

FINAL
Conoconnara Mitigation Project
Halifax County, North Carolina
DENR-EEP Contract No. 16-D05024
Year 4 Monitoring Report



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1.0 SUMMARY

This Annual Report details the monitoring activities during the 2010 growing season on the Conoconnara Mitigation Site. Construction of the Site, including planting of trees, was completed in March 2007. The 2010 data represent results from the fourth year of monitoring for both wetlands and streams.

The design for the Conoconnara Site involved stream restoration, non-riverine wetland restoration, non-riverine wetland enhancement, and non-riverine wetland preservation. After construction, it was determined that the project generated 5,050 feet of stream restoration, 69 acres of wetland restoration, eight acres of wetland enhancement, and 71 acres of wetland preservation. The As-Built survey is included as Appendix A.

This Annual Report presents the data from 12 automated hydrology monitoring stations, 24 vegetation monitoring plots, two crest gauges, one rain gauge, ten cross sections, approximately 3,000 linear feet of profile survey, and photographic reference locations, as specified in the approved Restoration Plan for the Site.

Weather station data from the Enfield Weather Station were used in conjunction with a manual rain gauge located on the site to document precipitation amounts. The manual gauge is used to validate observations made at the automated station. The site generally received normal rainfall amounts through the early part of the 2010 growing season, and experienced drought conditions in the latter half of the growing season.

In 2010, ten of the 12 hydrology monitoring gauges recorded a sub-surface hydroperiod of at least seven percent of the growing season. The additional gauges achieved the seven percent criterion based upon surface (perched) hydrology. Therefore, all 12 gauges met the hydrology success criterion defined in the Restoration Plan. The hydrology of the targeted restored wetland system (non-riverine wetland hardwoods) is highly variable across a given Site, supporting the ecological and functional diversity that makes these systems so valuable.

This Annual Monitoring Report provides data on vegetation survival at 24 vegetation monitoring plots. Year 4 monitoring documented a surviving vegetation average of 520 stems per acre, and a range of 310 to 720 stems per acre. The interim vegetation success criterion of the survival of 320 planted trees per acre at the end of year three had earlier been met at 23 of 24 plots. The Site is on track to meet the final vegetative success criteria of the survival of 260 planted trees per acre at the end of Year 5 of the monitoring period.

Multiple bankfull events were recorded at both Crest Gauge 1 and Crest Gauge 2 in 2010. The restored stream channel has remained stable and is providing the intended habitat and hydrologic functions. All monitored cross sections and longitudinal profiles for 2010 show little adjustment in stream dimension. There are a few areas of minor erosion, and no remedial actions or repairs are required.

2.0 INTRODUCTION

2.1 PROJECT DESCRIPTION

The Conoconnara Stream and Wetland Mitigation Project is in Halifax County, North Carolina. The site is just outside of Tillery, approximately 17 miles southeast of Roanoke Rapids (**Figure 1**). The property is 567 acres located immediately south of NC 561, and is accessed via a farm road 1.1 miles east of Tillery. Construction at the site was completed in March 2006. Groundwater, surface water, and rain gauges were functional beginning in March 2006. The 2010 monitoring season represents Year 4 of monitoring for the Site.

Looking Glass Run has a drainage area of 562 acres (0.88 mi²) at the downstream end of the restoration project. The USGS Scotland Neck, NC topographic quadrangle (**Figure 2**) shows that drainage from the site flows in two directions. The northern portion of the site flows primarily to Conoconnara Swamp, while the southern portion of the Site drains to Looking Glass Run. There were numerous agricultural ditches and swales on the project property that were used to promote drainage. The ditches and swales were constructed to route water off the site, draining areas that were once wetland. On-site topography, soils, and existing wetland areas demonstrate that the site historically supported both riverine and non-riverine wetland areas. The wetland mitigation is divided between four distinct sites. These include restoration areas in prior-converted cropland, one enhancement area in the Looking Glass Run headwaters, and one preservation area adjacent to the stream restoration corridor. The 63.64-acre wetland restoration area has a drainage area of 130 acres (0.20 mi²). The 5.36-acre wetland restoration area has a drainage area of 13.73 acres (0.02 mi²). The historic land use was agricultural production of cotton and soybeans, pine plantation, and woodland. Local drainage patterns had been altered in the past to drain wetlands and promote agricultural production. The restoration and preservation areas are protected by a conservation easement.

2.2 PROJECT PURPOSE

The objective of the Conoconnara Stream and Wetland Mitigation Project is to provide 5,050 stream mitigation units (SMU) and 87 wetland mitigation units (WMU) to the EEP through the full delivery process in the Roanoke River 03010107 hydrologic unit. Stream mitigation was provided through restoration on Looking Glass Run. Non-riverine wetland mitigation was provided through preservation, enhancement, and restoration. The Site was identified and developed by EBX to support the NC EEP full delivery mitigation process. Monitoring of the Conoconnara Site is required to demonstrate successful mitigation based on the criteria found in the Restoration Plan, and through a comparison to reference site conditions. The success criteria components will adhere to EEP and USACE guidelines. Hydrology, vegetation, and stream monitoring are conducted on an annual basis. This Annual Monitoring Report details the results of the monitoring efforts for 2010 (Year 4) at the Conoconnara Mitigation Site.

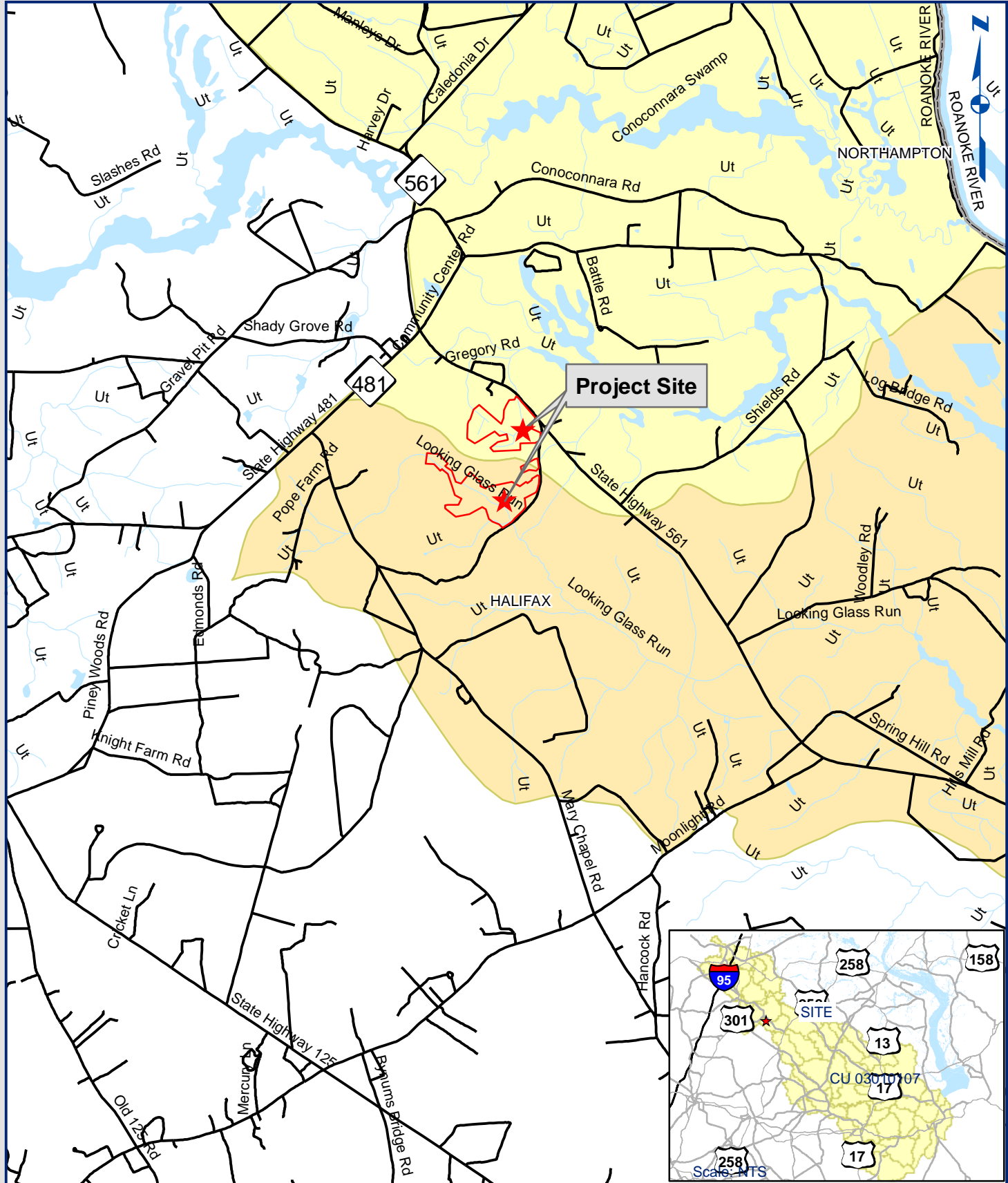





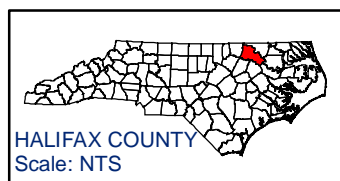
Figure 1.
Site Location Map
Conoconarra

SOURCES: NCDOT, NRCS, USGS

0 0.25 0.5 1 1.5 2 Miles

LEGEND

-  Road
-  Existing Waterbody
-  HUC 03010107090020
-  HUC 03010107090030



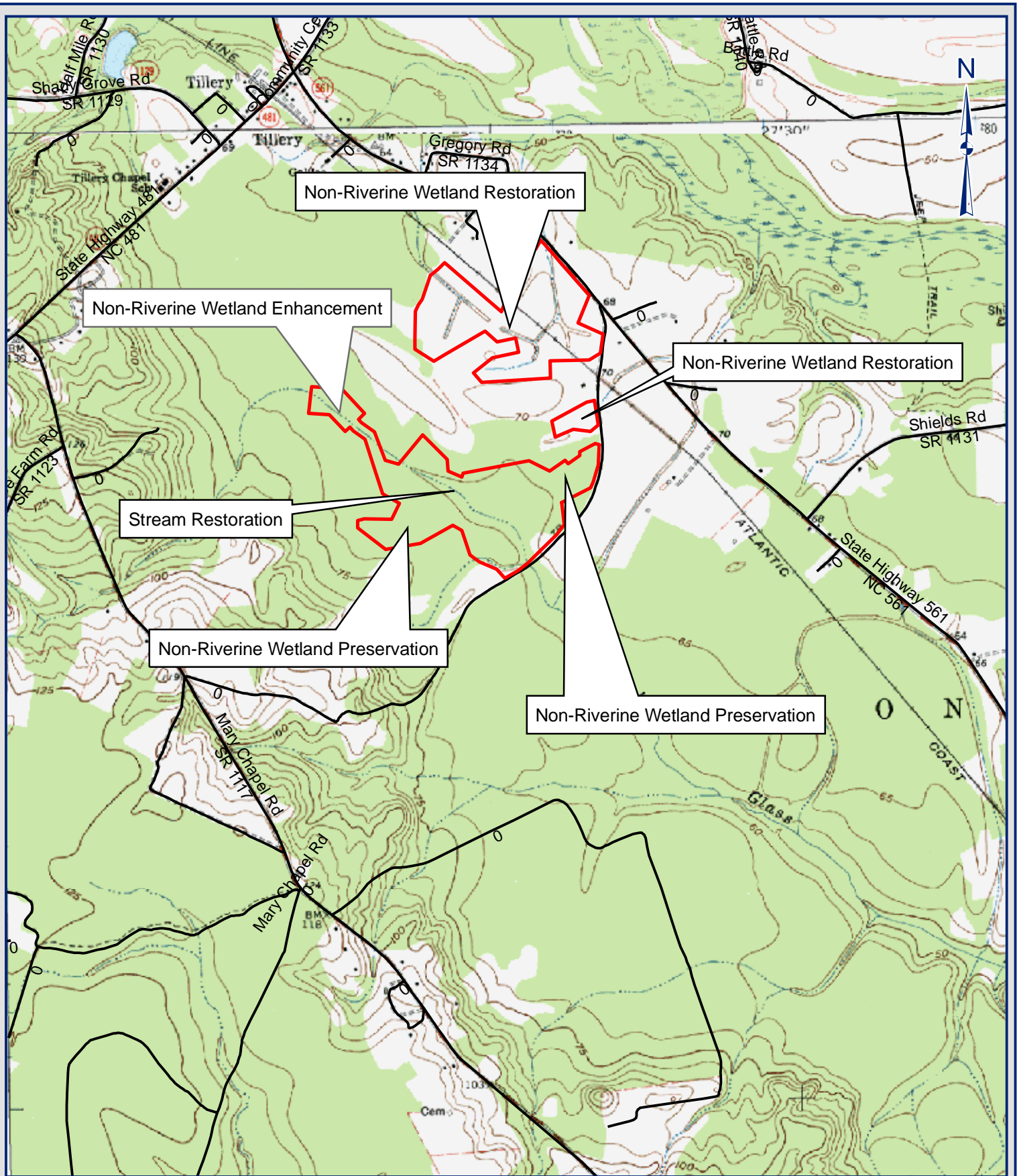


Figure 2.
 USGS Quad Map
 Conoconnara, Halifax County, NC
 0 500 1,000 2,000 3,000 4,000
 Feet

- LEGEND**
- Proposed Conservation Easement
 - Road
 - Stream

SOURCES: USGS, Scotland Neck, NC, Quadrangle, 1962
 Dawson Crossroads, NC, Quadrangle, 1960



Table 1. Project Mitigation Structure and Objectives

MITIGATION PRACTICE	SIZE	RATIO	MITIGATION UNITS
Wetlands			
Non-riverine wetland preservation	71 acres	1:5	14
Non-riverine wetland enhancement	8 acres	1:2	4
Non-riverine wetland restoration	69 acres	1:1	69
Total:			87 WMU's
Stream			
Stream Restoration (Looking Glass Run)	5,050 linear feet	1:1	5,050
Total:			5,050 SMU's

2.3 PROJECT HISTORY & SCHEDULE

Table 2. Project Activity and Reporting History

Month	Activity
November 2006	Approved Restoration Plan
March 2007	Construction Completed
March 2007	Post-restoration Monitoring Begins
November 2007	1st Annual Monitoring Report
November 2008	2nd Annual Monitoring Report
November 2009	3rd Annual Monitoring Report
October 2010	4th Annual Monitoring Report
November 2011 (Scheduled)	5th Annual Monitoring Report

Table 3. Project Contacts

Contact	Firm Information
Project Manager Norton Webster	EBX-Neuse 1, LLC (919) 608-9688
Designer Jeff Keaton, PE	WK Dickson and Co., Inc (919) 782-0495
Monitoring Contractor Daniel Ingram	WK Dickson and Co., Inc (919) 782-0495

3.0 HYDROLOGY

3.1 HYDROLOGIC SUCCESS CRITERIA

As stated in the Restoration Plan, the hydrology success criterion for the Site is to restore the water table at the Site so that it will remain within 12 inches of the soil surface for at least seven percent of the growing season continuously (approximately 15 days). The growing season is from March 30 to November 4. Based on daily minimum temperatures greater than 28 degrees Fahrenheit occurring in five out of ten years, the growing season for Halifax County is 214 days long. Gauge data will be compared to reference wetland well data in growing seasons with less than normal rainfall. If a restoration gauge hydroperiod exceeds the reference gauge hydroperiods in a period of low rainfall, and both gauges exceed five percent of the growing season, then the restoration gauge will be deemed successful. The results of hydrology monitoring across the wetland restoration Site are presented in this annual monitoring report.

3.2 DESCRIPTION OF HYDROLOGY MONITORING EFFORTS

Twelve automated Infinities groundwater gauges and one rain gauge were installed prior to the beginning of the first growing season (**Figure 3**). Three additional automated groundwater gauges were installed in an on-site reference wetland. Groundwater gauges were installed to a minimum depth of 40 inches below the ground surface. The monitoring protocol for the site specifies that automated monitoring stations will be downloaded and checked for malfunctions on a monthly basis. During monthly site visits, manual groundwater gauges are read, and rainfall totals are collected from the on-site rain gauge.

Surface gauges were installed in March 2009 at several well locations to document the presence of surface water in low areas beyond the measured subsurface hydroperiods. The surface gauges were Remote Data Systems WM40 automatic recording units installed at the surface without a bentonite seal. In early 2009, sub-surface ripping and minor re-contouring were performed in areas around gauges AW4, AW5, and AW11 in an effort to increase infiltration.

Automated Gauges

Infinities automatic groundwater gauges record water table elevations twice daily at 08:00 and 20:00. These automatic gauges employ pressure sensors that record water elevation above the bottom of the sensor (with atmospheric pressure compensation). Immediately adjacent to each automatic gauge is a manual calibration gauge. The calibration water table depth is recorded at monthly downloads. To determine wetland hydroperiods, the automatically recorded data are compared to the calibration data to determine a standard correction factor between the calibration gauge and the automatic gauge for each location. The standard correction factor is applied to correct daily readings. The corrected daily readings are used to determine wetland hydroperiods.

Data Interpretation

Wetland hydroperiods are calculated from twice-daily water table depth elevations. A hydroperiod is calculated if the water table is equal to or above 12 inches below ground surface for at least 24 hours. If a gauge falls below -12 inches for two consecutive readings (24 hours), then the hydroperiod ends at the last reading within -12 inches. If a gauge falls below -12 inches for only one reading then maintains a reading above -12 inches for a minimum of 24 hours, then the hydroperiod is calculated continuously. This methodology accounts for minor technical malfunctions experienced by the automatic gauges.

3.3 RESULTS OF HYDROLOGY MONITORING

During the 2010 growing season, all fifteen automated loggers performed well, and no periods of missing data were encountered. The following hydroperiod statistics were calculated for each monitoring station during the growing season: 1) most consecutive days that the water table was within 12 inches of the surface; 2) cumulative number of days that the water table was within 12 inches of the soil surface; and 3) number of times that the water table rose to within 12 inches of the soil surface (**Table 4**). Depth of groundwater for each of the monitoring gauges is shown in a graph with precipitation (**Figure 4**). This hydrograph demonstrates the reaction at each monitoring location of the groundwater level to specific rainfall events. Raw hydrograph data collected from the monitoring gauges is provided in **Appendix C**.

The Site was designed to function as a non-riverine wetland system. Hydrology in these wetlands is driven by precipitation, nearly level topography, and restrictive soil horizons. Wetland depressions and plugged ditches retained standing water throughout much of the growing season despite drier than normal conditions. A few of the shallow depressions became dry late in the

Legend

- Wells
- Vegetation Plots
- Conservation Easement
- Restored Channel
- Wetland Channels
- Site Road
- Roads

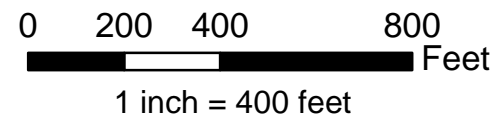
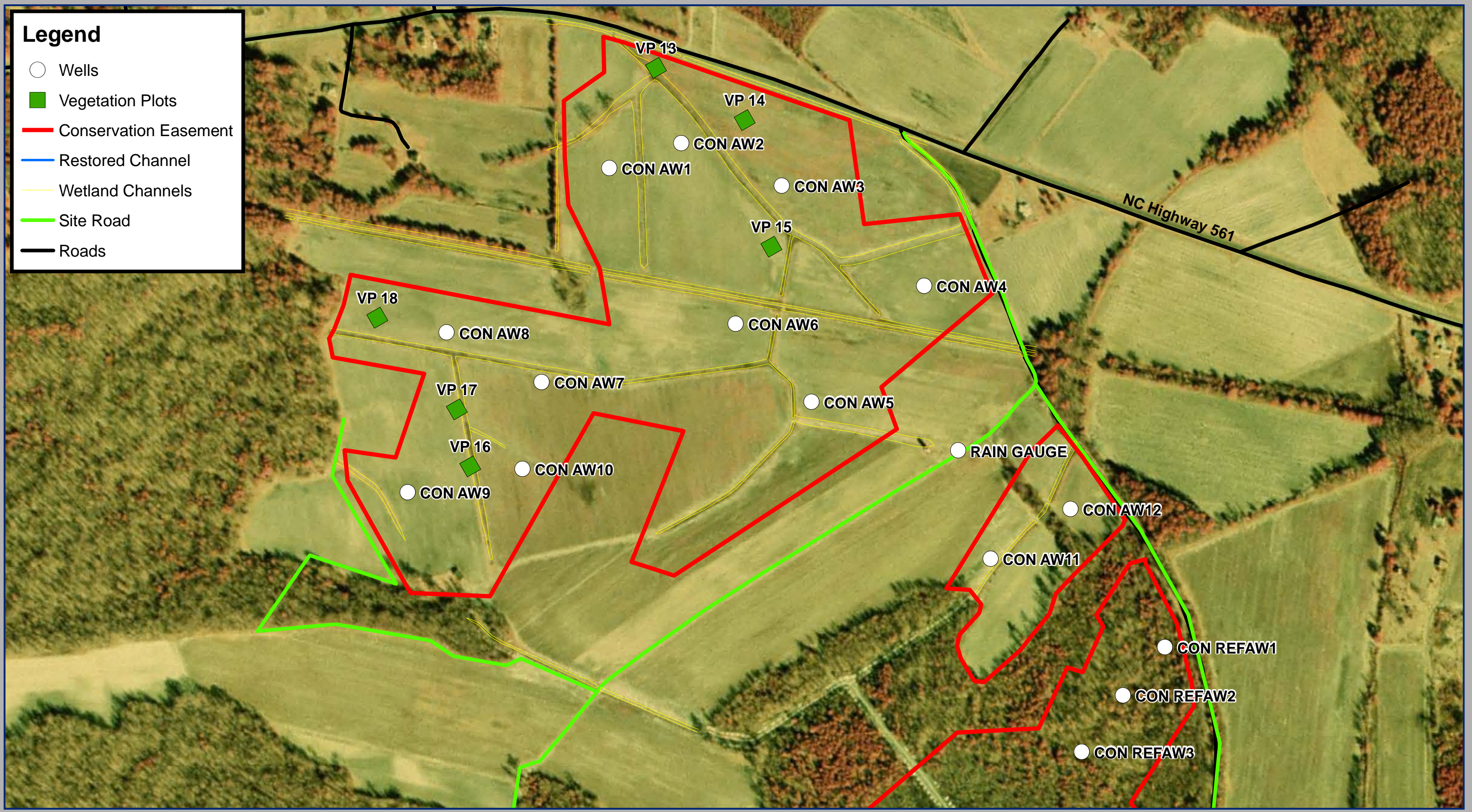
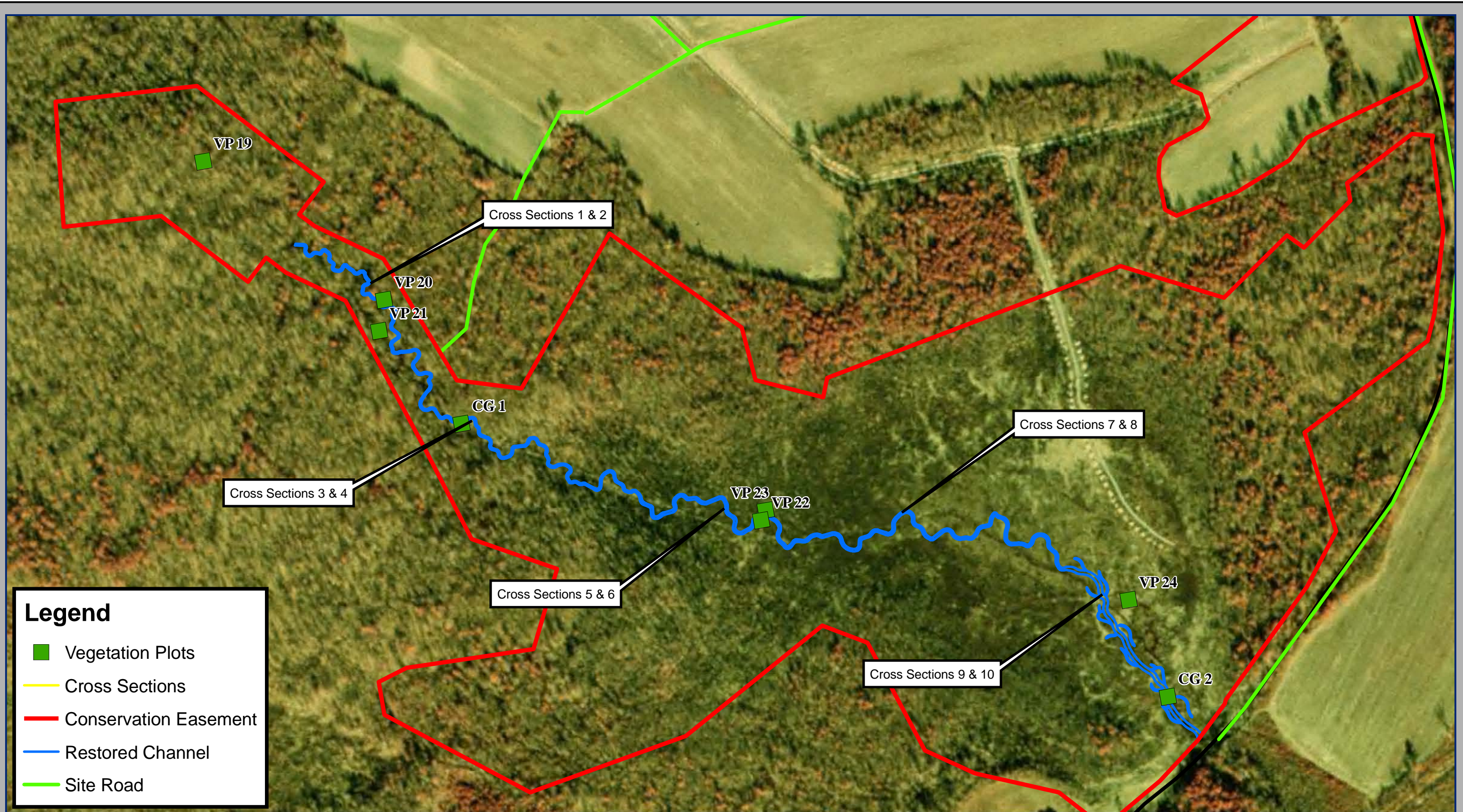


Figure 3a
Conoconnara
2010 Monitoring Overview Map





Legend

- Vegetation Plots
- Cross Sections
- Conservation Easement
- Restored Channel
- Site Road

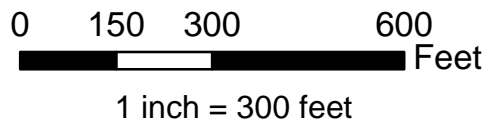
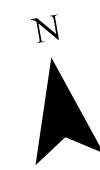


Figure 3b
Conoconnara
2010 Monitoring Overview Map



growing season. The data collected for the 2010 growing season for this Site indicate it is performing as described in the Mitigation Plan, with varying degrees of wetness documented.

