

Gray Farm Stream Restoration Monitoring Report – Year One

Contract # D05016-2

Iredell County, North Carolina



March 2007

Cataloging Unit – Catawba Basin 03050101

Prepared For:



**1652 Mail Service Center
Raleigh, NC 27699-1652**

Table of Contents

I. Executive Summary / Project Abstract	1
II. Project Background	2
1. Project Goals and Objectives	2
2. Project Structure, Restoration Type, and Approach	4
3. Location and Setting	5
4. Project History and Background	5
5. Monitoring Plan View	7
III. Project Condition and Monitoring Results	8
A. Vegetation Assessment	8
1. Problem Areas Plan View (Vegetation)	10
2. Vegetative Problem Areas Plan View	10
B. Stream Assessment	10
1. Problem Areas Plan View (Stream)	11
2. Problem Areas Table Summary	11
3. Numbered Issues Photo Section	11
4. Fixed Photo Station Photos	11
5. Stability Assessment	11
6. Quantitative Measures Summary Tables	12
IV. Methodology Section	17

Tables

Exhibit Table I.	Project Structure Table
Exhibit Table II.	Project Activity and Reporting History
Exhibit Table III.	Project Contact Table
Exhibit Table IV.	Project Background Table
Exhibit Table V.	Verification of Bankfull Events
Exhibit Table VII.	Categorical Stream Feature Visual Stability Assessment
Exhibit Table VIII.	Baseline Morphology and Hydraulic Summary
Exhibit Table IX.	Morphology and Hydraulic Monitoring Summary

Figure 1

Appendix A Vegetation Raw Data

- 1. Vegetation Survey Data Tables**
- 2. Vegetation Problem Area Photos**
- 3. Vegetation Monitoring Plot Photos**

Appendix B Geomorphologic Raw Data

- 1. Stream Problem Area Table**
- 2. Representative Stream Problem Area Photos**
- 3. Stream Photo-Station Photos**
- 4. Exhibit Table B.1. Qualitative Visual Stability Assessment**
- 5. Annual Overlays of Cross Section Plots**
- 6. Annual Overlays of Longitudinal Plots**
- 7. Annual Overlays of pebble count frequency distribution plots**

Appendix C Integrated Problem Area Plan View

I. Executive Summary / Project Abstract

The Gray Farm Stream Restoration project consists of two separate reaches (Reach 1 and Reach 2) along unnamed tributaries of Buffalo Shoals Creek, a tributary of the Catawba River (Hydrologic Cataloging Unit #03050101). The site is located approximately 10 miles due west of the City of Statesville in western Iredell County, NC. This report summarizes the monitoring efforts for Year 1 (2006) of the Gray Farm Stream Restoration Project.

Restoration construction of the Reach 2 began in early March 2006 and was completed in mid-April 2006. Restoration construction of the Reach 1 began in mid-April 2006 and was completed in early July 2006. Demobilization and minor Contractor punch list items were completed shortly thereafter. Installation of monitoring devices and As-built surveys for both reaches were performed as construction progressed.

Monitoring of the vegetated buffer was performed during the growing season of 2006, by Soil & Environmental Consultants, PA. Stem counts were performed within the established vegetation monitoring plots, resulting in an average live stem density of approximately 647 stems per acre.

Physical monitoring of the restored channel consisted of the collection of cross-section and representative longitudinal profile data and a visual assessment of the stream. Collected data was then compared with as-built data.

Based on Year 1 Monitoring results, the site has met all success criteria.

Year 2 Monitoring will commence in January of 2007.

II. Project Background

The Gray Farm Stream Restoration project is located in the Catawba Basin, Hydrologic Cataloging Unit 03050101. The site consists of two separate reaches (Reach 1 and Reach 2) along unnamed tributaries of Buffalo Shoals Creek, a tributary of the Catawba River Hydrologic Cataloging Unit #03050101). The site is located approximately 10 miles due west of the City of Statesville in western Iredell County, NC.

The restoration project objective was to restore the impaired streams to appropriately sized stream channels that are stable and self-maintaining, and will not aggrade or degrade over time. Restoration was accomplished with Rosgen-based natural channel design procedures and techniques. Reach 1 restoration was a combination of a Priority I (reconnection of the channel with its historic floodplain) restoration and a Priority II (construction of a new floodplain at a lower elevation) restoration. Reach 2 was a Priority I restoration. Restoring an appropriate sinuosity lengthened both channels, thereby lowering their bankfull slope.

The buffer of both reaches of the restored stream channel were planted with native tree and shrub species and seeded with a native grass seed mix. During construction, additional opportunities existed to create vernal pools, oxbows, or pocket wetlands within the riparian zone along the restored reaches.

Restoration construction of the Reach 2 began in early March 2006 and was completed in mid-April 2006. Restoration construction of the Reach 1 began in mid-April 2006 and was completed in early July 2006. Demobilization and minor Contractor punch list items were completed shortly thereafter. Installation of monitoring devices and As-built surveys for both reaches were performed as construction progressed.

1. Project Goals and Objectives

The goals of the Gray Farm Stream Restoration project are:

- 1) Improve local water quality within the restored channel reaches as well as the downstream watercourses through;
 - a. The reduction of current channel and off site sediment loads by restoring appropriately sized channels with stable beds and banks.
 - b. The reduction of nutrient loads (both soil enhancement practices and cattle) from adjacent agricultural fields with a restored riparian buffer.
 - c. The reduction of water temperatures provided by shading of the channel from canopy species along with the resultant increase in oxygen content.

- 2) Improve local aquatic and terrestrial habitat and diversity within the restored channels and their vicinity through;
 - a. The formation of varying bed form within the channels to provide for fish, amphibian, and benthic species.
 - b. The restoration of a suitable riparian buffer corridor which will provide both vertical and horizontal structure and connectivity with adjacent upland areas.
 - c. The restoration of understory and canopy species which will provide forage, cover, and nesting for a variety of mammals, reptiles, and avian species.
- 3) Improve local watershed conditions through the restoration of two low order streams (one first order, one second order) and the placement of permanent conservation easements.

Through the restoration process the following objectives were accomplished:

- 1) Restore approximately 7,610 linear feet of appropriately sized stream channel that is stable and self-maintaining, and will not aggrade or degrade over time. Restoration was accomplished with Rosgen-based natural channel design procedures and techniques.
- 2) Develop restored channels with the appropriate morphological characteristics (cross-sectional dimension, pattern, and longitudinal profile) utilizing collected reference reach data as a guide. Allow for no net loss of overall channel length in the process.
- 3) Create and/or improve bed form diversity (riffles, runs, pools, and glides) and improve aquatic and benthic macroinvertebrate habitat.
- 4) Construct a floodplain (or local bankfull bench) that is accessible at the proposed bankfull channel elevation.
- 5) Ensure channel and stream bank stabilization by integrating in-stream structures and native bank vegetation.
- 6) Establish a native forested and herbaceous riverine buffer plant community within a minimum width of 50 feet from the edge of the restored channel. This new community will be established in conjunction with the eradication of any existing exotic and/or undesirable plant species.
- 7) Improve water quality within the subject channels and the downstream receiving waters.

- 8) Supplement the education and conservation efforts for natural resources in Iredell County as indicated in program goals for the local Soil & Water Conservation District and the NC Cooperative Extension Service.

2. Project Structure, Restoration Type, and Approach

The restoration project objective was to restore the impaired streams to appropriately sized stream channels that are stable and self-maintaining, and will not aggrade or degrade over time. Restoration was accomplished with Rosgen-based natural channel design procedures and techniques. Restoring an appropriate sinuosity lengthened both channels, thereby lowering their bankfull slope. A total of 8,004 linear feet of stream channel were restored on site (8,004 SMU's).

Reach 1

Reach 1 restoration was a combination of a Priority I (reconnection of the channel with its historic floodplain) restoration and a Priority II (construction of a new floodplain at a lower elevation) restoration. Approximately 800 linear feet of this length was inundated by an existing farm pond that was removed.

One additional piped farm road crossing existed approximately 700 feet downstream of the dam. This piped crossing was removed and replaced with an in-stream crossing. Immediately downstream of the dam for a distance of approximately 1,000 feet, severe bank erosion, channel incision, and an overwidening of the stream channel was evidenced. This degradation appeared in large part due to previous uncontrolled releases from the existing dam spillway.

The lower two thirds of the reach were characterized by overly steep and undercut banks. Significant localized erosion was evidenced along this lower portion. Trees of large diameter lined the banks, many of which were undercut, suspended or had collapsed into the stream. The channel had down cut and over widened in many locations along the reach allowing no access to its floodplain. The last 200 feet (approximately) of the pre-existing channel was not down cut due to a change in surrounding topography.

The upper portion of Reach 1 has demonstrated pool development since the as-built survey. Significant sediment entered the pools at the upper end of Reach 1 shortly after construction. This sediment came from upstream sources including areas of cattle pasture and areas previously inundated due to the old pond. This sediment has been flushed from the system during the first year causing these pools to deepen to their previously excavated depth.

Reach 1 consists of 5,813 (5,813 SMU's) linear feet of restored Type C4 channel.

Reach 2

Reach 2 was a Priority I restoration. A small impoundment formerly existed near the lower end of the reach; however, it was drained and removed a number of

years prior. A piped farm road crossing existed at roughly the same location (the old dam embankment). This was the only existing crossing along the reach.

Throughout Reach 2, severe bank erosion, channel incision, and an over-widening of the stream channel were evidenced. This impairment appeared in large part due to previous uncontrolled grazing operations. The reach was characterized by overly steep, sloughing, and undercut banks. Significant localized erosion was evidenced along the entire reach. Trees of large diameter lined the banks, many of which were undercut, suspended or collapsed into the stream. The channel had down cut and over widened in many places along the reach allowing no access to its floodplain.

Reach 2 consists of 2,191 linear feet (2,191 SMU's) of restored Type B4 channel.

3. Location and Setting

The Gray Farm Stream Restoration project is located in the Catawba Basin, Hydrologic Cataloging Unit 03050101. The site consists of two separate reaches (Reach 1 and Reach 2) along unnamed tributaries of Buffalo Shoals Creek, a tributary of the Catawba River. The site is located approximately 10 miles due west of the City of Statesville in western Iredell County, NC.

Reach 1 is located immediately north of Bolick Road (SR 1532) and consisted of approximately 4,340 linear feet of impaired stream channel. Reach 2 is located immediately west of the intersection of New Sterling Road (SR 1525) and Gray House Road and consisted of approximately 1,600 linear feet of impaired stream channel. The watershed areas for Reaches 1 and 2 are estimated at approximately 0.91 square miles (582 acres) and 0.085 square miles (54 acres) respectively. See attached Figure 1.

4. Project History and Background

The following tables summarize the project history and background:

Exhibit Table I. Project Restoration Components Gray Farm Stream Restoration Site/EEP Project # 92219								
Project Segment or Reach ID	Existing Feet/Acres	Type	Approach	Footage or Acreage	Mitigation Ratio	Mitigation Units	Stationing	Comment
Reach I	3,000	R	P I	4,119	1:1	4,119	0+00 to 41+19	
Reach I	1,340	R	PII	1,694	1:1	1,694	41+19 to 58+13	
Reach II	1,600	R	P I	2,191	1:1	2,191	0+00 to 20+91	
Mitigation Unit Summations								
Stream (lf)	Riparian Wetland (Ac)	Nonriparian Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)	Comment			
8,004				18.38				

Exhibit Table II. Project Activity and Reporting History Gray Farm Stream Restoration Site/EEP Project # 92219		
Activity or Report	Data Collection Complete	Actual Completion or Delivery
Restoration Plan	Aug-05	Nov-05
Construction	Reach 1	Jul-06
	Reach 2	Apr-06
Temporary S&E mix applied to entire project area	Apr-06	Apr-06
Permanent seed mix applied to reach/segments 1 & 2	Apr-06	Apr-06
Plantings for reach/segments 1 & 2	Apr-06	Apr-06
Mitigation Plan / As-built (Year 0 Monitoring - baseline)	May-06	Jun-06
Year 1 Monitoring	Dec-06	Dec-06
Supplemental Planting	Dec-06	
Year 2 Monitoring		Dec-07
Year 3 Monitoring		Dec-08
Year 4 Monitoring		Dec-09
Year 5 Monitoring		Dec-10

Exhibit Table III. Project Contacts Table Gray Farm Stream Restoration Site/EEP Project # 92219	
Designer Primary Project Design POC	Soil & Environmental Consultants, PA 11010 Raven Ridge Rd Raleigh, NC 27614 Rebecca S. Wargo (919) 846-5900
Construction Contractor Construction Contractor POC	North State Environmental 2889 Lowery St. Winston-Salem, NC 27101 Darrell Westmoreland (336) 725-2010
Planting Contractor Planting Contractor POC	North State Environmental 2889 Lowery St. Winston-Salem, NC 27101 Darrell Westmoreland (336) 725-2010
Seeding Contractor Seeding Contractor POC	North State Environmental 2889 Lowery St. Winston-Salem, NC 27101 Darrell Westmoreland (336) 725-2010
Monitoring Performers	Soil & Environmental Consultants, PA 11010 Raven Ridge Rd. Raleigh, NC 2761
Stream Monitoring POC	Jessica Regan (919) 846-5900
Vegetation Monitoring POC	Jessica Regan (919) 846-5900
Wetland Monitoring POC	Jessica Regan (919) 846-5900

Exhibit Table IV. Project Background Table Gray Farm Stream Restoration Site/EEP Project # 92219	
Project County	Iredell
Drainage area	Reach 1 - 0.91 square miles (582 acres)
	Reach 2 - 0.085 square miles (54 acres)
Drainage impervious cover estimate (%)	< 20%
Stream Order	Reach 1 - 2nd order
	Reach 2 - 1st order
Physiographic Region	Piedmont
Ecoregion	Northern Inner Piedmont
Rosgen Classification of As-built	Reach 1 - C4
	Reach 2 - B4
Cowardin Classification	N/A
Dominant soil types	Reach 1 - Cw, CxB
	Reach 2 - CsE2
Reference site ID	Reach 1 - Tributary of Turkey Creek
	Reach 2 - Basin Creek
USGS HUC for Project and Reference	3050101
NCDWQ Sub-basin for Project and Reference	Reach 1 - 03-08-32 / 03-04-02
	Reach 2 - 03-08-32 / 03-07-01
NCDWQ classification for Project and Reference	Reach 1 - WS-IV; CA / C;NSW
	Reach 2 - WS-IV; CA / C; Tr; ORW
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	Reach 1 – No Fence, Reach 2 - 100%

5. Monitoring Plan View

Six (6) tree and shrub buffer vegetation plots (four (4) on Reach 1 and two (2) on Reach 2) and four (4) bank vegetation plots (two (2) on Reach 1 and two (2) on Reach 2) were established. All monitoring will occur within these observation plots throughout the monitoring period for as long as they continue to be representative of the community.

For all buffer monitoring plots, Level 1 of the Carolina Vegetation Survey-Ecosystem Enhancement Program (CVS-EEP) Protocol for Recording Vegetation will be utilized for vegetation sampling in Year 1. Subsequent monitoring years will utilize Level 2 of the CVS-EEP protocol in order to record and report woody plant volunteers within vegetation monitoring plots along with planted stems. A corner of each vegetation monitoring plot will be used as a permanent photo point for vegetation monitoring photos. Locations of these photo points are shown on the attached Monitoring Plan View.

A total of seven (7) nested riffle and pool segments were established along Reach 1, and two (2) nested riffle and pool segments were established along Reach 2. Each cross-section is also a designated photo point that will be photographed annually.

The locations of all monitoring devices are shown on Sheets 2 through 6 (Reach 1 – Monitoring Plan View) and Sheets 11 through 14 (Reach 2 - Monitoring Plan View).

III. Project Condition and Monitoring Results

A. Vegetation Assessment

The success of the adjacent riparian buffer will be based on the combined survival of tree and shrub species for the five-year monitoring period.

Survival of woody (tree and shrub) species planted within the restored buffers will be at least 320 stems/acre through year three, 288 stems/acre through year four, 260 stems/acre through year five. The stem count will be based on an average of the stem counts of the evaluated tree and shrub buffer vegetation plots. The success of the bank vegetation plots along the restored channels will be based on the survival of live-stake (or other) bank plantings for the five-year monitoring period. Survival of bank plantings will be based on a linear average of approximately 50 percent of the planted species within the restoration reaches.

Biological monitoring will be used as a general indicator of restoration success, however, no specific biological criteria applies to the success of the restoration reaches.

The approximately 18.4 acre restoration area was planted with various native hardwood tree and shrub species, native to the area. Reaches 1 and 2 were planted in April 2006. Supplemental planting was performed in December of 2006.

The following tree species were planted in the Riparian Buffer Area:

- *Alnus serrulata* (Tag Alder)
- *Betula nigra* (River Birch)
- *Carpinus caroliniana* (Ironwood)
- *Fraxinus pennsylvanica* (Green Ash)
- *Ilex opaca* (American Holly)
- *Lindera benzoin* (Spicebush)
- *Liriodendron tulipifera* (Tulip Poplar)
- *Platanus occidentalis* (Sycamore)
- *Quercus michauxii* (Swamp Chestnut Oak)
- *Quercus nigra* (Water Oak)
- *Quercus phellos* (Willow Oak)
- *Viburnum nudum* (Possumhaw)

Stream banks were planted with live stakes in two offset rows. The following shrub species were planted as live stakes:

- *Cornus amomum* (Silky Dogwood)

- *Salix sericea* (Silky Willow)
- *Sambucus canadensis* (Elderberry)

As previously described, a total of six (6) buffer vegetation monitoring plots were established on site in 2006. The success criteria for the site require a minimum of 320 live stems per acre for the first three (3) years of monitoring. Year 1 vegetation monitoring shows 647 live stems per acre. Future buffer vegetation monitoring data will be compared with Year 1 data to determine survival rates and stem densities for woody vegetation planted within the riparian buffer. Vegetation monitoring data for buffer plots was collected using the CVS-EPP monitoring protocol and is presented in Appendix A.

Four (4) bank vegetation plots were also established (two on each reach) to monitor survival of live-stake plantings along stream banks. Future bank vegetation monitoring data will be compared with Year 1 data to determine survival rates for live-stakes planted along stream banks. Live-stake counts by species and by plot are presented in the following tables:

Common Name	Species	REACH 1		Species Total	% of Total
		BANK 1	BANK 2		
Silky Dogwood	<i>Cornus amomum</i>	12	17	29	39%
Silky Willow	<i>Salix sericea</i>	30	16	46	61%
	TOTAL	42	33	75	

Common Name	Species	REACH 2		Species Total	% of Total
		BANK 1	BANK 2		
Silky Willow	<i>Salix sericea</i>	7	4	11	23%
Silky Dogwood	<i>Cornus amomum</i>	9	25	34	72%
Elderberry	<i>Sambucus canadensis</i>		2	2	4%
	TOTAL	16	31	47	

Herbaceous vegetation varies widely throughout the restoration site. The upper half of the buffer of Reach 1 is dominated by dense stands of switchgrass while the lower half is dominated by a low growing cover crop species. The upper half of the buffer of Reach 2 is dominated by low growing cover crop grasses with some native grasses and rushes present. The lower end of Reach 2 has a few very dense stands of aster (*Aster* sp.) that are up to 6 feet tall and have crowded out most other species in the area. These areas will be monitored closely in the future to ensure establishment of woody vegetation.

The stream banks on both reaches have a variety of herbaceous species including various sedges, rushes and some duck potato (*Sagittaria latifolia*). Soft rush (*Juncus effusus*), cattails (*Typha latifolia*) and a variety of sedges (*Carex* sp.) are among the species that are present in the wetland areas.

1. Problem Areas Plan View (Vegetation)

During a field inspection on November 27, 2006, a total of five localized areas of bare floodplain were observed. On Reach 1, three insignificant areas were observed, which appear to be due to surface flows creating small rills in the ground surface. These areas are shown on sheets 6 through 9.

On Reach 2, two insignificant areas of bare floodplain were observed. These appear to be due to localized poor soils which have inhibited plant growth on the floodplain and are shown on Sheets 14 through 16. Photos are included in Appendix A.

While we will continue to monitor these areas, based on vegetative success criteria the site currently exhibits strong vegetative success.

2. Vegetative Problem Areas Plan View

Vegetative problem areas are shown on Sheets 6 through 9 for Reach 1 and Sheets 14 through 16 for Reach 2 (Problem Area Plan View).

B. Stream Assessment

A review of available on-line USGS gauge sites was performed to determine if a suitable surrogate gauges was present in the area. No nearby gauge was identified. The closest USGS gauge to the site was on the Lower Little River (near Healing Springs, NC, Gauge Identification Number 02142000) which is approximately 15 miles from the project site. Based on this large distance, significant disparity in watershed sizes, and topographic variation, it is unlikely that a conclusive determination regarding the number of bankfull events experienced on the restoration site could be made.

Based on site observations, to include wrack lines, staining of vegetation, displaced/flattened vegetation, and observable sediment deposition, it is apparent that multiple overbank events have occurred.

Date of Data Collection	Date of Occurrence	Method	Photo # (if available)
4/24/2006	Unknown	Onsite observations (to include wrack lines, staining of vegetation, displaced/flattened vegetation, and observable sediment deposition)	N/A
6/22/2006	Unknown		N/A
10/19/2006	Unknown		N/A
11/27/2006	Unknown		N/A
12/18/2006	Unknown		N/A

1. Problem Areas Plan View (Stream)

An assessment of channel stability was also performed on November 27, 2006, by S&EC. Areas of concern that were observed and documented included some minor localized bank scour and a single stressed structure. These problem areas are shown on Sheets 6 through 9 for Reach 1 and Sheets 14 through 16 for Reach 2 (Problem Area Plan View).

And, while we will continue to monitor these areas, based on physical success criteria the site clearly exhibits stable conditions and meets the requirements for physical success.

2. Problem Areas Table Summary

Stream problem areas observed are shown in Table 6 in Appendix B.

3. Numbered Issues Photo Section

Representative photos of each category of stream problem area were taken and are shown in Appendix B.

4. Fixed Photo Station Photos

Photos from established photo stations (at each cross-section) were collected during the stream survey (November 2006). These photos are included in Appendix B.

5. Stability Assessment

A visual qualitative assessment was performed to inspect channel facets, meanders, bed, banks, and installed structures. This visual assessment was confirmed and enhanced with a quantitative assessment of the physical stream survey. The goal of this assessment is to provide a percentage of the features listed in Table VII that are in a state of stability. Table VII was compiled from the data in Table B1 in Appendix B of this report.

Table VIIa: Categorical Stream Feature Visual Stability Assessment Gray Farm Stream and Wetland Restoration Site/EEP Project # 92219 Reach 1					
Feature	MY-1 2006	MY-2 2007	MY-3 2008	MY-4 2009	MY-5 2010
A. Riffles	100%				
B. Pools	100%				
C. Thalweg	99%				
D. Meanders	100%				
E. Bed General	96%				
F. Bank Condition	100%				
G. Vanes/ J Hooks, etc.	99%				
H. Wads and Boulders	N/A				

Table VIIIb: Categorical Stream Feature Visual Stability Assessment Gray Farm Stream and Wetland Restoration Site/EEP Project # 92219 Reach 2					
Feature	MY-1 2006	MY-2 2007	MY-3 2008	MY-4 2009	MY-5 2010
A. Riffles	100%				
B. Pools	100%				
C. Thalweg	100%				
D. Meanders	99%				
E. Bed General	100%				
F. Bank Condition	100%				
G. Vanes/ J Hooks, etc.	99%				
H. Wads and Boulders	N/A				

6. Quantitative Measures Summary Tables

The following tables (Table VIII and Table IX) summarize the quantitative data collected from the cross-sectional and representative longitudinal stream survey. This data was analyzed and summarized, and then compared with baseline data types available for this project.

The Quantitative Morphology Tables illustrate the degree of departure, if any, of the current channel from the baseline data. Tables VIII and IX were compiled from the cross-section and profile raw data and plots located in Appendix B of this report.

**Table VIII. Baseline Morphology and Hydraulic Summary
GRAY FARM STREAM RESTORATION SITE (EEP Project #92219)**

REACH 1

Parameter	Pre-Existing Condition			Project Reference Stream			Design			As-built		
	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.
Dimension												
BF Width (ft)	15.77	15.77	15.77	32.08	32.08	32.08	15.2	15.2	15.2	13.62	19.48	16.02
Floodprone Width (ft)	19.41	52.54	20.39	100			47	90.34	47	37.49	89.67	61.53
BF Cross Sectional Area (ft ²)	17.87	17.87	17.87	79.79	79.79	79.79	17.84	17.84	17.84	11.01	17.92	13.79
BF Mean Depth (ft)	1.13	1.13	1.13	2.49	2.49	2.49	1.17	1.17	1.17	0.7	0.94	0.86
BF Max Depth (ft)	1.49	1.49	1.49	3.61	3.61	3.61	1.71	1.71	1.71	1.36	2.04	1.61
Width/Depth Ratio	13.96	13.96	13.96	12.43	12.43	12.43	12.67	12.67	12.67	18.63	20.07	19.46
Entrenchment Ratio	1.29	1.29	1.29	3.47	3.47	3.47	3.09	3.09	3.09	2.75	4.6	3.84
Wetted Perimeter (ft)	16.52	16.52	16.52	34.8	34.8	34.8	16.01	16.01	16.01	13.26	16.41	15.67
Hydraulic radius (ft)	1.08			2.29			1.11			0.69	0.92	0.83
Pattern												
Channel Beltwidth (ft)	67.62	137.29	98.27	70.8	91.93	84.35	26.1	61.8	40.75	59.32	93.89	72.85
Radius of Curvature (ft)	64.8	121.04	81.58	13.36	36.57	26.56	19.97	37.85	28.23	16.64	40.88	25.73
Meander Wavelength (ft)	716.91	716.91	716.91	148.13	291.09	221.56	77.08	117.13	95.07	77.08	117.13	94.8
Meander Width ratio	4.29	8.71	6.23	2.21	2.87	2.63	1.72	4.07	2.68	3.7	5.86	4.55
Profile												
Riffle length (ft)	N/A	N/A	N/A	32.94	48.35	40.29	19.31	54.86	30.86	25.87	54.2	37.85
Riffle slope (ft/ft)	0.00632	0.00657	0.00647	0.00809	0.01395	0.01074	0.0057			0.00092	0.0187	0.0062
Pool length (ft)	93.8	159.47	119.6	8.96	41.09	26.43	22.9	33.17	29.66	7.41	244.47	23.01
Pool Slope (ft/ft)	N/A	N/A	N/A	N/A	N/A	N/A	0.0009	0.0029	0.0013	0.0007	0.0064	0.0016
Pool spacing (ft)	347.07	525.3	444	44.08	130.73	67.98	51.66	82.92	67.79	12.35	142	70.94
Substrate												
d50 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
d84 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Additional Reach Parameters												
Valley Length (ft)	4258.3			648.35			4258.3			4258.3		
Channel Length (ft)	4939.628			758.58			5622			5813.3		
Sinuosity	1.16			1.17			1.29			1.36		
Water Surface Slope (ft/ft)	0.00647			0.01074			0.0057			0.00544		
BF slope (ft/ft)	0.00647			0.01074			0.0057			0.00544		
Rosgen Classification	F4			C4			C4			C4		
*Habitat Index	N/A			N/A			N/A			N/A		
*Macrobenthos	N/A			N/A			N/A			N/A		

**Table VIII. Baseline Morphology and Hydraulic Summary
GRAY FARM STREAM RESTORATION SITE (EEP Project #92219)
REACH 2**

Parameter	Pre-Existing Condition			Project Reference Stream			Design			As-built		
	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.
BF Width (ft)	5.34	5.34	5.34	4.86	4.86	4.86	6.9	6.9	6.9	7.38	8.21	7.8
Floodprone Width (ft)	7.04	7.04	7.04	8.73	8.73	8.73	12.4	12.4	12.4	13.96	39.05	26.53
BF Cross Sectional Area (ft ²)	3.88	3.88	3.88	1.94	1.94	1.94	3.96	3.96	3.96	4.14	6.77	5.46
BF Mean Depth (ft)	0.73	0.73	0.73	0.4	0.4	0.4	0.57	0.57	0.57	0.56	0.82	0.69
BF Max Depth (ft)	1.13	1.13	1.13	0.61	0.61	0.61	0.87	0.87	0.87	0.86	1.3	1.08
Width/Depth Ratio	7.32	7.32	7.32	12.15	12.15	12.15	12.11	12.11	12.11	1.01	13.18	11.3
Entrenchment Ratio	1.32	1.32	1.32	1.8	1.8	1.8	1.8	1.8	1.8	1.9	4.7	3.4
Wetted Perimeter(ft)	6.03	6.03	6.03	5.28	5.28	5.28	7.36	7.36	7.36	7.68	8.77	8.23
Hydraulic radius (ft)	0.64			0.37			0.94737	0.94737	0.94737	0.78261	1.11594	0.95652
Pattern												
Channel Beltwidth (ft)	43.58	68.11	54.22	6.97	22.7	13.32	9.49	16.5	12.65	11.83	22.05	16.96
Radius of Curvature (ft)	32.54	52.64	41.25	4.1	8.88	5.93	6.71	9.9	8.05	4.63	9.1	6.43
Meander Wavelength (ft)	209.46	394.66	334.46	22.47	68.78	46.57	31.6	37.12	34.08	27.51	34.72	31.75
Meander Width ratio	8.16	12.75	10.15	1.43	4.67	2.74	1.38	2.39	1.83	1.52	2.83	2.17
Profile												
Riffle length (ft)	N/A	N/A	N/A	5.52	7.6	6.39	4.93	7.24	5.88	3.36	11.6	5.6
Riffle slope (ft/ft)	0.0179	0.03688	0.02444	0.03022	0.05058	0.04025	0.0258			0.0053	0.0555	0.0279
Pool length (ft)	26.27	54.41	40.34	7.56	10.65	8.78	6.25	10.46	8.45	5.2	10.08	7.59
Pool Slope (ft/ft)	N/A	N/A	N/A	N/A	N/A	N/A	0.0017	0.0087	0.003	0.001	0.0092	0.0022
Pool spacing (ft)	125.7	474.65	265.15	20.17	70.04	46.72	15.73	23.84	19.22	9.43	28.94	19.51
Substrate												
d50 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
d84 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Additional Reach Parameters												
Valley Length (ft)	1872			216.55			1872			1872		
Channel Length (ft)	1965.6			266.36			2114			2191		
Sinuosity	1.05			1.23			1.16			1.2		
Water Surface Slope (ft/ft)	0.0286			0.039			0.0258			0.025		
BF slope (ft/ft)	0.0286			0.039			0.0258			0.025		
Rosgen Classification	G4			B4			B4			B4		
*Habitat Index	N/A			N/A			N/A			N/A		
*Macrobenthos	N/A			N/A			N/A			N/A		

