EEP NUTRIENT OFFSET
PROJECT SUMMARY

Town of Cary BMP
Stormwater Wetland BMPs
EEP #676

Synopsis

EEP has a contract with the Town of Cary for the delivery of nutrient reduction credit from their Phase I and Phase II Maynard Road stream restoration and BMP project located in Cary, North Carolina within the Neuse River Basin CU 03020201. The project was initiated by NCEEP to offset nutrient loading as a third-party credit provider in the Neuse River Basin (15A NCAC 02B .0240 and 15ANCAC 2B .0235). Stantec designed and oversaw construction of the linear stormwater wetland BMPs. Final construction and planting of the BMPs was completed in November 2007, however associated Phase II stream restoration and the As-Builts were not completed until June 2013. The City of Cary is charged with maintaining the site per a BMP MOA maintenance agreement, which extends for a 30-year period. The Town has contracted with Stantec to perform monitoring on the site. The Town is contracted to provide EEP a nutrient credit value over 30 years of **36,450 lbs reduction of Total Nitrogen for this project**, however, engineering calculations report the site will reduce more TN than that**.** Additionally, a reduction of Total Phosphorous is anticipated, however TP reduction credit is not available in the Neuse River Basin at this time.

Site Location

River Basin:	Neuse
CU:	03020201
14-digit HUC:	03020201
County:	Wake
Municipality:	Cary, NC
Receiving Waters:	Swift Creek

Project History

MOA/Easement:	MOA October 2004
Feasibility Study:	January 2008
Final Design:	February 2011
401 permit:	04-0313, issued 5/10/2004
Construction:	unknown-2012
DWQ site visit:	April 22, 2009
As-Builts:	June 2013 (waited until Phase II work was finished)
Planting:	2007-2012
Final Report due:	September 2015

Project Participants

Source Agency: NC Ecosystem Enhancement Program
Project Management: Town of Cary
Designer: Stantec
Landowner: Town of Cary
BMP Management: Town of Cary

BMP Design Parameters

BMP Type: Linear Stormwater Wetlands on non-jurisdictional streams
Watershed Area: 624 acres
Watershed Description: Urban, impervious residential, parking lots, roadways

Nutrient Removal (TN = Total Nitrogen)

Pre-BMP TN Loading: 443.6 lbs/yr
Post-BMP TN Loading: 266.2 lbs/yr
Post-BMP TN Removal: 177.4 lbs/yr
30-yr TN Removal: **5,322 lbs**

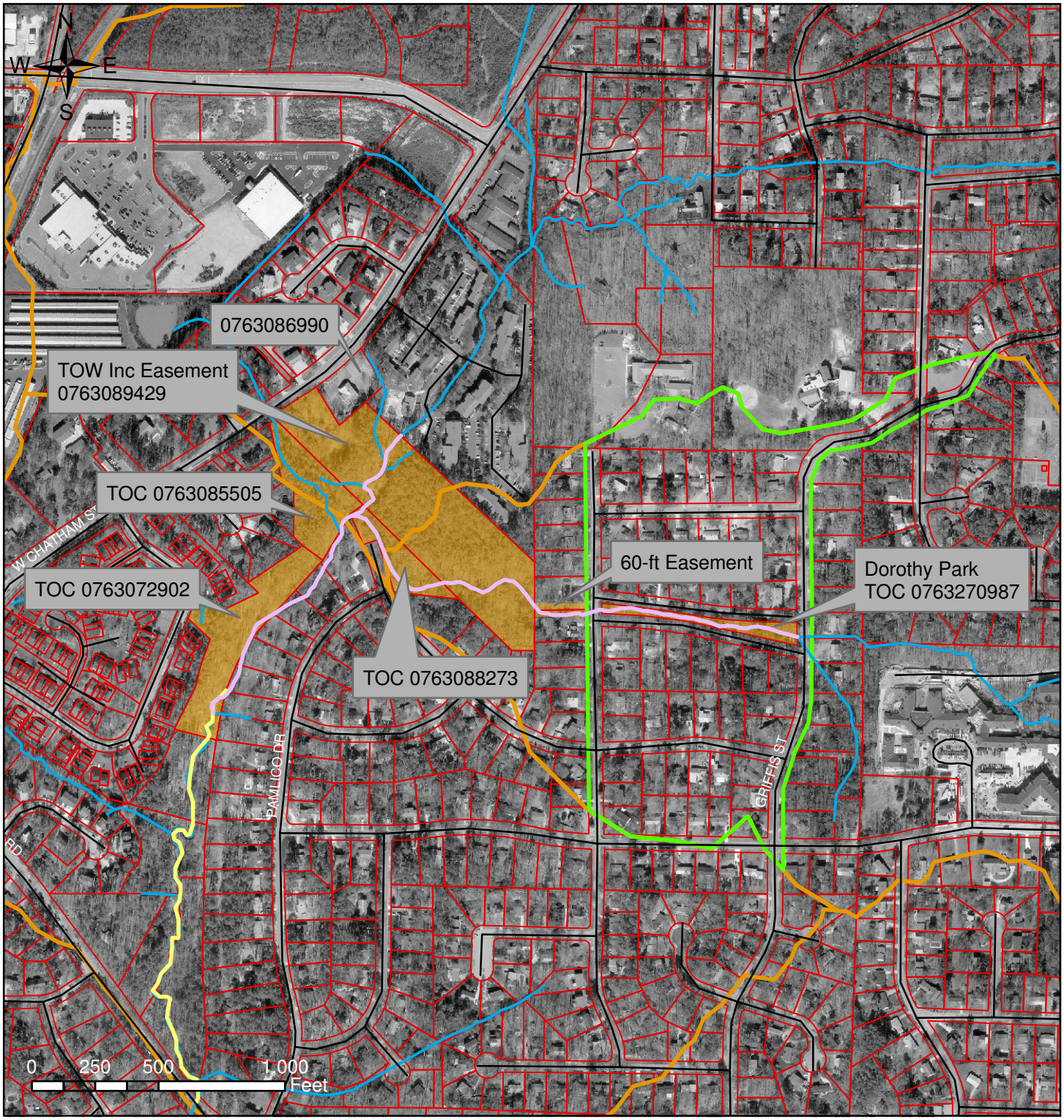
Property Protection & Maintenance

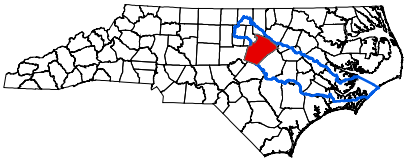
Property Protection Method: Town of Cary
Maintenance: Town of Cary is responsible for regular maintenance inspections and submitting quarterly reports to EEP for 2 years. The stream, buffer and BMP are also being monitored by Stantec.

Attachments:

- Site Location Map
- Design Calculations
- MOA
- DWQ Correspondence
- As-Builts

SITE MAP





Legend

- Phase II Restoration
- Roads
- Phase I Restoration
- Hydrography
- Dorothy Park Drainage Area
- Subbasins
- Phase II Parcels
- Property Line

Town of Cary
North Carolina

Town of Cary
Nitrogen Removal BMP Project

Figure 2. Project Site

CALCULATIONS

Excerpt from 2008 Feasibility Report

1 INTRODUCTION

In 2007, approximately 2000 feet of stream was restored for the Town of Cary as on-site mitigation for the widening of SW Maynard Road. In addition to the restoration, the Town obtained funding for a nutrient offset project to be constructed simultaneously. The Town designed, installed, and is currently monitoring this watershed-scale nitrogen (N) reduction best management practice (BMP) system in the Neuse River Watershed. Prior to installation a feasibility study was conducted and estimated that the project could reduce N loads by approximately 1339 pounds per year.

Recently, the Town has approved a second phase of stream restoration to include 4 additional upstream segments, for an additional 3,920 feet of stream restoration. This report investigates possible BMP opportunities and estimates the N load reductions possible with this second phase of stream restoration.

Factors and assumptions considered in this report are the same as those in the original feasibility study (Stantec, 2005) and include the N loading within the watershed, site constraints, BMP N-removal efficiency, size requirements and the cost of various BMPs. A number of assumptions were made for this study. Where appropriate, the assumptions and their basis have been outlined, or can be referred to in the Phase I feasibility report.

2 THE STUDY AREA

2.1 The Watershed

The original nitrogen removal study divided the study area into two subbasins. Because full nitrogen removal opportunities in the lower subbasin were addressed in the first phase of the restoration, this report investigates new opportunities available in the upper subbasin. This subbasin was further delineated into two subbasins based on two-foot contours derived from LIDAR data (NCDOT, 2005). Subbasin 1, which comprises approximately 334 acres, drains the downtown of Cary and residential areas. The 146-acre Subbasin 2 drains primarily residential areas (Figure 1).

2.2 The Site

The Phase II stream restoration will occur on parcels owned by the Town of Cary, including Dorothy Park (PIN 0763270987). Additionally, restoration will occur on an easement on parcel PIN 0763089429 and a 60-foot easement between parcels 0763185130 and 0763175924. Dorothy Park and the easement parcel (0763089429) represent the best possible locations for BMP installation on the restoration site.

2.3 Waters of the US

According to current interpretations of the Clean Water Act, the Waters of the US cannot be used as a water treatment system. This has implications for the placement of BMPs. Field reconnaissance has revealed that mostly jurisdictional waters are present on the parcels where proposed BMPs can be installed, limiting the use of in-line BMPs. Exceptions exist in Dorothy Park. A stormwater drain and curb inlets are present in the

park which drain roughly one-fourth of Subbasin 2 (Figure 2). Furthermore, stormwater from one parcel to the northwest of the easement parcel drains to non-jurisdictional waters in the easement parcel before entering the restoration site (Figure 2)

3 BEST MANAGEMENT PRACTICES

3.1 Selected BMP

Based on a consideration of location constraints, total N reduction efficiency, cost, and site hydrology, constructed stormwater wetlands appear to be the most appropriate choice within this watershed. These BMP structures have an estimated nitrogen removal efficiency of 40% (NCDWQ, 1999). Given the number of BMPs that must be installed and the different types of situations that are likely to be encountered during design, it is possible that several different types of BMP structures will ultimately be installed.

3.2 BMP Opportunities

As discussed in section 2.3, in-line BMP opportunities are limited. However, a significant amount of the drainage in Subbasin 2 can be treated through the installation of BMPs in Dorothy Park. Additionally, BMPs can be installed on the easement parcel to address stormwater drainage from PIN 0763086990 (Figure 2).

While no other BMP opportunities have been located which can address current stormwater runoff, opportunities exist to address future development scheduled to occur in the easement parcel PIN 0763089429. The development of townhouses is planned for this 8.3-acre parcel. Current regulations require the developer to install stormwater BMPs. However, given that stormwater ponds are the most common structure used in these cases, with an estimated removal efficiency of 25% (NCDWQ, 1999) further reduction of N loads from this parcel is possible.

4 NITROGEN REMOVAL

This section of the report identifies the current N loadings within the drainage area of Dorothy Park, parcel PIN 0763086990, and from future development on parcel PIN 0763089429. It then identifies how much N may be removed from the system by properly designed and installed BMPs during the Phase II restoration.

4.1 Nitrogen Loadings

Nitrogen loading from the drainage area of Dorothy Park, parcel PIN 0763086990 and parcel PIN 0763089429 were estimated using the parcel-based method previously described in the Town of Cary Nitrogen Removal BMP Project Feasibility Study prepared by Stantec Consulting Ltd. The same assumptions, land use categories, and event mean concentrations apply to the current study.

A load of approximately 360 lbs/acre/yr of N was calculated for the 35.4-acre drainage area of Dorothy Park. Additionally, it was estimated that 19 lbs of N per acre/yr is loaded

from the 0.9 acre parcel located northwest of the easement parcel. A total load of 85.8 lbs/acre/yr of N was estimated for the future development of the easement parcel. However, given that stormwater runoff from the new development will likely be treated using stormwater ponds prior to leaving the development (with an estimated removal efficiency of 25%); the final load from the parcel was calculated to be 64.4 lbs/acre/yr.

