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PANEL DISCUSSION: Stormwater Management/MS4 Permitting

Innovative Technologies and Approaches For Management of Storm Water

Steven Roy, LEED AP | Vice President, Director of Water Resources

ESS Group, Inc.

100 Fifth Avenue, 5th Floor, Waltham, MA 02451

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Part 1: Innovative Technologies for Stormwater Management

The practice of stormwater management at the municipal level has changed significantly over the past several years as the USEPA and state environmental agencies have developed more stringent requirements in response to the Clean Water Act Municipal Separate Storm Sewer System (MS4) requirements. Municipalities are now adopting required zoning bylaws and regulations to address stormwater controls for new development and redevelopment. In addition, the EPA is encouraging municipalities to better manage stormwater from their own facilities such as roads, DPW maintenance areas, and public buildings and parking areas. These new requirements mandate post-development stormwater controls, some amount of retrofits, and new requirements for water quality and stormwater volume control.

In addition to the CWA, there are other regulatory drivers that are requiring more stringent stomwater controls.

In December 2007, Congress passed The Energy Independence and Security Act (EISA) of 2007. The publicity surrounding the enactment of this new law focused on the provisions related to: fuel economy standards for passenger cars; use of renewable fuels; light bulb efficiency standards; efficiency improvements in existing and new federal buildings; and funding for research on solar and geothermal energy. Also contained in the Act was Section 438, Storm Water Runoff Requirements for Federal Development Projects. This small section of the Act has significantly changed the way that stormwater is managed at federal facilities and many states and municipalities are now adopting similar standards based on the requirements in the Act.

EISA sets forth new requirements for stormwater management for federal development projects. Specifically, Section 438 of the Act requires that *"the sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."*

The desire of this new requirement is for federal facilities to adopt green infrastructure and/or sustainable design techniques, also known as Low Impact Development (LID) practices. The primary goal of LID is to mimic the predevelopment site stormwater runoff conditions by using site design techniques that store, infiltrate, evaporate, and detain runoff. Use of these techniques helps to reduce off-site runoff and ensure adequate groundwater recharge or provide rainwater capture and storage for reuse purposes.

On October 5, 2009, President Obama signed Executive Order No. 13514, Federal Leadership in Environmental, Energy, and Economic Performance that required the US Environmental Protection Agency (U.S. EPA) to issue guidance on the implementation of Section 438 of EISA. The technical guidance was issued in December 2009 in document **EPA 841-B-09-0001. Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act (December 2009).** The guidance creates two paths for compliance with EISA. The first is to design, construct, and maintain stormwater management practices that control rainfall onsite and prevent runoff from all precipitation events less than or equal to the 95th percentile rainfall event to the "maximum extent technically feasible." The 95th percentile precipitation events range

throughout the U.S. from slightly over 1 inch to close to 2 inches of precipitation within a 24-hour period. In effect, 100% of the volume of stormwater from storms less than or equal to the 95th percentile event should not be discharged to surface waters but rather infiltrated or captured and reused. The second path relies on site specific hydrologic conditions and investigations to design, construct, and maintain stormwater management practices that preserve the pre-development runoff conditions. After conducting the appropriate studies, this goal can be achieved through the use of stormwater controls that infiltrate, evapotranspire, or use rainwater harvesting and reuse.

The following section outlines the many new innovative techniques that municipalities are either requiring of new development or are implementing to manage stormwater on public lands.

Infiltration Basins and Structures

Stormwater infiltration and on-site recharge is becoming a major component of most municipal stormwater programs. For example, the City of Boston has a requirement that the first one-inch of runoff from impervious surface must be captured and infiltrated on-site. The District of Columbia implemented a new onsite stormwater infiltration requirement that requires retention, infiltration or reuse of the first 1.2 inches of runoff from impervious surfaces from major development activities.

Infiltration systems can be as simple as a drywell managing rooftop recharge, to extremely complicated underground piping and infiltrations systems. Dry wells are large diameter concrete chambers with holes in the sides and bottom. There are many proprietary infiltration systems available in the marketplace. One manufacturer has developed a complete package system to address stormwater detention and infiltration. The CULTEC Contactor® and Recharger® chambers replace conventional stormwater retention/detention systems such as ponds, swales, pipe and stone trenches or beds, or concrete structures. The chambers may be used for drywells. Infiltration contact area is maximized by the fully open bottoms and perforated sidewalls. Water is collected in a catch basin or other collective device followed by a CULTEC Stormfilter® to treat the stormwater. The water is then directed into the Contactor® or Recharger® chambers and distributed via the side portal internal manifold. For additional information regarding CULTECH Proprietary infiltration devices, see http://www.cultec.com/index.html



Schematic of the CULTEC Stormwater Chamber (Image source: CULTECH).

