Houston
Council of Engineering Companies

May 30, 2008

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Gentlemen:

The Houston Council of Engineering Companies' Joint Storm Water Quality Subcommittee has spent the past year reviewing the Best Management Practices for Stormwater Runoff. With the encouragement of staff members of the City of Houston, Harris County, and Harris County Flood Control District, we undertook this challenge because seven years has passed since the original issue of the criteria and we thought it would be a useful undertaking to apply some of our lessons learned to the BMPs. With the approval of the HCEC Drainage Committee, Design Standards/Plan Review Committee and the HCEC Board of Directors, I respectfully present to you our recommendations for updating the "Minimum Design Criteria For Implementation of Certain Best Management Practices for Storm Water Runoff Options", published in 2001.

In addition, with the assistance of your staff who serve on this subcommittee, we also developed a two-page summary sheet, or checklist, which was determined would be beneficial to the reviewing agencies during the plan review process as well as for the submitting engineer to ensure all necessary information was contained in the SWQMPs. The checklist is also included in this package.

We are available to answer any questions you may have concerning our recommendations and hope they will meet with your approval and be adopted for use.

Sincerely,

Christina M. Lindsay
Executive Director

Enclosures

Cc: Ms. Alisa Max, Harris County, SWQ Division
Mr. John Blount, Harris County, Assistant Deputy Director
Ms. Carol Ellinger, City of Houston, Sr. Assistant Director
Mr. Mark Loethen, City of Houston, City Engineer
Mr. Joe Myers, Harris County Flood Control District

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Harris County / City of Houston
SWQMP Summary Sheet

Project Information

Project Name: _____

Project Number: _____

Location:

Address: # & Street: _____

City: _____ **State:** TEXAS **ZIP:** _____

Key Map: _____

Latitude (N): _____ Degrees Minutes Seconds

Longitude (W): _____ Degrees Minutes Seconds

Watershed: _____

Receiving stream: _____

Contact Information

Owner Name: _____

Owner Contact: _____

Owner Phone: _____

Owner Address:

Engineer Name: _____

Engineer Company: _____

Engineer Phone: _____

Engineer E-mail: _____

Site Information

Total Acres: _____

Existing Developed Acres: _____

Proposed Disturbed Acres: _____

Development Type: _____

Existing Wetlands: ☐ NO ☐ YES

Jurisdictional: ☐ NO ☐ YES ☐ UNKNOWN

USACE Permit #: _____

Prepared by HCEC-SWQ committee Jan 2008; Version 1.1

Harris County / City of Houston
SWQMP Summary Sheet

SWQ Controls

Check all that apply

Non-Structural: Described on page

- ☐ Waste Materials
- ☐ Hazardous Waste
- ☐ Sanitary Waste
- ☐ Landscaping Practices
- ☐ Public Education
- ☐ Inlet Markers

Structural: Described on page

Permanent Storm Water Quality Features

- ☐ Dry Basin
- ☐ Dry w/Detention
- ☐ Wet Basin
- ☐ Wet w/Detention
- ☐ Trash Separator
- ☐ Oil/Grit/Trash Separator
- ☐ 10/100yr Dry Basin
- ☐ 10/100yr Wet Basin
- ☐ Vegetative filter
- ☐ Grass swale
- ☐ Combination
- ☐ Urban Forestry
- ☐ Other:

Maintenance Information:

Maintenance: Described on page

Describe maintenance here including major activities, frequency responsible party and phone number.

Inspection Information:

Inspections: Described on page

Describe inspections here including major activities, frequency responsible party and phone number.

Prepared by HCEC-SWQ committee Jan 2008; Version 1.1

Recommendations from the Storm Water Quality Infrastructure Working Group
of the
Joint Storm Water Quality Subcommittee of HCEC
May 30, 2008

It is the belief of the working group, that these recommended changes would work best if they amended the document "Minimum Design Criteria for Implementation of Certain Best Management Practices for Storm Water Runoff Options" published by City of Houston, Harris County, and Harris County Flood Control District in 2001.

The following general recommendations should be included in the Introduction Section of the Manual.

General Recommendations

1. The storm water quality management plan and storm water pollution prevention plan must include references to the operation, maintenance and inspection to be completed during the construction phase of the project.

