

# Appendix I

INSERT STORMWATER MANAGEMENT ORDINANCE

# Appendix II

## **Definitions**

- (1) Base Flood – A flood having a one (1) percent probability of being equaled or exceeded in any given year (also referred to as the 100-year flood).
- (2) Base Flood Elevation (BFE) – The height of the Base Flood in relation to the National Geodetic Vertical Datum (NGVD) of 1929; commonly referred to as the "100-year flood elevation".
- (3) Base Flood Plain – The area inundated by the Base Flood.
- (4) Best Management Practice or “BMP” - Any structural or nonstructural control measure utilized to improve the quality and, as appropriate, reduce the storm water run-off rate. The term includes schedules of activities, prohibitions of practice, treatment requirements, operation and maintenance procedures, use of containment facilities, land use planning, policy techniques, and other practices that comply with the City of Shelbyville’s Stormwater Design Manual.
- (5) Board – The City of Shelbyville’s Board of Public Works and Safety.
- (6) Building – An enclosed structure constructed or erected partially or wholly above ground. The term “building” includes both the above-ground and the below-ground portions of the structure.
- (7) Building Opening – Any opening of a solid wall such as a window or door, through which floodwaters could penetrate.
- (8) Certifies Survey for Mineral Extraction - A certified survey demonstrating the number and proximity of residences located within the closest and most densely populated quarter mile adjacent to the proposed mineral extraction site.
- (9) Certify – A statement that a proposed development meets the requirements of the City of Shelbyville’s Stormwater Management Ordinance.
- (10) Channel – A conveyance intended to carry runoff such as a swale or ditch.
- (11) City- City of Shelbyville, Indiana
- (12) Clean Water Act – The Federal Water Pollution Control Act, 33 USC Sec 1251 et seq., as amended, and the applicable regulations promulgated thereunder.

- (13) CLOMR – A conditional Letter of Map Revision. A letter that indicates that FEMA will revise base flood elevations, flood insurance rate zones, flood boundaries, or floodways as shown on an effective FIRM or FBFM, after the as-built or record drawings confirming the proposed conditions are submitted and approved.
- (14) CLOMR-F – A Conditional Letter of Map Revision Based on Fill. A letter that indicates that FEMA will revise the base flood boundaries as shown on an effective FIRM. This letter does not apply to map revisions involving BFE or floodway delineation changes.
- (15) Construction Site Stormwater Runoff – Stormwater runoff from a development site following a land alteration.
- (16) Conveyance – Any pipe, swale, ditch, etc. intended to carry stormwater from one point to another.
- (17) Council – City of Shelbyville’s City Common Council
- (18) Culvert – A closed conduit such as a pipe designed for the conveyance of surface drainage water under a roadway, railroad, embankment or other impediment. (See also Pipe System)
- (19) Detention – A system which is designed to capture stormwater, store it and release it over a given period of time through an outlet structure at a controlled rate.
- (20) Detention Facility – A manmade structure for the temporary storage of stormwater runoff with a controlled release during or immediately following a storm.
- (21) Developed or Development – A land alteration that requires, pursuant to state law or local ordinance, the approval of a site plan, plat, special land use, planned unit development, rezoning of land, land division approval, private road approval or other approvals required for the construction of land or the erection of buildings or structures; provided, however, that for purposes of this Ordinance only, developed or development shall not include the actual construction of, or an addition, extension or modification to, an individual single-family or a two-family detached dwelling.
- (22) Developer – Any person proposing or implementing the development of land.
- (23) Development Site – Any land that is being or has been developed, or that a developer proposes for development.

- (24) Discharger – Any person who directly or indirectly discharges stormwater from any property. Discharger also means any employee, officer, director, partner, contractor, or other person who participates in, or is legally or factually responsible for, any act or omission that is or results in a violation of this Ordinance.
- (25) Ditch – An earthen conveyance with side slopes steeper than 5:1 or carrying greater than 10 cubic feet per second (cfs).
- (26) 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.
- (27) Drainage – The collection, conveyance, or discharge of ground water and/or surface water.
- (28) Drainage Facilities – All ditches, channels, conduits, retention-detention systems, tiles, swales, sewers, and other natural or artificial means of draining stormwater from land.
- (29) Drainageway – The area within which surface water or ground water is carried from one part of a lot or parcel to another part of the lot or parcel or to adjacent land.
- (30) Easement - An authorization grant by a property owner for the use by another of any designated part of his property for a clearly specified purpose including but not limited to common pedestrian ways and hiking and biking paths.
- (31) Engineer – A person licensed to practice engineering in the State of Indiana.
- (32) EPA – The United States Environmental Protection Agency.
- (33) Erosion – The process by which the ground surface is worn away by action of wind, water, gravity or a combination thereof.
- (34) Erosion and Sediment Control Plan – A plan that is designed to minimize the accelerated erosion and sediment runoff at a site during construction activities.
- (35) Farm Operation – Means any of the following activities involved in carrying on a farm business:
  - (a) growing, producing, raising or keeping animals or plants, including mushrooms, or the primary products of those plants or animals;
  - (b) clearing, draining, irrigating or cultivating land;
  - (c) using farm machinery, equipment, devices, materials and structures;

