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Braving the Storm: Managing Stormwater Pollution and Reducing Environmental Impact

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Introduction

In 1970, the United States Environmental Protection Agency (EPA) estimated that 85% of water pollution came from point sources, with the other 15% coming from non-point sources. With the passage of the Clean Water Act (CWA) those figures have been reversed; by 2010 point sources accounted for only 15% of pollution, with non-point sources making up the other 85%.[2]

Stormwater is the water from precipitation events such as rain and snow, including snowmelt. While it's easy to assume that stormwater is a natural process of the water cycle, many of its deleterious effects on the environment are man-made. Stormwater runoff occurs when precipitation from rain and snowmelt is not naturally absorbed into the ground. [3] Impervious surfaces (i.e., streets, parking lots, rooftops) preclude the natural absorption of stormwater as it instead accumulates debris, chemicals, sediments and other pollutants until it is ultimately discharged as runoff into a water system, thereby negatively affecting water quality.

While the CWA provides regulations and requirements for stormwater management, it is often left to the stormwater designer and/or facility as to the exact means and methods to achieve compliance and performance. New technologies and philosophies of green infrastructure are proving to be effective in not only the control of runoff but also providing a cost effective alternative to conventional stormwater controls.

This paper provides a brief overview of the stormwater measures within the CWA along with an introduction to green infrastructure controls. Stormwater issues and controls are site and area specific and this overview provides EHS Professionals a summary of potential requirements along with possible considerations for control measures.

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[1] Nothing herein should be construed to constitute legal counsel or to impart any rights upon any party. You are urged to seek competent local counsel when seeking to determine your duties and responsibilities under any statute, regulation, or any other agency or governmental action.

[2] From *The Ripple Effect*

[3] *See generally* 40 C.F.R. §122.26(b)(13).

Regulation of Water Pollution

The pollution of the waterways of the United States has been a concern since as early as the 19th century. However, the initial concern was pollution that impacted navigation and commerce.[4] The Federal Water Pollution Control Act (FWPCA), the first major law intended to address water pollution, was passed by Congress in 1948.[5] The FWPCA Amendments of 1972[6] amended the FWPCA and created what is currently known as the Clean Water Act (CWA).[7] The CWA authorized the EPA to establish effluent limits for discharges to waters of the United States. The EPA establishes effluent limits by setting both technology-based requirements and also water-quality standards. The technology-based requirements are established industry-wide, setting a consistent level of treating technology across a regulated industry. The water-quality standards are set as total maximum daily loads (TMDLs); the amount a waterbody can receive and still meet water quality standards. TMDLs are based upon the receiving water body and must consider the waterbody's current condition and impairment.

The primary method by which the CWA requirements are implemented is through a permitting system, the National Pollutant Discharge Elimination System (NPDES). Like many environmental programs, states are allowed to take over and administer the duties of the CWA.[8] As depicted in Figure 1[9] the vast majority of states have established programs to manage the CWA requirements.

The objective of the CWA was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The CWA established a number of goals, including "that the discharge of pollutants into the navigable waters be eliminated by 1985" and that "water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983." While the CWA achieved some measure of success, these goals were not and have not been met. Some of the reasons for the CWA's failure to meet these goals include that it did not address stormwater and non-point source pollution.

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[4] The Rivers and Harbors Act of 1899 provided authority to the Army Corp of Engineers to address impacts to navigation.

[5] Federal Water Pollution Control Act, Pub. L. 845.

[6] Federal Water Pollution Control Act Amendments, Pub. L. 92-500.

[7] Despite the early commencement of environmental regulation within the United States it was the 1970's that saw the creation of the current method of addressing environmental concerns. Not only was the EPA established in 1970 but the 1970's saw the modification of approaches to both air and water pollution to form the Clean Air and Water Acts, and also the establishment of laws such as the Toxic Substance Control Act, Endangered Species Act, Resource Conservation and Recovery Act, and Safe Drinking Water Act.

[8] Throughout the remainder of this paper the NPDES permit system will be discussed. State implementations of their own permit system follows the NPDES requirements though may incorporate state specific elements or requirements.

[9] *Available at* http://cfpub.epa.gov/npdes/statestats.cfm.

Incorporation of Stormwater into the CWA

Stormwater is the runoff from precipitation events such as rain and snow, including snowmelt, and associated surface runoff and drainage.[10] In 1987 Congress amended the CWA[11]; one of the amendments was to require the regulation of certain stormwater discharges. The EPA implemented this requirement by extending the NPDES permitting system to cover stormwater discharges from 1) industrial activities, 2) construction activities, and 3) municipal separate storm sewer systems (MS4s).[12]

Industrial Activities

There are ten categories of industrial activities that are covered under the NPDES stormwater program.[13] A facility may be excluded if they can certify "no exposure" (i.e., that their industrial material and operations are not exposed to stormwater). Business within these ten categories may develop a site specific individual NPDES permit or for facilities within 29 sectors of industrial activity (as described by SIC and activity) use the Multi-Sector General Permit (MSGP).[14] Benefits of the MSGP are that a facility does not need to develop their own permit and that permit coverage can be obtained relatively quickly from the filing of a Notice of Intent (NOI) to utilize the MSGP.[15]

