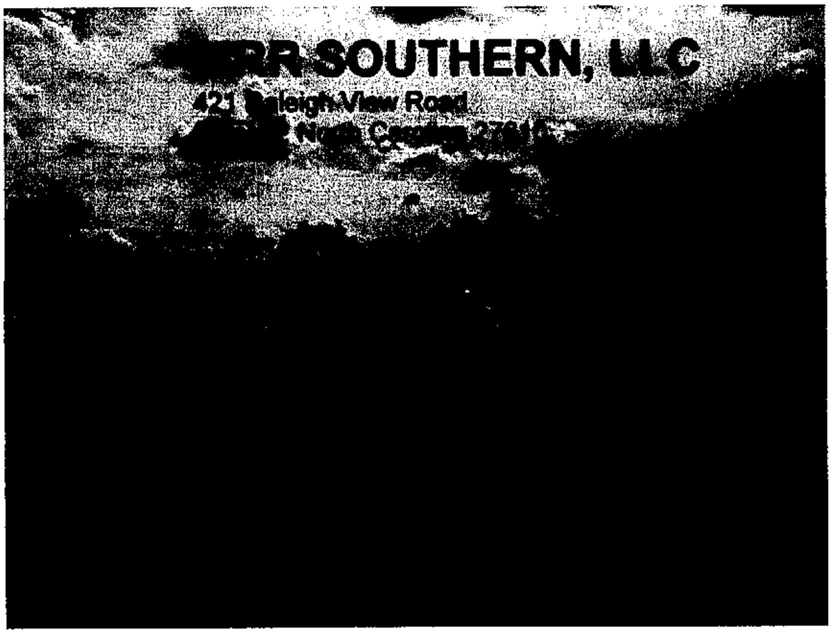
SITE APPLICATION DOCUMENT

Facility Plan and Operations Plan

MRR Wake Transfer Station, LLC
9220 Durant Road
Raleigh, North Carolina

Prepared for



May 2003

Prepared by

David Garrett, P.G., P.E.
Engineering and Geology

5105 Harbour Towne Drive, Raleigh, NC 27604 **Telephone/Fax (919) 231-1818**

Permit No. 92-34

David Garrett, P.G., P.E.

Engineering and Geology

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May 23, 2003

MAY 2003 Received

Mr. Jim Barber, Permitting Branch Head
NC DENR Division of Waste Management, Solid Waste Section
401 Oberlin Road
Raleigh, North Carolina, 27611

RE: Application for C&D Transfer Station Permit
MRR Wake Transfer Station, LLC
Wake County, North Carolina

Dear Mr. Barber:

On behalf of Material Reclamation and Recovery, LLC (MRR), I am pleased to present this permit application for a new C&D Transfer Station. This application is made pursuant to Solid Waste Rule 15A NCAC 13B .0400. Within this document please find the following: a Site Plan, an Operations Plan, an approval letter from the City of Raleigh Zoning Administrator, stating that proposed facility is consistent with the zoning of the property (Industrial-1), and a storm water and erosion control plan. The site is within the City limits and subject to the City of Raleigh storm water regulations.

The proposed facility is located at 9220 Durant Road, less than one mile from the current Wake County landfill, which is scheduled to cease taking C&D wastes on May 31, 2003. The proposed transfer station will provide a vital service to Wake County, in that no other landfills that take C&D wastes are located in this part of the County, and transferring the wastes is a cost-effective option. We are aware of another C&D transfer facility in the general vicinity. MRR endeavors to make this new transfer station a first-rate facility by complying with all relevant siting, design, and operational requirements. MRR is hoping to commence operations by mid to late-June, 2003.

The proposed facility will also help Wake County and the City of Raleigh attain their recycling goals, whereas the wastes will be sorted into a number of trucks, some destined to nearby recycling facilities, some to disposal facilities located elsewhere in Wake County. The transfer station is expected to handle between 250 and 500 tons per day of inert C&D wastes.

Please note that the site has been formerly used as a concrete batch plant, and much of the working areas are paved. All waste unloading, sorting, temporary storage and reloading activities will take place on the concrete pad. Non-paved (but hardened) surfaces will serve as staging areas, in which incoming traffic will be directed to wait and turn, as needed. There is an existing storm water control system that will be upgraded (net impervious surface area is unchanged, hence the nitrogen rules can be met by a relatively simple upgrade of the storm water system according to City of Raleigh officials). The former concrete plant site is ideally suited to a transfer station, and little site work will be required to make the facility operational.

On behalf of MRR, we appreciate the opportunity to submit this application and we look forward to your comments at your earliest convenience. Please contact me, or Mr. Chris Roof at MRR (telephone 919-835-2776), if you have any questions. We look forward to your response.

Sincerely,

G. David Garrett, P.G., P.E.

NORTH CAROLINA PROFESSIONAL SEAL 25462 ENGINEER G. DAVID GARRETT 5/23/03

cc: Chris Roof – General Manager, MRR
Norbert Hector – Managing Partner, MRR

5105 Harbour Towne Drive, Raleigh, North Carolina 27604
E-mail: david_garrett_pg@mindspring.com **919-231-1818** (Office and Fax) **919-418-4375** (Mobile)

OPERATIONS PLAN

Construction and Demolition Debris Transfer Station

MRR Wake Transfer Station, LLC

Prepared for:

MRR Southern, LLC
RALEIGH, NORTH CAROLINA

MAY 2003 WITH REVISIONS REQUESTED BY NCDENR SWS

David Garrett, P.G., P.E.
Engineering and Geology

5105 Harbour Towne Drive, Raleigh, North Carolina 27604 Telephone/Fax (919) 231-1818

MRR WAKE TRANSFER STATION, LLC

REVISED OPERATIONS PLAN

Revisions Current as of September 2, 2003

1. Facility Location and Description

The transfer facility is located at 9220 Durant Road, approximately I mile west of Capital Boulevard (US 1), in northern Raleigh. The site is approximately 2 miles north of the US I and 1-540 interchange. The site is within the limits of the City of Raleigh, This tract is zoned Industrial-1, which allows for the siting of the solid waste transfer station. A letter from the City of Raleigh's Zoning Administrator (Attachment 1) confirms this finding.

