1. What Are Green Roofs

In its basic definition, a green roof is a rooftop that is vegetated. Today, green roofs are emerging as a very effective means of addressing many of the environmental concerns that exist in today’s urban centers. In studies, they have shown great promise in reducing the urban heat island effect, improving air and water quality, and increasing the amount of plant life in an urban area.

2. Types of Green Roofs

Green Roofs are separated into two specific categories based upon their soil depths: the extensive green roof and the intensive green roof. The specific differences are shown in the table below. An example of each type, as seen in the Solaire Building is also shown below.

3. What Are CSOs

In many of the older cities throughout the country, the sewage systems carry both the sanitary sewage of everyday city life and also take on runoff during rainstorms. A major problem that combined sewage systems have had throughout their history has been that they are unable to handle the full amount of runoff from large rain events and the residential and industrial sewage that is produced by the surrounding city. A Combined Sewer Overflow (CSO) occurs when there is a rain event and the combined runoff and sewage levels are greater than the capacity of the sewage system. The excess sewage and rain water is discharged without treatment into surrounding bodies of water. CSOs pose a great threat to the environmental and sanitary conditions in many urban areas. In some cities, a CSO occurs almost every time it rains. The NYC DEP has budgeted $2 million dollars in 2004 for CSO abatement programs.

4. Our Green Roof

We are constructing an extensive green roof section on Steinman Hall, City College’s engineering building. We selected an extensive roof as the roof of Steinman was not equipped to handle the additional weight of an intensive roof design. We have chosen several varieties of Sedums, which are low maintenance and retain water well. The location of our green roof is pictured below.

5. Study Objectives

The objectives of this study are to demonstrate how green roofs can play a dramatic role in confronting the problems of storm water runoff. We will test the ability of different green roof designs to:

- Hold water during rain events using a mass balance approach.
- Quantify the insulating capabilities of the different designs by collecting temperature data.
- Perform based on a cost/benefit analysis versus more traditional CSO abatement measures.

The results of this study may yield further evidence that in cities, green roofs can be one of the most prudent solutions to CSOs environmentally and economically.

6. Quantifying Water Balance

Our primary objective in this study is to quantify the green roof section’s ability to retain rain water. This is important to reduce the amount of water that gets into the sewage system during large rain events. By holding this water, the frequency and magnitude of CSOs will be reduced. Our experimental design is illustrated below.

First we will determine the mass of water retained by the green roof (hence not entering the sewers) as:

\[ M_{\text{retained}} = \int \text{time of storm} \left( \text{m}_\text{soil} - \text{m}_\text{soil} \right) \, dt \]

Further, we will quantify the partitioning of water within the greenroof system between the soil and plants. A series of soil moisture probes will provide a spatial distribution of the amount of water in the soil, \( m_{\text{soil}} \). The water stored in the plants and lost to evapotranspiration can then be determined as:

\[ M_{\text{plants}} = M_{\text{retained}} - A \int \text{soil moisture probe} \, \text{time of storm} \, m_{\text{soil}} \, dt \]

Acknowledgements

I would like to extend my sincerest gratitude towards the EPA GRO, NOAA EPP/MSI, the Environmental Entrepreneurship Partnership (EEP) Program at the City College for providing the funding for this project to be possible. I would also like to thank the continued guidance of Professor Megan Wiley.