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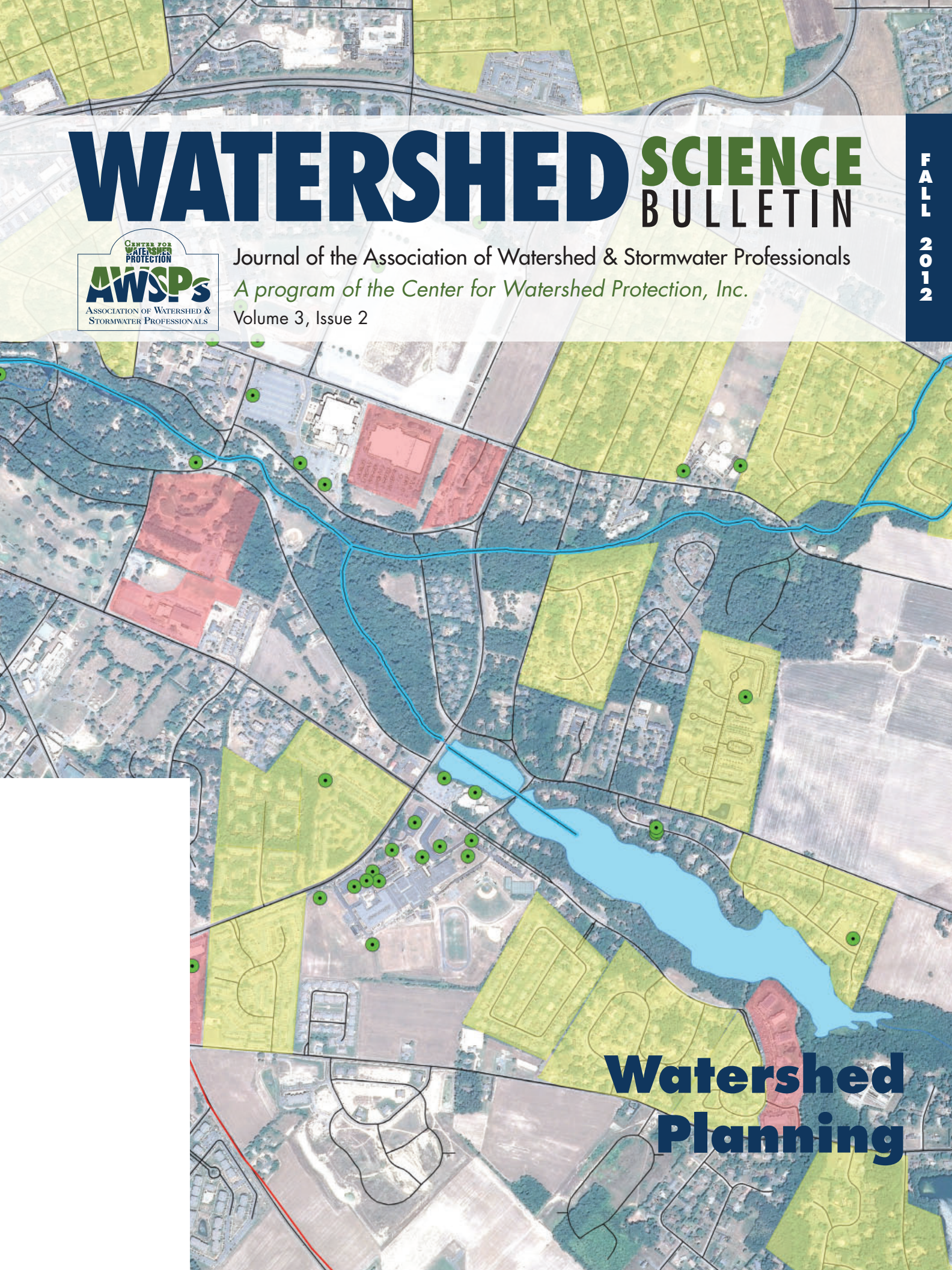

Watershed Planning

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showing Wicomico River watershed field assessment locations in Salisbury, Maryland.

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Tracking the Progress of Watershed Planning: Two Views

Stuart Lehman,[a] Karen Cappiella,[b] Julie Schneider,[c] and Laurel Woodworth[d]*

Abstract

This article evaluates watershed planning across the country from two perspectives—a bird's eye view and a ground-level view. The US Environmental Protection Agency (USEPA) provides a bird's eye view of the Clean Water Act Section 319 program based on an internal review of the agency's funding guidelines for the development of watershed plans (the "a–i criteria"). The Center for Watershed Protection provides the ground-level perspective with lessons learned from its recent survey of watershed plans developed for the restoration of water quality in small urban and suburban watersheds in the eastern United States. The major finding from the bird's-eye review of watershed planning is that many watershed plans being developed with USEPA funding are not sufficiently detailed to ensure the attainment of water quality standards. On the other hand, the ground-level review showed that most watershed plans are being used on some level and reported an impressive level of implementation. A summary of watershed planning elements to facilitate implementation is provided.

Introduction

This article evaluates the progress of watershed planning across the country from two perspectives—a bird's-eye view, from the perspective of a federal agency that funds watershed planning projects, and a ground-level view, from the perspective of local organizations and agencies that have developed and implemented watershed plans. The US Environmental Protection Agency (USEPA) provides funding and technical assistance for states and other entities managing water pollution. The Center for Watershed Protection (the Center) is a leading watershed research organization and local assistance provider. In this article, USEPA provides the bird's-eye view with a report on the results of an internal review (USEPA 2011) on how well the agency's guidelines have been followed for the development of watershed plans. The Center provides the ground-level perspective with lessons learned from its recent survey regarding watershed plans developed for the restoration of water quality in small urban and suburban watersheds in the eastern United States.

USEPA defines a *watershed approach* to water resource management as one that is hydrologically defined, involves all stakeholders, and strategically addresses priority water resource goals (USEPA n.d.). A watershed approach addresses all stressors (e.g., atmospheric deposition and stormwater runoff) for a single water body and integrates multiple programs (e.g., stormwater, wastewater, and drinking water), whether regulatory or voluntary. Watershed plans can be created at various scales to address a number of impacts to rivers, streams, lakes, and estuaries. The impacts include those that are physical (e.g., changes in flow regime and temperature), water quality–related (e.g., contamination with metals and nutrients), biological (e.g., a loss of sensitive species), and ecological (e.g., habitat fragmentation and loss). Any of these types of impacts can drive the need for watershed planning. Historically, physical impacts of flooding have been the motivation for hydrologic watershed planning, including the development of flood control reservoirs and levees. Impacts on water quality became an additional driver for watershed work in recent decades with the passage of the Clean Water Act (CWA). Impacts on aquatic biota, such as declining fisheries, are behind multistate watershed initiatives in the Chesapeake Bay, Puget Sound, and Great Lakes, among other locations. Mitigation requirements for impacts to streams and wetlands under Section 404 of the CWA are a major driver for the development of watershed-based plans to identify priority restoration sites to "replace" lost ecological functions.

