NEW YORK CITY SOIL AND WATER CONSERVATION DISTRICT

Reducing Stormwater Runoff through Green Infrastructure in a High Density Residential Development in New York City

New York/New Jersey Harbor Estuary Program Stewardship Grant Program
Project Code: 2009-032
NEI Job Code: 0355-002, 0286-002

Revised Final Report
August 12, 2010

Project Goal

The overall goal of the project is to reduce the amount of stormwater entering the CSO system through installation of a stormwater Low Impact Development practice ("LID") in a high density residential area of New York City. Specific objectives were to install a stormwater LID retrofit that incorporates vegetation and to use the LID as an educational resource for the building residents and tenants.

Project Summary

We identified a low-income housing complex owned by a not-for-profit organization on the Upper West Side of Manhattan. The site was selected for the size of the backyard (it spans the whole building complex), existence of a downspout draining one of the roofs, and the preschool housed on the ground floor. We designed a hybrid detention/retention[1] system of twenty rain barrels in series with a green wall of Woolly Pockets. All barrels, except one, have low flow orifices to discharge the water slowly into the sewer. One barrel has no outflow and is outfitted with a spigot. We also revived existing tree pits, which were filled with bricks and refuse. Native shade tolerant ferns and vines were planted in the Woolly Pockets while we selected flowering shrubs for the tree pits. We painted a mural incorporating elements of pollution, nature and water purification and developed a simple curriculum for the preschool.

Course of Action

Outreach to building/property owners to solicit application

Landmark West and Sustainable Yard reached out to the New York City Housing Authority to implement the project on the grounds of Amsterdam Houses. However, it became clear that the project would take much longer if we were to partner with the NYCHA. In order to ensure timely completion of the project, we decided to pursue private properties. Rather than solicit applications from potential property owners, we worked with Landmark West and Sustainable Yard to identify several low income/affordable housing buildings and community service centers owned and/or operated by not-for-profit organizations on the Upper West Side of Manhattan.

Site visits and application evaluation

We evaluated four properties: two low income housing buildings, one with a preschool, a residence for people at risk of becoming homeless, and supporting housing for formerly homeless people. The project team visited all four sites.

Selecting property owner

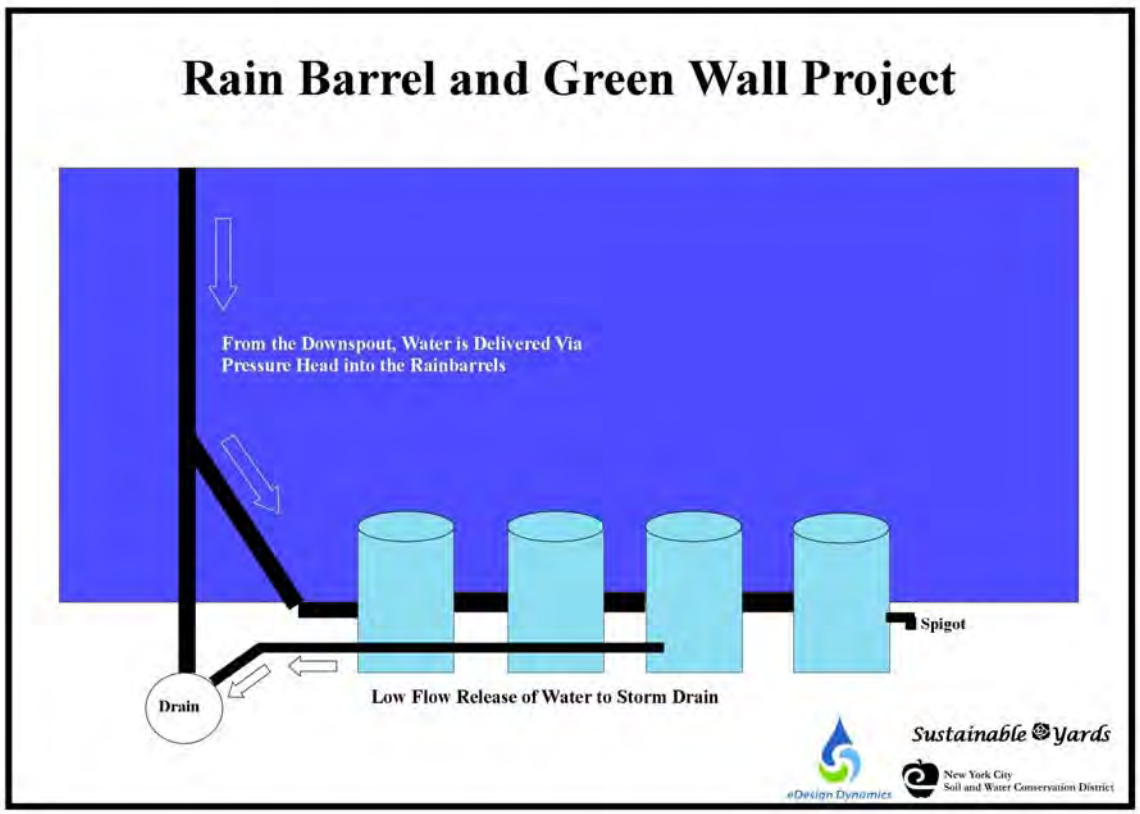
The low income housing complex with a preschool was selected as the project site because of several factors: a good size backyard (approximately 10' x 70'), relative ease of access from the street, existence of a downspout draining the roof, and presence of a preschool. The property owner, the Church of St. Matthew & St. Timothy, was also an eager partner. The reverend had been interested in upgrading the backyard to provide a better educational opportunity for the preschool students. She is also very keen on environmentally sound practices and showed a great deal of interest in participating in efforts to reduce CSO discharges.

