JOURNAL

OF THE NEW ENGLAND WATER ENVIRONMENT ASSOCIATION

VOLUME 53 NUMBER 1 / ISSN 1077-3002 SPRING 2019

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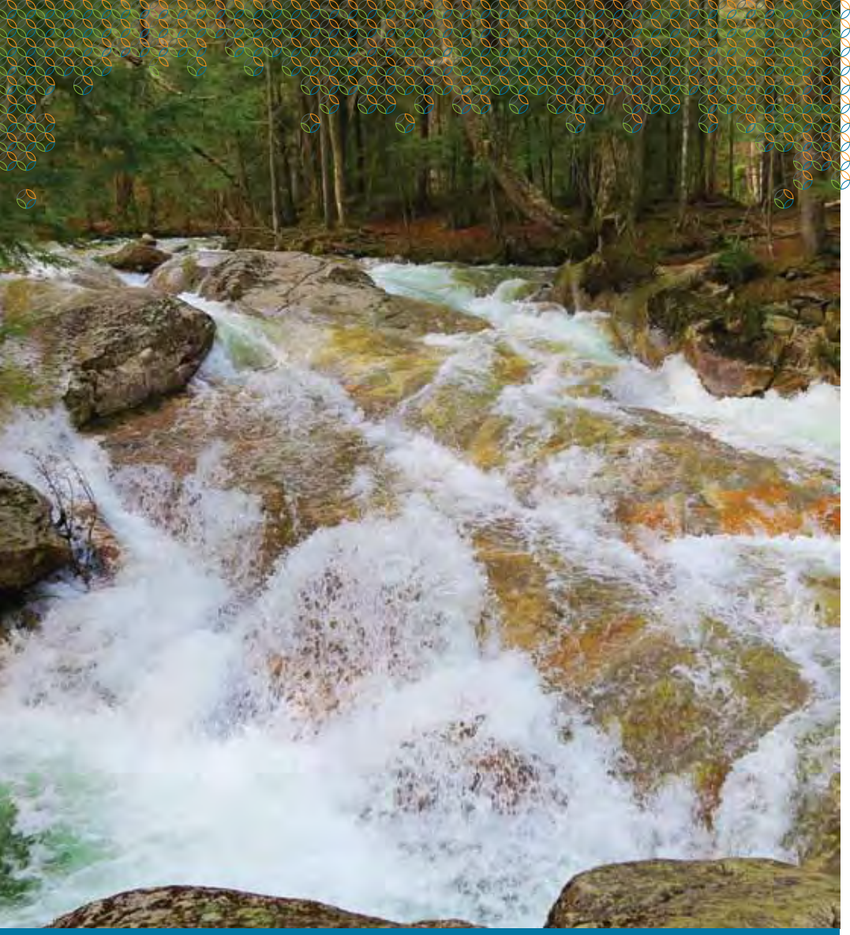

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NEWEA Journal ISSN #1077-3002
Published four times annually by New England Water Environment Association, Inc.
This is Volume 53 Number 1
Periodical postage paid at Woburn, MA 01801, and at additional mailing offices

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Postmaster:
Send address changes to:
NEWEA Journal
10 Tower Office Park, Suite 601
Woburn, MA 01801-2155

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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:

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Publication Title	The NEWEA Journal
Publication	#24559
Issue Frequency	Quarterly (four per year)
Annual Subscription Price	$20 (included with membership dues)
Complete Mailing Address, Known Office of Publication, General Business Office, Editors and Owner (non profit organization)	NEWEA, 10 Tower Office Park, Suite 601, Woburn, MA 01801
Contact Person/Managing Editor	Mary Barry, NEWEA Executive Director
Tax Status	No change during the preceding 12 months

Issue date for circulation data below: 09/10/2018

Publication title: The NEWEA Journal	Extent and nature of circulation: Technical/ Educational/ Environmental	Average no. copies each issue during preceding 12 months	No. copies of single issue published nearest to filing date
Total number of copies		2,500	2,500
Legitimate paid and/or requested distribution	Outside country paid/requested mail subscriptions	0	0
	In-country paid/ requested mail subscriptions	2,200	2,200
	Sales through dealers & carriers	8	8
	Requested copies distributed by other mail classes	0	0
Total paid and/or requested circulation		2,208	2,208
Total nonrequested distribution		0	0
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President's Message

Hello NEWEA members—and prospective members! It is difficult to express how much I am looking forward to my term as your 2019 president. It is truly an honor to work with all of you. Here we are already looking back at our Annual Conference, and what a fast-paced three days that was for me. My Sunday started off with the "onboarding" session, where Charlie Tyler and the Assessment and Development Committee put on a great presentation for our incoming chairs and officers. It was a great opportunity for all the attendees to understand what is expected of them in their new positions and the resources available to help make their volunteer efforts successful.

Also on Sunday, I was privileged to sit in on the Young Professionals Summit. This was my first look at this annual event, and I was amazed at the large number of attendees. Over the past three years, the attendance has continually grown, with this year's group hovering around 115. The presenters and the organization of the summit, coupled with the enthusiastic participation of the young audience, show me that NEWEA and our industry will be in good hands with these extraordinary future leaders.

Throughout the week I visited numerous NEWEA committee meetings and was encouraged to see the commitment and efforts of hundreds of dedicated committee members. Everyone in our industry should consider joining NEWEA and taking advantage of the valuable opportunities to work with this dynamic collection of professionals.

Kudos to Janine Burke-Wells for her remarkable year as president and energetic leader of the association. Her "Let's go all in" theme encouraged everyone to be increasingly engaged and resulted in record-breaking attendance for the annual conference as well as a sold-out trade fair floor. Ms. Burke-Wells should be as proud of her leadership and accomplishments as I am of her great work. She is a tough act for me to follow on the NEWEA stage.

We were fortunate to have WEF President-elect Jackie Jarrell and WEF's Manager of Association Engagement Kelsey Hurst in attendance at the Annual Conference this year. Jackie presented WEF's refreshed and relaunched Water's Worth It public awareness campaign. The enduring nationwide support and ongoing use of this popular grassroots effort was the driving force behind WEF's decision to regenerate Water's Worth It and give it a new beginning. WEF's goal for the campaign is to help raise public and industry awareness about the value and importance of water, water issues, the work of water professionals, and the infrastructure that supports and enables our communities.

While at the conference, no one should have missed the opportunity to visit the Innovation Pavilion program that was held on Tuesday. The NEWEA Innovation Task Force led by Howard Carter and Marcus Gay of the New England Water Innovation Network (NEWIN) put on an interactive event with panel discussions and a group of enthusiastic innovators exhibiting at the Pavilion. Mr. Gay did a great job emceeing the event. This is a perfect example of what NEWEA and NEWIN can do together to promote innovation in our industry.

Right outside the Innovation Pavilion, the NEWEA Student Poster Contest was held—more than 20 undergraduate and graduate students presented impressive investigative and innovative projects before a panel of volunteer judges. It was a perfect place for conference attendees to see this wonderful work and to interact with these talented students who will lead us forward with their own innovations into the water quality future. I was astounded at the obvious time and effort that the students put into the contest.

Our NEWEA awards ceremony continues to be a jam-packed event. More than 50 awards given by NEWEA, WEF, and EPA offer the well-deserved recognition that these outstanding facilities and individuals have earned. It is a great pleasure to see the pride on the faces of these people as they accept their awards.

As I stated in my remarks at the passing of the gavel, as your president one of my major priorities over the next year will be to continue using NEWEA as an on-ramp for the membership toward an innovation highway. Anyone who has come to know me knows that I love innovation. We have never been afraid to welcome the "latest and (so-called) greatest" innovations to the facility in Dover where I have worked for well over 20 years. In Dover,

One of my major priorities over the next year will be to continue using NEWEA as an on-ramp for the membership toward an innovation highway

innovation has helped us keep up with and surpass our water quality goals and requirements, and I hope to help bring innovation to the forefront for our vendors and members so that some of you may share the positive experiences that we have had over the years. One tool in that effort is our continuing to work on collaboration with NEWIN to find the right fit in bringing the benefits of both organizations together. Stay tuned for more progress in that regard.

In the coming months I will be working closely with Mary Barry and the energetic NEWEA staff and volunteers to produce a memorable Spring Meeting. This year we will welcome you all to my home turf, as the meeting will be at the historic Wentworth by the Sea in beautiful New Castle, New Hampshire. We look forward to seeing you there.

I am greatly honored to serve as NEWEA president for 2019, and I promise to do my very best in representing the association. Please do not hesitate to offer your best ideas for keeping NEWEA moving forward in these fascinating times.

From the Editor

Hello NEWEA! I would like to formally introduce myself to those of you within the organization whom I have yet to meet. My name is Alexandra (please, call me Allie) Bowen, and I am thrilled to have been given this opportunity, following suit with the mantra for 2018 of our past president, Janine Burke-Wells, and truly "go all in" by beginning my term as *Journal* editor. As Joe Boccadoro wrote in the 2018 Winter edition, he has successfully completed his term as editor for this impactful publication. Journal Committee members admire his dedication and his steady, committed leadership. I feel honored to follow Mr. Boccadoro and look forward to continuing the *Journal's* tradition for excellence by showcasing New England's great professional network within this noble industry built on innovation. I especially look forward to working alongside the committee members and NEWEA staff.

Alexandra Bowen, PE
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Our newly inaugurated NEWEA president, Ray Vermette, is focused on showcasing NEWEA as an "innovation highway." I think of the *Journal* as an "as-built" or "record drawing," which has and will continue to carefully document the innovations and innovators of today that will help us to identify, master, and practice the innovations of tomorrow.

In his first President's Message, Mr. Vermette noted that the Young Professionals (YP) Summit kicked off the 2019 Annual Conference with a bang. It was a total success made possible by the established industry professionals and dedicated YPs, alike, who worked tirelessly to make it valuable for every participant. As a YP myself, when I reflect upon my career thus far I cannot help but feel entirely grateful to those mentors who urged me to get involved with NEWEA, ASAP. This year's sold-out YP Summit proves that the YPs in New England are active and dedicated—so readers, please continue to spread the word and urge YPs in your office, at your facility, in your lab, or in your classroom to get involved!

In this edition of the *Journal*, we continue a recent initiative that started in the Winter 2018 edition in which two rock-star water YPs from Maine, Paula Drouin and Alex Buechner, were showcased in Spotlight. In this edition, we showcase two YPs from Massachusetts: former NEWEA YP Chair Ben Stoddard and current Chair Colin O'Brien. I look forward to continuing this initiative throughout future editions, by highlighting YPs from each New England state who have also gone "all in" and demonstrate our trusted leader Mr. Vermette's vision of promoting innovation on the regular.

Speaking of innovation, this edition's theme is stormwater (timely for the classic New England wet spring season). In today's world of perpetual urbanization and eminent climate change, stormwater management has irrefutably become a cornerstone practice for all environmental professionals. Degraded water quality, as result of increasing runoff volumes and reduced infiltration, has led to major developments in NPDES and MS4 permitting programs.

Four feature articles encapsulate the stormwater theme. First, the city of Lowell, Massachusetts, rehabilitated the formerly inoperable West Street Flood Pump Station, leading to the flood protection re-certification of a portion of the city. We then move to the City of Brotherly Love, Philadelphia, where various case studies illustrate how green stormwater infrastructure has simultaneously achieved stormwater goals while also promoting green spaces within the urbanized environment. The next article showcases urban parks in New York City, Atlanta, and Calgary, which have implemented an array of green stormwater infrastructure technologies using various funding sources. The final feature brings us back to New England, where underground structural stormwater storage products have been successfully employed at FedEx's Ground Distribution Center, a 100 acre (40.5 ha) site in Boylston, Massachusetts.

I am still feeling invigorated after this year's Annual Conference. As I serve as editor for my first edition of the *Journal*, I am certain that this association is in-line and totally on-point with perpetuating our industry's legacy by creating an inclusive platform for water environment professionals that fosters and promotes collaborative innovation!

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Industry News

The Claiborne Pell Bridge (aka the Newport Bridge) spans the East Passage of the Narragansett Bay in Rhode Island

EPA accelerates water infrastructure investments

– EPA Press Office

EPA has accelerated investment in the nation's aging water infrastructure, issuing seven Water Infrastructure Finance and Innovation Act (WIFIA) loans to help finance over $4 billion in water infrastructure projects that will improve water quality and create up to 6,000 jobs.

Over the past year, EPA has worked to get the financing, tools, and resources EPA's state, local, tribal, and other partners need to modernize outdated water infrastructure, while improving local water quality, creating jobs, and better protecting public health.

EPA has also taken a leading role in the administration's initiative to promote greater efficiencies in the infrastructure permitting process. These actions include a clear and predictable approach to identifying waters that are subject to federal authority through the Department of the Army's and EPA's proposed "Waters of the United States" rulemaking, implementation of the current administration's One Federal Decision initiative and through other improvements to the Clean Water Act permitting process. EPA will take these actions by cooperatively working with its state and tribal co-regulators with a goal of streamlining environmental permitting and increasing investments in critical water and other infrastructure projects.

Established by the WIFIA of 2014, EPA's WIFIA program is EPA's newest water financing program, which provides long-term, low-cost supplemental loans for regionally and nationally significant projects. In 2018, EPA issued seven WIFIA loans totaling nearly $2 billion to help finance over $4 billion for water infrastructure projects and create up to 6,000 jobs. In November 2018, EPA invited 39 additional projects in 16 states and Washington, D.C., to apply for WIFIA loans. Together, these selected borrowers will receive WIFIA loans totaling approximately $5 billion to help finance over $10 billion in water infrastructure investments and create up to 155,000 jobs.

In November 2018, EPA invited the Narragansett Bay Commission in Providence, Rhode Island, to apply for a $251 million WIFIA loan to make infrastructure improvements to control combined sewer overflows (CSOs). This project is expected to be co-funded through the state's Clean Water State Revolving Fund (SRF) program, administered by the Rhode Island Infrastructure Bank and the Rhode Island Department of Environmental Management. The loan will further the Narragansett Bay Commission's work to design and construct a storage tunnel and associated infrastructure to provide a storage volume of 58.6 million gal (222 million L), which will help reduce CSOs.

State revolving funds

The Clean Water and Drinking Water SRFs play an integral role in EPA's efforts to help communities replace or upgrade aging or inadequate drinking water and wastewater infrastructure through low-interest loans. Together, in 2018, the SRFs committed $9.6 billion in drinking water and clean water infrastructure loans and refinancing and disbursed $8.8 billion for drinking water and clean water infrastructure. This level of funding was facilitated through EPA's contribution of $2.2 billion to the SRFs in 2018.

In 2018, EPA awarded more than $200 million in SRF grants to the six New England states for the providing low-interest and subsidized loans to finance community-based water infrastructure projects, such as upgrades to municipal sewage plants and public drinking water systems. At the local level, these loans are helping to fix leaking pipes and older infrastructure, protect sources of drinking water supply, and build water storage tanks. The SRF loan provides funds to the communities allowing cities to construct wastewater facilities and systems, control "nonpoint" sources of water pollution, create green infrastructure projects, and protect estuaries.

For more information on the Infrastructure Initiative, visit whitehouse.gov/briefings-statements/building-stronger-america-president-donald-j-trumps-american-infrastructure-initiative.

Pease agrees to address contaminated stormwater runoff per lawsuit settlement

– Conservation Law Foundation

An agreement has been reached between the Conservation Law Foundation (CLF) and Pease Development Authority (PDA) in a lawsuit focused on Clean Water Act violations at Pease International Tradeport, the site of the former Pease Air Force Base in Portsmouth and Newington, New Hampshire. Significant development has made the Pease International Tradeport a major source of stormwater pollution that has degraded the health of local waters.

"Stormwater pollution is one of the greatest threats to the health of Great Bay," said Tom Irwin, vice president and director of CLF New Hampshire. "This historic agreement ensures that the Pease Development Authority will be playing by the same rules as communities throughout the Seacoast and will comply with the Clean Water Act. The health and safety of our waters is essential to our communities and our economy. No one has a right to pollute them."

Stormwater runoff contains numerous pollutants, including nitrogen—the pollutant of greatest threat to the Great Bay estuary—as well as metals, bacteria, and petroleum products. In addition, highly toxic perfluorinated and polyfluoroalkyl substances (PFAS) have been found at the Pease International Tradeport, including in brooks located at the site. PFAS are suspected carcinogens that have been linked to a variety of severe health problems.

The agreement requires PDA to apply for and obtain a Clean Water Act permit regulating discharges from the site's municipal separate storm sewer system (MS4). PDA will be required to implement a number of programs for managing stormwater pollution as well.

PDA must also reduce stormwater pollution from existing or future development, assess the presence and toxicity of PFAS chemicals in aquatic plant and animal communities, and implement a pilot project to evaluate emerging technologies that may be used to reduce PFAS contamination in surface waters at Pease International Tradeport.

CLF's Clean Water Act lawsuit against PDA is the first of its kind in requiring both a redeveloped military base to obtain an MS4 permit to reduce stormwater pollution, and the piloting of technologies to reduce PFAS pollution.

U.S. researchers find *Chlorella vulgaris* algae removes pollutants from wastewater

– Water Technology News

U.S. researchers have found that a single-celled fresh water algae *Chlorella vulgaris* is effective in eliminating pollutants from wastewater even at fluctuating levels.

The study, which was published in *Water Environment Research*, indicates that *C. vulgaris* removes harmful elements such as nitrogen and phosphorous from wastewater even when one kind of pollutant is not present. Some algae, however, need both nitrogen and phosphorous for them to be functional, thereby restricting their effectiveness in treating wastewater.

University of Arkansas Department of Civil Engineering associate professor Wen Zhang said: "One of the factors that significantly impacts algal wastewater treatment is nutrient availability.

"What is the ideal range of nitrogen-to-phosphrous mass ratio for algal growth? Because previous research failed to identify this, the efficacy of algal treatment has been difficult to predict or optimize."

Quality of wastewater fluctuates significantly, and this makes it tough to maintain algae growth for treatment. However, this study now indicates that this species of algae can survive even in the absence of either nutrient.

For the study, Zhang teamed up with John Chamberlin, a doctoral student in the environmental dynamics program, and Kristen Harrison, an undergraduate honors student in the Department of Crop, Soil, and Environmental Sciences.

The environmental engineers grew the algae in synthetic wastewater under several nutrient-limiting conditions and also in effluent from two wastewater treatment plants. It was found that the algae could effectively remove both nitrogen and phosphorous.

The research is funded by the Arkansas Biosciences Institute and the University of Arkansas Doctoral Academy.

Researchers find more than 60 percent of microplastics can be removed from wastewater

– Water Technology News

Researchers of the Chinese Academy of Sciences (CAS) have found that over 60 percent of microplastics can be eliminated from wastewater.

The scientists from the CAS Wuhan Botanical Garden studied the elimination of microplastics in a sewage treatment plant at Wuhan of Hubei Province.

They found that 64.4 percent of microplastics in wastewater can be eliminated and can be mostly be stored as sludge, reported Xinhua news agency.

At the sampling sites, the microplastics particles mainly found were fibre and fragments.

The percentage of bigger microplastics particles in treated wastewater was reduced compared to that in the influent wastewater. The reason for this is the decomposition in the waste stream and settlement into the sludge layer, according to the study that was published in *Chemical Engineering Journal*.

The main plastic component in wastewater, found at 54.8 percent, was polyamide, or nylon. This shows these microplastic particles may come from the wastewater discharged by washing clothes and polymer manufacturing firms, reported the agency.

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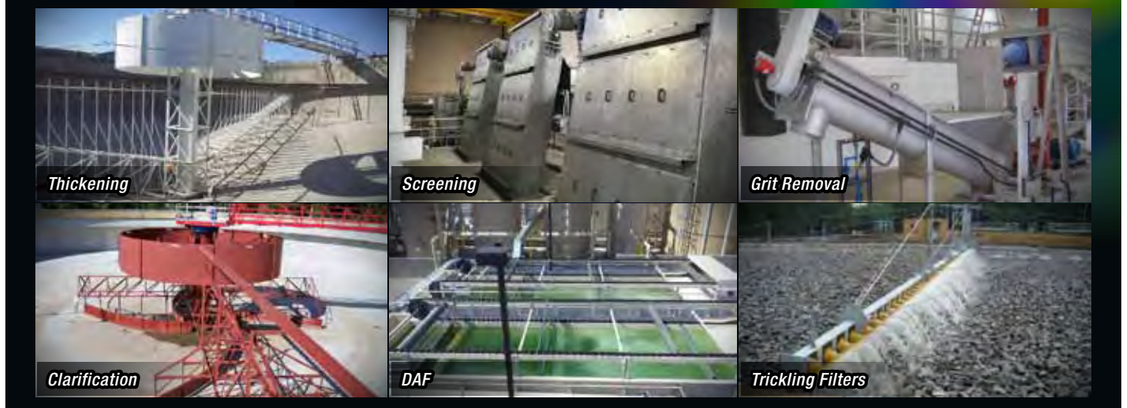

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Restoring flood resiliency with a flood pump station rehabilitation in Lowell

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ABSTRACT | Part of the city of Lowell, Massachusetts, located along the north bank of the Merrimack River, lost its flood protection certification several years ago because the city's West Street Flood Pump Station was in disrepair and inoperable. The city evaluated alternatives for restoring flood pumping capability by comparing the cost of rehabilitating the existing station to the construction of a new flood pump station. The result of the study was to rehabilitate two of the three 42 in. (107 cm) axial flow pumps and gate valves and reinstall them with new right-angle gear drives and 475 hp (354 kW) diesel engines. Structural renovations included steel frame and masonry rehabilitation. Improvements were also made for operation and maintenance of the pump station. Construction concluded with innovative field testing to demonstrate satisfactory capacity and performance to the Federal Emergency Management Agency and the U.S. Army Corps of Engineers to re-certify and re-accredit this critical component of the city's flood damage reduction system.

KEYWORDS | Alternatives analysis, axial flow, cost, Federal Emergency Management Agency (FEMA), flood, operation and maintenance, pumping, rehabilitation, testing, U.S. Army Corps of Engineers (ACOE)

INTRODUCTION

The city of Lowell is in Middlesex County, in northeastern Massachusetts, just downstream of the junction of the Concord and Merrimack rivers. It is about 25 mi (40 km) northwest of Boston. Lowell has about 106,000 residents and is the fourth largest city in the state. It was one of the country's first planned industrial towns. Common to New England industrial communities along rivers, Lowell is a combined sewer overflow (CSO) community.

Lowell's flood damage reduction system, which protects the Centralville neighborhood from the Merrimack River during flood events, includes a levee system and a flood pump station. The levee system, incorporating both concrete and earthen berms, stretches along Beaver Brook and the Merrimack River. The West Flood Pump Station (WFPS), located in the median of the VFW Highway, enables the city to pump stormwater and dilute sanitary sewage to the river when the Duck Island Wastewater Treatment Facility (DIWWTF) has maximized its wet weather throughput during a storm event, and the CSO cannot be activated by gravity due to high river level.

BRIEF HISTORY

The WFPS was constructed around 1940 as part of a U.S. Army Corps of Engineers (ACOE) flood protection project, authorized via the Flood Control Act of 1936. It was originally designed to pump combined sewer flows from the Centralville neighborhood to the Merrimack River when the river was at a flood stage and sewage could not flow to the river by gravity. At that time, all combined sewage flowed to the river. The WFPS was constructed with three 60 mgd (227 ML/d), 42 in. (107 cm) axial flow propeller pumps with right-angle drives and 415 hp (309 kW) Buffalo gasoline engines. One 16 in. (41 cm) centrifugal pump with its own drive and gasoline engine allowed the pump station to pump during lower flows. The cast-in-place concrete substructure includes a gravity discharge channel, outfall channel, wet well, and pump discharge channel. The WFPS is similar to many other flood pump stations constructed in New England industrial cities by the ACOE.

The WFPS was originally located on Lakeview Avenue, a two-lane road that ran along the river. In the 1950s, Mass Highway (now the Massachusetts Department of Transportation) constructed VFW Highway, confining the WFPS site to a highway median. In the 1970s, significant improvements to the Lowell sewer system were constructed, including the North Bank sewer interceptor, West Diversion structure, and DIWWTF. After the improvements to the sanitary system, most of the sewage from the Centralville neighborhood was routed through the West Diversion structure to the North Bank sewer interceptor for treatment at the DIWWTF. During wet weather events, when the capacity of the interceptor is exceeded, the gates in the diversion structure modulate and send CSOs into the outfall conduit to be discharged to the river by gravity. With the infrastructure improvements in the 1970s, the WFPS was only activated during a coincidental high combined sewage flow and a high river level. This allowed for discharge at the CSO when overflows could not be discharged to the river by gravity.

Pre-construction interior of West Flood Pump Station

According to Lowell Regional Wastewater Utility (LRWWU) personnel, the WFPS was rarely, if ever, run after the construction of the North Bank interceptor. The WPFS had been considered inoperable for more than 30 years and eventually was considered inactive for Federal Emergency Management Agency (FEMA) flood zone mapping, due to significant deficiencies identified by the ACOE. This designation caused the flood zone mapping in the area to be re-drawn to account for the flood damage reduction system deficiencies, requiring some residents within the Centralville neighborhood to buy flood insurance.

The city decided to restore the WFPS to reliable operation such that the station could be re-certified as part of the flood damage reduction system by the ACOE and be re-accredited by FEMA. Bringing the WFPS back to service and the subsequent petitioning of FEMA for flood map revision were priorities for the city to restore flood resiliency. Based on the 2017 report "West Street Pump Station – Lowell, MA: Interior Drainage/Coincident Frequency Analysis" by Hazen & Sawyer, the WFPS had to be restored to provide a total pumping capacity of at least 90 mgd (341 ML/d). This report analyzed the coincidence of both a 100-year interior storm and a 100-year river crest, and determined the necessary pumping capacity at the WFPS based on this coincident event.

EVALUATION AND ALTERNATIVES ANALYSIS

The first step in restoring the WFPS to operation was an evaluation of the existing pump station and determination of recommendations to restore the WFPS to reliable operation. Based on the initial investigation, it was determined that the concrete sub-structure was in good condition, but that the building would require extensive work including rehabilitation of the exterior and interior masonry, window and door replacement, and roof replacement. The original 42 in. (107 cm) axial flow propeller pumps were considered for rehabilitation, as the pump volutes and impellers appeared to be in good condition. The 42 in. (107 cm) wedge gate valves and flap gates used for backflow prevention on the discharge piping were also considered salvageable with rehabilitation. The gasoline engines used to drive the pumps were deemed unsalvageable and required replacement. Additionally, the electrical, plumbing, and HVAC systems within the building required replacement.

Following the condition assessment of the WFPS, an alternatives analysis assessed the operational and financial advantages and disadvantages of alternatives available to the city. The alternatives included the following:

- Rehabilitation or replacement of the building structure
- Rehabilitation or replacement of the pumps, discharge piping, and valves
- Replacement of the gasoline engines with either diesel engines or electric motors

Table 1. Pump alternatives/preliminary design decision matrix[1]

Alternative	Pump Capacity (Each)	Engine/ Motor	Drive Type	Pump, Motor/ Engine, and Gear Drive Cost	Soft-Starters and Main Electrical Distribution	Generator and Associated Electrical Equipment	Fuel Tank, Piping, and Additional HVAC	Total Costs[2, 3]
Pump Rehabilitation (2 pumps)	60 MGD (25' TDH)	Electric Motor	Right-Angle	$346,000	$254,000	$395,000	$100,000	$1,095,000
		Diesel Engine	Right-Angle	$385,500	$36,000	$68,000	$218,000	$707,500
Pump Replacement (3 pumps)	30 MGD (17.3' TDH)	Electric Motor	Direct (Submersible)	$444,000	$261,000	$380,000	$0	$1,085,000
			Right-Angle	$611,550	$203,000	$224,000	$100,000	$1,138,550
		Diesel Engine	Right-Angle	$696,300	$36,000	$68,000	$202,000	$1,002,300

1. Costs presented are as of the time of original submission to the city of Lowell (March 2016).
2. The cost comparison presents major cost differences among the pumping alternatives and does not represent the total pump station rehabilitation cost. Costs that apply to all the alternatives (i.e., valve replacement/rehabilitation, electrical, building rehabilitation, etc.) are not included.
3. The total cost represents the total for either two 60 mgd (227 ML/d) pumps or three 30 mgd (113.5 ML/d) pumps.

