the GREEN MACHINE

a living machine sustainable stormwater concept

Through the use of urban design, landscape architecture and civil engineering the City of Burlington has the opportunity to greatly advance its existing sustainable stormwater management. This concept uses an intricate interconnected system of civic spaces designed to collect, temporarily store and treat stormwater runoff. We are calling this system the GREEN MACHINE.

Burlington, like many cities around the world that have the good fortune of being situated on a body of water, has begun the transformation of the once industrial and polluted waterfront into an exciting and important source of civic pride and economic vitality. However, the water's edge is a sensitive and easily polluted transitional zone that must be treated in a thoughtful manner to minimize the impacts that Burlingtonians have on this precious resource.

State of the Art Stormwater System

Burlington has the opportunity to set into motion what can become a model for waterfront sustainable stormwater management. Because the concept of sustainable stormwater management has only been accepted as an integral part of municipal stormwater systems in the past few decades the municipal applications of these tools is limited to, for the most part, retrofit applications at small scales. Because the Burlington waterfront was industrialized for so long and underutilized for development and recreation it will become the next district for growth in the city's natural and organic growth. It is because of this delayed expansion that Burlington can take a holistic approach to growth in this district and include sustainable stormwater techniques in a way that most cities around the world do not have the opportunity to do.

Comprehensive Sustainable Stormwater Plan

Looking holistically at how Burlington handles stormwater at the waterfront, where soils are sandy and very conducive to stormwater infiltration, will allow a comprehensive stormwater plan with a twist. Instead of looking at sustainable stormwater techniques as a supplement to the conventional system, the strategy in Burlington would be to use the sustainable techniques as the first line of defense during storm events and the conventional system would be there for a backup. The system is conceived to integrate strategies where space allows in the downtown. In this area volume control is the primary concern. Any runoff that is not captured before it travels over the slope beyond Battery Street will be dealt with in new development and civic spaces in the waterfront district where the primary focus is on treatment. Existing civic space in the downtown such as parks plazas and streets, including Church Street, could be converted into part of the sustainable stormwater system.

Combining Civic Space & Stormwater Management Plan

While handling the runoff is the primary function of the system, because it has been designed simultaneously with this master plan, it is possible to ensure that each element of the system fits the context in which it is located and adds to the overall urban experience. All of the waterfronts civic spaces are designed to be active and vital places where citizens and visitors can enjoy all types of recreation, entertainment and retail experiences without realizing they are standing in a very advanced stormwater system.

1.GREEN STREETS

A green street is a thoroughfare that manages runoff at its source by incorporating a series of vegetated infiltration techniques to capture, temporarily store, and treat road runoff. They can be new streets or a retrofit of an existing thoroughfare. In cases of new road construction, the full range of techniques may be applied. This includes components such as flow-through planters and other sustainable stormwater solutions that allow stormwater from the street to enter planters through cuts in the curb. From there, the street trees and water-loving plant material removes impurities and allows water to naturally infiltrate or be stored elsewhere. Additional infiltration can be achieved through the use of pervious paving materials for sidewalks and streets.

2.GREEN BIKE PATH

Because bike paths are often adjacent to and link open spaces throughout a city, there are opportunities for them to become a Green Bike Path that is a part of a sustainable stormwater system. A green bike path is a system to utilize the linear form of a path to direct the stormwater runoff flows to the various elements of a sustainable stormwater system. The paving material, if any, could be pervious to allow some infiltration along its surface but an adjacent filter strip is also recommended.

3.RAIN GARDENS

A rain garden, also known as a vegetated infiltration basin, is a constructed or naturally occurring low spot in the landscape in which stormwater is collected and stored temporarily until it infiltrates the ground. Rain gardens can be designed for recreation as well as serving their stormwater infiltration function. As a recreational civic space, they work well because they store rainwater during a storm event and shortly thereafter when people are not usually playing in parks. After the water percolates they are available as a park again. With some adaptation, rain gardens can be located in all settings, from the most rural to the most urban locations.

4.BIOSWALES

A more utilitarian solution that utilizes the same concept of short term storage and infiltration is the bioswale. Bioswales are linear depressions with gently sloping sides, planted with vegetation that treat stormwater runoff from rooftops, streets, and parking lots by slowing and filtering it as it passes through them and then channeling any excess water to the storm sewer. The naturalistic aesthetic of the plantings make them an excellent solution for rural and suburban applications and their use in urban settings must be carefully considered so as not to create an anomaly in the character of the area.

