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ORDINANCE NO. 88-40-CM

WHEREAS, the members of the Board of Commissioners of the County of Tippecanoe, in the State of Indiana also are members of the Tippecanoe County Drainage Board; and

WHEREAS, at the present time, Tippecanoe County does not have a general Ordinance establishing storm drains and sediment control for the unincorporated areas of Tippecanoe County; and

WHEREAS, many problems have arisen in Tippecanoe County concerning storm drainage in the County; and

WHEREAS, there is a compelling necessity for the adoption of an Ordinance to govern the control of run-off of storm water and to protect, conserve and promote the orderly development of the land of Tippecanoe County and its water resources;

NOW, THEREFORE, BE IT ORDAINED AND ENACTED by the Board of Commissioners of the County of Tippecanoe, State of Indiana, and the Tippecanoe County Drainage Board that the attached document entitled "Tippecanoe County, Indiana, A General Ordinance Establishing Storm Drainage and Sediment Control" consisting of thirty-six pages plus an appendix of one page, BE, AND IT IS, HEREBY ENACTED AND ADOPTED AND APPROVED as a General Ordinance of Tippecanoe County.

ENACTED at Lafayette, Indiana on this 7th day of November, 1988.

THE TIPPECANOE COUNTY
BOARD OF COMMISSIONERS

Sue W. Scholer
Sue W. Scholer, President

Bruce V. Osborn
Bruce V. Osborn

Eugene R. Moore
Eugene R. Moore

ATTEST: Sarah S. Brown
Sarah S. Brown, Auditor

Adopted and Approved by the Tippecanoe County Drainage Board at Lafayette, Indiana, on this 7th day of November, 1988.

THE TIPPECANOE COUNTY
DRAINAGE BOARD

Bruce V. Osborn
Bruce V. Osborn

Sue W. Scholer
Sue W. Scholer

Eugene R. Moore
Eugene R. Moore

ATTEST: _____
Marilyn D. Turner, Sectetary

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TIPPECANOE COUNTY STORM DRAINAGE AND SEDIMENT CONTROL ORDINANCE

TABLE OF CONTENTS

TIPPECANOE COUNTY, INDIANA

A General Ordinance Establishing Storm

Drainage and Sediment Control

1. Purpose:

The purpose of this ordinance is to reduce the hazard to public health and safety caused by excessive storm water runoff, to enhance economic objectives, and to protect, conserve and promote the orderly development of land and water resources within the regulatory area. This ordinance regulates:

a. Storm water drainage improvements related to development of lands located within Tippecanoe County.

b. Drainage control systems installed during new construction and grading of lots and other parcels of land.

c. Erosion and sediment control systems installed during new construction and grading of lots and other parcels of land.

d. The design, construction and maintenance of storm water drainage facilities and systems.

2. Conflicting Ordinances:

The provisions of this ordinance shall be deemed as additional requirements to minimum standards required by other ordinances of the County. In case of conflicting requirements, the most restrictive shall apply.

3. Compliance with this and Other Ordinances:

In addition to the requirements of this ordinance, compliance with the requirements set forth in the Unified Zoning Ordinance of Tippecanoe County, Unified Subdivision Ordinance of Tippecanoe County and other applicable ordinances with respect to submission and approval of preliminary and final subdivision plats, improvement plans, building and zoning permits, construction, inspections, appeals, and similar matters, and compliance with applicable State of Indiana statutes and regulations shall be required. No building permit shall be issued for the construction, extension, remodeling, alteration or repair of any proposed or existing building in Tippecanoe County, except single family dwelling houses in approved subdivisions, until the plans for such construction, extension, remodeling, alteration or repair have been approved in writing by the Tippecanoe County Surveyor and the Tippecanoe County Drainage Board.

4. Definitions:

For the purpose of this ordinance, the following definitions shall apply:

a. Board - The Drainage Board of Tippecanoe County, Indiana and any subordinate employee to whom they shall specifically delegate a responsibility authorized by this ordinance.

b. 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.

c. Channel - 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.

d. 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.

e. Contiguous - Adjoining or in actual contact with.

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

g. 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.

h. Detention Storage - The temporary detaining of storage of storm water is storage basins, on rooftops, in streets, parking lots, school yards, parks, open spaces, or other areas under predetermined and controlled conditions, with the rate of drainage therefrom regulated by appropriately installed devices.

i. Drainage Area - The area from which water is carried off by a drainage system; a watershed or catchment area.

j. 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.

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

l. Duration - The time period of a rainfall event.

m. Erosion - Wearing away of the land by running water and waves, abrasion, temperature changes, ice and wind.

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

o. Flood of Flood Waters - The water of any watercourse which is above the banks of the watercourse. It also means the water of any lake which is above and outside the banks thereof.

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

q. Flood Plain - The area adjoining the river or stream which has been or may hereafter be covered by flood water; comprising the regulatory floodway and floodway fringe.

r. Flood Protection Grade - The elevation of the lowest floor of a building, including the basement, which shall be two feet above the elevation of the regulatory flood.

s. Floodway - See Regulatory Floodway.

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

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

v. Grade - 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.

w. Impact Areas - Areas defined and mapped by the Drainage Board which 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 center line of any regulated tile ditch.

x. Impervious - A term applied to material through which water cannot pass, or through which water passes with difficulty.

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

z. 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.

aa. Lateral Storm Sewer - A sewer that has inlets connected to it but has no other storm sewer connected.

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

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

dd. Minor Drainage Systems - Drainage systems having an area of less than one square mile.

ee. Off-Site - Everything not on site.

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

gg. Outfall - The point or location where storm runoff discharges from a sewer or drain. Also applies to the outfall sewer or channel which carries the storm runoff to the point of outfall.

hh. Peak Flow - The maximum rate of flow of water at a given point in a channel or conduit resulting from a predetermined storm or flood.

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

jj. Rainfall Intensity - The cumulative depth of rainfall occurring over a given duration, normally expressed in inches per hour.

kk. Reach - Any length of river, channel or storm sewer.

ll. Regulated Area - All of Tippecanoe County, except for land areas lying within the jurisdiction or incorporated area of any incorporated City or Town.

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

nn. Regulatory Flood - That flood having a peak discharge which can be equaled or exceeded on the average of once in a one hundred (100) year period, as calculated by a method and procedure which is acceptable to the Board. If a permit from the National Resources Commission for construction in the floodway is required (see Section ????VI), then the regulatory flood peak discharge should be calculated by a method acceptable to the Board and the Natural Resources Commission. This regulatory flood is equivalent to a flood having a probability of occurrence of one percent (1%) in any given year.

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

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

qq. 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.

rr. Runoff Coefficient - A decimal fraction relating the amount of rain which appears as runoff and reaches the storm sewer 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.

ss. Sediment - Material of soil and rock origin, transported, carried or deposited by water.

tt. 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.