4.2 Nitrogen Removal Estimates

The maximum possible nitrogen load reduction in the entire watershed by floodplain wetlands via overbank flow was previously addressed in the Town of Cary Nitrogen Removal BMP Project Feasibility Study (Stantec, 2005). As such, this report only addresses treatment attributable to in-line BMP installation in the second phase of restoration in order to avoid accounting for this method of reduction twice.

It is assumed that all loads calculated in section 4.1 will be delivered in well defined drainage systems where BMPs can be installed, with an N removal efficiency of 40%. Table 1 summarizes the parcel-based nutrient loading analysis, resulting in an estimated reduction of 177 lbs of total N.

Table 1. Total nitrogen (TN) loading and BMP reductions by parcel

Parcel	Parcel Zone Code	Area (acres)	TN Loading (lbs/yr)
763086990	B-2	0.92	19.38
763089429	RMF8	8.29	64.36[1]
Dorothy Park Drainage Area	R12	22.98	155.60
	Undeveloped	3.13	9.39
	Road	9.28	194.87
	Total	44.61	443.60
BMP Removal Efficiency			40%[2]
Total TN Load Reduction (lbs/yr)			177.44

[1] Assumes 25% of N previously removed due to installation of stormwater ponds by future development
[2] NCDWQ, 1999b

5 MONITORING

An upstream and a downstream site were isolated for N monitoring after the construction of the first phase of stream restoration. The upstream monitoring site is currently located within the future site of the second phase of restoration. In order to continue post-construction monitoring for the N removal achieved by the project, this site will be relocated further upstream.

6 ESTIMATED COST

The estimated costs for the design, construction, and monitoring of the proposed BMPs for N removal are presented in Table 2. Note that there is no proposed cost for Property

and Monitoring. The proposed BMPs can be constructed on parcels already owned by the Town of Cary. Also, there will be no monitoring costs, as monitoring of N reductions can be included in the existing monitoring scheme for the first series of BMPs, as noted in Section 5.

Table 2. Cost estimate for the proposed nitrogen removal BMP project

Cost Estimate		
Service		**Cost**
Feasibility study		$5,000
Design		$25,000
Survey		$5,000
Property		$0*
Construction	Earthwork	$20,000
	Planting	$10,000
Monitoring		$0†
Total		$65,000

* Proposed BMPs will be constructed on property already owned by the Town of Cary.
† Monitoring will be included in the existing monitoring scheme for the first series of BMPs.

7 CONCLUSIONS

The results of this study indicate that it is feasible to additionally remove approximately 177 pounds of total N per year from the Neuse River watershed through the installation of BMPs in the second phase of stream restoration near Maynard Road. With an approximately 30-year life of a BMP, the total removal is estimated to amount to 5,310 pounds of nitrogen.

It should be noted that the 177 pounds of total N per year is an estimate based on a number of assumptions. The estimate will vary depending on the actual design. The actual amount of N removal achieved by the project will be determined after the project is completed through post-construction monitoring.

MEMORANDUM OF AGREEMENT

STATE ON NORTH CAROLINA
COUNTY OF WAKE

MEMORANDUM OF AGREEMENT

THIS MEMORANDUM OF AGREEMENT, made this the 27th day of September, 2004, by and between the TOWN OF CARY, NC (TOC) and, the North Carolina Department of Environment and Natural Resources (NCDENR), ECOSYSTEM ENHANCEMENT PROGRAM (EEP).

WITNESSETH

THAT WHEREAS, the TOWN OF CARY and the EEP have authority to enter into this memorandum of agreement under G.S. 113-8 and G.S. 113-20;

WHEREAS, Town submitted a Proposal for "Nitrogen BMP System Implementation and Monitoring in an Urbanized Portion of the Town of Cary" ("Proposal"), which Proposal has been accepted for grant funding in the amount of $400,950 by NCDENR (EEP); and

WHEREAS, the parties desire to enter into this MOA to set forth the terms of the grant.

NOW THEREFORE, in consideration of the mutual promises, obligations, and benefits hereunder exchanged and obtained, the TOWN OF CARY and the EEP mutually covenant and agree as follows:

SECTION 1 - Background

The mission of the NC-DENR Ecosystem Enhancement Program (EEP; formerly the NC Wetlands Restoration Program) is to restore, enhance, and preserve wetlands, streams, and riparian buffer areas throughout North Carolina's 17 major river basins with the overall goals of improving water quality, instream and riparian habitat, floodwater storage, and recreation. The EEP is interested in restoring and protecting the wetlands, streams and unnamed tributaries within the Upper Swift Creek Drainage area (which includes portions of the Town of Cary) as part of a Local Watershed Planning effort initiated in 2003.

SECTION 2 – Purpose

The purpose of this Memorandum of Agreement (MOA) is to define and set forth the responsibilities of the TOWN OF CARY (TOC) and the ECOSYSTEM ENHANCMENT PROGRAM (EEP) for the nutrient offset project to be completed by the TOWN OF CARY and funded by the EEP. The project will be located within the western portion of the Swift Creek watershed. The project will occur on parcels identified as:

PIN # 1) 076305085505 (2.08 A)
PIN # 2) 076305072902 (2.90 A)

Additional parcels may be added to this list if identified in the design process.

The project is intended to enhance water quality within the Swift Creek watershed through the reduction of nitrogen loading rates into the surface water within the watershed. This reduction is to be accomplished through the use of specified best management practices as outlined in the project proposal. The project proposal entitles "Nitrogen BMP System Implementation and Monitoring in an Urbanized Portion of the Town of Cary" defines the timeframe, payment schedule, and project specifics not specifically addressed in this MOA and is attached hereto as Attachment 1 and incorporated herein by reference.

SECTION 3 – Areas of Authority and Responsibility

This project is located entirely within the jurisdiction of the TOWN OF CARY and on TOC owned property. The TOC's primary responsibilities during and after this project will be:

1. To install and maintain BMP's that will treat stormwater runoff generated from 270-acres within the Swift Creek Watershed. The BMP's will be designed to achieve at minimum a reduction in the nitrogen loading rate of 4.5 lbs/ac/yr from the established estimated baseline loading rate. This should result in a total annual reduction of 1,215 lbs of nitrogen per year.

2. To apply for and receive approval for all applicable environmental permits prior to the construction phase of this project.

3. To assume responsibility for the selection, oversight, and supervision of designated contractors and consultants to conduct this work.

4. To provide and ensure reasonable access for the EEP staff to all work sites during normal working hours for the project's duration.

5. To provide for public safety and work place security by keeping some or all of the work areas closed to the public as necessary, or, for the project's duration, whichever is deemed most prudent. Contractors will follow standard OSHA guidelines and will post the construction site. All law enforcement activities will be the responsibility of the TOC.

6. To have the TOC Public Information Officer notify or consult with EEP prior to issuing news releases relating to the nitrogen BMP grant project.

7. To meet with the EEP and/or its contractors and consultants every two months, or at a greater frequency sufficient to review and assess the project's progress and plans.

8. To notify EEP of any proposed changes to the scope of work contained in the proposal (Attachment 1) prior to adopting the change.

9. To provide a designated contact person from the TOC to coordinate and review all aspects of the project with the EEP, and its contractors or consultants.

10. To furnish water quality monitoring data to EEP on a quarterly basis for a two year period following BMP construction. Additionally, a BMP maintenance and inspection report will be submitted every five years for the term delineated in item #11 of this MOA.

11. To maintain the BMP's to ensure functionality for a period of 30-years.

The EEP is charged with restoring degraded wetlands, streams, and riparian areas throughout the State of North Carolina for the purposes of water quality protection, wildlife and fish habitat, floodwater storage, and recreation. EEP, its contractors, and its consultants will be allowed reasonable free access to all EEP funded BMP implementation sites. The primary responsibilities of the EEP and the contractors and consultants during and after this project will be:

1. To provide monetary funds at a rate of $ 330.00/lb of nitrogen removal estimated over a period of 30-years. For this TOC project the total funding has been established at $400,950 to be paid-out as outlined in attachment 1.

2. To review and comment on design plans submitted by the TOC and communicate with the TOC designated project manager within a reasonable timeframe.

3. To consult with the TOC's Public Information Officer and staff prior to issuing news releases relating to the nutrient offset project, and, to provide any comments needed to TOC PI Officer within 2-business days upon receipt of the draft news releases prepared by TOC regarding this project. If comments are not received by TOC in this time-frame it will be assumed that EEP has no comments. Additionally, DENR will identify and provide the name of the applicable DENR PI Officer to the TOC PI Officer (and staff) for media communication purposes related to this project.

4. To meet with the TOC staff at a frequency sufficient to review and assess the project's progress, as specified in section 3, item #7 of this MOA.

Both parties agree:

To work cooperatively to develop and implement a design plan that is agreeable to both entities. Both entities also agree to work cooperatively to develop a remedial action plan (RAP) that is agreeable to both entities in the event that post-construction remedial activities are necessary. Details related to the implementation of the RAP will be jointly discussed by both entities as necessary, if triggered.

SECTION 4 – Duration of this Agreement

The nutrient offset project guided by this agreement shall commence on the date that this agreement is signed by all parties and the agreement shall terminate upon submission of the final water quality monitoring report anticipated to be submitted or before September 30, 2007. The site maintenance phase of the project will commence upon completion of BMP construction and the subsequent two-year water quality monitoring phase (anticipated to terminate in September 2007). The Town of Cary also agrees to maintain the constructed BMP sites for a 30-year period and to submit a BMP site maintenance report to NCEEP upon completion of the 30th year.

SECTION 5 – Considerations

The parties mutually agree that this agreement does not at any time transfer ownership or management of any portion of the lands in the TOC and that all provisions of this MOA are consistent with this understanding. Furthermore, the parties mutually agree that payment for the project shall be established at the percentages and milestones outlined in the schedule/Payment table contained in Attachment 1.

SECTION 6 – Review of Project Plans

In order to protect the interests of all parties the TOC or its approved contractors and consultants shall furnish the EEP with copies of all plans and maps for this project for review and comment prior to the project's implementation.

SECTION 7 - Inspection

In order to ensure compliance with all EEP regulations and policies, the EEP staff shall have unrestricted access to all project areas during working hours.

SECTION 8 – Termination for Cause

If either party fails to perform or comply with any condition of this agreement and such failure should continue more than 30-days after written notice from the other party, and if the non-compliant party should not within 30-days commence to cure with due diligence the failure, then the aggrieved party may terminate this MOA on written notice to the non-compliant party, termination to be effective in not less than 15-days from receipt of the written notice. Additionally it is understood that if the project has progressed to the stage where the Town of Cary has committed to fund contractors, EEP will honor that funding in the event that the project was terminated.

SECTION 9 – No Waiver

The failure of either party to insist on strict performance of any condition of this agreement shall not be construed as a waiver of the right to insist on the performance of that condition in any other instance.

SECTION 10 – Modification or Termination by Consent

This MOA may be modified or terminated by mutual agreement of the parties as long as such modifications or termination are made in writing and signed by authorized officers from both agencies.

