

# MS4 Permit Improvement Guide



**U.S. ENVIRONMENTAL PROTECTION AGENCY**

**OFFICE OF WATER**

**OFFICE OF WASTEWATER MANAGEMENT**

**WATER PERMITS DIVISION**

**APRIL 2010**

**EPA 833-R-10-001**

# CHAPTER 5: POST-CONSTRUCTION OR PERMANENT/LONG-TERM STORMWATER CONTROL MEASURES

## Introduction

Phase I MS4s are required to address new development and significant redevelopment in their SWMPs through controls to reduce pollutants in stormwater discharges after construction is completed. See 40 CFR 122.26(d)(2)(iv)(A)(2).

The Phase II regulations require regulated small MS4 operators to develop, implement, and enforce a program to address stormwater discharges from new development and redevelopment sites that disturb greater than or equal to one acre to the MS4 (including projects that disturb less than one acre that are part of a larger common plan of development or sale). The regulations also require that the MS4 ensure that control measures are installed and implemented that prevent or minimize water quality impacts. See 40 CFR 122.34(b)(5)(i)

As part of these Phase II requirements, the MS4 must:

- Develop and implement approaches to addressing post-construction stormwater discharges that include a combination of structural and/or non-structural controls;
- Adopt adequate legal authority to enable the MS4 to address post-construction stormwater discharges from new development and redeveloped sites; and
- Ensure adequate long-term operation and maintenance of applicable post-construction control measures. See 40 CFR 122.34(b)(5)(ii).

As of April 2010, most MS4 permits only require permittees to adopt a post-construction program with enforceable requirements designed to reduce stormwater impacts from new development and redevelopment, without specifying a performance standard. To meet this requirement many MS4s have adopted criteria in ordinances or other legally enforceable mechanisms based on already promulgated flood-control based standards (i.e., focused only on discharge rates). However, performance standards can be a very useful and meaningful mechanism in the post-construction toolbox to ensure that water quality objectives are met.

The example permit provisions that follow present the current thinking on how to strengthen the effectiveness of the permittee's stormwater program by preventing the harmful effects of increased stormwater flows and pollutant loads from new development and redeveloped sites on receiving waterbodies. EPA recognizes that there are a wide variety of approaches that some states have already

### Included Concepts

- ▶ Post-construction stormwater management program
- ▶ Site performance standards
- ▶ Site plan review
- ▶ Long-term maintenance of post-construction stormwater control measures
- ▶ Watershed protection
- ▶ Tracking of post-construction stormwater control measures
- ▶ Inspections and enforcement
- ▶ Retrofit plan

taken to control discharges from new development and redeveloped sites, some of which are more stringent than the permit language recommended below. The language below includes components that EPA believes would provide focus and enforceability, and would bring about significant improvements in stormwater controls on site. However, the “maximum extent practicable” may be greater than is reflected in the example permit language below for some MS4s, and EPA encourages states, where possible, to go beyond these example provisions and to achieve even better watershed planning and water quality outcomes. For these reasons, this chapter presents the minimum permit provisions EPA currently recommends to be included in permits in order for permittees to reduce their discharges to the maximum extent practicable as well as the optional, more stringent, requirements.

## 5.1 Post-Construction Stormwater Management Program

### Example Permit Provision

- 5.1.1 The permittee must continue to implement a program to control stormwater discharges from new development and redeveloped sites that disturb at least one acre (including projects that disturb less than one acre that are part of a larger common plan of development or sale) that discharge into an MS4 [*or insert smaller alternative size*]. The program must apply to private and public development sites, including roads.
- 5.1.2 The program must require that controls are in place that will infiltrate, evapotranspire, or harvest and use stormwater from the site to meet the performance standards in Part 5.2 to protect water quality.
- 5.1.3 Written procedures for implementing this program, including the components described in Parts 5.2 – 5.8, must be incorporated into the SWMP document.

### Example Permit Requirement Rationale for the Fact Sheet

The stormwater regulations require that an MS4 develop and implement a program to address post-construction discharges from new development and redeveloped sites, and ensure the long-term operation and maintenance of these controls (see Part 5.4 for the maintenance requirements). (See 40 CFR 122.34(b)(5)). The permit requires the use of specific stormwater controls, i.e., those that infiltrate, evapotranspire, or harvest and use stormwater, with the aim of maintaining or restoring the pre-development stormwater runoff conditions at the site.