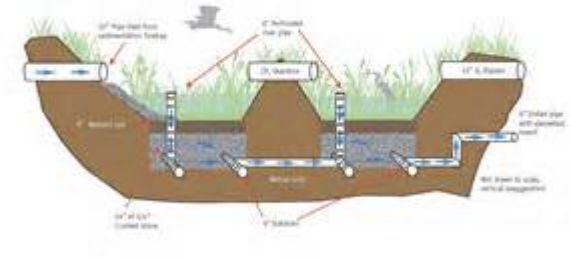
Rainwater Harvesting Systems

As available water becomes scarce, many communities are turning to rainwater harvesting and reuse to reduce potable water supply demand. Water is collected in cisterns and made available for reuse either in the building or for irrigation. Recent advances include connecting the harvesting systems to weather forecasts to maximize the amount of rainwater collected. In addition, green building certification programs such as LEED give points or credits for rainwater harvesting systems.



Constructed Wetlands/Subsurface Gravel Treatment Wetlands

A constructed stormwater wetland is a system designed to maximize pollutant removal through vegetative uptake, retention, and settling. A typical constructed wetland consists of a sediment forebay to provide pretreatment and dissipate energy, a base with shallow pockets planted with diverse emergent vegetation, deeper areas or micro-pools and a water quality outlet structure. In addition to water quality treatment, constructed wetlands are designed to control peak flow rates through extended detention above the permanent pool elevation. The interactions between the incoming stormwater runoff, aquatic vegetation, wetland soils, and associated physical, chemical, and biological processes are a fundamental part to reducing suspended soils, nutrients, metals, oils and grease, and trash. Site investigations must be conducted prior to design and construction to ensure proper soils, depth to groundwater and suitable land.



Bioretention/Raingardens

Bioretention and raingardens are plant-based stormwater management systems that filter pollutants and can also infiltrate stormwater volumes. Bioretention and raingardens can be very effective at removing urban runoff pollutants such as metals, oil and grease, nutrients, sediment, and bacteria through filtration, sedimentation, plant uptake, and biological processes.

Planter boxes and tree box filters are variations on the bioretention design theme and are becoming very common in ultra-urban environments.



Porous Surfaces



Porous pavement is a permeable alternative to conventional asphalt and concrete, and is usually constructed in pedestrian, urbanized, or residential settings with low traffic speeds and volumes. A highly permeable surface allows precipitation to pass through the pavement and a stone base, where runoff is retained and sediments and metals are treated to some degree. Porous pavement is designed to achieve peak flow attenuation of small intensity storms and groundwater recharge through infiltration into underlying soils. Porous pavement includes porous asphalt and pervious concrete, which are poured in place, and paving stones and grass pavers, which are typically precast and installed in an interlocking pattern to create a surface.

Manufactured Stormwater Filters



Stormwater filter systems come in all shapes and sizes and are designed to filter out pollution particles as well as dissolved chemicals. Manufacturers have developed package designs for a wide range of pollution targets and they can be sized to handle small to large stormwater flows. Recent innovations have included cartridge filter systems that can trap and remove nutrients such as phosphorus.

Summary

The effectiveness of stormwater control systems can vary. Many regulatory agencies provide standard charts of pollution percent removal for stormwater control measures. For more advanced information on stormwater treatment performance there are several web-based sources that have compiled available research. The International Stormwater Best Management Practices (BMP) Database project website features a database of over 530 BMP studies, performance analysis results, tools for use in BMP performance studies, monitoring guidance and other study-related publications. http://bmpdatabase.org/

Part 2: Integrated Municipal Stormwater and Wastewater Planning

1.0 INTRODUCTION

The Clean Water Act (CWA) was established to protect public health and the environment in part by preventing raw sewage and pollutants from entering the nation's waters. In order to comply with the CWA requirements, many states and municipalities focus on individual CWA requirements for protecting water quality instead of integrating requirements to address the most serious water quality issues first and in the most cost effective manner.

In response to input from municipalities regarding financial challenges in complying with separate CWA wastewater facility improvements and stormwater control improvements, the U.S. Environmental Protection Agency (EPA) issued a Memorandum about achieving water quality through **integrated municipal stormwater and wastewater plans** in October of 2011. This Memorandum sets the stage for EPA to work with states and communities to achieve the best solutions and cost-effective strategies for meeting the shared objectives and requirements of the CWA.

