WE&T

water environment and technology

- Energy optimization
- Workforce planning
- Water reuse
- Aeration

May 2015

Integrated water planning

Synchronizin

THE PROMISED A

A New England perspective on integrated planning and permitting

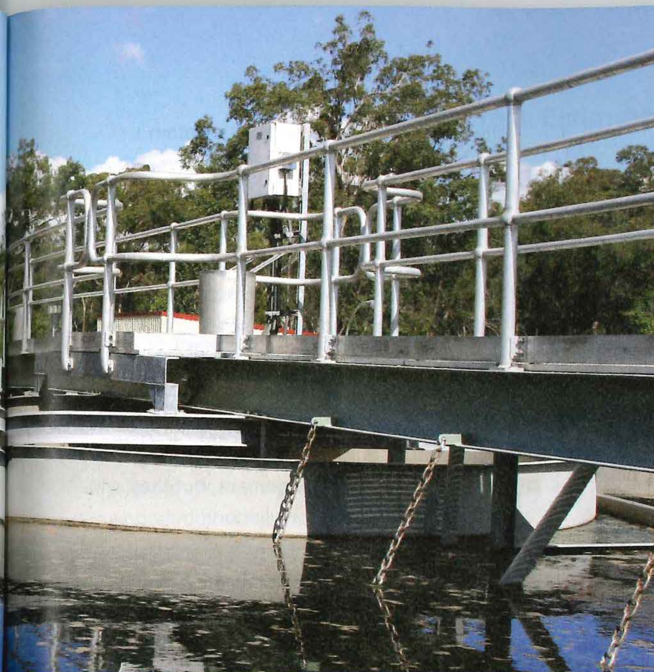
Zach Henderson and William Taylor

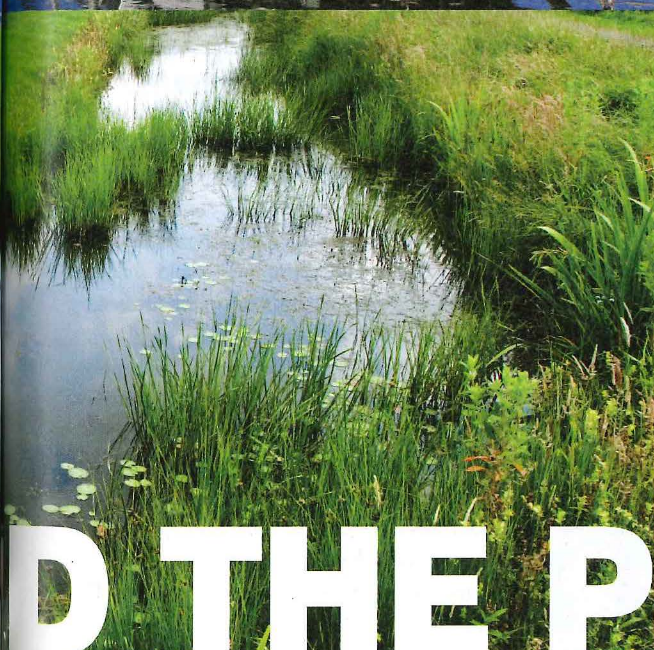
Traditional approaches to solving water quality problems are becoming increasingly unaffordable for municipalities. Integrated water resources planning offers communities an affordable path to meet water quality requirements and restore affected watersheds.