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

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

ww. Storage Duration - The length of time that water may be stored in any storm water control facility, computed from the time water first begins to be stored.

xx. Storm Sewer - A closed conduit for conveying collected storm water.

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

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

aaa. Tributary - Contributing storm water from upstream land areas.

bbb. 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.

ccc. Watercourse - Any river, stream, creek, brook, branch, natural or man-made drainage way in or into which storm water runoff or floodwaters flow either regularly or intermittently.

ddd. Watershed - See Drainage Area.

eee. 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.

5. Storm Water Control Policy:

It is recognized that, with the possible exception of the major watercourses such as the Wabash River and Tippecanoe River, the smaller streams and drainage channels serving Tippecanoe County do not have sufficient capacity to receive and convey storm water runoff resulting from continued urbanization. Accordingly, the storage and controlled release rate of excess storm water runoff shall be required for all new business, commercial and industrial developments, residential subdivisions, planned unit development, and any redevelopment or other new construction located within Tippecanoe County. Possible exceptions to the requirement are minor subdivisions and parcelization as described in the Unified Subdivision Ordinance. The Drainage Board, after thorough investigation and evaluation, may waive the requirement of controlled runoff for minor subdivisions and parcelization.

The release rate of storm water from developments, and redevelopments may not exceed the storm water runoff from the land area in its present state of development. The developer must submit to the Drainage Board, detailed computations of runoff before and after development or redevelopment which demonstrates that runoff will not be increased. These computations must show that the peak runoff rate after development for the 100 year return period storm of critical duration must not exceed the 10 year return period pre-development peak runoff rate. The critical duration storm is that storm duration that requires the greatest detention storage. Computations for areas up to and including 200 acres may be based on the Rational Method, typical runoff coefficients listed herein, and ten-year return rainfall data. For areas larger than 200 acres, hydrograph techniques and/or computer drainage modeling methods may be used. Hydrograph techniques and computer modeling methods used to determine storm water runoff shall be proven methods, subject to approval of the Drainage Board.

6. Information Requirements:

The following information and data prepared by a licenses professional engineer or land surveyor engaged in storm drainage design shall accompany plans of (1) each proposed major or minor subdivision lying within the Regulated Area prior to Final Plat Approval by the Area Plan Commission, and (2) each building permit application for construction of a commercial or industrial facility which is to be constructed on real estate which lies within the Regulated Area and which has not been subdivided pursuant to the Subdivision Ordinance of Tippecanoe County or prior sub-division control ordinances.

a. Contour Map:

A topographic map of the land to be subdivided and such adjoining land whose topography may affect the layout or drainage of the development. the contour intervals shall be one foot when slopes are less than four percent and shall be two feet when slope exceeds four percent. On this map, the following shall be shown:

(1) The location of streams and other flood water runoff channels, the extent of the floodplains at the established 100 year flood elevation where available, and the limits of the floodway, all properly identified.

(2) The normal shoreline of lakes, ponds, swamps, and detention basins, their floodplains, and lines of inflow and outflow if any.

(3) The location of regulated drains, farm drains, inlets and outfalls, if any of record.

(4) Storm, sanitary and combined sewers and outfalls, if any of record.

(5) Septic tank systems and outlet, if any of record.

(6) Seeps, springs, flowing and other wells, that are visible or of record.

(7) Soil names and their hydrologic classification for the proposed development when hydrologic methods requiring soils information are used.

b. Preliminary Drainage Plan:

A comprehensive plan, in preliminary form (or in combined preliminary and final form), designed to handle safely the storm water runoff and detain the increased storm water runoff. The plan shall provide or be accompanied by maps or other descriptive material indicating the feasibility of the drainage plan and showing the following:

(1) The extent and area of each watershed affecting the design of detention facilities as shown on USGS Quadrangle Maps or other more detailed maps as required by the Board.

(2) The preliminary layout and design of street storm sewers, where proposed, and other storm drains to be built, the outfall and outlet locations and approximate elevations, the receiving stream or channel and its 100 year return period water elevation.

(3) The location and design of the proposed street system where pavements are planned to be depressed sufficiently to convey or temporarily store overflow from the heavier rainstorms and outlets for such overflow.

(4) Existing streams and floodplains to be maintained, and new channels to be constructed, their locations, cross sections and profiles.

(5) Proposed culverts and bridges to be built, their materials, elevations, waterway openings and basis of their design.

(6) Existing detention ponds and basins to be maintained, enlarged, or otherwise altered and new ponds or basins to be built and the basis of their design.

(7) The estimated depth and amount of storage required by design of the new ponds or basins.

(8) The estimated location and percentage of impervious surfaces existing and expected to be constructed when the development is completed.

(9) Any interim plan which is to be incorporated into the development pending completion of the development and the final drainage plan.

c. Valley Cross Section:

One or more typical cross sections of all 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 thereto, 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.

d. Site Plan:

A plan drawn to scale showing dimensions of the site with existing and proposed storm drainage facilities.

e. Final Drainage Plans:

Upon approval of the preliminary drainage plans by the Drainage Board, final drainage plans shall be submitted to the Drainage Board. The final plans shall provide or be accompanies by calculations, maps and/or other descriptive material showing the following:

(1) The extent and area of each watershed tributary to the drainage channels in the development.

(2) The street storm sewers and other storm drains to be built, the basis of their design, outfall and outlet locations and elevations, receiving stream or channel and its high water elevations, and the functioning of the drains during high water conditions.

(3) The parts of the proposed street system where pavements are planned to be depressed sufficiently to convey or temporarily store overflow from storm sewers and over the curb runoff resulting from the heavier rainstorms and the outlets for such overflow.

(4) Existing streams and floodplains to be maintained, and new channels to be constructed, their locations, cross sections and profiles.

(5) Proposed culverts and bridges to be built, their materials, elevations, waterway openings and basis of their design.

(6) Existing detention basins and ponds to be maintained, enlarged, or otherwise altered and new basins or ponds to be built and the basis of their design.

(7) The estimated location and percentage of impervious surfaces existing and expected to be constructed when the development is completed.

(8) The slope, type and size of all sewers and other waterways.

(9) For all detention basins, a plot or tabulation of storage volumes with corresponding water surface elevations and a plot or tabulation of the basin outflow rates for those water surface elevations.