- Submersible or lineshaft vertical pumps
- Alternative pump capacities to reach the 90 mgd (341 ML/d) minimum total capacity

Based on the preliminary design, a decision matrix shown in Table 1 was presented to the city. The city determined that the pump station structure would be rehabilitated, as would the pumps, piping, and valves, to be driven by new diesel engines. After considering the increased maintenance for diesel engines relative to electric motors, the city chose this configuration based on the estimated total savings. To help with decision-making, LRWWU staff toured a flood pump station in Chicopee, Massachusetts, with a similar pump layout, right-angle drives, and diesel engines to better understand the operation and maintenance needs of a similar station run with diesel engines and right-angle drives. According to the WFPS original Operation & Maintenance manual and the original construction specifications, the original pumps each had a 60 mgd (227 ML/d) capacity at 24 ft (7.3 m) of total head. Therefore, only two pumps were necessary for rehabilitation, as the minimum total capacity required of the WFPS was determined to be 90 mgd (341 ML/d).

SCOPE OF IMPROVEMENTS

The improvements required to bring the WFPS back to service were extensive. Starting at the head of the WFPS, the trash rack and 96 by 72 in. (2.4 by 1.8 m) wet well and outfall slide gates were replaced. Two of the three 42 in. (107 cm) Fairbanks Morse axial flow propeller pumps were rehabilitated as follows:

- The suction piping, discharge piping, and shaft tube assemblies were sandblasted and repainted.
- The drive shaft sections were replaced and machined from 416 stainless steel.
- The 34 in. (86 cm) cast bronze propellers were blasted and coated with ceramic epoxy coating. One impeller had minor leading-edge damage that was repaired using ferrosilicon-filled epoxy resin before coating. The dunce caps were blasted, repaired, and epoxy coated.
- The top and bottom bowl assemblies were sandblasted and epoxy coated.
- The oiler mechanism was replaced with a new gravity-fed oiler assembly with solenoid controller to ensure the pump is oiled during engine run.

The third propeller pump was demolished. The 42 in. (107 cm) cast-iron Chapman wedge gate valves used as flow isolation on the pump discharge piping were sandblasted and epoxy coated. In addition, the bronze seats were hand stoned, the shaft was repacked, and new bearings were installed in the manual actuators. The 42 in. (107 cm) cast-iron Chapman flap valves, used for backflow prevention at the end of the pump discharge piping, were sandblasted and epoxy coated, and the bronze casings were hand stoned to improve their seal.

The gasoline engines were demolished, and two 475 hp (354 kW) diesel engines were installed. Because the original gasoline engines were water-cooled, the station's orientation was not configured to account for a large engine radiator fan with a wall duct. Thus, the new engines were installed with dual-core remote radiators. Since the station is in the median of the highway, the adjacent space was not adequate for installation of remote radiators; therefore, the remote radiators had to be installed on the station roof. The original 2.5:1 ratio right-angle gear drives could have been rehabilitated and reused; however, the original gear reduction ratio, selected for a 1,200 rpm gasoline engine, was not suitable for an 1,800 rpm diesel engine. Thus, the original right-angle gear units were replaced with 4:1 ratio right-angle gear drive units.

Interior and exterior of West Flood Pump Station—comparison of pre-construction and post-construction condition

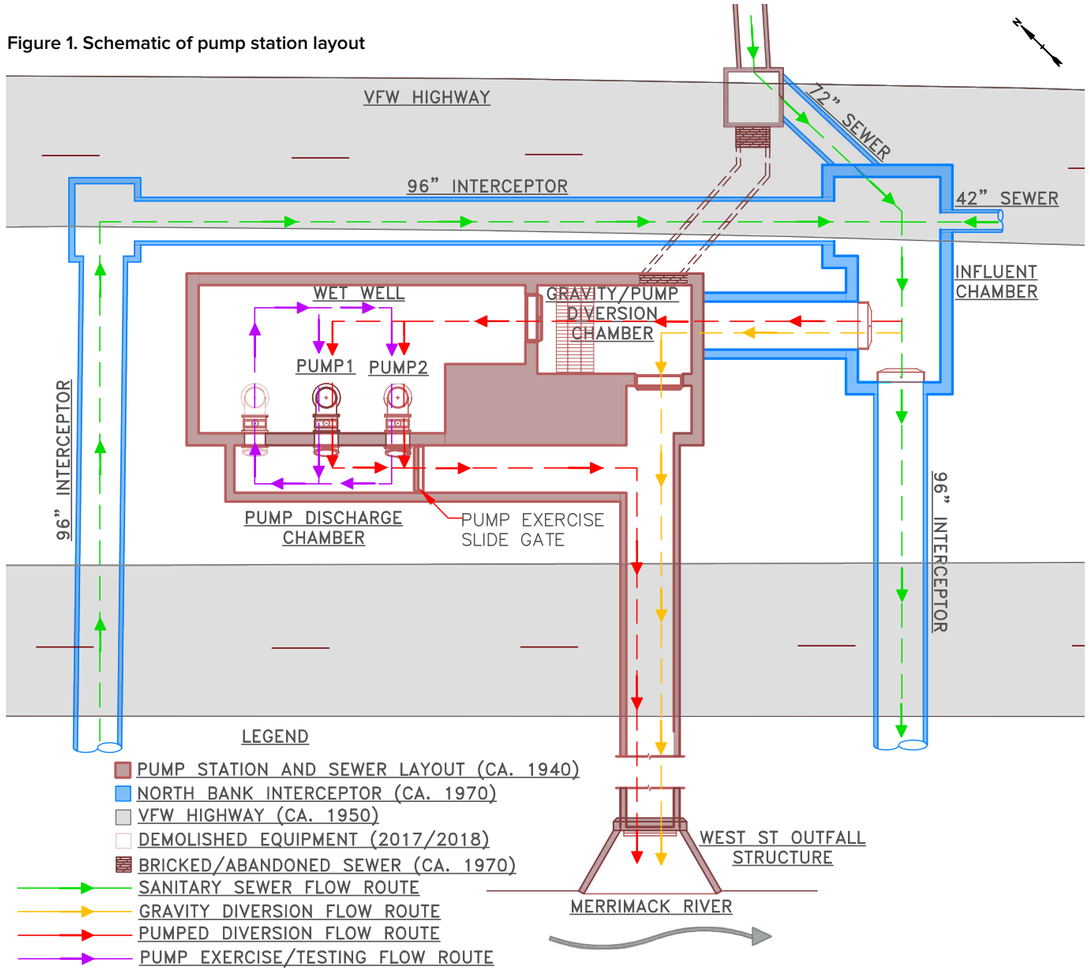
The structure required much of its exterior masonry to be demolished and replaced due to water intrusion. Three-dimensional laser scanning of the masonry enabled the city to determine which portions of the masonry were jacked and required replacement. The doors were replaced, and a new moment frame was constructed to allow for a new overhead door to be installed for ease of access and for removal of large equipment. The windows were replaced with prefabricated, insulated, translucent fiberglass sandwich panels. In addition, the existing roof and roof drainage were replaced with a PVC roofing system. The boiler heating system was replaced with gas-fired radiant heaters. The building ventilation required replacement and upsizing, as the original gasoline engines were water-cooled and required less airflow. The building's electrical components were replaced, and a new stand-by generator was installed.

Owing to the low expected frequency of activation, the WFPS is started manually to prevent instrumentation error or remote operator error through SCADA. After one engine is started and clutched, the PLC control system linearly modulates speed based on wet well level. If one pump cannot keep up with influent flow rates, the PLC will alert the operator to manually start a second pump. If ever the ultrasonic transducer or PLC fails, a backup float control panel can start and stop the pump engines via float switches in the wet well. See Figure 1 (next page).

PROJECT CHALLENGES

Originally, the WFPS would be activated during any instance when the river level was too high for sewage to be discharged by gravity. After construction of the North Bank interceptor and DIWWTF, the WFPS needed to be activated only during a CSO activation and coincidental high river level, greatly reducing the occurrence of activation. Also, the original design of the WFPS did not allow for exercising the WFPS during non-activation events. The lack of activations and inability to exercise the station led to the eventual disrepair of the WFPS.

Figure 1. Schematic of pump station layout



To enable the city to regularly operate the station and assess preparedness, the station was reconfigured with innovative design modifications so the city could "pump in a circle." The purple arrows in Figure 1 denote this circular pumping scheme. To do this, the following improvements were constructed:

- An "exercise" slide gate was installed on the inside of the pump discharge channel to prevent pumped water from exiting the discharge channel and flowing to the outfall.
- The discharge wall pipe and gate valve left from the demolished third original propeller pump were refurbished to allow pumped water from the discharge chamber to flow back into the wet well by gravity.
- The station uses clean water when exercising. To ensure adequate water for pumping, a city water pipe was installed with a solenoid valve and float switch. The solenoid valve and float switch allow the city to fill the wet well to a pre-determined level without having to be onsite.

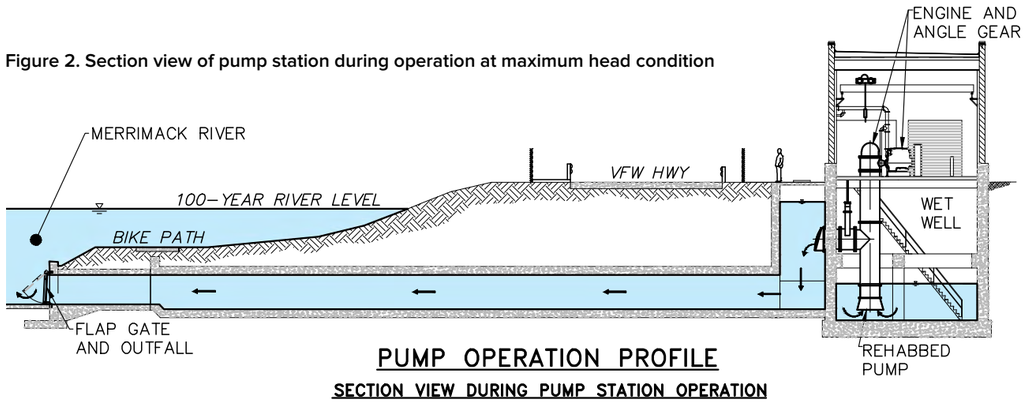
TESTING

Upon installation of the rehabilitated pumps, new engines, and right-angle drives, the pumps were field-tested. The performance testing was to determine if the pump station could deliver up to 120 mgd (454 ML/d) at the maximum system head during a 100-year river stage.

As part of the pump performance testing, the maximum system total dynamic head had to be determined to provide a reference point during testing. The maximum total dynamic head (TDH) was calculated based on several conservative assumptions:

- The river stage is at the 100-year level.
- Each pump is delivering 60 mgd (227 ML/d), and the total combined discharge flow through the outfall is 120 mgd (454 ML/d).

Figure 2. Section view of pump station during operation at maximum head condition



- The wet well water level is low (at the pump shutoff level).

Based on the above assumptions, the calculated maximum system TDH at each pump is approximately 16 ft (4.9 m). See Figure 2 for a section view of the pump station during operation at maximum TDH.

As discussed, improvements were made to allow the station to be exercised by "pumping in a circle" by adding a slide gate to the pump discharge channel and leaving behind the 42 in. (107 cm) wall pipe and gate valve (rehabilitated) when the third pump was removed during construction. This configuration was also used for the pump testing protocol, as follows:

- Before starting testing, the wet well and discharge channel were filled to the invert of the 42 in. (107 cm) wall pipe to provide an initial benchmark for total water volume.
- During pump testing, the pump engine was turned on and set at a specific speed.
- Once the recirculating pumped water reached equilibrium between the wet well and discharge channel, the water level in the pump discharge channel was measured relative to the invert of the wall pipe recirculating flow back into the wet well.
- A pressure gauge, with a port installed approximately 3 ft (0.9 m) above center of the pump bowl, was installed inside the pump station engine room at each pump to provide pressure readings during high-pressure pump tests.
- This testing was repeated for each pump for varying engine speeds (from 1,200 rpm to 1,920 rpm). To provide varying pressure conditions on the pumps, the discharge gate valve was also partially closed to provide field measurements at higher heads. The water level measurements within the discharge channel served two functions:
- The water level measurement was used to estimate pumped flow rate. If the water level in the discharge channel was above the crown of the wall pipe, the flow was calculated by modeling the wall pipe as a submerged orifice. If the water level in the discharge channel was below the crown of the wall pipe, the flow rate was calculated by modeling the wall pipe as a circular broad-crested weir.
- During lower head conditions, the pressure gauge was unable to provide a reading due to the pressure observed at the pump being less than the elevation differential between the gauge port and the gauge. In these instances, the static head was determined using the water level measurement in the discharge channel, and the dynamic head (friction loss) was estimated based on the calculated flow rate.

Field testing of rehabilitated pumps—view from interior of wet well

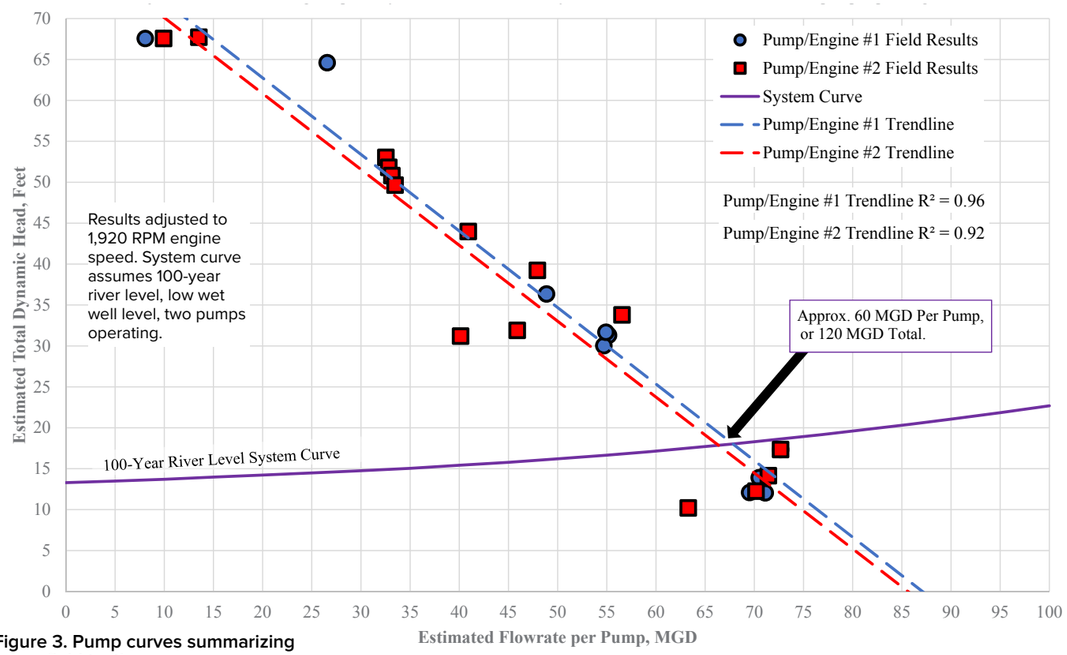


Figure 3. Pump curves summarizing pump field testing

Figure 3 shows the results of the pump testing. The pump curves were created by taking the flow rate and pressure estimates observed at varying engine speeds and applying the Affinity Laws to estimate pump performance at 1,920 rpm. Field testing shows that the WFPS appears capable of pumping at least 120 mgd (454 ML/d) at the maximum system head of 16 ft (4.9 m).

OUTCOMES/CONCLUSION

After decades of being inoperable, the WFPS is properly functioning. With these upgrades and other upgrades to the flood damage reduction system, the city is re-certifying with the ACOE and subsequent FEMA flood zone re-mapping. The efforts of LRWWU staff, local politicians, and state funding agencies have made the WFPS once again operational and the city more resilient to flooding.

The success of the WFPS modifications to allow for pump exercising could be translated to other New England flood pump stations with similar low usage and maintenance issues. The ability to properly exercise, maintain, and verify readiness of flood pump stations is crucial in ensuring flood resiliency.

ACKNOWLEDGMENTS

The authors acknowledge all the LRWWU staff for their contributions to this paper and to the successful execution of this project. We also thank the many Massachusetts Department of Environmental Protection staff who participated in the project's approval and administration of funding. Finally, we thank the ACOE and FEMA for their contributions to this project.

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Green stormwater infrastructure for CSO control—a case study of Philadelphia's approach

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ABSTRACT | *Green City, Clean Waters* is the city of Philadelphia's 25-year plan to create and recreate natural landscapes to absorb stormwater runoff from impervious surfaces while enhancing the overall sewer system with traditional infrastructure improvements. Over the past seven years, the Philadelphia Water Department has implemented green stormwater infrastructure tools to meet ever-increasing water quality and quantity control standards, reduce combined sewer overflows, and provide cleaner waterways for city residents. Green stormwater infrastructure is being implemented block by block to maximize the economic, social, and environmental benefits of introducing green space into an urban environment. This paper provides an overview of the *Green City, Clean Waters* program. Case studies illustrate how green stormwater infrastructure can meet stormwater goals while greening neighborhoods, improving outdoor recreation and educational spaces, and enhancing the quality of life for all residents.

KEYWORDS | *Green City, Clean Waters*, combined sewer overflow (CSO), EPA, green stormwater infrastructure (GSI), Philadelphia Water Department (PWD), resiliency, stormwater management, sustainability, triple-bottom-line benefits, urban infrastructure

Philadelphia skyline

INTRODUCTION

The city of Philadelphia is one of America's earliest developed cities, with extensive history in water management that dates back more than 200 years. Much of Philadelphia is between the Delaware and Schuylkill rivers, an ideal location for development and industry. In the mid-19th century, common practice was to discharge waste and trash into the waterways. This was beneficial because the waterways naturally carried the waste downstream and away from the developed areas of the city. As the population increased, however, this practice exposed Philadelphia's residents to pathogens and widespread epidemics. To remediate these issues and to reduce exposure to polluted surface waters, city engineers converted the natural stream beds into closed, combined sewer systems. The combined sewer systems provided capacity for the natural stream flow as well as industrial waste, sanitary waste, and stormwater runoff. While this practice was revolutionary in reducing exposure to pathogens and allowing for development on the desired grid pattern, it drastically changed Philadelphia's drainage system, hydrology, and topography. These engineering decisions made hundreds of years ago still affect the city's current stormwater management.

WATER MANAGEMENT IN A HISTORIC, URBAN ENVIRONMENT

The Philadelphia Water Department (PWD) oversees the treatment, supply, and distribution of drinking water, as well as the collection and treatment of both wastewater and stormwater for the greater Philadelphia region. In addition, PWD is responsible for providing safe and affordable services for the city's residents, while maintaining clean, attractive, fishable, and swimmable waterways. The city of Philadelphia and PWD have long committed to water quality, responding to such laws and regulations as the Clean Water Act of 1972, the Safe Water Drinking Act of 1974, Pennsylvania's Stormwater Management Act of 1978, and the Combined Sewer Overflow Control Policy of 1994. At stake are not just compliance, but also large-scale impacts such as potential cost increases for stormwater and wastewater management and protection of the expansive Delaware River watershed, from which the city's water supply is sourced.

PWD owns and maintains an extensive sewer system, including 3,700 mi (5,955 km) of sewers, 72,000 stormwater inlets, three wastewater treatment plants, 19 pump stations, 175 combined sewer overflow (CSO) regulating chambers, 164 combined sewer outfalls, and 455 separate stormwater outfalls. The combined sewer network makes up approximately 60 percent of the city's sewered area and is situated in the oldest and densest areas of city center.

Green City, Clean Waters at work

Philadelphia's Green Infrastructure Design Unit has contracted with several planning and design consultants for the Green City, Clean Waters program. Over the past seven years, this has led to the design of GSI practices within the public right-of-way on public schoolyards, public parks, and vacant land. With one consultant alone, for example, more than 90 GSI systems have been completed and another 240 GSI systems are being designed.

Key to effectively planning and completing the work is the block-by-block approach. While traditional gray infrastructure projects can take years to design and construct, GSI can be implemented on a more focused, tactical scale. In this way, projects can be implemented faster and across a much larger area compared to a traditional infrastructure approach.

George W. Nebinger Elementary School

The city's George W. Nebinger Elementary School project, in the Bella Vista neighborhood of South Philadelphia, is one example of how a relatively small project can be incorporated into a larger neighborhood revitalization to maximize benefits. This project came about from a unique partnership among PWD, Bella Vista Neighborhood Group, Philadelphia School District, EPA, and Partnership for the Delaware Estuary, aimed at transforming the urban schoolyard into a green space capable of managing stormwater runoff while serving as an outdoor classroom for the students. The stormwater management improvements include a rain garden with subsurface storage, permeable play surface, and an underground detention basin. Combined, the systems manage runoff from approximately 1 ac (0.4 ha) of the school's property and adjacent street network. Constructed in 2013, the GSI has created outdoor classroom and laboratory space for stormwater management and educational planning.

Philadelphia's combined sewer outfalls range in size from 2 ft (0.61 m) in diameter to rectangular sewers as large as 21 by 24 ft (6.4 by 7.3 m). Frequency and duration of CSOs depend on several factors, including precipitation depth, duration, location, drainage area, sewer size, and land cover. For this reason, some combined sewer outfalls discharge with every precipitation event, while others discharge only a few times per year. PWD has estimated that 16 billion gal (60.6 billion L) of untreated sewage is discharged annually because of its combined sewer system, enough water to fill approximately 24,000 Olympic-sized pools.

Philadelphia is just one of 772 cities in the United States dealing with combined sewer systems. While various solutions can be implemented to reduce CSOs, including complete sewer separation, large-scale storage, increased transmission, wastewater plant expansion, and satellite treatment, most of these options are not feasible due to cost or land availability. This is especially true for a city like Philadelphia, where land is at a premium and most of the sewer system is not easily accessible for upgrades.

ADVANTAGES OF GREEN STORMWATER INFRASTRUCTURE

Many municipalities are exploring green stormwater infrastructure (GSI) to reduce CSOs as a potentially more cost-effective option compared to the traditional "gray" approach. The traditional approach collects stormwater runoff in a pipe network and conveys it away from the development to be managed elsewhere. Conversely, GSI tactics treat stormwater as a resource instead of a nuisance by managing runoff with street-level vegetated systems that mimic the natural environment. In this way, GSI can provide social and environmental benefits beyond stormwater management.

GSI includes a range of systems and practices such as pavement and rooftop disconnections, rainwater harvesting, rain gardens and planter boxes, bioswales, trenches, bumpouts and planters, permeable pavement, green roofs, and living shorelines. It can also refer to conservation measures such as protection of open space, environmentally sensitive areas, and forests.

GSI is flexible in design and can be modified to meet various site conditions. It can be applied on an assortment of scales, making it feasible to manage runoff from one street up to a multi-acre park. While GSI typically manages smaller, more frequent precipitation events, it also can be combined with gray infrastructure (underground storage) as a flood control technique to manage larger storm events.

Where feasible, GSI allows stormwater runoff to infiltrate into the ground to recharge aquifers and restore base flows to local waterways, removing stormwater runoff effectively from the sewer system. In a dense, highly urbanized environment with utility conflicts and uncertain soil conditions, it is not always feasible or safe to infiltrate stormwater runoff. In these cases, GSI detains and slowly releases stormwater runoff back into the sewer system after a storm's peak, when the sewer system has greater capacity. Infiltration and detention/slow-release techniques are both effective for reducing CSOs as they manage the rate of stormwater runoff during wet weather events.

GSI elements such as vegetation and natural landscapes can provide several benefits beyond stormwater management. They can be used to enhance recreation and quality of life, reduce excessive heat and the urban heat island effect, improve air quality and habitats, offset climate change, and restore ecosystems. In addition, such infrastructure can reduce operational costs for sewage, increase property values, and create jobs for the local economy.

PHILADELPHIA'S GREEN CITY, CLEAN WATERS

As the city of Philadelphia reviewed its options to address CSOs, it performed a comprehensive analysis of several approaches. These included complete sewer separation; large-scale storage, plant expansion, and satellite treatment; GSI with increased transmission and treatment; and GSI with targeted traditional infrastructure. The cost-to-benefit analysis reviewed economic factors such as affordability, scalability (ability to apply the approach over a wide geographic region), and job creation; social benefits such as enhanced recreation, improved quality of life, and reduced heat island effect; and environmental benefits such as ecosystem restoration, improved air quality, reduction in energy, and offsets to climate change. Additionally, the analysis considered public opinion of each approach and the timeline for the benefits to be accrued.

GSI with targeted traditional infrastructure was chosen as the best alternative due to the cost savings, the ability to implement it across all watersheds, and the numerous community benefits within the urban environment. Owing to the small scale of GSI, benefits accrue immediately after construction, allowing the program to be adaptable over time to address changing conditions and uncertainty associated with climate change. This option would allow PWD to pilot the latest technology on a small scale while incrementally reducing CSOs. GSI with targeted traditional infrastructure was also seen as the most equitable option; the improvements can be implemented across the city, whereas those of a large gray infrastructure project would improve only one watershed at a time.

In 2011, PWD signed a Consent Order and Agreement (COA) with the Pennsylvania Department of Environmental Protection (PADEP) and EPA to reduce stormwater pollution entering Philadelphia's waterways, thus creating the *Green City, Clean Waters* program.

The *Green City, Clean Waters* guiding principle is to meet state and federal mandates to reduce CSO impacts. In doing so, the program uses rainwater as a resource, makes the sewer system more resilient, revitalizes the city, and motivates Philadelphia's residents to get involved with this important mission. While GSI is the primary focus of *Green City, Clean Waters,* the program also embraces traditional infrastructure to increase wet weather capacity. Where appropriate, the program calls for large area-wide disconnection projects with traditional gray infrastructure to relieve the overburdened sewer system. In these cases, new separate storm sewer mains route large volumes of stormwater runoff to a centralized system such as a concrete vault or other non-GSI storage system, or to newly constructed pieces of GSI. In addition, the program calls for upgrades to the wastewater treatment plants to expand treatment capacity.

On average, Philadelphia receives 42 in. (107 cm) of rain and more than 60 in. (152 cm) of overall precipitation each year. Approximately 85 percent of these events result in a precipitation depth of 1.5 in. (3.8 cm) or less. For this reason, GSI tactics are designed to provide static storage of 1 to 2 in. (2.5 to 5 cm) of runoff over the contributing impervious drainage area. Management of these smaller, more frequent storm events could generate big results in terms of CSO reduction for the city.

PWD, PADEP, and EPA agreed to specific performance goals to track the progress of *Green City, Clean Waters* over the duration of the program. To measure success, PWD has developed a performance metric called a "greened acre." One greened acre represents the management of 1 in. (2.5 cm) of stormwater runoff from 1 ac (0.4 ha) of impervious cover within the combined sewer area. In other words, 1 ac (0.4 ha) greened is equivalent to the management of 27,158 gal (102,800 L) of stormwater runoff during a storm event that generates 1 in. (2.5 cm) of precipitation or more. Each greened acre is significant for PWD, and for that reason, every greened acre is celebrated.

FUNDING

PWD recognizes that public investment, public/private partnerships, and community support are critical for this program to be successful. Its ratepayers fund public *Green City, Clean Waters* projects through various sources including private development, stormwater billing, public grants and funding, and bonds.

Green City, Clean Waters at work (continued)

Hestonville Garden

The city's Hestonville Lot and Baker Playground project, at the corner of 55th and Hunter streets in West Philadelphia, is another example of a small project that made a big impact. Several years ago, City Councilman Curtis Jones asked PWD to support his plan to make the vacant Hestonville Lot more accessible and inviting as well as to revamp Baker Playground with a new sidewalk and landscaping. Using high-level topographical information maps, PWD confirmed that the sites were at relative low points able to receive significant drainage from the public right-of-way, and a rain garden with subsurface stone storage at each site along with aesthetic improvements were subsequently designed. Combined, the resulting GSI at the Hestonville Lot and Baker Playground manage 1.39 ac (0.56 ha) greened.

Ingersoll Commons Park

The George W. Nebinger Elementary School, Heston Lot, and Baker Playground represent a small but essential piece in the green infrastructure fabric being knit together across the city. In the fall of 2017, PWD's GSI installations surpassed 1,000 ac (405 ha) greened, meaning approximately 27 million gal (102 million L) of stormwater runoff mitigated from a 1 in. (2.5 cm) rainfall event. Annually, this equates to over 1.1 billion gal (4.2 billion L) of polluted water diverted from waterways. PWD has exceeded its goals for the first seven years of the program and is ramping up GSI construction to meet ambitious mandates set for *Green City, Clean Waters'* 10-year benchmark in 2021. Philadelphia's nimble approach shows how CSOs can be managed on the micro scale for maximum results tailored to a city's budget and unique landscape.

