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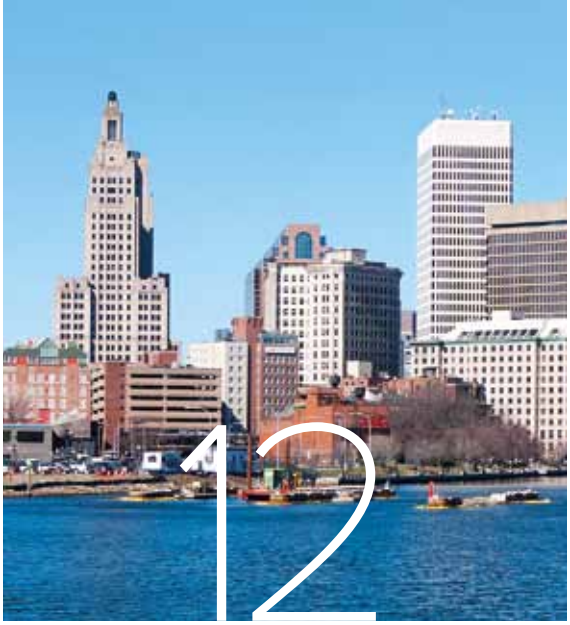

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Charles Tyler

OUR ASSOCIATION WAS ORGANIZED NINETY YEARS AGO in Hartford, Connecticut, on April 23, 1929, with the objectives of advancing the knowledge of design, construction, operation and management of waste treatment works and other water pollution control activities, and encouraging a friendly exchange of information and experience. From 40 charter members, the membership has steadily grown to more than 2,000 today. Membership is divided into the following classes:

Professional Member—shall be any individual involved or interested in water quality including any manager or other officer of a private waste treatment works; any person engaged in the design, construction, financing, operation or supervision of pollution control facilities, or in the sale or manufacture of waste treatment equipment.

Executive Member—shall be an upper level manager interested in water quality and who is interested in receiving an expanded suite of WEF products and services.

Corporate Member—shall be a sewerage board, department or commission; sanitary district; or other body, corporation or organization engaged in the design, consultation, operation or management of water quality systems.

Regulatory Member—this membership category is a NEWEA only membership reserved for New England Environmental Regulatory Agencies, including: USEPA Region 1, Connecticut Department of Energy and Environmental Protection, Maine Department of Environmental Protection, Massachusetts Department of Environmental Protection, New Hampshire Department of Environmental Services, Vermont Department of Environmental Conservation, and Rhode Island Department of Environmental Management.

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2019 RATES ($)

Professional	185
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Young Professional	70
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President's Message

As I submit my last President's Message for the *Journal*, I cannot begin to express how honored I am to have served as the association's 2019 president. Over the past 10 months we have all worked to keep NEWEA moving forward. You have heard me talk about the NEWEA/New England Water Innovation Network (NEWIN) collaboration; with the involvement of many committees and individuals we hope to have this venture completed at the Annual Conference in January. Though other NEWEA affairs may have appeared quiet since the Spring Meeting, it has been business as usual for your NEWEA officers as we continue monthly senior management team calls and ongoing committee program participation. Some of my many NEWEA experiences are described below.

On August 1, I attended the New Hampshire Water Pollution Control Association's (NHWPCA's) Golf Outing where WEF delegate (and nominee for NEWEA vice president) Fred McNeill once again led a jam-packed event with 23 teams competing at the Beaver Meadows Golf Course in Concord.

September 11 and 12 found me traveling to Point Lookout Resort in Northport, Maine, to attend the Maine Water Environment Association (MEWEA) Fall Conference. As always, the Maine association had much to offer attendees, with 36 technical sessions and a circular event pavilion for a host of vendors. Sharing the podium with MEWEA President Stacy Thompson, I was honored to re-present the NEWEA awards to all the deserving recipients from Maine.

As soon as I walked off the stage in Maine, I took a three-hour trip to the NHWPCA Fall Meeting. This year's event was held at the North Conway Water Precinct's wastewater facility. The facility tour featured three new inclined screw presses with associated equipment and a new septage receiving station. This new equipment includes automation to track and bill the septage haulers. Hats off to the North Conway staff for operating such a well-maintained facility.

Our own Meg Tabacsko (Public Communications and Outreach Award), Jeanette Brown (Emerson Distinguished Service Medal), and Paul Dombrowski (Fuhrman Medal for Outstanding Academic-Practice Collaboration) were honored at the WEF Awards and Recognition event

The next stop on my NEWEA itinerary was WEFTEC in beautiful Chicago! Once again, the NEWEA WEFTEC reception was held on Sunday evening at Soldier Field, and thanks to NEWEA staffers Mary Barry and Janice Moran it was another big hit with over 100 in attendance. Among the attendees was our WEF liaison, Kelsey Hurst; since she will not be able to attend our Annual Conference in January, we presented her with an honorary NEWEA 5-S shovel to remind her of her favorite member association.

On Monday morning we attended the Opening Session where we were welcomed by the commissioner and president of the Metropolitan Water District of Greater Chicago, Kari Steele, and treated to remarks from three WEF leaders—retiring WEF Executive Director Eileen O'Neill, incoming WEF Executive Director Walt Marlowe, and WEF President Tom Kunetz, who surely knows how to keep the attention of his audience!

One highlight of WEFTEC was seeing deserving New Englanders receive WEF awards. Our own Meg Tabacsko (Public Communications and Outreach Award), Jeanette Brown (Emerson Distinguished Service Medal), and Paul Dombrowski (Fuhrman Medal for Outstanding Academic-Practice Collaboration) were honored at the WEF Awards and Recognition event. Of pleasure to note is that Operations Challenge teams from Rhode Island and Connecticut won top spots in Division 2 competitions, and the NEWEA student design team (Margaret Keefe, Marcus Brunelle, Kestral Johnson, and Brendan Curran) won third place in the WEF student design competition. We are truly proud of all of you for your achievements.

Finally, we attended a reception for incoming WEF President Jackie Jarrell, whom many of you had a chance to meet at our 2019 NEWEA Annual Conference. She is truly "one of us," as her day job involves overseeing the operation and maintenance of five facilities for Charlotte Water (North Carolina) with a combined flow of 123 mgd (465 ML/d). I think that outgoing WEF President Tom Kunetz can rest assured that WEF is in good hands under Ms. Jarrell's leadership.

It was also rewarding to see many of you while attending the 2019 Residuals and Biosolids Conference in Springfield, Massachusetts, and the Utility Management Committee's Specialty Conference on Workforce Sustainability in Cromwell, Connecticut. Both events exemplified the dynamism and up-to-date informational value of NEWEA membership and programs.

In parting, I once again thank all our members and volunteers for your hard work and enthusiasm; you are the essence of NEWEA, and it is a privilege to represent you all.

From the Editor

Alexandra B. Greenfield (Bowen), PE, Environmental Engineer, CDM Smith, BowenAB@cdmsmith.com

Crystalline silica dust exposure is not a new risk to those working in the construction sector. Fortunately, Occupational Safety and Health Administration's (OSHA) recently revised silica standard will provide more protection to these workers, by increasing employers' responsibilities to minimize workers' exposure to the harmful dust. Much of the nation's workforce agrees that this revised rule is long overdue.

Silica is one of Earth's most abundant elements. Crystalline silica is a basic component of soil, sand, granite, and other minerals. When workers chip, cut, drill, or grind masonry materials, respirable-sized crystalline silica particles become ubiquitous. Because of their crystalline structure, inhaled silica dust particles can wreak havoc on sensitive lung tissue, a problem only exacerbated by a common habit of cigarette smoking. Inhalation of silica dust can cause lung cancer, chronic obstructive pulmonary disease (COPD), and an incurable, deadly disease called silicosis.

In the early 1900s, granite cutters in Vermont recognized the connection between the dust they were inhaling and the resulting fatal illnesses. By the 1930s they had successfully bargained for the installation of ventilation equipment in their work spaces. Unfortunately, workers across other industries in other parts of the country were not so quick to identify this correlation.

One of the worst industrial disasters in United States history occurred in Gauley Bridge, West Virginia—the Hawks Nest Tunnel disaster. In the early 1930s, thousands of men desperate for work during the Great Depression worked with virtually no protection in a tunnel full of silica dust (almost 75 percent of these men were African-Americans escaping the South). Hundreds of workers died from silicosis while building the tunnel, and another 1,500

Secretary of Labor Frances Perkins held a year-long National Silicosis Conference and initiated the campaign "Stop Silicosis"

In the early 1930s, hundreds of workers died from silicosis while building the Hawks Nest Tunnel

workers were reported to have contracted silicosis within two years of working on the project. Union Carbide (no stranger to industrial/environmental disasters) documents show that 80 percent of workers became ill, died, or walked off the job after six months.

Local Union Carbide doctors were puzzled by what they were observing: seemingly healthy young men's bodies were breaking down, at an alarming rate. Doctors misdiagnosed the deaths by referring to the disease as "tunnelitis" (later learning that these young men were suffering from silicosis). In response to the Hawks Nest Tunnel disaster, Frances Perkins, then current secretary of labor, held a year-long National Silicosis Conference and initiated the campaign "Stop Silicosis." The original 1938 "Stop Silicosis" video is posted on YouTube, where we can see Ms. Perkins herself address the working people of the United States and their employers (I love the internet!). The video emphasizes that silicosis can be prevented, if the practical control measures are applied. Those practical control measures? Turn the water on, and turn the vacuum on.

Despite this national campaign, severe silica exposure continued to be a major health hazard for construction workers. It was not until 1971 when OSHA formally established a silica permissible exposure limit (PEL), averaged over an eight-hour work period. Exposure was limited to the level of 250 µg/m^3 for construction work and 100 µg/m^3 for general industries. Some perspective: In 1971 Intel introduced the first "microprocessor," the Intel 4004. Forty years later and we cannot fathom leaving the house without a pocket-sized machine FAR more powerful than that Intel 4004, so why would we feel comfortable relying upon a defunct silica standard based on research and technologies established 40 years B.C. (before cellphones)?

The new (and final) rule was announced on March 25, 2016, and substantially reduces crystalline silica's PEL to 50 µg/m^3 for all workers across all industries. This new limit is half of the prior exposure limit for general industry and five times more stringent than the prior limit for construction. Enforcement of the construction standard became effective on September 23, 2017, and enforcement for the general industry standard became effective on June 23, 2018.

This new lower limit can be achieved using commonsense practical controls—in other words the limit should NOT be cost prohibitive to employers, making the U.S. Department of Labor's adoption of this lower exposure limit a no-brainer. Seventy-eight years after Frances Perkins first addressed the nation in the video "Stop Silicosis," Tom Ward, a masonry trainer in Michigan, reflects on Ms. Perkins' simple, astute, and, sadly, forgotten message "turn the water on, and turn on the vac." In this revamped "Stop Silicosis" video by the U.S. Department of Labor, Mr. Ward reflects on his father's diagnosis and long-term battle with silicosis.

With major tunnel projects popping up across the Northeast, it seems only right to reflect on the tragic missteps taken by previous generations and the unnecessary suffering imposed on workers and families since. Construction is a dangerous industry. Inherent risks are associated with a career in the construction industry that workers must accept; however, an unsafe work environment laden with crystalline silica dust is certainly not one of those risks to accept. #StopSilicosis

REFERENCES

- Federal Register. (2016, March 25). *Occupational Exposure to Respirable Crystalline Silica.* Retrieved from Federal Register: https://www.federalregister.gov/documents/2016/03/25/2016-04800/occupational-exposure-to-respirable-crystalline-silica
- Labor, U. D. (Director). (1938). "Stop Silicosis" [Motion Picture]
- Labor, U. D. (Director). (2016). "Stop Silicosis" [Motion Picture]
- Lancianese, A. (2019, January 20). "Before Black Lung, The Hawks Nest Tunnel Diaster Killed Hundreds." Retrieved from npr.org: https://www.npr.org/2019/01/20/685821214/before-black-lung-the-hawks-nest-tunnel-disaster-killed-hundreds
- Occupational Safety and Health Administration. (2018). https://www.osha.gov/dsg/topics/silica-crystalline/. Retrieved from osha.gov: https://www.osha.gov/dsg/topics/silicacrystalline/
- Silica-Safe.org. (2017). "Status of Regulary Efforts." Retrieved from Work Safely with Silica: https://www.silica-safe.org/regulations-and-requirements/status-of-regulatory-efforts/history

Industry News

The Narragansett Bay Commission, located in Providence, Rhode Island, has been invited to pursue a loan of up to $17 million for Bucklin Point resiliency improvements (photo: City of Providence)

Two Rhode Island Groups Invited to Apply for Water Infrastructure Loans

EPA is inviting 38 projects in 18 states to apply for Water Infrastructure Finance and Innovation Act (WIFIA) loans. Together, the selected borrowers will apply for WIFIA loans totaling approximately $6 billion to help finance $12 billion in water infrastructure investments and create almost 200,000 jobs. Two of the projects are in Pawtucket and Providence, Rhode Island.

EPA's WIFIA loans will allow communities across the country to implement projects to address national water priorities, including providing for clean and safe drinking water by reducing exposure to lead and emerging contaminants, addressing aging water infrastructure, and developing water recycling and reuse projects. Eight of the selected projects are water reuse or recycling projects, 11 projects will reduce lead or emerging drinking water contaminants, and 33 will address aging infrastructure. EPA received 51 letters of interest from both public and private entities in response to the 2019 WIFIA Notice of Funding Availability. After a robust, statutorily required review process, the WIFIA Selection Committee chose the Narragansett Bay Commission (NBC) and Bristol County Water Authority to pursue loans for proposed projects.

The NBC, located in Providence, has been invited to pursue a loan of up to $17 million for Bucklin Point resiliency improvements. The Bucklin Point project will address various needs so the wastewater treatment facility can treat flows that would have previously overflowed and operate efficiently, especially during elevated wet weather flows. The wastewater project could benefit a local population of 161,000 people.

The Bristol County Water Authority, located in Pawtucket, has been invited to pursue a loan of $26 million for the Pawtucket pipeline. This project will construct a new water supply pipeline from the Pawtucket Water Supply Board in Pawtucket, to provide the Bristol County Water Authority with an alternative water supply, benefiting a local population of 50,000 people.

"EPA is pleased that these two Rhode Island organizations are pursuing WIFIA financing for important water infrastructure projects," said EPA New England Regional Administrator Dennis Deziel. "Making wise and cost-effective investments now will mean cleaner water resources and healthier communities for many years to come."

Established by the Water Infrastructure Finance and Innovation Act of 2014, the WIFIA program is a federal loan and guarantee program administered by EPA. WIFIA's aim is to accelerate investment in the nation's water infrastructure by providing long-term and low-cost supplemental credit assistance for regionally and nationally significant projects.

EPA Announces Nearly $270 Million Water Infrastructure Loan to the Narragansett Bay Commission

EPA announced a WIFIA loan to the NBC to help reduce pollutant discharges into Narragansett Bay. This project is the first WIFIA loan awarded in New England and will help protect public health and the ecosystems of the largest estuary in this region.

During heavy rainstorms, combined sewer flows can exceed the capacity of the current system and overflow into local rivers and the Narragansett Bay. These overflows can carry pollutants such as sewage solids, metals, oil, grease, and bacteria that can affect human health and the environment. EPA's WIFIA loan will provide approximately $269 million to help fund the combined sewer overflow (CSO) phase IIIA facilities project. The project includes a long deep rock tunnel, two work shafts, four drop shafts, a tunnel pump station, and several improvements to the wastewater collection system.

"EPA is very pleased that the first WIFIA loan award here in New England will result in cleaner and more healthy water in Narragansett Bay," Mr. Deziel said. "In a major storm event, this combined sewer overflow construction project will keep approximately 60 million gallons (227 ML) of water contaminated with raw sewage, metals, oil, grease, and bacteria from being discharged directly into Narragansett Bay.

"We know Rhode Islanders value a clean and healthy bay. We're very proud of infrastructure investments Narragansett Bay Commission ratepayers have made over the past two decades to mitigate the century-old issue of CSOs, and the NBC is confident that this final phase of the CSO project will result in a bay that will be a beloved resource for our children and grandchildren," said NBC Chairman Vincent Mesolella.

"The WIFIA loan also ensures that the cost of this ambitious clean water project will be mitigated for our ratepayers."

The CSO phase IIIA facilities project will cost $548 million. EPA's WIFIA loan will finance nearly half of that figure—up to $269 million. Additionally, the Rhode Island Infrastructure Bank (RIIB), through co-funding from the Rhode Island Clean Water State Revolving Fund (RI CWSRF) and other programs, will support the project costs. The RI CWSRF program is co-managed by the RIIB and the Rhode Island Department of Environmental Management. The WIFIA loan will save the NBC an estimated $99.6 million compared to typical bond financing. Project construction and operation are expected to create 1,755 jobs.

The WIFIA loan closing was announced at an event hosted by the NBC at the Bucklin Point Wastewater Treatment Facility in East Providence, Rhode Island. Speakers included Messrs. Deziel and Mesolella, U.S. Senator Jack Reed (RI), Rhode Island General Treasurer Seth Magaziner, and Director of Rhode Island Department of Environmental Management Janet Coit.

EPA Funding for Local Groups Will Help Protect and Restore Southeastern New England Coastal Areas

Funding from EPA to 13 organizations in Massachusetts and Rhode Island will help promote cleaner water and healthier coastal ecosystems in southeastern New England. The awards, totaling $1.1 million for seven projects in Rhode Island, and $1.2 million for six projects in Massachusetts, are administered by Restore America's Estuaries (RAE), which partners with EPA to administer the program to advance the health of coastal ecosystems in southeastern New England.

"The bays, estuaries, and landscapes of southeastern coastal New England are the heart of our communities. Funding these projects and working with our partners to develop opportunities for collaboration and smart innovation continues to be a priority for EPA," said Mr. Deziel. "This funding will help protect clean water and build healthy watersheds, and is vital to the ecological health and economic vitality of our coastal communities."

The funding is provided under EPA New England's 2019 Southeast New England Program (SNEP) watershed grants. The grant program builds and supports partnerships that address the region's most pressing environmental issues, such as nutrient pollution and coastal habitat loss.

For 2019, RAE selected grant recipients through a rigorous competitive process. The $2.3 million in federal funds for the region will be matched by an additional $800,000 in state and local dollars, providing $3.1 million to protect and restore southeastern New England's environment. The awardees include municipalities, non-profit organizations, and academic institutions.

In Massachusetts, the 2019 SNEP watershed grants are providing $1.2 million to six local partnerships led by the following organizations:

- Association to Preserve Cape Cod (APCC), for the Three Bays Stormwater Project, supporting the design and installation of stormwater management to restore clean water to three estuaries in Barnstable. This grant continues funding provided to APCC by SNEP watershed grants in 2018 ($245,000).
- Buzzards Bay Coalition, for Promoting Salt Marsh Resilience, supporting research to better understand causes and trends of marsh loss on Buzzards Bay, as well as pilot-scale restoration to preserve threatened marshes ($223,533)
- Falmouth Rod & Gun Club (FRGC), for Upper Childs River & Bog Restoration, an innovative project to restore natural wetlands and trout habitat in three abandoned cranberry bogs in Falmouth. This grant continues funding provided to FRGC by SNEP watershed grants in 2018 ($245,000).
- Massachusetts Maritime Academy (MMA), for Buzzards Bay Stormwater Collaborative, a new and important partnership between MMA and eight Buzzards Bay municipalities. Students will support communities in stormwater compliance, integrated with a new MMA curriculum ($176,581).
- Woods Hole Oceanographic Institution, for Permeable Reactive Barriers—research and testing of an innovative technology to reduce nitrogen pollution by intercepting groundwater as it flows into coastal waters ($298,598)
- Buzzards Bay Coalition, for Prevent Nutrient Pollution from Composting, which will help communities reduce nutrient pollution to coastal waters from new composting facilities recently required by Massachusetts law ($27,695)

In Rhode Island, the 2019 SNEP watershed grants are providing $1.1 million to seven local partnerships led by the following organizations:

- Audubon Society of Rhode Island to create a regional center for stormwater innovation at Roger Williams Park in Providence ($177,534)
- City of Cranston to restore clean water at Spectacle Pond, with benefits to Roger Williams Park and the Pawtuxet River system ($187,500)
- Groundwork Rhode Island to install stormwater improvements in Providence and provide job training for urban youth ($198,891)
- City of Newport to implement an innovative approach to reducing urban stormwater by providing incentives to private property owners ($108,750)
- Northern Rhode Island Conservation District to establish a manure management program for small farmers in the Scituate Reservoir watershed, reducing pollution to Providence's drinking water supply ($113,976)
- Town of Warren to install innovative stormwater practices on waterfront streets to reduce pollution to Narragansett Bay ($25,000)
- Woonasquatucket River Watershed Council to install stormwater practices along the Woonasquatucket River Greenway, reducing pollution to the Providence River and Narragansett Bay ($245,000)

Note: All EPA industry news provided by EPA Press Office

$2.6 Million in Grants Awarded to Improve the Health of Long Island Sound

$1.6 million for 25 grants benefiting New England

Top federal and state environmental officials from New England and New York announced 35 grants totaling $2.6 million to local state and local government and community groups to improve the health and ecosystem of Long Island Sound. Twenty grants totaling $1.4 million benefit Connecticut. Three grants totaling $250,000 benefit Massachusetts and Vermont.

The Long Island Sound Futures Fund (LISFF) shows how projects led by local groups and communities make a difference in improving water quality and restoring habitat around the Long Island Sound watershed. This grant program combines funds from the EPA, U.S. Fish and Wildlife Service (FWS), and the National Fish and Wildlife Foundation (NFWF).

"EPA has a longstanding commitment to help protect and restore Long Island Sound, which provides numerous environmental benefits and economic and recreational opportunities," Mr. Deziel said. "These grants will help reduce impacts on the Sound from sources like stormwater and marine debris, which are priority issues for our agency."

"EPA and its federal, state, and local partners share great enthusiasm in supporting New Yorkers' active engagement and stewardship to protect the Long Island Sound," said EPA Region 2 Regional Administrator Pete Lopez. "These projects provide real long-term results, including improving water quality, preventing pollution, protecting and restoring habitat, wildlife and wetlands, and educating the public."

The LISFF 2019 grants will reach more than 200,000 residents through environmental education programs and conservation projects. Water quality improvement projects will include treating 8.2 million gal (31 ML) of stormwater, collecting 46,000 lb (20,900 kg) of floating trash, installing 23,000 ft^2 (2,137 m^2) of green infrastructure, and preventing 17,000 lb (7,711 kg) of nitrogen from entering Long Island Sound. The projects will plan to open 13.5 river mi (21.7 km) and restore 5 ac (2 ha) of riparian habitat for fish and wildlife. The grants are matched by $3.8 million from the grantees themselves, resulting in $6.4 million in funding for conservation projects around the Long Island Sound watershed in Connecticut, Massachusetts, New York, and Vermont.

In Connecticut the $1.4 million in grant funds will be matched with $1.4 million from the grantees, resulting in $2.8 million in community conservation. In Massachusetts and Vermont the $250,000 in grant funds will be matched with $300,000 from the grantees, resulting in $550,000 in community conservation.

"These significant federal grants totaling $900,000 go to 15 great organizations to preserve and improve our beloved Sound. The purposes are as varied and visible as the needs. The work will be tangible and real: install litter traps and trash skimmers, begin restoration of salt marshes, spur growth of fish and bird populations, and support environmental education," said U.S. Senator Richard Blumenthal.

"This is great news for Connecticut. These federal grants will go a long way in preserving and protecting Long Island Sound, which is central to our state's economy. I'll keep working to increase funding for Long Island Sound through my seat on the Appropriations Committee so more deserving projects like these get funded," said U.S. Senator Chris Murphy.

"The Long Island Sound is deeply important to the economy and ecology of Fairfield County. Conservation of the Long Island Sound is paramount, and these grants will go a long way in protecting its beauty and health," stated U.S. Congressman Jim Himes (CT). "Our shared hope is that residents of Fairfield County will be able to enjoy it for generations to come."

"One of the greatest environmental challenges facing our nation and its communities is the protection and restoration of highly productive estuaries," said Jeff Trandahl, executive director and CEO of NFWF. "The funding awarded today represents the foundation's and U.S. EPA's continuing commitment, as well as the commitment of the U.S Fish and Wildlife Service and other federal and state partners, to restoration aimed at improving the overall health of Long Island Sound."

The Long Island Sound Study initiated the LISFF in 2005 through EPA's Long Island Sound Office and NFWF To date, the LISFF has invested $22 million in 451 projects. The program has generated an additional $39 million in grantee match, for a total conservation impact of $62 million for regional and local projects. The projects have opened 176 mi (283 km) of the Connecticut River for fish passage, restored 1,114 ac (451 ha) of critical fish and wildlife habitat and open space, treated 212 million gal (801 ML) of pollution, and educated and engaged 4.9 million people in protection and restoration of the Sound.

"Healthy estuaries, rivers, and wetlands fuel surrounding communities that rely on them," said Wendi Weber, U.S. Fish and Wildlife Service North Atlantic-Appalachian Regional Director. "We are pleased to support these efforts that inspire people to be stewards of the natural world and restore free-flowing rivers and resilient marshes. These are investments that will pay off in water quality, recreational opportunities, healthy wildlife populations, and public safety."

"The Connecticut Department of Energy and Environmental Protection (DEEP) has been pleased with the review of this year's applications and impressed with the caliber and quality of the projects submitted," said DEEP Commissioner Katie Dykes. "These projects represent grass-roots, on-the-ground opportunities to improve water quality in the Sound, restore tidal wetlands, improve public access, and build resiliency to the communities surrounding this important natural resource."

Long Island Sound is an estuary that provides economic and recreational benefits to millions of people while also providing habitat for more than 1,200 invertebrates, 170 species of fish, and dozens of species of migratory birds.

For a list of the projects funded this year, go to longislandsoundstudy.net.

