City Pond Mitigation Project
Anson County, North Carolina

Year 3 Monitoring Report

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APPENDICES

1.0 SUMMARY

This Annual Monitoring Report details the monitoring data collected during Monitoring Year 3 at the City Pond Stream Restoration Site. Collected data included: monthly crest gauge readings, monthly on-site rain gauge readings, and monthly observations of current conditions, benthic macroinvertebrate survey, cross sections, digital images, and observations of potential problems with stream stability.

The design for the City Pond property involved the restoration of channel dimension, pattern, and profile on eight separate reaches and the enhancement of dimension and profile on one reach. After construction, it was determined that 9,869 linear feet of stream was restored and 705 linear feet of stream was enhanced.

The data presented in this Annual Monitoring Report is from 12 photo points, 3 crest gauges, and 20 cross sections on 8 reaches as required in the approved Restoration Plan for this site. Digital images were recorded at cross sections and at all in-stream structures.

Stream monitoring data show that little change has occurred in channel dimension as the stream channel experienced multiple bankfull events in 2007. Most in-stream structures continue to function as designed. Due to rainfall amounts being well below normal levels, several of the stream reaches experienced dry conditions for large portions of the growing season. Recorded rainfall on-site indicates below normal conditions existed on the site throughout most of the year, which confirms the weather station data in Wadesboro. It was concluded that the site remains on track to achieve the specified stream success criteria.

This Annual Monitoring Report also documents vegetation survival, based on five 1/10th acre vegetation monitoring plots, as specified in the approved mitigation plan. The vegetation monitoring for 2007 indicated a range of average survival of between 510 and 640 stems per acre. With an average across the site of 578 stems per acre, the site has met the initial vegetation survival criteria of 320 stems per acre surviving after the third growing season and specified in the Mitigation Plan for the site.

2.0 INTRODUCTION

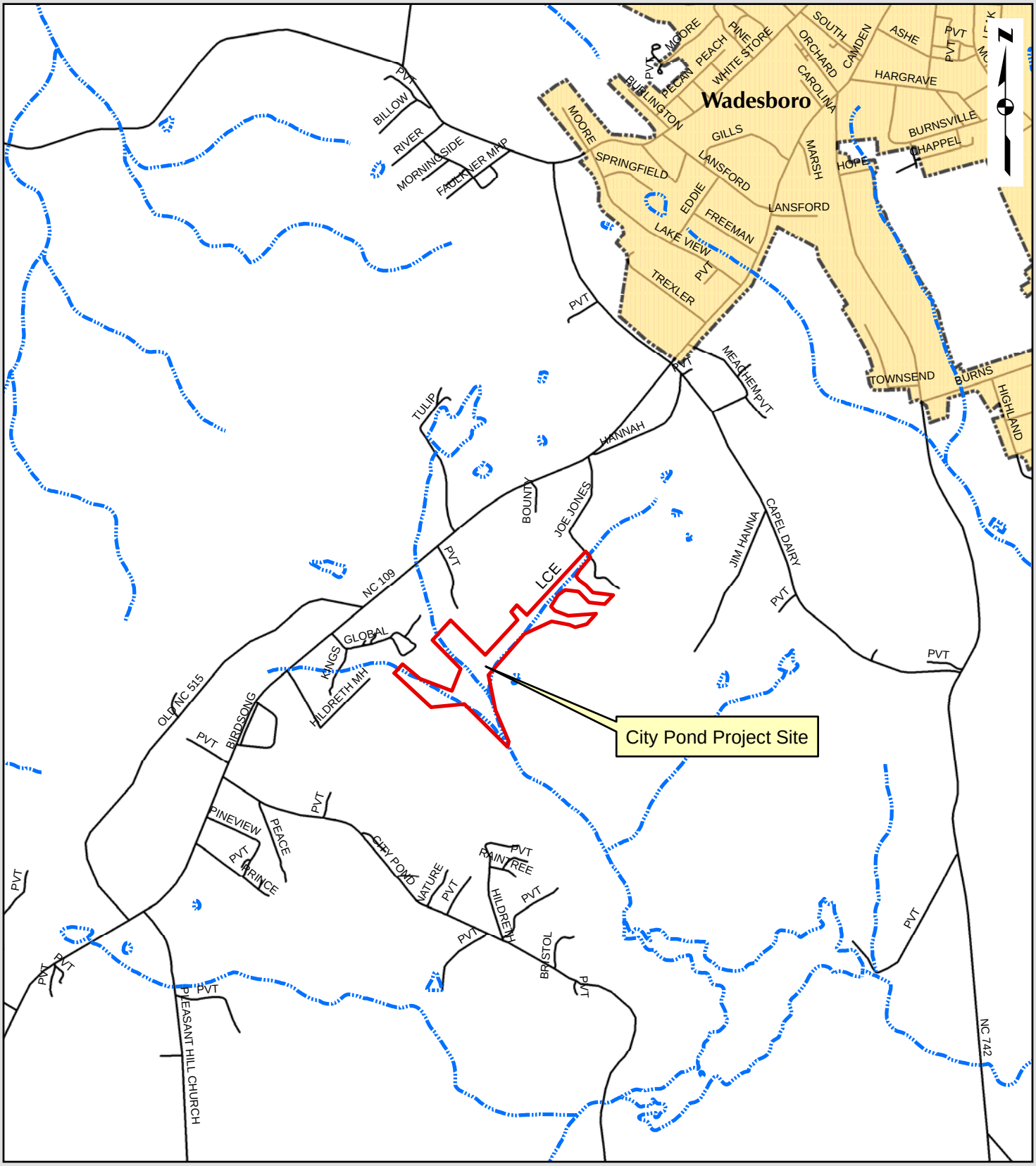
2.1 PROJECT

The City Pond Stream Restoration Project is located near the town of Wadesboro in Anson County, North Carolina (**Figure 1** & **Figure 2**). The stream systems that historically flowed through the site were channelized and, as a result, were highly incised prior to restoration. The design for the restored streams involved the construction of new meandering channels across the low slope valleys and restored step pool channels in the higher slope valleys.

The site has a history of pasture and hay production, preceded by row crop production. Ditches were used to increase land use and improve drainage when the land was under crop production. The streams on the project site were channelized, and riparian vegetation was cleared in most locations. Stream and riparian functions on the site had been severely impacted as a result of agricultural conversion.

The project involved the restoration and enhancement of 10,574 linear feet of channelized stream on several unnamed tributaries to City Pond. The project restored 9,869 linear feet of channel dimension, pattern, and profile, and enhanced 705 linear feet of channel dimension and/or profile.

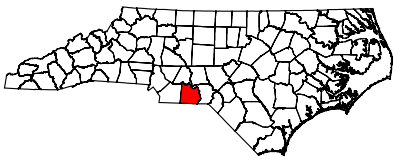
Table 1 shows the as-built lengths and restoration type per reach. The 2007 monitoring season represents the third year of monitoring for this site.



EBX

Figure 1.
City Pond Stream Mitigation Site
Project Location Map
Anson County, NC

1 inch equals 2,000 feet



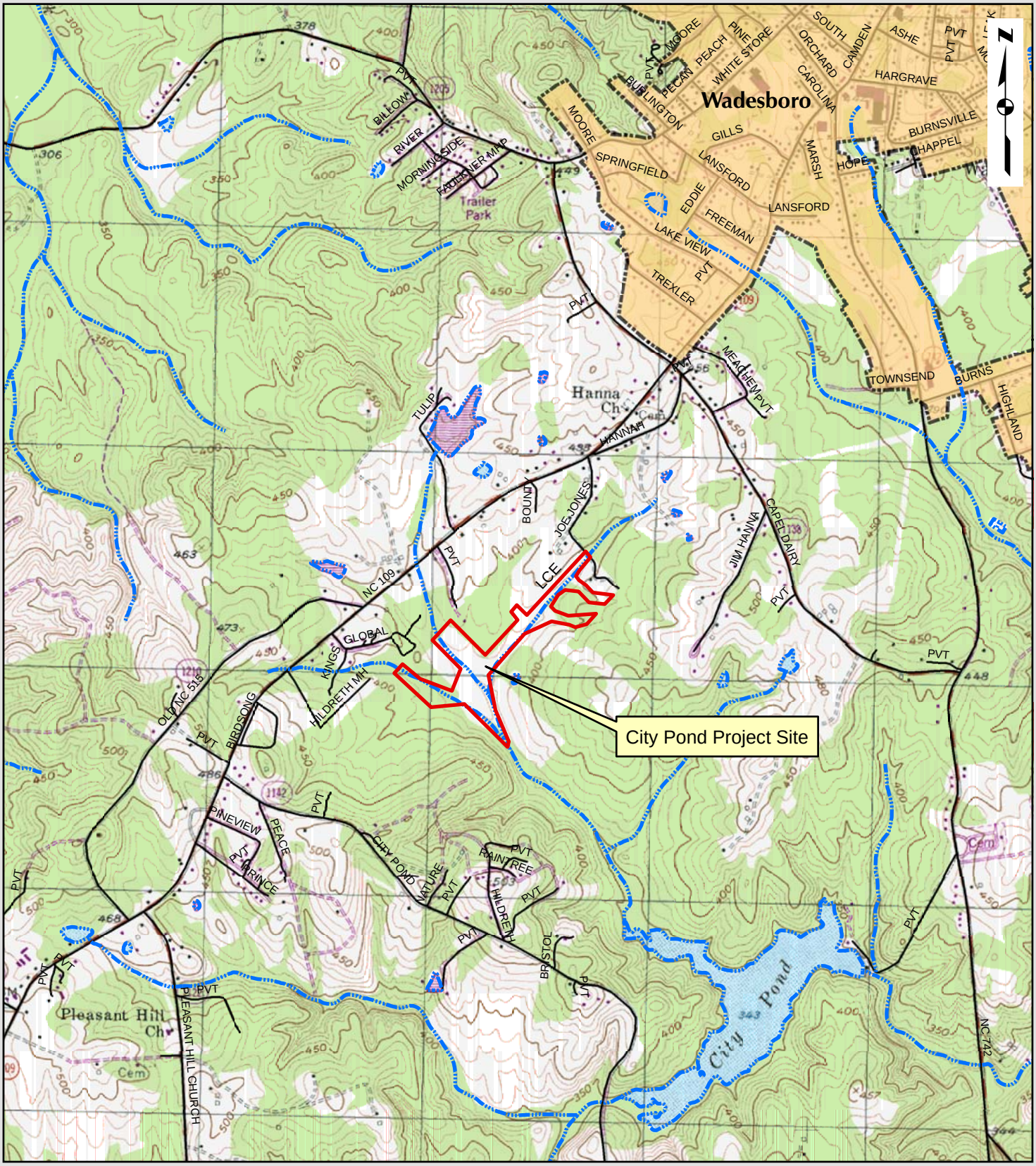


Figure 2.
City Pond Stream Mitigation Site
USGS Topographic Map
Anson County, NC

1 inch equals 2,000 feet

Table 1 Project Mitigation Structure and Objectives

Reach Name	As-Built Length (ft)	Restoration Approach
R1	705	Enhancement I
R2	2,611	Restoration
R3	777	Restoration
S1	734	Restoration
S2	1,150	Restoration
S3	710	Restoration
S4	1,711	Restoration
S5	1,744	Restoration
S6	432	Restoration
Total	10,574	

2.2 PROJECT PURPOSE

Monitoring of the City Pond Site is required to demonstrate successful mitigation based on the criteria described in the City Pond Mitigation Plan. Both stream and vegetation monitoring are conducted throughout the growing season. Success criteria must be met for five consecutive years. This Annual Report details the results of the stream monitoring for 2007 at the City Pond Stream Mitigation Site.

2.3 PROJECT HISTORY

This project was identified by EBX in the spring of 2004. The following table outlines project history and milestones, as well as background information (**Table 2**).

2.4 MONITORING PLAN VIEW

Table 2 Project History and Schedule

Date	Action Performed
Unknown	Pre-restoration Monitoring Gauges Installed
Unknown	Approved Mitigation Plan
November 2004	Construction Began
May 2005	Construction Completed
May 2005	Planting Completed
June 2005	Post Construction Monitoring Gauges Installed
August 2005	As-Built Report Submitted
November 2005	1st Annual Monitoring Report
February 2006	Replanted 3.5 acres with two year old trees
November 2006	2nd Annual Monitoring Report
November 2007	3rd Annual Monitoring Report
November 2008 (Scheduled)	4th Annual Monitoring Report
November 2009 (Scheduled)	5th Annual Monitoring Report

Plan view drawings of the project site are provided in **Figures 3a-3e**. The drawings include the appropriate information pertaining to monitoring of the project. These drawings show the locations of the following features:

- Cross section survey locations
- Crest Gauge Locations
- Vegetative Plots
- Benthic Macroinvertebrate Monitoring Locations

3.0 VEGETATION

3.1 VEGETATION SUCCESS CRITERIA

The interim measure of vegetative success for the City Pond Mitigation Plan will be the survival of at least 320 3-year-old planted trees per acre at the end of Year 3 of the monitoring period. The final vegetative success criteria will be the survival of 260 5-year-old planted trees per acre at the end of Year 5 of the monitoring period.

Up to 20% of the site species composition may be comprised of invaders. Remedial action may be required should these (i.e. sweetgum, red maple, etc.) present a problem and exceed 20% composition.

3.2 DESCRIPTION OF SPECIES AND VEGETATION MONITORING

The following tree species were planted in the Wetland Restoration Area:

Table 3 Planted Tree Species

ID	Scientific Name	Common Name	FAC Status
1	*Carya ovata*	Shagbark Hickory	FACU
2	*Quercus phellos*	Willow Oak	FACW-
3	*Diospyrus virginiana*	Persimmon	FAC
4	*Fraxinus pennsylvan.*	Green Ash	FACW
5	*Liriodendron tulipifera*	Yellow poplar	FAC
6	*Platanus occidentalis*	Sycamore	FACW-
7	*Quercus nigra*	Water Oak	FAC
8	*Ulmus americana*	American Elm	FACW
9	*Quercus laurifolia*	Laurel Oak	FACW

The following monitoring protocol was designed to predict vegetative survivability. Five plots were established on the City Pond Mitigation Site, to monitor approximately 2% of the site. The vegetation monitoring plots were designed to be 1/10th of an acre in size, or 50 feet x 87 feet dimensionally. The plots were randomly located and randomly oriented within the wetland restoration area.

Plot construction involved using metal fence posts at each of the four corners to clearly and permanently establish the area that was to be sampled. Ropes were then hung connecting all four corners to help in determining if trees close to the plot boundary were inside or outside of the plot. Trees right on the boundary and trees just outside of the boundary that appear to have greater than 50% of their canopy inside the boundary were counted inside the plot. A piece of white PVC pipe ten feet tall was placed over the metal post on one corner to facilitate visual location of the site throughout the five-year monitoring period.

All of the planted stems inside the plot were flagged with orange flagging and marked with a 3-foot-tall piece of half inch PVC to mark them as the planted stems (vs. any colonizers) and to help in locating them in the future. Each stem was then tagged with a permanent numbered aluminum tag.

3.3 RESULTS OF VEGETATION MONITORING

The following table presents stem counts for each of the monitoring stations. Each planted tree species is identified across the top row, and each plot is identified down the left column. The numbers on the top row correlate to the ID column of **Table 3**. Trees are flagged in the field on a quarterly basis before the flags degrade. Flags are utilized because they will not interfere with the growth of the tree. Volunteer species are also flagged during this process.

Table 4 2007 Vegetation Monitoring Plot Species Composition

Plot	1	2	3	4	5	6	7	8	9	Total	Stem/acre
CP1	0	19	10	1	4	11	7	12	0	64	640
CP2	1	23	0	1	1	4	0	28	0	58	580
CP3	2	4	26	2	2	7	0	8	0	51	510
CP4	0	8	10	20	0	1	13	13	0	65	650
CP5	0	10	4	5	9	9	6	4	4	51	510

Average Stems/Acre: 578
Range of Stems per Acre: 510-640

Volunteer species will also be monitored throughout the five year monitoring period. Below is a table of the most commonly found woody volunteer species.

Volunteer woody species were observed in most of the vegetation plots, but were deemed too small to tally. If these trees persist into the next growing season and exceed 12 inches in height, they will be flagged and added to the overall stems per acre assessment of the site. Sweetgum (*Liquidambar styraciflua*) is the most common volunteer, though privet (*Ligustrum sp.*) was also observed.

The following tree species were identified as volunteers within in the stream restoration area:

Table 5 Volunteer Tree Species in Vegetation Plots

ID	Scientific Name	Common Name	FAC Status
A	*Liquidambar styraciflua*	Sweetgum	FAC+
B	*Ligustrum sp.*	Privet	FAC
C	*Pinus sp.*	Pine	FAC

3.4 GENERAL VEGETATION OBSERVATIONS

After construction of the mitigation site, a permanent ground cover seed mixture of Virginia wild-rye (*Elymus virginicus*), switch grass (*Panicum virgatum*), and fox sedge (*Carex vulpinoidea*) was broadcast on the site at a rate of 10 pounds per acre. These species are dominant on the site, though they pose no threat to the survival or health of the planted or naturally occurring hydrophytic vegetation. Hydrophytic herbaceous vegetation is also occurring on site. Cattails (*Typha sp.*), rush (*Juncus effusus*), spikerush (*Eleocharis obtusa*), knotweed (*Polygonum persicaria*), iris (*Iris sp.*), arrow-leaf tearthumb (*Polygonum sagittatum*), and sedge (*Carex sp.*), all hydrophytic herbaceous plants, are frequently observed across the site, particularly in areas of inundation. Woolgrass (*Scirpus cyperinus*), an obligate wetland plant, is dominant in the central

wetter zone of the site. The presence of these herbaceous wetland plants helps to confirm the presence of wetland hydrology on the site.

There are zones of weedy species occurring on the site, though none seem to be posing any problems for the woody or herbaceous hydrophytic vegetation. Most of the weedy species are annuals and seem to pose very little threat to survivability onsite. Commonly seen weedy vegetation includes hay, dallisgrass (*Paspalum dilatatum*), dog fennel (*Eupatorium capillifolium*), buttercup (*Ranunculus sp.*), and blackberry (*Rhubus sp.*). Any threatening weedy vegetation found in the future will be documented and discussed.

3.5 VEGETATION CONCLUSIONS

This site was planted in bottomland hardwood forest species in March 2005. There were five 1/10th acre vegetation monitoring plots established throughout the planting areas. The 2007 vegetation monitoring documented that most of the site has an average tree density greater than 578 stems per acre. This site meets the interim success criteria of 320 trees per acre at the end of year three and is on trajectory to meet the final success criteria of 260 trees per acre by the end of year five as specified in the Mitigation Plan for the site.

At the beginning of 2006 growing season, two-year-old trees were replanted in proximity to and including Plot 5 due to exaggerated mortality of the previous year. That mortality was attributed to dry conditions shortly after the planting occurred in 2005 and to lower quality trees. The two-year-old saplings are overall healthy and their mortality rate is consistent with what is found throughout the site.

4.0 STREAM MONITORING

4.1 SUCCESS CRITERIA

As stated in the approved Restoration Plan, the stream restoration success criteria for the site includes the following:

Bankfull Events: Two bankfull flow events must be documented within the five-year monitoring period.

Cross sections: There should be little change in as-built cross sections. Cross sections shall be classified using the Rosgen stream classification method and all monitored cross sections should fall within the quantitative parameters defined for “E” or “C” type channels. Cross section data will be collected annually.

Longitudinal Profile: The longitudinal profiles should show that the bedform features are remaining stable, i.e. they are not aggrading or degrading. Bedforms observed should be consistent with those observed in “E” or “C” type channels. Profile data will be collected in monitoring Years 1, 3, and 5.

Photo Reference Stations: Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation and effectiveness of erosion control measures. Photos will be taken annually at permanent cross sections and grade control structures.

Benthic Macroinvertebrate Sampling: Benthic macroinvertebrates will be sampled annually in monitoring years 1, 2, and 3. Benthic macroinvertebrate samples will be identified and a tolerance value will be calculated.

4.2 STREAM MORPHOLOGY MONITORING PLAN

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

Bankfull Events: Three crest gauges were installed on the site to document bankfull events. The gauges record the highest out-of-bank flow events that occurred and are checked periodically through the year. The gauges are located on the lower part of R1, R2, and S4 (**Figures 3a-3e**).

Cross Sections: According to the As-Built Report written in August 2005, 20 cross sections are to be monitored along the restored tributaries R2, R3, S3, S4, S5, and S6. The cross sections were established during monitoring set-up in evenly distributed pairs of one riffle and one pool cross section per 1,000 linear feet of restored stream. Locations of cross sections are specified in **Figures 3a-3e**. Each cross section was marked on both banks with permanent pins to establish the exact transect used. Permanent cross section pins were surveyed and located relative to a common benchmark to facilitate easy comparison of year-to-year data. The annual cross section surveys include points measured at all breaks in slope, including floodplain, top of bank, bankfull, inner berm, edge of water, and thalweg. In addition, any fluvial features present will be documented. Permanent cross sections for 2007 (Year 3) were surveyed in July 2007.

Longitudinal Profile: Longitudinal profile will be surveyed in years one, three, and five of the five-year monitoring period. The profile will be conducted for a length of restored channel at least 3,000 feet in length. Features measured will include thalweg, inverts of located stream structures, water surface, bankfull, and top of low bank. The longitudinal survey was conducted for 2007 (Year 3) in July of 2007.

Photo Reference Stations: Photographs are used to visually document restoration success. Although specific photo points are not set up across the City Pond site, photos were taken at every located structure. Reference photos are taken at each permanent cross section from both stream banks. The survey tape is centered in the photographs of the bank, and the water line is located in the lower edge of the frame with as much of the bank as possible included in each photo. An abbreviated photo log of the City Pond site is included as **Appendix D**.

Benthic Macroinvertebrates: Benthic macroinvertebrate data will be collected from the reference reach (Beaverdam Branch) and within the project reach. Year 3 post-restoration sampling was done in early 2007. Sample collections follow protocols described in the standard operating procedures of the Biological Assessment Unit of the NC Division of Water Quality. The Qual-4 collection method is used for the collection of macroinvertebrate samples. The metrics to be calculated include total and EPT taxa richness, EPT abundance and biotic index values.

4.3 STREAM MORPHOLOGY MONITORING RESULTS

4.3.1 Cross Sections

The cross sections were surveyed during the monitoring set-up, Year 1, Year 2, and, for Year 3, July 2007. The baseline data has been compared with the Year 1 and Year 2 monitoring data in Appendix B. The surveyed cross sections for Year 3 are also included in Appendix B. The Year 3 channel cross sections showed that overall stream dimension remained stable during the third growing season. Some localized areas of bed scour and/or aggradation were noted; however, these adjustments are common and indicate a movement toward greater stability. There is very little difference between the baseline cross sections, and Years 1-3 cross sections.

4.3.2 Longitudinal Profile

A longitudinal profile survey was conducted along four separate reaches of the restoration project totaling approximately 3400 linear feet. Survey was conducted in reach R2 from STA 27+50 (XS 4) to STA 39+50 (XS 6), in reach R3 from STA 44+00 (XS 7) to STA 49+00 (XS 8), in reach S4 from STA 15+50 (XS 13) to STA 23+50 (XS 15), and in reach S5 from STA 14+00 (XS 10) to STA 23+00 (XS 12). The longitudinal profile information documents the elevations and locations of streambed features and in-stream grade control structures as shown in Appendix B. The profile and cross sections show that there has been very little adjustment to stream profile or dimension since construction.

4.3.3 Hydrology

During 2007 six bankfull events on the site were documented during site visits through the use of the onsite crest gauge and visual evidence of out-of-bank flow between March and May. These six events occurred in crest gauges 2 and 3 in reaches R2 and S4 while crest gauge 1 (located at the upper end of reach R2) registered no out-of-bank flows. The largest stream flow for Year 3 documented by the crest gauge on the site was a flow that occurred during May and was 2.1 feet above the bankfull stage. Based on observations of ponded water, debris lines, and sediment deposited on the floodplain, the bankfull event spread over much of the restored wetland areas adjacent to the stream.

