COPY

ORDINANCE NO. 08-09
PORTER COUNTY BOARD OF COMMISSIONERS

UNIFIED DEVELOPMENT ORDINANCE

WHEREAS, the Porter County Board of Commissioners adopted the Porter County Unified Development Ordinance; Ordinance No. 07-05 on Tuesday, May 1, 2007; and

WHEREAS, the Porter County Board of Commissioners has deemed it necessary to amend Chapter 7 Subdivision, Development Plan and PUD Design Standards; Section 7.28 (Storm Water Standards; General); of the Porter County Unified Development Ordinance.

NOW, THEREFORE, BE IT AND IT IS HEREBY ORDAINED THAT:

Chapter 7 Subdivision, Development Plan and PUD Design Standards; Section 7.28 (SM-01: Storm Water Standards; General) of the Porter County Unified Development Ordinance, shall be amended as follows:

7.28 SM-01: Storm Water Standards; General

This Storm Water Standards section applies to the following types of development:

A. Purpose and Intent: The purpose of this section is to establish minimum storm water management standards and controls to protect and safeguard the general health, safety and welfare of the public residing within watersheds in the County, through the following objectives to:
   1. Minimize increases in non-point source pollution caused by storm water runoff from development that might otherwise degrade local water quality;
   2. Minimize surface water runoff from specific sites during and after development to not exceed the pre-development hydrologic regime, to the maximum extent practicable;
   3. Ensure that soil erosion and sediment control facilities and storm water management facilities are properly designed, constructed, and incorporated into site development at the beginning of design and planning;
   4. Ensure that storm water management facilities are properly maintained so as to pose no threat to the public health and safety;
   5. Ensure that landowners control the volume and rate of storm water runoff originating from their property and maintain available flood storage areas so that surface and ground water quality is protected, erosion minimized, and flooding reduced;
   6. Encourage the design and construction of storm water management facilities that promote flood prevention, water quality protection, wildlife habitat preservation, and wetland protection;
   7. Reduce maintenance and remediation project costs resulting from accelerated soil erosion and sedimentation from uncontrolled storm water run off.

B. Considerations: *Section SM: Storm Water Standards* does not create any liability on the part of the County, the Plan Commission, or any elected or appointed official or employee thereof, for any damages that result from reliance on this section or any alterations required to conform to the engineering requirements established hereunder or any administrative decisions lawfully made thereunder. Any land-disturbing activity shall be accomplished in conformity with the storm water management standards.

C. Enforcement Authority: The enforcement authority for *§SM: Storm Water Standards* shall be the Plan Commission, its agents and employees. In addition, the Plan Commission may seek direction and assistance from the County Drainage Board, the County Surveyor, the County Engineer, the Natural Resources Conservation Service (NRCS) and the Indiana Department of Natural Resources (DNR).

D. Applicability: All proposals for land development submitted to the Plan Commission or Board of Zoning Appeals for approval shall provide for the collection and management of all storm and surface water drainage.

1. A Storm Water Management Plan is required for all development or land-disturbing activity, unless otherwise exempt per *§3: Exceptions.*
2. A Storm Water Management Plan shall be reviewed by the Plan Commission. The Plan Commission may delegate Storm Water Management Plan review and approval for individual Improvement Location Permits to the Executive Director.
3. *Exceptions*: *Section SM: Storm Water Standards* also applies to land-disturbing activities that are smaller than the minimum applicability criteria below, if the project site is a phase of a larger development, even if multiple separate and distinct land-disturbing activities take place at different times on different schedules. The following are exempt from a Storm Water Magagement Plan:
   a. Additions or modifications to an existing single-family dwelling;
   b. Land-disturbing activities that do not disturb more than 5,000 square feet, provided:
      i. The project site is not a phase of a larger development; and
      ii. The impervious surface coverage does not exceed 1,000 square feet;
   c. Repairs to any storm water management facility deemed necessary by the Plan Commission.
4. *Development Standards Variance*:
   a. Every applicant shall provide for storm water management as required per *§SM: Storm Water Standards* unless the Board of Zoning Appeals approves Development Standards Variances of specific requirements (see *§10.20: Development Standards Variance*).
   b. Supplemental Findings of Fact: In addition to the findings required for a Development Standards Variance per *§10.20(H)(7): Findings of Fact*, the Board of Zoning Appeals shall not approve a Development Standards Variance of any requirement, in whole or in part, of *§SM: Storm Water Standards* unless it makes findings based upon the evidence presented to it in each specific case that:
      i. Meeting the minimum on-site storm water management requirements of *§SM: Storm Water Standards* is not feasible due to the natural or existing physical characteristics of a site;
      ii. The proposed development is not likely to impair attainment of the objectives of *§SM: Storm Water Standards*, because at least one (1) of the following conditions applies:
         [a] The Plan Commission has approved and required the implementation of alternative minimum storm water management practices for the on-site management of storm water; or
         [b] The Plan Commission has approved and required the implementation of an in-place, off-site storm water management facility, which is designed and sized to provide a level of storm water control that is equal to or greater than that which would be afforded by on-site storm water management practices, and which has a legally obligated entity responsible for long-term operation and maintenance of the off-site storm water management facility; or
         [c] Other storm water management practices that are adequate to reduce the generation of storm water runoff are provided at the site; and
      iii. Provided that acceptable alternative storm water management mitigation measures are provided, the immediate downstream waterways will not be subject to:
         [a] Deterioration of existing culverts, bridges, dams and other structures;

[b] Deterioration of biological functions or habitat;
[c] Accelerated streambed or stream bank erosion or siltation; and
[d] Increased threat of flood or other damage to the public health and safety, or to downstream.

E. Permits and Procedures:
1. *Storm Water Management Plan Approval Required*: Unless specifically exempted per *§D(3): Exceptions*, no person shall receive a Building Permit, Erosion Control Permit, Improvement Location Permit, Mineral Extraction Permit, or any other permit required for land-disturbing activities without first meeting the requirements of *§SM: Storm Water Standards* prior to commencing the proposed land-disturbing activity.
2. Every development that is not exempt per *§D(3): Exceptions* shall submit the following information with the permit application form:
   a. Storm Water Management Plan (described in *§I: Storm Water Management Plan; Procedure and Approval; Contents of Plan*);
   b. Maintenance Commitment; and
   c. Nonrefundable Storm Water Management Plan review fee (this fee is based on the amount of land to be disturbed at the site; the fee structure shall be established by the Plan Commission).

F. Storm Water Design Manual:
1. *Authority*: The Plan Commission may furnish additional storm water management policies, practices, criteria and information, including storm water management specifications and staudards, for the proper implementation of the requirements of *§SM: Storm Water Standards*, in the form of a *Storm Water Design Manual*.
2. *Content*: Such Storm Water Design Manual shall include a list of acceptable storm water management practices, including specific design criteria for each storm water management facility. The *Storm Water Design Manual* may be updated and expanded from time to time, at the discretion of the Plan Commission, based on improvements in engineering, science, monitoring, and local maintenance experience. Storm water management systems that are designed and constructed in accordance with the design criteria of the *Storm Water Design Manual* will be presumed to meet the minimum requirements of *§SM: Storm Water Standards*.

G. Requirements: A storm water management system shall be provided to allow drainage of water runoff from all of the upstream drainage area and from all areas within the proposed subdivision to a place adequate to receive such runoff. Furthermore, a storm water management system shall be:
1. Designed and constructed in accordance with the *Storm Water Design Manual*.
2. Durable, easily maintained, retard sedimentation, and retard erosion. A storm water management system shall not be designed in a way that would endanger the public health and safety, or cause significant damage to property.
3. Sufficient to accept the water runoff from the site after development and the present water runoff from all areas upstream. Also, consideration shall be given to water runoff from future developments in undeveloped areas upstream which cannot reasonably be accommodated in the upstream area. The types of consideration should include, but need not be limited to, retention-detention facilities, over-sizing with fifteen-year law cost recovery, and the granting of adequate drainage easements for future construction. The type of future development shall be in accordance with the uses indicated in the Comprehensive Plan or the uses allowed by the current zoning district, whichever reflects the more intense use.
4. Design of peak discharge runoff rate shall be per the Porter County Storm Water Manual.:

5. Designed such that the low points of entry for residential, commercial and industrial structures are two (2) feet above the base flood elevation. In addition, avenues of ingress-egress shall also be above the base flood elevation.
6. Inspected during construction by a professional engineer, or a land surveyor, registered in the State, at the expense of the petitioner and certified in accordance with this section. This is in addition to the inspection provided by the County.

H. Basic Storm Water Management Design Criteria:

1. All storm water management systems shall be designed so that the specific storm frequency storage volumes (*e.g.* recharge, water quality, channel protection, storm events, *etc.*) as identified in the current *Storm Water Design Manual* are met, unless the Board of Zoning Appeals grants the applicant a Development Standards Variance, or unless the project is exempt. In addition, if the physical conditions of the site warrant greater control than the requirements of *§SM: Storm Water Standards* addresses, the Plan Commission and/or Board of Zoning Appeals reserves the right to impose conditions of approval stipulating additional storm water management mitigation measures deemed necessary to control the volume, timing and rate of runoff.
2. The storm water management practices and facilities for a site shall be chosen based on the physical conditions of the site, including the following factors:
   a. Topography;
   b. Maximum drainage area;
   c. Depth to water table;
   d. Soil types;
   e. Slopes and terrain; and
   f. Location in relation to environmentally-sensitive or other special features.
3. All storm water management systems shall be designed to convey storm water to allow for the maximum removal of pollutants, siltation, and reduction in flow velocities.
4. It is the purpose and intent of *§SM: Storm Water Standards* to require developments to have storm water system to conduct storm water to a detention or retention facility (when required), and then to an approved outfall.
5. All Storm Water Management Plans shall accommodate the runoff that enters the site from other locations in the tributary watershed. The off-site runoff may be diverted around the site or accommodated directly in the design of the on-site storm water management facilities. In no event shall off-site runoff be blocked or restricted by the proposed development. When appropriate, the pass-through runoff shall be directed through the site detention facilities to provide downstream protection. When so required, the discharge or detention facilities shall be designed to accommodate the pass-through runoff.
6. *Operation and Maintenance Agreements*: All storm water facilities shall have an enforceable Operation and Maintenance Agreement to ensure the systems function as designed. The Operation and Maintenance Agreement shall include any and all drainage easements required to access and inspect the storm water treatment facilities, and to perform routine maintenance as necessary to ensure continued proper functioning of the storm water treatment facilities. The Operation and Maintenance Agreement shall be a legally-binding covenant specifying the parties responsible for the proper maintenance of all storm water management facilities, and shall be secured as part of the approval process, or prior to issuance of any permits for land-disturbing activity.
7. *Drainage Easements*:
   a. When a subdivision or other major development is traversed by a waterway, drainage way, channel or stream, there shall be dedicated an approved drainage easement conforming substantially to such watercourse, of such width and construction to be adequate for both continued drainage purposes and maintenance of same. When possible, it is desirable that the

drainage be maintained by an open channel with landscaped banks and adequate width for maximum potential volume of flow.

b. Where topography or other conditions are such as to make impractical the inclusion of storm water management facilities within the right-of-way, then perpetual unobstructed drainage easements at least thirty (30) feet wide shall be provided across the property; said drainage easements shall extend from the right-of-way to a natural watercourse or to other storm water management facilities, and shall be indicated on the recorded Secondary Plat or in a recorded drainage easement instrument (see *§EA-01(C)(1): Drainage Easement Instrument Specifications*).

c. When a proposed storm water management system will carry water across private land either inside or outside the development, appropriate drainage easements must be secured and indicated on the Secondary Plat or recorded in a drainage easement instrument (see *§EA-01(C)(1): Drainage Easement Instrument Specifications*).

8. *Public and Private Storm Water Management Systems*: During the course of the planning and design of the storm water management facilities, it shall be determined and documented whether the storm water management system is to be public or private.

   a. Public storm water management facilities shall be maintained by the County after dedication to and acceptance by the County. Generally, public storm water management facilities shall be those in or under a public road, with road and storm water management system the responsibility of the County Highway Department, or regulated drains being the responsibility of the County Drainage Board.

   b. Private storm water management facilities shall be privately maintained. Rear yard swales, ditches that convey storm water from individual lots, or development detention facilities constructed as storm water management measures for a development shall be private storm water management systems. Provisions shall be made for the maintenance of private storm water management systems. On an individual site, the owner shall maintain the storm water management system. In a development, a property owners association, or similar entity, shall be established to provide for said maintenance.

   c. Recorded drainage easements shall be provided over all parts of public and private storm water management systems, and shall run to the public and to the County for purposes of maintaining the storm water management facilities located in the drainage easements. However, the establishment of said drainage easements shall in no manner obligate the County to maintain private storm water management systems but shall allow the County to enter and make temporary or emergency repairs to the storm water management system.

9. *Alternative Storm Water Management Mitigation Measures*: When the Board of Zoning Appeals has approved a Development Standards Variance of *§SM: Storm Water Standards*, the Board of Zoning Appeals may require that the petitioner satisfy the purposes and intent of *§SM: Storm Water Standards* by meeting one (1) or more of the alternative storm water management mitigation measures selected by the Board of Zoning Appeals. Alternative storm water management mitigation measures may include, but are not limited to the following:

   a. The purchase and donation of privately owned lands, or the grant of an open space conservation easement to be dedicated for preservation and/or reforestation. These lands should be located adjacent to an existing waterway in order to provide permanent buffer areas to protect water quality and aquatic habitat (The Plan Commission may initiate a County-sponsored rezone petition to place areas located in dedicated open space conservation easements in the WSO District);

   b. The creation of a storm water management facility or other drainage improvements on previously developed properties, public or private, that currently lack storm water management

facilities designed and constructed in accordance with the purposes and standards of *§SM: Storm Water Standards*;

c. Monetary fees-in-lieu to fund storm water management-related projects or studies, including regional wetland delineation studies, stream monitoring for water quality, stream flow monitoring, and threatened/endangered species studies;

d. An agreement for the granting of a drainage easement or dedication of land by the applicant, to be used for the construction of an off-site storm water management facility. Said agreement shall be entered into by the applicant prior to the recording of plats, or, if no record plat is required, prior to the issuance of the permit.

I. Storm Water Management Plan; Procedure and Approval; Contents of Plan:

1. *Preparer*:
   a. Three Acres or Less: For sites three (3) acres or less, Storm Water Management Plans and calculations shall be prepared by a registered professional engineer, registered land surveyor, architect, or landscape architect licensed to practice in the State of Indiana.
   b. Over Three Acres: For sites over three (3) acres in size, or with unique and/or sensitive drainage issues, Storm Water Management Plans shall be prepared, signed and sealed by a registered professional engineer or registered land surveyor.

2. *Individual One- and Two-unit Sites*: The Storm Water Management Plan may be shown on a sketch prepared by the applicant. The Storm Water Management Plan should be drawn as accurately as possible and clearly show all the storm water control measures proposed for the site. Arrows may be used to show the direction of surface flow. Location of swales, down spouts, sump pump discharges, and other storm water flow should be shown, with their direction of flow. Specific elevations may be requested by the Plan Commission.

3. *Subdivisions, Multiple-family Residential, Commercial, Industrial and PUD Sites*:
   a. Storm Water Management Plan: No application for development will be approved unless it includes a Storm Water Management Plan detailing how runoff and associated water quality impacts resulting from the development will be controlled or managed.
      i. The Storm Water Management Plan shall include sufficient information (*e.g.* maps, hydrologic calculations, *etc.*) to evaluate the environmental characteristics of the project site, the potential impacts of all proposed development of the site on the water resources, and the effectiveness and acceptability of the proposed storm water management measures.
      ii. The intent of this conceptual planning process is to initially determine the type of storm water management measures necessary for the proposed project, and to ensure adequate planning for runoff.
      iii. The following information shall be included in the Storm Water Management Plan, and is set forth on a checklist included in the Storm Water Design Manual:
         [a] Maps indicating the location of existing and proposed buildings, roads, easements, parking areas, utilities, storm water management facilities and erosion and sediment control facilities;
         [b] Maps should show proposed land use, with tabulation of the percentage of surface area to be used for various uses, pervious and impervious surface, drainage patterns, and limits of clearing and grading, along with a description of the proposed changes in natural conditions.
         [c] Sufficient engineering analysis to show that the proposed storm water management measures are capable of controlling the runoff in compliance with *§SM: Storm Water Standards*;
         [d] An inventory of the natural resources at the site and surrounding area, existing prior to the commencement of the project, and a description of the watershed and its relation to

the project site. The description should contain information including soil conditions, forest cover, topography, wetlands, and native vegetative areas on the site;

[e] A written description of the long-term provisions for maintenance;

[f] Initial drainage calculations shall be provided for the analysis of existing drainage courses, the design of any proposed drainage course, detention/retention facilities, and discharge control structures. Said calculations shall be thorough enough to allow a reasonable analysis of the expected impact by the development on the site itself as well as the properties downstream.

b. As-built Plan: Applicants are required to submit actual "As-built" Plans for any storm water management facilities or drainage easements located on-site after final construction is complete. The As-built Plan must show the final measurements compared with design specifications for all storm water management facilities and must be certified by an Indiana Professional Engineer or Indiana Professional Land Surveyor. A final inspection by the Plan Commission is required before the release of any performance sureties can occur.

c. Independent Engineer: The Plan Commission staff may have the Storm Water Management Plan reviewed by an independent registered engineer. Payment of the independent registered engineer shall be the responsibility of applicant and shall be paid in full prior to the any official hearing or decision. If payment is not made or the independent review has not been completed prior to any official hearing or decision the petition will be continued until the next Plan Commission date. If the continuation of a Plan Commission meeting is necessary, and if it requires re-notification of interested parties, the petitioner shall bare the cost of said re-notification. The fee for an independent registered engineer review shall be based on the Building, Planning and Zoning Fee Schedule.

J. Surety: The Plan Commission may require additional security or surety for installation of all storm water management facilities required under *§SM: Storm Water Standards* (see also *Chapter 10; §Surety Standards*).

K. Maintenance Easements and Covenants:

1. For those parts of a storm water management system that the County Drainage Board has not accepted as a regulated drain, and prior to the issuance of any permit that has a storm water management facility as one (1) of the requirements of the permit, the applicant or owner of the site must execute a Maintenance Easement Agreement that shall be binding on all subsequent owners of land served by the storm water management facility. The Maintenance Easement Agreement shall provide for access to the storm water management facility at reasonable times for periodic inspection by the Plan Commission, and for regular or special assessments of property owners to ensure that the storm water management facility is maintained in proper working condition to meet design standards and any other provisions established by *§SM: Storm Water Standards*. The form of the Maintenance Easement Agreement shall be approved by the Plan Commission Attorney and recorded.
2. Maintenance of all storm water management facilities shall be ensured through the creation of a formal Maintenance Covenant that includes the right of entry for inspection. This must be approved by the Plan Commission and recorded with the land prior to final plan approval.
3. In lieu of a Maintenance Covenant, the Plan Commission at its sole discretion may recommend acceptance and dedication to the County of any storm water management facility for maintenance, provided such storm water management facility meets all the requirements of *§SM: Storm Water Standards*, and includes adequate access and area, by drainage easement or otherwise, for inspection and maintenance.
4. Inspection of storm water management facilities may be done by the Plan Commission from time to time on any reasonable basis, including routine inspections, random inspections, inspections based upon complaints or other notice of possible violations, or areas identified with greater than typical

sources of sediment, contaminants or pollutants. Inspections may include, but are not limited to: review of maintenance and repair records, sampling of discharge from surface or ground water, and evaluating the condition of storm water management facilities.

This ordinance passed and adopted this 7th day of May, 2008.

PORTER COUNTY BOARD OF COMMISSIONERS

Robert P. Harper, President

John A. Evans

Carole M. Knoblock
Carole M. Knoblock

Attest: _____
James Kopp, Auditor

I affirm, under the penalties for perjury, that I have taken reasonable care to redact each social security number in this document, unless required by law.

Robert W. Thompson, Jr., AICP
Executive Director/County Planner

COPY

ORDINANCE NO. 08- 10
PORTER COUNTY BOARD OF COMMISSIONERS

UNIFIED DEVELOPMENT ORDINANCE

WHEREAS, the Porter County Board of Commissioners adopted the Porter County Unified Development Ordinance; Ordinance No. 07-05 on Tuesday, May 1, 2007; and

WHEREAS, the Porter County Board of Commissioners has deemed it necessary to amend Chapter 12 Definitions; Section 12.02 (Defined Words); of the Porter County Unified Development Ordinance.

NOW, THEREFORE, BE IT AND IT IS HEREBY ORDAINED THAT:

Chapter 12 Definitions; Section 12.02 (Defined Words) of the Porter County Unified Development Ordinance, shall be amended as follows:

Delete Definition for *Channel* as follows:

Channel: A natural or artificial watercourse with a definite bed and banks that conducts continuously or periodically flowing water.

Amend Definition for *Channel* as follows:

Channel: A portion of a natural or artificial waterway which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. It has a defined bed and bank which serve to confine the water.

This ordinance passed and adopted this 7th day of May, 2008.

PORTER COUNTY BOARD OF COMMISSIONERS

Robert P. Harper, President

John A. Evans

Carole M. Knoblock
Carole M. Knoblock

Attest: _____
James Kopp, Auditor

I affirm, under the penalties for perjury, that I have taken reasonable care to redact each social security number in this document, unless required by law.

_____
Robert W. Thompson, Jr., AICP
Executive Director/County Planner

Porter County, Indiana

Stormwater Design Manual

Porter County Plan Commission

Resolution No. 08-05

Adopted this 12th day of March 2008

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Appendices

Abbreviations

ASTM	American Society for Testing and Materials
CMP	Corrugated Metal Pipe
CN	Curve Number
DNR	Indiana Department of Natural Resources
ECP	Erosion Control Plan
ED	Wet Extended Detention
FHWA	Federal Highway Administration
HDS	Hydraulic Design Series
HDPE	High Density Polyethylene
HEC	Hydrologic Engineering Center
INDOT	Indiana Department of Transportation
LTAP	Local Technical Assistance Program
NGVD	National Geodetic Vertical Datum
NRCS	Natural Resources Conservation Service
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
SCS	Soil Conservation Service
SFHA	Special Flood Hazard Areas
SQP	Stormwater Quality Practices
TR	Technical Release
TSS	Total Suspended Solids
USGS	United States Geological Survey
WQv	Water Quality Volume

Definitions

Agricultural land disturbing activity. Tillage, planting, cultivation, or harvesting operations for the production of agricultural or nursery vegetative crops. The term also includes pasture renovation and establishment, the construction of agricultural conservation practices, and the installation and maintenance of agricultural drainage tile. For purposes of this rule, the term does not include land disturbing activities for the construction of agricultural related facilities, such as barns, buildings to house livestock, roads associated with infrastructure, agricultural waste lagoons and facilities, lakes and ponds, wetlands; and other infrastructure.

Base Flow. Stream discharge derived from groundwater sources as differentiated from surface runoff. Sometimes considered to include flows from regulated lakes or reservoirs.

Best Management Practices. Design, construction, and maintenance practices and criteria for stormwater facilities that minimize the impact of stormwater runoff rates and volumes, prevent erosion, and capture pollutants.

Buffer Strip. An existing or constructed, variable width strip of vegetated land intended to protect water quality and habitat.

Capacity (of a Storm Drainage Facility). The maximum flow that can be conveyed or volume that may be stored by a storm drainage facility without causing damage to public or private property.

Catch Basin. A chamber usually built at the curb line of a street for the admission of surface water to a storm drain or sub drain, having at its base a sediment sump designed to retain grit and detritus below the point of overflow.

Channel. A portion of a natural or artificial waterway which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. It has a defined bed and bank that serve to confine the water.

Comprehensive Stormwater Management. A comprehensive stormwater program for effective management of stormwater quantity and quality throughout the community.

Constructed Wetland. A manmade shallow pool that creates growing conditions suitable for wetland vegetation and is designed to maximize pollutant removal.

Construction activity. Land disturbing activities, and land disturbing activities associated with the construction of infrastructure and structures. This term does not include routine ditch or road maintenance or minor landscaping projects.

Construction site access. A stabilized stone surface at all points of ingress or egress to a project site, for the purpose of capturing and detaining sediment carried by tires of vehicles or other equipment entering or exiting the project site.

Contiguous. Adjoining or in actual contact with.

Contour. An imaginary line on the surface of the earth connecting points of equal elevation.

Contour Line. Line on a map which represents a contour or points of equal elevation.

Contractor or subcontractor. An individual or company hired by the project site or individual lot owner, their agent, or the individual lot operator to perform services on the project site.

Conveyance. Any structural method for transferring stormwater between at least two points. The term includes piping, ditches, swales, curbs, gutters, catch basins, channels, storm drains, rivers, streams and roadways.

Cross Section. A graph or plot of ground elevation across a stream valley or a portion of it, usually along a line perpendicular to the stream or direction of flow.

Culvert. A closed conduit without additional structures used for the conveyance of surface drainage water under a roadway, railroad, canal or other impediment.

Design Storm. A selected storm event, described in terms of the probability of occurring once within a given number of years, for which drainage or flood control improvements are designed and built.

Detention Facility or Detention Basin. A structure designed for the temporary storage of stream flow or storm runoff and gradual release of the stored water at a controlled rate. Detention facilities are a type of storm water management facility.

Detention Time. The theoretical time required to displace the contents of a tank or unit at a given rate of discharge (volume divided by rate of discharge).

Developer. Any person financially responsible for construction activity, or an owner of property who sells or leases, or offers for sale or lease, any lots in a subdivision.

Discharge. Usually the rate of water flow. A volume of fluid passing a point per unit time commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, or millions of gallons per day.

Disposal. The discharge, deposit, injection, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that the solid waste or

hazardous waste, or any constituent of the waste, may enter the environment, be emitted into the air, or be discharged into any waters, including ground waters.

Ditch. A man-made, open watercourse in or into which excess surface water or groundwater drained from land, stormwater runoff, or floodwaters is conveyed either continuously or intermittently.

Drain. A buried slotted or perforated pipe or other conduit (subsurface drain) or a ditch (open drain) for carrying off surplus groundwater or surface water.

Drainage. The removal of excess surface water or groundwater from land by means of ditches or subsurface drains. Also see Natural drainage.

Drainage Area. The area draining into a stream at a given point. It may be of different sizes for surface runoff, subsurface flow and base flow, but generally the surface runoff area is considered as the drainage area.

Drainage Easement. A legal right granted by a landowner to a grantee allowing the use of private land for storm water management purposes, and which is recorded against the property.

Dry Well. A type of infiltration practice that allows stormwater runoff to flow directly into the ground via a bored or otherwise excavated opening in the ground surface.

Duration. The time period of a rainfall event.

Environment. The sum total of all the external conditions that may act upon a living organism or community to influence its development or existence.

Erosion. The wearing away of the land surface by water, wind, ice, gravity, or other geological agents. The following terms are used to describe different types of water erosion:

- *Accelerated erosion*-- Erosion caused by development activities that exceeds the natural processes by which the surface of the land is worn away by the action of water or wind.

- *Channel erosion* --An erosion process whereby the volume and velocity of flow wears away the bed and/or banks of a well-defined channel.

- *Gully erosion* --An erosion process whereby runoff water accumulates in narrow channels and, over relatively short periods, removes the soil to considerable depths, ranging from 1-2 ft. to as much as 75-100 ft.

- *Rill erosion*--An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils (see Rill).

- *Splash erosion*--The spattering of small soil particles caused by the impact of raindrops on wet soils; the loosened and spattered particles may or may not be subsequently removed by surface runoff.

- *Sheet erosion*--The gradual removal of a fairly uniform layer of soil from the land surface by runoff water.

Erosion and sediment control. A practice, or a combination of practices, to minimize sedimentation by first reducing or eliminating erosion at the source and then as necessary, trapping sediment to prevent it from being discharged from or within a project site.

Fill Material. Any material used for primary purpose of replacing a wetland area with dry land or of changing the bottom elevation of a wetland or a waterbody. This definition shall be considered to be automatically amended to conform with the definition of fill material established from time to time by the United States of America or United States Army Corps of Engineers. Fill also includes materials used to raise the current elevation of any land area.

Filter Strip. Usually a long, relatively narrow area (usually, 20-75 feet wide) of undisturbed or planted vegetation used near disturbed or impervious surfaces to filter stormwater pollutants for the protection of watercourses, reservoirs, or adjacent properties.

Floatable. Any solid waste that will float on the surface of the water (larger than 4 mm along any single axis).

Flood (or Flood Waters). A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow, the unusual and rapid accumulation, or the runoff of surface waters from any source.

Floodplain. The channel proper and the areas adjoining the channel which have been or hereafter may be covered by the regulatory or 100-year flood. Any normally dry land area that is susceptible to being inundated by water from any natural source. The floodplain includes both the floodway and the floodway fringe districts.

Floodway. The channel of a river or stream and those portions of the floodplains adjoining the channel which are reasonably required to efficiently carry and discharge the peak flow of the regulatory flood of any river or stream.

Floodway Fringe. That portion of the flood plain lying outside the floodway, which is inundated by the regulatory flood.

Footing Drain. A drain pipe installed around the exterior of a basement wall foundation to relieve water pressure caused by high groundwater elevation.

Garbage. All putrescible animal solid, vegetable solid, and semisolid wastes resulting from the processing, handling, preparation, cooking, serving, or consumption of food or food materials.

Geographical Information System. A computer system capable of assembling, storing, manipulation, and displaying geographically referenced information. This technology can be used for resource management and development planning.

Grading. The cutting and filling of the land surface to a desired slope or elevation.

Grass. A member of the botanical family Graminae, characterized by blade-like leaves that originate as a sheath wrapped around the stem.

Groundwater. Accumulation of underground water, natural or artificial. The term does not include manmade underground storage or conveyance structures. All water below the surface of the ground.

Habitat. The environment in which the life needs of a plant or animal are supplied.

Highly Erodible Land (HEL). Land that has an erodibility index of eight or more.

