

APPROVED
DIVISION OF WASTE MANAGEMENT
SOLID WASTE SECTION
DATE 9/4/08 BY Pat Backus

A1 P2 Doc 4

PERMIT APPLICATION

**Thornton Road
Mixed Waste Transfer & Recycling Center
Raleigh, North Carolina**

Prepared for:

**Shotwell Transfer Station, Inc.
Raleigh, North Carolina**

**November 2007
Revised July 2008**

PERMIT ISSUE DOCUMENTS





RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services

~~New Permit # 9227-7~~
~~New Per - # 92-001~~

December 14, 2007

Scanned by Wilson	Date 5/12/08	Doc ID # 4468
----------------------	-----------------	------------------

Ms. Donna Wilson
Environmental Engineer II
North Carolina Dept. of Environment and Natural Resources
Division of Waste Management - Solid Waste Section
401 Oberlin Road, Suite 150
Raleigh, NC 27605

**Re: Permit Application - Transfer and Recycling Center
Shotwell Transfer Station, Inc. (NC Solid Waste Permit No. 92-27T)
Raleigh, North Carolina**

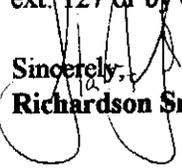
Dear Ms. Wilson:

On behalf of Shotwell Transfer Station, Inc., Richardson Smith Gardner & Associates, Inc. (RSGA) is hereby transmitting the two (2) enclosed Permit Applications {one (1) hard copy and one (1) electronic copy} for the above referenced project. Additionally, we have included information in response to correspondence dated November 30, 2007 from Amy Kadrie (copy attached).

Therefore, please find the following documents enclosed:

- Permit Application for the Thornton Road Mixed Waste Transfer & Recycling Center;
- Completed Compliance Review Survey; and
- Organization Chart for Mr. David King's interest in both Shotwell Landfill, Inc. and Shotwell Transfer Station, Inc.

We understand that this permit application is considered as a new transfer station and has an associated application fee of \$5,000. Therefore, please forward an invoice for submission of this fee at your earliest convenience. Should you have any questions or require clarification, please contact me at (919) 828-0577 ext. 127 or by email at stacey@rsgengineers.com.

Sincerely,

Richardson Smith Gardner & Associates, Inc.

Stacey A. Smith, P.E.
Project Manager
Att.

Cc: Mr. David King, Shotwell Transfer Station, Inc.
Mr. Ed Mussler III, P.E., NCDENR (cover letter)
Mr. Bradley Bailey, NCDENR (cover letter)
Ms. Amy Kadrie, NCDENR (permit application not included)
File



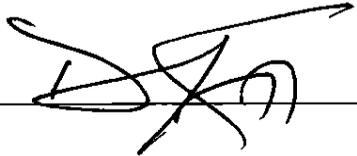
H:\Projects\David King\King 07-1 (Thornton Road Transfer)\Letter12-14-07.wpd

Signature page of applicant --

Name of facility Thornton Road Mixed Waste Transfer Station

I certify that the information provided by me in this application is true, accurate, and complete to the best of my knowledge.

I understand that North Carolina General Statute 130A-22 provides for administrative penalties of up to fifteen thousand dollars (\$15,000.00) per day per each violation of the Solid Waste Management Rules. I further understand that the Solid Waste Management Rules may be revised or amended in the future and that the facility siting and operations of this solid waste management facility will be required to comply with all such revisions or amendments.

Signature  David King

Title President, Shotwell Transfer Station, Inc.

Date May 23, 2008



North Carolina Department of Environment and Natural Resources

Dexter R. Matthews, Director

Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary

November 30, 2007

Mr. David King
Shotwell Transfer Station, Inc.
3209 Gresham Lake Road
Suites 114 & 115
Raleigh, NC 27615

Re: Compliance History Review

Dear Mr. King,

The agency has received your application for the name change of Permit Number 92-27T from PCM Construction Service to Shotwell Transfer Station, Inc. Under N.C.G.S. § 130A-294 (b2)(2), the agency will be conducting a review to determine past compliance with federal and state laws, regulations, and rules for the protection of the environment. Enclosed is a preliminary questionnaire for you to complete.

The Division is in receipt of your questionnaire for Shotwell Landfill Inc. However, we have not received the requested organizational chart for Shotwell Landfill Inc. Please submit one organizational chart for both Shotwell Landfill Inc. and Shotwell Transfer Station, Inc. with explanatory text that shows all business entities that are direct or indirect parents, subsidiaries or other affiliates of Shotwell Landfill Inc. and Shotwell Transfer Station, Inc. and depicts the relationships among all entities shown on each chart. The charts shall also include any partnerships and joint ventures in which any of the entities are engaged or which have a financial interest in any of the entities. For all business entities identified in the organizational charts, please identify those business entities which operated under a previous business name and identify the prior business name. Additional follow-up information may be requested.

Please be advised that under subsection N.C.G.S. § 130A-294(b3), the agency is not required to review your application until you have satisfied the agency that you have met the requirements of subsection (b2). The agency will also conduct a compliance review under N.C.G.S. § 130A-309.06(b), which pertains to the applicant's violations of statutes, rules, orders, or permit terms or conditions relating to any solid waste management facility in this State.

Sincerely,

Amy Kadrie
Compliance Officer

cc: Mark Poindexter, Field Operations Branch Head
Ed Mussler, Permitting Branch Head
Dennis Shackelford, Eastern District Supervisor
Donna Wilson, Permitting Engineer



North Carolina Department of Environment and Natural Resources

Dexter R. Matthews, Director

Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary

Compliance Review

The applicant, Shotwell Transfer Station, Inc., is requested to provide the following information. For purposes of the questions below, the phrase "within the past five years," means five years prior to the date of this request.

A. The following question applies to all the applicant's solid waste management activities.

1. With respect to the applicant's solid waste management activities, check whether the applicant has been a party to or received any of the following within the past five years:

- a. Compliance Order with a penalty
- b. Compliance order without a penalty
- c. Order to cease operating
- d. Order to abate public health nuisance [130A-19];
- e. Order to abate imminent hazard [130A-20];
- f. Order to abate nuisance scrap tire site [130A-309.60].
- g. Administrative Consent Agreement or Settlement Agreement (e.g., may involve revised permit conditions)
- h. Revocation or suspension of a permit
- i. Denial of a permit application for a solid waste management facility
- j. Penalty Collection lawsuit (lawsuit to collect an unpaid penalty)
- k. Confession of Judgment (for the payment and collection of an unpaid penalty or other monies owed to a special account, such as the scrap tire account or white goods account)
- l. Injunctive relief or law suit for injunctive relief
- m. Lawsuit for forfeiture of gain (N.C.G.S. §130A-28)
- n. Lawsuit for recovery of money (N.C.G.S. §130A-27)
- o. State Criminal action- misdemeanor or felony (N.C.G.S. 130A-25; 130A-26.2; 14-399]
- p. Federal criminal action-misdemeanor or felony

B. **[Note: Questions 2 and 3 cover any type of environmental violation.]**

Check all applicable boxes.

Within the past five years:

2. The applicant has been convicted of, or pled guilty or no contest to, a criminal violation of a statute, regulation, or rule for the protection of the environment.

- a. in state court
- b. in federal court
- c. not applicable

3. A monetary penalty (whether denominated as a civil penalty, an administrative penalty, a judicial penalty, or by some other designation), has been assessed against the applicant for the violation of a state or federal statute, rule, or regulation for the protection of the environment.

- a. in a state forum
- b. in a federal forum
- c. not applicable

[Note: Questions 4 and 5 will encompass those situations where a solid waste management facility operated in violation of solid waste management statutes/regulations, as well as groundwater, surface water, water quality, and air quality statutes/regulations, among others.]

4. With respect to any solid waste management facility owned or operated by the applicant, a lawsuit for injunctive relief has been filed against the applicant for the violation of a statute, regulation or rule for the protection of the environment.

- a. in state court
- b. in federal court
- c. not applicable

5. With respect to any solid waste management facility owned or operated by the applicant, a judgment, or consent judgment, for injunctive relief has been entered against the applicant for the violation of any statute, regulation or rule for the protection of the environment.

- a. in state court
- b. in federal court
- c. not applicable

6. A permit for a solid waste management facility owned or operated by the applicant has been revoked or suspended.

- a. in a state forum
- b. in a federal forum
- c. not applicable

7. The applicant submitted a permit application for the proposed ownership or operation of a solid waste management facility that has been denied.

- a. in a state forum
- b. in a federal forum
- c. not applicable

8. A governmental agency or unit has notified the applicant in writing that the applicant has operated or is operating a solid waste management facility without the requisite permit.

- a. yes
 b. not applicable

9. A governmental agency or unit has notified the applicant in writing that the applicant has operated or is operating a solid waste management facility outside the scope of the permitted activity.

- a. yes
 b. not applicable

For each question that has been marked with an answer other than "not applicable," please provide a written, detailed explanation, including how or if the matter has been resolved.

The applicant may be requested to provide a written, sworn statement certifying the status of the matter. Possible certification statements are as follows:

The applicant is now in compliance with all civil and criminal penalty provisions of any administrative order, consent agreement, settlement agreement, or court order.

The applicant is in compliance with the payment schedule for any assessed administrative penalties.

The applicant has filed and is presently pursuing, in good faith, a direct administrative or judicial appeal to contest the validity of the violation.

If the applicant certifies that the applicant is now in compliance, the applicant may be asked to submit proof from the agency having jurisdiction over the violation that the applicant is in the process of correcting or has corrected the violation to the satisfaction of the agency.

The applicant will be asked to certify the truth and accuracy of the answers provided to these compliance review questions.

I, DAVID W. KING, JR., hereby certify on behalf of Shotwell Transfer Station, Inc. as applicant's PRES. (title of position with applicant), that I have read the foregoing answers provided to the Compliance Review, that the information and answers contained in the responses to the Compliance Review are true and accurate based on my own knowledge and my review of documents and that I have not omitted any material information or falsified any information contained in the foregoing answers. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

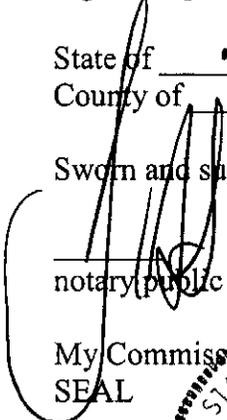
Signature/printed name and title too

 DAVID WALL KING, JR. PRES.

State of NORTH CAROLINA

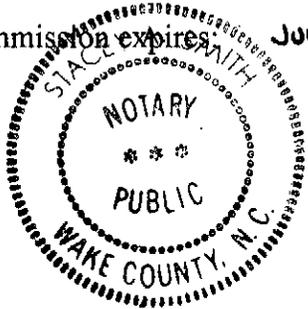
County of WAKE

Sworn and subscribed to before me this the 12th day of DEC, 2007.


notary public

My Commission expires JULY 11, 2009

SEAL



ORGANIZATIONAL EXPLANATION

The attached organizational chart shows the ownership structures and names of the various entities controlled by David W. King, Jr. Mr. King owns 100% of the common stock of Shotwell Landfill, Inc. and Shotwell Transfer Station, Inc. and 100% of the membership interests of Debris Removal Partners, LLC and Dynasty Holdings, LLC. All of these companies are run through Mr. King's office located at 3209 Gresham Lake Road, Suite 114-115, Raleigh. Although the companies are all owned by Mr. King, they are not related to each other beyond ownership; in other words, none of the companies are subsidiary companies of another.

Shotwell Landfill, Inc. owns and operates the landfill located at 4724 Smithfield Road, Wendell, North Carolina 27591. Debris Removal Partners, LLC owns and operates a container and hauling company that primarily removes debris from construction sites.

Dynasty Holdings, LLC ("Dynasty") owns the property located at 5509 Thornton Road in Raleigh (the "Property"). PCM Construction Services, LLC ("PCM") has operated a C&D transfer station on the Property for several years and is currently leasing the Property from Dynasty pursuant to the terms of a lease that expires on December 31, 2007. PCM has provided notice to Dynasty of its intent to vacate the premises and cease operation of the transfer station on December 29, 2007.

The permit application being submitted with this information will be in the name of Dynasty as the owner of the Property and Shotwell Transfer Station, Inc. as the operator. Shotwell Transfer Station, Inc. was formed for the sole purpose of operating the transfer station at 5509 Thornton Road. There will be an agreement between Dynasty and Shotwell Transfer Station, Inc. that sets forth the terms and conditions under which Shotwell Transfer Station, Inc. will operate the transfer station on the Property.

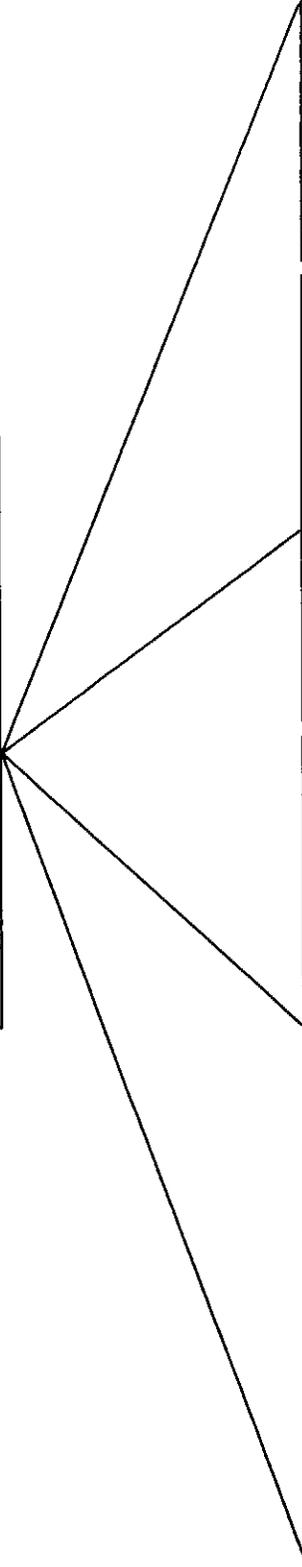
DAVID W. KING, JR.

Shotwell Landfill, Inc.

Debris Removal Partners, LLC

Dynasty Holdings, LLC

Shotwell Transfer Station, Inc.



PERMIT APPLICATION

**Thornton Road
Mixed Waste Transfer & Recycling Center
Raleigh, North Carolina**

Prepared for:

Shotwell Transfer Station, Inc.
Raleigh, North Carolina

**November 2007
Revised July 2008**

PERMIT ISSUE DOCUMENTS



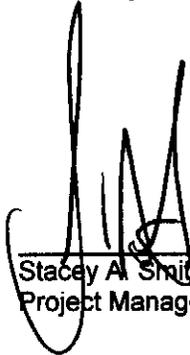
PERMIT APPLICATION

**Thornton Road
Mixed Waste Transfer & Recycling Center
Raleigh, North Carolina**

Prepared for:
**Shotwell Transfer Station, Inc.
Raleigh, North Carolina**

To the Attention of:
**Mr. David King
Shotwell Transfer Station, Inc.**

RSG Project No. KING-07-1


Stacey A. Smith, P.E.
Project Manager



November 2007

PERMIT ISSUE DOCUMENTS



EXECUTIVE SUMMARY

GENERAL

The following is a Transfer Facility Permit Application submitted on behalf of Shotwell Transfer Station, Inc. (Shotwell) for the construction and operation of a Mixed Waste Transfer Station and Recycling Center over the closed¹ Neuse Demolition Landfill and at the current location of Shotwell Transfer Station, Inc.² Construction Waste Transfer Facility (NC Solid Waste Permit No. 92-27T), *formerly known as PCM North Raleigh C&D Transfer Facility*, site in Wake County, North Carolina. It is the intent of Shotwell to expand the existing facility operations to include MSW and C&D transfer operations and recycling upon approval of this application.

This submittal focuses on the application and operational requirements of the proposed transfer and recycling facility. The attachments included herein comply with the submittal requirements under 15A NCAC 13B .0400 (Transfer Facilities), *Guidelines for the Preparation of Permit Applications for Transfer*, and applicable sections of Session Law 2007-550 (Solid Waste Management Act of 2007).

REGULATORY REFERENCES

This submittal has been prepared in accordance with the requirements of the North Carolina Transfer Facilities Rules (15A NCAC 13B.0400), *Guidance for Preparation of Permit Applications for Transfer Facilities*, Wake County Stormwater Ordinances, and the North Carolina Sedimentation Control Rules (15A NCAC 4) which are enforced by the Division of Waste Management (DWM), Wake County Environmental Services, and the Division of Land Quality, respectively, of the North Carolina Department of Environment and Natural Resources.

Included in this document are the following attachments (*with applicable rule(s) in italics*):

Legal Description of the Property (.0401 (3));
Erosion and Sediment Control Plan (.0401 (3));
Landfill Closure Documentation (.0401 (3));
Wetlands Determinations (.0401 (3));
Zoning Documentation (.0401 (2));
Operations Manual (.0402);
Traffic Requirements (§130A-295.5);
Financial Assurance (§130A-294 (b2)); and
Project Drawings (.0401(1)).

¹ Correspondence dated February 8, 1999 from Mr. Wayne Woodlief of Wake County to Mr. Wayne Adams of Neuse Landfill, Inc. accepting closure of the facility.

² Correspondence dated May 4, 2007 from Mr. J. Gardner of RSG to Mr. E. Mussler, NCDENR requesting change in owner/applicant/operator.

PROPERTY DESCRIPTION

The development is proposed on property owned by Dynasty Holdings, LLC. The complete tract is approximately 9.85 acres which is accessed from central portion of its southern boundary as shown in the Project Drawings provided in **Attachment K**.

The property is described in three (3) deed instruments as follows:

1. Wake County Deed Book 12249, Pages 225-227;
2. Wake County Deed Book 12876, Pages 394-397; and
3. Wake County Deed Book 12876, Pages 398-403.

The complete property is further clarified as “New Lot 3 Area” by a Recombination Plat described in Wake County Book of Maps 2007, Page 2838. It is noted that a series of property swaps occurred during the development of the site such that the complete property is resolved by adding and subtracting individual tracts from an initial “Old Lot Area” described in the Recombination Plat. Legal descriptions for this property is included in **Attachment A**.

PROPERTY OWNERSHIP AND OPERATION

The proposed facility will be operated by Shotwell Transfer Station, Inc. on property owned by Dynasty Holdings, LLC as described in correspondence to the Division dated May 4, 2007. A Landowner Authorization is provided as **Attachment B**. The owner of Dynasty formed Shotwell Transfer Station, Inc. to operate the facility. Articles of Incorporation for this new entity are also provided as **Attachment B**. *It is our understanding that the both the owner, Dynasty Holdings, LLC, and the operator, Shotwell Transfer Station, Inc., will be named on the permit.*

Owner and Operator: Dynasty Holdings, LLC & Shotwell Transfer Station, Inc.
Contact: Mr. David King
Address: 3209 Gresham Lake Road, Suite 115
Raleigh, North Carolina 27615
Phone: (919) 773-9899
Email: daviddebris@bellsouth.net

APPLICATION REQUIREMENTS

The following sections correspond with the permit application for a transfer facility as outlined in the North Carolina Solid Waste Transfer Facilities Rules. The site plan drawing was prepared by a professional engineer duly registered in the State of North Carolina.

SITING AND DESIGN STANDARDS

The following sections explain how the transfer and recycling facility complies with siting and design standards in Transfer Facilities Guidelines provided by the North Carolina Division of Waste Management and 15A NCAC 13B.0400.

Floodplain

The transfer and recycling facility is not located within a floodplain. However, the floodplain boundaries which border the property are shown on the project site plan and a copy of the flood plain map is included in **Attachment C**.

Surface Water Quality Standards

The facility is located over the closed Neuse Demolition Landfill and is bordered by wetlands and shallow surface water bodies (“beaver impoundments”) to the north. An un-named tributary is located to the northwest of the site that discharges into the Neuse River. All runoff within the facility boundary is controlled through channels and by two (2) sediment basins prior to discharge off site. All site development will be conducted in accordance with the Neuse River Basin - Nutrient Sensitive Waters Management Strategy (15A NCAC 2B .0235) and Wake County Stormwater Ordinances. The site does not include any wetlands within the development based on recent evaluation, currently under review by the Division of Water Quality and the Army Corps of Engineers. A copy of a preliminary wetlands evaluation determination by Jonathon Hopkins of Delineation Plus and surveyed by Murphy Geomatics is included in **Attachment D**.

Property Line Buffer

Although transfer facilities do not have a minimum buffer requirement, City of Raleigh Zoning buffers exist as follows:

- 50 foot buffer from development along the road frontage
- 20 foot side yard buffer from development within the I-1 zoning district
- 40 foot transitional side yard buffer from development adjacent to the R-4 zoning district.

Residential and Well Buffers

The nearest residence is approximately 500 feet from the transfer area. The transfer area, at its closed point, is greater than 300 feet from the property line bordering these residences.

Public Access

The site will not allow uncontrolled public access. The entrance road to the site passes the guard house. The boundaries outside the transfer and recycling areas currently include wetlands to the north and east, Thornton Road to the south, and a residential property to the west. The site will be protected from uncontrolled access through the use of fencing and gates.

Sedimentation Pollution Control Law

A Sedimentation and Erosion Control Plan and Stormwater Plan will be submitted to Wake County for approval. A preliminary plan is included in **Attachment E**. All future correspondence will be copied to the Division of Waste Management. This plan outlines measures to be taken during facility construction to minimize any sediment run-off due to land disturbance and will comply with both Wake County and City of Raleigh erosion control and stormwater ordinances.

Existing Closed Neuse Demolition Landfill

The proposed development occurs over a closed land clearing and inert debris (LCID) landfill which will require additional design and management concerns as follows:

- All structures shall be equipped with gas monitoring equipment to detect, at a minimum, the presence of H₂S and CH₄;
- All sediment basins shall be lined with a low permeability liner to minimize infiltration;
- All grading activities shall be conducted to replace a minimum of one (1) foot of soil cover and shall not allow standing water inside the limits of the closed landfill.;
- Areas where LCID materials are encountered will be simply excavated and hauled to the Shotwell Landfill, Inc. C&D facility (NC Solid Waste Permit No. 92-26) for either grinding or disposal. If unacceptable non-hazardous, non-C&D or non-LCID wastes are encountered, they will be containerized and covered until a load is generated wherein it will be transported to a facility licensed to accept MSW materials such as South Wake Landfill (NC Solid Waste Permit No. 92-22). If hazardous wastes are encountered, construction operations will cease and will be assessed by a hazardous removal contractor wherein the Division of Waste Management will be notified and an appropriate response plan will be developed dependent on the nature of the hazard. All waste manifests shall be obtained and recorded.;
- All tires encountered will be disposed at the North Wake Landfill (NC Solid Waste Permit No. 92-09); and
- All structures shall be designed by a licensed Professional Engineer.

The Neuse Demolition Landfill was operated under a Wake County Solid Waste Permit and was closed in 1999. A copy of the landfill permit and the closure acceptance by Mr. Wayne Woodlief of Wake County is included as **Attachment F**.

Existing Transfer Area Operations

Most all of the new construction associated with this application will not interfere with existing operation. Once the new transfer station is ready for operations and approved by the Division, operations will transfer away from the existing area. This area will then be graded and placed into its final condition as shown on the Permit Drawings.

ZONING

A letter from the City of Raleigh Planning & Zoning Department, the agency having zoning jurisdiction, has been obtained for the proposed project and has been included in **Attachment G**. The proposed transfer and recycling activities are allowed within the existing zoning.

OPERATIONS MANUAL

The Operations Manual outlines and describes protocols for facility operation and maintenance and was prepared to provide facility personnel with a clear understanding of how the Design Engineer assumed that the completed facility would be operated. Along with the Project Drawings, the Operations Manual has been prepared to comply with the requirements of 15A NCAC 13B.0402. A copy of the Operations Manual is included in **Attachment H**

TRAFFIC STUDY

In accordance with Session Law 2007-550, documentation from Mr. J.W. Bowman, P.E., Division Engineer with the North Carolina Department of Transportation (DOT) has been obtained and has been included in **Attachment I**. The proposed transfer and recycling center will not have a substantial impact on the limited controlled access highway (US 1).

FINANCIAL ASSURANCE

In accordance with Session Law 2007-550, an estimate has been provided for financial assurance of the transfer and recycling facility center. A copy of the estimate has been included in **Attachment J**.

Attachment A

Property Descriptions

WAKE COUNTY, NC 288
LAURA M RIDDICK
REGISTER OF DEEDS
PRESENTED & RECORDED ON
08/05/2008 AT 15:25:24

BOOK:013204 PAGE:00806 - 00808

*Prepared by and return to:
Ragsdale Liggett PLLC (Bolton)
Box 161*

Excise Tax Stamps: \$0.00 (without title search)
Parcel Identification Number: 0143452
Description for the Index: New Lot 3, B/M 2007 - 2838

NORTH CAROLINA QUITCLAIM DEED

THIS DEED made this the 5th day of August, 2008, by and between

Dynasty Holdings, LLC, a North Carolina limited liability company

hereinafter Grantor; and

Dynasty Holdings, LLC, a North Carolina limited liability company

whose address is **4070 Barrett Drive, Raleigh, North Carolina 27609**, hereinafter Grantee. The designation Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine or neuter as required by context.

WITNESSETH:

That the Grantor, for in consideration of the sum of Ten Dollars (\$10.00) to it in hand paid, the receipt of which is hereby acknowledged, has remised and released and by these presents does remise, release, convey, and forever quitclaim unto the Grantee, its successors and assigns all right, title, claim and interest of the Grantor in and to a certain lot or parcel of land lying and being in Wake County, North Carolina and more particularly described as follows:

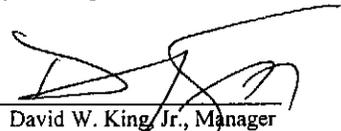
BEING ALL OF New Lot 3, as shown on a map entitled "Recombination Plat for Dynasty Holdings, LLC" recorded in Book of Maps 2007, Page 2838, Wake County Registry.

The Grantor acquired the Property through deeds recorded in Book 12555, Page 2556 and Book 12876, Page 394, as corrected and rerecorded in Book 12887, Page 2703; and this quitclaim deed is being recorded for the purpose of describing the entire Property as one tract consistent with the above referenced plat.

TO HAVE AND TO HOLD the aforesaid lot and parcel of land and all privileges thereunto belonging to him, the Grantee, his heirs and/or successors and assigns, free and discharged from all right, title, claim or interest of the Grantor or anyone claiming by, through, or under him.

IN WITNESS WHEREOF, the Grantor has caused this instrument to be signed in its company name by its duly authorized manager, the day and year first above written.

Dynasty Holdings, LLC

By: 
David W. King, Jr., Manager

STATE OF NORTH CAROLINA

COUNTY OF Wake

I, a Notary Public of the County and State aforesaid, certify that **David W. King, Jr.**, Manager of **DYNASTY HOLDINGS LLC**, a North Carolina limited liability company, personally appeared before me this day and either (i) being personally known to me; or (ii) having provided satisfactory evidence in the form of a: (circle one)

- (a) state issued driver's license;
- (b) state issued identification card; or
- (c) United States Passport

acknowledged to me that he voluntarily signed the foregoing instrument for the purpose stated therein as Manager of the limited liability company, under authority duly given by and on behalf of the corporation, on this the 5th day of August, 2008.

(SEAL)




Printed Name: Kimberly M. Coats
Notary Public

My commission expires: 11-12-2011



BOOK:013204 PAGE:00806 - 00808

**Yellow probate sheet is a vital part of your recorded document.
Please retain with original document and submit for rerecording.**



**Wake County Register of Deeds
Laura M. Riddick
Register of Deeds**

This Customer Group
_____ # of Time Stamps Needed

This Document
_____ New Time Stamp
_____ # of Pages
3

BK012249PG00225

WAKE COUNTY, NC 194
LAURA M RIDDICK
REGISTER OF DEEDS
PRESENTED & RECORDED ON
11/02/2006 AT 12:06:20
STATE OF NORTH CAROLINA
REAL ESTATE EXCISE TAX: \$900
BOOK:012249 PAGE:00225 - 00227

NORTH CAROLINA GENERAL WARRANTY DEED

Excise Tax: \$ 900.00

Parcel Identifier No. 1738425833 Verified by _____ County on the _____ day of _____, 20____
By: _____

Mai/Box to: GRANTEE

This instrument was prepared by: Tenika Hall, Attorney at Law

Brief description for the Index: 10 ACRE TRACT

THIS DEED made this 31st day of October, 2006, by and between

GRANTOR	GRANTEE
Lemuel H. Thornton and wife, Hazel R. Thornton 5325 Thornton Road Raleigh, NC 27604	Dynasty Holdings, LLC 4070 Barrett Drive Raleigh, NC 27609

The designation Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine or neuter as required by context.

WITNESSETH, that the Grantor, for a valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, has and by these presents does grant, bargain, sell and convey unto the Grantee in fee simple, all that certain lot or parcel of land situated in the City of Raleigh, _____ Township, Wake County, North Carolina and more particularly described as follows:

BEING 10 acres as shown on map recorded in Book of Maps 1985, page 935, Wake County Registry.

The property hereinabove described was acquired by Grantor by instrument recorded in Book 3554 page 249.

A map showing the above described property is recorded in Plat Book _____ page _____.

NC Bar Association Form No. L-3 © 1976, Revised © 1977, 2002

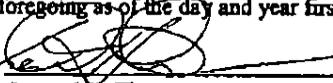
Printed by Agreement with the NC Bar Association - 1981 SoftPro Corporation, 333 E. Six Forks Rd., Raleigh, NC 27609

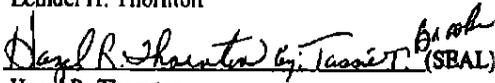
BK012249PG00226

TO HAVE AND TO HOLD the aforesaid lot or parcel of land and all privileges and appurtenances thereto belonging to the Grantee in fee simple.

And the Grantor covenants with the Grantee, that Grantor is seized of the premises in fee simple, has the right to convey the same in fee simple, that title is marketable and free and clear of all encumbrances, and that Grantor will warrant and defend the title against the lawful claims of all persons whomsoever, other than the following exceptions:

IN WITNESS WHEREOF, the Grantor has duly executed the foregoing as of the day and year first above written.

 (Entity Name)  (SEAL)
 Lemuel H. Thornton

By: _____
 Title: _____  (SEAL)
 Hazel R. Thornton

By: _____
 Title: _____ _____ (SEAL)

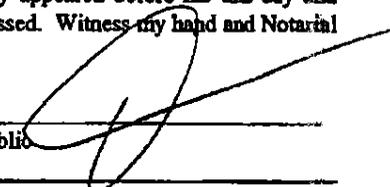
By: _____
 Title: _____ _____ (SEAL)

State of North Carolina - County of Wake

I, the undersigned Notary Public of the County and State aforesaid, certify that Lemuel H. Thornton and wife, Hazel R. Thornton personally appeared before me this day and acknowledged the due execution of the foregoing instrument for the purposes therein expressed. Witness my hand and Notarial stamp or seal this 31st day of October, 2006

My Commission Expires: _____

Belrdre L. Leach
Notary Public, Johnston Co., N.C.
My Commission Exp 12-15-07

 Notary Public 

State of North Carolina - County of _____

I, the undersigned Notary Public of the County and State aforesaid, certify that _____ personally came before me this day and acknowledged that he is the _____ of _____ a North Carolina or _____ corporation/limited liability company/general partnership/limited partnership (strike through the inapplicable), and that by authority duly given and as the act of such entity, he signed the foregoing instrument in its name on its behalf as its act and deed. Witness my hand and Notarial stamp or seal, this _____ day of _____, 20__.

My Commission Expires: _____

 Notary Public

State of North Carolina - County of _____

I, the undersigned Notary Public of the County and State aforesaid, certify that _____

Witness my hand and Notarial stamp or seal, this _____ day of _____, 20__.

My Commission Expires: _____

 Notary Public

The foregoing Certificate(s) of _____ is/are certified to be correct. This instrument and this certificate are duly registered at the date and time and in the Book and Page shown on the first page hereof.

 Register of Deeds for _____ County
 By: _____ Deputy/Assistant - Register of Deeds

BK012249PG00227



BOOK:012249 PAGE:00225 - 00227

**Yellow probate sheet is a vital part of your recorded document.
Please retain with original document and submit for rerecording.**



**Wake County Register of Deeds
Laura M. Riddick
Register of Deeds**

This Customer Group
_____ # of Time Stamps Needed

This Document
_____ **New Time Stamp**
_____ # of Pages

NORTH CAROLINA SPECIAL WARRANTY DEED

The attorneys preparing this instrument have made no title examination of this property and express no opinion as to the title unless contained in a separate written certificate.

Excise Tax \$0.00	Brief Description: Addition to New Lot 1
-------------------	--

This instrument was prepared by Williams Mullen Maupin Taylor, P.A. and should be mailed after recording to:

Ronald R. Rogers, Esq.
Williams Mullen Maupin Taylor
P.O. Box 19764
Raleigh, North Carolina 27619

Parcel # part of 043452 +
0351348

THIS DEED made this 14th day of December, 2007, by and between

GRANTOR	GRANTEE
Dynasty Holdings, LLC	ProDev VIII, LLC c/o Mr. Edward Brantley <u>5501 Thornton Rd</u> <u>Raleigh, NC 27616</u>

The designation Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine or neuter as required by context.

WITNESSETH, that the Grantor, for a valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, has and by these presents does grant, bargain, sell and convey

unto the Grantee in fee simple, all that certain lot or parcel of land situated in Wake County, North Carolina and more particularly described as follows (the "Property"):

SEE EXHIBIT A ATTACHED HERETO AND BY THIS REFERENCE INCORPORATED HEREIN.

TO HAVE AND TO HOLD the Property and all privileges and appurtenances thereto belonging to the Grantee in fee simple.

And Grantor covenants with the Grantee, that Grantor has done nothing to impair such title as Grantor received, and Grantor will warrant and defend the title against the lawful claims of all persons claiming by, under or through Grantor, except for the exceptions hereinafter stated.

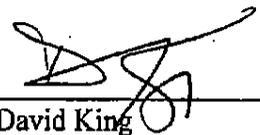
Title to the Property is subject to the following exceptions:

- (a) Ad valorem taxes for the current year.
- (b) Easements, restrictions and right-of-ways of public record.
- (c) Matters of survey.

IN WITNESS WHEREOF, the Grantor has caused this instrument to be signed as of the date first above written.

GRANTOR

DYNASTY HOLDINGS, LLC

By: 
 Name: David King
 Title: Manager

Wake County, North Carolina

I certify that the following person personally appeared before me this day acknowledging to me that he signed the foregoing document: David King, manager of Dynasty Holdings, LLC.

Date: December 14, 2007



Angela P. Wright, Notary Public
Angela P. Wright
 (Print or Type Name of Notary Public)

My commission expires: 12/27/08

TRACT 1

COMMENCING AT AN AXLE HAVING NORTH CAROLINA GRID COORDINATE VALUES OF Y=239038.405m AND X=650598.177m (NAD83) ; THENCE IN A GENERALLY SOUTHEASTERLY DIRECTION, S11°05'09"E, FOR A DISTANCE OF 979.95' TO A POINT IN THE NORTHEAST CORNER OF THAT CERTAIN 9.849 ACRE TRACT CONVEYED TO DYANSTY HOLDINGS, LLC BY DEED RECORDED IN DEED BOOK 12555, PAGE 2556, WAKE COUNTY REGISTRY (DESCRIBED THEREIN AS "TRACT 1"), AND SAID POINT BEING THE TRUE POINT OF BEGINNING; THENCE WITH THE BOUNDARY LINE OF CERTAIN PROPERTY NOW OWNED BY PRODEV VIII, LLC IN A GENERALLY SOUTH EASTERLY DIRECTION, S12°23'35"E, FOR A DISTANCE OF 338.03' TO A POINT; THENCE IN A GENERALLY NORTHWESTERLY DIRECTION, N86°58'38"W, FOR A DISTANCE OF 10.30' TO AN IRON PIPE SET; THENCE IN A GENERALLY SOUTHEASTERLY DIRECTION, S16°37'48"E, FOR A DISTANCE OF 40.71' TO AN IRON PIPE SET; THENCE IN A GENERALLY SOUTHWESTERLY DIRECTION, S48°26'54"W, FOR A DISTANCE OF 136.73' TO AN IRON PIPE SET; THENCE IN A GENERALLY SOUTHWESTERLY DIRECTION, S30°45'48"W, FOR A DISTANCE OF 258.23' TO AN IRON PIPE SET; THENCE IN A GENERALLY SOUTHEASTERLY DIRECTION, S17°48'42"E, FOR A DISTANCE OF 325.54' TO AN IRON PIPE SET; THENCE WITH THE NORTHERLY LINE OF THORNTON ROAD IN A GENERALLY SOUTHWESTERLY DIRECTION, S72°49'49"W, FOR A DISTANCE OF 18.87' TO AN IRON PIPE SET; THENCE CONTINUING WITH THE NORTHERLY LINE OF THORNTON ROAD IN A GENERALLY SOUTHWESTERLY DIRECTION, S71°39'37"W, FOR A DISTANCE OF 161.84' TO AN EXISTING IRON PIPE IN THE SOUTHEAST CORNER OF THAT CERTAIN PARCEL NOW OR FORMERLY OWNED BY TASSIE THORNTON BROOKS AS DESCRIBED IN A DEED RECORDED IN BOOK 12409, PAGE 877, WAKE COUNTY REGISTRY; THENCE WITH THE EASTERN LINE OF SAID TASSIE THORNTON BROOKS' PARCEL, N12°23'35"W, FOR A DISTANCE OF 244.55' TO AN IRON PIPE SET IN THE NORTHEAST CORNER OF SAID TASSIE THORNTON BROOKS' PARCEL; THENCE CONTINUING IN A GENERALLY NORTHWESTERLY DIRECTION ALONG THE OLD PROPERTY LINE OF DYNASTY HOLDINGS, LLC, N12°23'35"W, FOR A DISTANCE OF 723.45' TO A POINT IN THE CORNER OF THAT CERTAIN PARCEL CONVEYED TO PRODEV VIII, LLC BY DEED RECORDED IN BOOK 12841, PAGE 416, WAKE COUNTY REGISTRY; THENCE WITH THE OLD PROPERTY LINE OF PRODEV VIII, N76°56'05"E, FOR A DISTANCE OF 452.00' TO THE POINT AND PLACE OF BEGINNING, CONTAINING 293,637 SQUARE FEET OR 6.741 ACRES, MORE OR LESS ACCORDING TO SURVEY PREPARED BY JONATHAN F. MURPHY PLS-4382, TO WHICH REFERENCE IS MADE FOR A MORE PERFECT AND COMPLETE DESCRIPTION, AND BEING A PORTION OF NEW LOT 1 AS SHOWN ON A MAP

NOT OWNED BY PRODEV VIII, LLC IMMEDIATELY PRIOR TO THE DELIVERY OF DYNASTY HOLDINGS, LLC'S DEED TO PRODEV VIII, LLC DATED DECEMBER 14, 2007.

TRACT 2

BEING ALL OF THAT CERTAIN PROPERTY PREVIOUSLY ACQUIRED BY DYNASTY HOLDINGS, LLC BY DEED RECORDED IN BOOK 12249, PAGE 215, WAKE COUNTY REGISTRY, AND REACQUIRED BY DYNASTY HOLDINGS, LLC BY DEED RECORDED IN BOOK 12555, PAGE 2559, WAKE COUNTY REGISTRY (DESCRIBED THEREIN AS "TRACT TWO") AND MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT AN EXISTING IRON PIPE LOCATED S 55 DEGS 19' 27" E 4078.07 FEET FROM NCGS MONUMENT "WOMBLE" (N784501.233, E 2130926.8010, NAD 83), SAID EXISTING IRON PIPE BEING ALSO LOCATED IN THE NORTHERN RIGHT-OF-WAY OF THORNTON ROAD (SR 2043), IN NORTHERN WAKE COUNTY; RUNS THENCE FROM SAID BEGINNING POINT N 16 DEGS 45' 07" W 343.00 FEET TO AN IRON PIPE SET; RUNS THENCE S 73 DEGS 14' 54" W 11.85 FEET TO AN IRON PIPE SET; RUNS THENCE N 16 DEGS 45' 07" W 508.97 FEET TO A POINT IN THE LINE OF CERTAIN PROPERTY NOW OR FORMERLY OWNED BY THE CITY OF RALEIGH; RUNS THENCE WITH SAID LINE N 20 DEGS 00' 45" E 447.80 FEET TO A POINT; RUNS THENCE S 12 DEGS 23' 35" E 1215.21 FEET TO A POINT IN THE NORTHERN EDGE OF THE RIGHT-OF-WAY OF THORNTON ROAD (SR 2043); RUNS THENCE WITH THE NORTHERN EDGE OF THE RIGHT-OF-WAY OF THORNTON ROAD (SR 2043) S 73 DEGS 14' 43" WEST 163.81 FEET TO THE POINT AND PLACE OF BEGINNING. FOR FURTHER REFERENCE SEE A MAP AND SURVEY OF THE SAME ENTITLED "RECOMBINATION AND BOUNDARY SURVEY FOR THE PROPERTY OF TASSIE T. BROOKS", DATED JANUARY 8, 1996 AND PREPARED BY DAVID BARRIER, RLS.

SAVE AND EXCEPT THE FOLLOWING:

BEGINNING AT AN EXISTING IRON PIPE IN THE NORTHERN RIGHT-OF-WAY OF THORNTON ROAD; THENCE WITH THE LINE OF VOLKOV N 16 DEG 45' 07" W FOR A DISTANCE OF 257.75 FEET TO A POINT; THENCE WITH THE LINE OF BROOKS N 77 DEGS 36' 25" E FOR A DISTANCE OF 244.55 FEET TO AN EXISTING IRON PIPE; THENCE WITH THE LINE OF THORNTON ROAD NORTHERN RIGHT-OF-WAY S 73 DEGS 14' 43" W, FOR A DISTANCE OF 163.81 FEET TO THE POINT AND PLACE OF BEGINNING, CONTAINING 43,477 SQUARE FEET OR 0.998 ACRES.

AN OLD LOT AREA OF 4.9/4 ACRES) ON A MAP RECORDED IN BOOK OF
MAPS 2007, PAGE 2838, WAKE COUNTY REGISTRY, AND BEING A PORTION
OF "NEW LOT 1" ON SAID RECORDED MAP.

544849v1

BOOK:012876 PAGE:00398 - 00403

**Yellow probate sheet is a vital part of your recorded document.
Please retain with original document and submit for rerecording.**



**Wake County Register of Deeds
Laura M. Riddick
Register of Deeds**

NORTH CAROLINA GENERAL WARRANTY DEED

Excise Tax: 0

Parcel Identifier No. 2010F0363497 Verified by _____ County on the _____ day of _____, 20____
By: 0173766

Mail/Box to: GRANTEE

This instrument was prepared by: Tenika Hall, Attorney at Law

Brief description for the Index: LT 9.849 ACRE TRACT ON THORNTON ROAD,

THIS DEED made this 14th day of December, 2007, by and between

GRANTOR	GRANTEE
ProDev XXX, LLC a Virginia Limited Liability Company	Dynasty Holdings, LLC 3209 Gresham Lake Road, Ste 115 Raleigh, NC 27615

The designation Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine or neuter as required by context.

WITNESSETH, that the Grantor, for a valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, has and by these presents does grant, bargain, sell and convey unto the Grantee in fee simple, all that certain lot or parcel of land situated in the City of _____, _____ Township, _____ County, North Carolina and more particularly described as follows:

See Attached

The property hereinabove described was acquired by Grantor by instrument recorded in Book _____ page _____.

A map showing the above described property is recorded in Plat Book _____ page _____.

NC Bar Association Form No. L-3 © 1976, Revised © 1977, 2002

Printed by Agreement with the NC Bar Association - 1981 SofiPro Corporation, 333 E. Six Forks Rd., Raleigh, NC 27609

And the Grantor covenants with the Grantee, that Grantor is seized of the premises in fee simple, has the right to convey the same in fee simple, that title is marketable and free and clear of all encumbrances, and that Grantor will warrant and defend the title against the lawful claims of all persons whomsoever, other than the following exceptions:

IN WITNESS WHEREOF, the Grantor has duly executed the foregoing as of the day and year first above written.

ProDev XXX, LLC a Virginia Limited Liability _____ (SEAL)

By: [Signature] _____ (SEAL)
Title: Manager/Member

By: _____ (SEAL)
Title: _____

By: _____ (SEAL)
Title: _____

State of North Carolina - County of _____

I, the undersigned Notary Public of the County and State aforesaid, certify that _____ personally appeared before me this day and acknowledged the due execution of the foregoing instrument for the purposes therein expressed. Witness my hand and Notarial stamp or seal this _____ day of _____, 20__.

My Commission Expires: _____
Notary Public

State of North Carolina - County of _____

I, the undersigned Notary Public of the County and State aforesaid, certify that Edward Brantley personally came before me this day and acknowledged that he is the Manager/Member of ProDev XXX, LLC a Virginia Limited Liability Company, a North Carolina or _____ corporation/limited liability company/general partnership/limited partnership (strike through the inapplicable), and that by authority duly given and as the act of such entity, he signed the foregoing instrument in its name on its behalf as its act and deed. Witness my hand and Notarial stamp or seal, this 14 day of December, 2007.

My Commission Expires: _____
Deirdre L. Leach
Notary Public, Johnston Co., N.C.
My Commission Exp 12-15-2012
Notary Public

State of North Carolina - County of _____

I, the undersigned Notary Public of the County and State aforesaid, certify that _____

Witness my hand and Notarial stamp or seal, this _____ day of _____, 20__.

My Commission Expires: _____
Notary Public

The foregoing Certificate(s) of _____ is/are certified to be correct. This instrument and this certificate are duly registered at the date and time and in the Book and Page shown on the first page hereof.

By: _____ Register of Deeds for _____ County
Deputy/Assistant - Register of Deeds

COMMENCING AT AN AXLE HAVING NORTH CAROLINA GRID COORDINATE VALUES OF Y=239038.405m AND X=650598.177m (NAD83) ; THENCE IN A GENERALLY SOUTHEASTERLY DIRECTION, S33°19'26"E, FOR A DISTANCE OF 1918.51' TO A POINT IN THE NORTHERN BOUNDARY OF THE RIGHT OF WAY OF THORNTON ROAD AND SAID POINT BEING THE TRUE POINT OF BEGINNING; THENCE WITH THE NORTHERLY RIGHT OF WAY OF THORNTON ROAD ALONG THE ARC OF A CIRCULAR CURVE HAVING A DELTA ANGLE OF 04°13'14", A RADIUS OF 1103.28' AND AN ARC LENGTH OF 81.27' SUBTENDED BY A CHORD BEARING S55°34'42"W, FOR A DISTANCE OF 81.25' TO AN IRON PIPE SET; THENCE CONTINUING WITH SAID NORTHERLY LINE OF THORNTON ROAD ALONG THE ARC OF A CIRCULAR CURVE HAVING A DELTA ANGLE OF 05°10'17", A RADIUS OF 1103.28' AND AN ARC LENGTH OF 99.58' SUBTENDED BY A CHORD BEARING S60°16'28"W, FOR A DISTANCE OF 99.54' TO AN IRON PIPE SET; THENCE CONTINUING WITH SAID NORTHERLY LINE OF THORNTON ROAD ALONG THE ARC OF A CIRCULAR CURVE HAVING A DELTA ANGLE OF 10°30'33", A RADIUS OF 989.64' AND AN ARC LENGTH OF 181.52' SUBTENDED BY A CHORD BEARING S66°51'01"W, FOR A DISTANCE OF 181.27' TO AN IRON PIPE SET; THENCE CONTINUING WITH SAID NORTHERLY LINE OF THORNTON ROAD ALONG THE ARC OF A CIRCULAR CURVE HAVE A DELTA ANGLE OF 01°00'35", A RADIUS OF 6739.57' AND AN ARC LENGTH OF 118.76' SUBTENDED BY A CHORD BEARING S72°36'35"W, FOR A DISTANCE OF 118.76' TO AN IRON PIPE SET; THENCE CONTINUING WITH SAID NORTHERLY LINE OF THORNTON ROAD S73°30'52"W, FOR A DISTANCE OF 241.61' TO AN IRON PIPE SET IN THE SOUTHEASTERN CORNER OF THAT CERTAIN PARCEL NOW OWNED BY DYNASTY HOLDINGS, LLC AS DESCRIBED IN A DEED RECORDED IN BOOK 12555, PAGE 2556, WAKE COUNTY REGISTRY; THENCE IN A GENERALLY NORTHWESTERLY DIRECTION WITH THE EASTERN BOUNDARY OF THE AFORESAID PARCEL NOW OWNED BY DYNASTY HOLDINGS, LLC, N12°23'35"W, FOR A DISTANCE OF 595.74' TO A POINT; THENCE IN A GENERALLY SOUTHEASTERLY DIRECTION, S86°58'38"E, FOR DISTANCE OF 498.53' TO AN IRON PIPE SET; THENCE IN A GENERALLY SOUTHEASTERLY DIRECTION, S46°00'28"E, FOR A DISTANCE OF 410.28' TO THE POINT AND PLACE OF BEGINNING, CONTAINING 293,608 SQUARE FEET OR 6.740 ACRES, MORE OR LESS ACCORDING TO SURVEY PREPARED BY JONATHAN F. MURPHY PLS-4382, TO WHICH REFERENCE IS MADE FOR A MORE PERFECT AND COMPLETE DESCRIPTION, AND BEING THE PORTION OF NEW LOT 3 AS SHOWN ON A MAP RECORDED IN BOOK OF MAPS 2007, PAGE 2838, WAKE COUNTY REGISTRY, NOT OWNED BY DYNASTY HOLDINGS, LLC IMMEDIATELY PRIOR TO THE DELIVERY OF PRODEV VIII, LLC'S DEED TO DYNASTY HOLDINGS, LLC DATED DECEMBER 14, 2007.



BOOK:012876 PAGE:00394 - 00397

**Yellow probate sheet is a vital part of your recorded document.
Please retain with original document and submit for rerecording.**



**Wake County Register of Deeds
Laura M. Riddick
Register of Deeds**

Attachment B

Ownership Approvals

ARTICLES OF INCORPORATION

OF

SHOTWELL TRANSFER STATION, INC.

Pursuant to N.C. G. S. §55-2-02, the undersigned hereby submits these Articles of Incorporation for the purpose of forming a business corporation under the laws of the State of North Carolina:

1. The name of the corporation is **Shotwell Transfer Station, Inc.**
2. The number of shares the corporation is authorized to issue is 100,000. These shares shall be all of one class, designated as common stock.
3. The address of the initial registered office of the corporation is 3209 Gresham Lake Road, Suite 114, Raleigh, Wake County, North Carolina 27615, and the name of the initial registered agent at such address is David W. King, Jr.
4. The principal office address of the corporation is 3209 Gresham Lake Road, Suite 114, Raleigh, Wake County, North Carolina 27615.
5. The name and address of the incorporator is David K. Liggett, 2840 Plaza Place, Suite 400, Raleigh, North Carolina 27612.
6. To the fullest extent permitted by the North Carolina Business Corporation Act, no person who is serving or who has served as a director of the corporation shall be personally liable to the corporation or any of its shareholders for monetary damages for breach of duty as a director. No amendment or repeal of this article, nor the adoption of any provision of these articles of incorporation inconsistent with this article, shall eliminate or reduce the protection granted herein with respect to any matter that occurred prior to such amendment, repeal, or adoption.
7. These articles will become effective upon filing.

This the 30th day of April, 2007.



David K. Liggett, Incorporator

Certification by Land Owner (if different from Applicant):

I hereby certify that I have read and understand the application submitted by Shotwell Transfer Station, Inc for a permit to operate a municipal solid waste transfer station on land owned by the undersigned located at (address) 5505 Thornton Road; (city) Raleigh, NC, in Wake County, and described in Deed

Book and Page(s) DB 12249/PG 225; DB 12876/PG 400; DB 12876/PG 396; BM 2007/
PG 2838

I specifically grant permission for the proposed municipal solid waste transfer station planned for operation within the confines of the land, as indicated in the permit application. I understand that any permit will be issued in the names of both the operator and the owner of the facility/property. I acknowledge that ownership of land on which a solid waste management facility is located may subject me to cleanup of said property in the event that the operator defaults as well as to liability under the federal Comprehensive Environmental Responsibility, Compensation and Liability Act ("CERCLA"). Without accepting any fault or liability, I recognize that ownership of land on which a solid waste management facility is located may subject me to claims from persons who may be harmed in their persons or property caused by the solid waste management facility.

I am informed that North Carolina General Statute 130A-22 provides for administrative penalties of up to fifteen thousand dollars (\$15,000) per day per each violation of the Solid Waste Management Rules. I understand that the Solid Waste Management Rules may be revised or amended in the future, and that the siting and operation of the facility will be required to comply with any such revisions or amendments.

[Signature]
Signature

May 23, 2008
Date

David King, President, Dynasty Holdings, LLC
Print name

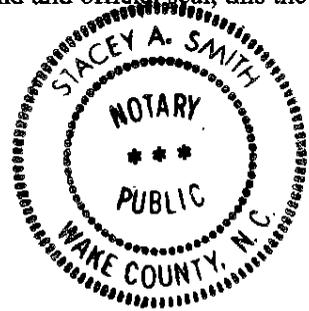
NORTH CAROLINA

WAKE County

I, STACEY A. SMITH, Notary Public for said County and State, do hereby certify that DAVID KING personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal, this the 23rd day of MAY, 2008

(Official Seal)



[Signature]
Notary Public

My commission expires 7-11-2009

Attachment C

FEMA FIRM Map

Attachment D

Preliminary Wetlands Evaluation



Michael F. Easley, Governor

William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Coleen Sullins, Director
Division of Water Quality

June 25, 2007

Jonathon Hopkins
Delineations Plus
P.O. Box 3097
Chapel Hill, NC 27575

NBRRO#07-123
Wake County

BASIN:
Neuse River **X** Tar-Pamlico
(15A NCAC 2B .0233) (15A NCAC 2B .0259)

Complaint NOV Buffer Determination **X**
Incident # Appeal Call

Project Name: 5505 Thornton Road

Location/Directions: located east of the intersection Capital Boulevard and Thornton Road

Subject Stream: UT to Neuse River

Date of Determination: 6/20/07

Feature(s)	Not Subject	Subject	Start @	Stop@	Stream Form Pts.	Soil Survey	USGS Topo
A		X	A1	A2		X	X
B		X	B1	B2		X	X
C		X (stream and beaver impoundment)	C			X	X
D	X (11/2/2006)					X	X
E	X	X (beaver impoundment)				X	
F		X (pond)				X	

Note: Feature A is subject to buffer rules from A1 to A2. Feature B is subject to buffer rules from B1 to B2. Feature C is subject to buffer rules from Flag C. The beaver impoundment is also subject to the buffer rules upstream of Flag C. Feature D is not subject to the buffer rules (determined by Eric Kulz 11/2/2006). Feature E is only subject to the buffer rules where it is a beaver impoundment. However, Feature E is not in the same place as depicted on the soils map. Feature F is a pond that is subject to the buffer rules. It outside of the property but the 50-ft buffer may encroach onto the property.

Explanation: The feature(s) listed above has or have been located on the Soil Survey of Wake County, North Carolina or the most recent copy of the USGS Topographic map at a 1:24,000 scale. Each feature that is checked "Not Subject" has been determined not to be a stream or is not present on the property. Features that are checked "Subject" have been located on the property and possess characteristics that qualify it to be a stream. There may be other streams located on your property that do not show up on the maps referenced above but, still may be considered jurisdictional according to the US Army Corps of Engineers and/or to the Division of Water Quality.



This on-site determination shall expire five (5) years from the date of this letter. Landowners or affected parties that dispute a determination made by the DWQ or Delegated Local Authority that a surface water exists and that it is subject to the buffer rule may request a determination by the Director. A request for a determination by the Director shall be referred to the Director in writing c/o Cyndi Karoly, DWQ Wetlands/401 Unit, 2321 Crabtree Blvd., Raleigh, NC 27604-2260. Individuals that dispute a determination by the DWQ or Delegated Local Authority that "exempts" a surface water from the buffer rule may ask for an adjudicatory hearing. You must act within 60 days of the date that you receive this letter. Applicants are hereby notified that the 60-day statutory appeal time does not start until the affected party (including downstream and adjacent landowners) is notified of this decision. DWQ recommends that the applicant conduct this notification in order to be certain that third party appeals are made in a timely manner. To ask for a hearing, send a written petition, which conforms to Chapter 150B of the North Carolina General Statutes to the Office of Administrative Hearings, 6714 Mail Service Center, Raleigh, N.C. 27699-6714. This determination is final and binding unless you ask for a hearing within 60 days.

