Year 3 Monitoring Report

Tulula Stream & Wetland Restoration

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S&EC Project No. 9444.D1
EEP Project No. 00035

Designed By HSMM

Prepared for

Ecosystem Enhancement PROGRAM

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I. Executive Summary / Project Abstract

This report summarizes the monitoring efforts for Year 3 (2005) of the Tulula Bog Stream and Wetland Restoration, located in Graham County.

Monitoring of the vegetated buffer was performed during the growing season of 2005, by Soil & Environmental Consultants, PA. Stem counts were preformed within the established vegetation monitoring plots, resulting in a live stem density of approximately 257 stems per acre.

The physical stream channel was surveyed, and a visual stability assessment was performed for the Tulula Creek Stream Restoration project. While there are several problem areas along the restored channel, the overall channel is deemed stable and successful. In 2006, the Year 4 Monitoring will commence.

An assessment of the stability of the wetland was preformed on during monthly visits that occurred from May through December, 2005, by S&EC. Groundwater gauges were downloaded monthly. Twenty (20) of the twenty-nine (29) gauges on-site achieved wetland success criteria of saturation for 12.5% of the growing season (29 days). The nine (9) gauges that did not meet criteria were consistent with those failing to meet hydrology in 2004.

II. Project Background

The background information for this report is referenced from previous monitoring reports submitted to the North Carolina Ecosystem Enhancement Program (NCEEP) by the Office of Natural Environment & Roadside Environmental Unit of the North Carolina Department of Transportation (NCDOT).

A. Location and Setting

The Tulula Bog Mitigation Site is a 222 acre tract located in Graham County, NC. The site it located off of Highway 129 between Topton and Robbinsville, as shown in Figure 1.

B. Structure and Objectives

The site was developed as mitigation for impacts created from the creation of highways in the surrounding areas. The mitigation site contains 102 acres of wetland restoration, 121 acres of upland buffer protection, 8,639 linear feet of stream restoration, and 1,248 linear feet of stream preservation.

Table I: Project Structure Table
Tulula Stream and Wetland Mitigation Site (EEP Project # 00035)

Segment/Reach ID	Linear Feet or Acreage
Wetland Restoration	102
Reach 1 -	8639 lf
Reach 2 -	1248 lf
Buffer Protection	121 ac

Table II: Project Objectives Table
Tulula Stream and Wetland Mitigation Site (EEP Project # 00035)

Segment/Reach ID	Objectives	Linear Feet or Acreage	Comment
Wetland Restoration	Restoration	102 ac	
Reach 1 - Restoration	Restoration	8639 lf	
Reach 2 - Preservation	Preservation	1248 lf	
Buffer	Preservation	121 ac	

C. Project History and Background

Year 1 Monitoring occurred in 2003, Year 2 monitoring was completed in 2004. 2005 serves as Monitoring Year 3 of 5. Additional details regarding the timeline of the project are included as Table III.

Table III: Project Activity and Reporting History Tulula Stream and Wetland Mitigation Site (EEP Project # 00035)		
Activity or Report	**Calendar Year of Completion or Planned Completion**	**Actual Completion Date**
Restoration Plan		
Monitoring Gauges Installed	2000	Jun-00
Phase I Planted	2002	Apr-02
Phase II Planted	2003	Mar-03
Initial-Year 1 monitoring	2003	Dec-03
Year 1 Vegetation Monitoring	2003	Sep-03
Year 2 monitoring	2004	Nov-04
Year 2 Vegetation Monitoring	2004	Jul-04
Four additional plots set	2004	Nov-04
Year 3 monitoring	2005	Dec-05
Year 3 Vegetation Monitoring	2005	May-05
Year 4 monitoring	2006	
Year 5 monitoring	2007	

The project was designed by HSMM. The construction contractor is unknown. Monitoring activities for Year 3 were performed by S&EC. Additional information regarding contractors is shown in Table IV.

Table IV: Project Contact Table Tulula Stream and Wetland Mitigation Site (EEP Project # 00035)	
Designer	HSMM 1305 Navaho Drive Raleigh, NC 27609
Monitoring Performers	Soil & Environmental Consultants, PA 11010 Raven Ridge Road Raleigh, NC 26714
Stream Monitoring POC	Rebecca Wargo, S&EC
Vegetation Monitoring POC	Jessica Regan, S&EC
Wetland Monitoring POC	Jessica Regan, S&EC

The project is located within Graham County, which is located within the Blue Ridge Belt of the Mountains of North Carolina. The site is located within a rural area. Additional information regarding the stream is included as Table V.

Table V: Project Background Table Tulula Stream and Wetland Mitigation Site (EEP Project # 00035)	
Project County	Graham
Drainage Area	2.41 sq. mi.
Drainage impervious cover estimate (%)	10%
Stream Order	$1^{st}/2^{nd}$
Physiographic Region	Mountain
Ecoregion	Blue Ridge
Rosgen Classification of As-Built	E4
Dominant Soil Types	Rc, Rd, Tf, Tg, Wa
USGS HUC for Project and Reference	06010204
NCDWQ Sub-basin for Project and Reference	04-04-04
NCDWQ classification for Project and Reference	WS-III, Tr
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	No
% of project easement fenced	N/A

D. Monitoring Plan View

A series of monitoring devices were previously established on-site. Seven (7) vegetation monitoring plots are present onsite.

A total of eight (8) survey reaches were established by UNC-Asheville along the reach of the restoration channel. Within each of these reaches, four (4) cross-sections (2 pools and 2 riffles) were permanently marked. Each cross-section is also a designated photo point that will be photographed annually.

Twenty-nine (29) electronic groundwater monitoring gauges were previously installed on-site. The gauges have been configured to record daily groundwater levels. A rain gauge is also present onsite.

The locations of all monitoring devices are shown on Sheets 1 through 4 (Monitoring Plan View).

III. Project Condition and Monitoring Results

A. Vegetation Assessment

The 33.3 acre wetland restoration area was planted with various hardwood tree and shrub species, native to the area. Initial planting occurred in April 2002, with the remainder planted in March 2003.

Three (3) vegetation monitoring plots were established onsite in 2003. In 2004, four (4) additional plots were installed. The success criteria for the site require a minimum of 320 live stems per acre for the first three (3) years of monitoring. At the end of Year 4, a density of 290 stems per acre is required. At the end of the 5-year monitoring period, a live stem density of 260 stems per acre must be achieved.

1. Soil Data

Table VI: Preliminary Soil Data
Tulula Stream and Wetland Restoration Site (EEP Project #00035)

Series	Max Depth (in.)	% Clay on Surface	K	T	OM %
Tf	*	*	*	*	*
Tg	*	*	*	*	*
Rc	*	*	*	*	*
Rd	*	*	*	*	*
Wa	*	*	*	*	*

* Items denoted with an asterisk have not been provided due to: lack of data provided for previous monitoring years, incorrect data provided for previous monitoring years, or these are items outside the scope of this year's monitoring effort.

2. Problem Areas Plan View (vegetation)

During a field inspection on July 19 and 20, 2005, an area of bare stream bank was observed. It is believed this area is due to excessive grazing. A photo is included in Appendix A.

Table VII: Vegetative Problem Areas
Tulula Stream and Wetland Restoration Site (EEP Project #00035)

Feature Issues	Number	Suspected Cause	Photo number
Bare Bank	1	Excessive browsing	1

3. Vegetative Problem Areas Plan View

Vegetative problem areas are shown on Sheets 5 through 8 (Problem Area Plan View).

4. Stem Counts

On May 27, 2005, S&EC conducted vegetation counts within each plot. The results of this survey are shown below in Table VIII.

The following tree species were planted in the Wetland Creation Area: *Nyssa sylvatica* var. *sylvatica* (Black Gum), *Quercus rubra* (Northern Red Oak), *Betula nigra* (River Birch), *Liriodendron tulipifera* (Tulip Poplar), *Quercus alba* (White Oak), and *Prunus serotina* (Black Cherry).

Table VIII: Stem Counts for Each Species Arranged by Plot
Tulula Stream and Wetland Mitigation Site (EEP Project # 00035)

Species	Plots							Year 3 Totals
	1	2	3	4	5	6	7	
***Nyssa sylvatica* var. *sylvatica* (Black Gum)**								0
***Quercus rubrum* (Northern Red Oak)**	9		5		1	4	2	21
***Betula nigra* (River Birch)**		4						4
***Liriodendron tulipifera* (Tulip Poplar)**		3	8	15	2	13	1	42
***Quercus alba* (White Oak)**	12	6	1	3	1	1		24
***Prunus serotina* (Black Cherry)**							8	8
Year 3 Totals	**21**	**13**	**14**	**18**	**4**	**18**	**11**	99
Year 2 Totals	32	26	25	22	4	23	15	147
Live Stem Density	420	246	250	314	70	313	192	
Average Live Stem Density								**257**
Survival % Per Plot (from Year 2)	66%	50%	56%	82%	100%	78%	73%	

* Numerous volunteers

The average stems per sample plot is 14 stems. The 2005 vegetation monitoring of the site revealed an average tree density of 257 stems per acre. This low survival can be attributed to high levels of inundation in some areas that have been impounded by beaver activity.

As shown in Table VIII, several plots have shown a survival rate of less than 80%. However, while not quantified in the above table, each plot has shown a large number of volunteers in addition to the original planted stems. If these new plants are taken into consideration, survival rate would be equal to or greater than 80%.

5. Vegetation Photo Plots

Photos taken during the May 27, 2005 Vegetation Sampling event are included as Appendix A.

B. Stream Assessment

1. Problem Areas Plan View (Stream)

An assessment of channel stability was preformed on July 19 and 20, 2005, by S&EC. Areas of concern that were observed and documented included localized bank scour, debris and beaver dams, and stressed or failing structures. These problem areas are shown on Sheets 5 through 8 (Problem Area Plan View).

2. Problem Areas Table Summary

Table IX: Stream Problem Areas
Tulula Stream and Wetland Restoration Site (EEP Project #00035)

Feature Issues	Number	Suspected Cause	Photo number
Bank Scour	1	Coir failure	1-2
	2	Coir Failure	
	3	Outside meander / drainage from bank	
	4	Outside meander / coir failure	
Failing Structures	1	Undercut Crossvane	N/A
	2	High Invert (crossvane) / Debris Jam	N/A
Debris Jam	1	Debris Jam – should be removed	3
Headcut	1	Small headcut	4

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 2005). These photos are included in Appendix B. No photos from Year 2 monitoring were provided for comparison.

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 X that are in a state of stability. Table X was compiled from the data in Table B1 in Appendix B of this report.

Table X: Categorical Stream Feature Visual Stability Assessment
Tulula Stream and Wetland Restoration Site (EEP #00035)

Feature	MY-1 2003	MY-2 2004	MY-3 2005
A. Riffles	*	*	96%
B. Pools	*	*	100%
C. Thalweg	*	*	100%
D. Meanders	*	*	79%
E. Bed General	*	*	96%
F. Channel General	*	*	N/A
G. Banks	*	*	100%
H. Vanes/ J Hooks, etc.	*	*	98%
I. Wads and Boulders	*	*	N/A

* Items denoted with an asterisk have not been provided due to: lack of data provided for previous monitoring years, incorrect data provided for previous monitoring years, or these are items outside the scope of this year's monitoring effort.

6. Quantitative Morphology

The following tables (Table XI and Table XII) summarize the quantitative data collected from the cross-sectional and 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. Only cross-sections from 2004 were provided for comparison with the data from 2005. Two of the survey reaches (Reaches IVA and VA) were consistently inundated throughout the monitoring period due to beaver activity onsite. Permanent markers for the cross-sections in these areas were not able to be located and therefore, not surveyed for the 2005 monitoring year.

It should be noted that the cross-sections for 2004 were not measured in the same manner as 2005 (2005 data was surveyed with Total Station) and because of this, the data does not overlay as well as would be expected. For most of the cross- sections, the comparison shows that there is little departure from 2004 to 2005, however, some cross-sections did not overlay in a consistent manner. This is due to the difference in surveying methods, not channel departure, and for this reason, only the 2005 data is shown for these cross-section. No profile data was provided for comparison with the data

from 2005. Tables XI and XII were compiled from the cross-section and profile raw data and plots located in Appendix B of this report.

Based on a review of available site data and observations made during 2005 site visits, no crest gauge has been installed on the site. A review of available on-line USGS gauge sites was performed to determine if a suitable surrogate gauge was present in the area. No nearby gauge was identified. The closest USGS gauge to the site was on the Nantahala River (new Hewitt, NC, Gauge Identification Number 03505550) which is approximately 3.466 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.

Table XI. Baseline Morphology and Hydraulic Summary
TULULA STREAM AND WETLAND RESTORATION SITE (EEP Project #00035)

Parameter	Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.
BF Width (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Floodprone Width (ft)	*	*	*	*	*	*	*	*	*	*	*	*
BF Cross Sectional Area (ft^2)	*	*	*	*	*	*	*	*	*	*	*	*
BF Mean Depth (ft)	*	*	*	*	*	*	*	*	*	*	*	*
BF Max Depth (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Width/Depth Ratio	*	*	*	*	*	*	*	*	*	*	*	*
Entrenchment Ratio	*	*	*	*	*	*	*	*	*	*	*	*
Wetted Perimeter(ft)	*	*	*	*	*	*	*	*	*	*	*	*
Hydraulic radius (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Pattern												
Channel Beltwidth (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Radius of Curvature (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Meander Wavelength (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Meander Width ratio	*	*	*	*	*	*	*	*	*	*	*	*
Profile												
Riffle length (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Riffle slope (ft/ft)	*	*	*	*	*	*	*	*	*	*	*	*
Pool length (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Pool spacing (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Substrate												
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*
Additional Reach Parameters												
Valley Length (ft)		*			*			*			*	
Channel Length (ft)		*			*			*			*	
Sinuosity		*			*			*			*	
Water Surface Slope (ft/ft)		*			*			*			*	
BF slope (ft/ft)		*			*			*			*	
Rosgen Classification		*			*			*			E4	
*Habitat Index		*			*			*			*	
*Macrobenthos		*			*			*			*	

* Items denoted with an asterisk have not been provided due to: lack of data provided for previous monitoring years, incorrect data provided for previous monitoring years, or these are items outside the scope of this year's monitoring effort.

Exhibit Table XII. Morphology and Hydraulic Monitoring Summary
TULULA BOG STREAM AND WETLAND RESTORATION SITE (EEP Project #00035)

Parameter	REACH I															
	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
	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
BF Width (ft)	13.8	13.8	13.8	6.42	15.7	15.7	15.7	11.02	11.8	11.8	11.8	7.16	15.7	15.7	15.7	8.64
Floodprone Width (ft)	*	*	*	50	*	*	*	50	*	*	*	50	*	*	*	50
BF Cross Sectional Area (ft^2)	18.8	21.92	19.04	6.76	27.93	24.22	25.23	11.63	13.99	15.69	15.12	10.07	27.59	28.02	26.23	11.69
BF Mean Depth (ft)	1.36	1.59	1.38	1.05	1.78	1.54	1.61	1.06	1.19	1.33	1.28	1.41	1.76	1.78	1.67	1.35
BF Max Depth (ft)	2.39	2.79	2.62	1.52	3.25	2.92	2.98	2.05	2.23	2.89	3.12	3.02	3.21	3.25	3.28	2.12
Width/Depth Ratio	*	*	*	6.1	*	*	*	10.43	*	*	*	5.09	*	*	*	6.38
Entrenchment Ratio	*	*	*	7.78	*	*	*	4.54	*	*	*	6.98	*	*	*	5.79
Wetted Perimeter(ft)	*	*	*	7.44	*	*	*	12.37	*	*	*	9.88	*	*	*	9.97
Hydraulic radius (ft)	*	*	*	0.91	*	*	*	0.94	*	*	*	1.02	*	*	*	1.17
Substrate																
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Parameter	REACH 1A															
	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
	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
BF Width (ft)	10.5	10.5	10.5	7.02	10.5	10.5	10.5	7.36	13.1	13.1	13.1	7.99	12.5	13.1	13.1	7.29
Floodprone Width (ft)	*	*	*	50	*	*	*	50	*	*	*	50	*	*	*	50
BF Cross Sectional Area (ft^2)	13.84	16.37	15.91	10.61	18.35	19.69	18.55	11.3	20.33	22.11	22.04	10.4	18.29	18.36	18.84	11.4
BF Mean Depth (ft)	1.32	1.56	1.52	1.51	1.75	1.88	1.77	1.54	1.55	1.69	1.68	1.3	1.46	1.4	1.44	1.56
BF Max Depth (ft)	2.62	3.25	3.28	2.42	2.95	3.12	2.98	2.41	2.72	2.98	3.02	1.74	2.49	2.59	2.66	1.93
Width/Depth Ratio	*	*	*	4.64	*	*	*	4.79	*	*	*	6.14	*	*	*	4.67
Entrenchment Ratio	*	*	*	7.12	*	*	*	6.79	*	*	*	6.29	*	*	*	6.86
Wetted Perimeter(ft)	*	*	*	9.18	*	*	*	9.62	*	*	*	9.41	*	*	*	9.5
Hydraulic radius (ft)	*	*	*	1.16	*	*	*	1.18	*	*	*	1.1	*	*	*	1.2
Substrate																
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Parameter	REACH II															
	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
	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
BF Width (ft)	16.4	16.4	16.4	8.42	16.4	16.4	16.4	9.15	13.1	13.1	13.1	10.13	14.4	14.4	14.4	11.74
Floodprone Width (ft)	*	*	*	50	*	*	*	50	*	*	*	50	*	*	*	50
BF Cross Sectional Area (ft^2)	20.33	21.92	21.88	9.83	25.02	27.83	26.03	11.52	14.8	16.35	16.29	11.29	23.34	24.76	24.4	16.38
BF Mean Depth (ft)	1.24	1.34	1.33	1.17	1.53	1.7	1.59	1.26	1.13	1.25	1.24	1.11	1.62	1.72	1.69	1.39
BF Max Depth (ft)	2.1	2.56	2.69	1.85	2.95	3.21	3.18	1.94	1.9	2.23	2.36	1.99	2.62	2.79	2.79	2.22
Width/Depth Ratio	*	*	*	7.21	*	*	*	7.27	*	*	*	9.09	*	*	*	8.42
Entrenchment Ratio	*	*	*	5.94	*	*	*	5.46	*	*	*	4.94	*	*	*	4.26
Wetted Perimeter(ft)	*	*	*	9.42	*	*	*	10.22	*	*	*	11.08	*	*	*	12.77
Hydraulic radius (ft)	*	*	*	1.04	*	*	*	1.13	*	*	*	1.02	*	*	*	1.28
Substrate																
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Parameter	REACH III															
	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
	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
BF Width (ft)	13.1	13.1	13.8	10.45	19	19	19	11.19	17.1	16.4	17.1	11.06	17.7	17.7	18.4	11.61
Floodprone Width (ft)	*	*	*	50	*	*	*	50	*	*	*	50	*	*	*	50
BF Cross Sectional Area (ft^2)	18.25	20.07	21.07	15.76	30.8	32.79	30.62	17.95	25.5	24.73	25.53	15.51	21.26	22.48	21.23	13
BF Mean Depth (ft)	1.39	1.53	1.53	1.51	1.62	1.73	1.61	1.6	1.49	1.51	1.49	1.4	1.2	1.27	1.15	1.12
BF Max Depth (ft)	2.39	3.15	3.21	2.92	3.08	3.28	3.25	2.25	2.76	2.82	2.95	2.49	2.46	3.08	3.12	2.41
Width/Depth Ratio	*	*	*	6.93	*	*	*	6.98	*	*	*	7.89	*	*	*	10.37
Entrenchment Ratio	*	*	*	4.78	*	*	*	4.47	*	*	*	4.52	*	*	*	4.31
Wetted Perimeter(ft)	*	*	*	13.15	*	*	*	12.91	*	*	*	12.55	*	*	*	13.07
Hydraulic radius (ft)	*	*	*	1.2	*	*	*	1.39	*	*	*	1.24	*	*	*	0.99
Substrate																
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Parameter	REACH IV															
	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
	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
BF Width (ft)	12.5	12.5	12.5	11.15	14.4	14.4	14.4	12.06	13.1	13.1	13.1	10.23	15.1	14.4	18.4	11.44
Floodprone Width (ft)	*	*	*	50	*	*	*	50	*	*	*	50	*	*	*	50
BF Cross Sectional Area (ft^2)	17.15	17.49	17.5	16.03	24.73	23.35	23.62	18.4	23.33	22.13	20.63	16.83	27.29	27.5	26.76	18.3
BF Mean Depth (ft)	1.37	1.4	1.38	1.44	1.72	1.62	1.64	1.53	1.78	1.69	1.57	1.64	1.81	1.91	1.45	1.6
BF Max Depth (ft)	2.3	2.43	2.64	2.7	3.05	3.02	3.15	2.69	3.25	3.08	3.18	3.4	3.25	3.28	3.25	2.69
Width/Depth Ratio	*	*	*	7.76	*	*	*	7.91	*	*	*	6.22	*	*	*	7.16
Entrenchment Ratio	*	*	*	4.48	*	*	*	4.15	*	*	*	4.89	*	*	*	4.37
Wetted Perimeter(ft)	*	*	*	12.69	*	*	*	13.5	*	*	*	12.58	*	*	*	12.92
Hydraulic radius (ft)	*	*	*	1.26	*	*	*	1.36	*	*	*	1.34	*	*	*	1.42
Substrate																
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Parameter	REACH IVA															
	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
	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
BF Width (ft)	12.5	12.5	12.5	*	13.8	13.8	13.8		15.1	15.1	15.7		13.8	13.8	13.8	
Floodprone Width (ft)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
BF Cross Sectional Area (ft^2)	14.66	15.4	15.54	*	19.49	21.11	20.5	*	21.9	21.52	20.16	*	19.17	21.73	20.88	*
BF Mean Depth (ft)	1.17	1.23	1.24	*	1.41	1.53	1.49	*	1.45	1.42	1.28	*	1.39	1.57	1.51	*
BF Max Depth (ft)	1.97	2.49	2.49	*	3.02	3.25	3.25	*	2.69	2.82	2.59	*	2.85	3.15	3.18	*
Width/Depth Ratio	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Entrenchment Ratio	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Wetted Perimeter(ft)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hydraulic radius (ft)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Substrate																
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Parameter	REACH V															
	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
	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
BF Width (ft)	15.1	15.1	15.1	12.48	16.4	15.78	16.4	11.93	13.8	13.8	13.8	11.69	16.4	16.4	16.4	10.37
	*	*	*	50	*	*	*	80	*	*	*	50	*	*	*	100
BF Cross Sectional Area (ft^2)	17.14	20.52	19.62	16.06	24.09	25.43	24.74	13.69	15.44	16.67	16.64	16.48	28.33	29.24	27.22	14.03
BF Mean Depth (ft)	1.13	1.36	1.3	1.29	1.47	1.61	1.51	1.17	1.12	1.21	1.21	1.41	1.73	1.78	1.66	1.35
BF Max Depth (ft)	1.9	2.62	2.49	2	2.43	2.66	2.56	2.13	1.94	2.79	2.79	2.29	3.02	3.12	3.15	2.36
Width/Depth Ratio	*	*	*	9.7	*	*	*	10.2	*	*	*	8.29	*	*	*	7.66
Entrenchment Ratio	*	*	*	4.01	*	*	*	6.7	*	*	*	4.28	*	*	*	9.65
Wetted Perimeter(ft)	*	*	*	13.3	*	*	*	12.96	*	*	*	12.94	*	*	*	11.62
Hydraulic radius (ft)	*	*	*	1.21	*	*	*	1.08	*	*	*	1.27	*	*	*	1.21
Substrate																
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Parameter	REACH VA															
	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
	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
BF Width (ft)	9.8	*	9.8	*	11.8	*	11.8	*	15.1		15.1		10.5		10.5	
Floodprone Width (ft)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
BF Cross Sectional Area (ft^2)	15.21	*	16.94	*	18.16	*	19.61	*	18.56	*	19.44	*	16.62	*	18.11	*
BF Mean Depth (ft)	1.55	*	1.73	*	1.54	*	1.66	*	1.23	*	1.29	*	1.58	*	1.72	*
BF Max Depth (ft)	2.46	*	2.72	*	2.72	*	3.05	*	2.23	*	2.46	*	2.43	*	3.12	*
Width/Depth Ratio	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Entrenchment Ratio	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Wetted Perimeter(ft)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hydraulic radius (ft)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Substrate																
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Parameter	As-built (2002)			MY-1 (2003)			MY-2 (2004)			MY-3 (2005)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft	*	*	*	*	*	*	*	*	*	30.12	108.9	55.83
Radius of Curvature (ft)	*	*	*	*	*	*	*	*	*	18.1	76.34	29.21
Meander Wavelength (ft)	*	*	*	*	*	*	*	*	*	35.68	125.91	81.86
Meander Width ratio	*	*	*	*	*	*	*	*	*	3.16387	11.43908	5.8645
Profile												
Riffle length (ft	*	*	*	*	*	*	*	*	*			
Riffle slope (ft/ft	*	*	*	*	*	*	*	*	*	0.00124	0.00669	0.00338
Pool length (ft	*	*	*	*	*	*	*	*	*	9.27	21.03	13.6
Pool spacing (ft	*	*	*	*	*	*	*	*	*	15.6	43.65	25.74
Additional Reach Parameters												
Valley Length (ft		*			*			*			0	
Channel Length (ft		*			*			*				
Sinuosity		*			*			*			1.61	
Water Surface Slope (ft/ft)		*			*			*			*	
BF slope (ft/ft)		*			*			*			0.00338	
Rosgen Classificatior		*			*			*			E4	
Habitat Index*		*			*			*			*	
Macrobenthos*		*			*			*			*	

C. Wetland Assessment

Ten (10) groundwater monitoring gauges along with one (1) surface gauge and a rain gauge were installed onsite in May 1998. The original rain gauge was replaced in May 2000. An additional surface gauge was installed on Site 2 in April 2003. The groundwater gauges record daily readings of groundwater depth.

Success criteria for wetland hydrology require that the area be inundated or saturated within 12" of the ground surface for a period of 12.5% of the growing season. The growing season in Mecklenburg County begins March 22 and ends November 11 (235 days). In order to attain hydrologic success, saturation within 12" of the ground surface is required for 29 consecutive days.

1. Problem Areas Plan View (Wetland)

An assessment of the stability of the wetland was preformed on during monthly visits that occurred from May through December 2005, by S&EC. Groundwater gauges were downloaded monthly.

As shown on the Problem Area Plan View (Sheets 5 through 8), twenty (20) of the twenty-nine (29) gauges on-site achieved wetland success criteria of saturation for 12.5% of the growing season (29 days). The nine (9) gauges that did not meet criteria were consistent with those failing to meet hydrology in 2004.

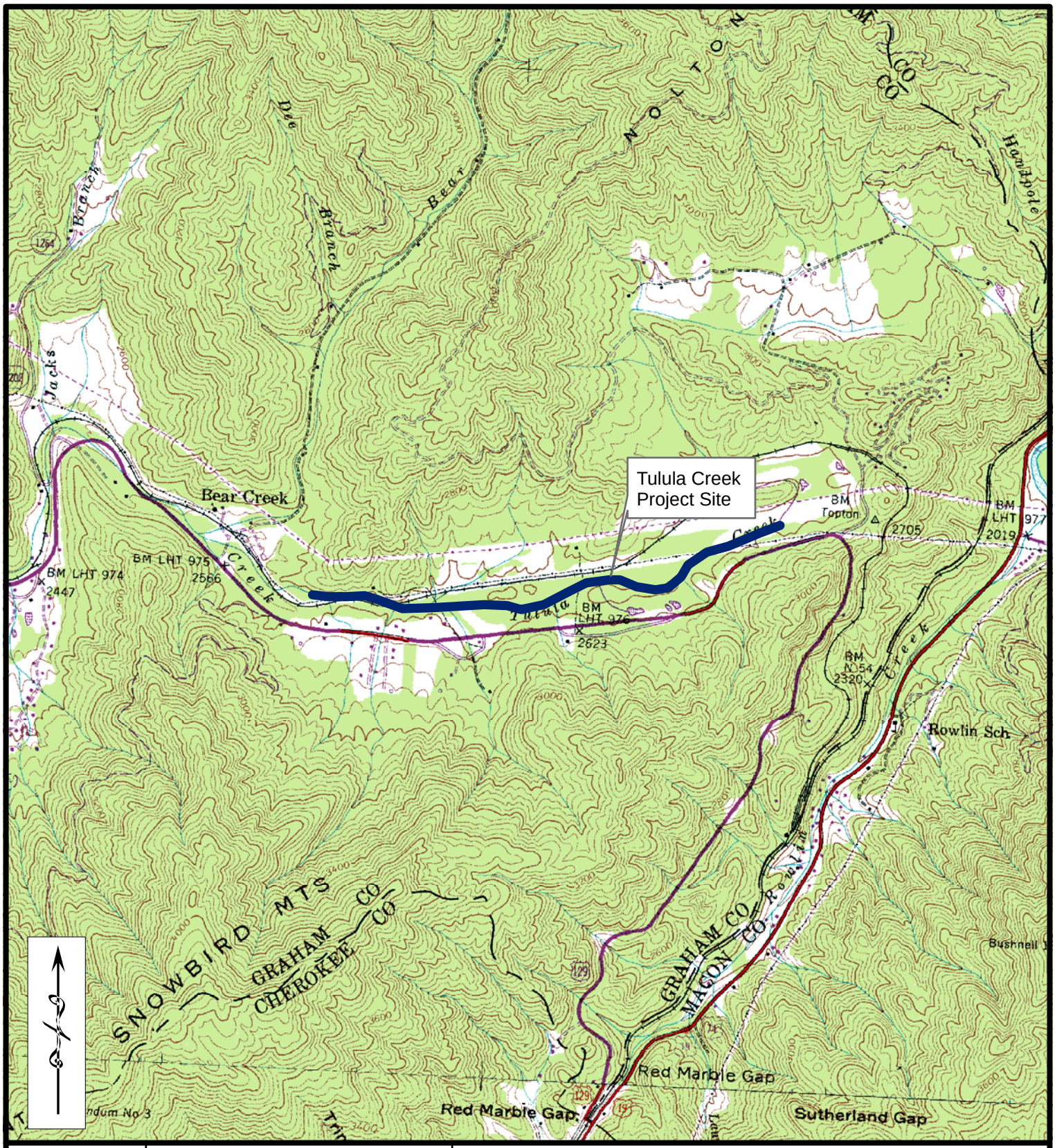
2. Wetland Criteria Attainment

Table XIII: Wetland Criteria Attainment
Tulula Stream and Wetland Mitigation Site (EEP Project # 00035)

Well ID	Well Hydrology Threshold Met?	Transect Mean	Vegetation Plot ID	Vegetation Survival Threshold Met?
A1	Y	80%	Plot 1	N
A2	N		Plot 2	N
A3	Y		Plot 3	N
A4	Y		Plot 4	Y
A5	Y		Plot 5	Y
B1	N	60%	Plot 6	N
B2	Y		Plot 7	N
B3	N			
B4	Y			
B5	Y			
C1	Y	100%		
C2	Y			
D1	N	66%		
D2	Y			
D3	Y			
E1	Y	75%		
E2	Y			
E3	Y			
E4	N			
F1	Y	50%		
F2	N			
F3	N			
G1	Y	100%		
G2	Y			
H1	Y	66%		
H2	Y			
H3	N			
I1	N	0%		
X1	Y	100%		

IV. Methodology Section

No unavoidable deviations from initially prescribed methodologies were implemented as a part of monitoring Year 3 (2005) activities.



Project No. 9444.D1	Figure 1 - Vicinity Map
Project Mgr.: JR	Tulula Creek Project Site NCEEP Year 3 of 5 Graham County, NC
Scale: 1" = 2,000'	Hewitt Quadrangle
12/08/05	

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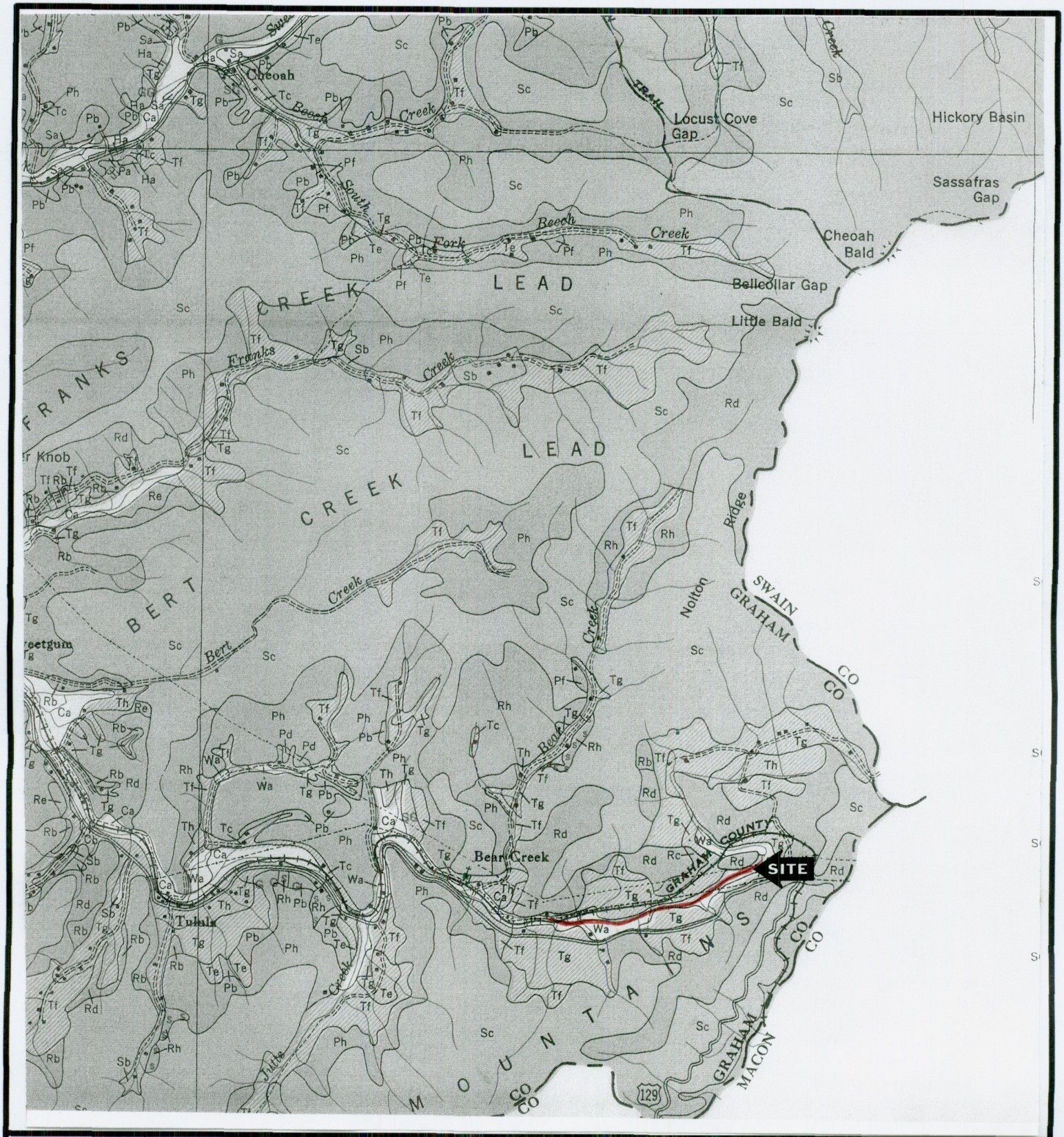
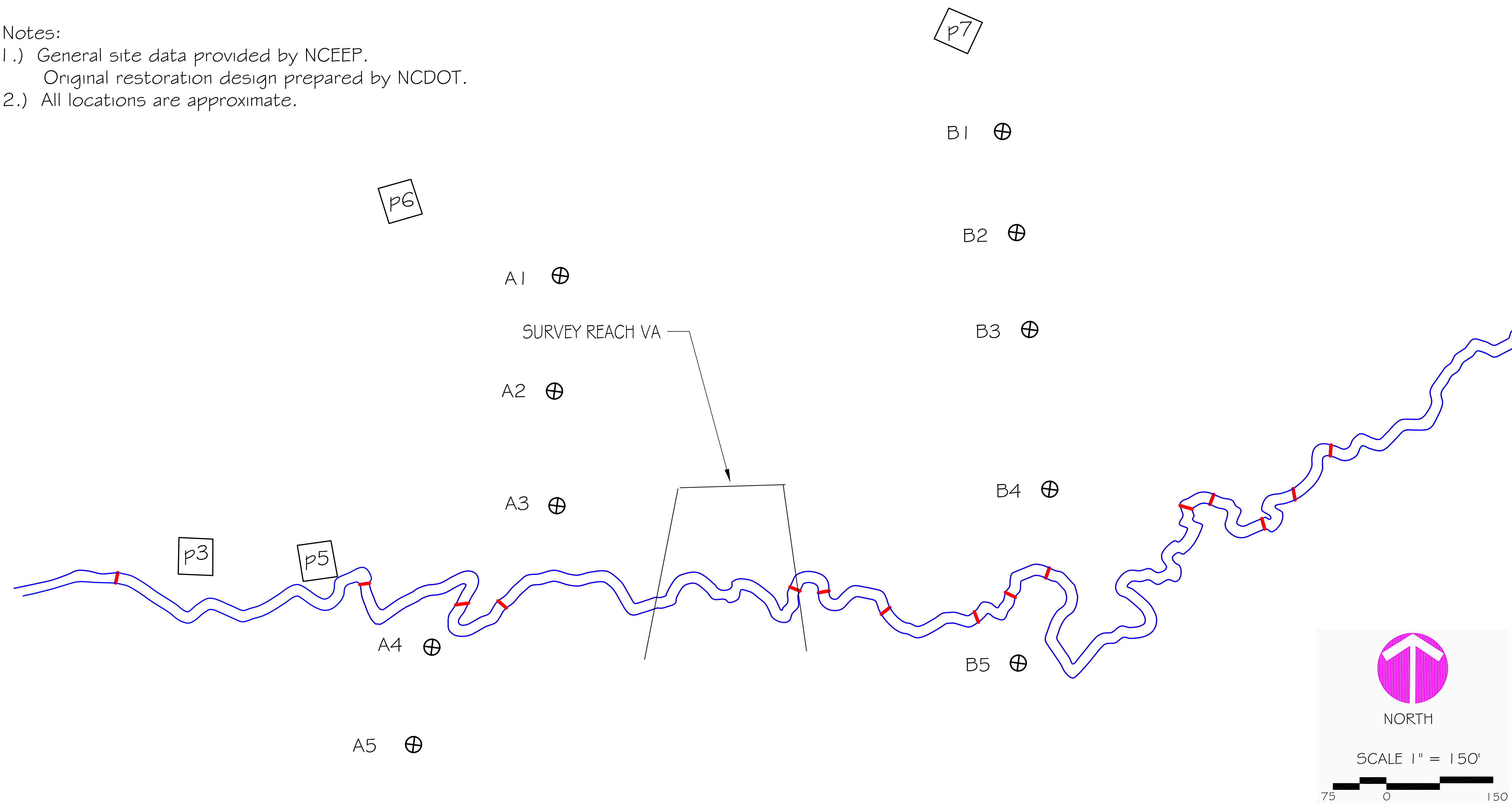


Project No. 9444.D1	Figure 2 - Soils Map	
Project Mgr.: JR	Tulula Creek NCEEP Year 3 of 5 Graham County, NC	S&EC Soil & Environmental Consultants, PA 11010 Raven Ridge Rd. • Raleigh, NC 27614 (919) 846-5900 • (919) 846-9467 Web Page: www.SandEC.com
Scale: 1" = 4000'	GrahamCounty 1942 Soil Survey	Ecosystem Enhancement PROGRAM
12/08/05		

Tulula Bog Stream and Wetland Restoration
Monitoring Year 3 of 5

LEGEND
- Existing Stream Banks
- Log Vane
- Beaver Dam
- Vegetation Plot
- Survey Reach
- Cross Section

Notes:
1.) General site data provided by NCEEP.
Original restoration design prepared by NCDOT.
2.) All locations are approximate.



MONITORING PLAN VIEW

NOVEMBER 2005

File: Sec\Jobs7-9k\9444.D1\PAPV\PAPV 11-17.dwg

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Project: TULULA BOG STREAM WETLAND RESTORATION	Project No.: 9444.D1
Location: GRAHAM CO., NC	Client: NCEEP
Proj. Mgr.: PKS	Drawn: JER
Scale: 1" = 150'	
Sheet Title: MONITORING PLAN VIEW-SEGMENT 1	Sheet No.: 1 OF 8

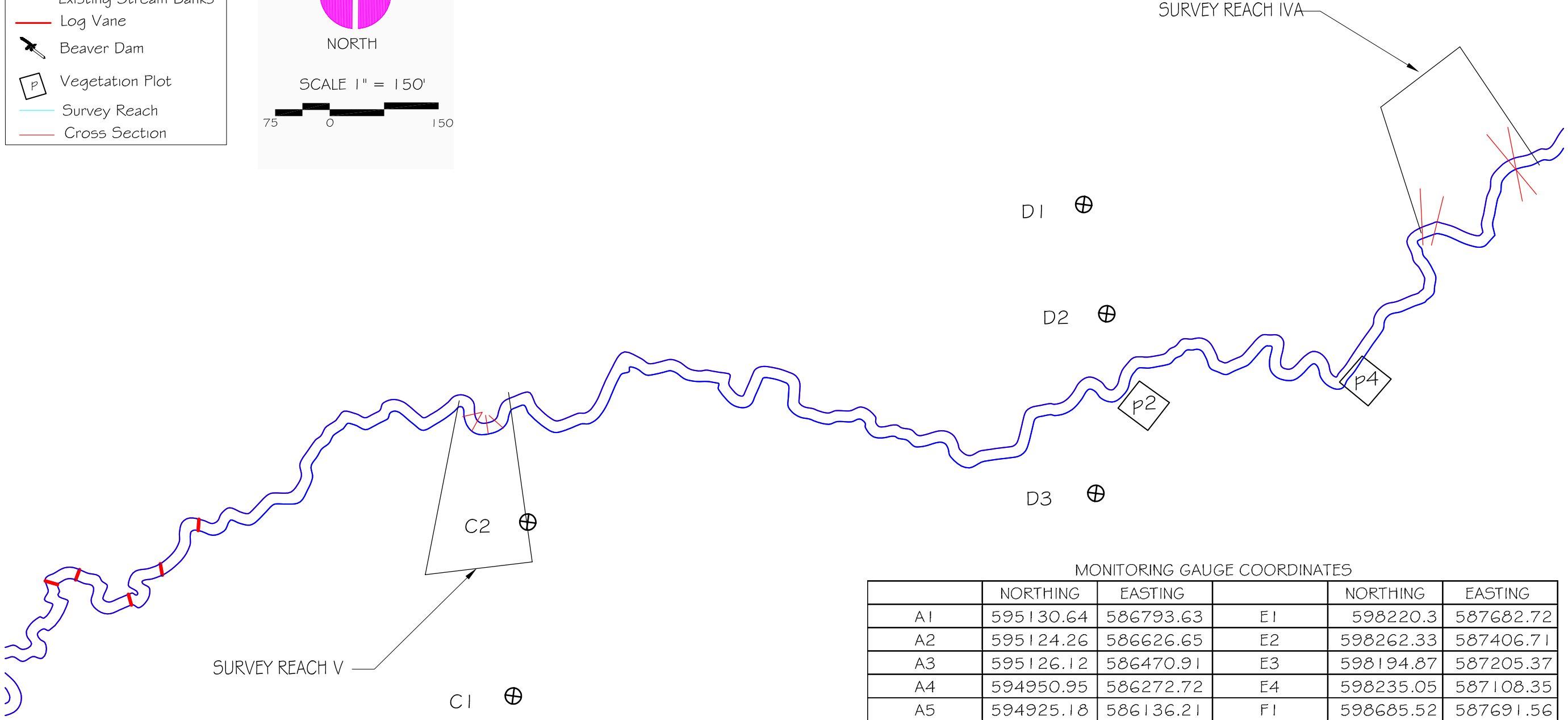
LEGEND

- Existing Stream Banks
- Log Vane
- Beaver Dam
- Vegetation Plot
- Survey Reach
- Cross Section

NORTH

SCALE 1" = 150'

75 0 150



Notes:

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Original restoration design prepared by NCDOT.