Hydrologic Unit Code. A numeric United States Geologic Survey code that corresponds to a watershed area. Each area also has a text description associated with the numeric code.

Hydrology. The science of the behavior of water in the atmosphere, on the surface of the earth, and underground. A typical hydrologic study is undertaken to compute flow rates associated with specified flood events.

Illicit Discharge. Any discharge to a conveyance that is not composed entirely of stormwater except naturally occurring floatables, such as leaves or tree limbs.

Impaired Waters. Waters that do not or are not expected to meet applicable water quality standards, as included on IDEM's CWA Section 303(d) List of Impaired Waters.

Impervious surface. Surfaces, such as pavement (asphalt, concrete and gravel) and rooftops, which prevent the infiltration of stormwater into the soil.

Individual building lot. A single parcel of land within a multi-parcel development.

Individual lot operator. A contractor or subcontractor working on an individual lot.

Individual lot owner. A person who has financial control of construction activities for an individual lot.

Infiltration. Passage or movement of water into the soil. Infiltration practices include any structural BMP designed to facilitate the percolation of run-off through the soil to groundwater. Examples include infiltration basins or trenches, dry wells, and porous pavement.

Inlet. An opening into a stormwater drainage system for the entrance of surface storm water runoff, more completely described as a storm drain inlet.

Land-disturbing Activity. Any activity that changes the land surface. This may include grading, digging, cutting, scraping or excavating of soil, placement of fill materials, paving, construction or substantial removal of vegetation, any activity which bares the soil or rock or involves the diversion or piping of any natural or man-made waterway.

Land Surveyor. A person licensed under the laws of the State of Indiana to practice land surveying.

Larger common plan of development or sale. A plan, undertaken by a single project site owner or a group of project site owners acting in concert, to offer lots for sale or lease; where such land is contiguous, or is known, designated, purchased or advertised as a common unit or by a common name, such land shall be presumed as being offered for sale or lease as part of a larger common plan. The term also includes phased or other construction activity by a single entity for its own use.

Lowest Adjacent Grade. The elevation of the lowest grade adjacent (abutting) to a structure, where the soil meets the foundation around the outside of the structure (including structural members such as basement walkout, patios, decks, porches, support posts or piers, and rim of the window well).

Lowest Floor. Refers to the lowest of the following:

1. The top of the basement floor;
2. The top of the garage floor, if the garage is the lowest level of the building;
3. The top of the first floor of buildings constructed on a slab or of buildings elevated on pilings or constructed on a crawl space with permanent openings; or
4. The top of the floor level of any enclosure below an elevated building where the walls of the enclosure provide any resistance to the flow of flood waters unless:

    a] The walls are designed to automatically equalize the hydrostatic flood forces on the walls by allowing for the entry and exit of flood waters, by providing a minimum of two opening (in addition to doorways and windows) having a total area of one (1) square foot for every two (2) square feet of enclosed area subject to flooding. The bottom of all such openings shall be no higher than one (1) foot above grade.

b] Such enclosed space shall be usable only for the parking of vehicles or building access.

Maintenance Agreement. A legally recorded document that acts as a property deed restriction and which provides for long-term maintenance of storm water management facilities, structures or practices.

Manhole. Storm drain structure through which a person may enter to gain access to an underground storm drain or enclosed structure.

Measurable storm event. A precipitation event that results in a total measured precipitation accumulation equal to, or greater than, one-half (0.1) inch of rainfall.

Mulch. A natural or artificial layer of plant residue or other materials covering the land surface which conserves moisture, holds soil in place, aids in establishing plant cover, and minimizes temperature fluctuations.

Municipal Separate Storm Sewer System. An MS4 meets all the following criteria: (1) is a conveyance or system of conveyances owned by the state, county, city, town, or other public entity; (2) discharges to waters of the U.S.; (3) is designed or used for collecting or conveying stormwater; (4) is not a combined sewer; and, (5) is not part of a Publicly Owned Treatment Works (POTW).

Refueling Area. An operating gasoline or diesel fueling area whose primary function is to provide fuel to equipment or vehicles.

Regulated Drain. An open drain, a tiled drain, or a combination of the two which was established through either the Circuit Court or Commissioners Court of the County prior to January 1, 1966 or by the County Drainage Board since that time, with rights of entry, maintenance, re-construction and construction exclusive to the Drainage Board and its agents.

National Pollution Discharge Elimination System. A permit developed by the U.S. EPA through the Clean Water Act. In Indiana, the permitting process has been delegated to IDEM. This permit covers aspects of municipal stormwater quality.

Natural Drainage. The flow patterns of stormwater run-off over the land in its pre-development state.

Nutrient(s). (1) A substance necessary for the growth and reproduction of organisms. (2) In water, those substances (chiefly nitrates and phosphates) that promote growth of algae and bacteria.

Open Drain. A natural watercourse or constructed open channel that conveys drainage water.

Open Space. Any land area devoid of any disturbed or impervious surfaces created by industrial, commercial, residential, agricultural, or other manmade activities.

Outfall. The point, location, or structure where a pipe or open drain discharges.

Outlet. The point of water discharge from a stream, river, lake, tidewater, or artificial drain.

Peak Discharge (or Peak Flow). The maximum instantaneous flow from a given storm condition at a specific location.

Percolation. The movement of water through soil in a vertical direction.

Permanent stabilization. The establishment, at a uniform density of seventy percent (70%) across the disturbed area, of vegetative cover or permanent non-erosive material that will ensure the resistance of the soil to erosion, sliding, or other movement.

Pervious. Allowing movement of water.

Point Source. Any discernible, confined, and discrete conveyance including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, or container from which pollutants are or maybe discharged (P.L. 92-500, Section 502[14]).

Porous pavement. A type of infiltration practice to improve the quality and reduce the quantity of storm water run-off via the use of manmade, pervious pavement which allows run-off to percolate through the pavement and into underlying soils

Professional Engineer. A person licensed under the laws of the State of Indiana to practice professional engineering.

Project site. The entire area on which construction or land disturbing activity is to be performed.

Project site owner. The person required to submit a stormwater permit application, and required to comply with the terms of this ordinance, including a developer or a person who has financial and operational control of construction activities, and project plans and specifications, including the ability to make modifications to those plans and specifications.

Rain garden. A vegetative practice used to collect and absorb or infiltraterunoff .

Receiving Stream, Receiving Channel, or Receiving Water. The body of water into which runoff or effluent is discharged. The term does not include private drains, unnamed conveyances, retention and detention basins, or constructed wetlands used as treatment.

Recharge. Replenishment of groundwater reservoirs by infiltration and transmission from the outcrop of an aquifer or from permeable soils.

Redevelopment. Alterations of a property that change a site or building in such a way that there is disturbances of one (1) acre or more of land. The term does not include such activities as exterior remodeling.

Regulatory Flood. The discharge or elevation associated with the 100-year flood as calculated by a method and procedure which is acceptable to and accepted by the Indiana Department of Natural Resources and the Federal Emergency Management Agency. The "regulatory flood" is also known as the "base flood".

Regulatory Floodway. See Floodway.

Release Rate - The amount of storm water release from a storm water control facility per unit of time.

Reservoir. A natural or artificially created pond, lake or other space used for storage, regulation or control of water. May be either permanent or temporary. The term is also used in the hydrologic modeling of storage facilities.

Retention. The storage of stormwater to prevent it from leaving the development site. May be temporary or permanent.

Retention Facility. A retention basin or alternative structure designed for the temporary storage of stream flow or storm runoff above a normal water level determined by an outflow structure, which gradually releases the stored water at a controlled rate. Retention facilities are a type of storm water management facility.

Retention basin. A type of storage practice, that has no positive outlet, used to retain storm water run-off for an indefinite amount of time. Runoff from this type of basin is removed only by infiltration through a porous bottom or by evaporation.

Return Period - The average interval of time within which a given rainfall event will be equaled or exceeded once. A flood having a return period of 100 years has a one percent probability of being equaled or exceeded in any one year.

Riparian zone. Of, on, or pertaining to the banks of a stream, river, or pond.

Riparian habitat. A land area adjacent to a waterbody that supports animal and plant life associated with that waterbody.

Runoff. That portion of precipitation that flows from a drainage area on the land surface, in open channels, or in stormwater conveyance systems.

Runoff Coefficient - A decimal fraction relating the amount of rain which appears as runoff and reaches the stormwater drainage system to the total amount of rain falling. A coefficient of 0.5 implies that 50 percent of the rain falling on a given surface appears as storm water runoff.

Sediment. Solid material (both mineral and organic) that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface.

Sedimentation. The process that deposits soils, debris and other unconsolidated materials either on the ground surfaces or in bodies of water or watercourses.

Sensitive Water. A waterbody in need of priority protection or remediation base on its:

providing habitat for threatened or endangered species,
usage as a public water supply intake,
relevant community value,
usage for full body contact recreation,
exceptional use classification as found in 327 IAC 2-1-11(b), outstanding State resource water classification as found in 327 IAC 2-1-2(3) and 327 IAC 2-1.5-19(b).

Site. The entire area included in the legal description of the land on which land disturbing activity is to be performed.

Slope. Degree of deviation of a surface from the horizontal, measured as a numerical ratio or percent. Expressed as a ratio, the first number is commonly the horizontal distance (run) and the second is the vertical distance (rise)--e.g., 2:1. However, the preferred method for designation of slopes is to clearly identify the horizontal (H) and vertical (V) components (length (L) and Width (W) components for horizontal angles). Also note that according to international standards (Metric), the slopes are presented as the vertical or width component shown on the numerator--e.g., 1V:2H. Slope expressions in this Ordinance follow the common presentation of slopes--e.g., 2:1 with the metric presentation shown in parenthesis--e.g., (1V:2H). Slopes can also be expressed in "percents". Slopes given in percents are always expressed as (100*V/H) --e.g., a 2:1 (1V:2H) slope is a 50% slope.

Soil. The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

Soil and Water Conservation District. A public organization created under State law as a special-purpose district to develop and carry out a program of soil, water, and related resource conservation, use, and development within its boundaries. A subdivision of State government with a local governing body, established under IC 14-32.

Solid Waste. Any garbage, refuse, debris, or other discarded material.

Spill. The unexpected, unintended, abnormal, or unapproved dumping, leakage, drainage, seepage, discharge, or other loss of petroleum, hazardous substances, extremely hazardous substances, or objectionable substances. The term does not include releases to impervious surfaces when the substance does not migrate off the surface or penetrate the surface and enter the soil.

Storm Duration. The length of time a rainfall or precipitation event occurs.

Storm Event. An estimate of the expected amount of precipitation within a given period of time. For example, a 10-yr. frequency, 24-hr. duration storm event is a storm that has a 10% probability of occurring in any one year. Precipitation is measured over a 24-hr. period.

Storm Sewer. A closed conduit for conveying collected storm water, while excluding sewage and industrial wastes. Also called a storm drain.

Stormwater / Storm Water. Water resulting from rain, melting or melted snow, hail, or sleet.

Storm Water Management. The use of structural or non-structural practices that are designed to reduce storm runoff pollutant loads, discharge volumes and / or peak flow discharge rates.

Stormwater Pollution Prevention Plan. A plan developed to minimize the impact of storm water pollutants resulting from construction activities.

Stormwater Runoff. The water derived from rains falling within a tributary basin, flowing over the surface of the ground or collected in channels or conduits.

Stormwater Quality Management Plan. A comprehensive written document that addresses stormwater runoff quality.

Stormwater Quality Practice. A practice, or a combination of practices, to control or minimize pollutants associated with storm water runoff.

Stormwater Drainage System - All means, natural or man-made, used for conducting storm water to, through or from a drainage area to any of the following: conduits and appurtenant features, canals, channels, ditches, storage facilities, swales, streams, culverts, streets and pumping stations.

Strip development. A multi-lot project where building lots front on an existing road.

Subdivision. Any land that is divided or proposed to be divided into lots, whether contiguous or subject to zoning requirements, for the purpose of sale or lease as part of a larger common plan of development or sale.

Subsurface Drain. A pervious backfield trench, usually containing stone and perforated pipe, for intercepting groundwater or seepage.

Surface Runoff. Precipitation that flows onto the surfaces of roofs, streets, the ground, etc., and is not absorbed or retained by that surface but collects and runs off.

Swale. An elongated depression in the land surface that is at least seasonally wet, is usually heavily vegetated, and is normally without flowing water. Swales conduct stormwater into primary drainage channels and may provide some groundwater recharge.

Temporary Stabilization. The covering of soil to ensure its resistance to erosion, sliding, or other movement. The term includes vegetative cover, anchored mulch, or other non-erosive material applied at a uniform density of seventy percent (70%) across the disturbed area.

Tile Drain. Pipe made of perforated plastic, burned clay, concrete, or similar material, laid to a designed grade and depth, to collect and carry excess water from the soil.

Topographic Map. Graphical portrayal of the topographic features of a land area, showing both the horizontal distances between the features and their elevations above a given datum.

Topography. The representation of a portion of the earth's surface showing natural and man-made features of a give locality such as rivers, streams, ditches, lakes, roads, buildings and most importantly, variations in ground elevations for the terrain of the area.

Trained individual. An individual who is trained and experienced in the principles of storm water quality, including erosion and sediment control as may be demonstrated by state registration, professional certification, experience, or completion of coursework that enable the individual to make judgments regarding storm water control or treatment and monitoring.

Urban Drain. A drain defined as “Urban Drain” in Indiana Drainage Code.

Urbanization The development, change or improvement of any parcel of land consisting of one or more lots for residential, commercial, industrial, institutional, recreational or public utility purposes.

Vegetated swale. A type of vegetative practice used to filter stormwater runoff via a vegetated, shallow-channel conveyance.

Water Quality. A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

Water Resources. The supply of groundwater and surface water in a given area.

Waterway. A natural or man-made watercourse, creek, ditch, drain, drainage way, ravine, river, stream, wetland, or diversion having well-defined banks and a bottom in a definite direction in a course or intermittently flowing.

Waterbody. Any accumulation of water, surface, or underground, natural or artificial, excluding water features designed and designated as water pollution control facilities.

Watercourse. Any river, stream, creek, brook, branch, natural or man-made drainageway in or into which stormwater runoff or floodwaters flow either continuously or intermittently.

Watershed. The region drained by or contributing water to a specific point that could be along a stream, lake or other stormwater facilities. Watersheds are often broken down into subareas for the purpose of hydrologic modeling.

Watershed Area. All land and water within the confines of a drainage divide. See also Watershed.

Wetlands. Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. This definition shall be considered to be automatically amended to conform with the definition of a wetlands established from time to time by the United States of America or United States Army Corps of Engineers.

SECTION I - PREAMBLE

These guidelines are to be used in conjunction with the Porter County, Indiana *Storm Water Control Ordinance.* This Storm Water Design Manual may be updated by the Porter County Plan Commission from time to time as new acceptable standards and specifications are developed for controlling storm water quantity and quality in Porter County, Indiana.

SECTION II - INTRODUCTION

There are two approaches for managing storm water runoff on a development site:

1. The use of better site design practices to reduce the amount of storm water runoff and pollutants generated and/or provide for natural treatment and control of runoff; and
2. The use of structural storm water controls to provide treatment and control of storm water runoff.

This Manual focuses on site design practices that may used to achieve the required goals through the use of structural storm water controls.

The first step in addressing storm water management begins with the site planning and design process. Development projects can reduce their impact on watersheds when careful efforts are made to conserve natural areas, reduce impervious cover and better integrate storm water treatment during the design process. By implementing a combination of nonstructural approaches, collectively known as storm water better site design practices, it is possible to reduce the amount of runoff and pollutants that are generated from a site and provide on-site treatment. The goals of better site design include:

1. Managing storm water quantity and quality as close to the point of origin as possible and minimizing collection and conveyance;
2. Preventing storm water impacts rather than mitigating them;
3. Utilizing simple, nonstructural methods for storm water management that are lower cost and lower maintenance than structural controls;
4. Creating a multifunctional landscape; and
5. Using hydrology as a framework for site design.

Better site design for storm water management includes a number of site design techniques such as preserving natural features and resources, effectively laying out the site elements to reduce impact, reducing the amount of impervious surfaces, and utilizing natural features on the site for storm water management. The aim is to reduce the environmental impact while retaining and enhancing the owner/developer's purpose and vision for the site. Many of the better site design concepts can reduce the cost of infrastructure while maintaining or even increasing the value of the property. Examples of storm water better site design practices and techniques are listed below in four categories:

1. Conservation of Natural Features and Resources:
    a) Preserve Undisturbed Natural Areas;
    b) Preserve Riparian Buffers;
    c) Avoid Floodplains;
    d) Avoid Steep Slopes;
    e) Minimize Siting on Porous or Erodible Soils.

2. Lower Impact Site Design Techniques:
    a) Fit Design to Terrain;
    b) Locate Development in Less Sensitive Areas;
    c) Reduce Limits of Clearing and Grading;
    d) Utilize Open Space Development;
    e) Consider Creative Development Design.

3. Reduction of Impervious Cover:
    a) Reduce Roadway Lengths and Widths;
    b) Reduce Building Footprints;
    c) Reduce the Parking Footprint;
    d) Use Fewer or Alternative Cul-de-Sacs;
    e) Create Parking Lot Storm Water “Islands”.

4. Utilization of Natural Features for Storm Water Management:
    a) Use Buffers and Undisturbed Areas;
    b) Use Natural Drainageways Instead of Storm Sewers;
    c) Use Vegetated Swale Instead of Enclosed Conduits;
    d) Drain Rooftop Runoff to Pervious Areas.

Reduction of adverse storm water runoff impacts through the use of better site design should be the first consideration of the design engineer. Operationally, economically and aesthetically, the use of better site design practices offers significant benefits over treating and controlling runoff downstream. The reduction of runoff and pollutants using better site design can reduce the required runoff peak and volumes that need to be conveyed and controlled on a site and, therefore, the size and cost of necessary drainage infrastructure and structural storm water controls. Hence, better site design concepts can be viewed as both a water quantity and water quality management tool.

The use of storm water better site design can also have a number of other ancillary benefits including:

1. Reduced construction costs;
2. Increased property values;
3. More open space for recreation;
4. More pedestrian friendly neighborhoods;
5. Protection of sensitive forests, wetlands, waterways, waterbodies and habitats;
6. More aesthetically pleasing and naturally attractive landscape.

The following sections discuss the use of structural storm water controls, the selection process for stormwater quality practices (SQPs) and landscaping features of SQPs.

SECTION IIIa – STORM WATER MANAGEMENT PLAN SUBMITTAL REQUIREMENTS (MAJOR SUBDIVISION AND DEVELOPENT PLAN)

The following items are required to be included and submitted in their entirety as part of the Storm Water Management Plan and shall be required at the time of Preliminary Plat Submittal and Site Plan Submittal.

A. Application and Checklists

A Storm Water Management Plan Permit Application; Preliminary Plat Storm Water Management Plan Initial Review Checklist and Storm Water Management Plan Technical Review Checklist shall be completed in its entirety by the Applicant and / or their Engineer / Surveyor and submitted for review with all information listed in this Section. The application and checklists may be found in Appendix III.

The checklists may not be all-inclusive. They are to be used as a guide to the designer and reviewer. Satisfactory completion of all items on each checklist does not necessarily constitute a satisfactory review of the entire project. Additional information may be required and requested of the Applicant.

B. Preliminary Plat

A signed, sealed and dated 24”x36” paper copy of the preliminary plat or site plan shall be provided with all information listed in this Section.

C. Professional Certification

The “Professional Certification” shall be completed in its entirety and submitted for review with all information listed in this Section. The form may be found in Appendix III.

D. Report

A complete drainage report (bound with each page numbered and dated) shall be submitted for review and approval. This report shall provide:

1) A cover sheet including:
    a) Subdivision name/Project Name;
    b) Project vicinity map;
    c) Developer’s name, address, telephone, fax and email address;
    d) Engineer and / or Land Surveyor’s name, address, telephone, fax and email address;
    e) Location of project including section(s), township(s) and range(s);
    f) Professional registration seal, signature and date;
    g) Revision date.

2) An index including sections, exhibits and appendices

3) A written narrative describing the existing and proposed runoff patterns, names of receiving streams or regulated drains, existing and proposed land cover and any other features that affect the site's hydrology and hydraulic characteristics.

4) A table or tables summarizing all variables (existing and proposed conditions) used in runoff calculations for each major watershed including drainage areas, percent pervious, percent impervious, runoff curve numbers, runoff coefficients, times-of-concentration, rainfall depths, intensities.

5) A summary table or tables of the results of all calculations / computer models including existing 2 year, 10 year and 100 year runoff rates and proposed runoff and release rates for each watershed, basin and sub-basin. This table should include the proposed detention release rates as well as the basin runoff rates, normal water elevations and high water elevations.

6) A written narrative of proposed post-construction water quality systems and how they are integrated into the site design.

7) A table or tables summarizing water quality calculations by basin including water quality volumes, forebay volumes, micro-pool volumes, water quality release rates, water quality detention times, etc… for each water quality facility.

8) A summary of special conditions encountered during the design process

9) A summary of proposed construction sequencing and staging

10) An appendix entitled, "Existing Major Watershed Parameter Calculations" providing details of the calculations of:
    a) Time of concentrations;
    b) Curve numbers and / or runoff coefficients.

11) An appendix entitled, "Existing Hydrology Calculations" providing calculations or model input and output for the calculation of existing 2-year, 10-year and 100-year flow rates and water elevations for the existing major watersheds.

12) An appendix entitled, "Proposed Major Watershed Parameter Calculations" providing details of the calculations of:
    a) Time of concentrations;
    b) Curve numbers and / or runoff coefficients.

13) An appendix entitled, "Proposed Major Watershed Modeling Calculations" providing calculations and / or model input for the calculation of proposed 2-year,

10-year and 100-year flow rates and water elevations of all proposed major watersheds, detention basins and / or retention basins.

14) An appendix entitled, “Proposed Outlet Structure Calculations” providing details of the calculations of:
   a) All low flow outlet structures (orifices, weirs, etc…);
   b) All emergency spillway structures.

15) An appendix entitled, “Proposed Major Overland Flow Calculations” providing details of the calculations of all overland flow routing locations including:
   a) Drainage ditches;
   b) Side yard swales;
   c) Rear yard swales;
   d) A basin map with the routing locations from sags in roadways (100 Year flow path routes).

16) An appendix entitled, “Proposed Storm Sewer Calculations” providing details of the calculations used to size proposed storm sewers including:
   a) Structure designations;
   b) Pipe diameter, length, slope;
   c) Contributing drainage area to each structure;
   d) Composite runoff coefficient to each structure;
   e) Cumulative time of concentration to each structure;
   f) Computed 10-year flow within each pipe;
   g) Full flow capacity of each pipe;
   h) Full flow velocity of each pipe;
   i) Hydraulic grade line at each manhole for the 25-year storm event;
   j) Rim elevation at each structure.

17) An appendix entitled, “Inlet Calculations” providing details of the calculations used to locate inlets including:
   a) Documentation of equations used;
   b) Structure designations;
   c) Proposed inlet manufacturer and model number;
   d) Proposed opening area of each inlet;
   e) Contributing drainage area to each inlet;
   f) Composite runoff coefficient to each inlet;
   g) Cumulative time of concentration to each inlet;
   h) Computed 10-year flow upstream of each inlet (including contributing flow and carry over flow from upstream inlets);
   i) Computed water depth at gutter upstream of each inlet;
   j) Computed spread upstream of each inlet;
   k) Computed carry over flow at each inlet;
   l) Maximum ponding depths at sag inlets (assuming 50% clogging of the grate).

18) An appendix entitled, “Water Quality Calculations” providing details of the calculations of:
    a) Water quality volume calculations including volumes and water elevations;
    b) Water quality release rate calculations including orifice calculations and detention time;
    c) Forebay and micropool volume calculations.

19) An appendix entitled, “Construction Storm Water Pollution Prevention Plan Calculations” providing detailed calculations for every pollution prevention practice proposed as required.

20) Other appendices as required to convey the intent of the Storm Water Management Plan (e.g. culvert calculations in accordance with Federal Highway Administration procedures and / or Indiana Department of Natural Resources requirements, scour calculations for channels, etc…)

21) An 8.5” x 11” or 11” x 17” exhibit entitled, “USGS Map” depicting the location of the site on the most current USGS map.

22) An 8.5” x 11” or 11” x 17 exhibit entitled, “Soils Map” depicting the location of the site on the most current Natural Resources Conservation Soil Survey Map

23) An 8.5” x 11” or 11” x 17 exhibit entitled, “National Wetland Inventory Map” depicting the location of the site on the most current National Wetland Inventory Map.

24) An exhibit entitled, “Existing Conditions Map” shall include one or more 24” x 36” drawing(s) clearly showing the following information:
    a) North arrow;
    b) Scale including bar scale (1:50 or 1:100 scale);
    c) Existing property lines;
    d) Existing land cover (e.g. woodland, brush, row crops, etc…);
    e) Legend;
    f) One-foot contours with contour intervals that are legible;
    g) Soil types in accordance with the Soil Survey as published by the Natural Resource Conservation Service;
    h) Onsite and offsite watershed boundaries and their designations that correspond to modeling designations;
    i) Flow arrows depicting the direction of flow in streams, ditches, sewers and other drainage conveyance features;
    j) Time of concentration paths identifying sheet flow, shallow concentrated flow and channel flow components;
    k) Hydrologic parameters for each existing watershed (onsite and offsite) to include drainage area in acres, time of concentration, and runoff coefficients and / or curve numbers;
    l) Calculated release rates for each watershed;

m) Depression areas with a table depicting stage and volume on the map for each depression area, if applicable;
n) Computed 100 year water levels for all depression areas;
o) Wetland boundaries (as delineated by a professional wetland scientist), if applicable;
p) Wetland boundaries (as identified on the National Wetland Inventory Maps), if applicable;
q) Boundaries of lakes, ponds, streams, creeks and rivers including their normal and computed 100 year water levels, if applicable;
r) Storm sewers and all other drainage features, if applicable;
s) Floodplain and floodway limits and 100-year flood elevations depicted on the most current Flood Insurance Studies, if applicable.

25) An exhibit entitled, “Proposed Major Watershed Map” shall include one or more 24” x 36” drawing(s) showing the following information:
a) North arrow;
b) Scale including bar scale (1:50 or 1:100 scale);
c) Existing and proposed property lines including all proposed lots and outlots;
d) Proposed major watershed boundaries (areas proposed to be tributary to each detention or retention facility) including off-site watershed boundaries and their designations that correspond to modeling designations;
e) Proposed detention or retention basin locations and its discharge and emergency spillway locations;
f) Flow arrows depicting the direction of flow in streams, ditches, sewers and other drainage conveyance features;
g) Proposed time of concentration paths identifying sheet flow, shallow concentrated flow and channel flow components;
h) Proposed 100-year flow into each detention or retention basin;
i) Proposed release rate from each detention or retention basin;
j) Proposed low water levels and computed 100-year levels for each detention or retention basin;
k) Hydrologic parameters for each proposed watershed (onsite and offsite) to include drainage area in acres, time of concentration, and runoff coefficients and / or curve numbers.

26) An exhibit entitled, “Sub-Basin Watershed Map” shall include one or more 24” x 36” drawing(s) showing the following information:
a) North arrow;
b) Scale including bar scale (1:50 or 1:100 scale);
c) Existing and proposed property lines including all proposed lots and outlots;
d) Proposed sub-basin boundaries (areas proposed to be tributary to each storm sewer inlet) including offsite watershed boundaries;

e) Hydrologic parameters for each proposed sub-basin (onsite and offsite) to include drainage area in acres, time of concentration, and runoff coefficients and / or curve numbers;
f) Flow arrows depicting the routing of flow from one sub-basin to the next sub-basin;
g) Inlets, catch basins and manholes with their respective designation (designation to match designation used in the model);
h) Pipes with their respective diameters and flow arrows indicating the direction of flow.

27) An exhibit entitled, "Proposed Water Quality Feature Map" shall include one or more 24" x 36" drawing(s) showing the following information:
a) North arrow
b) Scale including bar scale (1:50 or 1:100 scale)
c) Existing and proposed property lines including all proposed lots and outlots
d) Location and type of water quality facility (type to be labeled in accordance with water quality features identified in this manual e.g. water quality swale, wet extended detention ponds, etc…
e) Drainage area boundaries tributary to each water quality facility including proposed area and proposed impervious percentage
f) Computed water quality volume, forebay volume, micro-pool volume for each proposed water quality feature
g) Computed water quality release rate and detention time for each proposed water quality feature

29) Other exhibits as required to properly convey the intent of the Drainage Plan.

E. Construction Plans

Construction Plans showing the following information shall be provided on 24" x 36" sheets at a scale no more than 1" = 50 feet:

1) Title sheet showing the following information:
a) Subdivision name/Project Name;
b) Project vicinity map;
c) Developer's name, address, telephone, fax and email address;
d) Engineer and / or Land Surveyor's name, address, telephone, fax and email address;
e) Location of project including section(s), township(s) and range(s);
f) Professional registration seal, signature and date;
g) Revision date ***and*** description of revisions;
h) Index of drawings;
i) A table listing all water quality structures or practices and their center point longitude and latitude.

2) An existing topographic drawing clearly showing the following information:
   a) North arrow;
   b) Scale including bar scale (1:50 or 1:100 scale);
   c) Existing property lines;
   d) Existing land cover (e.g. woodland, brush, row crops, etc…);
   e) Legend;
   f) One-foot contours with contour intervals that are legible;
   g) Spot elevations;
   h) Soil types in accordance with the Soil Survey as published by the Natural Resource Conservation Service;
   i) Depression areas with a table depicting stage and volume on the map for each depression area, if applicable;
   j) Wetland boundaries (as delineated by a professional wetland scientist), if applicable;
   k) Wetland boundaries (as identified on the most current National Wetland Inventory Maps), if applicable;
   l) Boundaries of lakes, ponds, streams, creeks and rivers including their normal water levels, if applicable;
   m) Storm sewers and culverts (diameters, rim elevations and invert elevations) and all other drainage features, if applicable;
   n) Floodplain and floodway limits and 100-year flood elevations depicted on the Flood Insurance Studies, if applicable;
   o) All other requirements as set forth by Porter County;
   p) Bench mark information (NAVD88) as required by Porter County.