The (owner/future owners) should notify the Division of Water Quality (including any other Local, State, and Federal Agencies) of this decision concerning any future correspondences regarding the subject property (stated above). This project may require a Section 404/401 Permit for the proposed activity. Any inquiries should be directed to the Division of Water Quality (Central Office) at (919)-733-1786, and the US Army Corp of Engineers (Raleigh Regulatory Field Office) at (919)-876-8441.

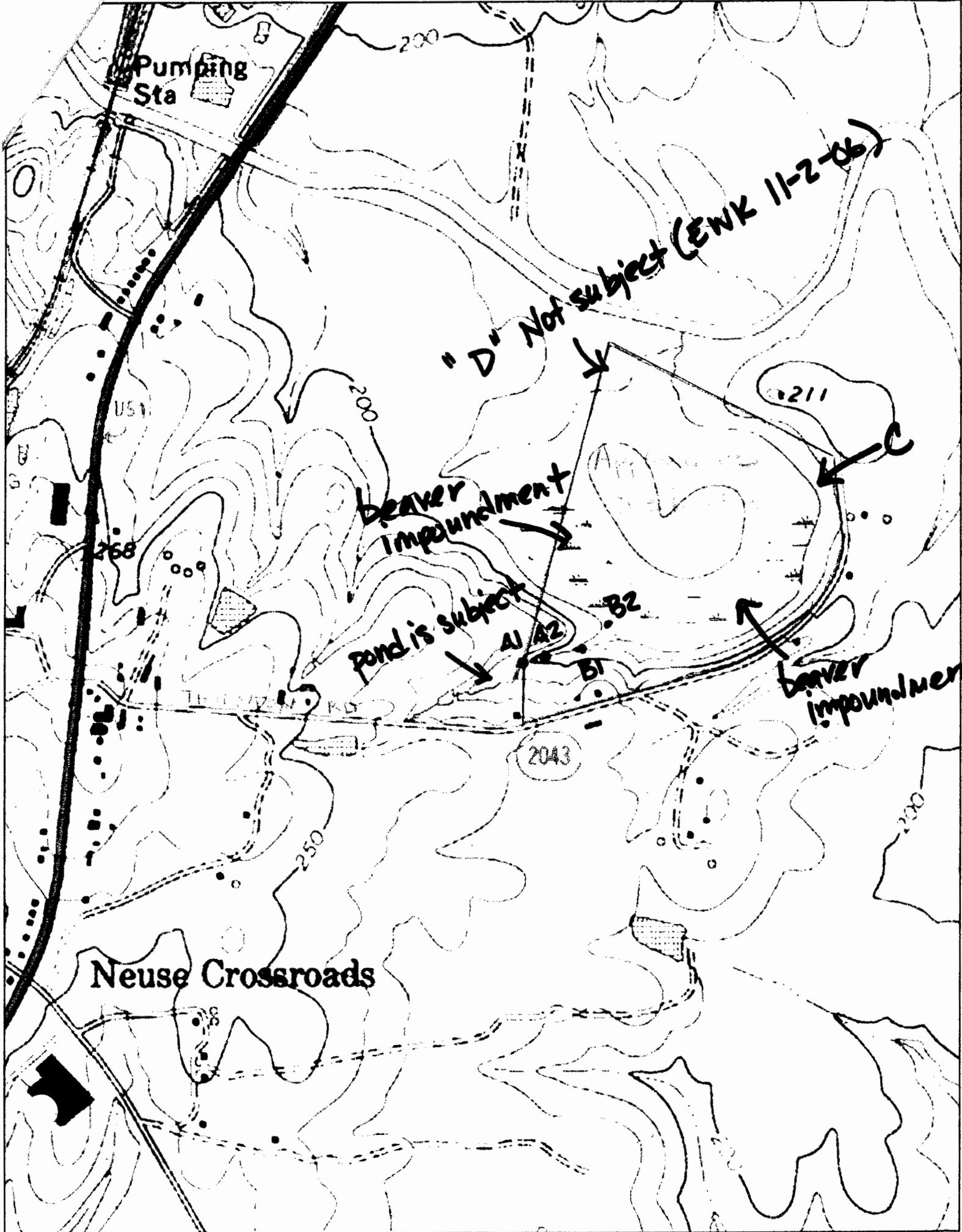
Respectfully,



Lauren C. Witherspoon
Environmental Senior Specialist

CC: Wetlands/ Stormwater Branch, 2321 Crabtree Blvd, Suite 250, Raleigh, NC 27604
RRO/SWP File Copy
Central Files

One
North Carolina
Naturally





Michael F. Easley
Governor
William G. Ross, Jr., Secretary
Department of Environment and Natural Resources
Alan W. Klimek, P.E., Director
Division of Water Quality

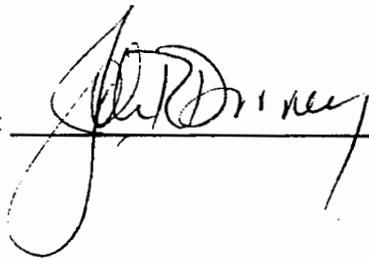
February 13, 2007
Buffer Interpretation/Clarification #2007-005

MEMORANDUM

RE: DWQ's stance on beaver impoundments within the Neuse Protected Riparian Buffer Rules 15A NCAC 02B.0233, the Randleman Lake Water Supply Watershed Buffer Rules 15A NCAC 02B.0250, the Tar-Pamlico Protected Riparian Buffer Rules 15A NCAC 02B.0259, and the Catawba Protected Riparian Buffer Rules 15A NCAC-02B.0243.

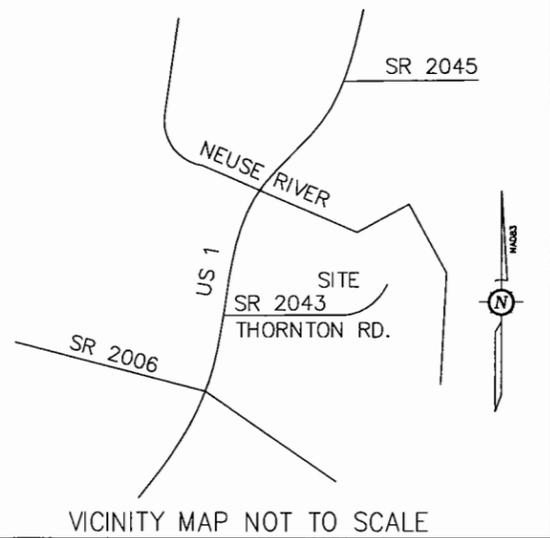
Background: Presently, there is no specific mention of how beaver impoundments are buffered and if they are in fact buffered in the Neuse Protected Riparian Buffer Rules, Tar-Pamlico Protected Riparian Buffer Rules, Randleman Water Supply Watershed Buffer Rules and the Catawba Protected Riparian Buffer Rules.

Solution:
Beaver impoundments are streams dammed up by beaver activity. Therefore, if the stream that is now a beaver impoundment shows on either the USGS Topo or the most recent version of the soil survey map, the beaver impoundment should be treated as an open water since it is a pond in the intent of the rules and must have a 50-foot protected riparian buffer around its perimeter measured from the elevation of the beaver dam. Streams coming into or out of a beaver impoundment also have the 50-foot protected riparian buffer.

Signature:  Date: 2/13/07



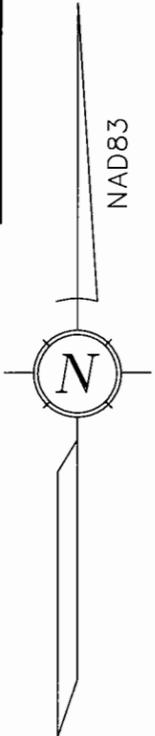
401 Oversight/Express Review Permits Unit
1650 Mail Service Center, Raleigh, North Carolina 27699-1650
2321 Crabtree Boulevard, Suite 250, Raleigh, North Carolina 27604
Phone: 919-733-1786 / FAX 919-733-6893 / Internet: <http://h2o.enr.state.nc.us/ncwetlands>



THIS CERTIFIES THAT THIS COPY OF THIS PLAT ACCURATELY DEPICTS THE BOUNDARY OF THE JURISDICTION OF SECTION 404 OF THE CLEAN WATER ACT AS DETERMINED BY THE UNDERSIGNED ON THIS DATE. UNLESS THERE IS A CHANGE IN THE LAW OR OUR PUBLISHED REGULATIONS, THIS DETERMINATION OF SECTION 404 JURISDICTION MAY BE RELIED UPON FOR A PERIOD NOT TO EXCEED FIVE YEARS FROM THIS DATE. THE DETERMINATION WAS MADE UTILIZING THE 1987 CORPS OF ENGINEERS WETLANDS DELINEATION MANUAL.

INTENTIONALLY UNSIGNED
ISSUED FOR REVIEW ONLY
PRELIMINARY PLAT
NOT FOR RECORDING,
SALES OR CONVEYANCE

NAME: _____
TITLE: _____
DATE: _____



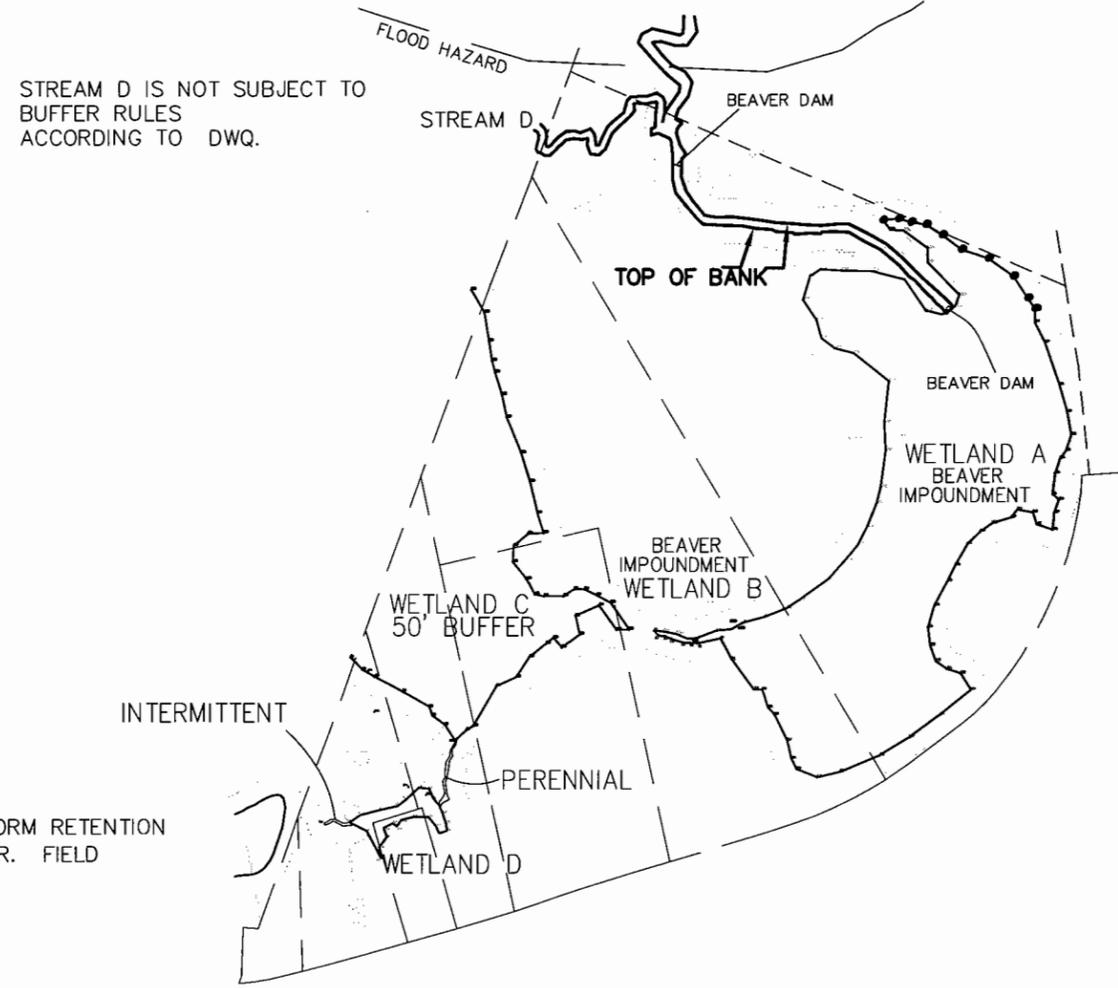
NOTES: NORTH CAROLINA STATE PLANE COORDINATES
DATUM IS NAD 83, COORDINATES DERIVED FROM
TRADITIONAL SURVEYING METHODS

WETLAND LINES HUNG BY JONATHAN HOPKINS, MPP, CERTIFIED WETLAND DELINEATOR FOR DELINEATIONS PLUS. WETLAND LINES HAVE NOT BEEN VERIFIED BY THE ARMY CORPS OF ENGINEERS AT THIS TIME.

DWQ FLAGS ARE NOT SHOWN ON THIS COPY, BUT BUFFER ZONES ARE APPROXIMATELY CORRECT.



ROUGH LOCATION FOR STORM RETENTION POND WITH A 50' BUFFER. FIELD VERIFICATION IS NEEDED.



TOTAL ACREAGE:
WETLAND ACREAGE:
INTERMITTENT/UNIMPORTANT CHANNEL:
PERENNIAL/IMPORTANT CHANNEL:

SHEET 1 OF 3



I, JONATHAN F. MURPHY, HEREBY CERTIFY THAT THIS SURVEY WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION; THAT THIS MAP DOES NOT REPRESENT A BOUNDARY SURVEY, AND IS NOT FOR RECORDATION. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS DAY OF _____ A.D., 200 . . .

JONATHAN F. MURPHY, PLS L-4382

PROJECT:	WEBTHOR PRELIMINARY WETLAND DELINEATION
CLIENT:	EDWARD BRANTLEY
LOCATION:	CITY OF RALEIGH, WAKE COUNTY, NORTH CAROLINA
DATE & SCALE:	OCTOBER 29, 2007 SCALE: 1" = 500'

Attachment E

**Preliminary Erosion and Sediment
Control Plan**

Stormwater & Erosion And Sedimentation Control Plan

Shotwell Transfer Station, Inc.

Wake County, North Carolina

Prepared For:

Shotwell Transfer Station, Inc.
5505 Thornton Road
Raleigh, North Carolina

December 2007

PRELIMINARY ISSUE



Stormwater & Erosion And Sedimentation Control Plan

Shotwell Transfer Station, Inc.

Raleigh, Wake County, North Carolina

Prepared for:

**Shotwell Transfer Station, Inc.
Raleigh, North Carolina**

To the Attention of:

**David King
Shotwell Transfer Station, Inc.**

RSG Project No. King 07-1

Kinjal B. Shah, E.I.
Staff Engineer

Stacey A. Smith, P.E.
Project Manager

December 2007



**SHOTWELL TRANSFER STATION, INC.
WAKE COUNTY, NORTH CAROLINA**

STORMWATER & EROSION AND SEDIMENTATION CONTROL PLAN

TABLE OF CONTENTS

	<u>Page</u>
1.0 NARRATIVE	1
1.1 Project Description	1
1.2 Contact Information	1
1.2.1 Engineer	1
1.2.2 Owner	1
1.2.3 Operator	1
1.3 Existing Site Conditions	2
1.4 Adjacent Areas	2
1.5 Site Soils Information	2
2.0 DESIGN GUIDELINES AND PROCEDURES	2
3.0 RUNOFF CALCULATIONS	3
4.0 IMPERVIOUS AREAS	4
5.0 NITROGEN LOADING ESTIMATIONS	4
6.0 EROSION AND SEDIMENTATION CONTROL MEASURES - INITIAL	4
6.1 Sediment Basins	4
6.2 Drainage Channels	5
6.3 Culvert Pipe	5
6.4 Silt Fence	5
6.5 Vegetative Stabilization	5
7.0 SCHEDULE FOR IMPLEMENTATION	6
8.0 INSPECTION AND MAINTENANCE	6
 APPENDICES	
Appendix A Erosion and Sedimentation Control Calculations	
Appendix B Nitrogen Loading Calculations	
Appendix C Erosion and Sedimentation Control Technical Specifications	
Appendix D Erosion and Sedimentation Control Plans and Details	

SHOTWELL TRANSFER STATION, INC.

EROSION AND SEDIMENTATION CONTROL PLAN

1.0 NARRATIVE

1.1 Project Description

Shotwell Transfer Station, Inc. operates construction and operation of Mixed Waste transfer station and Recycling under NC Solid Waste Permit No. 92-27T at their facility located off of Thornton Road (S.R. 2233) in Raleigh as shown in **Figure 1**.

This plan addresses the expansion of the existing transfer station facility to include MSW and C&D transfer operation over the closed Neuse Demolition Landfill. The proposed modification of the erosion control plan for the site includes a total disturbed area of 5.8 acres.

1.2 Contact Information

- 1.2.1 Engineer: For questions regarding this erosion and sedimentation control plan, please contact the following:

Richardson Smith Gardner & Associates, Inc.
Attn.: **Stacey A. Smith, P.E.**
14 N. Boylan Ave.
Raleigh, NC 27607
Phone: (919) 828-0577
Fax: (919) 828-3899.

- 1.2.2 Owner: The owner of the site and the person to contact should sediment control issues arise during the land-disturbing activity is as follows:

Dynasty Holdings, LLC.
Suite 115, 3209 Gresham Lake Road
Raleigh, North Carolina 27615
Phone: (919) 773-9899
Fax: (919) 773- 9898

Contact Person : David King

- 1.2.3 Operator: The operator of the site and the person to contact should sediment control issues arise during the land-disturbing activity is as follows:

Shotwell Transfer Station, Inc.
Suite 115, 3209 Gresham Lake Road
Raleigh, North Carolina 27615
Phone: (919) 773-9899
Fax: (919) 773- 9898

Contact Person : David King

Shotwell Transfer Station, Inc. (Site & Scalehouse Office)
5509 Thornton Road
Raleigh, North Carolina 27616

1.3 Existing Site Conditions

Existing ground surface elevations vary from El. 230 (feet) within the central area of the property to about El. 200 within the northwest, north and northeast portion of the site. Topographically, the site is a broad dissected ridge, generally sloping to the northwest and northeast. The site lies within the Neuse River drainage basin.

1.4 Adjacent Areas

The site is accessed by Thornton Road on southeast side. The transfer station is bounded by the commercial and residential properties to the north and east. The nearest water body is an unnamed creek of Neuse River located on the northeast site of the transfer station. Neuse River is located approximate 1.0 miles from the site.

1.5 Site Soils Information

The native surficial soils at the site fall under the categories of Sandy Loam (ApB & WmE) and Silty Loam (Wo & Wn) according to the GIS Website for Wake County. However, Shotwell Transfer Station will be on the top of closed Neuse Demolition Landfill. In our site visit to transfer station, we found surficial soils Clayey Sandy soil on western area of the property and loamy soil on the north, south and east area of the property. Therefore, based on the permeability of the soil, hydrologic soil groups (HSG) "B" and "C" are considered for purposes of runoff calculations.

2.0 DESIGN GUIDELINES AND PROCEDURES

The erosion and sediment control design for the landfill was conducted based on guidelines and procedures as set forth in the following references:

1. HydroCAD Software Solutions, LLC (2004), HydroCAD Stormwater Modeling System Owner's Manual - Version 7, Chocorua, NH.
2. North Carolina Division of Land Resources (1988 and 1993 Update), North Carolina Erosion & Sediment Control Planning & Design Manual, Raleigh, NC.
3. Stormwater Design Manual by Wake County, Draft August 2006
4. Erosion and Sedimentation Ordinance revised by Wake County, Draft February 10th, 2006.
5. North Carolina Division of Water Quality (July 2005) Updated Draft Manual of Stormwater Best Management Practices, (Public Comment Version), Raleigh, NC.

6. Malcom, H. Rooney (1989 & 2003 Supplement), Elements of Urban Stormwater Design, NC State Univ., Raleigh, NC.

3.0 RUNOFF CALCULATIONS

All stormwater flow volumes were calculated using the HydroCAD 7.10 computer program (utilizing USDA-NRCS (SCS) methods) based on 10-year 24-hour storm event. Rainfall quantities and/or intensities used in the analyses were derived from NOAA-35 and TP-40 data and have been included in **Appendix A**. Drainage areas were determined using a planimeter and/or AutoCAD on topographic sheets of the project area. For each drainage area, runoff curve numbers (SCS methods) and/or runoff coefficients (Rational Method) were selected based on ground cover conditions. Times of concentration were calculated by HydroCAD using SCS methods.

As per Wake County Stormwater Design Manual, (**Ref.3, Sec. 1-2-2**) the peak stormwater runoff leaving any site for the one-year storm shall be no greater for Post Development Conditions than Pre-Development Conditions. Also, Neuse River Nutrient Sensitive Waters Management Strategy (**Ref. 4**) requires no net increase in peak flow leaving the site from the Pre-Development Conditions for the 1-Year, 24-Hour storm. Therefore, the peak discharge for the 1-year 24-hour storm event was evaluated for both Pre-Developed and Post-Developed Conditions summarized in **Table 1**. However, the results for pre and post development conditions of transfer station are not comparable for any discharge point as the flow leaving from four different drainage areas in pre-development condition was sheet flow towards the existing wetlands on northwest, north and northeast direction. Also, drainage areas are different in pre and post development conditions.

TABLE 1: SUMMARY OF RUNOFF VALUES

Discharge Point (As shown in HydroCAD Model)	Pre–development Condition			Post–development Condition		
	Area (Ac)	1-Year Storm (cfs)	10-Year Storm (cfs)	Area (Ac)	1-Year Storm (cfs)	10-Year Storm (cfs)
Drainage Area -1 / Basin -1	2.11	2.97	8.9	3.47	0.18	1.34
Drainage Area-2 / Basin-2	1.16	1.93	5.47	2.13	0.17	6.02
Drainage Area-3	4.17	5.75	17	2.8	3.49	10.9
Drainage Area-4	2.38	3.08	9.42	1.09	1.48	4.3

Note:

Drainage Area-1 (pre-development) and Basin-1 (post-development) is located on the northeast side of the transfer station.

Drainage Area-2 (pre-development) and Basin-2 (post-development) is located on the northern side of the transfer station.

Drainage Area-3 (pre & post development) is located on the northwest side of the transfer station.

Drainage Area-4 (pre & post development) is located on the eastern side of the transfer station.

4.0 IMPERVIOUS AREAS:

Total impervious areas for Post-Developed Conditions breakdown as follows:

- C Access roads : 2.07 AC
- C Building:: 0.45 AC

Total : 2.52 AC or 43.55 % of the total facility area (5.8 Ac).

Therefore, the total impervious area for Post-Developed Condition is above the 15% threshold.

5.0 NITROGEN LOADING ESTIMATIONS

As per the Stormwater Ordinance (Ref:3, Appendix: G) Total Nitrogen (TN) Loading was evaluated for three conditions: (1) Pre-Developed Condition, (2) Post-Developed Condition with BMPs which are summarized in **Table 2**. Also, see **Appendix B** for detail calculations.

TABLE 2: SUMMARY OF TOTAL NITROGEN (TN) LOADING

Conditions	Drainage Area (AC)	TN Loading (lb/ac/yr)
Pre-Developed Condition	9.81	0.86
Post-Developed Condition with BMPs	9.49	4.29

Total Drainage Area for the Post-Developed Condition is less than the Pre-Developed Condition. However, the TN-loading for Post-Development condition from the site is more than the 3.6 lbs/ac limit; and therefore, nitrogen offset payment will be required for 0.69 lbs/ac (4.29 lb/ac -3.6 lb/ac).

6.0 EROSION AND SEDIMENTATION CONTROL MEASURES

The following erosion and sedimentation control measures are to be constructed as part of the proposed construction. Appendices A, B and C to this plan include calculations, technical specifications, and plans and details for each of these measures, respectively.

In most cases, the following erosion and sedimentation control measures were designed using the final drainage areas which were found to represent a worst case for design. Each calculation indicates what condition was used in the analysis.

6.1 Sediment Basins

Two permanent sediment basins (Sediment Basins-1 & 2) that will serve the site are designed in accordance with E&SCCP&DM Section 6.61. Sediment Basin-1 will be located on east site and sediment basin-2 will be located on north site of the proposed area.

Sediment basin design is subject to several requirements. The sediment basins must provide a basin volume of 1,800 ft³/acre of disturbed area. Other E&SCP&DM requirements for permanent basins include barrel and emergency weir-type spillway. Faircloth Skimmer is

used to dewater the basins. The size of the skimmer orifice is considered based on typical drawdown requirements of 2 to 5 days. 2" diameter of skimmer is used for basin-1 and 2. These basins will be built on the top of closed Neuse Demolition Landfill and therefore, the bottom of the basins will be covered with 40 mil LLPDE Geomembrane on the top of 2' thick soil liner to avoid infiltration through closed Neuse Demolition Landfill. In addition to E&SCP&DM requirements, each sediment basin was designed to have an adequate surface area to achieve an 80% settling efficiency of a 40 micron (silt size) particle at the peak discharge from the design storm. Each sediment basin was modeled with the HydroCAD computer program and a spreadsheet was used to verify the design requirements.

6.2 Drainage Channels

Drainage channel calculations were conducted using a reformulation of Manning's Equation in a spreadsheet format. The calculations determine the normal depth of flow based on the peak discharge from the design storm (from HydroCAD) and assumed channel dimensions/slope(s). Both temporary and/or permanent channel linings were chosen, as appropriate, based on the calculated velocity and/or shear stress

6.3 Culvert Pipe

Reinforce Concrete pipe will be used to carry flows from southern area of the transfer station to the sediment basin-1 located on eastern side of the property.

6.4 Silt Fence

Silt fencing design was based on criteria set forth in E&SCP&DM, Section 6.62 including the limitation of 100 feet of fencing for each ¼ acre of drainage area.

6.5 Vegetative Stabilization

Vegetative stabilization will be in accordance with the seeding schedule in the project specifications (provided as an attachment to this plan). The seeding schedule was based on Table 6.11k of E&SCP&DM which is applicable to this site.

7.0 SCHEDULE FOR IMPLEMENTATION

All erosion control measures will be placed before any land disturbance or waste placement may begin in that portion of the site which drains to the erosion control measures. Vegetative stabilization of disturbed areas will be in accordance with the following requirements:

- Temporary or permanent ground cover (or other acceptable measure(s)) adequate to restrain erosion on erodible slopes or other areas will be provided within 21 calendar days following completion of any phase of grading.
- Permanent ground cover for all disturbed areas will be provided within 15 working

days or 90 calendar days (whichever is shorter) following the completion of construction.

8.0 INSPECTION AND MAINTENANCE

As per NCDENR requirement, all erosion and sedimentation control measures will be inspected at least once every seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period. A rain gauge will be maintained on the site and a record of the rainfall amounts and dates will be kept properly.

During inspections, any stormwater discharges from the site will be observed for stormwater discharge characteristics to evaluate the effectiveness of the erosion and sedimentation control measures incorporating Best Management Practices (BMPs). If visible sedimentation is leaving the disturbed limits of the site, corrective action will be taken immediately to control the discharge of sediments.

Repairs to erosion and sedimentation control measures will be made as needed and accumulated sediment removed if necessary. All sediments which are removed from erosion and sedimentation control measures will be disposed of in an approved manner at a location to be designated by the Engineer in such a manner that further erosion and sedimentation will not occur.

Appendix A

Erosion and Sedimentation Control Calculations

**SHOTWELL TRANSFER STATION, INC.
WAKE COUNTY, NORTH CAROLINA**

STORMWATER & EROSION AND SEDIMENTATION CONTROL PLAN

APPENDIX A: STORMWATER & E&SC PLAN CALCULATIONS.

TABLE OF CONTENTS

- 1.0 Analysis of Design Storms
- 2.0 HydroCAD Analysis
 - 2.1 10-Year 24-Hour Storm Event for Post-Developed Condition
 - 2.2 10-Year 24-Hour Storm Event for Pre-Developed Condition
 - 2.3 2-Year 24-Hour Storm Event for Post-Developed Condition
 - 2.4 2-Year 24-Hour Storm Event for Pre-Developed Condition
 - 2.5 1-Year 24-Hour Storm Event for Post-Developed Condition
 - 2.6 1-Year 24-Hour Storm Event for Pre-Developed Condition
- 3.0 Sediment Basin Analysis
 - 3.1 Sediment Basin - 1
 - 3.2 Sediment Basin - 2
- 4.0 Drainage Channel Analysis
- 5.0 Outlet Protection Analysis

Analysis of Design Storms



RICHARDSON SMITH GARDNER & ASSOCIATES
 Engineering and Geological Services
 14 N. Boylan Avenue Tel: 919-828-0577
 Raleigh, NC 27603 Fax: 919-828-3899

SHEET: /
 JOB #: King o7-1
 DATE: 12/13/07
 BY: KBS
 CHKD BY:

Shotwell Transfer Station, Inc.
Analysis of Design Storms

DEPTH-DURATION-FREQUENCY TABLE*

LOCATION: **Shotwell Transfer Station, Inc.**

DURATION	RETURN PERIOD					
	2-YR (in)	5-YR (in)	10-YR (in)	25-YR (in)	50-YR (in)	100-YR (in)
5 min	0.48	0.54	0.59	0.66	0.72	0.78
10 min	0.80	0.92	1.02	1.16	1.28	1.39
15 min	1.02	1.19	1.32	1.51	1.66	1.81
30 min	1.36	1.68	1.89	2.20	2.44	2.68
60 min	1.76	2.18	2.48	2.91	3.25	3.58
2 hr	1.97	2.49	2.81	3.31	3.70	4.09
3 hr	2.17	2.74	3.14	3.71	4.16	4.60
6 hr	2.70	3.46	3.98	4.73	5.31	5.89
12 hr	3.17	4.10	4.74	5.64	6.35	7.05
24 hr	3.64	4.73	5.49	6.55	7.38	8.20

INTENSITY-DURATION-FREQUENCY TABLE*

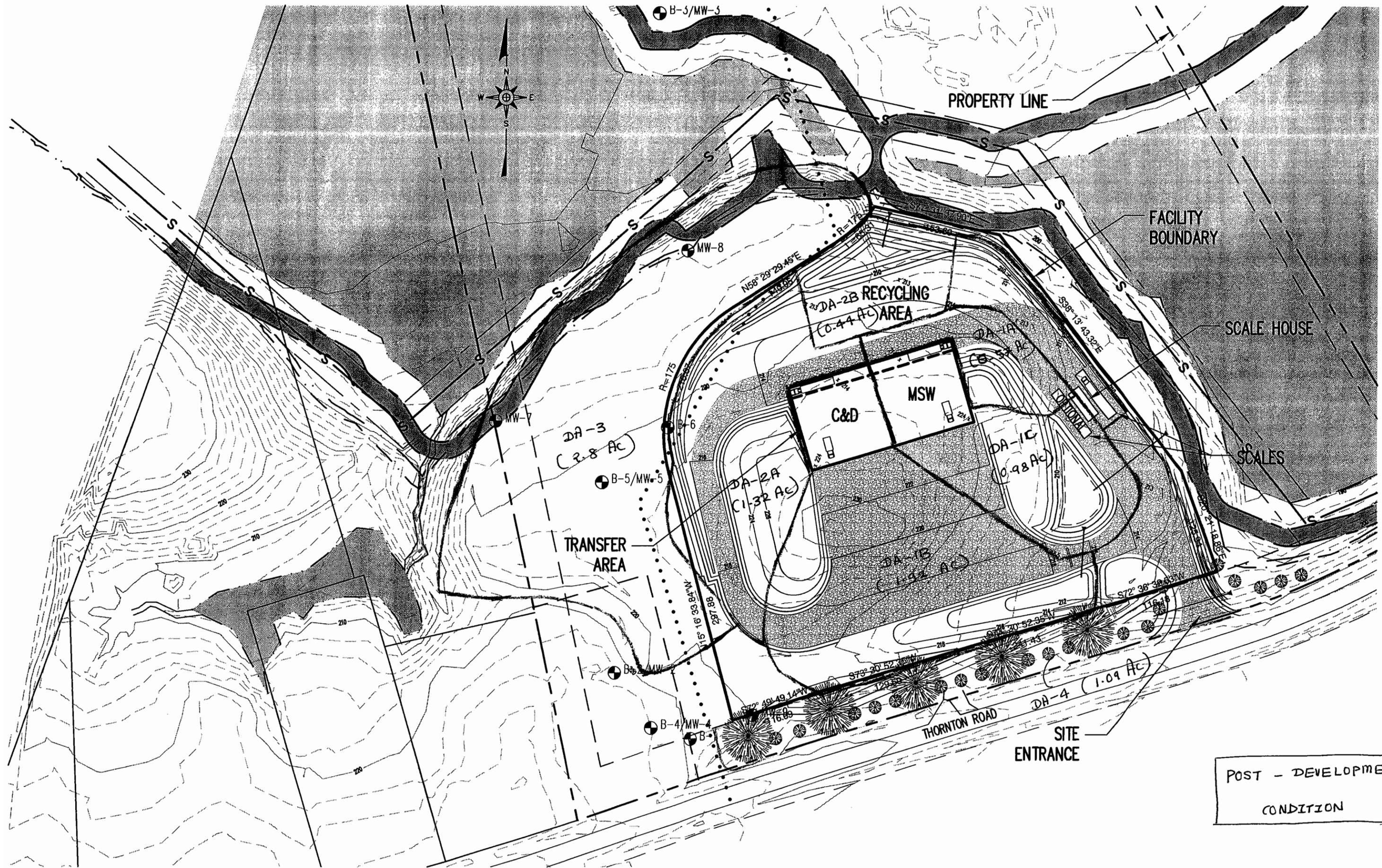
LOCATION: **Shotwell Transfer Station, Inc.**

DURATION	RETURN PERIOD					
	2-YR (in/hr)	5-YR (in/hr)	10-YR (in/hr)	25-YR (in/hr)	50-YR (in/hr)	100-YR (in/hr)
5 min	5.76	6.48	7.08	7.92	8.66	9.36
10 min	4.80	5.52	6.12	6.96	7.66	8.34
15 min	4.08	4.76	5.28	6.04	6.64	7.24
30 min	2.72	3.36	3.78	4.40	4.87	5.36
60 min	1.76	2.18	2.48	2.91	3.25	3.58
2 hr	0.99	1.25	1.41	1.66	1.85	2.05
3 hr	0.72	0.91	1.05	1.24	1.39	1.53
6 hr	0.45	0.58	0.66	0.79	0.89	0.98
12 hr	0.26	0.34	0.40	0.47	0.53	0.59
24 hr	0.15	0.20	0.23	0.27	0.31	0.34

Notes: * Source Information from NOAA Hydro-35 and USWB TP-40

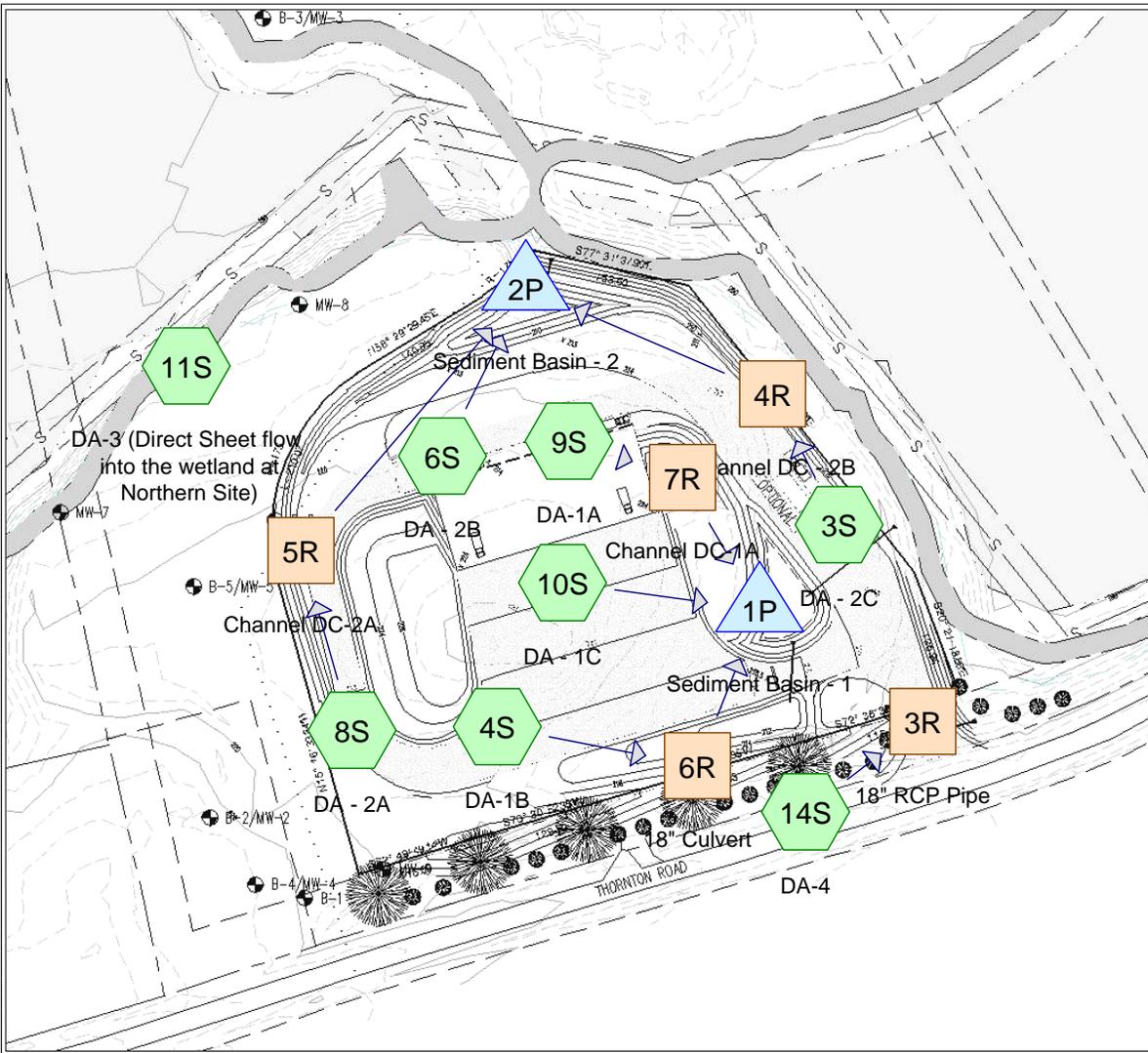
HydroCAD Analysis

HydroCAD Analysis for Post-Development Condition
(10-Year Storm Event)



POST - DEVELOPMENT
CONDITION

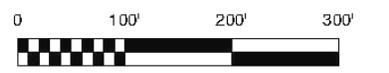
S:\CAD\Shelwell\Transfers\Stationing\07-16\hask\KING\60011.dwg 12/12/2007 3:17 PM



LEGEND

- 800 EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- PROPOSED 10' CONTOUR
- PROPOSED 2' CONTOUR
- PROPERTY LINE
- FEMA FLOOD ZONE "X" (SEE REFERENCE 2)
- FEMA FLOOD ZONE "AE" (SEE REFERENCE 2)
- NEUSE RIVER BUFFER
- NEUSE RIVER BUFFER (DISTURBABLE LIMITS)
- SURVEYED WETLANDS (SEE REFERENCE 5)
- ZONING LINE
- FACILITY BOUNDARY
- MONITORING WELL
- BUSH
- TREE

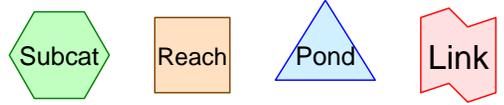
- REFERENCES**
1. EXISTING TOPOGRAPHY SURVEYED BY STOCKS ENGINEERING, P.A., DATED OCTOBER 2007.
 2. FLOOD ZONE LIMITS PROVIDED BY WAKE COUNTY GIS DEPARTMENT.
 3. PROPERTY LINES AND CITY OF RALEIGH SANITARY SEWER LOCATIONS PROVIDED BY STOCKS ENGINEERING, P.A., DATED OCTOBER 2007.
 4. ZONING LINES FROM SURVEY BY MURPHY GEOMATICS, PRESENTED IN DRAWING ENTITLED "RECOMBINATION PLAN FOR THORNTON II" DATED AUGUST 2006.
 5. WETLAND DELINEATION FROM DRAWING ENTITLED "NESTHOR PRELIMINARY WETLAND DELINEATION", PREPARED BY MURPHY GEOMATICS, DATED OCTOBER 29, 2007.



RICHARDSON SMITH GARDNER & ASSOCIATES
11500 Wake Forest Road, Raleigh, NC 27609
 www.rsgardner.com
 919.876.2000

DRAWN BY: J.A.L.	CHECKED BY:	SCALE: AS SHOWN	FIGURE NO. 2
DATE: Dec. 2007	PROJECT NO. KIR-G-07-	FILE NAME KIR-G-007-	

TITLE:
 THORNTON ROAD MIXED WASTE TRANSFER & RECYCLING CENTER SHOTWELL TRANSFER STATION, INC.
 FIGURE 2



Drainage Diagram for Thornton Road rev 2
 Prepared by {enter your company name here} 12/14/2007
 HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 1

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Time span=1.00-20.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: DA - 2CRunoff Area=0.370 ac Runoff Depth>3.28"
Tc=5.0 min CN=82 Runoff=2.29 cfs 0.101 af**Subcatchment 4S: DA-1B**Runoff Area=1.920 ac Runoff Depth>3.09"
Tc=5.0 min CN=80 Runoff=11.31 cfs 0.494 af**Subcatchment 6S: DA - 2B**Runoff Area=0.440 ac Runoff Depth>2.99"
Tc=5.0 min CN=79 Runoff=2.52 cfs 0.110 af**Subcatchment 8S: DA - 2A**Runoff Area=1.320 ac Runoff Depth>3.18"
Tc=5.0 min CN=81 Runoff=7.97 cfs 0.350 af**Subcatchment 9S: DA-1A**Runoff Area=0.573 ac Runoff Depth>2.54"
Tc=5.0 min CN=74 Runoff=2.84 cfs 0.121 af**Subcatchment 10S: DA - 1C**Runoff Area=0.980 ac Runoff Depth>3.57"
Tc=5.0 min CN=85 Runoff=6.48 cfs 0.292 af**Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland area)**Runoff Area=2.800 ac Runoff Depth>2.12"
Flow Length=190' Tc=7.1 min CN=69 Runoff=10.98 cfs 0.494 af**Subcatchment 14S: DA-4**Runoff Area=1.090 ac Runoff Depth>2.46"
Tc=5.0 min CN=73 Runoff=5.24 cfs 0.223 af**Reach 3R: 18" RCP Pipe**Peak Depth=0.98' Max Vel=3.7 fps Inflow=5.24 cfs 0.223 af
D=18.0" n=0.013 L=950.0' S=0.0032 '/' Capacity=5.90 cfs Outflow=4.30 cfs 0.221 af**Reach 4R: Channel DC - 2B**Peak Depth=0.69' Max Vel=2.2 fps Inflow=2.29 cfs 0.101 af
n=0.030 L=310.0' S=0.0097 '/' Capacity=16.80 cfs Outflow=2.07 cfs 0.101 af**Reach 5R: Channel DC-2A**Peak Depth=0.61' Max Vel=3.3 fps Inflow=7.97 cfs 0.350 af
n=0.030 L=400.0' S=0.0150 '/' Capacity=102.94 cfs Outflow=7.25 cfs 0.349 af**Reach 6R: 18" Culvert**Peak Depth=0.70' Max Vel=14.1 fps Inflow=11.31 cfs 0.494 af
D=18.0" n=0.013 L=50.0' S=0.0600 '/' Capacity=25.73 cfs Outflow=11.24 cfs 0.494 af**Reach 7R: Channel DC-1A**Peak Depth=0.55' Max Vel=3.1 fps Inflow=2.84 cfs 0.121 af
n=0.030 L=170.0' S=0.0235 '/' Capacity=40.88 cfs Outflow=2.70 cfs 0.121 af**Pond 1P: Sediment Basin - 1**Peak Elev=212.08' Storage=24,883 cf Inflow=20.25 cfs 0.907 af
Primary=0.23 cfs 0.175 af Secondary=1.11 cfs 0.174 af Outflow=1.34 cfs 0.349 af**Pond 2P: Sediment Basin - 2**Peak Elev=209.68' Storage=10,956 cf Inflow=11.40 cfs 0.559 af
Primary=0.20 cfs 0.144 af Secondary=5.82 cfs 0.207 af Outflow=6.02 cfs 0.351 af**Total Runoff Area = 9.493 ac Runoff Volume = 2.186 af Average Runoff Depth = 2.76"**

Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 2

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 3S: DA - 2C

Runoff = 2.29 cfs @ 11.95 hrs, Volume= 0.101 af, Depth> 3.28"

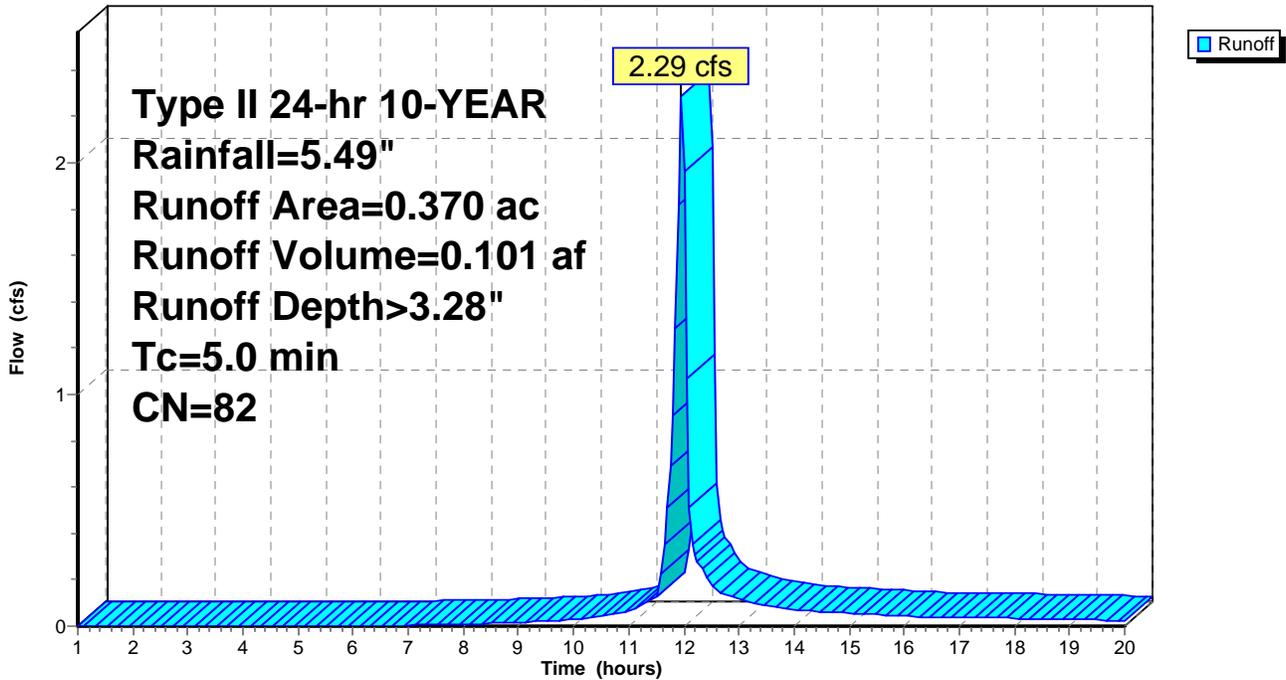
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Type II 24-hr 10-YEAR Rainfall=5.49"

Area (ac)	CN	Description
0.240	79	<50% Grass cover, Poor, HSG B
0.110	85	Gravel roads, HSG B
0.020	98	Paved parking & roofs
0.370	82	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 3S: DA - 2C

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 3

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 4S: DA-1B

Runoff = 11.31 cfs @ 11.96 hrs, Volume= 0.494 af, Depth> 3.09"

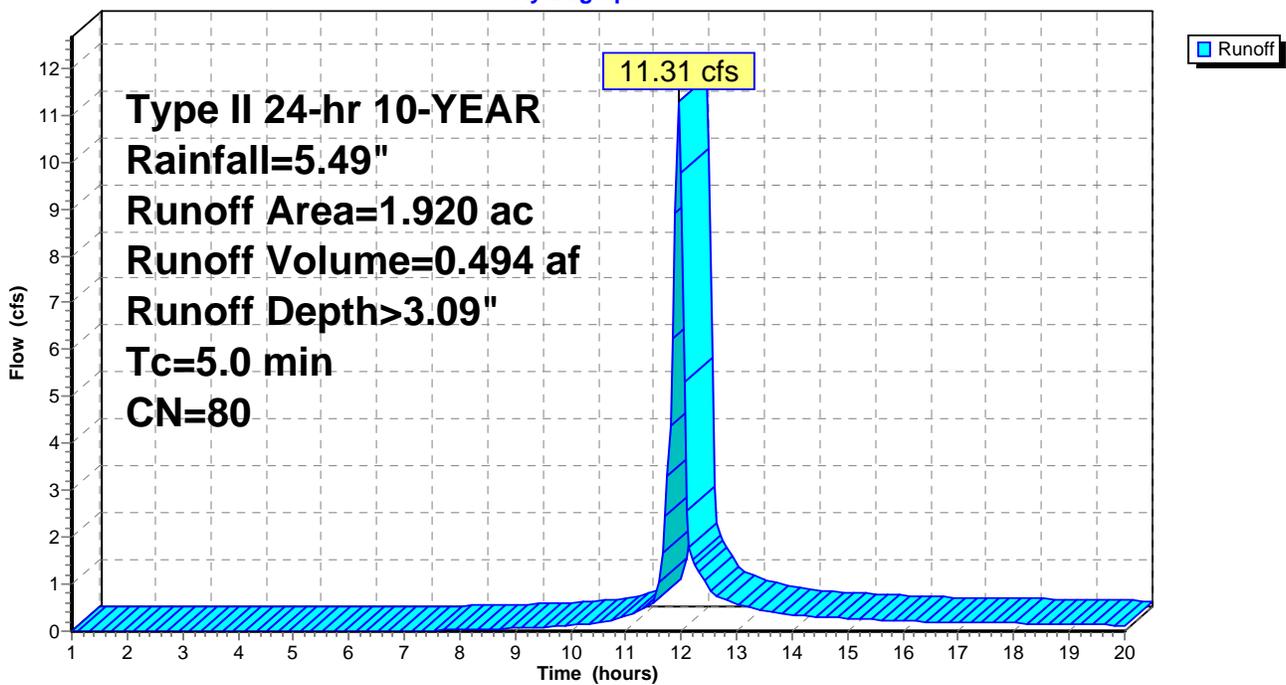
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YEAR Rainfall=5.49"

Area (ac)	CN	Description
0.770	69	50-75% Grass cover, Fair, HSG B
0.950	85	Gravel roads, HSG B
0.200	98	Paved parking & roofs
1.920	80	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 4S: DA-1B

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 4

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 6S: DA - 2B

Runoff = 2.52 cfs @ 11.96 hrs, Volume= 0.110 af, Depth> 2.99"

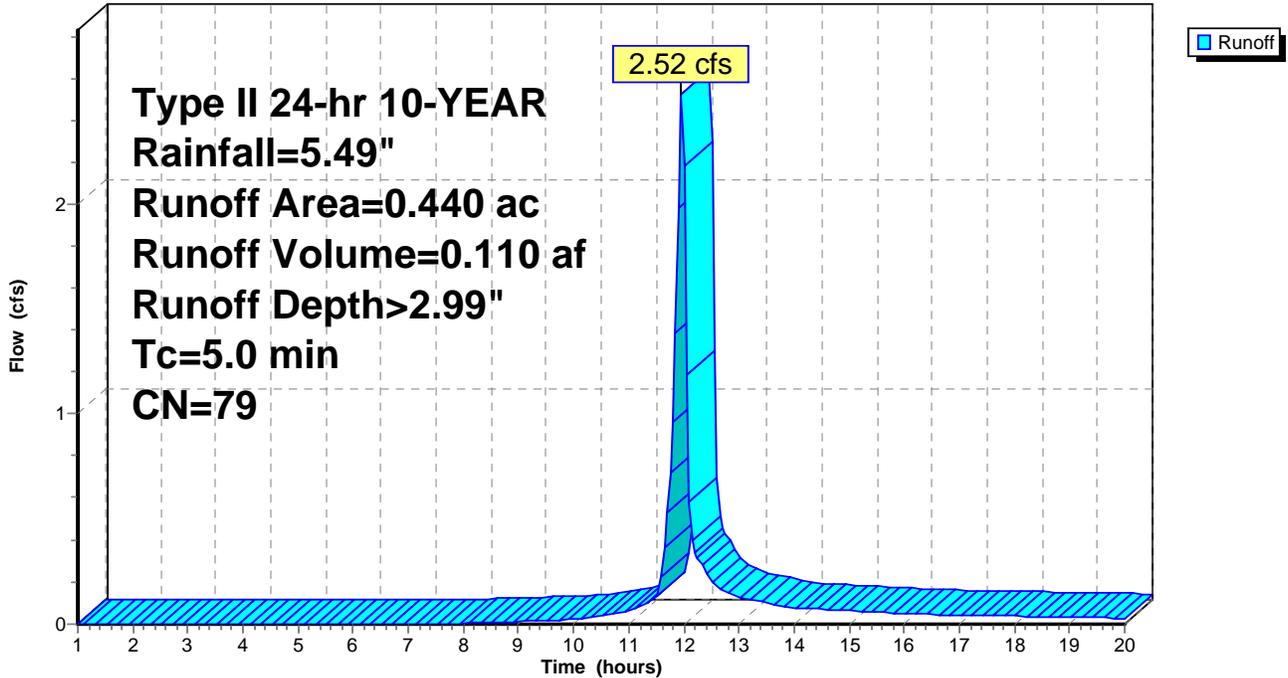
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YEAR Rainfall=5.49"

Area (ac)	CN	Description
0.440	79	<50% Grass cover, Poor, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 6S: DA - 2B

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 5

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 8S: DA - 2A

Runoff = 7.97 cfs @ 11.96 hrs, Volume= 0.350 af, Depth> 3.18"

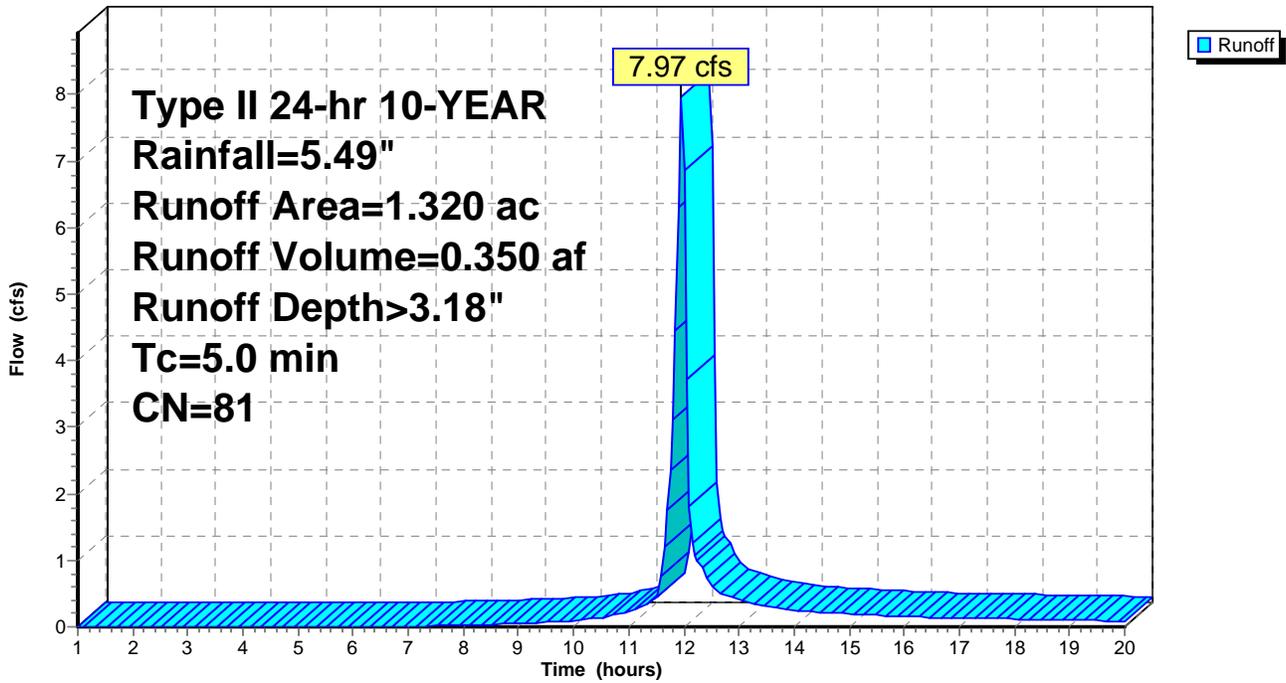
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YEAR Rainfall=5.49"

