Town of Chevy Chase
Water Drainage Ordinance
Users' Guide

Contents

Water Drainage Users' Guide

Please ensure that you submit a complete application, as incomplete applications will not be reviewed. If you have any questions about the Water Drainage Plan approval process, please call the Town Office at 301-654-7144.

I. History and Background

What is the history of the Water Drainage Ordinance?
In the summer of 2005, concerns about increasing development pressure (including increases in stormwater management problems) led the Town Council to unanimously vote to impose an emergency temporary moratorium on the demolition of existing houses and construction of new houses. During this six-month moratorium, the Water Subcommittee of the Environment Committee was appointed by Mayor Bill Hudnut and charged with devising "feasible steps (in collaboration with the county) that can be taken with regard to water management and impervious surface coverage on individual lots to minimize flooding and drainage issues."

Over several months, the Water Subcommittee gathered a large volume of data regarding water drainage issues in the Town. The Subcommittee held over 15 public meetings and conducted meetings and interviews with numerous experts, including Montgomery County officials, representatives from the Maryland Department of the Environment, water engineers, builders, attorneys, and others. The Subcommittee also sought to gain more empirical evidence on the true extent of water drainage problems, if any, from Town residents through a survey.

What did the Water Subcommittee learn from the water survey?

1) Many residents reported water drainage issues, both current and long standing. Many homeowners have had to deal with water drainage problems. Over 225 residents spent an average of $3,000 to mitigate water problems within their homes and on their property.

2) The Town's storm drainage system is very old. Some sections are in worse shape than others, possibly due to the age of the system and the gradual increase in impervious surfaces throughout the Town. The entire storm drainage system is poorly documented.

3) Because of the Town's hilly terrain, many houses are subject to runoff from adjacent properties. Because of the legacy terra cotta foundations, many original homes are extremely vulnerable to flooding resulting from runoff.

As a result of its extensive research and consultations, the Subcommittee concluded that an ordinance to regulate water drainage resulting from new construction and renovations is in the best interests of the Town.

What are some underlying assumptions that drove the creation of the ordinance?

1) Because of the potential overtaxing of Town storm drains, and because of our hilly and varied terrain that can lead to runoff issues between adjacent properties, the ordinance focuses on restricting runoff that is allowed to flow to the street and adjacent properties.

2) 90% of the potential water drainage in the Town is caused by a "3 month" storm event (1.25 inches of rain over a 24 hour period). The ordinance requires that new construction be designed with drainage systems that can retain water from such storms on the property and will not enable runoff to flow onto the street and adjacent properties.

3) A vast body of drainage and stormwater guidance has already been established by the Maryland Department of Environment in *The Maryland Stormwater Design Manual*. The issue of water drainage is technical; therefore, some parts of the Ordinance are technical.

4) Large projects (those over 700 square feet) have the most adverse affect on neighbors and the Town's drainage system.

5) The type of soil found in the Town is classified as hydrologic soil group B (USDA document TR-55).

II. Applicability

When is a Water Drainage Plan Required?

Under the ordinance, a water drainage plan is required if the new impervious surface created by a development activity and all other development activities within the two (2) year period prior to filing an application exceeds seven hundred (700) square feet. The following guidelines are used in determining whether proposed development activity creates a new impervious surface:

- The 700 square foot criterion always applies to the ground level footprint.
- The Town does not allow for any credits for removing an impervious surface, whether or not it is replaced with either a permeable surface or an impervious surface.
- The two (2) year period is measured from the date of the Town's final inspection for projects that require a building permit.
- The surface areas of uncovered decks or stoops that allow water to pass through to an unimproved (grass or soil) surface below are exempted from the 700 square foot threshold.
- Clean gravel surfaces where the gravel is at least four inches deep are considered to be permeable, and are not included in the 700 square foot threshold.
- All other semi-permeable surfaces are included in the water drainage calculations; however, many of these surfaces may serve as their own infiltration systems. Additionally, the relative permeability of these surfaces is accounted for by the calculation methodology used by the Town.
- Because they do not cause runoff, pools are not considered impervious surfaces. All decking around pools is considered to be impervious surface.
- The Town allows for the in-kind replacement, but not the expansion, of an existing driveway without regard to the Town's water drainage ordinance. If the driveway is expanded, the entire surface of the driveway is subject to a water drainage plan if the impervious surface threshold is reached.

Once you have determined that a plan is required, your first step is to hire a civil engineer or land surveyor to prepare your water drainage plan. This is a requirement of the Ordinance. You should feel free to contact the Town staff at any time to answer technical questions about the Ordinance or inquire about how the Ordinance specifically relates to your project.

III. Methodology

What are the Criteria for a Water Drainage Plan?
A Water Drainage Plan shall provide for water drainage measures that retain within the property the greater of the following:

a. The volume of all storm water runoff from all new impervious surfaces for a three month storm event, which is a storm event that produces 1.25 inches of rain over a 24 hour period, or
b. the volume by which post-construction site runoff from all impervious surfaces exceeds pre-construction site runoff from all impervious surfaces for a ten-year storm event, which is a storm event that produces 5.1 inches of rain over a 24 hour period.

In addition, 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.

In order to create a uniform, consistent standard for the above calculations, the Town has adopted the Soil Conservation Survey (CSC) Curve Number (CN) Method as the approved methodology for calculating the volume of water that must be infiltrated on site.

Curve Number Calculations:

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

   <u>CN Values Adopted by the Town:</u>

   98 – value for rooftops, asphalt and concrete; value for natural and concrete pavers set on concrete (highest number assigned, least permeable surface).

   94 - used for concrete or natural stone pavers with tight joints (sand in joints) or pre-cast surfaces underlain by stone dust or crusher run

   90 - value for gravel drives that are underlain by stone dust or crusher run

   85 - value for Eco-stone permeable interlocking concrete pavers that have wider joints that are filled with clean angular gravel

   80 – value for Turfstone Grid pavers with either grass growing or clean gravel installed in the joints and open spaces; this system must be underlain by clean gravel subbase/ filter cloth

   75 – value for gravel drives with clean gravel subbase/ filter cloth

75 – value for porous concrete driveways

75 – assigned value for lawns in the Town of Chevy Chase (lowest number assigned, most permeable surface)

Note: Please consult with the Town Engineer if you have questions about the Curve Number that the Town would assign to a specific proprietary product not listed above.

2) After the CN is determined, the SCS runoff equation must be solved for both a three-month storm event and a ten-year storm event.

For a three-month storm event:

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

Where:

Q = runoff (inches)
P = rainfall (inches; 1.25 inches for the 3-month storm event)
S = potential maximum retention after runoff begins (inches)
Ia = initial abstraction (inches) [all losses before runoff begins]
Also:
Ia = 0.2 S (Adopted by the Town based on empirical observation in small watersheds)

Substituting:

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

b) Solve for S (potential maximum retention after runoff begins)

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

c) Solve for Q (inches)

d) Calculate the required storage volume for a 3-month storm event.