- (d) applying fertilizers, manure, pesticides and biological control agents, including by ground and aerial spraying;
  - (e) conducting any other agricultural activity on, in or over agricultural land;  
and includes
  - (f) intensively cultivating in plantations, any
    - (i) specialty wood crops, or
    - (ii) specialty fiber crops
  - (g) conducting turf production
  - (h) processing or direct marketing the products of a farm owned or operated by the farmer, as well as products not of that farm to the extent that the processing or marketing of those products is conducted on the farmer's farm;
- 
- (36) FBFM – A Flood Boundary and Floodway Map. A floodplain management map issued by FEMA that depicts, based on detailed engineering analyses, the boundaries of the base or 100-year flood, the 500-year flood, and the floodway.
  - (37) Federal Emergency Management Agency (FEMA) – The agency of the federal government charged with emergency management.
  - (38) FIRM – A Flood Insurance Rate Map. A map issued by FEMA that is an official community map, on which FEMA has delineated both the special flood hazard areas and the insurance risk premium zones applicable to the community. This map may or may not include floodways.
  - (39) Flood or Flooding – A general and temporary condition of partial or complete inundation of normally dry land areas resulting from the overflow of water bodies or the unusual and rapid accumulation of surface water runoff from any source.
  - (40) Floodplain – Any land area subject to periodic flooding.
  - (41) Flood-Proofing – Any structural and/or non-structural additions, changes, or adjustments to structures or property that reduce or eliminate flood damage to land, or improvements utilities and structures.
  - (42) Flood Protection Elevation (FPE) or Flood Protection Grade (FPG) – The Base Flood Elevation plus two (2) foot at any given location.

- (43) Floodway – The channel of any watercourse and the adjacent land areas that must be reserved to carry and discharge a base flood without cumulatively increasing the water surface elevation more than one-tenth (1/10) of a foot due to the loss of flood conveyance or storage.
- (44) Grading – Any stripping, excavating, filling, and stockpiling of soil or any combination thereof and the land in its excavated or filled condition.
- (45) Gutter Spread – The spread of water on a roadway surface perpendicular from the face of the gutter into the driving lane.
- (46) IDEM – The Indiana Department of Environmental Management.
- (47) Illicit Connection – Any method or means for conveying an illicit discharge into water bodies or City of Shelbyville’s stormwater conveyance system.
- (48) Illicit Discharge – Any discharge to water bodies that does not consist entirely of stormwater, discharges pursuant to the terms of an NPDES permit, or exempted discharges as defined in this Ordinance.
- (49) Impervious Surface – Surface that does not allow stormwater runoff to percolate into the ground such as asphalt, concrete, roofs, and gravel.
- (50) Inlets – Structures of different shapes and materials that capture and control storm water runoff.
- (51) Land Alteration – Any action taken relative to land which either:
  - (a) Removes the natural ground cover;
  - (b) Changes the contour; or
  - (c) Increases the runoff rate; or
  - (d) Changes the elevation; or
  - (e) Decreases the rate at which water is absorbed; or
  - (f) Changes the drainage pattern; or
  - (g) Creates or changes a drainage facility; or
  - (h) Involves construction, enlargement or location of any building on a permanent foundation; or



(i) Creates an impoundment.