Table 6 Stream Areas Requiring Observation

Station	Feature	Conditions
R1 10+10	Left bank	Erosion;
R1 10+20	Left bank	Erosion behind coir matting;
S1 11+20	Log weir	Flow under log weir;
S1 12+00	Log weir	Flow under log weir;
R2 17+00	Right bank	No vegetation along bank;
R2 36+00	Right bank	Erosion behind coir matting;

Table 7 Crest Gauge Data

Date of Data Collection	Crest Gauge 1 Reading	Crest Gauge 2 Reading	Crest Gauge 3 Reading
March-07	0	1.0	1.2
April-07	0	0.7	0.1
May-07	0	2.1	0.1
June-07	0	0	0
July-07	0	0	0
August-07	0	0	0
September-07	0	0	0
October-07	0	0	0
November-07			

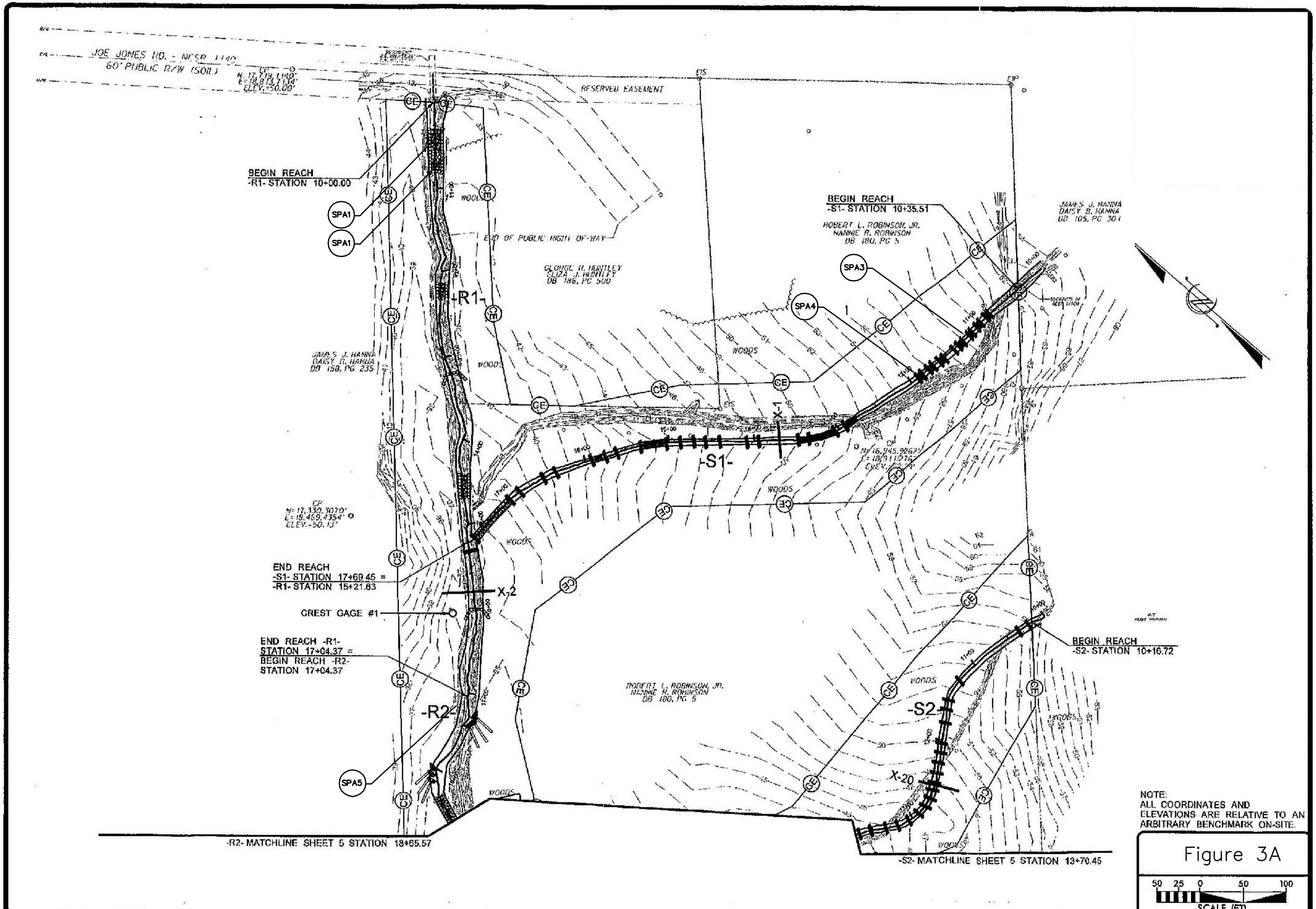

JOE JONES RD. - NCSR 1140
60' PUBLIC R/W (SOIL)
RESERVED EASEMENT
BEGIN REACH
-R1- STATION 10+00.00
SPA1
SPA1
END OF PUBLIC RIGHT-OF-WAY
GEORGE R. HUNTLEY
ELIZA J. HUNTLEY
DB 186, PG 500
-R1-
JAMES J. HANNA
DAISY B. HANNA
DB 158, PG 235
WOODS
BEGIN REACH
-S1- STATION 10+35.51
ROBERT L. ROBINSON, JR.
NANNIE R. ROBINSON
DB 180, PG 5
JAMES J. HANNA
DAISY B. HANNA
DB 105, PG 301
SPA3
SPA4
X-1
-S1-
END REACH
-S1- STATION 17+69.45 =
-R1- STATION 15+21.63
X-2
CREST GAGE #1
END REACH -R1-
STATION 17+04.37 =
BEGIN REACH -R2-
STATION 17+04.37
-R2-
SPA5
ROBERT L. ROBINSON, JR.
NANNIE R. ROBINSON
DB 180, PG 5
BEGIN REACH
-S2- STATION 10+16.72
-S2-
X-20
-R2- MATCHLINE SHEET 5 STATION 18+65.57
-S2- MATCHLINE SHEET 5 STATION 13+70.45
NOTE:
ALL COORDINATES AND ELEVATIONS ARE RELATIVE TO AN ARBITRARY BENCHMARK ON-SITE.
50 25 0 50 100
SCALE (FT)

Figure 3A

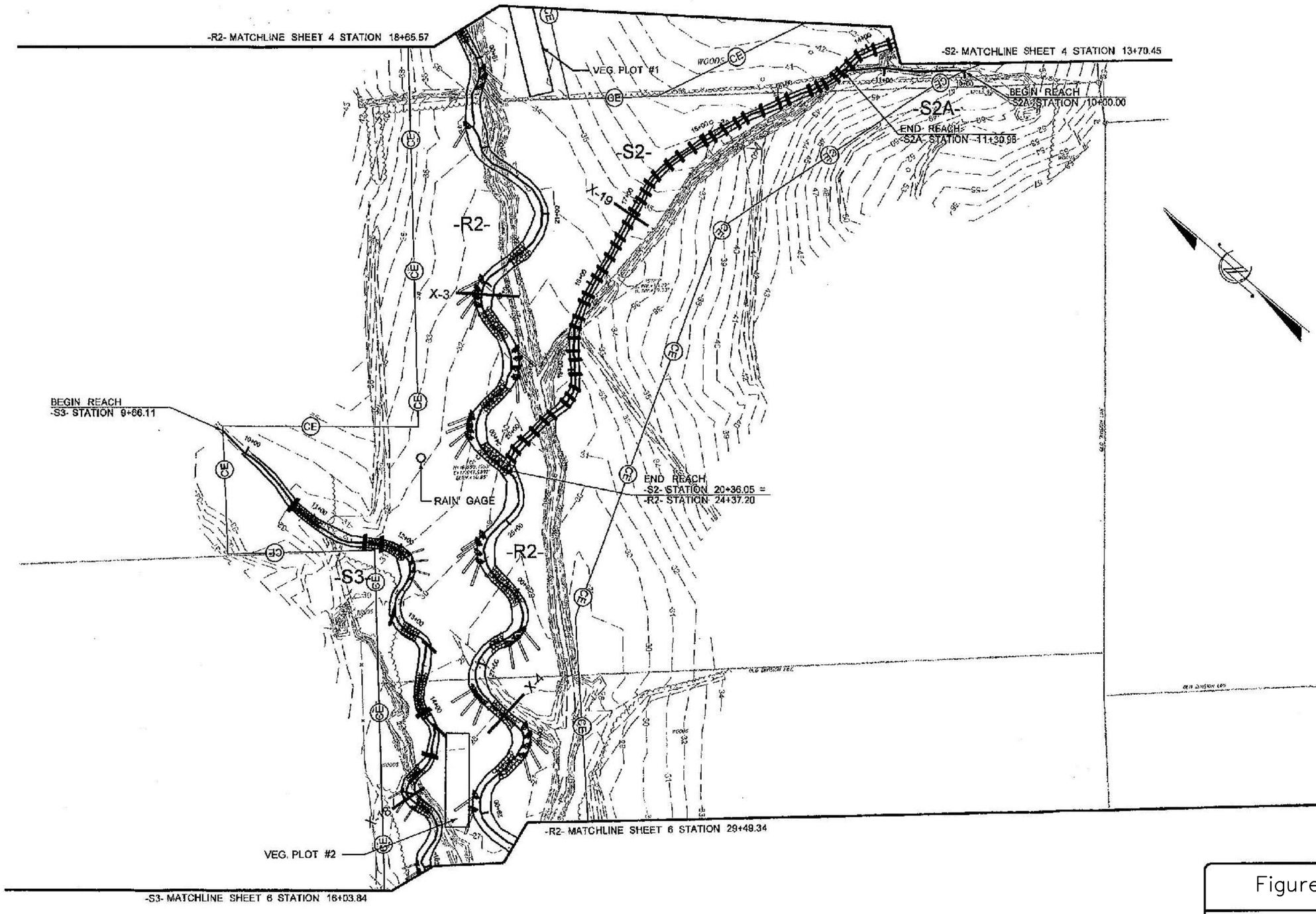


Figure 3B

50 25 0 50 100
SCALE (FT)

-R2- MATCHLINE SHEET 5 STATION 29+49.34

-S3- MATCHLINE SHEET 5 STATION 16+03.84

END REACH
-S3- STATION 16+76.22 =
-R2- STATION 30+62.18

-S3-

-R2-

X-5

-R2-

VEG. PLOT #3

SPA6

-R2- MATCHLINE SHEET 8
STATION 38+53.80

Figure 3C

50 25 0 50 100
SCALE (FT)

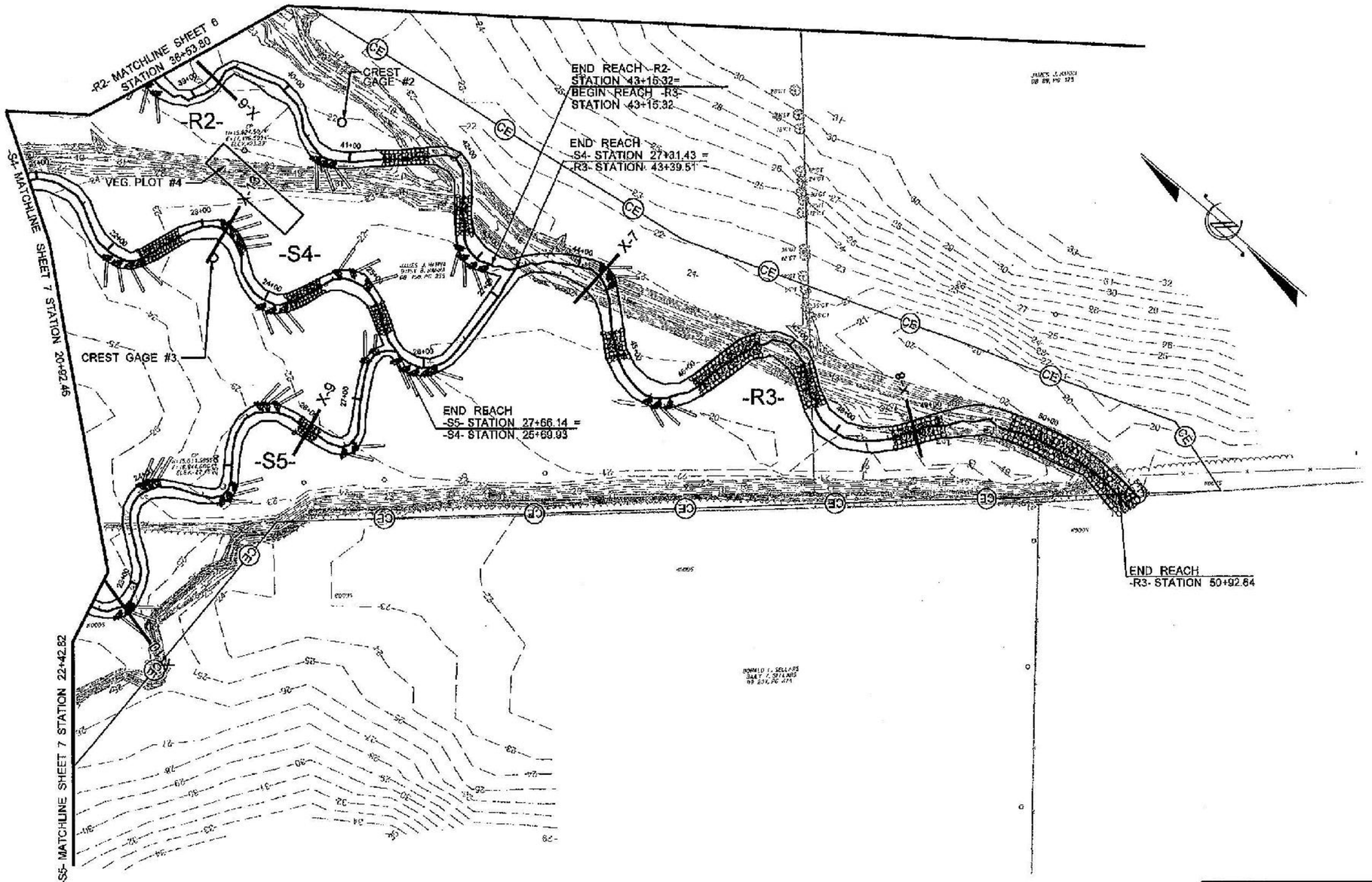


Figure 3D

50 25 0 50 100
SCALE (FT)

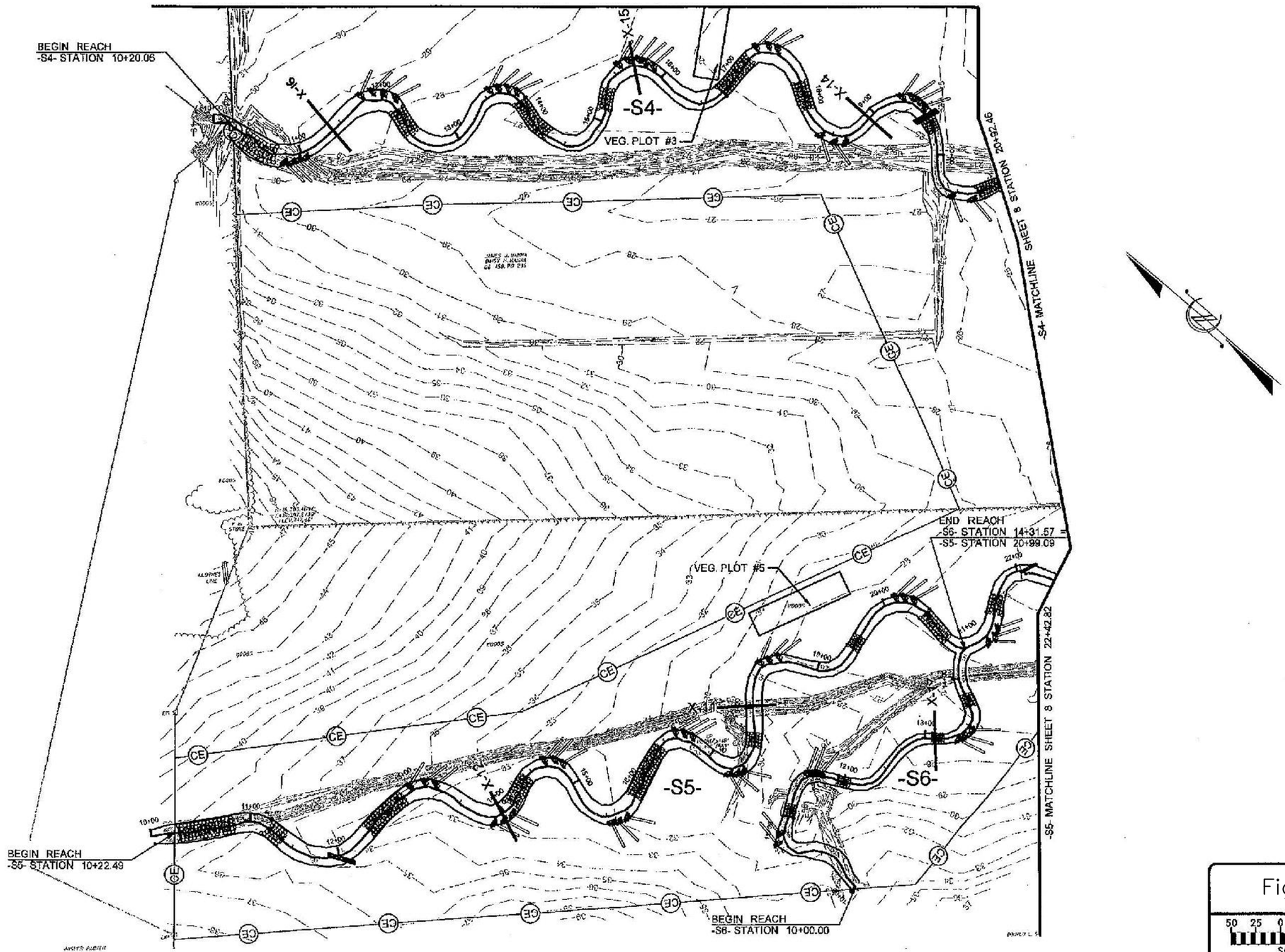

BEGIN REACH
-S4- STATION 10+20.06
X-16
X-15
-S4-
VEG. PLOT #3
X-14
-S4- MATCHLINE SHEET 8 STATION 20+97.96
END REACH
-S6- STATION 14+31.57 =
-S5- STATION 20+99.09
VEG. PLOT #5
X-11
X-12
X-13
-S5-
-S6-
-S5- MATCHLINE SHEET 8 STATION 22+42.82
BEGIN REACH
-S5- STATION 10+22.49
BEGIN REACH
-S6- STATION 10+00.00
CE
50 25 0 50 100
SCALE (FT)

Figure 3E

Table 8 County and On-site Rainfall Data

Month	Average	Normal Limits		Wadesboro Precipitation	On-Site Precipitation	Accumulated Average Rainfall Deficit
		30 Percent	70 Percent			
January	4.66	3.31	5.78	2.75	---	-1.91
February	3.56	2.18	4.37	2.69	8.536	-2.78
March	4.61	3.28	5.58	3.25	3.974	-4.14
April	2.94	1.54	3.78	3.67	3.981	-3.41
May	3.44	2.18	3.93	2.52	1.933	-4.33
June	4.56	2.74	5.84	4.54	4.030	-4.35
July	5.26	3.26	6.06	2.99	1.560	-6.62
August	4.41	2.67	5.36	1.59	1.750	-9.44
September	4.25	2.15	5.87	5.87	2.300	-12.00
October	3.66	1.85	4.87	4.87	0.050	-15.66
November	3.1	2.14	3.86	0.31	2.87	-18.45
December	3.28	2.16	3.83	---	---	---
Total	47.73	29.46	59.13	35.05	28.11	---

4.3.4 Climate Data

The entire state of North Carolina experienced increasingly severe drought conditions throughout 2007, with some areas experiencing the lowest average stream flows on record. The first signs of drought began in February in the western part of the state. By early spring, abnormally dry conditions had spread across the state, and the western edge of the state began to see "moderate" drought conditions. From late spring through the summer, conditions steadily worsened. By August, 98% of North Carolina's land area was designated as being in either "severe", "extreme", or "exceptional" drought (**Figure 4**). Additionally, lowest-ever average stream flows were recorded at 13 monitoring stations in August, including 9 in central North Carolina, 2 in the mountains, and 2 on the coastal plain. Nearly the entire state was categorized as experiencing "extreme" drought in September, with the southwest portion of the state categorized as experiencing "exceptional" drought. Figure 1 depicts the increasing severity of the drought throughout the year.

The City Pond restoration site experienced drought conditions consistent with state-wide trends. Precipitation levels at the Wadesboro monitoring station, near the City Pond site, fell within the normal range for much of the spring and summer. In July, the precipitation level fell below the normal range, to 2.99 inches (**Figure 5** and **Table 8**). During August, the Wadesboro station received 1.59 inches—2.82 inches below the average. The accumulated rainfall deficit—the difference between the long-term average and the observed monthly precipitation levels, aggregated monthly—grew moderately from January to July, then increased from a 4.35 inch deficit in July to a 9.44 inch deficit in August. Persistent and worsening drought conditions severely impacted the wetland hydroperiods at the City Pond restoration site.