Philadelphia's stormwater regulations, updated in January 2006, require development and redevelopment projects to manage the first 1.5 in. (3.8 cm) of stormwater runoff from all impervious areas for projects with an earth disturbance of 15,000 ft² (1,394 m²) or greater. Where feasible, this water quality volume must be infiltrated. Where infiltration is not feasible, the volume may be released at a maximum rate of 0.05 cfs per ac (3.5 L/s/ha) of contributing impervious drainage area. These requirements are consistent with the goals of the *Green City, Clean Waters* program. With an average redevelopment rate of 1 percent annually, PWD has estimated that private development could result in up to $1 billion in funding through 2036 for the program.

In July 2010, PWD transitioned from a water meter-based to a parcel area-based billing approach for stormwater utility fees, charging all property owners a monthly stormwater fee based on the land area and impervious cover within their site. Residential property owners pay a flat fee based on the average lot coverage and area throughout the city. To offset the stormwater fee, PWD allows non-residential property owners to file for stormwater credits for sites that have constructed stormwater management systems and have been approved through PWD's stormwater review process. To encourage retrofit stormwater management projects, PWD offers stormwater grants through its Stormwater Management Incentives Program and Greened Acre Retrofit Program. Once stormwater management practices are constructed and approved, those property owners can reduce their monthly stormwater bill.

Green initiatives are also funded through grant sources, including the William Penn Foundation, Growing Greener, Army Corps of Engineers, EPA, and others. Several non-profits, such as the Trust for Public Land, have worked with PWD to implement GSI on public properties using a mixture of public/private funding. PWD has estimated that public grants could result in another $1 billion in funding through 2036 for the *Green City, Clean Waters* program.

COMMUNITY OUTREACH AND PARTICIPATION

Philadelphia's public outreach division has launched several programs to encourage community participation, education, and ownership in the *Green City, Clean Waters* program. For example, the Soak It Up! Adoption program encourages local civic organizations and non-profits to tend to completed installations. Through this program, organizations can obtain a modest grant from PWD to monitor and beautify the GSI in their neighborhood. The program aims to include local organizations in helping to ensure that stormwater management practices remain aesthetically pleasing and to empower these organizations to proactively monitor their maintenance.

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ABSTRACT | Green stormwater infrastructure design projects in parks are made possible by diverse funding sources that share a common goal: improved water quality. Different typologies for green stormwater infrastructure in urban parks are applied to capture and manage stormwater runoff from drainage areas that originate beyond park borders, reduce runoff and pollutants in municipal separate storm sewer systems (MS4) and combined sewer systems, and mitigate localized flooding. Smart designs that consider site conditions make open spaces more accessible for diverse programs and uses. This paper will provide an overview of funding sources, design strategies, water quality improvements, and additional co-benefits provided by multi-objective green stormwater infrastructure in parks and public spaces. Example projects of all sizes from New York City, Atlanta, and Calgary will be described, and an example of a successful Institute for Sustainable Infrastructure Envision verification and award process for a stormwater park will also be shared.

KEYWORDS | Green stormwater infrastructure (GSI), park, stormwater management, pond, bioinfiltration, hydrologic and hydraulic (H&H) modeling, Institute for Sustainable Infrastructure, Envision, collaboration, innovation

Parks are vital to the well-being of our communities because they offer a variety of social, economic, and environmental benefits. In addition to these benefits, parks can deliver another vital service to municipalities: stormwater management. By installing green stormwater infrastructure (GSI), parks can act as collection facilities for surface runoff, serving to improve regional water quality and mitigate flooding.

Parks can provide unique opportunities for cities that are implementing GSI programs. These traditionally publicly funded programs often focus on publicly owned property and are enforced by consent decree to achieve certain water quality metrics. However, both municipalities and private developers are using a wide variety of funding strategies and metrics to implement multi-functional parks of all sizes and types to benefit the community and improve water quality.

COMMUNITY BENEFITS

Parks offer a wide range of recognized benefits to our communities. They improve the quality of life by providing social gathering places and beautifying the environment. Open space improves public health and safety by offering active and passive recreation facilities and providing greenspace for improved air quality in urban areas. Ecologists qualify and quantify the benefits of greening hardscapes, restoring habitat, and reconnecting people to more natural landscapes. More recently, economists are evaluating the impacts of parks on property values and revitalization of neighborhoods that have historically experienced a lack of interest or investment (Figure 1).

Combining parks and GSI can further maximize the benefits offered by open spaces in communities. The extent of potential stormwater management and co-benefits at a park will depend on many factors including park size, characteristics, constraints, schedule, budget considerations, and stakeholder buy-in. However, parks of all sizes in all types of communities can be constructed or retrofitted with GSI features to offer cost-sharing and achieve multiple community-level benefits.

The project team should collaborate with stakeholders to identify co-benefit opportunities and targets early in the project to make them easier to implement during design. Sustainable metrics such as the Institute of Sustainable Infrastructure's (ISI's) Envision rating system are valuable planning tools. Such systems help cities and developers identify, quantify, and maximize the co-benefits of their GSI features.

Figure 1. Stormwater lake at Historic Fourth Ward Park with new residential and commercial development built around the park several years after the park's construction

"Even though the (Historic Fourth Ward Park's) primary function is to alleviate flooding issues, the space that was created has jumpstarted private development in the area and provided a wonderful park to a community."
– The City Parks Alliance

GREEN STORMWATER INFRASTRUCTURE

Municipalities and developers install GSI in parks to control surface flooding, reduce the frequency and volume of combined sewer overflows (CSOs), and improve water quality in municipal separate storm sewer system (MS4) areas. In addition to managing runoff within park boundaries, these features can also capture stormwater runoff from adjacent drainage areas such as streets and sidewalks. These GSI features can either retain the runoff by infiltrating it into the ground or detain the runoff to facilitate treatment in MS4 areas and reduce peak flows in combined sewer areas.

FUNDING SOURCES

Traditionally, stormwater management projects are funded by local taxes or utility revenues such as water and wastewater bills or stormwater fees. However, funding for GSI can come from a variety of sources. Park projects often use local or federal grants and initiatives to fund parts of the project. These programs exist to fund developments specific to environmental improvements and community development. Many states offer low-interest loans with principal forgiveness or related grants to implement stormwater management and GSI. EPA also awards grants to projects that benefit urban water quality and community revitalization, while several other federal partners have developed grant programs to implement projects that mitigate flood risks.

Interagency collaborations have long existed at the local level between transportation, parks, and watershed departments. With maturing GSI programs in our cities, new opportunities for interagency collaboration are developing. For example, Mayor Bill de Blasio created the Community Parks Initiative (CPI) in New York City to fund projects in parks and playgrounds that have seen little investment since their creation. While New York City Parks and Recreation (NYC Parks) is the primary capital funding source for the CPI, the New York City Department of Environmental Protection (NYC DEP) helps fund GSI in all CPI parks located within the combined sewer system that advance progress toward its Consent Order milestones. As NYC DEP continues to expand its green infrastructure program, the agency works with NYC Parks and the New York City Department of Transportation (NYC DOT) to increase stormwater runoff capture with GSI. Based on this collaboration, parks adjacent to streets and sidewalks that generate large volumes of stormwater runoff may provide natural, cost-effective collection facilities for excess runoff.

As presented below with the case study from the city of Calgary, private developers can also be effective funding partners for implementing innovative and beneficial GSI in parks and plazas. New developments often need to meet minimal stormwater management requirements and green space metrics. Combining GSI with new parks and plazas is efficient and cost-effective in meeting these goals.

Collaboration between the public and private sectors is an innovative way to fund GSI projects in parks and achieve multiple benefits. The collaboration can be between city agencies that share common goals or between public and private entities. Additionally, non-profit organizations can be instrumental in brokering public and private sector partnerships as well as collaboration among all levels of government.

LONG-TERM SUCCESS

While planning and design are vital to a park project meeting water quality and community benefit goals, proper operations and maintenance (O&M) ensures that the project maintains this functionality throughout its life. Owing to their long-term scope, O&M costs usually exceed design and construction costs over the lifecycle of a project. For these reasons, planning and budgeting for maintenance should be integral to all phases of the GSI project.

During planning phases, the stakeholders should decide who will perform the maintenance tasks and identify skill gaps to address through hiring or training. Also, stakeholders should identify required changes to maintenance schedules and funding. If budget constraints are an issue, park workers may need to be responsible for maintaining the GSI facilities. If O&M funding is available, external crews may be hired to focus exclusively on the stormwater management facilities. Identifying these factors early will enable design decisions that cater to the capacity and expertise of the future maintenance staff. Depending on size and location, conservancies can form to successfully supplement maintenance through fundraising and volunteering events.

Ease of maintenance should also be considered during the design of the project. Small modifications during design can drastically improve the efficiency and effectiveness of O&M staff. Properly sized and accessible pre-treatment devices will concentrate debris and sediment in a contained area. At- or above-grade inlets, outlets, and outfalls make flushing and cleaning much easier. Native plantings have higher survival rates and may require less care than non-native alternatives. Designated access paths and maintenance staging areas allow the maintenance staff to access the GSI features with the necessary vehicles, tools, and equipment.

CASE STUDIES

The following case studies provide an overview of different collaborations, design strategies, and improvements provided by GSI in parks and other public spaces. All ask a key question: Are we using the opportunities presented to us as urban planners and engineers not only to comply with regulatory requirements but also to deliver community-level investments that can spur neighborhood revitalization, identity, and pride?

CASE STUDY 1: New York City Green Infrastructure Program

Since 2017, NYC DEP and its many partners have constructed, or are constructing, GSI practices in 55 parks with 45 more locations under design. In 2018, NYC DEP commenced task order contracts to investigate, design, and construct GSI at an additional 146 parks over the next five years. GSI practices include bioinfiltration, permeable pavers, subsurface storage, and turf fields, all constructed with the goal of capturing and managing stormwater from impervious surfaces in CSO tributary areas. These "on-site" projects are the result of a collaborative relationship among NYC DEP, NYC Parks, NYC DOT, New York City School Construction Authority (NYCSCA), and other agency partners.

Background

NYC DEP has been implementing an extensive system of GSI facilities citywide since the formation of the NYC DEP Green Infrastructure Program in 2010. This program captures stormwater runoff from impervious surfaces to reduce the volume of stormwater entering the city's combined sewer system. This reduces both the occurrence and the volume of CSOs to New York City waterbodies and helps meet the Consent Order between NYC DEP and the New York State Department of Environmental Conservation.

According to the NYC Green Infrastructure Plan, the program aims to reduce CSO volumes by 3.8 billion gal (14.4 billion L) per year by managing runoff from 10 percent of impervious surfaces citywide by 2030. The GSI practices constructed in this program will also provide community co-benefits such as increased urban greening, urban heat island reduction, and additional habitat for birds and pollinators around the city. The NYC DEP Green Infrastructure Program is primarily funded and managed under NYC DEP's capital budget and is supplemented by mayoral funds, agency partners, and environmental grants.

Early in the program, NYC DEP focused on installing right-of-way infrastructure such as bioswales and porous pavement within city sidewalks and parking lanes. To date, NYC DEP has installed approximately 4,000 right-of-way GSI practices (Figure 2).

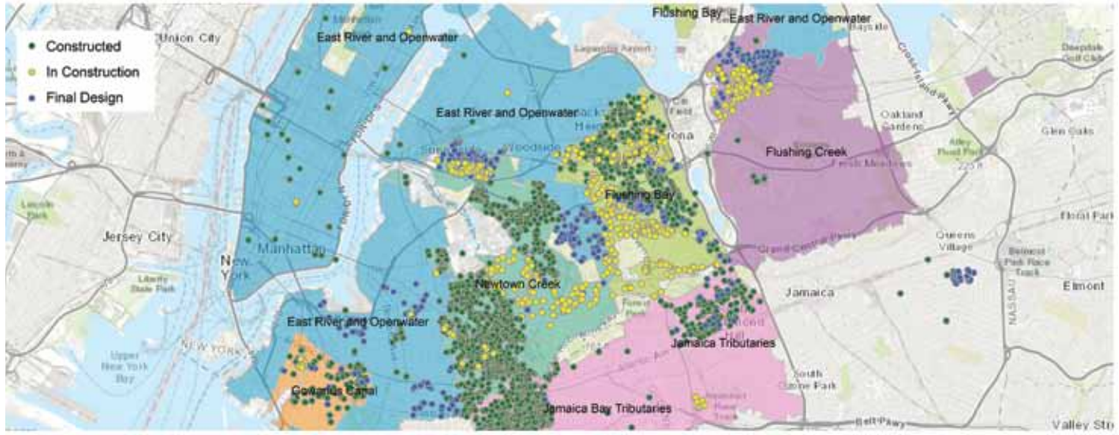


Figure 2. Locations of GSI practices in various stages of design and construction as shown on the NYC DEP Green Infrastructure Program map

More recently, however, the program advanced beyond the right-of-way and began focusing on retrofitting public properties such as parks, playgrounds, and plazas with larger GSI practices. Through the end of the Consent Order deadline in 2030, NYC DEP will continue to investigate GSI opportunities in the remaining parks to maximize the runoff volume captured. NYC DEP will also investigate including GSI in parks in MS4 areas to improve the water quality of stormwater runoff before discharge to receiving waterbodies. Because of the hundreds of parks being investigated, NYC DEP relies on a systematic approach to investigate, design, and construct GSI practices at these locations.

Park Selection Process

Because CSO reduction is the primary goal of the NYC DEP Green Infrastructure Program, NYC DEP focuses on installing GSI in parks located within the most problematic CSO tributary areas. Most of these areas are within the boroughs of the Bronx, Queens, and Brooklyn. With these focus areas identified, NYC DEP systematically assesses parks based on GSI construction feasibility factors such as impervious coverage, park size and accessibility, environmental hazards, and NYC Parks capital improvement plans. The result is a list of potential park sites of various sizes, surface cover types, and uses to be investigated for GSI retrofits.

Site Investigation

Once vetting is complete, NYC DEP organizes the parks geographically and packages them into capital design projects for further investigation and design. These projects involve siting and designing GSI within the parks while minimizing the impact to park programming. Consultant design teams visit each site to identify potential GSI practice locations and record site features such as existing drainage infrastructure and park entry and access restrictions. Ideal locations for GSI are low points of large impervious tributary areas that are near drainage inlets and clear of courts and play surfaces. These conditions maximize the runoff capture potential of GSI, accommodate overflow when the practices are fully inundated, and minimize conflicts with existing park uses.

Once potential GSI locations are identified, the design teams conduct site surveys to confirm the tributary areas and collect information to complete detailed design. Specialized contractors also perform geotechnical investigations to test for subsurface suitability. In ideal conditions, GSI will rely mainly on infiltration to manage stormwater runoff. If subsurface conditions are undesirable, underdrains will convey treated runoff back to the drainage system.

Designing in Challenging Conditions

Many characteristics of parks in ultra-urban environments make retrofits challenging. Several parks investigated under this program are relatively small, some less than 1 ac (0.4 ha), generate minimal runoff, and provide limited locations for GSI. Trees, structures, and site utilities present additional obstacles for excavation and infiltration. Because the retrofits are meant not to affect park programming, GSI must also avoid courts, play surfaces, and walkways. Subsurface conditions often include unsuitable materials that do not allow for adequate infiltration.

To meet these site challenges, NYC DEP and the design teams use different strategies. To minimize surface interference, many GSI practices include features such as porous pavement, turf fields, and subsurface storage. These practices can be installed adjacent to, or within, play areas while still providing

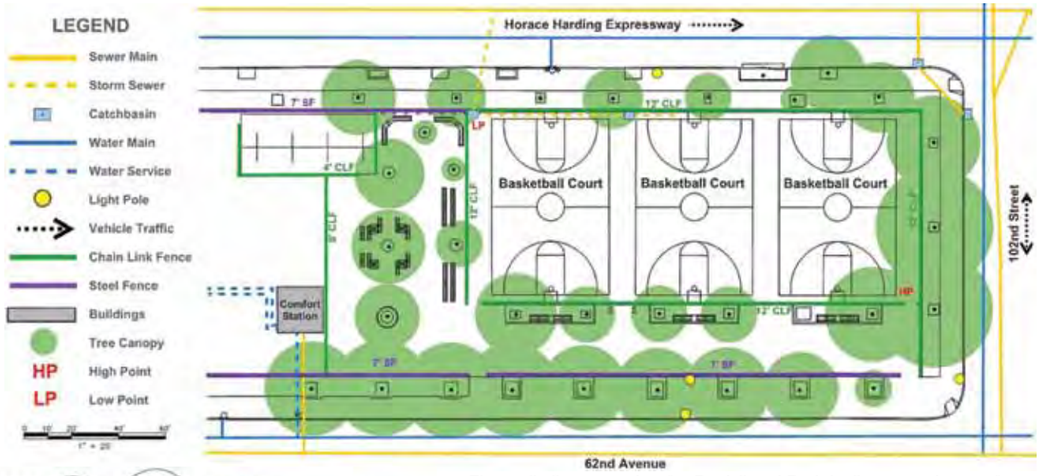


Figure 3. Concept plan for Real Good Park in Queens where, after a thorough site investigation, permeable asphalt was identified as feasible and cost-effective GSI

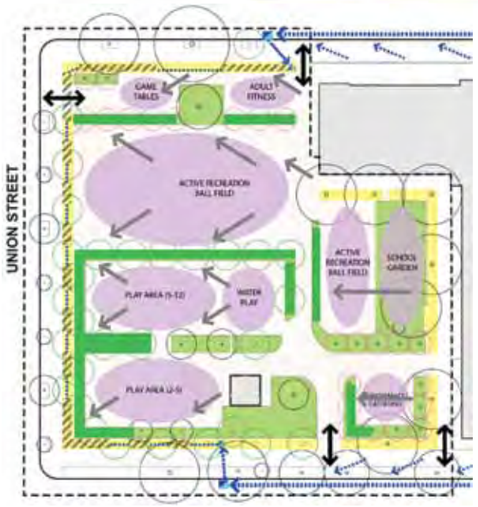


Figure 4. Bioinfiltration (green) at Bowne Playground in Queens manages site runoff, and a catch basin (blue) conveys right-of-way runoff to onsite GSI

safe, walkable surfaces. Figure 3 shows the concept design of a GSI retrofit in Queens that uses permeable asphalt between basketball courts.

To maximize stormwater management, GSI can intercept runoff within an adjacent right-of-way and convey it to the interior of the park. This strategy typically involves installing new catch basins along the curbs, which are connected to subsurface storage along the park perimeter.

Figure 4 shows the concept design that manages stormwater within the park using bioinfiltration and also maximizes the effectiveness of GSI practices by collecting runoff from the adjacent street.

Finally, if subsurface conditions prohibit infiltration, GSI practices can include a system of underdrains to connect back to the drainage systems. This configuration does not completely remove runoff from the combined sewer system but does delay the peak flow in its tributary, possibly helping in CSO reduction.

Applications for Other Cities

The NYC DEP Green Infrastructure Program is an example of how large cities in the region are implementing GSI in parks with challenging conditions. Many of these parks are small and have limited siting opportunities, but the program's strategies demonstrate a model for installing low-profile GSI to manage surface runoff and contribute co-benefits to the communities they serve.

CASE STUDY 2: HISTORIC FOURTH WARD PARK

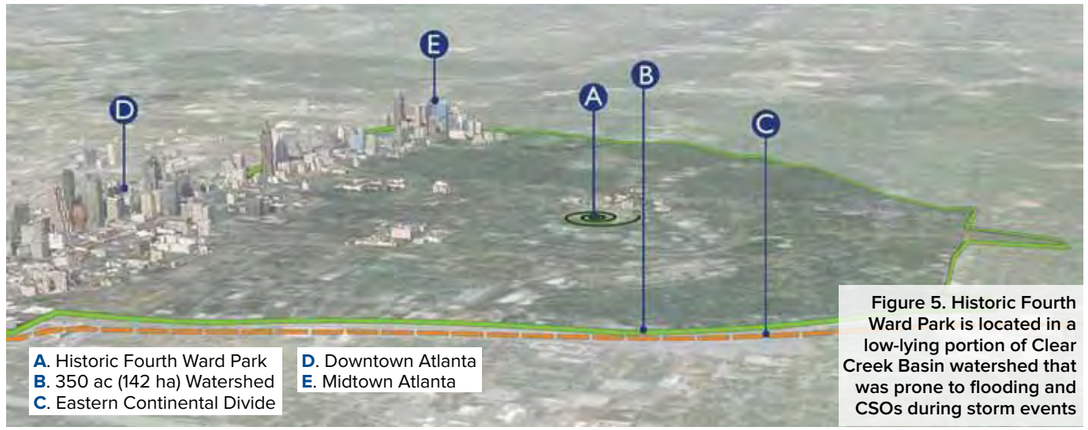
Introduction

On a site described by *The Atlanta Journal-Constitution* as "a barren expanse of cracked concrete, weeds, and towering trees surviving against a background of neglect," a 5 ac (2 ha) parcel within Atlanta's Historic Fourth Ward has undergone a dramatic transformation. A stunning new park in one of Atlanta's oldest neighborhoods grew out of a need to address the unglamorous problem of CSOs. The idea came from the people—rather than adding costly, traditional sewer tunnels to address the problem, the blighted industrial lowland area has been transformed into a park surrounding a functional stormwater retention lake.

The stormwater lake serves as the centerpiece of the new park, surrounded by walking trails, urban plazas, and native plantings. The project won several awards as a result of the multiple objectives achieved by the city, and ISI verified the project with an Envision Gold award.

Background

The setting for this multi-functional 5 ac (2 ha) park is the Historic Fourth Ward neighborhood,



A. Historic Fourth Ward Park
B. 350 ac (142 ha) Watershed
C. Eastern Continental Divide
D. Downtown Atlanta
E. Midtown Atlanta

Figure 5. Historic Fourth Ward Park is located in a low-lying portion of Clear Creek Basin watershed that was prone to flooding and CSOs during storm events

a former industrial area near downtown Atlanta that is now a destination for visitors and residents (Figure 5). While a current focal point in the city for redevelopment and resurgence, this neighborhood has long been the home of a concerned citizenry. Residents have been vocal to city officials about the racial, economic, and physical barriers that cut them off from other neighborhoods, infrastructure, and amenities.

The Atlanta Beltline provided opportunities to change this starting in the early 2000s. A 22 mi (35 km) loop of railroad corridors that formerly encircled Atlanta, the Beltline would connect multi-use trails, modern streetcars, and parks with a larger vision of integrating transportation, land use, greenspace, and sustainable growth planning for the city. At the same time, the city entered into two consent decrees with EPA to address operation of its wastewater facilities and combined and sanitary sewer overflows. On October 16, 2002, Mayor Shirley Franklin announced a new Clean Water Atlanta initiative with a plan to improve the city's wastewater system.

The Clear Creek Basin watershed was targeted by the city and the Department of Watershed Management because of its large size, volume of CSOs, and frequency of surface flooding during rain events. An underground tunnel to address capacity issues in the city's sewer system was proposed. The $70 million sewer relief tunnel would have been constructed through the Historic Fourth Ward neighborhood, and the area's dense development would have complicated the installation if traditional cut-and-cover methods were used. The project would have disrupted the neighborhood for years during construction. It also met resistance due to the anticipated impact on the historic neighborhood, as it is the birthplace of Martin Luther King, Jr. It was further noted that, while the tunnel would serve to drain the 350 ac (142 ha) watershed upstream of the Historic Fourth Ward, no other noticeable benefit would accrue to the neighborhood.

Collaborative Process

Atlanta Beltline Inc. (ABI, a voluntary non-profit association affiliated with the Atlanta Development Authority), in partnership with Trust for Public Land (a national non-profit that creates parks and preserves public land), proposed to construct an approximately 17 ac (7 ha) park in the Clear Creek Basin as part of its larger vision of an interconnected park encircling Atlanta. However, the idea of Historic Fourth Ward Park started with the residents of the Old Fourth Ward. Concerned citizens suggested that a better investment for their community would be to detain stormwater in a lake feature rather than buried below ground in the proposed tunnel. The city of Atlanta and ABI entered into a cooperative agreement to fund a stormwater management feature that would also become the focal point of the park and the Historic Fourth Ward neighborhood. Together, and at a cost of less than half that of the proposed tunnel, the city and ABI constructed a regional stormwater detention facility and public amenity that is maintained collaboratively by the Departments of Parks and Watershed Management and the Historic Fourth Ward Park Conservancy.

The stormwater feature had to capture and store a calculated amount of stormwater runoff (22 ac ft [27,000 m^3]) up to the 100-year rain event from a 350 ac (142 ha) watershed and achieve landmark park status as the first one to be constructed along the 22 mi (35 km) Beltline. Through master planning and community input meetings, ABI shaped a vision that appealed to the community and reflected the vision desired for this park. Subsequently, a lake was designed to be the signature view within the park setting and a celebration of water (Figure 6 next page).

Unique Stormwater Solution

The lake at Historic Fourth Ward Park captures excess runoff from the watershed via 10 inlets. Four primary inlets were designed as sculptural features

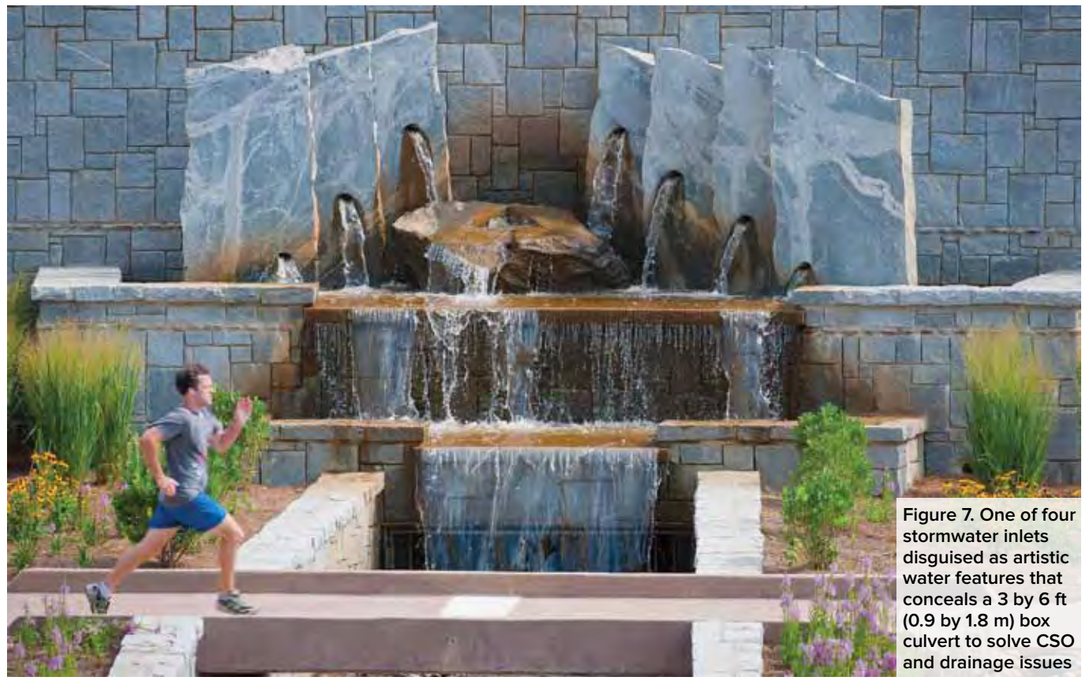


Figure 7. One of four stormwater inlets disguised as artistic water features that conceals a 3 by 6 ft (0.9 by 1.8 m) box culvert to solve CSO and drainage issues

Figure 6. South plaza channel artfully collects and conveys storm runoff to the lake through this ephemeral drainage feature

to disguise traditionally engineered components such as pipes, flared end sections, and rip rap (Figure 7). The lake captures and contains nearly 8 million gal (30 million L) of stormwater, providing capacity relief to the CSO. The stored volume is released in a controlled manner to the downstream trunk sewer (Figure 8). Storm levels such as the 100- and 500-year are indicated with horizontal bands on the constructed walls.

