



Water Drainage Workshop



FAST FACTS

Why the Water Drainage Ordinance?

- Increasing concerns over the inadequate public storm water drainage system resulting in historic street flooding
- Older house foundations with water seepage problems
- Private property topography/lot grading/hilly terrain/ sub-surface springs in Town
- As a result of larger houses being constructed, in 2005, former Mayor Hudnut was charged with taking feasible steps with regard to better managing storm water runoff on private property
- Data collected; consultation with Montgomery County and experts
- A new ordinance after numerous drafts; March 8, 2007 effective date

The Basics: Key Elements of the Ordinance

- A water drainage plan is required if the new impervious surface created by a development activity and all other development activities with the two year period prior to filing an application exceeds 700 s.f.
- Exemption: <700 s.f. of new impervious footprint is exempt and driveway repaving (note: no enlargement of driveway footprint)
- Infiltrating storm water onsite thereby restricting runoff to streets and onto neighboring properties
- 90% of runoff is caused by 3-month storm events - 1.25" over 24-hour period. Ordinance, therefore, requires retaining water on-site based on the 3-month storm
- 10-year storm (5.1") can be discharged to street but no more than pre-construction rate.
- No open water ponds; overflow discharges pass under sidewalk through curb
- All engineering calculations need to be included in the report.
- No credits offered for removing impervious surfaces
- Public notification by notice to neighboring property owners (7 days of receipt of plan); posting on the Town website

Key Elements- continued

- Plan and report to be prepared by a P.E. or licensed land surveyor in MD
- A water drainage plan and report for approval by Town engineer; 2 copies on paper, 1 electronic
- Plan must discuss impact on adjacent properties; easements , if needed
- Soil testing, hydrology and hydrologic computations
- Before and after site runoff computations
- Maintenance agreement/maintenance schedule
- Performance and/or Surety Bonds or Cash Bond

Water Drainage Board

- Composed of 3 appointed members, including a Professional Engineer

Functions:

- Variances for hardship circumstances on property based on engineering difficulties and site conditions
- Appeals (by a resident aggrieved by an approval or denial of the Town engineer's decision)

WATER ORDINANCE ENGINEERING WORKSHOP

Presented by:
William Bissell, P.E.
Town Engineer

Basic Requirements

- 1) The Applicant shall provide water drainage measures that retain all stormwater from all new impervious surfaces within the property for twenty-four (24) hours for a three month storm event.

- 2) For a storm event greater than a three month storm event, but not more than a ten year storm event, a water drainage system shall be designed and constructed so as not to allow site runoff to flow to any adjacent or nearby property at a rate greater than the pre-construction rate.

How much rainfall?

Three month storm event = 1.25 inches

Ten year storm event = 5.1 inches

How much runoff?

Calculate the runoff from all new impervious surfaces using the:

Soil Conservation Survey Curve Number Method

SCS Method

To estimate runoff from storm rainfall, SCS uses the runoff curve number (CN) method.

Determination of CN depends on the watershed's soil and cover conditions, which the model represents as hydrologic soil group, cover type, treatment, and hydrologic condition.

<u>Typical CN Values:</u>	<u>Curve No.</u>
Rooftops, asphalt, concrete	98
Semi-pervious pavement	?????
Gravel driveways	76 – 91
Open Space (lawn-good condition)	39 – 80

SCS Method (cont.)

After the CN is determined, apply the SCS runoff equation:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$

Where:

Q = runoff (inches)

P = rainfall (inches)

S = potential maximum retention after runoff begins (inches)

I_a = initial abstraction (inches) [all losses before runoff begins]

Also:

I_a = 0.2 S (empirical observation in small watersheds)

Substituting:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

SCS Method (cont.)

Solve for S (potential maximum retention after runoff begins)

$$S = \frac{1000}{CN} - 10$$

Finally, calculate Q (inches) and apply that depth over the new impervious areas to determine the required volume to retain for the 3-month storm event.

Follow same procedure for the 10-year storm event – solve for Q (in) and the retention volume for both the existing conditions and the new impervious areas. The difference between these two volumes will determine the required volume for retention up to the 10-year storm event.

SCS Method (cont.)

10-year Storm Event

-- “not to allow site runoff to flow to any adjacent or nearby property at a rate greater than the pre-construction rate.”

