

Appendix A
Low Impact Development Practices

ALTERNATIVE APPROACH FOR MANAGING
STORMWATER 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 pre-development 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 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 approach:

- A. 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 minimizes the amount of grading on site.
- B. 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.
- C. 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.

- D. 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 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 stormwater runoff, and should help reduce concentration of runoff to a single point in the development.
- E. 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. By routing roof drains and crowning the driveway to run off to the lawn, the lawn is essentially used as a filter strip.
- F. Reducing the Use of Storm Sewers. By reducing use of storm sewers for draining streets, parking lots, and back yards, 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.
- G. Reducing Street Widths. Street widths can be reduced by either eliminating on-street parking or by reducing roadway widths. Municipal planners and traffic designers should encourage narrower neighborhood streets which ultimately could lower maintenance.
- H. Limiting Sidewalks to One Side of the Street. A sidewalk on one side of the street may suffice in low-traffic neighborhoods. The lost sidewalk could be replaced with bicycle/recreational trails that follow back-of-lot lines. Where appropriate, backyard trails should be constructed using pervious materials.
- I. 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.
- J. 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.
- K. 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.
- L. In summary, a careful consideration of the existing topography and implementation of a combination of the above-mentioned techniques may avoid construction of costly stormwater control measures. Other benefits include reduced potential of downstream flooding, water quality degradation of receiving streams/water bodies and 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 B
Stormwater Best Management Practices

Operations and Maintenance Agreements

THIS AGREEMENT, made and entered into this ____ day of _____, 20____, by and between _____, (hereinafter the “Landowner”), and _____ County, Pennsylvania, (hereinafter “Municipality”);

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property as recorded by deed in the land records of _____ County, Pennsylvania, Deed Book _____ at page _____, (hereinafter “Property”).

WHEREAS, the Landowner is proceeding to build and develop the Property; and

WHEREAS, the SWM BMP Operation and Maintenance (O&M) Plan approved by the Municipality (hereinafter referred to as the “O&M Plan”) for the property identified herein, which is attached hereto as Appendix A and made part hereof, as approved by the Municipality, provides for management of stormwater within the confines of the Property through the use of BMPs; and

WHEREAS, the Municipality, and the Landowner, his successors and assigns, agree that the health, safety, and welfare of the residents of the Municipality and the protection and maintenance of water quality require that on-site SWM BMPs be constructed and maintained on the Property; and

WHEREAS, the Municipality requires, through the implementation of the SWM Site Plan, that SWM BMPs as required by said SWM Site Plan and the Municipal Stormwater Management Ordinance be constructed and adequately operated and maintained by the Landowner, successors, and assigns.

NOW, THEREFORE, in consideration of the foregoing promises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

1. The Landowner shall construct the BMPs in accordance with the plans and specifications identified in the SWM Site Plan.
2. The Landowner shall operate and maintain the BMPs as shown on the SWM Plan in good working order in accordance with the specific operation and maintenance requirements noted on the approved O&M Plan.
3. The Landowner hereby grants permission to the Municipality, its authorized agents and employees, to enter upon the property, at reasonable times and upon presentation of proper credentials, to inspect the BMPs whenever necessary. Whenever possible, the Municipality shall notify the Landowner prior to entering the property.
4. In the event the Landowner fails to operate and maintain the BMPs per paragraph 2, the Municipality or its representatives may enter upon the Property and take whatever action is deemed necessary to maintain said BMP(s). It is expressly understood and agreed that the

Municipality is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Municipality.

- 5. In the event the Municipality, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses (direct and indirect) incurred within 10 days of receipt of invoice from the Municipality.
- 6. The intent and purpose of this Agreement is to ensure the proper maintenance of the onsite BMPs by the Landowner; provided, however, that this Agreement shall not be deemed to create or affect any additional liability of any party for damage alleged to result from or be caused by stormwater runoff.
- 7. The Landowner, its executors, administrators, assigns, and other successors in interests, shall release the Municipality from all damages, accidents, casualties, occurrences, or claims which might arise or be asserted against said employees and representatives from the construction, presence, existence, or maintenance of the BMP(s) by the Landowner or Municipality.
- 8. The Municipality intends to inspect the BMPs at a minimum of once every three years to ensure their continued functioning.