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

- (52) Land Surveyor – A person licensed to practice land surveying in the State of Indiana.
- (53) Lift Stations – Facilities designed to move water from lower to higher elevations through pipes.
- (54) LOMA – A Letter of Map Amendment. The official determination by FEMA that a specific structure or lot is not within a regulatory floodplain due to naturally occurring high ground (i.e. without fill). A LOMA amends the effective FIRM.
- (55) LOMR – A Letter of Map Revision. A letter from FEMA that revises base flood elevations, flood insurance rate zones, flood boundaries, or floodways as shown on an effective FBFM or FIRM.
- (56) LOMR-F – A Letter of Map Revision Based on Fill. A letter that provides formal recognition by FEMA that either a parcel of property or a structure has been removed from the base or 100-year floodplain due to elevation based on the placement of fill. This letter does not apply to map revisions involving BFE or floodway delineation changes.
- (57) Lowest Floor – The lowest floor or the lowest enclosed area (including a basement), but not including an unfinished or flood-proof enclosure that is usable solely for parking of vehicles or building access.
- (58) Maintenance – Cleaning, removing obstructions from and making minor repairs to a drainage facility so that it will perform the function for which it was designed and constructed.
- (59) Manufactured BMP – A structural BMP designed for stormwater quality treatment constructed of a combination of manmade materials at an off-site facility.
- (60) Mineral Extraction – The removal of oil, gas, coal, ore, gravel, sand, aggregate or other resources from below the surface of the land.
- (61) MS4 – Municipal Separate Storm Sewer System is a system of storm water conveyances either owned or operated by the City that IDEM has designated as responsible to eliminate or minimize pollutant loadings of the storm water entering waters of the state.

- (62) MS4 Operator – The person locally responsible for development, implementation, or enforcement of the Storm Water Quality Management Plan (SWQMP) for the City of Shelbyville as regulated under 327 IAC 15-13, or a representative thereof.
- (63) NFIP – The National Flood Insurance Program. The requirements of the NFIP are codified in Title 44 of the Code of Federal Regulations.
- (64) Non-point Source Pollution – Pollution from any source other than from any discernible, confined, and discrete conveyances, and shall include, but not be limited to, pollutants from agricultural, silvicultural, mining, construction, subsurface disposal and urban runoff sources.
- (65) Non-Stormwater Discharge – Any discharge to the storm drain system that is not composed entirely of storm water.
- (66) Non-structural BMP – A BMP that is not constructed by physical means of land disturbance such as education, public information handouts etc.
- (67) NPDES – National Pollution Discharge Elimination System.
- (68) O & M Manual – Operations & Maintenance Manual describing the operation and maintenance requirements of a designed facility to maintain the designed capacity and efficiency of a facility.
- (69) Outfalls - The point where runoff discharges from a sewer pipe, ditch, or other conveyance to a receiving body of water.
- (70) Overland flow-way – Surface area that conveys a concentrated flow of stormwater runoff.
- (71) Peak Storm – The storm of a specified return period that produces the maximum runoff from a site or the maximum elevation in a detention pond. Storm durations of 0.5-, 1-, 2-, 3-, 6-, 12- and 24-hours shall be used to determine the peak storm.
- (72) Perimeter Drain – A subsurface pipe network designed and installed around the perimeter of a septic field for the purpose of effectively collecting and draining away excess subsurface waters.
- (73) Person – An individual, firm, partnership, association, public or Private Corporation, public agency, instrumentality, or any other legal entity.
- (74) Pipe System – Two or more pipes connected together by one or more structures such as a manhole designed to convey stormwater runoff.

- (75) Plan – Written narratives, specifications, drawings, sketches, written standards, operating procedures, or any combination of these, which contain information pursuant to this Ordinance.
- (76) Pollutant – A substance which causes or contributes to pollution which includes, but is not limited to the following: any dredged spoil, solid waste, vehicle fluids, yard wastes, animal wastes, agricultural waste products, sediment, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological wastes, radioactive materials, heat, wrecked or discharged equipment, rock, sand, cellar dirt, and industrial, municipal, commercial and agricultural waste, or any other contaminant or other substance defined as a pollutant under the Clean Water Act.
- (77) Pollution – The human-made or human-induced alteration of the quality of waters by waste to a degree which unreasonably affects, or has the potential to unreasonably affect, either the waters for beneficial uses or the facilities which serve these beneficial uses.
- (78) Property Owner – Any person having legal or equitable title to property, having a contractual interest in property, or any person having or exercising care, custody, or control over any property.
- (79) Reclamation Plan for Mineral Extraction – A document illustrating drainage patterns, both existing and proposed, at a mineral extraction site; proposed erosion control and off-site sedimentation control of the site; and proposed final land use and post construction stormwater quality BMPs for the site, all of which are documented at the initial approval of the SWMP and at 10-year intervals following the approval of a SWMP.
- (80) Record Drawings – Drawings prepared, signed and sealed by a professional engineer or land surveyor representing the final “As-Built” record of the actual in-place elevations, location of structures, and topography.
- (81) Registered Professional – An engineer, land surveyor or architect license under the laws of the State of Indiana to practice the respective profession.
- (82) Regulated Drain – A drain, either open channel or closed tile/sewer, subject to the provisions of the Indiana Drainage Code, I.C.-36-9-27.
- (83) Retention Facility – A system that is designed to capture stormwater and contain it until it infiltrates into the soil or evaporates.
- (84) Right-of-way - A strip of land occupied or intended to be occupied by a street, pedestrian-way, hiking path, biking path, crosswalk, railroad, electric transmission line, oil or gas pipeline, water main, sanitary or storm sewer