A. Proprietary Systems

With the proliferation of Proprietary Systems in the local area, there is a need to set some standards for those devices in one location. We recommend that a section be added after the detention pond criteria to include the following recommendations for minimum standards for proprietary systems.

Recommendations- Proprietary Systems

Proprietary Systems are defined as any system designed to be sold as a unit process to provide for storm water quality enhancement. Examples of proprietary systems include but not limited to: Stormceptors, Storm Troopers, CDS systems, ADS systems, Crystal Stream systems. These systems are characterized by a design standard based upon maximum flow rate.

1. The intensity (I) used for the design of all flow controlled systems will be 0.27 in/hr. The rational C-factor used in the calculation of required flow rate shall be 0.80. Flow shall be determined using the rational method. (Q=CIA)

2. All systems shall include a permanent sign (minimum size of 1 foot square) near the SWQ unit which indicates:

   a. Name and organization of the person responsible for maintenance;

   b. Phone number of person responsible for maintenance;

3. In an area viewable from the manhole provide the unit type and model number on an impressed manhole cover, sign, or embossed frame.

4. In selecting the location and type of storm water quality system, consider the following:

   a. Provision for all weather maintenance access;

   b. The optimal distance for the maintenance equipment from the all weather access to the unit of 10 feet;

   c. Any potential encumbrances that will make maintenance difficult.

   d. Long term and short term maintenance costs.

5. Provide design calculations that account for high flow bypass. The design should pass the design storm without causing the flow to exceed the top of the inlet pipe.

6. All proprietary units must function with 75% blockage of the trash screens.

7. All proprietary units in commercial developments must consider trash collection, floatables, solids retention, and oil and grease removal in their design.

8. All proprietary units in residential developments must consider trash collection, floatables, and solids retention in their design.

9. Proprietary systems are not appropriate under submerged conditions, where the tail water of the system exceeds the flow line of the outlet pipe.

10. Storm water pollution prevention plan must include references to the operation, maintenance and inspection of the SWQ Unit to be performed during the construction phase of the project.

B. Ponds

Create a section before all ponds that discuss outlet devices and their appropriate design equations.

Outlet Devices

The Following Standards Apply to Wet Ponds, Dry Ponds and Wetlands

1. Riser pipes

   a. Are not recommended as the preferred outlet device. Weirs and orifices are preferred.

   b. Need to provide an example drawing for a removable maintenance screen.

   c. The minimum diameter for holes should be 2-inches.

   d. The bottom hole needs to be at the proposed water surface of the pond. For dry ponds, the bottom hole needs to be at the flowline.

   e. A concrete apron should be provided around the bottom hole at the flowline of the outlet system.

2. Weirs

Provide a simplified weir equation to use for SWQ devices:

a. $Q = 3.2\ L\ H^{3/2}$ for rectangular sharp crested weirs. (HCFCD Manual, section 6.7.10)

b. $Q = 3.2\ (A)(H^{0.5})$ for trapezoidal sharp crested weirs.

c. $Q = 2.5 \tan(\theta/2) H^{5/2}$ or $Q = 1.25\ bH^{3/2}$ for triangular weirs. from Brater & King 5th Ed., pg 5-16

3. Orifices

$Q = 0.6\ A\ (2gH)^{1/2}$. (HCFCD Manual, section 6.7.6) H measured from center of orifice to water surface. The minimum orifice diameter should be 2 inches.

4. Inverted Pipes

$Q = 0.8\ A\ (2gH)^{1/2}$. (HCFCD Manual, section 6.7.6) H measured from center of inverted pipe at outlet side to water surface.

5. Horizontal Standpipes

a. For design storage depth < 1/2 pipe diameter above lip of standpipe, the standpipe acts as a weir, so use equation 2.a. above, with L = the circumference (pi * diameter) of the standpipe and H = height above lip of standpipe to the design storage depth.

b. For design storage depth >= 1/2 pipe diameter above lip of standpipe, the standpipe acts as an orifice, so use equation 3 above, with H = height above lip of standpipe to the design storage depth.

