Baseline Monitoring Document and As-built Baseline Report

Heath Dairy Road Stream Restoration Site
Randolph County, NC

SCO Project Number 040633101
EEP Project Number 170
NCDENR D06017S

Prepared for:

NCDENR Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Construction Completed: August 2013
Data Collection: April 2014
Submitted: July 2014

Heath Dairy Road Stream Restoration
Randolph County, NC

Baseline Monitoring Document and As-built Baseline Report

SCO Project Number 040633101
EEP Project Number 170

Prepared by:

701 Corporate Center Drive
Suite 475
Raleigh, NC, 27607
Phone: 919-854-6200
Fax: 919-854-6259

Project Manager:
Richard Prosser, PE
Phone: 919-760-4000
e-mail: Rick.Prosser@aecom.com

Table of Contents

APPENDICIES

EXECUTIVE SUMMARY

The Heath Dairy Road Stream Restoration site was identified by the North Carolina Department of Transportation (NCDOT) as a degraded reach of Back Creek and several unnamed tributaries, in Randolph County, North Carolina. The project was transferred to the North Carolina Ecosystem Enhancement Program (EEP) in 2005. The Heath Dairy Road Restoration Site encompasses approximately 7,708 linear feet of degraded channels.

The primary project goals were to improve local water quality, aquatic and terrestrial habitat, and preclude the construction of additional infrastructure and agricultural practices.

Historic land use of the site has consisted primarily of agriculture and livestock grazing. The streams within the project area were accessible to livestock, resulting in local disturbances to stream banks and wetland soil surfaces. Additional land use practices including the maintenance and removal of riparian vegetation, and relocating, dredging, and straightening of on-site streams all contributing to the degraded water quality and unstable channel characteristics.

Stream restoration, enhancement and preservation were proposed for the various reaches of Back Creek dependent upon the existing stream conditions and other constraints. Stream activities consisted of Restoration, Enhancement Level 1, and Enhancement Level 2. The majority of the stream reaches on the Site were designed as Type B4c streams. Restoration consisted of modifying the streams dimension, pattern and profile to achieve a stable stream channel. The installation of brush, rock, and wood structures were used throughout the restored reaches of the Site. Reaches proposed for Enhancement Level 1 activities had their dimension and profile modified, but pattern remained the same. Enhancement Level 2 activities consisted of fencing out livestock, spot stabilization, and planting a riparian buffer. The type of restoration by reach is presented in Table 1, Appendix A. A permanent Conservation Easement was obtained for the streams along the tract. Two separate Conservation Easements were obtained and recorded in 2005 and 2006.

Wetland enhancement and preservation also occurred in nine separate areas. Enhancement activities included soil restoration (scarification of compacted soil) and planting of wetland vegetation. There were no significant deviations in the as-built condition from those proposed in the restoration plan.

Monitoring is proposed for a period of 5 years. Stream components to be monitored include stability (dimension, pattern and profile), hydrology, and sediment transport. Vegetation plots have also been established to monitor restoration of the riparian vegetation. Wetlands will be monitored for hydrology and vegetation.

Preliminary vegetation data suggests a lower than desired stem density throughout much of the project. While the 11-foot spacing specified provides for 360 stems per acre it does not allow for much mortality. Additionally, several areas that were quite wet with standing water did not appear to be planted.

1.0. PROJECT GOALS, BACKGROUND, AND ATTRIBUTES

1.1 Location and Setting

The Heath Dairy Road Restoration Site is located in Randolph County, North Carolina, northwest of Asheboro and southwest of Randleman (Figure 1).

The site is located in the Back Creek watershed of the Yadkin-Pee Dee River Basin, United States Geological Survey (USGS) Hydrologic Unit Code 03040103050050, within the North Carolina Division of Water Quality (NCDWQ) sub-basin 03-07-09. Back Creek drains into the Back Creek (Lucas) Lake and then into the Uwharrie River approximately eleven miles downstream of the site. This HUC is identified as a Targeted Local Watershed (TLW) in EEP's 2003 and 2009 Yadkin River Basin Restoration Priority (RBRP) Plan (http://www.nceep.net/services/lwps/pull_down/by_basin/Yadkin_RB.html).

The site is located in a rural portion of Randolph County. The surrounding land uses consist of pastureland, woodland, and residential lots.

1.2 Project Goals and Objectives

Restoration goals identified in the 2009 Yadkin Pee Dee RBRP Plan include protection of wildlife resources, improved management of stormwater runoff, and mitigation of impacts resulting from urbanization in the area. Within the Back Creek watershed, 26% of streams are lacking riparian buffer. The following goals were established to guide the restoration process for the project:

- 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 from adjacent agricultural fields by restoring the riparian buffer, and
    c. the reduction of water temperatures provided through shading of the channel by canopy species along with the resultant increase in oxygen content.
- Improve local aquatic and terrestrial habitat and diversity within the restored channels and their vicinity through:
    a. the restoration of appropriate bed form to provide habitat for fish, amphibian, and benthic species,
    b. the enhancement of riparian wetlands along the stream corridor to provide additional landscape and habitat diversity,
    c. the restoration of a suitable riparian buffer corridor in order to provide both vertical and horizontal structure and connectivity with adjacent upland areas, and
    d. the restoration of understory and canopy species in order to provide forage, cover, and nesting for a variety of mammals, reptiles, and avian species.

- Preclude the construction of additional infrastructure and the combination of agricultural practices including cattle grazing and the application of pesticides and fertilizer within the riparian buffer area by providing a permanent conservation easement.

The projects measurable objectives are:

- Restore natural stable channel morphology and proper sediment transport capacity;
- Create and/or improve bed form diversity and improve aquatic and benthic macroinvertabrate habitat;
- Construct a floodplain (or local bankfull bench) that is accessible at the proposed bankfull channel elevation;
- Improve channel and stream bank stabilization by integrating in-stream structures and native bank vegetation;
- Restore 7,781 linear feet of stream through Priority I and II restoration from the existing 6,748 linear feet of stream;
- Enhance 960 linear feet of stream from the existing 960 linear feet of stream;
- Preserve 636 linear feet of stream;
- Enhance 0.6 acres of wetlands from the existing 0.6 acres of wetlands (all are riparian non-riverine wetlands);
- Preserve 1.18 acres of wetlands (all are riparian non-riverine wetlands, except Wetland J which is a riparian riverine wetland consisting of 0.090 acres of preservation); and,
- Restore approximately 30 acres of riparian buffer by establishing a native forested and herbaceous riparian buffer plant community.

1.3 Project Structure, Restoration Type and Approach

The Heath Dairy Road Restoration Site (the Site) restored or enhanced approximately 7,708 linear feet of degraded channels. Table 1 and Figure 2 in the Appendix present the project assets.

With the exception of the lower portion of Back Creek, the channel was designed as a Type B4c stream. This channel configuration provided the most stable form in moderately sloping colluvial valleys. Not only does it effectively convey bankfull discharge and sediment load but also conforms to the natural conveyance of flood flows. Along the lower reach of Back Creek where the topography opens into a broad flat alluvial floodplain the channel was designed as a Type E4 stream. The proposed channel dimensions, patterns, and profiles were based on hydraulic relationships and morphological dimensionless ratios of reference reaches.

Restoration consisted of Priority I and II activities which involved reconstruction of the channels along new and existing alignments. In-stream structures such as rock cross vanes, J-hook vanes, log vanes, and root wads were incorporated into the stream to provide energy dissipation, bank stabilization, grade control, and habitat diversity. Coir fiber matting was used to provide bank stability until vegetation becomes established. Bed material from the existing channel was mined and used in the riffles of the channels. Bed material was augmented with additional stone where necessary.

The channel alignments were established to provide maximum conformance to the existing valley form. Where stream channels had been previously moved away from the low point in the valley the alignments repositioned the channel to the proper location. Where the valley width narrowed, channel sinuosity was reduced. Where rock outcrops were present at the surface, the channel alignments were kept near their present locations.

At the request of the EEP the upper portion of Back Creek was redesigned as an enhancement reach to facilitate a paired watershed study to be conducted by North Carolina State University (NCSU). Enhancement efforts entailed raising the profile in place to reconnect the stream to the relic floodplain, construction of in-stream structures, and stabilization of the banks.

Nine separate wetland areas totaling 1.78 acres were identified on the Site. These wetland areas were enhanced by removal of grazing activity and planting of wetland vegetation. It is anticipated that several of these wetland areas will expand due to the restoration and the raising of the adjacent stream channel.

Following restoration activities the riparian buffer was planted with hardwoods.

1.4 Project History, Contacts and Attribute Data

The project was initiated by NCDOT in 2004 at which time they secured an option on the Ridge parcel. The project was transferred to EEP in 2005. Following field studies the Restoration Plan was finalized in 2009 and Design Plans were compete in 2011. Construction on the project was initiated in June 2012 and channel construction was completed in March 2013. Planting of the riparian buffer was completed in March 2014. Tables 2 through 4 in Appendix A provide information regarding the project.

2.0 SUCCESS CRITIERIA

The following section outlines the performance standards for the proposed mitigation. The performance standards are consistent with the requirements described in Federal rule for compensatory mitigation project sites as described in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.5 paragraphs (a) and (b).

2.1 Streams

Post-restoration monitoring of channel stability will include dimension (cross-sections), pattern and profile (longitudinal profile), and photo documentation of the project. Success criteria for the stream restoration also include substrate analysis and the frequency of bankfull events. The success criteria are described below for each parameter.

2.1.1 Dimension

Riffle cross-sections on the restoration reaches should remain relatively stable; however, due to the sand/silt nature of the substrate throughout the project reaches, fluctuations of the riffle bed elevation over time are expected. These fluctuations should be temporary and will likely

correspond to storm events. Riffle cross-sectional ratios (width-to-depth, depth ratio, and bank height ratio) should fall within the parameters defined for channels of the appropriate Rosgen stream type. If persistent changes are observed, these changes will be evaluated to assess whether the stream channel is showing signs of long term instability. Indicators of instability include a vertically incising thalweg or eroding channel banks. Changes in the channel that indicate a movement toward stability or enhanced habitat include a decrease in the width-to-depth ratio in meandering channels or an increase in pool depth. Remedial action would not be taken if channel changes indicate a movement toward stability.

2.1.2 Pattern and Profile

Longitudinal profile data for the stream restoration reaches should show that the bedform features are remaining stable. The riffles should be steeper and shallower than the pools, while the pools should be deep with flat water surface slopes. The relative percentage of riffles and pools should not change significantly from the design parameters. Adjustments in length and slope of run and glide features are expected and will not be considered a sign of instability. The longitudinal profile should show that the bank height ratio remains very near to 1.0 for the majority of the restoration reaches.

2.1.3 Photo Documentation

Photographs should illustrate the site's vegetation and morphological stability on an annual basis. Cross-section photos should demonstrate no excessive erosion or degradation of the banks. Longitudinal photos should indicate the absence of persistent bars within the channel or vertical incision. Grade control structures should remain stable. Deposition of sediment on the bank side of vane arms is preferable. Maintenance of scour pools on the channel side of vane arms is expected. Reference photos will also be taken for each of the vegetation plots.

2.1.4 Substrate

Substrate materials in the restoration reaches should indicate a progression towards or the maintenance of coarser materials in the riffle features and smaller particles in the pool features.

2.1.5 Bankfull Events

Two bankfull flow events in separate years must be documented on the project within the five-year monitoring period. Bankfull events will be documented using a crest gage, photographs, and visual assessments such as debris lines.

2.2 Wetlands

Wetland hydrology success criteria will be satisfied in restored wetland areas when saturated soil conditions occur within 12 inches of the ground's surface for a minimum of 12.5% of the growing season during average climatic conditions, or if the hydroperiod in the restored area is within 20% of the reference wetland's hydroperiod during drought conditions. These conditions do not have to be met since only enhancement and preservation credits are being sought, but collecting this data will provide additional supporting information.

2.3 Vegetation

Success will be determined by survival of target species within the sample plots. A minimum of 260 stems/acre must survive for at least five years after initial planting. If the vegetative success criteria are not met, the cause of failure will be determined and an appropriate corrective action will be taken.

The criteria for vegetative success will be as follows:

- A minimum survival rate of 320 trees per acre in the riparian buffer at the end of 3 years.
- A minimum survival rate of 260 trees per acre in the conservation easement at the end of 5 years.

These values include both planted and native volunteer species.

3.0 MONITORING PLAN

Monitoring stations consisting of cross-sections, vegetation plots, and photo points have been established and are shown on the As Built drawings in Appendix D.

3.1 Dimension

Twenty-eight permanent monitoring cross-sections have been established on the site as follows:

- Back Creek, 16 cross-sections
- West Branch, 5 cross-sections
- UT to West Branch, 1 cross-section
- North Branch, 3 cross-sections
- East Branch, 3 cross-sections

Permanent monuments of rebar have been established at each end of these cross-sections. The cross-sections will be surveyed each year, with measurements occurring at bankfull, top of bank, edge of water, and other significant breaks in slope. The cross-sections have been renumbered slightly from the numbers presented in the As Built to facilitate moving forward during the monitoring phase.

Reach	Monitoring XS No.	As Built XS No.	Feature
Back Creek	XS-1	XS-1	Pool
Back Creek	XS-2	XS-2	Riffle
Back Creek	XS-3	XS-3	Riffle
Back Creek	XS-4	XS-4	Pool
Back Creek	XS-5	XS-5	Pool
Back Creek	XS-6	XS-6	Riffle

Reach	Monitoring XS No.	As Built XS No.	Feature
Back Creek	XS-7	XS-7	Pool
Back Creek	XS-8	XS-14	Riffle
Back Creek	XS-9	XS-15	Pool
Back Creek	XS-10	XS-16	Riffle
Back Creek	XS-11	XS-17	Pool
Back Creek	XS-12	XS-18	Riffle
Back Creek	XS-13	XS-19	Pool
Back Creek	XS-14	XS-20	Riffle
Back Creek	XS-15	XS-21	Pool
Back Creek	XS-16	XS-28	Pool
West Branch	XS-17	XS-8	Riffle
West Branch	XS-18	XS-9	Pool
West Branch	XS-19	XS-10	Riffle
West Branch	XS-20	XS-12	Riffle
West Branch	XS-21	XS-13	Pool
UT to West Branch	XS-22	XS-11	Riffle
North Branch	XS-23	XS-22	Pool
North Branch	XS-24	XS-23	Riffle
North Branch	XS-25	XS-24	Riffle
East Branch	XS-26	XS-25	Pool
East Branch	XS-27	XS-26	Riffle
East Branch	XS-28	XS-27	Riffle

3.2 Profile

The restored length of Back Creek is 5300 feet in length. A minimum of 3000 feet will be surveyed each year. The profile will be broken into three, 1000-foot segments. Each segment will begin and end at the head of a riffle and will be as follows:

- 13+89 to 24+02
- 28+90 to 40+12
- 52+20 to 62+21

The entire lengths of the restored sections of the West Branch, North Branch, and East Branch will also be surveyed. The profile will be surveyed in detail, documenting the elevations of the thalweg, water surface, and bankfull. Pool and riffle features will be called out to calculate feature slopes and lengths.

For this baseline report the entire length of Back Creek, West Branch, East Branch and North Branch was surveyed. The small UT to East Branch was not surveyed due to its short length.

3.3 Pattern

Pattern measurements have been taken for the as-built condition and are documented in this report. Future pattern measurements will not be taken unless there is evidence that significant geomorphological adjustments have occurred.

3.4 Substrate

Pebble counts will be conducted at all of the permanent cross-sections. These pebble counts will occur each year of the monitoring period and be used to calculate the sediment distribution at the cross-sections and the D50 and D84 at each location.

3.5 Visual Assessment

A visual assessment of the stream to include an assessment of the bank (lateral stability), bed (vertical stability), the easement boundary, and site vegetation will be completed each year to document the necessary parameters required for the EEP monitoring report.

3.6 Vegetation

Twenty-six vegetation plots were established and assessed for the baseline vegetation monitoring. Vegetation data collection will follow the CVS-EEP Protocol for Recording Vegetation (Lee et al. 2006, http://cvs.bio.unc.edu/methods.htm). The baseline vegetation monitoring was conducted as a Level 1: Inventory of Planted Stems. Beginning in year one and continuing throughout the rest of the monitoring period, the site will be monitored using the Level 2 protocol (volunteer stems will be identified and counted).

3.7 Digital Photos

Four permanent photo stations have been established as part of the baseline monitoring. Starting in the first monitoring year, these photos will be taken in late October / early November, so that vegetative conditions are similar at the site between monitoring years. The photos will be used to make a qualitative assessment of channel aggradation or degradation, bank erosion, success of riparian vegetation, effectiveness of erosion control measures, and the presence or absence of developing in-stream bars. Any significant changes from the as-built conditions will be discussed and highlighted in the report. Additional photo points should be established if problem areas arise.

Digital photos of each of the vegetation plots will also be taken.

3.8 Hydrology

Four monitoring gauges were installed in or around wetland enhancement areas to monitor site hydrology. One gauge was installed by AECOM in Wetland B. Three gauges were installed by EEP personnel outside of Wetland A-1. Monitoring gauges were installed in accordance with USACE guidelines (USACE 1993b). Wetland hydrology will be monitored for five years.

4.0 BASELINE CONDITIONS

The project was built as designed with the following changes and additions based upon conditions encountered during construction:

- The root wads at Back Creek Sta. 13+50 were removed from the design. A boulder toe was placed in this area to protect the channel bank
- The log vane at Back Creek Sta. 11+69 (as-built) was changed to a rock vane due to the presence of bedrock at that location. The bedrock prohibited the proper installation of the log vane, but allowed for the construction of a rock vane.

A detailed baseline survey was conducted post-construction by Stewart-Proctor, in July 2013. The baseline survey of the longitudinal profile and the cross-sections shows that the as-built channel closely reflects the design conditions.

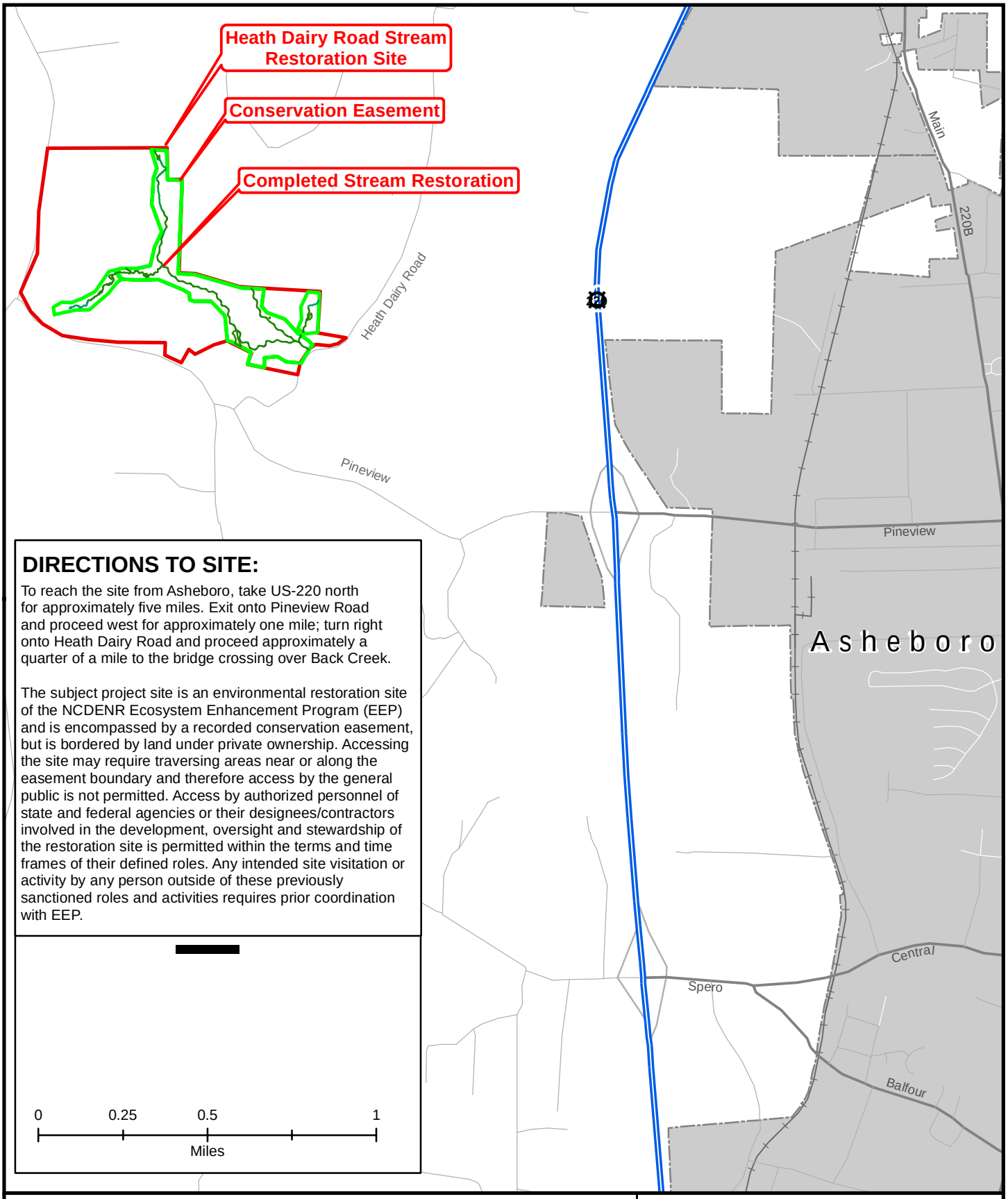
5.0 MAINTENANCE AND CONTINGENCY PLANS

Problem areas at the Heath Dairy Road Stream Restoration Site will be dealt with accordingly based on the severity of the problem and at the discretion of the EEP. Site maintenance may include reinstallation of coir matting, removal of debris from the channel, stabilization of bank erosion with protective structures, or adjustments to in-stream structures. All maintenance activities will be documented in the yearly monitoring reports.

6.0 REFERENCES

Lee, M.T., R.K. Peet, S.D. Roberts, T.R. Wentworth. 2006. *CVS-EEP Protocol for RecordingVegetation Version 4.0*.

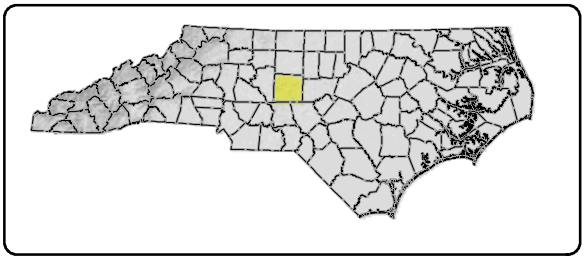
Appendix A – General Figures and Tables

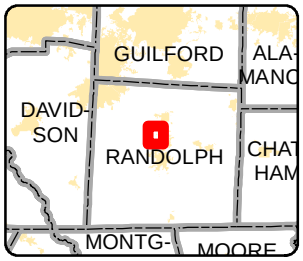


DIRECTIONS TO SITE:

To reach the site from Asheboro, take US-220 north for approximately five miles. Exit onto Pineview Road and proceed west for approximately one mile; turn right onto Heath Dairy Road and proceed approximately a quarter of a mile to the bridge crossing over Back Creek.

The subject project site is an environmental restoration site of the NCDENR Ecosystem Enhancement Program (EEP) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight and stewardship of the restoration site is permitted within the terms and time frames of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activities requires prior coordination with EEP.

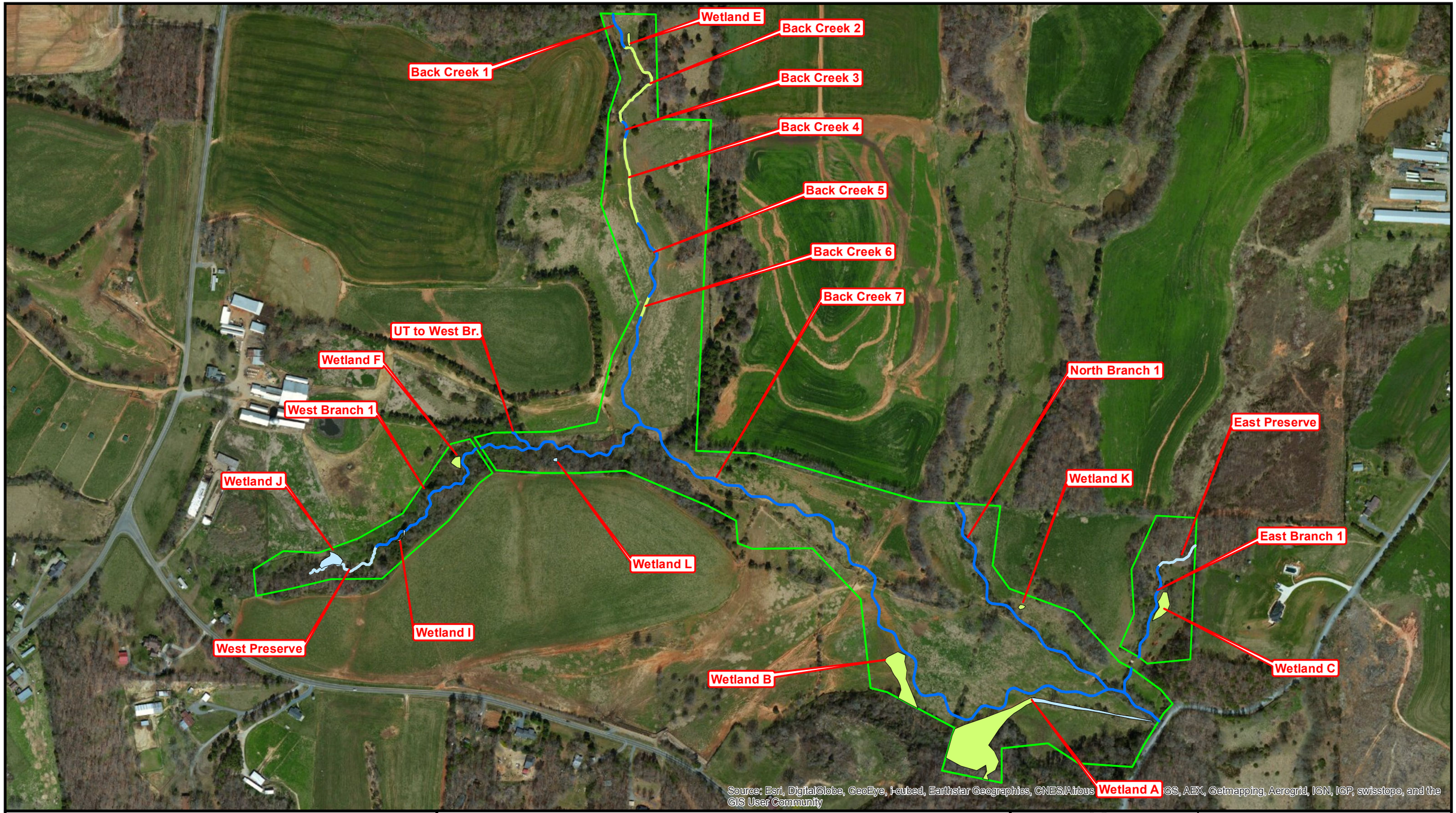


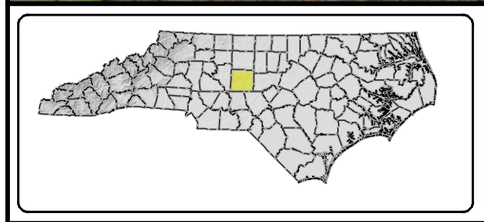


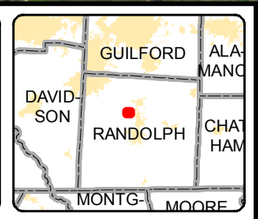
1. Vicinity Map

Heath Dairy Road Stream Restoration Site
Randolph County, NC
Project #: 60183329

Ecosystem Enhancement PROGRAM







Legend

- Stream Restoration
- Stream Enhancement I
- Stream Preservation
- Easement Boundary

Wetland Type

- Wetland Enhancement
- Wetland Preservation

N

0 100 200 400 600

Feet

2. Component/Asset Map

Heath Dairy Road Stream Restoration Site
Randolph County, NC
Project #: 60183329

Ecosystem Enhancement Program

Table 1. Project Components and Mitigation Credits
Heath Dairy Road Stream Restoration/ EEP No. 170

Mitigation Credits

	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Offset	Phosphorous Offset
Type	R	RE	R	RE	R	RE			
Totals	8421	127		0.54					

Project Components

Project Component	Stationing/Location	Existing Footage or Acreage	Approach	Restoration or Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio
Back Creek 1	10+00 – 11+55	149 LF	P2	Restoration	155 LF	1:1
Back Creek 2	11+55 – 16+25	470 LF	E1	Enhancement	470 LF	1.5:1
Back Creek 3	16+25 – 17+00	75 LF	P1	Restoration	75 LF	1:1
Back Creek 4	17+00 – 20+90	390 LF	E1	Enhancement	390 LF	1.5:1
Back Creek 5	20+90 – 24+60	374 LF	P1	Restoration	370 LF	1:1
Back Creek 6	24+60 – 25+60	100 LF	E1	Enhancement	100 LF	1.5:1
Back Creek 7	25+60 – 63+45	3450 LF	P1, P2	Restoration	3785 LF	1:1
West Preserve	14+58 - 18+75	417 LF	NA	Preservation	417 LF	5:1
West Branch 1	10+00 – 26+12	1523 LF	P1	Restoration	1590 LF*	1:1
North Branch 1	10+30 – 21+97	495 LF	P2	Restoration	1167 LF	1:1
East Preserve	5+01 - 7+20	219 LF	NA	Preservation	219 LF	5:1
East Branch 1	9+96 – 15+93	580 LF	P1	Restoration	537 LF*	1:1
UT to West Br.	10+36 – 11+38	102 LF	P1	Restoration	102 LF	1:1
Wetland A1	*NA*	1.075 AC	*NA*	Preservation	1.075 AC	5:1
Wetland A2	*NA*	0.136AC	*NA*	Enhancement	0.136 AC	2:1
Wetland B	*NA*	0.307 AC	*NA*	Enhancement	0.307 AC	2:1
Wetland C	*NA*	0.104 AC	*NA*	Enhancement	0.104 AC	2:1
Wetland E	*NA*	0.010 AC	*NA*	Enhancement	0.010 AC	2:1
Wetland F	*NA*	0.036 AC	*NA*	Enhancement	0.036 AC	2:1
Wetland I	*NA*	0.007 AC	*NA*	Preservation	0.007 AC	5:1
Wetland J	*NA*	0.090 AC	*NA*	Preservation	0.090 AC	5:1
Wetland K	*NA*	0.010 AC	*NA*	Enhancement	0.010 AC	2:1
Wetland L	*NA*	0.007 AC	*NA*	Preservation	0.007 AC	5:1

Component Summation

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	7781					30
Enhancement			0.60			
Enhancement I	960					
Enhancement II						
Creation						
Preservation	636		1.18			
High Quality Preservation						

*Liner footage for the ford (22 ft) and egress (50 ft) easements areas have been removed from West and East Branch respectively.