main, special landscaping, drainage, or for another special use. The usage of the term “right-of-way” for land platting purposes shall mean that every right-of-way hereafter established and shown on a final plat is to be separate and distinct from the lots or parcels adjoining such right-of-way and not included within the dimensions or areas of such lots or parcels. Rights-of-way intended for streets, crosswalks, water mains, sanitary sewers, storm drains, screening or special landscaping, or any other use involving maintenance by the Board of Public Works and Safety shall be dedicated to public use by the sub-divider on whose plat such right-of-way is established. All divisions of land along existing roadways shall dedicate half right of way for public purposes along it’s entire frontage in the amount as specified for the classification of the existing roadway.

- (85) Roadway drainage – The runoff and drainage located within 20 feet of the edge of public and/or private roadways adjacent to, abutting, or within the boundaries of the property to be addressed in a proposed Stormwater Management submittal.
- (86) Rule 5 – 327 IAC 15-5: State of Indiana’s General Permit Rule concerning erosion and sediment control and pollution prevention from developing areas (327 IAC 15-5).
- (87) Rule 13 – 327 IAC 15-13: State of Indiana’s General Permit Rule concerning stormwater runoff associated with MS4 conveyance.
- (88) Runoff – The waters derived from melting snow or rain falling within a tributary drainage basin that exceeds the infiltration capacity of the soils of that basin.
- (89) Sediment – Solid material, both organic and mineral 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.
- (90) Soil Erosion – The stripping of soil and weathered rock from land creating sediment for transportation by water, wind or ice, and enabling formation of new sedimentary deposits.
- (91) Storm Drain – A system of open or enclosed conduits and appurtenant structures intended to convey or manage stormwater runoff, ground water and drainage.
- (92) Storm Drain System – Publicly owned facilities operated by the City by which storm water is collect and/or conveyed, including but not limited to any roads with drainage systems, streets, gutters, curbs, inlets, piped storm drains, pumping facilities, retention and detention basins, natural and human-made or altered drainage channels, reservoirs and other drainage structures which are

within the City and are not part of a publicly owned treatment works as defined at 40 CFR Section 122.2

- (93) Stormwater – Any surface flow, runoff, and drainage consisting entirely of water from rain storm events.
- (94) Stormwater Management Plan (SWMP) - An engineered drainage plan that effectively addresses and manages stormwater runoff and discharge.
- (95) Stormwater Management Plan Approval (SWMPA) – An approval issued pursuant to this Ordinance from the MS4 OPERATOR that states all requirements of the City of Shelbyville Stormwater Management Ordinance have been met.
- (96) Stormwater Quality Management Plan – A comprehensive written document that addresses stormwater runoff quality within a municipal separate storm sewer system area.
- (97) Stormwater Runoff – The runoff and drainage of precipitation resulting from rainfall or snowmelt or other natural event or process.
- (98) Stormwater Runoff Facility – The method, structure, area, system, or other equipment or measures that are designed to receive, control, store, or convey stormwater.
- (99) Stream – A river, stream or creek which may or may not be serving as a drain, or any other water body that has definite banks, a bed, and visible evidence of a continued flow or continued occurrence of water.
- (100) Structural BMP – A structure designed and constructed for the purpose of stormwater quality treatment.
- (101) Swale – A depressed earthen designed to convey stormwater runoff with side slopes 5:1 or shallower and conveying no more than 10 cfs.
- (102) USACOE – The United States Army Corps of Engineers.
- (103) USEPA – The United States Environmental Protection Agency.
- (104) Water Body – A river, lake, stream, creek or other watercourse or wetlands.
- (105) Water Quality Volume (WQv) – The storage needed to capture and treat the volume of rainfall for 90% of the storm events which produce runoff in the watershed annually.
- (106) Watershed – A region draining into a common water body.

- (107) Wetlands – Land characterized by the presence of water at a frequency and duration sufficient to support wetland vegetation or aquatic life.