The facility consists of an approximately 4.27-acre site, a portion of which is paved and/or exhibits hardened surfaces. The site formerly hosted a concrete batch plant. The site is entered from Durant Road via a 600-foot long paved driveway, which is bordered by approximately 2 acres woods within the property boundary and other businesses along Durant Road. The site is bordered to the north and west by private industrial property and to the east by CSX Railroad. The site cannot be seen from Durant Road or any residential areas.

The facility includes an open paved area for tipping, sorting, and loading inert wastes, a paved parking area, and a gravel turn-around pad for collection vehicles. All waste-handling areas are surrounded by large concrete bin-block walls. Storm water is conveyed via ditches to on-site basins. A fueling pump and above-ground diesel storage tank (with secondary containment) exist away from and downhill of the waste handling areas. A permanent office building, scales, and a mobile scale house complete the on-site structures. A security gate and a 6-foot high chain-link fence with three strand-barbed wire surround the working areas.

Due to the nature of the wastes (inert construction and demolition materials), the drainage shall be handled as storm water. A pre-existing storm water control system will be upgraded for the facility. The site is served by public water but not sewer. A septic tank has been identified that serves the office building. The surrounding areas are served by public water and sewer. All streets are paved and local traffic patterns will not change.

2. Description of Solid Waste

The transfer station accepts construction and demolition (C&D) wastes from residential, commercial, and industrial projects. Materials to be accepted include brick, block, rock, uncontaminated soil, treated and untreated wood, stumps, limbs, brush and other vegetative material, construction debris, demolition debris (including properly packaged and transported asbestos wastes, by prior arrangement), land clearing debris, metals, and certain recyclables. The waste stream is expected to vary between 250 to 500 tons per day.

No waste water treatment sludge, special waste, regulated medical waste, or hazardous waste will be accepted at the transfer station, and no putrescible municipal solid wastes (MSW) will be accepted. A sign posted at the entrance states that no hazardous or liquid waste shall be received. MRR Wake Transfer Station, LLC, shall also conduct random waste screenings to insure that non-regulated materials are not accepted at this facility. A copy of the Waste Screening Program is included as Attachment 2 to this plan.

Construction and Demolition waste will be sorted at the transfer station for transport and disposal. Depending on the waste load, outbound trucks will transport the waste to one of MRR's processing or disposal areas located offsite. Recyclable metals, cardboard, wood waste, soil, masonry, sheet rock, and/or beneficial fill may be transported to the MRR recycling facility located on Raleigh View Road (south of the downtown area), to a MRR metals recycling facility located near Smithfield, NC, or to a MRR disposal facility located south of Raleigh. Non- recyclables shall be transported to a MRR disposal facility or to another destination.

3. Transportation of Waste

Routine Operations

Collection vehicles consisting of dump trucks, dump trailers, pickup trucks, and roll-off trucks will transport waste to the transfer facility. The collection trucks are initially weighed after arriving at the facility. Refuse will be deposited on a paved outdoor tipping area, where it is sorted and pushed into open concrete bunkers then transferred into transport trucks. A "cherry picker" material handler and/or a front-end loader will be used for sorting and loading the wastes.

The transport vehicles typically will consist of a tractor and a 50-foot aluminum body trailer, which will hold approximately 100 c.y. The trailers will be covered with tarps before leaving the transfer station. The majority of wastes shall be transferred each working day, except for small loads of inert debris and/or recyclables (e.g., scrap metal) may accumulate until a full trailer-load exists.

On-Site Waste Stockpiling

It is anticipated that stockpiles of certain recyclable waste may accumulate in the concrete bunkers for short periods of time, estimated up to one working week. No long-term storage of waste shall occur. Specific quantities of stockpiled materials (requested by NC DENR Solid Waste Section) are difficult to estimate until the facility becomes operational. Thus, the following estimates are based on the size of the trucks and bunkers built to accommodate these materials:

Scrap Metal	100 to 150 c.y.
Beneficial Fill*	100
Wood Waste**	100 to 150 c.y.

* e.g., brick, block, rock, uncontaminated soil

**e.g., recyclable materials only, no LCID to be stored

Asbestos Wastes

Certain C&D wastes containing asbestos may be accepted by prior arrangement and advance notification to the facility. NC DENR protocols for handling asbestos shall be observed. No asbestos wastes will be stored on-site. Arrangements shall be made for immediate transport.

Contingency Operations

In the event a loader breaks down, substitute loaders can be easily rented as backup. If a transfer truck breaks down, the trucking contractor has sufficient numbers of replacement units so that no delays will result. Natural light is sufficient for normal operations, therefore a loss of power will not affect transfer activities.