(Q (inches) / 12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

For the 10-year storm event:

a) Use the same formulas to solve the required storage volume in cubic feet. For the 10-year storm event, you must calculate the increase in the post-construction runoff (i.e. proposed conditions) and the pre-construction runoff (i.e. existing conditions). In order to calculate the increase, you must do the calculations below for both conditions.

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

Where:

Q = runoff (inches)
P = rainfall (inches; 5.1 inches for the 10-year storm event)
S = potential maximum retention after runoff begins (inches)
Ia = initial abstraction (inches) [all losses before runoff begins]
Also:
Ia = 0.2 S (Adopted by the Town based on empirical observation in small watersheds)

Substituting:

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

b) Solve for S (potential maximum retention after runoff begins)

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

c) Solve for Q (inches)

d) Calculate the required storage volume for the post-construction runoff

(Q (inches) / 12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

e) Calculate the required storage volume for the pre-construction runoff

(Q (inches) / 12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

f) Subtract the pre-construction runoff (e) from the post construction runoff (d) to determine the required storage volume for a 10-year storm.

3) The volume of water that must be retained on site (design volume) is the larger of the required storage volume for the 3-month storm event for new impervious surfaces or the increase in required storage volume from existing conditions to proposed conditions for the 10-year storm event.

The following worksheets and sample calculations will help walk you and your engineer/surveyor through the calculations. As always, please feel free to contact the Town with any questions you may have.

IV. Calculation Worksheets & Sample Projects

Calculate the 3-Month Required Storage Volume for the New Impervious Surface

Enter the Total Square Foot AREA of the New Impervious Surface: Box 1 [ ]

Describe the Cover Type of the New Impervious Surface ___________________________
(Rooftop, concrete or asphalt driveway, semi-pervious surfaces)

Determine Curve Number (CN) for New Impervious Surface : Box 2 [ ]
(go to Sec. 3 (Methodology) for CN values)

Calculate the Required Storage Volume to Retain; Do this calculation for each type of different cover type that comprises all of the New Impervious Area.

Solve for S (potential maximum retention after runoff begins, unit less value)

$S = \frac{1000}{CN} - 10$ S = Box 3 [ ]

Now Solve for Q

$$Q = \frac{(1.25 - 0.2S)^2}{(1.25 + 0.8S)}$$

Where:
Q = runoff (inches)
P = rainfall (1.25 inches for 3-Month Event)
S = potential maximum retention after runoff begins (inches)

Q = ____________________ Inches of Runoff

Convert the Inches of Runoff (Q) to Cubic Feet of Runoff by dividing Q by 12 and multiplying the result by the New Impervious Area (Box 1)

Q (inches) ÷ 12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

Required Storage Volume (cubic feet) = ________________________

If there is more than ONE type of New Impervious Surface, SUM all the calculated values for the Required Storage Volume.

Area 1 ___________cf + Area 2 ____________cf = _____________ Total Required Storage Volume (Cubic Feet)

3-Month Storm Event Total Required Storage Volume (cubic feet) to Retain: Box 4 [ ]

Calculate the 10-Year Required Storage Volume for the New Impervious Surface

The Surface Cover Type and Curve Number (CN) are the SAME as for the 3-Month Calculation

S = Box 3 $\boxed{}$

Solve for Q

$$Q = \frac{(5.1 - 0.2S)^2}{(5.1 + 0.8S)}$$

Where:
Q = runoff (inches)
P = rainfall (5.1 inches for 5-Year Event)
S = potential maximum retention after runoff begins (inches)

Q = ____________________ Inches of Runoff

Convert the Inches of Runoff (Q) to Cubic Feet of Runoff by dividing Q by 12 and multiplying the result by the New Impervious Area (Box 1)

Q (inches) ÷ 12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

Required Storage Volume (cubic feet) = ________________________

If there is more than ONE type of New Impervious Surface, SUM all the calculated values for the Required Storage Volume.

Area 1 ___________c.f. + Area 2 ____________c.f. = _____________ Total Required Storage Volume (Cubic Feet)

10-Year Storm Event Total Required Storage Volume (cubic feet) to Retain:

Box 5 $\boxed{}$

Calculate the 10-Year Runoff Volume for the EXISTING Conditions

This calculation is made using the same footprint used in the Proposed Conditions. These surfaces are to be removed, disturbed and/or altered during the proposed construction.

Describe the Cover Type of the Existing Surface(s) ___________________________
(Rooftop, concrete or asphalt driveway, semi-pervious surfaces)

Determine Curve Number (CN) for Existing Surfaces : CN ____________
(go to Sec. 3 (methodology) for CN values)

Calculate the Runoff Volume for the Existing Conditions; Do this calculation for each type of different cover type that comprises the same footprint as the New Impervious Area.

Solve for S (potential maximum retention after runoff begins, unit less value)

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

S = _____________

Now Solve for Q

$$Q = \frac{(5.1 - 0.2S)^2}{(5.1 + 0.8S)}$$

Where:
Q = runoff (inches)
P = rainfall (5.1 inc 6 for 5-Year Event)
S = potential maximum retention after runoff begins (inches)

Q = ____________________ Inches of Runoff

Convert the Inches of Runoff (Q) to Cubic Feet of Runoff by multiplying Q by the New Impervious Area

Q (inches) ÷ 12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

Existing Conditions Runoff Volume (cubic feet) = _________________________

If there is more than ONE type of Existing Surface, SUM all the calculated values for the Existing Conditions Runoff Volume.

Area 1 ___________cf + Area 2 ____________cf = _____________ Total Required Storage Volume (Cubic Feet)

10-Year Storm Event Total Runoff Volume for Existing Conditions (cubic feet):