3.3.1 Site Data

Locations of each automatic groundwater gauge and its 2010 growing season results can be found on **Figure 3**. Detailed results of hydrology monitoring in 2010 are presented in **Table 4** and **Figure 4**.

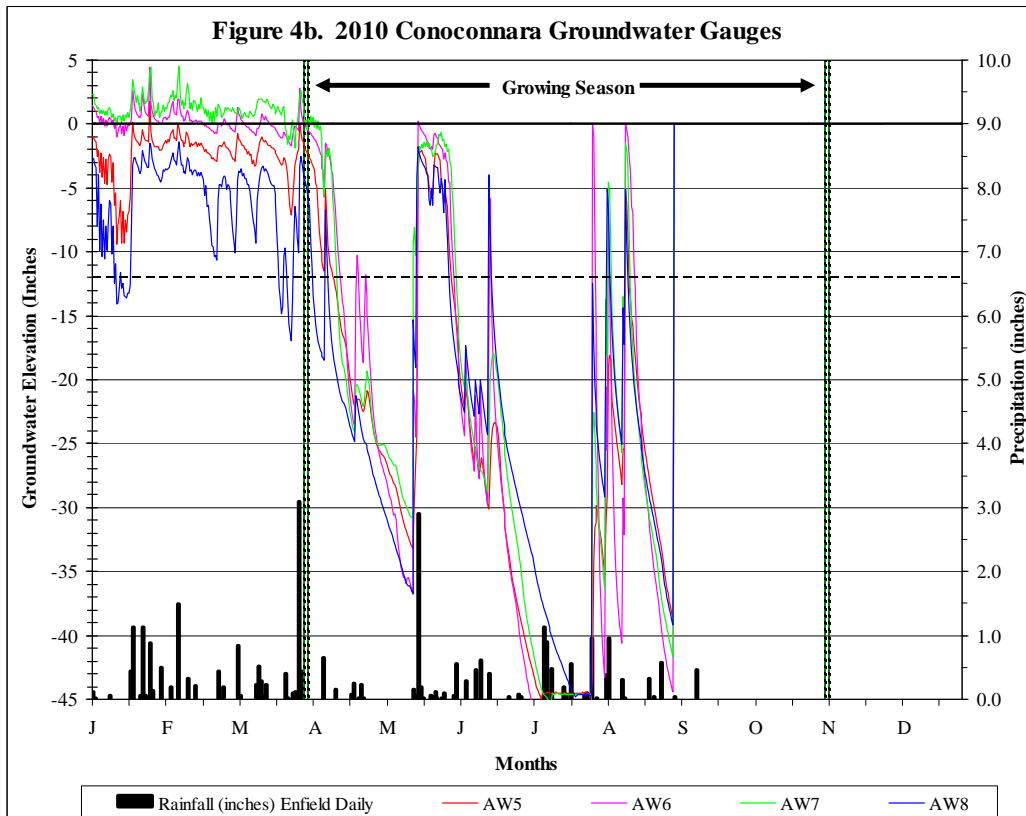
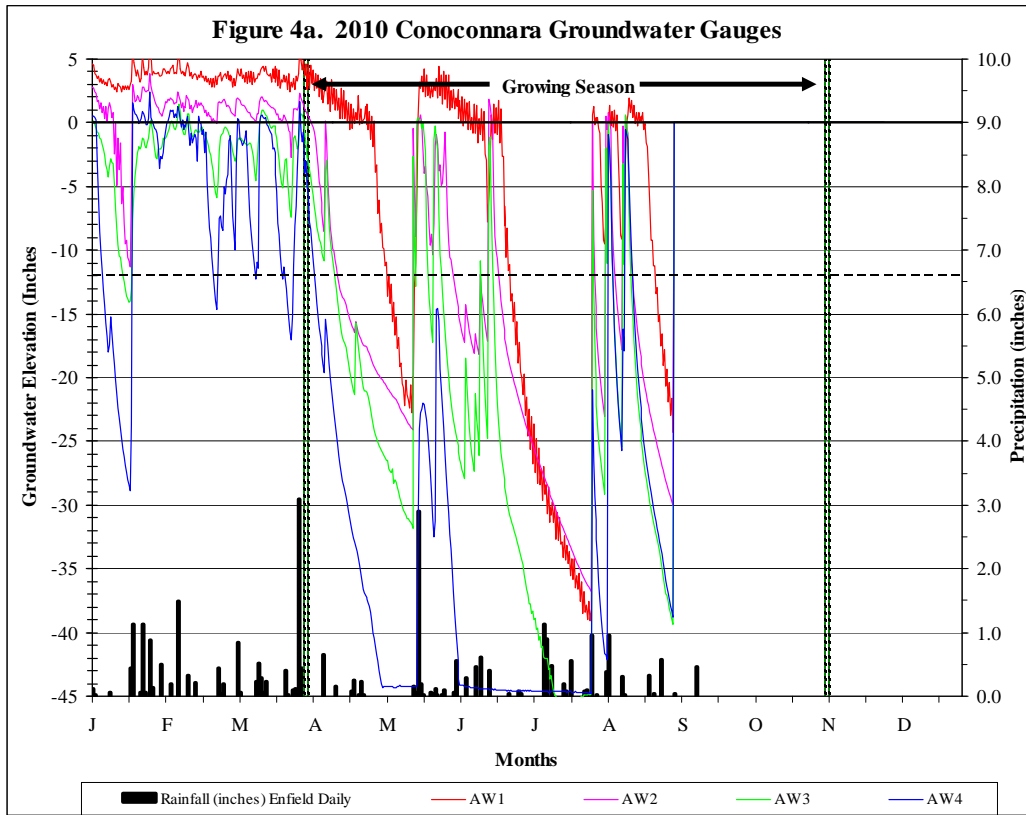
Ten of the 12 groundwater gauges met or exceeded the seven percent sub-surface hydrologic success criterion in 2010. The successful gauges generally experienced their maximum hydroperiods in March through early May. The lower performing gauges, AW4 and AW11, recorded hydroperiods of three and six percent of the 2010 growing season, respectively. Both gauges met the success criteria due to the presence of surface water for seven percent of the growing season. The soil near these gauges appears to have slow infiltration despite standing water in adjacent areas. Gauges AW4 and AW11 achieved seven percent hydroperiods at depths of 24 inches and 17 inches below the surface, respectively.

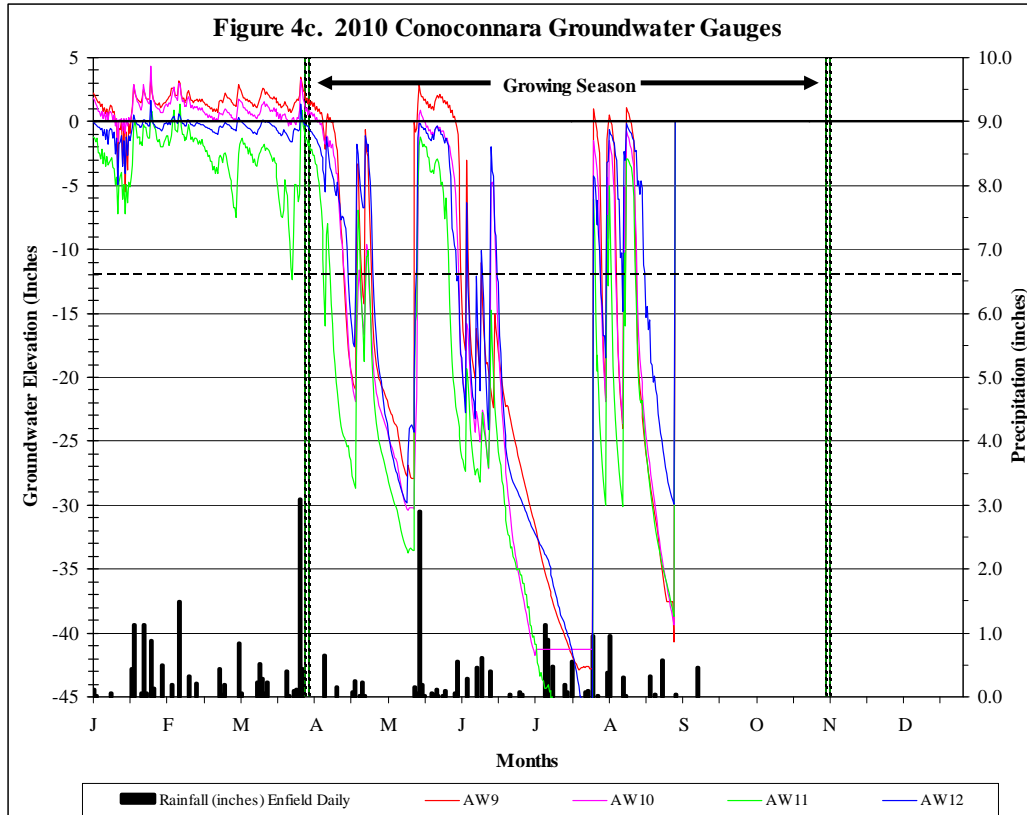
Table 4. Hydrologic Monitoring Results

2010 Max Hydroperiod (Growing season 30-Mar through 4-Nov, 214 days)					
Gauge	Consecutive		Cumulative		Occurrences
	Days	Percent of growing Season	Days	Percent of growing Season	
AW1	40	19	104	49	4
AW 1 Surface	40	19	103	48	4
AW2	17	8	46	21	7
AW3	14	7	34	16	8
AW 3 Surface	16	7	47	22	11
AW4	6	3	11	5	3
AW 4 Surface	14	7	38	18	11
AW5	14	7	30	14	3
AW 5 Surface	24	11	82	38	7
AW6	17	8	39	18	8
AW 6 Surface	19	9	52	24	12
AW7	18	8	37	17	4
AW 7 Surface	20	9	56	26	12
AW8	14	7	23	11	6
AW9	20	9	58	27	9
AW10	18	8	52	24	8
AW 10 Surface	21	10	73	34	11
AW11	13	6	34	16	9
AW 11 Surface	18	8	68	32	11
AW12	19	9	67	31	9
AW 12 Surface	46	21	120	56	3
REF AW1	22	10	34	16	4
REF AW2	20	9	29	14	5
REF AW3	17	8	24	11	4

Note: Data through September 2

Figure 4. Groundwater Hydrographs



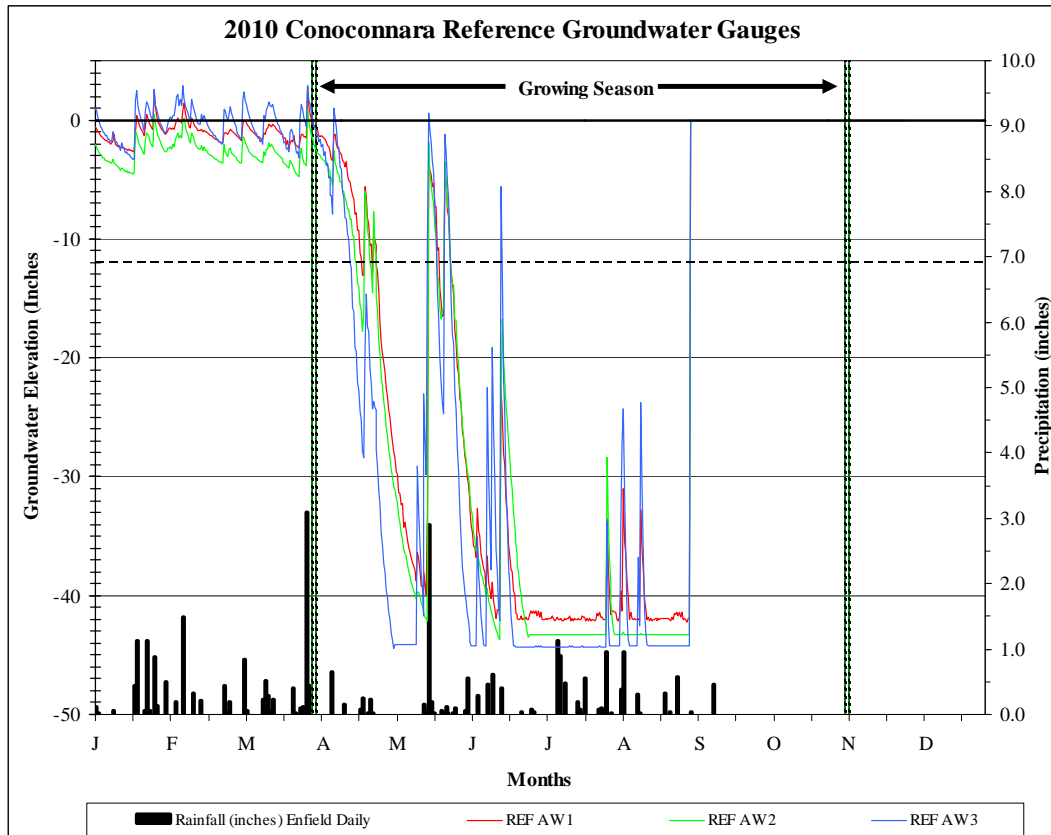


3.3.2 Reference Data

The approved Mitigation Plan provides that if the rainfall data for any given year during the monitoring period is not normal, the reference wetland data can be used to determine if there is a positive correlation between the performance of the restoration Site and the natural hydrology of the reference Site.

Three automated reference wells were observed during the 2010 growing season. The same hydroperiod statistics were calculated for each reference monitoring station during the growing season as were calculated for the site monitoring stations (**Table 4**). The reference wetland groundwater gauges exhibited wetland hydroperiods of seven to ten percent of the growing season, which exceeds the seven percent success criterion for the site. Raw data collected from the monitoring gauges is provided in **Appendix C**.

Figure 5. Reference Hydrographs



3.3.3 Climate Data

Table 5 and Figure 6 compare the 2010 monthly rainfall to historical precipitation for Halifax County (NRCS WETS Tables). Observed precipitation data were collected from an automated weather station in Enfield and an on-site manual rain gauge (Appendix C).

The Conoconnara Mitigation Site experienced mostly normal rainfall in the 2010 growing season. The April and August rainfall was below normal limits, and March rainfall was above normal limits. All other monthly rainfall totals were within normal limits. The rainfall totals from the Enfield weather station generally correlate poorly with data collected from the on-site manual rain gauge, but the total amounts of rainfall correlate well during April through August. This is likely due to the differing collection periods between the monthly totals, and the multiple small rain events recorded by the Enfield weather station.

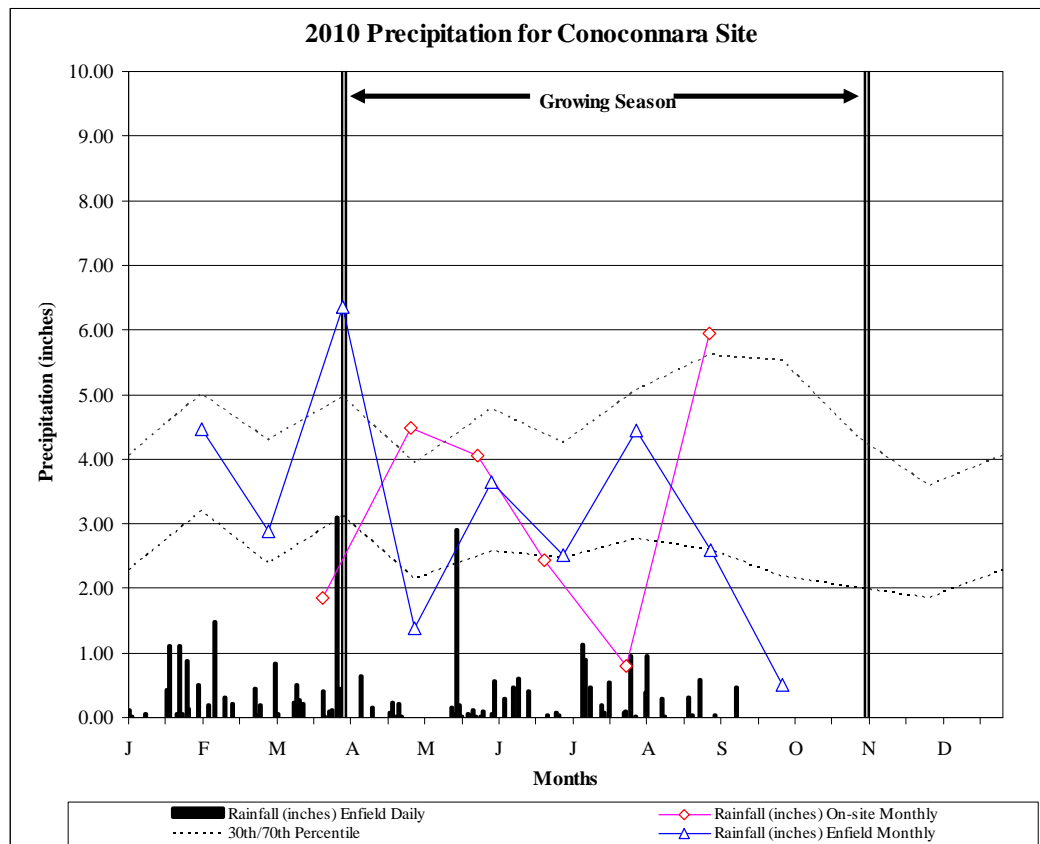
Table 5. Comparison of Normal Rainfall to Observed Rainfall

Month	Average	Normal Limits		Enfield Precipitation*	On-Site Precipitation**
		30 Percent	70 Percent		
January	4.23	3.20	5.01	4.47	---
February	3.47	2.37	4.29	2.88	---
March	4.22	3.12	4.95	6.36	1.85
April	3.16	2.14	3.94	1.38	4.48
May	3.94	2.58	4.77	3.64	4.05
June	3.62	2.48	4.25	2.52	2.43
July	4.25	2.76	5.07	4.45	0.79
August	4.26	2.60	5.62	2.59	5.94
September	4.58	2.19	5.52	0.50	---
October	3.33	2.01	4.35	---	---
November	3.04	1.86	3.59	---	---
December	3.26	2.29	4.06	---	---
Annual	---	40.39	49.25	---	---
Total	45.38	---	---	37.10	19.54

*Data through September 16

** Data through August

Figure 6. 2010 Precipitation Data



3.4 HYDROLOGIC CONCLUSIONS

Data collected from the groundwater monitoring gauges on the Conoconnara Mitigation Site document that ten of 12 hydrology monitoring stations (AW1, AW2, AW3, AW5, AW6, AW7, AW8, AW9, AW10, and AW12) recorded hydroperiods of at least seven percent of the growing season. Gauges AW4 and AW11 recorded hydroperiods of three and six percent of the growing season, respectively. The surface water gauges for AW4 and AW11 indicate the presence of ponding water for seven and nine percent of the growing season, respectively. Therefore, both gauges meet the minimum wetland criterion. The significant consecutive hydroperiods occurred during March through April, and May through June. Monitoring demonstrated that the hydrologic parameters of the mitigation site are similar to those of the reference site. **Figure 7** displays the hydrology monitoring results across the site. **Table 6** provides a summary of hydrologic monitoring results for the first four years of monitoring.

All wetland ditch plugs and outlets are stable and well vegetated. The impounded ditches and wetland depressions remained inundated throughout the early part of the growing season.