4. Operational Procedures

Hours of Operation

The transfer station operates on a 12 hour a day basis, six days a week for internal Wake Transfer Station trucks. The transfer station will operate from 7 a.m. to 5 p.m. Monday through Saturday for all other traffic, including customer drop-off, unless otherwise posted at the facility entrance. These operating hours may fluctuate based on the needs of the facility. The hours stated are for the receipt of waste; other activities pertaining to the transfer facility may be conducted beyond these hours.

Operator Responsibilities

An operator shall always be present at the transfer station during operating hours. The operator is responsible for the operations, maintenance, and general housekeeping of the facility. The operator directs all traffic into and out of the transfer station. The operator is also responsible for the movement of waste from the tipping area into the trailers.

The site shall be kept neat and presentable to the extent possible. Materials stored overnight shall be stockpiled in the bunker areas. The operator shall remove all loose debris, including any wind blown debris, lock all operating equipment, close and lock all doors to the transfer station, set security alarms, and lock the security gate at the entrance to the site.

Housekeeping/Vector Control Measures

No C&D waste shall be stored at the site longer than 7 days. A majority of the inert waste shall be transported within 24 hours, with the exception of weekends and holidays. Putrescible wastes shall be immediately placed into designated MSW roll-off containers and removed in accordance with a routine collection schedule (this may be contracted out). The tipping area shall be washed down periodically (as necessitated by operations) to minimize dust. Any wet or muddy waste materials may be placed in a bunker. Dusty wastes shall be lightly sprinkled with water prior to highway transport. Wash-down water shall be directed to the storm water system.

Recycling Activities

All recyclable goods shall be segregated and placed in concrete bunkers for temporary storage. These materials shall be loaded into a trailer for transport to a recycling facility. The facility is designed to promote separation of the recyclable inert materials from non-recyclable wastes.

5. Safety Considerations

Emergency procedures for fire and personal injury will be posted at the facility. Fire extinguishers will be placed strategically throughout the facility, as shown on the facility plan. Employees will be trained in the use of these extinguishers. Brooms, shovels, and water hoses are also available. Also present are routine equipment such as phones, radios, and first aid kits.

A sign indicating the permit number, and emergency contact phone number will be located at the facility entrance. The emergency contact is Chris Roof, General Manager, telephone number 919-835-3655. An after-hours phone number will be posted. The site is about a half-mile from the City of Raleigh Fire Station Number 22, located on Durant Road, which is the initial responder in the event of a fire. The North Wake County Hospital is located approximately 4 miles north of the site at the Falls Road-Durant Road intersection. For emergencies, employees should dial "911".

6. Site Requirements and Features

Stormwater and Erosion Control

The permanent stormwater and erosion control measures for the site include:

- Two stormwater detention basins with gravel-filter discharge weirs.
- A stormwater settling sump.
- Gravel filters around all stormwater inlets and discharges.
- Riprap armoring of all drainage outlets and channels with flow velocities over 4 feet per second.

All site areas not paved or graveled have been planted with grass to prevent erosion of cut and fill slopes. Restored open space shall be maintained as lawn or planted with trees and shrubs.

Drainage Control

The concrete pad is sloped away from the tipping area to prevent the contact of stormwater runoff with the solid waste. All site drainage is channeled into two permanent detention basins. The waste is not anticipated to generate leachate, as such all storm water shall be diverted to the basins and allowed to slowly discharge into surface drainage features.

RECEIVED
APR 25 2003
KENNEDY, COVINGTON
LOBDELL & HICKMAN, LLP

City Of Raleigh
North Carolina

April 23, 2003

Lacy H. Reaves
Kennedy Covington Lobdell & Hickman, LLP
Post Office Box 1070
Raleigh, NC 27602

Mr. Reaves:

This letter is to certify that according to our records the property located at 9220 Durant Road (PIN 1728726395) is zoned Industrial-1. Waste transfer stations are allowed in this zoning district. If you have any additional questions, please feel free to give me a call at (919) 890-3125 or send e-mail to amanda.bunce@ci.raleigh.nc.us.

Sincerely,

Amanda H. Bunce

Amanda H. Bunce
Zoning Administration
City of Raleigh

WASTE SCREENING AND INSPECTION PROGRAM

MRR WAKE TRANSFER STATION, LLC

1.0 INTRODUCTION

This prohibited waste exclusion program is designed to prevent prohibited wastes from entering the transfer station and designated landfill. Prohibited wastes include regulated hazardous wastes, regulated PCB wastes, and other wastes prohibited by state or local regulations or permit conditions. **PROPERLY PACKAGED ASBESTOS WASTES MAY BE ACCEPTED.**

For the purposes of this section, regulated hazardous waste means a solid waste that is a hazardous waste as defined in 40 CFR 261. 3, that is not excluded from regulation as a hazardous waste under 40 CFR 261.4 (b) or was not generated by a conditionally exempt generator.

Household hazardous waste and hazardous waste generated by a conditionally exempt generator are exempted from the screening requirements.

2.0 PROHIBITED WASTES

This transfer station is allowed to receive inert wastes classified as Construction and Demolition (C&D) wastes.

The transfer shall not accept the following:

- municipal/commercial solid wastes and household waste
- regulated hazardous wastes
- special wastes
- PCB wastes
- other prohibited wastes

REGULATED HAZARDOUS WASTE

Regulated hazardous waste must be disposed of or treated at a permitted hazardous waste disposal/treatment facility. **Any material contaminated by a hazardous waste is also deemed to be a hazardous waste.** RCRA permits are required to store, transport, and treat hazardous waste.

