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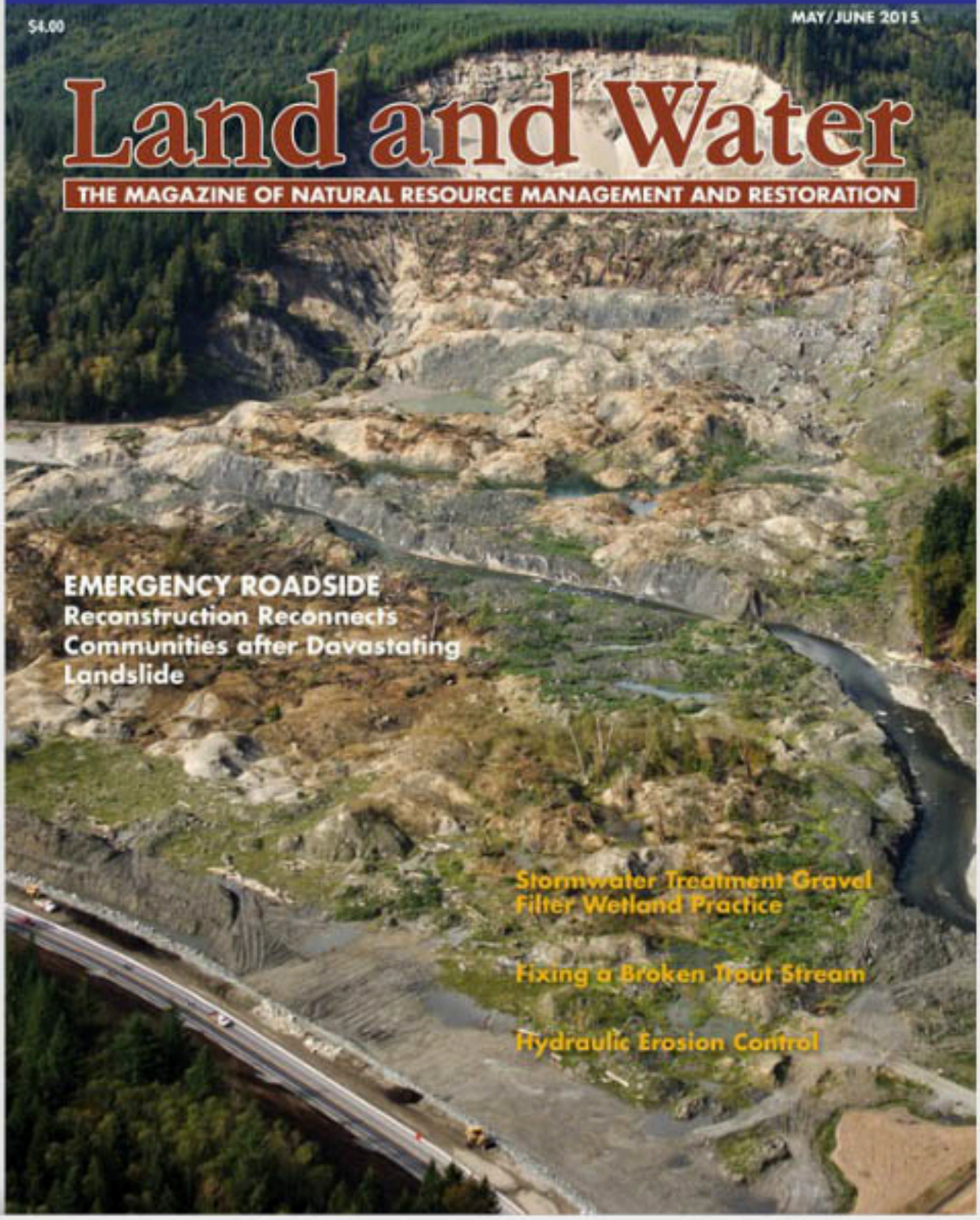
Land and Water

THE MAGAZINE OF NATURAL RESOURCE MANAGEMENT AND RESTORATION



EMERGENCY ROADSIDE
Reconstruction Reconnects Communities after Devastating Landslide

Stormwater Treatment Gravel Filter Wetland Practice

Fixing a Broken Trout Stream

Hydraulic Erosion Control

Stormwater Treatment Gravel Filter Wetland Practice in the Hudson Valley

Wappingers Stormwater System at work.