Many traditional stormwater management practices, and the permit language that drives them, fail to address the hydrologic modifications that increase the quantity of stormwater discharges, and cause excessive erosion and stream channel degradation. Frequently the volume, duration, and velocity of stormwater discharges cause degradation to aquatic systems. Protecting and restoring the physical, chemical and biological integrity of receiving waters must be a central issue in stormwater permits. The recent report of the National Research Council (*Urban Stormwater Management in the United States*, National Academies Press, 2008, [www.epa.gov/npdes/pubs/nrc\\_stormwaterreport.pdf](http://www.epa.gov/npdes/pubs/nrc_stormwaterreport.pdf)) recommends that the NPDES stormwater

program examine the impacts of stormwater flow, treat flow as a surrogate for other pollutants, and includes the necessary control requirements in stormwater permits. Specifically the report recommends that the volume retention practices of infiltration, evapotranspiration and rainwater harvesting be used as primary stormwater management mechanisms. For this reason, EPA recommends use of a permit condition that is based on maintaining or restoring predevelopment hydrology although other forms of this permit condition maybe appropriate as well.

Additional information on the development of a post-construction program for Phase II permittees can be found in the Center for Watershed Protection’s *Managing Stormwater In Your Community: A Guide for Building an Effective Post-Construction Program* (available at [www.cwp.org/postconstruction](http://www.cwp.org/postconstruction)). Also, EPA’s green infrastructure website includes information on post-construction controls and programs (see [www.epa.gov/greeninfrastructure](http://www.epa.gov/greeninfrastructure)).

## 5.2 Site Performance Standards

### Example Permit Provision

- 5.2.1 The permittee must establish, implement and enforce a requirement that owners or operators of new development and redeveloped sites discharging to the MS4, which disturb greater than or equal to one acre (including projects that disturb less than one acre that are part of a larger common plan of development or sale), design, install, implement, and maintain stormwater control measures that infiltrate, evapotranspire, harvest, and use stormwater discharges.
- 5.2.2 Within [*insert deadline, e.g., 12 months, 24 months, etc.*] the permittee must require that stormwater discharges from such new development and redevelopment sites be managed such that post-development hydrology does not exceed the pre-development hydrology at the site, in accordance with the performance standard set forth in this paragraph. The SWMP must describe the site design strategies, control measures, and other practices deemed necessary by the permittee to maintain or improve pre-development hydrology.<sup>11</sup> [*Insert a new development performance standard, such as one or a combination of the following:*

<b>Basis for Performance Standard</b>	<b>Description</b>	<b>Performance Standard</b>
Rainfall	Minimum storm volume to be retained on site.	Design, construct, and maintain stormwater management practices that manage rainfall on-site, and prevent the off-site discharge of the precipitation from [ <i>insert standards, such as “the first one inch of rainfall from a 24-hour storm preceded by 48 hours of no measurable precipitation”</i> ]. Discharge volume reduction can be achieved by canopy interception, soil amendments, evaporation, rainfall harvesting, engineered infiltration, extended filtration and/or evapotranspiration and any combination of the aforementioned practices. This first one inch of rainfall

<sup>11</sup> Big Darby Creek Watershed CGP, Part III.G.2.d. ([web.epa.ohio.gov/dsw/permits/DarbyStormWater\\_Final\\_GP\\_sep06.pdf](http://web.epa.ohio.gov/dsw/permits/DarbyStormWater_Final_GP_sep06.pdf))