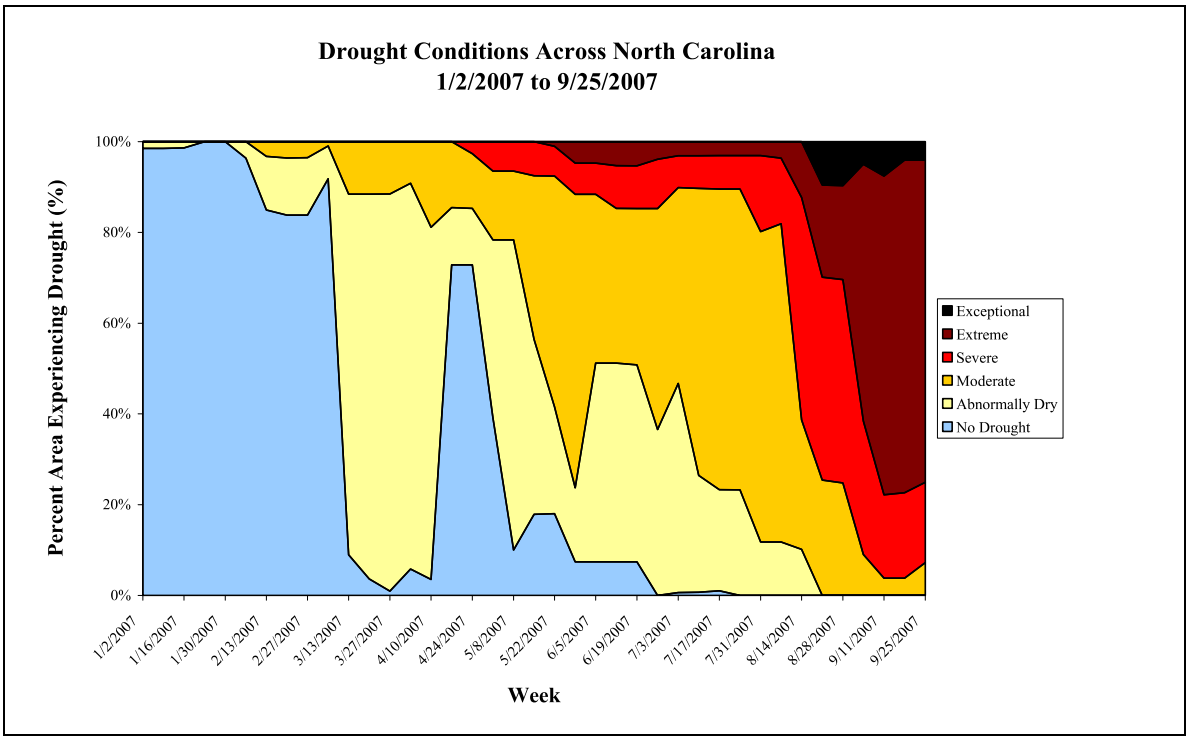


Figure 4 2007 NC Drought Conditions

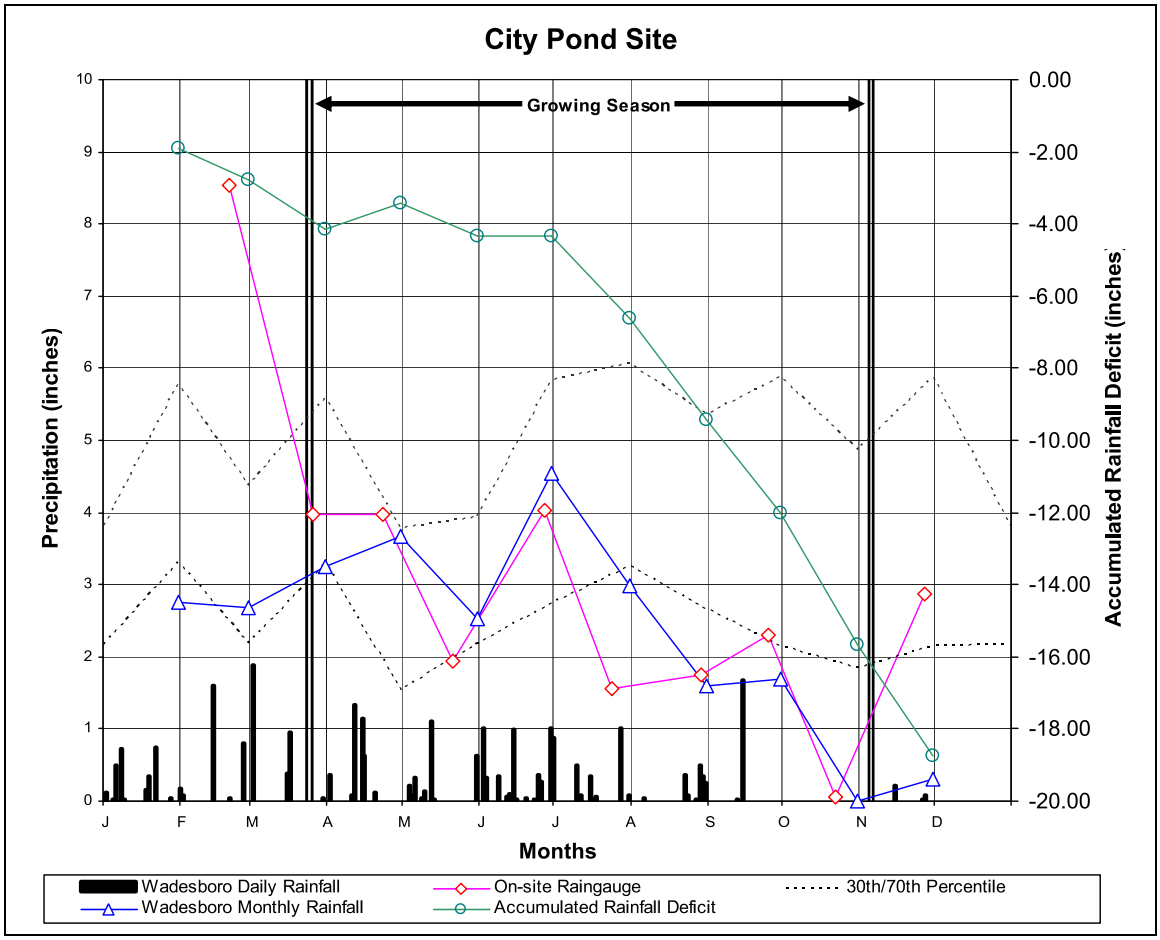


Figure 5 2007 Precipitation Data

4.4 BENTHIC MACROINVERTEBRATE SURVEY RESULTS

Four reaches were sampled for benthic macroinvertebrates along the restoration site in March 2007. Reaches sampled include R2, S4, S5, and R3. The North Carolina Division of Water Quality (NCDWQ) Qual-4 collection method was utilized. In addition to benthic sampling, NCDWQ habitat assessment forms were completed at each monitoring site. Benthos samples were preserved in alcohol and later identified to the lowest possible taxonomic level by an aquatic ecologist. **Tables 9-12** list the taxa encountered, relative abundance, and tolerance values. The NCDWQ Standard Operating Procedures for Benthic Macroinvertebrates (2006) assigns tolerance values for common macroinvertebrates in North Carolina. Tolerance values range from 0 to 10 with low scores indicating species that are intolerant to pollution, sediments, or other disturbances. Overall, the macroinvertebrate assemblage at City Pond is moderately to very tolerant and characteristic of year round flowing water. Low habitat scores at all sites were primarily due to little riparian vegetation.

Reach R2
The R2 reach received a habitat score of 69 out of 100 possible points. Six ephemeroptera, plecoptera, and trichoptera (EPT) taxa were collected (Table 8). Plecopteras represent one of the most intolerant species in stream systems. However, the plecoptera species *Perlesta placida*, abundant throughout the City Pond reaches, is comparatively tolerant with a tolerance value of 4.7 (**Table 9**). Both ephemeroptera taxa captured are tolerant species compared with most other ephemeropteras (Table 8). Abundant blackfly larvae (Simulids) were collected due to the flat rock

placed in the constructed riffle. Several crayfish that were too young to be identified were collected.

Reach R3
The R3 reach received a habitat score of 66 out of 100 possible points. A large amount of blackfly larvae (simulidae) were collected from a kick net sample taken from a constructed riffle in Reach 3 (**Table 10**). The abundance of black flies is likely due to the flat rock used in the constructed riffle which provides ideal habitat for these sessile filter feeding organisms. Taxa assemblage at R3 was similar to R2 with respect to EPT taxa.

Reach S4
The S4 site received a habitat score of 64 out of 90 possible points. Taxa assemblage at S4, was similar to R2 with respect to EPT taxa with the addition of one perlodid stonefly, *Isoperla bilineata* (**Table 11**). Crayfish too young for identification were abundant at Reach S4.

Reach S5
The S5 reach received a habitat score of 65 out of 90 possible points. Only two ephemeroptera species were collected at this site. Reach S5 was the only reach in City Pond where no plecopteras were collected. Thousands of blackfly larvae were collected here from a kick net sample at a constructed riffle (**Table 12**).

Table 9 Reach R2 Benthic Macroinvertebrate Data

Order	Family	Genus Species	Tolerance Value	No.
Plecoptera	Perlidae	*Perlesta placida*	4.7	16
Plecoptera	Nemouridae	*Amphinemura* spp	3.3	9
Ephemeroptera	Heptageniidae	*Stenonema femoratum*	7.2	1
Ephemeroptera	Caenidae	*Caenis* spp	7.4	11
Trichoptera	Rhyacophildae	*Rhyacophila ledra*	3.9	1
Trichoptera	Limnephilidae	*Ironoquia punctatissima*	7.8	4
Gastrapoda	Physidae	*Physella* spp	8.8	4
Coleoptera	Noteridae	*Hydrocanthus* spp	7.1	1
Diptera	Chironimidae	*Conchopelopia* Group	8.4	2
Diptera	Simulidae	*Prosimulium*	6	11
Diptera	Tipulidae	*Tipulia* spp	7.3	3
Total Number of Organisms				63
Total Number of Taxa				11
Total Number of EPT				42

Table 10 Reach R3 Benthic Macroinvertebrate Data

Order	Family	Genus Species	Tolerance Value	No.
Plecoptera	Perlidae	*Perlesta placida*	4.7	3
Plecoptera	Nemouridae	*Amphinemura* spp	3.3	3
Ephemeroptera	Caenidae	*Caenis* spp	7.4	9
Trichoptera	Rhyacopilidae	*Rhyacophila ledra*	3.9	1
Odonata	Coenagrionidae	*Ishnura* spp	9.5	1
Gastrapoda	Physidae	*Physella* spp	8.8	1
Coleoptera	Dytiscidae	*Agabus* spp	8.9	1
Coleoptera	Haliplidae	*Haliplus* spp	8.7	1
Diptera	Simulidae	*Prosimulium* spp	6	1000+
Diptera	Tipulidae	*Tipulia* spp	7.3	2
Total Number of Organisms				22
Total Number of Taxa				10
Total Number of EPT				16

Table 11 Reach S4 Benthic Macroinvertebrate Data

Order	Family	Species	Tolerance Value	No.
Plecoptera	Perlidae	*Perlesta placida*	4.7	31
Plecoptera	Perlodidae	*Isoperla bilineata*	5.4	1
Ephemeroptera	Caenidae	*Caenis* spp	7.4	1
Trichoptera	Rhyacophildae	*Rhyacophila ledra*	3.9	1
Trichoptera	Limnephilidae	*Ironoquia punctatissima*	7.8	1
Gastrapoda	Physidae	*Physella* spp	8.8	6
Decapoda	Gammaridae	*Gammarus* spp	9.1	1
Hemiptera	Corixidae	Corixidae	9	2
Coleoptera	Dytiscidae	*Hydroporus* spp	8.6	1
Diptera	Chironomidae	*Conchapelopia* Group	8.4	8
Diptera	Chironomidae	Orthocladiinae	NA	2
Diptera	Simulidae	*Prosimulium* spp	6	1
Diptera	Tipulidae	*Tipulia* spp	7.3	1
Total Number of Organisms				57
Total Number of Taxa				13
Total Number of EPT				35

Table 12 Reach S5 Benthic Macroinvertebrate Data

Order	Family	Species	Tolerance Value	No.
Ephemeroptera	Ephemerellidae	*Ephemerella catawba*	4.4	1
Ephemeroptera	Baetidae	*Callibaetis* spp	9.8	1
Gastrapoda	Physidae	*Physella* spp	8.8	5
Diptera	Chironomidae	*Conchapelopia* Group	8.4	1
Diptera	Chironomidae	Orthocladiinae	NA	2
Diptera	Simulidae	*Prosimulium* spp	6	1000+
Diptera	Tipulidae	*Tipulia* spp	7.3	1
Total Number of Organisms				11
Total Number of Taxa				7
Total Number of EPT				2

4.5 STREAM CONCLUSIONS

In-stream structures installed within the channel include constructed riffles, cross vanes, log vanes, log weirs, root wads, and step-pool structures. Visual observations of structures throughout the 2007 growing season indicated that most structures are functioning as designed. Two log weirs on reach S1 were undercutting and allowing water to flow underneath. There are also several areas of bank erosion due to improperly installed coir matting and low vegetation density. Although, these banks appear to be stabilizing and no immediate action is required, the banks will be monitored to ensure that they remain stable.

5.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

- Data collected during monitoring Year 3 and observations of conditions at the site indicate that the project continues to be successful. The stream morphology is generally stable. Several in-stream structures have some scour but appear to be functioning correctly. Very little fluvial erosion was observed. Some siltation is occurring resulting in vegetation growth in the channel, but no corrective actions are recommended at this time. It was concluded that the site continues to be on track to achieve the specified stream success criteria

- Vegetation monitoring efforts have documented the average number of stems per acre on site to be 578, which is a survival rate of 91% based on the initial planting count of 632 stems per acre. The interim vegetative success criteria for the end of the third growing season were achieved and the site remains on track to achieve the final success criteria at the end of Year 5.

- Overall, the project objectives are being met. Several organisms and fish were observed along the reaches. Habitat has been improved significantly through this project.

- Monitoring of stream stability and vegetation will continue through the 2008 and 2009 growing seasons.

APPENDIX A

As-Built Survey

2/26/03

PROJECT REFERENCE NO.	SHEET NO.
0166R	5

PROJECT ENGINEER

THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY:

KEVIN L. TWEEDY
027337
NOVEMBER 22, 2004

THIS MEDIA SHALL NOT BE CONSIDERED A CERTIFIED DOCUMENT

BUCK ENGINEERING
8000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

-R2- MATCHLINE SHEET 4 STATION 18+65.57

-S2- MATCHLINE SHEET 4 STATION 13+70.45

VEG. PLOT #1

BEGIN REACH
-S2A- STATION 10+00.00

END REACH
-S2A- STATION 11+30.98

-S2-

-S2A-

-R2-

X-19

X-3

JAMES J. HARRIS
DAISY B. HARRIS
DB 158, PG 235

JAMES J. HARRIS
DB 86, PG 505

JAMES J. HARRIS
DAISY B. HARRIS
DB 105, PG 501

BEGIN REACH
-S3- STATION 9+66.11

RAIN GAGE

END REACH
-S2- STATION 20+36.05 =
-R2- STATION 24+37.20

-S3-

-R2-

X-4

X-18

OLD DIVISION LINE

JAMES J. HARRIS
DAISY B. HARRIS
DB 126, PG 439

JAMES J. HARRIS
DB 291, PG 167

VEG. PLOT #2

GEORGIA WAYNE AND OTHERS
DB 235, PG 1

-R2- MATCHLINE SHEET 6 STATION 29+49.34

-S3- MATCHLINE SHEET 6 STATION 16+03.84

N

AS - BUILT PLAN

50 25 0 50 100
SCALE (FT)

10/18/2005
P:\0166R\Design\Plans\As_Built\0166R_EBX_AB_PSH_05.dgn

PROJECT REFERENCE NO.	SHEET NO.
0166R	6

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8000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

-R2- MATCHLINE SHEET 5 STATION 29+49.34

-S3- MATCHLINE SHEET 5 STATION 16+03.84

END REACH
-S3- STATION 16+76.22 =
-R2- STATION 30+62.18

VEG. PLOT #3

-R2- MATCHLINE SHEET 8
STATION 38+53.80

AS - BUILT PLAN

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SCALE (FT)

2/25/03

10/18/2005
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PROJECT REFERENCE NO.	SHEET NO.
0166R	7

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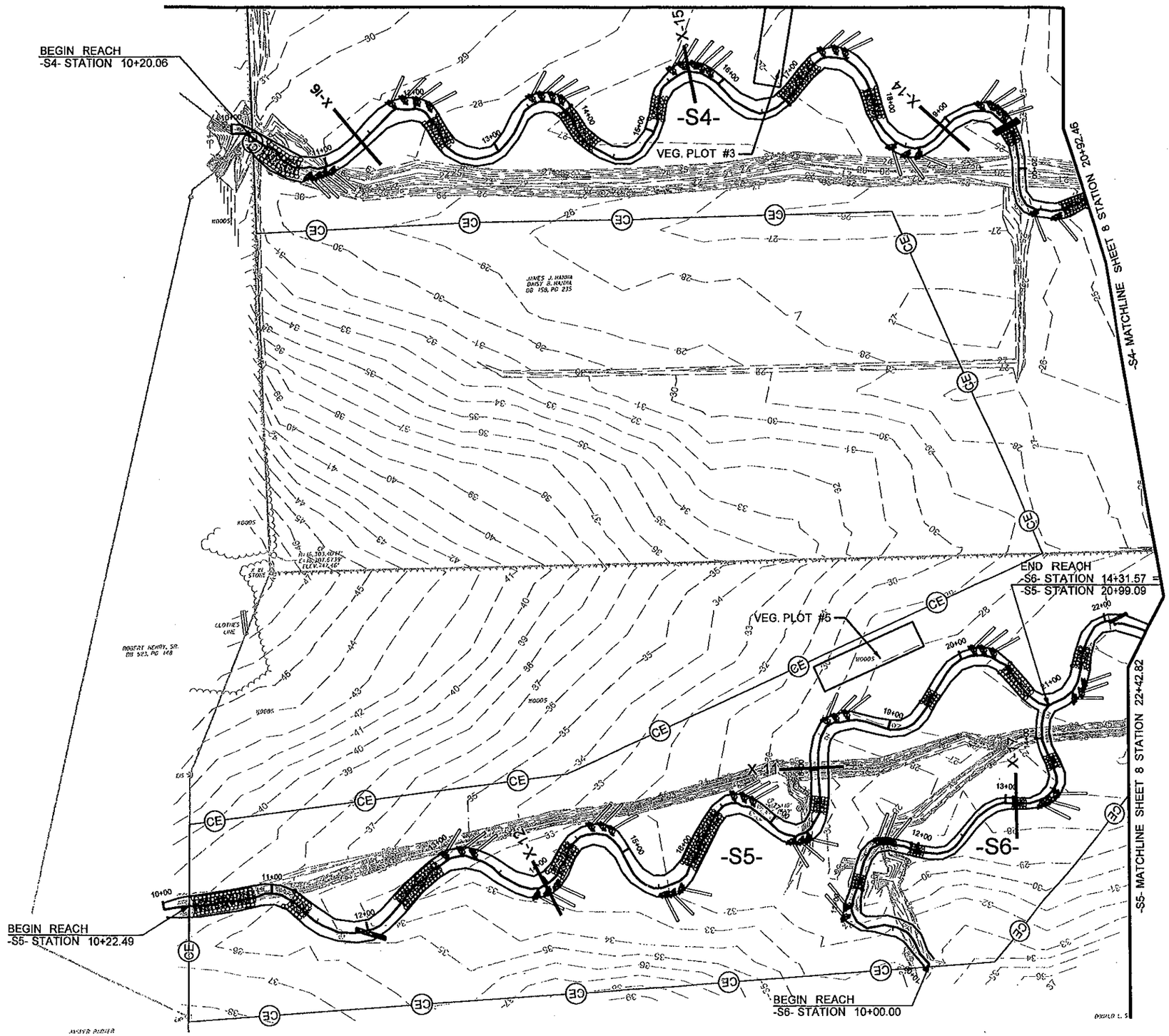
6000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490



AS – BUILT PLAN

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10/18/2005
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2/25/03

2/25/03

PROJECT REFERENCE NO.	SHEET NO.
0166R	8

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BUCK ENGINEERING
8000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

-R2- MATCHLINE SHEET 6 STATION 38+53.80

-S4- MATCHLINE SHEET 7 STATION 20+92.46

-S5- MATCHLINE SHEET 7 STATION 22+42.82

-R2-

-S4-

-S5-

-R3-

CREST GAGE #2

CREST GAGE #3

VEG. PLOT #4

END REACH -R2-
STATION 43+15.32=
BEGIN REACH -R3-
STATION 43+15.32

END REACH
-S4- STATION 27+31.43 =
-R3- STATION 43+39.51

END REACH
-S5- STATION 27+66.14 =
-S4- STATION 25+69.93

END REACH
-R3- STATION 50+92.64

JAMES J. HARRIS
DAISY B. HARRIS
DB 158, PG 255

JAMES J. HARRIS
DB 89, PG 375

DONALD L. SELLARS
SKEET T. SELLARS
DB 207, PG 874

AS - BUILT PLAN

50 25 0 50 100
SCALE (FT)

10/8/2005
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PROJECT REFERENCE NO.	SHEET NO.
0166R	13

PROJECT ENGINEER

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NOVEMBER 24, 2004

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BUCK ENGINEERING
8000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

VEGETATION SELECTION

TREES

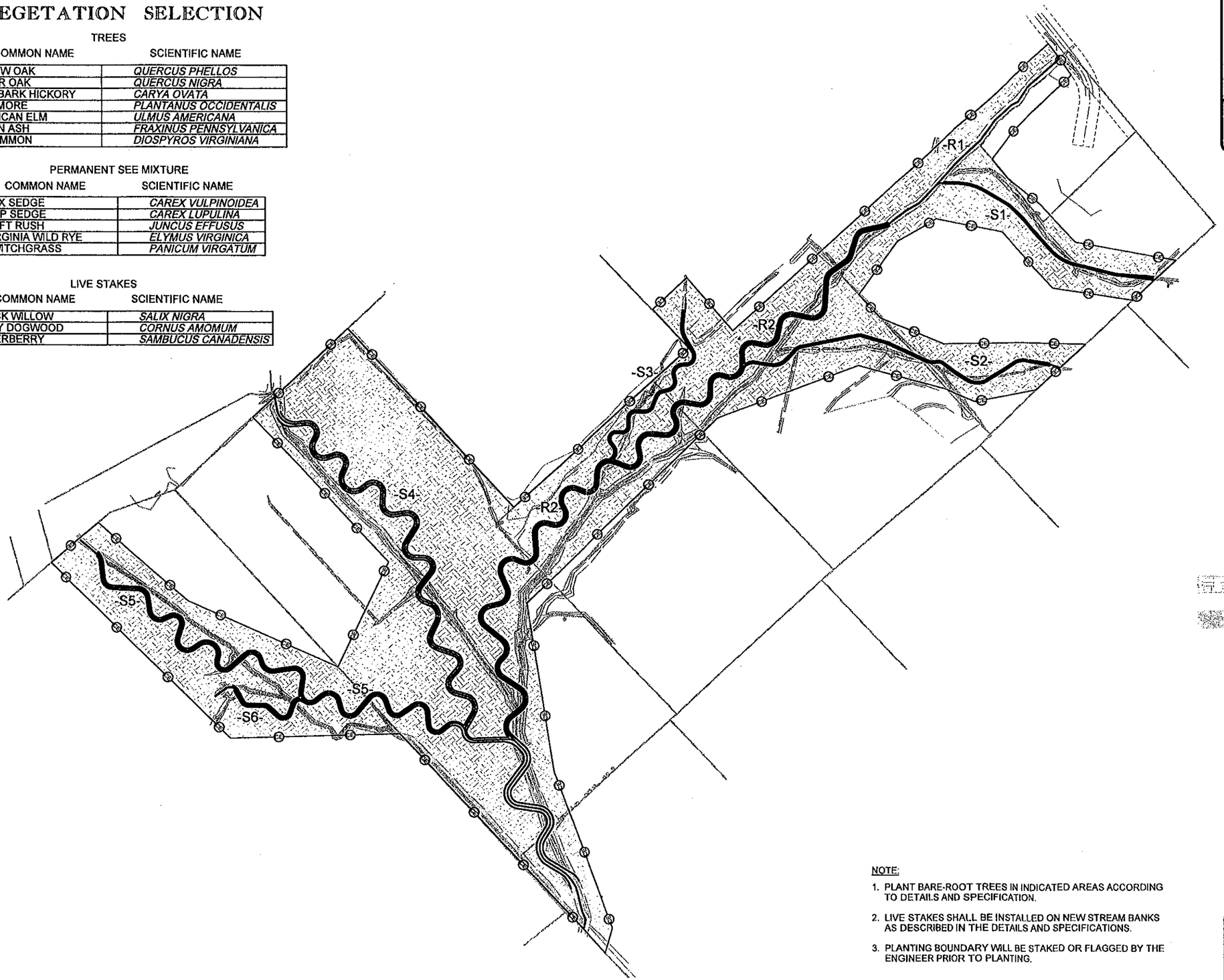
COMMON NAME	SCIENTIFIC NAME
WILLOW OAK	*QUERCUS PHELLOS*
WATER OAK	*QUERCUS NIGRA*
SHAGBARK HICKORY	*CARYA OVATA*
SYCAMORE	*PLANTANUS OCCIDENTALIS*
AMERICAN ELM	*ULMUS AMERICANA*
GREEN ASH	*FRAXINUS PENNSYLVANICA*
PERSIMMON	*DIOSPYROS VIRGINIANA*

PERMANENT SEE MIXTURE

COMMON NAME	SCIENTIFIC NAME
FOX SEDGE	*CAREX VULPINOIDEA*
HOP SEDGE	*CAREX LUPULINA*
SOFT RUSH	*JUNCUS EFFUSUS*
VIRGINIA WILD RYE	*ELYMUS VIRGINICA*
SWITCHGRASS	*PANICUM VIRGATUM*

LIVE STAKES

COMMON NAME	SCIENTIFIC NAME
BLACK WILLOW	*SALIX NIGRA*
SILKY DOGWOOD	*CORNUS AMOMUM*
ELDERBERRY	*SAMBUCUS CANADENSIS*



NAD 83

BARE ROOT PLANTING BOUNDARY

EXISTING CHANNEL FILL BOUNDARY

NOTE:

1. PLANT BARE-ROOT TREES IN INDICATED AREAS ACCORDING TO DETAILS AND SPECIFICATION.
2. LIVE STAKES SHALL BE INSTALLED ON NEW STREAM BANKS AS DESCRIBED IN THE DETAILS AND SPECIFICATIONS.
3. PLANTING BOUNDARY WILL BE STAKED OR FLAGGED BY THE ENGINEER PRIOR TO PLANTING.