An integrated approach to watershed management (Figure 1) that addresses all of a watershed's various pollution sources, conservation and restoration programs, and community goals has a better chance of identifying and addressing all of these impacts. Such an approach also promotes efficiency and can help ensure that the watershed plan is funded and implemented. The four-step, cyclical process shown in Figure 1 describes watershed management as an integrative and adaptive course of action that involves a wide variety of state, local, federal, and tribal programs as well as private initiatives (USEPA 1995a,b).

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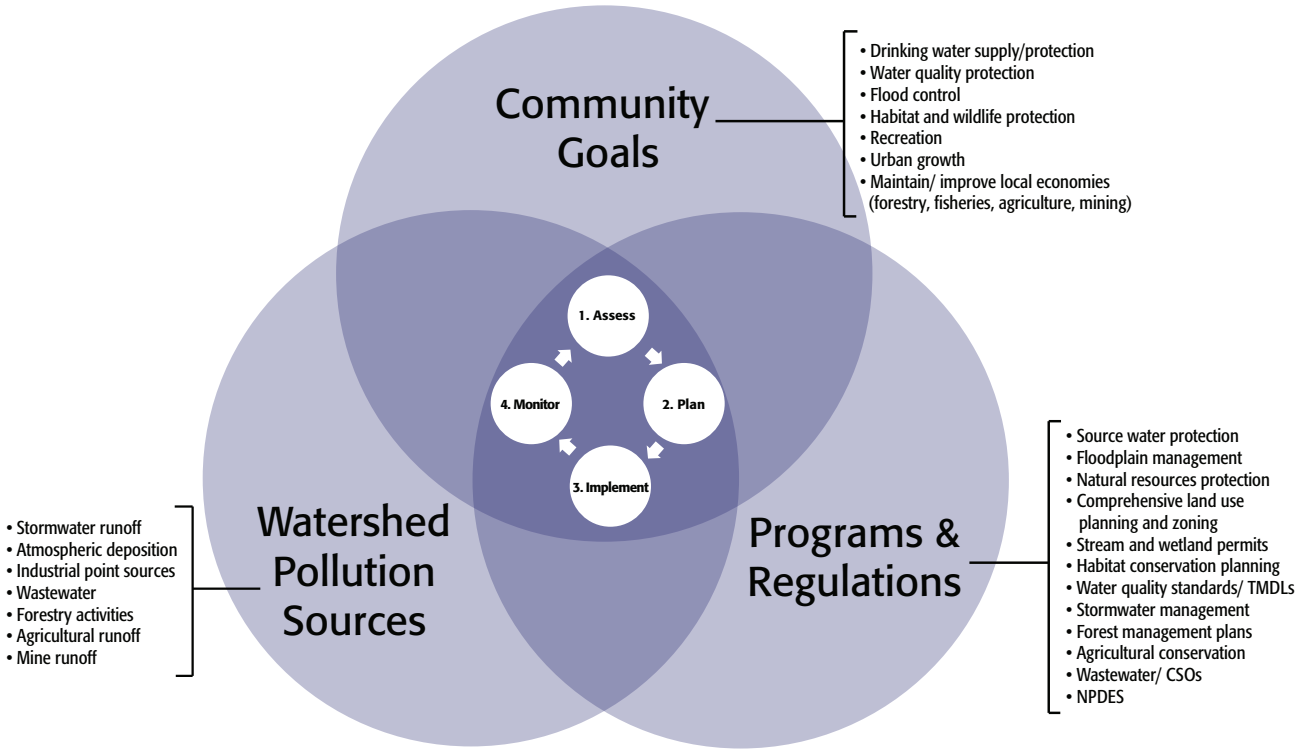

Figure 1. Integrated watershed management. CSO, combined sewer overflow; NPDES, National Pollutant Discharge Elimination System; TMDL, total maximum daily load.

While both USEPA and the Center support an integrated watershed management approach, most of the watershed plans funded or developed by these organizations deal primarily with water quality impacts, specifically nonpoint source pollution (which includes runoff from urban and agricultural areas). The CWA is the primary driver behind the development of USEPA-funded watershed-based plans; therefore, to date, much of the funding and opportunity for the improvement of water resources has been provided through state–federal partnerships to maintain or improve water quality, with limited integration of air quality, flood control, hazardous waste, groundwater, or other programs into the watershed plans. Similarly, the scope and budget for the Center's watershed plans is typically driven by a single entity (e.g., a municipality), often with a single objective, such as meeting the requirements of a stormwater permit. As a result, managing stormwater runoff is a major focus of the Center's watershed assessments and plans, whereas sectors such as agriculture, drinking water, and wastewater receive more limited attention.

To develop a watershed plan that integrates the objectives of multiple programs, collaboration among agencies must occur at the scoping stage for the watershed plan. However, each program often is handled by a separate local government department or state agency, whereas the entity developing the watershed plan has responsibilities and authority within just one of those areas. For example, stormwater, wastewater, and drinking water are typically addressed by separate agencies with different priorities and resources, and each of these agencies may have limited interaction with those that deal with land use planning and natural resources protection. This is a fundamental challenge of watershed planning. Addressing all pollution sources in a watershed plan can also be difficult. For example, developing specific watershed plan recommendations to address agricultural impacts can be limited by landowner privacy concerns. In some instances, close collaboration with key landowners at the early stages of plan development has been successful in overcoming these issues of data and property access.