[1] Detention refers to a system that temporarily holds water and releases it to the sewer system, while with a retention system water is infiltrated, evaporated and/or evapotranspired.

Design and construction
eDesign Dynamics developed a hybrid detention/retention system. Because the site was entirely paved and shady, we were unable to create enough vegetation or infiltration capacity for an entirely retention-based system. Twenty rain barrels were installed in series with low flow orifices that discharge water slowly after the rain event. This was done to eliminate the need to manually empty the barrels after each rain. One of the barrels is a rain water reuse barrel with a spigot so that plants can be irrigated using rain water (see diagram below for details).

To create a green wall, we installed Woolly Pockets fastened to a wooden frame (four rows of eight pockets across). We planted Virginia Creeper (*Parthenocissus quinquefolia*), Christmas Fern (*Polystichum acrostichoides*), Marginal Woodfern (*Dryopteris marginalis*), and Ostrich Fern (*Matteuccia struthiopteris*).

Barrel System Schematic

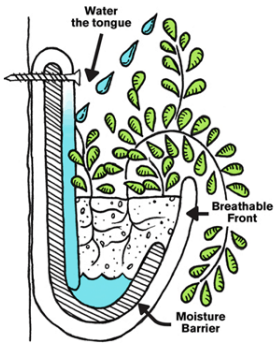


The downspout on the side of the building carries rain water off the roof (approximately 4,000 sq. ft.). At the diverter (the upside Y junction on the downspout) there is a valve to divert the rain water to the series of barrels. Because of the hydraulic pressure, all twenty barrels fill at the same rate, although in reality, friction inside the pipes makes barrels furthest away from the downspout fill at a slightly slower rate.

The valve at the diverter will be closed in November every year to prevent the system from freezing and opened in April.

The outflow pipes empty the barrels slowly over two days. Each barrel has its own outflow valve which can be adjusted to appropriate flow rate. The very last barrel does not have an outflow but instead is outfitted with a spigot for rain water use in the backyard.

Woolly Pockets Schematic



WoollyPockets are a modular vertical gardening system designed for small spaces. They are built with two layers; a breathable felt made out of 100% recycled plastic and a built-in moisture barrier made out of 60% recycled plastic.

Water is whisked from the back panel down to the soil. Because the front of the pockets is breathable, excess moisture can evaporate and soil is properly aerated.

