

STORMWATER OPERATIONS AND MAINTENANCE MANUAL AND BUDGET (Manual must be sealed by professional engineer)

Project: _____

CONSTRUCTED WETLAND

Raleigh, N.C.

Owners:

Prepared By.

Date:

Date: _____

Project Name and City file number: _____

Receiving Water Course

Date as Built Plans Certified to the City: _____

(The device must be inspected annually within two weeks plus or minus of this date by an individual certified to inspect BMP's by the State of North Carolina.)

BACKGROUND

DRAFT-6/2007

Location: Written description of each device elevations (permanent and temporary), areas, dimensions (width length and depth), volumes,(permanent and temporary) materials, plant material and other parameters like diameter of orifice, spillway, and rip-rap dissipaters (length width depth and type of stone. State a specific length of time when items such as rip rap will need replenishment; location on site; and lot number on the recorded subdivision plat; reduced site plan showing location of device; longitude and latitude of device. Explain how stormwater enters the wetland (pipes, grass swales and how stormwater runoff leaves the wetland (pipes, rip-rap etc.) Reduced detail of device showing all pertinent information as well as all associated elevations for items such as bottom, top, spillway, inlet, outlet, normal pool, etc. Include a written description of the device providing all pertinent details and dimensions. If device is not tied into another storm water system provide velocity dissipater details and dimensions. Provide a detail planting guide of aquatic plants for each wetland showing plant variety, number and their location.

Minimum design requirements are to be in accordance with North Carolina DENR's Stormwater BMP manual.

Provide draw down time of pond.

The pond will contain a fore bay _____. The pond will not contain a fore bay_____. If pond contains a fore bay provide a complete written description of it (length, width, depth, cubic feet capacity, aquatic plants etc.).

More detailed information can be obtained from construction drawings named _____ revision number _____ prepared by _____ sealed on _____ approved by the City on _____ and on file with _____.

Provide: List showing unit cost breakdown for materials and labor also provide total cost of structure. List must be broken down to show specifics i.e. Plant name and cost, conduit size and cost, etc;

Initial and ten (10) year cost breakdown for replacement cost of the device .

Receiving Water Course

DRAFT-6/2007

Contractor: (List below)

Impoundment & Dam	
Spillway	

OPERATIONS AND MAINTENANCE MANUAL

STORMWATER CONSTRUCTED WETLAND AREA

This manual establishes procedures for maintenance and operation of the _____ (project name) Constructed Wetlands in accordance with the City of Raleigh guidelines.

I. MAINTENANCE OF CONSTRUCTED WETLAND AREAS

A. Vegetation—The constructed wetlands have a ground cover of plantings outside of the ponding area, which if properly maintained will prevent erosion of the embankment and provide an easy surface for inspection. The grass will be most difficult to obtain in the area subject to water level fluctuation, and has been planted above the inundated areas. Grass should be fertilized every October and April. Wetland plants are located within all water level fluctuation areas. See, detailed planting guide in appendix. Check vegetation conditions within and surrounding the constructed wetland area and replace if necessary any damaged plant materials. Cat tails should be removed immediately along with and other invasive species. Remove sediment from forebay and insure all debris and vegetation does not obstruct the drawdown structure. Sediment should be removed carefully from the wetland with the sediment containing plant root material stored and replaced with care. Test wells should be placed within ten feet of each other in the wetland and in the forebay there is to be three permanent measurement structures (6j ±X6j± concrete post on a 24j±X24j±X 6j± concrete base both reinforced by #3 rebar, rebar in base is to be 6j± OC E/W and tied in with the rebar in the concrete post, there is to be a 1/4j±-1/2j± deep line chiseled in the post at the required elevation) in the pond

DRAFT-6/2007

in any fore bay required. They are to be located at the point of inflow, the geometric center, and the point of outflow. These structures should be clearly marked with required elevations that are easily seen from bank of the pond. The depth of the pond should be measured using a measuring stick at the locations of these aforesaid structures

Re-Seeding—Periodic re-seeding may be required to establish grass on areas where seed did not take or have been destroyed. Before seeding, fertilizer (12-12-12) should be applied at a minimum rate of 12 to 15 pounds per 1,000 SF. The seed should be evenly sown at a rate of three pounds per 1,000 SF. The seed should be covered with soil to the depth of approximately 1/4". Immediately following the planting, the area should be mulched with straw.

Trees and Shrubs—Trees, shrubs and other landscape vegetation should be permitted only as shown on the approved planting plan. The vegetation should be kept healthy and vibrant. If a tree or shrub dies it should be removed and replaced with another tree or shrub from the same species (see attached maintenance schedule).

