

**STORMWATER TECHNICAL
STANDARDS MANUAL
BLACKFORD COUNTY, INDIANA**

October 2019

TABLE OF CONTENTS

<i>Chapter</i>	<i>Title</i>
1	INTRODUCTION
2	METHODOLOGY FOR DETERMINATION OF RUNOFF RATES
3	METHODOLOGY FOR DETERMINATION OF DETENTION STORAGE VOLUMES
4	STORM SEWER DESIGN STANDARDS AND SPECIFICATIONS
5	OPEN CHANNEL DESIGN STANDARDS AND SPECIFICATIONS
6	STORMWATER DETENTION DESIGN STANDARDS FOR PEAK FLOW CONTROL
7	MISCELLANEOUS REQUIREMENTS
	APPENDIX A: ABBREVIATIONS AND DEFINITIONS
	APPENDIX B: STANDARD FORMS



Chapter One

INTRODUCTION

This document contains necessary technical standards for administering requirements of the Blackford County Stormwater Management Ordinance. This document should be considered a companion document to the ordinance. Whereas the ordinance contains most of the regulatory authority and general requirements of comprehensive stormwater management, this document contains the necessary means and methods for achieving compliance with the ordinance. In case there are conflicts between the requirements contained in this document and the ordinance, the requirements of the ordinance should prevail.

This document contains formulas and methodologies for review and design of stormwater quantity facilities. Chapters 2 through 6 contain stormwater conveyance and detention calculations and requirements. Chapter 7 contains miscellaneous standards regarding grading and building pad elevations, acceptable outlet and adjoining property impact requirements, no net loss floodplain storage requirements, floodway and FEH requirements, and requirements associated with proposed dams or levees. A glossary of terms is provided in Appendix A. Appendix B contains several useful and necessary standard forms.



Chapter Two

METHODOLOGY FOR DETERMINATION OF RUNOFF RATES

Runoff rates shall be computed for the area of the parcel under development plus the area of the watershed flowing into the parcel under development. The rate of runoff which is generated as the result of a given rainfall intensity may be calculated as follows:

A. Development sites up to 5 acres with a contributing drainage area up to 25 acres and no significant depressional storage

The Rational Method may be used, or a computer model that can generate hydrographs based on NRCS TR-55 time of concentration and curve number methodologies may be used with a 24-hour duration NRCS Type II storm. When determining post-developed conditions curve numbers, due to significant disturbance to the upper soil layers during construction activities, the initially determined hydrologic soil group for disturbed areas should be changed to the next less infiltrating capacity category (i.e., A to B, B to C, and C to D).

In the Rational Method, the peak rate of runoff, Q , in cubic feet per second (cfs) 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 (t_c) for a selected rainfall frequency.

A = Tributary drainage area in acres.

Values for runoff coefficient "C" are provided in **Tables 2-1** and **2-2**, which show values for different types of surfaces and local soil characteristics. The composite "C" value used for a given drainage area with various surface types shall be the weighted average value for the total area calculated from a breakdown of individual areas having different surface types. **Table 2-3** provides runoff coefficients and inlet times for different land use classifications.

Rainfall intensity shall be determined from data shown in **Table 2-4**.

In general, the time of concentration (t_c) methodology shall be as outlined in the U.S. Department of Agriculture (USDA) - NRCS TR-55 manual. In urban or developed areas, the methodology shall be the sum of the inlet time and flow time in the stormwater facility from the most remote part of the drainage area to the point under consideration. Flow time in storm sewers may be estimated by dividing the distance in feet by velocity of flow in feet per second. The velocity shall be determined using Manning's Equation (see Chapter 4). Inlet time is the combined time required for runoff to reach the storm sewer inlet. 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.

TABLE 2-1

Urban Runoff Coefficients				
<i>Type of Surface</i>	<i>Runoff Coefficient "C"</i> <i>(by Storm Recurrence Interval)</i>			
	<i>< 25 year</i>	<i>25 year</i>	<i>50 year</i>	<i>100 year</i>
◆ Hard Surfaces				
Asphalt	0.82	0.90	1.00	1.00
Gravel	0.85	0.94	1.00	1.00
Concrete	0.85	0.94	1.00	1.00
Roof	0.85	0.94	1.00	1.00
◆ Lawns (Sandy)				
Flat (0-2% Slope)	0.07	0.08	0.09	0.12
Rolling (2-7% Slope)	0.12	0.13	0.16	0.20
Steep (Greater than 7% Slope)	0.17	0.19	0.22	0.28
◆ Lawns (Clay)				
Flat (0-2% Slope)	0.16	0.18	0.21	0.26
Rolling (2-7% Slope)	0.21	0.23	0.28	0.35
Steep (Greater than 7% Slope)	0.30	0.33	0.40	0.50

Source: HERPICC Stormwater Drainage Manual, July 1995, and other sources.

TABLE 2-2

Rural Runoff Coefficients				
<i>Type of Surface</i>	<i>Runoff Coefficient "C"</i> <i>(by Storm Recurrence Interval)</i>			
	<i>< 25 year</i>	<i>25 year</i>	<i>50 year</i>	<i>100 year</i>
◆ Woodland (Sandy)				
Flat (0-2% Slope)	0.10	0.11	0.13	0.17
Rolling (2-7% Slope)	0.25	0.28	0.33	0.41
Steep (Greater than 7% Slope)	0.30	0.33	0.40	0.50
◆ Woodland (Clay)				
Flat (0-2% Slope)	0.30	0.33	0.40	0.50
Rolling (2-7% Slope)	0.35	0.39	0.46	0.58
Steep (Greater than 7% Slope)	0.50	0.55	0.66	0.83
◆ Pasture (Sandy)				
Flat (0-2% Slope)	0.10	0.11	0.13	0.17
Rolling (2-7% Slope)	0.16	0.18	0.21	0.26
Steep (Greater than 7% Slope)	0.22	0.24	0.29	0.36
◆ Pasture (Clay)				
Flat (0-2% Slope)	0.30	0.33	0.40	0.50
Rolling (2-7% Slope)	0.36	0.40	0.48	0.59
Steep (Greater than 7% Slope)	0.42	0.46	0.55	0.69
◆ Cultivated (Sandy)				
Flat (0-2% Slope)	0.30	0.33	0.40	0.50
Rolling (2-7% Slope)	0.40	0.44	0.53	0.66
Steep (Greater than 7% Slope)	0.52	0.57	0.69	0.86
◆ Cultivated (Clay)				
Flat (0-2% Slope)	0.50	0.55	0.66	0.83
Rolling (2-7% Slope)	0.60	0.66	0.79	0.99
Steep (Greater than 7% Slope)	0.72	0.79	0.95	1.00

Source: HERPICC Stormwater Drainage Manual, July 1995, and other sources.

TABLE 2-3

Runoff Coefficients by Land Use, Typical Inlet Times, and Storm Recurrence Interval													
<i>Land Use</i>	<i>Runoff Coefficients "C" (by Storm Recurrence Interval)</i>												<i>Inlet Time (Minutes) (4)</i>
	Flat (1)				Rolling (2)				Steep (3)				
	<i>< 25 year</i>	<i>25 year</i>	<i>50 year</i>	<i>100 year</i>	<i>< 25 year</i>	<i>25 year</i>	<i>50 year</i>	<i>100 year</i>	<i>< 25 year</i>	<i>25 year</i>	<i>50 year</i>	<i>100 year</i>	
Commercial (<i>CBD</i>)	0.75	0.83	0.99	1.00	0.83	0.91	1.00	1.00	0.91	1.00	1.00	1.00	5
Commercial (<i>Neighborhood</i>)	0.54	0.59	0.71	0.89	0.60	0.66	0.79	0.99	0.66	0.73	0.87	1.00	5 - 10
Industrial	0.63	0.69	0.83	1.00	0.70	0.77	0.92	1.00	0.77	0.85	1.00	1.00	
Garden Apartments	0.54	0.59	0.71	0.89	0.60	0.66	0.79	0.99	0.66	0.73	0.87	1.00	
Churches	0.54	0.59	0.71	0.89	0.60	0.66	0.79	0.99	0.66	0.73	0.87	1.00	
Schools	0.31	0.34	0.41	0.51	0.35	0.39	0.46	0.58	0.39	0.43	0.51	0.64	10 - 15
Semi Detached Residential	0.45	0.50	0.59	0.74	0.50	0.55	0.66	0.83	0.55	0.61	0.73	0.91	
Detached Residential	0.40	0.44	0.53	0.66	0.45	0.50	0.59	0.74	0.50	0.55	0.66	0.83	
Quarter Acre Lots	0.36	0.40	0.48	0.59	0.40	0.44	0.53	0.66	0.44	0.48	0.58	0.73	
Half Acre Lots	0.31	0.34	0.41	0.51	0.35	0.39	0.46	0.58	0.39	0.43	0.51	0.64	
Parkland	0.18	0.20	0.24	0.30	0.20	0.22	0.26	0.33	0.22	0.24	0.29	0.36	Must be computed

Source: *HERPICC Stormwater Drainage Manual, July 1995, and other sources.*

- (1) Flat terrain involves slopes of 0-2%.
- (2) Rolling terrain involves slopes of 2-7%.
- (3) Steep terrain involves slopes greater than 7%.
- (4) Interpolation, extrapolation and adjustment for local conditions shall be based on engineering experience and judgment.

B. Development sites larger than 5 Acres, contributing drainage area larger than 25 Acres, or with significant depressional storage

Runoff rate shall be determined using a computer model that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies. When determining post-developed conditions curve numbers, due to significant disturbance to the upper soil layers during construction activities, the initially determined hydrologic soil group for disturbed areas should be changed to the next less infiltrating capacity category (i.e., A to B, B to C, and C to D).

The 24-hour NRCS Type II rainfall distribution shall be utilized for runoff calculations. 24-hour Rainfall depth for various frequencies shall be taken from **Table 2-5**. The NRCS Type II distribution ordinates are provided in **Table 2-6**; this table should be used only when the rainfall distribution is not a default option in the computer program.

Examples of computer models that can generate such hydrographs include TR-55 (NRCS), TR-20 (NRCS), and HEC-HMS (COE). These programs may be downloaded free of charge from the associated agencies' web sites; other models may be acceptable.

TABLE 2-4

Rainfall Intensities for Various Return Periods and Storm Durations						
<i>Duration</i>	<i>Intensity (Inches/Hour)</i>					
	<i>Return Period (Years)</i>					
	2	5	10	25	50	100
5-min	5.14	6.07	6.82	7.69	8.38	9.02
10-min	4.01	4.72	5.26	5.89	6.35	6.79
15-min	3.27	3.86	4.31	4.85	5.24	5.62
30-min	2.19	2.65	2.99	3.42	3.74	4.06
60-min	1.34	1.66	1.91	2.22	2.47	2.71
2-hr	0.796	0.986	1.14	1.33	1.49	1.65
3-hr	0.567	0.703	0.811	0.956	1.07	1.19
6-hr	0.336	0.414	0.479	0.565	0.635	0.706
12-hr	0.193	0.237	0.272	0.320	0.358	0.397
24-hr	0.113	0.139	0.159	0.186	0.207	0.229

Source: NOAA Atlas 14 – Precipitation-Frequency Atlas of the United States, Volume 2, Version 3.0 (revised 2006) Hartford City, Indiana. Values for intermediate durations may be logarithmically interpolated.

TABLE 2-5

Rainfall Depths for Various Return Periods							
<i>Duration</i>	<i>Depth (Inches)</i>						
	<i>Return Period (Years)</i>						
	1	2	5	10	25	50	100
24-hr	2.27	2.72	3.33	3.81	4.46	4.97	5.49

Source: NOAA Atlas 14 – Precipitation-Frequency Atlas of the United States, Volume 2, Version 3.0 (revised 2006) Hartford City, Indiana.

TABLE 2-6

NRCS Type II Rainfall Distribution Ordinates					
Cumulative Storm Time (hr)	Cumulative Percent of Storm Depth	Cumulative Storm Time (hr)	Cumulative Percent of Storm Depth	Cumulative Storm Time (hr)	Cumulative Percent of Storm Depth
0.00	0	8.25	12.6	16.50	89.3
0.25	0.2	8.50	13.3	16.75	89.8
0.50	0.5	8.75	14	17.00	90.3
0.75	0.8	9.00	14.7	17.25	90.8
1.00	1.1	9.25	15.5	17.50	91.3
1.25	1.4	9.50	16.3	17.75	91.8
1.50	1.7	9.75	17.2	18.00	92.2
1.75	2	10.00	18.1	18.25	92.6
2.00	2.3	10.25	19.1	18.50	93
2.25	2.6	10.50	20.3	18.75	93.4
2.50	2.9	10.75	21.8	19.00	93.8
2.75	3.2	11.00	23.6	19.25	94.2
3.00	3.5	11.25	25.7	19.50	94.6
3.25	3.8	11.50	28.3	19.75	95
3.50	4.1	11.75	38.7	20.00	95.3
3.75	4.4	12.00	66.3	20.25	95.6
4.00	4.8	12.25	70.7	20.50	95.9
4.25	5.2	12.50	73.5	20.75	96.2
4.50	5.6	12.75	75.8	21.00	96.5
4.75	6	13.00	77.6	21.25	96.8
5.00	6.4	13.25	79.1	21.50	97.1
5.25	6.8	13.50	80.4	21.75	97.4
5.50	7.2	13.75	81.5	22.00	97.7
5.75	7.6	14.00	82.5	22.25	98
6.00	8	14.25	83.4	22.50	98.3
6.25	8.5	14.50	84.2	22.75	98.6
6.50	9	14.75	84.9	23.00	98.9
6.75	9.5	15.00	85.6	23.25	99.2
7.00	10	15.25	86.3	23.50	99.5
7.25	10.5	15.50	86.9	23.75	99.8
7.50	11	15.75	87.5	24.00	100
7.75	11.5	16.00	88.1		
8.00	12	16.25	88.7		

Source: National Resources Conservation Service (NRCS), "TR-20 Computer Program for Project Formulation Hydrology", page F9, May 1982.

NOTE: Use only when SCS Type II rainfall distribution is not a default option in the computer program.

C. Developments with one square-mile or larger drainage areas

For design of a major drainage system, as defined in **Appendix A**, discharge must be obtained from, or be accepted by, the Indiana Department of Natural Resources (IDNR). Other portions of the site must use the discharge methodology in the applicable section of this Chapter.



Chapter Three

METHODOLOGY FOR DETERMINATION OF DETENTION STORAGE VOLUMES

Required volume of stormwater storage for development sites shall be computed using a computer model that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies as described in chapter 2.

A. Post-Development Hydrologic Parameters

When determining post-developed conditions curve numbers, due to significant disturbance to upper soil layers during construction activities, the initially determined hydrologic soil group for disturbed areas should be changed to the next less infiltrating capacity category (i.e., A to B, B to C, and C to D).

B. Design Storm & Allowable Release Rates for Development Sites with On-site Detention Facilities

The 24-hour NRCS Type II rainfall distribution shall be used to determine required storage volume. Allowable release rates shall be determined based on methodologies provided in chapter 6.

C. Design Storm and Allowable Release Rates for Development Sites within a Designated Drainage Area Serviced by a Regional Detention facility

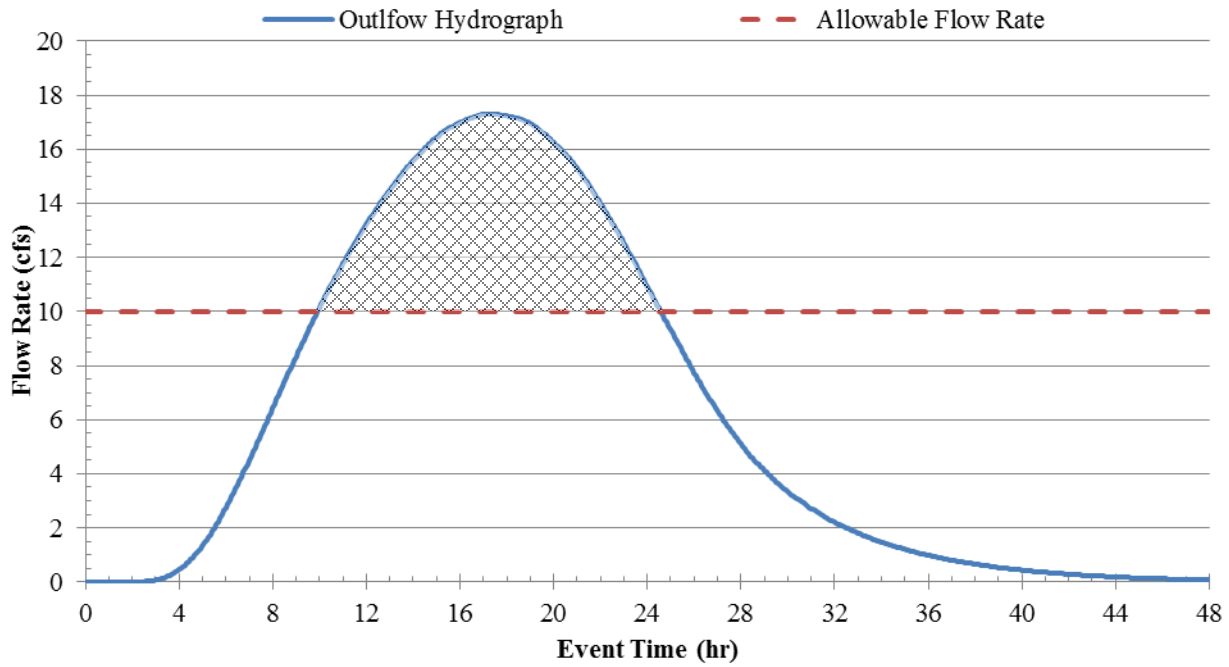
Development sites within designated drainage areas serviced by regional detention ponds are typically not required to provide on-site detention.

Where a regional detention facility is servicing or is planned to service a watershed, and that watershed has been declared a designated drainage area requiring developers to pay infrastructure development fees in lieu of providing on-site detention, the following method shall be used to estimate storage volume that would have been required for the proposed development. This estimated storage volume will be used to determine the fee based on the development site's proportionate share of regional detention storage.

The 24-hour NRCS Type II Rainfall Distribution shall be used to determine required storage volume with no on-site detention. The outflow hydrograph at the downstream-most point in the site's stormwater system shall be compared to the allowable release rate for the designated drainage area to determine the required storage volume. The allowable release rate for a designated drainage area shall be as defined by the resolution forming the designated drainage area.

The storage volume shall be determined by calculating the volume of outflow from the site that exceeds the given allowable release rate. For example, required storage volume for a 50-acre site in a designated drainage area with an allowable post-development 100-year release rate of 0.2 cfs/acre would be the volume of water represented by the cross-hatched area in **Figure 3-1**.

FIGURE 3-1
Required Storage Volume Determination Example





Chapter Four

STORM SEWER DESIGN STANDARDS AND SPECIFICATIONS

Storm sewers, whether private or public, and whether constructed on private or public property shall conform to design standards and other requirements contained herein. Proposed storm sewer systems must be sized and designed to convey at least the 10-year frequency on-site stormwater runoff, as well as anticipated 10-year frequency tributary off-site stormwater runoff assuming future developed condition. Also, an analysis of drainage system overflow must be completed in accordance with section M of this chapter to show safe routing of flood waters through the development, and that the development will not obstruct free flow of floodwaters from tributary off-site property in both current and fully-developed conditions.

