WATERSHED REVAMP

Deteriorating New York watershed gets upgraded with BMPs, green infrastructure & wetlands

By Steven Gruber

The village of Wappingers Falls and other communities in the Wappinger Creek watershed—the largest in Dutchess County, N.Y.—have been concerned for many years with flooding and the deterioration of water quality throughout the watershed.

Wappinger Lake is a community landmark that has served as a significant source of groundwater recharge for the village's drinking water wells, and provided recreation and wildlife habitat. The water depth and quality have been deteriorating steadily in recent years, primarily due to storm water runoff and the resulting sedimentation and associated nutrients.

Some of the key problems associated with the watershed and its management include:

- Flooding during major storm events;
- Declining groundwater quality and quantity;
- The high cost of clean drinking water;
- Loss of recreational assets and the resulting decline in business, taxes and property values; and
- Damage to the ecosystem, aquatic community and overall health due to sedimentation.

Growth pressure throughout the watershed has resulted in environmental degradation. It is predicted that Dutchess County, located 65 miles north of New York City, will grow by at least 20% by 2020. Because of this growth, nutrient loading and sedimentation will continue to threaten the designated uses of the lakes and streams in the Wappinger Creek watershed with an exponentially increasing impact. An integrated approach to storm water management and land use planning for future sustainable development was urgently required.

In 2010, Wappingers Falls began working with New York-based ecological wastewater treatment consultant Renewage. A preliminary water management plan was developed, incorporating previous studies for the entire 220-sq-mile watershed. The plan called for the installation of green infrastructure and BMPs, including Renewage's gravel wetland filters at strategic locations.

The New York State Department of Environmental Conservation's (NYSDEC) Hudson Estuary Program was supportive, and encouraged the village to lead by example and develop a demonstration project to show how this approach could work elsewhere in the watershed and in other areas of New York with similar issues.

A 2-acre infill site that had a damaged drainage swale flowing directly to the lake was selected. A preliminary design was developed to treat a 1.2-sq-mile sub-watershed and 240-acre drainage area. The filtration system captures and removes the sediment passing through it and is designed to attenuate a 25-year/24-hour storm event. (Plans for a larger culvert will provide protection from a 100-year storm.)

The system is composed of four treatment stages:

- Sediment retention forebay;
- Gravel wetland filter;
- Shallow wetland; and
- Outlet pool.

The subsurface flow gravel wetland traps and treats 85% to 95% of the sediment and suspended solids passing through it. Accumulated sediment is safely and easily flushed, enhancing treatment and extending the life of the system indefinitely.

The System

The gravel wetland filter is composed of four primary components, including a flow distribution system, layers of engineered stone and a flushing system to remove accumulated sediment. The

The subsurface flow gravel wetland traps and treats 85% to 95% of the sediment and suspended solids passing through it. Below: The completed wetland system

permanent water level is maintained just below the surface of the stone with an adjustable standpipe system. The filter's flushing system provides an opportunity to rejuvenate the wetland cell by allowing accumulated sediment to be safely flushed from matrix boxes on an impervious liner that trap the sediment below the stone media.

Air is pumped into the base of the wetland using a small compressor. While the sediment is agitated within the wetland, it is pumped out into a silt bag that captures the suspended sediment for safe disposal, and the filtered water drains back into the system, replacing what had been previously pumped out. This process is conducted twice annually. The system is routinely inspected for invasive species, signs of erosion and washout.

The flushing system enhances treatment and extends the useful life of the system. A constant water level is maintained below the planted surface of the wetland. Storm water is physically filtered as it passes through the stone, and biologically treated through plant uptake and soil microorganism activities. The biological treatment continues on the volume of water that remains in the wetland even after the storm has passed.

When storm water runoff flows exceed volume and intensity capacity, the water level rises within the wetland, up into the sediment forebay, and the water spills out into the shallow wetland. The outlet pool has a structure that allows a high overflow level and minimizes trash clogging.