**Exhibit Table IX. Morphology and Hydraulic Monitoring Summary
GRAY FARM STREAM RESTORATION SITE (EEP Project #92219)**

Parameter	REACH 1															
	RIFFLE 1				POOL 1				RIFFLE 2				POOL 2			
	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3
Dimension	2006	2006	2007	2008	2006	2006	2007	2008	2006	2006	2007	2008	2006	2006	2007	2008
BF Width (ft)	15.34	11.25			22.32	20.84			13.62	11.33			20.84	20.41		
Floodprone Width (ft)	54.53	50			61.28	62.34			59.9	60.26			57.43	58.07		
BF Cross Sectional Area (ft ²)	11.97	5.96			39.71	41.33			11.01	9.18			29.04	26.98		
BF Mean Depth (ft)	0.78	0.53			1.78	1.98			0.81	0.68			1.39	1.32		
BF Max Depth (ft)	1.39	0.87			3.29	3.47			1.53	1.25			2.89	2.74		
Width/Depth Ratio	19.67	21.23			12.54	10.53			16.81	19.94			14.99	15.46		
Entrenchment Ratio	3.56	4.44			2.75	2.99			4.4	4.45			2.76	2.85		
Wetted Perimeter(ft)	15.67	11.41			23.83	22.42			13.97	13.82			21.83	21.52		
Hydraulic radius (ft)	0.76	0.52			1.67	1.84			0.79	0.66			1.33	1.25		
Substrate																
d50 (mm)	N/A	N/A			N/A	N/A			N/A	N/A			N/A	N/A		
d84 (mm)	N/A	N/A			N/A	N/A			N/A	N/A			N/A	N/A		

Parameter	REACH 1															
	RIFFLE 3				POOL 3				RIFFLE 4				POOL 4			
	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3
Dimension	2006	2006	2007	2008	2006	2006	2007	2008	2006	2006	2007	2008	2006	2006	2007	2008
BF Width (ft)	12.94	12.1			20.75	21.49			15.7	19			20.28	21.29		
Floodprone Width (ft)	89.67	89.64			61.38	61.32			66.39	66.2			65.77	65.75		
BF Cross Sectional Area (ft ²)	9.49	9.25			34.09	33.59			11.02	13.49			32.64	38.77		
BF Mean Depth (ft)	0.73	0.76			1.64	1.56			0.7	0.71			1.61	1.82		
BF Max Depth (ft)	1.41	1.36			3.03	2.83			1.36	1.41			2.79	3.2		
Width/Depth Ratio	17.73	15.92			12.65	13.78			22.43	26.76			12.6	11.79		
Entrenchment Ratio	6.93	7.41			2.96	2.85			4.23	3.48			3.24	3.09		
Wetted Perimeter(ft)	13.26	12.46			21.78	22.45			16.01	19.29			21.59	22.97		
Hydraulic radius (ft)	0.72	0.74			1.57	1.5			0.69	0.7			1.51	1.69		
Substrate																
d50 (mm)	N/A	N/A			N/A	N/A			N/A	N/A			N/A	N/A		
d84 (mm)	N/A	N/A			N/A	N/A			N/A	N/A			N/A	N/A		

Parameter	REACH 1															
	RIFFLE 5				POOL 5				RIFFLE 6				POOL 6			
	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3
Dimension	2006	2006	2007	2008	2006	2006	2007	2008	2006	2006	2007	2008	2006	2006	2007	2008
BF Width (ft)	15.63	14.32			26.27	23.03			17.01	14.54			18.59	21.11		
Floodprone Width (ft)	72.27	64.56			68.23	68.53			50.57	60			60.15	62.76		
BF Cross Sectional Area (ft ²)	14.76	14.03			37.47	33.39			16	14.61			26.72	27.06		
BF Mean Depth (ft)	0.94	0.98			1.43	1.45			0.94	1.01			1.44	1.28		
BF Max Depth (ft)	1.67	2.27			2.75	3.08			1.56	1.49			2.83	3.14		
Width/Depth Ratio	16.63	14.61			18.37	15.88			18.1	14.4			12.91	16.49		
Entrenchment Ratio	4.62	4.51			2.6	2.98			2.97	4.13			3.24	2.97		
Wetted Perimeter(ft)	16.14	15.28			27.26	24.24			17.42	15			20.27	22.27		
Hydraulic radius (ft)	0.91	0.92			1.37	1.38			0.92	0.97			1.32	1.21		
Substrate																
d50 (mm)	N/A	N/A			N/A	N/A			N/A	N/A			N/A	N/A		
d84 (mm)	N/A	N/A			N/A	N/A			N/A	N/A			N/A	N/A		

Parameter	REACH 1							
	RIFFLE 7				POOL 7			
	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3
Dimension	2006	2006	2007	2008	2006	2006	2007	2008
BF Width (ft)	19.48	16.96			22.66	22.31		
Floodprone Width (ft)	50	50			51.23	55		
BF Cross Sectional Area (ft ²)	17.92	15.49			42.08	38.22		
BF Mean Depth (ft)	0.92	0.91			1.86	1.71		
BF Max Depth (ft)	2.04	1.61			3.47	3.06		
Width/Depth Ratio	21.17	18.64			12.18	13.03		
Entrenchment Ratio	2.57	2.95			2.26	2.46		
Wetted Perimeter(ft)	20.08	17.38			23.91	24.11		
Hydraulic radius (ft)	0.89	0.89			1.76	1.59		
Substrate								
d50 (mm)	N/A	N/A			N/A	N/A		
d84 (mm)	N/A	N/A			N/A	N/A		

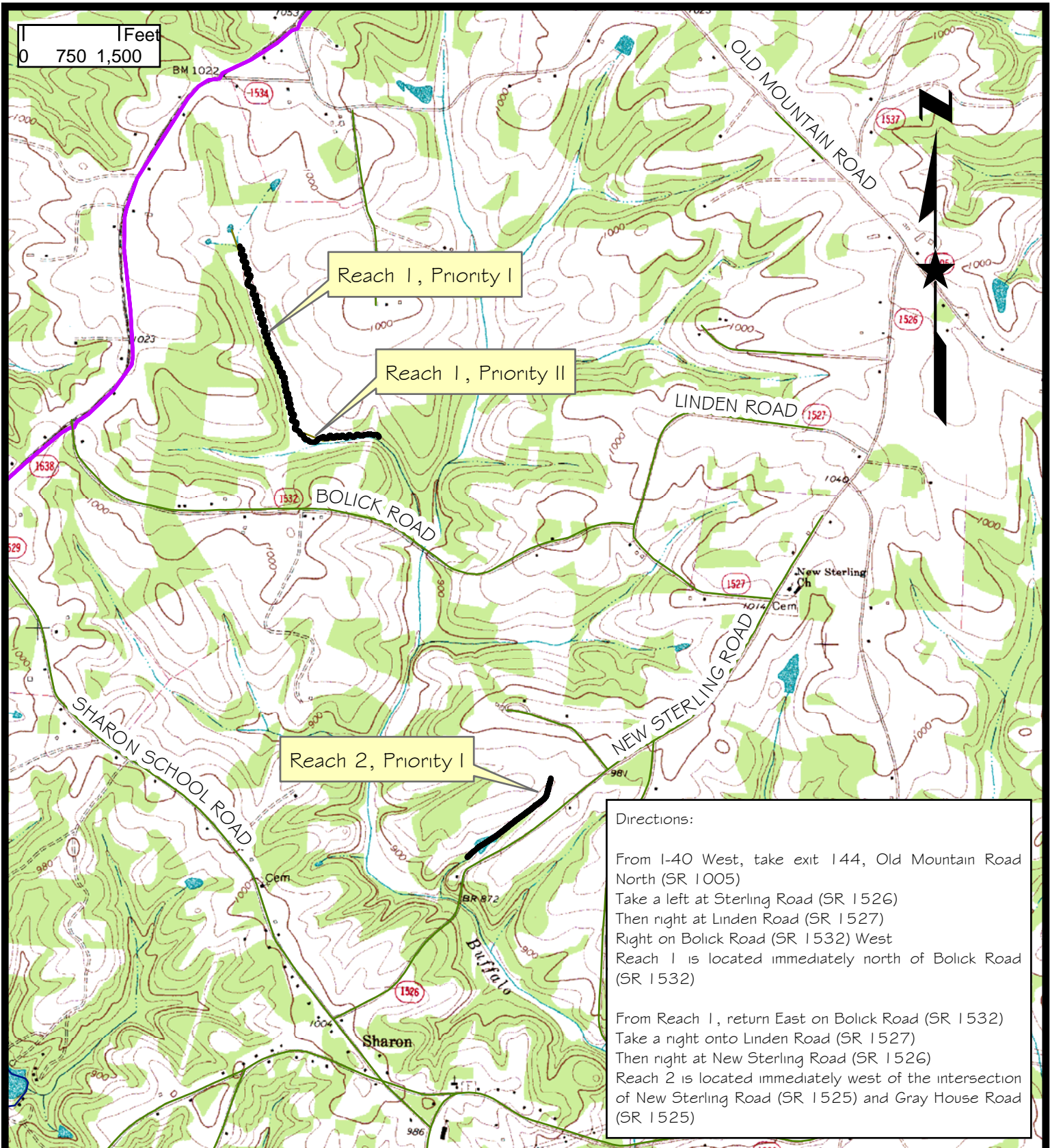
Parameter	As-built (2006)			MY-1 (2006)			MY-2 (2007)			MY-3 (2008)		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Channel Beltwidth (ft)	59.32	93.89	72.85	58.48	96.38	71.67						
Radius of Curvature (ft)	16.64	40.88	25.73	16.84	39.51	24.43						
Meander Wavelength (ft)	77.08	117.13	94.8	76.54	118.26	91.85						
Meander Width ratio	3.7	5.86	4.55	3.56	5.72	4.65						
Profile												
Riffle length (ft)	25.87	54.2	37.85	19.31	54.86	30.86						
Riffle slope (ft/ft)	0.00092	0.0187	0.0062	0.00125	0.01763	0.00883						
Pool length (ft)	7.41	244.47	23.01	14.19	31.92	24.11						
Pool Slope (ft/ft)	0.0007	0.0064	0.0016	0.0007	0.0029	0.0012						
Pool spacing (ft)	12.35	142	70.94	52.58	159	88.05						
Additional Reach Parameters												
Valley Length (ft)		4258.3			4258.3							
Channel Length (ft)		5813.3			5813.3							
Sinuosity		1.36			1.36							
Water Surface Slope (ft/ft)		0.00544			0.00544							
BF slope (ft/ft)		0.00544			0.00544							
Rosgen Classification		C4			C4							
Habitat Index*		N/A			N/A							
Macrobenthos*		N/A			N/A							

Parameter	REACH 2															
	RIFFLE 1				POOL 1				RIFFLE 2				POOL 2			
Dimension	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3
	2006	2006	2007	2008	2006	2006	2007	2008	2006	2006	2007	2008	2006	2006	2007	2008
BF Width (ft)	7.38	7.61			18.44	17.46			8.21	7.6			9.59	10.03		
Floodprone Width (ft)	23.08	26.25			46.7	46.7			39.05	26.17			54.65	51.62		
BF Cross Sectional Area (ft ²)	4.14	4.65			19.78	18.94			6.77	4.86			17.34	16.04		
BF Mean Depth (ft)	0.56	0.61			1.07	10.9			0.82	0.64			1.81	1.6		
BF Max Depth (ft)	0.86	0.98			2.6	2.64			1.3	1.19			3.2	2.88		
Width/Depth Ratio	13.18	12.48			17.23	16.02			10.01	11.88			5.3	6.27		
Entrenchment Ratio	3.13	1.84			2.53	2.67			4.76	3.44			5.7	5.15		
Wetted Perimeter(ft)	7.68	7.92			20.58	19.14			8.77	8.01			12.14	11.79		
Hydraulic radius (ft)	0.54	0.59			0.96	0.99			0.77	0.61			1.43	1.37		
Substrate																
d50 (mm)	N/A	N/A			N/A	N/A			N/A	N/A			N/A	N/A		
d84 (mm)	N/A	N/A			N/A	N/A			N/A	N/A			N/A	N/A		

Parameter	As-built (2006)			MY-1 (2006)			MY-2 (2007)			MY-3 (2008)		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Pattern												
Channel Beltwidth (ft)	11.83	22.05	16.96	11.56	23.13	17.05						
Radius of Curvature (ft)	4.63	9.1	6.43	4.776	9.84	6.32						
Meander Wavelength (ft)	27.51	34.72	31.75	28.61	35.43	32.47						
Meander Width ratio	1.52	2.83	2.17	1.43	2.94	2.33						
Profile												
Riffle length (ft)	3.36	11.6	5.6	4.93	7.24	5.88						
Riffle slope (ft/ft)	0.0053	0.0555	0.0279	0.0045	0.0393	0.1073						
Pool length (ft)	5.2	10.08	7.59	5.17	8.67	14.37						
Pool Slope (ft/ft)	0.001	0.0092	0.0022	0.00087	0.00754	0.00253						
Pool spacing (ft)	9.43	28.94	19.51	14.65	21.98	35.31						
Additional Reach Parameters												
Valley Length (ft)		1872.37			1872.37							
Channel Length (ft)		2190.67			2190.67							
Sinuosity		1.2			1.2							
Water Surface Slope (ft/ft)		0.025			0.025							
BF slope (ft/ft)		0.025			0.025							
Rosgen Classification		B4			B4							
Habitat Index		N/A			N/A							
Macrobenthos		N/A			N/A							

IV. Methodology Section

No deviations from initially prescribed methodologies were implemented as a part of monitoring Year 1 (2006) activities.



Project Number: 9385.D7
Project Manager: PKS
Scale: 1" = 1,500'
Date: FEBRUARY 2007

Map Title: Figure 1 - Project Location
Gray Farm Stream Restoration Site
EEP Job #
Iredell County, NC
Source: Stony Point Quadrangle

S&EC Soil & Environmental Consultants, PA
 11110 Raven Ridge Rd • Raleigh, NC 27614
 (919) 846-5900 • (919) 846-9467
 Web Page: www.SandEC.com



APPENDIX A

APPENDIX A –
Vegetation Survey Data Tables

Table 1. - Vegetation Metadata

Report Prepared By David Ingersoll
Date Prepared 12/20/2006 9:37

database name CVS_EEP_DataEntry_v202.mdb
database location \\Sec5\secdavid\EEP Guidelines\CVS-EEP-Veg Monitoring Protocols\CVS_EEP_DataEntry_v202

DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----

Metadata This worksheet, which is a summary of the project and the project data.
Plots List of plots surveyed.
Vigor Frequency distribution of vigor classes.
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.
Stem Count by Plot and Spp Count of living stems of each species for each plot; dead and missing stems are excluded.

PROJECT SUMMARY-----

Project Code	project Name	Description	length (ft)
GFR1	Gray Farm Reach 1	Gray Farm stream restoration - Reach 1	
GFR2	Gray Farm Reach 2	Gray Farm stream restoration - Reach 2	
stream-to-edge width (ft)	area (sq m)	Required Plots (calculated)	Sampled Plots
			4
			2

Table 2. – Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing
	<i>Alnus serrulata</i>		6				
	<i>Betula nigra</i>	1	4				
	<i>Cornus amomum</i>			3			
	<i>Fraxinus pennsylvanica</i>	1	5	1			
	<i>Quercus michauxii</i>		1				
	<i>Quercus nigra</i>		6	1			
	<i>Quercus phellos</i>		1	8			
	<i>Viburnum nudum</i>		1				
	<i>Viburnum</i>			1			
	<i>Ilex opaca</i>	3	2	1			
	<i>Carpinus caroliniana</i>			1			
	<i>Quercus</i>	1	6	6			
	<i>Lindera benzoin</i>		2	2			
	<i>Liriodendron tulipifera</i>	1	4				
	<i>Platanus occidentalis</i>	1	16	10			
TOT:	15	8	54	34			

Table 3. – Vegetation Damage by Species

	Species	All Damage Categories	(no damage)	Insects	Unknown	Vine Strangulation	(other damage)
	<i>Alnus serrulata</i>	6	6				
	<i>Betula nigra</i>	5	5				
	<i>Carpinus caroliniana</i>	1	1				
	<i>Cornus amomum</i>	3	3				
	<i>Fraxinus pennsylvanica</i>	7	6			1	
	<i>Ilex opaca</i>	6	6				
	<i>Lindera benzoin</i>	4	4				
	<i>Liriodendron tulipifera</i>	5	5				
	<i>Platanus occidentalis</i>	27	20	6			1
	<i>Quercus</i>	13	13				
	<i>Quercus michauxii</i>	1	1				
	<i>Quercus nigra</i>	7	6	1			
	<i>Quercus phellos</i>	9	7		2		
	<i>Viburnum</i>	1	1				
	<i>Viburnum nudum</i>	1	1				
TOT:	15	96	85	7	2	1	1

Table 4. – Vegetation Damage by Plot

	plot	All Damage Categories	(no damage)	Insects	Unknown	Vine Strangulation	(other damage)
	GFR1-01-buffer1	17	14		2	1	
	GFR1-01-buffer2	15	14				1
	GFR1-01-buffer3	15	15				
	GFR1-01-buffer4	11	7	4			
	GFR2-01-Buffer1	23	21	2			
	GFR2-01-Buffer2	15	14	1			
TOT:	6	96	85	7	2	1	1

Table 5. – Stem Count by Plot and Species

	Species	Total Stems	# plots	avg# stems	plot GFR1-01-buffer1	plot GFR1-01-buffer2	plot GFR1-01-buffer3	plot GFR1-01-buffer4	plot GFR2-01-Buffer1	plot GFR2-01-Buffer2
	<i>Alnus serrulata</i>	6	3	2	3	2				1
	<i>Betula nigra</i>	5	3	1.67			2	2	1	
	<i>Carpinus caroliniana</i>	1	1	1					1	
	<i>Cornus amomum</i>	3	2	1.5			1	2		
	<i>Fraxinus pennsylvanica</i>	7	4	1.75	2	3	1		1	
	<i>Ilex opaca</i>	6	4	1.5	1	1	2		2	
	<i>Lindera benzoin</i>	4	2	2		1			3	
	<i>Liriodendron tulipifera</i>	5	1	5						5
	<i>Platanus occidentalis</i>	27	6	4.5	3	3	9	7	4	1
	<i>Quercus</i>	13	3	4.33	2				4	7
	<i>Quercus michauxii</i>	1	1	1		1				
	<i>Quercus nigra</i>	7	3	2.33	3	3				1
	<i>Quercus phellos</i>	9	2	4.5	2				7	
	<i>Viburnum</i>	1	1	1		1				
	<i>Viburnum nudum</i>	1	1	1	1					
TOT:	15	96	15		17	15	15	11	23	15

Exhibit Table 6. Vegetative Problem Areas

Reach 1			
Feature/Issue	Station # / Range	Probable Cause	Photo #
Bare Flood Plain	5+10 - 5+50	Surface flow	1
	6+60 - 7+00	Surface flow	
	51+50 - 52+75	Surface flow	
Reach 2			
Feature/Issue	Station # / Range	Probable Cause	Photo #
Bare Flood Plain	2+40 - 2+65	Poor soil quality	2
	2+75 - 3+15	Poor soil quality	

APPENDIX A –
Vegetation Problem Area Photos



Typical Bare Bench/Floodplain—Reach 1—Year 1 (2006)



Typical Bare Floodplain—Reach 2—Year 1 (2006)

APPENDIX A –
Vegetation Monitoring Plot Photos



Vegetation Monitoring Plot—Reach 1—Buffer 1—Year 1 (2006)



Vegetation Monitoring Plot— Reach 1—Buffer 2—Year 1 (2006)



Vegetation Monitoring Plot—Reach 1—Buffer 3—Year 1 (2006)



Vegetation Monitoring Plot—Reach 1—Buffer 4—Year 1 (2006)



Vegetation Monitoring Plot—Reach 1—Bank 1—Year 1 (2006)



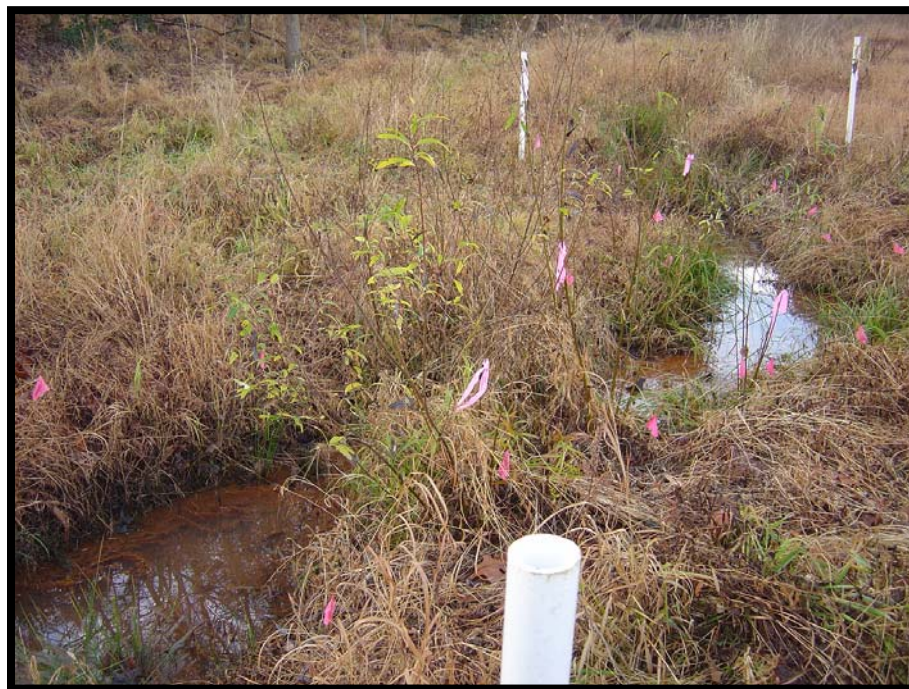
Vegetation Monitoring Plot—Reach 1—Bank 2—Year 1 (2006)



Vegetation Monitoring Plot—Reach 2—Buffer 1—Year 1 (2006)



Vegetation Monitoring Plot—Reach 2—Buffer 2—Year 1 (2006)



Vegetation Monitoring Plot—Reach 2—Bank 1—Year 1 (2006)



Vegetation Monitoring Plot—Reach 2—Bank 2—Year 1 (2006)

APPENDIX B

APPENDIX B –
Stream Problem Area Table

Exhibit Table B1a - Stream Problem Areas Gray Farm Stream and Wetland Restoration Site/EEP Project #XXXXXX Reach 1			
Feature Issue	Station numbers	Suspected Cause	Photo number
Bank Scour	5+30	Surface flow	1
	6+85	Surface flow	
	41+30	Downcutting Left Bank	
	41+30	Downcutting Right Bank	
	48+75	Structure geometry incorrect	

Exhibit Table B1b - Stream Problem Areas Gray Farm Stream and Wetland Restoration Site/EEP Project #XXXXXX Reach 2			
Feature Issue	Station numbers	Suspected Cause	Photo number
Bank Scour	17+60	Stressed structure – rock shift	2
Structures	17+60	Stressed structure – rock shift	

APPENDIX B –
Representative Stream Problem Area Photos



Typical Bank Scour—Reach —Year 1 (2006)



Typical Stressed Structure/Bank Scour—Reach 2—Year 1 (2006)

APPENDIX B –
Stream Photo Point Photos



Cross-Section 1—Reach 1—Riffle 1—As-Built (2006)



Cross-Section 1— Reach 1—Riffle 1—Year 1 (2006)



Cross-Section 1—Reach 1—Pool 1—As-Built (2006)



Cross-Section 1— Reach 1—Pool 1—Year 1 (2006)



Cross-Section 2—Reach 1—Riffle 2—As-Built (2006)



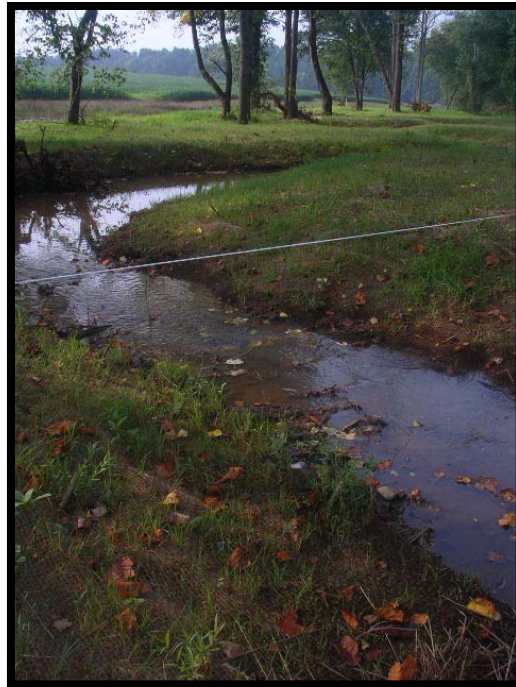
Cross-Section 2—Reach 1—Riffle 2—Year 1 (2006)



Cross-Section 2—Reach 1—Pool 2—As-Built (2006)



Cross-Section 2—Reach 1 - Pool 2—Year 1 (2006)



Cross-Section 3—Reach 1—Riffle 3—As-Built (2006)



Cross-Section 3—Reach 1—Riffle 3—Year 1 (2006)



Cross-Section 3—Reach 1—Pool 3—As-Built (2006)



Cross-Section 3—Reach 1 - Pool 3—Year 1 (2006)



Cross-Section 4—Reach 1—Riffle 4—As-Built (2006)



Cross-Section 4—Reach 1—Riffle 4—Year 1 (2006)



Cross-Section 4—Reach 1—Pool 4—As-Built (2006)



Cross-Section 4—Reach 1—Pool 4—Year 1 (2006)



Cross-Section 5—Reach 1—Riffle 5—As-Built (2006)



Cross-Section 5—Reach 1—Riffle 5—Year 1 (2006)



Cross-Section 5—Reach 1—Pool 5—As-Built (2006)



Cross-Section 5—Reach 1—Pool 5—Year 1 (2006)



Cross-Section 6—Reach 1—Riffle 6—As-Built (2006)



Cross-Section 6—Reach 1—Riffle 6—Year 1 (2006)



Cross-Section 6—Reach 1—Pool 6—As-Built (2006)



Cross-Section 6—Reach 1—Pool 6—Year 1 (2006)



Cross-Section 7—Reach 1—Riffle 7—As-Built (2006)



Cross-Section 7—Reach 1—Riffle 7—Year 1 (2006)



Cross-Section 7—Reach 1—Pool 7—As-Built (2006)



Cross-Section 7—Reach 1—Pool 7—Year 1 (2006)



Cross-Section 1—Reach 2—Riffle 1—As-Built (2006)



Cross-Section 1—Reach 2—Riffle 1—Year 1 (2006)



Cross-Section 1—Reach 2—Pool 1—As-Built (2006)



Cross-Section 1—Reach 2—Pool 1—Year 1 (2006)



Cross-Section 2—Reach 2—Riffle 2—As-Built (2006)



Cross-Section 2—Reach 2—Riffle 2—Year 1 (2006)



Cross-Section 2—Reach 2—Pool 2—As-Built (2006)



Cross-Section 2—Reach 2—Pool 2—Year 1 (2006)

APPENDIX B –

Exhibit Table B.1. Qualitative Visual Stability Assessment

Table B2. Qualitative Visual Stability Assessment
 Date: NOVEMBER 27, 2006
 GRAY FARM STREAM RESTORATION - REACH 1