Mowing—Grass mowing, brush cutting and removal of weed vegetation will be necessary for the proper maintenance of the areas. All area slopes and vegetation should be mowed when the grass exceeds 8" in height to a minimum of 3" three inches. Acceptable methods include the use of weed whips or power brush cutters and mowers.

B. Erosion—Erosion occurs when the water concentrates causing failure of the vegetation or when vegetation dies and sets up the environment for rill erosion and eventually gullies from the stormwater runoff. The areas should be inspected. Proper care of vegetative areas that develop erosion is required to prevent more serious damage to the site. Rills and gullies should be filled with suitable soil compacted and then seeded. Methods described in Section 1-A on vegetation should be used to properly establish the grass surface. Where eroded areas are detected, the cause of the erosion should be addressed to prevent a continued maintenance problem. Frequently, problems result from the concentration of runoff to one point of the

DRAFT-6/2007

constructed wetland area instead of a uniform distribution of runoff. This can be corrected by reshaping, to more evenly distribute the runoff in a sheet flow to areas not experiencing erosion problems .

Pest. Rodents such as groundhogs, muskrats and moles are attracted to moist, wet areas and can be quite dangerous to structural integrity and proper performance of the earthwork and drainage. Groundhogs and muskrats thrive on burrowing into the manmade earthwork, which become pathways for seepage. In the event that burrows are detected within the constructed wetland area, the rodents should be dealt with by removal.

E Trash and Debris--Trash acts as a barrier to stormwater infiltration and attracts unwanted pests. The constructed wetland area should be kept clear of debris such as loose bottles, cans, food containers and other forms of rubbish. The area should be cleared of debris as needed, but no less than twice a year.

II MAINTENANCE OF SPILLWAYS AND CONTROL Structure

Inspection of Conduits--Conduits should be inspected thoroughly once a year. Conduits should be visually inspected at the joints. Pipes should be inspected for proper alignment (sagging), elongation and displacement at joints, cracks, leaks, surface water, surface wear, loss of protective coating, corrosion and blockage. Problems with conduits most often occur at joints and special attention should be given to them during inspection. Joints should be checked for gaps caused by elongation or settlement and loss of joint filler material. Open joints can permit erosion of the earthwork and possibly the piping of soil material through the joints. A depression in the soil surface over the pipe may be signs that soil is being removed from around the pipe. Seepage may vary in appearance from a soft wet area to a flowing spring. It may show up first as an area where the vegetation is lusher and darker green.

The assistance of a civil engineer or geotechnical engineer qualified in the design of embankments should be retained to perform an inspection of the embankment. Lower the water surface elevation of the ponds until such time as an inspection can be performed by a qualified professional.

III. OPERATION

A. Drainpipes--Drainpipes should always be operable so that the water can be drawn down in the event of severe rain or for repairs or maintenance.

DRAFT-6/2007

B. Record Keeping--Operation of constructed wetland area should include recording of the following:

Annual Inspection Reports-- The owner/association shall keep a collection of written inspection reports prepared using the forms within this manual.. In accordance with Part 10 Chapter 9 of the Raleigh City Code, an annual inspection must be conducted by a North Carolina licensed professional engineer surveyor or landscape architect qualified in this area of expertise on the anniversary date the as-built drawings of the constructed wetlands was first certified under section 10-9025(c) of the Raleigh City Code. Copies of this inspections report, including a certification statement by the professional inspector shall be provided to the City of Raleigh Stormwater Management Division of the Public Works Department. Any deficiencies identified in the inspection report shall be corrected within thirty days.

Observations--All observations should be recorded. Where periodic inspections are performed following significant rainfall events (greater than one inch rain fall over a twenty four hour period or less), these inspections should be logged into the Periodic Inspection, Operations and Maintenance Form in Section IV of this manual. The completed Periodic Inspection, Operation & Maintenance Form shall be kept on record by the owner/association

Maintenance--Written records of maintenance and/or repairs should be recorded on the Checklist and Periodic Inspection, Operation and Maintenance Form in Section IV of this manual. The completed Checklist and Periodic Inspection, Operation & Maintenance Form shall be kept on record by the owner/association

Other Operational Procedures--The owner/association shall maintain a complete and up-to-date set of plans (as-built drawings) and all changes made to the constructed wetland area over time should be recorded on the as-builts. Any and all changes shall first be approved in writing by the City of Raleigh.

- C. Sedimentation and Dredging--Sedimentation from on-site and off-site soils will eventually result in the clogging of drainage conduits and will have to be removed. The frequency of this sediment removal can be reduced by ensuring that the site areas around the building be stabilized with a vegetative ground cover such that it restrains erosion. This would include application of fertilizer in October and April and/or other treatment necessary to promote a stable ground cover and minimize sedimentation to the constructed wetland. The removed material should be

DRAFT-6/2007

hauled offsite to a suitable landfill site or mounded somewhere on site, away from ponds streams and stormwater control measures, and stabilized with a ground cover sufficient to restrain erosion. .