Table 2. Project Activity and Reporting History Heath Dairy Road Stream Restoration/ EEP No. 170		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Restoration Plan	April 2009	May 2009
CLOMR	June 2010	March 2011
LOMR	April 2014	
Final Design – Construction Plans	NA	June 2011
Construction	NA	August 2013
Permanent seed applied to entire site	NA	August 2013
Plantings for entire site	NA	February 2014
Mitigation Plan (Year 0 Monitoring – baseline)	April 2014	May 2014
Year 1 Monitoring		
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		

Table 3. Project Contact Table Heath Dairy Road Stream Restoration/ EEP No. 170	
Owner NC Ecosystem Enhancement Program	Melonie Allen 2728 Capital Boulevard Suite 1H 103 Raleigh, NC 27604 919-368-9352
Designer AECOM of North Carolina, Inc.	Rick Prosser 701 Corporate Center Drive, Suite 475 Raleigh, NC 27607 919-760-4000
Landowner Mr. Phillip Ridge Dr. Edward Shackleford	 3562 Plainfield Road Sophia, NC 27350 336-861-4555 203 Shannon Road Asheboro, NC 27203 336-625-6222
Construction Contractor	Backwater Environmental 515 S. Kennedy Avenue Eden, NC 27288
Planting Contractor	Carolina Silvics, Inc. 908 Indian Trail Road Edenton, NC 27932
Seeding Contractor	Backwater Environmental 515 S. Kennedy Avenue Eden, NC 27288
Monitoring Performer AECOM of North Carolina, Inc.	Rick Prosser 701 Corporate Center Drive, Suite 475 Raleigh, NC 27607 919-760-4000

Table 4. Project Baseline Information and Attributes Heath Dairy Road Stream Restoration/ EEP No. 170					
Project Information					
Project Name	Heath Dairy Farm Road Stream Restoration				
Project County	Randolph				
Project Area (acres)	56.8				
Project Coordinates (lat/long)	35°46'47.85"N / 79°50'51.50"W				
Project Watershed Summary					
Physiographic Province	Piedmont				
Project River Basin	Yadkin				
USGS HUC for Project	03040103050050				
NCDWQ Sub-basin for Project	03-07-09				
Project Drainage Area (acres)	1722				
Project Drainage Area Percentage of Impervious Area	< 2%				
CGIA Land Use Classification	Agricultural Land – Cropland and Pasture				
Reach Summary Information (Pre-restoration)					
Parameters	**Back Creek**	**West Branch**	**North Branch**	**East Branch**	**UT to West Branch**
Length of Reach (feet)	5008	1940	495	799	102
Valley Classification	VIII	II	II	II	II
Drainage area (acres)	1722	90	730	160	32
NCDWQ Stream ID Score	NA	NA	NA	NA	NA
NCDWQ Water Quality Classification	WS-II, HQW	WS-II, HQW	WS-II, HQW	WS-II, HQW	WS-II, HQW
Morphological Description	G4, E4	G4	E4	G4	G4
Evolutionary Trend	NA	NA	NA	NA	NA
Underlying Mapped Soils	(DoB) Dogue and (BtC2) Badin-Tarrus Complex				
Drainage Class	Well Drained to Moderately Well Drained				
Soil Hydric Status	Non-hydric	Non-hydric	Non-hydric	Non-hydric	Non-hydric
Slope					
FEMA Classification	Detail Study	None	Detail Study	None	None
Native Vegetation	Mesic Mixed Hardwood Forest (Piedmont Subtype)				
Percent Composition of Exotic Invasive Vegetation	20%	20%	20%	20%	20%
Wetland Summary Information					
Parameters	**Wetland A**	**Wetland B**	**Wetland C**	**Wetland E - L**	
Size of Wetland)acres)	1.21	0.31	0.10	0.26	
Wetland Type	Riparian	Riparian	Riparian	Riparian	
Mapped Soil Series	(BtC2) Badin-Tarrus Complex				
Drainage Class	Moderately Well Drained				
Soil Hydric Series	Soil series not hydric but soils exhibited low-chroma colors and mottling				

Source of Hydrology	Surface drainage	Surface drainage	Toe of slope seepage	Toe of slope seepage
Hydrologic Impairment	No	No	No	No
Native Vegetation	Piedmont Bottomland Forest / Piedmont Alluvial Forest			
Percent Composition of Exotic Invasive Vegetation	20%	20%	20%	20%

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the US – Section 404	Yes	Yes	
Waters of the US – Section 401	Yes	Yes	
Endangered Species Act	Yes	Yes	
Historic Preservation Act	Yes	Yes	2/1/2007 Concurrence letter from SHPO
CZMA/CAMA	No	NA	
FEMA Floodplain Compliance	Yes	Yes	
Essential Fisheries Habitat	No	NA	

Appendix B – Morphological Summary Data and Plots

Table 5 – Baseline Stream Data Summary
Table 6 – Morphology and Hydraulic Monitoring Summary
Longitudinal Profile Plot
Cross-section Plots
Pebble Count Plots

Table 5. Baseline Stream Data Summary Heath Dairy Road Stream Restoration/ EEP No. 170					
	Existing Conditions	**Reference Reach**	**Design**		
Stream Reach	**Back Creek Upper**	**Fork Creek**	**Back Cr. Reach 1***	**Back Cr. Reach 2***	**Back Cr. Reach 3***
Stream Type	G4	B4c	B4c	B4c	B4c
Drainage Area (mi^2)	0.94	2.2	1.04	1.08	1.22
Bankfull Width (ft)	10.1	20.1	16.5	16.6	17.5
Mean Depth (ft)	1.68	1.73	1.2	1.2	1.3
Bankfull XS_{AREA} (ft^2)	17.0	34.8	19	19	22
Bankfull Discharge (cfs)	75	163	86	88	101
Bkf Mean Velocity (ft/s)	4.4	4.7	4.5	4.5	4.5
Width/Depth Ratio	6.0	12	14	14	14
Max. Riffle Depth (ft)	2.4	2.0	1.6	1.6	1.7
Riffle Depth Ratio	1.4	1.2	1.3	1.3	1.3
Max. Pool Depth (ft)	2.8	2.6	2.4	2.5	2.6
Pool Depth Ratio	1.7	1.5	2.0	2.0	2.0
Flood Prone Width (ft)	29	63	30 – 45	28 – 77	34 – 120
Entrenchment Ratio	1.4 – 4.5	2.7 – 3.1	1.9 – 2.9	1.7 – 4.8	2.0 – 7.0
Bank Height Ratio	1.4 – 2.3	1.2	1.0	1.0	1.0
Meander Length (ft)	190	37 – 172	110 – 120	125 – 145	130 – 145
Meander Length Ratio	19	1.8 – 8.6	7.1 – 7.7	7.8 – 9.1	7.6 – 8.5
Radius of Curvature (ft)	18	47 – 318	31 – 46	32 – 48	34 – 51
Rc Ratio	1.8	2.3 – 16	2 – 3	2 – 3	2 – 3
Belt Width (ft)	25	33 – 40	30 – 35	40 – 50	45 – 60
Meander Width Ratio	2.5	1.6 – 2.0	1.9 – 2.2	2.5 – 3.1	2.6 – 3.5
Sinuosity	1.0	1.05	1.1	1.1	1.1
Channel Slope (ft/ft)	0.0087	0.0079	0.0060	0.0062	0.0062
Valley Slope (ft/ft)	0.0087	0.0083	0.0066	0.0068	0.0068
Riffle Slope (ft/ft)	0.023	0.013	0.0060	0.0062	0.0062
Riffle Slope Ratio	2.6	0.1	1.0	1.0	1.0
Pool Slope (ft/ft)	0.0	0.001	0.0	0.0	0.0
Pool Slope Ratio	0.0	0.1	0.0	0.0	0.0
Pool Width (ft)	7.8	19.9	18.1	18.3	19.2
Pool Width Ratio	0.8	1.0	1.1	1.1	1.1
Pool Spacing (ft)	57.6	71 – 134	66 – 99	66 – 99	70 – 105
Pool Spacing Ratio	5.7	3.5 – 6.7	4 - 6	4 – 6	4 – 6
D_{50} (mm)	25	28	25	25	25
D_{84} (mm)	63	81	63	63	63

*See Restoration Plan dated 2009 for reach designations

Table 5. Baseline Stream Data Summary Heath Dairy Road Stream Restoration/ EEP No. 170					
	Existing Conditions	**Reference Reach**	**Design**		
Stream Reach	**Back Creek Lower**	**UT to Polecat Cr.**	**Back Creek Reach 4***		
Stream Type	E4	E4	E4		
Drainage Area (mi^2)	2.5	0.4	1.3		
Bankfull Width (ft)	13.8	9.4	16.5		
Mean Depth (ft)	3.07	1.13	1.4		
Bankfull XS_{AREA} (ft^2)	42.3	10.6	23		
Bankfull Discharge (cfs)	167	37.4	101		
Bkf Mean Velocity (ft/s)	3.9	3.5	3.0		
Width/Depth Ratio	4.5	8.3	12		
Max. Riffle Depth (ft)	4.1	1.6	2.0		
Riffle Depth Ratio	1.3	1.4	1.45		
Max. Pool Depth (ft)	5.0	1.6	3.5		
Pool Depth Ratio	1.6	1.8	2.2		
Flood Prone Width (ft)	200	50	200		
Entrenchment Ratio	14.5	5.3	12.5		
Bank Height Ratio	1.5	1.2	1.0		
Meander Length (ft)	160	56 – 85	135 – 155		
Meander Length Ratio	12	6 – 9	8.4 – 9.7		
Radius of Curvature (ft)	15	19 – 50	32 – 48		
Rc Ratio	1.1	2.0 – 5.3	2 – 3		
Belt Width (ft)	23	28 – 50	90		
Meander Width Ratio	1.7	3.0 – 5.3	5.6		
Sinuosity	1.0	1.4	1.3		
Channel Slope (ft/ft)	0.0045	0.012	0.0023		
Valley Slope (ft/ft)	0.0045	0.017	0.0030		
Riffle Slope (ft/ft)	0.0037	0.027	0.0023		
Riffle Slope Ratio	0.8	2.3	1.0		
Pool Slope (ft/ft)	0.0	0.017	0.0		
Pool Slope Ratio	0.0	1.4	0.0		
Pool Width (ft)	13.4	7.1	18.1		
Pool Width Ratio	1.0	0.8	1.1		
Pool Spacing (ft)	43	34 – 52	66 – 99		
Pool Spacing Ratio	3.1	3.6 – 5.5	4 – 6		
D_{50} (mm)	25	15	25		
D_{84} (mm)	81	91	81		

*See Restoration Plan dated 2009 for reach designations

Table 5. Baseline Stream Data Summary Heath Dairy Road Stream Restoration/ EEP No. 170					
	Existing Conditions	**Reference Reach**	**Design**		
Stream Reach	**Back Creek Lower**	**Fork Creek**	**Back Cr. Reach 4b***	**Back Cr. Reach 5***	
Stream Type	E4	B4c	B4c	B4c	
Drainage Area (mi^2)	2.5	2.2	1.34	2.69	
Bankfull Width (ft)	13.8	20.1	17.5	22.5	
Mean Depth (ft)	3.07	1.73	1.2	1.6	
Bankfull XS_{AREA} (ft^2)	42.3	34.8	22	36	
Bankfull Discharge (cfs)	167	163	101	174	
Bkf Mean Velocity (ft/s)	3.9	4.7	3.0	4.5	
Width/Depth Ratio	4.5	12	14	14	
Max. Riffle Depth (ft)	4.1	2.0	1.7	2.2	
Riffle Depth Ratio	1.3	1.2	1.4	1.4	
Max. Pool Depth (ft)	5.0	2.6	2.6	3.3	
Pool Depth Ratio	1.6	1.5	2.1	2.1	
Flood Prone Width (ft)	200	63	35	45	
Entrenchment Ratio	14.5	2.7 – 3.1	2.0	2.0	
Bank Height Ratio	1.5	1.2	1.0	1.0	
Meander Length (ft)	55	37 – 172	115	145	
Meander Length Ratio	4.0	1.8 – 8.6	6.6	6.6	
Radius of Curvature (ft)	13	47 – 318	35 – 52	44 – 66	
Rc Ratio	1.0	2.3 – 16	2 – 3	2 – 3	
Belt Width (ft)	35	33 – 40	40	60	
Meander Width Ratio	2.5	1.6 – 2.0	2.3	2.7	
Sinuosity	1.0	1.05	1.1	1.1	
Channel Slope (ft/ft)	0.0045	0.0079	0.0095	0.0095	
Valley Slope (ft/ft)	0.0045	0.0083	0.0105	0.0105	
Riffle Slope (ft/ft)	0.0037	0.013	0.0095	0.0095	
Riffle Slope Ratio	0.8	0.1	1.0	1.0	
Pool Slope (ft/ft)	0.0	0.001	0.0	0.0	
Pool Slope Ratio	0.0	0.1	0.0	0.0	
Pool Width (ft)	13.4	19.9	19.2	24.7	
Pool Width Ratio	1.0	1.0	1.1	1.1	
Pool Spacing (ft)	43	71 – 134	70 – 105	90 – 135	
Pool Spacing Ratio	3.1	3.5 – 6.7	4 – 6	4 – 6	
D_{50} (mm)	25	28	25	25	
D_{84} (mm)	81	81	81	81	

*See Restoration Plan dated 2009 for reach designations

Table 5. Baseline Stream Data Summary Heath Dairy Road Stream Restoration/ EEP No. 170					
	Existing Conditions	**Reference Reach**	**Design**		
Stream Reach	**North Branch**	**Fork Creek**	**North Branch**		
Stream Type	E4	B4c	B4c		
Drainage Area (mi^2)	2.5	2.2	1.14		
Bankfull Width (ft)	13.8	20.1	16.5		
Mean Depth (ft)	3.07	1.73	1.2		
Bankfull XS_{AREA} (ft^2)	42.3	34.8	20		
Bankfull Discharge (cfs)	167	163	92		
Bkf Mean Velocity (ft/s)	3.9	4.7	4.5		
Width/Depth Ratio	4.5	12	13		
Max. Riffle Depth (ft)	4.1	2.0	1.7		
Riffle Depth Ratio	1.3	1.2	1.4		
Max. Pool Depth (ft)	5.0	2.6	2.6		
Pool Depth Ratio	1.6	1.5	2.1		
Flood Prone Width (ft)	200	63	40 – 57		
Entrenchment Ratio	14.5	2.7 – 3.1	2.4 – 3.4		
Bank Height Ratio	1.5	1.2	1.0		
Meander Length (ft)	55	37 – 172	150 – 160		
Meander Length Ratio	4.0	1.8 – 8.6	9.1 – 9.7		
Radius of Curvature (ft)	13	47 – 318	33 – 49		
Rc Ratio	1.0	2.3 – 16	2 – 3		
Belt Width (ft)	35	33 – 40	40 – 50		
Meander Width Ratio	2.5	1.6 – 2.0	2.4 – 3.0		
Sinuosity	1.0	1.05	1.1		
Channel Slope (ft/ft)	0.0045	0.0079	0.0036		
Valley Slope (ft/ft)	0.0045	0.0083	0.0040		
Riffle Slope (ft/ft)	0.0037	0.013	0.0036		
Riffle Slope Ratio	0.8	0.1	1.0		
Pool Slope (ft/ft)	0.0	0.001	0.0		
Pool Slope Ratio	0.0	0.1	0.0		
Pool Width (ft)	13.4	19.9	16.5		
Pool Width Ratio	1.0	1.0	1.0		
Pool Spacing (ft)	43	71 – 134	66 – 99		
Pool Spacing Ratio	3.1	3.5 – 6.7	4 – 6		
D_{50} (mm)	25	28	25		
D_{84} (mm)	81	81	81		

Table 5. Baseline Stream Data Summary Heath Dairy Road Stream Restoration/ EEP No. 170					
	Existing Conditions	**Reference Reach**	**Design**		
Stream Reach	**East Branch**	**Fork Creek**	**East Branch**		
Stream Type	G4	B4c	B4c		
Drainage Area (mi^2)	0.05	2.2	0.25		
Bankfull Width (ft)	5.0	20.1	10.0		
Mean Depth (ft)	0.62	1.73	0.7		
Bankfull XS_{AREA} (ft^2)	3.1	34.8	7		
Bankfull Discharge (cfs)	8.5	163	30		
Bkf Mean Velocity (ft/s)	2.7	4.7	4.5		
Width/Depth Ratio	8	12	14		
Max. Riffle Depth (ft)	0.8	2.0	1.00		
Riffle Depth Ratio	1.3	1.2	1.4		
Max. Pool Depth (ft)	1.4	2.6	1.5		
Pool Depth Ratio	2.3	1.5	2.1		
Flood Prone Width (ft)	5.8	63	26 – 42		
Entrenchment Ratio	1.2	2.7 – 3.1	2.7 – 4.4		
Bank Height Ratio	2.6	1.2	1.0		
Meander Length (ft)	80	37 – 172	90		
Meander Length Ratio	16	1.8 – 8.6	9.5		
Radius of Curvature (ft)	9 – 43	47 – 318	21 – 31		
Rc Ratio	1.8 – 8.6	2.3 – 16	2 – 3		
Belt Width (ft)	16	33 – 40	25		
Meander Width Ratio	3.2	1.6 – 2.0	2.6		
Sinuosity	1.05	1.05	1.1		
Channel Slope (ft/ft)	0.011	0.0079	0.0080		
Valley Slope (ft/ft)	0.012	0.0083	0.0088		
Riffle Slope (ft/ft)	0.31	0.013	0.0080		
Riffle Slope Ratio	28	0.1	1.0		
Pool Slope (ft/ft)	0.0	0.001	0.0		
Pool Slope Ratio	0	0.1	0.0		
Pool Width (ft)	4.4	19.9	11.0		
Pool Width Ratio	0.9	1.0	1.1		
Pool Spacing (ft)	9 – 45	71 – 134	40 – 60		
Pool Spacing Ratio	2 – 9	3.5 – 6.7	4 – 6		
D_{50} (mm)	9	28	25		
D_{84} (mm)	19	81	81		

Table 5. Baseline Stream Data Summary Heath Dairy Road Stream Restoration/ EEP No. 170					
	Existing Conditions	**Reference Reach**	**Design**		
Stream Reach	**West Branch**	**Fork Creek**	**West Branch Reach 1***	**West Branch Reach 2***	**West Branch Reach 3***
Stream Type	G4	B4c	B4c	B4c	B4c
Drainage Area (mi^2)	0.05	2.2	0.05	0.06	0.14
Bankfull Width (ft)	5.0	20.1	5.8	6.2	8.2
Mean Depth (ft)	0.62	1.73	0.4	0.44	0.6
Bankfull XS_{AREA} (ft^2)	3.1	34.8	2.4	2.7	4.7
Bankfull Discharge (cfs)	8.5	163	9	10	19
Bkf Mean Velocity (ft/s)	2.7	4.7	4.5	4.5	4.5
Width/Depth Ratio	8	12	14	14	14
Max. Riffle Depth (ft)	0.8	2.0	0.55	0.6	0.8
Riffle Depth Ratio	1.3	1.2	1.38	1.36	1.36
Max. Pool Depth (ft)	1.4	2.6	0.8	0.9	1.0
Pool Depth Ratio	2.3	1.5	2.0	2.0	2.0
Flood Prone Width (ft)	5.8	63	12 – 22	12 – 30	16
Entrenchment Ratio	1.2	2.7 – 3.1	2.0 – 3.8	2.0 – 4.8	2.0
Bank Height Ratio	2.6	1.2	1.0	1.0	1.0
Meander Length (ft)	60 – 120	37 – 172	50 – 55	50 – 60	60 – 70
Meander Length Ratio	12 – 24	1.8 – 8.6	8.6 – 9.5	8.1 – 9.7	7.3 – 8.5
Radius of Curvature (ft)	9 – 43	47 – 318	12 – 17	12 – 19	16 – 25
Rc Ratio	1.8 – 8.6	2.3 – 16	2 – 3	2 – 3	2 – 3
Belt Width (ft)	20	33 – 40	15 – 20	15 – 20	25 – 30
Meander Width Ratio	4.0	1.6 – 2.0	2.6 – 3.4	2.4 – 3.2	3.1 – 3.7
Sinuosity	1.07	1.05	1.1	1.2	1.1
Channel Slope (ft/ft)	0.011	0.0079	0.0128	0.0174	0.00108
Valley Slope (ft/ft)	0.019	0.0083	0.0141	0.0209	0.00119
Riffle Slope (ft/ft)	0.31	0.013	0.0128	0.0174	0.0108
Riffle Slope Ratio	28	0.1	1.0	1.0	1.0
Pool Slope (ft/ft)	0.0	0.001	0.0	0.0	0.0
Pool Slope Ratio	0	0.1	0.0	0.0	0.0
Pool Width (ft)	4.4	19.9	6.4	6.8	9.0
Pool Width Ratio	0.9	1.0	1.1	1.1	1.1
Pool Spacing (ft)	9 – 45	71 – 134	23 – 35	25 – 37	32 – 49
Pool Spacing Ratio	2 – 9	3.5 – 6.7	4 – 6	4 – 6	4 – 6
D_{50} (mm)	9	28	9	9	9
D_{84} (mm)	19	81	19	19	19

*See Restoration Plan dated 2009 for reach designations

Exhibit Table 5b. Baseline Stream Data Summary
Heath Dairy Road Stream Restoration - EEP # 170

Parameter	As-built Baseline (Back Creek)			As-built Baseline (East Branch)			As-built Baseline (West Branch)			As-built Baseline (North Branch)								
Dimension and Substrate - Riffle	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Bankfull Width (ft)	12.23	39.55	20.21	8.75	10.23	9.61	6.65	8.79	7.34	18.46	19.17	18.83						
Floodprone Width (ft)	18.96	58.46	48.10	34.36	39.63	37.82	24.54	40.19	34.07	49.85	54.47	51.46						
Bankfull Mean Depth (ft)	0.38	2.34	1.37	0.62	0.93	0.75	0.58	0.83	0.68	1.32	2.68	1.79						
[1]Bankfull Max Depth (ft)	0.98	3.96	2.41	1.04	1.73	1.29	0.83	1.31	1.01	1.82	4.72	2.82						
Bankfull Cross Sectional Area (ft^2)	4.68	42.73	26.79	6.31	8.10	7.08	3.97	6.83	5.07	24.43	51.38	33.83						
Width/Depth Ratio	7.79	56.50	18.16	9.41	16.50	13.39	9.30	11.83	10.90	7.15	13.98	11.67						
Entrenchment Ratio	1.26	3.39	2.53	3.49	4.53	3.96	3.69	6.00	4.63	2.65	2.84	2.73						
[1]Bank Height Ratio																		
Profile																		
Riffle Length (ft)	11.16	43.77	33.9	20.74	61	40.89	15.66	22.33	19.57	27.53	56.54	37.03						
Riffle Slope (ft/ft)	0	0.018	0.01	0.005	0.024	0.011	0	0.02	0.012	0	0.027	0.0035						
Pool Length (ft)	25.75	57.51	36.95	15.4	29.52	27.8	4.17	19.5	12.34	29.76	59.45	43.74						
Pool Max depth (ft)	1.3	2.69	2.19	1.31	2.45	1.82	1.8	2.58	2.02	0.83	3.14	2.5						
Pool Spacing (ft)	34.33	84.11	63.11	30.84	54.06	41.86	23.37	44.34	34.05	66.83	90.74	80.97						
Pattern																		
Channel Beltwidth (ft)	20.92	71.71	47.45	15.2	33.72	21.23	10.31	20.44	15.85	16.97	44.48	33.65						
Radius of Curvature (ft)	27.45	46.2	38.7	6.55	19.17	15.14	27.45	33.95	29.61	21.07	36.63	29.39						
Rc/Bankfull width (ft/ft)	**2.24**	**1.17**	**1.91**	**0.75**	**1.87**	**1.58**	**4.13**	**3.86**	**4.03**	**1.14**	**1.91**	**1.56**						
Meander Wavelength (ft)	131	157	146.3	87	131	110	47	65.5	55.1	157	170	163						
Meander Width Ratio			2.35			2.21			2.16			1.79						
Transport parameters																		
Reach Shear Stress (competency) lb/f^2																		
Max part size (mm) mobilized at bankfull																		
Stream Power (transport capacity) W/m^2																		
Additional Reach Parameters																		
Rosgen Classification	B4c/E4			B4c			B4c			B4c								
Bankfull Velocity (fps)																		
Bankfull Discharge (cfs)																		
Valley length (ft)	4400			612			927			1082								
Channel Thalweg length (ft)	5296			647			1616			1168								
Sinuosity (ft)	1.2			1.1			1.7			1.1								
Water Surface Slope (Channel) (ft/ft)	0.0056			0.009			0.018			0.0061								
BF slope (ft/ft)	0.005			0.014			0.019			0.0054								
[3]Bankfull Floodplain Area (acres)																		
[4]Proportion over wide (%)																		
Channel Stability or Habitat Metric																		
Biological or Other																		