Project # 9385.D7

Feature Category	Metric (per As-built and reference baselines)	(# stable) Number performing as intended	Total number per As-built	Total Number / feet in unstable state	% perfor. in stable condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	34	34	NA	100%	
	2. Armor stable (e.g. no displacement)?	34	34	NA	100%	
	3. Facet grade appears stable?	33	34	NA	97%	
	4. Stable interval grade?	34	34	NA	100%	
	5. Feature spacing appropriate?	34	34	NA	100%	
	6. Minimal evidence of embedding/fining?	34	34	NA	100%	
	7. Depth appears appropriate for current discharge?	34	34	NA	100%	
	8. Length appropriate?	34	34	NA	100%	100%
B. Pools	1. Present? (e.g. not subject to severe aggradation?)	49	49	NA	100%	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6)	49	49	NA	100%	
	3. Thalweg located outer bend?	49	49	NA	100%	
	4. Spacing appropriate?	49	49	NA	100%	
	5. Non-aggrading (not filling)?	49	49	NA	100%	
	6. Length appropriate?	49	49	NA	100%	100%
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	34	34	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	33	34	NA	97%	99%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	49	49	NA	100%	
	2. Of those eroding, # w/ concomitant point bar formation?	N/A	49	NA	N/A	
	3. Apparent Rc within spec?	49	49	NA	100%	
	4. Sufficient floodplain access and relief?	49	49	NA	100%	100%
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	250	93%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	NA	NA	70	98%	96%
G. Banks	1. Apparent scour points from channel processes	NA	NA	0	100%	
	2. Apparent cut points from overland flow	NA	NA	100	97%	
	3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?)	NA	NA	0	100%	
	4. Tension cracks	NA	NA	0	100%	
	5. Bank gradient in excess of 40%?	NA	NA	0	100%	
	6. Collapse/slumping	NA	NA	0	100%	
	7. Ratio of bank height: bankfull height elevated	NA	NA	0	100%	100%
H. Vanes	1. Free of back or arm scour?	28	28	N/A	100%	
	2. Height appropriate?	28	28	N/A	100%	
	3. Angle and geometry appear appropriate?	27	28	N/A	96%	
	4. Free of piping or other structural failures?	28	28	N/A	100%	99%
I. Wads/Boulders	1. Free of scour?	0	0	N/A	N/A	
	2. Footing stable?	0	0	N/A	N/A	N/A

Notes:

Table B2. Qualitative Visual Stability Assessment
 Date: NOVEMBER 27, 2006
 GRAY FARM STREAM RESTORATION - REACH 2

Project # 9385.D7

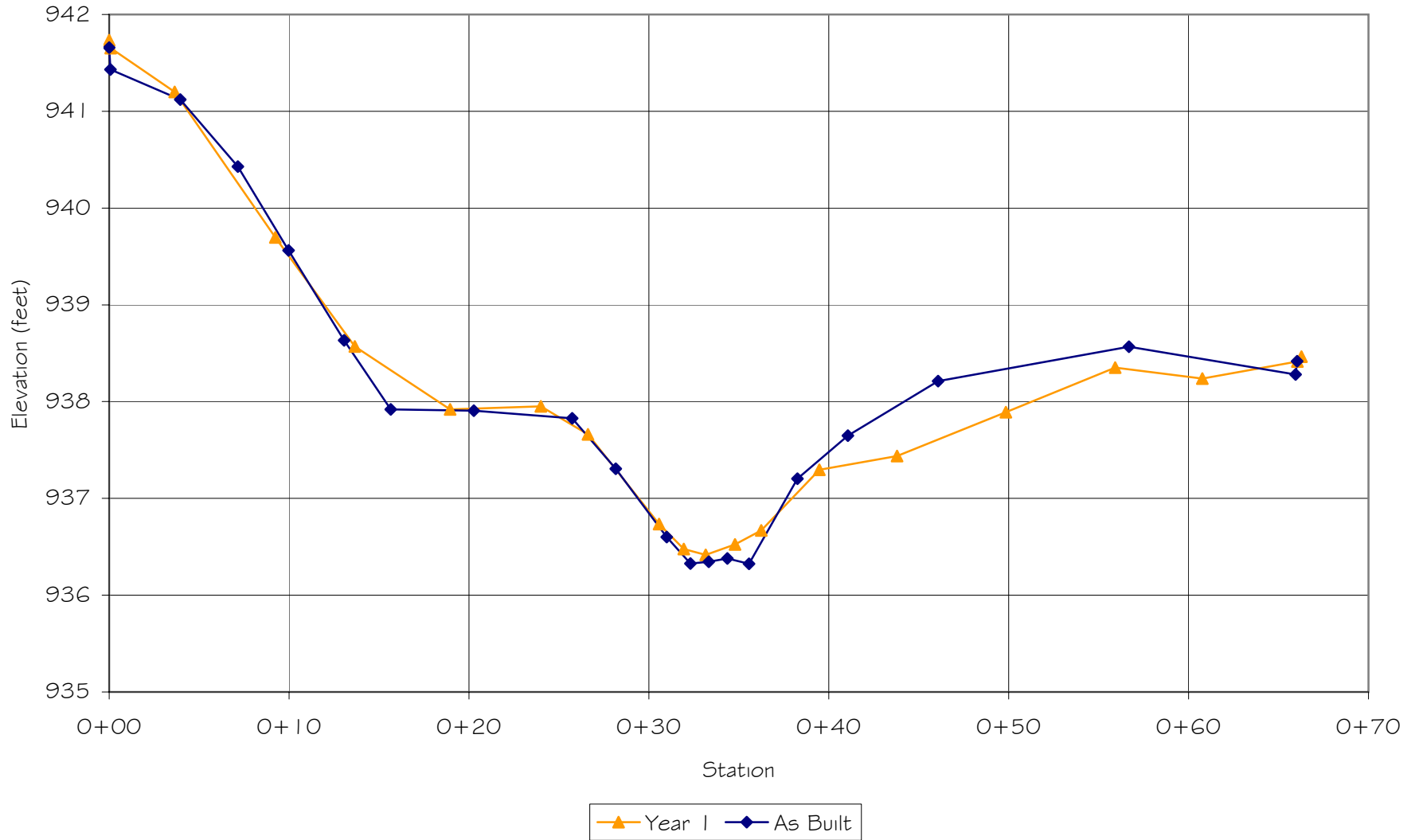
Feature Category	Metric (per As-built and reference baselines)	(# stable) Number performing as intended	Total number per As-built	Total Number / feet in unstable state	% perfor. in stable condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	51	51	NA	100%	
	2. Armor stable (e.g. no displacement)?	51	51	NA	100%	
	3. Facet grade appears stable?	51	51	NA	100%	
	4. Stable interval grade?	51	51	NA	100%	
	5. Feature spacing appropriate?	51	51	NA	100%	
	6. Minimal evidence of embedding/fining?	51	51	NA	100%	
	7. Depth appears appropriate for current discharge?	51	51	NA	100%	
	8. Length appropriate?	51	51	NA	100%	100%
B. Pools	1. Present? (e.g. not subject to severe aggradation?)	52	52	NA	100%	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6)	52	52	NA	100%	
	3. Thalweg located outer bend?	52	52	NA	100%	
	4. Spacing appropriate?	52	52	NA	N/A	
	5. Non-aggrading (not filling)?	52	52	NA	100%	
	6. Length appropriate?	52	52	NA	N/A	100%
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	51	51	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	51	51	NA	100%	100%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	51	52	NA	98%	
	2. Of those eroding, # w/ concomitant point bar formation?	N/A	N/A	NA	N/A	
	3. Apparent Rc within spec?	52	52	NA	100%	
	4. Sufficient floodplain access and relief?	52	52	NA	100%	99%
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	NA	NA	0	100%	100%
G. Banks	1. Apparent scour points from channel processes	NA	NA	20	98%	
	2. Apparent cut points from overland flow	NA	NA	0	100%	
	3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?)	NA	NA	0	100%	
	4. Tension cracks	NA	NA	0	100%	
	5. Bank gradient in excess of 40%?	NA	NA	0	100%	
	6. Collapse/slumping	NA	NA	0	100%	
	7. Ratio of bank height: bankfull height elevated	NA	NA	0	100%	100%
H. Vanes	1. Free of back or arm scour?	52	53	NA	98%	
	2. Height appropriate?	53	53	NA	100%	
	3. Angle and geometry appear appropriate?	52	53	NA	98%	
	4. Free of piping or other structural failures?	52	53	NA	98%	99%
I. Wads/Boulders	1. Free of scour?	0	0	NA	N/A	
	2. Footing stable?	0	0	NA	N/A	N/A

Notes:

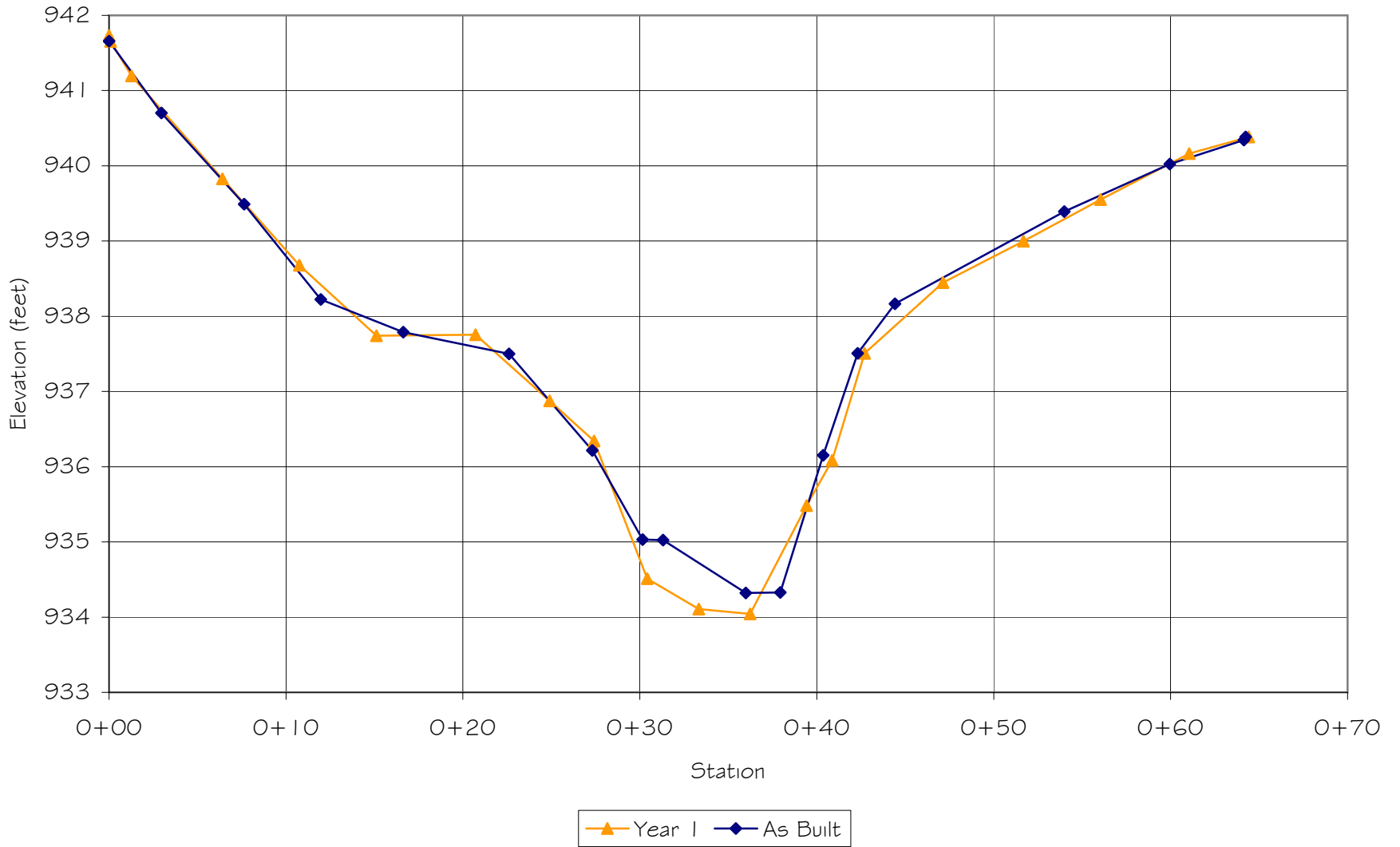
APPENDIX B –

Annual Overlays of Cross Section Plots

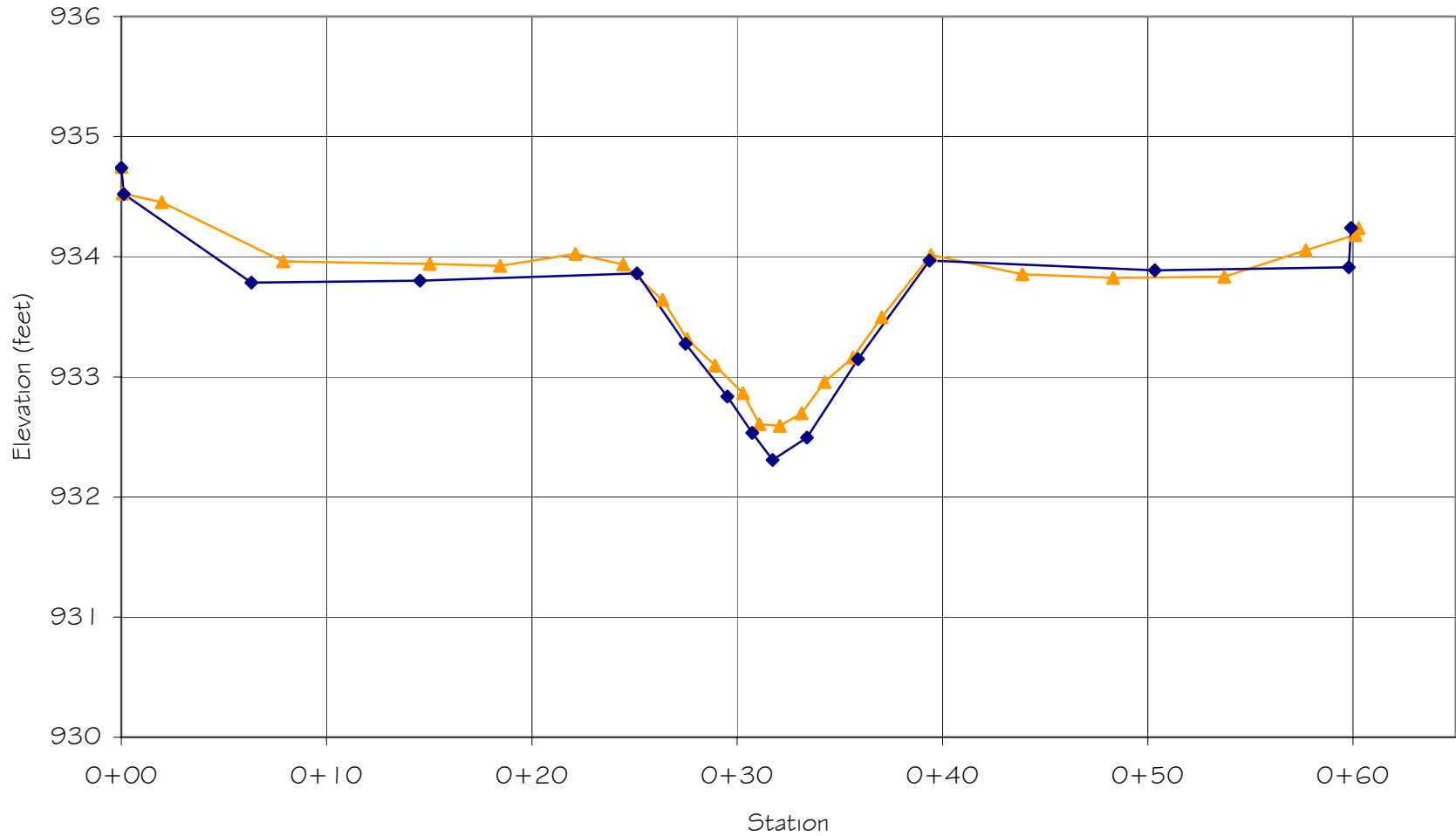
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 1 (RIFFLE)
(STA. 4+25)



GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 1 (POOL)
(STA. 4+65)

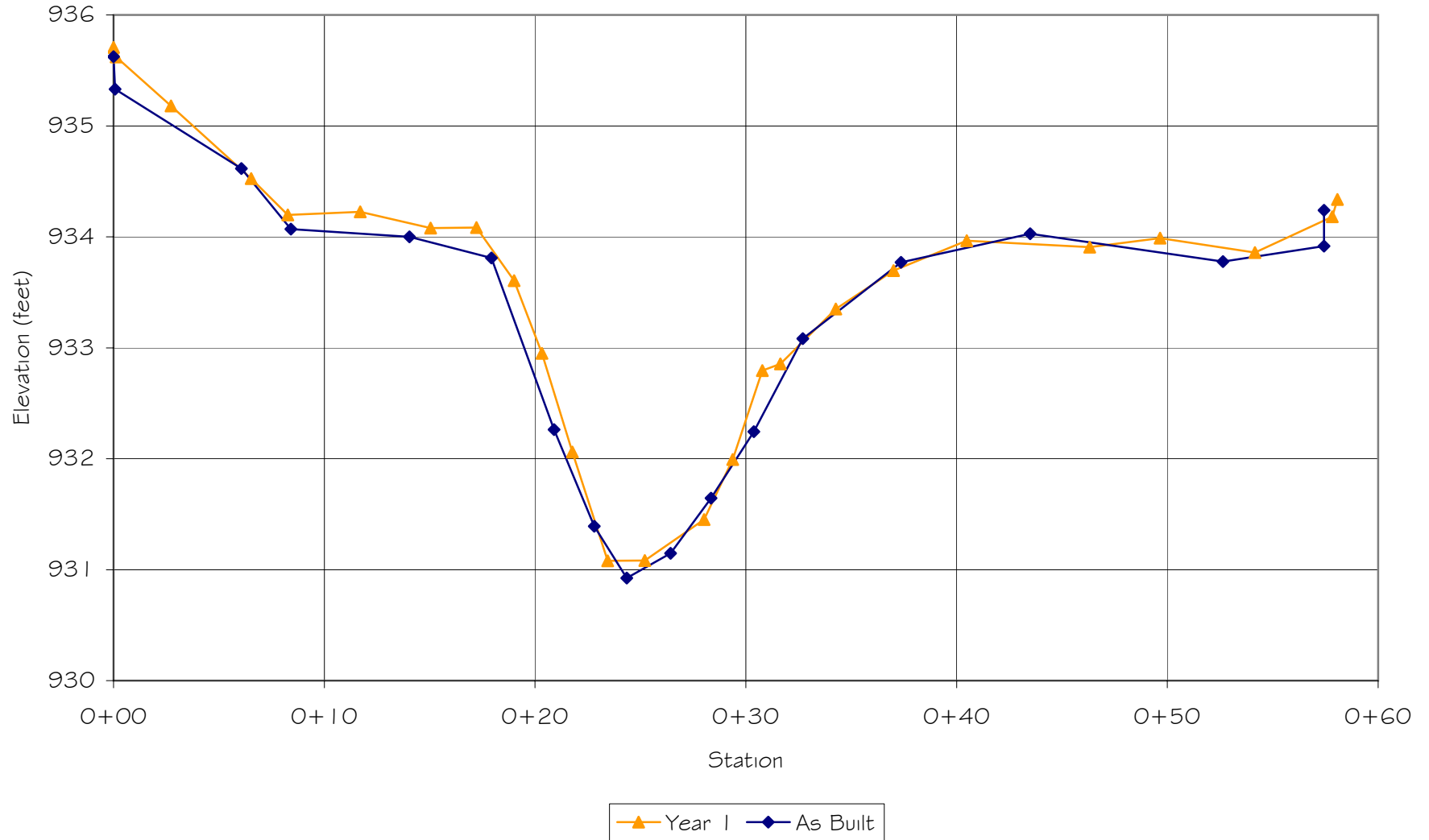


GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 2 (RIFFLE)
(STA. 13+55)

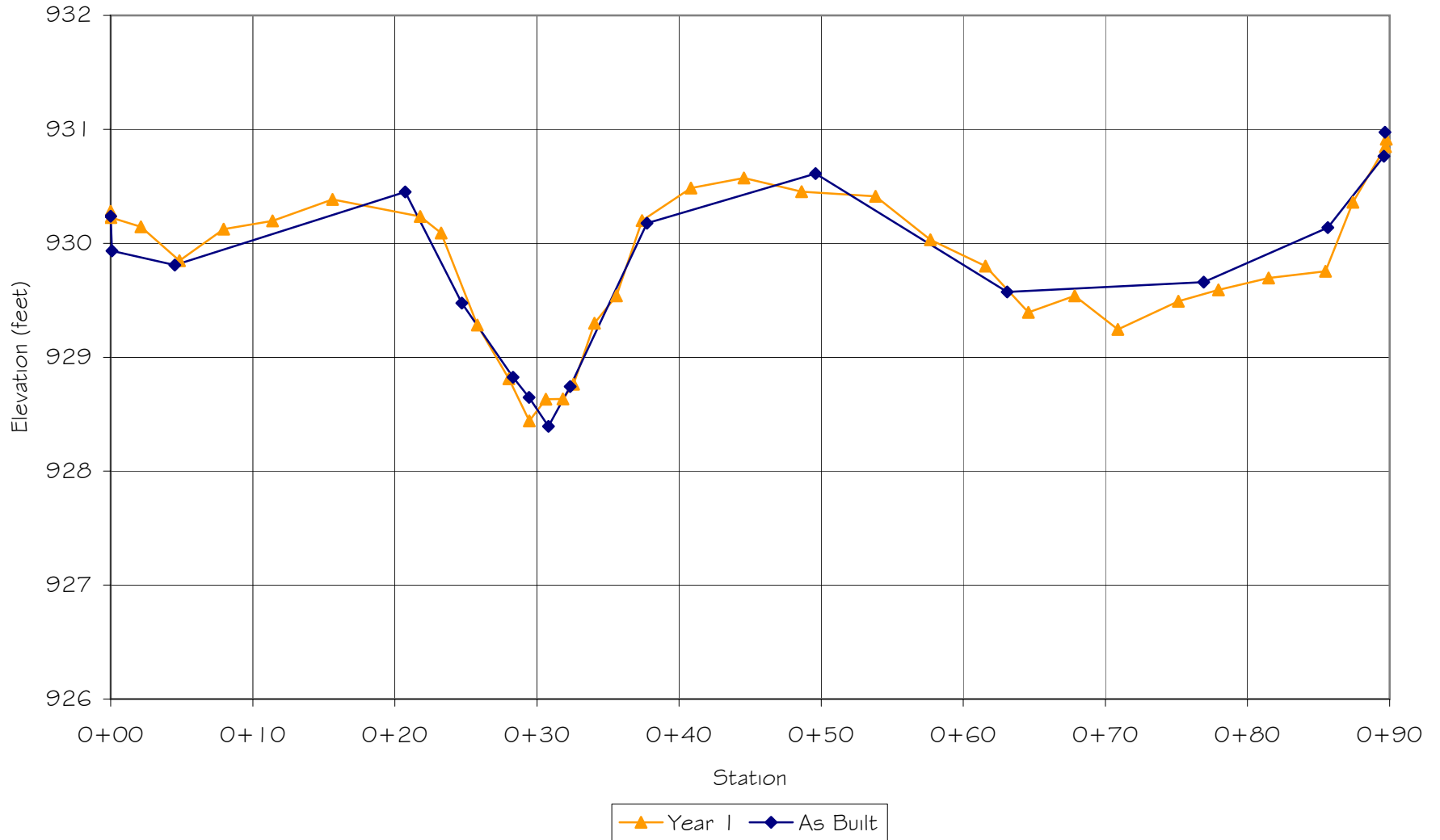


—▲— Year 1 —◆— As Built

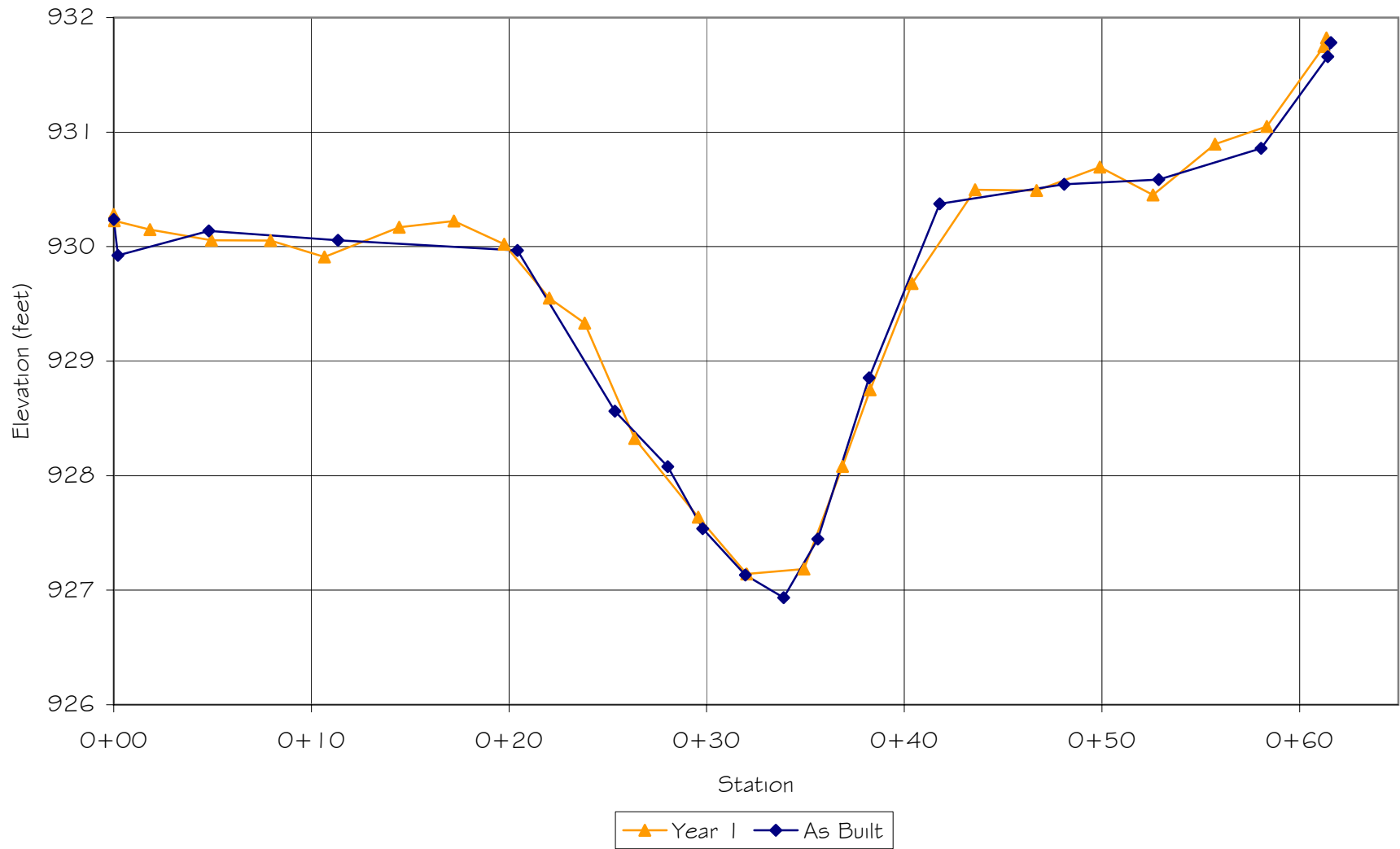
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REACH 1 - CROSS-SECTION 2 (POOL)
(STA. 13+90)



