



## Center for Watershed Protection **Five-Year Research Agenda**

The Center for Watershed Protection conducts applied research to understand the effects of land use activities on water resources and to evaluate the performance of watershed protection and restoration strategies. The goal of our research is to synthesize the best available science to develop tools that work to protect and restore our streams, rivers, lakes, wetlands and bays.

This document presents the Center's top ten research priorities for 2017-2021, each of which has important practical implications for watershed protection and restoration nationally. A short description of the proposed research is provided for our top three projects, followed by a summary of the remaining seven concepts.

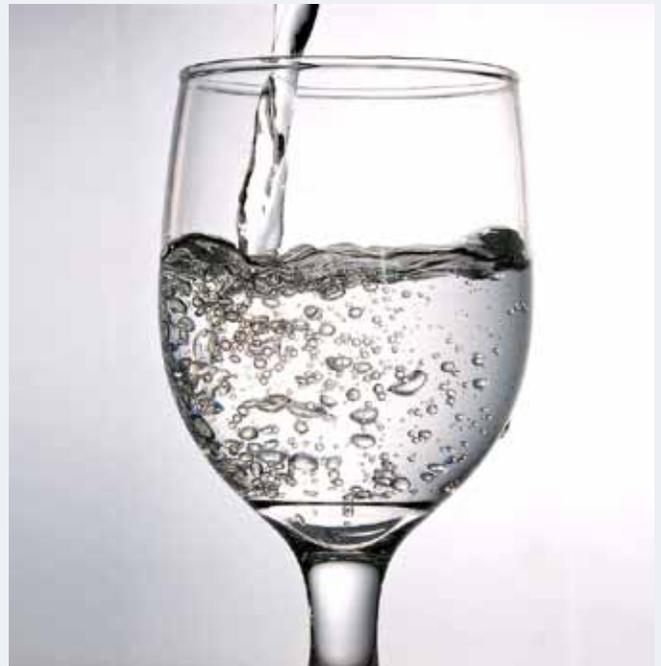
The topics include:

- 1** Protecting Drinking Water at its Source
- 2** Bringing Better Site Design into the 21<sup>st</sup> Century
- 3** Illicit Discharge Detection and Elimination Research
- 4** Updating Stormwater Retrofit Cost Data
- 5** Incentives for BMPs on Private Property
- 6** Assessing the Demand for a Stormwater Workforce
- 7** Managing Stormwater Runoff from Agriculture
- 8** Catchment-Scale Research on Land Cover Impacts and Restoration Effectiveness
- 9** The Impact of Pet Waste Outreach Programs
- 10** Leaf Litter Research Summit

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## 1 Protecting Drinking Water at its Source

Millions of people in the U.S. get their drinking water from public water supplies. The 1996 amendments to the Safe Drinking Water Act required that source water assessments be completed for all public water systems. States completed these assessments in the early 2000s; therefore, most of them are 15+ years old by now. Though the assessments were required, development of a source water protection program is still voluntary and surveys of water suppliers identify many challenges and obstacles to source water protection.



One of the biggest challenges is that water suppliers generally have little control over decisions about land use in the source water area, which have an enormous influence on water quality. At the municipal level, local land use planning agencies cite a lack of political/public support for drinking water protection, especially in the face

of high development pressure. This project will focus on bridging the disconnect between water supply management and local land use by producing results that make the case for source water protection in economic terms. The project will begin with a benchmarking survey of source water protection in the U.S. to identify needs and examples of successful approaches, and may also include:

- A report on the potential impacts and costs of not protecting source waters that addresses the question: “how do the costs of source water protection compare with the risks and costs associated with not protecting our water supplies?”
- Development of a model ordinance for source water protection
- Case studies of where source water protection has been successfully implemented through local land use regulation and conservation
- Compilation, packaging and delivery of new tools and data that are available for source water protection, such as tools for quantifying the economic benefit of source water protection and education and outreach materials the public, local officials, planners, landowners and utilities
- A Research Forum that convenes economists and other researchers to discuss a framework for defining the economic benefits of protecting local watersheds from land development

The results will be helpful in gaining greater local support to advance the formation of local source water collaboratives and/or payment for watershed services systems that recognize and quantify the true value of clean water.