Communities in The Hudson River Valley of New York State have been concerned with flooding and deteriorating water quality in the estuary and its sub watersheds for many years.

The Village of Wappingers Falls (population 6,000), in scenic Dutchess County lies on the western shores of Wappinger Lake. The lake is a manmade reservoir at the bottom of the 220-square mile Wappinger Creek Watershed. The creek meanders from near the Connecticut border through 13 small towns and villages, past Vassar College and the Town of Poughkeepsie, into the lake and out to the Hudson River.

The lake has been an iconic local landmark, recreational asset and has served as a significant source of groundwater recharge for The Village's drinking water wells.

The Problem

Growth pressure throughout the watershed has resulted in serious environmental degradation. Today the lake is shallower due to siltation from stormwater run-off, which has also led to the deterioration of water quality in the lake and throughout the watershed. The once healthy eco-system is now covered with algae and weeds. Some areas the lake are less than 6 inches deep.

Of greater concern was the depletion of the aquifers supporting the Village's drinking water wells. In 2010, the community was forced to borrow millions of dollars to construct a new water treatment facility.

In addition, The Village has experienced serious flooding during increasingly frequent major storm events. Residents have been displaced, property damaged and significant costs incurred. The deterioration of the lake has been coupled with a steady decline in property values and quality of life in the community.

It is predicted that Dutchess County will grow by at least 20% by 2020. Unchecked, sedimentation and nutrient loading into the watershed and lake will continue to threaten the designated uses of the

Installation of impervious liner, matrix boxes and gravel.

lake, resulting in further degradation and exponentially increasing ecological and economic costs. An inter-communal council of the13 communities in the watershed (WIC) has been meeting for many years, and several studies for stormwater management, and integrated land use planning have been undertaken. While some measures have been taken there has been no long term integrated solution for these difficult problems.

Call to Action

Wappinger Falls Village Mayor Matt Alexander is a great proponent of sustainable solutions and a respected visionary in the Hudson Valley. He was able to elicit enthusiasm and unanimous support from his board and community to find solutions.

In 2010, the Village began working with Renewage, a New York-based ecological stormwater and wastewater treatment consultant. A preliminary water management plan was developed for the entire 220-square mile watershed, incorporating previous studies. The plan called for the installation of several green infrastructure gravel wetland filters at major outfall points at strategic "infill" locations.

NY State DEC's Hudson Estuary Group was supportive, and encouraged Renewage and The Village to identify one site where a significant green infrastructure system could be built as a first step, to demonstrate how this approach could be funded, built and provide benefit.

A 2-acre infill site, in a flood-prone area in the middle of the Village was selected. The site had a damaged drainage swale flowing directly to the lake. Renewage's engineers David Whitney (EcoSolutions); David Maciolek (Aqua Nova) and Evan Fitzgerald, MS, developed a preliminary plan for a gravel wetland filter green infrastructure practice that would treat a 1.2-square mile sub-watershed in the Village and an overall drainage area of 240 acres.

The goal was to create a cost-effective system that would have real impact while showcasing best management practices in the design. The system would provide local flood resiliency while treating stomwater runoff before it entered the lake and surrounding waters. Plans were prepared with components that could be easily replicated like Lego pieces for sizing, installation, and replication in other areas.

In 2011, The Village was awarded a prestigious Green Innovation Grant from the State's Clean Water Revolving Fund. Final design and permitting went into high gear.

The Plan

The sub-surface-flow gravel wetland was designed to trap, treat and remove 85-95% of the sediment and suspended solids passing through it. Accumulated sediment can be easily and safely flushed, enhancing treatment and extending the life of the system indefinitely. The system is designed to attenuate a 25-year/24-hour storm event. (Plans for a larger culvert are in place that will provide protection from a 100-year storm.)

The system has several distinct components:

- Sediment retention forebay

Above: Construction of forebay. Below: Installation of Geo Web liner in forebay.