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MONITORING GAUGE COORDINATES

	NORTHING	EASTING		NORTHING	EASTING
A1	595130.64	586793.63	E1	598220.3	587682.72
A2	595124.26	586626.65	E2	598262.33	587406.71
A3	595126.12	586470.91	E3	598194.87	587205.37
A4	594950.95	586272.72	E4	598235.05	587108.35
A5	594925.18	586136.21	F1	598685.52	587691.56
B1	595750.07	586995.58	F2	598762.23	587425.08
B2	595769.85	586853.79	F3	598791.44	587266.91
B3	595741.54	586724.32	G1	599826.45	588026.37
B4	595816.32	586494.19	G2	600129.53	588005.24
B5	595772.23	586250.55	H1	599817.07	588160.15
C1	596661.77	586552.51	H2	599911.23	588296.05
C2	596644.19	586315.38	H3	600022.25	588252.82
D1	597427.42	586988.87	I1	599881.03	588397.15
D2	597459.17	586838.66	X1	599397.08	587506.26
D3	597448.7	586598.37			

MONITORING PLAN VIEW

NOVEMBER 2005

File: Sec\Jobs7-9\9444.D1\PAP\PAPV 11-17.dwg

Project No.: 9444.D1 | Drawn: JER
Proj. Mgr.: PKS | Scale: 1" = 150'
Project: TULULA BOG STREAM WETLAND RESTORATION
Location: GRAHAM CO., NC | Client: NCEEP
Sheet Title: MONITORING PLAN VIEW-SEGMENT 2 | Sheet No.: 2 OF 8

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LEGEND

- Existing Stream Banks
- Log Vane
- Beaver Dam
- Vegetation Plot
- Survey Reach
- Cross Section

Notes:

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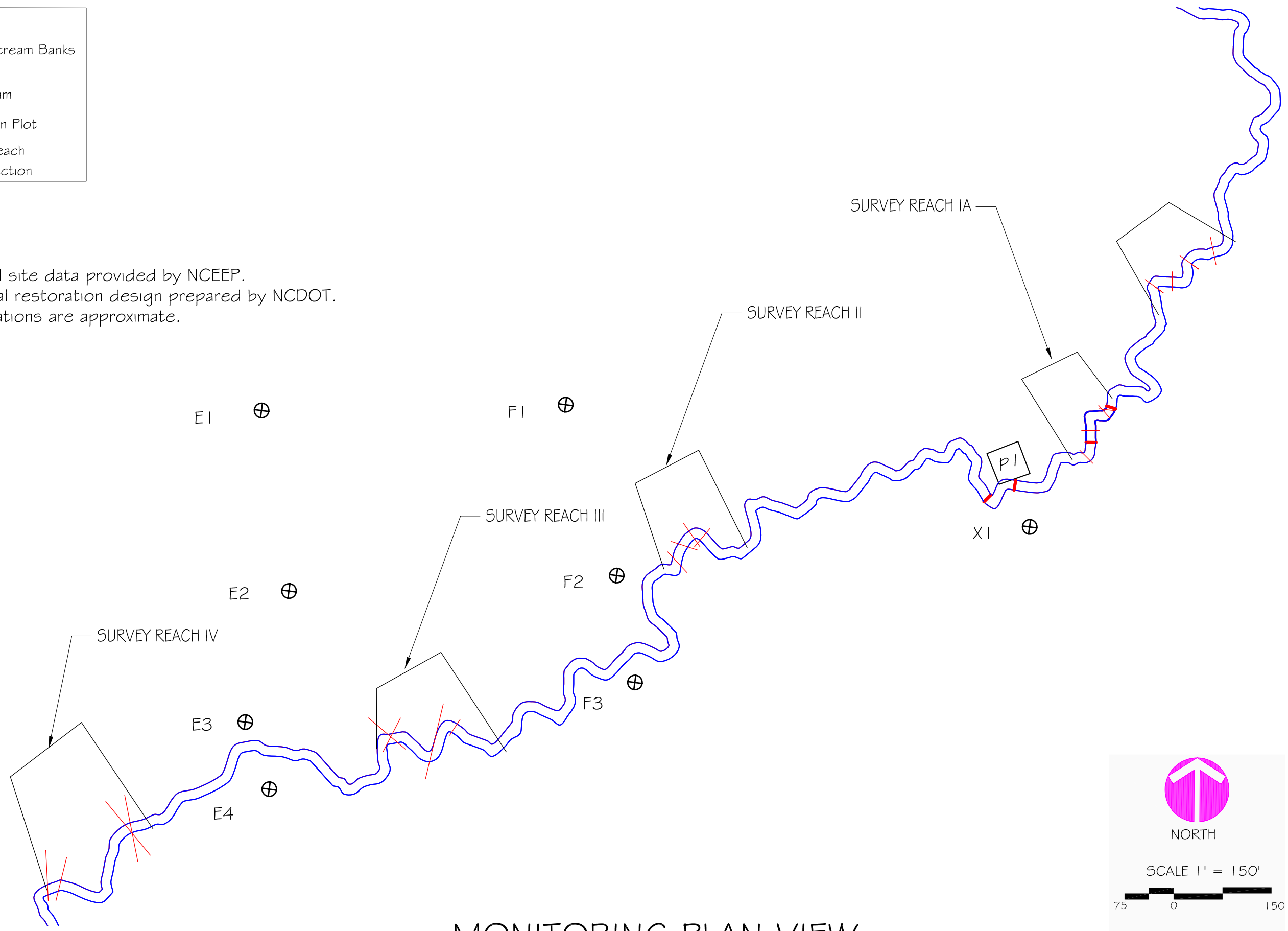

NORTH

SCALE 1" = 150'

75 0 150

MONITORING PLAN VIEW

NOVEMBER 2005

File: Sec\Jobs7-9\09444.01\PAP\PAPV 11-17.dwg

Project: TULULA BOG STREAM WETLAND RESTORATION

Location: WAKE CO., NC | Client: NCEEP

Sheet Title: MONITORING PLAN VIEW-SEGMENT 3

Project No.: 9444.01 | Proj. Mgr.: PKS | Drawn: JER | Scale: 1" = 150' | Sheet No.: 3 OF 8

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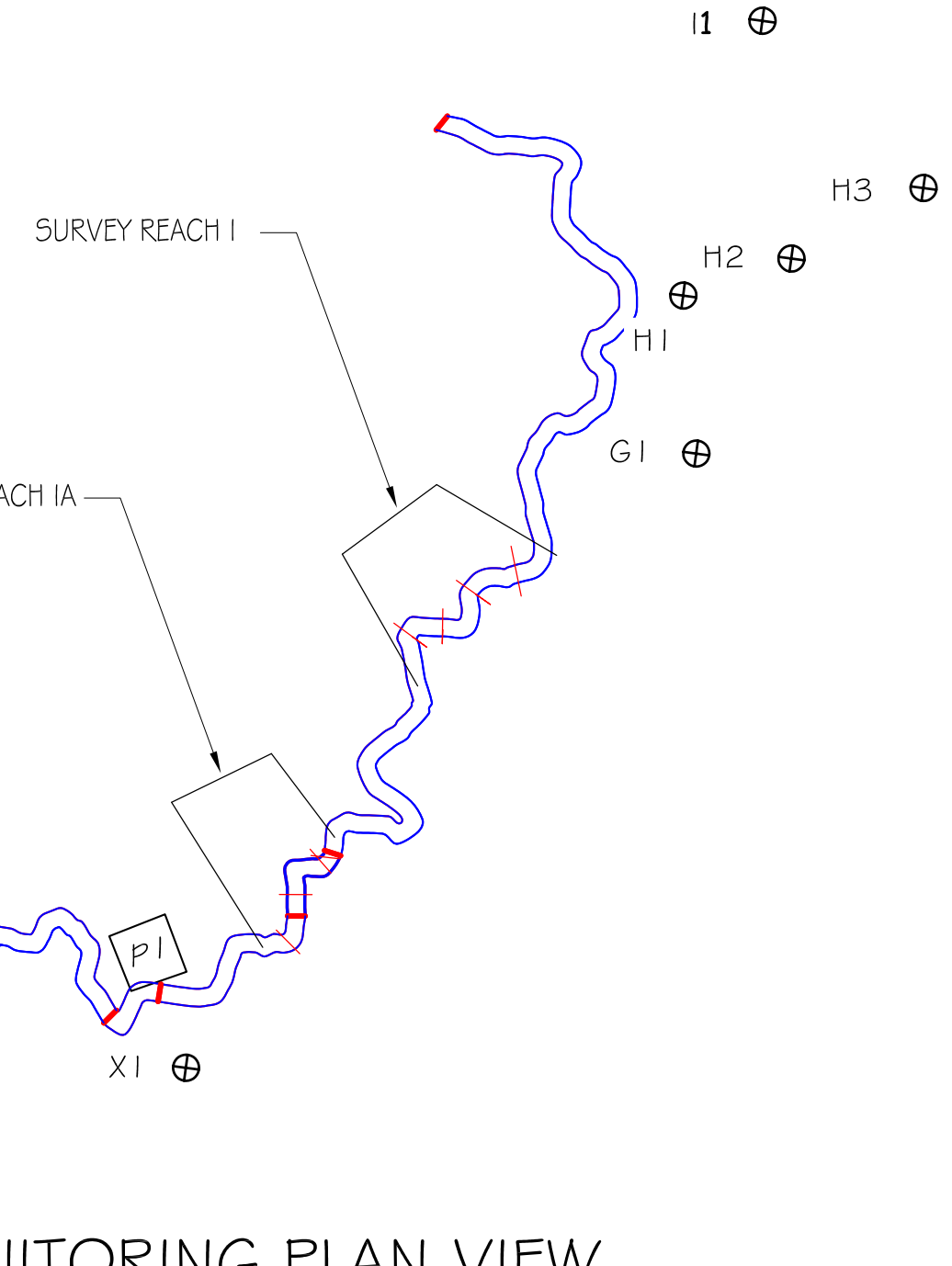
LEGEND

- Existing Stream Banks
- Log Vane
- Beaver Dam
- Vegetation Plot
- Survey Reach
- Cross Section



Notes:

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Original restoration design prepared by NCDOT.

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NORTH

SCALE 1" = 150'

75 0 150

MONITORING PLAN VIEW

NOVEMBER 2005

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Project: TULULA BOG STREAM WETLAND RESTORATION

Location: GRAHAM CO., NC | Client: NCEEP

Sheet Title: MONITORING PLAN VIEW-SEGMENT 4

Project No.: 9444.01 | Proj. Mgr.: PKS | Drawn: JER | Scale: 1" = 150' | Sheet No.: 4 OF 8

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LEGEND

Existing Stream Banks

Log Vane

Beaver Dam

PAPV LEGEND

STREAM PROBLEM AREAS-STRESSED

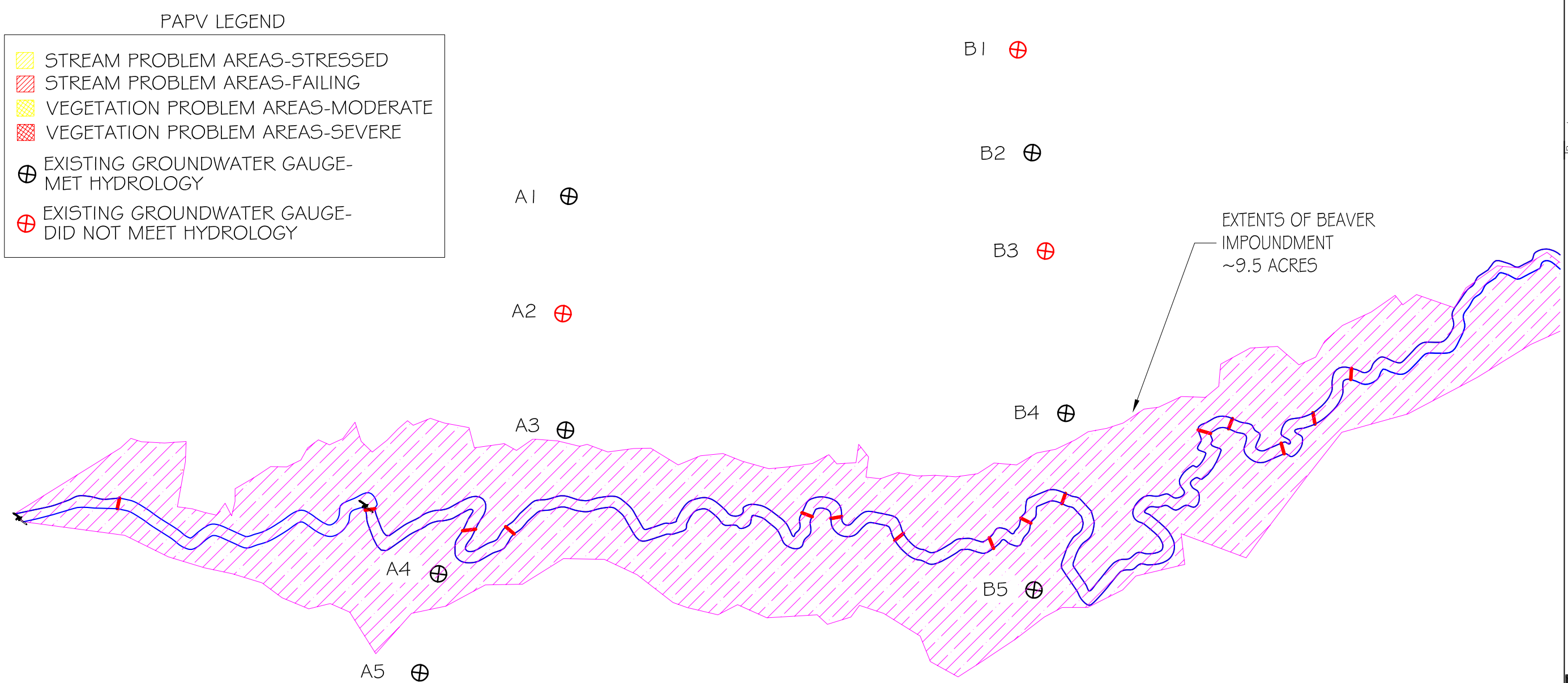
STREAM PROBLEM AREAS-FAILING

VEGETATION PROBLEM AREAS-MODERATE

VEGETATION PROBLEM AREAS-SEVERE

⊕ EXISTING GROUNDWATER GAUGE-MET HYDROLOGY

⊕ EXISTING GROUNDWATER GAUGE-DID NOT MEET HYDROLOGY



Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by NCDOT.

2.) Site evaluation prepared by Soil and Environmental Consultants, PA on 7/19-20/05.

3.) All locations are approximate.

4.) Those segments of restored channel which have been inundated due to beaver impoundments have NOT been evaluated for stability or vegetative cover.

5.) GPS boundary of beaver impoundment surveyed by S&EC.

NOVEMBER 2005

NORTH

SCALE 1" = 150'

75 0 150

PROBLEM AREA PLAN VIEW

Project No.: 9444.01
Proj. Mgr.: PKS
Drawn: JER
Scale: 1" = 150'
Client: NCEEP
Location: GRAHAM CO., NC
Project: TULULA BOG STREAM WETLAND RESTORATION
Sheet Title: PAPV-SEGMENT 1
Sheet No.: 5 OF 8

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LEGEND

- Existing Stream Banks
- Log Vane
- Beaver Dam

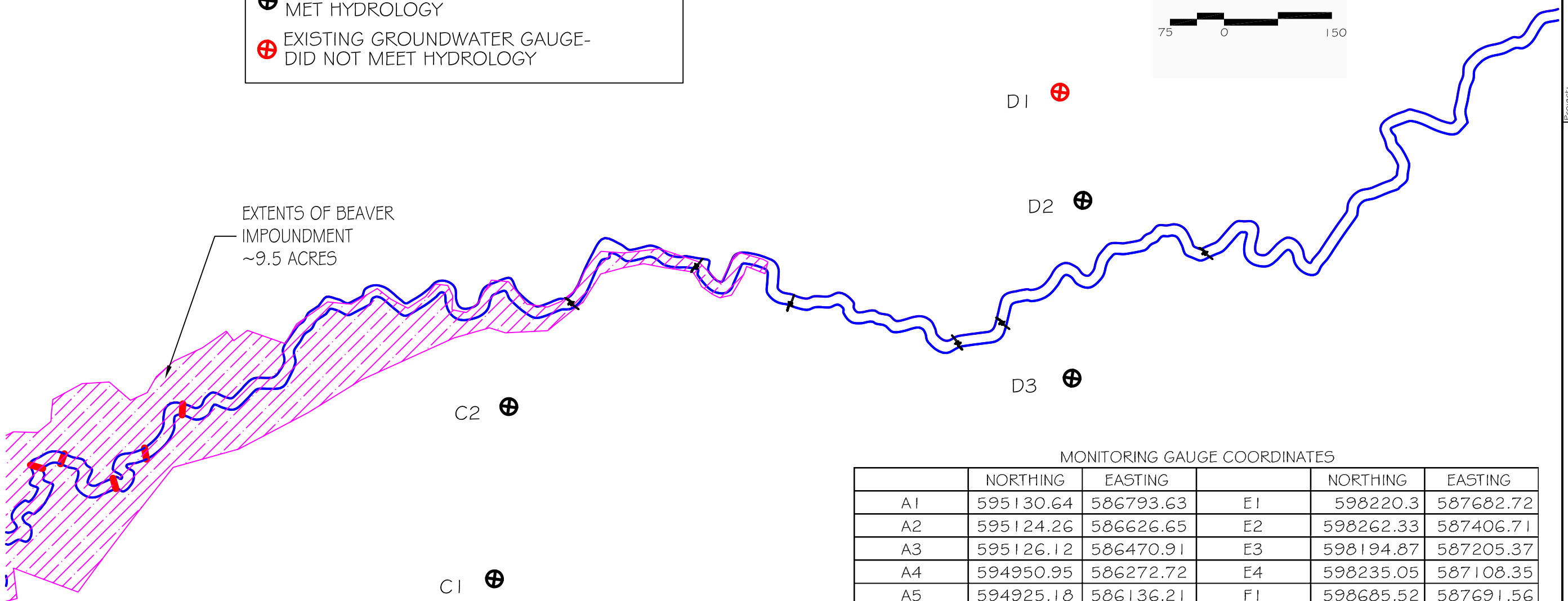
PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- STREAM PROBLEM AREAS-FAILING
- VEGETATION PROBLEM AREAS-MODERATE
- VEGETATION PROBLEM AREAS-SEVERE
- ⊕ EXISTING GROUNDWATER GAUGE- MET HYDROLOGY
- ⊕ EXISTING GROUNDWATER GAUGE- DID NOT MEET HYDROLOGY

NORTH

SCALE 1" = 150'

75 0 150



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A2	595124.26	586626.65	E2	598262.33	587406.71
A3	595126.12	586470.91	E3	598194.87	587205.37
A4	594950.95	586272.72	E4	598235.05	587108.35
A5	594925.18	586136.21	F1	598685.52	587691.56
B1	595750.07	586995.58	F2	598762.23	587425.08
B2	595769.85	586853.79	F3	598791.44	587266.91
B3	595741.54	586724.32	G1	599826.45	588026.37
B4	595816.32	586494.19	G2	600129.53	588005.24
B5	595772.23	586250.55	H1	599817.07	588160.15
C1	596661.77	586552.51	H2	599911.23	588296.05
C2	596644.19	586315.38	H3	600022.25	588252.82
D1	597427.42	586988.87	I1	599881.03	588397.15
D2	597459.17	586838.66	X1	599397.08	587506.26
D3	597448.7	586598.37			

PROBLEM AREA PLAN VIEW

NOVEMBER 2005

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Project: TULULA BOG STREAM WETLAND RESTORATION
Location: GRAHAM CO., NC
Client: NCEEP
Sheet Title: PAPV-SEGMENT 2

Project No.: 9444.D1
Proj. Mgr.: PKS
Drawn: JER
Scale: 1" = 150'
Sheet No.: 6 OF 8

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Ecosystem Enhancement Program

LEGEND

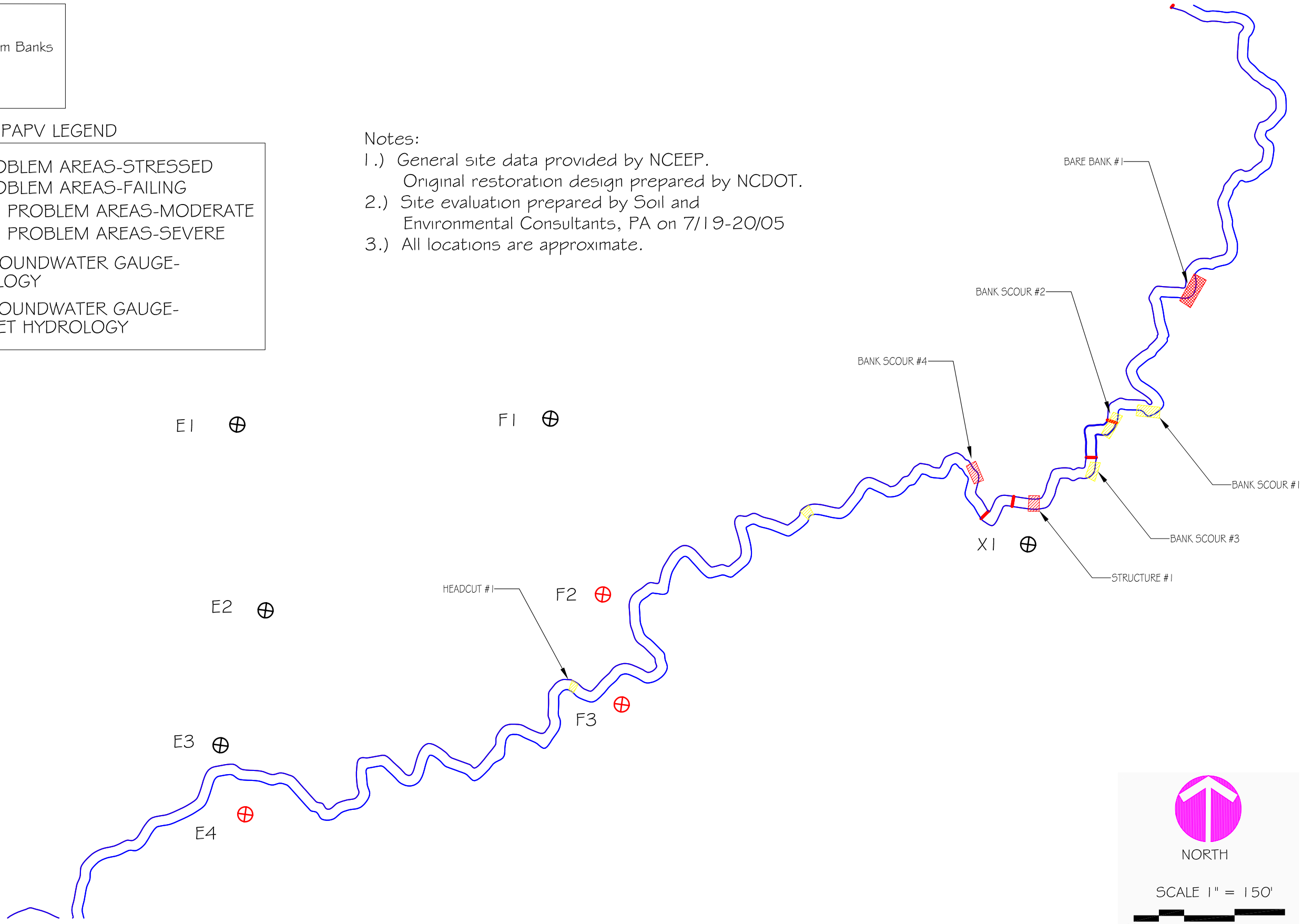
- Existing Stream Banks
- Log Vane
- Beaver Dam

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- STREAM PROBLEM AREAS-FAILING
- VEGETATION PROBLEM AREAS-MODERATE
- VEGETATION PROBLEM AREAS-SEVERE
- ⊕ EXISTING GROUNDWATER GAUGE-MET HYDROLOGY
- ⊕ EXISTING GROUNDWATER GAUGE-DID NOT MEET HYDROLOGY

Notes:

1.) General site data provided by NCEEP.
Original restoration design prepared by NCDOT.
2.) Site evaluation prepared by Soil and Environmental Consultants, PA on 7/19-20/05
3.) All locations are approximate.



PROBLEM AREA PLAN VIEW

NOVEMBER 2005

File: SecUobs7-9\9444.D1\PAPV\PAPV 11-17.dwg

Project: TULULA BOG STREAM WETLAND RESTORATION
Location: WAKE CO., NC
Client: NCEEP
Sheet Title: PAPV-SEGMENT 3
Project No.: 9444.D1
Proj. Mgr.: PKS
Drawn: JER
Scale: 1" = 150'
Sheet No.: 7 OF 8

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

LEGEND

- Existing Stream Banks
- Log Vane
- Beaver Dam

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
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Notes:

1.) General site data provided by NCEEP.
Original restoration design prepared by NCDOT.

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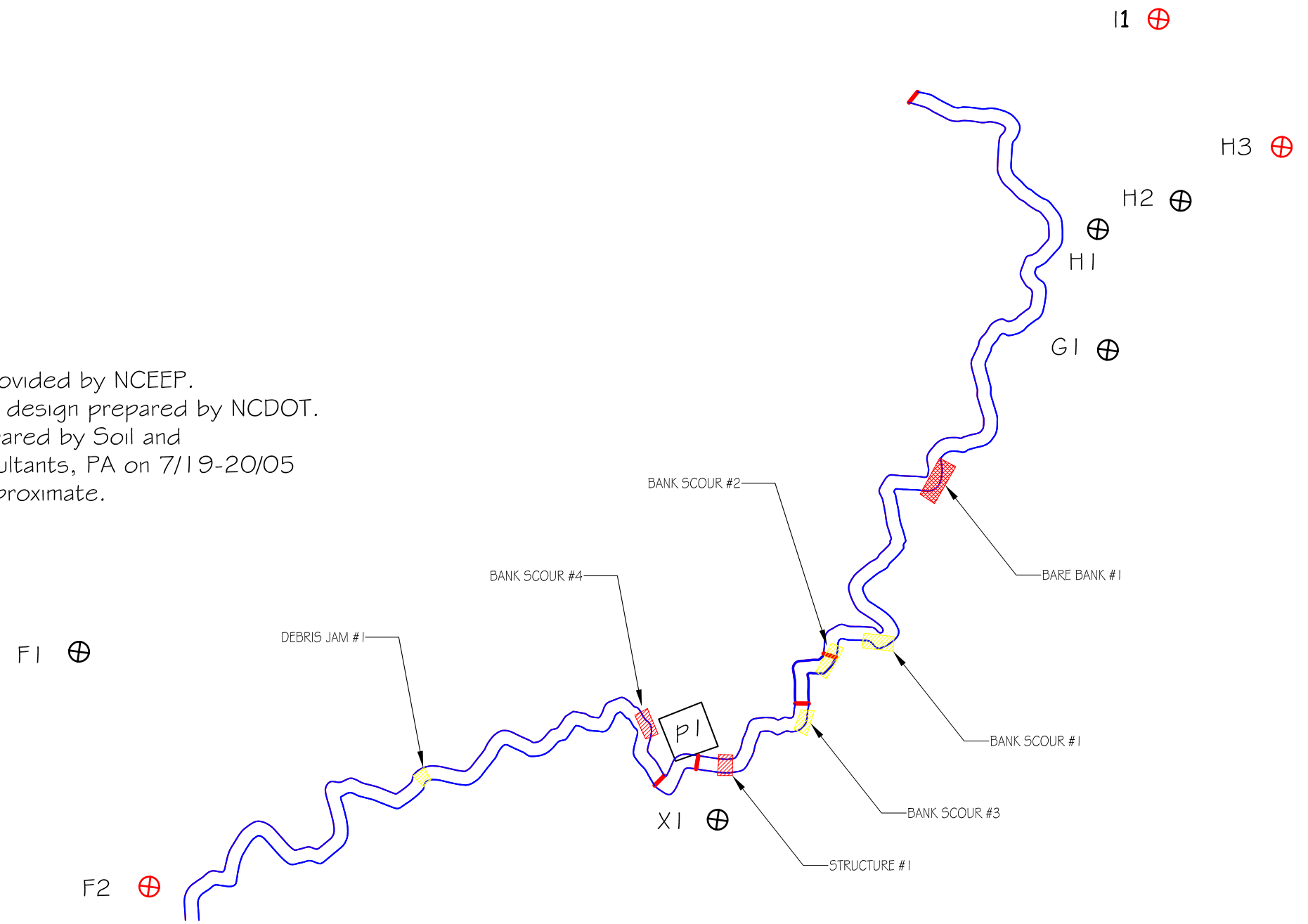
3.) All locations are approximate.



PROBLEM AREA PLAN VIEW

NOVEMBER 2005

NORTH

SCALE 1" = 150'

75 0 150

Project: TULULA BOG STREAM WETLAND RESTORATION
Location: GRAHAM CO., NC
Client: NCEEP
Sheet Title: PAPV-SEGMENT 4

Project No.: 9444.01
Proj. Mgr.: PKS
Drawn: JER
Scale: 1" = 150'
Sheet No.: 8 OF 8

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Ecosystem Enhancement Program

File: S:\cvl\obs7-9\9444.01\PAPV\PAPV 11-17.dwg

APPENDIX A

APPENDIX A –

Vegetation Survey Data Tables

Table VIII: Stem Counts for Each Species Arranged by Plot
Tulula Bog Stream and Wetland Mitigation Site (EEP Project # 00035)

Species	Plots							Year 3 Totals
	1	**2**	**3**	**4**	**5**	**6**	**7**	
***Nyssa sylvatica* var. *sylvatica* (Black Gum)**								0
***Quercus rubrum* (Northern Red Oak)**	9		5		1	4	2	21
***Betula nigra* (River Birch)**		4						4
***Liriodendron tulipifera* (Tulip Poplar)**		3	8	15	2	13	1	42
***Quercus alba* (White Oak)**	12	6	1	3	1	1		24
***Prunus serotina* (Black Cherry)**							8	8
Year 3 Totals	**21**	**13**	**14**	**18**	**4**	**18**	**11**	99
Year 2 Totals	32	26	25	22	4	23	15	147
Live Stem Density	420	246	250	314	70	313	192	
Average Live Stem Density								**257**
Survival % Per Plot (from Year 2)	66%	50%	56%	82%	100%	78%	73%	

EEP Stem Count Data Sheet

EEP Project #:	**00035**	**Date:**	5/27/2005
Project Name:	**Tulula Bog**	**Staff Name:**	J. Regan
Monitoring Contractor:	**S&EC**	**Staff Name:**	D. Gainey
County:	**Graham**		
8 Digit Catalog Unit	**06010204**		
Stream/Wetland Name:	**Tulula Creek**		

Plot Location

Plot ID	Species		Stem #
1	White Oak		12
1	Northern Red Oak		9

Plot Location

Plot ID	pecies	Stem #
5	Tulip Poplar	2
5	White Oak	1
5	Northern Red Oak	1

Plot Location

Plot ID	Species		Stem #
2	River Birch		4
2	Tulip Poplar		3
2	White Oak		6

Plot Location

Plot ID	pecies	Stem #
6	Tulip Poplar	13
6	White Oak	1
6	Northern Red Oak	4

Plot Location

Plot ID	Species		Stem #
3	White Oak		1
3	Northern Red Oak		5
3	Tulip Poplar		8

Plot Location

Plot ID	pecies	Stem #
7	Black Cherry	8
7	Northern Red Oak	2
7	Tulip Poplar	1

Plot Location

Plot ID	Species		Stem #
4	Tulip Poplar		15
4	White Oak		3

APPENDIX A –

Vegetation Problem Area Photos

Figure 1— Bare Bank 1

APPENDIX A –

Vegetation Monitoring Plot Photos

Vegetation Monitoring Plot 1—Year 3 (2005)

Vegetation Monitoring Plot 2—Year 3 (2005)

Vegetation Monitoring Plot 3—Year 3 (2005)

Vegetation Monitoring Plot 4—Year 3 (2005)

Vegetation Monitoring Plot 5—Year 3 (2005)

Vegetation Monitoring Plot 6—Year 3 (2005)

Vegetation Monitoring Plot 7—Year 3 (2005)

APPENDIX B

APPENDIX B –

Representative Stream Problem Area Photos

Figure 1— Typical Bank Scour

Figure 2—Typical Bank Scour

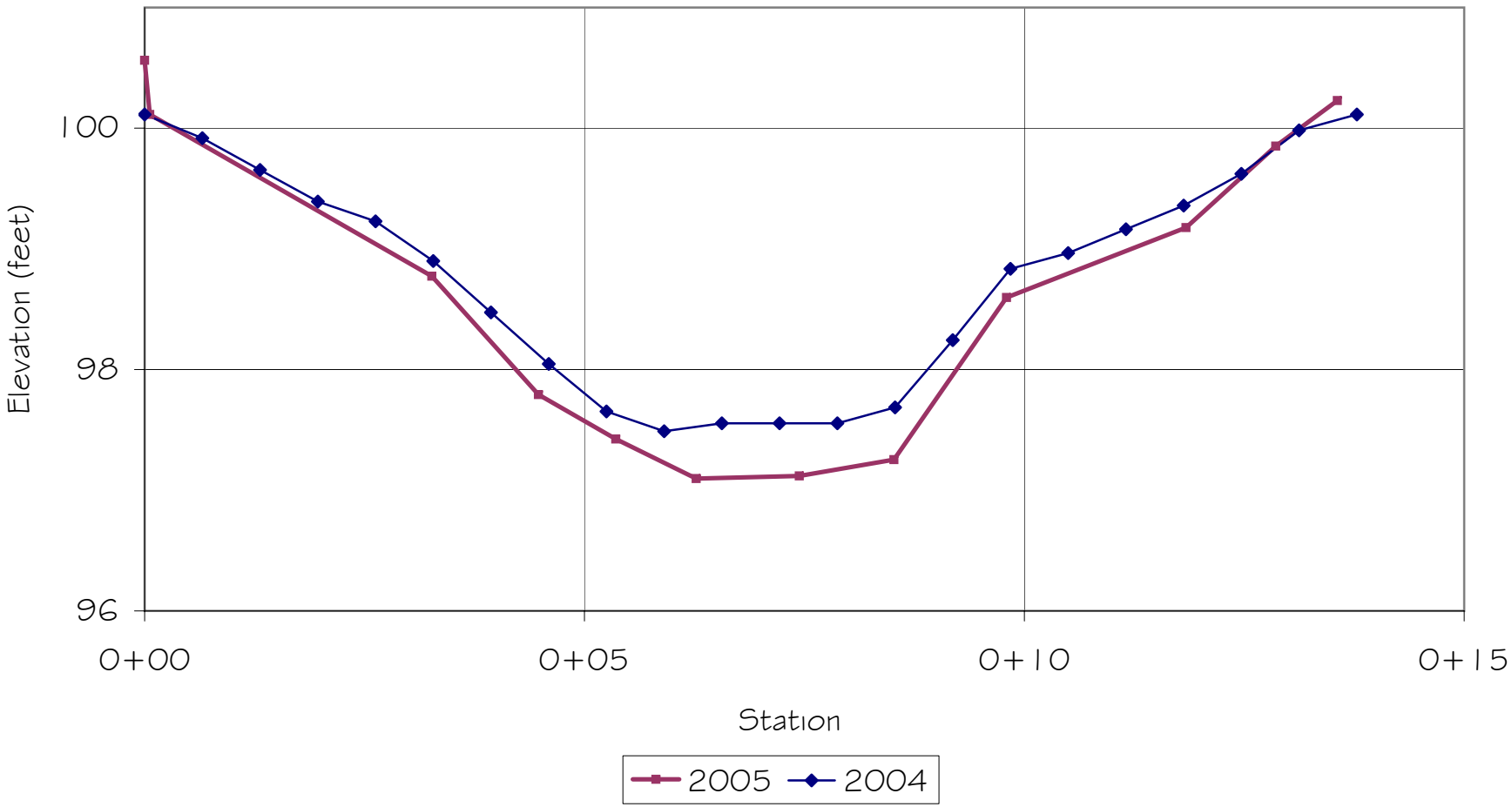
Figure 3—Debris Jam

Figure 4—Head Cut

APPENDIX B –

Cross-section Data

Tulula Stream and Wetland Restoration
(Reach 1) Cross-Section #1 - Riffle



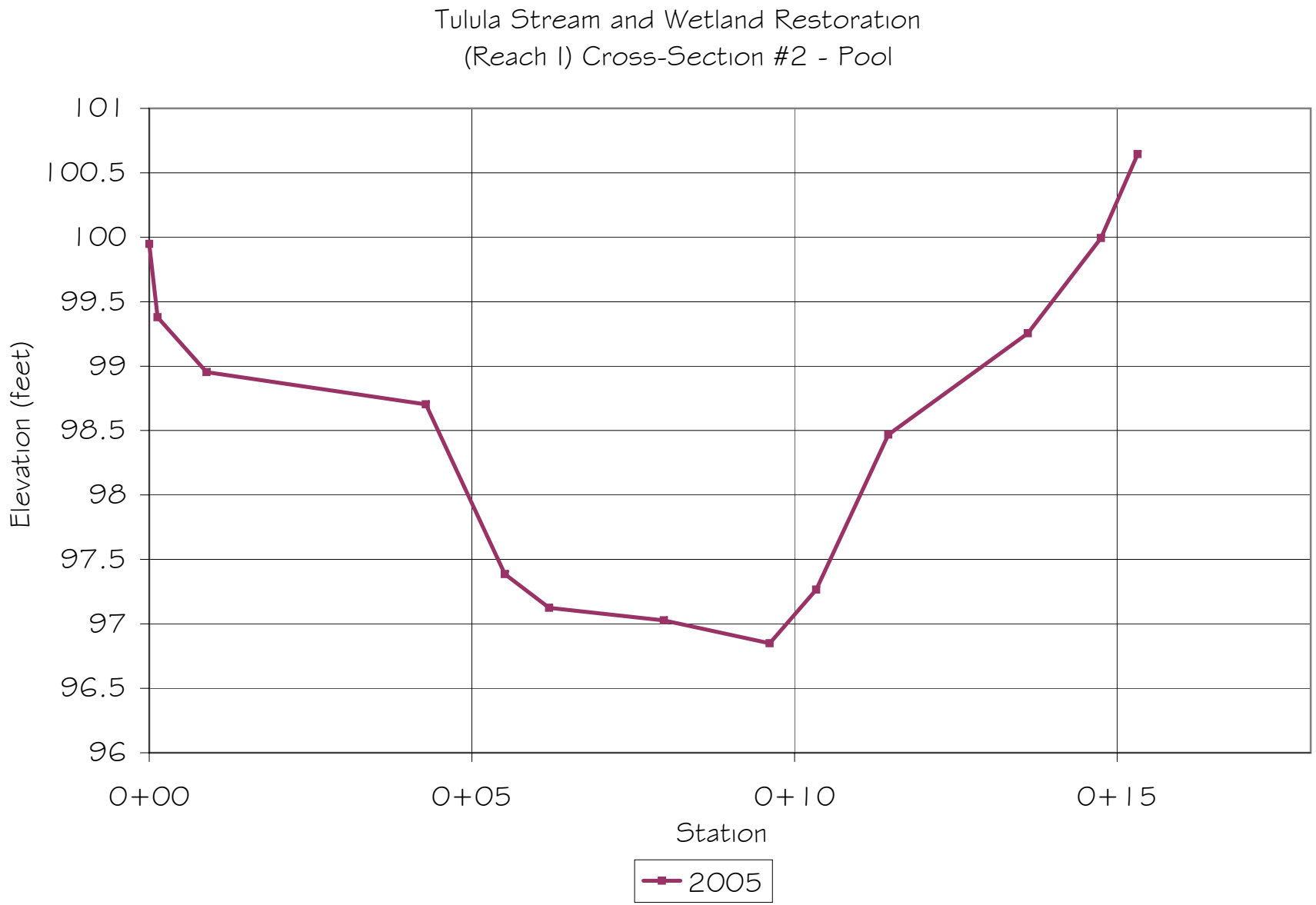
RIVERMORPH CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH 1 R1
Survey Date: 12/2/2005

Cross Section	Data Entry	
TAPE	FS	ELEV NOTE
0	0	100.5627
0.06	0	100.1137
3.27	0	98.7733
4.48	0	97.7924
5.36	0	97.4239
6.27	0	97.0963
7.44	0	97.118
8.52	0	97.2535
9.8	0	98.5965
11.84	0	99.1759
12.86	0	99.8518
13.56	0	100.2293

