

# 601 North Mitigation Report

Union County, North Carolina

USGS HUC: 03040105081010

Project ID No. D 06054-A



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## **Executive Summary**

The 601 North Stream Restoration Site (Site) lies within a conservation easement located within a parcel owned by Franklin W. Howey. The Site falls within Union County, North Carolina approximately seven miles south of Monroe, North Carolina. The streams within the Site drain a portion of the USGS hydrologic unit 03040105081010 within the Yadkin River Basin and 03-07-14 NCDWQ sub-basin.

Prior to restoration, the Site included one stream system (UT) that is an unnamed tributary to Wicker's Branch. UT has a drainage area of approximately 0.30 square miles. During the past two decades, the watershed for UT has predominantly consisted of crop land.

Prior to restoration, the Site consisted of primarily agricultural fields. For most of the length of the stream, the area adjacent to the existing stream had remained cleared and has been compacted due to agricultural practices. The stream channel appeared to have been straightened.

Due to the modification to the watershed, surrounding agricultural fields, and channel, the channel was downcut and expanded in width. In some sections, bedrock has limited downcutting, but accelerated lateral bank erosion and subsequent channel widening. These conditions impaired water quality by increasing sediment loads, increasing nutrient and pollution inputs due to direct contribution and lack of filtration by the riparian buffer, increased turbidity, elevated water temperature due to lack of significant shading by the riparian buffer, and reduced oxygen levels due to increased BOD and lack of reoxygenating features such as riffles. Wildlife habitat had been impaired by a lack of physical habitat in-stream or in the buffer, poor water quality, and impaired floodplain dynamics.

The stream was restored using a combination of Rosgen Priority I and II approaches. The channel restoration brought about stable channel geometry, introduced bed and bank features, stabilized the channel banks, and reconnected the channel to a floodplain. In total, channel restoration work restored 3,036 linear feet of stream. The riparian buffer was restored through conditioning the soil and planting native vegetation. Buffer restoration restored 7.5 acres of riparian buffer. Table 1 provides a summary of restoration values.

The stream restoration will improve water quality by reducing sediment inputs from unstable banks, decreasing nutrient and pollutants inputs by reducing direct contributions and filtering sheet flow within the riparian buffer, increase oxygen levels by decreasing BOD and introducing reoxygenating features such as riffle. Wildlife habitat will improve through the introduction of physical in-stream habitat and buffer habitat, improving water quality, and reestablishing flood plain dynamics.

Monitoring in 2008 through 2012 will assess the Site's stream and riparian areas to determine restoration success. The monitoring plan has been established based on guidance provided by The Stream Mitigation Guidelines disseminated by the United States Corps of Engineers – Wilmington District (McLendon, Scott, Fox, Becky et al.

2003) and the most current version of the EEP documents entitled “Content, Format, and Data Requirements for EEP Monitoring Reports”. Streams will be monitored for stability using cross section and longitudinal profile surveys and photo documentation. Riparian areas will be monitored for plant survival using stem counts.

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## **Narrative**

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Goals related to hydrology include:

- Re-establishing floodplain connection by raising bed elevations
- Increase flood storage by re-establishing floodplain

Goals related to water quality include:

- Reducing turbidity by reducing sediment inputs
- Reducing water temperatures by providing shading
- Increasing / stabilizing oxygen levels by reducing BOD/COD and increasing reoxygenating turbulence

Goals related to habitat include:

- Improve bed habitat by increasing riffle – pool diversity, reducing sediment deposition, and improving low flow water depths
- Improve bank habitat by increasing stability and woody biomass

- Improve floodplain habitat by establishing microtopography and hydrology, removing invasive vegetation, and increasing habitat diversity
- Improve food web dynamics by adding biomass (such as detritus, woody debris, and leaf matter) and re-establishing floodplain connection

The restoration achieves these goals through the following objectives:

- Stabilizing channel bed and banks through modifying dimension, pattern, and profile using natural channel design
- Installing in-stream structures such as rock vanes
- Installing in-bank structures such as root wads
- Raising stream bed elevations
- Restoring soils in riparian buffer
- Removing invasive vegetation
- Planting native vegetation in riparian buffer

Priority I and Priority II restoration approaches were used for this project. The Priority II approach was used to re-establish an active floodplain and stabilize the stream banks (Rosgen, David L. 1997). The Priority I approach was used to raise bed elevations and reconnect the channel to the abandoned floodplain. These methods were primarily employed to re-establish an appropriate stream cross section, bed form and pattern in order to improve habitat and ecosystem functions. The streams were also connected to flood plains which will re-establish more natural riparian conditions.

The riparian buffer was planted as four zones. Zone 1, the stream channel zone, was planted with fast growing; obligate pioneer species able to provide stability to the channel. Zone 2 was the stream bench zone consisting of planted tree and shrub species and seeded native herbaceous species typically found along stream banks in the region. Zone 3 was a forested riparian area consisting of selected tree and shrub species tolerant of range of inundation and saturation. Zone 4 was a transitional zone consisting of Zone 3 species tolerant of edge habitats. Zone 1 was planted with live stakes and the remaining zones were planted with bare roots seedlings. Planting spacing was determined according to planting type. The entire easement was planted as described above.

**Table 1: Mitigation Summary Table**

<b>Project Stream</b>	<b>Stream Restoration Linear Footage</b>	<b>Stream Enhancement Level II Linear Footage</b>	<b>Wetland Restoration Acreage</b>	<b>Wetland Enhancement Acreage</b>	<b>Riparian Buffer Restoration</b>
UT	3,036	0	0	0	7.5
<b>Total Site</b>	<b>3,036</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>7.5</b>
<b>Total SMU</b>	<b>3,036</b>	<b>0</b>	-	-	-
<b>Total WMU</b>	-	-	<b>0</b>	<b>0</b>	

**Table 2: Mitigation Unit Summary**

<b>Contract Stream Mitigation Units (SMU)</b>	<b>As-built Stream Mitigation Units (SMU)</b>	<b>Contract Wetland Mitigation Units (WMU)</b>	<b>As-built Wetland Mitigation Units (WMU)</b>
3,000	3,036	0	0

### **Modifications to the Restoration Plan and Construction Plan Summary**

The following is a summary of changes that were made from the Restoration Plan to the construction plans as well as changes implemented during construction. Most of the changes resulted from the contractor hitting bedrock while excavating the channel or installing structures.

Vernal Pools – The construction drawings show a total of eleven vernal pools that were proposed to be placed where concentrated storm water enters the buffer from the adjacent fields. A total of seven vernal pools were actually constructed and some of them are much larger than what was shown in the construction drawings. Existing field conditions made constructing the additional four vernal pools unnecessary.

Station 108+40 – A log Vane was added at this location to help protect the bank.