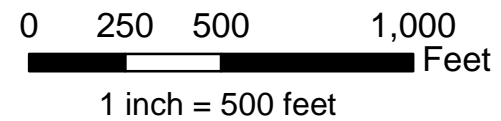
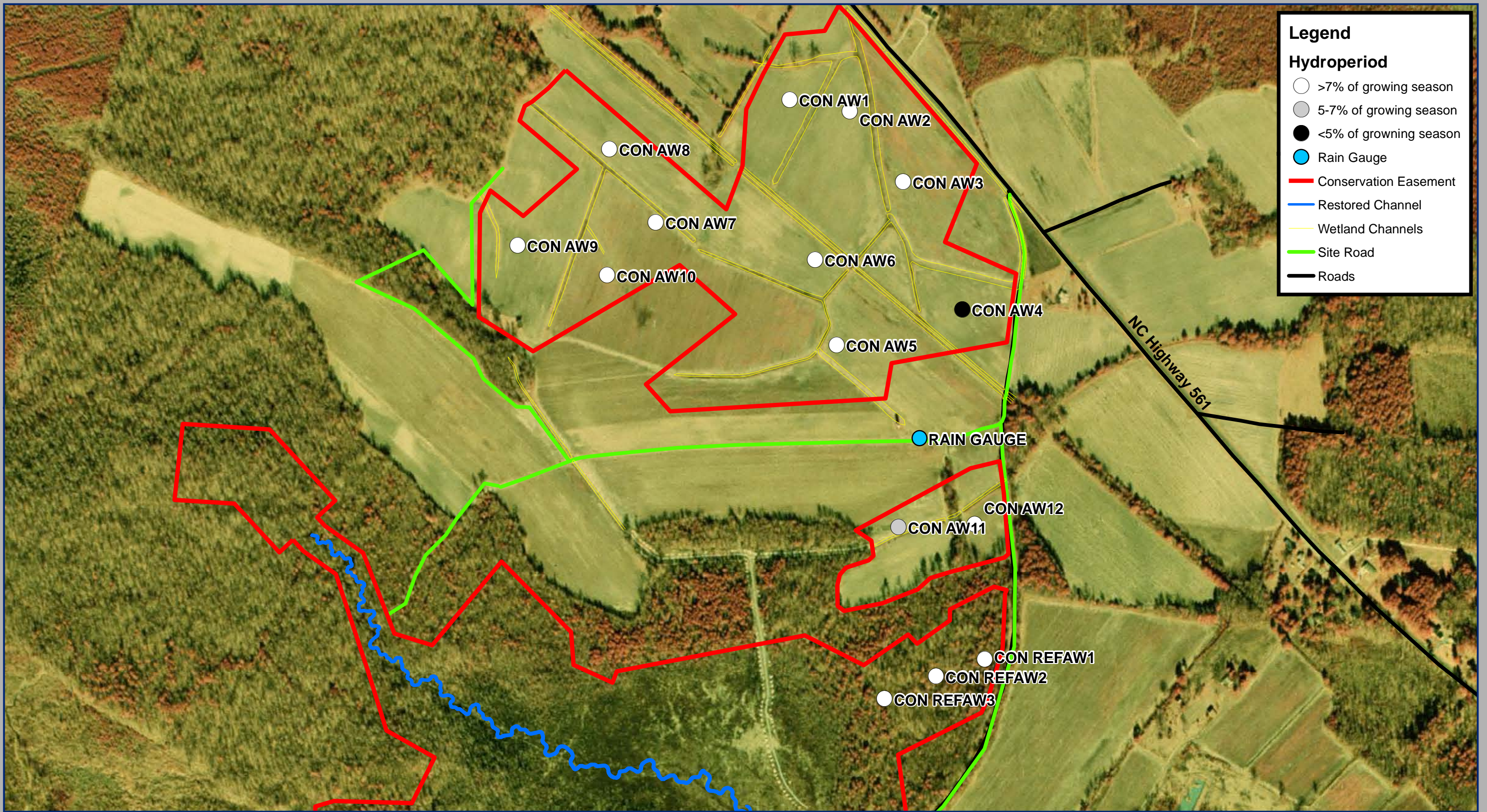


Figure 7
Conoconnara
2010 Sub-surface Hydrology Results Map



Table 6. Summary of Hydrologic Monitoring Results 2007-2010

Gauge	Max Consecutive Hydroperiod (%)			
	2007	2008	2009	2010
AW1	0	5	1	19
AW 1 Surface	---	---	2	19
AW2	6	18	8	8
AW3	2	8	8	7
AW 3 Surface	---	---	11	7
AW4	1	2	1	3
AW 4 Surface	---	---	2	7
AW5	4	7	7	7
AW 5 Surface	---	---	8	11
AW6	3	6	3	8
AW 6 Surface	---	---	3	9
AW7	2	4	3	8
AW 7 Surface	---	---	7	9
AW8	4	8	7	7
AW9	5	7	8	9
AW10	2	7	3	8
AW 10 Surface	---	---	3	10
AW11	0	0	8	6
AW 11 Surface	---	---	4	8
AW12	4	8	8	9
AW 12 Surface	---	---	23	21
REF AW1	4	26	13	10
REF AW2	12	25	13	9
REF AW3	0	16	12	8

4.0 VEGETATION

4.1 VEGETATION SUCCESS CRITERIA

Successful establishment of vegetation in wetland restoration, wetland enhancement, and riparian areas will be the survival of 260 planted trees following Year 5 monitoring. The Site must also meet the interim success criterion of the survival of at least 320 planted stems per acre at the end of the Year 3 monitoring period. Up to 20 percent of the composition may be comprised of volunteer species. Remedial action may be required should volunteers present a problem or exceed 20 percent composition.

Digital images will be subjectively used to evaluate the restoration Site over time. A series of images over the five-year monitoring period should demonstrate maturation of planted vegetation and volunteer hydrophytic species.

4.2 DESCRIPTION OF SPECIES AND VEGETATION MONITORING

Twenty-four semi-permanent vegetation sampling plots were established within the planted areas to monitor the success of planted vegetation. The 19 wetland vegetation plots are 0.10 acres in size, and the five riparian vegetation plots are 0.05 acres or 0.10 acres in size. The vegetation plots are distributed across the site, but the precise location and orientation of the plots was random (see locations on as-built drawings in **Appendix A**). The plots cover approximately two percent of the restored site. Each planted woody stem is located with a three-foot high section of white PVC pipe and identified with a permanent number. Re-planted stems are marked only with flagging. All live planted stems are remarked with flagging each year.

4.3 RESULTS OF VEGETATION MONITORING

Stem counts by species, estimated percent cover, and planted tree density were recorded for each of the monitoring plots (**Table 7**). In **Table 7**, each planted tree species is identified across the top row, and each plot is identified down the left column. All vegetation plots have met the interim success criterion of 320 trees per acre after Year 3. Planted tree densities ranged from 310 to 720 trees per acre in Year 4, with an average of 520 trees per acre. Plot 19 has 310 trees per acre due to low initial planting density and no re-plants. Plot 19 has a high density of desirable volunteer woody species. The locations of each vegetation plot and the 2010 monitoring status are shown on **Figure 7**.

The Conoconnara wetland restoration areas were re-planted prior to the 2009 growing season to offset excessive mortality. The re-planting included soil nutrient testing and fertilizer application. The survival from the re-planting was near 100 percent, and many trees previously thought to be have re-sprouted. This resulted in high densities across the Site. Due in part to the drought conditions experienced in 2010, survival decreased, but remains above the minimum acceptable criteria across the site. Few volunteer woody species were observed throughout the wetland restoration areas, likely due to a lack of seed sources nearby. Common volunteer woody species were found in vegetation plots located along the restored stream (VP20, VP21, VP22, and VP23) and in the wetland enhancement area (VP19). The volunteer species commonly found included sweetgum (*Liquidambar styraciflua*), loblolly pine (*Pinus taeda*), eastern baccharis (*Baccharis halimifolia*), black willow (*Salix nigra*), red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanicum*), cherrybark oak (*Quercus pagoda*), winged sumac (*Rhus copallinum*), devil's walkingstick (*Aralia spinosa*), Chinese privet (*Ligustrum sinense*), southern red oak (*Quercus falcata*), swamp chestnut oak (*Quercus michauxii*), and common persimmon (*Diospyros virginiana*). No volunteers were present in numbers large enough to jeopardize vegetation success.

4.4 VEGETATION OBSERVATIONS & CONCLUSIONS

The Site was originally planted in non-riverine hardwoods and riparian hardwood species in March 2007. The wetland restoration areas were re-planted in early 2008. However, due to planting late in the season, drought, and other environmental factors, the 2008 re-planting suffered greater than 90 percent mortality. The wetland restoration areas were planted again in early 2009 with 150 to 300 trees per acre, depending on surviving density. The 2009 planting included time-release fertilizer pellets at the time of planting to offset low fertility in the native soils. The Site had earlier met the interim success criterion of the survival of at least 320 planted stems per acre after Year 3 monitoring in 23 of 24 plots, and is on track to meet the final vegetative success criterion of 260 planted stems at after Year 5 monitoring.

Herbaceous vegetation on the site is well established. Estimated percent cover is greater than 95 percent across most of the site and within the plots. A number of common weeds were observed, but no remedial action is necessary. Hydrophytic herbaceous vegetation is common and includes switchgrass (*Panicum virgatum*), deertongue (*Dichanthelium clandestinum*), barnyardgrass (*Echinochloa crus-galli*), giant cane (*Arundinaria gigantea*), climbing hempvine (*Mikania scandens*), Pennsylvania smartweed (*Polygonum pennsylvanicum*), camphor pluchea (*Pluchea camphorate*), and sedge (*Carex* sp.). The presence of these herbaceous wetland plants helps to confirm the presence of wetland hydrology on the site.

Table 7. Results of 2010 Vegetation Monitoring

Plot No.	Size (acres)	Location	American Elm	Bald Cypress	Blackgum	Buttonbush	Green Ash	Musclewood	Oak-Cherrybark	Oak-Laurel	Oak-Overcup	Oak-Swamp Chestnut	Oak-Water	Oak-Willow	River Birch	Sycamore	Tulip Poplar	Water Tupelo	Baseline Stems per Acre	2010 Stems per Acre
1	0.1	Wet Rest.	0	5	2	1	5	9	0	0	5	0	2	7	1	0	0	0	580	370
2	0.1	Wet Rest.	0	12	2	1	6	0	0	0	0	4	0	11	0	8	0	0	540	440
3	0.1	Wet Rest.	0	13	2	0	9	2	0	1	13	3	1	7	0	4	0	0	450	550
4	0.1	Wet Rest.	4	12	4	0	6	1	0	3	3	0	5	9	2	2	1	1	550	530
5	0.1	Wet Rest.	0	15	6	0	6	0	0	2	10	2	4	4	0	5	0	0	550	540
6	0.1	Wet Rest.	1	6	0	0	5	14	0	2	8	1	1	1	0	3	1	0	540	430
7	0.1	Wet Rest.	0	7	3	0	12	4	2	0	5	5	0	4	1	3	0	0	610	460
8	0.1	Wet Rest.	0	15	14	0	11	0	0	0	1	4	1	8	0	3	0	0	560	570
9	0.1	Wet Rest.	0	5	4	1	4	10	4	0	5	12	1	4	9	0	0	2	790	610
10	0.1	Wet Rest.	0	10	0	0	7	0	0	0	8	4	6	6	0	3	0	1	650	450
11	0.1	Wet Rest.	0	27	4	0	7	0	0	2	4	5	2	5	0	9	0	1	600	660
12	0.1	Wet Rest.	0	6	4	0	3	3	0	3	10	1	4	23	0	4	0	3	590	640
13	0.1	Wet Rest.	0	2	1	0	12	3	0	3	6	0	1	12	0	5	0	0	540	450
14	0.1	Wet Rest.	0	15	1	0	7	9	0	0	10	0	3	2	0	2	0	0	550	490
15	0.1	Wet Rest.	0	23	7	4	7	0	0	0	12	0	1	7	0	3	0	0	540	640
16	0.1	Wet Rest.	0	11	3	2	7	0	0	0	7	0	8	4	0	3	0	0	560	450
17	0.1	Wet Rest.	0	17	6	0	10	0	0	0	8	3	1	9	0	1	0	3	530	580
18	0.1	Wet Rest.	0	13	2	0	20	0	0	0	4	3	1	7	0	10	0	0	620	600
19	0.1	Wet Enhanc.	0	3	5	0	8	2	0	1	0	4	3	5	0	0	0	0	650	310
20	0.05	Riparian	0	0	0	0	12	0	0	0	3	0	0	1	0	0	0	0	460	320
21	0.05	Riparian	0	1	0	0	20	0	0	0	1	2	3	7	0	2	0	0	820	720
22	0.05	Riparian	0	0	0	0	13	0	0	1	6	0	0	7	2	2	0	1	1000	640
23	0.05	Riparian	0	2	1	0	18	0	0	0	1	0	3	7	2	2	0	0	960	720
24	0.1	Riparian	0	3	2	0	21	0	0	0	0	0	0	2	2	2	0	0	610	320
Percent Composition			0.4	19.8	6.5	0.8	20.9	5.0	0.5	1.6	11.5	4.7	4.5	14.1	1.7	6.7	0.2	1.1		

Table 8. Vegetation Monitoring Summary

Plot No.	Size (acres)	Location	Size (acres)	Baseline Stems per Acre	Year 1 Stems per Acre	Year 2 Stems per Acre	Year 3 Stems per Acre	Year 4 Stems per Acre
1	0.1	Wet Rest.	0.1	580	500	510	670	370
2	0.1	Wet Rest.	0.1	540	340	540	440	440
3	0.1	Wet Rest.	0.1	450	290	570	530	550
4	0.1	Wet Rest.	0.1	550	380	580	540	530
5	0.1	Wet Rest.	0.1	550	380	540	460	540
6	0.1	Wet Rest.	0.1	540	450	520	460	430
7	0.1	Wet Rest.	0.1	610	540	610	610	460
8	0.1	Wet Rest.	0.1	560	390	540	610	570
9	0.1	Wet Rest.	0.1	790	710	600	560	610
10	0.1	Wet Rest.	0.1	650	420	570	610	450
11	0.1	Wet Rest.	0.1	600	470	330	580	660
12	0.1	Wet Rest.	0.1	590	520	430	620	640
13	0.1	Wet Rest.	0.1	540	400	500	550	450
14	0.1	Wet Rest.	0.1	550	470	590	530	490
15	0.1	Wet Rest.	0.1	540	320	590	570	640
16	0.1	Wet Rest.	0.1	560	320	520	550	450
17	0.1	Wet Rest.	0.1	530	390	500	540	580
18	0.1	Wet Rest.	0.1	620	360	570	640	600
19	0.1	Wet Enhancement	0.1	650	540	380	330	310
20	0.05	Riparian	0.05	460	340	320	340	320
21	0.05	Riparian	0.05	820	720	660	700	720
22	0.05	Riparian	0.05	1000	800	680	720	640
23	0.05	Riparian	0.05	960	860	820	800	720
24	0.1	Riparian	0.1	610	600	410	390	320
		Average Stems per Acre		619	480	537	556	520

5.0 STREAM MONITORING

5.1 STREAM SUCCESS CRITERIA

As stated in the Mitigation Plan, the stream restoration success criteria for the site include the following:

- *Cross Sections.* The mitigation plan for the Conoconnara project requires ten cross sections to be monitored on the restored channel. The cross sections were established during monitoring set-up in evenly distributed pairs of one shallow (riffle) and one pool per 1,000 linear feet of restored stream. Each cross section will be photographed and surveyed annually including measurements of floodplain, top of bank, bankfull, edges of water, and thalweg. In addition, any fluvial features present will be documented.
- *Longitudinal Profile.* Longitudinal profiles will be surveyed in years one through five of the monitoring period. The length of the measured profile will be at least 3,000 linear feet. Features measured will include thalweg, inverts of in-stream structures, water surface, bankfull, and top of low bank. Looking Glass Run is a sand bed channel, and is expected to have a dynamic bed and profile.

- *Hydrology.* Two crest gauges were installed at the site: one near the upstream end of Reach 2 (STA 11+95) and one near the downstream end of Reach 3 (STA 48+46). Crest gauges will be checked monthly to document high flows. During the gauge inspections, any high water marks or debris lines observed will be documented and photographed.
- *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.

5.2 STREAM MORPHOLOGY MONITORING PLAN

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

5.2.1 Cross Sections

Two permanent cross sections were installed per 1,000 linear feet of stream restoration work, with one of the locations being a shallow cross section, and one location being a pool cross section. Ten permanent cross sections were established across the mitigation site. 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 top of bank, bankfull, inner berm, edge of water, and thalweg. Permanent cross sections for 2010 (Year 4) were surveyed in September 2010.

5.2.2 Longitudinal Profile

A longitudinal profile will be completed each monitoring year. The profile will be conducted for a length of restored channel at least 3,000 feet in length. Measurements will include thalweg, water surface, inner berm, bankfull, and top of low bank. A common benchmark will be used each year to facilitate comparison of year-to-year data.

5.2.3 Hydrology

Two crest gauges were installed on the site to document bankfull events. The gauges are checked each month. The highest out-of-bank flow event that occurred during the past month is recorded. The gauge locations are shown on **Figure 3**.

5.2.4 Photo Reference Stations

Photographs are used to visually document the restoration success. All stream structures and cross section locations are photographed, as well as any potential problem areas. Photographs are taken at least once per year. A photo log of the Conoconnara site is included in **Appendix D**.

5.3 STREAM MORPHOLOGY MONITORING RESULTS

In-stream structures installed within the restored stream included log vanes, log weirs, woody debris bundles, fords, and root wads. Visual observations of structures throughout the past growing season have indicated that most structures are functioning as designed. Localized areas of elevated profile (shallows) have been colonized by wetland plant species due to intermittent stream flow. One log grade control structure is experiencing minor erosion on the right bank (**Table 9**). No corrective actions are recommended at this time, as the channel appears to be stable.

Photographs were taken throughout the monitoring season to document the evolution of the restored stream channel (**Appendix D**). Herbaceous vegetation is dense along the restored stream,

and the live stakes are thriving in most areas. Pools have maintained a variety of depths and habitat qualities, depending on the location and type of scour features (logs, root wads, transplants, etc.). During the early portion of the growing season, a consistent stream flow was observed during monthly site visits. The stream flow waned during the latter part of the growing season, and the channel was dry during the monitoring survey in September.

Stream observation areas are described in **Table 9**, and their locations are shown on **Figure 8**.

Table 9. Stream Observation Areas

SOA	Station	Feature	Description
1	22+20	Log Grade Control	Erosion behind right log toe, bed is stable, bank is vegetated, no repair recommended

5.3.1 Cross Sections

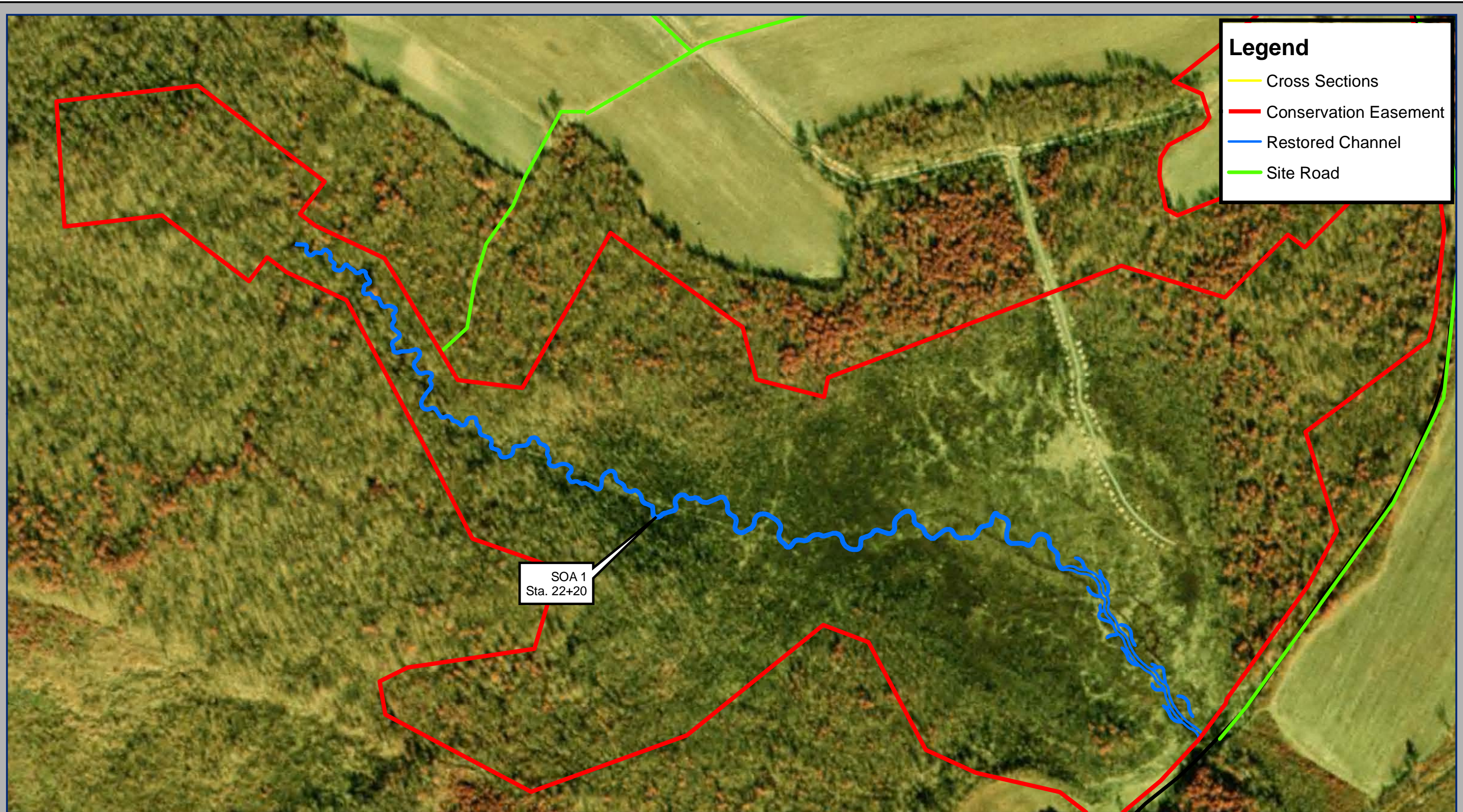
Year 4 cross-section monitoring data for stream stability were collected during September 2010 and compared to the As-Built data and monitoring data from Years 1 through 3. Permanent cross-sections document the stream dimension at ten locations (**Appendix B**). The cross-sections show that there has been little adjustment to stream dimension over the past year. All monitored cross-sections fell within the quantitative parameters defined for "E" type channels.

5.3.2 Longitudinal Profile

A longitudinal profile survey was conducted in Year 4 (**Appendix B**). The profile indicated there has been little adjustment to the stream profile or dimension over the past year. Following construction, the channel aggraded throughout most of its length, but that channel adjustment has stabilized.

5.3.3 Hydrology

During 2010, numerous bankfull events on the Site were documented during monthly site visits using the on-site crest gauges and visual evidence of out-of-bank flow. The largest stream flow documented by the downstream crest gauge (CG2) was a flow that occurred during April and was 2.0 feet above the bankfull stage at the crest gauge. Both crest gauges recorded readings during the months of February, March, April, and May. Crest gauge data is provided in **Table 10** and in **Appendix C**.



Legend

- Cross Sections
- Conservation Easement
- Restored Channel
- Site Road

SOA 1
Sta. 22+20



0 150 300 600 Feet
1 inch = 300 feet

Figure 8
Conoconnara
2010 Stream Observation Area Map



Table 10. Crest Gauge Data

Month	CG1	CG2
January	---	---
February	1.3	1.8
March	0.4	0.75
April	1.6	2.0
May	0.5	1.0
June	0.0	0.0
July	0.0	0.0
August	0.0	0.0
September	---	---
October	---	---
November	---	---
December	---	---

Table 11. Summary of Morphologic Monitoring Parameters

Parameter	As-Built			Year 4		
	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3
Stream Type	E5	E5	DA	E5	E5	DA
Drainage Area (Ac)	142.0	373.0	562.0	142.0	373.0	562.0
Bankfull Xsec Area, Abkf (sq ft)	14.2	15.1	12.5	10.1	7.2	6.9
Avg. Bankfull Width, Wbkf (ft)	14.5	12.5	12.0	11.5	8.7	9.5
Bankfull W/D	15.7	10.9	11.6	13.6	11.7	13.1
Bankfull Mean Depth, Dbkf (ft)	0.9	1.3	1.0	0.9	0.8	0.8
Bankfull Max Depth, Dmax (ft)	2.0	3.1	2.2	1.6	1.3	1.3

5.4 STREAM CONCLUSIONS

Overall, the Conoconnara stream restoration is functioning as designed. The floodplain and stream banks are well vegetated with diverse grasses and woody species keeping erosion to a minimum. One log grade control structure is experiencing minor erosion along the right bank. Cross sections show some channel constriction and aggradation as the channel stabilizes. No corrective actions are recommended at this time, as the channel appears to be stable.

6.0 CONCLUSIONS AND RECOMMENDATIONS

- Hydrologic monitoring has shown that wetland hydrology is being achieved throughout the Site. Ten of 12 gauges recorded successful sub-surface hydroperiods of at least seven percent of the growing season. The remaining two gauges (AW4 and AW11) exhibited sub-surface hydroperiods of three and six percent of the growing season, respectively. Adjacent surface gauges indicated surface water was present at monitoring gauges AW4 and AW11 during seven and nine percent of the growing season, respectively. Therefore, these gauges are considered to have met the hydrologic success criterion. If areas of concern are identified for the duration of the project, additional monitoring may be required, or there may be a reduction in credit at close-out of the project. The Site is performing as designed based on the results of four years of groundwater monitoring. Hydrologic conditions across the site are variable, supporting the ecological and functional diversity that makes these systems so valuable.

- The restored stream channel has remained stable, and is providing the intended habitat and hydrologic functions. All monitored cross sections and profiles for 2010 show little adjustment in stream dimension. Based on the results of the monitoring over the last four years, the Site is on track to achieve the stream success criteria specified in the Mitigation Plan.

