CITY OF PORTAGE

Porter County, Indiana

City Ordinance 92-5 - Drainage and Storm Water Management Ordinance

Technical Guide

April 2005

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1.0 INTRODUCTION

The City of Portage Drainage and Storm Water Management Ordinance (Reference 1) sets forth minimum standards for development activities, which require a permit. The City of Portage finds that:

- Water bodies, roadways, structures, and other property within, and downstream of the City of Portage are at times subjected to flooding;
- Flooding is a danger to the lives and property of the public and is also a danger to the natural resources of the City of Portage and the region;
- Land development alters the hydrologic response of watersheds and can result in increased storm water runoff rates and volumes, flooding, stream channel erosion, and sediment transport and deposition;
- Storm water runoff produced by land development contributes to increased quantities of water-borne pollutants;
- Storm water runoff, soil erosion, and nonpoint source pollution, due to land development within the City of Portage, have resulted in the deterioration of the water resources of the City of Portage and downstream municipalities. Increased storm water runoff rates and volumes, and the sediments and pollutants associated with storm water runoff from development projects with the City of Portage may, absent reasonable regulation and control, adversely affect the City of Portage's water bodies and water resources, and those of downstream municipalities;
- Storm water runoff, soil erosion, and nonpoint source pollution can be controlled and minimized by the regulation of storm water runoff from development;
- Adopting the standards, criteria and procedures contained in the Drainage and Storm Water Management Ordinance and implementing the same will address many of the deleterious effects of storm water runoff;
- Adopting these standards is necessary for the preservation of the public health, safety and welfare.

The purpose of this Technical Guide is to present recommended design and review procedures and guidelines for use in complying with the City's requirements. The Drainage and Storm Water Management Ordinance establishes minimum storm water management requirements and controls to protect and safeguard the general health, safety, and welfare of the public. The Drainage and Storm Water Management Ordinance seeks to accomplish, among others, the following objectives:

- To reduce flood damage;

- To minimize increased storm water runoff rates and volumes from identified new land development;

- To minimize the deterioration of existing watercourses, culverts and bridges, and other structures associated with storm water conveyance;

- To encourage water recharge into the ground where geologically favorable conditions exist;

- To prevent an increase in nonpoint source pollution;

- To maintain the integrity of stream channels for biological functions, as well as for drainage and other purposes;

- To minimize the impact of development upon stream bank and streambed stability;

- To reduce erosion from development or construction projects;

- To preserve and protect water supply facilities and water resources by means of controlling increased flood discharges, stream erosion, and runoff pollution;

- To reduce storm water runoff rates and volumes, soil erosion, and nonpoint source pollution, wherever practicable, from lands that were developed without storm water management controls meeting the purposes and standards of the Drainage and Storm Water Management Ordinance as well as future developments; and,

- To implement the minimum standards established in the Drainage and Storm Water Management Ordinance to protect water bodies from degradation resulting from changing land use where there are insufficient storm water management controls.

Definitions, formulas, criteria procedures and data are presented here in the Technical Guide to provide guidance to developers and consultants in project planning and design, and City enforcement staff in permits application and plan review. The intended use of the Guide is as an advisory guidance document to the Drainage and Storm Water Management Ordinance.

The Technical Guide presents minimum design requirements. When unusual or complex problems are encountered, it is the responsibility of the designer to identify such conditions and notify the City Engineer. In such cases, the designer shall propose an alternative higher standard, criteria, solution or methodology consistent with good planning and engineering practice and shall receive approval of the change prior to finalizing the design. Use of this Guide or the issuance of a permit does not release the designer of the design responsibility.

The City of Portage has furnished additional policy, criteria and information for the proper implementation of the water quality requirements of the Drainage and Storm

Water Management Ordinance and this Technical Guide in the form of a Drainage and Storm Water Management Best Management Practice Manual. The manual includes a list of acceptable Best Management Practices (BMPs), including the specific design criteria for each storm water practice. The manual may be updated and expanded from time to time, at the discretion of the local review authority, based on improvements in engineering, science, monitoring and local maintenance experience. BMPs that are designed and constructed in accordance with these design and sizing criteria will be presumed to meet the minimum water quality performance standards.

The material contained here is intended to provide guidance to engineers and designers in developing solutions to storm water management problems. This Guide is not intended to specify limitations on the creative design process. Within the requirements of the City of Portage Drainage and Storm Water Management Ordinance, a designer has flexibility in devising solutions. In the event of a disagreement between this Guide and the Drainage and Storm Water Management Ordinance, the Drainage and Storm Water Management Ordinance shall govern.

For reference purposes, the applicable sections of the City's Drainage and Storm Water Management Ordinance are included in the Technical Guide text and noted as "(Section X)".

1.1 General Permit Requirements

Any land alteration must be accomplished in conformance with the requirements of the City of Portage Drainage and Storm Water Management Ordinance. Virtually any land disturbing activity that changes the contour, elevation, drainage pattern, existing drainage facility; or increases the rainfall runoff rate or impermeability of the ground surface, or creates a drainage facility, including impoundments, is considered a land alteration and therefore requires a permit. In addition, construction, enlargement or location of any building on a permanent foundation other than a one or two-family dwelling or accessory structure in a non-impacted drainage area, requires a permit. Land alterations include, but are not limited to terracing, grading, excavating, constructing earthwork, drainage, installing drainage tile, filling and paving (Sections 1 and 2.G).

2.0 DEFINITIONS

Accelerated Erosion: The erosion caused by development activities that exceeds the natural processes by which the land is worn away by the action of water, wind or chemical action.

ACOE: The Army Corps of Engineers

Base Flood: The flooding having a one percent probability of being equaled or exceeded in a given year (also referred to as the 100-year flood).

Base Flood Elevation (BFE): The height of the base flood of 100-year flood in relation to the National Geodetic Vertical Datum (NGVD) of 1929.

BMP: Best Management Practices can refer to structural measures (ponds, swales, etc.) and non-structural measures (restrictive zoning, reduced impervious area, etc.) utilized for the benefit of water quality and, as appropriate, to reduce the storm water runoff rate. For the purposes of this technical guide, BMPs refer to structural water quality BMPs that comply with the "Drainage and Storm Water Management Best Management Practice Manual".

BMP Owner: The owner of the BMP, typically the property owner. The BMP owner may also be the leasee of the property in the case of a long-term lease. The leasee is considered the BMP owner only if the lease specifically states that construction by the leasee must meet applicable local codes and regulations.

Board: The City of Portage Storm Water Management Board.

Buffer Zones: Areas adjoining legal drains, natural drainageways, impacted drainage areas, wetlands and other natural features intended to provide protection from damage caused by runoff (Ordinance 00-29).

Building: An enclosed structure constructed or erected partially or wholly above ground. The term "building" includes both the above-ground and below-ground portions of the structure.

Certify: A statement that a proposed development meets the requirements of the Drainage and Storm Water Management Ordinance.

Channel: Is a natural or artificial watercourse with a definite bed and banks that conducts continuously or periodically the flow of water.

Clean Water Act: The Federal Water Pollution Control Act, 33 USC Sec 1251 et seq., as amended, and the applicable regulations promulgated thereunder.

CLOMR: A conditional Letter of Map Revision. A letter that indicates that FEMA will revise base flood elevations, flood insurance rate zones, flood boundaries, or floodways as shown on an effective FIRM or FBFM, after the as-built or record drawings confirming the proposed conditions are submitted and approved.

CLOMR-F: A Conditional Letter of Map Revision Based on Fill. A letter that indicates that FEMA will revise the base flood boundaries as shown on an effective FIRM. This letter does not apply to map revisions involving BFE or floodway delineation changes.

Conveyance: Any pipe, swale, ditch, etc. intended to carry storm water from one point to another.

Culvert: A closed conduit such as a pipe designed for the conveyance of surface drainage water under a roadway, railroad, embankment or other impediment.

Detention: The temporary storage of storm runoff in a storm water management practice with the goals of controlling peak discharge rates and / or providing gravity settling of pollutants.

Detention Facility: A manmade structure for the temporary storage of storm water runoff with a controlled release during or immediately following a storm.

Developed or Development: A land alteration that requires, pursuant to state law or local ordinance, the approval of a site plan, plat, special land use, planned unit development, rezoning of land, land division approval, private road approval or other approvals required for the construction of land or the erection of buildings or structures; provided, however, that for purposes of this Guide only, developed or development shall not include the actual construction of, or an addition, extension or modification to, an individual single-family or a two-family detached dwelling.

Developer: A person who undertakes land disturbance activities as result of development activities.

Development Site: Any land that is being or has been developed, or that a developer proposes for development.

Ditch: An earthern conveyance with side slopes steeper than 5:1 or carrying greater than 10 cubic feet per second.

Drainage: The collection, conveyance, or discharge of ground water and/or surface water.

Drainage Easement: The legal right granted by a landowner to a grantee allowing the use of private land for storm water management purposes and granting ingress and egress for the purpose of viewing the condition of the storm water management facility and maintaining the same if necessary in an emergency situation.

Drainage and Storm Water Management Facilities: All ditches, channels, conduits, retention-detention systems, tiles, swales, sewers, BMPs and other natural or artifical means of draining and treating storm water runoff from land.

Drainage Facility: All ditches, channels, conduits, levees, ponds, natural and manmade impoundments, tile, swales, sewers, and other natural or artificial means of draining surface and subsurface water from land.

Drainage and Storm Water Management Requirements: Includes the following:

1. Minimum drainage and storm water management standards stated in Section 26 of the Drainage and Storm Water Management Ordinance.

2. Regulations promulgated by the Board.

3. Obligations and requirements relating to drainage and storm water management established under the Subdivision Control Ordinance of Portage, Indiana.

4. Requirements stated under the Zoning Ordinance of Portage.

What is this reference?

5. Commitments relating to drainage made pursuant to Chapter 185 of the Indiana Acts of 1973.

6. Conditions relating to drainage attached to a grant of variance by the Board of Zoning Appeals.

7. Commitments relating to storm water quality treatment made pursuant to 327 IAC 15-5 and 327 IAC 15-13.

Engineer: The City Engineer of the City of Portage and any subordinate employee to whom he shall specifically delegate a responsibility authorized by the Ordinance.

EPA: Environmental Protection Agency

Erosion: The process by which the ground surface is worn away by action of wind, water, gravity or a combination thereof.

Erosion and Sediment Control Plan: A plan that is designed to minimize the accelerated erosion and sediment runoff at a site during construction activities and fulfills the requirements of 327 IAC 15-5 and 327 IAC 15-13.

FBFM: A Flood Boundary and Floodway Map. A floodplain management map issued by FEMA that depicts, based on detailed engineering analyses, the boundaries of the base or 100-year flood, the 500-year flood, and the floodway.

FEMA: The Federal Emergency Management Agency.

FIRM: A Flood Insurance Rate Map. A map issued by FEMA that is an official community map, on which FEMA has delineated both the special flood hazard areas and the insurance risk premium zones applicable to the community. This map may or may not include floodways.

Flood or Flooding: A general and temporary condition of partial or complete inundation of normally dry land areas resulting from the overflow of water bodies or the unusual and rapid accumulation or runoff of surface waters from any source.