Exhibit Table 6. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters – Cross Sections)

Heath Dairy Road Stream Restoration/EEP # 170 Segment/Reach: Back Creek XS1 - 10

	Cross Section 1 (Pool)							Cross Section 2 (Riffle)							Cross Section 3 (Riffle)							Cross Section 4 (Pool)							Cross Section 5 (Pool)						
Based on fixed baseline bankfull elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	21.75							16.91							33.25							14.97							18.29						
Floodprone Width (ft)	48.42							40.41							47.52							49.7							49.89						
Bankfull Mean Depth (ft)	1.47							1.01							0.85							1.69							1.6						
Bankfull Max Depth (ft)	2.37							1.44							2.39							2.73							2.83						
Bankfull Cross Sectional Area (ft^2)	32.01							17							28.13							25.29							29.28						
Bankfull Width/Depth Ratio	14.8							16.74							39.12							8.86							11.43						
Bankfull Entrenchment Ratio	2.23							2.39							1.43							3.32							2.73						
Bankfull Bank Height Ratio																																			
Based on current/developing bankfull feature																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft^2)																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft^2)																																			
d50 (mm)																																			

	Cross Section 6 (Riffle)							Cross Section 7 (Pool)							Cross Section 8 (Riffle)							Cross Section 9 (Pool)							Cross Section 10 (Riffle)						
Based on fixed baseline bankfull elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	14.27							18.83							26.3							20.68							39.55						
Floodprone Width (ft)	48.36							49.86							53.5							49.96							49.81						
Bankfull Mean Depth (ft)	0.87							1.59							0.97							1.81							0.7						
Bankfull Max Depth (ft)	1.32							3.07							2.19							2.83							1.8						
Bankfull Cross Sectional Area (ft^2)	12.41							29.94							25.6							37.43							27.8						
Bankfull Width/Depth Ratio	16.4							11.84							27.3							11.43							56.5						
Bankfull Entrenchment Ratio	3.39							2.65							2.04							2.42							1.26						
Bankfull Bank Height Ratio																																			
Based on current/developing bankfull feature																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft^2)																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft^2)																																			
d50 (mm)																																			

Exhibit Table 6. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters – Cross Sections)

Heath Dairy Road Stream Restoration/EEP # 170 Segment/Reach: Back Creek XS11-16; West Branch XS17-20

	Cross Section 11 (Pool)							Cross Section 12 (Riffle)							Cross Section 13 (Pool)							Cross Section 14 (Riffle)							Cross Section 15 (Pool)						
Based on fixed baseline bankfull elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	22.55							18.44							20.02							17.3							16.12						
Floodprone Width (ft)	49.62							50.15							51.14							58.46							51.74						
Bankfull Mean Depth (ft)	1.51							1.28							1.43							1.54							1.81						
Bankfull Max Depth (ft)	2.91							1.78							2.69							2.39							3.96						
Bankfull Cross Sectional Area (ft^2)	34.05							23.57							28.58							26.6							29.14						
Bankfull Width/Depth Ratio	14.93							14.41							14							11.23							8.91						
Bankfull Entrenchment Ratio	2.20							2.72							2.55							3.38							3.21						
Bankfull Bank Height Ratio																																			
Based on current/developing bankfull feature																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft^2)																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft^2)																																			
d50 (mm)																																			

	Cross Section 16 (Pool)							Cross Section 17 (Riffle)							Cross Section 18 (Pool)							Cross Section 19 (Riffle)							Cross Section 20 (Riffle)						
Based on fixed baseline bankfull elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	18.22							6.65							6.86							6.7							8.79						
Floodprone Width (ft)	55.55							24.54							25.89							40.19							39.84						
Bankfull Mean Depth (ft)	2.34							0.62							0.58							0.59							0.78						
Bankfull Max Depth (ft)	3.12							0.99							0.92							0.83							1.01						
Bankfull Cross Sectional Area (ft^2)	42.73							4.11							3.97							3.98							6.83						
Bankfull Width/Depth Ratio	7.79							10.73							11.83							11.36							11.27						
Bankfull Entrenchment Ratio	3.05							3.69							3.78							6.00							4.53						
Bankfull Bank Height Ratio																																			
Based on current/developing bankfull feature																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft^2)																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft^2)																																			
d50 (mm)																																			

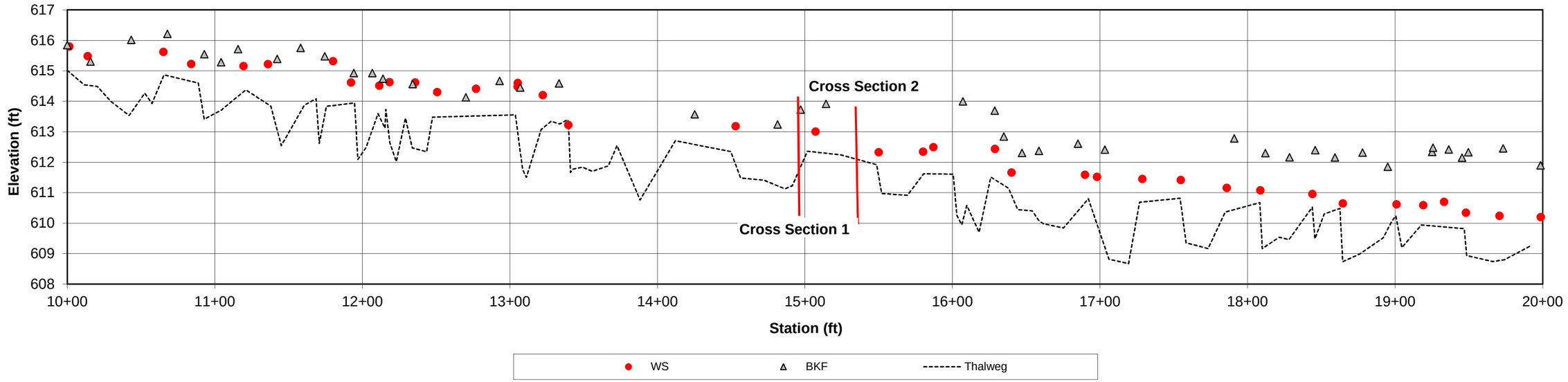
Exhibit Table 6. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters – Cross Sections)

Heath Dairy Road Stream Restoration/EEP # 170 Segment/Reach: West Branch XS21, UT to West Branch XS22-25; North Branch XS23-25; East Branch XS26-28

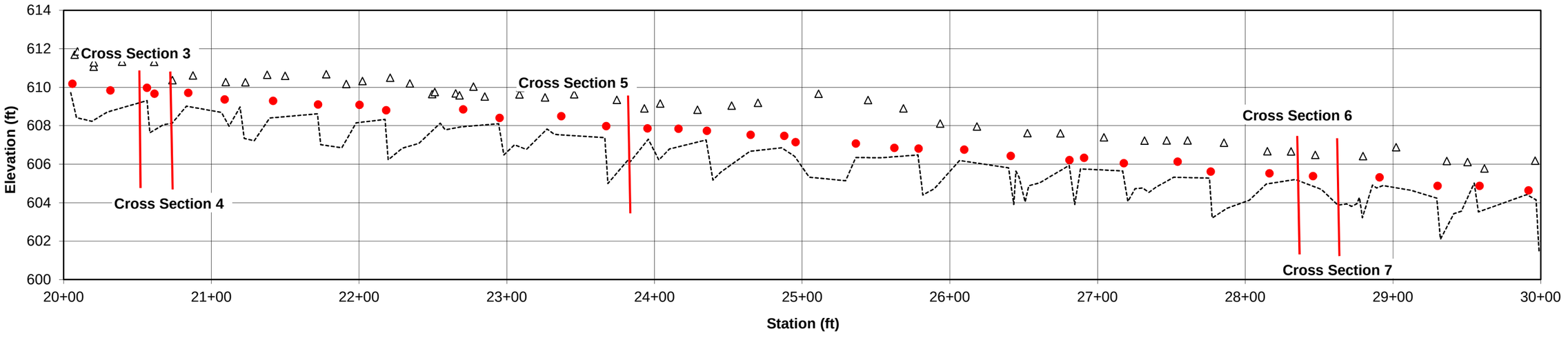
	Cross Section 21 (Pool)							Cross Section 22 (Riffle)							Cross Section 23 (Pool)							Cross Section 24 (Riffle)							Cross Section 25 (Riffle)						
Based on fixed baseline bankfull elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	7.72							8.59							19.17							18.46							18.86						
Floodprone Width (ft)	39.9							40.58							54.47							49.85							50.05						
Bankfull Mean Depth (ft)	0.83							0.52							2.68							1.32							1.36						
Bankfull Max Depth (ft)	1.31							0.84							4.72							1.93							1.82						
Bankfull Cross Sectional Area (ft^2)	6.44							4.46							51.38							24.43							25.68						
Bankfull Width/Depth Ratio	9.3							16.52							7.15							13.98							13.87						
Bankfull Entrenchment Ratio	5.17							4.72							2.84							2.70							2.65						
Bankfull Bank Height Ratio																																			
Based on current/developing bankfull feature																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft^2)																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft^2)																																			
d50 (mm)																																			

	Cross Section 26 (Pool)							Cross Section 27 (Riffle)							Cross Section 28 (Riffle)							Cross Section xxx (Pool)							Cross Section xxx (Riffle)						
Based on fixed baseline bankfull elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	8.75							10.23							9.84																				
Floodprone Width (ft)	39.63							39.46							34.36																				
Bankfull Mean Depth (ft)	0.93							0.62							0.69																				
Bankfull Max Depth (ft)	1.73							1.04							1.11																				
Bankfull Cross Sectional Area (ft^2)	8.1							6.31							6.83																				
Bankfull Width/Depth Ratio	9.41							16.5							14.26																				
Bankfull Entrenchment Ratio	4.53							3.86							3.49																				
Bankfull Bank Height Ratio																																			
Based on current/developing bankfull feature																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft^2)																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft^2)																																			
d50 (mm)																																			

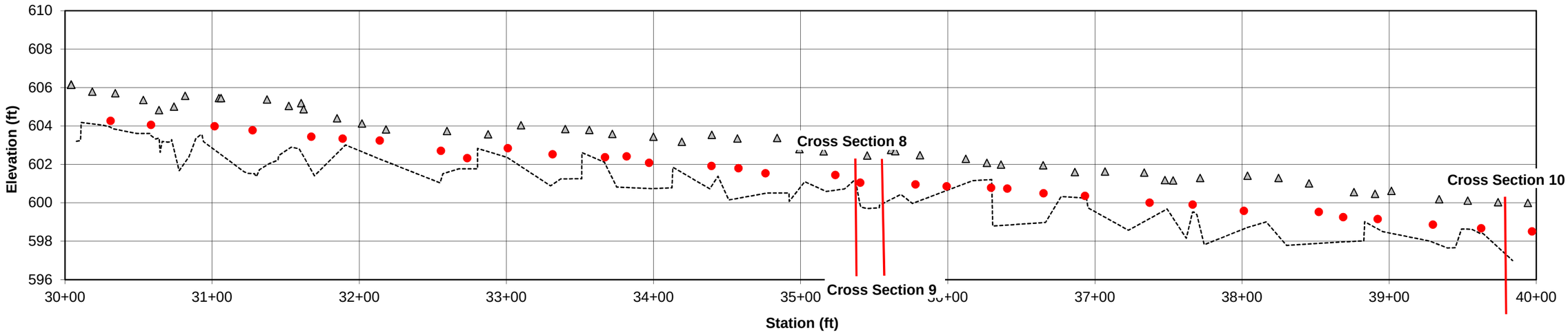
Back Creek Long Profile



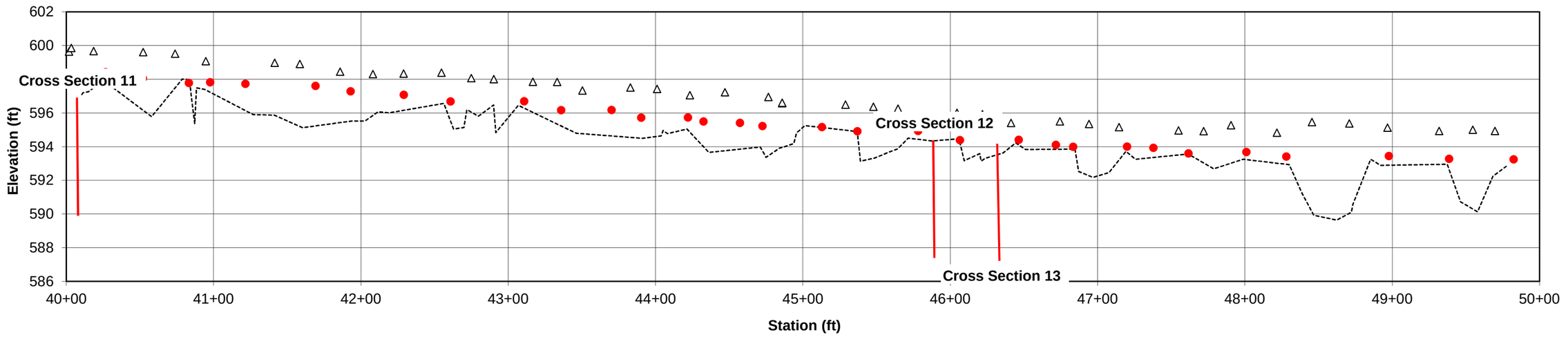
Back Creek Long Profile



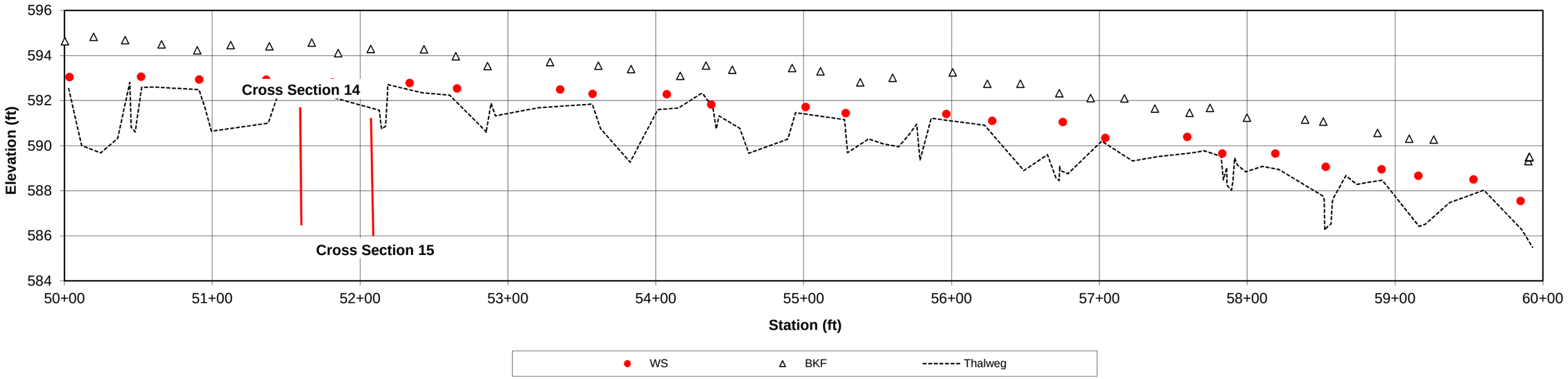
Back Creek Long Profile



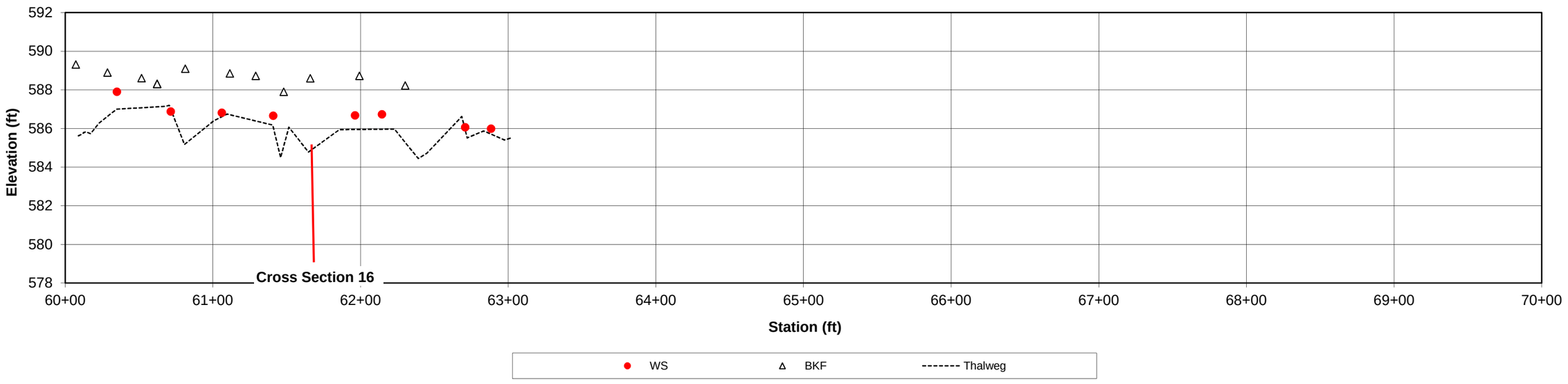
Back Creek Long Profile

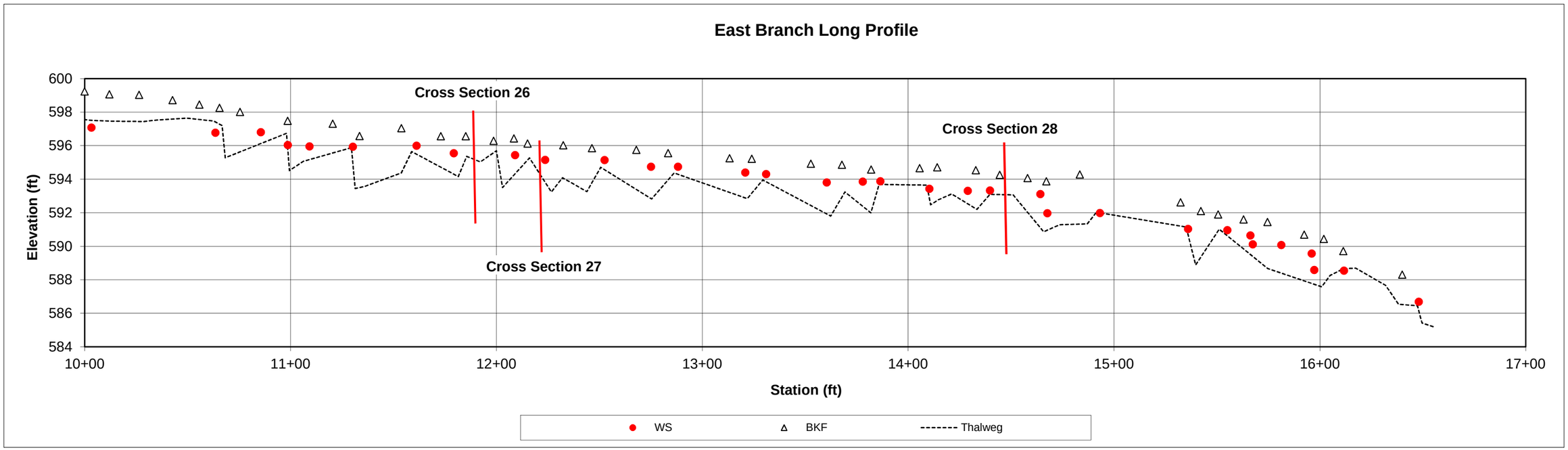


Back Creek Long Profile

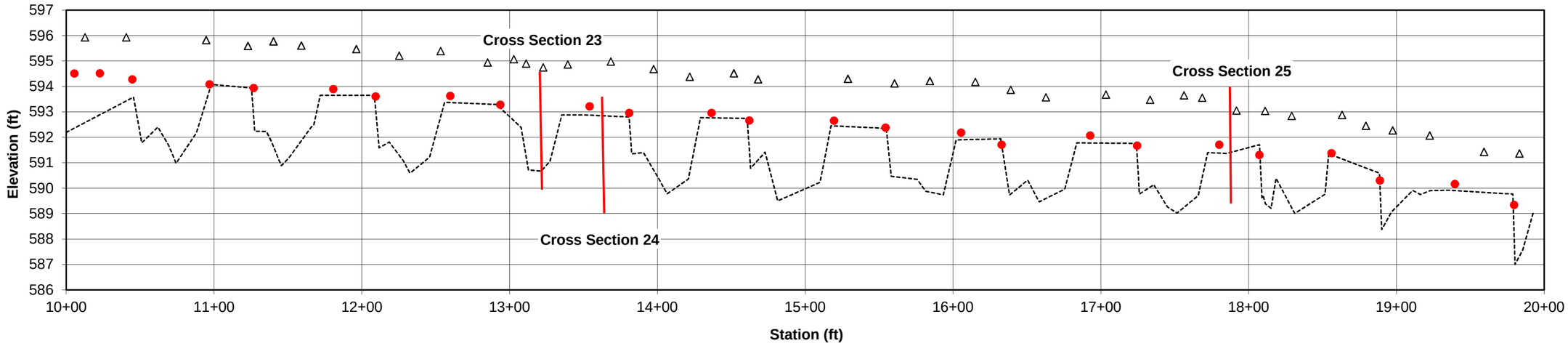


Back Creek Long Profile

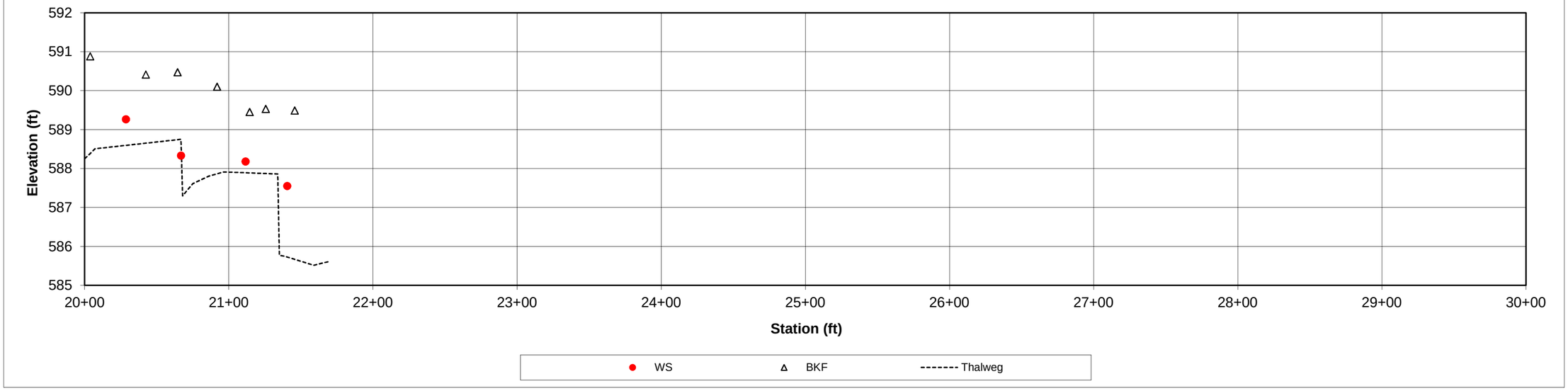


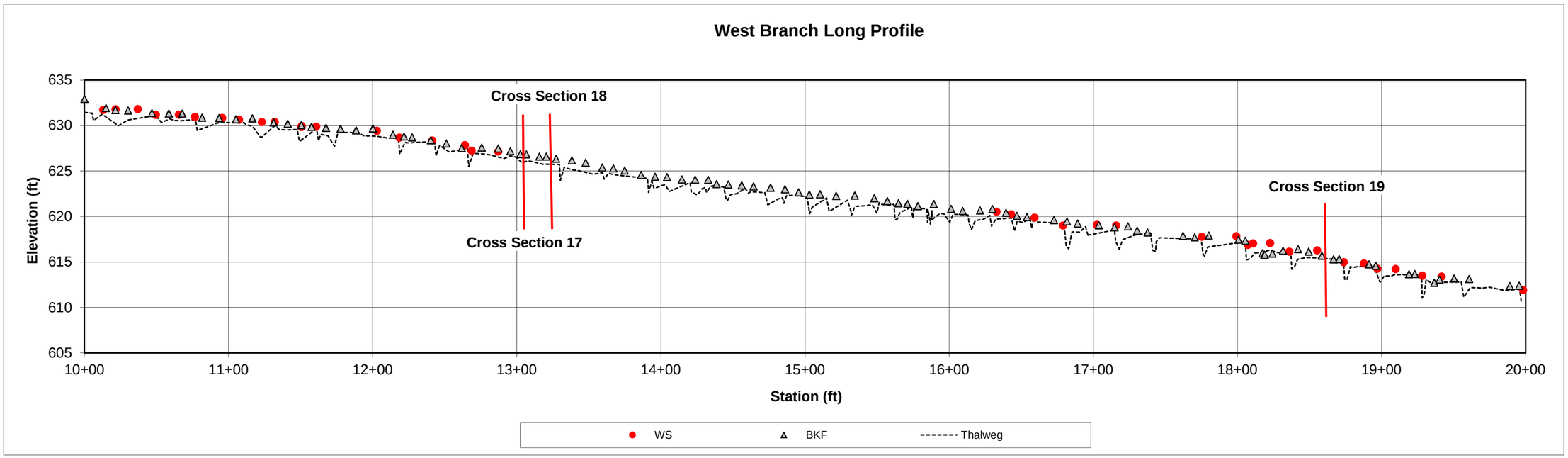

East Branch Long Profile
Cross Section 26
Cross Section 27
Cross Section 28
Elevation (ft)
600
598
596
594
592
590
588
586
584
10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
Station (ft)
WS
BKF
Thalweg