A. Design Storm Frequencies

1. Storm sewers, inlets, catch basins, and street gutters shall accommodate (subject to allowable spread provisions discussed later in this section) peak runoff from a 10-year return frequency storm calculated based on methodology described in chapter 2.
2. Culverts for interior local, collector, or arterial streets and roads shall be designed to convey peak runoff (with no roadway overtopping) from 25-year, 50-year, and 100-year frequency storms, respectively. Driveway culvert capacities shall be the same as required for the street classification to which the driveway connects. Required culvert capacity is 100-year frequency storm for streets or roads that are the only access to or from any portion of a commercial or residential development. Additionally, required culvert capacity may be increased to 100-year frequency storm when the design engineer or Blackford County Surveyor determine this is needed to protect existing or proposed buildings.
3. The allowable spread of water on collector streets for the design storm is limited to maintaining two clear 10-foot lanes. Local roads require one clear 10-foot lane; other access roads may have ponding across no more than one-half of the road width.
4. Overflow swales shall be provided at sag inlets to limit depth of ponding in street or parking lot to a maximum of seven inches above the gutter elevation. Additionally, runoff from the 100-year storm must be contained in the right-of-way.
5. Facilities functioning as major drainage systems as defined in **Appendix A** must meet IDNR design standards in addition to the Blackford County

standards. In case of discrepancy, the most restrictive requirements shall apply.

6. New 12-inch to 24-inch drain tiles and pipes shall be placed in 20-foot easements (10 feet from centerline on each side) and shall be designated on the record plat as 20-foot Regulated Drain Easement (RDE). New 24-inch and larger drain tiles and pipes shall be placed in 30-foot easements (15 feet from centerline on each side) and shall be designated on the record plat as 30-foot Regulated Drain Easement. Wider easements may be required when the depth of pipe is more than six feet.

B. Manning's Equation

Capacity of storm sewers sized by the Rational Method analysis must be determined using Manning's Equation where:

$$V = (1.486/n)(R^{2/3})(S^{1/2})$$

Then:

$$Q = (V)(A)$$

Where:

Q = capacity in cubic feet per second

V = mean flow velocity in feet per second

A = cross sectional area in square feet

R = hydraulic radius in feet

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

n = Manning's "n" or roughness coefficient

Hydraulic radius, R, is defined as cross-sectional area of flow divided by wetted flow surface (wetted perimeter). Allowable "n" values and maximum full-flow velocities are listed in **Table 4-1**.

**TABLE 4-1
Typical Values of Manning's "n"**

<i>Material</i>	<i>Manning's "n"</i>	<i>Maximum Velocities (feet/second)</i>
Closed Conduits		
Concrete	0.013	10
Vitrified Clay	0.013	10
HDPE	0.012	10
PVC	0.011	10
Circular CMP, Annular Corrugations, 2 2/3 x 1/2 inch		
Unpaved	0.024	7
25% Paved	0.021	7
50% Paved	0.018	7
100% Paved	0.013	7
Concrete Culverts	0.013	10
HDPE or PVC	0.012	10
Open Channels		
Concrete, Trowel Finish	0.013	10
Concrete, Broom Finish	0.015	10
Gunite	0.018	10
Riprap Placed	0.030	10
Riprap Dumped	0.035	10
Gabion	0.028	10
New Earth ¹	0.025	4
Existing Earth ²	0.030	4
Dense Growth of Weeds	0.040	4
Dense Weeds and Brush	0.040	4
Swale with Grass	0.035	4

Source of manning "n" values: LTAP Stormwater Drainage Manual, July 1995.

- ¹ New earth (uniform, sodded, clay soil)
- ² Existing earth (uniform, with some weeds)

C. Backwater Method for Pipe System Analysis

Hydraulic analysis of existing or proposed storm drains with submerged outfalls require a more sophisticated analysis. Backwater analysis provides a more accurate estimate of pipe flow by calculating individual head losses in surcharged pipe systems. These head losses are added to a known downstream water surface elevation to give a design water surface elevation for a given flow at the desired upstream location.

Tailwater conditions assumed for this computation should be verified by appropriate calculations. Total head losses may be determined as follows:

Total head loss = frictional loss + manhole loss + velocity head loss + junction loss

Computer models such as HYDRA, ILLUDRAIN, and STORMCAD are available to analyze storm drains under these conditions.

D. Minimum Size for Storm Sewers

The minimum diameter of storm sewers shall be 12 inches. When the minimum 12-inch diameter pipe will not limit the rate of release to the required amount, the rate of release for detention storage shall be controlled by an orifice plate or other device, subject to acceptance of the Blackford County Surveyor.

E. Pipe Cover, Grade, and Separation from Sanitary Sewers

Pipe grade shall be such that, in general, a minimum of 2.0 feet of cover is maintained over the top of the pipe. If the pipe is to be placed under pavement, or within 5 feet of the pavement, then the minimum pipe cover shall be 2.5 feet from top of pavement to top of pipe. Uniform slopes shall be maintained between inlets, manholes and inlets to manholes. Minimum allowable slope shall be that required to provide full-flow velocity of 2.5 feet per second. Maximum permissible velocities for various storm sewer materials are listed in **Table 4-1**. A minimum of 2.0 feet of vertical separation between storm sewers and sanitary sewers shall be required, or the sanitary sewer must be encased in concrete or ductile steel within 5 feet on each side of the centerline of the crossing.

F. Alignment

Storm sewers shall be straight between manholes and/or inlets.

G. Manholes/Inlets

Manholes and inlets shall be installed to provide human access for inspection and maintenance of continuous underground storm sewers. Casting access minimum inside diameter shall be 22 inches or rectangular opening of no less than 22 inches by 22 inches. Steps shall be provided in structures deeper than 4 feet, with the first step at depth of 2 feet and the following steps spaced every 1 foot to the bottom. When grade adjustments of manholes and inlets are required in the field to meet finish design or existing curb grade, adjustment rings with a maximum height of 12 inches may be used. Manholes shall be provided at the following locations:

1. Where two or more storm sewers converge.
2. Where pipe size or the pipe material changes.
3. Where a change in horizontal alignment occurs.
4. Where a change in pipe slope occurs.

The maximum spacing of manholes along straight sections of storm sewer shall be as shown in **Table 4-2**.

TABLE 4-2

Maximum Distance Between Manholes	
Size of Pipe (Inches)	Maximum Distance (Feet)
12 through 42	400
48 and larger	600

Manhole/inlet size shall be according to the Blackford County Standard Construction Details.

A minimum drop of 0.1 foot through manholes and inlet structures should be provided. Pipe slope should not be so steep that inlets surcharge (hydraulic grade line should remain below rim elevation).

Manhole/inlet inside sizing shall be as shown in **Table 4-3**.

TABLE 4-3

Manhole/Inlet Inside Sizing		
Depth of Structure	Minimum Diameter	Minimum Square Opening
Less than 5 feet	36 inches	36" x 36"
5 feet or more	48 inches	48" x 48"

H. Inlet Sizing and Spacing

Inlets shall be used to collect surface water and convey it to storm sewers, channels, or culverts. Inlet grate openings shall be adequate to pass the 10-year flow with 50% of sag inlet areas clogged. Inlets shall be provided upstream of intersections and shall be spaced at a maximum of 500-feet. Overflow paths from sag inlets to overflow channels or basins shall be provided. Inlet design and spacing may be done using hydraulic equations provided by manufacturers, or by using orifice and weir equations. Use of the U.S. Army Corps of Engineers HEC-12 computer program is also an acceptable method. Gutter spread on continuous grades may be determined using the Manning's equation, or by using **Figure 4-1**. Further guidance regarding gutter spread calculation may be found in the latest edition of HERPICC Stormwater Drainage Manual, available from the Local Technical Assistance Program (LTAP). At the time of printing of this document, contact information for LTAP was:

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

I. Installation and Workmanship

Bedding and backfill materials around storm sewers, subdrains and associated structures shall be as detailed in **Figure 4-2** and **Figure 4-3**. Dips and sags will not be allowed on newly installed storm systems. Also, infiltration from cracks, missing pieces, and joints would not be allowed. Variations from these standards must be justified and receive written acceptance from the Blackford County Surveyor.

J. Materials

Storm sewer manholes and inlets shall be constructed of cast in place concrete or precast reinforced concrete. Material and construction shall conform to sections 702 and 720 of the latest edition of the Indiana Department of Transportation (INDOT) Standard Specifications.

Pipe and fittings used in storm sewer construction shall be extra-strength ductile iron pipe (AWWA C-151), poly vinyl chloride pipe (AASHTO M252), polyethylene pipe (AASHTO M252 or AASHTO M294), or concrete pipe (AASHTO M170). Other pipe and fittings not specified herein or in Sections 907-908 of the latest edition of the INDOT "Standard Specifications" may be used only when specifically authorized by the Blackford County Surveyor. Pipe joints shall be flexible and watertight and shall conform to the requirements of Section 906, of the latest edition of the INDOT "Standard Specifications". Pipe and fittings for storm sewers placed within road right-of-way or in area subject to traffic loading shall be concrete.

K. Special Hydraulic Structures

Special hydraulic structures required to control flow in drainage systems include junction chambers, drop manholes, stilling basins, and other special structures. Use of special structures shall be limited to locations justified by prudent planning and by careful and thorough hydraulic engineering analysis. Certification of special structures by a certified Structural Engineer may be required.

L. Connections to Storm Sewer System

To allow connections to a storm sewer system, provisions for the connections shall be shown in the drainage calculations for the system. Specific language shall be provided in the protective covenants, on the record plat, or with the parcel deed of record, noting the ability or inability of the system to accommodate permitted connections like sump pumps and footing drains.

1. **Sump pumps** installed to discharge groundwater or stormwater shall be connected to a sub-surface drain provided by the developer. Sump pumps installed to discharge floor drain flow or other sanitary sewage shall be connected to the sanitary sewers. A stormwater sump pump shall only be used for discharge of stormwater.
2. **Footing drains and perimeter drains** shall be connected to manholes or curb inlets, or to designated storm sewers, channels or swales.
3. **Roof downspouts** and other roof drains of residential developments shall discharge onto the ground or be connected to the storm drainage system. No downspouts or roof drains shall be connected to public sanitary sewers.
4. **Garage and Basement floor drains** shall not be connected to storm sewers.
5. **Swimming Pool drains** shall not be connected to storm sewers.

None of the above-mentioned drains shall be connected to any road underdrains unless specifically authorized by Blackford County Surveyor.

M. Drainage System Overflow Design

Overflow paths throughout the development resulting from a 100-year storm event, shall be determined, clearly shown on the plans, and contained in permanent drainage easements with a minimum width of 10 feet along the centerline of the flow path. A continuous flood route from sag inlets to final outfall shall be shown and the minimum 10 feet along the centerline contained within an easement or road right-of-way. No fences or landscaping are allowed within the easement areas.

The minimum adjacent grade of any residential, commercial, or industrial building (the ground elevation next to the building after construction is completed that sits adjacent to the overflow path or may be subject to flooding by the overflow path) shall be 1 foot above the estimated 100-year elevation along the overflow path. **Table 4-4** provides minimum adjacent grades for buildings adjacent to overflow paths and minimum easement widths as a function of drainage area tributary to the overflow path. This table is based on 1 foot of freeboard above flood elevation and expected flow width assuming a grassed triangular channel section with 3:1 side slopes, and the difference in runoff between a 10-year frequency and 100-year frequency storm with a runoff coefficient of 0.45 and a time of concentration of 20 minutes.

In lieu of **Table 4-4**, the designer may calculate anticipated flow depth and width in the overflow system independently. The designer shall submit overflow path depth and width calculations to the Blackford County Drainage Board. Calculation must show lowest adjacent grades provide 1 foot of freeboard and proposed easement widths are sufficient; minimum easement width is 10 feet. In the case of existing upstream detention, an allowance equivalent to the reduction in flow rate provided may be made for upstream detention only when such detention and release rate have previously been approved by the Blackford County Drainage Board official

charged with the approval authority at the time of the approval, and evidence of its construction and maintenance can be shown.

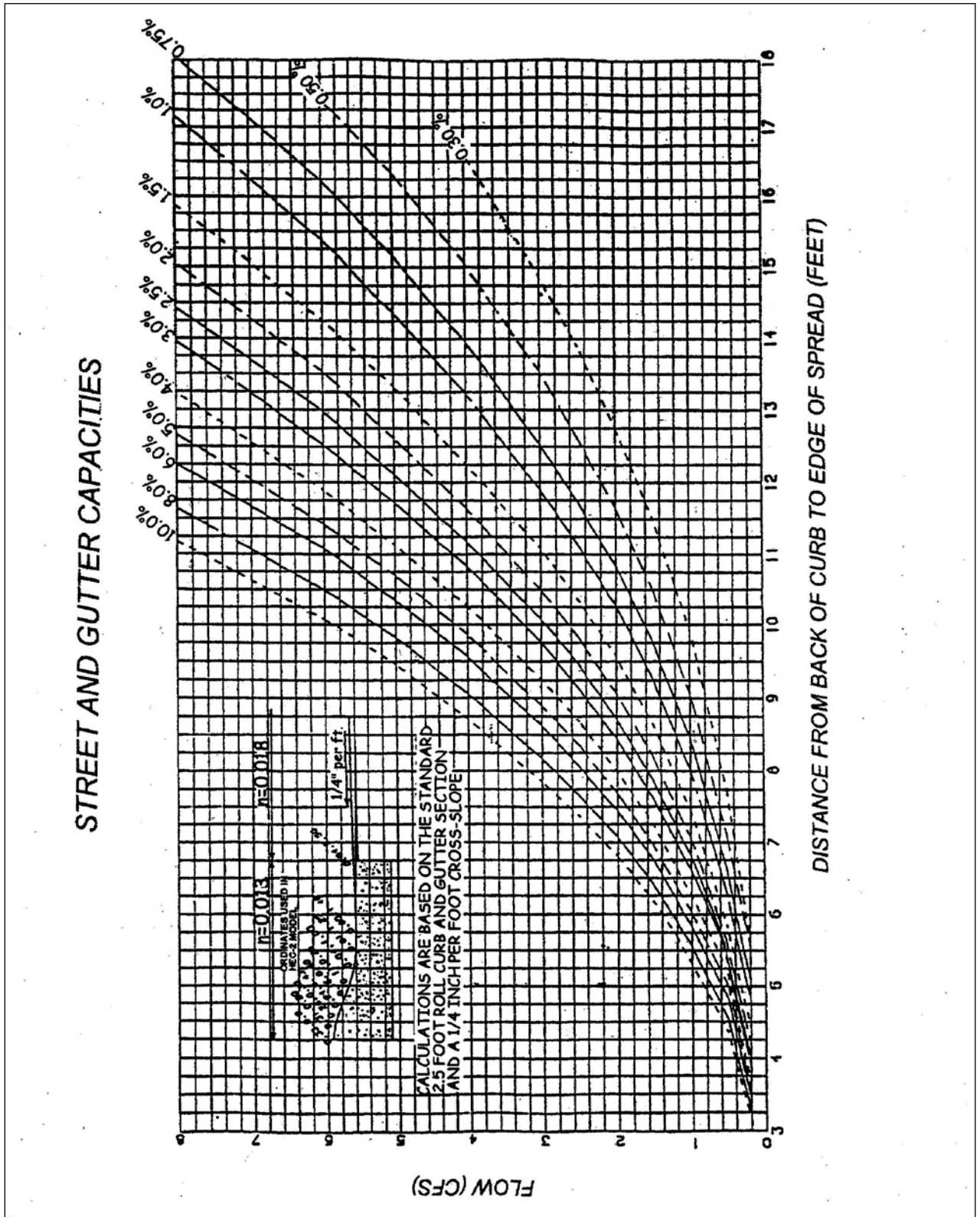
The overflow path may be modeled as a successive series of natural ponds and open channel segments. Ponding areas should be modeled as depressional areas as discussed in chapter 6, and channel reaches should be modeled using techniques discussed in chapter 5. The 100-year overflow path elevations may be based on hand calculations using normal depth calculations and storage routing techniques or determined using computer models.

If the designer uses **Table 4-4**, the Blackford County Drainage Board reserves the right to require independent review to verify proposed adjacent grades provide adequate freeboard, and proper overflow path easement widths are provided. The emergency routing easement width downstream of a detention pond should be determined independently based on proposed grading along the flow path and discharge used to size the detention pond emergency spillway.