A written report must be included with each preliminary and final drainage plan. The report will contain a summary description of: (a) the significant drainage problems associated with the project; (b) the analysis procedure used to evaluate these problems and to propose solutions; (c) any assumptions or special conditions associated with the use of these procedures, especially the hydrologic or hydraulic methods; (d) the proposed design of the drainage control system; and (e) 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 will be included as appendices to the written report and 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.

f. Submittal and Consideration of Plans:

Preliminary and final drainage plans and/or construction plans shall be submitted to the Drainage Board twenty (20) days prior to their regularly scheduled meeting. All preliminary plans, final plans and/or construction plans in compliance with the standards of this ordinance shall be approved by the Drainage Board. The Drainage Board and/or the county Surveyor shall stamp such approval on a copy of such plans and deliver the same to the applicant. The Board shall approve or disapprove any preliminary plans, final plans and/or construction plans within sixty (60) days of submission unless applicant consents to a continuance or extension. All approvals and disapprovals with written reasons shall be incorporated into the drainage board minutes.

The Tippecanoe County Surveyor is authorized to review engineering summaries of projects and based upon the same grant exemptions from any and all requirements of this ordinance and/or waive any requirements of this ordinance. Any applicant may appeal the decision of the Surveyor to the Drainage Board which shall also be authorized to grant exemptions from any and all requirements of this ordinance and/or waive any requirements of this ordinance in its discretion.

7. Determination of Runoff Quantities:

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

a. For areas up to and including 200 acres the Rational Method may be used. In the Rational Method, the peak rate of runoff, Q, in cubic feet per second is computed as:

$$Q = CIA$$

where: C = runoff coefficient, representing the characteristics of the drainage area and defined as the ratio of runoff to rainfall.

I = average intensity of rainfall in inches per hour for a duration equal to the time of concentration (tc) for a selected rainfall frequency.

A = tributary drainage area in acres.

Guidance to selection of the runoff coefficient "C" is provided by Table 1 and Table 1A which show values for different types of surface and local soil characteristics. The composite "C" value used for a given drainage area with various surface types shall be the weighted average value for the total area calculated from a breakdown of individual areas having different surface types.

TABLE 1

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Urban Runoff Coefficients

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

1. The coefficients of this tabulation are applicable to storms of 5 to 10 year frequencies. Coefficients for less frequent higher intensity storms shall be modified as follows:

Return Period (yrs)	Multiply "C" by
25	1.1
50	1.2
100	1.25

TABLE 1A

Rural Runoff Coefficients

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

1. The coefficients of this tabulation are applicable to storms of 5 to 10 year frequencies. Coefficients for less frequent higher intensity storms shall be modified as follows:

Return Period (yrs)	Multiply "C" by
25	1.1
50	1.2
100	1.25

Table 2 provides runoff coefficients and inlet times for different land use classifications. In the instance of undeveloped land situated in an upstream area, a coefficient or coefficients shall be used for this area in its present state of development.

Rainfall intensity shall be determined from the rainfall frequency curves shown in Figure 1 or from data shown in Table 5A. The time of concentration (tc) to be used shall be the sum of the inlet time and flow time in the drainage facility from the most remote part of the drainage area to the point under consideration. The flow time in the storm sewers may be estimated by the distance in feet divided by velocity of flow in feet per second. The velocity shall be determined by the Manning Formula. Inlet time is the combined time required for the runoff to reach the inlet of the storm sewer. It includes overland flow time and flow time through established surface drainage channels such as swales, ditches and sheet flow across such areas as lawns, fields and other graded surfaces. It may be computed by using Figure 2.

b. The runoff rate for areas in excess of 200 acres shall be determined by methods described in Paragraph 5 and Paragraph 14, Section e (2).

8. Amount of Runoff to be Accompanied by Various Parts of Drainage Facility:

Various parts of a drainage facility must accommodate runoff water as follows:

a. The minor drainage system such as inlets, catch basins, street gutters, swales, sewers and small channels which collect storm water must accommodate peak runoff from a 10-year return frequency storm. Duration shall be equal to or greater than the time of concentration or one hour if the time of concentration is less than one hour. A 1st quartile storm distribution shall be used for computer modeling.

These minimum requirements must be satisfied:

(1) The allowable spread of water on Collector Streets is limited to maintaining two clear 10 foot moving lanes of traffic. One lane is to be maintained on Local Roads, while Places can have a water spread equal to one-half of their width.

(2) Open channels carrying greater than 30 cubic feet per second shall be capable of accommodating peak runoff for a 50-year return frequency storm within the drainage easement.

(3) Culverts shall be capable of accommodating peak runoff from a 50-year return frequency storm when crossing under a road which is part of the rural functional classification

TABLE 2

Runoff Coefficients "C" By Land Use and Typical Inlet Times

Land Use	Runoff Coefficients			Inlet Times (minutes)
	Flat	Rolling	Steep	
Commercial (CBD)	0.75	0.83	0.91	5
Commercial (Neighborhood)	0.54	0.60	0.66	
Industrial	0.63	0.70	0.77	
Garden Apartments	0.54	0.60	0.66	
Churches	0.54	0.60	0.66	5-10
Schools	0.31	0.35	0.39	
Semi Detached Residential	0.45	0.50	0.55	
Detached Residential	0.40	0.45	0.50	
Quarter Acre Lots	0.36	0.40	0.44	10-15
Half Acre Lots	0.31	0.35	0.39	
Parkland	0.18	0.20	0.22	To Be Computed

1. Flat terrain 0-2 % slopes.

2. Rolling terrain 2-7% slopes.

3. Steep terrain greater than 7% slopes.

4. Interpolation, extrapolation and adjustment for local conditions shall be based on engineering experience and judgment.

5. The coefficients of this tabulation are applicable to storms of 5 to 10 year frequencies. Coefficients for less frequent higher intensity storms shall be modified as follows:

Return Period	Multiply "C" by
25	1.1
50	1.2
100	1.25

FIGURE 1

C0325

RAINFALL INTENSITY-DURATION-FREQUENCY CURVES

LAFAYETTE, INDIANA

(AFTER BURKE 1979)