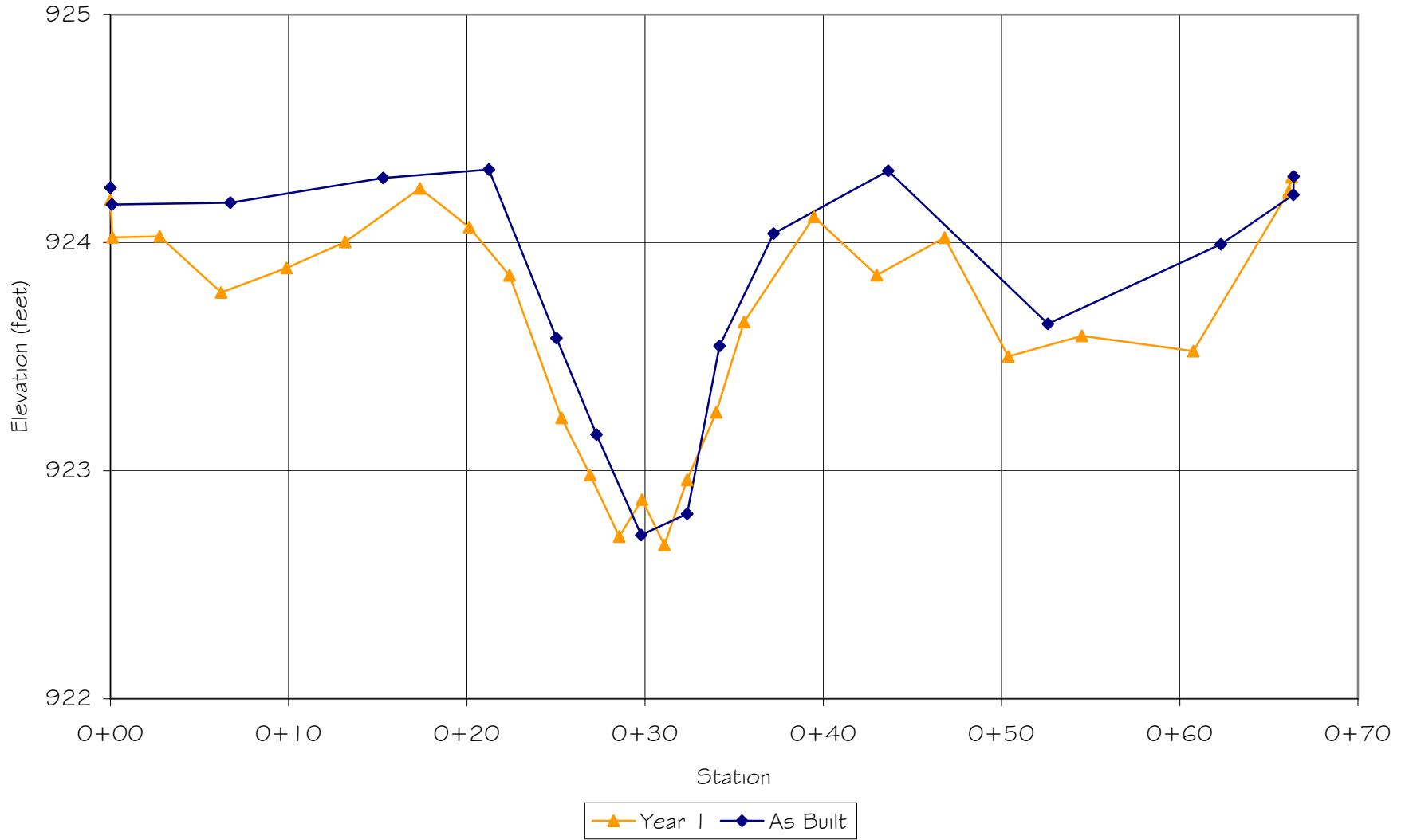
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 3 (RIFFLE)
(STA. 23+40)



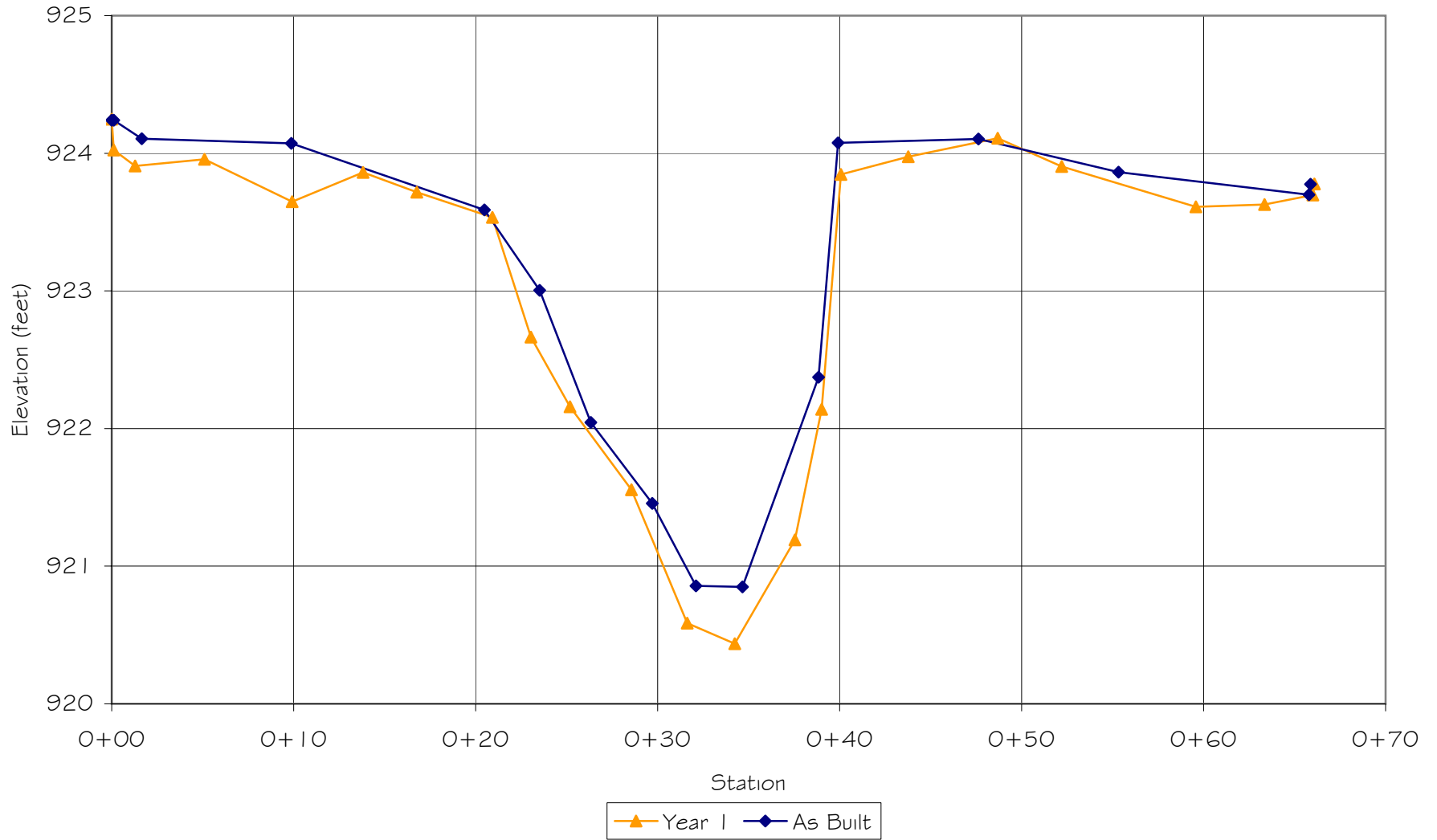
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 3 (POOL)
(STA. 23+20)



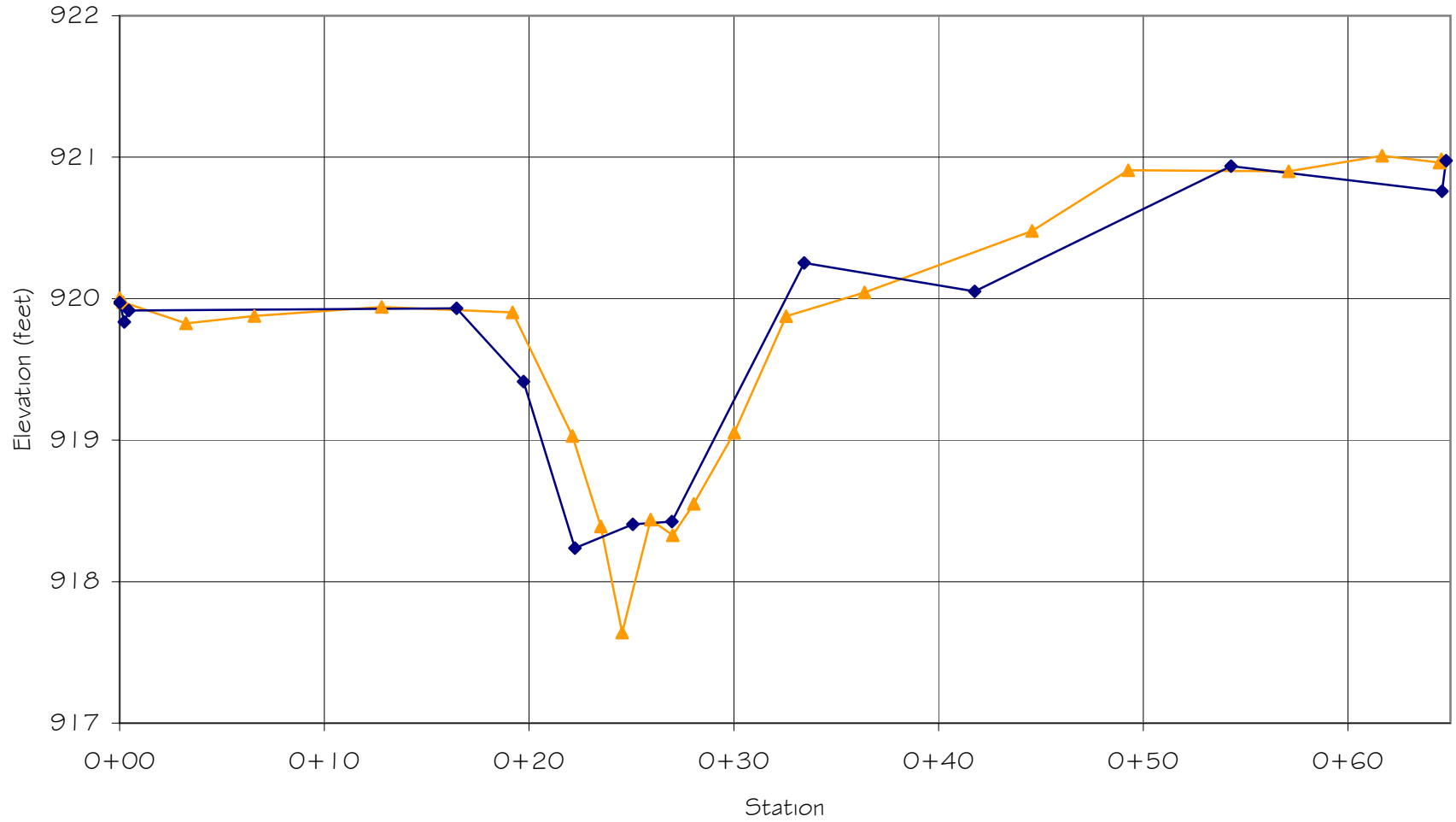
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 4 (RIFFLE)
(STA. 32+95)



GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 4 (POOL)
(STA. 33+30)

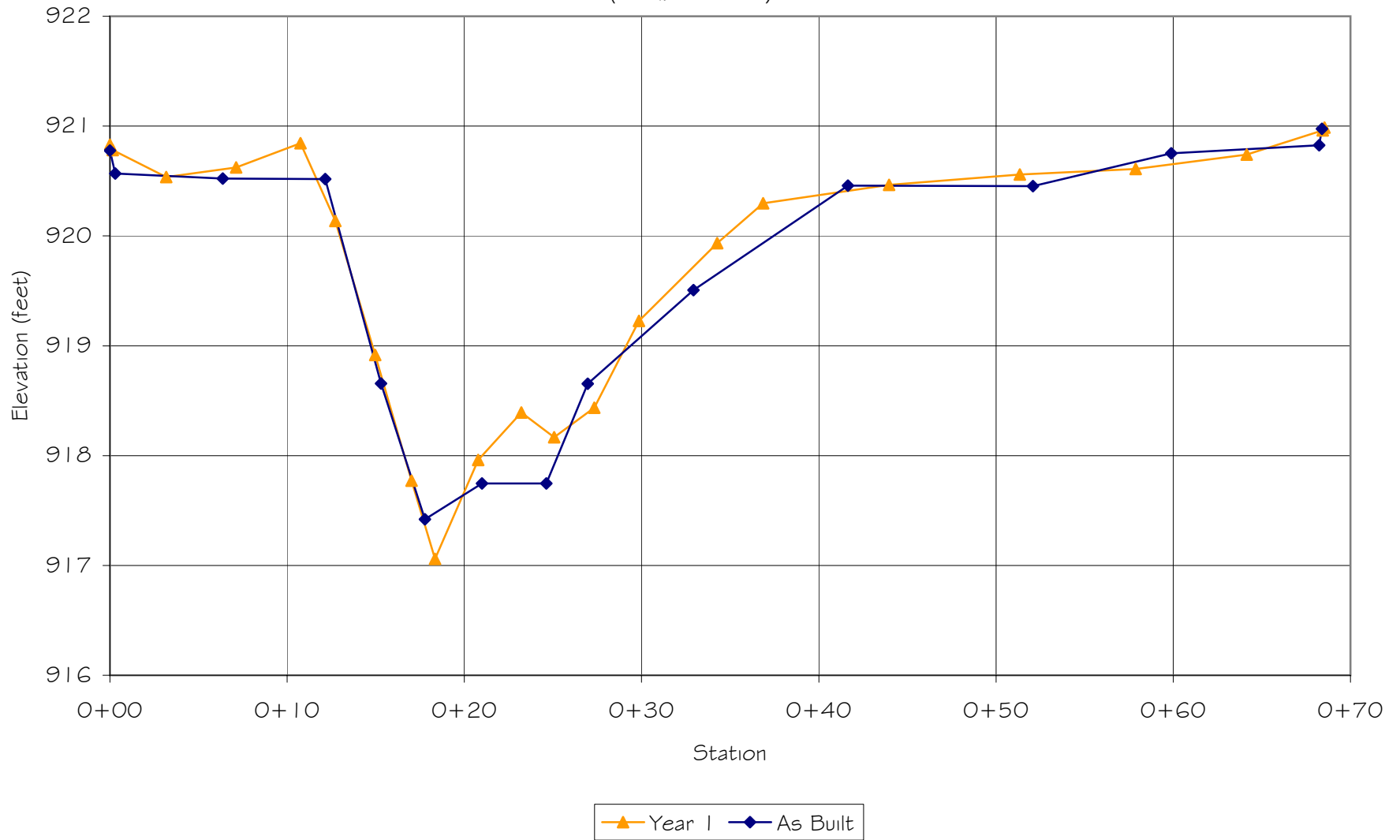


GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 5 (RIFFLE)
(STA. 39+30)

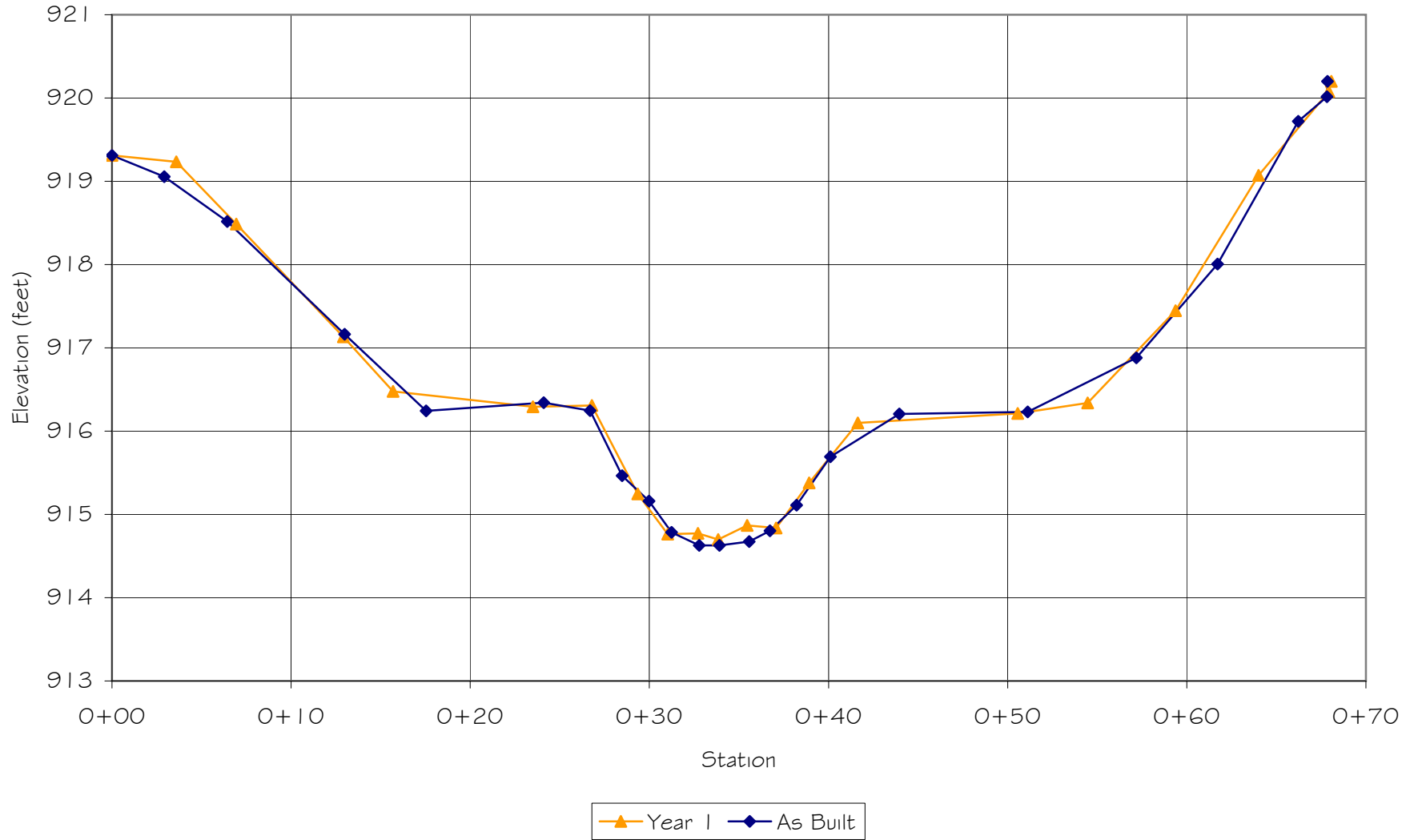


—▲— Year 1 —◆— As Built

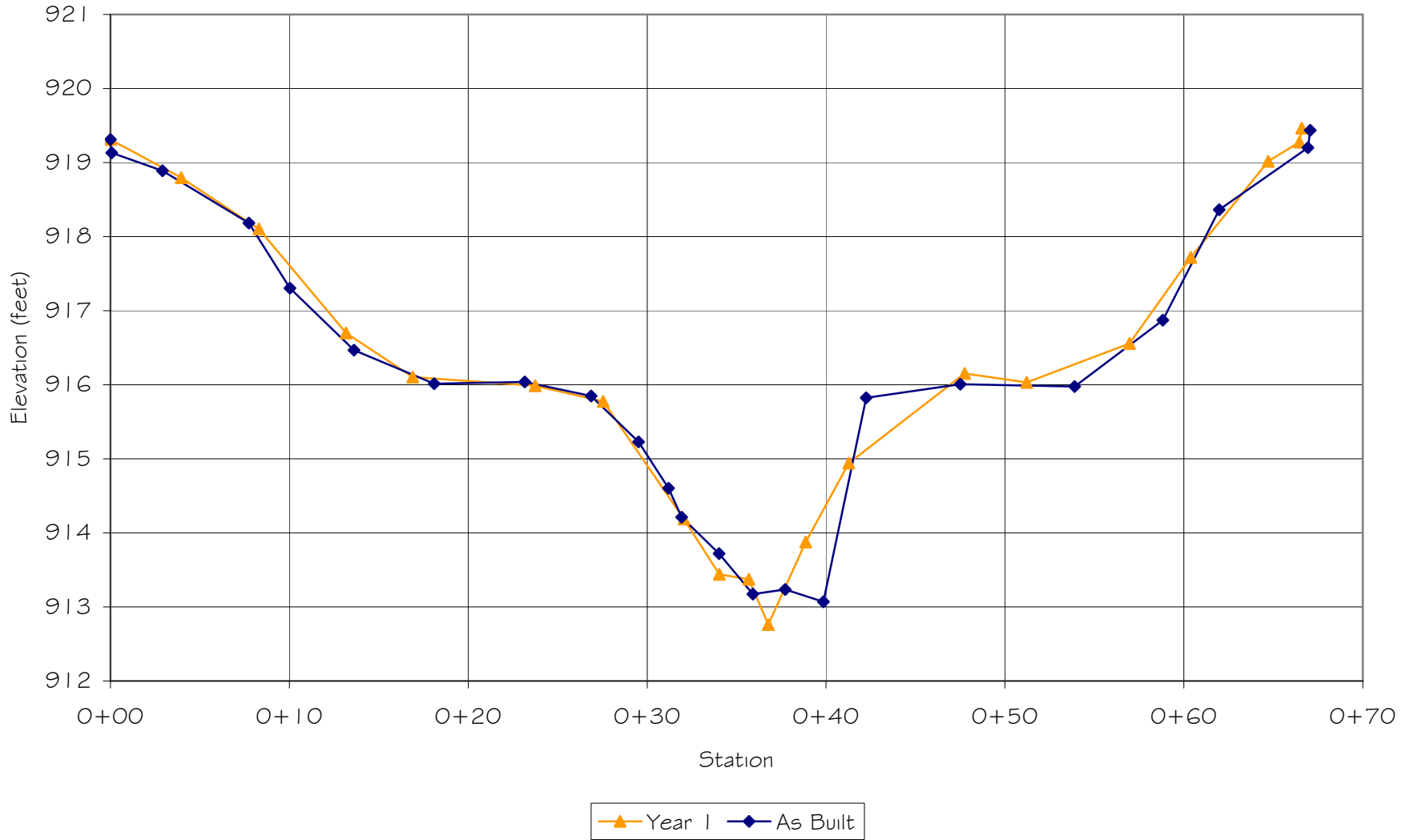
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 5 (POOL)
(STA. 38+95)



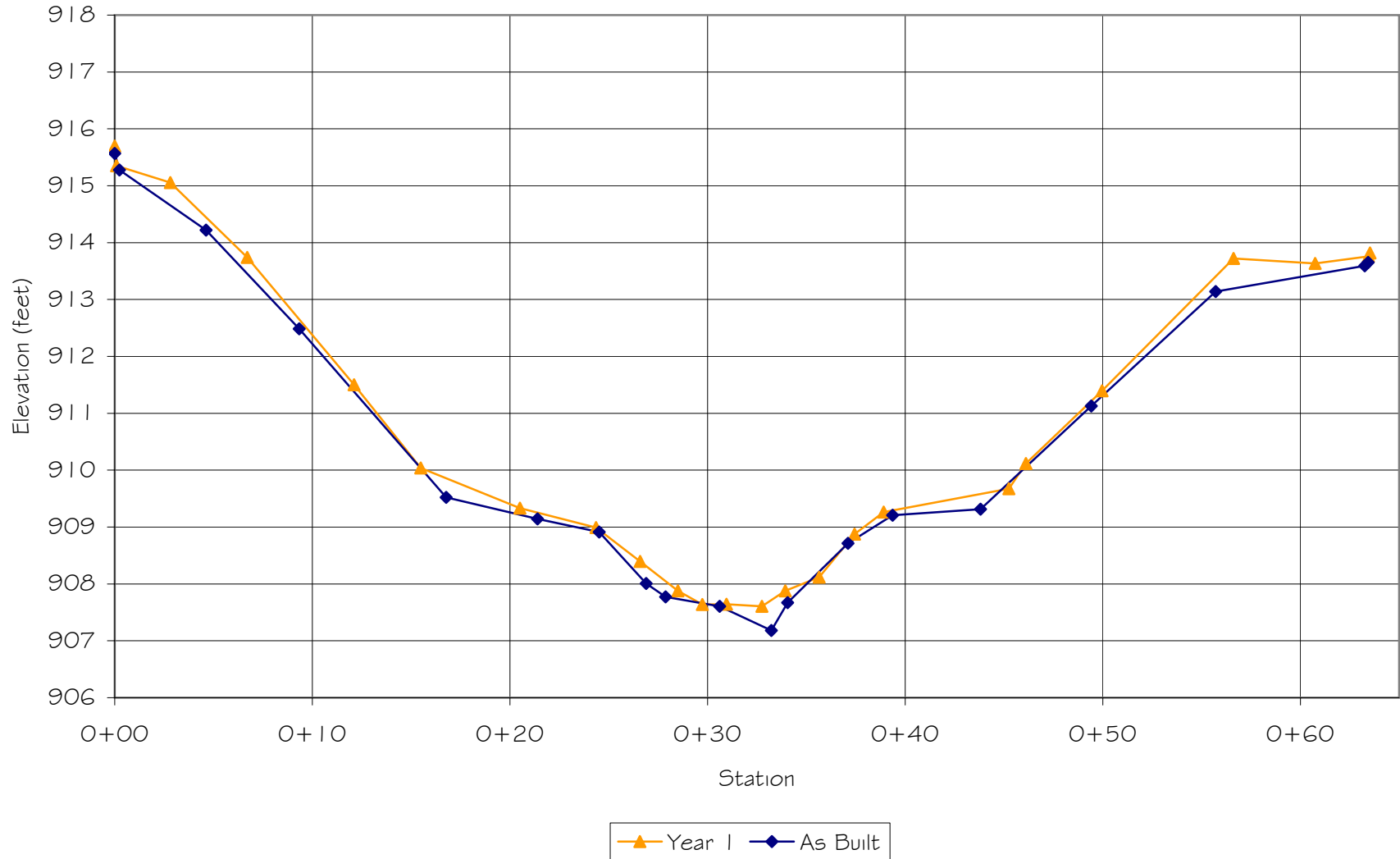
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 6 (RIFFLE)
(STA. 42+80)



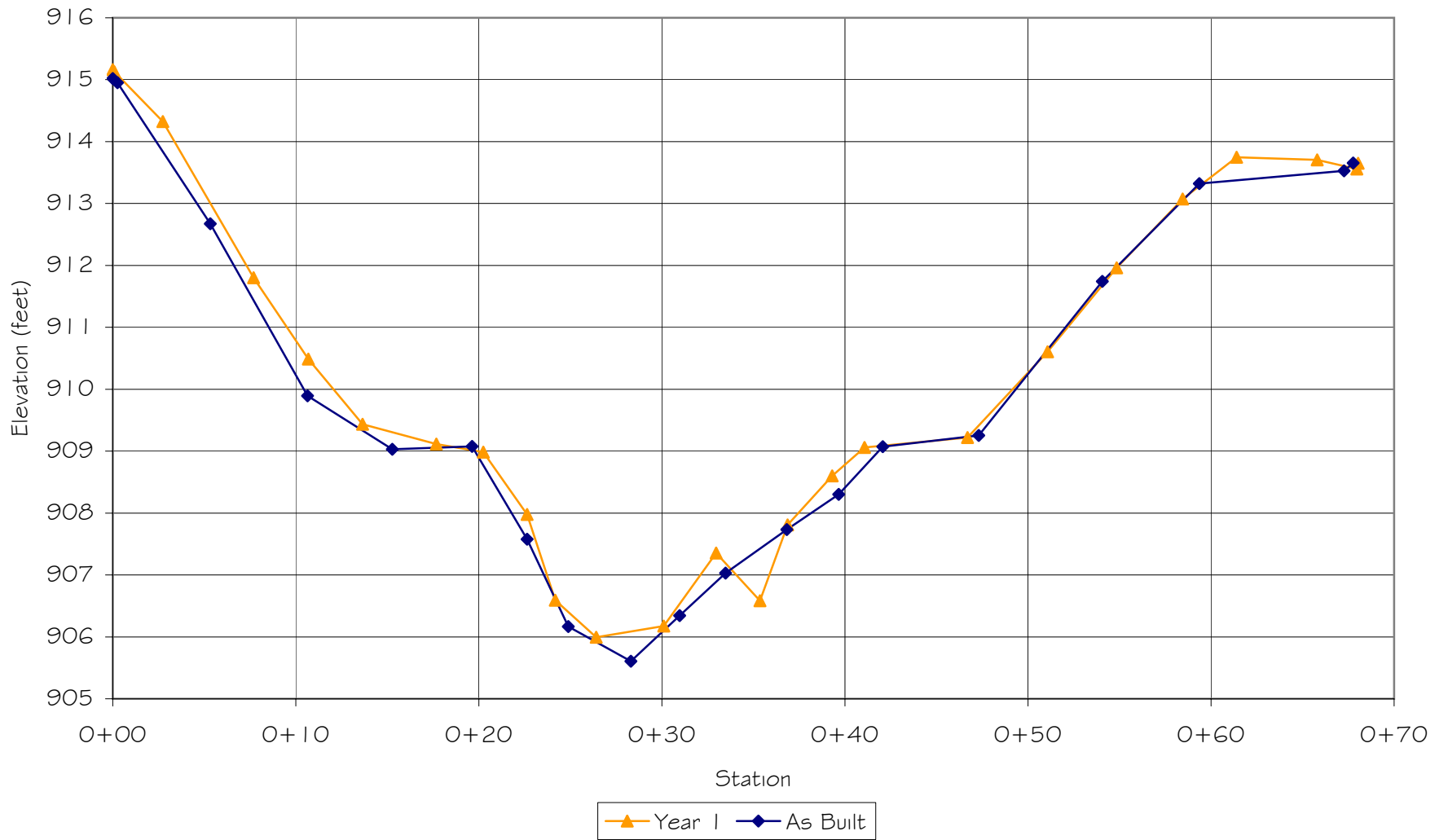
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 6 (POOL)
(STA. 43+10)