Box 6 | |
|---|

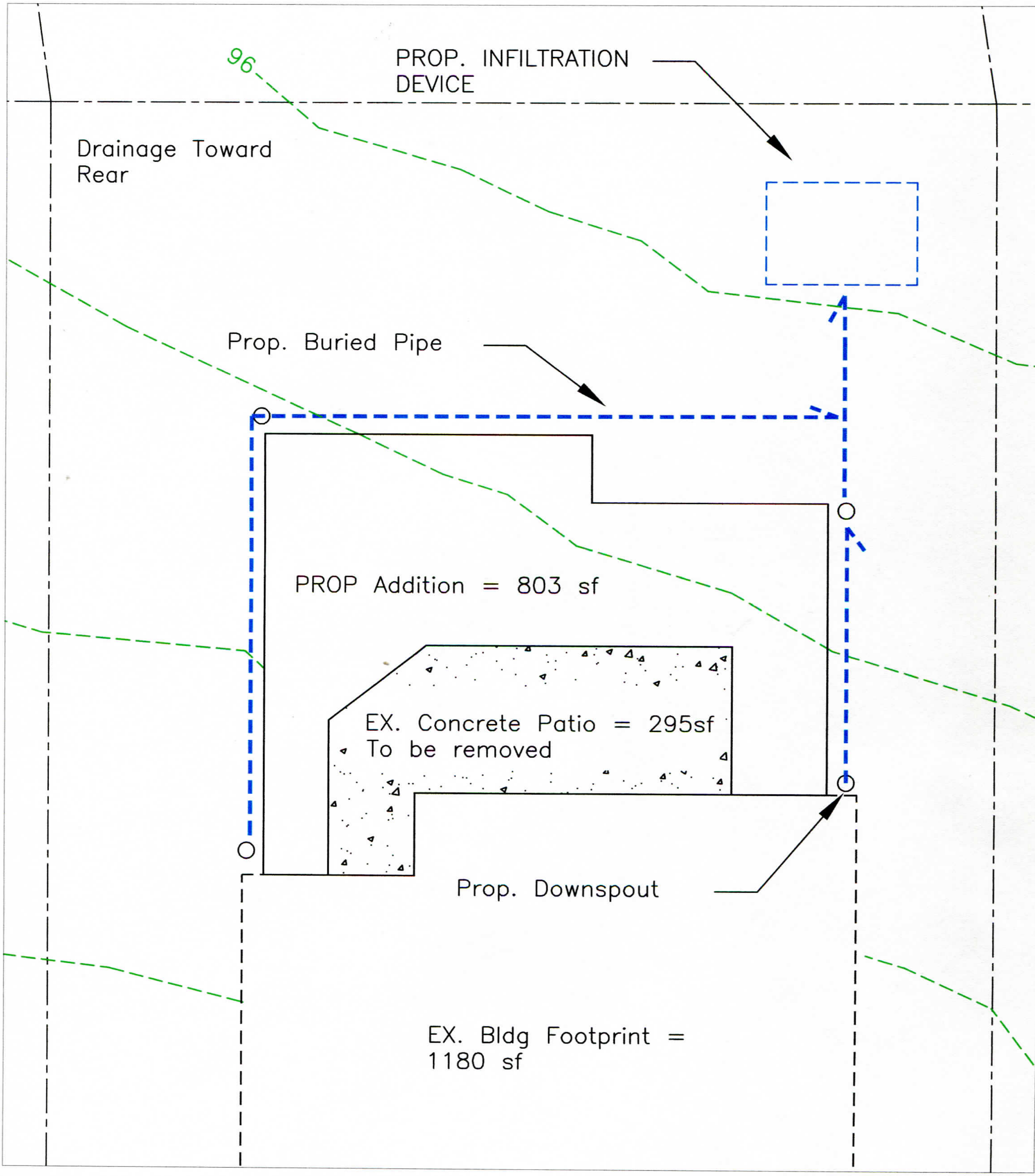
Calculate the Required Storage Volume to be Retained for the Proposed Project

Determine the INCREASE in runoff for the 10-Year Storm event by Subtracting the Existing 10-Year Runoff (Box 6) from Proposed 10-Year Runoff (Box 5)

Increase in 10-Year Storm Event Runoff = Box 7 [ ]

COMPARE the Values in Box 4 and Box 7. The LARGER value is the Required Storage Volume to Retain for the Proposed Project.

Box 8 [ ]



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

TYPICAL ADDITION PROJECT

Town of Chevy Chase
4301 Willow Lane
Chevy Chase, MD 20815

301-654-7144 (phone)
301-718-9631 (fax)
townoffice@townofchevychase.org

Town Permit No.: ____________

1. Calculate the 3-Month Storm Event Required Storage Volume for the New Impervious Surface

Enter the Total Square Foot AREA of the New Impervious Surface: Box 1 [803]

Describe the Cover Type of the New Impervious Surface: ROOFTOP

(Rooftop, concrete or asphalt driveway, semi-pervious surfaces)

Determine Curve Number (CN) for New Impervious Surface: Box 2 [98]

(go to Sec. III (Methodology) in Water Drainage Users' Guide for CN values)

Calculate the Required Storage Volume to Retain; Do this calculation for each different cover type that comprises all of the New Impervious Area.

Solve for S (potential maximum retention after runoff begins, unit less value)

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

S = Box 3 [0.2]

Now Solve for Q:

0.2

$$Q = \frac{(1.25 - 0.2S)^2}{(1.25 + 0.8S)}$$

0.2

Where:
Q = runoff (inches)
P = rainfall (1.25 inches for 3-Month Event)
S = potential maximum retention after runoff begins (inches)

Q = 1.0 Inches of Runoff

Convert the Inches of Runoff (Q) to Cubic Feet of Runoff by dividing Q by 12 and multiplying the result by the New Impervious Area (Box 1)

(Q (inches) ÷ 12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

Required Storage Volume (cubic feet) = 69

If there is more than ONE type of New Impervious Surface, add up all the calculated values for the Total Required Storage Volume.

Area 1 69 + Area 2 0 = 69 Total Required Storage Volume (Cubic Feet)

3-Month Storm Event Total Required Storage Volume (cubic feet) to Retain: Box 4 [69]

2. **Calculate the 10-Year Storm Event Required Storage Volume for the All Post Construction Impervious Surfaces**

The Surface Cover Type and Curve Number (CN) are the SAME as for the 3-Month Calculation

S = Box 3 $\boxed{0.2}$

Solve for Q

0.2

$$Q = \frac{(5.1 - 0.2S)^2}{(5.1 + 0.8S)}$$

0.2

Where:
Q = runoff (inches)
P = rainfall (5.1 inches for 5-Year Event)
S = potential maximum retention after runoff begins (inches)

Q = 4.9 Inches of Runoff

Convert the Inches of Runoff (Q) to Cubic Feet of Runoff by dividing Q by 12 and multiplying the result by the New Impervious Area (Box 1)

Q (inches) ÷ 12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

Required Storage Volume (cubic feet) = 325

If there is more than ONE type of New Impervious Surface, add up all the calculated values for the Total Required Storage Volume.

Area 1 325 + Area 2 0 (etc.) = 325 Total Required Storage Volume (Cubic Feet)

10-Year Storm Event Total Required Storage Volume (cubic feet) to Retain: $\boxed{325}$

3. **Calculate the 10-Year Storm Event Runoff Volume for Pre-Existing Surfaces**

This calculation is made using the same footprint used in the Proposed Conditions. These surfaces are to be removed, disturbed and/or altered during the proposed construction.

Describe the Cover Type of the Existing Surface(s) CONCRETE PATIO + GREENSPACE
(Rooftop, concrete or asphalt driveway, semi-pervious surfaces, green space)

Determine Curve Number (CN) for Existing Surfaces : CN 98 (PATIO) // 75 (GREEN SPACE)
(go to Sec. 3 (methodology) for CN values)

Calculate the Runoff Volume for the Existing Conditions; Do this calculation for each type of different cover type that comprises the same footprint as the New Impervious Area.