**Cost: \$250,000-\$350,000**

## 2 Bringing Better Site Design into the 21st Century

Published in 1998 as a consensus-based process for changing development regulations, the Center's Better Site Design Handbook outlines 22 model development principles for site design that act to reduce impervious cover, conserve open space, manage stormwater at new residential and commercial development sites; and reduce the overall cost of development. The Handbook's Codes and Ordinances Worksheet (COW), which was designed to facilitate an in-depth review of the standards, ordinances, and codes at the local level, has been used by the Center to review local development regulations in over 75 communities and by other organizations to make updates to their local codes or to conduct their own roundtables.

Much has happened in the world of stormwater and site planning in the 18 years since the release of the Better Site Design Handbook. Technical and regulatory advances have changed how stormwater is managed and sites are developed, and changing climate conditions may necessitate future modifications to stormwater designs. In addition, many users of the Handbook and the COW have noted updates are needed to reflect different development scenarios, and to address where development occurs. To respond this need, the Center for Watershed Protection is embarking on an effort to revise the Better Site Design Handbook and the related support products. The following updates are proposed:

- Updates to the COW questions to reflect the latest in stormwater management technology and regulations such as MS4 permits
- Different versions of the COW for different site situations including new development, redevelopment and stormwater retrofits
- New case studies
- Updated research on Better Site Design effectiveness
- A model code/ordinance library
- A section that addresses where development occurs
- Additional tips on how to get from code review to revisions, using lessons learned from the roundtables
- Online, web-accessible format

**Cost: \$250,000**



### 3 Illicit Discharge Detection and Elimination Research

Over the past few decades, we've developed efficient and effective ways to find illicit discharges of sewage into our storm drains and waterways. Yet, we are falling short on the best ways to actually fix these problems. This is evidenced in cities such as Baltimore, where sewage in local streams, streets and basements is a common occurrence.



Research shows that illicit discharges are a pervasive and persistent problem that can be a significant source of bacteria and nutrients in urban watersheds.

The Center released its Illicit Discharge Detection and Elimination (IDDE) manual in 2004 and recently assisted the Chesapeake Bay Program to recognize the removal of nutrient discharges to the stormwater system as a creditable BMP for meeting the Chesapeake Bay TMDL. Preliminary estimates show this is a very cost-effective BMP that also addresses a human health concern.

More work is needed to better quantify the pollutant removal and costs associated with correction of illicit discharges, to evaluate the effectiveness of proactive prevention strategies (e.g., inspection of laterals) that rely on systematic inspections of the system rather than outfall monitoring and tracking and to develop improved strategies for tracking down and eliminating these discharges. This would involve the integration of wastewater programs that are charged with the elimination of sanitary sewer overflows typically regulated by consent decree, and stormwater programs that are required to address illicit discharges through MS4 permits. The effectiveness of both programs at achieving water quality objectives can benefit from a watershed-based approach where decisions on implementation can be balanced against the cost-effectiveness of other watershed BMPs such as green infrastructure. This work would include a national benchmarking survey of state IDDE program requirements as well as specific research projects with individual communities. The IDDE guidance manual would be updated to reflect the results and other knowledge gained over the past 10 years.