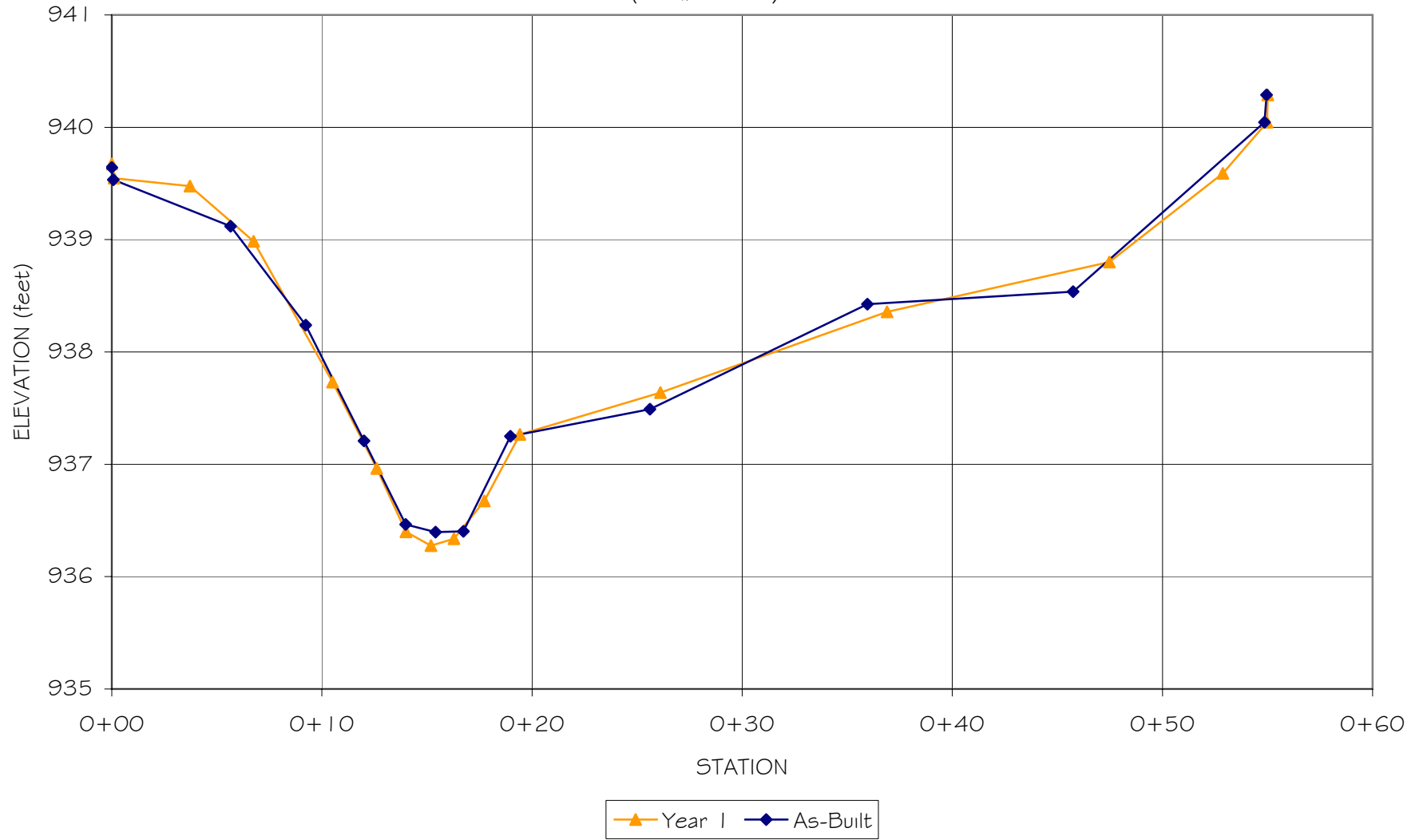
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 7 (RIFFLE)
(STA. 54+05)



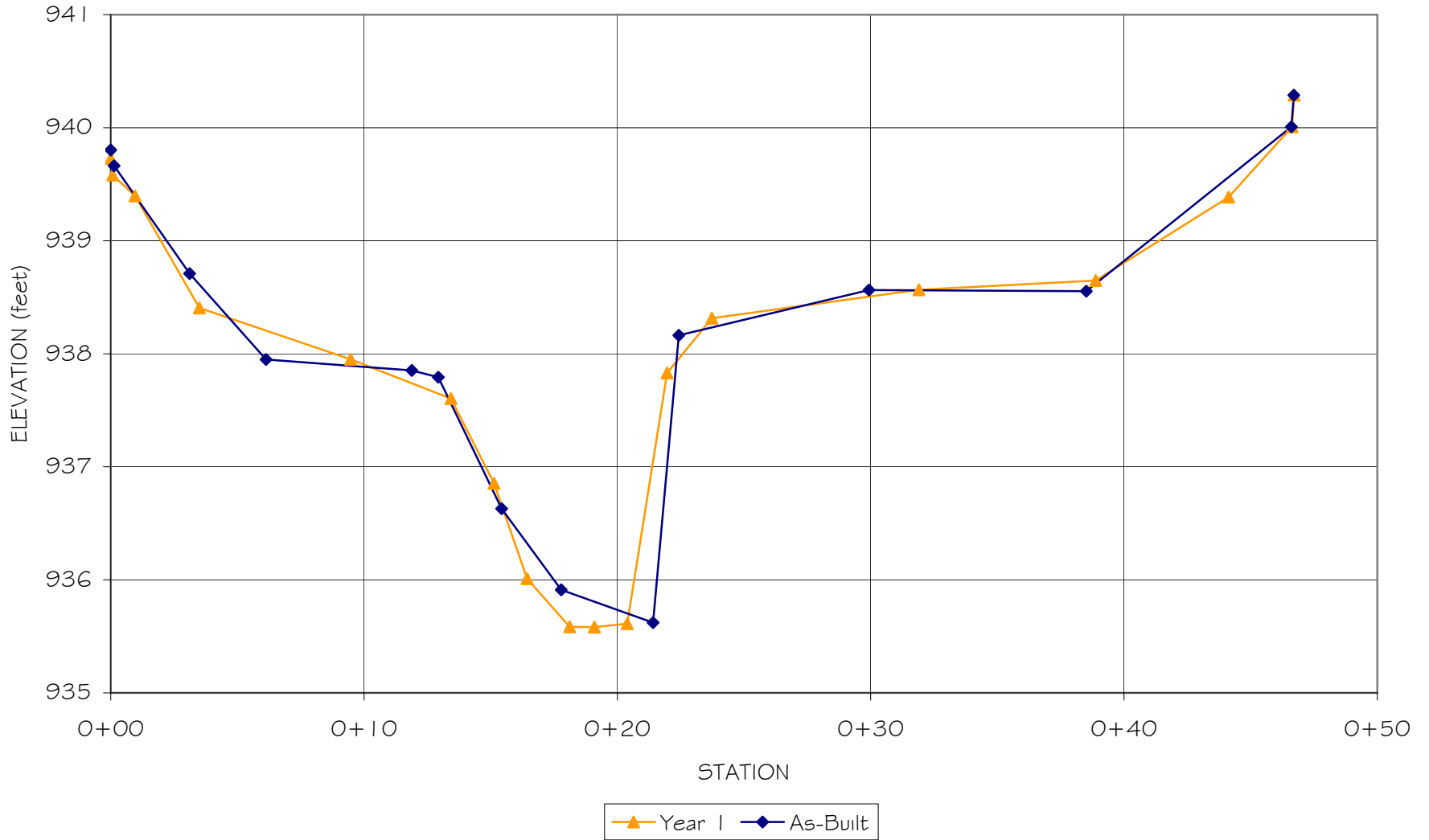
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 7 (POOL)
(STA. 54+45)



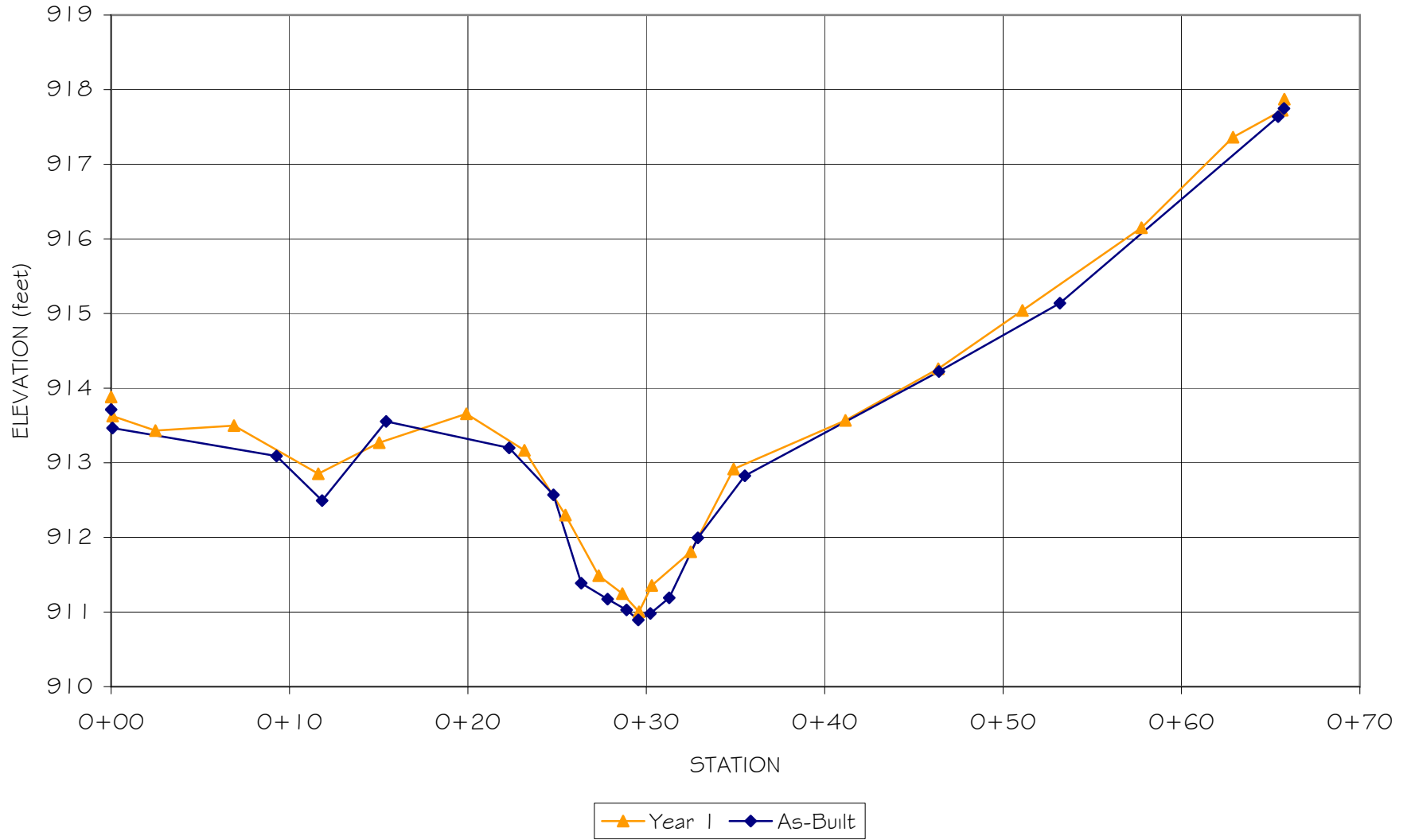
GRAY FARM STREAM RESTORATION
REACH 2 - CROSS-SECTION 1 (RIFFLE)
(STA. 6+30)



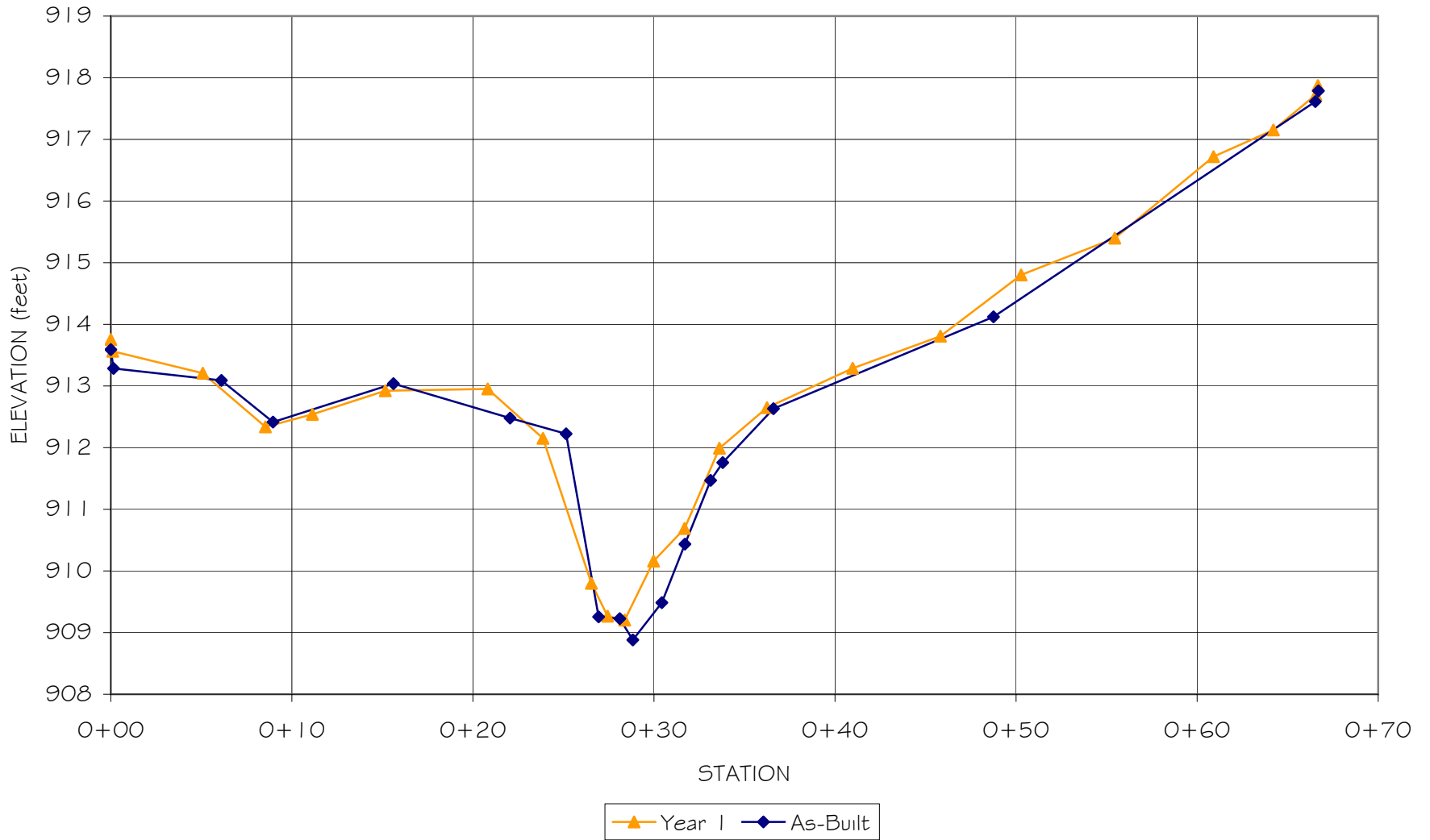
GRAY FARM STREAM RESTORATION
REACH 2 - CROSS-SECTION 1 (POOL)
(STA. 6+00)



GRAY FARM STREAM RESTORATION
REACH 2 - CROSS-SECTION 2 (RIFFLE)
(STA. 19+30)



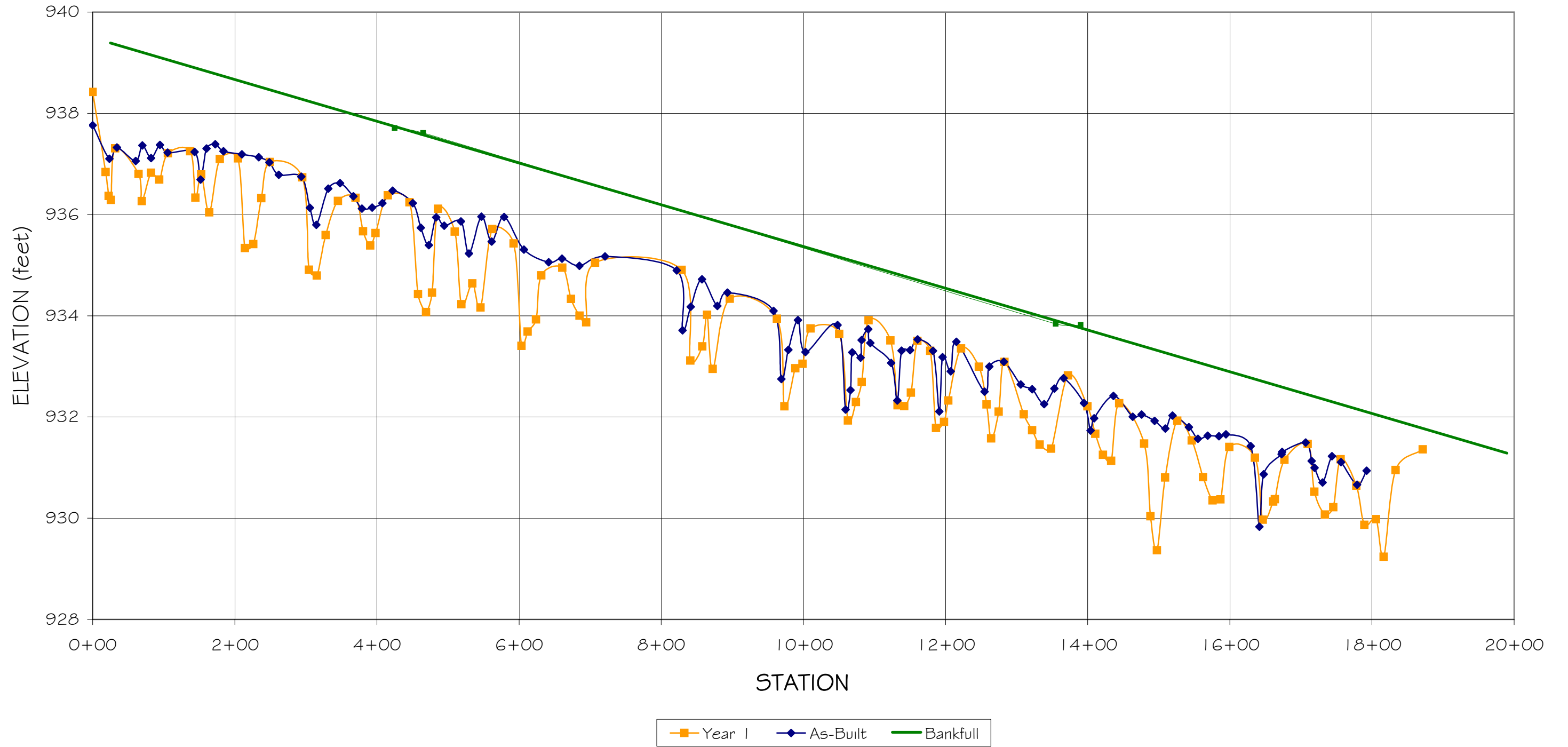
GRAY FARM STREAM RESTORATION
REACH 2 - CROSS-SECTION 2 (POOL)
(STA. 19+45)



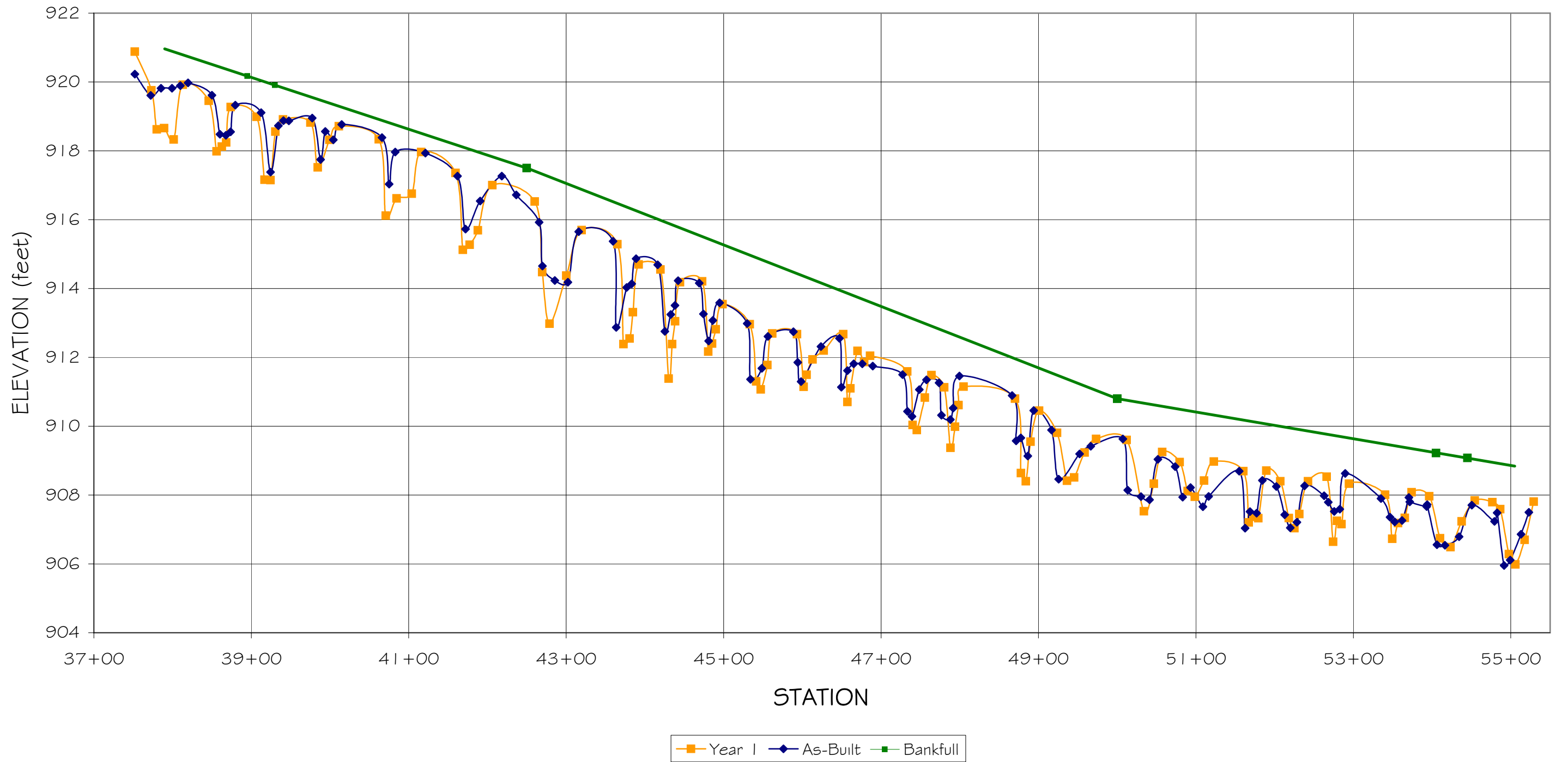
APPENDIX B –

Annual Overlays of Longitudinal Plots

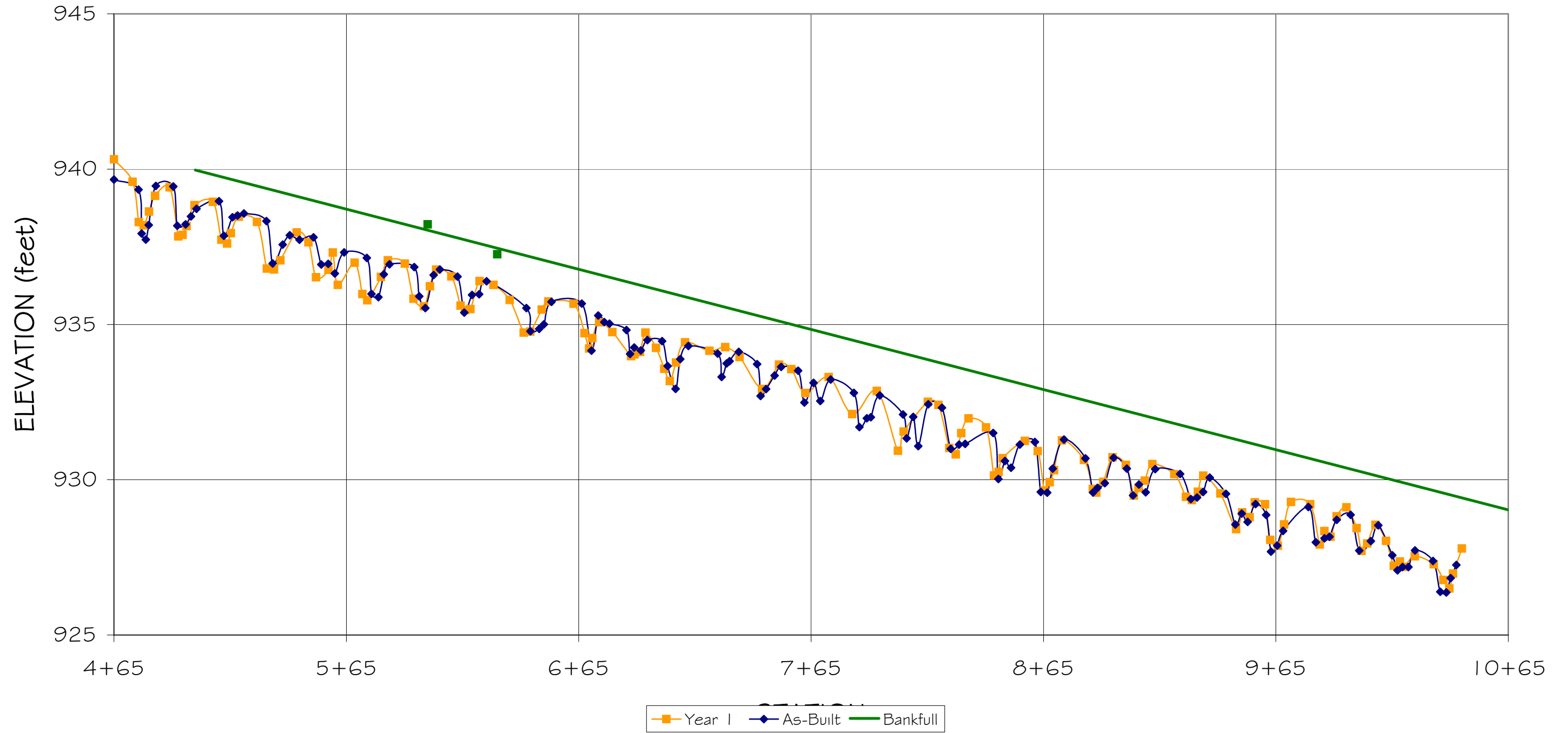
GRAY FARM STREAM RESTORATION
REACH 1 - LONGITUDINAL PROFILE
(STA. 0+00 TO 18+70)



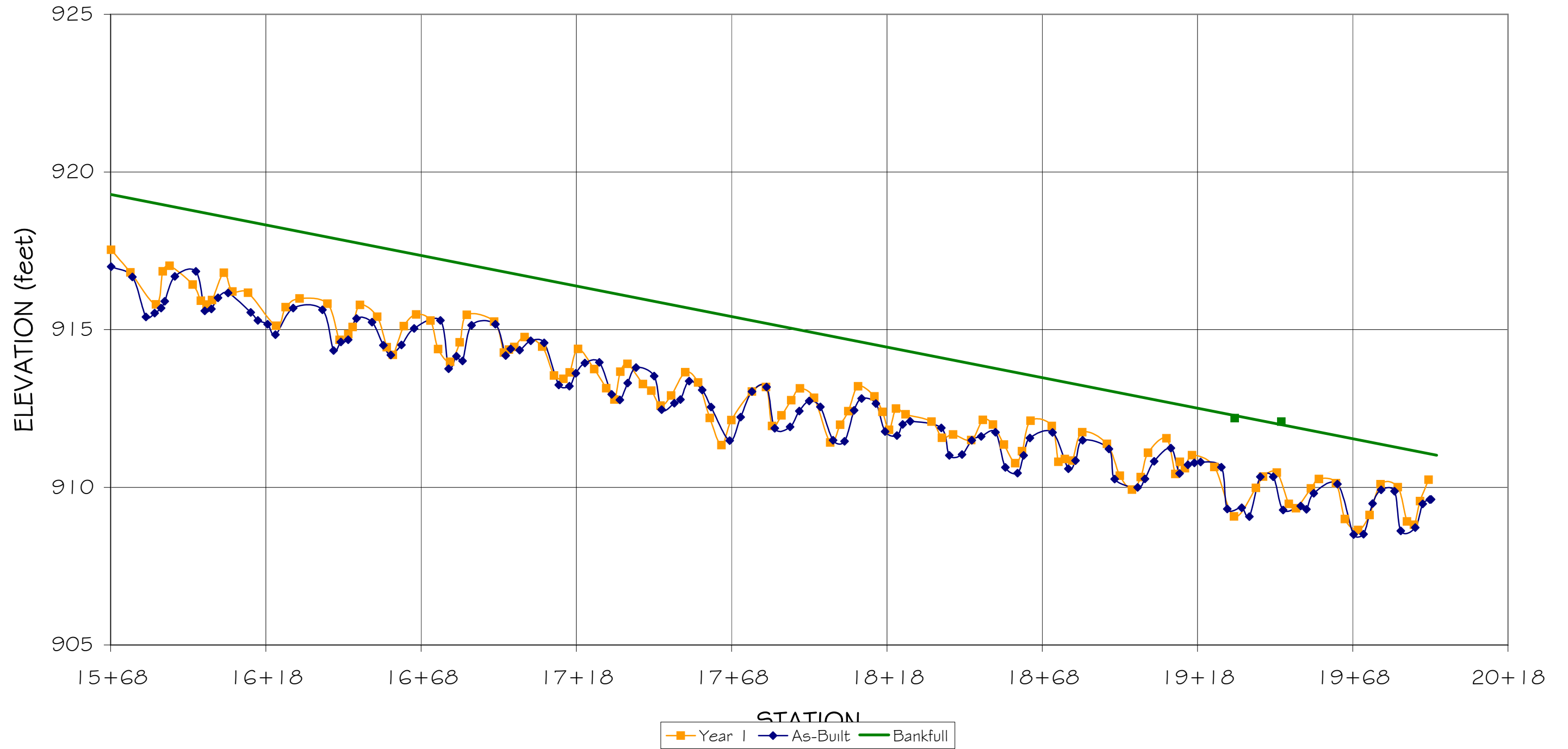
GRAY FARM STREAM RESTORATION
REACH 1 - LONGITUDINAL PROFILE
(STA. 37+50 TO 55+50)



