

GREEN ROOFS: IMPROVING AIR AND WATER QUALITY AROUND THE WORLD

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Nearly 35 years after the enactment of the Clean Water Act in 1972, many of our nation's waterways are still not safe for swimming and fishing. At the onset of the CWA, much of our water's contamination stemmed from industrial waste and other "point source" pollution. Today, however, the main pollution sources have changed. Nowadays, the number one source of water pollution stems from stormwater or "non-point source" pollution, leading to both urban runoff and combined sewer overflows (CSOs).

Urban runoff occurs when rainwater washes pollutants from rooftops, parking lots, roads, and other impervious surfaces into the stormwater system. It carries with it vehicle-related fluids including oil, grease, gasoline and hydrocarbons, along with other contaminants such as copper, zinc, lead, cadmium, chloride, and nitrate. Bacteria and other pathogens, such as pesticides, fertilizers, nutrients, sediment and debris are often washed into the system as well. Because stormwater is untreated, the pollutants, which are carried straight into our waterways, damage ecosystems and cause a major threat to human health. According to the EPA, over 10 trillion gallons of urban stormwater runoff flow into the nation's oceans, rivers, lakes and streams each year.¹

Combined sewer overflows (CSOs) occur in older areas of the country where sewer systems were originally designed to transport both sewage and stormwater through the same network. Due to the increase in population and rise in urban development, these antiquated systems no longer have the capacity during a heavy rainfall, to carry the high volume of rainwater and sewage that accumulate. As a result, the waste overflows into local waterways.

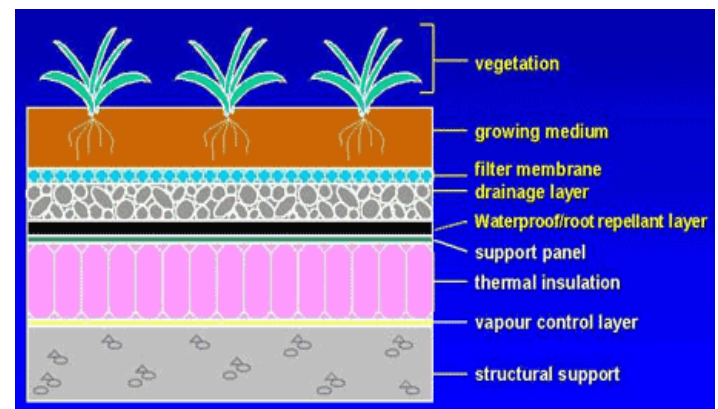
In contrast, when it rains in undeveloped areas, a large portion of rainwater is absorbed and filtered through the ground, and, over time, is eventually infiltrated into the nearest body of water. This process in part, decontaminates the water, slowly transporting it back into nature, filtering out pollutants in the process. However, when forests are cleared, and farmland and other open land is replaced by asphalt and other impervious surfaces, this process is eliminated. Instead, stormwater runs off at alarming rates. On a developed acre of impermeable surface in a 1-inch storm, 25,000 gallons of water run off the site. By contrast, only 2,700 gallons of stormwater runs off an undeveloped acre of land in the same 1-inch storm.²

In an effort to combat this problem, a number of Stormwater Best Management Practices (BMPs) have been formulated. Stormwater BMPs are methods that have been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint sources.³ They include: reconstructed wetlands, rain gardens, cisterns or rain barrels, permeable surfaces, vegetated swales, porous concrete and green roofs.

As opposed to attempting to capture, collect and treat the high levels of stormwater, which can be extremely costly, these BMPs attempt to counterbalance the negative effects of development and restore the Earth's natural processes.

Within the past couple of years, green roofs, an increasingly favored BMP, have begun to surface within mainstream society. Although used for many years in European countries such as Germany, the green roof market in the United States is fairly immature. "While green roofs comprise over 14% of flat-sloped roofs constructed in Germany they still remain a novelty in America."⁴ However, results from a recent study indicate a 72% growth in green roof square footage across North America between 2004 and 2005, and over 80% growth in the United States.⁵

Figure 1: Composition of a green roof



Source: www.greenroofs.org

A green roof system is an expansion of the current roof which features a high quality water proofing and root repellent system, a drainage system, filter cloth, a lightweight growing medium and plants.⁶ Although the cost of a green roof is more expensive than a conventional roof, they have a lifespan double, sometimes triple, that of a conventional roof. After the first two years, which involve slight upkeep and maintenance, the roof is virtually self-sustaining. Perhaps more astonishing is the phenomenal ability green roofs have to mitigate a number of environmental problems.

