Workshop participants acknowledged that reducing the overall outfall inspection frequency could enable the program to increase IDDE activities in higher-risk areas or reallocate scarce program resources to other, more effective implementation activities. Workshop participants also generally agreed that permittees should have outfall screening frequencies should adoption of asset management planning systems would greatly assist assessment, planning, and implementation of IDDE program adjustment and targeting.

3.4.1 Enable a More Focused Approach to Outfall Screening

Workshop participants indicated that the emphasis of IDDE programs may need to change over time. After initial efforts to inspect the entire system, it may be appropriate to reduce inspection frequency in areas where illicit discharges are less likely or less potentially harmful. A new permittee would need to identify and characterize its system, whereas a permittee that is continuing coverage may have already established an adequate baseline for evaluating the effectiveness of outfall screening and system inspection activities in its jurisdiction.

Participants suggested that certain areas of a storm sewer system should be identified as screening priorities while others could be de-emphasized based on local characteristics identified during the initial system assessment and outfall monitoring. In areas where no issues have been identified over an extended period or where piping systems are relatively new, it was suggested, communities should be able to redirect their resources to other program activities rather than continuing to screen these locations at regular intervals.

All respondents to the pre-workshop questionnaire agreed or strongly agreed that some MCMs and other program elements should be tailored and scaled to **emphasize productive activities** and deemphasize less productive activities.

In its *MS4 Permit Improvement Guide*, EPA has indicated support of a strategic approach: "Regular field screening of outfalls for non-stormwater discharges needs to occur in areas determined to have a higher likelihood for illicit discharges and illegal connections" (EPA, 2010, p. 24). The guide recommends that permits require some level of dry weather screening activities in priority areas throughout a permit term. However, based on discussions with stakeholders during the workshop, it was clear that many MS4 permits do not provide enough flexibility or guidance on how to tailor screening activities to better balance effectiveness with resource expenditure.

In instances where screening efforts have proven effective, the permit writer could incorporate provisions to incentivize the continuation of these activities; otherwise, resources could be reallocated to support more impactful efforts areas of the program. For example, if a permittee has screened outfalls for years without identifying an illicit discharge, the program could have a permit pathway to substantially reduce outfall screening frequency and invest those resources in a more effective effort.

Participants indicated that while national guidance recognizes the validity of adjusting IDDE programs to focus on higher-risk areas, additional guidance is needed to prompt permit writers to work with permittees to make these changes in permits. Specific examples illustrating how to adjust permit requirements to provide flexibility in IDDE programs could help spur permitting authorities to implement such changes.

ED_002551_00001739-00035

3.4.2 Establish Clear Guidance on Addressing Elevated Bacteria Levels in Stormwater

Photo: EPA

The significant health risk posed by human pathogens in stormwater and its link to leaking systems was raised as a significant concern during the workshop given challenges with efficient source identification/tracking. Many jurisdictions have found that high bacteria levels in stormwater discharges have cross-connections with sewage collection systems and laterals, as well as other local sources of human fecal bacteria (e.g., homeless encampments and illegal dumping of human waste).

Participants recommended the development and issuance of guidance materials to support improvements in two main areas: (1) effective methods/processes for identification of bacteria and (2) how to address bacteria sources associated with cross-connections.

During the workshop, participants described how several communities have effectively tailored their IDDE efforts to focus on human pathogen source tracking methods. Some participants suggested that EPA and/or States support development and endorse implementation of methods that effectively target human-related pathogen source detection and control and create permit language to facilitate these efforts. However, other participants noted that current national bacteria indicator criteria and beach action levels do not distinguish between animal and human sources of bacteria. Moreover, in cases where applicable state water quality standards do not distinguish between human and animal sources, a stormwater control strategy based solely on detecting and controlling human sources may not result in attainment of applicable standards.

The NRC report *Urban Stormwater Management in the United States* underscores the importance of IDDE program activities in identifying the presence of harmful human pathogens. It suggests prioritizing "***waters with a contact-recreation use designation that have had multiple exceedances of pathogen or indicator criteria in a relatively short period of time***" (NRC, 2009, p. 233).

EPA Region 1 (New England) has many jurisdictions with older sewer collection systems—in many cases with portions of combined sewers—that often have cross-connections between lines that convey sanitary waste and those that are intended for stormwater only. As part of the **Clean Charles Initiative**, EPA developed a methodology to detect sources of human-related illicit discharges through sampling for compounds normally found only in human waste (e.g., caffeine). This method has been incorporated into a new MS4 permit in the region. The new permit requires priority areas to be screened using this method within 5 years of permit issuance and all other areas within 10 years.

Local examples of approaches for targeting human sources of fecal bacteria for were briefly discussed during the workshop. When tests from water quality sampling activities return a high bacteria count, some local programs seek to identify the contamination type to determine the best intervention. The first step is to differentiate between human and animal sources (e.g., water fowl, raccoons, deer). Common assessment methodologies (e.g., microbial source tracking) can be difficult, labor-intensive, and expensive. Yet some participants view this chemical "fingerprinting" process as critical for source identification and implementing targeted mitigation strategies. Workshop participants noted that a compilation of available research and methods

ED_002551_00001739-00036

addressing the advantages and disadvantages of human source targeting approaches would be useful to MS4 programs.

In instances where human pathogens are positively identified, workshop participants expressed the need for clearer guidance on methods that effectively address various sources (e.g., failing laterals, collection system leakage, illegal dumping, and homeless encampments). It can be difficult for stormwater program operators to compel controls on activities outside their current local regulatory authorities. For example, failing or poorly located private septic systems and sewer laterals have been identified in some areas as significant sources of high bacteria levels in stormwater collection systems during dry and wet weather. Participants indicated a need for clearer guidance about regulatory options for addressing these types of sources.

Scientists at Lawrence Berkeley National Laboratory have developed a new technology called "**PhyloChip**" which uses DNA analyses to identify bacterial species. This technology has been used in some stormwater source tracking efforts.

3.5 Tailoring Industrial/Commercial Programs to Fit Local Needs and Align with Industrial Permits

Industrial facilities across the country are required to obtain direct permit coverage from their NPDES permitting agencies to cover stormwater discharges from their process areas. The permitting agency then has authority to evaluate compliance with permit conditions and pursue enforcement, if needed. Note that these permits generally do not address non-process areas of industrial facilities (e.g., rooftops and parking lots) that may constitute significant sources of some stormwater contaminants.

Photo: PG Environmental

Meanwhile, Phase I MS4 communities (and some Phase II communities) are required to keep inventories of potential industrial and commercial sites within their jurisdictions, specify control requirements, perform oversight inspections and enforcement follow-up activities, and conduct on-site water quality sampling when warranted. The main discrepancy between Phase I and II program requirements is that Phase II programs are not typically required to carry out this level of regulatory oversight.

Overall, workshop participants believed EPA and permitting authorities need to do more to clarify and eliminate uncoordinated overlaps between MS4 and industrial permits, share examples of how industrial and commercial stormwater control strategies can be adjusted and aligned to target higher-risk areas, and explore melding of IDDE and industrial/commercial program elements.

3.5.1 Reduce Overlap Between Industrial Stormwater Permits and Municipal Stormwater Permits

Workshop participants stressed the importance of addressing overlap in permit coverage related to industrial facilities discharging to an MS4. In some instances, regulatory authority under the industrial or MS4 permits may not be clearly delineated, leading to either insufficient coverage or duplicative coverage of these facilities. Most participants suggested that both industrial and commercial sources of stormwater pollution need to be addressed as part of the MS4 program;

ED_002551_00001739-00037

however, there was no consensus about what permitting approach would be most effective. A few participants strongly objected to creating any responsibility on the part of MS4 programs (and Phase II permittees in particular) to address industrial site discharges.

Seventy-two percent of pre-workshop questionnaire respondents indicated that clarifying relationships between industrial stormwater permit requirements and MS4 program requirements in future permitting actions would be helpful.

Participants highlighted concerns that current industrial permits may not (1) sufficiently address non-process areas of industrial facilities, or (2) adequately encompass commercial and institutional sources of stormwater pollution. Institutional sources include areas owned by other units of government (such as schools) that are often exempt from coverage by MS4 permits, although states are increasingly included such non-traditional sources in Phase II MS4 permits. Several environmental groups have petitioned for expansion of permitting coverage to require direct permitting of stormwater discharges from commercial, industrial, and institutional land uses.