6. Rock Filter Dams and Earthen Berms with infiltration through the berm are not appropriate as permanent storm water quality devices.

7. All outlet designs must consider tailwater conditions in the design of the outlet device.

Other Pond Considerations

1. Vegetation

a. Design Criteria Manual must state types of allowed and disallowed vegetation.

b. Trees

i. State whether trees should be encouraged, allowed, or disallowed.

ii. If trees are allowed, the Design Criteria Manual must specify type of trees allowed.

iii. Engineer must determine maximum number of trees.

c. Establishing vegetation

i. must be completed immediately upon completion of excavation and grading.

ii. provide for watering of vegetation during establishment period.

d. Intensity of inspections and maintenance requirements must be called out. Person or entity responsible for the maintenance during the warranty period must be identified.

e. Determine whether an all-weather access is being implemented.

i. Define appropriate materials for an all weather access.

ii. Define what portions of the pond require and all weather access.

The Following Recommendations Relate to Dry Ponds only

1. Pilot Channels

a. Requirement for reinforced concrete pilot channels or articulated concrete block should be identified. Formal reinforced pilot channels should be recognized as the recommended design choice. Develop standards including:

i. Minimum top width of pilot channel 6 feet (HCFCD Manual section 6.4.5)

ii. Maximum side slope = 3:1 (HCFCD Manual section 6.4.5)

iii. Minimum downstream slope = 0.1% (HCFCD Manual section 6.4.5)

iv. Minimum thickness of reinforced concrete should be 4-inch and articulated block width should be 6-inch.

v. Minimum depth of 1 foot (HCFCD Manual section 6.4.5)

vi. Method for measurement of siltation must be called out in the plan.

vii. Maintenance standards should be called out in the plan.

b. For wet pilot channels develop standards such as:

i. Minimum bottom slope is not required.

ii. Minimum depth of 1 foot. (HCFCD Manual section 6.4.5)

iii. Maximum depth of 2 feet.

iv. Maximum side slopes of 3:1. (HCFCD Manual section 6.4.5)

v. Minimum freeboard from static WSE to top of wet pilot channel of 6-inches.

vi. A dry safety bench along both sides of the pilot channel.

vii. Vector protection should be considered

viii. Method for measurement of siltation must be called out in the plan.

ix. Maintenance standards should be called out in the plan.

Wet Pond Standards

The following design related items should be included within the SWQMP design manual:

1. Type of edge

   a. If hard edge, call out material, and show design details

   b. If soft sloped edge, call out a criteria for triggering the reestablishment of the edge to prevent slope failure.

2. Type of Safety Benches

   a. For wet Benches define

      i. the allowed surface materials

      ii. range for slopes (2% to 10%)

      iii. Maximum Depth of 3 feet (Criteria Manual Page 16)

      iv. Minimum Depth of 1 foot

   b. For dry Benches define a range for the slopes (Criteria Manual Page 16, states 1-2%)

   c. For benches define the minimum width and ranges of slopes.

      i. Dry Benches: Minimum 10 feet wide, slope 2% to 10%

      ii. Wet Benches: Minimum 10 feet wide, slope 1% to 10%

      iii. Combination Wet/dry Benches

         1. Possible HCFCD pond – 10 feet dry, 4 feet wet, slope 2% to 10%

         2. Not HCFCD pond – 6 feet dry, 4 feet wet, slope 2% to 10%

      iv. Change Design Criteria Manual Page 19, Table 1.5- change to 8' maximum permanent pool depth.

3. Plan must state whether the pond will be part of the subdivision's recreational plan. The lake management plan is not a required part of the SWQMP documentation.

4. Dredging or Desilting Requirements

   a. Engineer needs to define the requirement for dredging.

   b. Engineer needs to develop standards for a maintenance trigger.

5. Redefine the length to width ratio based upon the travel distance, and the width of the channel perpendicular to that line of travel at the SWQ water surface to be 3:1.

6. Ask designers to consider the requirements for make-up water.

7. Develop as standards or ask designers to develop a lake management plan.

Other Comments

Over the course of implementing the program for the last 6 years, undoubtedly, there have been lessons learned, and knowledge discovered. It would be appropriate:

1. The county and city should develop education and/or certification classes for education of inspectors, laborers, and field superintendents which will discuss storm water pollution prevention, and their roles.