5.INFILTRATION PARKS

While rainwater naturally percolates through the ground in a park, a few changes in design and construction can allow them to capture, store for a short time and clean stormwater runoff.

Thinking about the park as a part of the stormwater system is crucial. Surrounding areas can be graded so that the rain water flows towards the parks. Breaks in the curbing along the street allow the water to reach the grassy surface of the park. Creating a gradual and imperceptible depression allows water to collect in the park and stay there long enough to infiltrate. In the end it is important that the park does not appear that it is a stormwater facility.

6.GREEN ROOFS (Add image)

Green roofs are waterproof, vegetative roofing systems in which a root barrier, drainage system, light weight planting medium and plants are layered on top of an impermeable membrane. They can be as simple as a shallow layer of low growing plants (“extensive”) or deeper and more complex combinations

of grasses, shrubs and even trees (“intensive”). Either way, they serve to insulate the building, reduce heating and cooling costs, absorb heat from sunlight, and to limit solar heat reflection into the atmosphere which contributes to the phenomenon known as the “heat island effect”. Stormwater not used by the vegetation can enter and be stored in a collection system such as rain barrels or cisterns for later use. Green roofs are not only utilitarian; they can also be designed as an outdoor garden amenity and be used as part of an urban agriculture program to produce food for the building or others nearby.

7.GREEN WALLS (add image)

Green walls are essentially a living, and therefore self-regenerating, cladding system using climbing plants. Whilst climbers have been used traditionally on buildings for centuries, modern methods using high-tensile steel cables have enabled the concept to be used far more adventurously. Green walls can dramatically reduce the maximum temperatures of a building by shading walls from the sun. Evergreen climbers provide winter insulation, by not only maintaining a pillow of air between the plant and the wall, by but reducing wind chill on the wall surface. All that can result in reduction of the heat island index. Other well-known public benefits are the diminution of noise levels, the absorption of CO2 emissions and the breakdown of a variety of air pollutants, not to mention that they can simply look very appealing and enhance the architecture of a particular building.

8.GREEN PLAZAS

Plazas are not often thought about as opportunities for stormwater infiltration but when well-planned and designed correctly then can provide an excellent solution in an urban environment. The majority of the plaza is hardscaped with pervious pavers. Infiltration planters with shade trees and lawn areas are strategically located for maximum pedestrian comfort and infiltration benefit. If necessary or desirable, a cistern can be located under the plaza and drainage channels can be integrated into the paving pattern to collect excess runoff and send it to the cistern for later use in irrigation.

9.PERVIOUS PARKING LOTS

Conventional paved surfaces including roads, sidewalks and particularly parking lots utilize asphalt, concrete, gravel or tar surfaces that are all impervious. As a result of the paving material chosen and their lack of permeability, these surfaces tend to exacerbate stormwater runoff related issues. There have been many recent innovations in materials and pervious pavement systems that are more permeable. These have been developed to allow water to infiltrate large and small-scale paved surfaces. In addition to the pervious paving, infiltration planters with shade trees should be applied in the parking field to further enhance the areas ability to manage and treat stormwater.

10.HABITAT RESTORATION

While most of the greatest waterfronts in the world are urbanized, in Burlington there is an opportunity to incorporate functioning natural ecosystems as a part of the waterfront experience. There are locations, particularly in and around the Barge Canal site, to repair the damage inflicted during decades of industrialization. By constructing wetlands and restoring the natural systems these areas can not only serve to attract wildlife but also become a part of the stormwater management system.

11.STAIRWAY CASCADES

Incorporating stormwater treatment with beauty and delight a staircase cascade can play a vital role in the conveyance of runoff in areas with substantial topographic changes. The stairs are gently sloped towards a series of parallel tiered infiltration planters. Because of the slope the high side of the staircase remains free for pedestrians to walk without much water underfoot. At the bottom of the staircase the knee wall of the stairs can extend beyond the stairs and used to direct the continuance of the flow is necessary.

12.RAINWATER HARVESTING

Rainwater harvesting is an ancient technique enjoying a revival in popularity due to the inherent quality of rainwater and interest in reducing consumption of treated water.Rainwater harvesting systems provide stormwater runoff containment while simultaneously storing water which can be used for irrigation, flushing toilets, washing clothes, washing cars, pressure washing, or it can be purified for use as everyday drinking water. There could be a direct public benefit of removing gallons of water from our wastewater treatment plan all the while helping to reduce the occurrence of combined sewer overflow

events during heavy rainfalls. In turn, rain harvesting can also save energy and reduce utility cost for property owners.