Fall 2015, Vol. 45, No. 3

New York Water Environment Association, Inc.

ClearWaters

Jamaica Bay Water Quality

Also Inside:

Suffolk Co. and Albany Co. Operator Spotlights

Highlights of Watershed Science Conference

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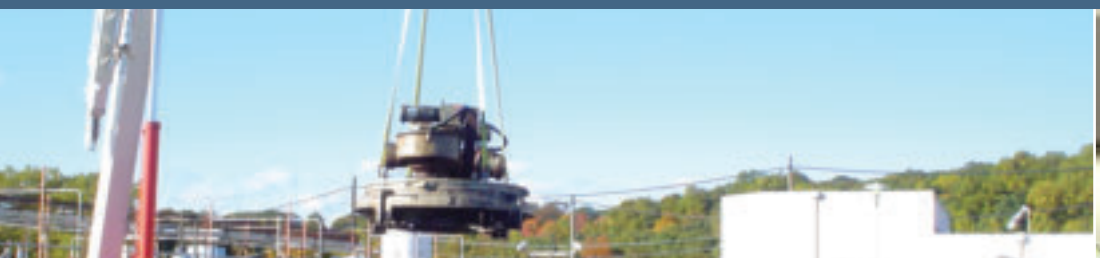

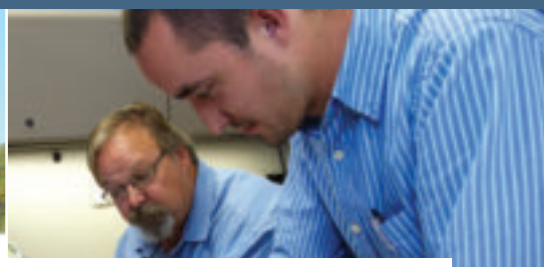

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Cover Image: Members of the Long Island Brown Tide operators team, this year's state winners, are seen at the Bergen Point Wastewater Treatment Plant in Suffolk County where they are in the UV disinfection building standing over one of its four channels. They are (l-r) Dale Grudier, Jake Miller, James Behr and Alec Breen. *Photo by Eric Haack (spock8113)*

Clear Waters (USPS 004-595) (ISSN 01642030) is published quarterly with a directory every four years in the fall by the New York Water Environment Association, Inc., 525 Plum Street, Suite 102, Syracuse, NY 13204. Subscription is through membership; public subscription is $25.00/year. PERIODICALS postage paid at Syracuse, NY. POSTMASTER: Send address changes to the New York Water Environment Association, Inc., 525 Plum Street, Suite 102, Syracuse, NY 13204. Ph: 315-422-7811, Fax: 315-422-3851.

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President's Message | Fall 2015

Doubleheader in Cooperstown

The 2nd annual CHAPEX meeting was held on the morning of July 22 at the Otesaga Resort Hotel with representatives from each chapter across the state in attendance. We had a rich agenda of relevant and beneficial topics. The meeting began with each chapter representative sharing inspiring success stories, followed by a dialogue on interfacing with the state association, professional development hour offerings, scholarship synergy, utilizing social media, and growing the membership. The balance of the meeting was dedicated to financial best practices. Copies of Quickbooks software were provided as a common financial platform for each chapter to use.

In the afternoon, Claire Baldwin of CDM Smith kicked off the NYWEA 2016–2020 Strategic Plan with several board members and committee chairs in attendance. Claire led the group with great exuberance and rallied the team to produce some very meaningful results.

Sewage Right to Know Rules and Regulations

In July, I attended a public meeting on the NYS Department of Environmental Conservation's Draft Rules and Regulations on the Sewage Right to Know Act. Joe DiMura, NYSDEC liaison, and his team provided a very informative presentation and responded to questions from the audience. I would like to thank NYWEA's President–Elect Joe Fiegl for compiling a long list of comments from our Utility Executive and Government Affairs committees. I believe NYWEA's response to NYSDEC will be relevant and useful in crafting the final rules and regulations.

Stormwater Task Force Workshop on Green Infrastructure

This workshop, held on July 30, was the first of its kind for NYWEA – a collaboration among NYWEA, Monroe County and the Rochester Institute of Technology (RIT). The intent of the workshop was to discuss maintenance of green infrastructure, which is an important component of the long-term success of these systems. As installation of green infrastructure practices overtakes that of traditional stormwater practices, planning and training are needed for green infrastructure systems that have very different maintenance needs than traditional grey infrastructure.

I would like to thank our workshop partners, including Greg Liberman from Environmental Design and Research and the NYWEA Stormwater Task Force; Dr. Karl Korfmacher, professor and undergraduate coordinator of the RIT Environmental Science Program; and Michelle Virts and Andy Sansone from the Monroe County Department of Environmental Services. The workshop was held on the RIT campus and included a walking tour of green infrastructure installations on the campus. The workshop attendees discussed design considerations, maintenance challenges, successes and lessons learned from RIT staff and the design team. The attendees were a diverse group of participants from educational institutions, sewer and water authorities, Riverkeeper, Soil and Water Conservation districts, municipalities, consultants and contractors. The diversity allowed for productive discussions by the group to share experiences.

Watershed Science and Technical Conference

A great program came to fruition with the NYWEA Watershed Science and Technical Conference held on September 9 at the Thayer Hotel at West Point. This annual conference is a great opportunity for elected officials, public works directors, engineers and anyone in the water profession to learn about the latest scientific and technical trends in water and wastewater science and technology. Many thanks go to Bill Harding from the NYS Department of State for his efforts in planning the conference, as well as to the long list of conference sponsors, especially the New York City Department of Environmental Protection.

Year of the Operator

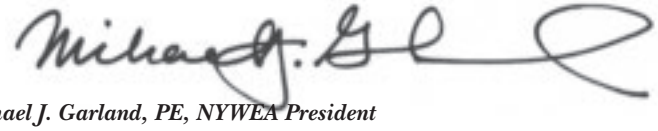
As many of you know, NYWEA made 2015 the "Year of the Operator," to celebrate the dedication and diversity of the men and women who operate our great water resource recovery facilities and collections systems, but also to better understand what can be done to attract and retain operators for the future. The recently created Operator of the Future Task Force, led by Jonathan Ruff (City of Plattsburgh) and Billy Grandner (formerly NYCDEP) is busy developing a white paper summarizing the results of surveys given to operators and managers across the state. *Clear Waters* magazine continues to prominently feature operators on the cover and inside each edition too. Operators from Albany County facilities are spotlighted in this edition, as are those pictured on the cover who are from Long Island and have participated in the state and national Operations Challenge competitions. The Brown Tide team won first place at NYWEA's Spring Technical Meeting this June. I marvel at their outstanding performance, as well as all the other teams from across the state who have devoted so much time and energy to compete among their peers.

WEFTEC

The Water Environment Federation's 88th Annual WEFTEC, held in Chicago from September 27–30, is truly an amazing conference with the who's who and what's what of wastewater! I was particularly interested in attending the Utility Executives Forum, Leadership Day, the Operator's Challenge and the Awards Reception. I was honored to accompany Monroe County Executive Maggie Brooks who received WEF's 2015 Public Officials Award for her commitment and dedication to the water environment.

Looking Forward to 88th Annual Meeting

Frosty frigid February seems like a long way away, but not for Joyette Tyler (chair) and Dave Barnes (co-chair) of the Conference Management Committee who are diligently planning the 88th Annual Meeting at the New York City Marriot Marquis from February 7–10, 2016. I'm pleased to announce that the theme will be the Year of the Operator! As part of the Opening Session, we will conduct another operator panel discussion, building on the interest and success of the spring meeting's operator panel discussion.



Michael J. Garland, PE, NYWEA President

Staying on Top of Your License and Certification

The New York Water Environment Association (NYWEA) is an approved sponsor with the NYS Education Department in issuing contact hours for engineers who attend our meetings. Based on a recent audit, we have a new procedure in issuing professional development hours (PDHs) that was launched at our Spring Technical Conference in June. Speaker evaluations are now required to be performed by each attendee *prior* to contact hours being issued. In the past, only moderators would fill out speaker evaluations. Now it is a requirement that every presentation sat in on be evaluated by *every* person who attends. The new procedure allows for performance feedback that speakers can use to improve their training sessions that will result in high quality training for engineers – a win-win situation. We are utilizing a Guidebook App to capture the relevant evaluation information via cell phones, notepads or computers. Refinements are being made for NYWEA's 88th Annual Meeting to make it as streamlined and efficient as possible for both the engineers obtaining PDHs and staff administering the program.

In addition to offering PDHs, NYWEA also issues renewal training contact hours for WWTP and water operators. The 2016 training catalog will be released online shortly, so be sure to check out the topics available in your area. Many thanks go to Keneck Skibinski and the chapter officers who identified relevant topics and published the catalog in a timely manner.

In this Year of the Operator Tanya Jennings, our Wastewater Certification Administrator, has developed a new brochure to promote operator certification. The brochure includes the requirements necessary for Grades 1–4 (including 1A, 2A, 3A and 4A), with a simplified format that answers the question, "How Do I Become a Certified Operator?" Also included are comments, one from a small plant operator (Donna Bee, Northport, LI), and one from a larger utility in upstate (Tim Murphy, Albany County). We hope this brochure will draw the interest of young people, who have not been exposed to the field. They are available on the NYWEA website or by calling Tanya directly at 315-422-7811, x4, or tmj@nywea.org.

Strategic Planning Session

What will NYWEA look like in 2020? On July 22, following our Chapter Exchange in Cooperstown, 22 volunteers and staff worked with facilitator Claire Baldwin of CDM Smith to brainstorm on new trends and shifts in thinking for the organization. This action oriented planning was intense and comprehensive, and sets the stage for 2016–2020 by clarifying the future direction of NYWEA. Many thanks to all who made the session a great success *(see photo)*!

Other Partnerships and Heart of Philanthropy

NYWEA is pleased to partner with environmental advocacy organizations to amplify our voices with elected officials on infrastructure funding. We are gearing up prior to the start of the legislative session to raise awareness together on water quality infrastructure needs and issues.

NYWEA's Strategic Planners: L–r (back to front): Anthony DellaValle, Dominic DiSalvo, Tom Lauro, Jonathan Ruff, Tucker Cox, Dick Pope, Joe Fiegl, Khris Dodson, Adam Cummings and John Fortin, Donna Bee, Wendi Richard, Geoff Baldwin, Will Stradling, Tanya Jennings, Robert Wither, Claire Baldwin, Mike Garland, Patricia Cerro-Reehil and Paul McGarvey

Regarding other partnerships, I was asked to be a keynote speaker at the Central Chapter Society of Women Engineers (SWE) meeting in May. It was their 30th anniversary meeting and 25th scholarship presentation. I was honored to address their members and experience the enthusiasm shown by the young scholarship winners first hand. Like all philanthropic organizations, it is not only important to raise money for our respective missions, but to serve a broader purpose of connecting people with similar interests. One of the speakers was a professor from Syracuse University, Joan Dannenhoffer. She explained that every one of her jobs was a result of networking at SWE meetings. I'm certain there are NYWEA members with a similar story to tell – careers generated through NYWEA connections. LinkedIn can connect you virtually to others in the field, but there's nothing that replaces a handshake, a smile and the all important eye to eye connection. Take the time to attend meetings and connect with others – it's a good move professionally and can advance careers. I hope to see you at one of our upcoming meetings!

Elected Officials Roundtables: Your Community's Biggest Capital Investment

In collaboration with the Environmental Finance Center of Syracuse University, NYWEA continues its Elected Officials roundtables, re-branded as "Your Community's Biggest Capital Investment." The next roundtable will be December 1st in the Chenango Town Hall. For registration information, go to the events page at *www.nywea.org*.

Jamaica Bay Theme

Toby Siegman, a Publications Committee member, came up with the terrific idea to cover Jamaica Bay for this *Clear Waters* issue. My thanks go to Toby for her hard work in the coordination of articles that are thought provoking and give us a greater appreciation of the "Jewel in the Crown" known as Jamaica Bay. I hope you find it as interesting as I have!

Patricia Cerro-Reehil
pcr@nywea.org

The Thayer Hotel, West Point

Highlights of NYC Watershed Science and Technical Conference

The NYWEA annual fall conference on NYC Watershed Science and Technical Conference was a lively and informative program that drew 170 participants from around the state to the historic West Point locale. With the six comprehensive technical sessions offered, a special spotlight was shone on water and wastewater operators this year.

"Operators across the country perform extraordinary and important functions around the clock every day. Part engineers, part chemists, part mechanics and part mathematicians, these operators walk a daily tightrope between disinfection and its by-products, and between waste disposal and environmental protection," commented William C. Harding, executive director of Watershed Protection and Partnership Council (WPPC). "Testing, repairing, adjusting, monitoring and responding to emergencies are all in the daily log for operators," he said. One of the sessions included an overview of the ABC certification exam, inclusive for all grade levels.

NYCDEP experts presented a session on different ways to forecast and assess the impact or probability of climatic changes on the New York City water supply. Another session dealt with the infiltration or causes of phytoplankton in water bodies, and the particular challenges of hydrilla infestation in the Croton River system. A "Muddy Waters" program included an examination of stormwater management design changes in an East-of-Hudson sub-watershed, implementation of stormwater green infrastructure *(see also next page)*, as well as innovative stormwater management at a trash transfer station. Modeling was discussed in regard to documenting long-term water quality data with land conditions; and advancements in ground penetrating radar technology. A number of other important topics for operators and improved facility operations were also presented.

To host this endeavor, NYWEA was joined by its organizing partners: New York City Department of Environmental Protection, WPPC, and NYS Department of State. The conference co-sponsors included, in addition to the aforementioned, the Catskill Watershed Corporation, NYS Department of Environmental Conservation, NYS Department of Health, NYWEA Lower Hudson Chapter, NYS Environmental Facilities Corporation, and the US Geological Survey.

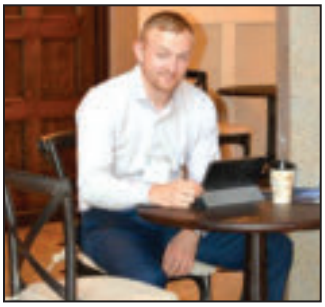
Look to *www.nywea.org* for information on upcoming conferences in 2016, including the 88th Annual NYWEA Meeting in New York City on February 7–10.

WPPC Executive Director William C. Harding welcomes everyone to the Conference.

Deputy Secretary of State Sandra Allen addresses the members and talks about her involvement in the historic watershed agreement.

Executive Director of the Water Research Foundation Rob Renner addresses conference members.

Meredith Taylor of NYCDEP talks about the invasive species hydrilla.



Alex Wright, technical solutions manager of ClearCove Systems, was a presenter on enhanced primary treatment.

Jim Mayfield, of NYCDEP, talks about the exploration and evaluation of long-term water quality data.

NYWEA Officers in attendance: (l-r) Geoff Baldwin, Tom Lauro, Steve Fangmann, Joe Fiegl and Paul McGarvey

Networking in the Exhibit Hall

Lisa Melville, WPPC, celebrates her birthday at the conference.

How to Maintain Green Infrastructure

On Thursday, July 30, 2015, the NYWEA Stormwater Task Force, in partnership with Monroe County Department of Environmental Services and Rochester Institute of Technology (RIT), hosted a training session entitled "Keys to Maintaining Green Infrastructure Systems." Presentations focused on a broad range of topics including: managing bio-retention basins, porous pavement, sustainable landscape management and other green infrastructure practices. Since many of the participants represented communities and institutions struggling to adapt to managing more infrastructure with fewer resources, these topics led to some very meaningful discussions.

The combination of classroom style presentations along with a tour/field trip featuring innovative green practices on the RIT campus, was well received by participants. There were over 30 people in attendance. Comments from the audience included "great tour," "excellent presentations," "great seminar" and, "enjoyed the content and site tour portion."

Directly involved in the event were Michael Garland, PE, NYWEA president, and director of Monroe County Department of Environmental Services (DES), who welcomed participants and kicked off the meeting; and Gregory Liberman, chair of the NYWEA Stormwater Management Task Force, and environmental project manager of Environmental Design and Research, Landscape Architecture, Engineering and Environmental Services, DPC (EDR), who coordinated the sessions and served as primary faculty. Other NYWEA Stormwater Task Force members, Jo Anne Gagliano, RLA, president of EDR; Andy Sansone, industrial waste manager of Monroe County DES; and Michelle Virts, associate engineer of Monroe County DES (also a member of the Stormwater Coalition of Monroe County), served as presenters, provided expert commentary and guided discussions. Karl Korfmacher, associate professor of Environmental Science, RIT; and Enid Cardinal, senior sustainability advisor, RIT, led the afternoon walking tour of built facilities on the RIT campus.

The NYWEA Stormwater Task Force would like to thank all of those who helped make this session a success and looks forward to presenting a similar training session for our NYWEA chapters as part of the Member Education Committee Catalogue of Training, and in future partnerships with other stormwater groups across the state.

Photo by Greg Liberman

Dr. Karl Korfmacher, professor and undergraduate coordinator of Environmental Science at the Rochester Institute of Technology, leads the group on a walking tour of campus green infrastructure practices.

Photo by Greg Liberman

The group gathers along a main pedestrian corridor on the RIT campus where it observes an established bio-retention system, outlet structure and native plantings.

Photo by Greg Liberman

The training session attendees review a newly constructed stormwater wetland system on campus.

Water Views | Fall 2015

The Gem of Jamaica Bay

Jamaica Bay, located in the southernmost part of New York City, is a natural gem of national importance and its restoration is vital. Historic dredging, filling, dumping and polluting have dramatically harmed the bay. Too much nitrogen, with associated algae blooms and low dissolved oxygen (DO), has been discharged to the bay. A number of studies have cited the high levels of nitrogen as a major factor in the bay's dramatic loss of critical marsh island habitats. These marshlands not only serve as prime wildlife habitat, but offer natural resiliency to the mainland against storms, diminishing storm surge and wave intensity. Many Jamaica Bay communities were flooded during Superstorm Sandy. More than half of the approximately 2,400 acres of marsh islands that existed in 1924 have been lost. As marshes decrease and disappear, storm protection is diminished.

A significant portion of the bay and upland areas are owned by the federal government as part of the Gateway National Recreation Area. The NYS Department of Environmental Conservation, New York City Department of Environmental Protection, and the federal Army Corps of Engineers are working on projects to restore these marshland areas. Since 2006, five projects have restored over 150 acres of Jamaica Bay's marsh island habitat, re-establishing ecological and flood protection benefits.

The levels of nitrogen, pathogens and "floatables" being discharged to the bay are being reduced through a multi-pronged approach. The NYSDEC and New York City have established consent order programs that will reduce the amount of nitrogen discharged from the four contributing New York City wastewater treatment plants (WWTPs) by nearly 50 percent. When completed, the city will have spent over $200 million on just the nitrogen treatment upgrades, dramatically reducing the extent of low DO. Bacteria and floatables from combined sewer overflow (CSO) outfalls are another significant problem facing the bay. Large CSO storage tanks at Paerdegat Basin and Spring Creek were installed to hold combined sewage for treatment at the city's WWTPs.

An extensive green infrastructure program to decrease CSOs is underway in many Jamaica Bay communities so that stormwater on the landscape is retained and never reaches the sewers. Because of their proven effectiveness, the city is investing $1.5 billion over the next 20 years to advance green initiatives, with additional benefits achieved through enhanced building code provisions. Still more efforts are underway to enhance CSO controls and reduce polluted runoff – so stay tuned.

The NYSDEC also is engaged in two floodplain projects around Jamaica Bay, using FEMA funding totaling $68 million to restore 151 acres of shoreline and upland along Spring Creek – enhancing the natural area and increasing flood protection for Howard Beach. The NYSDEC works with the Army Corps of Engineers on extensive restoration projects in the Rockaways that will increase resiliency against storms as well.

Improvements on the bay's ecology and coastal resiliency can be achieved at the same time. While all the work is not done, New Yorkers are seeing improvements and reaping the benefits of a healthier Jamaica Bay.

– James Tierney, Assistant Commissioner for Water Resources
NYS Department of Environmental Conservation

Focus on Safety | Fall 2015

Workplace Violence

Violent incidents are, unfortunately, frequently in the news with many cases taking place in a public setting or workplace – also known as workplace violence (WPV). A workplace, whether covered by requirements of the Occupational Safety and Health Administration (OSHA) or another occupational safety and health structure, needs to provide a "place of employment that is free from recognizable hazards that are causing or likely to cause death or serious harm to employees" *(OSHA General Duty Clause)*. Further defined by OSHA, workplace violence is, "any act or threat of physical violence, harassment, intimidation, or other threatening disruptive behavior that occurs at the work site." This could range from verbal abuse to bullying to physical assaults (including homicide). To some degree, WPV is present in many workplaces.