TABLE 4-4

Drainage Area (acres)	Minimum Building Adjacent Grade Above Overflow Path Invert (ft.)	Minimum Building Adjacent Grade Above Overflow Path Invert, if Overflow Path is in the Street (ft.)	Minimum Emergency Overflow Path Easement Width (ft.)
Up to 3	2.0	1.25	15
3-8	2.25	1.25	15
9-25	2.5	1.5	20
26-55	3.0	1.5	25
56-100	3.5	1.75	30
Over 100	Must be calculated independently	Must be calculated independently	Must be calculated independently

FIGURE 4-1
Street and Gutter Capacities (continuous grade)



**FIGURE 4-2
Bedding and Backfill Standards for Storm Sewers**

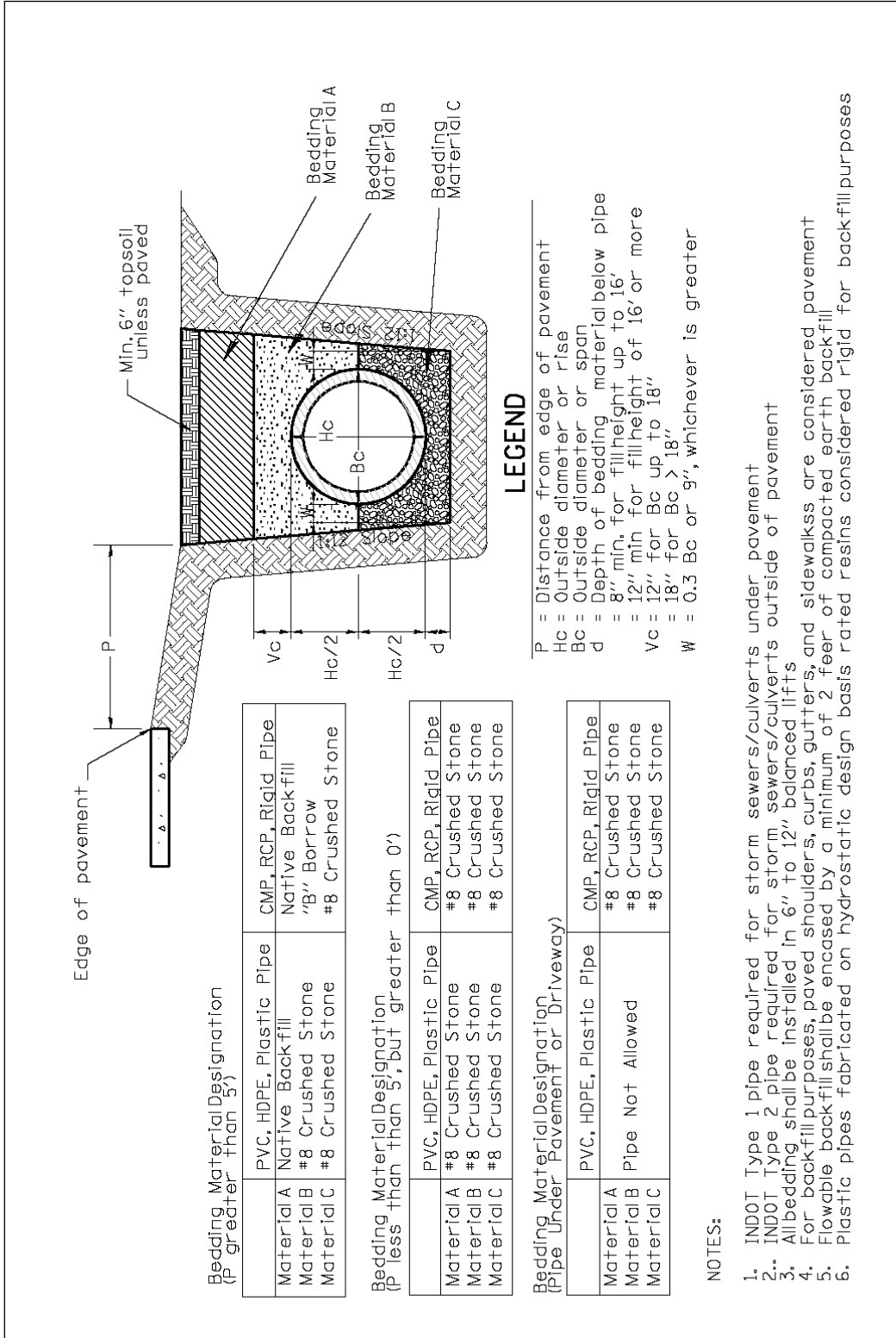
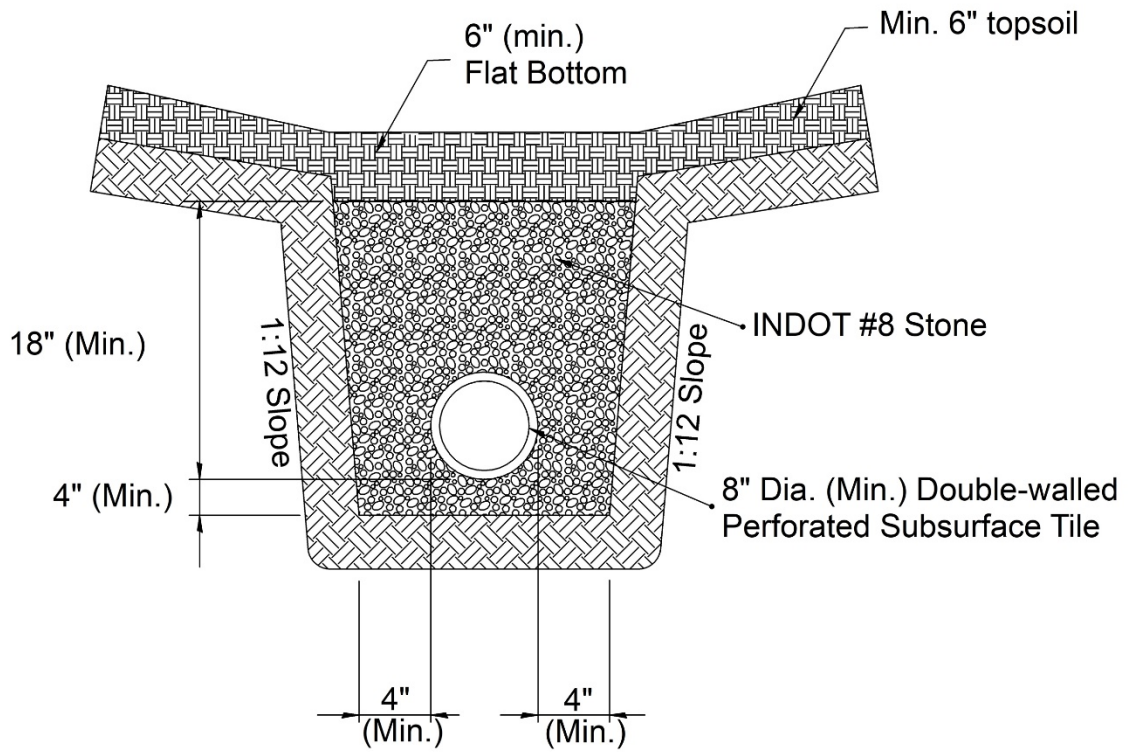


FIGURE 4-3
Bedding and Backfill Standards for Sub-drains under Swales





Chapter Five

OPEN CHANNEL DESIGN STANDARDS AND SPECIFICATIONS

Channels, whether private or public, and whether constructed on private or public land, shall conform to the design standards and other design requirements contained herein. Proposed channels must be sized and designed to convey at least the 10-year frequency on-site stormwater runoff, as well as anticipated 10-year frequency tributary off-site stormwater runoff assuming future developed condition. Also, an analysis of drainage system overflow must be completed in accordance with section M of this chapter to show safe routing of flood waters through the development, and that the development will not obstruct free flow of floodwaters from tributary off-site property in both current and fully-developed conditions.

A. Design Storm Frequencies

1. Channels and swales shall accommodate, as a minimum, peak runoff from a 10-year return frequency storm calculated as described in chapter 2.
2. Channels with capacity of more than 30 cfs at bank-full stage shall be capable of accommodating peak runoff for a 50-year return frequency storm within the drainage easement.
3. Channel facilities functioning as a major drainage system, as defined in **Appendix A**, must also meet IDNR design standards in addition to the Blackford County standards. In case of discrepancy, the most restrictive requirements shall apply.
4. Residential rear and side lot swales shall not convey more than 4 cfs during the 10-year event. The maximum length of rear and side lot swales before reaching an inlet shall not exceed 400 feet.
5. The performance of all parts of the drainage system must be checked for the 100-year flow conditions to confirm that buildings are properly located outside the 100-year flood boundary limits and that flow paths are confined to designated areas with proper easement.

B. Manning's Equation

The waterway area for channels shall be determined using Manning's Equation, where:

$$A = Q/V$$

A = Waterway area of channel in square feet

Q = Discharge in cubic feet per second (cfs)

V = Steady-State channel velocity, as defined by Manning's Equation (See Chapter 4)

C. Backwater Method for Drainage System Analysis

The determination of 100-year water surface elevation along channels and swales shall be based on accepted methodology and computer programs designed for this purpose. HEC-RAS is the preferred model for conducting such backwater analysis. The use of other computer models must be accepted in advance by the Blackford County Surveyor.

D. Channel Cross-Section and Grade

1. The required channel cross-section and grade are determined by the design capacity, the material in which the channel 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 channel grade shall be such that the velocity in the channel is high enough to prevent siltation but low enough to prevent erosion. Velocities less than 2 feet per second for the design storm are not acceptable, as siltation will take place and ultimately reduce the channel cross-section area. The maximum permissible velocities in vegetated-lined channels are shown in **Table 5-1**. In addition to existing runoff, the channel design should incorporate increased runoff due to the proposed development.
2. Where depth of design flow is slightly below critical depth, channels shall have freeboard adequate to cope with the effect of hydraulic jumps.
3. Along streets and roads, the bottom of the ditch should be low enough to install adequately sized driveway culverts without creating "speed bumps". The driveway culvert inverts shall be designed to adequately consider upstream and downstream culvert elevations. Use of open channels and swales within road right of way is only allowed in special circumstances when no other viable option exists. The applicant must consult with the Blackford County Highway Engineer prior to design.
4. Flow of a channel into a closed system is prohibited, unless runoff rate and head loss computations show the closed conduit has capacity to convey the 100-year channel flow either entirely or in combination with a defined overflow channel, with no reduction of velocity.

TABLE 5-1

Maximum Permissible Velocities in Vegetation-Lined Channels ¹			
<i>Cover</i>	<i>Channel Slope Range (Percent)³</i>	<i>Permissible Velocity ²</i>	
		<i>Erosion Resistant Soils (ft. per sec.)⁴</i>	<i>Easily Eroded Soils (ft. per sec.)⁴</i>
Bermuda Grass	0-5	8	6
	5-10	7	5
	Over 10	6	4
Bahia Buffalo Grass Kentucky Bluegrass Smooth Brome Blue Grama	0-5	7	5
	5-10	6	4
	Over 10	5	3
Grass Mixture Reed Canary Grass	0-5 ³	5	4
	5-10	4	3
Lespedeza Sericea Weeping Lovegrass Yellow Bluestem Redtop Alfalfa Red Fescue	0-5 ⁴	3.4	2.5
	5-10		
Common Lespedeza ⁵ Sudangrass ⁵	0-5 ⁶	3.5	2.5

¹ From Soil Conservation Service, SCS-TP-61, Handbook of Channel Design for Soil and Water Conservation.

² Use velocities exceeding 5 feet per second only where good channel ground covers and proper maintenance can be obtained.

³ Do not use on slopes steeper than 10 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

⁴ Do not use on slopes steeper than 5 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

⁵ Annuals - use on mild slopes or as temporary protection until permanent covers are established.

⁶ Use on slopes steeper than 5 percent is not recommended.

E. Side Slopes

1. Earthen channel and swale side slopes shall be no steeper than 3 horizontal to 1 vertical (3:1). Flatter slopes may be required to prevent erosion and for ease of maintenance.
2. Where channels will be lined with riprap, concrete, or other acceptable lining method, side slopes shall be no steeper than 2 horizontal to 1 vertical (2:1) with adequate provisions made for weep holes.
3. Side slopes steeper than 2 horizontal to 1 vertical (2:1) may be used for lined channels provided that the lining is designed and constructed as a structural retaining wall with provisions for live and dead load surcharge.
4. When the design discharge produces a depth of greater than three feet in the channel, appropriate safety precautions shall be added to the design based on reasonably anticipated safety needs at the site.

F. Channel Stability

1. Characteristics of a stable channel are:
 - a. It neither promotes sedimentation nor degrades the channel bottom and sides.
 - b. The channel banks do not erode to the extent that the channel cross-section is changed appreciably.
 - c. Excessive sediment bars do not develop.
 - d. Excessive erosion does not occur around culverts, bridges, outfalls or elsewhere.
 - e. Gullies do not form or enlarge due to the entry of uncontrolled flow to the channel.
2. Channel stability shall be determined for an aged condition and the velocity shall be based on the design flow or the bankfull flow.
3. Channel stability shall be checked for conditions representing the period immediately after construction. For this stability analysis, the velocity shall be calculated for the expected flow from a 10-year frequency storm or the bankfull flow, whichever is smaller. The allowable velocity in the newly constructed channel 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 is to be constructed are suitable for rapid establishment and support of erosion controlling vegetation.
 - b. Species of erosion controlling vegetation adapted to the area, and proven methods of establishment are shown.

- c. The channel design includes detailed plans for establishment of vegetation on the channel side slopes.

G. Drainage of Swales

Minimum swale slopes are 0.5%. All flow shall be confined to the specific easements associated with each rear and side lot swale that are part of the minor drainage system. Vegetated swales with a slope between 0.5% to 0.75% shall include paved gutters, and vegetated swales with a slope between 0.75% to less than 1.0% shall be drained with a tile system. Further guidance may be found in the latest edition of the Indiana Drainage Handbook.

H. Appurtenant Structures

The design of channels will include provisions for operation and maintenance and proper functioning of channels, laterals, and structures associated with the project. Recessed inlets and structures needed for entry of surface and subsurface flow into channels without significant erosion or degradation shall be included in the design of channel improvements. The design will also provide for necessary floodgates, water level control devices, and any other appurtenance structure affecting the functioning of the channels and the attainment of the purpose for which they are built.

The effects of channel improvements on existing culverts, bridges, buried cables, pipelines, and inlet structures for surface and subsurface drainage on the channel being improved and laterals thereto shall be evaluated to determine the need for modification or replacement.

I. Disposal of Spoil

Spoil material resulting from clearing, grubbing, and channel excavation shall be disposed of in a manner that will:

1. Minimize overbank wash.
2. Provide for the free flow of water between the channel and floodplain boundary unless the valley routing and water surface profiles are based on continuous dikes being installed.
3. Not hinder access for maintenance.
4. Leave the right-of-way in the best condition feasible, consistent with the project purposes, for productive use by the owner.

J. Materials

Materials acceptable for use as channel lining are:

1. Grass
2. Riprap

3. Concrete
4. Hand Laid Riprap
5. Precast Concrete Riprap
6. Gabions
7. Straw, Coconut Mattings, or other accepted material (only until grass is established)

Other lining materials must be accepted in writing by the Blackford County Surveyor. Materials shall comply with latest edition of INDOT Standard Specifications.

K. Drainage System Overflow Design

See Chapter 4, Section M.



Chapter Six

STORMWATER DETENTION DESIGN STANDARDS FOR PEAK FLOW CONTROL

Basins shall be provided to detain stormwater runoff that exceeds maximum peak release rate authorized by the stormwater ordinance. The required volume of storage provided in these basins, together with such storage as may be authorized in other on-site facilities, shall be as needed to control excess runoff from the 10-year and 100-year storms. Basins shall also provide adequate capacity to allow for sediment accumulation resulting from development and to permit the pond to function for reasonable periods between cleanings.

Detention basin design can be challenging, especially with additional considerations needed for bypassing runoff from off-site areas. The following calculation sequence is suggested for designing a detention pond.

1. Determine the main outlet control elevation based on site constraints and project requirements.
2. Route on-site 10-year and 100-year inflow hydrographs through pond (by temporarily ignoring off-site flows) and size main outlet to limit peak outflows to allowable release rates. If an orifice is used to limit outflow, the minimum allowable size is 4 inches. The resulting maximum water surface elevation is the top of peak flow control storage for on-site flows. If no off-site flows are routed through the detention facility, then this will be the pond's 100-year elevation and the emergency spillway invert elevation is also set at this elevation.
3. Preferably, off-site flows that are directed through the detention pond (rather than around the pond) should be routed through a separate outlet (such as a drop inlet structure) with its control elevation set no lower than the on-site 100-year pond elevation determined in Step 2. Alternatively, off-site flows may be routed through the emergency spillway designed as detailed below. Since this will result in water flowing over the emergency spillway more frequently, erosion control measures designed based on estimated frequency of use may be needed. The 100-year pond elevation is determined by routing on-site and off-site 100-year inflow hydrographs through the pond.

Additional details regarding design of stormwater detention facilities and management of offsite runoff are provided in the following sections.

A. Acceptable Detention Facilities

Increased stormwater runoff resulting from a development should be detained on-site in appropriate detention facilities. Measures that retard the rate of overland flow and the velocity in runoff channels may also be used to partially control runoff rates.

B. Allowable Release Rates

1. General Release Rates

In general, stormwater detention shall be designed to limit release rates for events up to and including the 10-year return period storm to the pre-developed peak 2-year return period runoff rate, and for the 11 to 100-year return period storms to the pre-developed peak 10-year return period rate. The county surveyor may require lower release rates for Impact Drainage Areas and for certain watersheds if more detailed data becomes available because of approved watershed studies.

For sites where the pre-developed area has more than one outlet, the release rate should be computed based on pre-developed discharge to each outlet point. The computed release rate for each outlet point shall not be exceeded at the respective outlet point even if the post developed conditions would involve a different arrangement of outlet points.

2. Site-Specific Release Rates for Sites with Depressional Storage

For sites with depressional storage, site-specific release rates should be calculated using methodology described in chapter 2. Account for each depressional storage area by modeling as a pond with outlet modeled as a weir at existing ground elevation that stormwater will overflow and drain away from the depressional storage area. Depressional storage areas should be modeled assuming they are empty at the beginning of a storm. The function of depressional storage should be modeled using an event hydrograph model to determine the effect of depressional storage on the existing site release rate.

3. Management of Off-site Runoff

Runoff from upstream tributary areas (off-site land areas) may be bypassed around the detention facility without attenuation. Off-site runoff may also be routed through the detention facility, provided that a separate outlet system or channel (separate from the primary outlet) is incorporated for the safe conveyance of off-site runoff.

The efficiency of a detention basin in controlling on-site runoff may be reduced when off-site area is significantly larger than on-site area. As general guidance, on-line detention may not be effective in controlling on-site runoff when the ratio of off-site to on-site area is larger than 5:1. Blackford County Surveyor may require additional detention (above and beyond that required for on-site area) when the ratio of off-site area to on-site area is larger than 5:1.

4. Downstream Restrictions

If the downstream receiving channel or storm drain does not have capacity to accommodate post-developed release rate provided above, then the release rate must be reduced to the capacity of the receiving downstream channel or storm sewer system. Additional detention will be required to store runoff volume that exceeds the capacity of the receiving channel or storm sewer system. When downstream restrictions are suspected, the Blackford County Drainage Board may require analysis to determine capacity of the receiving system.

When the proposed development site makes up only a portion of the watershed draining to the receiving channel or storm drain, the allowable release rate for the development will be in direct proportion to the ratio of the on-site drainage area to the total tributary watershed drainage area.

As an alternative to reduced release rates, the Blackford County Drainage Board may allow applicant to pursue increasing downstream system capacity. In this case, applicant would be responsible for obtaining permits and consents, and for covering all design, construction, and other expenses.

5. Documentation of Results

The results of allowable release rate calculations and modeling results must be summarized in a table that is included in the drainage technical report. The table must include, for each site outlet, pre-developed acreage tributary to each site outlet, and pre- and post-developed peak flow rates for 2, 10, and 100-year events.

C. General Detention Basin Design Requirements

1. The detention basin shall be designed so that a minimum 90% of peak detention storage volume is restored within 48 hours from the start of the 100-year storm.
2. The 100-year elevation of stormwater detention facilities shall be separated from any occupied building or structure by not less than 25 feet. The lowest adjacent grade (including walkout basement floor elevation) for residential, commercial, or industrial buildings shall be set a minimum of 2 feet above the 100-year pond elevation or the emergency overflow weir elevation, whichever is higher. In addition, any basement floor must be at least one foot above the normal water level of any wet pond or the local groundwater table, whichever is higher.
3. No detention facility or other water storage area, permanent or temporary, shall be constructed under or within 20 feet of any pole or high voltage electric line. Likewise, poles or high voltage electric lines shall not be placed within 20 feet of any detention facility or other water storage area.
4. Detention facilities shall be separated from parking lots and roadways by at least 50-feet, or an appropriately-selected and designed method of safety barrier,

such as guard rails, bollards, or other physical barriers capable of preventing passage of a vehicle into the pond.