Solve for S (potential maximum retention after runoff begins, unit less value)

$S = \frac{1000}{CN} - 10$ S = 0.2 (PATIO) 3.3 (GREEN SPACE)

Now Solve for Q

$$Q = \frac{(5.1 - 0.2S)^2}{(5.1 + 0.8S)}$$

Where:
Q = runoff (inches)
P = rainfall (5.1 inches for 5-Year Event)
S = potential maximum retention after runoff begins (inches)

Q = PATIO - 4.9 GREEN - 2.5 Inches of Runoff

Convert the Inches of Runoff (Q) to Cubic Feet of Runoff by dividing Q by 12 and multiplying the result by the New Impervious Area (Box 1)

Q (inches) ÷12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

Existing Conditions Runoff Volume (cubic feet) = PATIO 120 // GREEN SPACE 107

If there is more than ONE type of Existing Surface, ADD UP all the calculated values for the Total Existing Conditions Runoff Volume.

Area 1 120 cf + Area 2 107 cf = 227 Total Required Storage Volume (Cubic Feet)

10-Year Storm Event Total Runoff Volume for Existing Conditions (cubic feet):

Box 6 | 227

4. Calculate the Required Storage Volume to Retain for the Proposed Project

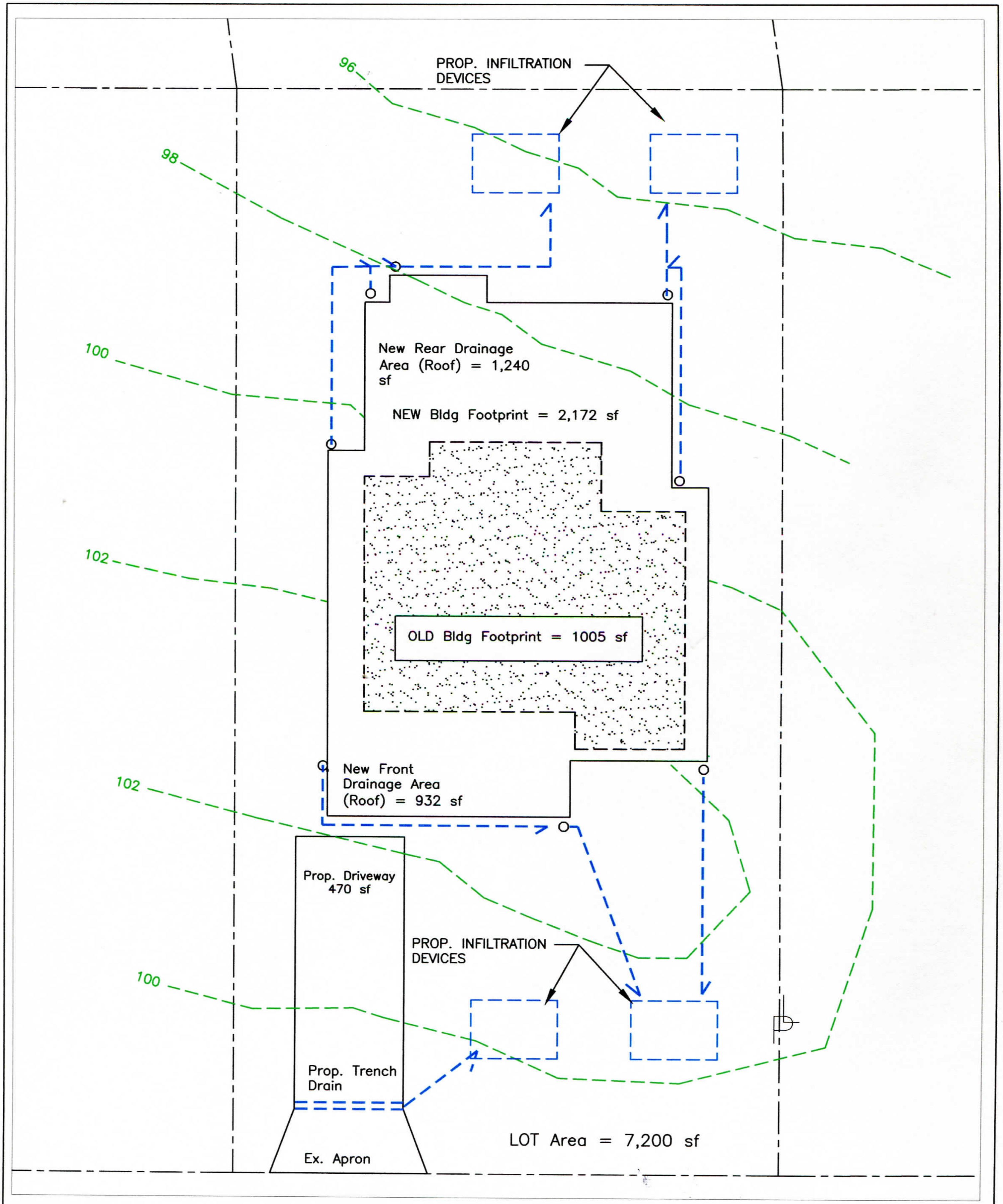
Determine the INCREASE in runoff for the 10-Year Storm event by Subtracting the Existing 10-Year Runoff (Box 6).from Proposed 10-Year Runoff (Box 5)

Increase in 10-Year Storm Event Runoff = Box 7 | 98

COMPARE the Values in Box 4 and Box 7. The LARGER value is the Required Storage Volume to Retain for the Proposed Project.

69 vs 98

Box 8 | 98



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

TYPICAL NEW HOME

Town of Chevy Chase
4301 Willow Lane
Chevy Chase, MD 20815

301-654-7144 (phone)
301-718-9631 (fax)
townoffice@townofchevychase.org

Town Permit No.: ____________

1. Calculate the 3-Month Storm Event Required Storage Volume for the New Impervious Surface

Enter the Total Square Foot AREA of the New Impervious Surface: Box 1 | 2,642 |

Describe the Cover Type of the New Impervious Surface: ROOF (2,172 SF) + DRIVEWAY (470)

(Rooftop, concrete or asphalt driveway, semi-pervious surfaces)

Determine Curve Number (CN) for New Impervious Surface: Box 2 | 98 |

(go to Sec. III (Methodology) in Water Drainage Users' Guide for CN values)

Calculate the Required Storage Volume to Retain; Do this calculation for each different cover type that comprises all of the New Impervious Area.