MS4 Permit Improvement Guide

		<i>must be 100% managed with no discharge to surface waters, except when the permittee chooses to implement the conditions in Part 5.2.5.d below.<sup>12</sup></i>
<i>Rainfall</i>	<i>Minimum storm size to be retained on site.</i>	<i>Design, construct, and maintain stormwater management practices that manage rainfall on-site, and prevent the off-site discharge of the precipitation from all rainfall events less than or equal to [insert standards, such as “the 95<sup>th</sup> percentile rainfall event”]. This objective must be accomplished by the use of practices that infiltrate, evapotranspire and/or harvest and reuse rainwater. The 95<sup>th</sup> percentile rainfall event is the event whose precipitation total is greater than or equal to 95 percent of all storm events over a given period of record.<sup>13</sup></i>
<i>Recharge/Runoff</i>	<i>Hydrologic analysis.</i>	<i>Design, construct, and maintain stormwater management practices that preserve the pre-development runoff conditions following construction. The post-construction rate, volume, duration and temperature of discharges must not exceed the pre-development rates and the pre-development hydrograph for 1, 2, 10, 25, 50 and 100 year storms must be replicated through site design and other appropriate practices. These goals must be accomplished through the use of infiltration, evapotranspiration, and/or rainwater harvesting and reuse practices. Defensible and consistent hydrological assessments and modeling methods must be used and documented.<sup>14</sup></i>
<i>Recharge</i>	<i>Groundwater recharge requirement.</i>	<i>Any “major development” project, which is one that disturbs [insert standards, such as at least one (1) acre of land or creates at least 0.25 acres of new or additional impervious surface], must comply with one of the following two groundwater recharge requirements:</i> <ul style="list-style-type: none"> <li><i>• Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site; or</i></li> <li><i>• Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater discharges volume from pre-construction to post-construction for the two-year storm is infiltrated.<sup>15</sup></i></li> </ul>
<i>Impervious Cover</i>	<i>Limiting total impermeable surface (or effective impermeable surface)</i>	<i>Minimize total impervious cover resulting from new development and redevelopment to [insert standards, such as &lt;10% of disturbed land cover and/or limit total amount of effective impervious surface to no more than 5% of the landscape].</i>

<sup>12</sup> West Virginia Small MS4 Permit ([www.wvdep.org/Docs/17444\\_SW\\_WV%20MS4%20permit%202009.pdf](http://www.wvdep.org/Docs/17444_SW_WV%20MS4%20permit%202009.pdf))

<sup>13</sup> Section 438, Energy Independence & Security Act (EISA) Guidance ([www.epa.gov/owow/NPS/lid/section438/pdf/final\\_sec438\\_eisa.pdf](http://www.epa.gov/owow/NPS/lid/section438/pdf/final_sec438_eisa.pdf))

<sup>14</sup> Section 438, Energy Independence & Security Act (EISA) Guidance ([www.epa.gov/owow/NPS/lid/section438/pdf/final\\_sec438\\_eisa.pdf](http://www.epa.gov/owow/NPS/lid/section438/pdf/final_sec438_eisa.pdf))

<sup>15</sup> New Jersey Stormwater Management Rules, N.J.A.C. 7:8 ([www.nj.gov/dep/rules/adoptions/2004\\_0202\\_njpdcs.pdf](http://www.nj.gov/dep/rules/adoptions/2004_0202_njpdcs.pdf))

5.2.3 Incentives for Redeveloped Sites. When considered at the watershed scale, certain types of developed sites can either reduce existing impervious surfaces, or at least create less ‘accessory’ impervious surfaces. The Permittee may develop a program to allow adjustments to the performance standard for new development or redevelopment sites that qualify. A reduction of *[insert the amount of stormwater the Permittee can reduce for utilizing redevelopment principles, e.g. 0.2 inches from the one inch runoff reduction standard]* may be applied to any of the following types of development. Reductions are additive up to a maximum reduction of *[insert amount, such as 0.75 inches]* for a project that meets four or more criteria. The permittee may choose to be more restrictive and allow a reduction of less than *[insert amount, such as 0.75 inches]* if they choose. In no case will the reduction be greater than *[insert amount, such as 0.75 inches]*.

