

**APPENDIX A**  
**OPERATION AND MAINTENANCE AGREEMENT**

**STORM WATER FACILITIES AND BEST MANAGEMENT PRACTICES (BMP) OPERATIONS AND MAINTENANCE (O&M) AGREEMENT AND DECLARATION OF EASEMENT THIS AGREEMENT AND DECLARATION OF EASEMENT** made this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by and between \_\_\_\_\_, of (hereinafter referred to as the “Grantor”) and **Manheim Borough**, Lancaster County, Pennsylvania, a borough duly organized under the laws of the Commonwealth of Pennsylvania, with its municipal office located at 15 East High Street, Manheim, PA 17545 (hereinafter referred to as the “Borough”).

**BACKGROUND**

Grantor is the owner of premises located \_\_\_\_\_, in the Manheim Borough, Lancaster County, Pennsylvania, as more specifically described in a deed recorded in Record Book \_\_\_\_\_, Page \_\_\_\_\_, in the Office of the Recorder of Deeds in and for Lancaster County, Pennsylvania, and as shown on the \_\_\_\_\_, prepared by \_\_\_\_\_, Drawing No. \_\_\_\_\_, dated \_\_\_\_\_, last revised \_\_\_\_\_ (hereinafter referred to as the “Premises”).

Prior to beginning construction on any subdivision or land development, Grantor is required, under the Manheim Borough Subdivision and Land Development Ordinance and the Manheim Borough Storm Water Management Ordinance (collectively referred to as the “Ordinance”), to file a final plan with Manheim Borough Council. Pursuant to the Ordinance, Grantor must provide storm water management data in its application. The Ordinance requires that Grantor’s final plan reflect and/or be accompanied with supporting documentation which identifies the ownership of, and the method of administering and maintaining, all permanent storm water management facilities. Drainage courses, swales, grassed waterways, storm water inlets, pipes, conduits, detention basins, retention basins, infiltration structures, and other storm water management facilities, including Best Management Practices facilities (“BMPs”), shall be included under the term “storm water management facilities” in this Agreement and Declaration of Easement. The purpose of this Agreement and Declaration of Easement is to describe the ownership and maintenance responsibilities for the storm water facilities which will be installed on the Premises and to impose the ownership and maintenance responsibilities upon Grantor, his heirs, personal representatives and assigns and upon successor owners of the Premises, and set forth the rights of the Borough.

NOW, THEREFORE, intending to be legally bound hereby and in consideration of receiving approval of its Subdivision and/or Land Development Plan or its Storm Water Management Site Plan (hereinafter referred to as the “Plan”) from Borough Council, and in consideration of receiving permits from the Borough to develop the Premises, Grantor, for Grantor and the heirs, personal representatives and assigns of Grantor, covenant and declare as follows:

1. The storm water facilities will be owned by Grantor, his heirs, personal representatives, successors and assigns.

2. All drainage courses, swales, storm water inlets, pipes, conduits, detention basins BMPs, and other storm water facilities shall be installed, constructed and maintained by Grantor, his heirs, personal representatives, successors and assigns, in a first-class condition in conformance with the Plan, as approved by Borough Council, including any accompanying storm water management plans and information, and as recorded in the Office of the Recorder of Deeds in and for Lancaster County, and in a manner sufficient to meet or exceed the performance standards and specifications set forth on the Plan, as approved by Borough Council, including any accompanying storm water management plans and information. These responsibilities shall include, but not be limited to, the following:
- (a) Liming, fertilizing, seeding and mulching of vegetated channels and all other unstabilized soils or areas according to the specifications in the “Erosion and Sediment Pollution Control Manual” published by the Pennsylvania Department of Environmental Protection, the Penn State Agronomy Guide, or such similar accepted standard.
  - (b) Reestablishment of vegetation by seeding and mulching or sodding of scoured areas or areas where vegetation has not been successfully established.
  - (c) Mowing as necessary to maintain adequate stands of grass and to control weeds. Chemical weed control may be used if federal, state and local laws and regulations are met. Selection of seed mixtures shall be subject to approval by the Borough.
  - (d) Removal of silt from all permanent structures which trap silt or sediment in order to keep the material from building up in grass waterways, pipes, detention or retention basins, infiltration structures, BMPs, and/or other facilities and thus reducing their capacity.
  - (e) Removal of silt from all permanent drainage structures, in particular BMPs, in order to maintain the design storage volumes. Regular programs shall be established and maintained.
  - (f) Regular inspection of the areas in question to assure proper maintenance and care, including but not limited to proper implementation of BMPs. **ADD ANY SPECIFIC INSPECTION REQUIREMENTS IN THE PCSM PLAN.**
  - (g) Regular maintenance to ensure that all pipes, swales and detention facilities shall be kept free of any debris or other obstruction. **ADD ANY SPECIFIC MAINTENANCE REQUIREMENTS IN THE PCSM PLAN.**
  - (h) Regular maintenance of all facilities designed to improve water quality to insure that such facility function in accordance with their design. **ADD ANY SPECIFIC MAINTENANCE REQUIREMENTS IN THE PCSM PLAN SUCH AS IF APPLICABLE:** Maintenance of the infiltration bed and infiltration system by mowing grass regularly over the infiltration bed; keeping the yard drains and roof drains free of debris in good repair at all times; flushing the infiltration system using a water hose at the cleanouts once every 90 days to ensure the infiltration system is clear of debris; keeping the sumps in the yard inlets and downspout sumps free of debris; and inspecting the infiltration bed four times per year or after each rain event exceeding one inch.
  - (i) Repair of any subsidence, including subsidence caused by sinkholes.
  - (j) **IF APPLICABLE:** Replacement of displaced riprap within the outlet energy dissipater immediately after it is displaced, particularly after major storm discharge events.
  - (k) **IF APPLICABLE:** Vacuum sweeping of areas of porous paving to keep surface free of sediment as needed, typically three to four times per year and maintaining all areas of porous paving free from sealing, surfacing or re-paving with non-porous materials.
  - (l) Removal of trash and debris on a regular basis.