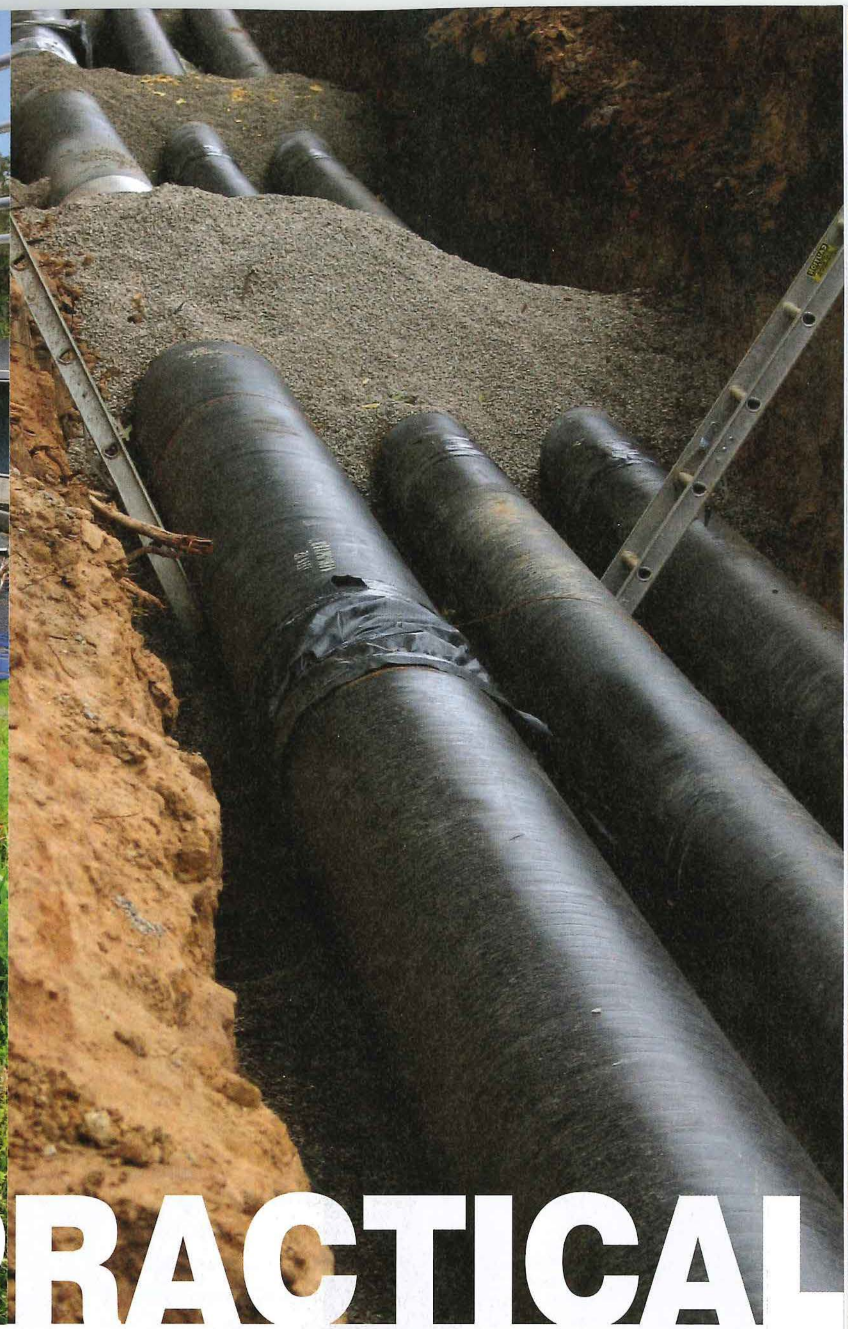
An integrated planning approach ideally would encompass point-source municipal stormwater and wastewater treatment, collection system management, and nonpoint sources. An integrated plan should result in cost savings, achievable capital renewal plans, targeted operations investments, balanced and equitable rate and fee structures, collaboration among stakeholders and regulatory entities, improved receiving water quality, and sustainable utility systems.

However, with the obligation to engage multiple stakeholders and address the regulatory mandates for myriad planning, engineering, and natural resource interests, municipalities and agencies need to push beyond traditional solutions. These challenges are likely to require modifications to public engagement, shared efforts between regulated and regulator at defining abatement cost-benefit analysis, and adjustments to conventional permitting approaches.