Floodplain: The channel proper and the areas adjoining any wetland, lake or watercourse which have been or hereafter may be covered by the regulatory flood. The floodplain includes both the floodway and the floodway fringe districts. Generally, for the Drainage and Storm Water Ordinance, this refers to the area inundated by the base or 100-year flood.

Floodway: The channel and that portion of the floodplain adjacent to a stream or watercourse that is reserved to convey the base flood.

IDEM: The Indiana Department of Environmental Management.

Impacted Drainage Areas: Areas defined or mapped by the Board, which are unlikely to be easily drained because of one or more factors such as topography, soil type or distance from adequate drainage and storm water management facilities.

Impervious Cover: Those surfaces that do not allow storm water runoff to percolate into the ground such as asphalt, concrete, roofs, and gravel.

Infiltration: The process of percolating storm water into the subsoil.

Infiltration Facility: Any structure or device designed to infiltrate retained water to the subsurface. These structures may be above or below grade.

Landowner: The legal or beneficial owner of land, including those holding the right to purchase or lease the land, or any other person holding proprietary rights in the land.

Land Alteration: Any action taken relative to land which either:

1. Removes the natural ground cover; or
2. Changes the contour; or
3. Changes the runoff rate and / or volume; or
4. Changes the elevation; or
5. Decreases the rate at which water is absorbed; or
6. Changes the drainage pattern; or
7. Creates or changes a drainage and storm water management facility; or
8. Involves construction, enlargement or location of any building on a permanent foundation; or
9. Creates an impoundment.

Land alteration includes (by way of example and not of limitation) terracing, grading, excavating, constructing earthwork, draining, installing drainage tile, filling and paving.

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

LOMA: A Letter of Map Amendment. The official determination by FEMA that a specific structure or lot is not within a regulatory floodplain due to naturally high ground (i.e. without fill). A LOMA amends the effective FIRM.

LOMR: A Letter of Map Revision. A letter from FEMA that revises base flood elevations, flood insurance rate zones, flood boundaries, or floodways as shown on an effective FBFM or FIRM.

LOMR-F: A Letter of Map Revision Based on Fill. A letter that provides formal recognition by FEMA that either a parcel of property or a structure has been removed from the base or 100-year floodplain due to elevation based on the placement of fill. This letter does not apply to map revisions involving BFE or floodway delineation changes.

Maintenance: Cleaning, removing obstructions from and making minor repairs to a drainage and storm water management facility so that it will perform the function for which it was designed and constructed.

Maintenance Plan: A drawn and written document that illustrates the procedures and processes necessary for long-term maintenance of a drainage and storm water management facility or BMP.

NFIP: The National Flood Insurance Program. The requirements of the NFIP are codified in Title 44 of the Code of Federal Regulations.

Non-structural BMP: A BMP that is not constructed by physical means of land disturbance, such as education, public information handouts, etc.

Nonpoint Source Pollution: Pollution from any source other than from any discernible, confined, and discrete conveyances, and shall include, but not be limited to, pollutants from agricultural, silvicultural, mining, construction, subsurface disposal and urban runoff sources.

NPDES: National Pollution Discharge Elimination System.

Off-line structure: BMPs that treat only the water quality volume (WQv). Flows exceeding the WQv bypass the structure and re-enter the watercourse below the BMP.

Off-Site Facility: A storm water management measure located outside the subject property boundary described in the permit application for land development activity.

On-Site Facility: A storm water management measure located within the subject property boundary described in the permit application for land development activity.

Overland Flow Route: Streets, swales or other depressed areas that will act as open channels and convey excess stormwater runoff to storage facilities.

Pollutant: A substance which causes or contributes to pollution which includes, but is not limited to the following: any dredged spoil, solid waste, vehicle fluids, yard wastes, animal wastes, agricultural waste products, sediment, incinerator residue, sewage,

garbage, sewage sludge, munitions, chemical wastes, biological wastes, radioactive materials, heat, wrecked or discharged equipment, rock, sand, cellar dirt, and industrial, municipal, commercial and agricultural waste, or any other contaminant or other substance defined as a pollutant under the Clean Water Act.

Pollution: The alteration of the quality of waters by introduction of a material to a degree which unreasonably affects, or has the potential to unreasonably affect, either the waters for beneficial uses or the facilities which serve these beneficial uses.

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

Proprietary System: A structural BMP designed for storm water quality treatment and/or quantity control constructed of a combination of manmade materials at an off-site facility.

Record Drawings: Drawings prepared, signed and sealed by a professional engineer or land surveyor representing the final "as-built" record of the actual in-place elevations, location of structures, and topography.

Redevelopment: Any construction, alteration or improvement exceeding square feet in areas where existing land use is high density commercial, industrial, institutional or multi-family residential.

Regulated Drain: A drain, either open channel or closed tile/sewer, subject to the provisions of the Indiana Drainage Code, I.C.-36-9-27.

Retention Facility: A facility designed to completely retain a specified amount of storm water runoff without release except by means of evaporation, infiltration or trapping.

Runoff: The waters derived from melting snow or rain falling within a tributary drainage basin that exceeds the infiltration capacity of the soils of that basin.

Special Flood Hazard Area – SFHA: Lands that are subject to inundation by the regulatory flood.

Storm Drain: A system of open or enclosed conduits and appurtenant structures intended to convey or manage storm water runoff, ground water, and drainage.

Storm Water: Any surface flow, runoff, and drainage consisting entirely of water from rain storm events.

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

Storm Water Runoff: The runoff and drainage of precipitation resulting from rainfall or snowmelt or other natural events or processes.

Storm Water Treatment: The implementation of measures designed to prevent or reduce point source or nonpoint source pollution inputs to storm water runoff and water bodies.

Structural BMP: A structure designed and constructed for the purpose of storm water quality treatment.

Swale: A depressed earthen conveyance designed to convey storm water runoff with side slopes 5:1 or shallower and conveying no more than 10 cfs.

TSS: Total suspended solids.

Water Body: A river, lake, stream, creek or other watercourse or wetlands.

Water Quality Volume (WQ_v): The storage needed to capture and treat the volume of rainfall for 90% of the storm events which produce runoff in the watershed annually.

Watercourse: A permanent or intermittent stream or other body of water, either natural or man-made, which gathers or carries surface water.

Watershed: The total drainage area contributing runoff to a single point.

Wetland: An area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

3.0 DRAINAGE AND STORM WATER MANAGEMENT PERMITS

3.1 Compliance With Standards and Regulations

All land alterations accomplished in the City of Portage shall adhere to and be in compliance with the minimum drainage and storm water management standards of the Drainage and Storm Water Management Ordinance and all regulations adopted by the Board in accordance with the Drainage and Storm Water Management Ordinance, unless a variance from the minimum drainage and storm water management standards or regulations has been received pursuant to Section 22 of the Drainage and Storm Water Management Ordinance (Section 26).

Land alteration shall be carried out in conformity with all existing covenants, variance conditions, plat restrictions and building code standards of the administrative building council (Section 33).

3.2 Exemptions

With the exception of the specific exemptions listed in Section 3 of the Drainage and Storm Water Management Ordinance, nearly all land alterations will require application

for and receipt of a Board approved drainage and storm water management permit. Primary exemptions include soil testing by qualified individuals; agricultural activities; gardening; fill placed on top of natural terrain, involving a depth less than one foot, a total volume less than 50 cubic yards, a slope less than 10% and not intended to support structures; maintenance of drainage facilities; installation of septic systems, installation of utilities and driveway construction.

The regulations stated in the Drainage and Storm Water Management Ordinance apply to all land alterations other than in conjunction with the construction, enlargement or location, on a permanent foundation, in a non-impacted drainage area of a one- or two-family dwelling or accessory structure (Section 32).

Land alterations which are not on the list of exemptions but which an applicant feels qualify as an exemption must be presented to the Board in writing. The burden of proof is upon the applicant to provide the appropriate documentation upon which the Board will make their decision. Such requests will be reviewed on an individual case basis and may delay the permit approval process at the applicant's expense (Section 3).

Every applicant shall provide for drainage and storm water management, unless they file a written request to waive this requirement. Requests to waive the drainage and storm water management plan requirements shall be submitted to the Board for approval. The minimum requirements for drainage and storm water management may be waived in whole or in part upon written request of the applicant, provided that at least one of the following conditions applies:

1. It can be demonstrated that the proposed development is not likely to impair attainment of the objectives of this ordinance.

2. Alternative minimum requirements for on-site management of storm water discharges have been established in a storm water management plan that has been approved by the Board and that is required to be implemented by local ordinance.

3. Provisions are made to manage storm water by an off-site facility. The off-site facility is required to be in place, to be designed and adequately sized to provide a level of storm water control that is equal to or greater than that which would be afforded by on-site practices and has a legally obligated entity responsible for long-term operation and maintenance of the storm water practice.

4. The Board finds that meeting the minimum on-site management requirements is not feasible due to the natural or existing physical characteristics (restraints) of a site.

In instances where one of the conditions above applies, the Board may grant a waiver from strict compliance with drainage and storm water management provisions that are not achievable, provided that acceptable mitigation measures are provided. However, to be eligible for a variance, the applicant must demonstrate to the satisfaction of the Board that the immediately downstream waterways will not be subject to:

1. Deterioration of existing culverts, bridges, dams, and other structures;

2. Deterioration of biological functions or habitat;

3. Accelerated streambank or streambed erosion or sediment loading;

4. Increased threat of flood damage to public health, life and property.

Furthermore, where compliance with minimum requirements for drainage and storm water management is waived, the applicant will satisfy the minimum requirements by meeting one of the mitigation measures selected by the Board. Mitigation measures may include, but are not limited to, the following:

1. The purchase and donation of privately owned lands, or the grant of an easement to be dedicated for preservation and/or reforestation. These lands should be located adjacent to the stream corridor in order to provide permanent buffer areas to protect water quality and aquatic habitat.

2. 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 this ordinance.

3.3 Eligibility

Persons, partnerships, corporations or their designees, which will be responsible for accomplishing the land alteration, are eligible to apply for a drainage and storm water management permit (Section 4). It is the responsibility of the applicant to know the requirements of the Drainage and Storm Water Management Ordinance and prepare an application in accordance with the identified provisions.

3.4 Application Procedures

In order for a permit to be issued, the applicant must provide the following data and satisfactorily answer comments or questions from the Board or City Engineer (Section 5).

1. The applicant meets the eligibility requirements of Section 4 of the Drainage and Storm Water Management Ordinance.

2. Information and data, including a complete technical analysis and report certified by a registered professional engineer or land surveyor to support the requested land alteration. The data requirements are identified in Sections 6 and 7 of the Drainage and Storm Water Management Ordinance and outlined in the “Drainage and Storm Water Management Permit Application, Plans & Specifications”, “Design Calculations” and “BMP Operation and Maintenance” data checklists.

3. The drainage and storm water management plan and support data are compliant with the Drainage and Storm Water Management Ordinance.