5. Slopes no steeper than 3 horizontal to 1 vertical (3:1) for safety, erosion control, stability, and ease of maintenance shall be permitted.
6. Safety screens having a maximum opening of four inches shall be provided for any pipe or opening 18-inches in diameter or larger.
7. Unless specifically required by the Blackford County Drainage Board, the decision to use fencing around detention ponds is left to the owner or developer. Recommendations contained within this document do not relieve the applicant, owner or developer from the responsibility of taking actions needed for public safety around detention basins.
8. Outlet control structures shall be designed to operate simply and shall require little or no maintenance or attention for proper operation. For maintenance purposes, the pond outlet shall be a minimum of 0.5 foot above the normal water level of the receiving water body. They shall limit discharges into existing or planned downstream channels or conduits so as not to exceed the predetermined maximum authorized peak flow rate. If an outlet control structure includes an orifice to restrict the flow rate, such orifice shall be no less than 4 inches in diameter.
9. Emergency overflow facilities such as a weir or spillway shall be provided for the release of exceptional storm runoff or in emergency conditions if the primary outlets become totally or partially inoperative. The overflow facility shall be of such design that its operation is automatic and does not require manual attention.

Emergency overflow facilities shall be designed to convey, without overtopping detention facility banks, 1.25 times the peak 100-year inflow from the entire contributing watershed draining to the detention facility. The weir length should be determined using the weir equation, with the overflow weir control elevation set no lower than the 100-year pond elevation; pond is assumed full to the overflow weir control elevation.

The emergency overflow routing from the emergency overflow facility to an adequate receiving system must be positive (by gravity) and shown on the construction plans. It must be sized to accommodate the design flow of the pond's emergency overflow weir. A minimum of 30 feet width along the centerline of this emergency overflow route shall be designated as permanent drainage easement. This emergency overflow easement shall be shown on the plans as hatched area or another distinctive symbol. No fences or landscaping may be constructed within the easement.

10. Grass or other suitable vegetative cover shall be provided along the banks of the detention storage basin. Vegetative cover around detention facilities should be maintained as appropriate.

11. Debris and trash removal, and other necessary maintenance shall be performed on a regular basis to provide continued operation as designed.
12. No residential lots or any part thereof may be used for any part of a detention basin assumed full to the 100-year water surface elevation or the emergency overflow weir elevation, whichever is higher. Detention basins assumed full to the 100-year water surface elevation or the emergency overflow weir elevation, whichever is higher, shall be placed within a common area either platted or legally described and recorded as a perpetual stormwater easement.
13. A minimum of 20 feet horizontally from the top of bank of the facility, or the 100-year pool if no defined top of bank is present, shall be dedicated as permanent stormwater easement if the above-noted boundary of the common area does not extend that far. Within this easement no trees may be planted within 50 feet of any pipe draining to the pond, or the pond outlet.

In addition, an exclusive easement to assure access to the pond from an adjacent public road right of way shall be required. No above-ground utilities or other obstruction that may hinder access shall be allowed within this exclusive access easement. Additional access easements may be required for larger ponds,

D. Additional Requirements for Wet-Bottom Facility Design

Where part of a detention facility will contain a permanent pool of water, all the items required for detention storage shall apply. Also, a controlled positive outlet will be required to maintain the normal pool elevation in the wet bottom facility and provide required detention storage above the design water level. Refer to **Figure 6-1** and **Figure 6-2** at the end of this chapter for visual clarification of the following additional conditions that also apply:

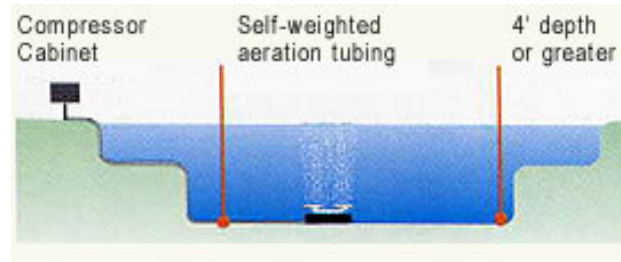
1. Facilities designed with permanent pools or containing permanent lakes shall have a water area of at least ½-acre with a minimum depth of eight feet over most of the pond area. If fish are to be used to keep the pond clean, a minimum depth of approximately 10 feet shall be maintained over at least 25 percent of the pond area. Construction trash or debris shall not be placed within the permanent pool.
2. Wet detention/retention ponds should have a vegetated safety ledge (approximately 6 inches below normal pool) or have native vegetation planted on the pond banks to create a riparian buffer (minimum 10 feet wide). Native vegetation can be installed as container grown plants or as seed at the time of construction. If native vegetation is planted on the pond banks, signage must be provided indicating that it is a natural “Do Not Mow” area. The vegetation should be planted in a manner so as not to hide or disguise the pond edge. Maintenance of the vegetated barrier shall be the responsibility of the owner or the homeowners’ association. Pond slopes shall be 3:1 (horizontal to vertical) or flatter.

3. For wet-bottom facilities without a security fence, a 10-foot wide maintenance ledge shall be installed approximately 12 inches above the permanent water level, and a 10-foot wide safety ledge shall be installed approximately 6 inches below the permanent water level. If a non-vegetated safety ledge is installed, the depth of the safety ledge shall be approximately 18 inches below normal pool. The slope between the two ledges shall be stable and protected from erosion with hard armoring or bioengineered techniques.

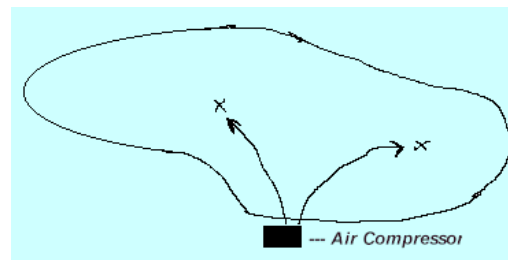
For wet-bottom facilities with a security fence, a 6-foot wide maintenance ledge shall be installed approximately 12 inches above the permanent water level, and a 6-foot wide safety ledge shall be installed approximately 6 inches below the permanent water level. If a non-vegetated safety ledge is installed, the depth of the safety ledge shall be approximately 18 inches below normal pool. The slope between the two ledges shall be stable and protected from erosion with hard armoring or bioengineered techniques.

4. Prior to final acceptance of construction and release of bonds, danger signs warning of deep water, possible flood conditions during storm periods, or other dangers, shall be installed at an interval of 400 feet around the perimeter of wet-bottom facilities without a vegetated safety ledge, riparian buffer, or a security fence. Maintenance of the warning signs shall be the responsibility of the owner or the homeowners' association.
5. A safety ramp exit from the lake shall be required and shall have a minimum width of 20 feet and exit slope of 6 horizontal to 1 vertical (6:1). The safety ramp shall be constructed of suitable material to prevent structural instability due to vehicles or wave action. Adequate access to the safety ramp shall be provided by locating it adjacent to public right-of-way or by providing a clear route recorded within an access easement or a common area.
6. Parks, playgrounds, and athletic fields shall be separated from stormwater detention facilities by no less than 100 feet, measured from the 100-year pool of the pond. Trails and sidewalks shall be separated from stormwater detention facilities by no less than 25 feet, measured from the 100-year pool of the pond.
7. Periodic maintenance is required in lakes to control weed and larval growth. The facility shall also be designed to provide for the easy removal of sediment that will accumulate during periods of reservoir operation. A means of maintaining the designed water level of the lake during prolonged periods of dry weather may also be required.
8. The outlet elevation of storm sewers entering the pond must be a minimum of 0.5 foot above the normal pool level.
9. Methods to prevent pond stagnation, including but not limited to surface or sub-surface aeration or destratification facilities that can, at a minimum, achieve one complete pond volume turnover per day should be considered. The figure below

shows a typical diffuser aeration system that consists of a quiet air compressor at the shore, aeration tubing, and one or more sets of diffuser heads.



Irregularly shaped ponds should be treated as two or three separate ponds. Likewise, larger ponds will also need multiple aeration units.



Design calculations to substantiate the effectiveness of proposed aeration facilities shall be submitted with final engineering plans. Design calculations should, at a minimum, indicate that the device and/or series of devices are providing a minimum volume turnover of once per 24 hours over most of the pond volume (i.e. pump radius of influence calculations, etc.). Agreements for the perpetual operation and maintenance of aeration facilities by the property owner or the HOA shall be prepared.

11. If the facility is located near an airport, a minimum horizontal separation distance between the airport property and the pond will need to be provided in accordance with latest edition of Federal Aviation Administration (FAA) advisory Circular 150/5200-33 titled Hazardous Wildlife Attractions on or Near Airports.

E. Additional Requirements for Dry-Bottom Facility Design

Dry detention basins shall comply with the following additional requirements:

1. Provisions shall be incorporated into facilities for complete interior drainage of dry bottom facilities, including proper grades to outlet structures, and longitudinal and transverse grades to perimeter drainage facilities, paved gutters, or sub-surface drains.
2. For residential developments, the maximum depth of stormwater stored shall not exceed four feet.

3. In excavated detention facilities, a minimum side slope of 3:1 shall be provided.

F. Parking Lot Storage

Paved parking lots may be designed to provide temporary detention storage on portions of their surfaces. Maximum depth of storage shall be limited to seven inches, ponding should be confined to areas furthest from the facility served, and the 100-year inundation boundary should be clearly shown on the construction plans. Before parking lot detention is allowed, a perpetual maintenance agreement must be executed by the owner or developer and filed with the Blackford County Drainage Board.

G. Detention Facilities in Floodplains

No detention facilities are allowed within FEMA regulatory floodplains.

H. Joint Development of Control Systems

Stormwater control systems may be planned and constructed jointly by two or more developers if compliance with the stormwater ordinance is maintained.

I. Diffused Outlets

When the allowable runoff is released in an area that is susceptible to flooding or erosion, the developer may be required to construct appropriate storm drains through such area to avert increased flood hazard caused by concentration of allowable runoff at one point instead of the natural overland distribution. The requirement of diffused outlet drains shall be at the discretion of the Blackford County Surveyor.

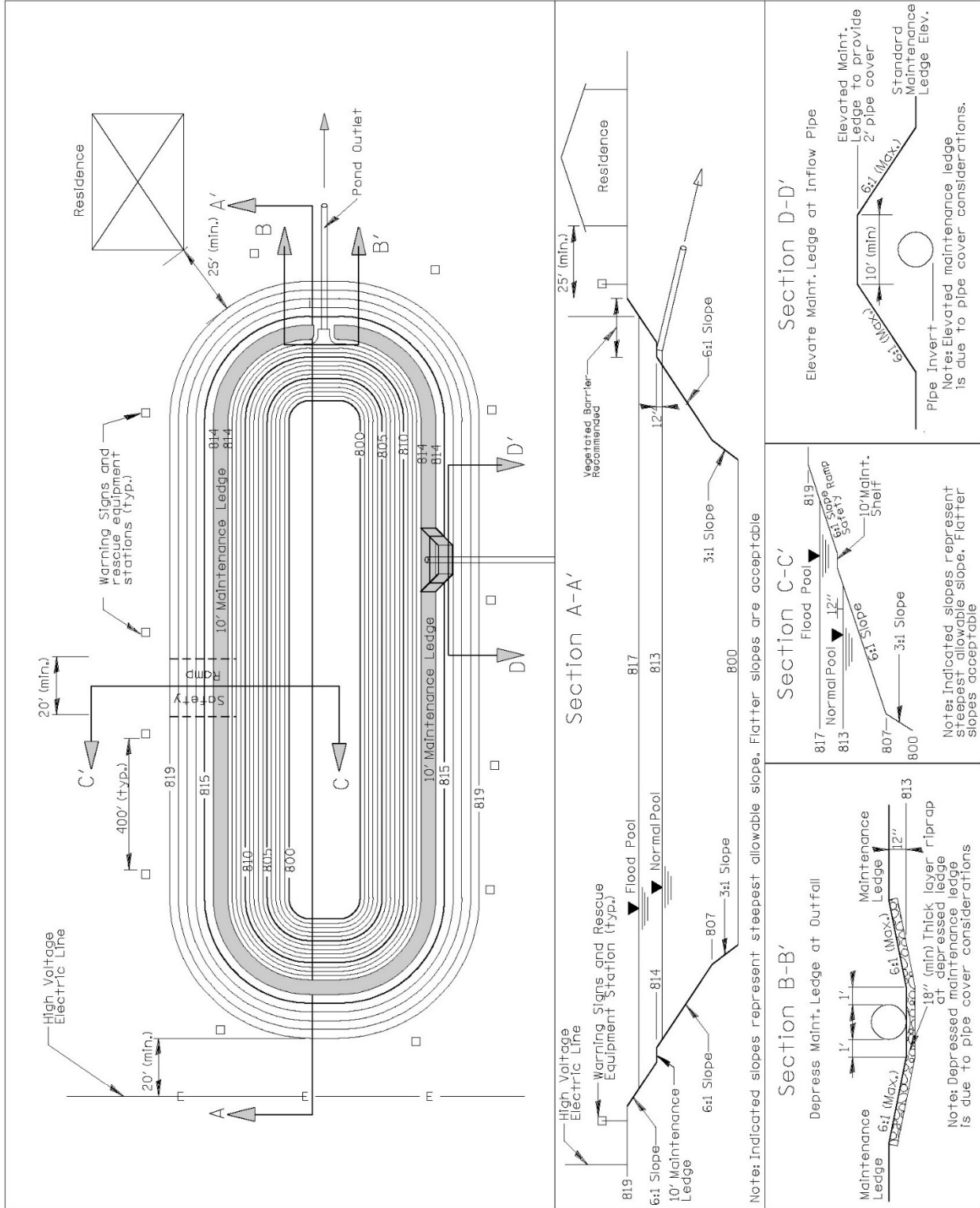
J. Allowance for Sedimentation

Detention basins shall be designed with an additional 10 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 to reduce cost of removal. For wet-bottom ponds, the sediment allowance may be provided below the permanent pool elevation. If the pond is used as a sediment control measure during active construction, the performance sureties will not be released until sediment has been cleaned out of the pond and elevations and grades have been reestablished as shown on approved plans.

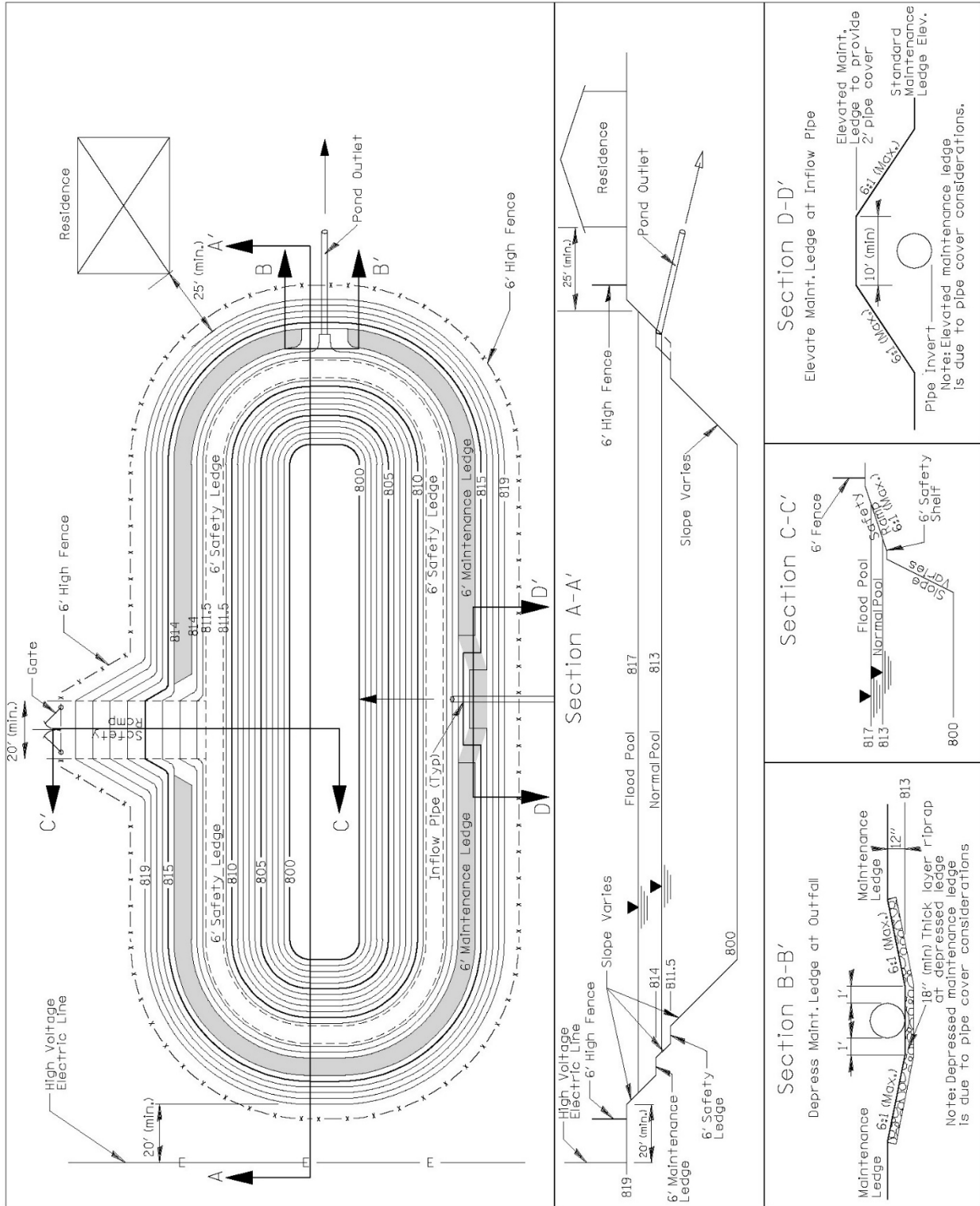
K. Maintenance

Routine maintenance of stormwater detention facilities is the responsibility of the owner or Homeowners' Association.

**FIGURE 6-1
Wet-Bottom Detention Facility – No Fence**



**FIGURE 6-2
Wet-Bottom Detention Facility – With Fence**





Chapter Seven

MISCELLANEOUS REQUIREMENTS

A. Grading and Building Pad Elevations

Minimum Federal and State Requirements

For structures located in Special Flood Hazards Area (SFHA) as shown on FEMA maps, the lowest floor elevation, including basement, shall be at or above the flood protection grade (FPG) and therefore have a minimum of 2 feet of freeboard above the 100-year flood elevation.

Additional Local Requirements

FPG for buildings located within or adjacent to SFHA shall be shown on the secondary plat.

For structures located outside FEMA or IDNR designated floodplains that are subject to flooding from a detention pond, the lowest adjacent grade (LAG) of residential, commercial, or industrial buildings shall be a minimum of 2 feet above the 100-year flood elevation or the emergency overflow weir elevation, whichever is higher.

For structures located outside FEMA or IDNR designated floodplains that are subject to flooding from an open ditch, the LAG of residential, commercial, or industrial buildings shall be a minimum of 2 feet above the 100-year flood elevation.

For structures fronting a flooding source other than a swale or emergency flood route, the floor of basements or crawl spaces (if provided) shall be a minimum of 1 foot above the normal pool level (if pond) or the 2-year flood level (if a stream or an open ditch). In addition, special considerations, based on detailed geotechnical analysis, should be made prior to considering placement of any basement below the 100-year flood elevation of an adjacent flooding source or pond.