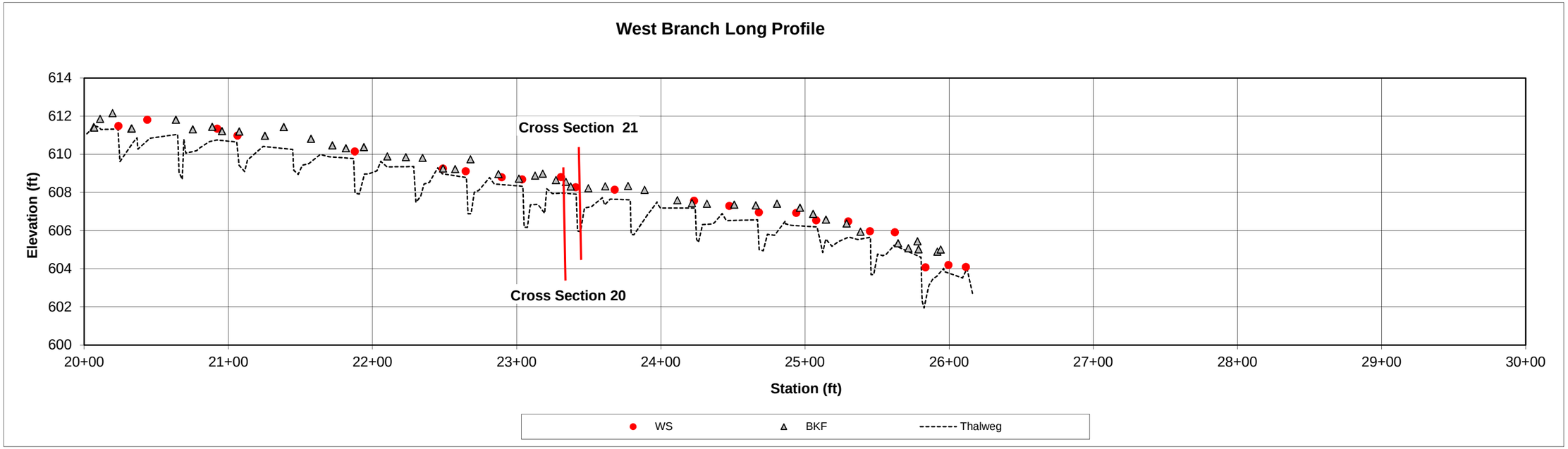
North Branch Long Profile

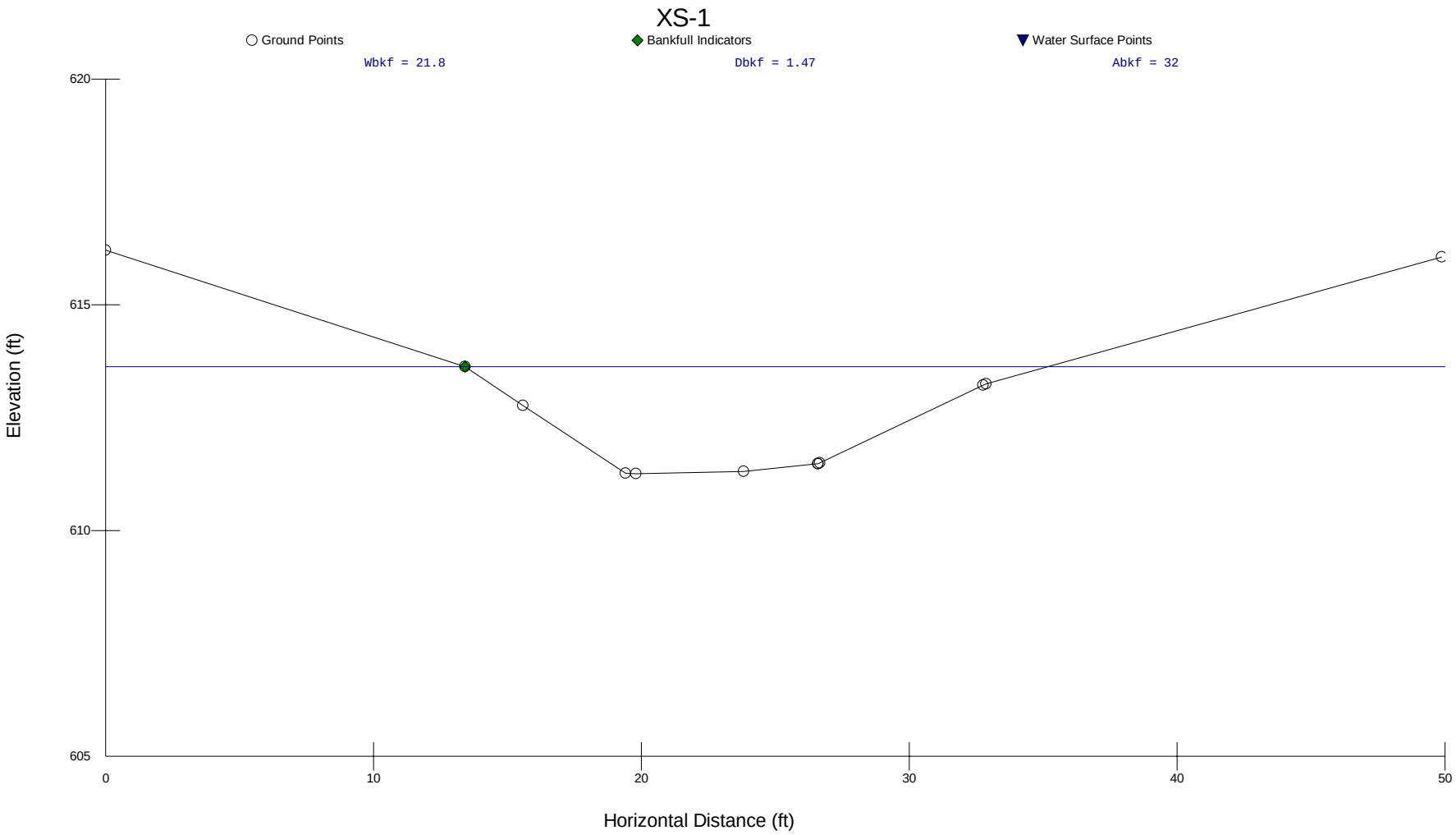


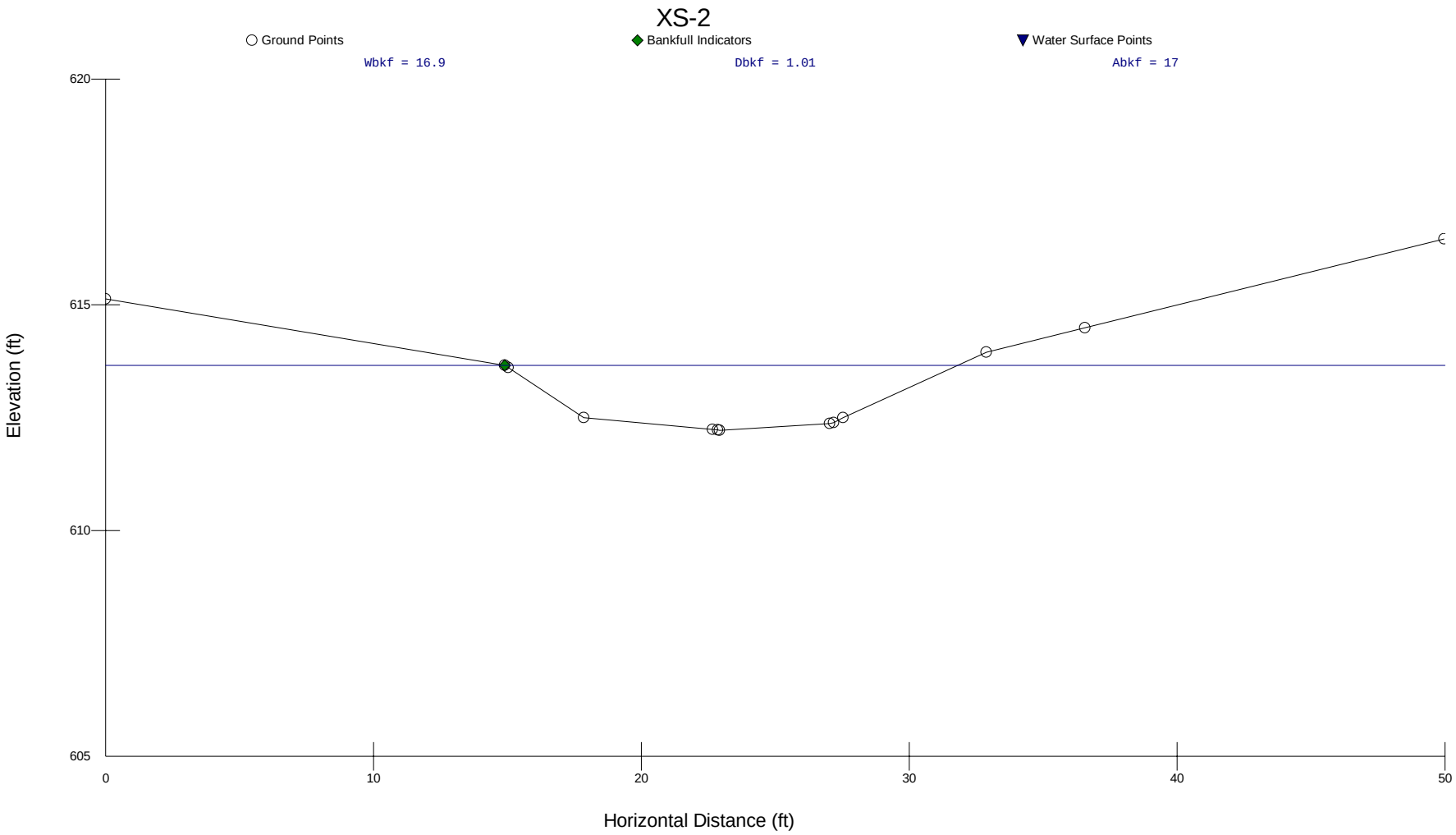
North Branch Long Profile

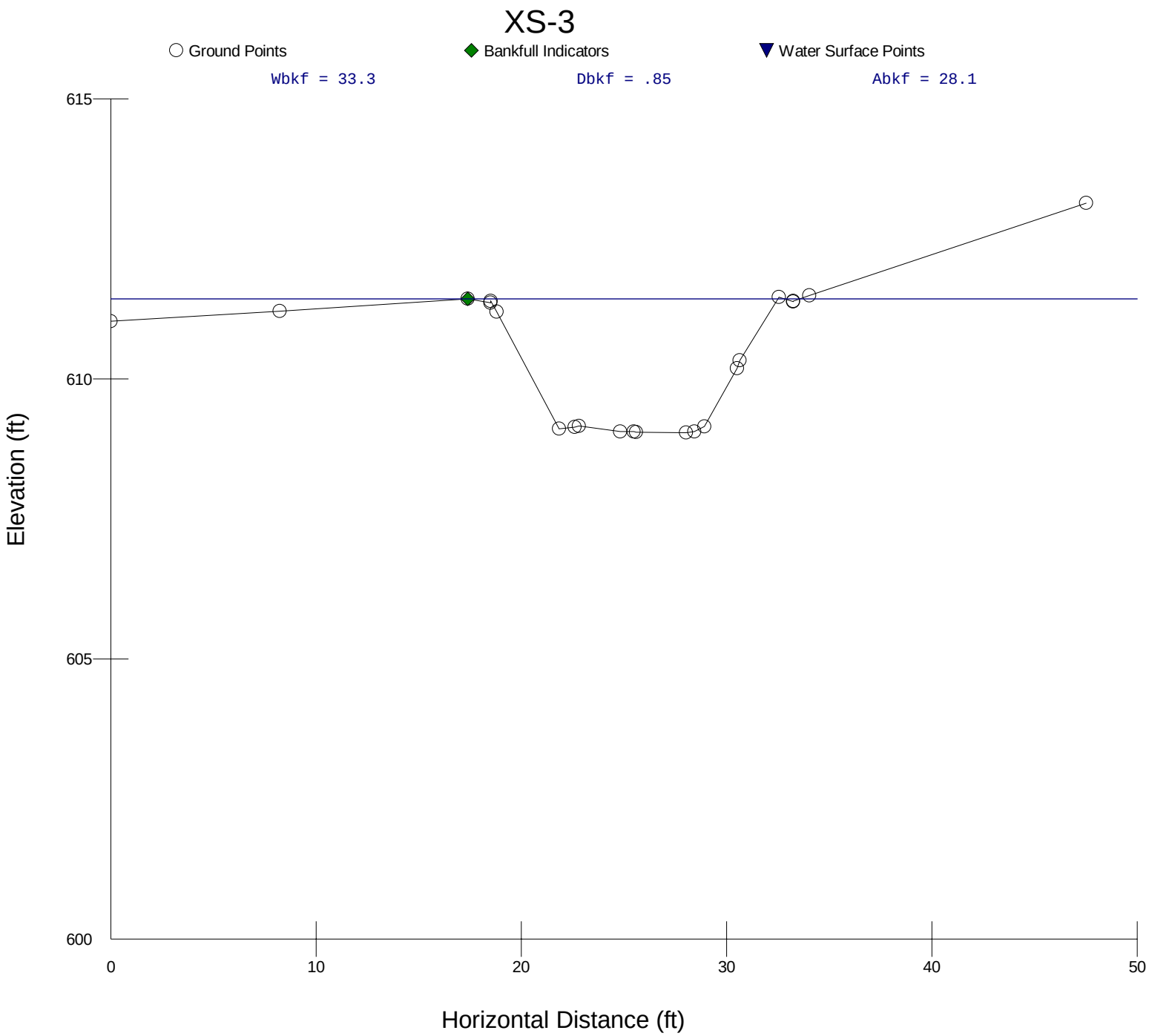


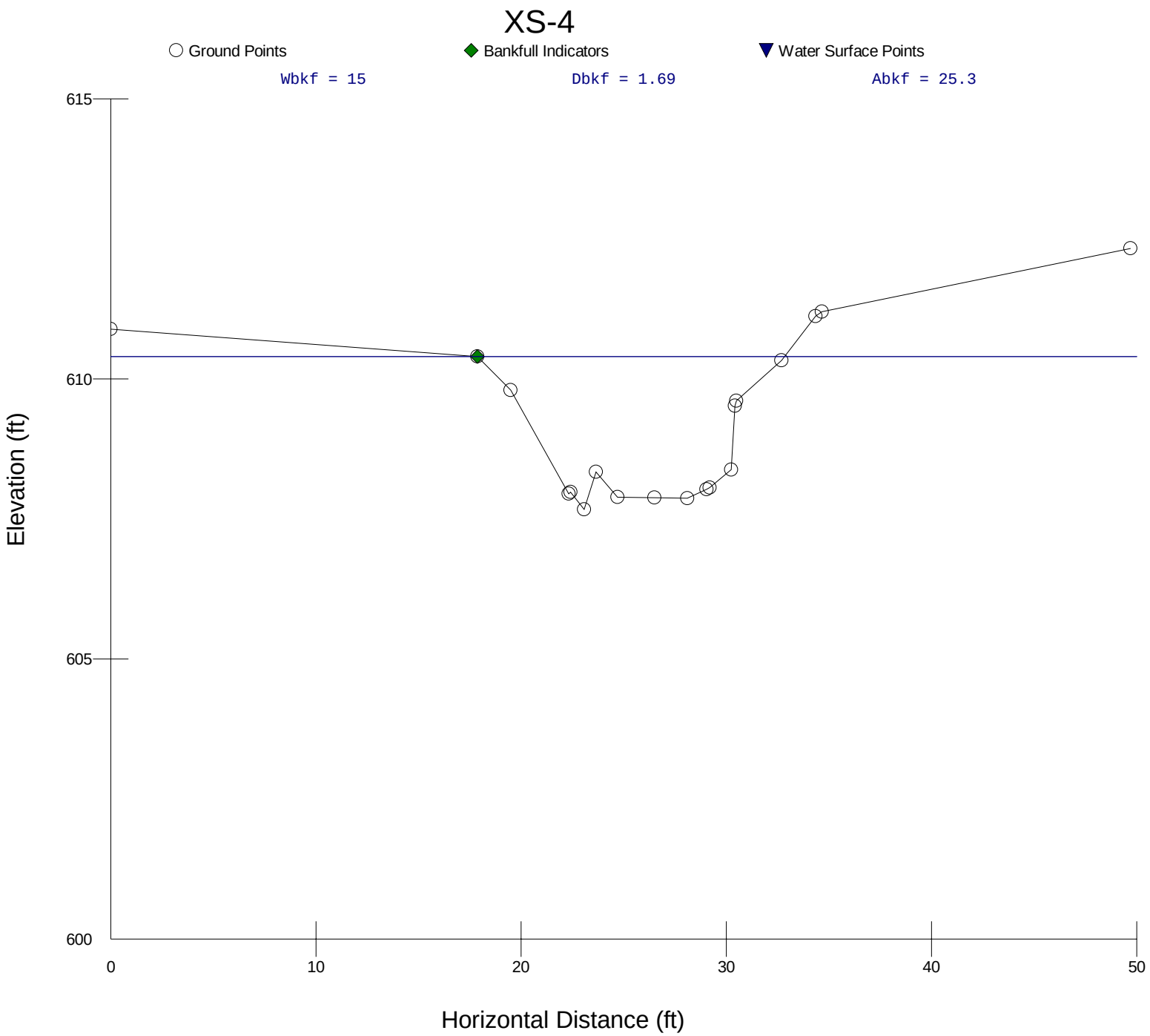

West Branch Long Profile
Elevation (ft)
635
630
625
620
615
610
605
Cross Section 18
Cross Section 17
Cross Section 19
10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
18+00
19+00
20+00
Station (ft)
WS
BKF
Thalweg

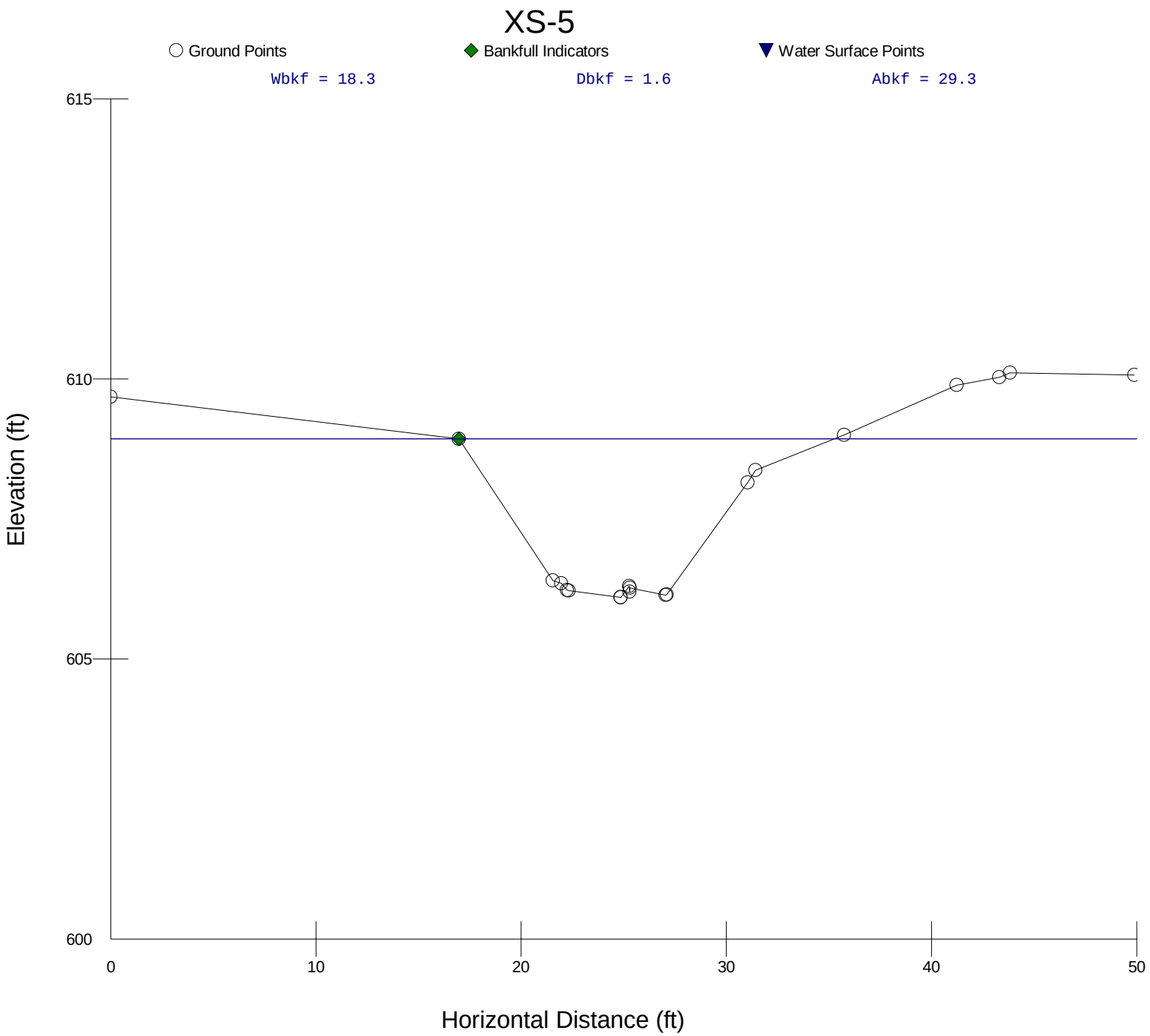

West Branch Long Profile
Elevation (ft)
614
612
610
608
606
604
602
600
Cross Section 21
Cross Section 20
20+00
21+00
22+00
23+00
24+00
25+00
26+00
27+00
28+00
29+00
30+00
Station (ft)
WS
BKF
Thalweg

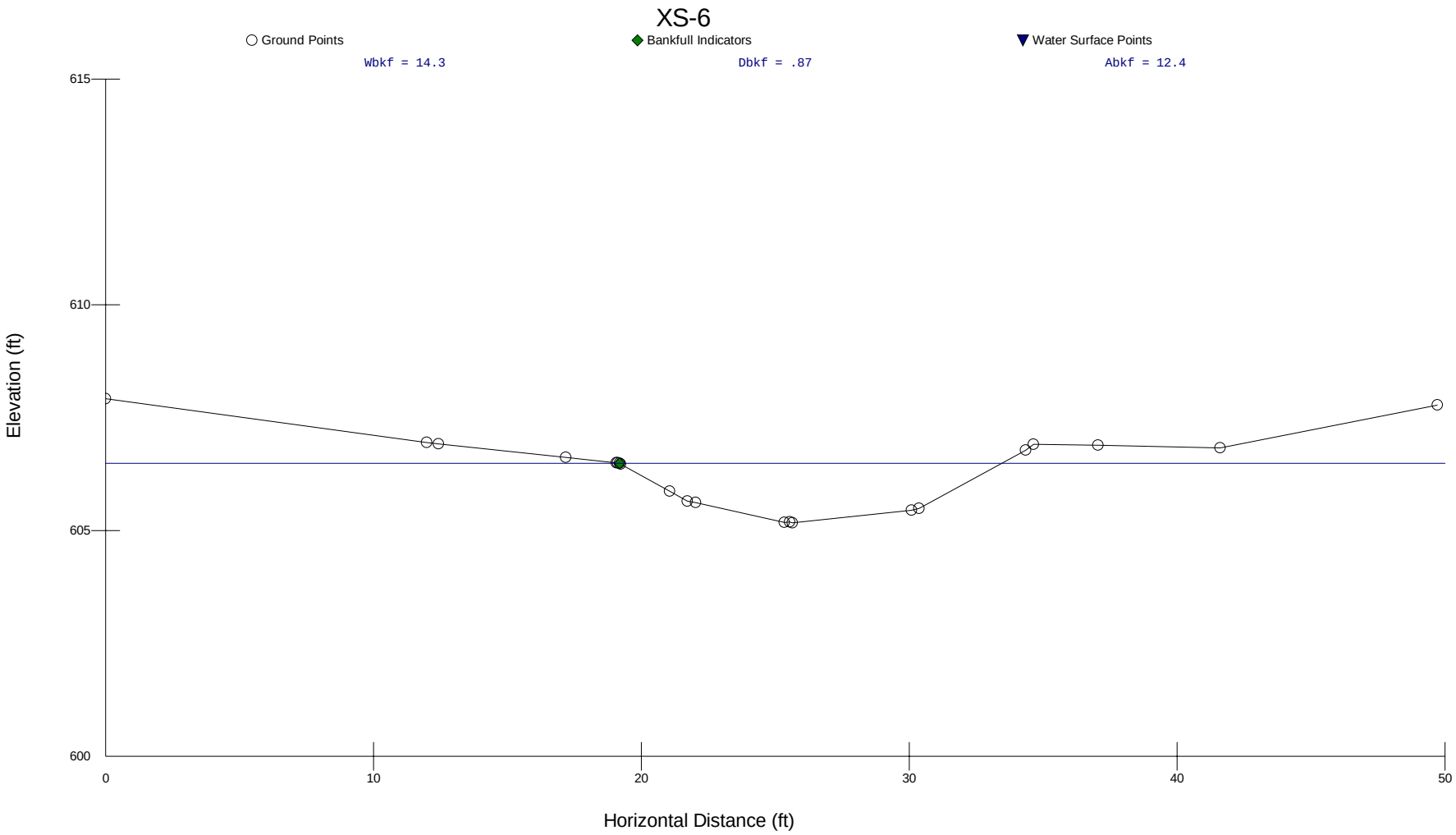

XS-1
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 21.8
Dbkf = 1.47
Abkf = 32
620
615
610
605
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

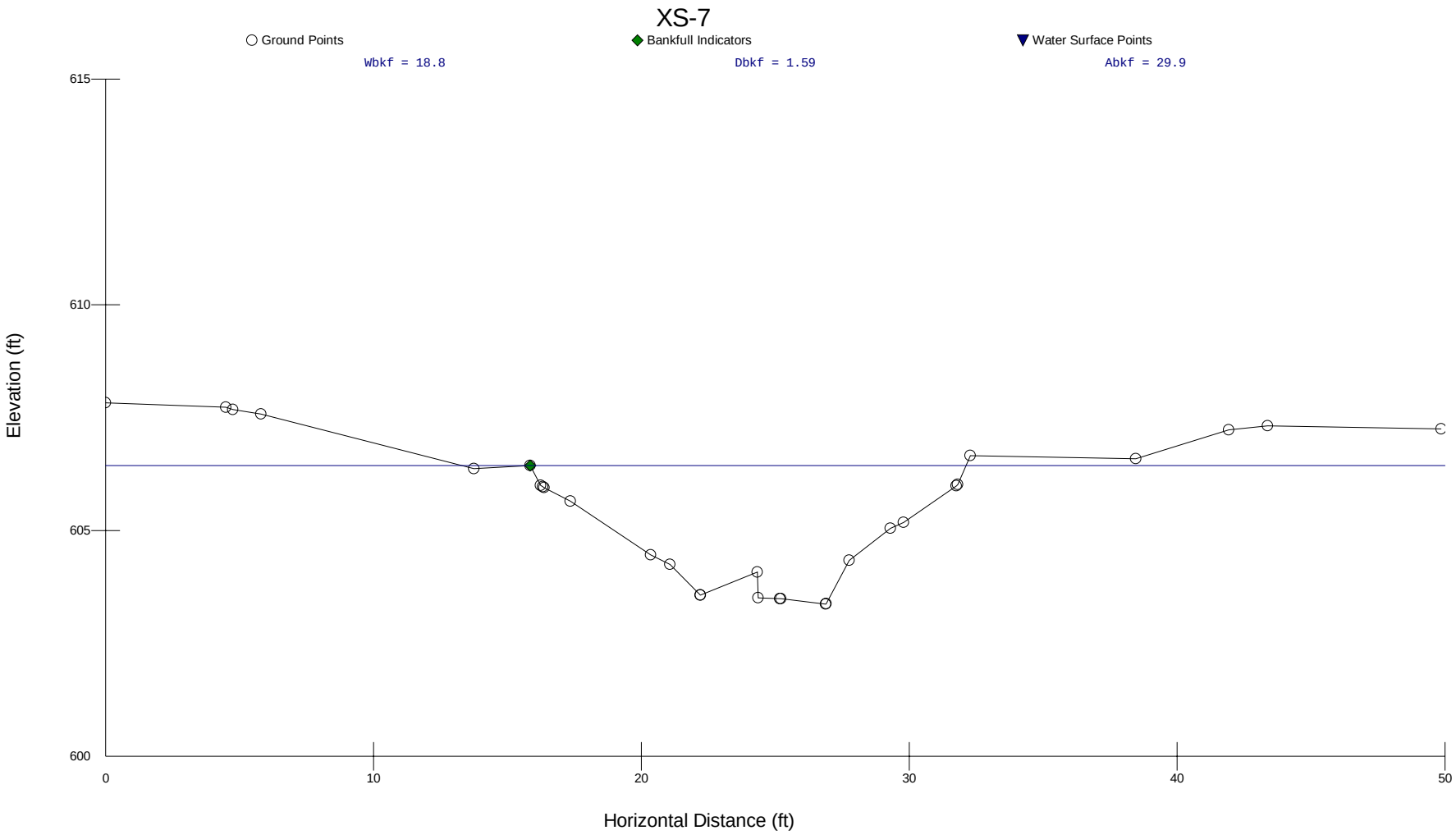

XS-2
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 16.9
Dbkf = 1.01
Abkf = 17
620
615
610
605
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