SECTION 11 – Notices

All notices required to be given under this agreement shall be deemed to have been given when reduced to writing and deposited, postage-paid, in the U.S. Mail or delivered by courier or in person to these addresses:

TOWN OF CARY (TOC)

Engineering Department
Tim Bailey, PE, Engineering Director
P.O. Box 8005
Cary, NC 27512

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES (NCDENR)

Ecosystem Enhancement Program (EEP)
Bill Gilmore, Program Director
1652 Mail Service Center
Raleigh, NC 27699-1652

9-24-2004
(Date)

By _____
Engineering Director,
Town of Cary

10/6/04
(Date)

By _____
Program Director
Department of Environment and
Natural Resources;
Ecosystem Enhancement Program

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Attachment 1

Nitrogen BMP System Implementation and Monitoring in an Urbanized Portion of the Town of Cary

Town Center Area Plan (TCAP) Area

Proposal for $400,950
Submitted to the North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program

Submitted by the Town of Cary Engineering Department

September 27, 2004

OVERVIEW
The Town of Cary (TOC) will work with the North Carolina Ecosystem Enhancement Program (NCEEP) to design, install, and monitor a watershed-scale nitrogen reduction best management practice (BMP) system in the Neuse River Basin. The study will focus on a sub-basin which drained a portion of Cary's proposed Town Center Area Plan (TCAP) downtown revitalization area. It is located in the western portion of the 8,000-acre Swift Creek watershed. Swift Creek (and unnamed tributaries which flow into Swift Creek in the TCAP area) are designated as 303(d) listed streams and contain protected species (Carolina Heel Splitter) downstream of the TCAP revitalization area. The Swift Creek watershed and the protected species benefit from the implementation of this proposed BMP system.

The purpose of the proposed BMP system is to improve the water quality in Swift Creek sub-basin by reducing nitrogen exports by approximately 1,215 pounds per year from a 636-acre urbanized watershed within the western portion of the Swift Creek sub-basin. The project will serve as a model demonstration site for urbanized watershed scale nitrogen reduction, and will provide a series of BMP's along an unnamed tributary to Swift Creek which drains approximately two thirds of the TCAP area, as necessary to properly manage existing and projected stormwater run-off and nitrogen management needs. Project tasks will be performed by a team of engineers, scientists, and technicians associated with the Town of Cary or its subcontractor. Total project cost is estimated at approximately $400,950.

If the Town is unsuccessful in finding enough suitable locations for BMP's within the identified sub-basin, adjacent sub-basins located within the Swift Creek Watershed will be analyzed. Prior approval will be sought from NCEEP prior to any changes in sub-basins.

SCOPE
Task 1. BMP Feasibility Assessment of TCAP Area Watershed
The project team will assess all possible nitrogen-reduction BMP's in the watershed and determine their cost-effectiveness and environmental benefit. The project team will recommend a system of BMP's that will result in average annual watershed nitrogen export reductions of approximately 1,215 pounds per year (4.5 pounds per acre from 270 treated acres).

Potential BMP's may include but are not limited to, the following:

- Stormwater wetlands designed to treat up to approximately 200-acres of developed watershed. The wetlands will be constructed within the floodplain and a remnant oxbow lake with several wetland complexes being integrated into the existing topography.

- At least three hundred linear feet of level spreaders helping to treat runoff from a 50-acre residential apartment complex/neighborhood completed approximately 15-years ago. The level spreader will be constructed on land owned by the Town of Cary along land adjacent to an unnamed tributary of Swift Creek, making construction relatively simple.

- The conversion of several stormwater ditches, which provide essentially no nitrogen reduction, to small pocket stormwater wetlands. These ditches are scattered throughout the watershed and treat a combined 12-20 acres.

Task 2. BMP Design
The project team will prepare construction plan sheets for each BMP to include a title sheet, existing conditions, a grading plan, typical cross sections, structure and vegetation details, and a summary of quantities. Other design items will include erosion control plans, vegetation planting plans, specifications, and a construction cost estimate. The Town will provide NCEEP with one set of the final plans.

Task 3. Permit Preparation
The project team will prepare documents associated with relevant permit applications.

Task 4. Construction Management
The project team will prepare construction bid packages and participate in the pre-bid, bid opening, and pre-construction meetings. The bid package will include final plans, specifications, and contract documents. The project team will provide construction oversight to ensure that construction is completed in accordance with plans and specifications.

Task 5 Water Quality Monitoring
The project team will design and install a water quality monitoring plan to evaluate water quality changes resulting from BMP implementation. Monitoring stations will be installed at several locations, including the watershed outlet to determine stream discharge, baseflow nutrient concentrations, and stormwater nutrient concentrations. Benthic and invertebrate monitoring established for the adjacent (downstream) Maynard Road stream restoration monitoring will be continued to help determine water quality benefits on Nitrogen BMP's. Data will be analyzed to determine average, annual nitrogen export from the watershed and upstream/downstream of selected BMP's. Water quality monitoring will be carried out for a minimum of 2-years following BMP construction with an interim report to be submitted at the end of year 1, and a final report submitted after completion of the second year. Water quality monitoring data will be submitted quarterly to NCEEP during the 2-year post-construction period.

Task 6. Project Management
The project manager will provide quarterly progress reports to NCEEP and coordinate invoices, phone conferences, letters, and meetings with NCEEP and other project personnel. The project manager will review all aspects of the project with NCEEP and other project personnel during regularly scheduled meetings.

Task 7. Education
The project team will conduct educational programs associated with this innovative project, including field tours, workshops, signage, and publications. Educational programs will be aimed at local officials, natural resource professionals working in watershed management, professional engineers and landscape architects, State/Federal regulatory agencies and the public.

Task 8. Remedial Action Plan (RAP)
The project team will develop a remedial action plan (RAP) that is agreeable to NCEEP and the TOC which can be used in the event that post-construction remedial activities are necessary.

SCHEDULE/PAYMENT MILESTONES
The proposed project timeline and payment schedule is as follows:

Milestone	Date	Cumulative Funding	
Complete Project Contract	September, 2004	$0	(0%)
Install Monitoring Equipment	November, 2004	$40,000	(10%)
Complete BMP Feasibility Analysis and Remedial Action Plan	January, 2005	$40,950	(10%)
Complete BMP Design	February, 2005	$60,000	(15%)

Complete Permit Applications	April, 2005	$20,000	(5%)
Complete Construction Documents, Bid Opening, and Begin Construction	June, 2005	$80,000	(20%)
Complete Construction	September, 2005	$80,000	(20%)
Complete Monitoring	September, 2007	$40,000	(10%)
Final Report	September, 2007	$40,000	(10%)

BUDGET

The proposed project budget is as follows:

Budget Item	**Requested Funding**
Travel	$1,000
Supplies/Miscellaneous ODC's	$30,000
Contracted Services	$369,950
Total	**$400,950**

Travel funding ($1,000) will be used to support approximately 300 person-trips to the project location, typically involving two project personnel. Each trip is approximately 5-miles roundtrip from Cary Town Hall. Supplies funding ($30,000) will support monitoring, data analysis, education programs, report preparation, plan development, and construction oversight. Contracted services funding ($369,950) will support engineering and surveying costs associated with BMP design, monitoring, and construction.

MBE REQUIREMENT

The Town of Cary will ensure that NCEEP's MBE requirements are met. Documentation of this will be provided with the construction documents.

c/mydocuments/carymoa3

CORRESPONDENCE

NOTES OF THE JANUARY 16, 2003, MEETING WITH THE DWQ

STREAM RESTORATION/BANKING ON SW MAYNARD ROAD WIDENING

TOWN OF CARY

Attendees: Mike Babuin, John Dorney, Brad Fairley, Pete Colwell

A brief meeting was held to discuss the process for Town of Cary obtaining mitigation credits for the proposed stream restoration project associated with SW Maynard Road Widening.

During the discussion, John Dorney offered the following comments:

- He indicated that the Town would probably not be required to go through the Mitigation Banking Review Team process. The MBRT process is long and tedious because it requires the agreement of at least 5 agencies (i.e., DWQ, Corps, WRC, Fish and Wildlife Service and EPA). He suggested that the Town do the project as off-site mitigation following the standard 401/404 permitting process. This requires agreement of only DWQ and the Corps. The mitigation plan submitted would have to include the following sections: existing conditions, methodology, proposed conditions, monitoring plan, dispensation of the property, establishment of the bank, the proposed service area and proposed credit release. H encourage the Town to get the Corps to buy-in to the Town's proposal to do the project as off-site mitigation rather than as a formal Mitigation Bank.

- John noted that a formal credit release schedule has not been established for streams. DWQ had proposed a fairly aggressive schedule (i.e., 50 percent after the first year) but this has yet to be adopted. He noted that the Town, a public agency that will not go bankrupt and that is willing to provide a bond for the required 5 years of monitoring/repair, would be in a strong position to argue for an aggressive release schedule.

- John Dorney encouraged us to arrange an on-site meeting with Todd St. John and the Corps Representative for the stream restoration and Bob Zarzecki for the buffers to ensure that they agree that the site is worth restoring and that credits would be given. He encouraged us to invite Steve Mitchell as a courtesy since he was involved at the beginning of the project when the 500 feet of restoration was mandated.

- John Dorney noted that although the 50 feet of buffer would be required for the stream mitigation, the Town would be able to get buffer and stream credit for the project – that is, they could double dip. He noted that all of the Town land would eligible for buffer credit but the credit ratio diminishes rapidly beyond the 50 feet.

- John Dorney encouraged Mike Babuin to contact the Mary Kay Murray from the City of Charlotte about their mitigation banking program. The City of Charlotte is in the process of doing the same thing that the Town of Cary is considering –

developing a bank of credits for internal use only. There is no plan to sell the credits.

John also offered some thoughts on the stream reach upstream of the 2000 feet identified for restoration as part of the initial project.

- He noted that the Town could expand the project in the future to bank additional credits.

- He noted that Charlotte had had a lot of success with stream restoration programs, even when there were many landowners involved – suggesting that it may be possible to do more stream restoration further upstream.

- He noted that even if it was impossible to get landowner cooperation for the upstream reach, that it might be possible to get more credits by developing wetlands to treat stormwater runoff on the Town owned property on the west side of the stream. John noted that in order to obtain credit for this work, a strong argument supporting the water quality benefits to the watershed of the stormwater retrofits would be needed. A benthic monitoring program would probably be the best way to create the necessary argument.

- John noted that in order to maximize credits on some projects with severe constraints, Charlotte had piped stormwater across a stream and developed a wetland on the other side to treat the stormwater prior to releasing it into the stream.

UT to Swift Creek and Proposed Wetland Areas

Meeting Minutes

May 10, 2005

Attendees: Andrea Wade, US Army Corps of Engineers
John Dorney, NCDWQ
Brad Fairley, Stantec Consulting Ltd.
Pete Colewell, Stantec Consulting Ltd.
Catherine Barker, Stantec Consulting Ltd.

Proposed wetland areas along the UT to Swift Creek were discussed in order to determine if it was feasible to use existing ditches and tributaries for hydrology for the created wetlands.

Overview:

-Discussed project and the primary goal of trying to improve water quality benefits
-Andrea brought up the fact that the stream should have been permitted as an IP and not Nationwide 27
-Pete discussed site specifics and the nature of the hydrology and existing conditions

Jurisdictional Waters:

-Andrea brought up the discussion of the existing wetlands being isolated vs jurisdictional-would have to go out to the field to verify
-John asked if the wetlands in the upper end were jurisdictional-limited with flow if it is
-Pete discussed the tributary next to the sewerline and how it would be best to restore it and widen the floodplain giving it a wetland buffer
-Pete also discussed the tributary at the top of the property and restoring it by stepping it down and widening its floodplain to provide a wetland buffer
-The rip rapped ditch that flows under the road to a culvert at the upper end of the property could potentially be a jurisdictional tributary depending on how the ACOE and NCDWQ view it and if it intercepts groundwater
-Other options for creating these wetlands is to expand on the existing wetland areas, meaning we could build beside them thereby increasing their treatment benefits-Andrea suggested that if the stormwater is piped and there is no mechanized machinery in the existing wetland while building the adjacent wetland, then they could not regulate and it could be possible
-The current JD map was discussed-Andrea says it would need to be resigned in order to call out those wetlands that are isolated
- USACE and DWQ support the idea of making water quality improvements but any improvements on jurisdictional waters must be in compliance with the Clean Water Act

Nonjurisdictional Waters:

-Dorney was concerned with the way the sizing looked for the proposed wetlands-would want to see the calculations for verification
-Dorney also asked if we were using the NCDWQ BMP Manual for calculations-Catherine confirmed and also added that we are also using Bill Hunt's manual

-10-year flooding was discussed and checking on that elevation to see if it leaves the channel would be useful in determining if the wetlands are going get any of that water
- USACE and DWQ fully support water quality improvements involving non-jurisdictional waters. There will be fewer regulatory requirements on such waters

Additional Credits:

-The topic of additional credits was brought up and Dorney doesn't believe the BMPs are going to do enough to warrant getting additional credits although the restoration of the tributaries would offer several hundreds of feet of stream for credit
-If the stormwater credits were met there might be discussion on whether or not additional credit could be obtained
-Dormey mentioned the NCEEP developing a flexible wetland mitigation program
-Andrea doesn't think there would be any additional credits from the ACOE for the wetlands because they lose jurisdiction if the wetlands are used for stormwater treatment-could give additional credits for the streams though

Permitting:
-Permitting that would be required would be a Nationwide 27, NCDWQ Buffer Rules, and the isolated wetland rules.