Two green giants—achieving cost-effective CSO control through green infrastructure

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ABSTRACT | Project Clean Lake is the Northeast Ohio Regional Sewer District's $3 billion, 25-year program to reduce the total volume of raw sewage discharges from 4.5 billion to 494 million gal (17 million to 1.9 million m^3) annually, with more than 98 percent of wet-weather flows receiving treatment. The challenges of integrating green infrastructure into this program can be demonstrated through two design projects: the first yielding major cost savings and the second downsized due to low cost-effectiveness and existing infrastructure interference. An innovative hydrology/hydraulics evaluation demonstrated that redirecting 228 ac (92 ha) of separate stormwater to three major green stormwater infrastructure facilities (total volume 6.2 million gal or 23.5 million L) could reduce the proposed length and size of a major relief sewer, saving $25 million in projected capital costs (nearly a 25 percent reduction). For the second project, many community co-benefits were achieved, although limited opportunities to remove stormwater volume resulted in modest combined sewer overflow reduction levels.

KEYWORDS | Combined sewer overflows (CSOs), green stormwater infrastructure, hydraulic modeling, community co-benefits, landscape architecture, stormwater management

INTRODUCTION

The Northeast Ohio Regional Sewer District entered a consent decree with U.S. EPA and Ohio EPA and the Department of Justice in 2011 to implement a long-term control plan within a 25-year period to control combined sewer overflows (CSOs) to Lake Erie and its tributary streams. As required by the consent decree, the District has developed a Green Infrastructure Plan, which describes how green stormwater infrastructure (GSI) will remove an annual 44 million gal (167 million L) of wet-weather CSO volume in addition to a projected annual 4 billion gal (15 million m^3) of CSO volume reduction through grey infrastructure control measures required under the consent decree. While the District agreed to this condition (increasing CSO volume reduction by 1 percent), achieving this goal cost-effectively was challenging. This paper summarizes two projects to satisfy the District's consent degree, each intended to achieve part of the 1 percent increased volume capture requirement through GSI:

- The larger East 140th Street Consolidation and Relief Sewer (E140CRS) project is integral to Project Clean Lake, relieving CSOs and frequent sewer surcharging within a 1,930 ac (781 ha) sewershed and ultimately discharging to the Euclid Creek/Dugway storage tunnel system with a capacity of 117 million gal (443 million L)
- The smaller but more complex Union-Buckeye Green Infrastructure project is in southeastern Cleveland and includes two project areas: Buckeye Road (Buckeye) and Slavic Village–Union Avenue (SVU), also intended to improve water quality by adding GSI to further reduce CSOs without removing grey infrastructure

These two contrasting projects revealed where GSI was effective at controlling CSOs and reducing investments in grey infrastructure, and conversely where GSI investments did not reduce grey investments and consequently were not cost-effective.

PROJECT OBJECTIVES

The following District CSO control objectives guided both studies:

- Reduce overflows to two or fewer in a typical year of rainfall
- Surcharge no less than 10 ft (3 m) below ground in combined and separate storm sewers during five-year, six-hour design storm or, for shallower pipes, maintain water surface elevation at the pipe crown (where feasible and cost-effective)
- Target stormwater redirection at areas served by separate sewers and/or combined sewers with few to no existing wastewater connections, to minimize investment in new separate storm and sanitary sewers
- Design storm sewers to collect all stormwater generated within the redirection area and size new storm sewers to convey the redirected stormwater without surcharge during the five-year, six-hour design storm
- For separate storm sewers, design GSI to capture and treat the runoff from 0.75 in. (1.9 cm) of rainfall according to criteria in Ohio EPA's "General Permit Authorization for Storm Water Discharges Associated with Construction Activity Under the National Pollutant Discharge Elimination System (Ohio EPA Permit No. OHC000004, April 11, 2013)"
- For combined sewers, design GSI to reduce runoff volume and attenuate peak flows up to and including the five-year, six-hour design storm
- Safely integrate GSI facilities into neighborhoods, maximizing the co-benefits of unprogrammed open park space and enhancing site vegetation
- Promote GSI to surrounding communities to enhance the image of GSI facilities as community-oriented infrastructure with desirable, positive neighborhood impacts

DESIGN CRITERIA

For both projects, the guidance documents used for the design of stormwater facilities/green infrastructure were the WEF 2010 Manual of Practice (MOP) 23, Design of Urban Stormwater Controls; 2014 WEF Green Infrastructure Implementation; the Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Manual; and the Ohio EPA NPDES permit. Based on these standards, numerous decisions were made.

Sites were chosen for the green stormwater basins that were large enough to maximize cost-effectiveness while allowing for desired stormwater management and providing tangible community co-benefits. The sites are near the downstream point of the runoff capture areas, near and up-slope from a separate storm sewer or culverted stream, where available, with adequate capacity to receive the regulated discharges from each basin.

The stormwater facility/green infrastructure design included the following: inlets/outlets and energy dissipation; emergency spillways; landscaping, such as trees (with protection), shrubs, perennials, and grasses; hardscape features including benches and tables, recreational paths, fencing, and public art installations; and area protection with at-grade barriers and landscape buffers.

To minimize maintenance requirements and costs, the designs included features for pretreatment of influent runoff through small-footprint solids and grit capture, high-velocity flow management, and proper runoff distribution; low-maintenance, resilient materials (e.g., vegetation, mulch, soil media, and structures); efficient dewatering with minimal standing water or saturated soils; safe and easy access for maintenance staff and machinery; and a public park aesthetic.

For public safety and welfare, slopes were kept shallow (3:1 or less) to facilitate basin egress and reduce water ponding, with barriers to restrict access where appropriate.

Based on public input at 60 percent and 90 percent design, the District evaluated the project's cost-effectiveness, including low life-cycle costs, ecological benefits (ecosystem services), economic and social benefits to low-income or minority populations, recreational and community gathering spaces, carbon footprint reduction and other climate change effects, energy savings, improved air quality, aesthetics, job creation, and increased property values.

PROJECT APPROACH

Work on the two projects is summarized below:

- Refining the existing hydrologic/hydraulic (H/H) models, including converting the District's baseline and consent decree models to a catchment modeling software platform, checking and refining catchment boundaries, re-establishing sanitary sewer flow conditions for each sewershed, revising the impervious area estimates within each drainage catchment, quantifying uncertainty in stormwater flow estimates, calibrating the model by analyzing flow data (obtained by 26 flow meters), and estimating future flow reductions for the projected vacant land
- Evaluating flow reduction using the revised H/H models to develop alternative flow reduction strategies. These strategies included GSI improvements to remove an additional 44 million gal (167 million L) of average annual CSO volume to comply with the consent decree requirements.
- Eliminating, realigning, and downsizing planned project components. The E140CRS project evaluated three relief sewer alignment alternatives to

Table 1. Stormwater management overview

Area Name	Drainage Area	Current Discharge Location	Redirected Stormwater Discharge Location
Page	86 acres (34 ha)	Combined sewer along Euclid Avenue north of Lee Road	Shaw Brook Culvert on Strathmore Avenue at Elderwood Avenue
Scioto	102 acres (41 ha)	Combined sewers south and east of intersection of Haden Avenue and Doan Avenue	Separate Storm Sewer on East 133rd Street at Garden Road
2nd Avenue	35 acres (14 ha)	Combined sewer along Euclid Avenue north of Taylor Road	Separate Storm Sewer on East 133rd Street at 2nd Avenue

determine the most cost-efficient routing and redirection of stormwater flows to two culverted streams to reduce combined sewer flows and eliminate or downsize relief sewer components. Such opportunities were not available for the Union-Buckeye project area. However, both projects evaluated green infrastructure and stormwater detention improvements to further reduce runoff volumes and peak flow rates.

- Exploring alternative sewer construction methods to minimize site disruptions, such as open-cut, conventional two-pass tunneling, micro-tunneling, and alternative horizontal and vertical pipe alignments and shaft locations
- Advancing conceptual designs to biddable design drawings by analyzing the geotechnical investigation and environmental site assessments; identifying required permits, easements, and areas of public disturbance; and preparing preliminary estimates of probable construction costs
- Requiring construction-phase services, including building facilities to meet design objectives and supervising installation of critical project components, particularly site grading and vegetation of GSI facilities

E140CRS PROJECT

The E140CRS project is integral to Project Clean Lake, relieving CSOs and frequent sewer surcharging within a 1,930 ac (781 ha) sewershed and ultimately discharging to the Euclid Creek/Dugway storage tunnel system with a capacity of 117 million gal (443 million L). A significant portion of this sewershed is served by separate storm and sanitary sewers discharging to culverted historic streams that, over time, became incorporated into the combined sewer system.

Evaluation and Preferred Alternative

An innovative H/H evaluation demonstrated that redirecting 228 ac (92 ha) of separate stormwater from the combined sewer system to three major GSI facilities (total volume 6.2 million gal [23 million L]) would reduce the length and size of the E140CRS relief sewers, saving $25 million (nearly a 25 percent reduction). The H/H modeling optimized the design of 14,000 ft (4,300 m) of 60 to 84 in. (152 to 213 cm) tunneled sanitary relief sewers, with seven access shafts and refinement of more than 30 CSO regulator structures. The H/H modeling was a refined, calibrated version of the District's baseline and consent decree models under the latest available catchment modeling platform. The E140CRS system model is part of the larger 13,980 ac (5,700 ha) Easterly District model, so intra-district interactions and proposed tunnel operating conditions had to be understood to properly size the E140CRS facilities.

The preferred alternative for the E140CRS project addressed the original objectives and incorporated the alternative evaluation. It consists of two sanitary sewer relief tunnel segments, an open-cut and tunnel CSO outfall extension, and three GSI stormwater management basin systems.

Two tunnel segments carry 60 to 84 in. (152 to 213 cm) diameter sanitary relief sewers among seven new tunnel access shafts. The pipe depths range from 31 to 62 ft (9.4 to 18.9 m).

The Main Line tunnel alignment varies in size from a 60 to 84 in. (152 to 213 cm) diameter relief sewer from Shaft DST-2 to Access Shaft No. 5. The sewer is installed by conventional tunneling. The main alignment is approximately 9,300 ft (2,800 m) long with a slope of 0.30 percent to 0.90 percent. Depths range from 28 to 50 ft (8.5 to 15.2 m).

The Woodworth Avenue tunnel segment is a 60 in. (152 cm) diameter relief sewer from Access Shaft No. 3 to Access Shaft No. 7. The sewer is installed by conventional tunneling. This tunnel segment is approximately 4,700 ft (1,400 m) long with a slope of 0.50 percent. Depths range from 34 to 62 ft (10.4 to 18.9 m) deep.

Other improvements include seven tunnel access shafts and one drop pipe connection; a CSO outfall including 570 ft (174 m) of 84 in. (213 cm) diameter open-cut sewer and 280 ft (85 m) of 84 in. (213 cm) diameter pipe in tunnel from Access Shaft No. 1 to a culvert structure at Nine Mile Creek; a regulator structure to divert combined sewer flows from the project area into an alternative interceptor; and inter- and intra-community relief sewers at various locations to convey combined sewage to the Main Line sewer.

The E140CRS project collects and redirects stormwater from 223 ac (90 ha) within three areas tributary to the stormwater management basins in Table 1 that drain into the combined sewer system. Stormwater from the three sewersheds is collected, as feasible, from existing separate storm sewers, new stormwater separation sewers, and individual properties. The collected stormwater is redirected by new storm sewers to green infrastructure facilities that control peak flows and water quality before discharge to a culverted stream and/or storm relief sewer.

Each of the three GSI facilities has an extended dry detention basin for water quality control, coupled with additional detention volume to control the peak flows during the five-year design storm to meet downstream capacity constraints. Bioretention basins as a viable treatment technology for the E140CRS project were ruled out during the 60 percent design due to the shallow depth of rock and lack of suitable soils at the basin sites.

In each system the basin configuration was determined by optimizing the size of the basin footprint, the volume and associated depth required to store the peak flow, property considerations/parcels to avoid, area reserved for amenities, and site topography. A pretreatment unit, sized for 20 percent of the water quality volume, occupies part of each basin.

The Page Avenue stormwater management system consists of approximately 3,354 ft (1,022 m) of new 12 to 36 in. (30 to 90 cm) diameter storm sewers, manholes, catch basins, and storm sewer separation to redirect stormwater from 86 ac (35 ha) to the Page GSI basin (Figure 1). This basin occupies a footprint of approximately 2.0 ac (0.8 ha) on 22 parcels on Page, Elderwood, and Wymore avenues. The available water storage volume in the basin is approximately 2.6 million gal (9.8 million L).

Peak flow attenuation allowed the outlet pipe diameter to be reduced from 48 in. (120 cm) to 18 in. (45 cm), reducing costs and avoiding several potential obstructions.

The Page GSI basin outfall runs northeast from an outlet control structure through a new 18 in. (45 cm) storm sewer running northeast from the approximately 1,356 ft (313 m) outfall to a new connection with the Nine Mile Creek culvert, with limited slope along the line compensated by additional detention storage in the basin.

The Scioto Avenue stormwater management system consists of approximately 8,856 ft (2,700 m) of new 12 to 54 in. (30 to 135 cm) diameter storm sewers, manholes, catch basins, and storm sewer separation to redirect stormwater from 102 ac (41 ha) to the Scioto GSI basin (Figure 1). This basin will occupy a footprint of approximately 1.5 ac (0.6 ha) on eight parcels on Mayfair, Hayden, and Scioto avenues. The available water storage volume in the basin will be approximately 3.1 million gal (11.7 million L).

Peak flow attenuation allows the outlet piping diameter to be reduced from 48 to 24 in. (120 to 60 cm), protecting the capacity of the E. 133rd Street relief storm sewer, reducing costs, and avoiding several potential obstructions.

The Scioto GSI basin outfalls through a new 18 to 24 in. (45 to 60 cm) storm sewer running west approximately 1,866 ft (569 m) to a new connection into an existing 36 in. (90 cm) diameter storm sewer on E. 133rd Street at Garden Avenue.

The 2nd Avenue stormwater management system consists of approximately 595 ft (181 m) of new 18 to 30 in. (45 to 75 cm) diameter storm sewers, manholes, and storm sewer separation to redirect stormwater from 35 ac (14 ha) to the 2nd Avenue GSI basin (Figure 1). This basin occupies a footprint of approximately 0.7 ac (0.3 ha) on eight parcels on First Street and Second Avenue. The available water storage volume in the basin is approximately 1.2 million gal (4.5 million L).

Since the E. 133rd storm relief sewer has adequate capacity for the 2nd Avenue area, little to no peak flow control storage is needed, allowing the basin area to be downsized to allow deeper ponding of the water quality volume.

The 2nd Avenue GSI basin outfalls from an outlet control structure through a new 18 in (45 cm) diameter storm sewer running west approximately 138 ft (42 m) to a new connection into an existing 18 in (45 cm) diameter storm sewer on E. 133rd Street at 2nd Avenue.

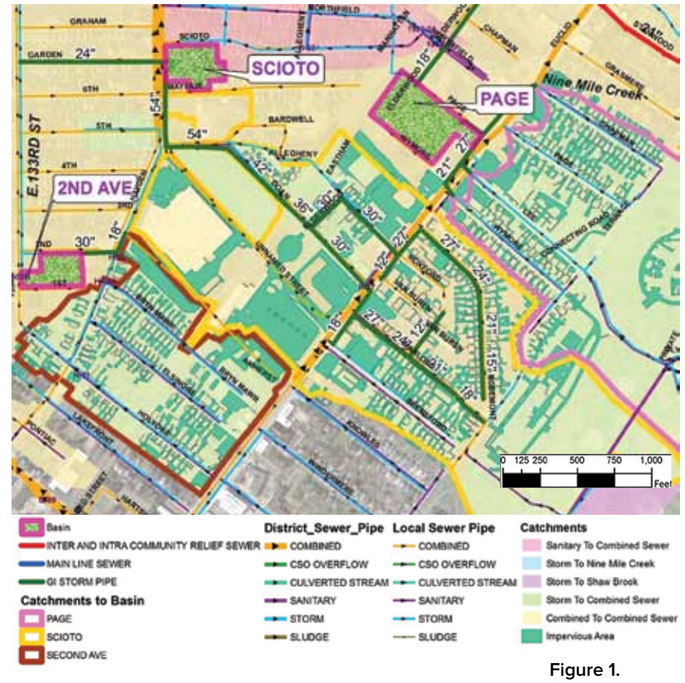

Figure 1. Page, Scioto, and Second Avenue stormwater management systems

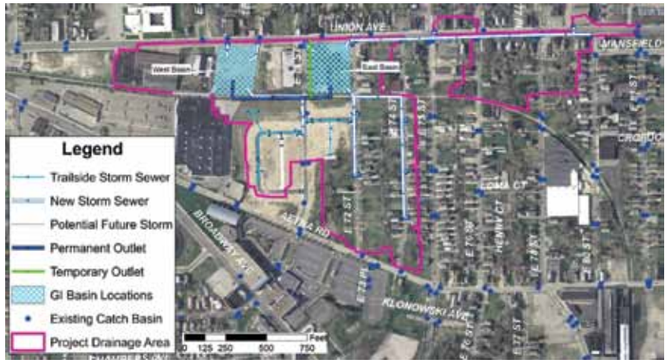

Figure 2. Slavic Village–Union (SVU) Avenue recommended plan

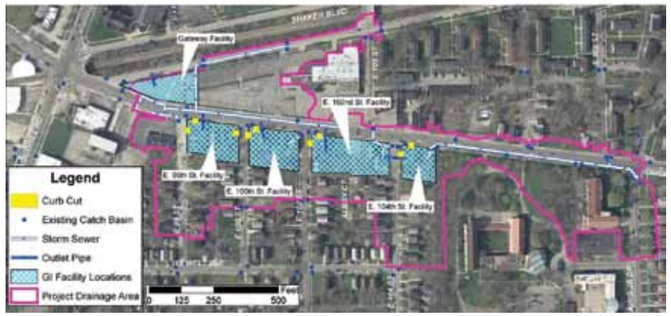

Figure 3. Buckeye Road recommended plan

UNION-BUCKEYE GREEN INFRASTRUCTURE PROJECT

For the Union-Buckeye Green Infrastructure (UBGI) project, the District wanted to decrease CSO volume annually by 3.3 million gal (12.5 million L) or more, per its Appendix 3 consent decree requirements, at a cost of around $2.50/CSO gal ($0.65/CSO L). The UBGI project consists of two project areas: Slavic Village-Union (SVU) Avenue (see Figure 2) and Giddings Brook Zone 2–Buckeye Road (see Figure 3). During design, the original concept in the District's GSI plan proved to be much less cost-effective than planned, largely due to limited infiltration capacity of native soils, the cost of new storm sewers to convey stormwater to the GSI facilities, and the lack of a separate stormwater outlet (as was present for the E140CRS project), requiring the GSI facilities to discharge back into the combined sewer system, thus reducing CSO control benefits.

Alternative Evaluation

These two neighborhoods lack the pockets of separate storm sewers and immediate opportunities to downsize a major relief sewer project, conditions so favorable for the E140CRS project. Thus, little opportunity existed to offset the cost of the extensive network of new storm sewers required to collect and convey stormwater to the proposed GSI facility sites. In addition, opportunities for a more decentralized deployment of GSI facilities were limited because the District does not control the public right-of-way and no road/streetscape improvements were envisioned for these neighborhoods.

Potential GSI and stormwater systems were evaluated by characterizing stormwater redirection opportunities within the project area, defining potential GSI sites, and defining potential storm sewer alignments for stormwater redirection. Separate storm sewers serve part of the SVU project area, with additional separate storm sewers nearby. In addition, the District's proposed CSO plan called for future installation of a separate trunk storm sewer for this area, potentially providing a separate stormwater outfall for these basins, that would significantly increase CSO control. In anticipation of this future stormwater outlet, the SVU stormwater control measures were designed to provide stormwater treatment, stormwater volume reduction, and peak flow attenuation through capture of the water quality volume, which according to Ohio EPA standards at the time were equivalent to runoff from a 0.75 in. (1.9 cm) rain event.

Similar opportunities to redirect separate storm sewers from combined sewers to GSI facilities and/or discharge them to a separate stormwater outfall did not exist in the Buckeye Road project area. As such, the Buckeye GSI facilities were designed to temporarily store runoff for all storms in the District's typical year of 121 storm events. After treatment and/or detention, the runoff is directed back to the combined sewer system. Additional volume was provided where cost-effective for peak flow attenuation during larger storm events.

The initial alternatives screening concluded that conveyance was the major cost and new storm sewers would be constrained by utility interference. In response, the District directed the use of shallow storm sewer pipes (with minimum cover of 2 to 3 ft [0.6 to 0.9 m]) and primary focus on collecting runoff from the right-of-way and surfaces draining to it. In addition, no residential roof tops were tied into the new storm system as part of this project. For non-residential sites, internally plumbed downspouts were not tied in, and external downspouts and/or parking lot catch basins were considered case by case. Considerations included not only cost-effectiveness but also the disruption to the site and property owner willingness. As a result, the GSI facility designs could not achieve CSO volume reduction targets cost-effectively, limiting the project to 2,300 ft (700 m) of associated storm sewers to divert, offload, and treat stormwater runoff from catchments within the two project areas.

SLAVIC VILLAGE–UNION PROJECT AREA

The recommended alternative for the SVU project area (12.1 ac [4.9 ha] of largely single-family residential development and a non-residential property) is adjacent to the Morgana Run Trail regional bike path, and will serve as a neighborhood/regional park to increase cost-effectiveness and supplement the limited CSO control benefits with community amenity co-benefits. It consists of two interconnected GSI facilities and five primary sections of storm sewers (Figure 2). The proposed GSI facility sites are south of Union Avenue, along the Morgana Run Trail. The west basin site is generally between E. 69th Street and E. 70th Street, and the east basin site is between E. 71st Street and E. 72nd Street. Both locations consist of primarily vacant or landbank properties. The proposed storm sewers redirect runoff to these sites from two areas: Union Avenue, between E. 69th Street and E. 80th Street, and residential areas between the Morgana Run Trail and Aetna Road, west of E. 74th Street.

Modeling indicates that the recommended alternative achieves annual CSO reduction of 7.5 million gal (28.4 million L) from existing conditions and an additional CSO reduction of 1.5 million gal (5.7 million L) when added to the proposed grey infrastructure CSO control projects.

BUCKEYE PROJECT AREA

Five small, interconnected GSI facilities and three primary sections of storm sewers (Figure 3) were designed for the Buckeye project area (11.7 ac [4.7 ha] of largely single-family residential development and a large church), providing limited CSO control benefits and serving as a revitalized gateway to this historic neighborhood. The proposed GSI facility sites are along Buckeye Road between Shaker Boulevard and Benedictine High School. The first site, the "Gateway" site, at the intersection of Buckeye Road and Shaker Boulevard, is a gateway from the west to this Buckeye Road neighborhood. The remaining four sites are located linearly along the south side of Buckeye Road. The gateway location is a vacant parcel last used as a dewatering facility for the new Buckeye–Woodhill light rail transit station, and the other sites are primarily on vacant or poorly maintained lots. The proposed storm sewers redirect runoff to these sites from three areas: Morning Star Baptist Church and parking lot between Shaker Boulevard and Buckeye Road; residential areas along E. 99th Street, E. 100th Street, E. 102nd Street, and E. 104th Street; and Buckeye Road between E. 104th and MLK Jr. Boulevard.

Modeling indicates that the recommended alternative reduces CSOs by 4.2 million gal (15.9 million L) from existing conditions and 1.0 million gal (3.8 million L) when added to the proposed grey infrastructure CSO control projects. In addition, it contributes 30 percent of the total UBGI project target of 3.3 million gal (12.5 million L) of CSO reduction.

KEY DESIGN CONSIDERATIONS

Several key considerations were incorporated into the design of the GSI facilities for the E140CRS and UBGI projects.

Stormwater and CSO Control Features

Each facility incorporated stormwater control strategies to cost-effectively maximize stormwater benefits:

- **Maximize CSO volume reductions**. The Buckeye GSI facilities discharge back to the combined sewer system, while the SVU facilities initially discharge to the CSO system until a separate stormwater outfall becomes available. In these situations, the CSO volume reduction is maximized by capturing the entire volume of all 121 storms (of the District's typical-year rainfall distribution) and discharging the volume not retained within the facility to the District's combined sewer, later dewatering the peak volume captured at a rate that balances CSO volume reduction, peak volume depth, and dewatering time.
- **Remove stormwater pollutants**. With the ability to discharge the E140CRS and SVU GSI facilities to separate stormwater overflow systems, the outlet discharges the water quality volume (i.e., runoff volume generated by 0.75 in. [1.9 cm] of runoff) within 24 hours. Pretreatment chambers and/or sumps are provided at basin inlets to minimize accumulation of the coarse sediment and debris within the basin, including GSI facilities not designed for stormwater pollutant removal.
- **Control peak discharges**. Peak discharge control is required if the designated discharge location does not have enough capacity to accept the peak flow delivered to the GSI facility by the stormwater drainage system and/or to minimize the cost-effectiveness of the GSI outlet piping. When necessary, basins have backflow preventers.
- **Configure facility to site**. Open surface detention facilities (or basins) are used at all but one site, because they are the least costly to construct, largely requiring excavation to intercept the influent storm sewers and capture the required stormwater volume. Surface detention features are vegetated suitably for both GSI functionality and neighborhood aesthetics and are graded to drain all accumulated stormwater toward the facility outlets. Rock vegetation, reinforcements, or other suitable treatments provide adequate energy dissipation at the storm sewer inlet.

Photo 1. Guardrails and thorny shrubs discourage pedestrian movement into basins

Photo 2. Low-growing non-woody vegetation ensures full site visibility and ease of movement by maintenance crews

Safety Considerations

When introducing periodic standing water into a populated urban location, safety is a primary concern. For the Union Buckeye and East 140th basin sites, a standard safety tool kit was developed and applied where applicable on each site. The standard safety features included the following:

- Maximum 3:1 slope for ease of internal basin maintenance and egress on foot
- Access drives and cantilevered sliding gate entryways for ease of access and operation by construction or maintenance machinery
- Guardrails to restrict pedestrian movement into basins (Photo 1)
- Thorny shrub deterrents along the inside basin perimeter to discourage pedestrian movement into basins (Photo 1)
- Low-growing non-woody vegetation to ensure full site visibility and allow for ease of movement by maintenance crews (Photo 2)
- Redundancy in outlet control structures to reduce the possibility of an uncontrolled overtopping event
- Emergency spillways to direct overflow away from sensitive structures and utilities, protecting the adjacent neighborhood as much as possible

For general site design, a 3:1 (horizontal:vertical) slope is considered a baseline for a stable vegetated slope. A 3:1 maximum for all site slopes ensures that maintenance crews can safely operate mowing equipment and machinery, and that slopes stay intact, stable, and walkable. By easing these grades to 5:1 for site access drives, a designated safe ingress/egress point from a cantilevered access gate to the basin floor can be established. With fluctuating hydrology and changing vegetation patterns designed into the lifecycle of these basins, ensuring that the foundation for these systems is solid and predictable is essential to long-term operational success and safety.