Area (ac)	CN	Description
1.020	79	50-75% Grass cover, Fair, HSG C
0.300	89	Gravel roads, HSG C
1.320	81	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 8S: DA - 2A

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 6

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 9S: DA-1A

Runoff = 2.84 cfs @ 11.96 hrs, Volume= 0.121 af, Depth> 2.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs

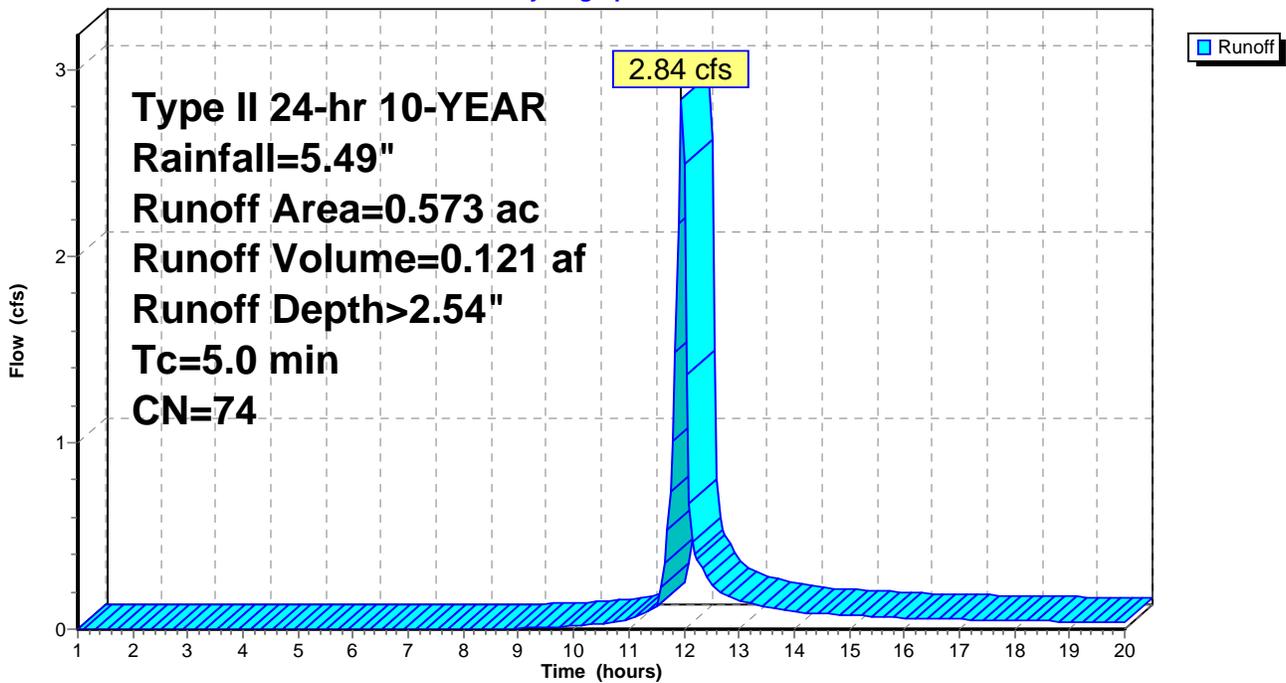
Type II 24-hr 10-YEAR Rainfall=5.49"

Area (ac)	CN	Description
0.390	69	50-75% Grass cover, Fair, HSG B
0.180	85	Gravel roads, HSG B
0.003	98	Paved parking & roofs
0.573	74	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 9S: DA-1A

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 7

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 10S: DA - 1C

Runoff = 6.48 cfs @ 11.95 hrs, Volume= 0.292 af, Depth> 3.57"

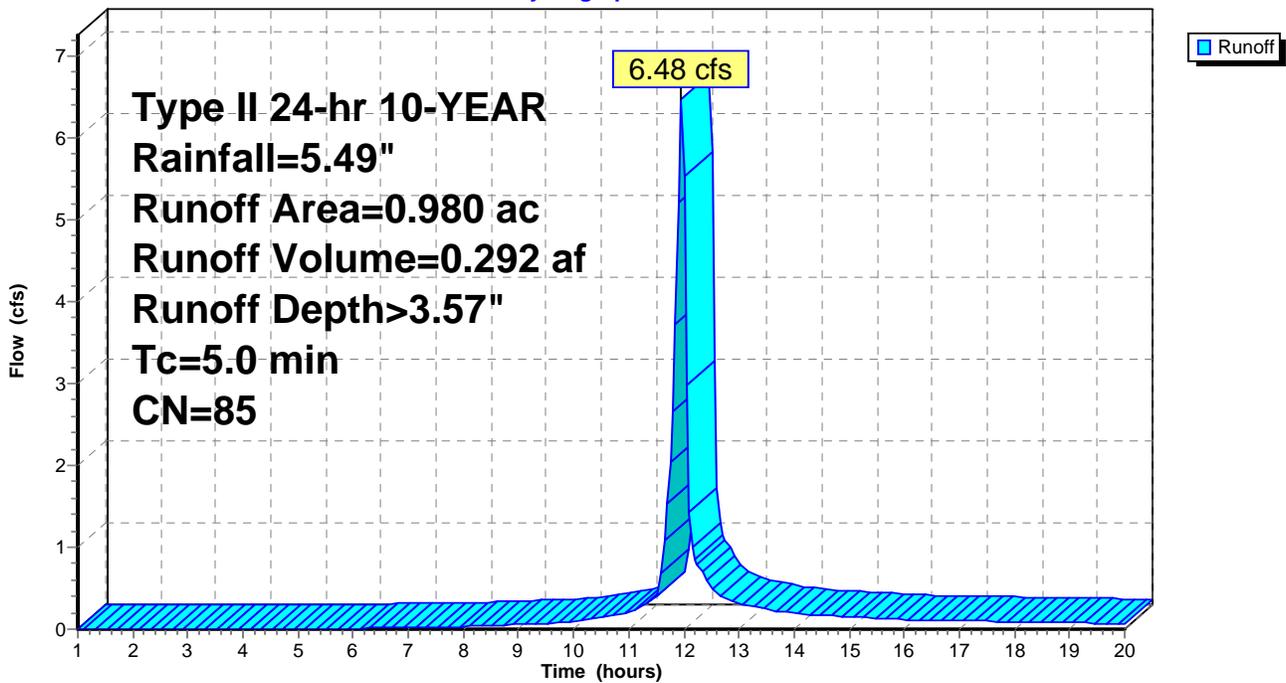
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YEAR Rainfall=5.49"

Area (ac)	CN	Description
0.520	79	<50% Grass cover, Poor, HSG B
0.230	85	Gravel roads, HSG B
0.230	98	Paved parking & roofs
0.980	85	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 10S: DA - 1C

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 8

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland at Northern Site)

Runoff = 10.98 cfs @ 11.99 hrs, Volume= 0.494 af, Depth> 2.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs

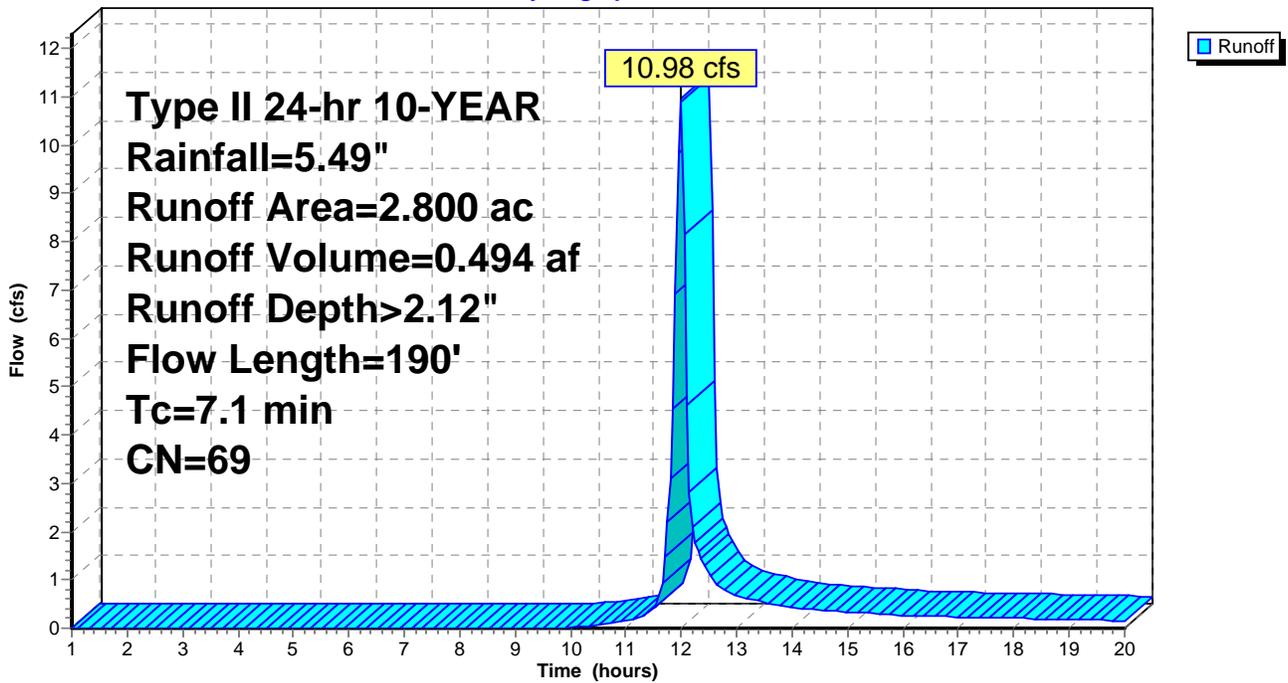
Type II 24-hr 10-YEAR Rainfall=5.49"

Area (ac)	CN	Description
2.800	69	Pasture/grassland/range, Fair, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	190	0.1000	0.4		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland at Northern Site)

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 9

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 14S: DA-4

Runoff = 5.24 cfs @ 11.96 hrs, Volume= 0.223 af, Depth> 2.46"

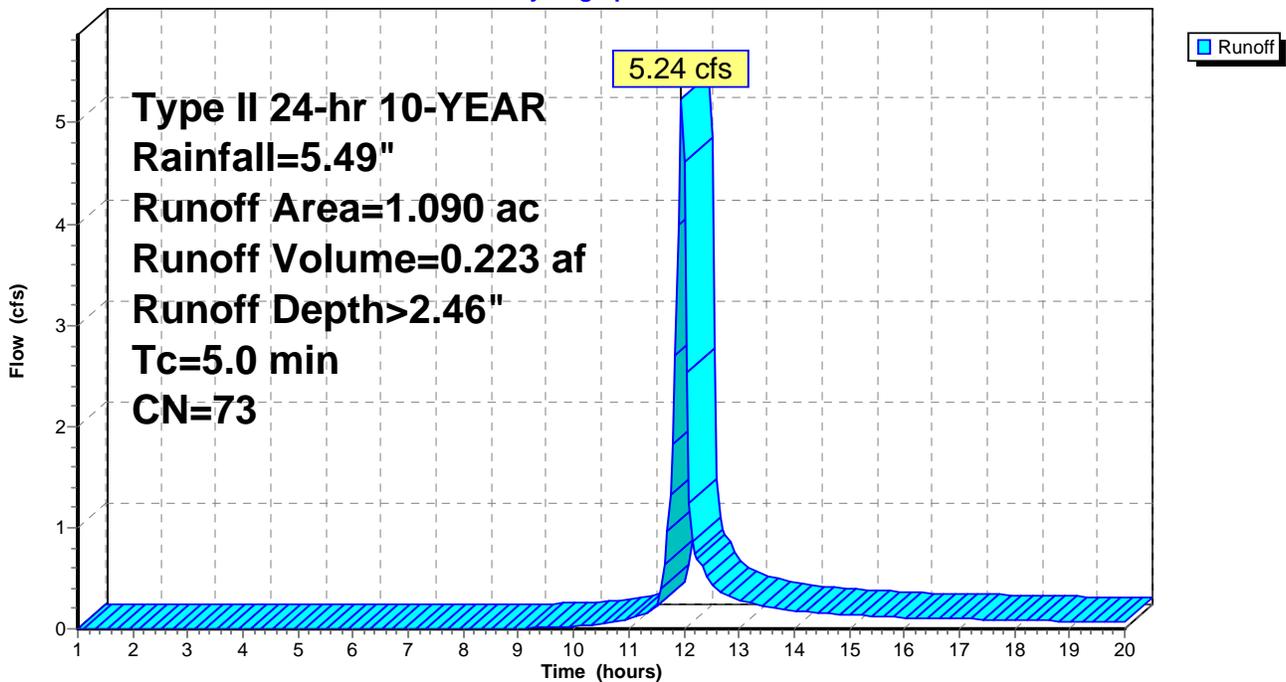
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Type II 24-hr 10-YEAR Rainfall=5.49"

Area (ac)	CN	Description
0.790	69	Pasture/grassland/range, Fair, HSG B
0.300	85	Gravel roads, HSG B
1.090	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 14S: DA-4

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 10

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Reach 3R: 18" RCP Pipe

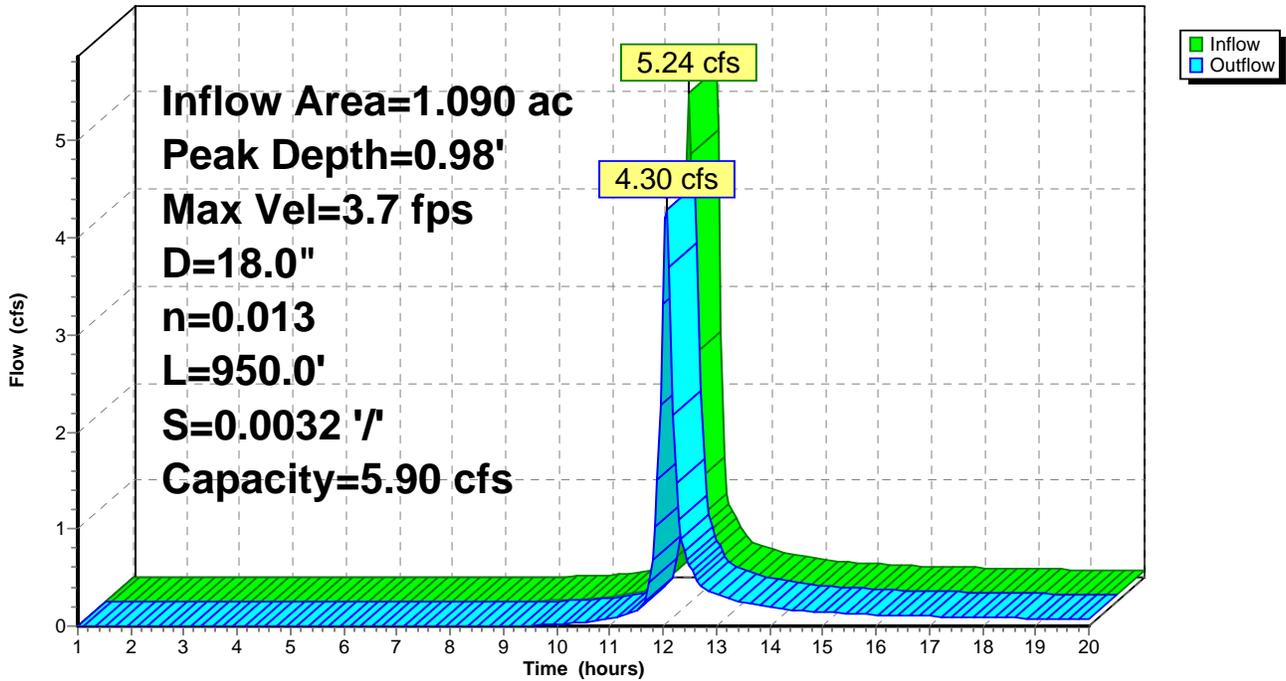
Inflow Area = 1.090 ac, Inflow Depth > 2.46" for 10-YEAR event
Inflow = 5.24 cfs @ 11.96 hrs, Volume= 0.223 af
Outflow = 4.30 cfs @ 12.07 hrs, Volume= 0.221 af, Atten= 18%, Lag= 6.9 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.7 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 11.9 min

Peak Depth= 0.98' @ 12.00 hrs
Capacity at bank full= 5.90 cfs
Inlet Invert= 207.00', Outlet Invert= 204.00'
18.0" Diameter Pipe, n= 0.013 Concrete pipe, bends & connections
Length= 950.0' Slope= 0.0032 '/'

Reach 3R: 18" RCP Pipe

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 11

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Reach 4R: Channel DC - 2B

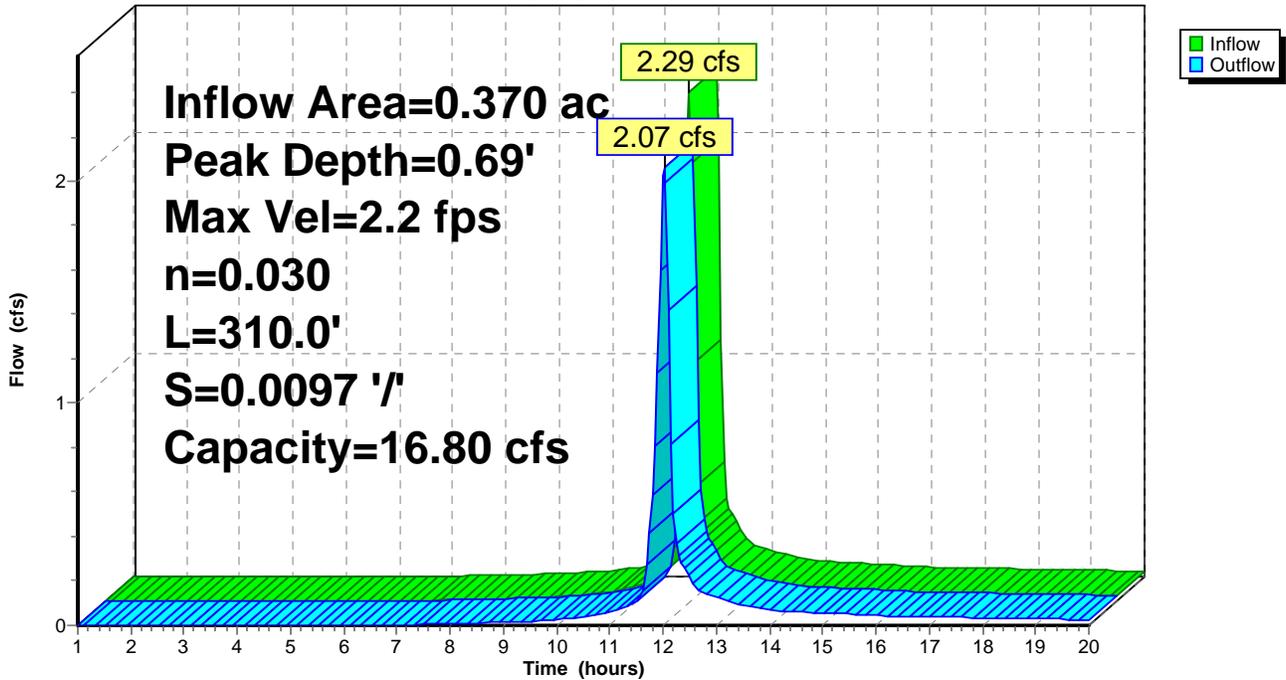
Inflow Area = 0.370 ac, Inflow Depth > 3.28" for 10-YEAR event
Inflow = 2.29 cfs @ 11.95 hrs, Volume= 0.101 af
Outflow = 2.07 cfs @ 12.02 hrs, Volume= 0.101 af, Atten= 10%, Lag= 4.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.2 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 6.2 min

Peak Depth= 0.69' @ 11.98 hrs
Capacity at bank full= 16.80 cfs
Inlet Invert= 214.00', Outlet Invert= 211.00'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/ Top Width= 6.00'
Length= 310.0' Slope= 0.0097 '/

Reach 4R: Channel DC - 2B

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 12

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Reach 5R: Channel DC-2A

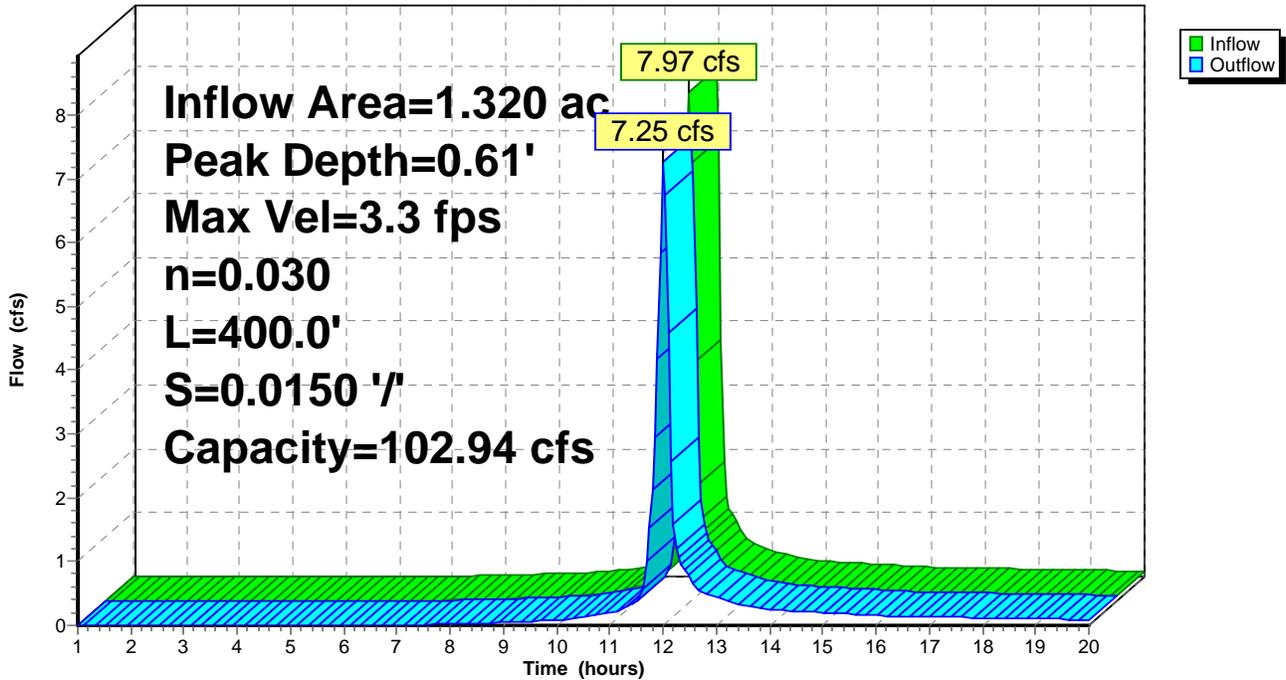
Inflow Area = 1.320 ac, Inflow Depth > 3.18" for 10-YEAR event
Inflow = 7.97 cfs @ 11.96 hrs, Volume= 0.350 af
Outflow = 7.25 cfs @ 12.01 hrs, Volume= 0.349 af, Atten= 9%, Lag= 3.5 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.3 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 6.8 min

Peak Depth= 0.61' @ 11.98 hrs
Capacity at bank full= 102.94 cfs
Inlet Invert= 216.00', Outlet Invert= 210.00'
2.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 400.0' Slope= 0.0150 '/'

Reach 5R: Channel DC-2A

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 13

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Reach 6R: 18" Culvert

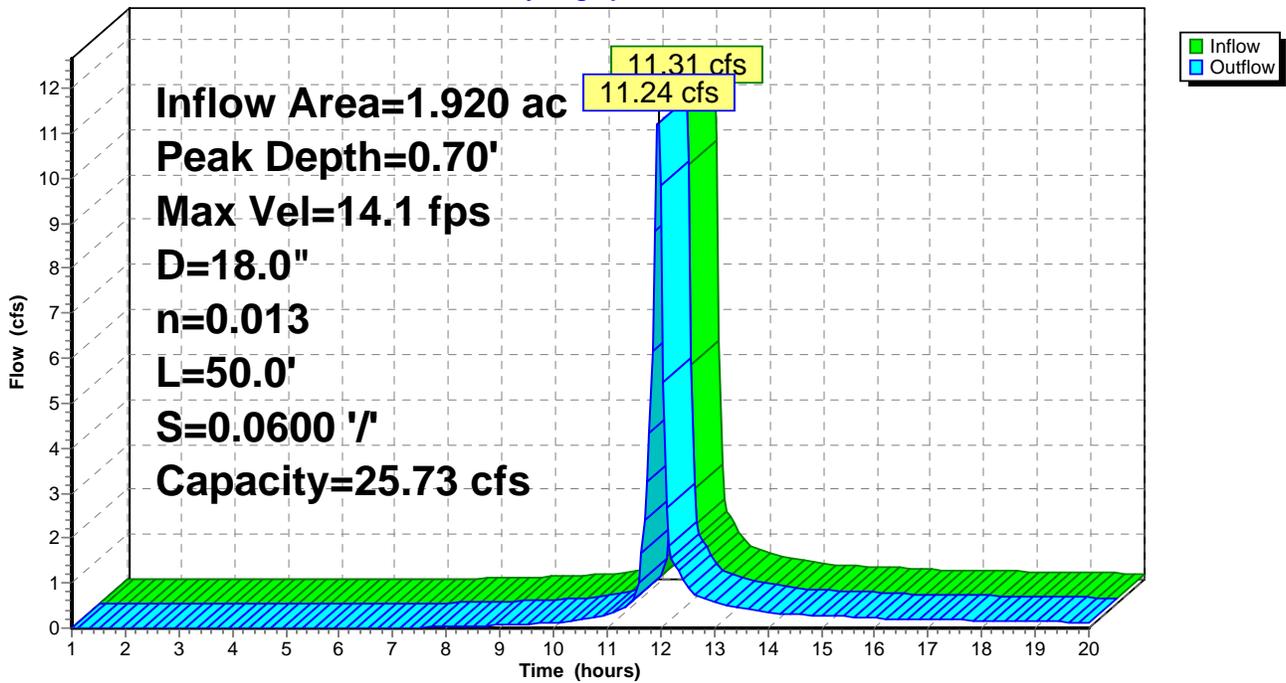
Inflow Area = 1.920 ac, Inflow Depth > 3.09" for 10-YEAR event
Inflow = 11.31 cfs @ 11.96 hrs, Volume= 0.494 af
Outflow = 11.24 cfs @ 11.96 hrs, Volume= 0.494 af, Atten= 1%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.1 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.5 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.70' @ 11.96 hrs
Capacity at bank full= 25.73 cfs
Inlet Invert= 212.00', Outlet Invert= 209.00'
18.0" Diameter Pipe, n= 0.013 Corrugated PE, smooth interior
Length= 50.0' Slope= 0.0600 '/'

Reach 6R: 18" Culvert

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 14

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Reach 7R: Channel DC-1A

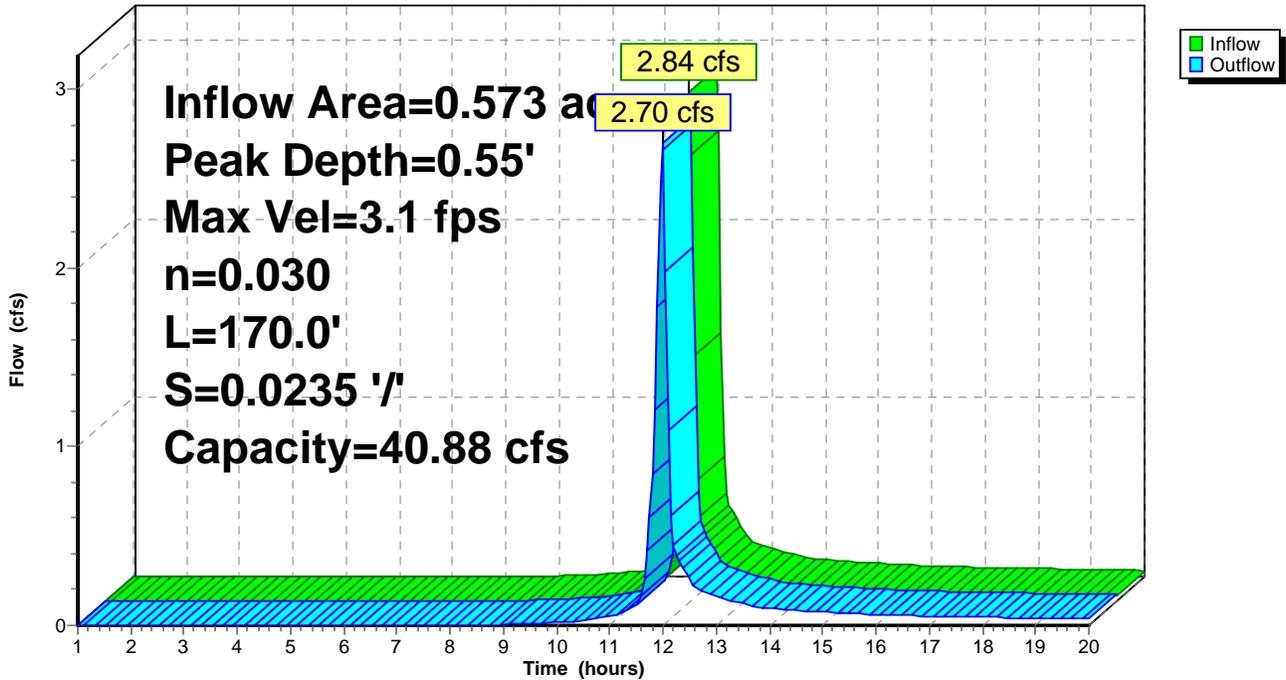
Inflow Area = 0.573 ac, Inflow Depth > 2.54" for 10-YEAR event
Inflow = 2.84 cfs @ 11.96 hrs, Volume= 0.121 af
Outflow = 2.70 cfs @ 11.99 hrs, Volume= 0.121 af, Atten= 5%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.1 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 2.4 min

Peak Depth= 0.55' @ 11.97 hrs
Capacity at bank full= 40.88 cfs
Inlet Invert= 214.00', Outlet Invert= 210.00'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/ Top Width= 9.00'
Length= 170.0' Slope= 0.0235 '/

Reach 7R: Channel DC-1A

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 15

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Pond 1P: Sediment Basin - 1

Inflow Area = 3.473 ac, Inflow Depth > 3.13" for 10-YEAR event
 Inflow = 20.25 cfs @ 11.96 hrs, Volume= 0.907 af
 Outflow = 1.34 cfs @ 12.66 hrs, Volume= 0.349 af, Atten= 93%, Lag= 42.3 min
 Primary = 0.23 cfs @ 12.66 hrs, Volume= 0.175 af
 Secondary = 1.11 cfs @ 12.66 hrs, Volume= 0.174 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 212.08' @ 12.66 hrs Surf.Area= 7,442 sf Storage= 24,883 cf
 Plug-Flow detention time= 202.8 min calculated for 0.348 af (38% of inflow)
 Center-of-Mass det. time= 116.8 min (890.1 - 773.3)

Volume	Invert	Avail.Storage	Storage Description
#1	207.00'	32,200 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
207.00	2,650	0	0
209.00	4,250	6,900	6,900
211.00	6,325	10,575	17,475
213.00	8,400	14,725	32,200

Device	Routing	Invert	Outlet Devices
#1	Primary	207.00'	4.0" x 120.0' long Barrel CPP, square edge headwall, Ke= 0.500 Outlet Invert= 206.00' S= 0.0083 '/ Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior
#2	Secondary	212.00'	20.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Device 1	207.00'	2.0" Vert. Faircloth Skimmer C= 0.600

Primary OutFlow Max=0.23 cfs @ 12.66 hrs HW=212.08' (Free Discharge)

↑**1=Barrel** (Passes 0.23 cfs of 0.27 cfs potential flow)

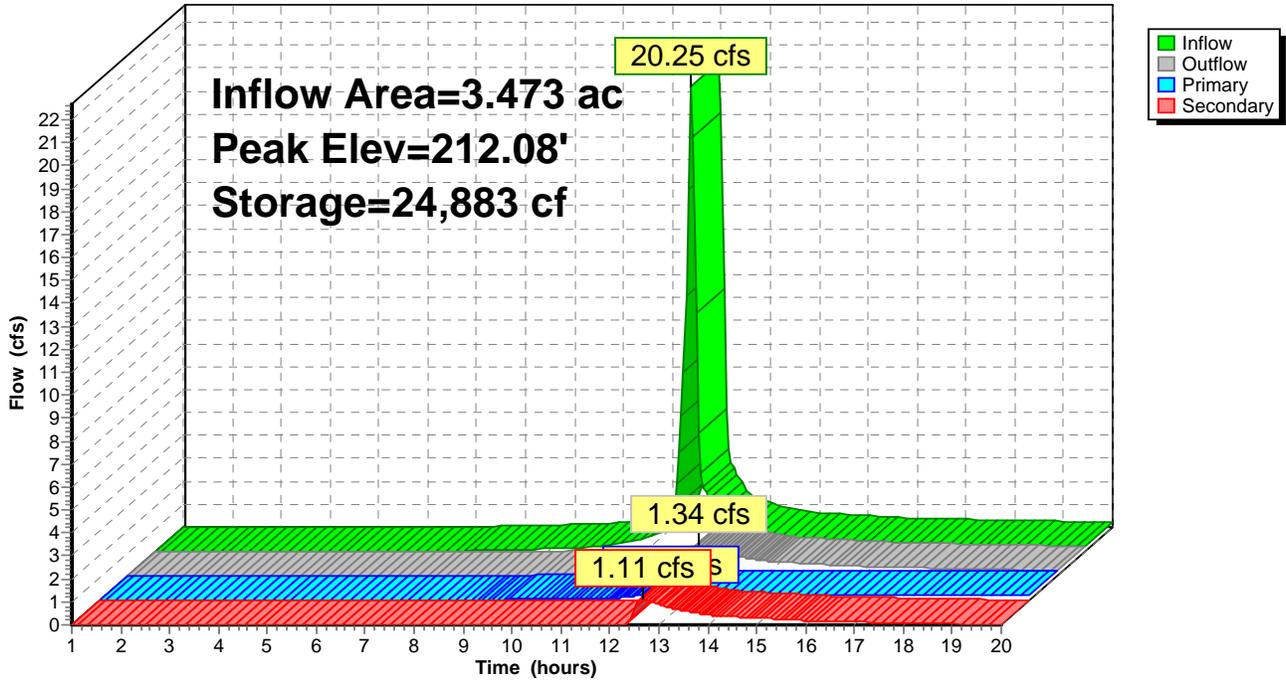
↑**3=Faircloth Skimmer** (Orifice Controls 0.23 cfs @ 10.8 fps)

Secondary OutFlow Max=1.04 cfs @ 12.66 hrs HW=212.08' (Free Discharge)

↑**2=Emergency Spillway** (Weir Controls 1.04 cfs @ 0.7 fps)

Pond 1P: Sediment Basin - 1

Hydrograph



Thornton Road rev 2

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 17

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Pond 2P: Sediment Basin - 2

Inflow Area = 2.130 ac, Inflow Depth > 3.15" for 10-YEAR event
 Inflow = 11.40 cfs @ 12.00 hrs, Volume= 0.559 af
 Outflow = 6.02 cfs @ 12.12 hrs, Volume= 0.351 af, Atten= 47%, Lag= 7.2 min
 Primary = 0.20 cfs @ 12.12 hrs, Volume= 0.144 af
 Secondary = 5.82 cfs @ 12.12 hrs, Volume= 0.207 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 209.68' @ 12.12 hrs Surf.Area= 4,776 sf Storage= 10,956 cf
 Plug-Flow detention time= 128.1 min calculated for 0.350 af (63% of inflow)
 Center-of-Mass det. time= 57.1 min (834.4 - 777.3)

Volume	Invert	Avail.Storage	Storage Description
#1	206.00'	12,556 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
206.00	1,185	0	0
210.00	5,093	12,556	12,556

Device	Routing	Invert	Outlet Devices
#1	Primary	206.00'	4.0" x 40.0' long Culvert CPP, square edge headwall, Ke= 0.500 Outlet Invert= 205.00' S= 0.0250 '/ Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior
#2	Secondary	209.30'	10.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Device 1	206.00'	2.0" Vert. Faircloth Skimmer C= 0.600

Primary OutFlow Max=0.20 cfs @ 12.12 hrs HW=209.65' (Free Discharge)

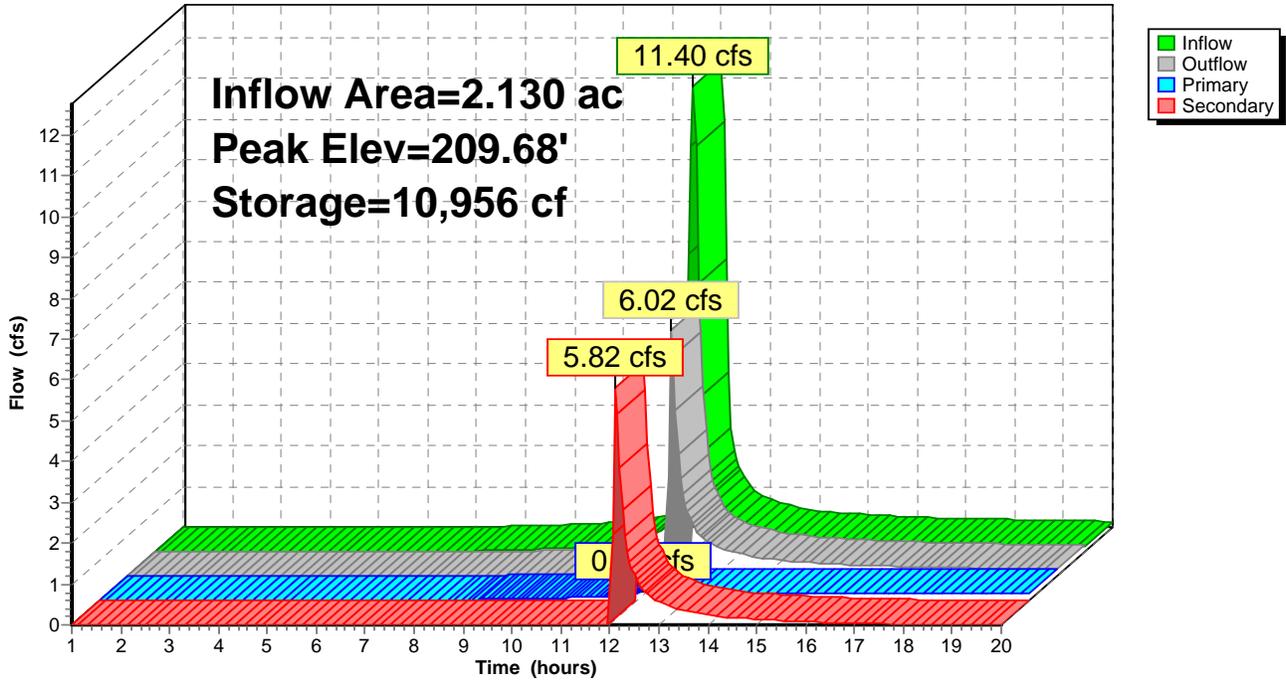
- ↑1=Culvert (Passes 0.20 cfs of 0.38 cfs potential flow)
- ↑3=Faircloth Skimmer (Orifice Controls 0.20 cfs @ 9.1 fps)

Secondary OutFlow Max=5.37 cfs @ 12.12 hrs HW=209.65' (Free Discharge)

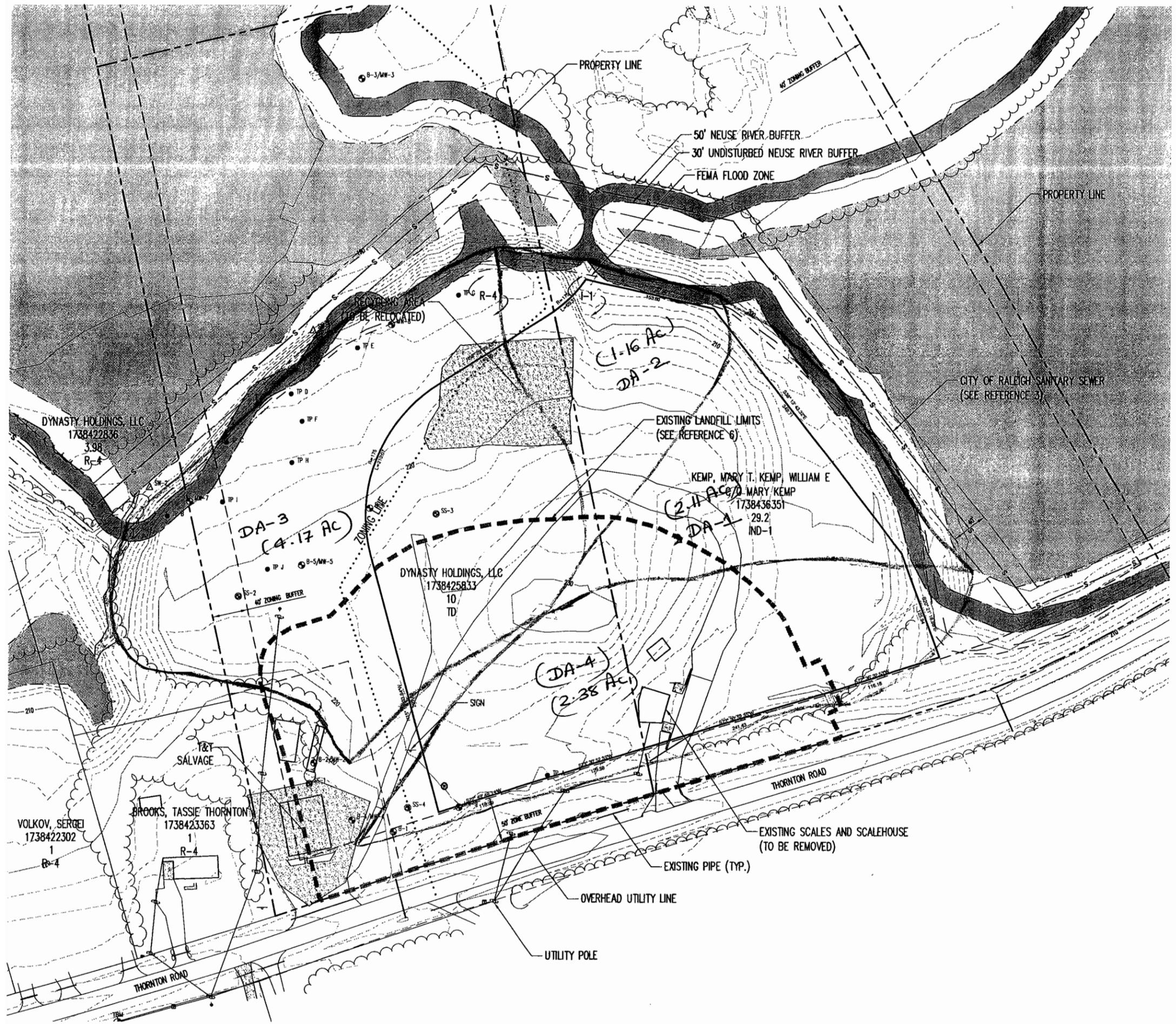
- ↑2=Emergency Spillway (Weir Controls 5.37 cfs @ 1.5 fps)

Pond 2P: Sediment Basin - 2

Hydrograph



HydroCAD Analysis of Pre-Development Condition
(10-Year Storm Event)



PRE - DEVELOPMENT
 CONDITION

Thornton Road - Pre Development

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 1

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Time span=1.00-20.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland a Runoff Area=4.170 ac Runoff Depth>2.20"
Flow Length=200' Tc=6.3 min CN=70 Runoff=17.35 cfs 0.765 af

Subcatchment 14S: DA-4 (Direct Sheet Flow into the Wetland Runoff Area=2.380 ac Runoff Depth>2.20"
Flow Length=240' Tc=7.9 min CN=70 Runoff=9.42 cfs 0.436 af

Subcatchment 15S: DA-2 (Direct Sheet Flow into the wetland Runoff Area=1.160 ac Runoff Depth>2.37"
Flow Length=150' Tc=4.7 min CN=72 Runoff=5.47 cfs 0.229 af

Subcatchment 16S: DA-1 (Direct Sheet Flow into the wetland Runoff Area=2.110 ac Runoff Depth>2.20"
Flow Length=180' Tc=5.6 min CN=70 Runoff=8.91 cfs 0.387 af

Total Runoff Area = 9.820 ac Runoff Volume = 1.818 af Average Runoff Depth = 2.22"

Thornton Road - Pre Development

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 2

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland at northwest site)

Runoff = 17.35 cfs @ 11.98 hrs, Volume= 0.765 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-YEAR Rainfall=5.49"

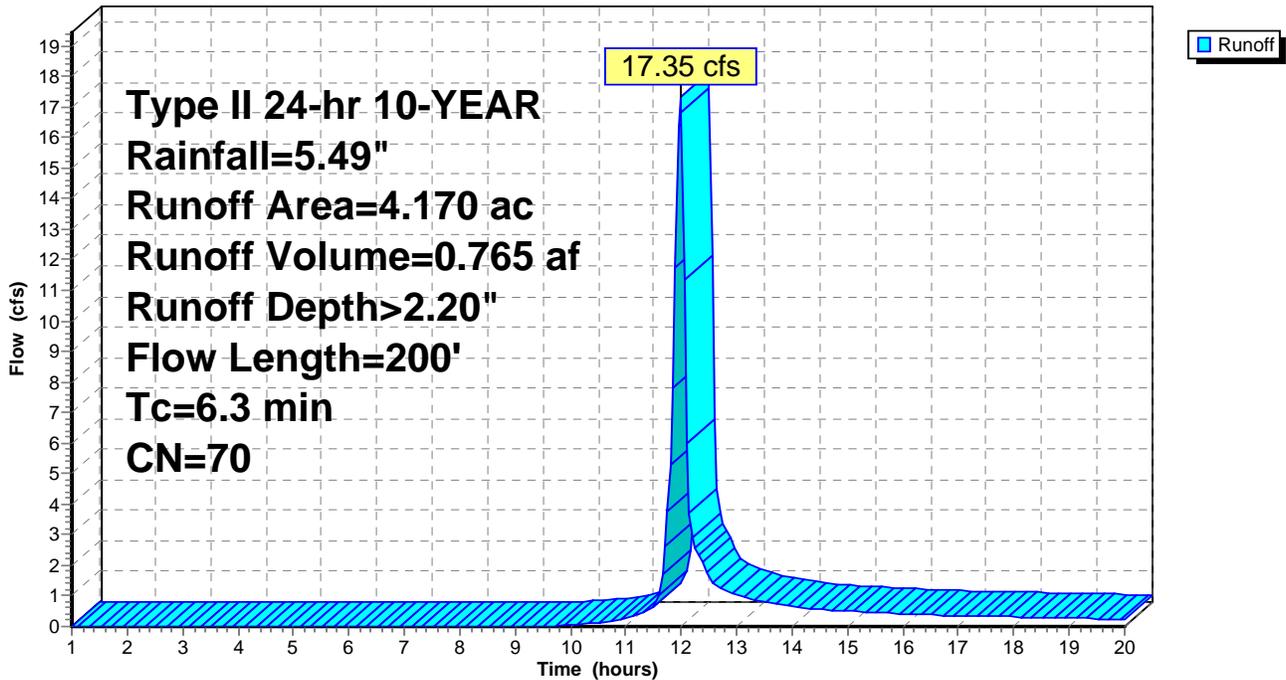
Area (ac)	CN	Description
3.790	69	Pasture/grassland/range, Fair, HSG B
0.160	85	Gravel roads, HSG B
0.220	85	Gravel roads, HSG B
4.170	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	200	0.1500	0.5		

Sheet Flow,
Range n= 0.130 P2= 3.70"

Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland at northwest site)

Hydrograph



Thornton Road - Pre Development

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 3

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 14S: DA-4 (Direct Sheet Flow into the Wetland at Eastern Site)

Runoff = 9.42 cfs @ 12.00 hrs, Volume= 0.436 af, Depth> 2.20"

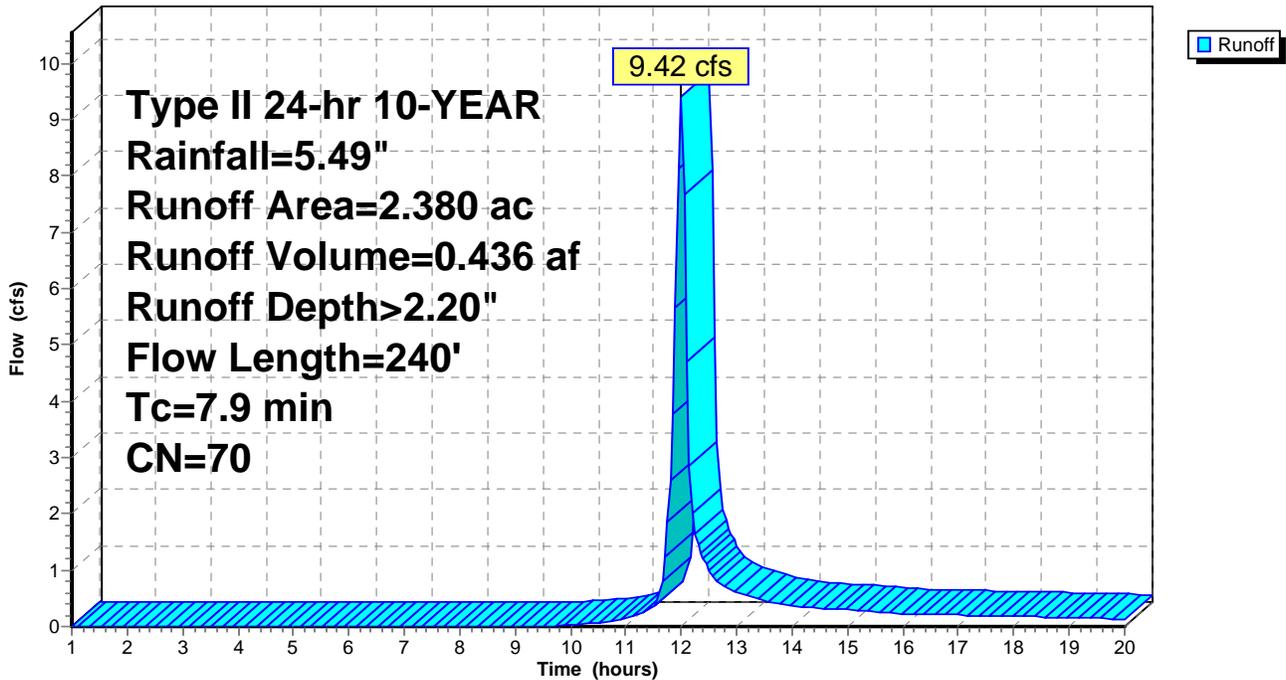
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Type II 24-hr 10-YEAR Rainfall=5.49"

Area (ac)	CN	Description
2.190	69	Pasture/grassland/range, Fair, HSG B
0.150	85	Gravel roads, HSG B
0.040	98	Paved parking & roofs
2.380	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	240	0.1250	0.5		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 14S: DA-4 (Direct Sheet Flow into the Wetland at Eastern Site)

Hydrograph



Thornton Road - Pre Development

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 4

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 15S: DA-2 (Direct Sheet Flow into the wetland on northern side)

Runoff = 5.47 cfs @ 11.96 hrs, Volume= 0.229 af, Depth> 2.37"

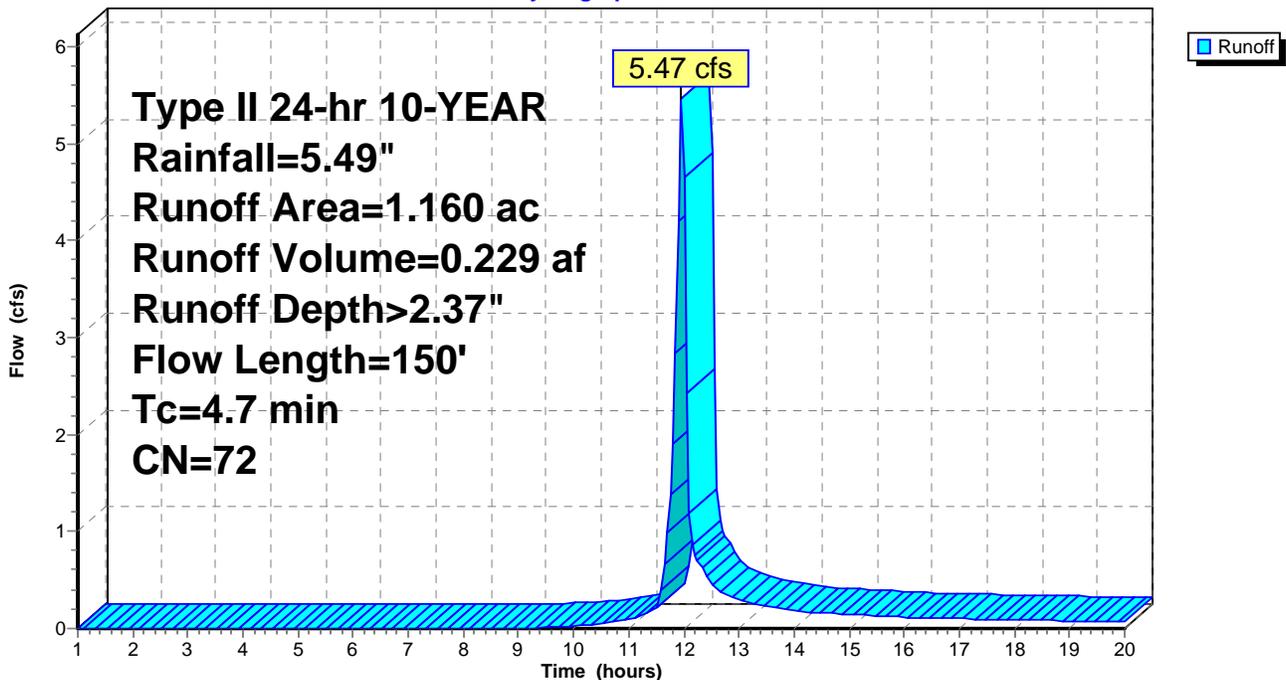
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YEAR Rainfall=5.49"

Area (ac)	CN	Description
0.966	69	Pasture/grassland/range, Fair, HSG B
0.074	85	Gravel roads, HSG B
0.120	85	Recycling area
1.160	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	150	0.1800	0.5		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 15S: DA-2 (Direct Sheet Flow into the wetland on northern side)

Hydrograph



Thornton Road - Pre Development

Type II 24-hr 10-YEAR Rainfall=5.49"

Prepared by {enter your company name here}

Page 5

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 16S: DA-1 (Direct Sheet Flow into the wetland on northeast side)

Runoff = 8.91 cfs @ 11.97 hrs, Volume= 0.387 af, Depth> 2.20"