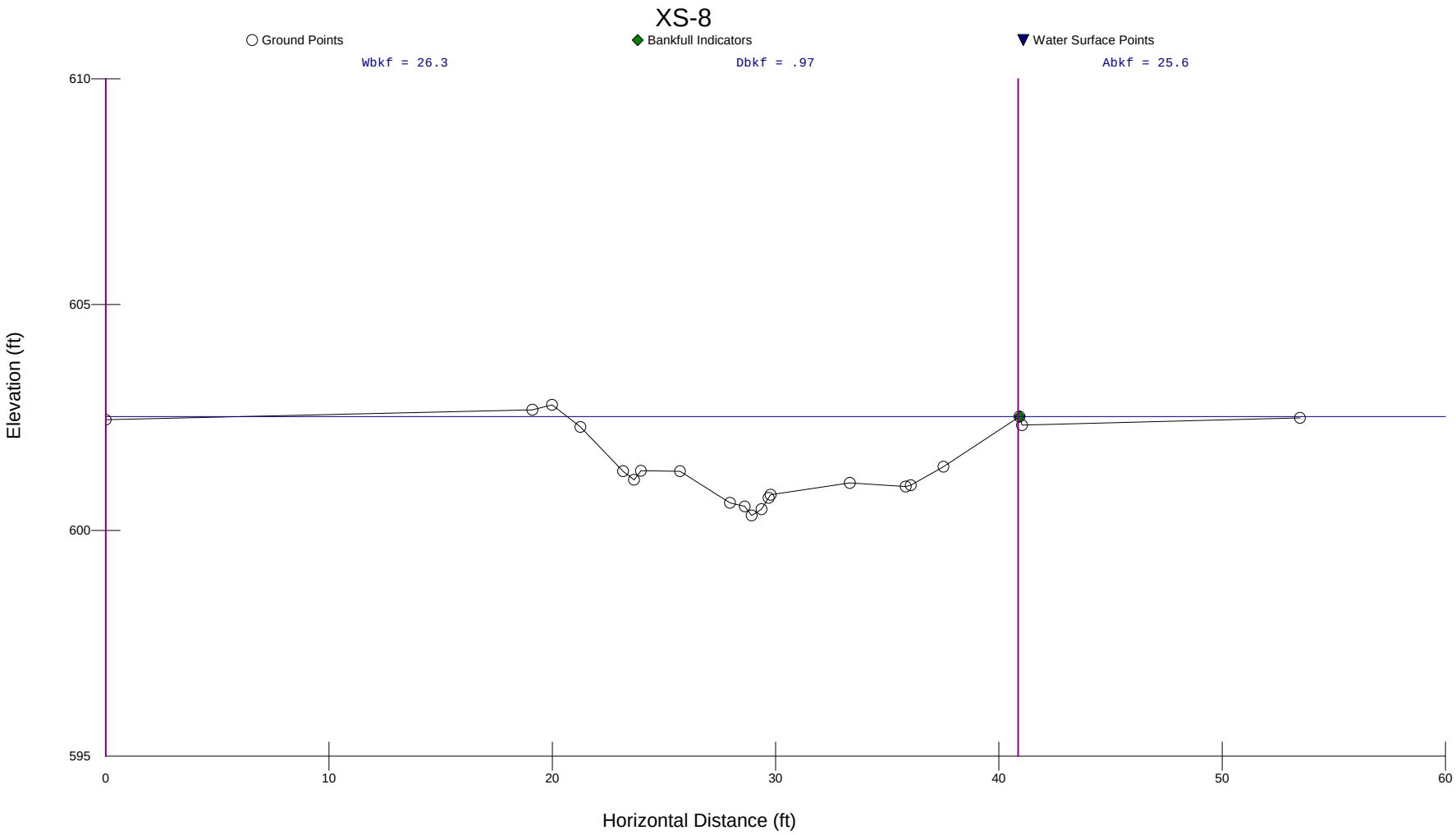

XS-3
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 33.3
Dbkf = .85
Abkf = 28.1
615
610
605
600
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

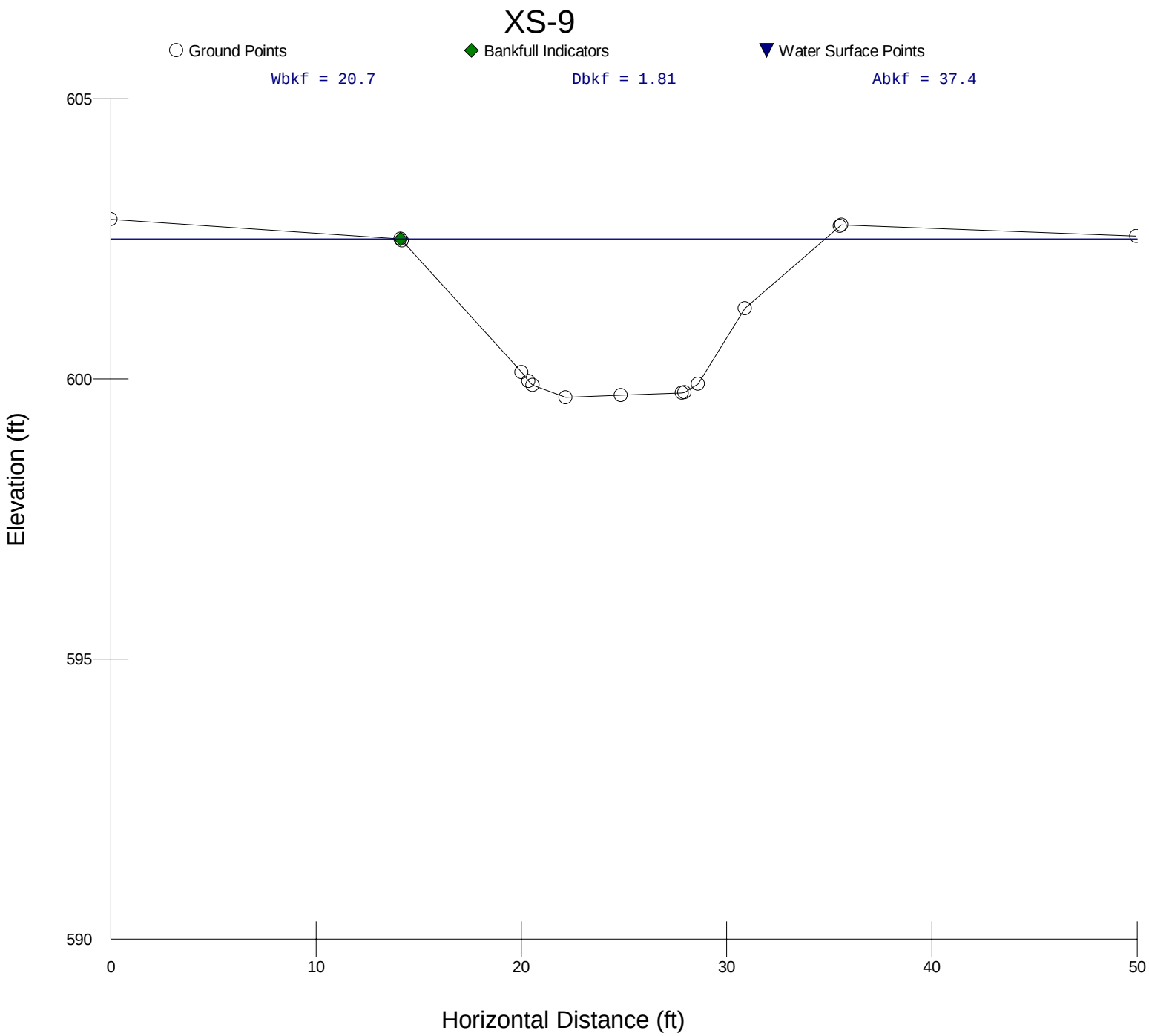

XS-4
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 15
Dbkf = 1.69
Abkf = 25.3
615
610
605
600
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

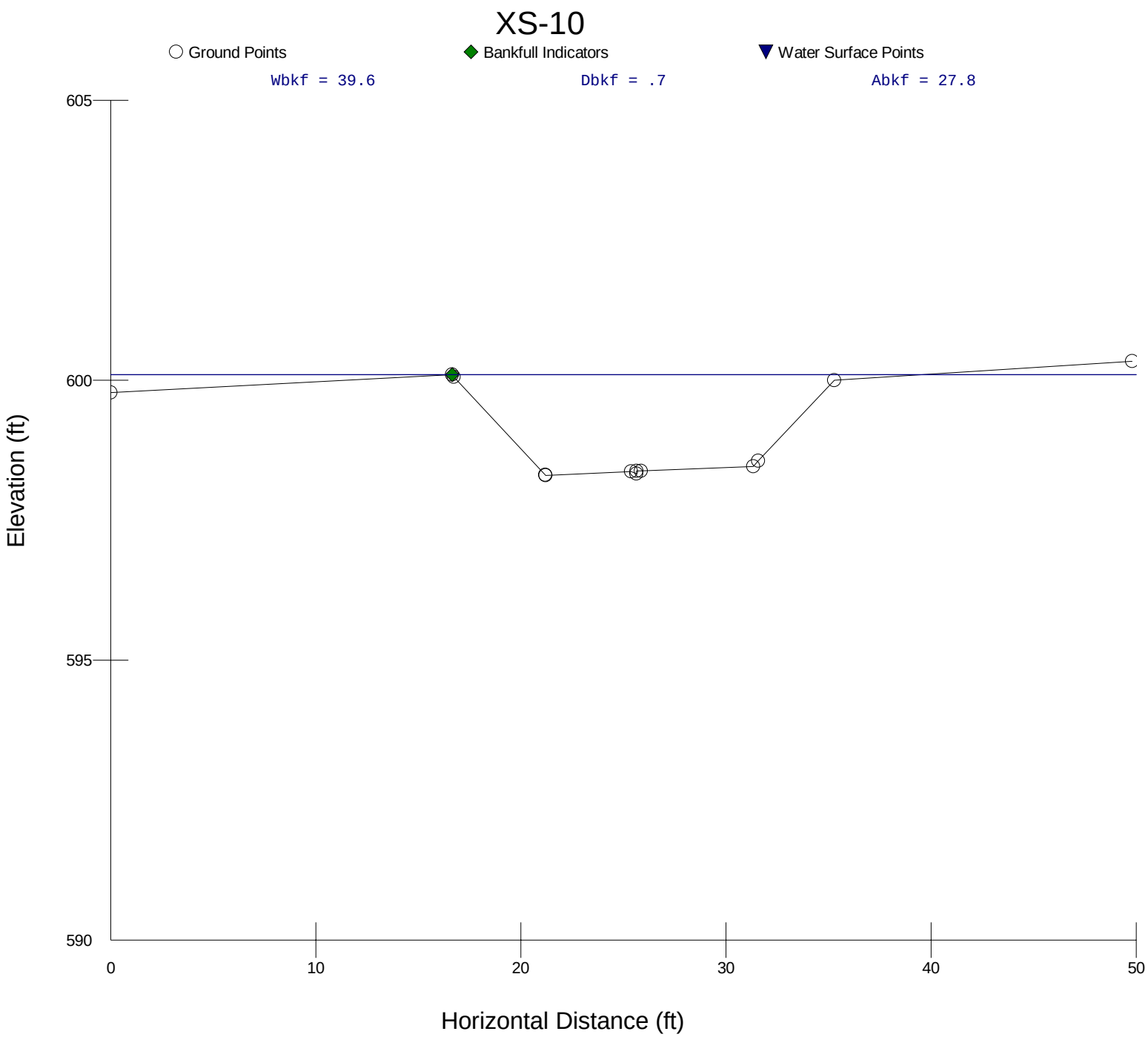

XS-5
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 18.3
Dbkf = 1.6
Abkf = 29.3
615
610
605
600
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

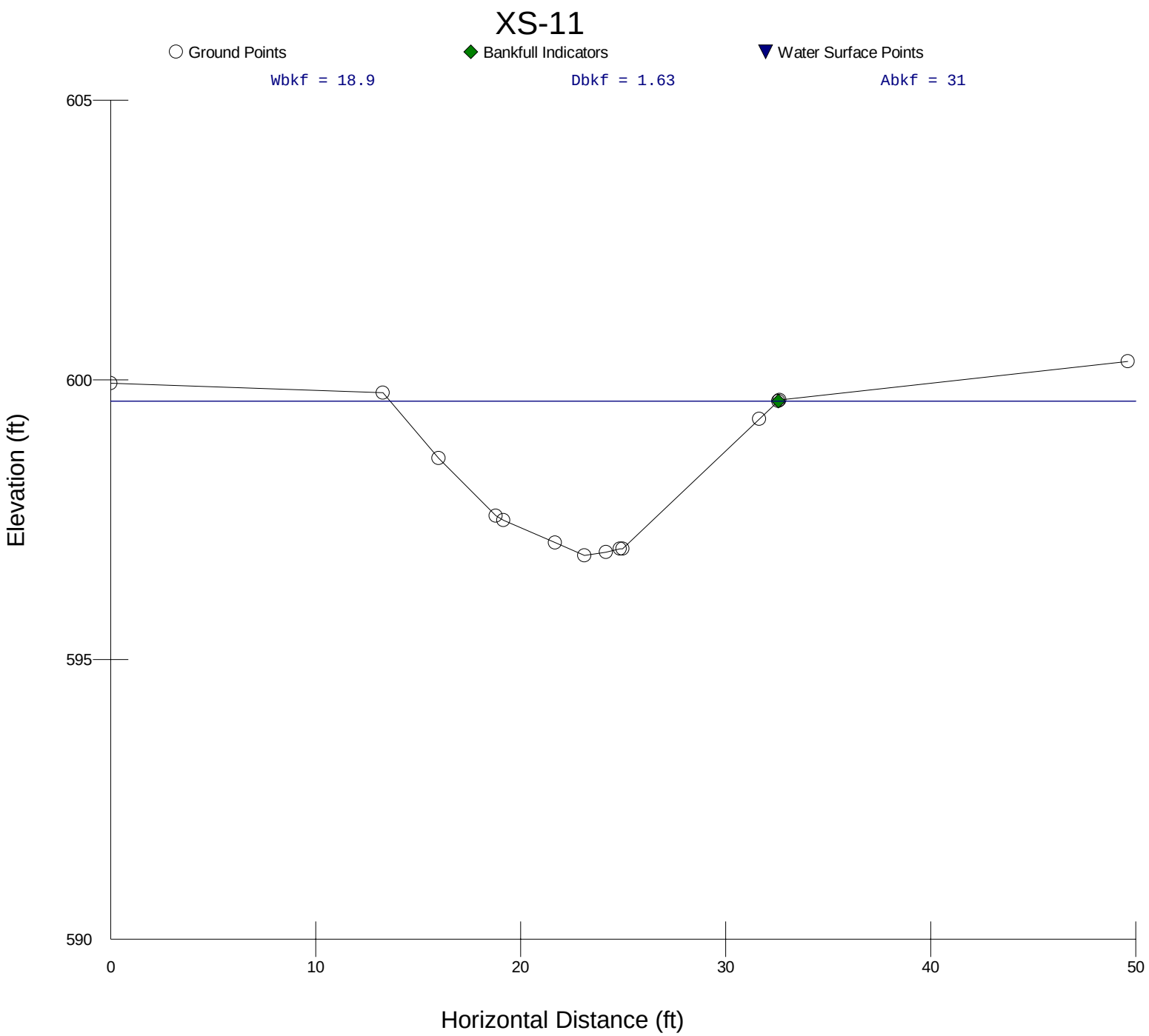

XS-6
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 14.3
Dbkf = .87
Abkf = 12.4
615
610
605
600
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

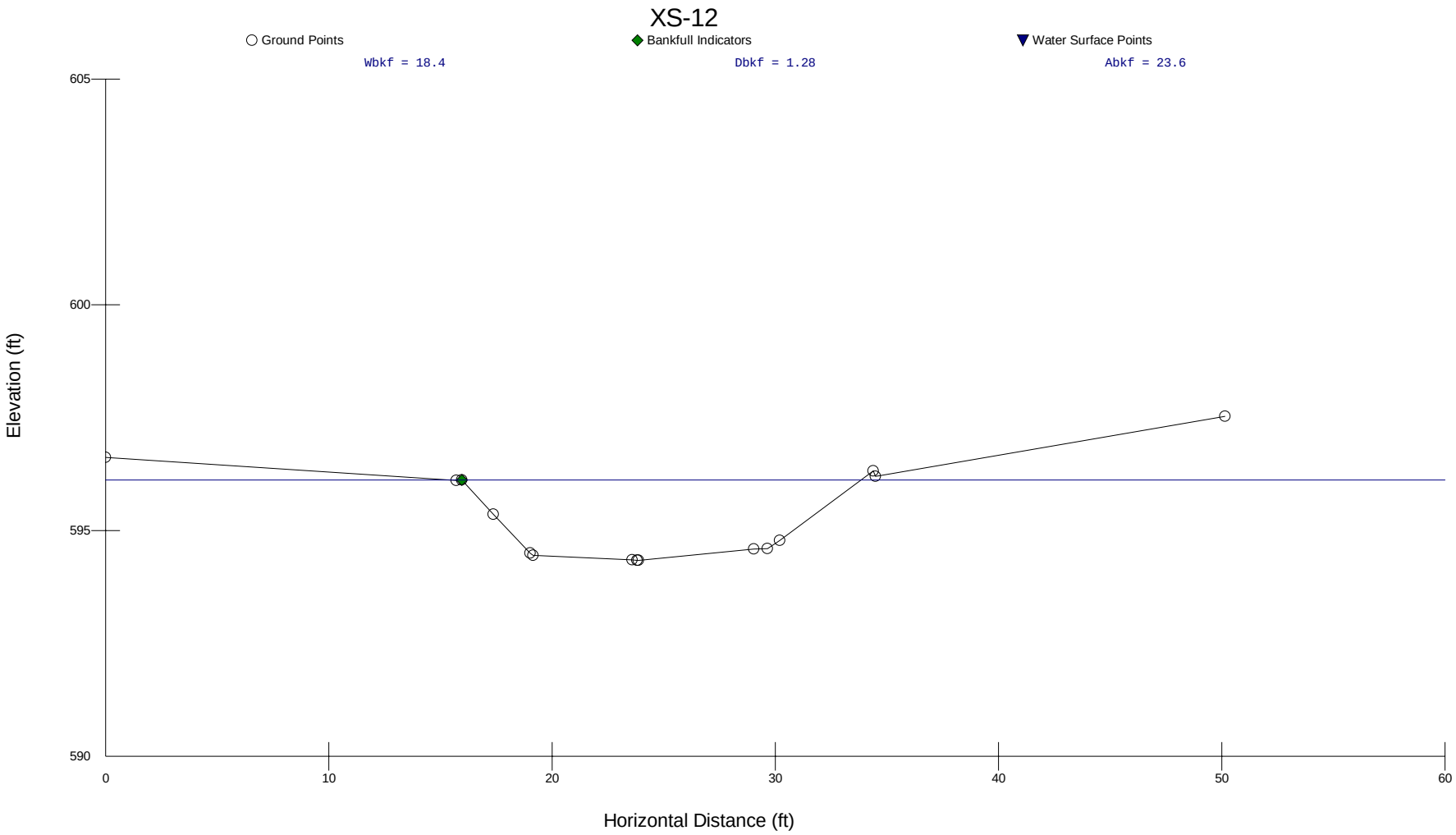

XS-7
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 18.8
Dbkf = 1.59
Abkf = 29.9
615
610
605
600
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

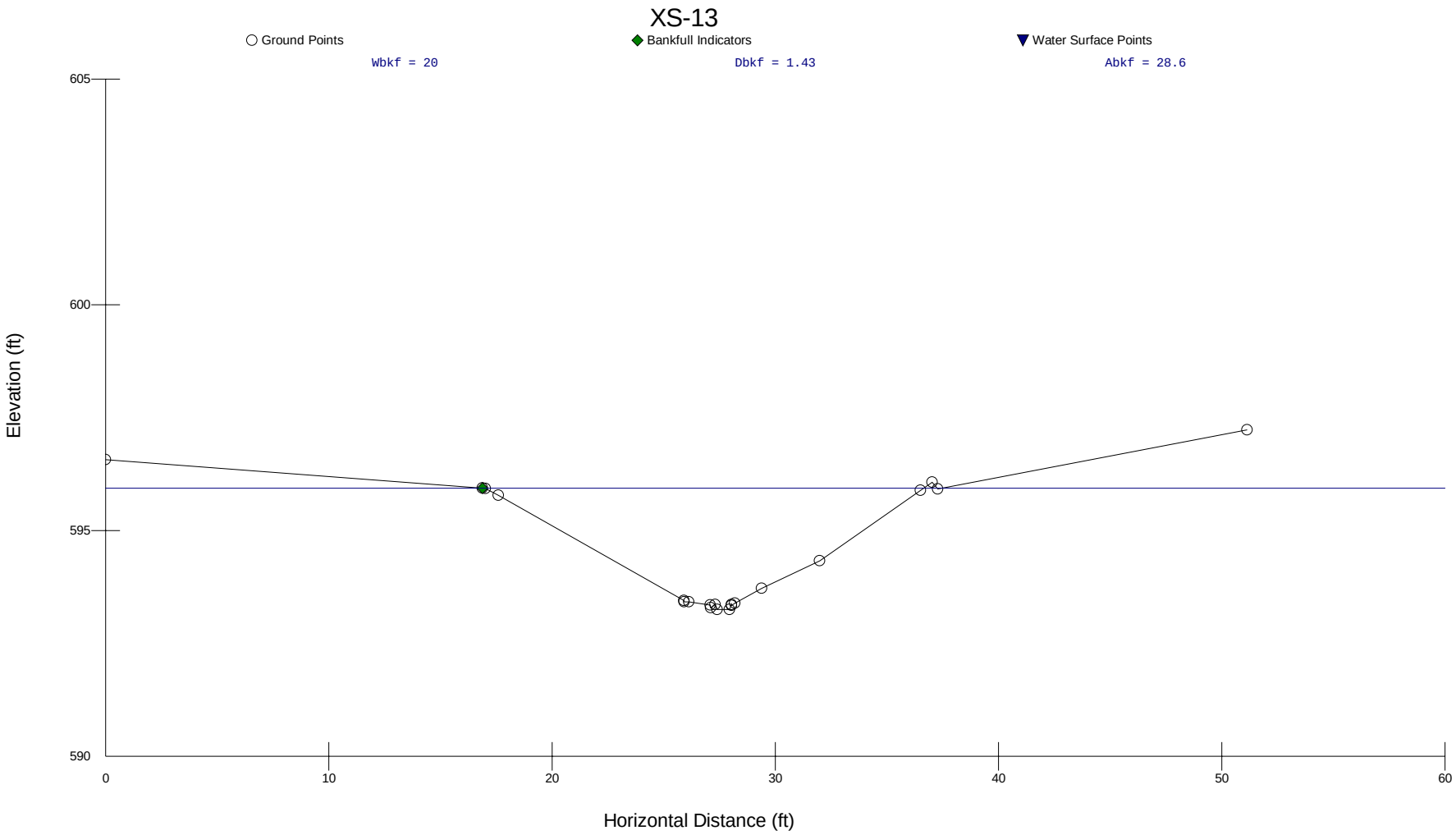

XS-8
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 26.3
Dbkf = .97
Abkf = 25.6
610
605
600
595
Elevation (ft)
0
10
20
30
40
50
60
Horizontal Distance (ft)

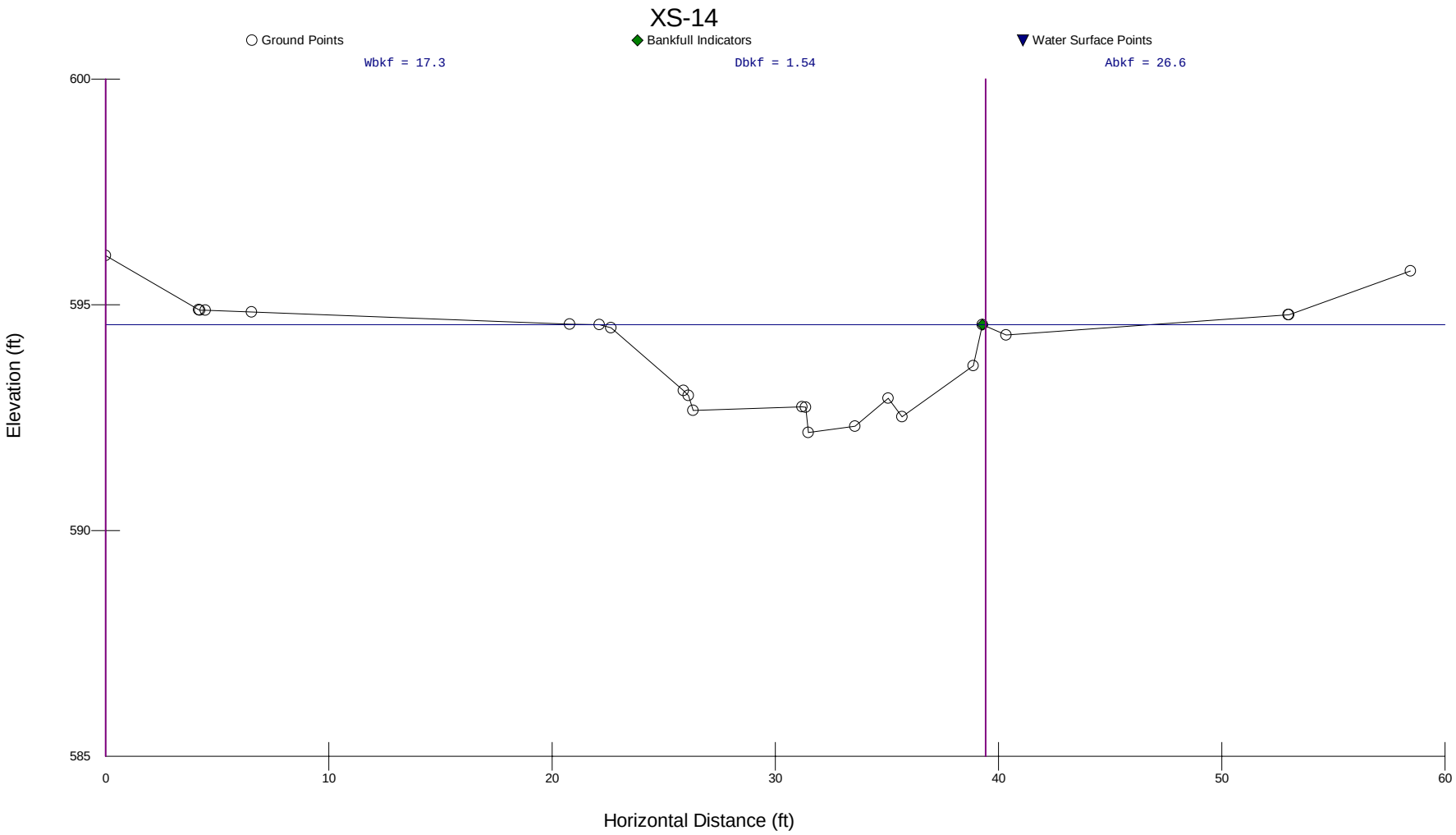

XS-9
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 20.7
Dbkf = 1.81
Abkf = 37.4
605
600
595
590
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