Hydrologic and hydraulic (H&H) modeling completed during design demonstrated that the lake installation caused an offsetting of the surface hydrographs from the subsurface flow regime, and this offsetting benefits the sewer system. The modeling program indicated a reduction in peak flow rates at the connection point to the trunk sewer; the peak flow rates were found to have decreased between 9.6 percent and 3.6 percent. As the lake serves a large watershed, a nine percent improvement in the 10-year storm flows equals a 44 mgd (167 ML/d) reduction in the trunk sewer flows. The Historic Fourth Ward Park lake also consolidates impounded water from non-engineered locations into a more centralized, engineered location. If sewer separation is necessary in future to further reduce CSOs, biological and mechanical water quality improvements are possible in the lake and additional storm drains can be installed to expand drainage areas.

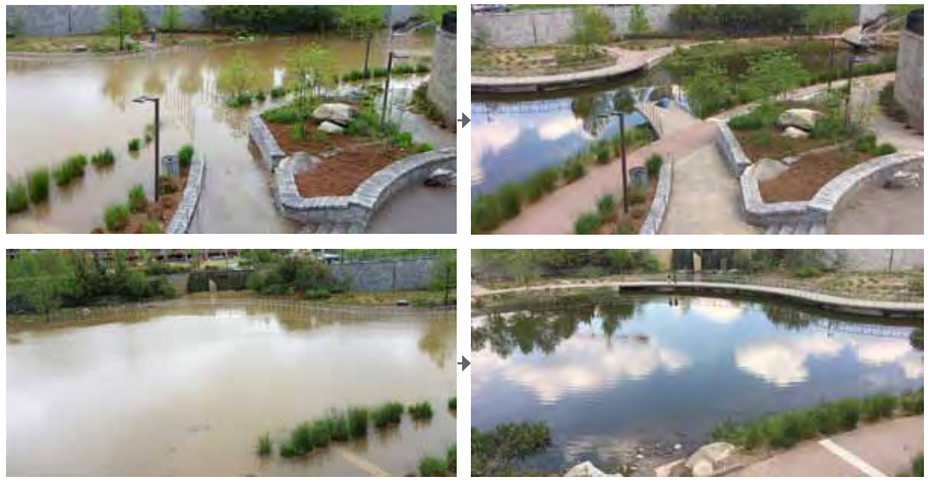
Infrastructure or Community Amenity?

For those who visit Historic Fourth Ward Park once, often, or even daily, realizing that the lake is a key component of the city's drainage infrastructure can be difficult. While this low engineering profile was the intent of design, the 2 ac (0.8 ha) lake was also designed to be the focal point of the park and a celebration of water. Design details and sculptural elements disguise engineering solutions as runoff enters the park at four entry points. The stormwater lake is surrounded by native plantings including drought-tolerant species and southern heritage plants to create a wetland habitat. Elevated walkways provide views of the lake and connections to the Beltline, with an additional network of walkways to provide circulation throughout the park. An amphitheater also overlooks the lake and provides a venue for educational field trips, concerts, and other events.

Since its opening in 2011, Historic Fourth Ward Park draws hundreds of visitors a day. The stormwater park today is surrounded by redevelopment and revitalization, including a mix of residential, commercial, and office space that did not exist prior to its construction. Historic Fourth Ward Park is an example of a sustainable design solution for a serious environmental problem that can trigger broader high-quality urban transformations within a community.

Envision Gold

The design and construction of Historic Fourth Ward Park aligns with the values and intent of ISI's Envision Rating System. Following construction, the project was registered with ISI to measure the stormwater park's actual sustainability benefits. The project scored high in the "Quality of Life" and "Leadership" credit categories as a result of the amenities incorporated into the design and the collaborative process used throughout. The project also scored well in the "Natural World" credit categories due to several key features of the site and its design. The project remediated a previous 12 ac (4.9 ha) brownfield site by transforming it into a community open space. In addition to managing runoff from a large upstream drainage area, the lake captures and detains all onsite runoff. The detained water is circulated through aeration features disguised as waterfalls and fountains and is further treated by the wetland plantings. Seventeen acres (6.9 ha) of park space are irrigated by the water stored in the lake. Historic Fourth Ward Park was awarded 44 percent of the total available points, consistent with Envision Version 2, and was awarded Envision Gold in 2016.



Flood event | Three days later

Figure 8. The perimeter walkway of the stormwater lake at Historic Fourth Ward Park was set at the 5-year storm level; the flood event depicted in the photos resulted from 4 in. (10 cm) of rain

CASE STUDY 3: RADIO PARK

Introduction

Radio Park is a planned urban park in Calgary that unites public open space with stormwater management to create a recreational destination. The park is within West District, an 84 ac (34 ha) master planned development envisioned as a high-density, mixed-use, compact, and transit-supportive neighborhood. A local housing development corporation, collaborating with the city of Calgary and engineering consultants, designed the park to be the heart of the development's urban center, resulting in an integrated park and stormwater management facility that provides a dynamic public open space within an urban environment.

The 8 ac (3.2 ha) park is organized around a central pond that provides stormwater storage for the West District development (Figure 9). Fountains, boardwalks, overlooks, and plantings transform the pond from stormwater infrastructure to park centerpiece. A performance venue, wintertime ice rink, and restaurant provide activities for all seasons. While sustainability and resiliency guided design, Radio Park was based on marrying previously discrete city requirements for public parkland and floodplains that had not been addressed together before.

Collaborative, Transparent Planning

The community was involved throughout planning and design. This involvement included an interactive facility for the public to visit to help plan Radio

Figure 9. All West District Central Park images used courtesy of S2 Architecture

Figure 10. Modeling runs determined inundation areas and impact on programmable spaces within the park; depicted here are the key elevations for the stormwater pond's final concept design

Park. Concept designs shared with city officials and the public illustrated different inundation levels as part of the complete master plan and profile plans to demonstrate impacts on park spaces and community connections, as well as anticipated O&M requirements. Initial investments would be further supported by tax revenue generated by the city and were anticipated to grow as a result of the West District urban development plan.

For the stormwater park concept to successfully advance toward implementation, collaboration among the developer, the design team, and the city was necessary. The city's regulations typically require separate land area for public open space (Municipal Reserve) requirements and utility-related (Public Utility Lot) requirements such as floodplain storage. Conceptual designs overlapping park areas with a stormwater pond illustrated the developer's vision for integrating these requirements with multi-functional and resilient spaces, while modeling demonstrated that flood elevations could be accommodated beyond the required design storm if overlapping with open space. In March 2018, the city approved the West District master plan including the stormwater park to meet both requirements with no additional impact on the greater developable area.

Access and Inundation

The design of Radio Park was influenced by two key conceptual planning steps: identification of Character Areas and modeling of inundation areas. These two steps, while distinct, were also interwoven and iterative. Character Areas identified the scope and location of different park functions from "arrive" to "reflect" and "play" to "meet," and ensured compliance with the city's Municipal Reserve requirements for park space dedication. At the center of the park, an area to "explore" with adjacent viewing areas was identified. This area was then designed to be a location for observation and travel through and around. It also would include a water feature surrounded by perimeter walkways, boardwalks, and plantings to promote passive recreation, ecological services, and educational opportunities. However, stormwater management features were not previously considered as a Municipal Reserve compliance strategy.

Modeling of inundation scenarios for different storm events to comply with the Public Utility Lot requirements was next conducted using available variants of stormwater management modeling software for single-event and continuous simulation. Modeling parameters included the extent of impervious surface planned as part of the identification of Character Areas as well as subsurface infiltration capacities and 55-year continuous modeling data. With the stormwater pond as the central feature within the park and a surface area of approximately 1.5 ac (0.6 ha) including wetland areas, modeling demonstrated that a permanent pool would require an approximate depth of 6.5 to 8 ft (2 to 2.4 m) and an elevation of 4,044 ft (1,232.6 m). Inundating the same pond with the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year storms resulted in elevations ranging from 4,045 to 4,048 ft (1,232.9 to 1,233.8 m).[1] However, the spatial or surface impact within the park including different Character Areas varied more significantly, as shown in Figure 10.

[1] 500-year storm was modeled with 24-hour duration data, not 55-year continuous data

Based on the Character Areas identified and the completed modeling, the active storage is designed to control storm frequencies up to the 500-year event; however, only programmable space, consisting primarily of hardscapes that could be easily maintained and restored to its pre-flood condition in a matter of days, was located within the 50-year storm flood elevation. The iterative process, between identifying Character Areas and modeling of inundation areas, designated an area largely to the southeast of the pond as one location that would lie within the 1:50 year "floodplain" to store water as needed. The design of this area includes drainage structures to quickly convey runoff from the surface area following rain events and retaining walls to facilitate storage. Vegetation will line the retaining walls to mask floodwater lines for cost-effective, long-term O&M.

Several pond design features from the lake at Historic Fourth Ward Park were also replicated. The entire northeastern edge of the pond at Radio Park is designed as a waterfall for aeration as well as to conceal inflow pipes (Figure 11). As the pond provides stormwater storage for West District, oil/grit separators are to be outside the park to collect sediment and trash prior to stormwater runoff entering the pond. Runoff, which also includes 100 percent of the runoff from within the park, enters the pond and is stored above the permanent pond and released at a controlled rate. Wetland vegetation surrounds the pond for additional water quality treatment and restored native habitat.

According to the developer, Radio Park also captures and celebrates the legacy of Calgary's local radio and television heritage by commemorating a strategic high point and location for landmark Calgary radio and television infrastructure.

The pond at Radio Park, much like the lake at Historic Fourth Ward Park, is the centerpiece with views afforded from all Character Areas. Connecting pathways bring users from inside and outside the park to the pond, with several pathways clearly demarcated in conceptual designs as emergency routes, if needed. Elevated walkways and boardwalks allow users to navigate the pond environment including wetland areas to explore, gather, and learn. As these areas are designed to flood, material selection for all walkways includes slip-resistant products to allow users to visit immediately following rain events and colored surfaces to minimize the visual impacts from the presence of water.

Figure 11. Waterfall for viewing and exploring by Radio Park users also serves as a key aeration facility for the lower stormwater pond

Current Investment, Future Revenue

One success of Historic Fourth Ward Park that interested the Calgary developer was the investment in the neighborhood that sprouted around the park following construction. The economic model for the West District development plan was built on the notion that an investment in a community amenity (that also functions as critical community infrastructure), if designed right, would return continuous benefits to the city. As a result, the developer agreed to construct a park that cost approximately $15 million—four times more than typical for the city of Calgary. It demonstrated that the full development plan with Radio Park as the centerpiece would accrue approximately $350 million (net present value) in future property tax revenue for the city over 50 years. A development scenario without such community amenities was estimated to accrue less than half of this forecasted value. For these reasons, the developer and design team pushed the boundaries of community uses and features within Radio Park, including an upper pond that serves as an ice skating rink (Figure 12 next page).

Conclusion

Atlanta City Council Member Kwanza Hall described Historic Fourth Ward Park as a rare public project that captured the imagination of everyone involved. Today, the city of Atlanta is implementing an even larger model for a new stormwater park. ABI continues to work with diverse communities to plan for stormwater parks that will serve as the focal points of neighborhoods in need of different infrastructure investments including transit connections, drainage, and access to open space. New York City continues to identify innovative partnerships and the most cost-effective design strategies for expanding GSI throughout its CSO

Figure 12. Multiple uses of water features serve the community during all seasons, including ice skaters during winter

areas. Collaborative and inclusive planning is no longer rare, and new opportunities for GSI in parks are frequently identified as GSI programs grow in our urban areas.

Through smart design that considers site conditions, conveying stormwater to parks or reconfiguring park spaces to accommodate ponding within park boundaries can help reduce localized flooding, thereby making park spaces more accessible. Though different design typologies for GSI in parks depend on whether a site is connected to an MS4 or a combined sewer system, or drains directly to an adjacent waterbody, collaboration and innovation can achieve multiple objectives within parks and for the communities that parks serve.

ACKNOWLEDGMENTS

The authors express thanks to the following firms and organizations for their contributions to this article: New York City (NYC) Department of Environmental Protection; NYC Department of Transportation; NYC Parks and Recreation; NYC School Construction Authority; City of Atlanta, Georgia; Atlanta Beltline, Inc.; Truman Development Corporation; CivicWorks Planning + Design; and S2 Architecture

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Delivering a stormwater solution for a package delivery giant

PATRICK HEALY, PE, Thompson-Liston Associates, Inc., Boylston, Massachusetts

ABSTRACT | New England hilltop sites present unique challenges to development, particularly stormwater management. At this site, structural underground retention systems were used to meet the challenges to protect wetland buffers and vernal pool habitat, and mitigate stormwater runoff. Key features of the large-scale development program included an access road, siting of a 390,000 ft² (36,000 m²) single-floor building with truck docks on two sides, high-volume trailer parking, and employee parking. This site included streams, certified vernal pools, wetland resources, steep slopes, deep ledge cuts, and blast rock fills. One goal from the outset was to create a balanced site. To select the sites for the stormwater management systems, adequate areas with suitable soil conditions to provide for infiltration had to be identified. Locations of the systems were affected by vernal pools and surrounding habitats, and proximity to wetland resources. Blast rock fill produced from the ledge cuts presented a challenge, and the system had to be modified during construction as products were already being manufactured and delivered to the site. With the addition of an impervious liner, a method was developed to mimic the rates of flow of the underlying native soil.

KEYWORDS | Hilltop site, stormwater management, stormwater mitigation, ledge cuts, blast rock fill, impermeable liner, infiltration, stormwater storage ponds, precast concrete modules, erosion control, stormwater discharge

A 100 ac (40.5 ha) site with rocky terrain, wetlands, and a protected wildlife habitat presented challenges for developing a large-scale distribution center. In New England, hilltop sites near major highways and population centers have been targeted for development. These sites can present challenges to development, particularly with stormwater management. This paper discusses a site in the central Massachusetts town of Boylston, where underground structural stormwater storage products were used effectively to manage stormwater flows. These products were critical in enabling the site development while managing stormwater runoff and still protecting wetlands and vernal pools.

The desired location was identified from a list of several undeveloped parcels by a contract property developer for a FedEx ground distribution center. Key features of the project included creating suitable access, siting a 390,000 ft² (36,000 m²) single-floor distribution building with truck docks on two sides, a high-volume trailer parking lot, and an employee parking lot.

Several site features had to be accounted for in the design of the site including a nearby perennial stream, several certified vernal pools, vegetated wetlands, steep slopes, and extensive ledge. These features increased the challenge of access for the large volume of expected truck traffic, limiting the practical slope of the access road to a maximum of 5 percent (see Figure 1).

Most of the building footprint was sited in ledge cut, while the parking and the access road were primarily in fill areas. Given the large volume of earth moving and ledge blasting involved, one goal from the outset was to balance ledge removal and fill to minimize export and import of materials. As the volume of ledge material increases dramatically during blasting, the plans had to be revised several times during design by raising the elevation of the building to reduce the volume of excess material requiring disposal off site.

Selecting sites for the stormwater management systems involved extensive soil tests in the fill areas to identify areas with suitable soils for infiltration. Sites needed to have adequate depth to ledge or groundwater and to be sufficiently removed from vernal pools, surrounding habitat, and wetland buffer zones, and situated in areas with relatively even fill cover.

Stormwater systems in Massachusetts must meet the commonwealth's stormwater standards, which require mitigation of peak flows, treatment of stormwater discharges to remove 80 percent of total suspended solids, and provisions for recharge to the

Several site features had to be accounted for in the design of the site including a nearby perennial stream, several certified vernal pools, vegetated wetlands, steep slopes, and extensive ledge

ground. In the final design, stormwater runoff from the access road, truck parking, and auto parking areas was treated with a combination of deep sump hooded catch basins, hydrodynamic separators installed in deep fill sections, and four surface infiltration ponds. Roof runoff is considered "clean" and does not require pretreatment, so it was targeted to be used to meet recharge requirements. For a distribution center site, design engineers were concerned about potentially high levels of hydrocarbon pollutants from paved areas adversely affecting the recharge system and ultimately the groundwater. For these reasons, runoff to the subsurface recharge systems is designed to be primarily from the building roofs.

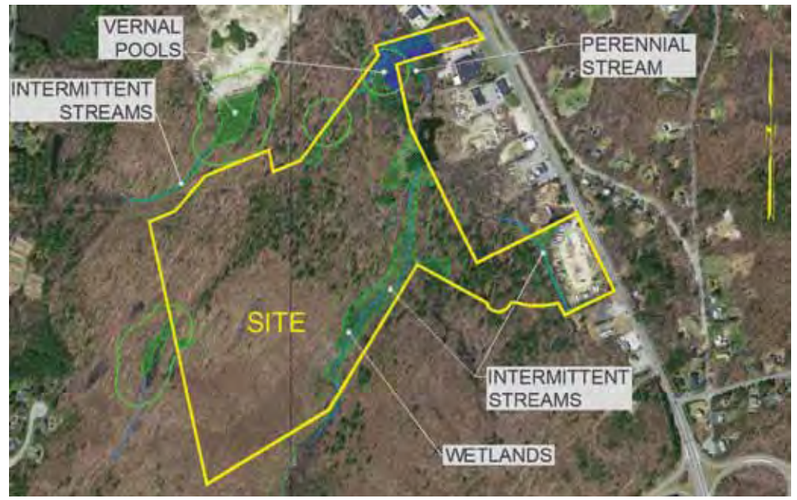

Figure 1. Site plan overview

Two areas were selected for installation of subsurface storage systems to accept all of the roof runoff and provide recharge through open bottoms into native soil. Approximately three-quarters of the roof area was directed to a large area northwest of the building that would ultimately be under the trailer parking lot. In the wide-open area, a subsurface system was installed as fill was placed, and the finished grade was raised up to 20 ft (6 m) above the

Figure 2. Annotated aerial view

natural ground level. The remaining quarter of the roof area was directed southeast of the building to an area that was furnished with up to 26 ft (8 m) of fill (see Figure 2).

A combination of the depth of fill and heavy trucking loads required structurally sound subsurface structures, leading the design engineers to select precast concrete modular chambers. A double stack system of 5 ft (1.5 m) deep precast modular chambers was incorporated into the design (see Figure 3).

During construction, it was determined that much less native soil was available than originally anticipated. Most of the fill used for the building, parking, and access road would have to be blast rock from the ledge cuts, which were up to 60 ft (18 m) high. Open-bottom structures constructed on up to 8 ft (2.4 m) of blast rock fill would have allowed for rapid passage of stormwater into the fill with the potential to break out horizontally through voids in the fill, resulting in little or no mitigation of peak flow rates.

Potential modifications to the subsurface systems were developed and evaluated during construction. Precast products were already being manufactured and delivered to the site. Alternatives considered included creating underground dams to pond the stormwater in voids of the rock fill, using geosynthetic clay liners to prevent lateral flow through the fill, and placing an impermeable liner system around the precast modular system. An impermeable PVC liner was selected as the most practical alternative.

A system then had to be designed to allow controlled release of retained stormwater into the fill to match the calculated recharge volume. A series of limited openings were devised to mimic the infiltration rate of the underlying native soil below the blast rock fill. The flexible nature of the PVC liner made cutting a series of regular holes in the liner impractical. A standpipe outlet was also ruled out due to maintenance concerns. Roof drains with small-diameter outlets were then selected to control the rate of outflow. In each of the two subsurface storage ponds, several such drains were placed in the bottoms of the ponds, and discharge from these limiting drains was directed through the bottom of the subsurface pond and into a crushed stone trench above the native ground.

Once it was decided to proceed with the liner, the team had to determine how it would be installed and situated relative to the precast concrete structures. (Photos 1–12 show the progression of the system installation.) The flexible PVC liner had to be protected from damage during the placement of the precast structures, and it had to be attached to the structures themselves at the top to form a complete envelope. At the base of the system, the impervious liner was sandwiched between two layers of non-woven filter fabric and placed on a level base of crushed stone. Then another layer of crushed stone was spread atop the filter fabric. This allowed the placement of the precast concrete modules in a way that would protect the PVC liner. The stackable modules were installed efficiently using a 33 ton (30 tonne) excavator. The precast module supplier assisted the contractor with installing the modules. The liner was stretched up to the top of the precast units along the outside and was mechanically attached to the tops of the modules. Where the inlet and outlet pipes penetrated the walls, the liner was sealed around the pipes with gasketed collar flanges bolted to the precast concrete walls. Crushed stone backfill was used around the fully lined system, forming a protective buffer to the surrounding blast

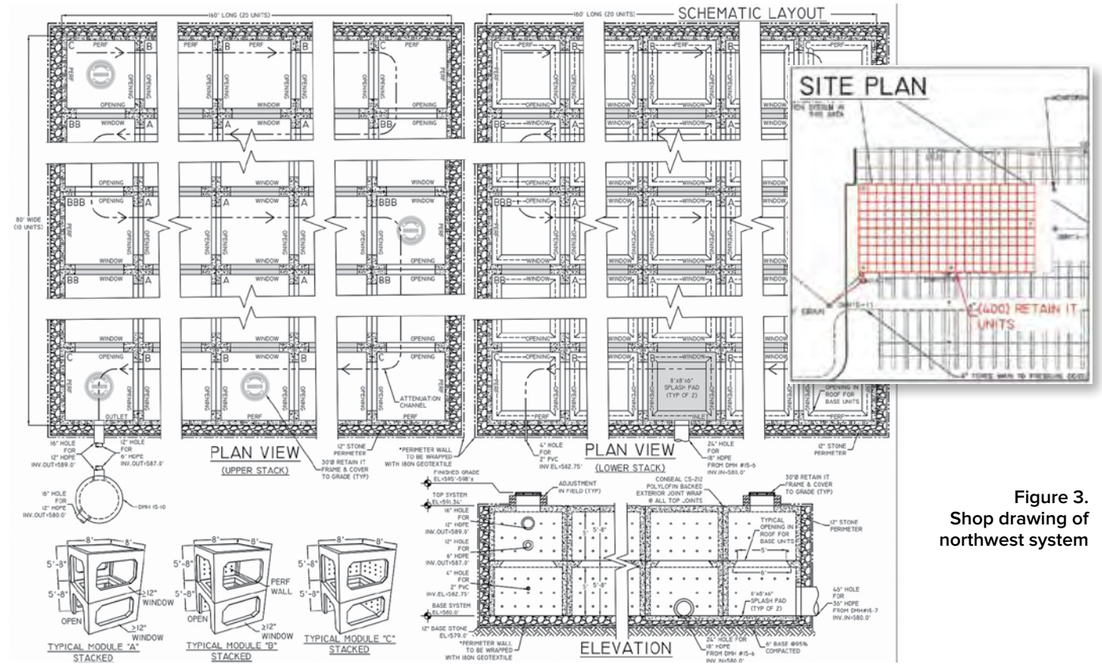

Figure 3. Shop drawing of northwest system

Photos: 1. Installation of PVC liner at northwest system 2. Placement of crushed stone base at northwest system 3. Roof drains used to throttle groundwater recharge 4. Placement of modular units at northwest system 5. Placement of the modular units at the southeast system


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Photos: 6. Continued installation of modules in northwest system 7. Overhead view during placement of southeast system with construction staging area and foundation visible 8. Completed modular precast concrete northwest system as liner is installed 9. Sealing outlet pipes 10. Beginning to backfill northwest system with crushed stone 11. Final view of fill over southeast system 12. Final view of trailer parking lot over northwest system

rock fill. The system was backfilled to subgrade with compacted structural fill.

Timing the installation of the subsurface stormwater system on the southeast side of the building posed its own challenge, since it was situated between the distribution center building and the construction staging area. Placement of extensive fill in the staging area and along the final access road on the low side of the system depended on timely completion of two large precast concrete culverts prior to the necessary relocation of the staging area. On the system's upper side the building foundation was already in place, limiting the available space for excavation. The first row of modules was placed on the building side first and then partially backfilled, thereby protecting the excavation while the rest of the system was installed and backfilled.

One advantage of building on a hilltop site surrounded with blast rock fill is that minimal erosion and sedimentation occurs during construction. Once the contractor installed gravel and crushed stone along the temporary access route and began to place blast rock fill at the perimeter of the site, no further erosion or stormwater discharge issues were experienced. That was done with over 45 ac (18 ha) of exposed surfaces and an aggressive 15-month construction timeline.

The use of subsurface structural stormwater storage ponds limited the project footprint and enabled environmental targets and a tight construction schedule to be met.

ACKNOWLEDGMENTS

- Developer: Scannell Properties, Indianapolis, IN
- General Contractor: ARCO National Construction Company, Inc., St. Louis, MO
- Site and Utility Contractor: Pierce Builders, Inc., Granby, CT
- Precast Stormwater Systems by: Retain-it, Granby, CT
- Photo credits: Scott Lander, Retain-it, LLC; Patrick Healy; Pierce Builders, Inc.; High Flyin' Drone Imagery

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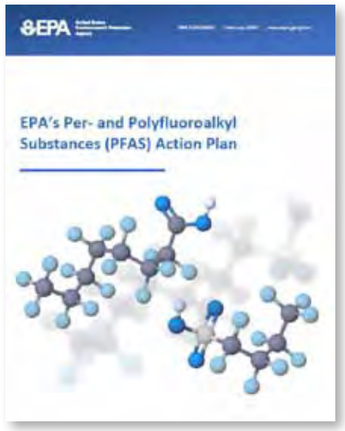
NEBRA Highlights

LAWPCA's quality biosolids compost is running out as the compost operation shuts down for now (file photo)

EPA releases PFAS Action Plan

Interest and concerns related to perfluorinated and polyfluorinated alkyl substances (PFAS) continue to increase. Drinking water quality remains the focus of public, regulatory, legislative, and media attention. Most states are using EPA's long-term public health advisory screening level of 70 parts per trillion (ppt) for evaluating the extent and significance of PFAS contamination. But several states, including several in the Northeast, have been more proactive, testing for PFAS widely and in varied media. Some are implementing lower screening values and regulatory standards (e.g., Vermont's 20 ppt groundwater standard for five PFAS chemicals combined). All would like clear guidance, standards, and actions on PFAS.



On February 14, EPA released a long-anticipated "PFAS Action Plan." It raised questions from citizen and environmental groups and some state agencies regarding the perceived lack of specific, immediate actions to establish tough regulatory standards for all PFAS, to advance cleanups, and to stop human exposures. Meanwhile, water quality professional groups, including NEBRA, recognized the realities EPA put forth in the Action Plan: that addressing PFAS is complicated, most of the PFAS compounds are not well researched, health implications are still being figured out, and the two most prominent PFAS—perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS)—have been phased out and are diminishing in people and various media (e.g., wastewater). EPA did commit to several short-term actions (for 2019 and 2020), including the following:

- Continuing the regulatory process of listing PFOA and PFOS as CERCLA hazardous substances
- Establishing Maximum Contaminant Levels (MCLs) in drinking water for PFOA and PFOS
- Developing and publishing analytical methods for PFAS in non-drinking waters (e.g., surface water) and solids (soils, sediments, and biosolids)
- Adding more PFAS chemicals to the next round of the unregulated contaminant monitoring rule (UCMR) testing of drinking water nationwide
- Advancing enforcement and assisting states with enforcement to reduce exposures
- Increasing risk communications related to PFAS

Wastewater utilities and associated programs (e.g., biosolids management) are having to pay attention. Because PFAS are so ubiquitous in modern commercial products and myriad industrial uses, test results show some PFAS compounds in every wastewater influent and effluent tested. And, in many cases, the levels measured are significant in relation to some of the regulatory standards being proposed. For example, in New Hampshire, the Department of Environmental Services is already wrestling with the likely need for some form of exemption or high dilution factor for wastewater effluent discharges to groundwater, because such wastewater facilities cannot cost-effectively meet the ambient groundwater standards for PFAS.

NEBRA has tracked this issue for the past two years and has extensive information available to members and other water quality professionals in a restricted-access web page. Contact the NEBRA office for access. At NEWEA's Annual Conference meeting, the Executive Committee voted funds to support NEBRA's work, making NEWEA members important participants. (Thank you, NEWEA!) NEWEA joins 34 other organizations from across North America in donating to NEBRA's PFAS research and tracking-dedicated "PFFund."