The Union Buckeye project's basins included relatively shallow, 1 ft (0.3 m) maximum ponding depths. Considering this, guardrail and thorny shrub deterrents were eliminated from these sites to allow for unobstructed views and movement across the sites for residents and law enforcement and to create a less formal, pastoral appearance. The East 140th Street basins, taking on a comparatively large volume of water and achieving ponding depths of several feet (meters), prompted additional protective measures. Owing to these much deeper ponding conditions, a protective guardrail was necessary around the East 140th Street basins. Using the International Building Code (IBC), a guardrail around the perimeter of each basin provided the physical barrier of the guardrail itself, as well as the implied separation of spaces, clearly delineating the line between the basin's functional area and the surrounding site's recreational area. To further deter site users from jumping the guardrail, a continuous row of thorny, ornamental, flowering shrubs was planted parallel and directly adjacent to the guardrail on the basin side (Photo 1).

Planning for the possibility of a rare, extreme storm event or unforeseen conditions restricting flow to basin outlets, emergency spillways were integrated into each basin design. The spillway directs the overflow volume to the safest location on the basin site, away from pedestrian and community infrastructure, residences, and primary transportation corridors. For the UBGI basin sites, spillways were graded into the earthen topography at the low point of each site, directing flow away from nearby residences. Spillways accommodate and drain maximum inlet pipe capacities. For the E-140CRS basin sites, spillways were designed into the site perimeter guardrails, trapezoidal in shape, to accommodate and drain maximum inlet pipe capacities.

Figure 4. The Buckeye neighborhood Gateway site utilizes subsurface chambers for stormwater storage. Impervious areas throughout the site drain to a demonstration rain garden (top insert). An abstracted water tower sculpture is a focal point

Community Co-Benefits

It was important to properly integrate GSI facilities into each neighborhood and provide community co-benefits using facility boundaries and other areas not integral to basic stormwater functions. With basins largely occupying the core of each site for both the UBGI and E140CRS projects, the areas surrounding these basins became available for recreational programming. Located in dense urban areas, these basins occupy valuable open space, prompting the inclusion of open lawn space, seating areas, and various public amenities.

Each GSI facility's landscaping scheme provides an unobstructed view from vehicles and sidewalks into the center of each site, as well as an ornamental tree-lined corridor along street frontages to add to the urban forest canopy. This configuration promotes a feeling of safety while also defining and separating the interior space of the site from the roadway. Improved sidewalks provide a wider, more accessible walking path with an enlarged street tree planting strip creating a buffer from the roadway. Open, accessibly graded grass lawn spaces allow for casual activities and gathering.

On the narrow Buckeye Road basin sites, improvements include enhanced streetscapes, limited open lawn space, and seating areas. On the west basin site, near the Morgana Run shared-use trail, adjacent open space use includes a paved pathway and pull-off picnic area with bicycle rack, picnic table, and shaded seating facilities. Picnic areas were also included at the Page, 2nd Avenue, and Scioto basins (E140CRS).

The Gateway site, with its stormwater storage largely in subsurface chambers as illustrated in Figure 4, capitalizes on the central space with a large open plaza and a more heavily planted urban park environment. Bench seating, waste receptacles, and a large, paved open area for hosting markets or community events provide an inviting space to the public and various opportunities for future use. Impervious areas throughout the site drain to a demonstration rain garden (Photo insert). The Gateway design's effect is a programmable community space with more intimate gathering spaces integrated throughout the GSI complex. The site departs from the large, open, airy spaces of the adjacent basin sites and showcases the diversity of urban green infrastructure. Public art was integrated throughout, branding the projects visually and tying together the aesthetic of the basin corridor and the Gateway site.

An existing Cleveland public art program brings further interest to the Buckeye basin sites with both standalone art as well as functional custom steel artwork by a local artist, and custom precast concrete seat walls inscribed with verses of locally inspired poetry. An abstracted water tower sculpture is a focal point and beacon for the new gateway to the Buckeye neighborhood (Photo insert). Within the gateway

Photo 3. Raindrop sculpture bicycle rack

Photos 4 and 5. Site-branded inlet covers

Photo 6. The Scioto Avenue basin site includes an outdoor classroom for use by an adjacent school

plaza, an abstracted raindrop sculpture bursts out of the concrete hardscape, serving as a bicycle rack (Photo 3). A more utilitarian piece of artwork was commissioned for the eight trench drain inlets to the Buckeye Road basins, where custom panels were cut and fitted into a standard frame to provide accessible and attractive site-branded inlet covers for the northwest corner of each basin site (Photos 4 and 5).

When assembled and observed together, these custom site elements create a cohesive image throughout the Buckeye Road basin complex. The inclusion of local artists provides a richness to the design, rooting it specifically to the Buckeye neighborhood, and immediately establishing community inclusion and ownership.

The Scioto Avenue basin (E140CRS) site harmonizes with its proximity to the adjacent Mayfair Elementary School by providing educational amenities, including an outdoor classroom (Photo 6) to accommodate an entire class at picnic table seating or along a seat wall curving inward toward the basin itself. A "ribbon" of paint, centered in the looping pathway, provides a clearly delineated route for students through the site to several vantage points, where informational signs describe various GSI structures. The outdoor classroom and informational loop allow for a lesson on green infrastructure and instruction on how Scioto Avenue basin fits into the water cycle and greater Cleveland's stormwater infrastructure.

Throughout all the basin sites for the UBGI and E140CRS projects, the open space surrounding the basins provides recreational opportunities for their neighborhoods. It shows a thoughtfulness in the design of these functional stormwater facilities by drawing from and adding to the spirit of place and gesturing to the community that while these sites help meet greater Cleveland's stormwater capture goals, they remain tied to their immediate neighborhoods. Passive recreation opportunities, from something as simple as an open lawn space with picnic seating to the complexity of an outdoor classroom with an informational loop, invites the public into these sites to use them as they would a community park. Inclusion of these amenities into an ongoing green infrastructure program, by capitalizing on the combined design, mobilization, and construction costs, also provides a much greater value, and at lower cost, to the city of Cleveland than if these two uses were to be planned for and sited separately.

CONCLUSIONS

These two projects illustrate the challenges of implementing GSI within established urban collection systems and as part of a mature CSO long-term control plan. GSI was cost-effective in the E140CRS project, because it significantly reduced stormwater volume that could be diverted and downsized the proposed grey facility. The added value of community co-benefits must also be included in the cost equation.

The decentralized nature of green infrastructure poses a challenge in that it requires a large network of facilities to effectively capture the stormwater within any given watershed. As urban space becomes increasingly limited, and as urban space increasingly becomes the area in most need of green infrastructure facilities, land use conflicts will arise that require safe, creative solutions to satisfy diverse interests. Solutions that address and capitalize multiple uses in one space can foster an inclusive environment and shift public perspectives on the design and construction of green infrastructure facilities within neighborhoods that might otherwise oppose such projects. Designing around these facilities as focal points, as if they were an ornamental pond in an urban park, highlighting the facilities, using premium materials with visual appeal, enhancing the vegetation, providing seating and gathering spaces, and giving space back to the public for open use, can lead to the sharing among all stakeholders in a successful design.

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REFERENCES

- CDM Smith (2016) Union/Buckeye Green Infrastructure (UBGI) Project, Basis of Design Report, 90 Percent Submittal, prepared for Northeast Ohio Regional Sewer District, Cleveland Ohio
- DLZ Ohio and CDM Smith (2016) East 140th Street Consolidation and Relief Sewer (CRS) Project, 100 Percent Basis of Design Report, prepared for Northeast Ohio Regional Sewer District, Cleveland Ohio
- Ohio Department of Natural Resources (2006, with periodic revisions and updates), Rainwater and Land Development: Ohio's Standards for Stormwater Management, Land Development and Urban Stream Protection, ODNR Division of Soil and Water Conservation, Columbus, Ohio
- Ohio Environmental Protection Agency (2013) General permit Authorization for Storm Water Discharges associated with Construction Activity under the National Pollutant Discharge Elimination System, Ohio EPA Permit No. OHC00004, Ohio EPA, Columbus, Ohio
- Water Environment Federation (2012) Design of Urban Stormwater Controls, WEF Manual of Practice No. 23 ASCE/EWRI Manuals and Reports on Engineering Practice No. 87 WEF Press, Water Environment Federation, Alexandria, Virginia
- Water Environment Federation (2014) Green Infrastructure Implementation WEF Press, Water Environment Federation, Alexandria, Virginia

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Emerging regulatory controls on PFAS

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ABSTRACT | Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are contaminants of emerging concern. EPA has developed an Action Plan for PFAS but has not yet set limits under the Safe Drinking Water or Clean Water acts, so several states are establishing preliminary concentration limits that are creating challenges for the wastewater and biosolids industry. The article examines current state regulatory trends and, specifically, limits established by New Hampshire and Maine and the impacts of those regulations. Key concepts are established as essential in assessing these chemicals, including human health impacts as well as feasibility, liability, cost, and benefit aspects. Several examples of unintended impacts to the wastewater and biosolids profession are referenced, and regulatory trends in other states are summarized. Summary data on PFAS levels measured in waters, wastewater, soils, and residuals are also provided.

KEYWORDS | Contaminants of emerging concern (CEC), PFAS, regulatory limits, biosolids recycling, land application, health impacts, NEBRA

INTRODUCTION

Concerns about perfluorinated and polyfluorinated alkyl substances (PFAS) continue to expand in New England and across the world. PFAS are persistent and sometimes bioaccumulative chemicals that provide stain, water, and grease resistance to fabrics and other substrates and that also have surfactant properties beneficial to many products and processes. These substances have been in common use since the 1950s and are found in trace amounts in the environment worldwide. Included in this family of substances are so-called long-chain (more than seven or eight carbons in the chain) chemicals of increasing concern, including perfluorooctane-sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluoroheptanoic acid (PFHpA), perfluorononanoic acid (PFNA), perfluorohexanesulphonic acid (PFHxS), and perfluorodecanoic acid (PFDA). PFOA and PFOS, the two most common, best-researched, and most concerning PFAS chemicals, were phased out in the 2000s. Included in the PFAS family are chemicals that have been introduced to replace PFOA and PFOS: GenX, Adona, and short-chain PFAS such as perfluorobutane sulfonic acid (PFBS) that are considered less toxic and persistent in the human body.

In 2019, regulatory actions in Maine and New Hampshire, aimed at reducing potential human health impacts from PFAS, have directly affected wastewater and biosolids programs. The ripple effects from those actions continue to propagate. Meanwhile, actions in a few other states are also raising concerns for water quality professionals. Municipalities and wastewater utilities and their biosolids programs are facing uncertainties related to potential liability and potential significant unforeseen costs as biosolids reuse practices and disposal alternatives become more restrictive.

Biosolids recycling to soils on farms and other lands has long benefited soils, crops, landowners, communities, and local economies. Based upon the longevity of PFAS in the environment and the growing concerns regarding the long-term health impacts of these substances, the benefits of biosolids recycling sometimes get lost. In the absence of EPA limits, a few states have begun to legislate and aggressively apply conservative standards aimed at reducing human exposures to PFAS. These regulations are having unintended impacts on the biosolids recycling industry. Some states' regulatory agencies, including most New England states, are developing limits for PFAS in drinking water, other waters, and for contaminated site cleanups well in advance of any action by EPA. These local numerical standards are being developed based on conservative human health risk calculations and without consideration of feasibility, costs, and benefits customarily used in developing maximum contaminant levels (MCLs) under safe drinking water programs (and that are required by the federal Safe Drinking Water Act). In Massachusetts, Vermont, and especially New Hampshire, the MCLs being developed for PFAS are within 10 to 20 parts per trillion (ppt) of the analytical method reporting limits (generally 2 ppt) and close to concentrations commonly found in wastewaters and septic systems, often measuring in the singles to tens of parts per trillion. In Maine, regulatory screening levels for PFAS—2.5 parts per billion (ppb) for PFOA and 5.2 ppb for PFOS—are so low that almost all biosolids tested exceeded the Maine target levels. Just to emphasize the minute nature of these limits, 1 ppt is equivalent to 1 second in 31,700 years. A ppb is 1 second in 31.7 years. Analytical abilities to accurately measure such tiny amounts remain challenging, with reporting levels at 2 ppt for clean drinking water. Analyses of wastewater and solids are even more challenging and have higher reporting limits.

This article aims to provide a greater understanding of impacts to inform regulatory decisions for these ubiquitous chemicals while maintaining wastewater and biosolids management options.

HEALTH IMPACTS STILL DEBATED

Water quality professionals—operators and engineers—must implement protections of public health and the environment. They rely on human health studies, toxicology calculations, risk assessments, and regulations that guide their work. PFAS are the most vexing contaminants of emerging concern (CECs), with health studies indicating "probable" or "possible" links that "may be" associated to negative health outcomes. Widely divergent proposed numerical standards for PFAS in drinking water indicate the levels of uncertainty related to PFAS toxicology. For example, Canada finalized PFOA and PFOS drinking water standards at 200 and 600 ppt this year, while New Hampshire set its at 11 to 18 ppt (Table 1). Massachusetts Department of Environmental Protection (MassDEP), which is considering an MCL of 70 ppt for six PFAS combined, summarizes the health impacts of PFAS this way:

> Studies indicate that exposure to sufficiently elevated levels of certain PFAS may cause a variety of health effects including developmental effects in fetuses and infants, effects on the thyroid, liver, kidneys, certain hormones and the immune system. Some studies suggest a cancer risk may also exist in people exposed to higher levels of some PFAS. Scientists and regulators are still working to study and better understand the health risks posed by exposures to PFAS, and MassDEP is following developments in this burgeoning area closely (MassDEP, 2019).

Key Concepts

- **Relatively minor amounts of PFAS** are conveyed to the environment by typical municipal wastewater (singles to tens of ppt) and biosolids (singles to tens of ppb). This represents ambient background levels for these persistent, widely used chemicals.
- **PFOA and PFOS—the most concerning—have been phased out** and background levels are now lower in human blood (>70 percent decrease) and are down in wastewater and biosolids. Phasing out uses of concerning PFAS addresses potential concerns most efficiently from such ambient background levels. PFOA and PFOS are becoming legacy issues.
- **Recycling municipal biosolids to soils** has not caused known impacts to food products and has only affected groundwater above EPA's health screening value of 70 ppt in rare cases—and only where there have been large industrial inputs to the sewer
- **Receivers of PFAS**—municipalities and utilities—cannot carry the major burden of addressing PFAS at the end of the pipe. If stringent water quality standards (less than the EPA health advisory level of 70 ppt) are set, funding must be provided, and society will pay more to reduce PFAS to such low levels.
- **Water resource recovery facilities** (WRRFs) can proactively follow and update best practices to cost-effectively reduce potential risks and liability related to PFAS: namely, consider upstream source control and industry best management practices
- **Regulatory agencies** should be aware of unintended impacts on WRRF programs when setting site cleanup and water quality standards for PFAS

This uncertainty around potential health impacts of PFAS is integrated in risk calculations. Toxicologists and risk assessors use routine formulas and protocols to determine appropriate acceptable PFAS levels in drinking water and other matrices, and part of that process is the use of "uncertainty factors"—multipliers that make up for gaps in knowledge about, for example, what the difference in impacts are to a laboratory rat versus a human. The levels of uncertainty around PFAS health impacts have resulted in uncertainty factors of up to 300 times or more. This means that, if research has suggested that a human dose of one unit is acceptable, the final calculated safe level would be 1/300th unit, after use of the uncertainty factors.

Public pressure, politics, and the highly cautious regulatory climate stemming from the Flint, Michigan lead-in-water crisis have combined to drive the accelerated pace to address PFAS with very strict standards layered with large uncertainty factors. This is true in New Hampshire and Maine. These two states provide examples of the challenges of establishing potentially overly conservative PFAS regulations.

IMPACTS OF SETTING LOW MCLs IN NEW HAMPSHIRE

New Hampshire is home to the former Pease Air Force Base as well as two manufacturers causing significant PFAS-contaminated drinking water sources. In the fall of 2018, the New Hampshire Department of Environmental Services (NHDES) began the regulatory process of setting drinking water MCLs for four PFAS—PFOA, PFOS, PFHxS, and PFNA—as required by a 2018 state law pushed through the legislature by concerned citizens. Initial numerical standards were proposed on December 31, 2018, but additional NHDES risk assessment work during the spring of 2019 led to far lower standards proposed in the final rule in June 2019 and formally approved in the required review by a legislative committee. The new standards took effect on September 30, 2019 (Table 1).

Table 1. New Hampshire drinking water maximum contaminant levels (MCLs) for four PFAS*

PFAS	ng/l or parts per trillion (ppt)
Perfluorooctanoic Acid (PFOA)	12
Perfluorooctanesulfonic Acid (PFOS)	15
Perfluorohexanesulfonic Acid (PFHxS)	18
Perfluorononanoic Acid (PFNA)	11

*Effective September 30, 2019

Wastewater and biosolids managers have two reasons to be concerned about these New Hampshire drinking water MCLs and identical groundwater standards:

1. **Potential for wastewater effluent and biosolids management to affect drinking water sources and groundwater at such low ppt levels.** Research on Cape Cod (Schaider et al., 2016) showed that septic systems in a purely residential neighborhood have released some PFAS compounds at levels that have affected neighboring drinking water wells at levels in the single to teens of ppt—close to New Hampshire's new standards. Other activities of modern living also likely affect waters at levels close to these New Hampshire regulatory numbers. As part of its rulemaking for setting the new MCLs, NHDES estimated that more than 10 percent of residential wells in the state will show PFAS above the new standards.
2. **Potential for municipalities and utilities to be held liable as "responsible parties" under the concept that is central to federal "Superfund" law (Comprehensive Environmental Response, Compensation, and Liability Act or CERCLA) and is mirrored by some state regulations of contaminated sites.** This is the unnerving question being considered today by public and private wastewater and biosolids management organizations in New Hampshire. If Water Resource Recovery Facility (WRRF) effluent or biosolids, which always (unfortunately) contain some trace amounts of PFAS, are thought to have caused drinking water or groundwater impacts above the new standards, will local utilities be required to pay for all or part of site investigation and remediation costs? So far, the answer in New Hampshire seems to be yes. Concerns are growing with utilities, farmers, landowners, and biosolids management companies. Because of reactions to these potential liability concerns, some 50,000 wet tons (45,000 wet tonnes) of biosolids routinely land-applied each year may have to go elsewhere. But the solids management market has limited capacity and flexibility (Beecher, 2016), which affects feasibility and drives up costs. In the summer of 2019, several WRRFs reported costs for solids management increasing from about $70 to about $130 per wet ton ($77 to $143 per wet tonne)—according to Shelagh Connelly of Resource Management, Inc. And limited local capacity at landfills and incinerators means WRRF managers are checking on options in the Midwest and Southeast, and increasing amounts of biosolids, including from New Hampshire, are being trucked to Canada.

Comment—estimating costs and weighing benefits... It is uncomfortable to talk about costs in the face of public health concerns. But cleanup and treatment for PFAS takes money, and municipalities and utilities will have to find that money. Going from 70 ppt (the EPA health advisory screening value for drinking water) to 10 to 20 ppt (as in New Hampshire, New Jersey, and soon maybe California, Michigan, and New York) makes a big difference in likely costs. The health benefits of such a fourfold reduction are uncertain, especially when considering, as noted above, that the uncertainty factors in PFAS human health risk calculations are >300 times. What will society end up paying for addressing PFAS, if regulatory standards are in the 10 to 20 ppt range? Will anyone be able to show benefits to public health that are worth the money spent?

Even as the state has adopted strict MCLs, it has not provided much funding to help municipalities and utilities, let alone homeowners. How and where will the new, low PFAS standards be enforced? What will happen if a community or household does not have the money needed to comply? And what will be the costs to communities, utilities, homeowners, and ratepayers? Many stakeholders believe NHDES failed to adequately include cost and benefit analyses when setting the MCLs.

To address the cost and liability issues, the New Hampshire Municipal Association is working with legislators on a bill to be introduced this fall that would provide at least partial grant funding for local PFAS remediation and enhanced testing at water and wastewater systems to help identify, reduce or remove the current liability concerns. Meanwhile, the state has sued manufacturers of PFAS, as have other states, and is hoping for hundreds of millions of dollars in settlement money to help pay for remediation. But that legal process could unfortunately take a decade or more to resolve, and municipalities and utilities are starting to bear the increased costs now.

In the late summer of 2019, the severity of New Hampshire's PFAS challenges led to legal actions related to wastewater and biosolids management:

- In one case, a private company that NHDES deemed a responsible party went out of business, forcing NHDES to take over PFAS mitigation. For 30 years, the company had managed septage at its southeastern New Hampshire facility under NHDES permits and in general compliance, according to NHDES records prior to this spring. However, this spring, NHDES deemed it to have affected neighbors' wells with PFAS at levels topping out at 175 ppt. NHDES officials are following standard procedures for groundwater contamination and site cleanup. NHDES intends to continue to seek payment from the company for costs incurred. But this is just one septage management program of several in the state that have impacted groundwater. Will other businesses be shut down? What will be the ongoing impacts of further enforcement on management of the state's septage?
- In a second case, a joint suit was filed against NHDES by the Plymouth Village Water & Sewer District, Resource Management Inc. (RMI, a biosolids management company), a farmer and RMI partner Charles Hanson, and 3M, claiming that the MCLs were adopted by a flawed, illegal process. The plaintiffs claim that NHDES is "required not only to analyze the science, but also to consider the costs and benefits to all affected parties that will result from establishing the standard (The Plymouth Village Water & Sewer District et al. v. Robert R. Scott, *2019*)." The plaintiffs seek an injunction against enforcement of the new MCL regulations and a court ruling requiring NHDES to properly and legally complete the regulatory process with proper notification and public comment.

PROPOSED FEDERAL LEGISLATION RAISES LIABILITY CONCERNS, TOO

Meanwhile, in the spring and summer of 2019, a score of PFAS-related amendments and bills were moving through Congress. Two House amendments to the National Defense Authorization Act (NDAA) concern water quality professionals, and WEF and the National Association of Clean Water Agencies (NACWA) are leading efforts to amend or defeat those amendments. One, the Dingell amendment (named for Rep. Dingell of Michigan), would require listing of PFAS under CERCLA—the Superfund law. The second, by Rep. Pappas of New Hampshire, would require similar listing under the Clean Water Act. Either amendment could create responsible party liability for wastewater utilities, municipalities, and related wastewater and biosolids management entities.

CERCLA has long had limited exemptions for municipalities, removing liability for waste management, but the proposed legislation does not clearly extend such exemptions. WEF and NACWA maintain it is not appropriate for municipalities and utilities to be liable for any PFAS they receive; they do not use PFAS and are not a contributing source. CERCLA and similar laws are intended to put the responsibility for costs of cleanups on those who profit from chemicals, such as manufacturers and industrial users.

In September and early October, as negotiations continued between the House and Senate on the NDAA amendments, WEF and NACWA urged their organization members to contact their congressional delegations.

MAINE CONTINUES ITS PARTIAL MORATORIUM ON BIOSOLIDS

On March 22, 2019, Maine DEP imposed a moratorium on biosolids recycling and required testing of all biosolids products prior to any further land application. This sudden regulatory action was in reaction to a news conference at Stoneridge Farm in Arundel, in which the farm had high levels of PFOS in the soil, in cow manure, and in milk. Milk sales were halted immediately upon discovery of the contamination in 2017, and the farm has been addressing the contamination since. Maine DEP's investigation suggested that the excessive PFOS came from an industrial material applied on the land in the late 1980s, not from municipal biosolids that were also applied for several years. But news reports and a lawsuit filed by the farm did not mention the industrial source.

Since the moratorium went into effect, 55 samples of biosolids have been tested, and only two have met the strict screening values that Maine DEP had devised (see Table 2). The North East Biosolids and

Residuals Association (NEBRA) and others have argued for two years that the screening values are not scientifically defensible for use with biosolids. The Maine biosolids test data are similar to data from recent testing of biosolids in other states, such as New Hampshire: single to tens of ppb (also referenced as ng/g). The Maine biosolids tested were almost all from non-industrial communities. These data establish what can be expected to be ambient background levels of PFAS in biosolids deriving from normal daily living environments (see Table 2 below and supplemental tables at the end of this article showing PFAS test results from a variety of media: groundwater, surface water, wastewater, landfill leachate, soils, biosolids, and septage).

Table 2. PFAS levels in Maine biosolids products*

Statistical Parameter	PFOA	PFOS
Max (ppb)	46	120
Min (ppb)	0.6	3.2
Mean (ppb)	8.5	25.4
Median (ppb)	3.8	22.9
n =	54	55
Maine DEP screening limit	2.5	5.2

*Maine DEP data; 55 samples tested by Maine WRRFs, April–August 2019, ppb (ng/g)

In late spring, Maine DEP allowed compost products to be marketed and distributed for the rest of 2019, but bulk-applied biosolids applications to land were heavily curtailed. Several WRRFs that have relied on land application have been stockpiling large volumes of solids this summer and fall and seeking disposal options at much higher costs. Presque Isle, which land applied liquid biosolids for many years, was forced into emergency dewatering and transportation to other disposal options—a large cost increase. Several field stockpiles of biosolids at farms were orphaned, some having to be removed and sent to landfill. The new disposal options being used by Maine WRRFs include out-of-state landfills and beneficial use in Canada.

In both Maine and New Hampshire, the biosolids management market has been disrupted because of the regulatory actions related to PFAS, and prices have risen, in some cases nearly doubling.

THE MAINE PFAS SUMMIT

The Maine Water Environment Association (MEWEA) aims to find compromises with Maine regulatory agencies. On September 13, 2019, as part of its annual fall convention, MEWEA hosted the Maine PFAS Summit, which attracted more than 150 stakeholders from around Maine and New England and included presentations from the Maine DEP commissioner, other DEP leadership, the Department of Agriculture, and the state toxicologist, as well as representatives from EPA, WEF, and NACWA.