3) Preliminary Plat showing the following information:
   a) Proposed drainage easements and their widths;
   b) All other requirements as set forth by Porter County.

4) Plan and profile drawings showing the following information related to storm sewers and ditches:
   a) Edge of pavement on the plan view;
   b) Curb and gutter on the plan view;
   c) Sidewalk on the plan view;
   d) Lots and lot numbers on the plan view;
   e) Easements and their dimensioned width on the plan view;
   f) Storm, sanitary and water utilities on the plan view;
   g) Structure numbers (corresponding to calculations), rim elevations and invert elevations on the plan view;
   h) Pipe diameters, materials and flow direction arrows on the plan view;
   i) Flow arrows depicting surface flow along roadways and through lots on the plan view;
   j) Profile grades of existing ground, proposed roadway centerline and proposed roadside ditch centerlines on the profile view;
   k) Pipe inverts, diameters, and slopes on the profile view.

5) Proposed Grading Plan drawing showing:
   a) Edge of pavement, curb and gutter, sidewalk;
   b) Lots and lot numbers;
   c) Conceptual building pads and driveways;
   d) Existing contours (light pen weight) with legible labels;
   e) Proposed contours with legible labels;
   f) Top of foundation grade elevations for each building pad;
   g) Minimum opening elevations (window wells, walk out basements);
   h) Proposed lowest adjacent grades at the four corners of the building pad;
   i) Proposed driveway slopes;
   j) Proposed finish grade spot elevations at the four corners of the lot and intermediate points as necessary to indicate high or low points;
   k) Flow arrows indicating the direction of proposed flow across each lot, side yards and rear yards;
   l) Flow arrows indicating the direction of flow along streets;
   m) Major flow arrows indicating routing of overland flow from sag points to the detention basin (major flow arrows shall be distinguishable from other flow arrows);
   n) Proposed storm sewers (light pen weight) including flow arrows and manhole, catch basin or inlet number.

6) One plan view for and section view for each detention / retention / water quality basin (plan view and section view on the same sheet) showing:
   a) Existing contours (light pen weight) with legible labels;
   b) Proposed contours for detention, retention and water quality basins with legible labels;
   c) Proposed side slopes on the plan view;
   d) Location of low flow and emergency spillway outlet structures, and inlet pipes (diameters and inverts) on the plan view;
   e) Normal water pool and 100-year water elevation on the plan view;
   f) Typical section of each detention / retention basin showing side slopes, safety ledges, top of berm elevations, existing ground profile across section, emergency overflow elevation, 100-year water surface elevation, water quality elevation and normal pool elevation, outlet structure elevations and sizes;
   g) Typical sections of each emergency spillway.

7) Detail sheets including the following information:
   a) Pipe materials, backfill and bedding details (including details for backfill and bedding requirements beneath and within five feet of roads);
   b) Manhole, catch basin, inlet details including a table of proposed castings for each structure;
   c) Outlet structures for detention or retention basins;
   d) Other water quality details (e.g. filter strips, vegetated swales, etc…);
   e) Other special stormwater management structures;
   f) Cross-sections for each swale, ditch, SQP, pond, etc…

8) Erosion control plans and details including the following information:
   a) Edge of pavements, curb and gutter and sidewalk;
   b) Lots and lot numbers;
   c) Proposed contours;
   d) Location of designated areas for stockpiles and construction entrances;
   e) Proposed storm sewer structures and pipes (light pen weight);
   f) Locations of all proposed erosion control features as required by Indiana Administrative Code and the Indiana Handbook for Erosion Control in Developing Areas;
   g) Details of erosion control practices as required by the site.

F. Geotechnical Report

A geotechnical report shall be provided that identifies ground water levels at all detention / retention and water quality feature sites. In-situ soil permeability shall be obtained and provided at each location where the retention and / or water quality facilities will rely on infiltration.

G. Operation and Maintenance Plan

An Operation and Maintenance (O&M) Manual shall be provided for each SQP. The O&M Manual shall be separately bound from the drainage design report and shall include:

1) Owner Name;
2) Owner Address;
3) Owner Phone number;
4) Description of the SQP, inspection procedures (both graphically and with text), etc.;
5) Inspection schedule;
6) Inspection checklist;
7) Site diagram with all SQPs delineated and identified;
8) Responsible Party.

The O&M manual shall be a standalone document that can be taken into the field in the future.

SECTION IIIb – STORM WATER MANAGEMENT PLAN SUBMITTAL REQUIREMENTS (MINOR AND ADMINISTRATIVE SUBDIVISIONS)

The following are the minimum submittal requirements for a administrative or minor subdivision drainage plan. The County will conduct a review of existing known problems in the vicinity of the proposed project and may, depending upon the nature and severity of the problems identified, require additional information from the applicant. Sources used during the County's investigation may include, but not be limited to: existing geographic information systems data; existing and new questionnaire data from the County's comprehensive drainage plan; and/or input from the County Plan Commission, County Surveyor's Office, County Planning Office, County Highway Department Office, and or the County Health Department Office.

A. Application and Checklists

Information supplied shall be the same as information provided for Major Subdivisions. Not applicable items should be noted as such with an explanation.

B. Preliminary Plat

Information supplied shall be the same as information provided for Major Subdivisions.

C. Professional Certification

Information supplied shall be the same as information provided for Major Subdivisions.

D. Report

A typewritten report shall be provided describing proposed construction activity (e.g. single family home with garage, driveway, septic field, grading, lot sizes) including an estimate of the disturbed area, and existing and proposed impervious area. The report shall also include a description of existing and proposed drainage conditions, soil types, wetlands (if present), etc. The report shall be bound and shall contain the following minimum information in appendices:

1) Overall Watershed Mapping – An overall watershed map shall be provided that shows the site in relation to its surrounding watershed. County LIDAR data shall be used as the base for this data. All areas with drainage to or through the site shall be delineated and drainage areas with acreage properly noted on the drawing.
2) Pre-developed and post-developed runoff rate calculations for each existing watershed outlet point from the site shall be provided. Calculations shall be provided in accordance with methodology outlined in this manual. Existing and proposed runoff

rates and percentage of decrease shall also be listed in a separate table as cfs/acre for comparison purposes.

3) Detention Calculations, as required by Section VI of the Stormwater Design Manual.
4) Outlet Documentation – The report shall provide documentation identifying that an adequate waterway exists to receive runoff from the site. Calculations may be required as part of this information.
5) Professional Certification - The professional certification form shall be completed and submitted in its entirety. A copy of this form is found in this manual.
6) Highway Department Letter of Approval - A letter from the Highway Department approving the proposed size of the driveway culverts shall be provided.

E. Construction Plans

Construction plans providing the following minimum information shall be provided:

1) Topographic data – Provide surveyed 1-foot contour and topographic data on NAVD 88 datum. Contour data shall be provided for a 50-foot buffer around the boundaries of the property being developed. County LIDAR data can be used to provide this buffer area. This information shall be provided at a scale not to exceed 1:100 and shall be legible.
2) Special Flood Hazards – The boundary and elevation of the special flood hazard shall be identified in conformance with FEMA maps, if applicable.
3) Grading – A grading plan shall be provided that at a minimum shows:
   a. Elevations of all structures; top of foundation grade elevation for each building pad; minimum opening elevations (window wells, walkout basements); proposed lowest adjacent grades at the four corners of the lots and intermediate points as necessary to indicate high or low points; flow arrows indicating the direction of proposed flow across each lot; side yards and rear yards; major flow arrows indicating routing of overland flow from sag points to the detention basin or other drainage facilities;
   b. Confirmation that off-site drainage will not be obstructed; and
   c. Improvements on the proposed site will not increase runoff onto adjacent sites.
4) Elevations – For all structures located in Special Flood Hazard Areas as shown on FEMA maps, the lowest floor elevations of all buildings shall be shown as a minimum of 2-feet above the 100-year flood elevation.
5) Detention Basins and Water Quality Features – If these facilities are required, plans shall be provided in accordance with the requirements for a major subdivision.
6) Driveway Culverts – Culvert location, diameter, and invert elevations shall be shown on the plans that are approved by the Porter County Highway Department.

7) Easements – In accordance with requirements outlined in the County's current Storm Water Design Manual, easements shall be provided to pass off-site stormwater through the property to be developed.

8) Sediment and Erosion Control Details – The plans shall show individual lot erosion and sediment control details. Minimum details to be provided include: silt fence installation detail and temporary construction entrance detail. Silt fence and temporary construction entrance shall be depicted on the plans.

F. Geotechnical Report

If detention/retention basins or water quality features are required, a geotechnical report meeting the requirements of the major subdivision submittal shall be provided.

G. Operation and Maintenance Plan

If water quality features are required, an operation and maintenance plan meeting the requirements of the major subdivision submittal shall be provided.

SECTION IIIc – STORM WATER MANAGEMENT PLAN SUBMITTAL REQUIREMENTS (ADMINISTRATIVE REVIEWS AND ADDITIONS LESS THAN 25,000 SFT)

The following are the minimum submittal requirements for a site expansion drainage plan. The County will conduct a review of existing known problems in the vicinity of the proposed project and may, depending upon the nature and severity of the problems identified, require additional information from the applicant. Sources used during the County's investigation may include, but not be limited to: existing geographic information systems data; existing and new questionnaire data from the County's comprehensive drainage plan; and/or input from the County Plan Commission, County Surveyor's Office, County Planning Office, County Highway Department Office, and or the County Health Department Office.

A. Application and Checklists

Information supplied shall be the same as information provided for Major Subdivisions. Not applicable items should be noted as such with an explanation.

B. Site Plan

Information supplied shall be the same as information provided for Major Subdivisions.

C. Professional Certification

Information supplied shall be the same as information provided for Major Subdivisions.

D. Report

A typewritten report shall be provided describing proposed construction activity (e.g. building expansion, parking expansion, lot sizes) including an estimate of the disturbed area, and existing and proposed impervious area. The report shall also include a description of existing and proposed drainage conditions, soil types, wetlands (if present), etc. The report shall be bound and shall contain the following minimum information in appendices:

1) Overall Watershed Mapping – An overall watershed map shall be provided that shows the site in relation to its surrounding watershed. County LIDAR data shall be used as the base for this data. All areas drainage to or through the site shall be delineated and drainage areas with acreage properly noted on the drawing.
2) Pre-developed and post-developed runoff rate calculations for each existing watershed outlet point from the site shall be provided. Calculations shall be provided in accordance with methodology outlined in this manual. Existing and proposed runoff

rates and percent decrease shall also be listed in a separate table as cfs/acre for comparison purposes.

3) Detention Calculations, as required by Section VI of the Stormwater Design Manual.
4) Outlet Documentation – The report shall provide documentation identifying that an adequate waterway exists to receive runoff from the site. Calculations may be required as part of this information.
5) Other Drainage Calculations – The report shall provide documentation and calculations for storm sewers, ditches, swales, and overland flow paths.
6) Professional Certification - The professional certification form shall be completed and submitted in its entirety. A copy of this form is found in this manual.
7) Highway Department Letter of Approval - A letter from the Highway Department approving the proposed size of the driveway culverts shall be provided.
8) Water Quality – Calculations in accordance with other sections in this manual shall be provided. Water quality may be limited to the increased impervious areas.

E. Construction Plans

Construction plans providing the following minimum information shall be provided:

1) Topographic data – Provide surveyed 1-foot contour and topographic data on NAVD 88 datum. Contour data shall be provided for a 50-foot buffer around the boundaries of the property being developed. County LIDAR data can be used to provide this buffer area. This information shall be provided at a scale not to exceed 1:100 and shall be legible. The topographic survey shall provide as-built information regarding the existing storm sewer system and detention pond (including outlet structures, contours, high water elevations).
2) Special Flood Hazards – The boundary and elevation of the special flood hazard shall be identified in conformance with FEMA maps, if applicable.
3) Grading – A grading plan shall be provided that at a minimum shows:
    a. Elevations of all structures; top of foundation grade elevation for each building pad; minimum opening elevations (window wells, walkout basements); proposed lowest adjacent grades at the four corners of the lots and intermediate points as necessary to indicate high or low points; flow arrows indicating the direction of proposed flow across each lot; side yards and rear yards; major flow arrows indicating routing of overland flow from sag points to the detention basin or other drainage facilities;
    b. Confirmation that off-site drainage will not be obstructed; and
    c. Improvements on the proposed site will not increase runoff onto adjacent sites.

4) Elevations – For all structures located in Special Flood Hazard Areas as shown on FEMA maps, the lowest floor elevations of all buildings shall be shown as a minimum of 2-feet above the 100-year flood elevation.
5) Detention Basins and Water Quality Features – If these facilities are required, plans shall be provided in accordance with the requirements for a major subdivision.
6) Other Drainage Features – Plans shall provide diameters, inverts, dimensions, rim elevations of all drainage features required for the construction of the project.
7) Driveway Culverts – Culvert location, diameter, and invert elevations shall be shown on the plans that are approved by the Porter County Highway Department.
8) Easements – In accordance with requirements outlined in the County's current Storm Water Design Manual, easements shall be provided to pass off-site stormwater through the property to be developed.
9) Sediment and Erosion Control Details – The plans shall show individual lot erosion and sediment control details. Minimum details to be provided include: silt fence installation detail and temporary construction entrance detail. Silt fence and temporary construction entrance shall be depicted on the plans.

F. Geotechnical Report

If detention/retention basins or water quality features are required, a geotechnical report meeting the requirements of the major subdivision submittal shall be provided.

G. Operation and Maintenance Plan

If water quality features are required, an operation and maintenance plan meeting the requirements of the major subdivision submittal shall be provided.

SECTION IV – SUBMITTAL AND REVIEW PROCEDURES

A. Preliminary Plat Storm Water Management Plan Review Process

A comprehensive stormwater management plan review will be conducted prior to Preliminary Plat approval. Detailed design and calculations must be submitted at the time of Preliminary Plat submission for review and approval. Initial Storm Water Management Plan Review and Detailed Drainage reviews of the material outlined in Section III will be provided in accordance with the following:

1) Initial Drainage Review

An initial drainage review will be conducted of the Storm Water Management Plan submittal at the time of preliminary plat. The review will identify whether all of the required information outlined in Section III of this Manual has been provided in the format required by Section III of this manual. The review will result in one of the following actions: satisfactory or unsatisfactory.

Should the initial drainage review find the information contained in the Storm Water Management Plan submittal satisfactory, a detailed drainage plan review will be conducted of the technical information contained within it. Should the initial drainage review find the information contained in the Storm Water Management Plan to be unsatisfactory, a letter will be issued to the developer and its engineer identifying those areas found to be unsatisfactory.

A resulting unsatisfactory review will result in the Developer's complete re-submittal of all items to the Plan Commission. The re-submittal will result in another initial drainage review. Re-submittals may result in an increase in review fees assessed by the County to the Developer per the Ordinance.

2) Detailed Storm Water Management Plan Review

The detailed storm water management plan review will result in one of two actions: satisfactory or unsatisfactory. Should the detailed plan review find the storm water management plan to be satisfactory, a letter will be issued to the Developer that the plan appears to conform to Porter County's ordinance. Should the detailed review result in an unsatisfactory status, a letter will be issued to the developer and its engineer identifying those areas found to be unsatisfactory. Re-submittals may result in an increase in review fees assessed by the County to the Developer per the Ordinance.

B. Final Plat Approval Storm Water Management Plan Review Process

All design issues with respect to drainage are expected to be resolved during the Preliminary Plat review process. As part of the Final Plat Storm Water Management Plan Review Process, the applicant is required to submit the following items:

1) Checklist for Final Plats (Appendix IV-1)
2) Executed Flooding Easements, as required (Appendix IV-2)
3) Soil Erosion and Sediment Control Permit
4) All other regulatory approvals (Indiana Department of Environmental Management, Indiana Department of Natural Resources, Army Corps of Engineers, etc…), as required

C. Project Completion

After the completion of construction and prior to the release of the performance bond related to drainage items, the Developer shall submit a fully executed "Porter County Plan Commission Drainage and Stormwater Management Permit Certification of Completion and Compliance," as-built plans and other information required by Porter County. The certification may be found in Appendix IV-3.

Permanent vegetation must be established for all drainage facilities and temporary vegetation must be established for all other locations including pervious areas in the street right-of-ways.

SECTION V – RUNOFF DETERMINATION

This Section describes approved methods for the determination of runoff for storage, conveyance and water quality computations.

A. Design Rainfall

1) Rainfall Intensity and Depths

a) Rainfall intensities and depths utilized in the design and analysis of stormwater management systems shall conform to the values in the following tables:

Table V-1
Rainfall Intensities for Various Return Period and Storm Duration

Source: "Rainfall Frequency Atlas of the Midwest," by Floyd A. Huff and James R. Angel, 1992

Duration	2	5	10	25	50	100
5 min	4.20	5.16	6.12	7.56	8.76	10.20
10 min	3.66	4.56	5.34	6.60	7.68	9.00
15 min	3.12	3.88	4.56	5.64	6.60	7.68
20 min	2.63	3.28	3.84	4.75	5.56	6.47
30 min	2.14	2.68	3.12	3.86	4.52	5.26
40 min	1.75	2.19	2.55	3.16	3.70	4.31
50 min	1.52	1.90	2.21	2.73	3.20	3.73
1 hr	1.36	1.70	1.98	2.45	2.87	3.35
2 hr	0.84	1.05	1.23	1.52	1.77	2.07
3 hr	0.62	0.77	0.90	1.11	1.30	1.52
6 hr	0.36	0.45	0.53	0.65	0.76	0.89
12 hr	0.21	0.26	0.31	0.38	0.44	0.52
24 hr	0.12	0.15	0.18	0.22	0.25	0.30

Table V-2
Rainfall Depths for Various Return Period and Storm Duration

Source: "Rainfall Frequency Atlas of the Midwest," by Floyd A. Huff and James R. Angel, 1992

Duration	2	5	10	25	50	100
5 min	0.35	0.43	0.51	0.63	0.73	0.85
10 min	0.61	0.76	0.89	1.10	1.28	1.50
15 min	0.78	0.97	1.14	1.41	1.65	1.92
20 min	0.88	1.09	1.28	1.58	1.85	2.16
30 min	1.07	1.34	1.56	1.93	2.26	2.63
40 min	1.17	1.46	1.70	2.10	2.46	2.87
50 min	1.26	1.58	1.84	2.28	2.67	3.11
1 hr	1.36	1.70	1.98	2.45	2.87	3.35
2 hr	1.68	2.09	2.45	3.03	3.54	4.13
3 hr	1.85	2.31	2.70	3.34	3.90	4.56
6 hr	2.17	2.71	3.16	3.91	4.57	5.34
12 hr	2.51	3.14	3.67	4.54	5.31	6.19
24 hr	2.89	3.61	4.22	5.22	6.10	7.12

B. Approved Methods to Determine Runoff

Runoff quantities shall be computed for the area of the parcel under development plus the area of the watershed flowing into the parcel (i.e. offsite areas) under the existing or future development conditions. Runoff rates, volumes and hydrographs shall be computed according to one of the following methods:

1) Rational Method

For areas up to and including 5 acres within well-defined watersheds and with no existing depressional storage, the Rational Method may be used in accordance with the equation:

$$Q = C\,I\,A$$

Where:
- Q = Peak Discharge (cfs)
- C = Runoff Coefficient
- I = Rainfall Intensity (in/hr)
- A = Contributing Drainage Area (acres)

The intensity should correspond to the time of concentration (Tc). The time of concentration shall be calculated using the NRCS TR-55 methodology.

Runoff coefficients shall be computed in accordance with the following tables:

Table V-3
Urban Runoff Coefficients

Type of Surface	Runoff Coefficient "C"
Asphalt	0.82
Concrete	0.85
Roof	0.85
Lawns (Sandy)	
Flat (0-2% Slope)	0.07
Rolling (2-7% Slope)	0.12
Steep (>7% Slope)	0.17
Lawns (Clay)	
Flat (0-2% Slope)	0.16
Rolling (2-7% Slope)	0.21
Steep (>7% Slope)	0.30

Table V-4
Rural Runoff Coefficients

Type of Surface	Runoff Coefficient "C"
Woodland (Sandy)	
Flat (0-5% Slope)	0.10
Rolling (5-10% Slope)	0.25
Steep (> 10% Slope)	0.30
Woodland (Clay)	
Flat (0-5% Slope)	0.30
Rolling (5-10% Slope)	0.35
Steep (> 10% Slope)	0.50
Pasture (Sandy)	
Flat (0-5% Slope)	0.10
Rolling (5-10% Slope)	0.16
Steep (> 10% Slope)	0.22
Pasture (Clay)	
Flat (0-5% Slope)	0.30
Rolling (5-10% Slope)	0.36
Steep (> 10% Slope)	0.42
Cultivated (Sandy)	
Flat (0-5% Slope)	0.30
Rolling (5-10% Slope)	0.40
Steep (> 10% Slope)	0.52
Cultivated (Clay)	
Flat (0-5% Slope)	0.50
Rolling (5-10% Slope)	0.60
Steep (> 10% Slope)	0.72

Table V-5
Runoff Coefficients "C" by Land Use

Land Use	Runoff Coefficients		
	Flat (1)	Rolling (2)	Steep (3)
Commercial (CBD)	0.75	0.83	0.91
Commercial (Neighborhood)	0.54	0.60	0.66
Industrial	0.63	0.70	0.77
Garden Apartments	0.54	0.60	0.66
Churches	0.54	0.60	0.66
Schools	0.31	0.35	0.39
Semi-Detached Residential	0.45	0.50	0.55
Detached Residential	0.40	0.45	0.50
Quarter Acre Lots	0.36	0.40	0.44
Half Acre Lots	0.31	0.35	0.39
Detention Basins, Wetlands, Ponds, Lakes	1.00		
Parkland	0.18	0.20	0.22

1. Flat terrain - 0-2% slopes
2. Rolling terrain – 2-7% slopes
3. Steep terrain - > 7% slopes

Note: The runoff coefficients for the project area should be calculated based on the actual surface types proposed. Generalized runoff coefficients such as a commercial or industrial runoff coefficient should only be applied to offsite areas where detailed knowledge of surface types is not readily available.

2) Hydrograph Methods

Hydrograph methods of determining runoff and routing of storm water shall be used to determine runoff rates and the storage volume required to control storm water runoff for watersheds greater than five (5) acres and / or all watersheds with depressional storage. TR-20 computer models or equivalent methods are accepted for use in analysis of the runoff and routing of storm water. Other procedures or methods such as computer programs may be used with prior approval of the plan commission.

An antecedent moisture condition of 2, reflective of normal soil moisture, shall be used with the curve number hydrologic method. Curve numbers and time of concentrations shall be computed in accordance with methods prescribed by the NRCS. Table V-6 provides typical curve number values that are to be used.

All hydrograph methods shall use the appropriate Huff, 50% rainfall distribution with the rainfall depth in Table V-2. The Huff, 50% rainfall distributions are given in Table V-7. Hydrographs shall include the 0.5-, 1-, 2-, 3-, 6-, 12- and 24-hr duration storm events.

The time of concentration shall be calculated using the NRCS TR-55 methodology.

Table V-6
Typical Land Use and Hydrologic Soil Group

Land Use Description	Hydrologic Soil Group			
	A	B	C	D
Cultivated land[1]: Without conservation treatment	72	81	88	91
With conservation treatment	62	71	78	81
Pasture or range land: Poor condition	68	79	86	89
Good condition	39	61	74	80
Meadow: Good Condition	30	58	71	78
Wood or forest land: Thin stand, poor cover, no mulch	45	66	77	83
Good cover[2]	25	55	70	77
Open Spaces, lawns, parks, golf courses, cemeteries, etc.				
Good condition: Grass cover on 75% or more of the area	39	61	74	80
Fair condition: Grass cover on 50% to 75 % of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious)	81	88	91	93
Residential:[3] (house + drive + lawn)				
Average lot size / Average % Impervious[4]				
1/8 acre or less / 65	77	85	90	92
1/4 acre / 38	61	75	83	87
1/3 acre / 30	57	72	81	86
3/4 acre / 25	54	70	80	85
1 acre and larger / 20	51	68	79	84
Detention basins, wetlands, ponds and lakes	98			
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads				
Paved with curbs and storm sewers	98	98	98	98
Gravel	76	85	89	91
Dirt	72	82	87	89

[1] For a more detailed agricultural land use curve numbers, refer to *National Engineering Handbook,* Section 4, Hydrology, Chapter 9, August 1972.

[2] Good cover is protected from grazing and litter and brush cover soil

[3] Curve numbers are computed assuming the runoff from the house and driveway.

[4] The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

Source: Soil Conservation Service, 1986.

Note: The curve numbers for the project area should be calculated based on the actual surface types proposed. Generalized curve numbers such as commercial or industrial curve numbers should only be applied to off-site areas where detailed knowledge of surface types is not readily available.

Table V-7 - Huff Ordinates				
% Storm Time	Huff Quartile (South Bend)			
	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
0	0.00	0.00	0.00	0.00
10	20.00	7.50	7.00	8.26
20	40.80	18.57	13.33	16.35
30	51.67	34.00	20.00	22.73
40	60.89	51.43	27.50	28.50
50	67.35	66.67	39.13	34.04
60	75.10	75.17	58.46	40.20
70	80.83	82.32	75.98	50.00
80	86.67	88.89	86.79	67.50
90	92.89	94.78	94.17	87.50
100	100.00	100.00	100.00	100.00

SECTION VI – MAJOR DRAINAGE SYSTEM; ROUTING PATH; DETENTION AND RETENTION

This Section identifies design requirements and considerations required for the design of a major drainage system for all developments including allowable release rates, downstream facilities, management of off-site runoff, compensatory storage, overland flow and grading requirements and detention and retention volume determination.

A. Allowable Release Rate

Stormwater detention shall be required as follows:

TABLE VI-1
Post-Development Peak Runoff Rate Requirements

Description	Major Subdivision and Development Plan	Minor and Administrative Subdivision	Administrative Reviews and Additions Less than 25,000 SF
Undetained peak post-developed runoff rates are greater than current conditions peak runoff rates.	More Restrictive of Condition A, B, or C	More Restrictive of Condition C or D	C, E, or F As Determined by the Executive Director or Stormwater Engineer
Project is upstream of a drainage problem area as identified by the County.	More Restrictive of Condition A, B, or C	More Restrictive of Condition C or E	C, E, or F As Determined by the Executive Director or Stormwater Engineer
Private infrastructure becomes public infrastructure.	Not applicable	More Restrictive of Condition A, B, or C	Not Applicable

Conditions are defined as follows:

A) County-wide release rate as defined in Section VI.A of the Stormwater Design Manual.
B) Special watershed release rate as defined by County ordinance, where applicable.
C) Available capacity of receiving waterway as defined by approved drainage calculations.
D) Current condition peak runoff rate as defined by approved drainage calculations. For existing conditions with detention basins, modeling shall be provided and include as-built information of the basin grading and outlet structure(s).
E) 20% less than the current condition peak runoff rate. If unable to attain 20% reduction of current peak runoff rate, DRC may approve a lower percentage if supported by an engineering report stating the compelling reasons benchmark was unable to be achieved.
F) The proposed disturbed area (DA) multiplied by the applicable release rate (RR) plus the current condition peak runoff rate from the remainder of the site (CCPR). DA x RR + CCPR in cubic feet per second.

1) Watersheds without Depressional Storage

a) The flood control volume shall be sized to detain the 100-year rainfall event from the entire contributing area with a maximum developed release rate of 0.13 cfs / acre or applicable special watershed release rate. For sites where the pre-developed area has more than one outlet, the release rate at each outlet shall be calculated using the pre-developed drainage area at that outlet point. The computed release rate for each outlet point shall not be exceeded at the respective outlet point even if the post developed condition would involve a different arrangement of outlet points.

2) Watersheds with Depressional Storage

a) The allowable release rate will be the less of either of the following: 0.13 cfs / acre (or applicable watershed release rate) of watershed, or the modeled runoff rate in which the model accounts for the depressional storage. The model should account for the depressional storage by treating the depressional storage as a pond whose outlet is a weir at an elevation that stormwater overflows the depressional storage area in the existing conditions. For modeling purposes, the initial state of the depressional storage area shall be dry or a legally established water level.

b) Existing wetlands shall not be utilized for the purposes of post-development stormwater storage.

B. Downstream / Receiving Facilities

1) Inadequate Downstream System

a) In the event the downstream receiving channel or storm sewer system is inadequate to accommodate the post-developed release rate provided above, then the allowable release rate shall be reduced to that rate permitted by the capacity of the receiving downstream channel or storm sewer system. Additional detention, as determined by the Porter County Drainage Board and/or Porter County Surveyor and/or Porter County Engineer, shall be required to store that portion of the runoff exceeding the capacity of the receiving sewers or waterways. When such downstream restrictions are suspected, Porter County may require additional analysis to determine the receiving system's limiting downstream capacity.

b) If the proposed development accounts for only a portion of the undeveloped watershed upstream of the limiting restriction, the allowable release rate for the development shall be in direct proportion to the ratio of its drainage area to the drainage area of the entire watershed upstream of the restriction.

2) Certification of Adequate Outlet

a) A licensed professional engineer or surveyor shall provide certification that an adequate outlet is available. The certification form is provided in Appendix III.

3) Discharge to Field Tiles

a) Discharge of stormwater to existing field tiles is prohibited.

4) Tail Water of Receiving Streams and Water Bodies

a) The 100-year tail water elevation of the receiving stream or water body shall be taken into consideration during the calculations for the purposes of the starting hydraulic grade line elevation.

b) Detention storage below the 100-year tail water elevation may not be counted as part of the required detention volume.