MS4 permittees at the workshop also expressed frustration that their programs must expend resources to inspect industrial facilities that theoretically should already be covered directly by the NPDES permitting authority (i.e., state or EPA). There was not a clear consensus within the group on whether having MS4 permittees evaluate process areas of industrial facilities was an effective use of program resources. Some participants believed duplication of requirements between industrial and MS4 permits was not efficient, while others suggested that setting locally developed requirements for industrial permittees through the MS4 program adds value. In general, participants agreed that redundant requirements should be minimized and that regulatory approaches for non-process areas of industrial facilities should be clarified. Some participants suggested that the MS4 program should strategically target sources not covered by an industrial stormwater permit (e.g., commercial facilities, non-process areas of industrial facilities).

Workshop participants identified EPA's residual designation authority (RDA) as a potentially useful regulatory mechanism to address gaps in permit coverage. RDA allows for the issuance of NPDES permits on a case-by-case basis if an unregulated discharge is determined to pose a serious threat to water quality. Participants suggested that enhanced controls required by new permits in commercial, institutional, and non-process areas of industrial facilities could help attain water quality standards while also helping to satisfy the municipal requirement for pollutant reduction. However, permitting authorities are concerned about creating a new class of permits, which could stress the limited resources of regulatory agencies and add complexity to an already confusing permitting landscape.

Regardless of whether control requirements are implemented under industrial, MS4, or a new class of NPDES permit, improved coordination in how related permits operate could help achieve water quality outcomes if it ensures priority sources are adequately addressed under one or multiple permitting arrangements.

Recognizing differences in how Phase I and Phase II permits address industrial and commercial sources, workshop participants discussed whether these distinctions continue to make sense. Though Phase II permittees are often only required to address industrial and commercial discharges through their education and outreach programs, EPA's *MS4 Permit Improvement Guide* encourages them to consider the water quality impact from these sources. "EPA recommends that permit writers consider including requirements pertaining to stormwater discharges to the

In California, some Regional Water Board programs work with waterkeeper groups on tools to prioritize inspections of industrial sites.

ED_002551_00001739-00038

MS4 from industrial sources in Phase II permits to further reduce stormwater pollutants from the MS4" (EPA, 2010, p. 85).

In the pre-workshop questionnaire, 76 percent of respondents disagreed or strongly disagreed with the statement, "having the MS4 permittees take on industrial site compliance makes sense for Phase I permittees but not Phase II permittees." During the workshop, the primary argument for Phase II MS4s to be exempt from industrial/commercial program requirements was the resource limitations often experienced by smaller municipalities. However, several participants asserted that the same requirements should apply to both Phase I and Phase II communities, suggesting that exempting Phase II MS4s from these requirements creates arbitrary distinctions in requirements based on population size and that most jurisdictions face resource constraints regardless of population.

3.5.2 Merge Industrial/Commercial Oversight Activities into the IDDE Program

The underlying goal of the industrial and commercial program element is to reduce or eliminate illicit discharges and stormwater pollution from industrial and commercial sites. Some workshop participants suggested that the illicit discharge program could be structured to incorporate private industrial and commercial sources based on existing tools and requirements. Below are some suggestions for how this could be accomplished.

Photo: PG Environmental

- An ordinance or other control mechanism could be used to (1) prohibit illicit discharges into the MS4 from privately owned industrial and commercial facilities, (2) ensure public staff access to these facilities to investigate potential illicit discharges, and (3) require implementation of BMPs to prevent stormwater pollution from the facilities.
- Potential illicit discharges from industrial and commercial facilities could be reported by the public through a reporting hotline (typically a requirement of the illicit discharge program), and the permittee could use its storm sewer system map (required under the illicit discharge program) to track illicit discharges upstream to industrial and commercial facilities.
- The program would also need to include a robust targeting strategy (based on pollutants of concern, geographic areas, land uses, etc.) and surveillance to proactively identify potential or actual illicit discharges from industrial and commercial sources.
- Permits could also include a separate requirement within the illicit discharge program element for permittees to report potential industrial stormwater permit "non-filers" to the appropriate permitting agency (e.g., state or EPA).

Under this scenario, the two program elements (industrial/commercial and IDDE) could largely be merged in part, with the intent of reducing the potential for illicit discharges through strategic and targeted surveillance efforts. Note that it still will be necessary to retain other elements of the industrial/commercial program that do not focus on illicit discharges.

3.5.3 Shift to Targeted Inspections

At the workshop, targeted facility inspections were described as more effective than a routine approach with set frequencies. In fact, 90 percent of pre-workshop questionnaire respondents

ED_002551_00001739-00039

suggested that local programs that target specific pollutant sources (e.g., trash from restaurants, wash water from vehicle maintenance yards) are likely more effective than generic industrial and commercial programs. Therefore, participants recommended abandoning the standard annual inspection requirement (e.g., 20 percent of facilities per year such that all facilities are inspected during a five-year permit term) in favor of a risk-based approach, focusing more frequent inspections on sources more likely to discharge pollutants of concern.

Instead of a routine inspection program with set frequencies, a workshop participant described a program in Florida that has **implemented a targeted approach using aerial imagery**. They use Google Maps to assess land use and review aerial photography of industrial and commercial areas for illicit discharges. When potential hotspots are identified, they will conduct fence line and drive-by inspections to validate. If any issues are observed, they then perform an on-site facility inspection to evaluate and document pollutant sources and eliminate illicit discharges through communication with the discharger or a more formal enforcement action.

To support a more targeted inspection approach, workshop participants suggested that permitting authorities provide guidance and examples both of commonly used surveillance approaches and new, emerging methods and tools for reconnaissance and verification. Permittees expressed interest in emerging targeting techniques (e.g., aerial imagery, searches by business type and license status, targeting based on past illicit discharge activity, techniques for identifying non-filers) that can be used to prioritize targeted inspections for detecting illicit discharges or pollutants of concern. Likewise, these efforts can be combined with targeted public participation efforts (e.g., stream cleanups, litter removal, improved signage and public awareness campaigns) so that more comprehensive control strategies are concentrated in particular areas or on particular pollutants of concern. For example, high trash-generating areas can be targeted with more frequent commercial business inspections, public education campaigns, street sweeping, and installation of trash capture devices.

3.6 Improving Programs to Address Public Agency Activities and Municipal Housekeeping

Phase I and II programs are required to take steps to reduce pollutant runoff from municipal facilities and operations. In most communities, street and road maintenance are of greatest focus. Preventative elements include identifying municipal facilities that present an elevated risk of pollution and implementing an appropriate control plan, inspecting and maintaining stormwater infrastructure (e.g., catch basins, storm sewer pipes), and training staff in pollution prevention strategies. Workshop participants generally agreed that BMPs and procedures included in this program area are worthwhile. They indicated that the program could be further enhanced through increased emphasis on asset management, facility targeting, updated guidance, and better training.

3.6.1 Incentivize Asset Management

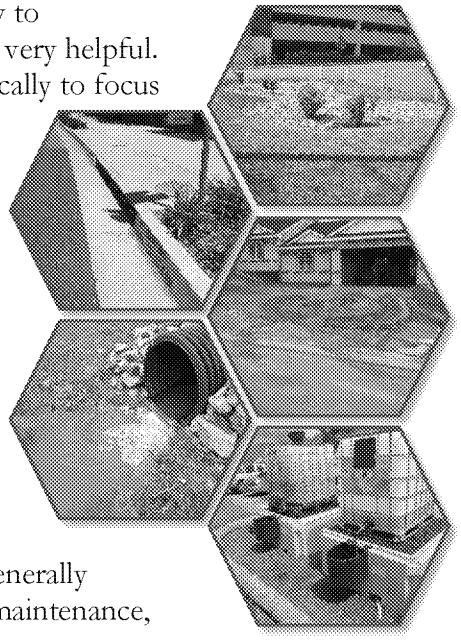
Seventy-six percent of survey respondents agreed or strongly agreed that requiring more holistic asset management enables tailoring of municipal MCM approaches to best support local asset mixes and issues.

Maintaining stormwater infrastructure is crucial for an effective MS4 program, yet basic tracking and upkeep can represent a significant expense for municipalities. More commonly implemented for wastewater and drinking water, AMPs can be an effective strategy for streamlining operation and maintenance (O&M) activities, supporting asset replacement and upgrade planning, and lowering long-term costs. Workshop participants familiar with the AMP approach indicated that

ED_002551_00001739-00040

it is especially useful for planning, cost management, problem targeting, tracking, and reporting.

Participants indicated that additional training and support on how to incorporate asset management in stormwater programs would be very helpful. They recommended establishing a multi-entity workgroup specifically to focus on building AMP training capacity and development resources. Most participants believed permits should incentivize adoption of asset management capability by enabling permittees to show how AMPs address other permit requirements. EPA Region 9 representatives noted that the region now incorporates AMP requirements into MS4 permits it issues as some permittees interested in AMPs have indicated they can only invest in program tools required by the permit.