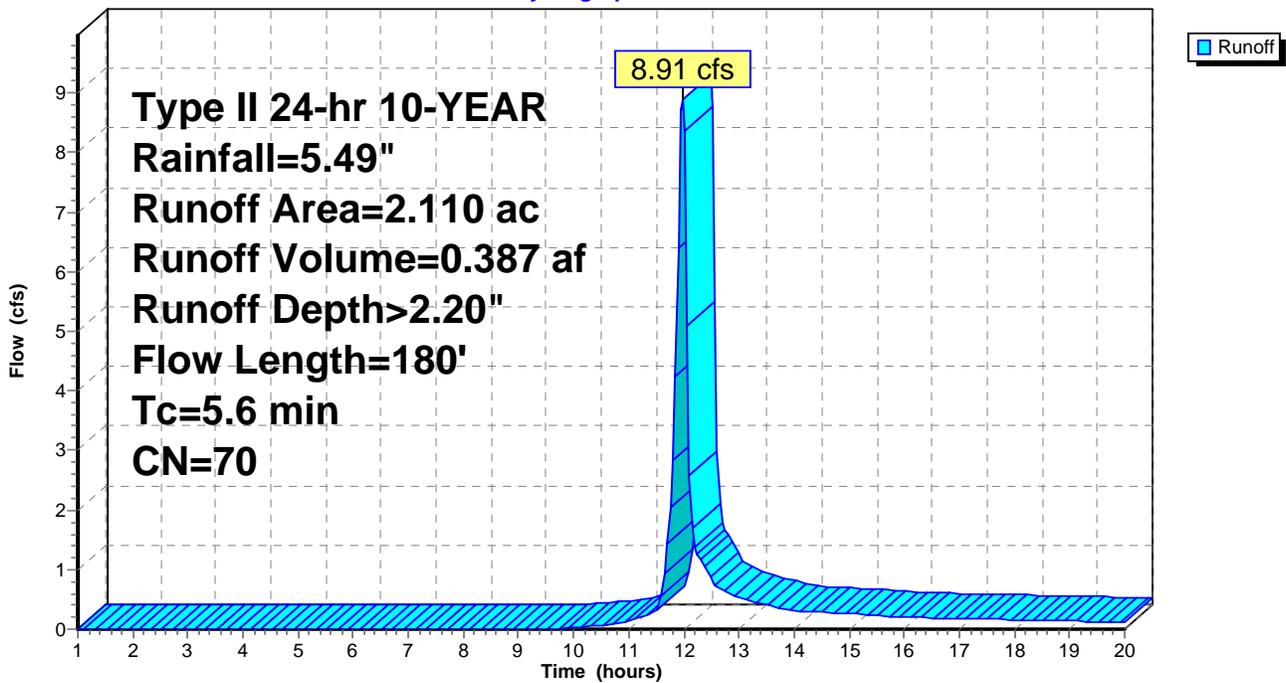
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YEAR Rainfall=5.49"

Area (ac)	CN	Description
2.000	69	Pasture/grassland/range, Fair, HSG B
0.110	85	Gravel roads, HSG B
2.110	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	180	0.1660	0.5		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 16S: DA-1 (Direct Sheet Flow into the wetland on northeast side)

Hydrograph



HydroCAD Analysis of Post-Development Condition
(2-Year Storm Event)

Thornton Road rev 2

Type II 24-hr 2-YEAR Rainfall=3.64"

Prepared by {enter your company name here}

Page 1

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Time span=1.00-20.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: DA - 2CRunoff Area=0.370 ac Runoff Depth>1.75"
Tc=5.0 min CN=82 Runoff=1.26 cfs 0.054 af**Subcatchment 4S: DA-1B**Runoff Area=1.920 ac Runoff Depth>1.61"
Tc=5.0 min CN=80 Runoff=6.04 cfs 0.257 af**Subcatchment 6S: DA - 2B**Runoff Area=0.440 ac Runoff Depth>1.54"
Tc=5.0 min CN=79 Runoff=1.33 cfs 0.056 af**Subcatchment 8S: DA - 2A**Runoff Area=1.320 ac Runoff Depth>1.68"
Tc=5.0 min CN=81 Runoff=4.33 cfs 0.185 af**Subcatchment 9S: DA-1A**Runoff Area=0.573 ac Runoff Depth>1.21"
Tc=5.0 min CN=74 Runoff=1.38 cfs 0.058 af**Subcatchment 10S: DA - 1C**Runoff Area=0.980 ac Runoff Depth>1.98"
Tc=5.0 min CN=85 Runoff=3.73 cfs 0.162 af**Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland area)**
Runoff Area=2.800 ac Runoff Depth>0.93"
Flow Length=190' Tc=7.1 min CN=69 Runoff=4.78 cfs 0.217 af**Subcatchment 14S: DA-4**Runoff Area=1.090 ac Runoff Depth>1.15"
Tc=5.0 min CN=73 Runoff=2.49 cfs 0.105 af**Reach 3R: 18" RCP Pipe**Peak Depth=0.61' Max Vel=3.0 fps Inflow=2.49 cfs 0.105 af
D=18.0" n=0.013 L=950.0' S=0.0032 '/' Capacity=5.90 cfs Outflow=1.97 cfs 0.104 af**Reach 4R: Channel DC - 2B**Peak Depth=0.55' Max Vel=1.9 fps Inflow=1.26 cfs 0.054 af
n=0.030 L=310.0' S=0.0097 '/' Capacity=16.80 cfs Outflow=1.15 cfs 0.054 af**Reach 5R: Channel DC-2A**Peak Depth=0.44' Max Vel=2.8 fps Inflow=4.33 cfs 0.185 af
n=0.030 L=400.0' S=0.0150 '/' Capacity=102.94 cfs Outflow=3.93 cfs 0.184 af**Reach 6R: 18" Culvert**Peak Depth=0.49' Max Vel=11.9 fps Inflow=6.04 cfs 0.257 af
D=18.0" n=0.013 L=50.0' S=0.0600 '/' Capacity=25.73 cfs Outflow=6.00 cfs 0.257 af**Reach 7R: Channel DC-1A**Peak Depth=0.42' Max Vel=2.6 fps Inflow=1.38 cfs 0.058 af
n=0.030 L=170.0' S=0.0235 '/' Capacity=40.88 cfs Outflow=1.29 cfs 0.058 af**Pond 1P: Sediment Basin - 1**Peak Elev=210.62' Storage=15,133 cf Inflow=10.89 cfs 0.477 af
Primary=0.20 cfs 0.136 af Secondary=0.00 cfs 0.000 af Outflow=0.20 cfs 0.136 af**Pond 2P: Sediment Basin - 2**Peak Elev=209.09' Storage=8,332 cf Inflow=6.02 cfs 0.294 af
Primary=0.18 cfs 0.125 af Secondary=0.00 cfs 0.000 af Outflow=0.18 cfs 0.125 af**Total Runoff Area = 9.493 ac Runoff Volume = 1.094 af Average Runoff Depth = 1.38"**

Thornton Road rev 2

Type II 24-hr 2-YEAR Rainfall=3.64"

Prepared by {enter your company name here}

Page 2

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 3S: DA - 2C

Runoff = 1.26 cfs @ 11.96 hrs, Volume= 0.054 af, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
0.240	79	<50% Grass cover, Poor, HSG B
0.110	85	Gravel roads, HSG B
0.020	98	Paved parking & roofs
0.370	82	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 4S: DA-1B

Runoff = 6.04 cfs @ 11.96 hrs, Volume= 0.257 af, Depth> 1.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
0.770	69	50-75% Grass cover, Fair, HSG B
0.950	85	Gravel roads, HSG B
0.200	98	Paved parking & roofs
1.920	80	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 6S: DA - 2B

Runoff = 1.33 cfs @ 11.96 hrs, Volume= 0.056 af, Depth> 1.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
0.440	79	<50% Grass cover, Poor, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Thornton Road rev 2

Type II 24-hr 2-YEAR Rainfall=3.64"

Prepared by {enter your company name here}

Page 3

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 8S: DA - 2A

Runoff = 4.33 cfs @ 11.96 hrs, Volume= 0.185 af, Depth> 1.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
1.020	79	50-75% Grass cover, Fair, HSG C
0.300	89	Gravel roads, HSG C
1.320	81	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 9S: DA-1A

Runoff = 1.38 cfs @ 11.96 hrs, Volume= 0.058 af, Depth> 1.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
0.390	69	50-75% Grass cover, Fair, HSG B
0.180	85	Gravel roads, HSG B
0.003	98	Paved parking & roofs
0.573	74	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 10S: DA - 1C

Runoff = 3.73 cfs @ 11.96 hrs, Volume= 0.162 af, Depth> 1.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
0.520	79	<50% Grass cover, Poor, HSG B
0.230	85	Gravel roads, HSG B
0.230	98	Paved parking & roofs
0.980	85	Weighted Average

Thornton Road rev 2

Type II 24-hr 2-YEAR Rainfall=3.64"

Prepared by {enter your company name here}

Page 4

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland at Northern Site)

Runoff = 4.78 cfs @ 11.99 hrs, Volume= 0.217 af, Depth> 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
2.800	69	Pasture/grassland/range, Fair, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	190	0.1000	0.4		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 14S: DA-4

Runoff = 2.49 cfs @ 11.96 hrs, Volume= 0.105 af, Depth> 1.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
0.790	69	Pasture/grassland/range, Fair, HSG B
0.300	85	Gravel roads, HSG B
1.090	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Reach 3R: 18" RCP Pipe

Inflow Area = 1.090 ac, Inflow Depth > 1.15" for 2-YEAR event
 Inflow = 2.49 cfs @ 11.96 hrs, Volume= 0.105 af
 Outflow = 1.97 cfs @ 12.10 hrs, Volume= 0.104 af, Atten= 21%, Lag= 8.3 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Max. Velocity= 3.0 fps, Min. Travel Time= 5.2 min
 Avg. Velocity= 1.2 fps, Avg. Travel Time= 13.5 min

Peak Depth= 0.61' @ 12.01 hrs
 Capacity at bank full= 5.90 cfs
 Inlet Invert= 207.00', Outlet Invert= 204.00'
 18.0" Diameter Pipe, n= 0.013 Concrete pipe, bends & connections
 Length= 950.0' Slope= 0.0032 '/'

Thornton Road rev 2

Type II 24-hr 2-YEAR Rainfall=3.64"

Prepared by {enter your company name here}

Page 5

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Reach 4R: Channel DC - 2B

Inflow Area = 0.370 ac, Inflow Depth > 1.75" for 2-YEAR event
Inflow = 1.26 cfs @ 11.96 hrs, Volume= 0.054 af
Outflow = 1.15 cfs @ 12.04 hrs, Volume= 0.054 af, Atten= 9%, Lag= 4.7 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.9 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 6.9 min

Peak Depth= 0.55' @ 11.99 hrs
Capacity at bank full= 16.80 cfs
Inlet Invert= 214.00', Outlet Invert= 211.00'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 310.0' Slope= 0.0097 '/'

Reach 5R: Channel DC-2A

Inflow Area = 1.320 ac, Inflow Depth > 1.68" for 2-YEAR event
Inflow = 4.33 cfs @ 11.96 hrs, Volume= 0.185 af
Outflow = 3.93 cfs @ 12.03 hrs, Volume= 0.184 af, Atten= 9%, Lag= 4.2 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.8 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 7.8 min

Peak Depth= 0.44' @ 11.99 hrs
Capacity at bank full= 102.94 cfs
Inlet Invert= 216.00', Outlet Invert= 210.00'
2.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 400.0' Slope= 0.0150 '/'

Reach 6R: 18" Culvert

Inflow Area = 1.920 ac, Inflow Depth > 1.61" for 2-YEAR event
Inflow = 6.04 cfs @ 11.96 hrs, Volume= 0.257 af
Outflow = 6.00 cfs @ 11.96 hrs, Volume= 0.257 af, Atten= 1%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.9 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.0 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.49' @ 11.96 hrs
Capacity at bank full= 25.73 cfs
Inlet Invert= 212.00', Outlet Invert= 209.00'
18.0" Diameter Pipe, n= 0.013 Corrugated PE, smooth interior
Length= 50.0' Slope= 0.0600 '/'

Thornton Road rev 2

Type II 24-hr 2-YEAR Rainfall=3.64"

Prepared by {enter your company name here}

Page 6

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Reach 7R: Channel DC-1A

Inflow Area = 0.573 ac, Inflow Depth > 1.21" for 2-YEAR event
 Inflow = 1.38 cfs @ 11.96 hrs, Volume= 0.058 af
 Outflow = 1.29 cfs @ 12.00 hrs, Volume= 0.058 af, Atten= 6%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Max. Velocity= 2.6 fps, Min. Travel Time= 1.1 min
 Avg. Velocity = 1.1 fps, Avg. Travel Time= 2.6 min

Peak Depth= 0.42' @ 11.98 hrs
 Capacity at bank full= 40.88 cfs
 Inlet Invert= 214.00', Outlet Invert= 210.00'
 0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
 Side Slope Z-value= 3.0 '/' Top Width= 9.00'
 Length= 170.0' Slope= 0.0235 '/'

Pond 1P: Sediment Basin - 1

Inflow Area = 3.473 ac, Inflow Depth > 1.65" for 2-YEAR event
 Inflow = 10.89 cfs @ 11.96 hrs, Volume= 0.477 af
 Outflow = 0.20 cfs @ 17.37 hrs, Volume= 0.136 af, Atten= 98%, Lag= 324.7 min
 Primary = 0.20 cfs @ 17.37 hrs, Volume= 0.136 af
 Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 210.62' @ 17.37 hrs Surf.Area= 5,928 sf Storage= 15,133 cf
 Plug-Flow detention time= 252.0 min calculated for 0.136 af (29% of inflow)
 Center-of-Mass det. time= 160.5 min (947.6 - 787.1)

Volume	Invert	Avail.Storage	Storage Description
#1	207.00'	32,200 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
207.00	2,650	0	0
209.00	4,250	6,900	6,900
211.00	6,325	10,575	17,475
213.00	8,400	14,725	32,200

Device	Routing	Invert	Outlet Devices
#1	Primary	207.00'	4.0" x 120.0' long Barrel CPP, square edge headwall, Ke= 0.500 Outlet Invert= 206.00' S= 0.0083 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior
#2	Secondary	212.00'	20.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Device 1	207.00'	2.0" Vert. Faircloth Skimmer C= 0.600

Thornton Road rev 2

Type II 24-hr 2-YEAR Rainfall=3.64"

Prepared by {enter your company name here}

Page 7

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Primary OutFlow Max=0.20 cfs @ 17.37 hrs HW=210.62' (Free Discharge)

↑1=Barrel (Passes 0.20 cfs of 0.23 cfs potential flow)

↑3=Faircloth Skimmer (Orifice Controls 0.20 cfs @ 9.1 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=207.00' (Free Discharge)

↑2=Emergency Spillway (Controls 0.00 cfs)

Pond 2P: Sediment Basin - 2

Inflow Area = 2.130 ac, Inflow Depth > 1.66" for 2-YEAR event
 Inflow = 6.02 cfs @ 12.01 hrs, Volume= 0.294 af
 Outflow = 0.18 cfs @ 15.16 hrs, Volume= 0.125 af, Atten= 97%, Lag= 188.7 min
 Primary = 0.18 cfs @ 15.16 hrs, Volume= 0.125 af
 Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 209.09' @ 15.16 hrs Surf.Area= 4,205 sf Storage= 8,332 cf
 Plug-Flow detention time= 238.1 min calculated for 0.125 af (43% of inflow)
 Center-of-Mass det. time= 154.4 min (946.3 - 791.9)

Volume	Invert	Avail.Storage	Storage Description
#1	206.00'	12,556 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
206.00	1,185	0	0
210.00	5,093	12,556	12,556

Device	Routing	Invert	Outlet Devices
#1	Primary	206.00'	4.0" x 40.0' long Culvert CPP, square edge headwall, Ke= 0.500 Outlet Invert= 205.00' S= 0.0250 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior
#2	Secondary	209.30'	10.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Device 1	206.00'	2.0" Vert. Faircloth Skimmer C= 0.600

Primary OutFlow Max=0.18 cfs @ 15.16 hrs HW=209.09' (Free Discharge)

↑1=Culvert (Passes 0.18 cfs of 0.36 cfs potential flow)

↑3=Faircloth Skimmer (Orifice Controls 0.18 cfs @ 8.4 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=206.00' (Free Discharge)

↑2=Emergency Spillway (Controls 0.00 cfs)

HydroCAD Analysis of Pre-Development Condition
(2-Year Storm Event)

Thornton Road - Pre Development

Type II 24-hr 2-YEAR Rainfall=3.64"

Prepared by {enter your company name here}

Page 1

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Time span=1.00-20.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland a Runoff Area=4.170 ac Runoff Depth>0.98"
Flow Length=200' Tc=6.3 min CN=70 Runoff=7.76 cfs 0.342 af

Subcatchment 14S: DA-4 (Direct Sheet Flow into the Wetland Runoff Area=2.380 ac Runoff Depth>0.98"
Flow Length=240' Tc=7.9 min CN=70 Runoff=4.18 cfs 0.195 af

Subcatchment 15S: DA-2 (Direct Sheet Flow into the wetland Runoff Area=1.160 ac Runoff Depth>1.10"
Flow Length=150' Tc=4.7 min CN=72 Runoff=2.55 cfs 0.106 af

Subcatchment 16S: DA-1 (Direct Sheet Flow into the wetland Runoff Area=2.110 ac Runoff Depth>0.98"
Flow Length=180' Tc=5.6 min CN=70 Runoff=4.00 cfs 0.173 af

Total Runoff Area = 9.820 ac Runoff Volume = 0.816 af Average Runoff Depth = 1.00"

Thornton Road - Pre Development

Type II 24-hr 2-YEAR Rainfall=3.64"

Prepared by {enter your company name here}

Page 2

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland at northwest site)

Runoff = 7.76 cfs @ 11.98 hrs, Volume= 0.342 af, Depth> 0.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
3.790	69	Pasture/grassland/range, Fair, HSG B
0.160	85	Gravel roads, HSG B
0.220	85	Gravel roads, HSG B
4.170	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	200	0.1500	0.5		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 14S: DA-4 (Direct Sheet Flow into the Wetland at Eastern Site)

Runoff = 4.18 cfs @ 12.00 hrs, Volume= 0.195 af, Depth> 0.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
2.190	69	Pasture/grassland/range, Fair, HSG B
0.150	85	Gravel roads, HSG B
0.040	98	Paved parking & roofs
2.380	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	240	0.1250	0.5		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 15S: DA-2 (Direct Sheet Flow into the wetland on northern side)

Runoff = 2.55 cfs @ 11.96 hrs, Volume= 0.106 af, Depth> 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
0.966	69	Pasture/grassland/range, Fair, HSG B
0.074	85	Gravel roads, HSG B
0.120	85	Recycling area
1.160	72	Weighted Average

Thornton Road - Pre Development

Type II 24-hr 2-YEAR Rainfall=3.64"

Prepared by {enter your company name here}

Page 3

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	150	0.1800	0.5		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 16S: DA-1 (Direct Sheet Flow into the wetland on northeast side)

Runoff = 4.00 cfs @ 11.98 hrs, Volume= 0.173 af, Depth> 0.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YEAR Rainfall=3.64"

Area (ac)	CN	Description
2.000	69	Pasture/grassland/range, Fair, HSG B
0.110	85	Gravel roads, HSG B
2.110	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	180	0.1660	0.5		Sheet Flow, Range n= 0.130 P2= 3.70"

HydroCAD Analysis of Post-Development Condition
(1-Year Storm Event)

Thornton Road rev 2

Type II 24-hr 1-YEAR Rainfall=3.20"

Prepared by {enter your company name here}

Page 1

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Time span=1.00-20.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: DA - 2CRunoff Area=0.370 ac Runoff Depth>1.41"
Tc=5.0 min CN=82 Runoff=1.02 cfs 0.044 af**Subcatchment 4S: DA-1B**Runoff Area=1.920 ac Runoff Depth>1.28"
Tc=5.0 min CN=80 Runoff=4.85 cfs 0.205 af**Subcatchment 6S: DA - 2B**Runoff Area=0.440 ac Runoff Depth>1.22"
Tc=5.0 min CN=79 Runoff=1.06 cfs 0.045 af**Subcatchment 8S: DA - 2A**Runoff Area=1.320 ac Runoff Depth>1.35"
Tc=5.0 min CN=81 Runoff=3.50 cfs 0.148 af**Subcatchment 9S: DA-1A**Runoff Area=0.573 ac Runoff Depth>0.94"
Tc=5.0 min CN=74 Runoff=1.06 cfs 0.045 af**Subcatchment 10S: DA - 1C**Runoff Area=0.980 ac Runoff Depth>1.63"
Tc=5.0 min CN=85 Runoff=3.08 cfs 0.133 af**Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland area)**
Runoff Area=2.800 ac Runoff Depth>0.69"
Flow Length=190' Tc=7.1 min CN=69 Runoff=3.49 cfs 0.162 af**Subcatchment 14S: DA-4**Runoff Area=1.090 ac Runoff Depth>0.88"
Tc=5.0 min CN=73 Runoff=1.89 cfs 0.080 af**Reach 3R: 18" RCP Pipe**Peak Depth=0.52' Max Vel=2.8 fps Inflow=1.89 cfs 0.080 af
D=18.0" n=0.013 L=950.0' S=0.0032 '/ Capacity=5.90 cfs Outflow=1.48 cfs 0.079 af**Reach 4R: Channel DC - 2B**Peak Depth=0.51' Max Vel=1.8 fps Inflow=1.02 cfs 0.044 af
n=0.030 L=310.0' S=0.0097 '/ Capacity=16.80 cfs Outflow=0.93 cfs 0.043 af**Reach 5R: Channel DC-2A**Peak Depth=0.39' Max Vel=2.6 fps Inflow=3.50 cfs 0.148 af
n=0.030 L=400.0' S=0.0150 '/ Capacity=102.94 cfs Outflow=3.18 cfs 0.147 af**Reach 6R: 18" Culvert**Peak Depth=0.44' Max Vel=11.1 fps Inflow=4.85 cfs 0.205 af
D=18.0" n=0.013 L=50.0' S=0.0600 '/ Capacity=25.73 cfs Outflow=4.82 cfs 0.205 af**Reach 7R: Channel DC-1A**Peak Depth=0.38' Max Vel=2.4 fps Inflow=1.06 cfs 0.045 af
n=0.030 L=170.0' S=0.0235 '/ Capacity=40.88 cfs Outflow=0.99 cfs 0.045 af**Pond 1P: Sediment Basin - 1**Peak Elev=210.01' Storage=11,733 cf Inflow=8.77 cfs 0.383 af
Primary=0.18 cfs 0.122 af Secondary=0.00 cfs 0.000 af Outflow=0.18 cfs 0.122 af**Pond 2P: Sediment Basin - 2**Peak Elev=208.61' Storage=6,417 cf Inflow=4.81 cfs 0.236 af
Primary=0.17 cfs 0.112 af Secondary=0.00 cfs 0.000 af Outflow=0.17 cfs 0.112 af**Total Runoff Area = 9.493 ac Runoff Volume = 0.861 af Average Runoff Depth = 1.09"**

Thornton Road rev 2

Type II 24-hr 1-YEAR Rainfall=3.20"

Prepared by {enter your company name here}

Page 2

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 3S: DA - 2C

Runoff = 1.02 cfs @ 11.96 hrs, Volume= 0.044 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
0.240	79	<50% Grass cover, Poor, HSG B
0.110	85	Gravel roads, HSG B
0.020	98	Paved parking & roofs
0.370	82	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 4S: DA-1B

Runoff = 4.85 cfs @ 11.96 hrs, Volume= 0.205 af, Depth> 1.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
0.770	69	50-75% Grass cover, Fair, HSG B
0.950	85	Gravel roads, HSG B
0.200	98	Paved parking & roofs
1.920	80	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 6S: DA - 2B

Runoff = 1.06 cfs @ 11.96 hrs, Volume= 0.045 af, Depth> 1.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
0.440	79	<50% Grass cover, Poor, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Thornton Road rev 2

Type II 24-hr 1-YEAR Rainfall=3.20"

Prepared by {enter your company name here}

Page 3

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 8S: DA - 2A

Runoff = 3.50 cfs @ 11.96 hrs, Volume= 0.148 af, Depth> 1.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
1.020	79	50-75% Grass cover, Fair, HSG C
0.300	89	Gravel roads, HSG C
1.320	81	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 9S: DA-1A

Runoff = 1.06 cfs @ 11.96 hrs, Volume= 0.045 af, Depth> 0.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
0.390	69	50-75% Grass cover, Fair, HSG B
0.180	85	Gravel roads, HSG B
0.003	98	Paved parking & roofs
0.573	74	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 10S: DA - 1C

Runoff = 3.08 cfs @ 11.96 hrs, Volume= 0.133 af, Depth> 1.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
0.520	79	<50% Grass cover, Poor, HSG B
0.230	85	Gravel roads, HSG B
0.230	98	Paved parking & roofs
0.980	85	Weighted Average

Thornton Road rev 2

Type II 24-hr 1-YEAR Rainfall=3.20"

Prepared by {enter your company name here}

Page 4

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland at Northern Site)

Runoff = 3.49 cfs @ 12.00 hrs, Volume= 0.162 af, Depth> 0.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
2.800	69	Pasture/grassland/range, Fair, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	190	0.1000	0.4		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 14S: DA-4

Runoff = 1.89 cfs @ 11.97 hrs, Volume= 0.080 af, Depth> 0.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
0.790	69	Pasture/grassland/range, Fair, HSG B
0.300	85	Gravel roads, HSG B
1.090	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Reach 3R: 18" RCP Pipe

Inflow Area = 1.090 ac, Inflow Depth > 0.88" for 1-YEAR event
 Inflow = 1.89 cfs @ 11.97 hrs, Volume= 0.080 af
 Outflow = 1.48 cfs @ 12.11 hrs, Volume= 0.079 af, Atten= 22%, Lag= 8.9 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Max. Velocity= 2.8 fps, Min. Travel Time= 5.7 min
 Avg. Velocity= 1.1 fps, Avg. Travel Time= 14.2 min

Peak Depth= 0.52' @ 12.02 hrs
 Capacity at bank full= 5.90 cfs
 Inlet Invert= 207.00', Outlet Invert= 204.00'
 18.0" Diameter Pipe, n= 0.013 Concrete pipe, bends & connections
 Length= 950.0' Slope= 0.0032 '/'

Thornton Road rev 2

Type II 24-hr 1-YEAR Rainfall=3.20"

Prepared by {enter your company name here}

Page 5

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Reach 4R: Channel DC - 2B

Inflow Area = 0.370 ac, Inflow Depth > 1.41" for 1-YEAR event
Inflow = 1.02 cfs @ 11.96 hrs, Volume= 0.044 af
Outflow = 0.93 cfs @ 12.04 hrs, Volume= 0.043 af, Atten= 9%, Lag= 4.9 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.8 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 7.1 min

Peak Depth= 0.51' @ 11.99 hrs
Capacity at bank full= 16.80 cfs
Inlet Invert= 214.00', Outlet Invert= 211.00'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 310.0' Slope= 0.0097 '/'

Reach 5R: Channel DC-2A

Inflow Area = 1.320 ac, Inflow Depth > 1.35" for 1-YEAR event
Inflow = 3.50 cfs @ 11.96 hrs, Volume= 0.148 af
Outflow = 3.18 cfs @ 12.03 hrs, Volume= 0.147 af, Atten= 9%, Lag= 4.5 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.6 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 8.1 min

Peak Depth= 0.39' @ 11.99 hrs
Capacity at bank full= 102.94 cfs
Inlet Invert= 216.00', Outlet Invert= 210.00'
2.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 400.0' Slope= 0.0150 '/'

Reach 6R: 18" Culvert

Inflow Area = 1.920 ac, Inflow Depth > 1.28" for 1-YEAR event
Inflow = 4.85 cfs @ 11.96 hrs, Volume= 0.205 af
Outflow = 4.82 cfs @ 11.96 hrs, Volume= 0.205 af, Atten= 1%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.1 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.8 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.44' @ 11.96 hrs
Capacity at bank full= 25.73 cfs
Inlet Invert= 212.00', Outlet Invert= 209.00'
18.0" Diameter Pipe, n= 0.013 Corrugated PE, smooth interior
Length= 50.0' Slope= 0.0600 '/'

Thornton Road rev 2

Type II 24-hr 1-YEAR Rainfall=3.20"

Prepared by {enter your company name here}

Page 6

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Reach 7R: Channel DC-1A

Inflow Area = 0.573 ac, Inflow Depth > 0.94" for 1-YEAR event
 Inflow = 1.06 cfs @ 11.96 hrs, Volume= 0.045 af
 Outflow = 0.99 cfs @ 12.00 hrs, Volume= 0.045 af, Atten= 6%, Lag= 2.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Max. Velocity= 2.4 fps, Min. Travel Time= 1.2 min
 Avg. Velocity = 1.0 fps, Avg. Travel Time= 2.7 min

Peak Depth= 0.38' @ 11.98 hrs
 Capacity at bank full= 40.88 cfs
 Inlet Invert= 214.00', Outlet Invert= 210.00'
 0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
 Side Slope Z-value= 3.0 '/' Top Width= 9.00'
 Length= 170.0' Slope= 0.0235 '/'

Pond 1P: Sediment Basin - 1

Inflow Area = 3.473 ac, Inflow Depth > 1.32" for 1-YEAR event
 Inflow = 8.77 cfs @ 11.96 hrs, Volume= 0.383 af
 Outflow = 0.18 cfs @ 16.64 hrs, Volume= 0.122 af, Atten= 98%, Lag= 280.3 min
 Primary = 0.18 cfs @ 16.64 hrs, Volume= 0.122 af
 Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 210.01' @ 16.64 hrs Surf.Area= 5,300 sf Storage= 11,733 cf
 Plug-Flow detention time= 250.2 min calculated for 0.122 af (32% of inflow)
 Center-of-Mass det. time= 159.9 min (951.6 - 791.7)

Volume	Invert	Avail.Storage	Storage Description
#1	207.00'	32,200 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
207.00	2,650	0	0
209.00	4,250	6,900	6,900
211.00	6,325	10,575	17,475
213.00	8,400	14,725	32,200

Device	Routing	Invert	Outlet Devices
#1	Primary	207.00'	4.0" x 120.0' long Barrel CPP, square edge headwall, Ke= 0.500 Outlet Invert= 206.00' S= 0.0083 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior
#2	Secondary	212.00'	20.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Device 1	207.00'	2.0" Vert. Faircloth Skimmer C= 0.600

Thornton Road rev 2

Type II 24-hr 1-YEAR Rainfall=3.20"

Prepared by {enter your company name here}

Page 7

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Primary OutFlow Max=0.18 cfs @ 16.64 hrs HW=210.01' (Free Discharge)

 ↑1=Barrel (Passes 0.18 cfs of 0.21 cfs potential flow)

 ↑3=Faircloth Skimmer (Orifice Controls 0.18 cfs @ 8.2 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=207.00' (Free Discharge)

 ↑2=Emergency Spillway (Controls 0.00 cfs)

Pond 2P: Sediment Basin - 2

Inflow Area = 2.130 ac, Inflow Depth > 1.33" for 1-YEAR event
 Inflow = 4.81 cfs @ 12.02 hrs, Volume= 0.236 af
 Outflow = 0.17 cfs @ 14.72 hrs, Volume= 0.112 af, Atten= 97%, Lag= 162.1 min
 Primary = 0.17 cfs @ 14.72 hrs, Volume= 0.112 af
 Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 208.61' @ 14.72 hrs Surf.Area= 3,734 sf Storage= 6,417 cf
 Plug-Flow detention time= 236.6 min calculated for 0.112 af (48% of inflow)
 Center-of-Mass det. time= 153.1 min (950.0 - 796.8)

Volume	Invert	Avail.Storage	Storage Description
#1	206.00'	12,556 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
206.00	1,185	0	0
210.00	5,093	12,556	12,556

Device	Routing	Invert	Outlet Devices
#1	Primary	206.00'	4.0" x 40.0' long Culvert CPP, square edge headwall, Ke= 0.500 Outlet Invert= 205.00' S= 0.0250 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior
#2	Secondary	209.30'	10.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Device 1	206.00'	2.0" Vert. Faircloth Skimmer C= 0.600

Primary OutFlow Max=0.17 cfs @ 14.72 hrs HW=208.61' (Free Discharge)

 ↑1=Culvert (Passes 0.17 cfs of 0.33 cfs potential flow)

 ↑3=Faircloth Skimmer (Orifice Controls 0.17 cfs @ 7.7 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=206.00' (Free Discharge)

 ↑2=Emergency Spillway (Controls 0.00 cfs)

HydroCAD Analysis of Pre-Development Condition
(1-Year Storm Event)

Thornton Road - Pre Development

Type II 24-hr 1-YEAR Rainfall=3.20"

Prepared by {enter your company name here}

Page 1

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Time span=1.00-20.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland a Runoff Area=4.170 ac Runoff Depth>0.74"
Flow Length=200' Tc=6.3 min CN=70 Runoff=5.75 cfs 0.257 af

Subcatchment 14S: DA-4 (Direct Sheet Flow into the Wetland Runoff Area=2.380 ac Runoff Depth>0.74"
Flow Length=240' Tc=7.9 min CN=70 Runoff=3.08 cfs 0.146 af

Subcatchment 15S: DA-2 (Direct Sheet Flow into the wetland Runoff Area=1.160 ac Runoff Depth>0.83"
Flow Length=150' Tc=4.7 min CN=72 Runoff=1.93 cfs 0.081 af

Subcatchment 16S: DA-1 (Direct Sheet Flow into the wetland Runoff Area=2.110 ac Runoff Depth>0.74"
Flow Length=180' Tc=5.6 min CN=70 Runoff=2.97 cfs 0.130 af

Total Runoff Area = 9.820 ac Runoff Volume = 0.614 af Average Runoff Depth = 0.75"

Thornton Road - Pre Development

Type II 24-hr 1-YEAR Rainfall=3.20"

Prepared by {enter your company name here}

Page 2

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Subcatchment 11S: DA-3 (Direct Sheet flow into the wetland at northwest site)

Runoff = 5.75 cfs @ 11.99 hrs, Volume= 0.257 af, Depth> 0.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
3.790	69	Pasture/grassland/range, Fair, HSG B
0.160	85	Gravel roads, HSG B
0.220	85	Gravel roads, HSG B
4.170	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	200	0.1500	0.5		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 14S: DA-4 (Direct Sheet Flow into the Wetland at Eastern Site)

Runoff = 3.08 cfs @ 12.00 hrs, Volume= 0.146 af, Depth> 0.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
2.190	69	Pasture/grassland/range, Fair, HSG B
0.150	85	Gravel roads, HSG B
0.040	98	Paved parking & roofs
2.380	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	240	0.1250	0.5		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 15S: DA-2 (Direct Sheet Flow into the wetland on northern side)

Runoff = 1.93 cfs @ 11.96 hrs, Volume= 0.081 af, Depth> 0.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
0.966	69	Pasture/grassland/range, Fair, HSG B
0.074	85	Gravel roads, HSG B
0.120	85	Recycling area
1.160	72	Weighted Average

Thornton Road - Pre Development

Type II 24-hr 1-YEAR Rainfall=3.20"

Prepared by {enter your company name here}

Page 3

HydroCAD® 7.10 s/n 001426 © 2005 HydroCAD Software Solutions LLC

12/14/2007

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	150	0.1800	0.5		Sheet Flow, Range n= 0.130 P2= 3.70"

Subcatchment 16S: DA-1 (Direct Sheet Flow into the wetland on northeast side)

Runoff = 2.97 cfs @ 11.98 hrs, Volume= 0.130 af, Depth> 0.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YEAR Rainfall=3.20"

Area (ac)	CN	Description
2.000	69	Pasture/grassland/range, Fair, HSG B
0.110	85	Gravel roads, HSG B
2.110	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	180	0.1660	0.5		Sheet Flow, Range n= 0.130 P2= 3.70"

Sediment Basin Analysis



RICHARDSON SMITH GARDNER & ASSOCIATES
 Engineering and Geological Services
 14 N. Boylan Avenue Tel: 919-828-0577
 Raleigh, NC 27603 Fax: 919-828-3899

SHEET: /
 JOB #: KING 07-3
 DATE: 11/16/07
 BY: KBS
 CHKD BY:

**Thornton Road Transfer Station
 Sediment Basin Analysis**

Basin No.: SB-1

DESIGN FOR WET (IF APPLICABLE) AND DRY STORAGE:

Areas Draining Into Basin:

Drainage Area	Area (acres)
A1. Landfill Slopes	3.5
A2. Other Areas	0.0
Total =	3.5 Acres

Basin Requirements:

Wet Storage:

Required Storage Capacity (ft³/Ac.) = 0 Enter "0" if Not Applicable.
 Required Storage Capacity (ft³) = 0
 Required Depth of Wet Storage (ft) = 0.0 Enter "0" if Not Applicable.

Dry Storage:

Required Storage Capacity (ft³/Ac.) = 1,800
 Required Storage Capacity (ft³) = 6,246
 Multiplier (X) for Desired Surface Area (Qp x X) = 0.01
 Peak Discharge into Basin (Qp) (cfs) = 20.3 From HydroCAD - 10-Yr, 24-Hr. Storm
 Desired Surface Area (Ac) = 0.20
 Desired Surface Area (ft²) = 8,821

Determine Stage-Storage Function:

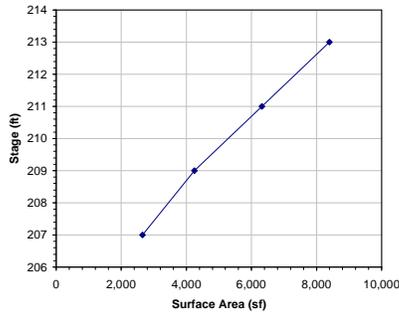
Contour	Area (ft ²)	Area (acres)	Incremental Volume (ft ³)	Cumulative Volume (ft ³)	Stage (ft)	In S	In Z	Z est
207	2,650	0.06		0	0			
209	4,250	0.10	6,900	6,900	2	8.84	0.69	2.00
211	6,325	0.15	10,575	17,475	4	9.77	1.39	4.00
213	8,400	0.19	14,725	32,200	6	10.38	1.79	6.00

Linear Regression Constants:

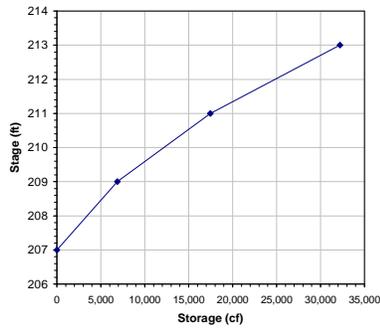
Ks = 2,596 Storage = 2596 z^{1.4}
 b = 1.40

*CAUTION: CHECK INPUT FOR REGRESSION ANALYSIS!

Stage-Surface Area Relationship



Stage-Storage Relationship



Basin Design Elevations:

Elev. of Bottom of Basin = 207.0

Cleanout:

Cleanout Requirement (% of Wet Storage) = 0 Enter "0" if Not Applicable
 Cleanout Requirement (% of Total Storage) = 50
 Basin Cleanout Volume (ft³) = 12,266 Based on 50% of Total Storage Volume
 Basin Cleanout Elevation = 210.0

Option-2 Faircloth Skimmer

Storage Volume (ft³) = 6,246
 Required Orifice Diameter (in) = 2.0 From Design Chart Based on 1 to 5 Day Drawdown

Basin Shape:

Length of Basin (ft) = 150
Width of Basin (ft) = 50
Desired Length to Width Ratio (X:1) = 3
Actual Length to Width Ratio (X:1) = 3.0 **O.K.**

SHEET: /
JOB #: KING 07-3
DATE: 11/16/07
BY: KBS
CHKD BY:

ROUTE DESIGN STORM: Use HydroCAD or Other Method.

Design Parameters:

Design Storm: 10-Yr, 24-Hr
Design Storm Rainfall (in) = 5.8
Rainfall Distribution: Type II
Runoff Method: SCS TR-20

Results:

Maximum Pool Elevation = 212.1
Surface Area at Maximum Pool (ft²) = 6,890
Peak Discharge (cfs) = 1.3

Check Settling Efficiency:

Particle Data:

Diam. (microns) = 40
Specific Gravity = 2.65
Settling Veloc. (ft/s) = 0.004140
Reynolds No. (<0.5) = 0.044284 **O.K.**

Efficiency Data:

Desired Efficiency (%) = 80
No. of Effective Cells = 1
Settling Efficiency (%) = 95.5 **O.K.**

DESIGN OUTLET STRUCTURES:

Design Barrel Structures:

Outlets:

Outlet No. 1 (for Dewatering Dry Storage): Size: 2' Dia Faircloth skimmer
Invert Elevation: 207.0

Barrel Design:

Type of Barrel: CPP
Diameter (in) = 4
Inv. In Elevation = 207.0
Inv. Out Elevation = 206.0
Length (ft) = 120.0
Slope (ft/ft) = 0.008

Emergency Spillway Calculations:

Crest Elev. (ft) = 212.0
Required Freeboard (ft) = 1.0
Top of Berm Elev. (ft) = 213.0
Required Capacity (cfs) = 1.3 **From HydroCAD - 10-Yr, 24-Hr. Storm**
Driving Head (ft) = 0.08 **From HydroCAD - 10-Yr, 24-Hr. Storm**
Weir Coefficient = 3.0
Length of Crest (ft) = 20 **Determine by Weir Equation***
Design Crest Length (ft) = 20

SUMMARY DATA:

Basin No.: SB-1

Elev. of Bottom of Basin = 207.0
Cleanout Elev. (ft) = 210.0
Emergency Spillway Elev. (ft) = 212.0
Top of Berm Elev. (ft) = 213.0
Top of Berm Width (ft) = 10
Barrel Diameter (in) = 4
Barrel Slope (%) = 0.8



**Thornton Road Transfer Station
 Sediment Basin Analysis**

Basin No.: SB-2

DESIGN FOR WET (IF APPLICABLE) AND DRY STORAGE:

Areas Draining Into Basin:

Drainage Area	Area (acres)
A1. Landfill Slopes	2.1
A2. Other Areas	0.0
Total =	2.1 Acres

Basin Requirements:

Wet Storage:

Required Storage Capacity (ft³/Ac.) = 0 Enter "0" if Not Applicable.
 Required Storage Capacity (ft³) = 0
 Required Depth of Wet Storage (ft) = 0.0 Enter "0" if Not Applicable.

Dry Storage:

Required Storage Capacity (ft³/Ac.) = 1,800
 Required Storage Capacity (ft³) = 3,834
 Multiplier (X) for Desired Surface Area (Qp x X) = 0.01
 Peak Discharge into Basin (Qp) (cfs) = 11.4 From HydroCAD - 10-Yr, 24-Hr. Storm
 Desired Surface Area (Ac) = 0.11
 Desired Surface Area (ft2) = 4,966

Determine Stage-Storage Function:

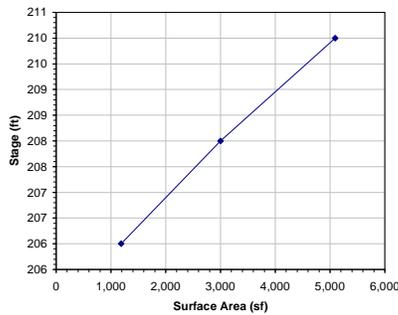
Contour	Area (ft ²)	Area (acres)	Incremental Volume (ft ³)	Cumulative Volume (ft ³)	Stage (ft)	In S	In Z	Z est
206	1,185	0.03		0	0			
208	3,000	0.07	4,185	4,185	2	8.34	0.69	2.00
210	5,093	0.12	8,093	12,278	4	9.42	1.39	4.00

Linear Regression Constants:

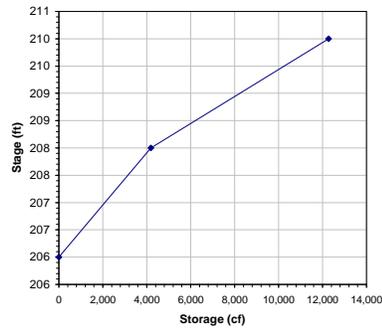
Ks = 1,426 Storage = 1426 z^{1.55}
 b = 1.55

*CAUTION: CHECK INPUT FOR REGRESSION ANALYSIS!

Stage-Surface Area Relationship



Stage-Storage Relationship



Basin Design Elevations:

Elev. of Bottom of Basin = 206.0

Cleanout:

Cleanout Requirement (% of Wet Storage) = 0 Enter "0" if Not Applicable
 Cleanout Requirement (% of Total Storage) = 50
 Basin Cleanout Volume (ft³) = 4,989 Based on 50% of Total Storage Volume
 Basin Cleanout Elevation = 208.2

Option-2 Faircloth Skimmer

Storage Volume (ft³) = 3,834
 Required Orifice Diameter (in) = 2.0 From Design Chart Based on 2 to 5 Day Drawdown

Basin Shape:

Length of Basin (ft) = 170
 Width of Basin (ft) = 50
 Desired Length to Width Ratio (X:1) = 3
 Actual Length to Width Ratio (X:1) = 3.4 **O.K.**

SHEET: /
 JOB #: KING 07-3
 DATE: 11/16/07
 BY: BDJ
 CHKD BY:

ROUTE DESIGN STORM: Use HydroCAD or Other Method.

Design Parameters:

Design Storm: 10-Yr, 24-Hr
 Design Storm Rainfall (in) = 5.8
 Rainfall Distribution: Type II
 Runoff Method: SCS TR-20

Results:

Maximum Pool Elevation = 209.7
 Surface Area at Maximum Pool (ft²) = 4,552
 Peak Discharge (cfs) = 6.0

Check Settling Efficiency:

Particle Data:

Diam. (microns) = 40
 Specific Gravity = 2.65
 Settling Veloc. (ft/s) = 0.004140
 Reynolds No. (<0.5) = 0.044284 **O.K.**

Efficiency Data:

Desired Efficiency (%) = 80
 No. of Effective Cells = 2
 Settling Efficiency (%) = 85 **O.K.**

DESIGN OUTLET STRUCTURES:

Design Barrel Structures:

Outlets:

Outlet No. 1 (for Dewatering Dry Storage): Size: 2.5" Dia **Faircloth skimmer**
 Invert Elevation: 206.0

Barrel Design:

Type of Barrel: CPP
 Diameter (in) = 4
 Inv. In Elevation = 206.0
 Inv. Out Elevation = 205.0
 Length (ft) = 40.0
 Slope (ft/ft) = 0.025

Emergency Spillway Calculations:

Crest Elev. (ft) = 209.3
 Required Freeboard (ft) = 0.7
 Top of Berm Elev. (ft) = 210.0
 Required Capacity (cfs) = 7.7 **From HydroCAD - 10-Yr, 24-Hr. Storm**
 Driving Head (ft) = 0.444 **From HydroCAD - 10-Yr, 24-Hr. Storm**
 Weir Coefficient = 3.0
 Length of Crest (ft) = 9 **Determine by Weir Equation***
 Design Crest Length (ft) = 10

SUMMARY DATA:

Basin No.: SB-2

Elev. of Bottom of Basin = 206.0
 Cleanout Elev. (ft) = 208.2
 Emergency Spillway Elev. (ft) = 209.3
 Top of Berm Elev. (ft) = 210.0
 Top of Berm Width (ft) = 10
 Barrel Diameter (in) = 4
 Barrel Slope (%) = 2.5

Drainage Channel Analysis

PROJECT Shotwell Transfer Station, LLC

SUBJECT Drainage Channel Analysis

SHEET 1 OF _____

JOB NO. King 07-1

DATE 12/29/07

COMPUTED BY KBS

CHECKED BY _____

Objective

To design drainage channels, ditches, etc. to handle stormwater flow from the design storm(s). The main design criteria will be to ensure that all drainage channels, ditches, etc. will be able to accommodate the peak discharge from the design storm without overtopping and without exceeding the allowable shear stress and/or velocity of the selected channel lining.

References

Federal Highway Administration (2001), Urban Drainage Design Manual, Hydraulic Engineering Circular No. 22, FHWA NHI-01-021, Second Ed., U.S. Dept. of Transportation, Washington, D.C.

North Carolina Division of Land Resources (2006), North Carolina Erosion & Sediment Control Planning & Design Manual, Raleigh, NC.

Malcom, H. Rooney (1989 & 2003 Supplement), Elements of Urban Stormwater Design, NC State Univ., Raleigh, NC.

Pennsylvania DEP Bureau of Watershed Protection (2000), Erosion and Sediment Pollution Control Program Manual.

Analysis

The following approach is used in the design of drainage channels:

1. Determine the peak discharge from the design storm(s) (from HydroCAD or spreadsheet methods). For permanent linings (Grass, TRM, rip rap, gabions, etc.) use the peak discharge from the 10-Yr 24-Hr storm unless otherwise specified. For grass lined channels, a smaller design storm (2-Yr 24-Hr - unless otherwise specified) is used to evaluate temporary linings.
2. Input other design parameters (bottom width; side slopes; minimum freeboard, min./max. slopes; and channel lining).
3. Based on the design parameters calculate normal depth of flow, velocity, Froude number, and maximum shear stress for both max./min. slopes. Also determine the critical slope and corresponding normal depth.
4. Compare the velocity and/or shear stress to allowable values (the maximum slope values will control). If values are exceeded, revise design parameters as required.
5. Based on normal depth values and required freeboard (generally use the greater of 6 inches or 25% of the flow depth), determine the minimum channel depth and top width for both max./min. slopes (the minimum slope values will control).
6. If the channel has a significant curved reach, evaluate the shear stress and superelevation of the water surface in the bend.

DRAINAGE CHANNEL.WPD



RICHARDSON SMITH GARDNER & ASSOCIATES

Engineering and Geological Services
14 N. Boylan Avenue, Raleigh, NC 27603
Telephone: (919) 828-0577

Calculations- Manning's Equation:

$$Q = \frac{1.49 AR^{2/3} S^{1/2}}{n} = AV \quad (\text{HEC-22 Eq. 5-5})$$

where:

- Q = discharge (cfs)
- n = Manning's roughness coefficient (See Below)
- A = cross sectional area of flow (ft²)
- R = hydraulic radius (ft) = A/P
- P = wetted perimeter
- S = slope of channel (ft/ft)
- V = average channel velocity (ft/sec)

- Maximum Shear Stress (Tractive Force Method):

$$\tau_d = \gamma d S \quad (\text{HEC-22 Eq. 5-13})$$

where:

- τ_d = maximum shear stress on channel lining (lb/ft²)
- γ = unit weight of water (62.4 lb/ft³)
- d = maximum depth of flow (ft)
- S = channel slope (ft/ft)

- Froude Number:

$$Fr = \frac{v}{\sqrt{\frac{gA}{T}}}$$

where:

- Fr = Froude number (dimensionless)
- v = flow velocity (ft/sec)
- g = acceleration of gravity (32.2 ft/sec²)
- A = cross-sectional area of flow (ft²)
- T = top width of flow (ft)

Note that A/T = the hydraulic depth (D). For $Fr > 1.0$, flow is supercritical; $Fr < 1.0$, flow is subcritical; $Fr = 1.0$, flow is critical.

**RICHARDSON SMITH GARDNER & ASSOCIATES**

Engineering and Geological Services
 14 N. Boylan Avenue, Raleigh, NC 27603
 Telephone: (919) 828-0577

Critical Slope:

The critical slope (S_c) is the slope at which $Fr = 1.0$. When the slope is between $0.7S_c$ and $1.3S_c$, unstable flow may occur as small flow disturbances can initiate a change in the flow state. If slopes are within this range, consider additional freeboard.

- Manning's Roughness Coefficient (n):Grass:

$$n = \frac{R^{1/6}}{\left[K + 19.97 \log(R^{1.4} S^{0.4}) \right]} \quad (\text{HEC-22 Eq. 5-6 - 5-10})$$

where:

 R = hydraulic radius (ft) K = vegetative coefficient (depending on retardance class)

= 15.8 (Class A)

= 23.0 (Class B)

= 30.2 (Class C)

= 34.6 (Class D)

= 37.7 (Class E)

 S = slope of channel (ft/ft)Rip Rap:

$$n = \frac{y^{1/6}}{21.6 \log\left(\frac{y}{d_{50}}\right) + 14} \quad (\text{PA DEP Manual Fig. 3})$$

where:

 y = depth of flow (ft) d_{50} = median size of rip rap (ft)**RICHARDSON SMITH GARDNER & ASSOCIATES**

Engineering and Geological Services

14 N. Boylan Avenue, Raleigh, NC 27603

Telephone: (919) 828-0577

- Curved Channels (Where Applicable):Shear Stress in Bend:

$$\tau_b = K_b \tau_d \quad (\text{HEC-22 Eq. 5-15})$$

where:

- τ_d = bend shear stress (lb/ft²)
 K_b = function of R_c/B (use HEC-22 Chart 21)
 τ_d = maximum shear stress on channel lining (lb/ft²)
 R_c = radius to the centerline of the channel (ft)
 B = bottom width of channel (ft)

Superelevation at Outside of Bend:

$$\Delta d = 0.5 \frac{V^2 T}{g R_c} \quad (\text{HEC-22 Eq. 5-11 modified})$$

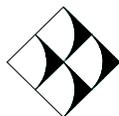
where:

- Δd = superelevation of water surface between the outer channel bank and the centerline of the channel (avg. water surface before bend) (ft)
 V = average channel velocity (ft/sec)
 T = top width of flow (ft)
 g = acceleration of gravity (32.2 ft/sec²)
 R_c = radius to the centerline of the channel (ft)

- Allowable Shear Stress/Velocity:Grass-Lined Channels:

For grass-lined channels, an allowable velocity approach is applicable for slopes flatter than 10%. For slopes of 10% and steeper appropriate permanent linings should be used. For use in the evaluation of curved channels, the following allowable shear stress values (lb/ft²) can be assumed based on retardance class:

- Class A: 3.70
 Class B: 2.10
 Class C: 1.00
 Class D: 0.60
 Class E: 0.35

**RICHARDSON SMITH GARDNER & ASSOCIATES**

Engineering and Geological Services
 14 N. Boylan Avenue, Raleigh, NC 27603
 Telephone: (919) 828-0577

Rip Rap-Lined Channels:

For rip rap-lined channels, an allowable velocity approach is applicable for slopes flatter than 10% (see attached table). For slopes of 10% or steeper, use the following equation:

$$\tau_{allow} = 4 \times d_{50} \quad (\text{HEC-22 Eq. 5-17})$$

where: τ_{allow} = allowable shear stress (lb/ft²)
 d_{50} = median size of rip rap (ft)

Reno Mattress or Gabion-Lined Channels:

For Reno mattress or gabion-lined channels, use allowable velocity for slopes flatter than 10% and allowable shear stress for slopes of 10% or steeper (see attached table).

Riprap Gradation, Filter Blanket Requirements, Maximum Velocities

NSA No.	Graded Rock Size (in)			Filter Blanket Requirements**		V _{max} (ft/sec)
	Max.	d ₅₀ *	Min.	Size NSA No.	Placement Thickness	
R-1	1.5	.75	No. 8	FS-1	N/A	2.5
R-2	3	1.5	1	FS-1	N/A	4.5
R-3	6	3	2	FS-1	3	6.5
R-4	12	6	3	FS-2	4	9.0
R-5	18	9	5	FS-2	6	11.5
R-6	24	12	7	FS-3	8	13.0
R-7	30	15	12	FS-3	10	14.5

* The d₅₀ stone size is the size exceeded by 50% of the total weight of the tonnage shipped (i.e. 50% by weight shall consist of pieces larger than the d₅₀ stone size*).

** This is a general standard. Soil conditions at each site should be analyzed to determine actual filter size. A suitable woven or non-woven geotextile underlayment, used according to manufacturer's recommendations, may be substituted for the filter stone.

Ref: PA DEP Manual Table 9

Maximum Permissible Velocities for Reno Mattress & Gabions

Type	n	Thickness Inches	Rock Fill Gradation (in)	Permissible* Velocity (fps)	Permissible** Shear Stress (lb/ft ²)
Reno Mattress	.025 - .030	6	3 - 6	6.0	8.35
	.025 - .030	6 - 10	3 - 6	12.0	8.35
	.025 - .030	10 - 12	3 - 6	15.0	8.35
	.025 - .030	12 - 18	4 - 6	18.0	8.35
Gabion	.027	>18	5 - 9	22.0	8.35

* Permissible velocities may be increased by the introduction of sand mastic grout. Refer to manufacturer's recommendations/specifications for permissible velocities and for recommendations regarding filters or geotextile fabric underlayment when using Reno mattresses or gabions for channel linings.