The pockets create a small reservoir, allowing Woolly's tongue to continue wicking water to roots, conserve water and keep soil nutrition in your Pocket.

Education

Although the site is a low income housing complex, we were informed by the Reverend of the church early on that we should work with the preschool because residents tend to be transient and not highly involved in the matters regarding the complex.

Our education coordinator developed fact sheets on 1) rain barrels, 2) green walls, and 3) our project and lesson plans appropriate for the very small children. We have also put together planting kits for children to grow their own plants.

To ensure safety of the students, barrel lids are fastened with cable ties or bolts so that children cannot open the lids. The open end of the barrel is closed with a tight fitting lid, so that mosquitoes will not be able to enter the barrel.

Maintenance

The system requires very little maintenance. Every fall the system needs to be shut down to prevent freezing and every spring it needs to be started up. It requires a simple turning of the lever at the diverter to shut down and start up the system.

Vegetations in the Woolly Pockets are native shade tolerant species. They should require minimum care after the first year.

Because we are vested in this project beyond the grant and have an interest in long-term performance of the system, we will maintain contact with the superintendent and the preschool after the grant period. We will visit the site in November to shut down and in April to start up. Any repair needs will need to be evaluated as they arise. Legally the agreement between the District and the landowner only makes the District responsible for the system through December 31, 2010. However, the District will make every effort to ensure the system is functional for the long haul.

The superintendent will be our first line of problem detection. He has observed and participated in the installation of the project and has a basic understanding of how the system works. We have also learned that he takes his work seriously and spends time maintaining the backyard.

Monitoring

Originally we planned to monitor the volume of water entering and exiting the system as well as the duration of detention. However, due to the timing of the project installation and the extensive nature of the development of a Quality Assurance Project Plan, the monitoring component of the project was

eliminated in an amended work plan. Because we no longer have funds to purchase monitoring equipment, we will only monitor qualitative aspects of the project to ensure proper functioning of the system. We will monitor for the barrels filling and draining after rain events, check for leaks or clogs and conduct visual inspection of the plants. To the extent possible, we will monitor the barrels after rain events (>1/4"). Plants will be monitored once a month until the above ground biomass dies off.

Accomplishments
We created a detention system that can hold a quarter-inch rain event (or ~1,000 gallons) and provided 50-gallon storage for irrigation.

We turned an entirely concrete backyard into an educational green space with a rain water collection system. While the backyard had always been used by the preschool children, it was simply an outdoor space without any place specific educational value. This project created a space that is rich with environmental educational opportunities. With teacher's guide we developed, children can learn a myriad of topics that are highly relevant to living in the urban environment. Topics include, but are not limited to, rain water harvesting, hydrologic cycles, ecological services, native plants, waste water management, green infrastructure, water conservation, and air quality. Children were also given supplies and materials to engage in their own planting. Furthermore, with correspondences sent home with the children, we reached out to the families.

During construction, the superintendent of the complex was very helpful and involved. He agreed to water the plants during the establishment period and is beginning to take ownership of the project. This relationship is very important in ensuring the project is maintained properly. We have also established a relationship with the director of the preschool. She is eager to incorporate the project into her curriculum and will engage the children in the maintenance of the project as well.

Evaluation
- Installed a rain barrel system that can detain approximately 1,000 gallons of rain water. The drainage area for the system (or the area of the roof) is approximately 4,000 sq. ft. Thus the system can detain more than a quarter inch of rain.
- Revived six tree pits previously filled with bricks and refuse and planted bushes that can attract butterflies and other insects.
- Created a green wall with a native species of vine and three native species of ferns.
- Turned a backyard into an educational space.
- Taught three teachers and the director about the CSOs, green infrastructure, and water quality.
- Developed fact sheets and lesson plans (attached) for the preschool.
- Have engaged the Director of the preschool fully to participate in the education program.
- Hosted an open house to introduce the project to the families from the preschool.
- Distributed a project fact sheet (attached) to all families of the school (51 children, ages three to five).
- Will be teaching lessons in September to all 51 children.