- Gravel wetland filter
- A shallow wetland
- Overflow bypass system
- Outlet pool
- Discharge outlet

Sediment Forebay

The sediment forebay acts much like a traditional stormwater managements' retention pond, and is a critical aspect in the system's ability to provide enhanced flood resiliency and provide hazard mitigation. The forebay is the first stop in the system and traps larger objects and detritus before they can enter the wetland treatment system and move further downstream.

The configuration of the site, and the engineers desire to limit the area of disturbance meant that their was not enough width to handle the necessary water volume. The solution was to create a deeper forebay. Lead PE David Whitney developed a unique and aesthetically attractive feature that used rows of GeoWeb to safely ensure the sidewalls could support the water volume. The top rows were planted with native flowering species.

Gravel Wetland Filter

Unlike many similar wetland designs, an impervious liner seals the base and walls of a 6' deep, 9,000 sq. foot pool, which protects adjacent native soils from untreated stormwater leaching and co-mingling with ground water. Rows of matrix boxes were placed on a gravel base at the bottom of the wetland cell to trap and retain the sediment and attached nutrients as they flow sub-surface from the sediment retention forebay. Large and small sized engineered stone was then layered in. The stone houses the unique flushing system.

A permanent water level is maintained just below the surface of the stone with an adjustable standpipe system. The gravel wetland filter's flushing system provides an opportunity to rejuvenate the wetland cell by allowing accumulated sediment to be safely flushed from the system. A layer of mulch on top of the stone provides substrate for the wetland plants.

Stormwater is physically filtered as it passes through the stone, and biologically treated through plant uptake and soil microorganism activities. The biological process continues to treat the volume of water that remains in the wetland even after the storm has passed.

Removing Sediment

To remove the sediment, air is pumped into the base of the wetland, using a small compressor. When the sediment is agitated within the wetland, it is pumped out into a silt bag that captures the suspended solids and unwanted materials for safe disposal. The filtered water drains back into the system, replacing what had been previously pumped out. This process is conducted twice annually. What makes the system easily manageable from a maintenance and cost perspective is that the pump is a separate entity, like a portable trash pump, with its own controls and valve box that can be easily brought to the site in a small pick up truck. There is no single large outlet on the bottom for compressed air, but rather a perforated manifold. The line can pump either air or water or both in or out as needed. Occasionally water can be taken out and back flushed as needed.

The system is routinely inspected for invasive species, signs of erosion, or washout.

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

The system is designed to attenuate a 25 year/24 hour storm event within a 1.2 square mile sub-watershed. The estimated amount of water flowing into the system during such an event was calculated using:

The HydroCAD® rainfall-runoff modeling platform, based upon the Natural Resources Conservation Service (NRCS)

TR-20 model and methods (SCS, 1983), was utilized for the calculation of peak runoff rates and routing to the treatment area for 24-hour storms. The water quality volume (WQv), 1, 10, 25, and 100-year storm data was obtained from the New York State Stormwater Management Design Manual (NYDEC, 2003).

The project site watershed was delineated using elevation data from the USGS National Elevation Dataset (NED) and from 5-foot, LiDAR-derived contours obtained from Dutchess County Planning. The basin outlet drains to the north eventually reaching Wappinger Lake about 1,800 feet downstream.

The WQ volume for this drainage area is 4.2 acre-ft (182,170 ft3). The WQv storm was analyzed using an alternative TR20 approach recommended for storm depths less than 2 inches. Using the known percent impervious cover for the watershed, a higher curve number was selected to accurately model the WQv from the site.

There is an allowance for a 3ft dynamic change in the outlet pool during major storm events.

The shallow wetland provides additional storage for treated stormwater discharged from the gravel wetland filter. The shallow wetland is designed to handle additional storm flows beyond a 25-year storm event. The stormwater 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.

There is a "fail-safe" emergency by-pass run-off system that protects the system and surrounding area from flash floods. Surface plants on the wetland provide an aesthetically attractive environment and help support a growing and vibrant eco-system.

Obstacles and Approvals

The project was awarded a $638,000 grant from New York State Environmental Facilities Corporation. The overall cost was approximately $725,000. The Village was still required to match at least 10% and make up all other shortfalls.