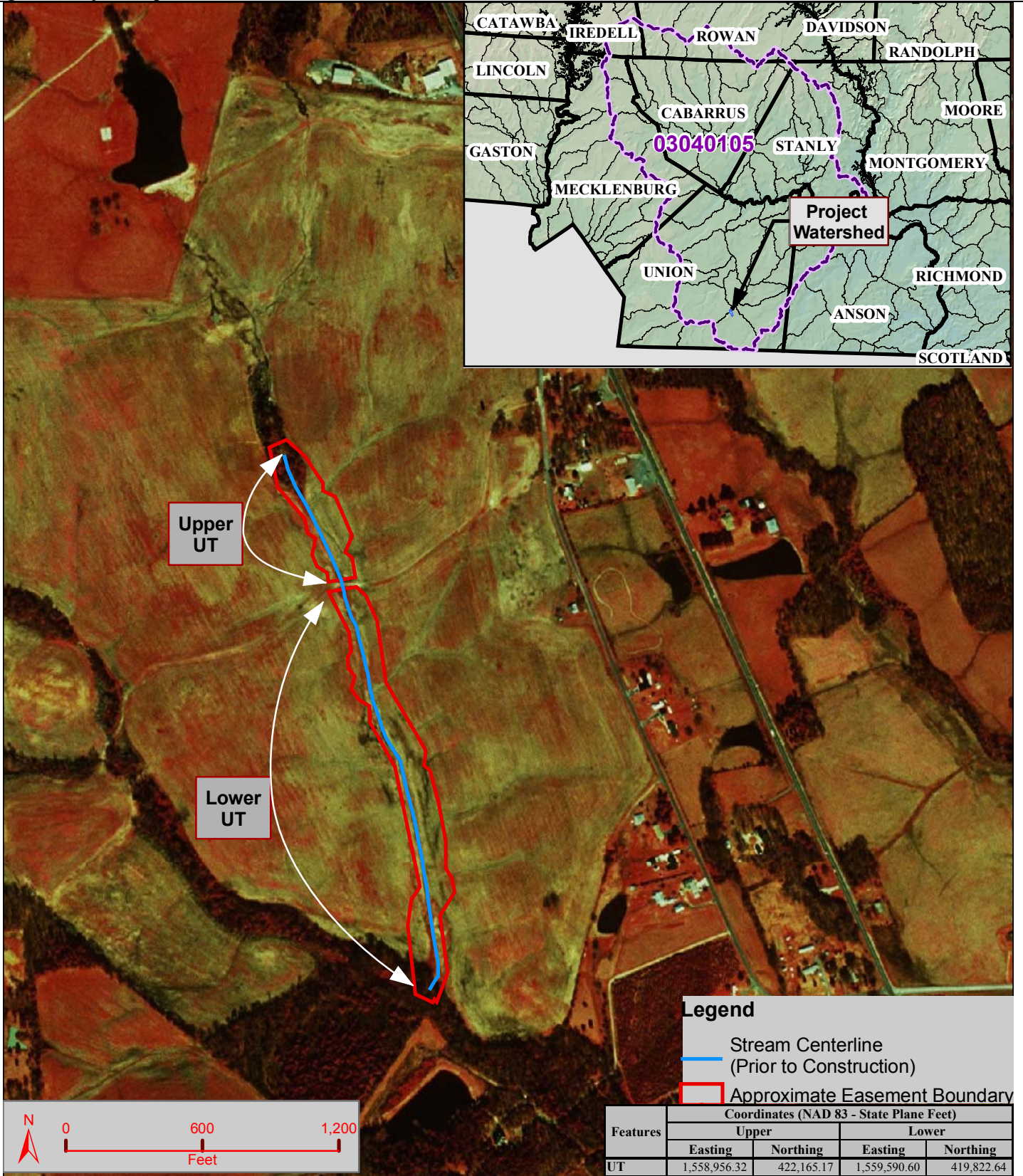
Station 109+30 – A log Vane was added at this location to help protect the bank from flows coming from the culvert.

Station 100+00 to 130+96 – (Entire Reach) – Constructed Riffles were used in every riffle except for the ones that are on bedrock. These constructed riffles were installed using native material from on-site (bedrock materials). Since enough bedrock material

was available on-site to place in every riffle and several riffles are at grade on bedrock, all rock cross vanes were removed from the plans. In the Record Set drawings all riffles are labeled as being constructed riffles or bedrock riffles.

Station 130+50 to 130+96 – This section of stream was shifted approximately 10 feet to the East to avoid impacting a large tree on the bank of Wicker Branch.

Figure 1 Project Map



Prepared For: 	<b>Project</b>	601 North Stream Restoration, Union County, North Carolina		
	<b>Date</b>	8/12/08	<b>Project Number</b>	012620009



## **Monitoring Plan**

The monitoring plan to evaluate the success of the stream restoration project is based on guidance provided by The Stream Mitigation Guidelines (McLendon, Scott, Fox, Becky et al. 2003) disseminated by the United States Corps of Engineers – Wilmington District and recommendations from the Ecosystem Enhancement Program. The collection and summarization of monitoring data will be conducted in accordance with the most current version of the EEP documents entitled “Content, Format, and Data Requirements for EEP Monitoring Reports”.

Monitoring work will occur annually for five years and includes reference photographs, channel materials sampling, site survey, and visual assessment and mapping of significant features. The success criteria and assessment methods for the Site’s streams and riparian buffer are provided below.

### **Stream Monitoring**

#### **Success Criteria**

The stream geometry will be considered successful if the cross-section geometry, profile, and sinuosity are stable or reach a dynamic equilibrium. It is expected that there will be minimal changes in the designed cross sections, profile, and/or substrate composition. Changes that may occur during the monitoring period will be evaluated to determine if they represent a movement toward a more unstable condition (e.g. down cutting, or bank erosion) or are minor changes that represent an increase in stability (e.g. settling, vegetative changes, coarsening of bed material, etc.).

Deviation from the design ratios will not necessarily denote failure as it is possible to maintain stability and not stay within the design geometry. Additionally, determination of true bankfull will be difficult until the stream has had adequate flooding events to create strong bankfull indicators.

#### **Assessment Methods**

The survey of channel dimension consists of six permanent cross sections placed at unique stream segments throughout the project extent. The cross sections represent 3 riffles and 3 pools. Annual photographs showing both banks will be taken for each cross section.

The survey of the longitudinal profile covers 3,000 feet of the project reaches. Newly-constructed meanders will be surveyed to provide pattern measurements.

Right and left bank view permanent photo stations have been set up to visually monitor stream conditions. These photo stations are mapped on the Record Drawings.

The entire restored length of stream will be investigated for channel stability and in-stream structure functionality. Any evidence of channel instability will be identified, mapped, and photographed. All structures will be inventoried for functionality.

## **Riparian Buffer Vegetation**

### **Success Criteria**

The success of riparian and wetland vegetation planting will be gauged by stem counts of planted species. Riparian and wetland vegetation will be considered successful with the survival of 260 planted stems per acre at the end of the fifth year of monitoring, with survival of 320 planted stems per acre at the end of the third year of monitoring as an interim measure of success. Photos taken at established photo points should indicate maturation of riparian vegetation community.

### **Assessment Methods**

The success of vegetation plantings will be measured through stem counts. Three permanent plots will be used to sample the riparian buffer and restoration wetlands. Each quadrant covers 1,000 square feet. During the counts, the health of the vegetation will be noted. The vegetation survey will occur during the growing season. Permanent photo points have been set up for each plot.