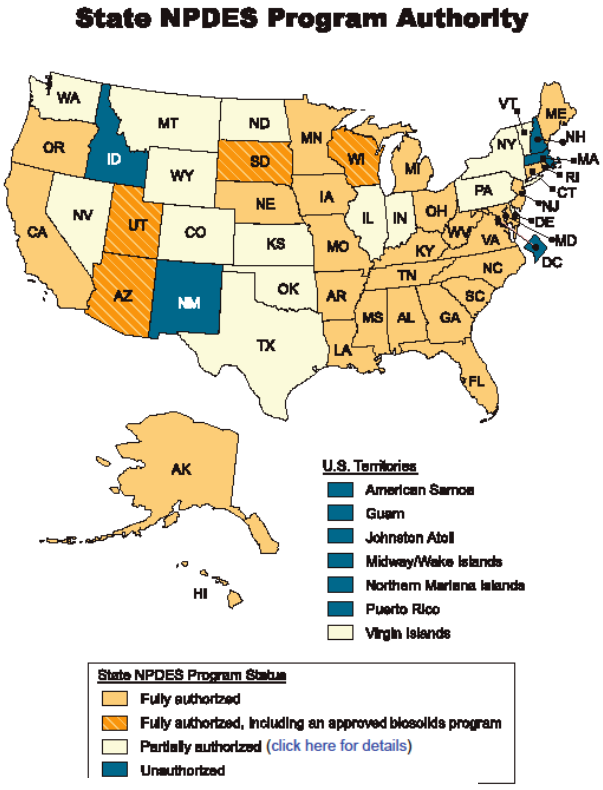

Figure 1. State NPDES Authority

Construction Activities

The NPDES stormwater program covers construction sites that involve clearing, grading, or excavating activities that disturb one or more acres. Smaller sites are also included where they are part of a larger common plan that is of one or more acres. Similar to industrial activities construction sites have the option of either developing and requesting an individual permit or may

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[10] *See generally* 40 C.F.R. §122.26(b)(13).
[11] Water Quality Act of 1987, Pub. L. 100-4.
[12] 40 C.F.R. §122.26(a).
[13] 40 C.F.R. §122.26(b)(14)(i)-(ix) and (xi).
[14] While beyond the scope of this paper the categories include heavy and light manufacturing, mining and exploration, hazardous waste TSDFs, landfills and dumps, metal scrapyards and automobile junkyards, steam power generating plants, transportation facilities with maintenance/cleaning/deicing operations, and treatment works.
[15] Coverage timing is dependent upon publication of the NOI and possibly the Stormwater Pollution Prevention Plan (SWPPP) but may range from 30 to 60 days.

utilize the Construction General Permit (GCP). Use of the GCP provides the same benefits as with the industrial program and is the predominant means of permit coverage.[16] The GCP, similar to an individual permit, establishes permit requirements to include effluent limits and development of a Stormwater Pollution Control Plan (SWPPP).

Municipal Separate Storm Sewer Systems
An MS4 is a system owned by a public entity that is designed to collect or convey stormwater, discharges to the waters of the United States and is not a combined sewer or part of a Publicly Owned Treatment Works (POTW). The MS4 NPDES stormwater program covers medium and large cities, certain counties with populations of 100,000 or more, small MS4s in urbanized areas, and small MS4s designated by the permitting authority. Small MS4s are covered by a general permit system while the larger MS4s generally utilize individual permits. MS4s are required to develop and implement a Stormwater Management Program (SWMP) intended to reduce the contamination of stormwater runoff and prevent illicit discharges.

The Environmental Impact of Stormwater

Stormwater runoff has the potential to cause significant environmental impacts. Diminished water quality is a consequence of stormwater pollution and can lead to ecosystem degradation, specifically causing adverse effects on plants, fish, animals and people. Sediment can cloud water and preclude the growth of plants and aquatic life. Excess nutrients, such as nitrogen, can lead to algae growths, also known as eutrophication, and lead to a reduction in the amount of dissolved oxygen in a water body. When algae die, they sink to the bottom and decompose, removing oxygen from the water. Diminished levels of dissolved oxygen can lead to fish-kills and the destruction of other aquatic organisms.[17]

Significant weather events can cause an increase in the amount of bacteria and other pathogens introduced into surface water systems used for drinking or recreational purposes. Heightened levels of bacteria can create health hazards and limit the recreational use of waterways, such as beach closures. Debris, commonly referred to as “floatables”, such as cigarette butts, plastic bags, bottles, cans, etc., can choke, suffocate or disable aquatic life and require increased efforts to remove if treated for drinking water purposes.

Household hazardous wastes such as pesticides, insecticides, paints, oils, greases can also be conveyed into a water system if not properly handled and can then poison aquatic life. Like debris, these substances also have to be removed from a water system if it is to be used for human consumption. When entering a sanitary or combined sewer system, both debris and household hazardous wastes require specific wastewater treatment processes to ensure removal.