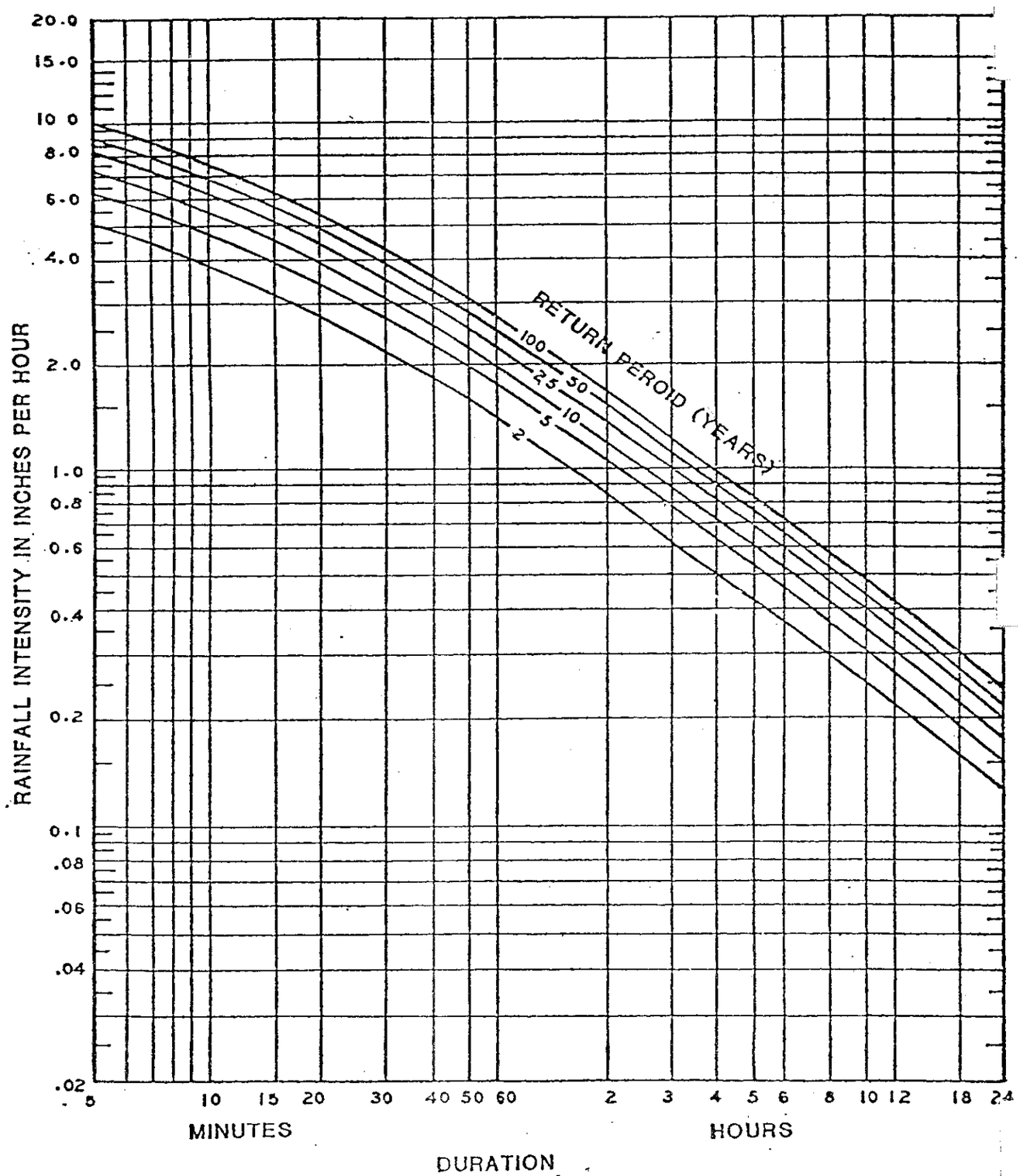
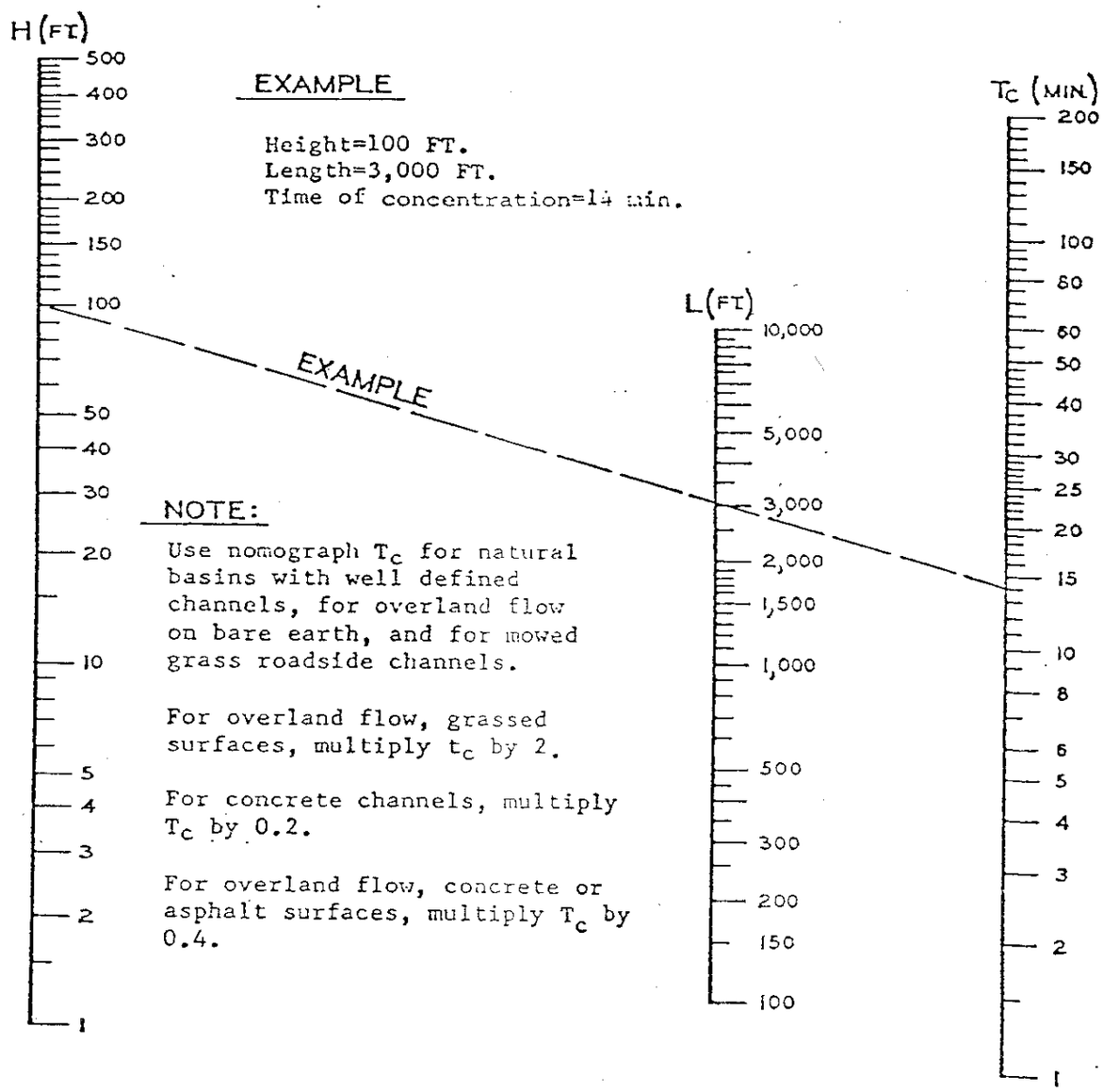


FIGURE 2

TIME OF CONCENTRATION FOR SMALL DRAINAGE AREAS



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system and are classified as principal or minor arterial, major or minor collector roads.

b. Major Drainage systems are defined in Paragraph 4 and shall be design in accordance with Indiana Department of Natural Resources Standards.