**Cost: \$210,000- \$275,000**

### 4 Updating Stormwater Retrofit Cost Data

Across the nation, cities and towns are gearing up to implement ambitious and costly stormwater retrofit strategies to achieve pollution reduction goals driven by MS4 permits, TMDLs and other watershed restoration efforts. The Center developed stormwater retrofit cost equations in 2007 for estimating planning-level costs of different retrofit types. Despite being outdated, this study is still the primary source available for estimating stormwater retrofit costs. More recent efforts to quantify costs still rely heavily on this study and on other similarly dated sources. The past five years has seen a huge rise in implementation of green infrastructure retrofits by municipal agencies, non-profits and consulting firms. The Center proposes to compile cost data from these installed practices to provide a much-needed update to the knowledge base on stormwater retrofit costs. The work will include collecting data from various sources and compiling into a consistent format; analyzing the data; and summarizing the results to provide more reliable estimates of the costs to design, construct and maintain these practices, so that communities can make better plans and determine which strategies are the most cost-effective. Sources of data will include the Center's own projects, municipal stormwater agencies, state agencies, consulting firms, and foundations that fund a significant amount of retrofit work.

**Cost: \$100,000-\$200,000**

## 5 Incentives for BMPs on Private Property

Communities across the U.S are faced with increasingly stringent requirements for managing stormwater and reducing pollution to meet regulatory requirements such as CSO reduction, MS4 permits, and TMDLs. Achieving compliance with these regulations requires reducing runoff and pollutants from already developed lands through stormwater retrofits. The availability of public land on which these practices can feasibly be installed is limited in most urban areas by available space, competing needs, utility conflicts and other factors. These site constraints make installing retrofits on public land much more costly than on private lands. For these reasons, communities must figure out how to also harness private lands for stormwater retrofit installation. They need to know what are the most effective incentives—including financial incentives, outreach, and technical assistance—to promote widespread use of stormwater BMPs on private property. This project will investigate which elements contribute to the success of local incentive programs and will use surveys to identify barriers to participation and to improve our knowledge on how to design, market and implement incentive programs to address these barriers.

**Cost: \$50,000-\$150,000**

## 6 Assessing the Demand for a Stormwater Workforce

Stormwater runoff is one of the only growing sources of water pollution in the U.S. and the regulations to curtail it have grown exponentially in the past few decades. EPA's 2008 Clean Watersheds Needs Survey illustrates this growing need, with estimated costs to control polluted runoff over the next 20 years at \$42.3 billion. These planned investments in water quality BMPs represent a significant local workforce development opportunity, as in many regions there is enormous demand to install stormwater management practices to meet Clean Water Act requirements, but there is a lack of skilled workers who know how to construct, inspect and maintain them. The Center is developing a Clean Water Certification and Workforce Development Program whose goal is to partner with local workforce development organizations and agencies to translate training opportunities into actual jobs and/or new businesses for individuals in low-income communities. A key early step to developing successful local workforce development programs is to have a complete understanding of how BMP implementation is planned over the next five to ten years. The Center proposes research to quantify the demand for stormwater BMP construction and workers, focusing on the Metropolitan Washington, DC region as a pilot study. Understanding the types, numbers, schedules, and locations of planned stormwater construction projects will highlight the specific skill sets needed to complete the job tasks associated with construction and maintenance of the projects and will lay the ground work for designing a local workforce development training program that meets this demand.

**Cost: \$150,000**

## 7 Managing Stormwater Runoff from Agriculture

Runoff from agricultural land is the single largest source of nutrients polluting U.S. waters. Yet not much has changed about agricultural BMPs in the last 20 years. Nutrient management techniques are important, but there is a limit (~10%) to how much nitrogen reduction can be achieved. Is there a place for runoff reduction practices—similar to those used to treat urban runoff—as a tool in the agriculture toolbox? This project will determine how to adapt these designs for agricultural use and ensure that adequate incentives are considered for landowners to make use of these practices. The latter will be addressed in part by aligning the codes/standards for NRCS practices available for cost-share with state or regional practice efficiencies. Specific BMPs would be included or excluded in this effort based on their water quality benefits. Initial focus regions would be the Chesapeake Bay and the Upper Mississippi River Basin, as there is an existing wealth of information in these areas.