***[Include a statement that the approved Operations and Maintenance (O&M) Plan is attached as an exhibit if there are any requirements in addition to those in Paragraph 2.]***

3. Grantor, his heirs, personal representatives, successors and assigns, shall be responsible for performing the foregoing maintenance.
4. Grantor, for himself, his heirs, personal representatives, successors and assigns, agrees that the failure to maintain all drainage courses, swales, storm water inlets, pipes, conduits, detention basins, BMPs, and other storm water management facilities in a first-class condition in conformance with this Agreement and Plan, as approved by Borough Council, including any accompanying storm water management plans and information, shall constitute a nuisance and shall be abatable by the Borough as such.
5. The Grantor agrees to provide the Borough with an annual written report documenting the following items:
  - (a) Listing of all Post-Construction Storm Water Management (PCSM) Best Management Practices (BMPs) that were installed to meet requirements in NPDES Permits for Storm Water Discharges Associated with Construction Activities approved since March 10, 2003;
  - (b) The exact location of the PCSM BMP (e.g., street address);
  - (c) Information (e.g., name, address, phone number(s)) for BMP owner and entity responsible for BMP Operation and Maintenance (O&M), if different from BMP owner;
  - (d) The type of BMP and the year it was installed;
  - (e) Maintenance required for the BMP type according to the Pennsylvania Storm Water BMP Manual or other manuals and resources;
  - (f) The actual inspection/maintenance activities performed for each BMP during the year;
6. Grantor, for himself, his heirs, personal representatives, successors and assigns, authorizes the Borough, at any time and from time to time, by its authorized representatives, to enter upon the Premises to inspect the storm water facilities. Grantor acknowledges that the Borough has the right to establish a schedule of regular inspections including, but not limited to, annual inspections. If the Borough determines to establish a schedule of inspections of storm water management facilities, Grantor, its successors and assigns, shall reimburse the Borough for the costs of such inspection and/or pay any annual fee for the administration of a Borough storm water management program.
7. The Borough may require that Grantor, and assigns or any future owner or occupier of the Premises or any part thereof, take such corrective measures as the Borough may deem reasonably necessary to bring the Premises into compliance with this Agreement and with the Plan, as approved by Borough Council, including any accompanying storm water management plans and information.
8. Upon the failure of the owner or occupier of the Premises or any part thereof to comply with the terms of this Storm Water Management Agreement or to take corrective measures following reasonable notice from the Borough, the Borough, through its authorized representatives, may take such corrective measures as it deems reasonably necessary to bring the Premises into compliance with this Agreement and with the Plan, as approved by Borough Council, including any accompanying storm water management plans and information, including, but not limited to, the removal of any blockage or obstruction from drainage pipes, swales, detention basins, and BMPs, and may charge the cost thereof to Grantor, his heirs, personal representatives, successors and assigns, or any owner of the Premises or any part thereof and, in default of such payment, may cause a municipal lien to be imposed upon the Premises or any part thereof. Any municipal lien filed pursuant to this Agreement shall be in the amount of all costs incurred by the Borough, plus a penalty of ten (10%) of such costs, plus the Borough's reasonable attorneys' fees.

9. If ownership or maintenance responsibility of the storm water management facilities is assigned to a home owners' association, condominium unit owners' association, or similar entity, the Borough shall be notified. If such association fails to properly maintain the storm water management facilities, the Borough shall have the same rights granted to municipalities under Section 705 of the Pennsylvania Municipalities Planning Code, Act of July 31, 1968, P.L. 805, No. 247, with reference to maintenance of common open space, to maintain the storm water management facilities. Any association so formed shall enter into an agreement with the Borough recognizing its duties and the Borough's rights under this Agreement.
10. Grantor hereby imposes upon the Premises for the benefit of all present and future owners of the Premises or part of the Premises, the Borough, and all other property owners affected by the storm water facilities, the perpetual right, privilege and easement for the draining of storm water in and through the drainage courses, swales, storm water inlets, pipes, conduits, detention basins, BMPs, and other storm water facilities depicted on the plan or plans submitted to the Borough or hereafter made of record and now or hereafter installed on or constructed upon the Premises and, in addition, easements of access to the storm water facilities.
11. Grantor agrees to indemnify the Borough and all of its elected and appointed officials, agents and employees (hereafter collectively referred to as the "Indemnitees") against and hold Indemnitees harmless from any and all liability, loss or damage, including attorneys' fees and costs of investigation and defense, as a result of claims, demands, costs or judgments against Indemnitees which arise as a result of the design, installation, construction or maintenance of the storm water facilities.
12. Grantor's personal liability under this Agreement shall cease at such time as (a) all storm water management facilities have been constructed in accordance with the specifications of the Manheim Borough Subdivision and Land Development Ordinance, the Manheim Borough Storm water Management Ordinance and the approved plans; (b) the storm water management facilities have been inspected and approved by the Borough Engineer; (c) all financial security, including any maintenance security, posted by Grantor has been released by the Borough; and (d) Grantor has transferred the Premises and/or all lots to be created from the Premises to third parties. Notwithstanding the foregoing, Grantor's personal liability shall continue for any violations of this Agreement and Declaration of Easement which occurred during the time that Grantor owned the Premises or any lot created from the Premises or in the event the storm water management facilities were not completed, inspected or approved as set forth in (a) through (c) herein.
13. It is the intent of the parties to this Agreement that personal liability and maintenance obligations shall pass to subsequent title owners upon change in ownership of the Premises or any lot created from the Premises, and such subsequent owners shall assume all personal liability and maintenance obligations for the time period during which they hold title. Personal liability shall remain for any violations of this Agreement and Declaration of Easement which occurred during the period in which an owner held title.
14. The Borough may, in addition to the remedies prescribed herein, proceed with any action at law or in equity to bring about compliance with the Manheim Borough Storm Water Management Ordinance, the Manheim Borough Subdivision and Land Development Ordinance and this Agreement.
15. This Agreement and Declaration of Easement shall be binding upon the Grantor, the successors and assigns of Grantor, and all present and future owners of the Premises or any part thereof and is intended to be recorded in order to give notice to future owners of the Premises of their duties and responsibilities with respect to the storm water facilities. Grantor shall include a specific reference to this Agreement in any deed of conveyance for the Premises or any part thereof.