9. Level of Protection for Urban Areas:

a. First floor elevations of all living units, commercially or industrially used buildings, shall be such that all floors including basements shall have 2 feet of freeboard above the 100 year flood elevation or at the flood protection grade.

b. The land grade at houses shall be based upon the maximum flood of record or upon a flood which may occur once in 100 years, which ever is greater, together with a freeboard of two to three feet.

10. Storm Sewer Design Standards:

All storm sewers, whether private or public, and whether constructed on private or public property shall conform to the design standards and other requirements contained herein.

a. Manning Equation:

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

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

V = mean velocity of flow in feet per second

R = the hydraulic radius in feet

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

N = roughness coefficient

The hydraulic radius, R, is defined as the cross sectional area of flow divided by the wetted flow surface or wetted perimeter. Typical "n" values and maximum permissible velocities for storm sewer materials are listed in Table 3.

TABLE 3

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Typical Values of Manning's n

Material	Manning's n	Desirable Maximum Velocities
Closed Conduits		
Concrete	0.013	15 f.p.s.
Vitrified Clay	0.013	15 f.p.s.
Brick	0.015	15 f.p.s.
Cast Iron	0.013	15 f.p.s.
Circular Corrugated Metal Pipe, Annular Corrugations, 2 2/3 x 1/2 in.		
Unpaved	0.024	7 f.p.s.
25% Paved	0.021	7 f.p.s.
50% Paved	0.018	7 f.p.s.
100% Paved	0.013	7 f.p.s.
Concrete Culverts	0.013	
Open Channels		
Concrete, Trowl Finish	0.013	
Concrete, Broom or Float Finish	0.015	
Gunite	0.018	
Riprap Placed	0.030	
Riprap Dumped	0.035	
Gabion	0.028	
New Earth (Uniform, Sodded, Clay)	0.025	
Existing Earth (Fairly Uniform, With Some Weeds)	0.030	
Dense Growth of Weeds	0.040	
Dense Weeds and Brush	0.040	
Swale With Grass	0.035	

c. Grade:

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

d. Alignment:

Storm sewers shall be straight between manholes insofar as possible. Where long radius curves are necessary to conform to street layout, the minimum radius of curvature shall be no less than 100 feet for sewers 42 inches and larger in diameter. Deflection of pipe sections shall not exceed the maximum deflection recommended by the pipe manufacturer. The deflection shall be uniform and finished installation shall follow a smooth curve.

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e. Manholes:

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

(1) Where two or more storm sewers converge.

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

(3) Where pipe size changes.

(4) Where an abrupt change in alignment occurs.

(5) Where a change in grade occurs.

(6) At suitable intervals in straight sections of sewer.

The maximum distance between storm sewer manholes shall be as follows:

Size of Pipe (inches)	Maximum Distance (feet)
12 thru 42	400
48 and larger	600

f. Inlets:

Inlets or drainage structures shall be utilized to collect surface water through grated openings and convey it to storm sewers, channels or culverts. Inlet design and spacing shall be in accordance with Section 7-400 of the Indiana Department of Highways' Road Design Manual - Volume 1 or other approved design procedure. The inlet grate opening provided must be adequate to pass the design 10 year flow with 50% of the sag inlet areas clogged. An overload channel from sag inlets to the overflow channel or basin shall be provided at sag inlets, so that the maximum depth of water that might be ponded in the street sag shall not exceed 7 inches.

11. Workmanship and Materials:

a. Workmanship:

The specifications for the construction of storm sewers shall not be less stringent than those set forth in the latest edition of the Indiana Department of Highways' "Standard Specifications"; additionally, ductile iron pipe shall be laid in accordance with American Water Works Association (AWWA) C-600 and clay pipe shall be laid in accordance with American Society of Testing Materials (ASTM) C-12.

b. Materials:

Storm sewer manholes and inlets shall be constructed of masonry, cast in place concrete or precast reinforced concrete. Material and construction shall conform to Indiana Department of Highways' "Standard Specifications", Section 720.

Pipe and fittings used in storm sewer construction shall be extra-strength clay pipe (ASTM C-700), ductile iron pipe (AWWA C-151), or concrete pipe (ASTM C-76). Other pipe and fittings not specified herein may be used only when specifically authorized by the County Drainage Board. Pipe joints shall be flexible and watertight and shall conform to the requirements of Section 715.02 - Materials, of the latest edition of the Indiana Department of Highways' "Standard Specifications".

c. Special Hydraulic Structures:

Special hydraulic structures required to control the flow of water in storm runoff drainage systems include junction chambers, drop manholes, inverted siphons, stilling basins, and other special structures. The use of these structures shall be limited to those locations justified by prudent planning and by careful and thorough hydraulic engineering analysis.

12. Open Channel Design Standards:

All open 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.

a. Manning Equation:

The waterway for channels shall be determined using Manning's Equation.

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

A = Waterway area of channel in square feet

Q = Discharge in cubic feet per second (cfs)

V, R, S & n are explained in Paragraph 10a

b. Channel Cross Section and Grade:

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 1.5 feet per second should be avoided since siltation will take place and ultimately reduce the channel cross section. The maximum permissible velocities in vegetal-lined channels are shown in Table 4. Developments through which the channel is to be constructed must be considered in design of the channel section.

c. Side Slopes:

Earthen channel side slopes shall be no steeper than 2 to 1. Flatter slopes may be required to prevent erosion and for ease of maintenance. Where channels will be lined, side slopes shall be no steeper than 1 1/2 to 1 with adequate provisions make for weep holes. Side slopes steeper than 1 1/2 to 1 may be used for lined channels provided that the side lining is designed and constructed as a structural retaining wall with provisions for live and dead load surcharge.

d. Channel Stability:

(1) Characteristics of a stable channel are:

(a) It neither aggrades or degrades beyond tolerable limits.

(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 or elsewhere.

TABLE 4

Maximum Permissible Velocities in Vegetal-Lined Channels(1)

Cover	Slope Range 2/ (percent)	Permissible Velocity 1/ Erosion Resistant Soils (ft. per sec)	Permissible Velocity 1/ Easily Eroded Soils (ft. per sec)
Burmuda 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	2/ 0-5	5	4
	5-10	4	3
Lespediza Sericea Weeping Lovegrass Yellow Bluestem Redtop Alfalfa Red Fescue	3/ 0-5 5-10	3.4	2.5
Common Lespedeza4/ Sundangrass 4/	5/ 0-5	3.5	2.5

1/ Use velocities exceeding 5 feet per second only where good covers and proper maintenance can be obtained.