Images representing various MS4 program elements that could be included in an asset management approach. Photos: PG Environmental

Importantly, some participants envisioned that a broad AMP provision could effectively replace many of the current MCMs. For example, publicly owned facilities, streets, catch basins, outfalls, storm drainage and conveyance systems, parking lots, and permanent stormwater BMPs are all physical assets. AMPs generally include identification, mapping, periodic or strategic inspection, maintenance, and periodic replacement. These activities could be addressed through a holistic AMP requirement rather than as separate MCMs. Stretching this concept further, multiple assets—privately owned industrial and commercial facilities, permanent BMPs, streets, parking lots, green infrastructure, water and transportation infrastructure, and even construction sites—could be viewed as assets that manage stormwater with potential discharges to the MS4 and be embodied within an AMP.

Some participants stressed that creating incentives for expanded AMPs could simplify permits and encourage more cost-effective and impactful efforts by local programs. Additionally, aggregating individual MCM obligations within an AMP framework better aligns with commonly applied municipal operations and funding frameworks.

The **City of San Diego**, California, published its *Watershed Asset Management Plan* in 2013. The strategy was developed to address water quality through both structural (i.e., devices and other physical infrastructure) and non-structural (i.e., activities) approaches. Natural elements, such as receiving waters, are included as assets. The city also classifies public perception and citizen behavior as assets—and requires corresponding funding allocations. *All program elements were designed with direct ties to the city's MS4 permit.*

Given that the implementation of asset management is still relatively new to the stormwater sector, several entities are developing support tools and informational resources, however, more work needs to be done.

- EPA Region 9 has been a strong proponent of asset management. Its recent white paper, *Asset Management Programs for Stormwater and Wastewater Systems: Overcoming Barriers to Development and Implementation* (EPA Region 9, 2017a), identifies critical factors for AMP development and provides several real-world communities' perspectives through case study examples. EPA Region 9 is also planning to provide asset management training in 2018–2019 to build upon the strategies outlined in their publication.

ED_002551_00001739-00041

- EPA Headquarters is likewise encouraging the adoption of asset management in stormwater programs as part of its long-term stormwater planning effort.
- University of Maryland's Environmental Finance Center, funded in part by EPA, launched the Municipal Online Stormwater Training (MOST) Center in 2015 to "bridge the gap in needed technical and financial stormwater management resources in the Chesapeake Bay watershed." It offers free online training, including the introductory course, "Asset Management for Stormwater."

3.6.2 Improve Municipal Facility Management/Housekeeping Program Guidance and Capacity

The stormwater sector is rapidly evolving as new information becomes available; however, workshop participants indicated that many program materials dealing with municipal housekeeping have not kept up (with some dating back to the 1990s). Workshop participants recommended establishing a formal mechanism for ensuring that guidance materials remain current. These updated guidance documents could be updated to enable tailoring of municipal housekeeping measures based on AMP provisions, local settings, land uses, and BMP performance. In turn, permits could provide flexibility in how jurisdictions receive credit for implementation activities and spend resources to target pollutants and/or land uses of concern.

Workshop participants indicated that more effective training is also needed to support program staff responsible for performing facility inspections to help maintain performance of BMPs and ensure compliance. Helpful training topics include inspection and maintenance approaches for both traditional structural assets and less conventional assets including green infrastructure. In addition, participants agreed that it would be helpful to highlight strategies that have resulted in accelerated correction of deficiencies for the full array of control practices. To ensure that maintaining or building staff capacity is an ongoing priority for communities, participants recommended finding ways to require and institutionalize regular staff training.

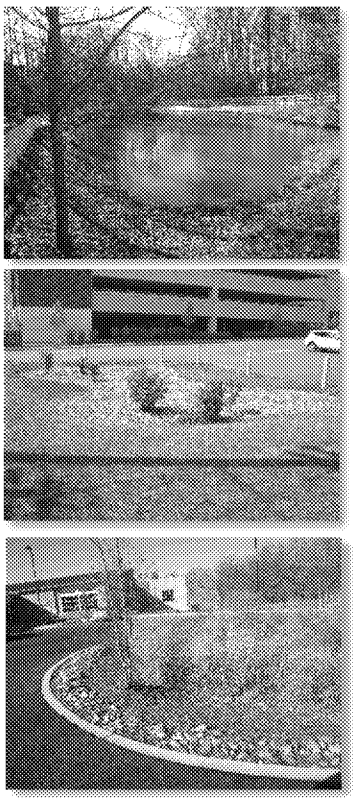
3.6.3 Adjust Focus of Facility Inspections

As municipalities have gained experience in implementing programs to manage stormwater from municipal facilities and assets, it has become evident that some approaches yield greater benefits than others. For example, several participants recommended that some types of facility inspections should be maintained or enhanced (e.g., vehicle maintenance facilities) while other inspections yielded less value after they had been done once or twice (e.g., storm sewer pipe inspections in dispersed residential areas). Several participants requested that permitting rules or guidance should be revised to clarify permitting flexibility to enable local programs to reduce frequency of inspections where they add little value in detecting problems, and targeting inspections in higher-risk areas or on pollutants of most concern.

3.7 Streamlining and Strengthening Local Post-Construction-Related Practices

Phase I and Phase II permittees are both required to address stormwater discharges from new and re-development, though the details of the applicable regulations for each differ somewhat. Some Phase I and Phase II permits include numeric post-construction design standards, and require permittees to adopt a regulatory mechanism to address post-construction runoff from these sources

ED_002551_00001739-00042



Photos: PG Environmental

and to ensure adequate long-term O&M of post-construction stormwater control measures. In contrast, other Phase I and Phase II permits are less clear about post-construction control expectations. Phase I federal regulations lack the specificity of the Phase II regulations, and Phase I permits around the country vary widely in how they address post-construction requirements.

Over the past 10 to 15 years, substantial energy has been focused at the national level on emphasizing and improving post-construction stormwater control requirements through development of new permitting approaches and provision of technical guidance and training on green infrastructure and low impact development methods. EPA has issued guidance on post-construction controls, including the *Compendium of MS4 Permitting Approaches*, Part 2: "Post-Construction Standards" (EPA, 2016c). Many MS4 permits now incorporate numeric post-construction control requirements applicable to new/redevelopment projects and, in some cases, to planning for long-term urban retrofitting. These approaches have gained traction as a central component in MS4 permits and associated local programs because in many settings they have been demonstrated to be effective in reducing stormwater runoff volumes and pollutant loading and in delivering collateral benefits such as improved urban amenities.

All California MS4 permits (including the Small MS4 General Permit) have specific numeric design criteria for post-construction BMPs and include hydromodification requirements.

Workshop participants evaluated opportunities to build upon recent improvements in post-construction requirements and practices. While workshop participants generally viewed these recent initiatives as positive, several opportunities to streamline and improve implementation of post-construction controls at the local and national level emerged during discussions.

3.7.1 Compile Relevant Local Requirements in One Place

In Minnesota, many cities have successfully adopted the practice of assembling all stormwater ordinances, design standards, and local regulatory mechanisms into a single guide made available to all builders and project designers.

Municipalities commonly have multiple regulations or requirements that are relevant to stormwater (e.g., drainage and flood control standards, post-construction runoff control requirements), all of which site designers and engineers must consider during project design and review. Workshop participants suggested that permitting authorities and construction industry groups encourage communities to compile all applicable local requirements into a central design/requirements guide. This would help keep requirements clear and accessible early in project planning to ensure that stormwater concerns are addressed in a streamlined manner.

ED_002551_00001739-00043

3.7.2 Incorporate Smart Stormwater Design into Municipal Planning Practices

In general, stormwater management (aside from flood prevention) has not been a main consideration for communities as they grew and developed over time, and alternative stormwater control approaches have not traditionally been viewed as methods for improving citizen quality of life. Workshop participants expressed a belief that this trend is changing due to a renewed focus on urban waterways and the advancement of green infrastructure and low impact development (which offer multiple benefits), leading to an increased focus on incorporating stormwater considerations into public projects.

In the workshop session focusing on public outreach and education, participants noted the importance of developing tools to communicate better about the multiple benefits of smart stormwater management in addition to water quality protection. The improvements in public outreach strategies should help ensure that consideration of stormwater management opportunities is integrated early in infrastructure planning processes. Workshop participants suggested that communities should incorporate multi-objective stormwater management considerations into the way a city "does business," folding smart stormwater design into standard city activities. For example, communities should look for potential stormwater system improvements as a matter of routine practice when doing roadway improvements, sidewalk enhancements, and work on other water-related systems (e.g., flood control, drinking water, wastewater).