Determine Peak Discharge using the SCS method

Graphical Peak Discharge Method.

$$q_p = q_u A_m Q F_p$$

q_p = peak discharge (cfs)

q_u = unit peak discharge (csm/in)

A_m = drainage area (mi²)

Q = runoff (in)

F_p = pond and swamp factor

Sample Project 1

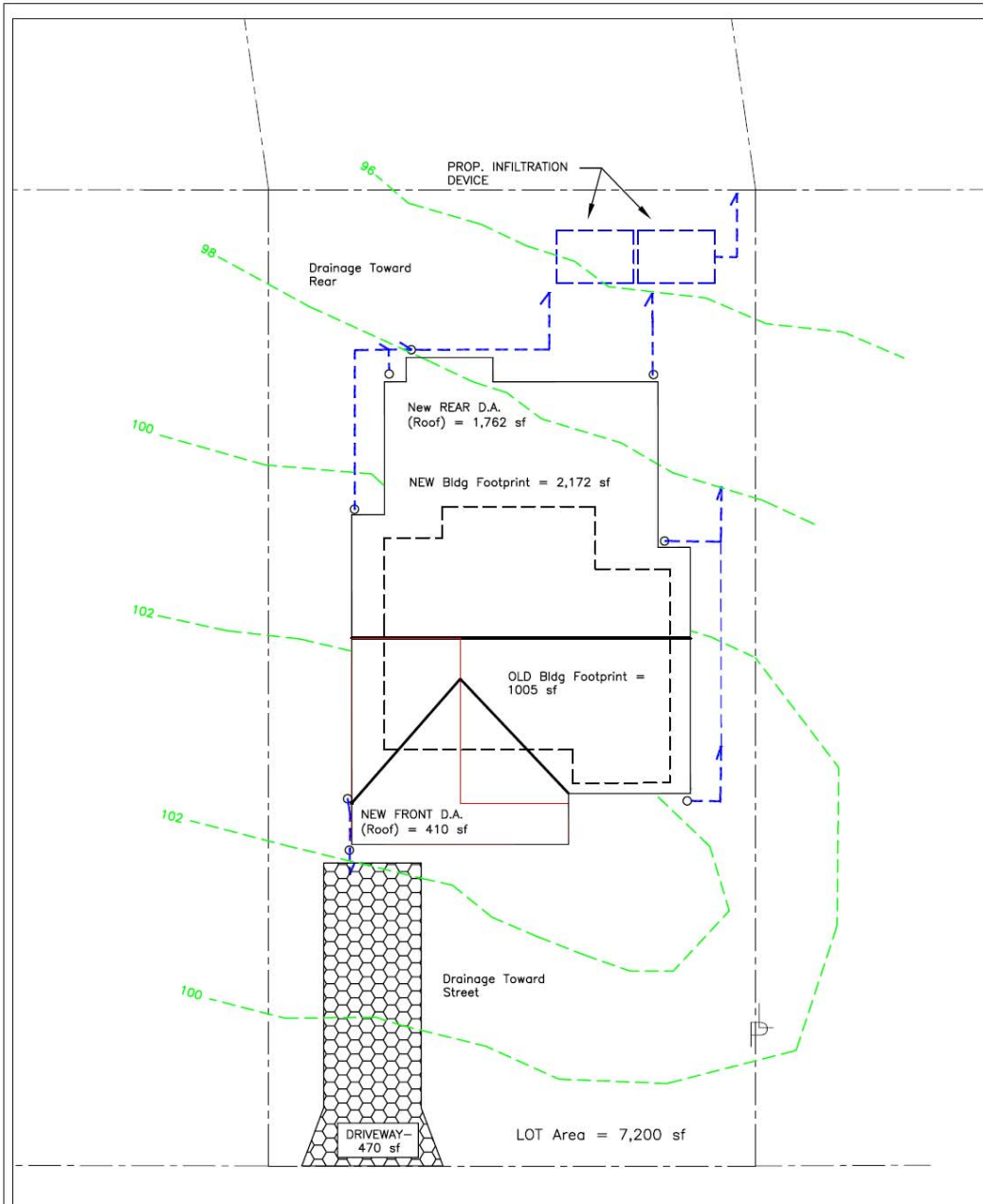
Typical 60-foot by 120-foot lot scheduled for new home construction.

- Existing impervious areas – rooftops = 1,005 sf (CN = 98)
- New impervious surface – rooftops = 2,172 sf (CN = 98)
- driveway = 470 sf (CN = 85)

Solve for 3-month storm event using:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

For the 1.25 inch 3-month storm, required retention volume = 187 cf



STORMWATER MANAGEMENT PLAN
TYP. 60' BY 120' LOT
(N.T.S.)

