Municipal Case Study

Vortex Flow™ Plays Crucial Role in World's Largest Raw Wastewater Energy Transfer System Serving Toronto Western Hospital

Vortex Flow™
ODOR & CORROSION CONTROL

PROJECT:
Wastewater Energy Transfer System, Toronto Western Hospital

PRODUCTS:
Vortex Flow™ Odour & Erosion Control System

CONTRACTOR:
Noventa

PROJECT SUCCESS:

- Suppresses Odour
- Dissipates Energy
- Improves Waste Water Quality
- Low-to-No System Maintenance

Award-Winning Technology Was Clear Solution for Large-Scale Odour and Erosion Control

CHALLENGE

Founded in 1895, Toronto Western Hospital (TWH) is a renowned teaching and research hospital specializing in neurology, neurosurgery, and musculoskeletal health. It's also part of the University Health Network (UHN), a major healthcare and medical research organization based in Toronto.

Across the country, hospitals and medical facilities are exploring new ways to innovate their operations to support Canada's 2030 Paris Agreement goals and achieve net-zero emissions by 2050. In 2021, Toronto-based green energy supplier Noventa approached TWH with a groundbreaking proposal to reduce their greenhouse emissions and environmental footprint.

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To install the WET system, engineers had to construct a 120 ft drop shaft and address two key challenges:

- Dissipating the energy of falling wastewater to prevent erosion to the structure
- Suppressing odours, particularly hydrogen sulfide gas (H_2S), from affecting the hospital and surrounding areas

That same year, the Federal Government awarded Noventa Energy Partners $42.9 million to install a new system that will provide clean energy to the hospital. Noventa's revolutionary Wastewater Energy Transfer (WET™) system will provide clean energy to TWH, using recovered heat extracted from wastewater in the sewage system to heat and cool the hospital. This project will supply about 90% of the hospital's heating and cooling needs and will help deliver substantial savings on energy costs.

The WET system is expected to help TWH reduce greenhouse gas emissions by roughly 169,000 tonnes, equivalent to removing approximately 52,000 cars off the road for a year.

This initiative is the world's largest raw wastewater thermal energy transfer project. It will deliver 19 megawatts of capacity (10 for heating and 9 for cooling) using 16 BG8 heat exchangers, making it eight times larger than any other installation globally.

Installing the WET system in Toronto's downtown core is a complex undertaking and involves constructing a massive 120 ft drop shaft or chamber all the way down into the sanitary trunk sewer that connects with the municipal sewer line.

Inside the chamber, pumps draw sanitary wastewater from the trunk sewer. The warm wastewater is then filtered, separating the solids from liquids. That liquid wastewater is then pumped upward, transitions to horizontal flow through a 90-degree bend, then passes through 16 heat exchangers. After the heat is extracted, the cooled wastewater is returned to the trunk sewer.

But the flow back down poses two key challenges. First is energy dissipation:

with the trunk sewer 120 ft deep, freefalling wastewater will gain significant speed and force, which can quickly erode the internal components of the drop structure.

The second challenge is the release of Hydrogen Sulfide gas (H_2S) formed by chemical reactions in the sewer. Turbulent flows, like those created by wastewater plunging from a height, can also create more gas due to the reaction of the air and sewage mixing. If this gas seeps into the hospital or surrounding area, it could pose serious health risks to staff and patients. At high concentrations, it could also be lethal to anyone who inhales it.

This system must integrate with Toronto's local sewer network. It also requires a solution to dissipate energy and suppress odours from a nearby collector line that passes through the system and connects to the trunk line at its base.

Engineers needed to find a solution that could both dissipate the energy of falling wastewater and suppress odours from the released gas for both of these sewer systems.

Overcoming these two critical challenges was essential to making this innovative raw wastewater treatment system fully operational.