The USEPA has given exemptions from storage, transport, and disposal requirements to certain generators based on source and quantities. All hazardous waste generated by households during their normal course of activities is exempt from regulation. Regulated generators must notify the EPA that they generate hazardous waste and receive an identification number from EPA or an authorized state agency.

PCB WASTES

RCRA regulates polychlorinated biphenyls (PCB's) based on the concentration of PCB's in the waste. The regulations contained in 40 CFR Part 761 contain these requirements:

- Waste containing more than 500 ppm of PCB's must be incinerated.
- Waste containing from 50 to 500 ppm must be disposed of by incineration, approved burning, or in a chemical waste landfill permitted to receive such wastes.
- The regulations are silent concerning wastes containing less than 50 ppm of PCB's.

According to the *Draft Technical Manual for Solid Waste Disposal Facility Criteria - 40 CFR Part 258* (USEPA, April 1992), "PCB wastes do not include small capacitors found in fluorescent light ballast, white goods (e.g., washers, dryers, refrigerators) or other consumer electrical products (e.g., radio and television units)."

EXAMPLES OF OTHER PROHIBITED WASTES

WASTE	BASIS OF PROHIBITION
Radioactive Wastes	Nuclear Regulatory Commission regulations
Bulk Liquids	RCRA Subtitle D (40 CFR 258.28)
Medical Wastes (infectious)	State Solid Waste Regulations
Whole Tires	State Solid Waste Regulations

3.0 LOAD INSPECTION PROGRAM

The purpose of the load inspection program is to detect prohibited wastes and discourage attempts to handle them at the transfer station.

INITIAL PROCEDURES ON THE TIPPING AREA

The initial step in the inspection program is to review incoming loads in the tipping area. The operator will observe incoming loads for any indication of the presence of prohibited wastes. Should the operator encounter suspicious-looking loads, they will summon appropriate personnel for further evaluation of the load. If prohibited wastes are identified during inspection of a load, the prohibited load will be reloaded, rejected and sent back to the generator.

LOAD INSPECTION PROCEDURES

The major elements of load inspections are:

- spread, break up, and visually examine wastes
- flag suspicious wastes
- maintain proper records

Origin of all loads are identified prior to proceeding onto the scales and tipping floor. All load inspections are performed at the tipping floor. The Transfer Station Manager will train transfer station operations employees in waste identification procedures.

4.0 IDENTIFYING PROHIBITED OR UNAUTHORIZED WASTES

Load inspections will be done using a variety of methods to detect prohibited wastes including:

- Questioning the driver about the source of the load and the nature of generators.

- Examining product labels, especially warning labels.

- Rejecting bulk liquids in containers for rejection.

- Separating sludges, powders, granular material or materials with unusual colors for evaluation and possible rejection.

- Inspecting containers to ensure that they are empty or do not contain prohibited wastes.

- Evaluating the load for odors that are not characteristic of C&D waste.

- **Inspectors should never deliberately inhale vapors from suspicious materials or containers because this may lead to injury or death.**

- Searching for special items that have a high probability of containing prohibited waste:

  - transformers
  - batteries
  - filters
  - compressors (freon)
  - mechanical equipment (capacitors)
  - red bags (medical waste)
  - bags that may contain asbestos (without prior notification to the operator)
  - obvious prohibited wastes such as tires, etc.

MANAGING PROHIBITED WASTES

The results of the load inspection will identify wastes as:

- Acceptable
- Prohibited

Acceptable waste can be moved from the tipping area to the transport trailer. The area should be cleaned to the extent that materials from this inspection do not impact the next load to be inspected.

Prohibited wastes detected during the inspection should be returned immediately to the hauler. If the hauler or generator is not available, the wastes will be safely stored for later disposal.

If unauthorized wastes are detected, the load will be rejected and returned to hauler.

5.0 TRAINING

District Manager, equipment operators, and scalehouse staff will be trained in the contents of this plan. Training will address the following topics:

- Inspection of tipping area and load inspection procedures.
- Identification of hazardous wastes, PCB wastes and other prohibited wastes.
- Waste handling procedures (acceptable and prohibited wastes).
- Health and safety.
- Record keeping.

6.0 RECORD KEEPING

State or EPA notification is required whenever a hazardous or PCB waste is detected. Records of these notifications will be kept and will include the date and time of notification, agency and individual contacted with phone numbers, and the information that was reported.

Records documenting the successful completion of training will be maintained on-site.

The following is a waste screening form that shall be used for random load inspections and for documentation of rejected waste loads.

MRR Wake Transfer Station
Permit No. xx-xx-T
Tel. 919-835-3655

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? (Check one) Yes______ No ______ N/A____

Description of Load: ____

____

Load Accepted (signature) ____________________ Date ____________
Load Not Accepted (signature) ____________________ Date ____________

Reason Load Not Accepted (complete below only if load not accepted) ____________________

Description of Suspicious Contents: Color ________ Haz. Waste Markings ___________
Texture ________ ____________________
Drums Present ________
Est. Cu. Yds. Present in Load ________ Smell ____________________
Est. Tons Present in Load ________
Emergency Management Authority Contacted? Yes______ No ______

Generator 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 Superintendent

Attach related correspondence to this form.
File completed form in Operating Record.