For structures adjacent to an emergency flood route (also referred to as overflow path and ponding areas), the minimum adjacent grade of the portion of the structure (the ground elevation next to the building after construction is completed that sits adjacent to the emergency flood route or may be subject to flooding by the emergency flood route) shall be a minimum of 1 foot above the estimated 100-year elevation of the emergency flood route assuming stormwater inlets and pipes are clogged with no discharge into the storm

sewer system. The building adjacent grade requirements (including default elevations above the overflow route bottom) for buildings adjacent to overflow path/ponding areas are further discussed in Chapter 4.

For structures adjacent to a road, the building's lowest entry elevation that is adjacent to and facing a road shall be a minimum of 2 feet above the edge of road elevation.

Finished floor elevation or lowest building entry elevation must be at least 6 inches above adjacent finished grade.

B. Lot Drainage

Lots shall be laid out to provide drainage away from buildings, and individual lot drainage shall be coordinated with the general stormwater drainage pattern for the subdivision. Drainage shall be designed to avoid concentration of stormwater runoff from one lot onto adjacent lots. Each lot owner shall maintain lot grade, as it relates to stormwater drainage, in compliance with approved construction plans.

It shall be the property owners' responsibility to maintain the natural features on their lots and to take preventive measures against erosion and deterioration of natural or manmade features on their lots.

C. Acceptable Outlet and Adjoining Property Impacts Policies

Design and construction of a stormwater facility shall provide for the discharge of stormwater runoff from off-site land areas as well as the stormwater from the area being developed (on-site land areas) to an acceptable outlet(s) having capacity to receive upstream (off-site) and on-site drainage. A Roadside Ditch is generally not considered an adequate outlet. The flow path from the development outfall(s) to a regulated drain, a Blackford County storm drain, or natural watercourse (as determined or approved by the Blackford County Surveyor) shall be provided on an exhibit that includes topographic information. Any existing field tile encountered during the construction shall also be incorporated into the proposed stormwater drainage system or tied to an acceptable outlet.

If an adequate outlet is not located on site, then off-site drainage improvements may be required. Those improvements may include, but are not limited to, extending storm sewers, clearing, dredging and/or removal of obstructions to open drains or natural water courses, and the removal or replacement of undersized culvert pipes as required by the Blackford County Surveyor.

D. Development within Floodways and Fluvial Erosion Hazard Corridors

Regulatory Floodway and Fluvial Erosion Hazard (FEH) Corridor along regulated drains or any natural stream watercourse are considered Impact Drainage Areas and must be preserved to minimize flooding and erosion impacts within the stream system.

Basis for Establishing Floodways

Regulatory floodways along streams in Blackford County are established by FEMA and shown on latest Flood Insurance Rate Maps.

Basis for Establishing Fluvial Erosion Hazard (FEH) Corridors

The Indiana Silver Jackets Hazard Mitigation Task Force has initiated a multi-agency program to identify, study and provide mitigation planning resources for communities who would like to adopt Fluvial Erosion Hazard (FEH) avoidance strategies. The resources provided by this project enable individuals and communities to better recognize areas prone to natural stream-erosion processes and adopt strategies to avoid FEH-related risks. The FEH resources define approximate setbacks for communities to better manage river corridors. The setbacks vary based on the stream's recent migration history (actively migrating or relatively stationary).

For actively migrating and relatively stationary streams, a GIS analysis algorithm generated bankfull width values for each stream segment using regional curves that are based on drainage area within each physiographic region in Indiana. For relatively stationary streams, the analysis used these values to create buffer zones of at least one bankfull width on each side (a total corridor width of 3 times bankfull width) or 100 feet on each side of the bankfull bank, whichever is greater. For actively migrating streams, GIS generated a total corridor width of 8 times bankfull width, which was manually edited and refined to reflect the digital elevation model and stream meander evidence.

The FEH corridors were created at a map scale of approximately 1:10,000 to 1:15,000. The depicted areas were not meant to be accurate beyond providing an approximate boundary of potential stream migration. A data layer containing FEH Corridors along Indiana streams is currently hosted by IDNR-Division of Water on their mapping portal currently at: <https://indnr.maps.arcgis.com/apps/webappviewer/index.html?id=43e7b307a0184c7c851b5068941e2e23>.

Despite its limited level of accuracy, the FEH corridor map created by the Indiana Silver Jackets constitutes best available data in Blackford County and is the basis for regulating development within these corridors by Blackford County Drainage Board. A scaled version of the Blackford County FEH corridor map is available from the Blackford County GIS website. More detailed mapping than that used as part of the Indiana Silver Jackets erosion

hazard mapping program may be provided by the applicant if it is based on detailed field assessment acceptable to the Blackford County.

Special Requirements within Floodways and FEH Corridors

No disturbance (fill or excavation) associated with a new development or redevelopment is permitted within FEH corridors or regulatory floodways, unless such modifications are part of a stream-wide restoration plan or a watershed master plan. This restriction does not apply to stormwater or tile outfalls. Any streambank stabilization effort within an FEH corridor shall require prior review by the Blackford County Surveyor to safeguard against potential negative impacts on other properties or on the stream morphological system.

E. No Net Loss Floodplain Storage Policy

Floodplains exist adjacent to natural and man-made streams, regardless of tributary drainage area and whether they have been previously identified or mapped. Due to potential impacts of floodplain loss on peak flow rates, floodplains are Impact Drainage Areas and disturbance should be avoided. When avoidance of floodplain disturbance is not practical, the natural functions of the floodplain should be preserved.

In an attempt to strike a balance between legitimate need for economic development within the Blackford County jurisdictional area and the need to preserve the natural functions of floodplains, compensatory excavation equivalent to the floodplain storage lost shall be required for activities within floodplain of streams located in Blackford County where drainage area of the stream is equal to or larger than one square mile.

General Requirements

Compensatory storage is the replacement of existing floodplain storage lost due to fill. Compensatory storage is required when a portion of the floodplain is filled, occupied by a structure, or when as a result of a project a change in the channel hydraulics occurs that reduces existing available floodplain storage. Compensatory storage must:

- Be provided regardless of whether the flooding source is mapped or whether flood elevations are published or not. When flood elevations are not available for a flooding source that has a drainage area equal to or larger than one square mile (640 acres), the applicant is to determine the 10-year and 100-year flood elevations at the site and get them approved by the IDNR prior to use for floodplain compensation calculations.
- Equal at least the volume of flood storage lost below the 10-year and 100-year flood elevations;
- Be operational prior to placement of fill, structures, or other materials temporarily or permanently placed in the regulatory floodplain;

- Be provided in the immediate vicinity of the flood storage lost, where practical;
- Be provided in such a way to mimic as close as possible the function provided by the lost floodplain storage. If floodplain storage is lost outside the active flow conveyance path, then it must be compensated for outside the flow conveyance path. A flood conveyance shelf (2-stage ditch), while increasing conveyance, is not an appropriate compensation for floodplain storage lost in the floodway fringe area.
- Be provided in addition to the site detention volume; and
- Drain freely and openly to the waterway.

Compensatory storage must be provided incrementally such that:

- Floodplain storage and conveyance capacity lost within the floodway shall be compensated for within the floodway;
- Floodplain storage lost within the floodway fringe shall be compensated for within the floodway fringe;
- Floodplain storage lost below the existing 10-year flood elevation shall be compensated for below the proposed 10-year flood elevation; and
- Floodplain storage lost above the existing 10-year flood elevation shall be compensated for above the proposed 10-year flood elevation.

Note that compensatory storage is required for activities in the regulatory floodplain. There is no threshold to compensatory storage; any volume of fill requires compensatory storage be provided. However, the compensatory storage requirement does not apply to specific activities in the regulatory floodplain, such as the floodproofing of an existing building, where the floodproofing measures such as berms or floodwalls are within 10 feet of the building, or crossing improvements, where artificially created storage is lost due to a reduction in head loss.

Computing Compensatory Storage

Computations must show 1 times compensation for floodplain storage volume lost for 10-year and 100-year storm events. Storage lost between the existing ground and the existing 10-year flood elevation must be compensated by providing 1 time the amount lost and be placed between the existing ground elevation and the proposed 10-year floodplain elevation. Storage lost between the existing 10-year and the existing 100-year elevation must be compensated by providing 1 times the amount lost and be placed between the proposed 10-year elevation and proposed 100-year elevation.

When preparing a grading plan, thought should be given to how compensatory storage will be quantified. One method is the use of cross sections and average end areas. The following requirements should be followed when preparing cross sections:

1. Prepare a detailed topographic survey tied to North American Vertical Datum of 1988 and the Blackford County Survey Control Network benchmarks.
2. Locate cross sections parallel to each other and perpendicular to a reference line, often a property line or fence line. Cross sections used in a hydraulic model are always perpendicular to flood flows, and not always parallel to each other. Therefore, these are often not suitable for computing flood fringe compensatory storage volumes.
3. Plot cross sections at a standard engineering scale to allow the reviewer to verify areas. Horizontal scale should be a maximum of 1"=50' and vertical scale should be a maximum of 1"=5', or as approved by the County.
4. Show existing grades, proposed grades, existing and proposed 10-year flood elevations, existing and proposed 100-year flood elevations, normal water level, a reference line, and floodway limits on the cross sections on the plans.
5. Locate cross sections no more than 150 feet apart, with a minimum of three cross sections per cut/fill area, or as necessary to accurately quantify cuts and fills.
6. Locate cross sections to pick up critical features such as berms, ditches, and existing and proposed structures.
7. Each cross section should be numbered or lettered and referenced on the plans.

This information is then used to compute areas of cut and fill. A sample grading plan, a typical cross section, and associated compensatory storage calculations for the 10-year flood are provided on **Figures 10-1**, **Figure 10-2**, and **Table 10-1**, respectively.

Volume of fill between cross sections is calculated by finding the average fill cross sectional area and multiplying it by the distance between the two cross sections. For example, the fill volume between cross sections A and B is calculated as follows:

$$\text{Average Fill Area} = (\text{Fill Area "A"} + \text{Fill Area "B"})/2$$

$$= (0 \text{ ft}^2 + 100 \text{ ft}^2)/2 = 50 \text{ ft}^2$$

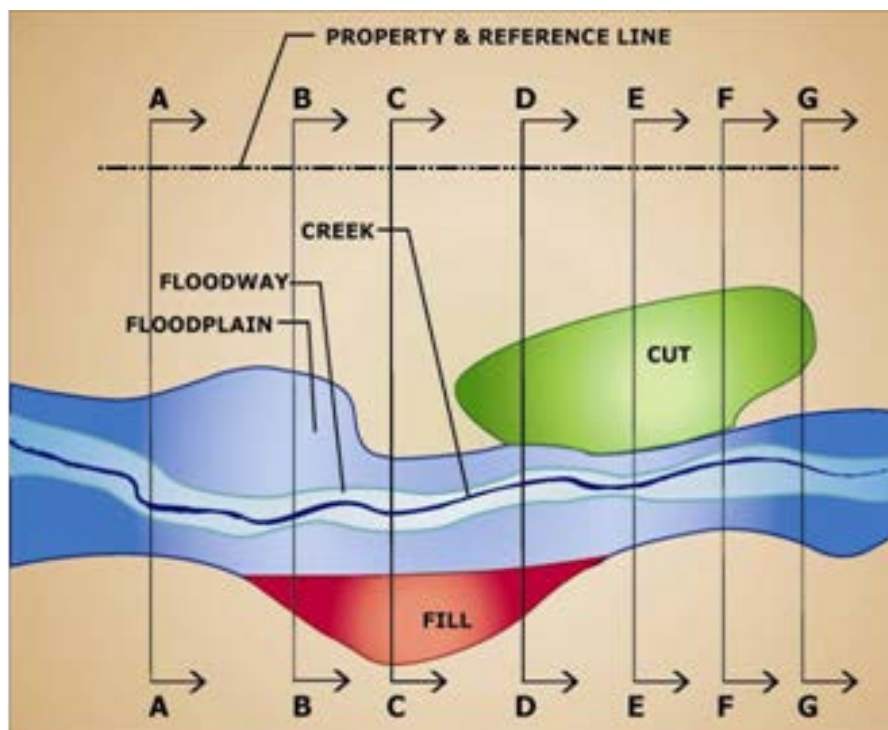
$$\text{Volume of Fill} = (\text{Average Fill Area}) \times (\text{Distance})$$

$$= (50 \text{ ft}^2) \times (150 \text{ ft}) = 7,500 \text{ ft}^3$$

Once the total volume of fill placed, for this example, between the 0-and 10-year flood elevations is determined, the total required compensatory storage can be calculated and compared against the total compensatory storage volume provided by the design as shown in the table. For this example:

$$\begin{aligned} \text{Required Compensatory Storage} &= (1) \times (\text{Total Volume of Fill}) \\ &= (1) \times (36,250 \text{ ft}^3) = 36,250 \text{ ft}^3 \end{aligned}$$

Figure 10-1 - Example Compensatory Storage Grading Plan



* Not to Scale & Topography not shown for clarity.

Figure 10-2 – Example Cross Section D-D

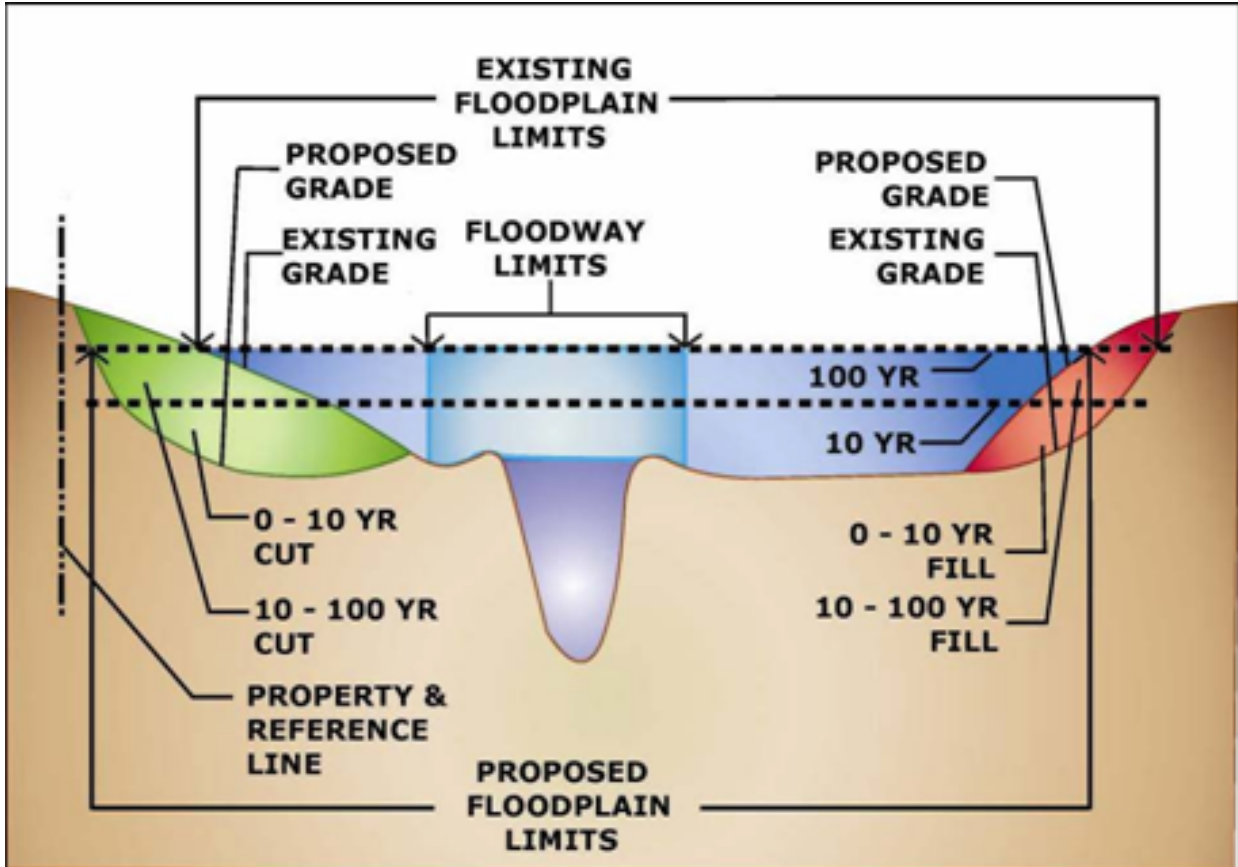


Table 1 - Example Compensatory Storage Calculations for 0-10 year event

Cross Section	Distance Between Sections (ft.)	Fill Area (sq. ft.)	Average Fill Area (sq. ft.)	Volume of Fill (cu. Ft.)	Cut Area (sq. ft.)	Average Cut (sq. ft.)	Volume of Cut (cu. Ft.)
A		0			0		
	150		50	7,500		0	
B		100			0		
	90		125	11,250		20	1,800
C		150			40		
	100		125	12,500		65	6,500
D		100			90		
	100		50	5,000		100	10,000
E		0			110		
	100		0	0		120	12,000
F		0			130		
	85		0	0		85	7,225
G		0			40		
Total Fill				36,250	Total Cut		37,525

Since the total volume of cut (37,525 ft^3 as shown in the table) is larger than that required (36,250 ft^3), the design meets the compensatory storage requirement for the 10-year flood. An additional table and calculation should be completed for the 100-year flood elevation in a similar manner to determine whether the design meets the compensatory storage requirement for the 100-year flood.