Several communities in New England are exploring an integrated planning approach. Communities in the Charles River watershed area, Cape Cod, Chicopee, and Springfield, all in Massachusetts; Durham, N.H.; and Portland, Maine, all are







D THE PRACTICAL

considering the approach to create actionable and sustainable clean water permits and goals.

Portland, Maine: Integrated clean water outreach

Portland is the largest city in Maine (66,000 city residents and 200,000+ in the urban area), with a diverse economy and residential, commercial, and industrial land uses. However, according to the 2012 Maine Department of Environmental Protection *Integrated Water Quality Monitoring and Assessment Report,* every freshwater, estuarine, and marine water in the greater Portland area is in nonattainment due to pollutants.

Like many New England communities, Portland has combined sewers and over the past 20 years has reduced its overall discharge of combined sewer overflow (CSO) by approximately 58%. The next stages of CSO abatement (Tier III) with separation, storage, and green infrastructure are expected to cost more than $170 million in capital investment over 15 years and, upon completion, will reduce overall CSO volume 88%.

The city currently complies with the Municipal Separate Storm Sewer System (MS4) general permit in Maine and has developed a management plan for its priority urban watershed with funding committed to watershed implementation efforts over the next 10 years. The total implementation cost for the Capisic Brook Watershed Management Plan, estimated at $20 million, covers only one of four small impaired urban watersheds in Portland. Annual MS4 operations and compliance costs are approximately $1.5 million. Wastewater treatment provided by the Portland Water District has an annual assessment close to $10 million.

In addition, the city recently developed a capacity, maintenance, operations, and management (CMOM) plan for sanitary sewer and overflow abatement. The CMOM plan suggests changes to staffing, organizational restructuring, and infrastructure renewal/capital investment at an estimated $2 million per year. Based on financial models associated with these investments (see Figure 1, p. 34), the

Figure 1. Projected revenue requirements for wastewater and stormwater services in Portland, Maine (2013)

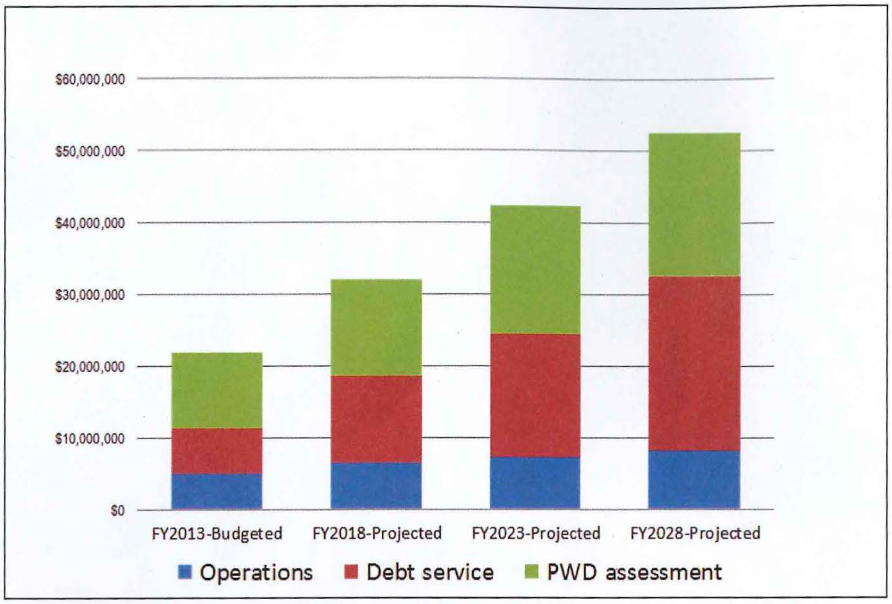
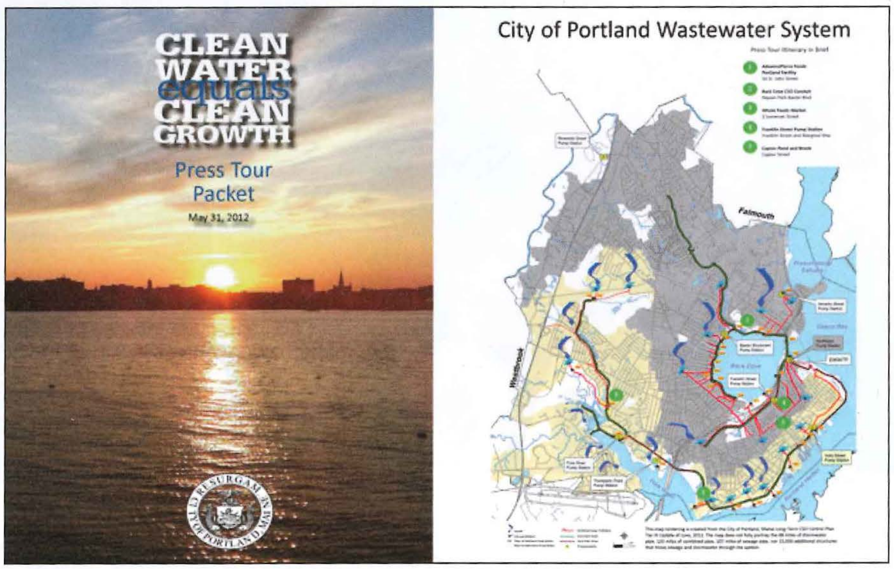