This Agreement shall be recorded at the Office of the Recorder of Deeds of _____

County, Pennsylvania, and shall constitute a covenant running with the Property and/or equitable servitude, and shall be binding on the Landowner, his administrators, executors, assigns, heirs, and any other successors in interests, in perpetuity.

ATTEST:

WITNESS the following signatures and seals:

(SEAL)

For the Municipality:

For the Landowner:

ATTEST:

_____ (City, Borough, Township)

County of _____, Pennsylvania

I, _____, a Notary Public in and for the county and state aforesaid, whose commission expires on the _____ day of _____, 20____, do hereby certify that _____ whose name(s) is/are signed to the foregoing Agreement bearing date of the _____ day _____, 20____, has acknowledged the same before me in my said county and state.

GIVEN UNDER MY HAND THIS _____ day of _____, 20____.

NOTARY PUBLIC

(SEAL)

Appendix C
Pollutant Loads from Specific Land Use

Worksheet 11 – BMPs for Pollution Prevention		
<p>Does the site design incorporate the following BMPs to address nitrate pollution? A summary “yes” rating is achieved if at least 2 Primary BMPs are provided across the site. “Provided across the site” is taken to mean that the specifications for that BMP set forward in Chapters 5 and 6 are satisfied.</p>		
	Yes	No
BMPs for Pollution Prevention:	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.4.1 – Protect Sensitive/Special Value Features	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.4.2 – Protect/Conserve/Enhance Riparian Buffers	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.4.3 – Protect/Utilize Natural Flow Pathways in Overall Stormwater Planning and Design	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.5.1 – Cluster Uses at Each Site; Build on the Smallest Area Possible	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.1 – Minimize Total Disturbed Area - Grading	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.2 – Minimize Soil Compaction in Disturbed Areas	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.3 – Re-Vegetate/Re-Forest Disturbed Areas (Native Species)	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.7.1 – Reduce Street Imperviousness	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.7.2 – Reduce Parking Imperviousness	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.8.1 – Rooftop Disconnection	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.8.2 – Disconnection from Storm Sewers	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.9.15 – Street Sweeping	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.1 – Riparian Buffer Restoration	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.2 – Landscape Restoration	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.3 – Soils Amendment and Restoration	<input type="checkbox"/>	<input type="checkbox"/>

Worksheet 12 – Water Quality Analysis of Pollutant Loading from All Disturbed Areas

Total Site Area (AC)	
Total Disturbed Area (AC)	
Disturbed Area Controlled by BMPs (AC)	

Total Disturbed Areas:

	Land Cover Classification	Pollutant			Cover (Acres)	Runoff Volume (AF)	Pollutant Load		
		TSS EMC (mg/l)	TP EMC (mg/l)	Nitrate-Nitrite EMC (mg/l as N)			TSS** (LBS)	TP** (LBS)	NO ₃ (LBS)
Pervious Surfaces	Forest	39	0.15	0.17					
	Meadow	47	0.19	0.3					
	Fertilized Planting Area	55	1.34	0.73					
	Native Planting Area	55	0.40	0.33					
	Lawn, Low-Input	180	0.40	0.44					
	Lawn, High-Input	180	2.22	1.46					
	Golf Course Fairway/Green	305	1.07	1.84					
	Grassed Athletic Field	200	1.07	1.01					
Impervious Surfaces	Rooftop	21	0.13	0.32					
	High Traffic Street/Highway	261	0.40	0.83					
	Medium Traffic Street	113	0.33	0.58					
	Low Traffic/Residential Street	86	0.36	0.47					
	Res. Driveway, Play Courts, etc.	60	0.46	0.47					
	High Traffic Parking Lot	120	0.39	0.60					
	Low Traffic Parking Lot	58	0.15	0.39					
TOTAL LOAD									
REQUIRED REDUCTION (%)							85%	85%	50%
REQUIRED REDUCTION (LBS)									

*Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

**TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

Worksheet 13 – Pollutant Reduction Through BMP Applications*

*Fill this worksheet out for each BMP type with different pollutant removal efficiencies. Sum pollutant reduction achieved for all BMP types on final sheet.