> **Vortex Flow is a simple solution that solves one of the biggest design challenges with this project. Other customers using Vortex Flow™ highly recommended the product, thanks in large part to it being very low maintenance.**
>
> **Cam Quinn**, Vice President
> Project Delivery, Noventa

SOLUTION

Since a wastewater energy transfer project of this scale had never been designed before, Noventa faced unique challenges when designing the system's wet well because of its significant depth. One of Noventa's engineering consultants, RV Anderson, suggested looking at IPEX's Vortex Flow™ system. The consulting firm designed the very first Vortex Flow unit installation in the GTA over 20 years ago and has installed many more since.

After speaking with IPEX, it became clear to Noventa that the Vortex Flow unit was the solution they were looking for. In fact, there was no other product that could meet all of the requirements for this project.

The Vortex Flow system effectively dissipates energy by guiding the wastewater flow through a vortex, which exits into what is called the "dissipation pool" at the bottom. When the wastewater leaves the dissipation pool, most of the energy has been dissipated. The Vortex Flow unit minimizes turbulence, reducing gas release and suppressing odours. Recognized for its groundbreaking design, the Vortex Flow system received the American Public Works Association (APWA) Technical Innovation Award in 2002.

The other potential solutions for erosion control and odour suppression simply weren't fit for the purpose.

One approach to suppress odours was adding chemicals like Bioxide to the wastewater, which would prevent H_2S gas from forming and being released. Alternatively, a chemical-free option involved allowing the gas to escape but capturing it and removing the odours using air filters or scrubbers.

Both of these options would require ongoing maintenance. Chemicals must be added continuously, costing $5,000–$10,000 per month. What's more, the use of chemicals would also negatively impact the project's

environmental footprint. Similarly, air scrubbers become saturated over time and must be replaced, requiring a regular supply of materials, which would also impact their decarbonization efforts. Both options also come with significant ongoing costs and operational demands.

For erosion control, the only alternative was to install baffles to break up the 120 ft vertical drop into hundreds of smaller drops. This would be done using a zigzag pattern of planks where wastewater flows from the inlet pipe onto one plank, drops to another below it, and so on. But while this method disrupts the flow, the constant motion can actually make odours worse.

Compare those solutions to the Vortex Flow system, which dissipates energy by spiralling flow to reduce velocity and impact and suppresses most odours. Vortex Flow also requires virtually no maintenance.

The Vortex Flow also naturally aerates the wastewater by drawing in air through spiral flow, allowing municipalities to save significantly on treatment costs. Since the wastewater arrives rich in dissolved oxygen, the need for additional oxygen pumping at the treatment facility is greatly reduced.

During the installation, Noventa and their contractor, BIRD Construction, made several on-site modifications to the Vortex Flow units. The product was specifically designed for easy on-site adjustments to meet the installation's unique specifications.