2.0 DESCRIPTION OF INTEGRATED STORMWATER AND WASTEWATER PLANNING

An Integrated Municipal Stormwater and Wastewater Plan is a voluntary approach that a municipality can pursue to achieve water quality objectives for wastewater and stormwater under the CWA. EPA issued a Memorandum that provides guidance on the development and implementation of Integrated Plans in June of 2012. The Memorandum provides a framework of operating principles and essential elements that EPA, states and municipalities should include in an effective Integrated Plan under the CWA. If a municipality chooses to develop an Integrated Plan, the Plan is used in the permit and enforcement processes and elements of the plan are typically incorporated into conditions and requirements in permits and enforcement orders.

Pursuing an Integrated Planning approach does not remove any obligations to comply with the CWA nor lower any existing regulatory or permitting standards. It provides a mechanism to address the most critical issues facing a municipality and provides a framework for appropriate project sequencing and scheduling. Municipalities and communities that develop an integrated plan must define the scope of the plan and identify other entities (adjoining towns, watershed groups, etc.) that are required to participate and assist in the plan's implementation.

The June 2012 EPA Memorandum identifies four overarching principles of a successful integrated plan which include:

1) maintenance of existing regulatory standards that protect public health and water quality,

2) allowing a municipality to balance CWA requirements in a manner that addresses the most pressing public health and environmental protection issues first,

3) the municipality is responsible for developing the Plan and EPA and/or the State will determine appropriate actions, which may include developing requirements and schedules in enforceable documents, and

4) innovative technologies, including green infrastructure, are important tools that generate many benefits, and may be fundamental aspects of a municipalities' plans for integrated solutions. Additional principles used in guiding municipalities in developing an Integrated Plan are also included in the June 2012 Memorandum.

The June 2012 Guidance Memorandum also recognizes that the specific details of an integrated plan will vary with each community's wastewater and stormwater needs and challenges, but indicates that each integrated plan should generally address the following required elements:

- Element 1 – A description of the water quality, human health and regulatory issues to be addressed in the plan;
- Element 2 – A description of existing wastewater and stormwater systems under consideration and summary information describing the systems' current performance;
- Element 3 – A process which opens and maintains channels of communication with relevant community stakeholders in order to give full consideration of the views of others in the planning process and during implementation of the plan;
- Element 4 – A process for identifying, evaluating and selecting alternatives and proposing implementation schedules;
- Element 5 – A process for evaluating the performance of projects identified in the Plan, which may include evaluation of monitoring data, information developed by pilot studies, and other studies/relevant information; and
- Element 6 – A process for identifying, evaluating and selecting proposed new projects or making modifications to ongoing or planned projects. A process for implementing schedules based on changing circumstances.

3.0 WHY DO COMMUNITIES PURSUE INTEGRATED PLANNING?

For the most part, communities that pursue an integrated stormwater and wastewater planning approach do so because they may be struggling to meet CWA regulatory requirements or may have been issued an enforcement action/order by EPA. These communities are looking for regulatory relief, flexibility, and cost saving approaches to correct compliance issues. In these circumstances, an integrated plan can be developed to maximize available funds through selecting the most cost effective alternatives that provide the best improvements in water quality and human health to address non-compliance issues.

Communities that choose to pursue integrated stormwater and wastewater plans benefit by 1) creating a plan to achieve the human health and water quality objectives of the CWA for their water bodies, 2) identifying efficiencies and prioritizing capital investments in wastewater and stormwater in a way that addresses the most critical issues first, and 3) adopting innovative approaches such as green infrastructure.

According to Weiss (2014), EPA's municipal enforcement program has recently evolved to allow enforcement orders to:

- include greater levels of green infrastructure,

- structure administrative orders to allow for adaptive management that would consider new or changing conditions,
- consider financial capabilities for both wastewater and stormwater costs, and
- use longer schedules to limit financial burdens on municipalities.

Other situations where municipalities may pursue an integrated planning approach include those that may have difficulties complying with total maximum daily load (TMDL) requirements for a water body. Green infrastructure and integrated planning can assist in developing TMDLs and in achieving TMDL limits.

To help support communities interested in developing and implementing an integrated planning approach to municipal wastewater and stormwater management, EPA recently offered $335,000 in technical assistance for communities seeking technical support. If a community was interested in pursuing technical assistance funding through EPA, they had to respond to EPA's "Request for Letters of Interest" by June 27, 2014. According to Weiss (personal communication), no similar funding mechanism is currently planned for fiscal year 2015; however, sometimes states have revolving funds that allow municipalities to borrow money at a low interest rate to cover costs during the planning stages.