REVEGETATION PLAN

150 75 0 150 200
SCALE (FT)

2/26/03

10/20/2005
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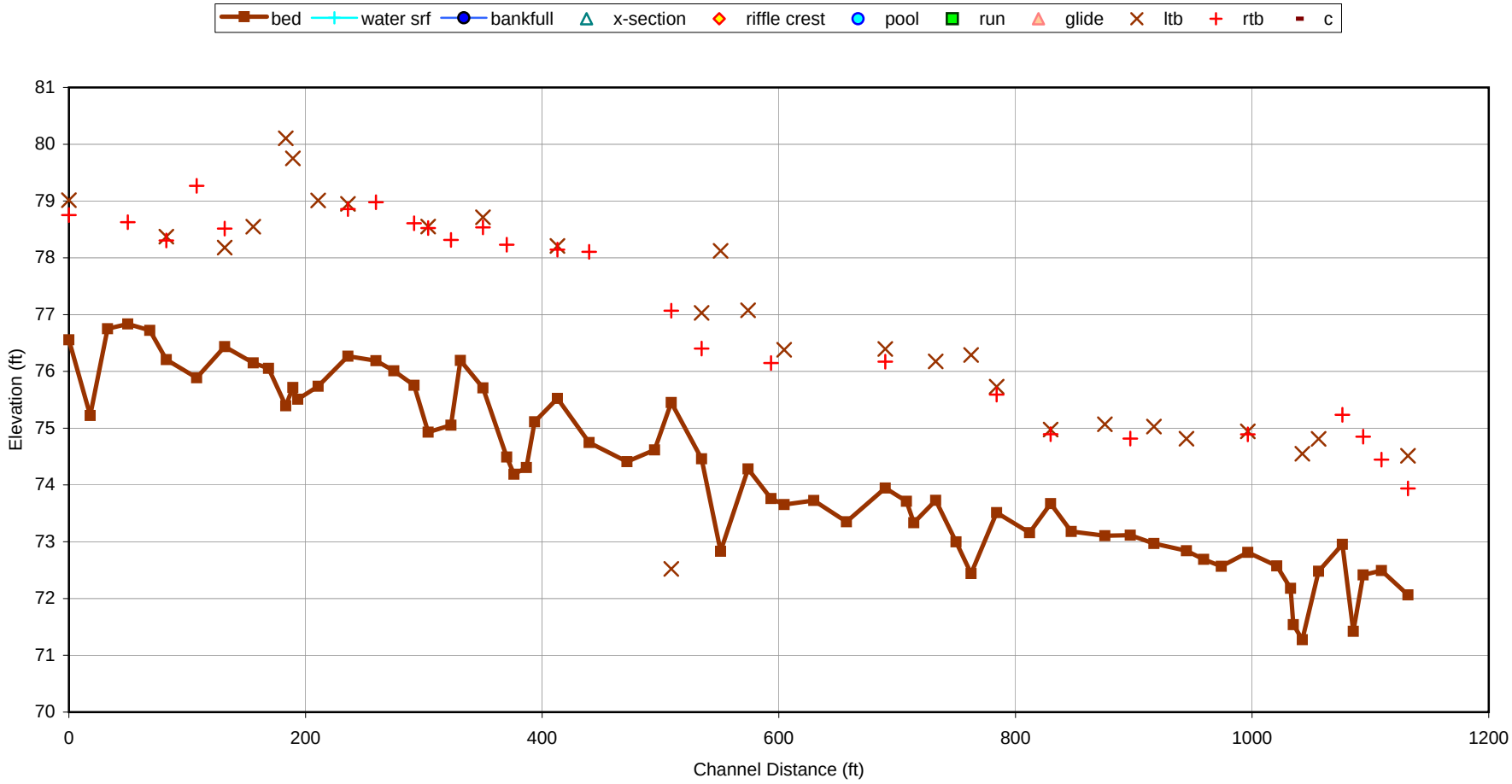
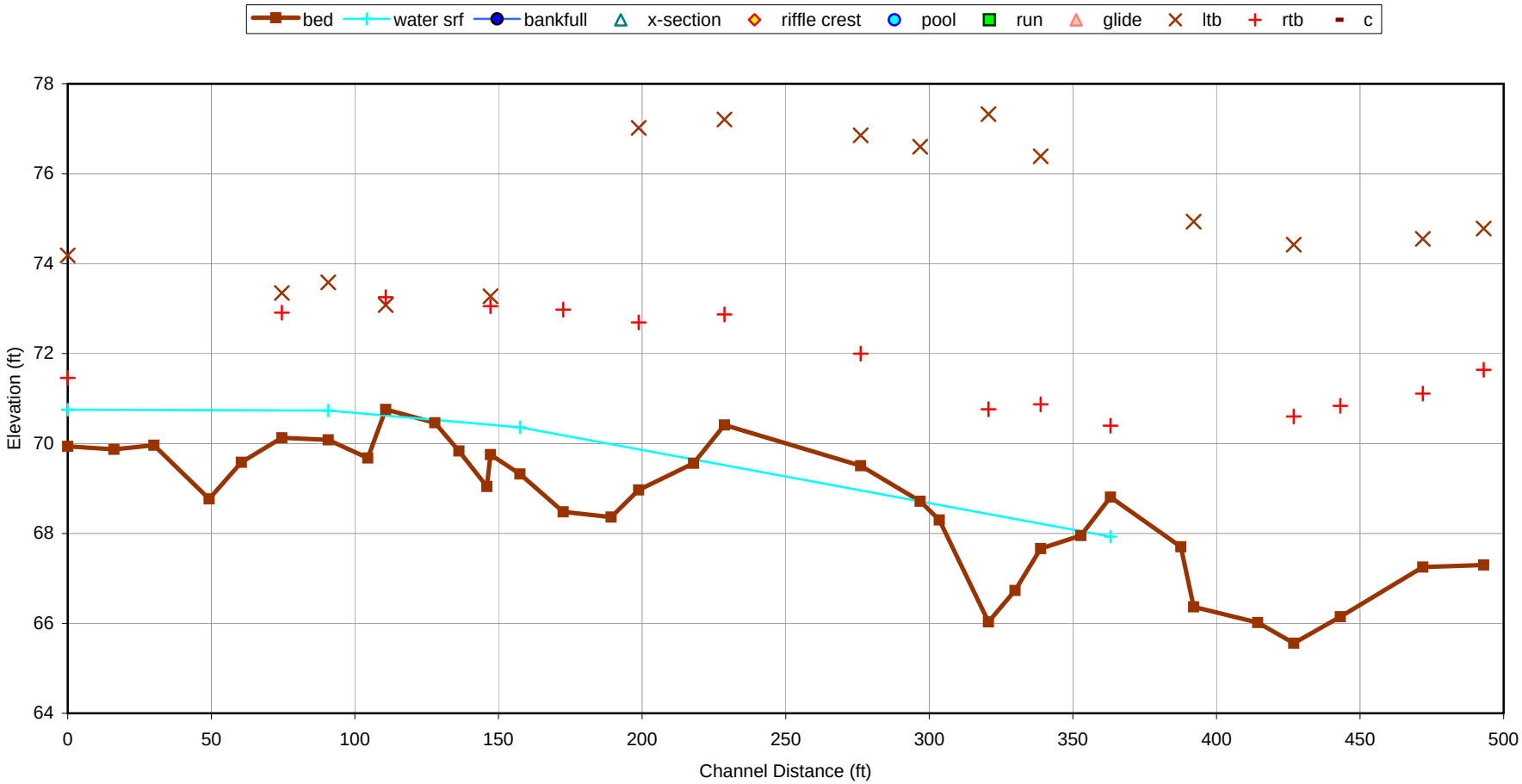
APPENDIX B

Profile and Cross Section Data

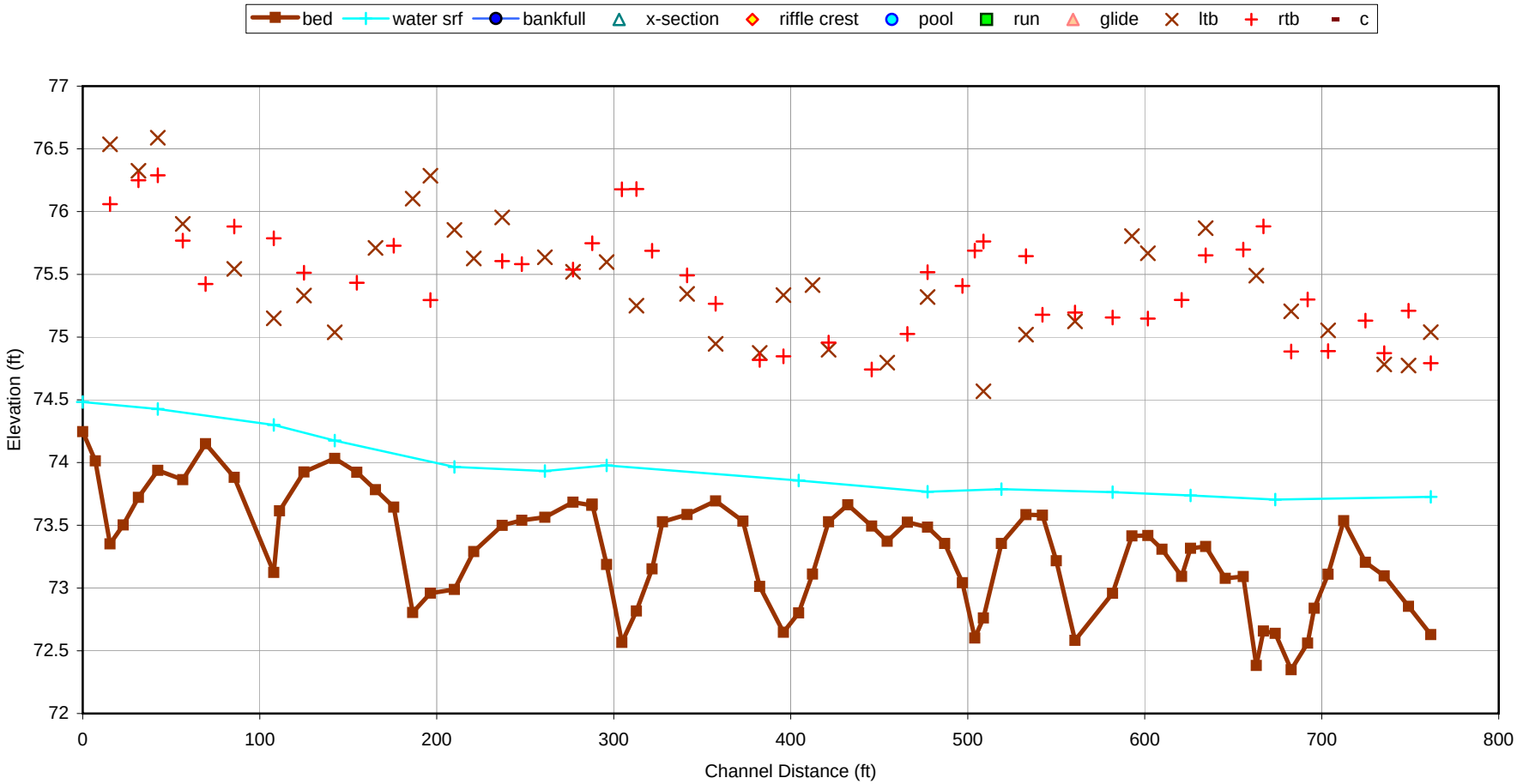
City Pond
Reach R2 Station 27+50 to 39+50



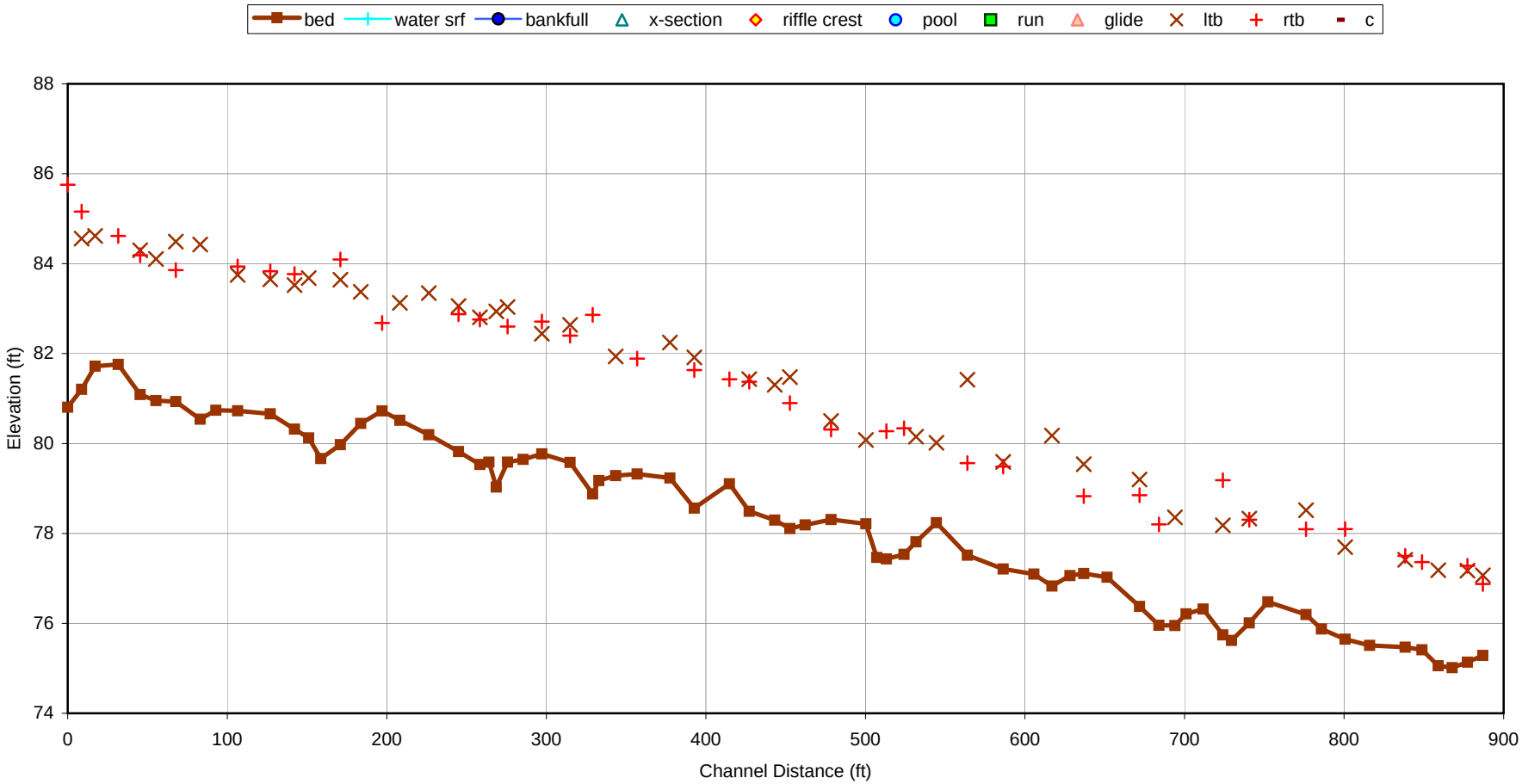
City Pond
Reach R3 Station 44+00 to 49+00

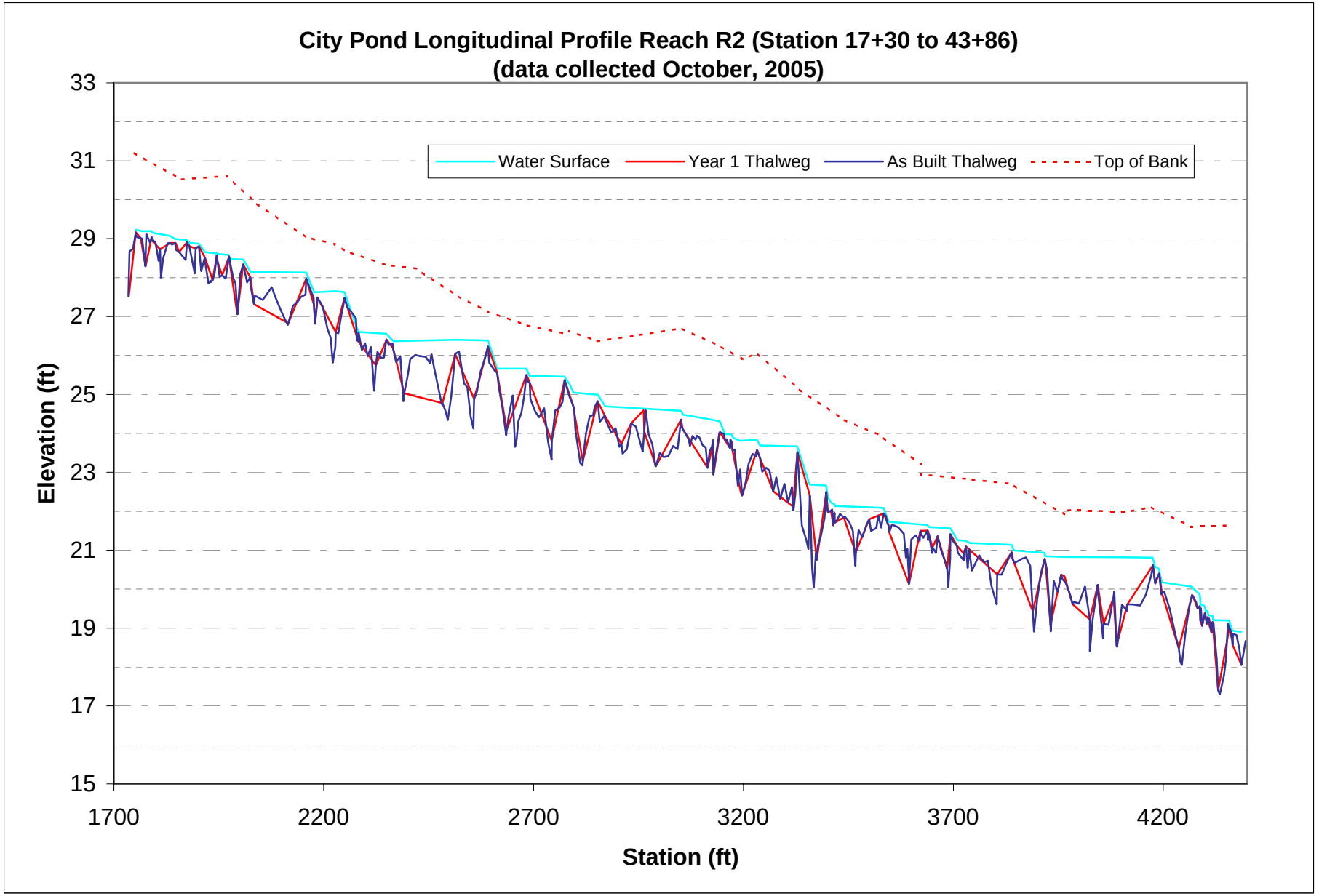


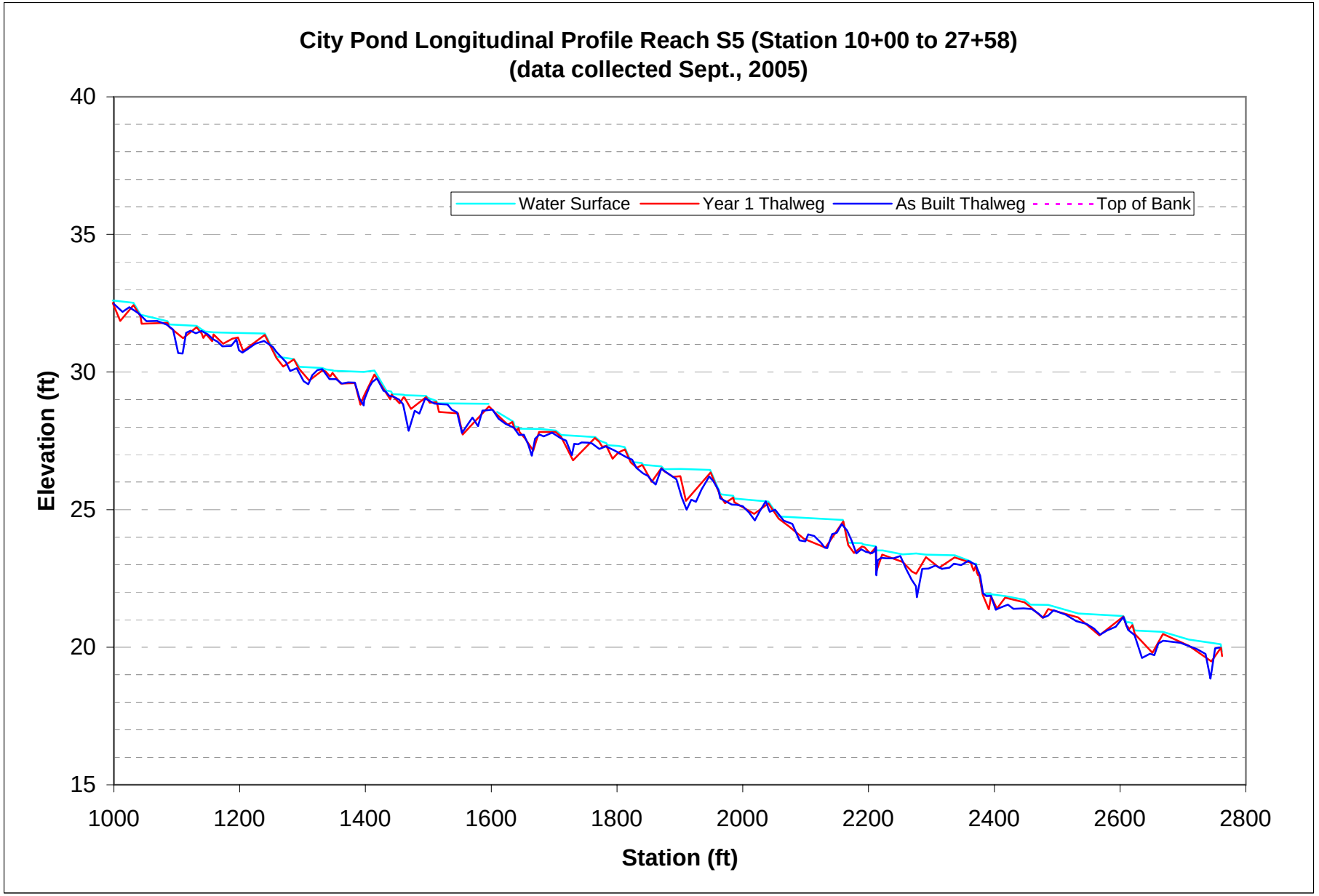
City Pond
Reach S4 Station 15+50 to 23+50