Industrial, construction and agricultural activities can be especially conducive to the creation of stormwater pollution and degradation or destruction of an ecosystem. Construction often leads to the clearing or reshaping of land and can cause erosion leading to increased runoff. Stormwater runoff from construction sites can easily transport sediments, debris and other construction related materials.

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[16] 40 C.F.R. §122.26(b)(14)(x) and 40 C.F.R. §122.26(b)(15).
[17] Paraphrased from US EPA (2003)

Sustainable Solutions to Stormwater Management

While the NPDES program establishes specific performance standards, there is specific latitude as to the methods and means chosen for compliance. There is a growing consensus that the most effective way for controlling and minimizing stormwater pollution is through the implementation of "green infrastructure" technologies. Green infrastructure is an approach to wet weather management that use natural systems, or engineered systems that mimic natural processes, to enhance overall environmental quality and provide utility services. Green infrastructure typically manages stormwater runoff in one of three ways: through the use of soil and vegetation as a construction technique; preservation of natural features; or, minimization or disconnection of impervious surfaces.[18] Some of the most commonly deployed examples of green infrastructure technologies include: green roofs, rain barrels, pervious paving, rain gardens, etc.

Many organizations utilize environmental management systems (EMS) to assist in managing their environmental impacts. Those with EMSs that conform to consensus standards, such as ISO 14001, are required to *continually improve* their environmental performance. With increased public awareness and scrutiny over the impacts that stormwater pollution can have on local waterways, the significance to which stormwater pollution presents itself as an organizational risk will only continue to rise.

The regulatory context in which stormwater pollution is managed appears to be shifting as well. In 2007 the EPA published its *Green Stormwater Infrastructure Statement of Intent* that has resulted in a paradigm shift where state and local governments are implementing policy tools that encourage the use of green infrastructure. Contained within the purpose of this statement are the goals to "promote the benefits of using green infrastructure in protecting drinking water supplies and public health." More often, private organizations and property owners are bearing the responsibility for identifying strategies to minimize the amount of stormwater runoff that impacts local surface waters; especially as public resources become increasingly constrained. According to the City of Philadelphia: "nationwide, water utilities find themselves under increasing pressure as they confront a new set of complex environmental, demographic and financial challenges…Unfortunately this dilemma comes at a time when the City is grappling with some very real problems of population and financial decline."

Philadelphia's *Green City, Clean Waters* program establishes Philadelphia's land-water infrastructure philosophy. One of the tenets of this philosophy includes "requirements and incentives for green stormwater infrastructure to manage runoff at the source on private land and reduce demands on sewer infrastructure."[19] In response to constrained resources, many local governments, particularly cities, are beginning to manage stormwater pollution less through capital expenditures and more through the levee of a tax, commonly referred to as a "stormwater utility." A stormwater utility is a fee assessed to a property owner based on an owner's gross area of property and the amount of area within that property that is constructed of impervious surfaces.

[18] From American Rivers
[19] From *Green City, Clean Waters*

Stormwater utilities incentivize property owners to minimize the amount of runoff being generated from their properties. But organizations need not sacrifice financial performance to achieve greater environmental performance. When comparing marginal abatement costs[20] of "green" vs. "grey[21]" infrastructure choices to control runoff, it is becoming increasingly apparent that green infrastructure is not only the optimal choice for the environment but also for organizations' budgets as well. In 2007, the EPA published a report summarizing 17 case studies where Low Impact Development (LID) and green infrastructure methods were used. The study concluded that[22]: "total capital cost savings ranged from 15 to 80 percent when LID methods were used, with a few exceptions in which LID project costs were higher than conventional stormwater management costs."

Organizations are further incentivized to manage their stormwater pollution with the increasing utilization of consensus-based programs that provide third-party verification of green building construction, such as United States Green Building Council's Leadership in Energy and Environmental Design (LEED) certification. For example, LEED's credit system for new construction, specifically, its "sustainable sites" credit includes requirements for both quantity and quality control of stormwater pollution.[23] Furthermore, stormwater pollution management during construction is a *prerequisite* for pursuing LEED certification of new construction projects.

Summary

The CWA and its implementing regulations provide comprehensive requirements covering stormwater management of certain types of industrial, construction, and municipal separate storm sewer systems. The NPDES system establishes technology and water quality standards, which are implemented for regulated facilities through either individual or general permits. In considering the development and implementation of stormwater controls EHS Professionals should consider green infrastructure technologies as they are one of the most effective methods for minimizing and controlling stormwater pollution and additionally typically provides a cost savings as compared to more conventional methods of stormwater control.

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[20] A "marginal abatement cost" is the cost difference of varying technologies to achieve a pollution reduction target.

[21] Grey infrastructure can be thought of the hard, engineered systems to capture and convey runoff, such as gutters, storm sewers, tunnels, culverts, detention basins, and related systems. (Odefey, et al. 2012)

[22] From US EPA (2007)

[23] From the United States Green Building Council (2012).

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