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Other recent PFAS developments:

- NEBRA has opened a public-facing web page on PFAS and biosolids/residuals: nebiosolids.org/pfas-biosolids.
- Biosolids and residuals (e.g., paper mill residuals) recycling projects have been disrupted or canceled because of concerns about PFAS, even though the materials to be used contain typically low, background concentrations of PFAS. Regulatory uncertainty continues to affect biosolids management.
- Some landfills question whether to take in sludges/biosolids/residuals because of PFAS concerns; one or two have decided not to, for now, pending further regulatory clarity.
- Litigation is imminent in Maine, with a landowner suing wastewater treatment facilities and others because of purported land application activities in the 1980s and 1990s. While this litigation seems unlikely to be successful, it adds to the uncertainty around PFAS.
- In December, New York health officials voted to recommend drinking water MCLs for PFOA and PFOS of 10 ppt each—the lowest proposed standards yet. The limited minimum cost estimates for compliance across New York were indicated to be in the hundreds of millions of dollars.
- At the beginning of the year, New Hampshire proposed drinking water MCLs for four PFAS, as required by a 2018 state law. Hearings on these new regulations were scheduled for March.
- Legislators around the region are considering bills related to PFAS, including one in the New Hampshire Senate that would impose specific, very low PFAS MCLs in drinking water (presumably overriding the regulatory process mentioned above).
- Citizen and environmental groups are asking for PFAS drinking water MCLs in the 1–2 ppt range—close to analytical minimum reporting limits and unattainable in many waters throughout the environment, where, today, urban, suburban, and even some rural surface and groundwaters have typical "background" levels of up to 10 ppt or more.

EPA's Office of Inspector General reviews EPA's biosolids regulatory program

On November 15, EPA's Office of Inspector General (OIG), an independent review branch of the agency, released a report reviewing EPA's biosolids regulatory program. The report questioned unmonitored contaminants in biosolids. EPA and its Office of Water, which has long implemented the 40 CFR Part 503 biosolids regulatory program, supports biosolids recycling and disagreed with parts of the OIG report, while agreeing to some recommended improvements.

NEBRA and other biosolids organizations subsequently collaborated on several documents responding to the OIG report. These documents can be downloaded from NEBRA's "News Archives" page:

- NEBRA's initial review of the OIG "At a Glance" summary
- Biosolids groups' FAQ quick reference guide to the November 2018 EPA OIG report
- Additional biosolids groups' responses and letters
- WEF news article about the OIG report
- January 2019 news story about the OIG report from the EHS Daily Advisor

From the same "News Archives" page, you can click to NEBRA information on trace chemicals in biosolids and WEF's Microconstituents/Trace Chemicals Fact Sheet (2017).

In brief/en bref...

- **NEBRA has published a technical review of "Biosludged,"** an online video released in November 2018. Created by and featuring entrepreneur Mike Adams, the video discusses biosolids recycling and, in NEBRA's opinion, makes some extreme claims.
- **Lewiston-Auburn Water Pollution Control Authority (LAWPCA) has suspended its biosolids composting operations**. Nitrate in groundwater associated with the facility has been a challenge for years; it appears to be leaking from the biofilter. Attempts to cost-effectively address the situation have not proved sufficient. In the past year or two, the capacity of the composting operation was being filled mostly with solids from other facilities; LAWPCA's solids are now anaerobically digested and used in direct land application programs.
- **WEF's "Words on Water" podcasts cover biosolids**! WEF podcasts and videos include biosolids experts explaining benefits and safety (podcast #37), biogas and renewable energy (podcast #42), and biosolids and climate change (podcast #45). These podcasts are the work of Travis Loop, WEF's communications director. Listen at wordsonwaterwef.com.

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Spotlight: **Young Professionals**

Last issue we showcased two young professionals in Maine who are devoted to the water environment profession. In this issue, we continue our tour of beautiful, scenic New England, in the commonwealth of Massachusetts, where they love that dirty water! The *Journal* spoke with the recently appointed chair for the NEWEA Young Professionals (YP) Committee, Colin O'Brien, and his trusted predecessor, Ben Stoddard. Mr. O'Brien is an environmental engineer at Brown and Caldwell in Andover, and Mr. Stoddard is a civil engineer at Kleinfelder in Boston. We took a few minutes to ask each of these devoted professionals about their experiences in our profession.

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

Colin: I entered the environmental industry in the summer of 2014 at my first internship with Brown and Caldwell, and then, following graduation from Clarkson University in New York, I became a full-time staff engineer in Brown and Caldwell's Andover office in May, 2015. Prior to my consulting work, I was heavily involved with Clarkson's New York Water Environment Association (NYWEA) student chapter, presiding over that chapter for two years. Much of my engineering coursework was focused on the water and wastewater industries. I attended WEFTECs in Chicago and New Orleans while I was in the student chapter. My experiences at WEFTEC really enticed me into becoming a part of this industry.

Ben: I grew up in rural Vermont where there is a prevalence of amazing rivers, lakes, and ponds for swimming and recreation. A few summers prior to college I volunteered to collect samples for a water quality monitoring program which was an awesome experience and led me on a path to an engineering degree and an appreciation for water resources. Now living and working in Boston, I've been able to apply that interest toward more complex problems and projects.

■ *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?*

Colin: The passion of those in our industry really surprised me when coming out of school and into the industry. At my first NEWEA Annual Conference, I remember sitting in on many different presentations and realizing that everyone across the board in our industry really cares about what we do for work and wants to make a difference.

Ben: The magnitude and age of existing systems. It was eye-opening to design and construct retrofits to existing brick collection systems in the Boston area that have been around for over 100 years. The craftsmanship and engineering that was executed without the technology we have today is impressive.

■ *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?*

Colin: I have been working in the water environment industry for just over five years. I decided this would be a good long-term career because I knew I would enjoy it. The water environment industry is diverse, ever-changing, and will be tasked with answering some of the toughest environmental challenges mankind has faced. I also saw lots of opportunity for growth in this industry as well as the advantage of being very secure, as water and wastewater infrastructure are critical components of modern culture.

Ben: I'm coming up on nine years since I graduated from the University of Vermont, almost eight of which have been spent living and working in the Boston area with Kleinfelder. The industry is full of professionals completely engaged in what they do, which is very inspiring. Our work is important to everyone and provides a lot of satisfaction.

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

Colin: I talk frequently about my work with others outside of the profession. Some find it comical, some think it's gross, and in some friend groups it inspires some interesting nicknames. When I talk about some of the projects I work on, like bioenergy projects that involve industry-leading technology and creative applications, people are usually surprised to hear because they couldn't even describe where the plant is that accepts their waste. It seems that those outside the industry are interested about what we do, but it isn't until someone from the industry talks to them that they become aware of what we do.

Ben: When it comes to urban collection systems and stormwater projects, most people are amazed to hear about the age and amount of subsurface infrastructure in our rights-of-way. I've also received a lot of great feedback on NEWEA's first annual rain garden service project that the YP Committee organized as part of the Spring Meeting last year.

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

Colin: Where to begin.... the list is very long. In lieu of ranting about how great NEWEA is, I will say that if you are passionate about what you do, or want to become passionate about what you do, and are interested in a career that is truly a career and not just a job, NEWEA will be the gateway to having that experience. NEWEA will provide you with the tools to meet new people, become more knowledgeable, improve your personal skills, understand the pulse of the industry, and (probably most importantly) show you what this industry is all about. There's a lot to benefit from being a part of NEWEA.

Ben: All the same benefits as non-YPs enjoy, plus you can be involved in the YP Committee! Networking is probably the highest on my list, in addition to the opportunity to be involved in the planning and attendance of some amazing YP events like the YP Summit, Mentoring Program, Poo & Brews, and Service Project. Getting involved in the YP Committee is a great place to start, but will also open doors into other committees and activities going on throughout NEWEA.

■ *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?*

Colin: Climate change is at the forefront of mankind's issues, but it is something we are already dealing with in our industry, and as far as I can tell it's not going away. I already see our industry changing, with utilities creating climate change resiliency plans and the integration of green infrastructure into stormwater and flood management to name a few examples. I think where the real challenge is going to be is coming up with even more creative engineering solutions to solve these problems. I see many water resource recovery facilities that sit very close to or even in the flood plain of their receiving water body. To move an entire facility out of this flood plain in most situations is not economically viable, so how do we get creative about this? Informing the public of the impact of climate change to our infrastructure seems like another uphill battle we will be fighting over the next few decades. While these may seem like monumental challenges, we have the talented people in this industry to solve these problems.

Ben: Particularly in a coastal city like Boston, a huge challenge in the near future will be addressing our infrastructure needs in response to a changing climate. We are fortunate that there is a lot of support for planning, designing, and building resilient infrastructure in New England, but this is really a global problem.

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

Colin: Get involved. As a student most of the YP events and conferences have significantly reduced (if not free) costs of attendance to students. It's nice to get out of the office and broaden your professional horizon, and there's almost always a networking or social aspect event tied to it. I am always encouraging the interns/co-ops and other junior level staff in my office to get out there and get involved. It's all about what you make of it; you will get out of it what you put into it.

Ben: People will always need clean water. Our industry is very engaging, supportive of collaboration and growth, open to new ideas, and full of like-minded individuals. There are a ton of great opportunities in our industry right now and the people are great!

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

Colin: Thinking way back now (or at least it feels that way), I would have to say there were two people that really stand out as individuals who helped me find my way to this industry. Stefan Grimberg, my environmental engineering advisor at Clarkson University, taught several of my engineering courses and was the advisor to our NYWEA student chapter. Professor Grimberg was always introducing students to his industry contacts at conferences, and he showed us what opportunities and careers were available in this industry. The second individual who comes to mind is Rich Lyons, the former Albany County Sewer District executive director; he was someone who I felt took me under his wing in my very early years of getting involved in the industry. Mr. Lyons was always interested in ways that he could support our student chapter through funding

"The industry is full of professionals completely engaged in what they do, which is very inspiring. Our work is important to everyone and provides a lot of satisfaction."

— BEN STODDARD

"...if you are passionate about what you do, or want to become passionate about what you do, and are interested in a career that is truly a career and not just a job, NEWEA will be the gateway to having that experience."

– COLIN O'BRIEN

support by the NYWEA Capital chapter, he always wanted to meet up at conferences and meet some of the new students we brought along, and he genuinely cared that we all succeeded. Experiencing this really made my career path decision an easy choice.

Ben: I've been fortunate to work at a great engineering firm with excellent mentors. There have been several individuals here at Kleinfelder who have led me through my career and encouraged my progress. As I transition out of the "YP" designation, I am excited to help mentor others in the same way.

Additionally, my mentor from the NEWEA Mentoring Program, Susan Sullivan, the executive director of the New England Interstate Water Pollution Control Commission, has been excellent.

■ *What has been your most rewarding experience with the NEWEA Young Professionals Committee?*

Colin: There have been two things that I would consider equally as the most rewarding experiences with the YP Committee. The first experience is one that I am currently going through and that is the opportunity to lead the YP Committee as the committee chair. It is quite an honor to lead and represent such a large group of talented, ambitious, and humble individuals. The second experience that has been equally gratifying is being able to share with other YPs the other great experiences that are a part of NEWEA and to show them what our professional organization is all about. It has been very rewarding to share these experiences with other YPs.

Ben: In general, I am really happy with what our committee has been able to accomplish over the last two years. The previous chair, Justin Skelly, did an awesome job, leaving the committee in a great place for growth and success, and I think we took advantage of that. We have also had amazing support from the NEWEA Executive Committee and in particular Jim Barsanti and Janine Burke-Wells. We organized the first annual YP Service Project where we successfully installed a beautiful rain garden at a community center in Newport, Rhode Island; we launched the reenergized NEWEA Mentor Program, which has received some great feedback from the first round of mentees; and we hosted numerous Poo & Brews all over New England. We also co-hosted, along with New England Water Works Association YPs, the third annual YP Summit, which has grown in interest and attendance in each consecutive year.

■ *Do you have any suggestions concerning what steps NEWEA and the state associations could take to attract and maintain young professionals to this line of work?*

Colin: I think right now NEWEA and the state associations have a great structure for making it easy for YPs to join the organization and get involved. Continuing some of our great programs like the Poo & Brews, Mentoring Program, and YP summit have really set up our industry for success in attracting the next generation of leaders. It would be good to see some development of "local" YP chapters to help open the door for more networking and interacting opportunities. For example, the Maine Water Environment Association has its own YP chapter. It holds its own meetings, has its own leadership structure, and hosts events. It is not easy for someone from Portland to travel to Boston just to attend a YP event. I would like to see this model spread throughout the member states of NEWEA.

Ben: I think NEWEA and the state associations are doing a lot of great things to attract YPs to our industry. We need to maintain an inviting attitude and showcase how our industry is exciting, satisfying, and full of great people. And it doesn't hurt to combine wastewater treatment plant tours with the promise of a networking event at a craft brewery afterward.

NEWEA's Spring Meeting & Exhibit

is an annual three-day technical meeting for water quality professionals. This event offers the opportunity to:

- Learn about the latest trends and research on water quality topics in technical sessions
- See the latest technology from exhibitors
- Tour the Peirce Island Wastewater Treatment Facility
- Compete in the Operations Challenge
- Earn Training Contact Hours (TCHs)

We expect over 300 engineers, consultants, scientists, operators, and students to attend and participate in this annual event.

Sponsor and exhibit opportunities are available.

The hotel room block at Wentworth by the Sea is now open. Book by May 12 to get NEWEA's discounted rate.

Registration information and the preliminary program will soon be available.

Visit springmeeting.newea.org to learn more and stay updated.

June 2 – 5, 2019
Wentworth by the Sea, New Castle, NH

For more information contact the NEWEA office
Phone: 781-939-0908 • Email: mail@newea.org

NEWEA
WORKING FOR WATER QUALITY

Vermont State Director Report

by Chris Robinson
chris.robinson@gmwea.org

Once again, we have had a busy year in Vermont. The Green Mountain Water Environment Association (GMWEA) has been active under the leadership of President Tom DiPietro and part-time Executive Director Daniel Hecht. Major events during 2018 are summarized below. Thank you to the volunteer committees and GMWEA board of directors for their dedication and commitment in making GMWEA such a great organization.

Vermont STEM Fair/Stockholm Junior Water Prize

On March 24, GMWEA sent a panel of seven judges to the annual Vermont Science, Technology, Engineering, and Mathematics (STEM) Fair, hosted each year by Norwich University. Our goal was to seek out the best student research projects of the year and encourage K-12 inquiry into water quality science by giving scholarships to the most promising investigators. The show features exhibits by about 200 middle school and high school winners of their schools' STEM project competitions.

Sunthoshini Premsankar

Sunthoshini Premsankar impressed us with "Neutralization of Pharmaceutical Pollution in Lake Champlain," an experiment on the effect of acetaminophen on duckweed, testing alternative absorbents and measuring the results with chromatography. Ms. Premsankar, a ninth-grader at Champlain Valley Union High School, received GMWEA's $150 scholarship and the Vermont nomination for the Stockholm Junior Water Prize.

GMWEA Spring Meeting and Awards

On May 24, GMWEA held its annual Spring Meeting at the Killington Grand Hotel. Six technical sessions along with the business meeting were attended by 170 attendees. During lunch, winners of GMWEA awards were recognized: Mike Barsotti, Michael J. Garofano Water Operator Excellence Award; Timothy Kingston, Wastewater Operator Excellence Award; Grand Isle Consolidated Water District, Water Facility Excellence Award; Richford Wastewater Treatment Facility, Wastewater Facility Excellence Award; Stone Corral Brewery, Industrial Wastewater Facility Award; Mike Swindell, Andrew D. Fish Laboratory Excellence Award; Gary Audy, Industrial Wastewater Operator Award; Nick Giannetti, Bob Wood Young Professional Award; Annie Costandi, Stormwater Award; Mark Simon, Elizabeth A. Walker Meritorious Service Award (awarded posthumously); Clean Waters, Inc., Corporate Sponsor Award; and two President's Awards—one to the town of Hartford and one to Eileen Toomey, our Continuing Education chair.

George Dow Memorial Golf Tournament

The event, held on August 18 at Cedar Knoll Country Club, was a success. This tournament, which has been held annually for over 25 years, was the 11th in honor of the late George Dow. Around 80 golfers participated in a day of golf followed by the famous chicken barbeque, awards, and door prizes.

GMWEA Fall Trade and Technical Conference

On November 8, nearly 400 water/wastewater/stormwater operators and water quality folks converged on South Burlington's Double Tree Conference Center for GMWEA's largest annual event. The day-long conference featured 100 vendor booths, six technical training sessions, a delicious lunch, and GMWEA's traditional raffle.

This year's bonus raffle prize, with entry requiring only a "like" on the GMWEA Facebook page, was a $400 Yeti Cooler. The raffle resulted in a ten-fold increase in the number of visitors to the GMWEA page. Thank you to NEWEA President Janine Burke-Wells for taking the podium to provide a few kind words about the organizations' activities and to NEWEA Executive Director Mary Barry for attending.

Small Education and Outreach Grant

GMWEA recently won a Small Education and Outreach grant from a program of the Lake Champlain Basin Program, funded by EPA. The $9,860 grant will allow GMWEA to produce four brochures to be distributed to citizens by Vermont cities and towns. Each brochure will describe a subset of pollutants typically flushed, poured, spread, or spilled by domestic water users, and will inform ratepayers/water end users what not to put into public sewer or private septic systems, with suggested alternative disposal/use practices. The four main contaminant groups addressed FOG (fat, oils, and grease), "flushables," PPCPs (pharmaceuticals and personal care products), and household hazardous wastes, such as paints, solvents, automotive fluids, and garden chemicals. GMWEA will also create four web pages containing the same information and provide the links for towns and others to post on their websites.

Operator Exchange

Vermont exchanged with New Hampshire for the Operator Exchange this past fall. Ernie Smalley, from Peterborough, New Hampshire, spent three days touring the White River Junction, Quechee, Montpelier, South Burlington, Essex Junction, and Shelburne facilities, and even rode along as a local farmer spread biosolids on a field. His visit finished with attendance at the fall trade show and conference. Vermont truly enjoyed Mr. Smalley's visit, and if you get a chance to see him, ask him if he enjoyed the tractor ride.

Regulator Meetings

GMWEA's Government Affairs Committee is in its second year of holding quarterly meetings with Vermont's Agency of Natural Resources water quality divisions.

About 20 stakeholders attend each meeting, led by Department of Environmental Conservation (DEC) Commissioner Emily Boedecker. Staff from the DEC's water, wastewater, stormwater, and wetlands divisions, and municipal and facility representatives from around the state participate. The meetings allow stakeholders to share concerns about crucial information, serve as brainstorming sessions for industry regulatory issues, and foster a sense of community among water quality professionals. The desired result is smarter water quality policy and more collaborative, effective implementation.

Vermont Operator Award, Wayne Graham

Vermont Alfred E. Peloquin Award, Wayne Elliott

Legislative Meet and Greet

This annual event was held on January 18 at the Statehouse in Montpelier, allowing GMWEA Government Affairs members to meet informally with legislators to discuss a multitude of issues.

Award Winners

Congratulations to the following individuals who were recognized at the January NEWEA Awards reception:

- Wayne Graham (Vermont Rural Water Association) – Vermont Operator Award
- Wayne Elliott (Aldrich & Elliott, P.C.) – Vermont Alfred E. Peloquin Award
- Sunthoshini Premsankar (Champlain Valley Union High School) – Vermont Stockholm Junior Water Prize

UPCOMING EVENTS

- **GMWEA Spring Meeting and Conference**—May 23 Killington Grand Hotel and Conference Center
- **Vermont Poo & Brew**—NEWEA, GMWEA, and Vermont Rural Water Association plan to include a morning facility tour and afternoon brewery tour (to be determined in the spring of 2019)
- **George Dow Golf Tournament**—August date to be determined at the Cedar Knoll Country Club, Hinesburg

For further information about GMWEA/NEWEA activities and events, contact Vermont Director Chris Robinson at chris.robinson@gmwea.org or visit gmwea.org.

Rhode Island State Director Report

by Scott Goodinson
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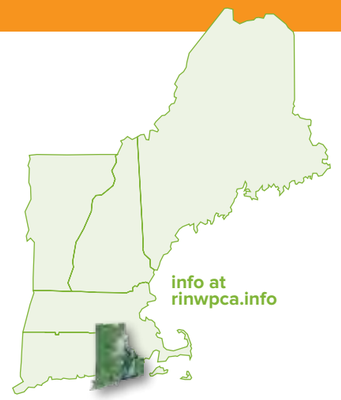

Last June the Narragansett Water Pollution Control Authority (NWPCA) held its annual Golf Classic at Potowomut Country Club. Another sellout crowd of 144 golfers enjoyed great weather, burgers, and hot dogs at the turn. Later they vied for a huge selection of raffle prizes, including a large-screen television, big cash, and several foursomes at a few local golf clubs while the crowd enjoyed an awesome prime rib dinner. It was another great year to be an NWPCA golfer!

Sawyer Award winner Bill Pateneaude (kneeling) poses with the latest graduates from the legendary Management Training Boot Camp, which he has championed for years

In August, NWPCA celebrated our Annual Chowder cook-off/general business meeting, hosted by the town of Narragansett and plant superintendent Peter Eldridge. As usual, the chowder competition was fierce, and no one went home hungry. August also marked our annual family barbecue and fireworks night at the Pawtucket Red Sox, where current and future members of our association enjoyed our PawSox, who will still be ours for a couple of years.

The annual NWPCA September Tradeshow/Clambake as always enabled great interaction among members of our profession and the good people who supply the equipment, commodities, and services upon which our industry relies. During the day, Ocean State Alliance, the Rhode Island Operations Challenge team, set up a laptop display and offered attendees a chance to compete in a version of the annual challenge event, with the competition opened to all trade show attendees. The top three individual scorers won gift certificates. At the climax of the event, NWPCA raffled off more than 40 coveted prizes and awarded scholarships totaling $3,000 to six deserving students.

Last November, to keep our collection systems specialists sharp, NWPCA sponsored National Association of Sewer Service Companies' (NASSCO's) Pipeline Assessment, Lateral and Manhole Certification program at the Warwick Sewer Authority. Fifteen industry professionals received their Pipeline Assessment and Certification Program (PACP)/Manhole Assessment and Certification Program (MACP) certification during the two-day training session.

December saw our annual Holiday Party, Food Drive, and Election of Officers. This year 127 members and guests celebrated another successful association year. In addition to sharing a great evening of fellowship, the generous attendees contributed 705 lbs (320 kg) of canned goods for donation to the Rhode Island food bank. Thank you to all for your contributions.

NWPCA held its first monthly meeting of 2019 on January 8. The newly elected officers took their chairs and presided at this annual planning event. The 2019 association committees were formed, and the 2019 meetings and events calendar was evaluated and discussed. The 2019 NWPCA board is as follows: Peter Eldridge, president; Peter Connell, vice president; Nora Lough, secretary; James Lauzon, treasurer; Bernard Bishop, Michael Bedard, Michael Spring, and Vincent Russo Jr., Executive Board; Scott Goodinson, NEWEA state director and past president; Paul Desrosiers, director of wastewater certification; and vendor consultants Stephen Buckley and Chris Campo. Congratulations to all, and best wishes for another successful year.

NWPCA has been invited again this year to attend the Career Fair at Johnston High School on April 11. This is an important opportunity for us to showcase our industry as a desirable career choice for these young people thinking about their occupational futures.

This year's State Legislative Event and Wastewater Day/Open House Week was held on March 27–30, kicking off with our Clean Water Legislative Luncheon at the State House in Providence and followed up by open house tours of the Westerly, Woonsocket, and East Providence facilities on March 29, and the Bristol and Warwick facilities on March 30 to showcase the importance of our work.

NWPCA is proud to offer congratulations to Ocean State Alliance, for its recent WEFTEC National Division II First-Place wins in the Process Control and Lab events. The nationally celebrated hard work of team members Eddie Davies, Ryan Patnode, Peter Rojas, and Kim Sandbach was also recognized at the NEWEA Annual conference awards luncheon. Hats off to all for a job well done!

Also recognized with NEWEA awards were Margaret O'Brien of Bristol, state science fair and RI Stockholm Junior Water Prize winner; Charles Labbe of Warwick, our Rhode Island Operator of the Year; Michael Spring of Providence who garnered the Rhode Island Alfred E. Peloquin Award; David Aucoin of Providence, this year's Operator Safety Award winner; and William Patenaude of Providence whose long-term, dedicated work to promote operator professionalism was celebrated with the prestigious Clair N. Sawyer Award. Congratulations to all on your well-deserved recognition!

Upcoming 2019 NWPCA Events		
Awards Banquet	TBD	check rinwpca.info
Golf Classic	June 24	Potowomut Country Club
Hot Dog Roast	August 6	Westerly WWTF
Chowder Cook-off	July 12	Scarborough WWTF
Pawtucket Red Sox Event	August 16	McCoy Stadium, Pawtucket

Please check rinwpca.info or our Facebook page for all NWPCA news and event updates.

Operator Safety Award, David Aucoin of Providence

Rhode Island Operator of the Year, Charles Labbe of Warwick

Dave Gaipo accepted the EPA Region 1 O&M Excellence Award for a Wastewater Treatment Facility for Warren, Rhode Island

Nick DeGemmis accepted the EPA Region 1 O&M Excellence Award for a Wastewater Treatment Facility for Westerly, Rhode Island

The Rhode Island Operations Challenge Team, Ocean State Alliance (Eddie Davies, Kim Sandbach, Ryan Patnode, and Peter Rojas), won First Place—National Division II in the Process Control and Lab events at the 2018 WEFTEC

New Hampshire State Director Report

by Steve Clifton
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The NEWEA 2019 Annual Conference in Boston brought with it a change at the New Hampshire state director position. Sean Greig, the 2016–2018 New Hampshire state director, enthusiastically passed the baton to me after the annual business meeting on Monday morning at the conference. Mr. Greig provided guidance during the event to help with my orientation, for which I will be forever grateful. I had not realized the effort required, and having Mr. Greig there made the transition easy. For those of you who do not know me, I have been in various positions in New Hampshire Water Pollution Control Association (NHWPCA), starting with treasurer, newsletter chairperson, and current newsletter committee member under the present chair, Stephanie Rochefort, winner of the WEF Member Association (MA) Laboratory Analyst Excellence Award for 2018.

2018 Year in Review

The first event of note in 2018 was the highly successful Legislative Affairs breakfast at the Holiday Inn in Concord. Led by Legislative Committee Chair Shelagh Connelly, the event aimed to capture the large House of Representatives (400 members) early in their year to instill wastewater infrastructure needs foremost in their thoughts.

Concord Hall St. WWTF tour guides Dave Tobiason and Mike Theriault

The NHWPCA 2018 Annual Trade Fair was held on April 13 at the Radisson Hotel in Nashua. Besides having more than 60 vendors in attendance, two technical sessions were offered to operators—Protective Coatings Solutions by Michael Woessner of the Righter Group and the Cost Advantages of Mechanical Seals versus Packing by Michael Sullivan of F.W. Webb (not to be confused with Michael Sullivan from Sullivan Associates).

The 2018 Summer Meeting and cookout was held on June 22 at Ellacoya State Park in Gilford. Thank you to the Activities Committee chair, Mike Theriault, and all those who helped.

The NHWPCA annual Fall Meeting occurred at the Concord Hall Street wastewater treatment facility (WWTF) on September 14 to highlight Concord's new post lime stabilization process to achieve Class A biosolids. A tour was held to show all the upgrades. Concord also has other first-class operations: its Penacook WWTF received the 2016 New Hampshire Plant of the Year Award (POTY), presented in 2017.

The 2018 Winter Meeting was held at the Keene WWTF on December 14. A morning tour highlighted the $8.5 million WWTF upgrade and the $1.6 million Martel Court Pumping Station upgrade. Lunch and presentations were held at the Courtyard Marriott in Keene. New Hampshire Department of Environmental Services (NHDES)-operated Franklin WWTF was awarded the 2017 POTY award, and Santa Claus was in attendance to distribute raffle prizes and enliven the festive holiday spirit.

Franklin treatment plant staff receive the POTY award at the NHWPCA 2018 Winter Meeting

2019 NEWEA Annual Conference

New Hampshire was well represented at the NEWEA 2019 Annual Conference in Boston. NEWEA has strong New Hampshire roots, and the tradition continues with the new NEWEA president, Ray Vermette, from the Dover WWTF. New Hampshire members who are active on various NEWEA committees seemed to be everywhere at the conference, including Mr. Greig, Tim Vadney, Michael Trainque, Shelagh Connelly, Ned Beecher, Fred McNeill, and the aforementioned Mr. Sullivan of Sullivan Associates. I apologize if I missed anyone.