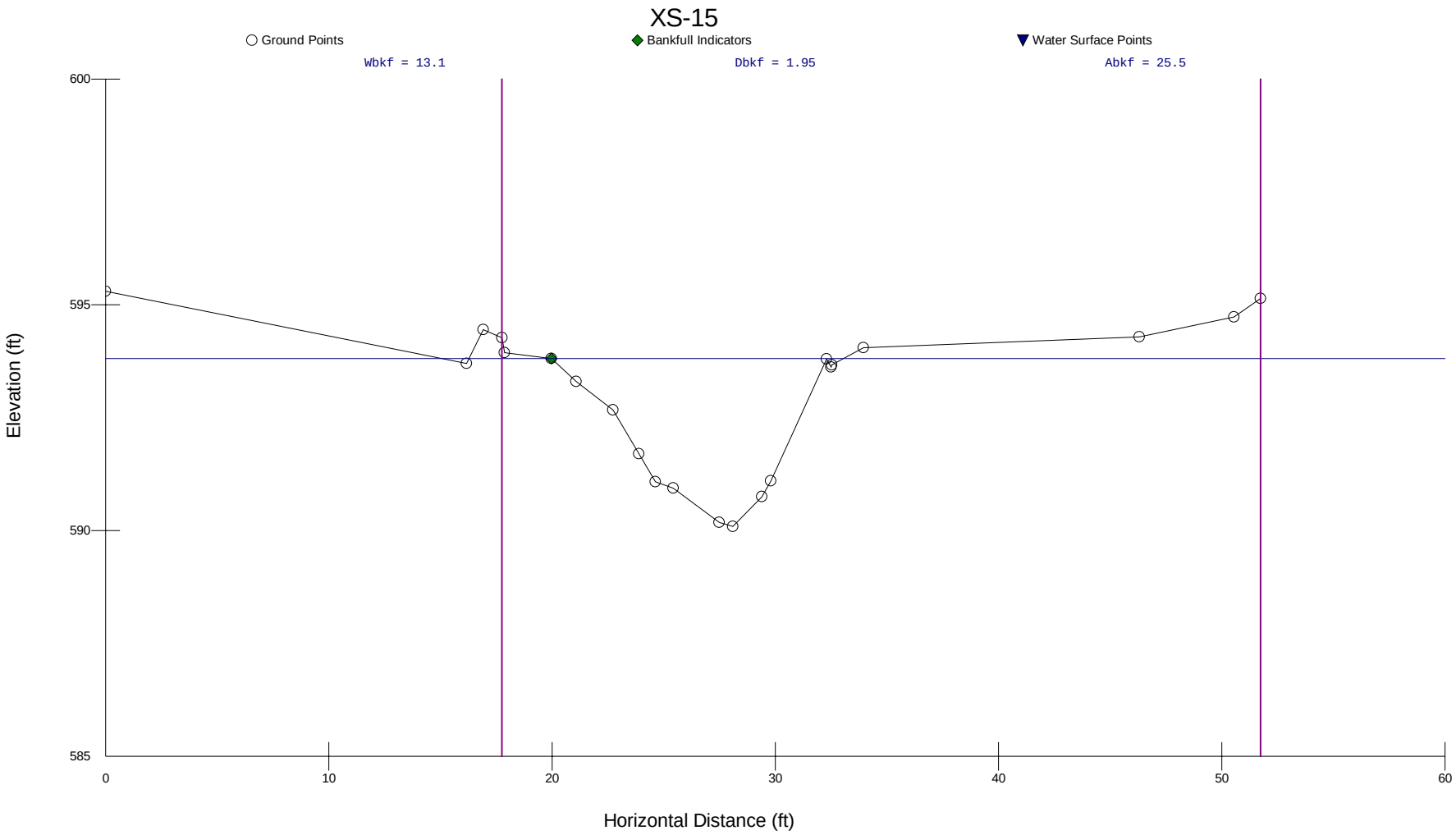

XS-10
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 39.6
Dbkf = .7
Abkf = 27.8
605
600
595
590
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

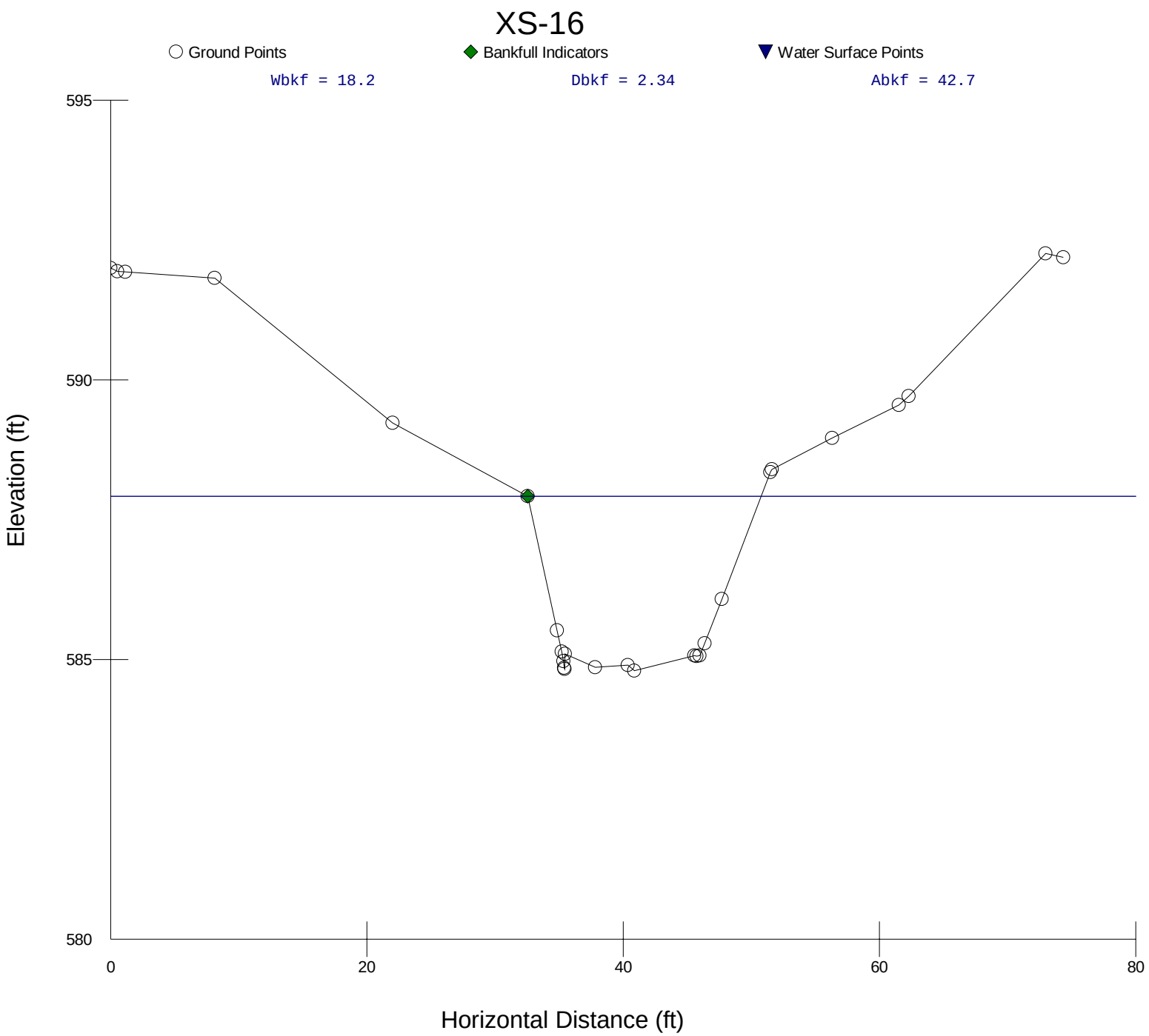

XS-11
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 18.9
Dbkf = 1.63
Abkf = 31
605
600
595
590
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

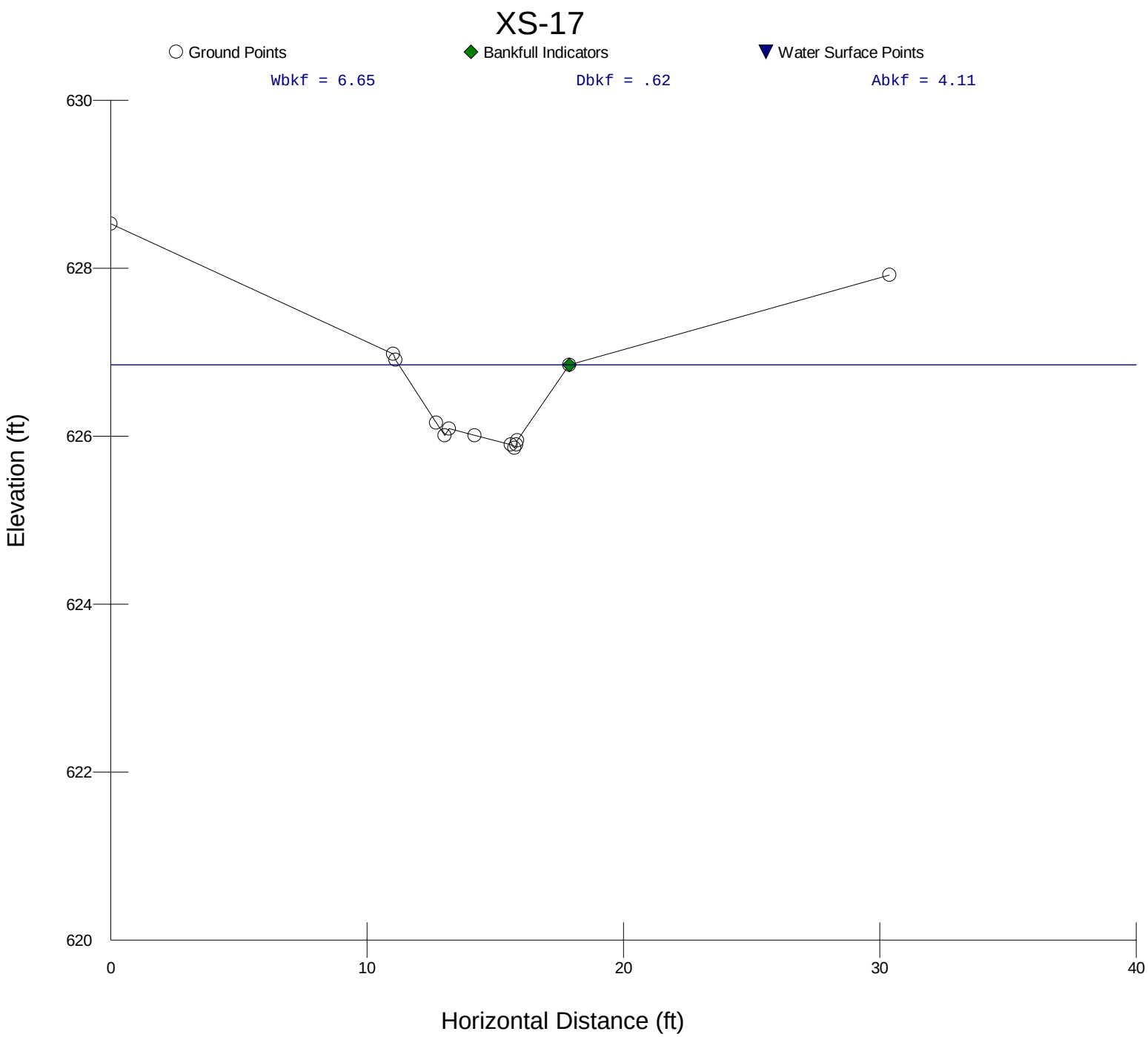

XS-12
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 18.4
Dbkf = 1.28
Abkf = 23.6
605
600
595
590
Elevation (ft)
0
10
20
30
40
50
60
Horizontal Distance (ft)

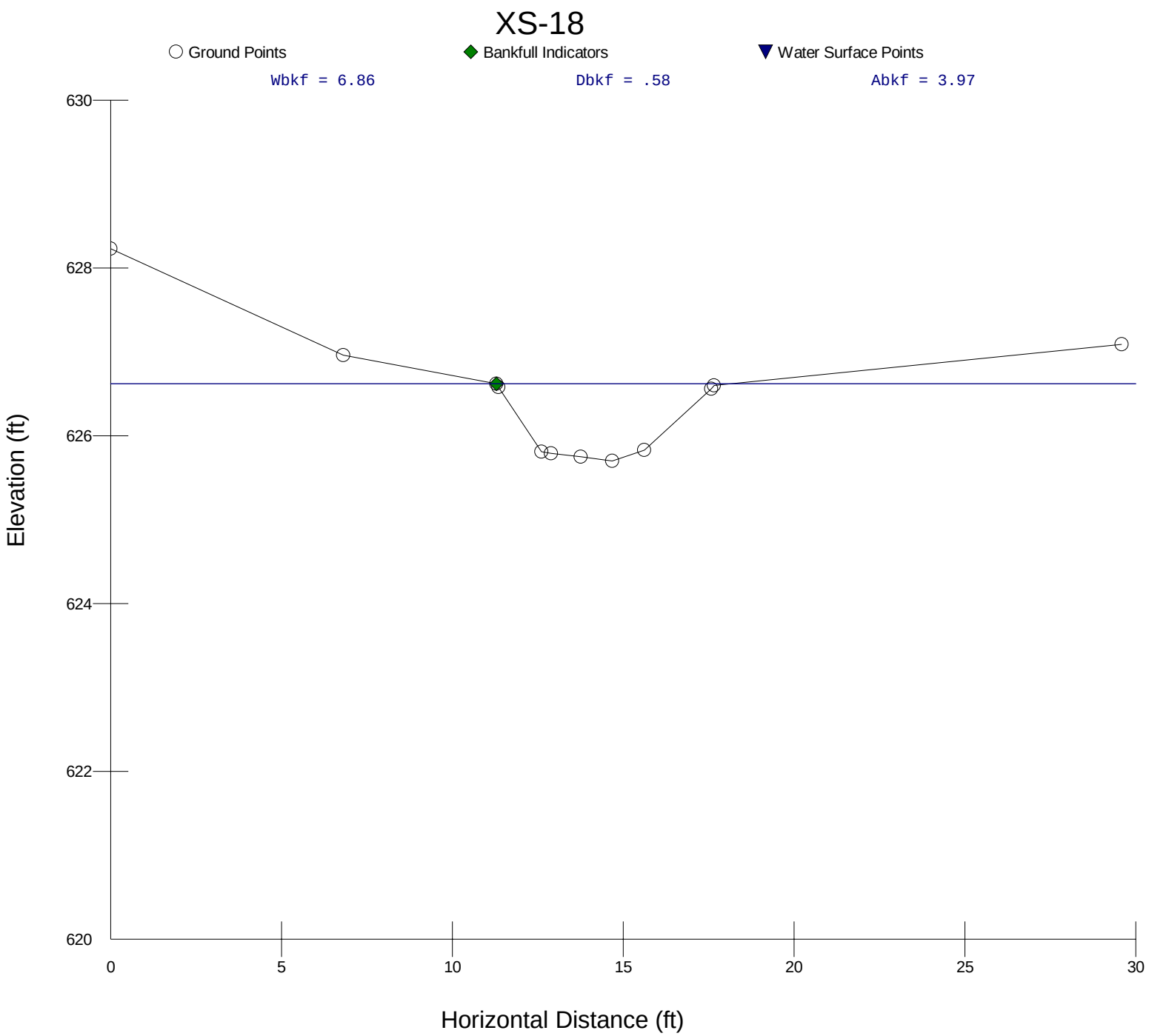

XS-13
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 20
Dbkf = 1.43
Abkf = 28.6
605
600
595
590
Elevation (ft)
0
10
20
30
40
50
60
Horizontal Distance (ft)

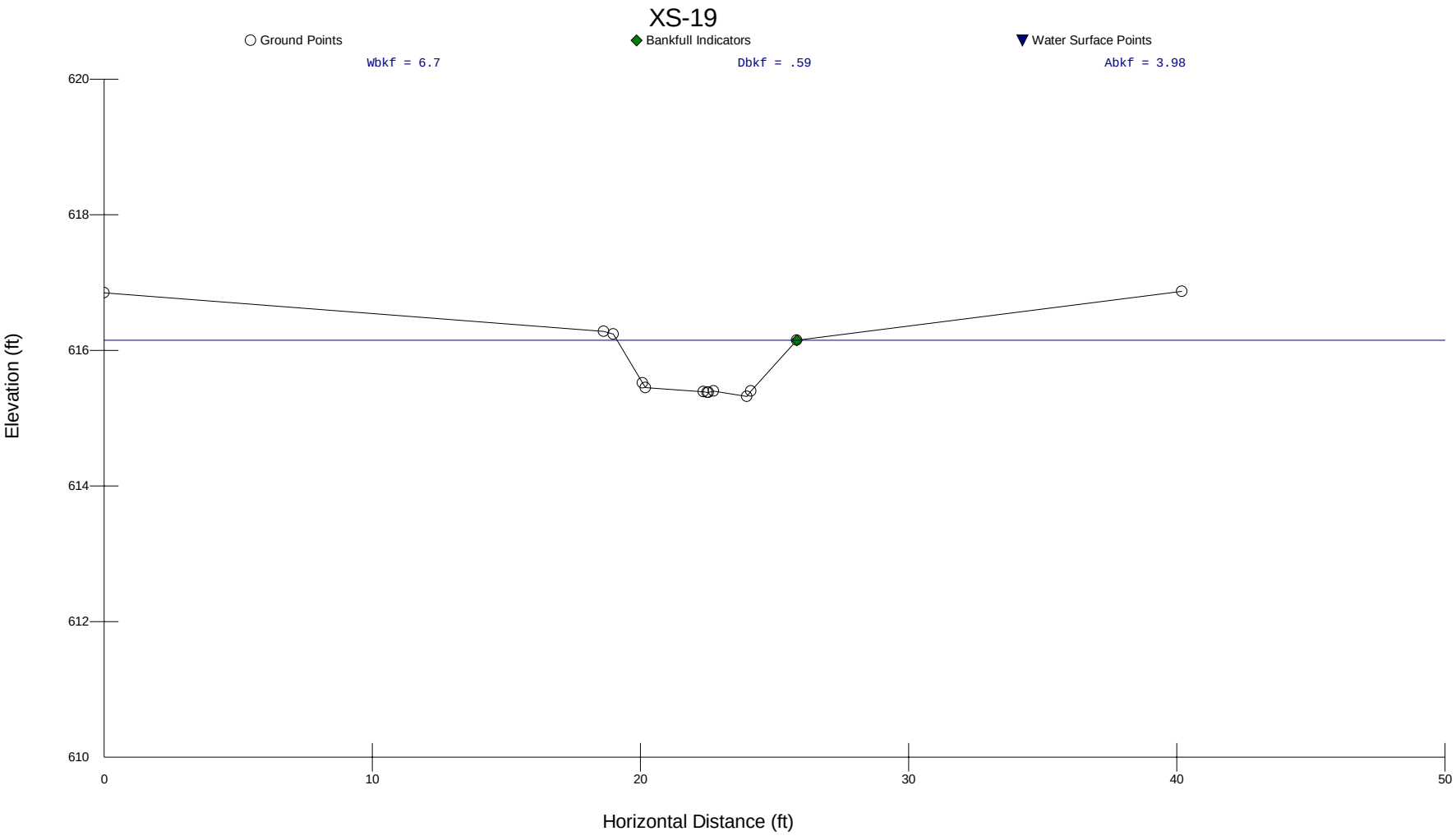

XS-14
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 17.3
Dbkf = 1.54
Abkf = 26.6
600
595
590
585
Elevation (ft)
0
10
20
30
40
50
60
Horizontal Distance (ft)

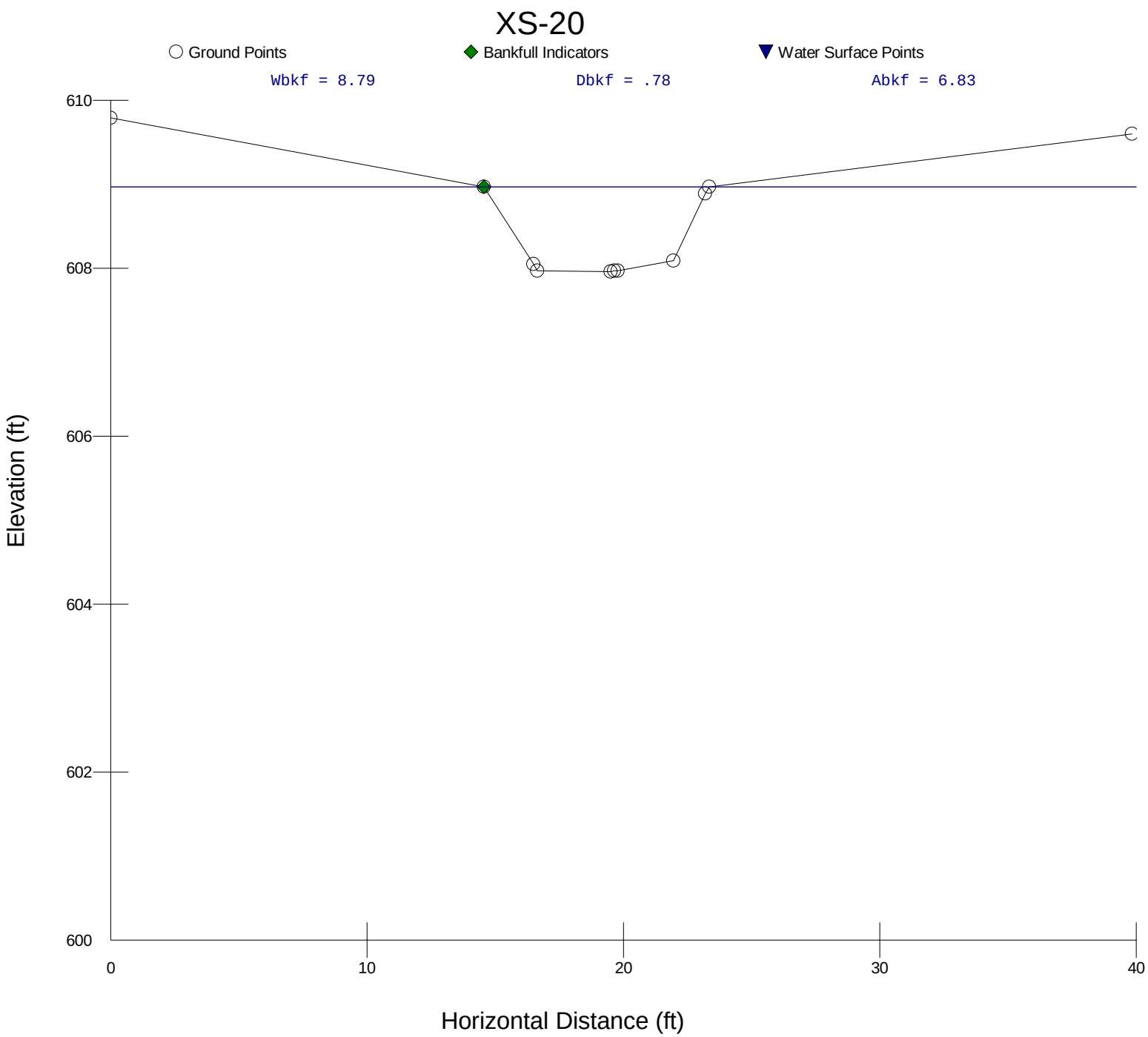

XS-15
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 13.1
Dbkf = 1.95
Abkf = 25.5
600
595
590
585
Elevation (ft)
0
10
20
30
40
50
60
Horizontal Distance (ft)

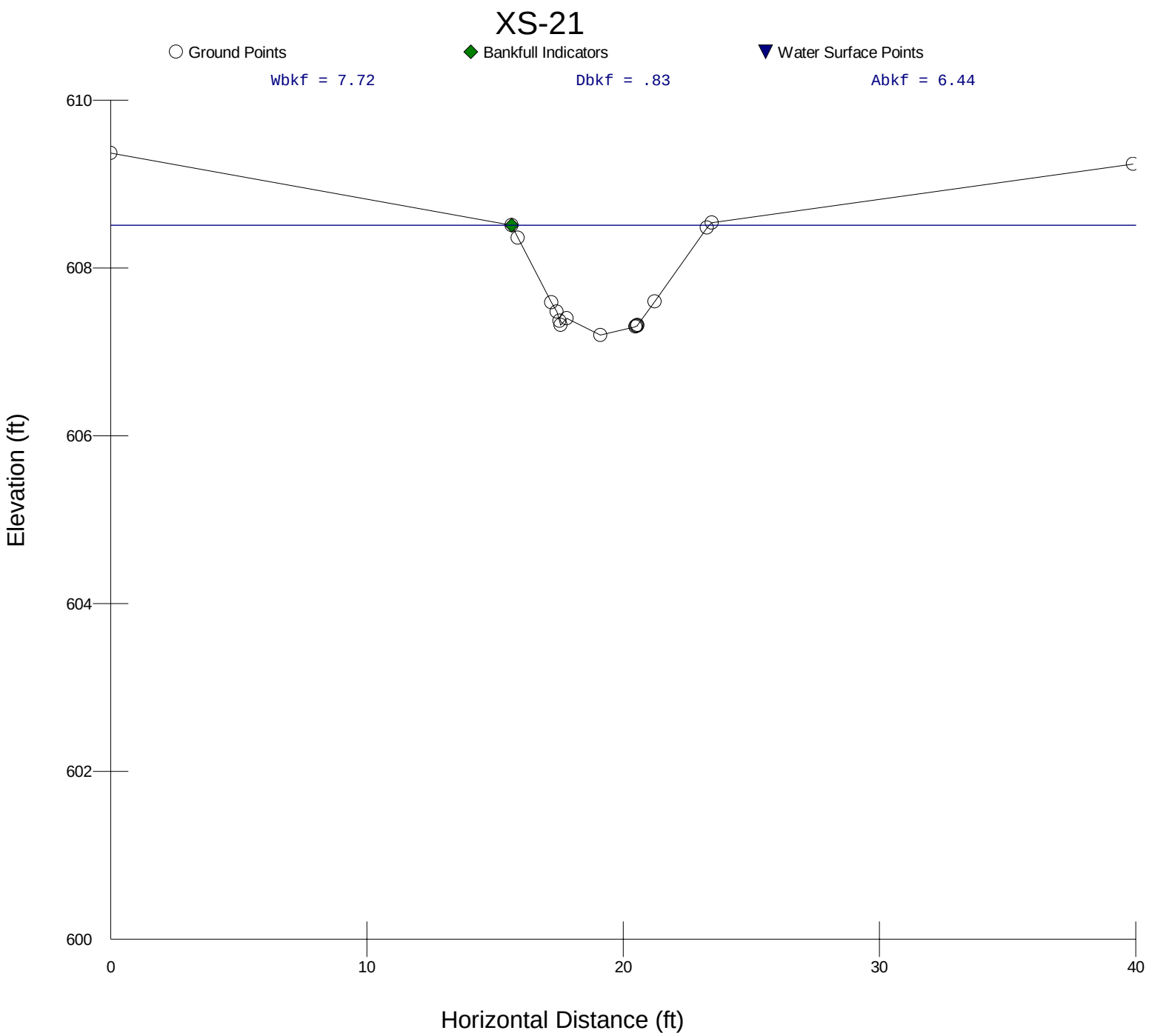

XS-16
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 18.2
Dbkf = 2.34
Abkf = 42.7
595
590
585
580
Elevation (ft)
0
20
40
60
80
Horizontal Distance (ft)