Figure 2. Integrated sewer press tour implemented to highlight clean water projects



user rates for wastewater and stormwater management and treatment in Portland are expected to double over the next 10 years.

The city also recently initiated a drainage system assessment process to provide defensible and prioritized cost estimates for annual budgeting, staffing, and operational expenditures in its stormwater program. This drainage system assessment will provide the final documentation of renewal and regulatory compliance needs for wastewater and stormwater infrastructure, complementing previous work on CSO abatement and wastewater collection system maintenance, and the outcomes are only to increase overall clean water asset management costs and level of service needs.

Billing structure changes needed

To pay for these "integrated" capital and operating costs, the city is changing its billing system for sewer charges. Previously, sewer collection system management, including combined sewer abatement and stormwater management efforts, was funded solely through sanitary sewer fees, which are charged to customers based on water use. This means that those paying the largest sewer use charges are the largest water users. They bear the burden for combined sewer abatement and stormwater management, but they may not be proportionally contributing to stormwater runoff.

The rate structure modifications include an additional fee based on the amount of runoff generated from a parcel. This new stormwater service fee structure will lower overall sewer rates for many high water use businesses and spread the burden for runoff, combined, and wastewater management more equitably. Linking fees to both water use and runoff volume generated is fairer fundamentally and will lower annual sanitary sewer fees compared to what customers would experience without a change in the fee structure.

But before embarking on major changes to billing, it was clear that Portland needed to increase citizen awareness in general about the use of current sewer revenue funds. Like many communities, Portland customers mostly are unaware of the sewer system unless something goes wrong. The infrastructure largely is invisible and the public doesn't understand the consequences of deferred maintenance or recognize the significant costs associated with operations and capital improvements. A recent survey of residents found that only 57% are aware that the city maintains a combined sewer system and only about one-third recognize where their sewer dollars are spent or the basis on which they are billed.