4. All bonds have been posted, covenants executed and easements dedicated as required by the Board.

5. The applicable fee, computed in accordance with Sections 16, 23 and 24 of the Drainage and Storm Water Management Ordinance.

3.5 Drainage and Storm Water Management Plans

A drainage and storm water management plan fulfilling the requirements of the Drainage and Storm Water Management Ordinance shall be submitted to the Board for approval before a drainage and storm water management permit can be obtained for a proposed land alteration. The drainage and storm water management plan shall be submitted in duplicate and shall contain complete, accurate and specific information regarding the proposed land alteration and impact upon adjacent properties. The following information shall demonstrate and describe surface and subsurface drainage and storm water management strategy and shall accompany each drainage and storm water management plan submitted for approval (Section 6):

3.5.1 Construction Features (Section 6.A).

1. Scale: As appropriate.

2. North arrow on each sheet.

3. Existing land contours:

   A. 1-foot contour intervals for land slopes less than 10%.

   B. 2-foot contour intervals for land slopes equal to or greater that 10%, but less than 20%.

   C. 5-foot contour intervals for land slopes equal to or greater than 20%.

4. Benchmarks, based on NGVD 29 or NAVD 88 datum, which are easily accessible and relocatable (a benchmark not based on these datum may be assumed for areas less that three acres in size).

5. Location and vicinity map for the proposed land alteration.
6. Existing and proposed drainage and storm water management facilities, including storm drains, manholes, inlets, swales, ditches, natural or manmade drainageways, storm water outlets and Best Management Practices (BMPs). The plans shall identify:

A. Location of the drainage and storm water management facility by planimetric distances, referenced from traverse lines, USGS section lines, property markers or road centerlines. In areas where such physical features are unavailable, the State of Indiana coordinate system or other acceptable horizontal and vertical datum may be used.

B. Direction of flow.

C. Elevation of storm drain and BMP inverts.

D. Gradient of storm drain and BMPs.

E. Size of storm drain and BMPs.

F. Capacity of storm drain and BMPs.

G. A sequence describing when each post construction stormwater quality treatment BMP will be installed.

H. Overland Flow Routes.

I. Impacted Drainage areas and SFHAs.

J. Locations of Buffer Zones.

7. Plan (top portion) and profile (bottom portion) shall be shown on the same sheet. The plans shall include:

A. Scale: 1 inch = 50 feet (horizontal), 1 inch = 5 feet (vertical).

B. Appropriate right-of-way and easement limits.

C. Sufficient information downstream to show effect of the drainage and storm water management facility on the outfall channel.

D. Centerline grade of road for existing or proposed storm drains located in a pavement or shoulder area.

E. Existing grade above existing or proposed storm drain located outside of pavement or shoulder areas.

F. Profile of undisturbed earth for storm drains and BMPs constructed on fill.

8. An Erosion Control Plan (ECP) pursuant to 327 IAC 15-5 which includes but is not limited to treatment controls, temporary and permanent seeding schedule, construction schedule, and maintenance schedule.

The above items are included in the "Drainage and Storm Water Management Permit Application Checklist" found at the rear of this Guide.

3.5.2 Design Calculations (Section 6.B)

Design calculations shall be provided in a separate report and are required as part of the drainage and storm water management plan. These calculations shall be in accordance with standards of the Board and all regulations of the Drainage and Storm Water Management Ordinance. The design calculations / report shall specifically include:

1. Natural Resources Assessment

    A. Maps identifying significant natural features and resources such as undisturbed forest areas, stream buffers and steep slopes that should be preserved to retain some of the original hydrologic function of the site.

    B. A site layout and narrative indicating the conservation and preservation of significant natural features.

2. Estimation of storm water runoff.

    A. Drainage area map with an appropriate scale and base or the 100-year floodplain where applicable.

    B. Weighted runoff coefficient and / or curve number computations.

    C. Time of concentration (tc) computations.

3. Closed conduit and open channel design computations.

    A. Size of pipe or channel cross-section.

    B. Pipe or channel invert.

    C. Roughness coefficients.

    D. Flow velocities (in feet per second).

    E. Design capacities (in cubic feet per second).

    F. Energy dissipation computations

4. Head loss computations in manholes and junction chambers.

5. Hydraulic gradient computations.

6. Erosion control methods.

7. Water Quality Volume (WQv) or water quality treatment rate calculations.

8. Best Management Practices (BMPs) computations.

9. A drainage narrative describing the existing conditions and flow patterns, the proposed conditions and flow patterns, summarizing the pre- and post-developed runoff calculations, indicating if any off-site flow is entering the site, explaining the effect of the project on both downstream and upstream drainageways and lands, discussing any special considerations / assumptions, etc.

The above items are included in the "Drainage and Storm Water Management Permit Application Checklists" found at the rear of this Guide.

3.5.3 BMP Operation and Maintenance Manual

An operations and maintenance (O&M) manual is required for each BMP as part of the drainage and storm water maintenance plan. The O&M manual will include the following:

1. BMP owner name, address, business phone number, home phone number, email address, cellular pone number, pager number;

2. Site drawings (8 ½" by 11"), showing both plan and cross-section views, showing the BMP and applicable features, including dimensions, maintenance easements, outlet works, forebays, signage, connecting structures, weirs, invert elevations, etc.;

3. Guidance on owner-required routine inspections;

4. Requirement of owner to perform maintenance;

5. Guidance on routine maintenance, including mowing, litter removal, woody growth removal, signage, etc.;

6. Guidance on remedial maintenance; such as inlet replacement, outlet works maintenance, etc.;

7. Guidance on sediment removal, both narrative and graphical, describing when sediment removal should occur in order to insure that the BMP remains effective as a water quality control device;

8. A statement that the City's representatives have the right to enter the property to inspect or in an emergency and, at the owners cost, maintain the BMP;

9. A tabular schedule showing inspection and maintenance requirements; and

10. Identification of the property / BMP owner as the party responsible for maintenance, including cost.

The above items are included in the "Drainage and Storm Water Management Permit Application Checklists" found at the rear of this Guide.

3.5.4 Additional Requirements

The Board or City Engineer may request additional data and information to be included in the plans, specifications and design calculations in order to evaluate the adequacy of the proposed design plans. A registered professional engineer or land surveyor, engaged in storm drainage and storm water management design must sign a certificate of sufficiency of plan (Exhibit A) and a certificate of obligation to observe (Exhibit B) as discussed in Section 3.4 of this Guide and Sections 5 and 6 of the Drainage and Storm Water Management Ordinance.

3.6 Duration of Permit

If the land alteration for which a drainage and storm water management permit has been issued has not commenced within two years from the date of its issuance, the permit shall expire. If the drainage activity is only partially completed and no substantial land alteration has occurred on the site for a period of on year, the permit shall expire. The Board, however, will consider written requests, based on good cause, for extension of permit durations to allow the completion of work (Section 8).

3.7 Revised Plans

The applicant is expected to provide the Board with detailed and accurate plans and specifications, which fully consider the site conditions. However, revisions, which reflect deviations from approved plans will be considered by the Board, provided they are filed in duplicate, prior to the revised plan being implemented. If approved by the Board, a copy of the revised plans and specifications shall be attached to the original permit and plans at the site (Section 9).

3.8 Impacted Drainage Areas

Geographic areas, which are defined and mapped by the Board as impacted drainage areas, are considered difficult to drain because of one or more factors such as topography, soil type or distance from an adequate drainage and storm water management facility (Section 2.0 of this Guide and Sections 2.F and 10 of the Drainage and Storm Water Management Ordinance). The Board will evaluate the following, among others, in determining the impacted drainage areas:

1. A floodway or floodplain designated in the Zoning Ordinance of the City of Portage, Indiana;

2. Land within 75 feet of each bank of any legal drain;

3. Land within 50 feet of each bank of a natural drainageway, including a river, stream, gully, ditch or other definite natural watercourse;

4. Land where there is not an adequate outlet, taking into consideration the capacity of depth of the outlet.

3.9 Performance Bonds

The Board may require the owner, developer or other parties to post a performance bond, from an Indiana licensed surety company to provide surety for the satisfactory completion of the approved provisions of a drainage and storm water management permit. The bond shall name the City of Portage as the enforcement party and be in an adequate amount to cover the cost of the proposed drainage and storm water management improvements (Section 11).

As an alternative to the bond, the Board may accept other security such as a properly conditioned irrevocable letter of credit, which meets the same objectives as a performance bond.

3.10 Covenants and Easements

The Board may require the execution of covenants or easements to achieve satisfactory present and future drainage and storm water management of a parcel for which a drainage and storm water management permit is requested and the area surrounding that parcel (Sections 12 and 13).

As a minimum, the Board shall require that the following covenant be executed by the owner or owners of such land which will be included in a recorded plat:

> "It shall be the responsibility of the owner of any lot or parcel of land within the area of this plat to comply at all times with the provisions of the drainage and storm water management plan as approved for this plat by the Storm Water Management Board of the City of Portage and the requirements of all drainage and storm water management permits for this plat issued by the Board".

The drainage and storm water management plans submitted in support of a permit application shall provide sufficient detail to identify existing or proposed covenants or easements. Applicants are encouraged to identify the planimetric dimensions and location of these and to initiate contact with affected property owners prior to the submittal of the permit application.

Access easements (easement) shall be provided for all storm water conveyances and facilities to be maintained by the City of Portage. In addition, easements shall be

provided for all conveyances, including ponds, carrying or receiving runoff from off-site drainage basins and for any pond serving greater than 5 acres. Regulated Drains (proposed and existing) may have additional easement requirements to ensure the provisions of this Manual and the Drainage and Storm Water Management Ordinance are met. The City Engineer shall be contacted to determine any special requirements prior to design. All storm water conveyances must be centered within the required easement.

Storm water BMPs must maintain easements as well. Storm water ponds shall maintain the same easement as required for a detention facility. Off-line manufactured BMP structures should maintain an easement that includes the connecting manholes and the weir structure. All easements should be clearly included on the plans. Water quality easements should be included in the O&M manual as outlined in Section 3.5.3 of this Guide. On a case-by-case basis the Board may determine additional easement requirements. The Board may require such additional easement requirements as are necessary to ensure the provisions of the Drainage and Storm Water Management Ordinance and this Technical Guide are met. The following table summarizes the easement widths required:

Table 1
Easement Requirements

Storm Water Facility Description	**Minimum Easement (ft)***
Detention Pond/Facility (Serving > 5.0 ac) (including all storm water pond BMPs)	20 horizontally from the 100-year elevation of the pond or maintainance road, whichever is more restrictive – Detention facilities shall not be constructed within the public right-of-way.
Storm sewer pipe and structures < 2 feet in diameter and < 6 feet to invert	15 feet (7.5 feet from centerline of pipe)
Storm sewer pipe and structures (> 2 feet in diameter and < 6 feet deep to invert)	20 (10' from center of pipe/structure)
Storm sewer pipe and structures (> 6 feet deep to invert)	25 (12.5' from center of pipe/structure)
Drainage Ditch	15 feet minimum from top of bank
Drainage Swale	10 feet minimum from top of bank
Structural and Manufactured BMPs	20 from the outside of BMP – Manufactured BMP units must maintain 20 from the center of the unit or 10 from the outside of the unit (whichever is greater) and include the connecting manholes when in an off-line configuration
* Unless directed by the City Engineer	

Any person who violates a covenant required under Section 12 of the Drainage and Storm Water Management Ordinance or any landowner who permits such a violation to occur on their land, may be notified in writing by the City Engineer that a violation exists and shall be given a reasonable amount of time to correct such violation. Failure to correct the violation within that reasonable time will allow the City of Portage, through the Board, to correct the violation at its expense and replace a lien on the land for all expenses incurred by the City for the accomplishment of the corrective action (Section 21).

