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Borough of Mohnton

Appendix 2

Design of Storm Drainage Systems

I. Method of Storm Water Run-off Calculations

The collection system shall be designed using the Rational Method in accordance with American Society of Civil Engineers Manual No. 37 or the U.S. Department of Agriculture Soil Cover Complex Method in Technical Release No. 55, latest edition.

The Rational Method uses the formula $Q = CiA$, where

“Q” is the required capacity in cubic feet per second for the collection system at the point of interest.

“C” is the runoff coefficient applicable to the entire drainage area. It shall be based upon existing development in the drainage area, consideration of soil conditions, topography, and the ultimate development of the proposed subdivision or land development.

“i” is the intensity of rainfall in inches per hour and shall be based on the applicable PennDOT storm intensity-duration-frequency curve, latest revision. Time of concentration calculations shall be submitted, and shall be based on methods outlined in Technical Release No. 55. The sheet and shallow concentrated flow lengths used in the calculations shall be justified based on existing or proposed topography. Time of concentration flow paths (pre-and post development) should be shown on the grading plan. The pre-development sheet flow length shall be 150 feet, unless a shorter length can be justified. The maximum post-development sheet flow length for unpaved surfaces shall be 150 feet, with a maximum flow length of 150 feet for most situations, depending on the proposed site grading.

“A” is the drainage area in acres.

A. Values of Coefficient “C”

1. The following runoff coefficients shall be used for calculating runoff using the Rational Method:

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RUNOFF COEFFICIENTS FOR THE RATIONAL METHOD*

HYDROLOGIC SOIL GROUP AND SLOPE RANGE

Land Use	A		B		C		D	
	0-6%	6%+	0-6%	6%+	0-6%	6%+	0-6%	6%+
Cultivated Land	0.25 ^a	0.35	0.30	0.40	0.35	0.45	0.40	0.50
	0.30 ^b	0.40	0.35	0.45	0.40	0.50	0.50	0.60
Meadow	0.10	0.13	0.13	0.19	0.16	0.23	0.19	0.26
	0.14	0.16	0.16	0.22	0.20	0.26	0.23	0.30
Forest	0.08	0.11	0.11	0.14	0.13	0.16	0.16	0.20
	0.11	0.14	0.14	0.18	0.16	0.20	0.20	0.25
Open Space (Lawn)	0.10	0.14	0.15	0.19	0.20	0.24	0.25	0.28
	0.16	0.20	0.20	0.25	0.25	0.30	0.30	0.35
Paving, Buildings Sidewalks	.95	.95	.95	.95	.95	.95	.95	.95

a Runoff coefficients for storm recurrence intervals less than 25 years.

b Runoff coefficients for storm recurrence intervals of 25 years or more.

* Higher coefficients may be required by the Borough Engineer due to local soil conditions.

II. Design of Drainage Facilities.

A. In the design of storm sewers, the following formulas shall be used:

$$V = 1.49 \frac{a}{n} s^{2/3} \quad \text{(Manning's Formula for velocity)}$$

$$Q = Va \quad \text{(Continuity Equation)}$$

Where:

V = velocity of flow (in feet per second)

n = coefficient or roughness

a = cross-sectional area of structure (in square feet)

p = perimeter of the wetted channel (in feet)

s = slope (in feet per foot)

Q = discharge (in cubic feet per second)

All storm sewers or culverts shall have a minimum diameter of 15 inches.

In all cases where drainage is collected by a headwall or catch basin where inlet or outlet control may govern, the pipe shall be designed as a culvert as outlined in Hydraulic Design Series No. 5, latest edition, of the U.S. De-

partment of Transportation, Federal Highway Administration. The allowable headwater should be determined by the specific entrance conditions and sound engineering judgment. The design of culverts shall not create excessive headwater depths.

- B. The coefficient of roughness, “n,” shall be as follows unless otherwise approved by the Borough Council.

Pipe Material	“n”
Concrete	0.012
Corrugated Steel	
Annular	0.024
Helical	
15”	0.012
18”	0.014
21”	0.016
24”	0.017
30”	0.018
36”	0.019
42”-54”	0.020
larger than 54”	0.021
PVC	0.011

For all open channels, the coefficients shall be taken from Table 5-6 and Figures 5-5 of Open-Channel Hydraulics by Ven Te Chow, Ph.D., McGraw-Hill Book Co., 1959.

- C. Permissible Flow Velocities in Open Channels.

The design of open channels, swales, diversions, etc. shall minimize possible erosion caused by excessive channel velocities. The storm sewer design frequency storm shall be used to deter the maximum channel velocity and type of ground cover required to stabilize the channel properly. The maximum permitted channel velocities are listed below.

Grass-lined channels shall be considered stable if the calculated velocity for the design flow does not exceed the allowable velocities shown below:

- (1) Three feet per second where only sparse vegetation can be established and maintained because of shade or soil condition.
- (2) Four feet per second where normal growing conditions exist and vegetation is to be established by seeding.

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- (3) Five feet per second where a dense, vigorous sod can be quickly established or where water can be temporarily diverted during establishment of vegetation. Netting and mulch or other equivalent methods for establishing vegetation shall be used.
- (4) Six feet per second where there exists a well established sod of good quality, or if root-reinforcing systems are installed.

These calculated grass-lined channel velocities may be exceeded if the designer can provide supportive design criteria as proof of erosion prevention.

Where the velocity of storm water runoff exceeds the allowable velocity, an erosion resistant lining shall be provided.

D. Permissible Velocities in Storm Pipe at Design Flow

Minimum – 2.5 feet per second

Maximum – the design shall consider the erosion potential at pipe outlets, and pipe manufacturer's suggested maximum velocities, if any, shall also be considered in the pipe design.

III. Additional Notes.

- A. All calculations are subject to approval by the Borough Council.
- B. A drawing showing all drainage areas contributing to drainage facilities shall be submitted with the storm water runoff calculations.
- C. Alternate methods of storm water runoff determination may be permitted by the Borough Council upon written request of the developer.
- D. When deemed appropriate by the Borough Council, storm water runoff determination using alternative methods may be required.
- E. When open channels are used, side slopes, depth of channel, and width of channel shall be subject to approval of the Borough Council and shall not be such that a danger to life, property and the public health, safety and welfare results.

(Ord. 516, 6/10/1992)