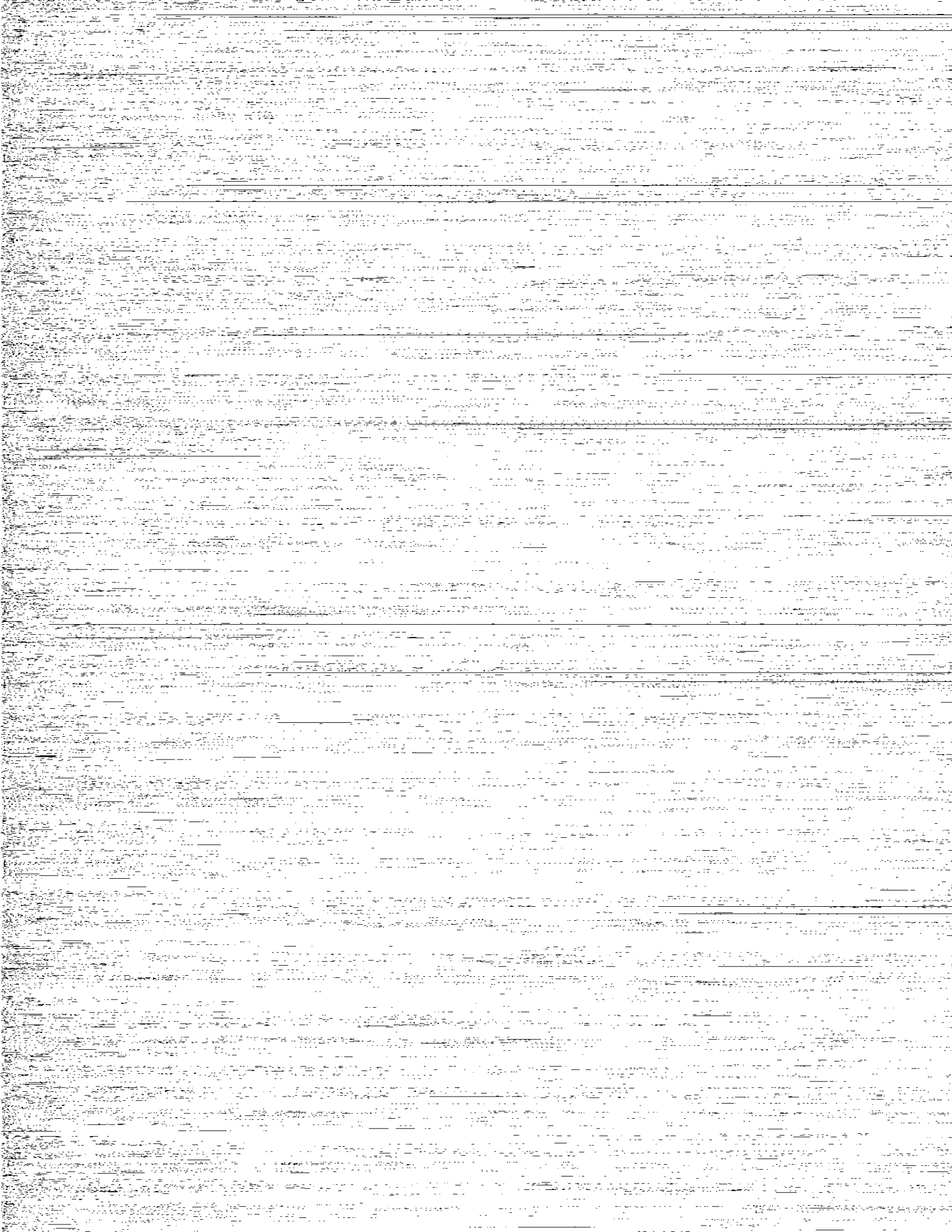
Appendix B
Land Ownership and Protection
To be completed by the EEP Property Section.