2. A new round of training should be initiated for engineers, inspectors, and developers. Some training ideas should include lessons learned.

3. Consider formally adding trash as a defined pollutant of interest.

4. Using of Wet Ponds for Storm Water Quality.

   Documentation has indicated that wet ponds are highly effective storm water quality systems, and that they are the best type of pond for handling both storm water quality for all events, and storm water detention for large events in a single system. In order to make these ponds more easily selected by developers, we suggest the following:

   a. Reimbursement from TCEQ

      i. HC, HCFCD and COH should consider contacting TCEQ about changing their policy of not reimbursing wet ponds that are combined with amenities.

b. Acceptance by HCFCD of wet ponds

    i. HCFCD should reexamine its policies regarding acceptance of maintenance of wet ponds to determine:

        1. Does their current policies encourage the design of wet or dry ponds?

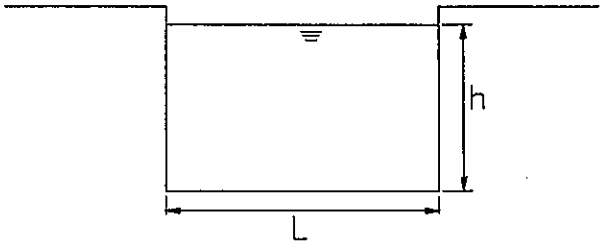
        2. Does the current policy regarding acceptance really provide the best long-term benefits to the public?

        3. Does the current policy protect the public?

c. HC should examine its submerged storm sewer rules to determine if the rules are potentially resulting in fewer wet pond designs due to the unknown factor of the future ownership of the storm sewers upstream of the detention pond.

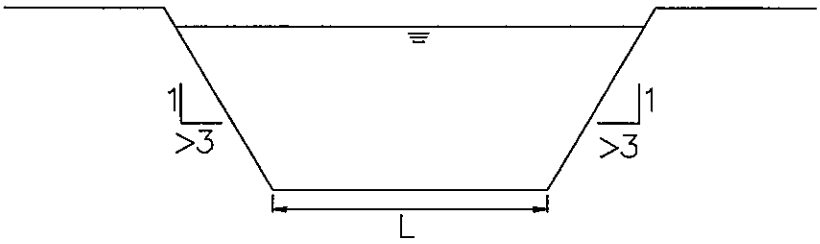
RECTANGULAR WEIR

$Q = 3.2Lh^{3/2}$



TRAPEZOIDAL WEIR

$Q = 3.6Lh^{3/2}$

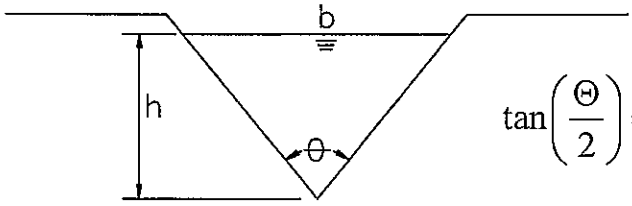


V NOTCH WEIR (Triangular Weir)