The approaches of USEPA and the Center differ in that USEPA funding for watershed plan development and implementation by states is directed toward more rural watersheds of a larger size (typically from hydrologic unit code [HUC] 8 scale in the western states to HUC 12 scale in the east), while the Center provides direct support to local governments and watershed groups in smaller (less than 259 km^2, HUC 12 scale or smaller) urban or urbanizing watersheds (Figure 2). Both approaches to watersheds involve working at the local level with landowners, land managers, and watershed groups. Both organizations also recognize the importance

USEPA 319-Funded Watershed Plans
- Predominantly rural
- Typical scale is HUC 8 (in the west) to HUC 12 watersheds (in the east)
- Incentive-based/nonregulatory
- Multi-agency technical support
- Leveraged USDA funding
- Key partners: conservation districts, university extensions, and nonprofit watershed groups

Local Watershed Plans Developed by the Center for Watershed Protection
- Predominantly urban and urbanizing
- Typical scale is smaller than HUC 12 watersheds
- Key partners: local governments and nonprofit watershed groups
- Key elements: low-impact development, stormwater retrofits, pollution source control

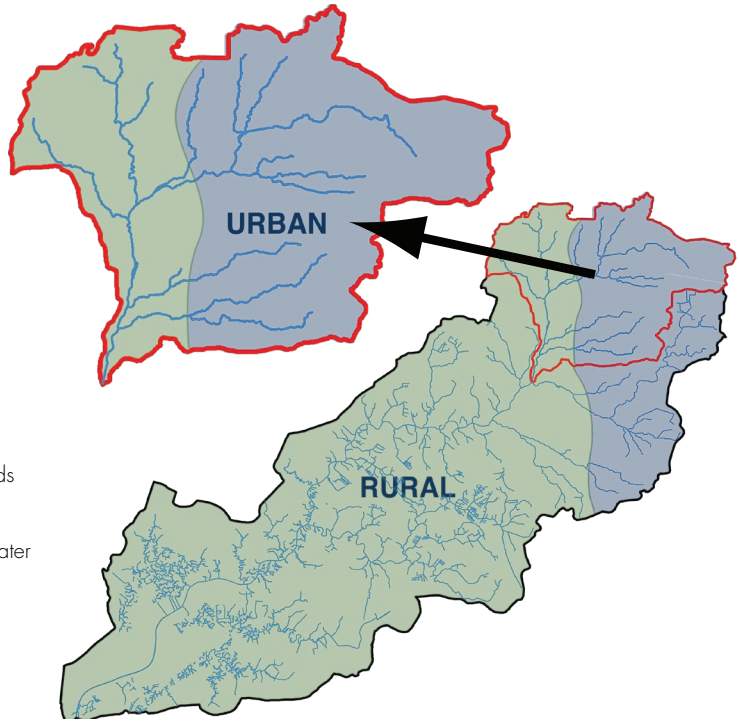

Figure 2. USEPA and Center for Watershed Protection—scale and focus of watershed plans. USEPA 319-funded watershed plans are funded through, and overseen by, the nonpoint source management program established under the Clean Water Act. USDA, US Department of Agriculture.

and value of leveraging resources from private and public sources to implement pollution control practices.

USEPA's Review of CWA Section 319–Funded Watershed Plans

Since the mid-1990s, USEPA has embraced an integrated watershed approach across its CWA programs. The agency has created guidance manuals, provided training, organized conferences, and created tools and online databases that support the alignment of these programs along watershed boundaries. Appendix A provides a summary of USEPA resources for watershed assessment, planning, and implementation. Watershed planning has been an integral part of the CWA since it was first authorized in 1972, beginning with Section 208, which required basin-wide plans for point and nonpoint sources, and with Section 303(d), which called for states to list impaired waters and develop total maximum daily loads (TMDLs; analyses of the level of pollution reduction needed to attain water quality standards). USEPA's funding guidelines suggest that watershed-based plans be developed using information from TMDLs and other water quality assessments and reports that can serve as building blocks for the plan. The CWA also authorizes states to conduct Section 401 certifications of federal permits and licenses that look comprehensively at water quality impacts.

Congress established the Section 319 national program to manage nonpoint sources in the 1987 amendments to the CWA. The program requires states to assess their waters for nonpoint source pollution or water quality threats, develop statewide nonpoint source management programs on a watershed-by-watershed basis, and provide funding for demonstration projects to manage nonpoint source pollution. Section 319 funds for states grew from $38 million in 1990 to about $100 million in 1998. In 1999, Congress doubled that amount to $200 million. This $100 million increase was termed *incremental* 319 funding for the purpose of guidance from USEPA. In 1999, USEPA began requiring that state programs focus their Section 319 watershed project funds on 303(d)-listed waters. Since 2003, the Section 319 funding guidelines for grants have required states to ensure that projects funded with the new incremental federal funds have watershed-based plans in effect that include nine specific elements (USEPA 2003). When these elements are incorporated into a watershed plan, implementation is more likely to lead to the attainment of water quality standards. In In addition to meeting these nonpoint source funding requirements, a plan provides the rationale for restoration work, and the plan itself can be used to inform decision making for a variety of federal, state, and local programs. The nine plan elements ("a–i criteria") to be addressed in a USEPA Section 319–funded watershed plan are listed below.

a. An identification of the causes and sources of pollution by land use subcategory.

b. An estimate of the load reductions expected for the management measures specified.

c. A description of the nonpoint source management measures that will need to be implemented to achieve the load reductions, and an identification of the critical areas in which those measures will be needed.

d. An estimate of the amounts of technical and financial assistance needed to implement the plan.

e. An information and education component that will be used to enhance public understanding of the project and encourage the early and continued participation by members of the public.

f. A schedule for implementing the nonpoint source management measures identified in the plan.

g. A description of interim, measurable milestones for determining whether nonpoint source management measures are being implemented.

h. A set of criteria that can be used to determine whether loading reductions are being achieved over time.

i. A monitoring component to evaluate the effectiveness of the implementation efforts over time.

Methods

In 2006 and 2008, USEPA's Nonpoint Source Control Branch conducted reviews of watershed-based plans (USEPA 2011). For both evaluations, USEPA requested that each regional USEPA office submit the best plan from each of the states in its region. In most cases, the requests were passed on to the state nonpoint source program staff for consideration. The primary purpose of both reviews was to determine how well local subgrantees and states were following USEPA's "a-i criteria" for the supplemental Section 319 funds that were intended for watershed project implementation. In addition, the reviews identified areas for improvement in watershed plans and provided examples of effective and innovative approaches to guide future watershed planning.

Table 1. Summary of 2008 review findings for "a–i criteria."