Lessons Learned
In a densely urban environment with paved ground surfaces, confined space, and limited light, it is difficult to create a retention system where harvested rainwater can be used as a resource to irrigate vegetation or infiltrated into the ground. At the project site, the best we could do was to detain and delay the rain water from entering the sewer system and divert only a small portion for irrigation of plants. While the benefit of a detention system cannot be overlooked, it was disappointing not to be able to use a greater volume of water.

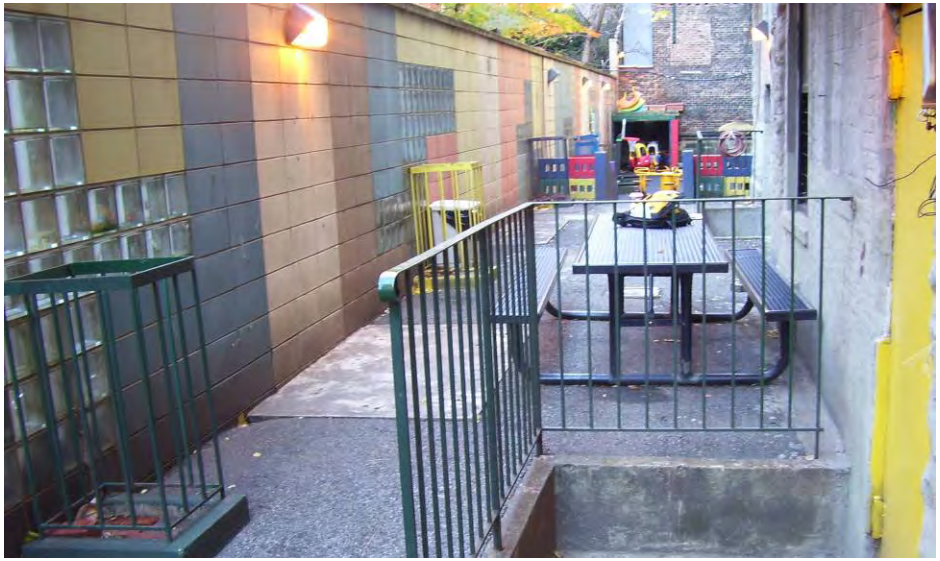
We wanted the project to benefit residents in a low income or affordable housing. While we succeeded in finding a project site, we were unable to engage the residents many of whom are transient. Fortunately we were able to work with the preschool on the ground floor and develop an educational program for the school. We hope to engage the families of the preschool children in disseminating the importance of sound stormwater management and individual actions.

Photographs

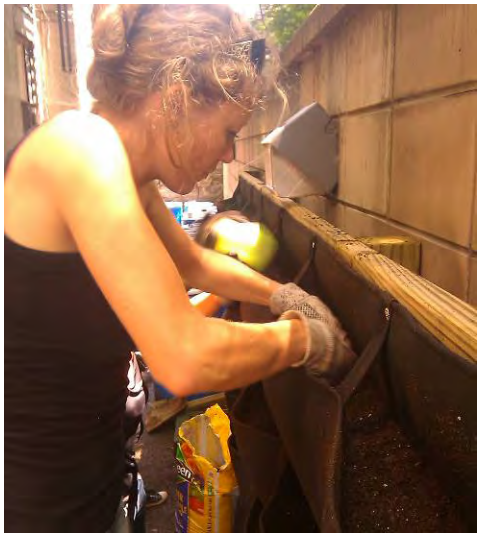
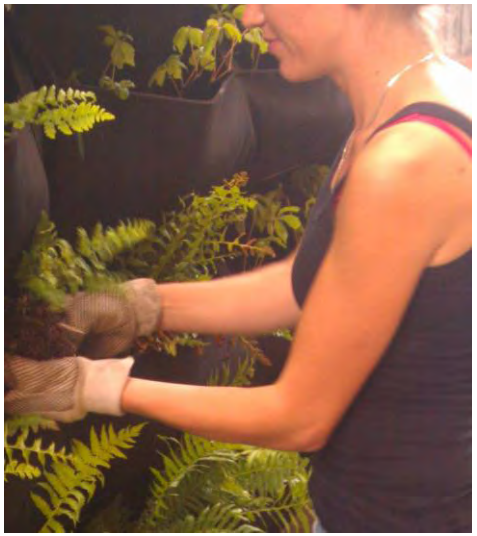
Project site before construction looking east. Note tree pits (next to the trash can and further away) enclosed in metal fences.