Cross Sectional Geometry

Floodprone	Elevation	(ft)	100.14
Bankfull	Elevation	(ft)	98.62
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	6.42
Entrenchment	Ratio		7.78
Mean	Depth	(ft)	1.05
Maximum	Depth	(ft)	1.52
Width/Depth	Ratio		6.1
Bankfull	Area	(sq	6.76
Wetted	Perimeter	(ft)	7.44
Hydraulic	Radius	(ft)	0.91
Begin	BKF	Station	3.46
End	BKF	Station	9.88


Tulula Stream and Wetland Restoration
(Reach 1) Cross-Section #2 - Pool
101
100.5
100
99.5
99
98.5
98
97.5
97
96.5
96
Elevation (feet)
0+00
0+05
0+10
0+15
Station
2005

RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH 1 P1
Survey Date: 12/2/2005

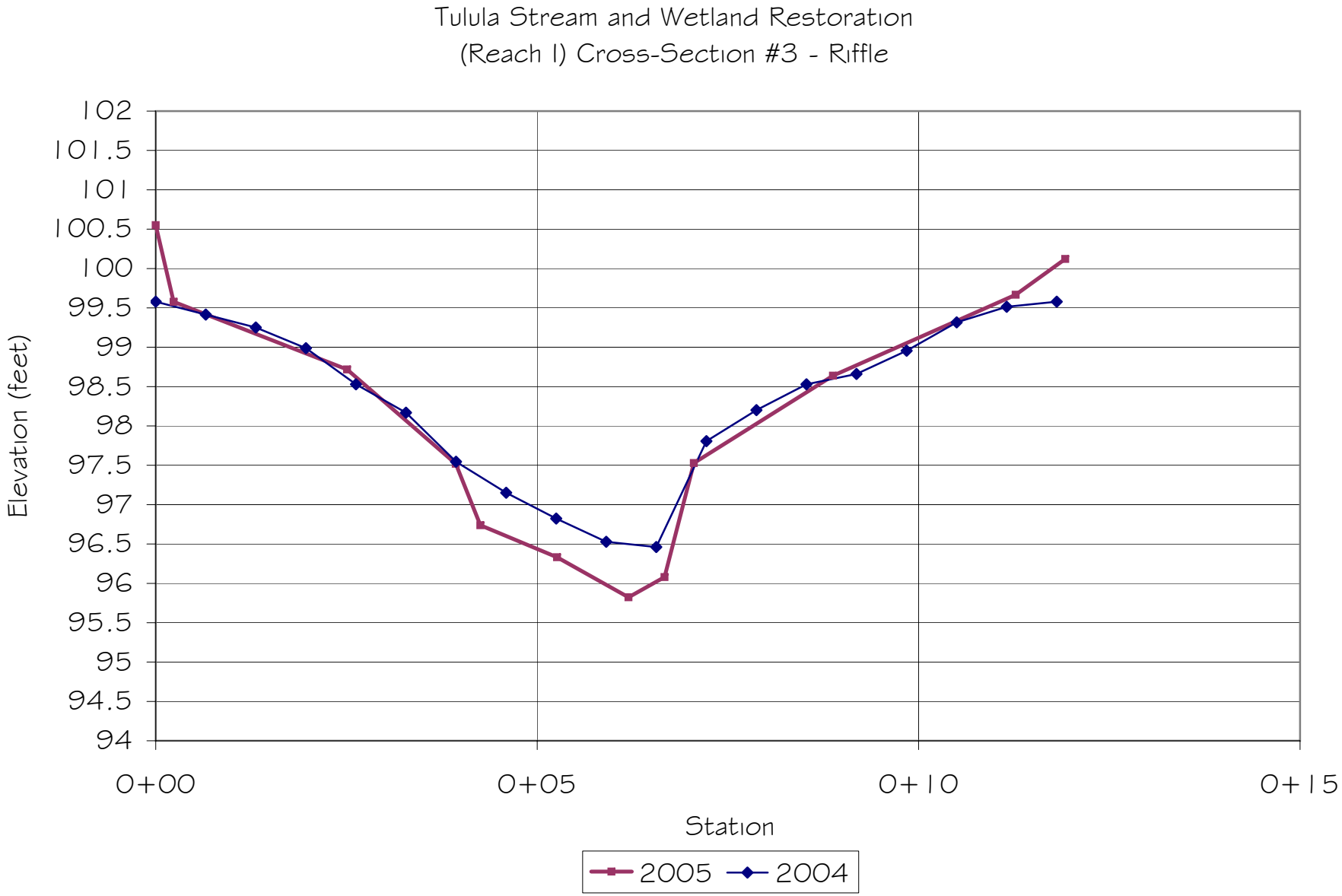
Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	99.9488	
0.13	0	99.3788	
0.89	0	98.9543	
4.29	0	98.7028	
5.51	0	97.3852	
6.2	0	97.1254	
7.98	0	97.0273	
9.61	0	96.8488	
10.34	0	97.2663	
11.45	0	98.4683	
13.62	0	99.2551	
14.75	0	99.9939	
15.32	0	100.6444	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	100.95
Bankfull	Elevation	(ft)	98.9
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	11.02
Entrenchm	Ratio		4.54
Mean	Depth	(ft)	1.06
Maximum	Depth	(ft)	2.05
Width/Dept	Ratio		10.43
Bankfull	Area	(sq	11.63
Wetted	Perimeter	(ft)	12.37
Hydraulic	Radius	(ft)	0.94
Begin	BKF	Station	1.62
End	BKF	Station	12.64


Tulula Stream and Wetland Restoration
(Reach 1) Cross-Section #3 - Riffle
Elevation (feet)
102
101.5
101
100.5
100
99.5
99
98.5
98
97.5
97
96.5
96
95.5
95
94.5
94
0+00
0+05
0+10
0+15
Station
2005
2004

RIVERMOI CROSS SECTION SUMMARY

River	Name:	Tulula	
Reach	Name:	2005	
Cross	Section	Name:	REACH1 R2
Survey	Date:	12/2/2005	

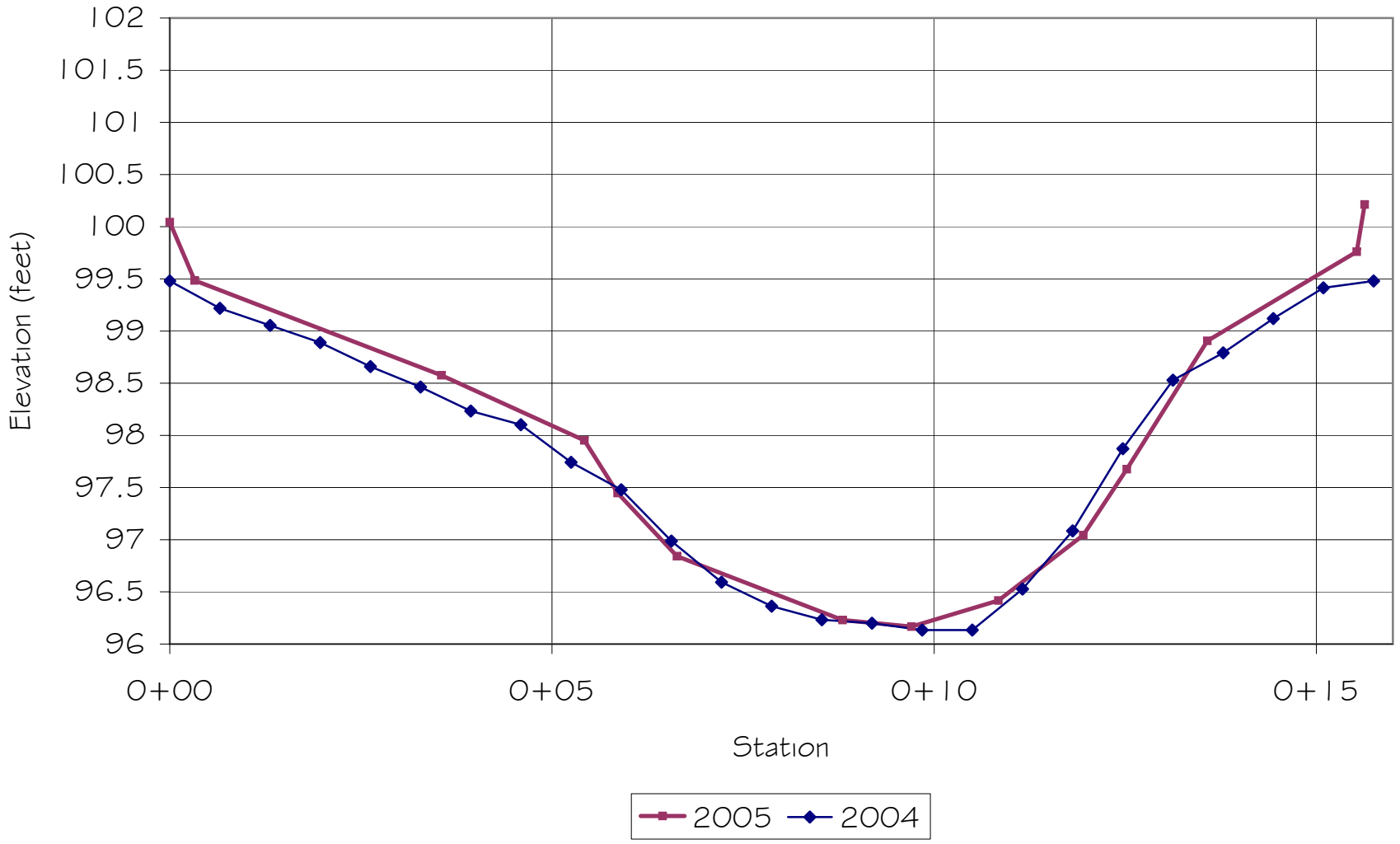
Cross	Section	Data	Entry
BM	Elevation:	0	ft
Backsight	Rod	Reading:	0 ft

TAPE	FS	ELEV	NOTE
0	0	100.5508	
0.23	0	99.5771	
2.51	0	98.7176	
3.93	0	97.5192	
4.26	0	96.7384	
5.26	0	96.3317	
6.2	0	95.8234	
6.67	0	96.0792	
7.05	0	97.528	
8.88	0	98.639	
11.27	0	99.6662	
11.92	0	100.1217	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	101.86
Bankfull	Elevation	(ft)	98.84
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	7.16
Entrenchment	Ratio		6.98
Mean	Depth	(ft)	1.41
Maximum	Depth	(ft)	3.02
Width/Depth	Ratio		5.09
Bankfull	Area	(sq	10.07
Wetted	Perimeter	(ft)	9.88
Hydraulic	Radius	(ft)	1.02
Begin	BKF	Station	2.19
End	BKF	Station	9.35

Tulula Stream and Wetland Restoration
(Reach 1) Cross-Section #4 - Pool



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH1 P2
Survey Date: 12/2/2005

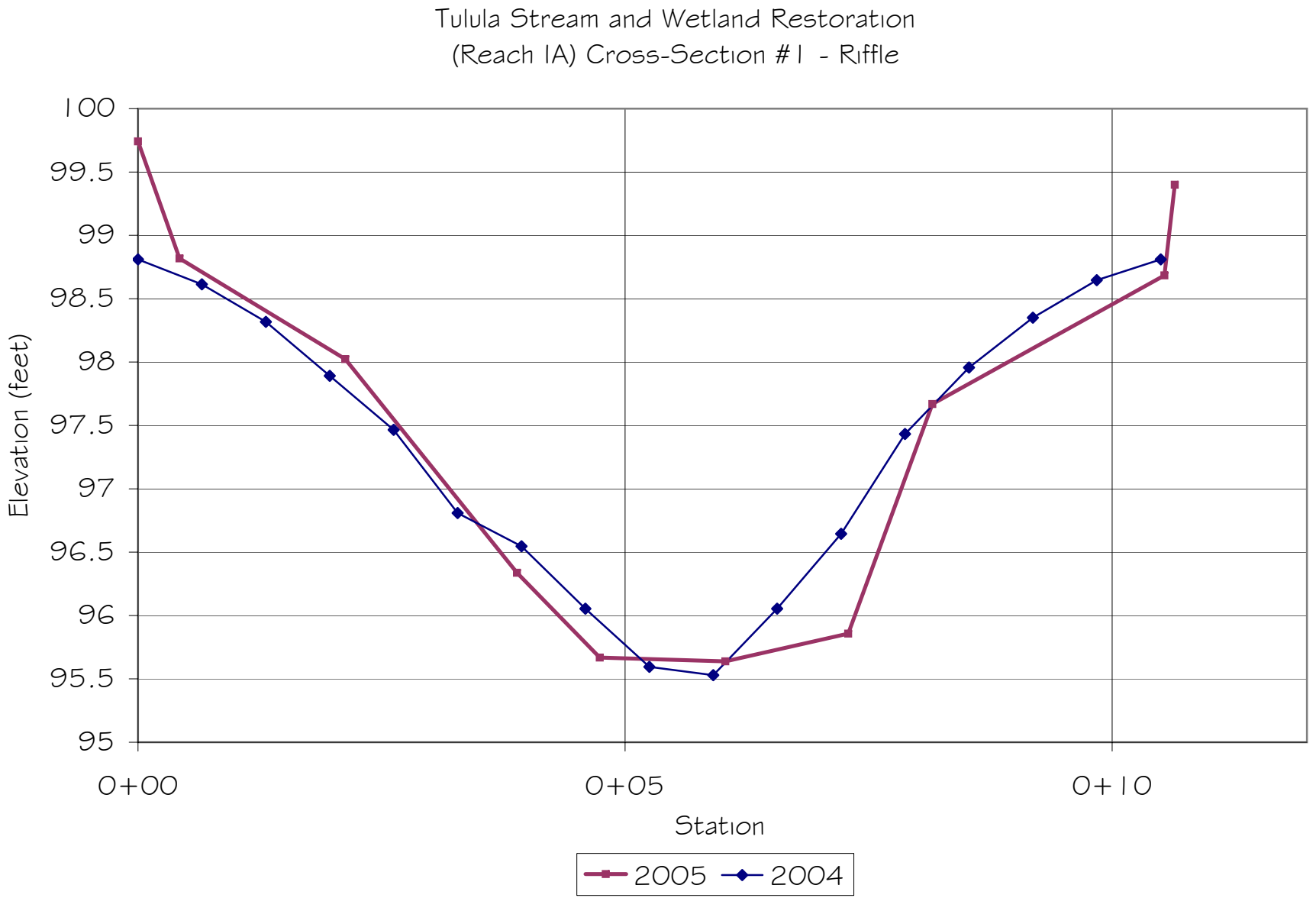
Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	100.0438	
0.33	0	99.4848	
3.55	0	98.5755	
5.42	0	97.9519	
5.86	0	97.4466	
6.64	0	96.8424	
8.8	0	96.2302	
9.7	0	96.1669	
10.84	0	96.4174	
11.95	0	97.0438	
12.52	0	97.6756	
13.57	0	98.9061	
15.53	0	99.7605	
15.63	0	100.2133	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	100.41
Bankfull	Elevation	(ft)	98.29
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	8.64
Entrenchm	Ratio		5.79
Mean	Depth	(ft)	1.35
Maximum	Depth	(ft)	2.12
Width/Dept	Ratio		6.38
Bankfull	Area	(sq	11.69
Wetted	Perimeter	(ft)	9.97
Hydraulic	Radius	(ft)	1.17
Begin	BKF	Station	4.41
End	BKF	Station	13.04


Tulula Stream and Wetland Restoration
(Reach 1A) Cross-Section #1 - Riffle
100
99.5
99
98.5
98
97.5
97
96.5
96
95.5
95
Elevation (feet)
0+00
0+05
0+10
Station
2005
2004

RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH1A R1
Survey Date: 12/2/2005

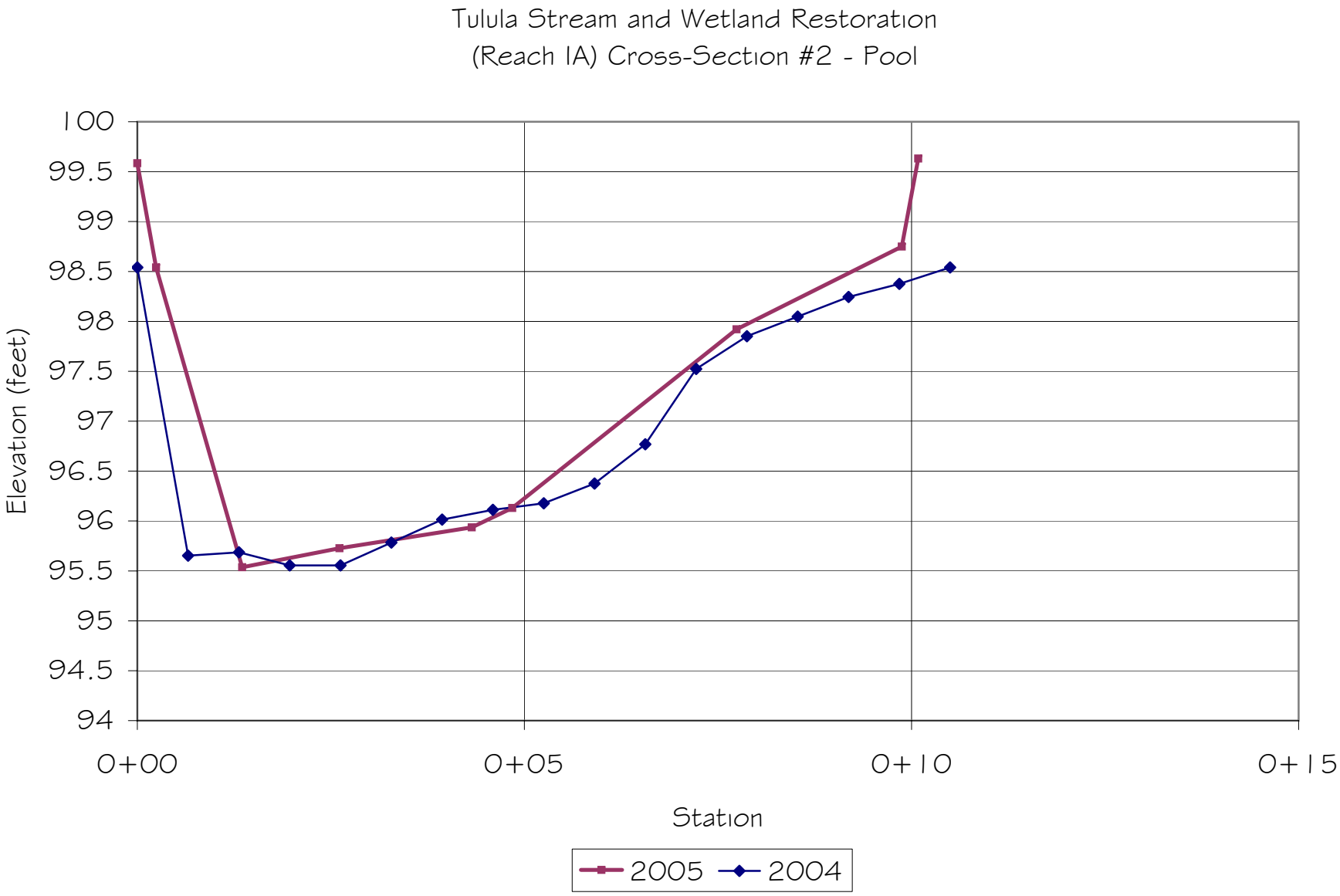
Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	99.7418	
0.43	0	98.8183	
2.13	0	98.0231	
3.89	0	96.337	
4.74	0	95.6681	
6.03	0	95.6381	
7.29	0	95.8571	
8.15	0	97.6687	
10.54	0	98.6836	
10.64	0	99.3993	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	100.48
Bankfull	Elevation	(ft)	98.06
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	7.02
Entrenchm	Ratio		7.12
Mean	Depth	(ft)	1.51
Maximum	Depth	(ft)	2.42
Width/Dept	Ratio		4.64
Bankfull	Area	(sq	10.61
Wetted	Perimeter	(ft)	9.18
Hydraulic	Radius	(ft)	1.16
Begin	BKF	Station	2.05
End	BKF	Station	9.07


Tulula Stream and Wetland Restoration
(Reach IA) Cross-Section #2 - Pool
Elevation (feet)
100
99.5
99
98.5
98
97.5
97
96.5
96
95.5
95
94.5
94
0+00
0+05
0+10
0+15
Station
2005
2004

RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH1A P1
Survey Date: 12/2/2005

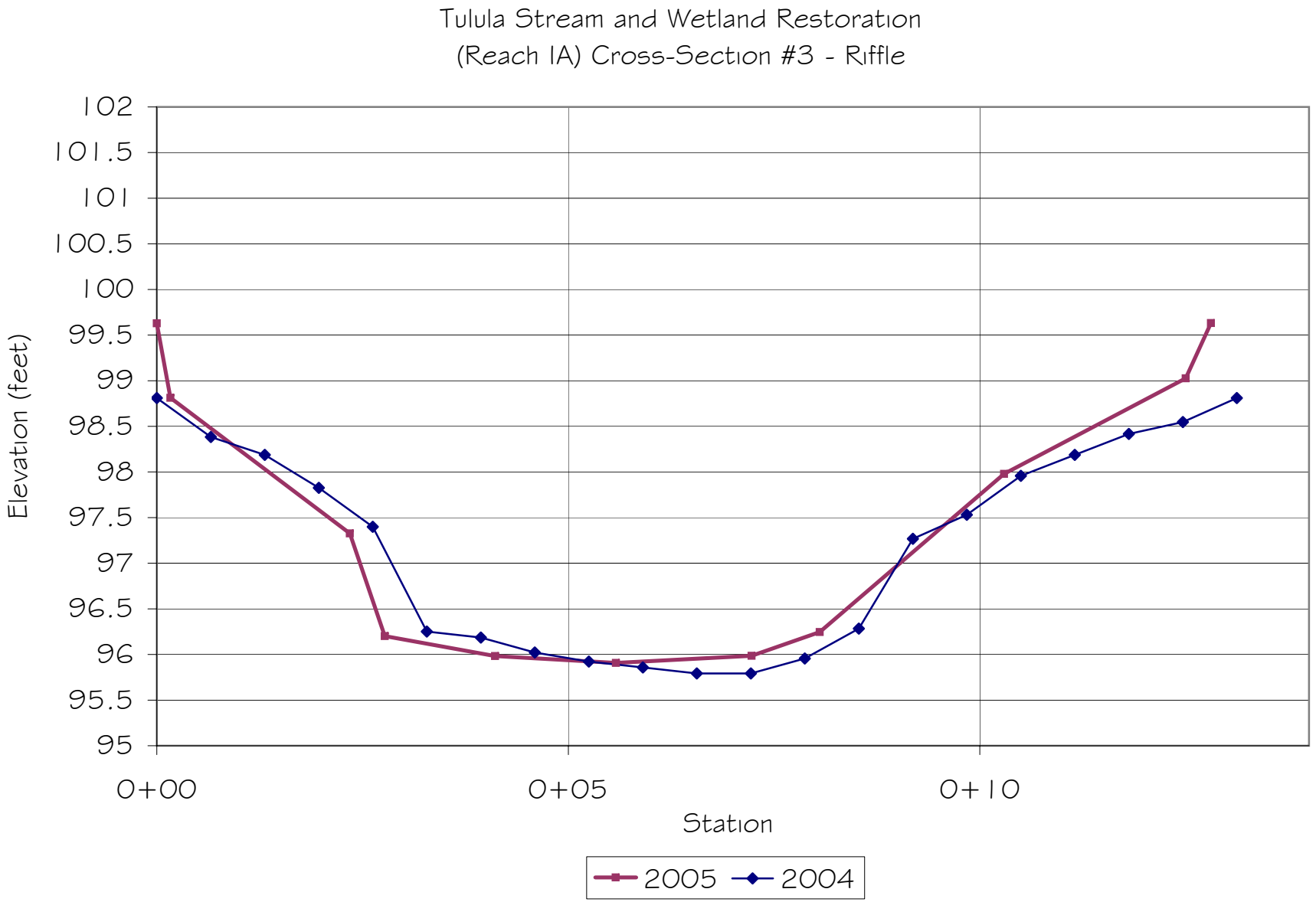
Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	99.5848	
0.24	0	98.5398	
1.35	0	95.5364	
2.61	0	95.727	
4.32	0	95.9364	
4.84	0	96.13	
7.74	0	97.92	
9.87	0	98.7498	
10.09	0	99.6308	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	100.36
Bankfull	Elevation	(ft)	97.95
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	7.36
Entrenchm	Ratio		6.79
Mean	Depth	(ft)	1.54
Maximum	Depth	(ft)	2.41
Width/Dept	Ratio		4.79
Bankfull	Area	(sq	11.3
Wetted	Perimeter	(ft)	9.62
Hydraulic	Radius	(ft)	1.18
Begin	BKF	Station	0.46
End	BKF	Station	7.82


Tulula Stream and Wetland Restoration
(Reach 1A) Cross-Section #3 - Riffle
Elevation (feet)
102
101.5
101
100.5
100
99.5
99
98.5
98
97.5
97
96.5
96
95.5
95
0+00
0+05
0+10
Station
2005
2004

RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH1A R2
Survey Date: 12/2/2005

Cross Section Data Entry

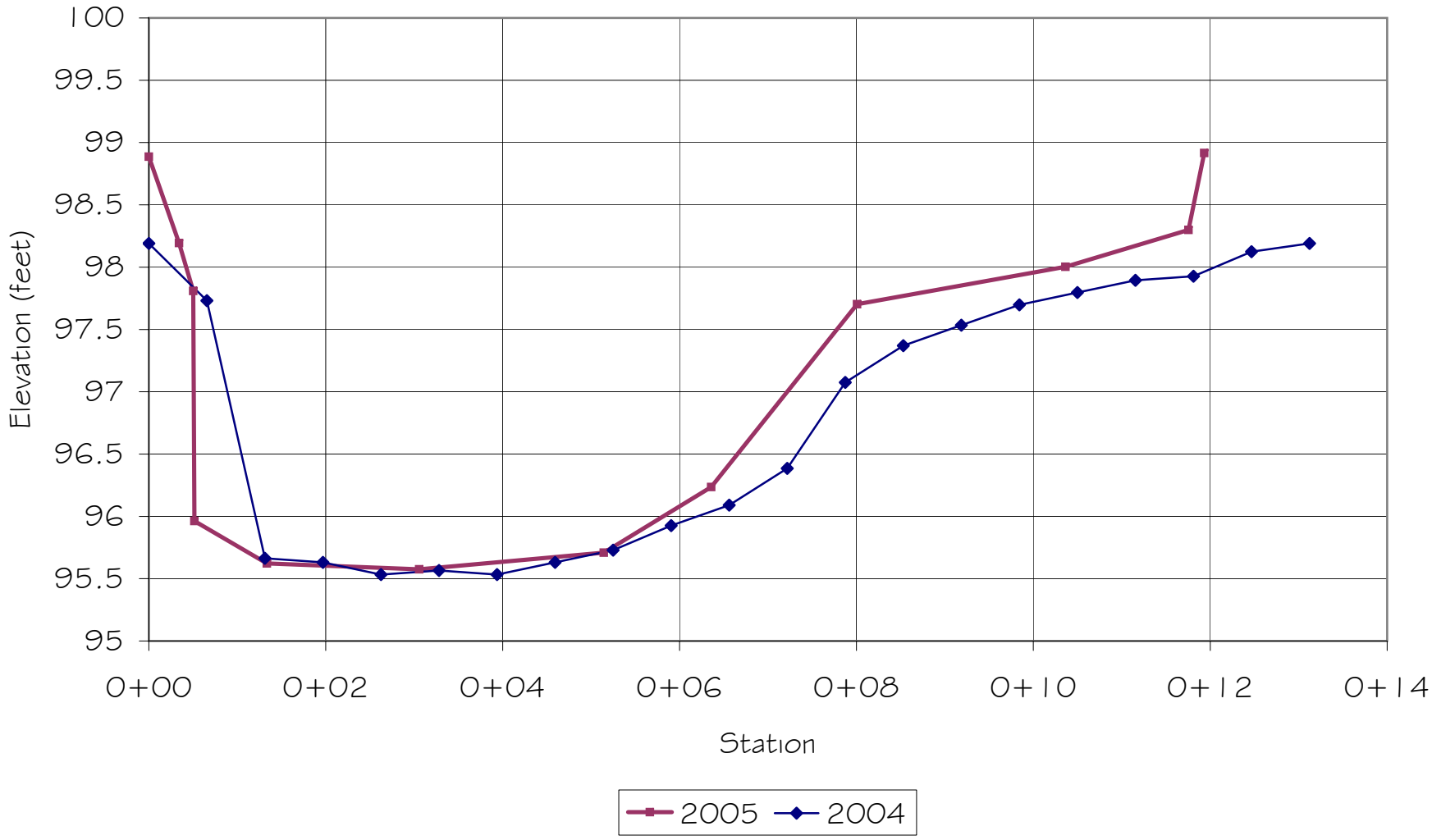
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	99.629	
0.17	0	98.8123	
2.35	0	97.3268	
2.77	0	96.2017	
4.11	0	95.9822	
5.58	0	95.9077	
7.23	0	95.9852	
8.06	0	96.2454	
10.29	0	97.9794	
12.5	0	99.0268	
12.81	0	99.6319	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	99.39
Bankfull	Elevation	(ft)	97.65
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	7.99
Entrenchm	Ratio		6.26
Mean	Depth	(ft)	1.3
Maximum	Depth	(ft)	1.74
Width/Dept	Ratio		6.14
Bankfull	Area	(sq	10.4
Wetted	Perimeter	(ft)	9.41
Hydraulic	Radius	(ft)	1.1
Begin	BKF	Station	1.88
End	BKF	Station	9.87

Tulula Stream and Wetland Restoration
(Reach IA) Cross-Section #4 - Pool



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH1A P2
Survey Date: 12/2/2005

Cross Section Data Entry

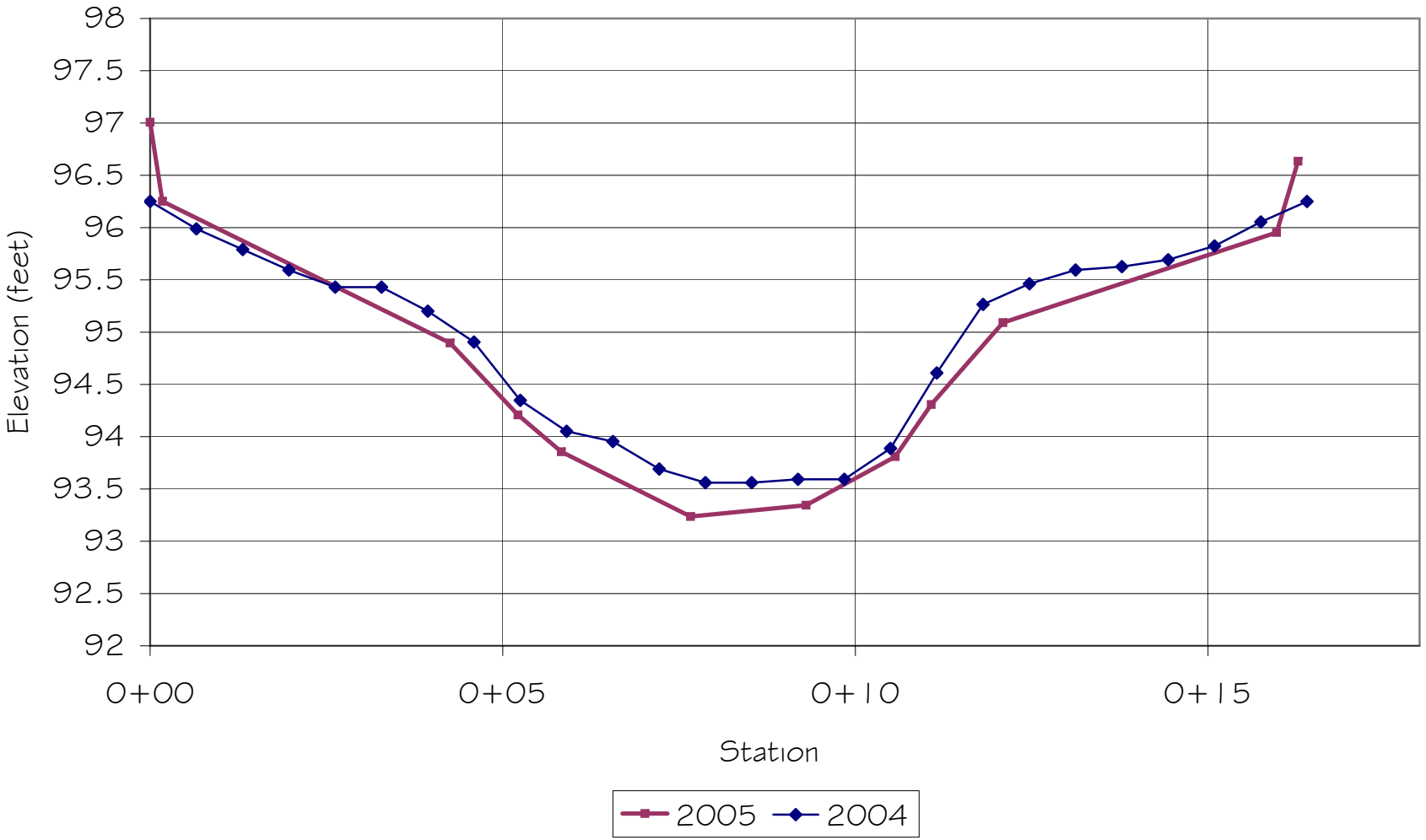
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	98.8867	
0.34	0	98.1935	
0.5	0	97.8095	
0.51	0	95.9626	
1.33	0	95.6222	
3.06	0	95.5752	
5.14	0	95.7085	
6.36	0	96.2351	
8.01	0	97.7023	
10.36	0	98.0033	
11.75	0	98.2986	
11.93	0	98.9158	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	99.44
Bankfull	Elevation	(ft)	97.51
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	7.29
Entrenchm	Ratio		6.86
Mean	Depth	(ft)	1.56
Maximum	Depth	(ft)	1.93
Width/Dept	Ratio		4.67
Bankfull	Area	(sq	11.4
Wetted	Perimeter	(ft)	9.5
Hydraulic	Radius	(ft)	1.2
Begin	BKF	Station	0.5
End	BKF	Station	7.79

Tulula Stream and Wetland Restoration
(Reach II) Cross-Section #1 - Riffle



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH 2 R1
Survey Date: 12/2/2005

Cross Section Data Entry

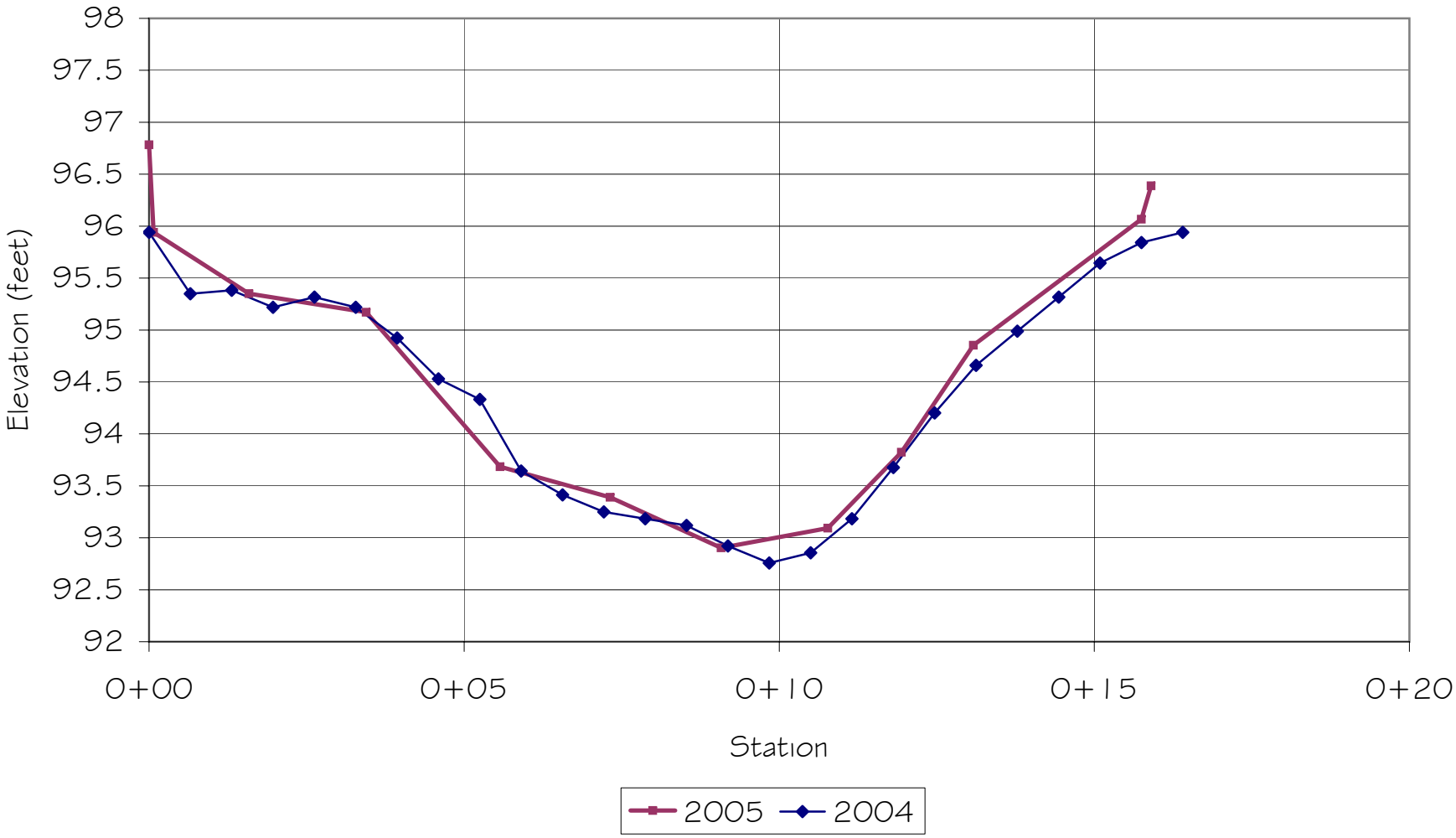
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	97.0072	
0.17	0	96.2516	
4.25	0	94.8966	
5.22	0	94.2079	
5.83	0	93.856	
7.66	0	93.2365	
9.3	0	93.3452	
10.56	0	93.81	
11.08	0	94.308	
12.09	0	95.0914	
15.97	0	95.9537	
16.28	0	96.6351	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	96.94
Bankfull	Elevation	(ft)	95.09
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	8.42
Entrenchm	Ratio		5.94
Mean	Depth	(ft)	1.17
Maximum	Depth	(ft)	1.85
Width/Dept	Ratio		7.21
Bankfull	Area	(sq	9.83
Wetted	Perimeter	(ft)	9.42
Hydraulic	Radius	(ft)	1.04
Begin	BKF	Station	3.67
End	BKF	Station	12.09

Tulula Stream and Wetland Restoration
(Reach II) Cross-Section #2 - Pool



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH 2 P1
Survey Date: 12/2/2005

Cross Section Data Entry

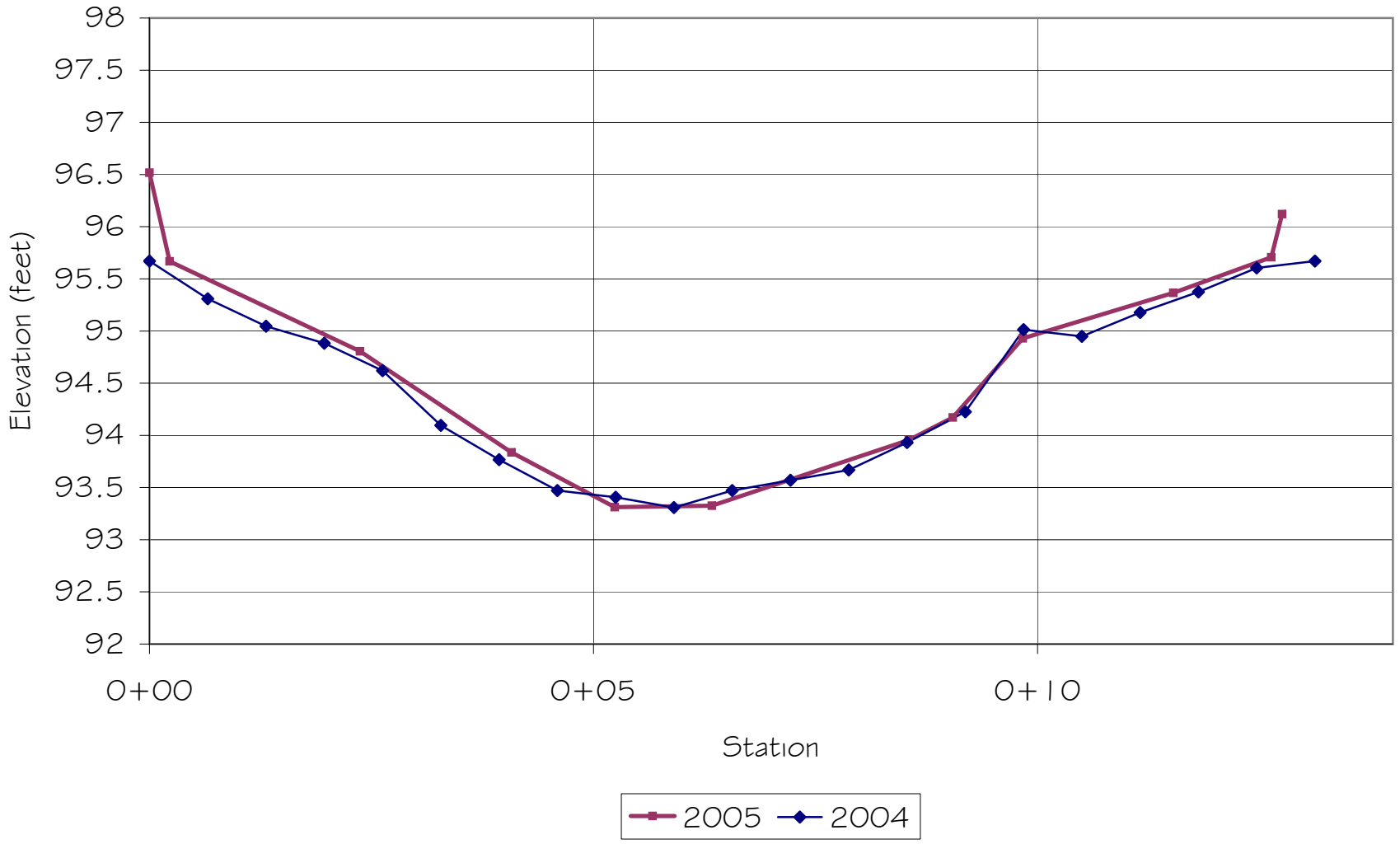
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	96.7826	
0.07	0	95.9398	
1.58	0	95.3501	
3.44	0	95.1707	
5.57	0	93.6842	
7.32	0	93.3904	
9.08	0	92.904	
10.77	0	93.0934	
11.94	0	93.8238	
13.08	0	94.8535	
15.75	0	96.0668	
15.9	0	96.3876	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	96.78
Bankfull	Elevation	(ft)	94.84
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	9.15
Entrenchm	Ratio		5.46
Mean	Depth	(ft)	1.26
Maximum	Depth	(ft)	1.94
Width/Dept	Ratio		7.27
Bankfull	Area	(sq	11.52
Wetted	Perimeter	(ft)	10.22
Hydraulic	Radius	(ft)	1.13
Begin	BKF	Station	3.91
End	BKF	Station	13.07