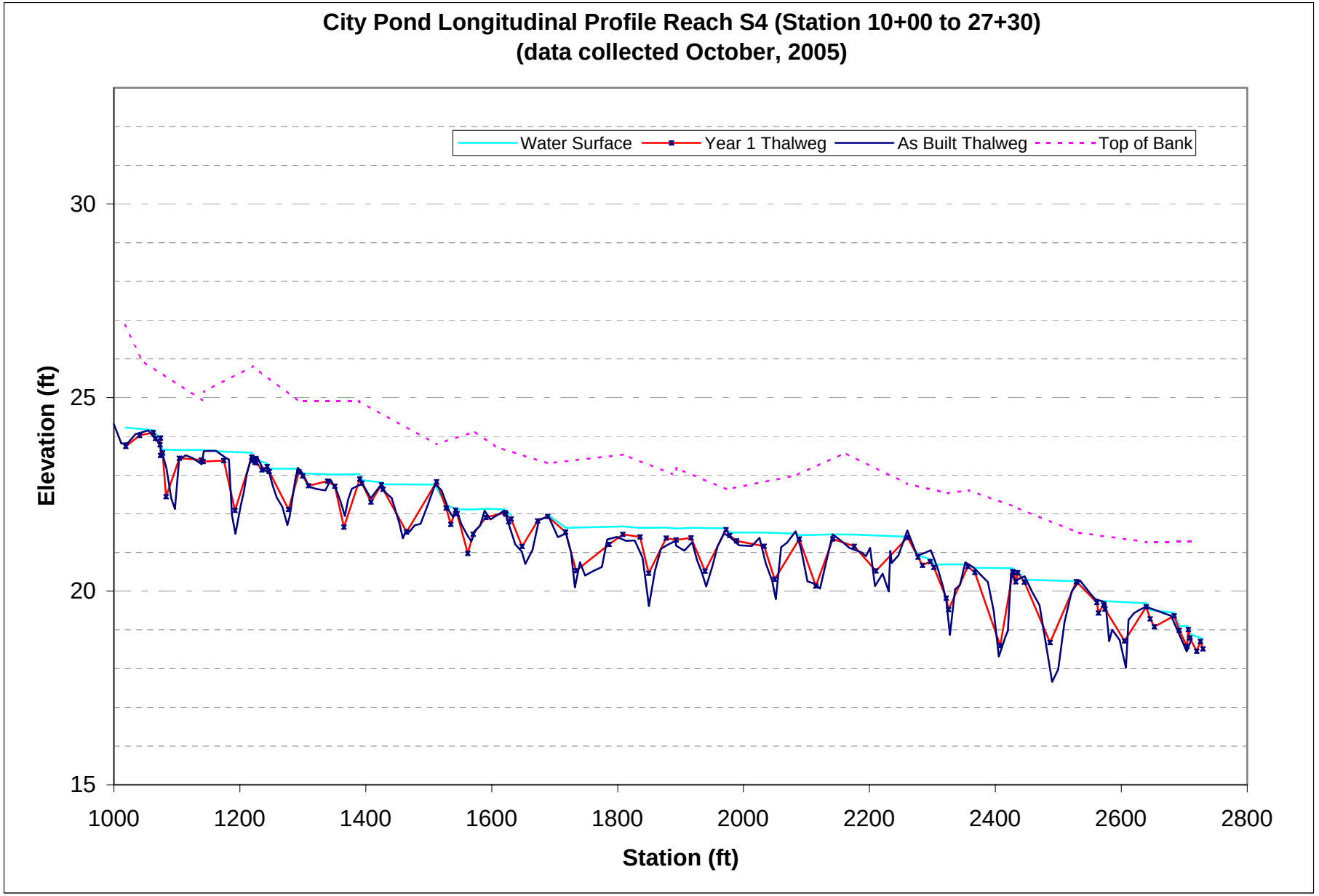


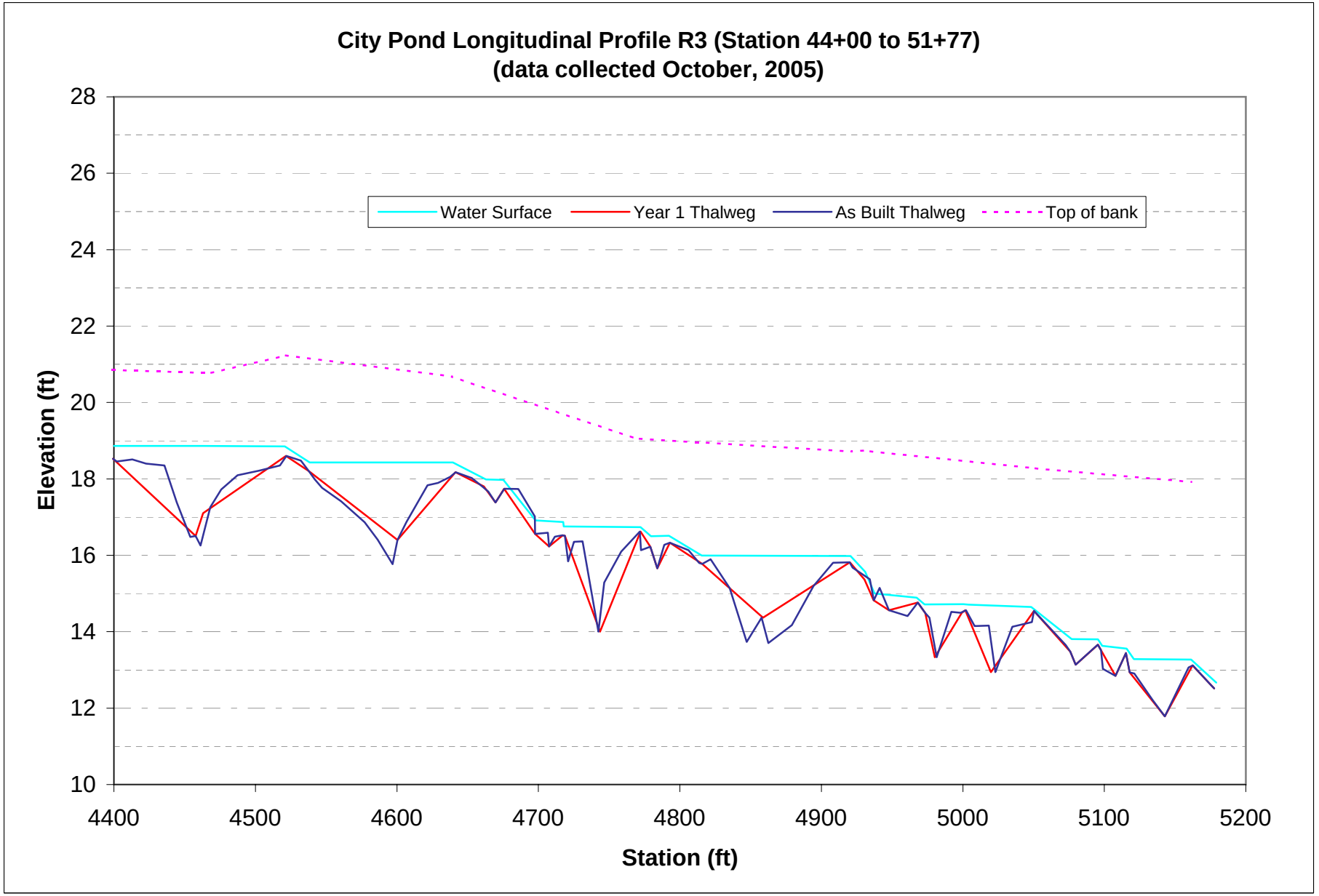
City Pond
Reach S5 Station 14+00 to 23+00




City Pond Longitudinal Profile Reach R2 (Station 17+30 to 43+86)
(data collected October, 2005)
Water Surface
Year 1 Thalweg
As Built Thalweg
Top of Bank
Elevation (ft)
33
31
29
27
25
23
21
19
17
15
1700
2200
2700
3200
3700
4200
Station (ft)

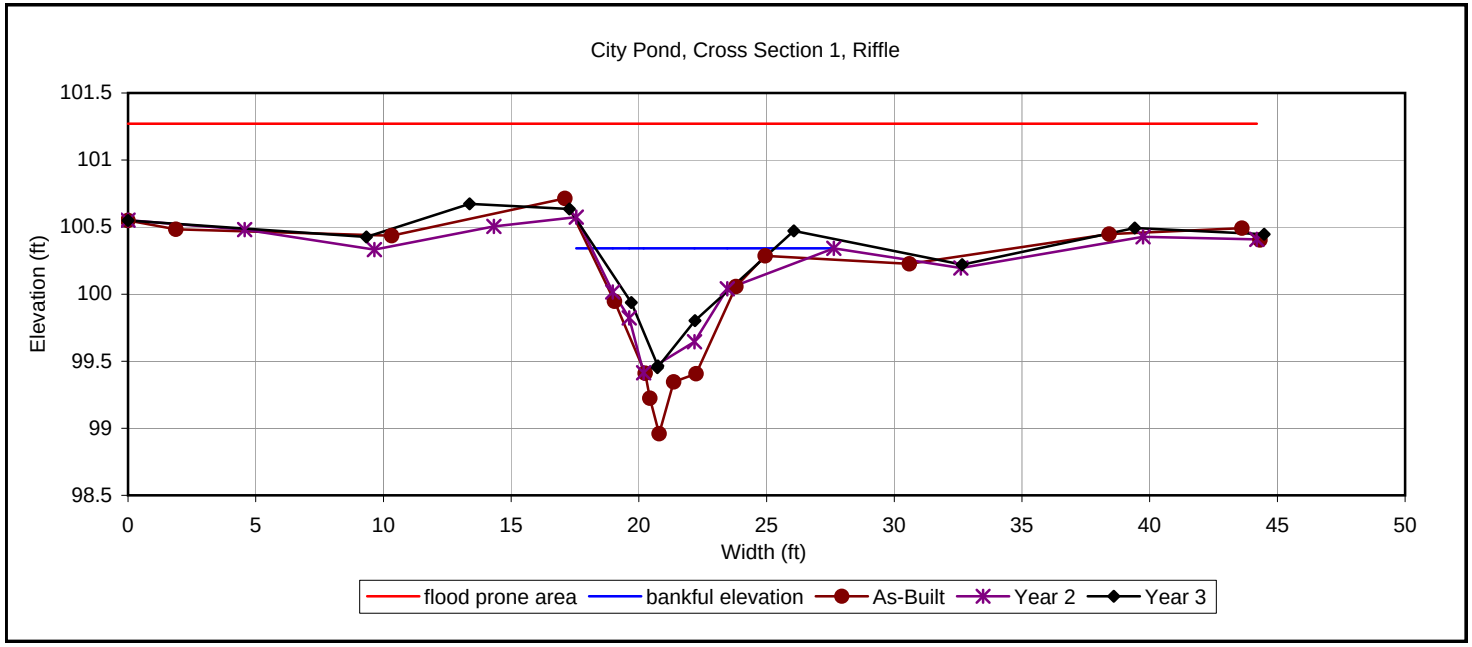

City Pond Longitudinal Profile Reach S5 (Station 10+00 to 27+58)
(data collected Sept., 2005)
Water Surface
Year 1 Thalweg
As Built Thalweg
Top of Bank
Elevation (ft)
40
35
30
25
20
15
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
Station (ft)


City Pond Longitudinal Profile Reach S4 (Station 10+00 to 27+30)
(data collected October, 2005)
Water Surface
Year 1 Thalweg
As Built Thalweg
Top of Bank
Elevation (ft)
30
25
20
15
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
Station (ft)


City Pond Longitudinal Profile R3 (Station 44+00 to 51+77)
(data collected October, 2005)
Water Surface
Year 1 Thalweg
As Built Thalweg
Top of bank
Elevation (ft)
28
26
24
22
20
18
16
14
12
10
4400
4500
4600
4700
4800
4900
5000
5100
5200
Station (ft)