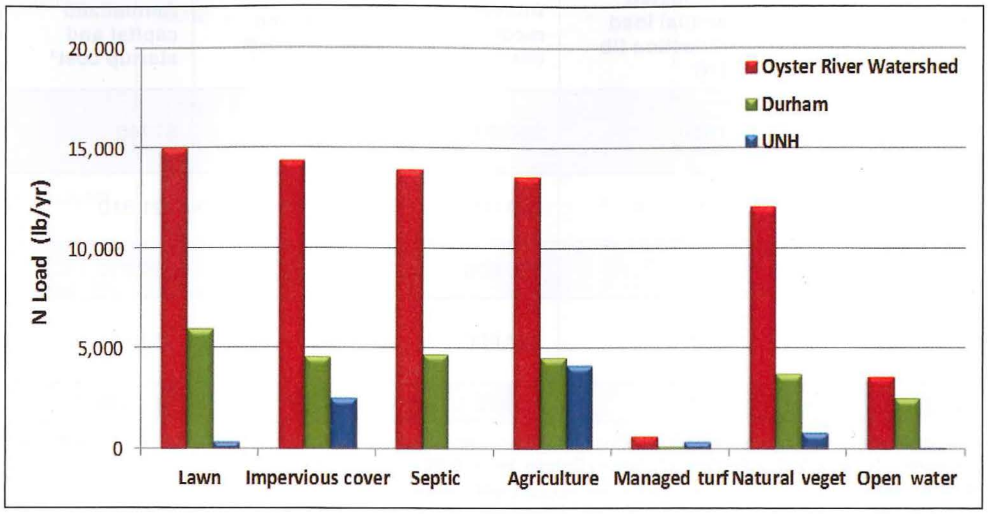
It's not how the money is raised, it's how it's spent

As a result, the city initiated development of an integrated outreach plan to help build a "clean water story." Outreach planning included a phone survey of residents, business small group meetings, message testing of comparable national outreach materials, and demographics research. The outreach plan recommended that the city present any fee changes in the context of a broader investment in clean water and economic growth. The primary message for Portland – "Clean Water Equals Clean Growth" – does not isolate stormwater, combined sewer, or wastewater concerns but instead speaks about broad investment in clean water.

The outreach planning identified that regardless of target audience, ratepayers and residents are unlikely to understand municipal utility revenue generation and use. Highlighting specific projects that are visible and sensible will enhance stakeholder engagement because citizens are less concerned about the nuances of how stormwater and wastewater systems function and more interested in seeing what their investments are generating. A review of similar messaging from other utilities indicated that outreach materials focused on communicating that "the government will spend the money wisely" were more successful than messages that did not make the case about how money would be spent. In addition, using phrases like "our city's clean water project priorities" instead of industry jargon such as "integrated planning" may be more successful from the onset.

An important outreach effort included a sewer tour event (see Figure 2, p. 34) for local press that highlighted the principles of clean water investment and provided an integrated wastewater and stormwater perspective on Portland's efforts at clean water compliance. The sewer tour and subsequent outreach efforts resulted in balanced coverage of the issues in the press and a recent unanimous vote by the Portland City Council to approve changes to the sewer billing system. City staff from the Department of Public Services will continue public outreach efforts to help maintain overall support for continued investments with its Clean Water Equals Clean Growth programs and use the new and more equitable fee structure to support integrated plan implementation.

Figure 3. Estimates of total nitrogen loading by land use source



Durham, N.H.: Integrated nutrient management

Durham, a small New England town with a population of just under 15,000, is the host community of the University of New Hampshire (UNH). The local population nearly doubles in size when UNH is in session. Durham and its surrounding communities feature forested land, open spaces, and greenways that radiate from an active walkable downtown and rapidly growing commercial district. Citizens have a strong sense of their New England heritage and seek to balance economic growth with the preservation of Durham's small-town atmosphere.

Faced with more stringent nitrogen effluent limits as part of its pending National Pollutant Discharge Elimination System (NPDES) permit renewal, the town and UNH conducted a preliminary evaluation on the cost-efficiency of various nitrogen abatement management strategies across pollution sources. The town and UNH share the use of Durham's water resource recovery facility (WRRF), which receives two-thirds of its flow from UNH. The WRRF discharges to the tidal portion of the Oyster River, a major tributary of the Great Bay Estuary, and is 1 of 18 facilities in the Great Bay watershed facing more stringent nitrogen discharge limits (with some communities facing limits of 3 mg/L total nitrogen [TN], considered to be the current limit of technology). Additionally, Durham and UNH both are regulated under the NPDES Small Municipal Separate Storm Sewer General Permit.