- 16. This Agreement and Declaration of Easement may be amended only by written instrument signed on behalf of all owners of the Premises and the Borough.
- 17. When the sense so requires, words of any gender used in this Agreement and Declaration of Easement shall be held to include any other gender, and the words in the singular number shall be held to include the plural, and vice versa.

IN WITNESS WHEREOF, the undersigned have caused this Agreement and Declaration to be executed on the day and year first above written.

Manheim Borough  
Lancaster County, Pennsylvania

Attest: \_\_\_\_\_ By: \_\_\_\_\_  
 (Assistant) Secretary (Vice) President Borough Council

[Manheim Borough SEAL]

COMMONWEALTH OF PENNSYLVANIA )  
 ) SS:  
 COUNTY OF LANCASTER )

On this, the \_\_\_\_\_ day of \_\_\_\_\_, A.D., 20\_\_\_\_, before me, the undersigned officer, a Notary Public in and for the aforesaid Commonwealth and County, personally appeared \_\_\_\_\_, who acknowledged \_\_\_self to be (Vice) President of Council of Manheim Borough, Lancaster County, Pennsylvania, and that he/she, as such officer, being authorized to do so, executed the foregoing Storm Water Management Agreement and Declaration of Easement, for the purposes therein contained, by signing the name of such Borough by \_\_\_self as such officer.

IN WITNESS WHEREOF, I set my hand and official seal.

Notary Public: \_\_\_\_\_

My Commission expires: \_\_\_\_\_

**SIGNATURE BLOCKS (Select appropriate Block and sign)**

**(INDIVIDUAL OR HUSBAND AND WIFE DEVELOPER)**

Witness:

\_\_\_\_\_

\_\_\_\_\_(SEAL)  
(Signature of Individual)

\_\_\_\_\_

\_\_\_\_\_(SEAL)  
(Signature of Spouse if Husband and Wife are Co-Developers)

**(PARTNERSHIP DEVELOPER\*)**

\_\_\_\_\_  
(Name of Partnership)

Witness:

\_\_\_\_\_

By \_\_\_\_\_(Seal)

Partner

\_\_\_\_\_

By \_\_\_\_\_(Seal)

Partner

\_\_\_\_\_

By \_\_\_\_\_(Seal)

Partner

\*All Partners must execute the Agreement.

**(CORPORATION DEVELOPER)**

\_\_\_\_\_  
(Name of Corporation)

ATTEST:

By: \_\_\_\_\_  
(Assistant) Secretary

By: \_\_\_\_\_  
(Vice) President

(CORPORATE SEAL)

**(LIMITED LIABILITY COMPANY LANDOWNER\*)**

\_\_\_\_\_  
(Name of Limited Liability Company)

Witness:

\_\_\_\_\_

By \_\_\_\_\_ (Seal)  
Member

\_\_\_\_\_

By \_\_\_\_\_ (Seal)  
Member

\_\_\_\_\_

By \_\_\_\_\_ (Seal)  
Member

\*All Members must sign.

**ACKNOWLEDGEMENTS**

**(ACKNOWLEDGMENT FOR INDIVIDUAL OR HUSBAND AND WIFE DEVELOPER)**

COMMONWEALTH OF PENNSYLVANIA        )  
  )        SS:  
COUNTY OF \_\_\_\_\_ )

On this, the \_\_\_\_ day of \_\_\_\_\_, 20\_\_, before me, the subscriber, a Notary Public, in and for the aforesaid Commonwealth and County, came the above-named \_\_\_\_\_ known to me (or satisfactory proven) to be the person(s) whose name(s) is/are subscribed on the within instrument and acknowledged the foregoing Storm Water Management Agreement and Declaration of Easement to be \_\_\_\_\_ act and deed and desired the same to be recorded as such.

IN WITNESS WHEREOF, I set my hand and official seal.  
Notary Public: \_\_\_\_\_  
My Commission expires: \_\_\_\_\_

**(ACKNOWLEDGMENT FOR CORPORATE DEVELOPER)**

COMMONWEALTH OF PENNSYLVANIA     )  
  )  
  )     SS:  
COUNTY OF \_\_\_\_\_ )

On this, the \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, before me, a Notary Public, personally appeared, the undersigned officer, \_\_\_\_\_ who acknowledged \_\_\_self to be the \_\_\_\_\_ of \_\_\_\_\_, a corporation, and that such officer being authorized to do so, acknowledged the foregoing instrument for the purpose therein contained, by signing the name of the corporation by \_\_\_self as \_\_\_\_\_.