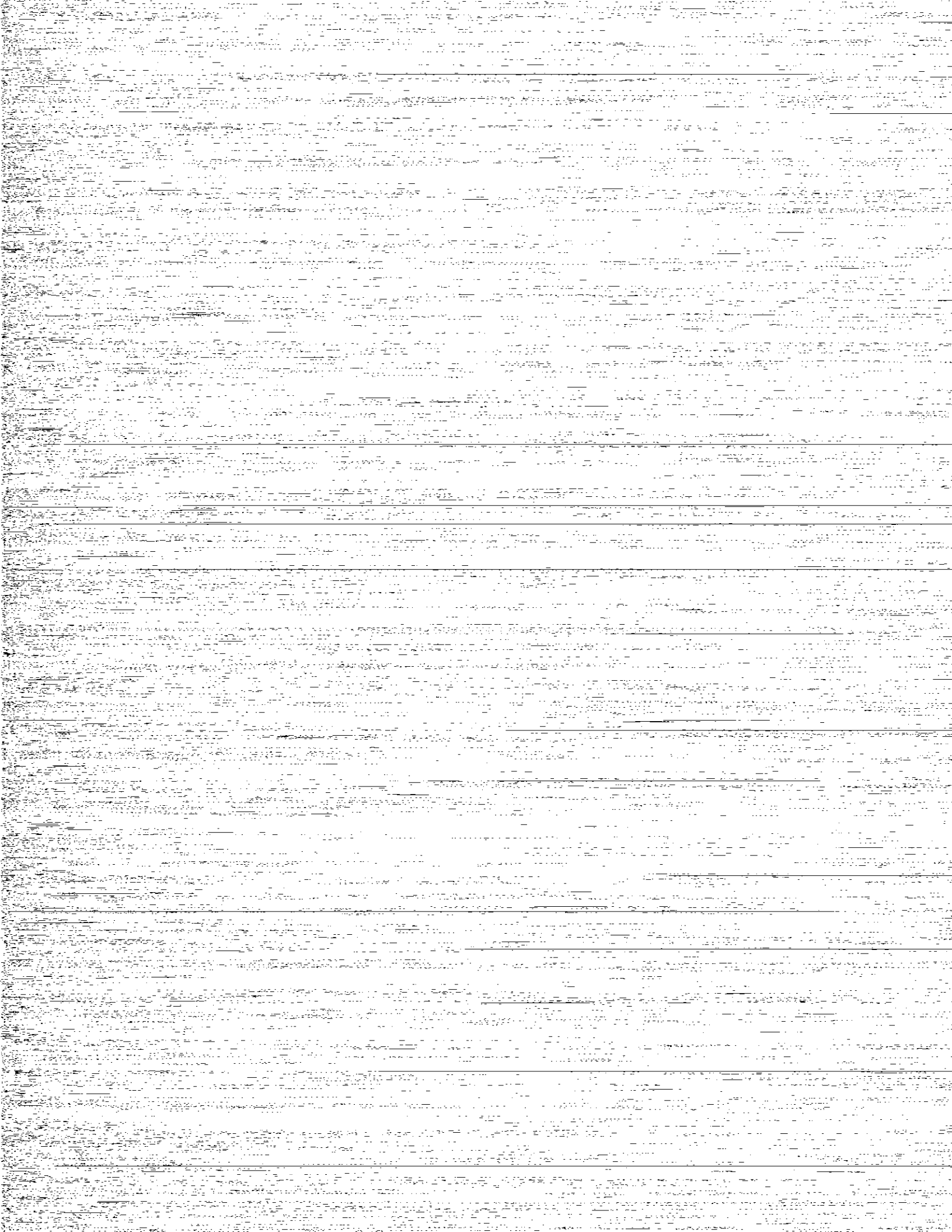
Appendix C
NCDWQ 401/USACE Section 404