Durham WRRF effluent nitrogen concentrations are below 8 mg/L seasonally. Facility upgrades currently under way will reduce the seasonal average annual effluent TN concentration to 5 mg/L. Achieving lower concentrations, however, will require additional capital investments and higher operational and maintenance costs. At an average discharge rate of 3785 m^3/d (1.0 mgd), the facility is estimated to discharge approximately 11 Mg/yr (12 ton/yr) of nitrogen. Reducing loads to 3 mg/L TN is expected to cost $625,000 per year over a 20-year repayment period (including capital, operations, and debt service but excluding collection system investments) or approximately $375/kg ($170/lb) of TN removed.

Cost-effectiveness evaluated for point, nonpoint solutions

The town and UNH conducted an integrated planning project that attempted to identify the most promising nonpoint source and stormwater management activities that may offset carbon-intensive investments at the facility. Nutrient pollutant management actions were evaluated for both cost-effectiveness and magnitude of the pollutant source addressed.

Pollutant loading modeling by source and land use originally developed by the New Hampshire Department of Environmental Services was updated with more recent data (*Oyster River Integrated Watershed Plan for Nitrogen Load Reductions: Final Technical Report,* prepared for the Town of Durham and the University of New Hampshire by Vanasse Hangen Brustlin Inc. in collaboration with Woodard & Curran Inc. in July 2014). Estimates of TN pollutant loading, shown in Figure 3 (above), were the basis of evaluation for management alternatives for nonpoint and stormwater sources.

References used in the cost-effectiveness evaluation included only management practices applicable to Durham land uses, were from a similar climate, and were sourced from reasonably current published documents (2003–2013). Figure 4 (pg. 37) shows the range of cost per pound of TN removed for the management practices as published.

Nonpoint source management and cost estimates

Management control	Estimated annual load reduction (lb TN)	Annual and recurring cost[1] (O&M)	Capital and startup cost[2]	Annualized capital and startup cost[3]	Estimated total annual cost	Total cost per pound of nitrogen removed[4]
Bay-friendly lawn fertilizer outreach program	1050	$50,000	$110,000	$7,740	$57,740	$50
UNH agricultural nutrient management	736	$60,000	$310,000	$21,810	$81,810	$110
Impervious cover retrofitting	370	$35,000	$850,000	$59,810	$94,810	$260
Septic system outreach and grant program	220	$80,000	$85,000	$5,980	$85,980	$390
Oyster bed restoration	2400	$3,000	$270,000	$19,000	$22,000	$10

Source: *Oyster River Integrated Watershed Plan for Nitrogen Load Reductions: Final Technical Report, July 2014.* Prepared for the Town of Durham and the University of New Hampshire by Vanasse Hangen Brustlin, Inc. in collaboration with Woodard & Curran.

[1] Annual operations and maintenance (O&M) costs include O&M activities, estimated staff time for annual program administration, and/or other recurring annual costs.

[2] Capital/startup costs include startup implementation costs associated with contracted services, equipment purchases, and/or design and construction of structural measures.

[3] Annualized costs convert capital cost annualized over 20 years at 3.5% interest.

[4] Cost per pound removed is calculated as total annual cost based on a 20-year repayment period divided by the estimated annual load reduction after implementation.

While an activity may have a lower cost per-unit pound removed, it may address only a small source of pollution and is, therefore, of less value to overall efforts. From Figure 4, it is apparent that agricultural, urban/suburban nitrogen source control, and septic improvements have the greatest benefit to reduction of overall loads at the lowest cost. The table (above) outlines several promising management actions, estimated load reduction, and costs projected for stormwater and nonpoint source abatement activities in Durham. (The primary source of load reduction values used to determine the benefit of management is the 2010 Chesapeake Bay Program and did not include site-specific modeling.)

The results look promising for nonpoint source pollution abatement investment as an alternative to limit-of-technology investments at the WRRF. The total cost to reduce a comparable annual TN pollutant load (~1.8 Mg or 2 tons) through nonpoint source and stormwater abatement is approximately $450,000 per year (including water quality modeling and monitoring), which is a savings of more than $200,000 per year. However, an obvious question is how defensible is the assumed load reduction for several nonpoint source abatement activities when compared to point-source abatement?