In Witness Whereof, I set my hand and official seal.  
Notary Public: \_\_\_\_\_  
My Commission expires: \_\_\_\_\_

**(ACKNOWLEDGMENT FOR PARTNERSHIP DEVELOPER)**

COMMONWEALTH OF PENNSYLVANIA     )  
  )  
  )     SS:  
COUNTY OF \_\_\_\_\_ )

On this, the \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, before me, a Notary Public, the undersigned officer, personally appeared \_\_\_\_\_ who acknowledged themselves to be all of the partners of \_\_\_\_\_, a \_\_\_\_\_ partnership, and that they, as such partners, being authorized to do so, executed the foregoing instrument for the purposes therein contained, by signing the name of the partnership by themselves as such partners.                         In Witness Whereof, I set my hand and official seal.

Notary Public: \_\_\_\_\_  
My Commission expires: \_\_\_\_\_



**(ACKNOWLEDGMENT FOR LIMITED LIABILITY COMPANY LANDOWNER)**

COMMONWEALTH OF PENNSYLVANIA     )  
  )  
  )     SS:  
  
COUNTY OF \_\_\_\_\_ )

On this, the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, before me, the undersigned officer, personally appeared \_\_\_\_\_ who acknowledged themselves to be all of the members of \_\_\_\_\_, a \_\_\_\_\_ limited liability company, and that they, as such members, being authorized to do so, executed the foregoing instrument for the purposes therein contained, by signing the name of said limited liability company by themselves as such members. In Witness Whereof, I set my hand and official seal.

Notary Public: \_\_\_\_\_  
My Commission expires: \_\_\_\_\_

**(ACKNOWLEDGMENT FOR MORTGAGEE)**

COMMONWEALTH OF PENNSYLVANIA     )  
  )  
  )     SS:  
  
COUNTY OF \_\_\_\_\_ )

On this, the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, before me, a Notary Public, the undersigned officer, personally appeared, \_\_\_\_\_ who acknowledged \_\_\_self to be the \_\_\_\_\_ of \_\_\_\_\_, a corporation, and that such officer being authorized to do so, acknowledged the foregoing instrument for the purpose therein contained, by signing the name of the Bank by \_\_\_self as \_\_\_\_\_.  
In Witness Whereof, I set my hand and official seal.

Notary Public: \_\_\_\_\_  
  
My Commission expires: \_\_\_\_\_

**JOINDER BY MORTGAGEE**

\_\_\_\_\_ (“Mortgagee”), as holder of a certain mortgage on the premises of \_\_\_\_\_ within Manheim Borough, Lancaster County, Pennsylvania, described in the Deed recorded in recorded in/at \_\_\_\_\_, in the Office of the Recorder of Deeds in and for Lancaster County, Pennsylvania, which mortgage, in the amount of \$ \_\_\_\_\_, is dated \_\_\_\_\_ and is recorded or is about to be recorded in the Recorder of Deeds Office in and for Lancaster County, Pennsylvania, as well as any other mortgages which Mortgagee may now or hereafter hold on the Premises (all such mortgages hereinafter collectively referred to as the “Mortgages”), joins in, consents to, and expressly approves the grant of easements and other rights and privileges described in the attached Storm Water Management Agreement and Declaration of Easement (the “Agreement”).

The Mortgagee, for itself, its successors and assigns (which shall include any assignee of the Mortgages and any purchaser of the Premises at a sale in foreclosure of the Mortgages or otherwise), hereby covenants and agrees that the rights and privileges herein granted with respect to the Premises shall not be terminated or disturbed by reason of any foreclosure or other action which may be instituted by the Mortgagee, its successors and assigns, as a result of any default under the Mortgages or the debt instruments that such Mortgages secure. Mortgagee by consenting to the Agreement shall not by virtue of its interest as Mortgagee be deemed to have undertaken any of the obligations of the Grantor under the Agreement, including but not limited to construction, maintenance, inspection or indemnification.

IN WITNESS WHEREOF, Mortgagee hereby joins in the execution of the Agreement as of this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
(Name of Mortgagee)

ATTEST: \_\_\_\_\_ By:  
[SEAL]

## **APPENDIX B LOW IMPACT DEVELOPMENT PRACTICES**

### **LOW IMPACT DEVELOPMENT PRACTICES ALTERNATIVE APPROACHES FOR MANAGING STORM WATER RUNOFF**

Natural hydrologic conditions may be altered radically by poorly planned development practices, such as introducing unneeded impervious surfaces, destroying existing drainage swales, constructing unnecessary storm sewers, and changing local topography. A traditional drainage approach of development has been to remove runoff from a site as quickly as possible and capture it in a detention basin. This approach leads ultimately to the degradation of water quality, as well as expenditure of additional resources for detaining and managing concentrated runoff at some downstream location.

The recommended alternative approach is to promote practices that will minimize post-development runoff rates and volumes, which will minimize needs for artificial conveyance and storage facilities. To simulate predevelopment hydrologic conditions, forced infiltration is often necessary to offset the loss of infiltration by creation of impervious surfaces. The ability of the ground to infiltrate runoff depends upon the soil types and its conditions.