The summit began with an update from the director of Maine DEP's Remediation and Waste Management Bureau. He noted the cooperation of a large majority of Maine WRRFs and biosolids recycling and paper mill residuals programs for their timely performance of PFAS testing and data submissions. He emphasized that a large proportion of Maine biosolids continue to be distributed because of the allowance of compost use, and his tone indicated a desire to maintain biosolids recycling.

However, the scrutiny on biosolids as a major PFAS concern continues. Maine DEP has scoured all available past records and compiled all historical data on all sites where biosolids and residuals have been applied. The intent is to prioritize the sites and begin testing them—despite data showing long-term municipal biosolids sites have typical low ppb levels and are not affecting farm products. Discovering more sites with soil PFAS levels above Maine's screening values will likely create confusion. Maine municipal stakeholders argue that the levels associated with biosolids use are generally far lower than the levels at PFAS hot spots at fire-fighting and military sites (via contamination from fire suppression foams), and that, for now, those sites should be the priority for Maine DEP actions.

In addition, Maine DEP is testing compost used in home gardens, closed unlined landfills, reclamation sites, septage, and polymers used at WRRFs. During the summer of 2019, DEP's PFAS actions, and the focus of the Maine PFAS task force, continued to be on wastewater and biosolids facilities, which are simply receivers and conveyors, and not one of the sources of PFAS. The one direct source of PFAS environmental contamination that Maine DEP is testing is Class B firefighting foam sites. MEWEA submitted letters of comment to Maine's PFAS task force contesting what they see as an inappropriately narrow focus on biosolids programs. MEWEA's efforts had effect: In the fall of 2019, the task force's rough draft recommendations included a broader focus.

The Maine Department of Agriculture's presentation to the summit emphasized that "recently conducted statewide retail fluid milk testing" found "all Maine-produced milk below reporting limits" for PFAS (testing was from stores throughout the state and all major milk brands). In addition, in testing of milk from "three dairy farms, with two that spread biosolids, all three showed levels below reporting limits (Maine Department of Agriculture, 2019)." NEBRA independently tested milk at some of the same and an additional long-term biosolids-use farm and obtained non-detect results. The Department of Agriculture also noted that soil levels measured on long-term-biosolids-use farms ranged from 2.6 to 12.9 ppb for PFOA and 5.6 to 20.9 ppb for PFOS. These values are in the range of other land-application sites in other states, and well below the levels at sites affected by fire-fighting and industrial discharges and the Stoneridge Farm in Arundel, where an industrial discharge has likely left up to 878 ppb of PFOS in the soil. The testing results lessened concern of widespread PFAS contamination on farms.

The Department of Agriculture's talk was followed by discussion with a fifth- and sixth-generation farm family directly affected by the biosolids moratorium, forced to dump milk for weeks during testing and realizing unexpected fertilizer costs. They expressed their concern about their reputation and the viability of their product market. Biosolids have been important to their fertilizer and soil management programs for 30 years. From their perspective, their livelihood is threatened by public regulatory actions when they have done nothing wrong and have long complied with Maine DEP and Department of Agriculture standards. They asked for better communications and for state regulators to inform the public further that their products and Maine milk are safe and healthy.

Additional presentations at the summit included the following:

- The state toxicologist explaining the PFAS risk assessment calculations by which numerical standards are set and why there are differences in different jurisdictions
- Northern Tilth summarizing the results of the statewide biosolids and soils PFAS sampling
- Stone Environmental presenting the PFAS leaching modeling they have been working on for NEBRA
- Alpha Analytical discussing PFAS lab analysis challenges

All the presentations are available at mewea.org/fall-convention.

The Maine DEP commissioner spoke to the summit over lunch, reiterating his reliance on the state risk assessors for setting numerical standards. Following questioning, the commissioner stated he does not have the authority to relax the biosolids and soil screening values. Many attendees had the impression that a greater understanding is needed about both the role of biosolids recycling in helping Maine reach its sustainability goals and the negative impacts from the biosolids moratorium.

MEWEA and other presenters emphasized data and science, and the summit culminated with representatives of EPA's Office of Water, WEF, and NACWA emphasizing actions and concerns at the federal level. EPA Office of Water summarized EPA's ongoing work on chemical risk analysis and developing approved analytical methods for PFAS. EPA invited participation in the PFAS problem formulation discussions coming this winter. It will hold an all-states-and-tribes biosolids meeting and training in the spring of 2020. NACWA covered the liability concerns with the proposed federal legislation, and WEF emphasized that states' regulatory activities accelerate one another.

OTHER STATES' ACTIONS PENDING

While Maine and New Hampshire may be at the forefront of PFAS regulations affecting wastewater and biosolids management, other states are not far behind. In the summer of 2019, California announced drinking water notification levels of 5.1 ppt for PFOA and 6.5 ppt for PFOS. These numbers were chosen because California's water boards were advised that these are the reasonable lowest limits of analytical capability; the health-based standards, they said, would be even lower.

As of the end of the summer of 2019, other states' activities on PFAS regulation included the following:

- **Alaska**—Further action on clean-up standards, etc., were put on hold pending EPA action, in part because of the recognition that state regulation of this issue has uncertainties; however, a major biosolids composting operation has been suspended because of PFAS issues
- **Florida**—Provisional target clean-up levels for PFOA and PFOS are being established, and the state is considering surface water screening values
- **Massachusetts**—Proposed site soil and groundwater clean-up values are in the 20 ppt range for residential groundwater; public comments have been taken; the process of setting state MCLs for drinking water is underway, likely considering about 20 ppt for six PFAS combined
- **Michigan**—Drinking water MCLs were to be proposed by October 1, to be finalized in the spring of 2020; some biosolids programs are on hold
- **New Jersey**—MCLs and groundwater standards recommended for at least two years (PFOA = 13 ppt, PFOS = 14 ppt), but they have not yet been adopted
- **New York**—Comments were due by September 24, 2019, regarding proposed drinking water MCLs: PFOA = 10 ppt, PFOS = 10 ppt
- **Vermont**—May 2019 state law requires the Vermont Department of Environmental Conservation to set MCLs for five PFAS by February 1, 2020 and later to adopt surface water standards
- **Wisconsin**—The state recommended groundwater standards and preventive actions; some biosolids programs are on hold already; the state asked utilities to voluntarily test for PFAS, but most refused, stating that approved analytical methods must come first

Interim Considerations & Guidance for WRRFs

Do you test for PFAS when you do not have to?
Current issues with testing:
- For public agencies, data are public
- What will you compare data to?
- No EPA-approved analytical method exists except for drinking water
- Comments have been received on the draft method for non-drinking waters SW 846 Method 8327
- The Department of Defense (DoD) provides guidance and encourages use of isotope dilution, "modified Method 537"
- Sampling requires great care to avoid contamination; a formal PFAS sampling and analysis plan is needed

Look upstream for industries that may use PFAS
- Consider landfill leachate (generally not a concern, unless it is a high proportion of flow; see the supplemental data tables)
- Apply source control and pollution prevention (P2) strategies to reduce PFAS in influent
- Is formal industrial pretreatment needed? How are small sources differentiated from larger ones?

Get Involved
- Be knowledgeable and actively involved in your states' actions on PFAS, including site clean-up standards, drinking water regulations, and groundwater and surface water standards. They need your input to help avoid unintended impacts on wastewater and biosolids management programs. Make sure drinking water, groundwater, and site remediation regulatory staff talk with wastewater and biosolids regulatory staff to find solutions together. Ensure that states know ambient background levels of PFAS in any media they decide to regulate.

Encourage source control
- Phase-out of particularly problematic PFAS is a proven solution to reduce exposures

Support research and best available science to help society understand the relative risk of PFAS
- This effort includes the relative importance of different pathways of exposure, the role wastewater and biosolids play as receivers and conveyors of PFAS, and the cost-efficiency of source control and phase-outs of the most-concerning PFAS

Continue to manage wastewater and biosolids with best management practices
- This includes agronomic rate applications that reduce PFAS inputs and risks

Most states are carefully following the PFAS issues, addressing any industrial and fire-fighting hotspots, and watching for EPA leadership as the science advances further.

CONCLUSION

In Maine and New Hampshire, some state regulators are evaluating the potential for centralized incineration facilities to destroy PFAS. As drinking water and other materials are cleaned of PFAS, the volume of concentrated PFAS waste is growing, and incineration at temperatures at or above 1,835˚F (1,000˚C) is likely best for destroying these emerging contaminants. Some suggest wastewater solids—biosolids—should all be managed this way in the future. NEBRA and other stakeholders believe such a policy would waste resources such as energy, organic matter, nutrients, and carbon sequestration potential. Northeastern states, along with some in the upper Midwest, are more aggressive on PFAS than most of the rest of the country. This is a crucial time for collaboratively developing policy that is practical, efficient, cost-effective, and environmentally sound.

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REFERENCES

- Beecher, N. 2016. "You have to take my sludge!", *NEWEA Journal*, Volume 50, Number 3
- Maine Dept. of Agriculture, 2019. Slide presentation to the Maine PFAS Summit, September 13, 2109, Northport, ME
- Massachusetts Dept. of Environmental Protection, 2019. https://www.mass.gov/info-details per-and-polyfluoroalkyl-substances-pfas
- Plymouth Village Water & Sewer District, Resource Management, Inc., Charles G. Hanson, and 3M Company, Plaintiffs V. Robert R. Scott, As Commissioner of The New Hampshire Department of Environmental Services, Defendant, complaint filed Sept. 30, 2019, Merrimack Superior Court
- Schaider et al., 2016. Septic systems as sources of organic wastewater compounds in domestic drinking water wells in a shallow sand and gravel aquifer. *Science of the Total Environment*, Volume 547, 15 March 2016

ABOUT THE AUTHOR

Ned Beecher was executive director of NEBRA from 1998 to 2019. He is now NEBRA's special projects manager and has focused on PFAS in the past three years. Mr. Beecher has led projects and authored articles, papers, and book chapters on biosolids management in the Northeast, eastern Canada, and around North America.

SUPPLEMENTAL TABLES

Recent PFAS test results—BIOSOLIDS, RESIDUALS, & SEPTAGE (ng/g, ppb), with soil standards for comparison

	PFOA*	PFOS*	PFNA*	PFHxS*	PFHpA*	PFDA	Notes
Biosolids products nationwide, 2018	~3 – ~15	~2 – ~90	ND – ~4		ND – ~4	<1 – ~17	Seven composts tested by Lazcano, Lee - Purdue
ME biosolids, 2019	0.6 – 46 (mean = 8.5)	3.2 – 120 (mean = 25.4)					55 biosolids sampled, cake & composts
Food waste & compostable foodware compost, 2018	~3 – 12	ND – ~2	ND – ~2	~0.2 – 1	ND – ~3	~1 – 3	PFHxA = ~9 – 50 seven composts tested by Choi, Lazcano - Purdue
ME septage, 2019	15 – 60	<10 – 121					Seven samples; typical levels > biosolids**
U. S. sewage sludges, 2001	12 – 70 (mean = 34)	308 – 618 (mean = 403)					Venkatesan & Halden, 2013; older sludges = higher PFOA & PFOS
STANDARDS							
Modeled PFAS levels in biosolids to avoid impacts to 1 m ground water above 70 ppt (EPA screen)	sum = <40 – 60: 40 PFOA + 0 PFOS *or* 0 PFOA + 60 PFOS						Stone Environmental PRZM modeling, 2019, for NEBRA
ME DEP screening level developed for non-agronomic residuals, 2018	2.5	5.2					Applied to biosolids & biosolids soils in 2019

All data are suspect & variable due to there being no approved analytical method other than for drinking water and different lab protocols in use.
*There were six PFAS included in the U.S. EPA Unregulated Contaminant Monitoring Rule 3 (UCMR 3) testing of drinking water; the sixth, not shown here, is PFBS.
** Septage may have higher levels than biosolids because it is older, having sat in septic tanks for up to 10 years, reflecting higher uses of PFOA and PFOS prior to the early-2000s phase-out of these 2 PFAS.
ND = not detected.

Recent PFAS test results—SOILS (ng/g, ppb), with soil standards for comparison

	PFOA*	PFOS*	Notes
Garden control soils, MN, ~2010	0.29 – 0.54	0.93 – 2.1	Considered "background"
VT "background" soils, 2019	0.52 – 4.9	0.11 – 9.7	66 locations; PFOS found at all
NH soils impacted by industrial air emissions, 2016	ND – 33		160 soil tests in 16 mi² (41 km²) area downwind of industrial facility
Biosolids amended soils, ME, 2019	1.1 – 12.9 (mean: 3.1)	2.1 – 20.9 (mean: 8.8)	Sampling at 29 fields where biosolids were used for ~20+ years
Decatur, AL industrially impacted biosolids soils, 2009	50 – 320	30 – 410	3M manufacturer discharged to WRRF for years
STANDARDS			
VT DEC, for dermal contact, 2016	300		Not for leaching to groundwater
MI EGLE (DEQ), 2016	350	0.22	Groundwater, surface water protection
ME DEP screening level developed for non-agronomic residuals, 2018	2.5	5.2	Applied to biosolids & biosolids soils in 2019

All data are suspect & variable due to there being no approved analytical method other than for drinking water and different lab protocols in use.
**There were six PFAS included in the U.S. EPA Unregulated Contaminant Monitoring Rule 3 (UCMR 3) testing of drinking water; the sixth, not shown here, is PFBS.
ND = not detected

Recent PFAS test results—GROUNDWATER (ng/l, ppt), with water standards for comparison							
	PFOA*	PFOS*	PFNA*	PFHxS*	PFHpA*	PFDA	Notes
Cape Cod residential wells impacted by septic systems		~3 – 9		~0.4 – 40	~0.3 – 1		Schaider et al., 2016
Long-term dewatered biosolids land application sites, VT 2019	ND – 6						VT DEC draft data, three sites
NHDES monitoring at sludge monofill, Franklin, NH, 2017	47 – 884						NHDES sludge management site
NHDES monitoring at septage lagoons / facilities, 2019	< 1 – 399	< 1 – 106	< 1 – 97	<1 – 57	<1 – 524		Does not include BRC, E. Kingston
Arundel, ME farm industrial sludge site groundwater, 2017	ND – 41	2 – 130					ME DEP investigation
Pease Tradeport, NH, 2014	4 – 350	15 – 2500	ND – 21	13 – 960	2 – 120		Firefighting foam
Battle Creek ANG Base, MI	≤ 21,500	≤ 55,000		≤ 38,400			Firefighting foam
STANDARDS							
Canada Health (2018) drinking water	200	600					
U.S. EPA drinking water screening value (2016) & Michigan groundwater	70						Applies to the sum of two PFAS
NHDES MCLs and AGQS (2019)	12	15	11	18			
MA DEP proposed groundwater limit for site cleanup (MCP) (2019)	20						Applies to the sum of six PFAS
VT groundwater limit (2018)	20						Applies to sum of five PFAS
NJ groundwater limit (2018)	10	10	13				2018 interim limits for PFOA & PFOS

All data are suspect & variable due to there being no approved analytical method other than for drinking water and different lab protocols in use.

*There were six PFAS included in the U.S. EPA Unregulated Contaminant Monitoring Rule 3 (UCMR 3) testing of drinking water; the sixth, not shown here, is PFBS.

ND = not detected. MCL = maximum contaminant level for drinking water, AGQS = ambient groundwater quality standard

Recent PFAS test results—BIOSOLIDS, RESIDUALS, & SEPTAGE (ng/g, ppb), with soil standards for comparison			
Location	**PFOA**	**PFOS**	**Notes**
Michigan	16 – 3,200	9 – 960	32 MI landfills & Mi Waters data (see report*)
Vermont	80 – 2,800	23 – 300	11 analyses of nine samples in 2018
United States	30 – 5,000	3 – 800	
Europe	ND – 1,000	ND – 1,500	
Australia	17 – 7,500	13 – 2,700	
China	281 – 214,000	1,150 – 6,020	
STANDARDS			
VT screening levels for landfill leachate, 2018	120,000	1,000	Guidance only
MI EGLE surface water limit (2015)	420	12	If source of drinking water; limits are being used to screen wastewater effluent
Canada Health (2018) drinking water	200	600	
U.S. EPA drinking water screening value (2016)	70		Applies to the sum of two PFAS

*Adapted from Michigan Waste & Recycling Association, Table 4.3, (https://www.michiganwasteandrecyclingassociation.com/)

Conclusion: Landfill leachate in the U.S. is not a large overall contributor to PFAS in WRRFs, unless the leachate is a very large proportion of the wastewater flow (rarely). Cutting it off is not likely to reduce PFAS levels significantly in most cases.

Recent PFAS test results: SURFACE WATER & WASTEWATER (ng/l, ppt), with water standards for comparison							
	PFOA*	PFOS*	PFNA*	PFHxS*	PFHpA*	PFDA	Notes
Van Etten Lake, MI (Dec. 2018)	131	497		531			Contamination from military site/fire fighting
NJ DSREH investigation (2019)	2 – 34	< 2 – 102	< 2 – 8	< 2 – 96	3 – 15	< 2	14 sites with PFAS sources nearby
Arundel, ME farm industrial sludge site, 2017	ND – 249	2 – 476					ME DEP investigation
Decatur, AL industrially impacted biosolids site, 2009	ND – 11000	ND – 84	ND – 286	ND – 6710	ND – 8250	ND – 838	U.S. EPA investigation
NY paper mill residuals compost site stormwater pond (2017)	100	140					Residuals' PFAS levels similar to average biosolids
Lapeer, MI WRRF effluent 2017		≤ 2000					Metal-finisher discharge = 19,000
NH WRRF influent (3 facilities) NH WRRF effluent (3 facilities)	6 – 50 6 – 49	4 – 22 < 4 – 14	< 4 < 4	< 4 – 7 < 4 – 8	< 4 – 8 < 4 – 19		NHDES, 2017
STANDARDS							
Canada Health (2018) drinking water	200	600					
U.S. EPA drinking water screening value (2016)	70					Applies to the sum of two PFAS	
NHDES MCLs and AGQS (2019)	12	15	11	18		NHDES starts setting surface water standards by Jan. 1, 2020	
MI EGLE surface water limit (2015)	420	12				If source of drinking water; limits are used to screen ww effluent	

All data are suspect & variable due to there being no approved analytical method other than for drinking water and different lab protocols in use.

*There were six PFAS included in the U.S. EPA Unregulated Contaminant Monitoring Rule 3 (UCMR 3) testing of drinking water; the sixth, not shown here, is PFBS.

ND = not detected MCL = maximum contaminant level for drinking water, AGQS = ambient groundwater quality standard

Tips and tricks for establishing a thrifty culvert management program

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ABSTRACT | Knowing that a few structures were approaching the end of their design life, the town of Sudbury initiated an innovative program to comprehensively evaluate more than 150 culverts and bridges. The town developed a crossing asset management program to inventory culverts and bridges. As a result, the town was able to to prioritize maintenance, repair, and replacement needs to proactively manage these assets and coordinate with planned roadway and utility work. This article discusses the town's approach to cost-effectively map, inventory, and inspect culverts as well as develop a risk-based prioritization to prepare a capital improvement plan and a maintenance and management plan.

KEYWORDS | Asset management, risk-based prioritization, programmatic approach, stormwater, culverts, bridges, GIS mapping, Capital Improvement Program

INTRODUCTION

The town of Sudbury is a suburban community in MetroWest Boston. Approximately 18,000 residents call this 25 mi^2 (65 km^2) town home. Although relatively close to an urban center, Sudbury has preserved its colonial history and rural aesthetic through careful development patterns and preservation of significant open space. Almost 20 percent of the town's land area consists of wildlife habitat and parks or streams, ponds, and wetlands. As the town evolved from farmlands to residential homes, roadway construction required that numerous bridges and culverts be installed to maintain connectivity of waterbodies and habitat and preserve community character. Structures exist where roadways cross waterbodies at 162 known locations, almost one per mi (1.6 km) of roadway in Sudbury. The Sudbury Department of Public Works (DPW) manages the operation and maintenance of 142 of these structures, the Massachusetts Department of Transportation (MassDOT) owns nine structures, and private entities own the remaining structures. Figure 1 shows the locations of culverts and bridges throughout the town.

MOTIVATION FOR A CULVERT PROGRAM

In 2013, the town faced an emergency when a segment of Landham Road collapsed over the roadway's crossing of Wash Brook. The culvert at this location was a corrugated metal pipe, more than 40 years old, that failed due to corrosion and scour. Repairs required a 3.6 mi (5.8 km) detour, and construction took longer than expected, which inconvenienced many residents and commuters who regularly used this north/south thoroughfare between Route 20 and Framingham. For residents, town staff, and local decision-makers, this situation emphasized the need for Sudbury to undertake a proactive inspection, maintenance, and repair program to avoid additional unanticipated collapses.

Following completion of the Landham Road culvert replacement, a new director and deputy director joined the Sudbury DPW, both eager for a programmatic approach to manage, operate, and maintain town-owned infrastructure. In Sudbury, the town oversees drainage and roadways but also must coordinate with the Sudbury Water District and gas and electrical utilities when planning and executing projects. There is a need for improved communication leading to more coordination on infrastructure projects.

The DPW leaders saw a need for an "asset management approach" to comprehensively understand the location and condition of town infrastructure, prioritize work, and couple improvements with other planned in-house and external projects. Such an approach would allow Sudbury to cost-effectively and efficiently manage resources. One component of this approach was to initiate a culvert management program. Along with obvious benefits such as maintaining safe streets, reducing overall capital and operational costs, and coordinating repair and replacement, DPW staff recognized that this program would help to create ownership of the assets by town staff, provide voters and elected officials with a defensible plan, and gather information to improve the likelihood of obtaining supplemental funding through grant programs. These benefits are critical to the successful long-term execution of the crossing management program.

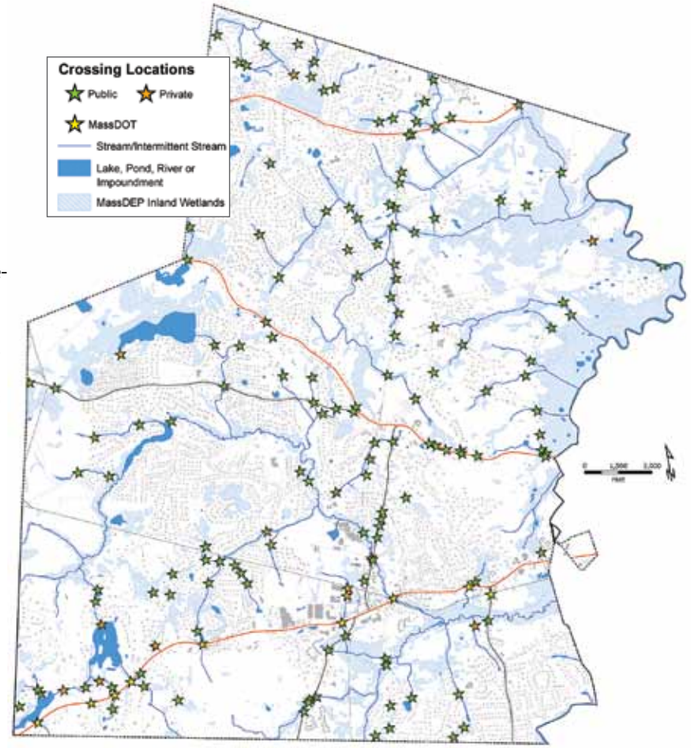


Figure 1. Culverts and bridges within Sudbury

CULVERT MANAGEMENT PROGRAM DEVELOPMENT PROCESS

The town's approach was to use publicly available and industry-approved inspection protocol, customized to accommodate Sudbury's wide variety of structure types, and implement the program using mostly its staff with targeted oversight by a consultant. The implementation team designed the overall crossing management program process to consist of the following steps:

1. Perform a "desktop" inventory of culverts and bridges
2. Determine field protocol and develop a tablet application for field assessment
3. Have town staff trained on the inventory process
4. Collect field data with consultant support
5. Assess risks based on condition of culverts and bridges, and prioritize needs
6. Prepare written maintenance, monitoring, and capital plans

This process allowed engineers and wetlands scientists to guide the work, be on-call for questions from the field, and comprehensively evaluate results, while DPW leaders could provide input at critical junctures and town staff could focus on the significant field effort. This dramatically reduced the overall program development cost and supported the DPW director and deputy director's goal of increasing DPW staff investment in the town's infrastructure.

INVENTORYING SUDBURY'S CULVERTS AND BRIDGES

"Desktop" Crossing Inventory

Using commercially available GIS spatial mapping and analytics software, the team prepared an initial inventory of likely locations of culverts and bridges throughout Sudbury. Figure 1 shows the results of that inventory. While town staff had institutional knowledge of crossing locations, electronic mapping improved efficiency by reducing the time staff spent identifying likely locations of structures

Overall crossing management program process

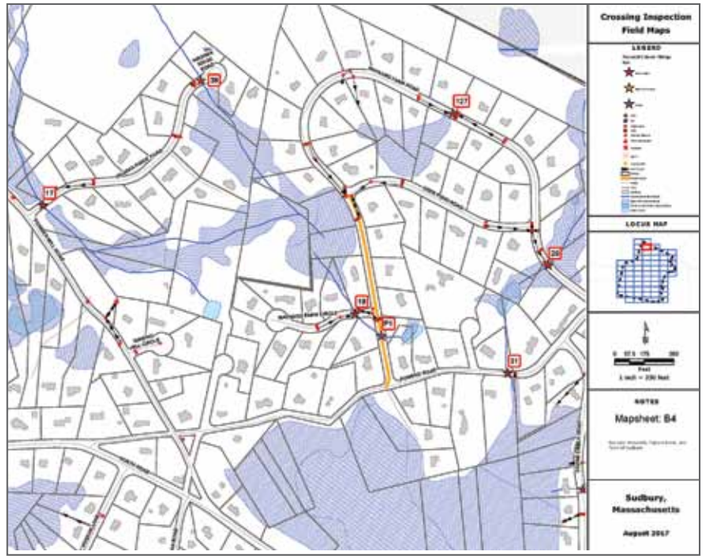


Figure 2. Image from crossing inspection field map book

and increased the probability all crossings would be captured. During this effort, publicly available wetland and waterbody data and the town's municipal separate storm sewer system (MS4) mapping, coupled with roadways and impervious cover, helped to systematically identify crossings throughout Sudbury. Locations where mapped streams and hydrologic connections crossed a road were considered obvious culverts or bridges. More time was needed to identify potential locations where crossings may have been installed to equalize wetlands. Given that Sudbury is almost 20 percent wetlands and waterbodies by area, many locations were possible. This method overestimated culverts and bridges in Sudbury; however, it also helped avoid overlooking structures necessary to include in the inventory. Between staff familiarity with town infrastructure and limited field work, the DPW easily verified the presence or absence of crossings at these types of locations.