1. Redeveloped sites
2. Brownfield redeveloped site
3. High density (>7 units per acre)
4. Vertical Density, (Floor to Area Ratio (FAR) of 2 or >18 units per acre)
5. Mixed use and Transit Oriented Development (within ½ mile of transit)<sup>16</sup>

5.2.4 Additional Requirements and Exceptions: The permittee must implement the following additional requirements where applicable:

- a. A site that is a potential hot spot with the reasonable potential for contaminating underground sources of drinking water must provide treatment for associated pollutants (e.g., petroleum hydrocarbons at a vehicle fueling facility).
- b. A site that discharges or proposes to discharge to any surface water or ground water that is used as a source of drinking water must comply with all applicable requirements relating to source water protection and must not cause an exceedance of drinking water standards.<sup>17</sup>
- c. Sites may not infiltrate stormwater in areas of soil contamination.
- d. For projects that cannot meet 100% of the performance standard in Part 5.2.2 on site, two alternatives are available: off-site mitigation and payment in lieu. If these alternatives are chosen, then the permittee must develop and fairly apply criteria for determining the circumstances under which these alternatives will be available and establish reasonable schedules for mitigation and require payment in lieu of prior to project inception. A determination that standards cannot be met on site must include multiple criteria that would rule out fully meeting the performance standard in Part 5.2.2, such as: too small a lot outside of the building footprint to create the necessary infiltrative capacity even with amended soils; soil instability as documented by a thorough geotechnical

<sup>16</sup> West Virginia Small MS4 Permit (Section C.b.5.a.ii.A.3)  
([www.wvdep.org/Docs/17444\\_SW\\_WV%20MS4%20permit%202009.pdf](http://www.wvdep.org/Docs/17444_SW_WV%20MS4%20permit%202009.pdf))

<sup>17</sup> West Virginia Small MS4 Permit (Section C.b.5.a.ii.A.2)  
([www.wvdep.org/Docs/17444\\_SW\\_WV%20MS4%20permit%202009.pdf](http://www.wvdep.org/Docs/17444_SW_WV%20MS4%20permit%202009.pdf))

analysis; a site use that is inconsistent with capture and reuse of stormwater; or too much shade or other physical conditions that preclude adequate use of plants. Sites must still maximize stormwater retention on-site, before applying the remaining stormwater to one of the alternatives. In instances where alternatives are chosen, technical justification as to the infeasibility of on site management is required to be documented.<sup>18</sup>

### Example Permit Requirement Rationale for the Fact Sheet

Developed land changes the hydrology of sites, leading to higher stormwater discharge volumes and higher pollutant loads. The purpose of this standard is to maintain or restore stable hydrology in receiving waters thereby protecting water quality by having post-construction hydrology mimic the natural hydrology of the area.

A simpler, but reasonably approximate ‘mimicking the natural hydrograph’ approach can typically be accomplished by retaining (as opposed to detaining stormwater for later discharge) on a developed site the volume of water that was retained prior to development, through the mechanisms of infiltration, evapotranspiration, and capture and use. By significantly reducing the volume of stormwater discharges, these mechanisms significantly reduce the discharge of pollutants in stormwater, making discharge volumes the ideal all-around focus and metric for stormwater management. These provisions must be clear about the retention requirement, e.g., an underdrained rain garden likely functions more as a detention and filtration system than an infiltration system.

In Part 5.2.3, the five types of development which qualify for incentives are redevelopment, brownfield redevelopment, high density, vertical density, and mixed use with transit oriented development. Redeveloping already degraded sites can reduce regional land consumption and minimize new land disturbance. Minimizing land disturbance and impervious cover is critical to maintaining watershed health. In addition to water quality benefits, cleaning up and reinvesting in brownfield properties increases local tax bases, facilitates job growth, utilizes existing infrastructure, takes development pressures off of undeveloped, open land, and both improves and protects the environment. The effect of low-density urbanization on watersheds and the hydrologic cycle is substantial. High-density development, including vertical density, slows land consumption rates and accommodates more land uses on a smaller footprint. Finally, mixing land uses and promoting transit-oriented development can directly reduce runoff since mixed-use developments have the potential to use surface parking lots and transportation infrastructure more efficiently, requiring less pavement.<sup>19</sup>

In Part 5.2.4.d, the permittee must establish clear and stringent criteria for the conditions under which payment in lieu and off-site mitigation could be used. These criteria must be related to physical constraints such as a combination of soils which limit infiltration opportunities, space or light limited situations restricting the amount of vegetation that can be used, and a land use that is not conducive to capture and use of stormwater. Further, appropriate schedules for

<sup>18</sup> *West Virginia Small MS4 Permit (Section C.b.5.a.ii.A.4)*  
([www.wvdep.org/Docs/17444\\_SW\\_WV%20MS4%20permit%202009.pdf](http://www.wvdep.org/Docs/17444_SW_WV%20MS4%20permit%202009.pdf))

<sup>19</sup> Adapted from the WV Phase II MS4 Fact Sheet  
([www.dep.wv.gov/WWE/Programs/stormwater/MS4/permits/Pages/default.aspx](http://www.dep.wv.gov/WWE/Programs/stormwater/MS4/permits/Pages/default.aspx))

payment and implementation of mitigation measures must be established to ensure stormwater impacts are addressed in a timely manner.