-Set up a meeting for May 31st at 8:30

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Water Quality

Beverly Eaves Perdue
Governor

Coleen H. Sullins
Director

Dee Freeman
Secretary

June 8, 2009

TO: Suzanne Klimek – NCEEP
Jeff Jurek - NCEEP

FROM: Cyndi Karoly - 401 Oversight and Express Permits Unit CBK

RE: Buffer Mitigation Site Evaluations
BMP (Town of Cary) – Wake County (Neuse 01)
EEP # 676 (no DWQ #)
Site Visit: 4/22/09 TLH/JRD
DWQ Contact Person: Tammy Hill

The BMP (Town of Cary) Site contains a series of linear wetland BMPs designed to yield nutrient offset credit. At the time of the site visit, BMP construction was nearing completion. Monitoring and other reports were unavailable, and the projected number of nutrient offset credits was unknown. Several BMPs had been installed parallel to a stream that is being restored by the Town of Cary as part of a larger greenway project. Jeff Jurek and Greg Melia from EEP and Brad Fairley from the design firm were also present on site. Schaffer

The site is in its first year post-construction. The BMPs appeared to be functioning as expected. BMP depths ranged from 0-24" with variable bottom profiles. Wetland vegetation (e.g. pickerelweed, lizard's tail, iris, *Juncus sp.*) had been planted and was becoming established. The BMPs will require occasional maintenance to remove sediment in order to ensure long-term functionality.

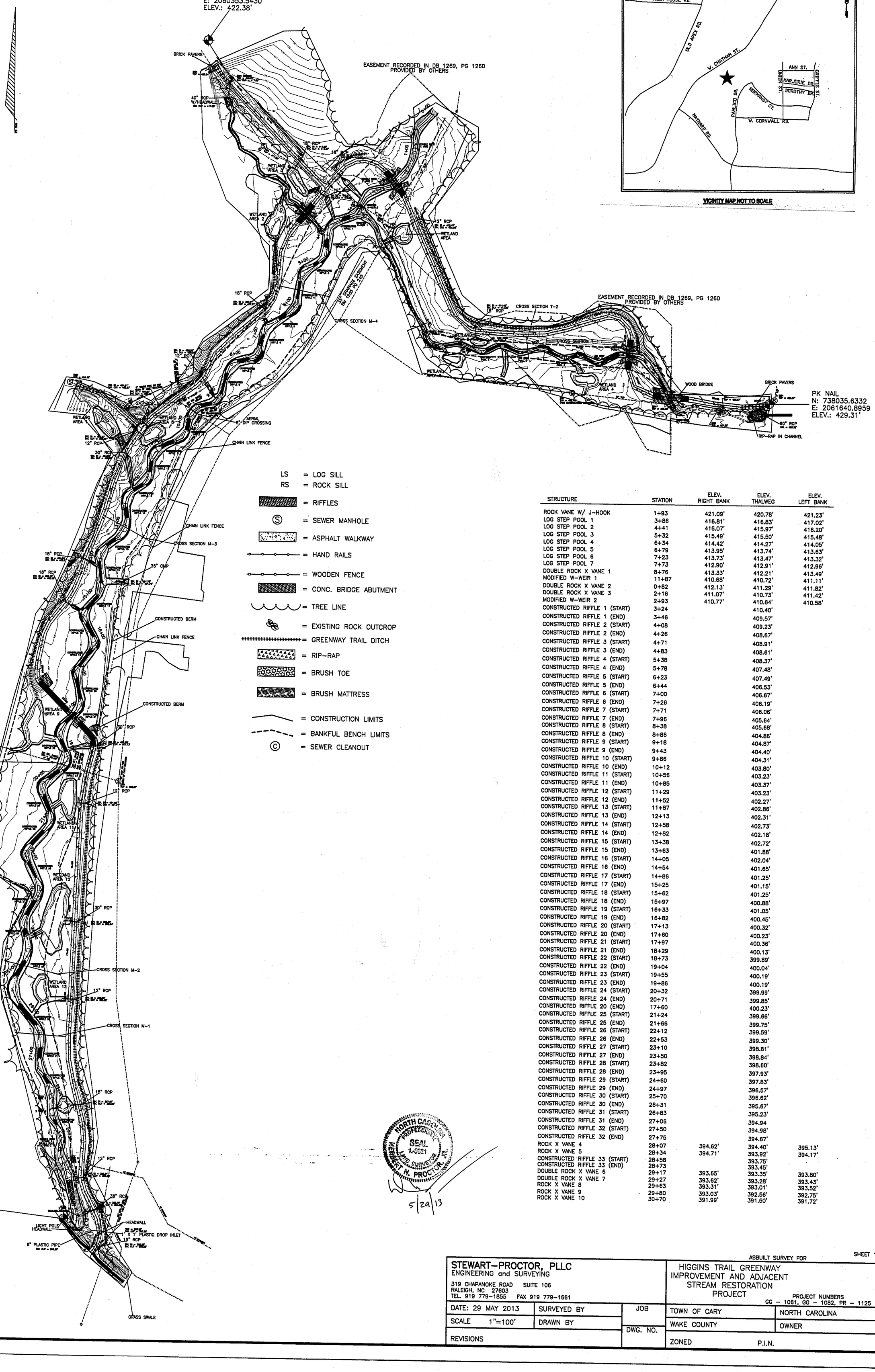
ITEMS TO ADDRESS: Please provide the total number of nutrient offset credits to be generated on this site. When available, submit an "as-built" plan to DWQ.

The BMP closest to Maynard Road was experiencing erosion and low vegetation survival. These issues must be corrected, and documentation of repairs must be submitted to DWQ. Cattails were already moving into the BMPs. These and other opportunistic plants will need to be monitored and may need to be controlled (without herbicides) as part of the ongoing maintenance of the site. Please provide the BMP maintenance plan to DWQ.

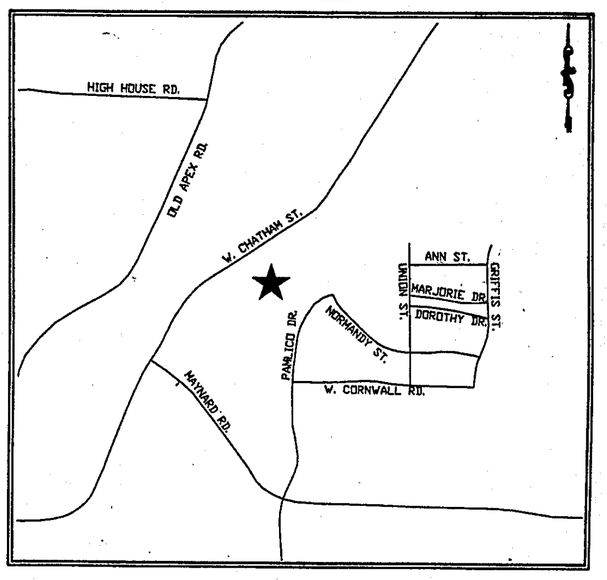
cc: Matt Matthews

401 Oversight/Express Review Permitting Unit
1650 Mail Service Center, Raleigh, North Carolina 27699-1650
Location: 2321 Crabtree Blvd., Raleigh, North Carolina 27604
Phone: 919-733-1786 \ FAX: 919-733-6893
Internet: http://h2o.enr.state.nc.us/ncwetlands/