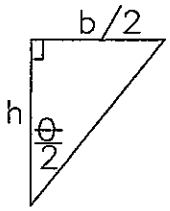
$Q = 2.5\tan(\frac{\theta}{2})h^{5/2}$

$Q = 2.5\tan(\frac{b}{2h})h^{5/2}$

$Q = 1.25bh^{3/2}$



$$\tan\left(\frac{\Theta}{2}\right) = \frac{b/2}{h} = \frac{b}{2h}$$

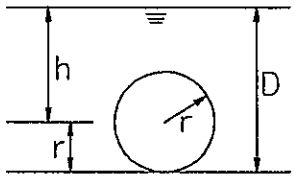


DRAWING 1
WEIRS

CIRCULAR ORIFICE

$$Q = 0.6A\sqrt{2gh}$$

$$A = \pi\frac{d^2}{4} = \pi r^2$$



r = radius
d = diameter
D = water depth

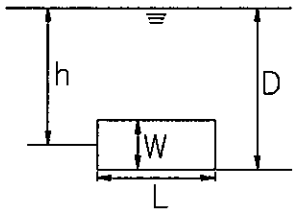
$$h = D - r = D - \frac{d}{2}$$

RECTANGULAR ORIFICE

$$Q = 0.6A\sqrt{2gh}$$

$$A = W * L$$

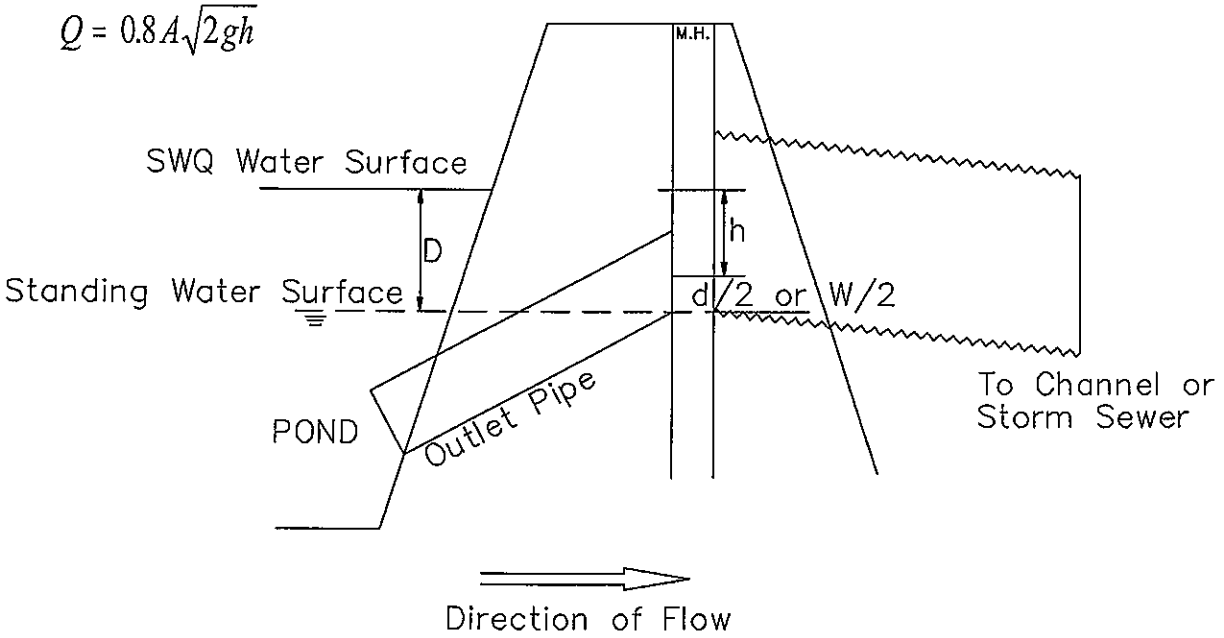
$$h = D - \frac{W}{2}$$



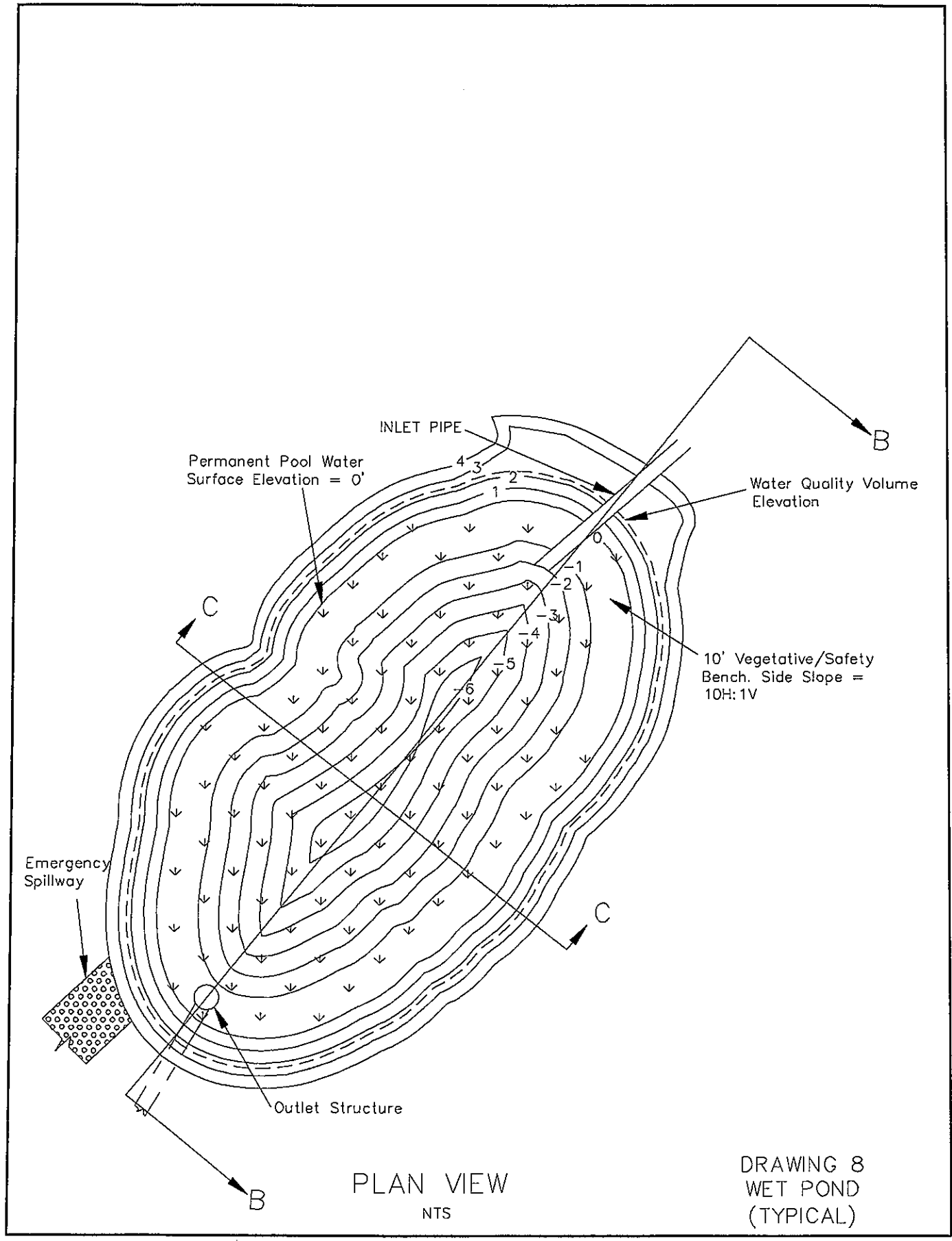
W = Orifice Height
L = Orifice Length
D = water depth