4.0 EXAMPLES OF COMMUNITIES UNDERGOING INTEGRATED PLANNING

4.1 Enforcement Driven Integrated Planning

4.1.1 Towns of Exeter, Stratham and Newfields, New Hampshire

In 2009, the New Hampshire Department of Environmental Services (NHDES) indicated that the Squamscott River and ten other sub-estuaries in the Great Bay Estuary were impaired for nitrogen. That same year, Great Bay was placed on EPA's 303(d) list of impaired and threatened waters. The towns of Exeter, Stratham and Newfields are working together in preparing an Integrated Plan for the Lower Exeter and Squamscott River to manage point and non-point wastewater sources in these towns. The Town of Exeter also has an administrative consent order that required the development of a point and nonpoint source stormwater control plan to address nitrogen loadings. The integrated planning process in these communities began as a way to meet new, more stringent wastewater and stormwater permit requirements and improve water quality in the Squamscott River and the Great Bay estuary.

The Plan will integrate stormwater and wastewater management within each municipality and will describe methods to offset loads at wastewater treatment facilities by managing nonpoint sources of pollution.

This integrated planning process is unique as the communities and groups involved received a grant from the NERRS Science Collaborative to develop the Integrated Plan. The ongoing integrated planning process for the Squamscott-Exeter watershed is a good example of inter-community cooperation and coordination as well as coordination with multiple agencies and other groups. More information can be found at www.wisenh.net.

4.1.2 Seattle and King County, Washington

According to Weiss (2014), these two areas have EPA issued administrative consent decrees that give the permittees five years to develop an Integrated Plan proposal. The Integrated Plan proposal would include additional CWA work aside from what is included in the decree. The consent decrees include language that allows for changes to the decree based on an Integrated Plan. Additional detail on Seattle's Integrated Planning, is provided below.

City of Seattle, Washington

Seattle Public Utilities drafted an Integrated Plan in response to compliance requirements under the CWA, state regulations and a consent decree. The Plan proposes methods to integrate sewage overflow reduction projects with stormwater control projects in hopes of achieving greater environmental benefits than from sewage overflow reduction alone.

The Integrated Plan proposes the implementation of three projects to reduce polluted stormwater runoff entering local waters: 1) arterial street sweeping expansion, 2) construction of a new water quality facility at South Park, and 3) working with local residents and community groups to identify areas for the construction of natural drainage systems in several watersheds. The benefits identified by the City of Seattle for these measures include: preventing 40 tons of additional pollutants from entering local waters, helping to reduce flooding by preventing clogged storm drains, and improving air quality and neighborhood cleanliness (arterial street sweeping); improving water quality in the Duwamish River which has known water quality issues including fish consumption warnings, reducing stormwater runoff into water providing habitat to salmon and other threatened and endangered species, and supporting cleanup efforts in the Duwamish River Superfund site (South Park Water Quality Facility); improving water quality in various creeks which have known water quality issues, reducing stormwater runoff into water that provides habitat to salmon and other threatened and endangered species, and channeling stormwater where no formal drainage exists (Natural Drainage System Partnering).

Seattle Public Utilities is in the process of evaluating public comments to the Draft Plan and then will prepare a Final Environmental Impact Statement regarding the planned alternatives.
http://www.seattle.gov/util/EnvironmentConservation/Projects/DrainageSystem/SewageOverflowPrevention/IntegratedPlan/index.htm

4.1.3 Kansas City, Kansas

Weiss (2014) reports that the Kansas City consent decree provides for the development of an Integrated Overflow Control Plan that will address combined sewer overflows (CSOs), sanitary sewer overflows (SSOs), municipal separate storm sewer systems and treatment plant issues.

4.1.4 Hampton Roads Sanitary District (HRSD), Virginia

According to Weiss (2014), HSRD is moving forward as an example of enforcement driven integrated planning even though the term "Integrated Planning" does not appear in the consent decree. Weiss (2014) indicates that the consent decree provides a schedule extension to allow HRSD and 13 satellite communities to explore better efficiency and prioritization of work through consolidation which is similar to the intent of integrated planning.

4.2 Permit Driven Integrated Planning

The following municipalities reported by Weiss (2014) developed or are developing integrated plans as part of future permit reissuance. Some examples provided by Weiss (2014) include:

4.2.1 Durham, New Hampshire

The town of Durham, New Hampshire is developing a plan for an integrated approach to managing discharges to the Oyster River estuary which is impaired by nutrients. In order to meet the new nitrogen effluent criteria, the town estimated that upgrading the wastewater treatment facility would cost approximately $20 million in capital improvements and $750,000 per year in annual operation and maintenance costs (Weiss, 2014). In addition, according to Weiss (2014), only about 20% of the total nitrogen load comes from the wastewater treatment facility with the remaining 80% coming from stormwater or nonpoint sources. The town submitted a plan in May of 2013 for the evaluation of an integrated approach to address these issues. The plan addressed MS4 controls, septic system improvements, green infrastructure, fertilizer usage and stream restoration as well as reconfiguring the wastewater treatment facility to meet a 5 mg/L year round nitrogen effluent concentration (Weiss, 2014).