WPV incidents may be categorized into four basic types – those of Criminal Intent, Client/Customer, Employment, or Personal Relationship. Criminal Intent (Type 1) is characterized by violent acts by those with no legitimate connection to the business/organization, such as terrorism, trespass, robbery, and vandalism. Client/Customer (Type 2) cases are those with a loose connection to the organization, such as a client, vendor or customer. Acts may include destruction of property or verbal aggression. Employment (Type 3) is typified by employees (current or past), contractors or others with an employment relationship, and these acts may include bullying, harassment or assault/fighting. Personal Relationship (Type 4) is characterized by those who are not employees, but have a personal connection to an employee, and would include current or former spouses, domestic partners, other relatives, or even friends. These acts are more personal and may result from romantic relationships gone sour, custody issues, or stalking.

WPV incidents may be divided into two major distinctions – those oriented to the organization itself, such as Types 1 and 2; or those connected to an individual, usually Types 3 and 4. There are differences in addressing threats to either the organization or to a person, but the process is the same.

A proven method of reducing risk is the ***Plan-Do-Check-Act*** model developed by W.E. Deming. The *Plan* step identifies the improvement by establishing the commitment to WPV prevention: to evaluate risks and hazards, identify control measures, and determine the resources needed to meet the objectives. The *Do* step implements the plans, programs and procedures. The *Check* action measures and evaluates how well the outcomes meet the objectives. The *Act* step allows regular and periodic tweaking of the processes to foster continuous improvement.

The WPV plan can and should be a part of security planning, emergency action plans, human resources policies, and critical incident response planning. Each person at a facility has a role in the process and the implementation of a solid WPV program to help protect the security of the physical plant and the personal safety of each worker.

– Eileen M. Reynolds, Certified Safety Professional
Owner, Coracle Safety Management

Overview of the Jamaica Bay Watershed – Helping NYC's "Jewel in the Crown" Shine

by Toby Siegman

This issue of *Clear Waters* delves into the history of Jamaica Bay (bay) and its watershed, as well as important initiatives underway to preserve and protect this valuable resource. Jamaica Bay is widely recognized as one of the most bountiful wildlife habitats in the northeastern United States. It is a 31-square-mile water body with a broader watershed of approximately 142 square miles, which includes portions of Kings, Queens and Nassau counties. The bay is a diverse ecological resource that supports multiple habitats, including open water, salt marshes, grasslands, coastal woodlands, maritime shrublands, and brackish and freshwater wetlands. These habitats support 91 fish species, 325 bird species, 50 butterfly species, as well as many reptile, amphibian and small mammal species. Jamaica Bay is part of Gateway National Park, and is cooperatively managed by the National Park Service, the US Department of Interior and the City of New York. This "jewel in the crown" of the national and city park systems serves as a vital source of recreation or leisure activities, educational programs and scientific research.

Jamaica Bay is widely recognized as one of the most bountiful wildlife habitats in the northeastern United States.

Unique Environmental Challenges

The proximity of Jamaica Bay to New York City's urban environment presents unique environmental protection challenges. The New York City Department of Environmental Protection (NYCDEP) owns and operates four wastewater treatment plants (WWTPs) and two combined sewer overflow facilities along Jamaica Bay and its tributaries, which play an essential role in protecting public health as well as the ecology and habitat of the waterway. The WWTPs have a combined design capacity to treat up to 340 million gallons of wastewater per day on a dry weather basis. At a cost of $230 million, NYCDEP is implementing advanced technology at its four WWTPs to reduce daily nitrogen discharges by up to 60 percent.

Nitrogen is a naturally occurring element that is found in food and other organic materials and is present in wastewater when it enters treatment plants. Because nitrogen is not a pathogen and poses no threat to human health, the WWTPs were not originally designed to remove it from the treated water before it is discharged into the receiving water body. However, high levels of nitrogen can degrade the overall ecology of a waterway by reducing the dissolved oxygen levels and promoting excessive algal growth, especially during warm weather. The NYCDEP has facilitated a greater than 30 percent reduction in nitrogen discharges into Jamaica Bay since the mid-1990s, demonstrating the department's long-term commitment to improving water quality by investing in cutting-edge technology and the ecological restoration of New York City's natural habitats. Learn more about NYCDEP's biological nitrogen removal program in this issue's "Battle of the Bulge" article.

The investment in nitrogen reduction technology is only one of many ongoing projects NYCDEP is undertaking to improve the health of Jamaica Bay. The NYCDEP's Jamaica Bay Watershed Protection Plan (JBWPP) provides a holistic assessment of completed, ongoing and future initiatives to further improve water quality and restore natural ecological functions within the bay. The JBWPP, first issued in 2007, was updated in 2014 and includes WWTP upgrades, oyster and ribbed mussel pilot projects, wetlands restoration, a marsh island wave attenuator study, green infrastructure projects, area-wide sewer upgrades, and geographic information system mapping. The critical work described in the JBWPP will be accomplished through partnerships among many different levels of government, local educational institutions, environmental leaders and dedicated community groups. The updated JBWPP is intended to serve as a blueprint for the future management of the bay and its watershed in order to achieve a shared vision for Jamaica Bay. The Jamaica Bay Watershed Protection Plan Update may be viewed at: *http://www.nyc.gov/html/dep/pdf/jamaica_bay/jbwpp_update_10012014.pdf.*

Learn more and keep current about NYCDEP initiatives in Jamaica Bay and the historical significance of, and impacts to, its watershed by reading the articles that follow. Many thanks are offered to the authors of this edition for their hard work and commitment!

Toby Siegman, PE, is a civil engineer with the New York City Department of Environmental Protection, Bureau of Wastewater Treatment (tsiegman@dep.nyc.gov). She was raised in the Jamaica Bay neighborhood of Canarsie, which is named after the Native American tribe that originally inhabited the area (http://www.oxforddictionaries.com/definition/english/Canarsie).

Little egret stands in the waters of Jamaica Bay Wildlife Refuge, Queens. *Photo: bigstockphoto.com; copyright: Francois Roux*

Background photo: Scenic Jamaica Bay wetland, part of Gateway National Park *Photo courtesy of Hazen and Sawyer*

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Rev. 7/16/15

Watershed Plan Protects and Preserves Jamaica Bay's Diverse Ecological Heritage

by John McLaughlin

The region surrounding New York Harbor is the undisputed global economic center with its treasured and diverse economic, cultural and ethnic resources. These resources have helped to shape the region into the vibrant and ever-changing metropolis that it is today. However, there is another very important and often under appreciated aspect which remains largely unnoticed. Some do not truly recognize what greatly defines the region and embodies the values we all share, and that is the area's diverse ecological heritage. When Henry Hudson first entered New York Harbor in 1609, he was greeted with a breathtaking and amazing display of ecological diversity and natural beauty that is difficult to imagine when entering the harbor today. Although significantly transformed, an ecologically diverse and vital ecosystem still remains today in many parts of the harbor, albeit on a much smaller scale, but nonetheless serving a critical function. To support development, housing and transportation hubs over the last 150 years, anthropogenic changes have significantly changed the ecosystem and, in most situations, have altered these once unmatched natural and diverse ecosystems irreversibly. The dichotomy of a functional and thriving ecosystem surviving despite profound anthropogenic changes to the environment is most evident within Jamaica Bay, one of the largest coastal wetland ecosystems in New York State.

The Jamaica Bay watershed drainage area is approximately 91,000 acres (140 square miles), with an average impervious surface covering 72 percent, and possessing a population of nearly 2.5 million people. Prior to Euro-American settlement, it is estimated that there were about 16,000 acres of salt marsh in Jamaica Bay *(US Fish and Wildlife Service, 1997)*. As of 1971, only about 4,000 acres of salt marsh remains in the bay *(National Academy of Sciences and National Board of Engineering, 1971)*. Today, approximately 1,000 acres of wetlands remain.

Jamaica Bay was established by Robert Moses as a New York City Park and transferred to the National Park Service (NPS) in 1972 with the formation of the Gateway National Recreation Area. A significant portion of the bay, approximately 9,100 acres, has also been designated by the NPS as the Jamaica Bay Wildlife Refuge and is designated by the New York State Department of State as a Significant Coastal Fish and Wildlife Habitat. Once a shallow estuary, the morphology and hydrodynamics of the bay and its tributaries have been substantially altered by dredging to create navigation channels and to obtain fill material for reclaiming wetlands for development. Over 12,000 acres of the original 16,000 acres of wetlands were lost to these efforts. Navigation channels exist throughout the bay proper and deep "borrow" sites with seasonally poor water quality can be found proximate to JFK airport. Virtually all of the tributary creeks and basins around the bay have been altered in this way.

Nature is resilient and has a large capacity for buffering, but she is not "unbreakable." However, in spite of the significant and evolving changes, Jamaica Bay remains an invaluable natural resource and an ecological powerhouse not only for the region, but also internationally. The bay has evolved over the last 25,000 years as an important and complex network of open water, salt marsh, grasslands, coastal woodlands, maritime shrublands, brackish and freshwater wetlands, and serves as an important ecological resource

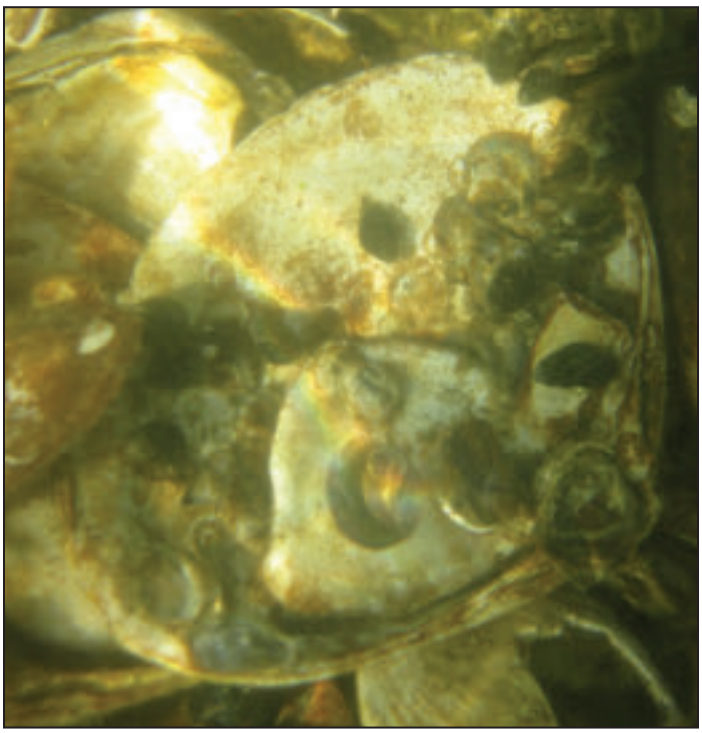

Photo courtesy of NYCDEP

The reintroduction of oyster spat (young) on shell is seen after two months on a 10' x 15' oyster bed constructed off of Dubos Point, Queens.

Photo courtesy of NYCDEP

Oyster spat on shell seen on a 1.75' x 2.5' reef ball made of concrete to take the place of declining reef surfaces on which oysters attach and grow.

for flora and fauna and the local human population. In addition to the natural pollutant attenuation and protection from tidal flooding it provides, the wildlife found here is commensurate with this complex network of natural systems, as evidenced by the 91 species of fish, 325 species of birds (of which 62 are confirmed to breed locally) and 54 species of butterflies; and it is an important habitat for many species of reptiles, amphibians and mammals. The bay is a critical stopover area along the Atlantic Flyway migration route and is one of the best birdwatching locations in the western hemisphere. The 20,000 acres of water, islands, marshes and shorelines support seasonal or year-round populations of 214 species of special concern, including state and federally endangered or threatened species.

Over the last 15 years, substantial investments have been made by New York City, including wastewater treatment upgrades and sewer system improvements that have resulted in measurable water quality improvements. These improvements have helped bring to light what is possible in terms of ecological restoration with the potential for it on a grand scale, and habitat improvements in what is already a valuable ecological hotspot. Thoughts of even considering oyster or submerged aquatic vegetation (SAV) restoration 20 years ago would have been considered impossible to achieve. The water quality of Jamaica Bay has greatly improved to the point where these are not only possible, but demonstration pilots to gather additional information on future restorations have already begun.

Jamaica Bay Watershed Plan

The geographic proximity of New York-New Jersey Harbor Estuary has defined its rich and ecologically diverse habitat. The region straddles the transitional boundaries of two distinct ecotones or plant communities. New York City is on the southern boundary of the Eastern Broadleaf Forest ecotone; and on the northern boundary lies the Coastal Plain Forest ecotone. The overlapping of these two ecotones not only results in greater ecological diversity than in the individual ecotones, but affords greater adjacent ecological community restoration opportunities and other enhanced benefits. For example, a scientific survey taken in June 2010 identified more bird species in the Jamaica Bay Wildlife Refuge than are found in Yellowstone and Yosemite parks combined. Nearly half of all the bird species found in North America thrives in the bay refuge.

Through collaborative partnerships, the New York-New Jersey Harbor Estuary can and has already become a more sustainable resource for all future generations to enjoy. However, to continue to realize these goals, many steps are required and a consensus of federal, state and local agencies is required.

While there are many daunting challenges to restoring further these once highly diverse ecological communities, the New York City Department of Environmental Protection (NYCDEP) and professional environmental representatives from federal, state and local agencies have not been deterred to help push forward the ecological process. As some of these systems have been long extirpated from the region, or have been so severely altered as to make them unrecognizable at first glance, an understanding is required of how their re-establishment can be accomplished within the new altered environmental context. To that end, the invaluable experiences of local restoration practitioners help to reinstate the region's natural heritage, while much research has gone into identifying community types for restoration, future goals and documentation of the biological requirements of indigenous ecosystem communities.

The current preservation and protection efforts within Jamaica Bay have engaged the efforts of federal, state and city governments and a strong and active network of community organizations and environmental advocates. However, the protection of Jamaica Bay as an environmental resource presents significant challenges. This is because Jamaica Bay is intimately connected to its vast watershed and the uses and activities contained within it. On average, the four Jamaica Bay wastewater treatment plants (WWTPs) treat about 240 mgd of sanitary flow but have a design dry weather capacity of 340 mgd with a wet weather capacity of 680 mgd. In the mid-1990s, prior to any BNR upgrades, the plants were discharging over 50,000 lbs/d of nitrogen in the bay and this, coupled with poor circulation due to the Rockaway peninsula and other anthropogenic constrictions, resulted in hypoxic conditions in certain areas of the bay. Today, the 12-month rolling average nitrogen discharge is down to approximately 28,000 pounds of nitrogen – a 44 percent reduction. When all the upgrades are completed, NYCDEP projects a nearly 60 percent reduction from baseline conditions.

While the environmental movement has been going strong for nearly 40 years, it is only in recent memory that true appreciation and value have been placed on the local ecologically diverse urban landscape of the harbor and the important ecological services the area provides. Recognizing the importance of this natural heritage has ultimately rekindled and renewed the spirit and obligation of citizens to help protect it. To help put this into action, Local Law 71 (LL 71), signed by Mayor David Bloomberg on July 20, 2005, tasked the NYCDEP to develop the Jamaica Bay Watershed Protection Plan (JBWPP). The plan assesses the technical, legal, environmental and economic feasibility of a variety of natural and gray infrastructure protection measures within the bay itself and within the 140-square-mile upland watershed. The purpose of the JBWPP is to develop a comprehensive watershed approach with specific action strategies for restoring, maintaining and protecting water quality; to improve and sustain the ecological integrity of the bay; and to provide public education and access now and into the future. The plan's main process goals are to:

- Improve water quality
- Protect, restore and enhance wetlands and upland ecosystems
- Protect, maintain and restore fish and wildlife habitats
- Preserve and enhance public use and enjoyment
- Provide public education and outreach
- Ensure sound land use practices on the bay perimeter and surrounding watershed
- Foster local watershed stewardship

The JBWPP is a living document that is regularly updated every two years to provide information on the status of the health of the bay, progress toward implementing the identified goals and strategies, assessment of new research information, and restoration techniques. To provide additional insight and expertise into the process, an advisory committee was formed to assist NYCDEP in development of the JBWPP. The Jamaica Bay Watershed Protection Plan Advisory Committee (JBWPPAC) was composed of seven members and the group was responsible, in part, for representing the broader public interest in the process. Member representation included federal and local academic institutions and environmental stakeholder groups.

The NYCDEP has traditionally solved the city's need for water and wastewater services with large infrastructure solutions. Much

continued on page 14

continued from page 13

of its current infrastructure system is a testament to these historic engineering marvels, such as the city's magnificent high quality drinking water supply system and colossal wastewater system that led to major improvements in the quality of the city's water bodies. Today, new infrastructure projects come at a significant cost, while achieving more modest incremental improvements. Therefore, the agency is looking for decentralized and integrated solutions that might be more financially and environmentally sustainable. In its approach, NYCDEP views ecology and sustainability as central themes in protecting and preserving Jamaica Bay.

The issues facing Jamaica Bay are expected to evolve, and these will be identified and addressed in regular plan updates. The JBWPP is intended to serve as a blueprint for the future management of the bay and its watershed and to achieve a shared vision for Jamaica Bay. The plan has identified a total of 127 strategies designed to improve water quality, ecology, biodiversity, education and public access to the bay. Several of these strategies include pilot studies of natural systems for water quality and the co-benefits of habitat improvement, such as: oysters, eelgrass, the Algal Turf Scrubber® and ribbed mussels.

Oysters: Re-introducing oysters to Jamaica Bay could potentially help regenerate the natural environment of the bay, once teaming with oysters, while providing additional water quality benefits. The goals of the Oyster Pilot Study were to demonstrate the effectiveness of water quality and ecological benefits from oyster habitats, demonstrate effectiveness of safeguards to avoid "attractive nuisance" problems and develop information on the requirements of restoring such a significant habitat type. Additionally, NYCDEP wanted to measure growth, survival, reproduction and recruitment under real world conditions exposed to predators – unlike smaller caged oyster studies.

In October 2010, NYCDEP conducted two oyster reintroduction pilot studies within Jamaica Bay – the design and construction of an oyster bed (10' x 15') off of Dubos Point, Queens, and the placement of oyster reef balls in Gerritsen Creek, Brooklyn. *(See photos on page 12.)* These oyster pilot projects were conducted to evaluate whether climatic and environmental conditions within the bay are suitable for oyster growth, survival and reproduction. The study also measured how effective these bivalves are at filtering various pollutants that affect the bay, such as nitrogen, other nutrients, and particulate organic matter. The sites were monitored on a bi-weekly basis through 2013 to determine if the oysters could survive, grow, reproduce and provide water quality and ecological benefits. Monitoring activities included discrete and continuous water quality sampling, photo/video documentation, site maintenance, and investigation of sediment and current patterns. While continuous monitoring has ceased, an assessment of the site in early Summer 2014 revealed that many oysters, in their fourth year of growth, were still alive and appeared healthy.

During Summer 2012, several oysters were tested for the presence of *Perkinsus marinus* (a pathogen known to cause dermo or perkinsosis) and a spore-forming protozoan known as *Haplosporidium nelsonase*. The oysters tested were found to be relatively disease free. While the results also indicated that the oysters had, in fact, reproduced, no recruitment was observed. This lack of recruitment remains a significant data research gap and must be addressed prior to ramping up further oyster restoration efforts. The answer, according to NYCDEP, may lie in the scale of current oyster reintroduction efforts. To help collect additional information on oyster recruitment, NYCDEP has received additional funding from the US Department of the Interior to implement a nearly half-acre oyster bed installation specifically designed to evaluate potential oyster recruitment by creating donor and receiver beds. Working with local academic institutions and environmental stakeholder groups, NYCDEP will begin design of this project in Fall 2015 and begin installation during Spring 2016. The department expects this project will provide valuable insight of oyster recruitment and future oyster implementation efforts.

Photo by Chris Pickerell, Cornell Cooperative Extension-Suffolk Co.

Blue mussel spat colonizing eelgrass leaf blades

Photo by Chris Pickerell, Cornell Cooperative Extension-Suffolk Co.

Cluster of newly planted eelgrass plants

Eelgrass: Submerged aquatic vegetation (SAV) beds are import-

ant for a number of fish and shellfish species. For this reason, the JBWPP initiated a pilot study for determining the potential of restoring SAV in Jamaica Bay. The goals of this study were to determine whether it was even possible to re-introduce eelgrass *(Zostera marina L.)* into Jamaica Bay given the significant physical alterations to the bay and the required habitat. Working with Cornell Cooperative Extension of Suffolk County, the study identified appropriate site selection parameters, limiting factors to establishment and growth, the most effective planting method(s), appropriate donor materials and the optimal planting season.