Location of Compensatory Storage

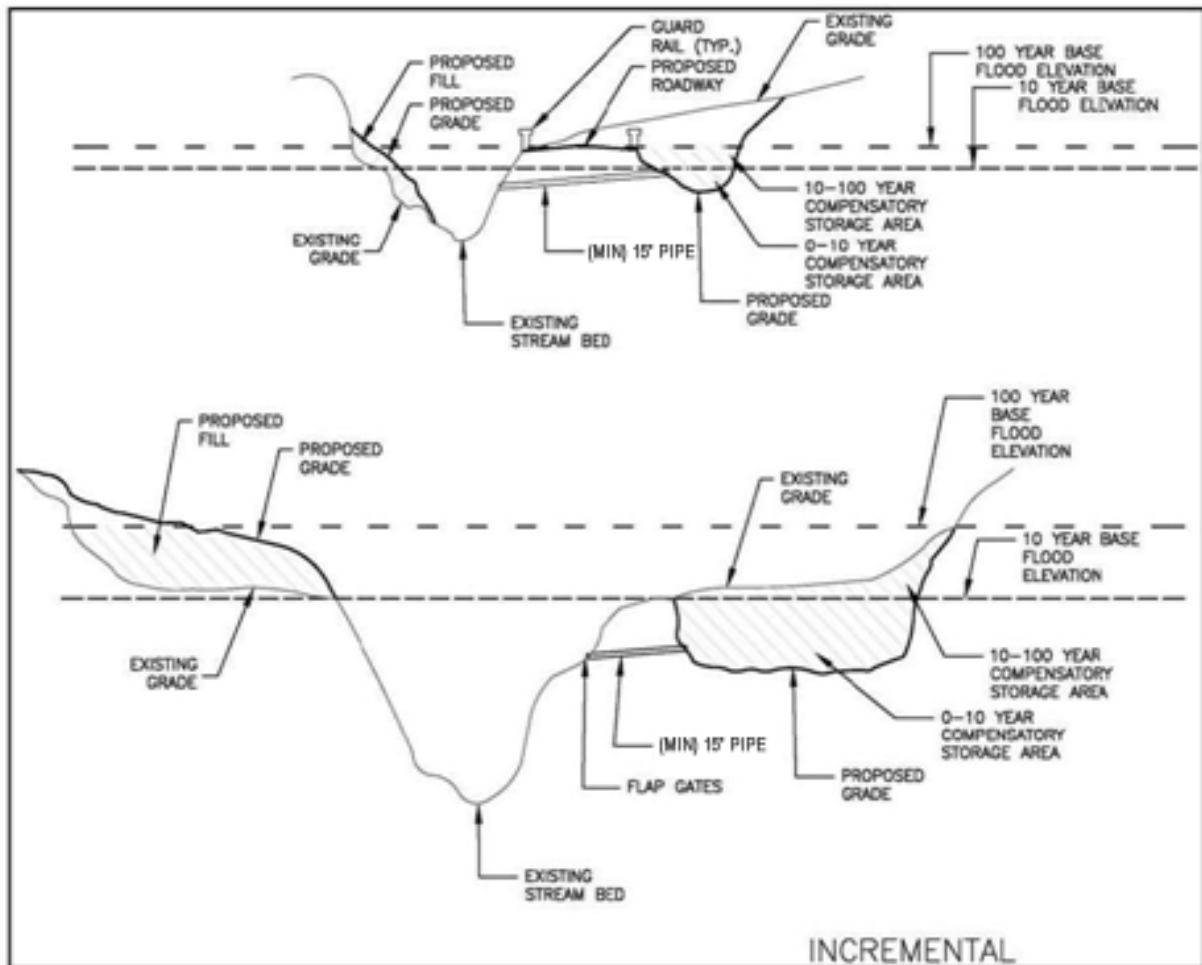
Compensatory storage must be located on-site and adjacent to or opposite the areas filled or occupied by a structure. In those rare instances when compensatory storage cannot be located adjacent to or opposite to the areas filled or occupied, engineering computations demonstrating that hydraulically equivalent compensatory storage has been provided is required. These computations must show that no increase in flood flows or flood depths will result as a result of the location of the proposed compensatory storage.

Compensatory storage must be constructed to drain freely and openly to watercourses. In some rare cases it may be necessary to install pipes to construct and/or operate a compensatory storage basin. This may occur when site constraints, such as a roadway or sidewalk, separate the waterway from the compensatory storage area. This is illustrated in the top half of **Figure 10-3**.

Another scenario may occur when a site cannot meet incremental storage requirements. If incremental storage requirements from the 10-year to 100-year elevations cannot be met, pipes could be installed with a flap gate to prevent the water from entering from the stream bed at lower elevations. The berm could then be set at the elevation of the 10-year flood elevation, thus allowing the storage to only become effective above the 10-year flood elevation. This is illustrated in the bottom half of the illustration in Figure 10-3.

The use of pipes in compensatory storage will require approval by the County. Pipes must be a minimum of 15 inches in diameter to allow water to enter and exit freely with a minimum head differential. If compensatory storage is proposed to be combined with detention, it must be demonstrated the compensatory storage and detention do not interfere with one another.

Figure 10-3 – Example of Compensatory Storage Connection to Stream through Pipe



Compensatory Storage in the Regulatory Floodway

Only fill associated with appropriate uses of the regulatory floodway may be allowed within the limits of the floodway. When (in rare circumstances) fill is allowed, provisions discussed above relating to compensatory storage must be met in addition to the items discussed below.

- Any fill placed within the existing floodway must be compensated for within the proposed floodway.
- Floodway storage lost below the existing 10-year base flood elevation shall be replaced below the proposed 10-year base flood elevation.
- Floodway storage lost between the existing 10-year flood elevation and the existing 100-year flood elevation shall be replaced between the proposed 10-year and proposed 100-year flood elevation.

Should excavation within a floodway be allowed in special circumstances, there shall be no reduction in floodway surface area as a result of a floodway

modification, unless such modification is part of a stream-wide plan or necessary to reduce flooding at an existing structure.

F. Policy on Dams and Levees

Dams and levees have the potential for significant, sometimes catastrophic consequences should they fail. In order to minimize the potential for loss of life and public safety, decrease the potential for increased flood damage and disaster costs, and safeguard the downstream property rights, the following shall be required by the Blackford County Surveyor for any proposed new or improvements to any existing dam or levee. These requirements are in addition to what is normally required for other development subject to this ordinance and/or that required by State or Federal agencies.

- i. Design of dams shall follow the requirements of the latest edition of IDNR-Division of Water “General Guidelines for New Dams and Improvements to Existing Dams in Indiana” as well as principles provided in the latest edition of “Indiana Dam Safety Inspection Manual”.
- ii. Design of levee/floodwalls shall follow the FEMA requirements and guidelines provided in 44 CFR Section 65.10 and USACE Engineer Manual 1110-2-193, Design and Construction of Levees.
- iii. An Incident and Emergency Action Plan (IEAP), including a detailed dam breach inundation map, shall be developed in accordance with the template provided in the latest edition of “Indiana Dam Safety Inspection Manual” and submitted to the Blackford County Surveyor. The detailed dam breach inundation map referenced in this paragraph shall be developed for both “Sunny Day Breach” Scenario (breach during normal loading conditions) and for maximum loading condition with breach assumed to occur as the spillway system is passing the Spillway Design Flood associated with the dam (“SDF + Breach” Scenario).
- iv. Unless the “Sunny Day Breach Inundation Area” is entirely contained within the applicant’s property and/ or contained within the existing 100-year floodplain, a copy of recorded flood inundation easement or a recorded written consent for every property within the potential “Sunny Day Breach Inundation Area” shall be submitted to the Blackford County Surveyor. Also required is the ownership or recorded easement of all property around the lake with an elevation below the top of the dam. In addition, the affected property owners whose properties are located within the “SDF + Breach Inundation Area” must be notified of a hearing relevant to the proposed added flooding risk, should such a man-made structure suffer a catastrophic failure. Notification of the time and place of the hearing shall be made in person or by certified mail at least 10 days prior to the hearing. Proof of notice to each landowner shall be filed by affidavit with the Blackford County Surveyor prior to the hearing.

- v. A copy of a Management and Maintenance Plan for the proposed dam or levee developed in accordance with the latest edition of “Indiana Dam Safety Inspection Manual” shall be submitted to the Blackford County Surveyor.
- vi. Unless the dam is subject to and regulated by IDNR, following the permitting and construction of the dam or levee, a copy of a formal periodic inspection report prepared in accordance with the recommendations contained in the latest edition of “Indiana Dam Safety Inspection Manual” shall be submitted to the Blackford County Surveyor along with evidence that the identified maintenance deficiencies have been corrected. The inspection report has to be submitted as it gets completed in accordance with the inspection frequency recommended in the latest edition of “Indiana Dam Safety Inspection Manual”.

G. Proposed Development Downstream of Dams

As indicated in the previous section, dams have the potential for significant, sometimes catastrophic consequences should they fail. Placing new development downstream of an existing dam does not only expose the future residents or users of the newly developed areas to a potential new significant risk but could also have an impact on the hazard rating of the dam, which can in turn make the dam non-compliant with state and federal standards. In order to minimize the potential for loss of life and public safety, decrease the potential for increased flood damage and disaster costs, and safeguard the upstream dam owner’s rights, the following shall be required by the Blackford County Surveyor for any proposed new development or redevelopment downstream of an existing dam. These requirements are in addition to what is normally required for new development or redevelopment subject to these Standards.

- i. Dam breach inundation maps have been created for several existing dams within the State of Indiana by the dam owners, IDNR, or others as part of development of individual IEAPs for these dams. When the development location is suspected by the applicant or the Blackford County Surveyor to be within an existing dam’s breach inundation zone, the applicant is required to include a copy of the breach inundation mapping associated with that dam as part of its stormwater management permit application. To locate such a mapping, the applicant should contact the dam owner, IDNR- Division of Water, Blackford County Surveyor, or other agencies to obtain the breach inundation map for the dam, if available. If no dam breach inundation map can be located for the dam, it will be the applicant’s responsibility to produce a Blackford County Surveyor-acceptable dam breach mapping either through directly contracting with a qualified engineer or through funding the production of such a map by the Blackford County Surveyor review consultant in accordance with standards and guidelines established by the IDNR-Division of Water.

- ii. If the location of the proposed development falls within the dam breach inundation zone on the map discussed under Item i (above), additional requirements as determined by Blackford County Surveyor may be imposed before a permit is issued and the development is allowed to occur. The noted additional requirements depend on several variables and are expected to vary case by case. Typical requirements could include relocating a portion or all of the proposed development to areas outside of the dam breach inundation zone, cost-sharing with the dam owner in necessary upgrades to the dam as a result of a potential hazard classification increase, addition of structural protection measures (such as flood protection levees), additional freeboard requirements, development and periodic exercise of warning and evacuation plans, and other measures considered necessary by Blackford County Surveyor to minimize the potential for loss of life and public safety, decrease the potential for increased flood damage and disaster costs, and safeguard the upstream dam owner's rights.

APPENDIX A

ABBREVIATIONS AND DEFINITIONS



ABBREVIATIONS AND DEFINITIONS

ABBREVIATIONS

BFE	Base Flood Elevation
BMP	Best Management Practice
CFS	Cubic Feet Per Second
CLOMR	Conditional Letter of Map Revision (from FEMA)
CLOMR-F	Conditional Letter of Map Revision Based on Fill (from FEMA)
CN	Curve Number
COE	United States Army Corps of Engineers
CSMP	Comprehensive Stormwater Management Program
CSO	Combined Sewer Overflow
CWA	Clean Water Act
ERM	Elevation Reference Mark
E&SC	Erosion and Sediment Control
EPA	Environmental Protection Agency
ETJ	Extraterritorial Jurisdiction
FBFM	Flood Boundary and Floodway Map
FEH	Fluvial Erosion Hazard
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Map
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FPG	Flood Protection Grade
FPS	Feet Per Second
GIS	Geographical Information System
GPS	Global Positioning System
HGL	Hydraulic Grade Line

HHW	Household Hazardous Waste
HUC	Hydrologic Unit Code
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
INDOT	Indiana Department of Transportation.
LAG	Lowest Adjacent Grade
LID	Low Impact Development
LOMA	Letter of Map Amendment (from FEMA)
LOMR	Letter of Map Revision (from FEMA)
LOMR-F	Letter of Map Revision Based on Fill (from FEMA)
MCM	Minimum Control Measure
MS4	Municipal Separate Storm Sewers
NAVD	North American Vertical Datum of 1988
NFIP	National Flood Insurance Program
NGVD 1929	National Geodetic Vertical Datum of 1929
NRCS	USDA-Natural Resources Conservation Service
NPDES	National Pollution Discharge Elimination System
NPS	Non-point source
POTW	Publicly Owned Treatment Works
SFHA	Special Flood Hazard Area
SWCD	Soil and Water Conservation District
SWPPP	Stormwater Pollution Prevention Plan
SWQMP	Stormwater Quality Management Plan
Tc	Time of Concentration
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids

USCS	Unified Soil Classification System
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service

DEFINITIONS

Acre-Foot (AF). A measure of water volume equal to the inundation of a flat one-acre area to a depth of one foot (43,560 cubic feet).

Administering authority. The designated unit of government given the authority to issue permits.

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

Agricultural land use conservation practices. Use of land for the production of animal or plant life, including forestry, pasturing or yarding of livestock, and planting, growing, cultivating, and harvesting crops for human or livestock consumption. Practices that are constructed on agricultural land for the purposes of controlling soil erosion and sedimentation. These practices include grass waterways, sediment basins, terraces, and grade stabilization structures.

Amortization Period. The length of time used to repay a debt or mortgage or to depreciate an initial cost.

Antecedent Runoff Condition. The index of runoff potential before a storm event. The index, developed by the Soil Conservation Service (SCS), is an attempt to account for the variation of the SCS runoff curve number (CN) from storm to storm.

Backflow Preventer. Device that allows liquids to flow in only one direction in a pipe. Backflow preventers are used on sewer pipes to prevent a reverse flow during flooding situations.

Backwater. The rise in water surface elevation caused by some obstruction such as a narrow bridge opening, buildings or fill material that limits the area through which the water shall flow.

Base Flood Elevation. The water surface elevation corresponding to a flood having a one percent probability of being equaled or exceeded in a given year.

Base Flood. See "Regulatory Flood".

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

Basement. A building story that is all or partly underground but having at least one-half of its height below the average level of the adjoining ground. A basement shall not be counted as a story for the purpose of height regulations.

Benchmark. A marked point of known elevation from which other elevations may be established.

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

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

Building. See "structure".

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

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

Centerline of Channel. The thalweg of a channel.

Channel Improvement. Alteration, maintenance, or reconstruction of the channel area for the purpose of improving the channel capacity or overall drainage efficiency. The noted "improvement" does not necessarily imply water quality or habitat improvement within the channel or its adjacent area.

Channel Modification. Alteration of a channel by changing the physical dimensions or materials of its bed or banks. Channel modification includes damming, rip-rapping or other armoring, widening, deepening, straightening, relocating, lining, and significant removal of bottom or woody vegetation. Channel modification does not include the clearing of dead or dying vegetation, debris, or trash from the channel. Channelization is a severe form of channel modification typically involving relocation of the existing channel (e.g., straightening).

Channel Stabilization. Protecting the sides and bed of a channel from erosion by controlling flow velocities and flow directions using jetties, drops, or other structures and/or by fining the channel with vegetation, riprap, concrete, or other suitable lining material.

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

Class V injection well. A type of well, which typically has a depth greater than its largest surface dimension, emplaces fluids into the subsurface, and does not meet the definitions of Class I through Class IV wells as defined under 40 CFR 146.5. While the term includes the specific examples described in 40 CFR 144.81, septic systems that serve more than one (1) single-family dwelling or provide service for non-domestic waste, dug wells, bored wells, improved sinkholes, french drains, infiltration sumps, and infiltration galleries, it does not include surface impoundments, trenches, or ditches that are wider than they are deep.

Closed Conduit. A pipe, tube, or tile used for transmitting water.

Combined Sewer Overflow. A system designed and used to receive and transport combined sewage so that during dry periods the wastewater is carried to a treatment facility. During storm events, the excess water is discharged directly into a river, stream, or lake without treatment.

Compensatory Storage. An artificial volume of storage within a floodplain used to balance the loss of natural flood storage capacity when artificial fill or substructures are placed within the floodplain.

Compost. Organic residue (or a mixture of organic residue and soil) that has undergone biological decomposition until it has become relatively stable humus.

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

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

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

Construction plan. A representation of a project site and activities associated with the project. The plan includes the location of the project site, buildings and other infrastructure, grading activities, schedules for implementation and other pertinent information related to the project site. A storm water pollution prevention plan is a part of the construction plan.

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

Contiguous. Adjoining or in actual contact with.

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

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

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

Control Structure. A structure designed to control the rate of flow that passes through the structure, given a specific upstream and downstream water surface elevation.

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

Convolution. The process of translating precipitation excess into a runoff hydrograph.

Crawl Space. Low space below first floor of a house where there has not been excavation deep enough for a basement, usually less than seven (7) feet in depth, but where there is access for pipes, ducts, utilities and similar equipment.

Critical Duration Analysis. The process of testing different rainfall durations to find that “critical duration”, which produces the highest peak runoff or the highest storage volume.

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

Crown of Pipe. The elevation of top of pipe.

Cubic Feet Per Second (CFS). Used to describe the amount of flow passing a given point in a stream channel. One cubic foot per second is equivalent to approximately 7.5 gallons per second.

Culvert. A closed conduit used for the conveyance of surface drainage water under a roadway, railroad, canal or other impediment.

Curve Number (CN). The Soil Conservation Service index that represents the combined hydrologic effect of soil, land use, land cover, hydrologic condition and antecedent runoff condition.

Dam. A barrier to confine or impound water for storage or diversion, to prevent gully erosion, or to retain soil, sediment, or other debris.

Damage. Measurable rise in flood heights on buildings currently subject to flooding, flooding of buildings currently not subject to flooding and increases in volume or velocity to the point where the rate of land lost to erosion and scour is substantially increased.

Datum. Any level surface to which elevations are referred, usually Mean Sea Level.

Dechlorinated swimming pool discharge. Chlorinated water that has either sat idle for seven (7) days following chlorination prior to discharge to the MS4 conveyance, or, by analysis, does not contain detectable concentrations (less than five-hundredths (0.05) milligram per liter) of chlorinated residual.

Depressional Storage Areas. Non-riverine depressions in the earth where stormwater collects. The volumes are often referred to in units of acre-feet.

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

Detention Basin. A facility constructed or modified to restrict the flow of storm water to a prescribed maximum rate, and to detain concurrently the excess waters that accumulate behind the outlet.

Detention Facility. A facility designed to detain a specified amount of stormwater runoff assuming a specified release rate. The volumes are often referred to in units of acre-feet.

Detention Storage. The temporary detaining of storage of stormwater in storage facilities, on rooftops, in streets, parking lots, school yards, parks, open spaces or other areas under predetermined and controlled conditions, with the rate of release regulated by appropriately installed devices.

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

Detention. Managing stormwater runoff by temporary holding and controlled release.

Detritus. Dead or decaying organic matter; generally contributed to stormwater as fallen leaves and sticks or as dead aquatic organisms.

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

Development. Any man-made change to improved or unimproved real estate including but not limited to:

1. Construction, reconstruction, or placement of a building or any addition to a building;
2. Construction of flood control structures such as levees, dikes, dams or channel improvements;
3. Construction or reconstruction of bridges or culverts;
4. Installing a manufactured home on a site, preparing a site for a manufactured home, or installing a recreational vehicle on a site for more than hundred eight (180) days;
5. Installing utilities, erection of walls, construction of roads, or similar projects;

6. Mining, dredging, filling, grading, excavation, or drilling operations;
7. Storage of materials; or
8. Any other activity that might change the direction, height, or velocity of flood or surface waters.

“Development” does not include activities such as the maintenance of existing buildings and facilities such as painting, re-roofing, resurfacing roads, or gardening, plowing and similar agricultural practices that do not involve filling, grading, excavation, or the construction of permanent buildings.

Direct Release. A method of stormwater management where runoff from a part or the entire development is released directly to the receiving stream without providing detention.

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

Disposal. The discharge, deposit, injection, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land/or water so that the solid waste or hazardous waste, or any constituent of the waste, may enter the environment, be emitted into the air, or be discharged into any waters, including

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

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

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

Drainage Classification (soil). As a natural condition of the soil, drainage refers to both the frequency and duration of periods when the soil is free of saturation. Soil drainage conditions are defined as:

- *Well-drained*--Excess water drains away rapidly, and no mottling occurs within 36 inches of the surface.
- *Moderately well drained*--Water is removed from the soil somewhat slowly resulting in small but significant periods of wetness, and mottling occurs between 18 and 36 inches.
- *Poorly drained*--Water is removed so slowly that it is wet for a large part of the time, and mottling occurs between 0 and 8 inches.
- *Somewhat poorly drained*--Water is removed from the soil slowly enough to keep it wet for significant periods but not all the time, and mottling occurs between 8 to 18 inches. *Very poorly drained*--Water is removed so slowly that the water table remains at or near the surface for the greater part of the time; there may also be periods of surface ponding; the soil has a black to gray surface layer with mottles up to the surface.