In addition, the initial inventory identified culverts and bridges that are likely privately owned because of their location on an unaccepted street based on the town's roadway ownership data and therefore did not need to be included in the program. Locations and ownership of structures in the MassDOT Highway Division Bridge Inspection Management System were also confirmed.

A map book was also created showing the culverts and bridges, town's drainage system, and roadways, as a field tool for DPW staff when access to the town's tablet is not available. Figure 2 shows an example page from the map book.

Crossing Inspection Protocol and Field Forms

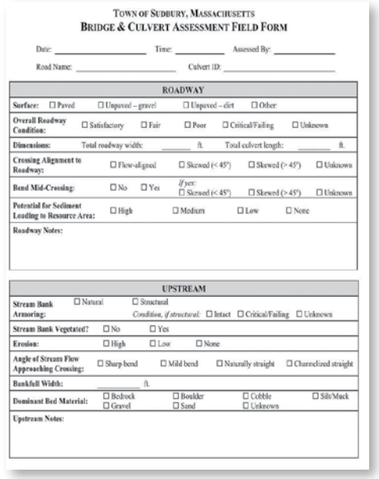
Sudbury's DPW director had seen the Culvert Assessment Guide from the town of Spencer, Massachusetts, and wanted to mirror this academic approach in Sudbury. An inspection protocol was prepared that adapted Spencer's process for Sudbury's goals and included nationally recognized stream crossing survey guidance. Potential funding opportunities were considered, including data collection that would support applications for grants and loans. The inventory gathered measurements and field conditions under six major categories:

1. Roadway
2. Upstream
3. Crossing inlet
4. Crossing outlet
5. Downstream
6. Operation and maintenance concerns

The protocol was extensive, but the team agreed that capturing as much information as possible while mobilized to avoid a second inventory later was worthwhile. The inventory gathered condition (satisfactory, fair, poor, critical/failing, unknown) of the following components for inclusion in the risk-based prioritization to rank likelihood of failure:

- Overall roadway condition
- Apron condition
- Cracking
- Crossing damage
- Condition of headwall/wingwall
- Scour
- Invert deterioration
- Cross-section deformation
- Joints and seams
- Footing condition
- Upstream/downstream embankments condition

The protocol ultimately consisted of an extensive guidance manual, a "quick guide" showing key measurement locations, and a field form that was produced both in a paper format and a tablet based format that used GIS data management and survey software applications. The cloud based data collection process using these applications allowed town staff to input inventory information that could be reviewed in real time by the consultant, associate photographs to the data, and avoid extensive post-processing and manual entry of paper records. While paper forms were not ultimately used, they were available throughout the field work in case the tablet or applications failed to work properly. A page from the paper form is included in Figure 3, and the tablet-based digital form is depicted in Figure 4.



TOWN OF SUDBURY, MASSACHUSETTS
BRIDGE & CULVERT ASSESSMENT FIELD FORM

Date: _____ Time: _____ Assessed By: _____
Road Name: _____ Culvert ID: _____

ROADWAY

Surface:	☐ Paved	☐ Unpaved – gravel	☐ Unpaved – dirt	☐ Other:	
Overall Roadway Condition:	☐ Satisfactory	☐ Fair	☐ Poor	☐ Critical/Failing	☐ Unknown
Dimensions:	Total roadway width: _____ ft.		Total culvert length: _____ ft.		
Crossing Alignment to Roadway:	☐ Flow-aligned	☐ Skewed (< 45°)	☐ Skewed (> 45°)	☐ Unknown	
Bend Mid-Crossing:	☐ No	☐ Yes	*If yes:* ☐ Skewed (< 45°)	☐ Skewed (> 45°)	☐ Unknown
Potential for Sediment Loading to Resource Area:	☐ High	☐ Medium	☐ Low	☐ None	
Roadway Notes:					

UPSTREAM

Stream Bank Armoring:	☐ Natural	☐ Structural *Condition, if structural:*	☐ Intact	☐ Critical/Failing	☐ Unknown
Stream Bank Vegetated?	☐ No	☐ Yes			
Erosion:	☐ High	☐ Low	☐ None		
Angle of Stream Flow Approaching Crossing:	☐ Sharp bend	☐ Mild bend	☐ Naturally straight	☐ Channelized straight	
Bankfull Width:	_____ ft.				
Dominant Bed Material:	☐ Bedrock ☐ Gravel	☐ Boulder ☐ Sand	☐ Cobble ☐ Unknown	☐ Silt/Muck	
Upstream Notes:					

Figure 3. Page from paper field form

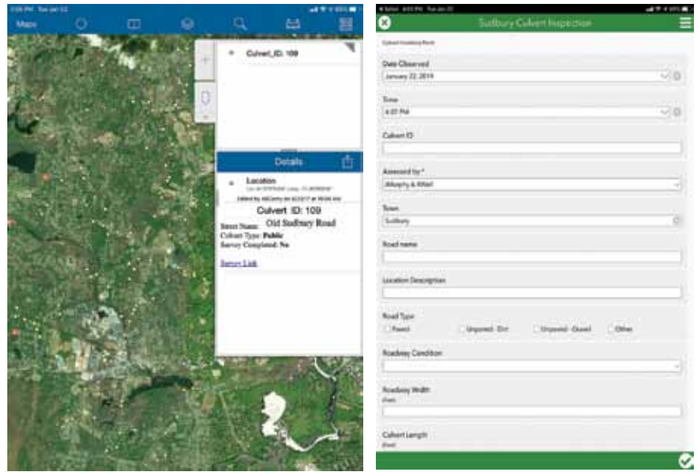


Figure 4. Images from tablet-based system

Field Effort

Sudbury's DPW survey/maintenance staff completed the bridge and culvert inventory. Using in-house resources for this field work reduced costs and enabled town staff to work at their own pace to fill gaps in their daily work schedule. This flexibility allowed staff to respond to more urgent planned and unanticipated public works duties.

At the start of the field work, town staff were trained on the inspection field work protocol and completion of field forms. This training aimed to achieve consistency in classification of conditions. The training program reviewed the developed protocol and provided instruction on using tablets to update culvert GIS maps and log key culvert attributes on field forms. Training consisted of both classroom time and "on the ground" data collection in the field, where the town staff then demonstrated proficiency by performing the inventory.

Town staff visited up to twelve culverts per day, an average of five culverts daily, for up to eight days per month. The inventory was completed over eight months.

During this time, the consultant monitored progress and reviewed data collected remotely through access to the GIS software platform's online applications. Using a consistent reviewer was critical to achieving uniformity across the many months of work and minimizing subjectivity throughout the vast amount of information collected. Each week, the consultant reviewed conditions shown in the photographs taken by the town and compared them to inventory data. Questions or discrepancies were addressed with additional follow up by town staff. For example, while the inventory form specified units, town staff often entered larger values as feet and small values as inches; this required clarification and, in some cases, revisiting the crossing. Overall, the photographs greatly facilitated off-site reviewers' understanding of the field-observed conditions.

A structural engineer visited priority culverts deemed critical due to structural or capacity issues indicated by town data as well as crossings with a unique structure type, a condition representative of multiple locations, or locations where there were remaining questions regarding the collected data. One day of structural site visits occurred about halfway through the inventory, while a second day of site visits was performed after town staff completed the inventory. The DPW Deputy Director joined the structural engineer, improving the communication of the findings and recommendations, and provided DPW leadership with a first-hand perspective of the actual field conditions observed. These follow-up inspections provided a clearer understanding of the condition of Sudbury's culverts and bridges, and aided in the final prioritization for maintenance, repair, replacement, or further evaluation and development of associated costs.

These site visits also helped town staff document needed repairs for decision-makers. On the first day of site visits, the structural engineer and DPW deputy director visited a culvert on Concord Road with a failing headwall previously identified by town staff. Between that first and second site visit by the consultant, this headwall failed completely and required a temporary emergency repair. Photos 1 and 2 (next page) represent the before and after conditions of the culvert. DPW leadership solicited emergency repair funds and received support from elected officials and the public for the expenditure, partially due to the comprehensive inventory and assessment program underway.

Photos 1a and 1b. Concord Road culvert at initial inventory

Photo 2. Concord Road culvert at second inventory

Findings

Overall, Sudbury's culverts and bridges are in good condition. Most of the crossings are concrete, 3 ft (0.9 m) or smaller in width/diameter, and only 2 to 5 ft (0.6 to 1.5 m) below the road surface. Besides the collapsed culvert on Concord Road, condition findings that warranted action included the following:

- Almost 33 percent of crossing inlets and almost 20 percent of the outlets inspected had obstructions, including wood, screen/grates, sediment, or trash that needed maintenance. Additionally, 21 crossings required sediment removal through jetting or hand extraction; 34 crossings required clearing of brush/debris by hand or with a small machine; and 12 crossings had bar racks and should be checked annually for functionality of bar rack and debris removal.
- In general, corrugated metal pipe crossings were in poor condition, or worse, but not yet failing. Photo 3 shows one of the town's corrugated metal pipe culverts. All corrugated metal crossings should be reinspected within the next five years.
- Eight crossings required reinspection due to snow cover. Twelve crossings could not be located and should be revisited to attempt to complete an initial inventory or confirm that the crossing does not exist.

Final Inventory

At the end of the inventory, Sudbury confirmed the following:

- The town owns eight bridges and 116 culverts, a total of 124 crossings
- Two bridges and 16 culverts are along the north-south rail trail and town-managed
- MassDOT owns or operates three bridges and six culverts on Route 20
- Eleven private crossings exist in the town

RISK-BASED PRIORITIZATION

Data-Driven Evaluation

To further the DPW leadership's goal of enacting a logical, data-driven asset management approach that creates a plan defendable to Sudbury's voters and elected officials, the team used the inventory data to determine the criticality of each crossing. Criticality is essentially risk, which is determined by combining the probability of failure with the consequence of failure. Probability of failure is a function of the culvert's condition and expected remaining useful life, while consequence reflects the impact of a crossing failure. Criticality rankings allow the town to manage its overall risk and provide a logical framework for allocating operation and maintenance and capital expenditures.

The likelihood that a crossing will fail is a function of the condition, performance, reliability, and maintenance history. Factors from the inventory that directed likelihood ("risk") of failure consisted of condition of the roadway, embankments, wingwall and headwall, inverts, joints and seams, and footings, as well as severity of cracking, scour, and deformation.

If a crossing were to fail, the resulting consequence of that failure would differ depending on several factors. In Sudbury, the predominant consequences of failing crossings are safety-related, such as road closures limiting the passage of emergency vehicles and other traffic, and flooding. The following factors were also considered:

- The shortest re-route distance if each crossing were to collapse
- Failure of crossings on major roadways will have a greater impact on public safety, residents, and commuters, and require greater construction and traffic control coordination depending on the criticality of the road
- Failure of a crossing on a dead-end road will have greater consequences. The ranking was based on the number of houses on the dead end.
- Failure within a floodplain will have a greater impact during a flooding event, leading to accelerated flooding
- Failure of larger structures costs more to replace or repair and reduces the flow that can be conveyed under a road

To determine overall criticality of each culvert, the sum of risk of failure factors was multiplied by the sum of consequence of failure factors. A higher number means a higher overall criticality. Figure 5 illustrates a criticality matrix, plotted from the dataset.

Real-World Factors Influencing Priorities

In prioritizing crossings for replacement and repair, town-planned and Sudbury Water District-planned projects must be considered by town staff. In addition, crossings with high criticality as well as with the potential for habitat improvement were considered. Sudbury is home to several coldwater fishery resources designed by Massachusetts Division of Fisheries and Wildlife as well as to various Natural Heritage and Endangered Species Program Priority Habitat and Estimated Habitat areas. Crossings in these areas that need replacement may be eligible for habitat-related funding.

RESULTS

The field work and risk-based prioritization process, showed 10 culverts needed replacing, 13 crossings needed repair, and extensive maintenance was required. Criticality combined with information from the site visits by a structural engineer helped in preparing a Capital Improvement Plan for culverts and bridges needing replacement or repairs. Also proposed were an initial maintenance program to remove sediment and clear brush/debris, a one-time reinspection program, and an annual inspection and maintenance program. As initial maintenance is completed, culverts will need to be further inventoried and inspected, and the overall program will require updates.

Photo 3. Example condition of a corrugated metal pipe culvert

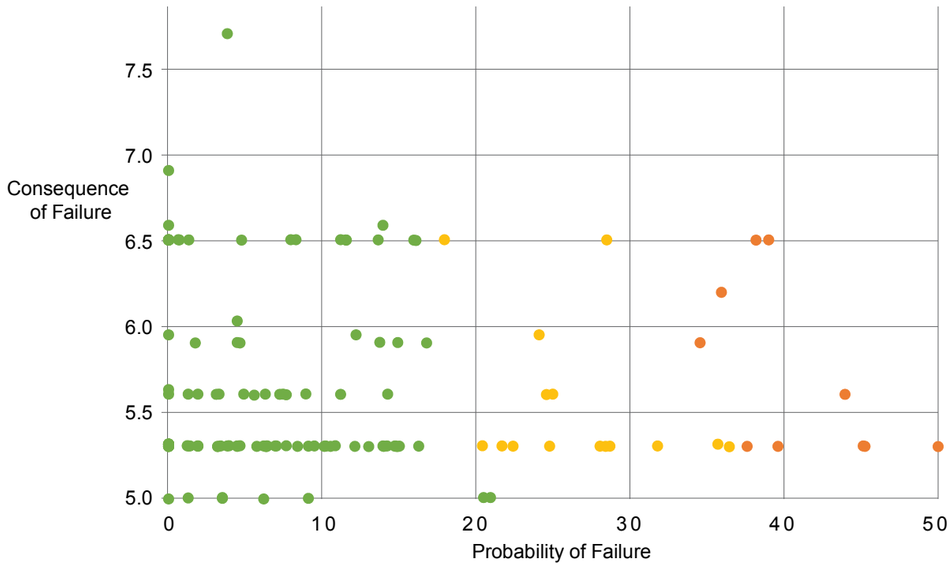


Figure 5. Criticality of Sudbury's culvert and bridge infrastructure

NEXT STEPS

Sudbury's culvert and bridge condition assessment has improved identification of town-owned infrastructure, associated condition, and financial and labor needs. With potential risks and liabilities identified, the town can use this information to garner political support and obtain local funding, as well as apply for grant funding wherever possible.

In the short-term, the town intends to address the high-priority crossings and perform initial maintenance while continuing with a routine inspection program. The DPW recognizes this program was a catalyst for the town's programmatic approach to inspection, maintenance, and repair/replacement of crossings and a vehicle to empower staff to take ownership of the town's assets. In the long term, the program will allow the DPW to evolve from reactive responses, such as with the Landham Road and Concord Road culverts, to proactive, data-driven decisions that maintain critical assets with a coordinated, cost-effective method that benefits public health and safety.

REFERENCES

- "Town of Spencer Culvert Assessment Guide," excerpted from a Worcester Polytechnic Institute Major Qualifying Project entitled "Designing a Culvert Management System for the town of Spencer, MA," July 2015
- *NAACC Stream Crossing Survey Data Form Instruction Guide*, developed by the North Atlantic Aquatic Connectivity Collaborative, May 2016.
- NAACC Stream Crossing Survey Data Form
- *Vermont Street Geomorphic Assessment Phase 2 Handbook – Rapid Stream Assessment Field Protocols*, developed by the Vermont Agency of Natural Resources, May 2009
- *New Hampshire Stream Crossing Initiative Field Manual*, Version 6.0
- Massachusetts Department of Ecological Restoration (DER) Culvert Replacement Municipal Assistance Grant Program Guidance
- EPA, "Fact Sheet: Asset Management for Sewer Collection Systems," April 2002

ABOUT THE AUTHORS

- Daniel Nason has more than 20 years of experience in public works management. Mr. Nason is Sudbury's director of public works responsible for public infrastructure including the drainage and culvert system. He is an active member of both the New England Chapter of American Public Works Association and the Norfolk Bristol Middlesex Highway Association.
- William O'Rourke serves a dual role as deputy director of public works and town engineer for Sudbury. He has more than 20 years of experience in planning, design, construction, and operation of municipal infrastructure including water, wastewater, and stormwater facilities.
- Janet Moonan is a project manager who oversees water, wastewater, and stormwater planning and design projects. Over Ms. Moonan's 15 years of experience in consulting, she has focused on leading watershed-type evaluations including drainage, culvert, and stream assessments, stormwater planning and permit compliance, and operation and capital planning for infrastructure.
- Eric Ohanian is a structural engineer with seven years of experience focusing on condition assessments and designing solutions for short-span structures. His achievements include an award for excellence in innovation by the Young Professionals in Transportation, Boston Chapter, and award-winning projects recognized by American Council of Engineering Companies (ACEC) of New Hampshire and Structural Engineers of New Hampshire.

On the road to a sustainable infrastructure: Part 1—defining our responsibilities

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ABSTRACT | This article, the first of a three-part series, introduces the need to incorporate sustainability into infrastructure design. We begin with how sustainability is defined and why it is important to include its three responsibilities—social well-being, environmental stewardship, and economic prosperity—into decision-making and design for infrastructure projects. Highlights of NEWEA's sustainability survey conducted earlier in 2019 are also presented.

KEYWORDS | Sustainability, triple bottom line, social well-being, environmental stewardship, economic prosperity, circular economy

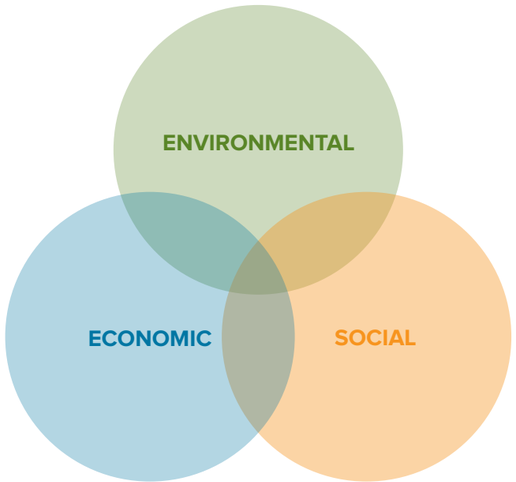

Figure 1.
Sustainable principles in balance create a three-legged stool often referred to as the "Triple Bottom Line"

INTRODUCTION

Sustainability has been commonly used in the water and wastewater industry for more than a decade, showing up in many NEWEA *Journal* articles and presentations across numerous NEWEA committees. The concept of sustainability is by no means new and, in fact, entire societies over the history of time have either thrived or failed based on their ability, or inability, to balance their social, environmental, and economic systems (Diamond, 2006). Sustainability took on its mainstream popularity around 30 years ago when the United Nations World Commission on Environment and Development published the report "Our Common Future," which also became known as the Brundtland Report. In this report the modern-day definition of sustainable development was defined as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (UN, 1987).

In February 2019, the NEWEA Sustainability Committee polled NEWEA members about their knowledge of, and challenges with, the concept of sustainability. In that survey (referred to herein as the 2019 sustainability survey), more than 65 percent of respondents resonated with the above definition as how they would define sustainability. Even though NEWEA membership seems to define the concept of sustainability similarly, there remains a myriad of "practical" definitions for what it means to build sustainable infrastructure.

Often, we reduce the concept of sustainability to strategies that we can easily quantify (e.g., energy use or chemical use) or that have a minor first cost. However, true sustainable infrastructure encompasses a much broader scope than we may have initially considered in our traditional approaches to planning and project work. This article is the first of a three-part series intended to provide a common understanding of the principles of sustainability and why they should be incorporated into every project we pursue, how we can broaden our thinking to apply those principles on infrastructure projects, and the challenges we need to overcome to succeed.

The sidebar defines certain terms used in this article and elsewhere related to the sustainability concepts discussed herein.

DEFINING SUSTAINABLE PRINCIPLES

Many in our industry are likely part of a private or public organization that serves its customers and clients based on a well-defined mission and vision. In business terms, the Brundtland Report definition of sustainable development serves as a "mission statement" for sustainability, with a vision that includes three fundamental core values, hereinafter referred to as responsibilities:

1. Social well-being
2. Environmental stewardship
3. Economic prosperity

These three responsibilities are often referred to as the triple bottom line of people, planet, and profits, and visually represented as a classic Venn diagram (see Figure 1).

Applying sustainability to projects requires that project teams strive to balance these three responsibilities to ensure that the implemented project holistically considers the short- and long-term impacts the project has on each responsibility. To understand the importance of balancing the three responsibilities, think of the triple bottom line as a three-legged stool; if one of the legs is shorter or longer than the other, the stool wobbles. If any one of the legs is too long or too short, the stool will not stand on its own; at that point, it no longer functions as a stool. The same holds true for any infrastructure project; if a decision overemphasizes one responsibility at the expense of the others, the project is not truly "sustainable" and may lead to unintended consequences.

One example pertinent to our industry is the unintended consequences of water conservation, especially in arid areas with limited water resources. Often, water reuse is relied upon in those areas to irrigate recreational and agricultural spaces. The more potable water is conserved, the less water is converted to wastewater, thereby raising the salinity of the water overall and creating unintended issues for irrigation of that water through typical reuse practices. Higher salinity in the recycled water leads to the need either to treat it using an energy-intensive process, or to provide make-up volume with potable water. Furthermore, water conservation leads to lower revenue generation for the utility; this in turn can decrease the funding available for capital projects, requiring water use rates to increase to address these needs. One seemingly positive action—water conservation—can lead to several unintended consequences across the three responsibilities and ultimately an unsustainable system, if the system is not considered more holistically.

Given how important it is to balance all three responsibilities, we need to look more closely at what characterizes each responsibility.

SUSTAINABLE SYSTEMS DEFINITIONS

Sustainability: a set of economic, environmental, and social conditions in which all of society has the capacity and opportunity to maintain and improve its quality of life indefinitely without degrading the quantity, quality, or the availability of economic, environmental, and social resources.

Sustainable Development: meets the needs of the present without compromising the ability of future generations to meet their own needs.*

Social Well-Being: addresses how people or communities might benefit or be impacted either directly or indirectly by an action, plan, or project.

Environmental Stewardship: addresses how our actions might directly or indirectly affect the natural capital of our planet.

Economic Prosperity: measures project value, including both traditional engineering economic metrics and indirect financial benefits, such as avoided costs or regional economic benefits.

Circular Economy: aims to redefine growth, focusing on positive society-wide benefits which strive to design waste out of the system, keep products and materials in use, and regenerate natural systems.

* 1987 Brundtland Report

The Three Responsibilities

In the 1990s, John Elkington coined the phrase "Triple Bottom Line" as a way of responsibly balancing decisions around "people, profit, and planet," which can be more broadly defined as social well-being, economic prosperity, and environmental stewardship (Elkington, 1997). Acting responsibly is at the core of sustainability; how these three responsibilities apply to infrastructure projects is introduced below.

1. Social well-being

Social well-being addresses how communities or stakeholders may be directly or indirectly affected

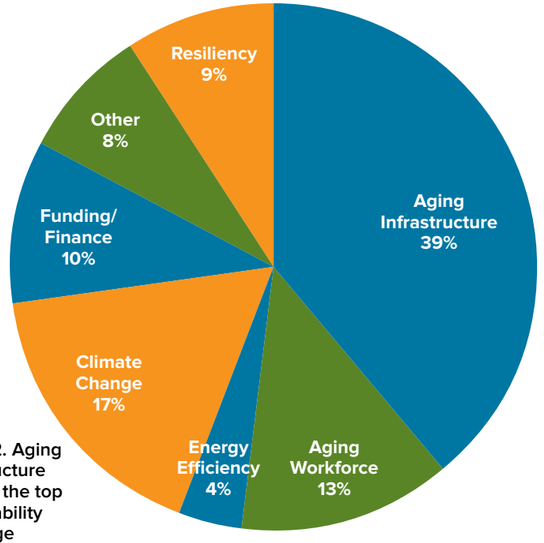

Figure 2. Aging infrastructure cited as the top sustainability challenge

by a project. Stakeholders could be any individual or group of advocates or adversaries that can either 1. have an impact on a project or decision, or 2. can be affected by a project or decision. They could be residents, construction workers, end users, abutters, operators, suppliers, or factory workers making the materials we are using on the project. When considering social well-being in our project decisions we should seek to improve the direct and indirect impacts a project may have on the local community. Our planning and design decisions should also consider the individuals and groups that supply products and materials, workers building the project, and the end users. The social well-being of infrastructure projects may include any number of the following responsibilities:

- Health and safety of workers and the public during construction
- Health and safety of the public and users during the project life
- Community involvement, awareness, and engagement
- User interaction and experience
- Supply chain human rights and labor practices

2. Environmental Stewardship

Environmental stewardship addresses how our projects might directly or indirectly affect the natural capital of our planet. To practice environmental stewardship, our planning and design decisions should first protect the natural environment and ultimately strive to improve and/or restore the environment. Environmental stewardship of infrastructure projects may include any of the following responsibilities:

- Responsible use of natural resources on the project
- Impact on natural resources during construction
- Impact on natural resources during and at the end of the project
- Protection and restoration of the natural habitat and its biodiversity throughout the life cycle
- Important issues such as climate change, toxic chemicals, and the sourcing of materials
- Supply chain resource and environmental issues based on material and product selection

3. Economic Prosperity

Economic prosperity defines the overall project value, including both traditional engineering economic metrics as well as indirect financial benefits, such as avoided costs or regional economic benefits. The direct financial aspects of an infrastructure project, such as capital costs, return on investment, and life cycle costs, are likely the most tangible and well understood of the three sustainability responsibilities. While direct financial aspects can quantify the various capital and operational costs of a project, they do not necessarily quantify the true value of a project. Indirect costs consider items such as the impact on the community during construction, the benefit to the community after construction, or certain avoided costs resulting from the project. Economic prosperity of infrastructure projects may include any number of the following responsibilities:

- Life cycle cost of project
- Funding source(s) for capital investments
- Funding source(s) for operation and maintenance
- Community development opportunities
- Avoided costs
- Economic impact on rate and/or taxpayers

MAKING THE CASE FOR SUSTAINABILITY

Now that we have more fully defined the core responsibilities of sustainability, how then do these responsibilities relate to our daily lives and jobs particularly when working on infrastructure projects? Furthermore, why is it important that we incorporate them in our industry? According to the 2019 sustainability survey, 39 percent of NEWEA respondents noted that the most pressing sustainability topic facing our industry is aging infrastructure (see Figure 2). This is supported by our nation's overall infrastructure having received a grade of D+ in the 2017 Infrastructure Report Card from the American Society of Civil Engineers (ASCE), and wastewater infrastructure also having received a D+ grade. The report estimates that 56 million people are expected to connect to centralized treatment plants by 2032, and that $271 billion will be needed to meet current and future demands (ASCE, 2017).