4.2.2 Spokane, Washington

The City of Spokane is in the process of developing an integrated plan to manage stormwater and wastewater to meet CWA requirements. Prior to pursuing an integrated management approach, the City had planned to spend $300 million on constructing large underground storage tanks to reduce combined sewer overflows from multiple overflow points. However, this would have been strictly a "grey solution" and would not have addressed other sources of pollution to the Spokane River such as stormwater inputs or pollutant and nitrogen inputs that come from sources outside of the combined wastewater source (http://www.spokanewastewater.org/Docs/Stormwater/IntegratedCWPBriefing.pdf).

The Integrated Plan proposes focusing on three projects that would result in the greatest improvement to the river. These projects include working on reducing overflows from the two largest combined sewer basins in the south part of Spokane and evaluating stormwater on the north side of Spokane where there are separate storm sewers. The City believes that by focusing on managing stormwater in this part of Spokane, they will have a greater impact on reducing pollutants like heavy metals, PCBs, and phosphorus than if they were to address other combined sewers.

(http://www.spokanewastewater.org/Docs/Stormwater/IntegratedCWPBriefing.pdf)

The three goals of the integrated plan identified by the City are to: 1) clean the Spokane River faster by prioritizing projects that have a greater impact on reducing pollutants in the River over projects that have less environmental value; 2) implement cost-effective and innovative approaches by investigating "grey" and "green" solutions (storm gardens, pervious pavements, and other technologies); and 3) integrate with other critical city infrastructure to provide multiple benefits such as street rehabilitation, water main replacement, park and golf course improvements, sidewalks, sewer collection systems, and pedestrian/bike lanes or paths.

4.2.3 Lawrence, Kansas

As described in Weiss (2014), the City of Lawrence's wastewater treatment plant does not have enough capacity to handle wet weather events. As a result, the city developed a Wastewater Facilities Master Plan that evaluates alternatives and recommends actions to provide additional wet weather storage and treatment capacity and to reduce wet weather flow by 35% through sanitary sewer rehabilitation, sewer replacement and rapid Inflow/Infiltration (I/I) reduction (Weiss, 2014). The City of Lawrence entered into a Memorandum of Understanding (MOU) with the Kansas Department of Health and Environment that adopts the Wastewater Master Plan and other documentation as an Integrated Plan. The MOU also indicates that the State of Kansas agrees with the intent of the City to pursue the improvement projects in accordance with the details of the Plan and that the Plan will be referenced in Lawrence's NPDES permits upon re-issuance. In addition, the permits will contain requirements for Lawrence to provide annual updates on Plan progress and reopener provisions to amend the Plan (Weiss, 2014).

Through Integrated Planning, municipalities have the framework to design and implement innovative stormwater controls as part of the water quality solution that traditionally was focused primarily at the wastewater treatment plant.

ADDITIONAL RESOURCES

Please see the following links for additional information on integrated planning.

- EPA Integrated Planning Website
  http://cfpub.epa.gov/npdes/integratedplans.cfm
- EPA's Integrated Municipal Stormwater and Wastewater Planning Approach Framework
  http://www.epa.gov/npdes/pubs/integrated_planning_framework.pdf
- Integrated Planning FAQs
  http://www.epa.gov/npdes/pubs/sw_integratedmunicipal_planning_faq.pdf
- The National Association of Clean Water Agencies (NACWA) Integrated Planning
  http://www.nacwa.org/index.php?option=com_content&view=article&id=1767&Itemid=356
- Water Integration for Squamscott-Exeter
  www.wisenh.net

- Seattle Public Utilities, The Integrated Plan Alternative
  http://www.seattle.gov/util/EnvironmentConservation/Projects/DrainageSystem/SewageOverflowPrevention/IntegratedPlan/index.htm
- Oyster River Integrated Watershed Plan, Durham, New Hampshire
  http://www.oysterriveriwp.com/
- Briefing Paper – Integrated Clean Water Plan – City of Spokane, Washington
  http://www.spokanewastewater.org/Docs/Stormwater/IntegratedCWPBriefing.pdf
- Integrated 2012 Wastewater Utilities Plan, Lawrence, Kansas
  http://www.lawrenceks.org/assets/utilities/pdf/ReportFinal.pdf