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

Drop Manhole. Manhole having a vertical drop pipe connecting the inlet pipe to the outlet pipe. The vertical drop pipe shall be located immediately outside the manhole.

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

Dry-Bottom Detention Basin. A basin designed to be completely dewatered after having provided its planned detention of runoff during a storm event.

Duration. The time period of a rainfall event.

Earth Embankment. A man-made deposit of soil, rock, or other material often used to form an impoundment.

Elevation Certificate. A form published by the Federal Emergency Management Agency that is used to certify the 100-year or base flood elevation and the lowest elevation of usable space to which a building has been constructed.

Elevation Reference Mark (ERM). Elevation benchmark tied to the National Geodetic Vertical Datum of 1929 and identified during the preparation of a Flood Insurance Study prepared for the Federal Emergency Management Agency.

Emergency Spillway. Usually a vegetated earth channel used to safely convey flood discharges around an impoundment structure.

Energy Dissipater. A device to reduce the energy of flowing water.

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

Erosion and sediment control measure. A practice, or a combination of practices, to control erosion and resulting sedimentation. and/or off-site damages.

Erosion and sediment control system. The use of appropriate erosion and sediment control measures to minimize sedimentation by first reducing or eliminating erosion at the source and then as necessary, trapping sediment to prevent it from being discharged from or within a project site.

Erosion control plan. A written description and site plan of pertinent information concerning erosion control measures designed to meet the requirements of the ordinance or these Standards.

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

- *Accelerated erosion* -- Erosion much more rapid than normal or geologic erosion, primarily as a result of the activities of man.
- *Channel erosion* -- An erosion process whereby the volume and velocity of flow wears away the bed and/or banks of a well-defined channel.
- *Gully erosion* --An erosion process whereby runoff water accumulates in narrow channels and, over relatively short periods, removes the soil to considerable depths, ranging from 1-2 ft. to as much as 75-100 ft.
- *Rill erosion*--An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils (see Rill).
- *Splash erosion*--The spattering of small soil particles caused by the impact of raindrops on wet soils; the loosened and spattered particles may or may not be subsequently removed by surface runoff.

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

Extraterritorial Jurisdiction (ETJ). Areas located outside the corporate limits of a community over which the community has statutory development authority.

Farm or Field Tile. A pipe installed in an agricultural area to allow subsurface drainage of farmland for the purpose of agricultural production.

FEMA. The Federal Emergency Management Agency.

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

Final stabilization. The establishment of permanent vegetative cover or the application of a permanent non-erosive material to areas where land disturbing activities have been completed and no additional land disturbing activities are planned under the current permit.

Floatable. Any solid waste that will float on the surface of the water.

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

Flood Boundary and Floodway Map (FBFM). A map prepared by the Federal Emergency Management Agency that depicts the FEMA designated floodways within a community. This map also includes delineation of the 100-year and 500-year floodplain boundaries and the location of the Flood Insurance Study cross-sections.

Flood Crest. The maximum stage or elevation reached or expected to be reached by the waters of a specific flood at a given time.

Flood Duration. The length of time a stream is above flood stage or overflowing its banks.

Flood Easement. Easement granted to identify areas inundated by the 100-year flood and prohibit or severely restrict development activities.

Flood Elevation. The elevation at all locations delineating the maximum level of high waters for a flood of given return period.

Flood Fighting. Actions taken immediately before or during a flood to protect human life and to reduce flood damages such as evacuation, emergency sandbagging and diking.

Flood Forecasting. The process of predicting the occurrence, magnitude and duration of an imminent flood through meteorological and hydrological observations and analysis.

Flood Frequency. A statistical expression of the average time period between floods equaling or exceeding a given magnitude. For example, a 100-year flood has a magnitude expected to be equaled or exceeded on the average of once every hundred years; such a flood has a one-percent chance of being equaled or exceeded in any given year. Often used interchangeably with "recurrence interval".

Flood Hazard Area. Any floodplain, floodway, floodway fringe, or any combination thereof which is subject to inundation by the regulatory flood; or any flood plain as delineated by Zone X on a Flood Hazard Boundary Map.

Flood Hazard Boundary Map (FHBM). A map prepared by the Federal Emergency Management Agency that depicts Special Flood Hazard Areas as a Zone A within a community. There are no study text, base flood elevations, or floodways associated with this map.

Flood Insurance Rate Map (FIRM). A map prepared by the Federal Emergency Management Agency that depicts Special Flood Hazard Areas within a community. This map also includes the 100-year or Base Flood Elevation at various locations along the watercourses. More recent versions of the FIRM may also show the FEMA designated floodway boundaries and the location of the Flood Insurance Study cross-sections.

Flood Insurance Study (FIS). A study prepared by the Federal Emergency Management Agency to assist a community participating in the National Flood Insurance Program in its application of the program regulations. The study consists of a text which contains community background information with respect to flooding, a floodway data table, summary of flood discharges, flood profiles, a Flood Insurance Rate Map, and a Flood Boundary and Floodway Map.

Flood Profile. A graph showing the relationship of water surface elevation to a specific location, the latter generally expressed as distance above the mouth of a stream of water flowing in a channel. It is generally drawn to show surface elevation for the crest or a specific magnitude of flooding, but may be prepared for conditions at any given time or stage.

Flood Protection Grade (FPG). The elevation of the regulatory or 100-year flood plus two (2) feet of freeboard if the flooding source is a lake, pond, stream, or an open channel/ditch (or 1 foot of freeboard if the flooding source is an overflow path/ponding area provided that the elevation of the overflow path/ponding area is calculated based on the assumption of fully plugged storm pipe system).

Flood Resistant Construction (Flood Proofing). Additions, changes or adjustments to structures or property that are designed to reduce or eliminate the potential for flood damage.

Flood Storage Areas. Depressions, basins, or other areas that normally stand empty or partially empty, but fill with rainfall runoff during storms to hold the runoff and reduce downstream flow rates. The volumes are often referred to in units or acre-feet.

Floodplain Management. The operation of a program of corrective and preventive measures for reducing flood damage, including but not limited to flood control projects, floodplain land use regulations, flood proofing of buildings, and emergency preparedness plans.

Floodplain Regulations. General term applied to the full range of codes, ordinances and other regulations relating to the use of land and construction within floodplain limits. The term encompasses zoning ordinances, subdivision regulations, building and housing codes, encroachment laws and open area (space) regulations.

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

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

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

Fluvial Erosion Hazard (FEH) Corridor. Fluvial (riverine) Erosion Hazard corridors represent the areas along the streams (including the channel and immediate overbanks areas) that are believed

to be subject to stream movement or streambank erosion. These corridors have been delineated for most actively migrating and relatively stationary streams in Indiana through an Indiana Silver Jackets initiative, with data for Blackford County currently contained on the Blackford County GIS website. More detailed mapping than that used as part of the Indiana Silver Jackets erosion hazard mapping program may be provided by the applicant if it is based on detailed field assessment acceptable to the Blackford County.

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

Forebay (or Sediment Forebay). A small pond placed in front of a larger detention structure such as a wet pond, dry pond, or wetland to intercept and concentrate a majority of sediment that is coming into the system before it reaches the larger structure.

Freeboard. An increment of height added to the base flood elevation to provide a factor of safety for uncertainties in calculations, unknown local conditions, wave actions and unpredictable effects such as those caused by ice or debris jams. (See Flood Protection Grade).

French Drain. A drainage trench backfilled with a coarse, water-transmitting material; may contain a perforated pipe.

Gabion. An erosion control structure consisting of a wire cage or cages filled with rocks.

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

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

Geotextile Fabric. A woven or non-woven, water-permeable synthetic material used to trap sediment particles, prevent the clogging of aggregates with fine grained soil particles, or as a separator under road aggregate.

Geotextile Liner. A synthetic, impermeable fabric used to seal impoundments against leaks.

Global Positioning System. A system that provides specially coded satellite signals that is processed by a receiver, which determines position, velocity, and time. The system is funded and controlled by the U.S. Department of Defense.

Grade. (1) The inclination or slope of a channel, canal, conduit, etc., or natural ground surface usually expressed in terms of the percentage the vertical rise (or fall) bears to the corresponding horizontal distance. (2) The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared to a design elevation for the support of construction, such as paving or the laying of a conduit. (3) To finish the surface of a canal bed, roadbed, top of embankment, or bottom of excavation, or other land area to a smooth, even condition.

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

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

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

Grassed Waterway. A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses and used to conduct surface water from an area.

Ground Cover (horticulture). Low-growing, spreading plants useful for low-maintenance landscape areas.

Groundwater Recharge. The infiltration of water into the earth. It may increase the total amount of water stored underground or only replenish supplies depleted through pumping or natural discharge.

Groundwater. Accumulation of underground water, natural or artificial. The term does not include

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

Hard Surface. See "Impervious Surface."

High Water. Maximum designed permitted, or regulated water level for an impoundment.

Household Hazardous Waste. Solid waste generated by households that is ignitable, toxic, reactive, corrosive, or otherwise poses a threat to human health or the environment.

Hydraulic Grade Line (HGL). For Channel flow, the HGL is equal to the water surface whereas for pressure flow it is the piezometric surface.

Hydraulics. A branch of science that deals with the practical application of the mechanics of water movement. A typical hydraulic study is undertaken to calculate water surface elevations.

Hydrodynamic Loads. Forces imposed on structures by floodwaters due to the impact of moving water on the upstream side of the structure, drag along its sides, and eddies or negative pressures on its downstream side.

Hydrograph. For a given point on a stream, drainage basin, or a lake, a graph showing either the discharge, stage (depth), velocity, or volume of water with respect to time.

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

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

Hydrometeorologic. Water-related meteorological data such as rainfall or runoff.

Hydrostatic Loads. Those loads or pressures resulting from the static mass of water at any point of floodwater contact with a structure. They are equal in all direction and always act perpendicular to the surface on which they are applied. Hydrostatic loads can act vertically on structural members such as floors, decks and roofs, and can act laterally on upright structural members such as walls, piers, and foundations.

IDNR. Indiana Department of Natural Resources.

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

Impact Areas. Areas defined or mapped that are unlikely to be easily drained because of one or more factors including but not limited to any of the following: soil type, topography, land where there is not adequate outlet, a floodway or floodplain, land within 75 feet of each bank of any regulated drain or within 75 feet from the centerline of any regulated tile ditch.

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

Impervious surface. Surfaces, such as pavement and rooftops, which prevent the infiltration of stormwater into the soil.

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

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

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

INDOT. Indiana Department of Transportation. Generally used here to refer to specifications contained in the publication "INDOT Standard Specifications."

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

Infiltration. Passage or movement of water into the soil.

Infiltration Swales. A depressed earthen area that is designed to promote infiltration.

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

Intermittent Stream. A stream which carries water a considerable portion of the time, but which ceases to flow occasionally or seasonally because bed seepage and evapotranspiration exceed the available water supply.

Invert. The inside bottom of a culvert or other conduit.

Junction Chamber. A converging section of conduit, usually large enough for a person to enter, used to facilitate the flow from one or more conduits into a main conduit.

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

Land-disturbing Activity. Any man-made change of the land surface, including removing vegetative cover that exposes the underlying soil, excavating, filling, transporting and grading.

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

Lateral Storm Sewer. A drain that has inlets connected to it but has no other storm drain connected.

Life Cycle Cost. Cost based on the total cost incurred over the system life including research, development, testing, production, construction, operation, and maintenance. Costs are normally determined on present worth or equivalent annual cost basis.

Low Entry Elevation. The elevation in a structure where overbank flooding can enter the structure.

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

Lowest Floor. Refers to the lowest of the following:

1. The top of the basement floor;
2. The top of the garage floor, if the garage is the lowest level of the building;
3. The top of the first floor of buildings constructed on a slab or of buildings elevated on pilings or constructed on a crawl space with permanent openings; or
4. The top of the floor level of any enclosure below an elevated building where the walls of the enclosure provide any resistance to the flow of flood waters unless:
 - a] The walls are designed to automatically equalize the hydrostatic flood forces on the walls by allowing for the entry and exit of flood waters, by providing a minimum of two opening (in addition to doorways and windows) having a total area of one (1) square foot for every two (2) square feet of enclosed area subject to flooding. The bottom of all such openings shall be no higher than one (1) foot above grade.
 - b] Such enclosed space shall be usable only for the parking of vehicles or building access.

Low Impact Development. LID is a land planning and engineering design approach with a goal of replicating the pre-development hydrologic regime of urban and developing watersheds. The primary goal of LID is to mimic a site's predevelopment hydrology by reducing the impervious surface, infiltrating, filtering, storing, evaporating, and detaining runoff close to its source.

Major Drainage System. Drainage system carrying runoff from an area of one or more square miles.

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

Manning Roughness Coefficient or Manning's "n" Value. A dimensionless coefficient ("n") used in the Manning's equation to account for channel wall frictional losses in steady uniform flow.

Measurable storm event. A precipitation event that results in a total measured precipitation accumulation equal to, or greater than, one-half (0.5) inch of rainfall.

Minimum Control Measure. Minimum measures required by the NPDES Phase II program. The six (6) MCMs are: Public education and outreach, Public participation and involvement, Illicit discharge detection and elimination, Construction site runoff control, Post-construction runoff control, and Pollution prevention and good housekeeping.

Minor Drainage Systems. Drainage system carrying runoff from an area of less than one square mile.

Minor Subdivision. See Subdivision, Minor.

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

Multi-Family. Any structure which contains three or more dwelling units. A dwelling unit is any structure, or part of a structure, which is constructed to a house a family.

Municipal, state, federal, or institutional refueling area. An operating gasoline or diesel fueling area whose primary function is to provide fuel to either municipal, state, federal, or institutional equipment or vehicles.

Mutual Drain. A drain that: (1) Is located on two or more tracts of land that are under different ownership; (2) was established by the mutual consent of all the owners; and (3) was not established under or made subject to any drainage statute.

National Flood Insurance Program (NFIP). The NFIP is a Federal program enabling property owners to purchase flood insurance. The Federal Emergency Management Agency administers the NFIP in communities throughout the United States. The NFIP is based on an agreement between local communities and the Federal government which states that if a community will implement floodplain management measures to reduce future flood risks to new construction and substantially improved structures in flood hazard areas, the Federal government will make flood insurance available within the community as a financial protection against flood losses that do occur.

National Geodetic Vertical Datum of 1929. The nationwide, Federal Elevation datum used to reference topographic elevations to a known value.

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

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

Nonagricultural land use. Commercial use of land for the manufacturing and wholesale or retail sale of goods or services, residential or institutional use of land intended primarily to shelter people, highway use of land including lanes, alleys, and streets, and other land uses not included in agricultural land use.

Nonpoint Source Pollution. Pollution that enters a water body from diffuse origins on the watershed and does not result from discernable, confined, or discrete conveyances.

Normal Depth. Depth of flow in an open conduit during uniform flow for the given conditions.

North American Vertical Datum of 1988 (NAVD 1988). The nationwide, Federal Elevation datum used to reference topographic elevations to a known value.

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

Off-site. Everything not located at or within a particular site.

Off-site Land Areas. Those areas that by virtue of existing topography naturally shed surface water onto or through the developing property.

100-Year Frequency Flood. See “regulatory flood”.

On-Site. Located within the controlled or urbanized area where runoff originates.

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

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

Orifice. A device which controls the rate of flow from a detention basin.

Outfall scouring. The deterioration of a streambed or lakebed from an outfall discharge to an extent that the excessive settling of solid material results and suitable aquatic habitat is diminished.

Outfall. The point, location, or structure where a pipe or open drain discharges to a receiving body of water.

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

Overland Flow. Consists of sheet flow, shallow concentrated flow and channel flow.

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

Percolation. The movement of water through soil.

Perennial Stream. A stream that maintains water in its channel throughout the year.

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

Permeability (soil). The quality of a soil that enables water or air to move through it. Usually expressed in inches per hour or inches per day.

Pervious. Allowing movement of water.

Pesticides. Chemical compounds used for the control of undesirable plants, animals, or insects. The term includes insecticides, herbicides, algicides, rodenticides, nematocides, fungicides, and growth regulators.

pH. A numerical measure of hydrogen ion activity, the neutral point being 7.0. pH values below 7.0 are acid, and above 7.0 are alkaline.

Phasing of construction. Sequential development of smaller portions of a large project site, stabilizing each portion before beginning land disturbance on subsequent portions, to minimize exposure of disturbed land to erosion.

Phosphorus (available). Inorganic phosphorus that is readily available for plant growth.

Piping. The formation of "pipes" by underground erosion. Water in the soil carries the fine soil particles away, and a series of eroded tubes or tunnels develop. These openings will grow progressively larger and can cause a dam failure.

Planimetric Data. Horizontal measurements involving distances or dimensions on a diagram, map, Plat of Survey or topographic map. Normally in units of feet.

Plat of Survey. A scaled diagram showing boundaries of a tract of land/or subdivision. This may constitute a legal description of the land and be used in lieu of a written description.

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

Pollutant of concern. Any pollutant that has been documented via analytical data as a cause of impairment in any waterbody.

Porosity. The volume of pore space in soil or rock.

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

Private Drain. A drain that: (1) Is located on land owned by one person or by two or more persons jointly; and (2) was not established under or made subject to any drainage statute.

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

Programmatic Indicator. Any data collected by an MS4 entity that is used to indicate implementation of one (1) or more minimum control measures.

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

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

Probable Maximum Flood. The most severe flood that may be expected from a combination of the most critical meteorological and hydrological conditions that are reasonably possible in the drainage basin. It is used in designing high-risk flood protection works and citing of structures and facilities that shall be subject to almost no risk of flooding. The probable maximum flood is usually much larger than the 100-year flood.

Publicly Owned Treatment Works (POTW). A municipal operation that breaks down and removes contaminants in the wastewater prior to discharging to a stream through primary and/or secondary treatment systems.

Qualified professional. An individual who is trained and experienced in storm water treatment techniques and related fields as may be demonstrated by state registration, professional certification, experience, or completion of coursework that enable the individual to make sound, professional judgments regarding storm water control or treatment and monitoring, pollutant fate and transport, and drainage planning.

Radius of Curvature. Length of radius of a circle used to define a curve.

Rain garden. A vegetative practice used to alter impervious surfaces, such as roofs, into pervious surfaces for absorption and treatment of rainfall.

Rainfall Intensity. The rate at which rain is falling at any given instant, usually expressed in inches per hour.

Reach. Any length of river, channel or storm drain.

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

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

Recurrence Interval. A statistical expression of the average time between floods equaling or exceeding a given magnitude.

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

Regional Pond. A detention/retention basin sized to detain/retain the runoff from the entire watershed, on-site and off-site, tributary to the pond's outlet.

Regulated Area. The following areas within Blackford County:

1. All territory of the county except for a territory of a municipality located within the county unless the municipality has entered into an agreement to adopt the Blackford County Stormwater Management Ordinance.
2. All areas, within a municipality, that directly drain to a regulated drain.

Regulated Drain. A drain subject to the provisions of the Indiana Drainage Code, I.C.-36-9-27.