D. Surface water inspection

Example Maintenance Schedule for constructed wetland areas

Description	Method	Frequency	Time of year
SOIL			
Inspect and repair erosion	Visual	Monthly	All year
ORGANIC LAYER			
Remulch any void area	By hand	As needed	As needed
Remove previous mulch layer before applying new layer (optional)	By hand	Once every 2-3 years	Spring
Any additional mulch added	By hand	Once a year	Spring
PLANTS			
Removal and replacement of all dead and diseased vegetation considered beyond treatment	See planting specifications	Twice a year	As directed by landscaper
Treat all diseased trees and shrubs	Mechanical or by hand	N/A	Varies, dependent on insect or disease infestation
Removal of cattails and other invasive species	By hand or through hand application of herbicide	As needed	As needed
Watering of plant material shall take place at the end of each day for fourteen consecutive days and after planting is completed	By hand	Daily	Immediately after completion of project
Replacement of support stakes	By hand	Once a year	Only remove stake in the spring

DRAFT-6/2007

Replace any deficient stakes or wires	By hand	As needed	As needed
---------------------------------------	---------	-----------	-----------

IV. INSPECTION, OPERATION AND MAINTENANCE CHECKLISTS

Constructed Wetland INSPECTION CHECKLIST				Date _____
				Time _____
INSPECTORS _____				
SPILLWAYS ;Ü DRAINS ;Ü OUTLETS				ACTION
CHECK/CIRCLE CONDITION NOTED	OBSERVATIONS	REPAIRS	MONITOR	INVESTIGATIVE
Principal Spillway	Type:			
Trashrack debris/cracks/rust/deterioration				
improper alignment				
cracks/deterioration				
joint deterioration				
seepage/piping				
Undercutting				
Erosion				
Debris				
Lake Drain/Other Outlets	Type:			
Gate/valves				
Operability				
Riprap				

DRAFT-6/2007

GENERAL COMMENTS, SKETCHES & FIELD MEASUREMENTS

[b1]

PERIODIC INSPECTION, OPERATION AND MAINTENANCE RECORDS					PROJECT NAME : NUMBER & LOCATION OF DEVICE (LONGITUDE AND LATITUDE) & WRITTEN DESCRIPTION OF LOCATION	
DATE	TIME	RAIN	POOL LEVEL	WEATHER CONDITIONS	GENERAL OBSERVATIONS OR COMMENTS	RECORDED BY
DATE	MAINTENANCE PERFORMED				COMMENTS	RECORDED BY

DRAFT-6/2007

rodent burrows				
CREST				
ruts/erosion				
cracks/settlement				
poor alignment				
D/S SLOPE				
vegetation/erosion				
rodent burrows				
slough/slides/cracks				
seepage/wetness				
POOL				
erosion/ground cover				
sedimentation				
water quality				
plant location/height				
mosquito controls				
ABUTMENT				
vegetation/erosion				
slough/slides/cracks				
seepage/wetness				

GENERAL COMMENTS, SKETCHES & FIELD MEASUREMENTS

IV

Provide: List showing description, unit cost breakdown for materials and labor also provide total cost of structure. List must be broken down to show specifics i.e. Plant name and cost, conduit size and cost,

FOR ITEMIZED CONSTRUCTION COSTS AND TEN YEAR BUDGET
REPLACEMENT CONTRIBUTION SCHEDULE

:

DRAFT-6/2007

The design engineer bases all costs opinions upon best available information. Cost and reconstruction opinion may vary significantly from actual costs. The design engineer assumes no responsibility for the above cost opinions.

Replacement Schedule*

(Note: Developer contribution plus first year annual replacement payments are due immediately to create replacement account; all subsequent payments are due on July 1 of each year. All monies shown on the following schedule will be paid to the City of Raleigh)

List as:

Initial Payment_____

Initial + First Annual Replacement Payment_____

First Five Years

Year	Replacement Payment
1	**
2-20__	
3-20__	
4-20__	
5-20__	

Second Five Years

Year	Replacement Payment
6-20__	
7-20__	
8-20__	
9-20__	
10-20__	

DRAFT-6/2007

Total Replacement Amount [: _____

* The replacement schedule is computed by the following formulae:

Years 1-5 (total estimated initial construction cost from Paragraph B X 0.85 X 0.67) /5

Years 6-10(**total** estimated initial construction cost from Paragraph B X 0.85 X 0.33) /5

** Developer contribution of 15% plus first annual replacement payment

The periodic inspection checklist should follow the next checklist.

DRAFT-6/2007