Stormwater and Erosion Control Plan

Construction and Demolition Debris Transfer Station

MRR Wake Transfer Station, LLC

Prepared for:

MRR Southern, LLC
RALEIGH, NORTH CAROLINA

MAY 2003

David Garrett, P.G., P.E.
Engineering and Geology

5105 Harbour Towne Drive, Raleigh, North Carolina 27604 **Telephone/Fax (919) 231-1818**

Project: **Material Recovery - Wake Transfer Station**

Description: **Summary of Design Criteria**

References: Malcom, H.R., Elements of Urban Stormwater Design, © NCSU, Raleigh, NC, 1989

North Carolina Erosion and Sedimentation Control Planning and Design Manual (NCESC), NC DENR Division of Land Resources, 1988

NCDOT Roadway Design Manual, NC Department of Transportation, 1990

Design Conditions:

Construct C&D (inert waste) transfer station on the site of a former concrete batch plant. There will be relatively little ground disturbance. Most surfaces are paved or hardened CABC stone.

Site is located approximately 1 mile west of US 1 in northern Raleigh, NC (use rainfall data)

Final configuration will consist of stormwater capture over paved and hardened surfaces within the main work areas. Existing stormwater conveyances and control devises will be upgraded.

Drainage calculations are furnished for the following areas (some undisturbed):

Drainage Area No.	Drainage Area, ac.	Slope Ratios	Final Surface
1a	0.506	2 to 5%	Paved
1b	0.229	2 to 5%	Packed ABC Stone
2a	0.219	2 to 5%	Paved and Packed ABC Stone
2b	0.229	2 to 5%	Packed Gravel Drive
3	0.190	2 to 5%	Paved
4	0.264	2 to 5%	Paved
5	0.082	2 to 5%	Open space, vegetated
Total	**1.719 Acres**		

Entrance drive excluded (will remain unchange). Areas 3 and 4 will be unchanged.

The following conveyences have been designed:

Channel No.	Drainage Area No.
1a	1a
1b	1a, 1b
2	2a
3	2a, 2b, 5

Project: **Material Recovery - Wake Transfer Station**

Description: **Methodologies**

The method for determining the runoff discharge, Q, within a specific drainage area (or small watershed) for a design storm is the Rational Equation, Q = CIA

Composite runoff coefficients, C are determined for each drainage area according to slope ratio and vegetation conditions at final buildout

Runoff Intensity, I, is found by calculating the time of concentration, Tc for each area, where Tc is determined by Kirpich's Equation:

Tc = (L^3/H)^0.385 / 128 — L = hydraulic length of the drained area

H = the fall along length L

Note: Tc is typically based on the 25-year, 5-min. storm, where max. I occurs

Drainage area, A, is determined by planimeter from site topographic map; channel length and grades serving that drainage area are also determined from topographic map

Rainfall duration and intensity taken from nomographs presented for a region of interest, e.g., Raleigh, NC, in the North Carolina Erosion and Sedimentation Control Planning and Design Manual (NCESC)

Thus, the intensity, I, of a 25-year, 5-minute storm is 7.5 inches/hour

The depth, D, of a 25-year, 24-hour design storm is 7.25 inches

The runoff properties determined for each drainage area are used to size the outlet channels and/or drainage swales, pipes, traps, and sedimentation basins as follows:

Channels are typically trapezoidal and are analysed by the Normal Depth Proceedure

Catch basins (as needed) are designed using the basic weir equation; culverts and down-pipes are designed using Manning's Equation

Swales are treated as shallow trapezoidal channels of variable side slope ratio

Sediment traps are sized to provide at least 1800 c.f. per disturbed acre, 3.5 foot max. sediment depth; the stone weirs are designed based on NCESC criteria prorated per acreage

Sedimentation basins (riser and barrel structures), if needed, are designed by the "Chain Saw" routing method (ref. Malcom) and typically provide a min. settling efficiency of 70% for a 40-micron particle (clay fraction) during Q25; discharge is typically restricted to 30 cfm to allow use of conventional level spreaders adjacent to protected riparian buffers

Project: **Material Recovery - Wake Transfer Station**

Description: **Stormwater Basin No. 1**

Watershed Composition: (Reference Malcom Exhibit 1)

Slope conditions:	**Drainage Area, ac.**	**Percent of Area, Ai**	**Ci, Runoff Coefficient**	**Product (Ai x Ci)**
Rough graded, unimproved	0	0%	0.35	0.00
Undisturbed area, wooded	0	0%	0.10	0.00
Roads and hard surfaces	0.735	100%	0.90	90.00
Summation	0.735	100%		90.00

Composite Runoff Coefficient, C = Σ (Ai x Ci) Σ Ai = 0.90

Design Discharge, Q25 = 4.96 CFS = **5** **CFS**

Sediment Traps: 1800 c.f./ac. with max. sed. depth = 3.5

Required basin volume 1,323 c.f. with side slope ratio, m = 2

Base dimensions (length x width) 20 x 15 = 300 s.f.

Resulting soil storage volume = 1,540 c.f. Dimensions are OK

Stone Weir capacity:

Drainage Area 0.735 ac.