3.7.3 Create Guidance on Off-site Stormwater Crediting

Due to hydrological, geotechnical, and/or financial constraints, implementing post-construction stormwater management projects at a development site may be infeasible or undesirable. Several workshop participants mentioned that some communities are exploring or have attempted to implement programs to authorize implementation of post-construction controls at alternative locations, usually within the same watershed. These programs normally involve creation of a crediting system through which developers can receive credit for off-site control projects and accountability for permit requirements can be maintained.

Many MS4 permits recognize that on-site controls may be infeasible and authorize off-site controls. However, few local stormwater crediting programs have been successfully implemented to date. Workshop participants suggested that more detailed guidance (with illustrative examples) on how to structure and operate a stormwater crediting program would help communities build more success with off-site controls, reduce program development costs, and receive credit for regional-scale projects. Participants were also interested in developing clearer permitting guidance, as existing MS4 permit provisions are often vague and provide insufficient controls on off-site crediting programs to ensure they operate smoothly and provide adequate accountability. Following the workshop, EPA Region 9 issued a new report, *Off-site Stormwater Crediting: Lessons from Wetland Mitigation.* This report discusses key considerations in implementing stormwater crediting programs and incorporating crediting program provisions in MS4 permits.

3.7.4 Continue to Build Capacity for BMP Maintenance

Ensuring long-term O&M of structural BMPs is vital for various reasons. From a water quality standpoint, structural BMPs (whether traditional gray infrastructure or green infrastructure) must be

ED_002551_00001739-00044

maintained to ensure they provide pollutant reductions as designed. Likewise, models used to plan for or demonstrate pollutant reductions for compliance with a TMDL WLA use assumptions that deployed BMPs are functioning effectively (see Section 3.8.3). However, observations from MS4 program inspections across the country continue to identify post-construction BMP O&M as an area of struggle. Some programs do not know the location of each of their BMPs; others have fully mapped and integrated their controls into AMPs. A minority of programs are evaluating their controls' actual effectiveness.

Photo: EPA

Maintenance practices, obligations, and tracking for public and private BMPs vary considerably throughout the country; some programs are implementing comprehensive and effective "real time" maintenance programs while others perform little systemic maintenance. Workshop participants suggested improved guidance incorporating examples of more successful BMP tracking and management approaches is needed for communities to learn how to ensure installed BMPs operate as expected over time.

Several permittee representatives at the workshop brought up the question of whether it is feasible for public entities (MS4 permittees) to ensure proper O&M of private small-scale green infrastructure BMPs as the number of these practices continues to expand. They contended that it was not possible to oversee these practices with the resources typically available to an MS4 permittee, so there should be a size/scale threshold for private green infrastructure BMPs below which an MS4 permittee would not have O&M oversight responsibility. Other participants disagreed, suggesting that MS4 permittees would have ultimate responsibility for water quality outcomes whether BMPs are located on public or private property. Additional guidance on how to establish appropriate thresholds would be needed for permits to better address this type of local resource limitation.

Many post-construction permit provisions are silent or unclear concerning BMP maintenance requirements and lack any ongoing tracking, reporting, or evaluation provisions to help ensure proper maintenance occurs following BMP installation. Some workshop participants indicated that guidance on how to write and implement permit requirements concerning BMP tracking and maintenance would be helpful. A related issue is that following property transfers, new owners either are unaware of ongoing BMP maintenance obligations or have no legal obligation to maintain the BMP. It was noted that the concern about maintenance of BMPs on private land can also be addressed by creating or clarifying local requirements concerning BMP maintenance by land owners both before and after land sales.

WEF and DC Water founded the **National Green Infrastructure Certification Program** in 2016 to set national certification standards for green infrastructure construction, inspection, and maintenance workers.

Workshop participants noted the emergence of green infrastructure certification programs designed to provide training for the design, installation, and maintenance of commonly used stormwater controls. Consensus was reached that these programs are a positive step but that greater visibility, access, and potentially consistency are needed to ensure they are widely used and effective. There are

ED_002551_00001739-00045

opportunities to either require or incentivize their use through MS4 permits as a mechanism to address the long-term BMP maintenance challenges.

Workshop participants stressed that capacity building is needed in the MS4 program overall to ensure the efficacy of BMPs (both traditional and green infrastructure) in both private and public domains. It was suggested that a compendium be developed to display the range of practices used for O&M of BMPs, including aspects such as inventories and tracking, construction inspections to ensure proper installation, maintenance inspections, maintenance techniques, tracking mechanisms, and enforcement approaches to correct identified issues.

3.7.5 Continue to Build Capacity for Green Infrastructure Approaches

Green infrastructure continues to gain momentum as a viable option for stormwater treatment and control in many areas of the country and has become increasingly attractive for the additional benefits that it may offer a community (e.g., aesthetics, air quality improvement, increased property values). However, workshop participants believed green infrastructure should not be viewed as a solution for all stormwater-related concerns.

Decentralized green infrastructure practices can lead to a proliferation in the number of BMPs in a community, increasing the challenges associated with inventorying, ensuring proper installation, and ensuring proper O&M of BMPs. Moreover, concerns were raised that when full life-cycle costs are considered in some settings, distributed green infrastructure approaches may be less cost-effective than more traditional control approaches and larger-scale infiltration facilities. Green infrastructure may not be effective in addressing certain pollutants (e.g., trash, some pesticides) that are not generally associated with diffuse runoff. More guidance would help communities evaluate life-cycle costs of green infrastructure and identify settings in which green infrastructure is likely most effective.

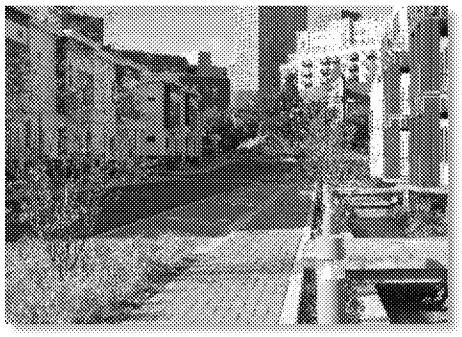


Photo: EPA

With stormwater capture and infiltration being basic tenets of green infrastructure design, workshop participants discussed issues about the actual water balance within urban areas. Participants suggested that additional research needs to be done in different watersheds to explore the impact of too much or too little infiltration on instream flows, groundwater level, and groundwater quality.

Workshop participants suggested that an overall educational platform be developed for all levels of staff interacting with green infrastructure (e.g., permit writers, planners, designers, inspectors) to help build capacity within the program and ensure success into the future. Participants also noted the need for vocational training and certification for green infrastructure workers who construct, inspect, and maintain green infrastructure projects.

3.8 Supporting Water-Quality-Based and TMDL-Based Requirements

The main purpose of municipal stormwater programs is to protect and restore water quality, yet many local programs were slow in the early years of stormwater permitting to take effective action to meet specific water quality goals. Many urban waters remain impaired by elevated pollutant levels

ED_002551_00001739-00046

Photo: EPA

coming from polluted runoff (and other sources), and the damaging effects of urban runoff are accelerated by increases in impervious surfaces through urban development.

EPA and states have increasingly emphasized the use of the TMDL process to develop watershed-scale plans to target pollutant sources, slow urban runoff, and plan needed controls. Since the early 2000s, MS4 programs have evolved to begin implementing new approaches to controlling pollutants coming from urban runoff based on TMDLs.

Changing MS4 programs to address TMDLs has led many permitting authorities, permittees, and stakeholders to reevaluate traditional program elements (e.g., MCMs) because the effectiveness of these base program elements in controlling key pollutants and achieving water quality goals has been increasingly questioned over the past 10 years. Several observers suggest that actions by MS4 permittees to address water quality issues through targeted structural BMPs can have impacts that are longer-lasting and more quantifiable than some traditional "base program" activities in the MS4 program.

Some progress has been made in improving water quality outcomes but much remains to be done. Two key obstacles to implementing more effective water-quality-based controls are the difficulty of efficiently controlling pollutant discharges from diffuse sources, and the challenge of adding water-quality-based control strategies to base stormwater programs that are already resource-limited. Participants spent a significant part of the workshop discussing how MS4 programs (and associated permit requirements) can improve efforts to meet water quality goals expressed through TMDLs while adjusting base program approaches to focus on the most effective implementation strategies.

