Long Island Nitrogen Action Plan (LINAP) Newsletter

Advancing Clean Water Initiatives: A Decade of Progress with the Center for Clean Water Technology.

As we approach the ten-year milestone of both the Long Island Nitrogen Action Plan (LINAP) and the inception of the Center for Clean Water Technology (Center), it's an opportune time to reflect on the vast achievements of the Center. In this edition of the LINAP newsletter, Dr. Christopher Gobler, Co-Director of the Center and Professor at the School of Marine and Atmospheric Sciences at Stony Brook University, offers insights into its evolution, pivotal projects, and its enduring commitment to safeguarding Long Island's water resources.

The Center for Clean Water Technology is a groundbreaking initiative launched in 2015, dedicated to engineering clean water solutions that safeguard public health and the environment while stimulating economic growth in New York and beyond. Funded by the New York State Environmental Protection Fund, administered by the New York State Department of Environmental Conservation and additional state funding from the New York State Department of Health, the Center plays a pivotal role in driving innovation and delivering much-needed improvements in water and wastewater technology.

Long Island's water quality has been in decline. Harmful algal blooms caused by excessive nitrogen pollution are causing declines in fisheries as well as threats to public health. Widespread loss of wetlands have weakened the island's natural resiliency against coastal storms, and contamination of the region's sole source aquifer threatens drinking water supplies. The leading source of nitrogen contamination is wastewater from the more than 400,000 cesspools and septic systems in Nassau and Suffolk Counties -- the greatest concentration of individual onsite wastewater disposal systems in the nation.

The Center is committed to researching, developing, and commercializing cost-effective solutions to remove nitrogen and other contaminants from household wastewater and drinking water. Key focus areas include enhancing individual onsite wastewater treatment systems, tackling emerging contaminants in drinking water, and fostering collaboration with water utilities, government agencies, engineering firms, and academic institutions. The Center's mission to engineer clean water solutions for the protection of public health and the environment while promoting economic development is not only vital for Long Island but also holds the potential to address water quality challenges worldwide.

The Center's creation, like LINAP, was spurred in part by the aftermath of Superstorm Sandy. Dr. Gobler explains that the devastation wrought by the storm underscored the critical link between nitrogen pollution and environmental vulnerability. "The Center was partly created in response to Superstorm Sandy and its aftermath. The storm showed that areas with intact wetlands fared better against flooding compared to those without," said Dr. Gobler. "Around the same time definitive scientific evidence confirmed that nitrogen overloading was destroying our wetlands."

Tasked with developing cost-effective nitrogen removal solutions, the Center began by researching the types of current on-site septic technologies used to address nitrogen and then subsequently began designing, testing and installing them. One of the key advancements made by the Center is in Nitrogen Removing Biofilters (NRBs). These filters remove nitrogen and other pollutants from wastewater by nitrification in a sand bed followed by denitrification in an anoxic (oxygen free) sand/woodchip biofilter.

The Center has developed three variations of NRBs: unlined, lined, and a nitrifying sand bed coupled with a saturated woodchip box. Recent testing revealed that the lined and woodchip box NRBs achieve 85 percent and 90 percent removal rates, respectively, of total nitrogen, outperforming the unlined version and other Innovative Alternative Onsite Wastewater Treatment Systems (IA) tested by Suffolk County's Department of Health Services that have been provisionally accepted or approved for general use in the County. The Center has obtained provisional approval for the lined systems and plans to train engineers and contractors to implement their widespread installation. Additionally, they're working on modifications to the unlined design to enhance its denitrification capabilities.

Installation of NRB. Photo Credit: CCWT

“These systems are essentially just sand, wood chips, and PVC pipes. We even have a design that doesn't require electricity,” Dr. Gobler explains. “Our goal is to create the most environmentally protective systems possible, and if that's not one of our own, we have ways to improve existing systems using add-on technologies we have created like our woodchip-box that can be attached to an IA system for even greater nitrogen removal. We aim for solutions that offer the best environmental and public health benefits while remaining as affordable as possible.” The Center sees the opportunity to commercialize the NRB installation process for installers, creating a competitive business environment that will drive the overall cost of NRBs even lower, making them more affordable for residential and commercial applications.