Sample Project 1

Typical 60-foot by 120-foot lot scheduled for new home construction.

Solve for 10-year storm event using:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

Existing Conditions

Rooftop area = 1,005 sf (CN = 98)

Yard area = 1,167 sf (CN = 75)

For the 5.1 inch storm, existing runoff volume = 653 cf

Proposed Conditions

Rooftop area = 2,172 sf (CN = 98)

For the 5.1 inch storm, proposed runoff volume = 880 cf

10-year volume = 880 cf – 653 cf = **227 cf**

Required volume to retain = larger of 227 cf or 187 cf = **227 cf**

Sample Project 1

Typical 60-foot by 120-foot lot scheduled for new home construction.

Don't forget about the paver driveway!!

Proposed Conditions

Driveway area = 470 sf (CN = 85)

Rooftop area = 410 sf (CN = 98)

- For the 1.25 inch storm, proposed runoff volume = 47 cf
- For the 5.1 inch storm, proposed runoff volume = 302 cf

Use the footprint of the driveway as the retention device (washed stone subgrade with 40-percent void space).

Req'd volume = $302 \text{ cf} / 0.4 = 755 \text{ cf}$

Find sub-base depth:

$755 \text{ cf} / 470 \text{ sf} = 1.6 \text{ foot depth (19.2 inches) of stone media}$

Sample Project 2

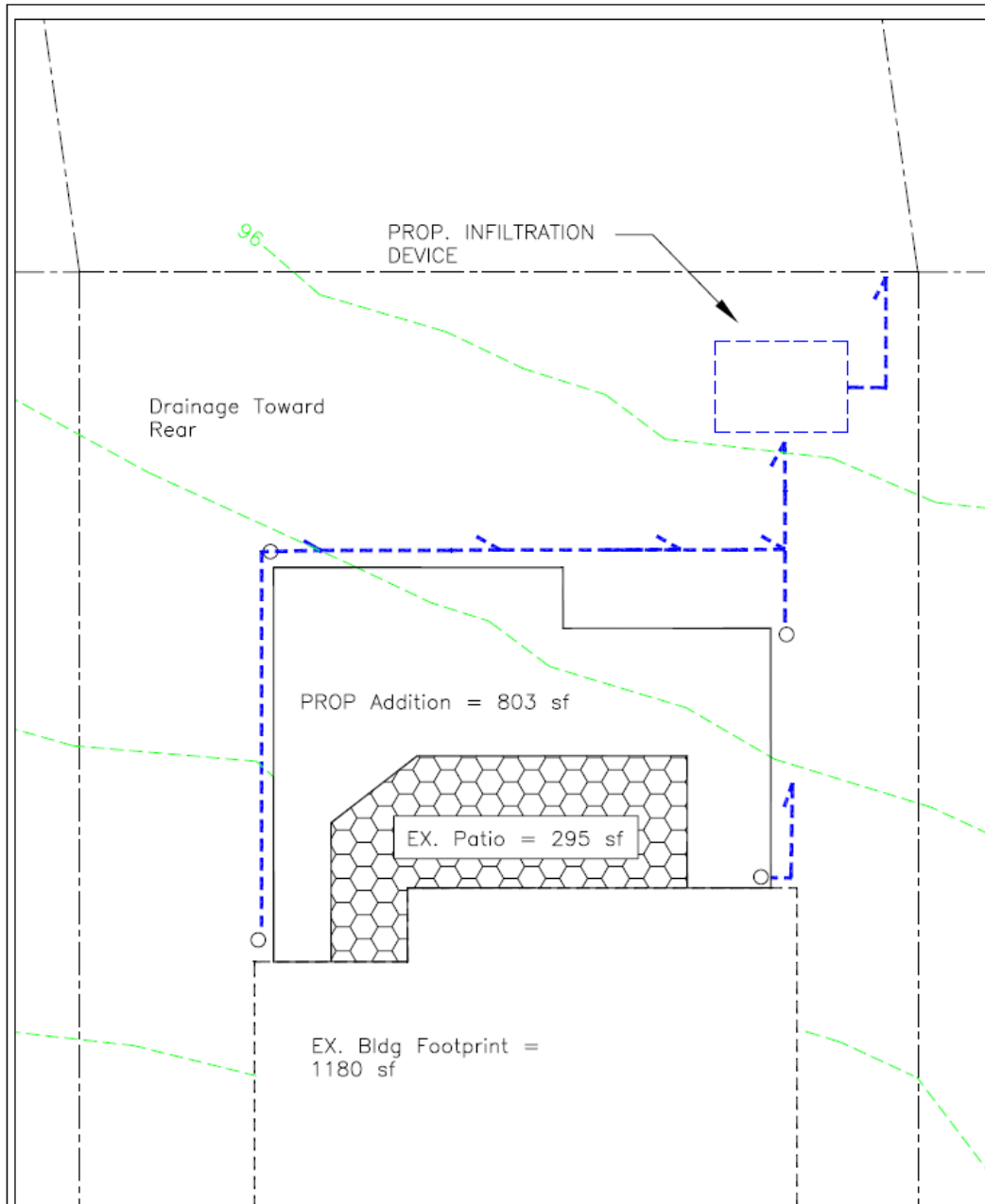
Typical lot scheduled for new addition.