## Recommendations for Permit Writer

---

Many communities have adopted criteria based on already promulgated flood-control based standards (i.e., focused only on discharge rates). This example permit language instead promotes the concept that effective standards should be based on the objective of maintaining or restoring stable hydrology to protect the quality of receiving waters by having post-construction hydrology mimic the natural hydrology of the area. The permit language provides a number of example standards that can be used to achieve this objective.

Performance standards should take into account the wide variability in hydrologic conditions in different areas. Ideally, standards should reflect the local naturally-occurring hydrology with respect to runoff, infiltration, evapotranspiration, and storage – that is, the water balance that would be present in the absence of development. Key parameters, such as rainfall patterns, soil characteristics, and topography, can be used to establish likely ‘natural’ hydrology. Where maintaining or reestablishing such hydrologic conditions is infeasible, off-site mitigation, payment-in-lieu, or fee programs may be used. Based on current (2010) information, EPA recommends that permits allow for a combination of techniques that utilize infiltration, capture and use, and evapotranspiration as appropriate, rather than relying only on infiltration or some other technique alone to meet performance standards.

The permit writer could include a performance standard that stipulates that predevelopment hydrographs match post-development hydrographs. In order for this type of performance standard to be effective, the permit writer should make sure that the permit clearly spells out all variables of the hydrograph (volume, rate, duration, frequency) to be matched, and not just the discharge rate. Many current pre-post hydrology standards focus only on discharge rate, which is primarily a flood control approach. In addition, a pre-development condition should also be defined, and that condition should be one that is reasonably ‘natural’, rather than simply the conditions (perhaps already fairly impervious) that existed immediately prior to the current developed site. A calculator tool based on key hydrologic parameters (soil, rainfall, slope, and vegetation) or an on-site rainfall retention standard that is appropriate for that area can help the permittee determine what constitutes pre-development hydrology and the means by which it may be matched.

As contemplated in the example permit provisions, permit writers may want to consider the difference between new development and redevelopment sites, as well as differences among some types of developed sites, in establishing performance standards. From the standpoint of imperviousness at a watershed scale, redeveloped sites are usually more desirable than new development sites, which replace relatively naturally functioning green spaces with impervious surfaces such as roads, and parking lots. Certain types of development generate less impervious surfaces than others. For example, typically, there is little or no increase in net stormwater discharges when redeveloping underused properties such as vacant properties, brownfield sites, or greyfield sites, since new impervious cover replaces existing impervious cover. The net discharge increase from already developed properties would likely be zero since the site was already predominately impervious cover. In many cases, redeveloped sites break up or remove some portion of the impervious cover, converting it to pervious cover and allowing for some stormwater infiltration. Redevelopment sites can produce a net improvement in regional water quality by decreasing total impervious area and its

associated stormwater discharges. Redeveloped sites can also reduce regional land consumption. By building on underused, already degraded land, the pressure to convert previously undeveloped land is reduced. Therefore differential standards for new development and redeveloped sites, as well as for different types of developed sites, may be reasonable. However, they should be crafted to minimize creation of imperviousness at the watershed scale, and still include some reasonable level of stormwater management at the site scale.

Redevelopment is the act of improving by renewing or restoring any developed property that results in the land disturbance of one acre or greater, and that has one of the following characteristics:

- Land that currently has an existing structure, such as buildings or houses, or
- Land that is currently covered with an impervious surface, such as a parking lot or roof, or
- Land that is currently degraded and is covered with sand, gravel, stones, or other non-vegetative covering.