The Center is also working on a variety of Permeable Reactive Barrier (PRB) projects. A PRB is a subsurface structure that treats contaminated groundwater by allowing the groundwater to pass through media that helps remove containments. PRBs have the potential to help mitigate legacy nitrogen that remains in groundwater for decades from past activities and may continue seeping into coastal waters for years to come. PRBs may be useful in those areas in particular. “PRBs have the potential to be a promising approach to deal with legacy nitrogen. They are a great solution in specific areas under specific circumstances. For a PRB to be successful, you need both high groundwater flow rates and high nitrate levels. It is important that PRBs are sited and installed correctly so they don’t cause unintended harm to the environment, such as greenhouse gases or high levels of iron in the groundwater leaving the PRB. So rather than putting PRBs everywhere, we now have a more nuanced approach.”

Experiments at the Center’s Wastewater Research and Innovation Facility (WRIF) have been ongoing with the aim of continually improving the design of the Center’s wastewater treatment technology. In fact, a nitrogen sensor was developed at the facility which simultaneously measures nitrate and ammonia in wastewater and final treated effluent. “The nitrogen sensor provides continuous monitoring, unlike traditional methods that only offer snapshots during limited times, namely weekdays between 10:00am and 3:00pm when people sample septic systems. This continuous data is valuable for understanding system performance during peak usage times like in the earlier part of the morning, on weekends, and special events. Both municipalities and companies see the benefits of this real-time data, which is more cost-effective and informative than periodic manual sampling and lab analysis,” said Dr. Gobler. There are plans for widespread development of the nitrogen sensors and to implement them throughout Suffolk County to monitor the performance of the thousands of IAs that have been installed.

In 2019 the NYS Center for Clean Water Technology opens Wastewater Research and Innovation Facility. Photo Credit: CCWT

Innovative approaches to wastewater treatment, such as urine separation, are also promising methods being examined. "Approximately 75 percent of nitrogen in wastewater comes from urine. By separating and addressing urine, we can achieve a 75 percent reduction in nitrogen, comparable to advanced systems," said Dr. Gobler. Research by the Center has shown that sterilized urine can be converted into an effective fertilizer, comparable to commercial products that already exist. The next steps involve developing the necessary infrastructure and creating a viable commercial product to move this initiative forward. "While it's unrealistic to expect everyone to do this at home, there are significant opportunities in public restrooms in large gathering areas, stadiums, and similar facilities where urinals already separate urine. The plumbing required is simple, and this approach can substantially reduce nitrogen loads. If you did just that, it would make a significant dent in the nitrogen load."

Today, the Center's scope has broadened to address a wider range of contaminants and treatment methodologies. In addition to septic systems degrading water quality, historic human activities and industrial practices have contributed to the contamination of Long Island's aquifers. The Center is researching methods to remove emerging contaminants from drinking water, focusing initially on 1,4-dioxane through advanced technologies like advanced oxidation processes such as ultraviolet/hydrogen peroxide treatment. The next phase of their research has focused on contaminants like poly- and perfluoroalkyl substances (PFAS). Beyond laboratory research, the Center will address this issue by establishing a testing facility at drinking water distribution sites to monitor a wide suite of PFAS and evaluate the effectiveness of existing and alternative treatment technologies. Dr.

Gobler emphasizes that central to the Center's success is its collaborative approach. The Center is collaborating with water utilities, NYS officials, engineering firms, and other academic institutions to build a research program to address concerns regarding emerging contaminants and to accelerate the pace of innovation in water technology.

Dr. Gobler noted that the solutions developed by the Center can be adapted for a broader market, promoting innovation and establishing a new industry that addresses water quality challenges across the nation and beyond.

As we near a decade of progress with the Center for Clean Water Technology, the journey towards cleaner, safer water continues. Looking ahead, the Center remains committed to its core mission while adapting to emerging challenges. Continued research and innovation are paramount, with a focus on developing environmentally protective and cost-effective solutions.