# Appendix III

<u><b>TYPE OF SURFACE</b></u>	<u><b>RUNOFF COEFFICIENT</b></u>
<u>Non-Urban Areas</u>	
Bare Earth	0.55
Steep Grassed Areas (slope 2:1)	0.60
Turf Meadows	0.25
Forested Areas	0.20
Cultivated Fields	0.30
<u>Urban Areas</u>	
All Watertight Roof Surfaces	0.90
Pavement (concrete, asphalt)	0.85
Gravel	0.85
Impervious Soils (Heavy)	0.55
Impervious Soils (with turf)	0.45
Slightly Pervious Soil	0.25
Slightly Pervious Soil (with turf)	0.20
Moderately Pervious Soil	0.15
Moderately Pervious Soil (with turf)	0.10
Business, Commercial & Industrial	0.85
Apartments & Townhouses	0.70
Schools & Churches	0.55
Single Family Lots < 10,000 ft <sup>2</sup>	0.45
Lots < 12,000 ft <sup>2</sup>	0.45
Lots < 17,000 ft <sup>2</sup>	0.40
Lots > ½ Acre	0.35
Park, Cemetery or Unimproved Area	0.30

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**Table 3.1.1 (TR-55 Table 3-1) : Runoff Coefficient's for use in the Rational Method calculations for Pipe, Channel and Detention Design**



### Worksheet 3: Time of Concentration (T<sub>C</sub>) or travel time (T<sub>t</sub>)

Project	By	Date
Location	Checked	Date

Check one:  Present  Developed

Check one:  T<sub>C</sub>  T<sub>t</sub> through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet.  
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T<sub>C</sub> only)

	Segment ID			
1. Surface description (table 3-1) .....				
2. Manning's roughness coefficient, n (table 3-1) .....				
3. Flow length, L (total L + 300 ft) ..... ft				
4. Two-year 24-hour rainfall, P <sub>2</sub> ..... in				
5. Land slope, s ..... ft/ft				
6. $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T <sub>t</sub> ..... hr		+		=

Shallow concentrated flow

	Segment ID			
7. Surface description (paved or unpaved) .....				
8. Flow length, L ..... ft				
9. Watercourse slope, s ..... ft/ft				
10. Average velocity, V (figure 3-1) ..... ft/s				
11. $T_t = \frac{L}{3600 V}$ Compute T <sub>t</sub> ..... hr		+		=

Channel flow

	Segment ID			
12. Cross sectional flow area, a ..... ft <sup>2</sup>				
13. Wetted perimeter, p <sub>w</sub> ..... ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ..... ft				
15. Channel slope, s ..... ft/ft				
16. Manning's roughness coefficient, n .....				
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V ..... ft/s				
18. Flow length, L ..... ft				
19. $T_t = \frac{L}{3600 V}$ Compute T <sub>t</sub> ..... hr		+		=
20. Watershed or subarea T <sub>C</sub> or T <sub>t</sub> (add T <sub>t</sub> in steps 6, 11, and 19) ..... Hr				