Meanwhile, today's infrastructure design and construction projects are receiving increasing pressure to reduce costs, raise public participation, and lessen environmental impacts. In certain situations, pressures are increasing for projects not only to minimize the potential impacts but also to restore or improve the conditions. Therefore, these responsibilities cannot be treated as mutually exclusive; they must be holistically considered so that each "leg of the stool" equally supports the overall project.

Recognizing that we are now building and repairing the infrastructure of tomorrow, much of which is expected to last into the next century, a strong case is to be made for creating a more circular economy within our industry so that all three legs of the stool are equally supported. A circular economy aims to redefine growth, focusing on positive society-wide benefits. It gradually decouples economic activity from the consumption of finite resources, and it designs waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital, and is based on three principles:

1. Design out waste and pollution
2. Keep products and materials in use
3. Regenerate natural systems

This contrasts sharply with the more traditional linear economy of the "take, make, dispose" model of production (see Figure 3 for these contrasting models). A linear economy leads to non-replenishable resource use, increases in emissions and toxic chemical use, disruption to our natural systems, and higher financial risks. A circular economy, on the other hand, focuses on value preservation and conservation; this leads to resource reuse, restorative design, and performance economics, better balancing the legs of the stool by accounting for overall social well-being.

Putting these principles into practice requires a shift in approach from our traditional, linear thinking to a more circular, holistic approach. One such approach is explored below.

Figure 3. As we strive to address our aging infrastructure, we should consider the opportunities and benefits of moving from a linear economy to a circular one

Applying the Three Responsibilities

No two infrastructure projects are identical. While the engineering approach from one project to another may be similar, an endless list of potential challenges among projects can affect the design approach and execution. These challenges may include rare and endangered species, sensitive resource areas, traffic congestion, concerned citizens, non-governmental organizations, regulatory deadlines, funding shortfalls, groundwater impacts, etc. When an infrastructure project is being defined, identifying these challenges (and project risks) and their potential impact on the three responsibilities is important. This early integration of sustainable thinking can help to ensure that the "right project" is selected.

Representing the Venn diagram as a sustainability fractal as shown in Figure 4, each responsibility overlaps with the adjacent responsibility, thereby forming three complementary zones identified in Figure 4 as viable, equitable, and bearable, in which the following holds:

- Viable projects balance the tradeoffs/benefits of economic and environmental aspects.
- Equitable projects balance the tradeoffs/benefits of economic and social aspects.
- Bearable projects balance the tradeoffs/benefits of social and environmental aspects.

An old engineering design axiom says "cost, quality, schedule—pick two." A similar challenge also applies to sustainable projects in which the tendency is to focus on one or two of the three responsibilities. For a project to be truly sustainable, we must holistically assess and address all three responsibilities and balance them. Fortunately, many infrastructure projects by their very nature commonly evolve from two and sometimes three of the responsibilities.

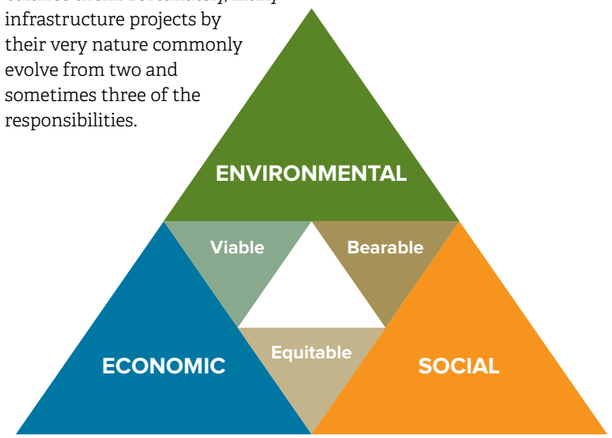

Figure 4. The sustainability fractal can be used to evaluate projects against the three responsibilities and to balance the Triple Bottom Line

For example, consider a park project that would provide a social benefit to the residents in a local community. If the town leaders have a fixed budget to design and build the park, they could move forward without community input to save money. By doing so the town leaders would be exercising their fiscal responsibility, and while the park would likely provide a social benefit to the community, the project may miss critical social elements by overemphasizing the economic responsibility. A more "equitable" approach would be to engage the community to find out what residents would like the park to look like and the features that should be included. Provided that the community interests are met within the budget, this more equitable approach would balance the economic and social responsibilities. Many publicly funded projects such as parks, roads, schools, and municipal buildings are by nature socio-economic projects. However, even addressing these two responsibilities simultaneously does not necessarily make the project sustainable, as environmental responsibility has not been considered. To shift this project from a socio-economic project to a sustainable one, the town would need to consider how the project could address the environmental aspects. For example, the town could include certain green construction techniques in the design such as low-impact development, reclaimed materials for construction, a solar canopy over the parking area, shade tree plantings, or groundwater infiltration. Again, by considering the third responsibility of environmental stewardship in the design, the project balances the three responsibilities, making this a more sustainable project.

MOVING SUSTAINABILITY FORWARD

In the 2019 sustainability survey, the Sustainability Committee asked NEWEA members how we can most effectively advance the concepts and principles of sustainable thinking in our industry within New England. More than 90 percent of respondents commented that communication and education should take top priority, with an emphasis on topic-focused seminars and webinars. In response to that comment, the Sustainability Committee has committed to publishing this three-part series of articles that will provide a common understanding of sustainability's three responsibilities, and lay a foundation for utilities and the engineering community to apply daily to drive improvements on water, wastewater, and stormwater projects.

Communities, with the assistance of planning and design teams, spend much time defining infrastructure projects and their boundaries while establishing the materials and methods of construction within those boundaries. What if communities were to begin to move from a linear to a circular economy, leading the way toward more ecologically effective and restorative designs? What if project teams were to incorporate more sustainable methods and materials into the already beneficial infrastructure and utility projects serving their communities as a matter of course? What if projects were viewed through a more sustainable lens that expands the design boundary beyond the project limits? What if those same communities and project teams looked for value-added direct and indirect benefits associated with the selection of more sustainable materials and methods from a holistic perspective? What if...?

Our hope is that this article provides a basic introduction to sustainable principles while offering a vision for the importance of integrating the three responsibilities in the planning, design, and construction phases of infrastructure projects. The NEWEA Sustainability Committee encourages you not only to see that potential, but as leaders and members in your respective organizations to start implementing those responsibilities today! In our next article, we will share methods and techniques that design teams can apply during the design process to integrate sustainability into utility and infrastructure projects.

ACKNOWLEDGMENTS

Special thanks to the Sustainability Committee members for their input and development of the 2019 sustainability survey.

REFERENCES

- Diamond, Jarod (2006), *Collapse: How Societies Choose to Fail or Succeed,* New York: Penguin Books
- United Nations World Commission on Environment and Development (1987), *Our Common Future.* Oxford: Oxford Press
- Elkington, John (1997), *Cannibals with Forks: The Triple Bottom Line of the 21st Century Business,* Capstone, Oxford
- American Society of Civil Engineers (2017), "2017 Infrastructure Report Card," https://infrastructurereportcard.org/cat-item/wastewater/, referenced 06/12/2019

ABOUT THE AUTHORS

- Wayne Bates, a principal engineer and industrial sector practice leader at Tighe & Bond, has more than 30 years of civil and environmental engineering experience. Mr. Bates is also an adjunct professor at Worcester Polytechnic Institute (WPI) and UMass Dartmouth where he teaches courses in sustainable infrastructure and green product design. Over the past three years he has traveled with the UMass Amherst Engineers Without Borders Ghana team as a professional mentor.
- Courtney Eaton has 20 years of experience in the planning and design of wastewater and water reuse systems, with an emphasis on sustainable planning and design. She has been a member of the NEWEA Sustainability Committee for the past 10 years and chair since 2017.
- Meredith Zona has more than 40 years of environmental engineering experience, with a focus on wastewater system design and incorporation of energy-efficient measures. She is a past publications director of NEWEA and has served on several NEWEA committees.

NEBRA Highlights

Northeast Residuals & Biosolids Conference keynote speaker Karen Schuett, co-founder and CEO of Livestock Water Recycling, from Calgary, Alberta

Northeast Residuals & Biosolids Conference

This year's annual collaboration with NEWEA's Residuals Management Committee was a great success. The conference, held in Springfield, Massachusetts, started out with a Poo & Brew event hosted by NEWEA's Young Professionals Committee. The Poo part was at Westfield's water resource recovery facility where more than 70 people toured the facility, hosted by Jeff Gamelli and Ken Gagnon

Nearly 150 attendees and 10 exhibitors were at this year's conference

and welcomed there by the mayor of Westfield. With so many people attending, the tour had to broken up into four groups. NEWEA leaders Sue Guswa (Woodard & Curran project manager for Westfield) and Nick Tooker (UMass professor assisting Westfield with innovative process controls) jumped in to lead tour groups. The Brew part was at the Westfield River Brewery.

The conference officially kicked off on Thursday morning with the annual meeting of NEBRA members. NEBRA members elected board members and voted in the proposed slate of officers for 2020. Board members reelected for three-year terms were Mike Hodge (Casella Organics), Chris Hubbard (De Nora Water Technologies), Michael Lannan (Tech Environmental Inc.), Deborah Mahoney (Hazen & Sawyer), and Tom Schwartz (Woodard & Curran). Officers elected for 2020 were Tom Schwartz, president; Deb Mahoney, vice president; Andrew Carpenter (Northern Tilth), Treasurer; and Isaiah Lary (Lewiston-Auburn Water Pollution Control Authority), secretary. Most significantly, NEBRA membership voted to file an amicus curiae brief in the lawsuit filed by others against the New Hampshire Department of Environmental Services (NHDES) regarding the way new groundwater standards were set for perfluoroalkyl and polyfluoroalkyl substances (PFAS)—more on this later in this article.

The conference keynote speaker this year was from Calgary, Alberta. Karen Schuett, co-founder and CEO of Livestock Water Recycling, spoke about how her company had perceived opportunities in water-related problems that farmers were having in Canada that led to a patented water recycling process having great results for farmers and the environment. The first day of the conference also included a "regulatory roundup" from five of the New England states, and various presentations related to biosolids management, technologies, and end uses. The second day was dedicated to PFAS, which generated lively but sobering discussions about the impacts of PFAS on biosolids programs.

Nearly 150 attendees and 10 exhibitors were at this year's conference, possibly a record. In addition to attendees from the northeastern United States and Canadian provinces, which were well represented, attendees came from as far away as Minnesota, Texas, Utah, and Ontario. That may be due to the second day's agenda, dedicated to the hot topic of PFAS. Although that subject may have been daunting, the conference ended on a positive note with ideas for helping NEBRA members weather the PFAS landscape. All of the conference presentations have been uploaded on both NEBRA and NEWEA websites (go to nebiosolids.org/annual-conference).

Proceedings from the Northeast Residuals & Biosolids Conference appear on page 65

NEBRA's Plans for PFAS Work in 2020

Over the past two years, NEBRA has been a national leader on PFAS related to biosolids and residuals management (and wastewater to some extent), hosting bi-monthly updates for the water quality profession, tracking research and policy in New England and other states, and commenting on legislation and regulations. NEBRA's efforts have helped spur engagement on the PFAS issue by numerous state, regional, and national water quality groups. Many of those organizations, including the California Association of Sanitation Agencies (CASA) as well as the National Association of Clean Water Agencies (NACWA) and WEF nationally, have now taken leadership on the issue. With these agencies in the lead, NEBRA's board and staff have decided that our smaller organization will best serve its members by reducing its involvement in the PFAS issue by retracting its scope somewhat to focus on the challenging PFAS issues specific to New England.

NEBRA appreciates the support and involvement from across the continent over the past year. The fast pace of the expanding PFAS issue has stretched NEBRA's budget past its limits for 2019, and we are seeking donations by December 31 to help us close out this year in the black. We are then making a more modest request for PFFund (NEBRA's fund dedicated to its PFAS research, tracking, and information gathering and dissemination) contributions for 2020, with a goal of $45,000. For that amount, NEBRA can provide the following:

- Ongoing collaboration with other leading organizations addressing PFAS in wastewater and biosolids/residuals
- Train-the-trainer style webinars and workshops to quickly ramp up additional experts in other states and regions to ensure a large repertoire of water quality professionals are engaged on the PFAS issue
- Continuation of the NEBRA PFAS advisory group, made up of PFAS-focused NEBRA members and others who support the PFFund
- Assistance toward the development, advancement, coordination, and support of appropriate PFAS research regarding residuals and biosolids application to soil, including coordinating with the W4170 research group and further developing PFAS soil leaching modeling and relevant field data

In support of its efforts NEBRA is accepting PFFUND contributions from interested organizations and individuals at the nebiosolids.org website.

NEBRA Files "Friend of the Court" Brief in New Hampshire Case

On October 17, NEBRA filed an amicus curiae brief in support of the Superior Court case against NHDES concerning public meeting and input requirements bypassed during PFAS rulemaking. The filing action was approved earlier that morning by a vote of the NEBRA members at its annual meeting in Springfield, Massachusetts.

Commonly known as a "Friend of the Court" filing, the brief supports the claim that NHDES did not follow administrative procedures in setting the new maximum contamination level (MCL) for PFAS in drinking water. The brief emphasizes that these substances are found everywhere in the environment (including the Arctic), a result of chemicals that are still used widely in firefighting foams, stain repellents, and other products society depends on.

NEBRA has been involved in PFAS research on sampling, monitoring, reporting, health effects, and other studies. NEBRA contends that the MCL set by NHDES will affect the two main ways—beneficial reuse and landfilling—biosolids are managed in New Hampshire, significantly increasing costs and disrupting recycling programs that have operated successfully for decades. The NEBRA brief does not address any of these PFAS concerns directly; instead it addresses the rulemaking process for establishing limits, supporting the claim that the state did not follow New Hampshire's Administrative Procedure Act when it failed to re-solicit public comment on the MCL after NHDES set a limit significantly lower than the originally proposed one. NEBRA's brief also supports the claim that the state erred in setting the new MCL by not addressing the unfunded mandates on political subdivisions as required by the state constitution. Finally, NEBRA agrees with the claim that NHDES did not follow the state's drinking water legislation when it failed to consider the costs and benefits of establishing the new standard.

Odds & Ends

NEBRA has completed the Sludge Survey for the Massachusetts Clean Energy Center (MACEC). It can be found on NEBRA's website as well as the MACEC website at masscec.com/completed-organics-energy-studies. Major thanks to the Massachusetts Water Pollution Control Association for assisting NEBRA with the study.

NEBRA hosted its 14th session of the North East Digestion Roundtable on October 4. The topic for this session was "Making use of microbial data from anaerobic digesters in New England and throughout the world" and featured UMass-Amherst professors Caitlyn Butler and Nick Tooker discussing recently collected samples from about 20 anaerobic digesters, mostly in New England. Those samples are being analyzed for the amount and type of microbes present (along with a larger set of samples from around the world).

NEBRA announced an online member survey in October. We want to hear from all our members, so if you are (or think you are) a member and did not hear about this, please call or email the NEBRA office. Survey results will help inform membership services. As always, members are encouraged to call the office or email with questions or issues.

Janine Burke-Wells, Executive Director
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For additional news or to subscribe to NEBRAMail, NEBRA's email newsletter, visit nebiosolids.org

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North East Biosolids & Residuals Association

Committee Focus

Laboratory Practices

NEWEA Volunteer Laboratory Certification Program—History and Status

This article is based on interviews with Laboratory Practices Committee (LPC) members who conceived and founded this important NEWEA program as well as with those leading the effort.

NEWEA's Laboratory Practices Committee (LPC) comprises laboratory specialists from facilities and other entities throughout New England and is the regional counterpart to WEF's LPC. These committees address laboratory procedures, operations, and excellence within the water environment industry. The NEWEA LPC also oversees a unique regional laboratory certification program aimed at operations personnel in relatively smaller facilities for whom precision-critical laboratory duties are only one part of each challenging day.

Current active members of the LPC: Walter Palm (chair), Danielle Morrison, Jim Galasyn, Marylee Santoro, Nora Lough, Tim Loftus, Phyllis Rand, Carmen Krzesik, and Andy Fish

THE LABORATORY CERTIFICATION PROGRAM was conceived by Andrew Fish while he was working as a laboratory specialist and inspector for the Vermont Department of Environmental Conservation (DEC). Part of his responsibility was evaluating those responsible for laboratory testing in the state's treatment facilities, and it soon became apparent to him that these hard-working and conscientious plant operators needed training in both laboratory techniques and practical laboratory theory. The Analyst 1 exam was originally (and still is) a written exam following a 48-hour hands-on laboratory course that he developed for the Vermont DEC. Mr. Fish based the original questions on his years of training operators and evaluating Vermont wastewater plant laboratories. The questions were intended to represent real life and exemplify New England-specific wastewater lab issues. Mr. Fish notes that he was fortunate to have support for this from Vermont DEC Director Marylin Davis. To promote his passion for laboratory excellence, he used numerous methods to stimulate operator interest in laboratory work, and he was well-known in Vermont as the author of the long-running "Lab Guru" column in the Green Mountain Water Environment Association newsletter.

When the idea of voluntary laboratory certification in Vermont was first introduced in the early 1990s, the authorities wanted to make the program mandatory, but Mr. Fish argued that making the certification "pass or get fired" might discourage rank-and-file operations personnel from participating. A voluntary program was viewed as a low-pressure, welcoming learning experience for operations personnel who already had the onerous responsibility of operating complex treatment facilities to meet strict permit limits. During his discussion with his Vermont superiors, Mr. Fish formally requested and was granted permission by the state to introduce this concept to NEWEA as a regional voluntary certification program.

Mr. Fish joined the infant NEWEA LPC while he was reaching out to the other New England states to gauge interest in certification. He began to introduce the voluntary certification concept to the committee. In 1996, he became chair of the LPC, and with help from is fellow enthusiastic LPC members, namely Nancy McAuley-Lesieur, Phyllis Rand, Paul Fitzgibbons, Colleen Spero, Gus Schlessinger, and later Tim Loftus (all proficient and well-respected laboratorians), the certification concept blossomed into a viable program. With additional support from Executive Director Elizabeth Haffner (later Cutone), and unanimous approval from the NEWEA Executive Committee, the LPC officially founded the NEWEA Voluntary Laboratory Analyst Certification Program and prepared the first NEWEA Analyst 1 exam along with an accompanying study guide.

In early 1997, LPC members involved in the program's development were the first to become certified under the NEWEA program, in part to ensure that the process worked and to confirm that any procedural bugs could be addressed within the committee confines. A few months later, at the 1997 NEWEA Spring Meeting in Portsmouth, New Hampshire, the Analyst 1 exam was first offered to a broader NEWEA audience. Tim Loftus was among the 29 participants (as was a young New Hampshire operator named Raymond Vermette, now NEWEA president). While taking the exam, Mr. Loftus's interest was piqued, and he joined the LPC to offer his chemistry/lab manager/writing skills to help further develop the certification program. His participation was welcomed as he wrote more questions and helped to further standardize the existing ones. He also led laboratory outreach by writing quarterly articles for the operation newsletters in the six New England states, and New Jersey, NEWEA, and even a couple of websites. He intended these educational articles to cover the basic information an analyst would need to know to pass the exam. Soon the committee, in an effort largely led by the late Paul Fitzgibbons, produced a more advanced Analyst 2 exam to cover more complex analyses.

Mr. Fish recalled one of the big challenges was whether all the New England states used the same standards for laboratory procedures (e.g., did all states use the same methods, require the same level of quality control, etc.). As a further complication, while some states are "delegated" to uphold EPA mandates, others remain "undelegated" and must follow strict EPA policies directly. As a state official with NEWEA connections, Mr. Fish was able to reach out to his counterparts in other states to make these determinations. The certification program and tests were carefully formulated to adhere to EPA guidelines, which are required by all New England states and therefore acceptable to these states.

Some debate again took place about accepting the certification as voluntary; Connecticut, for example, initially wanted the certification to be mandatory for that state. However, initiating a formal state regulation represents a lot of work, and eventually the idea was scrapped as too difficult to track and enforce. Another advantage to the voluntary nature of the certification program is that operators who may not be adept test-takers can be tested independently without the extreme pressure of a "pass or face the consequences" situation.

During the program's development, Mr. Fish was able to call upon and share experience that he had gained through serving for six years on the Exam Verification Committee of the Association of Boards of Certification (ABC—a national water resources certification organization). To maintain the credibility of the local exams, NEWEA's LPC and its certification subcommittee have generally echoed the procedures used by the ABC Exam Verification Committee.

According to Mr. Fish, perhaps the most important and consistently challenging problem with all certifications is exam integrity. Difficulties can include such things as operators copying and sharing questions with others, and proctors and/or trainers and training organizations copying or otherwise obtaining exam questions, sections of exams, or entire exams and sharing with trainees either directly or through modified training materials.

In the first couple of introductory years of the program, the LPC proctors traveled at their own expense throughout New England to offer exams for NEWEA to advance the program. As time passed, the New England Interstate Water Pollution Control Commission (NEIWPCC) began to sponsor the program, making it even more worthwhile for NEWEA-sanctioned instructors/proctors to offer the NEWEA exam, at no expense to NEWEA, following a NEIWPCC-sponsored two-day exam review course.

To free up committee resources for other purposes, the LPC eventually appointed a subcommittee tasked with managing the certification program. Ultimately NEWEA oversees the current program, but the LPC, more specifically the LPC's analyst exam subcommittee, is the workhorse behind this program. Mr. Loftus noted that the exam subcommittee continues to keep up with the most current test procedures and other legal aspects of the subject analyses, so the exam questions reflect the duties of a typical wastewater treatment plant analyst.

According to both Mr. Fish and Mr. Loftus, to obtain an analyst certificate one must pass a proctored Analyst 1 and/or Analyst 2 exam. The exams cover the typical analyses that would be required of NPDES permits in New England. Subjects covered in the exam include total suspended solids (TSS), coliform/E.coli, biochemical oxygen demand (BOD), pH, dissolved oxygen, wastewater microbiology, disinfection, and sampling techniques. Additional subjects covered are QA/QC, safety, management practices, and several other analyses (e.g., the phosphorus and nitrogen [P and N] series) that would be found in more advanced wastewater laboratories. The different exam levels reflect the levels of complexity.

Future possibilities for the Laboratory Certification Program include aligning certification with a NEWEA effort under development to institute a uniform procedure for certifications within various areas of expertise across the industry. The LPC and NEWEA are exploring how to offer these exams similarly to the way many states offer wastewater license examinations—enabling candidates to take a proctored exam electronically at a host venue. At this time there are no plans for certified analysts to renew their certifications although consideration has been given to either a five-year renewal or ongoing refresher education to keep knowledge current. Perhaps the decision of whether to require certification renewal or continuing education would be best left to individual states or even individual concerned employers.

The LPC is always looking for new members and would welcome anyone interested in making a difference in laboratory practices

Overall, the program has fulfilled its initial mission to continually increase the competence of water reclamation operator-analysts. Some 2,200 laboratory technicians and operators are now performing valid analyses and have received certificates confirming their technical knowledge. Many operators have included this certification on resumes and have found that it has helped them to "get their foot in the door" at wastewater facilities and laboratories.

Other WEF member associations (among them California Water Environment Association [WEA], North Carolina American Water Works Association–WEA, and Ohio WEA) also have voluntary laboratory certification programs, and some states (such as Georgia and Kentucky) have their own state-run certificate programs. The NEWEA program is likely most uncommon in that it is administered regionally but accepted locally by the constituent states. This program is clearly important in helping instill and ensure integrity among water reclamation personnel responsible for the validity of laboratory results. Members of NEWEA's LPC should be extremely proud of the great accomplishments that the laboratory certification program has achieved.

"Our committee has been very active and committed to producing a high-quality exam that will benefit everyone wishing to know more about wastewater testing procedures," says Walter Palm, current NEWEA LPC chair. "The LPC is always looking for new membership and would welcome anyone interested in making a difference in laboratory practices."

Spotlight: **Young Professionals**

Jessica Coelho and Brian Brown are established Young Professionals (YPs) within the industry. Jessica Coelho is a project engineer II with the Metropolitan District Commission of Connecticut (MDC) in Hartford and Brian Brown is an environmental engineer with CDM Smith in East Hartford, Connecticut. The Journal asked these YPs to reflect on their careers thus far and advise the next wave of environmental professionals.

Journal *How did you come to enter the clean water profession?*

JC: I became interested in the environmental field in high school. I went on to look for environmental engineering in colleges. I graduated from WPI (Worcester Polytechnic Institute) with a degree in civil engineering with a concentration in environmental science. I began working in the water and wastewater field immediately after college and have been ever since.

Jessica Coelho

BB: When entering college, I knew I wanted to do something in the engineering world. But beyond that, I had no real clue exactly what. After a year or two of college, where they made us dip our toes into a lot of different engineering fields, I knew the environmental world was what I wanted to focus on. Following that, I was able to do a co-op/internship where I saw and worked with various clean water projects and loved it. The couple (many?) not-awesome grades in structural analysis classes also may have played a small part in it.

■ *How long have you been in the water environment field and why did you decide that this work would make a good long-term career for you?*

JC: I have been working for a water/wastewater authority (MDC) for nearly 12 years. Like most graduates, I wasn't exactly sure what I would be doing for my career... or what I wanted to do! I am fortunate to have found what I enjoy so early on. In this field, I can find a balance of honing my skillset while continuously finding more to learn.