**Based on vegetation completely grown.

Ref: PA DEP Manual Table 13



RICHARDSON SMITH GARDNER & ASSOCIATES

Engineering and Geological Services
 14 N. Boylan Avenue, Raleigh, NC 27603
 Telephone: (919) 828-0577



RICHARDSON SMITH GARDNER & ASSOCIATES
 Engineering and Geological Services
 14 N. Boylan Avenue Tel: 919-828-0577
 Raleigh, NC 27603 Fax: 919-828-3899

SHEET: /
 JOB #: KING 07-1
 DATE: 11/21/07
 BY: KBS
 CHKD BY:

**Thornton Road Transfer Station
 Drainage Channel Analysis (Grass Lined)**

Channel No. DC-1A

Design Parameters:

PEAK DISCHARGE, Q_2 = 1.3 ft³/s Source: HydroCAD 2-Yr 24-Hr
 PEAK DISCHARGE, Q_{10} = 2.7 ft³/s Source: HydroCAD 10-Yr 24-Hr

Bottom Width, B = 0.0 ft
 Left Side Slope, z_1 = 3.0 horizontal :1 vertical
 Right Side Slope, z_2 = 3.0 horizontal :1 vertical

Minimum Freeboard = 0.5 ft

Maximum Channel Slope, S_{max} = 0.023 ft/ft
 Minimum Channel Slope, S_{min} = 0.020 ft/ft

Permanent Grass Lining:
 Grass Retardance = D
 K = 34.6
 V_{allow} = 4.5 ft/sec
 τ_{allow} = 0.60 lb/ft²

Temporary Lining:
 Temporary Lining Used (Y/N) = Y
 RECP Product Name = NA Green - Curlex I, or equal
 Manning's Coefficient, n = 0.035
 τ_{allow} = 1.55 lb/ft²

Bare Ground (If Temporary Lining Not Used):
 Manning's Coefficient, n = 0.020
 V_{allow} = 2.0 ft/sec

Normal Depth

Depth of Flow (Norm. Depth) Y_n ft	Manning's Roughness Coefficient n	Area of Flow A ft ²	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Average Velocity V_n ft/s	Flow Rate Q ft ³ /s	Froude Number F_r (Normal) #	Maximum Shear Stress τ_d lb/ft ²	Allowable Velocity (V) or Sh. Stress (S) Used? V_{allow}/V_n or τ_{allow}/τ_d	Factor of Safety V_{allow}/V_n or τ_{allow}/τ_d	Comment
Q2													
Maximum Slope:													
0.44	0.035	0.57	2.75	0.21	2.61	0.22	2.25	1.3	0.85	0.6	S	2.5	O.K.
Minimum Slope:													
0.45	0.035	0.59	2.81	0.21	2.67	0.22	2.13	1.3	0.80	0.6	S	2.8	O.K.
Q10													
Maximum Slope:													
0.81	0.086	1.94	5.09	0.38	4.83	0.40	1.38	2.7	0.38	1.2	V	3.3	O.K.
Minimum Slope:													
0.84	0.087	2.09	5.28	0.40	5.01	0.42	1.31	2.7	0.36	1.0	V	3.4	O.K.

Critical Depth

Depth of Flow (Crit. Depth) Y_c ft	Manning's Roughness Coefficient n	Area of Flow A ft ²	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Section Factor $Z=AD^{1/2}$ ft ^{2.5}	Flow Rate Q ft ³ /s	Average Velocity V_c ft/s	Froude Number F_r (Critical) #	Uniform-Flow Critical Slope S_c ft/ft	Comment
Q2												
0.41	0.035	0.49	2.56	0.19	2.43	0.20	0.22	1.3	2.55	1.00	0.032	Slopes Near S_c - Check Freeboard.
Q10												
0.55	0.072	0.89	3.45	0.26	3.27	0.27	0.47	2.6	2.96	1.00	0.123	Flow is Stable.

Determination of Minimum Channel Depth & Top Width (Based on Q25)

Maximum Slope		Minimum Slope		
Minimum Channel Depth T ft	Minimum Top Width T ft	Minimum Channel Depth T ft	Minimum Top Width T ft	
1.31	7.83	1.34	8.01	



RICHARDSON SMITH GARDNER & ASSOCIATES
 Engineering and Geological Services
 14 N. Boylan Avenue Tel: 919-828-0577
 Raleigh, NC 27603 Fax: 919-828-3899

SHEET: /
 JOB #: KING 07-1
 DATE: 11/21/07
 BY: BDJ
 CHKD BY:

**Thornton Road Transfer Station
 Drainage Channel Analysis (Grass Lined)**

Channel No. DC-2A

Design Parameters:

PEAK DISCHARGE, Q2 = 3.9 ft³/s
 PEAK DISCHARGE, Q10 = 7.3 ft³/s

Source: HydroCAD 2-Yr 24-Hr
 Source: HydroCAD 10-Yr 24-Hr

Bottom Width, B = 2.0 ft
 Left Side Slope, z1 = 3.0 horizontal :1 vertical
 Right Side Slope, z2 = 3.0 horizontal :1 vertical

Permanent Grass Lining:
 Grass Retardance = D
 K = 34.6
 V_{allow} = 4.5 ft/sec
 τ_{allow} = 0.60 lb/ft²

Temporary Lining:
 Temporary Lining Used (Y/N) = Y
 RECP Product Name = NA Green - Curlex I, or equal
 Manning's Coefficient, n = 0.035
 τ_{allow} = 1.55 lb/ft²

Minimum Freeboard = 0.5 ft
 Maximum Channel Slope, S_{max} = 0.015 ft/ft
 Minimum Channel Slope, S_{min} = 0.008 ft/ft

Bare Ground (If Temporary Lining Not Used):
 Manning's Coefficient, n = 0.020
 V_{allow} = 2.0 ft/sec

Normal Depth

Depth of Flow (Norm. Depth) Y _n ft	Manning's Roughness Coefficient n	Area of Flow A ft ²	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Top Width T ft	Hydraulic Depth D=A/T ft	Average Velocity V _n ft/s	Flow Rate Q ft ³ /s	Froude Number F _r (Normal) #	Maximum Shear Stress τ _d lb/ft ²	Allowable Velocity (V) or Sh. Stress (S) Used? V _{allow} /V _n or τ _{allow} /τ _d	Factor of Safety V _{allow} /V _n or τ _{allow} /τ _d	Comment
Q2													
Maximum Slope:													
0.48	0.035	1.63	5.00	0.33	4.85	0.34	2.46	4.0	0.75	0.4	S	3.5	O.K.
Minimum Slope:													
0.56	0.035	2.03	5.51	0.37	5.33	0.38	1.96	4.0	0.56	0.3	S	5.6	O.K.
Q10													
Maximum Slope:													
0.90	0.071	4.19	7.66	0.55	7.37	0.57	1.72	7.2	0.40	0.8	V	2.6	O.K.
Minimum Slope:													
1.07	0.075	5.53	8.74	0.63	8.39	0.66	1.31	7.2	0.28	0.5	V	3.4	O.K.

Critical Depth

Depth of Flow (Crit. Depth) Y _c ft	Manning's Roughness Coefficient n	Area of Flow A ft ²	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Top Width T ft	Hydraulic Depth D=A/T ft	Section Factor Z=AD ^{1/2} ft ^{2.5}	Flow Rate Q ft ³ /s	Average Velocity V _c ft/s	Froude Number F _r (Critical) #	Uniform-Flow Critical Slope S _c ft/ft	Comment
Q2												
0.41	0.035	1.30	4.56	0.29	4.43	0.29	0.71	4.0	3.08	1.00	0.028	Flow is Stable.
Q10												
0.56	0.061	2.03	5.51	0.37	5.33	0.38	1.26	7.1	3.51	1.00	0.079	Flow is Stable.

Determination of Minimum Channel Depth & Top Width (Based on Q25)

Maximum Slope		Minimum Slope		
Minimum Channel Depth ft	Minimum Top Width T ft	Minimum Channel Depth ft	Minimum Top Width T ft	
1.40	10.37	1.57	11.39	



RICHARDSON SMITH GARDNER & ASSOCIATES
 Engineering and Geological Services
 14 N. Boylan Avenue Tel: 919-828-0577
 Raleigh, NC 27603 Fax: 919-828-3899

SHEET: /
 JOB #: KING 07-1
 DATE: 11/21/07
 BY: BDJ
 CHKD BY:

**Thornton Road Transfer Station
 Drainage Channel Analysis (Grass Lined)**

Channel No. DC-2B

Design Parameters:

PEAK DISCHARGE, Q_2 = 1.2 ft³/s
 PEAK DISCHARGE, Q_{10} = 2.1 ft³/s

Source: HydroCAD 2-Yr 24-Hr
 Source: HydroCAD 10-Yr 24-Hr

Bottom Width, B = 0.0 ft
 Left Side Slope, z_1 = 2.0 horizontal :1 vertical
 Right Side Slope, z_2 = 2.0 horizontal :1 vertical

Permanent Grass Lining:

Grass Retardance = D
 K = 34.6
 V_{allow} = 4.5 ft/sec
 τ_{allow} = 0.60 lb/ft²

Temporary Lining:

Temporary Lining Used (Y/N) = N
 RECP Product Name = NA Green - Curlex I, or equal
 Manning's Coefficient, n = 0.035
 τ_{allow} = 1.55 lb/ft²

Minimum Freeboard = 0.25 ft
 Maximum Channel Slope, S_{max} = 0.010 ft/ft
 Minimum Channel Slope, S_{min} = 0.007 ft/ft

Bare Ground (If Temporary Lining Not Used):

Manning's Coefficient, n = 0.020
 V_{allow} = 2.0 ft/sec

Normal Depth

Depth of Flow (Norm. Depth) Y_n ft	Manning's Roughness Coefficient n	Area of Flow A ft ²	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Average Velocity V_n ft/s	Flow Rate Q ft ³ /s	Froude Number F_r (Normal) #	Maximum Shear Stress τ_d lb/ft ²	Allowable Velocity (V) or Sh. Stress (S) Used? V_{allow}/V_n or τ_{allow}/τ_d	Factor of Safety V_{allow}/V_n or τ_{allow}/τ_d	Comment
Q2													
Maximum Slope:													
0.58	0.035	0.66	2.57	0.26	2.30	0.29	1.72	1.1	0.57	0.4	V	1.2	O.K.
Minimum Slope:													
0.63	0.035	0.78	2.80	0.28	2.50	0.31	1.47	1.1	0.46	0.3	V	1.4	O.K.
Q10													
Maximum Slope:													
1.05	0.094	2.18	4.67	0.47	4.18	0.52	0.95	2.1	0.23	0.7	V	4.7	O.K.
Minimum Slope:													
1.16	0.099	2.67	5.17	0.52	4.62	0.58	0.78	2.1	0.18	0.5	V	5.8	O.K.

Critical Depth

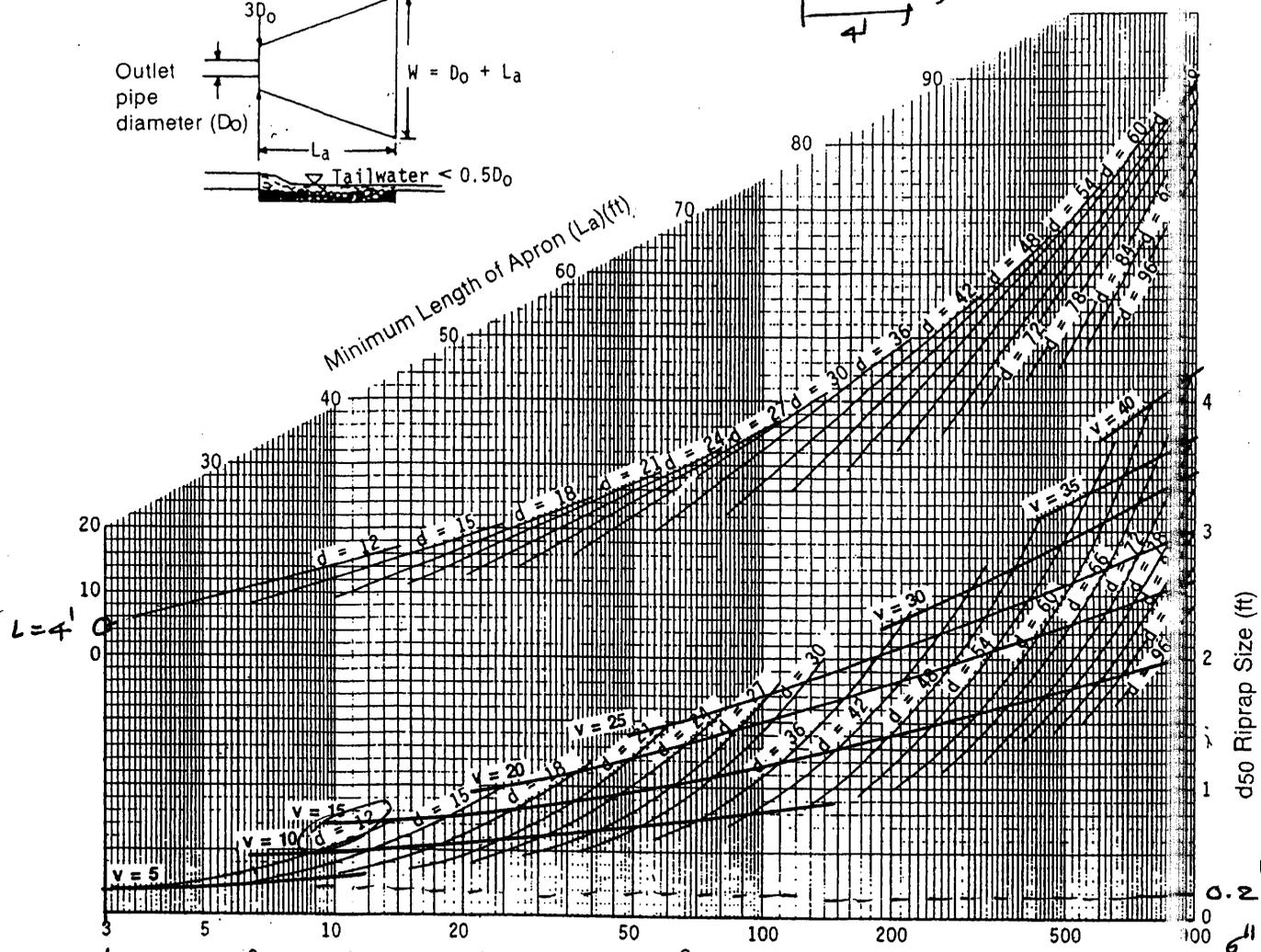
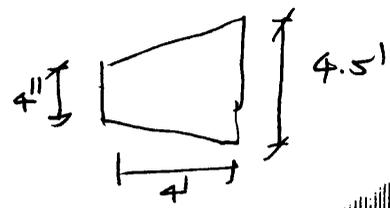
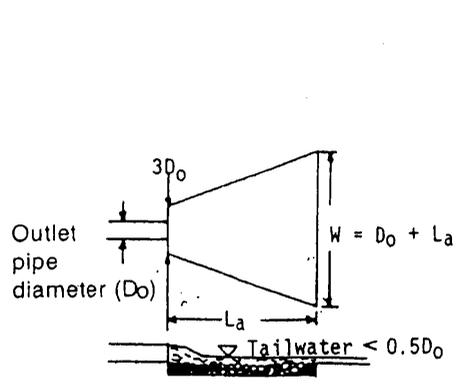
Depth of Flow (Crit. Depth) Y_c ft	Manning's Roughness Coefficient n	Area of Flow A ft ²	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Section Factor $Z=AD^{1/2}$ ft ^{2.5}	Flow Rate Q ft ³ /s	Average Velocity V_c ft/s	Froude Number F_r (Critical) #	Uniform-Flow Critical Slope S_c ft/ft	Comment
Q2												
0.46	0.035	0.41	2.03	0.20	1.82	0.23	0.20	1.1	2.71	1.00	0.034	Flow is Stable.
Q10												
0.59	0.072	0.68	2.62	0.26	2.34	0.29	0.37	2.1	3.07	1.00	0.132	Flow is Stable.

Determination of Minimum Channel Depth & Top Width (Based on Q25)

Maximum Slope		Minimum Slope		
Minimum Channel Depth T ft	Minimum Top Width T ft	Minimum Channel Depth T ft	Minimum Top Width T ft	
1.30	5.18	1.41	5.62	

Outlet Protection Analysis

Riprap Outlet Protection at the end of Basin - 1 & Basin - 2



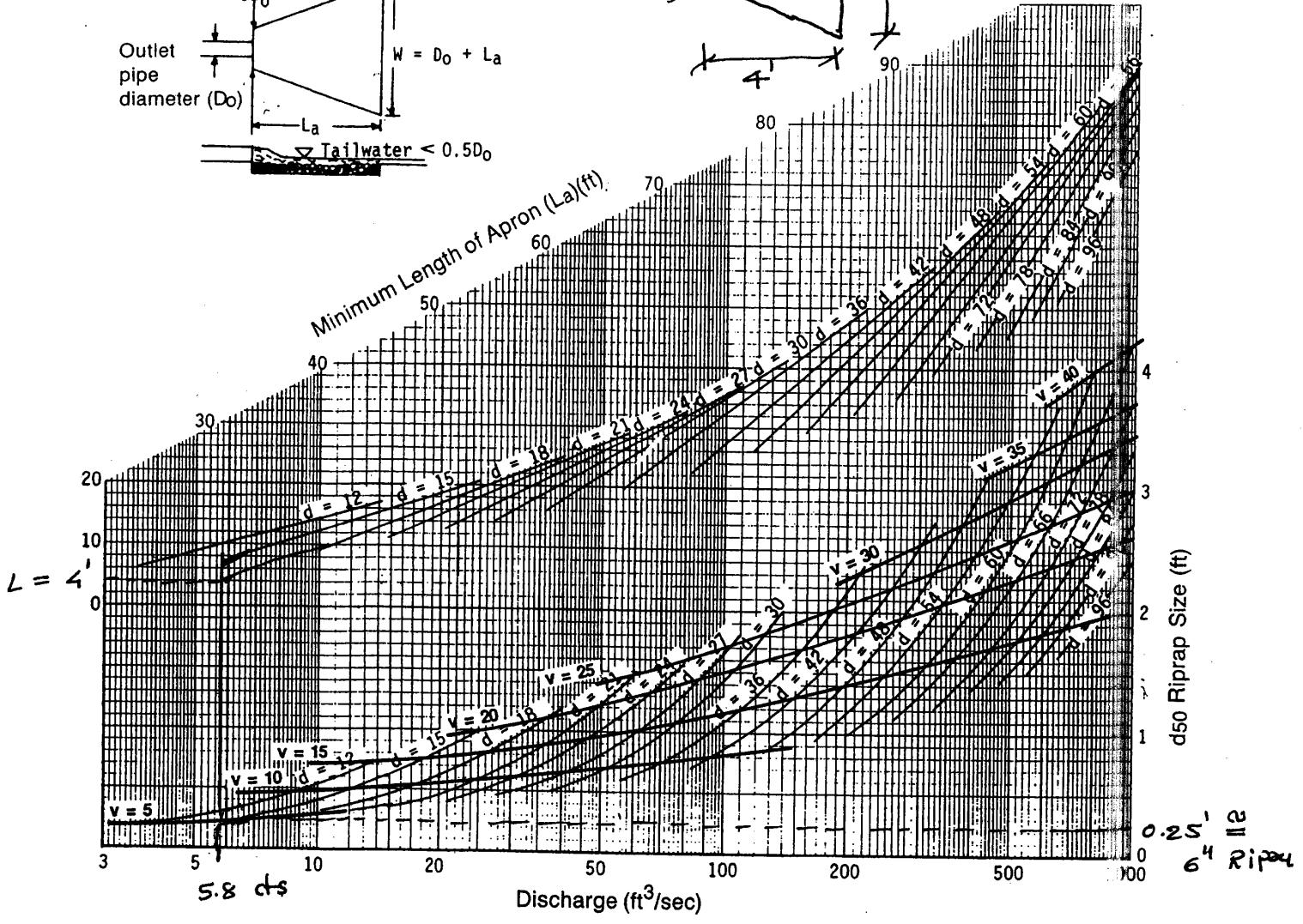
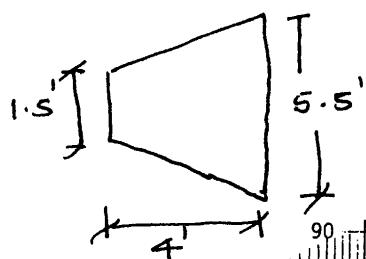
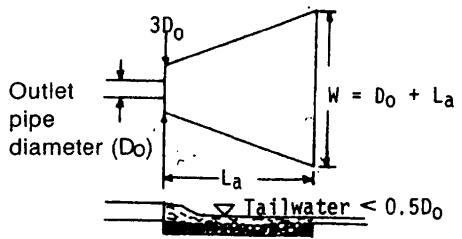
3 cfs \rightarrow from 10-yr storm Discharge (ft^3/sec) event by Hydrod analysis

Curves may not be extrapolated.

Figure 8.06a Design of outlet protection from a round pipe flowing full, minimum tailwater condition ($T_w < 0.5$ diameter)

Size of the outlet pipe for Basin-1 & Basin-2 is 4" ϕ . However, in this case I used minimum diameter pipe for outflow, which is 12" dia for conservative approach.

Riprap Outlet Protection at the end of Basin-1 Appendices



Curves may not be extrapolated.

Figure 8.06a Design of outlet protection protection from a round pipe flowing full, minimum tailwater condition ($T_w < 0.5$ diameter).

Appendix B

Nitrogen Loading Calculations

Total Nitrogen Loading Calculation for Pre Developed Condition (Automated)

Neuse River Basin:

Includes Cary, Durham, Garner, Goldsboro, Havelock, Kinston, New bern, Raleigh, Smithfield, Wilson, Durham County, Johnston County, Orange County, Wake County, and Wayne County.

Project Name: SHOTWELL TRANSFER STATION
 Date: 11/26/2007
 By: Kinjal Shah Checked By: _____

Directions (same for pre-development and post-development tables):
 > Enter the acres of each type of land cover in the green boxes. The spreadsheet will calculate all of the values in light blue.
 > Compare total areas of development in pre- and post- tables for consistency (bottom of column (2)), and also for consistency with the site plans. If all of these values are not the same, there is an error that must be corrected.
 > Unless drainage onto the development from offsite is diverted around or through the site, offsite catchment area draining in must be included in the acreage values and treated.

Pre-development: (Compliance point - Drainage Area - 1)

(1) Type of Land Cover	(2) Area (acres)	(3) S.M. Formula (0.46 + 8.3I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (3) * (6) (2) *
Transportation impervious	0.19	1.83	2.60	0.91	0.19	0.07
Roof impervious		1.83	1.95	0.00	0.11	0.00
Managed pervious (lawn/landscaped)		1.83	1.42	0.00	0.28	0.00
Managed pervious (cropland)		1.83	4.23	0.00	1.23	0.00
Managed pervious (pasture)	0.96	1.83	2.04	3.59	0.62	1.09
Wooded pervious		1.83	0.94	0.00	0.14	0.00
Fraction Impervious (I) =	0.17		TN Loading (lb/yr) =	4.50	TP Loading (lb/yr) =	N/A
Total Area of Development =	1.15		TN Exp. Coeff. (lb/ac/yr) =	3.91	TP Exp. Coeff. (lb/ac/yr) =	N/A

Pre-development: (Compliance point - Drainage Area - 2)

(1) Type of Land Cover	(2) Area (acres)	(3) S.M. Formula (0.46 + 8.3I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (3) * (6) (2) *
Transportation impervious	0.11	0.89	2.60	0.26	0.19	0.02
Roof impervious		0.89	1.95	0.00	0.11	0.00
Managed pervious (lawn/landscaped)		0.89	1.42	0.00	0.28	0.00
Managed pervious (cropland)		0.89	4.23	0.00	1.23	0.00
Managed pervious (pasture)	2.00	0.89	2.04	3.64	0.62	1.11
Wooded pervious	0.00	0.89	0.94	0.00	0.14	0.00
Fraction Impervious (I) =	0.05		TN Loading (lb/yr) =	3.90	TP Loading (lb/yr) =	N/A
Total Area of Development =	2.11		TN Exp. Coeff. (lb/ac/yr) =	1.85	TP Exp. Coeff. (lb/ac/yr) =	N/A

Pre-development: (Compliance point - Drainage Area - 3)

(1) Type of Land Cover	(2) Area (acres)	(3) S.M. Formula (0.46 + 8.3I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (3) * (6) (2) *
Transportation impervious	0.38	0.89	2.60	0.88	0.19	0.06
Roof impervious		0.89	1.95	0.00	0.11	0.00
Managed pervious (lawn/landscaped)		0.89	1.42	0.00	0.28	0.00
Managed pervious (cropland)		0.89	4.23	0.00	1.23	0.00
Managed pervious (pasture)	3.79	0.89	2.04	6.91	0.62	2.10
Wooded pervious	0.00	0.89	0.94	0.00	0.14	0.00
Fraction Impervious (I) =	0.09		TN Loading (lb/yr) =	7.79	TP Loading (lb/yr) =	N/A
Total Area of Development =	4.17		TN Exp. Coeff. (lb/ac/yr) =	1.87	TP Exp. Coeff. (lb/ac/yr) =	N/A

Pre-development: (Compliance point - Drainage Area -4)

(1) Type of Land Cover	(2) Area (acres)	(3) S.M. Formula (0.46 + 8.3I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (3) * (6) (2) *
Transportation impervious	0.15	0.89	2.60	0.35	0.19	0.03
Roof impervious	0.04	0.89	1.95	0.07	0.11	0.00
Managed pervious (lawn/landscaped)		0.89	1.42	0.00	0.28	0.00
Managed pervious (cropland)		0.89	4.23	0.00	1.23	0.00
Managed pervious (pasture)	1.80	0.89	2.04	3.28	0.62	1.00
Wooded pervious	0.39	0.89	0.94	0.33	0.14	0.05
Fraction Impervious (I) =	0.08		TN Loading (lb/yr) =	4.03	TP Loading (lb/yr) =	N/A
Total Area of Development =	2.38		TN Exp. Coeff. (lb/ac/yr) =	1.69	TP Exp. Coeff. (lb/ac/yr) =	N/A

Weighted Average of Nutrient Loadings from the Catchments:

	Catchment Acreage	Pre Developed TN Loading (lb/ac/yr)	Pre Developed TP Loading (lb/ac/yr)
Drainage Area -1	1.15	3.91	N/A
Drainage Area -2	2.11	1.85	N/A
Drainage Area -3	4.17	1.87	N/A
Drainage Area -4	2.38	1.69	N/A
TOTAL FOR DEVELOPMENT	9.81	0.86	N/A

Total Nitrogen Loading Calculation for Post Developed Condition with BMPs (Automated)

Neuse River Basin:

Johnston County, Orange County, Wake County, and Wayne County.

Project Name: SHOTWELL TRANSFER STATION				
Date: 12/7/2007				
By: Kinjal Shah		Checked By: _____		

Directions:

> It may be advantageous to split the development into separate catchments to be handled by separate BMPs. The tables below allow the development to be split into as many as three catchments, and can be copied for greater than three. NOTE: Unless runoff flowing onto the development from offsite is routed separately around or through the site, the offsite catchment area draining in must be included in the acreage values of the appropriate land use(s) and treated.

> **Above each table:** Enter the catchment acreage in the top green blank. Based on a comparison of the post-development TN and TP export coefficients you calculated above to the rule requirements of 4.0 lb/ac/yr TN and 0.4 lb/ac/yr TP, select BMP(s) from the list for treating the catchment runoff. Enter the chosen BMP(s) nutrient removal rates in the green blanks. If more than one BMP is to be used in series, the combined removal rates will be calculated automatically in the blue blanks.

> **Catchment Tables:** Enter the acres of each type of land cover in the green boxes. The spreadsheet will calculate all of the light blue boxes. NOTE: Compare the Total Catchment Acreage for the Development (final table) to the value you established in the pre-BMP worksheet tables, and also to the site plans, for consistency. All of these values need to be the same

		TN	TP	Design Standard
		BMP	Wet Detention Pond	25
Nutrient	Stormwater Wetland	40	35	NC BMP Manual
Removal	Sand Filter	35	45	NC BMP Manual
Rates	Bioretention	35	45	NC BMP Manual
	Grass Swale	20	20	NC BMP Manual
	Vegetated Filter Strip w/ Level Spreader	20	35	NC BMP Manual
	Dry Detention	10	10	NC BMP Manual

Compliance Point: Sediment Basin - 1

Total acreage of catchment 1 = **3.47** ac
 First BMP's TN removal rate = **10** %
 Second BMP's TN removal rate = **0** %
 Third BMP's TN removal rate = **0** %
 TOTAL TN REMOVAL RATE = **10** %

First BMP's TP removal rate = **0** %
 Second BMP's TP removal rate = **0** %
 Third BMP's TP removal rate = **0** %
 TOTAL TP REMOVAL RATE = **0** %

(1) Type of Land Cover	(2) Catchment Acreage	(3) S.M. Formula (0.46 + 8.3I*Imp. fraction)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (3) * (6) (2) *
Transportation impervious	1.36	4.75	2.60	16.80	0.19	1.23
Roof impervious	0.43	4.75	1.95	4.01	0.11	0.23
Managed pervious	1.48	4.75	1.42	9.98	0.28	1.97
Wooded pervious	0.00	4.75	0.94	0.00	0.14	0.00
Area taken up by BMP	0.20	4.75	1.95	1.85	0.11	0.10
Fraction Impervious (I) =	0.52		Pre-BMP TN Load (lb/yr) =	32.64	Pre-BMP TP Load (lb/yr) =	N/A
Total Area of Development =	3.47		Pre-BMP TN Export (lb/ac/yr) =	9.40	Pre-BMP TP Export (lb/ac/yr) =	N/A
			Post-BMP TN Load (lb/yr) =	29.38	Post-BMP TP Load (lb/yr) =	N/A
			Post-BMP TN Export (lb/ac/yr) =	8.46	Post-BMP TP Export (lb/ac/yr) =	N/A

Compliance Point: Sediment Basin - 2

Total acreage of catchment 2 = **2.13** ac
 First BMP's TN removal rate = **20** %
 Second BMP's TN removal rate = **10** %
 Third BMP's TN removal rate = **0** %
 TOTAL TN REMOVAL RATE = **28** %

First BMP's TP removal rate = **0** %
 Second BMP's TP removal rate = **0** %
 Third BMP's TP removal rate = **0** %
 TOTAL TP REMOVAL RATE = **0** %

(1) Type of Land Cover	(2) Catchment Acreage	(3) S.M. Formula (0.46 + 8.3I*Imp. fraction)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (3) * (6) (2) *
Transportation impervious	0.41	2.14	2.60	2.28	0.19	0.17
Roof impervious	0.02	2.14	1.95	0.08	0.11	0.00
Managed pervious	1.40	2.14	1.42	4.25	0.28	0.84
Wooded pervious	0.00	2.14	0.94	0.00	0.14	0.00
Area taken up by BMP	0.30	2.14	1.95	1.25	0.11	0.07
Fraction Impervious (I) =	0.20		Pre-BMP TN Load (lb/yr) =	7.86	Pre-BMP TP Load (lb/yr) =	N/A
Total Area of Development =	2.13		Pre-BMP TN Export (lb/ac/yr) =	3.69	Pre-BMP TP Export (lb/ac/yr) =	N/A
			Post-BMP TN Load (lb/yr) =	5.66	Post-BMP TP Load (lb/yr) =	N/A
			Post-BMP TN Export (lb/ac/yr) =	2.66	Post-BMP TP Export (lb/ac/yr) =	N/A

Compliance Point: Drainage Area - 3

Total acreage of catchment 2 =	2.8	ac				
First BMP's TN removal rate =	0	%	First BMP's TP removal rate =		%	
Second BMP's TN removal rate =	0	%	Second BMP's TP removal rate =		%	
Third BMP's TN removal rate =	0	%	Third BMP's TP removal rate =		%	
TOTAL TN REMOVAL RATE =	0	%	TOTAL TP REMOVAL RATE =	0	%	

(1) Type of Land Cover	(2) Catchment Acreage	(3) S.M. Formula (0.46 + 8.3I*Imp.	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (3) * (6)
Transportation impervious	0.00	0.46	2.60	0.00	0.19	0.00
Roof impervious	0.00	0.46	1.95	0.00	0.11	0.00
Managed pervious	2.21	0.46	1.42	1.44	0.28	0.28
Wooded pervious	0.00	0.46	0.94	0.00	0.14	0.00
Area taken up by BMP	0.00	0.46	1.95	0.00	0.11	0.00
Fraction Impervious (I) =	0.00		Pre-BMP TN Load (lb/yr) =	1.44	Pre-BMP TP Load (lb/yr) =	N/A
Total Area of Development =	2.21		Pre-BMP TN Export (lb/ac/yr) =	0.65	Pre-BMP TP Export (lb/ac/yr) =	N/A
			Post-BMP TN Load (lb/yr) =	1.44	Post-BMP TP Load (lb/yr) =	N/A
			Post-BMP TN Export (lb/ac/yr) =	0.65	Post-BMP TP Export (lb/ac/yr) =	N/A

Compliance Point: Drainage Area - 4

Total acreage of catchment 2 =	1.09	ac				
First BMP's TN removal rate =	0	%	First BMP's TP removal rate =		%	
Second BMP's TN removal rate =	0	%	Second BMP's TP removal rate =		%	
Third BMP's TN removal rate =	0	%	Third BMP's TP removal rate =		%	
TOTAL TN REMOVAL RATE =	0	%	TOTAL TP REMOVAL RATE =	0	%	

(1) Type of Land Cover	(2) Catchment Acreage	(3) S.M. Formula (0.46 + 8.3I*Imp.	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (3) * (6)
Transportation impervious	0.30	2.75	2.60	2.14	0.19	0.16
Roof impervious	0.00	2.75	1.95	0.00	0.11	0.00
Managed pervious	0.39	2.75	1.42	1.52	0.28	0.30
Wooded pervious	0.40	2.75	0.94	1.03	0.14	0.15
Area taken up by BMP	0.00	2.75	1.95	0.00	0.11	0.00
Fraction Impervious (I) =	0.28		Pre-BMP TN Load (lb/yr) =	4.70	Pre-BMP TP Load (lb/yr) =	N/A
Total Area of Development =	1.09		Pre-BMP TN Export (lb/ac/yr) =	4.31	Pre-BMP TP Export (lb/ac/yr) =	N/A
			Post-BMP TN Load (lb/yr) =	4.70	Post-BMP TP Load (lb/yr) =	N/A
			Post-BMP TN Export (lb/ac/yr) =	4.31	Post-BMP TP Export (lb/ac/yr) =	N/A

Weighted Average of Nutrient Loadings from the Catchments:

	Catchment Acreage	Post-BMP TN Loading (lb/ac/yr)	Post-BMP Loading (lb/ac/yr)	TP
Basin - 1	3.47	8.46	N/A	
Basin - 2	2.13	2.66	N/A	
Drainage Area -3	2.80	0.65	N/A	
Drainage Area -4	1.09	4.31	N/A	
TOTAL FOR DEVELOPMENT	9.49	4.38	N/A	

Note: The nutrient loading goals are 4.0 lb/ac/yr for TN and 0.4 lb/ac/yr for TP. If the post-development nutrient loading is below these levels, then the BMPs planned are adequate. Otherwise, additional BMPs and/or modifications in development plans are required.

Appendix C

Erosion and Sedimentation Control Technical Specification

**SHOTWELL TRANSFER STATION, INC.
WAKE COUNTY, NORTH CAROLINA**

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

<u>Section No.</u>	<u>Specification</u>
02110	Site Preparation
02222	Excavation
02223	Embankment
02240	Geotextiles
02270	Erosion and Sedimentation Control
02271	Rip Rap
02275	Rolled Erosion Control Products
02500	Roadway Work
02612	CPE Pipe
02778	LLDPE Geomembrane
02930	Revegetation

SECTION 02110

SITE PREPARATION

Site Preparation: Site Preparation includes clearing, grubbing, and stripping operations which precede the proposed construction.

A. DESCRIPTION

1. General:

- a. The Contractor shall furnish all labor, material, and equipment to complete Site Preparation in accordance with the Contract Drawings and these Specifications.
- b. Principal items of work include:
 - 1. Notifying all authorities owning utility lines running to or on the property. Protect and maintain all utility lines to remain and cap those that are not required in accordance with instructions of the Utility Companies, and all other authorities having jurisdiction.
 - 2. Clearing the site within the clearing limits, including removal of grass, brush, shrubs, trees, loose debris, and other encumbrances except for trees to remain.
 - 3. Boxing and protecting all areas to be preserved.
 - 4. Removing all topsoil from designated areas and stockpiling on site where directed by the Engineer for future use.
 - 5. Disposing from the site all debris resulting from work under this Section.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

<u>Work</u>	<u>Section</u>
Excavation	02222
Embankment	02223

B. MATERIALS Not Used.

C. SUBMITTALS Not Used.

D. CONSTRUCTION

1. Clearing of the Site:

- a. Clearing limits, as shown on the Contract Drawings, shall be established by the Contractor's Surveyor. Once established, the clearing limits shall be inspected and approved by the Engineer prior to clearing the affected areas.
- b. Before removal of topsoil, and start of excavation and grading operations, the areas within the clearing limits shown on the Contract Drawings shall be cleared and grubbed.
- c. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, fallen timber, brush, bushes, rubbish, fencing, and other perishable and objectionable material.

Should it become necessary to remove a tree, bush, brush, or other plants outside the clearing limits, the Contractor shall do so only after permission has been granted by the Engineer.

- d. Excavation resulting from the removal of trees, roots, and the like shall be filled with suitable material, as approved by the Engineer, and thoroughly compacted per the requirements contained in Section 02223, Embankment, of these Specifications.
- e. In temporary construction easement locations, only those trees and shrubs shall be removed which are in actual interference with excavation or grading work under this Contract, and removal shall be subject to approval by the Engineer. However, the Engineer reserves the right to order additional trees and shrubs removed at no additional cost to the Owner, if such, in his opinion, they are too close to the work to be maintained or have become damaged due to the Contractor's operations.
- f. Unless otherwise shown or specified, the Contractor shall clear and grub a strip at least 15 feet wide along all permanent fence lines installed under this Contract.

2. Stripping and Stockpiling Existing Topsoil:

- a. Existing topsoil and sod on the site within areas designated on the Contract Drawings shall be stripped to whatever depth it may occur, and stored in locations directed by the Engineer.
- b. The topsoil shall be free of stones, roots, brush, rubbish, or other unsuitable materials before stockpiling.
- c. Care shall be taken not to contaminate the stockpiled topsoil with any unsuitable materials.

3. Grubbing:

- a. Grubbing shall consist of the removal and disposal of all stumps, roots, logs, sticks, and other perishable materials to a depth of at least 6 inches below ground surfaces.
- b. Large stumps located in areas to be excavated may be removed during grading operations, subject to the approval of the Engineer.

4. Disposal of Cleared and Grubbed Material:

All trees, stumps, roots, and bushes shall be disposed of by burning (Only if allowed by the Owner and local zoning) or shall be removed from the site and disposed of by the Contractor. The Contractor shall receive written authorization from the Owner prior to burning. Any material other than plant growth shall not be burned. On-site and off-site disposal areas are subject to approval by the Engineer. Ashes and residue from burning operations shall be removed from the site and disposed of by the Contractor. The Contractor shall also obtain all of the required permits for his burning operations, as applicable.

END OF SECTION

SECTION 02222

EXCAVATION

Excavation: Excavation includes excavating, sealing, hauling, scraping, undercutting, removal of accumulated surface water or ground water, stockpiling, and all necessary and incidental items as required for bringing the landfill and related structures to the specified lines and grades.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment required to complete Excavation of the project area in accordance with the Contract Drawings and these Specifications, except as noted below:

- a. Clearing and grubbing and removal of topsoil is addressed in Section 02110, Site Preparation, of these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

<u>Work</u>	<u>Section</u>
Site Preparation	02110
Embankment	02223
Erosion and Sedimentation Control	02270
Roadway Work	02500

3. Definitions:

- a. Excavation: shall consist of the removal and satisfactory disposal and/or stockpiling of materials located within the limits of construction including widening cuts and shaping of slopes necessary for the preparation of roadbeds, landfill slope areas, cutting of any ditches, channels, waterways, entrances, and other work incidental thereto.
- b. Borrow: shall consist of approved on-site material required for the construction of embankments/fills or for other portions of the work.
- c. Select Borrow: shall consist of approved off-site material required for the construction of embankments/fills, roadway subgrade, backfilling, or for

other portions of the work as shown on Contract Drawings or in these Specifications. The Contractor shall make his own arrangements for obtaining select borrow and pay all costs involved.

- d. Unsuitable Material: is any in-place or excavated material which contains undesirable materials, or is in a state which is not appropriate; in the opinion of the CQA Engineer, for the intended use or support of planned structures, embankment, or excavation. This may include but not be limited to organic material, waste/refuse, soft, or wet material not meeting required specifications, etc.
- e. Unsuitable Materials Excavation (Overexcavation): shall consist of the removal and satisfactory disposal of all unsuitable material located within the limits of construction. Where excavation to the finished grade section shown results in a subgrade or slopes of unsuitable material, the Contractor shall overexcavate such material to below the grade shown on the Contract Drawings or as directed by the Engineer and CQA Engineer.

B. MATERIALS

Excavation shall include the removal of all soil, weathered rock, boulders, conduits, pipe, and all other obstacles encountered and shown on the Contract Drawings or specified herein.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer before approval is given to proceed:

- 1. Plans of open cut excavations showing side slopes and limits of the excavation at grade.
- 2. List of disposal site(s) for waste and unsuitable materials.
- 3. Descriptive information on Excavation equipment to be used.

D. CONSTRUCTION

- 1. The Contractor shall conduct Excavation activities in such a manner that erosion of disturbed areas and off site sedimentation is absolutely minimized as outlined in Section 02270, Erosion and Sedimentation Control, of these Specifications.
- 2. The Contractor shall excavate to the lines and grades shown on the Contract Drawings and stockpile all suitable excavated materials. As the excavation is made, the materials will be examined and identified to the CQA Engineer.

The Contractor will perform all surveys necessary to establish and verify lines and grades for all Excavation, including pipe excavations, soil overexcavation, and anchor trenches.

3. Stockpiling:

The Contractor shall stockpile the materials in appropriate stockpiles as approved by the CQA Engineer. The Contractor shall use equipment and methods as necessary to maintain the moisture content of soils stockpiled (excluding topsoil) at or near their optimum moisture content.

Stockpiles shall be properly sloped and the surfaces sealed by the Contractor at the end of each working day, or during the day in the event of heavy rain, to the satisfaction of the Engineer.

4. The Contractor shall protect all existing facilities and structures including, but not limited to, existing utilities, monitoring wells, signs, grade stakes, etc. during the grading and stockpiling operations.
5. All excavations shall be made in the dry and in such a manner and to such widths as will give ample room for properly constructing and inspecting the structures and/or piping they are to contain and for such sheeting, timbering, pumping, and drainage as may be required.
6. Excavation slopes shall be flat enough to avoid sloughs and slides that will cause disturbance of the subgrade or damage of adjacent areas. Slides and overbreaks which occur due to negligence, carelessness, or improper construction techniques on the part of the Contractor shall be removed and disposed of by the Contractor as directed by the Engineer at no additional cost to the Owner.
7. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded. All protruding roots and other vegetation shall be removed from slopes.
8. The bottom of all excavations for structures and pipes shall be examined by the CQA Engineer for bearing value and the presence of unsuitable material. If, in the opinion of the CQA Engineer, additional Excavation is required due to the low bearing value of the subgrade material, or if the in-place materials are soft, yielding, pumping and wet, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted structural fill, or material directed by the CQA Engineer. No payment will be made for subgrade disturbance caused by inadequate Dewatering or improper construction methods.
9. Any areas excavated below design subgrade elevations by the Contractor, unless directed by the CQA Engineer, shall be brought back to design elevations at no

cost to the Owner. The Contractor shall place and compact such material in accordance with Section 02223, Embankment, of these Specifications.

10. The Contractor shall dispose of excess or unsuitable excavation materials on-site at location(s) approved by the Owner.
11. The Contractor shall properly level-off bottoms of all excavations. Proof-rolling shall be conducted with appropriate equipment.
12. Upon reaching subgrade elevations shown in excavation areas, the Contractor shall scarify subgrade soils to a minimum depth of 6" and obtain the CQA Engineer's approval of quality. If unsuitable materials are encountered at the subgrade elevation, perform additional excavations as approved by the CQA Engineer to remove unsuitable materials.
13. Overexcavation and Backfill:

Where subgrade materials are determined to be unsuitable, such materials shall be removed by the Contractor to the lengths, widths and depths approved by the CQA Engineer and backfilled with suitable material in accordance with Section 02223, Embankment, of these Specifications unless further excavation or earthwork is required. No additional payment will be made for such excavation and backfill 1 foot or less than the finished subgrade. Unsuitable material excavation greater than 1 foot beneath the finished subgrade shall be made on a unit price basis for excavation and backfill, only as approved by the Engineer and CQA Engineer prior to the work. Unit price for overexcavation and backfill greater than 1 foot in depth shall include disposal of unsuitable materials.

15. All cuts shall be brought to the grade and cross section shown on the Contract Drawings, or established by the Engineer, prior to final inspection.
16. The Contractor shall protect finished lines and grades of completed excavation against excessive erosion, damage from trafficking, or other causes and shall repair any damage at no additional cost to the Owner.
17. Trench Excavation:
 - a. All pipe Excavation and trenching shall be done in strict accordance with these Specifications, all applicable parts of the OSHA Regulations, 29 CFR 1926, Subpart P, and other applicable regulations. In the event of any conflicts in this information, safe working conditions as established by the appropriate OSHA guidelines shall govern.
 - b. The minimum trench widths shall be as indicated on the Contract Drawings. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be

limited to the maximum dimensions shown on the Contract Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing.

- c. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.
- d. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, obstructions, or structures.
- e. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately one hundred (100) feet.
- f. Pipe Bedding: All pipe bedding shall be as shown on the Contract Drawings, unless otherwise specified herein.

18. Sheeting and Bracing:

- a. The Contractor shall furnish, place, and maintain such sheeting and bracing which may be required to support sides of Excavation or to protect pipes and structures from possible damage and to provide safe working conditions in accordance with current OSHA requirements. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports put in at the sole expense of the Contractor. The Contractor shall be responsible for the adequacy of all sheeting and bracing used and for all damage resulting from sheeting and bracing failure or from placing, maintaining, and removing it.
- b. The Contractor shall exercise caution in the installation and removal of sheeting to insure that excessive or unusual loadings are not transmitted to any new or existing structure. The Contractor shall promptly repair at his expense any and all damage that can be reasonably attributed to sheeting installation or removal.
- c. All sheeting and bracing shall be removed upon completion of the work.

19. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion and sedimentation control operations shall be performed at the Contractor's sole expense.

END OF SECTION

SECTION 02223

EMBANKMENT

Embankment: Embankment is the on-site compacted fill that provides the foundation and the berms for the containment area, the subgrade for some access roadways and structures, and backfill around structures and piping.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete Embankment including borrowing, hauling, screening, discing, drying, compaction, control of surface and subsurface water, final grading, sealing, and all necessary and incidental items as detailed or required to complete the Embankment, all in accordance with the Contract Drawings and these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

<u>Work</u>	<u>Section</u>
Excavation	02222
Erosion and Sedimentation Control	02270
Roadway Work	02500

3. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) are hereby made a part of these Specifications.

ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³).
ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
ASTM D 2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
ASTM D 2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
ASTM D 2937	Standard Test Method for Density of Soil in Place by the Drive Cylinder Method.
ASTM D 2974	Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
ASTM D 4959	Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method.
ASTM D 6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

4. Definitions:

- a. Embankment: Shall include construction of all site earthwork including roadways, subgrade, perimeter berm embankments, including preparation of the areas upon which materials are to be placed. Embankment may also be referred to as structural and/or controlled fill. All Embankment materials may be either (off-site) Select Borrow or (on-site) Borrow unless otherwise noted on Contract Drawings or specified by the Engineer.
- b. Prepared Subgrade: The ground surface after clearing, grubbing, stripping, excavation, scarification, and/or compaction, and/or proof rolling to the satisfaction of the CQA Engineer.
- c. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes. Well-graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters. Well-graded is used to define a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

- d. Unclassified Fill: The nature of materials to be used is not identified or described herein but must be approved by the Engineer prior to use.

B. MATERIALS

1. Embankment materials shall consist of clean well-graded natural soil classified as SW, SM, SM-SC, SC, ML, CL-ML, or CL (ASTM D 2488) containing no topsoil or other deleterious material. Other material classifications may be approved by the Engineer.
2. Stones or rock fragments shall not exceed one half the maximum lift thickness as compacted in any dimension. Isolated rocks shall be a maximum of 24-inches in any dimension.
3. Embankment materials shall have a 12% maximum loss on ignition (ASTM D 2974).

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer before approval is given to proceed:

1. Descriptive information on compaction equipment to be used for construction of Embankment.
2. Descriptive information on the location and source of any off-site borrow material to be used for Embankment, where applicable. Information shall include Standard Proctor curves (ASTM D698) for each borrow material.

D. CONSTRUCTION

1. The Contractor shall conduct Embankment activities in such a manner that erosion of disturbed areas and off-site sedimentation is absolutely minimized as outlined in Section 02270, Erosion and Sedimentation Control, of these Specifications.
2. All placement and compaction of Embankment shall be performed only when the CQA Engineer is informed by the Contractor of intent to perform such work.
3. Embankment shall be placed and compacted to the lines and grades shown on the Contract Drawings. Placement of Embankment outside the construction limits shall occur only as directed and approved by the Engineer.

The Contractor will perform all surveys necessary to establish and verify lines and grades for all Embankment.

4. The Contractor shall protect all existing facilities including, but not limited to, utilities and monitoring wells.
5. Subgrade Preparation:
 - a. The CQA Engineer shall inspect the exposed subgrade prior to placement of Embankment to assure that all rocks, topsoil, vegetation, roots, debris, or other deleterious materials have been removed.
 - b. Prior to placement of Embankment, the exposed subgrade shall be proofrolled using a static smooth-drum roller, loaded tandem axle dump truck, or other suitable equipment in the presence of the CQA Engineer. Any soft or unsuitable materials revealed before or during the in-place compaction shall be removed as directed by the CQA Engineer and replaced with suitable Embankment.
6. Surfaces on which Embankment is to be placed, shall be scarified or stepped in a manner which will permit bonding of the Embankment with the existing surface.
7. The Contractor shall be responsible for preparing the materials for the Embankment, including but not limited to, in-place drying or wetting of the soil necessary to achieve the compaction criteria of these Specifications.
8. Embankment materials shall be placed in a manner permitting drainage and in continuous, approximately horizontal layers.
9. Compaction Requirements:
 - a. The Contractor shall compact Embankment in accordance with the requirements shown in Table 1 of this section. If Embankment does not meet the specified requirements, the Contractor shall rework the material, as may be necessary and continue compaction to achieve these requirements, or remove and replace the material to achieve the specified requirements, at Contractor's expense.
 - b. Each lift shall be compacted prior to placement of succeeding lifts. In confined areas, mechanical equipment, suitable for small areas and capable of achieving the density requirements, shall be required.
 - c. Lift compaction shall be performed with an appropriately heavy, properly ballasted, penetrating-foot or smooth-drum vibratory compactor depending on soil type. Compaction equipment shall be subject to approval by the CQA Engineer.

10. Embankment that becomes excessively eroded, soft, or otherwise unsuitable shall be removed or repaired by the Contractor as directed by the CQA Engineer, at no cost to the Owner.
11. The exposed surface of Embankment shall be rolled with a smooth-drum roller at the end of each work day to protect from adverse weather conditions.
12. Where Embankment is to be placed and compacted on slopes that are steeper than 3:1, the subgrade shall be benched to a minimum depth of 6 inches and the Embankment shall be placed in horizontal lifts.
13. Backfilling for Structures and Piping:
 - a. All structures, including manholes and pipes shall be backfilled with Embankment as shown in the Contract Drawings and as described in these Specifications.
 - b. Where sheeting is used, the Contractor shall take all reasonable measures to prevent loss of support beneath and adjacent to pipes and existing structures when sheeting is removed. If significant volumes of soil cannot be prevented from clinging to the extracted sheets, the voids shall be continuously backfilled as rapidly as possible. The Contractor shall thereafter limit the depth below subgrade that sheeting will be driven in similar soil conditions or employ other appropriate means to prevent loss of support.
 - c. When backfilling around structures, do not backfill until concrete has sufficiently cured (as determined by the CQA Engineer) and is properly supported. Place backfill in a manner to avoid displacement or damage of structures.

TABLE 1: REQUIRED EMBANKMENT PROPERTIES

ITEM	Required % Standard Proctor (ASTM D698)²	Required Moisture Content³	Maximum Lift Thickness (Compacted) (inches)
Embankment	95	As Required for Compaction	8
Embankment Beneath Structures and Roads ¹	98		8
Backfill Around Structures	95		8
Backfill in Pipe Trenches	95		6
Unclassified Fill	N/A	N/A	N/A

Notes:

1. Embankment beneath structures shall be considered to include a zone 10 feet out from the foundation of the structure extending down to the natural ground on a 45° slope. Embankment beneath roads shall be considered to include all embankment placed within 2 vertical feet of the final wearing surface and shall also include shoulders.
2. Determine field density using ASTM D 6938, ASTM D 1556, ASTM D 2167, or ASTM D 2937.
3. Determine field moisture content using ASTM D 6938, ASTM D 2216, ASTM D 4643, or ASTM D 4959.
4. The Engineer may allow exceptions to the above criteria for areas outside of the containment area which are not subject to significant long-term loads.

END OF SECTION

SECTION 02240

GEOTEXTILES

Geotextiles: For the proposed construction, a Type GT-S (Separator/Filter) Geotextile is specified. The Type GT-S Geotextile will be placed between soil subgrade and aggregate in access roads, and in some erosion control and drainage applications.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of Geotextiles including all necessary and incidental items as detailed or required for the Contractor to complete the installation in accordance with the Contract Drawings and these Specifications, except as noted below:

- a. Geotextiles used as a Silt Fence is covered under Section 02270, Erosion and Sedimentation Control, of these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

<u>Work</u>	<u>Section</u>
Erosion and Sedimentation Control	02270
Roadway Work	02500

3. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) and the American Association of State Highway and Transportation Officials (AASHTO) are hereby made a part of these specifications.

ASTM D 3786 Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method.

ASTM D 4355 Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).

ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
ASTM D 5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
AASHTO M 288	Standard Specification for Geotextiles.

B. MATERIALS

1. General:

The materials supplied under these Specifications shall consist of new, first-quality products designed and manufactured specifically for the purpose of this work, which shall have been satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes.

Labels on each roll of Geotextile shall identify the length, width, lot and roll numbers, and name of Manufacturer.

2. The Type GT-S Geotextile shall be a nonwoven spunbonded or nonwoven needlepunched synthetic fabric consisting of polyester or polypropylene manufactured in a manner approved by the Engineer. Woven fabrics may be used in certain applications if approved in advance by the Engineer.

3. Not used.

4. All Geotextiles shall conform to the properties listed in Table 1 of this section.

C. SUBMITTALS

Prior to the installation of Geotextiles, the Contractor shall submit the following to the CQA Engineer:

1. Mill Certificate and Sample: Prior to shipping to the site, the Contractor shall submit a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for each type of Geotextile attesting that the Geotextiles meet the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample of each Geotextile to be used. The samples shall be labeled with the product name and be accompanied by the Manufacturer's specifications.
2. Shipping, Handling, and Storage Instructions: The Manufacturer's plan for shipping, handling, and storage shall be submitted for review.
3. Seaming Procedures:

Submit proposed seaming procedures including proposed method and equipment.
4. Quality Control Certificates: For Geotextiles delivered to the site, quality control certificates, signed by the Manufacturer's quality assurance manager shall be provided which represent every roll of each type of Geotextile supplied. Each certificate shall have the roll identification number(s), test methods, frequency, and test results. At a minimum, the test results and frequency of testing shall be as shown in Table 2 of this section.
5. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

D. CONSTRUCTION

1. Shipping, Handling, and Storage:

All Geotextiles shall be shipped, handled, and stored in strict accordance with the Manufacturer's recommendations.

2. Failing CQA Material Control Tests:

Geotextiles that are rejected upon testing shall be removed from the project site and replaced at Contractor's cost. Sampling and CQA testing of Geotextiles supplied as replacement for rejected material shall be performed by the CQA Engineer at Contractor's cost.

3. Installation:

- a. The surface receiving the Geotextiles shall be prepared to a relatively smooth condition, free of obstructions, standing water, excessive depressions, debris, and very soft, excessively wet, and/or loose pockets of

soil. This surface shall be approved by the CQA Engineer prior to Geotextile placement.

- b. Geotextiles shall be placed to the lines and grades shown on the Contract Drawings. At the time of installation, Geotextiles shall be rejected by the CQA Engineer if they have defects, rips, holes, flaws, evidence of deterioration, or other damage.
- c. The Geotextiles shall be placed smooth and free of excessive wrinkles.
- d. On slopes, Geotextiles shall be anchored at the top and unrolled down the slope. In the presence of wind, all Geotextiles shall be weighted with sandbags or other material as approved by the CQA Engineer. Geotextiles unlifted by wind may be reused upon approval by the CQA Engineer.