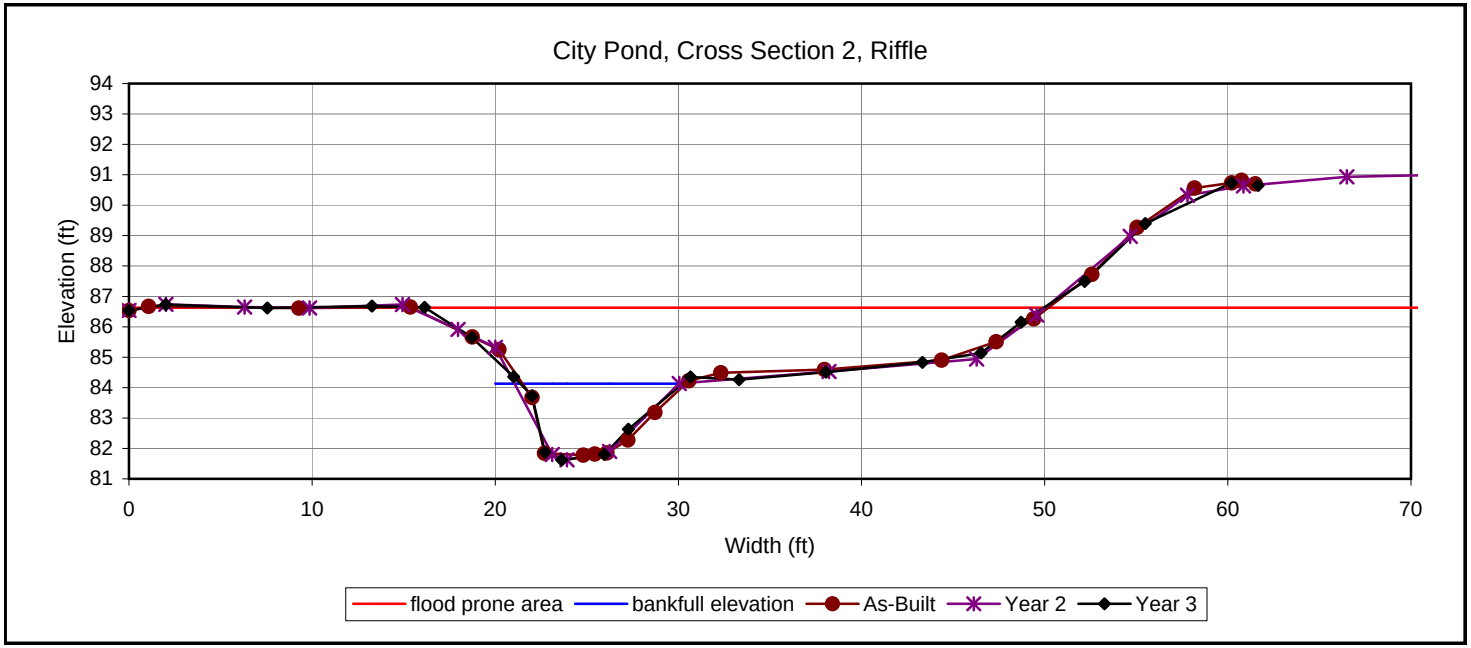
Left bank

Right bank



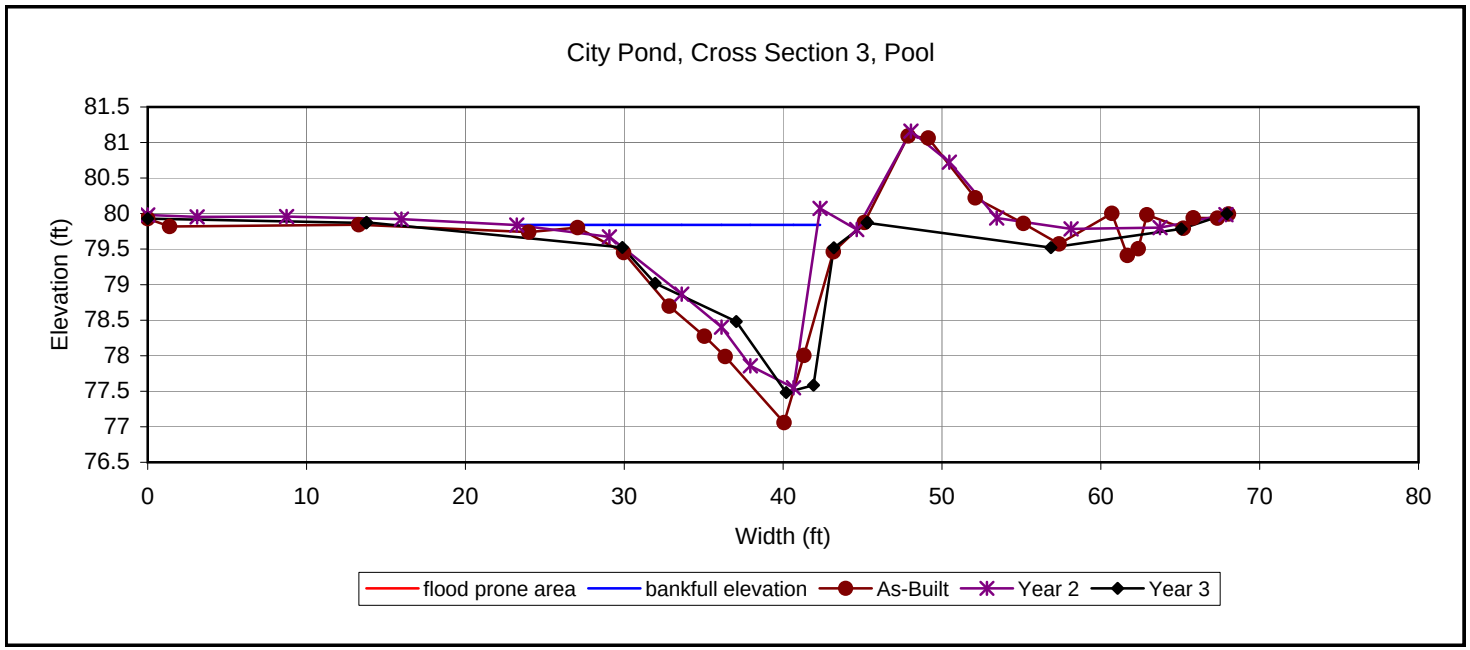
Left bank

Right bank



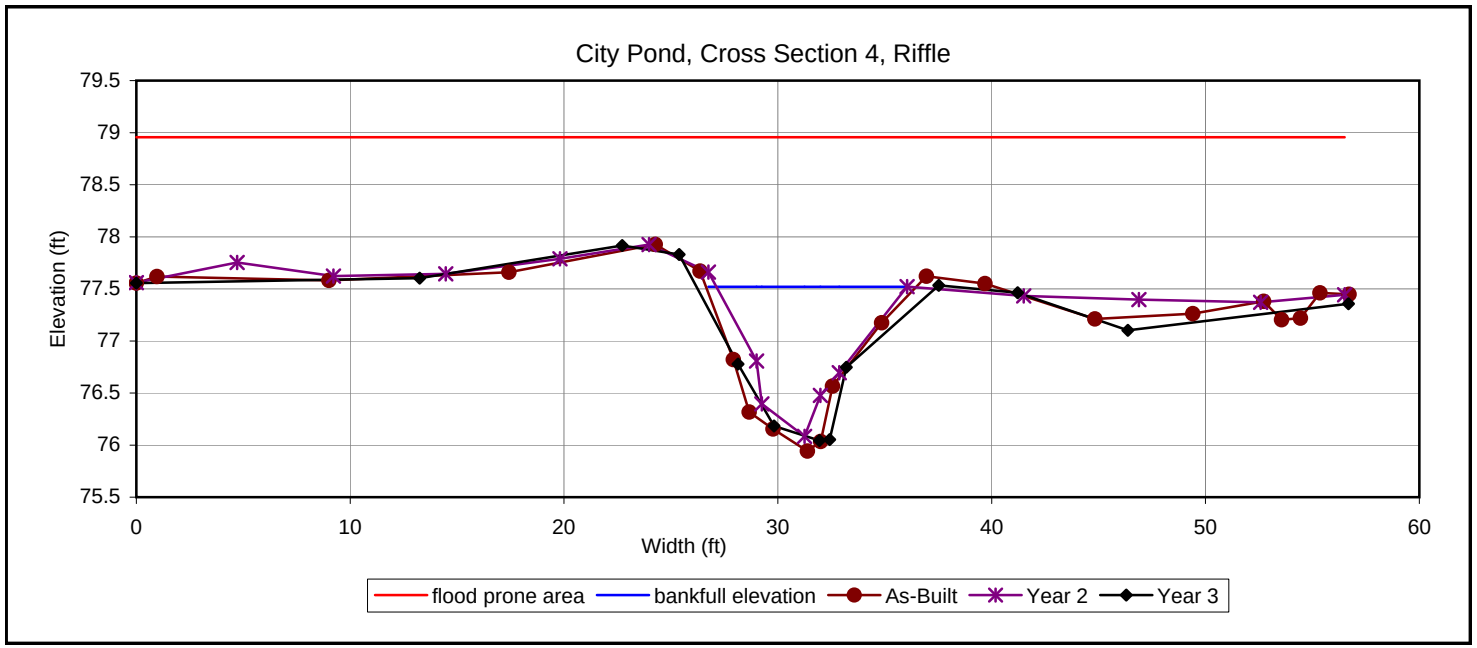
Left bank

Right bank



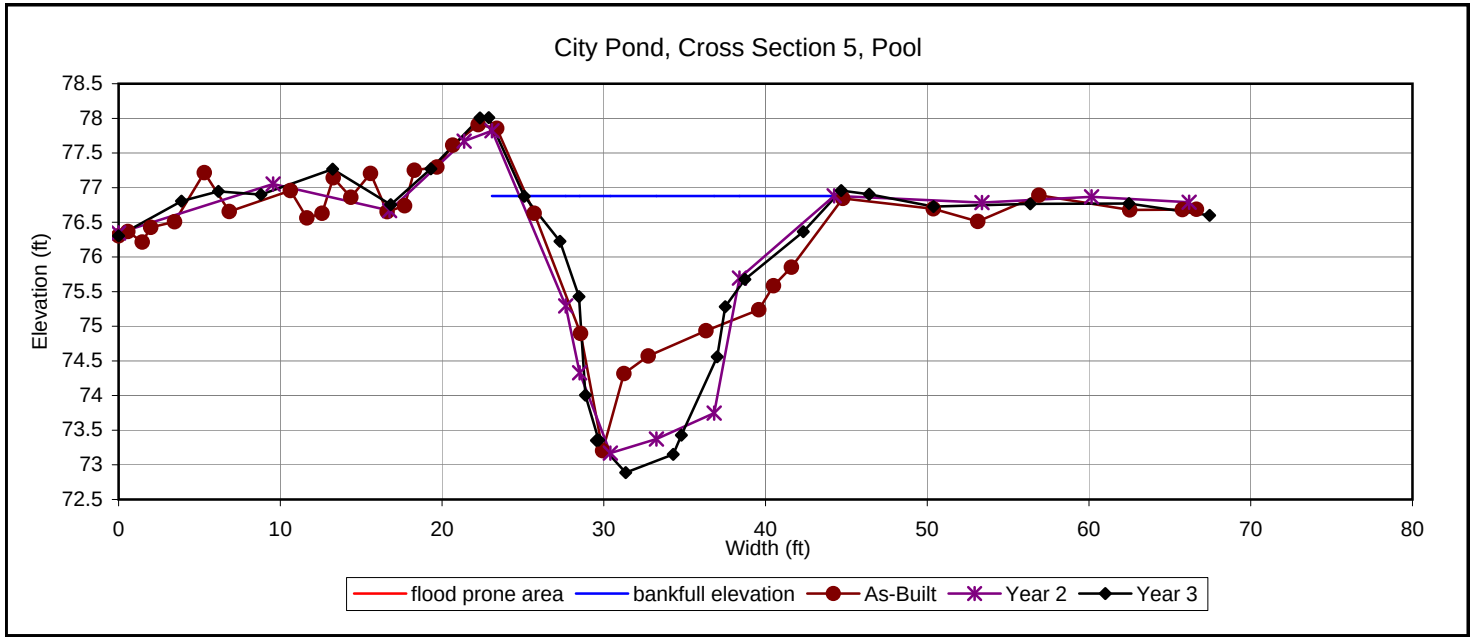
Left bank

Right bank

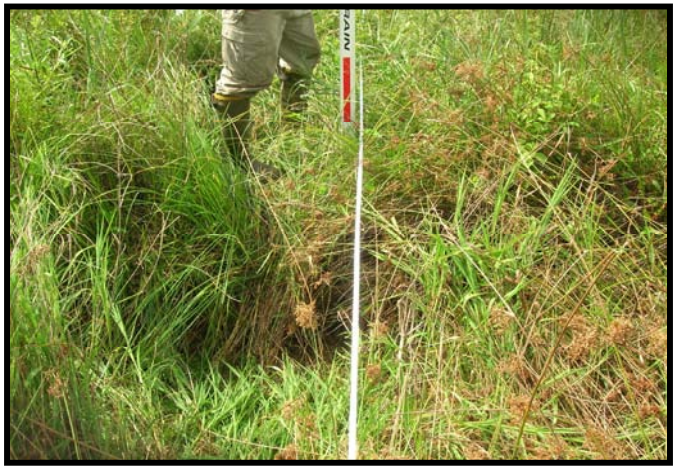


Left bank

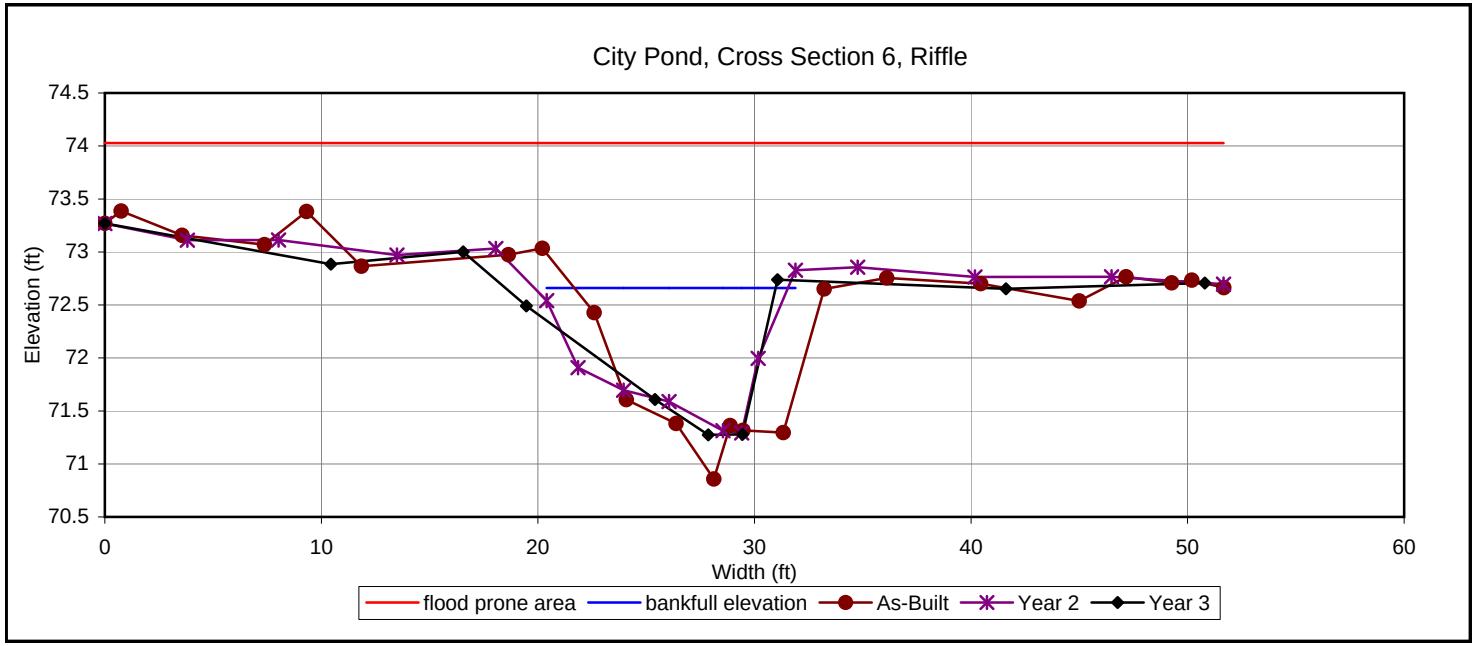
Right bank



Left bank

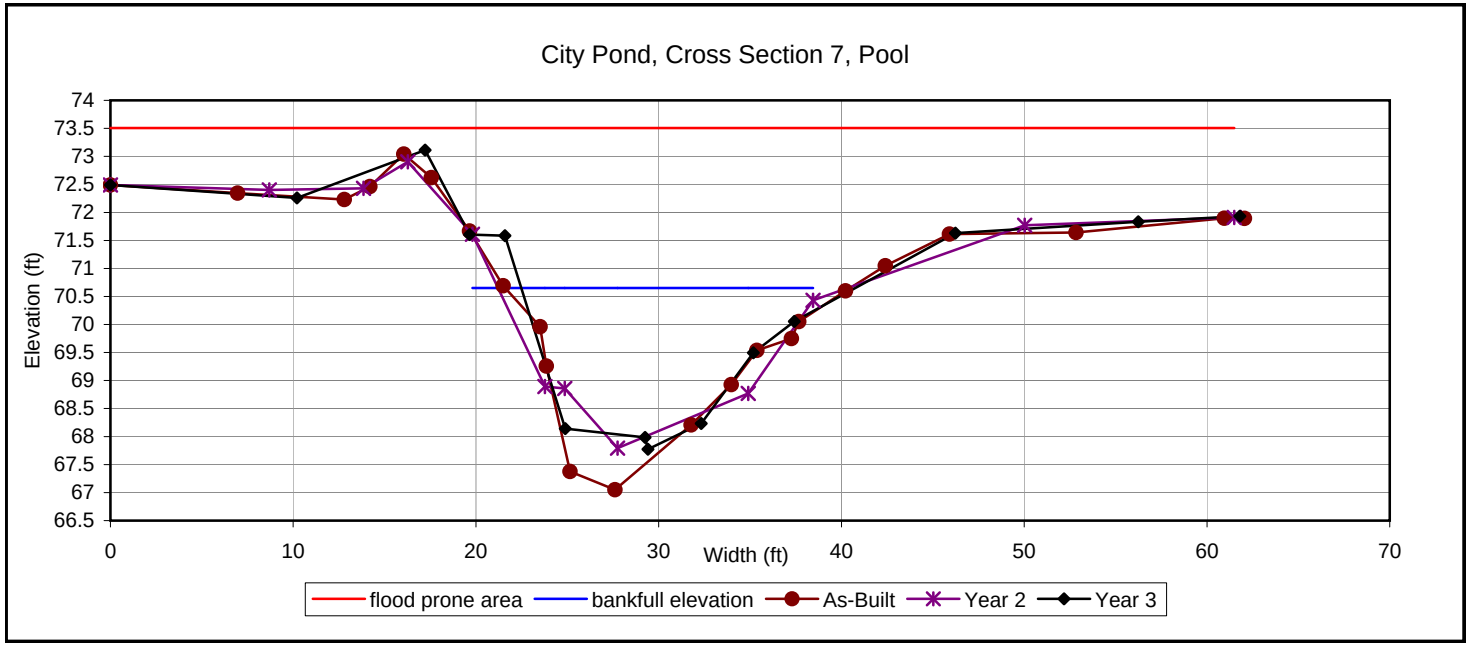


Right bank



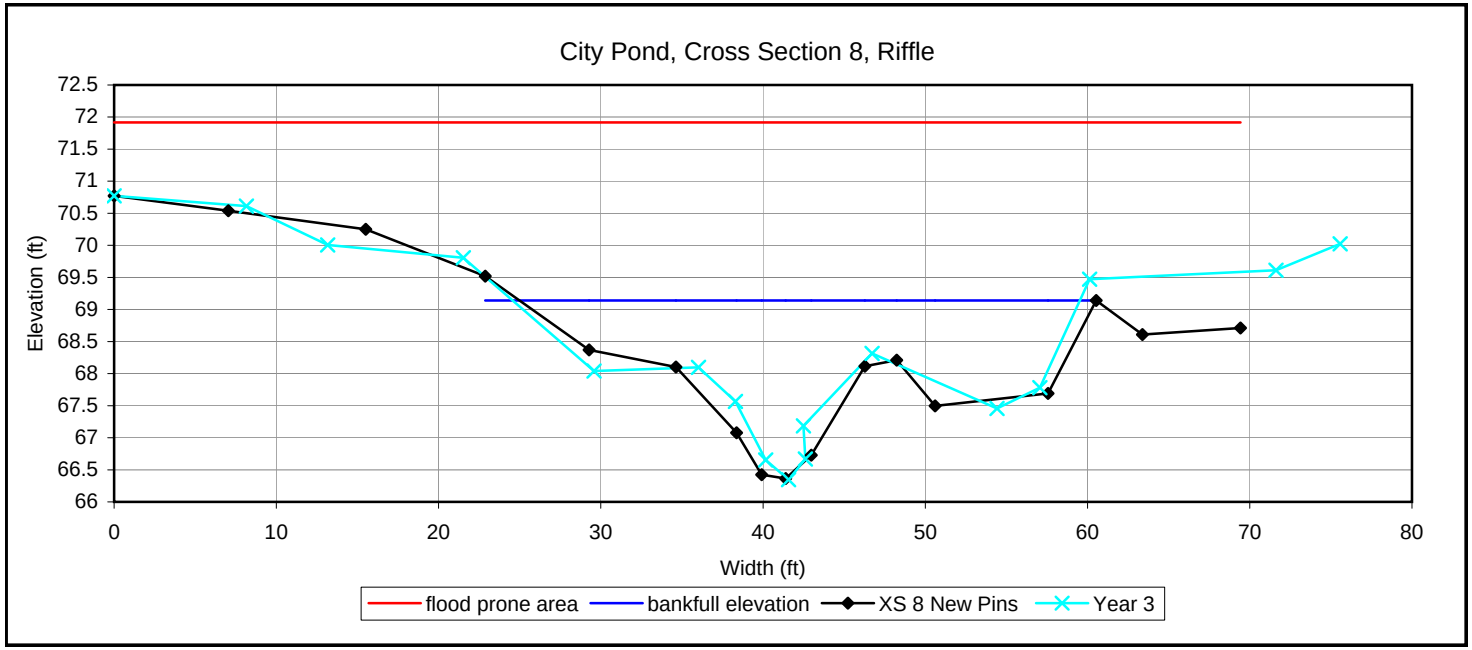
Left bank

Right bank



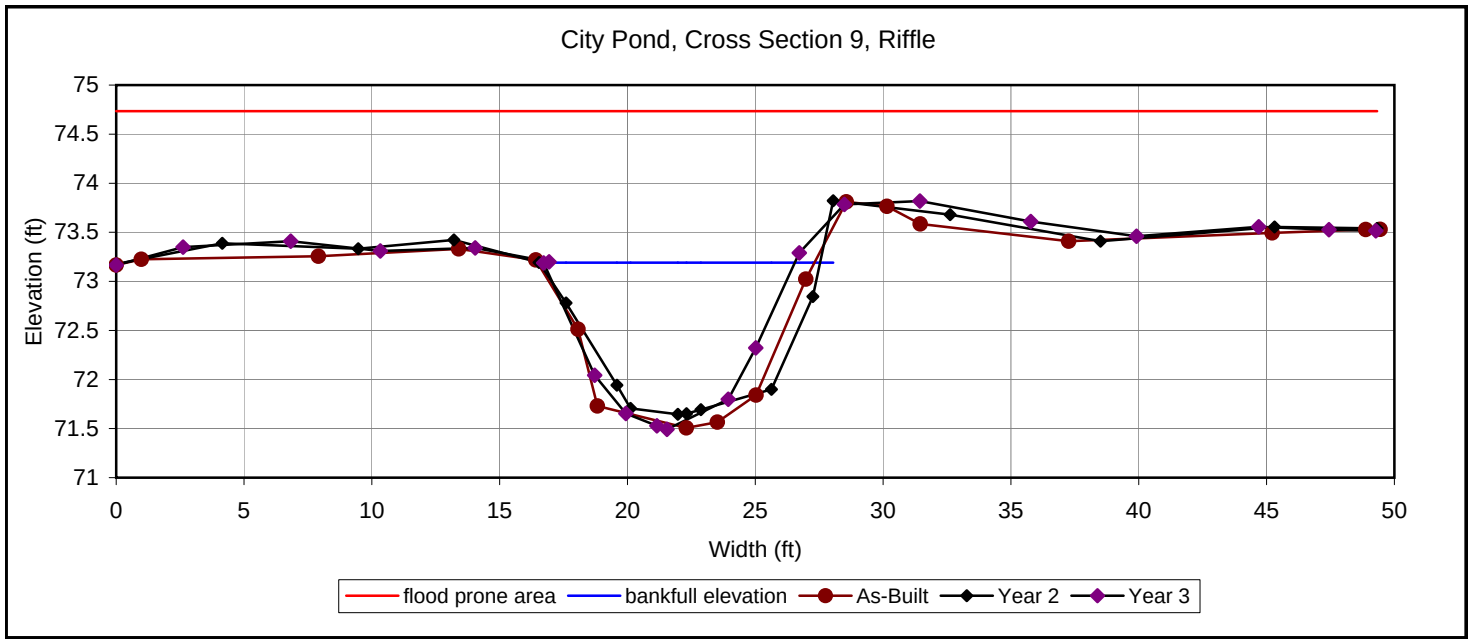
Left bank

Right bank



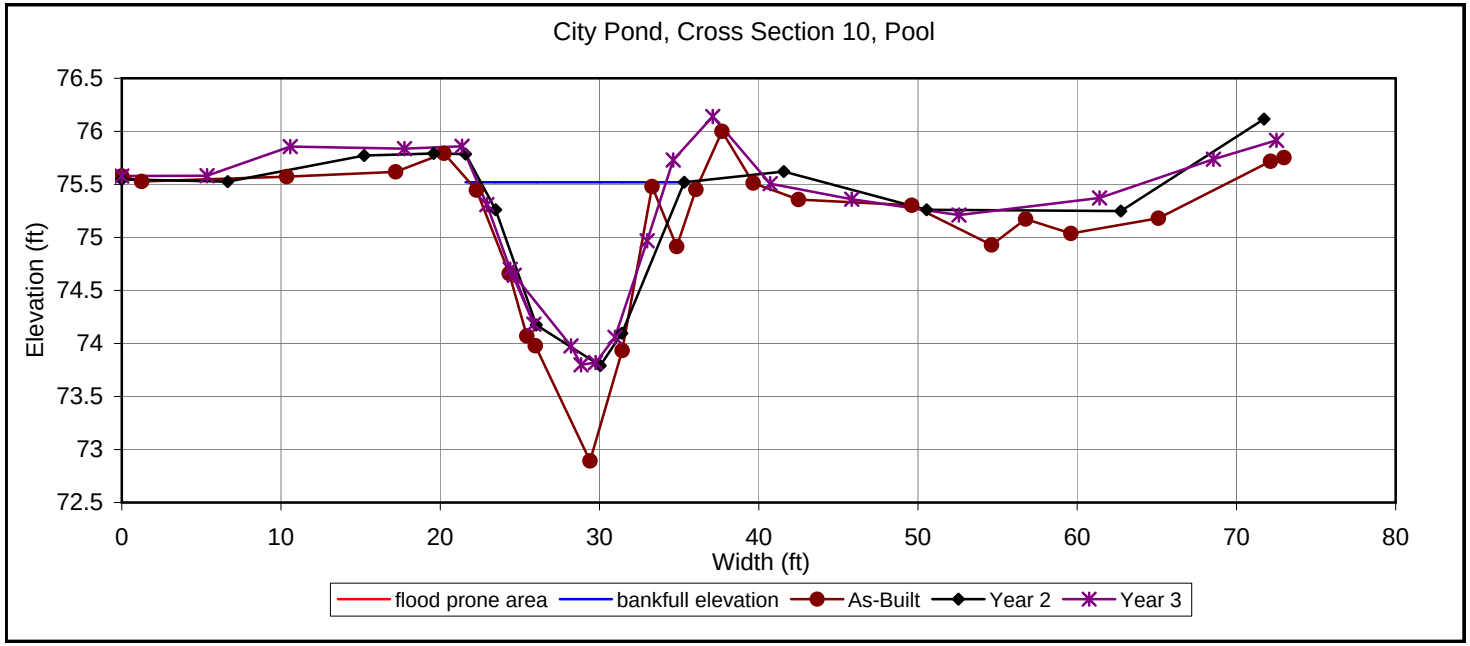
Left bank

Right bank



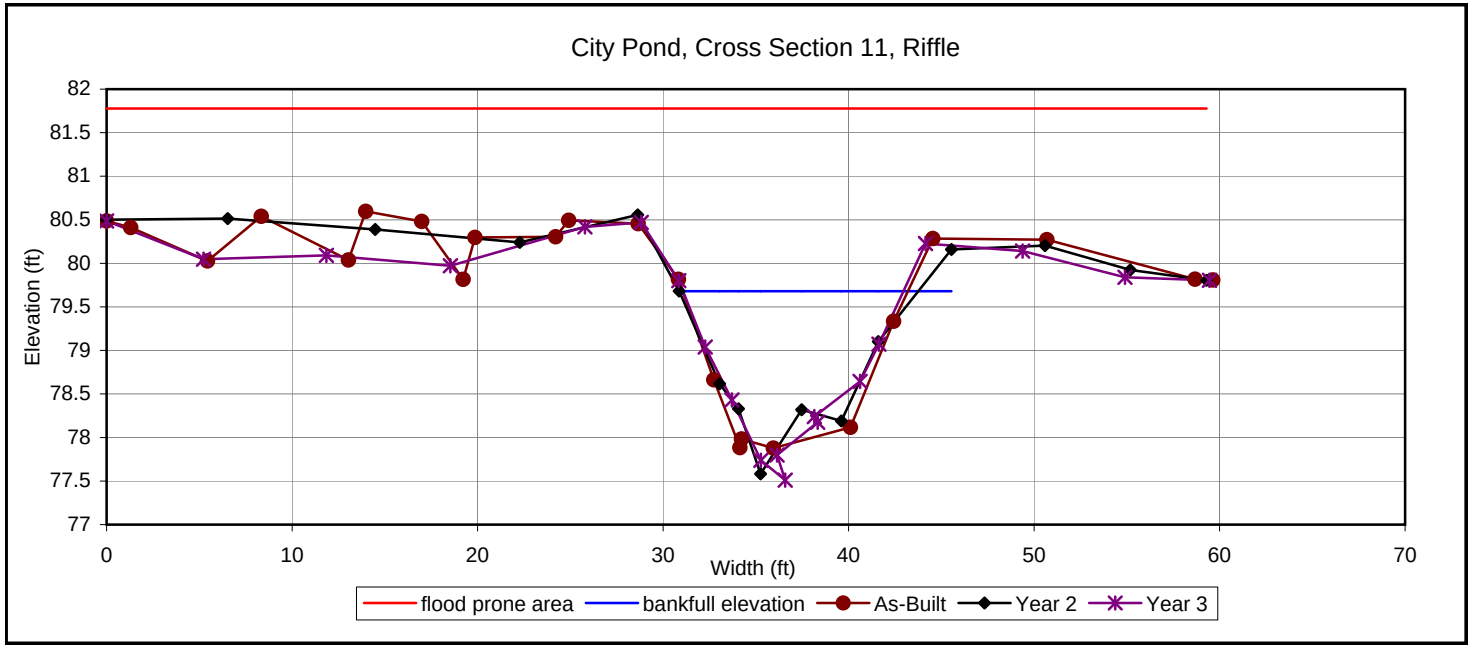
Left bank

Right bank



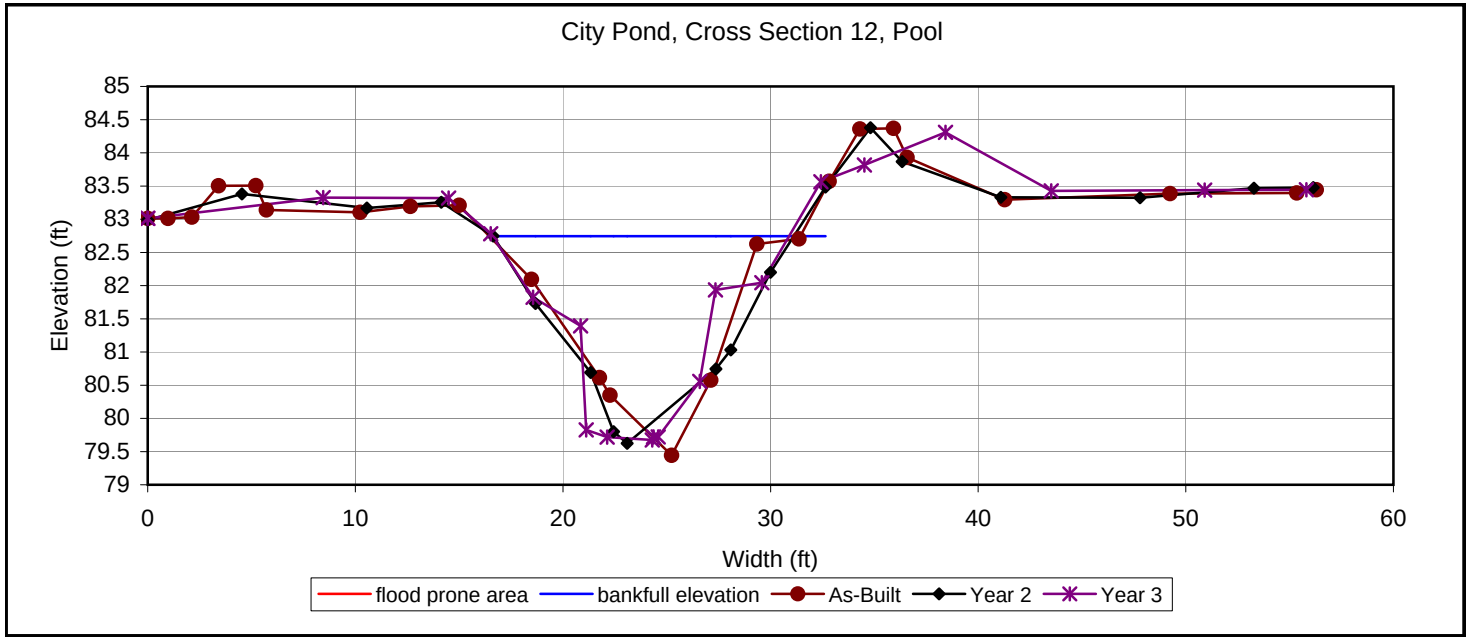
Left bank

Right bank



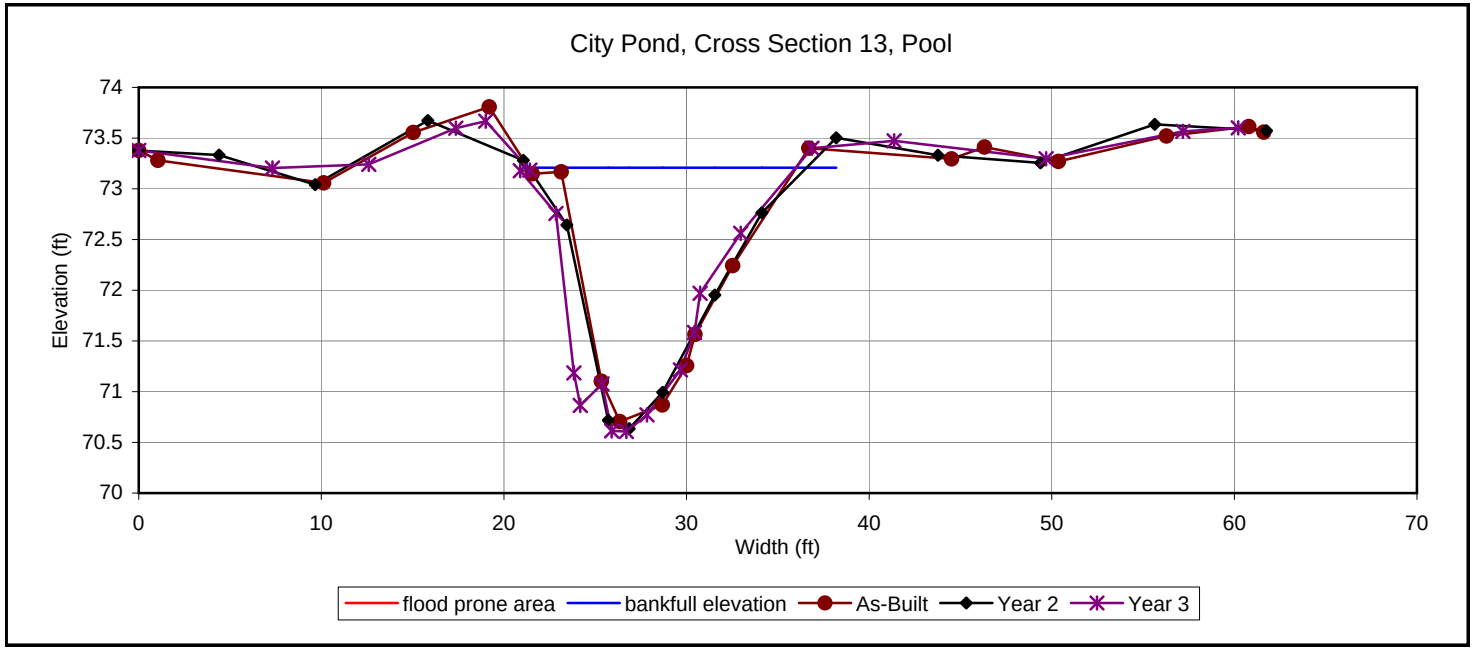
Left bank

Right bank



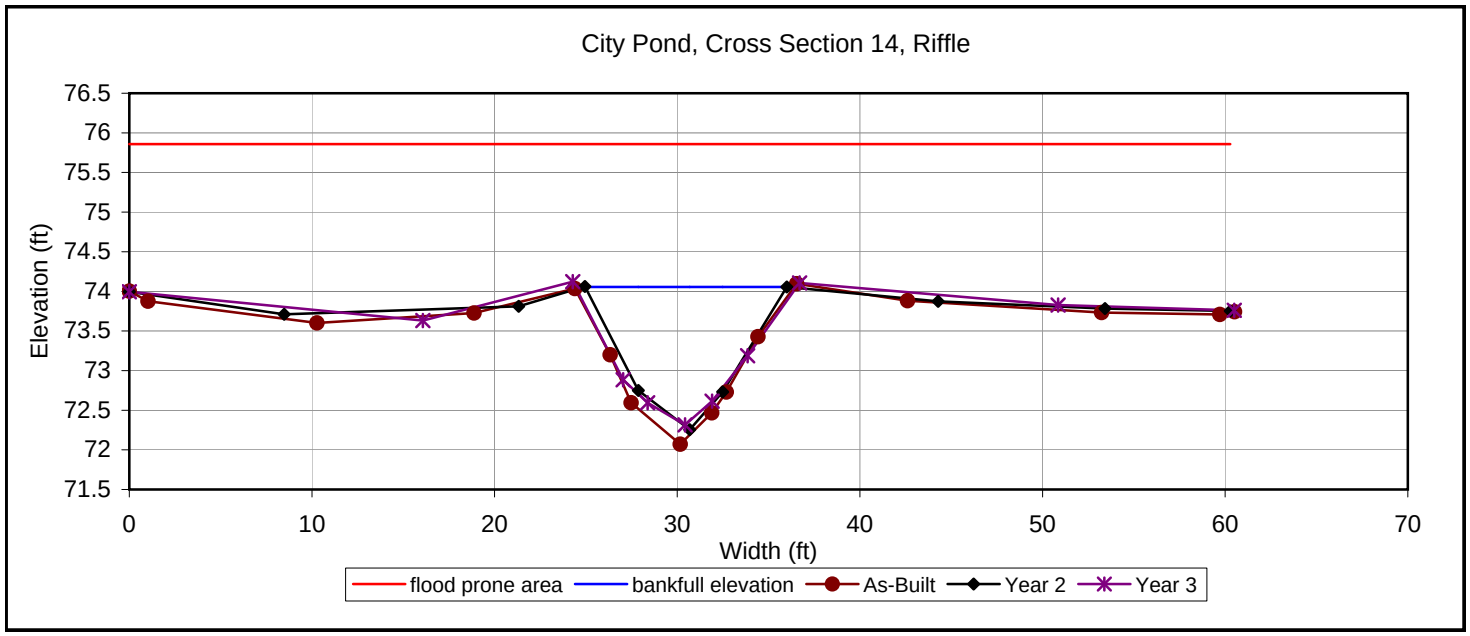
Left bank

Right bank



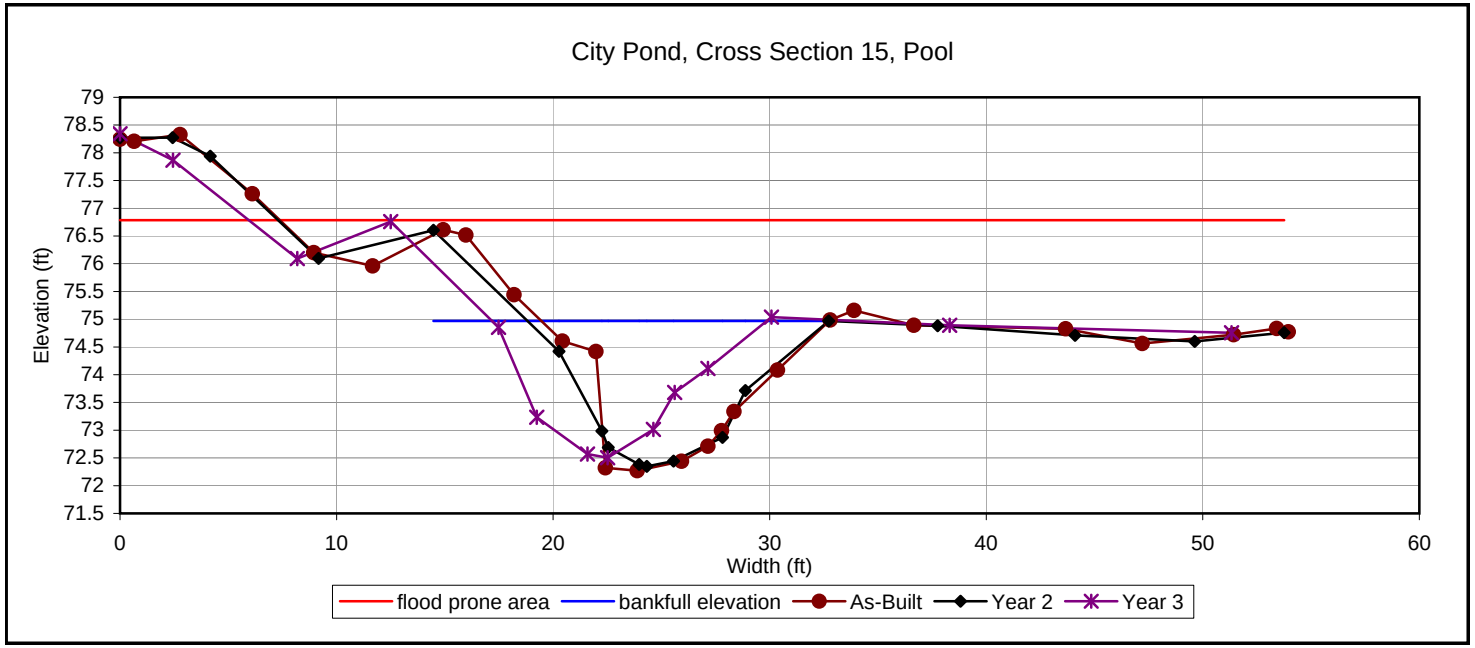
Left bank

Right bank



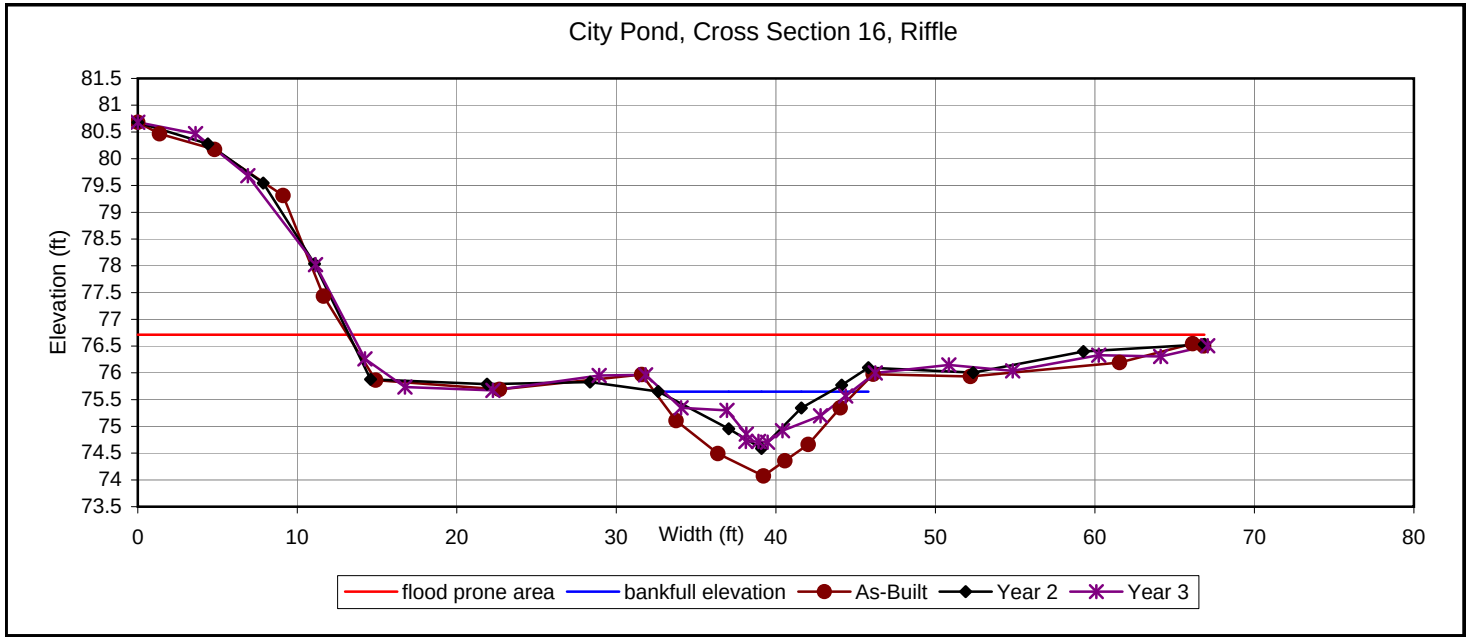
Left bank

Right bank



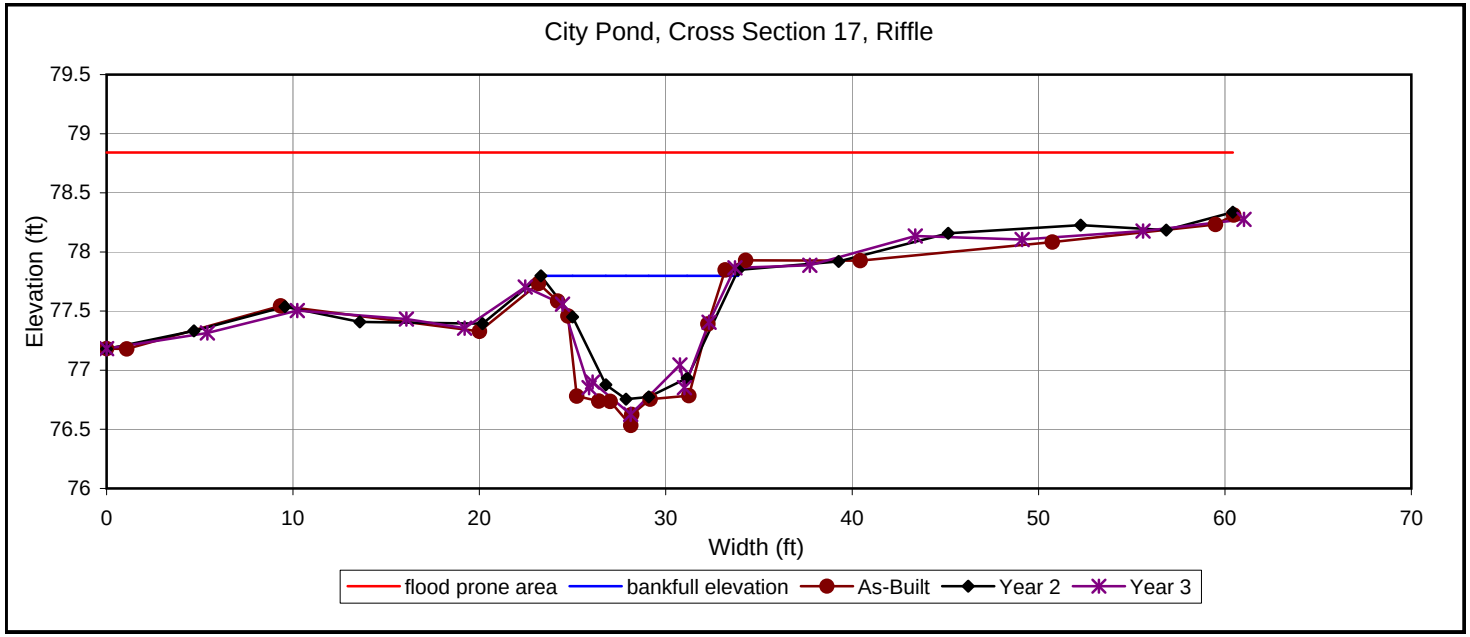
Left bank

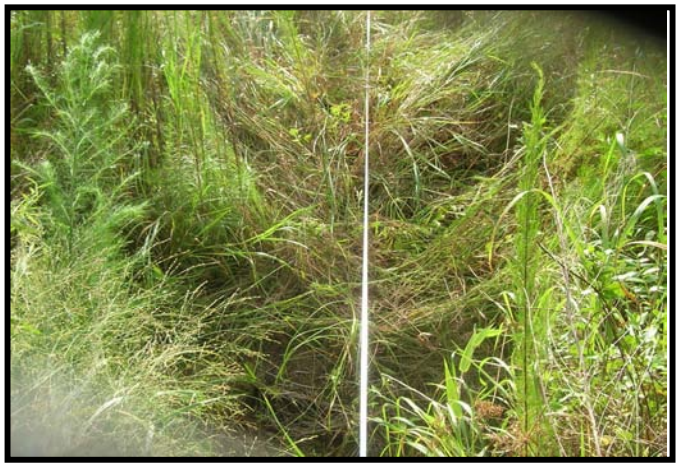
Right bank



Left bank

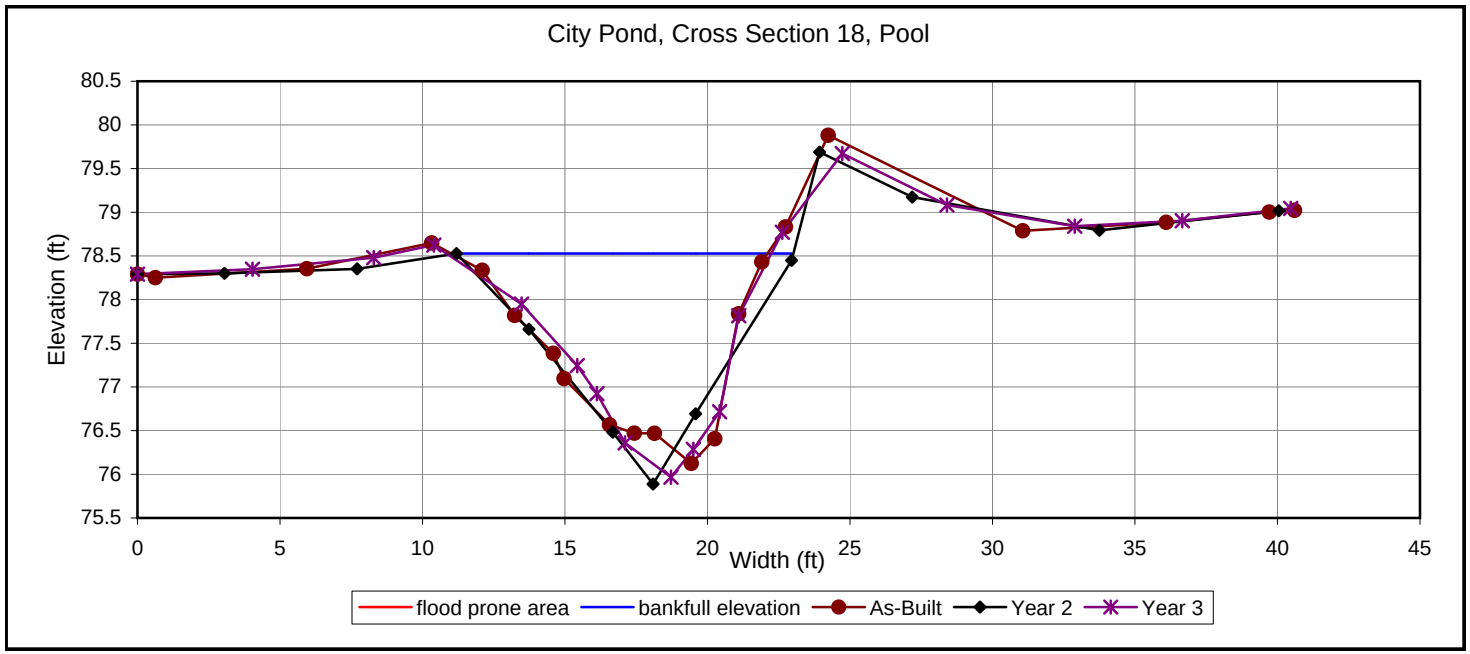
Right bank





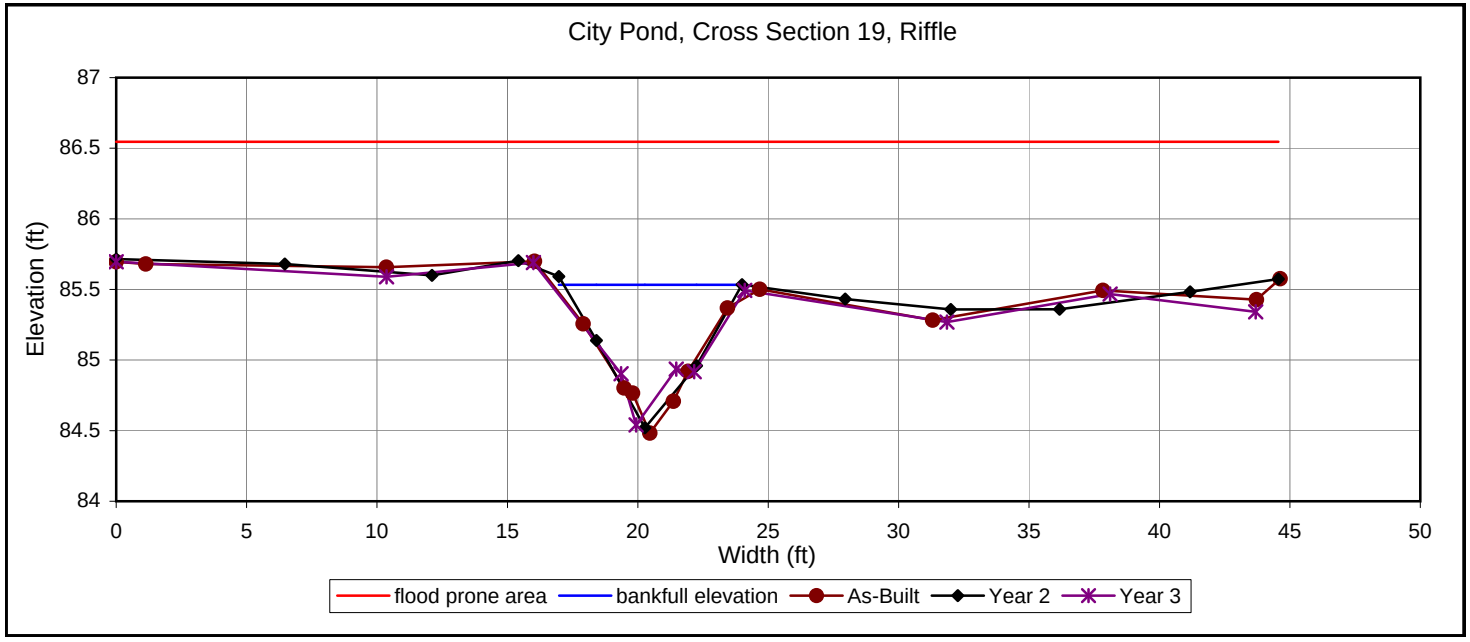
Left bank

Right bank



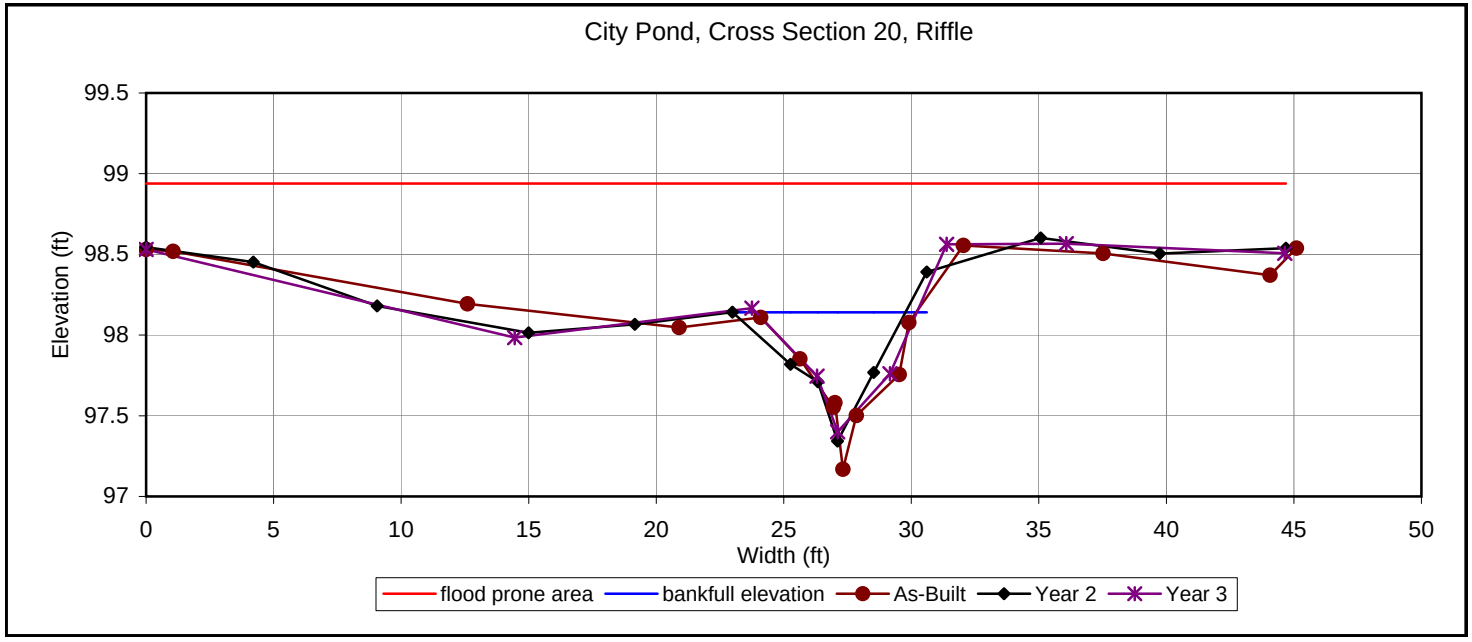
Left bank

Right bank



Left bank

Right bank



APPENDIX C

2007 Gauge Data