**Cost: \$180,000**

## 8 Catchment-Scale Research on Land Cover Impacts and Restoration Effectiveness

The Center has studied the impacts of urbanization on stream health and has helped many communities implement restoration projects to mitigate these impacts over the past 25 years. Yet some key questions remain regarding the relationship between land use/land cover and watershed health and the extent to which restoration strategies are actually effective at improving watershed health. The Center's home state of Maryland is a treasure trove of data stemming from unique requirements such as the Forest Conservation Act, which establishes rules that minimize the loss of existing forest, and in some cases re-establish forests, on development sites; the MS4 permits, which require restoration of 20-30% of untreated impervious cover and require jurisdictions to review and revise their development regulations to promote Environmental Site Design, and House Bill 987, which requires Phase I MS4s to establish a stormwater utility fee. Key data sources resulting from these and other programs include: detailed spatial data on impervious cover, including whether it is treated or untreated, statewide 1-meter resolution land cover data that identifies tree canopy, impervious cover and turf cover; databases tracking the forest acres cleared, conserved and planted at development sites; outfall water quality monitoring data from the 10 Phase I MS4 jurisdictions; and statewide stream biological survey data. All this provides a perfect laboratory to further examine these research questions at the catchment scale. This work would include data compilation and analysis to answer one or more of the following questions:

- Does Environmental Site Design actually reduce impervious cover?
- Does the Forest Conservation Act work to reduce forest loss?
- What is the relationship between urban tree canopy in a catchment and nutrient concentrations at the outlet?
- What is the relationship between level of "treatment" in a catchment and water quality at the outfall? How does the type and location of the treatment and the level of development affect this relationship?
- What percent of a catchment needs to be treated with BMPs to reduce runoff enough to protect stream channels?

**Cost: \$100,000- \$450,000**

## 9 The Impact of Pet Waste Outreach Programs

Most people don't initially think of their furry friend Fido when they hear the term "water pollution." Yet, dogs produce a LOT of waste and this waste contains pathogens (such as bacteria) and nutrients, two of the most common causes of river and stream pollution in the US, according to the EPA. Although preliminary estimates show that an outreach program to encourage dog owners to pick up their pet's waste is one of the most cost-effective strategies for reducing nutrients in urban runoff, additional research is needed. This work would include monitoring studies to learn more about the contribution of pet waste to bacteria and nutrient loads in streams, and to measure the before-and-after effects of an outreach program on people's behavior and, ultimately, on water quality.

**Cost: \$200,000- \$300,000**

## **10** Leaf Litter Research Summit

Leaf litter is a needed energy and food source to streams, yet urban development dramatically alters the timing, amount and type of leaf litter in streams and can result in excessive delivery of phosphorus to urban streams and nutrient-sensitive lakes. Phosphorus readily leaches from leaves once immersed in runoff; however, questions remain about the relative contribution of this nutrient source relative to other sources in the watershed. A comprehensive review of the collective research nationwide on this topic has yet to be done, and agreement on how best to address this phosphorus source as part of stormwater management programs is also needed. Programs such as leaf litter collection and street sweeping appear to be very cost-effective nutrient removal strategies in terms of the cost per pound removed, but either are not “credited” as part of nutrient reduction strategies, or do not directly account for leaf litter as part of the crediting approach. The Center proposes to convene researchers and those responsible for meeting water quality goals to translate the science on urban leaf litter and to reach agreement among these stakeholders on how to best manage leaf litter as part of stormwater programs. This work will involve convening up to 25 notable researchers, local stormwater managers, State and Federal government agencies and non-profit organizations at a one-day summit to share, distill, discuss and build consensus on the role of leaf litter in stormwater management programs. The results will be summarized in a white paper and will provide the first step in developing state/regional crediting strategies for reducing nutrients from urban leaf litter as well as local programs that maximize nutrient reduction.

**Cost: \$80,000**



Leading the nation with clean water solutions

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