4. Seams:

- a. All Geotextile seams shall be continuously sewn or heat bonded with methods approved by the Engineer. Overlapping of seams may also be allowed if approved in advance by the Engineer. All seams must be approved by the CQA Engineer.
- b. On slopes of 6H:1V or steeper, all seams shall be oriented parallel to (in the direction of) the slope unless otherwise approved by the Engineer.
- c. Seams to be sewn shall be sewn using a Type 401 stitch. One or two rows of stitching may be used. Each row of stitching shall consist of 4 to 7 stitches per inch. The minimum distance from the geotextile edge to the stitch line nearest to that edge (seam allowance) shall be 1.5 inches if a Type SSa (prayer or flat) seam is used. The minimum seam allowance for all other seam types shall be 1.0 inches.
- d. Seams to be heat bonded shall be bonded using hot plate, hot knife, ultrasonic, or other approved devices.

5. Repair Procedures:

- a. Any Geotextile that is torn, punctured, or otherwise damaged shall be repaired or replaced, as directed by the CQA Engineer, by the Contractor at no additional cost to the Owner. The repair shall consist of a patch of the same type of Geotextile placed over the failed areas and shall overlap the existing Geotextile a minimum of 18 inches from any point of the rupture. Patches shall be spot sewn or heat bonded so as not to shift during cover placement.

- b. Slopes Flatter Than 6H:1V: Damaged areas of a size exceeding 10 percent of the roll width shall be removed and replaced across the entire roll width with new material. Damaged areas of a size less than 10 percent of the roll width may be patched.
- c. Slopes of 6H:1V or Steeper: Geotextile panels which require repair shall be removed and replaced with new material. Replacement material shall be sewn as previously described in this specification.

6. Cover Placement:

Placement of cover over Geotextiles shall be performed in a manner as to ensure that the Geotextiles or underlying materials are not damaged. Cover material shall be placed such that excess tensile stress is not mobilized in the Geotextile.

TABLE 1: REQUIRED GEOTEXTILE PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE ¹	
			TYPE GT-S	
Geotextile Construction (NW = Nonwoven) (W = Woven)	-----	-----	NW ² or W ³	
Mass per Unit Area (Unit Weight)	ASTM D 5261	oz/yd ²	N/A	
Ultraviolet Resistance (500 hrs)	ASTM D 4355	%	70	
Strength Class ⁴	AASHTO M 288	Class	2	
Tensile Properties:	ASTM D 4632			
Grab Strength		lbs	160 (NW) 250 (W)	
Grab Elongation		%	≥ 50 (NW) < 50 (W)	
Puncture Resistance	ASTM D 4833	lbs	55 (NW) 90 (W)	
Trapezoidal Tear Strength	ASTM D 4533	lbs	55 (NW) 90 (W)	
Burst Strength	ASTM D 3786	psi	200 (NW) 400 (W)	
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Sieve	70+	
Permittivity	ASTM D 4491	sec ⁻¹	1.0	

Notes:

1. Minimum Average Roll Value (MARV).
2. Nonwoven geotextiles that have been heat calendered are not acceptable, unless approved by the Engineer in advance.
3. Woven geotextiles shall be approved in advance by the Engineer. Woven geotextiles formed exclusively with slit film fibers are not acceptable.
4. AASHTO M 288 criteria includes the above listed requirements for: Tensile Properties, Puncture Resistance, Trapezoidal Tear Strength, and Burst Strength.

TABLE 2: REQUIRED MANUFACTURER QUALITY CONTROL TESTS

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
Mass per Unit Area (Unit Weight)	ASTM D 5261	200,000 ft ²
Ultraviolet Resistance (500 hrs)	ASTM D 4355	Periodic
Tensile Properties	ASTM D 4632	200,000 ft ²
Burst Strength (Diaphragm Methods)	ASTM D 3786	200,000 ft ²
Apparent Opening Size (AOS)	ASTM D 4751	Periodic
Permittivity	ASTM D 4491	Periodic
Puncture Resistance	ASTM D 4833	200,000 ft ²
Trapezoidal Tear Strength	ASTM D 4533	200,000 ft ²

END OF SECTION

SECTION 02270

EROSION AND SEDIMENTATION CONTROL

Erosion and Sedimentation Control: Erosion and Sedimentation Control is a system of construction and engineered measures (devices, structures, practices, etc.) which act to minimize surface water induced erosion of disturbed areas and the resulting off-site sedimentation.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of and maintain Erosion and Sedimentation Control measures and related work in accordance with the Contract Drawings and these Specifications.

All Erosion and Sedimentation Control work shall be in accordance with the latest edition of the North Carolina Erosion and Sediment Control Planning and Design Manual as well as applicable regulations.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

	<u>Work</u>	<u>Section</u>
	Rip Rap	02271
	Rolled Erosion Control Products	02275
	Revegetation	02930

3. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) are hereby made a part of these specifications.

ASTM D 3786 Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method.

ASTM D 4355 Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).

ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

B. MATERIALS

1. Permanent Sediment or Detention Basins:

Permanent sediment or detention basins shall be constructed as shown on the Contract Drawings.

2. Permanent Drainage Channels, Diversions, Swales, and Ditches:

Permanent drainage channels, diversions, swales, and ditches shall be constructed as shown on the Contract Drawings.

3. Silt Fence:

Silt fences shall be constructed as shown on the Contract Drawings and as needed, based on the Contractor's discretion and Engineer's approval. The silt fence is a permeable barrier erected within and downgradient of small disturbed areas to capture sediment from sheet flow. It is made of filter fabric buried at the bottom, stretched, and supported by posts and wire mesh backing. Silt fence shall conform to the following properties:

- a. Posts: Posts shall be 1.33 lb/linear foot steel (preferred) or wood with a minimum length of 5 feet. Steel posts shall be "U" or "T"-type. Wood posts shall have a minimum diameter of 4-inches.
- b. Filter Fabric: Filter fabric shall be a woven geotextile made specifically for sediment control. Filter fabric shall conform to the properties listed in Table 1 of this section.

4. Rip Rap:

Rip Rap shall conform to the requirements of Section 02271, Rip Rap, of these Specifications.

5. Rolled Erosion Control Products (RECPs):

Rolled Erosion Control Products (RECPs) shall conform to the requirements of Section 02275, Rolled Erosion Control Products, of these Specifications.

6. Other Work:

In addition to the Erosion and Sedimentation Control measures shown on the Contract Drawings, the Contractor shall provide adequate means to prevent any sediment from entering any storm drains, drop inlets, ditches, streams, or bodies of water downstream of any area disturbed by construction. Excavation materials shall be placed upstream of any trench or other excavation to prevent sedimentation of off-site areas. In areas where a natural buffer area exists between the work area and the closest stream or water course, this area shall not be disturbed. All paved areas shall be scraped and swept as necessary to prevent the accumulation of dirt and debris. Work associated with this provision shall be considered incidental to the project and no separate payment will be made.

7. Temporary and Permanent Ground Cover:

The Contractor shall provide temporary or permanent ground cover (or other acceptable measure(s)) adequate to restrain erosion on erodible slopes or other areas within 21 calendar days following completion of any phase of grading. The Contractor shall provide permanent ground cover for all disturbed areas within 15 working days or 90 calendar days (whichever is shorter) following the completion of construction.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Submit a certification and summary of all required test results, prior to installation, that all Erosion and Sedimentation Control materials manufactured for the project have been produced in accordance with these Specifications.
2. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into construction.

D. CONSTRUCTION

1. Establishment of Erosion and Sedimentation Control Measures:
 - a. All Erosion and Sedimentation Control measures will be constructed according to the Contract Drawings and these Specifications.
 - b. Due to the nature of the work required by this Contract, it is anticipated that the location and nature of the Erosion and Sedimentation Control measures may need to be adjusted on several occasions to reflect the current phase of construction.
 - c. Erosion and Sedimentation Control measures shall be established prior to the work in a given area. Where such practice is not feasible, the Erosion and Sedimentation Control measure(s) shall be established immediately following completion of the clearing operation.
 - d. The construction schedule adopted by the Contractor will impact the placement and need for specific measures required for the control of erosion. The Contractor shall develop and implement such additional techniques as may be required to minimize erosion and prevent or correct the discharge of sediment outside the limits of construction (unless controlled by other on-site measure(s)).
 - e. The location and extent of Erosion and Sedimentation Control measures shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from construction areas. All deviations from the control provisions shown on the Contract Drawings shall have the prior approval of the Engineer.
2. Inspection and Maintenance of Erosion and Sedimentation Control Measures:
 - a. The Contractor shall furnish the labor, material, and equipment required for the inspection and maintenance of all Erosion and Sedimentation Control measures. Maintenance shall be scheduled as required for a particular measure to maintain the removal efficiency and intent of the measure.
 - b. All Erosion and Sedimentation Control measures shall be inspected at least once every seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period and appropriate maintenance conducted. A rain gauge shall be maintained on the site and a record of the rainfall amounts and dates shall be kept properly.
 - c. Maintenance shall include, but not be limited to:

- (1) The removal and satisfactory disposal of trapped or deposited sediments from basins, traps, barriers, filters, and/or drainage features/devices;
 - (2) Replacement of filter fabrics used for silt fences upon loss of efficiency; and
 - (3) Replacement of any other components which are damaged or cannot serve the intended use.
- d. The Contractor shall accept and maintain any existing sediments that are included in existing sediment traps or basins that accept or will accept stormwater flow and or sediment accumulation from all areas within the Contractor's limits of construction.
 - e. Sediments removed from Erosion and Sedimentation Control measures shall be disposed of in locations that will not result in off-site sedimentation as approved by the Engineer.
 - f. All Erosion and Sedimentation Control measures shall be maintained to the satisfaction of the Engineer until the site has been stabilized.

3. Graded Slopes and Fills:

The angle for graded slopes and fills shall be no greater than the angle that can be retained by vegetated cover or other adequate measures.

4. Finish Grading:

All disturbed areas shall be uniformly graded to the lines, grades, and elevations shown on the Contract Drawings. Finished surfaces shall be reasonably smooth, compacted, and free from irregular surface changes. Unless otherwise specified, the degree of finish shall be that ordinarily obtainable from either blade or scraper operations. Areas shall be finished to a smoothness suitable for application of topsoil.

5. Revegetation:

Revegetation shall conform to the requirements of Section 02930, Revegetation, of these Specifications.

6. Cleanup:

- a. The Contractor shall remove from the site all subsoil excavated from his work and all other debris including, but not limited to, branches, paper, and rubbish in all landscape areas, and remove temporary barricades as the work proceeds.
- b. All areas shall be kept in a neat, orderly condition at all times. Prior to final acceptance, the Contractor shall clean up the entire landscaped area to the satisfaction of the Engineer.

TABLE 1: REQUIRED SILT FENCE FILTER FABRIC PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE ¹
Grab Tensile Strength ²	ASTM D 4632	lbs	100 x 100
Grab Elongation	ASTM D 4632	%	20 (Max.)
Trapezoidal Tear Strength ²	ASTM D 4533	lbs	65 x 65
Burst Strength	ASTM D 3786	psi	300
Puncture Resistance	ASTM D 4833	lbs	65
Ultraviolet Resistance (500 hrs)	ASTM D 4355	%	80
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Sieve	30+
Permittivity	ASTM D 4491	sec ⁻¹	0.05

Notes:

- 1. Minimum Average Roll Value (MARV).
- 2. Values for machine and cross machine direction (MD x XD), respectively.

END OF SECTION

SECTION 02271

RIP RAP

Rip Rap: This section includes all rip rap aprons and channel protection.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of Rip Rap for protection of earthen slopes against erosion as indicated, including all necessary and incidental items, in accordance with the Contract Drawings and these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

<u>Work</u>	<u>Section</u>
Erosion and Sedimentation Control	02270

3. Reference Standards:

The latest revision of the following standards of the North Carolina Department of Transportation (NCDOT) are hereby made a part of these Specifications.

NCDOT Standard Specifications for Roads and Structures.

B. MATERIALS

1. Rip Rap: Rip Rap shall be of the size indicated on the Contract Drawings and shall conform to NCDOT Section 1042, Rip Rap Materials.

2. Geotextiles: Geotextiles shall conform to the requirements outlined in Section 02240, Geotextiles, of these Specifications.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Submit a certification and summary of all required test results prior to installation, that all Rip Rap has been produced in accordance with these Specifications.
2. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into construction.

D. CONSTRUCTION

1. Surface Preparation:
 - a. Trim and dress all areas to conform to the Contract Drawings as indicated with tolerance of 2 inches from theoretical slope lines and grades.
 - b. Bring areas that are below allowable minimum tolerance limit to grade by filling with compacted Embankment material similar to adjacent material.
 - c. Geotextiles shall be placed as shown on the Contract Drawings and in accordance with Section 02240, Geotextiles, of these Specifications.
 - d. Do not place any stone material on the prepared surface prior to inspection and approval to proceed from the Engineer.

2. Placing Rip Rap:

Rip Rap shall be placed in accordance with NCDOT Section 868, Rip Rap.

END OF SECTION

SECTION 02275

ROLLED EROSION CONTROL PRODUCTS

Rolled Erosion Control Products: Rolled Erosion Control Products (RECPs) include erosion control blankets (ECB) placed in channels and on slopes.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of all RECPs in accordance with the Contract Drawings and these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

<u>Work</u>	<u>Section</u>
Erosion and Sedimentation Control	02270
Revegetation	02930

3. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) are hereby made a part of these specifications.

ASTM D 4355	Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
ASTM D 6475	Standard Test Method for Measuring Mass per Unit Area of Erosion Control Blankets.
ASTM D 6524	Standard Test Method for Measuring the Resiliency of Turf Reinforcement Mats.
ASTM D 6525	Standard Test Method for Measuring Nominal Thickness of Permanent Erosion Control Products.

ASTM D 6566 Standard Test Method for Measuring Mass per Unit Area of Turf Reinforcement Mats.

ASTM D 6818 Standard Test Method for Ultimate Tensile Properties of Turf Reinforcement Mats.

B. MATERIALS

1. General:

The materials supplied under these Specifications shall consist of new, first-quality products designed and manufactured specifically for the purpose of this work, which shall have been satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes.

Labels on each RECP shall identify the length, width, product name, and name of Manufacturer.

2. Erosion Control Blanket (ECB) (Single Net):

ECB (single net) shall consist of a machine-produced mat of straw or wood excelsior fiber covered on the top side with a photodegradable extruded plastic or woven biodegradable netting and sewn together with degradable thread. ECB (single net) shall also conform to the properties listed in Table 1 of this section. ECB (single net) shall be S75, as manufactured by North American Green, CURLEX I, as manufactured by American Excelsior Company, LANDLOK S1, as manufactured by Propex Fabrics, or approved equal.

3. Anchor: Anchors for RECPs shall consist of machine made staples of No. 8 gauge new steel wire formed into a “U” shape. The size when formed shall be not less than 8 inches in length with a throat of not less than 1 inch in width. Longer anchors may be required for loose soils. Other anchors, such as metal pins or plastic pegs, may also be used if approved in advance by the Engineer.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Mill Certificate and Sample: Prior to shipping to the site, the Contractor shall submit a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for each RECP attesting that each RECP meets the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample of each RECP to be used. The sample shall be labeled with the product name and be accompanied by the Manufacturer's specifications.

2. Shipping, Handling, and Storage Instructions: The Manufacturer's plan for shipping, handling, and storage shall be submitted for review.
3. Installation Guidelines/Instructions: The Manufacturer's guidelines/instructions for installation shall be submitted for review.
4. Furnish copies of delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

D. CONSTRUCTION

1. Shipping, Handling, and Storage:

All RECPs shall be shipped, handled, and stored in strict accordance with the Manufacturer's recommendations.

2. Installation - General:

- a. Placing of RECPs shall be done immediately following seeding. Seeding shall be performed in accordance with Section 02930, Revegetation, of these Specifications.
- b. RECPs shall be placed to the lines and grades shown on the Contract Drawings. The earth surface shall be smooth and free from stones, clods, or debris which will prevent the contact of the RECP with the soil. Care shall be taken to preserve the required line, grade, and cross section of the area.
- c. RECPs shall be unrolled in the direction of the flow of water and shall be applied without stretching so that it will lie smoothly but loosely on the soil surface.
- d. At the time of installation, RECPs shall be rejected, if they have defects, rips, holes, flaws, evidence of deterioration, or other damage.
- e. The Engineer may require adjustments in the installation requirements to fit individual conditions.

3. Installation - Channels:

RECPs installed in channels shall be unrolled parallel to the direction of water flow. The first roll shall be centered longitudinally in the channel and anchored with staples. Subsequent rolls shall be installed outward to the edges of the channel and be lapped to allow installation of a common row of anchors. RECP ends shall be overlapped with the upstream ends on top ("shingled"). Refer to the

Contract Drawings and/or the Manufacturer's installation guidelines/instructions for installation details.

4. Maintenance:

Maintenance of RECPs shall be in accordance with Section 02270, Erosion and Sedimentation Control, of these Specifications.

TABLE 1: REQUIRED ROLLED EROSION CONTROL PRODUCT PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE ₁
Erosion Control Blanket (ECB) (Single Net)			
Mass per Unit Area	ASTM D 6475	lbs/yd ²	0.5 ± 10% (Straw) 0.7 ± 10% (Excelsior)
Tensile Strength ²	ASTM D 6818	lbs/ft	50 x 65
Tensile Elongation	ASTM D 6818	%	20
Maximum Permissible Shear Stress (Un-Vegetated)	-----	lb/ft ²	1.55
Functional Longevity	-----	months	12

Notes:

1. Typical for ECB; Minimum Average Roll Value (MARV) for TRM and HPTRM.
2. Values for machine and cross machine direction (MD x XD), respectively.

END OF SECTION

SECTION 02500

ROADWAY WORK

Roadway Work: Roadway Work refers to the construction of gravel road surfaces, the repair and reconstruction of existing roads.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment required to complete construction of all Roadway Work including gravel roads, and repair of existing gravel roads in accordance with the Contract Drawings and these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

<u>Work</u>	<u>Section</u>
Excavation	02222
Embankment	02223

3. Reference Standards:

The latest revision of the following standards of the North Carolina Department of Transportation (NCDOT) are hereby made a part of these Specifications:

NCDOT Standard Specifications for Roads and Structures.

B. MATERIALS

1. Geotextiles:

Geotextiles shall conform to the requirements outlined in Section 02240, Geotextiles, of these Specifications.

2. Aggregate Base Course (ABC):

All work, including materials, associated with ABC shall be in accordance with NCDOT Section 520, Aggregate Base Course, except that Articles 520-7 (Contractor Furnished Laboratory), 520-12 (Method of Measurement), and 520-13 (Basis of Payment) shall be deleted. Type "A" or "B" aggregate will be acceptable for this project.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Submit a certification and summary of all required test results, prior to installation, that all materials for Roadway Work have been produced in accordance with these Specifications.
2. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into construction.

D. CONSTRUCTION

1. General:

All Roadway Work including the replacement of portions of the existing roads shall be to the limits, grades, thicknesses, and types as shown on the Contract Drawings. Patches for pipe crossings and areas damaged during the construction work shall be asphalt or gravel, depending upon the material encountered, unless otherwise indicated.

2. Earthwork:

The earthwork for all Roadway Work shall be completed in accordance with Section 02222, Excavation, and Section 02223, Embankment, of these Specifications and as shown on the Contract Drawings.

3. Geotextiles:

Geotextiles shall be placed as shown on the Contract Drawings and in accordance with Section 02240, Geotextiles, of these Specifications. If overlapped seams are used, overlaps shall be a minimum of 12 inches.

4. Aggregate Base Course:

ABC shall be constructed in accordance with NCDOT Section 520.

5. Underground Utility Lines:

Where an underground utility line is beneath the Roadway Work, backfilling shall be carried out with special care, and the final consolidation shall be accomplished by a vibratory roller. Construction of Roadway Work over the trench shall be deferred as long as practicable.

END OF SECTION

SECTION 02612

CORRUGATED POLYETHYLENE (CPE) PIPE

Corrugated Polyethylene (CPE) Pipe: CPE Pipe is used in the storm water system.

A. DESCRIPTION

1. General:

The Contractor shall furnish labor, material, and equipment to complete installation of CPE Pipe in accordance with the Contract Drawings and these Specifications.

2. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) and the American Association of State Highway and Transportation Officials (AASHTO) are hereby made a part of these specifications.

ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

ASTM D 2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

ASTM D 3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

AASHTO M 252 Specification for Corrugated Polyethylene Drainage Tubing, 3 to 10 Inch Diameter.

AASHTO M 294 Specification for Corrugated Polyethylene Pipe, 12 to 36 Inch Diameter.

3. Quality Assurance:

Quality Assurance during placement of CPE Pipe will be provided by the Owner.

B. MATERIALS

1. All CPE Pipe shall be manufactured from new materials conforming with the requirements of cell class 324420C (4 to 10 inch diameter) Or 335420C (12 inch and greater diameter) as defined and described in ASTM D 3350.
2. All CPE Pipe shall be of the size indicated on the Contract Drawings and have smooth interior walls (AASHTO “Type S”) and outer corrugated walls with either annular or spiral corrugations.
3. All CPE Pipe shall meet the requirements of AASHTO M 252 (3 to 10 inch diameter) or AASHTO M 294 (12 to 36 inch diameter).
4. The minimum parallel plate stiffness values when tested in accordance with ASTM D 2412 shall be as follows:

<u>Pipe Diameter (inches)</u>	<u>Pipe Stiffness (psi)</u>
4	50
6	50
8	50
10	50
12	50
15	42
18	40
24	34

5. Visible defects, such as cracks, creases, crazing, non-uniformly pigmented areas, or undispersed raw materials shall not be acceptable and will result in rejection of the pipe by the CQA Engineer.
6. Pipe Perforations: The perforations of the perforated CPE Pipe shall be as shown on the Contract Drawings.
7. CPE Pipe fittings and couplings shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Only fittings and couplings supplied or recommended by the pipe manufacturer shall be used.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Submit a certification and summary of all required test results, prior to installation, that all CPE Pipe manufactured for the project has been produced in accordance with these Specifications.
2. Submit a copy of the CPE Pipe Manufacturer's recommendations for shipping, handling, and storage of pipe.
3. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into construction.

D. CONSTRUCTION

1. Shipping , Handling, and Storage:

All CPE Pipe shall be shipped, handled, and stored in strict accordance with the Manufacturer's recommendations.

2. CPE Pipe Installation:

- a. The Contractor shall install CPE Pipe to the lines and grades shown on the Contract Drawings. Line and grade of piping shall be maintained with laser or approved equivalent. The Contractor shall give the CQA Engineer sufficient notice so that he may observe field location and installation activities.
- b. Perforated CPE Pipe shall be placed during construction as shown on the Contract Drawings.

3. Cleaning:

All CPE Pipe shall be cleaned of any accumulation of silt, debris, or foreign matter of any kind and shall be kept clear of such accumulation until final acceptance of the work.

END OF SECTION

SECTION 02778

LLDPE GEOMEMBRANE

LLDPE Geomembrane (LLDPE-GM): The LLDPE Geomembrane serves as the primary hydraulic barrier in the Basin 1 & 2. It is of great importance that the LLDPE-GM be free from defects and installed free from damage.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of LLDPE-GM including all necessary and incidental items as detailed or required to complete the installation in accordance with the Contract Drawings and these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

<u>Work</u>	<u>Section</u>
Excavation	02222
Embankment	02223

3. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) and the Geosynthetic Research Institute (GRI) are hereby made a part of these Specifications.

ASTM D 792	Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
ASTM D 1004	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
ASTM D 1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique.
ASTM D 1603	Standard Test Method for Carbon Black in Olefin Plastics.

ASTM D 5199	Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
ASTM D 5321	Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
ASTM D 5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
ASTM D 5820	Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.
ASTM D 5994	Standard Test Method for Measuring Core Thickness of Textured Geomembrane.
ASTM D 6392	Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
ASTM D 6693	Standard Test Method for Determining Tensile Properties of Nonreinforced Flexible Polyethylene and Nonreinforced Polypropylene Geomembranes.
GRI GM9	Cold Weather Seaming of Geomembranes.
GRI GM12	Asperity Measurement of Textured Geomembranes Using a Depth Gage.
GRI GM17	Standard Specification for Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes.
GRI GM19	Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes.

4. Quality Control:

Not Used.

5. Quality Assurance:

Quality Assurance during installation of LLDPE-GM will be provided by the Owner.

6. Manufacturers Qualifications:

The Manufacturer shall have previously demonstrated his ability to produce the required LLDPE-GM by having successfully manufactured a minimum of 5,000,000 ft² of LLDPE-GM for hydraulic containment purposes.

7. Installer Qualifications:

- a. Installation of the LLDPE-GM shall be performed by an Installer that has installed a minimum of 5,000,000 ft² of LLDPE-GM (or similar material) within the past five (5) years in similar landfill installations.
- b. All Installation Supervisors assigned to the Project shall have previously managed the installation of at least 2,000,000 ft² of LLDPE-GM (or similar material) using the same techniques to be used on site.
- c. All seaming equipment operators shall have demonstrated performance on previous geomembrane installations and/or documented training.

8. Warranties:

- a. General: Should a defect occur, which is covered under warranty, the Warrantor shall bear all costs for repair and/or relocation and replacement of the LLDPE-GM.
- b. Workmanship: The Contractor shall furnish the Owner a warranty from the Installer of the LLDPE-GM which warrants their workmanship to be free of defects on a prorata basis for five (5) years after the final acceptance of the Work. This warranty shall include but not be limited to all field seams, anchor trenches, attachments to appurtenances, and penetration seals, as applicable.
- c. Manufacturer's Warranty: The Contractor shall furnish the Owner a warranty from the LLDPE-GM Manufacturer for the materials used. The material warranty shall be for defects or failures related to manufacture on a prorata basis for five (5) years after the date of shipment.

B. MATERIALS

1. General:

The materials supplied under these Specifications shall consist of new, first-quality products designed and manufactured specifically for the purpose of this work, which shall have been satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes. The LLDPE-GM and LLDPE-GM Manufacturer shall be approved by the Engineer.

The LLDPE-GM shall be supplied in rolls which shall have a minimum width of 22 feet. The roll length shall be maximized to provide the largest manageable sheet for the fewest seams. Labels on the roll shall identify the thickness, length, width, lot and roll numbers, and name of Manufacturer.

2. LLDPE-GM Materials:

- a. Textured LLDPE-GM shall be 40 mils thick. Resin and sheet properties of LLDPE-GM shall meet or exceed the requirements of GRI GM17.
- b. Materials classified as Very Flexible Polyethylene (VFPE) which otherwise meet the requirements of this section are also acceptable.

3. Extrusion Resin/Typical Extrudate:

Extrusion resin/typical extrudate used for extrusion seaming of LLDPE-GM shall be linear low density polyethylene (LLDPE). Physical properties shall be the same as the LLDPE-GM sheet. The extrudate's additives shall be thoroughly dispersed throughout the rod or bead. The extrudate shall be free of contamination by moisture or foreign matter and shall be recommended for use with the associated sheet material.

4. Texturing:

Textured LLDPE-GM, where required, shall be fabricated using coextrusion or impingement methods. Texturing shall not be created by lamination, structuring, or embossing. Texturing applied to LLDPE-GM using impingement methods shall be bonded securely to the parent LLDPE-GM. All texturing shall be uniform in appearance and coverage on the finished sheet. Textured LLDPE-GM shall be textured on both sides of the sheet.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Pre-Installation Requirements:

Prior to LLDPE-GM installation, the Contractor shall submit the following:

- a. Mill Certificate and Sample: Prior to shipping to the site, the Contractor shall submit a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for the LLDPE-GM attesting that the LLDPE-GM meets the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample of the LLDPE-GM to be used. The sample shall be labeled with the product name and be accompanied by the Manufacturer's specifications.
- b. Qualifications:
 - (1) Submit list of equipment and personnel proposed for the Project. Include equipment type and quantities. Include personnel experience on similar projects.
 - (2) Submit resume and references of Installation Supervisor to be assigned to the Project, including data and duration of employment and pertinent experience information.
 - (3) Submit resumes and references of installation personnel who will perform seaming operations, including dates and durations of employment and pertinent experience information.
- c. Shipping, Handling, and Storage Instructions: The Manufacturer's plan for shipping, handling, and storage shall be submitted for review.
- d. Delivery Date: Submit notification of the scheduled delivery dates for the materials.
- e. Installation Procedures and Drawings:

Submit installation procedures and (shop) drawings for carrying out the work.

 - (1) Installation procedures to be addressed shall include but not be limited to material installation, repair, and protection to be provided in the event of rain or strong winds.
 - (2) Shop drawings shall have LLDPE-GM sheet layout with proposed size, number, position, and sequence of placing all panels, and indicating the location of all field seams. Shop drawings shall also show complete details and/or methods for anchoring the LLDPE-

GM, making field seams, and making seals around pipes and structures penetrating the LLDPE-GM (if applicable).

Following review, these procedures and drawings shall be used for installation of the LLDPE-GM. Any deviations from these procedures and drawings must be approved by the Engineer and CQA Engineer.

- f. Quality Control Certificates: For LLDPE-GM delivered to the site, quality control certificates, signed by the Manufacturer's quality assurance manager shall be provided which represent every roll of LLDPE-GM. Each certificate shall have the roll identification number(s), test methods, frequency, and test results. At a minimum, the test results and frequency of testing shall meet or exceed the requirements of GRI GM17.
- g. Contractor Quality Control Test Results: The Contractor shall provide the results of required testing.
- h. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

2. Post-Installation Requirements:

Upon completion of the LLDPE-GM installation, the Contractor shall submit the following:

- a. Certificate stating that the LLDPE-GM has been installed in accordance with the Drawings, Specifications, and the Manufacturer's recommendations.
- b. Completed Manufacturer's and workmanship warranties.
- c. Record Information: Record information shall include but not be limited to:
 - (1) CQC Documentation: Includes trial seam logs, panel placement logs, panel seaming logs, non-destructive seam testing report forms, field destructive seam testing report forms, and repair logs.
 - (2) As-Built Drawing: Includes the requirements listed in Paragraph D.8 (Surveying) of this Specification.

Finalization of payment for LLDPE-GM installation shall not be made until the above submittals have been reviewed by the CQA Engineer.

D. CONSTRUCTION

1. Shipping, Handling, and Storage:

The LLDPE-GM shall be shipped, handled, and stored in strict accordance with the Manufacturer's recommendations.

2. Failing CQA Material Control Tests:

LLDPE-GM that is rejected upon testing shall be removed from the project site and replaced at Contractor's cost. Sampling and CQA testing of LLDPE-GM supplied as replacement for rejected material shall be performed by the CQA Engineer at Contractor's cost.

3. Subgrade Preparation:

- a. The surface of the subgrade shall be smooth, uniform, free from sudden changes in grade (such as vehicular ruts), rocks or stones greater than ½ inch in size, debris, and deleterious materials. During actual placing and seaming of the LLDPE-GM, the subgrade shall be kept free of all standing water. If the subgrade below the LLDPE-GM becomes excessively wet and unstable as determined by the CQA Engineer, it shall be dried and recompact, and replaced if needed.
- b. Before an individual panel of LLDPE-GM is installed; the Contractor and Installer shall verify in writing and submit to the CQA Engineer:
 - (1) Lines and grades are in conformance with the Drawings and Specifications.
 - (2) The surface area to be lined has been rolled and compacted, free of irregularities and abrupt changes in grade.
- c. The Contractor shall not proceed with LLDPE-GM installation until a complete report on all Compacted Soil Barrier (if required) CQA testing has been submitted and approved by the CQA Engineer. If the Contractor proceeds with LLDPE-GM installation prior to completion of these tests, the Contractor will do so at his own risk. If any tests fail, the Contractor shall be required to remove LLDPE-GM and reconstruct the Compacted Soil Barrier to specification requirements. All costs associated with such actions (including the costs of additional testing) shall be paid for entirely by the Contractor.

4. LLDPE-GM Placement:

a. Weather Conditions:

LLDPE-GM placement shall not proceed at an ambient temperature below 32° F or above 100° F unless otherwise authorized, in writing, by the Engineer. Installation of LLDPE-GM at temperatures below 32° F, if authorized by the Engineer, shall follow GRI GM9. LLDPE-GM placement shall not be performed during precipitation, excessive moisture, in an area of ponded water, or in excessive winds. Any portion of LLDPE-GM or subgrade damaged due to weather conditions shall be repaired at the Contractor's cost.

b. Method of Placement:

- (1) Each panel of the LLDPE-GM shall be installed in accordance with the approved shop drawings prepared by the Contractor. The layout shall be designed to keep field seaming of the LLDPE-GM to a minimum and consistent with proper methods of LLDPE-GM installation.
- (2) Panels shall be oriented perpendicular to the line of the slope crest (i.e., down and not across slope).
- (3) The LLDPE-GM shall be placed smooth and free of excessive wrinkles.
- (4) LLDPE-GM rolls shall be placed using proper spreader and rolling bars with cloth slings. If a sheet must be displaced a distance greater than its width, a slip sheet shall be used.
- (5) The CQA Engineer shall inspect each panel, after placement and prior to seaming, for damage and/or defects. Defective or damaged panels shall be replaced or repaired, as approved by the CQA Engineer and as described in this section.
- (6) The Installer shall avoid dragging the LLDPE-GM on rough soil subgrades.
- (7) All LLDPE-GM shall be anchored as shown on the Contract Drawings and consistent with Manufacturer's recommendations.
- (8) Personnel working on the LLDPE-GM shall not smoke, wear damaging shoes, or involve themselves in any activity that may damage the LLDPE-GM, in the opinion of the CQA Engineer.

- (9) The LLDPE-GM shall be properly weighted to avoid uplift due to wind.
- (10) Vehicular traffic across the LLDPE-GM shall not be allowed, except that four-wheel (or greater) all-terrain vehicles (ATVs) with low ground pressure may be allowed if approved in advance by the Engineer. The Contractor shall submit proposed equipment and procedures for use of ATVs to the CQA Engineer as part of his submittals. If ATVs are allowed by the Engineer, each ATV shall be operated such that no sudden stops, starts, or turns are made.
- (11) All damage shall be recorded and located on the record drawings.
- (12) The LLDPE-GM shall be kept free of debris, unnecessary tools, and materials. In general, the LLDPE-GM area shall remain neat in appearance.

c. Pipe Penetrations:

All pipe penetrations through the LLDPE-GM shall be as shown in the Contract Drawings. Alternative penetration details may be approved by the Engineer and CQA Engineer.

5. Field Seams:

- a. Individual panels of LLDPE-GM shall be laid out and overlapped by a minimum of 4 inches prior to seaming. The area to be seamed shall be cleaned and prepared in accordance with the Manufacturer's recommendations.
- b. Dual or single track hot wedge methods shall be used for straight seams.
- c. Extrusion fillet methods shall be used to seam cross seam tees, patches, repairs, and penetration boots. All extrudate shall be free of dirt, dry, and protected from damage. To limit overgrinding, the amount of grinding exposed after an extrusion seam is completed shall be less than ¼ inch.
- d. The seaming equipment used shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the LLDPE-GM so as to ensure that changes in environmental conditions will not affect the integrity of the seam.
- e. All seams shall have a seam number that corresponds with the panel layout numbers. The numbering system shall be used in the development of the

record drawings. Seam numbers shall be derived from the combination of the two panel numbers that are to be seamed together.

- f. Where horizontal seams are required on sloped surfaces, the panels shall be placed such that the "upstream" panel forms the upper panel and overlaps the "downstream" panel in order to minimize infiltration potential. All seams constructed on slopes of 6H:1V or steeper shall be vertical seams, except where slope lengths exceed standard roll lengths and elsewhere as approved in advance by the Engineer. Where approved, end seams on slopes of 6H:1V or steeper shall be staggered a minimum of 5 feet and shall be made at an angle of approximately 45 degrees.
- g. All panels placed on slopes of 6H:1V or steeper shall extend a minimum of 5 feet beyond the grade break with a slope flatter than 6H:1V.
- h. All seams shall extend to the full extent of the anchor trench (where applicable).
- i. Unless otherwise approved by the Engineer, all "T" seams (i.e., the result of three panels placed together) shall be staggered a minimum of 3 feet along either seam and shall be covered with a patch.
- j. No junctions of four or more panels shall be allowed unless approved by the Engineer.
- k. If extrusion seaming equipment is stopped for longer than one minute, it shall be purged to remove heat-degraded extrudate. All purged extrudate shall be placed on a sacrificial sheet and disposed of.
- l. To prevent moisture buildup during seaming, it may be necessary to place a movable protective layer of plastic directly below each overlap of LLDPE-GM that is to be seamed.
- m. If required, a firm substrate shall be provided by using a flat board or similar hard surface directly under the seam overlap to achieve proper support.
- n. All seams (including repairs) shall meet or exceed the requirements of GRI GM19 and Table 1 of this section.
- o. No overlying material shall be placed over the LLDPE-GM until approved by the CQA Engineer.

6. Anchor Trench:

- a. The anchor trench shall be constructed as shown on the Contract Drawings and as specified herein. The anchor trench shall be maintained by the Contractor.
- b. Slightly rounded corners shall be provided in the trench to avoid sharp bends in the LLDPE-GM.
- c. The anchor trench shall be adequately drained to prevent water ponding and softening to adjacent soils. The anchor trench shall be backfilled with controlled fill material and compacted to 90% standard Proctor dry density (ASTM D 698).
- d. If the anchor trench is located in a clay susceptible to desiccation, the amount of trench open at any time shall be limited to one day of LLDPE-GM installation capacity.

7. Repair Procedures:

- a. Any portion of the LLDPE-GM exhibiting signs of defect or failing a nondestructive or a destructive test, shall be repaired by the Geomembrane Installer. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be made by the CQA Engineer. The procedures available include:
 - (1) Patching - Apply a new piece of LLDPE-GM sheet over, and at least 6-inches beyond the limits of a defect. The patch shall be extrusion seamed to the underlying LLDPE-GM. This method should be used to repair holes, tears, destructive test locations, undispersed raw materials, contamination by foreign matter, dents, pinholes, and pressure test holes.
 - (2) Capping - Apply a new strip of LLDPE-GM along the length of a delineated faulty seam. The cap strip shall extend at least 6-inches beyond the limit of the seam and the edges shall be extrusion seamed to the underlying LLDPE-GM. This method should be used to repair lengths of extrusion or hot wedge seams.
 - (3) Replacement - The faulty seam is removed and replaced.
- b. In addition, the following provisions shall be satisfied:
 - (1) Surfaces of the LLDPE-GM which are to be repaired shall be abraded no more than one hour prior to the repair;

- (2) All surfaces must be clean and dry at the time of the repair;
- (3) All seaming equipment used in repairing procedures must be approved;
- (4) The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the CQA Engineer;
- (5) Extrusion seaming of flaps of dual track hot wedge seams is not acceptable. A patch or cap strip shall be used; and
- (6) Patches or caps shall extend at least 6-inches beyond the edge of the defect, and all patch corners shall be rounded.

8. Surveying:

- a. After completion of a segment of LLDPE-GM, the Contractor shall survey LLDPE-GM to obtain the following information:
 - (1) Location and numbering of all panels/seams.
 - (2) Location of all repairs/patches;
 - (3) Location of all destructive test locations; and
 - (4) Location of all pipe penetrations and other appurtenances (if applicable).
- b. No overlying materials shall be placed before survey information is obtained.
- c. The Contractor shall provide the CQA Engineer with updated survey information when requested by the CQA Engineer to verify that the required information is being obtained.

9. Cover Placement:

Placement of materials over LLDPE-GM shall be performed in a manner as to ensure that LLDPE-GM and the underlying geosynthetics are not damaged; minimal slippage of LLDPE-GM on the underlying geosynthetics occurs; no excess tensile stresses occur in the LLDPE-GM; and that no portion of the LLDPE-GM develops excessive wrinkles or crimp. Wrinkles that exceed approximately 6 inches in height and cannot be eliminated by amended placement and covering methods or LLDPE-GM that becomes crimped shall be cut and repaired by the Geosynthetics Installer in a method approved by the Engineer.

TABLE 1: REQUIRED SEAM STRENGTH PROPERTIES

PROPERTY	TEST METHOD	VALUE	
		Hot Wedge Seams	Extrusion Fillet Seams
40 mil			
Shear Strength ¹	ASTM D 6392	60 lbs/inch	
Shear Elongation at Break ²		50%	
Peel Strength ¹		50 lbs/inch	44 lbs/inch
Peel Separation (Incursion)		≤ 25%	
Locus-of-Break		See Note 3	

Notes:

1. Values listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values.
2. Omit elongation measurements when performing field tests.
3. Regarding the locus-of-break patterns of the different seaming methods in shear and peel, the following are unacceptable break codes per their description in ASTM D 6392 (in this regard, SIP is an acceptable break code):

Hot Wedge: AD and AD-BRK with > 25% Separation

Extrusion Fillet: AD1, AD2, and AD-WLD (unless strength is achieved).

END OF SECTION

SECTION 02930

REVEGETATION

Revegetation: Revegetation includes permanent Revegetation of all site areas disturbed by the Contractor whether inside the Contract Limits or not.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete Revegetation in accordance with the Contract Drawings and these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

<u>Work</u>	<u>Section</u>
Embankment	02223
Erosion and Sedimentation Control	02270
Rolled Erosion Control Products	02275

3. Warranty:

The Contractor shall be responsible for the satisfactory establishment and growth of a permanent stand of vegetation for a period of one year following the final seeding as judged by the Engineer. During this period, the Contractor shall be responsible for the maintenance items described in Paragraph D.4 (Maintenance) of this Specification.

B. MATERIALS

1. Limestone: Unless otherwise defined by specific soil tests, supply agricultural grade ground limestone conforming to the current “Rules, Regulations, and Standards of the Fertilizer Board of Control.”

2. Fertilizer: Unless otherwise defined by specific soil tests, supply commercial fertilizer of 10-20-10 analysis, meeting applicable requirements of State and Federal law. Do not use cyanamic compounds of hydrated lime. Deliver fertilizer in original containers labeled with content analysis.

3. Grass Seed: Supply fresh, clean, new-crop seed as specified in Table 1 of this section. Do not use seed which is wet, moldy, or otherwise damaged. Deliver seed in standard sealed containers labeled with producer's name and seed analysis, and in accord with US Department of Agriculture Rules and Regulations under Federal Seed Act.
4. Mulch: Supply clean, seed-free, threshed straw of oats, wheat, barley, rye, beans, or other locally available mulch material.
 - a. Do not use mulch containing a quantity of matured, noxious weed seeds or other species that will be detrimental to seeding, or provide a menace to surrounding land.
 - b. Do not use mulch material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.
5. Binder: Supply emulsified asphalt or synthetic binder.
6. Water: Supply potable, free of substances harmful to growth.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Results of soil tests performed and proposed modifications, if any, to the specified requirements.
2. Certificates for each grass seed mixture, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed. Certify that each container of seed delivered is fully labeled in accordance with Federal Seed Act and equals or exceeds specification requirements.
3. Copies of invoices for fertilizer, showing grade furnished and total quantity applied.

D. CONSTRUCTION

1. The Contractor shall establish a smooth, healthy, uniform, close stand of grass from the specified seed. Prior to Revegetation, the Contractor shall adequately test the soils to be revegetated to ensure the adequacy of the specified requirements. Any modifications to these requirements deemed necessary after the review of soil test results, shall be at the Contractor's sole expense. The Engineer will perform the observations to determine when successful Revegetation is achieved.

2. Soil Preparation:

- a. Limit preparation to areas which will be planted soon after preparation.
- b. Loosen surface to minimum depth of four (4) inches.
- c. Remove stones, sticks, roots, rubbish and other extraneous matter over three (3) inches in any dimension.
- d. Spread lime uniformly over designated areas at the rate specified in Table 1 of this section.
- e. After application of lime, prior to applying fertilizer, loosen areas to be seeded with double disc or other suitable device if soil has become hard or compacted. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.
- f. Distribute fertilizer uniformly over areas to be seeded at the rate specified in Table 1 of this section.
 - (1) Use suitable distributor.
 - (2) Incorporate fertilizer into soil to depth of a least two (2) inches.
 - (3) Remove stones or other substances which will interfere with turf development or subsequent mowing.
- g. Grade seeded areas to smooth, even surface with loose, uniformly fine texture.
 - (1) Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
 - (2) Fine grade just prior to planting.

3. Seeding:

- a. Use approved mechanical power driven drills or seeders, mechanical hand seeders, or other approved equipment.
- b. Distribute seed evenly over entire area at the rate specified in Table 1 of this section.

- c. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds, excessive moisture, or other factors.
- d. Resume work only when favorable condition develops, or as directed by the Engineer.
- e. Lightly rake seed into soil followed by light rolling or cultipacking.
- f. Immediately protect seeded areas against erosion by mulching or placing Rolled Erosion Control Products in accordance with Section 02275 of these Specifications, where applicable.
 - (1) Spread mulch in a continuous blanket at the rate specified in Table 1 of this section.
 - (2) Immediately following spreading mulch, secure with evenly distributed binder at the rate specified in Table 1 of this section.

4. Maintenance:

The Contractor shall be responsible for maintaining all seeded areas through the end of his warranty period. The Contractor shall provide, at his expense, protection of all seeded areas against damage at all times until acceptance of the work. Maintenance shall include, but not be limited to, the following items:

- a. Regrade and revegetate all eroded areas until adequately stabilized by grass.
- b. Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.
- c. Replant bare areas using same materials specified.

TABLE 1: SEEDING SCHEDULE

MATERIAL	SEED TYPE	APPLICATION RATE¹
Lime	-----	4,000 lbs/acre
Fertilizer	-----	1,000 lbs/acre
Seed		
Permanent:	Kentucky 31 Tall Fescue	80 lbs/acre
	Pensacola Bahiagrass	50 lbs/acre
	Sericea Lespedeza ³	30 lbs/acre
	Kobe Lespedeza	10 lbs/acre
	Seasonal Nurse Crop ²	See Note 2
Temporary:	Seasonal Nurse Crop ²	See Note 2
Mulch	-----	4,000 - 5,000 lbs/acre
Binder	-----	150 gallons/acre

Notes:

1. Application rates and/or chemical analysis shall be confirmed or established by a soil test(s).
2. Use seasonal nurse crop in accordance with seeding dates as stated below:

April 15 - August 15	10 lbs/acre German Millet or
	15 lbs/acre Sudangrass
August 16 - April 14	25 lbs/acre Rye (grain).
3. From September 1 - March 1, use unscarified Sericea seed.

END OF SECTION

Appendix D

Erosion and Sedimentation Control Plans & Details

Drawings are attached as an Attachment E - Preliminary E &SC Plan

Attachment F

Neuse Demolition Landfill
Closure Documentation

WSWM
WAKE COUNTY
SOLID WASTE MANAGEMENT

February 8, 1999

Mr. Wayne Adams
Neuse Landfill
Post Office Box 995
Garner, North Carolina 27529

Re: Landfill Closure Inspection

Dear Mr. Adams:

I inspected the Neuse LCID Landfill on February 3, 1999 for compliance with closure requirements as per the permitted plans and specifications. The landfill appeared to be in accordance with all closure requirements.

Wake County thanks you for your solid waste services rendered to the citizens of Wake County during the operation of you landfill.

Sincerely,



Wayne Woodlief
Interim Solid Waste Director

PERMIT NO. : 88-002

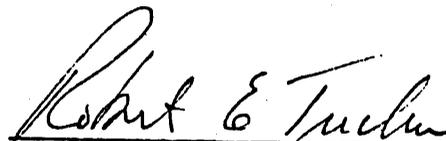
DATE ISSUED: July 19, 1988

WAKE COUNTY
COMMUNITY DEVELOPMENT SERVICES
SOLID WASTE DIVISION
POST OFFICE BOX 550
RALEIGH, NORTH CAROLINA 27602

SOLID WASTE MANAGEMENT PERMIT

Neuse Landfill, Inc., 8441 Garby Drive, Raleigh, North Carolina 27604 is hereby issued a permit to operate a demolition landscape debris landfill located off of Secondary Road 2043 in Neuse River Township in Wake County. This permit is issued in accordance with Article 13B of the General Statutes of North Carolina and all rules promulgated thereunder. This permit is limited to the area shown on a plan dated June 2, 1988 entitled "Neuse Landfill" prepared by Little and Little, Raleigh, North Carolina.

This permit is issued subject to the attached conditions and is not valid until the conditions set forth in items 1, 2 and 3 are satisfied.



Robert E. Tucker, P.E.
Assistant County Engineer

PERMIT NO. : 88-002

DATE ISSUED: July 19, 1988

SOLID WASTE MANAGEMENT PERMIT

CONDITIONS

1. This permit shall be recorded in the Wake County Register of Deeds Grantor Index in the names of Lemuel H. Thornton and wife, Hazel K. Thornton and Edward D. Thornton, the owners of the property. After recording, the Register of Deeds shall mail the original permit instrument, affixed with the registrar's seal, together with the book, page number, and date of recording to:

Wake County Community Development Services
Solid Waste Division
P. O. Box 550
Raleigh, N.C. 27602

2. All site preparation must be performed in accordance with the Approved Plan prepared by Little and Little dated June 2, 1988. Site inspection must be performed by the Solid Waste Division prior to the acceptance of wastes.
3. The area indicated as an existing stockpile shall be stabilized in accordance with Wake County Soil Erosion Standards.
4. Access to the site shall be barricaded or manned when not in use.
5. Operation of this site shall be in accordance with the Approved Plan and all applicable rules set forth by the Solid Waste Management Rules of the State of North Carolina and the Wake County Code of General Ordinances.
6. Materials to be disposed of at this site shall be limited to demolition and land clearing debris (i.e. no paper or putrescible waste).

NORTH CAROLINA

WAKE COUNTY

I, a notary public of the County and State aforesaid, certify that Robert E. Tucker personally appeared before me this day and acknowledged the execution of the foregoing instrument. Witness my hand and official stamp or seal, this the 19th day of July, 1988.



Notary Public

My commission expires: 7-24-90

Attachment G

Zoning Documentation



City Of Raleigh
NORTH CAROLINA

REC'D OCT 26 2007

October 25, 2007

Richardson Smith Gardner & Associates, Inc.
14 N Boylan Avenue
Raleigh, North Carolina 27603

Re: 5505 & 5509 Thornton Road
Parcel Identification No. 1738425855 & 17338436351

Dear Mr. Smith,

Please be advised that the above referenced property is zoned Industrial -1. This zoning classification will permit a waste transfer station. According to our records there are No known zoning violations on this property that will prevent this use.

If I maybe of further assistance, please do not hesitate to contact us at (919) 516-2549.

Sincerely,

Peggy J. Bledsoe, Assistant Zoning Administrator

Cc: Walter Fulcher, Zoning Administrator

INSPECTIONS DEPARTMENT

219 Fayetteville Street Mall
Raleigh, North Carolina 27601

Post Office Box 590
Raleigh, North Carolina 27602
(Mailing Address)

222 West Hargett Street
Raleigh, North Carolina 27602



City Of Raleigh
North Carolina

October 24, 2007

David King C/O Dynasty Holdings LLC
3209 Gresham Lake Road, Suite 115
Raleigh, NC 27615

Re: Zoning Verification, PIN 1738425833

This letter is to verify that according to our records the referenced property is zoned:

Industrial-1 Conditional Use; (Z-59-89) and

Residential-4

with the following overlay districts (if any):

None

This is all the information that I am able to provide on this property. The Department of City Planning and the Inspections Department no longer provide letters on zoning compliance.

If you have any additional questions, please feel free to give me a call at (919) 516-2626 or send e-mail to <Dhanya.Sandeep@ci.raleigh.nc.us>.

Sincerely,

RALEIGH DEPARTMENT OF CITY PLANNING

Dhanya Sandeep, Planner II

ORDINANCE NO. (1990) 482 ZC 267
Effective: 1/16/90

Z-59-89 Thornton Road, north side, between U.S. 1 North and the Neuse River, north of Perry Creek Road, being Parcels 74 and 77, Tax Map 30'6 and a portion of Parcel 1, Tax Map 307 approximately 30:acres, as shown on a map entitled "Neuse Landfill Phase II dated 12/12/1989, rezoned to Industrial-1 Conditional Use District according to the following conditions:

Conditions

- A. Off premise signs (billboards) will not be permitted.
- B. A transitional protective yard (type A) minimum forty (40) feet in width shall be maintained adjacent to Residential-4 properties.
- C. Right-of-way (100 feet and 20 feet at slope easement on both sides) for future Neuse River drive shall remain at Residential-4 value.
- D. Upon development the rate of stormwater runoff will comply with CR 7107.
- E. The maximum floor area ratio for retail uses shall not exceed .15.
- F. If in the future, any other type industrial use, (other than the present landfill type of use) is proposed the owners will submit a site plan for Planning Commission review and City Council approval.
- G. The existing landfill and any future expansion of the landfill will accept only stumps, brush, trees, wood products, blocks, bricks, concrete or metal. Paper, tires, hazardous or toxic waste, oil, batteries or any noxious material will not be accepted.



City Of Raleigh
North Carolina

October 24, 2007

David King C/O Dynasty Holdings LLC
3209 Gresham Lake Road, Suite 115
Raleigh, NC 27615

Re: Zoning Verification, PIN 1738436351

This letter is to verify that according to our records the referenced property is zoned:

Industrial-1 Conditional Use; (Z-59-89) and

Residential-4

with the following overlay districts (if any):

None

This is all the information that I am able to provide on this property. The Department of City Planning and the Inspections Department no longer provide letters on zoning compliance.

If you have any additional questions, please feel free to give me a call at (919) 516-2626 or send e-mail to <Dhanya.Sandeep@ci.raleigh.nc.us>.

Sincerely,

RALEIGH DEPARTMENT OF CITY PLANNING

Dhanya Sandeep, Planner II

ORDINANCE NO. (1990) 482 ZC 267
Effective: 1/16/90

Z-59-89 Thornton Road, north side, between U.S. 1 North and the Neuse River, north of Perry Creek Road, being Parcels 74 and 77, Tax Map 30'6 and a portion of Parcel 1, Tax Map 307 approximately 30:acres, as shown on a map entitled "Neuse Landfill Phase II dated 12/12/1989, rezoned to Industrial-1 Conditional Use District according to the following conditions:

Conditions

- A. Off premise signs (billboards) will not be permitted.
- B. A transitional protective yard (type A) minimum forty (40) feet in width shall be maintained adjacent to Residential-4 properties.
- C. Right-of-way (100 feet and 20 feet at slope easement on both sides) for future Neuse River drive shall remain at Residential-4 value.
- D. Upon development the rate of stormwater runoff will comply with CR 7107.
- E. The maximum floor area ratio for retail uses shall not exceed .15.
- F. If in the future, any other type industrial use, (other than the present landfill type of use) is proposed the owners will submit a site plan for Planning Commission review and City Council approval.
- G. The existing landfill and any future expansion of the landfill will accept only stumps, brush, trees, wood products, blocks, bricks, concrete or metal. Paper, tires, hazardous or toxic waste, oil, batteries or any noxious material will not be accepted.