New Hampshire also had numerous NEWEA, WEF, and EPA award recipients. John Adie, from NHDES won the prestigious Alfred E. Peloquin Award for excellence in the field. Leo Gaudette from the Merrimack WWTF won the NEWEA Operator Award. Stephanie Rochefort from Somersworth's WWTF won the WEF-MA Laboratory Excellence Award. Winchester's WWTF won the EPA Region 1 O&M Program Excellence award, and Tim Bilodeau of Lancaster won Region 1's Operator of the Year Award. The city of Keene, represented by Eric Swope, took home the Region 1 Industrial Pretreatment Excellence Award, and Keene's Donna Hanscom, recently retired, witnessed the presentation.

Meghana Avvaru won New Hampshire's Stockholm Junior Water Prize (SJWP), which is the world's most prestigious youth award for a water-related science project. Ms. Avvaru's winning research is, "An Economical Approach for Detecting Water Contamination at Homes – Preventing a Public Drinking Water Crisis." Congratulations to Ms. Avvaru, who attends Nashua High School South, and to her teacher Stephen Minnigh.

The Plymouth Village Water & Sewer District represented by Jason Randall came away with the NEWEA Asset Management Award. Finally, Jim Taylor and the Merrimack biosolids composting team won the NEWEA Biosolids Management Award. Although Mr. Taylor recently retired, succeeded by Sarita Croce, he was on hand to help accept the award.

Upcoming Events

The 2019 board of directors for NHWPCA, as elected at the winter meeting in December, includes the following members: Past President Tim Vadney, President Kurt Robichaud, Vice President Ken Conaty, Secretary David Mercier, Treasurer Cornerstone Management, 1st Director Michael Carle, 2nd Director Robert Robinson, 3rd Director Ryan Peebles, 1st Director-at-Large Mike Theriault, and 2nd Director-at-Large Aaron Costa.

Many reasons exist for NHWPCA members to support NEWEA in 2019, starting with the president of NEWEA, our own Mr. Vermette. Operator training events, membership networking, Operations Challenge, WEF membership, and the latest equipment information from the vendors are just some of the reasons why NEWEA is worth your time and commitment. If you are not already a member of NEWEA, please consider joining to enhance your growth as a professional in the industry. As the NEWEA New Hampshire state director, I can be reached at sclifton@underwoodengineers.com or at 603-436-6192. Please contact me with any NEWEA questions. I will do my best to serve NHWPCA and NEWEA ably in this role.

Upcoming 2019 NHWPCA Events		
Trade Fair	April 5	Radisson Hotel, Nashua
Summer Outing	June 21	Ellacoya State Park, Gilford
Ocean Networking Trip	July 12	More info at NHWPCA
Golf Tournament	August 1	Beaver Meadows golf club, Concord

Be sure to check NHWPCA.org for all upcoming events

Massachusetts State Director Report

by Justin deMello
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For Massachusetts questions or suggestions, please contact me at jdemello@woodard-curran.com.

In November 2018, the Massachusetts Water Pollution Control Association (MWPCA) welcomed a familiar face to the executive director role. Mickey Nowak, who started his wastewater career in January 1978 just could not get enough of the industry following his formal retirement. For many of you, Mr. Nowak needs no introduction, but for those of you who have not had the opportunity to work with him over his 40-year career here is a quick introduction. In 1975, he was at Springfield Technical Community College majoring in graphic arts. Many of his friends were in the environmental science program, which was funded by the recently passed Clean Water Act to provide trained operators for all the new wastewater treatment plants being built. He quickly switched majors and never looked back. In his most recent position as project manager with SUEZ Water Environment Services at the Springfield, Massachusetts wastewater treatment facility (WWTF), Mr. Nowak oversaw compliance with all regulating agencies, including environmental permitting, reporting, water quality, air quality, safety, and QA/QC. In addition, he conducted strategic and budget planning.

The MWPCA board of directors is thrilled to have Mr. Nowak at the helm. His initiatives so far have been focused on increasing training opportunities, increasing membership, and responding to members. This year is shaping up to be the best year yet!

Event Updates

Operator Exchange

This year, the NEWEA Operator Exchange paired Massachusetts and Maine. MWPCA hosted Jeremy Court, wastewater operator from Biddeford, Maine. Mr. Court was chauffeured around the state to several wastewater treatment facilities. The tour included stops at the Upper Blackstone Water Pollution Abatement District, Springfield WWTF, Greater Lawrence Sanitary District, and several small decentralized and

Professor Bob Rak shows a simulator in the extensive training lab at Bristol Community College

onsite facilities with technologies including membrane bioreactors, submerged attached growth bioreactors, and sequencing batch reactors. The annual Operator Exchange continues to enable operators to tour several facilities, learn about different technologies, and network with peers. It is a great opportunity to see new facilities, learn about new technologies, and make lasting friendships within the industry.

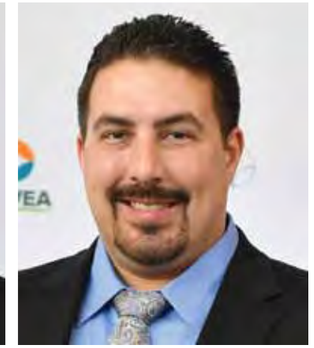
Fall Tradeshow

MWPCA hosted its 2018 Annual Tradeshow on September 12 at the Wachusett Mountain Resort in Princeton. Thirty-five vendors and 150 members attended the event. While the rain prohibited the usual chairlift rides to take in the scenic views, vendors were excited to keep operators around the base lodge a bit longer to educate attendees on the latest technologies and services. As always, the lunch was on point, and we already look forward to this year's event!

Winter Meeting

In December, MWPCA held its winter meeting and career fair at the Bristol Community College in Fall River. The event was well-attended with more than 50 members, 35 students, and eight professional vendors looking to hire. The program began with a 45-minute session on what it is like to be a municipal wastewater operator, the day-to-day activities, and how we are an integral part of keeping the environment clean. From there multiple vendors conducted short presentations on operating water, wastewater, and stormwater systems, while students were taken on revolving tours of professor Bob Rak's incredible on-campus environmental technology lab and training center. Additionally, the Massachusetts Department of Environmental Protection (MassDEP) spoke on the upcoming management training program. The event concluded with a career fair and pizza lunch for the student attendees.

Alfred E. Peloquin Award, David Duest



Operator Award, Rob Delgado

NEWEA Conference and Awards

MWPCA appeared in force at January's NEWEA Annual Conference in Boston with 20 members taking advantage of the MWPCA-sponsored pass on Operator's Day while several others won impressive NEWEA, EPA, and WEF awards. Among others, MWPCA member Rob Delgado from Barnstable was awarded the NEWEA Operator Award and David Duest from the Massachusetts Water Resources Authority (MWRA) was honored with the Alfred E. Peloquin Award.

Spring Meeting

MWPCA hosted its spring meeting on March 20, 2019, at the Devens Common Center, in Devens. The meeting included a presentation about the Devens WWTF along with technical presentations from various vendors on sludge dewatering technologies, UV disinfection, and H_2S in collection systems.

Upcoming Events

Washington, D.C. Fly-In

On April 3–4, 2019, water professionals from across the United States will meet in Washington, D.C., as part of the Water Week 2019 National Water Policy Fly-In. The event is organized by the National Association of Clean Water Agencies (NACWA) and WEF. Representatives from all 50 states will gather on Capitol Hill to meet with state legislators to discuss the importance of water and encourage continued public investment in our most precious resource. It will be an incredible opportunity to meet with legislators and remind them that, while the taps keep flowing and the toilet water keeps disappearing, we must *not* be forgotten and investment in water is necessary and worth it. If you are interested in participating, please contact Justin deMello or Mickey Nowak.

Legislative Event

In May, MWPCA will host its annual legislative event at the State House in Boston in cooperation with Massachusetts Water Works Association (MWWA) and the American Council of Engineering Companies of Massachusetts (ACEC/MA). For the third straight year, MWPCA will team up with MWWA and ACEC/MA to create a stronger message around the importance of water and infrastructure investment. The event will include meetings with state representatives and senators in the morning followed by a networking lunch with legislators and aids. Topics include: Infiltration and Inflow (I/I) Regulation Changes, Municipal Separate Storm Sewer System (MS4) Permit, Aging Workforce, Lead in Drinking Water, and Climate Resiliency.

Other Massachusetts-based events and opportunities for engagement

Management Training – New England Interstate Water Pollution Control Commission, MassDEP, and MWPCA will start another Massachusetts Wastewater Management Training Program this spring. This one-year program is for developing essential skills to propel candidates into management positions. Topics include Introduction to Management, Advanced Process Control, Working with the Media, NPDES Permitting & State Regulations, Engineering Design & Blueprint Reading, Predictive/Preventive Maintenance, Microbiology, Finance & Budgeting, and Job Shadowing.

Water Warriors Initiative

This initiative promotes jobs in the water industry for returning military service members. MWPCA has eight committee members, spearheaded by Jeremiah Murphy. The committee is working with MassDEP to allow up to two additional years of education credit toward wastewater treatment certification licenses for applicants with military backgrounds. We encourage those of you with a military background, or others with an interest in advocating for this enriching program, to become involved.

Upcoming 2019 MWPCA events		
Summer Meeting	June 12	Log Cabin, Holyoke
Golf Outing	June 18	Shaker Hills Country Club, Harvard
Operator Exchange	September	Various sites across Massachusetts

Maine State Director Report

by Jeffrey McBurnie
Jeff.McBurnie@casella.com

Hopefully the harsh realities of winter are becoming a distant memory, and the hope of a pleasant spring is in full bloom. Although our focus is likely affected by thoughts of upcoming summer downtime and vacations, the Maine Water Environment Association (MEWEA) remains active and on task. MEWEA is a truly volunteer organization that has been impactful in Maine and beyond for years. It is humbling to serve as its representative to NEWEA. The following is a glimpse of what we have been up to, as well as what we will be doing during the year.

NEBRA Conference in Halifax, Nova Scotia

In September, several MEWEA members traveled to the North East Biosolids & Residuals Association (NEBRA) Annual Conference, which this year went international, being held together with the Canadian Biosolids and Residuals Conference in Halifax, Nova Scotia. In addition to attending many informative technical sessions, attendees took in the local culture.

Scott Firmin leads an MWUA process control training

Family Skate Night

MEWEA's Young Professionals group hosted a family skate night at the Thompson Point skating facility in Portland. Nearly 20 Young Professionals, and their families and friends, attended.

NEWEA Conference

MEWEA was well represented at the NEWEA Annual Conference in Boston in January. In addition to many members being there as attendees and vendors, several were there in a service capacity (committee chairs, state director, ASA representatives, Executive Committee, etc.) to NEWEA/WEF or as awardees. Awardees from Maine who were recognized at the Awards Luncheon included André Brousseau (Peloquin), Stacy Thompson (Operator of the Year), Joy Lord (Committee Service), Mei Tian (Stockholm Junior Water Prize), Doug Miller (Founders), Allison Fisher (Young Professional), Howard Carter (Bedell), and York Sewerage District (Wastewater Utility).

Collaborative Training with Maine Water Utilities Association

MEWEA provided two full days (February 5 and 6) of joint training with the Maine Water Utilities Association (MWUA) at its Annual Conference in Portland. MEWEA sponsored nine hours of training on a wide range of topics including human capital management, solar energy, stormwater, FOG (fats, oils, and grease), wastewater nutrients, biosolids, pumps, and activated sludge process control. Many of the sessions were filled or standing room only. Several sessions were led and/or moderated by MEWEA members.

Legislative Breakfast

On February 28, MEWEA and several other cosponsors hosted their annual Legislative Breakfast at the Senator Inn and Spa in Augusta. This is an opportunity for industry leaders and legislators to network so that our elected officials better understand the issues that wastewater treatment and other water quality professionals face. The commissioners of Maine's Department of Environmental Protection and Department of Health and Human Services provided the keynote talks for this event.

Ski Day

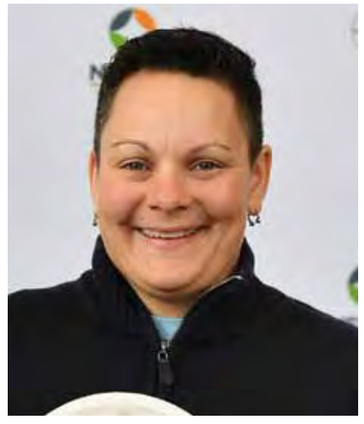
On March 22, the 2019 Ski Day was jointly hosted by MEWEA and the New Hampshire Water Pollution Control Association at Wildcat Mountain Ski Resort in Gorham, New Hampshire. It was a great opportunity to informally network while enjoying the great outdoors.

Award recipients from the 2019 NEWEA Annual Conference

Wastewater Utility Award, York Sewer District, York Beach, Maine

Alfred E. Peloquin Award, André Brousseau

Young Professional Award, Allison Fisher



Operator Award, Stacy Thompson

North Country Convention

In late April, MEWEA will be providing support to the Joint Environmental Training Coordinating Committee's North Country Convention at the Northern Maine Community College in Presque Isle on April 24–25. This semi-annual, two-day program provides training and networking opportunities to operators and other water professionals who may feel isolated due to their remote northern Maine locations.

Please check with the association website at MEWEA.org for more event information as the year progresses.

Washington, D.C. Fly-In

Plans are underway for MEWEA's annual trip to Washington, D.C., to participate in the WEF/National Association of Clean Water Agencies Water Policy Fly-In on April 3–4. MEWEA members and municipal officials will participate in policy discussions and engage Maine's senators and representatives (and staff) in their offices.

Connecticut State Director Report

by Bill Norton
WNorton@fairfieldct.org

Managers' Leadership Program

Art Enderle continues his successful Managers' Leadership Program (MLP) with 17 students from 16 communities around Connecticut for the 2018–2019 class year. The MLP involves 10 full-day class sessions covering topics including effective management skills, supervision, and financial knowledge to manage and operate a wastewater treatment facility effectively. Since 2012, the MLP has seen more than 90 graduates (including this class) assume responsibilities throughout treatment facilities up to and including superintendent positions.

As Mr. Enderle states, "Seeing all the success the program had realized, with so many grads being promoted and more than a few becoming superintendents, it became clear there was a real need to restart the program. We had also received great reviews from the grads, many of whom stated that there had never been a venue such as this that prepared operators for a transition into management. Each year we have improved on the content of the class and the presenters. We have become more focused on supervision, management, and finance. Today's superintendent must be more of a utility manager, and so we are gearing the 10-month class in that direction. We bring in the best speakers and attempt to engage all of the class and expose them to real world issues."

Thank you to Mr. Enderle and Kevin Shlatz (MLP graduate and superintendent of the Enfield water pollution control facility who assisted with the program) for their outstanding work in creating and continuing this program to enhance the skills of our operators and provide Connecticut with future water pollution control facility leaders.

Upcoming 2019 CWPAA/CAWPCA Events		
CWPAA Product Show	April 25	New Life Church, Wallingford
CAWPCA Spring Workshop	May 3	Aqua Turf Club, Plantsville
Wastewater Operators Appreciation Day	TBD	More info at: ctwpaa.org
Sewer Open Golf Tournament	June 21	Skungamaug River Golf Club, Coventry

Annual CWPAA Product Show

The Connecticut Water Pollution Abatement Association (CWPAA) will again hold its Annual Product Show on Thursday, April 25, at the New Life Church in Wallingford. This is a great opportunity to informally network with colleagues, vendors, consultants, Certification Advisory Committee (CAC) members, and Department of Energy and Environmental Protection (DEEP) staff. This year's program will again feature the Annual Business Meeting, election of officers, and important association updates. Admission is free to all operators, with lunch provided at no charge to all CWPAA members—another great reason to join CWPAA!

Operator Appreciation Day Event

CWPAA will sponsor its third annual Operator Appreciation Day event. The date and details for this year's event have yet to be finalized at this writing, so please look for further details and announcements at the CWPAA Product Show, Connecticut Association of Water Pollution Control Authorities' (CAWPCA's) Spring Workshop, and cwpaa.org.

CWPAA Ski Classic

On Friday, February 1, 2019, 30 skiers descended upon Stratton Mountain Ski area in southern Vermont for a great day of skiing, fun, and networking for CWPAA's ninth annual Ski Classic. Connecticut, Massachusetts, and New Hampshire were all represented. The temperature was cold at the start, -14°F (-25°C) at the top, but warmed up to +15°F (-9°C), enough to make the day quite enjoyable. The sun was out and the wind was calm. The skiing conditions were excellent, with packed powder conditions throughout the day. The mountain was fully operational, and every trail was open. All skiers and boarders met at the Grizzly's lounge at around 2:00 pm after a full day of skiing and boarding for well-deserved nachos, wings, adult beverages, and networking. Attendees ranged from engineers, municipal workers, vendors, and government officials. Thanks to the six sponsors of this year's event: Aqua Solutions, Distinctive Tree Care, GA Fleet, Green Mountain Pipeline Services, Myers Pumps, and Pond Technical Sales. Their help allowed, among other things, a drastically reduced lift ticket price! We look forward to another excellent Ski Classic event in 2020. The Green Mountain Water Environment Association has already expressed interest in attending next year's event. Please mark your calendars for next year's event, February 7, 2020.

Award recipients from the 2019 NEWEA Annual Conference

Operator Award, John Bodie

Public Educator Award, Christian Lund

William D. Hatfield Award, Francis Russo

Operator Exchange Program

NEWEA's Operator Exchange program allows operators from the six New England states to visit other state facilities and learn about different states' requirements and to witness operation of different types of facilities, processes, and equipment. This year, Connecticut exchanged an operator with Rhode Island. Connecticut's operator was Evan Klotzer from the Stafford Springs WPCF; you can review his fantastic experience and report on the CWPAA web site. Connecticut hosted Gwin Cox from the Warwick WPCF. Mr. Cox spent Tuesday and Wednesday (November 13 and 14) touring six WPCFs, and his visit culminated with his attending the Managers' Forum sponsored by CWPAA and New England Interstate Water Pollution Control Commission (NEIWPCC) on November 15 at the Metropolitan District Training Center in Hartford. Thank you to the following individuals, staff, and facilities for making Mr. Cox's Operator Exchange experience successful: Jeff Bowers and Metropolitan District staff; Ray Weaver and Hockanum River WPCF staff; Ed Kozlowski and Milford–Housatonic WPCF staff; Tom Hyde and Stratford WPCF staff; John Bodie and Fairfield WPCF staff; and Manny Furtado and Westport WPCF staff. A special thank you goes to Ray Weaver and Virgil Lloyd for making all the hosting arrangements.

Managers' Forum

The Managers' Forum continues to be one of the most popular events for Connecticut operators. It was held on Thursday, November 15, 2018, and was jointly sponsored as before by CWPAA and NEIWPCC.

Program highlights included the traditional and informative regulatory update by DEEP staff, who addressed topics such as the outlook for the Clean Water Fund with the budget finally passed by the legislature, and an interactive discussion with the CAC. Many CAC members were present for the wide-ranging discussion, which covered topics such as certification tests, selection of questions, and input to a soon-expected continuing education program requirement.

Government Affairs Update

CWPAA and CAWPCA again represented Connecticut well in legislative matters this spring. Volunteers from both groups attended two meet-and-greet days in Hartford, where they met with legislators and committee chairpersons to support legislation important to the wastewater industry, including funding of the Clean Water Fund. The two groups will send representatives to Washington, D.C., as part of NEWEA's Congressional Fly-In to conduct meetings with Connecticut's congressional delegation.

CWPAA and CAWPCA Continuing Collaboration

CWPAA and CAWPCA have again this year been collaborating for the benefit of the water profession in the state. CWPAA generally provides programs targeted to operators, and CAWPCA focuses on professionals and volunteers in management—noting that these are generalizations, and much overlap exists in program content and common interest.

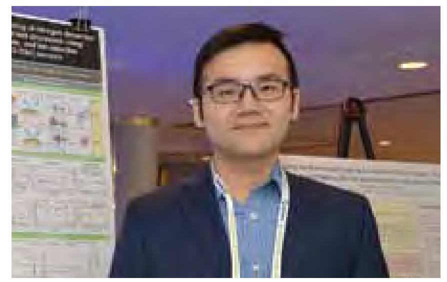
The leadership of these two organizations have conducted meetings that have led to collaboration on several initiatives. These discussions will continue through 2019.

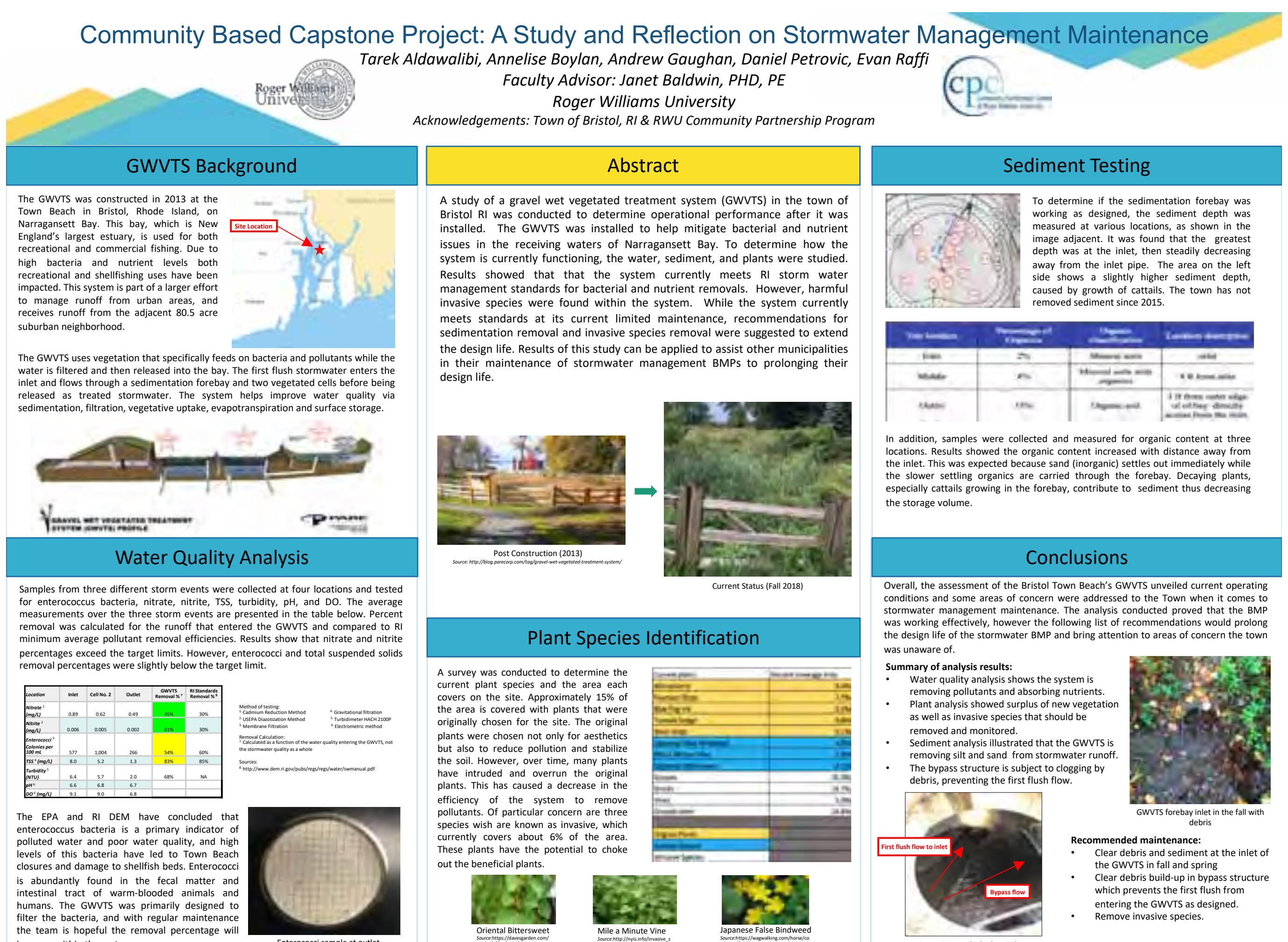
2019 Student Poster Board Competition

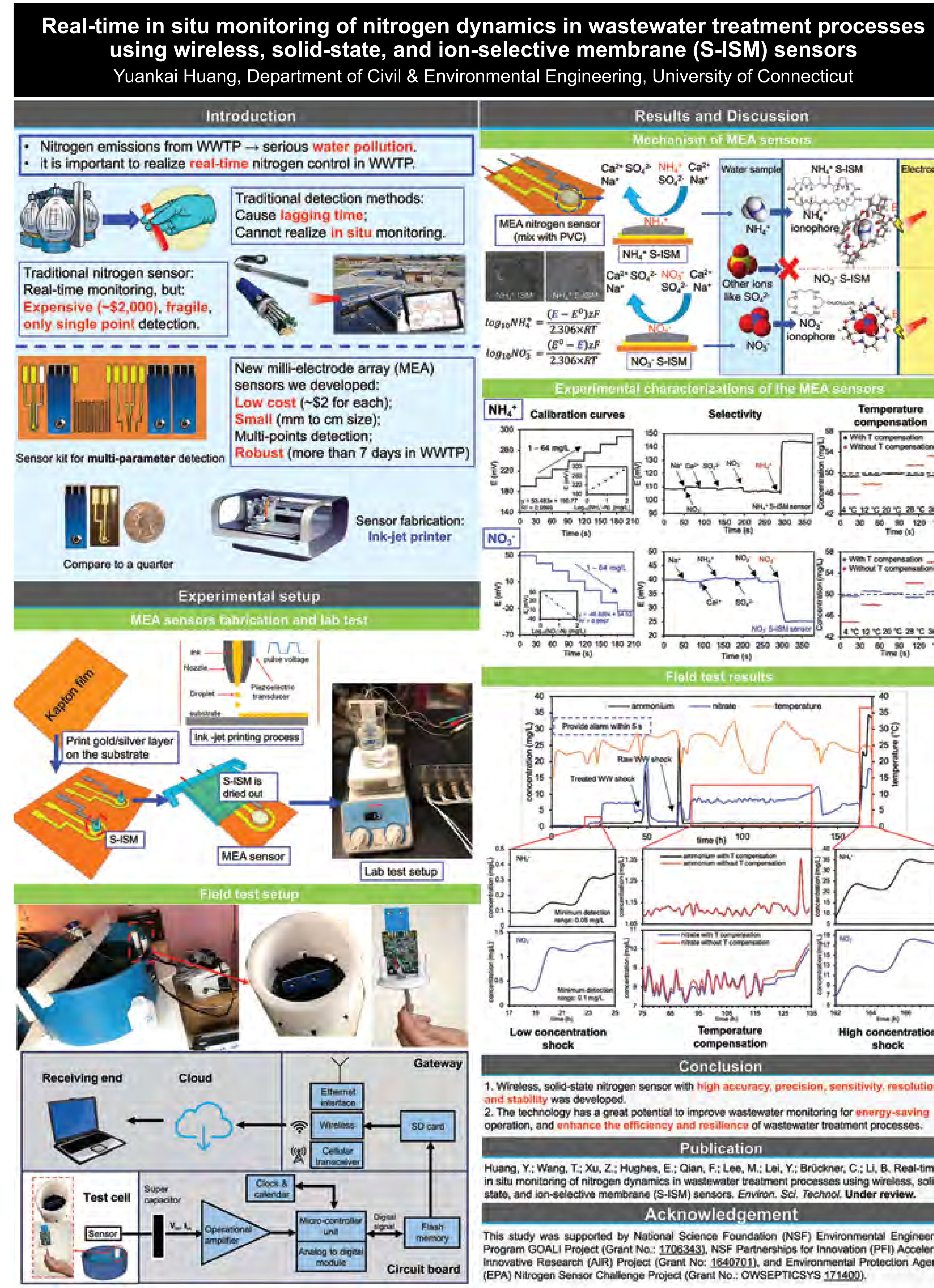
Another successful student poster competition organized by the Student Activities Committee took place on Tuesday during the Annual Conference. This year, the competition was held with the Innovation Pavilion, and students participated from eight universities: Northeastern University, University of Hartford, University of Massachusetts at Amherst, Roger Williams University, Smith College, University of Maine, University of Connecticut, and University of Rhode Island. Nine undergraduate and nine graduate poster entries were displayed and judged, and the proximity to the Innovation Pavilion allowed for plenty of interaction and enthusiasm among the students and entrepreneurs. The winning posters, presented by undergraduates Annelise Boylan, Evan Raffi, Daniel Petrovic, Andrew Gaughan, and Tarek Aldawalibi of Roger Williams University, and graduate Yuankai Huang of University of Connecticut, are reproduced here. The Student Activities Committee would like to thank all the volunteer judges for helping make this event a success.