Watershed Element	Survey Findings
a: Identify causes and sources that need to be controlled to achieve estimated load reductions	• Sources were identified in most plans, however load estimates from significant source categories (e.g., agriculture or urban land) were sometimes missing. • Sources of pollution often were not quantified at a level useful for watershed restoration (e.g., more specificity was needed regarding locations and types of sources).
b: Estimate load reduction from management measures	• Plans did not provide load reduction estimates. • Load estimates were not linked to overall watershed goals.
c: Identify type and location of management measures to achieve load reduction	• Most plans met this criterion, however some did not explain why certain measures were selected.
d: Provide estimate of costs, funding sources, and partners responsible for implementation	• Most plans met this criterion. • Some plans were missing detailed information.
e: Educate the public and encourage participation	• Most plans included an educational component but did not discuss the potential results of these efforts.
f: Implementation schedule	• Plans often included only a 1-year schedule. • Specific details for implementation were missing (e.g., responsible partner, cost, and timeline).
g: Interim, measurable milestones to assess implementation	• Plans often included only a 1-year schedule. • Specific details for implementation were missing (e.g., responsible partner, cost, and timeline).
h: Establish criteria to determine if goals are achieved	• Plans that did not address element b also did not adequately address element h since these are closely related. • Confusion was evident between elements g (achievement of implementation steps, like the number of best management practices installed per year) and h (expected levels of pollutants of concern at points in time). • Most plans did not identify how progress would be reviewed or who would conduct the review.
i: Establish a monitoring program to assess progress	• Most plans relied on existing state monitoring plans. • The timeline and responsibility for monitoring was lacking in a few plans.

Source: USEPA 2011.

The 2006 review covered 30 plans, and the 2008 review addressed 49 watershed plans. With both evaluations, USEPA developed a scoring system to judge how well the plans addressed the "a–i criteria," with weighting to provide some reflection of the relative importance of each of the nine elements. The agency did not set a pass/fail score for the overall plans; instead, it used the results to identify the relative ranking by which to select model plans. In the 2008 review, USEPA collected additional details about each plan—including watershed size, watershed plan author, pollutant(s) addressed, and models used—to look for trends related to the quality of watershed plans.

In addition to the two watershed plan reviews, USEPA conducted a self-evaluation of its administration of Section 319 funds in 2011, in part to see if the CWA Section 319 national nonpoint source program could be more effective. For this evaluation, USEPA headquarters staff conducted interviews with regional USEPA staff and state nonpoint source program managers. States and regions were given an opportunity to review and provide comments on the assessment. The results of this evaluation are also presented below as they pertain to watershed planning.

Results

The 2006 plan review found that, while some plans were good enough to be shared as examples among state nonpoint source programs, many plans did not adequately address all of the "a–i criteria" and therefore were not likely to lead to the attainment of water quality standards. Plans reviewed in 2008 primarily addressed sediment, bacteria, and nutrients, and many were authored by private consultants or state environmental agencies. The size of the watershed was not correlated with the quality of the plan; however, plans that used models consistently scored higher than plans that relied solely on monitoring data (USEPA 2011). In both the 2006 and 2008 reviews, the elements that scored consistently high were "a" (identify causes and sources of pollution), "c" (describe recommended management measures), "e" (public education), and "i" (monitoring). The elements that were consistently inadequately addressed in both reviews were "b" (expected load reductions) and "h" (criteria for determining if load reductions are met), which is unsurprising given that these two elements go hand in hand. For example, many of the plans did not provide any load reduction estimates, making it difficult to determine whether the proposed measures would meet the defined water quality goals (element "h"). Table 1 provides a summary of the major findings for each individual watershed element from the 2008 review.

Each review called out specific elements of certain plans that USEPA believes provide good examples of addressing one or more of the nine elements, even for plans that had deficiencies overall. Six plans from the 2006 review and four plans from the 2008 review provided the best examples of watershed plans (Table 2).

Table 2. Watershed plans comprehensively addressing "a–i criteria" in USEPA watershed plan reviews.

Watershed Plans from 2006 Review	
Corsica River Watershed, Maryland	The watershed area is approximately 40 square miles. This plan includes a $9 million municipal wastewater treatment plant upgrade and about the same amount in nonpoint source controls. Load reductions are based on the same model being used for the Chesapeake Bay restoration effort. (http://dnrweb.dnr.state.md.us/download/bays/cr_strategy.pdf)
Crab Orchard Creek Watershed, Tennessee	This plan addresses several abandoned mine drainage sites in one watershed. A spreadsheet model is used to estimate alkalinity levels after treatment with limestone, wetland creation, grading, and revegetation. Many of the structures provide neutralization for 30 or more years. (http://www.discoveret.org/chota/COC_Watershed_Plan.pdf)
South Branch Yellow Medicine River Watershed, Minnesota	This plan uses models and literature values to estimate source loadings and load reductions from BMPs. Addresses fecal coliform pollution from livestock, wildlife, pets, and humans in a three-county watershed. (http://www.pca.state.mn.us/publications/wq-iw7-01c.pdf)
Millers Creek Watershed, Michigan	This detailed plan for a partly urban watershed includes the campus of the University of Michigan and reports on various load reduction scenarios for proposed projects and existing treatment systems. (http://www.aamillerscreek.org/Findings.htm)
Flint River Watershed, Alabama	This is a short plan that nevertheless provides a good example of watershed-based planning. The plan provides an example of how the SWAT model can be used to develop pre- and post-BMP implementation scenarios to estimate expected pollution reductions. The plan has a good cost section. (http://www.flintriverconservation.org/FlintRivermgtplan.pdf)
Fort Cobb Watershed, Oklahoma	This plan does an excellent job of evaluating current loads, identifying the primary sources, and establishing an effective management scheme for reaching reduction goals. The planners use the "PRedICT" scenario builder to evaluate treatment effects and implementation costs. (http://www.ok.gov/conservation/documents/Ft.%20Cobb%20Watershed%20Based%20Plan%202009.6.22.pdf)
Watershed Plans from 2008 Review	
Lake Eucha/ Spavinaw River Watershed, Oklahoma	This plan nicely describes the overall goals and how they relate to the needed load reductions and interim water quality measures. The watershed is modeled using the SWAT model, and the plan has a detailed monitoring component. (http://www.environment.ok.gov/documents/CWA/GrantWorkplans/Eucha-Spavinaw%20Watershed%20Riparian%20Protection%20Initiative/EuchaSpavWBPRev2-07.pdf)
Lower Big Blue/Lower Little Blue River Watersheds, Kansas	This plan uses the SWAT model to compare various pollution control scenarios. The plan describes how the model was selected, validated, and run. The plan targets critical areas and provides a breakdown of costs for alternative BMP scenarios. (http://www.kdheks.gov/nps/wraps/Tuttle_Plan&summary.pdf)
Hawksbill and Mill Creek Watersheds, Virginia	For this plan, three specialized stakeholder groups provided detailed planning information and recommendations on identifying sources and selecting BMPs. Targeted locations are identified for maximum load reduction. (http://www.deq.state.va.us/Portals/0/DEQ/Water/TMDL/ImplementationPlans/hksmillip.pdf)
Lower Monocacy River Watershed, Maryland	The plan is an update to an earlier plan so it serves as an example of how an adaptive approach can be applied to planning and improving the pollutant reduction estimates. The plan uses several assessment approaches for various land uses, including a stream corridor assessment and the Impervious Cover Model to assess loads. Costs and benefits are provided, and a cost–benefit analysis is done, which is rarely the case. (http://www.dnr.state.md.us/watersheds/surf/proj/lmon_char.html)

Notes: BMP, best management practice; PRedICT, Pollution Reduction Impact Comparison Tool; SWAT, Soil and Water Assessment Tool.