Attachment H

Operations Manual

Operations Manual

**Thornton Road
Mixed Waste Transfer & Recycling Center
Raleigh, North Carolina**

Prepared for:
Shotwell Transfer Station, Inc.
Raleigh, North Carolina

**November 2007
Revised July 2008**



**SHOTWELL TRANSFER STATION, INC.
THORNTON ROAD MIXED WASTE TRANSFER & RECYCLING CENTER**

OPERATIONS MANUAL

TABLE OF CONTENTS

	<u>Page</u>
1.0 GENERAL FACILITY OPERATIONS	
1.1 Overview	1.0-1
1.2 Contact Information	1.0-1
1.2.1 Operator	1.0-1
1.2.2 Owner	1.0-2
1.2.3 Design Engineer	1.0-2
1.2.4 North Carolina Department of Environment and Natural Resources	1.0-2
1.3 Access Control	1.0-2
1.3.1 Physical Restraints	1.0-3
1.3.2 Security	1.0-3
1.4 Signage	1.0-3
1.5 Communications	1.0-3
1.6 Facility Operation Hours	1.0-3
1.7 Litter Control	1.0-3
1.8 Fire and Safety	1.0-4
1.8.1 Fire Control	1.0-4
1.8.2 Safety	1.0-4
1.9 Severe Weather Conditions	1.0-4
1.9.1 Ice Storms	1.0-5
1.9.2 Heavy Rains	1.0-5
1.9.3 Electrical Storms	1.0-5
1.9.4 Windy Conditions	1.0-5
1.9.5 Violent Storms	1.0-5
1.10 Equipment Requirements	1.0-5
1.11 Personnel Requirements	1.0-5
1.12 Health and Safety	1.0-6
1.12.1 Personal Hygiene	1.0-6
1.12.2 Personal Protective Equipment	1.0-6
1.12.3 Mechanical Equipment Hazard Prevention	1.0-7
1.12.4 Employee Health and Safety	1.0-7
1.12.5 Physical Exposure	1.0-7
1.12.6 Material Safety Data Sheets	1.0-7
1.13 Utilities	1.0-7
1.14 Record Keeping Program	1.0-8

Table of Contents (Continued)

	<u>Page</u>
2.0 WASTE HANDLING OPERATIONS	
2.1 Overview	2.0-1
2.2 Acceptable Wastes	2.0-1
2.2.1 MSW Transfer Station	2.0-1
2.2.2 C&D Transfer Station	2.0-1
2.2.3 Recycling Area	2.0-1
2.3 Prohibited Wastes	2.0-2
2.3.1 MSW Transfer Station	2.0-2
2.3.2 C&D Transfer Station	2.0-2
2.4 Waste Screening Programs	2.0-2
2.4.1 Waste Receiving and Inspection	2.0-3
2.5 Facility Operations	2.0-3
2.5.1 Operating Capacity	2.0-3
2.5.2 Service Area	2.0-4
2.5.3 Disposal Facility	2.0-4
2.5.4 Personnel Requirements	2.0-4
2.5.5 Equipment Requirements	2.0-5
2.5.6 Building Features	2.0-5
2.6 Transfer Operations	2.0-6
2.6.1 Access	2.0-6
2.6.2 General Procedures	2.0-6
2.6.3 Recycling/Source Separation	2.0-7
2.6.4 Transfer Manifest Documentation	2.0-7
2.7 Recycling Area Operations	2.0-8
2.7.1 Containers	2.0-8
2.7.2 Other Storage Areas	2.0-8
2.7.3 Markets	2.0-8
3.0 ENVIRONMENTAL MANAGEMENT	
3.1 Overview	3.0-1
3.2 Surface Water Control	3.0-1
3.2.1 Erosion Control	3.0-1
3.2.2 Sedimentation Control	3.0-1
3.3 Leachate Management	3.0-1
3.3.1 Leachate Collection	3.0-2
3.3.2 Operation & Maintenance of Leachate Management Systems	3.0-2
3.3.3 Record Keeping	3.0-2
3.4 Vector Control	3.0-2
3.5 Odor Control	3.0-2
3.6 Dust Control	3.0-2

Table of Contents (Continued)

FIGURES

Figure 1	Site Location Map
Figure 2	Site Plan

APPENDICES

Appendix A	EPA Method 9095 - Paint Filter Liquids Test
Appendix B	Waste Screening Form

SECTION 1.0 GENERAL FACILITY OPERATIONS

1.1 OVERVIEW

This Operations Manual was prepared for operations of the Thornton Road Mixed Waste Transfer Station facility (Permit No. 92-27T) located at 5565 Thornton Road (SR 2043) in Raleigh, North Carolina as shown in **Figure 1**. This document discusses the operation of the transfer station and other solid waste management activities as follows:

- C&D Transfer Station;
- MSW Transfer Station; and
- Recycling Center.

Refer to **Figure 2** for the general layout of the facility.

The information contained herein was prepared to provide personnel with an understanding of how the Design Engineer envisioned that the completed facility would be operated. While deviations from the operations outlined here may be acceptable, they should be reviewed and approved by the Design Engineer. Please refer to the appropriate permit application for a detailed discussion and calculations for the individual components of operation and process unit.

All personnel involved with the management or supervision of the facility shall review the documents and update from time to time as needed. A copy of this Operations Manual will be kept at the facility and will be available for use at all times.

1.2 CONTACT INFORMATION

All correspondence and questions concerning the operation of the Thornton Road Transfer Station should be directed to the appropriate company and regulatory personnel listed below. For fire or police emergencies dial 911.

1.2.1 **Shotwell Transfer Station, Inc.** (Operator)

Shotwell Transfer Station, Inc.
3209 Gresham Lake Road, Suite 115
Raleigh, North Carolina, NC 27615
Phone: (919) 773-9899
Fax: (919) 773-9898

Contact: David King
daviddbris@bellsouth.net

1.2.2 Dynasty Holdings, LLC (Owner)

Dynasty Holdings, LLC
3209 Gresham Lake Road, Suite 115
Raleigh, North Carolina, NC 27615
Phone: (919) 773-9899
Fax: (919) 773-9898

Contact: David King
daviddbris@bellsouth.net

1.2.3 Richardson Smith Gardner & Associates, Inc. (Design Engineer)

Richardson Smith Gardner & Associates, Inc.
14 N. Boylan Avenue
Raleigh, North Carolina, NC 27603
Phone: (919) 828-0577
Fax: (919) 828-3899

Contact: Stacey A. Smith, P.E.
stacey@rsgengineers.com

1.2.4 North Carolina Department of Environment and Natural Resources

North Carolina DENR - Raleigh Central Office
401 Oberlin Road, Suite 150
Raleigh, NC 27605
Phone: (919) 508-8400
Fax: (919) 715-3605

Division of Waste Management (DWM) - Solid Waste Section:

Field Operations Branch Head:	Mark Poindexter
Eastern Regional Supervisor:	Jason Watkins
Waste Management Specialist:	Bradley Bailey

1.3 ACCESS CONTROL

Limiting access to the solid waste management facility is important for the following reasons:

- Unauthorized and illegal dumping of waste materials is prevented.
- Trespassing, and injury resulting therefrom, is discouraged.
- The risk of vandalism is greatly reduced.

Access to active areas of the transfer stations will be controlled by a combination of fences and natural barriers, and strictly enforced operating hours. An attendant will be on duty at all times

when the facility is open for public use to enforce access restrictions.

1.3.1 Physical Restraints

The site will be accessed by an entrance on Thornton Road as shown on **Figure 2**. Scales and a scale house and office are provided at the entrance. All waste will have been weighed prior to being processed on the site. The entrance will have a gate which will be securely locked during non-operating hours.

1.3.2 Security

Frequent inspections of gates and fences will be performed by facility personnel. Evidence of trespassing, vandalism, or illegal operation will be reported to the Owner.

1.4 SIGNAGE

A prominent sign(s) containing the information required by the DWM will be placed at the main facility entrance. This sign(s) will provide information on operating hours, operating procedures, and acceptable wastes. Additional signage will be provided as necessary within the facility to distinctly distinguish the roadway to the transfer station and recycling area(s). Service and maintenance roads for use by operations personnel will be clearly marked and barriers (e.g., traffic cones, barrels, etc.) will be provided as required.

1.5 COMMUNICATIONS

The scale house/office have telephones in case of emergency and for the conduct of day-to-day business. Emergency telephone numbers are displayed in the scale house and office.

1.6 FACILITY OPERATING HOURS

Normal hours of operation will be 6:00 A.M. to 5:00 P.M. Monday to Friday and 7:00 A.M. to 2:00 P.M. Saturday. Facility will be closed on Sunday.

In the event of disaster or other emergency situations the supervisor will request approval from the commission's regional office to allow additional temporary operating hours.

1.7 LITTER CONTROL

The Transfer Building and litter fencing within the site provide barriers against scattering litter; the perimeter fence acts as barrier to keep litter contained within the site. Transfer Station Operators pick up litter within the site daily and respond to weather and heavy wind conditions that may spread litter.

The litter control crew picks up litter outside the site fences and on access roads each weekday. Any load that is not secured in a manner that would prevent material from leaving the vehicle while it is in motion is subject to an additional fee. Transfer trailers are covered by heavy tarp

lids to minimize litter and potential for birds to enter the trailer and spread litter.

1.8 FIRE AND SAFETY

1.8.1 Fire Control

The possibility of fire within the transfer station or a piece of equipment must be anticipated in the daily operation of the facility. Fire suppression equipment shall be provided to control accidental fires and arrangements shall be made with the local fire protection agency. The transfer station building shall be equipped with hose bibs located on each wall of the facility an appropriate number of fire extinguishers to effectively control accidental fires. A combination of factory installed fire suppression systems and/or portable fire extinguishers will be operational on all heavy pieces of equipment at all times. For larger or more serious outbreaks, the local fire department will respond.

The Owner will verbally notify the DWM (see **Section 1.2**) within 24 hours of discovery of a fire within any transfer or recycling area. In addition, written documentation describing the fire, the actions carried out to extinguish the fire, and a strategy for preventing future occurrences will be provided to the DWM within 15 days following any such occurrence.

1.8.2 Safety

All aspects of the operation of the facility were developed with the health and safety of operations staff, customers, and neighbors in mind. Prior to commencement of operations, a member of the operating staff will be designated site safety officer. This individual, together with the facility's management will modify the site safety and emergency response program to remain consistent with National Solid Waste Management Association and Occupational Safety and Health Administration (OSHA) guidance.

Safety equipment provided includes equipment rollover protective cabs, seat belts, audible reverse warning devices, hard hats, safety shoes, and first aid kits. All personnel will be encouraged to complete the American Red Cross Basic First Aid Course. Other safety requirements as designated by the Owner will also be implemented.

1.9 SEVERE WEATHER CONDITIONS

Unusual weather conditions can directly affect the operation of the facility. Some of these weather conditions and recommended operational responses are as follows.

1.9.1 Ice Storms

An ice storm can make access to the facility dangerous, prevent movement and, thus, may require closure of the facility until the ice is removed or has melted.

1.9.2 Heavy Rains

Exposed soil surfaces can create a muddy situation in some portions of the facility during rainy periods. The control of drainage and use of crushed stone on unpaved roads should provide all-weather access for the site and promote drainage away from critical areas. In areas where the aggregate surface is washed away or otherwise damaged, new aggregate should be used for repair.

Intense rains can affect leachate managements systems. As applicable, staff shall maintain adequate temporary storage capacity in the leachate management systems. After such a rain event, inspection by personnel will be initiated and corrective measures taken to dispose of any additional leachate before the next rainfall.

1.9.3 Electrical Storms

The open recycling areas of the facility are susceptible to the hazards of an electrical storm. If necessary, recycling activities will be temporarily suspended during such an event. To guarantee the safety of all field personnel, refuge will be taken in the on-site buildings or in rubber-tired vehicles.

1.9.4 Windy Conditions

Facility operations during a particularly windy period may require that the active tipping area be temporarily shifted to a more sheltered area.

1.9.5 Violent Storms

In the event of hurricane, tornado, or severe winter storm warning issued by the National Weather Service, facility operations may be temporarily suspended until the warning is lifted.

1.10 EQUIPMENT REQUIREMENTS

The Owner will maintain on-site equipment required to perform the necessary transfer and recycling activities. Periodic maintenance of all equipment, and minor and major repair work will be performed at designated maintenance zones.

1.11 PERSONNEL REQUIREMENTS

At least one member of the supervisory staff will be experienced in the management of transfer station operations. Each facility employee will go through an annual training course (led by supervisory staff). As part of this training, personnel learn to recognize loads which may contain prohibited wastes.

1.12 HEALTH AND SAFETY

All aspects of the transfer and recycling center operations were developed with the health and safety of the operating staff, customers, and neighbors in mind. Prior to commencement of operations of the facility, a member of the operating staff will be designated site safety officer. This individual, together with the facility's management will modify the site safety and emergency response program to remain consistent with National Solid Waste Management Association and Occupational Safety and Health Administration (OSHA) guidance.

Safety equipment provided includes equipment rollover protective cabs, seat belts, audible reverse warning devices, hard hats, safety shoes, and first aid kits. Facility personnel will be encouraged to complete the American Red Cross Basic First Aid Course. Other safety requirements as designated by the Owner will also be implemented.

Each facility employee will go through annual training course in health and safety (led by supervisory staff). All training shall be documented and attested to by signatures of the trainer and trainee. The following are some general recommendations for the health and safety of workers at the Thornton Road Mixed Waste Transfer and Recycling Center.

1.12.1 Personal Hygiene

The following items are recommended as a minimum of practice:

- Wash hands before eating, drinking, or smoking.
- Wear personal protective equipment as described in **Section 1.12.2**.
- Wash, disinfect, and bandage ANY cut, no matter how small it is. Any break in the skin can become a source of infection.
- Keep fingernails closely trimmed and clean (dirty nails can harbor pathogens).

1.12.2 Personal Protective Equipment

Personal Protective Equipment (PPE) must be evaluated as to the level of protection necessary for particular operating conditions and then made available to facility employees. The list below includes the PPE typically used and/or required in a solid waste management facility workplace.

- Safety shoes with steel toes.
- Noise reduction protection should be used in areas where extended exposure to continuous high decibel levels are expected.
- Disposable rubber latex or chemical resistant gloves for handling and/or sampling of waste materials.
- Dust filter masks

Following use, PPE's should be disposed of or adequately cleaned, dried, or readied for reuse.

1.12 HEALTH AND SAFETY

All aspects of the transfer and recycling center operations were developed with the health and safety of the operating staff, customers, and neighbors in mind. Prior to commencement of operations of the facility, a member of the operating staff will be designated site safety officer. This individual, together with the facility's management will modify the site safety and emergency response program to remain consistent with National Solid Waste Management Association and Occupational Safety and Health Administration (OSHA) guidance.

Safety equipment provided includes equipment rollover protective cabs, seat belts, audible reverse warning devices, hard hats, safety shoes, and first aid kits. Facility personnel will be encouraged to complete the American Red Cross Basic First Aid Course. Other safety requirements as designated by the Owner will also be implemented.

Each facility employee will go through annual training course in health and safety (led by supervisory staff). All training shall be documented and attested to by signatures of the trainer and trainee. The following are some general recommendations for the health and safety of workers at the Thornton Road Mixed Waste Transfer and Recycling Center.

1.12.1 Personal Hygiene

The following items are recommended as a minimum of practice:

- Wash hands before eating, drinking, or smoking.
- Wear personal protective equipment as described in **Section 1.12.2**.
- Wash, disinfect, and bandage ANY cut, no matter how small it is. Any break in the skin can become a source of infection.
- Keep fingernails closely trimmed and clean (dirty nails can harbor pathogens).

1.12.2 Personal Protective Equipment

Personal Protective Equipment (PPE) must be evaluated as to the level of protection necessary for particular operating conditions and then made available to facility employees. The list below includes the PPE typically used and/or required in a solid waste management facility workplace.

- Safety shoes with steel toes.
- Noise reduction protection should be used in areas where extended exposure to continuous high decibel levels are expected.
- Disposable rubber latex or chemical resistant gloves for handling and/or sampling of waste materials.
- Dust filter masks

Following use, PPE's should be disposed of or adequately cleaned, dried, or readied for reuse.

1.12.3 Mechanical Equipment Hazard Prevention

The loaders and other equipment should be operated with care and caution. All safety equipment such as horns, backup alarms, and lights should be functional. A Lockout-Tagout program shall be used to identify equipment in need or under repair and insure that operation is “off-limits” prior to maintenance or repair. All operators shall be trained in the proper operation of equipment.

1.12.4 Employee Health and Safety

Some general safety rules are:

- Consider safety first when planning and conducting activities.
- Review the equipment O&M Manual prior to attempting repairs/changes.
- Remember the buddy system in case of repair of mechanical equipment
- Post emergency contact phone numbers.
- Provide easy and visible access to the Right to Know materials.
- Provide easy and visible access to the first aid kit and fire extinguishers.

1.12.5 Physical Exposure

Facility personnel may come in contact with the fluids, solids, and airborne constituents found at the transfer and recycling center. Routine training should be conducted regarding the individual and collective materials used in the recycling process and their associated hazards. Training concerning safe work practices around these potential exposures should use equipment and proper disposal procedures.

1.12.6 Material Safety Data Sheets

Material Safety Data Sheets (MSDS) shall be collected on every waste (if available) that enters the facility. Information shall also be made available for all chemicals stored on site for use by the County. MSDS sheets shall be stored in a location with all other Right to Know information for the site.

1.13 UTILITIES

Electrical power, water, and telephone will be provided at the scale house/office. Restrooms will be provided at the site.

1.14 RECORD KEEPING PROGRAM

The Owner will maintain the following records in an operating record at the landfill:

- A. Waste inspection records (see **Section 2.4**);
- B. Daily tonnage records - including source of generation, scale certifications;
- C. Waste determination records;

- D. List of generators and haulers that have attempted to dispose of restricted wastes;
- E. Employee training procedures and records of training completed;
- F. Leachate records (see **Section 3.3.3**);
- G. Annual facility reports;
- H. Cost estimates or financial assurance documentation.

The operating record will be kept up to date by the Owner or his designee. It will be presented upon request to the DWM for inspection. A copy of this **Operations Manual** will be kept at the facility and will be available for use at all times.

SECTION 2.0 WASTE HANDLING OPERATIONS

2.1 OVERVIEW

This section describes the required waste handling operations for the Thornton Road Transfer Station facility. In addition to the MSW and C&D waste received at this facility, the facility also processes recyclables new construction wastes such as lumber, ferrous and non-ferrous metals, etc. These materials are stored at the facility until there are sufficient quantities for pick up by various recycling contractors.

2.2 ACCEPTABLE WASTES

2.2.1 MSW Transfer Station

Only the waste as defined by NC General Statute 130A-290 (a) (18a) may be received at the MSW transfer station.

2.2.2 C&D Transfer Station

Only the following wastes may be received at the C&D transfer station:

- Construction and Demolition Debris Waste: (Waste or debris from construction, remodeling, repair, or demolition operations on pavement or other structures)
- Inert Debris Waste: (Concrete, brick, concrete block, uncontaminated soils and rock, untreated and unpainted wood, etc.)
- Land Clearing & Inert Debris: as defined by G.S. 130A-290 (a) (15), specifically, waste that is generated solely from land-clearing activities, such as stumps, trees, etc.
- Asphalt: in accordance with G.S. 130A-294 (m)
- Other Wastes as Approved by the Solid Waste Section of the Division of Waste Management.

2.2.3 Recycling Area

Only the following wastes may be received at the facility recycling area or as source separated in the transfer area(s):

- Non-treated, non-painted clean wood (lumber)¹;
- Pallets (damaged and un-damaged);
- Cardboard;
- Brick and block (undamaged and un-painted); and
- Metal (ferrous and non-ferrous).

¹ Engineered wood products such as particle board or glue laminated timbers are not acceptable for recycling.

2.3 PROHIBITED WASTES

2.3.1 MSW Transfer Station

Only wastes as defined in **Section 2.2.1** above may be accepted in the MSW transfer station. No other wastes may be accepted including the following wastes:

- Whole Scrap Tires
- Used Oil
- White Goods
- Lead Acid Batteries
- Yard Waste
- Construction and Demolition Debris (C&D) (Except as allowed in the C&D transfer station)
- Discarded computer equipment
- Oyster Shells
- Rigid plastic containers
- Aluminum Cans

In addition, operating criteria prohibit other materials from receipt within the MSW transfer station. These materials include:

- Hazardous waste as defined by NC General Statute 130A-290 (a) (8), including hazardous waste from conditionally exempt small quantity generators.
- Polychlorinated biphenyls (PCB) wastes as defined in 40 CFR 761 with the exception of trace amounts found in materials such as consumer electronics.
- Bulk or non-containerized liquid wastes unless the waste is household waste other than septic waste and waste oil. A liquid determination will be performed by the paint filter test (see **Appendix A** for apparatus and procedure).
- Containers holding liquid wastes unless the waste is household waste.

2.3.2 C&D Transfer Station

Only wastes, as defined in **Section 2.2.2** above may be accepted in the C&D transfer station. No other wastes may be accepted.

2.4 WASTE SCREENING PROGRAMS

In order to assure that prohibited wastes are not entering the facility, screening programs have been implemented. Waste received at both the scale house entrance and waste taken to the tipping areas or recycling areas are monitored by trained personnel. These individuals have been trained to spot indications of suspicious wastes, including: hazardous placarding or markings, liquids, powders or dusts, sludges, bright or unusual colors, drums or commercial size

containers, and "chemical" odors. Screening programs for visual and olfactory characteristics of prohibited wastes are an ongoing part of the facility operation.

2.4.1 Waste Receiving and Inspection

All vehicles must stop at the scale house located at the entrance of the facility and visitors are required to sign-in. All waste transportation vehicles are weighed and the content of the load assessed. The scale attendant(s) requests from the driver of the vehicle a description of the waste it is carrying to ensure that unacceptable waste is not allowed into the facility. The attendant(s) then visually checks the vehicle as it crosses the scale. Signs informing users of the acceptable and unacceptable types of waste are posted at the scale house. Once passing the scales, the vehicles are routed to the appropriate transfer or recycling area as appropriate.

Vehicles are randomly selected for screening on a regular basis, depending on personnel available. At least one vehicle per week will be randomly selected by inspection personnel. A random truck number and time will be selected (e.g., the tenth load after 10:00 a.m.) on the day of inspections. However, if something looks suspicious is spotted in any waste load, that load is inspected further.

Vehicles selected for inspection are directed to an area on the tipping floor where the vehicle will be unloaded. Waste is carefully spread using suitable equipment. An attendant trained to identify wastes that are unacceptable inspects the waste discharged at the screening area. If unacceptable waste is found, the load will be isolated, reloaded, and the generator/hauler will be logged and escorted out of the facility. For unacceptable wastes that are non-hazardous, the Owner will then notify officials of the DWM (see **Section 1.2**) within 24 hours of attempted disposal of any waste the facility is not permitted to receive in order to determine the proper course of action. The hauler is responsible for removing unacceptable waste from the facility property.

If no unacceptable waste is found, the load will be pushed into the transfer trailer and/or equipment. All random waste inspections will be documented by operations staff using the waste screening form provided in **Appendix B**.

In addition to random waste screening described above, waste unloaded on the tipping floor face will be inspected by the equipment operators, trained to spot unacceptable wastes, before and during pushing into the transfer trailer and/or equipment. Any suspicious looking waste is reported immediately to the designated primary inspector for further evaluation.

2.5 FACILITY OPERATIONS

2.5.1 Operating Capacity

The Operating Capacity for the transfer area is estimated to be approximately 1,000 tons per day of mixed waste (MSW and C&D wastes).

2.5.2 Service Area

The anticipated service area for the transfer facility (subject to change) is generally anticipated to be concentrated in Wake County and its surrounding counties as follows: Johnston, Durham, Granville, Franklin, Nash, Harnett, and Chatham. Waste will not be accepted from out of state or from Orange County.

2.5.3 Disposal Facility

The anticipated disposal facilities for the transfer station (subject to change) includes any facility in the State of North Carolina or the Commonwealth of Virginia that holds a solid waste permit for the specific waste disposed. However, is generally anticipated for disposal at the following facilities (In order of priority):

MSW

1. Upper Piedmont Regional Landfill (Permit No. 73-04)
2. Sampson County MSW Landfill (Permit No. 82-02)
3. South Wake MSW Landfill (Permit No. 92-22)

C&D

1. Shotwell C&D Landfill (Permit No. 92-26)
2. WCA Material Recovery C&D Landfill (Permit No. 92-31)
3. Red Rock Disposal C&D Landfill (Permit No. 92-28)

In the event that new disposal facility agreements are negotiated other than the list (above). Shotwell will provide a notice to the Division of Waste Management within 30 calendar days.

2.5.4 Personnel Requirements

The anticipated personnel requirements for operation and maintenance of the site are listed in the following table.

Description	Primary Function (Allocation)
1) Site Manager	Overall management of the facility
2) Scale house Attendant	Receiving and weight for incoming loads
3) Operators (3)	Management of tipping floor and recycling areas
4) Commercial Drivers (4-6)*	Transfer of C&D and MSW Waste
5) Labor (3)	General labor and operational staff around the site

* Commercial drivers subject to change in response to actual volume of waste received.

2.5.5 Equipment Requirements

The anticipated equipment requirements for operation and maintenance of the site are listed in the following table.

Description	Primary Function (Allocation)
1) Excavator	Recycling operations and sorting
2) Front End Loader	Loading, recycling, and site cleanup
3) Skid Steer Loader	Loading, recycling, and site cleanup
4) Transfer Trucks (4-6)*	Collection and transfer of C&D and MSW Waste
5) Compaction System	Package product system to achieve higher compaction rates of MSW in transfer operations
6) Dump Truck	Hauling material around site.

* Commercial drivers subject to change in response to actual volume of waste received.

2.5.6 Building Features

The anticipated building features of the transfer area are listed in the following table.

Description	MSW	C&D
1) Roof	Yes	Yes
2) Sides (3)	Yes	Yes
3) Concrete Floor	Yes	Yes
4) Leachate Collection and Storage	Yes	Yes
5) Ventilation	Yes	Yes
6) Water Supply	Yes	Yes
7) Lighting	Yes	Yes
8) Interior Office & Bathrooms	No	No
9) Explosive Gas Monitoring	Yes	Yes
10) Communications (Telephone, Radios, Cell Phones)	Yes	Yes
11) Fire Suppression/Sprinkler System	No	No

2.6 TRANSFER OPERATIONS

2.6.1 Access

Traffic will be clearly directed to the appropriate transfer or recycling area. For the transfer area(s). Traffic speed on the site should be less than 10 MPH. Rutting of gravel roadway surfaces must be repaired by placement of additional gravel on the roadway and not solely by grading the rut. This will maintain the separator geotextile placed below most gravel roadway surfaces.

2.6.2 General Procedures

The transfer operations will be conducted in accordance with the approved Operation Plan and conditions of the Solid Waste Permit issued by the North Carolina Division of Solid Waste Management (DWM).

Facility operations are anticipated as follows:

1. Collection vehicles delivering waste to the facility will enter through the main entrance;
2. Pass by and over the scales and scalehouse for weight;
3. Continue along the access road until reaching the transfer station tipping area or recycling area;
4. The tipping area has “push” walls running along the interior of the building that direct the waste to feed “hoppers”overlying the transfer trailers and/or equipment on the lower level of the building. The building is divided into two separate tipping areas, one for MSW and one for C&D. The attendant will direct vehicles, waiting to unload, to back into the facility through the entrance. Adequate area is available in front of the transfer area for drivers to queue their vehicles into a backing maneuver. Station operating personnel will be on the station floor to direct and guide the vehicles.
5. The vehicles will back onto the tipping floor to an area designated by the attendant. MSW vehicles will be directed to one side of the floor, whereas C&D vehicles will be directed to the opposite portion of the building.
6. Once the vehicle is in position, the waste load will be discharged directly onto the tipping floor.
7. A spotter will inspect the discharged waste before it is mixed with other waste on the tipping floor and pushed by a rubber-tired loader into the open top transfer trailers, specifically designed for hauling MSW and C&D wastes, respectively, located in the lower level of the Transfer Station. All MSW waste will stay in the covered area of the transfer station.

2.6.3 Recycling/Source Separation

As a means of capturing recyclable materials and/or waste screening, source separation will be conducted on the tipping floor as follows:

1. The track hoe, loader, or laborers will separate materials to be recycled and/or processed from the loads before the waste is pushed into the open top transfer trailers. It is anticipated that most of the recyclables and materials to be separated will arrive at the transfer area as C&D waste. Demolition debris will not be recycled and/or processed and will be directly pushed into the transfer vehicle. Asbestos (known) containing C&D will not be accepted. MSW wastes will not be recycled and/or processed.
2. Materials to be recycled and/or processed may stay on the floor of the building (not in containers) for no longer than the close of the business day. At the end of each day, all recyclable materials shall be transported by skid steer loader, etc. to the recycling area in appropriately labeled bins or roll-off containers.
3. Treated wood and/or engineered wood products (any wood other than virgin wood) waste must be discarded in the C&D trailer.
4. Materials, as defined in **Section 2.2.3**, to be recycled will be pulled from the C&D waste and loaded into roll-off containers in the transfer floor area or immediately outside the transfer station to the recycling area in appropriately labeled bins or roll-off containers.
5. Cardboard will be transported to the recycling area into an appropriately labeled container.
6. Concrete (cement and asphaltic/bituminous) may be delivered and stockpiled at the limits of the recycling area until a load is generated or it is removed from the site for sale as fill, aggregate, etc., as markets allow.

2.6.4 Transfer Manifest Documentation

Shotwell employs a truck scale data management software program to track all inbound and outbound waste. Inbound traffic will follow procedures outlined in **Section 2.6.2**. Outbound transfer operations are anticipated as follows:

1. Once the transfer trailer is full, the driver will exit over the scales and scalehouse for weight;
2. The scalehouse attendant will prepare a load summary including weight and a source summary for all wastes received in that trailer's load. The attendant will then instruct the driver to the appropriate disposal facility as outlined in **Section 2.5.3** based on waste type and/or source summary.

2.7 RECYCLING AREA OPERATIONS

The facility's recycling area located north of the transfer station is used to store, separate, and contain recyclable materials. These materials are generated from source separated waste from the transfer station and/or pre-sorted materials such as new C&D directly off-loaded into an appropriate container. A temporary recycle storage area is included in the transfer station tipping floor prior to storage in this area which must be cleaned each day. The facility is equipped with equipment to facilitate hand sorting of materials, and bins for storage as defined in **Section 2.5.5**.

2.7.1 Containers

Containers (generally 8'x20' or 8'x15') holding various recyclable, separated, or other transfer related items will be stored in the recycling area. The containers will be removed from the site as they are filled.

2.7.2 Other Storage Areas

All other recyclable waste products will be stored around the recycling area. These products will be maintained in discrete piles and/or containers as follows:

- Wood pallets will be delivered and containerized (~100 CY);
- Concrete/asphalt materials will be delivered and stockpiled (~100 CY); and
- Clean wood debris will be delivered and containerized (~100 CY).

2.7.3 Markets

The final destination of the recyclable materials separated from the waste may vary depending on market prices for such materials. However, final markets are anticipated as follows:

- a. Metals: TT&E, Wise Recycling, Raleigh Metals, etc.
- b. Pallets: Shotwell C&D Landfill for grinding to Craven County Waste to Energy (WTE) or McGill Environmental for compost.
- c. Clean Wood: Shotwell C&D Landfill for grinding to Craven County Waste to Energy (WTE) or McGill Environmental for compost.
- d. Cardboard: Paper Stock Dealers, Sonoco Products, etc.

No grinding or composting will be performed on-site.

SECTION 3.0 ENVIRONMENTAL MANAGEMENT

3.1 OVERVIEW

This section reviews the overall environmental management tasks required for the successful operation of the facility.

3.2 SURFACE WATER CONTROL

As used herein, the definition of “surface water” is water which results from precipitation or site run-on that has not contacted the waste.

Proper control of surface water at the transfer or recycling areas will accomplish the following goals:

- Prevent the run-on of surface water into waste handling area(s);
- Prevent the run-off of surface water that has come into contact with the waste (i.e. leachate);
- Limit the erosion caused by surface waters; and
- Limit sediments carried off-site by surface waters.

Separate erosion and sedimentation control plans are provided for the site to Wake County. These plans describe both short and long term engineered features and practices for preventing erosion and controlling sedimentation at this site.

3.2.1 Erosion Control

Erosion control measures have been taken within the drainage channels and at points of stormwater discharge. All site features should be inspected regularly for erosion damage and promptly repaired.

3.2.2 Sedimentation Control

Stormwater run-off from the site is conveyed to an on-site sediment basin and/or trap. The basin and/or trap should be inspected regularly for sediment build-up or erosion damage. The basin and/or trap should be cleaned out when sediment fills the lower half of the basin.

3.3 LEACHATE MANAGEMENT

The leachate management system for the proposed MSW & C&D transfer station consists of concrete tipping floor, collection trenches and leachate transmission piping, valve boxes, valves, and a leachate storage tank prior to either pump and hauling or direct connection to the City of

Raleigh sewer system.

3.3.1 Leachate Collection

Leachate from each transfer area unit is collected in perimeter floor drains that drain to low end(s) of each area. Leachate collected drains to a central leachate storage tank which flows by gravity via an HDPE force main to the City of Raleigh sewer system or pumped directly to a truck for hauling to a local publicly owned treatment works (POTW), as necessary.

3.3.2 Operation and Maintenance of Leachate Management Systems

Operation and maintenance of the leachate management system shall include routine inspections and maintenance to insure that accumulated solids are removed from the leachate storage tank, all floor drains are periodically cleaned of obstructions, and the system maintains a clear flow path into the City sewer system. The Solid Waste Manager or his designee will be responsible for following and documenting, as required, these activities.

3.3.3 Record Keeping

Accurate records will be maintained at the facility in accordance with **Section 1.14**.

3.4 VECTOR CONTROL

Control of insects, rodents, and birds will be accomplished by periodic cleaning of the facility. Spilled or wind-blown debris along the access road will be cleaned up daily and placed in the transfer truck. The transfer areas will be cleaned and swept daily and the MSW area washed down daily. If vector control becomes a problem, additional measures will be taken to ensure the protection of human health.

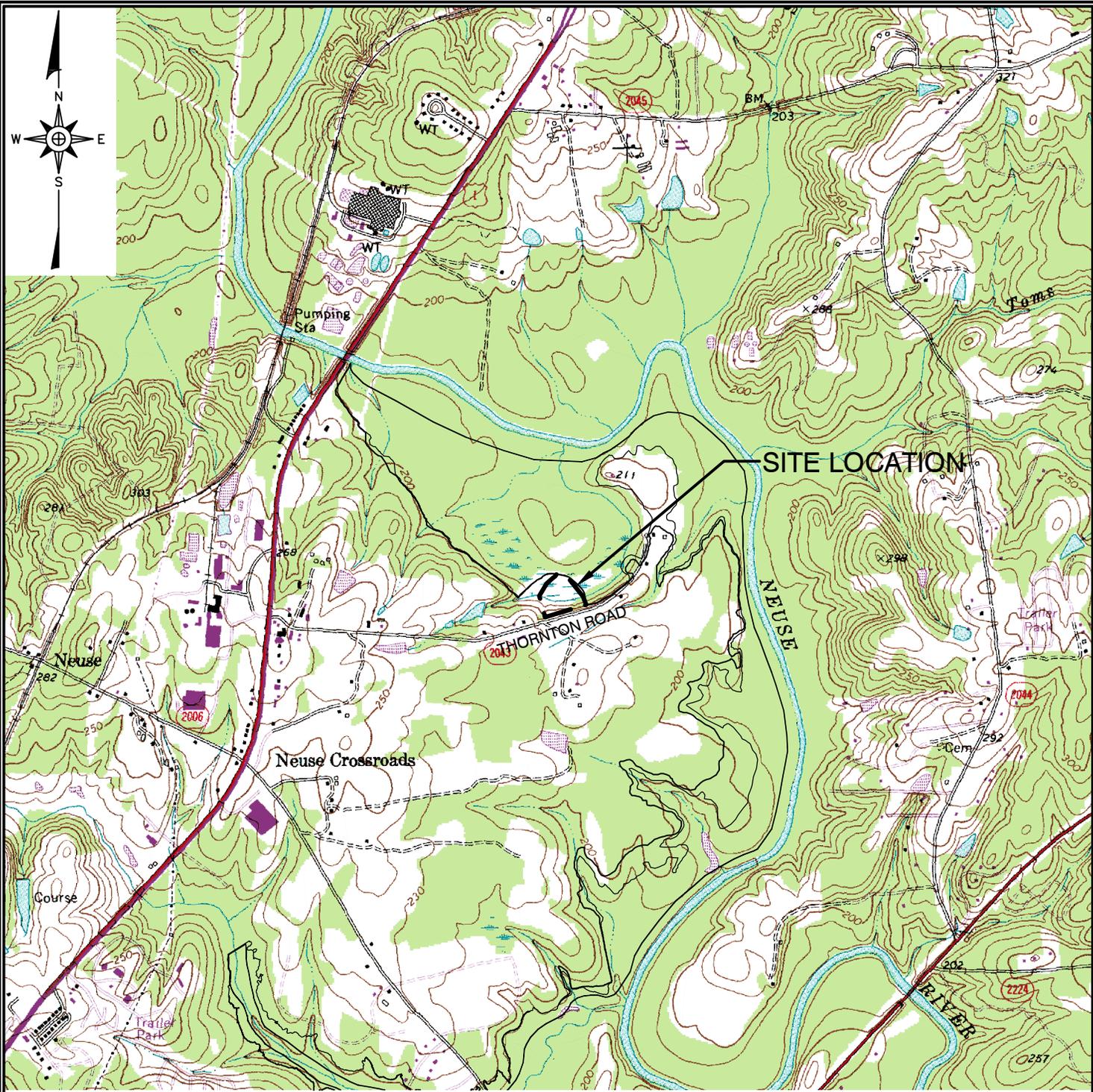
3.5 ODOR CONTROL

Odorous or potentially odorous materials will be pushed into the transfer truck covered as soon as possible to avoid odor problems. Additionally, the transfer areas will be cleaned and swept daily and the MSW area washed down daily. If odor control becomes a problem, additional measures will be taken to ensure odor control.

3.6 DUST CONTROL

Dust related to waste hauler traffic on the access roads will be minimized by using a water truck or a sprinkler system to limit dust on the gravel portion of the road.

G:\CAD\Shotwell Transfer Station\King 07-1\Temporary Property Line\sheets\KING-A0007A.dwg - 12/14/2007 12:26 PM



REFERENCE:

- 1. TOPOGRAPHY FROM U.S.G.S. 7.5 MIN. QUADRANGLE "WAKE FOREST, N.C.", DATED 1967, PHOTOREVISED 1987.

0 2000' 4000' 6000'

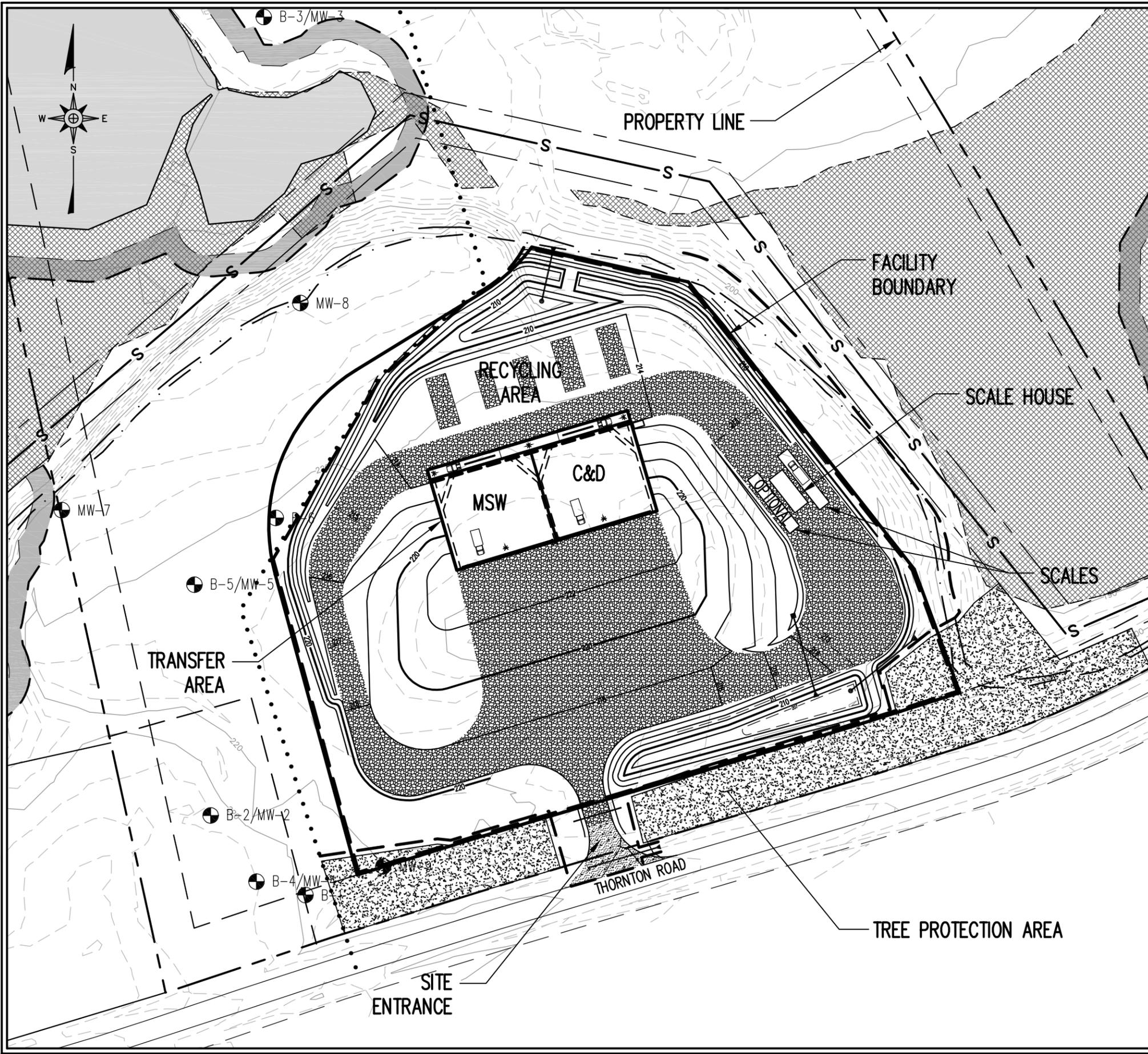


SITE LOCATION MAP


RICHARDSON SMITH GARDNER & ASSOCIATES
 14 N. Boylan Ave. Raleigh, N.C. 27603 www.rsgengineers.com
 ph: 919-828-0577 fax: 919-828-3899

SCALE:	DRAWN BY:	CHECKED BY:	DATE:	PROJECT NO.	FIGURE NO.	FILE NAME
AS SHOWN	J.A.L.		Dec. 2007	KING 07-3	1	KING-A0007A

G:\CAD\Shotwell Transfer Station\King 07-1\rev 080608\sheets\KING-B0011A.dwg - 8/6/2008 5:25 PM



LEGEND

- 800 EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- PROPOSED 10' CONTOUR
- PROPOSED 2' CONTOUR
- PROPERTY LINE (SEE REFERENCE 6)
- FEMA FLOOD ZONE "X" (SEE REFERENCE 2)
- FEMA FLOOD ZONE "AE" (SEE REFERENCE 2)
- NEUSE RIVER BUFFER
- NEUSE RIVER BUFFER (DISTURBABLE LIMITS)
- SURVEYED WETLANDS (SEE REFERENCE 5)
- ZONING LINE
- FACILITY BOUNDARY
- MONITORING WELL

REFERENCES

1. EXISTING TOPOGRAPHY PROVIDED BY STOCKS ENGINEERING, P.A., DATED OCTOBER 2007.
2. FLOOD ZONE LIMITS FROM FLOOD INSURANCE RATE MAP (FIRM) NUMBER 3720173800J, PANEL 1738, EFFECTIVE DATE MAY 2, 2006.
3. CITY OF RALEIGH SANITARY SEWER LOCATIONS PROVIDED BY STOCKS ENGINEERING, P.A., DATED OCTOBER 2007.
4. ZONING LINES FROM SURVEY BY MURPHY GEOMATICS, PRESENTED IN DRAWING ENTITLED "RECOMBINATION PLAT FOR THORNTON II" DATED AUGUST 2006.
5. WETLAND DELINEATION FROM DRAWING ENTITLED "WEBTHOR PRELIMINARY WETLAND DELINEATION", PREPARED BY MURPHY GEOMATICS, DATED OCTOBER 29, 2007.
6. SITE PROPERTY LINE FROM DRAWING ENTITLED "RECOMBINATION PLAT FOR DYNASTY HOLDINGS, LLC" PREPARED BY MURPHY GEOMATICS, DATED NOVEMBER 2007.



RICHARDSON SMITH GARDNER & ASSOCIATES
www.regengineers.com
14 N. Boylan Ave. Raleigh, N.C. 27603
ph: 919-826-0577 fax: 919-826-3899

FIGURE NO.	2	FILE NAME	KING-B0011A
SCALE:	AS SHOWN	PROJECT NO.	KING 07-1
CHECKED BY:		DATE:	Aug. 2008
DRAWN BY:	J.A.L.		

TITLE:
THORNTON ROAD MIXED WASTE TRANSFER & RECYCLING CENTER SHOTWELL TRANSFER STATION, INC.
FIGURE 2

Appendix A

EPA Method 9095
Paint Filter Liquids Test

METHOD 9095
PAINT FILTER LIQUIDS TEST
From EPA SW-846

1.0 SCOPE AND APPLICATION

- 1.1 This method is used to determine the presence of free liquids in a representative sample of waste.
- 1.2 The method is used to determine compliance with 40 CFR 264.314 and 265.314.

2.0 SUMMARY OF METHOD

- 2.1 A predetermined amount of material is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5 minute test period, the material is deemed to contain free liquids.

3.0 INTERFERENCES

- 3.1 Filter media were observed to separate from the filter cone on exposure to alkaline materials. This development causes no problem if the sample is not disturbed.

4.0 APPARATUS AND MATERIALS

- 4.1 Conical paint filter: Mesh number 60 (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden for an approximate cost of \$0.07 each.
- 4.2 Glass funnel: If the paint filter, with the waste, cannot sustain its weight on the ring stand, then a fluted glass funnel or glass funnel with a mouth large enough to allow at least 1 inch of the filter mesh to protrude should be used to support the filter. The funnel is to be fluted or have a large open mouth in order to support the paint filter yet not interfere with the movement, to the graduated cylinder, of the liquid that passes through the filter mesh.
- 4.3 Ring stand and ring or tripod.
- 4.4 Graduated cylinder or beaker: 100-mL.

5.0 REAGENTS

- 5.1 None.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

- 6.1 All samples must be collected according to the directions in Chapter Nine of EPA SW-846.
- 6.2 A 100 mL or 100 g representative sample is required for the test. If it is not possible to obtain a sample of 100 mL or 100 g that is sufficiently representative of the waste, the analyst may use larger size samples in multiples of 100 mL or 100 g, i.e., 200, 300, 400 mL or g. However, when larger samples are used, analysts shall divide the sample into 100-mL or 100-g portions and test each portion separately. If any portion contains free liquids, the entire sample is considered to have free liquids.

7.0 PROCEDURE

- 7.1 Assemble test apparatus as shown in Figure 1.
- 7.2 Place sample in the filter. A funnel may be used to provide support for the paint filter.
- 7.3 Allow sample to drain for 5 minutes into the graduated cylinder.
- 7.4 If any portion of the test material collects in the graduated cylinder in the 5-min. period, then the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314.

8.0 QUALITY CONTROL

- 8.1 Duplicate samples should be analyzed on a routine basis.

9.0 METHOD PERFORMANCE

- 9.1 No data provided.

10.0 REFERENCES

- 10.1 None required.

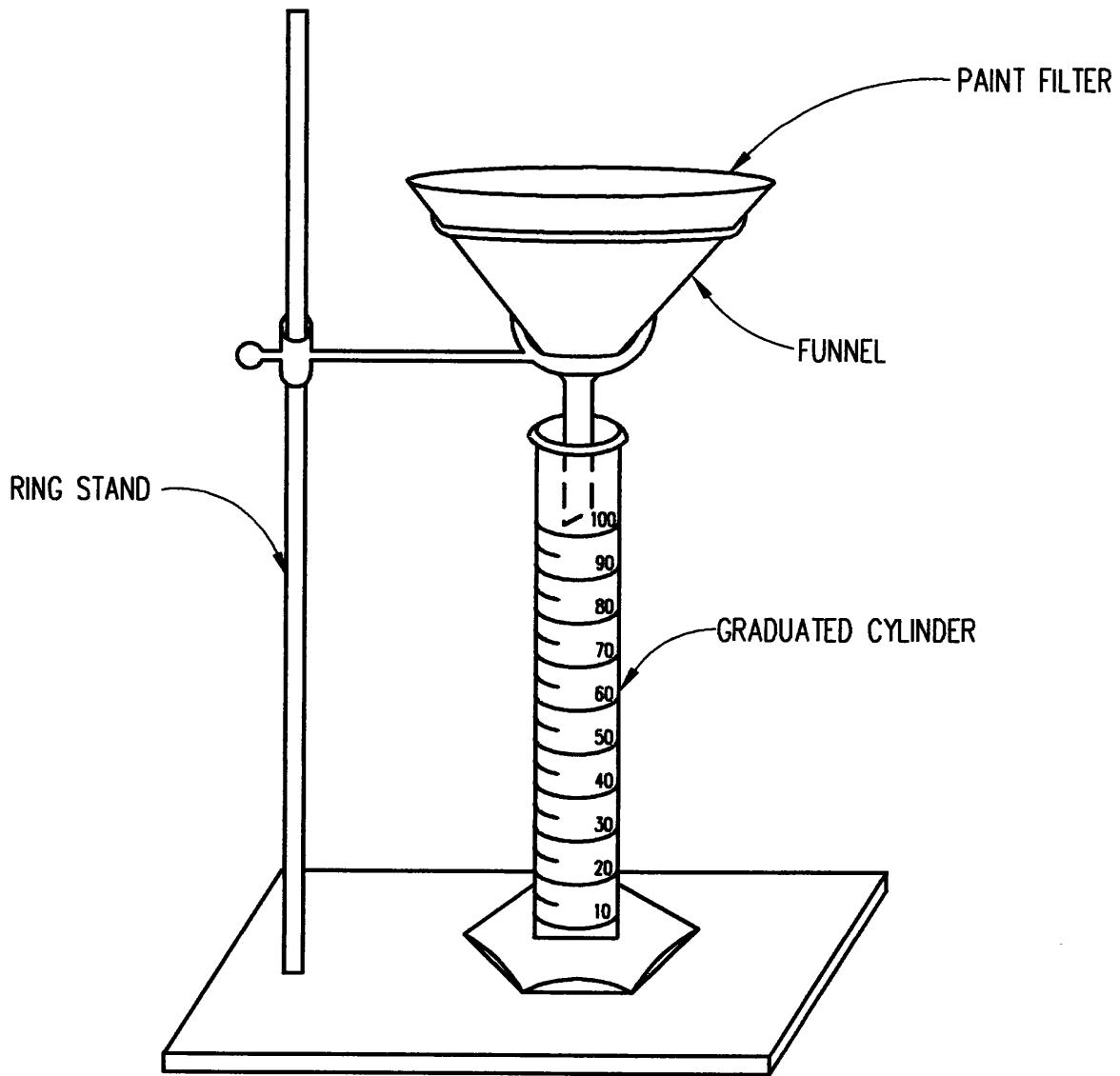
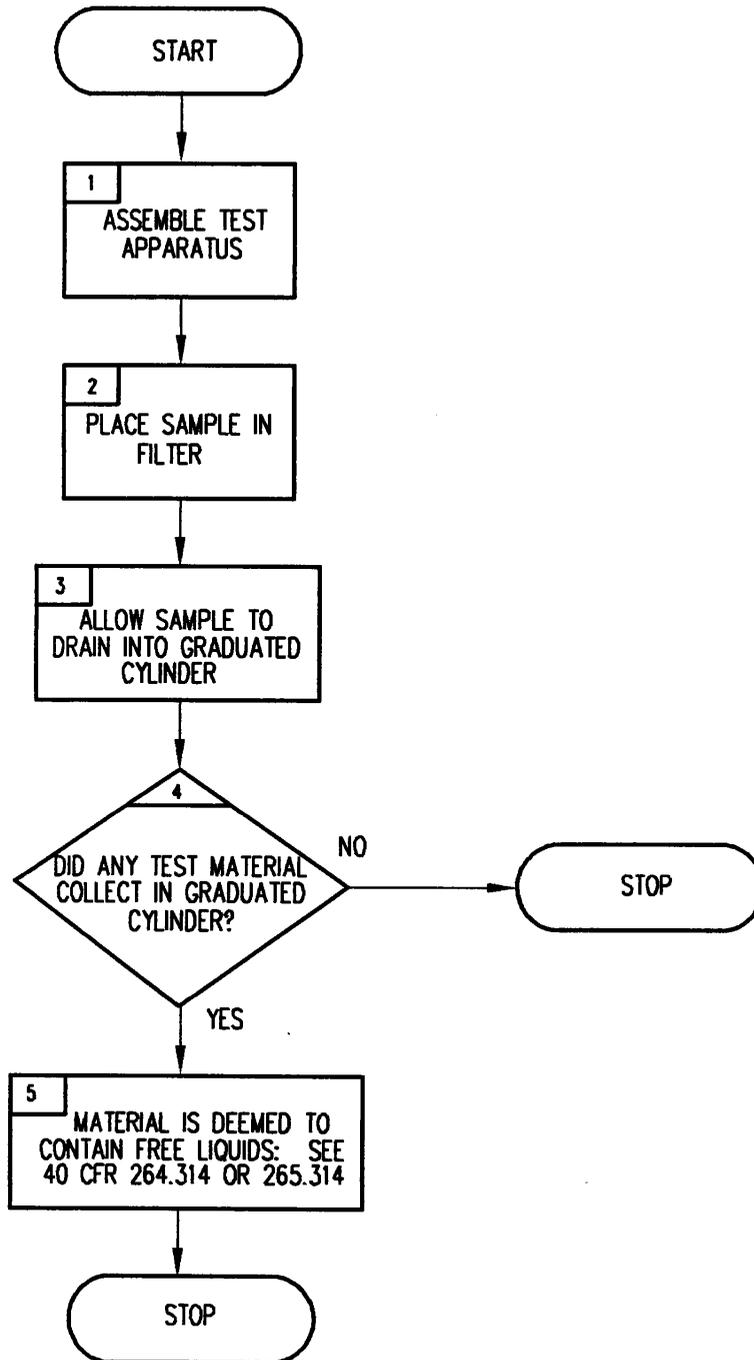


FIGURE 1. PAINT FILTER TEST APPARATUS.

METHOD 9095
PAINT FILTER LIQUIDS TEST



Appendix B

Waste Screening Form

Shotwell Transfer Station, Inc.
Thornton Road Mixed Waste Transfer & Recycling Center

WASTE SCREENING FORM

Day / Date: _____ Time Weighed in: _____
Truck Owner: _____ Driver Name: _____
Truck Type: _____ Vehicle ID / Tag No: _____
Weight _____ Tare: _____
Waste Generator / Source: _____

Reason Load Inspected: Random Inspection _____ Staff Initials _____
 Detained at Scales _____ Staff Initials _____
 Detained by Operating Staff _____ Staff Initials _____

Inspection Location: _____

Approved Waste Determination Form Present? Yes _____ No _____ N/A _____

Description of Load: _____

Load Accepted (signature) _____ Date _____
Load Not Accepted (signature) _____ Date _____

Reason Load Not Accepted (complete only if load not accepted)

Description of Suspicious Contents: Color _____ Haz. Waste Markings _____
 Texture _____
 Drums Present _____ Smell _____
 Est. Cu. Yds. Present in Load _____
 Est. Tons Present in Load _____

Emergency Management Contacted? Yes _____ No _____

Company or Authority Contacted? _____
Hazardous Materials Present: _____

Hauler Notified (if waste not accepted) Phone: _____ Time Contacted: _____
Other Observations: _____

Final Disposition
Signed _____ Date _____
 Waste Screening Inspector or Solid Waste Manager

Attach related correspondence to this form.
File completed form in Operating Record.

Attachment I

Traffic Documentation



REC'D NOV 27 2007

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

DAVID MCCOY
SECRETARY

November 21, 2007

COUNTY: **Wake**
SUBJECT: **Proposed Shotwell Transfer Station
Thornton Road (SR 2043)**

Stacey A. Smith, P.E.
Richardson, Smith, Gardner & Associates
14 North Boylan Avenue
Raleigh, N.C. 27603

Mr. Smith,

We have completed a review of your memorandum dated October 30, 2007, which provides Trip Generation information and Traffic Impact Analysis associated with the subject project. Based on our review we offer the following comments:

The proposed facility will be located 0.8 miles east of the intersection of US 1 and Thornton Road. Thornton Road is a two-lane dead end roadway. US 1 is a 4-lane median divided facility with limited control of access. The proposed project will generate a total of 515 trips daily when the municipal solid waste operation is added to the construction debris operation. This increase in traffic **will not** have any substantial impact on the adjacent limited controlled access facility.

The increase in traffic may have impacts on the traffic operations along Thornton Road and at the intersection of US 1. The additional tonnage may impact the existing pavement structure of Thornton Road. Therefore, roadway improvements and pavement strengthening may be required to mitigate these impacts. These improvements will be made requirements of any subsequent Driveway Permit issued by the District Engineer.

Feel free to contact Reid Elmore, Wake County District Engineer, or myself if you need further assistance with this matter.

Sincerely,

A handwritten signature in black ink that reads "J. W. Bowman".