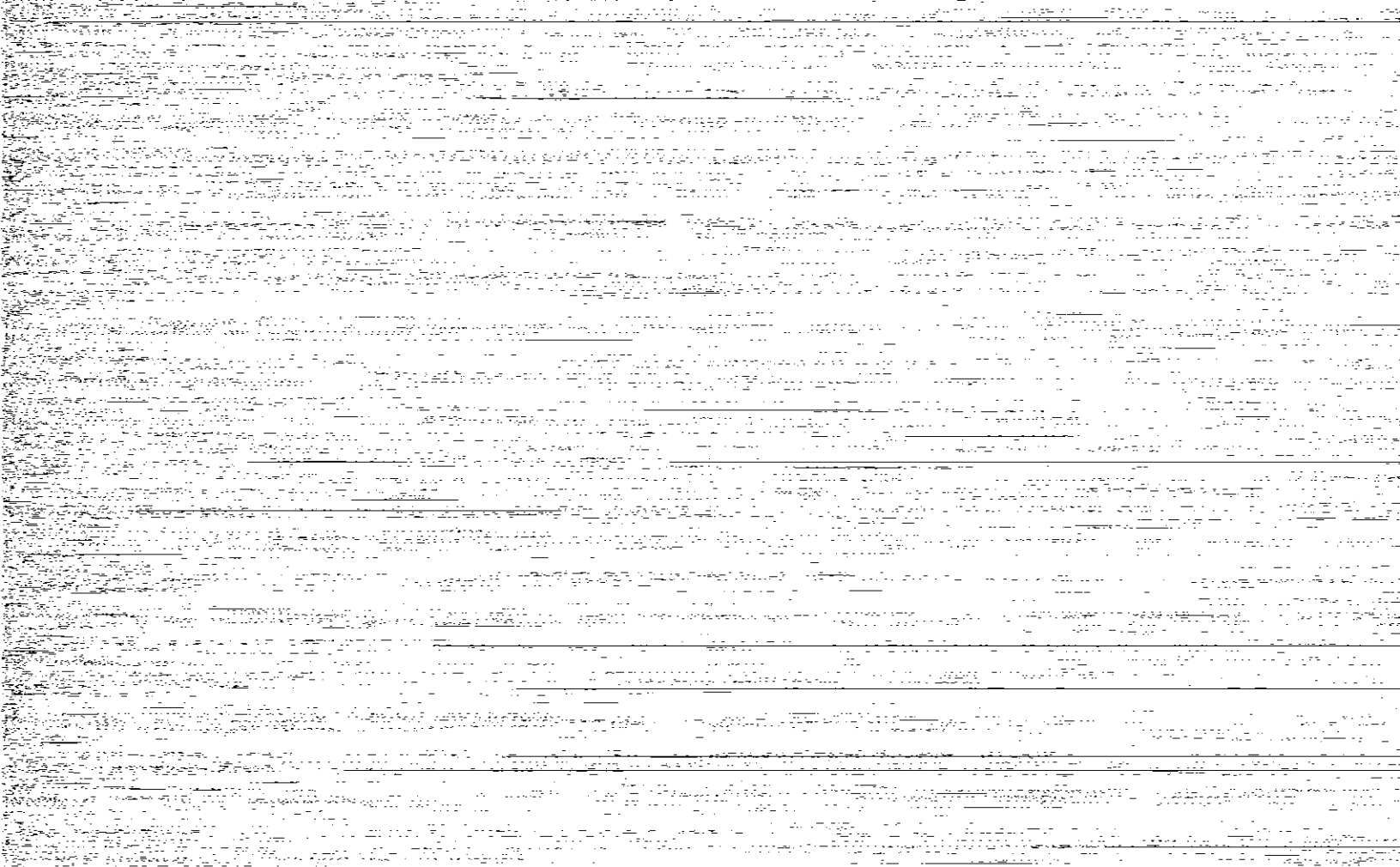


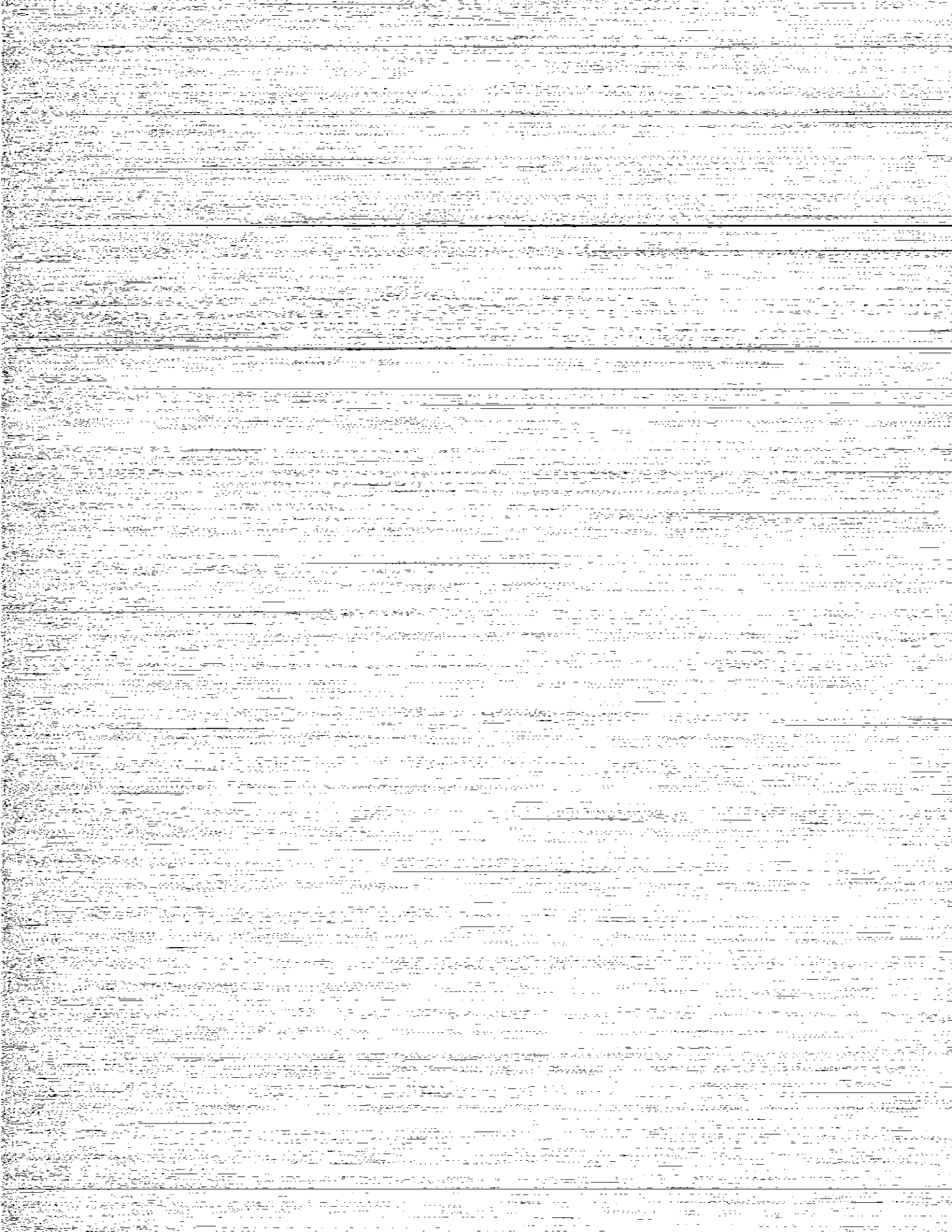