- Vegetation monitoring efforts have documented the average number of stems per acre on the Site to be 520, with a range of 310 to 720 stems per acre. The Site had earlier met the interim success criterion of the survival of at least 320 planted stems per acre after Year 3 in 23 of 24 plots, and is on track to meet the final success criterion of 260 planted stems per acre after the Year 5 monitoring period.

- Monitoring of vegetation, stream stability, and hydrology of this Site will continue through 2011.

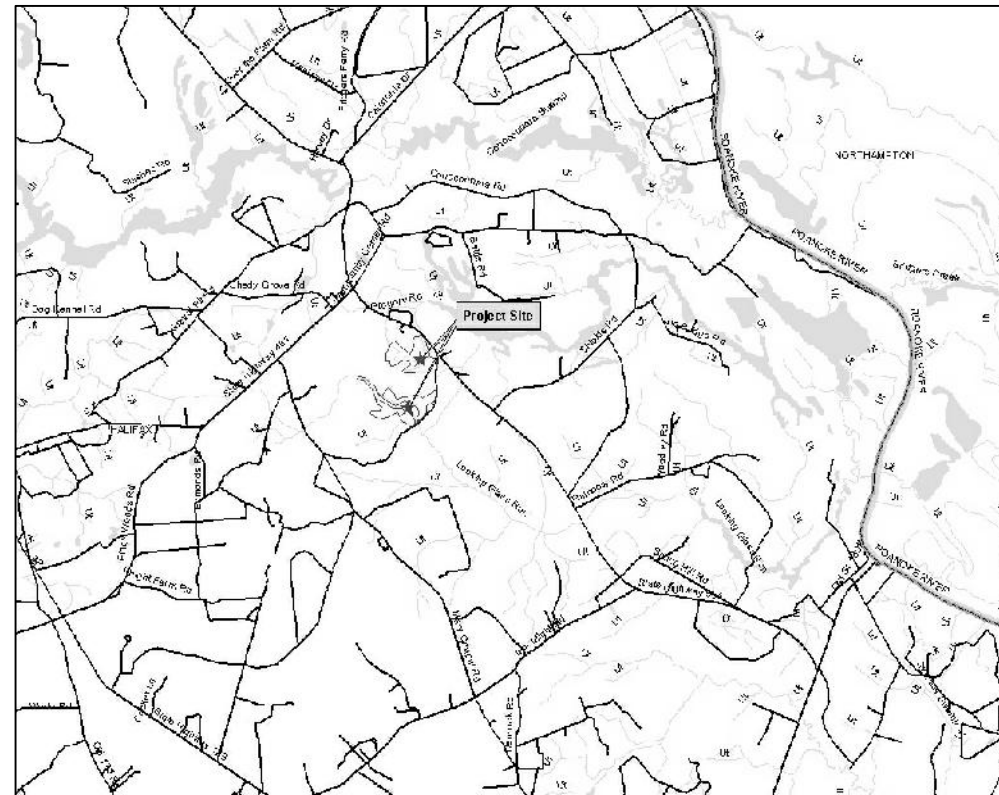
APPENDIX A

As-Built Survey

CONOCONNARA MITIGATION PROJECT

AS-BUILT PLANS

APRIL 2007



VICINITY MAP
NTS

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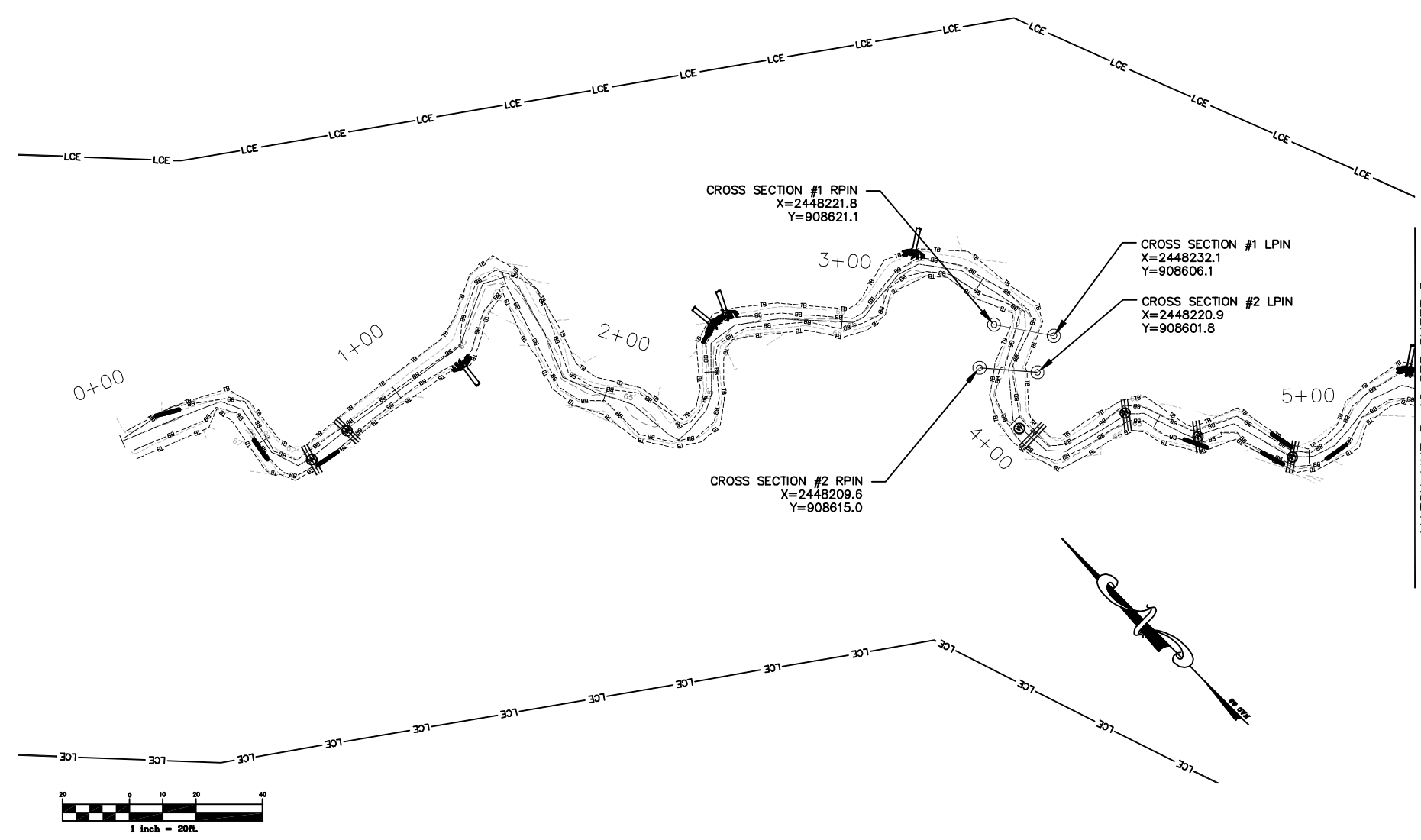
**2530 MERIDIAN PARKWAY SUITE 200
DURHAM, NC 27713
919-545-2929**



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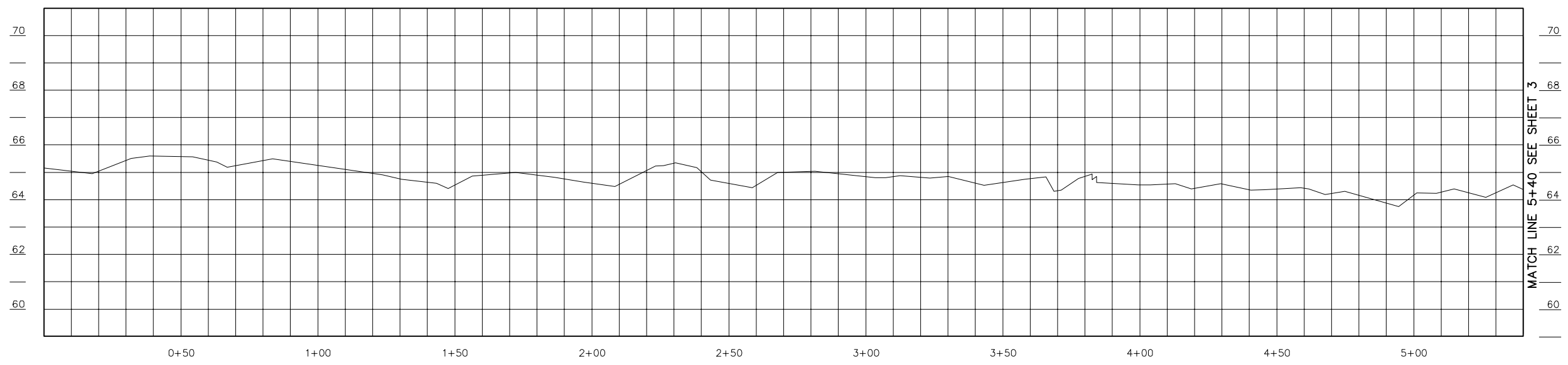


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- LEGEND**
- BOTTOM OF BANK
 - TOP OF BANK
 - CONTOURS
 - CENTER OF CHANNEL
 - LIMITS OF CONSERVATION EASEMENT
 - LOG RAMP
 - SMALL WOODY DEBRIS
 - CROSS SECTION
 - LOG GRADE CONTROL
 - LOG TOE PROTECTION
 - FORD CROSSING
 - ROOT WAD

MATCH LINE 5+40 SEE SHEET 3



Horizontal Scale: 1 inch = 20ft.
 Vertical Scale: 1 inch = 2ft.
NOTE:
 Profile Alignment is Thalweg of As-Built Channel

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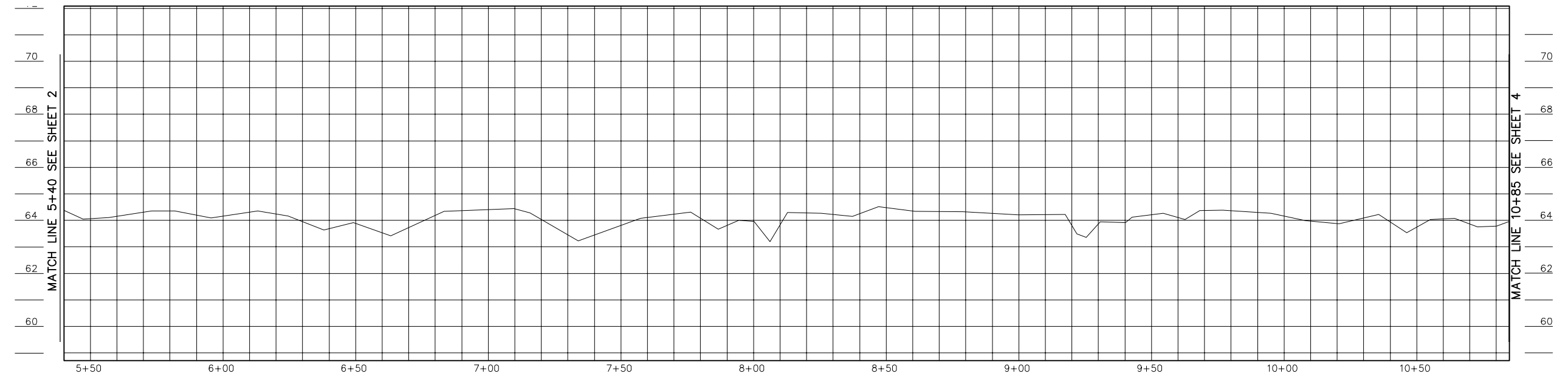
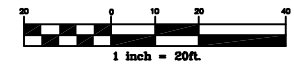
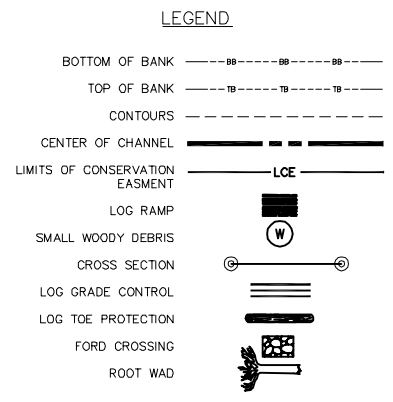
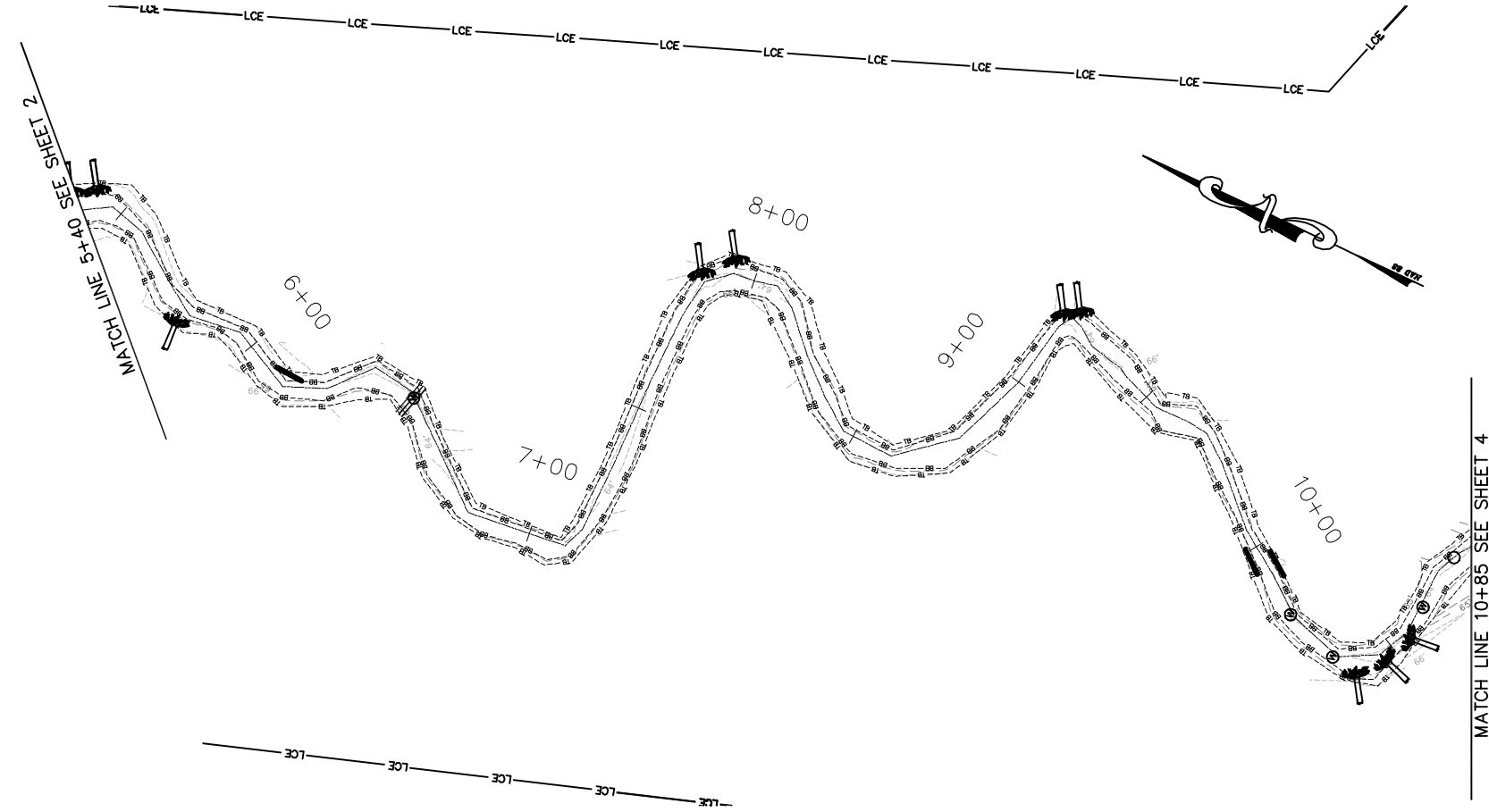
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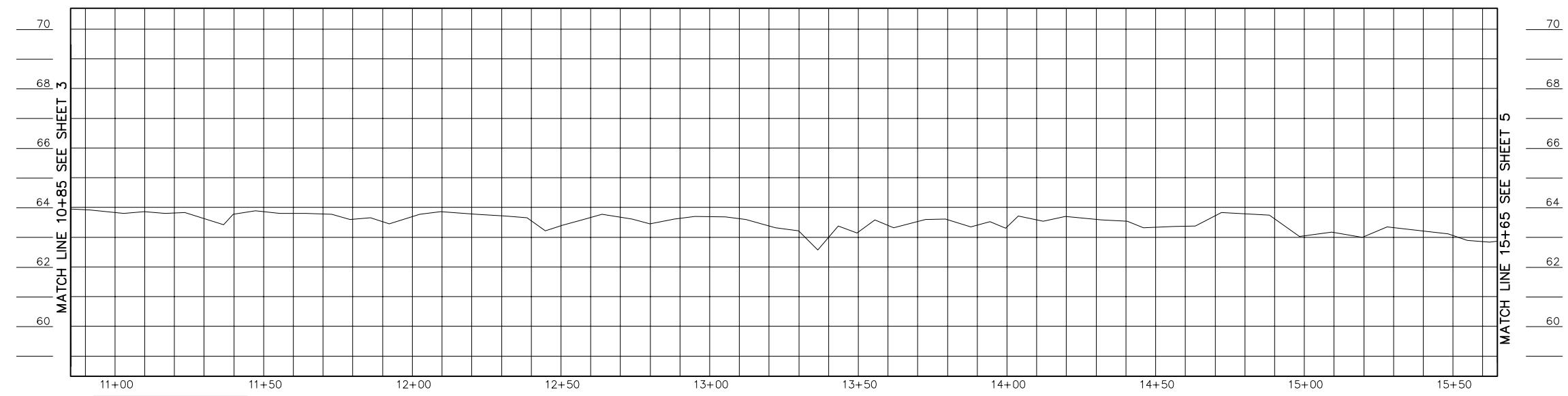
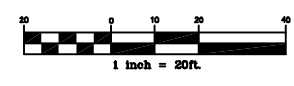
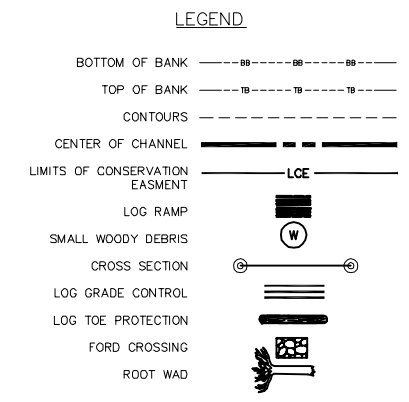
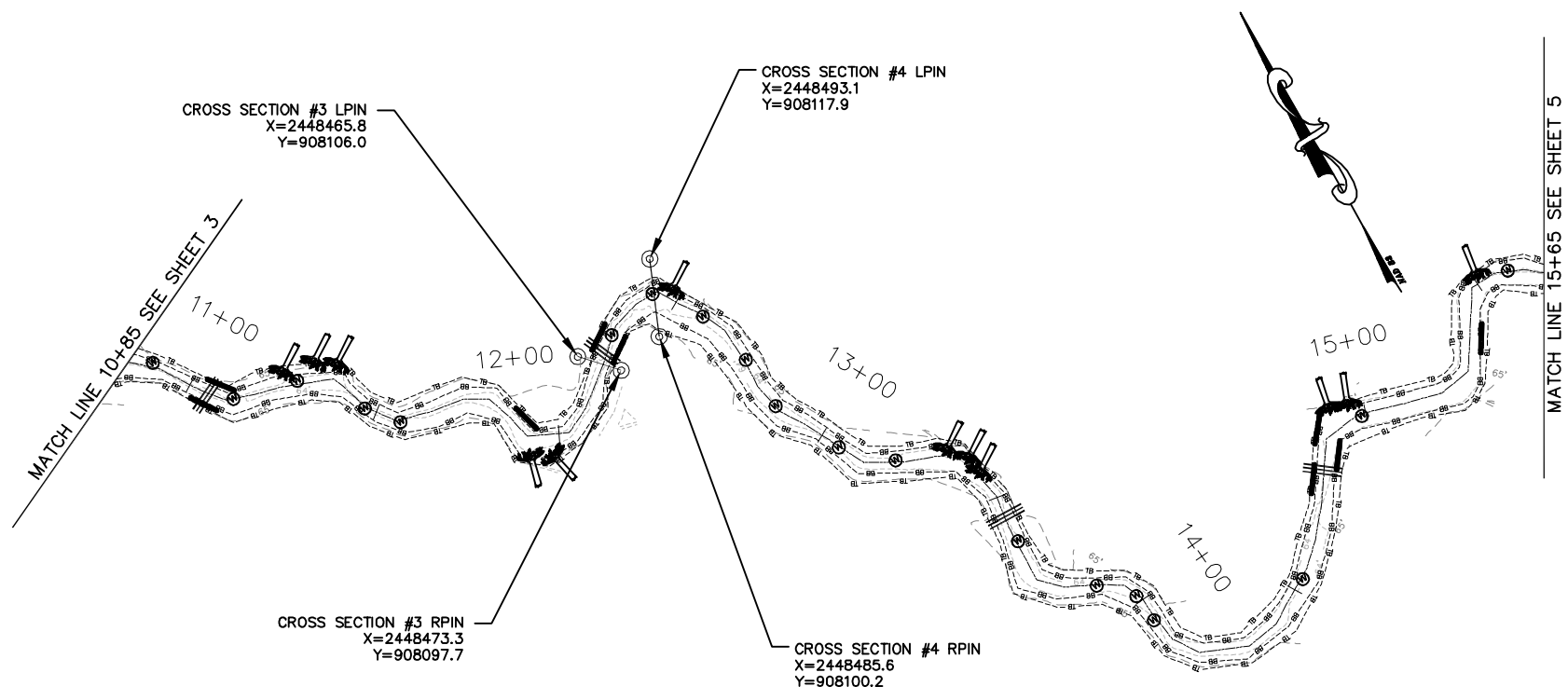
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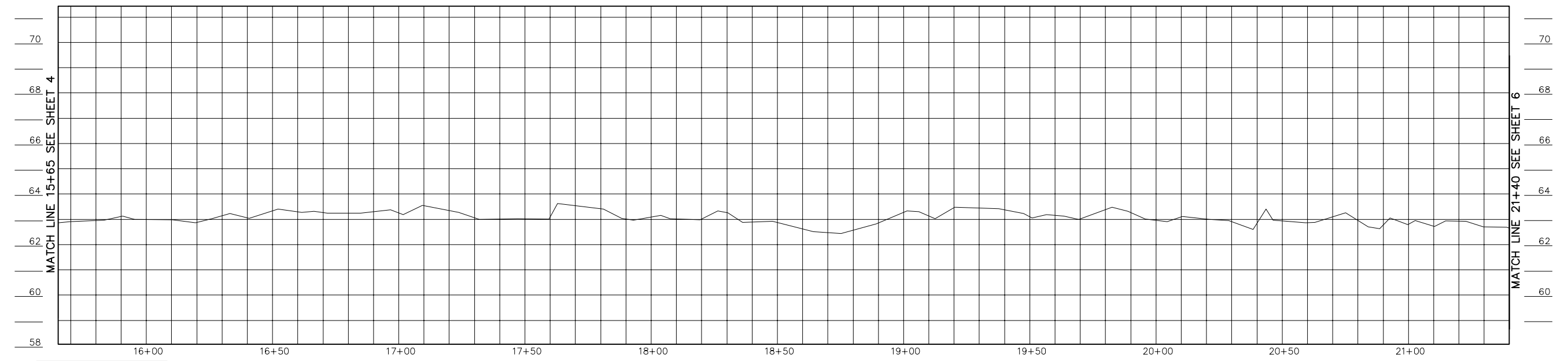
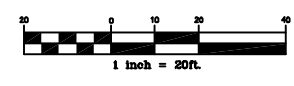
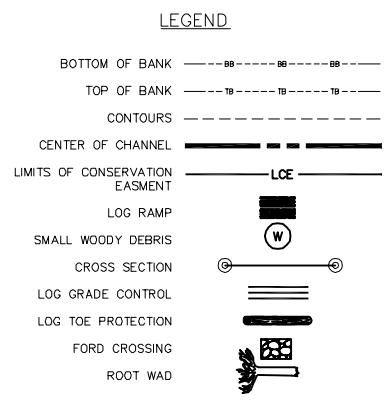
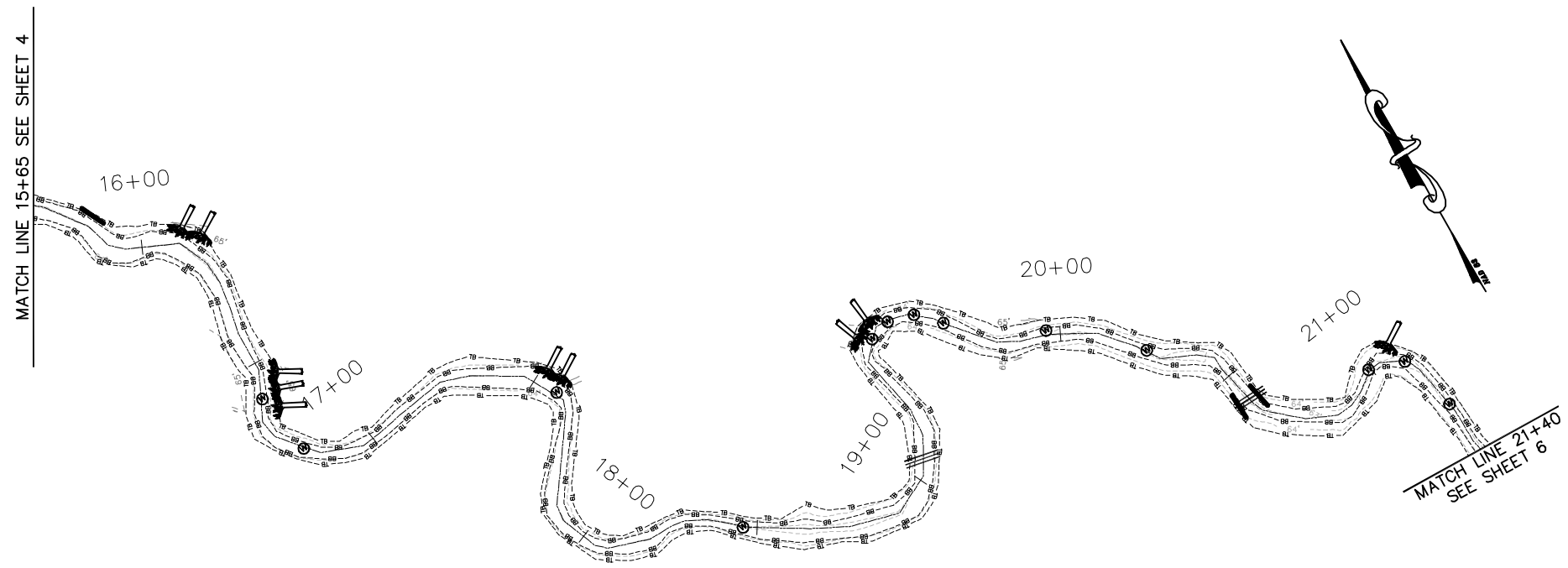
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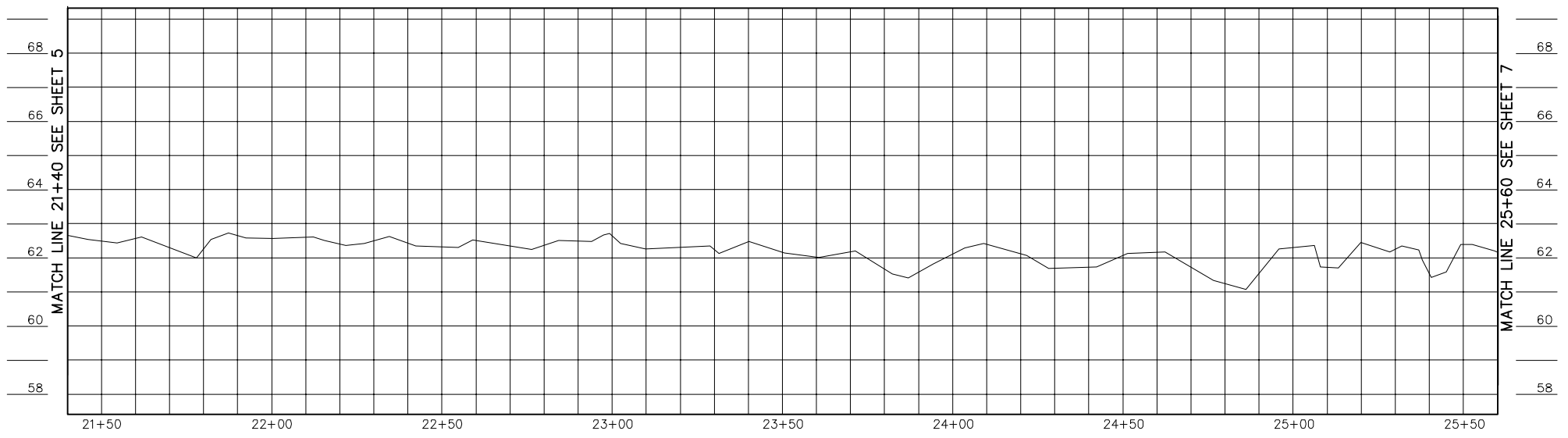
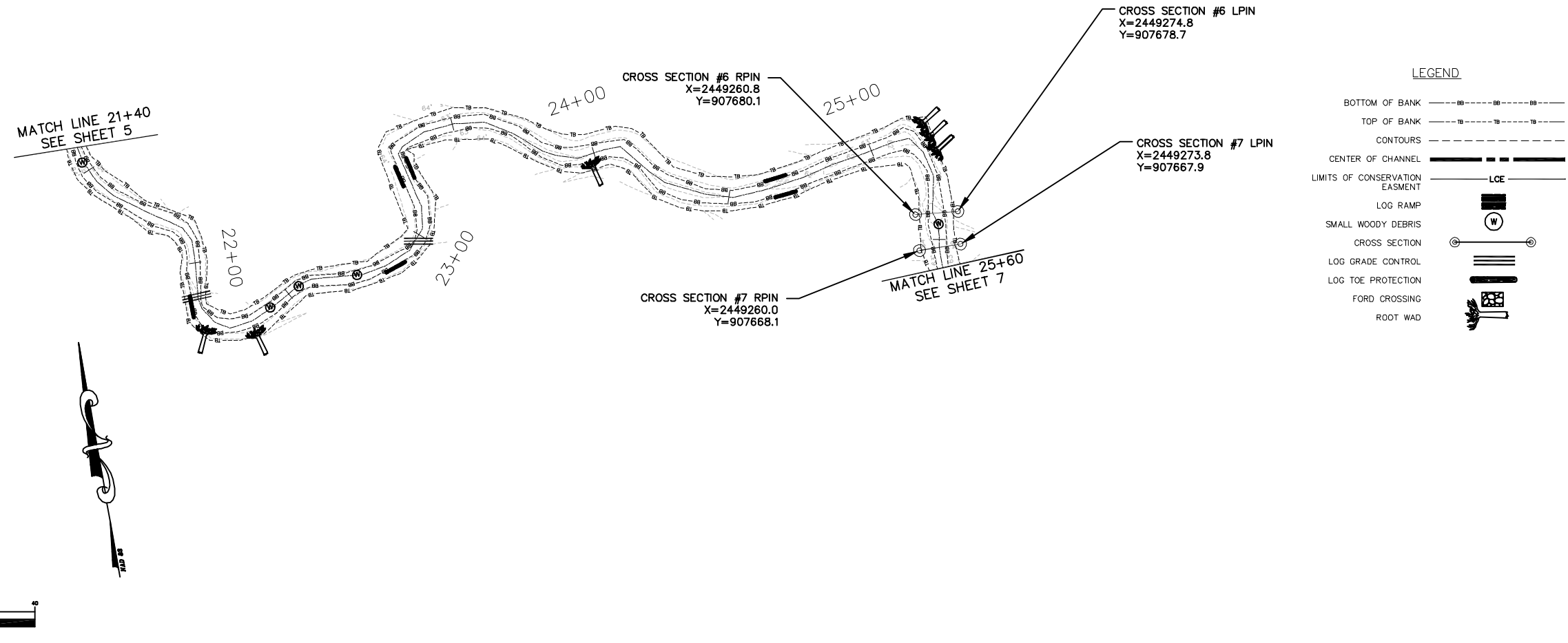
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 STA. 15+65 TO STA. 21+40