Preschool yard at the west end.

Project site before construction looking west to the preschool yard.



Construction phase: arrival of the rain barrels.

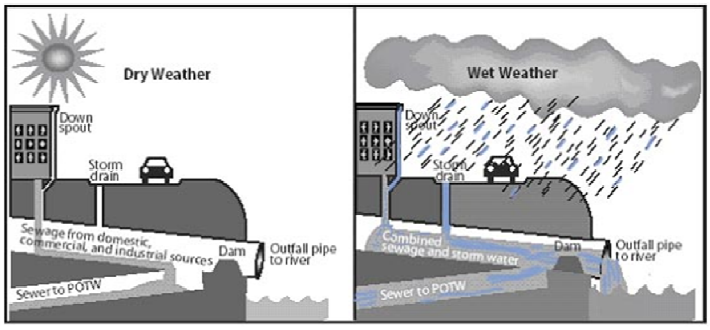
Wooden frame on which Woolly Pockets were fastened (L). Filling the pockets with potting soil (M). Planting native ferns (R).


Inflow and outflow pipes connected to the downspout (L). Outflow from each barrel outfitted with a lever to control flow (R).

Finished yard with the educational mural. District's educator explaining the project to a parent from the preschool (lower right).

West 83rd Street Rain Barrel and Green Wall

Our city traditionally treated rain water as a waste material. More than a hundred years ago engineers designed our sewer system to whisk away both our sewage and rain water falling on the roofs and streets in the same pipe. But during rain, our waste water treatment plants cannot handle the volume of sewage and the rain water and as a result raw, untreated sewage diluted with rain water is discharged into our waterways, like the Hudson River.



The City has addressed this problem by building so called "end of pipe" engineering solutions, such as large tanks (capacity of tens of millions of gallons requiring acres of city land and hundreds of millions of dollars) that can temporarily hold rain water. Many New Yorkers believe, however, that it is better to prevent rain water from entering the sewer system in the first place.

The New York City Soil and Water Conservation District received a grant from the NY/NJ Harbor Estuary Program and the New England Interstate Water Pollution Control Commission to implement a project that will reduce the amount of rain water from entering the sewer system during rain. We selected 122-130 West 83rd Street for this project.

Our project features twenty rain barrels connected to the downspout that drains one of the roofs. The water is temporarily stored in the barrels and slowly released to the sewer. One of the barrels is a rain water collection barrel with a spigot.

We also installed a Green Wall – a vertical garden – and opened up existing tree pits so that the water from the rain collection barrel can be used for greening the backyard. The plants on the Green Wall are all native species that are well adapted to shady areas (like the forest floor). Some of the plants in the tree pits bushes that attract butterflies.

Because education on this issue is very important, we developed a curriculum for the preschool and are donating materials and supplies to teach the curriculum. We hope the children will lean the importance of water in our City and how to be a responsible citizen!

For more information on this project or our programs, please contact Rebecca Schultz, Education Coordinator, at rebecca@nycswcd.net.

Rain Barrel

Detention System

A rain barrel detention system collects and captures water from roof runoff, reducing the amount of storm water that goes into the sewer systems at one time

How It Works

1. When it rains, water starts to collect on the roof, emptying and flowing into the downspout.
2. From the downspout, the water is then routed into the 20 rain barrels through a diverter.
3. The barrel slowly allows the water in trickle out, reducing the water flow into the sewers at one time.
4. If an overflow occurs, the water is routed through the barrels into the overflow pipe.
5. The water stored in the rain barrels can be used to water plants by using the spigot.