The USEPA reviews of watershed plans from around the country show that improvements are needed to promote the development of higher-quality watershed plans. Based on these reviews, USEPA (2011) made the following specific recommendations for the states: (1) dedicate sufficient Section 319 funds to watershed plan development to ensure that the "a–i criteria" are adequately addressed and (2) develop watershed plans at a scale that provides the appropriate level of detail (e.g., HUC 12).

The watershed plan evaluation report (USEPA 2011) also includes the following recommendations for USEPA:

- work more closely with the states to increase technical capacity and to ensure that states are investing adequate funding in plan development and implementation;
- distribute the "best" watershed plans to provide examples for plan developers; and
- interview developers of the best watershed plans to gain insight that can be incorporated into watershed planning resources.

A notable finding from USEPA's evaluation of the 319 program in 2011 is that, although CWA Section 319 funding has contributed to more than 355 "success stories" nationwide, largely due to efforts in planning comprehensive watershed projects, this represents only about 1% of the total number of impaired waters (USEPA 2011). Thus, USEPA must find other ways to leverage CWA Section 319 funds and reduce costs related to planning and implementation. The agency is promoting various ways to leverage programs and resources for watersheds. For example, the USEPA Wetlands Program is supporting efforts by the Environmental Law Institute and The Nature Conservancy to help state regulatory agencies and wetland mitigation banks find high-quality sites within watersheds that would serve as cost-effective targets of stream and wetland mitigation funds. USEPA also suggests that states document the need for watershed planning and implementation as part of their annual *needs surveys* to qualify for Clean Water State Revolving Fund (SRF) low-interest loans for pollution control work. The SRF can be applied to efforts to address both point and nonpoint sources and has been successfully used to fund land acquisition in California, source water protection in New York, and stormwater retrofits in Massachusetts, to name a few. Nearly all of the above success stories involve leveraging state and other federal funds and technical assistance (e.g., USDA programs and advisors).

The Center's Review of Small Urban Watershed Plans

The Center has been developing watershed-based plans since its inception in 1992. To date, the organization has developed or contributed to the development of plans for more than 50 watersheds across the country. The Center's approach to watershed planning has evolved over the years, but some constant features have included:

- a focus on small watersheds (e.g., less than 259 km^2) and their subwatersheds (e.g., 26–52 km^2) as the appropriate scale for planning and implementation;
- a focus on urban and urbanizing watersheds;
- a rapid approach to watershed assessment and plan development;
- close coordination with local partners who are committed to watershed restoration; and
- the inclusion of specific recommendations with guidance for their implementation.

The earliest Center guidance on watershed planning, the *Rapid Watershed Planning Handbook* (Center for Watershed Protection 1998), was heavily focused on protecting watersheds from the impacts of land development. This document introduced the "eight tools of watershed protection," which provide a framework for the development of a watershed plan that considers all phases of the land development process, from land use planning through the design and construction phase, and ultimately to building occupancy. More recent Center guidance has focused on restoring small

urban watersheds. Planning and assessment techniques for this purpose are documented in the Urban Subwatershed Restoration Manual Series (Schueler and Kitchell 2005; Kitchell and Schueler 2005; Wright et al. 2005; Schueler et al. 2007). Appendix A summarizes the Center's resources for watershed assessment, planning, and implementation.

Methods

The Center recently conducted a follow-up survey on a subset of the numerous watershed plans the organization has developed over the years. The goal was to gain insight that would help inform future watershed plans and planning guidance. More specifically, the survey set out to determine whether the plans are being used, the extent of implementation that has occurred, and key lessons learned in the planning process and in making the plan recommendations a reality. Of the watershed plans completed, the survey targeted 14. The survey included only plans that were at least five years old to allow sufficient time to evaluate implementation progress. In some cases, very old plans (older than ~15 years) were not selected because too little information existed about the plans and the appropriate local contacts. Since the majority of plans were located in Maryland and Virginia, the Center gave plans outside of these states a higher priority to provide better geographic representation.

The Center compiled contact information for each plan and developed a short, 14-question survey (Appendix B). After emailing the survey to each contact, Center staff followed up with emails and phone calls to encourage a higher response rate. We received 11 survey responses, for a 79% response rate, from eight states in the eastern United States (Figure 3).

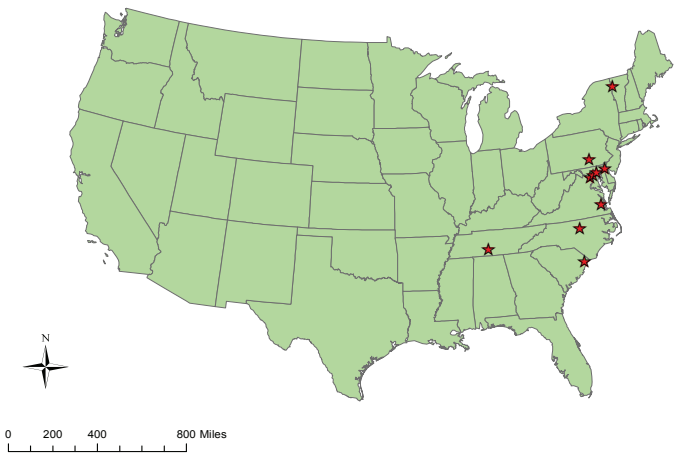

Figure 3. Locations of watersheds for 11 survey respondents. Insert this: 1 mile ≈ 1.6 km.

The watershed plans reviewed were developed between 2001 and 2006 for watersheds ranging in size from 26 to 337 km^2. The watersheds include highly urban areas (e.g., Harrisburg, Pennsylvania), suburban development (Howard County, Maryland), and rural lands (Marshall County, Tennessee), and most of the watersheds have a combination of these land use types. As a result, the plan recommendations included a mix of protection and restoration strategies, with a few plans for the more urban watersheds focusing solely on restoration. The Center conducted a variety of stream and upland field assessments to develop the plan recommendations. Most plans included estimates of pollutant reduction benefits associated with the recommendations, and some plans also included local program and code reviews.