C. Management of Off-Site Runoff

At least one waterway opening shall be provided for each watershed at the upstream edge of the parcel to accept upstream drainage. Additional openings should be provided as necessary to prevent any increase in water elevation on adjacent properties. Runoff from upstream tributary areas (off-site land areas) may be bypassed around the detention / retention facility without attenuation. Such runoff may also be bypassed through the detention / retention facility without attenuation, provided that a separate outlet system or channel is incorporated for the safe passage of flows, i.e., not through the primary outlet of the detention / retention facility. Unless the facility is being designed as a regional detention facility, the primary outlet structure shall be sized and the invert elevation of the overflow weir determined according to the on-site runoff only. Once the size and location of the primary outlet structure and the invert elevation of the overflow weir are determined by considering on-site runoff only, the 100-year facility elevation is determined by routing the entire inflow, on-site and off-site through the facility.

Additional detention (above and beyond that required for on-site area) may be required by Porter County when the ratio of off-site area to on-site area is larger than a 5:1 ratio.

D. Compensatory Storage

Floodplains exist adjacent to all natural and man-made streams, regardless of contributing drainage area or whether they have been previously identified or mapped. Due to potential impacts of floodplain loss on peak flows in streams and on the environment, disturbance to floodplains should be avoided. When the avoidance of floodplain disturbance is not practical, the natural functions of floodplain should be preserved to the extent possible.

Compensatory excavation equivalent to the floodplain storage lost shall be required for all activities within floodplain of streams located in Porter County where drainage area of the stream is equal or larger than one square mile. This requirement shall be considered to be above and beyond the minimum requirements provided in the applicable flood hazard areas ordinance currently in effect in Porter County. Porter County may alter the compensation ratio, based on extenuating circumstances, for a specific project.

Note that by definition, compensatory storage is the replacement of the existing floodplain and, in rare exceptions, the floodway storage lost due to fill. Compensatory storage is required when a portion of the floodplain is filled, occupied by a structure, or when as a result of a project a change in the channel hydraulics occurs that reduces the existing available floodplain storage. The compensatory storage should be located adjacent or opposite the placement of the fill and maintain an unimpeded connection to an adjoining floodplain area.

Computations must show no net loss of floodplain storage for 2-year, 10-year, 50-year, and 100-year storm events. That is, the post-development 2-year floodplain storage along a stream shall be the same as 2-year pre-development floodplain storage along the stream within the property limits, the post-development 10-year floodplain storage along a stream shall be the same as 10-year pre-development floodplain storage along the stream within the property limits, and so on.

Calculations for floodplain volume shall be submitted in tabular form showing calculations by cross-section. The average end method shall be used. The volume of floodplain storage under the without-project conditions and the with-project conditions should be determined using the average-end-area method with plotted cross-sections at a horizontal to vertical ratio of between 5:1 and 10:1, with 2- through 100-year flood elevations noted on each cross section. The scale chosen should be large enough to show the intent of proposed grading and be clearly legible. Cross-sections should reflect both the existing and proposed conditions on the same plot. The location and extent of the compensatory storage area as well as the location and orientation of cross-sections should be shown on the grading plan.

E. Overland Flow and Grading Requirements

Overflow paths and ponding areas throughout the development resulting from a 100-year storm event, calculated based on all contributing drainage areas, on-site and off-site, in their proposed or reasonably anticipated land use and with storm sewer system assumed completely plugged, shall be determined, clearly shown as hatched areas on the plans, and a minimum width of 30 feet along the centerline of the flow path contained in permanent drainage easements. A statement shall be added to the plat that would refer the viewer to the construction plans to see the entire extent of overflow path as hatched areas. No fences or landscaping can be constructed within the easement areas that may impede the free flow of stormwater through this path. These areas are to be maintained by the property owner or be designated as common areas that are to be maintained by the homeowner's association.

The overflow path / ponding may be modeled as successive series of natural ponds and open channel segments. Ponds should be modeled similar to that discussed for modeling of depressional areas as described in this Section. Channels should be modeled according to modeling techniques described in Section VII. The calculations for determining the 100-year overflow path/ponding elevations may be based on hand calculations utilizing normal depth calculations and storage routing techniques or performed by computer models. Examples of computer models that may be used are TR-20, HEC-HMS, HEC-1 and HEC-RAS.

Where the street is designated as the overland flow path, the depth of flow shall not exceed 12-inches at the gutter line for local and collector streets and shall not exceed six inches depth at the crown for arterial streets.

Maximum yard slopes must be 3:1 where soil has been disturbed during construction processes. Finished floor elevation must be no less than 6-inches above finished grade and a minimum of 15-inches above an adjacent centerline of road elevation. Finished floor elevations should also be 2-feet above the maximum design flow elevation of the overland flow route(s) through the development.

For all structures located in the Special Flood Hazards Area (SFHA) as shown on the FEMA maps, the lowest floor elevations of all residential, commercial, or industrial buildings shall be 2-feet above the 100-year flood elevation.

For areas outside a FEMA designated floodplain, the lowest adjacent grade (including walkout basement floor elevation) for all residential, commercial, or industrial buildings adjacent to storm water management features shall be 2-feet above the 100-year flood elevation under proposed conditions. Any basement floor must be at least two-feet above the permanent water level (normal pool) of a retention facility.

For sites adjacent to existing water bodies including lakes, ponds, and wetlands, where there is a possibility during the 100-year 24-hour design storm that the water surface elevation of the water body encroaches onto the development, a detailed hydraulic/hydrologic analysis is required to determine the extents of the 100-year flood elevation encroachment onto the subject development. This encroachment shall be taken into consideration during the design of all infrastructure and lots. All critical elevations as defined elsewhere in this manual shall be set a minimum of 2-feet above this elevation.

F. Detention Volume Determination

1) Computation Methods

Computations for the determination of detention volume shall be based on the Rational Method or Hydrograph Methods. Calculations shall ignore the presence of infiltration.

a) Rational Method

The Rational Method may be used for sites with areas up to five (5) acres and no depressional storage. The procedure is as follows:

i. Determine the total site drainage area in acres, A, and determine the allowable release rate, Q_u.
ii. Determine the composite runoff coefficient, C_d, based on developed conditions
iii. Determine the 100-year return period rainfall intensity, I_d, for various storm durations, t_d, for the developed area using Table V-1.
iv. Determine developed inflow rates, Q_d, for various storm durations, t_d, measured in hours, $Q_d = C_d I_d A$
v. Compute the storage rate, S_d, for various storm durations, t_d up through the time of concentration of the developed area. $S_{td} = Q_d - Q_u$
vi. Compute required storage volume, S_R, in acre-feet for each storm duration, t_d. $S_R = S_{td} \times (t_d / 12)$
vii. Select the largest storage volume computed for detention basin design.

The results of the calculations should be presented in tabular form in the technical information report.

b) Hydrograph Methods

Hydrograph methods of determining runoff and routing of storm water shall be used to determine runoff rates and the storage volume required to control storm water runoff for watersheds greater than five (5) acres and / or all watersheds with depressional storage. A critical duration analysis shall be conducted in order to determine the maximum required storage volume. Depths from each of the 100 year storms identified in Table V-2 shall be used and a model run for each duration to determine the maximum required storage volume and elevation. The appropriate Huff distribution ordinates shall be used for each storm in accordance with Table V-7. The first quartile Huff distribution shall be used for storm durations equal to or less than 6 hours. The second quartile Huff distribution shall be used for storms greater than 6 hours and less than or equal to 12 hours. The third quartile Huff distribution shall be used for storms greater than 12 hours and less than or equal to 24 hours. Fourth quartile Huff distributions shall apply to storm durations greater than 24 hours.

Hydrographs shall be routed directly to the detention basins and not through any conveyance system.

G. Detention Outfall Design

1) Outlet Design

a) The outlet may be designed using the orifice equation, rearranged to solve for area.

$$Q = CA(2gH)^{1/2}$$

Where:

A	=	Required area (sft)
Q	=	Required Outflow (cfs)
C	=	Orifice coefficient (approx. 0.6)
2g	=	two times the gravitation constant (g = 32.2 ft/s^2)
H	=	Height of design high water level above centriod of orifice outlet

b) Other types of outlet devices shall have full design calculations provided for review.

c) The outlet shall be designed to prevent clogging.

d) Orifice plates shall have a minimum diameter of 4 inches. Perforated risers with stone filters or buried perforated piping with stone filters shall be used if the required design flow is less than the capacity of a 4-inch orifice.

e) Riser pipes with holes or slits less than 4 inches in diameter shall have a stone and gravel filter placed around the outside of the pipe.

f) Hoods and trash racks shall be placed on riser pipes. Grate openings shall be a minimum of 3 inches on center.

g) Orifices used to maintain a permanent pool shall be designed to withdraw water a minimum of 1 foot below the surface of the pond in order to prevent clogging of the orifice.

h) Riser pipes shall have a minimum diameter of 24 inches. Riser pipes greater than 5 feet in height shall be 48 inches in diameter.

i) Riser pipes shall be constructed of reinforced concrete or corrugated metal and be set in a concrete base. Plastic is not an acceptable riser material.

j) Where feasible, a drain for completely dewatering the detention system shall be placed installed for maintenance purposes. Where a drain is not feasible, the plans should include a note stating the pump rate required to drain the detention system within 24 to 48 hours.

k) Outlets shall be conveyed directly into an easement of the existing conveyance.

2) Emergency Overflow

a) All detention systems must have a provision for overflow at the high water level. A spillway shall be designed for the inflow of a 100-year rainfall event from the entire fully developed watershed (not the peak pond release rate) with a minimum of 1 foot of freeboard above the design flow. The spillway shall be sized using the weir equation:

$$Q = 2.6\ LH^{3/2}$$

Where:	Q	=	Discharge (cfs)
	2.6	=	Coefficient of Discharge
	L	=	Length of spillway crest (ft)
	H	=	Total head measured above spillway crest (ft)

b) Emergency overflows shall be protected with riprap or a permanent erosion control blanket to prevent erosion of the structure.

c) Emergency overflows shall be conveyed directly into an easement of the existing conveyance.

H. Retention / Infiltration Volume Determination

Retention / Infiltration basins (stormwater storage with no positive outlet) are only allowed on a case-by-case basis. Prior to their acceptance, the Developer / Engineer shall document to the Plan Commission that all other options have been explored and are not technically feasible.

1) Retention / Infiltration basins shall be sized to accommodate back-to-back 100-year storm events from the entire upstream watershed. Hydrograph Methods described in Section V shall be utilized in this determination.

2) No credit shall be given for infiltration from the system when calculating the required storage volume.

3) Maximum Drain Time

The infiltration basin shall be designed to drain completely within 72 hours. A design infiltration rate of 0.5 times the infiltration rate determined by geotechnical investigation (not to exceed 1 in/hr for underground systems), shall be used to estimate the maximum time to drain by the equation:

$$72 > 12\ D/I$$

Where:	72	=	Maximum allowable drain time (hours)
	12	=	Factor to convert inches to feet
	D	=	Basin depth (feet)
	I	=	Design infiltration rate (in/hr)

4) Underground Infiltration and Retention Systems

Underground infiltration or retention systems are discouraged and will be allowed only when adequate space for an aboveground system is not available. The site grading shall provide for parking lot storage of excess runoff should the underground infiltration or retention system fail to function adequately. Manufactured underground systems shall be approved on a case-by-case basis. The owner shall take full legal responsibility for the performance and safe operation of the system(s).

I. Geometry Requirements

1) Side slopes for open dry basins and wet basins shall not be steeper than 4:1 (horizontal:vertical).
2) One foot of freeboard shall be provided between the 100-year water level and the top of the berm.
3) Flood control volumes must be provided above the permanent pool elevation. Any volume provided below the invert of the outlet of a permanent pool pond is considered "dead storage" and will not be considered as detention volume.
4) The distance between inlets and outlets shall be maximized. If possible, inlets and outlets should be offset at opposite longitudinal ends of the facility. The length of the flow path across the basin can be maximized by increasing the length to width ratio of the entire design (a minimum length to width ratio of 3:1 shall be used unless structural measures are used to extend the flow path) and by increasing the dry weather flow path within the system to attain maximum sinuosity.
5) Irregular detention basin shorelines shall be provided.
6) Snow storage in the detention system shall not displace more than 50% of the available storage volume and shall not impede drainage through the system.
7) Permanent pools for wet basins shall be a minimum of 8 feet deep in the center of the basin.
8) The bottom of an infiltration basin shall be a minimum of 4 feet above the highest known water table elevation as determined by a geotechnical investigation.
9) The floor of the infiltration basin shall be flat to encourage uniform ponding and infiltration.
10) The floor of an infiltration basin shall be scarified to a depth of 4 to 6 inches after final grading has been established.
11) All detention basins shall have a minimum bottom slope toward the outlet of 1-percent unless appropriate invert treatment measures are provided. Where invert treatment measures are provided, the minimum allowable bottom slope shall be 0.3-percent.

J. Inlet Design Requirements

1) Pre-treatment of stormwater is required for all inlets to detention, retention and infiltration basins. Pretreatment shall be in accordance with Section IX.

2) Inlets and outlets require energy dissipation and transition from outlet to open channel based on the maximum velocities given in the Grassed Waterways section of these guidelines.
3) Inlet pipes shall not be submerged or partially submerged at normal pool elevations.

K. Public Safety Requirements

1) A minimum 5 foot-wide ledge with a maximum slope of 6% shall be provided around the perimeter of open basins over 5 feet deep. The ledge shall be located 3 feet above the bottom of open dry basins or 1 foot below the normal water level of wet basins. Fencing to prevent unauthorized access may be provided in lieu of the ledge.
2) Detention basins that have an impoundment volume of 50 acre-feet or more, and a hydraulic head of 15 feet or more, must meet the requirements of the Dam Safety guidelines of the Indiana Department of Natural Resources

L. Construction and Maintenance Requirements

1) A minimum 20 foot-wide maintenance access route and easement from a public or private right-of-way to the basin shall be provided. The access way shall have a slope of no greater than 5:1 (H:V), and shall be stabilized to withstand the passage of heavy equipment. Direct access to the forebay, control structures, and the outlet shall be provided.
2) Outlet control structures shall be placed near or within the embankment to facilitate maintenance access.
3) Upland construction areas shall be completely stabilized prior to final grading and construction of the detention basin. The detention basin shall be constructed first as a temporary erosion control measure during construction.
4) Compaction of the soil in the infiltration or retention basin area during excavation and grading is prohibited. Use of equipment with low earth pressure loading is required. The final 2 feet of depth shall be removed by excavating to finished grade.
5) Upland construction areas shall be completely stabilized prior to final infiltration basin construction. All accumulated sediment shall be removed prior to final acceptance.

SECTION VII – CONVEYANCE DESIGN

This Section describes accepted methods for the design of storm sewers, inlets, swales and ditches, culverts and bridges and easements.

A. Storm Sewers

1) Design Frequency

a) The storm sewer shall be designed to convey runoff from a 10-year frequency rainfall event with the free surface below the crown of the pipe.

b) Hydraulic grade line calculations shall be provided to ensure that the hydraulic grade line for the 25-year storm event does not exceed the rim elevation at any storm structure.

2) Design Methods

a) Storm sewer design velocities, capacities and friction losses shall be used on Manning's equation:

$$Q = \frac{1.49\, AR^{2/3} S^{1/2}}{n}$$

Where:

Q	=	Discharge (cfs)
A	=	Wetted Area (sft)
R	=	Hydraulic Radius (ft)
S	=	Slope (ft/ft)
n	=	Manning's coefficient (See Table VII-1)

For hydraulic analysis of existing or proposed storm sewer systems that possess submerged outfalls, a backwater analysis shall be provided. The backwater analysis shall include calculations accounting for total headloss in the system where total headloss equals frictional losses plus manhole losses plus velocity head losses plus junction losses.

For storm sewer analysis / design using computer models, the specific software shall be approved by the Drainage Board. The designer shall inquire about approval prior to use.

The storm sewer software should not provide attenuation through the nodes and pipes, i.e. inflow to nodes and pipes should equal outflow. Documentation such as a node / pipe inflow / outflow report shall be provided with the drainage report.

Table VII-1
Typical Manning's n Values

Material	**Manning's n**
Closed Conduits	
Concrete	0.013
Vitrified Clay	0.013
Brick	0.015
Cast Iron	0.013
Circular Corrugated Metal Pipe, Annular Corrugations -2 2/3 X 1/2 in.	
Unpaved	0.024
25% Paved	0.021
50% Paved	0.018
100% Paved	0.013
Circular Corrugated Metal Pipe, Helical - 2 2/3 X 1/2 in. Unpaved Corrugations	
12 in.	0.011
18 in.	0.013
24 in.	0.015
36 in.	0.018
48 in.	0.020
60 in. or larger	0.021
Corrugated Polyethylene, Smooth Interior Pipe	0.012
Concrete Culverts	0.013
Open Channels	
Concrete, Trowel Finish	0.013
Concrete , Broom or Float Finish	0.150
Gunite	0.018
Riprap Placed	0.030
Riprap Dumped	0.035
Gabion	0.028
New Earth (Uniform, Sodded, Clay)	0.025
Existing Earth (Faintly uniform, with some Weeds)	0.030
Dense Growth of Weeds	0.040
Dense Weeds and Brush	0.040
Swale with Grass	0.035

3) Minimum Velocity

a) The minimum full flow storm sewer velocity shall be 3.0 feet per second.

4) Maximum Velocity

a) The maximum allowable storm sewer velocity shall be 15 feet per second for RCP, PVC and HDPE. The maximum allowable storm sewer velocity shall be 7 feet per second for CMP.

5) Minimum Diameter

a) Storm sewer pipe shall have a minimum diameter of 12-inches.

6) Minimum Cover

a) The minimum depth of cover shall be the greater of 24-inches from finished grade to the outside top or manufacturer's requirements whichever is greater.

7) Change in Pipe Size

a) When changes in pipe size occur, the crown of the upstream pipe shall match the crown of the downstream pipe.

8) End Treatment

a) All outlets shall include flared end sections or headwalls with wingwalls.

b) All outlets shall include protective measures such as riprap to prevent scour at the outlet pipe. Protective measures shall be designed in accordance with HEC-14, "Hydraulic Design of Energy Dissipators for Culverts and Channels" as published by the Federal Highway Administration.

9) Material

a) Storm sewer pipe shall be reinforced concrete or smooth interior wall polyethylene in accordance with the current Indiana Department of Transportation (INDOT) Standard Specifications.

b) Pipe joints shall be gasketed in accordance with manufacturer's recommendations to prevent excessive infiltration or exfiltration.

B. Manholes, Catch Basins and Inlets

1) Manhole Spacing

Manhole spacing shall not exceed 400 feet for sewers with diameters less than 42-inches in diameter and 600 feet for sewers with diameters greater than or equal to 42-inches in diameter.

2) Location of Manholes, Catch Basins and Inlets

a) Manholes shall be placed at all changes in pipe direction, pipe material, pipe slope, pipe size, and inlet connection locations. Blind connections are not acceptable.

b) A catch basin or manhole shall be installed at the upstream end of the storm sewer or at any location where stormwater enters the storm sewer.

c) 48-inch diameter or 24-inch diameter catch basins may be substituted for manholes at the two most upstream locations.

3) Structure Dimensions

a) Minimum inside diameter of all manholes shall be 48 inches. Minimum inside diameters for catch basins and inlet structures shall be 24 inches.

b) Manholes and/or inlets shall be installed to provide human access to continuous underground storm sewers for the purpose of inspection and maintenance. The casting access minimum inside diameter shall be no less than 36 inches or a rectangular opening of no less than 22 inches by 22 inches.

4) Connections to Manholes

a) Connections to manholes shall be made with a resilient connector for pipe diameters 24 inches or less.

5) Markings

a) All Inlets must be pre-stamped with an appropriate “clean water” message.

C. Inlet Design

Inlets shall be utilized to collect surface water through grated openings and convey it to storm sewers, channels, or culverts.

1) Inlet design and spacing may be done using the hydraulic equations by manufacturers or orifice/weir equations. Use of the U.S. Army Corps of

Engineers HEC-12 computer program is also an acceptable method. Gutter spread on continuous grades may be determined using the Manning's equation. Further guidance regarding gutter spread calculation may be found in the latest edition of HERPICC Stormwater Drainage Manual, available from the Local Technical Assistance Program (LTAP). At the time of printing of this document, contact information for LTAP was:

Indiana LTAP
Purdue University
Toll-Free: (800) 428-7369 (Indiana only)
Phone: (765) 494-2164
Fax: (765) 496-1176
Email: inltap@ecn.purdue.edu
Website: www.purdue.edu/INLTAP/

2) Spacing and/or number of catch basins and inlet structures required to accommodate the design flows in streets, private drives, and parking areas shall be provided based on inlet capacity with no ponding occurring during a 10-year storm. Local roads shall have a 10-foot clear lane open from flooding during the 10-year storm event. A collector road shall have two 10-foot clear lanes open from flooding during storm events.

3) The inlet grate opening provided shall be adequate to pass the design 10-year flow with 50% of the sag inlet areas clogged. An overland flow route from sag inlets to the overflow channel or storage basin shall be provided at sag inlets in accordance with requirements in Section VI.

4) Inlet structures shall be placed at low points of streets and yards, and be spaced a maximum of 400 feet apart.

5) No more than 150 feet of street drainage will be allowed to flow around a corner.

6) No flow will be allowed across a street intersection.

D. Swales, Ditches and Overland Flow Paths

1) Design

a) Swales, ditches and overland flow paths shall be designed to contain the 100-year flow within its banks with a 2-foot freeboard between the 100-year water surface elevation and the lowest adjacent structure opening.

b) Velocities, capacities, and friction losses shall be based on Manning’s formula. Typical Manning’s “n” values for open channels, swales, and ditches are included in Table VII-1; however, a minimum “n” value of 0.035

shall be used as the roughness coefficient for open channels, unless special treatment is given to the bottom and sides (riprap, paving, mown sod).

c) Minimum bottom width for grassed waterways shall be 1 foot or an equivalent parabolic section.

d) Minimum bottom slope shall be 0.50%. Underdrains or other methods of drying the ditch bottom shall be provided for slopes less than 1%.

e) Side slopes shall be no steeper than 3:1 (horizontal:vertical [H:V]).

f) Grassed waterway flow velocities shall be neither siltative or erosive. The minimum velocity for vegetated channels shall be 1.5 ft/s. The maximum velocity shall be 4 ft/s. Riprap protection or equivalent erosion control measures shall be used where the velocity exceeds 4 ft/s, up to maximum allowable design velocity of 8 ft/s.

g) Where maximum velocities are exceeded due to channel slope, rock check dams, or grade control structures shall be used to reduce overall flow velocities.

h) Erosion control blankets shall be used to protect bare channels.

i) Outlets into grassed waterway shall enter at an angle of 90 degrees or less with the direction of flow.

j) A minimum clearance of 4 feet is required between vegetated swale and ditch inverts and underground utilities unless special provisions are approved. In no case will less than 2 feet of clearance be allowed.

E. Culverts and Bridges

1) Approval

a) Bridges and or culvert crossings of waterways must be approved by the Porter County Highway Engineer (County Engineer) and permitted by the Indiana Department of Natural Resources (DNR), Division of Water where applicable.

2) Design Requirements

a) In-lieu of more restrictive requirements by other regulatory agencies, the design of culverts shall be in accordance with the Federal Highway Administration publication Hydraulic Design Series No.5 (HDS-5),

"Hydraulic Design of Highway Culverts", Report No. FHWA-IP-85-15, the Federal Highway Administration's HY-8 computer model, or the U.S. Army Corps of Engineer's HEC-RAS computer model.

b) Sizing of culverts and bridges shall include consideration for entrance and exit losses, tail water condition, and inlet and outlet control considerations.

c) Culverts not requiring a permit from the DNR shall be designed for a minimum 10-year storm in the developed watershed with a maximum outlet velocity of 8 feet per second (ft/s). A maximum of 1 foot of inlet submergence may be permitted, if this does not back up water out of the easement or onto a county road.

d) During the 100-year storm event, road overflow shall not exceed seven (7) inches above the centerline crown elevation of the roadway. The 100-year storm event must be checked to determine the flooded area so that a building restriction line can be shown on a record plat. The lowest elevation where water may enter any adjacent structures must be outside this delineation.

e) Open culverts which pose a threat of damage to property or a hindrance of public services due to backwater and/or road overflow shall be analyzed utilizing the direct-step backwater method or reservoir flood routing techniques for determination of the depth of flow over the culvert/roadway during the peak discharge from the 100-year design storm event, backwater elevations, downstream flow velocities and resulting channel scour impacts.

3) Minimum Size

a) Minimum diameter of a drive culvert shall be 12 inches.

b) Minimum diameter of a road-crossing culvert shall be 15 inches or equivalent pipe arch.

4) End Treatment

a) Headwalls, wingwalls, and all other end treatments shall be designed to ensure the stability of the surrounding soil. INDOT, County Engineer, or manufacturer's designs may be used.

5) Material

a) Culverts may be reinforced concrete pipe, corrugated steel pipe, box culvert or arch pipe in accordance with the current INDOT Standard Specifications.

6) Minimum Cover

a) The minimum depth of cover shall be the greater of 24-inches from finished grade to the outside top or manufacturer's requirements whichever is greater.

F. Drainage Easements

An easement, or release of right-of-way, not land ownership, is the approved method of providing access to, and protection of, public storm drainage facilities. Transfer of land ownership to Porter County Board of Commissioners, the Porter County Drainage Board or a conservancy district in the County is not allowed unless permitted in writing by the Porter County Board of County Commissioners or other applicable authorities.

All natural waterways, drainage ditches or swales, enclosed storm drains, detention or retention facilities, or established drains within the plat or development plan shall have granted easements shown on the plat.

1) Easement Types

a) Regulated Drains

Private (exclusive) easements for county regulated drains shall be granted to the Porter County Drainage Board and must be shown on the plat or development plan.

b) Surface Drainage

Private easements for surface drainage are for the benefit of upland lots within the subdivision or upland sites that currently drain across the proposed plat. Any improper construction, development, or grading that occurs within these easements will interfere with the drainage rights of those upland lots. Private easements for surface drainage are for the continuous passage of surface water and each lot owner will be responsible for maintaining the surface drainage system across his property. No construction is permitted within the private easement for surface drainage. This includes swimming pools, sheds garages, patios, decks, or any other permanent structure or landscaping feature that may interfere with surface drainage.

c) Yard Drainage

All proposed lots or development plans shall have yard drainage. Storm water shall be collected from all proposed developments and routed through the proposed storm water drainage facilities proposed for the subdivision or development plan. Storm water shall not flow directly from

any development parcel to an adjoining parcel without going through the stormwater management system. Private easements for yard drains are for the benefit of individual lots within the subdivision or development plan. Any improper construction that occurs with these easements will interfere with the future maintenance of the enclosed yard drain system. Provisions applying to surface drains shall apply to yard drains.

d) Outside the Development

Easements will be required downstream of a development when the receiving discharge point is not a waterway and / or lacks sufficient capacity or grade to be of ongoing service to the plat without regular maintenance. Easements will not be required through public right-of-way (i.e., county roads). Recordable release of rights-of-way shall be submitted to the plan commission prior to construction. The County may require downstream drain construction and/or maintenance prior to plat approval.

e) Over Flow Paths

Easements for overflow paths shall be a minimum of 30-feet in width in accordance with Section VI of this Manual.

2) Agreements

When the proposed project will alter drainage patterns or increase flooding on private property (other than that owned by the developer), an agreement between the owners may be required relieving Porter County of any and all responsibility for damage that might occur. An acceptable “flooding” easement is in included in the Appendix IV-2. The agreement must be submitted to the plan commission prior to construction, if required.

3) Easement Widths

The following minimum easement widths are required with the confines of the proposed development.

a) Non-regulated open drains (waterways, ditches, major overland flow paths)
   i) The minimum of: the distance between the open drain top of banks plus 15 feet each side of its top of bank, or 40 feet.
   ii) The easement shall be centered on the centerline of the open drain.
b) Regulated open drains (waterways, ditches, major overland flow paths)
   i) Width between top of bank plus 75 feet each side of the top of bank.

ii) The easement shall be centered on the centerline of the open drain.

c) Enclosed drains (pipes, tiles, yard drains, etc.)

Enclosed drains shall have a minimum easement width of 30 feet centered on the centerline of the enclosure. Larger easements may be required depending upon diameter of the enclosed drain or depth of construction.

d) Storm Water Facilities (detention basins, retention basins, water quality features, etc.)

A minimum 20 foot-wide maintenance access route surrounding the entire facility shall be provided to all storm water facilities above the top of bank. Access shall be provided to the forebay, control structures, and outlet. Adequate access for routine sediment removal shall be provided. The entire facility and access route shall be included in an easement.

4) Utilities

If any utilities are to be located within the drainage easement of the proposed subdivision, the proprietor's engineer shall present plans detailing such utilities to the plan commission for their approval as to location. Utility plans shall be presented at the same time as drainage plans so that all details of construction and location may be checked and properly oriented with each other.

5) Existing Easements

The Book and Page reference from the Office of the Porter County Recorder for all recorded easements shall be shown on the final plat. Regulated drainage easements, private easements for drainage purposes, drainage easements, drainage and utility easements, or other variations of these recorded subdivisions are considered exclusive easements that may be utilized by the plan commission for the purposes of assessing and inspecting open or closed drains.

SECTION VIII - CONSTRUCTION WATER QUALITY

A. General Requirements

Location of erosion and sediment control facilities shall be shown on the plans and details shall be provided. The erosion and sediment control plans shall be prepared and executed in accordance with current Indiana Administrative Code requirements, Porter County's Erosion Control Ordinance and in accordance with the most current edition of the Indiana Stormwater Manual.

All earth changes and utilities shall be designed, constructed, and maintained in such a manner as to minimize the extent and duration of earth disruption.

Sedimentation control facilities shall be designed to remove sediment from storm water before the storm water leaves the site of the earth change activity. Calculations shall be provided with the Storm Water Management Plan.

Vegetative stabilization or other soil erosion control measures shall be installed and maintained throughout the development process.

Earth changes shall be staged to keep the exposed areas of the soil as small as practicable. Critical areas exposed during construction shall be protected with temporary vegetation, mulching, filter fences, or other methods of stabilization. A schedule and staging plan shall be included with the soil erosion control plan.