AS-BUILTS



SITE LOCATION



VICINITY MAP NOT TO SCALE

STRUCTURE	STATION	ELEV. RIGHT BANK	ELEV. THALWEG	ELEV. LEFT BANK
ROCK VANE W/ J-HOOK	1+93	421.09'	420.78'	421.23'
LOG STEP POOL 1	3+86	416.81'	416.83'	417.02'
LOG STEP POOL 2	4+41	416.07'	415.97'	416.20'
LOG STEP POOL 3	5+32	415.49'	415.50'	415.48'
LOG STEP POOL 4	6+34	414.42'	414.27'	414.05'
LOG STEP POOL 5	6+79	413.95'	413.74'	413.83'
LOG STEP POOL 6	7+23	413.73'	413.47'	413.32'
LOG STEP POOL 7	7+73	412.90'	412.91'	412.96'
DOUBLE ROCK X VANE 1	8+76	413.33'	412.21'	413.49'
MODIFIED W-WEIR 1	11+87	410.68'	410.72'	411.11'
DOUBLE ROCK X VANE 2	0+82	412.13'	411.29'	411.82'
DOUBLE ROCK X VANE 3	2+16	411.07'	410.73'	411.42'
MODIFIED W-WEIR 2	2+93	410.77'	410.64'	410.58'
CONSTRUCTED RIFFLE 1 (START)	3+24		410.40'	
CONSTRUCTED RIFFLE 1 (END)	3+46		409.57'	
CONSTRUCTED RIFFLE 2 (START)	4+08		409.23'	
CONSTRUCTED RIFFLE 2 (END)	4+26		408.67'	
CONSTRUCTED RIFFLE 3 (START)	4+71		408.91'	
CONSTRUCTED RIFFLE 3 (END)	4+83		408.61'	
CONSTRUCTED RIFFLE 4 (START)	5+38		408.37'	
CONSTRUCTED RIFFLE 4 (END)	5+78		407.48'	
CONSTRUCTED RIFFLE 5 (START)	6+23		407.49'	
CONSTRUCTED RIFFLE 5 (END)	6+44		406.53'	
CONSTRUCTED RIFFLE 6 (START)	7+00		406.67'	
CONSTRUCTED RIFFLE 6 (END)	7+26		406.19'	
CONSTRUCTED RIFFLE 7 (START)	7+71		406.06'	
CONSTRUCTED RIFFLE 7 (END)	7+96		405.64'	
CONSTRUCTED RIFFLE 8 (START)	8+38		405.68'	
CONSTRUCTED RIFFLE 8 (END)	8+86		404.86'	
CONSTRUCTED RIFFLE 9 (START)	9+18		404.87'	
CONSTRUCTED RIFFLE 9 (END)	9+43		404.40'	
CONSTRUCTED RIFFLE 10 (START)	9+86		404.31'	
CONSTRUCTED RIFFLE 10 (END)	10+12		403.80'	
CONSTRUCTED RIFFLE 11 (START)	10+56		403.23'	
CONSTRUCTED RIFFLE 11 (END)	10+85		403.37'	
CONSTRUCTED RIFFLE 12 (START)	11+29		403.23'	
CONSTRUCTED RIFFLE 12 (END)	11+52		402.27'	
CONSTRUCTED RIFFLE 13 (START)	11+87		402.86'	
CONSTRUCTED RIFFLE 13 (END)	12+13		402.31'	
CONSTRUCTED RIFFLE 14 (START)	12+58		402.73'	
CONSTRUCTED RIFFLE 14 (END)	12+82		402.18'	
CONSTRUCTED RIFFLE 15 (START)	13+38		402.72'	
CONSTRUCTED RIFFLE 15 (END)	13+63		401.88'	
CONSTRUCTED RIFFLE 16 (START)	14+05		402.04'	
CONSTRUCTED RIFFLE 16 (END)	14+54		401.65'	
CONSTRUCTED RIFFLE 17 (START)	14+86		401.25'	
CONSTRUCTED RIFFLE 17 (END)	15+25		401.15'	
CONSTRUCTED RIFFLE 18 (START)	15+62		401.25'	
CONSTRUCTED RIFFLE 18 (END)	15+97		400.88'	
CONSTRUCTED RIFFLE 19 (START)	16+33		401.05'	
CONSTRUCTED RIFFLE 19 (END)	16+82		400.45'	
CONSTRUCTED RIFFLE 20 (START)	17+13		400.32'	
CONSTRUCTED RIFFLE 20 (END)	17+60		400.23'	
CONSTRUCTED RIFFLE 21 (START)	17+97		400.36'	
CONSTRUCTED RIFFLE 21 (END)	18+29		400.13'	
CONSTRUCTED RIFFLE 22 (START)	18+73		399.89'	
CONSTRUCTED RIFFLE 22 (END)	19+04		400.04'	
CONSTRUCTED RIFFLE 23 (START)	19+55		400.19'	
CONSTRUCTED RIFFLE 23 (END)	19+86		400.19'	
CONSTRUCTED RIFFLE 24 (START)	20+32		399.99'	
CONSTRUCTED RIFFLE 24 (END)	20+71		399.85'	
CONSTRUCTED RIFFLE 20 (END)	17+60		400.23'	
CONSTRUCTED RIFFLE 25 (START)	21+24		399.66'	
CONSTRUCTED RIFFLE 25 (END)	21+66		399.75'	
CONSTRUCTED RIFFLE 26 (START)	22+12		399.59'	
CONSTRUCTED RIFFLE 26 (END)	22+53		399.30'	
CONSTRUCTED RIFFLE 27 (START)	23+10		398.81'	
CONSTRUCTED RIFFLE 27 (END)	23+50		398.84'	
CONSTRUCTED RIFFLE 28 (START)	23+82		398.60'	
CONSTRUCTED RIFFLE 28 (END)	23+95		397.93'	
CONSTRUCTED RIFFLE 29 (START)	24+60		397.83'	
CONSTRUCTED RIFFLE 29 (END)	24+97		396.57'	
CONSTRUCTED RIFFLE 30 (START)	25+70		396.62'	
CONSTRUCTED RIFFLE 30 (END)	26+31		395.67'	
CONSTRUCTED RIFFLE 31 (START)	26+83		395.23'	
CONSTRUCTED RIFFLE 31 (END)	27+06		394.94	
CONSTRUCTED RIFFLE 32 (START)	27+50		394.98'	
CONSTRUCTED RIFFLE 32 (END)	27+75		394.67'	
ROCK X VANE 4	28+07	394.62'	394.40'	395.13'
ROCK X VANE 5	28+34	394.71'	393.92'	394.17'
CONSTRUCTED RIFFLE 33 (START)	28+58		393.75'	
CONSTRUCTED RIFFLE 33 (END)	28+73		393.45'	
DOUBLE ROCK X VANE 6	29+17	393.65'	393.35'	393.80'
DOUBLE ROCK X VANE 7	29+27	393.62'	393.28'	393.43'
ROCK X VANE 8	29+63	393.31'	393.01'	393.52'
ROCK X VANE 9	29+80	393.03'	392.56'	392.75'
ROCK X VANE 10	30+70	391.99'	391.50'	391.72'

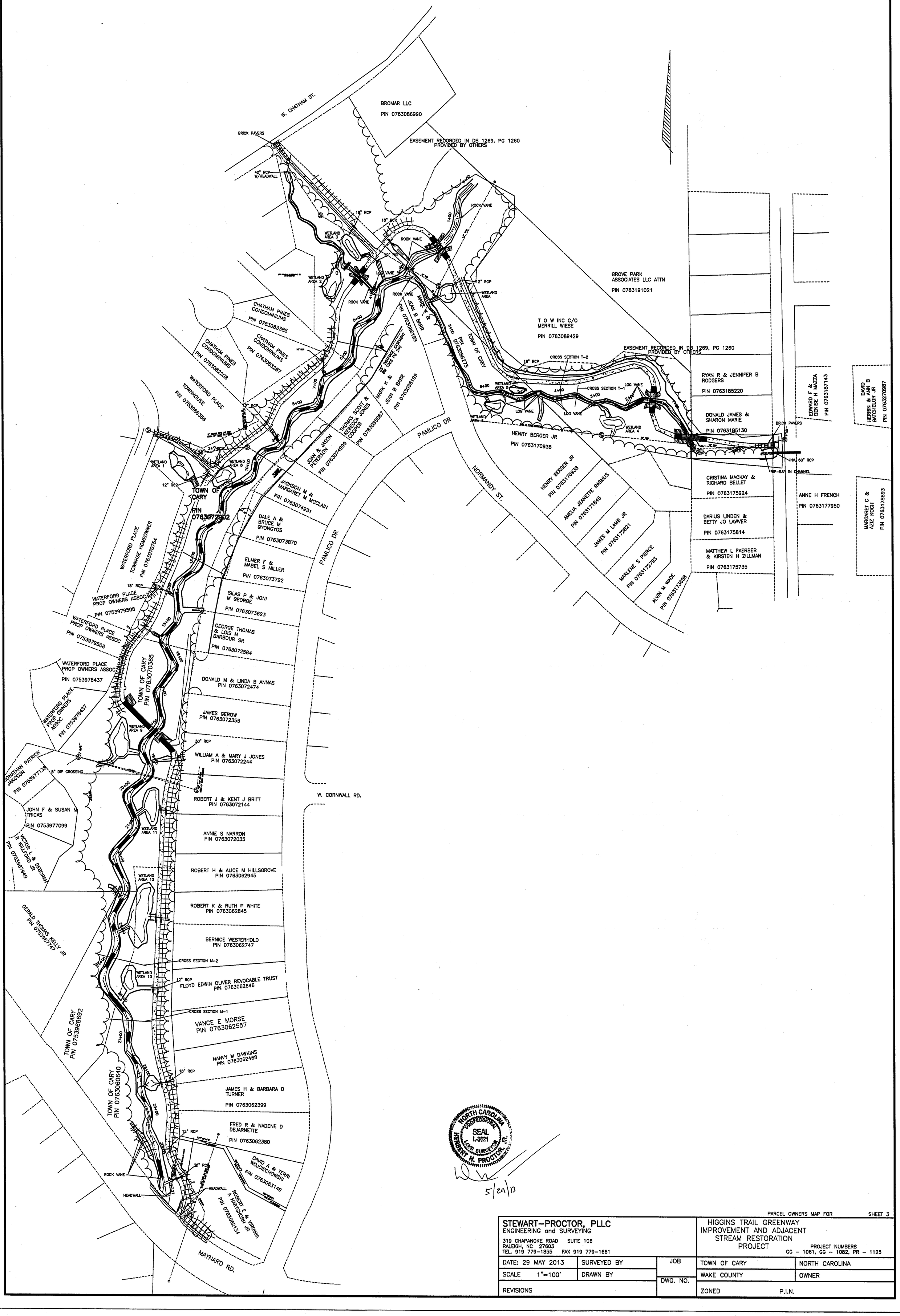
NORTH CAROLINA PROFESSIONAL SEAL L-3821 LAND SURVEYOR HERBERT H. PROCTOR, JR.

5/29/13

SHEET 1

ASBUILT SURVEY FOR

STEWART-PROCTOR, PLLC ENGINEERING and SURVEYING 319 CHAPANOKE ROAD SUITE 106 RALEIGH, NC 27603 TEL. 919 779-1855 FAX 919 779-1661			HIGGINS TRAIL GREENWAY IMPROVEMENT AND ADJACENT STREAM RESTORATION PROJECT PROJECT NUMBERS GG - 1081, GG - 1082, PR - 1125
DATE: 29 MAY 2013	SURVEYED BY	JOB	TOWN OF CARY / NORTH CAROLINA
SCALE 1"=100'	DRAWN BY		WAKE COUNTY / OWNER
REVISIONS		DWG. NO.	ZONED P.I.N.

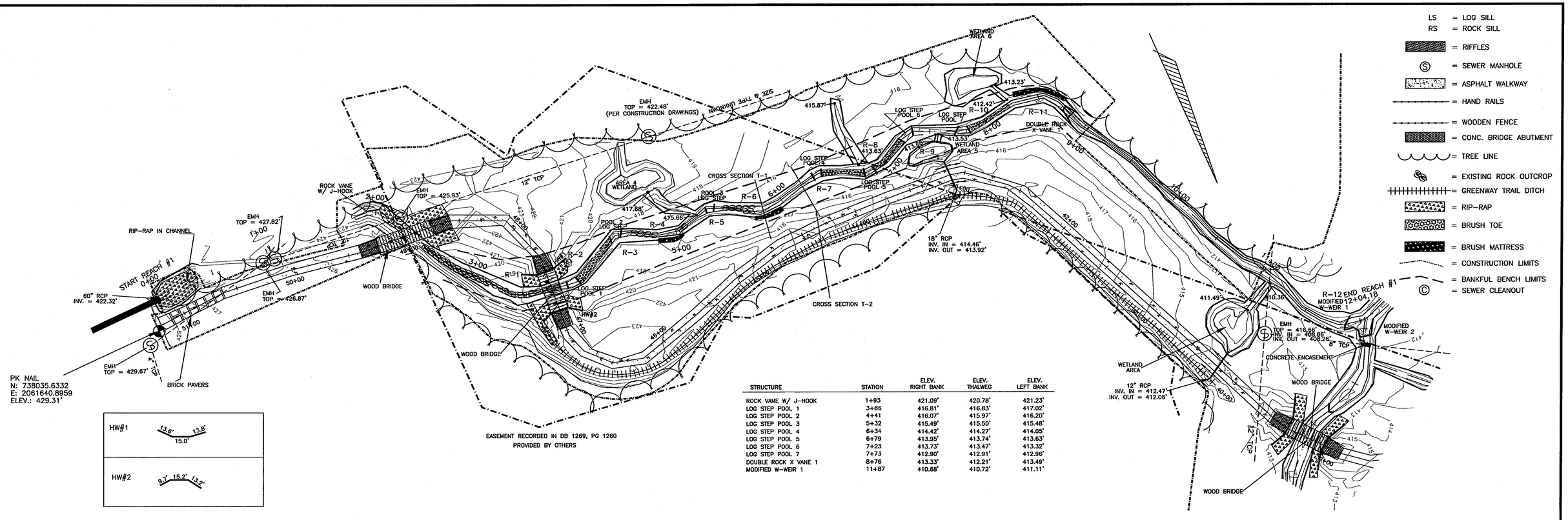


NORTH CAROLINA PROFESSIONAL SEAL L-3621 LAND SURVEYOR HERBERT N. PROCTOR, JR.