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
1-Jan-2007	08:00:00						
1-Jan-2007	20:00:00					0.1	
2-Jan-2007	08:00:00						
2-Jan-2007	20:00:00					0.12	
3-Jan-2007	08:00:00						
3-Jan-2007	20:00:00					0	
4-Jan-2007	08:00:00						
4-Jan-2007	20:00:00					0	
5-Jan-2007	08:00:00						
5-Jan-2007	20:00:00					0.01	
6-Jan-2007	08:00:00						
6-Jan-2007	20:00:00					0.5	
7-Jan-2007	08:00:00						
7-Jan-2007	20:00:00					0	
8-Jan-2007	08:00:00						
8-Jan-2007	20:00:00					0.73	
9-Jan-2007	08:00:00						
9-Jan-2007	20:00:00					0.01	
10-Jan-2007	08:00:00						
10-Jan-2007	20:00:00					0	
11-Jan-2007	08:00:00						
11-Jan-2007	20:00:00					0	
12-Jan-2007	08:00:00						
12-Jan-2007	20:00:00					0	
13-Jan-2007	08:00:00						
13-Jan-2007	20:00:00					0	
14-Jan-2007	08:00:00						
14-Jan-2007	20:00:00					0	
15-Jan-2007	08:00:00						
15-Jan-2007	20:00:00					0	
16-Jan-2007	08:00:00						
16-Jan-2007	20:00:00					0	
17-Jan-2007	08:00:00						
17-Jan-2007	20:00:00					0	
18-Jan-2007	08:00:00						
18-Jan-2007	20:00:00					0.15	
19-Jan-2007	08:00:00						
19-Jan-2007	20:00:00					0.35	
20-Jan-2007	08:00:00						
20-Jan-2007	20:00:00					0	
21-Jan-2007	08:00:00						
21-Jan-2007	20:00:00					0	
22-Jan-2007	08:00:00						
22-Jan-2007	20:00:00					0.75	
23-Jan-2007	08:00:00						
23-Jan-2007	20:00:00					0	
24-Jan-2007	08:00:00						
24-Jan-2007	20:00:00					0	
25-Jan-2007	08:00:00						

