Rainwater Harvesting Optimization at Tufts University: Choosing the best buildings for economic and environmental benefits

**Tufts Hydrology: Where the water flows**

This project’s objective is to recommend which roofs on Tufts can have the highest positive economic benefit, and the highest environmental benefits for reducing water in sewer systems that often overflow. Using a digital elevation map and hydrology toolset from ArcGIS, three water basins were developed on the Tufts hill. All of the area is in the Mystic River Watershed, but from the Tufts Hill, some water flows South into Somerville, some flows North towards the depressed rail track, and some flows Northwest towards the Mystic River.

Network analysis data from the MWRA shows that the water from the Tufts Hill flows into 3 main stormwater systems. Water from the North slope flows into the Medford separated sewer system, the Northwest slope flows into the Mystic stormwater system, and the South slope drains into Somerville’s combined sewer system. The watershed analysis and the image from the network analysis overlap well, so for this project the basins will be assumed to flow into their respective sewer systems.

The Northwest sewer system had the first CSO points to be completely closed in 1996 in the Somerville Baffle Manhole Separation (MWRA, 2012). The water that now flows in that system is successfully diverted and treated. The water in the Medford system is in a separated sewer that appears secure from overflows. However, MyWRA and the other watershed advocacy groups have started to question if sanitary sewer overflows are causing current contamination. The water in the combined sewer system has the highest known environmental impact. During precipitation events this water overflows at Outfall CAM017, and at Prison Point (Estes, 2012).

Three Minor Water sheds

- Tufts Hydrology and Runoff
  - Tufts University lies in the watershed of the Mystic River, a major tributary to the Boston Harbor. Since the Clean Water Act was passed, this river has been legally considered inexcusably contaminated. The Massachusetts Water Resource Authority started a program to reduce combined sewer overflows (CSOs) in 1987 which has reduced discharge by 82% (MWRA, 2012).
  - Despite these efforts, the Mystic earned a D in 2010 (Deegan, 2011), which means failing to meet swimming and boating standards some to most of the time. Clearly, the current efforts are not cleaning up the river enough. Many of the issues come from the heavy burden of stormwater on the sewer system.
  - Tufts, called the light on the hill, is also like the fault on the hill. The stormwater that enters the system on Tufts campus flows downhill, off the campus into surrounding neighborhoods. It contributes to the water contamination problems in the watershed, but does not experience the issues of flooding and contamination. It could set an example for how to responsibly lower one’s water impact.

**Tufts Topography and Runoff**

Tufts Hydrology and Runoff

- Notice the prevalence of large buildings on high elevation. All of the water that runs off these buildings into the streets will travel downhill, into the surrounding storm water system.

**Project Area Impervious Surfaces**

- 2,360,830 square feet of impervious surfaces - 168,155 gallons of runoff, average per day.

- Approximate Project Outline
  - Tufts’ three different stormwater systems match with Tufts’ three minor water sheds. Further GIS work should work with the MWRA to incorporate their GIS analysis.

**Recommendations for Tufts**

By calculating the areas of the building footprints, I rated the buildings on Tufts Campus from largest to smallest. There are 4 buildings with roof areas larger than 25,000 square feet in, or partially in, the Somerville Combined Sewer Watershed. With rainwater harvesting, those buildings could save Tufts a collective $118,100 over the next 10 years.

- Tisch Library — $47,130
- Ginn Complex — $30,590
- Aidekman Complex — $27,860
- Campus Center — $12,960

**Limitations**

The main issue with this GIS analysis is the separation of the Network analysis information of the sewer system, and the hydrology analysis. Ideally, these would have been calculated in ArcGIS in tandem. The model the MWRA used to create the sewer analysis image was too large to share with a student. Future iterations of this work will either recreate that network analysis, or work with the MWRA to use a portion of their model.

**References**