- New impervious surface – rooftops = 803 sf (CN = 98)
- Existing surface – flagstone patio = 295 sf (CN = 90)
– yard (grassy) = 508 sf (CN = 75)

For the 1.25 inch storm, required retention volume = 69 cf

For the 5.1 inch storm, existing runoff volume = 192 cf
proposed runoff volume = 325 cf
difference **133 cf**

Required volume to retain = larger of **133 cf** or 69 cf = **133 cf**



**STORMWATER MANAGEMENT PLAN
TYP. ADDITION PROJECT
(N.T.S.)**

Pervious Pavement??

1* Water and Environment Specialty Conference of the Canadian Society for Civil Engineering
1^{re} Conférence spécialisée sur l'eau et l'environnement de la Société canadienne de génie civil



Saskatoon, Saskatchewan, Canada
June 2-5, 2004 / 2-5 juin 2004

STUDY ON THE SURFACE INFILTRATION RATE OF PERMEABLE PAVEMENTS

E. Z. Bean¹, W. F. Hunt¹, D. A. Bidelspach¹ and Robert J. Burak²

1. Department of Biological and Agricultural Engineering, North Carolina State University, North Carolina, USA
2. Interlocking Concrete Pavement Institute, Washington, DC, USA

ABSTRACT: Asphalt surfaces have greatly increased the amount of pollutant-carrying runoff entering surface waters. To counteract this, permeable pavement can be installed to allow water to infiltrate, thus reducing runoff and acting as a filter. This study tested the surface infiltration rate of 27 permeable pavement sites in North Carolina, Maryland and Delaware. One of these sites in North Carolina was monitored to compare pollutant loads of asphalt runoff to those in infiltrate. Concrete grid pavers (CGP) and permeable interlocking concrete pavers (PICP) were tested with pavement ages ranging from six months to 20 years. Two infiltration tests were run on 14 CGP lots filled with sand. The initial test was on the existing condition of the surface and second test was run after the removal of the top layer of residue (1.3 - 1.9 cm) to simulate maintenance. Maintenance improved the infiltration rate on 13 of 14 sites. Analysis of the data showed that maintenance improves surface permeability at a confidence level of 99.8%. The median average infiltration rate increased from 5.0 cm/hr., for existing conditions, to 8.0 cm/hr after maintenance. Eleven PICP sites were also tested. Sites built in close proximity to loose fine particles had infiltration rates significantly less than sites free of loose fines. Averages of each condition are 60 cm/hr and 2000 cm/hr respectively. Even the minimum existing infiltration rates were comparable to those of a grassed sandy loam soil. Water quality data included in this study shows the results of six storms from June to October, 2003. With only a few storms to compare, only Zinc has been identified as having a statistically significant difference between infiltrate and runoff.

Pervious Pavement??



Figure 1: PICP



Figure 2: CGP

Fig 1: Permeable Interlocking Concrete Paver (9% open area)

Fig 2: Concrete Grid Paver (30% open area)

Pervious Pavement??

No real defined CN for either PICP or CGP
or for Porous Concrete/ asphalt

Performance of these products are based on
long term maintenance. -- must keep the
sub-base void spaces (washed gravel at
 $V_v = 40\%$) clean –

- Periodic vacuum (4x per year?)
- Power washing (4x per year?)
- Replace sub-base (every 10 years?)

Questions/ Answers

- Do your homework before you call
- Don't hesitate to call to verify requirements
- Be flexible about inspection dates
- Be prepared prior to inspection
- Don't worry – we are here to help