If lakes, ponds, or wetlands are located on or near the site, both temporary and permanent erosion control measures must be provided which intercept runoff and trap sediment before runoff reaches any water body. The locations of these measures shall be shown on the erosion control plans.

Soil disturbance and removal of natural ground vegetation and tree roots within 75 feet of the ordinary high water mark of any lake or stream, or within 25 feet of regulated wetlands shall be prohibited unless approved by the plan commission. A lake or stream buffer area greater than 75 feet may be required by the Porter County, if necessary, for soil erosion control purposes. Structures, roads, parking lots, storm water facilities, and other site improvements shall not be located in the buffer area. The buffer area shall be shown on the erosion control plans.

Storm water runoff control and soil erosion control measures shall be installed before grading, filling, or removal of vegetative cover is initiated.

Sediment basins, desilting basins, or silt traps are required as needed for all earth changes. Basins and traps shall be sized to contain sediment-laden runoff. A minimum of 250 cf/ac capacity shall be provided in the sediment basin. The location of these basins shall be shown on the erosion control plans.

Sediment basins shall be designed with an overflow spillway or other design features to minimize the potential for breaching during the 100-year rainfall event. Sediment basin design calculations must be submitted with the Storm Water Management Plan.

Filter fences and other soil erosion control facilities installed at the perimeter of a development site shall be installed to allow for onsite maintenance. The proposed location of fences and other facilities shall be shown on the erosion control plans.

Temporary seeding with 0.5 lb/1,000 sft of oats, barley, or annual ryegrass shall be completed within 48 hours of an earth change. A note indicating this shall be provided on the erosion control plans.

Erosion control blankets shall be installed in accordance with manufacturer's recommendations in all disturbed areas where concentrated runoff may occur, including ditches, swales, detention basins and open channels. Erosion control blankets shall also be placed on all steep slopes in excess of 1:3 (vertical:horizontal). Exact locations of these blankets shall be shown on the erosion control plans with a definitive hatching.

Permanent erosion control measures for all slopes, channels, ditches, or any disturbed land area shall be completed within 5 calendar days after final grading or the earth change has been completed. All temporary soil erosion control measures shall be maintained throughout the duration of the earth change, including the later stages of development. Maintenance activities include, but are not limited to, removal of accumulated sediment, structural repairs, and reseeding or replacement of vegetative cover. Exact locations of these blankets shall be shown on the erosion control plans.

Soil stockpile locations and erosion control measures shall be depicted on the erosion control plans.

A construction sequence plan shall be included on the construction drawings. The plan shall require the construction of perimeter protection, stable entrances to the construction site, and stable outlet(s) from the stormwater detention facilities prior to any other construction.

SECTION IX - POST CONSTRUCTION WATER QUALITY

Changes in the land surface from development can produce a negative impact on the environment. A change from pervious to impervious surfaces can increase the runoff rate and volume as well as pollutants from a development. The increase in runoff rate shall be addressed per Section 6. The increase in pollutant load after development shall be addressed as described in this section.

Pollutants deposited on to surfaces or present within the surface material can be dislodged and entrained by the rainfall-runoff process. Usually the stormwater that initially runs off an area will be more polluted than the stormwater that runs off later, after the rainfall has 'cleansed' the catchment. The stormwater containing this high initial pollutant load is called the 'first flush'.

The existence of this first flush of pollutants provides an opportunity for controlling stormwater pollution from a broad range of land uses. First flush collection systems are employed to capture and isolate this most polluted runoff, with subsequent runoff being diverted directly to the stormwater system.

The first flush can be addressed as a volume or a runoff rate and stormwater quality units (SQUs) can be engineered to address either. Generally, volume based SQUs are those that are constructed on-site and rate based SQUs are manufactured off-site and installed during development.

The choice between volume based or rate-based SQUs must be made by the design engineer with consideration to the client's needs. However, it is recommended the total number of SQUs be kept to a minimum to reduce all future maintenance costs. Regional SQUs should be given priority.

The following sub-sections discuss the determination of both water quality volume and first flush treatment rate. Approved SQUs both constructed and manufactured are provided in Appendix IX-1 and IX-2. The maximum approved treatment rate and design requirements for manufactured SQUs are included in Appendix IX-2.

A. Water Quality Volume Determination

The minimum required water quality volume is given by the equation:

$$WQv = 1815 \times A \times I$$

Where:	WQv	=	Water quality volume (cft)
	1815	=	0.5 inch of runoff x 3,630 to convert ac-in to cft
	A	=	Contributing drainage area (ac)
	I	=	Percent impervious expressed as a ratio or decimal.

This volume must be released over a 24-hr period as a minimum. The maximum release rate to detain this volume for at least 24 hours is 0.05 cfs/impervious acre. This volume can be included in the overall flood control volume.

All constructed SQUs shall include pre-treatment such as a forebay at all outlets into the pond, swale, etc. The treatment forebay shall be sized to store 10% of the water quality volume (WQv). All forebays should also include a permanent sediment marker for visual inspection of the sediment depth.

B. Water Quality Rate Determination

The design flow rate for manufactured stormwater quality units (SQUs) shall be determined using the SCS runoff methodology as outlined below.

1) Delineate the watershed basins served by each SQU. Tabulate the total impervious and pervious areas. Please note impervious and pervious area runoff rates MUST be calculated as separate basins. The sizing calculation assumes the impervious area is connected directly to the SQU and the Tc calculation must be adjusted for this assumption (i.e. no flow over grass).
2) Determine the time of concentration using the TR-55 methodology (Worksheet 3) for each basin.
3) Calculate the curve numbers (CN) for each basin, using CN=98 for the impervious basin.
4) Determine the peak discharge from the 0.3 in storm using the appropriate Huff, 50% rainfall distribution (Storm duration 0 up to and including 6 hrs – 1st Quartile, 6.1 to 12 hrs – 2nd Quartile, 12.1 to 24 hrs – 3rd Quartile. A single hydrograph for each basin should be determined and all basin hydrographs added to determine the peak flow. Storm durations of 15-, 30- and 45 minutes as well as 1-, 2-, 3- 6- 12- and 24- hours should be checked to determine the peak SQU flow.

C. Operation and Maintenance Requirements

1) Operation and Maintenance Plans

   Operation and maintenance plans shall be required with the construction drawings and should be included in the subdivision petition or development plan petition to the plan commission (or for other developments, legally binding documents such as the property deed or condominium master deed). The plan shall include the following information:

   a) An annual estimated maintenance budget, itemized by task. The financing mechanism shall also be described.
   b) A copy of the final site plan with the approved storm water management system for the development that delineates the conveyance system, storm water facilities, easements and buffer areas. The locations of all SQUs should be clearly delineated.

c) A listing of tasks to be completed for inspection of each component of the storm water management system. Lists of typical maintenance activities are included in Appendices IX-1 and IX-2 for each approved SQU**.**

d) The party responsible for performing each maintenance activity including name, address, phone number, emergency contact number, etc.

e) A defined description of the procedures for record keeping of maintenance operations and expenditures.

f) A schedule for implementation, and a time frame for corrective measures to be taken. Language shall be included which states that if the private entity fails to act within the time frame specified, the responsible governmental entity may perform the needed maintenance and assess the costs against the property owners within the subdivision (or other development).

g) Routine maintenance inspections will be conducted at least twice a year in the spring and in the fall, including inspection of all structural elements conducted annually. Corrective action shall be completed within thirty (30) days of regularly scheduled inspection or notification that action is required.

h) Emergency inspection on an as-needed basis. Corrective action shall be completed within 36 hours of notification unless threat to public health, safety, and welfare requires immediate action.

2) Operation and Maintenance Agreements

Regular maintenance is critical to the effective operation of all SQUs. Maintenance responsibility should be vested with a responsible party by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval.

3) Private Systems

A legally binding maintenance agreement shall be executed before final approval is granted. The agreement shall be included in the property deed restrictions or condominium master deed documents so that it is binding on all subsequent property owners.

D. Maintenance Plans

Maintenance plans shall be required with the construction drawings and should be included in the subdivision petition or development plan petition to the plan commission (or for other developments, legally binding documents such as the property deed or condominium master deed). The plan should include the following information.

- An annual estimated maintenance budget, itemized by task. The financing mechanism shall also be described.

- A copy of the final site plan with the approved storm water management system for the development that delineates the conveyance system, storm water facilities, easements and buffer areas. The locations of all SQUs should be clearly delineated.

- A listing of tasks to be completed for inspection of each component of the storm water management system. Lists of typical maintenance activities are included in Appendices IX-1 and IX-2 for each approved SQU**.**

- The party responsible for performing each maintenance activity including name, address. phone number, emergency contact number, company name, etc.

- A defined description of the procedures for record keeping of maintenance operations and expenditures.

- A schedule for implementation, and a time frame for corrective measures to be taken. Language shall be included which states that if the private entity fails to act within the time frame specified, the responsible governmental entity may perform the needed maintenance and assess the costs against the property owners within the subdivision (or other development).

- Routine maintenance inspections will be conducted at least twice a year in the spring and in the fall, including inspection of all structural elements conducted annually. Corrective action shall be completed within thirty (30) days of regularly scheduled inspection or notification that action is required.

- Emergency inspection on an as-needed basis. Corrective action shall be completed within 36 hours of notification unless threat to public health, safety, and welfare requires immediate action.

- A note to update the plan and notify the county.

Appendix I

(Not Used)

Appendix II

(Not Used)

Appendix III-1

Storm Water Management Plan Permit Application

Porter County Plan Commission
Storm Water Management Plan Permit Application

Land Alteration / Project Name:
Location of Project (attach legal description):

Owner Information		
Name:		
Contact:		
Address:		
Phone:	Fax:	Email:

Developer Information (if not Owner)		
Name:		
Contact:		
Address:		
Phone:	Fax:	Email:

Engineer Information		
Name:		
Contact:		
Address:		
Phone:	Fax:	Email:

Contractor Information		
Name:		
Contact:		
Address:		
Phone:	Fax:	Email:

Submitted By_____ Day_____

Appendix III-2a

Stormwater Management Plan Checklist for Major Subdivision and Development Plan

Stormwater Management Plan Checklist for Major Subdivision and Development Plan (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
A. Stormwater Management Plan Checklist for Major Subdivisions				
B. Preliminary Plat				
C. Professional Certification				
D. Report				
1) A cover sheet including:				
a) Subdivision name;				
b) Subdivision vicinity map;				
c) Developer's name, address, telephone, fax and email address;				
d) Engineer and / or Land Surveyor's name, address, telephone, fax and email address;				
e) Location of project including section(s), township(s) and range(s);				
f) Professional registration seal, signature and date;				
g) Revision date.				
2) An index including sections, exhibits and appendices				
3) A written narrative describing the existing and proposed runoff patterns, names of receiving streams or regulated drains, existing and proposed land cover and any other features that affect the site's hydrology and hydraulic characteristics				
4) A table or tables summarizing all variables (existing and proposed conditions) used in runoff calculations for each major watershed including drainage areas, percent pervious, percent impervious, runoff curve numbers, runoff coefficients, times-of-concentration, rainfall depths, intensities.				
5) A summary table or tables of the results of all calculations / computer models including existing 2 year, 10 year and 100 year runoff rates and proposed runoff and release rates for each watershed, basin and sub-basin. This table should include the proposed detention release rates as well as the basin runoff rates.				
6) A written narrative of proposed post-construction water quality systems and how they are integrated into the site design.				

Stormwater Management Plan Checklist for Major Subdivision and Development Plan (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
7) A table or tables summarizing water quality calculations by basin including water quality volumes, forebay volumes, micro-pool volumes, water quality release rates, water quality detention times, etc… for each water quality facility.				
8) A summary of special conditions encountered during the design process				
9) A summary of proposed construction sequencing and staging				
10) An appendix entitled, “Existing Major Watershed Parameter Calculations” providing details of the calculations of:				
a) Time of concentrations;				
b) Curve numbers and / or runoff coefficients.				
11) An appendix entitled, “Existing Hydrology Calculations” providing calculation or model input and output for the calculation of existing 2-year, 10-year and 100-year flow rates and water elevations for the existing major watersheds.				
12) An appendix entitled, “Proposed Major Watershed Parameter Calculation” providing details of the calculations of:				
a) Time of concentrations;				
b) Curve numbers and/or runoff coefficients.				
13) An appendix entitled, “Proposed Major Watershed Modeling Calculation” providing calculations and/or model input for the calculation of proposed 2-year, 10-year, and 100-year flow rates and water elevations of all proposed major watersheds, detention basins and/or retention basins.				
14) An appendix entitled, “Proposed Outlet Structure Calculations” providing details of the calculation of:				
a) All low flow outlet structures (orifices, weirs, etc…)				
b) All emergency spillway structures.				
15) An appendix entitled, “Proposed Major Overland Flow Calculations” providing details of the calculation of all overland flow routing locations including:				
a) Drainage ditches;				
b) Side yard swales:				
c) Rear yard swales:				
d) A basin map with the routing locations from sags in roadways.				

Stormwater Management Plan Checklist for Major Subdivision and Development Plan (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
16) An appendix entitled, “Proposed Storm Sewer Calculations” providing details of the calculations used to size proposed storm sewers including:				
a) Structure designations;				
b) Pipe diameter, length, slope;				
c) Contributing drainage area to each structure;				
d) Composite runoff coefficient to each structure:				
e) Cumulative time of concentration to each structure;				
f) Computer 10-year flow within each pipe;				
g) Full flow capacity of each pipe;				
h) Full flow velocity of each pipe;				
i) Hydraulic grade line at each manhole for the 25-year storm event;				
j) Rim elevation at each structure.				
17) An appendix entitled, “Inlet Calculations” providing details of the calculations used to locate inlets including:				
a) Documentation of equations used;				
b) Structure designations;				
c) Proposed inlet manufacturer and model number;				
d) Proposed opening area of each inlet;				
e) Contributing drainage area of each inlet;				
f) Composite runoff coefficient to each inlet;				
g) Cumulative time of concentration to each inlet;				
h) Computer 10-year flow upstream of each inlet (including contributing flow and carry over flow from upstream inlets);				
i) Computed water depth at gutter upstream of each inlet;				
j) Computed spread upstream of each inlet;				
k) Computed carry over flow at each inlet;				
l) Maximum ponding depths at sag inlets (assuming 50% clogging of the grate).				
18) An appendix entitled, “Water Quality Calculations” providing details of the calculations of:				
a) Water quality volume calculations including volumes and water elevations;				
b) Water quality release rate calculations including orifice calculations and detention time;				
c) Forebay and micropool volume calculations.				

Stormwater Management Plan Checklist for Major Subdivision and Development Plan (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
19) Other appendices are required to convey the inlet of the Drainage Plan (e.g. culvert calculations in accordance with Federal Highway Administration procedures and/or Indiana Department of Natural Resources requirements, scour calculations for channels, etc…)				
20) An 8.5" x 11" or 11" x 17" exhibit entitled, "USGS Map" depicting the location of the site on the most current USGS map.				
21) An 8.5" x 11" or 11" x 17" exhibit entitled, "Soils Map" depicting the location of the site on the most current Natural Resources Conservation Soil Survey Map.				
22) An 8.5" x 11" or 11" x 17" exhibit entitled, "Nation Wetland Inventory Map" depicting the location of the site on the most current National Wetland Inventory Map.				
23) An exhibit entitled, "Existing Conditions Map" shall include one or more 24' x 36" drawing (s) showing the following information:				
a) North arrow;				
b) Scale including bar scale (1:50 or 1:100 scale);				
c) Existing property lines;				
d) Existing land cover (e.g. woodland, brush, row crops, etc…);				
e) Legend;				
f) One-foot contours with contour intervals that are legible;				
g) Soil types in accordance with the Soil Survey as published by the Natural Resource Conservation Service;				
h) Onsite and offsite watershed boundaries and their designations that correspond to modeling designations;				
i) Flow arrows depicting the direction of flow in streams, ditches, sewers and other drainage conveyance features;				
j) Time of concentration paths identifying sheet flow, shallow concentrated flow and channel flow components;				
k) Hydrologic parameters for each existing watershed (onsite and offsite) to include drainage area in acres, time of concentration, and runoff coefficients and/or curve numbers;				
l) Calculated release rates for each watershed;				

Stormwater Management Plan Checklist for Major Subdivision and Development Plan (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
m) Depression areas with a table depicting stage and volume on the map for each depression area, if applicable				
n) Computed 100 year water levels for all depression areas;				
o) Wetland boundaries (as delineated by a professional wetland scientist and Chapter 12 UDO definition), if applicable;				
p) Wetland boundaries (as identified on the National Wetland Inventory Maps), if applicable;				
q) Boundaries of lakes, ponds, streams, creeks and rivers including their normal and computed 100-year water levels, if applicable;				
r) Storm sewers and all other drainage features, if applicable;				
s) Floodplain and floodway limits and 100-year flood elevations depicted on the most current Flood Insurance Studies, if applicable.				
24) An exhibit entitled, “Proposed Major Watershed Map” shall include one or more 24” x 36” drawing (s) showing the following information;				
a) North arrow				
b) Scale including bar scale (1:50 to 1:100 scale);				
c) Existing and proposed property lines including all proposed lots and outlets;				
d) Proposed major watershed boundaries (areas proposed to be tributary to each detention or retention facility) including off-site watershed boundaries and their designations that correspond to modeling designations;				
e) Proposed detention or retention basin locations and its discharge and emergency spillway locations;				
f) Flow arrows depicting the direction of flow in streams, ditches, sewers, and other drainage conveyance features;				
g) Proposed time of concentration paths identifying sheet flow, shallow concentrated flow and channel flow components;				
h) Proposed 100-year flow into each detention or retention basin;				
i) Proposed release rate from each detention or retention basin;				

Stormwater Management Plan Checklist for Major Subdivision and Development Plan (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
j) Proposed low water levels and computed 100-year levels for each detention or retention basin;				
k) Hydrologic parameters for each proposed watershed (onsite and offsite) to include drainage area in acres, time of concentration, and runoff coefficients and/or curve numbers.				
25) An exhibit entitled, “Sub-Basin Watershed Map” shall include one or more 24” x 36” drawing(s) showing the following information:				
a) North arrow				
b) Scale including bar scale (1:50 or 1:100 scale);				
c) Existing and purposed property lines including all proposed lots and outlots;				
d) Proposed sub-basin boundaries (areas proposed to be tributary to each storm sewer inlet) including offsite watershed boundaries;				
e) Hydrologic parameters for each proposed sub-basin (onsite and offsite) to include drainage area in acres, time of concentration, and runoff coefficients and/or curve numbers;				
f) Flow arrows depicting the routing of flow from one sub-basin to the next sub-basin;				
g) Inlets, catch basins and manholes with their respective designation (designation to match designation used in the model);				
h) Pipes with their respective diameters and flow arrows indication the direction of flow.				
26) An exhibit entitled, “Proposed Water Quality Feature Map” shall include one or more 24” x 36” drawings(s) showing the following information:				
a) North arrow				
b) Scale including bar scale (1:50 or 1:100)				
c) Existing and proposed property lines including all proposed lots and outlots				
d) Location and type of water quality facility (type to be labeled in accordance with water quality features identified in this manual e.g. water quality swale, wet extended detention ponds, etc…)				
e) Drainage area boundaries tributary to each water quality facility including proposed area and proposed impervious percentage				

Stormwater Management Plan Checklist for Major Subdivision and Development Plan (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
f) Computed water quality volume, forebay, volume, micro-pool volume for each proposed water quality feature				
g) Computed water quality release rate and detention time for each proposed water quality feature.				
29) Other exhibits as required to properly convey the intent of the Drainage Plan.				
E. Construction Plans				
Construction Plans showing the following information shall be provided on 24”x36” sheets at a scale no more than 1” = 50 feet:				
1) Title sheet showing the following information:				
a) Subdivision name;				
b) Subdivision vicinity map;				
c) Developer’s name, address, telephone, fax and email address;				
d) Engineer and/or Land Surveyor’s name, address, telephone, fax and email address;				
e) Location of project including section(s), townships(s) and range(s);				
f) Professional registration seal, signature, and date;				
g) Revision date and description of revisions;				
h) Index of drawings;				
i) A table listing all water quality structures or practices and their center point longitude and latitude.				
2) An exiting topographic drawing showing the following information:				
a) North arrow				
b) Scale including bar scale (1:50 or 1:100 scale);				
c) Existing property lines;				
d) Existing land cover (e.g. woodland, brush, row crops, etc…);				
e) Legend				
f) One-foot contours with contour intervals that are legible;				
g) Spot elevations;				
h) Soil types in accordance with the Soil Survey as published by the Natural Resource Conservation Service;				
i) Depression areas with a table depicting stage and volume on the map for each depression area, if applicable.				

Stormwater Management Plan Checklist for Major Subdivision and Development Plan (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
j) Wetland boundaries (as delineated by a professional wetland scientist), if applicable;				
k) Wetland boundaries (as identified on the most current National Wetland inventory Maps), if applicable;				
l) Boundaries of lakes, ponds, streams, creeks and rivers including their normal water levels, if applicable;				
m) Storm sewers and culverts (diameters, rim elevations and invert elevations) and all other drainage features, if applicable;				
n) Floodplain and floodway limits and 100-year flood elevations depicted on the Flood Insurance Studies, if applicable;				
o) All other requirements as set forth by Porter County;				
p) Bench mark information (NAVD88) as required by Porter County.				
3) Preliminary Plat showing the following information:				
a) Proposed drainage easements and their widths;				
b) All other requirements as set forth by Porter County.				
4) Plan and profile drawings showing the following information related to storm sewers and ditches;				
a) Edge of pavement on the plan view;				
b) Curb and gutter on the plan view;				
c) Sidewalk on the plan view;				
d) Lots and lot numbers on the plan view;				
e) Easements and their dimensioned width on the plan view;				
f) Storm, sanitary and water utilities on the plan view;				
g) Structure numbers (corresponding to calculations), rim elevations on the plan view;				
h) Pipe diameters, materials and flow direction arrows on the plan view;				
i) Flow arrows depicting surface flow along roadways and through lots on the plan view;				
j) Profile grades of existing ground, proposed roadway centerline and proposed roadside ditch centerlines on the profile view;				
k) Pipe inverts, diameters, and slopes on the profile view.				
5) Proposed Grading Plan drawing showing:				

Stormwater Management Plan Checklist for Major Subdivision and Development Plan (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
a) Edge of pavement, curb and gutter, sidewalk;				
b) Lots and lot numbers;				
c) Conceptual building pads and driveways;				
d) Existing contours (light pen weight) with legible labels;				
e) Proposed contours with legible labels;				
f) Top of foundation grade elevation for each building pad;				
g) Minimum opening elevations (window wells, walk out basements);				
h) Proposed lowest adjacent grades at the four corners of the building pad;				
i) Proposed driveway slopes;				
j) Proposed finish grade spot elevations at the four corners of the lots and intermediate points as necessary to indicate high or low points;				
k) Flow arrows indicating the direction of proposed flow across each lot, side yards and rear yards;				
l) Flow arrows indicating the direction of flow along streets;				
m) Major flow arrows indicating routing of overland flow from sag points to the detention basin (major flow arrows shall be distinguishable from other flow arrows);				
n) Proposed storm sewers (light pen weight) including flow arrows and manhole, catch basin or inlet number.				
6) One plan view for and section view for each detention/retention/water quality basin (plan view and section view on the same sheet) showing:				
a) Existing contours (light pen weight) with legible labels;				
b) Proposed contours for detention, retention, and water quality basins with legible labels;				
c) Proposed side slopes on the plan view;				
d) Location of low flow and emergency spillway oulet structures, and inlet pipes (diameters and inverts) on the plan view;				
e) Normal water pool and 100-year water elevation on the plan view;				

Stormwater Management Plan Checklist for Major Subdivision and Development Plan (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
f) Typical section of each detention/retention basin showing side slopes, safety ledges, top if berm elevations, existing ground profile across water quality elevation and normal pool elevation, outlet structure elevations and sizes;				
g) Typical sections of each emergency spillway.				
7) Detail sheets including the following information:				
a) Pipe materials, backfill and bedding details (including details for backfill and bedding requirements beneath and within five feet of roads);				
b) Manhole, catch basin, inlets details including a table of proposed castings for each structure;				
c) Outlet structures for detention or retention basins;				
d) Other water quality details (e.g. filter stripes, vegetated swales, etc…);				
e) Other special stormwater management structures;				
f) Cross-sections for each swale, ditch, SQP, pond, etc…				
8) Erosion control plans and details including the following information:				
a) Edge of pavements, curb and gutter and sidewalk;				
b) Lots and lot numbers;				
c) Proposed contours;				
d) Location of designated areas for stockpiles and construction entrances;				
e) Proposed storm sewer structures and pipes (light pen weight);				
f) Locations of all proposed erosion control features as required by Indiana Administrative Code and the Indiana Handbook for Erosion Control in Developing Areas;				
g) Details of erosion control practices as required by the site;				
F. Geotechnical Report				
A geotechnical report shall be provided that identifies ground water levels at all detention/retention and water quality feature sites. In-situ soil permeability shall be obtained and provided at each location where the retention and/or water quality facilities will rely on infiltration.				

Stormwater Management Plan Checklist for Major Subdivision and Development Plan (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
G. Operation and Maintenance Plan				
An Operation and Maintenance (O & M) Manual shall be provided for each SQP. The O & M Manual shall be separately bound from the drainage design report and shall include:				
1) Owner Name;				
2) Owner Address;				
3) Owner Phone number;				
4) Description of the SQP, inspection procedures (both graphically and with text), etc.;				
5) Inspection schedule;				
6) Inspection checklist;				
7) Site diagram with all SQPs delineated and identified;				
8) Responsible Party.				

Appendix III-2b

Stormwater Management Plan Checklist for Minor and Administrative Subdivisions

Storm Water Management Plan Checklist for Minor and Administrative Subdivisions (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
A. Stormwater Management Plan Checklist for Minor and Administrative Subdivisions				
B. Preliminary Plat				
C. Professional Certification				
D. Report				
1) Overall watershed mapping				
2) Pre- and post-developed runoff rate calculations				
3) Pre- and post-developed runoff rate calculation summary table				
4) Detention calculations, if required				
5) Professional certification				
6) Highway Department letter of approval for driveway culvert				
E. Construction Plans				
1) Topographic data				
2) Special flood hazard information				
3) Grading plan showing structures, confirmation off-site drainage will not be obstructed, and improvements on site will not increase runoff to adjacent properties				
4) Grading plan showing elevations of all structures; top of foundation grade elevation for each building pad; minimum opening elevations (window wells, walkout basements); proposed lowest adjacent grades at the four corners of the lots and intermediate points as necessary to indicate high or low points; flow arrows indicating the direction of proposed flow across each lot; side yards and rear yards; major flow arrows indicating routing of overland flow from sag points to the detention basin or other drainage facilities				
5) Lowest floor elevations are a minimum of 2-feet above 100-year flood elevation				
6) Detention basins and water quality features information is provided, if required				
7) Driveway culvert information is provided				
8) Easements are provided as required				
9) Sediment and erosion control plan is provided				
F. Geotechnical Report				
Geotechnical report is provided, if detention or water quality features are required				
G. Operation and Maintenance Plan				
Operation and Maintenance Plan is provided, if water quality features are required				
1) Owner Name;				

Storm Water Management Plan Checklist for Minor and Administrative Subdivisions (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
2) Owner Address;				
3) Owner Phone number;				
4) Description of the SQP, inspection procedures (both graphically and with text), etc.;				
5) Inspection schedule;				
6) Inspection checklist;				
7) Site diagram with all SQPs delineated and identified;				
8) Responsible Party.				

Appendix III-2c

Stormwater Management Plan Checklist for Administrative Reviews and Additions Less than 25,000 SFT

Storm Water Management Plan Checklist for Administrative Reviews and Additions Less than 25,000 SFT (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
A. Stormwater Management Plan Checklist for Site Expansion Projects				
B. Site Plan showing parcel boundaries, dimensions, etc.				
C. Professional Certification				
D. Report				
1) Overall watershed mapping				
2) Pre- and post-developed runoff rate calculations				
3) Pre- and post-developed runoff rate calculation summary table				
4) Detention calculations, if required				
5) Other drainage calculations (storm sewer, ditch, swale, overland flow path, etc.)				
6) Professional certification				
7) Highway Department letter of approval for driveway culvert				
8) Water quality calculations				
E. Construction Plans				
1) Topographic data				
2) Special flood hazard information				
3) Grading plan showing structures, confirmation off-site drainage will not be obstructed, and improvements on site will not increase runoff to adjacent properties				
4) Grading plan showing elevations of all structures; top of foundation grade elevation for each building pad; minimum opening elevations (window wells, walkout basements); proposed lowest adjacent grades at the four corners of the lots and intermediate points as necessary to indicate high or low points; flow arrows indicating the direction of proposed flow across each lot; side yards and rear yards; major flow arrows indicating routing of overland flow from sag points to the detention basin or other drainage facilities				
5) Lowest floor elevations are a minimum of 2-feet above 100-year flood elevation				
6) Detention basins and water quality features information is provided, if required				
7) Other drainage features				
8) Driveway culvert information is provided				
9) Easements are provided as required				
10) Sediment and erosion control plan is provided				

Storm Water Management Plan Checklist for Administrative Reviews and Additions Less than 25,000 SFT (P – Provided; NP – Not Provided; NA – Not Applicable)				
Item	**P**	**NP**	**NA**	**Comment**
F. Geotechnical Report				
Geotechnical report is provided, if detention or water quality features are required				
G. Operation and Maintenance Plan				
Operation and Maintenance Plan is provided, if water quality features are required				
1) Owner Name;				
2) Owner Address;				
3) Owner Phone number;				
4) Description of the SQP, inspection procedures (both graphically and with text), etc.;				
5) Inspection schedule;				
6) Inspection checklist;				
7) Site diagram with all SQPs delineated and identified;				
8) Responsible Party.				