GRAY FARM STREAM RESTORATION
REACH 2 - LONGITUDINAL PROFILE
(STA. 4+65 TO 10+65)



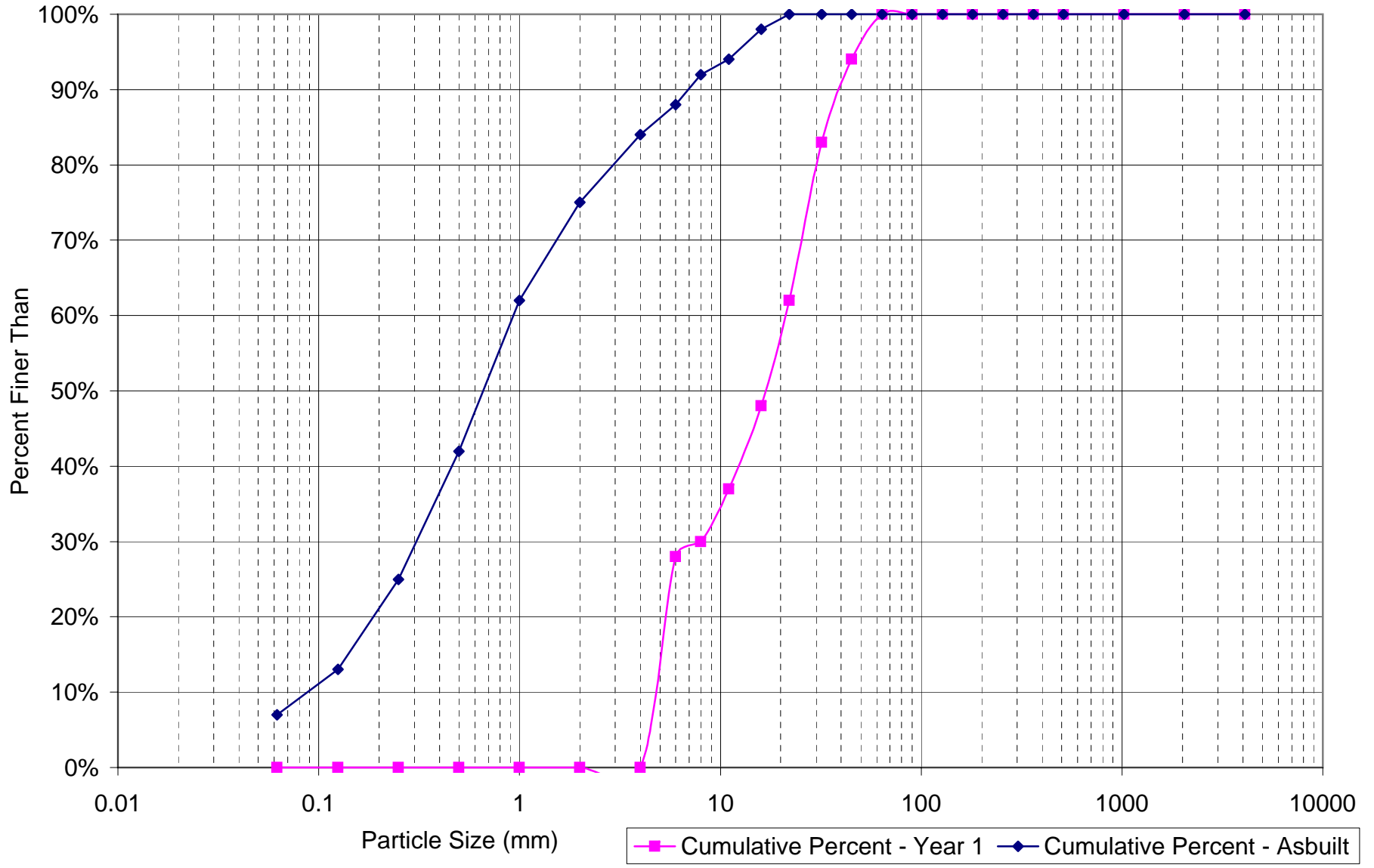
GRAY FARM STREAM RESTORATION
REACH 2 - LONGITUDINAL PROFILE
(STA. 15+68 TO 20+18)



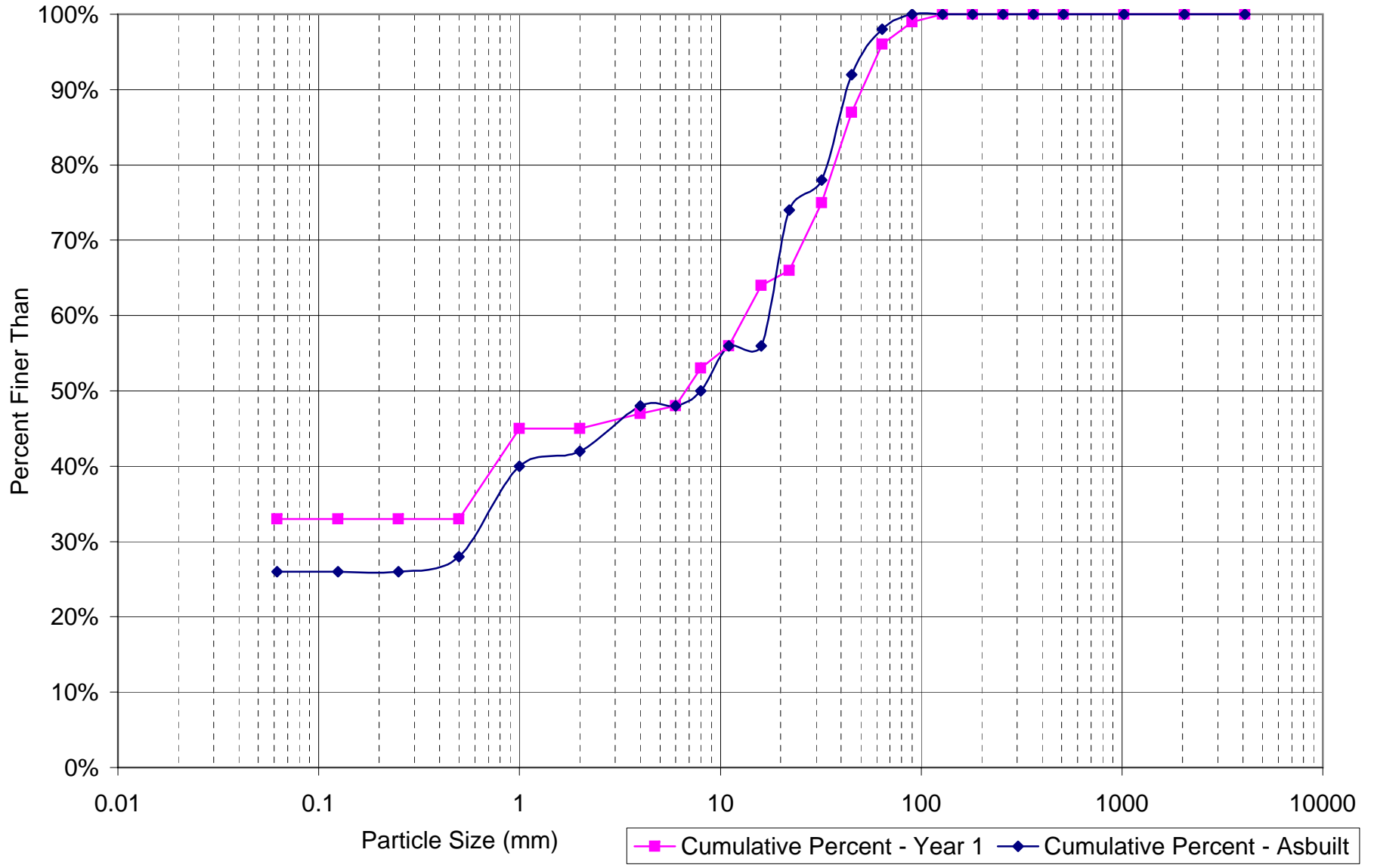
APPENDIX B –

Annual Overlays of pebble count frequency distribution plots

Pebble Count, Gray Farm Reach 1



Pebble Count, Gray Farm Reach 2







APPENDIX C

APPENDIX C –

Integrated Problem Area Plan View

DRAWINGS PRINTED
AT HALF-SCALE

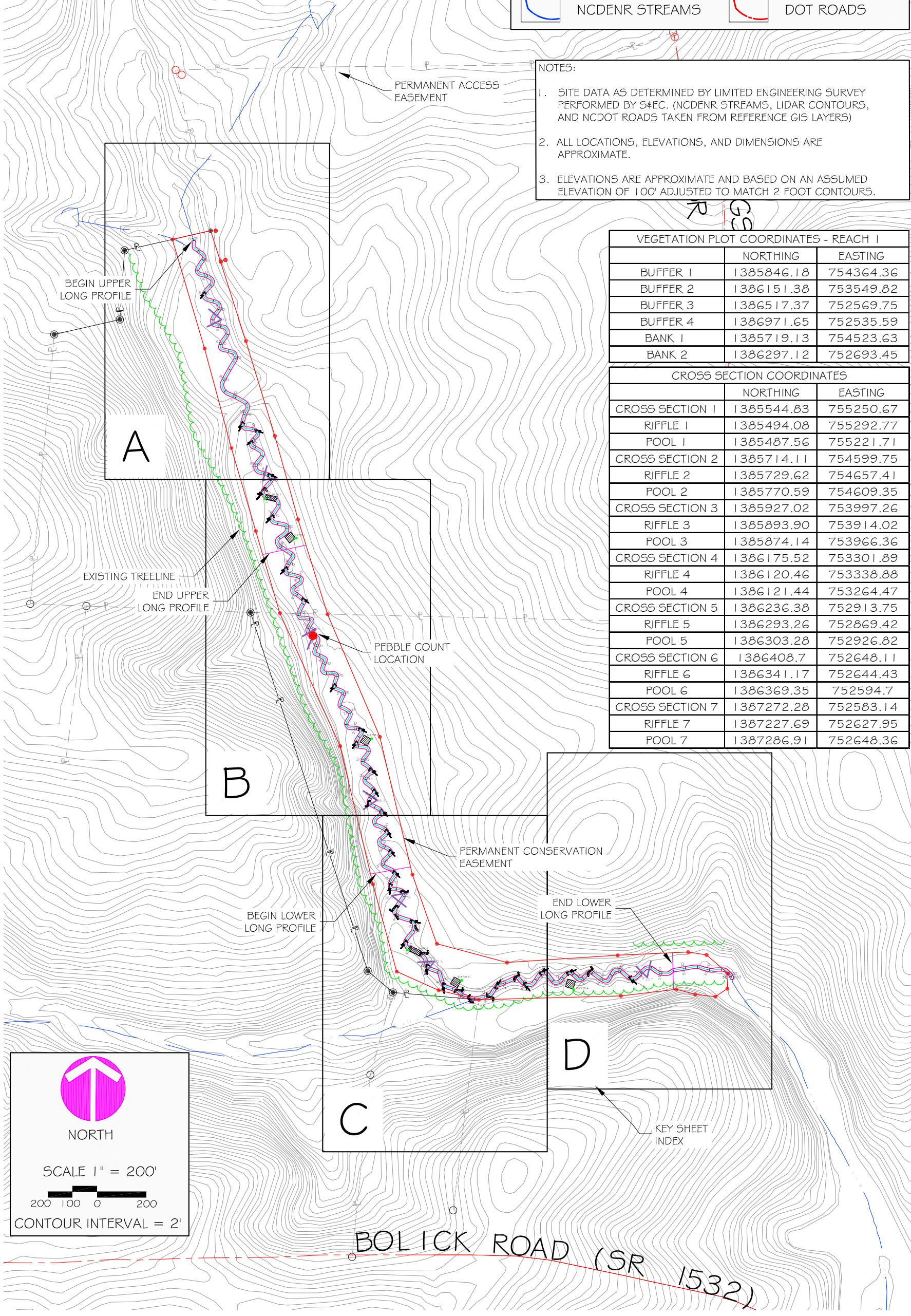
 RESTORED STREAM CHANNEL	 EXISTING CONTOURS
 EXISTING NCDENR STREAMS	 EXISTING DOT ROADS


NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
2. ALL LOCATIONS, ELEVATIONS, AND DIMENSIONS ARE APPROXIMATE.
3. ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.

VEGETATION PLOT COORDINATES - REACH 1		
	NORTHING	EASTING
BUFFER 1	1385846.18	754364.36
BUFFER 2	1386151.38	753549.82
BUFFER 3	1386517.37	752569.75
BUFFER 4	1386971.65	752535.59
BANK 1	1385719.13	754523.63
BANK 2	1386297.12	752693.45

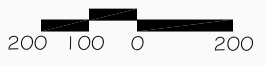
CROSS SECTION COORDINATES		
	NORTHING	EASTING
CROSS SECTION 1	1385544.83	755250.67
RIFFLE 1	1385494.08	755292.77
POOL 1	1385487.56	755221.71
CROSS SECTION 2	1385714.11	754599.75
RIFFLE 2	1385729.62	754657.41
POOL 2	1385770.59	754609.35
CROSS SECTION 3	1385927.02	753997.26
RIFFLE 3	1385893.90	753914.02
POOL 3	1385874.14	753966.36
CROSS SECTION 4	1386175.52	753301.89
RIFFLE 4	1386120.46	753338.88
POOL 4	1386121.44	753264.47
CROSS SECTION 5	1386236.38	752913.75
RIFFLE 5	1386293.26	752869.42
POOL 5	1386303.28	752926.82
CROSS SECTION 6	1386408.7	752648.11
RIFFLE 6	1386341.17	752644.43
POOL 6	1386369.35	752594.7
CROSS SECTION 7	1387272.28	752583.14
RIFFLE 7	1387227.69	752627.95
POOL 7	1387286.91	752648.36





NORTH

SCALE 1" = 200'



CONTOUR INTERVAL = 2'

REVISIONS			
REV.	DESCRIPTION	DATE	APP.



Soil & Environmental Consultants, PA
11010 Raven Ridge Road • Raleigh, North Carolina 27614 • Phone: (919) 846-5900 • Fax: (919) 846-9467
www.SandEC.com

Project: GRAY FARM STREAM RESTORATION YEAR 1 MONITORING

Location: IREDELL CO., NC Client: NC ECOSYSTEM ENHANCEMENT PROGRAM

Sheet Title: REACH 1 RESTORATION SITE LAYOUT & KEYSHEET

Project No.: 9385.D7


Proj. Mgr.: JER Drawn: RSW

Scale: 1" = 200'

Sheet No.: 1 OF 16


NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
2. ALL LOCATIONS, ELEVATIONS, AND DIMENSIONS ARE APPROXIMATE.
3. ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.



NORTH







SCALE 1" = 50'







CONTOUR INTERVAL = 2'

DRAWINGS PRINTED
AT HALF-SCALE

**LEGEND FOR
ASBUILT FEATURES**

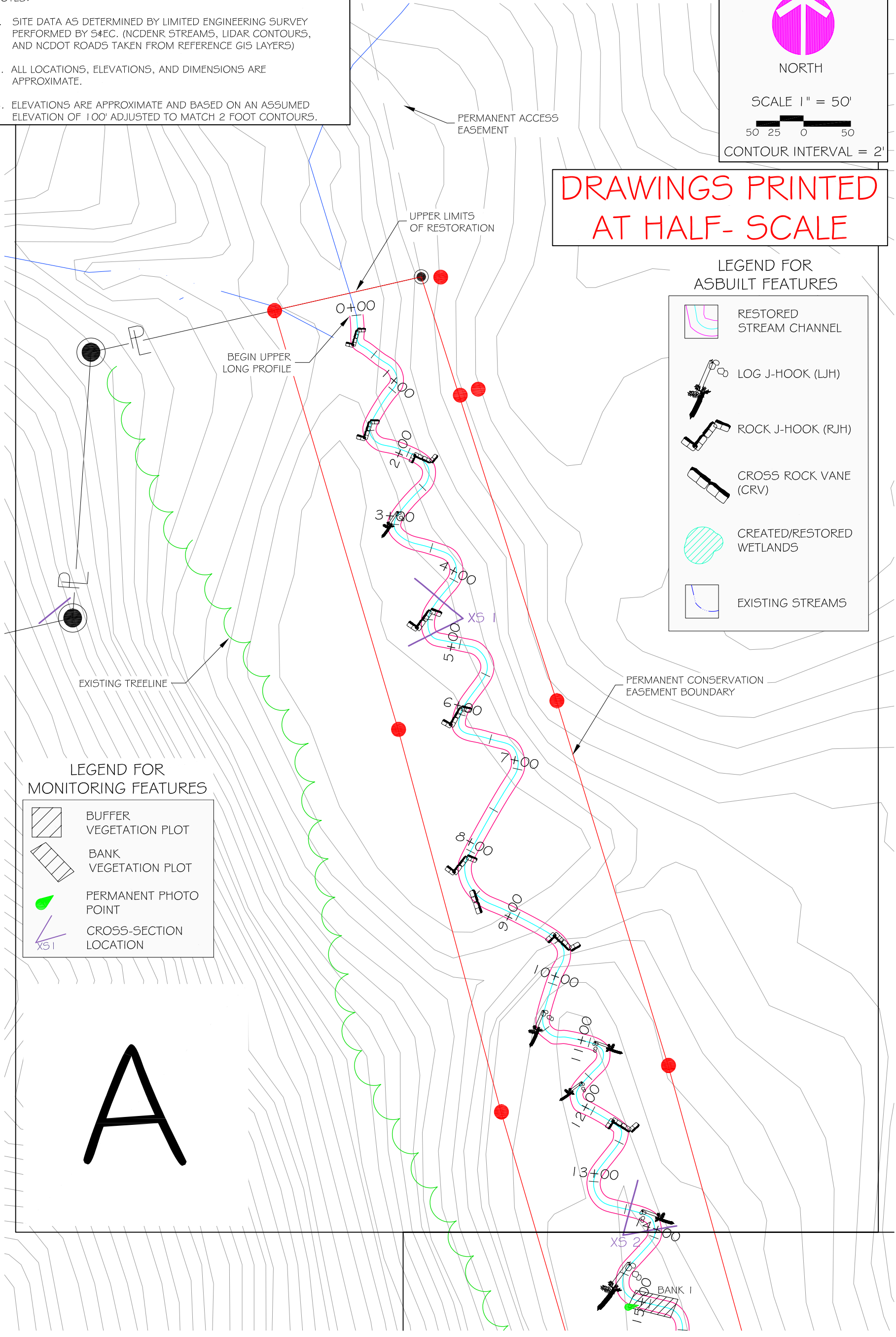
	RESTORED STREAM CHANNEL
	LOG J-HOOK (LJH)
	ROCK J-HOOK (RJH)
	CROSS ROCK VANE (CRV)
	CREATED/RESTORED WETLANDS
	EXISTING STREAMS

**LEGEND FOR
MONITORING FEATURES**

	BUFFER VEGETATION PLOT
	BANK VEGETATION PLOT
	PERMANENT PHOTO POINT
	CROSS-SECTION LOCATION

REACH 1 MONITORING PLAN VIEW - A

A

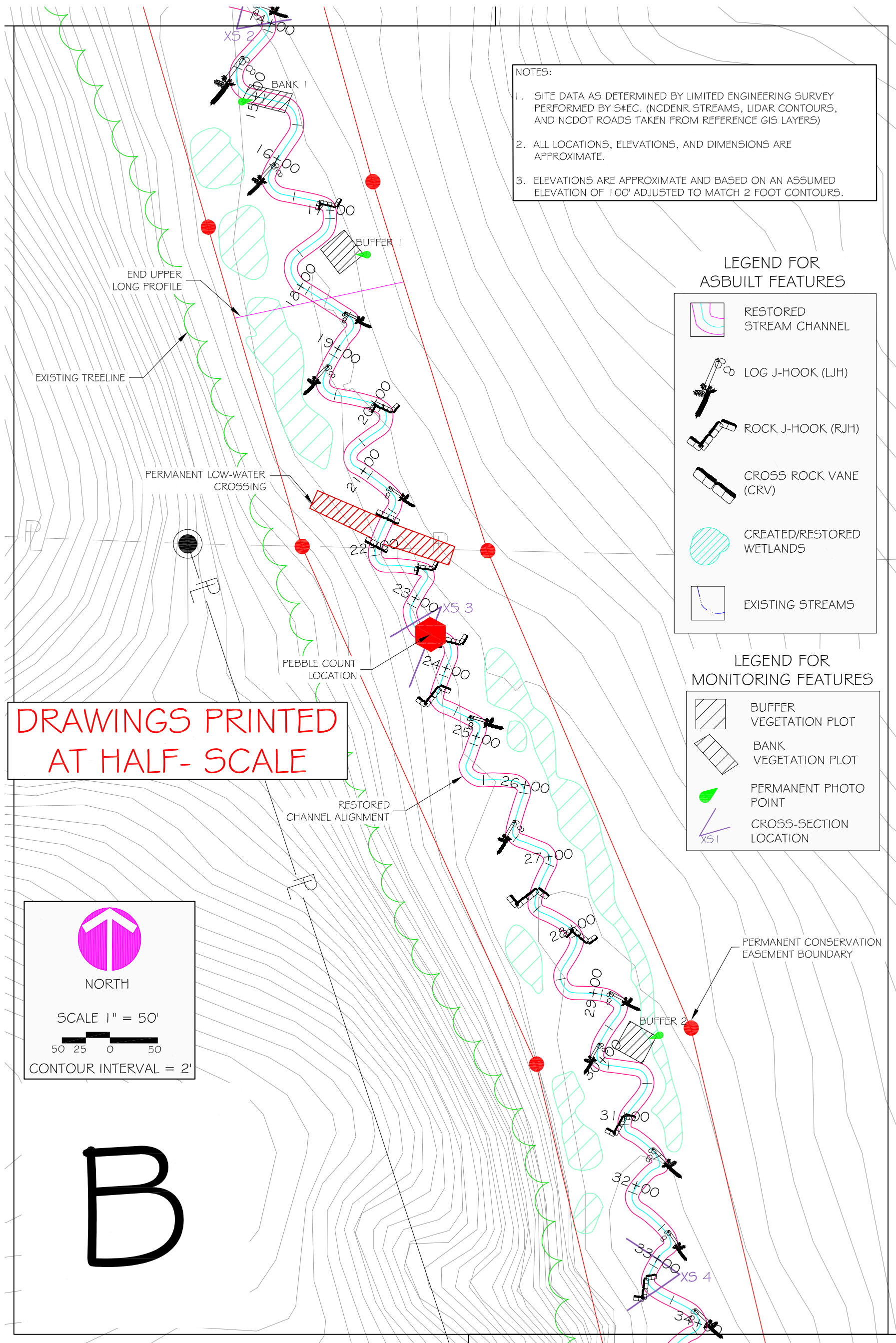


REVISIONS			
REV.	DESCRIPTION	DATE	APP.



Soil & Environmental Consultants, PA
 11010 Raven Ridge Road • Raleigh, North Carolina 27614 • Phone: (919) 846-5900 • Fax: (919) 846-9467
www.SandEC.com

Project:	GRAY FARM STREAM RESTORATION YEAR 1 MONITORING	Project No.:	9385.D7
Location:	IREDELL CO., NC	Client:	NC ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title:	REACH 1 MONITORING PLAN VIEW - A	Scale:	1" = 50'
		Sheet No.:	2 OF 16



NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
2. ALL LOCATIONS, ELEVATIONS, AND DIMENSIONS ARE APPROXIMATE.
3. ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

LEGEND FOR MONITORING FEATURES

- BUFFER VEGETATION PLOT
- BANK VEGETATION PLOT
- PERMANENT PHOTO POINT
- CROSS-SECTION LOCATION

DRAWINGS PRINTED AT HALF-SCALE

NORTH
 SCALE 1" = 50'

 CONTOUR INTERVAL = 2'

B

REVISIONS			
REV.	DESCRIPTION	DATE	APPR.



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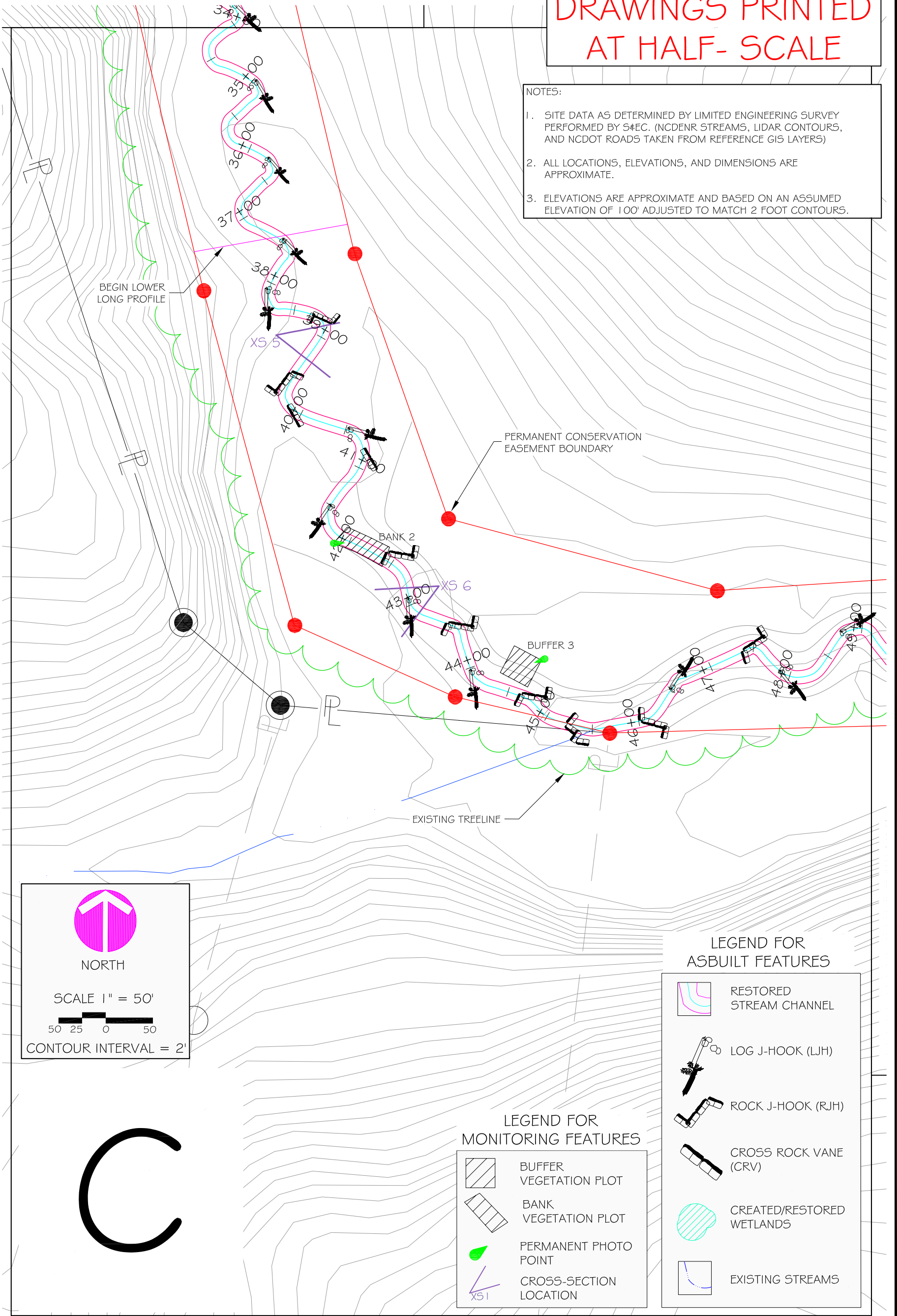
Project: GRAY FARM STREAM RESTORATION YEAR 1 MONITORING
 Location: IREDELL CO., NC
 Client: NC ECOSYSTEM ENHANCEMENT PROGRAM
 Sheet Title: REACH 1 MONITORING PLAN VIEW - B

Project No.: 9385.D7
 Proj. Mgr.: JER
 Drawn: RSW
 Scale: 1" = 50'
 Sheet No.: 3 OF 16

REACH 1 MONITORING PLAN VIEW - C

DRAWINGS PRINTED
AT HALF-SCALE

- NOTES:
1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
 2. ALL LOCATIONS, ELEVATIONS, AND DIMENSIONS ARE APPROXIMATE.
 3. ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.



