Can Bioswales Effectively Manage Storm Water Runoff in New Haven?

NRCA Student: Chelsey Reyes[1]

Community Partner: Dawn Henning[2]

[1]Common Ground High school ; [2]City of New Haven

INTRODUCTION

Storm water runoff is water that runs off into drains where it goes straight into streams, river, lakes, or the ocean. Storm water runoff is a problem because it can contribute to water pollution by running throughout the surface of the streets and collecting oil, pesticides, bacteria and other harmful chemicals. Storm water runoff can also contribute to flooding. Excessing rain events overwhelm drains, leaving no place to store the water.

The purpose of this project was to investigate if bioswales could effectively manage storm water runoff in New Haven. Would building and installing bioswales solve problems such as pollution and flooding? And if so, could it save the City of New Haven money? We specifically looked at the Elm Street bioswale recently installed by the engineers with the City of New Haven.

Fig 1. Before and after construction of the Elm Street bioswale in downtown New Haven in winter.

What is a bioswale?

- **A natural solution to deal with storm water**
- **Designed as an engineered garden, generally 5 ft x 15 ft, and located on a sidewalk that is wide and won't be a disturbance to the public (Fig 2)**
- **The sidewalk is removed and dug approximately 5 ft deep, then filled with about 2.5 ft of stone and covered with about 2 ft of soil. Plants are also planted so they can utilize the collected water**
- **Curb cutouts and a gentle slope attract water from the street into the garden**
- **Bioswales are designed to capture a certain quantity of water**

Fig 2: Diagram of a bioswale showing the soil and stone layer underground

DEFINING THE WATERSHED

- **First, we needed to define the watershed of the Elm Street bioswale to help locate what water will be captured into the bioswale**
- **A map of Elm Street between High and College Streets was studied to identify contour lines and slopes, determine the elevation of the street, and the direction of water flow (Fig 3)**
- **Additional measurements were taken to confirm elevations and flow direction using surveying equipment (Fig 4)**

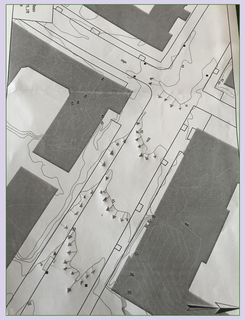

Fig 3: A map of the contour lines on Elm Street between High and College Streets.

Fig 4: Chelsey using surveying equipment to determine the height of High Street.

CALCULATING STORM WATER CAPTURE POTENTIAL

- **A bioswale can capture stormwater in two ways—storage within its layers and infiltration to the deep soils (Fig 2)**
- **To calculate storage potential, the volume of each layer of the bioswale was determined (Fig 5)**
- **The top layer of the bioswale is the surface layer where water can pond which measures approximately 0.167 ft x 15 ft x 5 ft or 12.5 ft^3.**
- **The next layer is the soil layer which measures 1.5 ft deep x 5 ft x 15 ft. Assuming 20% void space, the resulting volume is then measured as 22.5 ft^3**
- **The final layer is the stone layer which was 2.5 ft deep with 40% void space for a total volume of 75 ft^3**
- **After the water completely goes through all the bioswale layers, it eventually infiltrates at 12" per hour.**

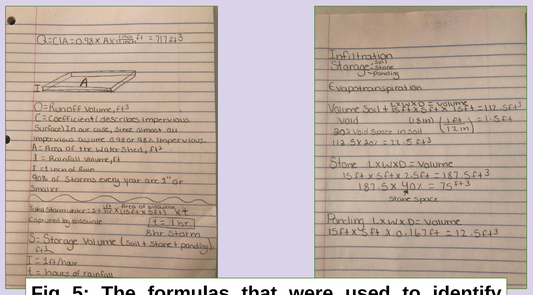

Fig 5: The formulas that were used to identify captured stormwater (left), and the volume calculations of each layer (right).

RESULTS

- **Most rainfall events are 1" or smaller. The amount of runoff captured by the Elm Street bioswale was estimated for the 1" storm**
- **An example would be if it rained for eight hours, the amount of runoff from the watershed to the bioswale would be 717 ft^3**
- **The total amount of stormwater the Elm Street bioswale could capture over eight hours is 709 ft^3 (Fig 7)**
- **By looking at the results you can see that the bioswale is able to capture 98% of the rain event. This means much less water is entering the storm sewer system, preventing flooding and pollution**

Fig 6: Storm water entering a bioswale. Picture by Dawn Henning.

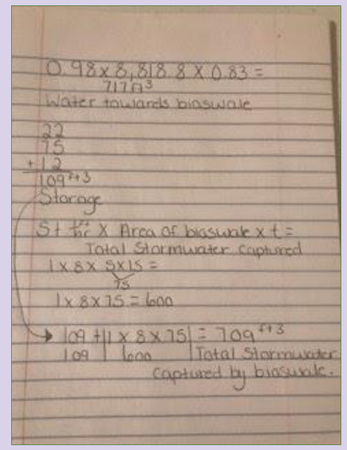

Fig 7: The caculations of water coming into and being captured by the bioswale.

CONCLUSIONS

- **Bioswales give great benefits to New Haven, which include savings on time, space, and money.**
- **200 more bioswales are planned to be built in New Haven, as a natural solution to storm water run-off, rather than putting pipes underground.**
- **Building bioswales beautifies communities by planting more trees, bushes, flowers.**
- **More bioswales should be built because they are very helpful towards the community. By having bioswales it can decrease the number of flooodings that can be caused in the future.**

ACKNOWLEDGEMENTS

My experience was positive. When signing up for this program I was unaware of what I know now. Anytime I would go to downtown New Haven, I never noticed the bioswales that were built. I knew nothing about them nor what they were used for. Once I had started the NRCA program I had learned new things that gave me more knowledge about the environment and how useful bioswales are. I want to thank Abby Beissinger for giving me this opportunity, and this experience. I also want to thank Dawn Henning, my community partner for taking time to help me throughout my project. She has exposed me more into the engineering field, and supported me throughout these past few months. Special thank you to United Illuminating for the scholarship to the NRCA to study storm water management.