Over the four-year study, ultimately all plantings failed (not immediately, but eventually) for a variety of reasons, including decreased light penetration in eastern sections of the bay, bioturbation effects and hydrodynamics. However, not all the news was bad, as the effort enabled NYCDEP to learn what does and doesn't work in Jamaica Bay and to determine better planting methods and seasonal timing. The study also established that water quality is not limiting to eelgrass growth in western sections of the bay.

It is likely that the mortality experienced among the various planting populations throughout the bay were due to a number of site specific conditions. For example, monitoring results suggested that water quality at the Breezy Point location appeared to be suitable for growth and that plant mortality was attributable to blue mussel colonization and strong sediment movement (sand waves) that buried many of the tender shoots. During Fall 2011, there was an unusually large population of blue mussel larvae all along the east coast. This was a major contributor to the demise of the planting due to the larvae attaching to the eelgrass blades and reducing the ability of the plant to photosynthesize.

Algal Turf Scrubber

An Algal Turf Scrubber (ATS) was constructed at the Rockaway WWTP, a plant located on Jamaica Bay. The ATS is a patented water treatment technology developed by Dr. Walter Adey and held by the Smithsonian Institution with licensing to Hydromentia.

The ATS uses algae to filter pre-chlorinated WWTP effluent for nutrient removal. The purpose of the study was to determine the effectiveness of the system at removing nutrients, carbon and other pollutants and to identify potential beneficial uses of the algae collected.

In September 2010, the pilot was successfully constructed and operated for two growing seasons, demonstrating good pollutant removal rates. It was also found that the algae could be harvested and converted to biofuel. Using the algae harvested from the study, one liter of butanol was produced. The ATS used algae to filter nutrients from a small portion of the Rockaway WWTP effluent flow (2,400 gallons per hour maximum).

The ATS pilot system mimicked a stream ecosystem in a constructed environment designed to promote algal growth. It consisted of an inclined floway – a long, slightly sloped, shallow trough made of waterproof materials and raised on a support frame – and a screen liner. Wastewater effluent was pumped into the floway in regular pulses and the algae took up nutrients, carbon and other pollutants from the source water while producing high levels of oxygen that oxygenated the effluent.

Periodic harvesting of the algal turf removed nutrients and pollutants from the system while stimulating continued algal growth and increasing algal uptake efficiencies. Algae collected throughout the life of the project was sent to the University of Arkansas

continued on page 16

continued from page 15

Photo by Biohabitats, Inc.

Overview of algal turf scrubber showing two floways

for processing into butanol. Monitoring results indicated that approximately 2.13 kg/m^2 of nitrogen, 0.32 kg/m^2 of phosphorus, and 13.65 kg/m^2 of carbon were removed from the water and captured in the algae in 2012, with daily algae productivity averaging approximately 13 g/m^2/day. Of this, approximately 70 kg of dry algae were harvested and sent to the University of Arkansas for conversion to biofuel.

Photo by Biohabitats, Inc.

Algae being harvested from ATS floway

Ribbed Mussels: The discharge from combined sewer overflows (CSOs) and WWTPs contain organic particulates, nutrients, and undesirable chemical contaminants. Filtration of these discharges by ribbed mussels could potentially remove substantial quantities of these constituents that accumulate in water and degrade water quality. While the filtering capacity of ribbed mussels is well known, it is unclear whether that capacity can be adapted to the practical application of filtering discharges to improve water quality. The NYCDEP has undertaken this pilot study to evaluate if a "wall" of ribbed mussels could be built to support a sufficient ribbed mussel population to carry out effective filtration and improve water quality.

Several artificial structures were constructed in Fresh Creek, a tributary to Jamaica Bay, to encourage the growth of ribbed mussels. Started in July 2011, the study monitored ribbed mussel growth and water quality to measure their effectiveness in removing nutrients and particulate organic matter from the water. Monitoring and data analysis continued through late Fall 2014. Naturally recruited mussel spat, i.e., mussel larvae, was observed beginning in June 2012. The spat was generally observed to occur in the nooks and crannies of the cargo netting and metal pilings. In the last count of mussels in Summer 2014, over 150 mussels were observed to have set on the structures. While this is well below the expected colonization density, the structure may need to reach a biological threshold before full colonization can occur. The structure will remain in place and further assessments of ribbed mussel density will be made in the future. Should there be sufficient densities, measurement of potential water quality improvements could be undertaken.

Photo courtesy of NYCDEP

Buoys are seen protecting installed ribbed mussel array at Fresh Creek, a tributary to Jamaica Bay, to encourage mussel growth.

Photo courtesy of NYCDEP

Close up view of attached ribbed mussels

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Improving Plant Performance and Reliability for the Jamaica Wastewater Treatment Plant

by Alyki Malliaros, Carl Lagasca and Kevin Clarke

At the end of the nineteenth century, the emergence of Jamaica Bay as a recreation area, complete with beaches, hotels, restaurants, and amusement parks motivated the construction of New York City's first municipal wastewater treatment plants (WWTPs).[1] The original Jamaica WWTP, built in 1903 in the Jamaica area of Queens, was one of the city's initial treatment facilities that discharged into the Jamaica Bay and was strategically located in proximity to widely used public beaches.[2] The plant was originally designed to provide primary treatment with chemical coagulation and chlorine disinfection for an average design flow of 1 mgd.[3] While the initial motivation of the city's first WWTPs was to protect public bathing areas and the health of beach goers, the establishment of the Metropolitan Sewage Commission and the newly found link between waterborne bacteria and diseases soon shifted the focus to the maintenance of water quality.[2]

The first major expansion and facility upgrades of the Jamaica WWTP occurred in 1926 when the original plant was demolished and new facilities including a grit chamber, a fine-screenings chamber, a pumping station and a chlorination facility were constructed. These new facilities were designed to treat an average design flow of 50 mgd that would still discharge to Jamaica Bay. No other major modifications were implemented until 1940.[3]

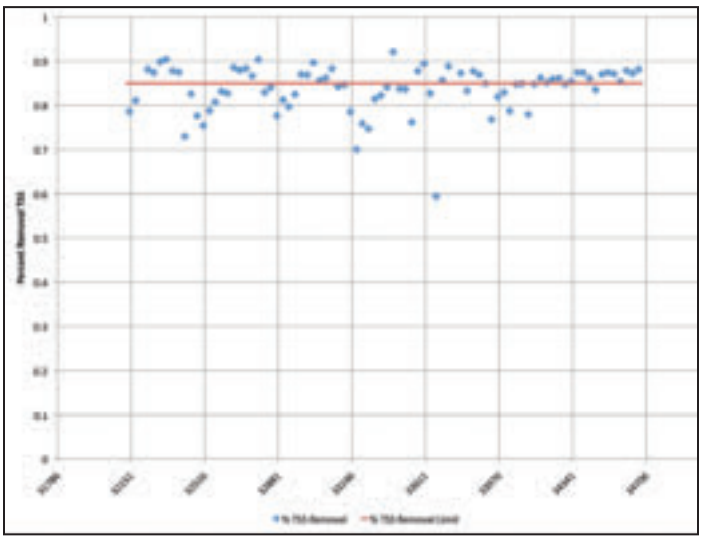
In 1940, the Department of Public Works upgraded the Jamaica WWTP to a 65 mgd modified aeration plant. New facilities included a blower and power building, a new chlorination building, a screenings dewatering building, four aeration tanks, eight final settling tanks, two sludge thickeners, and 12 sludge digesters. The plant was also designed to provide a 65 percent reduction of suspended solids (SS) and biochemical oxygen demand (BOD).[3]

As the population of Queens continued to grow, the plant became overburdened. It was upgraded in the 1960s to provide increased hydraulic capacity, with primary treatment and disinfection for average annual and peak flows of 100 and 200 mgd, respectively, and secondary treatment for flows up to 150 mgd. Upgrades included conversion of the secondary treatment facilities to step-feed aeration. In addition, the modifications provided for 85 percent removal of BOD and SS.[3]

The 1970s saw further modernization of the plant and the construction of an additional gravity thickener to meet new federal treatment mandates.[3]

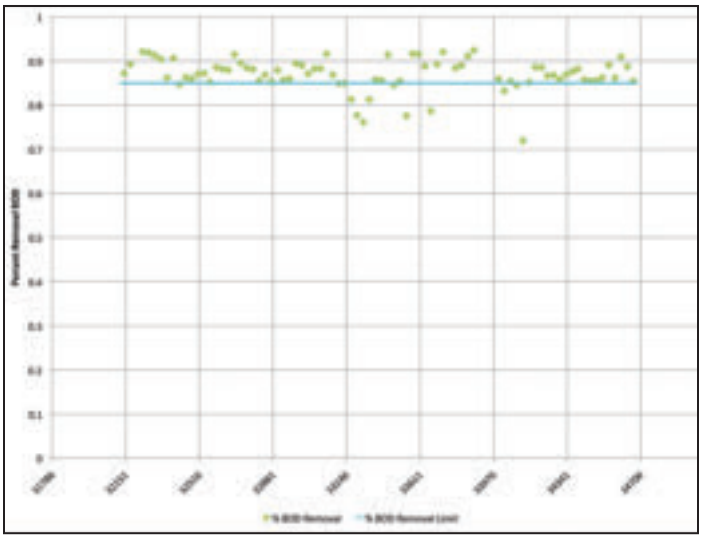
Stabilization Study

By the late 1980s, the plant was experiencing a number of problems that rendered it unable to meet its mandated discharge standards of 85 percent removal of TSS and BOD from its effluent discharged to Jamaica Bay. Deficiencies included inadequate hydraulic capacity to meet peak flow demands, odor problems, inefficient equipment, and outdated instrumentation and controls. Of particular concern was the unequal flow and solids distribution between the primary sludge tanks (PSTs), which caused two of the four PSTs to take most of the flow and solids loading. During this period, the plant regularly exceeded effluent limits for TSS and BOD as can be seen in ***Figures 1*** and ***2***. In the figures, data points that are below the solid permit limit lines indicate months in which the plant exceeded its permit.



Graph courtesy of AECOM using NYCDEP data

Figure 1. Jamaica WWTP Percent Total Suspended Solids Removal from 1988-1994



Graph courtesy of AECOM using NYCDEP data

Figure 2. Jamaica WWTP Percent Biochemical Oxygen Demand Removal from 1988-1994

In light of these deficiencies, the New York Department of Environmental Protection (NYCDEP) implemented a stabilization program with the goal of improving plant performance and reliability. As part of the stabilization program, NYCDEP commissioned AECOM (formerly Metcalf and Eddy) to conduct a study to identify operational and design issues, evaluate alternatives for correcting the various deficiencies, and recommend a means of implementing the suggested remedial measures. The program, which ran from 1989 to 1991, determined a number of specific plant improvements that would be required to stabilize the plant's performance, ranking them in order of priority. The outcome of the program was a two-phased construction upgrade approach, with the most pressing issues being addressed under Phase 1, and the

continued on page 20

continued from page 19

remaining deficiencies corrected under Phase 2. The engineering design services for the Phase 1 and Phase 2 stabilization upgrades were further contracted with AECOM.

Phase 1 Stabilization Upgrades

Design of the Phase 1 contract was performed between 1995 and 1996. As part of the Phase 1 upgrades, several new facilities were designed specific to increasing the plant's hydraulic capacity and improving the plant's process performance. These included: new main sewage pumps (MSPs) with variable frequency drives; new primary splitter box; an additional primary settling tank with sludge and scum collectors, primary sludge pumps, piping, valves, controls, and other appurtenances; new return sludge pumps with variable frequency drives; new waste sludge pumps; new sodium hypochlorite feed and storage system including new chlorine contact tank, feed system, dilution water pumps, sodium hypochlorite transfer pumps, storage tanks; as well as new odor control systems including packed towers, fans, pumps, storage tanks, piping, valves, and associated accessories. ***Figures 3A*** and ***3B*** show some of the construction involved in the Phase 1 primary treatment system upgrades.

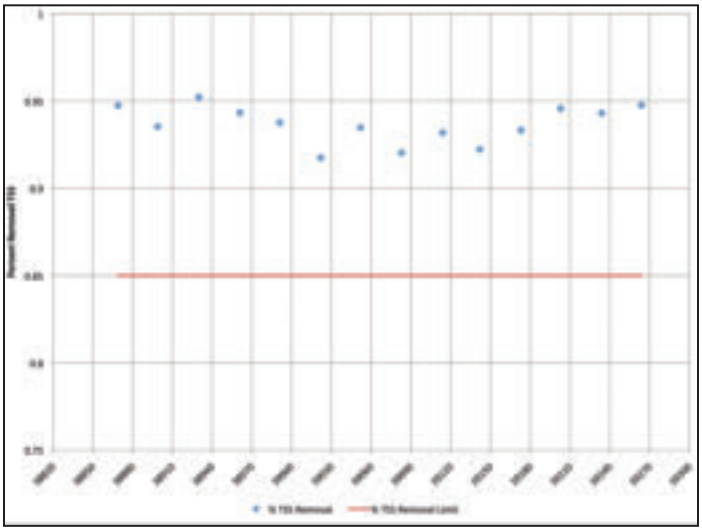
Courtesy of AECOM

Courtesy of AECOM

Figures 3A and 3B: Construction of the Phase 1 primary treatment upgrades, including the new primary splitter box (top) and the new primary settling tank (bottom)

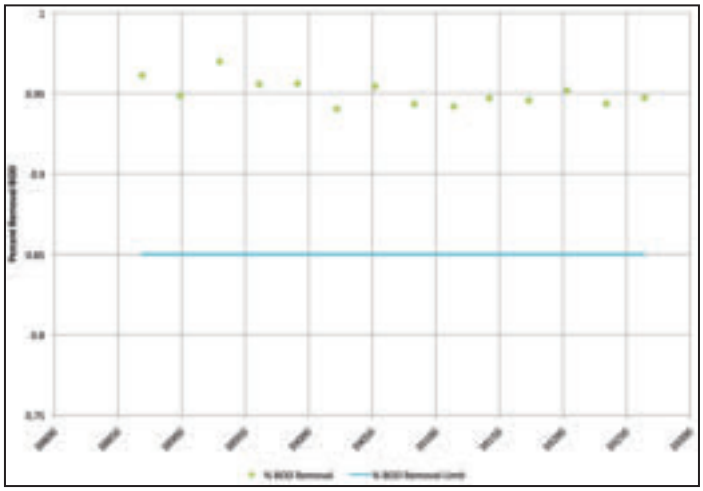
Phase 1 Performance Evaluation

Construction of the Phase 1 upgrades reached substantial completion in July 2006. Subsequent review of plant performance during a year-long certification period, spanning from July 15, 2006 to July 15, 2007, revealed significant improvement in plant performance when compared against baseline pre-Phase 1 conditions. As seen in ***Figure 4*** and ***Figure 5***, percent TSS and BOD removals were above their respective limits of 85 percent removal. The average percentages of TSS and BOD removal during the certification period were 93 percent and 94 percent, respectively.



Courtesy of AECOM

Figure 4. Percent TSS Removal during the 1-Year Certification Period after Completion of Phase 1 Stabilization Upgrades



Graph courtesy of AECOM using NYCDEP data

Figure 5. Percent BOD Removal during the 1-Year Certification Period after Completion of Phase 1 Stabilization Upgrades

Phase 2 Stabilization Upgrades

The Phase 2 stabilization upgrades addressed the remaining deficiencies not remedied under Phase 1. The Phase 2 design began in 2004 and was completed in 2005. The project's scope of work included a new sludge screening building with a new primary sludge screening system; degritted sludge wet well; degritted primary sludge pumping system; residuals containers and container conveying system; new final settling tank peripheral energy dissipating inlet baffles; new sludge blanket indicators; new gravity belt thickener (GBT); as well as aeration tank instrumentation and process air control improvements. ***Figure 6*** shows an aerial view of the Jamaica WWTP during construction of the Phase 2 improvements.

Courtesy of NYCDEP

Figure 6. Aerial view of the Jamaica WWTP during construction of Phase 2 improvements project

As part of its commitment to protecting the Jamaica Bay watershed, NYCDEP saw an opportunity to increase plant process performance by addressing the nitrogen concentrations in its effluent. Since nitrogen, which is a naturally occurring element, is not a pathogen and does not pose a threat to human health, New York City WWTPs were not originally designed to remove it. However, nitrogen promotes eutrophication of the surface waters and the excessive growth of algae blooms in the bay, which can result in various water quality deficiencies, such as low dissolved oxygen levels (hypoxia), loss of biodiversity, and murky waters.

In 2011, during construction of the Phase 2 upgrades, NYCDEP entered into the First Amended Nitrogen Consent Judgment (FANCJ) with the New York State Department of Environmental Conservation (NYSDEC). As part of this agreement, NYCDEP was required to upgrade the Jamaica WWTP to operate Level 2 biological nitrogen removal (BNR) in order to reduce nitrogen discharges from the facility into Jamaica Bay. Biological nitrogen removal is a process by which the organic nitrogen found in wastewater is converted to nitrogen gas (N_2) that can be released harmlessly into the atmosphere instead of being discharged into a receiving body of water. Level 2 refers to the minimum treatment technology that must be installed and operated at the plant. More specifically, Level 2 treatment entails the installation of baffle walls, mixers in anoxic zones, multiple froth control systems, wet weather tank controls, as well as upgrades to the return activated sludge (RAS) system and process air capacity based on the existing plant's footprint.[4]

The FANCJ represents the culmination of several years of joint efforts between NYCDEP and NYSDEC to improve the water quality in Jamaica Bay. A timeline for implementation of BNR was established, with the mandate requiring BNR startup at Jamaica by December 31, 2014.

At NYCDEP's request, AECOM redesigned the aeration system to comply with the requirements of the FANCJ, converting the plant from conventional step-feed aeration to Level 2 step-feed BNR, via change order to the Phase 2 Stabilization Program Contract. These BNR upgrades included modifications to the existing process air blowers to improve dissolved oxygen (DO) control; new air distribution piping sized to accommodate the higher BNR air flow requirements; new tapered air diffuser grid patterns modified to facilitate the installation of tank baffles; new overflow and underflow baffles

continued on page 22

continued from page 21

installed within the aeration tanks to establish specialized process zones (anoxic, switch, pre-anoxic, and oxic); new hyperbolic mixers installed in the anoxic, switch, and pre-anoxic zones to allow for complete mixing without aeration; and, finally, new surface waste activated sludge (SWAS) pump stations and other froth control modifications to control the growth of foam in the aeration tanks.

Figures 7A and ***7B*** show the new froth hood and baffle wall installations in the aeration tanks.

Courtesy of NYCDEP

Courtesy of NYCDEP

Figures 7A and 7B. Aeration tank upgrades to accommodate BNR (biological nitrogen removal) at the Jamaica Bay plant: froth hoods (top) and overflow/underflow baffles (bottom)

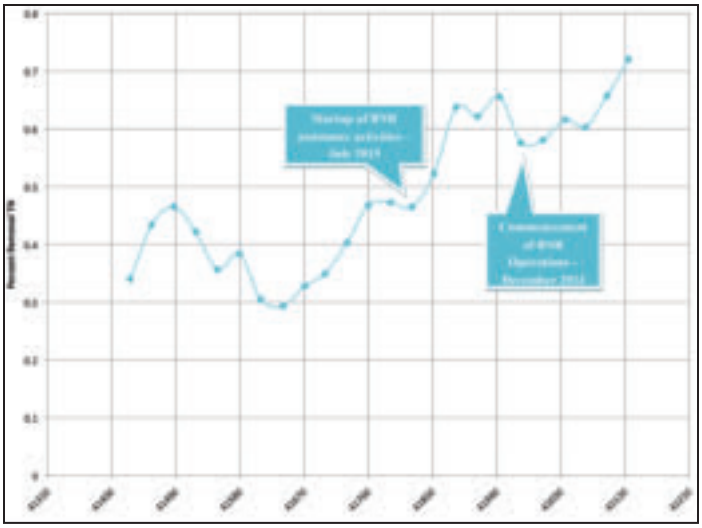
Evaluation of Phase

Starting in July 2014, with technical process support from AECOM, the NYCDEP plant operations staff began its preparations for the commencement of BNR operations at the Jamaica Bay WWTP. Support activities focused on how to operate new and existing equipment at the aeration tanks ***(Figure 8)*** in a manner consistent with Level 2 BNR, including gate settings, wasting protocols and air balancing.