NORTH

SCALE 1" = 50'

50 25 0 50

CONTOUR INTERVAL = 2'

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

LEGEND FOR MONITORING FEATURES

- BUFFER VEGETATION PLOT
- BANK VEGETATION PLOT
- PERMANENT PHOTO POINT
- CROSS-SECTION LOCATION

REVISIONS			
REV.	DESCRIPTION	DATE	APP.



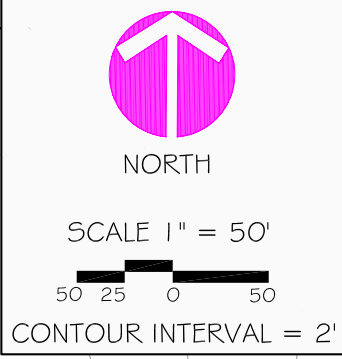
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Project:	GRAY FARM STREAM RESTORATION YEAR 1 MONITORING	Project No.:	9385.D7
Location:	IREDELL CO., NC	Client:	NC ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title:	REACH 1 MONITORING PLAN VIEW - C	Scale:	1" = 50'
		Sheet No.:	4 OF 16

NOTES:

- SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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- ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.



DRAWINGS PRINTED
AT HALF-SCALE

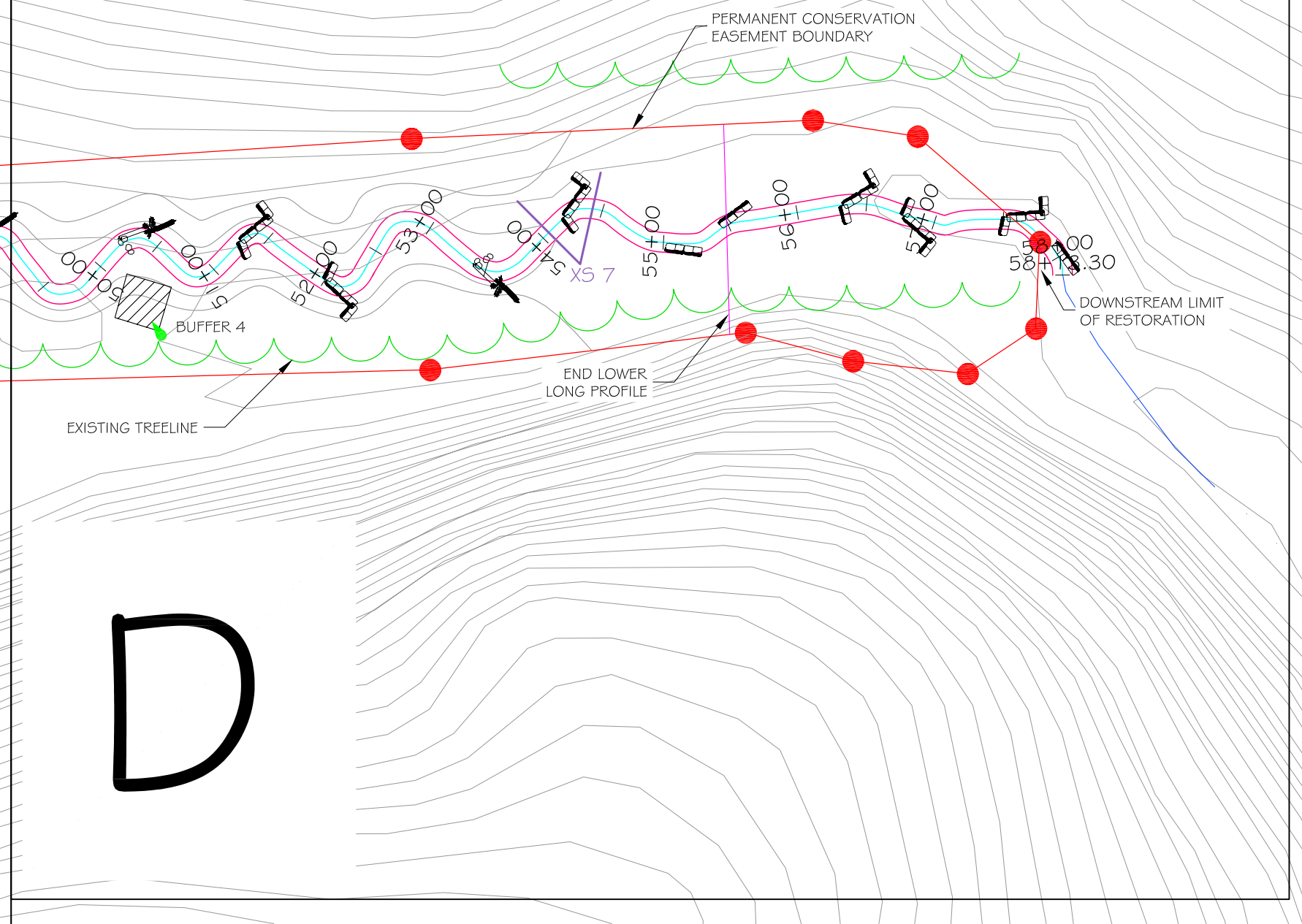
LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

LEGEND FOR MONITORING FEATURES

- BUFFER VEGETATION PLOT
- BANK VEGETATION PLOT
- PERMANENT PHOTO POINT
- CROSS-SECTION LOCATION

REACH 1 MONITORING PLAN VIEW - D



D

REVISIONS			
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Location:		IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title:		REACH 1 MONITORING PLAN VIEW - D	Scale: 1" = 50'
			Sheet No.: 5 OF 16

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NOTES:

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NORTH







SCALE 1" = 50'







CONTOUR INTERVAL = 2'

DRAWINGS PRINTED
AT HALF-SCALE

LEGEND FOR ASBUILT FEATURES

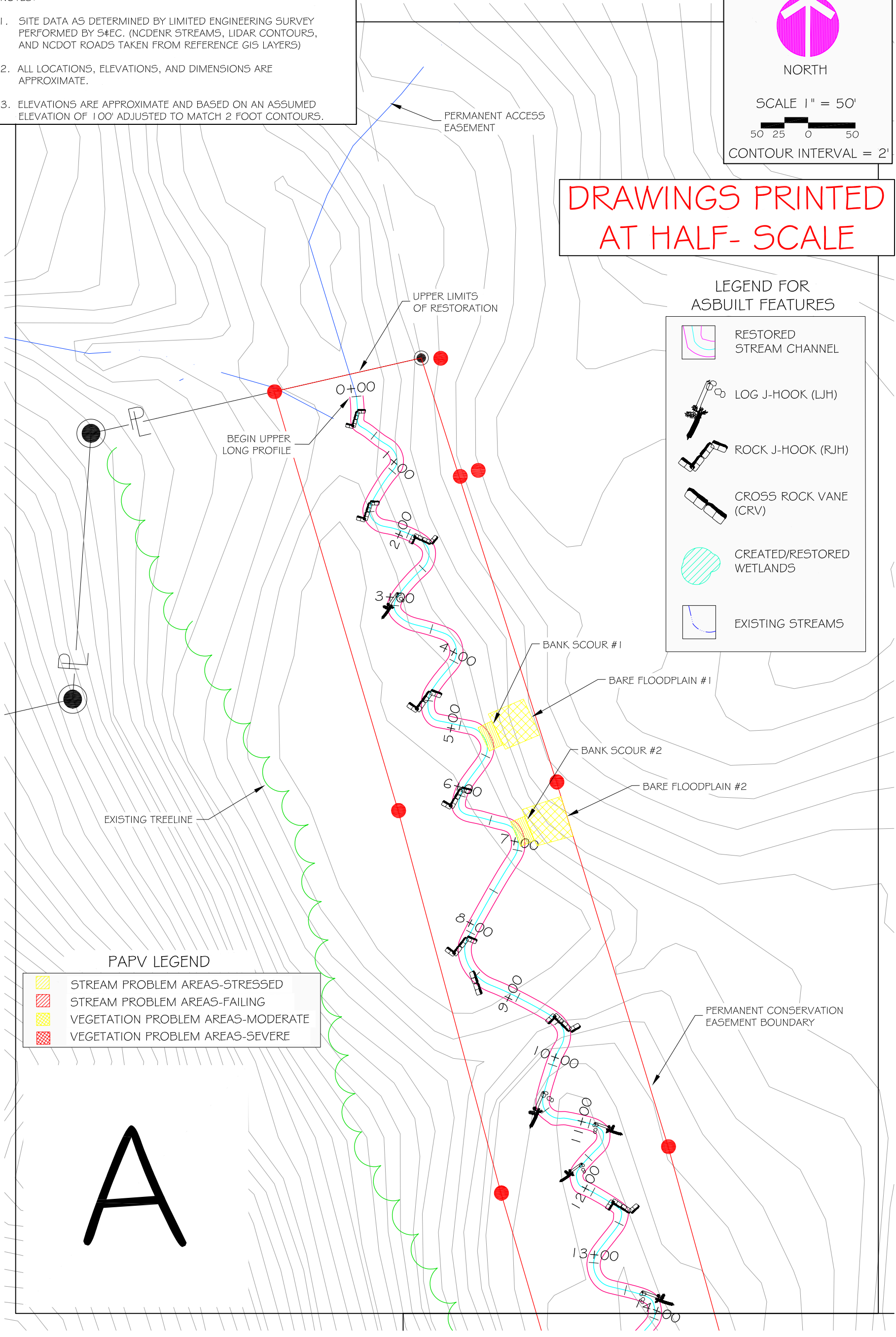
	RESTORED STREAM CHANNEL
	LOG J-HOOK (LJH)
	ROCK J-HOOK (RJH)
	CROSS ROCK VANE (CRV)
	CREATED/RESTORED WETLANDS
	EXISTING STREAMS

PAPV LEGEND

	STREAM PROBLEM AREAS-STRESSED
	STREAM PROBLEM AREAS-FAILING
	VEGETATION PROBLEM AREAS-MODERATE
	VEGETATION PROBLEM AREAS-SEVERE

REACH 1 PROBLEM AREA PLAN VIEW - A

A

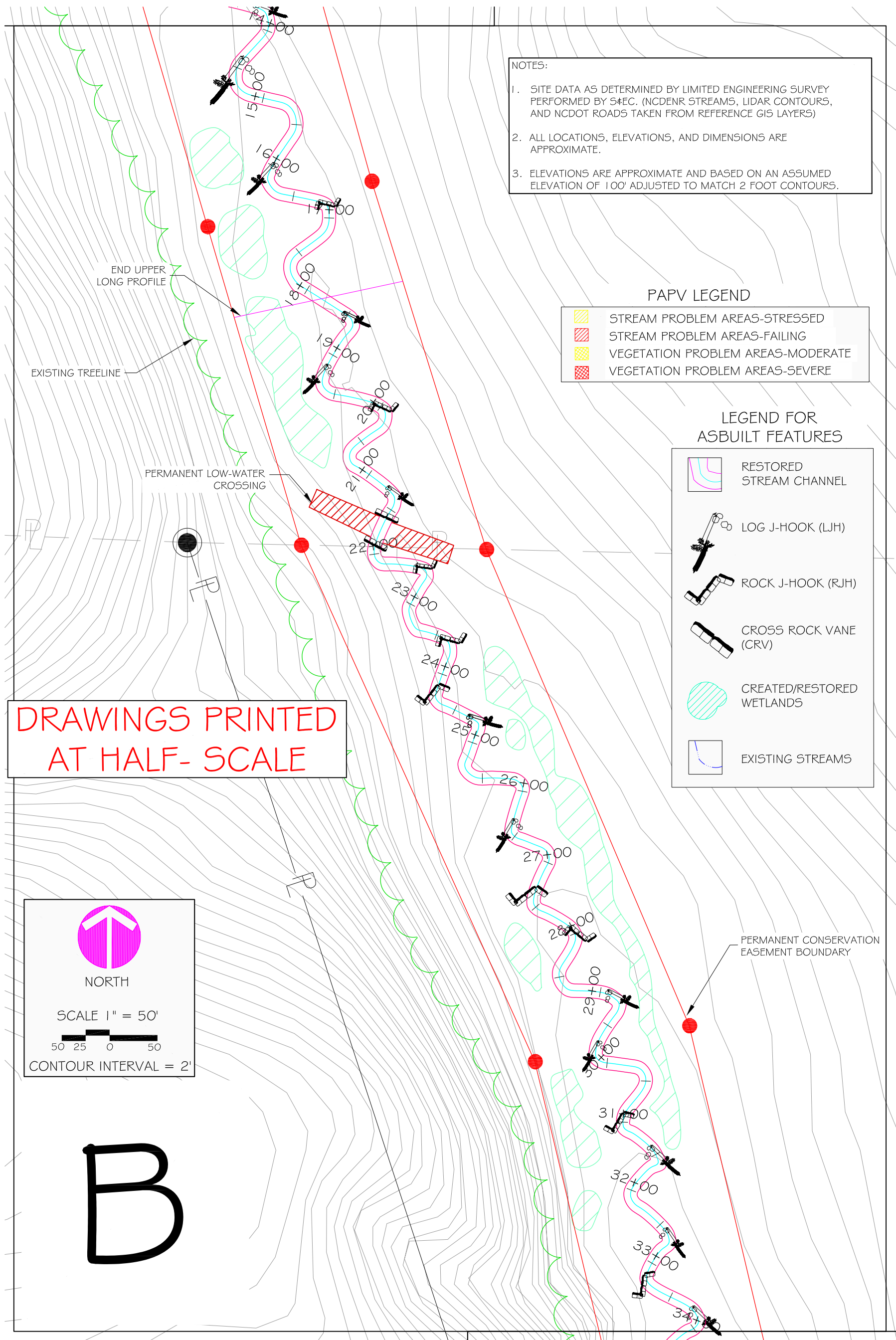


REVISIONS			
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Project:	GRAY FARM STREAM RESTORATION YEAR 1 MONITORING	Project No.:	9385.D7
Location:	IREDELL CO., NC	Client:	NC ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title:	REACH 1 PROBLEM AREA PLAN VIEW - A	Scale:	1" = 50'
		Sheet No.:	6 OF 16



NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- STREAM PROBLEM AREAS-FAILING
- VEGETATION PROBLEM AREAS-MODERATE
- VEGETATION PROBLEM AREAS-SEVERE

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

DRAWINGS PRINTED AT HALF-SCALE

NORTH

SCALE 1" = 50'

CONTOUR INTERVAL = 2'

B

REV.	DESCRIPTION	DATE	APPR.



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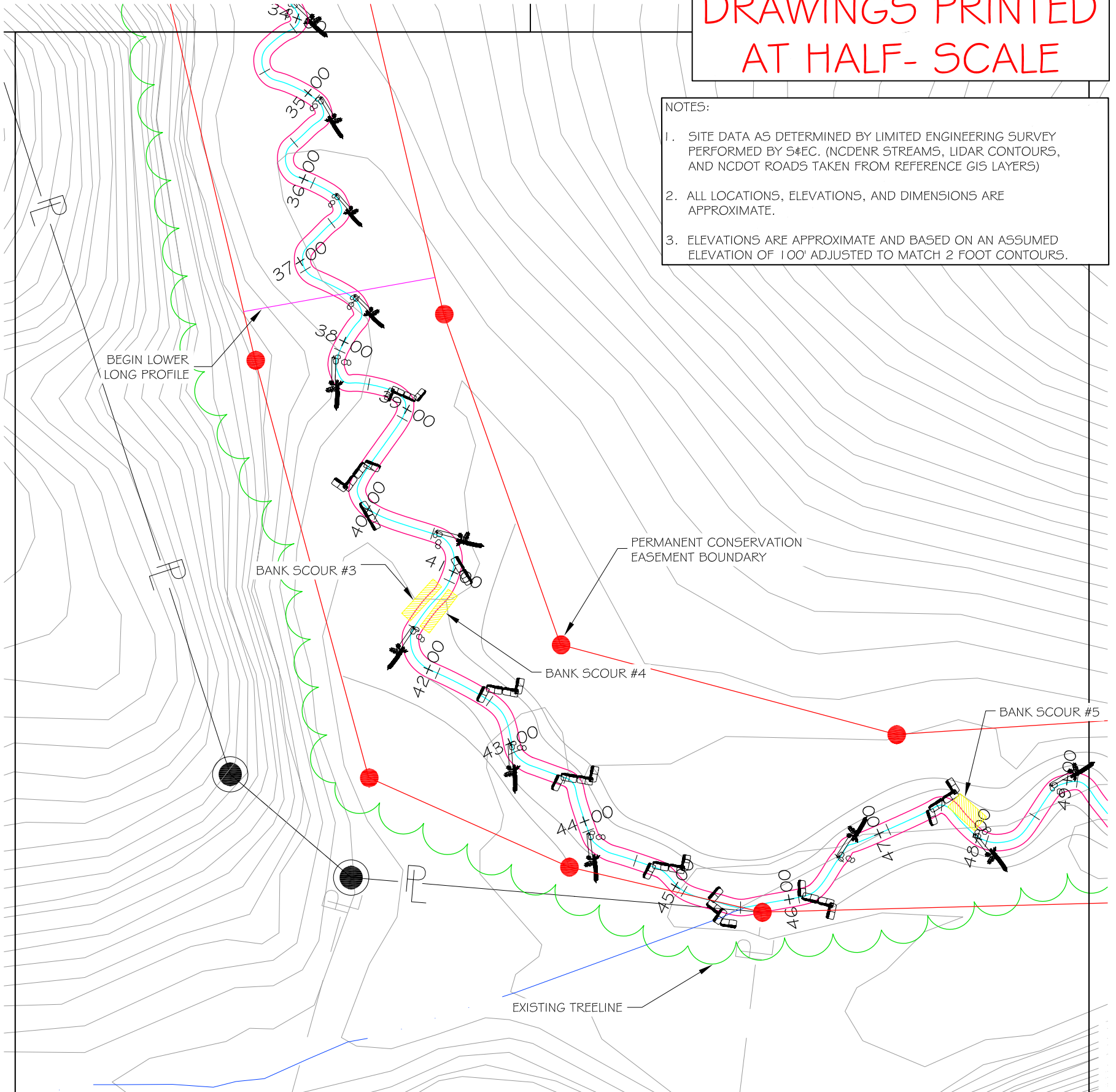
Project: GRAY FARM STREAM RESTORATION YEAR 1 MONITORING
 Location: IREDELL CO., NC
 Sheet Title: REACH 1 PROBLEM AREA PLAN VIEW - B

Project No.: 9385.D7
 Proj. Mgr.: JER
 Scale: 1" = 50'
 Sheet No.: 7 OF 16

DRAWINGS PRINTED
AT HALF-SCALE

- NOTES:
1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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REACH 1 PROBLEM AREA PLAN VIEW - C



NORTH

SCALE 1" = 50'

CONTOUR INTERVAL = 2'

C

LEGEND FOR
ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- STREAM PROBLEM AREAS-FAILING
- VEGETATION PROBLEM AREAS-MODERATE
- VEGETATION PROBLEM AREAS-SEVERE

REVISIONS			
REV.	DESCRIPTION	DATE	APPR.



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Project:	GRAY FARM STREAM RESTORATION YEAR 1 MONITORING	Project No.: 9385.D7
Location:	IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title:	REACH 1 PROBLEM AREA PLAN VIEW - C	
Scale:	1" = 50'	Proj. Mgr.: JER Drawn: RSW
Sheet No.:	8 OF 16	

NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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NORTH

SCALE 1" = 50'

50 25 0 50

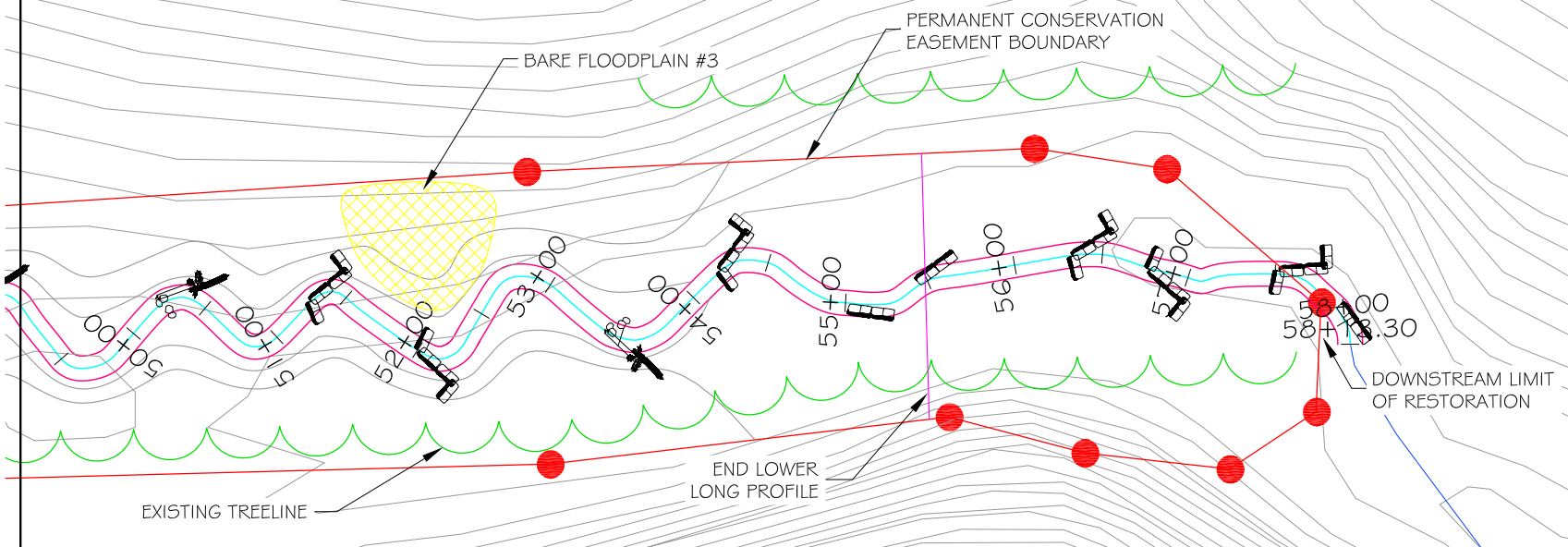
CONTOUR INTERVAL = 2'

DRAWINGS PRINTED
AT HALF-SCALE

**LEGEND FOR
ASBUILT FEATURES**

	RESTORED STREAM CHANNEL
	LOG J-HOOK (LJH)
	ROCK J-HOOK (RJH)
	CROSS ROCK VANE (CRV)
	CREATED/RESTORED WETLANDS
	EXISTING STREAMS

REACH 1 PROBLEM AREA PLAN VIEW - D



D

PAPV LEGEND

	STREAM PROBLEM AREAS-STRESSED
	STREAM PROBLEM AREAS-FAILING
	VEGETATION PROBLEM AREAS-MODERATE
	VEGETATION PROBLEM AREAS-SEVERE

REVISIONS			
REV	DESCRIPTION	DATE	APPR



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Project: GRAY FARM STREAM RESTORATION
 YEAR 1 MONITORING
 Location: IREDELL CO., NC
 Sheet Title: REACH 1 PROBLEM AREA PLAN VIEW - D

Project No.: 9385.D7
 Proj. Mgr.: JER
 Drawn: RSW
 Scale: 1" = 50'
 Sheet No.: 9 OF 16





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NOTES:

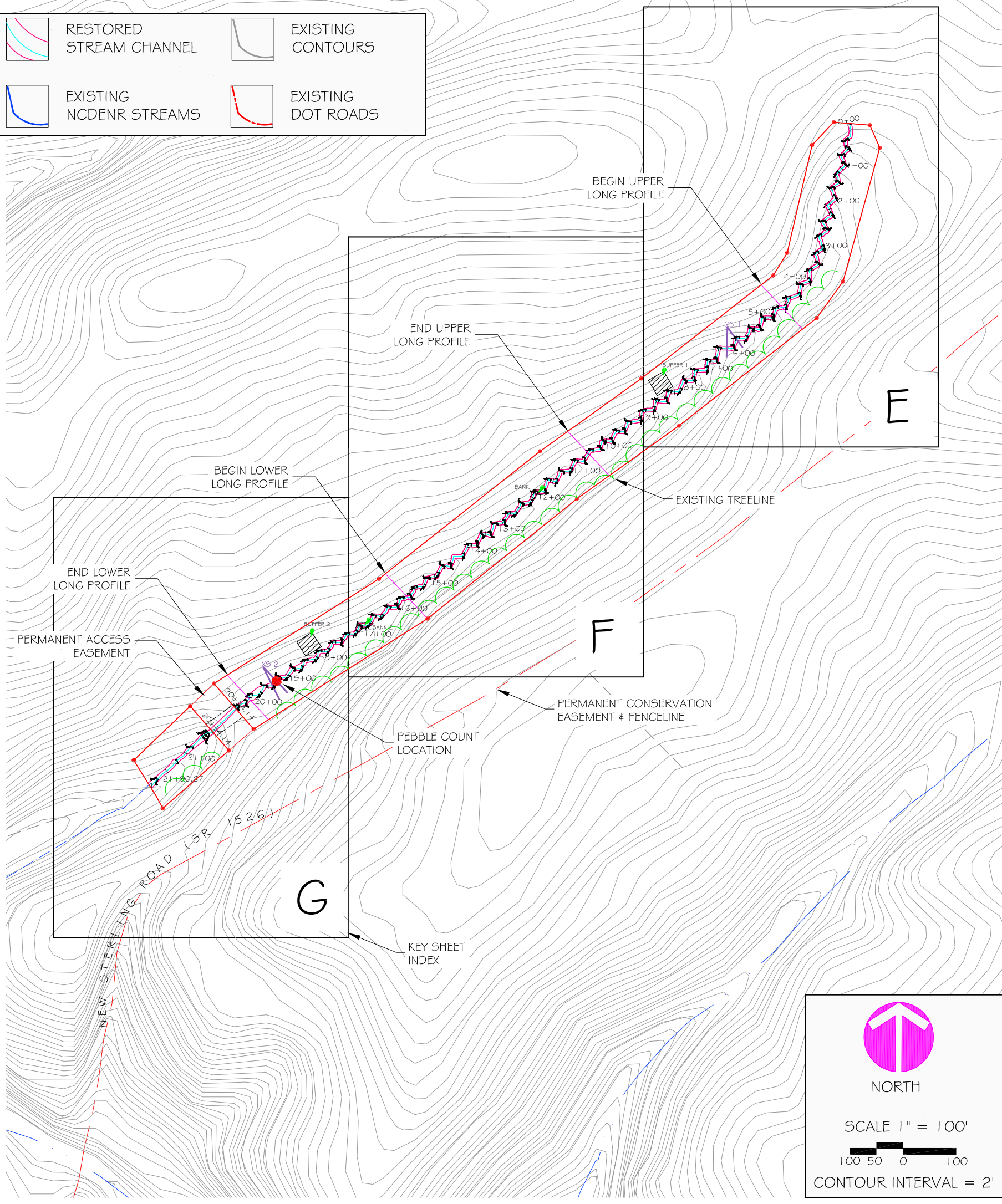
1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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DRAWINGS PRINTED
AT HALF-SCALE

MONITORING FEATURES COORDINATES - REACH 2		
	NORTHING	EASTING
CROSS SECTION 1	1390081.29	746853.93
RIFFLE 1	1390079.60	746799.51
POOL 1	1390109.67	746817.05
CROSS SECTION 2	1389209.56	746215.22
RIFFLE 2	1389254.69	746167.91
POOL 2	1389238.99	746155.98
BUFFER 1	1389961.86	746771.34
BUFFER 2	1389300.47	746281.07
BANK 1	1389733.94	746553.76
BANK 2	1389408.61	746305.49

	RESTORED STREAM CHANNEL		EXISTING CONTOURS
	EXISTING NCDENR STREAMS		EXISTING DOT ROADS


REACH 2 RESTORATION SITE LAYOUT & KEYSHEET





NORTH

SCALE 1" = 100'



CONTOUR INTERVAL = 2'

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Project:	GRAY FARM STREAM RESTORATION YEAR 1 MONITORING	Project No.:	9385.D7
Location:	IREDELL CO., NC	Client:	NC ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title:	REACH 2 RESTORATION SITE LAYOUT & KEYSHEET	Scale:	1" = 100'
		Proj. Mgr.:	PKS
		Drawn:	R5W
		Sheet No.:	10 OF 16

NOTES:

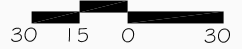
1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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DRAWINGS PRINTED
AT HALF-SCALE



NORTH

SCALE 1" = 30'



CONTOUR INTERVAL = 2'