Required weir length 4 ft. Ref. NCESC Table 6.60a

Outlet Structure: Use level spreader Ref. NCESC Table 6.40a

Entrance Width = 10 feet Depth = 0.5 End Width = 3' Length =

Trap Design Summary:

Use 2H:1V side slopes with bottom dimensions of 20 feet by 15 feet
Use a stone filter weir with a minimum length of 4 feet
Dig 1.5 feet deep with 3 foot high perimeter dikes and a 2 foot high weir,
OR dig into ground approximately 3.5 feet and place 1-foot high berm
Build the stone filter weir with rip-rap, d50 = 12", extend down-slope as need
Underlay the rip-rap with 8 o.s.y. non-woven geotextile with water stops
Project: **Material Recovery - Wake Transfer Station**

Description: Stormwater Basin No. 2

Watershed Composition: (Reference Malcom Exhibit 1)

Slope conditions:	**Drainage Area, ac.**	**Percent of Area, Ai**	**Ci, Runoff Coefficient**	**Product (Ai x Ci)**
Rough graded, unimproved	0	0%	0.35	0.00
Undisturbed area, wooded	0	0%	0.10	0.00
Roads and hard surfaces	0.448	61%	0.90	54.86
Summation	0.448	61%		54.86

Composite Runoff Coefficient, C = Σ (Ai x Ci) Σ Ai = 0.90

Design Discharge, Q25 = 3.02 CFS = **4** **CFS**

Sediment Traps: 1800 c.f./ac. with max. sed. depth = 3.5

Required basin volume 806 c.f. with side slope ratio, m = 2

Base dimensions (length x width) 12 x 12 = 144 s.f.

Resulting soil storage volume = 840 c.f. Dimensions are OK

Stone Weir capacity:

Drainage Area 0.735 ac.

Required weir length 4 ft. Ref. NCESC Table 6.60a

Outlet Structure: Use rip-rap outlet protection, per NCESC Figure

Length = minimum 6 feet Use d50 = 12 inches

Trap Design Summary:

Use 2H:1V side slopes with bottom dimensions of 12 feet by 12 feet
Use a grass-lined weir with a minimum width of 4 feet
Dig 1.5 feet deep with 3 foot high perimeter dikes and a 2 foot high weir,
OR dig into ground approximately 3.5 feet and place 1-foot high berm
Line the overflow face with rip-rap, d50 = 12", extend down-slope as needed
Underlay the rip-rap with 8 o.s.y. non-woven geotextile with water stops

Project: **Material Recovery - Wake Transfer Station**

Description: **Pipe #1 on north site of tipping area, on Channel 2**

References: Malcom, H.R., Elements of Urban Stormwater Design, © NCSU, Raleigh, NC, 1989

North Carolina Erosion and Sedimentation Control Planning and Design Manual (NCESC), NC DENR Division of Land Resources, 1988

NCDOT Roadway Design Manual, NC Department of Transportation, 199

Design Conditions: **Q25 = 2 CFS** **Use Corrugated Metal Pipe**

Channel Slope, S	0.015	dimensionless (determine from site plan)		
Channel Depth, ft.	1	feet (initially assigned based on site geometry)		
Number of pipes, N =	1	So each pipe carries	2	cfs
Culvert diameter, d, ft =	1.5	= 18 inches		
Culvert length, L =	30	feet	Determine from site geometry	
Culvert slope, s =	0.015		Determine from site geometry	
Manning's n =	0.024		Reference Malcom Exhibit 7	

Q allowable = 1.486 / n*A*R^2/3*s^1/2 = **7** **cfs**

Where:
Q = theoretical flow at "just full" conditions in cfs
A = area of pipe = pd^2/4 = 1.77 s.f.
R = hydraulic radius = A / P = 0.375 ft
P = wetted perimeter, circumference of a round pipe flowing just full
S = longitudinal slope, defined above (neglects friction losses)

Check Velocity for "just full" conditions: V = s^1/2 * d^2/3 / 8.9*n = 0.8 fps

COMMENT: Culvert discharges into unlined, hardened sump, exit velocity is OK

COMMENT: Provide rip-rap apron at outlet with d50 = 12 inches, see schedule

COMMENT: Protect ends with rip-rap or use mitered ends – rip-rap preferred

COMMENT: Designed for no backwater!

Design Calculations for Channel No.   1

Description: Perimeter drain for west side, below Drainage Area 1a
Designed for post-closure conditions (anticipated max. flow)

Slope Conditions:		**Drainage Area, ac.**	**Percent Area, Ai**	**Ci, Runoff Coefficient**	**Product (Ai x Ci)**
Side slopes	lawn, steep (>7%)	0	0%	0.35	0.00
Cap areas	lawn, (2 – 7%)	0	0%	0.22	0.00
Impervious road surfaces		0.506	100%	0.90	90.00
	Summation	0.51	100%		90.00

Composite Runoff Coefficient, C = **Σ (Ai x Ci) / Σ Ai** **= 0.90**

Peak Design Discharge for the Q25 = 3.42 = **4** **CFS**

Design Conditions:

Drainage Area, A	0.51	acres
Maximum Relief, H	4	feet (height above outlet within drainage area
Hydraulic Length, L	235	feet (distance along main drainage feature)
Max. flow depth:	1	foot, trapezoidal channel, m = 3
Channel Slope, S	0.017	Maximum slope Length = 235 feet
	0.000	Minimum slope Length = 0 feet

Required Channel Dimensions: **Analyzed by Normal Depth Proceedure**

Bottom width, B = 2 feet
Minimum depth = 1 feet
Top width = 2m*y + B = 8 feet

Maximum slope section(s):
Manning's n coefficient = 0.030
Normal Depth = 0.42 ft.
Velocity = 2.9 fps < 4 fps
Below permissible velocity for vegetation
Shear stress, T = 0.4 psf straights
0.5 psf curves