Appendix III-3

Preliminary Plat Storm Water Management Plan Technical Review Checklist

Storm Water Management Plan Technical Review Checklist

NA – Not Applicable; S – Satisfactory; U - Unsatisfactory

Description	NA	S	U	Comment
General Grading				
Existing Contours				
Proposed Contours				
Lot corner and intermediate spot grades				
Lowest adjacent grades				
Finished floor elevations				
Lowest Opening Grades				
Section VI - Major Drainage System; Routing Path; Detention and Retention				
Allowable Release Rate				
Release rate of 0.13 cfs / acre for each outlet				
Depressional storage accounted for properly				
Downstream / Receiving Facilities				
Waterway exists downstream				
Downstream waterway has capacity				
Executed Certification of Adequate Outlet				
Management of Off-Site Runoff				
Off-site runoff is managed appropriately				
Runoff from upstream is not being obstructed				
Outlet structure designed appropriately to pass on-site and off-site flows				
Compensatory Storage				
Compensatory storage in accordance with Section VI				
Overland Flow and Grading Requirements				
Overland flow paths and computations				
Overland flow paths shown on plans as hatched area (30' min.)				
2-foot freeboard				
Modeling of overland flow paths				
Maximum street depth of 12-inches				
Detention Volume Determination				
NRCS Hydrograph methods used if area > 5 acres				
Runoff Curve Numbers or Runoff Coefficients				
Times of Concentrations				
Rainfall intensities and depths				
Rainfall distributions				
Rational method for detention				
Hydrograph methods – critical duration volumes / flows				
Calculated stage, storage, discharge curves match plans				
Detention Outfall Design				
Outlet calculations match model and plans				
Outlet designed to prevent clogging				
Hoods / trash racks				
Riser pipes				
Outlet directed to waterway with easement				
Emergency overflow calculations match design plans				
Erosion protection of emergency overflow				
Retention / Infiltration Volume Determination				
Documentation is provided that demonstrates to the County that an infiltration basin is the only feasible method to manage stormwater.				
Back to back 100-year storm events (w/o infiltration)				
72-hour maximum drain time				
Geometry Requirements				
Side slopes				
Freeboard				
Distance between inlet and outlet is maximized				

Storm Water Management Plan Technical Review Checklist

NA – Not Applicable; S – Satisfactory; U - Unsatisfactory

Description	NA	S	U	Comment
Irregularity of shorelines				
Permanent pools				
Water table / basin bottom				
Inlet Design Requirements				
Pre-treatment design				
Erosion protection				
Inlet pipes are not submerged at normal level				
Public Safety Requirements				
Ledge				
IDNR Criteria				
Construction and Maintenance Requirements				
Access route				
Location of outlet structures				
Stabilization of upland areas				
Infiltration basin construction considerations				
Section VII – Conveyance Design				
Storm Sewers				
10-year storm analysis				
25-year storm HGL analysis				
Rainfall intensities				
Manning n values				
Minimum and maximum velocities				
Minimum diameter				
Minimum cover				
End treatments				
Material				
Inverts, diameters, slopes consistent between plans and calculations				
Manholes, Catch Basins and Inlets				
Location and spacing				
Details and dimensions				
Materials				
Markings				
Inlet Design				
10-foot clear lane for local road				
Two 10-foot clear lanes for collectors				
50% clogging at sag inlets				
Spacing				
Swales, Ditches and Overland Flow Paths				
Freeboard				
Velocities				
Geometry				
Longitudinal Slope				
Protection from Erosion				
Culverts and Bridges				
Approvals				
Minimum size				
End treatment				
Material				
Minimum cover				
Drainage Easements				
Regulated drains				
Surface drainage				
Yard drainage				
Outside the development				
Stormwater management facilities				
Agreements				
Existing easements				
Consistent between plat and construction plans				
Section VIII – Construction Water Quality				
Rule 5 requirements				
Construction sequence				

Storm Water Management Plan Technical Review Checklist NA – Not Applicable; S – Satisfactory; U - Unsatisfactory				
Description	**NA**	**S**	**U**	**Comment**
Stockpile locations and measures				
Erosion control plan elements shown on plans				
Section IX – Post-Construction Water Quality				
Water quality volume(s)				
Water quality rate(s)				
Pre-treatment volume(s)				
Operation and Maintenance				
Calculations consistent with plans				

Appendix III-4

Professional Certification

PROFESSIONAL CERTIFICATION FORM

Development Name: _____

General Location: _____

Legal Description of parent tract for proposed subdivision to be attached with deed showing current ownership.

I,_____, a Licensed Professional Engineer and /or Professional Land Surveyor in the State of Indiana, do hereby certify that:

1. The lands to be developed to wit: naturally drain into the area served by the existing Waterway, or that the existing Waterway is the only reasonably available outlet for the drainage from the lands to be developed.

2. There is adequate capacity in the existing Waterway to service lands to be developed without detriment or diminution of drainage service provided or to be provided in the foreseeable future to the area in the existing watershed.

Signature: _____

Type or print: _____

Date: _____

Indiana PE or LS Number: _____

Appendix IV-1

Checklist for Final Plat

CHECKLIST FOR FINAL PLATS

Subdivision Name: _____

Developer: _____

Location: _____

Reviewed By: _____

Initial Reviews	**Dates Completed**
1. Preliminary plat (including site plan, Grading & drainage plan, and Engineering calculations) and review fees:	
Submitted	_____
Approved	_____
2. Construction drawings: Submitted	_____
Approved:	_____
Prior to Construction	
3. Evidence of contractor's insurance coverage.	_____
4. Construction contract information	_____
5. Inspection deposit paid.	_____
6. Recordable easements for downstream properties, or "flooding" easement agreement submitted.	_____
7. Soil erosion and sedimentation control permit.	_____
8. Certification of adequacy of existing receiving Drains.	_____
- or –	
Approval has been given for any improvements required to existing county regulated drains.	_____

Prior to Final Plat Approval		**Dates Completed**
9.	Certification that county drains and storm water system have been improved in accordance with approved construction drawings.	_____
	- or –	
	The proprietor has entered into an agreement with the Board of Commissioners and has posted surety for faithful performance of the agreement.	_____
10.	Recordable release of easements within the plat provided in the name of the entity responsible for maintenance.	_____
11.	A conservancy district has been established, legal descriptions and maintenance agreement provided.	_____
	- or –	
	A letter of commitment from local municipality governmental agency, or association has been executed.	_____
12.	Maintenance plan submitted.	_____
13.	Copies of restrictive covenants.	_____
14.	Guarantee for repairs (Maintenance bond) Of any defects in the work for a period of two years.	_____
Upon Completion of Construction		
15.	Construction record drawings.	_____
16.	Certification that county regulated drains and storm water system have been improved in accordance with approved construction drawings.	_____
17.	Release of surety.	_____
Two Years After Final Completion of Construction		
18.	Return maintenance bond.	_____

Appendix IV-2

Flooding Easement

FLOODING EASEMENT

THIS AGREEMENT, made and entered into this _____ day of _____,20_____, for an consideration of $_____and prospective benefits to be derived by reason of construction, operating, improving and maintaining of a certain Drain under the supervision of the Porter County Surveyor and Porter County Plan Commission as hereinafter described, _____,("Landowners") do hereby convey and release to the Porter County Surveyor and Porter County Plan Commissioner, on behalf of the Porter County Drainage District, (the "Drainage District public body corporate of 155 Indiana Avenue, Suite 303, Valparaiso, IN 46383, an Easement for _____Drain situated in the County and State aforesaid, Landowners do hereby convey release to Drainage District a Drainage Easement with an elevation of approximately _____ above mean sea level, USGS datum, for drainage purposes and flood control.

WHEREAS, the Drainage District wishes to obtain an easement from Landowners in the event that there is an increase in the velocity or quantity of water flowing onto Landowners' property as a result of the construction, maintenance, improvement, or operation of the Drain.

NOW THEREFORE, the parties agree as follows:

1. Landowners hereby grant, convey, and release unto Drainage District as Easement over their lands for the purpose of allowing for increases in velocity or quantity of water flow over Landowners' property.

2. Said Easement is described separately as follows:

3. Landowners, their heirs, executors, administrators, successors and assigns reserve their rights and privileges to the area encompassed by the Easement as may be used and enjoyed to include planting and harvesting of agricultural crops so long as the use(s) do not interfere with or abridge rights granted to and Easement hereby acquired by the Drainage District;

4. Landowners, their heirs, executors, administrators, successors, and assigns hold Drainage District harmless to all claims to damages in any way arising from or incident to the drainage and increased flow onto said premises by reason of said Drain, or at any time in the future, such release for damages releases the Drainage District, its successors, and assigns from any damages whatsoever arising out of the flooding of said lands within the Easement right-of-way to any depth at any time in future by reason of the construction of such drainage improvements and the flooding caused by said construction, or their use during the time of construction or at any time in the future;

5. This Easement may be terminated in whole or in part by written agreement of all the parties;

6. This conveyance shall be deemed sufficient to vest in Drainage District and Easement in said lands for the uses and purposes of any increased flow onto the Landowners' property.

In witness whereof, the parties hereto have executed this Agreement the day and year first above written.

WITNESSES: LANDOWNERS:

sign _____ sign_____
type/print type/print

sign_____ sign_____
type/print type/print

WITNESSES:

sign_____ sign_____
type/print Porter County Surveyor

sign_____ sign_____
type/print Executive Director
Porter County Plan Commission

STATE OF INDIANA)
)ss.
COUNTY OF_____)

The foregoing instrument was acknowledged before me this _____day of _____,20_____, by_____.

_____
,Notary

_____County, Indiana

My commission expires:_____

STATE OF INDIANA)
)ss.
COUNTY OF_____)

The foregoing instrument was acknowledged before me this _____day of _____,20_____, by_____.

_____
,Notary

_____County, Indiana

My commission expires:_____

STATE OF INDIANA)
)ss.
COUNTY OF_____)

The foregoing instrument was acknowledged before me this _____day of_____,20_____, by the Porter County Surveyor and Porter County Plan Commission.

_____
,Notary
_____County, Indiana
My commission expires:_____

When Recorded Return To:

Porter County Surveyor
155 Indiana Ave., Suite 303
Valparaiso, IN 46383

Executive Director
Porter County Plan Commission
155 Indiana Ave., Suite 304
Valparaiso, IN 46383

Appendix IV-3

Porter County Plan Commision Drainage and Stormwater Management Permit Certification of Completion and Compliance

PORTER COUNTY PLAN COMMISSION
DRAINAGE AND STORMWATER MANAGEMENT PERMIT
CERTIFICATION OF COMPLETION AND COMPLIANCE

Land Alternation/Project Name:_____

_____

Permit Number: _____ Date Permit Issued: _____

Engineer/Survey or Information:

Name: _____

Contacts: _____

Address: _____

Phone: _____ Fax: _____Email: _____

I hereby certify that:

1. I am an Indiana registered Professional Engineer or Land Surveyor;
2. I am familiar with the requirements applicable to such land alteration and Porter County Codes.
3. I have personally observed the land alteration accomplished pursuant to the above referenced Drainage and Storm-water Management Permit, and
4. To the best of my knowledge, information and belief such land alteration has been performed and completed in conformity with all permit requirements, with the exception of

   _____
   _____
   _____
   _____

Submitted By: _____ Date: _____

Approved by Department of Plan Commission

By: _____ Date: _____

Appendix V

(Not Used)

Appendix VI

(Not Used)

Appendix VII

(Not Used)

Appendix VIII

(Not Used)

APPENDIX IX-1

Approved Constructed SQUs

A. Wet Ponds

Conventional dry detention basins do not provide a permanent pool and are not recommended for general applications to meet water quality criteria, as they fail to demonstrate an ability to meet the majority of the water quality goals. In addition, dry detention basins are prone to clogging and re-suspension of previously settled solids and require a higher frequency of maintenance than wet ponds if used for untreated storm water flows. These facilities can be use in combination with appropriate water quality controls to provide channel protection, and over-bank and extreme flood storage.

1) Wet Detention Ponds:

A wet detention pond provides all of the water quality volume storage in a permanent pool. The permanent pool of water is equal to the water quality volume. Figure 1 illustrates wet detention ponds.

a) Advantages

- Creation of aquatic and terrestrial habitat (particularly for waterfowl)
- High community acceptance, landscaping, and amenity potential
- High pollutant removal efficiency and downstream channel protection when properly designed and maintained.
- Permanent pool helps to prevent scour and re-suspension of sediments
- Can be designed for combined flood control and storm water quality control
- Limited risk of groundwater quality impacts over the long term
- Can provide uptake of soluble pollutants such as phosphorus, through biological activity
- Can be used as a regional facility

b) Limitations

- Cannot be placed on steep unstable slopes
- Need base flow or supplemental water if water level is to be maintained
- Often infeasible in very dense urban areas due to space requirements
- Downstream warming can shift tropic status
- Upstream channels can be heavily impacted when wet ponds are “on line” and serve large drainage areas (>25 acres)
- Potential loss of wetlands, forest and floodplain habitat associated with poor site selection for the pool
- May need liner in higher permeable soils
- Require a large drainage area (>25 acres) to retain the permanent pool

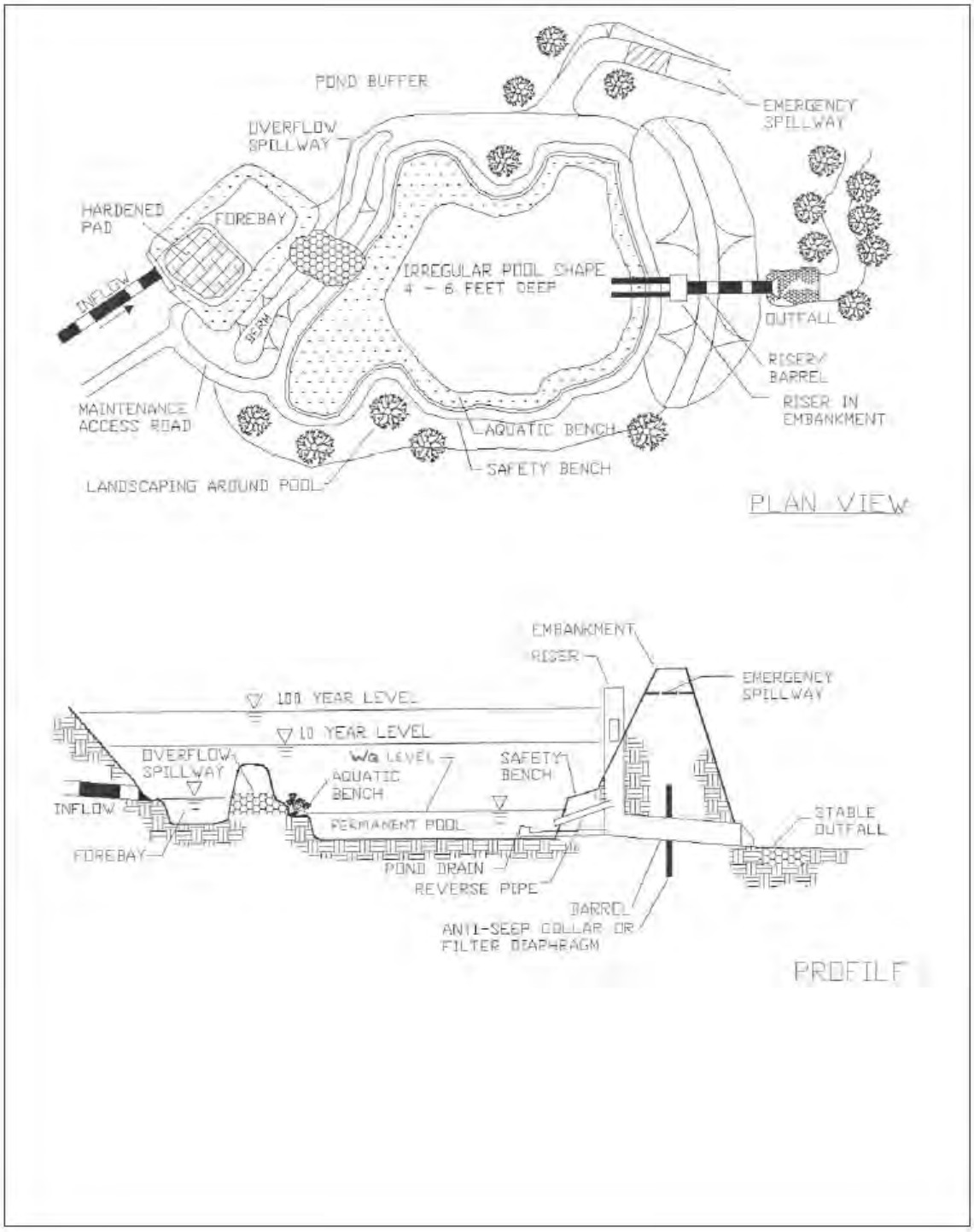

Figure 1 – Wet Pond

2) Wet Extended Detention (ED) Ponds:

A wet extended detention (ED) pond is a wet pond where the water quality volume is split evenly between the permanent pool and the extended detention storage provided above the permanent pool. A low flow channel with a minimum grade of 0.50% generally characterizes these basins. The remainder of the basin should drain towards this channel at a minimum 1% slope. This low flow channel should end at the lip of the lower stage, where riprap or gabion baffles will be placed to prevent scour and re-suspension. These ponds are suitable for any size tributary area from an individual commercial development to a large residential area. During storm events, water is detained above the permanent pond and released over 24-48 hours. This design has similar pollutant removal to a traditional wet pond, but consumes less space. Refer to Figure 2 for an example illustration of wet ED ponds.

a) Advantages

- Can create both terrestrial and aquatic wildlife habitat with appropriate pondscaping and vegetation management
- Small permanent pool allows sedimentation to occur in confined location; maintenance is relatively easier
- Can be designed for combined flood control and storm water quality control
- High pollutant removal efficiency and downstream channel protection when properly designed and maintained
- Can provide uptake of soluble pollutants such as phosphorus, through plant uptake and biological processes
- Less hazardous than other storm water ponds with deeper permanent pools

b) Limitations

- Improper site selection can create wetland, forest and habitat conflicts
- May need liner in highly permeable soils
- Possible thermal and oxygen depleted discharge can impact downstream aquatic life
- Need base flow or supplemental water if water level is to be maintained
- May be inappropriate in dense urban areas due to space concerns

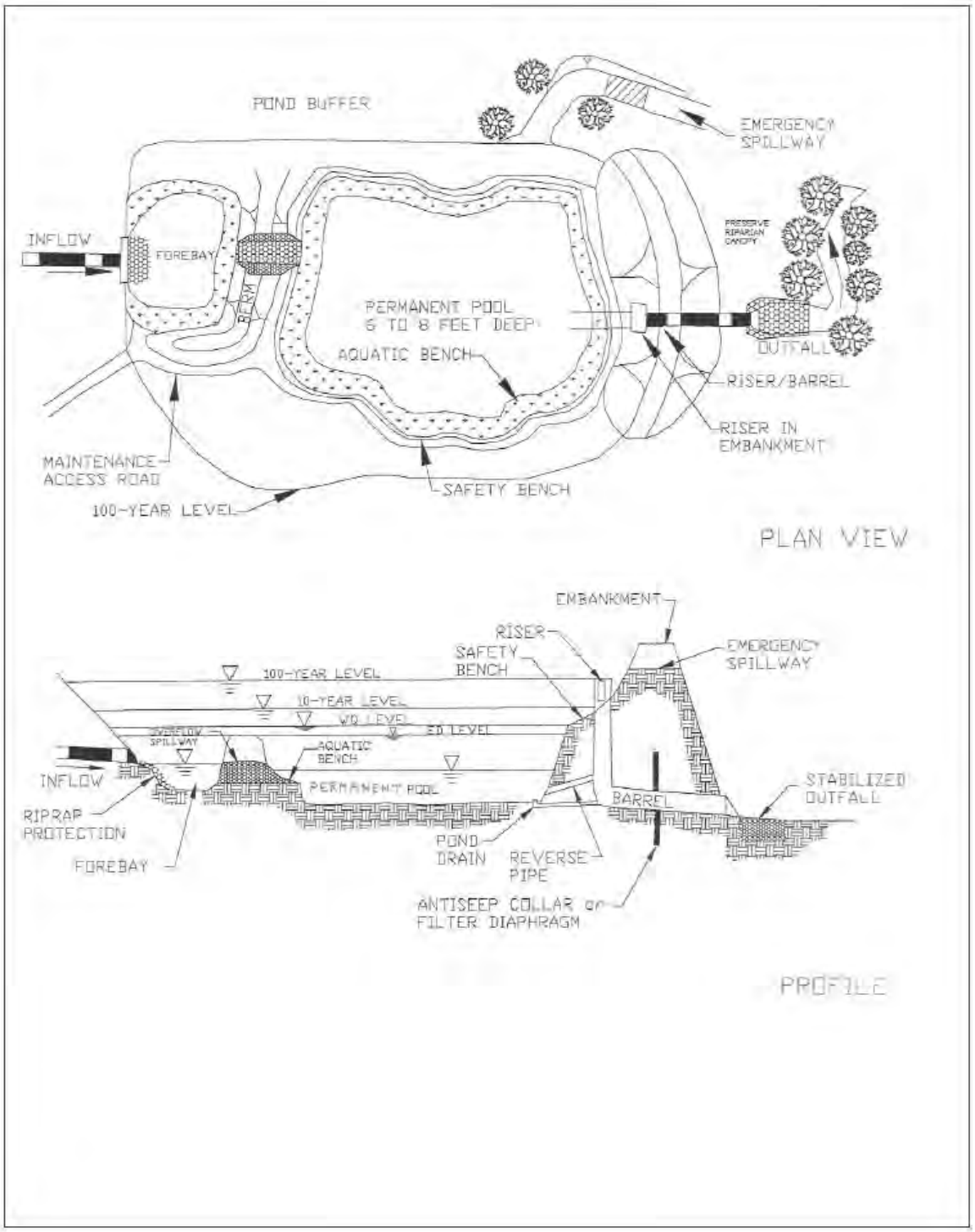

Figure 2 Wet Extended Pond

3) Micropool Extended Detention (ED) Pond:

The micro-pool extended detention pond is a variation of the wet ED pond where only a small micro-pool is maintained at the outlet to the pond. The outlet is sized to detain the water quality volume for 24 hours. The micro-pool prevents re-suspension of previously settled sediments and prevents clogging of the low flow orifice. The permanent pool volume is typically sized for approximately 0.1 inch per impervious acre. Figure 3 illustrates a micro-pool extended detention pond.

a) Advantages

- Less expensive pond option
- High pollutant removal efficiency and downstream channel protection when properly designed and maintained
- Can be designed for combined flood control and storm water quality control

b) Limitations

- Inability to vegetate banks and bottom above permanent pool may result in erosion and re-suspension of sediments
- Limitations of the water quality orifice diameter may preclude use in small watersheds
- May create mosquito breeding conditions and other nuisances if not properly constructed or maintained

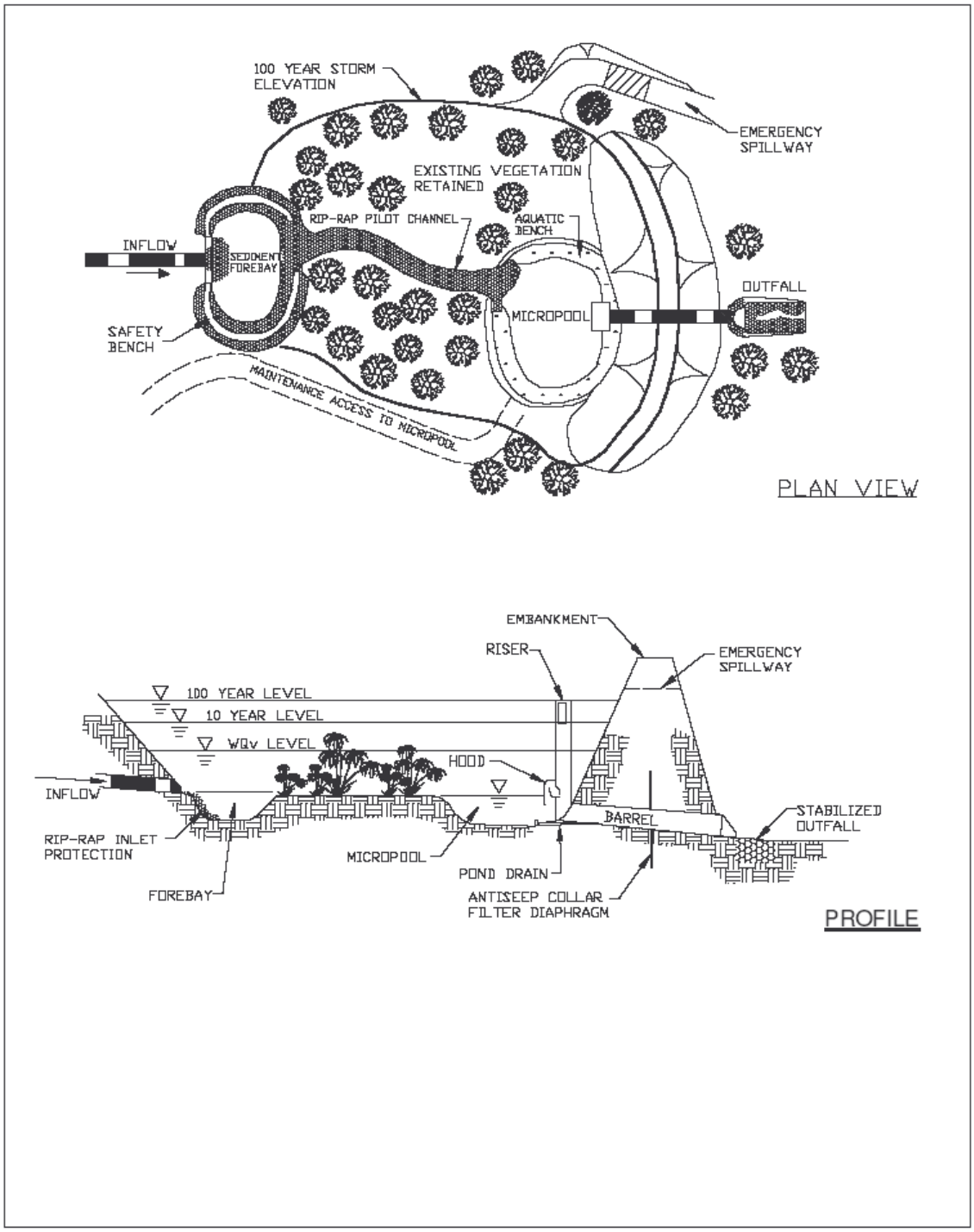

Figure 3 Micropool Extended Wet Detention

4) Multiple Pond Systems

Multiple pond systems consist of constructed facilities that provide water quality and quantity volume storage in two or more cells. The additional cells can create longer pollutant removal pathways and improved downstream protection. Figure 4 illustrates a multiple pond system.

a) Advantages

- Provide higher and more consistent levels of urban pollutant removal than a single treatment system due to longer flow paths and increased retention time
- Enhance habitat value
- High pollutant removal efficiency and downstream channel protection when properly designed and maintained
- Can de designed for combined flood control and storm water quality control

b) Limitations

- May need liner in highly permeable soils

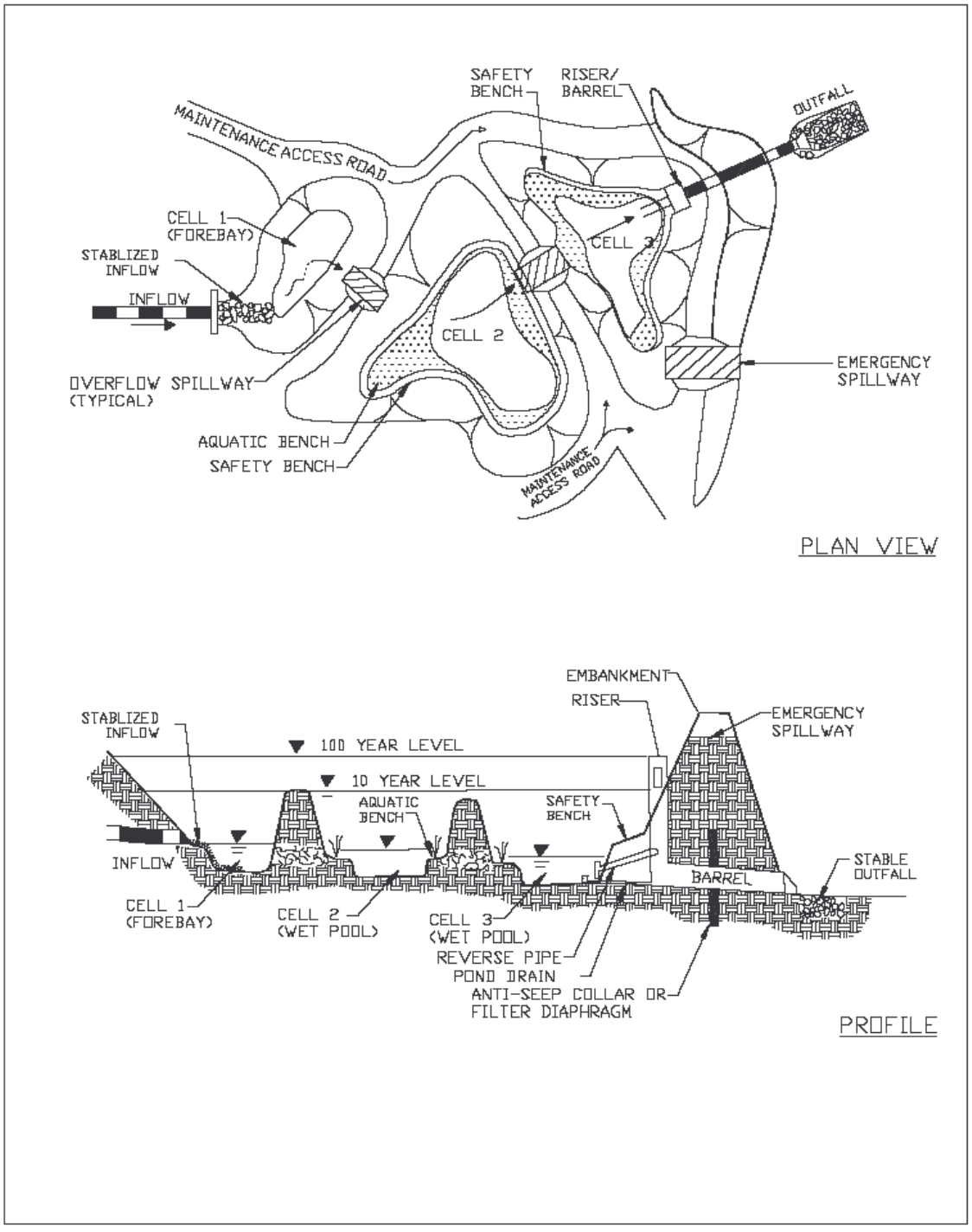

Figure 4 Multiple Pond System

5) Pocket Pond

A pocket pond drains a smaller area than a traditional wet pond and the permanent pool is maintained by intercepting the groundwater. Excavation to groundwater interception should be avoided where the land uses draining to the pond may contaminate drinking water supplies. Figure 5 illustrates a pocket pond

a) Advantages

- Can be used on site where space is at a premium, or in a retrofit situation

b) Limitations

- Somewhat high maintenance requirements
- Wet ground adjacent to the pond may provide a breeding ground for mosquitoes if not properly constructed or maintained
- Low habitat and amenity value