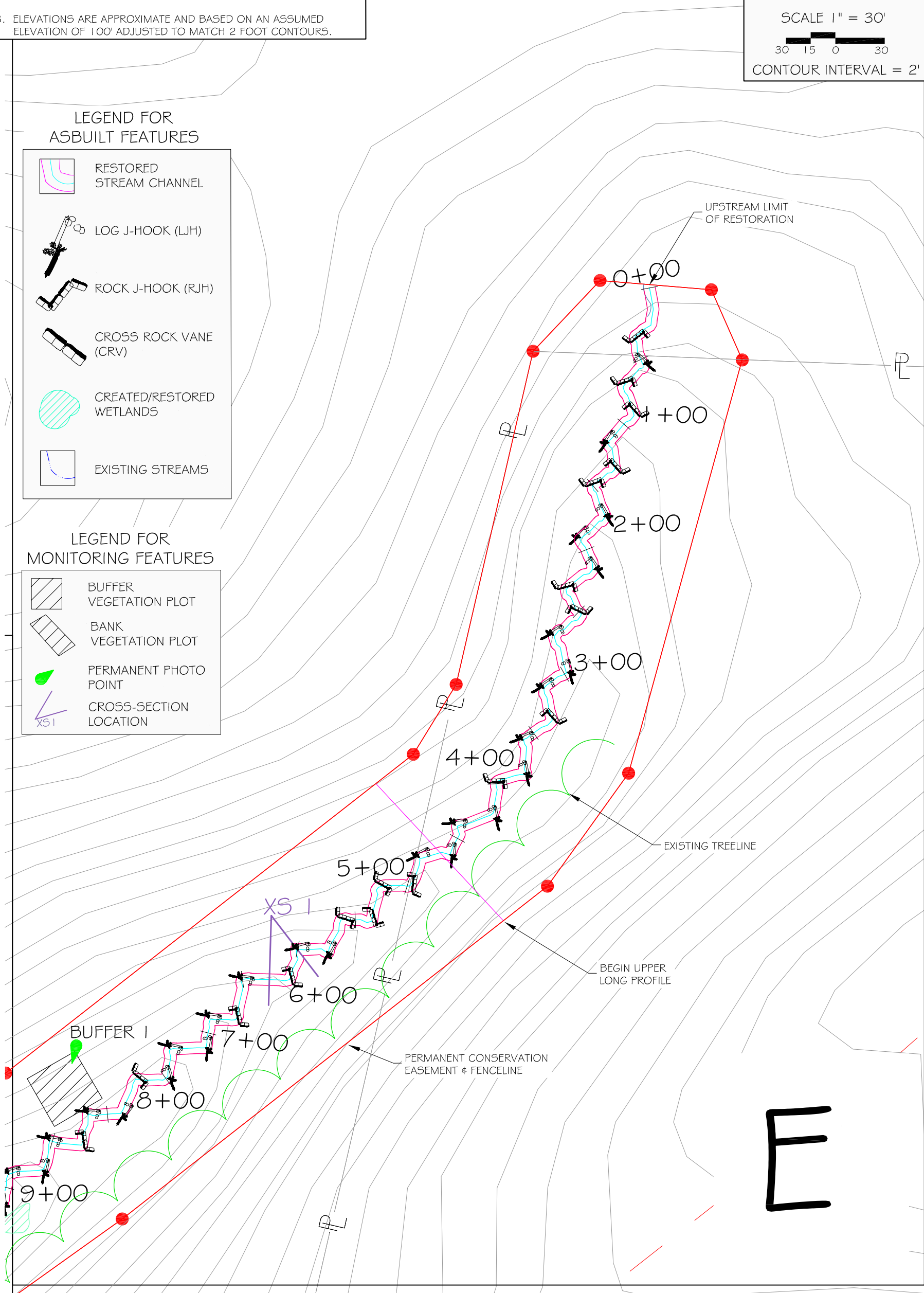
LEGEND FOR
ASBUILT FEATURES

	RESTORED STREAM CHANNEL
	LOG J-HOOK (LJH)
	ROCK J-HOOK (RJH)
	CROSS ROCK VANE (CRV)
	CREATED/RESTORED WETLANDS
	EXISTING STREAMS

LEGEND FOR
MONITORING FEATURES

	BUFFER VEGETATION PLOT
	BANK VEGETATION PLOT
	PERMANENT PHOTO POINT
	CROSS-SECTION LOCATION

REACH 2 MONITORING PLAN VIEW - E



REVISIONS			
REV	DESCRIPTION	DATE	APPR




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Project: GRAY FARM STREAM RESTORATION YEAR 1 MONITORING		Project No.: 9385.D7
Location: IREDELL CO., NC		Proj. Mgr.: PKS
Client: NC ECOSYSTEM ENHANCEMENT PROGRAM		Drawn: RSW
Sheet Title: REACH 2 MONITORING PLAN VIEW - E		Scale: 1" = 30'
		Sheet No.: 11 OF 16

NOTES:


1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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**DRAWINGS PRINTED
AT HALF-SCALE**









NORTH

SCALE 1" = 30'







CONTOUR INTERVAL = 2'

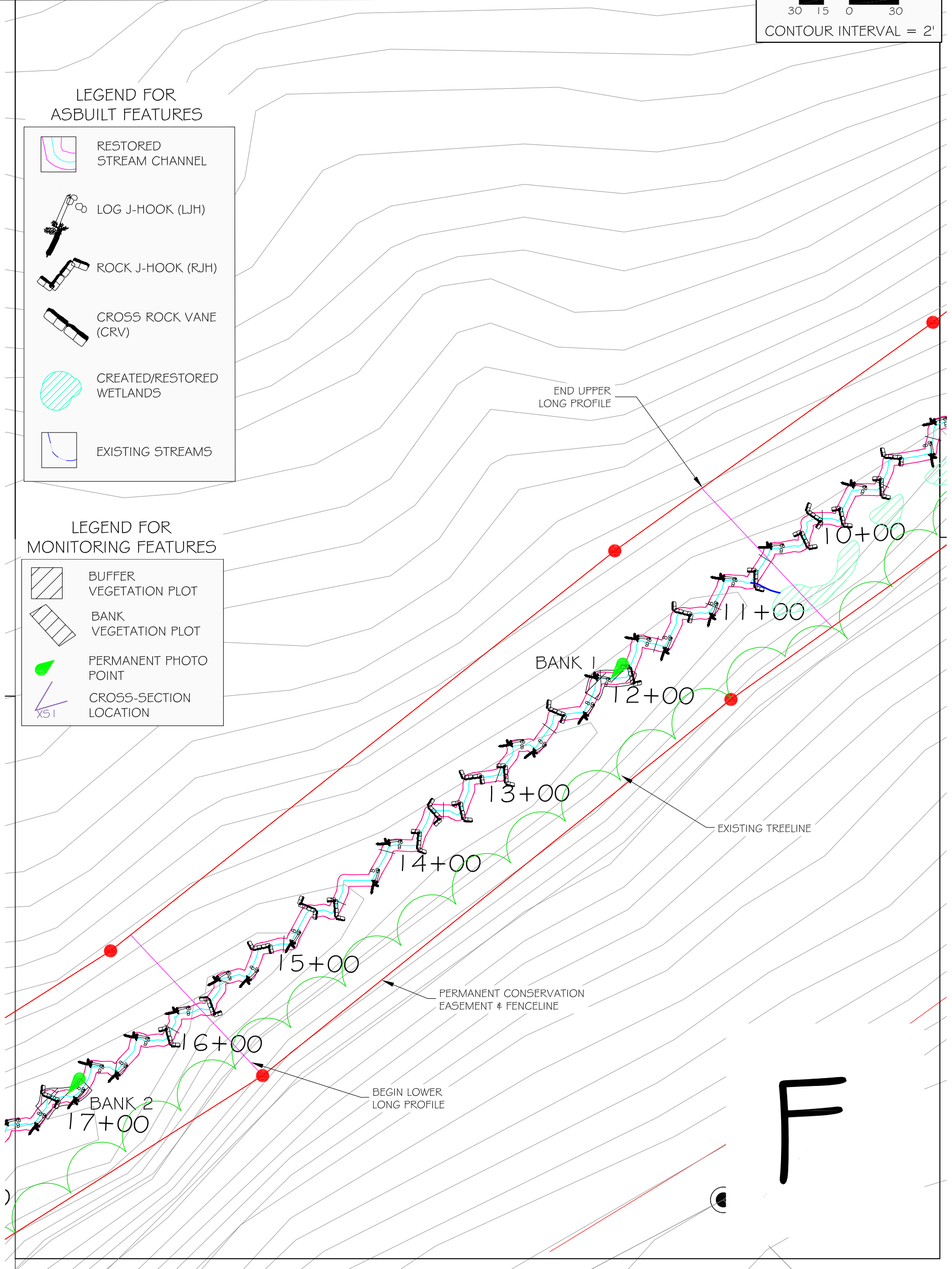
**LEGEND FOR
ASBUILT FEATURES**

-  RESTORED STREAM CHANNEL
-  LOG J-HOOK (LJH)
-  ROCK J-HOOK (RJH)
-  CROSS ROCK VANE (CRV)
-  CREATED/RESTORED WETLANDS
-  EXISTING STREAMS

**LEGEND FOR
MONITORING FEATURES**

-  BUFFER VEGETATION PLOT
-  BANK VEGETATION PLOT
-  PERMANENT PHOTO POINT
-  CROSS-SECTION LOCATION

REACH 2 MONITORING PLAN VIEW - F



F

REVISIONS			
REV	DESCRIPTION	DATE	APPR



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Project: GRAY FARM STREAM RESTORATION YEAR 1 MONITORING
 Location: IREDELL CO., NC
 Client: NC ECOSYSTEM ENHANCEMENT PROGRAM
 Sheet Title: REACH 2 MONITORING PLAN VIEW - F

Project No.: 9385.D7
 Proj. Mgr.: PKS
 Drawn: RSW
 Scale: 1" = 30'
 Sheet No.: 12 OF 16

NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S#EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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DRAWINGS PRINTED
AT HALF-SCALE



NORTH

SCALE 1" = 30'

30 15 0 30

CONTOUR INTERVAL = 2'

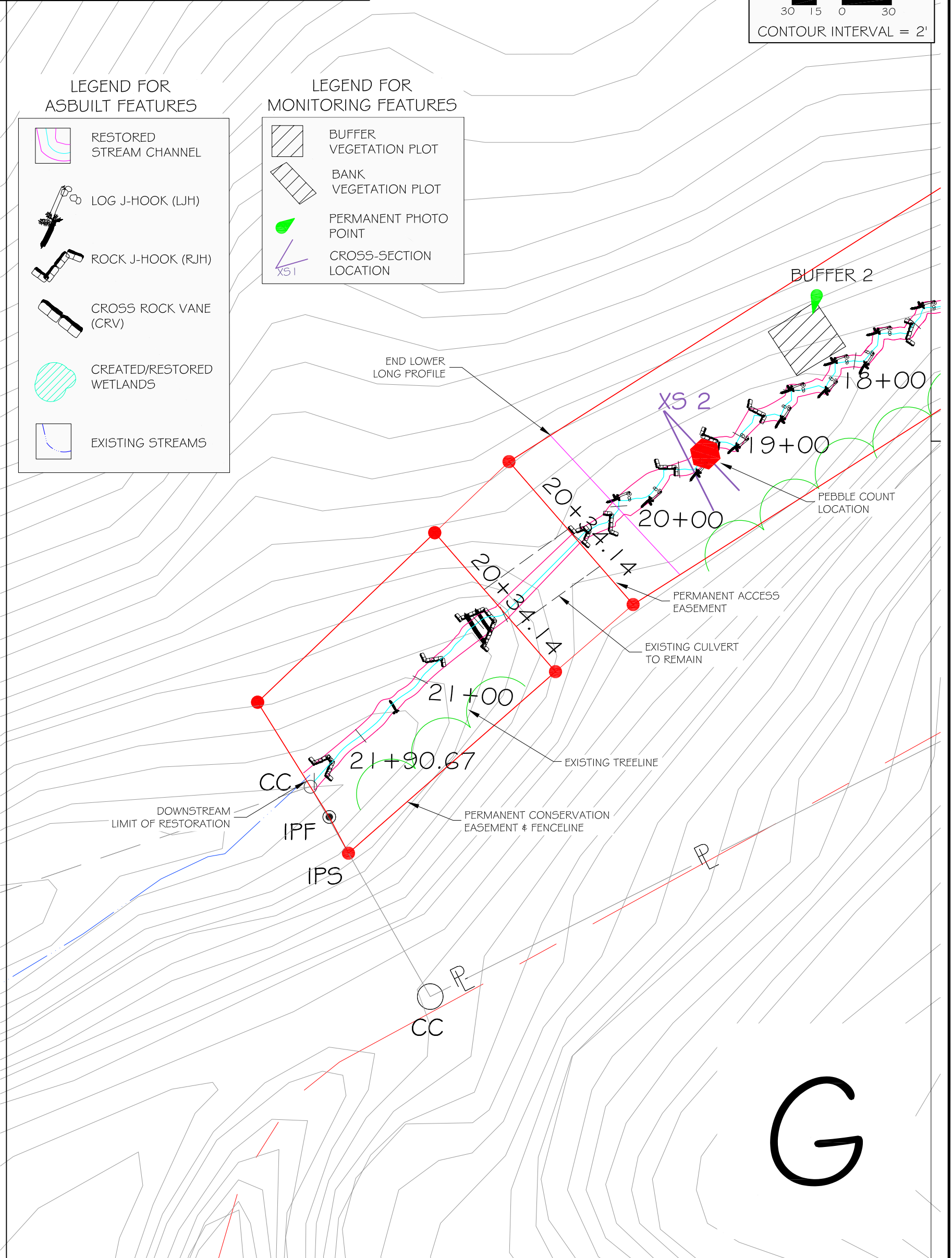
LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

LEGEND FOR MONITORING FEATURES

- BUFFER VEGETATION PLOT
- BANK VEGETATION PLOT
- PERMANENT PHOTO POINT
- CROSS-SECTION LOCATION

REACH 2 MONITORING PLAN VIEW - G



REVISIONS			
REV	DESCRIPTION	DATE	APPR

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Project: GRAY FARM STREAM RESTORATION YEAR 1 MONITORING		Project No.: 9385.D7
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Proj. Mgr.: JER Drawn: RSW
Sheet Title: REACH 2 MONITORING PLAN VIEW - G		Scale: 1" = 30'
		Sheet No.: 13 OF 16

NOTES:

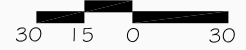
1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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DRAWINGS PRINTED
AT HALF-SCALE



NORTH

SCALE 1" = 30'



CONTOUR INTERVAL = 2'

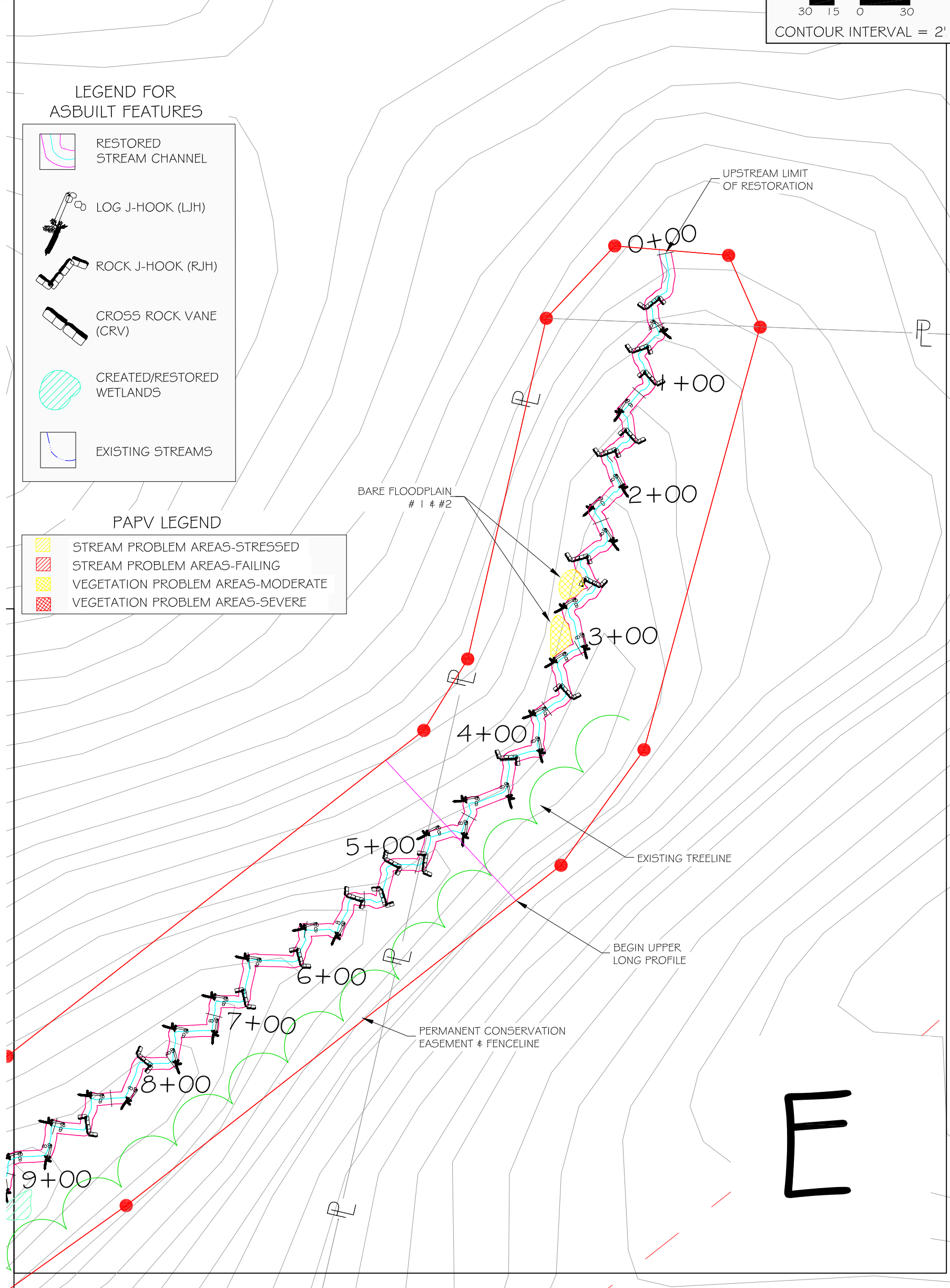
LEGEND FOR
ASBUILT FEATURES

	RESTORED STREAM CHANNEL
	LOG J-HOOK (LJH)
	ROCK J-HOOK (RJH)
	CROSS ROCK VANE (CRV)
	CREATED/RESTORED WETLANDS
	EXISTING STREAMS

PAPV LEGEND

	STREAM PROBLEM AREAS-STRESSED
	STREAM PROBLEM AREAS-FAILING
	VEGETATION PROBLEM AREAS-MODERATE
	VEGETATION PROBLEM AREAS-SEVERE

REACH 2 PROBLEM AREA PLAN VIEW - E



REVISIONS			
REV.	DESCRIPTION	DATE	APPR.




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Project: GRAY FARM STREAM RESTORATION YEAR 1 MONITORING		Project No.: 9385.D7
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Proj. Mgr.: JER Drawn: DCI
Sheet Title: REACH 2 PROBLEM AREA PLAN VIEW - E	Scale: 1" = 30'	Sheet No.: 14 OF 16

NOTES:


1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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**DRAWINGS PRINTED
AT HALF-SCALE**









NORTH

SCALE 1" = 30'







CONTOUR INTERVAL = 2'

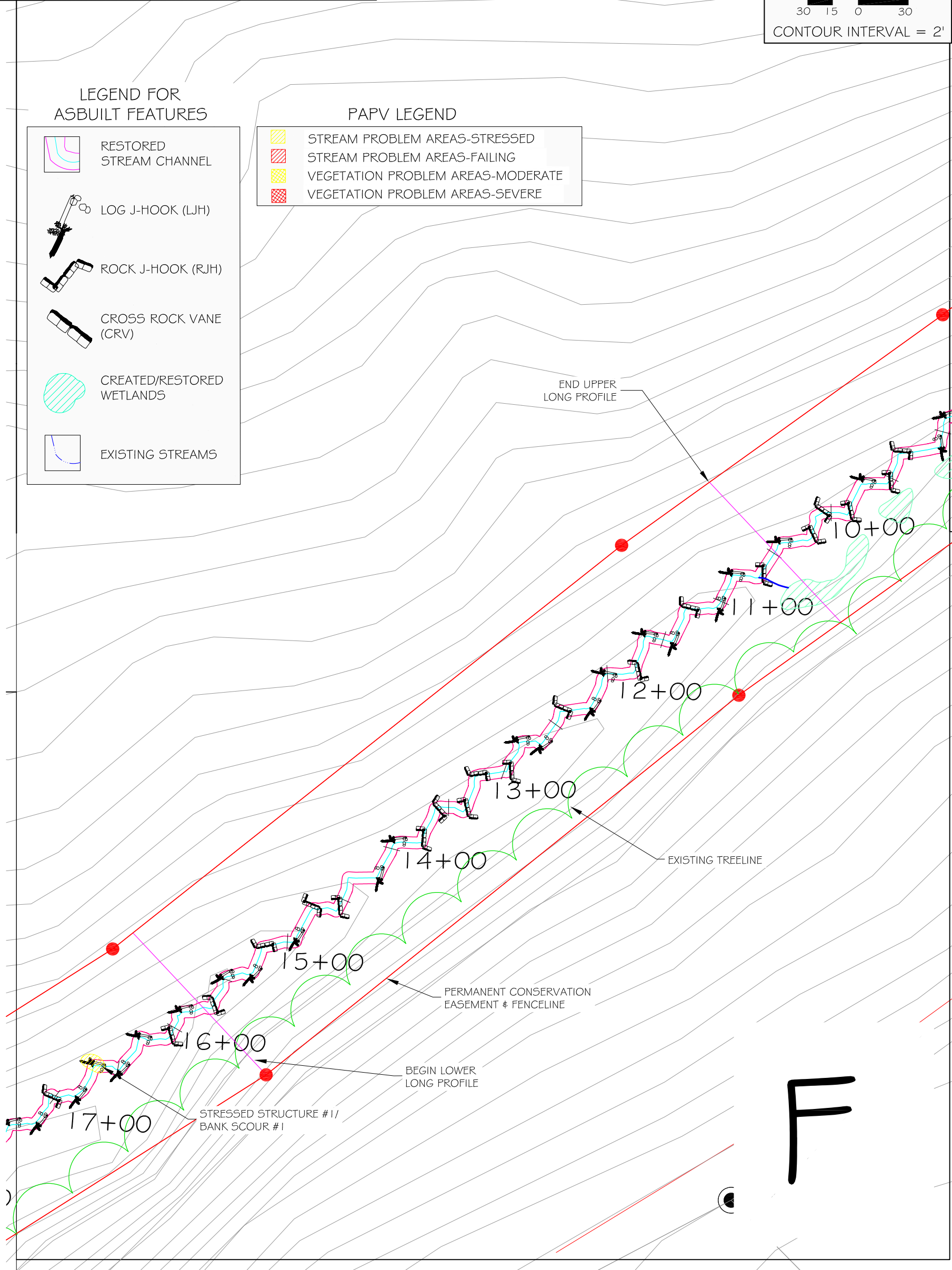
**LEGEND FOR
ASBUILT FEATURES**

-  RESTORED STREAM CHANNEL
-  LOG J-HOOK (LJH)
-  ROCK J-HOOK (RJH)
-  CROSS ROCK VANE (CRV)
-  CREATED/RESTORED WETLANDS
-  EXISTING STREAMS

PAPV LEGEND

-  STREAM PROBLEM AREAS-STRESSED
-  STREAM PROBLEM AREAS-FAILING
-  VEGETATION PROBLEM AREAS-MODERATE
-  VEGETATION PROBLEM AREAS-SEVERE

REACH 2 PROBLEM AREA PLAN VIEW - F



REVISIONS			
REV	DESCRIPTION	DATE	APPR



Soil & Environmental Consultants, PA
 11010 Raven Ridge Road • Raleigh, North Carolina 27614 • Phone: (919) 846-5900 • Fax: (919) 846-9467
 www.SandEC.com

Project:	GRAY FARM STREAM RESTORATION YEAR 1 MONITORING	Project No.:	9385.D7
Location:	IREDELL CO., NC	Client:	NC ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title:	REACH 2 PROBLEM AREA PLAN VIEW - F	Scale:	1" = 30'
		Sheet No.:	15 OF 16

NOTES:

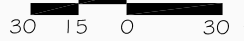
1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
2. ALL LOCATIONS, ELEVATIONS, AND DIMENSIONS ARE APPROXIMATE.
3. ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.

**DRAWINGS PRINTED
AT HALF-SCALE**



NORTH

SCALE 1" = 30'



CONTOUR INTERVAL = 2'

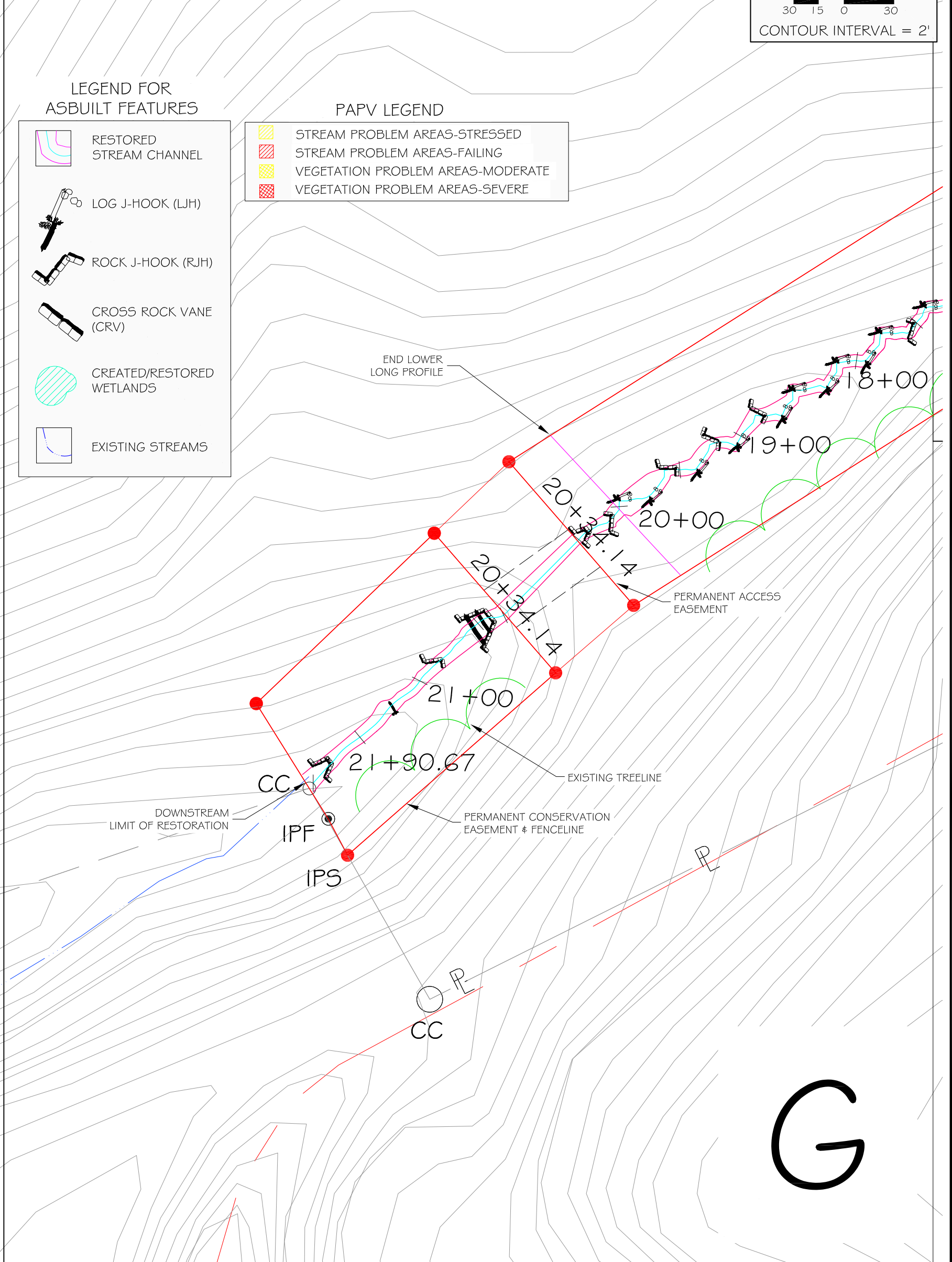
**LEGEND FOR
ASBUILT FEATURES**

	RESTORED STREAM CHANNEL
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PAPV LEGEND

	STREAM PROBLEM AREAS-STRESSED
	STREAM PROBLEM AREAS-FAILING
	VEGETATION PROBLEM AREAS-MODERATE
	VEGETATION PROBLEM AREAS-SEVERE

REACH 2 PROBLEM AREA PLAN VIEW - G



REVISIONS			
REV	DESCRIPTION	DATE	APPR

S&EC

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Project: GRAY FARM STREAM RESTORATION YEAR 1 MONITORING		Project No.: 9385.D7
Location: IREDELL CO., NC		Proj. Mgr.: JER
Client: NC ECOSYSTEM ENHANCEMENT PROGRAM		Drawn: RSW
Sheet Title: REACH 2 PROBLEM AREA PLAN VIEW - G		Scale: 1" = 30'
		Sheet No.: 16 OF 16