## **References**

- McLendon, Scott, Becky Fox, et al. (2003). Stream Mitigation Guidelines. United States Army Corps of Engineers - Wilmington District, United States Environmental Protection Agency, North Carolina Wildlife Resources Commission and North Carolina Department of Natural Resources - Division of Water Quality.
- Rosgen, David L. (1997). A Geomorphic Approach to Restoration of Incised Rivers. Management of Landscapes Disturbed by Channel Incision.

Attachment 1  
Record Drawings

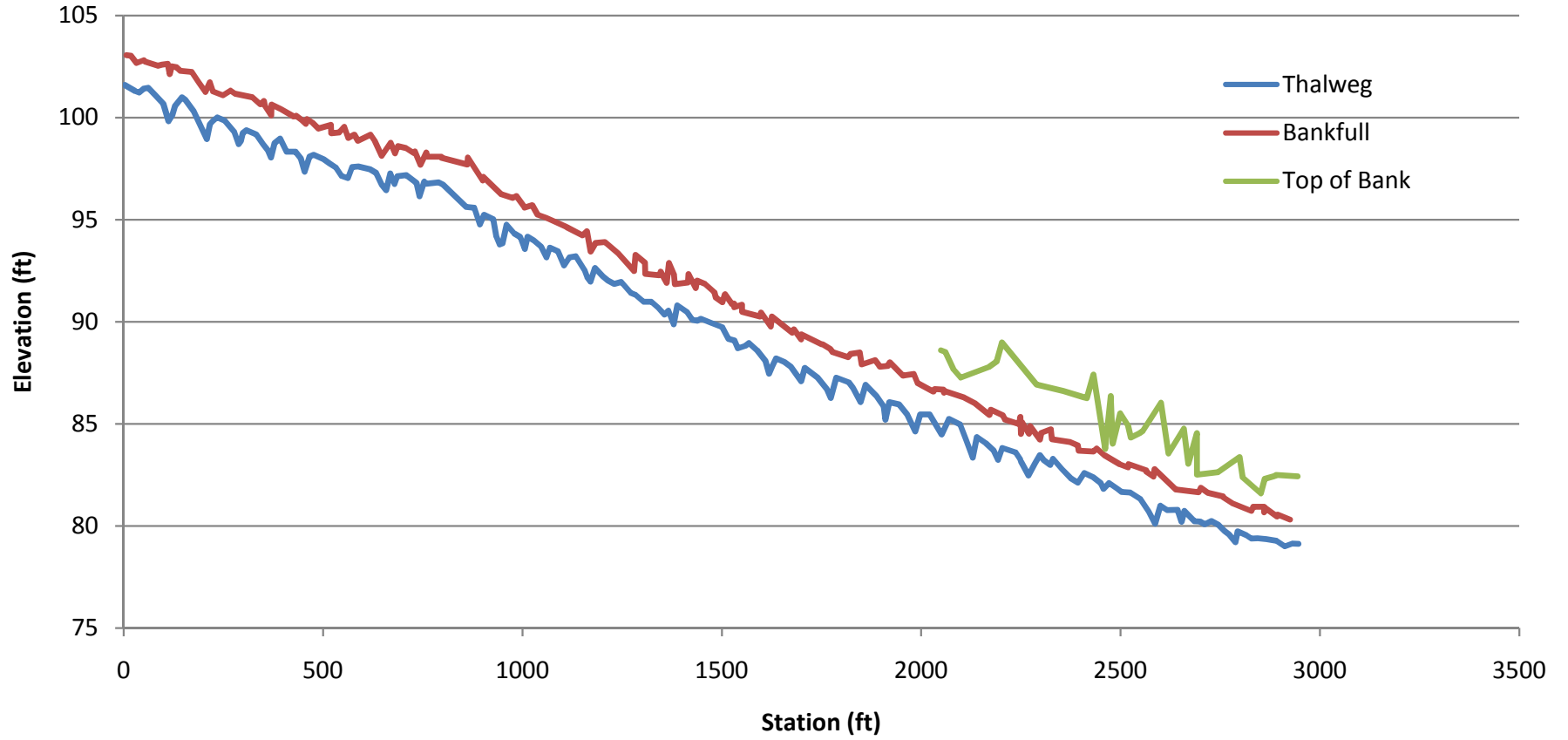
(See Record Drawing Set separate from this  
document – Dated 06/13/2008)