Undergraduate winners: (L to R): Evan Raffi, Andrew Gaughan, Daniel Petrovic, and Tarek Aldawalibi (Annelise Boylan not shown) of Roger Williams University.

Graduate winner: Yuankai Huang, University of Connecticut





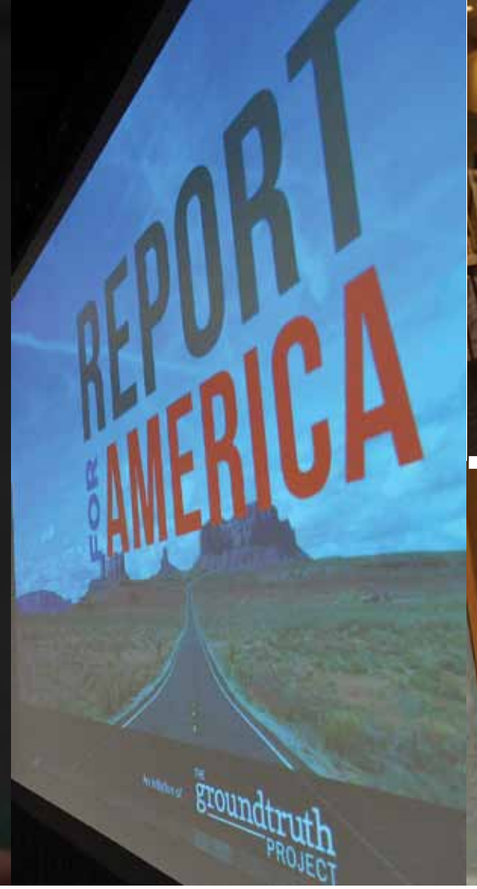


2019 Annual Conference & Exhibit

Boston Marriott Copley Place
Boston, MA
January 21–24

PROCEEDINGS

Keynote speaker Charles Sennott, founder and CEO of The Ground Truth Project, delivers an address about social and environmental justice



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1. NEWEA President Janine Burke-Wells and WEF President-elect Jackie Jarrell cut the ribbon, officially opening the exhibit hall
2. Executive Director Mary Barry and soon to be retired office adminstrator, the outstanding Linda Austin
3. Young Professional exhibitors at registration
4. Patrick Smith, Monica McMann, Meg Tabacsko and Danielle DiRuzza at the end of a long day

The 89th Annual NEWEA Conference convened with a meeting of the Executive Committee with all chairs on Sunday, January 27, 2019. More than 2,400 attended this three-day event, which featured over 200 exhibitors and 34 technical sessions.

The Annual Business Meeting was held on Monday, January 28. Nominating Committee Chair Matt Formica presented the slate for officers for 2019 as follows:

- Vice President – Virgil Lloyd
- Treasurer – Clayton "Mac" Richardson
- Council Director—Meeting Management – Katelyn Biedron
- Council Director—Treatment, Sys Operations, and Management – Philip Forzley
- WEF Delegate – James Barsanti (through WEFTEC 2022)
- Connecticut Director – William "Bill" Norton
- Maine Director – Jeffrey McBurnie
- New Hampshire Director – Steve Clifton

In accordance with the provisions of Article 9.3.2 of the NEWEA Constitution & Bylaws, these officers will advance to the following positions:

- President – Raymond Vermette
- President-Elect – Jennifer Kelly Lachmayr
- Past President – Janine Burke-Wells

The remaining incumbents are fulfilling unexpired terms:

- WEF Delegate – Frederick McNeill (through WEFTEC 2019)
- WEF Delegate – Matthew Formica (through WEFTEC 2020)
- WEF Delegate – Susan Guswa (through WEFTEC 2021)
- Council Director – Collections Systems and Water Resources – John Digiacomo (3rd year)
- Council Director – Communication – Meg Tabacsko (2nd year)
- Council Director – Outreach – Justin Skelly (2nd year)
- Massachusetts Director – Justin deMello (3rd year)
- Rhode Island State Director – Scott Goodinson (2nd year)
- Vermont State Director – Christopher Robinson (2nd year)

All nominees have indicated their willingness to serve. Respectfully submitted by the NEWEA Nominating Committee: Matt Formica (Chair), Ray Willis, Jim Barsanti Priscilla Bloomfield, Meg Tabacsko

34 Technical Sessions

SESSION 1
Public Education: Greening our World: Community Involvement in Stormwater Quality Improvements
Moderators:
- Allison McMordie, Tighe & Bond
- Danielle DiRuzza, MWRA

Real-Time, Continuous Monitoring of Green Infrastructure at Boston's Middle Schools
- Genevieve Ho, OptiRTC
- Kate England, Boston Water & Sewer Commission

Approaches for Using Youth Education to Increasing Stormwater Awareness
- Paul Mathisen, Worcester Polytechnic Institute
- Corey Denenberg Dehner, Worcester Polytechnic Institute

Think Blue Massachusetts—A Statewide Stormwater Awareness Campaign
- Kerry Reed, City of Framingham, MA/ Massachusetts Statewide Municipal Stormwater Coalition
- Robin Craver, Town of Charlton, MA/ Massachusetts Statewide Municipal Stormwater Coalition
- Eric Eckl, Water Words That Work, LLC

Soak Up the Rain: NEWEA's 1st Community Service Project
- Kate Roosa, Kleinfelder
- Marc Weller, Pare Corporation
- Sara Churgin, East Rhode Island Conservation District
- Ben Stoddard, Kleinfelder

SESSION 2
Utility Management 1: Making Utilities Resilient
Moderators:
- Jason Lavoie, Kleinfelder
- Don Gallucci, Weston & Sampson

Disaster Recovery: Response to a Major Fire at a Water Resource Recovery Facility
- Jeff Kalmes, Town of Billerica, MA
- Tom Hazlett, Woodard & Curran

Smart City…Smart Water: How Newport News is Leading Virginia's Smart Cities Efforts
- Jessica Hou, Gannett Fleming Engineers and Architects, Inc

City of Framingham's Emergency Preparedness, Risk Management, and Business Continuity Planning
- James Barsanti, City of Framingham, MA
- Kate Novick, Gradient Planning
- Blake Lukis, City of Framingham, MA
- Ashley Dunn, City of Framingham, MA
- Stephen Leone, City of Framingham, MA

Town of Ayer, MA: Resilient Strategies in a Rural Non-coastal Community
- Jennifer Lachmayr, Arcadis
- Mark Wetzel, Town of Ayer, MA

1. A VIP panel presentation at the Young Professionals (YP) Summit 2. Maine's Michael Guethle adds to the summit panel discussion 3. Rachel Watson at the Executive Committee microphone 4. Nathan Little makes a point during the YP Summit

SESSION 3
Watershed Management: Solutions Without Borders—Data Collection and Modeling for Watershed Management
Moderators:
- Jennifer Johnson, Nitsch Engineering, Inc.
- Sara Greenberg, GHD

A Tale of Two Neighborhoods and Beyond—Climate Change Preparedness and Resiliency Planning for City of Cambridge
- Nathalie Beauvais, Kleinfelder
- Indrani Ghosh, Kleinfelder
- Katherine Watkins, City of Cambridge, MA

A Watershed Permit to Facilitate Nitrogen Management in Cape Cod's Pleasant Bay
- Michael Giggey, Wright-Pierce
- Brian Dudley, MassDEP
- Carole Ridley, Ridley Associates

Condensing the Water Budget to Guide Planning Efforts for Connecticut's Water Management
- Rebecca Guihan, CDM Smith
- Kathryn Swanson, CDM Smith
- Elaine Sistare, Town of Putnam, CT

Regress Me or Not Here AI Comes
- Constantine Karos, CDM Smith
- Joshua Registe, CDM Smith
- Maryanne Taylor, CDM Smith
- Ken Zegel, Suffolk County Department of Health Services

SESSION 4
Government Affairs
Moderators:
- Robert Fischer, City of South Burlington, VT
- Raymond Willis, Onsite Engineering

The Roundtable Session of common issues/solutions and information exchange
Panelists:
- Joseph Haberek, RI DEM
- Rowland Denny, CT DEEP
- Brian Kavanah, ME DEP
- Susannah King, MassDEP
- Shea Miller, VT DEC
- Tracy Wood, NH DES

NPDES Permit Renewal—What to Expect and How to Prepare
- Michael Schrader, Tighe & Bond
- Janet Moonan, Tighe & Bond

Legislative Update: Massachusetts Bill Promoting Climate Change Adaptation, Environmental and Natural Resource Protection, and Investment in Recreational Assets and Opportunity
- Steven Torres, West Group Law, PLLC
- Jillian Jagling, West Group Law, PLLC
- Teno West, West Group Law, PLLC

SESSION 5
Stormwater 1: Not Knowing What You Don't Know—Finding a Path to a Resilient Solution
Moderators:
- Kate Edwards, Arcadis
- Patrick Gordon, StormTrap

Evaluation of Street Flooding Solutions in a Highly Transited Urban Area using a Detailed Flow Dynamics 2D Model
- Yovanni Catano, Stantec
- David Bedoya, Stantec

An Integrated Approach to Resilience—Case Study in Bridgeport, Connecticut
- Roni Deitz, Arcadis
- Tyler Carson, Arcadis

1. A celebratory group pose at the YP Summit reception 2. Stockholm Junior Water Prize state winners Elise Mizerak (MA), Sunthoshini Premsankar (VT), and Verna Yin (CT) 3. Kevin Brander, Don St. Marie, and Charlie Tyler share a laugh at the 5S luncheon 4. Some NEWEA officers sported stylish NEWEA hosiery

Humble Hummocks: Designing a "Hedge" against Future Storm Surge
- Kirsten Ryan, Kleinfelder
- David Kaplan, City of Cambridge, MA

City of Medford: 2D Inundation Model and Flood Mitigation Strategies
- Kenneth Yu, Kleinfelder
- Alicia Hunt, City of Medford, MA

SESSION 6
CSO/Wet Weather 1: Combined Sewer Overflow and Wet Weather Plannings
Moderators:
- Rita Fordiani, Kleinfelder
- David Goncalves, Mott MacDonald

Wet Weather Preparation at the Massachusetts Water Resources Authority
- Stephen Cullen, Massachusetts Water Resources Authority
- Charles Ryan, Massachusetts Water Resources Authority

What is in Your Data? Performing Data Analytics to Quantify Seven Years of Sewer Rehabilitation Projects for a Metro Boston Municipality
- Ayman Halaseh, CDM Smith

Integrated Planning: Balancing What You are Required to do with What You Must Do
- Joseph Laliberte, CDM Smith
- Susan Negrelli, The Metropolitan District Commission

The West Lynn Sewer Separation Project
- David VanHoven, Stantec
- Anthony Marino, Lynn Water & Sewer Commission
- Daniel O'Neill, Lynn Water & Sewer Commission

SESSION 7
Plant Operations 1: Pushing the Limit on Phosphorus Removal
Moderators:
- Tom Hazlett, Woodard & Curran
- Nick Tooker, UMass Amherst

Leveraging Full-Scale Experience and Applied Research for Ultralow TP with Ballasted Sedimentation
- Patrick Dunlap, Black & Veatch
- Jim Fitzpatrick, Black & Veatch
- Will Walkup, Black & Veatch

The Power of Partnering: Present and Future Generations of Engineers and Operators Collaborate on Hands-on State Point Clarifier Analysis Training
- Susan Guswa, Woodard & Curran
- Todd Brown, University of Hartford

Start-up and Optimization of a Tertiary Phosphorus Removal System at Clinton WWTP
- Caitlin Hunt, Massachusetts Water Resources Authority
- Shannon Beaton, Stantec
- Ethan Wenger, Massachusetts Water Resources Authority

Chemical Precipitation as Primary, Polishing or Back-up Process for Phosphorus Removal
- Jurek Patoczka, Mott MacDonald

SESSION 8
Collection System 1: I/I Collection Systems
Moderators:
- Peter Garvey, Dewberry
- Anthony Maressa, City of Fitchburg










1. Courtney Eaton leads a Sustainability Committee discussion 2. Stacy Thompson at the Affiliated State Association meeting. 3. John DiModica at the Energy Committee meeting 4. Jen Muir makes a point during a Monday session 5. A packed Government Affairs Committee meeting

Use of LIDAR Scanning and Other Innovative Condition Assessment Strategies to Guide Targeted Rehabilitation of the North Metropolitan Sewer
- Benjamin Agrawal, Hazen and Sawyer
- Charles Wilson, Hazen and Sawyer
- Patricia Mallett, Massachusetts Water Resources Authority
- Kathleen McCue Cullen, Massachusetts Water Resources Authority

Private Work, Public Benefit—How Installing Sump Pumps Relieved Neighborhood Sewer Backups
- Katelyn Biedron, CDM Smith
- Jason Waterbury, The Metropolitan District Commission
- Chris Coyle, CDM Smith

Inflow and Infiltration Removal: Three communities, three approaches
- Chris Henry, Mott MacDonald

Innovative, Real-Time Data Sharing Methods Create Efficiencies in Sewer Assessments on Nantucket
- Daniel Kramer, Hazen and Sawyer
- David Gray, Town of Nantucket, MA
- Deborah Mahoney, Hazen and Sawyer
- Charles Wilson, Hazen and Sawyer

SESSION 9
Asset Management 1: Optimize your Capital Cost Outputs—What Matters Most?

Moderators:
- Dan Capano, Gannett Fleming Engineers
- John Sykora, Weston & Sampson

Service Levels and Performance Management—Step 1 in the Asset Management Cycle
- Kevin Campanella, Burgess & Niple, Inc.

Pairing Wastewater & Roadway Risk-Based Assessments to Prioritize South Portland, ME's Infrastructure Investments
- Rachel Osborn, Woodard & Curran
- Peter Lyons, Woodard & Curran
- Brad Weeks, City of South Portland, ME

Assessing the Long-Term Financial Sustainability of Water Mains Using Monte-Carlo Simulation
- Cris Perez, Kleinfelder

Use of an Asset Management Plan to Meet State Fiscal Sustainability Plan Requirements
- Len Sekuler, Arcadis
- Jason Waterbury, The Metropolitan District Commission

SESSION 10
Young Professionals: Addressing Technical and Staffing Changes

Moderators:
- Rachel Watson, Stantec
- Vanessa Borkowski, Stantec

Improving the Fort Point Channel—A Challenging IDDE Project in Boston, MA
- Jonnas Jacques, Kleinfelder
- Amy Schofield, Boston Water & Sewer Commission
- Charlie Jewell, Boston Water & Sewer Commission
- David Peterson, Kleinfelder

Infusing Youth in the Water and Wastewater field
- Landon Kendricks, Woodard & Curran

Phosphorus Removal at an SBR Plant
- Paul Moran, Tighe & Bond
- Kellie Rotunno, R2O Consulting

1. A hallway exhibitor shows his wares 2. Virgil Lloyd, John Digiacomo, Mike Wilson, and Scott Goodinson plan logistics at the awards luncheon 3. An exhibitor adjusts his display 4. Exhibitors vying (and crying) for customer attention 5. John Jackman networks in the busy hallway between sessions

Hydraulic Capacity Assessment in City of Fitchburg
- Eliza Morrison, Wright-Pierce
- Matthew Corbin, Wright-Pierce

SESSION 11
Sustainability 1: Mitigating the Risk and Adaptively Responding to Changing Conditions—Climates, Regulations and Beyond

Moderators:
- Courtney Eaton, Kleinfelder
- Wayne Bates, Tighe & Bond

Climate Resilience Guidelines for the City of Boston
- Julie Eaton, Weston & Sampson
- Steven Roy, Weston & Sampson

Resilience Strategies for South Boston—Mitigating Risk through Partnerships
- Kathryn Edwards, Arcadis
- Mia Mansfield, City of Boston, MA

Massachusetts Water Resources Authority's Climate Change Strategy: A Commitment to Sustainability, Sea Level Rise Adaptation, and Energy Efficiency
- Hillary Monahan, Massachusetts Water Resources Authority

Traditional Engineering Solutions Become the Cornerstone of Adaptive Management Strategy—Falmouth Case Study
- Sandra Tripp, GHD
- Amy Lowell, Town of Falmouth, MA

SESSION 12
Energy: Tried and True Projects that will Save Your Facility Energy and Money

Moderators:
- Cynthia Castellon, Tighe & Bond
- Tracy Chouinard, Brown and Caldwell

P3s and the Water-Energy Nexus—Opportunities for Water Sector Energy Projects
- Bruce Tobey, Pannone Lopes Devereaux & O'Gara LLC
- Sean McGinniss, The Horinko Group

Sustainable Wastewater Facilities—A Creative Approach to Energy Management and Cost Control
- Carina Hart, JKMuir, LLC
- David Newman, The ECG Group
- Jen Muir, JKMuir, LLC
- Kendra McQuilton, The ECG Group
- Denis Cuevas, City of Waterbury, CT

Mixer Upgrades at the South Essex Sewerage District—A Successful Energy Reduction Project
- David Michelsen, South Essex Sewerage District
- Peter Pommersheim, South Essex Sewerage District

The Largest Cost Savings You Don't Know About
- Alexandra Rozen, JKMuir, LLC
- Chelsea Conlon, JKMuir, LLC

SESSION 13
Asset Management 2: Condition Assessment, A Key to Sound Cost, Level of Service, Risk, Investment, Funding and Asset Decisions

Moderators:
- John Jackman, Hoyle, Tanner & Associates
- Gary Arthur, Fiberglass Institute

13.1—Going From Condition To Risk:

Predictive and Condition Assessment using Smart Technology
- Rob Jordan, Hayes Pump

1. The Innovation Pavilion drew an interested crowd **2.** Griffin Moriarty (right) of UMass Amherst conversing with Mark Hopkinson at the Innovation Pavilion **3.** NEWIN's Marcus Gay introduces an innovation panel of speakers.

Collection System Condition and Risk using Asset Management Software and PACP
- Ken Conaty, Town of Merrimack, NH

Capital Prediction based on Asset Management
- Rod Lovely, Assetic

13.2—Inspection Practices For Owners:

Inspecting Fiberglass Assets and Emerging Regulations
- Gary Arthur, Fiberglass Institute

Case Histories for Fiberglass Odor Control Assets
- Dick Pope, Hazen and Sawyer

Case Histories for Other Fiberglass Assets
- Randy Nixon, Corrosion Probe

SESSION 14
Plant Operations 2: WRRF Upgrade and Case Studies

Moderators:
- John Adie, New Hampshire DES
- Benjamin Levin, Hazen and Sawyer

Morris Cove Pump Station VFD Rehabilitation
- Paul Ketchum, Arcadis
- Greg Bazydola, Arcadis
- Brian Robinson, Flow Tech, Inc.

From Odors to Ocean Breezes—Tackling Odor Control Through Operational and Capital Improvements
- Eric Kelley, Environmental Partners Group, Inc.
- Christopher Pratt, City of Newburyport, MA
- Robert Rafferty, Environmental Partners Group

WWTP Primary Clarifier/Thickener Upgrade
- Frederick McNeill, City of Manchester, NH
- Robert Robinson, City of Manchester, NH
- David Mercier, Underwood Engineers, Inc.

Hydraulic Improvements and Lessons Learned with Upgrades to Two 75 ft Squircle Secondary Clarifiers in Chicopee, MA
- Jacob Weinrich, Tighe & Bond
- Mike Williams, SUEZ

SESSION 15
Utility Management 2: Effective Program Management

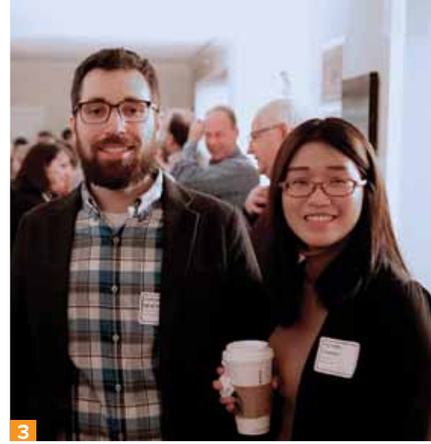
Moderators:
- Tim Vadney, Wright-Pierce
- Scott Firmin, Portland Water District

Alternative Project Delivery for Water/Wastewater Facility Projects
- Hillary Holmes, Stantec
- Denise Descheneau, Upper Blackstone Clean Water

Evolution of a CMOM Program in Waterbury, CT
- Julie Silva, Woodard & Curran

Public Utility Management A.S. and B.S. Degree Programs
- Wesley Winterbottom, Gateway Community College
- Janet Hayes, Gateway Community College

Program Management at DC Water—Value Added for Successful CIP Implementation
- John Wujek, Mott MacDonald



1. Amy Anderson, Corey Meyers, Allison Zeoli, and Mary Penny gather at the start of a day **2.** University of Hartford's Ryann Yearwood with her team's microbiology poster **3.** Jordan Heath and Yichen Zhang at a networking reception **4.** Debbie Hoyes and Mike Curtis **5.** Sawyer Award winner Bill Patenaude with Traci Pena **6.** Tom Hazlett at a Plant Operations Committee meeting

SESSION 16
Operator Ingenuity: Wastewater Treatment Facilities throughout New England–A Virtual Tour from an Operator's Perspective

Moderators:
- Helen Gordon, Environmental Partners Group
- Elena Proakis Ellis, City of Melrose, MA

A virtual tour of wastewater treatment facilities in all six New England states
- Dana DiScuillo, Town of Narragansett, RI
- Robert Fischer, City of South Burlington, VT
- Daniel Munsey, Brunswick Sewer District
- David St. Armand, City of Manchester, NH
- Anthony Piazzi, Town of Simsbury, CT
- Scott Urban, SUEZ

SESSION 17
Residuals: Advances in Biosolids Planning and Treatments

Moderators:
- Natalie Sierra, Brown and Caldwell
- Christopher Muller, Brown and Caldwell

Integrating Sustainability into Biosolids Master Planning
- Tracy Chouinard, Brown and Caldwell
- Natalie Sierra, Brown and Caldwell
- John Willis, Brown and Caldwell

Operations of a Thermal Hydrolysis and Digestion System
- Peter Loomis, CDM Smith

Pyrolysis as an Innovative Technology for Microconstituent Removal from Biosolids
- John Ross, Brown and Caldwell

Advanced Digestion and Biogas Handling—Planning, Design and Construction
- Eric Spargimino, CDM Smith

SESSION 18
Safety: The Top 10 of Safety and Security

Moderators:
- David Wright, Weston & Sampson
- David Horowitz, Tighe & Bond

OSHA Top Ten and How They May Impact Wastewater Treatment Facilities
- David Horowitz, Tighe & Bond
- Alan Stratton, Tighe & Bond

Bringing Better Security Practices to the Water Sector for a New Normal
- Corinne Ketchum, Arcadis
- Ryan Joyce, Arcadis

Most Common Fatalities
- David Wright, Weston & Sampson

The Top 10!
- David Wright, Weston & Sampson

SESSION 19
Plant Operations 3: WRRF Optimization Upgrades

Moderators:
- Pamela Westgate, Kleinfelder
- Travis Peaslee, Lewiston-Auburn WPCA

Effects of Food to Microorganism (F/M) Ratio and Feast-Famine Condition on NO_2 Accumulation During Denitrification
- Mehran Andalib, Stantec
- Art Umble, Stantec
- Amanda Ford, Hazen and Sawyer

Don't Stop Me Now: Implementing MBR Upgrades Without Interrupting Operations
- Joshua Jondro, Woodard & Curran
- Brent Sutter, Woodard & Curran








1. Young Professionals hear about MWRA wet weather preparation 2. Hillary Holmes speaks on alternative project delivery 3. Barry Wenskowicz and Seth MacDonald listen to a presentation on energy 4. Jennifer Wood and Shonesia Davis take in a morning stormwater session 5. Genevieve Ho and Kate England promote green education 6. Angela Godwin, editor of *Water World* attends a technical session

Sludge Settleability Improvements at the East End WWTF
- Benjamin Levin, Hazen and Sawyer
- Deborah Mahoney, Hazen and Sawyer
- Paul Rodriguez, Portland Water District
- Scott Firmin, Portland Water District

Optimizing Pumping Operations—Maintaining your Pumps will Help, but your Control System Can do Much Better
- Frederick Mueller, Tighe & Bond

Session 20
Collection System 2: Pumping Resilience

Moderators:
- Kara Johnston, CDM Smith
- John Murphy, Stantec

Retrofitting a Pump Station for Improved Performance, O&M, Aesthetics and Odor Control
- Erik Osborn, Woodard & Curran
- Sean Tarbox, Woodard & Curran

Approaches to Address Resiliency and Reduce Risk at Pump Stations
- Amy Sowitcky, Tighe & Bond
- Daniel Roop, Tighe & Bond

Westport's Pump Station No. 2 Force Main Replacement Project using HDD: A Case Study
- Bryan Thompson, Town of Westport, CT
- Abhinav Huli, Haley & Aldrich
- Lori Carriero, Tighe & Bond

Improving Pump Station Resilience, City of Warwick, RI
- Peter Calderazzo, Dewberry
- Earl Bond, Warwick Sewer Authority

Session 21
Industrial Wastewater: Resurgence of Industrial Wastewater Treatment and Regulatory Opportunities in 2018

Moderators:
- Sarah White, UniFirst Corp.
- Darrell Interess, LabCentral

Maybe We Can Do This!! Beneficial Re-Use of a Nutrient-rich Wastewater
- Michael Curtis, Quantum Biopower

Lessons Learned from Warwick's First Craft Brewery
- BettyAnne Rogers, Warwick Sewer Authority
- Debbie Hoyes, Arcadis

Regulations Playing Catchup on Sustainable Industrial Water Reuse
- Edward Sharood, Woodard & Curran

An Innovative Approach to Brewery Waste Treatment at the Alchemist Brewery
- Michael Smith, Weston & Sampson
- Daniel Dair, World Water Works

Session 22
Water Reuse: Water Reuse—Across the Country and in your Own Back Yard

Moderators:
- Nick Ellis, Hazen and Sawyer
- Meredith Zona, Stantec

Coast to Coast—Creative Water Reuse Options in the USA
- Robert Little, Woodard & Curran

Save Water, Save Money—The Water Kaizen Blitz Process
- Hope Matis, Arcadis
- Evangelina Belia, Primodal Inc.