Partly as a result of the decline in the lake quality, Wappinger Falls has been a struggling community. Fortunately, the costs of all prior studies were credited by the State and the final cost to The Village was manageable.

The proposed treatment area was not located on a state designated wetland, but it still required NY DEC, US Army Corp and numerous other regulatory approvals, which were obtained in 2012.

Though the proposed design was expected to exceed NY State sediment removal guidelines, some design elements were not specified in the State stormwater manual. It was successfully argued that the project was meant to be an innovative demonstration practice and that similar systems designed by the same engineers were operating successfully in other states.

The system is now the first of its type and scale approved and operating in this part of New York, and thus serves as a tremendous precedent for application in other areas with similar problems.

Construction was bid, a team assembled, and the first shovel went in the ground in July 2013. Construction was complete in October. Congressional Reps, State Senators, County officials, municipal leaders, media and an enthusiastic public attended the groundbreaking and inauguration in November 2013.

Cost Benefits

- Properly maintained, the system has an unlimited life cycle.
- Even without grant funding, compared to the cost of inaction or alternative retention pond storm-water management, this BMP will yield a return on investment within 8-10 years.
- A Gravel Filter Wetland can achieve significantly better results than traditional approaches, while also providing cost effective hazard mitigation.
- Innovative "green" technologies are often eligible for state and federal grants, as well as other low-cost funding options.

The Wappinger's Falls stormwater wetland system has been operating since October 2013 and has become an integral educational environmental showcase for this type of BMP in the Hudson Valley.

The practice has become its own aesthetic eco-system, and home to many native species and wildlife.

The Wappingers Creek Watershed communities are now seeking funding to research and develop other Green Infrastructure to protect the communities and resources in the watershed. Several communities in surrounding counties in the Hudson Valley have studied the system and are exploring means by which they may address similar problems. **L&W**

by Steven Gruber

Water Quality Deterioration from Stormwater Run-off	**Benefits of Wetland Treatment**
Sedimentation fills and pollutes vital / precious water bodies	Stormwater wetlands remove 85-95% of sediment
Stormwater carries PH and other pollutants into lakes, rivers creating algae, odors, destroying fish and other eco habitats	Wetland treatment creates a natural eco-system – revitalizing water quality in watersheds
Recreational assets destroyed –decline in property values	Community growth and health benefit

Flooding Costs / Consequences	**Benefits of Stormwater Wetland Management**
Dept. Public Works costs – road repairs, municipal clean up	Adequate stormwater system contains and controls run-off
Emergency Services	Greatly reduced emergency costs
Damage to municipal infrastructure (treatment facilities)	No mixing of I&I, repairs to facilities, down time
Insurance	Lower premiums, limited match payments
Damage to private properties / businesses	Property values higher – more growth, more tax revenue
Relocation of Residents	Limited liabilities and greater community stability
Legal, Engineering and other professional fees	Municipality able to operate within budget
Loss of tax revenues	Ability to pay off stormwater capital costs quickly
Aquifers depleted, Drinking water imperiled leading to Health risks; Costs of building water treatment facilities	Capital and O&M costs of wetland filter, with unlimited life cycle returns investment in less than 10 years vs new facility
New Water treatment facility $6,000,000 + debt service	Wetland has unlimited life cycle, low O&M

Planting on the wetland.

Outlet from wetland to discharge outlet pool.

Key Personel
Project Coordinator:
Steven Gruber (Renewage)
Fred Lambiase (Renewage support)

Lead Engineer:
David Whitney PE (EcoSolutions)

Engineer NY:
David Maciolek PE (Aqua Nova)
Environmental Science:
Evan Fitzgerald, MS (Fitzgerald Environmental)

Village of Wappingers Falls:
Mayor Matt Alexander
Joseph Paggi PE
John Karge (Village Clerk)

Construction:
Sun Up Enterprises NY

Funding:
NY State Environmental Facilities Corp

Thanks to:
NYS DEC Hudson Estuary Group

Video Link
https://youtu.be/_HxBa8K32Vo

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