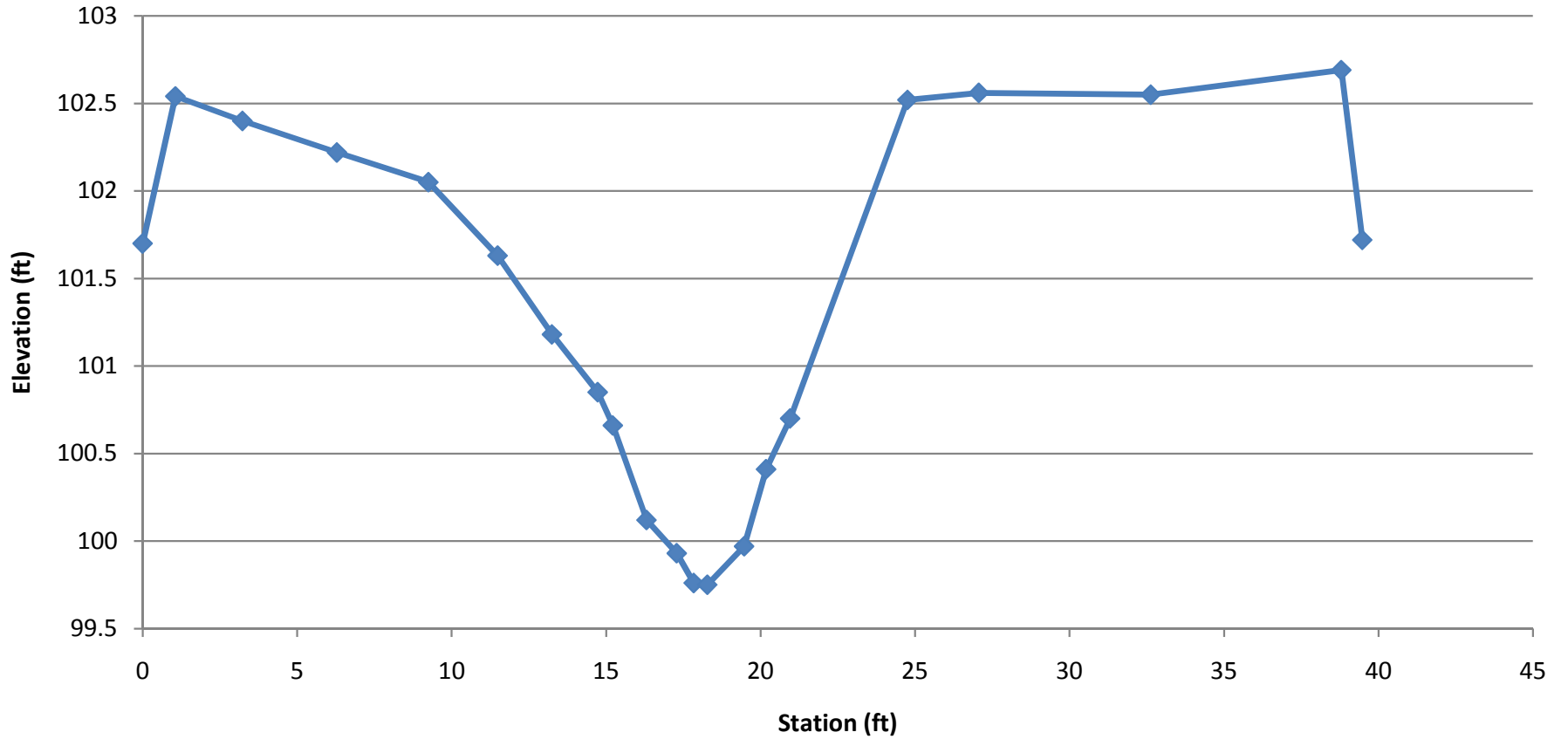
Attachment 2  
Baseline Monitoring

# Stream Geomorphology

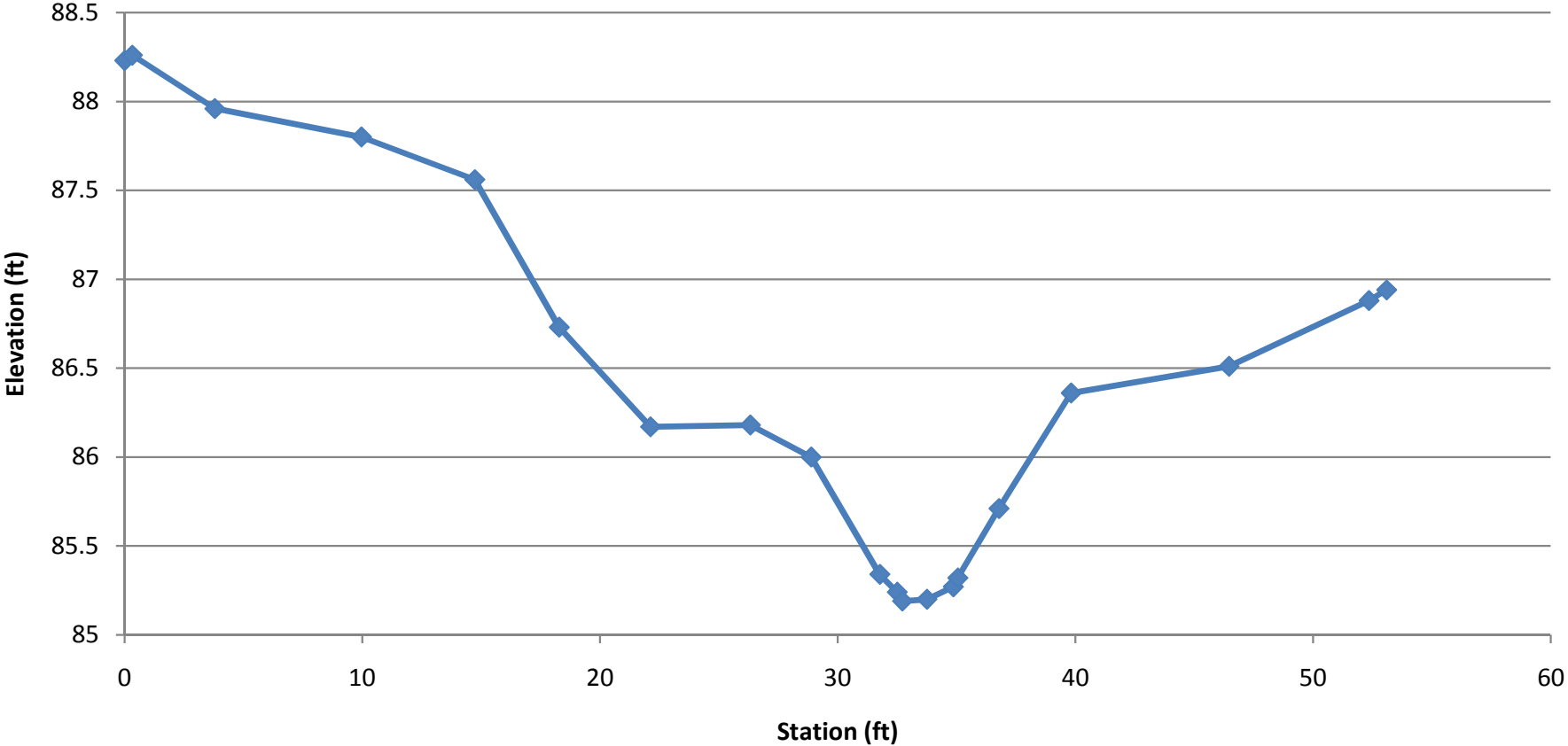
# 601 North Reach 1 Longitudinal Profile



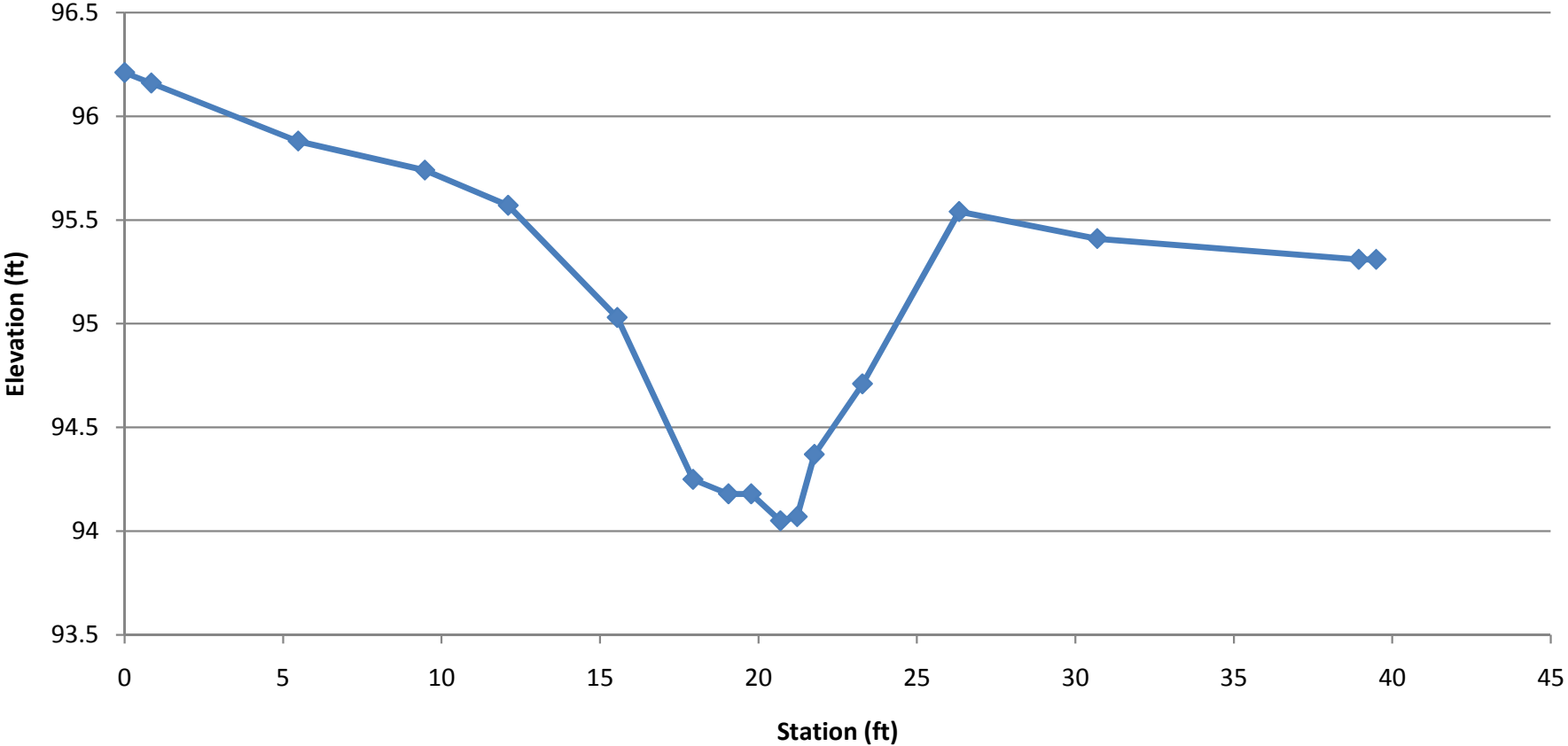
# 601 North Reach 1 Pool Cross Section 1