At the end of 2014, most of the $83 million BNR construction upgrades were near completion, and on December 1, 2014, NYCDEP certified the commencement of Level 2 BNR operations at the plant, one month ahead of the judgement milestone date.[5,6] Substantial completion for the remaining Phase 2 improvements is scheduled for the end of 2015.

Courtesy of NYDEP

Figure 8. Jamaica WWTP aerial of completed aeration tanks



Graph courtesy of AECOM using NYCDEP data

Figure 9. Total Nitrogen Removal from June 2013 through June 2015

Figure 9 shows the percent removals of total nitrogen for the period starting June 2013 and ending May 2015. According to the graph, between June 2013 and July 2014, the plant was averaging 39 percent removal of total nitrogen. After startup, the plant saw increased removal of nitrogen with the average removal between July 2014 and May 2015 being 61 percent.

Future of the Jamaica WWTP

With the majority of the original stabilization upgrades completed, Jamaica is successfully operating below its SPDES discharge permit limits. Furthermore, ongoing BNR operations at the facility are expected to reduce the amount of nitrogen discharged to the bay by approximately 6,500 pounds per day or an estimated 2.5 million pounds per year.[5] As seen by these results, NYCDEP's forward thinking and planning for the Jamaica WWTP have played a significant role in the protection of and the future conditions of Jamaica Bay.

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Bergen Basin Bending Weirs Reduce CSOs

by Charles Wilson, Frank Ayotte, Peter Young and Keith Mahoney

The New York City Department of Environmental Protection (NYCDEP) is under an Order of Consent issued by the New York State Department of Environmental Conservation (NYSDEC) in 2005 to reduce combined sewer overflows (CSOs) throughout New York City's combined sewer systems. The city has the overall goal of taking a comprehensive watershed-based approach to long-term CSO control planning to address the impacts of CSOs on the water quality and use of the waters of New York Harbor and to achieve compliance with the provisions of the Clean Water Act and Environmental Conservation Law. The City of New York's ongoing CSO Long Term Control Plan (LTCP) Project has produced recommendations for each of the city's 18 water bodies and 14 wastewater treatment plants (WWTPs) service areas in order to reduce CSO discharges throughout the New York Harbor. Final LTCPs are currently under development, but some interim cost effective CSO reduction measures have already been identified to achieve earlier benefits prior to finalization of the LTCPs.

The NYCDEP owns and operates sanitary and combined sewer systems that discharge to various WWTPs, which provide treatment capacity for up to two times the respective WWTP's design dry weather flow (2DDWF). The NYCDEP's combined sewer system includes various CSO structures, referred to as regulators, designed to provide hydraulic relief during large storm events that exceed the 2DDWF, and discharge combined flows to surface waters. In the Jamaica WWTP service area, of the 10 regulators, regulators JA-3 and JA-14 in the West Interceptor and regulator JA-6 in the East Interceptor, were selected for modifications for CSO reduction. The regulator modifications consist of retrofitting the existing structures with bending weirs.

The study area is located in the Queens borough of New York City. The service area for the Jamaica WWTP is shown in dark green in ***Figure 1***, and is comprised of 25,521 acres. Approximately 21 percent (5,386 acres) of the total area is serviced by combined sewers; 8 percent (2,077 acres) transports runoff directly into nearby water bodies (direct drainage); and 71 percent (18,058 acres) is serviced by separate storm and sanitary sewers. In total, the area is serviced by 211 miles of combined sewers, 512 miles of sanitary sewers, and 198 miles of storm sewers.

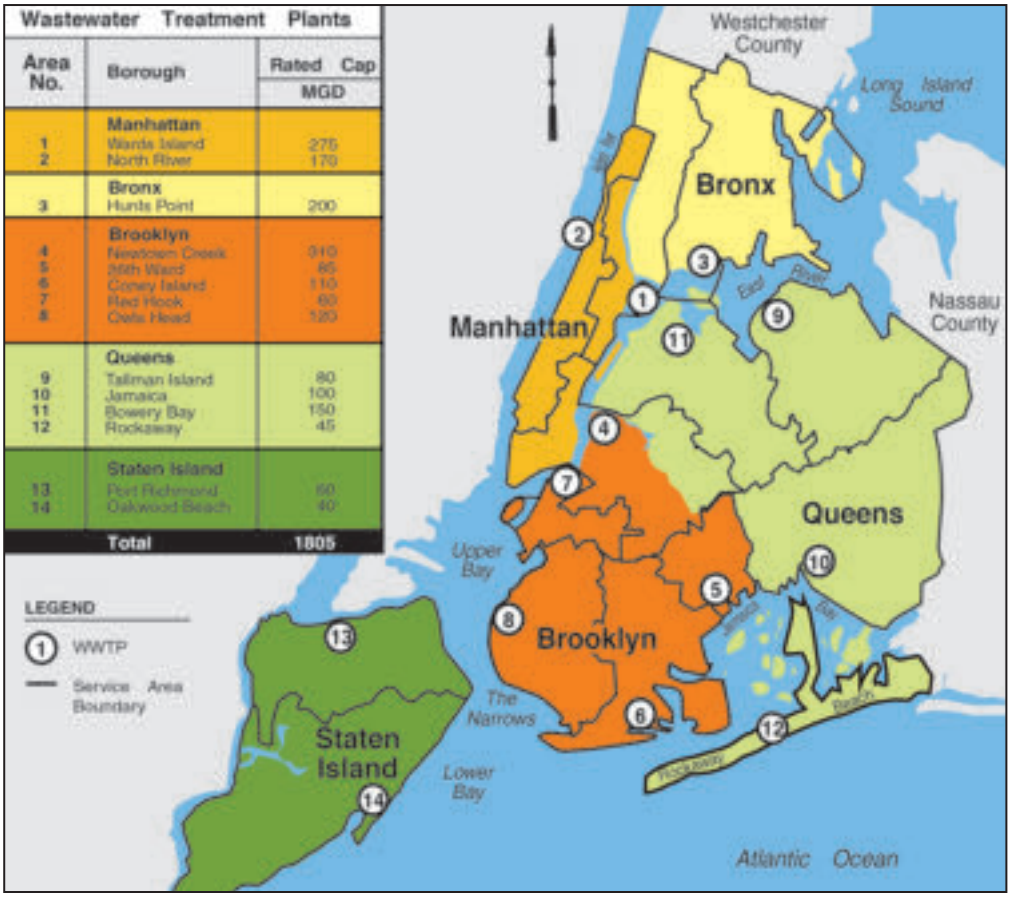
The Jamaica WWTP service area is highly urbanized and contains a large percentage of impervious surfaces. Runoff from roof drains, street gutters, and catch basins are tied into the combined sewer system, generating rapid and intense flow peaks in excess of the Jamaica WWTP capacity, even though New York City WWTPs were generally designed to process higher flows during wet weather. Flow regulators in the combined sewer system limit the amount of flow to the interceptor sewer and divert excess flow to nearby water bodies via outfall lines when the hydraulic capacity of the interceptor system is exceeded. Because the city is situated on the coast, most of the regulator structures have tide gates associated with them to prevent receiving waters from infiltrating the sewer system. Diversion chambers often exist in conjunction with regulators to divert excessive flows to outfalls and subsequently to receiving waters.

Interceptors convey regulated flow from the CSO regulators and connecting branch interceptors to the WWTP. The Jamaica WWTP receives its wastewater from two interceptors: the East and West interceptors. The West Interceptor collects dry weather and some wet weather flow from various CSO regulators (including JA-3 and JA-14) and is 72 inches in diameter. The East interceptor collects dry weather and some wet weather flow from various CSO regulators (including JA-6) and is 92 inches in diameter. The West Interceptor serves the drainage area west of the Van Wyck Expressway, which is mostly combined sewer service, while the East Interceptor serves the drainage area east of the Van Wyck Expressway (Interstate I-678), an area of mostly separate sanitary sewers.

A typical regulator structure consists of three chambers; a diversion chamber, a regulator chamber, and a tidal or outfall chamber. During dry weather, flow from the combined sewer enters the diver-

continued on page 26

Wastewater Treatment Plants		
Area No.	Borough	Rated Cap MGD
	Manhattan	
1	Wards Island	275
2	North River	170
	Bronx	
3	Hunts Point	200
	Brooklyn	
4	Newtown Creek	310
5	26th Ward	80
6	Coney Island	110
7	Red Hook	60
8	Owls Head	120
	Queens	
9	Tallman Island	80
10	Jamaica	100
11	Bowery Bay	150
12	Rockaway	45
	Staten Island	
13	Port Richmond	60
14	Oakwood Beach	40
	Total	**1805**



Courtesy of NYCDEP

Figure 1. New York City Wastewater Treatment Plants Service Areas

continued from page 25

sion chamber, where flow is diverted to the regulator chamber passing through a sluice gate. Flow is then conveyed to the interceptor through a branch interceptor connection. Most of the sluice gates in the regulator system have actuators for operation and remote monitoring. Wet weather flow in excess of the regulator's hydraulic capacity passes over the diversion overflow weir, through the tidal chamber and discharges to the outfall causing a CSO event. Tide gates are flap gates that open downstream to permit relief of wet weather flows. The gates are closed by downstream tide levels to prevent inflow to the regulator chamber and ultimately to the plant. Gates are constructed either of timber or cast iron.

Regulator JA-3 is located at the intersection of 123rd Street and 150th Avenue in the South Ozone Park section of Queens. Regulator JA-14 is within one block of Regulator JA-3 at 124th street and North Conduit Avenue. These regulators serve the combined sewer area west of the Van Wyck Expressway. Regulator JA-6 is located at the intersection of 225th Street and 138th Avenue and serves the combined sewer area near Thurston Basin. See ***Figure 2*** for an aerial plan showing the location of these regulators in the service area.

Bending Weir Benefits and Technology

InfoWorks hydrologic/hydraulic sewer system models were developed, calibrated and validated using flow monitoring and rainfall data collected throughout the city's sewer system and used to develop alternatives for CSO reduction. The output from the InfoWorks models are used as loadings into various receiving water quality models that were developed in parallel to demonstrate in-stream water quality standard attainment.

The existing system has conveyance limitations in the West Interceptor and relatively low weir crest elevations that result in CSO discharges occurring before significant surcharging and buildup of driving head in the downstream interceptor can occur. Based on InfoWorks model simulations, an analysis determined that, in addition to a parallel 48-inch diameter sewer across the Belt Parkway to relieve a local system bottleneck, regulator modifications at Regulators JA-3, JA-14 and JA-6 will provide relief for the hydraulic restrictions already detailed. The additional capacity provided by increasing the hydraulic head at regulator structures JA-3 and JA-14 utilizing bending weirs will convey more flow across the Belt Parkway and thereby reduce the amount of CSO discharging into Bergen Basin. The bending weir at Regulator JA-6 will also increase the hydraulic head in the downstream sewers, better utilizing in-system capacity and reducing CSO discharges to Thurston Basin. Modeling indicates that, during a typical annual average rainfall condition, CSO volumes to Bergen and Thurston Basin could be reduced by 170 million gallons per year by implementing bending weirs alone.

Bending weirs are passive devices that are designed to maximize upstream in-system storage and capacity for smaller and medium-sized storms, while allowing flows generated during larger storm events to discharge in a similar manner as they do without the bending weirs. Conversely, while increasing the fixed weir height of a regulator will also increase storage capacity, it will reduce the discharge capacity of the regulators during large events. Thus, bending weirs were selected to accomplish the dual goal of reducing CSOs during more frequent storms, and maintaining current flow capacity at the outfalls during larger storms.

In general, the following features and benefits are common to many, if not all types of bending weirs:

- Maximize in-system storage
- Reduce CSO discharges, both in frequency and volume
- Improve weir coefficient compared to a fixed weir
- Ensure longevity in a sewerage environment with a stainless steel construction
- Reduce capital costs compared to other CSO reduction strategies, including pipe upsizing, sewer separation, retention tanks or treatment facilities
- Require low maintenance
- Install drop-in easy with customizable equipment

While there are at least four types of bending weirs in existence, the overtopping counterweighted type was selected for this application. The design of the flap incorporates a relationship between the fixed and dynamic hydraulic forces and the design of the eccentric control disc balancing the counterweight arrangement. The flap, in its up or resting position, holds back the rising water until the flow reaches the design set point level. When the activation level is reached, the weight of water will overcome the counterweights – lowering the flap and releasing the overflow downstream. The flap will continue bending as the water level rises until it meets the bottom stop strip and prevents the unit from exceeding its bending limits. In the fully open (down) position, the equipment is flush with the fixed weir level. When the water level recedes, the flap will automatically return to the upright resting position. In the fully open position the equipment allows flows which will either

Courtesy of NYCDEP

Figure 2. Aerial Plan of Regulators JA-3, JA-6 and JA-14

exceed or at least be equivalent to those of a fixed weir.

The flap is constructed from stainless steel with stiffeners connected to a solid stainless steel shaft. Stainless steel side plates include preformed stops that match the flap's contoured shape and seal the openings when the unit is in its resting, upright position. The shaft is attached to a counterweight assembly which can either be mounted downstream in the sewer or within a separate dry compartment that is not exposed to the sewer flows, the latter of which is the preferred option. Although the equipment is factory tested and balanced, it can be field adjusted as well by adding or removing weights.

This equipment is customizable based on length and height to address specific overflow rates. The fixed weir may have to be either raised or lowered to optimize the equipment selection to achieve the design flow rate for a specific site. The equipment requires sufficient height on the downstream side of the fixed weir for anchoring the flap. The practical minimum fixed weir height is 12 inches. The equipment also requires space for the unit to be in the fully open down position which corresponds with the unit height.

Figure 3 illustrates a 3D CAD rendering of the existing Regulator JA-3, which includes a double-barrel influent/effluent configuration. The bending weirs are shown in orange color, and are displayed in the fully open (down) position. Flow enters the regulator from the background, and then is normally conveyed to the right into the West Interceptor en route to the WWTP. If wet weather flows overwhelm the system, then a CSO can occur, with flow traveling towards the foreground and into Bergen Basin. The counterweight chamber is also shown to the right of the bending weirs.

Courtesy of Hazen and Sawyer

Figure 3. 3D CAD Rendering of Regulator JA-3

Objectives in Applying Bending Weirs

The regulator modifications at JA-3, JA-14 and JA-6 will achieve the following objectives:

- Increase the height of the effective overflow elevation in Regulators JA-3, JA-6 and JA-14 by two feet. Increasing the effective overflow elevation in the diversion area by two feet results in reducing CSO events and volume compared to the existing hydraulic conditions. Increasing the effective overflow elevation will allow for increased storage in the collection system to minimize the frequency of overflows.
- Maintain the current hydraulic capacity in the interceptor system during significant wet weather events. Modifications to the overflow elevation in Regulators JA-3, JA-6 and JA-14 must not adversely impact the users upstream of the regulators.
- Increase the hydraulic capacity at regulator JA-3 at the orifice between the diversion area and regulator chamber. Currently, the hydraulic capacity is limited by the 36-inch by 48-inch sluice gate installed in the common wall between regulator chamber and the diversion area.

To reiterate, while bending weirs are passive devices designed to maximize upstream in-system storage and capacity for smaller to medium-sized storms, they also allow flows generated during larger storm events to discharge in a similar manner as they do without the bending weirs. Conversely, while increasing the fixed weir height of a regulator will also increase storage capacity, it will reduce the discharge capacity of the regulators during large events. Therefore, bending weirs were selected to accomplish the dual goal of reducing CSOs during more frequent storms, and maintaining current flow capacity at the outfalls during larger storms. By implementing bending weirs alone, during typical annual average rainfall, CSO volumes to Bergen and Thurston basins could be reduced by 170 million gallons per year.

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Wave Attenuator Study Helps Jump-Start Ecological Process in Jamaica Bay

by John McLaughlin

From a habitat standpoint, as well as an economic perspective, the wetlands of Jamaica Bay are critical for three groups of wildlife: shellfish, finfish, and waterfowl. Several species of invertebrates, including fiddler crabs and ribbed mussels, spend essentially all of their lives in the salt marsh. Numerous fish species spend all or part of their lives in or around the salt marsh. Mullet and menhaden feed and mature in shallow waters at high tide. Striped bass and shad pass by salt marshes from the ocean on their way to rivers to spawn. Large numbers of waterfowl and other birds use the salt marsh during their spring and fall migrations, and some stay for the summer to nest.

Over time, these valuable resources that comprise the ecological integrity of Jamaica Bay have dwindled in acreage. The current Jamaica Bay estuary is only about half of its pre-colonial extent and the salt marsh wetlands that have been a defining ecological feature of the bay are decreasing. Over the last 150 years, interior wetland islands and perimeter wetlands have been permanently removed as a result of extensive filling operations, with shorelines hardened and bulk headed to stabilize and protect existing communities and infrastructure. Deep channels and borrow areas have been dredged, altering bottom contours and affecting natural flows. Natural tributaries, along with their important benefits of balanced fresh water and coarse wetland building sediment exchanges, have essentially disappeared leaving behind deposits of silts and particulates from urban runoff.

To date, there is no consensus among ecological experts on the cause of the erosion of the marsh islands, which range from rising sea levels, bathymetric changes, mean tidal range changes and warmer water temperatures to increased nitrogen inputs. Acknowledging that these daunting challenges to restoring an urban estuary need to be overcome, federal, state and local agency representatives have not been deterred to help jump-start the ecological process and hopefully reverse this trend. Recently restored salt marsh islands are extremely vulnerable to the damaging effects of wind and wave energies due to their limited vegetative cover and the limited benefits of sediment anchoring from an under-developed root system. These vulnerabilities are further exploited by the potential synergistic effects as a result of the substantial anthropogenic changes to the natural environment. These areas are also vulnerable to erosive forces from ice flows during the winter months. Adding to the complexity of the wetland, loss data interpretation includes the various yearly natural fluctuations that are not

continued on page 31

Photo by Biohabitats, Inc.

A typical eroding wetland marsh edge, this is at the Brandt Point site.

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continued from page 29

readily observed. Significant meteorological events and even smaller chronic events have likely played a significant role in earlier marsh building and marsh destruction. However, during quiet meteorological years, wetland systems are able to gain acreage and, in years of above normal events, the wetland acreage is usually lost to wave and wind erosion.

Pilot Study Uses Wave Attenuators

While not an ideal scenario from an ecological perspective, the use of a temporary wave attenuator system may provide important research data and inform future design modifications that can be effectively used to armor the vulnerable windward fringes of these marshes, allowing sufficient protection while *Spartina alterniflora* (smooth cordgrass) becomes fully established. The floating breakwater systems reduce energy in the wave thereby creating an environment for protection and accretion of the shoreline to occur. Used in combination with other restoration protection measures, these treatments may help to reduce the rate of loss of existing wetlands and increase the protective benefits of previous restoration efforts. These systems also have the potential to increase the capture of marsh building sediments and may allow the outward expansion and stabilization of these wetland systems.

To evaluate their effectiveness, during Summer 2015 the New York City Department of Environmental Protection (NYCDEP) installed a floating wetland wave attenuator at Brant Point along the southern shoreline of Jamaica Bay, near a severely degraded and an actively eroding wetland edge. The department installed approximately 400 linear feet of a wave attenuator system that includes the use of anchored floating wetland "islands" offshore to the wetland edge to deflect and reduce the energy of incoming waves and potentially allow the accumulation of important wetland building sediments. These temporary structures are only a proxy for future oyster beds around wetlands to evaluate the wave energy reduction and sediment capture potential. These systems are providing the research data collection mechanism and the use of these structures, other than for their use as a proxy for oyster beds in protecting wetland edges, cannot be overstated. These systems would not be contemplated for a wider scale application and are simply a research tool. Companion oyster research efforts also occurring in Jamaica Bay and other parts of the region will hopefully address the elusive critical recruitment issue so that oyster populations can once again provide the co-benefit of protecting and assisting with wetland building efforts.

Several key parameters determined the final design of the wave attenuator. These site specific considerations included: water depth, storm data, wave action and soil conditions. The NYCDEP determined the placement, sizing and anchoring of the attenuators using modeling, field characterization and research on historical weather patterns. Permits for construction have been obtained from the New York State Department of Environmental Conservation, the New York City Parks and Recreation and the United States Army Corp of Engineers. The study is expected to last one year and the results of the project will be compiled at its completion.

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Spring Creek Combined Sewer Overflow Retention Treatment Facility to Lead Disinfection Study

by Keith Mahoney, Keith Beckmann and Tom Sayan

The New York City Department of Environmental Protection (NYCDEP) Spring Creek Combined Sewer Overflow (CSO) Retention Treatment Facility (RTF) was one of the earliest facilities of its kind, predating the 1972 Clean Water Act. The concept of the CSO RTF was first identified as part of a 1959 preliminary engineering study that was evaluating causes of the elevated pathogen levels in the recreational waters in the adjacent Jamaica Bay. A supplemental preliminary design report was prepared in 1962 that proposed construction of the Spring Creek CSO facility. The CSO RTF was later constructed and placed into operation in the early 1970s with a construction cost at the time of about $17 million. An aerial photo of the existing Spring Creek CSO RTF is shown in ***Figure 1***.