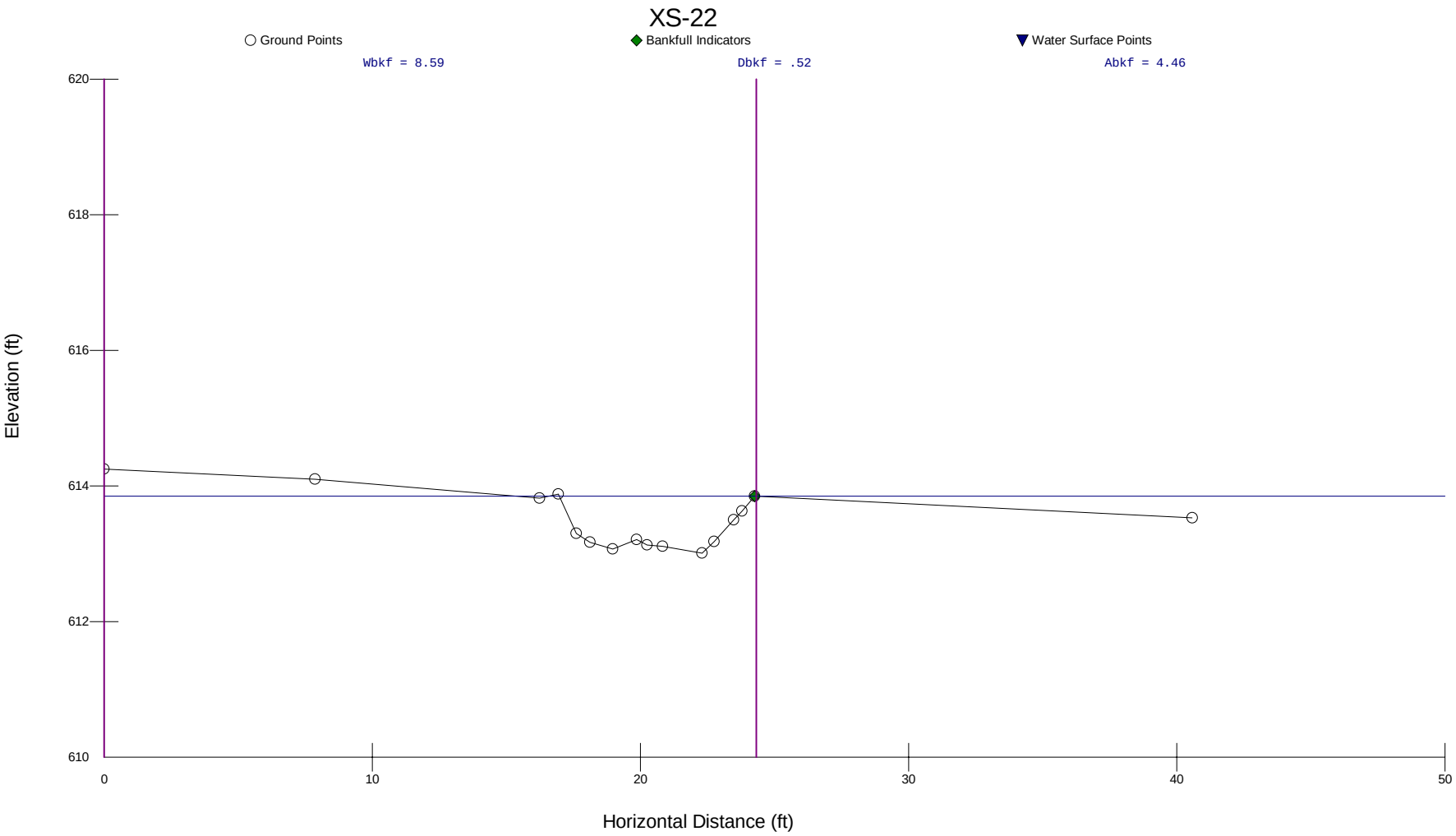

XS-17
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 6.65
Dbkf = .62
Abkf = 4.11
630
628
626
624
622
620
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)

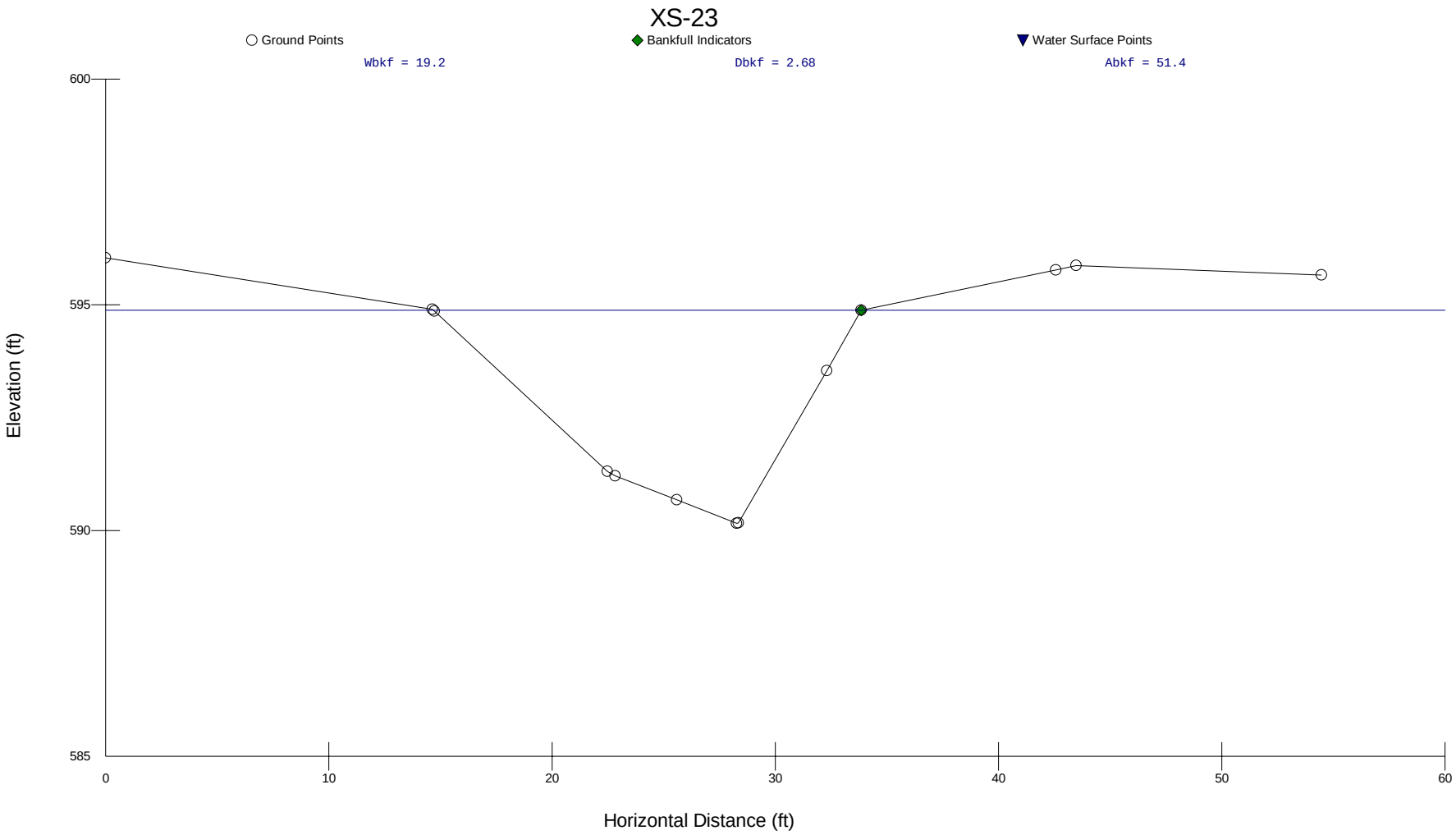

XS-18
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 6.86
Dbkf = .58
Abkf = 3.97
630
628
626
624
622
620
Elevation (ft)
0
5
10
15
20
25
30
Horizontal Distance (ft)

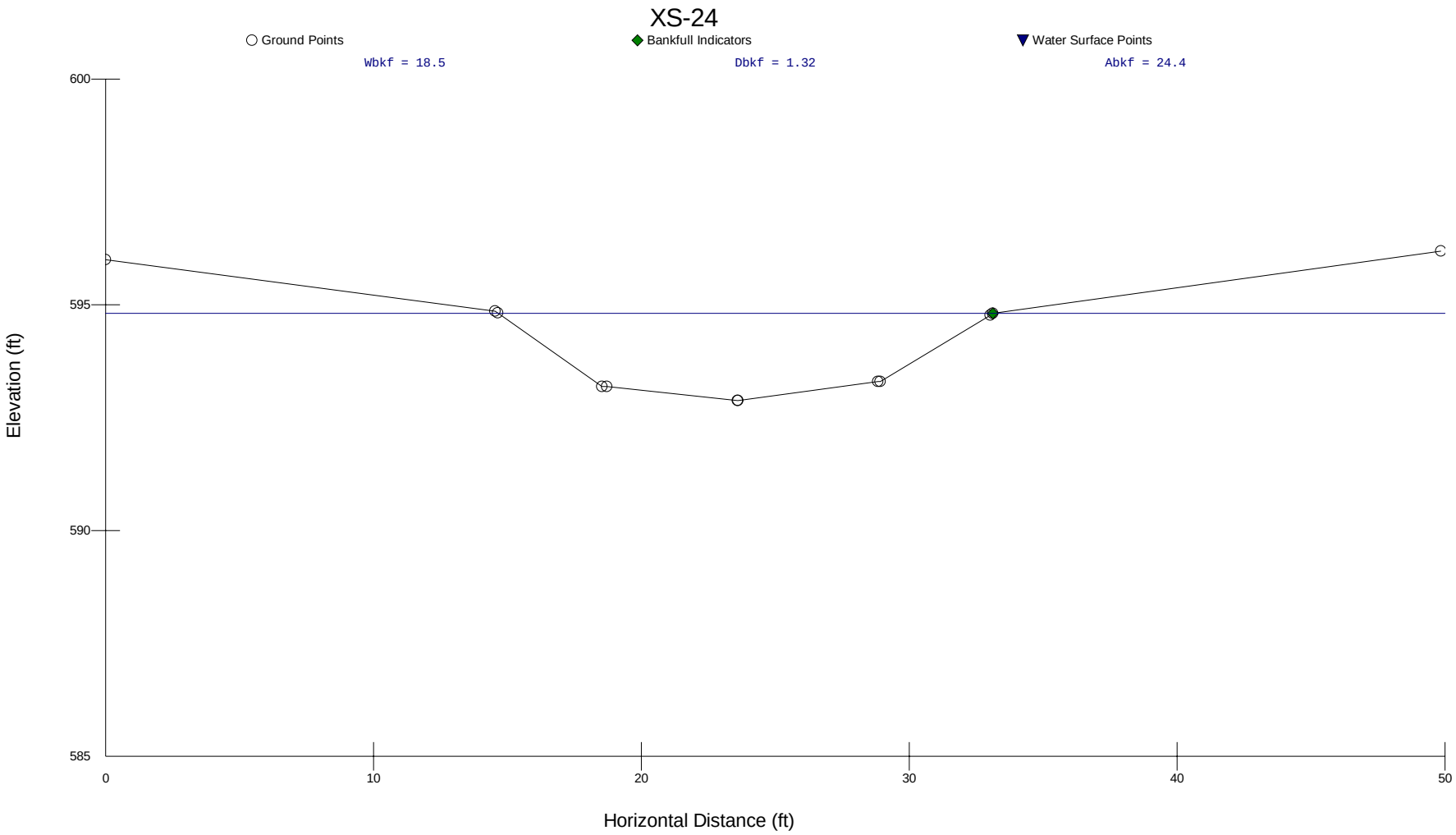

XS-19
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 6.7
Dbkf = .59
Abkf = 3.98
620
618
616
614
612
610
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

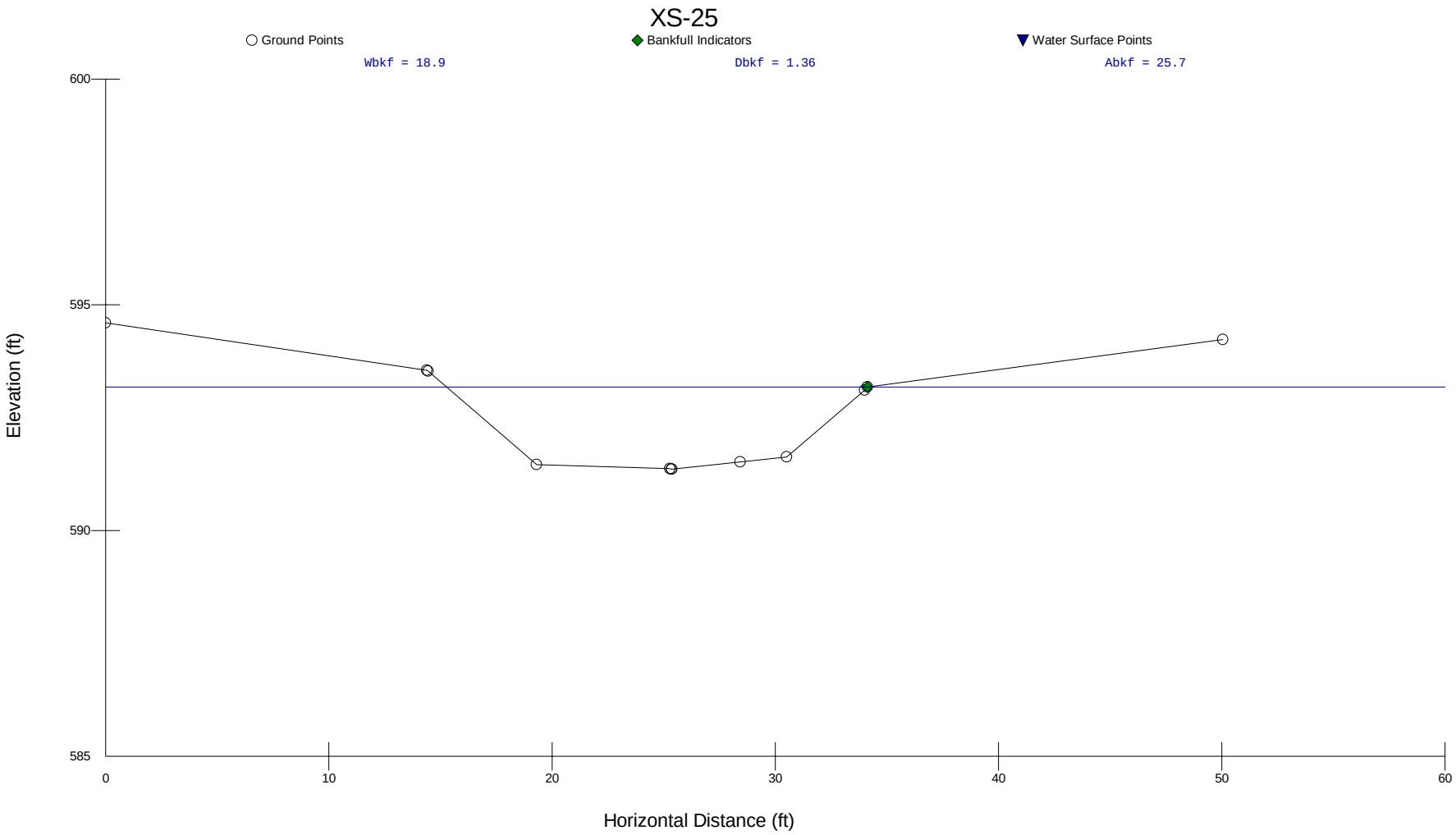

XS-20
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 8.79
Dbkf = .78
Abkf = 6.83
610
608
606
604
602
600
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)

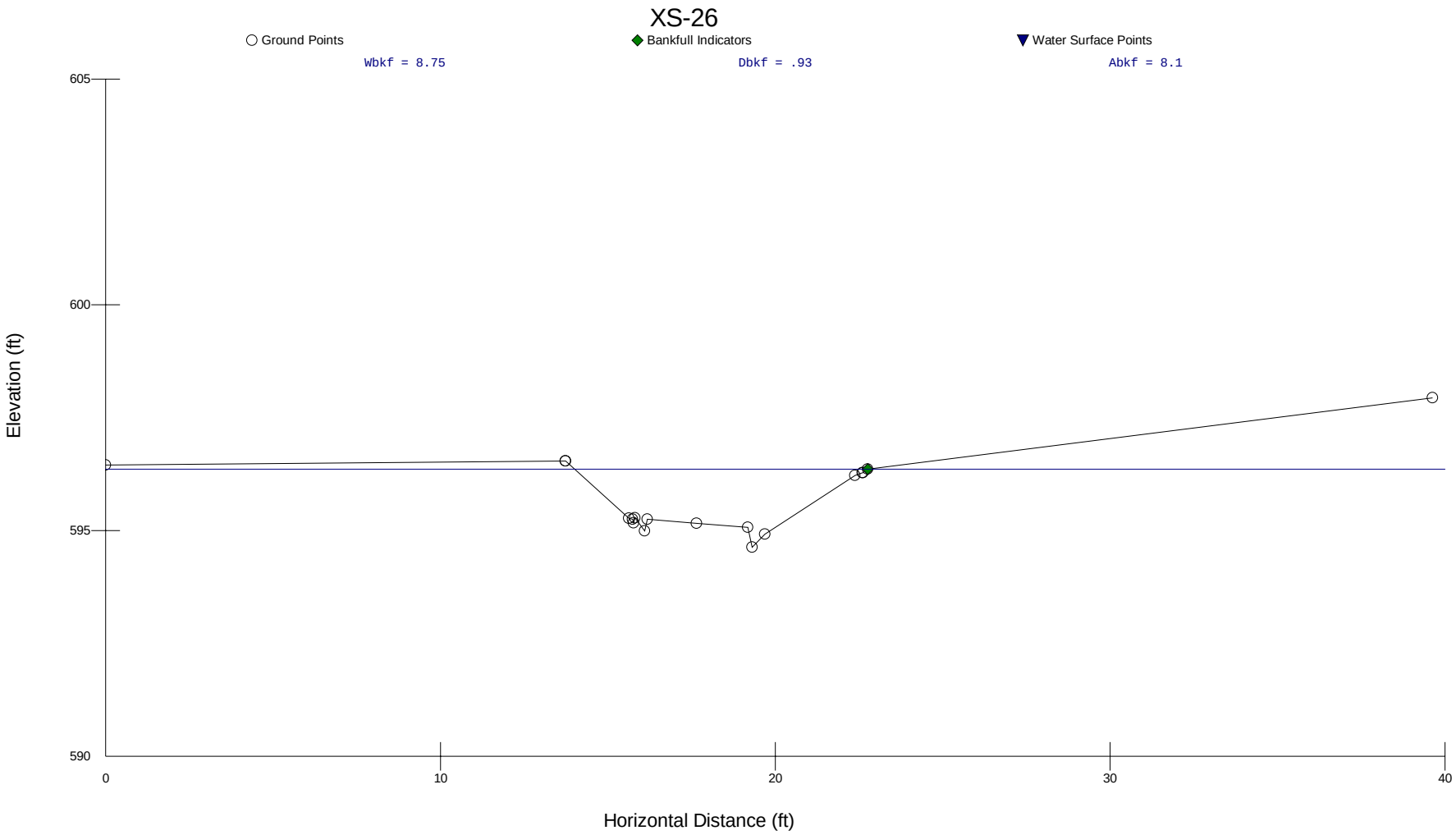

XS-21
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 7.72
Dbkf = .83
Abkf = 6.44
610
608
606
604
602
600
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)

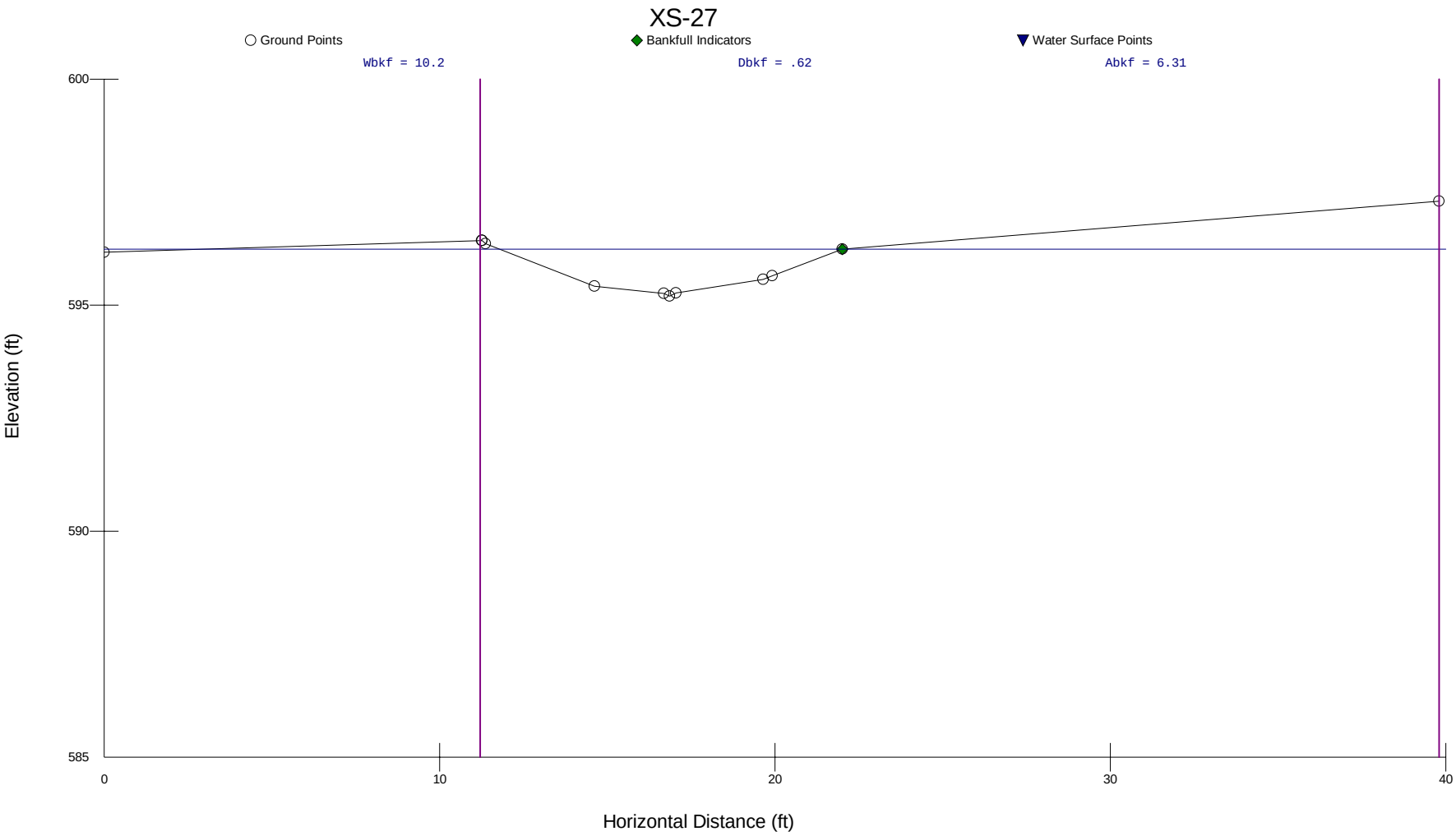

XS-22
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 8.59
Dbkf = .52
Abkf = 4.46
620
618
616
614
612
610
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

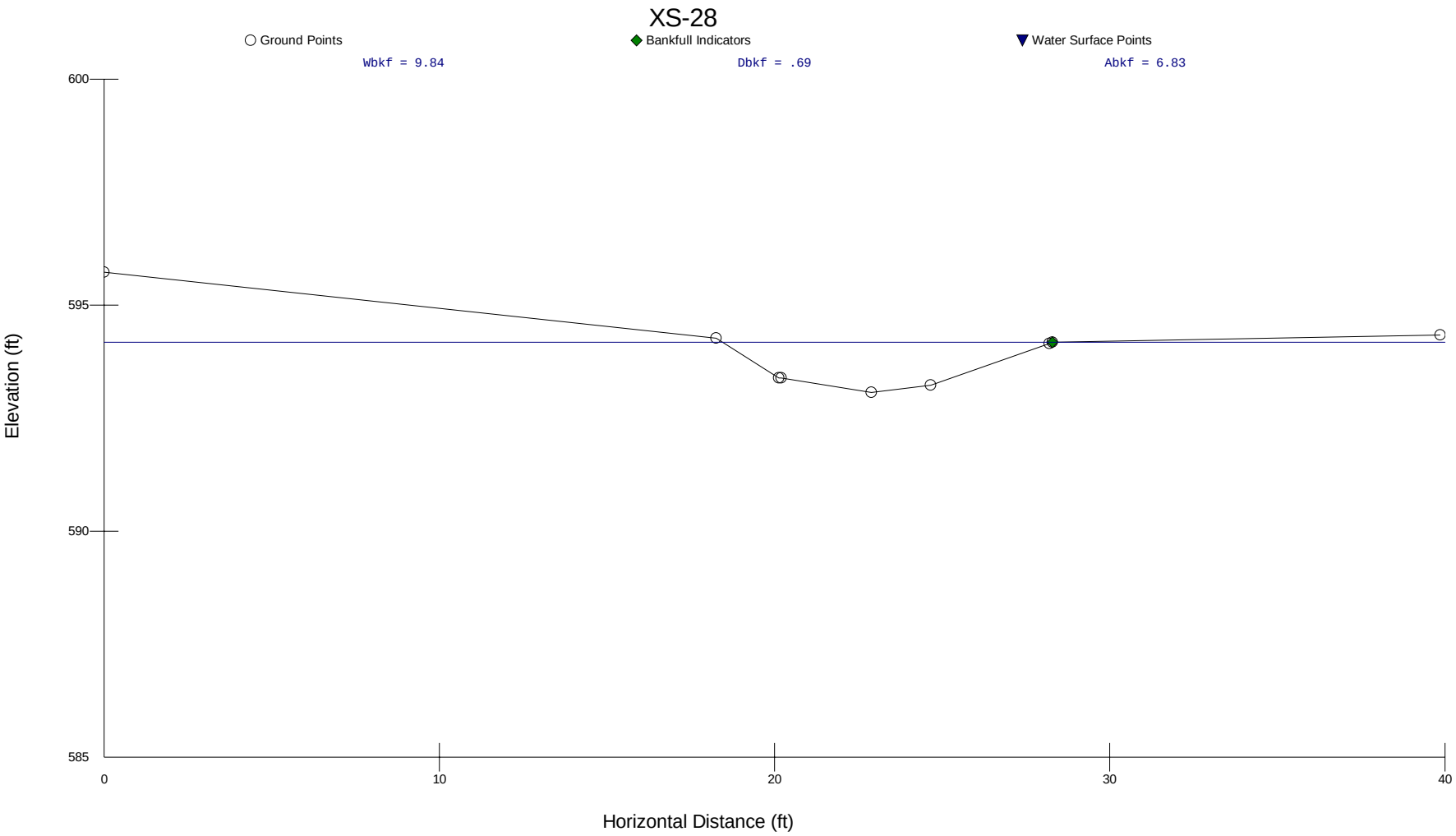

XS-23
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 19.2
Dbkf = 2.68
Abkf = 51.4
600
595
590
585
Elevation (ft)
0
10
20
30
40
50
60
Horizontal Distance (ft)