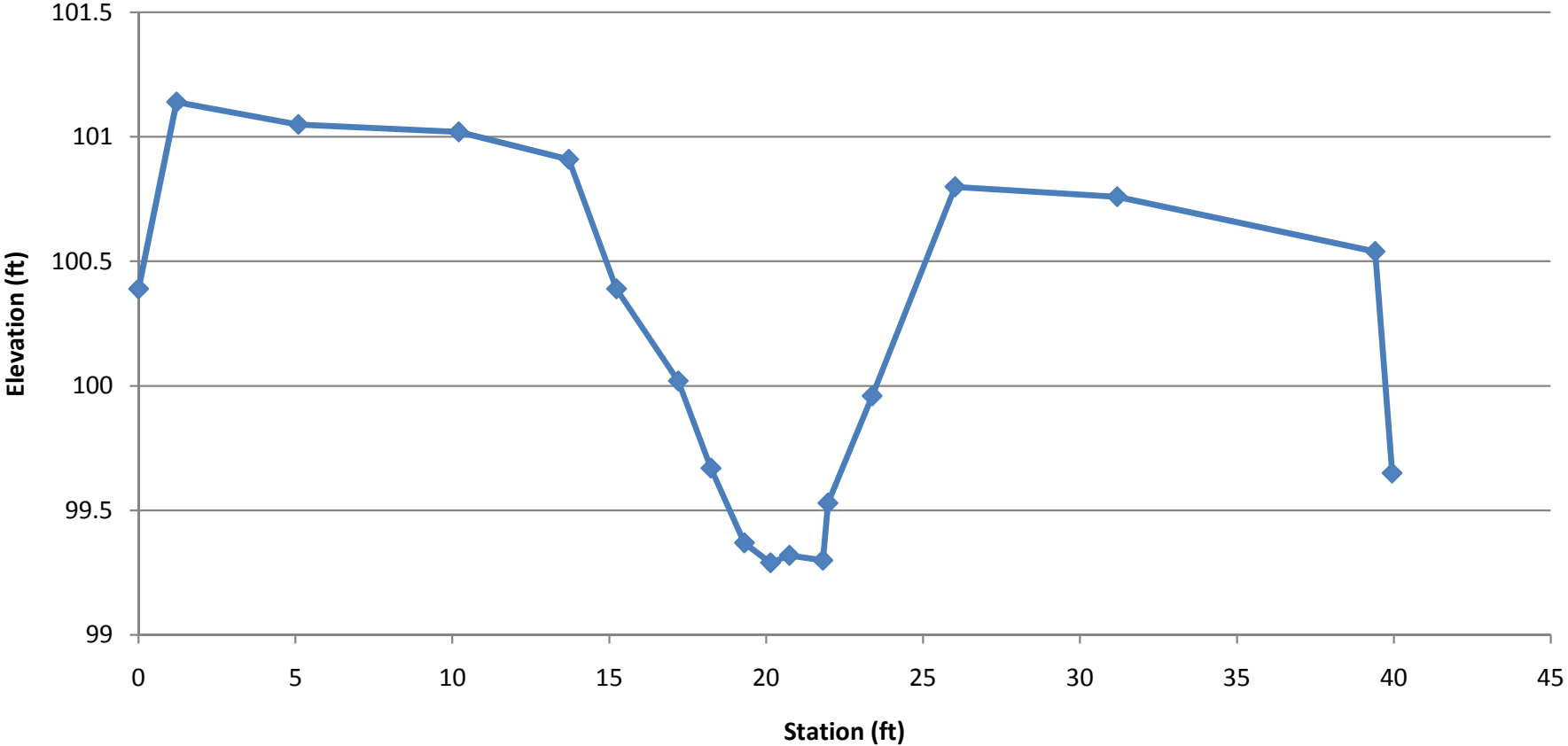
### 601 North Reach 1 Riffle Cross Section 3



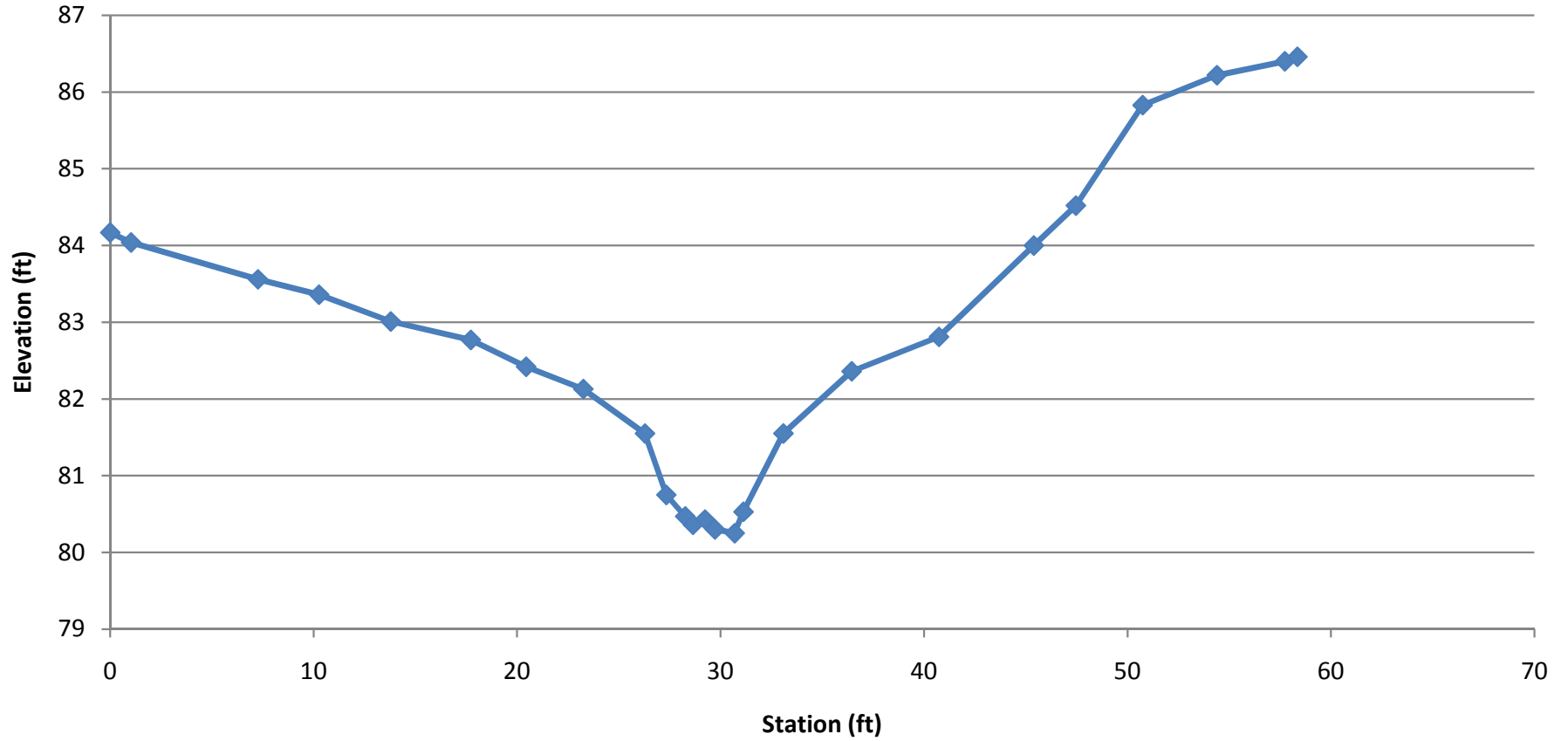
# 601 North Reach 1 Riffle Cross Section 2