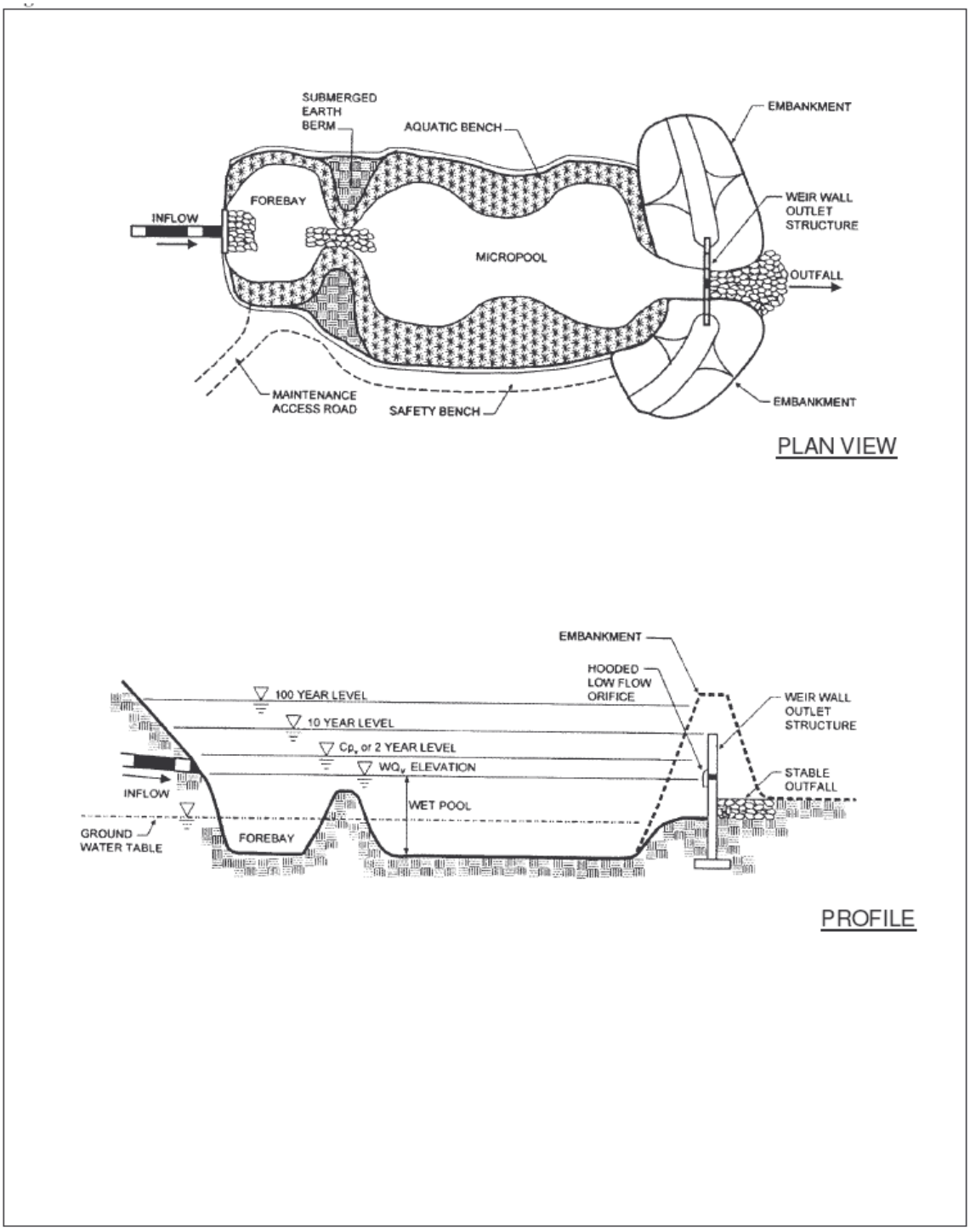

Figure 5 Pocket Pond

Table 1 **Sample Maintenance Activity Schedule for Wet Ponds**	
Activity	**Schedule**
Clean and remove debris form inlet and outlet structures; Mow side slopes	Monthly
If wetland components are included, inspect for invasive vegetation	Semiannual Inspection
Inspect for damage, paying particular attention to the control structure; Check for signs of eutrophic conditions; Note signs of hydrocarbon build-up, and remove appropriately; Monitor for sediment accumulation in the facility and forebay; Examine to ensure that inlet and outlet devices are free of debris and operational; and Check all control gates, valves, or other mechanical devices.	Annual Inspection
Repair undercut or eroded areas	As Needed
Perform wetland plant management and harvesting	Annually (if needed)
Removal of sediment from the forebay	5 to 7 years or after 50% of the total forebay capacity has been lost
Monitor sediment accumulation, and remove sediment when the pond volume has become reduce significantly, or the pond becomes eutrophic.	10 to 20 years or After 25% of the permanent pool volume has been lost

Table 2
Stormwater Pond Operation, Maintenance, and Management
Inspection Checklist for SQU Owners

Project: _____
Owner Change since last inspection? Y N
Owner Name, Phone: _____
Owner Address: _____
Location: _____
Site Status: _____
Date: _____ Time: _____
Inspector: _____

Maintenance Item	**Satisfactory/ Unsatisfactory**	**Comments**
I. Embankment and Emergency Spillway(inspect annually and after major storms)		
1. Vegetation/Ground cover adequate		
2. Embankment erosion		
3. Animal Burrows		
4. Cracking, bulging, or siding of dam		
a. Location (upstream, downstream ,toe)		
b. Description		
5. Drains clear and functioning		
6. Seeps or leaks		
7. Slope protection failure		
8. Vertical/horizontal alignment of top of dam		
9.Emergency spillway clear of obstructions		
10. other (describe)		

Maintenance Item	**Satisfactory/ Unsatisfactory**	**Comments**
II. Riser and Principal Spillway (inspect annually)		
Type: Reinforced concrete _____ Corrugated Pipe _____ Masonry _____		
1. Low Flow orifice blocked		
2. Trash rack		
a. Debris removal necessary		
b. Corrosion detected		
3. Weir trash rack		
a. Debris removal necessary		
b. Corrosion detected		
4. Excessive sediment accumulation in riser		
5. Concrete/Masonry condition		
a. Cracks or displacement		
b. Spalling		
c. Joint failures		
6. Metal pipe condition		
7. Control valve operational		
8. pond drain valve operational		
9. Outfall channels functioning		
10. Other (describe)		

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
III. Permanent Pool (Inspect monthly)		
1. Undesirable Vegetative growth		
2. Floatable removal necessary		
3. Visible pollution		
4. Shoreline problem		
5. Other (describe)		
IV. Sediment Forebay		
1.Sedimentation noted		
2. Sediment cleanout necessary (50% + full)		
V. Dry Pond Areas		
1. Vegetation/Ground cover adequate		
2. Low flow channels clear of obstructions		
3. Standing water or wet spots		
4. Sediment and/or trash accumulation		
5. Other (describe)		
VI. Other (Inspect monthly)		
1. Erosion at outfalls		
2. Endwalls and headwalls		
3. Encroachment into pond or easement area		
4. Complaints from residents		
5. Public hazards		

Additional Comments

_____
_____
_____
_____
_____

Actions to be taken:	**Timeframe:**

B) Bioretention

Bioretention areas, or rain gardens, are structural water controls developed in the early 1990's that capture and temporarily store the water quality volume using soils and vegetation in landscaped areas to remove pollutants from storm water runoff. Bioretention areas are engineered facilities in which runoff is conveyed as sheet flow to the "treatment area." consisting of a grass buffer strip, ponding area, organic or mulch layer, planting soil, and vegetation. An optional sand bed can be included in the design to provide aeration and drainage of the planting soil. The filtered runoff is typically collected and returned to the conveyance system, though it can be exfiltrated into the surrounding soil in areas with acceptable porous soils, the practice of infiltration may not be permitted in Wellfield Zoning Overlay District.

There are numerous design applications, both on – and off-line, for bioretention areas. These include single-family residential lots, small subdivisions, as off-line facilities adjacent to parking lots, along highways and road drainage swales, within larger landscaped pervious areas, and as landscaped islands in impervious or high-density environments. However, the structures are not suitable as regional storm water quality or quantity SQU's

Bioretention facilities can provide a limited amount of water quality control, with the storage provided by the facility included in the design of any downstream detention structures. Bioretention areas are designed for intermittent flow and to drain and aerate between rainfall events. Sites with continuous flow from groundwater sump pumps or other areas must be avoided.

Bioretention areas consist of:

- Grass filter strip between the contributing drainage area and the ponding area;
- Ponding areas containing vegetation with a planting soil bed,
- Organic/mulch layer, and
- Gravel and perforated pipe under-drain system to collect runoff that has filtered through the soil layers (Bioretention areas can optionally be designed to infiltrate into the soil).

Optional design components include:

- Sand filter layer to spread flow, filter run-off and aid in aeration and drainage of the planting soil;
- Stone diaphragm at the beginning of the grass filter strip to reduce velocities and spread
- Inflow diversion or an overflow structure.

Figure 6 provides an example of a boretention area.

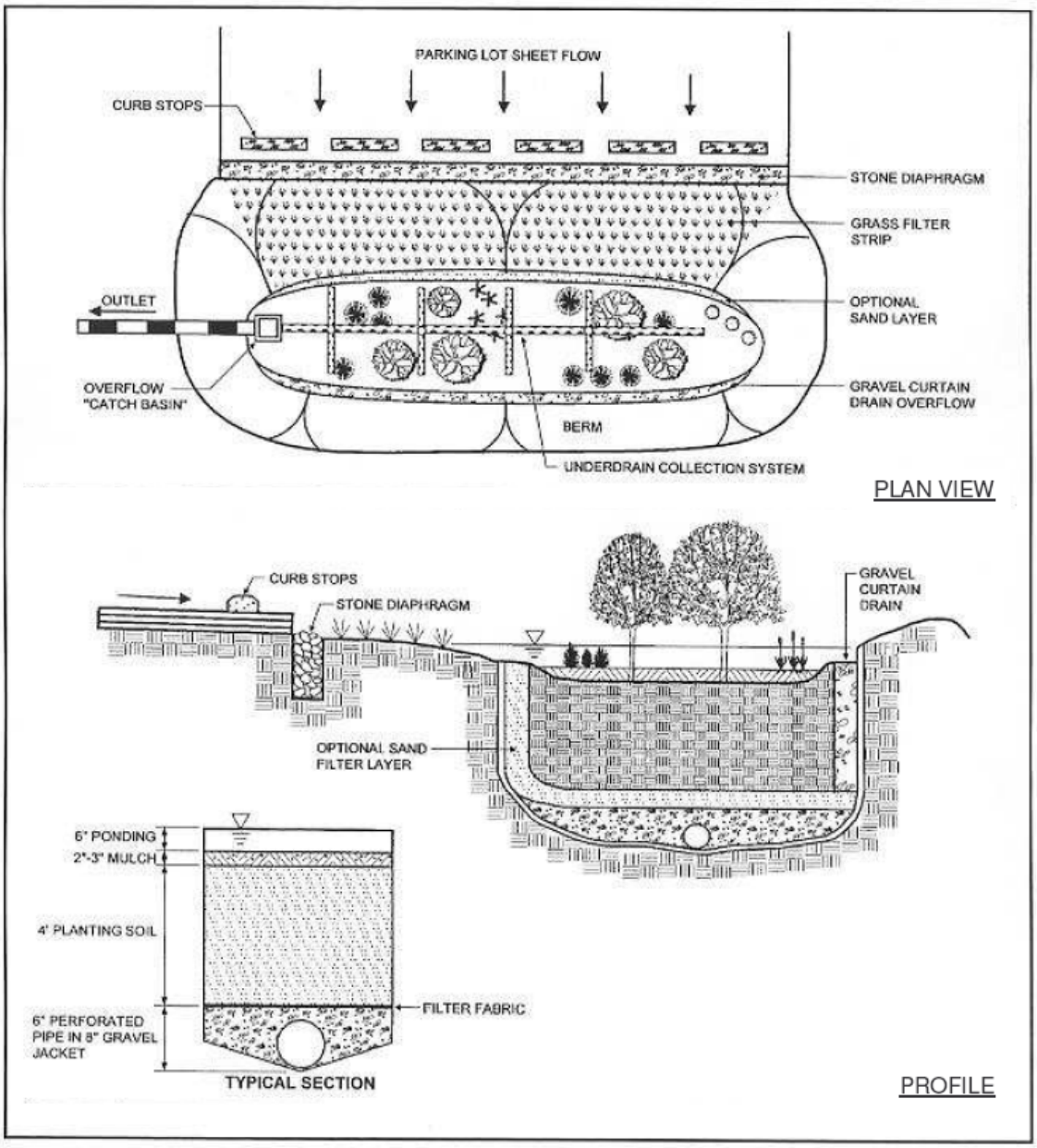

Figure 6 - Bioretention

The following design and site considerations must be incorporated into the SQU plan including bioretention areas:

1) The drainage area (contributing or effective) must be 5 acres or less (0.5 to 2 acres is preferred).
2) The minimum size for the facility is 200 ft^2, with a length to width ratio of 2:1. The slope of the site can be no more than 6%.
3) Planting soil filter bed is sized using Darcy's Law equation with a filter bed drain time of 48 hours and a coefficient of permeability (k) of 0.5 ft/day. The planting soil bed must be at least 4 feet deep. Planting soils must be sandy loam, loamy sand or loam texture with clay content rating for 10 to 25 percent. The soil must have an infiltration rate of at least 0.5 inches per hour and a pH between 5.5 and 6.5. In addition, the planting soil should have a 1.5 to 3 percent organic content and a maximum 500-ppm concentration of soluble salts
4) The maximum ponding depth in Bioretention areas is 6 inches
5) Filter strip design for pre-treatment must follow the requirements outlined and provide treatment to 25% of the $WQ_{v.}$
6) The mulch layer must consist of 2-3 inches of commercially available fine shredded hardwood mulch or shredded hardwood chips.
7) The sand bed must be 12-18 inches thick. Sand must be clean and have less than 15% silt or clay content.
8) Pea gravel for the diaphragm and curtain, where used, must be ASTM D 448 size No.6 (1/8" to1/4').
9) The underdrain collection system must be equipped with a 6 inch perforated PVC pipe in an 8-inch gravel layer. The pipe must have 3/8-inch perforations, spaced on 6-inch centers with a minimum of 4 holes per row. The pipe is spaced at a maximum of 10 feet on center, and a minimum grade of 0.5% must be maintained. A permeable filter fabric is placed between the gravel layer and the planting soil bed.
10) The required elevation difference needed form the inflow to the outflow is 5 feet.
11) The depth from the bottom of the bioretention facility to the seasonally high water table must be a minimum of 2 feet.
12) Runoff captured by facility must be sheet flow to prevent erosion of the organic or mulch layer. Velocities entering the mulch layer must be between 1-2 fps.
13) Continuous flow from groundwater, sump pumps or other areas to the bioretention area is prohibited.
14) An overflow structure and a non-erosive overflow channel must be provided to safely pass the flow from the bioretention area that exceeds the storage capacity to a stabilized downstream area. The high flow structure within the bioretention area can consist of a yard drain catch basin, with the throat of the catch basin inlet typically 6 inches above the elevation of the shallow ponding area.

15) All components of the SQU must be located within an easement. Access to the SQU must be located within the SQU, if needed.

16) If the Bioretention area is used as a sediment control measure during active construction, the performed sureties will not be released until sediment has been cleaned out of the Bioretention area and elevations and grades have been reestablished as noted in the approved storm water management plan for post-construction runoff control.

Table 3

Bioretention Operation, Maintenance, and Management Inspection Checklist for SQU Owners

Site Name: _____
Owner Change since last inspection? Y N
Owner Name, Phone:_____
Owner Address:_____
Location:_____
Site Status: _____
Date: _____ Time:_____
Inspector: _____

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
I. Debris Cleanout (Inspect monthly)		
1. Debris in bioretention area and contributing areas		
2. Litter (branches, etc.) removed		
II. Vegetation (Inspect monthly)		
1. Plant height not less than design water depth		
2. Fertilized per specifications		
3. Plant composition according to approved plan		
4. Grass height no greater than 6 inches		
5. No evidence of erosion		
III. Dewatering (Inspect monthly)		
1. Dewaters between storms		
2. No evidence of standing water		
Maintenance Item	**Satisfactory/ Unsatisfactory**	**Comments**
IV. Sediment Deposition (Inspect annually)		
1.Swale clean of sediments		
2.Sediments should be no more than 20% of the swale design depth		
V. Outlet/Overflow Spillway (Inspect annually and after major storm)		
1. No need for repair		
2. No evidence if erosion		
3. No evidence of any blockages		
VI. Integrity of Filter Bed (Inspect annually)		
1. Filter bed not blocked of filled		

Additional Comments:

_____

_____

_____

_____

_____

Actions to be taken:	**Timeframe:**

C. Water Quality Swales

Dry water quality swales are channels designed and constructed to capture and treat storm water runoff within dry cells formed by check dams or other means. Dry water quality swales are also described as biofiltration swales. These swales are designed with a limited slope for slow, shallow flow to allow particulates to settle out and to promote infiltration. Water quality swales are limited to areas with low impervious acreage, such as residential developments.

Dry swales are channels designed with a filter bed and under-drain system. They are designed to filter and infiltrate the entire WQ_v through the bottom of the swale. Runoff is collected by a perforated pipe and discharged at the outlet. Water quality swales are dry most of the time and are therefore well suited for residential areas. Refer to Figure 7 for a schematic of a dry swale.

The following site and design criteria must be followed:

1) Water quality swales treat only water quality volume. An additional measure is needed to provide detention in conjunction with the water quality swale. The swales can be designed as on-line or off-line structures. Larger storms pass non-erosively through the channels.
2) Water quality swales are limited to peak discharges generally less than 5 to 10 cfs and runoff velocities less than 2.5 ft/sec. The maximum drainage area is 5 acres. The maximum ponding time must be less than 48 hours, and a minimum ponding time of 30 minutes is recommended.
3) Pretreatment of 10% of the water quality volume should be provided. This pretreatment may be obtained by providing check dams at pipe inlet and / or driveway crossings. Additionally, all direct discharges of concentrated flow (e.g. by pipe) shall be pretreated.
4) The maximum design flow depth is 1 foot, with a ponding depth of 18 inches at the end of the channel.
5) Swale cross-section must have side slopes of 3:1 (h:v) of flatter. Bottom widths must be between 2-8 feet wide.
6) Underlying soils shall have a high permeability (fc > 0.5 inches per hour). Seasonally high water table must be greater than 3 feet below the bottom of the swale.
7) Water quality swale must have a minimum length of 100 feet.
8) Provide a sediment forebay at the inlet to the swales.
9) Locate the swale and all of its components within a drainage easement. The easement should include access to the SQU.
10) The maximum allowable length of a swale within a residential subdivision is 300 feet.
11) Swales must be completely sodden, well vegetated, and follow the natural, pre-development drainage path when possible.
12) Vegetation should be uniform with fine, turf-forming water-resistant grasses. Wetland vegetation should be used in areas with high

groundwater and/or little slope. Vegetation examples include Big Bluestem grass, Cardinal Flower, and Arrowhead.

13) Check dams may be used to enhance water quality and reduce velocities. Anti-clogging devices and/or skimmers shall be provided on each check dam and/or outlet to prevent clogging.

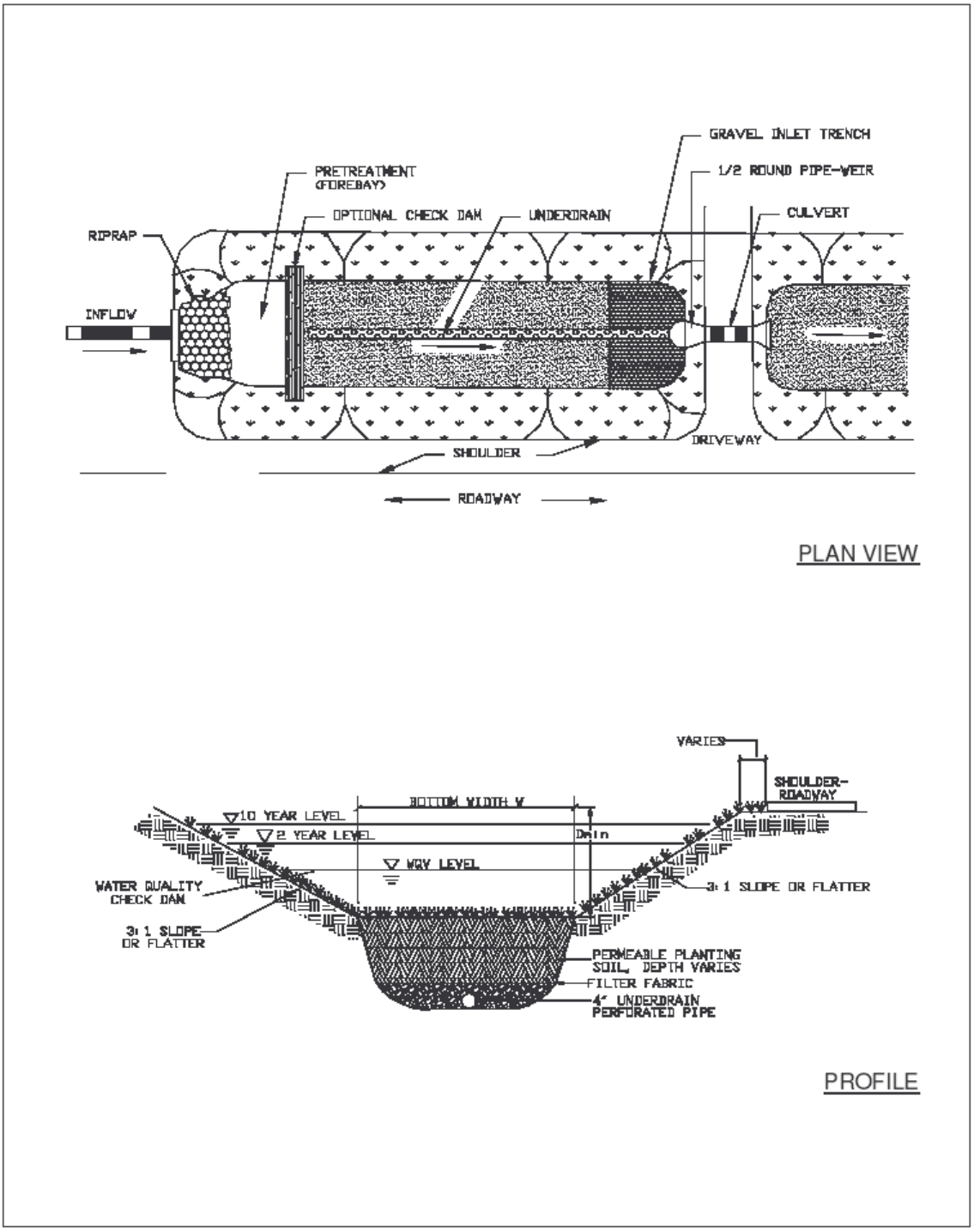

Figure 7 - Water Quality Swale

Table 4
Water Quality Swale Operation, Maintenance, and Management Inspection checklist for SQU Owners

Site Name: _____
Owner Change since last Inspection? Y N
Owner Name, Phone:_____
Owner Address:_____
Location:_____
Site Status:_____
Date: _____
Time: _____
Inspector:_____

Maintenance Item	**Satisfactory/ Unsatisfactory**	**Comments**
I. Debris Cleanout (Inspect monthly)		
1. Contributing areas free of debris		
II. Check Dams or Energy Dissipators (Inspect annually and after major storms)		
1. No evidence of flow going around structures		
2. No evidence of erosion at downstream toe		
3. Soil Permeability		
III. Vegetation (Inspect monthly)		
1. Minimum mow depth not exceeded		
2. No evidence of erosion		
3.Fertilized per specification		
IV. Dewatering (inspect monthly)		
1. Dewaters between storms		
V. Sediment Deposition (inspect annually)		
1. clean of sediment		

Additional Comments:

_____
_____
_____
_____
_____

Actions to be taken:

	Timeframe:

D. Biofilters

Biofilters are densely vegetated sections of land, designed to treat runoff from and remove pollutants through vegetative filtering and infiltration. Biofilters must receive runoff from adjacent areas as sheet flow. The vegetation slows the runoff and filters out sediments and other pollutants. However, the TSS removal provided is less than 80 percent. Therefore, biofilters must be used in a treatment train in conjunction with other management practices to provide the 80 percent performance goal such as a wet detention pond.

Biofilters are best suited to treating runoff from roadways, rooftops, small parking areas and pervious areas, They can be easily incorporated into residential developments as land-use buffers and setbacks.

Allowable bio-filter variations are filter strips and riparian buffers.

1) Filter strip

A filter strip is a uniformly graded and densely vegetated strip of land. The vegetation can be grasses or a combination of grass and woody plants. Pollutant removal efficiencies are based upon a 50-foot wide strip. Refer to Figure 9 for a schematic of a Filter strip. Uniform sheet flow must be maintained through the filter strip to provide pollutant reduction and to avoid erosion.

2) Riparian buffer:

A riparian buffer is a strip of land with natural, woody vegetation along a stream or other watercourse. Besides the undergrowth of grasses and herbaceous vegetation, the riparian buffer includes deep rooted trees. The buffer area consists of three parts; an inner core buffer zone, a middle zone, and an outer buffer zone. The inner core buffer zone shall extend 25 feet form each side of a natural drainage way and 50 feet from each bank of a legal drain. The middle zone shall extend an additional 25 feet from either side of the inner core zone, the outward limit of the defined 100-year floodplain limit, or the outward limit of jurisdictional wetland habitat, whichever is greater. The outer buffer zone shall consist of an additional 20-foot setback to structures. The inner core buffer zone is to remain undisturbed during and after construction, The middle zone can be maintained by mowing or other maintenance; tree removal is allowed by permit. The outer buffer zone may consist of forest or maintained turf. Uniform sheet flow must be maintained through the filter strip to provide pollutant reduction and to avoid erosion. Refer to Figure 8 for a schematic of a riparian buffer.