3.11 Certificate of Completion and Compliance

A Certificate of Completion and Compliance (found at the rear of this Guide) shall be filed by a registered professional engineer or land surveyor, engaged in storm drainage and storm water management design, shall be filed with the Board within 10 days after completion of the land alteration (Section 14). This is a requirement of the permit process and failure to follow this may invalidate the permit.

3.12 Inspections

The City Engineer or authorized representatives may make inspections at any time upon, around or about the premises. Such inspections may be made before; during or after the land alteration is completed. The purpose, among other reasons, is to verify compliance with the provisions of the Drainage and Storm Water Management Ordinance and the permit approved by the Board for the improvements. Applicants and their representative shall afford the appropriate City staff an opportunity for inspection and make a copy of the plans, specifications and permit available at the site (Section 15).

3.13 Revocation of Permits

The Board may revoke a drainage and storm water management permit where the application, plans or support documents required by Section 5 of the Drainage and Storm Water Management Ordinance reflect (Section 17):

1. A false statement or misrepresentation of facts; or

2. Lack of compliance with drainage and storm water management requirements; or

3. Failure to comply with Sections 3, 4, 5, 6, 7 or 9 of the Drainage and Storm Water Management Ordinance; or

4. Failure to post bond, execute covenants or dedicate easements as required by the Board and described in Sections 11, 12 and 13, respectively of the Drainage and Storm Water Management Ordinance.

3.14 Stop-Work Orders

Stop-work orders, which require the suspension of a land alteration may be issued whenever the City Engineer, Building Commissioner or authorized representatives discover any of the circumstances listed below (Section 18):

1. Land alteration proceeding in an unsafe manner; or

2. Land alteration occurring in violation of a drainage and storm water management requirement and in a way that may not be easily corrected; or

3. Land alteration accomplished in violation of a drainage and storm water management requirement after the applicant has received written notification of the violation; or

4. Land alteration, which requires a drainage and storm water management permit, is proceeding without a drainage and storm water management permit.

The City of Portage will follow the procedures listed below when issuing stop-work orders (Section 18):

1. Notification shall be in writing;

2. Identification of the land alteration which is in violation;

3. Citation of the Drainage and Storm Water Management Ordinance regulation which has been violated;

4. The conditions under which the land alteration may be resumed;

5. One copy of the stop-work order shall be posted on the parcel of land in a conspicuous manner;

6. One copy of the stop-work order shall be delivered to the permit applicant;

7. If convenient, copies shall be delivered to the person performing the land alteration and the owner of the parcel of land.

3.15 Civil Action

The City may initiate civil action to restrain any person, partnership, corporation or their designees from performing a land alteration, which violates either a drainage and storm water management requirement or plans and specifications filed for a drainage and storm water management permit. Additionally, the City may initiate civil action against land owners which allow either a drainage and storm water management requirement or plans and specifications filed for a drainage and storm water management permit to be violated

through a land alteration. The reasons for a civil action shall include, but not be limited to (Section 19):

5. Enforcing the provisions of a stop-work order;

6. Preventing the accomplishment of a land alteration in violation of a drainage and storm water management requirement;

7. Requiring accomplishment of a land alteration in accordance with either drainage and storm water management requirements or plans and specifications filed for a drainage and storm water management permit.

3.16 Penalties

Any person, partnership or corporation violating the provisions or minimum standards of the Drainage and Storm Water Management Ordinance or regulations promulgated by the Board with regards to the Drainage and Storm Water Management Ordinance shall be guilty of a misdemeanor and may be fined up to $1,000.00 (Section 20).

The revocation of a permit, issuance of a stop-work order, initiation of civil action or assessment of penalties shall not limit the assessment of other penalties or fines provided by the Drainage and Storm Water Management Ordinance (Sections 17.B, 18.B, 19.B and 20). Refer to the section regarding additional penalties when an application for a drainage and storm water management permit is made after a land alteration is commenced (Section 3.18 of this Guide and Section 16 of the Drainage and Storm Water Management Ordinance).

3.17 Variance Procedure

The Board may modify or waive any minimum standard found in the Drainage and Storm Water Management Ordinance provided that an applicant for a drainage and storm water management permit can demonstrate that (Section 22):

1. A minimum drainage and storm water management standard regulation is unfeasible or unreasonably burdensome, and

2. An alternative plan submitted by the applicant will achieve the same objectives and purpose.

The request for a variance shall be made in writing, including all necessary support information and be provided to the City Engineer who shall make a recommendation to the Board within 20 days. Thereafter, the Board shall either grant or deny the variance request (Section 22).

3.18 Applications Fees

The Board shall have the power to determine the amount of fees (Section 23). Fees for drainage and storm water management permits shall be collected by the Clerk-Treasurer for the City of Portage (Section 25).

Fees for all land alterations shall be required as specified in Section 23 of the Drainage and Storm Water Management Ordinance, except for the following (Section 24):

1. Land Alteration for which a fee cannot be charged by the City of Portage because of a federal or state law, or

2. Land alteration accomplished by an employee or contractor of the City of Portage in the course of government duties.

If a land alteration requiring a drainage and storm water management permit is commenced by the permit applicant without compliance with the provisions of Section 3 of the Drainage and Storm Water Management Ordinance, the permit fee shall be double the applicable amount defined in Section 23 of the Drainage and Storm Water Management Ordinance. Furthermore, if such land alteration is completed or substaintially completed, the permit fee shall be 10 times the applicable amount defined in Section 23 of the Drainage and Storm Water Management Ordinance. The maximum fee incurred shall be $300.00 plus the amount of the normal fee for the permit (Section 16).

4.0 PERFORMANCE CRITERIA FOR DRAINAGE AND STORM WATER MANAGAMENT FACILTIES

A drainage and storm water management facility for a parcel shall be provided which allows drainage and treatment of storm water runoff from each portion of the parcel as well as the upstream area, which drains through the parcel (Section 34). The drainage and storm water management facility shall (Section 35):

1. Accommodate the storm water runoff from the required rainfall event or greater without endangering public safety and health or causing significant damage to the property;

2. Be designed to treat the Water Quality Volume (WQ_v) or the water quality treatment rate.

3. Be durable;

4. Be easily maintained;

5. Be safe to persons;

6. Minimize off-site sedimentation to the maximum extent practicable; and

7. Minimize erosion to the maximum extent practicable.

Additionally, the drainage and storm water management facility should be designed (References 2 and 3) to operate in accordance with the provisions of the Drainage and Storm Water Management Ordinance.

4.1 Runoff Within the Parcel

Runoff quantities shall be computed for the area of the parcel under development plus the area of the watershed flowing into the parcel under existing or future development conditions (Section 36). At least one waterway opening shall be provided for each watershed at the upstream edge of the parcel to accept upstream drainage (Section 38).

Reasonable future development for the area upstream of the parcel should be considered. The nature of future development shall be that projected by the Comprehensive Land Use Plan for the City of Portage adopted by the Plan Commission or that allowed by current zoning districts, whichever reflects the more intense use. The amount of runoff not accommodated in connection with such future development shall be determined by good engineering practice and may assume use of retention-detention systems except for:

1. Land alteration not requiring a permit;

2. Parcels too small for a retention-detention facility;

3. Parcels where it is technically unfeasible to use a retention-detention facility;

4. Parcels where the cost of a retention-detention facility is substantially higher than the cost of providing for increase runoff capacity through the parcel.

Improvements such as retention-detention facilities may be included when the conditions of the land makes use of such improvements feasible and appropriate (Section 36).

4.1.1 Calculations of Runoff

The quantity of runoff which is generated as the result of a given rainfall intensity may be calculated as follows:

1. For areas up to and including 5 acres, the Rational Method may be used. In the Rational Method, the peak rate of runoff, Q, in cubic feet per second is computed as:

$$Q=CIA$$

where: C = runoff coefficient, representing the characteristics of the drainage area and defined as the ratio of runoff to rainfall. I = average intensity of rainfall in inches per hour for a duration equal to the time of concentration (tc) for a selected rainfall frequency.

A = tributary drainage area in acres. Guidance to selection of the runoff coefficient "C" is provided by Tables 2 and 3, which show values for different types of surface and local soil characteristics. The composite "C" value used for a given drainage area with various surface types should be the weighted average value for the total area calculated from a breakdown of individual areas having different surface types. Table 4 provides runoff coefficients different land use classifications. In the instance of undeveloped land situated in an upstream area, a coefficient or coefficients should be used for this area in its present or existing state of development.

Rainfall intensity should be determined from the rainfall frequency curves shown in Figure 1 or from data shown in Table 5. The time of concentration (tc) to be used should be the sum of the inlet time and flow time in the drainage facility from the most hydraulically distant point of the drainage area to the point under consideration. The flow time in the storm sewers may be estimated by the distance in feet divided by velocity of full flow in feet per second. The velocity should be determined by the Manning Equation. All times-of-concentration calculations shall be done using the methodology outlined in NRCS TR-55 (Worksheet 3).

Inlet time is the combined time required for the runoff to reach the inlet of the storm sewer. It includes overland flow time and flow time through established surface drainage channels such as swales, ditches and sheet flow across such areas as lawns, fields, and other graded surfaces.

2. The runoff rate for areas in excess of 5 acres should be determined by methods described in Section 4.5.6 of this Guide.

Table 2
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 3
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 4
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 Acres Lots	0.31	0.35	0.39
Parkland	0.18	0.20	0.22

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

Table 5
Rainfall Intensities for Various Return Period and Storm Durations

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

4.1.2 Amount of Runoff to be Accommodated by Various Parts of the Drainage and Storm Water Management Facility

Various parts of a drainage and storm water management facility should accommodate storm water runoff as follows:

1. The minor drainage and storm water management system such as inlets, catch basins, street gutter, swales, sewers and small channels, which collect storm water, should accommodate peak runoff from a post developed 10-year return period storm. Rainfall duration should be equal to the time of concentration for the rational method. The appropriate Huff rainfall distribution should be used to determine the peak runoff for hydrograph / computer modeling methods. These minimum requirements should be satisfied:

    A. The allowable spread of water on collector streets is limited to maintaining two clear 10-foot moving lanes of traffic. One 10-foot lane is to be maintained for local roads.

    B. Open channels carrying peak flows greater than 30 cubic feet per second should be capable of accommodating peak runoff for a 50-year return period storm within the drainage easement.

    C. Culverts should be capable of accommodating peak runoff from a 50-year return period storm when crossing under a road which is part of the Indiana Department of Highways rural functional classification system and are classified as principal or minor arterial, major or minor collector roads.