Tulula Stream and Wetland Restoration
(Reach II) Cross-Section #3 - Riffle



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH 2 R2
Survey Date: 12/2/2005

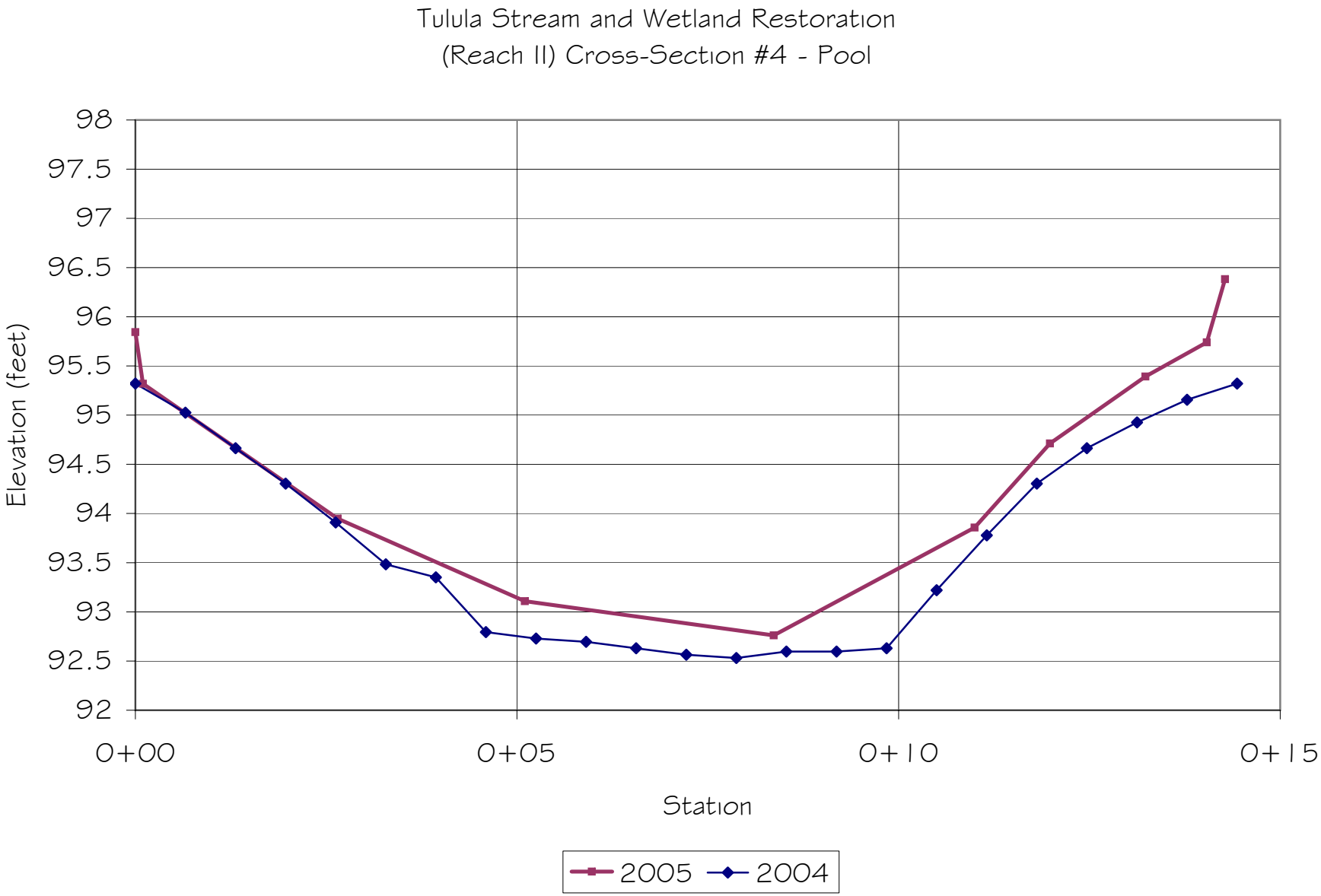
Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	96.5171	
0.23	0	95.6682	
2.37	0	94.8058	
4.08	0	93.8363	
5.24	0	93.3122	
6.33	0	93.3262	
8.55	0	93.9555	
9.05	0	94.1709	
9.83	0	94.9298	
11.53	0	95.3654	
12.63	0	95.7068	
12.75	0	96.1208	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	97.29
Bankfull	Elevation	(ft)	95.3
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	10.13
Entrenchm	Ratio		4.94
Mean	Depth	(ft)	1.11
Maximum	Depth	(ft)	1.99
Width/Dept	Ratio		9.09
Bankfull	Area	(sq	11.29
Wetted	Perimeter	(ft)	11.08
Hydraulic	Radius	(ft)	1.02
Begin	BKF	Station	1.14
End	BKF	Station	11.27


Tulula Stream and Wetland Restoration
(Reach II) Cross-Section #4 - Pool
Elevation (feet)
98
97.5
97
96.5
96
95.5
95
94.5
94
93.5
93
92.5
92
0+00
0+05
0+10
0+15
Station
2005
2004

RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH2 P2
Survey Date: 12/2/2005

Cross Section Data Entry

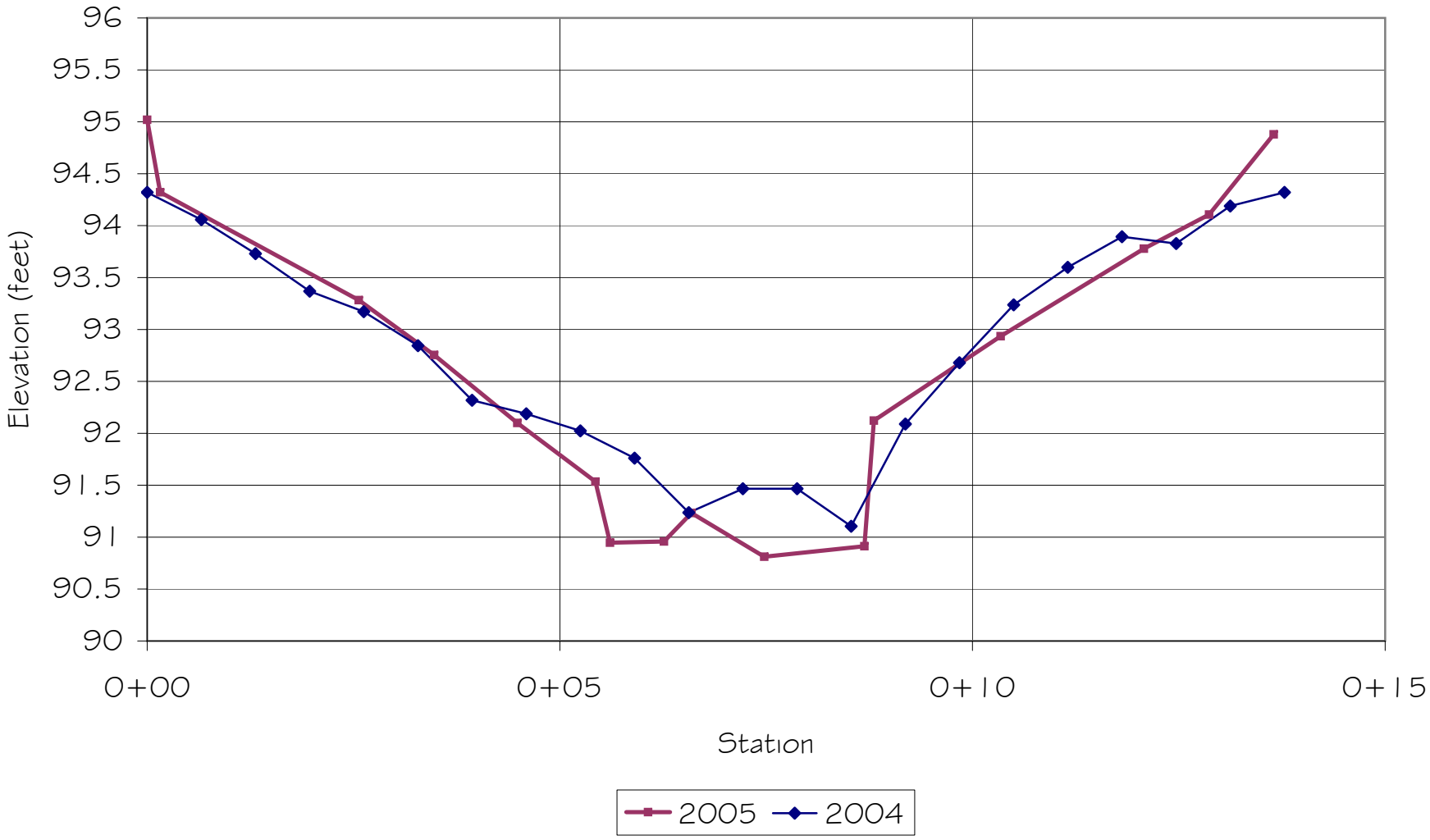
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	95.8433	
0.1	0	95.3189	
2.65	0	93.9477	
5.1	0	93.108	
8.36	0	92.7604	
11	0	93.8575	
11.98	0	94.7121	
13.23	0	95.3923	
14.04	0	95.7403	
14.28	0	96.3823	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	97.2
Bankfull	Elevation	(ft)	94.98
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	11.74
Entrenchm	Ratio		4.26
Mean	Depth	(ft)	1.39
Maximum	Depth	(ft)	2.22
Width/Dept	Ratio		8.42
Bankfull	Area	(sq	16.38
Wetted	Perimeter	(ft)	12.77
Hydraulic	Radius	(ft)	1.28
Begin	BKF	Station	0.73
End	BKF	Station	12.47

Tulula Stream and Wetland Restoration
(Reach III) Cross-Section #1 - Riffle



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH3 R1
Survey Date: 12/2/2005

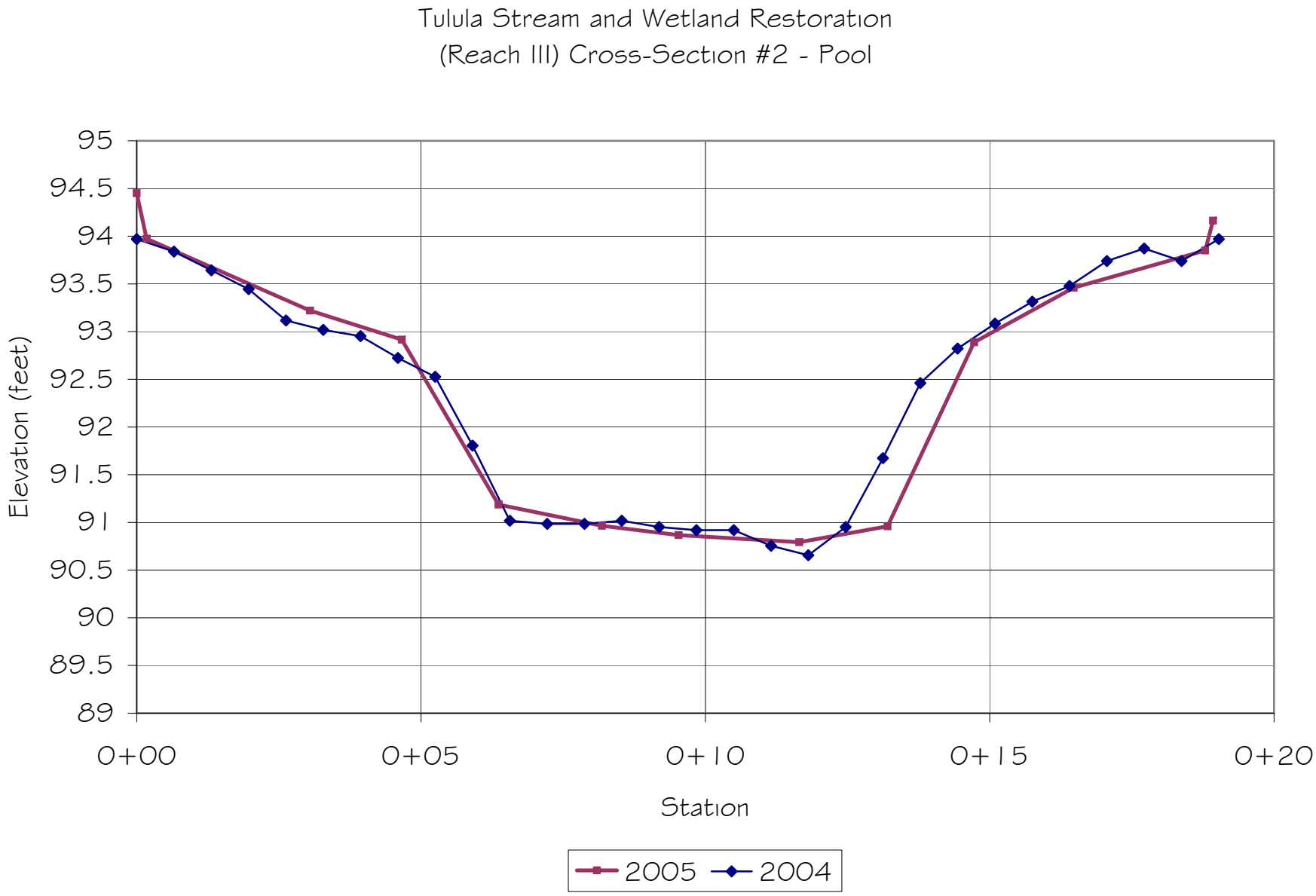
Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	95.0188	
0.16	0	94.3215	
2.56	0	93.282	
3.48	0	92.7544	
4.49	0	92.0992	
5.43	0	91.5347	
5.61	0	90.9462	
6.26	0	90.9585	
6.59	0	91.2327	
7.48	0	90.811	
8.69	0	90.9123	
8.81	0	92.1226	
10.34	0	92.9345	
12.08	0	93.7785	
12.87	0	94.1067	
13.65	0	94.8787	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	96.65
Bankfull	Elevation	(ft)	93.73
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	10.45
Entrenchm	Ratio		4.78
Mean	Depth	(ft)	1.51
Maximum	Depth	(ft)	2.92
Width/Dept	Ratio		6.93
Bankfull	Area	(sq	15.76
Wetted	Perimeter	(ft)	13.15
Hydraulic	Radius	(ft)	1.2
Begin	BKF	Station	1.53


Tulula Stream and Wetland Restoration
(Reach III) Cross-Section #2 - Pool
Elevation (feet)
95
94.5
94
93.5
93
92.5
92
91.5
91
90.5
90
89.5
89
0+00
0+05
0+10
0+15
0+20
Station
2005
2004

RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH3 P1
Survey Date: 12/2/2005

Cross Section Data Entry

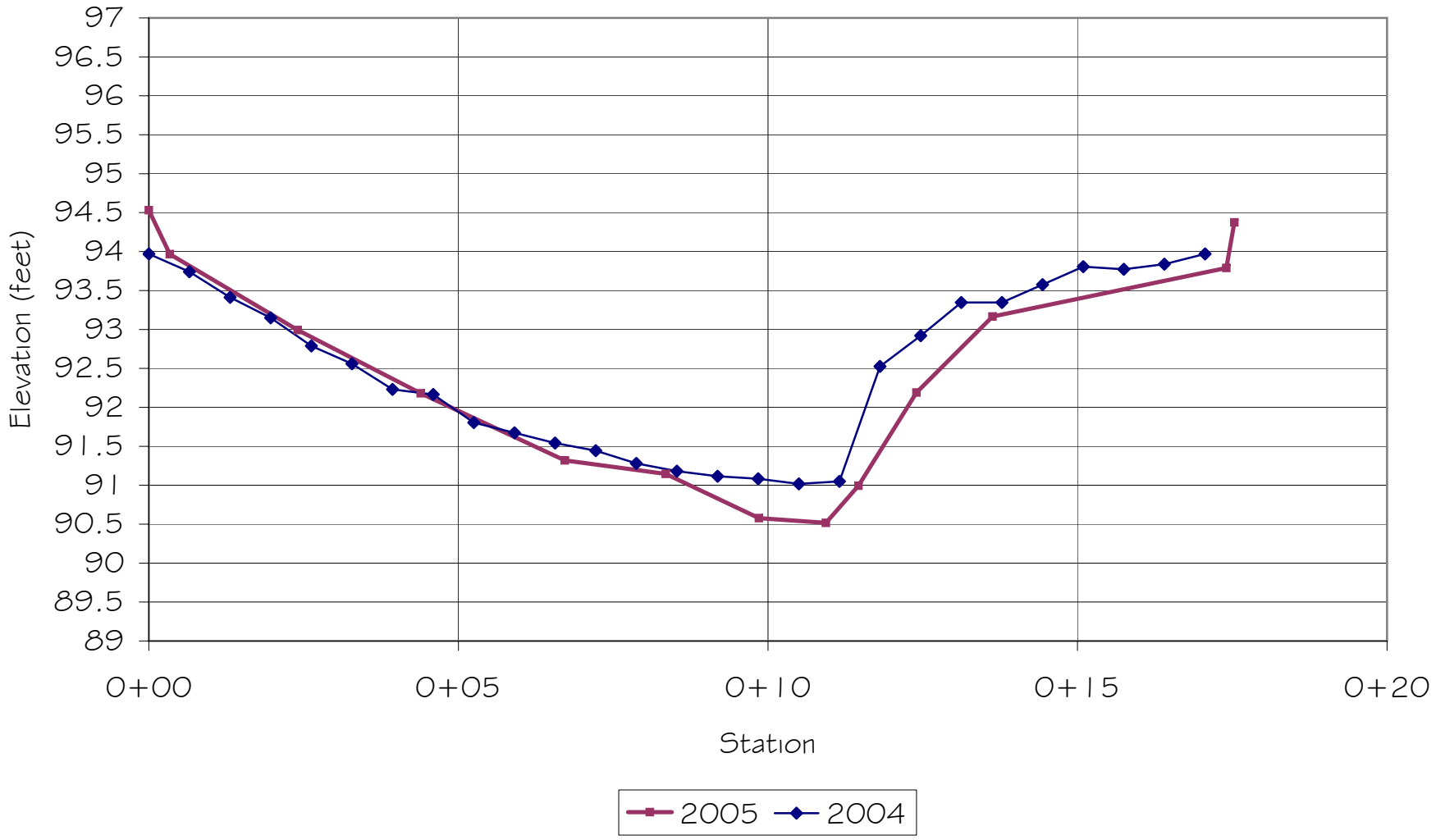
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	94.452	
0.17	0	93.9733	
3.05	0	93.2203	
4.66	0	92.9162	
6.36	0	91.1865	
8.18	0	90.9636	
9.53	0	90.867	
11.65	0	90.7917	
13.2	0	90.9591	
14.73	0	92.8874	
16.48	0	93.4606	
18.79	0	93.8494	
18.93	0	94.1632	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	95.29
Bankfull	Elevation	(ft)	93.04
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	11.19
Entrenchm	Ratio		4.47
Mean	Depth	(ft)	1.6
Maximum	Depth	(ft)	2.25
Width/Dept	Ratio		6.98
Bankfull	Area	(sq	17.95
Wetted	Perimeter	(ft)	12.91
Hydraulic	Radius	(ft)	1.39
Begin	BKF	Station	4
End	BKF	Station	15.2

Tulula Stream and Wetland Restoration
(Reach III) Cross-Section #3 - Riffle



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH3 R2
Survey Date: 12/2/2005

Cross Section Data Entry

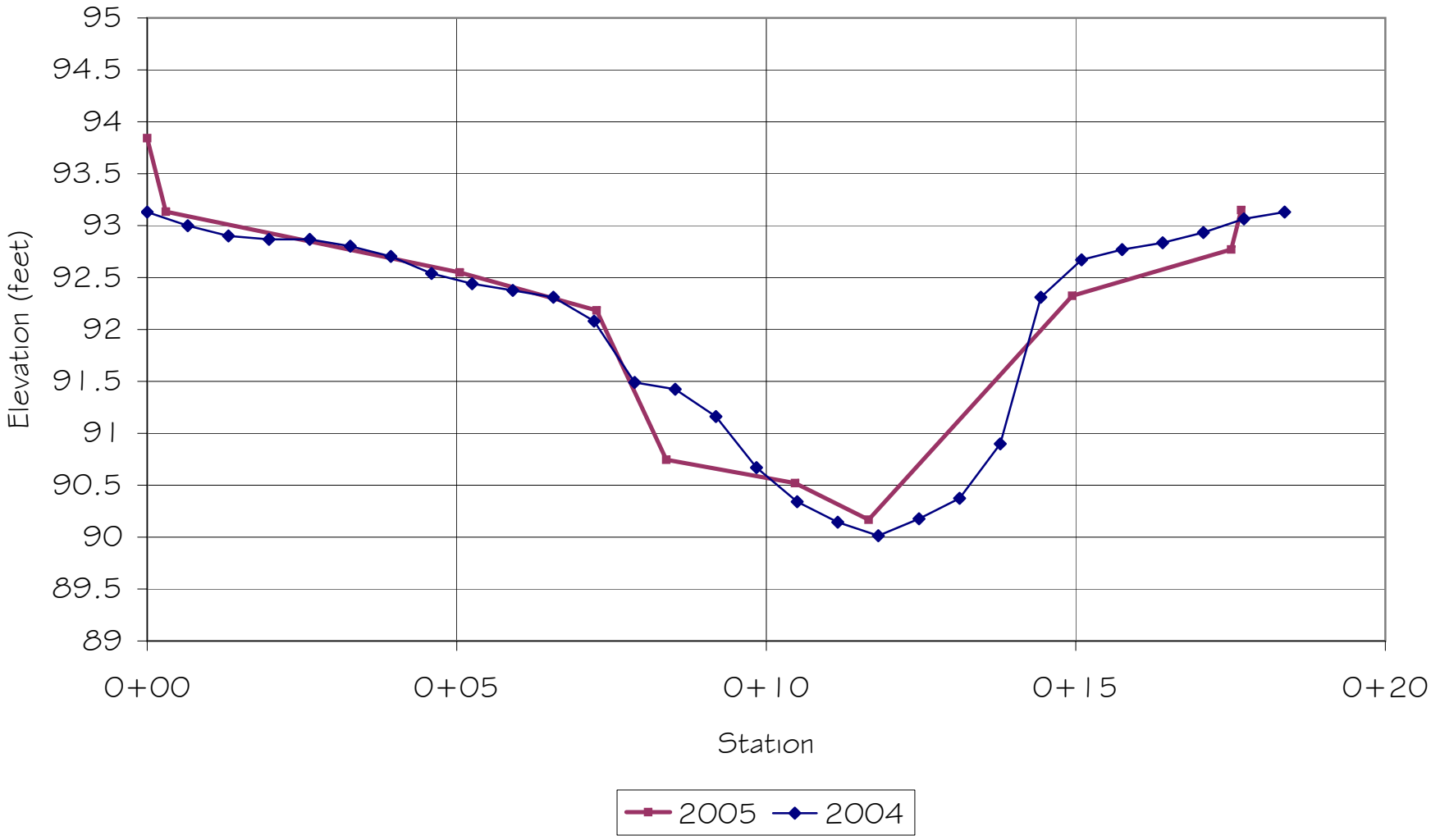
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	94.5304	
0.34	0	93.9667	
2.41	0	92.9919	
4.39	0	92.1803	
6.72	0	91.3186	
8.35	0	91.1447	
9.86	0	90.5781	
10.94	0	90.5175	
11.46	0	90.9941	
12.4	0	92.1904	
13.63	0	93.1653	
17.4	0	93.7901	
17.53	0	94.374	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	95.5
Bankfull	Elevation	(ft)	93.01
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	11.06
Entrenchm	Ratio		4.52
Mean	Depth	(ft)	1.4
Maximum	Depth	(ft)	2.49
Width/Dept	Ratio		7.89
Bankfull	Area	(sq	15.51
Wetted	Perimeter	(ft)	12.55
Hydraulic	Radius	(ft)	1.24
Begin	BKF	Station	2.37
End	BKF	Station	13.43

Tulula Stream and Wetland Restoration
(Reach III) Cross-Section #4 - Pool



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH3 P2
Survey Date: 12/2/2005

Cross Section Data Entry

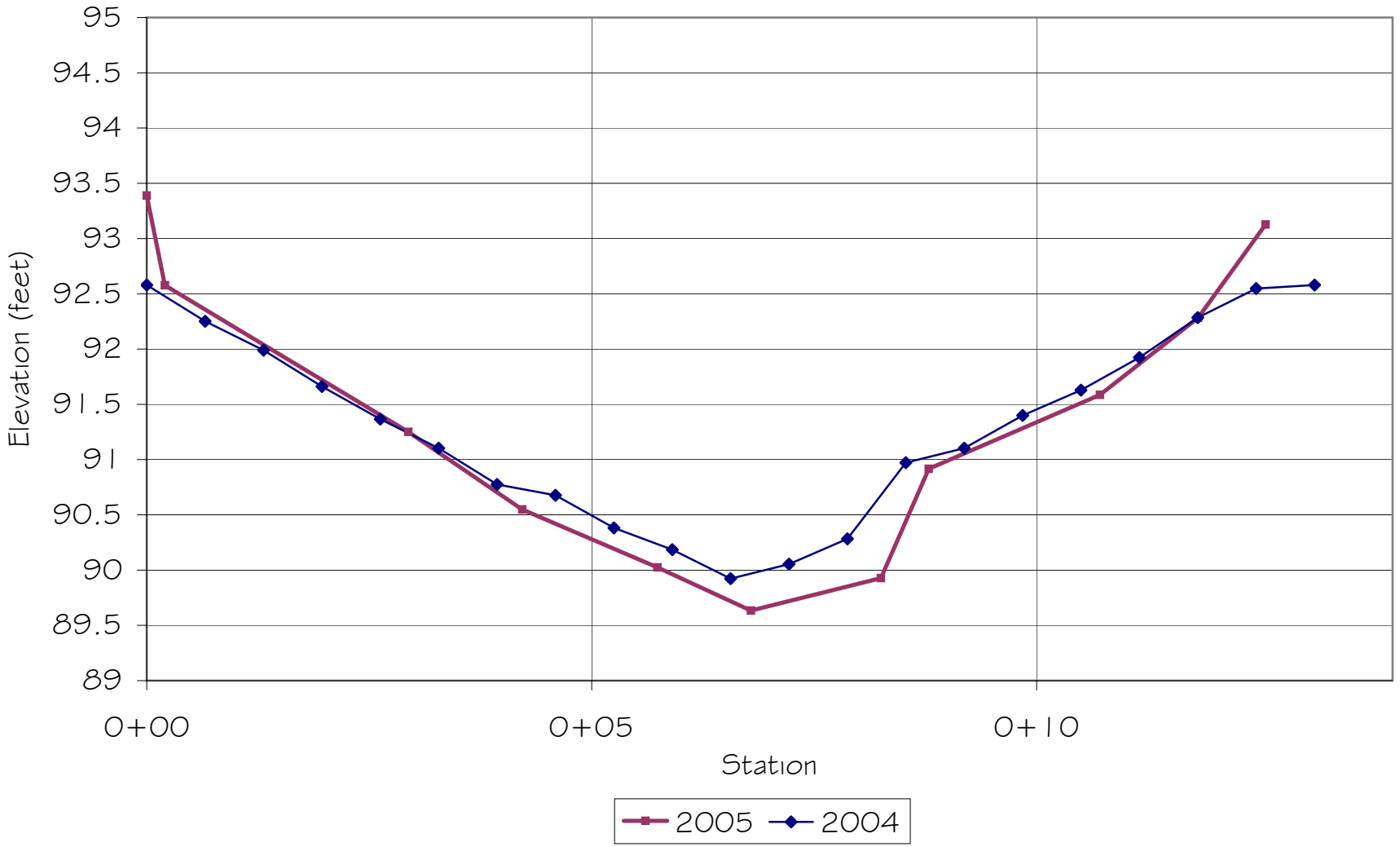
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	93.8425	
0.3	0	93.1341	
5.05	0	92.5496	
7.26	0	92.1845	
8.39	0	90.7454	LEW
10.46	0	90.5206	
11.65	0	90.1676	
14.94	0	92.324	
17.51	0	92.77	
17.67	0	93.1498	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	94.99
Bankfull	Elevation	(ft)	92.58
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	11.61
Entrenchm	Ratio		4.31
Mean	Depth	(ft)	1.12
Maximum	Depth	(ft)	2.41
Width/Dept	Ratio		10.37
Bankfull	Area	(sq	13
Wetted	Perimeter	(ft)	13.07
Hydraulic	Radius	(ft)	0.99
Begin	BKF	Station	4.8
End	BKF	Station	16.42

Tulula Stream and Wetland Restoration
(Reach IV) Cross-Section #1 - Riffle



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH4 R1
Survey Date: 12/2/2005

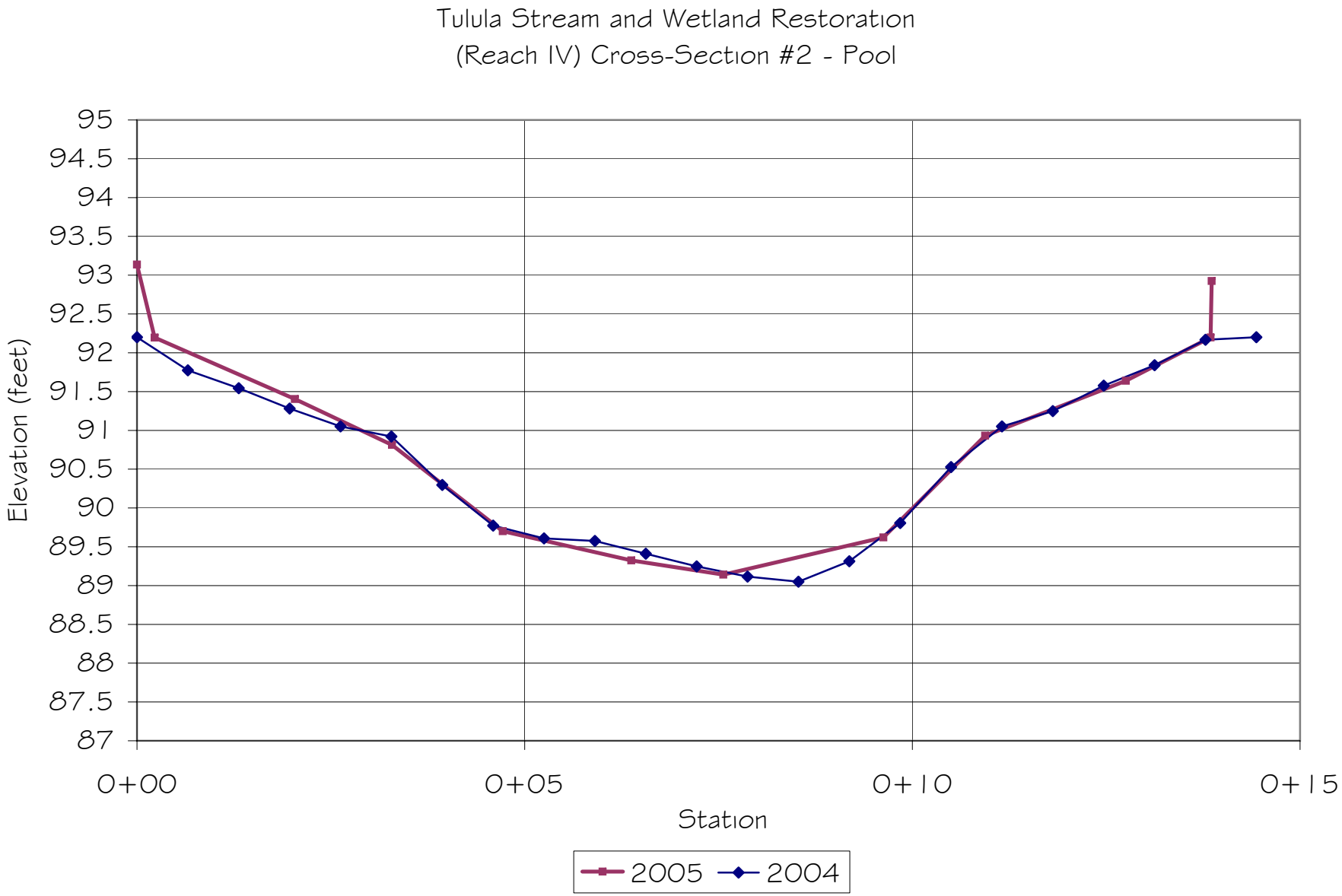
Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	93.3889	
0.2	0	92.5773	
2.94	0	91.2501	
4.22	0	90.5486	LEW
5.74	0	90.0247	IVR1
6.79	0	89.6333	IVR1
8.25	0	89.9279	REW
8.79	0	90.9164	
10.71	0	91.5858	
11.82	0	92.2838	
12.57	0	93.1267	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	95.03
Bankfull	Elevation	(ft)	92.33
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	11.15
Entrenchm	Ratio		4.48
Mean	Depth	(ft)	1.44
Maximum	Depth	(ft)	2.7
Width/Dept	Ratio		7.76
Bankfull	Area	(sq	16.03
Wetted	Perimeter	(ft)	12.69
Hydraulic	Radius	(ft)	1.26
Begin	BKF	Station	0.71
End	BKF	Station	11.86


Tulula Stream and Wetland Restoration
(Reach IV) Cross-Section #2 - Pool
Elevation (feet)
95
94.5
94
93.5
93
92.5
92
91.5
91
90.5
90
89.5
89
88.5
88
87.5
87
0+00
0+05
0+10
0+15
Station
2005
2004

RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH4 P1
Survey Date: 12/2/2005

Cross Section Data Entry

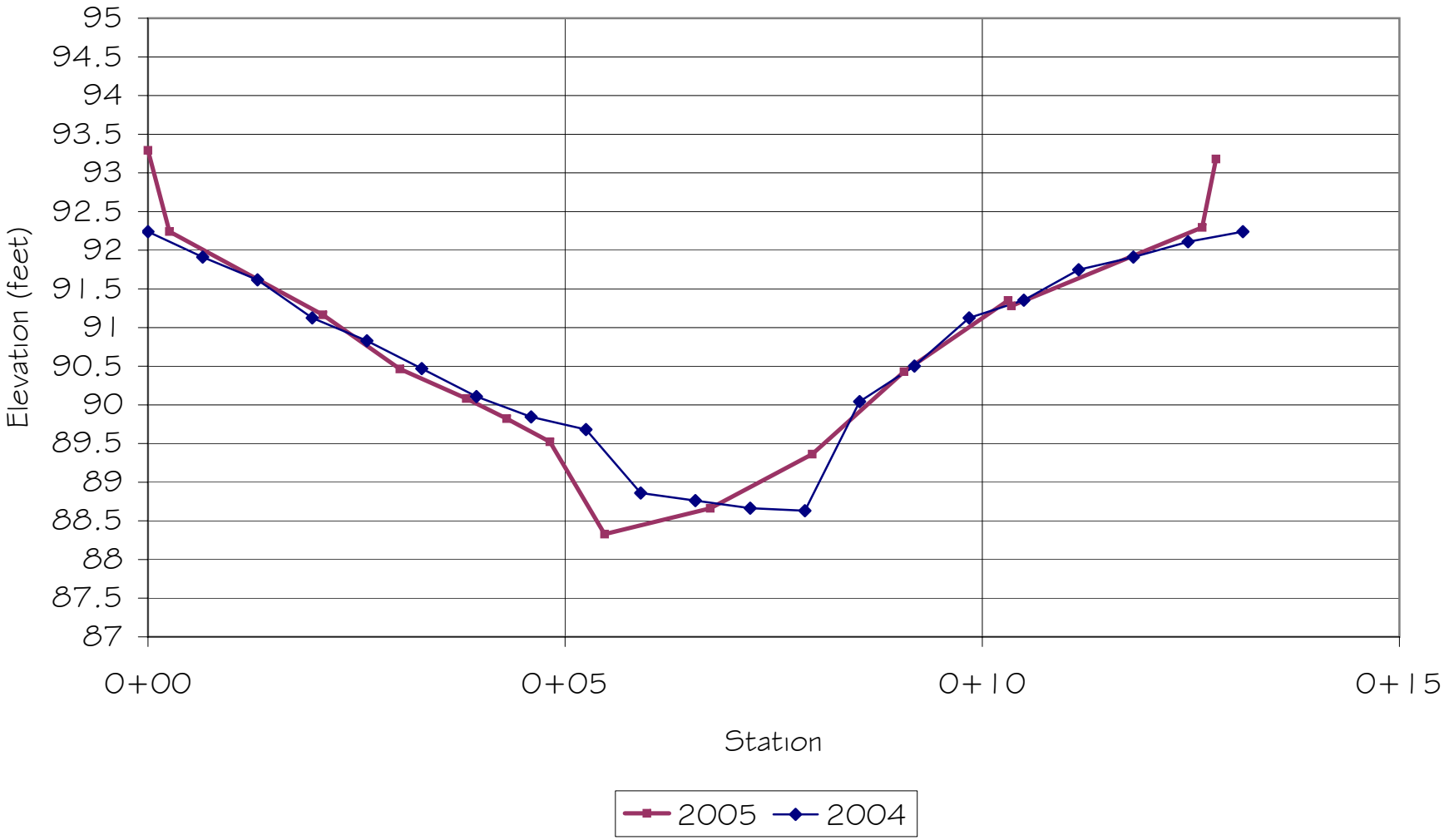
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	93.1365	
0.23	0	92.1951	
2.04	0	91.4031	
3.29	0	90.8132	
4.72	0	89.7013	LEW
6.38	0	89.3242	
7.56	0	89.1415	
9.63	0	89.621	REW
10.94	0	90.9324	
12.75	0	91.6394	
13.85	0	92.1974	
13.86	0	92.9248	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	94.52
Bankfull	Elevation	(ft)	91.83
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	12.06
Entrenchm	Ratio		4.15
Mean	Depth	(ft)	1.53
Maximum	Depth	(ft)	2.69
Width/Dept	Ratio		7.91
Bankfull	Area	(sq	18.4
Wetted	Perimeter	(ft)	13.5
Hydraulic	Radius	(ft)	1.36
Begin	BKF	Station	1.06
End	BKF	Station	13.13

Tulula Stream and Wetland Restoration
(Reach IV) Cross-Section #3 - Riffle



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH4 R2
Survey Date: 12/2/2005

Cross Section Data Entry

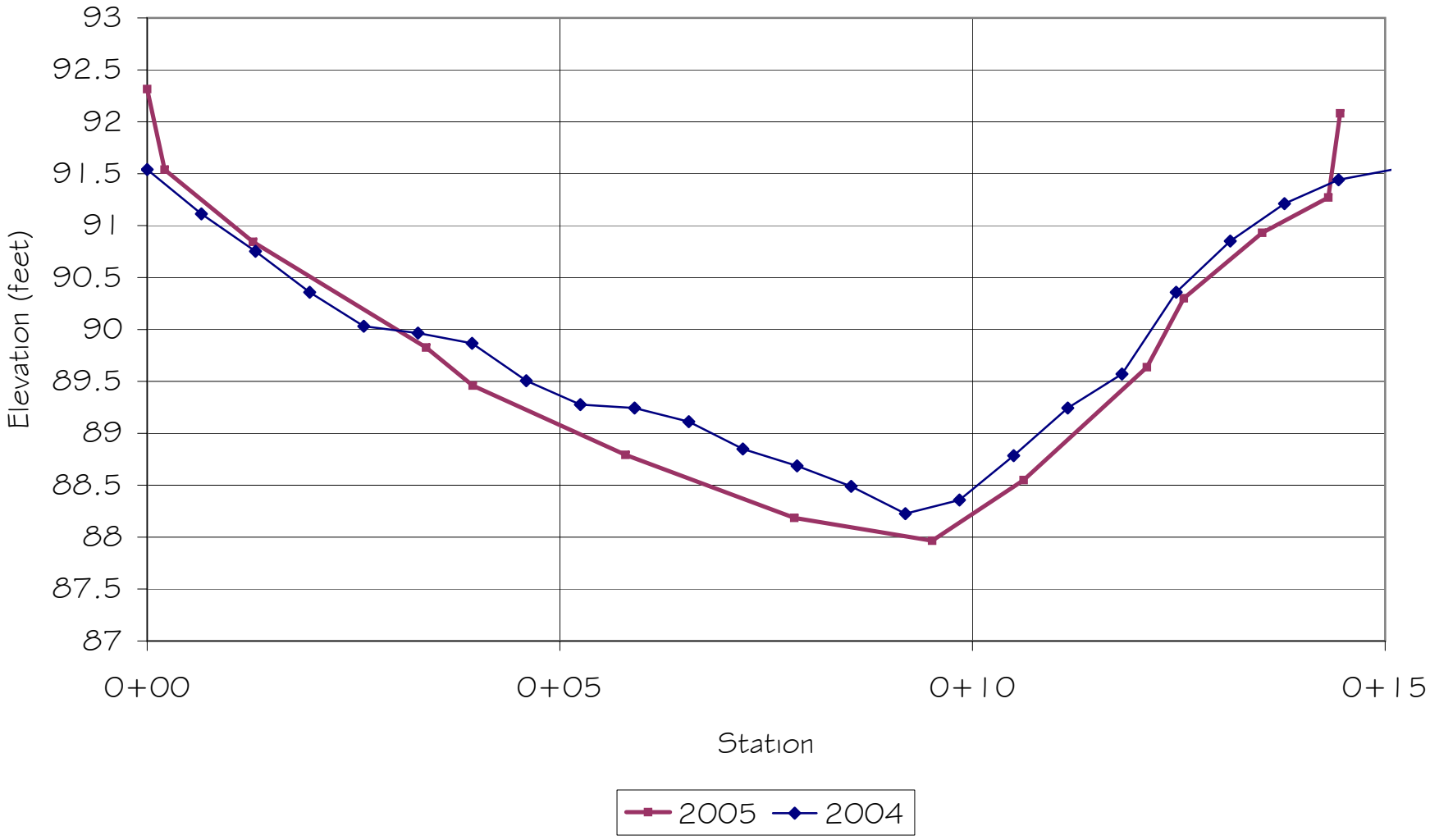
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	93.2908	
0.26	0	92.242	
2.1	0	91.1636	
3.02	0	90.4645	
3.82	0	90.0814	
4.3	0	89.8216	
4.82	0	89.5232	LEW
5.47	0	88.3291	
6.74	0	88.6616	
7.96	0	89.3628	REW
9.06	0	90.4291	
10.35	0	91.28	
12.64	0	92.2945	
12.77	0	93.1794	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	95.13
Bankfull	Elevation	(ft)	91.73
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	10.23
Entrenchm	Ratio		4.89
Mean	Depth	(ft)	1.64
Maximum	Depth	(ft)	3.4
Width/Dept	Ratio		6.22
Bankfull	Area	(sq	16.83
Wetted	Perimeter	(ft)	12.58
Hydraulic	Radius	(ft)	1.34
Begin	BKF	Station	1.13
End	BKF	Station	11.37