Preserving natural hydrologic conditions requires careful alternative site design considerations. Site design practices include preserving natural drainage features, minimizing impervious surface area, reducing the hydraulic connectivity of impervious surfaces, and protecting natural depression storage. A well-designed site will contain a mix of all those features. The following describes various techniques to achieve the alternative approaches:

1. **Preserving Natural Drainage Features.** Protecting natural drainage features, particularly vegetated drainage swales and channels, is desirable because of their ability to infiltrate and attenuate flows and to filter pollutants. However, this objective is often not accomplished in land development. In fact, commonly held drainage philosophy encourages just the opposite pattern - streets and adjacent storm sewers typically are located in the natural headwater valleys and swales, thereby replacing natural drainage functions with a completely impervious system. As a result, runoff and pollutants generated from impervious surfaces flow directly into storm sewers with no opportunity for attenuation, infiltration, or filtration. Developments designed to fit site topography also minimize the amount of grading on site.
2. **Protecting Natural Depression Storage Areas.** Depressional storage areas have no surface outlet, or drain very slowly following a storm event. They can be commonly seen as ponded areas in farm fields during the wet season or after large runoff events. Traditional development practices eliminate these depressions by filling or draining, thereby obliterating their ability to reduce surface runoff volumes and trap pollutants. The volume and release-rate characteristics of depressions should be protected in the design of the development site. The depressions can be protected by simply avoiding the depression or by incorporating its storage as additional capacity in required detention facilities.
3. **Avoiding Introduction of Impervious Areas.** Careful site planning should consider reducing impervious coverage to the maximum extent possible. Building footprints, sidewalks, driveways, and other features producing impervious surfaces should be evaluated to minimize impacts on runoff.
4. **Reducing the Hydraulic Connectivity of Impervious Surfaces.** Impervious surfaces are significantly less of a problem if they are not directly connected to an impervious conveyance system (such as storm sewer). Two (2) basic ways to reduce hydraulic connectivity are: routing of roof runoff over lawns; and reducing the use of storm sewers. Site grading should promote increasing travel time of

storm water runoff and should help reduce concentration of runoff to a single point in the development.

5. **Routing Roof Runoff Over Lawns.** Roof runoff can be easily routed over lawns in most site designs. The practice discourages direct connections of downspouts to storm sewers or parking lots, The practice also discourages sloping driveways and parking lots to the street. The routing of roof drains and crowning the driveway to allow runoff to discharge to pervious areas is desirable as the pervious area essentially acts as a filter strip.
6. **Reducing the Use of Storm Sewers.** By reducing the use of storm sewers for draining streets, parking lots, and backyards, the potential for accelerating runoff from the development can be greatly reduced. The practice requires greater use of swales and may not be practical for some development sites, especially if there are concerns for areas that do not drain in a "reasonable" time. The practice requires educating local citizens and public works officials, who expect runoff to disappear shortly after a rainfall event.
7. **Reducing Street Widths.** Street widths can be reduced by either eliminating on-street parking or by reducing cartway widths. Municipal planners and traffic designers should encourage narrower neighborhood streets, which ultimately could lower maintenance and maintenance related costs.
8. **Using Permeable Paving Materials.** These materials include permeable interlocking concrete paving blocks or porous bituminous concrete. Such materials should be considered as alternatives to conventional pavement surfaces, especially for low use surfaces such as driveways, overflow parking lots, and emergency access roads.
9. **Reducing Building Setbacks.** Reducing building setbacks reduces driveway and entry walks and is most readily accomplished along low-traffic streets where traffic noise is not a problem.
10. **Constructing Cluster Developments.** Cluster developments can also reduce the amount of impervious area for a given number of lots. The biggest savings is in street length, which also will reduce costs of the development, Cluster development "clusters" the construction activity onto less-sensitive areas without substantially affecting the gross density of development.

In summary, careful consideration of the existing topography and implementation of a combination of the above mentioned techniques may avoid construction of costly storm water control measures. Other benefits include: reduced potential of downstream flooding, reduced water quality degradation of receiving streams and water bodies, enhancement of aesthetics, and reduction of development costs. Beneficial results include: more stable baseflows in receiving streams, improved groundwater recharge, reduced flood flows, reduced pollutant loads, and reduced costs for conveyance and storage.