# 601 North Reach 1 Riffle Cross Section 1



### 601 North Reach 1 Pool Cross Section 3





## 601 North Reach 1 Pool Cross Section 2

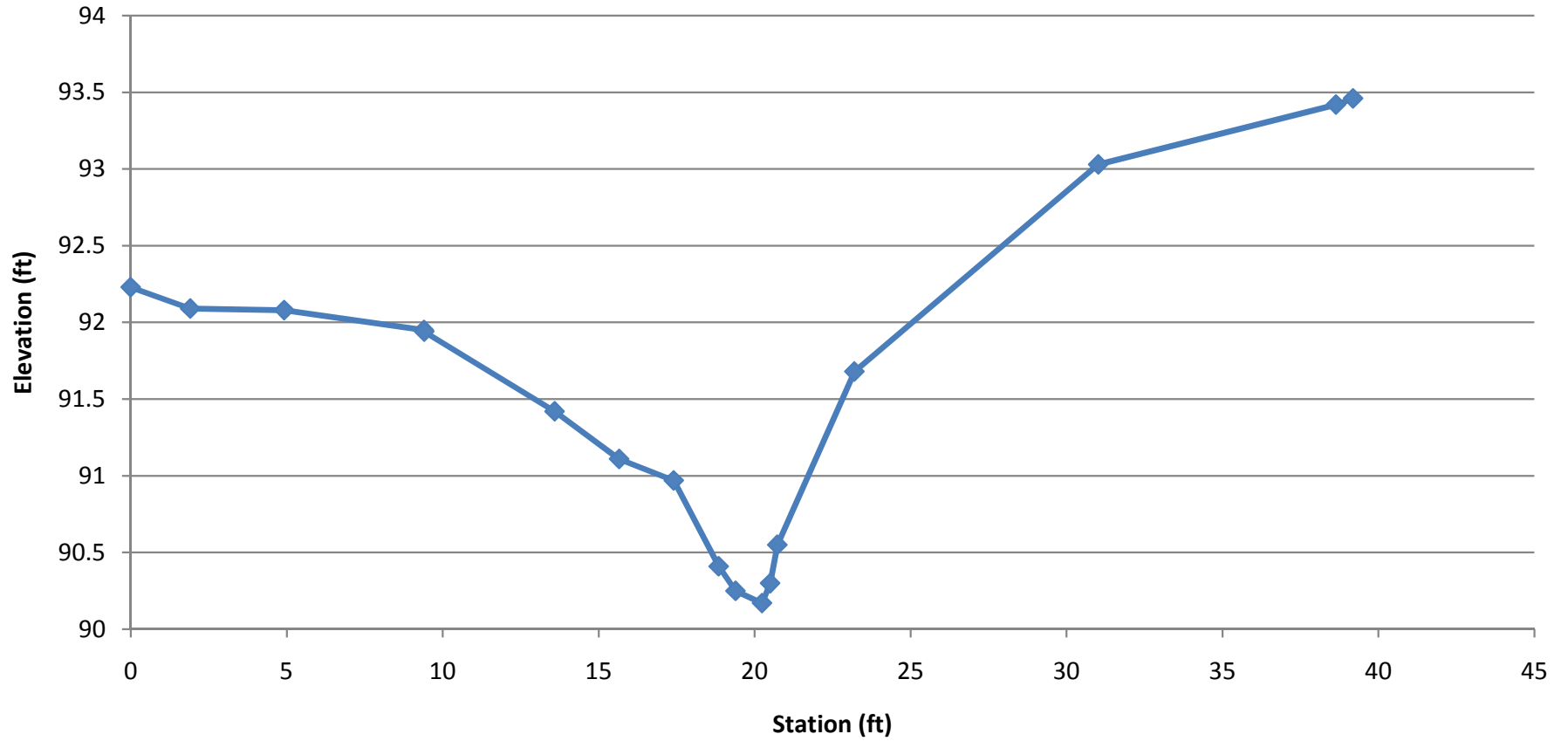


Photo Page 1



Permanent Photo Point #1 (May 29, 2008)



Permanent Photo Point #2 (May 29, 2008)



Photo Page 2



Permanent Photo Point #3 (May 29, 2008)



Permanent Photo Point #4 (May 29, 2008)





Permanent Photo Point #5 (May 29, 2008)



Permanent Photo Point #6 (May 29, 2008)





Permanent Photo Point #7 (May 29, 2008)



Permanent Photo Point #8 (May 29, 2008)



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Permanent Photo Point #9 (May 29, 2008)



Permanent Photo Point #10 (May 29, 2008)





Permanent Photo Point #11 (May 29, 2008)



Permanent Photo Point #12 (May 29, 2008)



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Permanent Photo Point #13 (May 29, 2008)



Permanent Photo Point #14 (May 29, 2008)





Permanent Photo Point #15 (May 29, 2008)



Permanent Photo Point #16 (May 29, 2008)



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Permanent Photo Point #17 (May 29, 2008)



Permanent Photo Point #18 (May 29, 2008)





Permanent Photo Point #19 (May 29, 2008)



Reach Starting Point Photo (May 29, 2008)





Reach Ending Point Photo (May 29, 2008)



PXS1: Looking Downstream (May 29, 2008)





PXS1: Looking Upstream (May 29, 2008)



PXS1: Looking at Left Bank (May 29, 2008)





PXS1: Looking at Right Bank (May 29, 2008)



PXS2: Looking Downstream (May 29, 2008)