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
25-Jan-2007	20:00:00					0	
26-Jan-2007	08:00:00						
26-Jan-2007	20:00:00					0	
27-Jan-2007	08:00:00						
27-Jan-2007	20:00:00					0	
28-Jan-2007	08:00:00						
28-Jan-2007	20:00:00					0.03	
29-Jan-2007	08:00:00						
29-Jan-2007	20:00:00					0	
30-Jan-2007	08:00:00						
30-Jan-2007	20:00:00					0	
31-Jan-2007	08:00:00						
31-Jan-2007	20:00:00					0	2.75
1-Feb-2007	08:00:00						
1-Feb-2007	20:00:00					0.18	
2-Feb-2007	08:00:00						
2-Feb-2007	20:00:00					0.08	
3-Feb-2007	08:00:00						
3-Feb-2007	20:00:00					0	
4-Feb-2007	08:00:00						
4-Feb-2007	20:00:00					0	
5-Feb-2007	08:00:00						
5-Feb-2007	20:00:00					0	
6-Feb-2007	08:00:00						
6-Feb-2007	20:00:00					0	
7-Feb-2007	08:00:00						
7-Feb-2007	20:00:00					0	
8-Feb-2007	08:00:00						
8-Feb-2007	20:00:00					0	
9-Feb-2007	08:00:00						
9-Feb-2007	20:00:00					0	
10-Feb-2007	08:00:00						
10-Feb-2007	20:00:00					0	
11-Feb-2007	08:00:00						
11-Feb-2007	20:00:00					0	
12-Feb-2007	08:00:00						
12-Feb-2007	20:00:00					0	
13-Feb-2007	08:00:00						
13-Feb-2007	20:00:00					0	
14-Feb-2007	08:00:00						
14-Feb-2007	20:00:00					1.6	
15-Feb-2007	08:00:00						
15-Feb-2007	20:00:00					0	
16-Feb-2007	08:00:00						
16-Feb-2007	20:00:00					0	
17-Feb-2007	08:00:00						
17-Feb-2007	20:00:00					0	
18-Feb-2007	08:00:00						
18-Feb-2007	20:00:00					0	

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
19-Feb-2007	08:00:00						
19-Feb-2007	20:00:00					0	
20-Feb-2007	08:00:00						
20-Feb-2007	20:00:00	NA	1.95	0.00	8.536	0	
21-Feb-2007	08:00:00						
21-Feb-2007	20:00:00					0.03	
22-Feb-2007	08:00:00						
22-Feb-2007	20:00:00					0	
23-Feb-2007	08:00:00						
23-Feb-2007	20:00:00					0	
24-Feb-2007	08:00:00						
24-Feb-2007	20:00:00					0	
25-Feb-2007	08:00:00						
25-Feb-2007	20:00:00					0	
26-Feb-2007	08:00:00						
26-Feb-2007	20:00:00					0.8	
27-Feb-2007	08:00:00						
27-Feb-2007	20:00:00					0	
28-Feb-2007	08:00:00						
28-Feb-2007	20:00:00					0	2.69
1-Mar-2007	08:00:00						
1-Mar-2007	20:00:00					0	
2-Mar-2007	08:00:00						
2-Mar-2007	20:00:00					1.89	
3-Mar-2007	08:00:00						
3-Mar-2007	20:00:00					0	
4-Mar-2007	08:00:00						
4-Mar-2007	20:00:00					0	
5-Mar-2007	08:00:00						
5-Mar-2007	20:00:00					0	
6-Mar-2007	08:00:00						
6-Mar-2007	20:00:00					0	
7-Mar-2007	08:00:00						
7-Mar-2007	20:00:00					0	
8-Mar-2007	08:00:00						
8-Mar-2007	20:00:00					0	
9-Mar-2007	08:00:00						
9-Mar-2007	20:00:00					0	
10-Mar-2007	08:00:00						
10-Mar-2007	20:00:00					0	
11-Mar-2007	08:00:00						
11-Mar-2007	20:00:00					0	
12-Mar-2007	08:00:00						
12-Mar-2007	20:00:00					0	
13-Mar-2007	08:00:00						
13-Mar-2007	20:00:00					0	
14-Mar-2007	08:00:00						
14-Mar-2007	20:00:00					0	
15-Mar-2007	08:00:00						

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
15-Mar-2007	20:00:00					0	
16-Mar-2007	08:00:00						
16-Mar-2007	20:00:00					0.38	
17-Mar-2007	08:00:00						
17-Mar-2007	20:00:00					0.95	
18-Mar-2007	08:00:00						
18-Mar-2007	20:00:00					0	
19-Mar-2007	08:00:00						
19-Mar-2007	20:00:00					0	
20-Mar-2007	08:00:00						
20-Mar-2007	20:00:00					0	
21-Mar-2007	08:00:00						
21-Mar-2007	20:00:00					0	
22-Mar-2007	08:00:00						
22-Mar-2007	20:00:00					0	
23-Mar-2007	08:00:00						
23-Mar-2007	20:00:00					0	
24-Mar-2007	08:00:00						
24-Mar-2007	20:00:00					0	
25-Mar-2007	08:00:00						
25-Mar-2007	20:00:00					0	
26-Mar-2007	08:00:00						
26-Mar-2007	20:00:00	0	1.00	1.20	3.97	0	
27-Mar-2007	08:00:00						
27-Mar-2007	20:00:00					0	
28-Mar-2007	08:00:00						
28-Mar-2007	20:00:00					0	
29-Mar-2007	08:00:00						
29-Mar-2007	20:00:00					T	
30-Mar-2007	08:00:00						
30-Mar-2007	20:00:00					0.03	
31-Mar-2007	08:00:00						
31-Mar-2007	20:00:00					0	3.25
1-Apr-2007	08:00:00						
1-Apr-2007	20:00:00					0	
2-Apr-2007	08:00:00						
2-Apr-2007	20:00:00					0.36	
3-Apr-2007	08:00:00						
3-Apr-2007	20:00:00					0	
4-Apr-2007	08:00:00						
4-Apr-2007	20:00:00					0	
5-Apr-2007	08:00:00						
5-Apr-2007	20:00:00					0	
6-Apr-2007	08:00:00						
6-Apr-2007	20:00:00					0	
7-Apr-2007	08:00:00						
7-Apr-2007	20:00:00					0	
8-Apr-2007	08:00:00						
8-Apr-2007	20:00:00					0	

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
9-Apr-2007	08:00:00						
9-Apr-2007	20:00:00					0	
10-Apr-2007	08:00:00						
10-Apr-2007	20:00:00					T	
11-Apr-2007	08:00:00						
11-Apr-2007	20:00:00					0.07	
12-Apr-2007	08:00:00						
12-Apr-2007	20:00:00					1.34	
13-Apr-2007	08:00:00						
13-Apr-2007	20:00:00					0	
14-Apr-2007	08:00:00						
14-Apr-2007	20:00:00					0	
15-Apr-2007	08:00:00						
15-Apr-2007	20:00:00					1.15	
16-Apr-2007	08:00:00						
16-Apr-2007	20:00:00					0.63	
17-Apr-2007	08:00:00						
17-Apr-2007	20:00:00					0	
18-Apr-2007	08:00:00						
18-Apr-2007	20:00:00					0	
19-Apr-2007	08:00:00						
19-Apr-2007	20:00:00					0	
20-Apr-2007	08:00:00						
20-Apr-2007	20:00:00					0.12	
21-Apr-2007	08:00:00						
21-Apr-2007	20:00:00					0	
22-Apr-2007	08:00:00						
22-Apr-2007	20:00:00					0	
23-Apr-2007	08:00:00						
23-Apr-2007	20:00:00	0	0.70	0.10	3.98	0	
24-Apr-2007	08:00:00						
24-Apr-2007	20:00:00					0	
25-Apr-2007	08:00:00						
25-Apr-2007	20:00:00					0	
26-Apr-2007	08:00:00						
26-Apr-2007	20:00:00					0	
27-Apr-2007	08:00:00						
27-Apr-2007	20:00:00					0	
28-Apr-2007	08:00:00						
28-Apr-2007	20:00:00					0	
29-Apr-2007	08:00:00						
29-Apr-2007	20:00:00					0	
30-Apr-2007	08:00:00						
30-Apr-2007	20:00:00					0	3.67
1-May-2007	08:00:00						
1-May-2007	20:00:00					0	
2-May-2007	08:00:00						
2-May-2007	20:00:00					0	
3-May-2007	08:00:00						

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
3-May-2007	20:00:00					0	
4-May-2007	08:00:00						
4-May-2007	20:00:00					0.21	
5-May-2007	08:00:00						
5-May-2007	20:00:00					0.08	
6-May-2007	08:00:00						
6-May-2007	20:00:00					0.33	
7-May-2007	08:00:00						
7-May-2007	20:00:00					0	
8-May-2007	08:00:00						
8-May-2007	20:00:00					0	
9-May-2007	08:00:00						
9-May-2007	20:00:00					0.03	
10-May-2007	08:00:00						
10-May-2007	20:00:00					0.13	
11-May-2007	08:00:00						
11-May-2007	20:00:00					0	
12-May-2007	08:00:00						
12-May-2007	20:00:00					0	
13-May-2007	08:00:00						
13-May-2007	20:00:00					1.11	
14-May-2007	08:00:00						
14-May-2007	20:00:00					0.01	
15-May-2007	08:00:00						
15-May-2007	20:00:00					0	
16-May-2007	08:00:00						
16-May-2007	20:00:00					0	
17-May-2007	08:00:00						
17-May-2007	20:00:00					T	
18-May-2007	08:00:00						
18-May-2007	20:00:00					0	
19-May-2007	08:00:00						
19-May-2007	20:00:00					0	
20-May-2007	08:00:00						
20-May-2007	20:00:00					0	
21-May-2007	08:00:00						
21-May-2007	20:00:00	0	2.10	0.10	1.933	0	
22-May-2007	08:00:00						
22-May-2007	20:00:00					0	
23-May-2007	08:00:00						
23-May-2007						0	
24-May-2007							
24-May-2007						0	
25-May-2007							
25-May-2007						0	
26-May-2007							
26-May-2007						0	
27-May-2007							
27-May-2007						0	

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
28-May-2007							
28-May-2007						0	
29-May-2007							
29-May-2007						0	
30-May-2007							
30-May-2007						0	
31-May-2007							
31-May-2007						0.62	2.52
1-Jun-2007							
1-Jun-2007						0	
2-Jun-2007							
2-Jun-2007						0	
3-Jun-2007							
3-Jun-2007						1	
4-Jun-2007							
4-Jun-2007						0.32	
5-Jun-2007							
5-Jun-2007						T	
6-Jun-2007							
6-Jun-2007						0	
7-Jun-2007							
7-Jun-2007						0	
8-Jun-2007							
8-Jun-2007						0	
9-Jun-2007							
9-Jun-2007						0.35	
10-Jun-2007							
10-Jun-2007						0	
11-Jun-2007							
11-Jun-2007						0	
12-Jun-2007							
12-Jun-2007						0.05	
13-Jun-2007							
13-Jun-2007						0.1	
14-Jun-2007							
14-Jun-2007						0.03	
15-Jun-2007							
15-Jun-2007						0.98	
16-Jun-2007							
16-Jun-2007						0.02	
17-Jun-2007							
17-Jun-2007						0	
18-Jun-2007							
18-Jun-2007						0	
19-Jun-2007							
19-Jun-2007						0	
20-Jun-2007							
20-Jun-2007						0.03	
21-Jun-2007							

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
21-Jun-2007						T	
22-Jun-2007							
22-Jun-2007						0	
23-Jun-2007							
23-Jun-2007						0.02	
24-Jun-2007							
24-Jun-2007						0	
25-Jun-2007							
25-Jun-2007						0.37	
26-Jun-2007							
26-Jun-2007						0.27	
27-Jun-2007							
27-Jun-2007		NA	NA	NA	4.03	0	
28-Jun-2007							
28-Jun-2007						0	
29-Jun-2007							
29-Jun-2007						0	
30-Jun-2007							
30-Jun-2007						1	4.54
1-Jul-2007							
1-Jul-2007						0.88	
2-Jul-2007							
2-Jul-2007						0	
3-Jul-2007							
3-Jul-2007						0	
4-Jul-2007							
4-Jul-2007						0	
5-Jul-2007							
5-Jul-2007						0	
6-Jul-2007							
6-Jul-2007						0	
7-Jul-2007							
7-Jul-2007						0	
8-Jul-2007							
8-Jul-2007						0	
9-Jul-2007							
9-Jul-2007						T	
10-Jul-2007							
10-Jul-2007						0.5	
11-Jul-2007							
11-Jul-2007						0.04	
12-Jul-2007							
12-Jul-2007						0.07	
13-Jul-2007							
13-Jul-2007						0	
14-Jul-2007							
14-Jul-2007						T	
15-Jul-2007							
15-Jul-2007						0	

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
16-Jul-2007							
16-Jul-2007						0.35	
17-Jul-2007							
17-Jul-2007						0.02	
18-Jul-2007							
18-Jul-2007						0.06	
19-Jul-2007							
19-Jul-2007						0	
20-Jul-2007							
20-Jul-2007						0	
21-Jul-2007							
21-Jul-2007						0	
22-Jul-2007							
22-Jul-2007						0	
23-Jul-2007							
23-Jul-2007						0	
24-Jul-2007							
24-Jul-2007		NA	NA	NA	1.56	0	
25-Jul-2007							
25-Jul-2007						0	
26-Jul-2007							
26-Jul-2007						0	
27-Jul-2007							
27-Jul-2007						0	
28-Jul-2007							
28-Jul-2007						1	
29-Jul-2007							
29-Jul-2007						0	
30-Jul-2007							
30-Jul-2007						0	
31-Jul-2007							
31-Jul-2007						0.07	2.99
1-Aug-2007							
1-Aug-2007						0	
2-Aug-2007							
2-Aug-2007						0	
3-Aug-2007							
3-Aug-2007						0	
4-Aug-2007							
4-Aug-2007						0	
5-Aug-2007							
5-Aug-2007						0	
6-Aug-2007							
6-Aug-2007						0.03	
7-Aug-2007							
7-Aug-2007						0	
8-Aug-2007							
8-Aug-2007						0	
9-Aug-2007							

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
9-Aug-2007						0	
10-Aug-2007							
10-Aug-2007						0	
11-Aug-2007							
11-Aug-2007						T	
12-Aug-2007							
12-Aug-2007						0	
13-Aug-2007							
13-Aug-2007						0	
14-Aug-2007							
14-Aug-2007						0	
15-Aug-2007							
15-Aug-2007						0	
16-Aug-2007							
16-Aug-2007						0	
17-Aug-2007							
17-Aug-2007						T	
18-Aug-2007							
18-Aug-2007						0	
19-Aug-2007							
19-Aug-2007						0	
20-Aug-2007							
20-Aug-2007						0	
21-Aug-2007							
21-Aug-2007						0	
22-Aug-2007							
22-Aug-2007						0	
23-Aug-2007							
23-Aug-2007						0.37	
24-Aug-2007							
24-Aug-2007						0.08	
25-Aug-2007							
25-Aug-2007						0	
26-Aug-2007							
26-Aug-2007						0	
27-Aug-2007							
27-Aug-2007						0.02	
28-Aug-2007							
28-Aug-2007						0	
29-Aug-2007							
29-Aug-2007		0	0	0	1.75	0.5	
30-Aug-2007							
30-Aug-2007						0.34	
31-Aug-2007							
31-Aug-2007						0.25	1.59
1-Sep-2007							
1-Sep-2007						0	
2-Sep-2007							
2-Sep-2007						0	

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
3-Sep-2007							
3-Sep-2007						0	
4-Sep-2007							
4-Sep-2007						0	
5-Sep-2007							
5-Sep-2007						0	
6-Sep-2007							
6-Sep-2007						0	
7-Sep-2007							
7-Sep-2007						0	
8-Sep-2007							
8-Sep-2007						0	
9-Sep-2007							
9-Sep-2007						0	
10-Sep-2007							
10-Sep-2007						0	
11-Sep-2007							
11-Sep-2007						0	
12-Sep-2007							
12-Sep-2007						0	
13-Sep-2007							
13-Sep-2007						0.01	
14-Sep-2007							
14-Sep-2007						0	
15-Sep-2007							
15-Sep-2007						1.68	
16-Sep-2007							
16-Sep-2007						0	
17-Sep-2007							
17-Sep-2007						0	
18-Sep-2007							
18-Sep-2007						0	
19-Sep-2007							
19-Sep-2007						0	
20-Sep-2007							
20-Sep-2007						0	
21-Sep-2007							
21-Sep-2007						0	
22-Sep-2007							
22-Sep-2007						0	
23-Sep-2007							
23-Sep-2007						0	
24-Sep-2007							
24-Sep-2007						0	
25-Sep-2007							
25-Sep-2007		0	0	0	2.3	0	
26-Sep-2007							
26-Sep-2007						0	
27-Sep-2007							

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
27-Sep-2007						0	
28-Sep-2007							
28-Sep-2007						0	
29-Sep-2007							
29-Sep-2007						0	
30-Sep-2007							
30-Sep-2007						0	1.69
1-Oct-2007							
1-Oct-2007						0	
2-Oct-2007							
2-Oct-2007						0	
3-Oct-2007							
3-Oct-2007						0	
4-Oct-2007							
4-Oct-2007						0	
5-Oct-2007							
5-Oct-2007						0	
6-Oct-2007							
6-Oct-2007						0	
7-Oct-2007							
7-Oct-2007						0	
8-Oct-2007							
8-Oct-2007						0	
9-Oct-2007							
9-Oct-2007						0	
10-Oct-2007							
10-Oct-2007						0	
11-Oct-2007							
11-Oct-2007						0	
12-Oct-2007							
12-Oct-2007						0	
13-Oct-2007							
13-Oct-2007						0	
14-Oct-2007							
14-Oct-2007						0	
15-Oct-2007							
15-Oct-2007						0	
16-Oct-2007							
16-Oct-2007						0	
17-Oct-2007							
17-Oct-2007						0	
18-Oct-2007							
18-Oct-2007						0	
19-Oct-2007							
19-Oct-2007						0	
20-Oct-2007							
20-Oct-2007						0	
21-Oct-2007							
21-Oct-2007						0	

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
22-Oct-2007							
22-Oct-2007					0.05	0	
23-Oct-2007							
23-Oct-2007						0	
24-Oct-2007							
24-Oct-2007						0	
25-Oct-2007							
25-Oct-2007						0	
26-Oct-2007							
26-Oct-2007						0	
27-Oct-2007							
27-Oct-2007						0	
28-Oct-2007							
28-Oct-2007						0	
29-Oct-2007							
29-Oct-2007						0	
30-Oct-2007							
30-Oct-2007						0	
31-Oct-2007							
31-Oct-2007						0	0
1-Nov-2007							
1-Nov-2007						0	
2-Nov-2007							
2-Nov-2007						0	
3-Nov-2007							
3-Nov-2007						0	
4-Nov-2007							
4-Nov-2007						0	
5-Nov-2007							
5-Nov-2007						0	
6-Nov-2007							
6-Nov-2007						0	
7-Nov-2007							
7-Nov-2007						0	
8-Nov-2007							
8-Nov-2007						0	
9-Nov-2007							
9-Nov-2007						0	
10-Nov-2007							
10-Nov-2007						0	
11-Nov-2007							
11-Nov-2007						0	
12-Nov-2007							
12-Nov-2007						0	
13-Nov-2007							
13-Nov-2007						0	
14-Nov-2007							
14-Nov-2007						0	
15-Nov-2007							

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
15-Nov-2007						0.21	
16-Nov-2007							
16-Nov-2007						0	
17-Nov-2007							
17-Nov-2007						0	
18-Nov-2007							
18-Nov-2007						0	
19-Nov-2007							
19-Nov-2007						0	
20-Nov-2007							
20-Nov-2007						0	
21-Nov-2007							
21-Nov-2007						0	
22-Nov-2007							
22-Nov-2007						0	
23-Nov-2007							
23-Nov-2007						0	
24-Nov-2007							
24-Nov-2007						0	
25-Nov-2007							
25-Nov-2007						0	
26-Nov-2007							
26-Nov-2007						0.02	
27-Nov-2007							
27-Nov-2007		0	0	0	2.87	0.08	
28-Nov-2007							
28-Nov-2007						0	
29-Nov-2007							
29-Nov-2007							
30-Nov-2007							
30-Nov-2007							0.31
1-Dec-2007							
1-Dec-2007							
2-Dec-2007							
2-Dec-2007							
3-Dec-2007							
3-Dec-2007							
4-Dec-2007							
4-Dec-2007							
5-Dec-2007							
5-Dec-2007							
6-Dec-2007							
6-Dec-2007							
7-Dec-2007							
7-Dec-2007							
8-Dec-2007							
8-Dec-2007							
9-Dec-2007							
9-Dec-2007							

						Weatherstation Rainfall Data	
Date	Time				On-site Raingauge	Wadesboro Daily Rainfall	Wadesboro Monthly Rainfall
dd-mmm-yyyy	hh:mm:ss	CG1	CG2	CG3			
10-Dec-2007							
10-Dec-2007							
11-Dec-2007							
11-Dec-2007							
12-Dec-2007							
12-Dec-2007							
13-Dec-2007							
13-Dec-2007							
14-Dec-2007							
14-Dec-2007							
15-Dec-2007							
15-Dec-2007							
16-Dec-2007							
16-Dec-2007							
17-Dec-2007							
17-Dec-2007							
18-Dec-2007							
18-Dec-2007							
19-Dec-2007							
19-Dec-2007							
20-Dec-2007							
20-Dec-2007							
21-Dec-2007							
21-Dec-2007							
22-Dec-2007							
22-Dec-2007							
23-Dec-2007							
23-Dec-2007							
24-Dec-2007							
24-Dec-2007							
25-Dec-2007							
25-Dec-2007							
26-Dec-2007							
26-Dec-2007							
27-Dec-2007							
27-Dec-2007							
28-Dec-2007							
28-Dec-2007							
29-Dec-2007							
29-Dec-2007							
30-Dec-2007							
30-Dec-2007							
31-Dec-2007							
31-Dec-2007							

APPENDIX D

2007 Site Photos

Left bank erosion @ station 10+20 facing upstream (R1)

Left bank erosion @ station 10+20 facing downstream (R1)

Erosion behind log weir @ station 11+20 (S1)

Erosion behind log weir @ station 12+00 (S1)

No vegetation along bank @ station 17+00 (R2)

Erosion behind coir matting @ station 36+00 (R2)

Improper installation of coir matting along Reach R1

Root wad

Vegetation in channel (typ.)

Typical length of channel in Reach S4

Constructed riffle (typ.)

Log weir (typ.)

Log grade control/constructed riffle in Reach S1 (typ.)