BB: I have been in the water field for close to 10 years. Knowing that what you are doing has some sort of benefit to the world and the environment, regardless of how miniscule it is, makes going to work rewarding.

■ *You have both been working in the industry for some time. What has surprised you most about this industry that you might not have been aware of when you were fresh out of school?*

JC: In school, you spend your years learning the technical information that will prepare you for your career. You don't fully understand that you are also learning the social aspect of the job like working as a team. The environmental field in particular involves being able to work with colleagues, state and town officials, clients and consultants, and the general public. I wasn't fully aware of this when I graduated, but it has come to be one of the most challenging and yet most interesting parts of the job.

BB: It's truly amazing when you realize the network of pipes, pumps, structures, facilities, etc., that exist "in the wild" that you never would know if you weren't in the industry.

■ *Do you talk with people outside the profession about what you do for work? What kind of reactions do you typically get from those outside the profession?*

JC: Yes. I am lucky to be surrounded by a diverse group of professionals. All vary but all have a respect for each other's different levels of success in their respective careers.

BB: We can all be guilty at times of being unaware and taking for granted things outside our individual "bubble" we live in. So I find it enjoyable to talk with people and teach them some of the simpler facts about clean water, what they can do to make a personal small difference, and tell them things like "yes, when you flush your toilet, it does not go straight out to the ocean, no matter what your aunt told you she read on Facebook."

■ *What benefit do young professionals gain from being involved in NEWEA?*

JC: Being involved in a large group like NEWEA provides the opportunity to network professionally and socially. Having a group of young professionals in the same field as you allows you the opportunity to bounce ideas off of each other and lays a foundation for the next generation of environmental professionals.

BB: I think the interactions that are provided between experienced and younger professionals are great, and allow for professional exchanges of info, opinions, and experiences that otherwise may not happen. It also gives you a sneak peek into what other professionals in the industry are doing and the types of career paths and concentrations that are out there.

■ *What challenges do you see for the water environment profession in the near future? How do you see the industry changing in response to these challenges?*

JC: The biggest challenge I see now is a loss of historical knowledge. We are approaching a time where a large group of individuals who have been in the industry will be retiring. There will be a gap between the loss of those individuals and the younger professionals. Although technology is always changing and the field is always evolving, the knowledge of those who have been in the industry for years is always invaluable.

BB: It feels as if we are stuck in a constant stage of "catching up," whether it be wastewater/water, or even outside of the water pocket with other infrastructure like roads, bridges, etc. Ensuring that we are continually "repairing/fixing" the country's infrastructure at a quicker rate than the infrastructure as a whole is degrading/failing seems to be a challenge. It can be frustrating when so much also depends on lawmakers and policies/funding outside of your control.

■ *What advice would you give to students or young people considering a career in the environmental field?*

JC: Take as many opportunities as possible to reach out to and/or intern with those in the field so that you can have a realistic idea of the different career options available.

Also, never be afraid to admit you do not know something. Ask questions!

BB: Keep an open mind and try your hand out at various types of projects when you are young; you may stumble into a career path or role that you didn't think you would enjoy. And it's extremely cliché, but it's also very true: Don't be afraid to ask questions.

■ *Thinking back, was there a person who helped you feel welcome in the field or served as a mentor to help your progress?*

JC: I walked into a very welcoming group. Colleagues and my manager were willing to take me under their wing to guide me and answer any questions that I had (and I had a lot!).

BB: I am grateful to have spent my entire career so far at a single company, even beginning in college at a co-op program, and am thankful to all those who welcomed me. Especially when I was a messy-haired 20-something-year-old with no idea what I was doing. Having experienced colleagues who are willing to spend the extra time and be patient enough to teach you makes a world of difference in the development of a professional, and it's something that I hope to pass on.

Brian Brown

■ *What has been your most rewarding experience in your career thus far?*

JC: When I began working, I thought that completing my first project, start to finish, would be such a great feeling. In reality, I feel the most accomplished when working well with those around me, whether it be working well on a team professionally or helping a customer with a problem and making their life a little easier because of it. For every handful of bad experiences you have, it is that one good experience that makes it all worthwhile.

BB: I love anything you get to see from its infancy to its complete implementation and construction. Seeing something scribbled on a piece of paper one day and then another day (usually many days later) having this idea or concept completed and constructed is fulfilling, and it gives you real perspective as to how much effort goes into every piece of infrastructure in our world.

■ *What is a fun fact about you that your professional network may be surprised to learn about you?*

JC: Despite my lack of athletic prowess, I play a variety of sports in social leagues including kickball, volleyball, bowling, and golf.

BB: My wife's and my dream is to go on a couples *Wheel of Fortune* one day. She gets to be the letter guesser though (duh). I love *Jeopardy* more, but I know I'm not smart enough, unless they made an exception and allowed me into the *Jeopardy Kids* episodes.

WEF Delegate Report

During the 92nd Annual WEFTEC in Chicago, our NEWEA WEF delegation—Matt Formica (past NEWEA president and associate vice president at AECOM) and Susan Guswa (municipal wastewater practice leader at Woodard and Curran), incoming delegate James Barsanti (past NEWEA president and director of water and wastewater for the city of Framingham, Massachusetts), outgoing delegate Fred McNeill (chief engineer of the Environmental Protection Division for the city of Manchester, New Hampshire), and WEF delegate-at-large Susan Sullivan (executive director of the New England Interstate Water Pollution Control Commission)—promoted New England's activities and initiatives while helping to develop and implement WEF's strategic goals and objectives. NEWEA's WEF delegates participated in House of Delegates (HOD) meetings, workgroups, and committees, coordinating with other WEF HOD committee members and the WEF board of trustees.

For our WEF delegates, WEFTEC began with an early Saturday morning HOD meeting where WEF leadership summarized its strategic objectives and accomplishments. WEF President Tom Kunetz kicked the meeting off with a brief overview of the *State of the Federation*. He discussed WEF's critical objectives which include the following:

- **Developing an engaged membership**. Mr. Kunetz began by introducing the new WEF director of association engagement, Lisa Ruane, who is charged with fostering the exchange of information and ideas between WEF and the member associations (MAs). We were recently notified that Ms. Ruane will be attending our NEWEA 2020 Annual Conference. Mr. Kunetz continued by highlighting the WEF grant program (from which NEWEA received a $20,000 matching grant—the largest of any MA) and emphasizing partnerships with MAs.
- **Providing a broad range of professional content and programming**. This includes WEF's efforts to create technical fact sheets with handy references for operators, its ongoing outreach to members on the evolving perfluoroalkyl and polyfluoroalkyl substances/perfluorooctanoic acid (PFAS/PFOA) issues, and WEF's annual review of WEFTEC's program content to ensure it remains informative, valued, and relevant to the membership.
- **Generating increased public awareness of the value of water**. Similar to our NEWEA initiatives, WEF focuses on increasing public awareness and perception of our water infrastructure. The presentation included the premiere trailer of *Brave Blue World*, a newly produced documentary film to promote the importance and urgency to address the challenges and opportunities facing our water industry. WEF has produced this film with industry leaders and innovators, and it features contributions from our own Boston superstar Matt Damon. The trailer was warmly and enthusiastically received by the delegates in attendance. The film premiered in Los Angeles on December 16 and will soon be available to NEWEA and other MAs for film-screening events.
- **Innovative technologies and approaches**. In concert with NEWEA President Ray Vermette's theme of innovation, WEF is also emphasizing the importance of this industry topic. Mr. Kunetz noted the WEF/Water Research Foundation (WRF) *Leaders Innovation Forum for Technology* (LIFT) program that provides leadership training to eligible members, and he announced the establishment of a workforce diversity and inclusion task force to review ways we can leverage the skills of all our members.

Other highlights of the HOD meeting included an interesting debate about the most important issues facing our water industry. The discussion was led by a three-person panel—Dave Galbraith, WEF delegate from Atlantic Canada, who presented on climate change; Steven Drangsholt, WEF delegate from the Pacific Northwest, who presented on improving communications; and our own Ms. Sullivan, WEF at-large delegate, who presented on government advocacy. An entertaining and lively exchange of ideas took place, with each panelist providing viewpoints and responding to comments from their counterparts as well as questions from the HOD members in the audience.

WEFTEC also included several highlights that allowed our NEWEA members to shine. The HOD meeting nominated and approved two NEWEA stalwarts to the WEF board of trustees: Howard Carter, director of the Water Resource Recovery Department for the city of Saco, Maine, past NEWEA president, past WEF delegate, and past HOD Speaker of the House; and John Trofatter, global sales manager for Teledyne ISCO, past chair of both the WEF Committee Leadership Council and WEF Operations Challenge Committee.

Later in the conference, NEWEA was well represented at the Operations Challenge event by Rhode Island's Ocean State Alliance, Connecticut's Franken Foggers, and Force Maine who all competed admirably and with much gusto in each event. NEWEA was also honored at the WEF Awards and Presidential Celebration: the Public Communication and Outreach Program Award (individual category) was presented to Meg Tabacsko, public education program manager at the Massachusetts Water Resources Authority and NEWEA Communications Council director, for her long career dedicated to youth outreach and education; the Emerson Distinguished Service Medal was presented to Jeanette Brown, past WEF president, for her years of teaching process principles and her support of operations excellence; and the Ralph Fuhrman Medal for Outstanding Water Quality Academic-Practice Collaboration was presented to a team that included (among others) Paul Dombrowski, WEF fellow and chief technologist at Woodard and Curran, and April Gu, WEF fellow and former Northeastern University professor (now at Cornell University), who have both been active and supportive in many NEWEA activities over the years, for their modeling approach to improvements in biological phosphorous removal at water reclamation and recovery facilities.

Our individual WEF delegates were interviewed; below are their impressions, WEFTEC highlights, and upcoming activities.

Fred McNeill—As NEWEA's outgoing WEF delegate, Mr. McNeill thanked the NEWEA membership for supporting his enriching and rewarding three-year delegate experience.

He was honored to represent one of WEF's most active and vibrant MAs nationally. He found it educational and professionally fulfilling to participate in the development of national goals, objectives, and policies for the wastewater industry through his work with WEF. As a delegate, Mr. McNeill was a member of the Operator Initiative workgroup and Operator Advisory panel. Being a licensed operator and manager of one of New England's largest wastewater utilities, he recognizes that our operators are on the front lines of environmental stewardship and appreciates the critical job they perform 24/7/365. He also recognizes the challenges of recruiting and retaining qualified professionals to fill these positions during the "graying" of our current work force. He noted that WEF nationally, NEWEA regionally, and our state associations locally are all engaged in replenishing our diminishing work force with the best and the brightest of the next generation of water professionals. Mr. McNeill looks forward to continuing his work with NEWEA, WEF, and the next generation of water professionals to promote and sustain our critical industry.

Jim Barsanti has been looking forward to his new NEWEA role as a WEF delegate, and he approached this year's WEFTEC conference with much anticipation of participating in his first

HOD meeting. He found it energizing to meet and get to know incoming delegates from around the country, HOD Speaker of the House Dean Miller from Pennsylvania, and recently appointed WEF Executive Director Walt Marlowe. This year Mr. Barsanti will be the chair of the HOD Outreach Committee, which aims to create awareness of HOD activities and work products within the HOD at large and among MA leadership. Work includes providing resources and training to WEF delegates and MA leaders and ensuring WEF work products are available on the WEF website and WEFCOM. Mr. Barsanti is also participating on the Water Utility Workforce of the Future workgroup. This workgroup will coordinate with the WEF Operator Advisory panel and the WEF Plant Operations and Maintenance Committee to enhance programs and practices that promote the water utility workforce of the future. The focus will be on facility and collection system operators, mechanics, and laboratory technicians. The workgroup will develop materials and collaborate with the MAs regarding local water utility workforce development and recruitment and will assist the MAs in delivering materials that promote the water utility profession. Mr. Barsanti was also honored to be asked by WEF Trustees Joan Hawley from Wisconsin and Mr. Carter to participate on the Operator Advisory panel. This group is charged with promoting the professional status of operators, licensure, training, and retention, as well as increasing the number of operator-oriented events at WEFTEC. Mr. Barsanti expects a busy and rewarding year building new relationships with his WEF counterparts while participating in these activities.

Sue Guswa related how she gained a new appreciation for how large and significant WEFTEC is as she rolled around the conference on a knee scooter and hobbled between buildings on crutches while recovering from foot surgery. The support from her fellow WEF delegates, colleagues, and conference attendees reinforced her belief that our water infrastructure is in the good hands of generous and creative professionals. In her second year as a WEF delegate, Ms. Guswa is excited to be a member of the HOD Nominating Committee and the chair of the HOD Public Education workgroup. The HOD Nominating Committee reviews applications for committees and HOD leadership positions and makes recommendations to the HOD Speaker. The HOD Public Education workgroup is charged with promoting the *Brave Blue World* documentary (described above in the critical objective regarding the Value of Water program) and facilitating at least one screening of the movie through each MA that targets an audience outside its association. The objective is to have this movie viewed by as many people as possible and to spur conversations about the value of water in communities. To support the screenings, WEF is developing a toolbox that includes social media content, graphics, blogs, clips from the film, and more. Stay tuned for more exciting news about this movie!

Matt Formica will serve on the HOD Steering Committee this year. The HOD is the deliberative and representational body of WEF and advises the board of trustees on strategic direction and public policy development. The HOD Steering Committee reviews and prioritizes information from committees and workgroups, developing and summarizing the information, and advising and directing the speaker of the house and the HOD. As a member of the Steering Committee, Mr. Formica will help steer the direction of WEF to mirror the priorities of NEWEA. He will also serve on the *Brave Blue World* workgroup (discussed above) to advance NEWEA's mission of public education.

Annual Conference & Exhibit Preview

January 26–29, 2020 • Boston Marriott Copley Place, Boston, Massachusetts

This premier water quality event and exhibit features 32 technical sessions, a student poster session that showcases the work of students studying in our industry, two floors of exhibitors featuring the industry's latest products, and the second annual Innovation Pavilion! In keeping with this year's theme, "Inspiring the Water Revolution," this year's program is focused on bringing innovation to the forefront for our members and friends for all three days!

On Monday, join us at the Opening Session to hear from our Keynote Speaker Kit Krugman, Global Executive Director of Women in Innovation (WIN). We encourage you to attend any number of our technical sessions and roundtable discussions and visit both floors of our exhibit hall. The afternoon winds down with an Exhibit Hall reception on the 3rd floor.

Tuesday is NEWEA Operator Day! We will celebrate operators with a full program of technical sessions geared towards operators, the Operator Ingenuity technical session on Tuesday morning, the Operator's Reception at noon, and countless networking opportunities at the 4th floor Exhibit Hall Reception.

Stop by the 3rd floor on Tuesday to visit the Innovation Pavilion. The program features exhibits and presentations from some of the most promising water technology companies in the region, as well as Shark Tank pitches from students. Additionally, we plan to formally announce the full merger of NEWEA with the NorthEast Water Innovation Network (NEWIN) during the Opening Session. Once finalized, the merger will grant existing NEWEA members the opportunity to connect with NEWIN's network of innovators and attend additional events focused on water innovation and provide NEWIN members with access to NEWEA, and WEF, membership benefits, as well as NEWEA's expertise cultivated throughout 90 years of industry experience.

The final day of the conference features a full day of technical sessions and exhibits, our Wednesday lunch-time awards ceremony recognizing outstanding efforts in our industry, and the passing of the gavel to the 2020 NEWEA President, Jennifer Kelly Lachmayr. The Awards Luncheon sells out annually, so don't miss out! We hope you take advantage of all the 2020 Annual Conference has to offer and use this occasion to catch up with old acquaintances and friends and cultivate new ones.

Enjoy the 2020 Conference!
Raymond Vermette, NEWEA President
Amy Anderson, NEWEA Program Committee Chair

Conference Events

SUNDAY, JANUARY 26

Registration—4th Floor ..... Noon – 4:00 PM

MONDAY, JANUARY 27

Registration—4th Floor ..... 7:00 AM – 6:00 PM
Technical Sessions 1 – 5 ..... 8:30 – 10:30 AM
Exhibits ..... 10:30 AM – 6:30 PM
Opening Session ..... 11:00 AM
Technical Sessions 6 – 11 ..... 2:00 – 4:30 PM
Exhibit Hall Reception ..... 4:30 – 6:30 PM

TUESDAY, JANUARY 28

Registration—4th Floor ..... 7:00 AM – 6:00 PM
Innovation Pavilion ..... 8:00 AM – 4:00 PM
Exhibits ..... 8:00 AM – 6:00 PM
Technical Sessions 12 – 17 ..... 9:00 – 11:30 AM
Technical Sessions 18 – 23 ..... 1:30 – 4:00 PM
Exhibit Hall Reception ..... 4:00 – 6:00 PM

WEDNESDAY, JANUARY 29

Registration—4th Floor ..... 7:30 AM – 2:00 PM
Exhibits ..... 8:00 AM – 1:00 PM
Awards Presentation & Gavel Passing...11:00 AM
Technical Sessions 24 – 28 ..... 8:30 – 11:00 AM
Technical Sessions 29 – 32 ..... 1:00 – 3:00 PM

Conference Registration

Register online/ download a complete conference program at newea.org
Phone: 781-939-0908

Early registration rate before January 6

Event Hotel

Boston Marriott Copley Place Hotel
110 Huntington Ave.
Boston, MA 02116
617-236-5800

SINGLE—$209
DOUBLE—$229

Conference Exhibitors

ABBA Pump Parts & Service
ADS Environmental Services
Advanced Drainage Systems, Inc.
Aegion-Underground Solutions, Inc.
AeroMod
Aerus, LLC
Airvac- a brand of Aqseptence Group
AP/M CentriPipe
Applied Dynamics
AQUA SOLUTIONS, INC.
Asahi/America, Inc.
Associated Electro-Mechanics Inc.
Atlantic Fluid Technology Inc.
Avanti International
BAU/HOPKINS
BDP Industries
Blake Group Holdings
Biowaste Pyrolysis Solutions, LLC
BMC Corp
Boyson and Associates, Inc.
C.N. Wood Co., Inc.
Carl Lueders & Company
Carlsen Systems
Casella Organics Company
Coyne Environmental Services
Cretex Specialty Products
CSI Controls
CST
CUES
David F. Sullivan & Associates, Inc.
Denali Water Solutions, LLC
DeZurik
Diversified Infrastructure Services Inc.
DN Tanks, Inc.
DUKES ROOT CONTROL
Duperon Corp.
EDI
EMS New England
Environmental Operating Solutions, Inc. (EOSi)
EST Associates
Evoqua Water Technologies
F. R. Mahony & Associates, Inc.
Flood Control International
Flottweg Separation Technology
Flow Assessment Services, LLC
Flow Tech, Inc.
FlowWorks
Ford Hall Company
Fusion Environmental Solutions
GA Fleet - Fleet Pump&Service
Gabriel Novac & Assoc.
Grande Water Management
Green Mountain Pipeline Services
Grundfos Water Utility, Inc.
Hach
Hayes Pump Inc.
Hazen and Sawyer
Hobas Pipe USA
Holland Company
Howden
Hubbard-Hall Inc.
ILC Dover
Infra Pipe Solutions Ltd.
Ipex
ITpipes
J.F. McDermott Corporation
J&R Sales and Service, Inc.
Kemira Water Solutions
Kusters Water
LandTech Consultants, Inc.
M.A. Selmon Company, Inc.
Madewell Products. Corp.
Maltz Sales Company
Martindale Associates Inc
Mechanical Solutions Inc.
MIH Trident
National Filter Media
National Water Main Cleaning Company
Neo Water Treatment
New England Environmental Equipment, Inc.
NEWEA
NORESCO
Oakson
Ober-Read & Associates
Orenco Systems Inc.
PICA Corp
POND Technical
Primex Controls
Pump Systems Inc
R.H. White Construction Co., Inc.
Rain for Rent
Raven Lining Systems
RCAP Solutions, Inc.
RMI & Shincci-USA
Rockwell Automation
Russell Resources Inc.
Savy & Sons
Schulz Group, Power Systems by Timken
Sealing Systems, Inc.
Seepex Inc.
Shea Concrete Products
SmartCover Systems
SNF Polydyne
Spire Metering Technology
Sprayroq, Inc
Stacey DePasquale Engineering, Inc.
StormTrap
SUEZ
SULLIVAN ASSOCIATES/RITEC ENVIRONMENTAL
Sunbelt Rentals - Pump Solutions
Synagro Northeast, LLC
Technology Sales Associates
The MAHER Corporation
Thompson Pipe Group
TriNova
Troy Valve
Truax Corporation
Trumbull
United Concrete - Building Group
USABlueBook
USP Technologies
Victaulic
VIR Proteus
Walker Wellington, LLC
WAPRO
Water Analytics
WATTS
Wescor Associates, Inc.
WesTech Engineering Inc.
Whipps, Inc.
WhiteWater
Williamson Pump & Motor
Worcester Polytechnic Institute
Xylem - Decision Intelligence

– As of 11/19/19

2020 Award Recipients

NEWEA Awards

Alfred E. Peloquin, CT ..... Virgil Lloyd
Alfred E. Peloquin, ME ..... Aubrey Strause
Alfred E. Peloquin, MA ..... John Murphy
Alfred E. Peloquin, NH ..... Mary Jane L. Meier
Alfred E. Peloquin, RI ..... Nick DeGemmis
Alfred E. Peloquin, VT ..... Christopher Cox
Asset Management ..... City of Westfield WWTP
Biosolids Management ..... Greater Lawrence Sanitary District
Clair N. Sawyer ..... Paul Dombrowski
Committee Service ..... Phil Forzley
E. Sherman Chase ..... Rowland C. Denny
Elizabeth A. Cutone Executive Leadership ..... Ned Beecher
Energy Management Achievement ..... City of Somersworth WWTP
Founders ..... Howard Carter
James J. Courchaine Collection Systems ..... James Barsanti
Operator, CT ..... Todd Wolowicz
Operator, ME ..... Alex Buechner
Operator, MA ..... Michael Delaney
Operator, NH ..... Noelle Osborne
Operator, RI ..... Craig Danella
Operator, VT ..... Robert Fischer
Operator Safety ..... Aram Varjabedian
Past President's Plaque and Pin ..... Janine Burke-Wells
Paul Keough ..... Robin Leal Craver
Public Educator ..... John Lee
Wastewater Utility ..... Town of East Windsor
Young Professional ..... Danielle DiRuzza

NEWEA Recognition (Stockholm Junior Water Prize)

CT ..... Brooks Ferguson and Colin Mulshine
ME ..... Marina Mohawass
MA ..... Benjamin Dwyer
NH ..... Kavya Phadke
RI ..... Brooke Newbury
VT ..... Esther Koo

WEF (presented at WEFTEC)

Operations Challenge Division II Process Control ..... Franken Foggers
Operations Challenge Division II Laboratory ..... Ocean State Alliance
Public Communication & Outreach Program ..... Meg Tabacsko
Emerson Distinguished Service Medal .... Jeanette Brown
Ralph Fuhrman Medal ..... Paul Dombrowski
Student Design Competition ..... Margaret Keefe, Marcus Brunelle, Kestral Johnson, and Brendan Curran

WEF—MA Awards

Arthur Sidney Bedell ..... Travis Peaslee
Laboratory Analyst Excellence ..... Carmen Krzesik
WEF Service ..... Frederick J. McNeill
WEF Life Membership ..... Edward F. Quann
WEF Life Membership ..... Dennis M. Geran
WEF Life Membership ..... Henry S. Albro
WEF Life Membership ..... Frank Underwood
WEF Life Membership ..... Robert Sheldon
WEF Life Membership ..... Eugene Forbes
William D. Hatfield ..... Jeffrey Kalmes
Quarter Century Operator ..... William Norton
Quarter Century Operator ..... Joseph Madigan
Quarter Century Operator ..... Everett Weaver
Quarter Century Operator ..... Frank Cavaleri
Quarter Century Operator ..... Jennifer Nicholoson

Proposed Changes to the NEWEA Constitution and Bylaws

NEWEA is updating the organization's constitution and bylaws. The proposed changes will be presented and voted upon at the NEWEA annual membership meeting on January 27, 2020.

Below is a table summarizing the 2020 proposed changes to the NEWEA Bylaws.
In general, the changes include:

1. Addition of a sixth council director, bringing Executive Committee membership to 20 members.
2. Clear listing of the six council director positions, including Public Outreach Council; Collection Systems and Water Resources Council; Treatment, Systems Operation and Management Council; Innovation Council; Communications Council; and Meeting Management Council.
3. Addition of a NEWEA-only (non-WEF) membership category to validate our current "Regulator" membership category and the option for other such categories in future.
4. Language changes suggested by the WEF Bylaws Committee, mostly clarifying the WEF/NEWEA relationship and documentary harmony.
5. Addition of a clause related to procedure in the case of an ultimate dissolution of the NEWEA corporation, requiring a two-thirds membership vote before proceeding; this sensible addition was strongly suggested by the WEF Bylaws Committee.

The following table denotes specific sections of the NEWEA Bylaws that have been altered with explanations of the changes.

Section(s)	Nature of Change
3.1	Added language stating that NEWEA objectives are in harmony with WEF objectives
5.1, 5.2	Added references to NEWEA Association-only memberships
6.2, 6.3	Moved reference to WEF officer status to a separate section for clarity
6.6.1, 7.1.1	Added reference to clarify that there are six state and six council directors
7.1.2, 9.1.3.1	Added language clarifying that WEF delegates must be WEF members
7.2	Added language to include NEWEA members sitting on WEF Board as honorary EC members
9.1.2.6	Added "other duties" clause to Vice President description
9.1.5 et sub	Added language to clarify Council Director roles and to include sixth council director and defined council titles, including addition of Innovation Council
9.1.6 et sub	Added language to clarify State Director roles
9.1.7	Added "other duties" clause to Past President description
9.1.8.1	Added language clarifying honorary WEF officer role with NEWEA Executive Committee
9.2 et sub	Added language to clarify terms of office and to include sixth council director
9.3.1	Clarifying language for annual officer nomination process
11.3.1	Altered language to reflect current renewal and dues reconciliation procedures
11.4 et sub	Added section defining NEWEA Association-only (non-WEF) memberships
12.1.1 et sub	Added language re: NEWEA Association-only memberships and NEWEA direct dues billing
14.2.4.2	Clarified term language in case of Treasurer sitting on nominating committee
19.1, 19.2	At suggestion of WEF, added language regarding procedure for corporate dissolution

The above changes have been reviewed and recommended by the NEWEA Bylaws Committee, reviewed and accepted by the WEF Bylaws Committee, and approved by the NEWEA Executive Committee at its November 12, 2019 meeting in Woburn, Massachusetts.