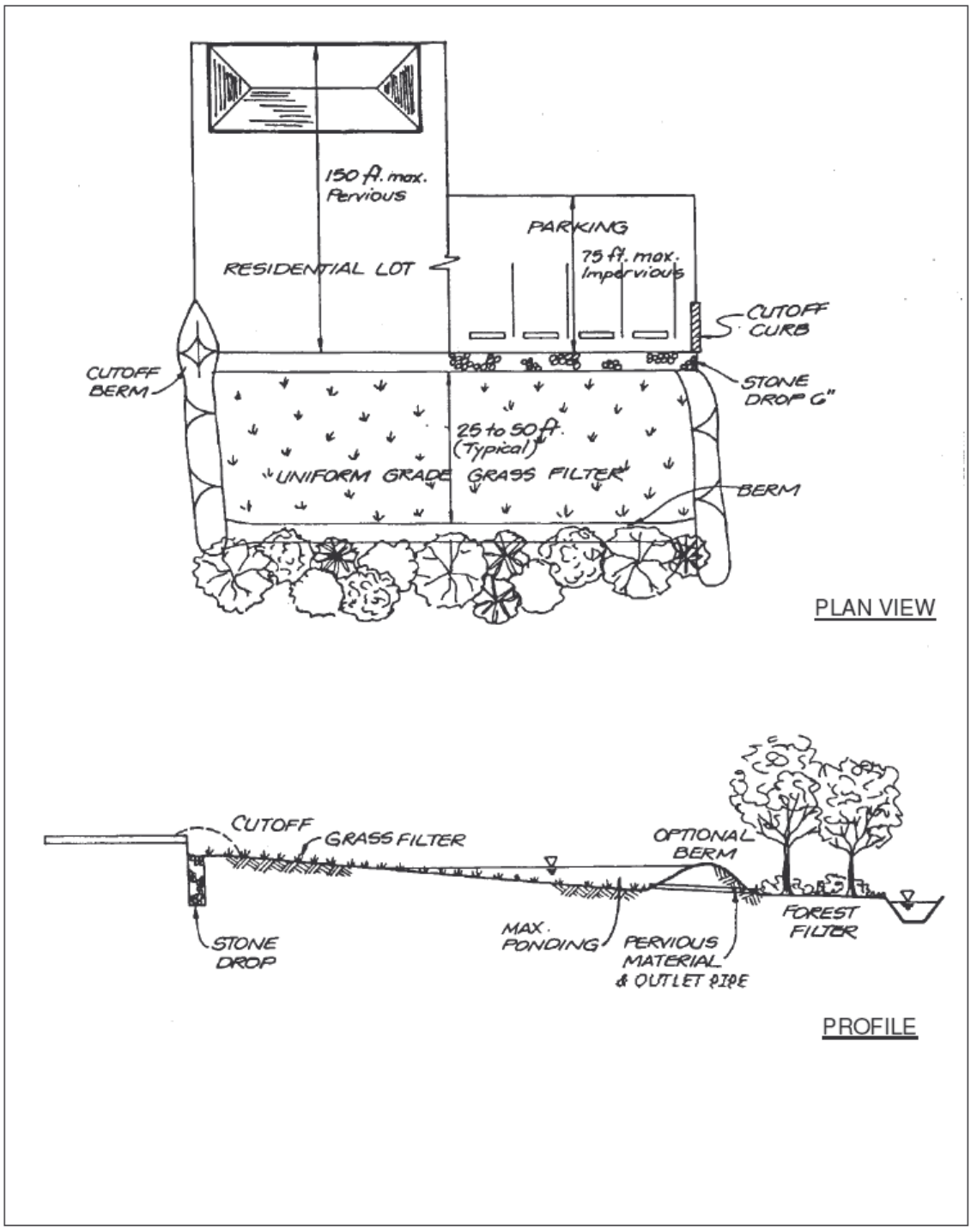

Figure 8 – Filter Strip

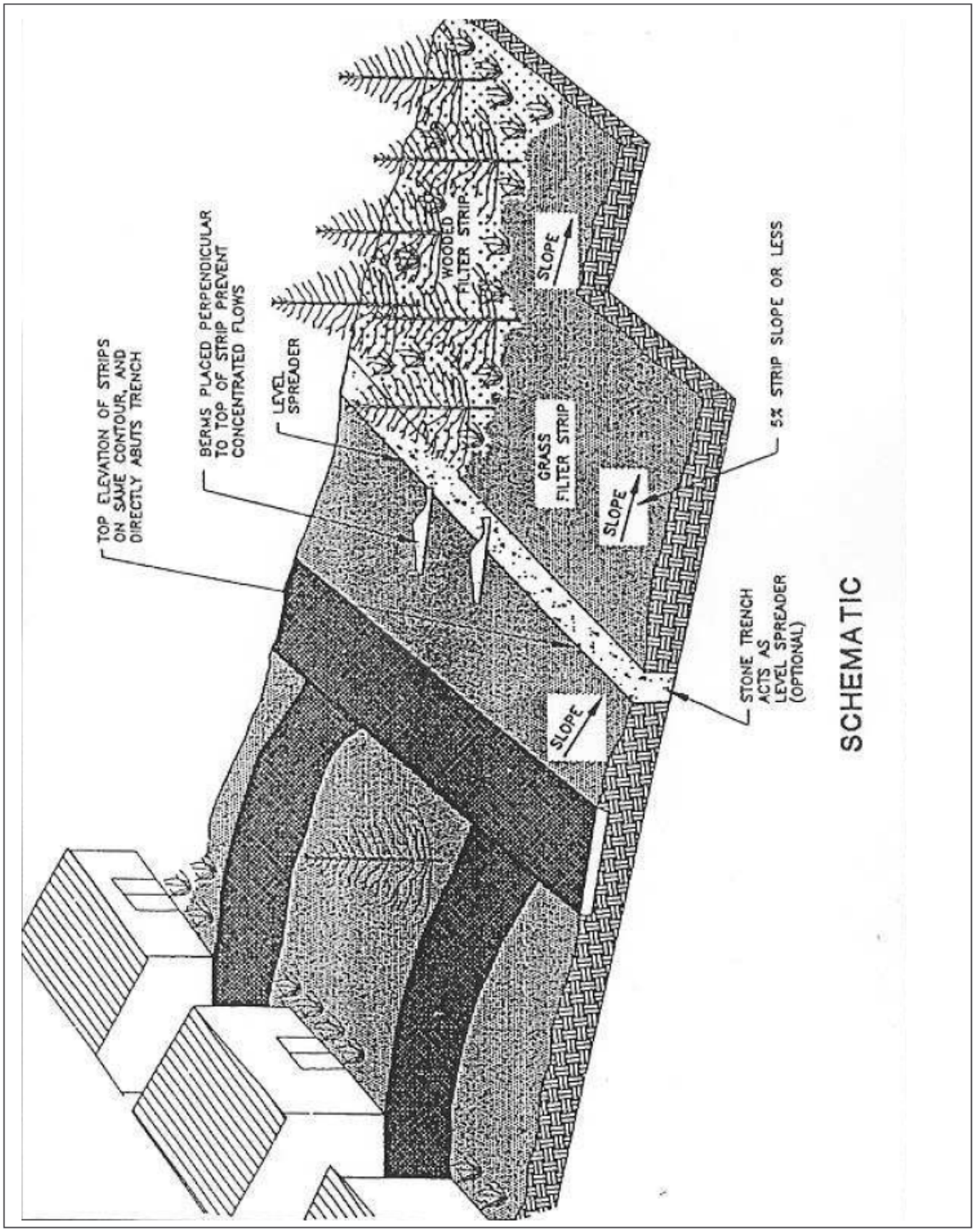

Figure 9– Filter Strip

The following site and drainage considerations must be included in the SQU plan:

1) To ensure sheet flow into the filter strips and riparian buffers, flow spreaders or level spreaders must be designed and installed where concentrated runoff flows into filter strips or riparian buffers.
2) Level Spreader: The grade of a level spreader shall be 0%. Stone trenches shall use 6 to 8 inch stone with a geo-textile underlay. The channel grade for the last 20 feet of the dike or diversion entering the level spreader must be less than or equal to 1% and designed to provide a smooth transition into spreader. The depth of a level spreader as measured from the lip must be a least 6 inches. The level spreader lip must be constructed on undisturbed soil (not fill material) to uniform height and zero grade over length of the spreader. The maximum drainage area to the level spreader shall be 10 acres or less with the optimal size being less than 5 acres. The maximum flow into the spreader must be 30 cfs or less.
3) Appropriate length, width, and depth of level spreaders shall be selected from the following table.

Design Flow (cfs)	Entrance Width (ft)	Depth (ft)	End Width (ft)	Length (ft)
0-10	10	0.5	3	10
10-20	16	0.6	3	20
20-30	14	0.7	3	30

4) Capacity of the spreader, filter strip and riparian buffer length (perpendicular to flow) must be determined by estimating the volume of flow that is diverted to the spreader for water quality control.
5) The released runoff to the outlet must be on undisturbed stabilized areas in sheet flow and mot allowed to re-concentrate below the structure.
6) Slope of the filter strip from a level spreader must not exceed 10 percent.
7) All disturbed areas must be vegetated immediately after construction.
8) The minimum filter strip width is 20 feet.
9) Filter strips must be designed for slopes between 2 percent and 6 percent.
10) Ensure that flows in excess of design flow move across and around the filter strip without damaging it.
11) Filter strips can be used effectively as pretreatment measures. The minimum sizing criteria are as follows.

Parameters	**Impervious Area**				**Pervious Area (lawns, etc.)**			
Maximum Inflow Approach Length (ft)	35		75		75		100	
Filter Strip Slope (max =6%)	<2%	>2%	<2%	>2%	<2%	>2%	<2%	>2%
Filter Strip Minimum Length	10	15	20	25	10	12	15	18

12) Riparian buffers: The use of buffers is limited to drainage areas of 10 acres or less with the optimal size being less than 5 acres.
13) Slope of the buffer from a level cannot exceed 10 percent.
14) Top edge of buffer must directly abut the contributing impervious area and follow the same elevation contour line.
15) Biofilters and level spreaders must be located within a drainage easement. A copy of the easement should be included with the SQU operations and maintenance manual.
16) A conservations easement shall be provided across the buffer area to prevent development on top of the buffer area.

Table 5
Biofilter and Buffer Operation, Maintenance, and Management Inspection Checklist for SQU Owners

Site Name: _____
Owner Change since last inspection? Y N
Owner Name, Phone:_____
Owner Address:_____
Location:_____
Site Status:_____
Date: _____
Time: _____
Inspector:_____

Maintenance Item	**Satisfactory/ Unsatisfactory**	**Comments**
I. Debris Cleanout (Inspect monthly)		
1. Plant composition according to approved plan		
2. Vegetation is healthy		
3. Grass height not more than 6 inches		
4. No evidence of erosion		

Additional Comments:
_____
_____
_____
_____
_____

Actions to be taken:	**Timeframe:**

Appendix IX-2

Approved Manufactured SQUs

Rate Based SQUs

Performance Matrix for Manufactured SQUs that remove 80% or more of OK 110 (110 micron sized Particles)

**PLEASE NOTE: All SQUs should be configured as off-line units unless a detailed hydraulic analysis and documentation is provided. The analysis must demonstrate the up- and downstream pipes will have the capacity as required by the Stormwater Design and Construction Specification Manual and surcharging created by high rainfall storms will not result in loss of previously captured material.

Table 1

Manufactured SQU	SQU System Model	Max Treatment Flow (cfs)
Stormceptor® [1]	STC 450	0.3
	STC 900	0.64
	STC 2400	1.06
	STC 4800	1.77
	STC 7200	2.47
	STC 11000	3.53
	STC 16000	4.94
Downstream Defender® [1]	4 Foot Diameter	1.3
	6 Foot Diameter	4.1
	8 Foot Diameter	9.4
	10 Foot Diameter	17.7
VortSentry®	VS30	0.26
	VS40	0.58
	VS50	1.07
	VS60	1.77
	VS70	2.70
	VS80	3.90
Vortechs® [1]	1000	0.6
	2000	1.0
	3000	1.6
	4000	2.3
	5000	3.2
	7000	4.1
	9000	5.2
	11000	6.4
	16000	9.3
	PC1319 or 1319 CIP	10.9
	PC1421 or 1421 CIP	12.7
	1522 CIP	14.6

Manufactured SQU		SQU System Model	Max Treatment Flow (cfs)
		1624 CIP	16.6
		1726 CIP	18.7
		1827 CIP	21.0
		1929 CIP	23.4
		2030 CIP	25.9
		2131 CIP	28.5
		2233 CIP	31.3
		2334 CIP	34.2
		2436 CIP	37.3
		2538 CIP	40.4
		2639 CIP	43.7
		2740 CIP	47.2
		2842 CIP	50.7
		2943 CIP	54.4
		3045 CIP	58.2
		3146 CIP	62.2
		3349 CIP	70.5
		3958 CIP	98.4
		4060 CIP	103.5
Aqua-Swirl™ 2		AS-2	0.29
		AS-3	0.50
		AS-4	0.75
		AS-5	1.20
		AS-6	1.70
		AS-7	2.30
		AS-8	3.00
		AS-9	3.80
		AS-10	4.70
		AS-12	6.80
CDS Technologies [1,2]	**Inline**	PMIU20_15_4	0.33
		PMIU20_15	0.33
		PMSU20_15_4	0.33
		PMSU20_15	0.33
		PMSU20_20	0.52
		PMSU20_25	0.75
		PMSU30_20	0.94
		PMSU30_30	1.41
		PMSU40_30	2.12
		PMSU40_40	2.82
	Offline	PSWC20_15	0.33
		PSWC20_20	0.52
		PSWC20_25	0.75

Manufactured SQU		SQU System Model	Max Treatment Flow (cfs)
	Offline	PSWC30_20	0.94
		PSWC30_30	1.41
		PSWC40_30	2.12
		PSWC40_40	2.82
		PSWC56_40	4.23
		PSWC56_53	6.58
		PSWC56_68	8.93
		PSWC56_78	11.75
		PSW30_30	1.41
		PSW50_42	4.23
		PSW50_50	5.17
		PSW70_70	12.22
		PSW100_60	14.10
		PSW100_80	21.62
		PSW100_100 [b]	30.08
ADS Stormwater Quality Units[2]		3620WQB	0.7
		3640WQB	1.6
		4220WQB	0.86
		4240WQB	1.83
		4820WQB	1.13
		4840WQB	2.39
		6020WQB	1.47
		6040WQB	3.12

[1] *Temporary Approval*
[2] *Off-line use only*

Volume Based SQUs*

Table 2

Manufactured SQU	SQU System Model	Max Treatment Flow (cfs)
Stormvault®	N/A	N/A*

*Storage volume to be calculated per Section IX.

Checklist 1 - Stormceptor Checklists

The following notes / maintenance items should be included in the operations and Maintenance Manual (O & M Manual):

1) The maximum sediment depth should be clearly specified, e.g. 8”.

2) Graphical and written description of sediment measuring procedure. This should include the use of a dipstick tube equipped with a ball valve (e.g. Sludge Judge®)

3) Oil removal procedure during routine cleanout.

4) The O & M Manual should specify if entry into the SQU should be considered an OSHA confined space and guidelines followed.

5) The O & M Manual should clearly state water and sediment from cleaning procedures should NOT be dumped into a sanitary sewer.

6) A minimum inspection frequency of 6 months should be specified in the narrative and the tabular inspection schedule.

7) Off-line configurations must include inspection and maintenance of connecting manhole and diversion weir.

8) Detail drawing of proposed SQU should be included.

9) Note in the manual to clean unit immediately if there is a hydrocarbon spill (e.g. gasoline or oil).

10) A note should be provided indicating disposal of all sediment must be in accordance with all federal, state and local requirements.

The following items should be specified on all plans referencing a Stormceptor SQU submitted for approval:

1) The elevation of the outlet pipe should be a minimum of 1” (0.0833’) below the elevation of the inlet pipe.

2) There is a minimum requirement for 2 ft of cover above the crown of the pipe to grade for the unit.

3) A 6” stone base should be shown on the detail.

4) The backfill should be specified as required by the adjoining pipe.

5) Detail drawing of SQUs should be included on plans.

6) Detail of connecting structures and diversion for off-line configurations should be included.

The following requirements should be addressed in drainage design reports:

1) The design storm must not create a hydraulic tailwater condition on the SQU. A first flush hydraulic gradeline evaluation should be included in the report.

2) The design storm should be the peak runoff for a 0.3 inch rainfall depth using the Appropriate Huff, 50% rainfall distribution. The contributing watershed should be modeled with the pervious and impervious areas inputted as separate areas (i.e. not combined using a single curve number).

3) The velocity of the water entering the unit must be below 4.27 ft/s up to the treatment design flow rate.

4) The 10-yr pipe capacity up and downstream of any diversion structure should be documented with calculations to demonstrate the water surface for the 10-yr storm is below the crown of the pipe as required by the Design Manual.

5) Diversion structure design should be documented with calculations as appropriate.

Checklist 2 - Checklists for Downstream Defender

The following notes / maintenance items should be included in the operations and Maintenance Manual (O & M Manual):

1) The maximum sediment depth should be clearly specified, e.g. 8”.

2) Graphical and written description of sediment measuring procedure. This should include the use of specific equipment (e.g. Sludge Judge®).

3) Oil removal procedure during routine cleanout.

4) The O & M Manual should specify if entry into the SQU should be considered an OSHA confined space and guidelines followed.

5) The O & M Manual should clearly state water and sediment from cleaning procedures should NOT be dumped into a sanitary sewer.

6) A minimum inspection frequency of 6 months should be specified in the narrative and the tabular inspection schedule.

7) Off-line configurations must include inspection and maintenance of connecting manhole and diversion weir.

8) Detail drawing of proposed SQU should be included.

9) Note in the manual to clean unit immediately if there is a hydrocarbon spill (e.g. gasoline or oil).

10) A note should be provided indicating disposal of all sediment must be in accordance with all federal, state and local requirements.

The following items should be specified on all plans referencing a Downstream Defender SQU submitted for approval:

1) The minimum cover above the crown of the pipe to grade for the unit should be as required by Stormwater Design Manual.

2) A 6” stone base should be shown on the detail.

3) The backfill should be specified as required by the adjoining pipe.

4) Detail drawing of SQUs should be included on plans.

5) Detail of connecting structures and diversion weirs etc. for off-line configurations should be included.

The following requirements should be addressed in drainage design reports:

1) The design storm should not create a hydraulic tailwater condition on the SQU. A first flush hydraulic gradeline evaluation should be included in the report.

2) The design storm should be the peak runoff for a 0.3 inch rainfall depth using the appropriate Huff, 50% rainfall distribution. The contributing watershed should be modeled with the pervious and impervious areas inputted as separate areas (i.e. not combined using a single curve number).

3) The 10-yr pipe capacity up and downstream of any diversion structure should be documented with calculations to demonstrate the water surface for the 10-yr storm is below the crown of the pipe as required by the Design Manual.

4) Diversion structure design should be documented with calculations as appropriate.

Checklist 3 - Checklist for VortSentry

The following notes / maintenance items should be included in the operations and Maintenance Manual (O & M Manual):

1) The maximum sediment depth should be clearly specified, e.g. 8”.

2) Graphical and written description of sediment measuring procedure. This should include the use of any specific equipment (e.g. Sludge Judge®).

3) Oil removal procedure during routine cleanout.

4) The O & M Manual should specify if entry into the SQU should be considered an OSHA confined space and guidelines followed.

5) The O & M Manual should clearly state water and sediment from cleaning procedures should NOT be dumped into a sanitary sewer.

6) A minimum inspection frequency of 6 months should be specified in the narrative and the tabular inspection schedule.

7) Off-line configurations must include inspection and maintenance of connecting manhole and diversion weir.

8) Detail drawing of proposed SQU should be included.

9) Note in the manual to clean unit immediately if there is a hydrocarbon spill (e.g. gasoline or oil).

10) A note should be provided indicating disposal of all sediment must be in accordance with all federal, state and local requirements.

The following items should be specified on all plans referencing a VortSentry SQU submitted for approval:

1) The minimum cover above the crown of the pipe to grade for the unit should be as required by Stormwater Design Manual.

2) A 6” stone base should be shown on the detail.

3) The backfill should be specified as required by the adjoining pipe.

4) Detail drawing of SQUs should be included on plans.

5) Detail of connecting structures and diversion weirs etc. for off-line configurations should be included.

The following requirements should be addressed in drainage design reports:

1) The design storm should not create a hydraulic tailwater condition on the SQU. A first flush hydraulic gradeline evaluation should be included in the report.

2) The design storm should be the peak runoff for a 0.3 inch rainfall depth using the appropriate Huff, 50% rainfall distribution. The contributing watershed should be modeled with the pervious and impervious areas inputted as separate areas (i.e. not combined using a single curve number).

3) Diversion structure design should be documented with calculations as appropriate.

4) The 10-yr pipe capacity up and downstream of any diversion structure should be documented with calculations to demonstrate the water surface for the 10-yr storm is below the crown of the pipe as required by the Design Manual.

Checklist 4 - Checklist for Vortechs Sytems

The following notes / maintenance items should be included in the operations and Maintenance Manual (O & M Manual):

1) The maximum sediment depth should be clearly specified, e.g. 8”.

2) Graphical and written description of sediment measuring procedure. This should include the use of any specific equipment (e.g. Sludge Judge®).

3) Oil removal procedure during routine cleanout.

4) The O & M Manual should specify entry into the SQU should be considered an OSHA confined space and guidelines followed.

5) The O & M Manual should clearly state water and sediment from cleaning procedures should NOT be dumped into a sanitary sewer.

6) A minimum inspection frequency of 6 months should be specified in the narrative and the tabular inspection schedule.

7) Off-line configurations must include inspection and maintenance of connecting manhole and diversion weir.

8) Detail drawing of proposed SQU should be included.

9) Note in the manual to clean unit immediately if there is a hydrocarbon spill (e.g. gasoline or oil).

10) Inspection of each chamber for sediment should be addressed.

11) A note should be provided indicating disposal of all sediment must be in accordance with all federal, state and local requirements.

The following items should be specified on all plans referencing a Vortechs SQU submitted for approval:

1) The minimum cover above the crown of the pipe to grade for the unit should be as required by Stormwater Design Manual.

2) A 6” stone base should be shown on the detail.

3) The backfill should be specified as required by the adjoining pipe.

4) Detail drawing of SQUs should be included on plans.

5) Detail of connecting structures and diversion weirs etc. for off-line configurations should be included.

6) Note on detail for contractor to level unit.

The following requirements should be addressed in drainage design reports:

1) The design storm should not create a hydraulic tailwater condition on the SQU. A first flush hydraulic gradeline evaluation should be included in the report.

2) The design storm should be the peak runoff for a 0.3 inch rainfall depth using the appropriate Huff Quartile, 50% rainfall distribution. The contributing watershed should be modeled with the pervious and impervious areas inputted as separate areas (i.e. not combined using a single curve number).

3) Inlet must be 90 degrees to side of unit.

4) The unit MUST be off-line if peak design flow greater than 100 gpm / ft^2 (0.22275 cfs / ft^2) of treatment (grit) chamber.

5) Diversion structure design should be documented with calculations as appropriate.

6) The 10-yr pipe capacity up and downstream of any diversion structure should be documented with calculations to demonstrate the water surface for the 10-yr storm is below the crown of the pipe as required by the Design Manual.

Checklist 5 - Checklists for Aqua-Swirl

The following notes / maintenance items should be included in the operations and Maintenance Manual (O & M Manual):

1) The maximum sediment depth should be clearly specified, e.g. 8”.

2) Graphical and written description of sediment measuring procedure. This should include the use of any specific equipment (e.g. Sludge Judge®).

3) Oil removal procedure during routine cleanout.

4) The O & M Manual should specify entry into the SQU should be considered an OSHA confined space and guidelines followed.

5) The O & M Manual should clearly state water and sediment from cleaning procedures should NOT be dumped into a sanitary sewer.

6) A minimum inspection frequency of 6 months should be specified in the narrative and the tabular inspection schedule.

7) Off-line configurations must include inspection and maintenance of connecting manhole and diversion weir.

8) Detail drawing of proposed SQU should be included.

9) Note in the manual to clean unit immediately if there is a hydrocarbon spill (e.g. gasoline or oil).

10) Inspection of each chamber for sediment should be addressed.

11) Use of adsorbent pads for oil removal from unit should be discussed.

12) A note should be provided indicating disposal of all sediment must be in accordance with all federal, state and local requirements.

The following items should be specified on all plans referencing an Aqua-Swirl SQU submitted for approval:

1) The minimum cover above the crown of the pipe to grade for the unit should be as required by Stormwater Design Manual.

2) A base of 12” of Class I material, as defined by ASTM D 2321, compacted to 95% proctor density must be provided.

3) Backfill must be Class I, compacted to 90% proctor density, extend at least 3.5 ft beyond the outside of the unit and for the full height.

4) The connection is made with a flexible connector and a sheer guard.

5) Detail drawing of SQUs should be included on plans.

6) Detail of connecting structures and diversion weirs etc. for the off-line configurations should be included.

7) A reinforced concrete pad must be provided when traffic loading (roadway, parking areas) is anticipated. The pad should extend 12" beyond the outside diameter of the unit.

8) Bollards should be installed around the unit in non-traffic areas.

The following requirements should be addressed in drainage design reports:

1) The first flush design storm should not create a hydraulic tailwater condition on the SQU outlet. A first flush hydraulic gradeline evaluation should be included in the report.

2) The design storm should be the peak runoff for a 0.3 inch rainfall depth using the appropriate Huff Quartile, 50% rainfall distribution. The contributing watershed should be modeled with the pervious and impervious areas inputted as separate areas (i.e. not combined using a single curve number).

3) Diversion structure design should be documented with calculations as appropriate.

4) The 10-yr pipe capacity up and downstream of any diversion structure should be documented with calculations to demonstrate the water surface for the 10-yr storm is below the crown of the pipe as required by the Design Manual.

Checklist 6 - Checklists for CDS Technologies

The following notes / maintenance items should be included in the operations and Maintenance Manual (O & M Manual):

1) The maximum sediment depth should be clearly specified, e.g. 8”.

2) Graphical and written description of sediment measuring procedure. This should include the use of any specific equipment (e.g. Sludge Judge®).

3) Oil removal procedure during routine cleanout (if equipped with oil baffle or if absorbants are used).

4) The O & M Manual should specify entry into the SQU should be considered an OSHA confined space and guidelines followed.

5) The O & M Manual should clearly state water and sediment from cleaning procedures should NOT be dumped into a sanitary sewer.

6) A minimum inspection frequency of 6 months should be specified in the narrative and the tabular inspection schedule.

7) Off-line configurations must include inspection and maintenance of connecting manhole and diversion weir.

8) Detail drawing of proposed SQU should be included.

9) Note in the manual to clean unit immediately if there is a hydrocarbon spill (e.g. gasoline or oil).

10) Inspection of both inner and outer areas of the screen for sediment should be addressed.

11) Disposal according federal, state and local requirements should also be noted for sediments etc.

The following items should be specified on all plans referencing a CDS SQU submitted for approval:

1) The 2400 µm must be specified and shown on the detail drawing. The 4800µm screen should not be approved.

2) The minimum cover above the crown of the pipe to grade for the unit should be as required by Stormwater Design Manual.

3) A 6” stone base should be shown on the detail.

4) The backfill should be specified as required by the adjoining pipe.

5) Detail drawing of SQUs should be included on plans.

6) Detail of connecting structures and diversion weirs etc. for off-line configurations should be included.

7) A minimum 24” access opening / casting should be shown.

The following requirements should be addressed in drainage design reports:

1) The design storm should not create a hydraulic tailwater condition on the SQU. A first flush hydraulic gradeline evaluation should be included in the report.

2) The design storm should be the peak runoff for a 0.3 inch rainfall depth using the appropriate Huff Quartile, 50% rainfall distribution. The contributing watershed should be modeled with the pervious and impervious areas inputted as separate areas (i.e. not combined using a single curve number).

3) Diversion structure design should be documented with calculations as appropriate.

4) The 10-yr pipe capacity up and downstream of any diversion structure should be documented with calculations to demonstrate the water surface for the 10-yr storm is below the crown of the pipe as required by the Design Manual.

Checklist 7 - Checklists for Stormvault®

The following notes / maintenance items should be included in the Operations and Maintenance Manual (O & M Manual):

1) A detailed cleaning procedure should be provided

2) A maximum sediment depth should be clearly specified, e.g. 8".

3) Oil removal procedure during routine cleanout.

4) The O & M Manual should specify entry into the SQU should be considered an OSHA confined space and guidelines followed.

5) The O & M Manual should clearly state water and sediment from cleaning procedures should NOT be dumped into a sanitary sewer.

6) A minimum inspection frequency of 6 months should be specified in the narrative and the tabular inspection schedule.

7) The Manual must include inspection and maintenance of connecting manhole and diversion weir.

8) Detail drawing of proposed SQU should be included.

9) Note in the manual to clean unit immediately if there is a hydrocarbon spill (e.g. gasoline or oil).

10) Inspection of each chamber or treatment zone should be addressed.

11) A note should be provided indicating disposal of all sediment must be in accordance with all federal, state and local requirements.

The following items should be specified on all plans referencing a Stormvault SQU submitted for approval:

1) The backfill should be specified as required by the manufacturer and copies provided on the plans.

2) Detail drawing of SQUs should be included on plans.

3) Detail of connecting structures and diversion weirs etc. for off-line configurations should be included.

The following requirements should be addressed in drainage design reports:

1) The WQv should be calculated per Section IX and the outlet sized to detain the that volume over 24 hrs.

2) The design of the diversion structure should be documented.

3) Diversion structure design should be documented with calculations as appropriate.

4) The 10-yr pipe capacity up and downstream of any diversion structure should be documented with calculations to demonstrate the water surface for the 10-yr storm is below the crown of the pipe as required by the Design Manual.

Checklist 8 - Checklists for ADS SQU

The following notes / maintenance items should be included in the operations and Maintenance Manual (O & M Manual):

1) The maximum sediment depth should be clearly specified, e.g. 8”, and not just referenced to diameter of unit.

2) Graphical and written description of sediment measuring procedure. This should include the use of any specific equipment (e.g. Sludge Judge®)

3) Oil removal procedure during routine cleanout.

4) The O & M Manual should specify entry into the SQU should be considered an OSHA confined space and guidelines followed.

5) The O & M Manual should clearly state water and sediment from cleaning procedures should NOT be dumped into a sanitary sewer.

6) A minimum inspection frequency of 6 months should be specified in the narrative and the tabular inspection schedule.

7) Inspection and maintenance of connecting manhole and diversion weir should be included in narrative and checklist.

8) Detail drawing of proposed SQU should be included as well as diversion structure.

9) Note in the manual to clean unit immediately if there is a hydrocarbon spill (e.g. gasoline or oil).

10) Disposal according federal, state and local requirements should also be noted for sediments etc.

11) THE MANUAL MUST CLEARLY NOTE THE UNIT MUST BE REFILLED WITH WATER AFTER EACH CLEANING.

12) Cleanout should be specified for once a year at a minimum.

The following items should be specified on all plans referencing an ADS SQU submitted for approval:

1) The bedding / backfill must be #57 or #8 stone

2) The installation details (6 steps) provided by the manufacturer should be included on the plans. They are available from the website.

3) Concrete collar around risers for traffic loading conditions.

4) The minimum cover above the crown of the pipe to grade for the unit as required by manufacturer.

5) Detail drawing of SQUs should be included on plans.

6) Detail of connecting structures and diversion weirs etc. should be included.

7) A minimum of two 24” access opening / casting should be shown.

8) All diversion structures and connecting pipes should meet the current Stormwater Design and Construction Specification Manual requirements.

The following requirements should be addressed in drainage design reports:

1) The design storm should not create a hydraulic tailwater condition on the SQU. A first flush hydraulic gradeline evaluation should be included in the report.

2) The design storm should be the peak runoff for a 0.3 inch rainfall depth using the appropriate Huff Quartile, 50% rainfall distribution. The contributing watershed should be modeled with the pervious and impervious areas inputted as separate areas (i.e. not combined using a single curve number).

3) Diversion structure design should be documented with calculations as appropriate. The diversion should be designed to limit the flow to the unit.

4) The 10-yr pipe capacity up and downstream of any diversion structure should be documented with calculations to demonstrate the water surface for the 10-yr storm is below the crown of the pipe as required by the Design Manual.