Source: Google Earth

Figure 1. The Spring Creek Wastewater Treatment Plant's combined sewer overflow retention treatment facility

Description of Spring Creek CSO Retention Facility

The Spring Creek CSO RTF, located on Spring Creek along the Brooklyn-Queens border, has served to capture the CSO from tributary drainage areas since the early 1970s. The tributary area is composed of a total of 3,256 acres, of which 1,874 acres are in Brooklyn and 1,382 acres are in Queens. The storage capacity of the Spring Creek facility is about 20 million gallons (MG), with 13.8 MG in basin storage and the remaining 6.2 MG within the influent barrels. The CSO is conveyed to the facility by four overflow barrels from the Autumn Avenue Regulator (26W-R3) serving the Borough of Brooklyn, and by two overflow barrels from the 157th Avenue Regulator (JA-R2), serving the Borough of Queens. This flow is temporarily stored in the influent barrels and the basins during storm conditions, and then it is returned to the collection system for treatment in the 26th Ward Wastewater Treatment Plant (WWTP). A portion of retained CSO volume flows back to the 26th Ward WWTP via gravity, and the remaining CSO volume is pumped back to the 26th Ward plant. The original facility was designed for chlorine disinfection and was operated in this mode until the facility was upgraded in 2007. The hypochlorite disinfection system was also upgraded as part of this project, but it was never placed back into operation. Aside from CSO storage and the disinfection system, Spring Creek CSO RTF was also designed for removing settleable solids and floatables from the CSO discharge.

Regulatory Requirements

In accordance with the Amended CSO Consent Order between NYCDEP and New York State Department of Environmental Conservation (NYSDEC), NYCDEP undertook an extensive CSO program and to date has incurred about $2.1 billion in design and construction costs with an additional $1.7 billion allocated for future CSO control projects. Additionally, NYCDEP is required to prepare and submit a CSO Long Term Control Plan to identify additional CSO controls to further improve water quality throughout New York City. As part of this program, NYSDEC requested NYCDEP to consider disinfection as a CSO mitigation alternative. It was agreed that a disinfection demonstration study would be conducted to evaluate the viability of CSO disinfection. Originally, the study was to be conducted at the NYCDEP Alley Creek CSO RTF, but since the Spring Creek CSO RTF was designed for disinfection, it was decided to conduct the demonstration study there in order to expedite the project. The disinfection demonstration study is anticipated to start next Summer 2016, and be conducted over one year.

Spring Creek Facility Disinfection Demonstration Study

For the most part, the existing chlorination system at the Spring Creek CSO facility is operational, but a few enhancements have been identified prior to the start of this demonstration study. Since accurate flow measurement is critical to hypochlorite dosing controls, it was decided to install a new flow monitoring system using ADS TRITON meters in the influent channels to provide more accurate flow measurements that pace the hypochlorite dosage. In addition, electrical and instrumentation work will be required to power the new flow meters and run a signal to a new control panel in the existing hypochlorite room. The existing hypochlorite metering pumps ***(Figure 2)*** and carrier water pumps will still be used, but some repairs will need to be made to the hypochlorite diffuser piping located in the two influent channels.

The NYCDEP will be conducting an intensive sampling program when this CSO disinfection demonstration facility is placed into operation, and some work will even be done prior to startup. Currently, Manhattan College is performing some chlorine dose response tests to quantify the chlorine doses needed at the CSO facility to achieve pathogen kills while maintaining low total residual chlorine (TRC) concentrations to mitigate potential chlorine toxicity issues in the receiving waters. The City University of New York will be conducting full-scale sampling at the Spring Creek CSO RTF. This will include collecting pathogen and TRC samples to quantify the effectiveness of the full-scale disinfection system to quantify pathogen kills and corresponding TRC concentrations. Lastly, the Great Lakes Environmental Center in conjunction with Manhattan College will perform chlorine degradation studies to determine if there will be any acute chlorine toxicity issues in the receiving waters. Since there are very infrequent CSO events at the Spring Creek CSO RTF and access to the waterway is limited, bench-scale degradation studies will be conducted, as illustrated

Photo by Tom Sayan – NYCDEP

Figure 2. Existing hypochlorite metering pumps

in ***Figure 3***.

Aside from chlorine disinfection, NYCDEP continues to evaluate emerging disinfection technologies that may be applicable for CSO disinfection, along with continuing to evaluate and implement other CSO mitigation strategies, such as green infrastructure, enhancements to the sewer conveyance system, CSO storage facilities, CSO treatment facilities, and more. The findings from this disinfection demonstration study will be incorporated into the CSO long term control plans to help better inform selection of the most viable CSO mitigation alternative for each specific waterbody.

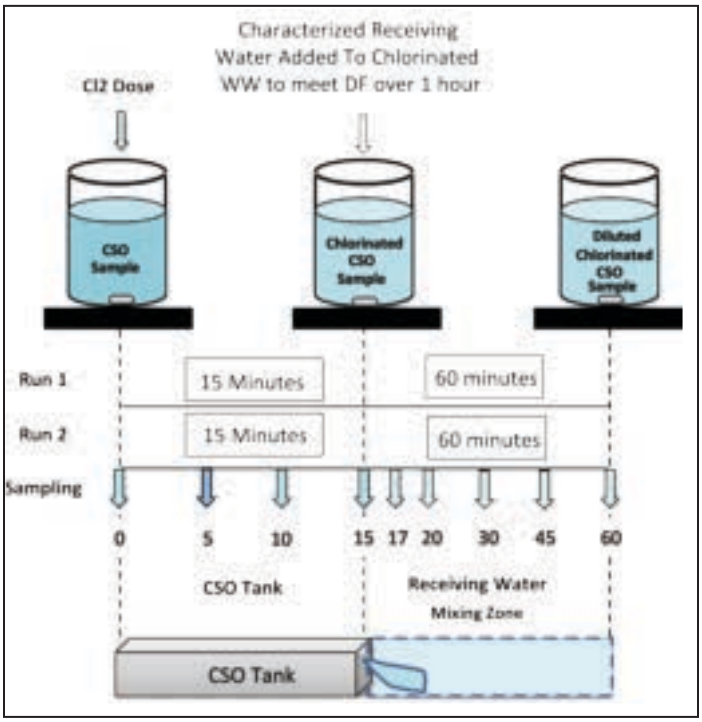

Image by Robert Sharp, Manhattan College

Figure 3. Illustration of Chlorine Degradation Study

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Evolution of 26th Ward WWTP Leads to Big Nitrogen Reductions in Jamaica Bay

by Daniel A. Solimando, James G. Mueller, Keith P. Mahoney, Sarah D. Galst and Robert D. Smith

Jamaica Bay, a 28,000-acre estuary, is an important ecological resource in New York City with a vast network of open waters, salt marshes, woodlands and fresh water wetlands. It serves as a vital source of recreation and leisure for thousands of local residents and visitors. The bay supports numerous species of fish and birds, and is an important habitat for many species of reptiles, amphibians and mammals. The bay's proximity to New York City's ultra-urban environment produces unique environmental protection challenges.

Over the past decade, the New York City Department of Environmental Protection (NYCDEP) has been working to provide water quality improvement in Jamaica Bay by upgrading one of its wastewater treatment plants (WWTPs) to discharge significantly less nitrogen. The 26th Ward WWTP, located along Hendrix Creek and discharging directly to Jamaica Bay, has received a myriad of process enhancements, all directly aimed at reducing the nitrogen discharged. The treatment improvements consist of multiple phases and will ultimately cost approximately $36.8 million when finished – $22 million for step-feed BNR (biological nitrogen removal), $2.8 million for alkalinity addition, and $12 million for supplemental carbon addition. These improvements have achieved an overall decrease of 10,000 pounds of nitrogen discharged each day into Jamaica Bay ***(Figure 1)***.

Courtesy of NYCDEP

Figure 1. The 26th Ward WWTP shown in the foreground, discharges into Jamaica Bay, seen in background.

Source: http://structuresofcoastalresilience.org

Figure 2. BNR upgrades are helping to protect the sensitive Jamaica Bay estuary, which is surrounded by New York City and used by the city's populace for recreation.

Implementation History of Nitrogen Removal

In the 1990s, water quality surveys of Jamaica Bay identified low dissolved oxygen (DO) conditions, otherwise known as hypoxia. Hypoxic environments are brought on by the decay of algae, which flourish under high nutrient conditions, such as an excess of nitrogen, and are indications of poor water quality. The impetus behind the implementation of BNR processes at the 26th Ward WWTP was to improve water quality, resulting in increased DO concentrations, by reducing nitrogen discharges.

The NYCDEP worked with the surrounding community to ensure transparency in its plans for upgrading the plant and assure the interested citizens groups that the goals for nutrient removal would be attained. Tripartite discussions were held among the New York State Department of Environmental Conservation (NYSDEC), NYCDEP and citizens groups, focusing on ways in which nitrogen discharges from Jamaica Bay WWTPs could be reduced through enhanced nitrogen removal technology and treatment; additional studies and monitoring to assist in the nitrogen reduction effort; and environmentally beneficial projects that mitigate poten-

continued on page 36

continued from page 35

Courtesy of Metcalf and Eddy of New York

Figure 3. The Applied Research Program facility shown here supplied NYCDEP with valuable information used to shape the city's BNR program. Sophisticated pilots were used to mimic full-scale treatment, allowing the city to gain experience with alternate modes of operation.

tial adverse impacts of nitrogen discharges into Jamaica Bay ***(Figure 3)***.

The NYCDEP embraced its role as a good steward of the environment, ultimately deciding to:

- Implement BNR infrastructure improvements at all Jamaica Bay WWTPs
- Accept stricter limits on nitrogen discharges to Jamaica Bay over time, reflecting those improvements
- Undertake additional studies and monitoring to track and further improve water quality in the bay
- Ensure a total of $13 million in funding for projects that benefit the environment, including salt marsh restoration in Jamaica Bay

Planning for BNR

The NYCDEP created an Applied Research Program to supply technical and engineering information for use in the development of a long-term nitrogen reduction plan for NYCDEP WWTPs. This research facility was located at the 26th Ward WWTP ***(Figure 3)*** and tested various process configurations, supplemental chemicals, and operational strategies. The information gathered by the Applied Research Program was instrumental in selecting the city's ultimate approach to nitrogen removal.

As a result of the research program, NYCDEP selected step-feed BNR with separate centrate treatment and supplemental carbon addition to meet the long-term effluent nitrogen goals. These upgrades have been phased in over time, with final completion slated for this year. At the 26th Ward WWTP, a contract was put in place to design and construct the $36.8 million worth of BNR upgrades, with construction completion of the first set of upgrades in 2011, and final completion anticipated for December 2015.

Implementation of BNR Upgrades

The modifications and additions necessary for BNR operation included aeration tank baffle walls to create a physical barrier between anoxic and oxic environments; mixers to keep solids in suspension under anoxic conditions; increased aeration to support nitrification; froth control mechanisms to proactively remove froth-forming organisms from the treatment train; supplemental chemical addition in the form of alkalinity and carbon; and instrumentation for better monitoring of the BNR process.

The 26th Ward WWTP upgrades also included a separate centrate treatment (SCT) process to treat the high-strength waste stream returning from the dewatering of anaerobically digested sludge. This process was installed in Aeration Tank 3, and resulted in the development of the aptly named "AT-3 Process," where nitritation/denitritation was conducted.

Construction of the BNR upgrades was initiated in 2007. During construction, the plant maintained operations, meeting secondary treatment goals for solids and carbon removal, and providing wastewater treatment for the surrounding community. The first phase of upgrades was completed in 2011, and additional phases are ongoing today ***(Figure 4)***.

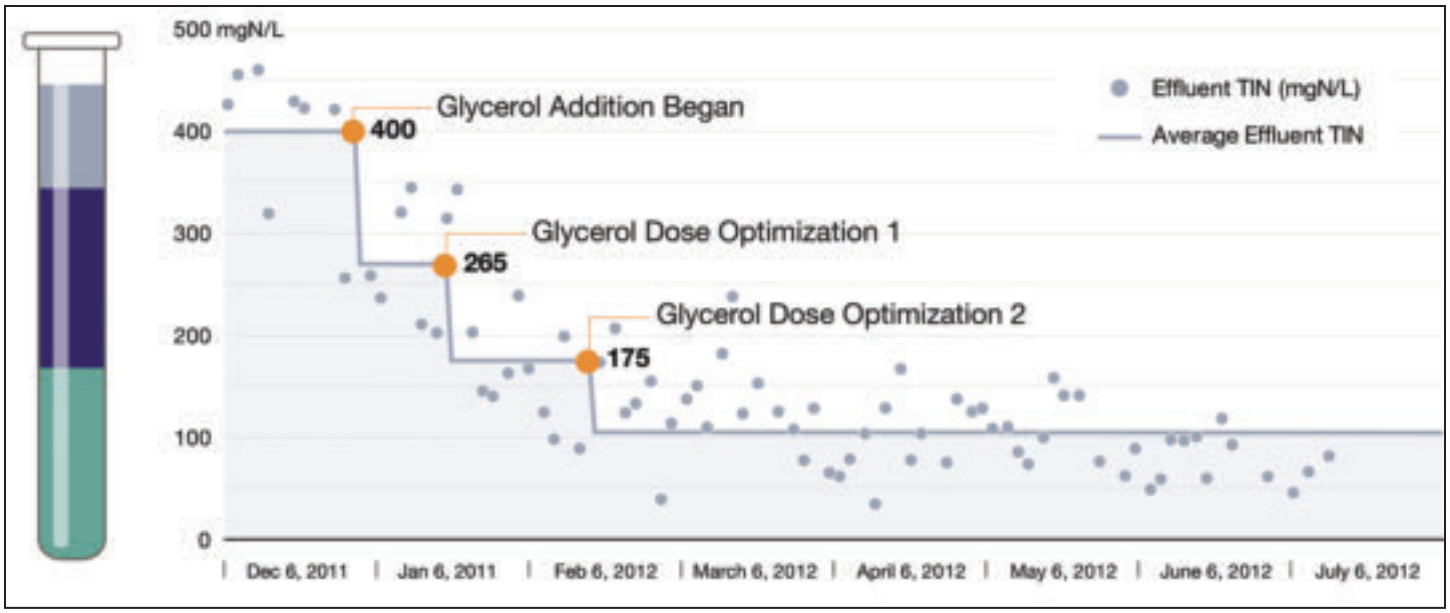
BNR Operations and Optimization

With the conclusion of each major phase of the upgrades, NYCDEP supported a lengthy and thorough training and optimization sampling program. Training was provided to plant staff at the 26th Ward prior to the new facilities coming online in BNR mode in order to ensure that the staff was aware of all new operational requirements. Sampling was conducted: gathering profiles of nitrogen speciation through the aeration tanks to determine if nitrification and denitrification were proceeding; measuring pH and DO concentrations in the treatment mixed liquor to ensure the optimal environment for BNR processes; and taking solids concentrations measurements to calculate flow distribution and monitor solids inventory.

The data collected during these sampling programs were used to inform process changes with the goal of optimizing operations of the newly upgraded system, as well as providing lessons to other BNR facilities on how to best operate. The resulting performance

Courtesy of NYCDEP

Figure 4. BNR upgrades at the 26th Ward WWTP include the construction of supplemental carbon addition facilities.



Courtesy of Hazen and Sawyer and NYCDEP

Figure 6. Glycerol reduces 26th Ward total nitrogen discharges into Jamaica Bay.

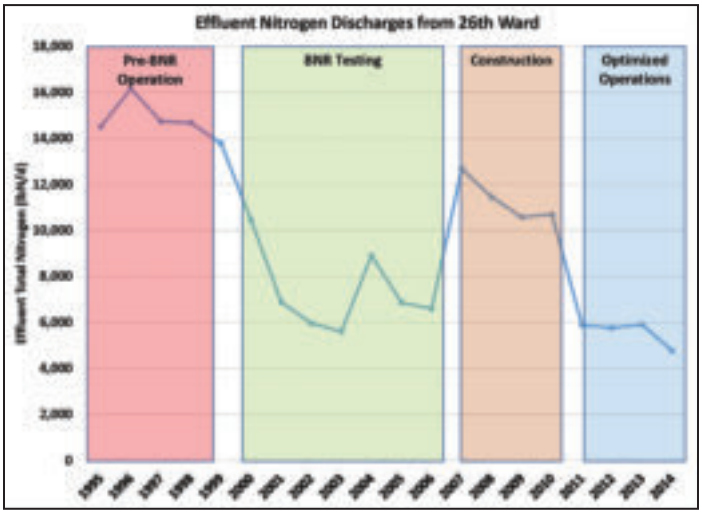
at the 26th Ward facility since the implementation of BNR has reduced the nitrogen discharged into Jamaica Bay by 67 percent, dropping from 15,000 lb/d to 5,000 lb/d. Currently, almost four million less pounds of nitrogen are discharged each year to Jamaica Bay from the 26th Ward WWTP ***(Figure 5)***.

Continued Innovations in BNR

After the first phase of BNR upgrades was completed in 2011, continued performance enhancements have been implemented. In 2012, the NYCDEP conducted the first application in the United States of glycerin to denitrify a high-strength ammonia waste stream in its 26th Ward SCT process. The glycerol facility has resulted in 67 percent reduction in the effluent nitrogen, decreasing discharges from 5,800 lb/day of total inorganic nitrogen in December 2011 to 1,900 lb/day of total inorganic nitrogen ***(Figure 6)***. The successes of the city's glycerol application earned it the prestigious American Council of Engineering Companies of New York Empire Award, distinguishing it as the best overall project designed and constructed in New York State. This performance exceeded expectations, and provided valuable information used to design other glycerol facilities in New York City.

Current contracts at the 26th Ward WWTP are constructing permanent chemical addition facilities for both alkalinity addition to the SCT process and glycerol addition to all aeration tanks. These projects represent the final stages to the BNR improvements of the 26th Ward WWTP, to be completed by the end of this year.

In the near future, NYCDEP will be conducting a three-year intensive water quality sampling program that has been formulated with input from a distinguished panel team of experts, representing NYSDEC, the Natural Resources Defense Council, and NYCDEP. This sampling will determine the overall impacts and benefits to water quality from the infrastructure investments.



Courtesy of Hazen and Sawyer and NYCDEP

Figure 5. Effluent nitrogen discharged to Jamaica Bay decreased by 67 percent due to BNR treatment.

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Upgrading the Coney Island Wastewater Treatment Plant for Biological Nitrogen Removal

by Keith Mahoney, M. Laura Grieco and George Bloom

Jamaica Bay (bay) is a part of the New York/New Jersey Estuary System and is one of the largest and most productive coastal ecosystems in the State of New York, as well as within the northeastern United States. It is an important recreational destination for local, national and international visitors. It contains approximately 9,100 acres of surface waters, including the largest tidal wetland complex in New York State. These wetlands provide benefits, such as natural water quality improvement, flood protection, and shoreline erosion control for the commercial and residential areas in and around the bay in Brooklyn and Queens. Jamaica Bay is also a habitat for marine life and a spawning nursery ground for aquatic species with its nutrient rich waters. It consists of navigable channels averaging 27 feet in depth encircling most of the outer ring of the bay. Much of the area in the center of the bay consists of narrow channels and tidal marsh islands, as shown in ***Figure 1***.

Water Quality in Jamaica Bay

The New York City Department of Environmental Protection (NYCDEP) has been monitoring water quality data within Jamaica Bay as part of its Harbor Survey Program. The locations of the water quality monitoring stations within the bay are shown in ***Figure 2***. For the most part, water quality in Jamaica Bay is very good but there are some areas that have low dissolved oxygen (DO) levels (less than 13 percent) and marshland loss is an ongoing concern within Jamaica Bay. Dissolved oxygen in the water column is critical for the survival of all aquatic life forms, including fish and invertebrates, such as crabs, clams and zooplankton. Elevated nitrogen levels are a common stressor associated with lowered DO levels in waters like Jamaica Bay. Excess nitrogen fuels eutrophic conditions and rapid phytoplankton growth. The phytoplankton, in turn, are decomposed by bacteria, a process that reduces DO levels and can lead to hypoxic waters, particularly in the bottom waters of the bay. These low DO levels are compounded by physical alterations that were made to the bay in which the outer channels were dredged to support navigation; these deep pockets, particularly in the back end of the bay, typically have very low DO levels in the bottom waters during the summer months.