To review the current and proposed changes, please see the NEWEA Website at: https://www.newea.org/about-us/executive-committee/committee-resource-center/. If for some reason you cannot access this document, please call the NEWEA Executive Office at 781-939-0908.

We invite you to attend the Business Meeting on Monday, January 27, 2020 at 8:00 AM.

Thank you
NEWEA Bylaws Committee
NEWEA Executive Committee

Specialty Conferences, Training, & Networking Proceedings

YOUNG PROFESSIONALS NETWORKING EVENTS

NEWEA's Young Professionals Committee hosts a popular multi-discipline networking event aptly named Poo & Brew. This event features a tour of a local wastewater treatment facility followed by networking at a brewery. These events are open to organization members and non-members, consisting of professionals in the early stages of their water industry careers.

Sponsored by: ADS Environmental Services, AECOM, Aqua Solutions, Arcadis, Brown and Caldwell, Carlsen Systems, CDM Smith, David F. Sullivan & Associates, Dewberry, Edward N. Nazaretian Memorial Fund, Environmental Partners Group, EST Associates, Flow Assessment Services, Fuss & O'Neill, Green Mountain Pipeline Services, Hazen and Sawyer, Hoyle Tanner & Associates, Jacobs, The MAHER Corporation, Mott MacDonald, NASSCO, Stantec, SUEZ, Tata & Howard, Tighe & Bond, Weston & Sampson, Woodard & Curran, Wright-Pierce

POO & BREW #20

More than 50 attendees toured the town of South Windsor, Connecticut's water pollution control facility (WPCF) on Friday, May 17, 2019. A networking reception was held afterward at the Connecticut Valley Brewing Company in Windsor, Connecticut.

The event was co-hosted by the Connecticut Water Pollution Abatement Association. Environmental Services, Inc., and GA Fleet were event supporters.

POO & BREW #21

A tour of Warwick, Rhode Island's wastewater treatment facility (WWTF) was featured, followed by networking at the Proclamation Ale Co, in Warwick, Rhode Island. Thirty-eight attendees participated in the event held on Thursday, July 25, 2019.

POO & BREW #22

This event highlighted the city of Biddeford, Maine's WWTF. A networking event was held afterward at Banded Brewing Company in Biddeford, Maine. Thirty-eight attendees participated in the event held on Thursday, August 29, 2019.

The event was co-hosted with the Maine Water Environment Association.

POO & BREW #23

A tour of the University of Connecticut's WPCF in Storrs, Connecticut was featured and followed by networking at the Hop Knot in Storrs. Forty-five attendees participated in the event held on Friday, October 4, 2019.

POO & BREW #24

This event was held with the Annual NEWEA/NEBRA Residuals & Biosolids Conference in Springfield, Massachusetts and highlighted a tour of the city of Westfield, Massachusetts water resource recovery facility (WRRF), followed by networking at the Westfield River Brewing in Westfield. One hundred six attendees participated in the event held on Wednesday, October 16, 2019.

The event was co-hosted by NEBRA and MWPCA.

PUBLIC EDUCATION TEACHER TRAINING

NEWEA's Public Education Committee held a teacher training workshop and tour on Tuesday, August 20, 2019, at the Narragansett Bay Commission in Providence, Rhode Island. The event attracted 30 New England teachers and educators.

The program featured Bonnie Combs, Blackstone River Valley National Heritage Corridor, who gave the keynote address.

Attendees participated in a walking tour of the Field's Point wastewater treatment plant and CSO tunnel laboratory followed by three concurrent workshops. Workshops included a behind-the-scenes laboratory tour, hands-on World Water Monitoring Challenge workshop, and workers' activity.

SMALL COMMUNITY CONFERENCE

Nitrogen and Phosphorous Removal

The Small Community Committee of NEWEA held a specialty conference in Providence, Rhode Island, on September 11, 2019. The event had 44 attendees.

The technical presentations commenced on Wednesday, September 11, with NEWEA Past President Janine Burke-Wells and NEWEA Small Community Committee Vice Chair Ian Catlow providing the Welcome and Opening Remarks to meeting attendees.

TECHNICAL PRESENTATIONS

Narragansett Bay TMDL Update
- Jonathan Stone, Save the Bay

Cape Code 208 Plan Update
- Sharon Rooney, Tighe & Bond (formerly Cape Code Commission)

Pilot Testing Results from New Residential Denitrifying
- Michael Loberg, Vineyard Medical Care
- John Smith, KleanTu LLC

Lessons Learned in Orleans—Financing the Downtown Sewer System
- Tom Parece, AECOM

NHDES and RD Funding Opportunities
- Rob Polys, Woodard & Curran

Rate Making and the Secret to Project Funding
- Michael Schrader, Tighe & Bond

The Small Community Conference ended with a boat tour.

WATERSHED WEBINAR

MS4 Lessons Learned in South Burlington, Vermont

The Watershed Management Committee of NEWEA held a webinar on September 30, 2019, focusing on Vermont's first stormwater utility and the lessons learned over the past decade of stormwater implementation.

The webinar presented by David Wheeler, stormwater project manager from South Burlington, highlighted the process of establishing a stormwater utility, development of flow restoration plans (FRPs) to meet flow-based TMDL requirements in multiple watersheds in South Burlington, implementation of FRP projects, current development of a phosphorous control plan (PCP) to meet the phosphorous TMDL for Lake Champlain, and the collaborative relationship between the city of South Burlington and the neighboring town of Shelburne, which includes resource and cost sharing to help comply with Shelburne's MS4 permit requirements.

NORTH EAST RESIDUALS & BIOSOLIDS

NEWEA's Residuals Management Committee held a multi-day specialty conference and exhibit on October 16–18, 2019, at the Sheraton Hotel in Springfield, Massachusetts. Meeting registrants included 134 attendees and 11 exhibitors for a total of 145 registrants. The conference was held with the North East Biosolids & Residuals Association (NEBRA) and Massachusetts Water Pollution Control Association (MWPCA).

The technical presentations commenced on Thursday, October 17, 2019, with NEWEA President Ray Vermette and NEWEA Residuals & Biosolids Management Committee Chair Natalie Sierra providing the Welcome and Opening Remarks to meeting attendees. Karen Schuett, co-founder and CEO, Livestock Water Recycling, gave the keynote presentation.

Together with the conference, NEWEA's Young Professionals Committee held its famous Poo & Brew networking event (#24) on Wednesday, October 16, which featured a facility tour of the city of Westfield WRRF and networking at Westfield River Brewing in Westfield, Massachusetts. One hundred six people attended this event, setting an attendance record for the Poo & Brew events. A networking reception was held in the exhibit area on Thursday as well.

TECHNICAL PRESENTATIONS

Thursday, October 17, 2019

SESSION 1: REGULATIONS

Moderator
- Jennifer Lichtensteiger, NEIWPCC

A comparison of New England Agricultural Phosphorus Indices
- Amanda Wheeler, Northern Tilth
- Andrew Carpenter, Northern Tilth

New England Regulatory Roundup Discussion
- Rowland Denny, CT DEEP
- Kevin Brander, MassDEP
- Carla Hopkins, MEDEP
- Ray Gordon, NHDES
- Eamon Twohig, VTDEC

SESSION 2: BIOSOLIDS PLANNING AND END USE

Moderators
- Eric Spargimino, CDM Smith
- Mike Lannan, Tech Environmental

Long-term Sustainability in Thermal Drying Facility Operations through Innovative Asset Management and Strategic Capital Improvements
- Sean Murnan, NEFCO
- Ryan Siegel, Tighe & Bond

Allan Horneman challenges attendees on PFAS leachability

Initial Feasibility Study for Co-Digestion at the Rockland WWTP
- John Ross, Brown & Caldwell
- John Loughlin, Town of Rockland

Jeffrey Mine Reclamation Project—Simply Amazing
- Nicholas Leblanc, Englobe.

Re-Building & Sustainable Land Application Program using Dried Class A Biosolids
- Michael Potash, Resource Management, Inc.
- April Sargent, Resource Management, Inc.

Using Sludge Rheology in Solids Systems Design and Planning
- Dr. Tracy Chouinard, Brown & Caldwell

The Mass Sludge Survey 2018
- Ned Beecher, NEBRA
- Janine Burke-Wells, NEBRA

Resource Recovery Could Unlock Economic Opportunity and Leverage Dormant Industrial Infrastructure
- Chloe Greenberg, Woodard & Curran

TECHNICAL PRESENTATIONS

Friday, October 18, 2019

WELCOME & OPENING REMARKS:
- Tom Schwartz, NEBRA President

SESSION 3: PFAS

Moderators
- Andrew Carpenter, Northern Tilth
- Ned Beecher, NEBRA

PFAS in Biosolids—State of Knowledge and Treatment Opportunities
- Jay Surti, Hazen and Sawyer

Residuals-Related PFAS Sampling—What Fun!
- Leigh Dorsey, Northern Tilth
- Andrew Carpenter, Northern Tilth

PFAS in Waste—Is That the Forever Chemical's Final Destination?
- Harry Behzadi, Emerging Technologies

Assessment of PFAS Leachability from Biosolids in 3.1 Square Miles Agricultural Area
- Allan Horneman, Arcadis

What if We Had to Treat All Water to Part per Trillion levels—What Would be the Environmental Impact of Treatment
- Michael Lannan, Tech Environmental
- Tim Jones, Tech Environmental

Update on PFAS Efforts
- Ned Beecher, NEBRA

EXHIBITORS

Biowaste Pyrolysis Solutions, LLC
BDP Industries, Inc.
Casella Organics
David F. Sullivan & Associates
Englobe Corp.
MWPCA
NEBRA
Resource Management, Inc.
Savy & Sons LLC
Walker Wellington LLC
WesTech Engineering, Inc.

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Fuss & O'Neil, Inc.
GHD, Inc.
Hazen and Sawyer
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Jacobs
Kleinfelder
Mott MacDonald
NEFCO
Stantec
Suez
Tata & Howard
The MAHER Corporation
Tighe & Bond
Weston & Sampson
Woodard & Curran
Wright-Pierce


Leigh Dorsey poses a question

2020 NEWEA Executive Committee*

*Proposed 2020 NEWEA Executive Committee—pending the election vote at the annual business meeting of the membership on January 27, 2020, at the Annual Technical Conference and Exhibition

PRESIDENT
Jennifer K. Lachmayr
Wakefield, MA

PRESIDENT-ELECT
Virgil J. Lloyd
Manchester, CT

VICE PRESIDENT
Frederick J. McNeill
Manchester, NH

TREASURER
Clayton "Mac" Richardson
Lewiston, ME

PAST PRESIDENT
Raymond A. Vermette, Jr.
Dover, NH

EXECUTIVE DIRECTOR
Mary Barry

DIRECTORS—COUNCIL
Collection Systems and Water Resources
Vonnie Reis
Framingham, MA

Communications
Meg Tabacsko
Chelsea, MA

Meeting Management
Katelyn Biedron
Manchester, NH

Public Outreach
Justin Skelly
Worcester, MA

Treatment, Systems Operation and Management
Philip Forzley
Manchester, CT

DIRECTORS—STATE
William Norton
Fairfield, CT

Jeffrey McBurnie
Saco, ME

Adam Yanulis
Westwood, MA

Steve Clifton
Portsmouth, NH

Scott Goodinson
Warwick, RI

Chris Robinson
Shelburne, VT

WEF DELEGATES
James R. Barsanti
Framingham, MA

Matthew Formica
Chelmsford, MA

Peter B. Garvey
Boston, MA

Susan Guswa
Enfield, CT

Upcoming Meetings & Events

NEWEA ANNUAL CONFERENCE & EXHIBIT
January 26–29, 2020
Boston Marriott Copley Place Hotel
Boston, MA

NATIONAL WATER WEEK—DC FLY-IN
April 26–May 2, 2020
Washington, D.C.

NEWEA SPRING MEETING & EXHIBIT
May 31–June 3, 2020
Fairlee, VT

This is a partial list. Please visit the state association websites and NEWEA.org for complete and current listings.

AFFILIATED STATE ASSOCIATIONS AND OTHER EVENTS

CWPAA/MWPCA/GMWEA 9TH ANNUAL SKI CLASSIC
January 31, 2020
Stratton Mt. VT

MEWEA LEGISLATIVE BREAKFAST
February 27, 2020
Augusta Civic Center

NHWPCA LEGISLATIVE BREAKFAST
March 4, 2020
Holiday Inn, Concord NH

MWPCA TRADE SHOW,
March 18, 2020
Devens Common Center, Devens, MA

SUSTAINABILITY CONFERENCE
March 26, 2020
Augusta Civic Center, Augusta, ME

NHWPCA/MEWEA SKI DAY
March 27, 2020
Sugarloaf, ME

NHWPCA TRADE FAIR
April 3, 2020
Radisson Hotel Nashua, Nashua, NH

MEWEA SPRING CONFERENCE,
April 3, 2020
Black Bear Inn, Orono, ME

CWPAA ANNUAL TRADE SHOW
April 30, 2020
New Life Church, Wallingford CT

GMWEA MEMBER MEETING & TRAINING CONFERENCE
May 21, 2020
Killington Grand Hotel, Kilington, VT

NWPCA AWARDS BANQUET
May 21, 2020

MWPCA GOLF TOURNAMENT,
June 17, 2020
Heritage Country Club, Charlton, MA

CWPAA ANNUAL SEWER OPEN GOLF TOURNAMENT,
June 19, 2020
Skungamaug River Golf Course, Coventry, CT

Measurement unit conversions and (abbreviations) used in the *Journal*

U.S.	International System of Units (SI)
Liquid volume	
gallon (gal)	liter (L)
cubic feet (ft^3)	cubic meters (m^3)
cubic yards (yd^3)	cubic meters (m^3)
acre-feet (ac ft)	cubic meters (m^3)
Flow	
million gallons per day (mgd)	million liters per day (ML/d)
for larger flows (over 264 mgd)	cubic meters per day (m^3/d)
gallons per minute (gpm)	liters per minute L/m
Power	
horsepower (hp)	kilowatts (kW)
British Thermal Units (BTUs)	kilojoules (kJ) / watt-hours (Wh)
Velocity	
feet per second (fps)	meters per second (m/s)
miles per hour (mph)	kilometers per hour (km/h)
Gas	
cubic feet per minute (ft^3/min)	cubic meters per minute (m^3/min)

U.S.	International System of Units (SI)
Length	
inches (in.)	centimeters (cm)
feet (ft)	meters (m)
miles (mi)	kilometers (km)
Area	
square feet (ft^2) or yards (yd^2)	square meters (m^2)
acre (ac)	hectare (ha)
square miles (mi^2)	square kilometers (km^2)
Weight	
pounds (lb)	kilograms (kg)
pounds per day (lb/d)	kilograms per day (kg/d)
ton – aka short ton (tn)	metric ton or tonne (MT)
Pressure	
pounds/square inch (psi)	kiloPascals (kPa)
Inches water column (in wc)	kiloPascals (kPa)
Head	
feet of head (ft of head)	meters of head (m of head)

New Members August–October 2019

Larry Abatiell
Newmarket, NH (PRO)

Robert Antonelli Jr
City of Worcester DPW & Parks
Worcester, MA (PRO)

Miles Bateman
Brighton, MA (YP)

Elizabette F Botelho
City Of Chicopee Department of Public Works
Chicopee, MA (PRO)

Dylan H Brown
Norwich Public Utilities
Norwich, CT (PWO)

Alida Brown
Manchester, NH (STU)

Michael Ciacciarella
Naugatuck, CT (PRO)

Michael Conlon
Randolph, MA (PWO)

Brendan Curran
Stantec
Boston, MA (YP)

Alex Czerwinski
Savy & Sons
Amston, CT (PRO)

David Dane
Water Resource Protection
South Portland, ME (PRO)

Michael Delaney
Milford, MA (PWO)

Paul M Dombrowski
Amesbury, MA (ACAD)

Samuel Downes
Tighe & Bond
Westwood, MA (YP)

Carley Dykstra
Haverhill, MA (YP)

Christopher Dzidek
Boston Water & Sewer Commission
Boston, MA (PRO)

Michael Fiske
Polyfab
Wilmington, MA (PRO)

Craig Fuller
Wakefield, MA (PRO)

Matthew Garneau
South Windsor, CT (YP)

Jonathan S Gerhard
Town Of Narragansett
Narragansett, RI (PRO)

Mark Godfrey
Chelmsford, MA (PRO)

Christian Griffith
Wellesley, MA (YP)

Lucica Hiller
Kleinfelder
Boston, MA (PRO)

Jen Huang
Cambrian Innovation
Watertown, MA (PRO)

Selens Jeffrey
Centerville, MA (PWO)

Marckenley Joseph
Massachusetts Water Resources Authority
North Dartmouth, MA (YP)

Kelsey Burrell
Woodard & Curran
Portland, ME (YP)

Sally Kramer
Kleinfelder
Boston, MA (YP)

Cole Lesperance
Town Of Uxbridge Wastewater Treatment Facility
Uxbridge, MA (PWO)

Baikun Li
South Windsor, CT (ACAD)

Ricky Ma
Watertown, MA (YP)

Terry Marshall
DN Tanks
Wakefield, MA (YP)

Thomas Mathiau
Metropolitan District, Conn
Hartford, CT (PWO)

Richard Meskill
Meriden Department of Public Utilities
Meriden, CT (PRO)

Isaac Mudge
Cambridge, MA (STU)

Elizabeth Olson
Beverly, MA (YP)

Gary Pavao
Norton, MA (PWO)

Elaine Pereira
Brayton Point
Somerset, MA (PRO)

Kevin Perry
Westport, MA (YP)

Meghan Powers
Weymouth, MA (YP)

Jill Rossini
Medway, MA (YP)

Alexandra Rozen
West Hartford, CT (YP)

Matthew Scarborough
Burlington, VT (ACAD)

Claire Shillington
Amherst, MA (YP)

Kevin Smith
AECOM
Chelmsford, MA (PRO)

Sarah Socolosky
Stantec
Burlington, MA (YP)

Lindsay Strole
Agawam, MA (YP)

David Titus
Taunton, MA (PWO)

Ellen Weiner
Golder Associates
Manchester, NH (YP)

Reed Winter
Waitsfield, VT (STU)

Gregory Woods
Sutton, MA (PRO)

Drew Youngs
NEIWPCC
Lowell, MA (YP)

Joseph Zaleski
New Haven, CT (PRO)

GM2 Associates
Glastonbury, CT (COR)

Academic (ACAD)
Affiliate (AFF)
Complimentary (COMP)
Corporate (COR)
Dual (DUAL)
Executive (EXEC)
Honorary (HON)
Life (LIFE)
Professional (PRO)
Professional WW/OPS (PWO)
Student (STU)
Young Professional (YP)

Thank you

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Build relationships with water industry leaders *and* make a positive impact on the water environment

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NEWEA offers companies the opportunity to promote their products and services throughout the year by participating in multiple sponsorship activities. Annual Sponsorships include:

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For more information
contact Jordan Gosselin
Email: jgosselin@newea.org
Phone: 781-939-0908

NEWEA
WORKING FOR WATER QUALITY

Advertiser Index

NEWEA/WEF* Membership Application 2019

Water Environment Federation® the water quality people® · NEWEA WORKING FOR WATER QUALITY

Personal Information (please print clearly)

Last name | M.I. | First Name | (jr. sr. etc)

Business Name (if applicable)

Street or P.O. Box (☐ Business Address ☐ Home Address)

City, State, Zip, Country

Home Phone Number | Mobile Phone Number | Business Phone number

Email Address

☐ Check here if renewing, please provide current member I.D.

***NEWEA is a member association of WEF (Water Environment Federation). By joining NEWEA, you also become a member of WEF.**

Employment Information (see back page for codes)

1. ORG Code | Other (please specify) | 2. JOB Code: | Other (please specify)

3. Focus Area Codes | Other (please specify

Signature (required for all new memberships) | *Date*

Sponsorship Information

WEF Sponsor name (optional) | Sponsor I.D. Number | ACQ. Code for WEF use only | WEF 19

Membership Categories (select one only)

		Member Benefit Subscription	Dues
☐ **Professional Package**	Individuals involved in or interested in water quality	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online*	$185
☐ **Young Professional Package**	New members or formerly student members with 5 or less years of experience in the industry and less than 35 years of age. This package is available for 3 years. Date of birth (mm/yy) _____	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online*	$70
☐ **Professional Wastewater Operations (PWO) Package**	Individuals in the day-to-day operation of wastewater collection, treatment or laboratory facility, or for facilities with a daily flow of < 1 mgd or 40 L/sec. License # _____	■ WE&T (including *Operations Forum*) ■ *WEF Highlights Online*	$110
☐ **Academic Package**	Instructors/Professors interested in subjects related to water quality.	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online* ■ *Water Environment Research* (Online)	$185
☐ **Student Package**	Students enrolled for a minimum of six credit hours in an accredited college or university. Must provide written documentation on school letterhead verifying status, signed by an advisor or faculty member.	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online* ■ *Water Environment Research* (Online)	$15
☐ **Executive Package**	Upper level managers interested in an expanded suite of WEF products/services.	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online* ■ *World Water* ■ *Water Environment Research* (Online) ■ *Water Environment Regulation Watch*	$355
☐ **Dual**	If you are already a member of WEF and wish to join NEWEA		$45
☐ **Corporate Membership** (member benefits for one person)	Companies engaged in the design, construction, operation or management of water quality systems. Designate one membership contact.	■ *WE&T* (including *Operations Forum*) ■ *Water Environment Research* (Print) ■ *Water Environment Regulation Watch* ■ *WEF Highlights Online*	$420
☐ **New England Regulatory Membership**	This membership category is a NEWEA only membership reserved for New England Environmental Regulatory Agencies, including: USEPA Region 1, CT Department of Energy and Environmental Protection, ME Department of Environmental Protection, MA Department of Environmental Protection, NH Department of Environmental Services, VT Department of Environmental Conservation, and RI Department of Environmental Management		$50

WEF Utility Partnership Program (UPP): NEWEA participates in the WEF Utility Partnership Program (UPP) that supports utilities to join WEF and NEWEA while creating a comprehensive membership package for designated employees. As a UPP Utilities can consolidate all members within their organization onto one account and have the flexibility to tailor the appropriate value packages based on the designated employees' needs. Contact WEF for questions & enrollment (703-684-2400 x7750).

Payment

☐ **Check or money order enclosed**
Made payable to NEWEA
10 Tower Office Park, Suite 601
Woburn, MA 01801
For more information: 781.939.0908
Fax 781.939.0907 NEWEA.org

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Card # | Security/CVC

Signature | Exp. Date

Name on Card (please print)

Billing Address (☐ check here if same as above) | Street/PO Box | City, State, Zip

Depending upon your membership level, $10 of your dues is allocated towards a subscription to the NEWEA Journal.

NEWEA/WEF* Membership Application 2019

Water Environment Federation® the water quality people®

NEWEA WORKING FOR WATER QUALITY

To help us serve you better, please complete the following:
(choose the one that most closely describes your organization and job function)

What is the nature of your ORGANIZATION?

(circle one only–required) (ORG)

1
Public/Private Wastewater Plants and/or Drinking Water and/or Stormwater

2
Public/Private Wastewater Only

3
Public/Private Drinking Water Only (e.g. municipality, utility, authority)

4
Industrial Systems/Plants

5
Consulting or Contracting Firm

6
State, Federal, Regional Government Agency

7
Research or Analytical Laboratories

8
Educational Institution

9
Manufacturer of Water/Wastewater/ Stormwater Equipment or Products

10
Water/Wastewater/Stormwater Product Distributor or Manufacturer's Rep.

11
Public/Private Stormwater (MS4) Program Only

12
Public Financing, Investment and Banking

13
Non-profits

99
Other _____
(please specify)

What is your Primary JOB FUNCTION?

(circle one only) (JOB)

1
Management: Upper or Senior

2
Management: Engineering, Laboratory, Operations, inspection, Maintenance

3
Engineering and Design Staff

4
Scientific and Research Staff

5
Operations/Inspection Maintenance

6
Purchasing/Marketing/Sales

7
Educator

8
Student

9
Elected or Appointed Public Official

10
Other _____
(please specify)

What are your KEY FOCUS AREAS?

(circle all that apply) (FOC)

1
Collection Systems

2
Drinking Water

3
Industrial Water/Wastewater/ Process Water

4
Groundwater

5
Odor/Air Emissions

6
Land and Soil Systems

7
Legislation (Policy, Legislation, Regulation)

8
Public Education/Information

9
Residuals/Sludge/Biosolids/Solid Waste

10
Stormwater Management/ Floodplain Management/Wet Weather

11
Toxic and Hazardous Material

12
Utility Management and Environmental

13
Wastewater

14
Water Reuse and/or Recycle

15
Watershed/Surface Water Systems

16
Water/Wastewater Analysis and Health/ Safety Water Systems

17
Other _____
(please specify)

Optional Items (OPT)

Years of industry employment? _____
1 (1 to 5) **2** (6 to 10) **3** (11 to 20)
4 (21 to 30) **5** (>30 years)

Gender? _____
1 Female **2** Male

Education level? (ED) _____
1 High School **2** Technical School
3 Some College **4** Associates Degree
5 Bachelors Degree
6 Masters Degree **7** JD **8** PhD

Education/Concentration Area(s) (CON) _____
1 Physical Sciences (Chemistry, Physics, etc.)
2 Biological Sciences **3** Engineering Sciences
4 Liberal Arts **5** Law **6** Business

Water quality professionals, with fewer than 5 years working experience and under the age of 35, are eligible to join WEF as an Active Member, while participating in the NEWEA/WEF Young Professionals Program. This program allows up to 50% off of the Active Member dues, valid for the first three years of membership. This program is available for new member applicants and Student Members.

***NEWEA is a member association of WEF (Water Environment Federation). By joining NEWEA, you also become a member of WEF.**

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