2. Major drainage and storm water management systems are those carrying runoff from an area of one or more square miles, and should be designed in accordance with Indiana Department of Natural Resources Standards.

4.1.3 Water Quality Volume/Rate Calculations

In order to protect and maintain water quality, a portion of the storm water runoff created by the development project must be treated. All development projects requiring drainage and storm water management permits are required to treat their runoff. BMPs may be designed to treat on a volumetric basis or flow rate basis.

The runoff volume to be treated or the peak flow rate to be treated by a BMP shall be determined by the following methods.

1. The Water Quality Volume (WQ_v) is the storage needed to capture and treat the storm water runoff from the first one-inch of rainfall. In numerical terms, it is equivalent to an inch of rainfall multiplied by the volumetric runoff coefficient (R_v) and the site area.

    The following equation is used to calculate WQ_v (in acre-feet):

$$\mathbf{WQ_v = \frac{(P)\ (R_v)\ (A)}{12}}$$

where:

WQ_v = water quality volume (acre-feet)
P = 1 inch of rainfall
R_v = 0.05 + 0.009(I) where I is the <u>percent</u> impervious cover (expressed as a percent value not a fraction or decimal)
A = area in acres

2. The peak water quality treatment rate shall be determined using hydrograph generation methods. The hydrograph shall use the Huff 1st Quartile, 50% distribution with a 1 inch rainfall and a one hour storm duration. The peak rate of this hydrograph shall be used as the minimum water quality treatment rate. Alternatively, the TR-55 Graphical Peak Discharge Method can be used to determine the peak water quality treatment rate. Similarly, a 1-inch rainfall shall be used.

   Documentation for all proposed proprietary or manufactured BMPs shall be provided clearly demonstrating the BMP will remove 80% of the particles listed below at this peak flow rate.

Runoff Particle Distribution

Particle Size (μm)	% of TSS
250	20
125	40
75	40

4.2 Runoff Downstream of the Parcel

The drainage and storm water management facility within the parcel shall be designed such that there will be no increase in peak discharge, pollutant loads, or runoff rates as a result of the development unless the downstream facilities are sufficient to accept (Section 37):

1. The post development runoff from the parcel; plus

2. The present runoff from developed areas upstream; plus

3. The present runoff from undeveloped areas upstream; plus

4. The present runoff from those areas through which the drainage and storm water management facility passes.

4.3 Recommended Storm Sewer Design Criteria

All storm sewers, whether private or public, and whether constructed on private or public property should conform to the design standards and other requirements contained herein. They shall be constructed in accordance with the current standards and specifications adopted by the Board of Public Works and Safety.

4.3.1 Manning's Equation

The hydraulic capacity of storm sewers should be determined using the Manning's Equation:

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

V = mean velocity of flow in feet per second

R = the hydraulic radius in feet

S = the slope of the energy grade line in feet per foot

n = roughness coefficient

The hydraulic radius, R, is defined as the cross sectional area of flow divided by the wetted flow surface or wetted perimeter. Typical "n" values and maximum permissible velocities for storm sewer materials are listed in Table 5. Roughness coefficient (n) values for other sewer materials can be found in standard hydraulics texts and references.

4.3.2 Minimum Size

The minimum size of all storm sewers should be 12 inches. The rate of release for detention storage should be controlled by an orifice plate or other devices, subject to approval of the Board, where the 12-inch pipe will not limit the rate or release as required.

TABLE 6

Typical Values of Manning's "n"

Material	Manning's n	Desirable Maximum Velocities
Closed Conduits		
Concrete	0.013	15 f.p.s.
Vitrified Clay	0.013	15 f.p.s.
Brick	0.015	15 f.p.s.
Cast Iron	0.013	15 f.p.s.
Circular Corrugated Metal Pipe, Annular Corrugations – 2 2/3 x ½ in.		
Unpaved	0.024	7 f.p.s.
25% Paved	0.021	7 f.p.s
50% Paved	0.018	7 f.p.s
100% Paved	0.013	7 f.p.s
Circular Corrugated Metal Pipe, Helical – 2 2/3 x ½ in., Unpaved Corrugations		
12"	0.011	
18"	0.013	
24"	0.015	
36"	0.018	
48"	0.020	
60" or Larger	0.021	
Corrugated Polyethylene, Smooth Interior Pipe	0.012	15 f.p.s.
Concrete Culverts	0.013	
Open Channels		
Concrete, Trowel Finish	0.013	
Concrete, Broom or Float Finish	0.015	
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	

4.3.3 Grade

Sewer grade should be such that, in general, a minimum of two feet of cover is maintained over the top of the pipe. Pipe cover less than the minimum may be used only upon approval of the Engineer. Uniform slopes shall be maintained between inlets, manholes and inlets to manholes. Final grade should be set with full consideration of the capacity required, sedimentation problems and other design parameters. Minimum and maximum allowable slopes should be those capable of producing velocities of two and one-half and 15 feet per second, respectively, when the sewer is flowing full.

4.3.4 Alignment

Storm sewers should be straight between manholes whenever possible. Where long radius curves are necessary to conform to street layout, the minimum radius of curvature should be no less than 100 feet for sewers 42 inches and larger in diameter. Deflection of pipe sections should not exceed the maximum deflection recommended by the pipe manufacturer. The deflection should be uniform and finished installation shall follow a smooth curve. Pipes should be installed so that the crown of the upstream pipe matches the crown of the downstream pipe unless otherwise approved by the Engineer.

4.3.5 Manholes

Manholes should be installed to provide access to continuous underground storm sewers for the purpose of inspection and maintenance. Manholes should be provided at the following locations:

1. Where two or more storm sewers converge.

2. At the point of beginning or at the end of a curve, and at the point of reverse curvature (PC, PT, PRC).

3. Where pipe size changes.

4. Where an abrupt change in alignment occurs.

5. Where a change in grade occurs.

6. At suitable intervals in straight sections of sewer.

The maximum distance between storm sewer manholes should be 300 feet unless special exception is granted by the City Engineer.

4.3.6 Inlets

Inlets or drainage structures shall be utilize to collect surface water through grated openings and convey it to storm sewers, channels or culverts. Inlet design and spacing

shall be in accordance with the most current of the Indiana Department of Highways Road Design Manual – Volume 1, Part IV or other approved design procedure. The inlet grate opening provided must be adequate to pass the design 10-year flow with 50% of the sag inlet areas clogged.

Inlets shall be spaced to limit the allowable spread of water on collector streets to two clear 10-foot moving lanes of traffic. The spacing on local roads shall limit the spread to one 10-foot lane. Inlet spacing shall be determined using the equation:

$$Q = \frac{0.56}{n} * S_x^{1.67} * S^{0.5} * T^{2.67}$$

where:

Q = discharge, cfs (Including any carryover as appropriate)

S_x = cross slope of the pavement (ft/ft) (= 0.02, the typical street cross-slope)

T = top width of water from vertical face of gutter into roadway (ft)

S = longitudinal grade of street (ft/ft)

n = Manning's roughness coefficient (= 0.016).

Inlets shall be placed where T equals the maximum allowable spread.

An overland flow route from sag inlets to an overflow channel or basin shall be provided at sag inlets, so that the maximum depth of water that might be ponded during extreme storm events in the street sag does not exceed 12 inches. All overflow channels shall direct the runoff to the detention facility. Overload storage basins shall be modeled using the 100-year storm to demonstrate the peak elevation will not flood adjoining structures. Alternatively, if an overload channel of storage basin is not feasible, the design engineer may submit hydraulic gradeline calculations showing the 100-yr storm hydraulic gradeline does not exceed a height of 12 inches above the casting.

4.4 Recommended Open Channel / Swale Design Criteria

All open channels and swales, whether private or public, and whether constructed on private or public land, should conform to the design standards and other design requirements contained herein.

4.4.1 Manning's Equation

The capacity of open channels / swales should be determined using Manning's Equation.

$$Q = AV = A \frac{1.486}{n} R^{2/3} S^{1/2}$$

where: A = Waterway area of channel in square feet
Q = Discharge in cubic feet per second (cfs)
V, R, S & n are explained in Section 4.3.1

4.4.2 Cross-Section and Grade

The required cross-section and grade are determined by the design capacity, material in which the channel or swale is to be constructed, and the requirements for maintenance. A minimum depth may be required to provide adequate outlets for subsurface drains, tributary ditches, or streams. The grade should be such that the velocity in the channel or swale is high enough to prevent siltation but low enough to prevent erosion. Velocities less than 1.5 feet per second should be avoided because siltation will take place and ultimately reduce the cross-section. The maximum permissible velocities in vegetal-lined channels and swales are shown in Table 6. Developments through which the channel or swale is to be constructed should be considered in the design of the channel section.

4.4.3 Side Slopes

Earthen channel side slopes shall be no steeper than 3 (horizontal) to 1 (vertical). Flatter slopes may be required to prevent erosion and for ease of maintenance. Where channels will be lined, side slopes should be no steeper than 1-1/2 to 1 with adequate provisions made for weep holes.

Side slopes steeper than 1-1/2 to 1 may be used for lined channels provided that the side lining and structural retaining wall are designed and constructed with provisions for live and dead load surcharge.

4.4.4 Stability

1. Characteristics of a stable channel / swale are:

    A. It neither aggrades nor degrades beyond tolerable limits.

    B. The banks do not erode to the extent that the cross-section is changed appreciably.

    C. Excessive sediment bars do not develop.

    D. Excessive erosion does not occur around culverts, bridges or elsewhere.

    E. Gullies do not form or enlarge due to the entry of uncontrolled surface flow to the channel.

2. Stability should be determined for an aged condition and the velocity should be based on the design flow or the bank full flow, whichever is greater, using

"n" values for various channel linings as shown in Table 7. In no case is it necessary to check stability for discharges greater than that from a 100-year return period storm.

TABLE 7
Maximum Permissible Velocities in Vegetal-Lined Channels / Swales*

Cover	Slope Range[2] (%)	Permissible Velocity[1]	
		Erosion Resistant Soils (fps)	Easily Eroded Soils (fps)
Bermuda Grass	0-5 5-10 >10	8 7 8	6 5 4
Bahia Buffalo Grass Kentucky Bluegrass Smooth Brome Blue Grama	0-5 5-10 >10	7 6 5	5 4 3
Grass Mixture Reed Canary Grass	[2]0-5 5-10	5 4	4 3
Lespediza Sericea Weeping Lovegrass Yellow Bluestem Redtop Alfalfa Red Fescue	[3]0-5 5-10	3.4	2.5
Common Lespedeza[4] Sundangrass	[5]0-5	3.5	2.5

A. Use velocities exceeding 5 feet per second (fps) only where good cover and proper maintenance can be obtained
B. Do not use on slopes steeper than 10 % except for vegetated side slopes in combination with stone, concrete, or highly resistant vegetative center section.
C. Do not use on slopes steeper than 5% except for vegetated side slopes in combination with stone, concrete, or highly resistant vegetative center section.
D. Annuals – use on mild slopes or as temporary protection until permanent covers are established.
E. Use on slopes steeper than 5% is not recommended

* From Natural Resources Conservation Service, NRCS-TP-61, Handbook of Channel Design for Soil and Water Conservation.