As a result of these low DO levels, the New York State Department of Conservation (NYSDEC) and the NYCDEP have entered into a First Amended Nitrogen Consent Judgment (FANCJ) (#04-402714) that requires NYCDEP to significantly reduce nitrogen discharges into Jamaica Bay. To date, both the 26th Ward and Jamaica waste-

continued on page 40

Courtesy of NYCDEP

Figure 1: The expanse of Jamaica Bay includes the largest tidal wetland complex in the state.

continued from page 39

Courtesy of NYCDEP

Figure 2. Jamaica Bay's harbor map showing survey water quality sampling stations

water treatment plants (WWTPs) have been upgraded for biological nitrogen removal (BNR) at a cost of about $100 million. The later phases of work include supplemental chemical facilities at the Jamaica and 26th Ward WWTPs to enhance nitrogen removal, along with upgrading the Coney Island and Rockaway WWTPs for BNR in the near future.

Coney Island WWTP

Wastewater treatment began in New York City in the late 1890s at two sites in Brooklyn, NY and one site in Queens, NY. These facilities would eventually become known as the Coney Island, 26th Ward, and Jamaica WWTPs. The three areas received a high priority due to the public recreational beaches within Jamaica Bay. Early forms of wastewater treatment involved chemically enhanced primary settling and seasonal disinfection.

In 1940, the New York City Department of Public Works (later known as the Department of Environmental Protection) upgraded the Coney Island WWTP to be able to support a quickly growing city population. In conjunction to primary settling, the upgraded facility included a high rate secondary biological treatment system and solids handling facilities.

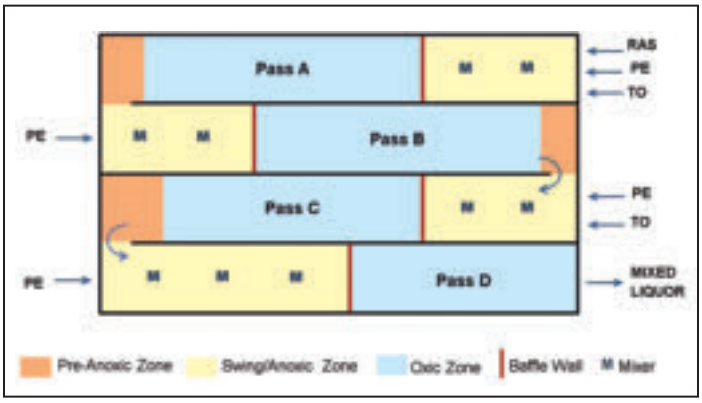
As the population of Queens continued to grow, the plant became overburdened. It was upgraded in the 1960s to provide increased hydraulic capacity, with primary treatment and disinfection for average annual and peak flows of 100 and 200 mgd, respectively, and secondary treatment for flows up to 150 mgd. Upgrades included conversion of the secondary treatment facilities to step-feed aeration. In addition, the modifications provided for 85 percent removal of biological oxygen demand (BOD) and total suspended solids (TSS).[1]

The 1970s saw further modernization of the plant and the construction of an additional gravity thickener. In addition, BOD removal was improved from 85 to 90 percent removal in order to maintain compliance with new federal water quality mandates including the Water Quality Act of 1972. The last major upgrade at Coney Island was completed in the early 1990s.

Coney Island WWTP BNR Upgrade

As required by the FANCJ, Coney Island is required to be retrofitted for step-feed BNR. The step-feed BNR process was developed in New York City in the early 1990s and is a relatively high rate biological process. It is able to nitrify and denitrify with hydraulic retention times of about four hours using existing aeration tanks, thus making this type of retrofit extremely cost effective. This Coney Island WWTP BNR upgrade is projected to cost less than $30 million and is expected to reduce nitrogen discharges into Jamaica Bay by about 3,300 lbs/d. The mandated Construction Notice to Proceed Date for the step-feed BNR upgrade is in 2017, and the corresponding Mandated Construction Completion Date is December 2020.

As illustrated in ***Figure 3***, the step-feed BNR retrofit requires anoxic zones to be established at the head end of each pass where the primary effluent is fed to the aeration tanks; this acts as a carbon source that enables the facultative heterotrophs to convert nitrite and nitrate to nitrogen gas. The nitrification reaction takes place in the oxic zones and requires oxygen plus a higher sludge age to select for autotrophic bacteria. These autotrophic bacteria consume inorganic carbon (a.k.a., alkalinity) in the presence of oxygen and are able to convert the ammonia nitrogen to nitrite and nitrate.



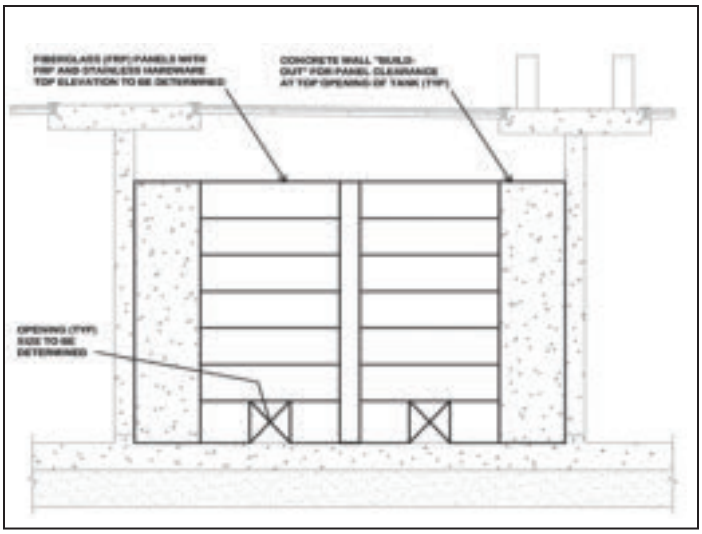
Courtesy of NYCDEP

Figure 3. Typical Step-Feed BNR Configuration

The construction elements required to implement the step-feed BNR process consist of installing baffles ***(Figure 4)*** between the anoxic and oxic zones to prevent DO from backmixing into the anoxic zones along with pre-anoxic zones to reduce DO concentrations just prior to the anoxic zones. Since there is no air in the anoxic zones, some type of mechanical mixing is required to keep the biomass in suspension so hyperbolic mixers have been selected for the Coney Island WWTP. The nitrification reaction also requires additional process air, as it requires approximately 4.6 lbs of oxygen to convert ammonia to nitrate; however, the existing blowers have sufficient capacity so the upgrade will only require installation of a new fine bubble tapered diffuser grid to provide the proposed amount of oxygen to each oxic zone of the aeration tanks.

In addition to modifications in aeration tanks to support the nitrification and denitrification processes, another design consideration includes froth control. The increased sludge age needed to select for autotrophic bacteria also selects for many types of filamentous bacteria that result in both frothing of the aeration tanks, along with sludge bulking (poor settling sludge). In order to mitigate these filamentous bacteria, multiple froth and bulking technologies are being applied in the Coney Island step-feed BNR upgrade, such as: surface wasting of biomass to preferentially waste frothing filaments from the surface of the aeration tanks; polymer addition that could be used during severe frothing events to force the filaments back into solution; rehabilitation of the surface spray water system in the aeration tanks; and use of hypochlorite to mitigate frothing and sludge bulking.

To date, the NYCDEP has significantly reduced nitrogen dis-



Courtesy of NYCDEP

Figure 4. Construction Elements of Step-Feed BNR Process

charges into the bay by about 30 percent. When the remaining BNR projects are completed, including this Coney Island step-feed BNR upgrade, it is projected that nitrogen loadings will be reduced by up to 60 percent. The reduction in nitrogen loadings will help prevent eutrophication from occurring in the bay, will improve overall DO levels, and will reduce severity and duration of hypoxia. On completion of these BNR projects, NYCDEP will undertake a comprehensive post-construction monitoring program to quantify water quality benefits and ecological improvements associated with these nitrogen reductions.

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Improving Jamaica Bay Water Quality through Reduction of Wet Weather Discharges to Paerdegat Basin

by James G. Mueller, Keith P. Mahoney, Robert D. Smith and Anna D. Walsh

Combined sewer overflow (CSO) discharges have traditionally been the major source of pollution entering Paerdegat Basin, a 1.25-mile tributary of Jamaica Bay located in the Borough of Brooklyn in the southern portion of New York City. These discharges caused significant violations to New York State water quality standards for dissolved oxygen, coliforms, floatables, and settleable solids. In 1986, the New York City Department of Environmental Protection (NYCDEP) retained the services of Hazen and Sawyer to develop a CSO facilities plan and lead the preliminary and final design effort for the Paerdegat Basin CSO Facility.

In 1992, NYCDEP entered into an Order on Consent with the New York State Department of Environmental Conservation (NYSDEC) to reduce CSOs throughout the New York City's combined sewer system. The Paerdegat Basin CSO Facility was one of several projects to be constructed under the consent order, and a result of recommended measures for reducing CSOs and improving water quality in the basin. The consent order stipulated construction of the CSO Facility in accordance with the approved Facility Plan and required construction completion by May 31, 2011.

The facility was placed into operation on March 29, 2011 serving a tributary population of 500,000, and receiving CSO from a drainage area of approximately 6,000 acres.

Prior to this facility's construction and 2011 commissioning, CSO discharges flowed directly into Paerdegat Basin, leading to water quality issues, particularly during wet weather. After this project was completed, approximately 30 million gallons of CSO volume capacity can be stored offline in the CSO retention tanks and tank influent channels, and an additional 20 million gallons can be retained in the sewers. In a typical year, the Paerdegat CSO facility results in up to 70 percent reduction in biochemical oxygen demand (BOD) and total suspended solids (TSS), preserving and protecting the Jamaica Bay estuary, part of New York City's only national park.

Photo courtesy of NYCDEP

When the Paerdegat Basin CSO Facility, seen here, was placed into service in 2011, Paerdegat Basin greatly reduced CSO discharges to Jamaica Bay.

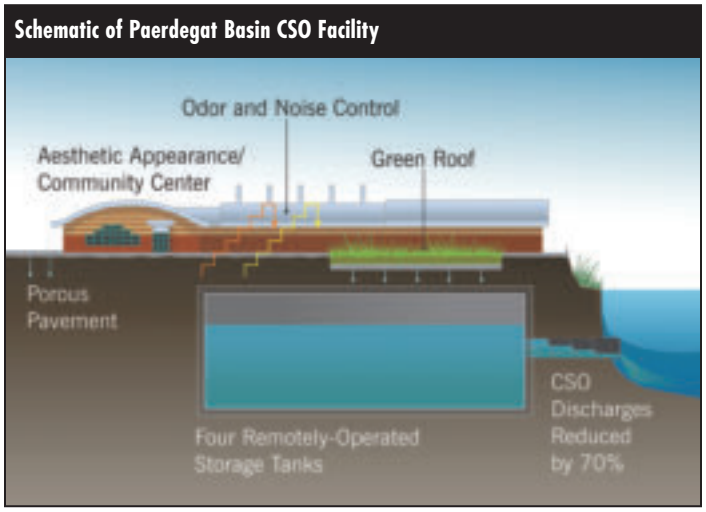
Facility Operation

Retained combined sewage is pumped to the gravity interceptor via two discrete transfer systems. The first includes three 135 hp (horsepower) vertical centrifugal CSO pumps, each rated for 16.8 mgd. The other system has two 85 hp pumps, each with a nominal 3.6 mgd capacity, to handle the slurry of combined sewage and settled solids in four offline storage tanks.

After each storm event, the tanks are cleaned using a system of 48 flushing gates. Located at each end of the storage tank, the gates open sequentially to release controlled amount of water and create hydraulic wave action to push settled solids to the wet well, which is then pumped by the grit pumps described above.

All incoming flow is screened prior to entering the storage tanks. The screening facility is designed to pass flow of up to 2 billion gallons per day and to remove large-sized debris and floatables using six 9-foot-wide reciprocating rake (climber) screens. Collected screenings are transported via a molded pan belt conveyor to a storage container for ultimate offsite disposal.

The CSO tanks and all process areas are ventilated and receive odor control. The odor control system consists of five exhaust air trains, each containing motorized inlet and outlet dampers, an activated carbon vessel and variable speed fan. Each carbon vessel is designed for 36,000 cfm (cubic feet per minute) max flow, and the fans are 150 hp each.



Schematic courtesy of NYCDEP

The Paerdegat Basin CSO Facility includes several innovative features:

Gravity Harnesses Overflow: After a storm event, up to 33 percent of the CSO stored offline can be returned to the sewer system by gravity, flowing back over regulator benches to an interceptor that conveys flow to the NYCDEP's Coney Island Wastewater Treatment Plant (WWTP). The gravity return of this CSO portion yields extensive energy and cost savings while improving water quality.

Hydroself Flushing Gates Remove Grit, Clean Tanks: The stored

continued on page 44

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continued from page 42

CSO is retained in flushing reservoirs for tank cleaning. After the tanks have been drained, the flushing gates on the reservoirs are activated in succession. A high celerity wave is released and any grit and debris that have settled are scoured from the tank bottom. The use of CSO to flush the tank floor conserves city water resources and provides a significant cost and labor savings to the city.

Maintenance Flexibility: Individual bays of the CSO facility can be taken offline for maintenance or repair without having to remove the overall facility from the collections system network. This provides NYCDEP with greater operational and staffing flexibility.

Remote Operation: Considering NYCDEP's staffing needs, the design engineer maximized operating flexibility. The facility can be operated solely from the Coney Island WWTP, if necessary or preferred. Personnel are required onsite only for routine maintenance and periodic inspection. The degree of automation is estimated to save the department $1.6 million per year in comparison to a fully manned facility.

Community Impacts

The CSO facility's design is unique in its minimization of impacts on the community. The project prevents the reformation of the CSO sediment mound at the head of the basin which previously would lower dissolved oxygen levels to near zero and cause nuisance odors in the surrounding community. The design both conceals the major components and integrates public space. The CSO tanks are located underground; a visually pleasing landscaped berm and noise barriers shield the facility from public view; while a 40-foot-wide esplanade along the basin's edge provides a scenic space for area residents and accommodates educational tours. The facility also provides a much needed meeting hall for the local community board with a separate entrance and parking.

Green and Grey Infrastructure

The CSO facility offers a unique harmony in centralized (grey infrastructure) solutions and distributed green solutions for urban storm runoff management, such as porous pavement and green roofs. This synergy allows the city to take maximum advantage of the benefits from both types of solutions and demonstrate how green and grey infrastructure can work together to achieve water quality goals.

Photo courtesy of NYCDEP

The Collection Facility South (CFS) building's original, striking appearance – featuring the curved roof and low-lying design – minimizes impacts to the community while combining green and gray infrastructure.

Natural Area Park and Ecology Park

In conjunction with the water quality improvements, NYCDEP created nearly 100 acres of park land in the undeveloped property adjacent to Paerdegat Basin for the community's benefit, including constructed wetlands on both sides of the basin which promote species biodiversity and preserve the ecological character of Jamaica Bay. The plan for the Natural Area Park and Ecology Park was developed taking into account the coastal setting and climatic conditions of the area. The Natural Area Park features a restoration of a coastal grassland community to much of the project site. Public access will be restricted in the Natural Area Park, as its goal is to promote habitat restoration and ecological improvement.

The Ecology Park is a smaller, five-acre section of the project that highlights many of the plant community types that exist or once existed in New York City. While it is as natural as possible,

Photo courtesy of NYCDEP

The completion of construction and improvement of water quality in the basin have promoted the return of wildlife and increased access to public recreation, such as kayaking and fishing.

Photo courtesy of NYCDEP

Natural Area Park and Ecology Park provide public space and environmental benefits to the local community.

the Ecology Park has pedestrian walkways and will be maintained through irrigation, as well as other horticultural management practices. The Ecology Park exhibits many of the ecological communities of New York City in one location and will be used as an educational resource to promote awareness of the various environments found throughout the city.

Post-Construction Compliance Monitoring and CSO Facility Overflow

As part of the City-wide Post-Construction Compliance Monitoring Program, NYCDEP compiles performance related information and conducts modeling activities for the Paerdegat Basin CSO Facility. The results are submitted annually to NYSDEC. For calendar year 2013, the following performance results were reported:

CSO Storage and Floatables Control

- 125 total number of storm events in drainage area
- 116 or 93 percent of storm events fully captured
- 50 MG storage capacity fully utilized during 10 storm events
- 9 events resulted in an overflow
- 1,477 MG total volume retained in the tanks and upstream sewers
- 506 cubic yards of floatable material were removed from CSO entering the tank that otherwise would have been discharged to Paerdegat Basin

Water Quality – Dissolved Oxygen and Pathogens

- DO and fecal coliform monitored at two locations within Paerdegat Basin
- Monthly attainment of DO standards improved by as much as 5 percent (July) based on model results. Two excursions were below the >4.0 mg/L Class I criterion
- 94 percent annual attainment of DO standards meets the 90 percent attainment performance metric
- Fecal coliform geometric mean of available samples was lower than the Class I standard of <2,000 cells/100 mL. Two discrete samples were above 2,000 cells/100 mL
- Monthly geometric mean fecal coliform concentrations in the basin are reduced by 28 to 94 percent based on modeling results; and the waterbody should meet the applicable standards each month.

The Paerdegat Basin CSO Retention Facility satisfied the CSO storage and floatables capture goals and the water quality performance metrics in Paerdegat Basin.

In completing the construction of the Paerdegat Basin CSO Facility, NYCDEP has achieved its goals: delivering the construction of the facility two months ahead of NYSDEC's consent order schedule mandate; reducing CSO discharges; maximizing the re-use of existing NYCDEP infrastructure; and ultimately improving Paerdegat Basin water quality.

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Photo courtesy of NYCDEP

Wetlands are a critical component of the Jamaica Bay ecosystem. The Paerdegat CSO Facility Project created several acres of tidal wetlands to stabilize the shoreline and provide a tidal habitat for native species.

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The Battle of the Bulge: Development and Management of Multi-Million Dollar BNR Upgrade in New York City

by James G. Mueller, Keith P. Mahoney, Robert D. Smith, Sarah D. Galst and Norman S. Bradley

In 1994, the Long Island Sound Study (LISS) identified nitrogen discharges from wastewater treatment plants as a leading cause of hypoxic conditions in western portions of the Long Island Sound. In 2001, phased reductions over a 15-year period leading to a long-term Total Maximum Daily Load (TMDL) were approved by the United States Environmental Protection Agency (USEPA) for effluent total nitrogen discharges into the Long Island Sound. Faced with future stringent effluent total nitrogen discharge limits, the New York City Department of Environmental Protection (NYCDEP) began implementing a series of biological nitrogen removal (BNR) upgrades at four treatment plants that discharge to the East River, and two that discharge to Jamaica Bay. The NYCDEP needed to partner with regulators, third party stakeholders, and the consultant community to develop and then implement a plan to achieve the following nitrogen limit stepdowns:

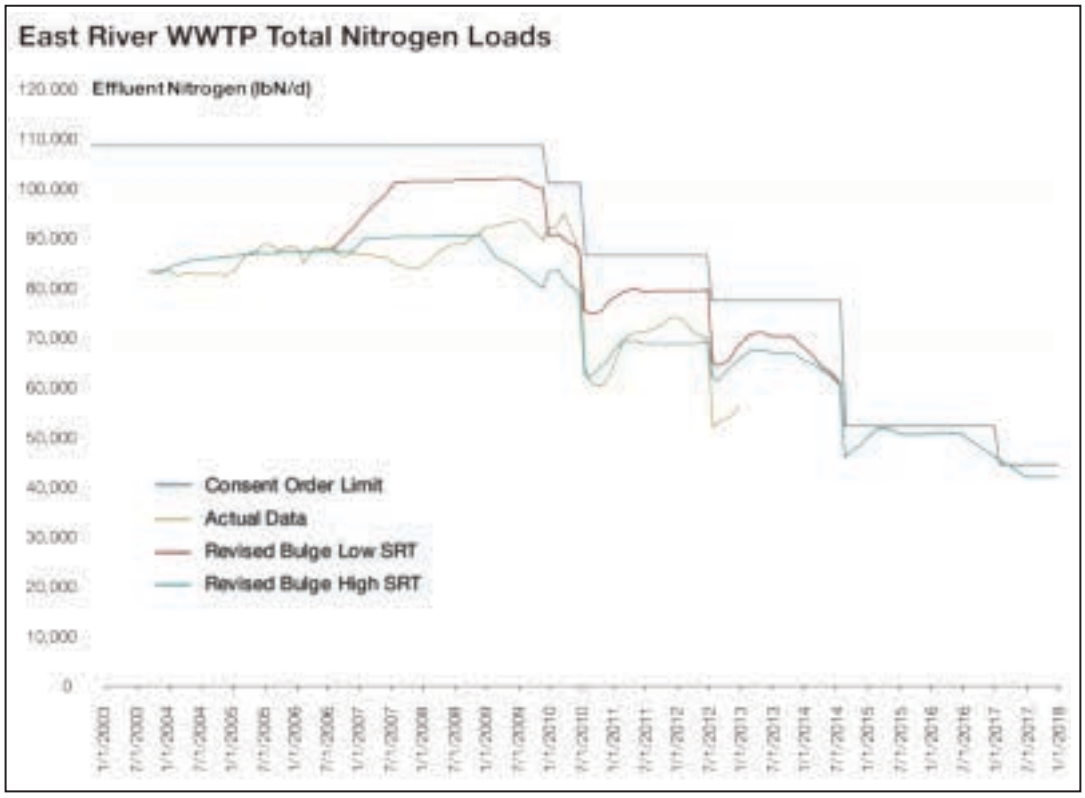
Time period	Consent Order Nitrogen Limits (lb/d)
Initial Limit	108,375
Starting January 2010	101,075
Starting July 2010	86,375
Starting July 2012	77,275
Starting August 2014	52,275
Starting January 2017	44,325

In support of the BNR program, New York City invested in building and calibrating a regional predictive model of dissolved oxygen concentrations throughout western Long Island Sound that was ultimately peer reviewed and adopted by LISS as the water quality model of record for the East River Program. The model led to the establishment of the above limits using a TMDL approach. The entire region (and the regulatory community) benefited from this investment that led to appropriate nitrogen reduction targets for utilities throughout Long Island Sound. Its adoption resulted in more cost-effective capital projects in the Upper East River, which was closer to the "hot spot," or the portion of LIS with the highest frequency of water quality issues near the New York State/Connecticut border, from a water quality perspective. The development of a construction bulge allowed for further cost-effective capital investment to allow construction to move as fast as possible on the long-term solution of final limits without having to divert excessive cost to also meet unnecessarily aggressive interim limits. The end result was a program that achieves the final limits more quickly with a greater net environmental benefit.