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NOTE:
Profile Alignment is Thalweg
of As-Built Channel

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'	3101 JOHN HUMPHRIES WYND RALEIGH, NC 27612 (919) 782-0495	RELEASED FOR APPROVALS	DATE
DRAWN BY TRIS	PROJECT DATE 06/2006	 community infrastructure consultants	BIDDING	
APPROVED BY MSE	PROJECT NUMBER 600200ORA		CONSTRUCTION	
FILE NAME as-built.dwg	PLOT DATE 11/07/08	Office Locations: North Carolina South Carolina Georgia Florida	RECORD DWG.	

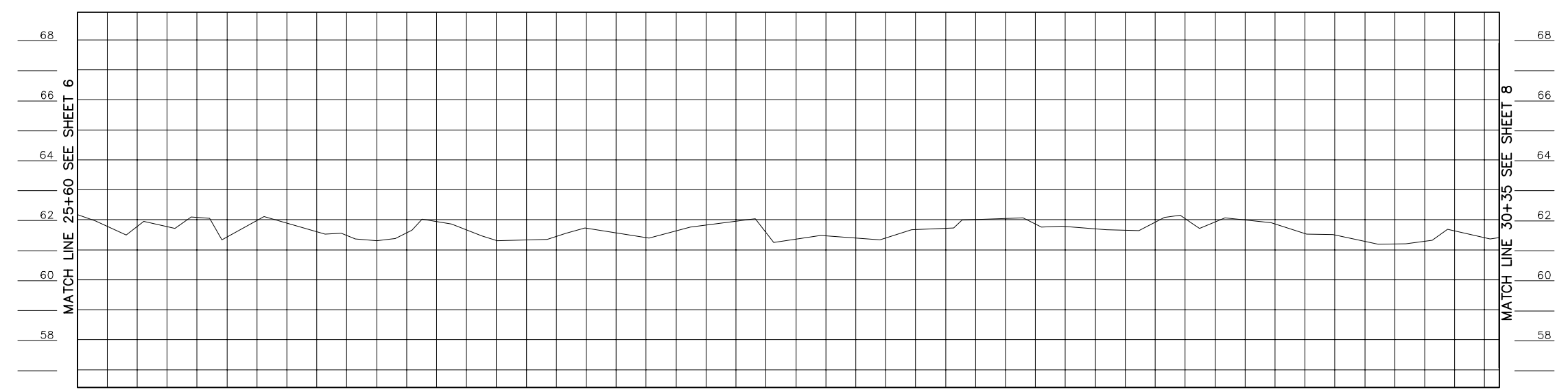
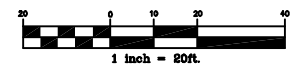
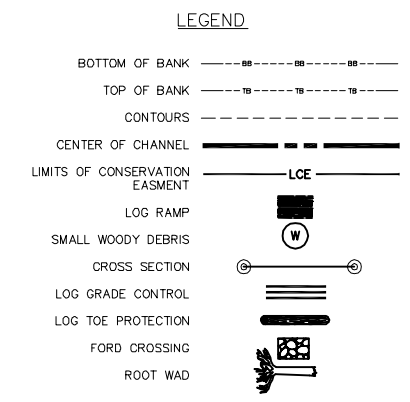
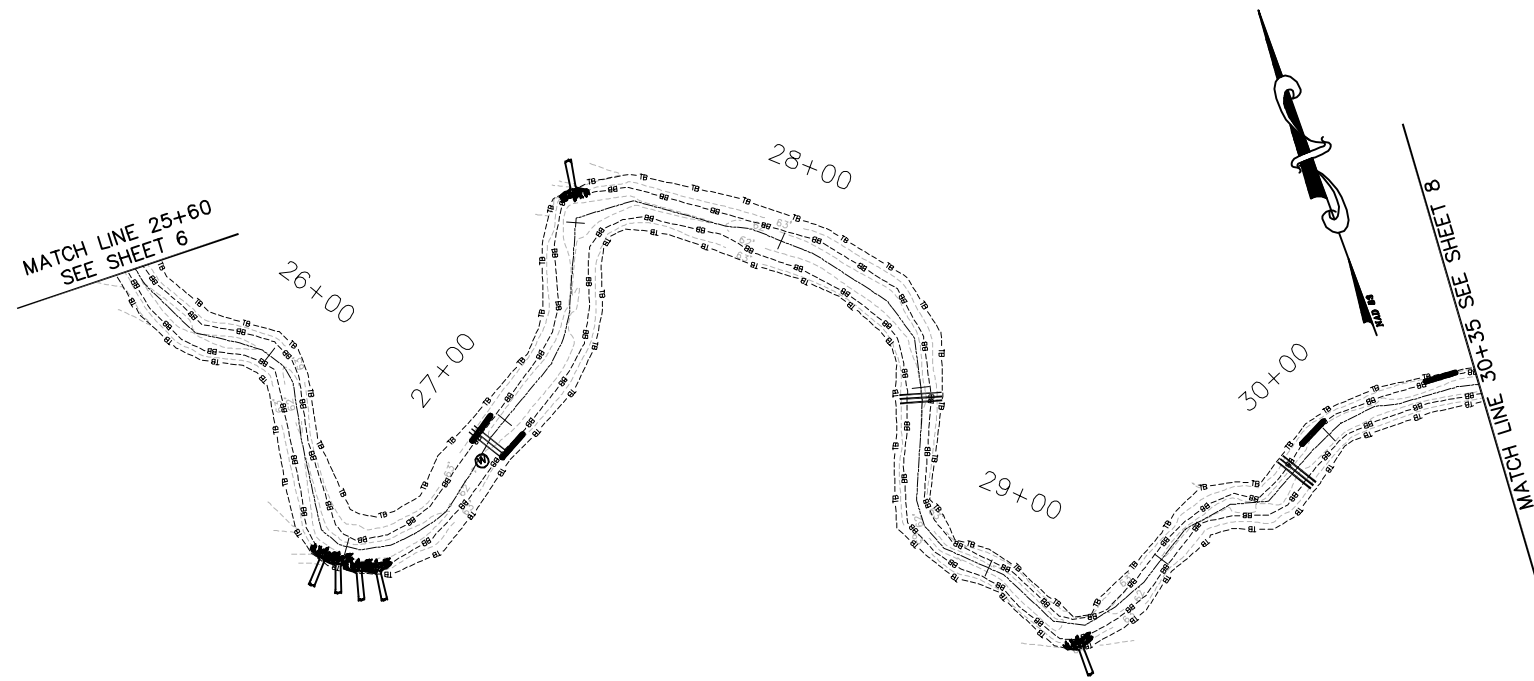


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CONOCOANNARA RESTORATION
HALIFAX COUNTY, NORTH CAROLINA

CONOCOANNARA AS-BUILT PLANS
STA. 21+40 TO STA. 25+60

I:\Projects\EBX\600200ORA\CADD\Swamp Restoration\Conoconnara Swamp Restoration\dwg\As-Built

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REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'
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APPROVED BY MSE	PROJECT NUMBER 600200RA
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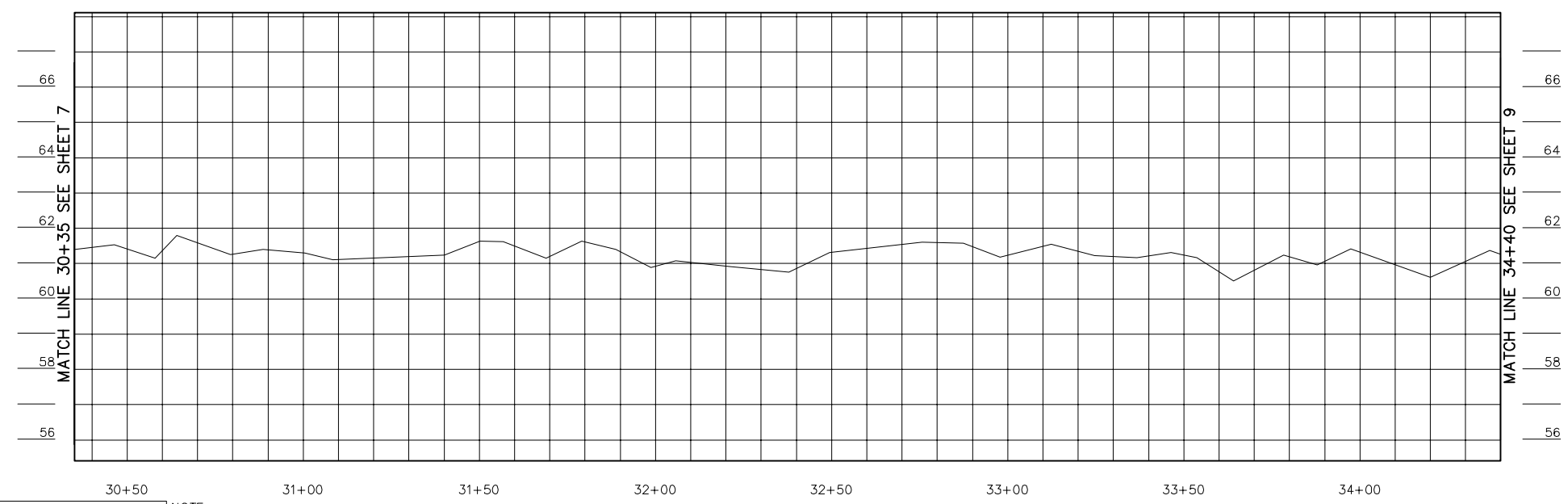
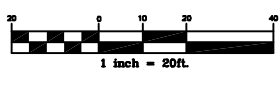
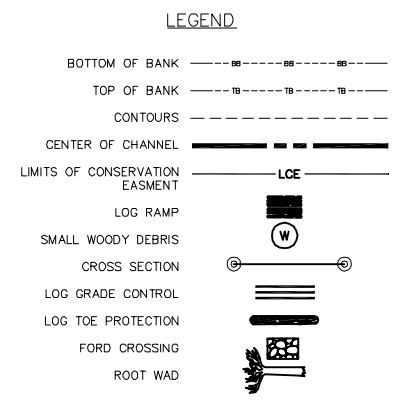
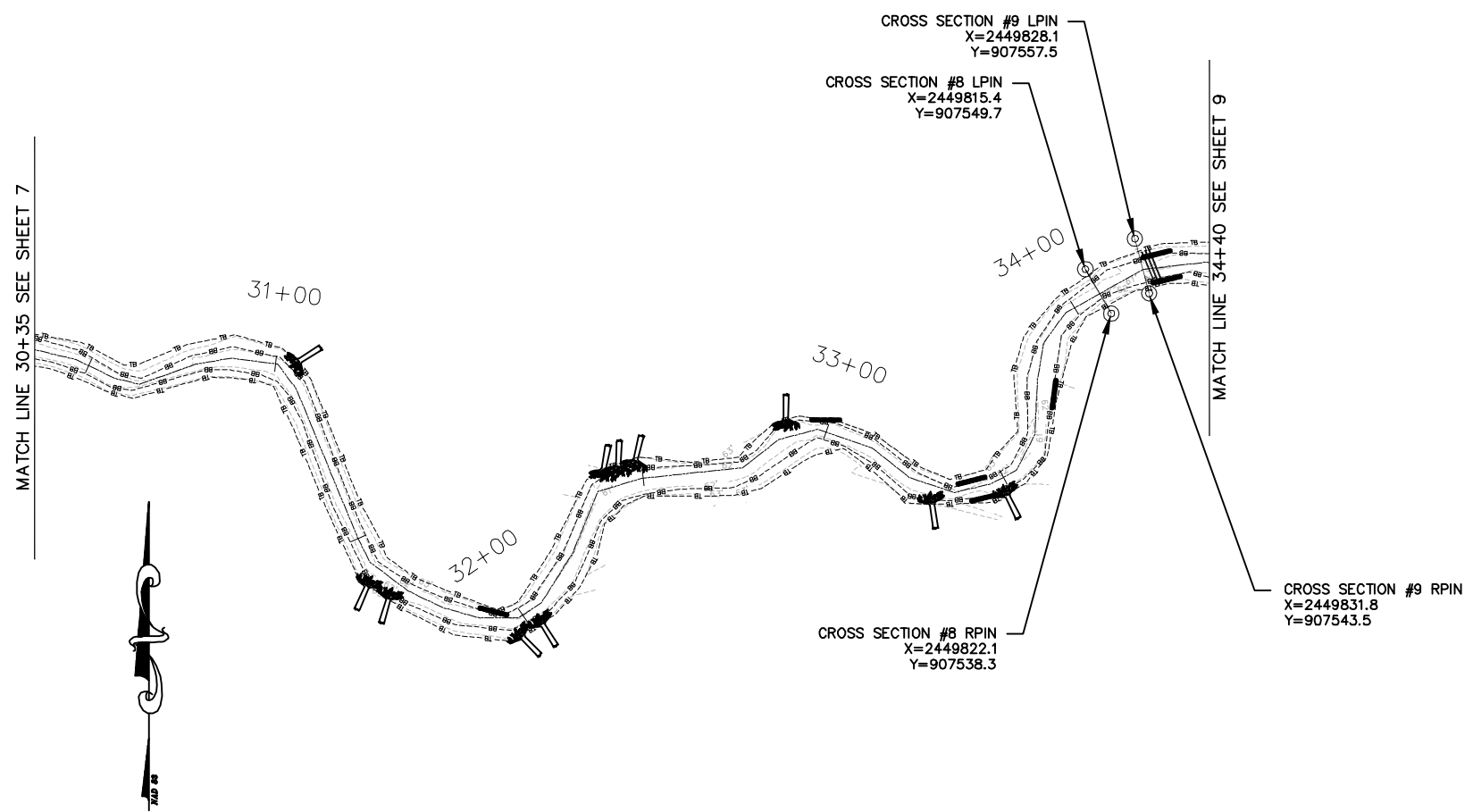
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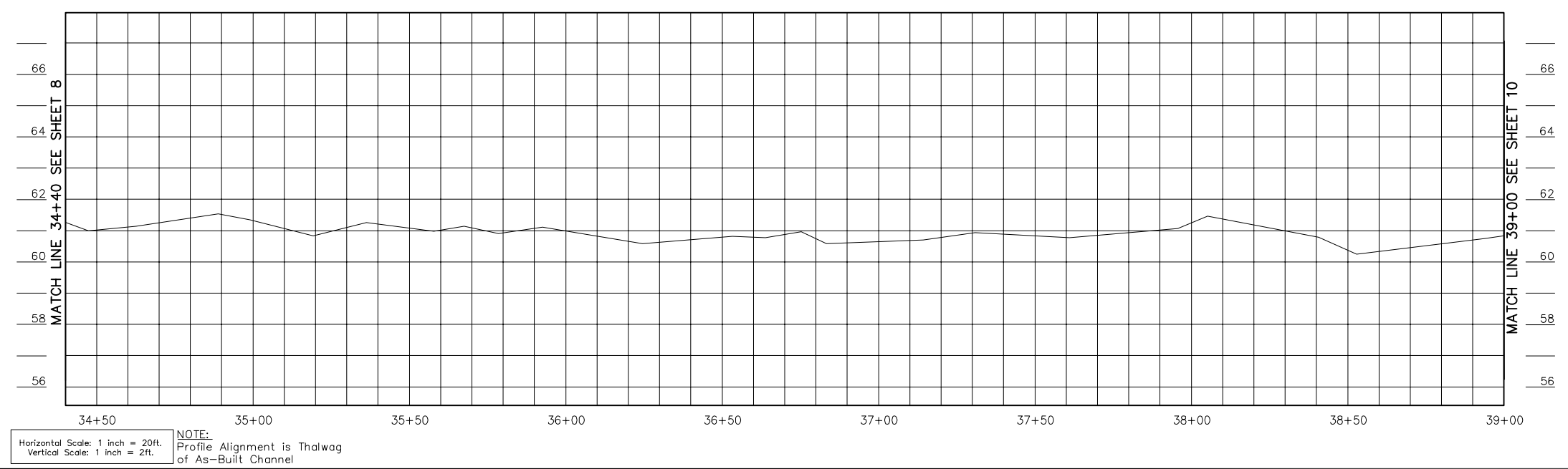
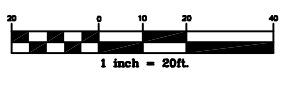
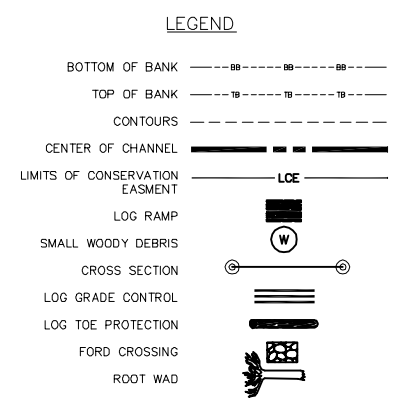
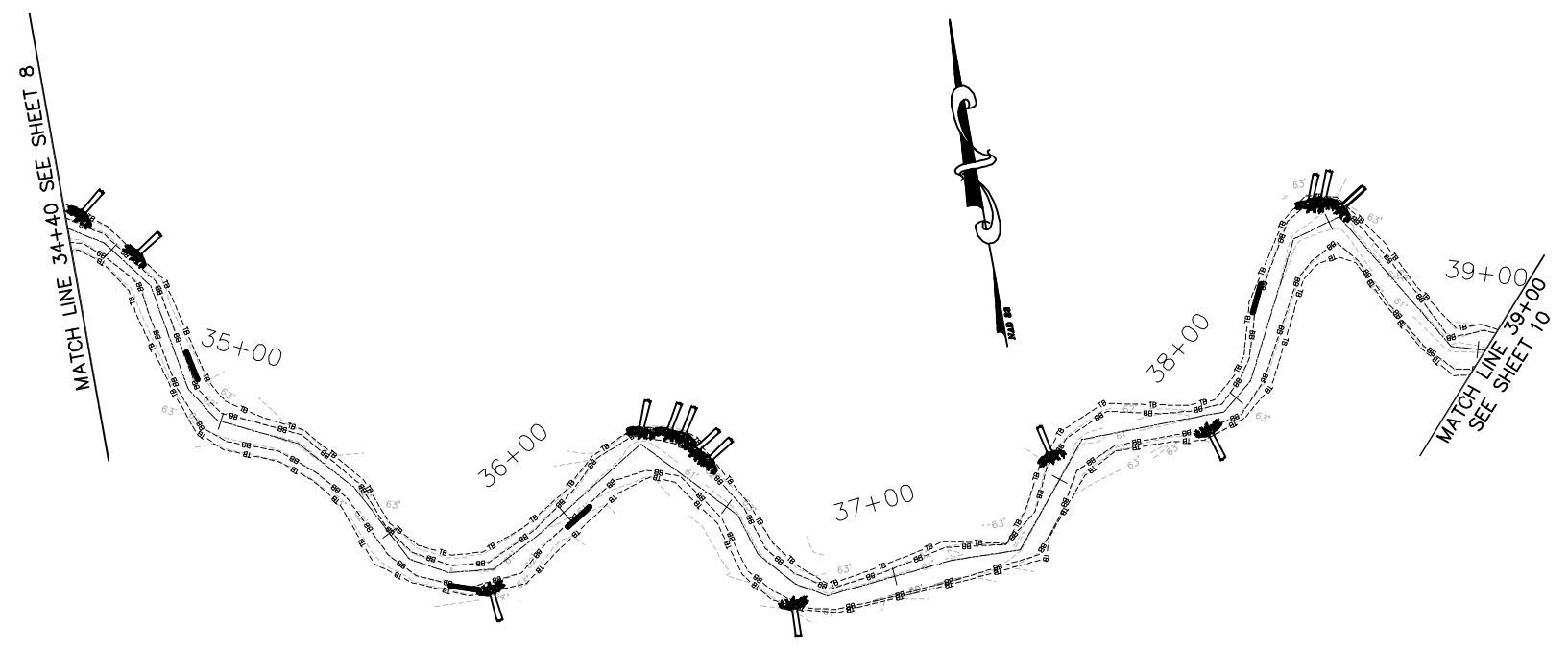