Present-value analysis and other factors to consider

Determining the cost-effectiveness of any stormwater or wastewater management solution must include net present-value (NPV) analysis. This allows comparisons between capital expenditures that occur at a point in time and ongoing operations and maintenance (O&M) costs. Installing a new technology at a point source treatment facility may have a high initial capital cost and perhaps result in higher, lower, or roughly equivalent O&M costs, while nonpoint source watershed improvements may have a lower initial capital cost, but result in higher O&M costs. A sound NPV analysis accounts for the time period of interest, initial investments, and discounting rates of different alternatives. The cost estimates for the different alternatives in Durham account for a reasonable expectation of capital/startup costs along with an annual maintenance and operation expense over a similar period of repayment.

Several of the referenced studies reviewed acknowledge that the selected lifecycle can affect cost-effectiveness significantly. For example, agricultural management and nonpoint management programs are likely to have a shorter lifecycle than structural treatment systems, perhaps skewing their apparent cost-effectiveness. As such, the selection of a regionally accepted planning period and consistent discounting rates would improve comparability to point-source solutions, which are financed differently. Integrated planners should gain consensus at the outset to determine the appropriate planning horizon and approach for operations, capital, and program development cost estimation for the broad range of nontraditional and nonstructural management activities. Additionally, regulatory agency approval and region-specific and simplified practices for nutrient load reduction calculations will assure communities that the recommended management practices will result in meaningful and defensible results.

From integrated planning to integrated permitting

In October 2011, the U.S. Environmental Protection Agency (EPA) issued a memorandum, "Achieving Water Quality Through Integrated Municipal Stormwater and Wastewater Plans," that recognizes that permitting and enforcement programs are flexible enough to utilize integrated planning and prioritize wastewater and stormwater obligations.

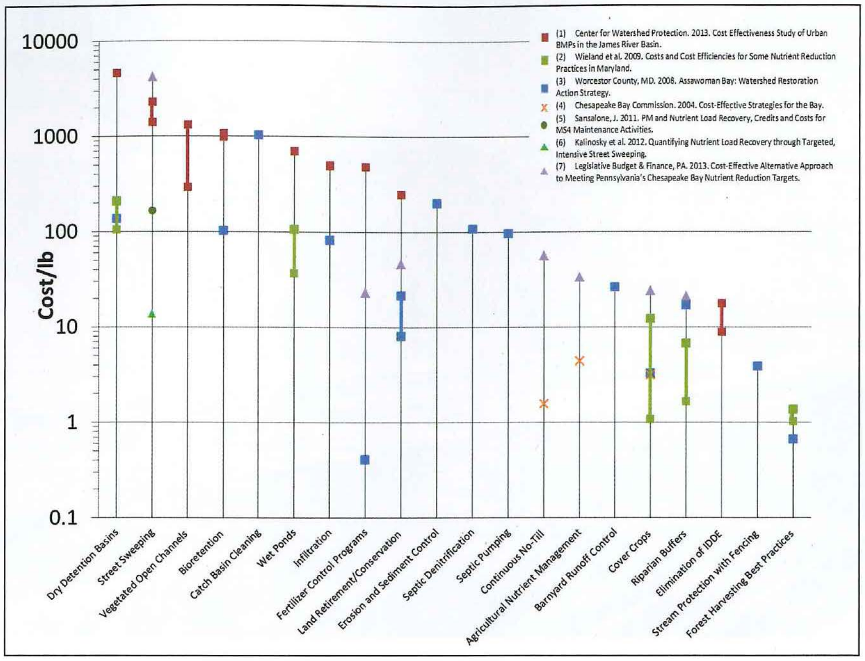
However, the memorandum makes no explicit mention of the link between planning and permitting, even though permits are key to the integrated planning approach. Subsequently, EPA issued a more detailed guidance document on June 5, 2012, in which EPA explicitly recognized that all or part of an integrated plan could be incorporated into an NPDES permit as appropriate.