3.8.1 Clarify Water-Quality-Based Approaches and Progression

There is a wide range of practice used across the United States to implement water-quality-based requirements in MS4 permits and the monitoring associated with those requirements. These approaches are described in EPA's 2017 *Compendium of MS4 Permitting Approaches*, Part 3: "Water Quality-Based Requirements." Specifically, many MS4 permits identify relevant TMDLs and WLAs and include associated requirements such as numeric or narrative effluent or receiving water limits, implementation of specific controls and monitoring/modeling approaches, and related plan approval/annual reporting requirements. Implementation strategies have varied widely. Following are a few prominent examples.

- **Chesapeake Bay TMDL implementation** through the Virginia Phase II MS4 permit aims to reduce loadings of nitrogen, phosphorus, and total suspended solids (TSS) to the Bay and uses BMP "expert panels" to identify BMP pollutant removal efficiencies/credits for calculating permittees' progress. Individual jurisdictions have developed TMDL "action plans" that identify steps they will take over time to meet their WLAs and, ultimately, the water quality objectives the TMDLs were designed to achieve.
- The **Los Angeles County MS4 permit** (applicable to 86 co-permittees) includes numeric water-quality-based effluent limits (WQBELs) associated with multiple TMDLs. The permit

ED_002551_00001739-00047

provides alternative compliance pathways including one based on implementation of multi-benefit regional projects that retain (infiltrate or capture and reuse) stormwater from the 85th percentile, 24-hour storm event. This permit approach has proven controversial, resulting in ongoing litigation from both environmental groups and several municipalities. Nonetheless, the approach has led to development of an involved modeling process to demonstrate "reasonable assurance" that pollutant reductions will be achieved through implementation of specified BMPs and projects. This "reasonable assurance analysis" method is further described below.

- To help meet the objectives of the Lake Tahoe TMDL, the **Lake Tahoe MS4 permit** requires reductions of discharges of fine sediment particles (FSP; 10 percent), total phosphorus (TP; 7 percent), and total nitrogen (TN; 7 percent) by each co-permittee during the permit term. The co-permittees have developed a quantitative, performance-based estimation and tracking approach called the "Lake Clarity Crediting Program" to guide implementation by individual landowners and document their attainment of TMDL pollutant load reductions.

There are also many jurisdictions across the country whose MS4 permits do not include specific water-quality-based requirements. As participants noted at the workshop, permitting authorities have substantial flexibility concerning incorporation of water-quality-based requirements in MS4 permits. Some permits reference TMDLs and WLAs and require development of an implementation plan following permit issuance but provide little detail about how and when TMDL requirements are to be met. In other cases, TMDLs have not been completed to address impaired waters and the permits establish vague, narrative implementation and adjustment requirements to meet water quality goals. Most workshop participants believed that more work remains to be done in most jurisdictions to improve approaches of MS4 permits and associated local programs to develop and implement effective water-quality-based controls. Participants identified a need for clearer guidance and sharing of successful approaches to assist improvements in permits and program design.

The graphic below presents a general continuum of water quality regulatory conditions and resultant requirements/actions contained in MS4 permits across the country. As one moves to the right, the level of requirements and potential complexity (and cost) of implementation increases.

Water Quality Regulatory Condition	*Water quality standard (WQS) not established*	*WQS established*	*Waterbody impaired (303d listed) but TMDL not completed*	*TMDL completed with stormwater WLAs*	*TMDLs and other watershed priorities exist (co-benefits)*
Water Quality-Based Permit Requirement/ Permittee Actions	*No/limited monitoring required, usually receiving water only*	*Receiving water and (sometimes) outfall monitoring required*	*Targeted pollutant monitoring required and potentially targeted BMPs required*	*Numeric or narrative limits backed by varied implementation terms:* *- specific BMPs* *- implementation plan development* *- control targeting based on modeling/ monitoring analysis*	*More flexible implementation plan requirements supported by enhanced modeling to include co-benefits*

Workshop participants stressed the need to better document and describe available water-quality-based approaches. Specifically, the rationale and progression from no, or limited, water-quality-based monitoring and analysis to enhanced modeling to guide specific long-term implementation planning needs to be better communicated. The applicability, process, objectives, and timelines for these various approaches are not well understood by most stakeholders. The lack of consistent terms, use of jargon, and lack of clear national standards or expectations concerning water-quality-based controls add to the confusion. Participants believed better definition and communication would lead to enhanced understanding and support by citizens, elected officials, MS4 program staff, and permit writers.

3.8.2 Strengthen Incorporation of TMDLs into MS4 Permits

TMDLs have become an increasingly important driver of change in MS4 permits and programs. Across the country there is wide variability in how TMDLs are developed and then subsequently incorporated into MS4 permits; this is documented in a couple of EPA publications. The 2017 *Compendium of MS4 Permitting Approaches*, Part 3: "Water Quality-Based Requirements" (EPA, 2017a) presents examples of various approaches by permitting authorities. An EPA Region 9 document memo, *Helpful Practices for Addressing Point Sources and Implementing TMDLs in NPDES Permits*, discusses the relationships between TMDLs and NPDES permits and identifies permitting practices that facilitate incorporate of TMDLs in permits in workable ways (EPA Region 9, 2015).

Workshop participants expressed a need for sharing lessons learned and creating specific guidance that identifies various options and pathways to incorporating TMDLs into MS4 permits. Workshop participants suggested that this effort should involve EPA, multiple states, and other stormwater-focused organizations (e.g., WEF, NMSA, Association of Clean Water Administrators [ACWA]) and should evaluate options and approaches for incorporating TMDLs and addressing water quality impairments. As for other efforts to improve program standards and guidance mentioned in this report, the results of projects to clarify water-quality-based approaches need to be articulated in a way that enables citizens, elected officials, MS4 program staff, and permit writers to better understand the various approaches, their pros and cons, and their objectives.

Participants noted that the national TMDL program has changed its priorities and is increasingly recognizing that water quality impairments can be addressed through approaches that do not include TMDL development. On one hand, using non-TMDL approaches may afford desirable flexibility in the design of local control strategies. On the other, it can be difficult to translate provisions of non-TMDL pollution management plans into effective and enforceable NPDES permit requirements. Participants recommended that new guidance on incorporating water-quality-based controls in MS4 permits address implementation of both TMDLs and non-TMDL alternatives.

3.8.3 Improve Transparency and Accountability When Using Models

Recent years have seen more modeling to support the identification and selection of stormwater management strategies and to demonstrate permit compliance; however, these approaches are not common across the spectrum of MS4 permits in the United States. This increase has, in part, been driven by the development of MS4 permitting frameworks that allow for this approach (generally termed "reasonable assurance analysis," or RAA) to address water quality protection requirements and restoration of waterbody beneficial uses.

ED_002551_00001739-00049

> "From a regulatory perspective, **reasonable assurance** can be interpreted as the demonstration that the implementation of a watershed or stormwater management plan will, in combination with operation of existing system assets and programs, result in sufficient pollutant reductions or reduced stormwater impacts over time to meet TMDL wasteload allocations, WQBELs, or other targets specified in the MS4 permit or identified in the plan" (EPA Region 9, 2017b, p. 6).

When using an RAA approach, communities tend to be very engaged with the regulatory authority to develop the necessary processes, and longer planning horizons for on-the-ground project implementation that allow permittees to prioritize and pursue multi-benefit projects may be appropriate.

In many cases, the development of model-based, long-term planning approaches stemmed from concerns that imposing firm numeric limits with tight compliance timeframes gave MS4 programs insufficient time and flexibility to implement holistic, watershed-scale implementation plans. By committing to providing robust analysis to show the adequacy of long-term control plans in meeting TMDL-based water quality requirements, communities argue, they can focus on implementing specific controls and projects delineated in these plans and be less concerned about accountability for short-term water quality outcomes that are not within their control. Permitting authorities presumably gain from this approach because they obtain longer-term implementation assurances backed by solid modeling or monitoring analysis. This approach can be costly and time-consuming, but may be more cost-effective in the long run than traditional planning and adaptation processes.

During the workshop, there was substantial interest in and concern about this approach. In general, workshop participants identified a need to improve transparency and accountability when using models to predict BMP performance and project long-term needs, and to provide additional information and guidance that can help make model-based approaches more mainstream. There are examples of RAA approaches being used in at least four states (Virginia, California, Washington, and Massachusetts), and in 2017 EPA Region 9 developed a report titled *Developing Reasonable Assurance: A Guide to Performing Model-Based Analysis to Support Municipal Stormwater Program Planning*. This RAA guide discusses various aspects of RAA, including the role of RAA in stormwater management planning, changes in MS4 permits to enable RAA approaches, factors to consider when selecting RAA methods, performing RAAs, and moving from planning to implementation. Importantly, the guide notes the following:

> "…RAA can serve as an analytical tool supporting a range of engineering, asset management, and financial planning activities beyond the stormwater management plan. Linking the RAA with other water management, economic, and financial planning tools, the resulting evolving stormwater program planning framework can support quantitative assessment of the costs and benefits of stormwater projects to inform long-term planning objectives, as well as coupling of stormwater projects with other water resource project opportunities to capitalize on multiple project benefits and improve funding opportunities" (EPA Region 9, 2017b, p. 38).