## APPENDIX C – STORM WATER MANAGEMENT DESIGN CRITERIA

**TABLE C-1 - RATIONAL METHOD RUNOFF COEFFICIENTS**

### Hydrologic Soil Group and Slope Range

Land Use	A			B			C			D		
	0 to 2%	2 to 6%	6+%	0 to 2%	2 to 6%	6+%	0 to 2%	2 to 6%	6+%	0 to 2%	2 to 6%	6+%
Cultivated Land	0.08 <sup>a</sup>	0.13	0.16	0.11	0.15	0.21	0.14	0.19	0.26	0.18	0.23	0.31
	0.14 <sup>b</sup>	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41
Pasture	0.12	0.20	0.30	0.18	0.28	0.37	0.24	0.34	0.44	0.30	0.40	0.50
	0.15	0.25	0.37	0.23	0.34	0.45	0.30	0.42	0.52	0.37	0.50	0.62
Meadow	0.10	0.16	0.25	0.14	0.22	0.30	0.20	0.28	0.36	0.24	0.30	0.40
	0.14	0.22	0.30	0.20	0.28	0.37	0.26	0.35	0.44	0.30	0.40	0.50
Forest	0.05	0.08	0.11	0.08	0.11	0.14	0.10	0.13	0.16	0.12	0.16	0.20
	0.08	0.11	0.14	0.10	0.14	0.18	0.12	0.16	0.20	0.15	0.20	0.25
Residential 1/8 acre	0.25	0.28	0.31	0.27	0.30	0.35	0.30	0.33	0.38	0.33	0.36	0.42
	0.33	0.37	0.40	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
Residential 1/4 acre	0.22	0.26	0.29	0.24	0.29	0.33	0.27	0.31	0.36	0.30	0.34	0.40
	0.30	0.34	0.37	0.33	0.37	0.42	0.36	0.40	0.47	0.38	0.42	0.52
Residential 1/3 acre	0.19	0.23	0.26	0.22	0.26	0.30	0.25	0.29	0.34	0.28	0.32	0.39
	0.28	0.32	0.35	0.30	0.35	0.39	0.33	0.38	0.45	0.36	0.40	0.50
Residential 1/2 acre	0.16	0.20	0.24	0.19	0.23	0.28	0.22	0.27	0.32	0.26	0.30	0.37
	0.25	0.29	0.32	0.28	0.32	0.36	0.31	0.35	0.42	0.34	0.38	0.48
Residential 1 acre	0.14	0.19	0.22	0.17	0.21	0.26	0.20	0.25	0.31	0.24	0.29	0.35
	0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.40	0.31	0.35	0.46
Industrial	0.67	0.68	0.68	0.68	0.68	0.69	0.68	0.69	0.69	0.69	0.69	0.70
	0.85	0.85	0.86	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.71	0.71	0.72	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.89	0.90
Streets	0.70	0.71	0.72	0.71	0.72	0.74	0.72	0.73	0.76	0.73	0.75	0.78
	0.76	0.77	0.79	0.80	0.82	0.84	0.84	0.85	0.89	0.89	0.91	0.95
Open Space	0.05	0.10	0.14	0.08	0.13	0.19	0.12	0.17	0.24	0.16	0.21	0.28
	0.11	0.16	0.20	0.14	0.19	0.26	0.18	0.23	0.32	0.22	0.27	0.39
Parking	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87
	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97

**NOTES:**

<sup>a</sup>Runoff coefficients for storm recurrence intervals less than twenty five (25) years.

<sup>b</sup>Runoff coefficients for storm recurrence intervals of twenty five (25) years or more.

Source: Rawls, W.J., S.L. Long, and R.H. McCuen, 1981. Comparison of Urban Flood Frequency Procedures Preliminary Draft Report prepared for the Soil Conservation Service, Beltsville, Maryland

<b>Runoff Curve Numbers for Cultivated Agricultural Land:</b>						
<b>Cover Description</b>			<b>Curve Numbers for Hydrologic Soil Groups</b>			
<b>Cover Type</b>	<b>Treatment</b>	<b>Hydrologic Condition</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
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
		Poor	64	75	83	85
		Good	55	69	78	83
	C & T	Poor	63	73	80	83
	Good	51	67	76	80	

**TABLE C-2 - RUNOFF CURVE NUMBERS (FROM NRCS (SCS) TR-55)**

<b>Runoff Curve Numbers for Urban Areas</b>					
<b>Cover Description</b>		<b>Curve Numbers for Hydrologic Soil Groups</b>			
<b>Cover Type and Hydrologic Condition</b>	<b>Average Percent Impervious Area</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<i>Fully Developed Urban Areas (Vegetation Established)</i>					
Open Space (lawns, parks, golf courses, etc.):					
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.		98	98	98	98
Streets and Roads:					
Paved: Curbed and Storm Sewers		98	98	98	98
Paved: Open Ditches		83	89	92	93
Gravel		76	85	89	91
Dirt		72	82	87	89
Urban Districts:					
Commercial and Business	85%	89	92	94	95
Industrial	72%	81	88	91	93
Residential Districts by Average Lot Size:					
1/8 Acres or less	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

<b>Runoff Curve Numbers for Other Agricultural Lands</b>					
<b>Cover Description</b>		<b>Curve Numbers for Hydrologic Soil Groups</b>			
<b>Cover Type</b>	<b>Hydrologic Condition</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
Pasture, Grassland, or Range – Continuous Forage for Grazing	Poor	77	86	91	94
	Fair	76	85	90	93
	Good	74	83	88	90
<hr/>					
Meadow – Continuous Grass, Protected from Grazing and Generally Mowed for Hay	--	30	58	71	78
<hr/>					
Brush – Brush, Weed, Grass Mixture with brush the major element	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30	48	65	73
<hr/>					
Woods – Grass Combination (orchard or tree farm)	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
<hr/>					
Woods	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77
<hr/>					
Farmsteads – Buildings, Lanes, Driveways and Surrounding Lots.	--	59	74	82	86

**TABLE C-3 - MANNING'S EQUATION "n" ROUGHNESS COEFFICIENTS**

<b>Description</b>	<b>Manning's "n"<sup>1</sup></b>
Smooth-Wall Plastic Pipe	0.011
Concrete Pipe	0.012
Smooth-Lined Corrugated Metal Pipe	0.012
Corrugated Plastic Pipe	0.024
Annular Corrugated Steel And Aluminum Alloy Pipe (Plain or Polymer Coated)	
68 mm x 13 mm (2 2/3 in x 1/2 in) Corrugations	0.024
75 mm x 25 mm (3 in x 1 in) Corrugations	0.027
125 mm x 25 mm (5 in x 1 in) Corrugations	0.025
150 mm x 50 mm (6 in x 2 in) Corrugations	0.033