Infiltration may not be appropriate in all cases. For example, a site that is a potential hot spot with the reasonable potential for significant pollutant loading(s) may not be appropriate for stormwater infiltration. Hot spots may include commercial, industrial, institutional, municipal, or transportation related operations that may produce higher levels of stormwater pollutants, and/or present a higher level or risk for spills, leaks, or illicit discharges such as: gas stations, petroleum wholesalers, vehicle maintenance and repair, auto recyclers, recycling centers and scrap yards, landfills, solid waste facilities, wastewater treatment plants, airports, railroad stations and associated maintenance facilities, and highway maintenance facilities.

In addition, the permit writer may want to consider what type of flexibility to afford sites where the owner/operator is not able to meet the performance standard on site. For instance, if a site is constrained by size or previous impervious surfaces, such that the use of control measures that infiltrate stormwater is severely limited, the permit could allow alternatives for meeting the performance standard in other ways such as payment in lieu and off-site mitigation within the same watershed.

Off-site mitigation and payment in lieu programs are options that can be used in these instances. Off-site mitigation generally means that control measures may be implemented at another location, in the same watershed/watershed as the original project, and as approved by the regulatory agency. Payment in lieu programs generally mean that the developer pays a fee to the permittee which will then be applied to a stormwater control project, in lieu of installing the required control measures.

If the permit writer chooses to include an off-site mitigation or payment in lieu program in the permit, the permit writer could specify that the programs meet several criteria, for example, those described in the 2009 West Virginia Phase II General Permit Fact Sheet

[www.dep.wv.gov/WWE/Programs/stormwater/MS4/permits/Pages/default.aspx](http://www.dep.wv.gov/WWE/Programs/stormwater/MS4/permits/Pages/default.aspx)):

1. The permittee must establish clear and stringent criteria for the conditions under which these options are available that must be related to real physical constraints such as a combination of soils limiting infiltration opportunities, space or light limited situations restricting the amount of vegetation that can be used, and a land use that is not conducive to capture and use of

stormwater. While one or two of these characteristics should not be adequate to qualify for the alternative, the combination of multiple constraints could;

2. A minimal requirement for at least [0.4 inch] of stormwater managed on-site;
3. A [1:1.5 ratio] of the amount of requisite stormwater not managed on site to the amount of stormwater required to be mitigated at another site, or for which in-lieu payments must be made;
4. If demonstrated to the permittee that it is completely infeasible to manage the remainder [0.4 inches], then the ratio for this unmanaged portion is [1:2].
5. The necessary tracking systems for both types of programs, including the necessary inventory of public and retrofit projects for off-site mitigation; and,
6. The establishment of a credible valuation structure for payment in lieu, i.e., what is the actual cost for the permittee to provide retrofits for the necessary amount of stormwater, not just a token payment. The purpose of these provisions is to disincentivize the use of alternatives unless really needed, but also to provide a financial foundation for implementation of public stormwater management projects, including retrofits where those needs have been identified.

Additional justification for the development types which qualify for these incentives can be seen in the West Virginia Phase II MS4 Permit Fact Sheet

([www.dep.wv.gov/WWE/Programs/stormwater/MS4/permits/Pages/default.aspx](http://www.dep.wv.gov/WWE/Programs/stormwater/MS4/permits/Pages/default.aspx)).

### 5.3 Site Plan Review

#### Example Permit Provision

- 5.3.1 To ensure that all applicable new development and redeveloped sites conform to the performance standards required in Part 5.2, the permittee must continue to implement project review, approval, and enforcement procedures that include:
  - a. Procedures for the site plan review and approval process(es) that include inter-departmental consultations, as needed, and a required re-approval process when changes to an approved plan are desired; and
  - b. A requirement for submittal of 'as-built' certifications within 90 days of completion of a project.
- 5.3.2 The permittee must conduct site plan reviews, using the procedures described in Part 5.3.1, of all new development and redeveloped sites which will disturb greater than or equal to one acre [or a smaller threshold as set by the permitting authority] and discharge to the MS4 (including sites that disturb less than one acre that are part of a larger common plan of development or sale). The site plan review must specifically address how the project applicant meets the performance standards in Part 5.2 and how the project will ensure long-term maintenance as required in Part 5.4.