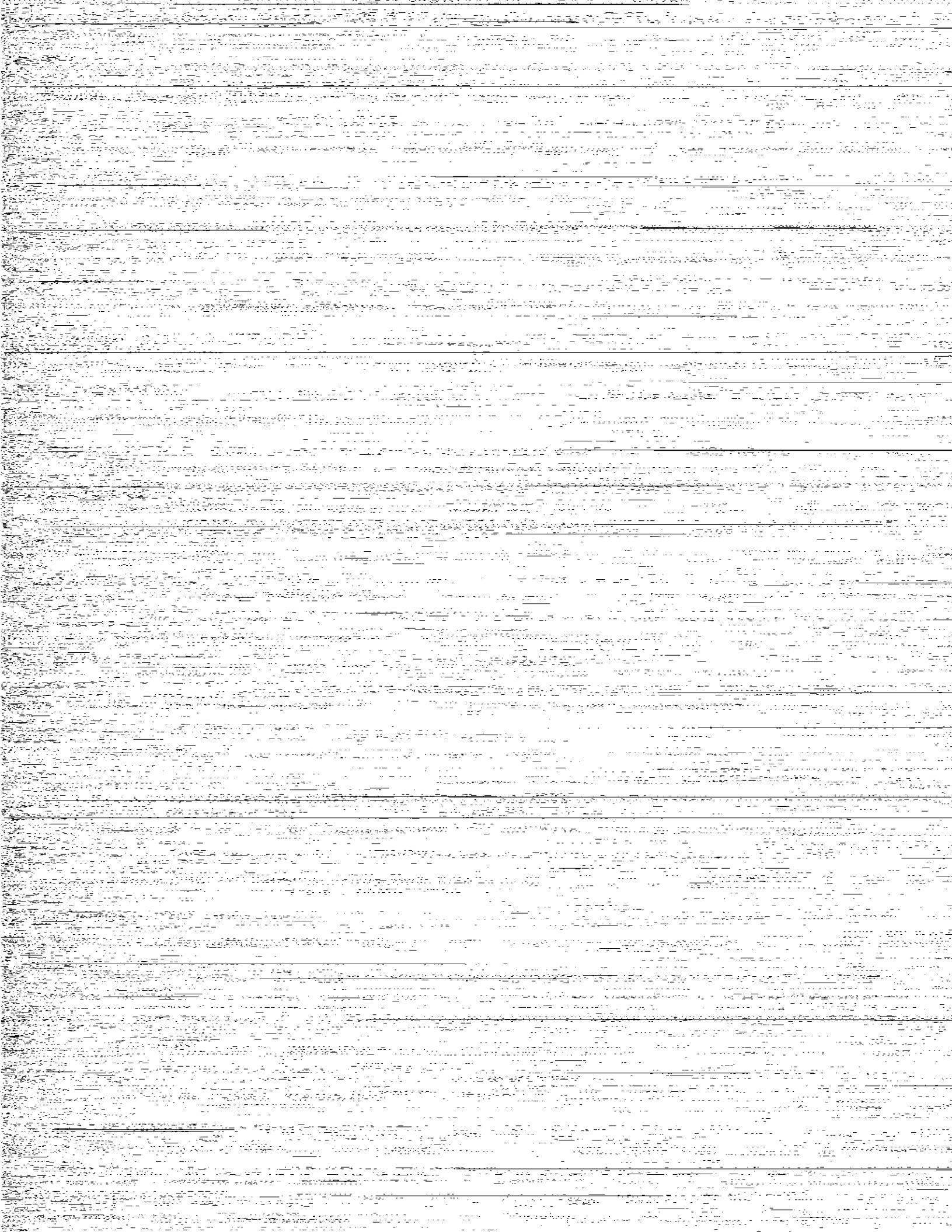












Appendix D

Debit Ledger

Closeout Coordinator to obtain.