Helically Corrugated Steel And Aluminum Alloy Pipe (Plain or Polymer Coated)	
75 mm x 25 mm (3 in x 1 in), 125 mm x 25 mm (5 in x 1 in), or 150 mm x 50 mm (6 in x 2 in) Corrugations	0.024
Helically Corrugated Steel And Aluminum Alloy Pipe (Plain or Polymer Coated)	
68 mm x 13 mm (2 2/3 in x 1/2 in) Corrugations	
a. Lower Coefficients*	
450 mm (18 in) Diameter	0.014
600 mm (24 in) Diameter	0.016
900 mm (36 in) Diameter	0.019
1200 mm (48 in) Diameter	0.020
1500 mm (60 in) Diameter or larger	0.021
b. Higher Coefficients**	0.024
Annular or Helically Corrugated Steel or Aluminum Alloy Pipe Arches or Other Non- Circular Metal Conduit (Plain or Polymer Coated)	0.024
Vitrified Clay Pipe	0.012
Ductile Iron Pipe	0.013
Asphalt Pavement	0.015
Concrete Pavement	0.014
Grass Medians	0.050
Grass - Residential	0.030
Earth	0.020
Gravel	0.030
Rock	0.035
Cultivated Areas	0.030 - 0.050
Dense Brush	0.070 - 0.140
Heavy Timber (Little undergrowth)	0.100 - 0.150
Heavy Timber (with underbrush)	0.40
Streams:	
Some Grass And Weeds (Little or no brush)	0.030 - 0.035
Dense Growth of Weeds	0.035 - 0.050
Some Weeds (Heavy brush on banks)	0.050 - 0.070

Notes:

\* Use the lower coefficient if any one (1) of the following conditions apply:

- a. A storm pipe longer than twenty (20) diameters, which directly or indirectly connects to an inlet or manhole, located in swales adjacent to shoulders in cut areas, shoulders in cut areas or depressed medians.
- b. A storm pipe which is specially designed to perform under pressure.

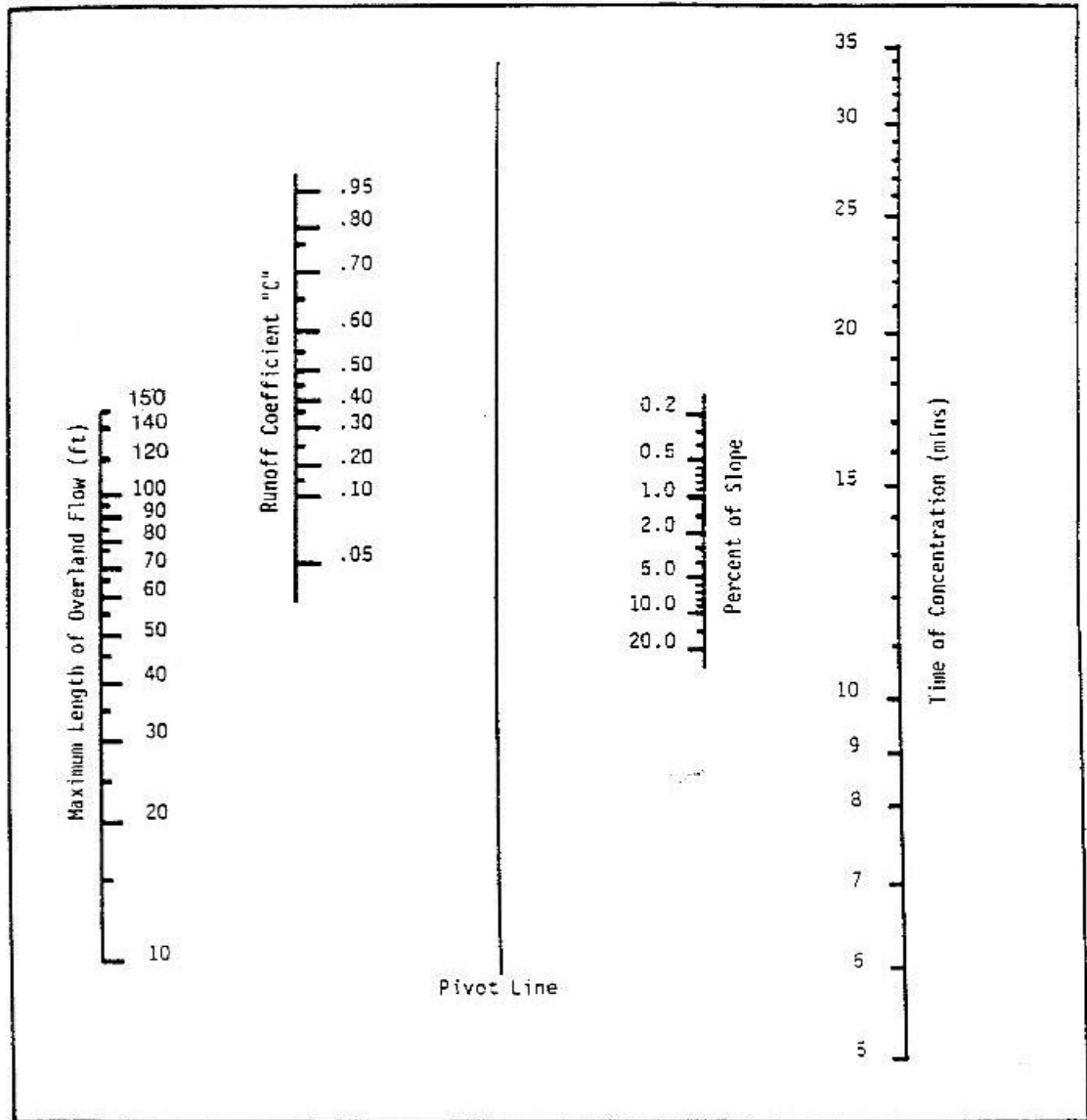
\*\* Use the higher coefficient if any one (1) of the following conditions apply:

- a. A storm pipe which directly or indirectly connects to an inlet or manhole located in highway pavement sections or adjacent to curb or concrete median barrier.
- b. A storm pipe which is shorter than twenty (20) diameters long.
- c. A storm pipe which is partly lined helically corrugated metal pipe.