Acing the Aquifer—Field Methods to Help Keep the Budget Under-Par
- Kathryn Swanson, CDM Smith
- Karilyn Heisen, CDM Smith
- Robert Schreiber, CDM Smith

1. Nathalie Beauvais discusses climate resiliency 2. Michael Smith speaks regarding treatment of craft brewery waste 3. NEWEA President Ray Vermette presents Past President Janine Burke-Wells with her own well-used gavel

Direct Water Reuse in New England—Today and Tomorrow
- Bruce Douglas, NSU Water

Session 23
Stormwater 2: Shades of Green & Gray (and Beyond)—Promoting GI & LID in Design

Moderators:
- Marc Gabriel, Nitsch Engineering, Inc.
- Natalie Pommersheim, Environmental Partners Group

Massachusetts Watershed-based Tool for Statewide Watershed Planning
- David Roman, Geosyntec Consultants
- Andrea Braga, Geosyntec Consultants
- Julia Keay, Geosyntec Consultants
- Malcolm Harper, MassDEP

Underground Stormwater Detention and Rainwater Harvesting System for Northbrook Park District
- Brett Holmes, StormTrap
- Paul Siegfried, Baxter & Woodman Consulting Engineers

Greening Springfield: Springfield's Green Infrastructure Technical Guide
- Lori Kennedy, VHB
- Matthew Sokop, City of Springfield, MA
- Corrin Meise-Munns, Pioneer Valley Planning Commission

Improving Resiliency in an Urban Industrial and Commercial Area Through Green and Grey Stormwater Infrastructure Planning and Assessment
- Andrew Walker, Weston & Sampson
- Steven Roy, Weston & Sampson

Session 24
Small Community: Coastal Solutions and Outreach Approaches

Moderators:
- Chris Hayward, Orenco Systems
- Ian Catlow, Tighe & Bond

Engaging the Public on the Importance of Maintaining Municipal Infrastructure for a Small Community—A Public Outreach Success Story in Funding a Major Wastewater Infrastructure Upgrade
- Marc Drainville, GHD
- Benn Sherman, Town of Uxbridge, MA

Critical Success Factors to Locating Acceptable Effluent Recharge Sites
- Karilyn Heisen, CDM Smith
- Michaela Bogosh, CDM Smith
- Jeff Colby, Town of Yarmouth, MA

Beginning Anew—A Collection System, Effluent Treatment Facility, and Effluent Disposal System Design from Scratch for a Small Cape Town
- Tess Laffer, AECOM
- Thomas Parece, AECOM

Fighting Floatables in Small Town Pump Stations
- Rachel Schnabel, Fuss & ONeill

Session 25
Asset Management 3: Big Data—How to Efficiently Capture Data and Use it Effectively

Moderators:
- Demetrios Vidalis, Boston Water & Sewer Commission
- John Rogers, City of Framingham, MA

Applying GIS & Business Intelligence Technology and Leveraging Big Data to Support More Effective Utility Management
- Jayson Brennen, CDM Smith
- Harry Finklea, West Virginia University

Sewer System Asset Data Collection with ESRI Mobile Apps
- Peralie Burbank, City of Bangor, ME
- Patrick Cowan, City of Bangor, ME

Quantified Efficiency and Enhancements of Day-to-Day Operations Utilizing an Enterprise Geographic Information System—"A Regional Authority's Perspective"
- Ricardo Ceballos, Greater New Haven WPCA
- Tony Yates, Langan
- Brett Milburn, Langan

Tips and Tricks for Establishing a Thrifty Culvert Asset Management Program
- Janet Moonan, Tighe & Bond
- Eric Ohanian, Tighe & Bond
- Daniel Nason, Town of Sudbury, MA
- William O'Rourke, Town of Sudbury, MA

Session 26
Microconstituents: Assessment and Treatment of Contaminants of Emerging Concern

Moderators:
- Ned Beecher, NEBRA
- Laurel Schaider, Silent Spring Institute

Assessment of Micro Plastics in Wastewater and Drinking Water
- Dounia Elkhatib, University of Rhode Island
- Vinka Oyanedel-Craver, University of Rhode Island

First Time Use of Ozofractionation to Treat AFFF Release and Validation by TOP Assay
- Allan Horneman, Arcadis
- Jeff McDonough, Arcadis
- Yousof Aly, Arcadis
- Ian Ross, Arcadis

Regulatory, Technical and Communication Challenges for Licensed Environmental Remediation Professionals
- Nick Hastings, Woodard & Curran

Lessons Learned in PFAS Water and Wastewater Treatment from Half Way Around the World
- Marc Drainville, GHD
- Anastasia Rudenko, GHD
- Ali Farhat, GHD
- Chris Hertle, GHD

Session 27
Stormwater 3: MS4 Compliance—Panel Discussion from all New England Communities

Moderators:
- Zach Henderson, Woodard & Curran
- Kerry Reed, City of Framingham, MA

Working Together to Get More for Less
- Tom DiPietro – South Burlington, VT's cooperative efforts with a neighboring town
- Jami Fitch, Town of Scarborough, ME – Building Multi-Town Community Support
- Michael Dietz, UCONN – Building Tools for CT communities
- Kerry Reed – Statewide Collaboration in MA

Overcoming Challenges in Construction and Post-construction Programs—Lessons Learned
- Angela Blanchette, Scarborough, ME
- Kara Falise, Cambridge, MA
- Jamie Houle, UNH Stormwater Center
- David Wheeler, South Burlington, VT

Session 28
Sustainability 2: Considering Innovative Strategies to Achieve Improved Efficiency and Sustainability

Moderators:
- Meredith Zona, Stantec
- Robert Montenegro, Grundfos

Aiming for Envision Platinum in Advanced Wastewater Treatment Plant Design—Upper York Sewage Servicing (UYSS) Water Reclamation Centre Case Study
- Anastasia Rudenko, GHD
- Dianna Senior, GHD
- Adam Lachmann, Regional Municipality of York

Achieving Revenue Enhancement and Sustainability Gains through Utility Efficiency
- Jay Sheehan, Woodard & Curran

Beat Ultra-Low Phosphorus Targets with Reactive Filtration: How Marlborough, MA Efficiently Meets 0.07 mg/L
- Nick Janous, Nexom

Case Study of Blended Blower Technologies for Optimum Aeration Efficiency
- Paul Petersen, Atlas Copco
- Laurel Schaich, CDM Smith

Session 29
Collection System 3: Rehabilitation Issues

Moderators:
- Scott Lander, Retain-It
- David Pavlik, Town of Lexington, MA

A Penny (Road) Saved is a Lesson (L) earned
- Ryan Henley, Weston & Sampson
- Scott Dixon, City of Melrose, MA
- Elena Proakis Ellis, City of Melrose, MA
- John Potts, Weston & Sampson

Narragansett Bay Commission Rehabilitation of Large Diameter Brick Sewer with GeoSpray Geopolymer Mortar
- Scott Naiva, Milliken Infrastructure
- Meg Goulet, Narragansett Bay Commission
- James Fleming, National Water Main Cleaning

Beware of Cross Bores!—New NASSCO Guidelines for Prevention and Detection
- Laurie Perkins, Wright-Pierce

21st Century Solutions for 19th Century Sewer Systems
- Tom Perry, Multi Utilities Ventures

Session 30
Energy/Residuals: Resource Recovery—Maximizing Energy Generation

Moderators:
- Tom Schwartz, Woodard & Curran
- Eric Spargimino, CDM Smith

GLSD's Co-Digestion of Food Waste and its Path to Net Zero Energy Use
- Richard Weare, Greater Lawrence Sanitary District
- Ben Mosher, CDM Smith

Next Generation Resource Recovery: Co-Digestion to Renewable Natural Gas (RNG) Pipeline Injection at the Des Moines WRF
- Dustin Craig, CDM Smith
- Peter Loomis, CDM Smith
- Laurel Schaich, CDM Smith

Getting the Most Value from Digester Gas at GNHWPCA's East Shore WPAF
- Jay Kemp, Black & Veatch

FOG to Biodiesel Pilot Facility
- Justin Motta, Stantec
- Richard Parnas, University of Connecticut

Session 31
CSO/Wet Weather 2: Green Wet Weather Solutions

Moderators:
- Steve Perdios, Dewberry
- Jason Kreil, Woodard & Curran

The Solution to This Pollution is Bioswales—Greater New Haven's Innovative Approach to CSO Abatement
- Douglas Brisee, Fuss & O'Neill, Inc.
- Erik Mas, Fuss & O'Neill

Green Stormwater Infrastructure for CSO Control
- Bernadette Callahan, Stantec

Analysis of the Implementation of City-Wide Green Infrastructure Solutions to Address Combined Sewer Overflow. Case Studies: New York City, Philadelphia, and Cleveland
- Kathryn DePippo, Mott MacDonald
- John Scheri, Mott MacDonald
- Kellie Rotunno, R2O Consulting

Flood Mitigation in the Birthplace of America—The Cohocksink Storm Flood Relief Project
- Gary Snyder, Mott MacDonald

Session 32
Stormwater 4: MS4 Compliance—Building on Progress Made as We Start a New Chapter

Moderators:
- Virginia Roach, CDM Smith
- Angela Blanchette, Town of Scarborough, ME

Heads or Tails—Where to Start Looking for Sewage in Your Storm Drains
- Garrett Bergey, SDE, Inc.

RIDOT's Stormwater Program—Tracking Progress
- Lauren Caputo, VHB
- Cambria Ung, VHB

Lessons from the Chesapeake Bay—Leveraging Ecosystem Restoration TMDL Reduction Practices for Comprehensive Resilient Solutions
- Glenn Muckley, Stantec
- Doug Beisch, Stantec

Boston's IDDE Program—Lessons Learned from 20 Years of Experience
- Amy Schofield, Boston Water and Sewer Commission
- Garrett Bergey, SDE, Inc.

Session 33
Water For People: Global Solutions for Increasing Access to Safe Water

Moderators:
- Renie Jesanis, Massachusetts Water Resources Authority
- Tenzin Lama, MassDEP

Sustainable Engineering Solutions to Alleviate Water Scarcity in Saviefe-Deme, Ghana
- Samantha LeValley, UMass Amherst
- Victoria Hennon, UMass Amherst
- Michael Andrick, UMass Amherst
- Wayne Bates, Tighe & Bond

Increasing the Water Security of the Island Republic of Kiribati Through a Multi-Prong Approach
- Anastasia Rudenko, GHD
- Phoebe Mack, GHD
- Audrey Degnan, GHD

Ovoid Ceramic Filters Evaluated for Improved Water Purification in Developing Communities
- Zachary Shepard, University of Rhode Island
- Elizabeth Lux, University of Rhode Island
- Vinka Oyanedel-Craver, University of Rhode Island

Why are They all So Happy...It's in the Water
- Rachel Watson, Stantec

Session 34
Collection System 4: Tidal Issues

Moderators:
- Ryan Wingard, Wright-Pierce
- Kara Keleher, Weston & Sampson

Roxbury Canal Sewer Separation—The Boston Water and Sewer Commission's Continued Commitment to Environmental Stewardship and Infrastructure Reliability.
- Michael Carroll, Stantec
- Irene McSweeney, Boston Water & Sewer Commission
- Daniel Kucharski, Stantec

Not on My Watch—Using CIPP to Ensure Disaster Doesn't Strike
- Justin deMello, Woodard & Curran
- Paul Costello, City of Quincy, MA

Identification and Removal of Tidal Intrusion Sources in Manchester-by-the-Sea's Wastewater Collection System
- Allison Shivers, Tata & Howard, Inc.

Nantucket Sewers—Our Island Story
- Laurie Toscano, Weston & Sampson
- David Gray, Town of Nantucket, MA
- Andrew Patnode, Weston & Sampson

POSTER BOARD DISPLAYS

The Significance of Good Modeling on Design of Biological Nutrient Removal Processes with Influent Inhibitory Compounds
- Christopher Andres, Stantec

Can't Reach Your Dirty Assets? Challenges of a Cross Country Collection System Cleaning and Assessment Program in Springfield, MA
- Timothy Baril, Kleinfelder

Best Practices for BNR (Biological Nutrient Removal) Mixing
- Ian Belczyk, Xylem Water Solutions

Mapping Out MS4 Compliance: Options and Approaches to Improve the MS4 Asset Inventory
- Janelle Bonn, Woodard & Curran

Structural Polyurethane and Rehabilitation of America's Infrastructure
- Rob Emmerson, Sprayroq, Inc.

Role of Ultrafiltration and Reverse Osmosis in Improving the Water Quality Index for Potable Water Reuse–A Case Study
- Mohamed Hamoda, Kuwait University

Online Nitrite Monitoring for Efficient Removal of Nitrogen from Wastewater
- Robert Smith, YSI – a Xylem brand

Enhancing Sustainability—Evaluation of Two Screening Technologies
- Thomas Steinke, Parkson Corporation

UNDERGRADUATE STUDENT POSTER BOARD COMPETITION

Community Based Capstone Project: a Study and Reflection on Stormwater Management Maintenance
- Annelise Boylan, Evan Raffi, Daniel Petrovic, Andrew Gaughan, Tarek Aldawalibi; Roger Williams University

The Bbanda Distribution System - Providing Clean, Accessible Water to the People of Bbanda, Uganda
- Peter Botticello, Jeffery Ling, Allison Murray; Northeastern University

Wastewater Treatment Microbiology
- Ryann Yearwood, Sultan Alyami, Alex Minolfo; University of Hartford

Mycoremediation as a Removal Method for E. coli in Natural Systems
- Tijana Cooley, Ojaswi Aryal; Smith College

Zooplankton Mediated Removal of E. Coli in Natural Systems
- Ruby Kohn, Tyler Feeney; Smith College

Understanding Biological Nitrogen Removal using Tidal Flow Constructed Wetland Technology for Wastewater Treatment and Water Reuse
- Kestral Johnston; Northeastern University

Removal of Phosphorus in the New Hartford Treatment Plant
- Denise Prussen, Matthew Garneau, Caitlin Cervello, Kaustubh Bhasm; University of Hartford

Phosphorus Removal—Springfield Regional Wastewater Treatment Facility
- Stephen Tyler Arnold; University of Hartford

H2gO—Portable Water Treatment System
- Isabella Silverman, Alexa Leone, Ian Hallman; University of Rhode Island

Pumps and Valves
- Shaun Vasselin, Nick Kennedy, Robert Joie; University of Hartford

An Evaluation of Point of Use Water Treatment Methods
- Hannah Wharton; UMass Amherst

The Effect of Acetate, Butyrate, and Propionate on the Efficiency of Double Chamber Microbial Fuel Cells
- Isabella Cobble; UMass Amherst

GRADUATE STUDENT POSTER BOARD COMPETITION

Modeling of Beta Blocker Biotransformation by Denitrifying Mixed Culture Communities
- Amy Hunter; Tufts University

The Emergent Risk of Food Waste Recovery: Characterizing the Contaminants in MSW Organics from Different Sources
- Astha Thakali; University of Maine

Method for and Characterization of Novel Anammox Composition Reactor Chemistry to Support In-Situ Sensing for Real-Time Process Controls
- Umang Chauhan; Northeastern University

GRADUATE STUDENT POSTER BOARD COMPETITION (continued)

The Resiliency and Performance of Oxygenic Photogranules Under Light-Induced Stress Conditions
- Sam Downes; UMass Amherst

Bench Scale Examination of Acid Mine Drainage Addition to Municipal Wastewater for Co-treatment
- Charles Spellman Jr., Travis Tasker, Joseph Goodwill, William Strosnider; University of Rhode Island

Managing Disinfection Byproduct Formation Using an Energy Efficient LED-UV Disinfection System
- Hichem Hadjeres; University of Rhode Island

Exploring the Potential of Citizen Science through Evaluation of Commercial Water Quality Test Kits
- LeighAnn D'Andrea; UMass Amherst

Real-time in situ Monitoring of Water and Air Flow Velocity Using Flat Flexible Thin Mm-sized Resistance-Typed Sensor Film (MRSF)
- Yingzheng Fan; University of Connecticut

Real-time, in situ Monitoring of Nitrogen Dynamics in Wastewater Treatment Processes Using Wireless, Solid-State, and Ion-Selective Membrane (S-ISM) sensors
- Yuankai Huang; University of Connecticut

Closing the Knowledge Gaps in Intermittent Water Supply: An Experimental Lab-scale Pipeloop for the Investigation of Intermittent Water Supply
- Mariam Alkattan; UMass Amherst

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Stacey DePasquale Engineering, Inc.
StormTank
StormTrap
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TenCate Geotube
The MAHER Corporation
Thermal Process Systems
Titus Industrial Group, Inc.
Toshiba Magnetic Flowmeters
Truax
TruGrit Traction, Inc.
Trumbull Manufacturing, Inc.
Ultraflote LLC
Underground Inspection Technologies
Unison Solutions
United Concrete Products, Inc.
United Rentals Fluid Solutions
USABLUEBOOK
USP Technologies
Verder
VersaFlex/Raven
Vogelsang
Walker Process Equipment – Div. of McNish Corporation
Walker Wellington LLC
WasteCorp Pumps
Wemco Weir Specialty Pumps
Wescor Associates, Inc.
WESTECH
WhiteWater, Inc.
Williamson Pump & Motor
Worcester Polytechnic Institute
Xylem Dewatering Solutions Inc - Godwin Pumps
Xylem Dewatering Solutions, Inc. - Flygt Pumps
ZCL | Xerxes

The following companies received award of recognition of continuously exhibiting at the NEWEA Annual Conference:

25-Year Award
- Blake Equipment

10-Year Award
- DN Tanks

2019 Awards & Recognitions

Allison Fisher of Portland, Maine, receiving the Young Professional Award

U.S. EPA REGION I NEW ENGLAND AWARDS

Wastewater Treatment Plant Operation and Maintenance Excellence Award

- Winchester, New Hampshire Wastewater Pollution Control Facility represented by Rick Meleski, Plant Manager
- Windham, Connecticut Wastewater Pollution Control Facility represented by David Garland, Chief Operator
- Westerly, Rhode Island Wastewater Treatment Facility represented by Nick DeGemmis
- Warren, Rhode Island Wastewater Treatment Plant represented by Dave Komiega
- Leominster, Massachusetts Wastewater Treatment Plant represented by Robert Chalifaux, Chief Operator

Wastewater Treatment Plant Operator of the Year Excellence Award

- Tim Bilodeau, Lancaster, New Hampshire Wastewater Treatment Facility
- Paula Ely, Great Barrington, Massachusetts Wastewater Treatment Plant

Wastewater Trainer of the Year

- Nora Lough, Narragansett Bay Commission

Industrial Pretreatment Program Excellence Award

- City of Keene, New Hampshire represented by Eric Swope, Industrial Pretreatment Coordinator
- Charles River Water Pollution Control District, Medway, Massachusetts represented by Kristen Mucciarone, Industrial Pretreatment Coordinator

WEF – MA AWARDS & RECOGNITIONS

WEF Fellow

- James Courchaine

WEF Service/Delegate Award

- Susan Sullivan, Lowell, MA

WEF Life Membership

- John Struzziery, Hull, MA

George W. Burke, Jr. Award

- UConn Reclaimed Water Facility (Woodard & Curran)

Laboratory Analyst Excellence Award

- Stephanie Rochefort, Somersworth, NH

William D. Hatfield Award

- Francis Russo, Meriden, CT

Arthur Sidney Bedell Award

- Howard Carter, Saco, ME

Operations Challenge Division II—2nd Place Process Control

- Franken Foggers, CT

Operations Challenge Division II—1st Place Process Control and 1st Place Lab

- Ocean State Alliance, RI

Biosolids Management Award
Merrimack, New Hampshire Public Works Director Kyle Fox, NEWEA's Janine Burke-Wells, James Taylor, Leo Gaudette, and Assistant Public Works Director—Wastewater Sarita Croce celebrate the award

NEWEA award recipients: 1. John Vetere, E. Sherman Chase 2. Joy Lord, Committee Service Award 3. William Patenaude, Clair N. Sawyer 4. Alan Taubert, Elizabeth A. Cutone Executive Leadership

NEWEA RECOGNITIONS

Scholarship Recipients 2018

Undergraduate Student

- William Adsit
  University of Connecticut

Graduate Student

- Astha Thakali
  University of Maine

Non-environmental Student

- Ashley Loto
  University of Connecticut

Student Design Competition

- Sabrina Castaneda, Anna Mallonée, Joanna Sullivan
  Northeastern University, Boston, MA

Stockholm Junior Water Prize

- Verna Yin, Cos Cob, CT
- Elise Mizerak, Holden, MA
- Mei Tian, Bangor, ME
- Meghana Avvaru, Nashua, NH
- Margaret O'Brien, Bristol, RI
- Sunthoshini Premsankar, Williston, VT

NEWEA acknowledged retiring officers and committee chairs

OFFICER	OFFICE
Raymond Vermette	President-Elect
Virgil Lloyd	State Director - Connecticut
Marylee Santoro	Council Director/Treatment, Systems Operations, & Management Council

CHAIR	COMMITTEE
Ivonne Hall	CSO/Wet Weather Issues
Joseph Boccadoro	*Journal*
James Galasyn	Laboratory Practices
Ashley Dunn	Newsletter
Kerry Reed	Registration
Udayarka Karra	Scholarships
Robert Montenegro	Sustainability
Ben Stoddard	Young Professionals

NEWEA AWARDS

NEWEA Operator Award

Connecticut

- John Bodie, Fairfield, CT

Maine

- Stacy Thompson, Saco, ME

Massachusetts

- Robert Delgado, Barnstable, MA

New Hampshire

- Leo Gaudette, Nashua, NH

Rhode Island

- Charles Labbe, Warwick, RI

Vermont

- Wayne Graham, Essex Junction, VT

Alfred E. Peloquin Award

Connecticut

- Michael Bisi, Glastonbury, CT

Maine

- André Brousseau, Springvale, ME

Massachusetts

- David Duest, Winthrop, MA

New Hampshire

- John Adie, Concord, NH

Rhode Island

- Michael Spring, Providence, RI

Vermont

- Wayne Elliott, Essex Junction, VT

NEWEA AWARDS

Operator Safety Award

- David Aucoin, Providence, RI

James J. Courchaine Collection Systems Award

- Angelo Salamone, Chelsea, MA

Paul Keough Award

- Andrew Bramante, Greenwich, CT

Young Professional Award

- Allison Fisher, Portland, ME

Public Educator Award

- Christian Lund, Groton, CT

Biosolids Management Award

- James Taylor and the Merrimack Biosolids Composting Team, Merrimack, NH

Asset Management Award

- Plymouth Village Water and Sewer District, Plymouth, NH

Energy Management Achievement Award

- Town of Fairfield, Fairfield, CT

Wastewater Utility Award

- York Sewer District, York Beach, ME

Committee Service Award

- Joy Lord, Lisbon Falls, ME

E. Sherman Chase Award

- John Vetere, Boston, MA

Clair N. Sawyer Award

- William Patenaude, Providence, RI

Founders Award

- Douglas Miller, Cape Elizabeth, ME

Elizabeth A. Cutone Executive Leadership Award

- Alan Taubert, Salem, MA

Past President's Plaque and Pin

- James Barsanti, Framingham, MA

New Members November 2018 – January 2019

Andrew Gwinn
Hydro International Portland, ME (PRO)

Paola Molloy
Norwalk, CT (PRO)

Richard Hoch
Howell Labs
Bridgton, ME (PRO)

Lucner Charlestra
MWRA
Boston, MA (PRO)

Done Greb
Watertown, CT (PRO)

Christine Montemurro
CDM Smith
Boston, MA (PRO)

Ty Wagner
Mattabassett District
Cromwell, CT (YP)

Jamie Pearce
Onset Computer
Bourne, MA (PRO)

Aaron Desatnik
Ceres Partners
Concord, MA (PRO)

Felicia Morrissette
NEFCO
North Quincy, MA (PRO)

Justin Early
City of Lewiston
Lewiston, ME (PRO)

Bruce Fountain
Suez NA
Danielson, CT (PWO)

Nico James
Massachusetts Water Resources Authority
Chelsea, MA (YP)

Laura Nakolan
TRC Environmental
Boston, MA (YP)

John Ososkie
Jacobs
Wethersfield, CT (PRO)

Daniel Scott
Kleinfelder
Boston, MA (YP)

Salvatore Smarra
City of Worcester DPW
Worcester, MA (PRO)

Edward Suslovic
New England Environmental Finance Center
Portland, ME (PRO)

Cassidy Wallitsch
Woodard & Curran
Portland, ME (YP)

Rick Emery
South Kingstown WWTF
Wakefield, RI (PWO)

Nick Sangillo
Hungerford & Terry Inc.
Clayton, NJ (DUAL)

Yuankai Huang
University of Connecticut
Storrs, CT (STU)

Mariam Alkattan
West Springfield, MA (STU)

Annelise Boylan
Bristol, RI (STU)

Sara Francis
Gloucester, MA (STU)

Julia Hostetter
Prescott, AZ (STU)

Michael Nelson
Boston Water & Sewer Commission
Roxbury, MA (PRO)

Brooke Paradis
Pelham, NH (STU)

Rhonda Pogodzienski
AECOM
Chelmsford, MA (PRO)

William Renault
Town of Wakefield
Wakefield, MA (PRO)

Evan Pereira
Canton, MA (YP)

Stephanie Alimena
Kleinfelder
Boston, MA (YP)

William Adsit
Branford, CT (STU)

Kaustubh Bhasme
Hartford, CT (STU)

Christine Carroll
Sekisui SPR Americas LLC
Austell, GA (PRO)

Emmalee Cherington
City of South Burlington
South Burlington, VT (PRO)

Leighann D'Andrea
Plymouth, MA (STU)

Nicola Elardo
Groveland, MA (STU)

Nafis Fuad
Willington, CT (STU)

Hillary Holmes
Boston, MA (PRO)

Jacob Kostandin
Somersworth, NH (STU)

Valerie Preler
Block Island Maritime Institute
New Shoreham, RI (PRO)

Astha Thakali
Orono, ME (STU)

Rebecca Weidman
Massachusetts Water Resources Authority
Chelsea, MA (PRO)

Nicolas Evans
Dracut, MA (PWO)

Bryce Annino
Corrosion Probe, Inc.
Centerbrook, CT (PRO)

Daryl Coppola
Marlborough, MA (YP)

Gray Fisher
Westfield, MA (PRO)

Rychel Gibson
Yarmouth, ME (PRO)

Thomas Hogan
Wright-Pierce
Middletown, CT (PRO)

Ashley Loto
Amston, CT (STU)

Michael Low
Boston, MA (STU)

Kevin Manning
Town of Nantucket
Nantucket, MA (PWO)

Katherine Robles
West Hartford, CT (PRO)

Olivia (XinNan) San
Lexington, MA (STU)

Paul Southworth
Boston Water & Sewer Commission
Roxbury, MA (YP)

David St. Armand
City of Manchester
Manchester, NH (PRO)

Christina Stringer
NEIWPCC
Lowell, MA (PRO)

Marianna Zak
Stantec
Boston, MA (YP)

Sean Murnan
NEFCO
North Quincy, MA (PRO)

Carl Peterson
Borden & Remington Corp
Fall River, MA (PRO)

Dallas Schwartz
Xylem Analytics HQ
Rancho Cordova, CA (PRO)

Jamie Craig
Weston & Sampson
Peabody, MA (YP)

Kristin Monfetti
Springfield Water and Sewer Commission
Springfield, MA (PRO)

Erik Walling
Brunswick Sewer District
Brunswick, ME (PWO)

Nathan Desrosiers
Town of Manchester By the Sea
Manchester By The Sea, MA (PRO)

Greggory Bisi
Rocky Hill, CT (PWO)

Felicia Gerardi
Burlington, MA (YP)

Marissa Liggiero
Town of Lexington
Lexington, MA (YP)

Michael Sprague
Town of Lexington
Lexington, MA (YP)

Jessica Sweeney
CF Technologies
Hyde Park, MA (YP)

Tom Milligan
City of Biddeford
Biddeford, ME (PWO)

Colleen Dougherty
AECOM
Rocky Hill, CT (PRO)

Mark P. Mucia
Milton, VT (PWO)

Visha P Raval
Fairfield, CT (PRO)

Isaiah A Lewis
Haverhill WWTF
Haverhill, MA (PRO)

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)

Upcoming Meetings & Events

PLANT OPERATIONS CONFERENCE AND EXHIBIT
March 21, 2019
Marriott Courtyard, Billerica, MA

CONGRESSIONAL BRIEFING/NATIONAL POLICY FLY-IN
April 3 - 4, 2019
Washington, DC

OPERATIONS CHALLENGE TRAINING DAY
April 12, 2019
West Warwick, RI

WATER FOR PEOPLE 5K AND KIDFEST
May 4, 2019
Deer Island, Winthrop, MA

NEWEA SPRING MEETING & EXHIBIT
June 2-5, 2019
Wentworth by the Sea, New Castle, NH

TEACHER TRAINING WORKSHOP
August 20, 2019
NBC, Providence RI

AFFILIATED STATE ASSOCIATIONS AND OTHER EVENTS

NEWWA SPRING CONFERENCE
April 3-4, 2019
DCU Center, Worcester, MA

NHWPCA SPRING TRADE FAIR
April 5, 2019
Radisson Hotel, Nashua, NH

CWPAA SPRING TRADE SHOW
April 25, 2019
New Life Church, Wallingford, CT

CAWPCA SPRING WORKSHOP
May 3, 2019
Aqua Turf Club, Plantsville, CT

GMWEA ANNUAL MEETING
May 23, 2019
Killington Grand Resort, Killington, VT

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

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)

Thank you

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Tetra Tech
Tighe & Bond
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Build relationships with water industry leaders *and* make a positive impact on the water environment

Join NEWEA's 2020 Annual Sponsor Program

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

- NEWEA Annual Conference
- NEWEA Spring Meeting & Golf Tournament
- NEWEA Golf Classic
- A web presence on NEWEA.org's sponsorship program page
- The option to customize sponsorship levels by selecting to participate in up to eight additional unique NEWEA events plus additional activities

Sponsorship Benefits:

- Increased corporate visibility and marketing opportunities before a wide audience of water industry professionals
- Relationship-building access to key influencers involved in advancing water industry services, technology, and policy
- Recognition as an environmental leader among peers and customers

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

NEWEA
WORKING FOR WATER QUALITY

Advertiser Index

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The Summer issue advertising deadline is May 1, 2019

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Email: jgosselin@newea.org
Call: 781-939-0908

Upcoming *Journal* Themes

Summer 2019—**Wastewater Treatment**
Fall 2019—**Collection Systems**
Winter 2019—**Safety**

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
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Woburn, MA 01801
For more information: 781.939.0908
Fax 781.939.0907 NEWEA.org

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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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