Though the RAA guide provides a solid foundation, workshop participants identified a need to build on it to more fully articulate the RAA process and associated compliance pathways. This effort would illustrate the range of RAA applications and provide additional guidance to help increase the level of consistency in RAA implementation and the level of confidence that this approach will result in timely compliance.

ED_002551_00001739-00050

A caution on the RAA approach is that it can be difficult to include non-treatment BMPs in the analysis. Accounting for benefits of public education, IDDE programs, pollution prevention, and good housekeeping approaches in watershed-scale water quality models is difficult. This challenge tends to lead municipalities to focus the solution on treatment BMPs that may or may not have the highest return on investment.

3.8.4 Increase Understanding of Multiple Benefit Projects

Photo: EPA

Capital limitations can represent a significant constraint for MS4 programs, and pursuing projects that deliver multiple benefits is one effective strategy for gaining broader stakeholder buy-in and, potentially, accessing more funding. For example, in addition to water quality improvements, green infrastructure installations can yield other tangible benefits that are attractive to a community (e.g., increased property value), increasing the political capital of local stormwater funding initiatives. While workshop participants recognized that multi-benefit projects and programs are appealing, they also noted that many state and local program managers are relatively unfamiliar with methods for incorporating multi-benefit planning perspectives into program operations. Permitting approaches designed to incentivize holistic multi-benefit program implementation are also poorly understood.

Greater cross-program coordination can help municipalities identify the projects that represent the most efficient use of resources and maximize positive environmental outcomes (e.g., water quality, water supply augmentation, reduction in flood risk, and improvements in infrastructure and amenities). AMPs can also be of great value in assisting cross-program coordination and in linking program planning with financing options. Workshop participants indicated that there needs to be greater understanding and awareness of a triple-bottom-line approach that evaluates the environmental, financial, and social benefits and difficulties of different stormwater project options.

Additional guidance would help both permitting agencies and local programs build capacity to pursue integrated urban water management approaches through stormwater program operations. It will be important to increase understanding of the need to consider life-cycle costs, including long-term O&M costs, in selecting among different management approaches. Engaging staff from across departments (e.g., road project managers, parks personnel) about the benefits of integrating green infrastructure and other multi-benefit approaches will be especially critical for securing buy-in, since other departments may bear responsibility for long-term maintenance. Workshop participants suggested that an important first step is compiling existing information and assessing resources that can help build capacity to pursue multi-benefit approaches (e.g., case studies).

3.8.5 Create Guidance on Stream Restoration Crediting

As discussed in Section 3.7.3, some communities are pursuing off-site stormwater crediting programs to help enable developers to meet post-construction requirements through off-site projects. Similarly, some communities are developing a variation on stormwater control crediting through which public and private landowners could satisfy pollution control requirements by financing stream restoration (which could increase the capacity of streams to assimilate pollutants

ED_002551_00001739-00051

and support their designated uses). Stream restoration efforts and demand for "credits" for those efforts in lieu of on-site water quality treatment has become an issue of increased interest among urban stakeholders.

Photo: PG Environmental

Among workshop participants, there was some difference in opinion on whether stream restoration should be eligible as a means for a development/re-development project to satisfy water quality treatment requirements. One permittee representative at the workshop indicated their jurisdiction was trying to create a program to allow some credit for pollutant reduction through stream restoration. Another permittee representative indicated that stream restoration should be used as a retrofit approach, but developers should take care of water quality treatment issues on site for new and re-development projects.

During the workshop, it was recognized that determining the proper translators between pollutant loading or runoff reduction requirements and stream restoration measures would be difficult. There was some agreement among workshop participants that the best place to address stream restoration accounting, if and where appropriate, as a means of addressing a water quality impairment, is within the TMDL program. Nonetheless, participants suggested that guidance on restoration crediting programs would be helpful to ensure the equitability and legal, financial, managerial, and technical integrity of the approaches employed.

ED_002551_00001739-00052

4 Opportunities and Next Steps

EPA Region 9, in partnership with the State of California and EPA Headquarters, convened the *Improving Stormwater Permitting and Program Implementation Approaches* workshop to catalyze change in how MS4 permits are written and stormwater programs implemented. Specifically, they seek to improve water quality by optimizing the use of scarce permitting and program implementation resources. Through facilitated dialogues, participants helped to identify permit and program practices that are viewed as less productive and highlighted more impactful, innovative approaches.

Photo: PG Environmental

"While working at the watershed scale encompasses a broad range of partners, better cooperation is needed even within the water sector. Many communities are working to improve water quality under multiple Clean Water Act programs" (WEF, 2015, p. 23).

Key findings from this workshop and a follow-on workshop about stormwater program monitoring, evaluation, tracking, and reporting provisions will be broadly shared among EPA, state permitting agencies, local MS4 permitting agencies, permittee and research associations, and associated consultants and stakeholders. EPA anticipates working with these parties to conduct further program evaluations and identify specific actions for implementation. Collectively, these recommendations provide a strong foundation for improving programs and permits and, ultimately, water quality.

Workshop participants recommended multiple specific actions and strategies to address the issues and opportunities discussed at the workshop. The following table identifies these actions and strategies within relevant activity categories, and identifies organizations that may be best suited to carry out these recommendations.

Strategy/Action	Key Organizations	
REGULATION REVISION		
• Phase I and II requirement consolidation • MS4 implementation requirements • Alignment of MS4 and industrial stormwater permit requirements	☑ **ACWA** ☑ **Businesses** ☑ **Citizen groups** ☐ Consultants ☑ **EPA**	☑ **NMSA** ☑ **Permittee groups** ☑ **States** ☐ Universities ☐ WEF
POLICY GUIDANCE		
• MS4 program expectations • MCM flexibility • Compliance timeframes and schedules • Compliance evaluation criteria	☑ **ACWA** ☐ Businesses ☑ **Citizen groups** ☐ Consultants ☑ **EPA**	☑ **NMSA** ☑ **Permittee groups** ☑ **States** ☐ Universities ☑ **WEF**
TECHNICAL GUIDANCE		
• BMP performance and selection	☐ ACWA	☑ **NMSA**

ED_002551_00001739-00053

• Water quality-based approaches • Monitoring design • Public outreach effectiveness • Bacteria analysis/control strategies	☐ Businesses ☐ Citizen groups ☑ **Consultants** ☑ **EPA**	☑ **Permittee groups** ☐ States ☐ Universities ☑ **WEF**
OPERATIONS GUIDANCE		
• Asset management planning • Long-term planning approaches • Finance planning • Stormwater and restoration crediting options	☑ **ACWA** ☐ Businesses ☐ Citizen groups ☐ Consultants ☑ **EPA**	☑ **NMSA** ☑ **Permittee groups** ☑ **States** ☐ Universities ☑ **WEF**
CASE STUDIES/BEST PRACTICES		
• MCM flexibilities • Water-quality-based control planning • True source control methods • Bacteria detection and control strategies • Post-construction streamlining • Multi-benefit approaches	☑ **ACWA** ☐ Businesses ☐ Citizen groups ☑ **Consultants** ☑ **EPA**	☑ **NMSA** ☑ **Permittee groups** ☑ **States** ☐ Universities ☑ **WEF**
RESEARCH		
• BMP effectiveness/costs/applicability • Public outreach methods • Multi-benefit management approaches	☐ ACWA ☐ Businesses ☐ Citizen groups ☑ **Consultants** ☐ EPA	☐ NMSA ☐ Permittee groups ☐ States ☑ **Universities** ☑ **WEF**
ADVOCACY		
• Program funding and utility formation • Cross-program coordination/governance alignment • True source control approaches • Multi-benefit management approaches	☑ **ACWA** ☑ **Businesses** ☑ **Citizen groups** ☐ Consultants ☐ EPA	☑ **NMSA** ☑ **Permittee groups** ☑ **States** ☐ Universities ☑ **WEF**
TRAINING		
• Funding options and outreach methods • Asset management planning • MCM targeting and flexibility • Water-quality-based approaches • BMP siting, tracking, and maintenance • Stormwater monitoring and assessment	☑ **ACWA** ☐ Businesses ☐ Citizen groups ☑ **Consultants** ☑ **EPA**	☑ **NMSA** ☑ **Permittee groups** ☑ **States** ☐ Universities ☑ **WEF**