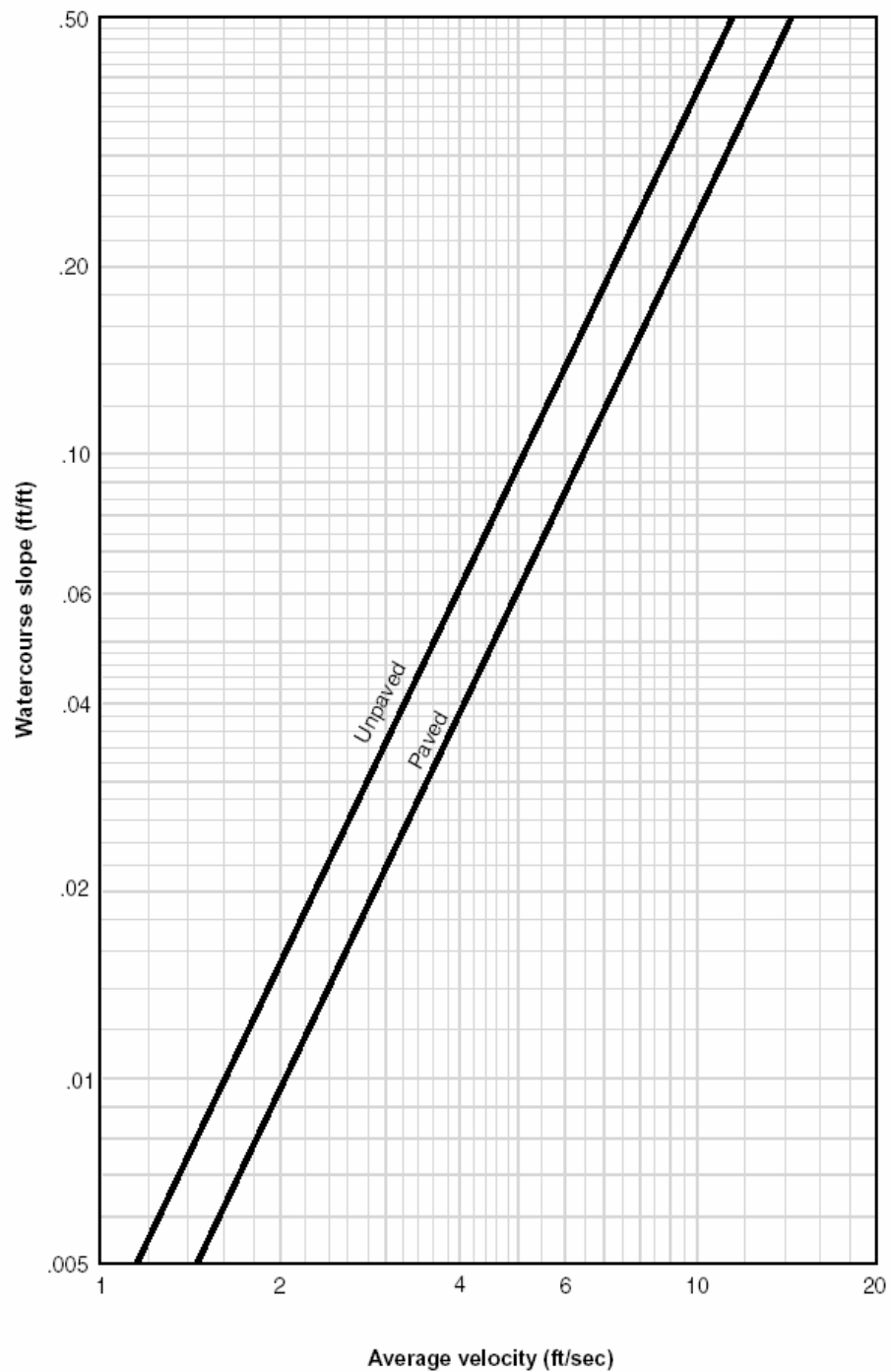
### Worksheet 3.2.1: Time of Concentration or Travel Time Worksheet

<b><u>SURFACE DESCRIPTION</u></b>	<b><u>n</u></b>
Smooth Surfaces (concrete, asphalt, gravel, bare soil)	0.011
Fallow (no residue)	0.05
Cultivated Soils:	
Residue cover $\leq$ 20%	0.06
Residue cover $>$ 20%	0.17
Grass:	
Short Grass Praire	0.15
Dense Grass	0.24
Bermuda Grass	0.41
Range (natural)	0.13
Woods:	
Light Underbrush	0.40
Dense Underbrush	0.80

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**Table 3.1.2: Roughness coefficient's (Manning's n) for sheet flow to be used in Time-of-Concentration calculations**

**Figure 3-1** Average velocities for estimating travel time for shallow concentrated flow



**Figure 3.3.1: Average Velocities for Estimating Travel Time for Shallow Concentrated Flow.**

## Worksheet 2: Runoff curve number

Project	By	Date				
Location	Checked	Date				
Check one: <input type="checkbox"/> Present <input type="checkbox"/> Developed						
<b>1. Runoff curve number</b>						
Soil name and hydrologic group (appendix A)	Cover description  (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN <sup>1/</sup>			Area  <input type="checkbox"/> acres <input type="checkbox"/> mi <sup>2</sup> <input type="checkbox"/> %	Product of CN x area
		Table 22				
<sup>1/</sup> Use only one CN source per line					<b>Totals</b> ➡	
CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = _____ = _____ ;					<b>Use CN</b> ➡	

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### Worksheet 3.2.2: Runoff Curve Number Worksheet

**Table 2-2a** Runoff curve numbers for urban areas<sup>1/</sup>

Cover description	Average percent impervious area <sup>2/</sup>	Curve numbers for hydrologic soil group			
		A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) <sup>3/</sup> :					
Poor condition (grass cover < 50%) .....		68	79	86	89
Fair condition (grass cover 50% to 75%) .....		49	69	79	84
Good condition (grass cover > 75%) .....		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way) .....		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way) .....		98	98	98	98
Paved; open ditches (including right-of-way) .....		83	89	92	93
Gravel (including right-of-way) .....		76	85	89	91
Dirt (including right-of-way) .....		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) <sup>4/</sup> .....		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) .....		96	96	96	96
Urban districts:					
Commercial and business .....	85	89	92	94	95
Industrial .....	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses) .....	65	77	85	90	92
1/4 acre .....	38	61	75	83	87
1/3 acre .....	30	57	72	81	86
1/2 acre .....	25	54	70	80	85
1 acre .....	20	51	68	79	84
2 acres .....	12	46	65	77	82
<i>Developing urban areas</i>					
Newly graded areas (pervious areas only, no vegetation) <sup>5/</sup> .....		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

<sup>1</sup> Average runoff condition, and  $I_a = 0.2S$ .