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HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 30+35 TO STA. 34+40

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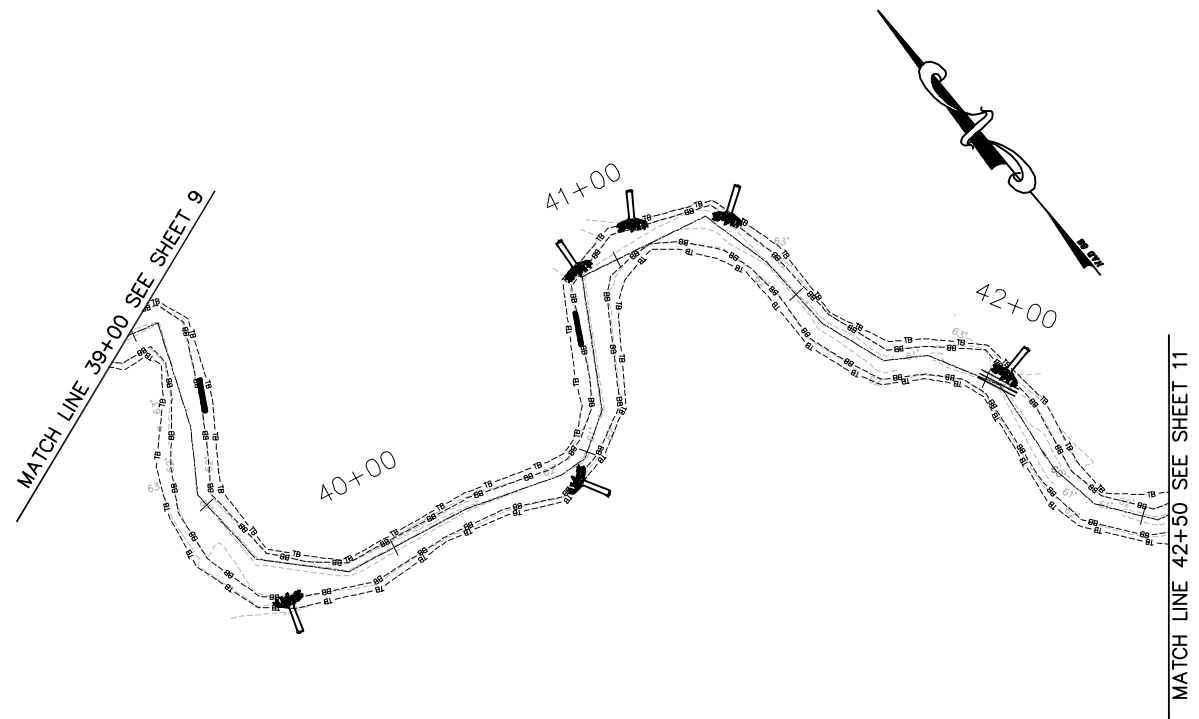
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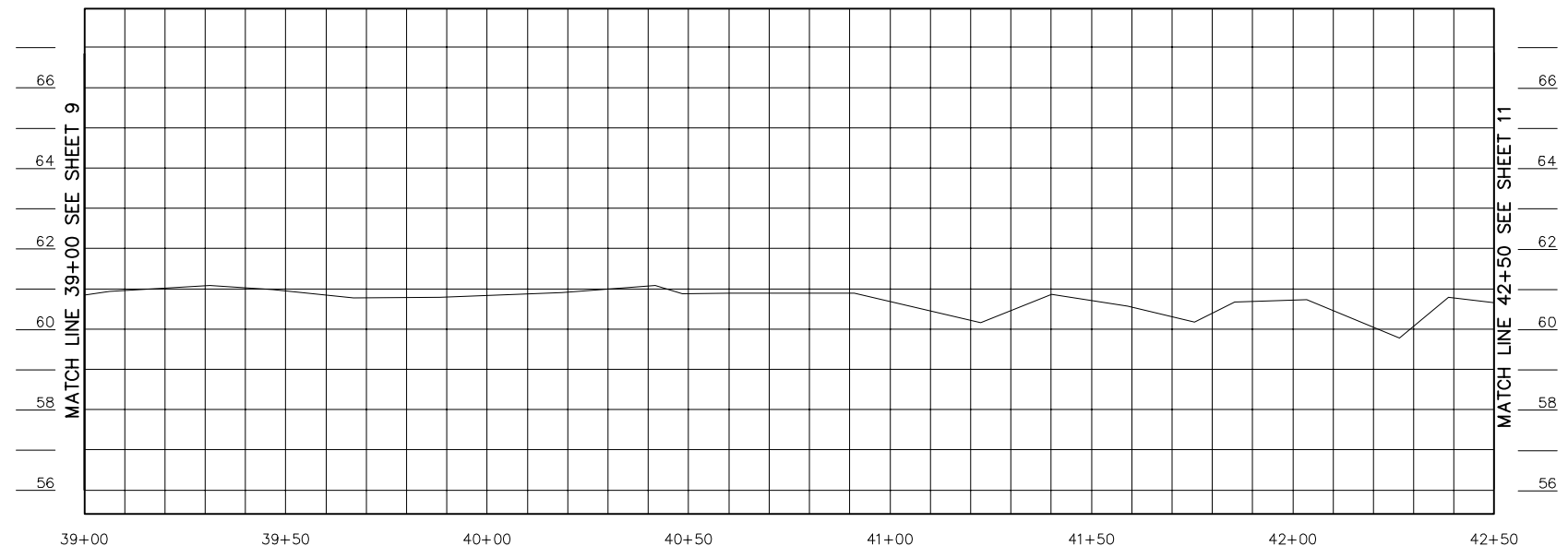
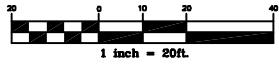
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HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 34+40 TO STA. 39+00

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- LEGEND**
- BOTTOM OF BANK ---●●●●●●---
 - TOP OF BANK ---▬▬▬▬---
 - CONTOURS - - - - -
 - CENTER OF CHANNEL ————
 - LIMITS OF CONSERVATION EASEMENT ———— LCE ————
 - LOG RAMP [Symbol]
 - SMALL WOODY DEBRIS (W) [Symbol]
 - CROSS SECTION [Symbol]
 - LOG GRADE CONTROL [Symbol]
 - LOG TOE PROTECTION [Symbol]
 - FORD CROSSING [Symbol]
 - ROOT WAD [Symbol]



Horizontal Scale: 1 inch = 20ft.
Vertical Scale: 1 inch = 2ft.

NOTE:
Profile Alignment is Thalweg
of As-Built Channel

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'
DRAWN BY TMS	PROJECT DATE 06/2006
APPROVED BY MSE	PROJECT NUMBER 600200ORA
FILE NAME as-built.dwg	PLOT DATE 11/07/08

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RELEASED FOR	DATE
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BIDDING	
CONSTRUCTION	
RECORD DWG.	

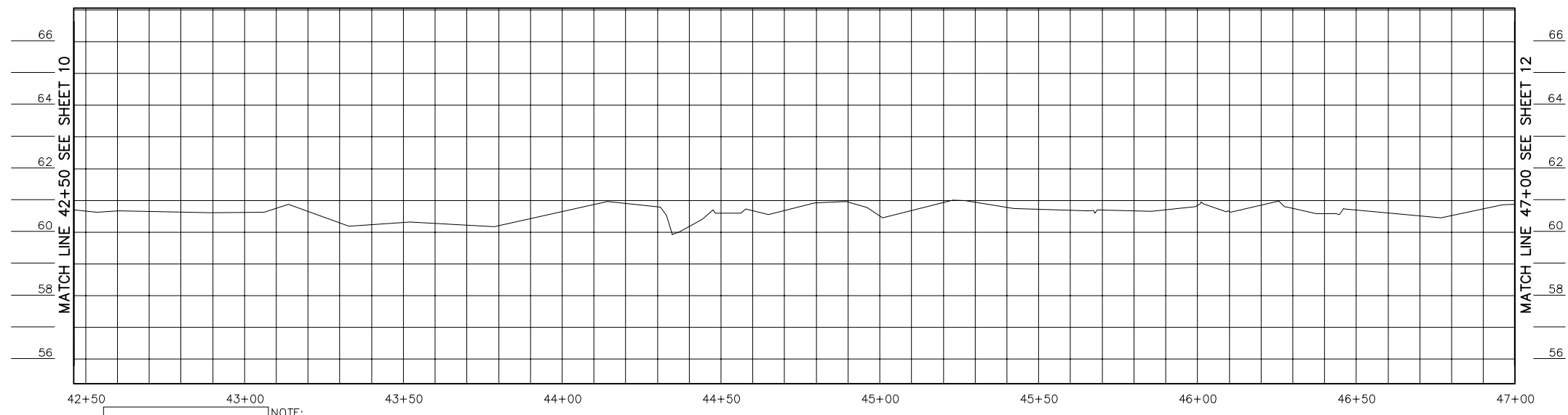
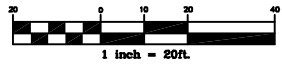
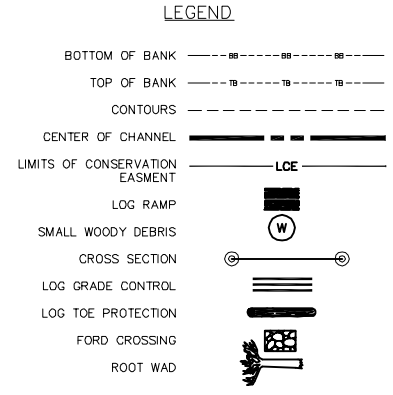
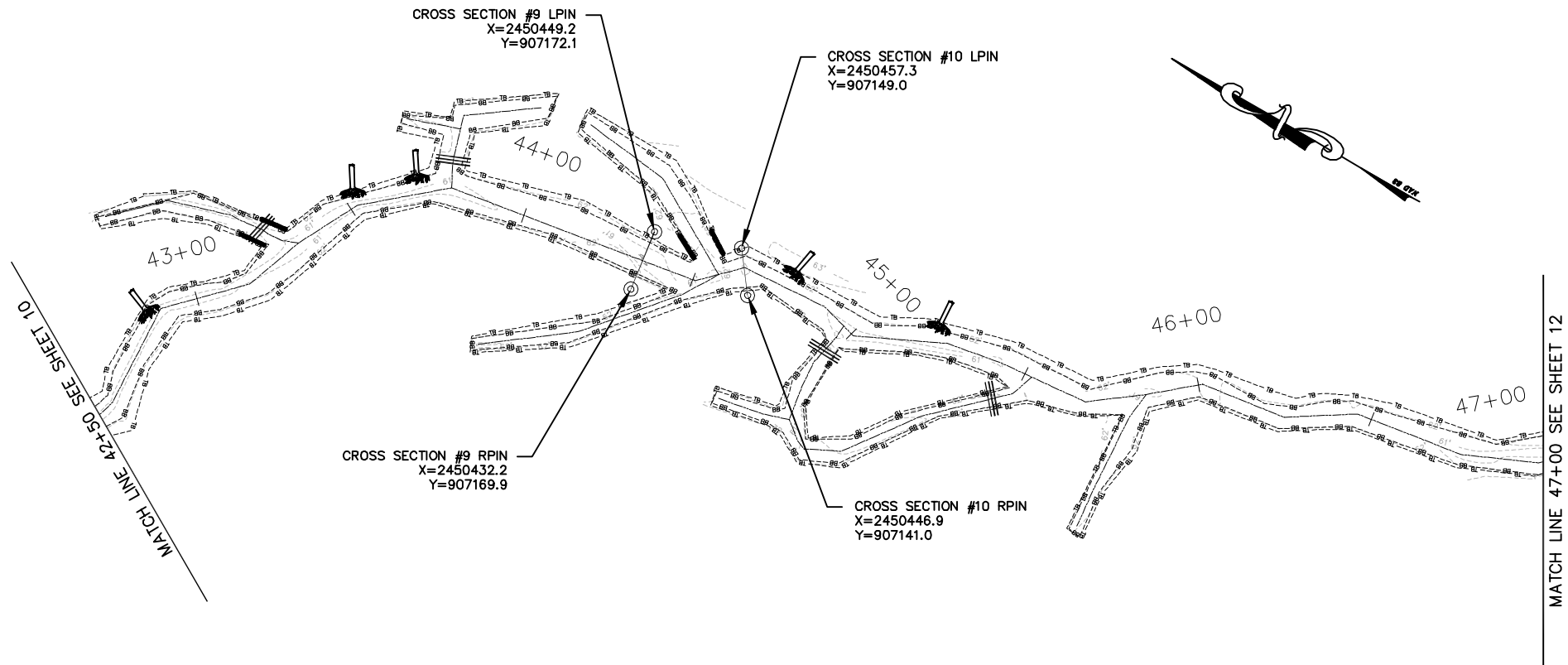


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HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 39+00 TO STA. 42+50

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NOTE:
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of As-Built Channel

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'
DRAWN BY TRS	PROJECT DATE 06/20/06
APPROVED BY MSE	PROJECT NUMBER 600200ORA
FILE NAME as-built.dwg	PLOT DATE 11/07/08

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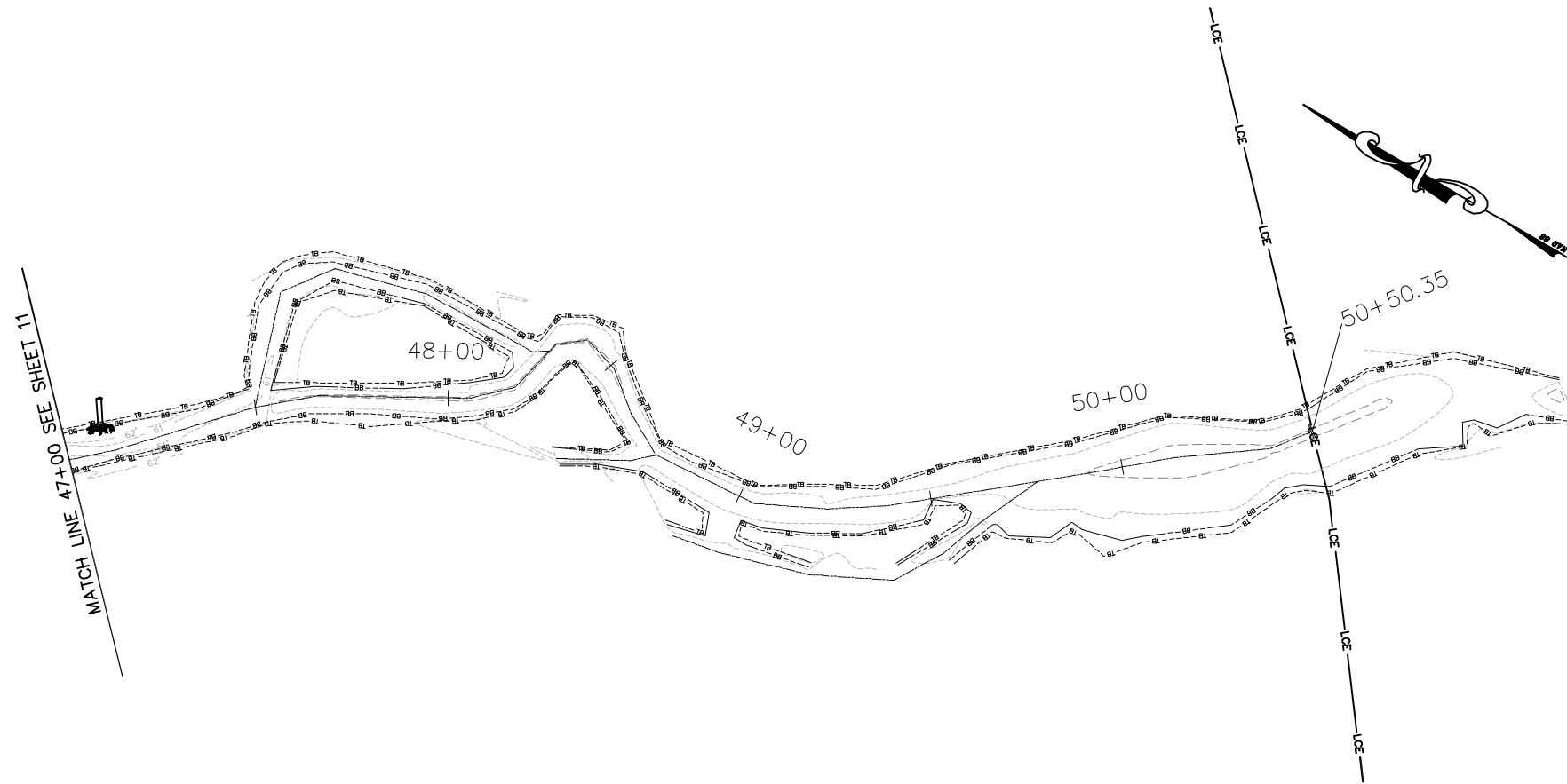
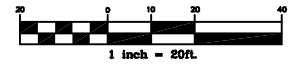


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HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 42+50 TO STA. 47+00

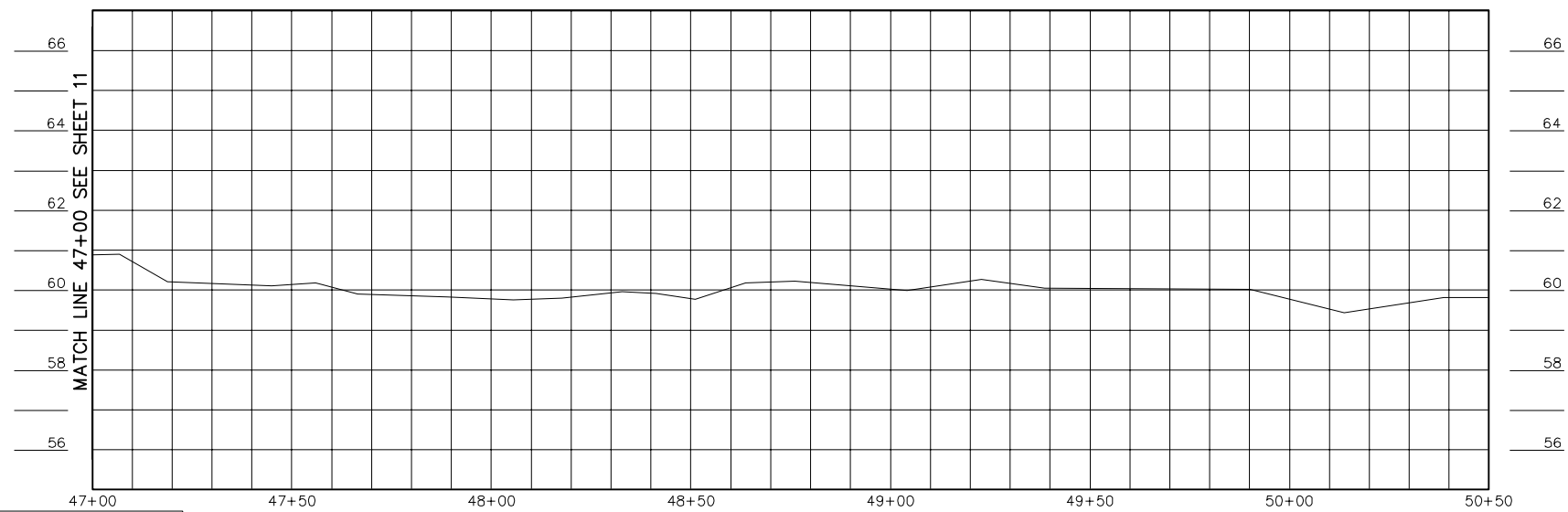
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LEGEND

BOTTOM OF BANK	---
TOP OF BANK	-▲-
CONTOURS	- - - - -
CENTER OF CHANNEL	—————
LIMITS OF CONSERVATION EASEMENT	————— LCE
LOG RAMP	■
SMALL WOODY DEBRIS	⊙ W
CROSS SECTION	⊙ — ⊙
LOG GRADE CONTROL	
LOG TOE PROTECTION	—
FORD CROSSING	⊞
ROOT WAD	⊞