REFERENCES

- American Society of Civil Engineers. (2017). *2017 infrastructure report card: A comprehensive assessment of America's infrastructure.* Retrieved from URL: https://www.infrastructurereportcard.org/
- Campbell, C. W., Dymond, R., Key, K. & Dritschel, A. (2017). *Western Kentucky University Stormwater Utility Survey 2017.* Retrieved from URL: https://www.wku.edu/seas/undergradprogramdescription/stormwaterutilitysurvey.php
- EPA (U.S. Environmental Protection Agency). (2017a). *Compendium of MS4 permitting approaches part 3: Water quality-based requirements.* (EPA Publication No. 830-S-17-001).
- EPA. (2017b). Stormwater discharges from municipal sources. Webpage: "NPDES Stormwater Program," linked from "National Pollutant Discharge Elimination System (NPDES)" at epa.gov. US EPA, Office of Water. Retrieved from URL: https://www.epa.gov/npdes/stormwater-discharges-municipal-sources
- EPA. (2016a). *Community solutions for stormwater management: A guide for voluntary long-term planning,* linked from "Green Infrastructure" at epa.gov. US EPA, Office of Water. Retrieved from URL: https://www.epa.gov/green-infrastructure/community-solutions-stormwater-management-guide-voluntary-long-term-planning
- EPA. (2016b). *Compendium of MS4 permitting approaches part 1: Six minimum control measures.* (EPA Publication No. EPA-810-U-16-001).
- EPA. (2016c). *Compendium of MS4 permitting approaches part 2: Post construction standards.* (EPA Publication No. EPA-810-R-16-017).
- EPA. (2014). *Post-construction performance standards & water quality-based requirements: A compendium of permitting approaches.* (EPA Publication No. 833-R-14-003).
- EPA. (2010). *MS4 permit improvement guide.* (EPA Publication No. 833-R-10-001).
- EPA. (2007). *MS4 program evaluation guidance.* (EPA Publication No. 833-R-07-003).
- EPA. (2005). Stormwater Phase II final rule: Small MS4 stormwater program overview. (EPA Publication No. 833-F-00-002).
- EPA Region 9. (2018). *Off-site stormwater crediting: Lessons from wetland mitigation.*
- EPA Region 9. (2017a). *Asset management programs for stormwater and wastewater systems: Overcoming barriers to development and implementation*, linked from "Sustainable Water Infrastructure" at epa.gov. US EPA, Office of Water. Retrieved from URL: https://www.epa.gov/sustainable-water-infrastructure/asset-management-programs-stormwater-and-wastewater-systems
- EPA Region 9. (2017b). *Developing reasonable assurance: A guide to performing model-based analysis to support municipal stormwater program planning*, linked from "NPDES Wastewater & Stormwater Permits" at.epa.gov/region9. US EPA, Pacific Southwest, Region 9. Retrieved from URL: https://www3.epa.gov/region9/water/npdes/stormwater.html
- EPA Region 9. (2015). *Helpful practices for addressing point sources and implementing TMDLs in NPDES permits*, linked from "NPDES Wastewater & Stormwater Permits" at.epa.gov/region9. US EPA, Pacific Southwest, Region 9. Retrieved from URL: https://www.epa.gov/npdes/helpful-practices-addressing-point-sources-and-implementing-tmdls-npdes-permits

ED_002551_00001739-00055

- Fiorino, D. J. (2006). *The new environmental regulation*. Cambridge, MA: MIT Press.
- National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System General Permit Remand Rule, 40 CFR 122 (2016). Volume 81, No. 237.
- NPDES—Regulations for Revision of the Water Pollution Control Program Addressing Storm Water Discharges, 40 CFR 9, 122, 123, & 124 (1999). Volume 64, No. 235.
- NRC (National Research Council). (2009). *Urban stormwater management in the United States*. National Academies Press, Washington, D.C.
- New York City Department of Environmental Protection. (2017). *Innovative & integrated stormwater management*, linked from "Resources" at waterrf.org. The Water Research Foundation. Retrieved from URL: http://www.waterrf.org/resources/Pages/NYC-Stormwater-Report.aspx
- Reese, A. J. (2016). Ten emerging stormwater best management practices. *Stormwater Magazine, 17*(6), 8-17.
- Reese, A. J. (2001). Stormwater paradigms. *Forester Daily News*. Retrieved from URL: https://foresternetwork.com/daily/water/stormwater-management/stormwater-paradigms/
- WEF (Water Environment Federation). (2016). Moving stormwater public education to prime time. *The Stormwater Report*. Retrieved from URL: http://stormwater.wef.org/2016/07/moving-stormwater-public-education-prime-time/
- WEF. (2015). Rainfall to results: The future of stormwater. *The Stormwater Institute*. Retrieved from URL: http://wefstormwaterinstitute.org/rainfall-to-results/

ED_002551_00001739-00056

APPENDIX A: WORKSHOP ATTENDEES

Name	Organization	Location
Randy Bartlett	Fairfax County	Fairfax, VA
Ellen Blake	EPA Region 9	San Francisco, CA
Eugene Bromley	EPA Region 9	San Francisco, CA
Geoff Brosseau	California Stormwater Quality Association	Menlo Park, CA
Sean Bothwell	California Coastkeeper Alliance	San Francisco, CA
Seth Brown	Water Environment Federation; Storm and Stream	Alexandria, VA
Steve Carter	Paradigm H2O	San Diego, CA
Chris Crompton	County of Orange	Santa Ana, CA
Matt Fabry	San Mateo County	Redwood City, CA
Steve Fleischli	Natural Resources Defense Council	Santa Monica, CA
Holly Galavotti	EPA Headquarters	Washington, DC
Wes Ganter	PG Environmental	Golden, CO
Greg Gholson	EPA Region 9	San Francisco, CA
Christopher Henninger	Arizona Department of Environmental Quality	Phoenix, AZ
Bobby Jacobsen	PG Environmental	Golden, CO
Drew Kleis	City of San Diego	San Diego, CA
Peter Kozelka	EPA Region 9	San Francisco, CA
Keith Lichten	San Francisco Bay Regional Water Quality Control Board	Oakland, CA
Thomas Mumley	San Francisco Bay Regional Water Quality Control Board	Oakland, CA
Thelma Murphy	EPA Region 1	Boston, MA
Randy Neprash	National Municipal Stormwater Alliance; Minnesota Cities Stormwater Coalition; Stantec, Inc.	St. Paul, MN
Mark Nuhfer	EPA Region 4	Atlanta, GA
Nell Green Nylen	University of California, Berkeley	Berkeley, CA
Jeff Odefey	American Rivers	Nevada City, CA
Renee Purdy	Los Angeles Regional Water Quality Control Board	Los Angeles, CA
Dominic Rocques	Central Coast Regional Water Quality Control Board	San Luis Obispo, CA
Abbey Stockwell	Washington Department of Ecology	Olympia, WA
Scott Taylor	National Municipal Stormwater Alliance; Michael Baker International	Carlsbad, CA
Robert van den Akker	City of Buckeye	Buckeye, AZ

ED_002551_00001739-00057

APPENDIX B: WORKSHOP AGENDA

Overview

This first workshop will focus on the evolution of stormwater programs and permitting requirements, including minimum control measures, industrial/construction program requirements, and water quality based control requirements. A follow-on workshop is being planned to assess stormwater program monitoring, evaluation, tracking, and reporting provisions. Workshop feedback will be synthesized with other existing research to produce a white paper discussing opportunities to strengthen MS4 permits and implementation programs.

Structure

Throughout the workshop, participants will be encouraged to consider whether and how existing MS4 program requirements, including but not limited to minimum control measures (MCMs), continue to add value and to identify ways to improve program effectiveness. To enable these discussions, each session will follow the same general structure:

- ☐ **Conversation starter**. A guest speaker will provide a 5-10 minute overview, outlining the regulatory context, summarizing evolution over time, or sharing a brief example case study.
- ☐ **Hypotheses review**. Thank you for responding to the pre-meeting survey! We will summarize survey responses to help identify the degree of agreement or disagreement concerning key lessons learned and improvement opportunities.
- ☐ **Discussion.** The facilitator will then lead in-depth group discussion. For each permit element, we will consider 3 basic questions:
  1. How effective has this program element been in improving water quality and achieving other program objectives?
  2. How can implementation of this program element be improved in the future?
  3. How can permits be improved to facilitate improvement in how this element is implemented?
- ☐ **Findings/Recommendations**. Each session will be focused to solicit participant ideas concerning important findings and specific actions to strengthen and improve the corresponding MS4 program/permit element. The workshop will conclude with a recap in an effort to identify areas of agreement and disagreement and issues needing further evaluation before adjourning. The work we do at the workshop will inform preparation of a paper that will summarize our work and hopefully help guide future actions to help improve MS4 permits and programs in the future.