<sup>2</sup> The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

<sup>3</sup> CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

<sup>4</sup> Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

<sup>5</sup> Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

**Table 3.1.3: Runoff Curve Numbers for Urban Areas**

**Table 2-2b** Runoff curve numbers for cultivated agricultural lands <sup>1/</sup>

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment <sup>2/</sup>	Hydrologic condition <sup>3/</sup>	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
C&T+ CR	Poor	65	73	79	81	
	Good	61	70	77	80	
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
C&T+ CR	Poor	60	71	78	81	
	Good	58	69	77	80	
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
Good	51	67	76	80		

<sup>1/</sup> Average runoff condition, and  $I_a=0.2S$

<sup>2/</sup> Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

<sup>3/</sup> Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good  $\geq 20\%$ ), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

### Table 3.1.4: Runoff Curve Numbers for Cultivated Agricultural Lands

**Table 2-2c** Runoff curve numbers for other agricultural lands <sup>1/</sup>

Cover description	Hydrologic condition	Curve numbers for hydrologic soil group			
		A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. <sup>2/</sup>	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. <sup>3/</sup>	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 <sup>4/</sup>	48	65	73
Woods—grass combination (orchard or tree farm). <sup>5/</sup>	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. <sup>6/</sup>	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 <sup>4/</sup>	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

<sup>1</sup> Average runoff condition, and  $I_a = 0.2S$ .

<sup>2</sup> *Poor*: <50% ground cover or heavily grazed with no mulch.

*Fair*: 50 to 75% ground cover and not heavily grazed.

*Good*: > 75% ground cover and lightly or only occasionally grazed.

<sup>3</sup> *Poor*: <50% ground cover.

*Fair*: 50 to 75% ground cover.

*Good*: >75% ground cover.

<sup>4</sup> Actual curve number is less than 30; use CN = 30 for runoff computations.

<sup>5</sup> CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

<sup>6</sup> *Poor*: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.

*Fair*: Woods are grazed but not burned, and some forest litter covers the soil.

*Good*: Woods are protected from grazing, and litter and brush adequately cover the soil.

**Table 3.1.5: Runoff Curve Numbers for Other Agricultural Lands**

<b>Return Period</b>	<b>a</b>	<b>b</b>	<b>N</b>	<b>R<sup>2</sup></b>
2	32.852	7	0.7780	0.99966
5	46.060	8	0.7859	0.99958
10	56.974	9	0.7953	0.99952
25	72.739	10	0.8115	0.99942
50	84.475	11	0.8147	0.99940
100	92.718	11	0.8145	0.99942

**Table 3.1.6: IDF EQUATION VALUES**



		<b>Return Period – Rainfall Intensity (in/hr)</b>					
<b>Hours</b>	<b>Minutes</b>	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>
0.08	5	4.75	6.14	6.99	8.08	8.83	9.69
0.17	10	3.63	4.75	5.48	6.40	7.07	7.77
0.25	15	2.97	3.92	4.55	5.34	5.94	6.53
0.5	30	1.98	2.64	3.09	3.65	4.10	4.50
1	60	1.25	1.67	1.96	2.31	2.62	2.88
2	120	0.76	1.02	1.20	1.40	1.59	1.75
3	180	0.56	0.75	0.88	1.03	1.17	1.29
6	360	0.33	0.44	0.52	0.60	0.68	0.75
12	720	0.20	0.26	0.30	0.35	0.39	0.43
24	1440	0.11	0.15	0.17	0.20	0.22	0.25

**Table 3.1.7: IDF Table**

		<b>Return Period – Rainfall Depth (in)</b>					
<b>Hours</b>	<b>Minutes</b>	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>
0.08	5	0.40	0.51	0.58	0.67	0.74	0.81
0.17	10	0.61	0.79	0.91	1.07	1.18	1.30
0.25	15	0.74	0.98	1.14	1.34	1.49	1.63
0.5	30	0.99	1.32	1.55	1.83	2.05	2.25
1	60	1.25	1.67	1.96	2.31	2.62	2.88
2	120	1.52	2.04	2.40	2.80	3.18	3.50
3	180	1.68	2.25	2.64	3.09	3.51	3.87
6	360	1.98	2.64	3.12	3.60	4.08	4.50
12	720	2.40	3.12	3.60	4.20	4.68	5.16
24	1440	2.64	3.60	4.08	4.80	5.28	6.00