Reaching Treatment Objectives in Jamaica Bay

The modeling framework that was set for the East River program was then applied to the Jamaica Bay nitrogen program. Nitrogen was also identified as the causal agent for water quality issues in Jamaica Bay, with NYCDEP's four wastewater treatment plants being the primary contributors. Years of water quality monitoring contributed to a peer-reviewed, calibrated Jamaica Bay eutrophication model, known as JEM. The NYCDEP invested more than $100 million in technologies to remove nitrogen from these plants. As with the East River, JEM gave NYCDEP and NYCDEC a platform to determine the most cost-effective suite of upgrades at the four treatment plants to achieve treatment objectives in an efficient manner.

The team identified BNR enhancements via the activated sludge process as the most economical "backbone" for achieving nitrogen limits, as this process best takes advantage of existing tankage and infrastructure. In order to upgrade existing tanks to the BNR process, they needed to be taken out of service for several months at a time to install baffles, mixers, froth control measures, and other upgrades. Taking units out of service decreases treatment performance in the short term, but is necessary to achieve meaningful long-term nitrogen reduction performance improvement. This balance between bridging short-term performance loss (and meet-



Courtesy of NYCDEP

The "nitrogen bulge" is a visual representation, shown here, of the balance between the short and long-term objectives of the New York City nitrogen program.

ing interim discharge limits) with longer term objectives needed to be addressed with a planning/operational support tool developed for the NYC nitrogen program: the East River construction bulge.

The NYCDEP nitrogen permit is a bubble limit that amalgamates the monthly nitrogen discharge from six different point sources combined into a 12-month rolling average. Ultimately, NYCDEP developed the East River construction "bulge" as a visual representation of this phased progress over time of achieving stricter discharge standards, as shown in the graph. The term "bulge" refers to the short-term increase in nitrogen discharges as tanks and equipment are taken out of service, followed by steady incremental progress attaining multiple limit stepdowns over time.

Managing a program this large and complex required extensive planning for the delivery of the core program, in addition to the consideration of hundreds of process, construction, and legal contingencies. The BioWin software process model was selected to simulate the processes at each plant for each major phase of development, including post-construction operations. Plant specific wastewater quality, operational procedures, seasonal conditions, and infrastructure changes were modeled for each stage of construction. The BioWin results provided projected effluent nitrogen concentrations that were used to create the bulge, a calibrated and effective planning and operational tool not only to assess the impact of change, but to effectively communicate the impacts to a variety of technical and nontechnical stakeholders. The bulge was used throughout construction to analyze the impact of potential construction acceleration measures, sequencing modifications and scope changes.

The NYSDEC and NYCDEP partnership alleviated concerns about short-term progress toward longer term treatment goals. The NYCDEP agreed to maximize its ability to reduce nitrogen reduction in the short term while extended term solutions were being constructed. The NYCDEP was able to avoid having to construct capital intensive, interim treatment technologies in the East River, which would have a low return on investment given the department's limited capital budget and general needs across its portfolio of assets.

As a practical example, construction at the Wards Island WWTP slipped behind the initial schedule due to unforeseen delays associated with the National State of Good Repair Assessment rehabilitation, unrelated to BNR. The consultant team analyzed alternatives to take additional tanks out of service. Ultimately, NYCDEP determined that taking four aeration tanks out of service rather than three would not pose a significant risk to the plant's secondary treatment State Pollution Discharge Elimination System (SPDES) permit or interim nitrogen limits. The NYCDEP implemented this acceleration measure and, ultimately, achieved its consent order completion date without violating its monthly permit requirements

Throughout the history of the nitrogen program, NYCDEP has taken advantage of applied research and advances in technology to adapt to opportunities and mitigate threats. For example, in 2006 the city worked with NYSDEC to modify the design approach to "advanced basic BNR," which achieved equivalent treatment performance at a cost savings of approximately $800 million in comparison to the originally agreed upon design approach. To this day, NYCDEP continues to innovate and show a leadership position in the field. For example, this summer NYCDEP released a request for proposal to modify existing tankage at the Wards Island WWTP to use the ANAMMOX® (anaerobic ammonium oxidation) process for sidestream treatment, potentially reducing operating costs by several hundred thousand dollars a year.

Courtesy of Hazen and Sawyer

The BioWin process modeling that underlies the East River bulge is built upon years of operational support, which has refined its calibration and accuracy. Co-author Sarah Galst is seen here taking a solids profile of a Bowery Bay WWTP aeration tank to determine the flow distribution within the tank.

As many of the East River WWTPs reach construction completion, the underlying work behind the bulge has proven effective at translating the lessons learned to operational staff being asked to employ a new operational paradigm. Process engineering support has collaborated with plant staff for the first year of operation. A dedicated sampling and monitoring program at each plant has provided early warning signs of process upsets and transferred technical knowledge to key staff. Biweekly conference calls and meetings have proven to be effective for coordination, and key operational parameters are summarized on plant specific posters utilized as a key reference at each facility.

The program has been highly successful. Over $1.6 billion of BNR construction has been completed in the East River, and the city has achieved its nitrogen discharge permit every month since the 2001 inception of limits. The investment and commitment by NYCDEP has accomplished major water quality improvements that cut nitrogen discharges by 41 percent to the East River and 22 percent to Jamaica Bay. The final phase of the East River BNR program is adding supplemental carbon storage and feed at the four East River plants; construction is underway and is slated to be completed in 2016.

James G. Mueller, PE, is Assistant Commissioner of the Bureau of Wastewater Treatment for the New York City Department of Environmental Protection. He may be reached at jmueller@dep.nyc.gov. Keith P. Mahoney, PE, is the Bureau of Wastewater Treatment Chief for NYCDEP. Robert D. Smith, PE, is Vice President of Hazen and Sawyer. Sarah D. Galst, PE, is Senior Associate, and Norman S. Bradley, PE, is Senior Associate, both with Hazen and Sawyer.

Operators Spotlight:

In Suffolk County Teamwork Means Success

Both **Dale Grudier**, a 30-year veteran, and **Alec Breen**, a relative newcomer, are second-generation wastewater treatment professionals who possess competitive natures to excel at the facilities where they work on Long Island. Working together with other colleagues on the Brown Tide team, they achieved first place at this year's annual NYWEA Operations Challenge competition *(see Ops Challenge sidebars)*.

At 50, Dale celebrates 30 years with the Suffolk County Department of Public Works, in 1985 starting from a helper position from which he steadily rose in staff responsibilities and professional education. He obtained 3A operator state certification in 1988 and 4A certification in 2007, as well as a mechanical technology associate's degree in 2010. Two years ago, he was named assistant operations supervisor for the Bergen Point Wastewater Treatment Plant.

Photo by Eric Haack (spork8113

From the roof, colleagues Alec Breen (l) and Dale Grudier view their Bergen Point WWTP worksite located off the south bay of Long Island.

"I developed an interest in this field because my father also was an operator with Suffolk County for many years. I found I enjoyed the day-to-day challenges of troubleshooting – coming up with solutions that cover many disciplines from electrical and mechanical operations, to chemistry processes, and record keeping. Ultimately, my work is protecting the environment using the knowledge I have gleaned over a lifetime of experience."

Scaling the career ladder from operations to administration, Dale has experienced different job perspectives and developed new skills sets as required. He successfully did so by recognizing the importance of both mentoring and continued education.

"I have always encouraged those around me to work toward a higher career path through certification. I maintain a library of past tests and quizzes that can be used for study aids, and I often lend them to up and coming operator trainees to prepare for exams."

One such up-and-comer, Alec Breen, arrived as an operator trainee in 2013 with a BS degree from SUNY Plattsburgh, already having grown up as a member, if you will, of the Suffolk County wastewater family. His father is a municipal wastewater administrator there and his mother a former microbiologist. While growing up, they impressed upon Alec the importance of maintaining a clean, healthy water environment and demonstrated two professional roles one could fill in that endeavor.

"I entered the field with the simple desire to serve the public," Alec commented, "knowing wastewater treatment's role in both public health and environmental preservation. Continuing in it, I have been surprised by the field's complexity and the seemingly endless amount of knowledge it requires to master," he noted.

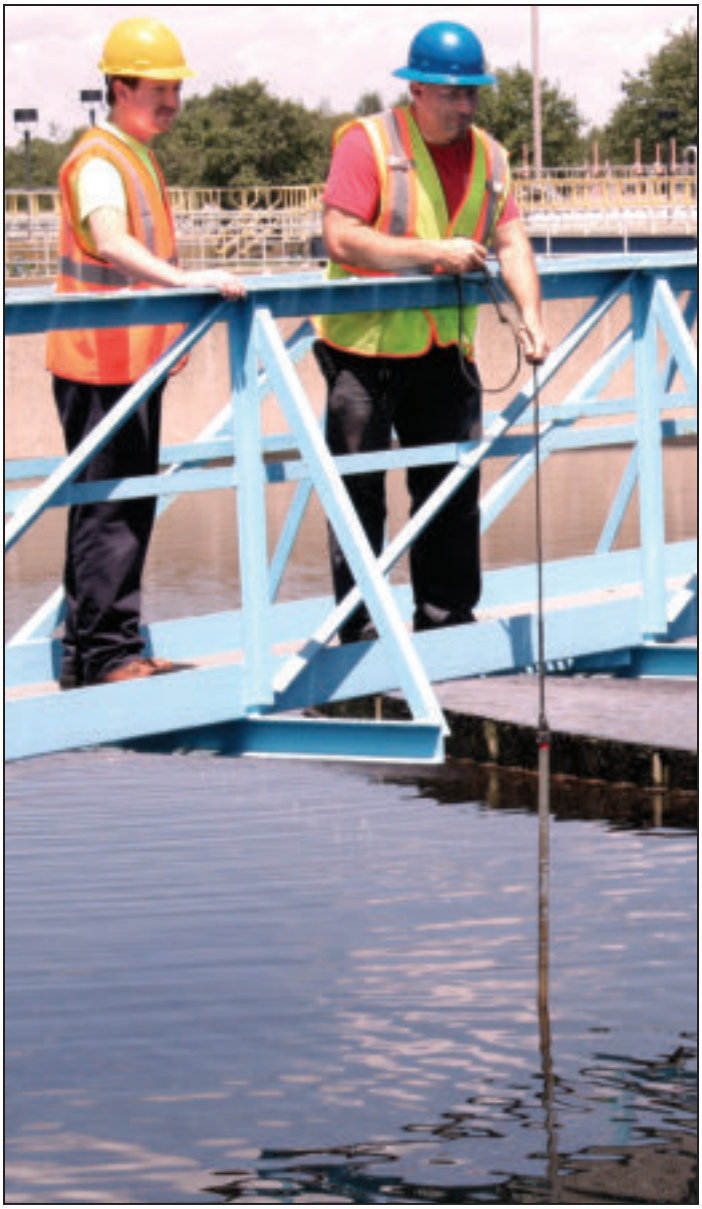
While he also enjoys the wide scope of disciplines and know-how required in day-to-day problem solving on the job, Alec notes that, "the most challenging for an operator with limited experience is how overwhelming the control of a plant's process can be. From making short-term adjustments, to managing a natural disaster, or planning a future that may be a decade away, the amount of variables that must be given due diligence is something that can only be mastered through experience."

With this in mind, "Dale serves as a great manager and mentor to all those starting their careers at Bergen Point," observes Alec. "His management style is 'let me show you' rather than fixing something on his own or dismissing a concern. Whether he explains how something works, identifies the actual problem or maybe gives alternative solutions to a problem, he always does so in a way to be genuinely helpful."

Alec, who lives in Stony Brook with his wife of five years, Ashley, decided to join the Brown Tide Ops team representing NYWEA's Long Island Chapter as a way of expanding his knowledge of the field while engaging in something he's always enjoyed – competition. He played varsity soccer in high school and, "my competitive nature has quite often been the best way for me to motivate myself to achieve."

Alec, Dale and other operators have been known to get together for a day of mountain biking – which can turn somewhat competitive racing back to the parking lot. The challenge may be to beat Dale, who on his own time is not only an avid biker, but holds a 4th degree black belt in Judo and is a marathon runner. Dale resides where he grew up in Rocky Point with his wife Paula, and they have two grown daughters and a son.

Upon becoming a NYWEA member in 2006, Dale was asked to join the Ops Challenge team by then team captain, Roy Zimmerman, and did so "because it appealed to my competitive and goal-oriented nature." He attributes this involvement to helping him achieve different levels of success – awarded the NYWEA SSSSS Gold Shovel in 2008 and a Chapter Achievement Award in 2013. Dale became



Photos by Eric Haack (spock8113

Alec and Dale are shown checking the sludge blanket depth at the final clarifier and Dale takes samples for settling and sludge volume index calculation. Alec (right) at the microscope in the plant's lab, checks for harmful filamentous sludge bacteria.

captain of the Brown Tide in 2013.

The Brown Tide has won the New York State championship six times in the past 10 years, and for three years took second place. In 2007, the team came in second place overall for Division II at WEFTEC, the national competition. "In 2013 we had the best score nationally for both Division I and Division II in the Safety Event category," noted Dale.

The team participates in four competitions each year.

"The time we commit to practice and preparing for these events has catapulted us to victory thus far, and we anticipate more success in the future," Dale said.

Indeed, it takes a commitment both in time and energy, from coming in early to work and staying late for practice – studying and strategizing for competitions, especially the two weeks prior to a competition, they explained.

"I think our success in competition stemmed from our members' experience and our cohesiveness as a team to help, teach and critique one another, knowing our underlying and only goal is to win," Alec commented.

Besides Dale and Alec, the other dedicated Brown Tide members are: **James Behr**, a WWTP helper currently studying for his 3A license at Bergen Point; **Jake Miller**, a Highway Department labor crew leader on the Bergen Point road crew who recently transferred to the Industrial Waste department; and **Brian Blouin** is the coach/alternate, who is a 4A certified operator and an operations crew chief, also at Bergen Point.

"The places we have visited and awards we have won are too numerous to list, but the pride we all felt by coming together as a team to achieve these goals is an indescribable feeling of accomplishment. The members of the Brown Tide are successful because, to a person, we all have the burning desire to be the very best at what we do," Dale observes.

"While at the very heart of it we enjoy the fun of competing and representing our sponsors – with most of whom we are as much friends as colleagues – we remain dedicated to being the best team we can," agreed Alec.

Bergen Point is a 30 mgd 4A Wastewater Treatment Plant which sits on the great south bay of Long Island in West Babylon, NY. The facility employs contact stabilization, activated sludge process with UV disinfection, eight belt presses and a scavenger waste facility, and 26 pump stations. The plant is currently being upgraded to a 40 mgd flow as well as having many pumps and other equipment upgraded to assist with the increased capacity.

continued on page 52

continued from page 51

Ops Challenge: Complex and Outside their Comfort Zone

John Fortin, PE, Ops Challenge chair

NYWEA started the Operations Challenge in 1988 with three teams representing three chapters. "A NYCDEP process engineer then, I was a member of the first Metropolitan Chapter North River team that competed in that first event," recalls John Fortin, who has chaired the Operations Challenge Subcommittee of the Wastewater Facilities Committee since 1992. The number of teams has varied throughout the years with as many as eight teams competing in a given year, he explained.

A significant way that the NYWEA Operations Challenge has grown is in how it is coordinated and run, according to Fortin. In the beginning, there was one main coordinator from the O&M Committee who worked with a chapter representative to procure all the equipment and supplies.

Courtesy of NYWEA

Brown Tide team members work on the Collection Systems event during the Operations Challenge in 2014.

"Because of the complexity of the program's events, I started to use the same model as the Water Environment Federation's (WEF). Now, I am the overall coordinator with five assistant coordinators – one responsible for each event. They update me on any WEF rule changes and procure equipment and supplies to be used. I update and distribute the rules, solicit judges, handle any issues prior to and during the events, score the events based on a WEF scoring system and announce the winners," he said. The Conference Committee assists with the location of the events and any site issues regarding those events, he added.

Members of the Operators Challenge Subcommittee each assist and collaborate with the Conference Committee to organize the event. Those dedicated members are: William Grandner (Metropolitan Chapter), Larry Brincat (Metropolitan Chapter), Harold Robinson (Metropolitan Chapter), Joe Massaro (Metropolitan Chapter), Dale Grudier (Long Island Chapter) and Donna Bee (Long Island Chapter).

Outside Comfort Zone

"The comprehensiveness of each event makes participants learn many new things that are outside their comfort zone," Fortin commented. "By doing so, it shows them that their capabilities and talents are much stronger than they may have imagined." As an example, most team members do not perform laboratory work as part of their day-to-day duties. So, they may have to learn how to use the meters and all the glassware (beakers, pipettes, etc.) in order to perform the event."

"There is a major commitment of time for the operators if they hope to perform well," he noted, "with team operators proving to be very competitive and dedicated. This dedication shows throughout their careers, as many competitors have risen through the ranks and gone on to become plant chiefs and assistant plant chiefs," he said.

With regards to NYWEA, says Fortin, the Operations Challenge is another way it shows its dedication to operators. In addition to the cost of running the Operations Challenge held during the NYWEA Spring Technical Meeting, teams that place first and second are given financial support to represent

Courtesy of NYWEA

Ken Smith of the Genesee Valley Water Recyclers works on the laboratory portion of the 2014 Operations Challenge.

NYWEA at the WEFTEC Operations Challenge held in the fall. Fortin also serves as the Division 1 head judge for the Pump Maintenance event held at WEFTEC.

Fortin is the Northeast Region O&M Services Manager for Hazen and Sawyer and also serves in the WEF House of Delegates. "I am always very impressed with the knowledge the operators demonstrate in the state and national events and how competitive they are in performing them. What also impresses me is the level of professionalism and comradery that the operators show as they compete."

continued on page 55

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continued from page 52

Donna Bee: Ultimate Ops Challenge Booster!

Photo by Ashley Breen

Donna Bee stands next to a wastewater pump used in a Pump Maintenance event.

As soon as Donna Bee first witnessed an Operations Challenge event, she was hooked.

As a newly certified operator attending the June 2011 NYWEA Spring Technical Meeting at the Sagamore Resort, she said: "I was lucky enough to watch the teams from both New York and New England compete. It was unlike anything I had ever seen! The teams were so determined and focused, and I was utterly amazed at the speed with which they completed their tasks. I was hooked and wanted to learn more about the Ops Challenge," she said.