Asphalt and concrete rooftops, roads, and parking lots cover up to 75 percent of land area in dense cities like New York, while open space in sprawling cities like Phoenix, Arizona is lost to development at a rate of 1.2 acres per hour.⁷ During the summer, urban areas are often 2°F to 8°F hotter than surrounding areas⁸ caused by an overabundance of dark surfaces such as rooftops, parking lots and roads. This phenomenon is known as the "heat island" effect.

When temperatures increase it takes more energy to cool buildings. As power plants struggle to keep up with the increase

in energy demand, more pollutants are emitted and air quality declines. Scientists predict that as development continues and global warming advances, this trend will become more pronounced.

Green roofs help to combat the heat island effect by both increasing vegetation and increasing surface reflectivity. In fact, green roofs have been shown to outperform reflective rooftops in reducing the ambient air temperature.⁹ “While a typical asphalt roof can reach 160°F on a summer day, green roofs and other vegetated surfaces rarely exceed 80°F¹⁰. Instead of absorbing sunlight like a black roof, the plants on a green roof use moisture from the soil and evaporate it through their leaves, a process known as evapotranspiration¹¹. This process cools the leaf’s surface as well as surrounding areas.

When surrounding areas are cooler, it takes less energy to run air conditioners and lower amounts of pollutants are released into the air. Lower air temperatures are also better for human health and are less conducive to smog.

As discussed before, rain, though normally thought of as a good thing, has become a leading cause of pollution. Managing stormwater can be a long and costly endeavor. As a result, many municipalities around the country are beginning to invest significantly in various stormwater management alternatives.

Figure 2: Green Roof atop Chicago’s city hall



Source: www.asla.org

Green roofs are one alternative. When it rains, the roof acts like a sponge, storing rainwater in the soil and vegetation. What is not used by the plants through evapotranspiration is evaporated back into the atmosphere by the sun. During an extremely heavy storm, the amount of water that the roof does not maintain trickles out at a much slower rate, reducing the pace of runoff and giving wastewater treatment plants time to catch up with the influx of rain and sewage. As a result, overflows are minimized.

Green roofs also help to remove harmful particulate matter from the air. Acting as a natural bio-filter, they prohibit a significant amount of nitrogen, phosphorus and other pollutants from being washed off the roof and into the water, thus improving the water quality of runoff.

Not only do green roofs provide green space in urban areas, but they also provide natural habitat for plant and animal species, increasing the level of biodiversity in the area. With

the destruction of wetlands and other habitat, and the increase in noise, air and water pollution, many cities become intolerable to native plant and animal species. Green roofs have the ability to link fragmented habitat, and support and preserve the species that live there.

Another benefit of green roofs is the aesthetic value they provide. In addition to being an attractive addition to the urban environment, exposure to nature has physical and psychological benefits as well, producing a calming effect and decreasing stress levels in people. They can even serve as local community gardens, providing local produce for residents, and increasing community interaction and environmental awareness.

Many cities around the United States have begun to research, advocate and incorporate green roofs into government policy; creating incentives for residents, spearheading educational campaigns and in some cases mandating green roofs on new development. CSO-plagued cities, such as Boston, Minneapolis, and Chicago have all chosen to LEED¹² by example by retrofitting City Hall with a green roof. (Figure 2)

With over 14 billion gallons of sewage overflows in Hamilton County, and growing concern over air and water quality, Cincinnati could benefit widely by incorporating a green building/green roof policy and mimicking those efforts made by other cities in America and around the world. As the city prepares to reinstate the Office of Environmental Quality, and adopt a city-based LEED legislation, they open the door to LEED the Midwest in the protection, management, and conservation of our environmental, natural, and energy resources.

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