J. W. Bowman, P.E.
Division Engineer

JWB/tre

Cc: Reid Elmore, District Engineer



MEMORANDUM

To: J. Wally Bowman, P.E., NCDOT Division 5 Engineer
From: Andrew Topp, P.E., Martin/Alexiou/Bryson, PLLC
Date: October 30, 2007
Subject: Proposed Shotwell Transfer Station – Trip Generation

Introduction

A bill was recently passed in the North Carolina General Assembly that affects the permitting process for new solid waste facilities. This bill, Senate Bill 1492, contains a subsection (included in Appendix) that dictates the terms of a traffic study requirement. Shotwell Landfill, Inc. is seeking to modify its current transfer station along Thornton Road (SR 2043) in Raleigh, which requires adherence to this new law. Before commencing with the full development plans for the site and typical driveway permit process, Shotwell Landfill, Inc., is seeking certification from NCDOT as is required by this new law, summarized below:

“obtaining a certification from the Division Engineer of the Department of Transportation that the proposed facility will not have a substantial impact on highway traffic.”

In this context, “highway” is defined as the limited access highway (L.A.H.) which waste vehicles travel. The roads traveled between the L.A.H. and the site is the “approach road.” These roads are shown in Figure 1. This memorandum provides an estimate of the traffic that will be generated by the proposed Shotwell Transfer Station expansion planned along Thornton Road (SR 2043) in Raleigh, North Carolina. It also provides an estimate of the site’s possible traffic impacts as is required to address the above requirements.

Project Background

The current site located along the north side of Thornton Road, approximately 0.8 mile east of Capital Boulevard, as shown in Figure 1. It presently serves as a transfer station that accepts approximately 200 tons of new construction debris (CD) daily. The owner seeks a permit that will allow them to also accept municipal solid waste (MSW). As a result, the site is planning to accept up to 200 tons of construction debris and 800 tons of municipal solid waste.

Traffic Generation

The *Institute of Transportation Engineers (ITE) Trip Generation Manual, 7th Edition* does not presently generate traffic for transfer stations. As a result, the CD-related trips were derived from a traffic count conducted at their current driveway. This A.M. peak period (6:45 to 8:45) count was conducted on Tuesday, October 16th and the P.M. peak period (2:15 to 5:00) was counted on Wednesday, October 10th. The facility operated under normal and representative conditions on these days. Note that much smaller trucks typically bring in CD debris when compared to MSW loads, which results in higher traffic rates for the CD as compared to the anticipated MSW.

The MSW-related trips were developed by estimating the traffic per four trip types into the site. The first category includes trucks used to haul MSW to the transfer station from the surrounding businesses and neighborhoods. Although a range of garbage trucks may be used for this operation, it was assumed that each truck will carry 10 tons on average and will be spaced relatively evenly over the 9 hours of operation (7:00 A.M. to 4:00 P.M.). The second trip type is hauling the waste from the transfer station to the landfill, where maximum load tractor trailers are typically used. A tractor trailer carrying 35 tons on average, which is shy of the Federal 40-ton limit, is assumed to make this continuous movement throughout the day. The following calculations summarize our estimates for these two trip types.

<u>Hauling MSW to TS</u>		<u>Hauling MSW from TS to Landfill</u>	
800	tons/day	800	tons/day
10	tons/truck	35	tons/truck
80	trucks/day (each way)	23	trucks/day
9	hrs/day	9	hrs/day
8.9	trucks/hour	2.5	trucks/hour
10	trucks/A.M. peak hour (each way)	3	trucks/A.M. peak hour (each way)
1	truck/P.M. peak hour (each way)	2	truck/P.M. peak hour (each way)

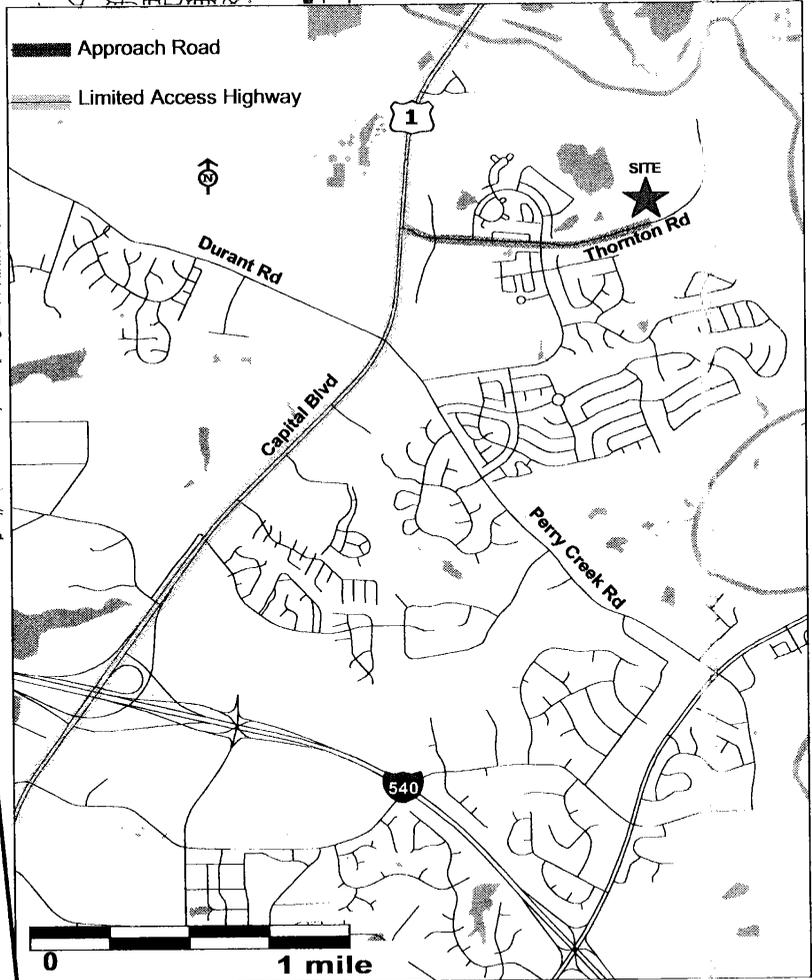
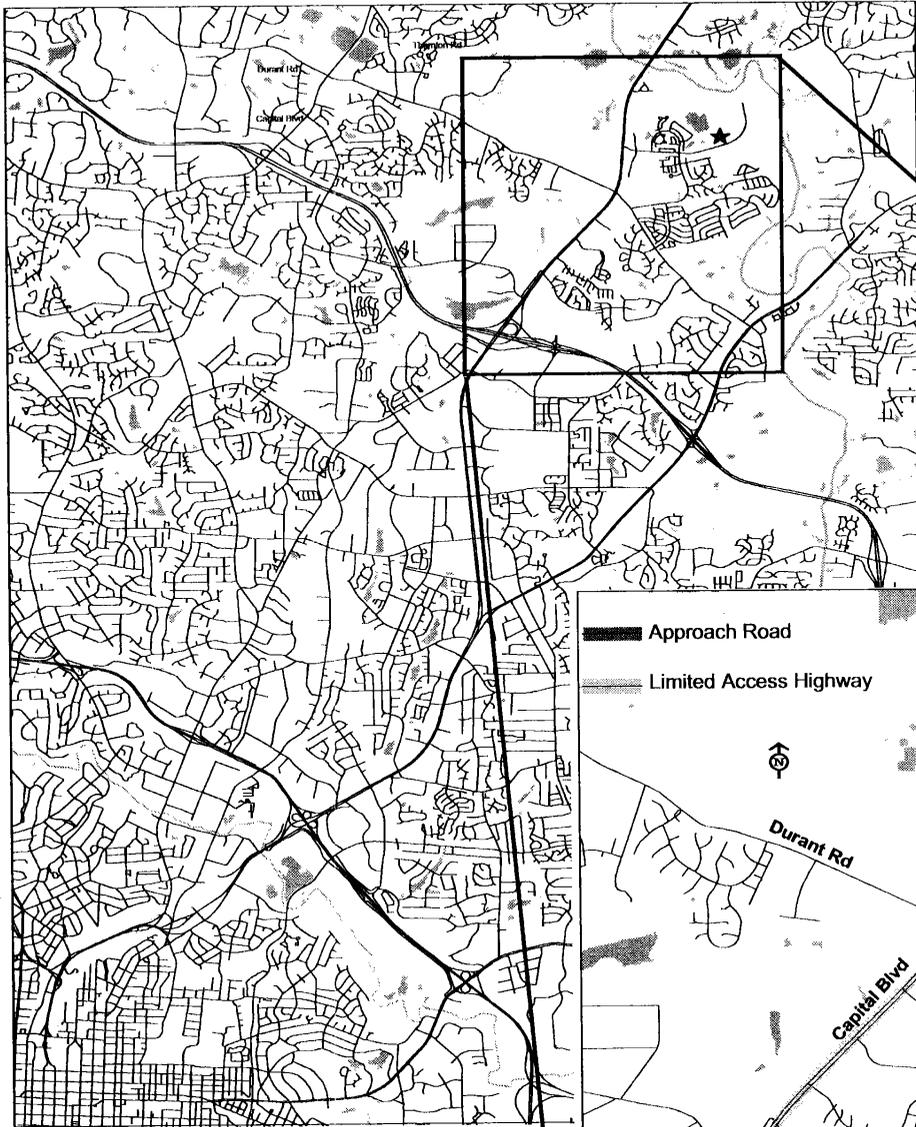
In addition to the truck trips, there may be employee-based and other trip types. The employee trips were derived using rates that are similar to other industrial uses and assuming five new employees. The remaining ("other") trips were assumed to include deliveries, residents dropping off items to be recycled, or other miscellaneous types of trips.

The following table summarizes the estimated daily and peak hour (between 7:00 to 9:00 A.M. and 4:00 to 6:00 P.M.) trips to be generated by this development.

Table 1: Transfer Station Trip Generation Estimate

Trip Types	Daily	A.M. Peak (7:00-9:00)			P.M. Peak (4:00-6:00)		
		Enter	Exit	Total	Enter	Exit	Total
Construction Debris (200 Tons/Day)							
Obtained from traffic count	245	11	15	26	5	11	16
Municipal Solid Waste (800 Tons/Day)							
Hauling MSW to transfer station	160	10	10	20	1	1	2
Hauling MSW to landfill	46	3	3	6	2	2	4
Employee-based trips	14	2	1	3	1	3	4
Other trips	50	3	3	6	6	6	12
MSW Total	270	18	17	35	10	12	22
CD + MSW Total	515	29	32	61	15	23	38

The transfer station is expected to increase its traffic generation from 26 trips presently during the A.M. peak to 61 trips once the municipal solid waste is added. During the P.M. peak hour, an additional 22 trips will be added to the 16 generated as part of the construction debris operations, resulting in approximately 38 trips. Although the facility closes at 4:00, it is assumed that some trips will continue to be generated between 4:00 and 5:00 as the last few truck trips are made, remaining employees leave, and a few recycling or after hour drop-offs may be made.



**MARTIN
ALEXIOU
BRYSON**

Figure 1
Site Vicinity Map

Proposed Shotwell Transfer
Station
Raleigh, NC

Traffic Impacts

All traffic traveling to and from the facility is expected to use Thornton Road, which constitutes the approach route, from Capital Boulevard (US 1), which is considered to be the nearest limited access highway.

Thornton Road is a two-lane roadway that has been widened in conjunction with recent residential and commercial development. It has a 20-foot pavement width along the 0.25-mile stretch between the site driveway and the start of the Thornton Commons residential development. Along the Thornton Commons frontage west to Capital Boulevard, Thornton Road has a width ranging from 29 to 36 feet. The two lanes along Thornton Road can accommodate the additional transfer station traffic without substantial degradation in operations. Since only minimal development exists east of the site driveway and the driveway itself carries a relatively low volume of traffic, no turn lanes are recommended at the site driveway. It is, however, recommended to pave the driveway to reduce dust and debris potentially being tracked onto Thornton Road. In addition, upgrading the roadway and shoulders to meet standards set by the NCDOT District Engineer along the site's frontage is also recommended. This is likely accomplished by upgrading the roadway between the site's driveway and the Thornton Commons development to full 12-foot lanes and ensuring a 6-foot clear zone offset from the roadway.

Capital Boulevard (US 1) is a multi-lane arterial that extends through Wake County from Franklin County southwest to Chatham County. It has partially controlled access in the vicinity of the site (i.e. north of I-540) and carries a high volume of traffic (53,000 vehicles per day cited on the 2005 AADT map).

As a result of the high traffic volume of traffic along Capital Boulevard and the relatively minor amount of new traffic being added by the site (approximately 270 new trips per day), the traffic impacts along this highway are projected to be very minimal, and in our opinion will not have a substantial impact on the highway traffic.

APPENDIX

**GENERAL ASSEMBLY OF NORTH CAROLINA
SESSION 2007**

**SESSION LAW 2007-550
SENATE BILL 1492**

"§ 130A-295.5. Traffic study required for certain solid waste management facilities.

(a) An applicant for a permit for a sanitary landfill or for a transfer station shall conduct a traffic study of the impacts of the proposed facility. The Department shall include as a condition of a permit for a sanitary landfill or for a transfer station a requirement that the permit holder mitigate adverse impacts identified by the traffic study. The study shall include all of the following at a minimum:

- (1) Identification of routes from the nearest limited access highway used to access the proposed facility.
- (2) Daily and hourly traffic volumes that will result along each approach route between the nearest limited access highway and the proposed facility.
- (3) A map identifying land uses located along the identified approach routes, including, but not limited to, residential, commercial, industrial development, and agricultural operations. The map shall identify residences, schools, hospitals, nursing homes, and other significant buildings that front the approach routes.
- (4) Identification of locations on approach routes where road conditions are inadequate to handle the increased traffic associated with the proposed facility and a description of the mitigation measures proposed by the applicant to address the conditions.
- (5) A description of the potential adverse impacts of increased traffic associated with the proposed facility and the mitigation measures proposed by the applicant to address these impacts.
- (6) An analysis of the impact of any increase in freight traffic on railroads and waterways.

(b) An applicant for a permit for a sanitary landfill or for a transfer station may satisfy the requirements of subsection (a) of this section by obtaining a certification from the Division Engineer of the Department of Transportation that the proposed facility will not have a substantial impact on highway traffic."

Attachment J

Financial Assurance Estimate



DATE: 18-Jul-08
 BY: SAS

Financial Assurance
Shotwell Transfer Station, Inc.
Thornton Road Mixed Waste Transfer & Recycling Center
Engineer's Remedial Cost Estimate (7-17-08 Revision)

Item No.	Item Description	Unit	Contractor			Comments
			Quantity	Unit Price	Total Price	
Facility Area (Horizontal Plan) ---->		AC	8			
1.0	Pre-Remedial Response			Subtotal	\$4,000.00	
1.1	Coordination, Contracts, and Management	AC	8	\$500.00	\$4,000.00	RSGA Estimate
2.0	Remedial Response Activities				\$182,000.00	Ref. 1
2.1	Surveys and Layout	AC	8	\$250.00	\$2,000.00	RSGA Estimate
2.2	Mobilization, Demobilization, and Project Closeout	AC	8	\$500.00	\$4,000.00	RSGA Estimate
2.3	Wash Down & Cleanup of the Transfer Station	DY	2	\$1,500.00	\$3,000.00	Assume single work crew per day.
2.4	Fencing & Concrete Barrier Protection	LF	200	\$15.00	\$3,000.00	Assume close transfer station door and place concrete barriers across wall.
2.5	Excess Waste Disposal (C&D & MSW)	TN	5,000	\$30.00	\$150,000.00	Five (5) days of waste as specified by NCDENR. at th South Wake Landfill fee.
2.6	Excess Recycling Disposal	CY	500	\$10.00	\$5,000.00	Assume cost of loading and transport.
2.7	Leachate Disposal	GAL	50,000	\$0.10	\$5,000.00	Assume one (1) week capacity of leachate
2.8	Erosion & Sediment Control (grading, silt fence, maintenance, etc.)	AC	8	\$500.00	\$4,000.00	RSGA Estimate
2.9	Revegetation	AC	4	\$1,500.00	\$6,000.00	RSGA Estimate
3.0	Quality Assurance, Certification, & Deed Notation				\$3,000.00	
3.1	Engineering and Reporting	LS	1	\$2,500.00	\$2,500.00	RSGA Estimate
3.2	Surveying and Deed Notation	LS	1	\$500.00	\$500.00	RSGA Estimate
Remedial Response Estimate ---->					\$189,000	
10% Contingency ---->					\$18,900	
Total Estimate ---->					\$207,900 (2007\$)	(See Note 1)

Notes:

- All costs are presented in current dollars and should be increased at an inflation rate of 1.5% if additional review is not performed annually.
- This ESTIMATE has been prepared for financial assurance purposes only and shall not be considered a replacement for an actual bid from a licensed contractor and is considered acceptable within a +/- 10% of the Total Estimate value.

References:

- Thornton Road Mixed Waste Transfer & Recycling Center Permit Application by Richardson Smith Gardner & Associates, Inc dated November 2007.

Denotes values calculated in spreadsheet.

Attachment K

Project Drawings

SHOTWELL TRANSFER STATION, INC.
WAKE COUNTY, NORTH CAROLINA

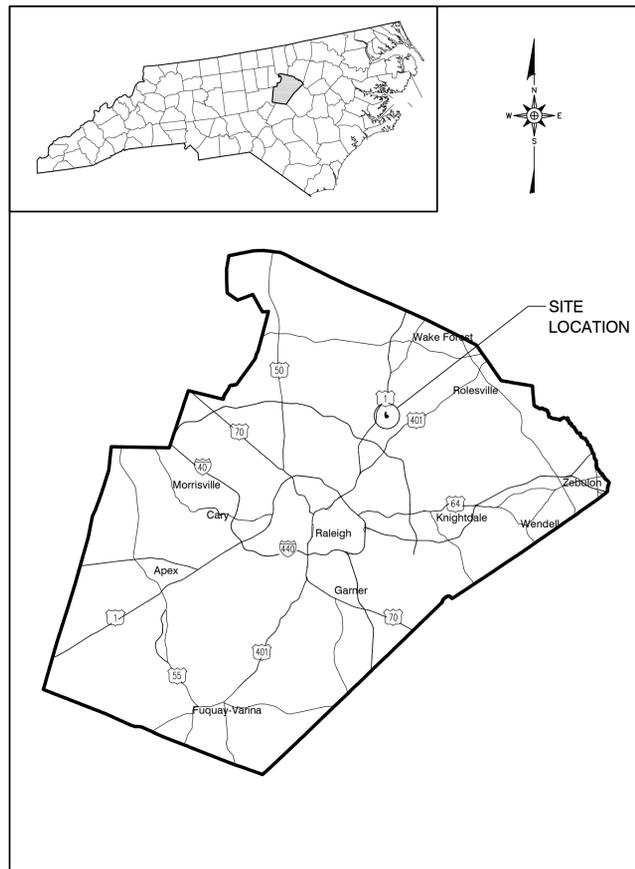
THORNTON ROAD MIXED WASTE TRANSFER & RECYCLING CENTER PERMIT DRAWINGS

DECEMBER 2007

PERMIT ISSUE
NOT FOR CONSTRUCTION

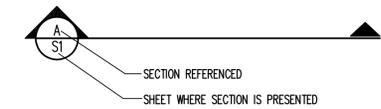
REVISION
NO.
DATE

SHEET NO.	DRAWING NO.	TITLE
1		TITLE - COVER SHEET
2	S1	EXISTING SITE CONDITIONS
3	S2	SITE PLAN
4	EC1	EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 1 OF 2)
5	EC3	EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 2 OF 2)

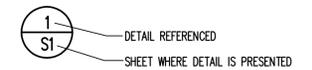


SITE LOCATION MAP
NOT TO SCALE

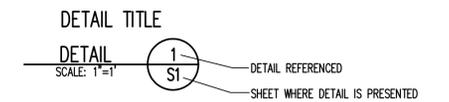
STANDARD SECTION LOCATION (SHEET AND DETAIL)



STANDARD DETAIL CALLOUT



STANDARD DETAIL TITLE AND CALLOUT



STANDARD REVISION CALLOUT (SHEET AND DETAIL)



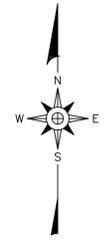
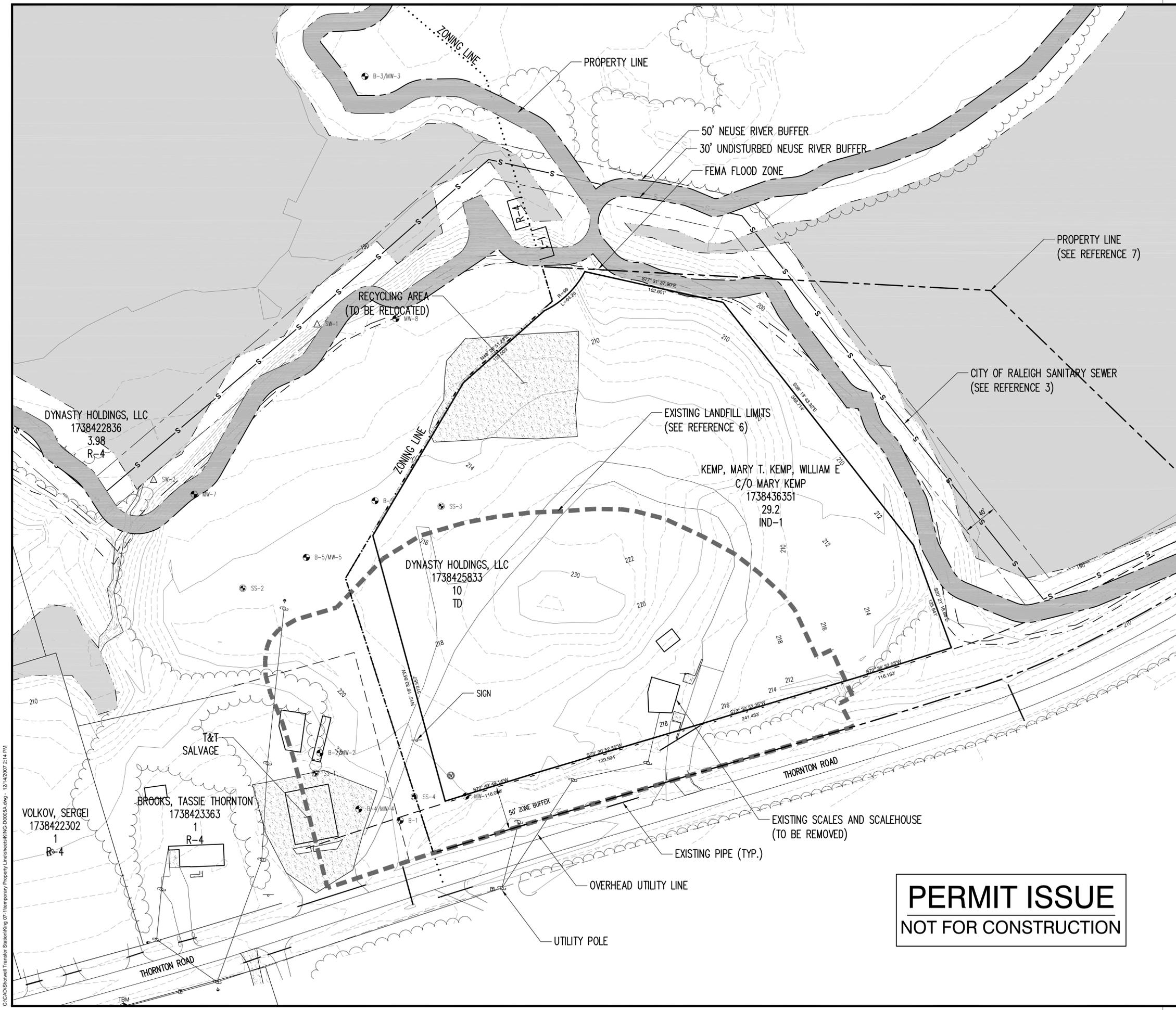
DATE	NO.	REVISION DESCRIPTION	REVISION
	1		

**RICHARDSON SMITH GARDNER
& ASSOCIATES**

14 N. Boylan Ave.
Raleigh, N.C. 27603

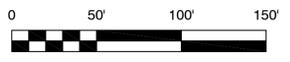
www.rsgengineers.com

ph: 919-828-0577
fax: 919-828-3899



- LEGEND**
- 800 — EXISTING 10' CONTOUR (SEE REFERENCE 1)
 - - - - - EXISTING 2' CONTOUR
 - — — — — PROPERTY LINE
 - - - - - FEMA FLOOD ZONE "X" (SEE REFERENCE 2)
 - - - - - FEMA FLOOD ZONE "AE" (SEE REFERENCE 2)
 - - - - - NEUSE RIVER BUFFER
 - ZONING
 - — — — — FACILITY BOUNDARY
 - — — — — PERMITTED LANDFILL LIMITS (SEE REFERENCE 6)
 - SURFICIAL SOIL SAMPLE LOCATION
 - MONITORING WELL AND/OR SOIL BORING LOCATION
 - △ SURFACE WATER SAMPLE LOCATION
 - TEST PIT EXCAVATION LOCATION
 - SURVEYED WETLANDS (SEE REFERENCE 5)
 - NEUSE RIVER BUFFER (DISTURBABLE LIMITS)

- REFERENCES**
1. EXISTING TOPOGRAPHY SURVEYED BY STOCKS ENGINEERING, P.A., DATED OCTOBER 2007.
 2. FLOOD ZONE LIMITS PROVIDED BY WAKE COUNTY GIS DEPARTMENT.
 3. CITY OF RALEIGH SANITARY SEWER LOCATIONS PROVIDED BY STOCKS ENGINEERING, P.A., DATED OCTOBER 2007.
 4. ZONING LINES FROM SURVEY BY MURPHY GEOMATICS, PRESENTED IN DRAWING ENTITLED "RECOMBINATION PLAT FOR THORNTON II" DATED AUGUST 2006.
 5. WETLAND DELINEATION FROM DRAWING ENTITLED "WEBTHOR PRELIMINARY WETLAND DELINEATION", PREPARED BY MURPHY GEOMATICS, DATED OCTOBER 29, 2007.
 6. PERMITTED LANDFILL LIMITS FROM DRAWING ENTITLED "SITE PLAN, NEUSE LANDFILL", SHEET 2 OF 3, PREPARED BY LITTLE & LITTLE, RALEIGH, NC, DATED MARCH 18, 1988, REVISED JUNE 2, 1988.
 7. SITE PROPERTY LINE FROM DRAWING ENTITLED "RECOMBINATION PLAT FOR DYNASTY HOLDINGS, LLC" PREPARED BY MURPHY GEOMATICS, DATED NOVEMBER 2007.



**PERMIT ISSUE
NOT FOR CONSTRUCTION**

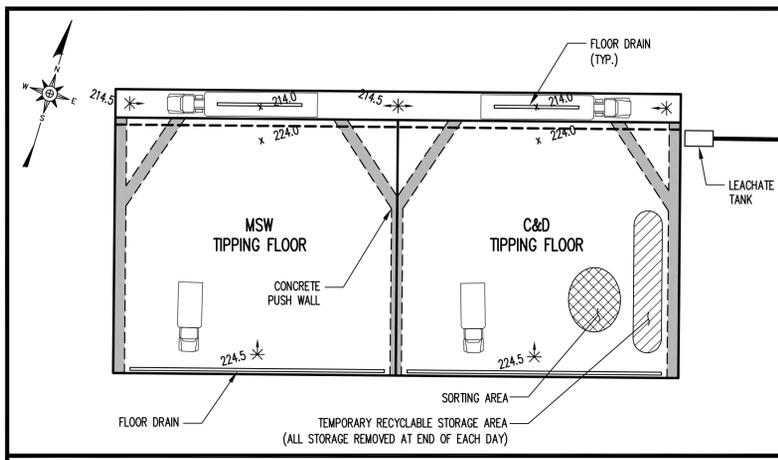
DATE	NO.	REV.	NO.	REV.	NO.	REV.	NO.	REV.	NO.

RICHARDSON SMITH GARDNER & ASSOCIATES
 14 N. Boylan Ave.
 Raleigh, N.C. 27603
 www.regengineers.com
 ph: 919-228-0577
 fax: 919-228-3889

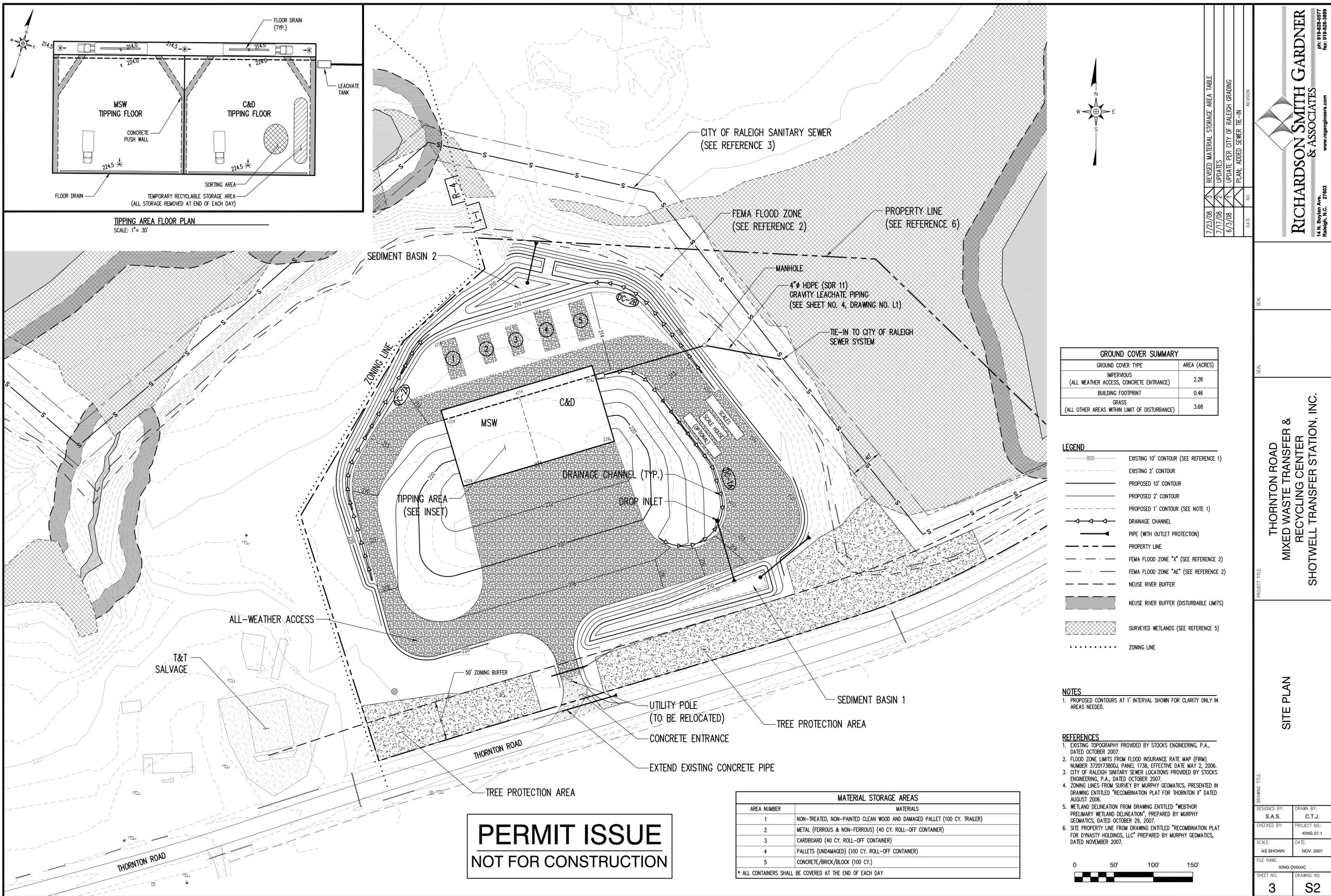
**THORNTON ROAD
MIXED WASTE TRANSFER &
RECYCLING CENTER
SHOTWELL TRANSFER STATION, INC.**

PROJECT TITLE:	
EXISTING SITE CONDITIONS	
DRAWING TITLE:	DESIGNED BY:
	S.A.S.
CHECKED BY:	DRAWN BY:
	J.A.L.
SCALE:	PROJECT NO.:
AS SHOWN	KING 07-1
DATE:	FILE NAME:
NOV. 2007	KING-00005A
SHEET NO.:	DRAWING NO.:
2	S1

G:\CAD\Shotwell Transfer Station\King 00005A.dwg - 12/14/2007 2:14 PM



TIPPING AREA FLOOR PLAN
SCALE: 1" = 30'



GROUND COVER SUMMARY	
GROUND COVER TYPE	AREA (ACRES)
IMPERVIOUS (ALL WEATHER ACCESS, CONCRETE ENTRANCE)	2.26
BUILDING FOOTPRINT	0.46
GRASS (ALL OTHER AREAS WITHIN LIMIT OF DISTURBANCE)	3.68

- LEGEND**
- 800 — EXISTING 10' CONTOUR (SEE REFERENCE 1)
 - — — EXISTING 2' CONTOUR
 - — — PROPOSED 10' CONTOUR
 - — — PROPOSED 2' CONTOUR
 - — — PROPOSED 1' CONTOUR (SEE NOTE 1)
 - >>> — DRAINAGE CHANNEL
 - | — PIPE (WITH OUTLET PROTECTION)
 - — — PROPERTY LINE
 - — — FEMA FLOOD ZONE "X" (SEE REFERENCE 2)
 - — — FEMA FLOOD ZONE "AE" (SEE REFERENCE 2)
 - — — NEUSE RIVER BUFFER
 - — — NEUSE RIVER BUFFER (DISTURBABLE LIMITS)
 - — — SURVEYED WETLANDS (SEE REFERENCE 5)
 - ZONING LINE

NOTES
1. PROPOSED CONTOURS AT 1' INTERVAL SHOWN FOR CLARITY ONLY IN AREAS NEEDED.

- REFERENCES**
- EXISTING TOPOGRAPHY PROVIDED BY STOCKS ENGINEERING, P.A., DATED OCTOBER 2007.
 - FLOOD ZONE LIMITS FROM FLOOD INSURANCE RATE MAP (FIRM) NUMBER 3720173800J, PANEL 1738, EFFECTIVE DATE MAY 2, 2006.
 - CITY OF RALEIGH SANITARY SEWER LOCATIONS PROVIDED BY STOCKS ENGINEERING, P.A., DATED OCTOBER 2007.
 - ZONING LINES FROM SURVEY BY MURPHY GEOMATICS, PRESENTED IN DRAWING ENTITLED "RECOMBINATION PLAT FOR THORNTON II" DATED AUGUST 2006.
 - WETLAND DELINEATION FROM DRAWING ENTITLED "WETHOR PRELIMINARY WETLAND DELINEATION", PREPARED BY MURPHY GEOMATICS, DATED OCTOBER 29, 2007.
 - SITE PROPERTY LINE FROM DRAWING ENTITLED "RECOMBINATION PLAT FOR DYNASTY HOLDINGS, LLC" PREPARED BY MURPHY GEOMATICS, DATED NOVEMBER 2007.

MATERIAL STORAGE AREAS	
AREA NUMBER	MATERIALS
1	NON-TREATED, NON-PAINTED CLEAN WOOD AND DAMAGED PALLET (100 CY. TRAILER)
2	METAL (FERROUS & NON-FERROUS) (40 CY. ROLL-OFF CONTAINER)
3	CARDBOARD (40 CY. ROLL-OFF CONTAINER)
4	PALLETS (UNDAMAGED) (100 CY. ROLL-OFF CONTAINER)
5	CONCRETE/BRICK/BLOCK (100 CY.)

* ALL CONTAINERS SHALL BE COVERED AT THE END OF EACH DAY

PERMIT ISSUE
NOT FOR CONSTRUCTION

REVISED MATERIAL STORAGE AREA TABLE

DATE	NO.	REVISION
7/23/08	1	REVISED MATERIAL STORAGE AREA TABLE
7/17/08	2	UPDATES
6/3/08	1	UPDATE PER CITY OF RALEIGH GRADING PLAN, ADDED SEWER TIE-IN

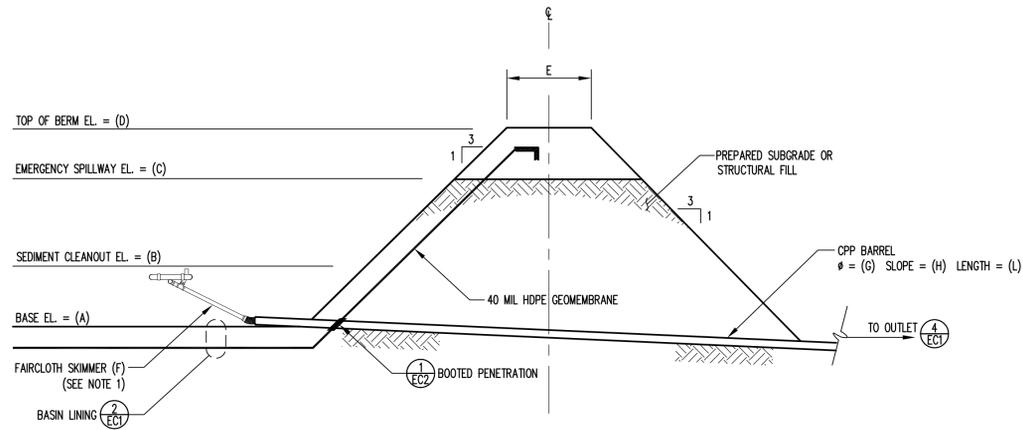
RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave.
Raleigh, N.C. 27603
www.rsgengineers.com
ph: 919-228-0577
fax: 919-228-3889

THORNTON ROAD
MIXED WASTE TRANSFER &
RECYCLING CENTER
SHOTWELL TRANSFER STATION, INC.

SITE PLAN

DESIGNED BY: S.A.S.
DRAWN BY: C.T.J.
CHECKED BY: PROJECT NO.: KING 07-1
SCALE: DATE: NOV. 2007
AS SHOWN
FILE NAME: KING-D0004C
SHEET NO.: DRAWING NO.:
3 S2

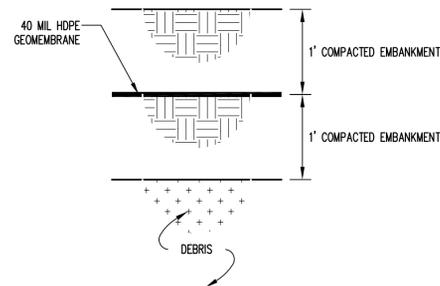
G:\CAD\Shotwell Transfer Station\King 07-1\rev-072008\sheet\KING-D0004C.dwg - 7/23/2008 10:31 AM



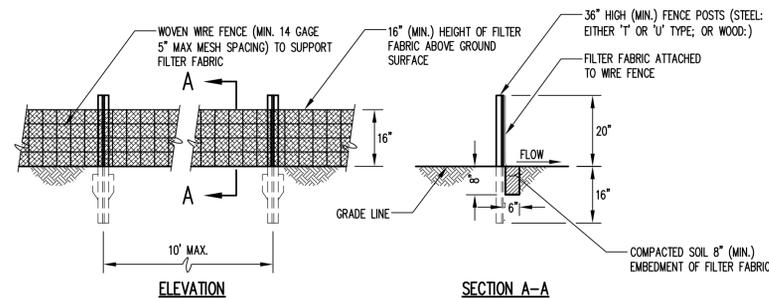
BASIN	A (FT)	B (FT)	C (FT)	D (FT)	E (FT)	F (IN)	G (IN)	H (FT/FT)	L (FT)
1	207.0	210.0	212.0	213.0	10	2.0	4	0.008	120
2	206.0	208.0	209.3	210.0	10	2.0	4	0.025	40

NOTE:
1. SEE FIGURE 6.64A FROM THE 6/06 EDITION OF THE NC EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL. ALSO REFER TO J.W. FAIRCLOTH & SON INC. (WWW.FAIRCLOTHSKIMMER.COM) FOR INSTALLATION INFORMATION.

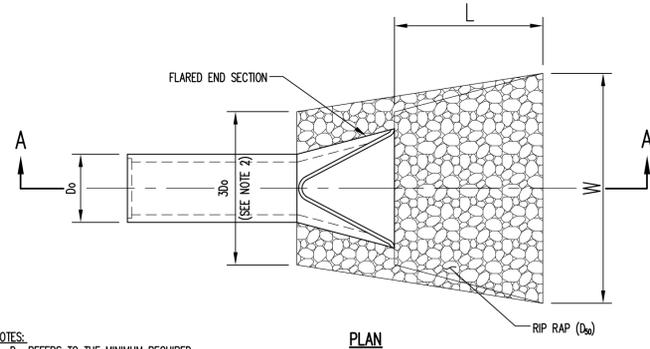
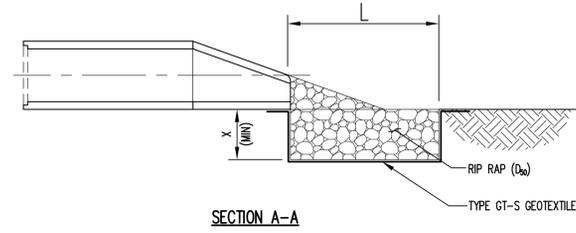
SEDIMENT BASIN
DETAIL 1
NOT TO SCALE (EC1)



SEDIMENT BASIN LINING
DETAIL 2
NOT TO SCALE (EC1)



SILT FENCE
DETAIL 3
NOT TO SCALE (EC1)

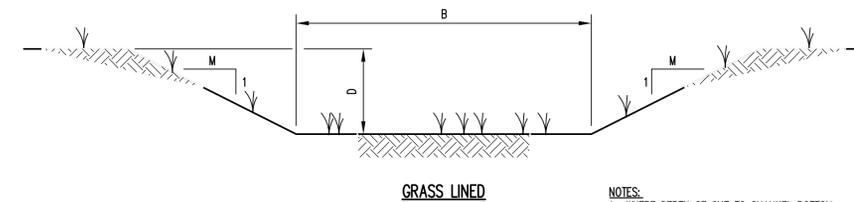
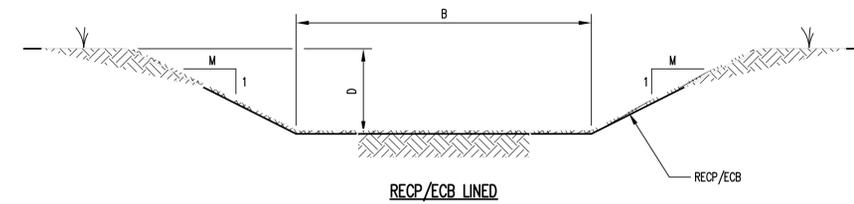


NOTES:
1. D60 REFERS TO THE MINIMUM REQUIRED AVERAGE STONE SIZE.
2. FOR MORE THAN ONE PIPE, EXTEND RIP RAP 1.0' MIN. BEYOND OUTSIDE EDGES OF PIPES.

RIP RAP OUTLET PROTECTION					
PIPE/OUTLET	D ₆₀	L (FT)	W (FT)	X (IN)	D ₅₀ (IN)
OUTLET FROM BASIN-1	4"	4	4.5	12	6
OUTLET FROM BASIN-2	4"	4	4.5	12	6
OUTLET FROM 18" CULVERT INTO BASIN 1	18"	10	11.5	12	6
OUTLET OF EMERGENCY SPILLWAY FROM BASIN 1	12"	8	9	12	6

* RIP RAP WIDTH IS EQUAL TO CHANNEL WIDTH AT FLOW DEPTH OF 2 FEET.

RIP RAP OUTLET PROTECTION
DETAIL 4
NOT TO SCALE (EC1)



NOTES:
1. WHERE DEPTH OF CUT TO CHANNEL BOTTOM EXCEEDS 'D', INSTALL TRM TO HEIGHT 'D' ABOVE CHANNEL BOTTOM.
2. REFER TO SCHEDULE THIS SHEET.

DRAINAGE CHANNELS
DETAIL 6
NOT TO SCALE (EC1)

CHANNEL SCHEDULE				
CHANNEL/SWALE	WIDTH (B)	DEPTH (D)	SLOPE (M)	LINING
DC-1A	0	1.5'	3	ECB
DC-2A	2'	2'	3	ECB
DC-2B	0	1.5'	2	GRASS

SEEDING SCHEDULE		
MATERIAL	SEED TYPE	APPLICATION RATE
LIME	-	4,000 LBS/ACRE
FERTILIZER	-	1,000 LBS/ACRE
SEED		
PERMANENT	KENTUCKY 31 TALL FESCUE	80 LBS/ACRE
	PENSACOLA BAHIAGRASS	50 LBS/ACRE
	SERICEA LESPEDEZA	30 LBS/ACRE
	KOBE LESPEDEZA	10 LBS/ACRE
	SEASONAL NURSE CROP	SEE NOTE 2
TEMPORARY	SEASONAL NURSE CROP	SEE NOTE 2
MULCH	-	4,000-5,000 LBS/ACRE
BINDER	-	150 GALLONS/ACRE

NOTES:
1. APPLICATION RATES AND/OR CHEMICAL ANALYSIS SHALL BE CONFIRMED OR ESTABLISHED BY A SOIL TEST.
2. USE SEASONAL NURSE CROP IN ACCORDANCE WITH SEEDING DATES AS STATED BELOW:
APRIL 15 - AUGUST 15 10 LBS/ACRE GERMAN MILLET OR 15 LBS/ACRE SUDANGRASS
AUGUST 16 - APRIL 14 25 LBS/ACRE RYE (GRAIN)
3. FROM SEPTEMBER 1 - MARCH 1, USE UNSCARIFIED SERICEA SEED.

SEEDING SCHEDULE
DETAIL 5
NOT TO SCALE (EC1)

PERMIT ISSUE
NOT FOR CONSTRUCTION

REVISION

NO.	DATE	BY	DESCRIPTION

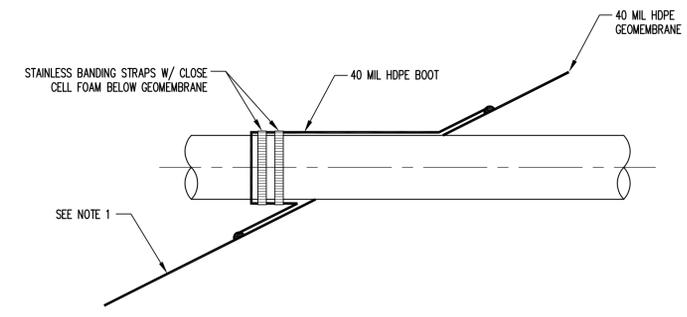
RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave.
Raleigh, N.C. 27603
www.rsgengineers.com
ph: 919-828-0077
fax: 919-828-3899

THORNTON ROAD
MIXED WASTE TRANSFER &
RECYCLING CENTER
SHOTWELL TRANSFER STATION, INC.

EROSION AND SEDIMENTATION
CONTROL DETAILS
(SHEET 1 OF 2)

DESIGNED BY: S.A.S.	DRAWN BY: J.A.L.
CHECKED BY: AS SHOWN	PROJECT NO.: KING 07-1
SCALE: AS SHOWN	DATE: NOV. 2007
FILE NAME: KING-D0009A	DRAWING NO.:
SHEET NO. 4	DRAWING NO. EC1

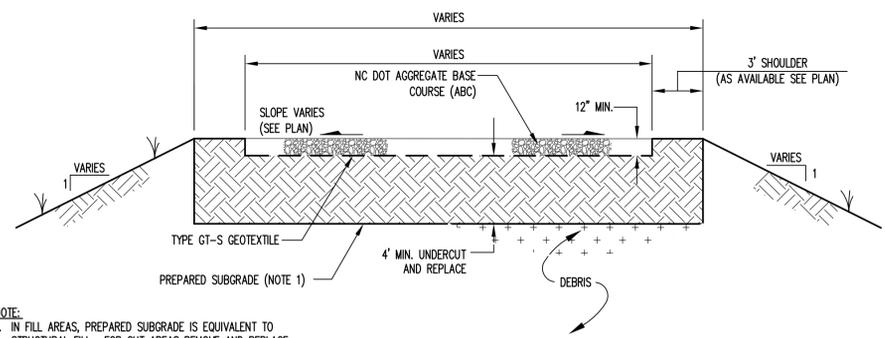
PERMIT ISSUE
NOT FOR CONSTRUCTION



NOTE:
 1. AT THE PIPE PENETRATION, CUT THE GEOSYNTHETIC LINER SO THAT THE SECONDARY GEOMEMBRANE EXTENDS A MIN. 1-FOOT BEYOND THE PRIMARY GEOMEMBRANE. CONTINUOUSLY WELD THE PRIMARY GEOMEMBRANE TO THE SECONDARY GEOMEMBRANE. THE APRON ON THE PIPE BOOT SHALL BE WELDED TO THE SECONDARY GEOMEMBRANE.

BOOTED PIPE PENETRATION

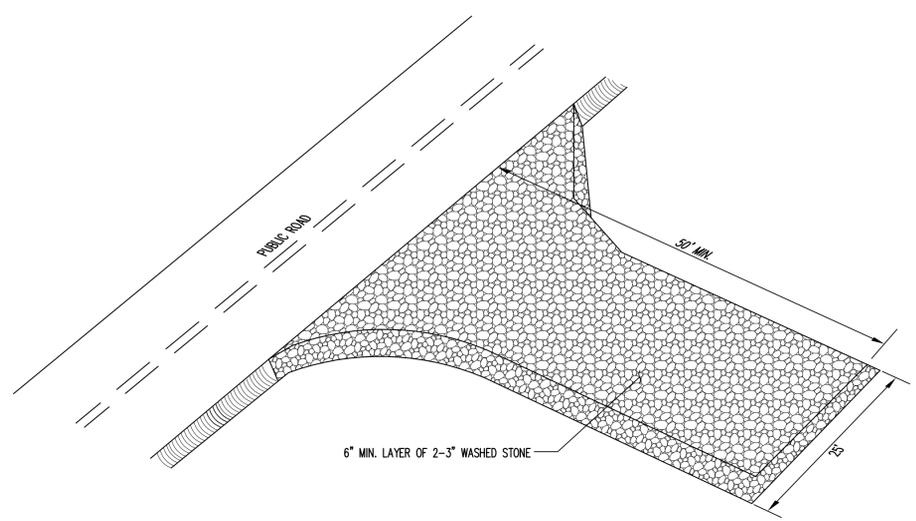
DETAIL 1
 NOT TO SCALE EC2



NOTE:
 1. IN FILL AREAS, PREPARED SUBGRADE IS EQUIVALENT TO STRUCTURAL FILL. FOR CUT AREAS REMOVE AND REPLACE WITH STRUCTURAL FILL (SEE PROJECT SPECIFICATIONS.)

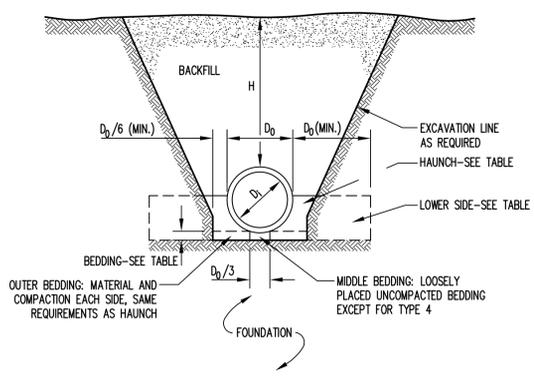
TYPICAL ROADWAY CROSS SECTION

DETAIL 2
 NOT TO SCALE EC2



TEMPORARY GRAVEL CONSTRUCTION ENTRANCE

DETAIL 3
 NOT TO SCALE EC2



STANDARD PIPE TRENCH INSTALLATION FOR CONCRETE PIPES

DETAIL 4
 NOT TO SCALE EC2

(BASED ON AMERICAN CONCRETE PIPE ASSOCIATION RECOMMENDATIONS)

STANDARD EMBANKMENT INSTALLATION SOILS AND MINIMUM COMPACTION REQUIREMENTS			
INSTALLATION TYPE	BEDDING THICKNESS	HAUNCH AND OUTER BEDDING	LOWER SIDE
TYPE 1	D ₀ /24" (600mm) MINIMUM, NOT LESS THAN 3" (75mm). IF ROCK FOUNDATION, USE D ₀ /12" (300mm) MINIMUM, NOT LESS THAN 6" (150mm).	95% SW, SP, GW, GP	90% SW, SP, GW, GP; 95% ML, SM, GM OR GC, SC WITH <20% PASSING NO.200 SIEVE; OR 100% CL, MH, SC, GC, CH.
TYPE 2	D ₀ /24" (600mm) MINIMUM, NOT LESS THAN 3" (75mm). IF ROCK FOUNDATION, USE D ₀ /12" (300mm) MINIMUM, NOT LESS THAN 6" (150mm).	90% SW, SP, GW, GP; OR 95% ML, SM, GM OR GC, SC WITH <20% PASSING NO.200 SIEVE	85% SW, SP, GW, GP; 90% ML, SM, GM OR GC, SC WITH <20% PASSING NO.200 SIEVE; OR 95% CL, MH, SC, GC, CH.
TYPE 3	D ₀ /24" (600mm) MINIMUM, NOT LESS THAN 3" (75mm). IF ROCK FOUNDATION, USE D ₀ /12" (300mm) MINIMUM, NOT LESS THAN 6" (150mm).	85% SW, SP, GW, GP; 90% ML, SM, GM OR GC, SC WITH <20% PASSING NO.200 SIEVE; OR 95% CL, MH, SC, GC, CH	85% SW, SP, GW, GP; 90% ML, SM, GM OR GC, SC WITH <20% PASSING NO.200 SIEVE; OR 95% CL, MH, SC, GC, CH.
TYPE 4	NO BEDDING REQUIRED, EXCEPT IF ROCK FOUNDATION, USE D ₀ /12" (300mm) MINIMUM, NOT LESS THAN 6" (150mm).	NO COMPACTION REQUIRED, EXCEPT IF CL, MH, SC, GC, CH USE 85%.	NO COMPACTION REQUIRED, EXCEPT IF CL, MH, SC, GC, CH USE 85%.

NOTES:
 1. COMPACTION AND SOIL SYMBOLS (95% SW) REFER TO SW SOIL MATERIAL (USCS CLASSIFICATION) WITH MINIMUM STANDARD PROCTOR COMPACTION (ASTM D 698) OF 95%.
 2. THE TRENCH TOP ELEVATION SHALL BE NO LOWER THAN 0.1H BELOW FINISHED GRADE OR, FOR ROADWAYS, ITS TOP SHALL BE NO LOWER THAN AN ELEVATION OF 1'(0.3m) BELOW THE BOTTOM OF THE PAVEMENT BASE MATERIAL.
 3. SOIL IN BEDDING AND HAUNCH ZONES SHALL BE COMPACTED TO AT LEAST THE SAME COMPACTION AS SPECIFIED FOR THE MAJORITY OF SOIL IN THE BACKFILL ZONE.
 4. THE TRENCH WIDTH SHALL BE WIDER THAN SHOWN IF REQUIRED FOR ADEQUATE SPACE TO ATTAIN THE SPECIFIED COMPACTION IN THE HAUNCH AND BEDDING ZONES.
 5. FOR TRENCH WALLS THAT ARE WITHIN 10 DEGREES OF VERTICAL, THE COMPACTION OR FIRMINESS OF THE SOIL IN THE TRENCH WALLS AND LOWER SIDE ZONE NEED NOT BE CONSIDERED.
 6. FOR TRENCH WALLS WITH GREATER THAN 10 DEGREE SLOPES THAT CONSIST OF EMBANKMENT, THE LOWER SIDE SHALL BE COMPACTED TO AT LEAST THE SAME COMPACTION AS SPECIFIED FOR THE SOIL IN THE BACKFILL ZONE.

G:\CAD\Shovel Transfer Station\King 07\Temporary Property Line\sheet\KING-D0010A.dwg - 12/14/2007 2:16 PM

DATE	NO.	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
 14 N. Boylan Ave.
 Raleigh, N.C. 27603
 ph: 919-828-0077
 fax: 919-828-3899
 www.rsgengineers.com

PROJECT TITLE:
**THORNTON ROAD
 MIXED WASTE TRANSFER &
 RECYCLING CENTER
 SHOTWELL TRANSFER STATION, INC.**

DRAWING TITLE:
**EROSION AND SEDIMENTATION
 CONTROL DETAILS
 (SHEET 2 OF 2)**

DESIGNED BY:	DRAWN BY:
CHECKED BY:	PROJECT NO.:
SCALE:	DATE:
AS SHOWN	NOV. 2007
FILE NAME:	KING-D0010A
SHEET NO.	DRAWING NO.
5	EC2