Required channel liner material **Grass w/ straw mulch**

Estimate Flow Depth in Trapezoidal Channel by Normal Depth Procedure

Channel No.	**1**		**Maximum slope**
	Assumed channel lining		Grass w/ straw mulch
	Manning's coefficient, n		0.030 (NCESC, Table 8.05e)
	Channel Gradient, S		0.017
	Channel Side Slope, m		3
	Calculated Flow for	Q25	4 CFS

Rearrange Manning's Equation: (Reference Malcom Eq. II-16)

Zreq = A*R^.0667 = Q*n/1.49*S^0.5 = 0.62 use for comparison (see below)

Calculate Zavg = A * R^0.667 for various flow depths by iterative procedure
(find "normal" flow for design width, B = 2 feet):

B, ft.	y, ft.	A, s.f.	P, ft.	R, ft.	Zavg		Comment
2	0.50	1.75	5.16	0.34	0.85		Deep
2	0.40	1.28	4.53	0.28	0.55		Shallow
2	0.46	1.55	4.91	0.32	0.72		Deep
2	0.44	1.46	4.78	0.31	0.66		Deep
2	0.42	1.37	4.66	0.29	0.61	√	Shallow

Normal flow for design condition: 0.42 feet

COMMENT: Flow < max. allowable depth of 1 feet

Recalculate I	**Bottom width, B =**	**2**	**feet**
	Minimum depth =	**1**	**feet**
	Top width = 2m*y + B =	**8**	**feet**

Check Velocity: (Reference Malcom Eq. II-11)

V = Q/A = Q/(B*y + M*y^2) = 2.9 < 4 fps OK
Below permissible velocity for vegetation

> 2.5 fps
Requires temporary liner

Tractive Force Procedure: (Reference NCESC, App. 8.05)

T = y * d * s = 0.4 psf (for straight channel) where y = 62.4 pcf

Tb = Kb * T = 0.5 (for bend in channel) Kb min = 1.05
Rc = 75 feet

Design Calculations for Channel No. 1b

Description: Perimeter drain for west side, below Drainage Area 1b
Designed for post-closure conditions (anticipated max. flow)

Slope Conditions:		**Drainage Area, ac.**	**Percent Area, Ai**	**Ci, Runoff Coefficient**	**Product (Ai x Ci)**
Side slopes	lawn, steep (>7%)	0	0%	0.35	0.00
Cap areas	lawn, (2 – 7%)	0	0%	0.22	0.00
Impervious road surfaces		0.735	100%	0.90	90.00
	Summation	0.74	100%		90.00

Composite Runoff Coefficient, C = Σ **(Ai x Ci) /** Σ **Ai = 0.90**

Peak Design Discharge for the Q25 = 4.96 = 5 CFS

Design Conditions:

Drainage Area, A	0.74	acres
Maximum Relief, H	4	feet (height above outlet within drainage area
Hydraulic Length, L	100	feet (distance along main drainage feature)
Max. flow depth:	1	foot, trapezoidal channel, m = 3
Channel Slope, S	0.010	Maximum slope Length = 100 feet
	0.000	Minimum slope Length = 0 feet

Required Channel Dimensions: **Analyzed by Normal Depth Proceedure**

Bottom width, B =	2	feet
Minimum depth =	1	feet
Top width = 2m*y + B =	8	feet

Maximum slope section(s):

Manning's n coefficient = 0.030
Normal Depth = 0.55 ft.
Velocity = 2.5 fps < 4 fps
Below permissible velocity for vegetation
Shear stress, T = 0.3 psf straights
0.4 psf curves

Required channel liner material **Grass w/ straw mulch**

Estimate Flow Depth in Trapezoidal Channel by Normal Depth Procedure

Channel No. 1b			**Maximum slope**
	Assumed channel lining		Grass w/ straw mulch
	Manning's coefficient, n		0.030 (NCESC, Table 8.05e)
	Channel Gradient, S		0.01
	Channel Side Slope, m		3
	Calculated Flow for	Q25	5 CFS

Rearrange Manning's Equation: (Reference Malcom Eq. II-16)

Zreq = A*R^.0667 = Q*n/1.49*S^0.5 = 1.01 use for comparison (see below)

Calculate Zavg = A * R^0.667 for various flow depths by iterative procedure
(find "normal" flow for design width, B = 2 feet):

B, ft.	y, ft.	A, s.f.	P, ft.	R, ft.	Zavg		Comment
2	0.60	2.28	5.79	0.39	1.22		Deep
2	0.50	1.75	5.16	0.34	0.85		Shallow
2	0.56	2.06	5.54	0.37	1.07		Deep
2	0.54	1.95	5.42	0.36	0.99		Shallow
2	0.55	2.01	5.48	0.37	1.03	√	Deep

Normal flow for design condition: 0.55 feet

COMMENT: Flow < max. allowable depth of 1 feet

Recalculate I	**Bottom width, B =**	**2**	**feet**
	Minimum depth =	**1**	**feet**
	Top width = 2m*y + B =	**8**	**feet**

Check Velocity: (Reference Malcom Eq. II-11)

V = Q/A = Q/(B*y + M*y^2) = 2.5 < 4 fps OK
Below permissible velocity for vegetation

< 2.5 fps OK
Below permissible velocity for bare soil

Tractive Force Procedure: (Reference NCESC, App. 8.05)

T = y * d * s = 0.3 psf (for straight channel) where y = 62.4 pcf

Tb = Kb * T = 0.4 (for bend in channel) Kb min = 1.05
Rc = 75 feet

Design Calculations for Channel No. **2**

Description: Road ditch between Pipe No. 1 and Pipe No. 2
Designed for post-closure conditions (anticipated max. flow)