2/ 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.

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

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

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

(1) From Soil Conservation Service, SCS-TP-61, Handbook of Channel Design for Soil & Water Conservation.
(e) Gullies do not form or enlarge due to the entry of uncontrolled surface 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 bank full flow, whichever is greater, using an "n" values for various channel linings as shown in Table 3. In no case is it necessary to check channel stability for discharges greater than that from a 100-year frequency storm.

(3) Channel stability must be checked for conditions immediately after construction. For this stability analysis the velocity shall be calculated for the expected flow from a ten-year frequency storm on the watershed, or the bank full flow, which ever is smaller, and the "n" value for the newly constructed channels is fine-grained soils and sands may be determined in accordance with the National Engineering Handbook 5, Supplement B, Soil Conservation Service and shall not exceed 0.025. 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.

e. Drainage of Waterways:

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

f. Establishment of New Regulated Drain:

When the Drainage Board determines it is necessary to establish a new regulated drain each developer must provide the necessary information and meet the requirements of the 1965 Indiana Drainage Code, as amended, for the establishment of a new Regulated Drain. The Drainage Board shall determine the necessary easements for adequate maintenance of any new Regulated Drain.

g. Appurtenant Structures:

The design of channels will provide for all structures required for the proper functioning of the channel and the laterals thereto and travelways for operation and maintenance. 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 is also to provide for necessary flood gates, water level control devices, and any other appurtenance affecting the functioning of the channels and the attainment of the purpose for which they are built. The effect 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. Culverts and bridges which are modified or added as part of channel improvement projects shall meet reasonable standards for the type of structure, and shall have a minimum capacity equal to the design discharge or governmental agency design requirements, whichever is greater.

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h. Disposition of Spoil:

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

(1) Minimize overbank wash.

(2) Provide for the free flow of water between the channel and floodplain unless the valley routing and water surface profile are based on continuous dikes being installed.

(3) Not hinder the development of travelways for maintenance.

(4) leave the right-of-way in the best condition feasible, consistent with the project purposes, for productive use by the owner.

(5) Improve the aesthetic appearance of the site to the extent feasible.

(6) Be approved by the IDNR or US Army Corps of Engineers (whichever is applicable) if deposited in the floodway.

13. Construction and Materials:

a. Construction:

Specifications shall be in keeping with the proceeding standard and shall describe the requirements for proper installation of the project to achieve its intended purpose.

b. Materials:

Materials acceptable for use as channel lining are:

1. Grass
2. Revetment Riprap
3. Concrete
4. hand-laid Riprap
5. Precast Cement Concrete Riprap
6. Grouted Riprap
7. Gabions

Other lining materials shall receive specific approval of the Drainage Board. Materials shall comply with the latest edition of the Indiana Department of Highways' "Standard Specifications".

14. Storm Water Detention:

The following shall govern the design of any improvement with respect to the detention of storm water runoff.

a. Acceptable Detention Methods:

The increased storm water runoff resulting from a proposed development should be detained on-site by the provisions of appropriate wet or dry bottom reservoirs, by storage on flat roofs, parking lots, streets, lawns, or other acceptable techniques. Measures which retard the rate of overland flow and the velocity in runoff channels shall also be used to partially control runoff rate. Detention basins shall be sized to store excess flows from storms with a one hundred (100) year return period. control devices

shall limit the discharge to a rate no greater than that prescribed by this ordinance (see Paragraph 14, Section e).

b. Design Storm:

Design of storm water detention facilities shall be based on a return period of once in 100 years. The storage volume and outflow rate shall be sufficient to handle storm water runoff from a storm duration equal to or greater than the time of concentration for the watershed. Rainfall depth-duration-frequency relationships and intensity-duration-frequency relationships shall be given in Table 5 and 5A.

c. Allowable Release Rate:

The allowable release rate of storm water originating from a proposed development shall not exceed the amount specified in Paragraph 5, Storm Water Control Policy.

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

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

d. Drainage System Overflow Design:

Drainage systems shall have adequate capacity to convey the storm water runoff from all upstream tributary areas through the development under consideration for a 100 year return period design storm calculated on the basis of the upstream land in its present state of development. An allowance, equivalent to the reduction in flow rate provided, shall be made for upstream detention when such upstream detention and release rate have previously been approved by the Drainage Board and evidence of its construction can be shown.

e. Determination of Storage Volume:

(1) The required volume of storm water storage shall be calculated using the Rational Method and based on the runoff from a 100-year return period storm. The following 11 step procedure may be used to determine the required volume of storage. Other design methods may also be used, subject to approval of the Drainage Board, and as described in Paragraph 14, Section e (2).

Step	Procedure
1.	Determine total drainage area in acres "A".
2.	Determine composite runoff coefficient "Cu" based on existing land use.
3.	Determine time of concentration "tc" in minutes based on existing conditions.
4.	Determine rainfall intensity "Iu", in inches per hour, based on time of concentration and using Figure 1 or from data given in Table 5A for the 10 year return period.
5.	Compute runoff based on existing land use and 10 year return period. Qu=CuIuAu, or the allowable release rate "0".
6.	Determine composite runoff coefficient "Cd" based on developed conditions and a 100 year return period.
7.	Determine 100-year return rainfall intensity "Id" for various storm durations "td" up through the time of concentration for the developed area using Table 5A.
8.	Determine developed inflow rates "Qd" for various storm durations times "td", measured in hours. $Qd = CdIdA$
9.	Compute a storage rates "td" for various storm durations "td" up through the time of concentration of the developed area. $Std = Qd - Qu$

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10. Compute required storage volume SR in acre feet for each storm duration "td". This assumes a triangular hydrograph of duration (2*td) hours with a peak flow of Std dt td hours.

$$SR = (Std)\ \frac{td}{12}$$

11. Select largest storage volume computed in step 10 for any storm duration "td" for detention basin design.

(2) Methods other than the rational method for determining runoff and routing of storm water may be used to determine the storage volume required to control storm water runoff. The procedures or methods used must receive the prior approval of the Board. The ILLUDAS, TR-20 and TR-55 models are approved by the Board for appropriate use in analysis of the runoff and routing of storm water. The use of these models or other approved procedures can be defined in a seven step procedure to determine the required storage volume of the detention basin.