Tulula Stream and Wetland Restoration
(Reach IV) Cross-Section #4 - Pool



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH4 P2
Survey Date: 12/2/2005

Cross Section Data Entry

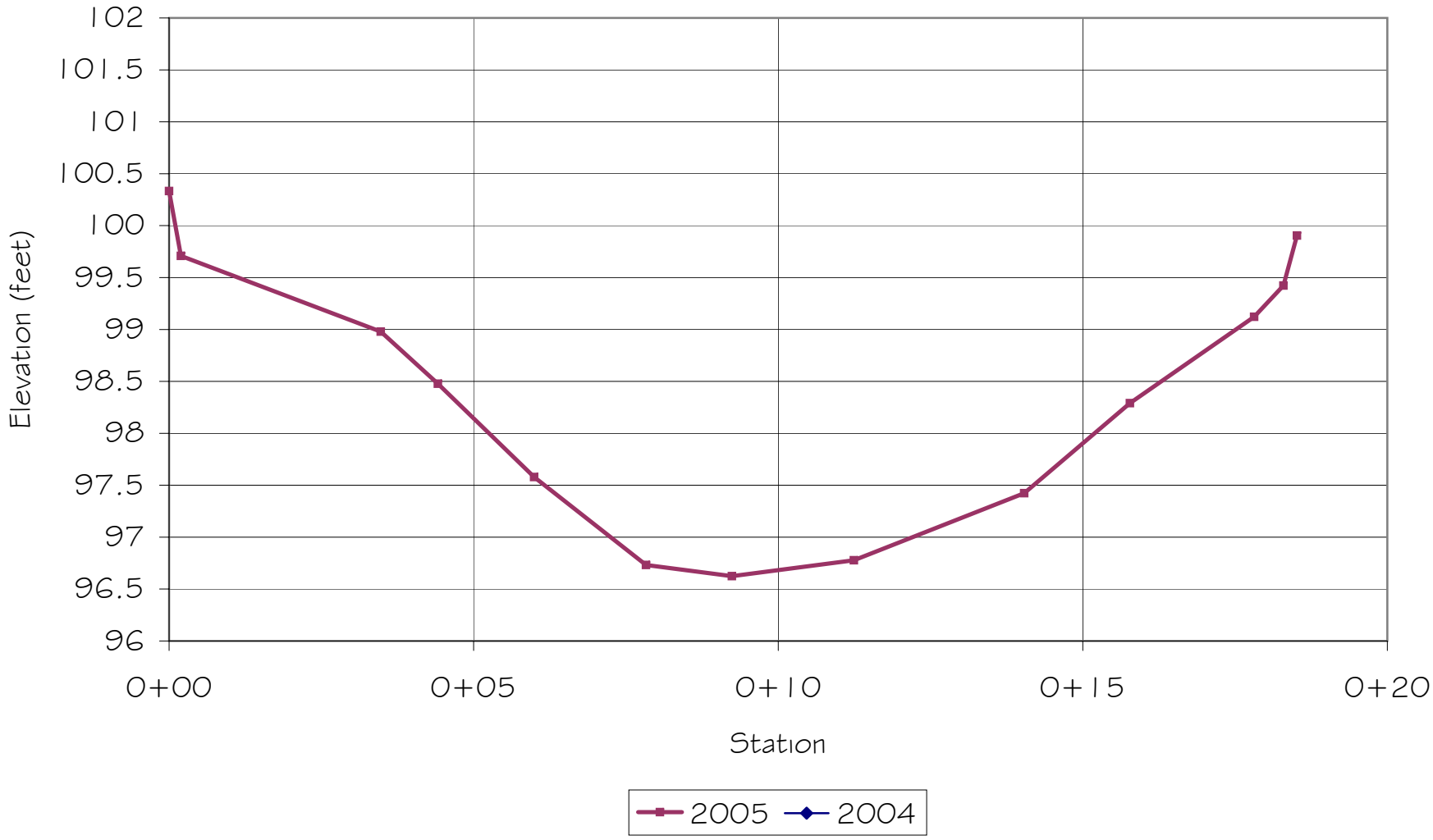
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	92.3151	
0.21	0	91.5387	
1.28	0	90.8436	
3.38	0	89.8258	
3.94	0	89.4592	LEW
5.8	0	88.7925	IVP2
7.84	0	88.1862	IVP2
9.51	0	87.9653	IVP2
10.62	0	88.5492	IVP2
12.11	0	89.6362	REW
12.56	0	90.3007	
13.51	0	90.9303	
14.31	0	91.2714	
14.45	0	92.0805	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	93.35
Bankfull	Elevation	(ft)	90.66
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	11.44
Entrenchm	Ratio		4.37
Mean	Depth	(ft)	1.6
Maximum	Depth	(ft)	2.69
Width/Dept	Ratio		7.16
Bankfull	Area	(sq	18.3
Wetted	Perimeter	(ft)	12.92
Hydraulic	Radius	(ft)	1.42
Begin	BKF	Station	1.66
End	BKF	Station	13.1

Tulula Stream and Wetland Restoration
(Reach V) Cross-Section #1 - Riffle



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH5 R1
Survey Date: 12/2/2005

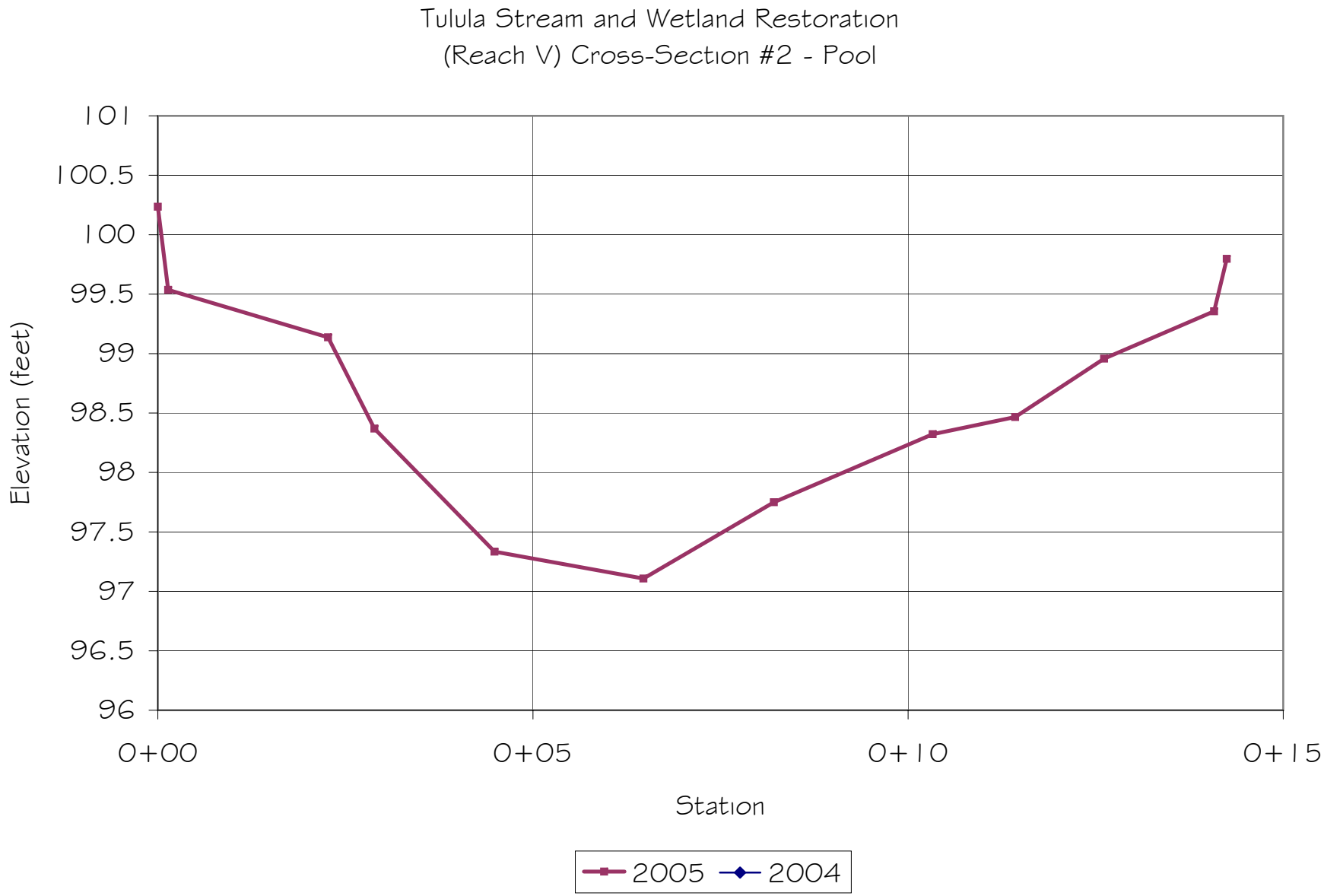
Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	100.3328	
0.19	0	99.709	
3.47	0	98.9788	
4.41	0	98.4778	LEW
5.99	0	97.5785	VR1
7.83	0	96.7315	VR1
9.24	0	96.625	VR1
11.24	0	96.7778	VR1
14.04	0	97.4237	VR1
15.77	0	98.2906	REW
17.81	0	99.1215	
18.3	0	99.4229	
18.52	0	99.9049	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	100.64
Bankfull	Elevation	(ft)	98.63
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	12.48
Entrenchm	Ratio		4.01
Mean	Depth	(ft)	1.29
Maximum	Depth	(ft)	2
Width/Dept	Ratio		9.7
Bankfull	Area	(sq	16.06
Wetted	Perimeter	(ft)	13.3
Hydraulic	Radius	(ft)	1.21
Begin	BKF	Station	4.12
End	BKF	Station	16.6


Tulula Stream and Wetland Restoration
(Reach V) Cross-Section #2 - Pool
Elevation (feet)
101
100.5
100
99.5
99
98.5
98
97.5
97
96.5
96
0+00
0+05
0+10
0+15
Station
2005
2004

RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH5 P1
Survey Date: 12/2/2005

Cross Section Data Entry

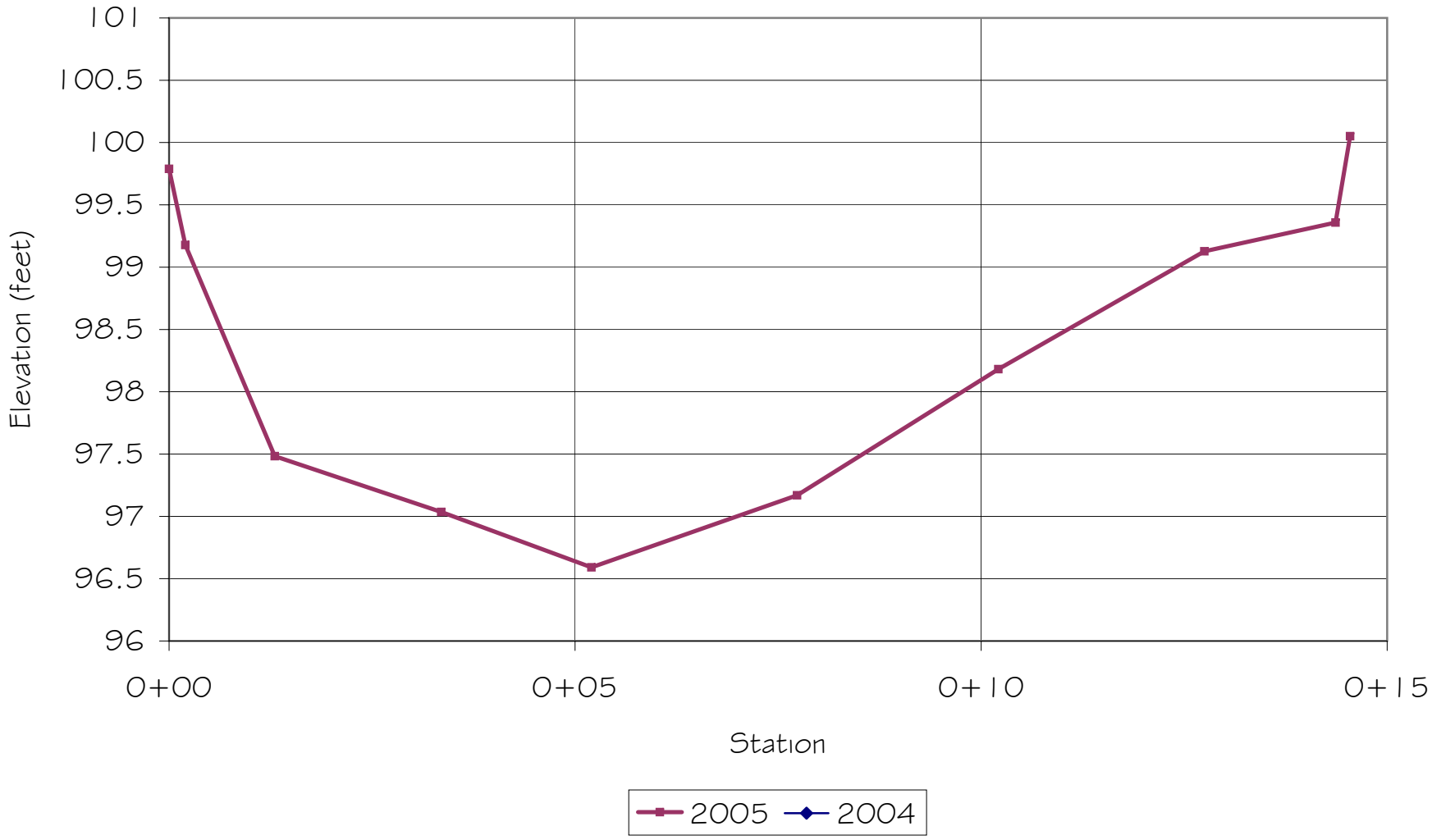
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	100.2356	
0.14	0	99.5365	
2.27	0	99.1367	
2.89	0	98.3693	LEW
4.49	0	97.3344	VP1
6.47	0	97.1075	VP1
8.21	0	97.7491	VP1
10.33	0	98.3219	VP1
11.43	0	98.4662	REW
12.61	0	98.9579	
14.08	0	99.3558	
14.25	0	99.7973	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	101.37
Bankfull	Elevation	(ft)	99.24
Floodprone	Width	(ft)	80
Bankfull	Width	(ft)	11.93
Entrenchm	Ratio		6.7
Mean	Depth	(ft)	1.17
Maximum	Depth	(ft)	2.13
Width/Dept	Ratio		10.2
Bankfull	Area	(sq	13.96
Wetted	Perimeter	(ft)	12.96
Hydraulic	Radius	(ft)	1.08
Begin	BKF	Station	1.72
End	BKF	Station	13.65

Tulula Stream and Wetland Restoration
(Reach V) Cross-Section #3 - Riffle



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH5 R2
Survey Date: 12/2/2005

Cross Section Data Entry

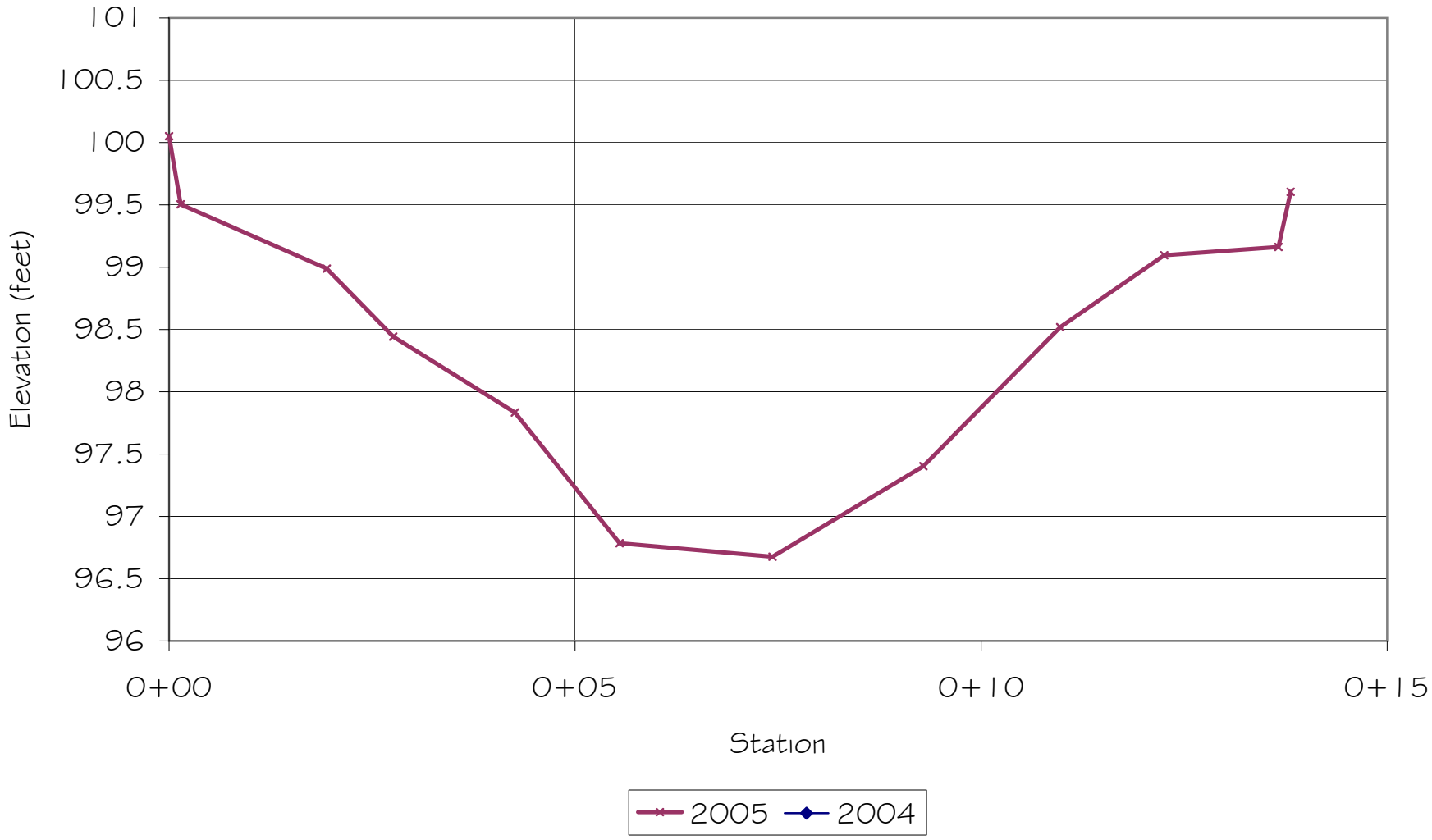
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	99.7892	
0.2	0	99.1781	
1.3	0	97.4829	LEW
3.35	0	97.0356	VR2
5.2	0	96.591	VR2
7.73	0	97.1688	VR2
10.21	0	98.1819	REW
12.75	0	99.1277	
14.36	0	99.3576	
14.54	0	100.0506	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	101.17
Bankfull	Elevation	(ft)	98.88
Floodprone	Width	(ft)	50
Bankfull	Width	(ft)	11.69
Entrenchm	Ratio		4.28
Mean	Depth	(ft)	1.41
Maximum	Depth	(ft)	2.29
Width/Dept	Ratio		8.29
Bankfull	Area	(sq	16.48
Wetted	Perimeter	(ft)	12.94
Hydraulic	Radius	(ft)	1.27
Begin	BKF	Station	0.39
End	BKF	Station	12.08

Tulula Stream and Wetland Restoration
(Reach V) Cross-Section #4 - Pool



RIVERMOI CROSS SECTION SUMMARY

River Name: Tulula
Reach Name: 2005
Cross Section Name: REACH5 P2
Survey Date: 12/2/2005

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	100.0508	
0.14	0	99.504	
1.94	0	98.9886	
2.76	0	98.4423	LEW
4.26	0	97.8342	VP2
5.55	0	96.7843	VP2
7.43	0	96.6766	VP2
9.29	0	97.4033	VP2
10.97	0	98.5189	REW
12.25	0	99.0956	
13.66	0	99.1622	
13.81	0	99.6044	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	101.4
Bankfull	Elevation	(ft)	99.04
Floodprone	Width	(ft)	100
Bankfull	Width	(ft)	10.37
Entrenchm	Ratio		9.65
Mean	Depth	(ft)	1.35
Maximum	Depth	(ft)	2.36
Width/Dept	Ratio		7.66
Bankfull	Area	(sq	14.03
Wetted	Perimeter	(ft)	11.62
Hydraulic	Radius	(ft)	1.21
Begin	BKF	Station	1.76
End	BKF	Station	12.13

Figure 1—Reach I, Cross-section #1, Riffle 1 (2005)

Figure 2—Reach I, Cross-section #2, Pool 1 (2005)

Figure 3—Reach I, Cross-section #3, Riffle 2 (2005)

Figure 4—Reach I, Cross-section #4, Pool 2 (2005)

Figure 5—Reach IA, Cross-section #1, Riffle 1(2005)

Figure 6—Reach IA, Cross-section #2, Pool 1(2005)

Figure 7 –Reach IA, Cross-section #3, Riffle 2 (2005)

Figure 8—Reach IA, Cross-section #4, Pool 2 (2005)

Figure 9—Reach II, Cross-section #1, Riffle 1 (2005)

Figure 10—Reach II, Cross-section #2, Pool 1 (2005)

Figure 11—Reach II, Cross-section #3, Riffle 2 (2005)

Figure 12—Reach II, Cross-section #4, Pool 2 (2005)

Figure 13—Reach III, Cross-section #1, Riffle 1 (2005)

Figure 14—Reach III, Cross-section #2, Pool 1 (2005)

Figure 15—Reach III, Cross-section #3, Riffle 2 (2005)

Figure 16—Reach III, Cross-section #4, Pool 2 (2005)

Figure 17—Reach IV, Cross-section #1, Riffle 1 (2005)

Figure 18—Reach IV, Cross-section #2, Pool 1 (2005)

Figure 19—Reach IV, Cross-section #3, Riffle 2 (2005)

Figure 20—Reach IV, Cross-section #4, Pool 2 (2005)

Figure 21—Reach V, Cross-section #1, Pool 1 (2005)

Figure 22—Reach V, Cross-section #2, Riffle1 (2005)

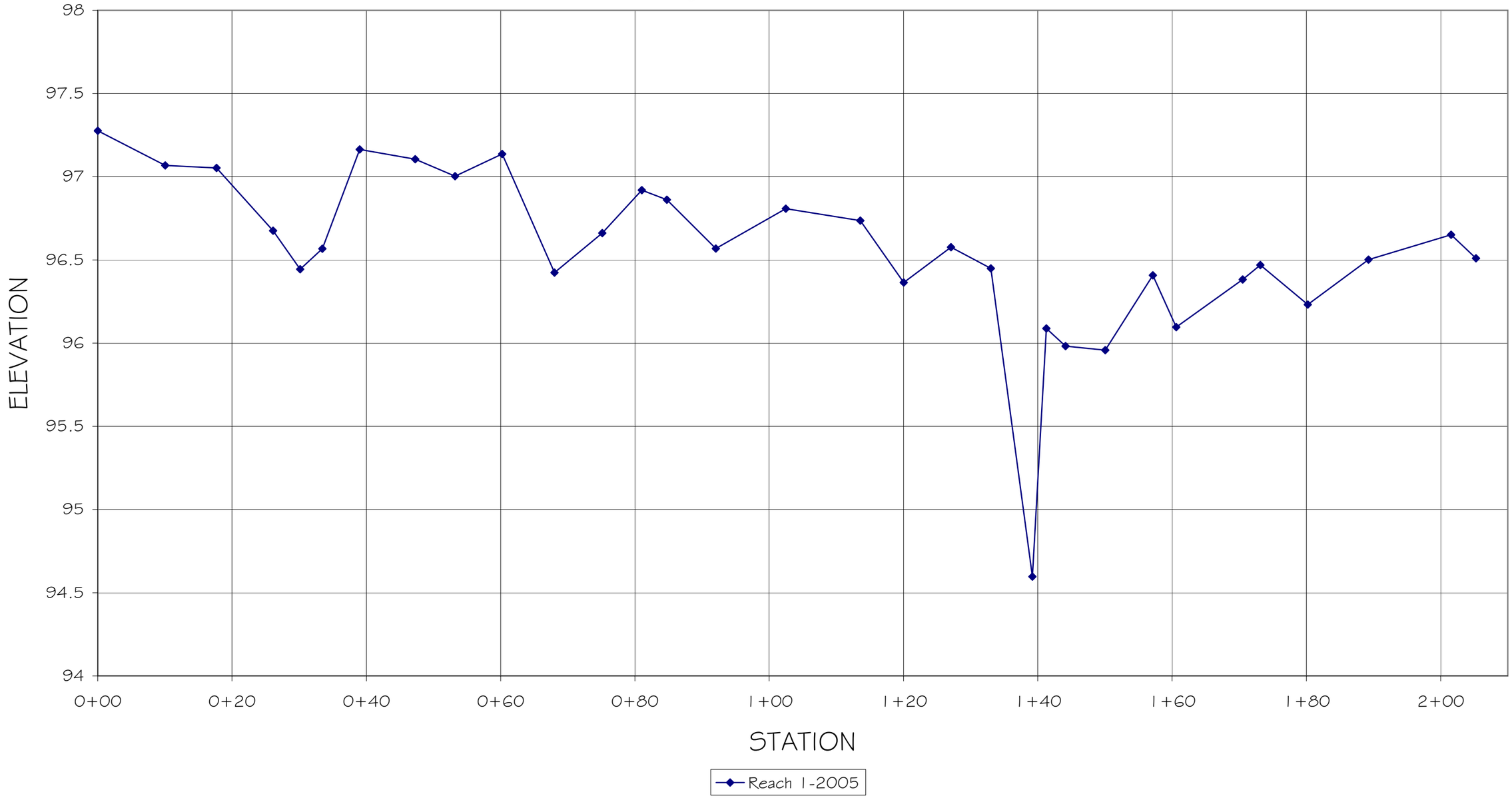
Figure 23—Reach V, Cross-section #3, Pool 2 (2005)

Figure 24—Reach V, Cross-section #4, Riffle 2 (2005)

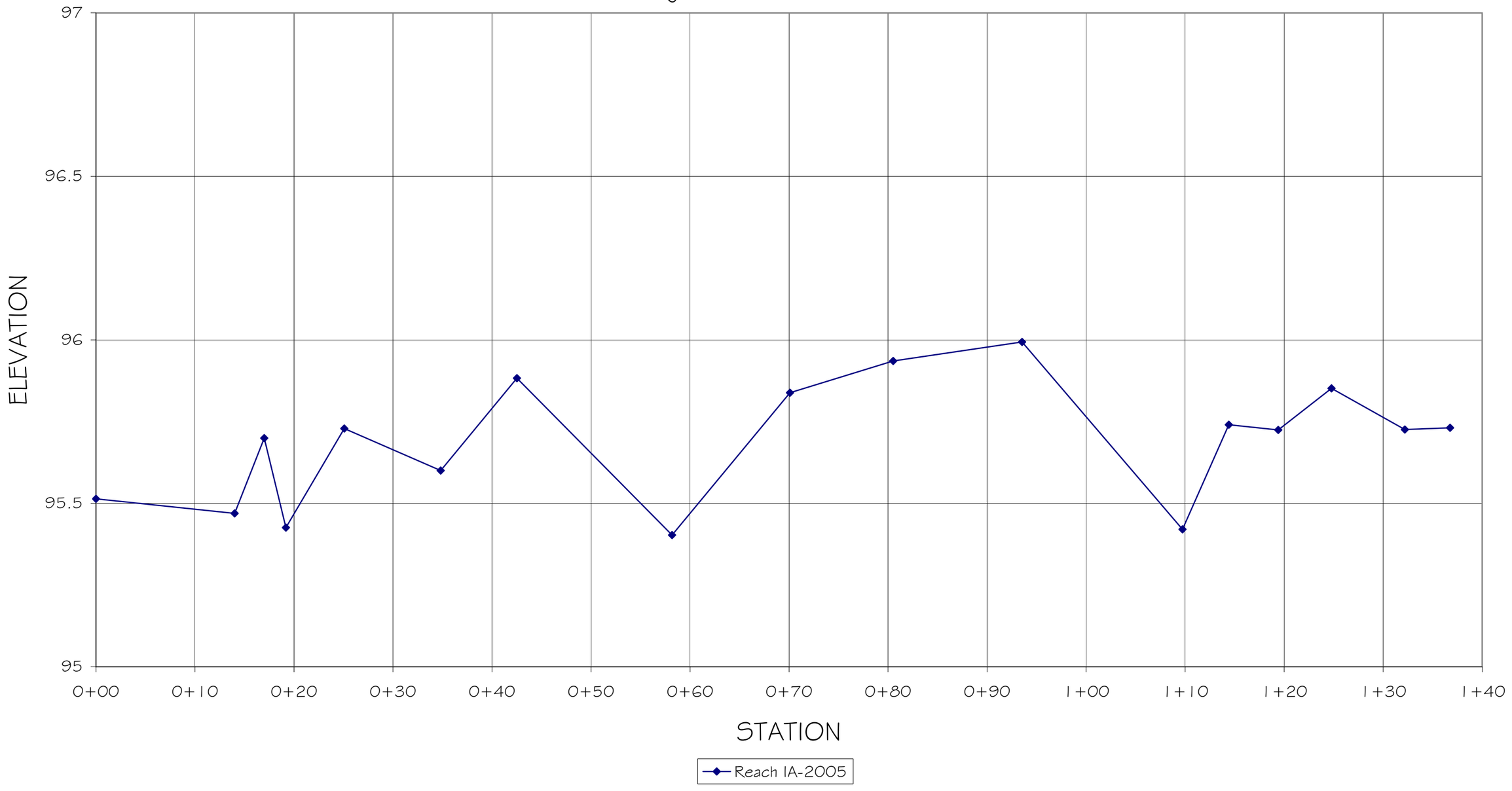
APPENDIX B –

Longitudinal Profile

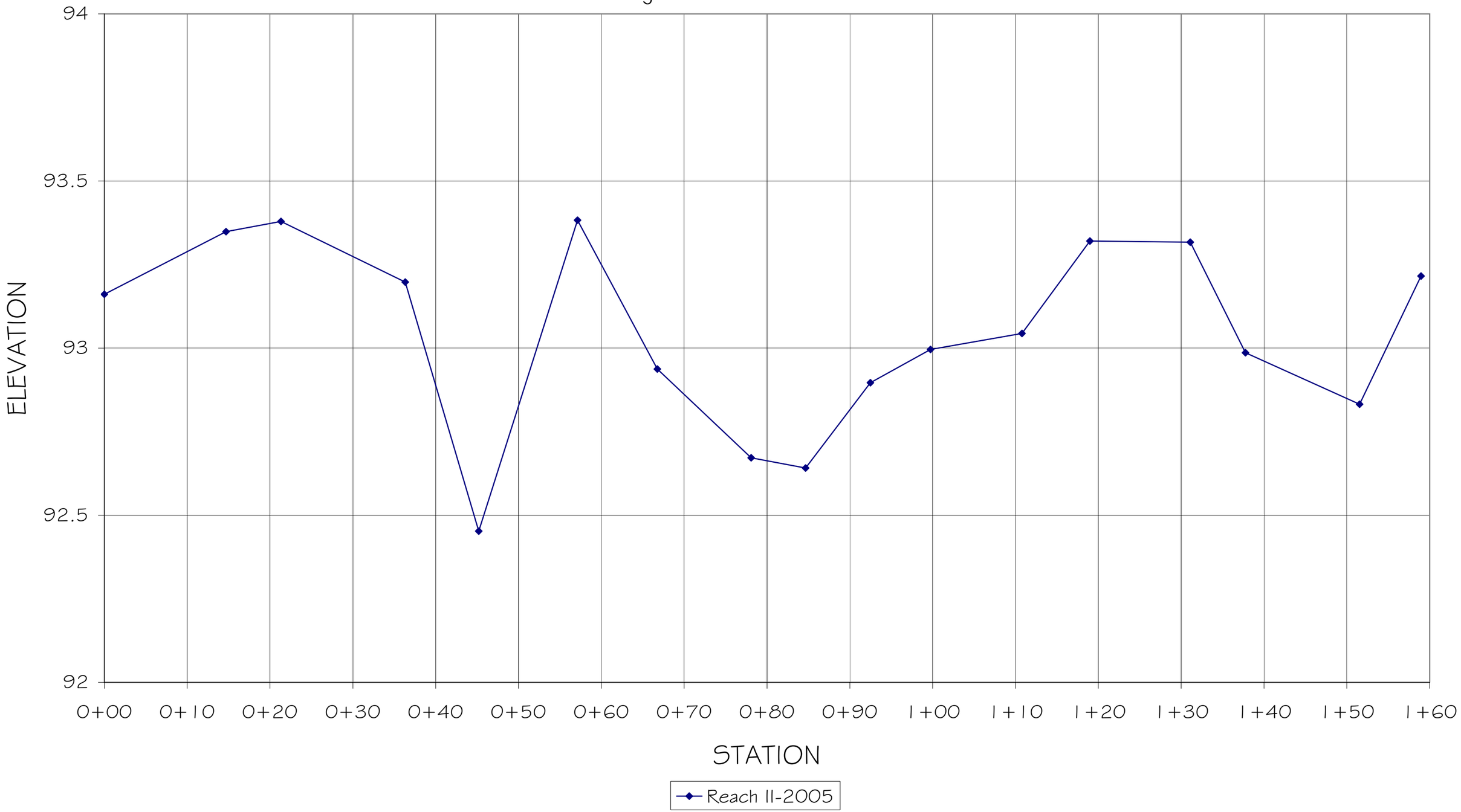
Tulula Stream and Wetland Restoration
Longitudinal Profile - Reach 1



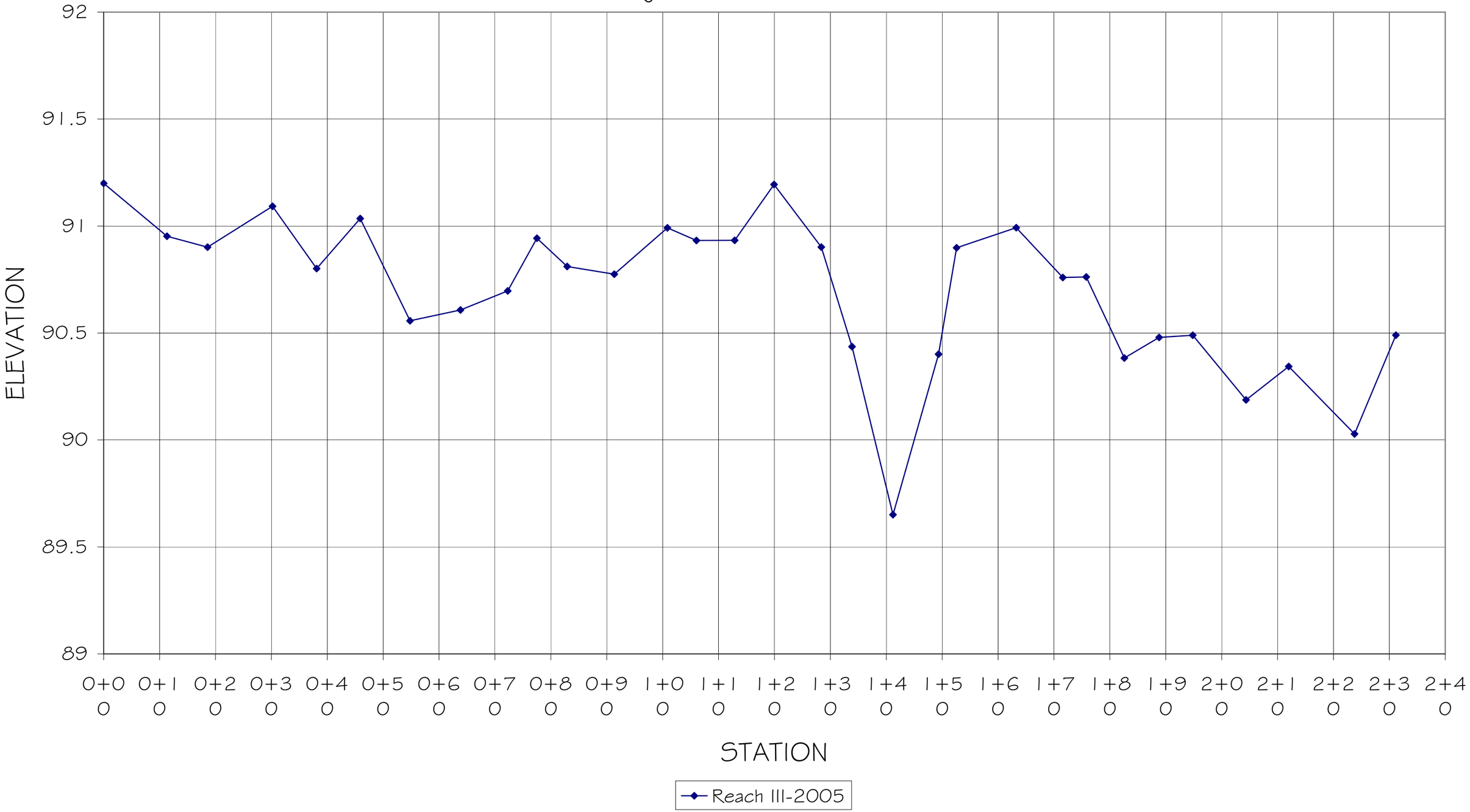
Tulula Stream and Stream Restoration
Longitudinal Profile - Reach IA



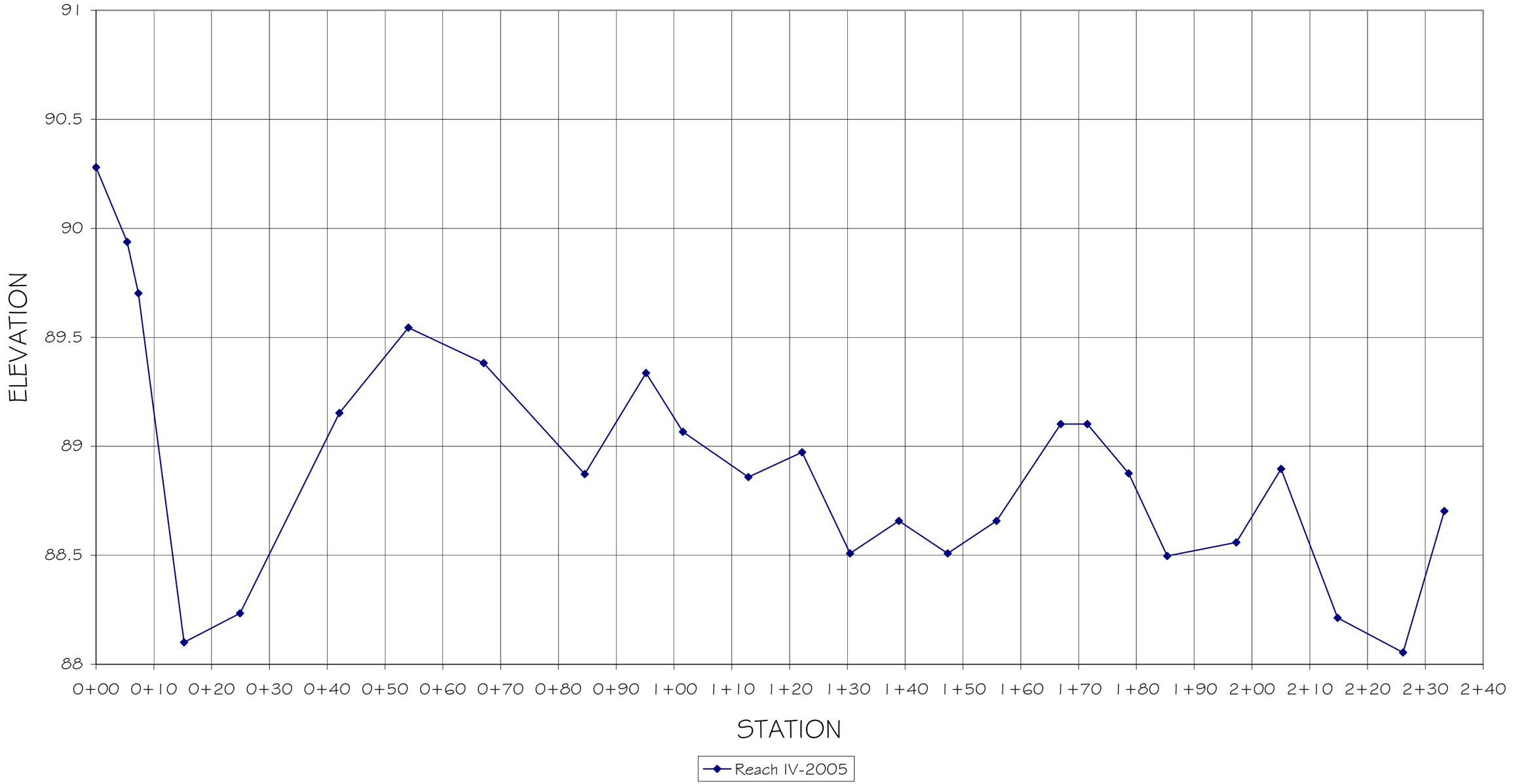
Tulula Stream and Wetland Restoration
Longitudinal Profile - Reach II