Slope Conditions:		**Drainage Area, ac.**	**Percent Area, Ai**	**Ci, Runoff Coefficient**	**Product (Ai x Ci)**
Side slopes	lawn, steep (>7%)	0	0%	0.35	0.00
Cap areas	lawn, (2 – 7%)	0	0%	0.22	0.00
Impervious road surfaces		0.219	100%	0.90	90.00
	Summation	0.22	100%		90.00

Composite Runoff Coefficient, C = **Σ (Ai x Ci) / Σ Ai** **=** **0.90**

Peak Design Discharge for the **Q25** = 1.48 = **2** **CFS**

Design Conditions:

Drainage Area, A	0.22	acres				
Maximum Relief, H	130	feet (height above outlet within drainage area)				
Hydraulic Length, L	170	feet (distance along main drainage feature)				
Max. flow depth:	1	foot, trapezoidal channel, m =			3	
Channel Slope, S	0.012	Maximum slope	Length	=	170	feet
	0.000	Minimum slope	Length	=	0	feet

Required Channel Dimensions: **Analyzed by Normal Depth Proceedure**

Bottom width, B =	1	feet
Minimum depth =	1	feet
Top width = 2m*y + B =	7	feet

Maximum slope section(s):

Manning's n coefficient = 0.041
Normal Depth = 0.47 ft.
Velocity = 1.8 fps < 4 fps
Below permissible velocity for vegetation
Shear stress, T = 0.4 psf straights
0.4 psf curves

Required channel liner material **Grass w/ gravel rip-rap, d50 = 2"**

Estimate Flow Depth in Trapezoidal Channel by Normal Depth Procedure

Channel No.	**2**		**Maximum slope**
	Assumed channel lining		Grass w/ gravel rip-rap, d50 = 2"
	Manning's coefficient, n		0.041 (NCESC, Table 8.05e)
	Channel Gradient, S		0.012
	Channel Side Slope, m		3
	Calculated Flow for	Q25	2 CFS

Rearrange Manning's Equation: (Reference Malcom Eq. II-16)

Zreq = A*R^.0667 = Q*n/1.49*S^0.5 = 0.50 use for comparison (see below)

Calculate Zavg = A * R^0.667 for various flow depths by iterative procedure
(find "normal" flow for design width, B = 1 feet):

B, ft.	y, ft.	A, s.f.	P, ft.	R, ft.	Zavg		Comment
1	0.50	1.25	4.16	0.30	0.56		Deep
1	0.40	0.88	3.53	0.25	0.35		Shallow
1	0.46	1.09	3.91	0.28	0.47		Shallow
1	0.48	1.17	4.04	0.29	0.51		Deep
1	0.47	1.13	3.97	0.29	0.49	√	Shallow

Normal flow for design condition: 0.47 feet

COMMENT: Flow < max. allowable depth of 1 feet

Recalculate I	**Bottom width, B =**	**1**	**feet**
	Minimum depth =	**1**	**feet**
	Top width = 2m*y + B =	**7**	**feet**

Check Velocity: (Reference Malcom Eq. II-11)

V = Q/A = Q/(B*y + M*y^2) = 1.8 < 4 fps OK
Below permissible velocity for vegetation

< 2.5 fps OK
Below permissible velocity for bare soil

Tractive Force Procedure: (Reference NCESC, App. 8.05)

T = y * d * s = 0.4 psf (for straight channel) where y = 62.4 pcf

Tb = Kb * T = 0.4 (for bend in channel) Kb min = 1.05
Rc = 75 feet

Estimate Flow Depth in Trapezoidal Channel by Normal Depth Procedure

Channel No. 3			**Maximum slope**
	Assumed channel lining		Stone rip-rap, d50 = 12"
	Manning's coefficient, n		0.034 (NCESC, Table 8.05e)
	Channel Gradient, S		0.1
	Channel Side Slope, m		3
	Calculated Flow for	Q25	4 CFS

Rearrange Manning's Equation: (Reference Malcom Eq. II-16)

Zreq = A*R^.0667 = Q*n/1.49*S^0.5 = 0.29 use for comparison (see below)

Calculate Zavg = A * R^0.667 for various flow depths by iterative procedure
(find "normal" flow for design width, B = 4 feet):

B, ft.	y, ft.	A, s.f.	P, ft.	R, ft.	Zavg		Comment
4	0.30	1.47	5.90	0.25	0.58		Deep
4	0.20	0.92	5.26	0.17	0.29		Shallow
4	0.26	1.24	5.64	0.22	0.45		Deep
4	0.24	1.13	5.52	0.21	0.39		Deep
4	0.22	1.03	5.39	0.19	0.34	√	Deep

Normal flow for design condition: 0.22 feet

COMMENT: Flow < max. allowable depth of 1 feet

Recalculate I	**Bottom width, B =**	**4**	**feet**
	Minimum depth =	**1**	**feet**
	Top width = 2m*y + B =	**10**	**feet**

Check Velocity: (Reference Malcom Eq. II-11)

V = Q/A = Q/(B*y + M*y^2) = 3.9 < 4 fps OK
Below permissible velocity for vegetation

> 2.5 fps
Requires temporary liner

Tractive Force Procedure: (Reference NCESC, App. 8.05)

T = y * d * s = 1.4 psf (for straight channel) where y = 62.4 pcf

Tb = Kb * T = 1.4 (for bend in channel) Kb min = 1.05
Rc = 75 feet