**Table 3.1.8: IDD Table**

<b>Cumulative Storm Rainfall (percent) for Given Storm Type</b>				
<b>Cumulative Storm Time (Percent)</b>	<b>First Quartile</b>	<b>Second Quartile</b>	<b>Third Quartile</b>	<b>Fourth Quartile</b>
5	16	3	3	2
10	33	8	6	5
15	43	12	9	8
20	52	16	12	10
25	60	22	15	13
30	66	29	19	16
35	71	39	23	19
40	75	51	27	22
45	79	62	32	25
50	82	70	38	28
55	84	76	45	32
60	86	81	57	35
65	88	85	70	39
70	90	88	79	45
75	92	91	85	51
80	94	93	89	59
85	96	95	92	72
90	97	97	95	84
95	98	98	97	92

(SOURCE: Rainfall Frequency Atlas of the Midwest by Huff and Angel)

**Table 3.1.9: Median Time Distributions of Heavy Storm Rainfall at a Point**

# Appendix IV

<b><u>Pipe Material</u></b>	<b><u>Manning's n</u></b>
Concrete Pipe	0.012
Concrete Boxes	0.012
Corrugated Metal Pipe or Pipe Arch	
2 2/3" x 1/2" Helical Corrugation	0.022
2 2/3" x 1/2" Annular Corrugation	0.022
15" to 36"	0.025
42" to 96"	0.024
3" x 1" Corrugation	0.027
5" x 1" Corrugation	0.025
Structural Plate Pipe or Pipe Arch	
6" x 2" Corrugation	0.033
9" x 2 1/2" Corrugation	0.035
Spiral Ribbed Corrugated Metal Pipe	0.013
Smooth High Density Polyethylene (HDPE)	0.012
Smooth Lined Interior Polyvinyl Chloride (PVC)	0.012
Smooth Interior Corrugated HDPE	0.012
Ductile Iron Pipe	0.012

**Table 4.1.1: Manning's "n" Values for Pipes**









<u>Type of Gutter or Pavement</u>	<u>Manning's "n"</u>
Concrete	0.012
Asphalt Pavement:	
Smooth Texture	0.013
Rough Texture	0.016
Concrete Gutter – Asphalt Pavement:	
Smooth	0.013
Rough	0.015
Concrete Pavement:	
Float Finish	0.014
Broom Finish	0.016
For Gutters with small slope, where sediment may Accumulate, increase the "n" values above by:	0.002

USDOT, FHWA, HDS-3 (1961)

**Table 4.1.2: Roughness coefficient's (Manning's n) for Street and Pavement Gutters**

<u>Open Channel Surface Material</u>	<u>n</u>
Concrete	0.012
Gravel Bottom with sides	- Concrete 0.020
	- Mortared Stone 0.023
	- Rip-Rap 0.033
Natural Stream Channels:	
Clean, Straight Stream	0.030
Clean, Winding Stream	0.040
Winding with weeds and pools	0.050
With Heavy Brush and Timbers	0.100
Flood Plains:	
Pasture	0.035
Field Crops	0.040
Light Brush and Weeds	0.050
Dense Brush	0.070
Dense Trees	0.100

Chow, 1959

**Table 4.1.3: Roughness coefficient's (Manning's n) for Open Channel Surfaces**

### Typical Maximum Velocities for Open Channel Linings

<b>Open Channel Lining Material</b>	<b>Desirable Maximum Velocity (ft/s)</b>
Concrete, Trowel Finish	15
Concrete, Broom or Float Finish	15
Rip-Rap	10
Gabions	10
New Earth (Uniform, Sodded, Clay)	3-5
Existing Earth (Fairly Uniform, With Some Weeds)	3-5
Dense Weeds	3-5
Swale with Grass	3-5

**Table 4.1.4: Desirable Maximum Velocities for Open Channel Linings**

# Appendix V

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# Appendix VI

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# Appendix VII



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# Appendix VIII

INSERT SHELBYVILLE STANDARDS

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# Appendix X

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# Appendix XI



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# Appendix XII

INSERT EROSION & SEDIMENT CONTROL ORDINANCE