Horizontal Scale: 1 inch = 20ft.
Vertical Scale: 1 inch = 2ft.
NOTE: Profile Alignment is Thalweg of As-Built Channel

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'
DRAWN BY TRS	PROJECT DATE 06/2006
APPROVED BY MSE	PROJECT NUMBER 600200RA
FILE NAME as-built.dwg	PLOT DATE 11/07/08

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HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 47+00 TO STA. 50+50.35

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PLANTING PLAN

Zone 1 (saturated/undated)		Quantity
Willow oak (<i>Quercus phellos</i>)		2040
Water oak (<i>Quercus nigra</i>)		3920
Sycamore (<i>Platanus occidentalis</i>)		4200
Green Ash (<i>Fraxinus pennsylvanica</i>)		4200
Laurel oak (<i>Quercus laurifolia</i>)		800
Swamp blackgum (<i>Nyssa biflora</i>)		4240
Musclewood (<i>Carpinus caroliniana</i>)		3000
Water tupelo (<i>Nyssa aquatica</i>)		4175
Bald cypress (<i>Taxodium distichum</i>)		4220
Swamp chestnut oak (<i>Quercus phellos</i>)		2000

Zone 2 (saturated)		Quantity
Yellow poplar (<i>Liriodendron tulipifera</i>)		3850
American elm (<i>Ulmus americana</i>)		3650
Cherrybark oak (<i>Quercus pagodaefolia</i>)		2800
Pawpaw (<i>Asimina triloba</i>)		1900
Blackgum (<i>Nyssa sylvatica</i>)		2100
Willow oak (<i>Quercus phellos</i>)		2140
Water oak (<i>Quercus nigra</i>)		1440
River Birch (<i>Betula nigra</i>)		2004
Green Ash (<i>Fraxinus pennsylvanica</i>)		1980
Swamp chestnut oak (<i>Quercus phellos</i>)		800

UPSTREAM SINGLE THREAD CHANNEL

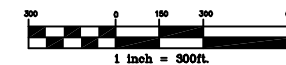
PLANTING PLAN

ZONE 3 (Upstream Single-Thread Channel)		Quantity
Green Ash (<i>Fraxinus pennsylvanica</i>)		1975
Sycamore (<i>Platanus occidentalis</i>)		1500
Swamp blackgum (<i>Nyssa biflora</i>)		510
Bald cypress (<i>Taxodium distichum</i>)		555
Water oak (<i>Quercus nigra</i>)		1184
Willow oak (<i>Quercus phellos</i>)		1520
Overcup Oak (<i>Quercus lyrata</i>)		1050
River Birch (<i>Betula nigra</i>)		950
Carolina Ash (<i>Fraxinus caroliniana</i>)		1750

DOWNSTREAM MULTIPLE THREAD CHANNEL

ZONE 4 (Downstream Multiple Thread Channel)

	Quantity
Bald cypress (<i>Taxodium distichum</i>)	325
Water tupelo (<i>Nyssa aquatica</i>)	679
Overcup oak (<i>Quercus lyrata</i>)	550
River Birch (<i>Betula nigra</i>)	600
Water oak (<i>Quercus nigra</i>)	156
Laurel oak (<i>Quercus laurifolia</i>)	300
Swamp blackgum (<i>Nyssa biflora</i>)	150
Carolina Ash (<i>Fraxinus caroliniana</i>)	650



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REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 300'
DRAWN BY TRS	PROJECT DATE 06/2006
APPROVED BY ME	PROJECT NUMBER 600200RA
FILE NAME wetland.dwg	PLOT DATE 11/07/2008



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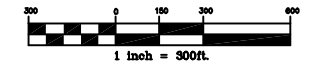
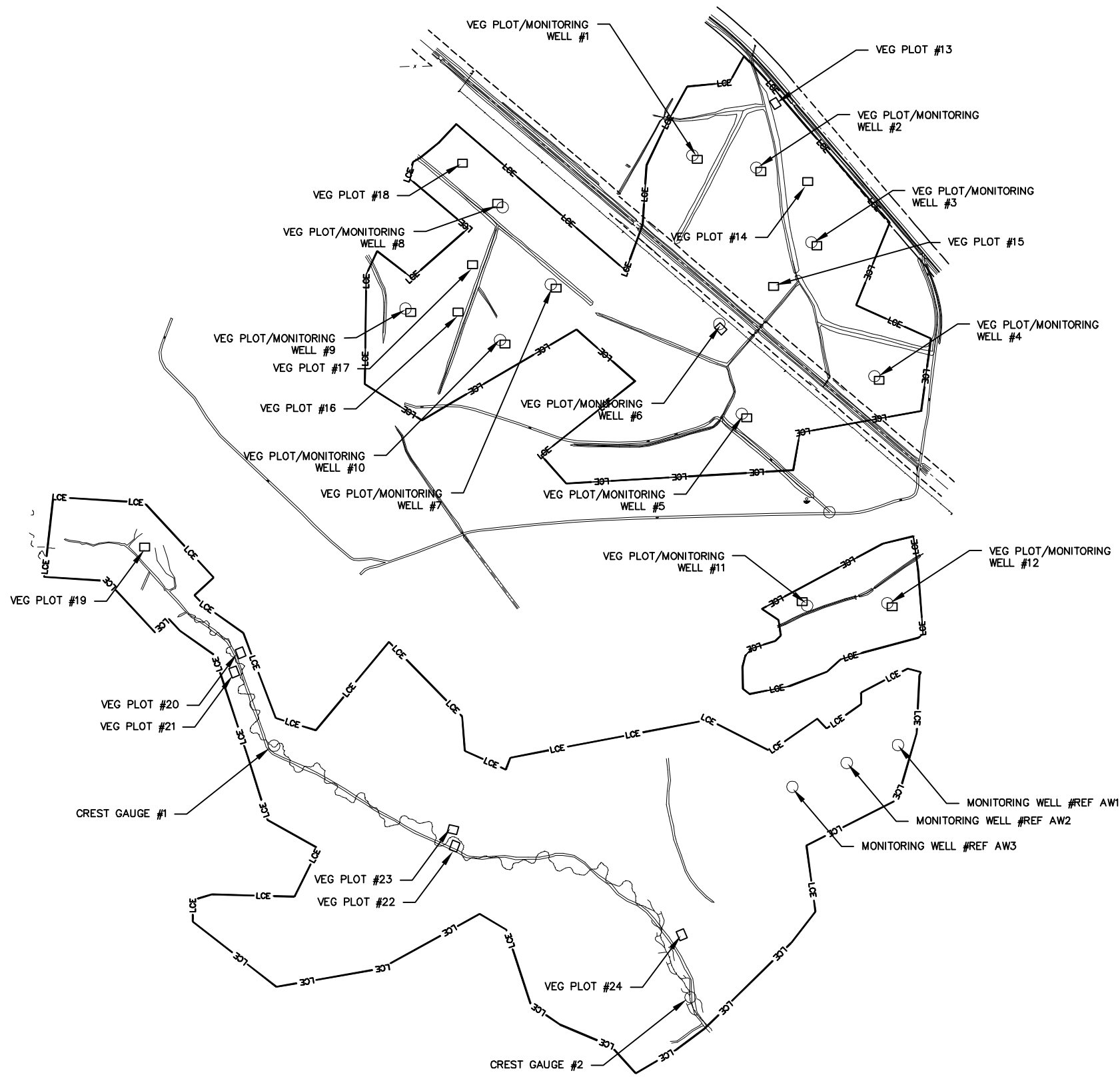
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HALIFAX COUNTY, NORTH CAROLINA

AS-BUILT
PLANTING PLAN

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REV. NO.	DESCRIPTION	DATE

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DRAWN BY TRS	PROJECT DATE 06/2006
APPROVED BY ME	PROJECT NUMBER 6002006A
FILE NAME welland.dwg	PLOT DATE 11/07/2008



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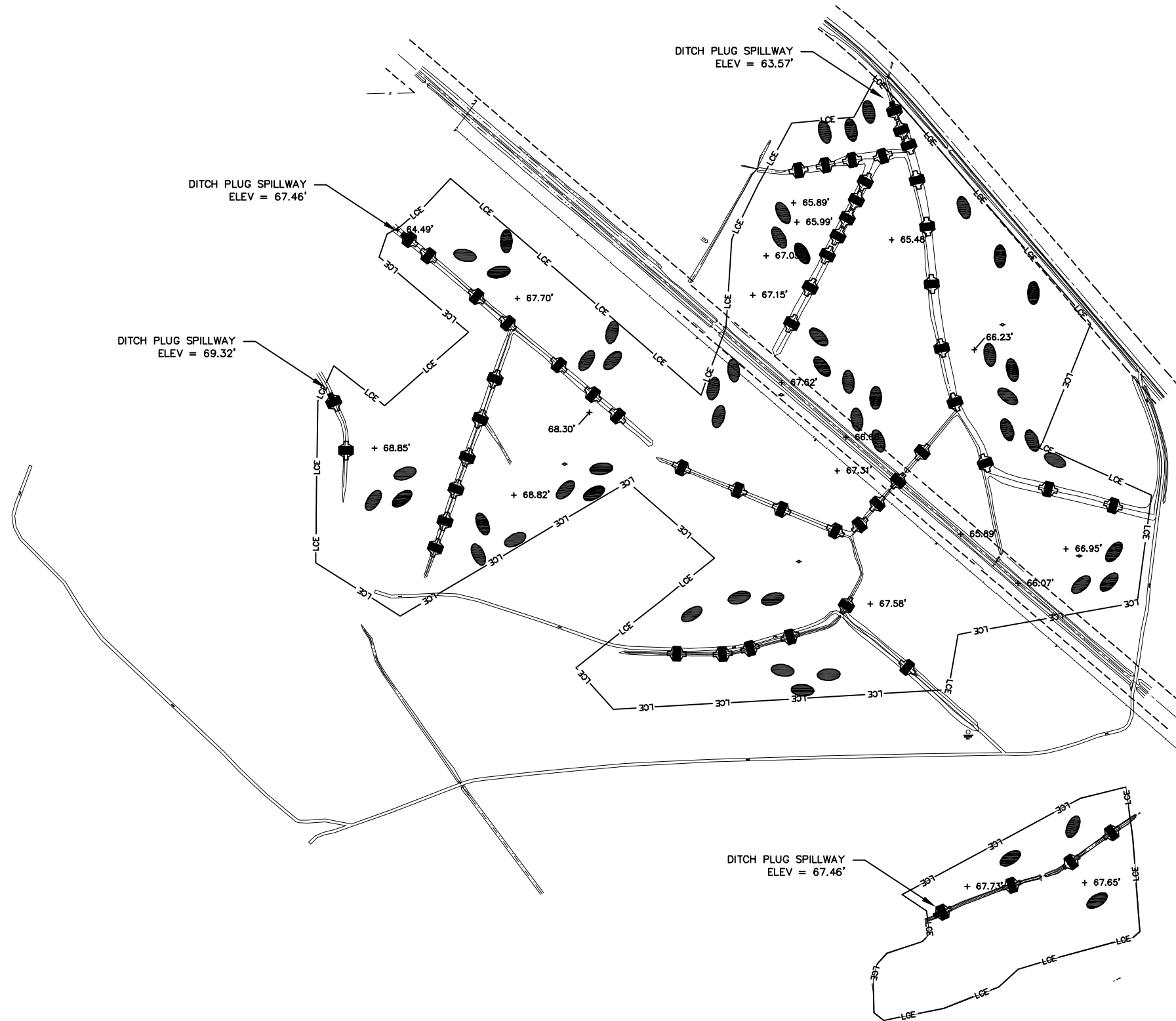
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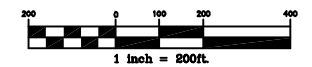
WELL/VEG PLOT LOCATIONS

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LEGEND

- CHANNEL PLUG
- CHANNEL PLUG WITH SPILLWAY
- WETLAND DEPRESSION
- LIMITS OF CONSERVATION EASEMENT
- PROPOSED SPOT ELEVATION **+ 66.50'**
- RAPTOR POLE



REV. NO.	DESCRIPTION	DATE

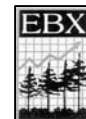
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APPROVED BY ME	PROJECT NUMBER 6002006RA
FILE NAME wetland.dwg	PLT DATE 11/07/2008



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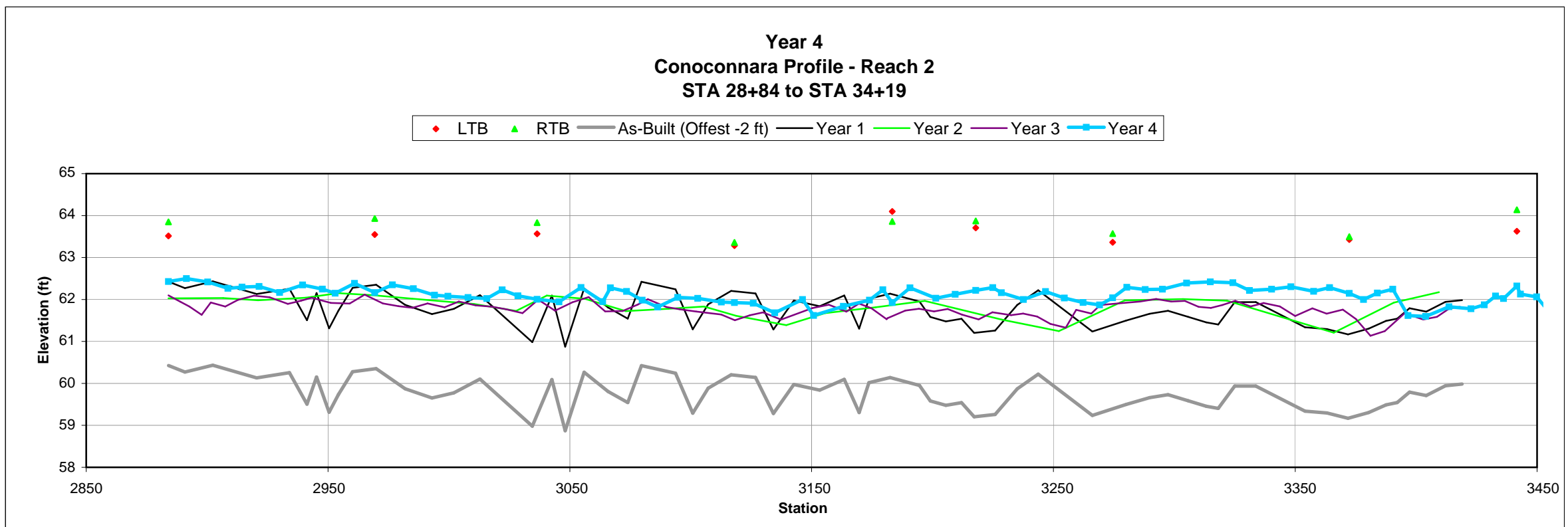
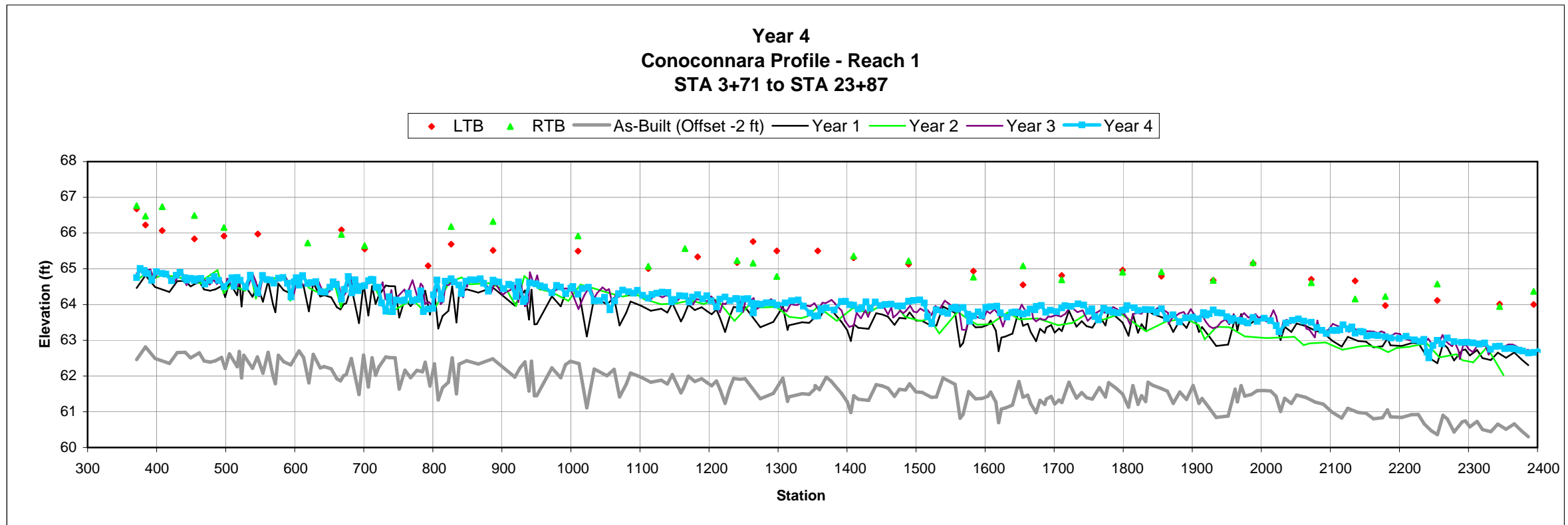


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HALIFAX COUNTY, NORTH CAROLINA