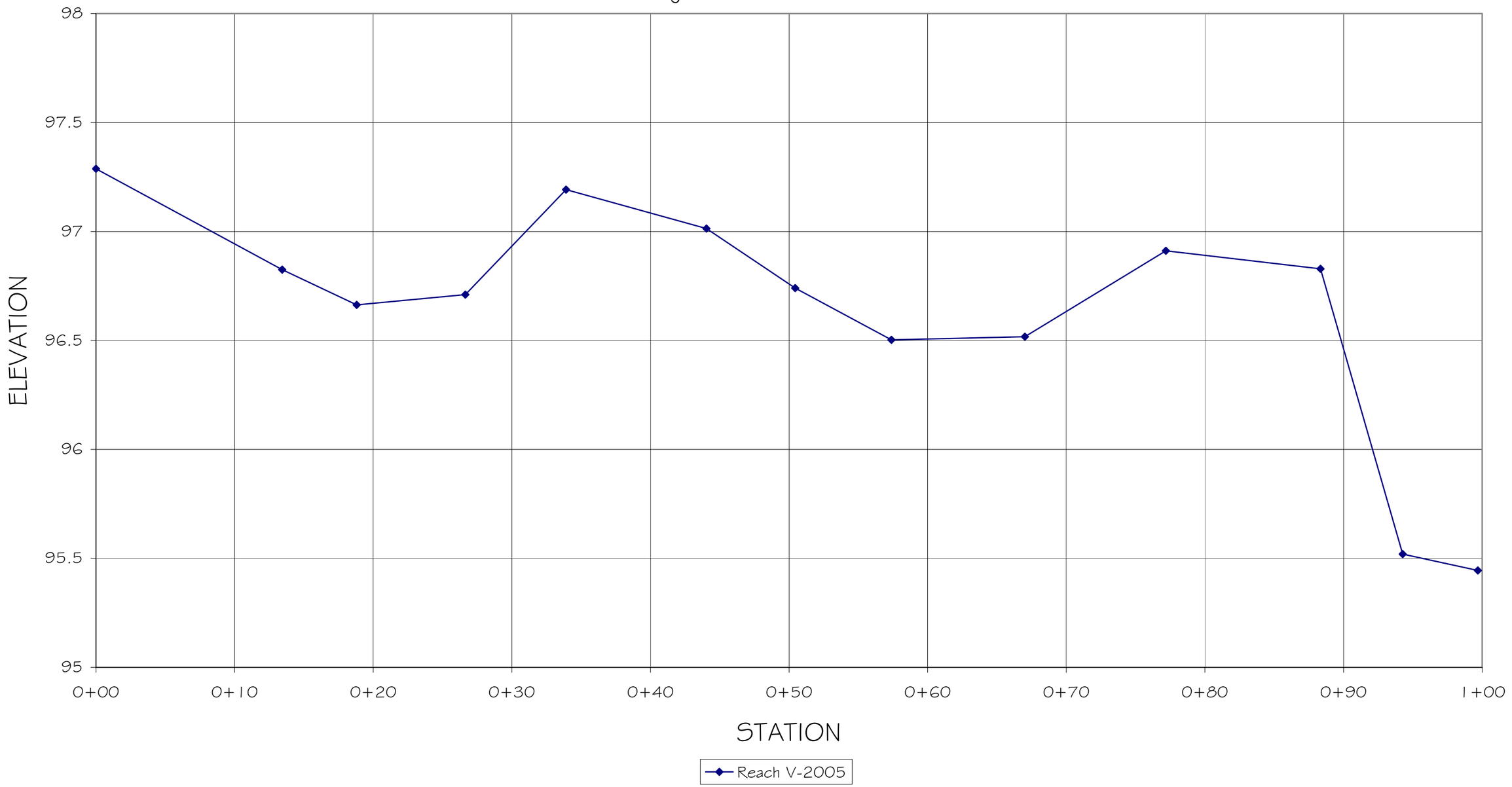
Tulula Stream and Wetland Restoration
Longitudinal Profile - Reach III



Tulula Stream and Wetland Restoration
Longitudinal Profile - Reach IV



Tulula Stream and Wetland Restoration
Longitudinal Profile - Reach V



PT #	N?	E?	ELEVATION	COMMENT			
100	5063.6135	8036.6131	97.2756	tw	0.00	0.00	Reach I
103	5053.7125	8038.3112	97.068	tw	10.05	0+10.0	
104	5046.1259	8037.4788	97.0523	tw	7.63	0+17.7	
107	5039.5377	8032.2133	96.6752	tw	8.43	0+26.1	
108	5037.8067	8028.5711	96.4439	tw	4.03	0+30.1	
124	5036.2748	8025.6373	96.5676	tw	3.31	0+33.5	
125	5034.0883	8020.5402	97.1641	tw	5.55	0+39.0	
128	5031.8538	8012.5797	97.1055	tw	8.27	0+47.3	
141	5030.5409	8006.7844	97.0035	tw	5.94	0+53.2	
142	5029.821	7999.7933	97.1368	tw	7.03	0+60.2	
145	5027.8906	7992.2644	96.4236	tw	7.77	0+68.0	
146	5024.2116	7986.156	96.6616	tw	7.13	0+75.1	
147	5019.727	7982.369	96.9195	tw	5.87	0+81.0	
163	5016.7318	7980.1231	96.8614	tw	3.74	0+84.8	
164	5009.4671	7979.6272	96.5681	tw	7.28	0+92.0	
167	4999.1286	7981.0858	96.8076	tw	10.44	1+02.5	
168	4988.0989	7979.9293	96.7366	tw	11.09	1+13.6	
171	4984.0626	7974.8843	96.3643	tw	6.46	1+20.0	
172	4983.4817	7967.8761	96.5762	tw	7.03	1+27.1	
175	4984.2627	7961.9855	96.4493	tw	5.94	1+33.0	
176	4983.5053	7955.8243	94.5968	tw	6.21	1+39.2	?
177	4983.9331	7953.8066	96.0881	tw	2.06	1+41.3	
192	4983.7973	7950.9535	95.9819	tw	2.86	1+44.1	
193	4983.6032	7945.0466	95.9578	tw	5.91	1+50.0	
196	4982.7192	7937.9933	96.4072	tw	7.11	1+57.1	
197	4981.6905	7934.666	96.0963	tw	3.48	1+60.6	
200	4972.5597	7930.87	96.3825	tw	9.89	1+70.5	
215	4969.9636	7930.5355	96.4687	tw	2.62	1+73.1	
216	4963.2009	7932.5757	96.2313	tw	7.06	1+80.2	
219	4954.3688	7934.6027	96.5017	tw	9.06	1+89.3	
220	4942.6703	7938.3712	96.6514	tw	12.29	2+01.6	
221	4939.435	7940.1827	96.5097	tw	3.71	2+05.3	
225	4803.9823	7881.666	95.5136	tw	0.00	0.00	Reach IA
228	4789.9821	7881.1823	95.4692	tw	14.01	0+14.0	
229	4787.0084	7881.4487	95.6994	tw	2.99	0+17.0	
240	4784.8421	7881.7816	95.4256	tw	2.19	0+19.2	
241	4779.1039	7880.4328	95.7288	tw	5.89	0+25.1	
253	4773.0872	7872.7788	95.6002	tw	9.74	0+34.8	
254	4771.6206	7865.2211	95.8827	tw	7.70	0+42.5	
257	4766.3227	7850.4783	95.4029	tw	15.67	0+58.2	
260	4754.4738	7851.6714	95.8382	tw	11.91	0+70.1	
272	4744.0787	7852.4931	95.9355	tw	10.43	0+80.5	
273	4731.0802	7853.151	95.9936	tw	13.02	0+93.5	
276	4714.915	7852.0691	95.4203	tw	16.20	1+09.7	
277	4710.5094	7850.4866	95.7403	tw	4.68	1+14.4	
290	4708.564	7845.8881	95.7245	tw	4.99	1+19.4	
291	4706.3551	7840.9876	95.8516	tw	5.38	1+24.8	
292	4704.7857	7833.7514	95.7257	tw	7.40	1+32.2	
295	4704.6805	7829.181	95.7309	tw	4.57	1+36.8	

298	4528.6508	7340.6876	93.1611	tw	0.00	0.00	Reach II
301	4523.0492	7327.1132	93.3485	tw	14.68	0+14.7	
302	4520.9812	7320.8034	93.379	tw	6.64	0+21.3	
305	4520.1091	7305.8318	93.1976	tw	15.00	0+36.3	
306	4523.9655	7297.8345	92.4524	tw	8.88	0+45.2	
309	4531.3076	7288.4339	93.3828	tw	11.93	0+57.1	
322	4536.6889	7280.4425	92.9373	tw	9.63	0+66.8	
323	4541.9927	7270.4341	92.6719	tw	11.33	0+78.1	
326	4542.7424	7263.9071	92.6412	tw	6.57	0+84.7	
327	4540.7124	7256.3528	92.8965	tw	7.82	0+92.5	
340	4536.1545	7250.7037	92.9961	tw	7.26	0+99.7	
341	4526.9133	7244.6582	93.0439	tw	11.04	1+10.8	
344	4519.3194	7241.5605	93.3204	tw	8.20	1+19.0	
357	4507.6206	7238.3933	93.3169	tw	12.12	1+31.1	
358	4501.1706	7236.7241	92.9863	tw	6.66	1+37.8	
371	4489.929	7228.7686	92.832	tw	13.77	1+51.5	
372	4488.2129	7221.5545	93.2157	tw	7.42	1+59.0	
377	4197.5889	6981.9875	91.1995	tw	0.00	0.00	Reach III
380	4193.9102	6971.2798	90.9522	tw	11.32	0+11.3	
381	4192.6285	6964.1363	90.9014	tw	7.26	0+18.6	
384	4196.0335	6953.0246	91.0925	tw	11.62	0+30.2	
385	4199.1351	6945.7592	90.8011	tw	7.90	0+38.1	
388	4202.5378	6938.7512	91.0353	tw	7.79	0+45.9	
405	4207.4214	6931.2999	90.5571	tw	8.91	0+54.8	
406	4213.438	6924.5648	90.6077	tw	9.03	0+63.8	
409	4217.7494	6917.2955	90.6968	tw	8.45	0+72.3	
410	4220.0043	6912.5856	90.9431	tw	5.22	0+77.5	
426	4220.8459	6907.2422	90.811	tw	5.41	0+82.9	
427	4216.3333	6900.1179	90.775	tw	8.43	0+91.3	
430	4208.0463	6895.4716	90.9915	tw	9.50	1+00.8	
431	4202.877	6894.9244	90.9326	tw	5.20	1+06.0	
432	4196.2145	6893.3842	90.9334	tw	6.84	1+12.9	
435	4189.5871	6891.0056	91.1943	tw	7.04	1+19.9	
436	4182.0778	6887.1201	90.9015	tw	8.45	1+28.4	
439	4178.2507	6883.1848	90.4364	tw	5.49	1+33.9	
440	4173.8972	6877.2756	89.6507	tw	7.34	1+41.2	
442	4175.9765	6869.3992	90.4011	tw	8.15	1+49.4	
443	4177.9018	6866.8102	90.8985	tw	3.23	1+52.6	
446	4185.1047	6858.9415	90.9925	tw	10.67	1+63.3	
447	4190.4478	6852.5356	90.7594	tw	8.34	1+71.6	
448	4193.6461	6849.8303	90.7619	tw	4.19	1+75.8	
464	4195.033	6843.1576	90.3829	tw	6.82	1+82.6	
465	4196.478	6837.0998	90.4795	tw	6.23	1+88.8	
466	4197.1471	6831.1273	90.4896	tw	6.01	1+94.8	
469	4197.6333	6821.6069	90.1872	tw	9.53	2+04.4	
470	4195.913	6814.1716	90.3435	tw	7.63	2+12.0	
483	4187.6817	6805.7496	90.0282	tw	11.78	2+23.8	
484	4180.3145	6806.4552	90.4898	tw	7.40	2+31.2	

489	4034.7743	6452.174	90.2797	tw	0.00	0.00	Reach IV
492	4033.6252	6446.9101	89.9375	tw	5.39	0+05.4	
493	4033.1189	6445.0405	89.7022	tw	1.94	0+07.3	
505	4030.764	6437.4877	88.1009	tw	7.91	0+15.2	
506	4027.1278	6428.5288	88.2341	tw	9.67	0+24.9	
521	4014.716	6416.6283	89.1525	tw	17.20	0+42.1	
524	4003.2131	6413.4289	89.5441	tw	11.94	0+54.0	
525	3991.21	6408.3563	89.3818	tw	13.03	0+67.1	
528	3974.0533	6404.9789	88.8725	tw	17.49	0+84.6	
529	3963.4809	6405.7638	89.3362	tw	10.60	0+95.2	
530	3957.1008	6406.0194	89.0664	tw	6.39	1+01.5	
533	3945.7813	6406.1478	88.8591	tw	11.32	1+12.9	
534	3936.4854	6405.9402	88.9729	tw	9.30	1+22.2	
537	3928.9019	6402.5606	88.5089	tw	8.30	1+30.5	
538	3925.2606	6394.9379	88.6578	tw	8.45	1+38.9	
537	3928.9019	6402.5606	88.5089	tw	8.45	1+47.4	
538	3925.2606	6394.9379	88.6578	tw	8.45	1+55.8	
541	3924.8711	6383.8307	89.102	tw	11.11	1+66.9	
543	3924.9502	6379.2387	89.102	tw	4.59	1+71.5	
544	3925.558	6372.105	88.8762	tw	7.16	1+78.7	
545	3927.6412	6365.7765	88.4969	tw	6.66	1+85.3	
561	3932.4541	6354.8311	88.5592	tw	11.96	1+97.3	
562	3934.4064	6347.3315	88.8966	tw	7.75	2+05.0	
563	3935.9873	6337.6826	88.2133	tw	9.78	2+14.8	
580	3932.9546	6326.7697	88.0541	tw	11.33	2+26.1	
581	3930.3708	6320.1085	88.7032	tw	7.14	2+33.3	
700	586705.0219	596630.4843	97.2879	tw	0.00	0.00	Reach V
703	586692.6854	596625.1737	96.8249	tw	13.43	0+13.4	
704	586688.1736	596622.2461	96.6632	tw	5.38	0+18.8	
705	586682.2377	596617.1249	96.7104	tw	7.84	0+26.6	
706	586681.2349	596609.9337	97.1923	tw	7.26	0+33.9	
707	586679.3875	596599.9738	97.0137	tw	10.13	0+44.0	
708	586679.7805	596593.5837	96.7402	tw	6.40	0+50.4	
709	586682.6792	596587.2723	96.5029	tw	6.95	0+57.4	
710	586690.759	596582.0397	96.5174	tw	9.63	0+67.0	
711	586700.7635	596580.2273	96.9115	tw	10.17	0+77.2	
712	586711.8877	596579.396	96.8287	tw	11.16	0+88.3	
713	586716.8999	596576.2286	95.5197	tw	5.93	0+94.3	
714	586718.5057	596571.0468	95.4448	tw	5.42	0+99.7	

RIVERMOI REACH SUMMARY

River Name: Tulula
Reach Name: 2005

Stream	Valley	Type	Val	Q(cfs)	DA(sq
E4	VIII	0.0054	142.52	2.41	

Dimension Summary

Variable				Min	Avg	Max
Floodprone	Width	(ft)		50	50	50
Riffle	Area	(Sq	ft)	6.76	12.97	16.83
Max	Riffle	Depth	(ft)	1.52	2.36	3.4
Mean	Riffle	Depth	(ft)	1.05	1.35	1.64
Riffle	Width	(ft)		6.42	9.52	12.48
Pool	Area	(Sq	ft)	11.3	11.51	11.69
Max	Pool	Depth	(ft)	1.93	2.13	2.41
Mean	Pool	Depth	(ft)	1.06	1.38	1.56
Pool	Width	(ft)		7.29	8.58	11.02
Run	Area	(Sq	ft)	0	0	0
Max	Run	Depth	(ft)	1.85	2.12	2.8
Mean	Run	Depth	(ft)	0	0	0
Run	Width	(ft)		0	0	0
Glide	Area	(Sq	ft)	0	0	0
Max	Glide	Depth	(ft)	1.77	2.08	2.28
Mean	Glide	Depth	(ft)	0	0	0
Glide	Width	(ft)		0	0	0

Pattern Summary

Variable	Min	Avg	Max
Sinuosity		1.61	
Meander	Wavelengt (ft)	35.68	81.86	125.91
Radius	of Curvature	18.1	29.21	76.34
Belt	Width (ft)	30.12	55.83	108.9

Profile Summary

Data Based on the following:
REACH1

Variable			Min	Avg	Max
S	riffle	(ft/ft)	0.00124	0.00338	0.00669
S	pool	(ft/ft)	0	0.00106	0.00321
S	run	(ft/ft)	0.02911	0.07411	0.24222
S	glide	(ft/ft)	0.01961	0.04112	0.08681
P	-	P	15.6	25.74	43.65
P	length	(ft)	9.27	13.6	21.03
Dmax	riffle	(ft)	1.52	2.36	3.4
Dmax	pool	(ft)	1.93	2.13	2.41
Dmax	run	(ft)	1.85	2.12	2.8
Dmax	glide	(ft)	1.77	2.08	2.28
Bankfull	Slope	(ft/ft)		0.00338	

Hydraulic Summary

Variable			Min	Avg	Max
Discharge	(cfs)			142.52	
Hyd	Radius	(ft)	0.91	1.15	1.34
Bkf	Shear	(lb/	0.19	0.24	0.28

RIVERMOI REACH SUMMARY

River Name: Tulula
Reach Name: 2005

Stream	Type	Valley	Type	D50(mm)	Val	Slope	BKF	Q(cfs)	DA(sq
	E	4	VIII	5	0.0054	142.52	2.41		

Dimension Summary

Variable				Min	Avg	Max
Pool	Area	/	Abkf	0.87124	1.08944	1.41866
Max	Pool	Depth	/Dbkf	1.42963	1.68148	1.99259
Mean	Pool	Depth	/Dbkf	0.78519	1.02222	1.18519
Pool	Width	/	Wbkf	0.76576	1.08403	1.26681
Run	Area	/	Abkf	0	0	0
Max	Run	Depth	/Dbkf	1.37037	1.57037	2.07407
Mean	Run	Depth	/Dbkf	0	0	0
Run	Width	/	Wbkf	0	0	0
Glide	Area	/	Abkf	0	0	0
Max	Glide	Depth	/Dbkf	1.31111	1.54074	1.68889
Mean	Glide	Depth	/Dbkf	0	0	0
Glide	Width	/	Wbkf	0	0	0

Pattern Summary

Variable				Min	Avg	Max
Sinuosity					1.61	
Lm	/	W	bkf	3.7479	8.59874	13.22584
Rc	/	W	bkf	1.90126	3.06828	8.01891
Wblt	/	Wbkf	(MWR)	3.16387	5.8645	11.43908

Profile Summary

Data Based on the following:

Variable						Min	Avg	Max
S	riffle	/	S	bkf	(ft/ft)	0.36686	1	1.97929
S	pool	/	S	bkf	(ft/ft)	0	0.31361	0.9497
S	run	/	S	bkf	(ft/ft)	8.61243	21.92604	71.66272
S	glide	/	S	bkf	(ft/ft)	5.80178	12.16568	25.68343
P	-	P	/	W	bkf	1.63866	2.70378	4.58508
P	length	/	W	bkf	(ft)	0.97374	1.42857	2.20903
Dmax	riffle	/	D	bkf	(ft)	1.12593	1.74815	2.51852
Dmax	pool	/	D	bkf	(ft)	1.42963	1.68148	1.99259
Dmax	run	/	D	bkf	(ft)	1.37037	1.57037	2.07407
Dmax	glide	/	D	bkf	(ft)	1.31111	1.54074	1.68889
Bankfull	Slope	(ft/ft)					0.00338	

Hydraulic Summary

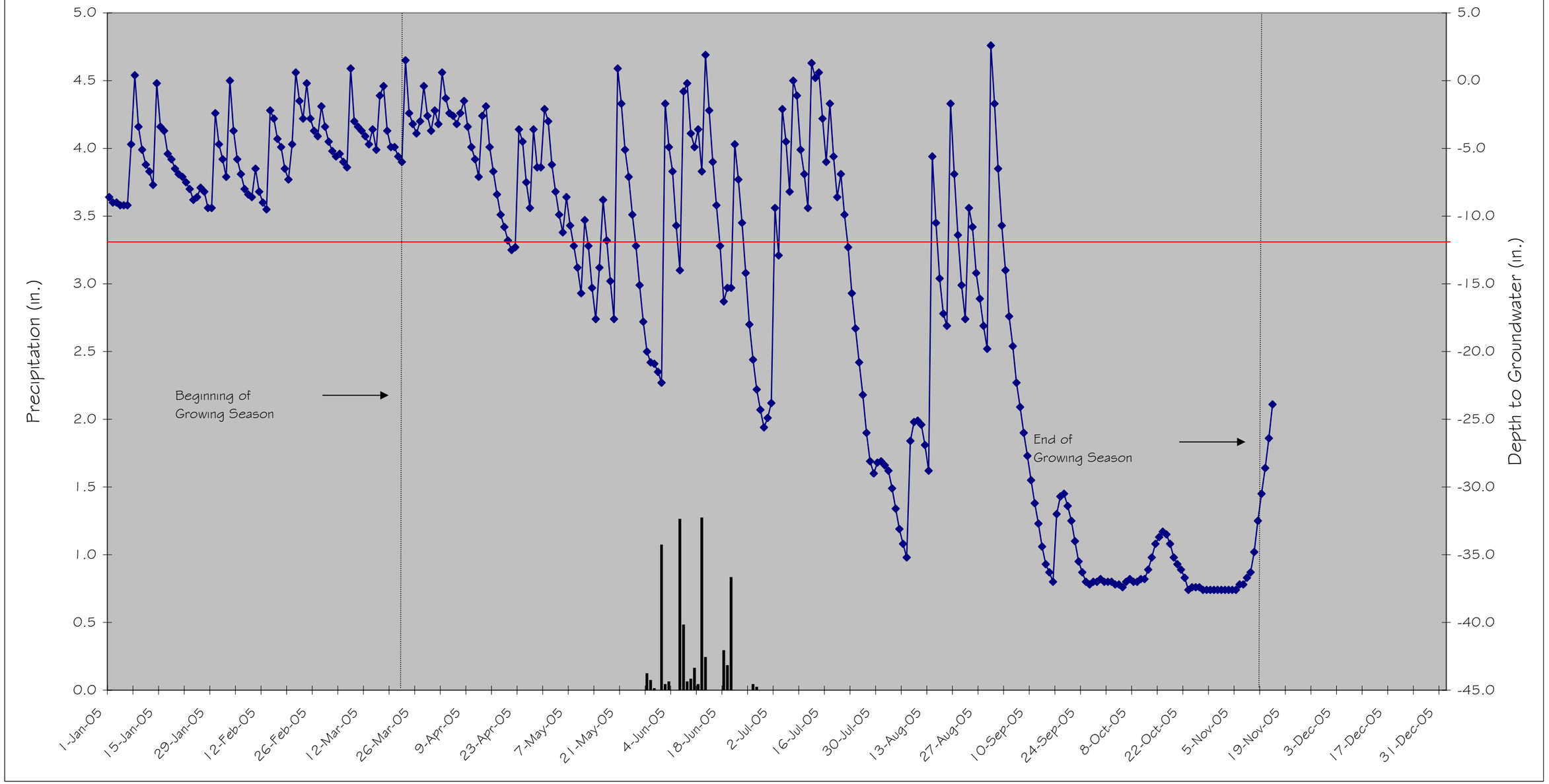
Variable					Min	Avg	Max
HR	/	D	bkf	(ft)	0.67407	0.85185	0.99259
Bkf	Shear	(lb/	sq	ft)	0.19	0.24	0.28

APPENDIX C

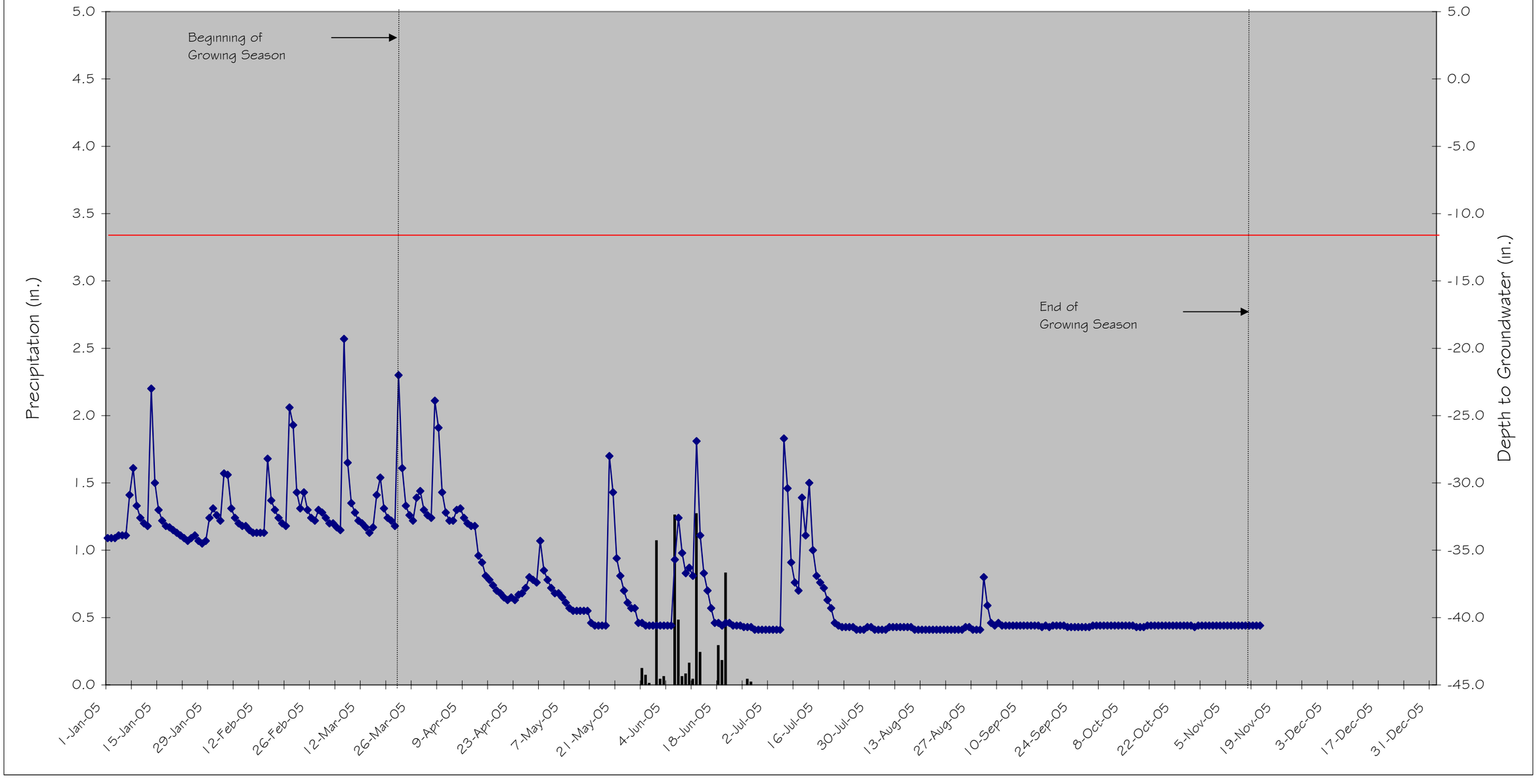
APPENDIX C –

Groundwater Gauge Summary Information

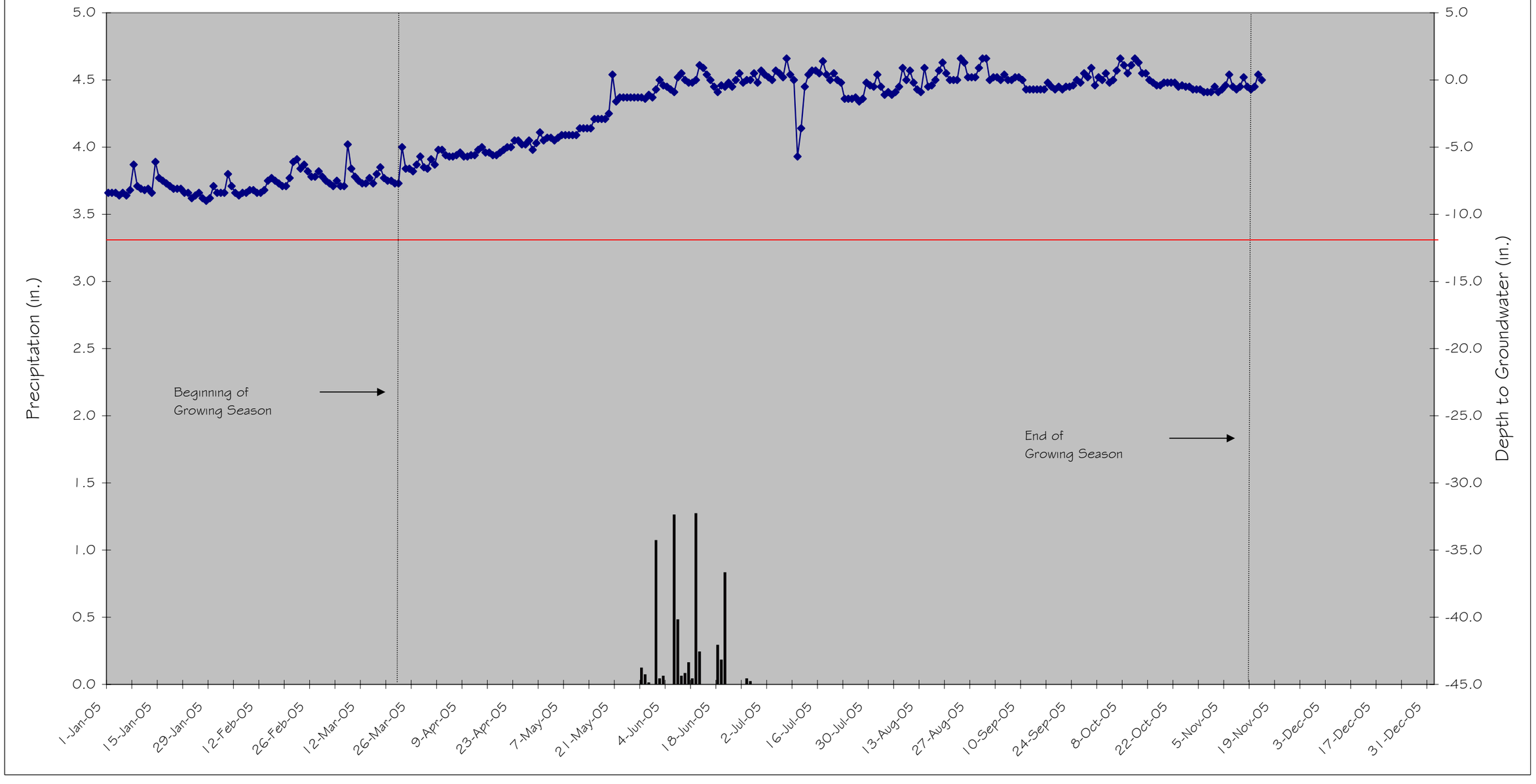
Tulula Stream and Wetland Restoration Site
Groundwater Gauge A1



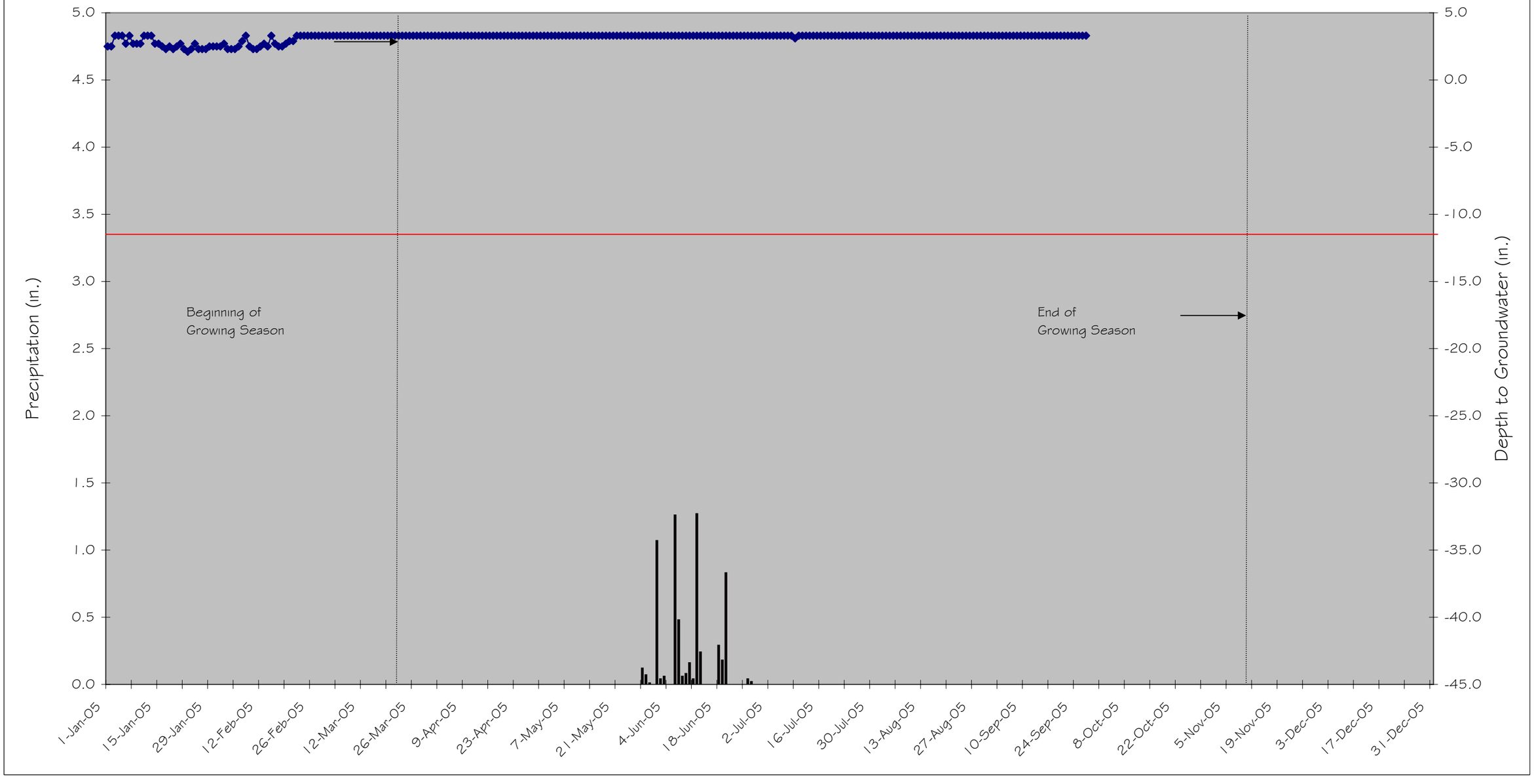
Tulula Stream and Wetland Restoration Site
Groundwater Gauge A2



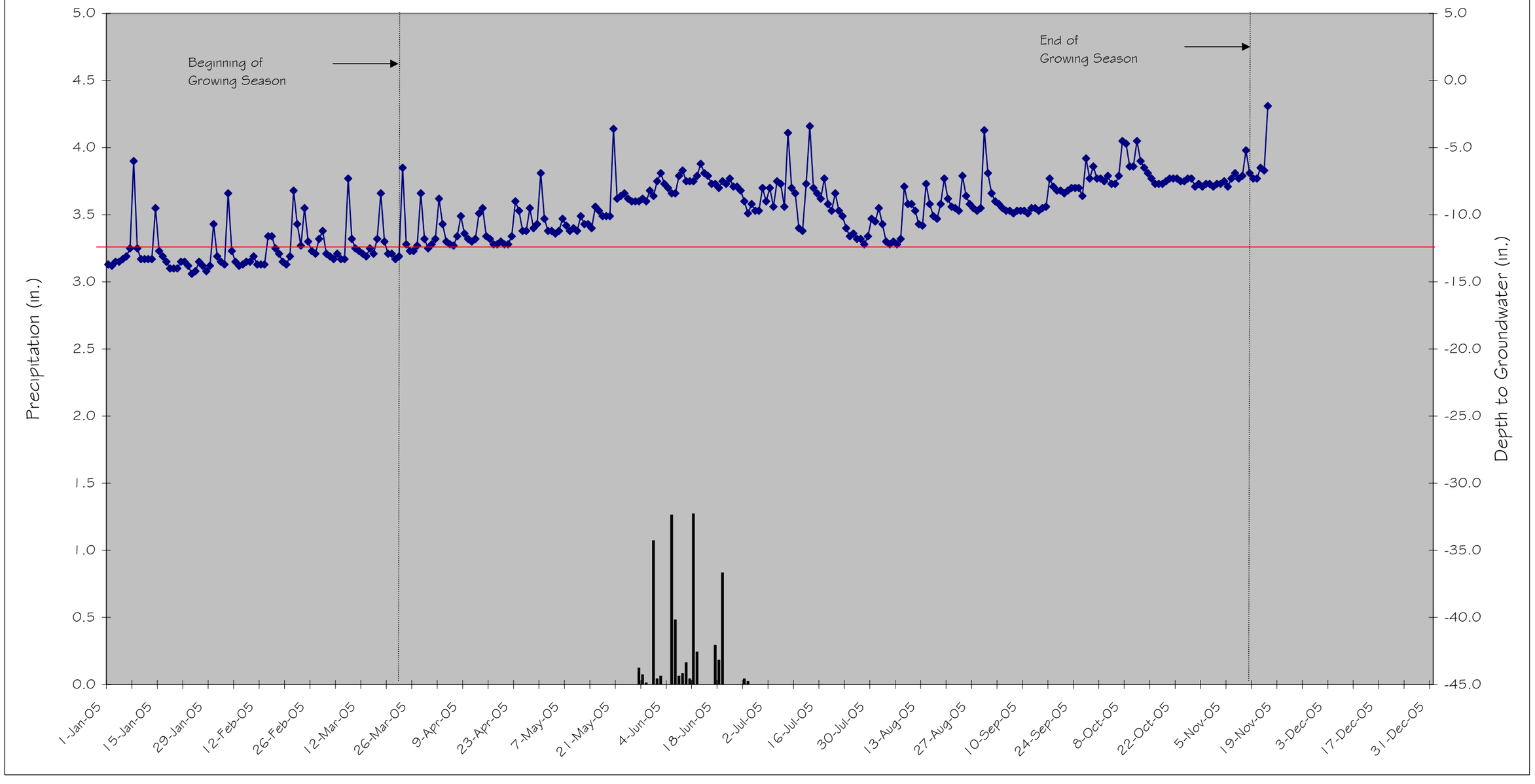
Tulula Stream and Wetland Restoration Site
Groundwater Gauge A3



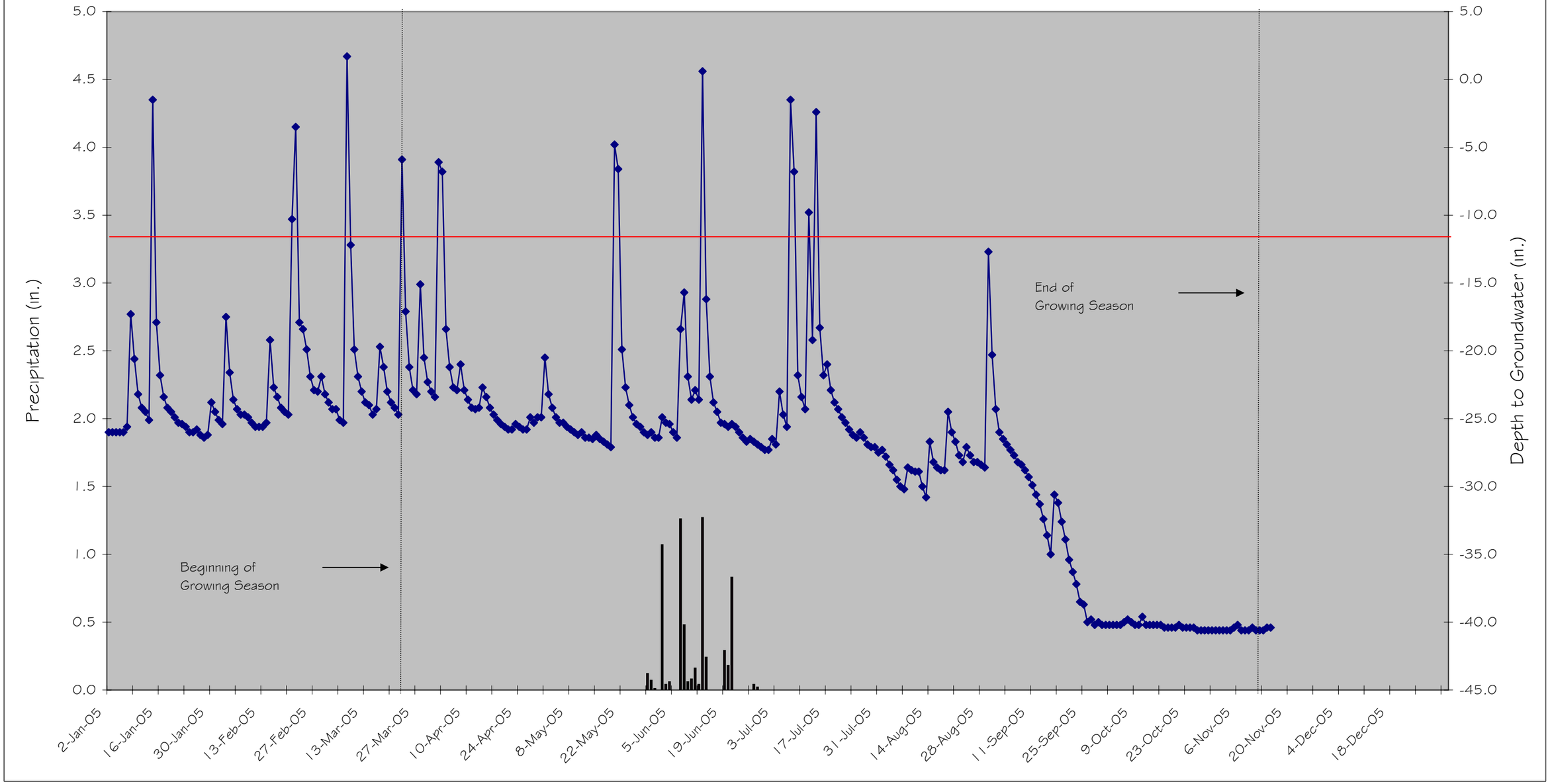
Tulula Stream and Wetland Restoration Site
Groundwater Gauge A4