Solve for S (potential maximum retention after runoff begins, unit less value)

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

S = Box 3 | 0.2 |

Now Solve for Q:

0.2

$$Q = \frac{(1.25 - 0.2S)^2}{(1.25 + 0.8S)}$$

0.2

Where:
Q = runoff (inches)
P = rainfall (1.25 inches for 3-Month Event)
S = potential maximum retention after runoff begins (inches)

Q = 1.0 Inches of Runoff

Convert the Inches of Runoff (Q) to Cubic Feet of Runoff by dividing Q by 12 and multiplying the result by the New Impervious Area (Box 1)

(Q (inches) ÷ 12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

Required Storage Volume (cubic feet) = 228

If there is more than ONE type of New Impervious Surface, add up all the calculated values for the Total Required Storage Volume.

Area 1 228 + Area 2 ________ = 228 Total Required Storage Volume (Cubic Feet)

3-Month Storm Event Total Required Storage Volume (cubic feet) to Retain: Box 4 | 228 |

2. Calculate the 10-Year Storm Event Required Storage Volume for the All Post Construction Impervious Surfaces

The Surface Cover Type and Curve Number (CN) are the SAME as for the 3-Month Calculation

S = Box 3 $\boxed{0.2}$

Solve for Q

0.2

$$Q = \frac{(5.1 - 0.2S)^2}{(5.1 + 0.8S)}$$

0.2

Where:
Q = runoff (inches)
P = rainfall (5.1 inches for 5-Year Event)
S = potential maximum retention after runoff begins (inches)

Q = 4.9 Inches of Runoff

Convert the Inches of Runoff (Q) to Cubic Feet of Runoff by dividing Q by 12 and multiplying the result by the New Impervious Area (Box 1)

Q (inches) ÷ 12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

Required Storage Volume (cubic feet) = 1,071

If there is more than ONE type of New Impervious Surface, add up all the calculated values for the Total Required Storage Volume.

Area 1 1,071 + Area 2 ________(etc.) = 1,071 Total Required Storage Volume (Cubic Feet)

10-Year Storm Event Total Required Storage Volume (cubic feet) to Retain: $\boxed{1,071}$

3. Calculate the 10-Year Storm Event Runoff Volume for Pre-Existing Surfaces

This calculation is made using the same footprint used in the Proposed Conditions. These surfaces are to be removed, disturbed and/or altered during the proposed construction.

Describe the Cover Type of the Existing Surface(s) ROOFTOP (1,005) + GREEN SPACE (1,637 *)
(Rooftop, concrete or asphalt driveway, semi-pervious surfaces, green space)

Determine Curve Number (CN) for Existing Surfaces : CN 98 ROOF
(go to Sec. 3 (methodology) for CN values) 75 GREEN SPACE

NEW
2,642
- 1,005
* 1,637 SF

Calculate the Runoff Volume for the Existing Conditions; Do this calculation for each type of different cover type that comprises the same footprint as the New Impervious Area.

Solve for S (potential maximum retention after runoff begins, unit less value)

$S = \frac{1000}{CN} - 10$ S = 0.2 ROOF / 3.3 GREEN SPACE

Now Solve for Q

$$Q = \frac{(5.1 - 0.2S)^2}{(5.1 + 0.8S)}$$

Where:
Q = runoff (inches)
P = rainfall (5.1 inches for 5-Year Event)
S = potential maximum retention after runoff begins (inches)

Q = ROOF 4.9 IN | GREEN SPACE 2.5 IN Inches of Runoff

Convert the Inches of Runoff (Q) to Cubic Feet of Runoff by dividing Q by 12 and multiplying the result by the New Impervious Area (Box 1)

Q (inches) ÷12) x Impervious area (square feet) = Required Storage Volume (cubic feet)

Existing Conditions Runoff Volume (cubic feet) = ROOF 407 / GREEN SPACE 345

If there is more than ONE type of Existing Surface, ADD UP all the calculated values for the Total Existing Conditions Runoff Volume.

Area 1 407 cf + Area 2 345 cf = 752 Total Required Storage Volume (Cubic Feet) (ROOF) (GREEN SPACE)

10-Year Storm Event Total Runoff Volume for Existing Conditions (cubic feet):

Box 6 | 752 |

4. Calculate the Required Storage Volume to Retain for the Proposed Project

Determine the INCREASE in runoff for the 10-Year Storm event by Subtracting the Existing 10-Year Runoff (Box 6).from Proposed 10-Year Runoff (Box 5)

Increase in 10-Year Storm Event Runoff = Box 7 | 318 |

COMPARE the Values in Box 4 and Box 7. The LARGER value is the Required Storage Volume to Retain for the Proposed Project.

228 VS. 318 Box 8 | 318 |

V. <u>Infiltration Testing Requirement</u>

Once the volume of water required to be infiltrated is determined (design volume), a test must be done to confirm that the soil percolates. Testing must be conducted by a qualified professional. This professional shall either be a registered professional engineer, soil scientist or geologist and must be licensed in the State of Maryland.

The soil test should ensure that neither the groundwater table nor solid bedrock is located within four feet of the bottom of a proposed infiltration tank. This test can be done either by digging a test pit or by boring a hole (refer to standards listed in the Design Manual). The Town's Urban Forest Ordinance applies for this testing; therefore, trees must be protected. Please consult with the Town if you have questions about what locations on your property are acceptable for testing.

VI. Options for Water Infiltration

The Ordinance requires a certain volume of stormwater runoff (measured in cubic feet of water) to be retained on-site. Stormwater runoff cannot be retained with surface ponds. Bioretention cells are reviewed on a case-by-case basis and may be approved at the discretion of the Town Engineer.

The most effective method to safely convey and control stormwater runoff for medium density residential projects is to capture the runoff and direct it toward an infiltration device known as a drywell. A drywell is an underground structure that disposes of unwanted stormwater runoff, by dissipating it into the ground through infiltration. It is a passive structure through which water flows under the influence of gravity. The captured runoff discharges through a number of small exit openings distributed over a large surface area along the sides and bottom of the drywell. The internal composition of a drywell contains airspace that can accept an initial inrush of water very quickly, until the air is displaced. After that, the drywell only can accept water as fast as it can dissipate it through infiltration. Water is typically directed into a drywell directly from the roof via downspouts, or from at-grade improvements through the use of trench drains.

1. Gravel Devices

The gravel filled drywell is by far the simplest type and has been in use throughout the history of modern man. An open trench is backfilled with clean angular gravel that, by-volume, has 60 percent solids (the gravel) and 40 percent air space. This internal composition ratio is known as the porosity of the device, which is a measure of how much capacity is provided to capture the runoff. The gravel media also is used to provide structural support for loads above the trench, and, due to its angular shape, the gravel is virtually non-compactable after placement. Typical gravel sizes include No. 57 blue stone and any other clean angular gravel (not bank run gravel, which is rounded).