The shallow wetland provides additional storage for treated storm water discharged from the gravel wetland filter. It is designed to handle additional storm flows beyond a 25-year storm event. The original storm water channel meanders through the shallow wetland with intentional flood plain, pocket ponds and vegetated swales. Each of these elements performs a specific function ranging from treatment to peak flow dissipation.

Aesthetically, the shallow wetland closely resembles a natural wetland, and provides habitat for a diverse range of plant and animal species. The water surface is exposed throughout at depths, which allow for a variety of plants, including submerged, floating and emergent species.

Operation and maintenance costs are minimal (approximately $6,000 annually) and the system can be managed locally.

Funding & Construction

Most civil engineers, municipal planners and regulators working in the field are well versed in conventional storm water management (retention ponds), so the alternative of using a green

The gravel wetland filter's flushing system allows accumulated sediment to be safely flushed from matrix boxes on an impervious liner that trap the sediment below the stone media.

infrastructure wetland treatment can come as a paradigm shift. Renewage engineers made the case to New York State Environmental Facilities Corp. (EFC), which funded the project, and NYSDEC regulators that:

- Storm water wetlands can achieve significantly better results than traditional approaches, providing cost-effective hazard mitigation while improving water quality.
- In the wake of three devastating 100-year storm events in two years, new approaches needed to be considered.
- The cost-benefit, including initial capital and long-term operation/life-cycle costs, is significantly lower than alternative options or maintaining the status quo.
- Innovative green technologies often are eligible for state and federal grants, as well as other low-cost funding options.

In 2011, Wappingers Falls was awarded a $638,000 Green Innovation Grant from EFC under the Clean Water State Revolving Fund to design and build the system, which is the first of its type and scale in New York state. It received all local, state and federal regulatory approvals, including from the U.S. Army Corps of Engineers (USACE). Construction began in July 2013 and was completed in October 2013.

Challenges

One challenge for the project was acquiring adequate land at a major outfall point to the lake. There was an ideal

2-acre site in a drainage swale along the storm water runoff culvert that had experienced significant nearby flooding. A small regional newspaper owned the land. Because of the topography, drainage swale and NYSDEC restrictions on construction, the landowner was unable to develop the site and was willing to provide the village with a permanent easement in exchange for favorable zoning changes on a nearby property. The agreement and its approval took more than a year to negotiate.

Another issue was ensuring that the proposed site was not a classified wetland and thus a restricted area for disturbance by either the state or USACE. The village's environmental lawyer arranged a meeting with the NYSDEC regional director. The heads of all affected departments were notified and were able to provide assurance that the site was not a designated wetland. An application was filed with USACE, which inspected the site and determined that the proposed plan was appropriate and acceptable with certain conditions, which were met.

A funding challenge arose as well. The grant, which the EFC was administering under the auspices of NYSDEC, required the village to contribute 10% of costs and any overage. This was overcome when the corporation allowed the village to count the cost of previous engineering studies undertaken to ascertain optimal treatment location and preliminary engineering required to obtain the grant and permitting, thus mitigating the cost to the community.

A regulatory issue—that the gravel filter wetland design was not listed as approved by NYSDEC's 2010 New York State Stormwater Management Design Manual—was solved when Renewage engineers were able to provide EFC and NYSDEC with examples of similar projects that were successfully constructed in other states, making this project a demonstration project for other jurisdictions. EFC and NYSDEC agreed on and approved engineering plans.

After Construction

The Wappingers Falls storm water wetland system has been working as designed since October 2013 and has become an integral educational environmental showcase for this type of approach in New York.

The communities in the Wappingers Creek watershed are seeking funding to conduct further studies to identify other major outfall points where similar BMPs may be adopted. Several communities in Dutchess and surrounding counties in the Hudson Valley have studied the system and are exploring means by which they also may address similar issues. SWS

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