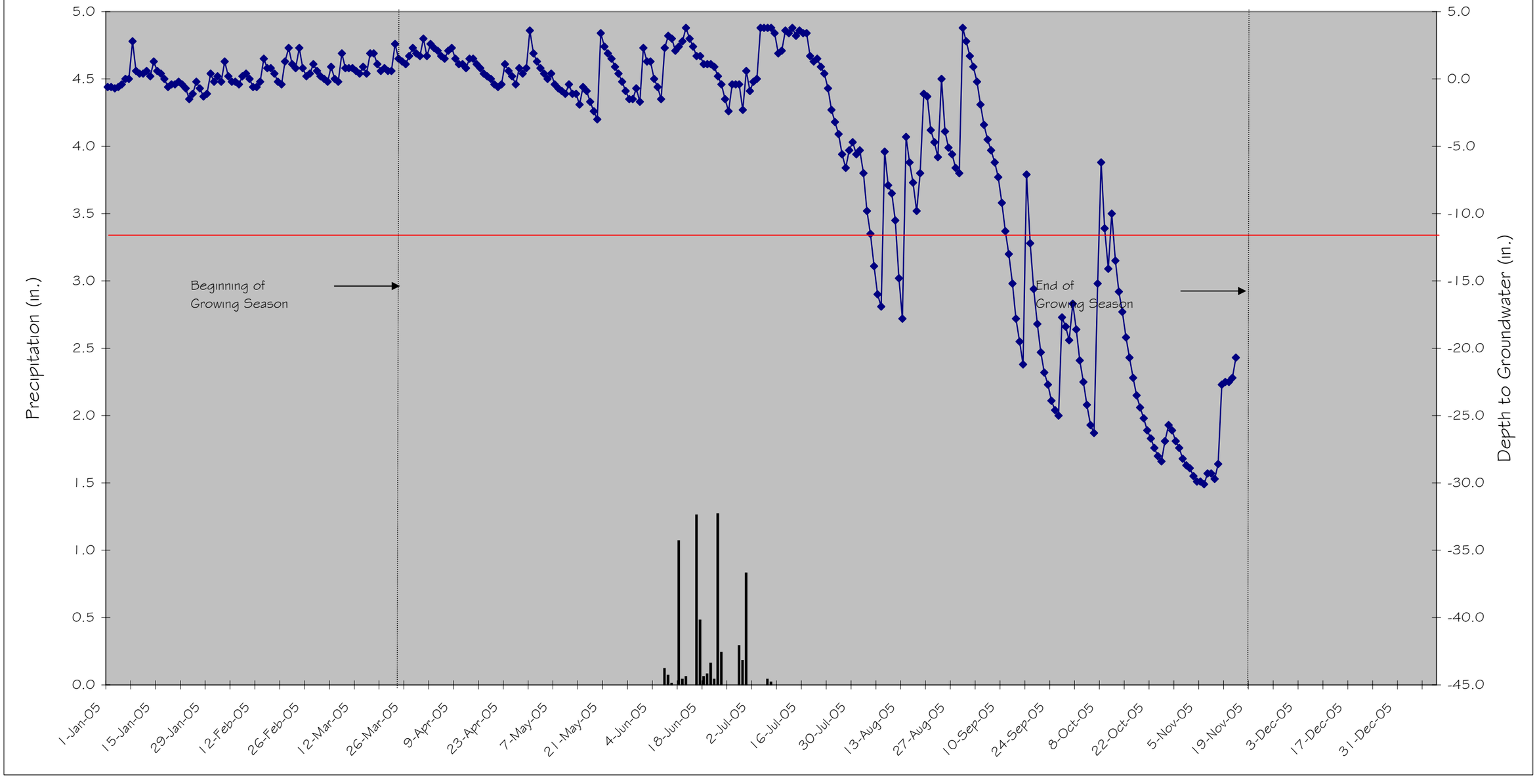
Tulula Stream and Wetland Restoration Site
Groundwater Gauge A5



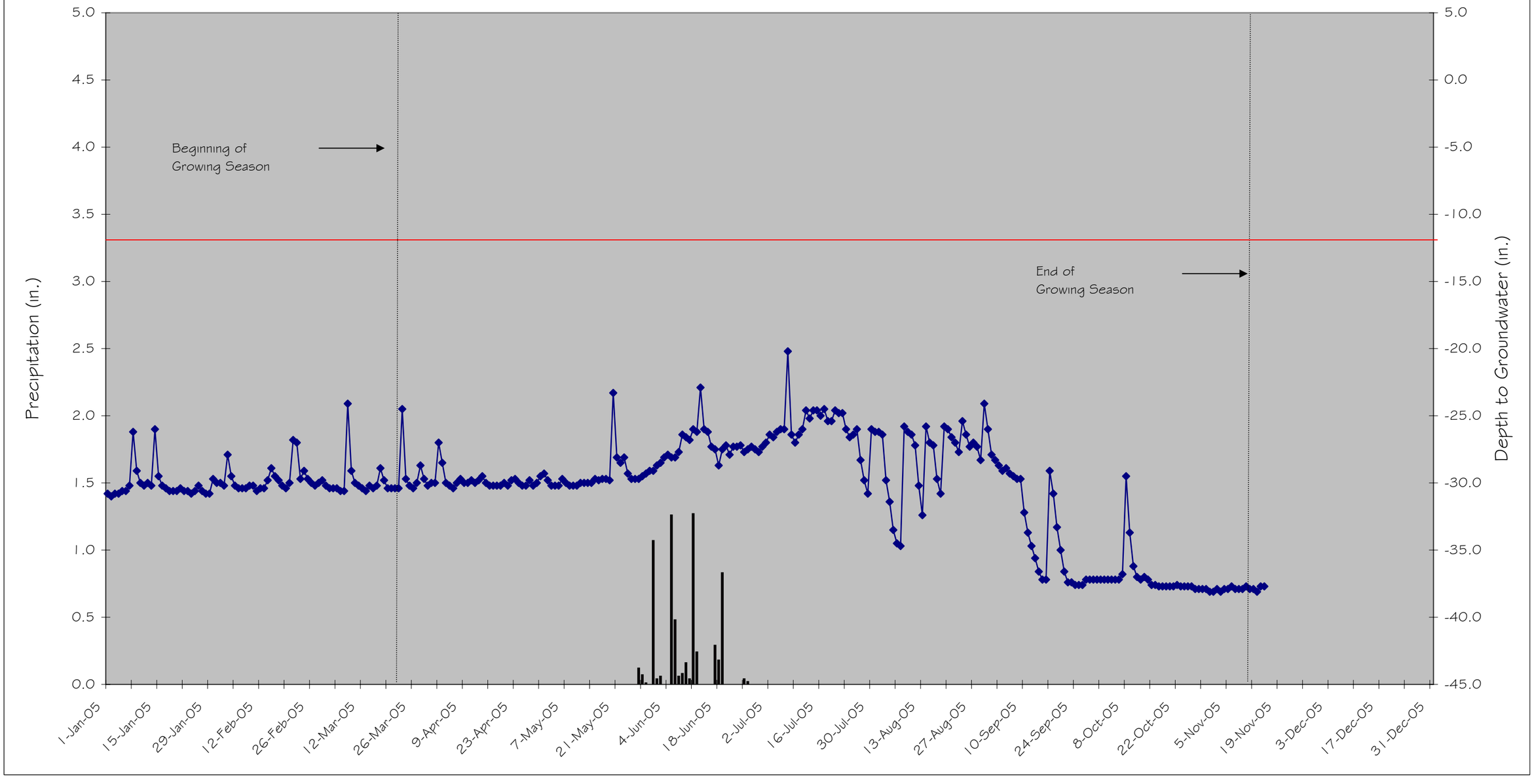
Tulula Stream and Wetland Restoration Site
Groundwater Gauge B1



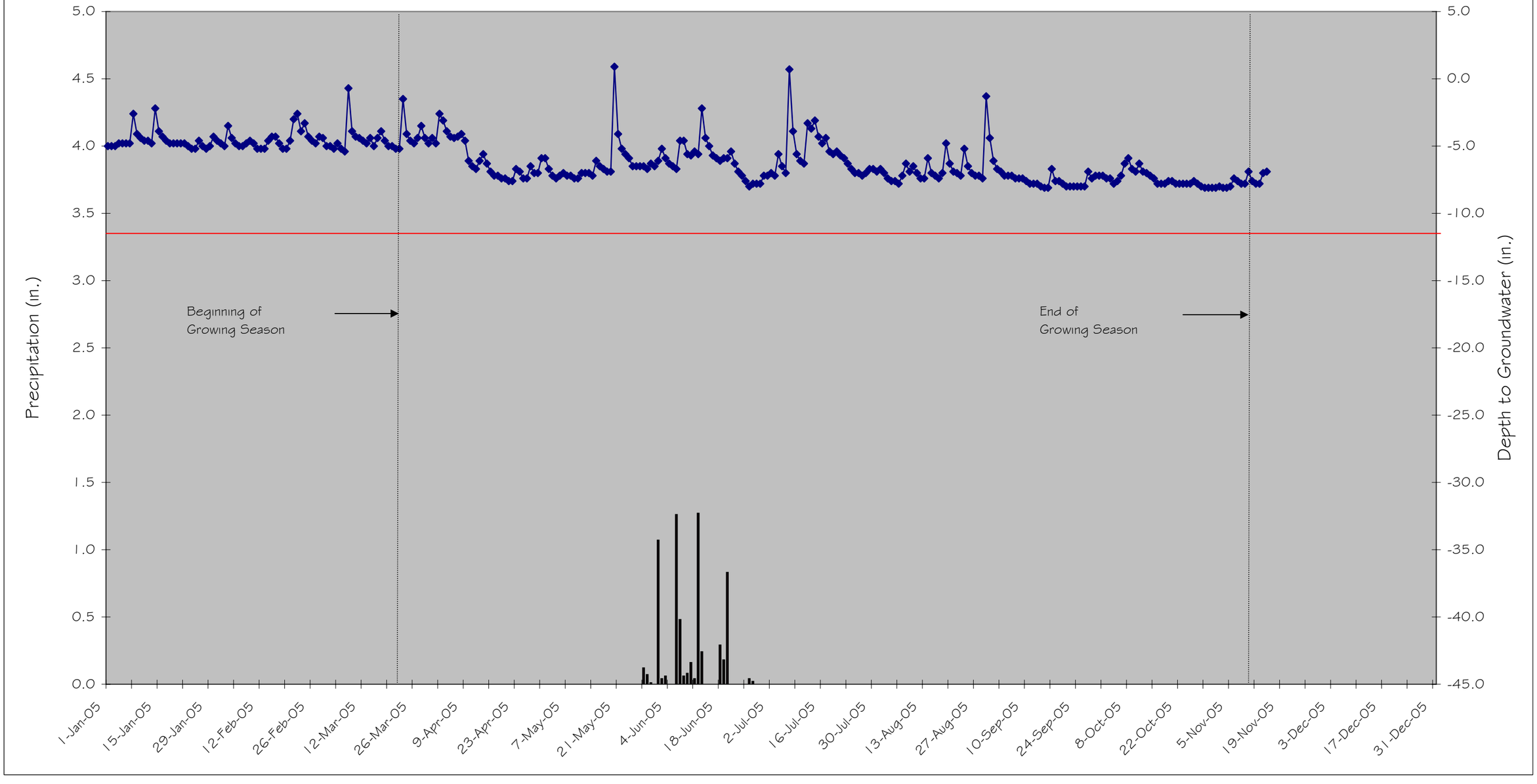
Tulula Stream and Wetland Restoration Site
Groundwater Gauge B2



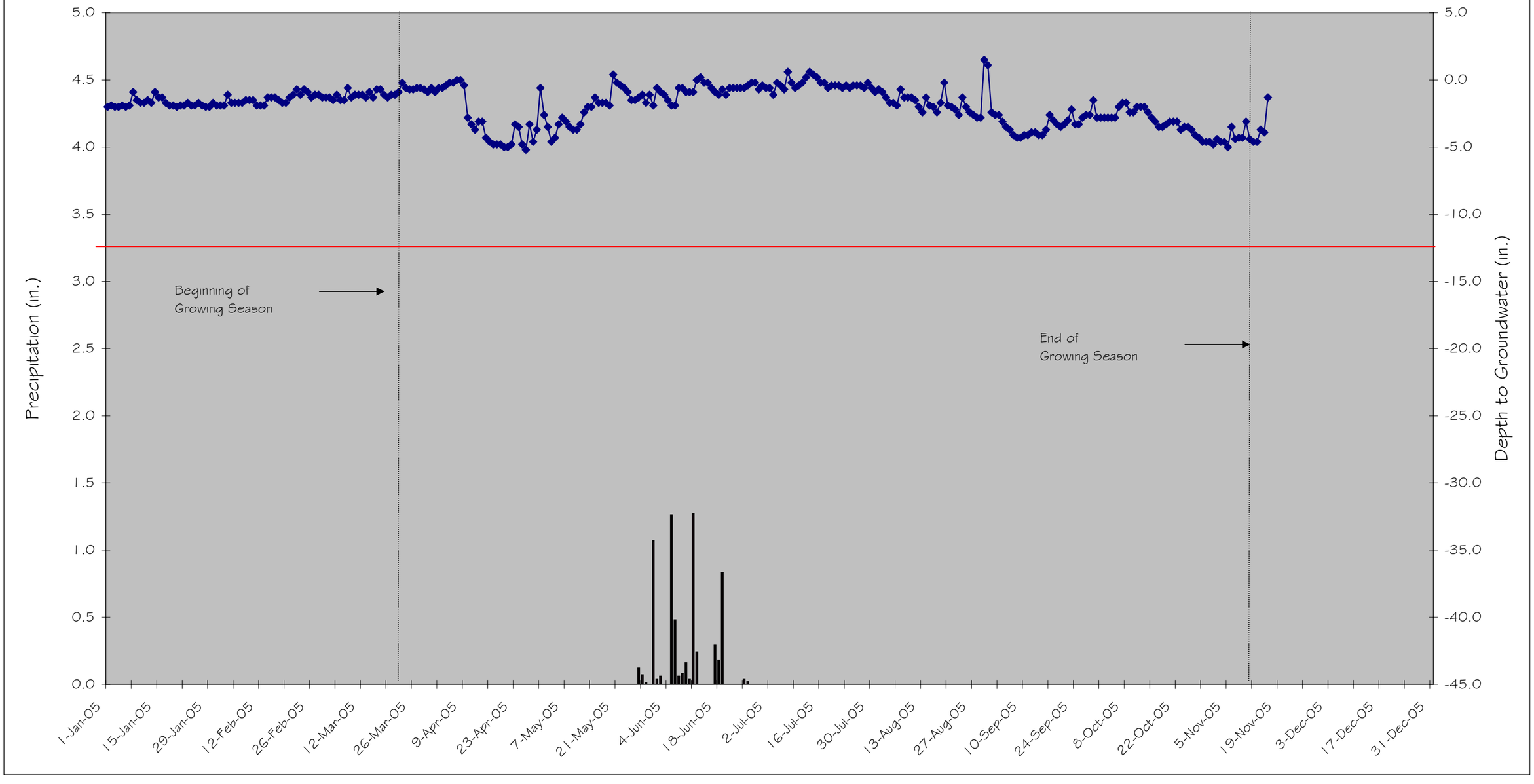
Tulula Stream and Wetland Restoration Site
Groundwater Gauge B3



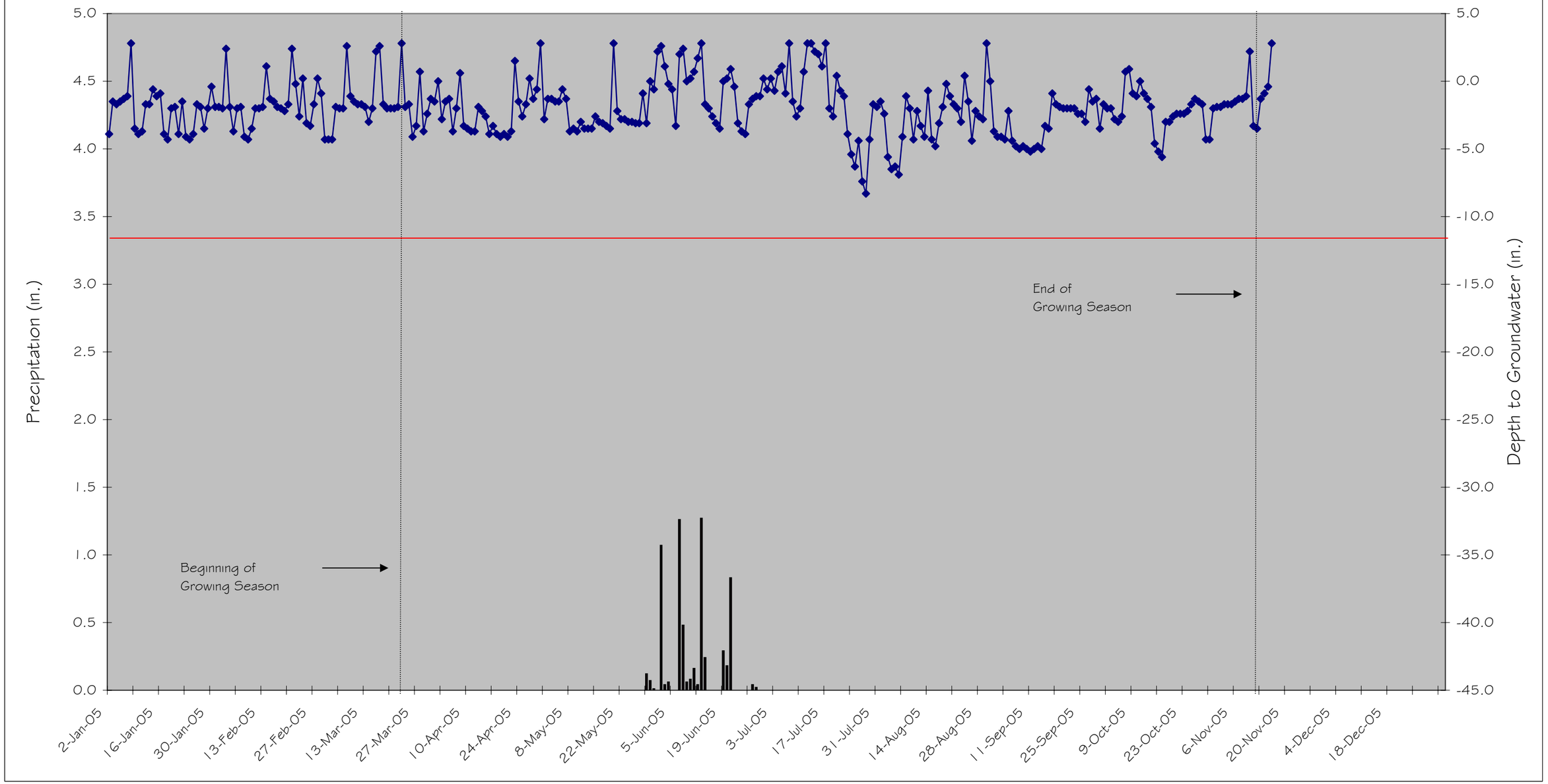
Tulula Stream and Wetland Restoration Site
Groundwater Gauge B4



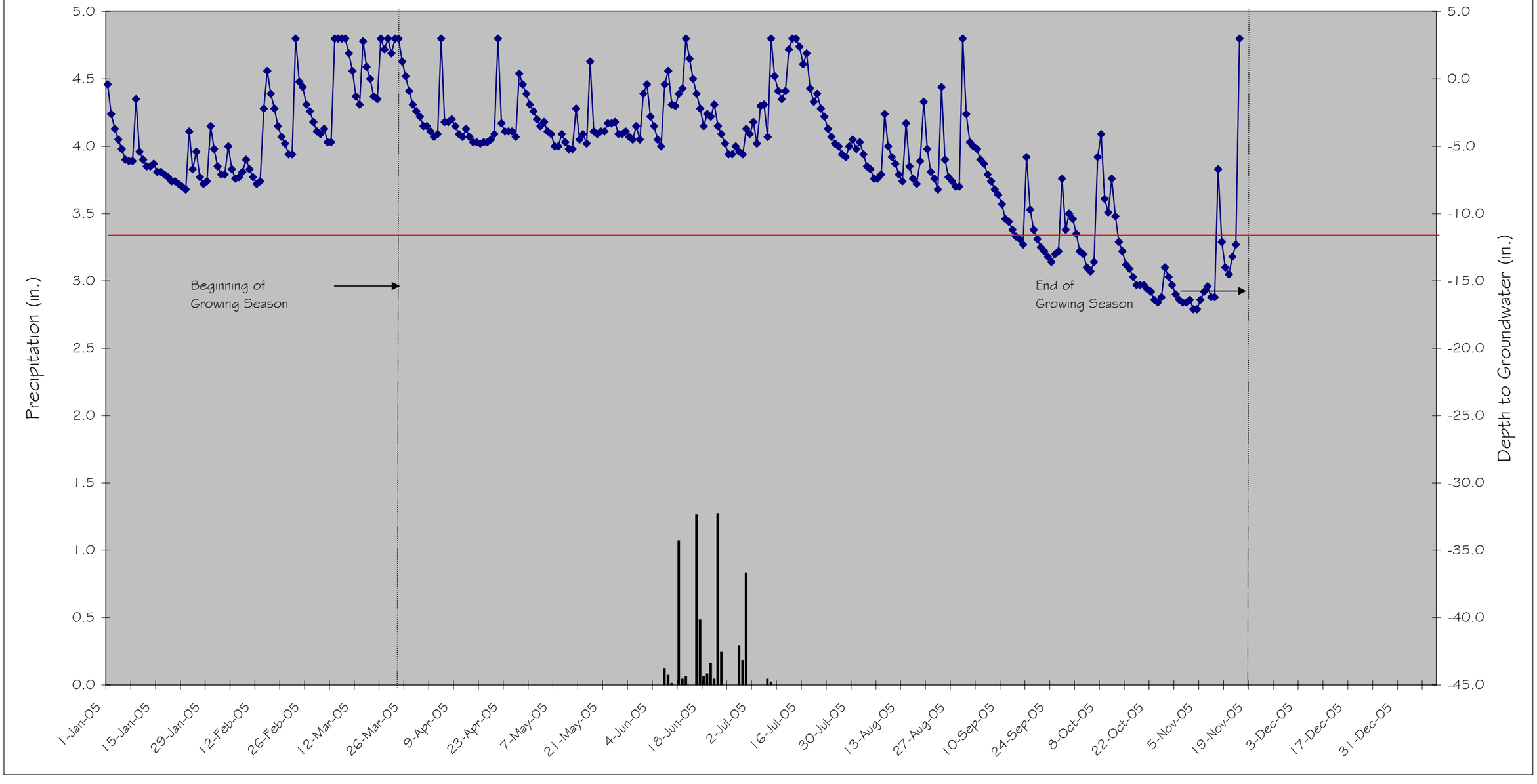
Tulula Stream and Wetland Restoration Site
Groundwater Gauge B5



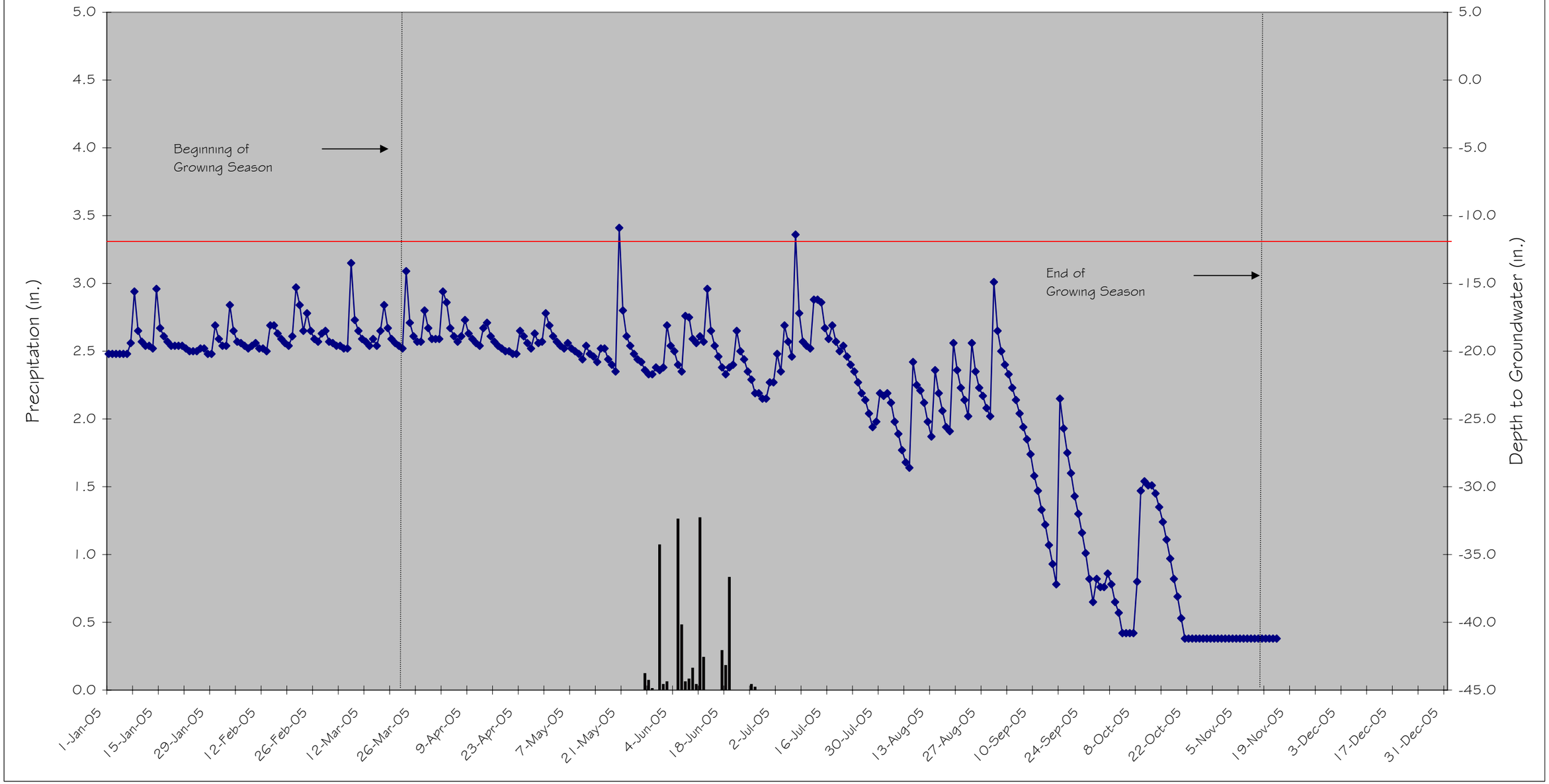
Tulula Stream and Wetland Restoration Site
Groundwater Gauge C1



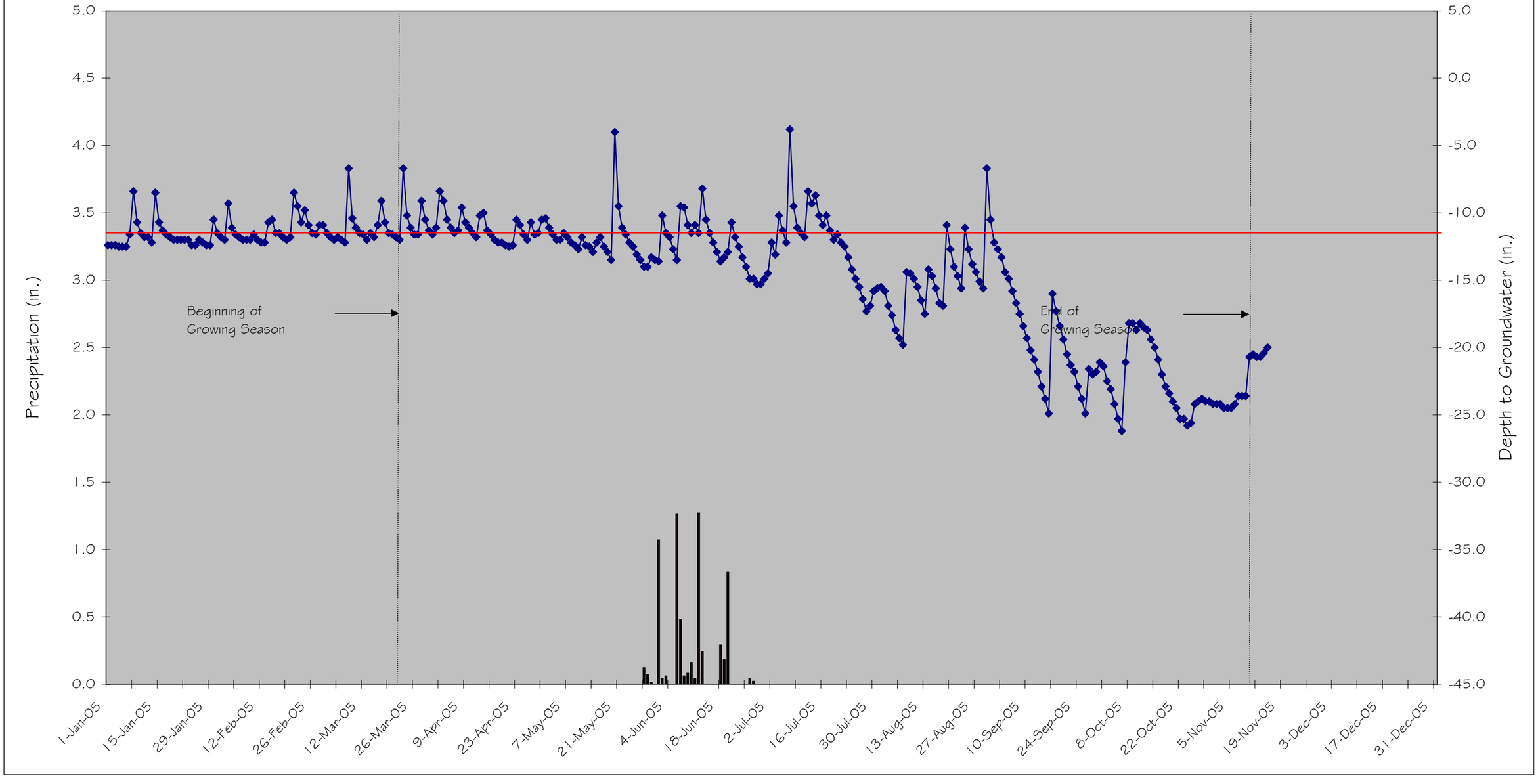
Tulula Stream and Wetland Restoration Site
Groundwater Gauge C2



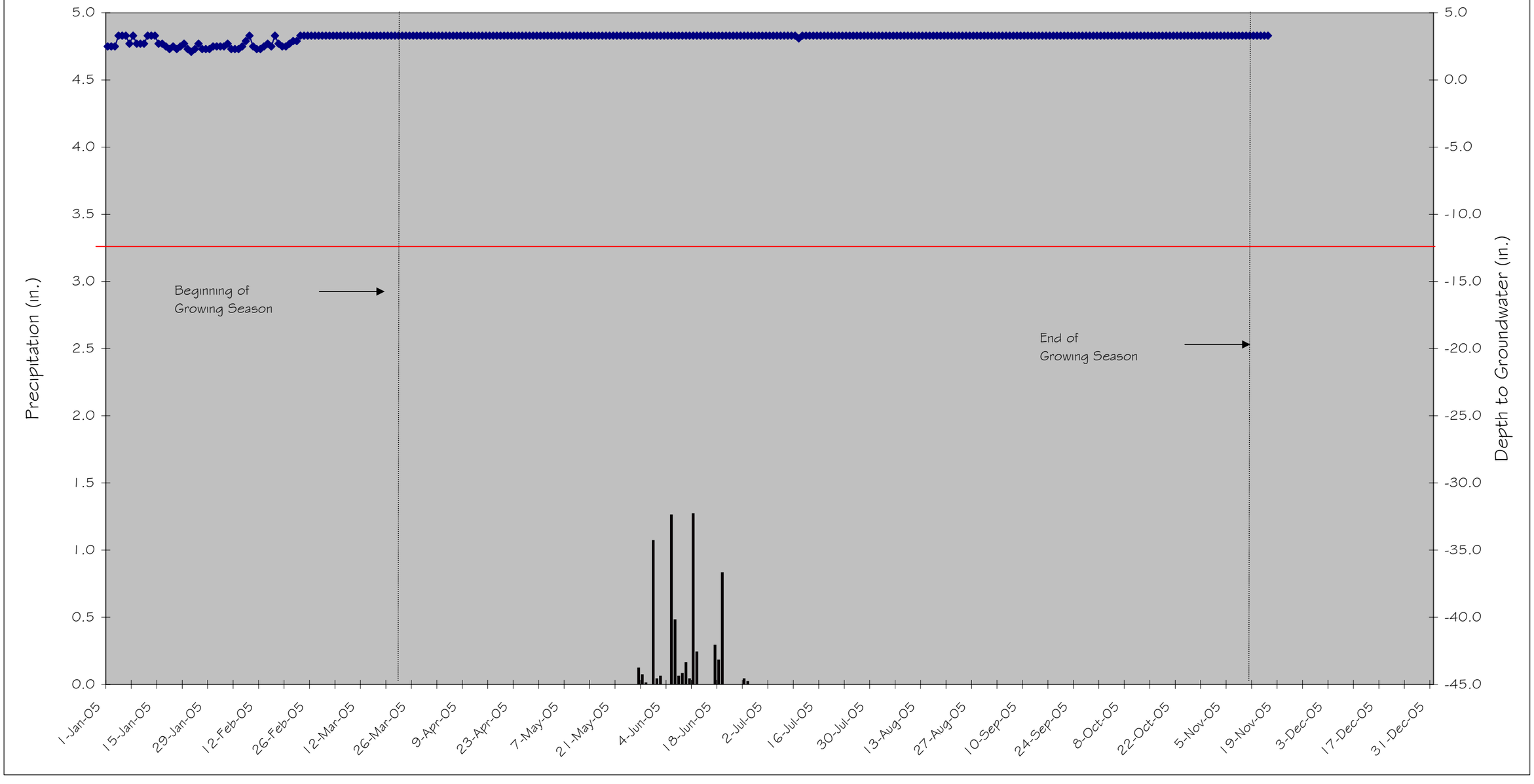
Tulula Stream and Wetland Restoration Site
Groundwater Gauge D1



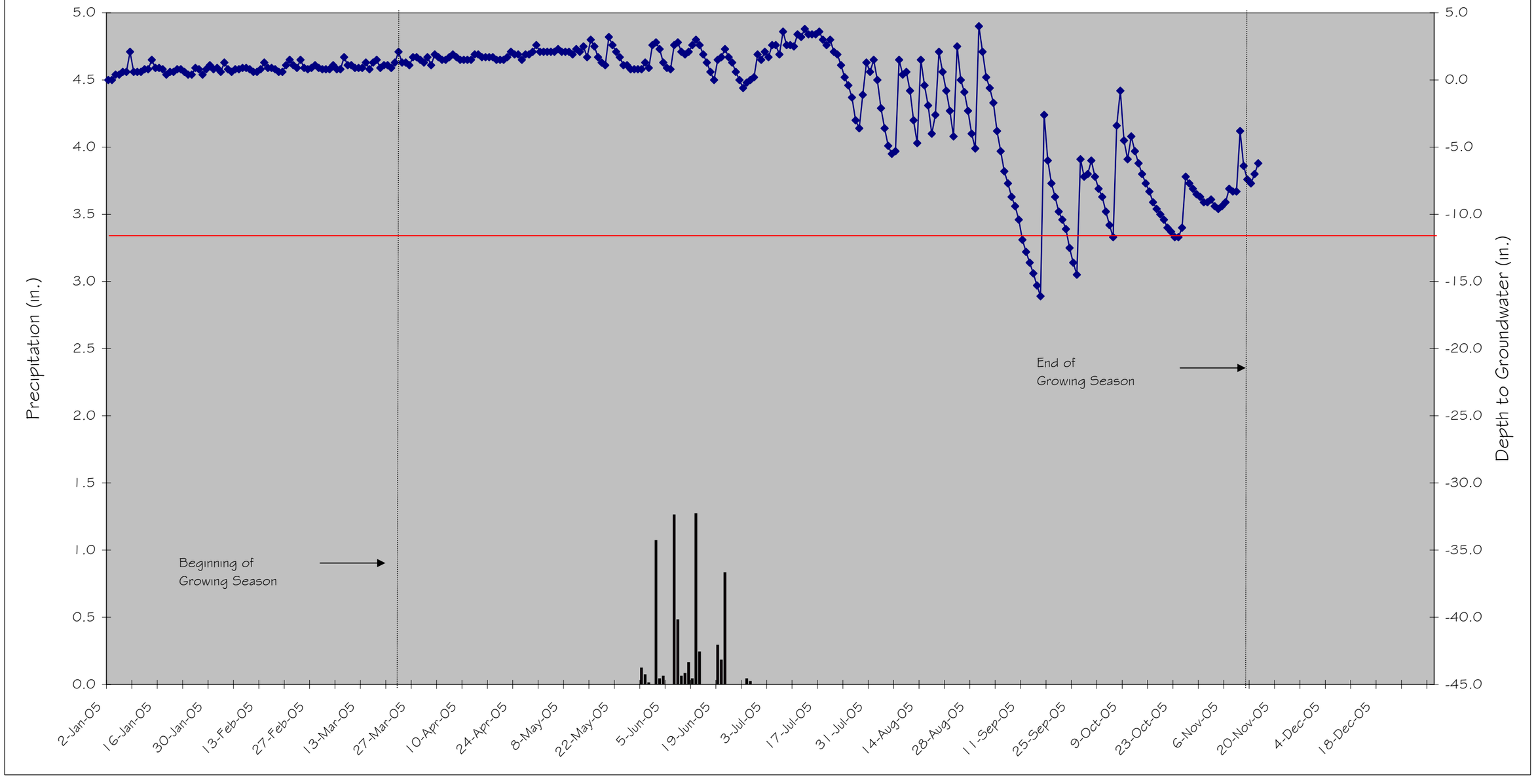
Tulula Stream and Wetland Restoration Site
Groundwater Gauge D2



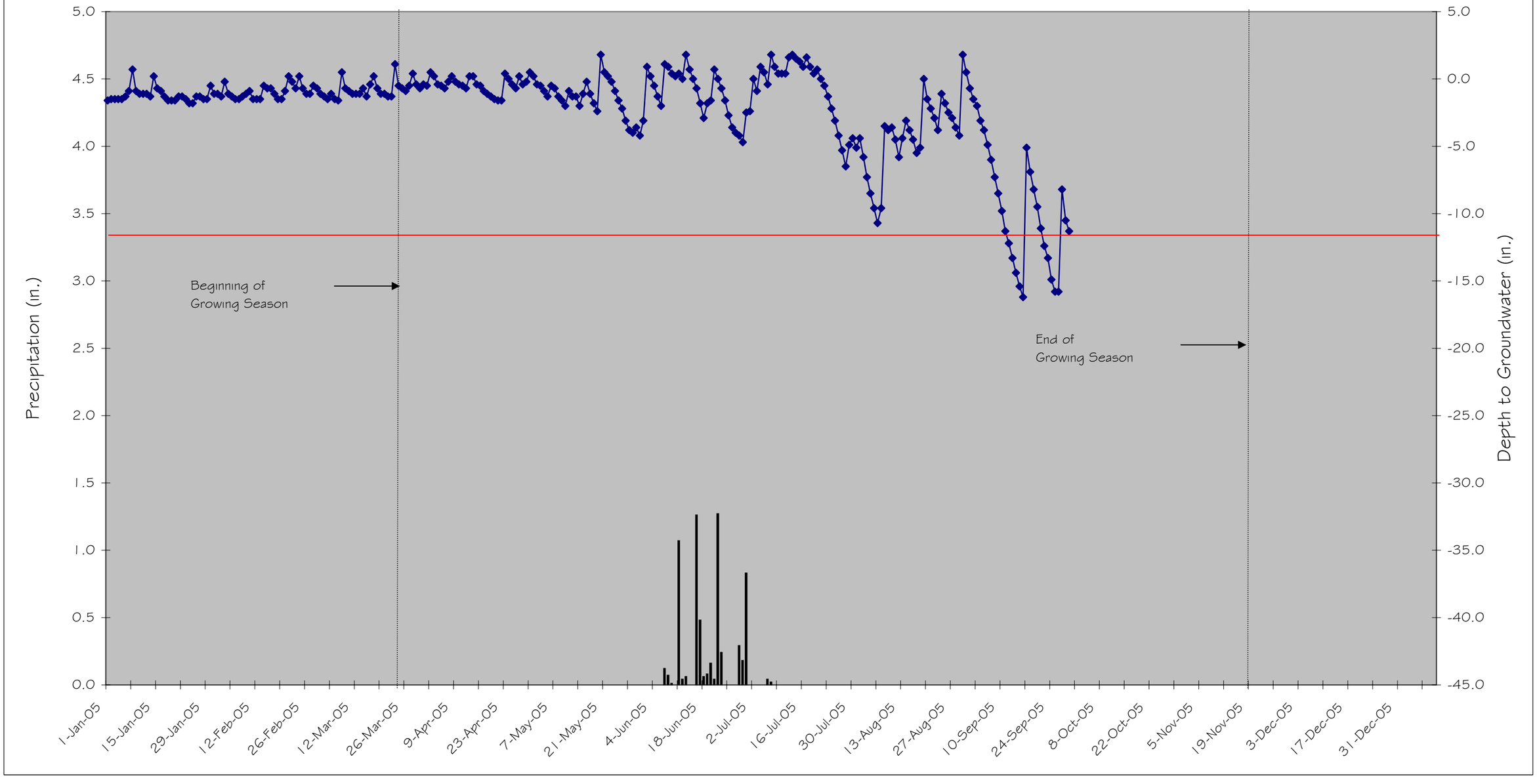
Tulula Stream and Wetland Restoration Site
Groundwater Gauge D3