A gravel drywell system is easy to design and install and can occupy any shape that can be excavated. During construction, the gravel media is placed inside a filter fabric envelope to prevent surrounding soil from migrating into the void space and thereby decreasing the void ratio that is reserved for surface runoff. Although a gravel drywell is easy to install, they are just as easy to install incorrectly and often suffer from premature sedimentation and clogging as a result of a torn filter fabric or clogging at the inlet location from gutter leaf detritus.

The Town of Chevy Chase does not promote the use of gravel filled drywells due to their short life span and the difficult and costly methods of cleaning a clogged system.

2. Manufactured Devices

Manufactured modular drywell units are usually constructed with post-consumer and post-industrial recycled plastics (e.g. polypropylene) and provide up to 95 percent air space capacity for stormwater runoff collection. The modular units are commercially available at home improvement centers and are manufactured in various shapes and sizes. Most of these units also provide a measure of structural support to vertical loading from the ground surface above; many of these products can be buried underneath residential driveways. These devices can be monitored for sedimentation that decreases the storage volume; they can be easily flushed and pumped to remove excess sediment buildup. Some of the commercially available drywell systems are listed below. This is not a comprehensive list, and the Town can certainly approve the use of a system not found on this list.

- Recharge Chambers™ – typically sold as individual units that are shaped as open-bottomed arches with structural corrugations to withstand loading from above. These units provide the largest volume in a single unit and require clean gravel at the bottom and sides to add storage volume and provide a level substrate to support the structure; cannot be reduced in size for small applications.

- StormTech Chamber™ - a very close competitor to Recharge Chambers™ and similar in shape, although 30% smaller in size.

- Rain Tank™ Module – these are composed of small rectangular boxes that can be stacked together and connected to make larger modules, which offers great design flexibility for differing shapes and storage volumes; cumbersome to install for large applications.

- EcoRain System Tanks – a very close competitor to Rain Tanks and similar in shape, sizes and design flexibility.

- Rain-Store (Rainstore[3]) - modular and stackable shelf-type structures that offer a range of very small to very large configurations; not readily available in the mid-Atlantic region.

- Flo-Well® Vessel – easy to design; durable and long lasting; provides the smallest volume in a single unit; cumbersome to install for large applications.

3. Permeable or Semi-permeable Surfaces

These are paving surfaces that allow a portion of the water landing on them to reach the underlying soil for infiltration. The terms permeable and pervious have the same meaning in the context of the Town's water drainage ordinance but are actually considered as Semi-Permeable for engineering analysis. The permeability (or perviousness) and rate of infiltration for different types of ground covers are directly dependent on the infiltration rates of the aggregates used for the joint and drainage openings, the bedding, base, and subbase materials, and ultimately, the subgrade or native soil matrix that exists on-site. If these systems are designed and installed to the manufacturer's specifications, the Town allows them to act as their own infiltration systems (they will capture and infiltrate whatever water naturally falls on them). There are two restrictions on this: 1) they cannot be installed on slopes greater than 5%, and 2) they cannot accept water directed from downspouts or other impervious surfaces, or perform as an infiltration system for that excess water.

There are generally two types of Semi-Permeable Surfaces: pre-cast concrete pavers and poured-in-place paving systems. Pre-cast pavers are further grouped into Permeable Interlocking

Concrete Pavers (PICP) and Concrete Grid Pavers (CGP). Poured-in-place paving systems include porous concrete and pervious asphalt.

Permeable Interlocking Concrete Pavers – PICPs are concrete block pavers that create voids through open joints or on the corners of the pavers. Photo-analysis is used to determine that open, or void, space is at least nine percent (9%) of the surface area. PICPs are designed to funnel water between blocks into a base layer of washed sand and gravel where water slowly drains away through the soil. The open areas in the paving system provide 20-50% more opportunity for the drainage of water than in the normal impervious paved system. PICPs are available from manufacturers that incorporate the name “Eco-Stone” in their product line.

Concrete Grid Pavers – CGP paving systems are comprised of concrete blocks with voids inside and between the blocks. Photo-analysis is used to determine that open, or void, space is approximately thirty percent (30%) of the surface area. The grid pattern is usually honeycombed or lattice shaped and the voids collect water during rain events. The water then slowly drains into the soil below. The grid pattern is filled with gravel and/or grass to create a visually appealing appearance. If grass is desirable, better growing conditions are encouraged by the addition of soil to the subbase sand and gravel mix. CGPs are available from manufacturers that incorporate the name “Turf Stone” in their product line.

Porous Concrete - In porous concrete, controlled amounts of water and cementitious materials are used to create a paste that forms a thick coating around aggregate particles. A porous concrete mixture contains little or no sand, which thereby creates a substantial void content within the matrix that allow for rapid drainage. Typically, between 15% and 25% of the hardened concrete consists of void or open space. Poured-in-place porous concrete surfaces require similar machinery to standard concrete pavement.

Pervious Asphalt - Poured-in-place pervious asphalt requires the same mixing and application materials and has the same blacktop appearance as traditional impervious asphalt. The formula is different with small stone and fine particulate matter being removed and the quantity of tar reduced. Sealants to waterproof new surfaces are not applied. Pervious asphalt is seldom used in residential applications in the Mid-Atlantic region due to seasonal climate changes.

Each of the types of Semi-Permeable paving surfaces are characterized by their Curve Number, which is used to determine the volume of runoff that develops from the surface. The Curve Number Table, Section III, lists the associated CN values for these types of surfaces.

4. Alternative Methods for Stormwater Management

The most efficient and economical method for handling runoff from new impervious surfaces is through on-site infiltration systems, comprised of underground retention tanks. There are alternative methods for handling runoff that can augment a typical residential infiltration system, such as Rain Barrels and Green Roofs. The Town engineer will allow the use of alternative methods, as long as 1) they are permitted by the Maryland Stormwater Design Manual, 2) overflow is automatically directed into a more traditional infiltration system, and 3) they utilize permanent equipment that is capable of being inspected.

Rain Barrels are water tanks that are used to collect and store rain water runoff, typically from rooftops via rain gutters. A rain barrel is typically used in a residential application to harvest and store runoff for future use. The most readily available barrels are typically 55 gallons in size and are positioned at the bottom of a downspout; almost all have a manual spigot at the bottom of the barrel to allow for gravity drainage into garden hoses that can deliver the harvested water to planting beds or lawns.

The Town's water drainage ordinance does not prohibit the use of rain barrels, but does require very specific installation guidelines if the barrel is to be inter-connected with an infiltration system. In a typical scenario, a rain barrel will be connected to a downspout to collect roof top runoff and will overflow to the home's infiltration system. Careful piping is required so all runoff that is directed to a full rain barrel will be diverted to the home's infiltration system.