WETLAND AS-BUILT PLANS

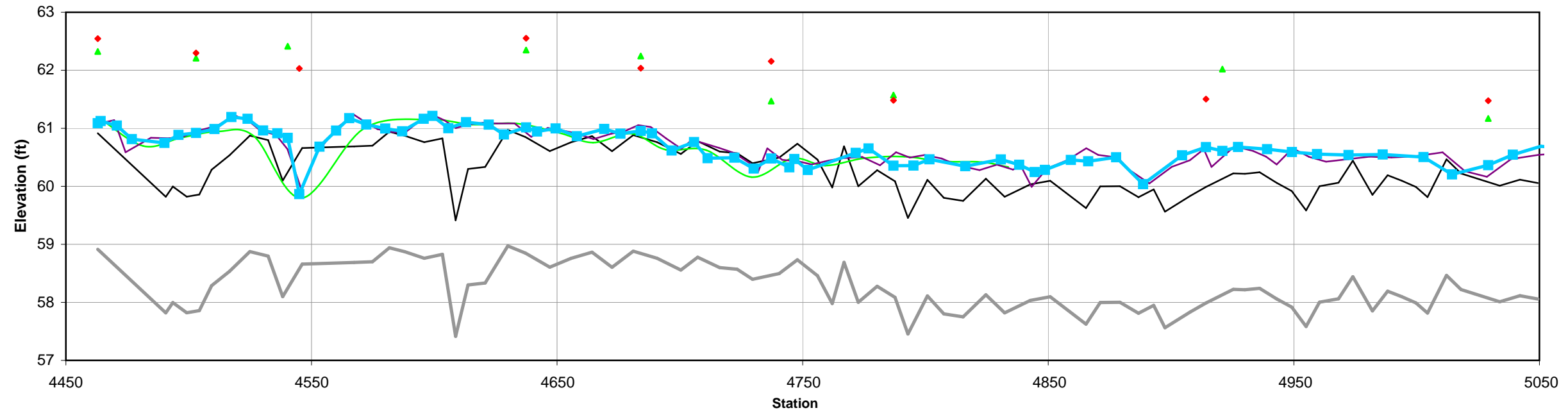
APPENDIX B

2010 Profile and Cross Section Data



Year 4
Conoconnara Profile - Reach 3
STA 44+63 to STA 50+49

▲ RTB ◆ LTB — As-Built (Offset -2 ft) — Year 1 — Year 2 — Year 3 —■ Year 4

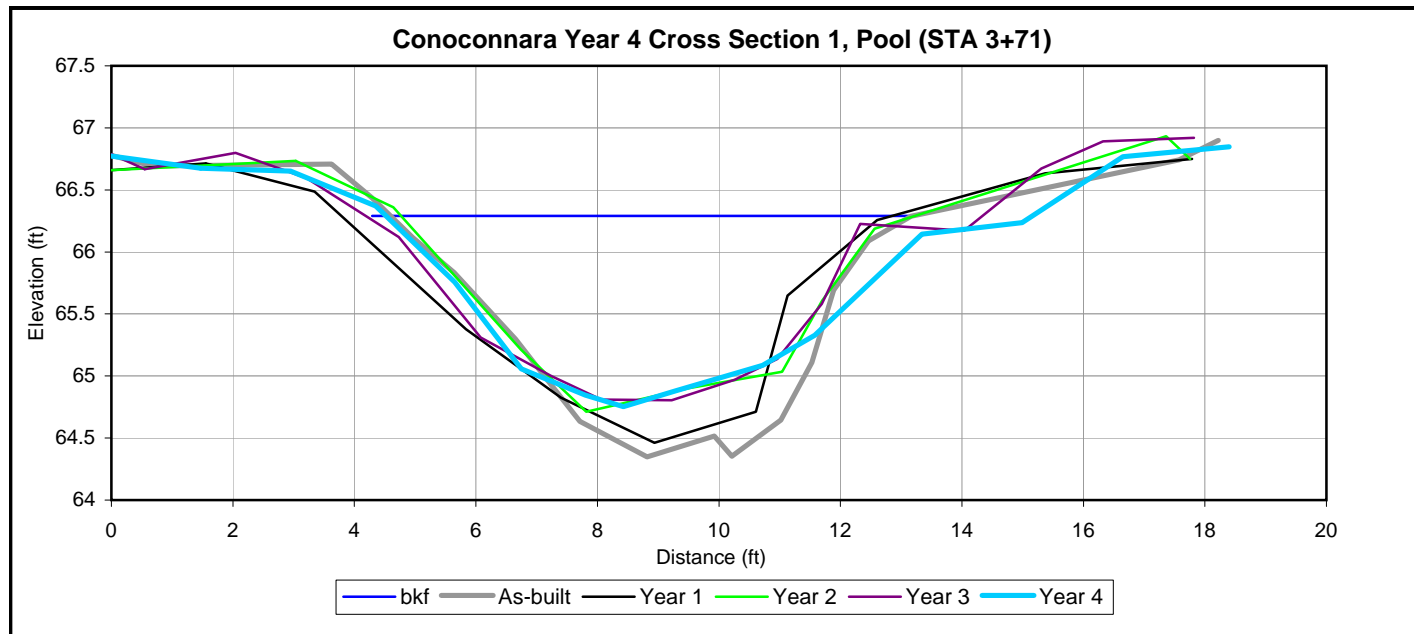




Left bank



Right bank

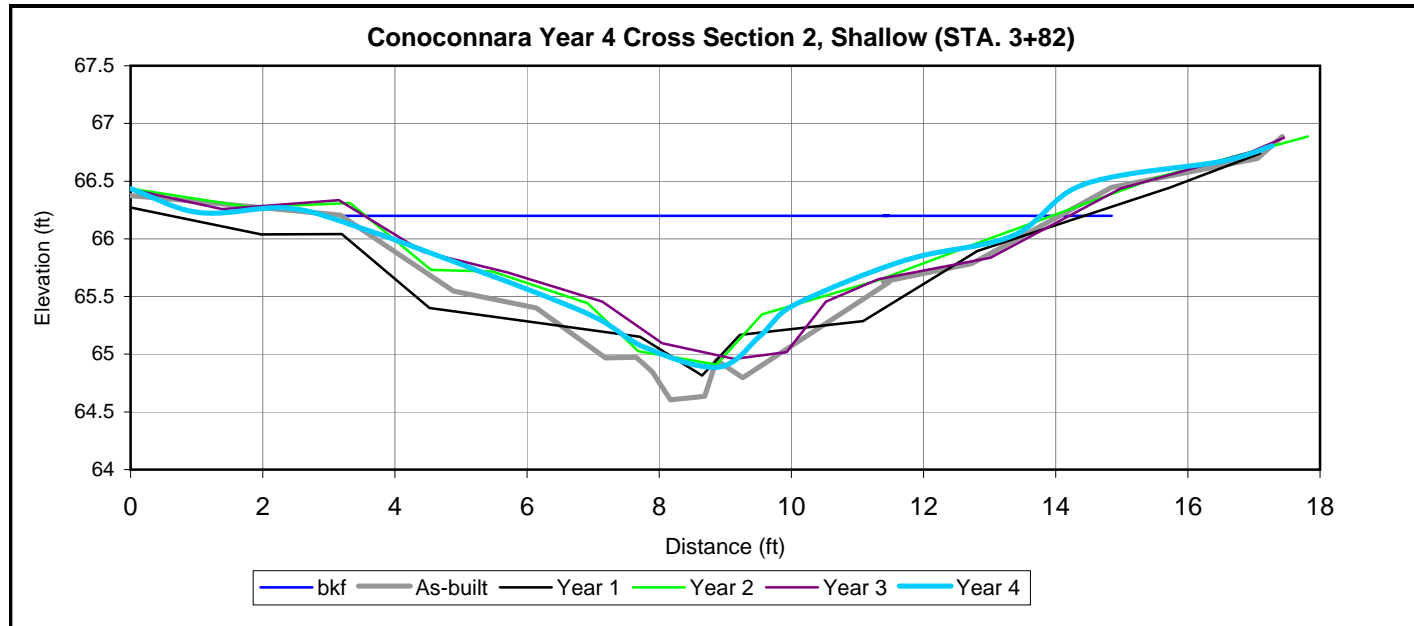




Left bank



Right bank

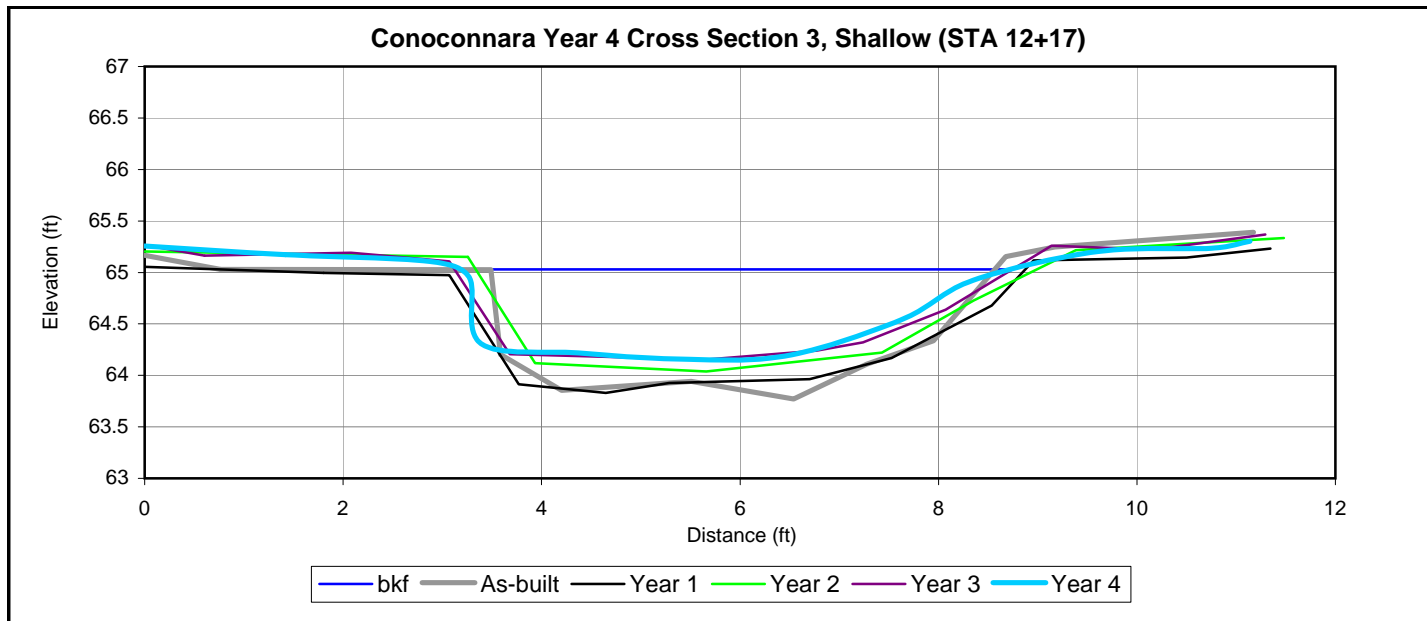




Left bank



Right bank

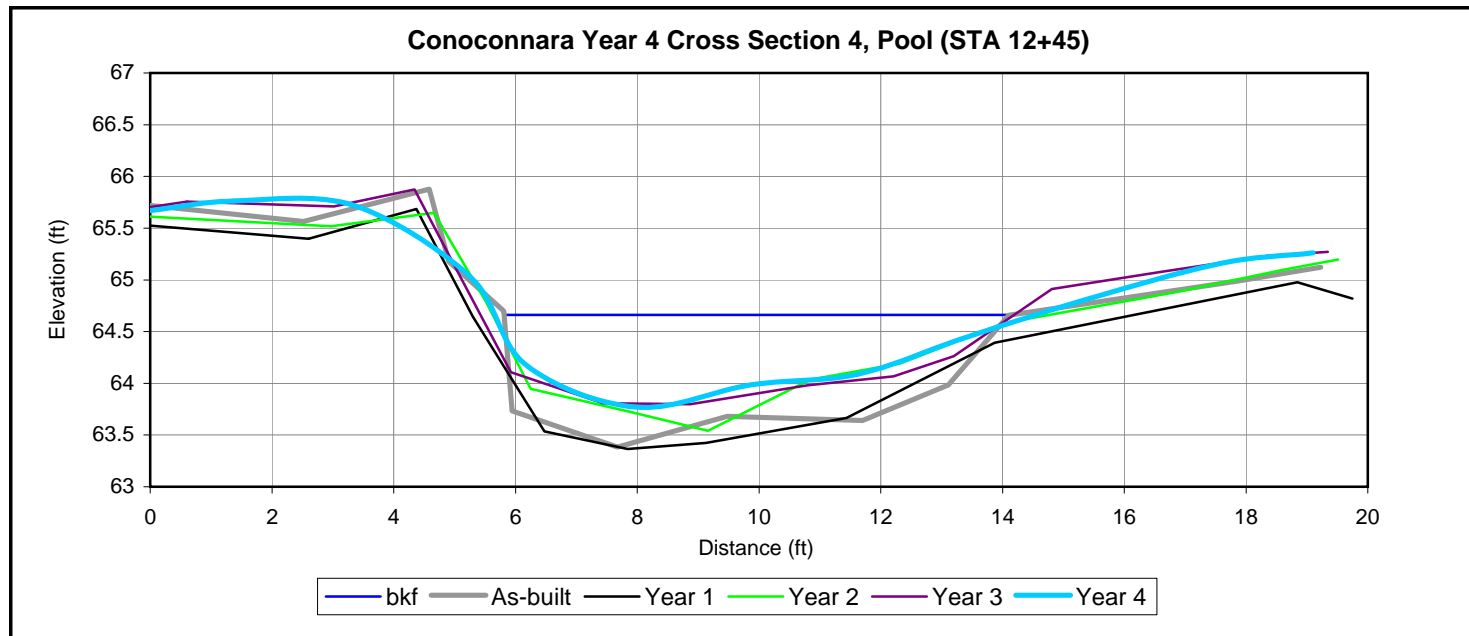




Left bank



Right bank

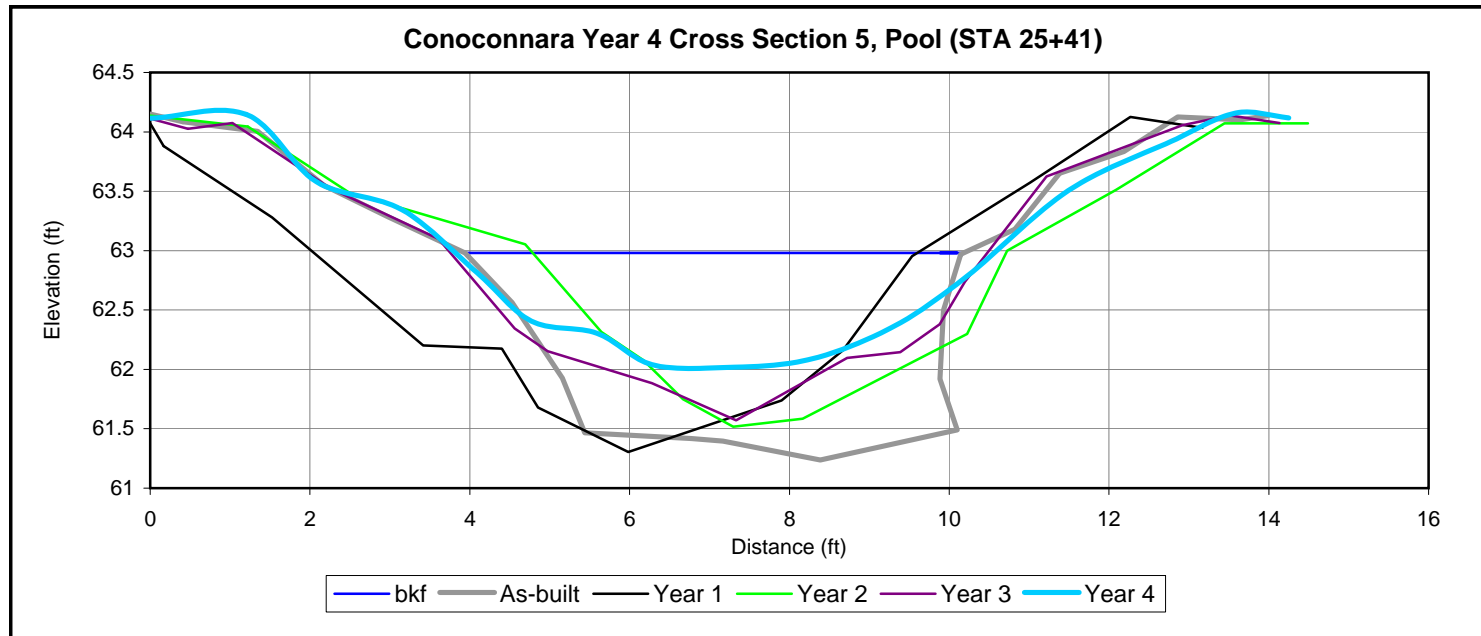




Left bank



Right bank

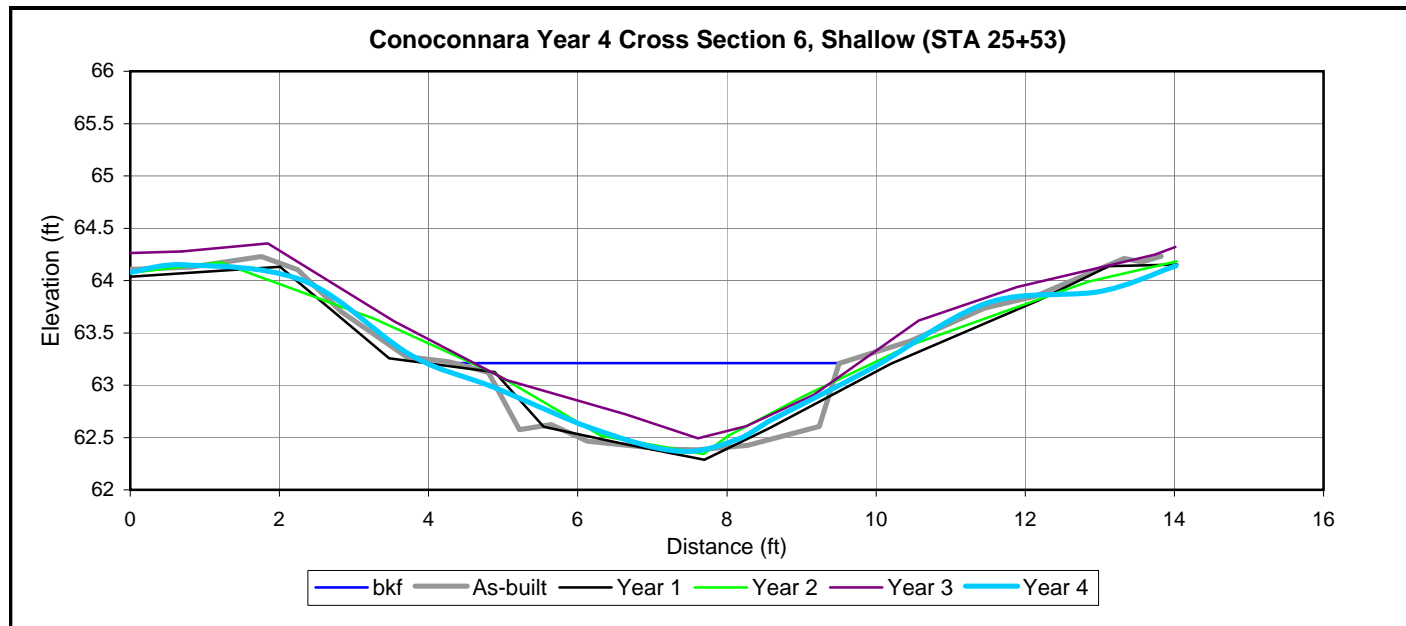




Left bank



Right bank

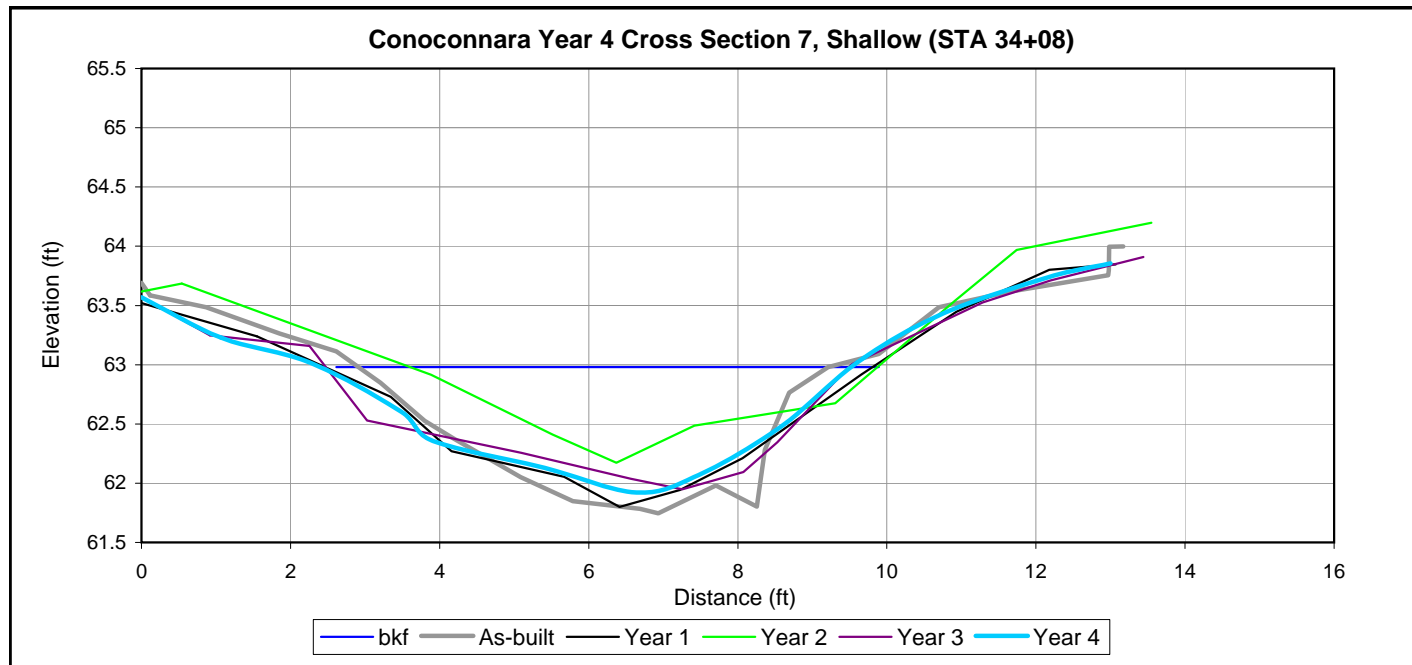




Left bank



Right bank

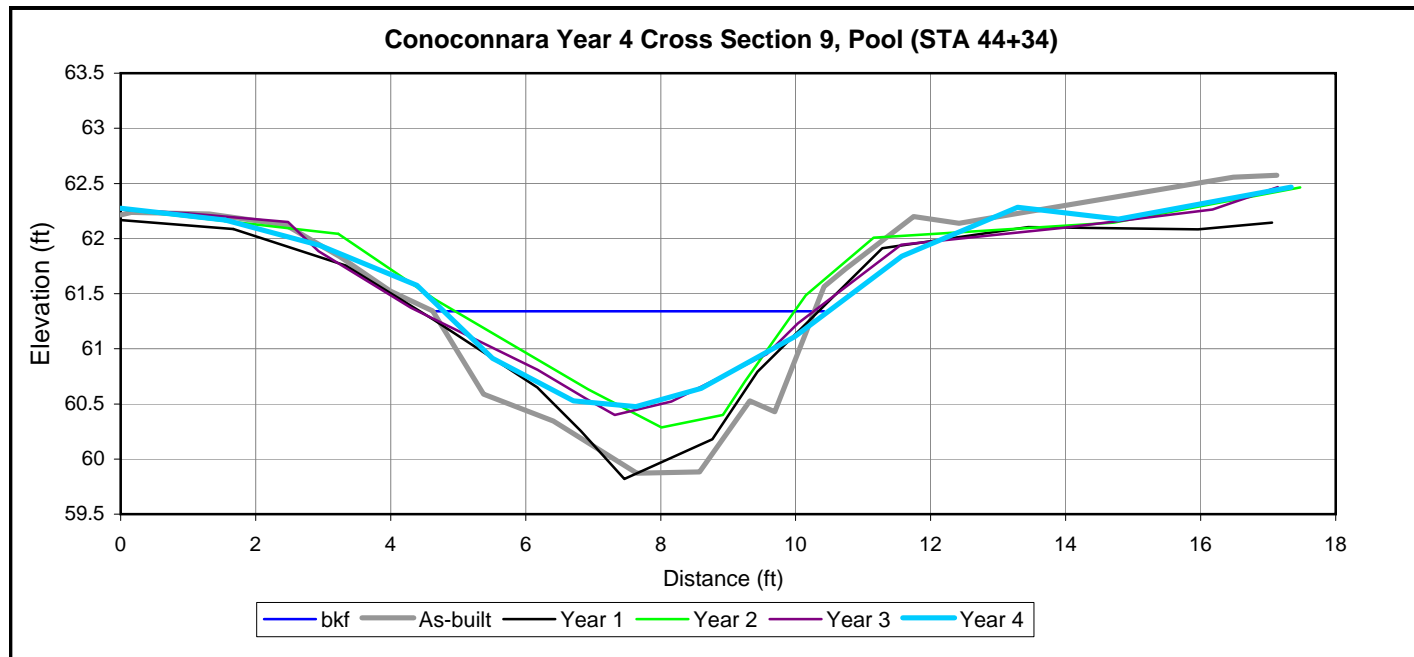




Left bank



Right bank

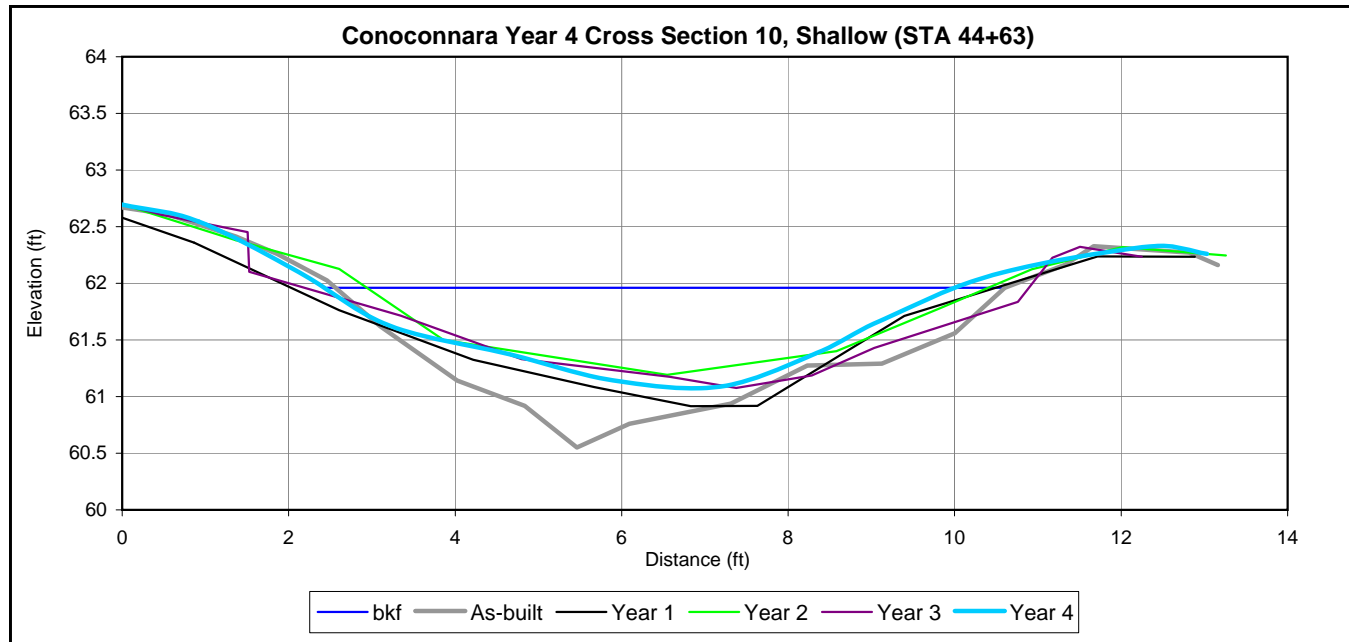




Left bank



Right bank



APPENDIX C

2010 Gauge Data

APPENDIX D

2010 Site Photos

Appendix D
2010 Site Photos – Stream Observation Areas and General Conditions Photos



Photo #1
SOA Log Grade Control with erosion along left bank. Sta. 22+20



Photo #2
Log Grade Control, Sta. 11+10

Appendix D
2010 Site Photos – Stream Observation Areas and General Conditions Photos



Photo #3
Log Toe, Sta. 11+90



Photo #4
Log Grade Control, Sta. 20+60

Appendix D
2010 Site Photos – Stream Observation Areas and General Conditions Photos



Photo #5
Log Grade Control, Sta. 26+90



Photo #6
Rootwad, Sta. 27+60

Appendix D
2010 Site Photos – Stream Observation Areas and General Conditions Photos



Photo #7
Rootwad, Sta. 31+60



Photo #8
Log Grade Control, Sta. 34+80

Appendix D
2010 Site Photos – Stream Observation Areas and General Conditions Photos



Photo #9
Log Toe, Sta. 40+00



Photo #10
Rootwad, Sta. 42+00

Appendix D
2010 Site Photos – Stream Observation Areas and General Conditions Photos



Photo #11
Side Channel, Sta. 43+30



Photo #12
Side Channel, Sta. 45+80

Appendix D
2010 Site Photos – Stream Observation Areas and General Conditions Photos



Photo #13
Side Channel, Sta. 46+50



Photo #14
Log Grade Control, Sta. 48+70

Appendix D
2010 Site Photos – Stream Observation Areas and General Conditions Photos



Photo #15
Log Grade Control, Sta. 50+10



Photo #16
Ford, Sta. 50+70

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #1



Vegetation Plot #2

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #3



Vegetation Plot #4

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #5



Vegetation Plot #6

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #7



Vegetation Plot #8

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #9



Vegetation Plot #10

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #11



Vegetation Plot #12

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #13



Vegetation Plot #14

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #15



Vegetation Plot #16

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #17



Vegetation Plot #18

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #19



Vegetation Plot #20

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #21



Vegetation Plot #22

Appendix D
2010 Site Photos – Conoconnara Vegetation Plot Photos



Vegetation Plot #23



Vegetation Plot #24