Currently a senior operator at the 2A Northport Water Reclamation Facility in Suffolk County, Long Island, Donna often has crossed paths with her LI Chapter-sponsored team, the Brown Tide, and became friends with the members. She offered to volunteer with event logistics, taking a burden off them by handling registration, fundraising and travel arrangements.

"The more I became involved, the more I wanted to give back to the teams and to the event," she said.

Eventually, Donna approached the NYWEA Board of Directors about sponsoring a competition that would host out-of-state teams to join in the Spring Meeting competition. This would expand the experience for the New York teams that compete in the spring but are not fortunate enough to participate at the national WEFTEC event, she explained.

"The NYWEA board wholeheartedly supported the idea," Donna said, "and a new event was born, called the NYWEA Annual Operations Challenge Invitational."

"It has been a privilege to work with so many hard working, talented people as part of the Ops Challenge family," she commented. "The event wouldn't exist without the hard work and dedication of dozens of volunteers that make it happen." The Ops Challenge is coordinated by John Fortin along with 20 volunteers who judge the events; people at each chapter level assist their local teams; and the chapters and vendors sponsor their team's expenses, she explained.

"These are men and women – operators, other water professionals, engineers and vendors – all working together to better our profession through practice and training."

Photo by Ashley Breen

Donna Bee with Brown Tide team at a recent Tri-Association Conference competition held in Maryland. The team took 2nd place in both the Laboratory and Connections Systems events. Seen are (r-l) Dale Grudier, Jake Miller, Donna Bee, Alec Breen, James Behr and Brian Blouin.

These competitions, she added, "allow for enhanced training and camaraderie, which combine to make the participants elite members of a very talented field. Any employer should count themselves lucky to have these go-getters on their staff!"

Very accomplished herself, Donna serves on the NYWEA LI Chapter Board as chair of the Operations and Maintenance Committee and member of the Wastewater Facilities Committee. Additionally, she was selected to serve as an operator representative on the state NYWEA board. She is an inductee of the Select Society of Sanitary Sludge Shovelers and recipient of her chapter's 2012 Ernest Lisi Operator of the Year Award.

Courtesy of NYWEA

Bob Withers, far left, talks with the New Jersey Devils who came to NY to compete in the First Regional Operations Challenge. (L–r): Art Cowan, Carl Seabrook, Josh Palombo, George McCabe and Coach Tim Fisher, Sr.

Read about the Water Environment Federation's role in the national Operations Challenge held at the annual WEF Technical Exposition and Conference (WEFTEC), on page 57.

Operators Spotlight continued on page 56

continued from page 55

Operators Spotlight:

North and South Work Together for Clean Water

In the 1970s, environmentalism was gaining ground, with water pollution control in the forefront.

"The Clean Water Act was passed in 1972 and I wanted to be a part of cleaning up our nation's waterways," said **Craig Cummings**, 57. He started as a process operator I in 1978 for the Albany County Sewer District (ACSD) North Plant after graduating from SUNY Morrisville with an associate's degree in wastewater technology. Today, he is chief operator at the North facility with a 4A certification.

Vince Cordi, 50, became chief operator of ACSD's South Plant in January 1, 2015, having transferred there three years prior. In 1985, he had obtained an associate's degree in Environmental Science and Natural Resource Management from Paul Smith College and started his career as a technician for the Albany County Soil and Water Conservation District. He joined the ACSD in 1990 as a laboratory technician before moving into plant operations where he ran belt dewatering presses and incinerators at both Albany County's North and South plants. He holds 4A certification.

Photo by Tim Murphy - ACSD

Craig Cummings (left), chief operator of the Albany County Sewer District North Plant with Vince Cordi, chief operator of the ACSD South Plant.

"Since a very young age," said Vince, "I wanted to pursue a career protecting the environment. While studying at Paul Smith College I became aware and focused on the importance of preserving our planet's natural resources, namely the soil and water."

"Our very existence depends on having clean safe water to drink and fertile, non-contaminated soil to grow food. As the Earth's population grows and the more taxed our planet becomes, cleaning up water for reuse and return to the natural ecosystem is paramount for maintaining a healthy future for our children."

"Forty years ago," observed Craig, "the Hudson River was completely polluted. Heavy mats of debris were often seen floating down river, the area was odorous and no one wanted to spend any time along the Hudson. Flash forward to current day, and we see striped bass migrating up river with many boats and guide fishing. There are dinner cruise ships and concerts along the shoreline with families picnicking there now. I'm proud of the hard work and efforts I and many others have been involved in to transform the historic Hudson River into a desirable resource to enjoy," said Craig.

While wastewater treatment plants continue to play a major function in cleaning waterways like the Hudson, such facilities still carry a bad rap, Craig said.

"The public seems to have a negative connotation of wastewater treatment plants, perhaps because in the 1960s they were poorly run or odorous. The term 'sewage treatment' plant also promotes a negative image and I fear the general public imagines a vile work environment. Few may know that these are high-tech facilities which apply chemistry, biology, mechanical, electrical and environmental engineering. If I could, I'd like to do away with the old terms, and call our facilities pure waters facilities, clear waters facil-

Photo by Vince Cordi-ACSD

The ACSD South Plant's four-channel Wedeco Duron ultraviolet system

continued from page 55

Photo by Scott Nash-ACSD

Vince Cordi stands next to control panels for the ultraviolet module lift and wipers at the South Plant.

ities or water reclamation facilities. We should work to change our public relations image."

Another challenge and the biggest by far, both Craig and Vince agree, is the rate of attrition or retirement in the profession.

"This industry is definitely going high tech," said Craig. "Many plants are generating power onsite to offset the high energy consumption they use. Digital controls are being put in place, so the industry will need highly qualified people to run these complicated plants."

"Many senior operators are leaving with decades of experience and being replaced with operators with often just months of training," according to Vince, who co-chairs NYWEA's Succession Planning Task Force. "These new operators have to be trained and mentored faster and more thoroughly than previous generations. My advice to new operators is to seek out training, become licensed, and consider joining NYWEA. The ties you'll make and knowledge you'll gain will enable you to meet the demands of this changing industry and insure a lucrative life-long career."

"This workforce challenge, along with technological advancements in treatment processes," he adds, "guarantees to keep the wastewater field both interesting and rewarding to those who embrace it."

The Albany County Sewer District's North and South Wastewater Treatment Plants perform conventional secondary activated sludge treatment while the North facility handles an average 23 mgd flow, designed for a maximum flow of 88 mgd; and the South an average flow of 22 mgd, designed for a maximum of 45 mgd. Both handle solids onsite with a belt press for dewatering sludges followed by onsite incineration. Effluent to the Hudson River from the North plant is disinfected with sodium hypochlorite, while effluent from the South plant is treated by ultraviolet disinfection.

Both Operators Spotlight articles were compiled and edited by Clear Waters editor, Lois Hickey (clearwaters525@aol.com), with much assistance from the operators featured and others mentioned. Thank you all!

WEF: National Importance of Operations Challenge

The Water Environment Federation (WEF) and its global network of members and Member Associations provide water quality professionals, such as engineers, scientists, regulators and utility managers, around the world with the latest in water quality education, training and business opportunities. A less visible but crucial segment of the membership are the plant operators. Operations Challenge celebrates the contribution of the talented hands-on personnel with a unique professional skills competition, one of the marquee events of the association's annual conference.

Teams are evaluated in five events that demonstrate the span of skills necessary for contemporary water quality professionals to effectively deliver clean water and sanitation services to their communities. The event exposes participants to emerging practices and products in a competitive, educational, and social atmosphere. It is the culmination of qualifying events held by WEF Member Associations that occur during the year prior to WEF's Technical Exposition and Conference (WEFTEC).

Competing in Operations Challenge enables those that typically would not be able to attend WEFTEC the opportunity to go to the largest water quality event in the world. It is there they are often exposed for the first time to breadth of the water quality industry, their vital role in it, and the virtually limitless opportunities for a rewarding career.

As the water quality industry moves beyond mere pollution mitigation toward increasing focus on comprehensive resource recovery, the job of the water quality professional is going to become more complex. Operations Challenge provides a venue that cultivates leadership qualities. As the industry's premier skills competition, Operations Challenge is unmatched in delivering cross training, team building, and professional development. A common reason for attrition on teams is that members get promoted to management positions and are no longer eligible to participate.

The event has doubled in participation since its 1988 debut, and engenders passionate loyalty among competitors and volunteers. Participants that have been involved for more than 20 years are not uncommon. Many of the association's volunteer leaders have emerged from the program, including several WEF presidents.

This logistically complex event requires more than 100 volunteers onsite, and hundreds more to support the qualifying events held throughout the country prior to WEFTEC. The program is highly interactive, and provides continuous cooperation with members as the competition protocols are constantly reviewed and updated to reflect current industry practice. One of the five events is revised each year, making the event dynamic and always exposing the teams to new concepts, products and procedures.

Few people understand the magnitude and complexity of the effort required to constantly and safely provide clean water and sanitation services. But the lack of these services would have profound consequences for public health and our quality of life. There is no greater disparity in the importance of one's job and the prestige of one's job as there is for water quality operators. Their resulting collaboration, facilitated by participating in Operations Challenge, enhances the delivery of these vital services to all of their communities when they return home.

Operations Challenge fosters the evolution of public works employees into stewards of the earth's most essential natural resource. This exceptional event has been emulated by associations in other countries – there are now skills competitions in South America and Europe, and, in 2015, two teams from Germany will compete at WEFTEC for the first time. This type of cross cultural, peer-to-peer mentoring of operations personnel is invaluable to the industry.

— by Steve Harrison, Manager, WSEC Technical Programs, WEF

Operator Quiz Test No. 109 – Primary/Preliminary Treatment

The following questions are designed for trainees as they prepare to take the ABC wastewater operator test. It is also designed for existing operators to test their knowledge. Each issue of *Clear Waters* will have more questions from a different section of wastewater treatment. Good Luck!

1. What would be considered a typical detention time in a properly designed primary clarifier?:
   a. 4 hours
   b. 30 minutes
   c. 1.5 hours
   d. 12 hours

2. What is the length required of a grit channel that is 5-feet wide with a 17-inch water depth and has a flow of 2 mgd to achieve a proper settling rate (0.075 ft/sec)?:
   a. 12 inches
   b. 10.5 feet
   c. 6.7 feet
   d. 8.2 feet

3. A properly designed primary clarifier will remove 90 percent of which of the following?:
   a. Total Suspended Solids
   b. Biochemical Oxygen Demand
   c. Settleable Solids
   d. Phosphorus

4. Applying ferrous chloride to primary clarifiers is most commonly used to treat for:
   a. Fecal Coliform
   b. Biochemical Oxygen Demand
   c. Phosphorus
   d. Total Suspended Solids

5. Which of the following would not be considered preliminary treatment?:
   a. Screening
   b. Grit Removal
   c. Denitrification
   d. Grease Removal

6. Grit is composed mainly of:
   a. Plastic
   b. Sand
   c. Organic Material
   d. Wood

7. What is the detention time of a rectangular primary sedimentation tank that is 50 ft. x 25 ft. x 10 ft. with an influent flow of 2.25 mgd?:
   a. 2.0 hours
   b. 1.0 hours
   c. 0.5 hours
   d. 1.67 hours

8. A plant is installing a circular primary sedimentation tank that has a diameter of 50 ft. and a depth of 15 ft. to treat peak flows of 2.5 mgd. Is this tank sized appropriately?:
   a. Yes, detention time of 2.1 hours during peak flows will allow for proper settling of solids.
   b. Yes, detention time of 1.68 hours during peak flows will allow for proper settling of solids.
   c. No, detention time of 0.5 hours during peak flows will not allow for proper settling of solids.
   d. No, detention time of 0.68 hours during peak flows will not allow for the proper settling of solids.

9. What is the surface loading rate of a rectangular primary sedimentation tank with the dimensions of 60 ft. long x 30 ft. wide x 15 ft. deep with an influent flow of 9.0 mgd?:
   a. 2,000 gpd/sq. ft.
   b. 3,000 gpd/sq. ft.
   c. 4,000 gpd/sq. ft.
   d. 5,000 gpd/sq. ft.

10. A plant has a primary sedimentation tank with a volume of 20,000 cu. ft. and is experiencing an increase in primary effluent total solids. The influent total solids to the clarifier are normal, the sludge pumping equipment is working correctly, and the influent flow is 6.0 mgd. What is the best explanation for the increase in primary effluent solids?:
    a. Surface scum polluted the sample
    b. Elevated flows increased tank solids resulting in high sludge blankets
    c. Decreased detention time resulted in short circuiting
    d. A malfunction in upstream grit collection equipment

11. What is the weir overflow rate of a primary clarifier that has a diameter of 60 ft., a depth of 15 ft., and an influent flow of 3.0 mgd?:
    a. 15,924 gpd/ft of weir
    b. 17,480 gpd/ft of weir
    c. 13,887 gpd/ft of weir
    d. 12,998 gpd/ft of weir

12. Why are Parshall flumes commonly used to measure wastewater flows?:
    a. A V-notch weir allows flow to be easily measured
    b. Pressure differences can be easily measured on both sides of a closed contracting pipe
    c. Depth of flow in a narrow free flowing channel allows flow quantity to be measured
    d. Parshall flumes are not used to measure flow

Answers on page 62.

For those who have questions concerning operator certification requirements and scheduling, please contact Tanya May Jennings at 315-422-7811 ext. 4, tmj@nywea.org, or visit www.nywea.org/OpCert.

Resources

To advertise or to become a member, contact Rebecca Martin at 315-422-7811 ext. 5 or e-mail her at rebecca@nywea.org.

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Position Description: We are currently seeking a Water & Wastewater Project Engineer for our Rochester, NY office. The successful applicant(s) will work with experienced, licensed civil engineers and team with multi-discipline corporate professionals on water treatment and distribution projects, wastewater treatment and collection projects, and other civil and municipal engineering projects. A project engineer may perform a number of tasks including: planning and design of small to medium sized projects; data collection and analysis; preparation of maps and plans; assistance in construction inspection, evaluation of existing infrastructure, preparation of reports and forms; and design tasks associated with water and wastewater infrastructure improvement projects.

Required Knowledge and Skills: The position requires graduation from a 4-year accredited college with a BS in civil engineering and 4 to 8 years of water and wastewater engineering experience. A thorough knowledge of engineering principals; a working knowledge of construction; a good understanding of construction plans and specifications and their application to public works projects; the ability to make moderately difficult technical computations and to compile engineering data; and the ability to understand and carry out complex technical oral or written instructions are important. Knowledge of AutoCAD, Civil 3D, WaterCAD, SewerCAD, and Excel software are a plus.

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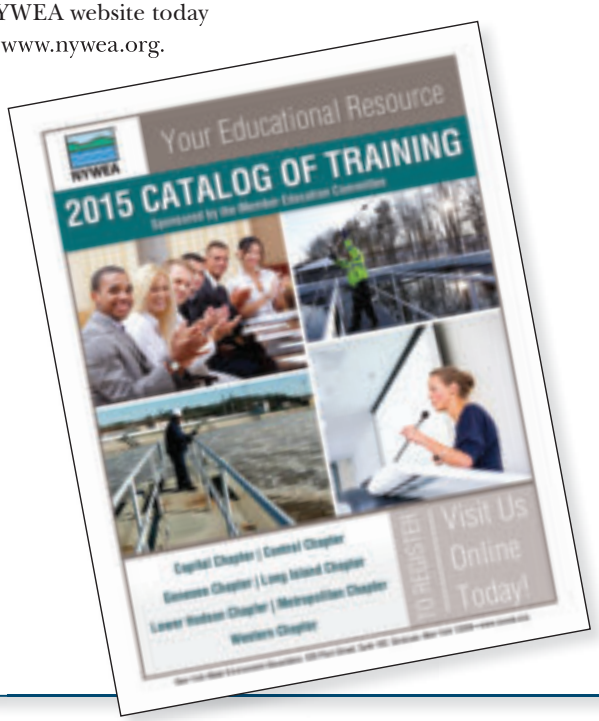
Contact hrinfo@clarkpatterson.com with questions or submission of resumes.

2015 Training Catalog Lists Training through December.

NYWEA exists to enrich the lives of its members through educational training opportunities that include the added benefit of networking with peers and others interested in the profession. The 2015 Training Catalog includes 19 events scheduled throughout the year. To view the catalog, visit the NYWEA website today at www.nywea.org.



Fall 2015, Vol. 45, No. 3

Clear Waters

New York Water Environment Association, Inc.

Answers from page 58: 1C, 2D, 3C, 4C, 5C, 6B, 7B, 8A, 9D, 10C, 11A, 12C

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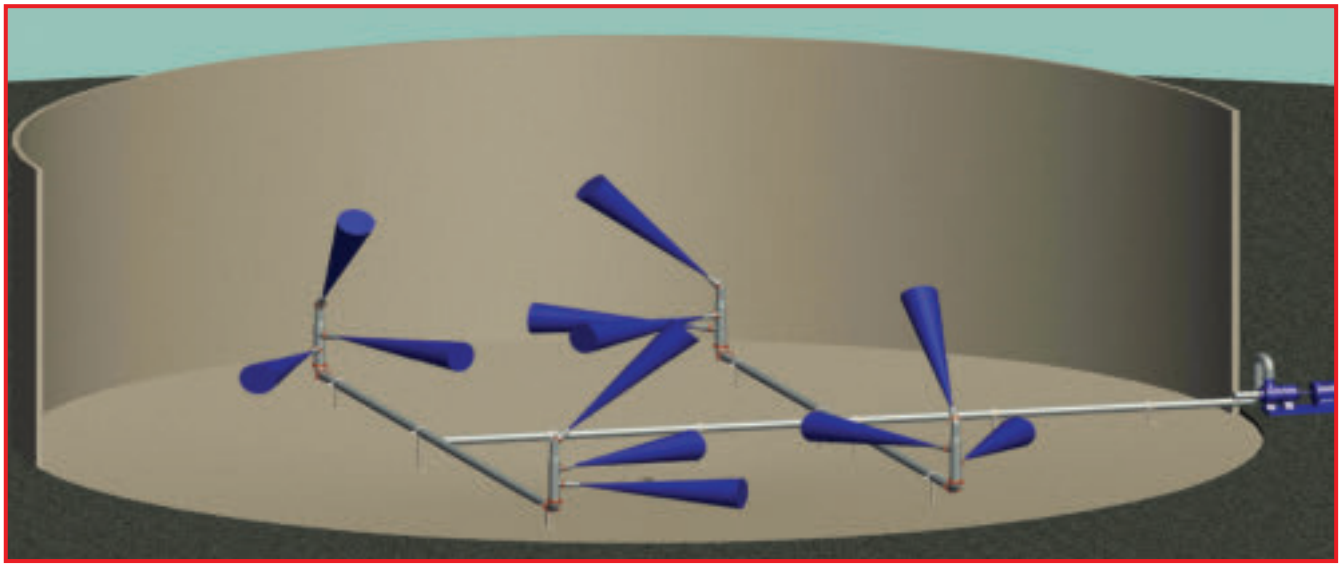

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Customer Testimonial IV:

Environment One

The Town of Peru, NY

Located in the heart of New York's Adirondack Mountains, the Town of Peru sits in a picturesque landscape in the beautiful and historically significant Valcour region of Lake Champlain. The Town has more than 7,000 residents.

In 1985, the Town of Peru installed its first low pressure sewer system, which consisted of centrifugal grinder pumps in fiberglass basins. Water & Wastewater Superintendent Greg Timmons says candidly that he doesn't miss the days when the town owned and maintained two-horsepower, centrifugal pumps with float controls.

"The E/One Upgrade system has made our lives easier and cut down on our costs dramatically."

"I used to have at least two guys on call out of a total of six to answer emergency calls on weekends. Back then it wasn't a question of if we were going to have emergency calls every night, it was how many are we going to have...We were always dealing with hung up floats, jammed cutters and continuous runs."

All this began to change in 2003 when the Town of Peru started replacing their centrifugal pumps with E/One Upgrade pumps. Since then the town has replaced all but two of the remaining centrifugal pumps with the simple and reliable E/One Upgrade.

"We have reduced our overtime for emergency calls by 75%. We don't have any of the old problems that we had with centrifugal pumps."

"We don't answer emergency calls every day like we used to. The E/One Upgrade system has made our lives easier and cut down on our costs dramatically. I'm very happy with the product and level of support we get."

Gregory Timmons
Water & Wastewater Superintendent
Town of Peru, NY

With more than 25 years experience, Greg is a second-generation Superintendent, following in the footsteps of his father, who previously served in the same position in the Town of Peru.

Greg is a hands-on supervisor, who frequently responds to emergency calls personally, and he can describe service calls from 20 years ago in perfect detail - right down to where it was, what his crew encountered, and how they fixed it.

e one
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