5/29/13

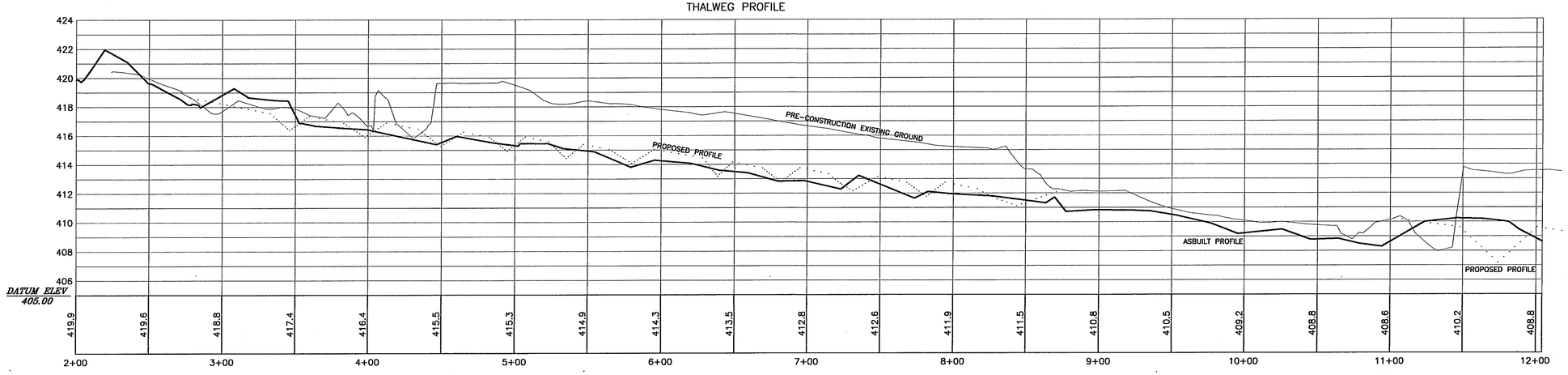
PARCEL OWNERS MAP FOR SHEET 3

STEWART–PROCTOR, PLLC ENGINEERING and SURVEYING 319 CHAPANOKE ROAD SUITE 106 RALEIGH, NC 27603 TEL. 919 779–1855 FAX 919 779–1661			HIGGINS TRAIL GREENWAY IMPROVEMENT AND ADJACENT STREAM RESTORATION PROJECT PROJECT NUMBERS GG – 1061, GG – 1082, PR – 1125	
DATE: 29 MAY 2013	SURVEYED BY	JOB	TOWN OF CARY	NORTH CAROLINA
SCALE 1"=100'	DRAWN BY		WAKE COUNTY	OWNER
REVISIONS		DWG. NO.	ZONED P.I.N.	



STRUCTURE	STATION	ELEV. RIGHT BANK	ELEV. THALWEG	ELEV. LEFT BANK
ROCK VANE W/ J-HOOK	1+93	421.09'	420.78'	421.23'
LOG STEP POOL 1	3+86	416.81'	416.63'	417.02'
LOG STEP POOL 2	4+41	416.07'	415.97'	416.20'
LOG STEP POOL 3	5+32	415.49'	415.50'	415.48'
LOG STEP POOL 4	6+34	414.42'	414.27'	414.05'
LOG STEP POOL 5	6+79	413.95'	413.74'	413.63'
LOG STEP POOL 6	7+23	413.73'	413.47'	413.32'
LOG STEP POOL 7	7+73	412.90'	412.91'	412.96'
DOUBLE ROCK X VANE 1	8+76	413.33'	412.21'	413.49'
MODIFIED W-WEIR 1	11+87	410.68'	410.72'	411.11'

THALWEG PROFILE



SCALE 1:40 HORIZONTAL
SCALE 1:4 VERTICAL

NORTH CAROLINA PROFESSIONAL SEAL L-3021 LAND SURVEYOR HERBERT H. PROCTOR, JR.
5/29/13

ASBUILT SURVEY FOR SHEET PP1

STEWART-PROCTOR, PLLC
ENGINEERING and SURVEYING
319 CHAPANOKE ROAD SUITE 106
RALEIGH, NC 27603
TEL. 919 779-1855 FAX 919 779-1661

HIGGINS TRAIL GREENWAY IMPROVEMENT AND ADJACENT STREAM RESTORATION PROJECT — REACH 1
PROJECT NUMBERS GG - 1061, GG - 1082, PR - 1125

DATE: 29 MAY 2013	SURVEYED BY	JOB	
SCALE	DRAWN BY	DWG. NO.	
REVISIONS			
TOWN OF CARY		NORTH CAROLINA	
WAKE COUNTY		OWNER	
ZONED	P.I.N.		

START REACH #2
0+00

DOUBLE ROCK X VANE 2
DOUBLE ROCK X VANE 3
MODIFIED W-WEIR 2
MODIFIED W-WEIR 1
CONCRETE ENCASEMENT
411.38'
12" RCP
INV. IN = 412.57'
INV. OUT = 412.25'
410.01'
408.55'
CONSTRUCTED RIFFLE 1
CONSTRUCTED RIFFLE 2
CONSTRUCTED RIFFLE 3
CONSTRUCTED RIFFLE 4
CONSTRUCTED RIFFLE 5
CONSTRUCTED RIFFLE 6
CONSTRUCTED RIFFLE 7
CONSTRUCTED RIFFLE 8
CONSTRUCTED RIFFLE 9
CONSTRUCTED RIFFLE 10
CONSTRUCTED RIFFLE 11
CONSTRUCTED RIFFLE 12
CONSTRUCTED RIFFLE 13
CONSTRUCTED RIFFLE 14
R-12
R-13
R-14
R-15
R-16
R-17
R-18
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R-20
R-21
R-22
R-23
R-24
R-25
R-26
R-27
R-28
R-29
R-30
HW#1
HW#2
HW#3
HW#4
HW#5
HW#6
HW#7
KW#1
KW#2
KW#3
KW#4
KW#5
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00
11+00
12+00
13+00
CROSS SECTION M-4
35' DRAINAGE EASEMENT
BM 1965 PG 240
CHAIN LINK FENCE
MATCH LINE STA. 14+00 REACH 2 SEE SHEET 4
EASEMENT RECORDED IN DB 1269, PG 1260
PROVIDED BY OTHERS
18" RCP
INV. IN = 412.13'
INV. OUT = 411.92'
18" RCP
INV. IN = 414.62'
INV. OUT = 413.93'
413.60'
411.57'
412.38'
412.40'
WETLAND AREA 2
WETLAND AREA 3
WETLAND AREA 8
WETLAND AREA 1
18" RCP
INV. IN = 407.71'
INV. OUT = 407.57'
12" RCP
INV. IN = 406.50'
INV. OUT = 405.95'
6" DIP AS PER DOT OR CARY RECORDS
6" TRUSS PIPE AS PER TOWN OF CARY RECORDS
24" RCP
INV. IN = 404.57'
INV. OUT = 403.86'
24" RCP
INV. IN = 404.61'
INV. OUT = 403.87'
30" RCP
INV. IN = 404.07'
INV. OUT = 403.68'
12" RCP
INV. OUT = 404.02"
INV. IN = 404.97'
410.23'
405.02'
TOP = 405.95'
DIP (RT. BANK)
DIP (THALWEG)
TOP = 405.90'
EMH
TOP = 412.63'
403.73'
403.55'
402.79'
EMH
TOP = 416.28'
EMH
TOP = 424.16'
EMH
TOP = 417.95'
INV. = 411.45'
EMH (STORM)
TOP = 425.91'
INV. OUT = 417.09'
40" RCP
W/HEADWALL
INV. OUT = 417.00'
HW#5
NEW SIDEWALK
TOP BACK OF CURB
EMH
TOP = 429.24'
NCGS WK 80
N: 738845.9080
E: 2060353.5430
ELEV.: 422.38'
TOP BACK OF CURB

HEADWALL DIMENSIONS (NOT TO SCALE)

HW#3	15.2', 19.0', 15.1'
HW#4	15.3', 15.4', 16.6'
HW#5	6.5', 4.5', 4.5'
HW#6	13.2', 13.2', 14.7'
HW#7	13.2', 14.8', 13.1'

KNEEWALL DIMENSIONS (NOT TO SCALE)

KW#1	1.5', 10.5', 1.5'
KW#2	2.7', 5.4', 4.0'
KW#3	4.0', 3.0', 2.7'
KW#4	1.5', 2.8', 2.7'
KW#5	4.0', 1.8', 2.8'

STRUCTURE	STATION	ELEV. RIGHT BANK	ELEV. THALWEG	ELEV. LEFT BANK
DOUBLE ROCK X VANE 2	0+82	412.13'	411.29'	411.82'
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CONSTRUCTED RIFFLE 4 (END)	5+78		407.48'	
CONSTRUCTED RIFFLE 5 (START)	6+23		407.49'	
CONSTRUCTED RIFFLE 5 (END)	6+44		406.53'	
CONSTRUCTED RIFFLE 6 (START)	7+00		406.67'	
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CONSTRUCTED RIFFLE 9 (END)	9+43		404.40'	
CONSTRUCTED RIFFLE 10 (START)	9+86		404.31'	
CONSTRUCTED RIFFLE 10 (END)	10+12		403.80'	
CONSTRUCTED RIFFLE 11 (START)	10+56		403.23'	
CONSTRUCTED RIFFLE 11 (END)	10+85		403.37'	
CONSTRUCTED RIFFLE 12 (START)	11+29		403.23'	
CONSTRUCTED RIFFLE 12 (END)	11+52		402.27'	
CONSTRUCTED RIFFLE 13 (START)	11+87		402.86'	
CONSTRUCTED RIFFLE 13 (END)	12+13		402.31'	
CONSTRUCTED RIFFLE 14 (START)	12+58		402.73'	
CONSTRUCTED RIFFLE 14 (END)	12+82		402.18'	

LS = LOG SILL
RS = ROCK SILL
= RIFFLES
Ⓢ = SEWER MANHOLE
= ASPHALT WALKWAY
= HAND RAILS
= WOODEN FENCE
= CONC. BRIDGE ABUTMENT
= TREE LINE
= EXISTING ROCK OUTCROP
= GREENWAY TRAIL DITCH
= RIP-RAP
= BRUSH TOE
= BRUSH MATTRESS
= CONSTRUCTION LIMITS
= BANKFUL BENCH LIMITS
Ⓒ = SEWER CLEANOUT

PROPOSED PROFILE
THALWEG PROFILE
PRE-CONSTRUCTION EXISTING GROUND
PROPOSED PROFILE
ASBUILT PROFILE
DATUM ELEV 400
412
410
408
406
404
402
411.6 411.0 410.7 411.1 409.8 409.8 409.1 408.2 409.1 407.4 407.7 407.7 406.3 406.6 406.0 404.2 404.7 405.0 402.4 402.4 403.6 402.5 402.0 402.9 402.6 402.3 401.0
0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00

ASBUILT SURVEY FOR

SEAL L-3321 NORTH CAROLINA REGISTERED LAND SURVEYOR
5/24/13

SCALE 1:40 HORIZONTAL
SCALE 1:4 VERTICAL

STEWART-PROCTOR, PLLC
ENGINEERING and SURVEYING
319 CHAPANOKE ROAD SUITE 106
RALEIGH, NC 27603
TEL. 919 779-1855 FAX 919 779-1661