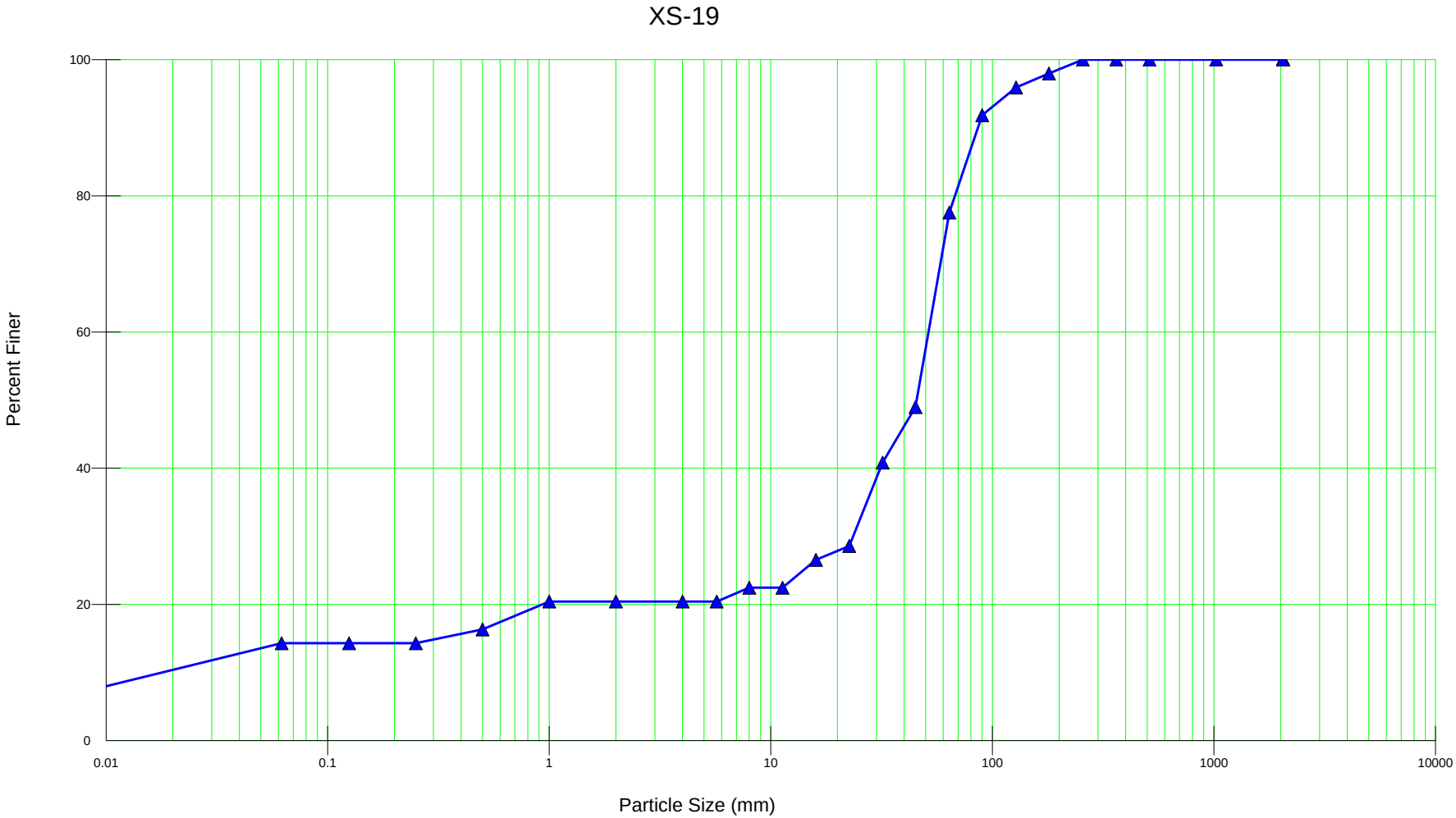

XS-24
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 18.5
Dbkf = 1.32
Abkf = 24.4
600
595
590
585
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)


XS-25
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 18.9
Dbkf = 1.36
Abkf = 25.7
600
595
590
585
Elevation (ft)
0
10
20
30
40
50
60
Horizontal Distance (ft)

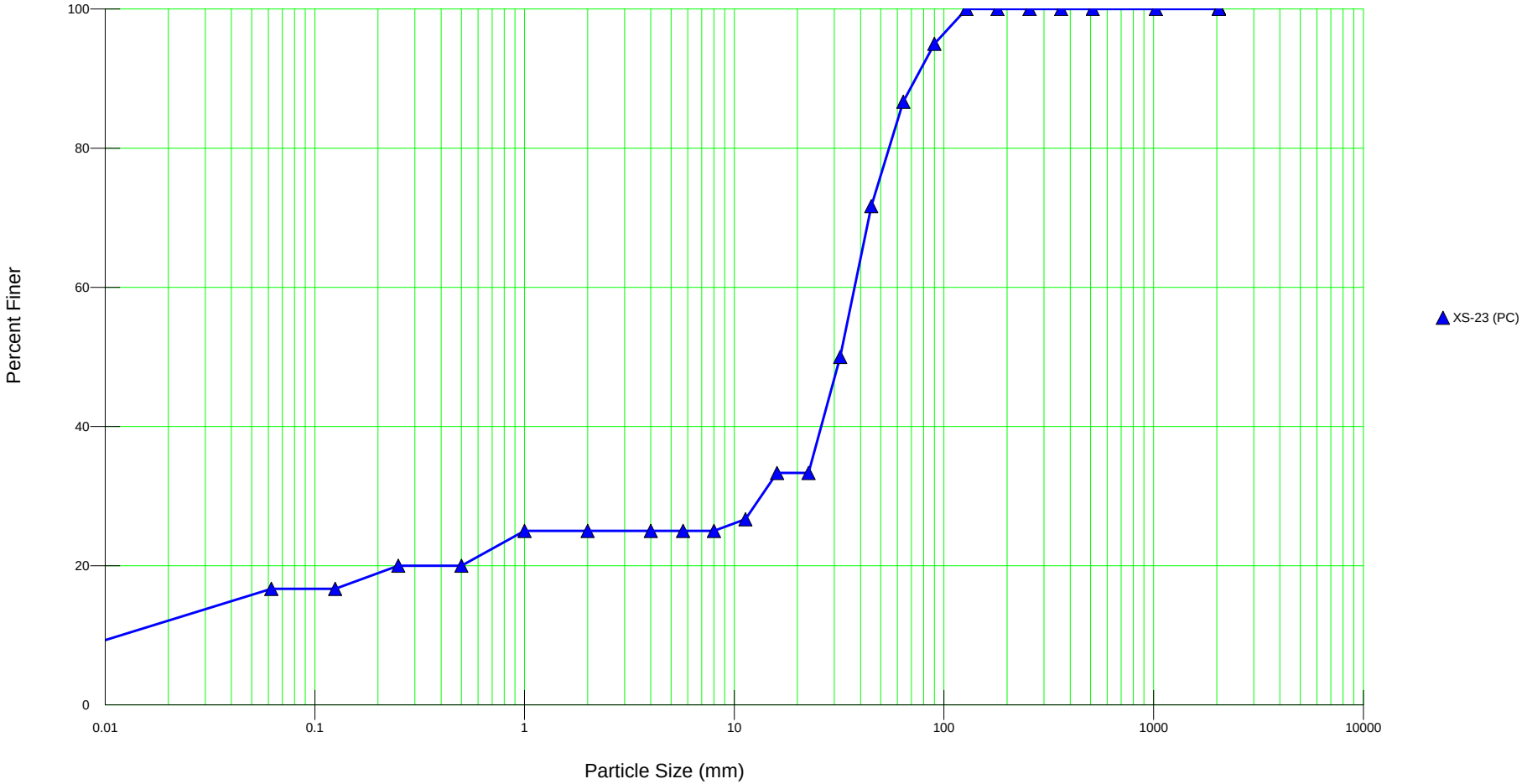

XS-26
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 8.75
Dbkf = .93
Abkf = 8.1
605
600
595
590
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)


XS-27
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 10.2
Dbkf = .62
Abkf = 6.31
600
595
590
585
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)


XS-28
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 9.84
Dbkf = .69
Abkf = 6.83
600
595
590
585
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)


XS-19
Percent Finer
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)

XS-23 As Built



Appendix C – Vegetative Data

Table 7 – Vegetation Plot Data
CVS Output Tables
Vegetation Monitoring Plot Photos
Photo Points

Table 7. Vegetation Plot Stem Count Summary

Species		Plots*																									MY5 Totals	MY4 Totals	MY3 Totals	MY2 Totals	MY1 Totals	Baseline Totals
Scientific Name	**Common Name**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**						
Betula nigra	River birch				1					1	1		1						1	2		4											**11**
Carya glabra	Pignut hickory		2					1		1			1												1	1							**7**
Diospyros virginiana	Common persimmon	7		1				1						3	3	1		4		4				1									**25**
Fraxinus pennsylvanica	Green ash								3		1		5	1			3		8			3	1		1	3	3						**32**
Liriodendron tulipifera	Tuliptree	2		2								1				2	1	1															**9**
Platanus occidentalis	American sycamore			3	3		1	2									1	1		1				1									**13**
Quercus	Oak		4	1	2	3	3	3	1	3	3	5	3	2	1	1	3	2		2			4	3	2	2	1						**54**
Quercus falcata	Southern red oak									1															1								**2**
Quercus michauxii	Swamp chestnut oak															2											2						**4**
Quercus nigra	Water oak								1									1															**2**
Quercus phellos	Willow oak		2			1									1		1			2		1	1	1	3								**13**
TABLE SUMMARY																																	
	Plot area (acres)	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025						**0.65**
	Species count	2	3	4	3	2	2	4	3	4	3	2	4	3	3	4	5	5	2	5	0	3	3	4	5	3	3						
	Stem count	***9***	***8***	***7***	***6***	***4***	***4***	***7***	***5***	***6***	***5***	***6***	***10***	***6***	***5***	***6***	***9***	***9***	***9***	***11***	***0***	***8***	***6***	***6***	***8***	***6***	***6***						**172**
	Total stems per acre	***360***	***320***	***280***	***240***	***160***	***160***	***280***	***200***	***240***	***200***	***240***	***400***	***240***	***200***	***240***	***360***	***360***	***360***	***440***	***0***	***320***	***240***	***240***	***320***	***240***	***240***						**265**

Report Prepared By	Ron Johnson
Date Prepared	5/12/2014 13:53

database name	cvs-eep-entrytool-v2.3.1.mdb
database location	\\usral3fp001\Watershed_Prod\30000s\30127_Heath_Dairy\F_Closing\Mitigation Plan\Vegetation
computer name	USRAL3LT109
file size	64618496

DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------

Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; de

PROJECT SUMMARY----------

Project Code	170
project Name	Heath Dairy Road
Description	Stream and wetland restoration
River Basin	Yadkin-Pee Dee
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	26

natural/volunteer stems.

ead and missing stems are excluded.

Living planted stems, excluding live stakes, per acre: Negative (red) numbers indicate the project failed to reach requirements in a particular year.

Project Code	Project Name	River Basin	Year 0 (baseline)
170	Heath Dairy Road	Yadkin-Pee Dee	-267.7151177

Total stems, including planted stems of all kinds (including live stakes) and natural/volunteer stems:

Project Code	Project Name	River Basin	Year 0 (baseline)
170	Heath Dairy Road	Yadkin-Pee Dee	267.7151177

plot	Plot Level	Year	Latitude/Northing	Longitude/Easting	Zone	Datum	Date Sampled	Planted Living Stems
170-01-0001	2	0	35°47'16.091"º	79°51'9.061"º		NAD83/WGS84	4/21/2014	9
170-01-0010	2	0	35°46'55.313"º	79°51'18.946"º		NAD83/WGS84	4/21/2014	5
170-01-0011	2	0	35°46'57.212"º	79°51'16.805"º		NAD83/WGS84	4/21/2014	6
170-01-0012	2	0	35°46'58.118"º	79°51'12.85"º		NAD83/WGS84	4/21/2014	10
170-01-0013	2	0	35°46'57.992"º	79°51'10.883"º		NAD83/WGS84	4/22/2014	6
170-01-0014	2	0	35°46'55.969"º	79°51'4.255"º		NAD83/WGS84	4/22/2014	5
170-01-0015	2	0	35°46'54.602"º	79°50'59.679"º		NAD83/WGS84	4/22/2014	6
170-01-0016	2	0	35°46'53.421"º	79°50'57.833"º		NAD83/WGS84	4/22/2014	9
170-01-0017	2	0	35°46'51.718"º	79°50'55.897"º		NAD83/WGS84	4/22/2014	9
170-01-0018	2	0	35°46'49.08"º	79°50'54.963"º		NAD83/WGS84	4/22/2014	9
170-01-0019	2	0	35°46'53.912"º	79°50'51.463"º		NAD83/WGS84	4/22/2014	11
170-01-0002	2	0	35°47'12.023"º	79°51'8.803"º		NAD83/WGS84	4/21/2014	8
170-01-0020	2	0	35°46'51.609"º	79°50'50.544"º		NAD83/WGS84	4/22/2014	0
170-01-0021	2	0	35°46'50.193"º	79°50'46.725"º		NAD83/WGS84	4/22/2014	8
170-01-0022	2	0	35°46'48.441"º	79°50'46.791"º		NAD83/WGS84	4/22/2014	6
170-01-0023	2	0	35°46'46.255"º	79°50'46.41"º		NAD83/WGS84	4/22/2014	6
170-01-0024	2	0	35°46'46.634"º	79°50'42.463"º		NAD83/WGS84	4/22/2014	8
170-01-0025	2	0	35°46'47.801"º	79°50'42.623"º		NAD83/WGS84	4/22/2014	6
170-01-0026	2	0	35°46'50.292"º	79°50'40.654"º		NAD83/WGS84	4/22/2014	6
170-01-0003	2	0	35°47'9.901"º	79°51'9.546"º		NAD83/WGS84	4/21/2014	7
170-01-0004	2	0	35°47'9.14"º	79°51'8.558"º		NAD83/WGS84	4/21/2014	6
170-01-0005	2	0	35°47'7.096"º	79°51'7.46"º		NAD83/WGS84	4/21/2014	4
170-01-0006	2	0	35°47'4.259"º	79°51'7.375"º		NAD83/WGS84	4/21/2014	4
170-01-0007	2	0	35°47'0.877"º	79°51'7.516"º		NAD83/WGS84	4/21/2014	7
170-01-0008	2	0	35°46'57.91"º	79°51'7.471"º		NAD83/WGS84	4/21/2014	5
170-01-0009	2	0	35°46'54.081"º	79°51'20.928"º		NAD83/WGS84	4/21/2014	6

Planted Living Stems EXCLUDING Live Stakes	Dead/Missing Stems	Natural (Volunteer) Stems	Total Living Stems
9	0	0	9
5	0	0	5
6	0	0	6
10	0	0	10
6	0	0	6
5	0	0	5
6	0	0	6
9	0	0	9
9	0	0	9
9	0	0	9
11	0	0	11
8	0	0	8
0	0	0	0
8	0	0	8
6	0	0	6
6	0	0	6
8	0	0	8
6	0	0	6
6	0	0	6
7	0	0	7
6	0	0	6
4	0	0	4
4	0	0	4
7	0	0	7
5	0	0	5
6	0	0	6

Total Living Stems EXCLUDING Live Stakes	Planted Living Stems per ACRE	Planted Living Stems EXCLUDING Live Stakes PER ACRE
9	364.2170787	364.2170787
5	202.3428215	202.3428215
6	242.8113858	242.8113858
10	404.685643	404.685643
6	242.8113858	242.8113858
5	202.3428215	202.3428215
6	242.8113858	242.8113858
9	364.2170787	364.2170787
9	364.2170787	364.2170787
9	364.2170787	364.2170787
11	445.1542073	445.1542073
8	323.7485144	323.7485144
0		
8	323.7485144	323.7485144
6	242.8113858	242.8113858
6	242.8113858	242.8113858
8	323.7485144	323.7485144
6	242.8113858	242.8113858
6	242.8113858	242.8113858
7	283.2799501	283.2799501
6	242.8113858	242.8113858
4	161.8742572	161.8742572
4	161.8742572	161.8742572
7	283.2799501	283.2799501
5	202.3428215	202.3428215
6	242.8113858	242.8113858

Natural (Volunteer) Stems PER ACRE	Total Living Stems PER ACRE	Total Living Stems EXCLUDING Live Stakes PER ACRE	# species
0	364.2170787	364.2170787	2
0	202.3428215	202.3428215	3
0	242.8113858	242.8113858	2
0	404.685643	404.685643	4
0	242.8113858	242.8113858	3
0	202.3428215	202.3428215	3
0	242.8113858	242.8113858	4
0	364.2170787	364.2170787	5
0	364.2170787	364.2170787	5
0	364.2170787	364.2170787	2
0	445.1542073	445.1542073	5
0	323.7485144	323.7485144	3
	0	0	0
0	323.7485144	323.7485144	3
0	242.8113858	242.8113858	3
0	242.8113858	242.8113858	4
0	323.7485144	323.7485144	5
0	242.8113858	242.8113858	3
0	242.8113858	242.8113858	3
0	283.2799501	283.2799501	4
0	242.8113858	242.8113858	3
0	161.8742572	161.8742572	2
0	161.8742572	161.8742572	2
0	283.2799501	283.2799501	4
0	202.3428215	202.3428215	3
0	242.8113858	242.8113858	4

vigor	Count	Percent
2	151	87.8
3	21	12.2

	Species	CommonName	4	3	2	1	0	Missing	Unknown
	Betula nigra	river birch		5	6				
	Diospyros virginiana	common persimmon			25				
	Fraxinus pennsylvanica	green ash		16	16				
	Quercus falcata	southern red oak			2				
	Quercus michauxii	swamp chestnut oak			4				
	Quercus nigra	water oak			2				
	Quercus phellos	willow oak			13				
	Quercus	oak			54				
	Carya glabra	pignut hickory			7				
	Liriodendron tulipifera	tuliptree			9				
	Platanus occidentalis	American sycamore			13				
TOT:	11	11		21	151				

Damage	Count	Percent Of Stems
(no damage)	172	100

	Species	CommonName	Count of Damage Categories	(no damage)
	Betula nigra	river birch	0	11
	Carya glabra	pignut hickory	0	7
	Diospyros virginiana	common persimmon	0	25
	Fraxinus pennsylvanica	green ash	0	32
	Liriodendron tulipifera	tuliptree	0	9
	Platanus occidentalis	American sycamore	0	13
	Quercus	oak	0	54
	Quercus falcata	southern red oak	0	2
	Quercus michauxii	swamp chestnut oak	0	4
	Quercus nigra	water oak	0	2
	Quercus phellos	willow oak	0	13
TOT:	11	11	0	172

	plot	Count of Damage Categories	(no damage)	(no stems on plot)
	170-01-0001	0	9	
	170-01-0002	0	8	
	170-01-0003	0	7	
	170-01-0004	0	6	
	170-01-0005	0	4	
	170-01-0006	0	4	
	170-01-0007	0	7	
	170-01-0008	0	5	
	170-01-0009	0	6	
	170-01-0010	0	5	
	170-01-0011	0	6	
	170-01-0012	0	10	
	170-01-0013	0	6	
	170-01-0014	0	5	
	170-01-0015	0	6	
	170-01-0016	0	9	
	170-01-0017	0	9	
	170-01-0018	0	9	
	170-01-0019	0	11	
	170-01-0020			1
	170-01-0021	0	8	
	170-01-0022	0	6	
	170-01-0023	0	6	
	170-01-0024	0	8	
	170-01-0025	0	6	
	170-01-0026	0	6	
TOT:	26	0	172	1

	Comment	Species	SpType	CommonName	Total Planted Stems	#plots	avg#stems	plot 170-01-0001	plot 170-01-0002	plot 170-01-0003	plot 170-01-0004	plot 170-01-0005	plot 170-01-0006	plot 170-01-0007	plot 170-01-0008	plot 170-01-0009	plot 170-01-0010	plot 170-01-0011	plot 170-01-0012	plot 170-01-0013	plot 170-01-0014	plot 170-01-0015	plot 170-01-0016	plot 170-01-0017	plot 170-01-0018	plot 170-01-0019	plot 170-01-0020	plot 170-01-0021	plot 170-01-0022	plot 170-01-0023	plot 170-01-0024	plot 170-01-0025	plot 170-01-0026
		Betula nigra	Tree	river birch	11	7	1.57			1				1	1		1						1	2		4						
		Carya glabra	Tree	pignut hickory	7	6	1.17		2				1		1			1												1	1	
		Diospyros virginiana	Tree	common persimmon	25	9	2.78	7		1				1						3	3	1		4		4				1			
		Fraxinus pennsylvanica	Tree	green ash	32	11	2.91								3		1		5	1			3		8			3	1		1	3	3
		Liriodendron tulipifera	Tree	tuliptree	9	6	1.5	2		2								1				2	1	1									
		Platanus occidentalis	Tree	American sycamore	13	8	1.62			3	3		1	2									1	1		1				1			
		Quercus	Shrub Tree	oak	54	22	2.45		4	1	2	3	3	3	1	3	3	5	3	2	1	1	3	2		2			4	3	2	2	1
		Quercus falcata	Tree	southern red oak	2	2	1									1														1		
		Quercus michauxii	Tree	swamp chestnut oak	4	2	2														2												2
		Quercus nigra	Tree	water oak	2	2	1								1									1									
		Quercus phellos	Tree	willow oak	13	9	1.44		2			1									1		1			2		1	1	1	3		
	n/a: no stems				0	1																					0						
TOT:	1	11	11	11	172	12		9	8	7	6	4	4	7	5	6	5	6	10	6	5	6	9	9	9	11	0	8	6	6	8	6	6

	Comment	Species	CommonName	Total Stems	# plots	avg# stems	170-01-0001	170-01-0002	170-01-0003	170-01-0004	170-01-0005	170-01-0006	170-01-0007	170-01-0008	170-01-0009	170-01-0010	170-01-0011	170-01-0012	170-01-0013	170-01-0014	170-01-0015	170-01-0016	170-01-0017	170-01-0018	170-01-0019	170-01-0020	170-01-0021	170-01-0022	170-01-0023	170-01-0024	170-01-0025	170-01-0026
		Betula nigra	river birch	11	7	1.57				1				1	1		1						1	2		4					
		Carya glabra	pignut hickory	7	6	1.17		2					1		1			1												1	1	
		Diospyros virginiana	common persimmon	25	9	2.78	7		1				1						3	3	1		4		4				1			
		Fraxinus pennsylvanica	green ash	32	11	2.91								3		1		5	1			3		8			3	1		1	3	3
		Liriodendron tulipifera	tuliptree	9	6	1.5	2		2								1				2	1	1									
		Platanus occidentalis	American sycamore	13	8	1.62			3	3		1	2									1	1		1				1			
		Quercus	oak	54	22	2.45		4	1	2	3	3	3	1	3	3	5	3	2	1	1	3	2		2			4	3	2	2	1
		Quercus falcata	southern red oak	2	2	1									1															1		
		Quercus michauxii	swamp chestnut oak	4	2	2															2											2
		Quercus nigra	water oak	2	2	1								1									1									
		Quercus phellos	willow oak	13	9	1.44		2			1									1		1			2		1	1	1	3		
	no stems on plot				1																				0							
TOT:	1	11	11	172	12		9	8	7	6	4	4	7	5	6	5	6	10	6	5	6	9	9	9	11	0	8	6	6	8	6	6

Vegetation Monitoring Plot 1 – 4/21/14

Vegetation Monitoring Plot 4 – 4/21/14

Vegetation Monitoring Plot 2 – 4/21/14

Vegetation Monitoring Plot 5 – 4/21/14

Vegetation Monitoring Plot 3 – 4/21/14

Vegetation Monitoring Plot 6 – 4/21/14

Vegetation Monitoring Plot 7 – 4/21/14

Vegetation Monitoring Plot 10 – 4/21/14

Vegetation Monitoring Plot 8 – 4/21/14

Vegetation Monitoring Plot 11 – 4/21/14

Vegetation Monitoring Plot 9 – 4/21/14

Vegetation Monitoring Plot 12 – 4/21/14

Vegetation Monitoring Plot 13 – 4/21/14

Vegetation Monitoring Plot 16 – 4/22/14

Vegetation Monitoring Plot 14 – 4/21/14

Vegetation Monitoring Plot 17 – 4/22/14

Vegetation Monitoring Plot 15 – 4/22/14

Vegetation Monitoring Plot 18 – 4/22/14

Vegetation Monitoring Plot 19 – 4/22/14

Vegetation Monitoring Plot 22 – 4/22/14

Vegetation Monitoring Plot 20 – 4/22/14

Vegetation Monitoring Plot 23 – 4/22/14

Vegetation Monitoring Plot 21 – 4/22/14

Vegetation Monitoring Plot 24 – 4/22/14

Vegetation Monitoring Plot 25 – 4/22/14

Photo Point 1 downstream – 4/22/14

Vegetation Monitoring Plot 26 – 4/22/14

Photo Point 1 – 4/22/14

Photo Point 1 upstream – 4/22/14

Photo Point 2 downstream – 2/22/14

Photo Point 2 Back Creek – 2/22/14

Photo Point 3 upstream – 2/22/14

Photo Point 2 upstream – 2/22/14

Photo Point 3 downstream – 2/22/14

Photo Point 2 West Branch – 2/22/14

Photo Point 4 – 2/21/14

Appendix D – As-Built Plan Sheets