3. Stability should be checked for conditions immediately after construction. For this stability analysis, the velocity should be calculated for the expected flow from a ten-year return period storm on the watershed, or the bank full flow, whichever is smaller. The "n" value for newly constructed channels and swales in fine-grained soils and sands may be determined in accordance with

the National Engineering Handbook 5, Supplement B, Natural Resources Conservation Service and should not exceed 0.025. The allowable velocity in the newly constructed channel or swale may be increased by a maximum of 20 percent to reflect the effects of vegetation to be established under the following conditions:

A. The Soil and site in which the channel or swale is to be constructed are suitable for rapid establishment and support of erosion controlling vegetation.

B. The species of erosion controlling vegetation specified is acceptable for the area, and proven methods of establishment are shown.

C. The channel or swale design includes detailed plans for establishment of vegetation on the side slopes.

4. The design of energy dissipators shall be in conformance with the methods and procedures outlined in HEC-14, "Hydraulic Design of Energy Dissipators for Culverts and Channels" as published by the Federal Highway Administration.

4.4.5 Drainage of Waterways

Vegetated waterways that are subject to low flows of long duration or where wet conditions prevail shall be drained with a tile system or by others means such as paved gutters. Tile lines may be outletted through a drop structure at the end of the waterway or through a standard tile outlet.

4.4.6 Appurtenant Structures

The design plans for channels/ swales will contain all structures required for the proper functioning of the channel or swale and associated drainageways and account for operation and maintenance. Recessed inlets and structures needed for entry of surface and subsurface flow into channels or swales without significant erosion or degradation should be included in the design of improvements. The design should also provide the necessary floodgates, water level control devices, and any other appurtenance structures affecting the functioning of the channels or swales and the attainment of the purpose for which they are built.

The effect of channel / swale improvements on existing culverts, bridges, buried cables, pipelines and inlet structures for surface and subsurface drainage on the channel / swale being improved should be evaluated to determine the need for modification or replacement. Culverts and bridges which are modified or added as part of channel improvement projects should meet reasonable standards for the type of structure, and should have a minimum capacity equal to the design discharge or governmental agency design requirements, whichever is greater.

4.5 Storm Water Detention

All developments will require detention unless directed by the City Engineer.

4.5.1 Acceptable Detention Methods

The increased storm water runoff resulting from a proposed development should be detained on-site by the provisions of appropriate wet or dry bottom reservoir, by storage on parking lots, streets, lawns, or other acceptable techniques. Measures, which retard the rate of overland flow and the velocity in runoff channels, should also be used to control the runoff rate. Control devices should limit the discharge to a rate no greater than that prescribed by the Drainage and Storm Water Management Ordinance.

4.5.2 Design Storm

Design of storm water detention facilities should be based on a return period of once in 100 years. The storage volume and outflow rate should be sufficient to handle storm water runoff from a critical duration storm, as defined in Sections 4.5.5 and 4.5.6 of this Guide. Rainfall intensity-duration-frequency relationships and depth-duration-frequency relationships should be those given in Tables 4 and 7, respectively.

4.5.3 Allowable Release Rate

In general, the allowable release rate of storm water originating from a proposed development should not exceed the amounts described in Sections 4.5.5 and 4.5.6 of this Guide.

In the event the natural downstream channel or storm sewer system is inadequate to accommodate the release rate provided above, then the allowable release rate should be reduced to that rate permitted by the capacity of the receiving downstream channel or storm sewer system. Additional detention, as determined by the Board, shall be required to store that portion of the runoff exceeding the capacity of the receiving sewers or waterways.

If more than one detention basin is involved in the development of the area upstream of the limiting restriction, the allowable release rate from any one-detention basin should be in direct proportion to the ratio of its drainage area to the drainage area of the entire watershed upstream of the restriction.

If off-site runoff enters the detention facility, the allowable release rate should be determined by adding the off-site existing 10-year hydrograph to the on-site existing 10-year hydrograph. The detention volume should then be determined adding the proposed on-site 100-yr runoff hydrograph to the existing 10-yr off-site hydrograph and routing the resulting hydrograph through the storage facility. The additional off-site runoff shall be conveyed by a structure such as weir set at or above the peak elevation resulting from the previous hydrograph routing through the proposed detention facility.

TABLE 8
Rainfall Depths for Various Return Periods and Storm Durations

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

4.5.4 Drainage and Storm Water Management Facilities Overflow Design

Drainage and storm water management facilities should have adequate capacity to convey the storm water runoff from all upstream tributary areas through the development under consideration for a storm of a 100-year design return period calculated on the basis of the upstream land in its present state of development. An allowance, equivalent to the reduction in flow rate provided, should be made for upstream detention when such upstream detention and release rate have previously been approved by the Board and evidence of its construction can be shown. The overflow shall be designed to accommodate the peak 100-year inflow to the detention facility with 1' of freeboard.

4.5.5 Determination of Storage Volume – Rational Method

For drainage areas of 5 acres or less, the Rational Method may be used to determine the required volume of storm water storage. The following eleven-step procedure may be used to determine the required volume of storage using this methodology. Other design methods may also be used, subject to approval of the Board, and as described in Section 4.5.6.

Steps Procedure

1. Determine the total site drainage area in acres "A".

2. Determine composite runoff coefficient "C_u" based on existing land use (undeveloped).

3. Determine time of concentration "tc" in minutes based on existing conditions.

4. Determine rainfall intensity "I_u" in inches per hour, based on time of concentration and using Figure 1 or from data given in Table 4 for the 10-year return period.

5. Compute runoff based on existing land use (undeveloped), and 10-year return period:

$$Q_u = C_u I_u A$$

6. Determine composite runoff coefficient "C_d" based on developed conditions and a 100-year return period.

7. Determine the 100-year return period rainfall intensity "I_d" for various storm durations "t_d" for the developed area using Table 4.

8. Determine developed inflow rates "Q_d" for various storm durations "t_d", measured in hours.

$$Q_d = C_d I_d A$$

9. Compute a storage rate "S_{td}" for various storm durations "t_d" up through the time of concentration of the developed area.

$$S_{td} = Q_d - Q_u$$

10. Compute required storage volume "S_R" in acre-feet for each storm duration "t_d". This assumes a triangular hydrograph of duration ($2^* t_d$) hours with peak flow of S_{td} at t_d hours.

$$S_R = S_{td} (t_d/12)$$

11. Select the largest storage volume computed in Step 10 for detention basin design.

4.5.6 Determination of Storage Volume – Hydrograph Methods

Hydrograph methods for determining runoff and routing of storm water shall be used to determine the storage volume required to control storm water runoff for drainage areas greater than 5 acres. TR-20 and TR-55 computer models are accepted for use in analysis of the runoff and routing of storm water. Other procedures or methods may be used with prior approval by the City Engineer. The use of these models can be defined in a four-step procedure to determine the required storage volume of the detention basin.

Step Procedure

1. Determine the drainage area, the composite curve number and the time-of-concentration for both the undeveloped and the developed conditions of the basin or basins tributary to the proposed storage facility. Complete documentation shall be provided in the report for all input parameters (i.e. drainage basin map with delineation of the time-of-concentration path, copies of time-of-concentration and curve number calculations, etc).

2. If TR-20 is selected, determine the 10-year, undeveloped peak flow using the appropriate Huff rainfall distribution (see Table 9 for the Huff ordinates) for each storm duration listed in Table 8. Denote this flow by Q_u^{10}. If TR-55 is used, determine the 10-year 24 hour undeveloped peak flow using the SCS Type II distribution. Denote this flow by Q_u^{10}.

3. Determine the allowable release rate using the peak 10-year flow determined in step 2.

4. If TR-20 is used, determine the 100-year peak outflow and elevation of the proposed storm water facility for developed conditions by routing hydrographs for each storm duration listed in Table 8. If TR-55 is used, volume shall be determined by the developed 100 year 24 hour SCS Type II distribution with a peak outflow of Q_u^{10} . Copies of outlet sizing calculations and stage-storage tables shall be provided in the report.

4.5.7 General Detention Basin Design Requirement

Basins should be constructed to temporarily detain the storm water runoff, which exceeds the maximum peak flow rate authorized by the Drainage and Storm Water Management Ordinance. The volume of storage provided in these basins, together with such storage as may be authorized in other on-site facilities should be sufficient to control excess runoff from the 100-year storm.
The following design principals are recommended:

1. Detention basins shall be constructed in accordance with the Drainage and Storm Water Management Best Management Practice Manual.

2. The maximum planned depth of storm water stored (without a permanent pool) should not exceed 4 feet.

3. All storm water detention facilities should be separated by not less than 50 feet from any building or structure to be occupied.

Table 9
Huff Rainfall Distribution Ordinates

Cumulative Storm Rainfall (Percent) for Given Storm Type				
Cumulative Storm Time (%)	1st Quartile (Rainfall Duration 6 hours or less)	2nd Quartile (Rainfall Duration 6.1 to 12 hours)	3rd Quartile (Rainfall Duration 12.1 to 24 hours)	4th Quartile (Rainfall Duration > 24 hours)
5	16	3	3	2
10	33	8	6	5
15	43	12	9	8
20	52	16	12	10
25	60	22	15	13
30	66	29	19	16
35	71	39	23	19
40	75	51	27	22
45	79	62	32	25
50	82	70	38	28
55	84	76	45	32
60	86	81	57	35
65	88	85	70	39
70	90	88	79	45
75	92	91	85	51
80	94	93	89	59
85	96	95	92	72
90	97	97	95	84
95	98	98	97	92
100	100	100	100	100

4. Safety screens having a maximum opening of 4 inches should be provided for any pipe or opening to prevent children or large animals from crawling into the structures.

5. Danger signs should be mounted at appropriate locations to warn of deep water, possible flooding conditions during storm periods and other dangers that exist. Fencing should be provided if deemed necessary by the Board.

6. Outlet control structures should be designed to operate as simply as possible and shall require little or no maintenance or attention for proper operation. They should limit discharges into existing or planned downstream channels or conduits so as to not exceed the predetermined maximum authorized peak flow rate. Outlet structures shall be constructed of pre-cast concrete. CMP will not be considered acceptable.

7. Emergency overflow facilities such as a weir or spillway should be provided for the release of exceptional storm water runoff or in emergency conditions should the normal discharge devices become totally or partially

inoperative. The overflow facility should be of such design that its operation is automatic and does not require manual attention. The overflow shall be designed to accommodate the peak 100-year inflow to the detention facility with 1' of freeboard.

8. Grass or other suitable vegetative cover should be provided throughout the entire basin area. Grass should be cut regularly at approximately monthly intervals during the growing season or as required.

9. Debris and trash removal and other necessary maintenance should be performed on a regular basis to assure continued operation in conformance to design.

10. A safety ledge 4 to 6 feet in width is recommended and should be installed in all ponds approximately 30 to 36 inches below the permanent water level. In addition, a similar maintenance ledge 12 to 18 inches above the permanent water line should be provided. The slope between the two ledges should be stable and of a material such as stone or riprap which will prevent erosion due to wave action.

