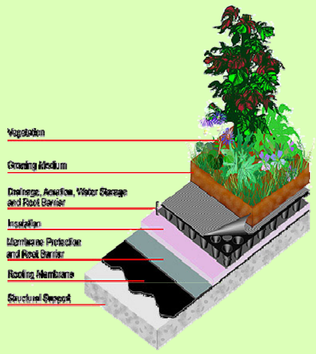
Changing Campus Permeability: Green Roofs Soaking It In At Tufts

Green Roof Description

Green roofs, also known as vegetated roof covers, have gained recognition as BMPs (best management practices) for reducing stormwater flows in urban areas. They are comprised of drainage, growing media, and plant layers, and set above the original buildings' roof decks. Because of their water retention, evaporation, and transpiration capabilities, green roofs turn an impermeable surface into a semi-permeable surface that reduces stormwater runoff. Such a reduction slows the flooding rates of urban areas during storms, as well as mitigates the amount of water that can carry urban pollutants into receiving water bodies.



Source: Great Lakes WATER Institute

Tufts

Because Tufts is a university with a large amount of indoor space and an otherwise landscaped environment, a significant portion of the Medford campus' impermeable surface is its roof area. Many of the campus buildings have flat roofs, which makes for cheaper and easier green roof installation. This poster provides many of the variables necessary for analyzing the effects of campus-wide green roof installation.

Danny Lutz

Biology 94:

Colleen Butler and Colin Orians

Outlines of Potential Green Roof Space

Campus Green Roof Potential

The roofs on Tufts' Medford campus vary in size, shape, and pitch. Pitch is the most important characteristic to check when preparing to install a green roof; sloped roofs over 10˚ require protection against substrate erosion, and the International Green Roof Association recommends against constructing green roofs on slopes over 30˚. The total area of potential green roofs on Medford campus, comprised of all selected roofs shown above, is **54235.33** meters. However, this number does not include Sophia Gordon Hall and the new Granoff Music Center –both have not yet appeared on MassGIS but would surely add significantly to campus green roof area.

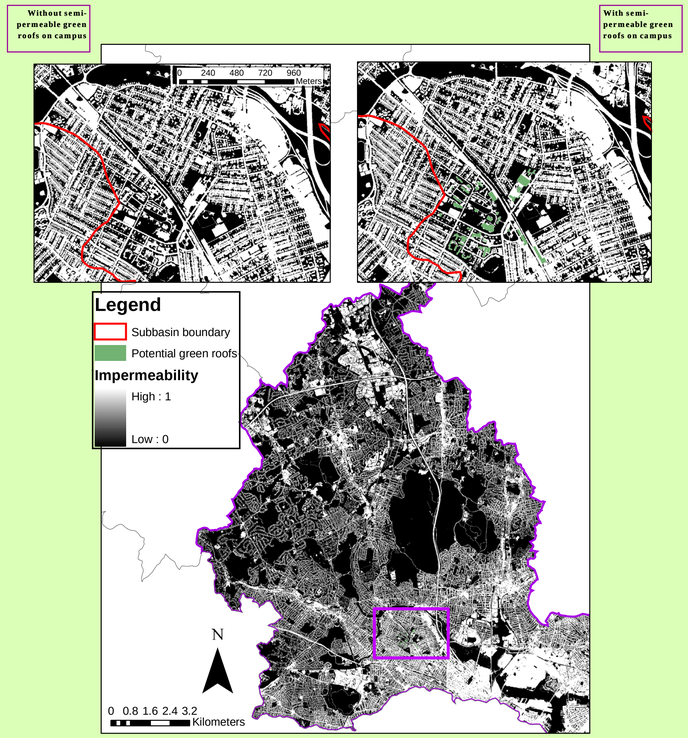
Source: rooflite: Certified Green Roof

Extensive or intensive?

As opposed to intensive green roofs, **extensive green roofs** require less maintenance and most often don't need irrigation. They are comprised of drought-tolerant plant species, such as sedum.

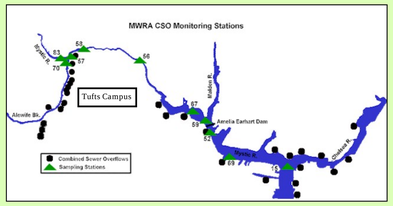
How Do The Roofs Fit In?

The Mystic watershed, housing 8 percent of Massachusetts' population in 1 percent of its area, is one of the most densely populated regions of the state. As an overburdened urban area, much of its surface is impermeable –that is, precipitation cannot seep through the surface into the groundwater supplies. In areas with surfaces of high impermeability, stormwater runoff increases and accelerates, leading to a higher chance of flooding. Tufts is located in a subbasin within the watershed that flows northeast into the Mystic River (pictured below in the upper boxes as the dark curving ribbon).

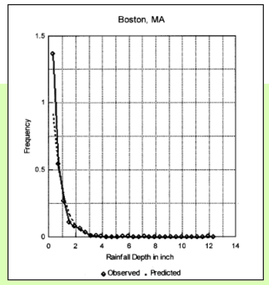


Mystic River Watershed Surface Permeability

Combined Sewer Overflow (CSO)



Source: Mystic River Watershed Association (MWRA)



Source: Guo and Urbonas, 2002

Local Precipitation Patterns

Researchers James C. Y. Guo and Ben Urbonas, in their paper discussing runoff capture curves for stormwater quality-control designs, offered an equation that predicts yearly rainfall event-depth frequencies. The equation is,

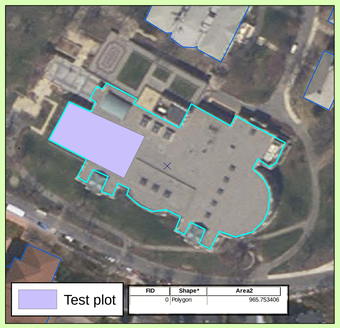
$$f(D) = \frac{1}{D_m} e^{-D/Dm}$$

where $f(D)$ = frequency of rainfall event-depth D; and D_m = average rainfall event-depth. In Boston, the average rainfall event-depth is **17.78**.

Future Directions

Calculating Stormwater Reduction

Tufts Biology graduate student Colleen Butler is researching green roof capabilities of a variety of plant species, and will experiment to find roof stormwater reduction rates. The experiment will likely take place on a portion of the Tisch Library roof. Once a "stormwater reduction per square foot" is calculated, we can run a modeling program for stormwater management analysis. Future modeling analysis will likely use the program STELLA Streamflow, which takes the inputs of surface permeability and local precipitation rates to create a runoff output. With the model, we can observe the runoff impacts of green roofs from campus, city, subbasin, and watershed perspectives.



Potential Watershed Effects

Within the Mystic River watershed there are numerous combined sewer overflows (CSOs) along the Mystic and downriver from Tufts' Medford campus. CSOs are built-in openings in a city's drainage system that act as release valves by letting excess flows leave the system. The cities of Boston and Somerville, among others, have old systems that send both stormwater and sewage through the same pipes; during heavy precipitation events, the system will overflow, sending both stormwater and sewage into nearby receiving water bodies. Acting as BMPs, green roofs mitigate the amount of stormwater sent into sewer pipes. They would help to fulfill the goals of the Mystic Watershed Collaborative, a partnership between the Mystic River Watershed Association and Tufts that is working to improve river water quality. Through stormwater modeling, we will be able to assess the amount of runoff reduced by installing a system of campus green roofs.