Results

When asked about **drivers for developing a watershed plan** in their communities, more than half of the survey respondents indicated that a primary motive was to create a prioritized list of specific watershed protection and restoration projects for implementation. A second major goal was to address existing or anticipated regulations and policies, such as National Pollutant Discharge Elimination System (NPDES) stormwater permits and TMDLs. In a handful of cases, funding was mentioned as a motive for developing the watershed plan, either because funding was available for the planning effort, or to improve chances of securing project funding in the future. Other drivers included citizen concerns about erosion and flooding, staff interest, and knowledge that watershed planning could help protect water resources from the impacts of urban growth.

Two questions in the survey attempted to gauge **the extent to which each watershed plan has been used by the community**. All plans were reportedly used to some extent. Some plans were used to select, justify, and/or guide the implementation of capital improvement projects. Other Elements of some plans have been incorporated into local government activities, policies, and initiatives, either on an informal basis or by formally incorporating plan elements into the community's comprehensive plan and/or stormwater management ordinance.

When asked to list the **most useful components of the watershed plan**, respondents nearly unanimously asserted that a prioritized list of specific protection and restoration projects is one of the most useful elements of a plan. Several survey respondents explained that ranking and prioritizing recommended projects turns the watershed plan into a realistic

Table 3. Recommendations for watershed planning improvements.

Topic	Recommendation for Improvement
Plan goals and scope	• Carefully consider the goals and planned use of the plan up front so that it can be scoped and budgeted accordingly. For example, will it be an assessment of watershed impairments that identifies specific improvement measures? Will the plan provide a basis for, or can it be integrated with, other initiatives, such as the creation of a TMDL implementation plan? • Ensure that the plan complies with USEPA's "a–i criteria" such that recommended projects are eligible for USEPA Section 319 implementation funding.
Planning process	• Engage local elected and appointed officials during plan development to educate them in watershed planning and increase their investment in the plan's recommendations. • Promote cooperation among the various watershed jurisdictions. • Engage citizens and the development community throughout the process to address concerns and gain support. • Consider how to best communicate the plan to the public once it is complete.
Plan content	• Use design work for specific projects to develop more accurate cost estimates; for planning-level recommendations (e.g., retrofit 20% of impervious cover), use planning-level costs. • Provide cost data for low-impact development practices. • Provide better data on runoff and pollutant reduction benefits of specific recommended stormwater projects. • Do not spend too much time collecting detailed site-level data (e.g., stream cross-sections) that may change by the time projects are implemented in the future.

roadmap for future implementation. Others mentioned that the field work itself was an important component of the process to identify watershed problems and projects and to increase awareness.

The survey asked participants **how the watershed planning process could have been improved.** This question received a variety of responses, but Table 3 highlights a few common themes and important points.

Each of the 11 watershed plans has reportedly been implemented on some level. The survey asked participants to list the specific activities that have been implemented from their watershed plans to date. Table 4 shows the five most commonly implemented types of recommendations, with an estimate of the extent of implementation. Many activities reported in the surveys were not quantified by survey respondents, so the metrics in Table 4 represent only a portion of the implementation resulting from the plans in these watersheds.

Other types of plan recommendations that have been implemented in one or more of the watersheds include greenway establishment, monitoring programs, the protection of priority natural areas, improved stream buffer management, the creation of financial incentive programs for stormwater projects, exclusion fencing for livestock, stormwater program improvements, and pollution prevention programs.

The survey asked participants to identify the **actions implemented that were most successful at meeting watershed goals**. Stormwater retrofits and stream enhancements were the most common responses to this question, and many of these projects also included an educational or public involvement element. Other types of projects that helped meet watershed goals involved changes to local stormwater rules and/or design criteria intended to help reduce the environmental impact of future development.

By far, the most commonly identified **implementation challenge** was a lack of funding. Only one community had a dedicated source of stormwater management funding (initially from development fees, and then through a stormwater utility), but for most other respondents, cost was noted as a significant barrier to implementation. Other commonly cited challenges were either competing interests among the public or lack of public support, and political resistance or apathy. For example, attempts to pass ordinances for

Table 4. Top five activities implemented from watershed plans.

Watershed Management Practice	Implementation Quantified by Survey Respondents
Stormwater management retrofit projects	> 40 individual projects implemented, treating approximately 429 ha
Stream/floodplain stabilization and restoration projects	6,578 m of stream restored
Public outreach, sometimes targeted to specific groups or industries	Not quantified
Changes to stormwater management regulations, ordinances, or design requirements	Not quantified
Vegetative plantings, especially in riparian zones	2,475 trees and other vegetation planted

wider riparian buffers were blocked due to public opposition in two of the watersheds surveyed. A few respondents described the implementation of practices on private property as a challenge due to either restrictions on the use of public funds on private property or a lack of interest from private landowners.

Some survey participants also shared **lessons learned from implementation**:

- Have access to a robust engineering team if the plan calls for structural stormwater retrofits and stream restoration projects.
- Account for the cost of doing preventive maintenance when developing maintenance budgets for stormwater management practices.
- Secure funds for monitoring to enable a demonstration of the project's benefits.

The survey asked participants to describe **how the plan has helped improve conditions in their watersheds**. Although most respondents did not quantify improvements in water quality as a result of the plan, the majority noted other, more qualitative, indicators of improvement. These included the implementation of projects that addressed obvious pollution problems, such as streambank erosion, as well as visual improvements to the stream and riparian zone. Additionally, in all but one watershed, respondents identified benefits resulting from the watershed planning process itself. These included increased awareness of watershed problems, the formation of citizen advocacy groups, staff training opportunities, and knowledge gained to inform future studies and watershed plans.

Two of the watersheds experienced notable improvements. Stormwater retrofits and pollution prevention practices were implemented in Englesby Brook, a 640–ha watershed in an urban section of Burlington, Vermont. These actions, which were recommended in a 2001 watershed plan to address bacteria impairments, have resulted in the reopening of a public beach at the mouth of the stream. In Lewisburg, Tennessee, the 2003 watershed plan developed for the Big Rock Creek watershed contained recommendations for restoring an urban section of the stream that had experienced much erosion, siltation, and habitat alteration. With the use of streambank stabilization and stream restoration techniques, and with better management of buffers along the stream, this section of Big Rock Creek has been "visibly transformed and vastly improved with healthy riparian buffers, improved stream habitat, and increased species diversity" (L. Colley, Duck River Program Manager, The Nature Conservancy, personal communication, 2012).