When considering the transition from integrated planning to permitting, EPA identified the following Clean Water Act permitting and regulatory requirements:

- individual NPDES permits,
- combined sewer overflows,
- separate sewer overflows, and
- MS4s.

Typically, municipalities have been subject to administrative enforcement orders to eliminate CSOs or address wastewater discharges in accordance with long-term plans. In addition, for those municipalities' NPDES permit violations, integrated permitting considerations were channeled into enforcement actions. To date, very few integrated planning and permitting resolutions exist outside the enforcement arena. EPA acknowledged in 2013 that enforcement often provides greater flexibility for achieving long-term compliance than a 5-year permit.

Figure 4. Range of cost per pound of TN "removed"



EPA did recognize that, in some circumstances, compliance schedules in permits may be an appropriate mechanism to integrate multiple, overlapping requirements. One example is the Town of Durham and UNH. Durham is not a CSO community, but the town and UNH, along with EPA Region 1 and New Hampshire Department of Environmental Services, are considering an integrated permit, which would consolidate the Durham NPDES permit with its and UNH's MS4 permits. (UNH's MS4s are located in Durham but permitted separately under the MS4 program.) It makes sense for Durham and UNH to consider one consolidated permit, which would allow coordinated implementation across jurisdictions and cooperative plan preparation, monitoring, and reporting. This is a voluntary action by the permittees and regulators was there are no current permit violations.

Permitting hurdles – and other challenges – to consider

Several initial hurdles exist to integrated permitting. The first is the attainment status of receiving waters, which may have a total maximum daily load that would provide an instream water quality target and allocation for point and nonpoint sources. Nonpoint source pollutants may represent a significant portion of loads, yet NPDES programs do not typically cover these sources. However, they may be the most cost-effective options for pollution abatement under an integrated plan.

Permitting flexibility also may be limited based on best practicable control technology currently available or best professional judgment requirements for a particular municipality or watershed. In each case, NPDES permit limits and conditions will have to be negotiated based on planning findings, projected reductions in loadings, trading/credits allowed, or length of compliance schedules needed.

Finally, the use and value of a compliance schedule depends on state authority to grant compliance schedules and the regulator's willingness to provide compliance schedules longer than the 5-year permit term. EPA's compliance schedule guidance explicitly extended compliance schedules longer than 5 years. However, states may not have explicit authority to authorize compliance schedules regardless of length. For example, the State of New Hampshire did not have a rule or law authorizing compliance schedules and, therefore, EPA could not provide a compliance schedule in permits issued for facilities such as the Durham WRRF. New Hampshire has developed a rule to authorize compliance schedules, partially driven by the desire for integrated permits.

As integrated NPDES permitting largely is uncharted territory, many questions remain. Will permitting agencies include consideration of joint reporting and joint liability for co-permittees? Further, will the integrated permit allow consolidation of required reports, plans, and monitoring requirements across Clean Water Act programs? Will trading be allowed between watersheds or subwatersheds and between point and nonpoint sources? Will permits contain reopener provisions to facilitate adaptive management based on future implementation of the management plan and examination of the water quality impact of controls?

The promise

Integrated planning in New England faces significant challenges. Unique New England town-based jurisdictions and home rule, aged infrastructure, the public's lack of understanding of utility services and rate structures, and limited cost–benefit analysis guidance likely will slow development of integrated plans.

However, with clear guidance from regulators on cost–benefit analyses for nontraditional pollution abatement, simple modifications to the "siloed" lexicon of wastewater, combined sewer and stormwater management, and increased permitting flexibility, the investment in integrated planning and permitting may result in the ultimate goal – clean and safe water.

__Zach Henderson__ is a technical manager at Woodard & Curran (Portland, Maine) and __William Taylor__ is a partner at Pierce Atwood LLP (Portland, Maine).