Step	Procedure
1.	Calibrate the hydrologic/hydraulic model that is to be used for prediction of runoff and routing of storm water.
2.	For each storm duration listed in Table 5, perform steps three through six.
3.	Determine the ten (10) year, undeveloped peak flow. Denote this flow by Qu10.
4.	Determine the one hundred (100) year runoff hydrograph (Hd100) for developed conditions.
5.	Determine the hydrograph that must be stored (Hs100) by subtracting a flow up to Qu10 from the hydrograph (Hd100) found in step 4.
6.	Determine the volume of water (Vs) to be stored by calculating the area under the hydrograph Hs100.
7.	The detention basin must be designed to store the largest volume (Vs) found for any storm duration analyzed in step 6.

f. General Detention Basin Design Requirements:

Basins shall be constructed to detain temporarily the storm water runoff which exceeds the maximum peak flow rate authorized by this Ordinance. The volume of storage provided in these basins, together with such storage as may be authorized in other on-site facilities shall be sufficient to control excess runoff from the one hundred (100) year storm.

The following design principles shall be observed:

(1) The maximum volume of water stored and subsequently released at the design release rate shall not result in a storage duration in excess of 48 hours unless additional storms occur within the period.

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

(3) All storm water detention facilities shall be separated by not less than 25 feet from any building or structure to be occupied.

(4) All excavated excess spoil shall be spread so as to provide for aesthetic and recreational features such as sliding hills, sports fields, and etc. Slopes no steeper than 6 horizontal to 1 vertical for safety, erosion control, stability and ease of maintenance shall be permitted.

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

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

(7) Outlet control structures shall be designed to operate as simply as possible and shall require little or no maintenance and/or attention for proper operations. They shall limit discharges into existing or planned downstream channels or conduits so as not to exceed the predetermined maximum authorized peak flow rate.

(8) Emergency overflow facilities such as a weir or spillway shall be provided for the release of exceptional storm runoffs or in emergency conditions should the normal discharge devices become totally or partially inoperative. The overflow facility shall be of such design that its operation is automatic and does not require manual attention.

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

(10) Debris and trash removal and other necessary maintenance shall be performed on a regular basis to assure continued operation in conformance to design.

(11) Hydraulic calculations shall be submitted to substantiate all design features.

(12) No detention basin or other water storage area, permanent or temporary, shall be constructed under or within ten (10) feet of any pole or high voltage electric line.

(13) No residential lots or any parts thereof, shall be used for any part of a detention basin or for the storage of water, either temporary or permanent.

g. Dry Bottom Basin Design Requirements:

Detention basins which will not contain a permanent pool of water shall comply with the following requirements:

(1) Provisions shall be incorporated to facilitate complete interior drainage of dry bottom basins, to include the provisions of natural grades to outlet structures, longitudinal and transverse grades to perimeter drainage facilities, paved gutters, or the installation of subsurface drains.

(2) The detention basin shall, whenever possible, be designed to serve as a secondary or multipurpose function. Recreational facilities, aesthetic qualities (open spaces) or other types of use shall be considered in planning the detention facility.

h. Wet Bottom Basin Design Requirements:

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

(1) Basins designed with permanent pools or containing permanent lakes shall have a water area of at least one-half acre. 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. The remaining lake area shall have no extensive shallow areas, except as required by subsection (3) below.

(2) In excavated lakes the underwater side slopes in the lake shall be stable. In the case of valley storage, natural slopes may be considered to be stable.

(3) A safety ledge four to six feet in width is required and must be installed in all lakes approximately 30 to 36 inches below the permanent water level. In addition, a similar maintenance ledge 12 to 18 inches above the permanent water line shall be provided. The slope between the two ledges shall be stable and of a material such as stone or riprap which will prevent erosion due to wave action.

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

(5) Periodic maintenance is required in lakes to control weed and larval growth. The reservoir shall also be designed to provide for the easy removal of sediment which will accumulate during periods of reservoir operation. A means of maintaining the designed water level of the lake during prolonged periods of dry weather is also required.

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

(7) Aeration facilities to prevent pond stagnation shall be provided, if required. Design calculations to substantiate the effectiveness of these aeration facilities shall be submitted with final engineering plans. Agreements for the perpetual operation and maintenance of aeration facilities shall be prepared to the satisfaction of the Drainage Board.

(8) Basins designed with permanent pools or containing permanent lakes shall be surrounded by a nonclimable chain link fence at least six (6) feet in height plus a barb wire suitably posted to prevent unauthorized entry into the pool area.

i. Roof Top Storage

Detention storage requirements may be met in total or in part by detention on flat roofs. Details of such design to be included in the building permit application shall include the depth and volume of storage, details of outlet devices and downdrains, elevations of emergency overflow provisions.

j. Parking Lot Storage:

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

k. Facility Financial Responsibilities:

The construction cost of storm water control systems and required facilities which are identified in the Unified Subdivision Ordinance of Tippecanoe County shall be accepted as part of the cost of land development. If general public use of the facility can be demonstrated, negotiations for public participation in the cost of such development may be considered.

l. Facility Maintenance Responsibility:

Maintenance of detention/retention facilities during construction, and thereafter, shall be the responsibility of the land developer/owner. Assignment of responsibility for maintaining facilities serving more than one lot or holding shall be documented by appropriate covenants to property deeds, unless responsibility is formally accepted by a public body, and shall be determined before the final drainage plans are approved.

Storm water detention and retention basins may be donated to the County or other unit of government designated by the County, for ownership and permanent maintenance providing:

(1) The County or other governmental unit is willing to accept responsibility.

(2) The facility has been designed and constructed according to all applicable provisions of this ordinance.

(3) All improvements have been constructed, approved and accepted by the County for land area served by the drainage basin.

(4) Retention ponds containing a permanent pool of water have all slopes between the riprap and high water line sodded and the remaining land area hydroseeded; are equipped with electrically driven aeration devices, if required to maintain proper aerobic conditions and sustain aquatic life; have a four-foot wide crushed limestone walkway at the high water line entirely around the body of water; and provide suitable public access acceptable to the responsible governmental agency, providing further that the high water line is not closer than 35 feet to any property line.

(5) Dry detention ponds shall have all slopes, bottom of the basin and areas above the high water line hydroseeded; and provided further that the high water line is not closer than 25 feet to any development boundary.

m. Inspections:

All public and privately owned detention storage facilities will be inspected by representatives of the County not less often than once every two years. A certified inspection report covering physical conditions, available storage capacity and operational condition of key facility elements will be provided to the owner.