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

Regulatory Floodway. See Floodway.

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

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

Retail gasoline outlet. An operating gasoline or diesel fueling facility whose primary function is the resale of fuels. The term applies to facilities that create five thousand (5,000) or more square feet of impervious surfaces or generate an average daily traffic count of one hundred (100) vehicles per one thousand (1,000) square feet of land area.

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

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

Retention Facility. A facility designed to completely retain a specified amount of stormwater runoff without release except by means of evaporation, infiltration or pumping. The volumes are often referred to in units of acre-feet.

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

Revetment. Facing of stone or other material, either permanent or temporary, placed along the edge of a stream to stabilize the bank and protect it from the erosive action of the stream. Also see Revetment riprap.

Right-of-Way for a County Drain. The statutory right of way as defined by Indiana Code for a regulated drain.

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

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

Riprap. Broken rock, cobble, or boulders placed on earth surfaces, such as the face of a dam or the bank of a stream, for protection against the action of water (waves). Revetment riprap is material graded such that: (1) no individual piece weighs more than 120 lbs. and (2) 90-100% will pass through a 12-inch sieve, 20-60% through a 6-inch sieve, and not more than 10% through a 12-inch sieve.

River Restoration. Restoring the channel of a stream or ditch to its perceived original, non-obstructed capacity by means of clearing & snagging, obstruction removal, and inexpensive streambank protection measures. The term "restoration", as noted, does not necessarily imply restoration or improvement of water quality or habitat within the channel or its adjacent area.

Riverine. Relating to, formed by, or resembling a stream (including creeks and rivers).

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

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

Sand. (1) Soil particles between 0.05 and 2.0 mm in diameter. (2) A soil textural class inclusive of soils that are at least 70% sand and 15% or less clay.

Sanitary Backup. The condition where a sanitary sewer reaches capacity and surcharges into the lowest area.

Scour. The clearing and digging action of flowing water.

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

Sediment Forebay. See "Forebay".

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

Seepage. The passage of water or other fluid through a porous medium, such as the passage of water through an earth embankment or masonry wall.

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

providing habitat for threatened or endangered species,

usage as a public water supply intake,

relevant community value,

usage for full body contact recreation,

exceptional use classification as found in 327 IAC 2-1-11(b), outstanding state resource water classification as found in 327 IAC 2-1-2(3) and 327 IAC 2-1.5-19(b).

Settling Basin. An enlargement in the channel of a stream to permit the settling of debris carried in suspension.

Silt Fence. A fence constructed of wood or steel supports and either natural (e.g. burlap) or synthetic fabric stretched across area of non-concentrated flow during site development to trap and retain on-site sediment due to rainfall runoff.

Silt. (1) Soil fraction consisting of particles between 0.002 and 0.05 mm in diameter. (2) A soil textural class indicating more than 80% silt.

Siphon - A closed conduit or portion of which lies above the hydraulic grade line, resulting in a pressure less than atmospheric and requiring a vacuum within the conduit to start flow. A siphon utilizes atmospheric pressure to effect or increase the flow of water through a conduit. An inverted siphon is used to carry storm water flow under an obstruction such as a sanitary sewer.

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

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

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

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

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

Special Flood Hazard Area. An area that is inundated during the 100-Year flood.

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

Spillway - A waterway in or about a hydraulic structure, for the escape of excess water.

Standard Project Flood. A term used by the U.S. Army Corps of Engineers to designate a flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonable characteristics of the geographical area in which the drainage basin is located, excluding extremely rare combinations. The peak flow for a standard project flood is generally 40 – 60 percent of the probable maximum flood for the same location.

Stilling Basin - A basin used to slow water down or dissipate its energy.

Storage practices. Any structural BMP intended to store or detain stormwater and slowly release it to receiving waters or drainage systems. The term includes detention and retention basins.

Storm drain signing. Any marking procedure that identifies a storm sewer inlet as draining directly to a receiving waterbody so as to avoid dumping pollutants. The procedures can include painted or cast messages and adhesive decals.

Storm Duration. The length of time that water may be stored in any stormwater control facility, computed from the time water first begins to be stored.

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

Storm Frequency. The time interval between major storms of predetermined intensity and volumes of runoff--e.g., a 5-yr., 10-yr. or 20-yr. storm.

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

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

Stormwater Facility. Ditches, channels, conduits, levees, ponds, natural and manmade impoundments, wetlands, tiles, swales, sewers and other natural or artificial means of draining surface and subsurface water from land.

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

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

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

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

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

Stream Gauging. The quantitative determination of streamflow using gauges, current meters, weirs, or other measuring instruments at selected locations (see Gauging station').

Stream Length. The length of a stream or ditch, expressed in miles, from the confluence of the stream or ditch with the receiving stream to the upstream extremity of the stream or ditch, as indicated by the solid or dashed, blue or purple line depicting the stream or ditch on the most current edition of the seven and one-half (72) minute topographic quadrangle map published by the United States Geological Survey, measured along the meanders of the stream or ditch as depicted on the map.

Stream. See intermittent stream, Perennial stream, Receiving stream.

Streambanks. The usual boundaries (not the flood boundaries) of a stream channel. Right and left banks are named facing downstream.

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

Structure. Refers to a structure that is principally above ground and is enclosed by walls and a roof. The term includes but is not limited to, a gas or liquid storage tank, a manufactured home or a prefabricated building, and recreational vehicles to be installed on a site for more than 180 days.

Structural Engineer. A person licensed under the laws of the State of Indiana to engage in the designing or supervising of construction, enlargement or alteration of structures or any part thereof.

Structural Floodplain. Management Measures. Those physical or engineering measures employed to modify the way floods behave, (e.g., dams, dikes, levees, channel enlargements and diversions).

Subarea/Sub-basin. Portion of a watershed divided into homogenous drainage units which can be modeled for purposes of determining runoff rates. The subareas/sub-basins have distinct boundaries, as defined by the topography of the area.

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

Subdivision, Minor. The subdivision of a parent parcel into any combination of not more than three (3) contiguous or non-contiguous new residential, commercial, or industrial building sites. The parcel shall front upon an existing street which is an improved right-of-way maintained by the County or other governmental entity and not involve any new street.

Subsoil. The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below which roots do not normally grow.

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

Subwatershed. A watershed subdivision of unspecified size that forms a convenient natural unit. See also Subarea.

Sump Failure. A failure of the sump pump that results in inundation of crawl space or basement.

Sump Pump. A pump that discharges seepage from foundation footing drains.

Surcharge. Backup of water in a sanitary or storm sewer system in excess of the design capacity of the system.

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

Suspended Solids. Solids either floating or suspended in water.

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

Tailwater. The water surface elevation at the downstream side of a hydraulic structure (i.e. culvert, bridge, weir, dam, etc.).

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

Thalweg. The deepest point (or centerline) of a channel.

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

Tile Drainage. Land drainage by means of a series of tile lines laid at a specified depth, grade, and spacing.

Time of Concentration (tc). The travel time of a particle of water from the most hydraulically remote point in the contributing area to the point under study. This can be considered the sum of an overland flow time and times of travel in street gutters, storm sewers, drainage channels, and other drainage ways.

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

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

Topsoil. (1) The dark-colored surface layer, or a horizon, of a soil; when present it ranges in depth from a fraction of an inch to 2-3 ft. (2) Equivalent to the plow layer of cultivated soils. (3) Commonly used to refer to the surface layer(s), enriched in organic matter and having textural and structural characteristics favorable for plant growth.

Total Maximum Daily Load. Method used to establish allowable loadings for specified pollutants in a surface water resource to meet established water quality standards.

Toxicity. The characteristic of being poisonous or harmful to plant or animal life. The relative degree or severity of this characteristic.

TP-40 Rainfall. Design storm rainfall depth data for various durations published by the National Weather Service in their Technical Paper 40 dated 1961.

Trained individual. An individual who is trained and experienced in the principles of storm water quality, including erosion and sediment control as may be demonstrated by state registration, professional certification (such as CESSWI and/or CPESC certification), or other documented and applicable experience or coursework as deemed sufficient by the County that enable the individual to make judgments regarding storm water control or treatment and monitoring.

Transition Section. Reaches of the stream of floodway where water flows from a narrow cross-section to a wide cross-section or vice-versa.

Tributary. Based on the size of the contributing drainage area, a smaller watercourse which flows into a larger watercourse.

Turbidity. (1) Cloudiness of a liquid, caused by suspended solids. (2) A measure of the suspended solids in a liquid.

Underdrain. A small diameter perforated pipe that allows the bottom of a detention basin, channel or swale to drain.

Unified Soil Classification System. A system of classifying soils that is based on their identification according to particle size, gradation, plasticity index, and liquid limit.

Uniform Flow. A state of steady flow when the mean velocity and cross-sectional area remain constant in all sections of a reach.

Unit Hydrograph. A unit hydrograph is the hydrograph that results from one inch of precipitation excess generated uniformly over the watershed at a uniform rate during a specified period of time.

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

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

Vegetative practices. Any nonstructural or structural BMP that, with optimal design and good soil conditions, utilizes various forms of vegetation to enhance pollutant removal, maintain and improve natural site hydrology, promote healthier habitats, and increase aesthetic appeal. Examples include grass swales, filter strips, buffer strips, constructed wetlands, and rain gardens.

Vegetative Stabilization. Protection of erodible or sediment producing areas with: permanent seeding (producing long-term vegetative cover), short-term seeding (producing temporary vegetative cover), or sodding (producing areas covered with a turf of perennial sod-forming grass).

Water Course. Any river, stream, creek, brook, branch, natural or man-made drainage way in or into which stormwater runoff or floodwaters flow either regularly or intermittently.

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

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

Water Table. (1) The free surface of the groundwater. (2) That surface subject to atmospheric pressure under the ground, generally rising and falling with the season or from other conditions such as water withdrawal.

Waterbody. Any accumulation of water, surface, or underground, natural or artificial.

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

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

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

Waterway. A naturally existing or manmade open conduit or channel utilized for the conveyance of water.

Weir. A channel-spanning structure for measuring or regulating the flow of water.

Wellhead protection area. Has the meaning set forth at 327 IAC 8-4.1-1(27).

Wet-Bottom Detention Basin (Retention Basin) - A basin designed to retain a permanent pool of water after having provided its planned detention of runoff during a storm event.

Wetlands. Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

APPENDIX B

STANDARD FORMS

Application for Stormwater Permit
Petition to Blackford County Drainage Board
Statement of Financial Responsibility
Application Submittal Checklist
Certificate of Completion

Blackford County
Application for Stormwater Permit
(to be completed by Applicant)

Project Name:

General Location:

File Number:

Date Completed:

1. Application Fee

Check attached

2. Construction Plans

Title sheet which includes location map, vicinity map, operating authority, design company name, developer name, and index of plan sheets.

Boundary survey of project site, including drainage easements and wetlands, completed in accordance with Rule 12 of Title 865 of IAC or applicable and subsequently adopted rule/regulation

Existing project site layout with the following information:

	Topographic map of site and such adjoining land that may affect layout or drainage of development, 1-foot contour intervals when slopes are two percent or less, 2-foot intervals when slopes exceed two percent, elevations in National Geodetic Vertical Datum of 1929 (NGVD) or North American Vertical Datum of 1988 (NAVD), horizontal datum Indiana State Plane Coordinates, NAD83, note showing datum information.
	Location, name, and normal water level of wetlands, lakes, ponds, and water courses.
	Location of existing structures.
	100-year floodplains, floodway fringes, and floodways. Please note if none exist.
	Identification and delineation of vegetative cover such as grass, weeds, brush, and trees.
	Location of storm, sanitary, combined sewer, and septic tank systems and outfalls.
	Identification and delineation of sensitive areas.
	Location of regulated drains, farm drains, inlets and outfalls.
	Location of and plan to protect and preserve existing cornerstones (if any).

Grading and drainage plan with the following information:

	Location of proposed site improvements, including roads, utilities, lot delineation and identification, proposed structures, and common areas.
	100-year floodplains, floodway fringes, and floodways (if applicable).
	Delineation of proposed land disturbing activities.
	Existing and proposed topographic information at appropriate contour interval.
	Location, size, and dimensions of existing streams to be maintained, and new drainage systems such as culverts, bridges, storm sewers, conveyance channels, and 100-year overflow paths/ponding areas shown as hatched areas, along with the associated easements.
	Location, size, and dimensions of features such as permanent retention or detention facilities, including existing or manmade wetlands, used for the purpose of stormwater management. Include existing retention or detention facilities that will be maintained, enlarged, or otherwise altered and new ponds or basins to be built.
	One or more typical cross sections of existing and proposed channels or other open drainage facilities carried to a point above the 100-year high water and showing the elevation of the existing land and the proposed changes, together with the high water elevations expected from the 100 year storm under the controlled conditions called for by this ordinance, and the relationship of structures, streets, and other facilities

Utility plan sheet(s) showing location of proposed utility lines for the project	
Storm sewer plan/profile sheet(s) showing elevation, size, length, location of proposed storm sewers; existing and proposed ground; structure elevations; and utility crossings.	
Plat with the following information:	
	Legal description.
	Cross reference to Rule 12.
	Regulated drain statement and table.
Other information required by Blackford County Surveyor to evaluate proposed project.	
3. Stormwater Technical Report	
A summary report with the following information:	
	The significant drainage problems associated with the project.
	The significant drainage problems associated with the project.
	The analysis procedure used to evaluate these problems and to propose solutions.
	Any assumptions or special conditions associated with the use of these procedures, especially the hydrologic or hydraulic methods.
	The proposed design of the drainage control system.
	The results of the analysis of the proposed drainage control system showing that it does solve the project's drainage problems. Any hydrologic or hydraulic calculations or modeling results must be adequately cited and described in the summary description. If hydrologic or hydraulic models are used, the input and output files for all necessary runs must be included in the appendices. A map showing any drainage area subdivisions used in the analysis must accompany the report.
	Soil properties, characteristics, limitations, and hazards associated with the project site and the measures that will be integrated into the project to overcome or minimize adverse soil conditions.
	Identification of any other state or federal water quality permits that are required for construction activities associated with the owner's project site.
	Proof of Errors and Omissions Insurance for the registered professional engineer or licensed surveyor showing a minimum amount of \$1,000,000 in coverage.
Hydrologic and Hydraulic Analysis with the following information:	
	A hydraulic report detailing existing and proposed drainage patterns on the subject site. The report should include a description of present land use and proposed land use. Any off-site drainage entering the site should be addressed as well. This report should be comprehensive and detail the steps the engineer took during the design process.
	All hydrologic and hydraulic computations should be included in the submittal. These calculations should include but are not limited to: runoff curve numbers and runoff coefficients, runoff calculations, stage-discharge relationships, times-of-concentration and storage volumes.
	Hard copies of input and output from computer models, and digital copy of input files.
	A set of exhibits should be included showing the drainage sub-areas and a schematic detailing of how the computer models were set up.
	A conclusion which summarizes the hydraulic design and details how this design satisfies this Ordinance.
4. Application Submittal Checklist	
	Completed and all items provided with project submittal.

**PETITION
TO
BLACKFORD COUNTY DRAINAGE BOARD**

THE UNDERSIGNED, as owner(s) of the proposed subdivision to be known as:

final number of lots: _____, situated in Section _____,

Township _____, Range _____, _____ Township,

Blackford County, Indiana, and more particularly described as follows:

(ATTACH LEGAL DESCRIPTION OF PROPERTY)

do(es) hereby petition the Blackford County Drainage Board to accept the drainage system and the easements therefore in and for said proposed Subdivision into the County Regulated Drainage System, and to establish a maintenance fund therefore.

STATE OF INDIANA)
)
COUNTY OF _____)

The undersigned, having been duly sworn upon oath, say(s) that the above information is true and correct and is (their) (his) (her) voluntary act and deed.

Owner Signature

Owner Signature

Owner Printed

Owner Printed

Address

Address

Subscribed and sworn to before me, a Notary Public, within and for said County and

State, this _____ day of _____, 20_____.

Notary Public

(Notary Stamp or Seal)

My Commission Expires

ENGINEER'S STATEMENT

I hereby certify to the best of my knowledge and belief:

1. That the plans and specifications attached to and made part of this petition were prepared by me or under my direct supervision.
2. That these plans and specifications were prepared in accordance with applicable codes and ordinances.
3. That I will perform reasonable and regular inspections of this project during construction as required to enable me to certify, upon completion, that the work was done in accordance with approved construction plans and specifications.

DATE: _____ SIGNATURE: _____

Telephone: _____ Typed Name: _____

Indiana Registration Number: _____

Address: _____

This petition given primary approval this ____ day of _____, 20____.

* * * * *

This petition given approval and the above-mentioned drains accepted/not accepted into the Blackford County Regulated Drainage System this _____ day of _____, 20____.

BLACKFORD COUNTY DRAINAGE BOARD

Statement of Financial Responsibility

The undersigned of the proposed project to be known as

do hereby agree to take full responsibility of financial payment of review fees incurred on the above project. I am aware that the review fees will begin as soon as primary and/or secondary application is filed and continues until the project is approved and/or withdrawn. I understand that if the project is withdrawn the review fees are still due and payable from the application date to the date on the letter of withdrawal. No project will receive an approval letter nor will the plat be approved for recording until all fees are paid. All review fees are made payable to the Blackford County Drainage Board.

The undersigned, having duly sworn upon oath, that the above information has been read and fully understood to be true and correct and is (undersigned) voluntary act and deed. The undersigned assumes responsibility for the aforementioned fees.

Signature

Mailing Address

Signature Printed

City, State, Zip Code

STATE OF INDIANA)

)

COUNTY OF _____)

Subscribed and sworn before me, a Notary Public, within and for said County and State, this _____ day of _____, 20_____.

My Commission Expires _____

Notary Public _____

(Notary Stamp or Seal)

Application Submittal Checklist

Project Name: _____

Engineer: _____ Contact Person: _____

Address: _____

Phone Number: _____ Fax Number: _____

Developer/Owner: _____ Contact Person: _____

Address: _____

Phone Number: _____ Fax Number: _____

Project Information:

Section: _____ Township: _____ Range: _____

Township: _____ City: _____

Number of Lots: _____ Acres: _____

Parcel Number: _____ Reg. Drain: _____

Accepted Drainage Footage:

Open: _____ Tile: _____

Checklist:

1 Copy of Secondary Petition Signed & Notarized by Owner: _____

1 Copy of Legal Description: _____ 2 Sets of Plans: _____

1 Copy of Engineer Statement: _____ 1 CD (with complete project submittal): _____

1 Copy of NOI (only if in County): _____ 1 Check for Application Fee: _____

1 Copy of Secondary Stormwater Permit Application: _____

1 Copy of Regulated Drain Exhibit: _____

1 Copy of Stormwater Drainage Technical Report: _____

1 Copy of Stormwater Pollution Prevention Plan for Construction Sites: _____

1 Copy of Post-Construction Stormwater Pollution Prevention Plan: _____

Original Letter and 1 copy of Financial Responsibility: _____

1 Copy of Secondary Project Check-In Checklist (this sheet): _____

OFFICE USE ONLY

Assessment: _____

Revisions: _____

Approval: _____

Denial: _____