Discussion

USEPA's review of watershed plans found that many plans do not adequately address the "a–i criteria" and are therefore less likely to lead to the attainment of water quality standards. From the perspective of USEPA, additional resources and assistance appear to be needed for developing watershed plans. Alternatively, the agency's nonpoint source program may need to clarify its guidance or consider ways to leverage more effective or widespread technical assistance to state and local entities. The Center's bottom-up review of watershed plans provided suggestions for improving the success of watershed plans in terms of whether the recommendations are implemented.

Several trends are apparent from the Center's watershed plan survey regarding the elements that are most important for getting from planning to implementation. First, regulatory requirements, such as NPDES and TMDLs, are major drivers for planning and implementation. Second, implementation is more likely to occur when the actions recommended in the plan are explicit and prioritized. Other approaches that survey respondents considered most successful include folding public education and involvement into restoration activities; engaging local elected officials and key stakeholders *early* in the process of recommending changes to stormwater rules, policies, or design criteria; and identifying a steady local source of funding for the implementation of stormwater-related actions outlined in the watershed plan. A lack of funding, followed by a lack of public support, were identified as the most common barriers to plan implementation.

The challenge of limited funding is echoed in (1) USEPA's review of the nonpoint source program, which identified a need to find other ways to leverage CWA Section 319 funds and reduce costs related to planning and implementation, and (2) the summary report from the USEPA watershed plan reviews, which recommends that USEPA work with states to ensure that they dedicate enough resources to fully address the "a–i criteria." Watershed planning offers a process by which one can leverage resources from other CWA programs to meet multiple objectives and make more efficient use of available resources. Most watershed planning efforts do not take full advantage of these potential collaborations. For example, plans that are driven entirely by NPDES permit requirements may fail to consider and address the objectives of other programs, such as TMDLs

Table 5. Integrated watershed planning.

Community or Program Objective	Link to Watershed Plan
NPDES stormwater program	Water quality goals of program; identify priority projects to meet water quality goals; stormwater mitigation fees, capital improvement budgets, or utility can provide source of funding for implementation; departments of transportation in particular may be a good source of funding for mitigation projects within the same watershed that can achieve stormwater objectives.
TMDLs	Water quality goals of TMDL; a single plan may be able to address both the point and nonpoint load allocations and other water quality goals; Section 319 funding is available for the implementation of nonpermitted stormwater sources.
CSO control plans	Stormwater projects that help address TMDLs and provide other community benefits, such as increased tree canopy and improved air quality, can also reduce the frequency of CSOs; because elimination of CSOs is mandated, funding is allocated by local governments to address them.
Drinking water source protection	Assessments conducted for source water protection can be done in conjunction with assessments for TMDL development and other watershed plan efforts; the scale may differ, but the source water area could be dealt with as a single subwatershed in a larger watershed plan.
Land use planning	A watershed plan should consider whether changes to zoning or local codes and ordinances are necessary to achieve watershed plan goals.
Floodplain management	If included in a watershed plan, stormwater management and land use planning are important tools for addressing a community's floodplain management goals.
Endangered Species Act	Habitat conservation plans for listed species may be available for targeting conservation practices in a watershed plan.
Stream and wetland permits	Mitigation for impacts to streams and wetlands under CWA Section 404 requires a watershed approach; therefore, identifying priority sites for mitigation that also address watershed plan goals can leverage implementation funding.
Conservation planning	Green infrastructure plans, wetland conservation plans, forest conservation plans, and other natural resources plans provide a good source of data to include in the watershed plan as a basis for identifying priority conservation projects.
Clean Water SRF program	SRF low-interest loans are available for upgrades to wastewater systems and nonpoint source-related watershed projects placed on state SRF priority lists.
Agricultural programs	Funding is available from various USDA programs for the implementation of agricultural BMPs and wetlands and wildlife conservation projects; these can be critical to meeting the water quality objectives of TMDLs, source water protection, and so on.
Forest conservation	In states with forest conservation requirements, mitigation fees can be used to fund watershed planning projects; USDA Forest Service and State Forestry programs can address priority sources of sediment and habitat degradation.

Notes: BMP, best management practice; USDA, US Department of Agriculture.

or long-term control plans for combined sewer overflows (CSOs), missing opportunities to pool resources from each program to fund implementation in areas of overlapping priority. The key challenge related to integrating multiple programs within a watershed plan is the enormity of the effort involved with coordinating the plan among numerous stakeholder agencies that have limited communication with each other and often different (or competing) objectives, funding directives, and authority. Table 5 illustrates the various community objectives one can address with a watershed plan as well as the potential sources of implementation funding that can be leveraged by tying various program objectives into the watershed plan. This table provides a starting point for watershed plan developers to identify these important linkages at the scoping stage.

Two funding strategies that probably hold the key to sustained funding for watershed plan implementation are water quality trading and stormwater utilities. A water quality trading program allows sources that reduce their pollutant loadings below target levels to sell their surplus reductions or "credits" to other sources that cannot meet their target levels. This approach allows pollution sources that can reduce pollutants at low cost (e.g., agriculture) to sell credits to those facing higher-cost pollution reduction options (e.g., wastewater treatment plants), and improves the ability of communities to meet their water quality goals. In some cases, trading is the only feasible way to meet a TMDL. Most water quality trading programs have focused on nutrients, although one could establish such programs for other pollutants (Center for Watershed Protection and Williamsburg Environmental Group 2010).

Watershed plan recommendations that address stormwater runoff from urban areas are often the most expensive to implement. Communities can pursue regulatory approaches, such as requiring retrofits to be installed as sites are repaved or redeveloped, or incentive-based approaches, such as the District of Columbia's RiverSmart Homes program, which offers incentives to homeowners for reducing stormwater runoff from their properties. Often these incentives come in the form of

reduced stormwater utility fees. Stormwater utilities provide a source of funding from monthly or quarterly fees charged to landowners for the amount of stormwater produced on their properties. The fees are typically based on the amount of impervious surface on the property and are administered separately from the general fund to ensure a reliable source of funding for the operation of stormwater programs, the maintenance of stormwater infrastructure, and compliance with stormwater permits (Hirschman and Kosco 2008). The development of a utility requires state enabling legislation and local legal authority (e.g., an ordinance), which can take different forms depending on a state's legal structure. The revenue stream can also be used to issue bonds and provide leverage for grants and loans such as the SRF low-interest loans for water projects.