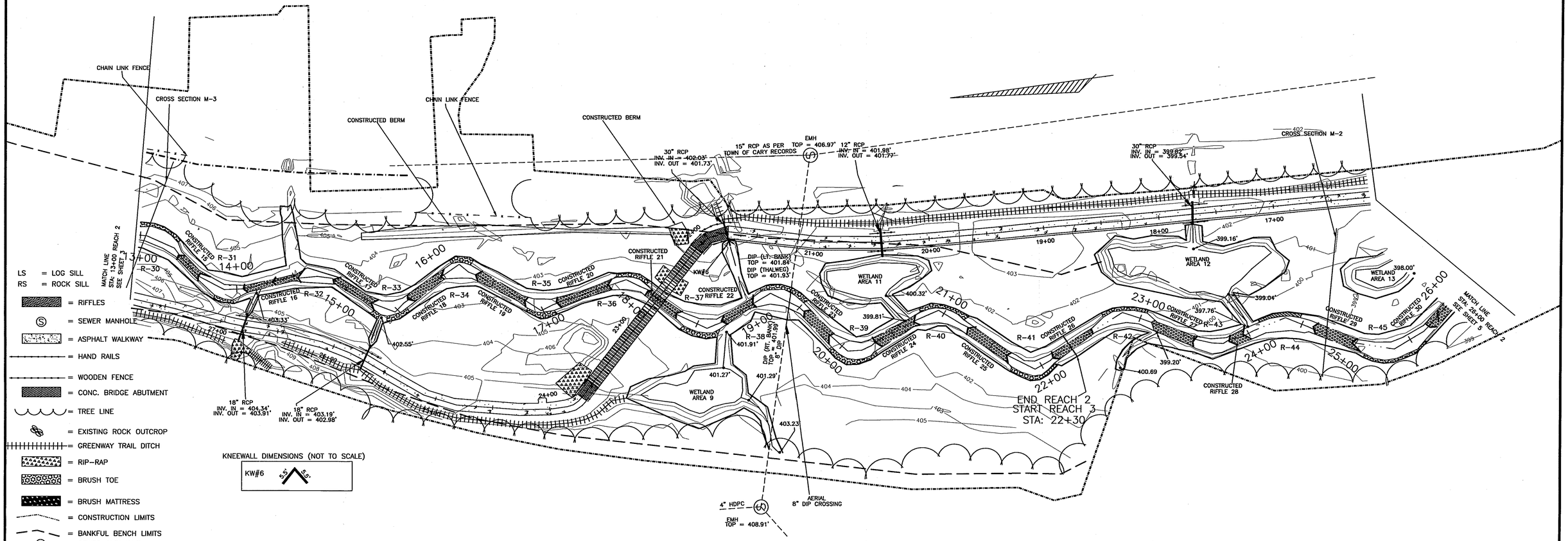
DATE: 29 MAY 2013 | SURVEYED BY
SCALE | DRAWN BY
REVISIONS
JOB
DWG. NO.

HIGGINS TRAIL GREENWAY IMPROVEMENT AND ADJACENT STREAM RESTORATION PROJECT

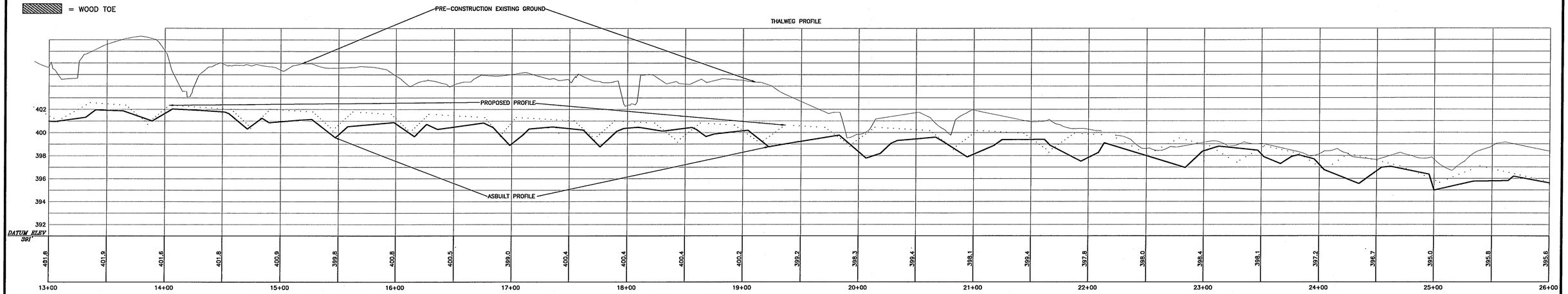
PROJECT NUMBERS
GG - 1061, GG - 1082, PR - 1125

SHEET PP2 REACH 2

TOWN OF CARY | NORTH CAROLINA
WAKE COUNTY | OWNER
ZONED | P.I.N.

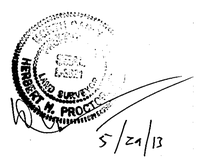


KNEEWALL DIMENSIONS (NOT TO SCALE)



STRUCTURE	STATION	ELEV. RIGHT BANK	ELEV. THALWEG	ELEV. LEFT BANK
CONSTRUCTED RIFFLE 15 (START)	13+38		402.72'	
CONSTRUCTED RIFFLE 15 (END)	13+63		401.88'	
CONSTRUCTED RIFFLE 16 (START)	14+05		402.04'	
CONSTRUCTED RIFFLE 16 (END)	14+54		401.65'	
CONSTRUCTED RIFFLE 17 (START)	14+86		401.25'	
CONSTRUCTED RIFFLE 17 (END)	15+25		401.15'	
CONSTRUCTED RIFFLE 18 (START)	15+62		401.25'	
CONSTRUCTED RIFFLE 18 (END)	15+97		400.88'	
CONSTRUCTED RIFFLE 19 (START)	16+33		401.05'	
CONSTRUCTED RIFFLE 19 (END)	16+82		400.45'	
CONSTRUCTED RIFFLE 20 (START)	17+13		400.32'	
CONSTRUCTED RIFFLE 20 (END)	17+60		400.23'	
CONSTRUCTED RIFFLE 21 (START)	17+97		400.36'	
CONSTRUCTED RIFFLE 21 (END)	18+29		400.13'	
CONSTRUCTED RIFFLE 22 (START)	18+73		399.89'	
CONSTRUCTED RIFFLE 22 (END)	19+04		400.04'	

STRUCTURE	STATION	ELEV. RIGHT BANK	ELEV. THALWEG	ELEV. LEFT BANK
CONSTRUCTED RIFFLE 23 (START)	19+55		400.19'	
CONSTRUCTED RIFFLE 23 (END)	19+86		400.19'	
CONSTRUCTED RIFFLE 24 (START)	20+32		399.99'	
CONSTRUCTED RIFFLE 24 (END)	20+71		399.85'	
CONSTRUCTED RIFFLE 20 (END)	17+60		400.23'	
CONSTRUCTED RIFFLE 25 (START)	21+24		399.66'	
CONSTRUCTED RIFFLE 25 (END)	21+66		399.75'	
CONSTRUCTED RIFFLE 26 (START)	22+12		399.59'	
CONSTRUCTED RIFFLE 26 (END)	22+53		399.30'	
CONSTRUCTED RIFFLE 27 (START)	23+10		398.81'	
CONSTRUCTED RIFFLE 27 (END)	23+50		398.84'	
CONSTRUCTED RIFFLE 28 (START)	23+82		398.60'	
CONSTRUCTED RIFFLE 28 (END)	23+95		397.93'	
CONSTRUCTED RIFFLE 29 (START)	24+60		397.83'	
CONSTRUCTED RIFFLE 29 (END)	24+97		396.57'	
CONSTRUCTED RIFFLE 30 (START)	25+70		396.62'	
CONSTRUCTED RIFFLE 30 (END)			395.67'	



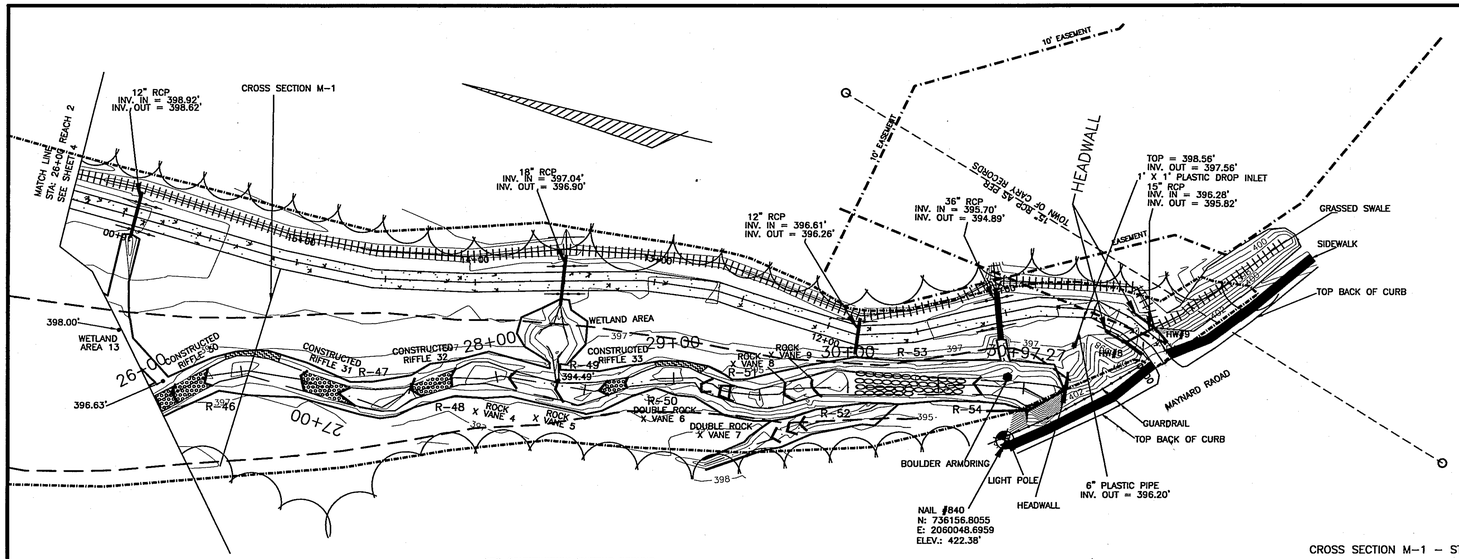
SCALE 1:40 HORIZONTAL
SCALE 1:4 VERTICAL

ASBUILT SURVEY FOR — SHEET PP3

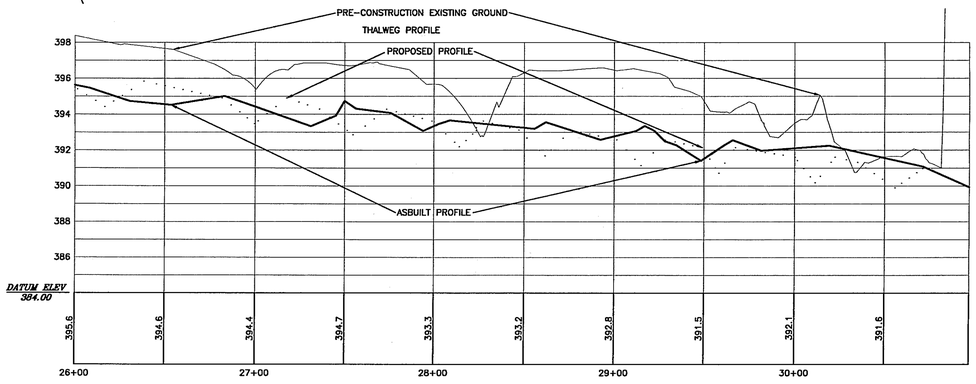
STEWART-PROCTOR, PLLC
ENGINEERING and SURVEYING
319 CHAPANOKE ROAD SUITE 106
RALEIGH, NC 27603
TEL. 919 779-1855 FAX 919 779-1661

HIGGINS TRAIL GREENWAY IMPROVEMENT AND ADJACENT STREAM RESTORATION PROJECT — REACH 2 AND REACH 3
PROJECT NUMBERS GG - 1061, GG - 1082, PR - 1125

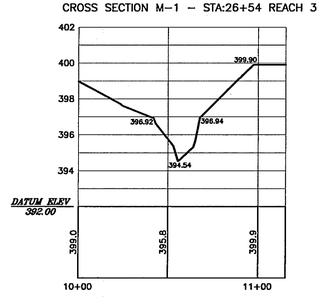
DATE: 29 MAY 2013	SURVEYED BY	JOB	TOWN OF CARY / NORTH CAROLINA
SCALE	DRAWN BY		WAKE COUNTY / OWNER
REVISIONS		DWG. NO.	ZONED / P.I.N.