APPENDIX C-4

NOMOGRAPH FOR DETERMINING SHEET FLOW

(for use with the Rational Method)



**APPENDIX C-5**

**Worksheet #1: Time of concentration (T<sub>c</sub>) or travel time (T<sub>t</sub>)**

Project \_\_\_\_\_ By \_\_\_\_\_ Date \_\_\_\_\_

Location \_\_\_\_\_ Checked \_\_\_\_\_ Date \_\_\_\_\_

Circle one: Present    Developed \_\_\_\_\_

Circle 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 coeff., n (table 3-1) . . . . .				
3. Flow length, L (total L ≤ **150 ft). . . . . ft				
4. Two-yr 24-hr 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		+		= <input type="text"/>

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		+		= <input type="text"/>

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 coeff., n . . . . .				
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V . . . . . ft/s				
18. Flow length, L. . . . . ft				
19. $T_t = \frac{L}{3600V}$ Compute T <sub>t</sub> . . . . . hr		+		= <input type="text"/>
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				<input type="text"/>

\*Table 3-1 per latest TR-55, Urban Hydrology for Small Watershed  
 \*\*150' sheet flow length per latest TR-55 revision

APPENDIX C-6

AVERAGE VELOCITIES FOR ESTIMATING TRAVEL TIME FOR SHALLOW CONCENTRATED FLOW

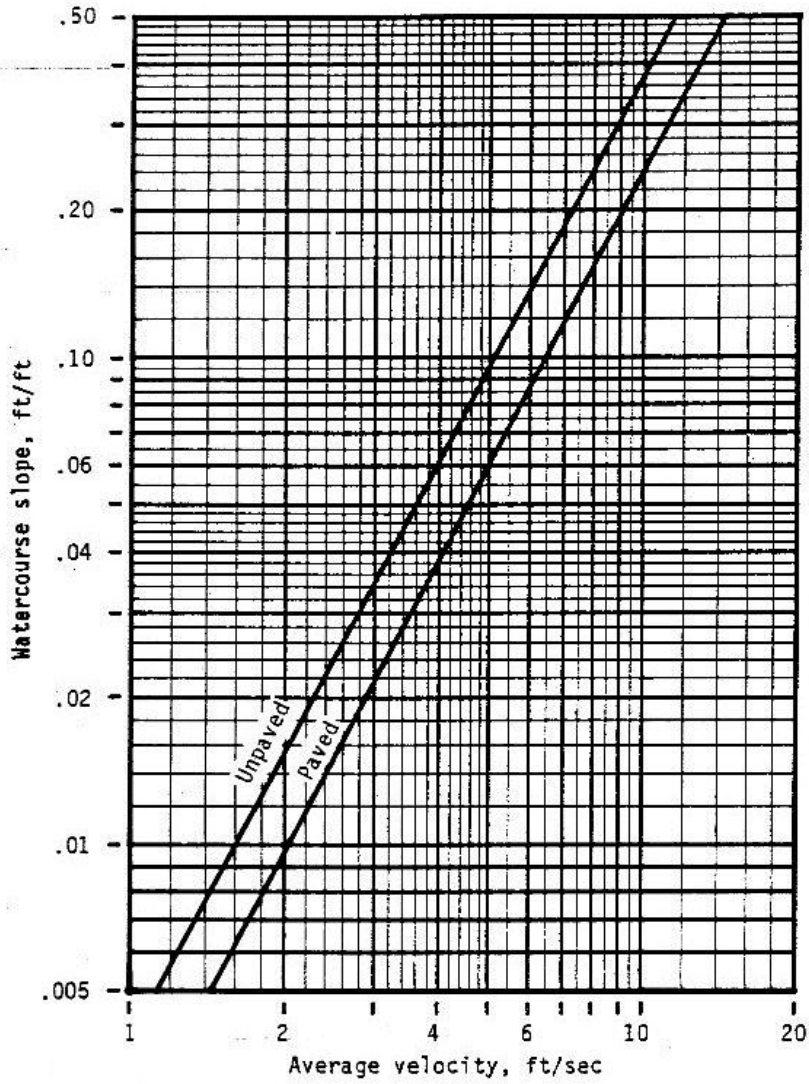


Figure 3-1.—Average velocities for estimating travel time for shallow concentrated flow.

**APPENDIX D**

**Carbonate Geology Certification**

The following note shall be attached to all Storm Water Management Site Plans and signed and sealed by the developer's qualified professional, "I, \_\_\_\_\_, certify that the proposed detention basin is/is not (*circle one*) underlain by carbonate geology."

**APPENDIX E**

**Manheim Borough Storm Water Management Site Plan Approval Certification**

At a meeting on \_\_\_\_\_, 20\_\_\_\_, the Council approved this project, and all conditions have been met. This approval includes the complete set of plans and information that are filed with the Borough in File No. \_\_\_\_\_, based upon its conformity with the standards of the Manheim Borough Storm Water Management Ordinance.

\_\_\_\_\_  
Council Signature                  Council Signature

**APPENDIX F**

**Manheim Borough Engineer Review Certificate**

Reviewed by the Manheim Borough Engineer this \_\_\_\_\_ day of \_\_\_\_\_, 20 .

\* \_\_\_\_\_

\* Signature of the Manheim Borough Engineer.

**APPENDIX G**

**Landowner Acknowledgement of Permanence of BMPs**

I, the undersigned hereby represent that no person shall modify, remove, fill, landscape, or alter any Storm Water Management BMPs, facilities, areas, or structures without the written approval of **Manheim Borough**.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Owner or Owner's agent