PXS2: Looking Upstream (May 29, 2008)



PXS2: Looking at Left Bank (May 29, 2008)





PXS2: Looking at Right Bank (May 29, 2008)



PXS3: Looking Downstream (May 29, 2008)



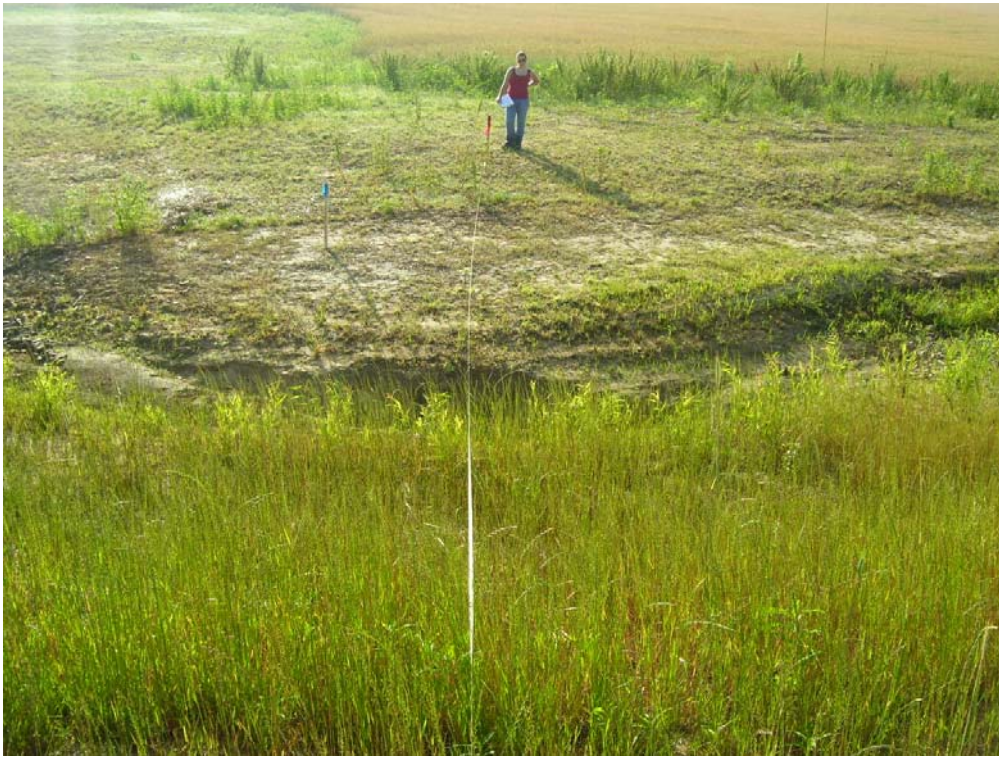


PXS3: Looking Upstream (May 29, 2008)



PXS3: Looking at Left Bank (May 29, 2008)





PXS3: Looking at Right Bank (May 29, 2008)



RXS1: Looking Downstream (May 29, 2008)



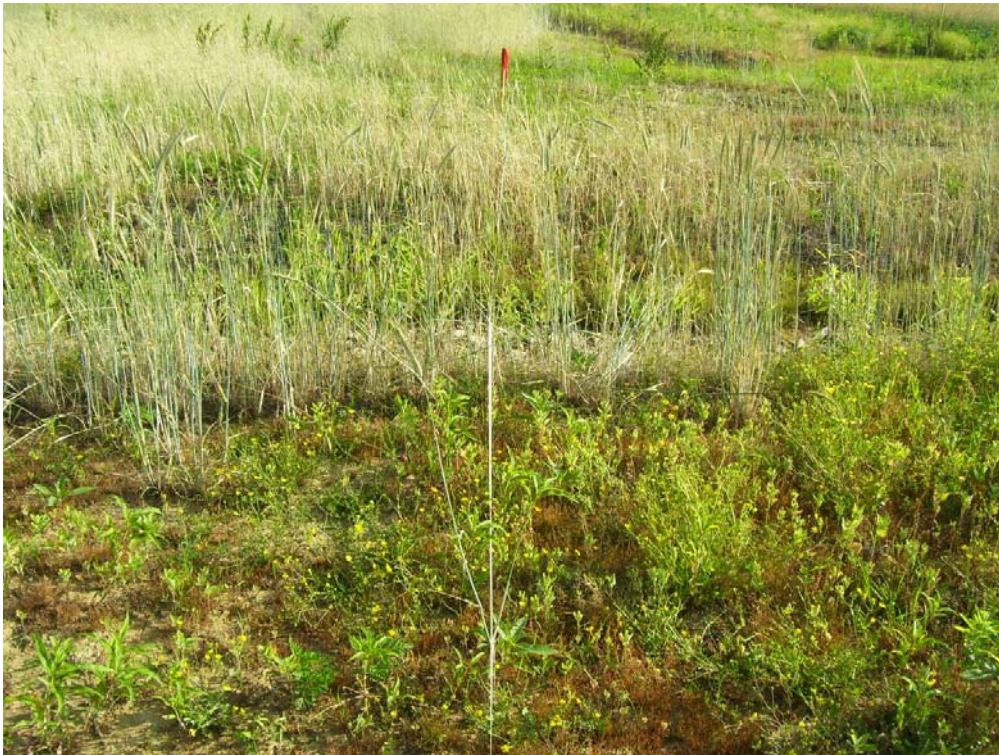


RXS1: Looking Upstream (May 29, 2008)



RXS1: Looking at Left Bank(May 29, 2008)





RXS1: Looking at Right Bank (May 29, 2008)



RXS2: Looking Downstream (May 29, 2008)





RXS2: Looking Upstream (May 29, 2008)



RXS2: Looking at Left Bank (May 29, 2008)



Photo Page 21



RXS2: Looking at Right Bank (May 29, 2008)



RXS3: Looking Downstream (May 29, 2008)