Respondents in the Center's watershed plan survey identified public support as very important for plan implementation. In the USEPA (2011) review, watershed plan element "e," which requires the inclusion of an educational component in the watershed plan, consistently scored well, indicating that most watershed plans document their educational efforts. However, the USEPA report shows that the information provided for element "e" does not indicate how these public education campaigns were designed to enhance public understanding or involvement, leaving a question about whether the public will actually support implementation. This is an area where the USEPA guidance could be clarified so that watershed plan developers can better make this link. An emerging area of focus in public outreach campaigns that could help enhance this guidance is community-based social marketing (McKenzie-Mohr and Smith 1999), an approach that draws from research in social psychology to design public education programs based on the knowledge level, motivations, and impediments identified in the target audience. Responses from the Center survey that highlight successful measures to gain public support include involving stakeholders, especially elected officials, in the planning process from the start to ensure "ownership" of the plan; selecting projects with high visibility and installing educational signage; and engaging local residents to get involved in project implementation. Survey respondents mentioned that one of the challenges related to gaining public support is that people may not see the value in restoring a resource they do not directly use, such as a small urban stream. Clearly, we need to learn more about how to communicate the value of these resources to local residents in terms that matter to them (e.g., finances and quality of life).

Conclusion

The major finding from the "bird's-eye" review of watershed planning in the United States is that many watershed plans being developed with USEPA funding are not sufficiently detailed to ensure the attainment of water quality standards. Given the findings of the USEPA self-evaluation that only about 1% of the total number of impaired waters have been restored, a primary challenge of the USEPA watershed program will be determining how to bring more resources to bear (both financial and technical) and target pollution abatement across the landscape.

On the other hand, the "ground-level" review showed that most watershed plans are being used on some level and also reported an impressive level of implementation, although data were not sufficient to quantify water quality or other improvements resulting from this implementation. The important plan elements for getting to implementation included funding, public support, a list of specific recommended projects, and a regulatory driver such as NPDES. While the last factor is often instrumental to spur the development of watershed plans, a singular focus on a particular program or regulatory mandate can limit the ability of the planning effort to integrate with other programs and address pollution sources beyond just stormwater.

The obstacle of limited funding and resources for watershed plan development and implementation cannot be addressed with a single solution. Increased integration across programs, although challenging, may be the key to leveraging resources from multiple programs, making the planning process more efficient, and also providing a more comprehensive roadmap for improvement in a watershed. Stormwater utilities and water quality trading—as well as emerging innovative funding mechanisms and programs that require or encourage restoration on private lands—will probably need to be explored as part of the solution as well.

In spite of these challenges, both USEPA and the Center found many cases where multipartner collaborative efforts are starting to show measurable progress in managing watersheds. A watershed plan provides a roadmap for improvement in each watershed, with its unique set of problems and community goals. By documenting the critical decisions, responsibilities, analytical procedures, and funding needs, watershed managers can learn from these efforts and develop ways to disseminate this knowledge more widely across the country.

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Appendix A: Online Resources and Tools for Watershed Plan Development

US Environmental Protection Agency Watershed Planning Resources	Center for Watershed Protection Watershed Planning Resources
General Resources • Watershed Central (online watershed management tools) • Community-Based Watershed Management: Lessons Learned from the National Estuaries Program (document) **Assessment** • MyEnvironment (online portal for GIS data, permits, and monitoring data) • Healthy Watersheds (website) • Rapid Bioassessment Protocols for Streams and Rivers (document) • Source Water Protection (website) **Planning** • Handbook for Developing Watershed Plans To Restore and Protect Our Waters • Plan Builder (online tool on Watershed Central website) • Watershed-Based Permitting (website) **Implementation** • Water Quality Trading Tool Kit for Permit Writers (document) • Sustainable Finance: Watershed Funding (website) **Monitoring** • Section 319 Monitoring Program Projects (website) Available at: www.epa.gov/owow www.epa.gov/nps and www.epa.gov/safewater/sourcewater	**Assessment** • Unified Subwatershed and Site Reconnaissance: A User's Manual, Version 2.0 • Unified Stream Assessment: A User's Manual, Version 2.0 **Planning** • Rapid Watershed Planning Handbook: A Comprehensive Guide to Managing Urbanizing Watersheds • Methods to Develop Restoration Plans for Small Urban Watersheds (document) • An Integrated Framework to Restore Small Urban Watersheds (document) • Using Local Watershed Plans to Protect Wetlands (document) • Urban Watershed Forestry Manual. Part 1: Methods for Increasing Forest Cover in a Watershed (document) • The Watershed Treatment Model **Implementation** • Urban Stormwater Retrofit Practices, Version 1.0 (document) • Urban Stream Repair Practices (document) • Pollution Source Control Practices (document) • Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments • Better Site Design: A Handbook for Changing Development Rules in Your Community Available at: www.cwp.org and www.awsps.org/publications/owl-intro.html

Appendix B: Survey of Watershed Plans

Watershed Plan:

1. What was the driver/reason for developing a watershed plan in your community?
2. Is the watershed plan used in your community?
3. Has the plan been integrated into other departments of the community? (e.g., comprehensive planning, development codes and ordinances, erosion and sediment control regulations, etc.)
4. Please list the parts of the plan that are most useful to your community in achieving local watershed/stormwater goals.
5. Please list aspects of the watershed plan that could be improved to help achieve local watershed/stormwater goals and the recommended improvements.
6. Please describe how the plan has helped improve watershed conditions. (e.g., reduce pollutants, engage public, increase awareness of issues, etc.)
7. Since the development of this watershed plan, has your community continued to develop additional watershed plans? If so, what, if anything, has changed in the plan?

Watershed Plan Implementation:

1. Have recommendations from this plan been implemented (e.g., stream clean-ups, changes in programs, etc.)?

If Yes,

2. Please list/describe the specific activities and metrics (e.g., # of acres, etc.) that were implemented. (e.g., 5 residential downspouts disconnected, etc.)
3. What was the cost of implementation for each project implemented? (e.g., cost of materials, staff time, construction, etc.) If you are willing to share cost data please email or mail it to us at xxx@cwp.org or Center for Watershed Protection, 8390 Main Street, 2nd Floor, Ellicott City, MD 21043, Attn: x.
4. Of the projects implemented, which are most successful in terms of meeting watershed goals? (e.g., goals can include pollutant removal, increasing community awareness, etc.)
5. Please describe the biggest challenges (e.g., cost, property rights, community support, etc.) and barriers (e.g., poor soils, contractors, etc.) to implementation. What lessons were learned during implementation that you would change next time?

If No,

6. Why have recommendations not been implemented? Please mark the answer below that best describes your answer. ❑ Lack of funding
   - ❑ Political resistance
   - ❑ Property rights
   - ❑ Lack of community support
   - ❑ Lack of staff
   - ❑ Other: _____

7. Please provide any additional information about the plan in the space provided below.

_____

_____

_____