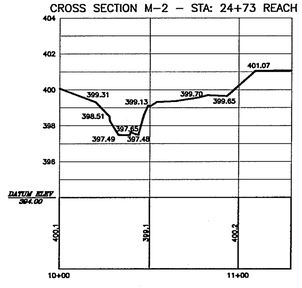
STRUCTURE	STATION	ELEV. RIGHT BANK	ELEV. THALWEG	ELEV. LEFT BANK
CONSTRUCTED RIFFLE 30 (END)	26+31		395.67'	
CONSTRUCTED RIFFLE 31 (START)	26+83		395.23'	
CONSTRUCTED RIFFLE 31 (END)	27+06		394.94	
CONSTRUCTED RIFFLE 32 (START)	27+50		394.98'	
CONSTRUCTED RIFFLE 32 (END)	27+75		394.67'	
ROCK X VANE 4	28+07	394.62'	394.40'	395.13'
ROCK X VANE 5	28+34	394.71'	393.92'	394.17'
CONSTRUCTED RIFFLE 33 (START)	28+58		393.75'	
CONSTRUCTED RIFFLE 33 (END)	28+73		393.45'	
DOUBLE ROCK X VANE 6	29+17	393.65'	393.35'	393.80'
DOUBLE ROCK X VANE 7	29+27	393.62'	393.28'	393.43'
ROCK X VANE 8	29+63	393.31'	393.01'	393.52'
ROCK X VANE 9	29+80	393.03'	392.56'	392.75'
ROCK X VANE 10	30+70	391.99'	391.50'	391.72'



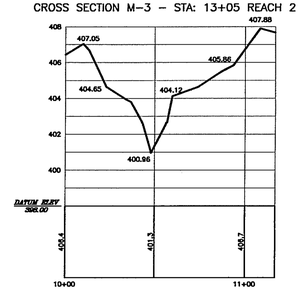
CROSS SECTION M-1 – STA:26+54 REACH 3



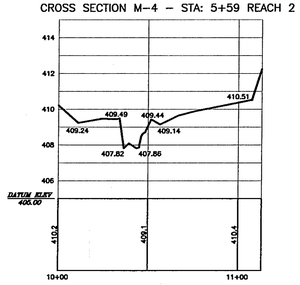
CROSS SECTION M-2 – STA: 24+73 REACH 3



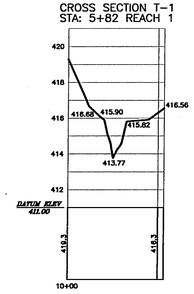
CROSS SECTION M-3 – STA: 13+05 REACH 2



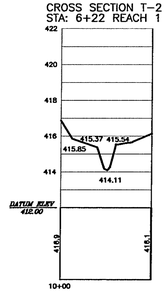
CROSS SECTION M-4 – STA: 5+59 REACH 2



CROSS SECTION T-1
STA: 5+82 REACH 1



CROSS SECTION T-2
STA: 6+22 REACH 1



HEADWALL DIMENSIONS (NOT TO SCALE)

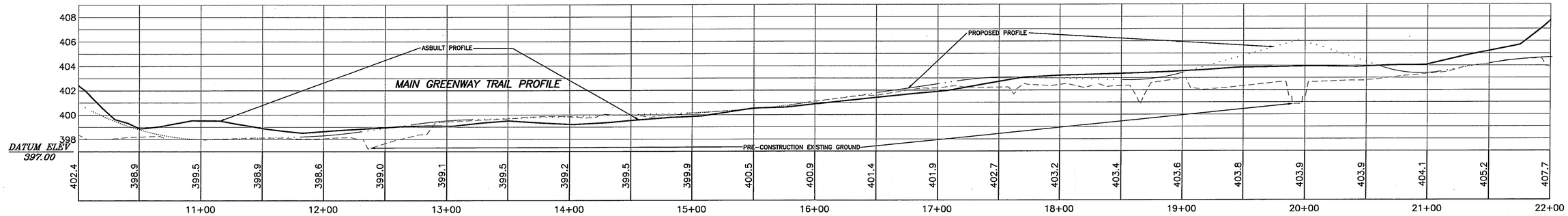
HW#8	11.4' / 12.7'
HW#9	12.9' 10.7'

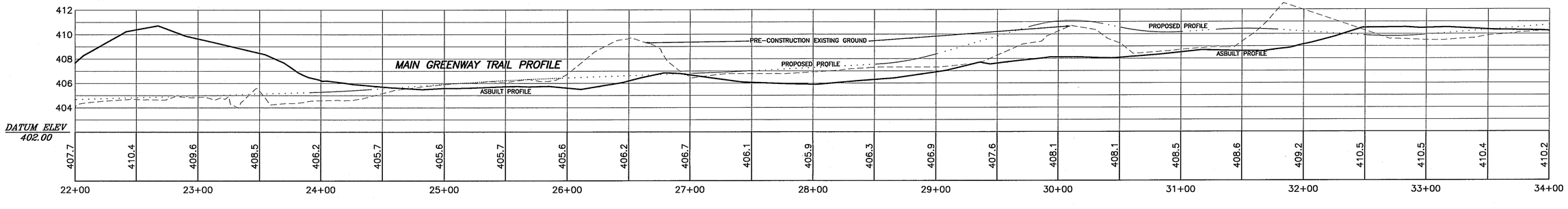
LS = LOG SILL
RS = ROCK SILL
= RIFFLES
= SEWER MANHOLE
= ASPHALT WALKWAY
= HAND RAILS
= WOODEN FENCE
= CONC. BRIDGE ABUTMENT
= TREE LINE
= EXISTING ROCK OUTCROP
= GREENWAY TRAIL DITCH
= RIP-RAP
= BRUSH TOE
= BRUSH MATTRESS
= CONSTRUCTION LIMITS
= BANKFUL BENCH LIMITS
= SEWER CLEANOUT
= WOOD TOE

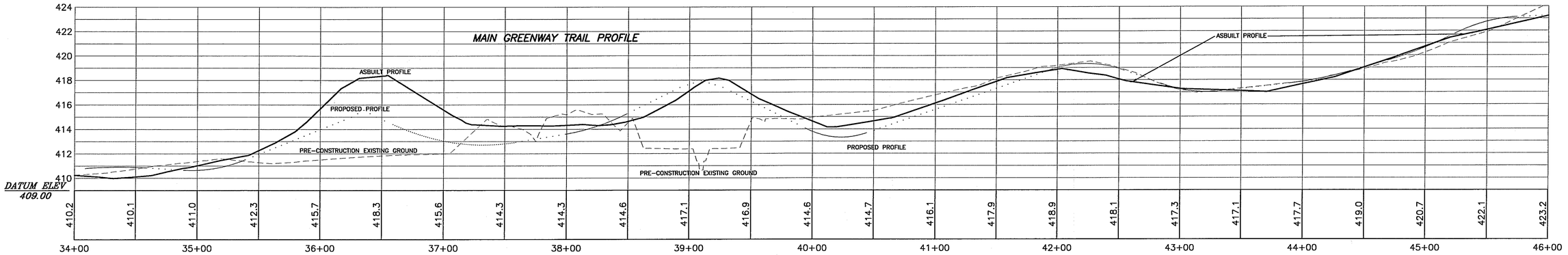
ASBUILT SURVEY FOR SHEET PP4

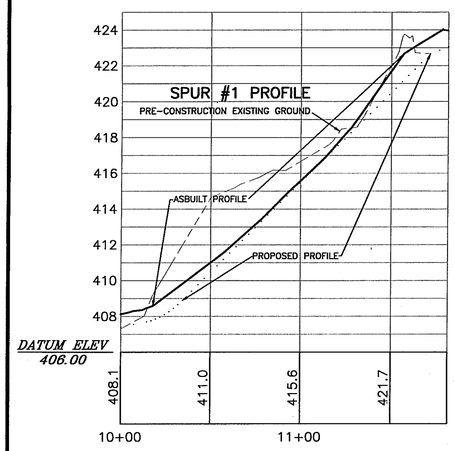
STEWART-PROCTOR, PLLC ENGINEERING and SURVEYING 319 CHAPANOKE ROAD SUITE 106 RALEIGH, NC 27603 TEL. 919 779-1855 FAX 919 779-1661			HIGGINS TRAIL GREENWAY IMPROVEMENT AND ADJACENT STREAM RESTORATION PROJECT REACH 3 AND CROSS SECTIONS PROJECT NUMBERS GG - 1061, GG - 1082, PR - 1125
DATE: 29 MAY 2013	SURVEYED BY	JOB	TOWN OF CARY / NORTH CAROLINA
SCALE 1"=40	DRAWN BY		WAKE COUNTY / OWNER
REVISIONS		DWG. NO.	ZONED P.I.N.

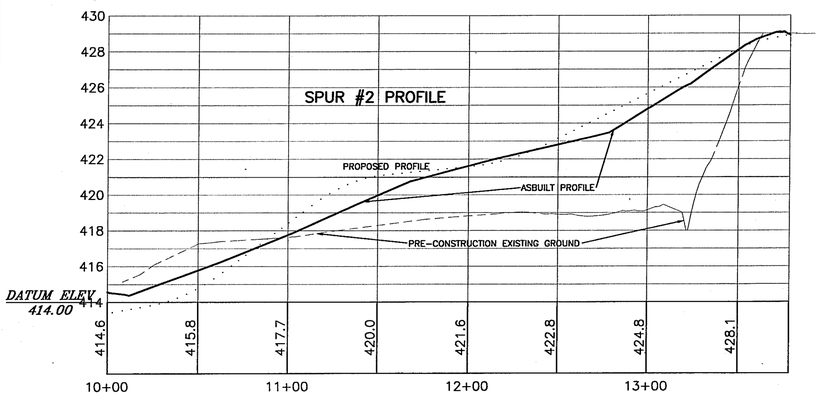
SCALE 1:40 HORIZONTAL
SCALE 1:4 VERTICAL

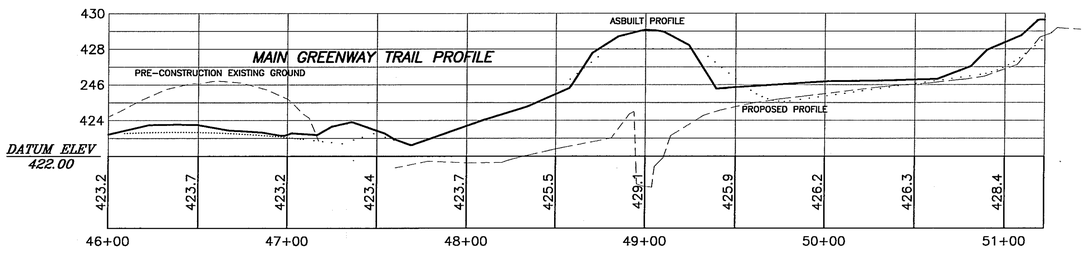












FOR PLAN VIEW SEE SHEETS PP1–PP4

NORTH CAROLINA PROFESSIONAL SEAL L-4361 LAND SURVEYOR HERBERT N. PROCTOR

5/29/13

SCALE 1:40 HORIZONTAL
SCALE 1:4 VERTICAL

ASBUILT SURVEY FOR — SHEET PP5

STEWART–PROCTOR, PLLC ENGINEERING and SURVEYING 319 CHAPANOKE ROAD SUITE 106 RALEIGH, NC 27603 TEL. 919 779–1855 FAX 919 779–1661		HIGGINS TRAIL GREENWAY IMPROVEMENT AND ADJACENT STREAM RESTORATION PROJECT	GREENWAY PROFILES
DATE: 29 MAY 2013	SURVEYED BY	JOB	TOWN OF CARY	NORTH CAROLINA
SCALE 1"=40	DRAWN BY	DWG. NO.	WAKE COUNTY	OWNER
REVISIONS			ZONED P.I.N.	PROJECT NUMBERS GG – 1061, GG – 1082, PR – 1125