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n. Corrective Measures:

If deficiencies are found by the inspector, the owner of the detention/retention facility will be required to take the necessary measurements to correct such deficiencies. If the owner fails to do so, the county will undertake the work and collect from the owner usig lien rights if necessary.

o. Joint Development of Control Systems:

Storm water control systems may be planned and constructed jointly by two or more developers as long as compliance with this Ordinance is maintained.

p. Installation of Control systems:

Runoff and erosion control systems shall be installed as soon as possible during the course of site development. The Board will require an erosion control plan to be submitted as part of the construction plans and specifications. Detention/retention basins shall be designed with an additional six percent of available capacity to allow for sediment accumulation resulting from development and to permit the pond to function for reasonable periods between cleanings. Basins should be designed to collect sediment and debris in specific locations so that removal costs are kept to a minimum.

q. Detention Facilities in Floodplains:

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

r. Off-site Drainage Provisions:

When the allowable runoff is released in an area that is susceptible to flooding, the developer may be required to construct appropriate storm drains through such area to avert increased flood hazard caused by the concentration of allowable runoff at one point instead of the natural overland distribution. The requirement of off-site drains shall be at the discretion of the Drainage Board.

s. Detention Systems shall be Regulated Drains:

All storm water detention systems shall be incorporated into a regulated drain under the jurisdiction of the Tippecanoe Drainage Board; and, if no regulated drain exists in the area, the Developer shall petition to establish such regulated drain pursuant to the provisions of I.C.-36-9-27-54, and the drainage plans shall not be approved until such petition is submitted in a form approved by the Surveyor to the Drainage Board.

15. Erosion Control:

Erosion control plans shall be submitted as part of the construction plans and specifications and shall include the following:

(1) Temporary erosion control measures necessary during the initial construction and establishment phases up to final site grading and seeding.

(2) A permanent erosion control plan of all the graded and non-hard surface areas within the proposed development, as planned for completion, up to and including seeding of the final lot on which business or residential dwellings are to be placed.

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(3) Details concerning removal of temporary erosion control devices after the initial establishment of adequate vegetative cover.

(4) Maintenance procedures, as part of the continuing plan, to keep all of the land under adequate cover and erosion at an acceptable minimum.

16. Certifications Required:

After completion of the project and before final approval and acceptance can be made, a professionally prepared and certified "As Built" set of plans shall be submitted to the Drainage Board for review. These plans shall include all pertinent data relevant to the completed storm drainage system and shall include:

(1) Pipe Size and Pipe Material.

(2) Invert Elevations.

(3) Top Rim Elevations.

(4) Lengths of all Pipe Structures.

(5) Submit Data and Calculations showing Detention Basin Storage Volume.

(6) Certified Statement on Plans saying the Completed Storm Drainage System substantially complies with Construction Plans as approved by the Drainage Board.

All such submitted plans shall be reviewed for compliance within 30 days after submission to the Drainage Board or tippecanoe County Surveyor. If notice of none compliance is not given within 30 days of submission of the plans, the plans shall be construed as approved and accepted.

17. Changes in Plan:

Any significant change or deviation in the detailed plans and specifications after granting formal approval shall be filed in duplicate with and approved by the Drainage Board prior to the land development involving the change. Copies of the changes, if approved, shall be attached to the original plans and specifications.

18. Determination of Impact Drainage Areas:

The Drainage Board is authorized, but is not required to classify certain geographical areas as Impact Drainage Areas and to enact and promulgate regulations which are generally applied. In determining Impact Drainage Areas, the Drainage Board shall consider such factors as topography, soil type, capacity of existing legal drains and distance from adequate drainage facility. The following areas shall be designated as Impact Drainage Areas, unless good reason for not including them is presented to the Drainage Board.

a. A floodway or floodplain as designated by the Unified Subdivision Ordinance of Tippecanoe County.

b. Land within 75 feet of each bank of any regulated ditch.

c. Land within 75 feet of the center line of any regulated drain tile.

Land where there is not an adequate outlet, taking into consideration the capacity and depth of the outlet, may be designated as an Impact Drainage Area by resolution of the Drainage Board. Special requirements for development within any Impact Drainage Area shall be included in the resolution.

19. Other Requirements:

a. Sump Pumps:

Sump pumps installed to receive and discharge groundwaters or other storm waters shall be connected to the storm sewer where possible or discharged into a designated storm drainage channel. Sump pumps installed to receive and discharge floor drain flow or other sanitary sewage shall be connected to the sanitary sewers. A sump pump shall be used for one function only, either the discharge of storm waters or the discharge of sanitary sewage.

b. Down Spouts:

All down spouts or roof drains shall discharge onto the ground or be connected to the storm sewer. No down spouts or roof drains shall be connected to the sanitary sewers.

c. Footing Drains:

Footing drains shall be connected to storm sewers where possible or designated storm drainage channels. No footing drains or drainage tile shall be connected to the sanitary sewer.

d. Basement Floor Drains:

Basement floor drains shall be connected to the sanitary sewers.

20. Disclaimer of Liability:

The degree of protection required by this ordinance is considered reasonable for regulatory purposes and is based on historical records, engineering and scientific methods of study. Larger storms may occur or storm water runoff depths may be increased by man-made or natural causes. This ordinance does not imply that land uses permitted will be free from storm water damage. This ordinance shall not create liability on the part of Tippecanoe County or any officer or employee thereof for any damage which may result from reliance on this ordinance or on any administrative decision lawfully made thereunder.

21. Corrective Action:

Nothing herein contained shall prevent Tippecanoe County from taking such other lawful action as may be necessary to prevent or remedy any violation. All costs connected therewith shall accrue to the person or persons responsible.

22. Repealer:

All ordinances or parts thereof in conflict with the provisions of this ordinance are repealed.

23. When Effective:

This ordinance shall become effective after its final passage, approval and publication as required by law.

24. Exempt Projects:

All residential, commercial or industrial subdivision (major or minor) or construction project thereon, which has had its drainage plan approved by the Drainage Board prior to the effective date of this ordinance shall be exempt from all of the requirements of this ordinance.

APPENDIX

EXAMPLE

Example using procedure outlined on pages 26 & 27 to determine detention storage volume.

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Area = 40 Acres
Allowable Release Rate "Q" = 18.30 cfs
Composite Developed Runoff Coefficient "Cd" = 0.45

Storm Duration "td" (hours)	Rainfall Intensity "Id" 100 (in./hr.)	Inflow Rate "Qd" (cfs)	Allowable Release Rate "Q" (cfs)	Storage Rate "Std" (cfs)	Require Storage "Sr" (acre-feet)
0.08	9.84	177.12	18.30	158.82	1.06
0.17	7.50	135.00	18.30	116.70	1.65
0.25	6.20	111.60	18.30	93.30	1.94
0.33	5.55	99.90	18.30	81.60	2.24
0.50	4.32	77.76	18.30	59.46	2.48
0.67	3.60	64.80	18.30	46.50	2.60
0.83	3.10	55.80	18.30	37.50	2.59
1.0	2.72	48.96	18.30	30.66	2.56
1.5	2.20	39.60	18.30	21.30	2.66
2.0	1.67	30.06	18.30	11.76	1.96
3.0	1.20	21.60	18.30	3.30	0.83
4.0	1.00	18.00	18.30	-----	-----
5.0	0.84	-----	-----	-----	-----

Detention Storage Volume Required = 2.66 Ac. Ft.