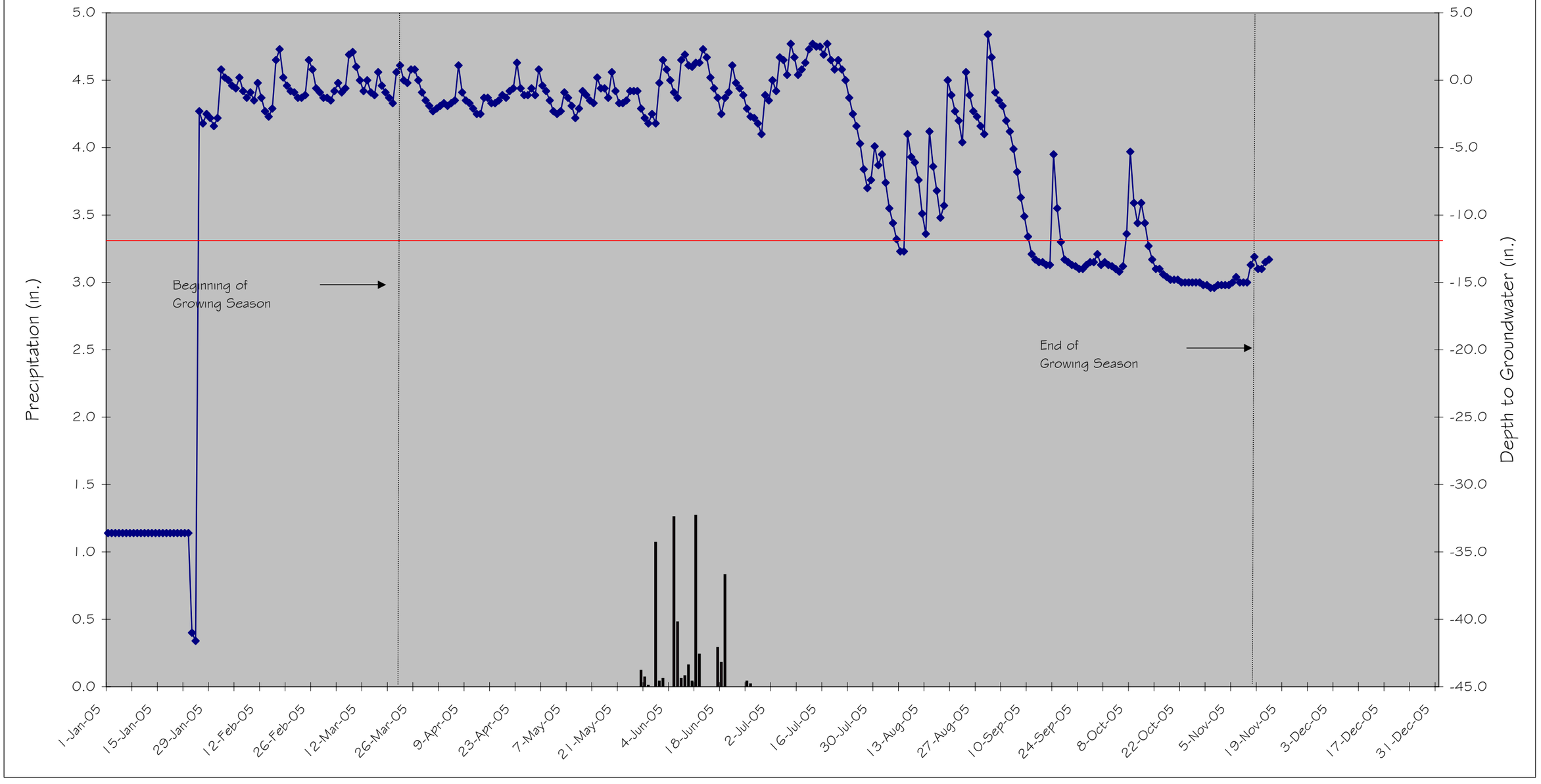
Tulula Stream and Wetland Restoration Site
Groundwater Gauge E1



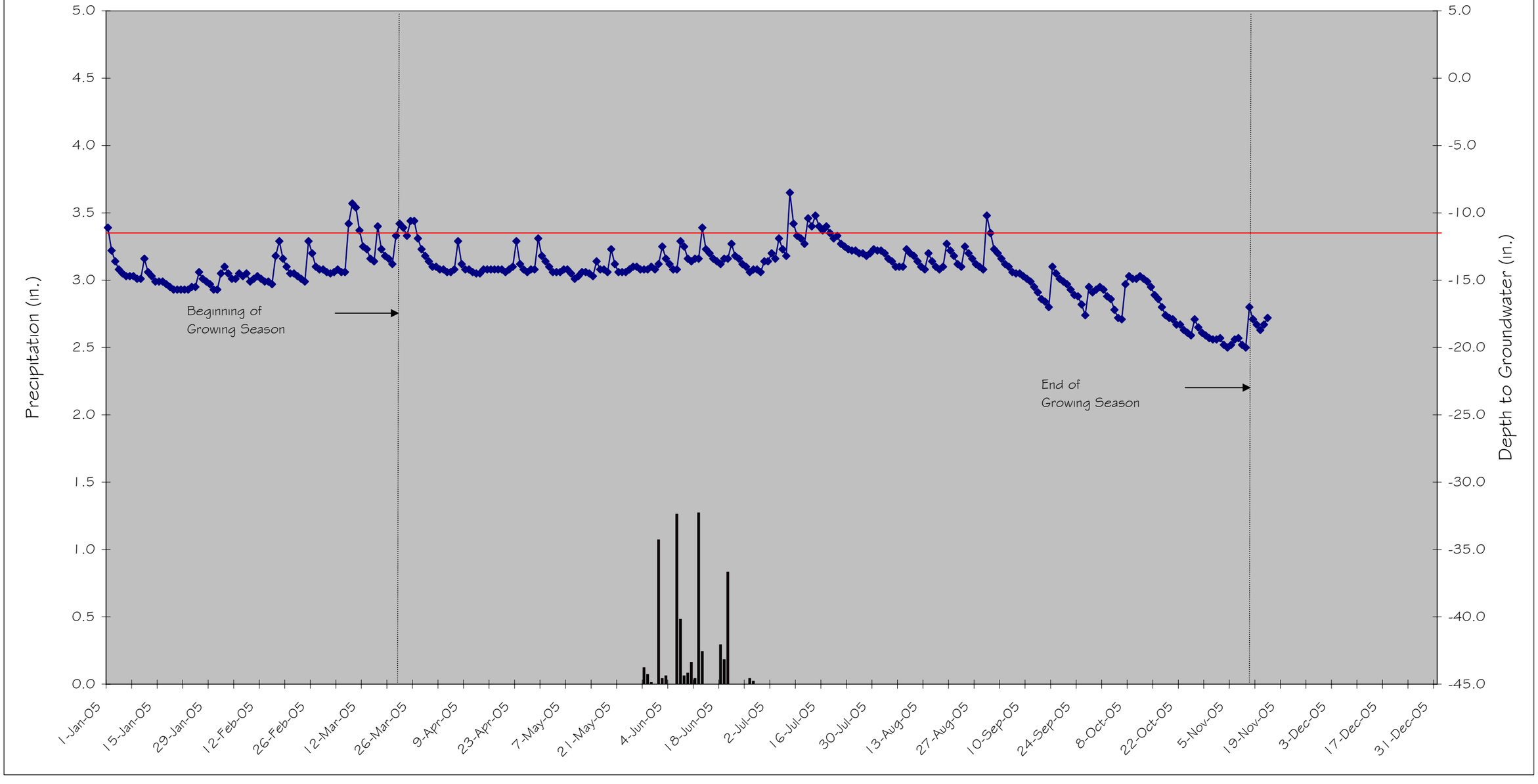
Tulula Stream and Wetland Restoration Site
Groundwater Gauge E2



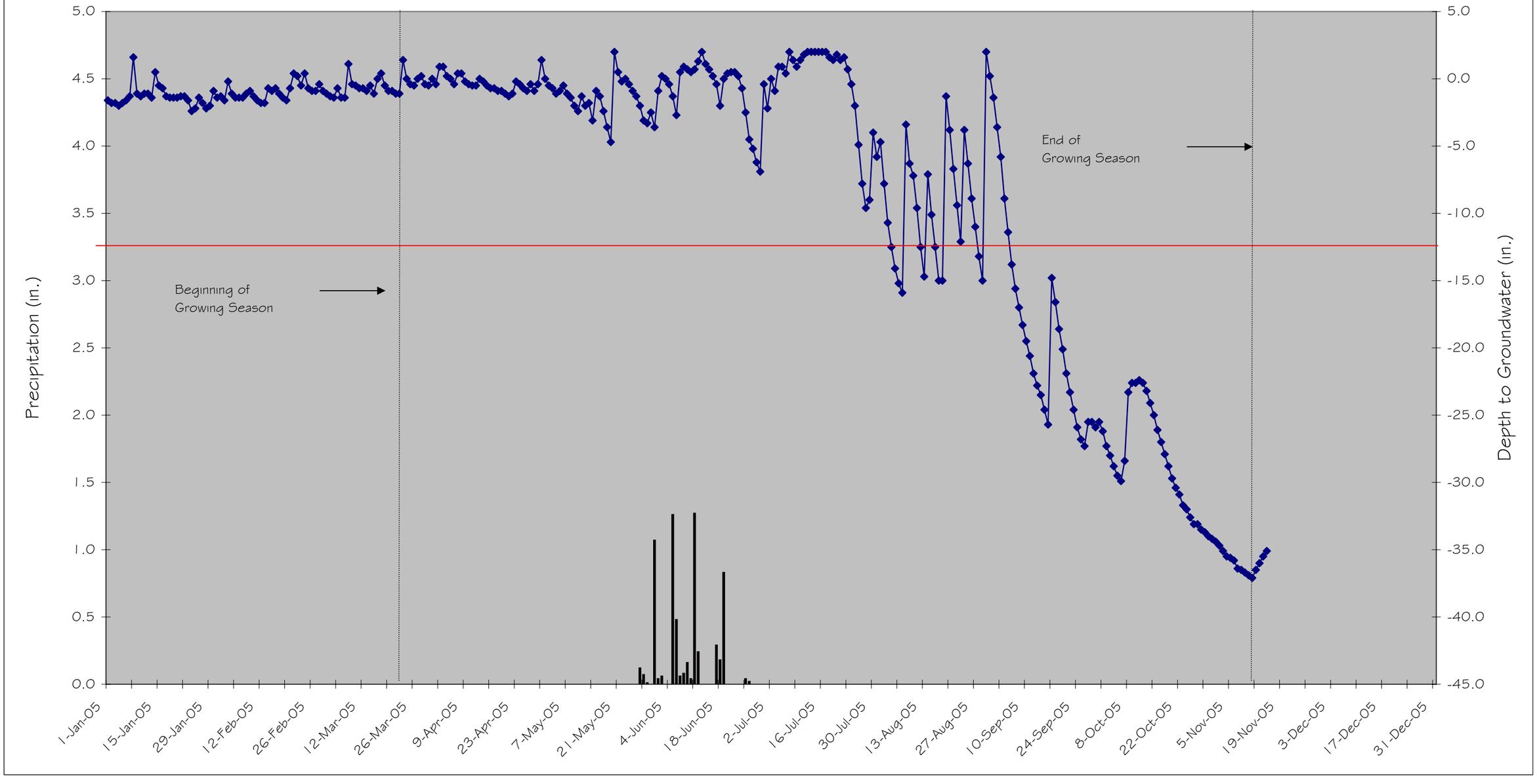
Tulula Stream and Wetland Restoration Site
Groundwater Gauge E3



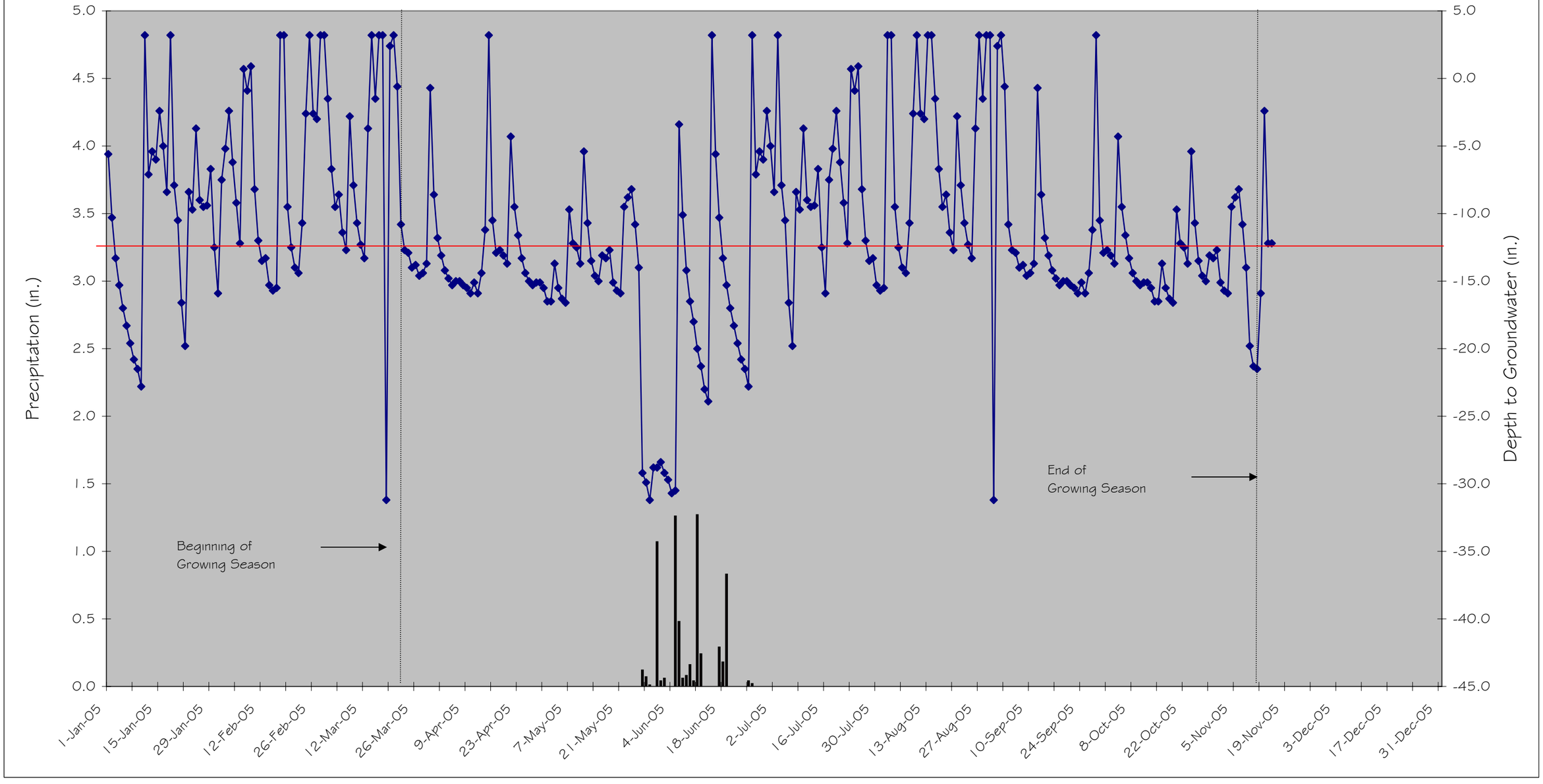
Tulula Stream and Wetland Restoration Site
Groundwater Gauge E4



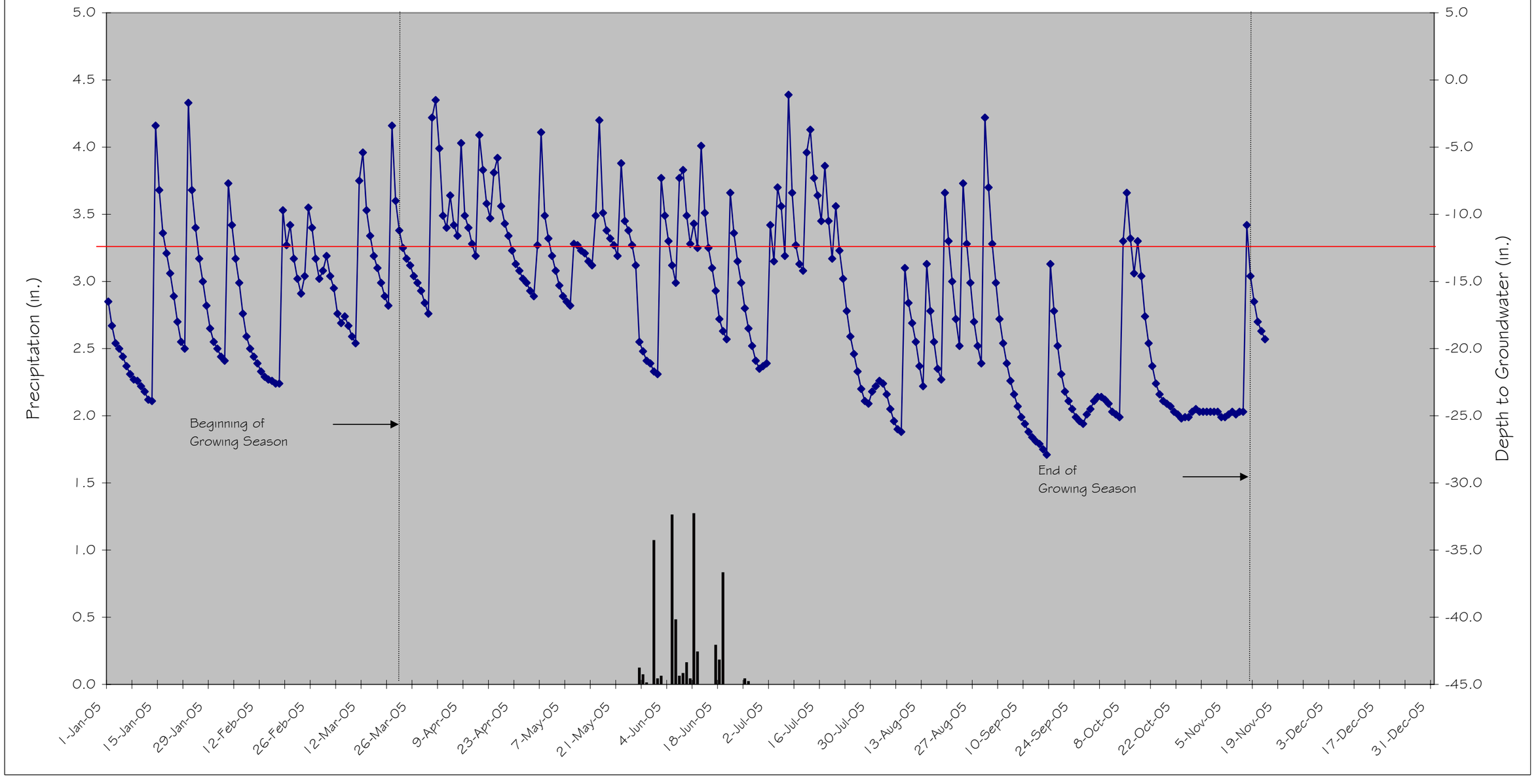
Tulula Stream and Wetland Restoration Site
Groundwater Gauge F1



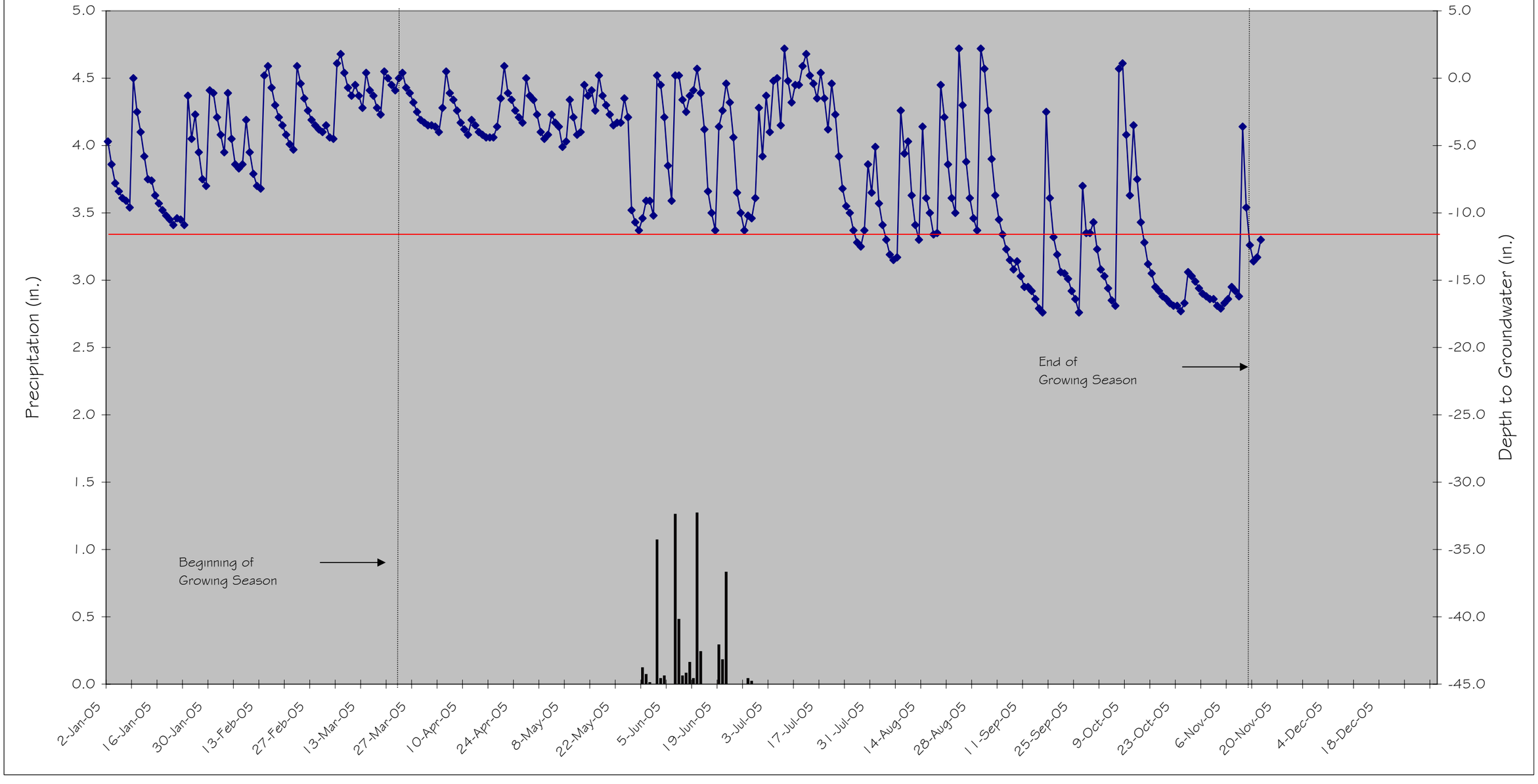
Tulula Stream and Wetland Restoration Site
Groundwater Gauge F2



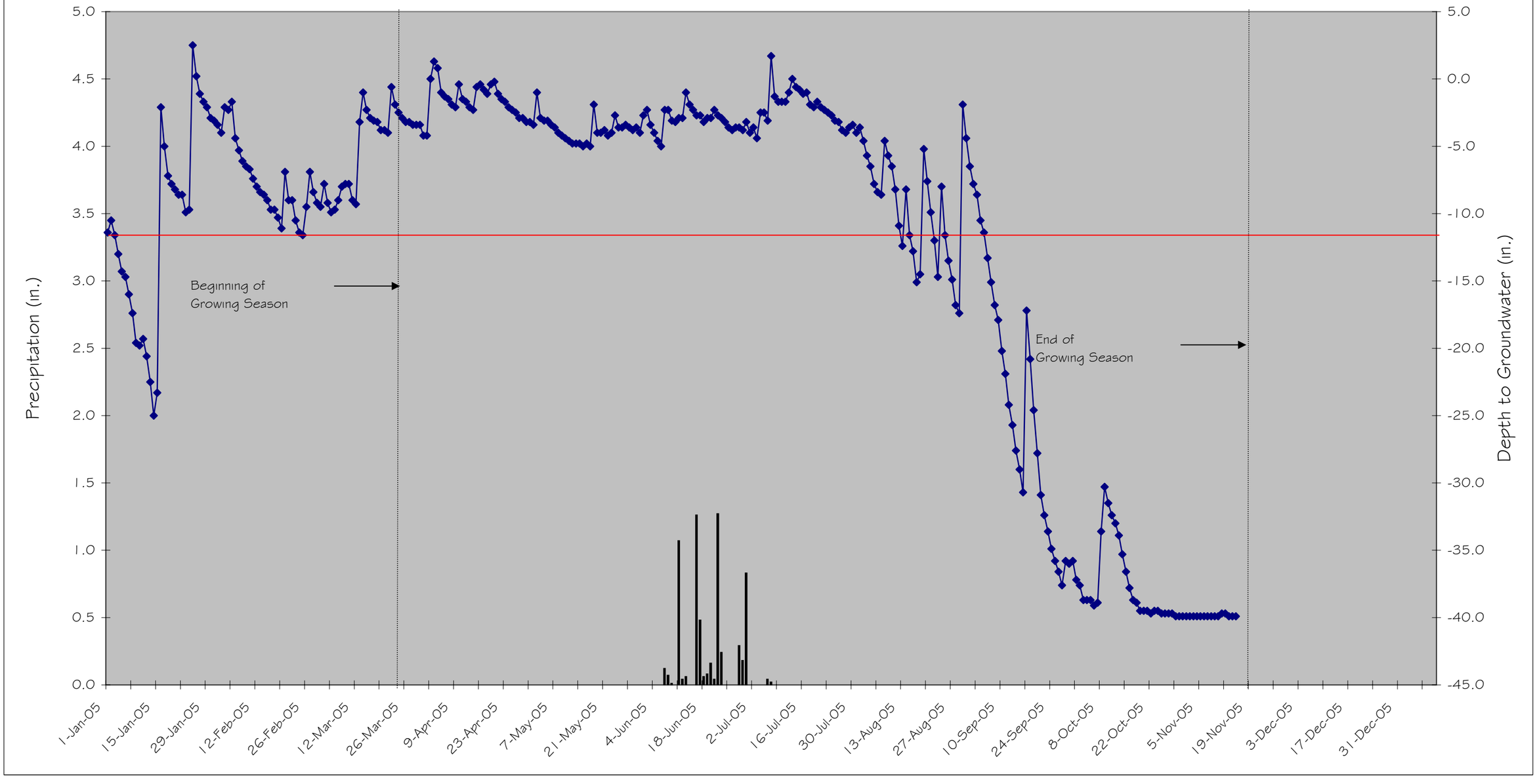
Tulula Stream and Wetland Restoration Site
Groundwater Gauge F3



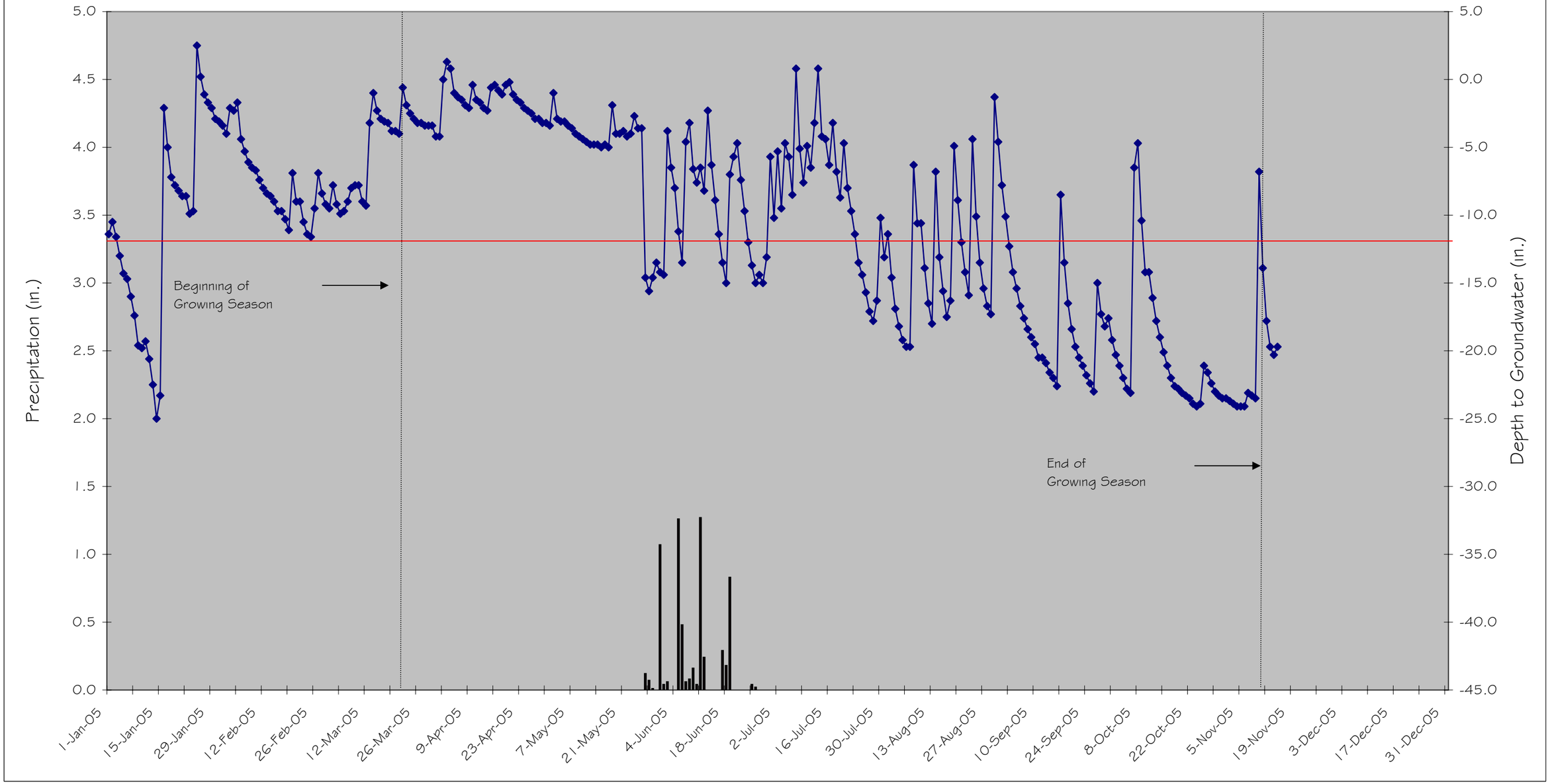
Tulula Stream and Wetland Restoration Site
Groundwater Gauge G1



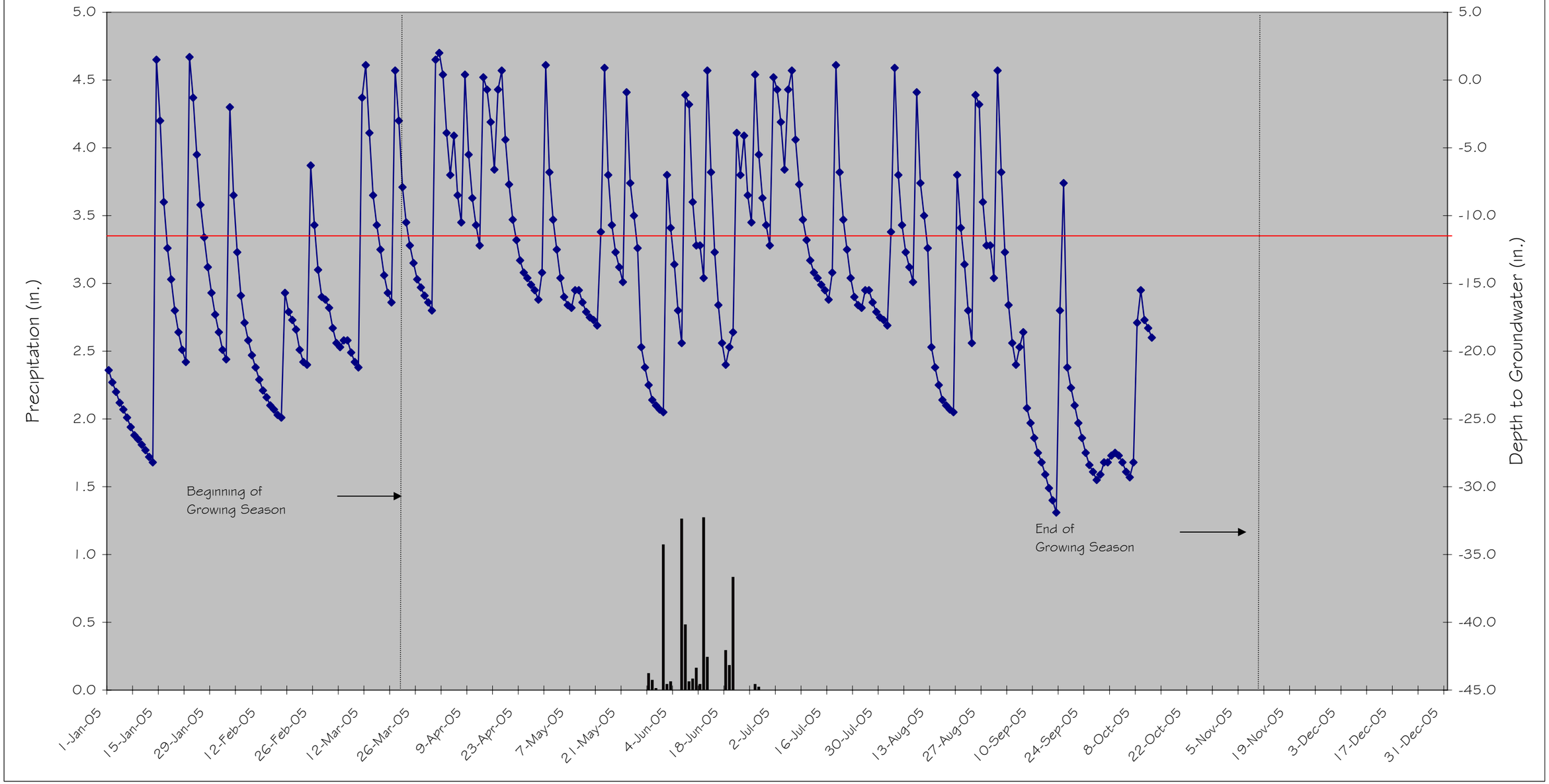
Tulula Stream and Wetland Restoration Site
Groundwater Gauge G2



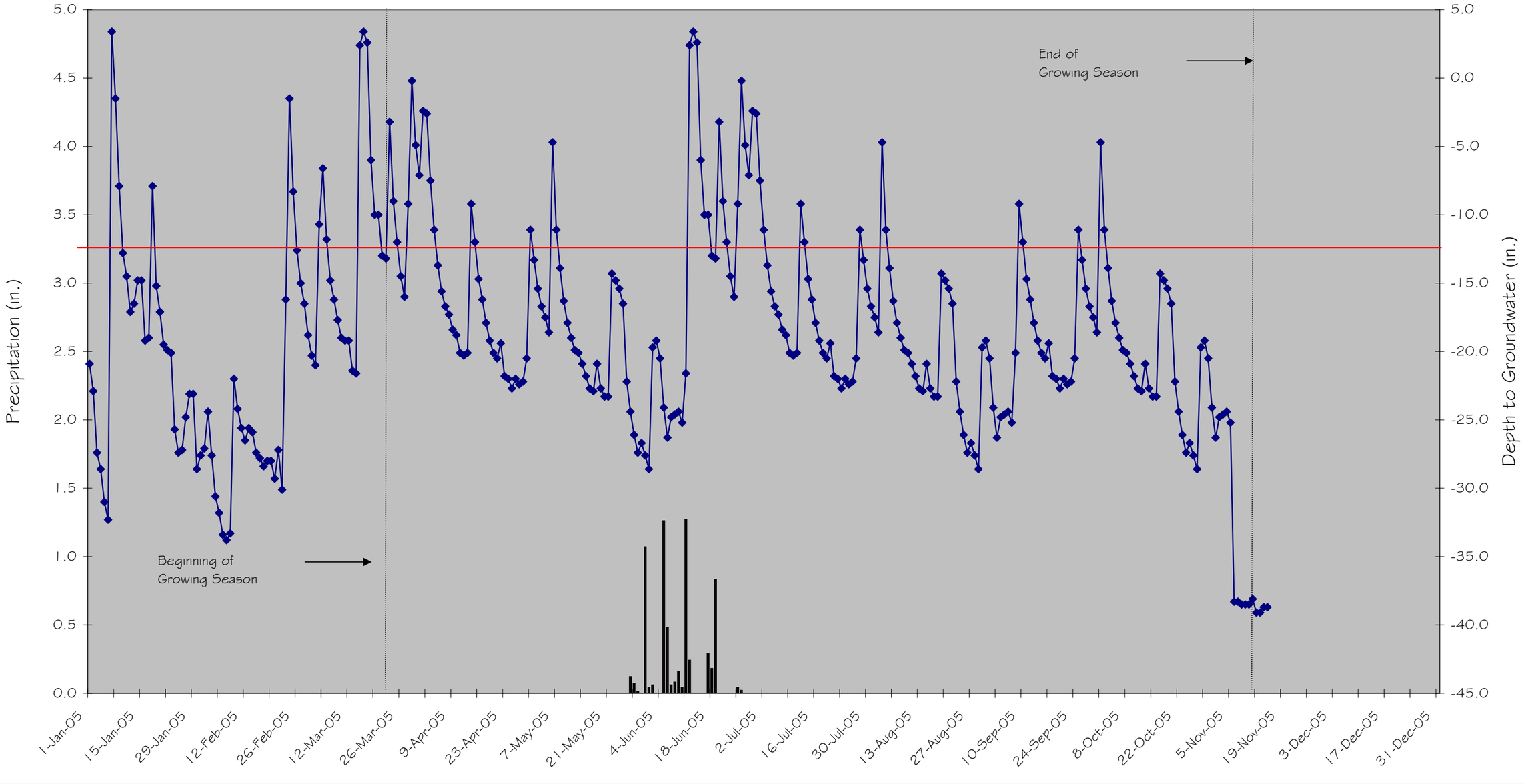
Tulula Stream and Wetland Restoration Site
Groundwater Gauge H1



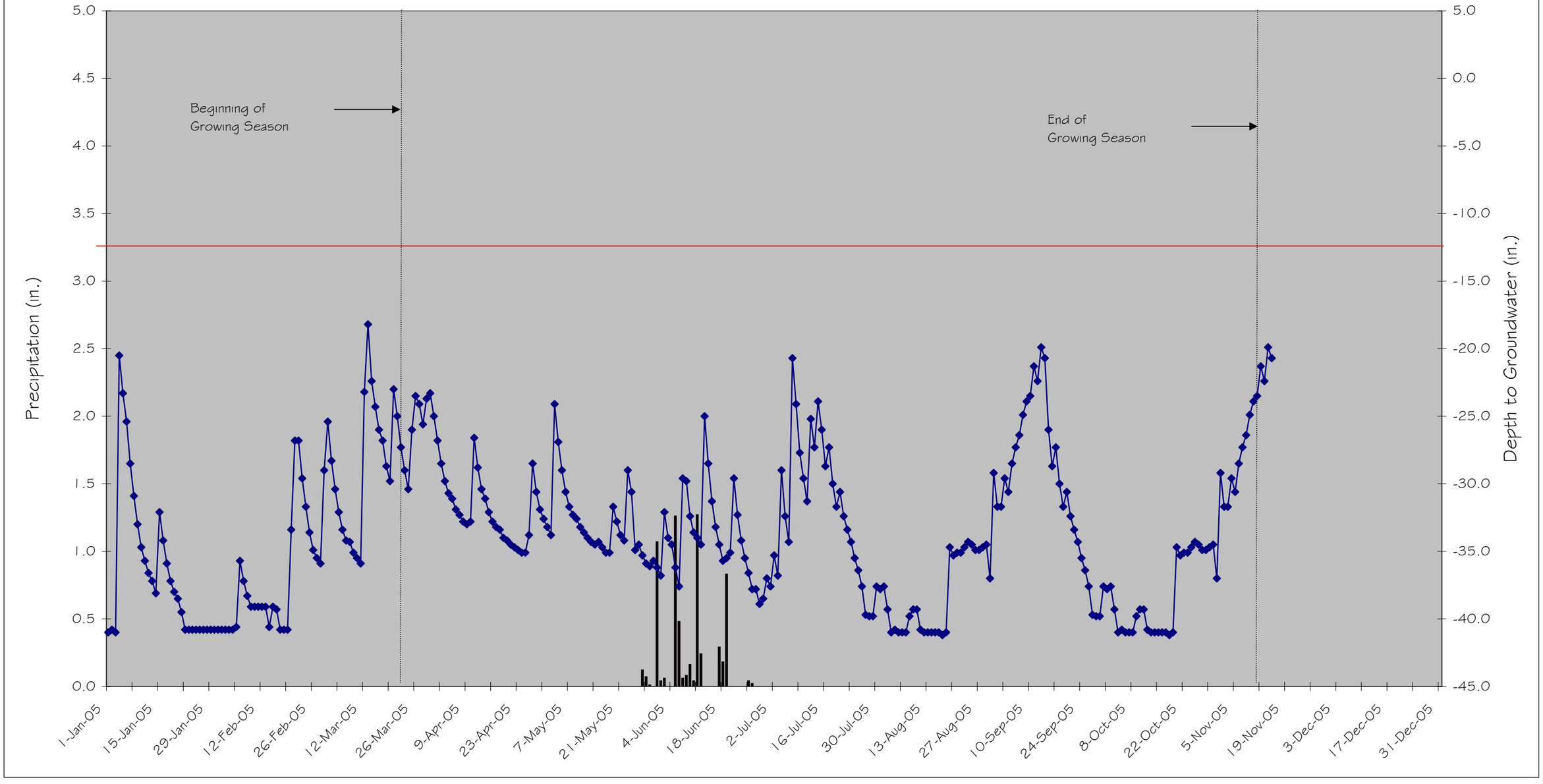
Tulula Stream and Wetland Restoration Site
Groundwater Gauge H2



Tulula Stream and Wetland Restoration Site
Groundwater Gauge H3



Tulula Stream and Wetland Restoration Site
Groundwater Gauge 11



Tulula Stream and Wetland Restoration Site
Groundwater Gauge X1