ED_002551_00001739-00058

Agenda

TUESDAY, DECEMBER 5, 2017

9:00-9:45am	**Welcome and Overview of Workshop Agenda**
	Dave Smith, EPA Region 9 and Wes Ganter, PG Environmental ☐ Welcome ☐ Introductions ☐ Review of Workshop Purpose and Agenda
9:45-10:45 am	**Session 1: Learning from Program Evolution Over Time**
Conversation Starter: Tom Mumley, San Francisco Bay Regional Water Quality Control Board	
10:45-11:00 am	**Break**
11:00-11:45am	**Session 2: Building Program Capacity**
Conversation Starter: Randy Bartlett, Fairfax County, VA	
11:45-12:30	**Session 3 Building Multi-Objective Vision**
Conversation Starter: Drew Kleis, City of San Diego	
12:30-1:30pm	**Lunch**
1:30-2:30 pm	**Session 4: Public Education, Outreach, and Involvement**
Conversation Starter: Matt Fabry, San Mateo County	
2:30-3:15pm	**Session 5: Illicit Discharge Detection and Elimination**
Conversation Starter: Thelma Murphy, EPA Region 1	
3:15-3:30 pm	**Break**
3:30-4:15pm	**Session 6: Industrial/Commercial Program Requirements**
Conversation Starter: Robert Van Den Akker, Buckeye, AZ	
4:15-4:45	**Review of Day 1 and Initial Synthesis**

Wednesday, December 6, 2017

8:30-8:45	**Reset and Chart Day 2**
	Wes Ganter, PG Environmental
8:45-9:45 am	**Session 7: Municipal Operations and Maintenance Programs**
Conversation Starter: Chris Henninger, Arizona Department of Environmental Quality	
9:45-10:00 am	**Break**
10:00-11:00 am	**Session 8: New/Redevelopment and Post-Construction Requirements**
Conversation Starter: Randy Neprash, NMSA, MCSC, and Stantec	
11:00-12:00	**Session 9: Water Quality Based & TMDL Based Requirements**
Conversation Starter: Renee Purdy, Los Angeles Regional Water Resources Control Board	
12:00-1:00	**Lunch**
1:00-2:00 pm	**Session 10: Alternative Approaches to Achieving Water Quality Based Requirements**
Conversation Starter: Steve Carter, Paradigm Environmental	
2:00-4:00pm	**Session 11: Reflection, Synthesis, and Wrap Up**
☐ Identify areas of agreement, disagreement, or warranting more exploration. ☐ Review and fine tune findings and potential actions. ☐ Setting the stage for 2nd workshop (monitoring and effectiveness) (A break will be provided during this Session)	
4:00-4:30pm	**Meeting Evaluation and Closing**

APPENDIX C: PRE-WORKSHOP QUESTIONNAIRE RESULTS

1. The MS4 permits and programs have multiple elements or components. We have listed some of these components below. Assuming it is possible to make meaningful improvements for each of these components, how would you rate the potential for significant improvement (for cost-effective positive environmental outcomes) for each component?

	Significant potential for improvement	Some potential	Little potential	No potential	No opinion or insufficient knowledge	TOTAL	Significant or Some Potential	Little or No Potential
Public Education & Outreach	9	10	10	0	0	29	66%	34%
Illicit Discharge Detection & Elimination (IDDE)	6	16	7	0	0	29	76%	24%
Industrial/Commercial Programs	8	17	3	0	1	29	86%	10%
Municipal Operations & Maintenance	6	16	7	0	0	29	76%	24%
New/Redevelopment & Post-construction Controls	16	10	3	0	0	29	90%	10%
Water Quality-based & TMDL-based Permit Requirements	19	9	1	0	0	29	97%	3%
Monitoring & Evaluation	21	7	1	0	0	29	97%	3%
BMP Tracking & Reporting	12	11	6	0	0	29	79%	21%
Program Technical Assistance & Guidance for Permittees	16	9	4	0	0	29	86%	14%

2. What are the key elements of program effectiveness? (Actual responses; not edited)

- Permits allow stormwater management programs to be tailored to watershed-specific characteristics and pollutant sources and to be flexible to address emerging issues; implementation actions are informed by an up-front analysis that links them with desired water quality outcomes; and monitoring and tracking inform adaptive management. Permits allow stormwater management programs to be tailored to watershed-specific characteristics and pollutant sources and to be flexible to address emerging issues; implementation actions are informed by an up-front analysis that links them with desired water quality outcomes; and monitoring and tracking inform adaptive management.
- Greater emphasis on what CASQA calls true source control (pollution prevention); including TSS reduction and runoff reduction could make stormwater quality programs much more effective.
- Tangible water quality improvements or stabilization.

- Clearly established goals with corresponding performance metrics; effective and accurate data documentation; and periodic and consistent review/analysis of data. A lot of MS4 program requirements tend to be documentation of the completion of activities, not necessarily the evaluation of how effective those activities were to achieve a certain goal. The "WHY" is often missed in this process. This is an area for significant improvement to tie more to clear environmental, economic, and social "wins."
- Cost-effectively comply with clear, specific, and measurable permit requirements to (1) reduce pollutant loads in stormwater, (2) reduce discharges of pollutants to water bodies, (3) improve water quality in receiving waters, (3) reduce the quantity of stormwater discharged into water bodies (and related erosion / stream alteration), and (4) minimize flooding of urban areas. All of the elements/components listed in Question 1 are critical to achieving these goals.
- Clear identification of expectations regarding actions to be completed, or a process for developing and implementing actions, that addresses associated water quality problems, combined with a tracking and reporting mechanism and a process for continuous improvement/reflection about whether the program is thinking about and doing the right thing.
- Know the relative water quality value/benefit (e.g., pollution prevention, pollutant load reduction) of actions (i.e., BMPs) with consideration of costs, doability, and acceptability. Set performance measures (quantitative where possible or at least semi-quantitative) for categorical (program component) actions. Set realistic permit term performance measures for water quality drivers. Establish user-friendly action tracking mechanism: easy in, easy out.
- Measurable achievement of performance benchmarks or environmental outcomes.
- Need quantifiable metrics that can be tracked. Would be helpful to have common metrics for all permitees of a single permit.
- Measurable goals that are related to water quality, not widget counting that demonstrates a program was implemented. An effective program has the shortest distance between regulation and water quality.
- Short, clear permits with easy to understand compliance obligations. Monitoring to determine compliance with the permit terms, including WQSs. Enforceable permit obligations. Minimal but necessary data reporting to ensure permittees are held accountable.
- Measureable water quality improvements directly attributable to MS4 program activities.
- The key elements of program effectiveness are measurable reductions in stormwater pollutants reaching waterways, measurable improvements in sources control, and greatly improved understanding of stormwater pollution on the part of the public and elected officials.
- Putting available resources toward the most cost-effective activity that will result in the greatest environmental benefit.

- Pounds of pollutant removed/$$ spent; (2) were water quality goals clearly spelled out; (3) were water quality goals achieved and verified by monitoring/modelling; and (4) consideration of non-water quality benefits, recreation, habitat, and water supply.
- Having a designated permit coordinator/project manager staff in the MS4 with at least 50% or more of their time designated to stormwater compliance. Knowledgeable staff that have time to look at the compliance issues. Having buy-in from the top -- municipal manager on down and also from elected officials -- that the compliance activities are required. Regulatory authority and management buy-in to use that authority. Having a permitter that knows what is needed for permit compliance and for surface water quality protection and communicates that with their permittees, including providing a list of BMPs that are specific to the region. Having a permitter/permittee open forum for communication.
- Ability to comply with permits, ability to optimize use of urban stormwater, creation of stable resources and program capacity, integration of stormwater program with other water infrastructure programs, and capacity to deliver desired service levels in cost-efficient manner.
- Funding/resources and political will/support.
- We need to start looking at the receiving waters rather than the current blizzard of proxies that are expensive and can be confounding.
- Program effectiveness includes defined expectations, quantifiable end points, and ability to adapt based on new information.
- Good data; realistic, well-crafted study questions.
- Quantifiable metrics; clear time frames.
- The implementation requirements need to add value. It seems to me that there are many reporting requirements that add cost without providing real water quality benefits.
- It's a Clean Water Act program and should be about effectiveness in terms of water quality standards. Do MS4 discharges cause or contribute to exceedances of standards?
- Clarity. Enforceability. Linkage to water quality outcomes.
- Better understanding costs and effectiveness.