If the homeowner decides to install a rain barrel as part of an approved water drainage plan, and wants to include the barrel's volume as part of the required storage volume, then the rain barrel must have an automatic drawdown device that will empty the barrel into the infiltration system within the 24-hour period following a precipitation event. An automatic drawdown device can be a simple low-flow orifice at the barrel's outlet or a spigot that is kept in the open position. An in-line rain barrel that comprises a portion of the required storage volume for infiltration must be able to work without the homeowner's direct involvement (i.e. having to cycle a valve or spigot). All approved infiltration systems must be functional throughout the year and even during periods when the homeowner has traveled away from the home.

Green Roofs are building roofs that are partially or completely covered with vegetation and a growing medium, planted over a waterproof membrane. Also known as "living roofs," green roofs serve several purposes for a building, such as absorbing rainwater, providing insulation, creating a habitat for wildlife, and helping to lower urban air temperatures and combat the heat island effect.

An applicant for a water drainage plan who wishes to include a green roof as part of the design must provide sufficient engineering with the water drainage application that will show the amount of rainwater uptake by the plants (evapotranspiration), the expected infiltration, and resulting runoff as determined by the types and density of plants, the type of planting media used, and the slope of the planted areas. A primary concern in the construction of a green roof is how to collect the remaining runoff and divert that flow into the home's infiltration system.

VII. Installation and Other Technical Specifications

In order to ensure that all systems function as intended, the Town requires that all proprietary systems be installed following the manufacturers recommended guidelines. For all systems that utilize gravel as "void space" for infiltration, the Town requires that the gravel used be clean (washed) and free of sediment when installed. As a general rule, no trees may be planted within five feet of a drywell to ensure that its function is not disrupted. In addition, in order to inspect the system and ensure that it is functioning correctly, the Town requires each drywell to be installed with an observation well. This observation well is a PVC pipe, at least 6 inches in diameter, that is installed to the bottom of the drywell. The observation well should have a screw-type cap to ensure that it is accessible for inspection.

As part of the permitting process, the Town collects a performance bond to ensure that the system is installed as designed and functions correctly. This can either be a cash bond, surety bond, or letter of credit from a bank. Once the system passes its final inspection, this bond is returned. If the system is not installed correctly, the Town may use the bond to pay for corrections to the system.

Other Technical Specifications:

- An infiltration system shall be located at least five (5) feet from any property line, ten (10) feet from any proposed building on the subject property with a basement or cellar foundation, twenty (20) feet from any existing building on any adjoining property with a basement or cellar foundation, and five (5) feet from any existing and proposed building that does not have a basement or cellar foundation.
- Retention and detention open-water ponds shall not be allowed on residential property.
- During development activity, excavated soil used for foundation backfill shall be the only soil stored on the property. The applicant shall cover this soil to prevent migration onto adjacent properties.
- All overflow pipes from containment vessels or other mechanisms that discharge water into the street shall pass under sidewalks and through curbing.
- An infiltration system may not receive runoff until the entire contributory drainage area to the infiltration system has received final stabilization and permission is granted by the Town engineer. An infiltration system shall be installed as late as possible in the sequence of construction.
- All water drainage retention devices must be installed within the applicant's property, and not within adjoining properties, unless a variance is granted by the Water Board

Infiltration on Slopes

The Town has adopted the following technical specifications for at-grade and buried infiltration on slopes:

1. At-Grade Infiltration:

Infiltration devices that receive surface water directly from at-grade sources are called Infiltration Trenches. These devices are not commonly used in residential applications due to the difficulty of construction and high maintenance requirements. Infiltration Trenches are subject to detailed specifications, which can be found in the Montgomery County Maryland Department of Permitting Services (DPS) "E" Documents Water Resources Section on the DPS website; the link is under the Stormwater Management Facility Design Specifications for "Infiltration Trench (INF)."

2. Buried Infiltration:

Buried infiltration systems are called "Drywells" and differ from at-grade systems in that stormwater runoff is conveyed to a buried system by way of buried piping or direct infiltration from constructed pervious surfaces.

Buried drywell systems proposed for installation in the Town may be allowed on slopes greater than 15% based on existing and proposed site conditions, including but not limited to factors such as:

- volume of the proposed drywell
- ability to maintain the drywell in a working capacity
- steepness and length of the slope
- geological conditions
- distance from neighboring properties
- condition of down-grade properties
- results of percolation tests
- proximity and extent of proposed grading and/or fill soils

These systems will be evaluated on a case-by-case basis by the Town Engineer.

VIII. Maintenance Requirements:

The Ordinance requires that the infiltration systems that are installed function in perpetuity. This can typically be achieved through regular maintenance. As part of the permitting process, an applicant (and any trustees if there is a mortgage on the property) must sign a maintenance agreement, that is recorded in the land records and binding on any subsequent owners, requiring the systems to be maintained in a working capacity. The maintenance agreement gives the Town the authority to make repairs to systems that are not functioning correctly and charge the cost of the repair to the current homeowners.

The Town has written maintenance standards for each piece of commonly-used water retention and drainage equipment to ensure that a system continues to function properly (see below). The maintenance schedules submitted with applications should recite the Town standards for each piece of equipment or type of material proposed. These standards will typically cover all installations in the Town; however, the Town Engineer evaluates each application on the specific site conditions that are proposed.

Drywell Systems

Drywell systems require both periodic inspections and maintenance. The drywell is installed with an observation well that should be monitored twice a year and after every large storm event (>0.5 inches). The depth of water in the drywell should be checked each day at the same time for up to 4 days after major storm events. It is recommended that a logbook be maintained showing the depth of water in the drywell at the time of each observation in order to determine the rate at which the system dewaters after a runoff-producing storm event. Recording the depth of the drywell by measuring the distance from the top of the observation well to the bottom of the drywell will assist in determining if sediment is accumulating at the bottom. The Town Engineer will perform as-built and periodic measurements of the depth and record and keep this data at the Town office. During the measurement, it is possible to feel the consistency of the material at the bottom with a steel tape measure. At the initial installation (as-built), the bottom should have a solid and hard feel when the tape measure is contacting the bottom. Any soft or spongy feel with the tape measure indicates debris accumulation and the possibility of a failed system or poor maintenance practices.

Once the performance characteristics of the system have been verified, the Town will perform annual inspections, unless the performance data suggests that a more frequent schedule is required. The goal is to have the drywell empty through infiltration within 72 hours after a major storm event. The Town keeps a record of all systems located in the Town and archives the results of all inspections.