BMP Type: _____

Disturbed Area Controlled by this BMPs
(AC)

Disturbed Area Controlled by this BMPs:

	Land Cover Classification	Pollutant			Cover (Acres)	Runoff Volume (AF)	Pollutant Load**		
		TSS EMC (mg/l)	TP EMC (mg/l)	Nitrate-Nitrite EMC (mg/l as N)			TSS** (LBS)	TP** (LBS)	NO ₃ (LBS)
Pervious Surfaces	Forest	39	0.15	0.17					
	Meadow	47	0.19	0.3					
	Fertilized Planting Area	55	1.34	0.73					
	Native Planting Area	55	0.40	0.33					
	Lawn, Low-Input	180	0.40	0.44					
	Lawn, High-Input	180	2.22	1.46					
	Golf Course Fairway/Green	305	1.07	1.84					
	Grassed Athletic Field	200	1.07	1.01					
Impervious Surfaces	Rooftop	21	0.13	0.32					
	High Traffic Street/Highway	261	0.40	0.83					
	Medium Traffic Street	113	0.33	0.58					
	Low Traffic/Residential Street	86	0.36	0.47					
	Res. Driveway, Play Courts, etc.	60	0.46	0.47					
	High Traffic Parking Lot	120	0.39	0.60					
	Low Traffic Parking Lot	58	0.15	0.39					
TOTAL LOAD TO THIS BMP TYPE									
POLLUTANT REMOVAL EFFICIENCIES FROM APPENDIX A. STORMWATER MANUAL (%)									
POLLUTANT REDUCITON ACHIEVED BY THIS BMP TYPE (LBS)									
POLLUTANT REDUCTION ACHIEVED BY ALL BMP TYPES (LBS)									
REQUIRED REDUCTION from WS12 (LBS)									

*Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

**TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

APPENDIX D

Standard Schedule for Maintenance of Stormwater Management Facilities

The Stormwater Management Plan developed for the Project is supplemented by this Maintenance Plan to help ensure continuing operations of all stormwater facilities.

The following is a list of items that shall be inspected and corrective action taken by the Owner:

Note: Owner refers to individual ultimately responsible for storm facility condition and function.

1. Outlet conditions in Detention Facility.
2. Storm sewer, swales, concrete gutters and other conveyance devices.
3. Catch Basins, Manholes and other stormwater catchment/transition structures.
4. Access for maintenance.

The following actions will be taken by the Owner to help ensure the facilities shown on the plan and identified above are in working order:

1. Replace or repair facilities so as to function as intended.
2. Remove silt debris and trash in catch basin/storm sewers.
3. Repair outlet structures.
4. Remove any silt, debris and trash in Detention Facility.
5. Disposal of collected silt, debris and trash in a manner which will not adversely affect the environment.
6. Replace eroded material and re-vegetate eroded areas. Seed and mulch disturbed areas.

The corrective actions to be taken are not limited to those listed above.

Stormwater Facilities Maintenance Plan

The inspection shall be undertaken by a minimum of two (2) persons at least two (2) times per year on or before March 1st and October 1st. Additional inspections will be required if it becomes apparent facilities are not functioning properly. Corrective actions will then be taken within thirty (30) days of the discovery of the deficiencies as required to help ensure continuing operation of stormwater facilities. Any deficiencies noted in items inspected by the Owner shall be documented and corrective actions taken by the Owner. This recommended Maintenance Plan shall not be considered a guarantee as to the adequacy of the stormwater management facilities in the future.

O'Hara Township may require other items to be included in the agreement where determined necessary to guarantee the satisfactory maintenance of all facilities. If stormwater facilities are not maintained by O'Hara Township, the Owner shall maintain all facilities in accordance with the approved maintenance schedule and shall keep all facilities maintained in a safe and attractive manner. The Owner shall convey to O'Hara Township easements and/or rights-of-way to assure access for periodic inspections by O'Hara Township and maintenance if required. The Owner shall keep on file with O'Hara Township the name, address and telephone number of the person or company responsible for maintenance activities and an as-built drawing of all stormwater facilities. In the event of a change, new information will be submitted to O'Hara Township within ten (10) days of the change. The Owner shall establish any special maintenance funds or other financing sources, in accordance with the approved maintenance plan. If the Owner fails to maintain the stormwater control facilities, following due notice (30 days) by O'Hara Township to correct deficiencies, O'Hara Township shall perform the necessary maintenance or corrective work. The Owner shall reimburse O'Hara Township for all costs associated with the required maintenance of the stormwater control facilities.