4.5.8 Dry Bottom Basin Design Requirements

Detention basins which will not contain a permanent pool of water, should follow the criteria listed below:

1. The bottom slopes of the basin shall all drain to the outlet drain and must contain either minimum grades of 2% or under drains leading to the outlet drain.

2. Provisions should be incorporated to facilitate complete interior drainage of dry bottom basins, to include the provision of natural grades to outlet structures, longitudinal and transverse grades to perimeter drainage facilities, paved gutters, or the installation of subsurface drains.

3. The detention basin should, whenever possible, be designed to serve a secondary or multipurpose function. Best Management Practices, aesthetic qualities (open spaces) or other types of use should be considered in planning the detention facility.

4.5.9 Wet Bottom Basin Design Requirements

Where part of a detention basin will contain a permanent pool of water, all the items required for detention storage should apply except that the system of drains with a positive gravity outlet required to maintain a dry bottom basin will not be required. A controlled positive outlet will be required to maintain the design water level in the wet bottom basin and provide required detention storage above the design water level. BMPs

shall be constructed to treat storm water prior to entering the permanent pool. The following additional conditions should also be considered:

1. Basins designed with permanent pools or containing permanent ponds should have a water area of at lease one-half acre. If fish are to be maintained in the pond, a minimum depth of approximately 10 feet should be maintained over at least 25 percent of the pond area. The remaining pond area should have no extensive shallow areas, except as required by subsection (3) below. Ponds not intended to maintain fish shall have a minimum depth of 8 feet.

2. In excavated ponds, the underwater side slopes in the pond should be stable. Earthen side slopes shall be no steeper than 3 (horizontal) to 1 (vertical). For basins with permanent water depth in excess of 4 feet, the side slopes shall be no steeper than 5 (horizontal) to 1 (vertical). In the case of valley storage, natural slopes may be considered to be stable.

3. A safety ramp exit from the pond is required in all cases and should have a minimum width of 20 feet and exit slope of 6 (horizontal) to 1 (vertical). The ramp should be of a material that will prevent its deterioration due to vehicle use and/or wave action.

4. Periodic maintenance is required in ponds to control weed and larval growth. The pond should also be designed to provide for the easy removal of sediment, which will accumulate during periods of pond operation. A means of maintaining the designed water level of the pond during prolonged periods of dry weather is also required.

5. For emergency use, basin cleaning or shoreline maintenance, facilities shall be provided or plans prepared for auxiliary equipment to permit emptying and drainage.

4.5.10 Parking Lot Storage

Paved parking lots may be designed to provide temporary detention storage of accumulated storm water on all or a portion of their surfaces. Outlets will be designed so as to empty the stored waters slowly. Depths of storage must be limited to a maximum depth of 6 inches so as to prevent damage to parked vehicles and so that access to parked vehicles is not impaired. Ponding should, in general, be confined to those positions of the parking lots farthest from the area served and should not be provided in the natural path of pedestrians.

4.5.11 Facility Maintenance Responsibility

Maintenance of detention-retention facilities during construction and thereafter, shall be the responsibility of the landowner. Assignment of responsibility for maintaining facilities serving more than one lot or holding shall be documented by appropriate

covenants to property deeds, unless responsibility is formally accepted by a public body, and shall be determined before the final drainage and storm water management plans are approved.

4.5.12 Installation of Control Systems

Runoff and erosion control systems shall be installed as soon as possible during the course of site development and in accordance with Rule 5 (327 IAC 15-5). Detention-retention basins should be designed with an additional 6 percent of available capacity to allow for sediment accumulation resulting from development and to permit the pond to function for reasonable periods between cleanings. Basins should be designed to collect sediment and debris in specific locations so that removal costs are kept to a minimum. During and at the close of construction activities the basins shall be maintained pursuant to Rule 5 (327 IAC 15-5).

4.5.13 Detention Facilities in Floodplains

If detention storage is provided within a floodplain, only the net increase in storage volume above that which naturally existed on the floodplain will be credited to the development. No credit will be granted for volumes below the elevation of the regulatory flood at the location unless compensatory storage is also provided.

4.5.14 Downstream Receiving Facility Provisions

When the allowable runoff is released in an area that is susceptible to flooding, the developer may be required to construct appropriate storm drains through the area to avert increased flood hazards caused by the concentration of allowable runoff at one point instead of the natural overland distribution. The requirement for downstream receiving facility provisions will be at the discretion of the Board.

4.6 Structures

The drainage storm water management facility shall be such that all habitable structures are free from a 100-year flood (Section 39) and storm water shall be directed away from structures (Section 40).

New structures built on natural high ground and involving no fill must have the lowest adjacent grade to the structures at or above the 100-year flood elevation. New structures built on fill must have both the lowest adjacent grade and the lowest floor (including basement) of the structure at or above the 100-year flood elevation. The regulations for new structures to be at or above the 100-year flood are the requirements of the National Flood Insurance Program (NFIP) and apply to all habitable and non-habitable structures. Through its participation in the NFIP, the City of Portage has agreed that new construction in and near designated 100-year floodplains will be compliant with the Federal regulations. For additional information see Section 6.0 of this Guide.

4.7 Additional Considerations

Land alterations shall be accomplished so as to prevent damage to adjacent property (Section 41). The maximum vertical fall of earth on the parcel shall be 6" per foot (2' horizontal to 1' vertical). Slopes of materials other than earth shall be at the safe angle of repose for the respective materials (Section 42).

Land alterations shall be accomplished in such a way that the post-development grades are permanent and stable. Vegetative cover or landscaping may be buried in the ground only if the activity will not interfere with the stability of fill or cause settlement or erosion (Section 43). Subsurface drainage should be sufficient to intercept seepage that would affect earth slope stability of a building foundation or create undesirable wetness (Section 44).

4.8 Storm Water Treatment

4.8.1 Treatment requirements

The City of Portage has adopted a policy that the control of storm water runoff quality citywide will be based on the management of total suspended solids (TSS). This requirement is being adopted as the basis of the city's storm water quality management program for all areas of the city. It should also be noted that control of sediment is required for construction site runoff citywide. The target TSS removal rate is 80%. In addition to TSS removal, storm water treatment Best Management Practices (BMPs) must also be designed to treat the water quality volume (WQ_v) or the water quality treatment rate (Section 56).

For new development, structural BMPs shall be designed to remove 80% of the average annual post development TSS. It is presumed that a BMP complies with this performance standard if it is:

1. Sized to capture the prescribed water quality volume (WQ_v) or water quality treatment rate.

2. Constructed properly, and

3. Maintained regularly.

The following requirements shall be fulfilled:

1. All storm water runoff generated from land development and land use conversion activities shall not discharge untreated storm water runoff directly into a jurisdictional wetland or local water body without adequate treatment. Where such discharges are proposed, the impact of the proposal on the wetland shall be assessed using a method acceptable to the Board.

In no case shall the impact be any less than allowed by the Army Corps of Engineers (ACOE) or IDEM.

2. Infiltration practices shall not be allowed where storm water is generated from highly contaminated source areas as recognized by the EPA, IDEM or the Board; where storm water is carried in a conveyance system that also carries contaminated, non-storm water discharges; and where storm water is being managed in a designated groundwater recharge area.

3. Land development projects shall comply with the water quality performance-based criteria in accordance with the following:

   A BMP shall be located, designed, and maintained to achieve the target pollutant removal efficiencies to effectively reduce the pollutant load to the required level.

4. Storm water discharges to critical areas with sensitive resources (i.e., cold water fisheries, shellfish beds, swimming beaches, recharge areas, water supply reservoirs) may be subject to additional criteria, or may need to utilize or restrict certain storm water management practices at the discretion of the Board.

5. Industrial sites which are listed under the Standard Industrial Code are required to prepare and implement a storm water pollution prevention plan, and shall file a notice of intent (NOI) under the provisions of the National Pollutant Discharge Elimination System (NPDES) general permit. The storm water pollution prevention plan requirement applies to both existing and new industrial sites.

6. Storm water discharges from land uses or activities with higher potential pollutant loadings may require the use of specific structural BMPs and pollution prevention practices at the discretion of the Board.

7. Prior to design, applicants are required to consult with the City Engineer to determine if they are subject to additional storm water design requirements.

8. Discharges will not be allowed directly into sinkholes or fractured bedrock, without treatment that results in discharge meeting Indiana ground water quality standards as referenced in 327 IAC 2-11.

9. Any storm water practice that is a Class V injection well must ensure that the discharge from such practices meets Indiana ground water quality standards as referenced in 327 IAC 2-11.

4.8.2 Structural Best Management Practices (BMPs)

Table 10 identifies recommended structural BMPs that can be used in Portage for water quality control. The BMPs noted in Table 10 are recommended BMPs if designed according to the criteria set forth in the Drainage and Storm Water Management Ordinance and the Drainage and Storm Water Management Best Management Practice Manual. Note that many of these measures can also be designed to meet the water quantity control requirements.

TABLE 10
Recommended BMPs

Current Use	Planned Use	Approved BMP
Open Land	Commercial strip, light industrial, institutional (individual lots)	Bioretention, wet pond, riparian buffer, water quality swale, proprietary system, filter strips, porous surfaces
Open Land	Commercial or individual subdivision	Wet pond, riparian buffer, filter strips, porous surfaces
Open Land	Residential	Bioretention, wet pond, riparian buffer, water quality swale, filter strips, porous surfaces
Commercial building or strip (medium imperviousness)	Commercial building or strip	Bioretention, wet pond, proprietary system, filter strips
Commercial building or strip (small lot, high imperviousness)	Commercial building or strip	Bioretention, proprietary system, filter strips
Transportation Infrastructure	Increased transportation infrastructure	Water quality swales, filter strips

4.8.3 Innovative BMPs

BMPs not included in Table 9 must be professionally certified and approved by the City Engineer. ASTM standard methods must be followed when verifying performance of new measures. New BMPs must meet the 80% TSS removal rate and must have a low to medium maintenance requirement to be considered by the City. Testing to establish the TSS removal rate must be conducted by an independent testing facility, not the BMP manufacturer.

4.8.4 Operation and Maintenance Plan

Each structural BMP on a site must have an operations and maintenance plan. The maintenance plan must be submitted with the drainage and storm water management plan and approved by the Board. The approved operations and maintenance plan must also be provided to the BMP owner. Sample BMP inspection forms can be found in the "Drainage and Storm Water Management Best Management Practice Manual".

4.8.5 BMP Maintenance

The owner of the structural BMP is required to perform routine inspections to assure the practice is operating efficiently and effectively. Completed inspection forms must be maintained by the BMP owner and produced upon request by the City.

The City will also perform periodic inspections of permanent BMPs. The City will inspect the facility and bill the owner as determined necessary by the Board. If the City determines a BMP is in need of maintenance or repair, the City will notify the BMP owner and provide a timeframe for completing the maintenance and repairs. If the maintenance or repairs are not completed within the designated timeframe, the City shall perform the repairs or maintenance and bill the owner for the actual costs for the work.