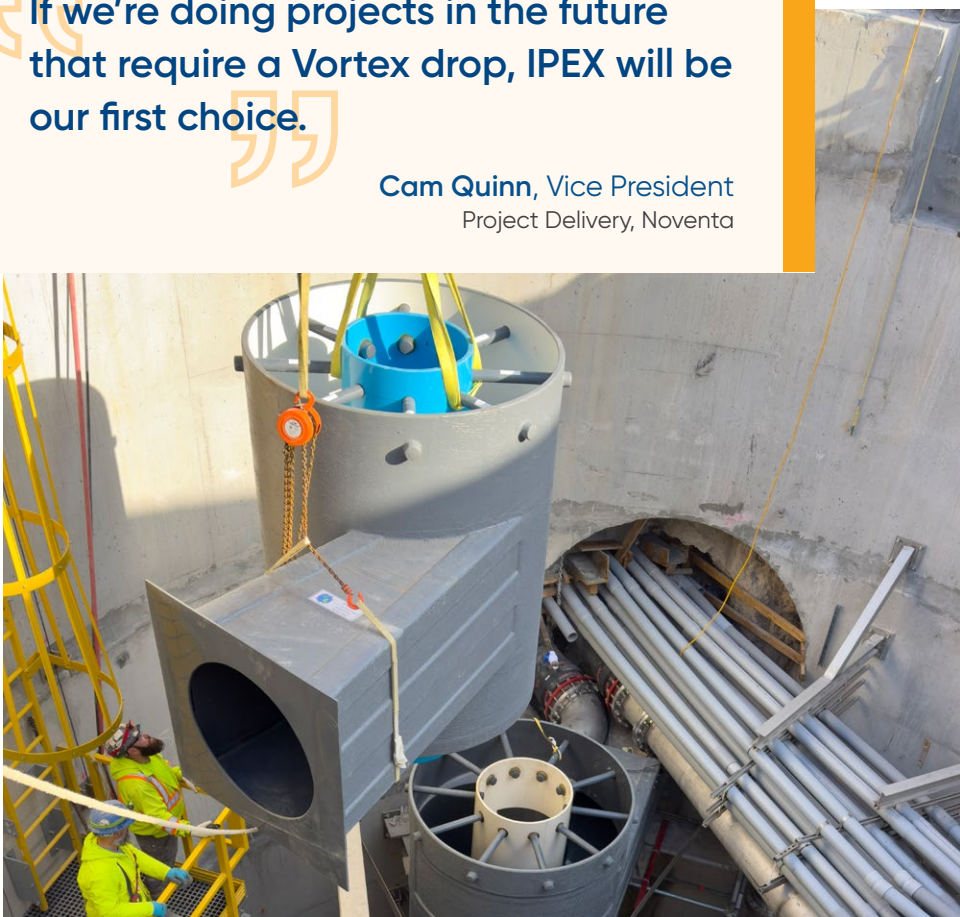
Given the tight space, the contractors worked carefully to ensure the units fit snugly against the wall while accommodating the various pipes entering and exiting the chamber. The drop shaft was trimmed to size without difficulty, thanks to IPEX always providing shafts an extra meter longer than needed. Additionally, the inlet flume at the top was modified to account for the surrounding piping. All adjustments were made without issue, and IPEX supplied updated drawings to Noventa after each iteration to guarantee a seamless installation process.

The Vortex Flow units are designed to make maintenance and inspections inside the chamber safer and easier. Normally, this type of work would require bypassing the flow, which can be costly and, in some high-traffic areas, impractical. With the Vortex Flow in place, hydrogen sulfide gas levels are significantly reduced, ensuring a cleaner and safer work environment for maintenance crews. The Vortex Flow helps protect sensitive equipment within the chamber by preventing wastewater from seeping in and causing potential damage.

Undertaking this massive construction project in the heart of downtown Toronto was no easy task. One of the biggest challenges was coordinating the logistics of getting people and equipment to the site, which required extensive planning and effort.

To proactively manage the complexity of this build, IPEX worked closely with all key stakeholders, including contractors, engineers and utility operators, to maintain constant communication and complete this large-scale project on time and on budget.

> **"If we're doing projects in the future that require a Vortex drop, IPEX will be our first choice."**
>
> **Cam Quinn**, Vice President
> Project Delivery, Noventa



RESULTS

The TWH project started in June 2021, and the Vortex Flow unit was installed in November 2024.

The Vortex Flow unit is currently in the commissioning stage, so the project is not yet complete. There is also still some more work to be done before the city's second Vortex Flow unit will be commissioned. The project is expected to be completed and operational by late Q1 or Q2 2025.

The wastewater energy transfer system has already proven to be a groundbreaking solution for more energy-efficient heating and cooling methods. Noventa's WET project will open the door for hospitals and other municipal facilities to take advantage of raw wastewater for large-scale decarbonization initiatives.

Fast & Easy Installation

The installation process has been seamless and, according to the engineers, nearly like a plug-and-play solution. Commissioning has been straightforward and simple as well. After an hour of testing with clean water, the engineers transitioned the system to sewage. IPEX has also successfully operated the system under various conditions without any issues. .

On-Site Technical Support

The IPEX team was on-site multiple times to support Noventa and other key stakeholders during the installation and remained available when needed.

Energy Efficiency

By working with IPEX's Vortex Flow system, Noventa was able to leverage the sewer right beneath the hospital's front door to decarbonize its operations and meet its green energy goals. This method not only reduces natural gas consumption but also improves their overall energy efficiency. It's clear that the WET system significantly outperforms traditional heating.

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