INVERTED PIPE

$$Q = 0.8A\sqrt{2gh}$$



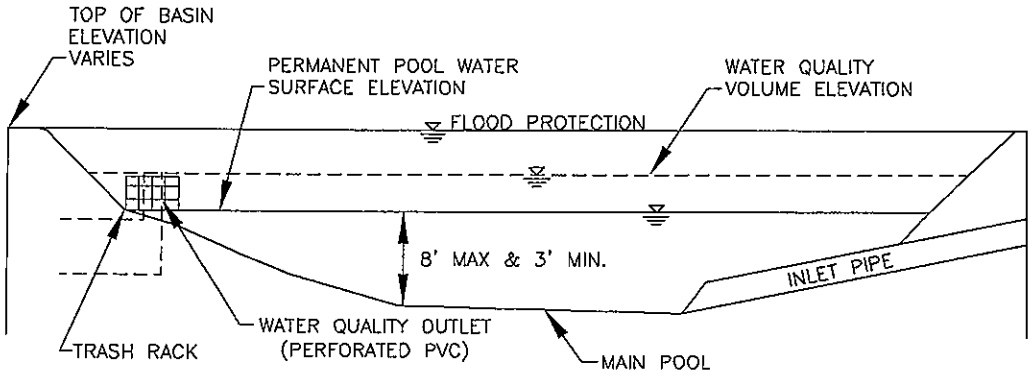
DRAWING 2
ORIFICES



PLAN VIEW
NTS

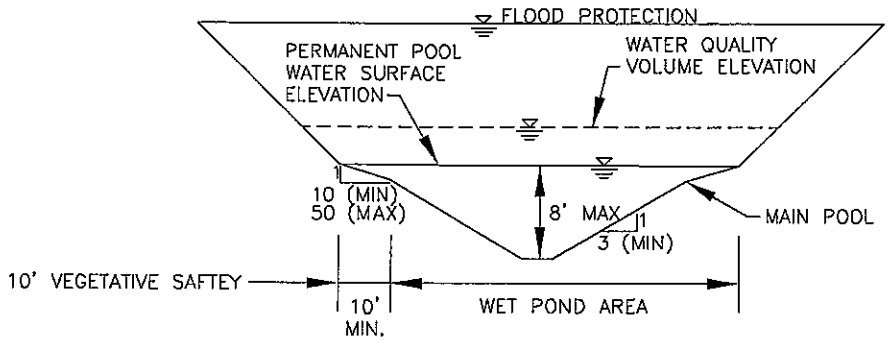
DRAWING 8
WET POND
(TYPICAL)

K:\SdskLand\Marketing~Culp\dwg\Exhibits\Wet Pond LINEWORK.dwg 8/16/2007 10:26:16 AM CDT



SECTION B–B

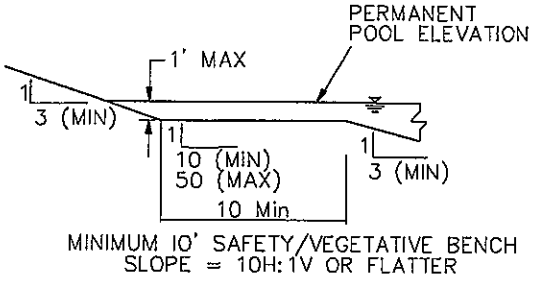
NTS



SECTION C–C

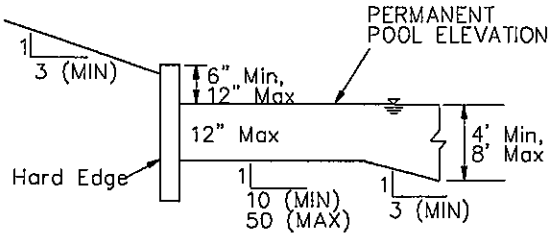
NTS

DRAWING 9
WET POND CROSS SECTIONS
(TYPICAL)

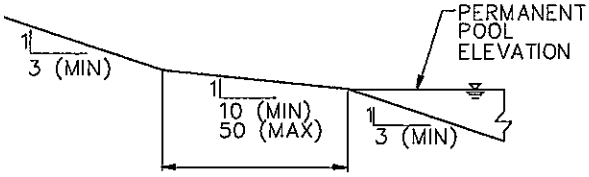


MINIMUM 10' SAFETY/VEGETATIVE BENCH
SLOPE = 10H:1V OR FLATTER

VEGETATIVE BENCH
NTS

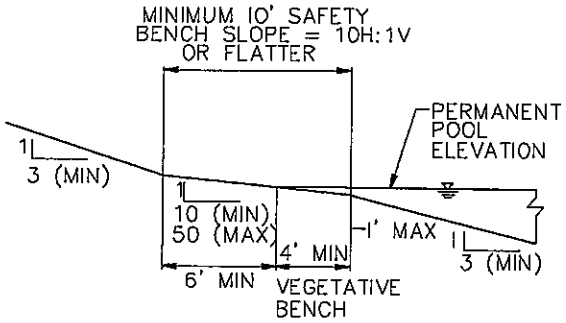


VEGETATIVE BENCH
WITH HARD EDGE
NTS



MINIMUM 10' SAFETY BENCH
SLOPE = 10H:1V OR FLATTER

DRY SAFETY BENCH
NTS



COMBINED VEGETATIVE AND DRY
SAFETY BENCH
NTS

TO MINIMIZE VEGETATIVE MAINTENANCE, WET SHELVES SHOULD BE CONCRETE EXCEPT WITHIN 30' OF OUTLET STRUCTURE OF POND

DRAWING 10
WET POND SAFETY/
VEGETATIVE CROSS SECTIONS