For maintenance, drywell systems should be devoid of sediment or excessive leaves and debris entering the system. Roof gutters and downspouts should be cleared of excess leaves and tree debris in the fall and in the late spring to prevent the accumulation of debris in the drywell.

a) Gravel Drywells

Gravel drywells cannot be flushed and pumped like manufactured drywell systems due to the gravel media which represents 60% percent of the drywell by volume. Standing water, or algal growth on the top of a drywell may indicate failure due to sedimentation in the gravel media. Ponding on the surface above the drywell should generally not occur for long periods (at least 48 hours) following a storm event. Algal growth that is seen in the observation well may also indicate that the system is clogged and not discharging back to the ground through infiltration. Sediment that accumulates at the bottom of the observation well, which can be felt by a steel tape measure, should not exceed 3 inches in depth. If any of these occurrences are observed, the gravel media should be excavated, cleaned and replaced.

b) Manufactured Drywell Systems
Unlike gravel drywells, manufactured drywells are 95% void space in volume and are, therefore, easier to maintain than gravel drywells. Any accumulation of soil or debris that results in a measured decrease of three (3) inches or greater in vertical void space (regardless of the type of product), should initiate a cleaning process. The removal of excessive sediment or debris is accomplished by flushing the system with water to loosen the debris and then pumping it dry to remove the suspended mass.

Permeable or Semi-permeable Surfaces.
The majority of Semi-Permeable pavements function well with little or no maintenance. Maintenance consists primarily of preventing clogging of the void structure. In preparing the site prior to construction, drainage of surrounding landscaping shall be designed to prevent flow of materials onto pavement surfaces. Soil, rocks, leaves, and other debris may infiltrate the voids and hinder the flow of water, decreasing the utility of the pavement. Landscaping materials such as mulch, sand, and topsoil shall not be allowed to accumulate on Semi-Permeable pavements, even temporarily.

Vacuuming shall be performed at the turn of each season and more frequently, as required, to prevent fallen leaves or grass clippings from becoming ground into the surface by foot and vehicular traffic. Other cleaning options may include power blowing and pressure washing. At a minimum, vacuuming and pressure washing must be performed twice per year.

If the Town finds that a permeable or semi-permeable surface is no longer functioning, the homeowner would be required to remove the improvement (pavement or paver), excavate and clean the gravel media used in the sub-base and replace the improvement to the original installation specs.

IX. Town Review and Approval Process

Following the submission of a water drainage plan, the Town distributes a summary of the proposed plan and copies of relevant documents and calculations to all properties adjoining or confronting the subject property. The notice provides a chance for those residents most affected by a water drainage plan to ask questions or provide comments to the Town engineer before a plan is evaluated for approval. The plan is posted on the Town website for at least 30 days. In addition, the Town posts a large sign on the subject property stating that a water drainage plan has been filed and is available for review in the Town office by any resident who is interested.

If necessary, the Town engineer will make himself available in the Town Office or on site to meet with concerned residents. The Town attorney has advised that the engineer's review of a water drainage plan must be based on the strict technical requirements of the ordinance; however, the engineer has been instructed to give due consideration to any comments received from all residents of the Town.

X. Variance Process

If you are trying to design a system and find that it is impossible to meet the requirements of the ordinance, you may apply for a variance. The Town has appointed a Water Drainage Board to hear all variance requests. A Water Drainage Variance Application is available on the Town's web site or in the Town Office.

The Water Drainage Board can only approve the variance if it finds that **all** of the following requirements are met:

- There are engineering difficulties such that strict adherence to the requirements of the Water Drainage Ordinance would result in undue hardship to the applicant;
- The proposed variance would not be detrimental to any adjoining or nearby property, or any public right of way; and;
- The proposed variance would, as nearly as practical, accomplish the intent and purpose of the requirements of the Water Drainage Ordinance.

Because of the strict threshold that the Water Drainage Board must meet in order to approve a variance request, an applicant should look at all alternatives to evaluate whether it is possible to meet the standards of the ordinance.

Once a variance application is filed, the Town staff will schedule a public hearing and send a notice and supporting documents to the Water Drainage Board and all adjacent homes. The variance is heard at a public hearing, where all interested parties are allowed to provide testimony. Written comments also can be introduced into the record. Once a decision is made by the Water Drainage Board, the Town Attorney will draft a written decision reflecting the approval, denial, or approval with conditions of the request. Any party aggrieved by a decision of the Water Drainage Board may appeal within thirty (30) days of the issuance of the decision to the Circuit Court for Montgomery County and thereafter to the appellate courts of the state within the time and manner prescribed within the Maryland Rules of Procedure relating to judicial review of administrative agency decisions.

XI. Appeal Process

Any person (the applicant or any other interested party) who is aggrieved by a decision of the Town Manager to approve or deny an application may file an appeal of the decision to the Water Drainage Board. The appeal must be filed within 30 days of the Manager's decision and must state the reason for the appeal. Similar to a variance, once an appeal is filed, the Town staff will schedule a public hearing and send a notice and supporting documents to the Water Drainage Board and all adjacent homes. The appeal is heard at a public hearing, where all interested parties are allowed to provide testimony. Written comments also can be introduced into the record. Following the public hearing, the Water Board may affirm, reverse or modify the decision of the Town Manager or Town engineer, or may approve a water drainage plan upon such conditions, terms or restrictions as the board may deem necessary, after considering the following factors:

- The evidence presented by the applicant;
- The recommendations of the Town Manager or Town engineer, and the reasons why the Town Manager or Town engineer took the action on which the appeal is based;
- The evidence in support or opposition presented by any interested persons; and
- The extent to which an alternative plan would more efficiently or effectively fulfill the intent of the Water Drainage Ordinance.

Once a decision is made by the Water Drainage Board, the Town Attorney will draft a written decision reflecting the approval, denial, or approval with conditions of the request. Any party aggrieved by a decision of the Water Drainage Board may appeal within thirty (30) days of the issuance of the decision to the Circuit Court for Montgomery County and thereafter to the appellate courts of the state within the time and manner prescribed within the Maryland Rules of Procedure relating to judicial review of administrative agency decisions

XII. Inspection Information

The Ordinance requires that a drainage system be maintained in perpetuity. In order make sure that the system is installed correctly, and continues to function correctly, the Town engineer performs a number of inspections both during and after the installation. During the installation, inspections are done at excavation, placement of the system, hook-up of the downspouts or trench drains, and a final inspection where an as-built certification from the builder is required. Following the engineer's approval of the final inspection, the performance bond that is collected with the application is returned.

The Town Office maintains a record of each drainage system installed in the Town. This file includes the locations of all required components of a drainage system and the results from all inspections. These files are available for review during regular office hours.

After final approval of the system, the Town continues to inspect the systems periodically. Prior to any inspection, the Town delivers a notice to the house advising the occupants of the pending inspection. If any parts of the system are not readily accessible, the Town engineer will coordinate access with the owners at that time.

The Town engineer inspects each system 6 months after installation is complete. During the first six months of operation, large storms will likely have occurred to test the system, so any problems can be identified early and remedied. After the six-month inspection, the Town engineer inspects each system yearly to ensure that they continue to function.

Following an inspection, the Town provides a written report detailing any required maintenance needed to ensure the proper functioning of the system and stating that maintenance must be completed within 30 days.