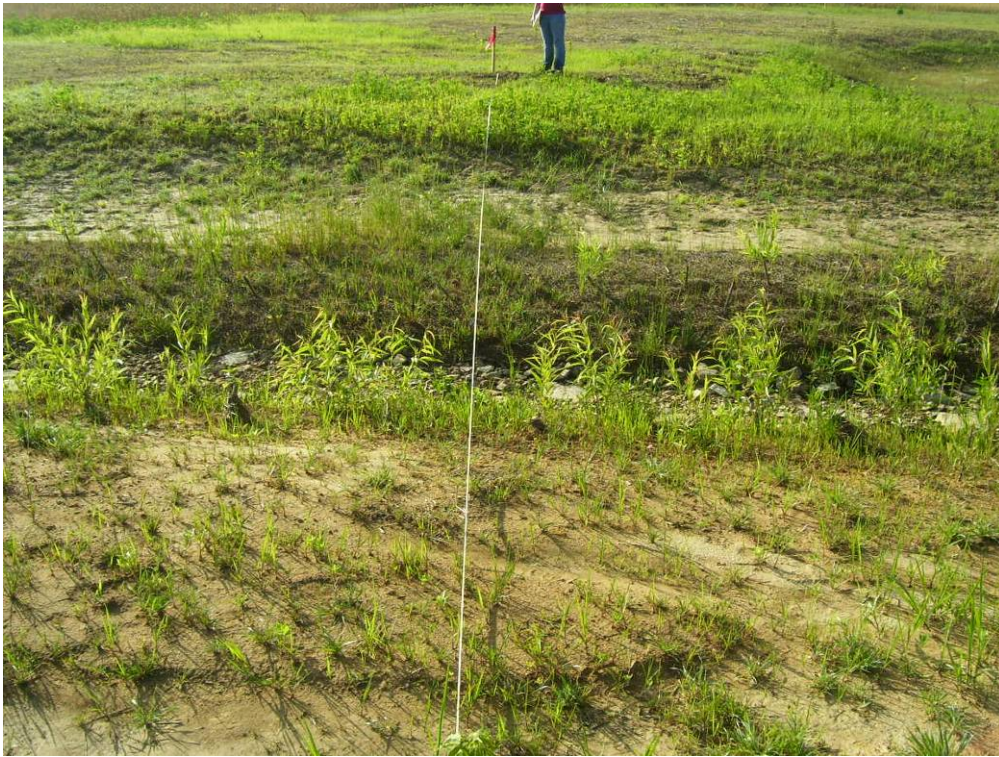


RXS3: Looking Upstream (May 29, 2008)



RXS3: Looking at Left Bank (May 29, 2008)





RXS3: Looking at Right Bank (May 29, 2008)



# Vegetation



## Environmental Banc & Exchange

IPO Number: NC-01-2007

Monitoring Plots Baseline Data

Site: 601 North Plot: N2 Date: 9-May-08

No	Species	Coordinates		ddh (mm)	Height (cm)	DBH (cm)	Vigor
		X (m)	Y (m)				
1	AT	0.17	0.42	3	42		3
2	AT	0.25	3.30	2	33		2
3	CO	0.36	6.50	4	27		2
4	CO	0.43	9.42	1	17		2
5	BN	3.01	2.20	2	37		3
6	QM	3.50	8.67	5	56		3
7	QN	3.65	6.16	2	65		1
8	BN	6.75	9.46	2	39		4
9	BN	6.88	6.85	4	49		4
10	QN	7.05	2.23	3	65		1
11	FP	7.15	4.69	2	50		4
12	FP	9.21	7.94	1	21		4
13	Q	9.64	5.33	4	60		1
14	Q	9.85	2.74	2	51		1

**Vigor Code**

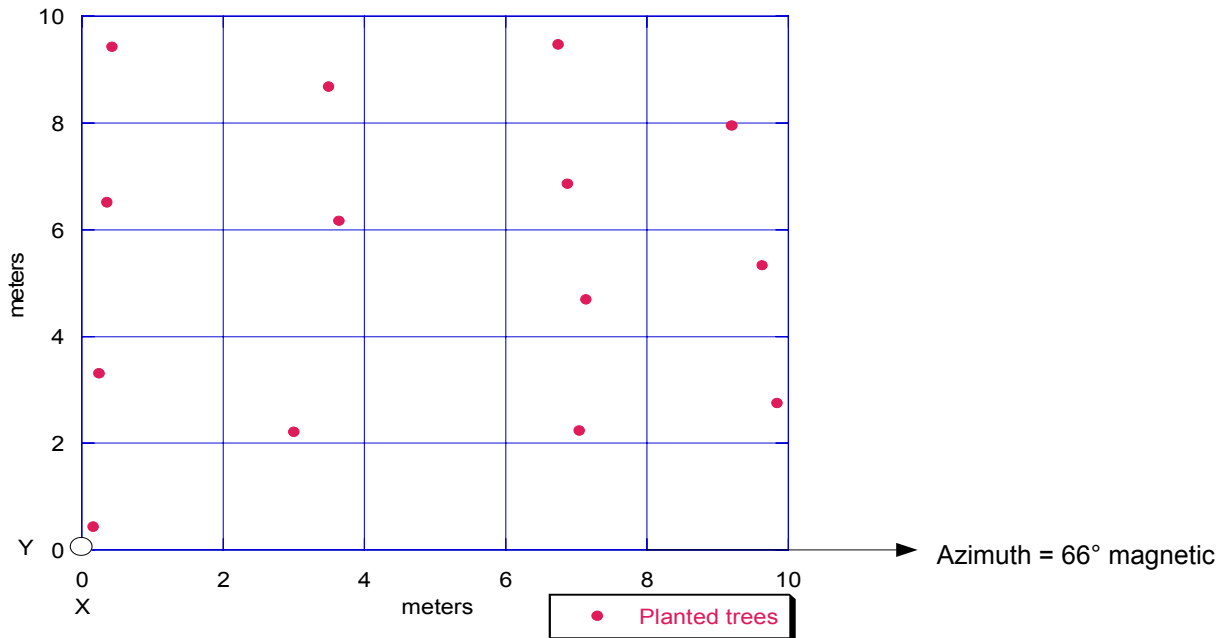
- 4 = Excellent
- 3 = Good
- 2 = Weak
- 1 = Unlikely to survive
- 0 = Dead
- M = Missing

**Species Code**

- AT = Asimina triloba
- BN = Betula nigra
- CO = Carya ovata
- FP = Fraxinus pennsylvanica
- QM = Quercus michauxii
- QN = Quercus nigra
- QP = Quercus phellos
- Q = Quercus species unknown

**Plot Photograph** is taken from origin toward opposite corner.

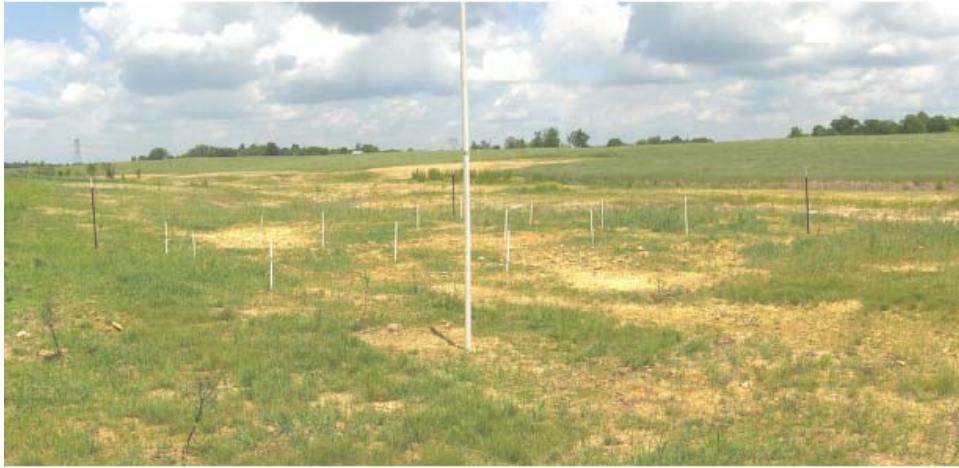
<1.37m                      >1.37m  
**601 North**  
Plot N2



Plot origin is the most Southwest corner and is identified by a 10' section of PVC pipe.



**601 North Vegetation Plot Photos  
June, 2008**



Vegetation Plot 1



Vegetation Plot 2



Vegetation Plot 3