WoollyPockets

Vertical Gardening System

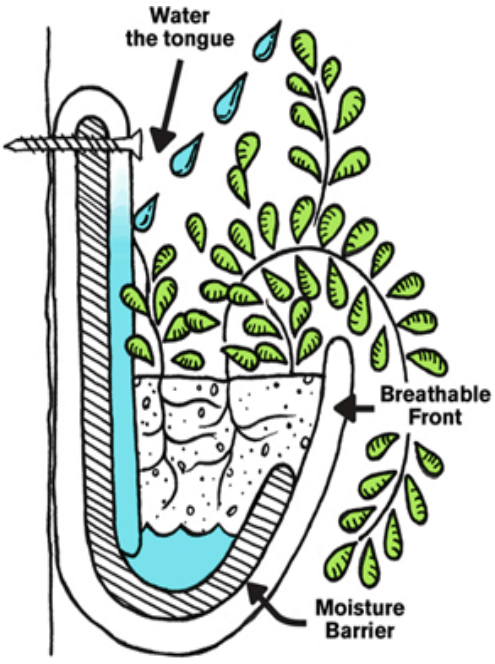
For more information, please visit www.woollypocket.com

WoollyPockets are a modular vertical gardening system designed for small spaces. They are built with two layers; a breathable felt made out of 100% recycled plastic and a built-in moisture barrier made out of 60% recycled plastic.

WoollyPockets are maintained like any other gardening container. When watering, be sure to water the tongue of the system to prevent water from escaping from the front.

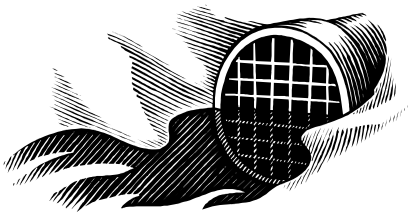
Benefits of gardening in breathable containers:

- the soil aerates naturally, which helps it to drain and conserve water.
- the roots know when it should stop growing, preventing root-bound plants



New York City
Soil and Water Conservation District

Combined Sewage Overflow System

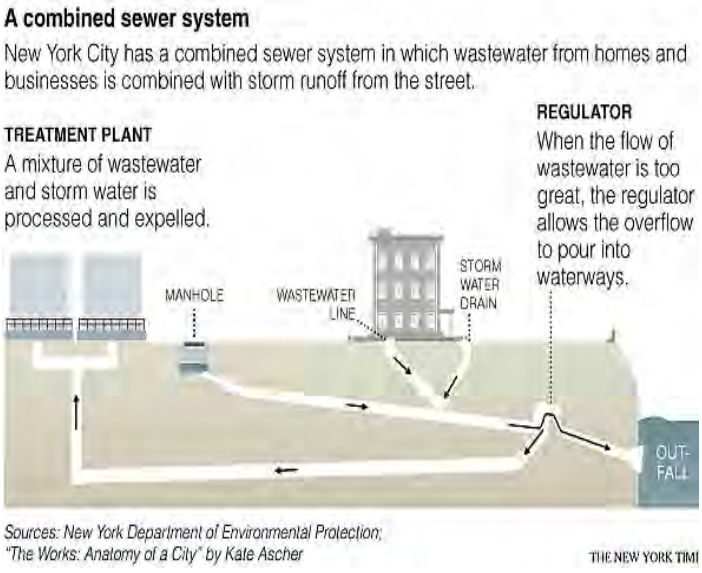


How it Works:

During a rain event, stormwater goes down the stormdrains and connects with the sewage system. Exceeding capacity, Sewage Treatment Plants release the combined rain and sewage water into the bay, river, or creek untreated.

Why does it happen?

CSO events happen because much of the City is covered in concrete, not allowing water infiltration into the ground. If more of the city was covered in green space, via gardens, parks or greenroofs, the amount of rainfall into the stormdrains would decrease, thus decreasing CSO events.