The City must be notified of any changes in BMP ownership, major repairs, or BMP failure in writing within 30 days. The letter should be addressed to:

Storm Water BMP Modifications
City of Portage Engineer
6070 Central Avenue
Portage, Indiana 46388

4.8.6 Landscaping Details and Specifications

All structural BMPs must have a landscaping plan detailing and specifying the vegetation to be included as part of the practice. Maintenance methods and procedures for vegetation shall be specified by the Operation and Maintenance plan discussed in Section 4.8.4. The landscaping plan must be prepared by a registered landscape architect or the Soil and Water Conservation District and approved as part of the drainage and storm water management permit. Landscaping details can be found in the "Drainage and Storm Water Management Best Management Practice Manual".

5.0 SEDIMENT AND EROSION CONTROL

All persons who cause, in whole or in part, any earth change to occur shall provide soil erosion and sedimentation control so as to adequately prevent soils from being eroded and discharged or deposited onto adjacent properties or into a storm water drainage system, a public street or right of way, wetland, creek, stream, water body, or floodplain.

All development shall be in accordance with all applicable federal, state and local ordinances, rules and regulations.

Prior to making any earth change on a development site, the developer shall first obtain a soil erosion permit. The developer shall install storm water runoff facilities and shall phase the development activities so as to prevent construction site storm water runoff and off-site sedimentation.

Land alterations, including regrading, which strip the land of vegetations, shall be accomplished in a manner, which minimizes erosion or the addition of sediments to natural and manmade drainageways. This will reduce the impact on adjacent properties and water quality of receiving waters. Whenever feasible, natural vegetation shall be retained, protected and supplemented.

Cut and fill operations shall be kept to a minimum to ensure conformity with existing topography to reduce the potential erosion (Section 52). Applicants shall follow the procedures and comply with the requirements of "Rule 5" (327 IAC 15-5), regarding sediment and erosion control during construction. This state rule is administered by the Indiana Department of Environmental Management (IDEM). The regulation applies to all sites where construction activity disturbs 1 acre or more or disturbances of less than one (1) acre of land that are part of a larger common plan of development or sale if the larger common plan will ultimately disturb one (1) or more acres of land. Applicants are required per Rule 5 to have an approved erosion control plan and approved sediment and erosion control devices in place prior to the beginning of land disturbances.

Sediment controls should be installed whenever runoff from disturbed portions of the parcel will leave the parcel. Sediment controls may include vegetative buffer strips, filter barriers, sediment basins, debris basins or silt traps (Section 56). Vegetative buffer strips should only be used where runoff is dispersed and exits the parcel as sheet flow. Filter barriers should not be used in areas of concentrated flow. Synthetic filter fences are more effective than straw bales and should be used in series. Straw bales should also be anchored with stakes and grounded to reduce unfiltered underflow by burying the lower 3 inches of each bale.

Any flow from a disturbed parcel should pass through a vegetative filter barrier or sediment basin before entering a storm drain inlet. Existing inlets or those being constructed in a disturbed area should have all flow diverted away from them, be plugged or protected by a filter. Downstream development parcels should be protected from increases in volume, velocity, and sediment load or peak flow rates.

5.1 Stabilization

The duration of time, which an area remains exposed, shall be kept to a practical minimum and the area stabilized as quickly as possible (Section 53). Applicants are encouraged to implement sediment and erosion control for stockpiles exposed longer than 3 days and the remainder of the property within 15 days. Temporary vegetation or mulch shall be used to protect exposed areas during development (Section 54). For areas

subject to daily disturbance, a weighted cover of impermeable material may be used, if approved by the City Engineer.

Stockpiles should be located outside of drainageways and the 100-year floodplain if possible. It may be necessary to divert drainage around a stockpile that must be located in a drainageway.

Soil stabilization should be maintained in an effective condition throughout construction until permanent vegetation stabilization is achieved.

5.2 Permanent Stabilization

Permanent vegetation or structural erosion control devices shall be installed as soon as practical (Section 53) after as-built topographic conditions are finalized. Permanent stabilization requires permanent structures, pavement or vegetation sufficiently mature to withstand an annual climate cycle or permanent mulch.

6.0 FEMA MAP AMENDMENT AND MAP REVISION REQUIREMENTS

Structures and / or lots located within a Federal Emergency Management Agency (FEMA) designated flood zone can be removed from the 100-year floodplain. There are three different procedures that the FEMA can use to remove a structure or parcel of property from the floodplain: Letter of Map Amendment (LOMA), Letter of Map Revision Based on Fill (LOMR-F) and LOMR. For community officials and applicants, the result is the same for each procedure – the removal of a structure or property from the 100-year floodplain to eliminate the National Flood Insurance Program (NFIP) regulations pertaining to construction in a designated floodplain and the mandatory Federal requirement for the purchase of flood insurance. Individuals or developers should contact FEMA or the local flood plain manager to discuss the requirements for removal and needed forms.

7.0 LIST OF REFERENCES

This date will need to be updated.

1. Drainage and Storm Water Management Ordinance, “Ordinance 92-5”, (effective February 24, 1992) City of Portage, Porter County, Indiana.

2. “A General Ordinance Establishing Storm Drainage Control, H-88-5”, Highway Extension and Research Project for Indiana Counties and Cities (HERPICC) Reports, Purdue University.

3. Highway Extension and Research Project for Indiana Counties (HERPIC), ”County Storm Drainage Manual”, Christopher B. Burke, Research Engineer, Purdue University.

4. “Time Distribution of Heavy Rainstorms in Illinois” ISWS/CIR-173/90, Floyd A. Huff.

5. “Federal Emergency Management Agency, National Flood Insurance Program and Related Regulations” FEMA, Washington, D.C. 20472.

8.0 APPLICATIONS, EXHIBITS, DATA REQUEST CHECKLISTS AND FEMA CERTIFICATION/APPLICATION FORMS.

Exhibit A

Permit No. _____

City of Portage
Drainage & Stormwater Management Permit Application

Land Alternation / 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: _____ Date: _____

TO BE COMPLETED BY DEPARTMENT OF PUBLIC WORKS

Reviewed By: _____ Date: _____

- ❑ Approved
- ❑ Approved as Noted
- ❑ Not Approved, Revise & resubmit

Comments: _____

_____

_____

_____

_____

Exhibit B

City of Portage
Drainage & Stormwater Management Permit Application
Checklist

General Requirements:

Submitted (Initials)	Reviewed (Initials)	
_____	_____	Sealed Plans & Computations
_____	_____	Bound Report with Index and Page Numbering
_____	_____	Appropriate Scale
_____	_____	North Arrow
		Existing Contours
_____	_____	1-foot contours for slopes less than 10%
_____	_____	2-foot contours for slopes greater than 10% and less than 20%
_____	_____	5-foot contours for slopes greater than 20%
		Benchmark
_____	_____	NGVD 29
_____	_____	NGVD 88
_____	_____	Assumed for areas less than 3 acres
_____	_____	Location Map
_____	_____	Vicinity Map

Existing & Proposed Drainage Facilities:

Submitted (Initials)	Reviewed (Initials)	
_____	_____	Location of the drainage and storm water management facility by planimetric distances, referenced from traverse lines, USGS section lines, property markers or road centerlines. In areas where such physical features are unavailable, the State of Indiana coordinate system or other acceptable horizontal and vertical datum may be used.
_____	_____	Direction of flow
_____	_____	Elevations of storm drain and BMP inverts
_____	_____	Gradient of storm drain and BMPs

_____	_____	Size of storm drain and BMPSs
_____	_____	Capacity of storm drain and BMPs
_____	_____	A sequence describing when each post construction stormwater quality treatment BMP will be installed.
_____	_____	Overland Flow Route(s)
_____	_____	Impacted Drainage areas and SFHAs
_____	_____	Locations of Buffer Zones

Plan & Profile Sheet(s)

Submitted (Initials)	Reviewed (Initials)	
_____	_____	Scale: 1" = 50' (horizontal), 1" = 5' (vertical)
_____	_____	Appropriate right-of-way and easement limits
_____	_____	Sufficient information downstream to show effect of the drainage and storm water management facility on the outfall channel
_____	_____	Centerline grade of road for existing or proposed storm drains located in a pavement or shoulder area
_____	_____	Existing grade above existing or proposed storm drain located outside of pavement or shoulder areas
_____	_____	Profile of undisturbed earth for storm drains and BMPs constructed on fill.
_____	_____	An Erosion Control Plan (ECP) pursuant to 327 IAC 15-5 which includes but is not limited to treatment controls, emporary and permanent seeding schedule, construction schedule, and maintenance schedule

Design Calculations

Submitted (Initials)	Reviewed (Initials)	
		Natural Resources Assessment:
_____	_____	Maps identifying significant natural features and resources such as undisturbed forest areas, stream buffers and steep slopes that should be preserved to retain some of the original hydrologic function of the site

_____	_____	A site layout and narrative indicating the conservation and preservation of significant natural features
		Estimation of storm water runoff:
_____	_____	Drainage area map with an appropriate scale and base or the 100-year floodplain where applicable
_____	_____	Weighted runoff coefficient and / or curve number computations
_____	_____	Time of concentration (Tc) computations
		Closed conduit and open channel design computations
_____	_____	Size of pipe or channel cross-section
_____	_____	Pipe or channel invert
_____	_____	Roughness coefficients
_____	_____	Flow velocities (in feet per second)
_____	_____	Design capacities (in cubic feet per second)
_____	_____	Energy dissipation computations

BMP Operation and Maintenance Manual

Submitted (Initials)	Reviewed (Initials)	
_____	_____	BMP owner name, address, business phone number, email address and cellular pone number
_____	_____	Site drawings (8 ½" by 11"), showing both plan and cross-section views, showing the BMP and applicable features, including dimensions, maintenance easements, outlet works, forebays, signage, connecting structures, weirs, invert elevations, etc.
_____	_____	Guidance on owner-required routine inspections
_____	_____	Requirement of owner to perform maintenance
_____	_____	Guidance on routine maintenance, including mowing, litter removal, woody growth removal, signage, etc.
_____	_____	Guidance on remedial maintenance; such as inlet replacement, outlet works maintenance, etc.
_____	_____	Guidance on sediment removal, both narrative and graphical, describing when sediment removal should occur

in order to insure that the BMP remains effective as a water quality control device

_____ _____ A statement that the City's representatives have the right to enter the property to inspect or in an emergency and, at the owners cost, maintain the BMP.

_____ _____ A tabular schedule showing inspection and maintenance requirements

_____ _____ Identification of the property / BMP owner as the party responsible for maintenance, including cost

Exhibit C

CITY OF PORTAGE
DRAINAGE AND STORMWAER MANAGEMENT PERMIT
CERTIFICATE OF COMPLETION AND COMPLIANCE

Land Alternation / Project Name: _____

_____

Permit No.: _____ Date Permit Issued: _____

Engineer/Surveyor Information:

Name: _____

Contact: _____

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 City of Portage Ordinance No. _____;

3. I have personally observed the land alteration accomplished pursuant to the above referenced Drainage and Stormwater 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 Public Works

By: _____ Date: _____