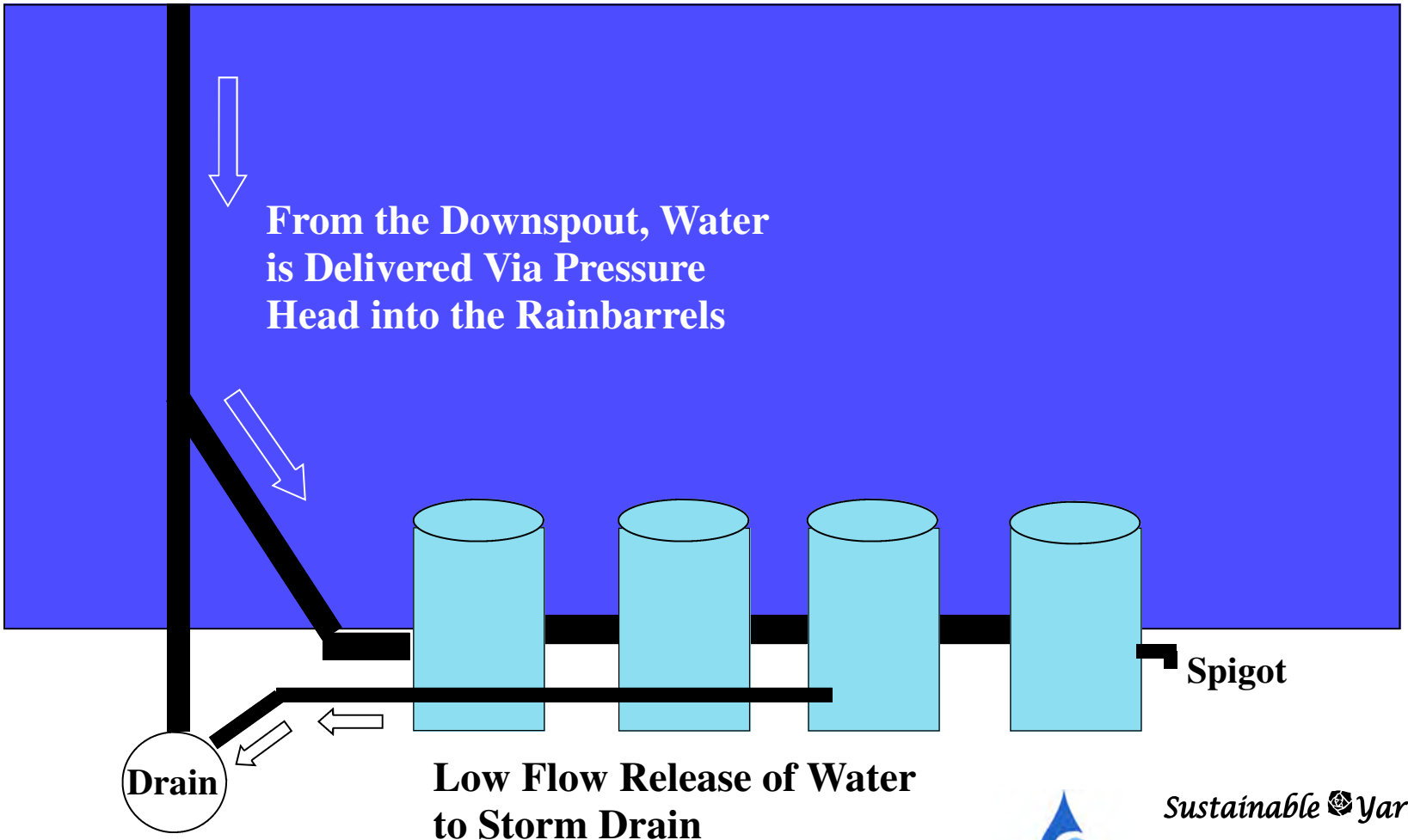
Why is this important?

CSO events decrease the water quality of our rivers, streams and creeks and are a source of concern to our health by being a significant source of disease-carrying pathogens. They also inhibit our recreation by polluting our beaches and waterfronts where we swim, boat, and fish. In addition, CSO events destroy the health of many aquatic organisms that are a local food source to many.

What can you do?

- Learn more
- Help educate about the issue
- Conserve water
- Plant a garden
- Don't litter

Rain Barrel and Green Wall



eDesign Dynamics

Sustainable Yards

New York City
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