



It's Alive!

Story and Photos by Doug Curtis

Thirty-seven percent of the nation's capital is presently covered with impervious surfaces such as roads, buildings, and parking lots. Serious impairment to streams usually begins when the amount of imperviousness in a watershed reaches 10 percent. Planners are attempting to utilize a number of tools to protect watersheds from the pressures of increased development, but one that is often overlooked in the United States—until recently—is a “green” roof. This technique can be used on structures with flat or sloped roofs to provide additional green space and mitigate environmental degradation related to an ever increasing amount of impervious surfaces.

The National Park Service Center for Urban Ecology in Washington, D.C., which staffs the Natural Resources and Science Division for the National Capital Region, has a vested interest in using sustainable technology that reduces and mitigates the adverse impacts of impervious surfaces in an ultra urban area. The Center for Urban Ecology has taken action to reduce the human-produced, or anthropogenic, impacts on the environment attributable to its facility. A 7,000-square-foot, lightweight, extensive green

roof has been installed to detain storm water, improve insulation properties and conserve energy, prolong roof life, and reduce ambient air temperatures. The “living” roof mitigates the urban heat island effect, fixing dust and particulate matter, while it also provides habitat for birds, bees, and butterflies.

The idea for a green roof for the facility arose after an exchange team comprised of leaders from agencies and nonprofit organizations with an interest in urban watershed management along the Potomac River visited with watershed professionals in Germany. Countries such as Germany have already tackled urban watershed issues similar to those now being experienced in the nation's capital. Germany has long been viewed as a leader in sustainability. For example, policy tools such as an “impervious surface tax,” which requires owners to pay for cleaning storm water runoff attributable to their property, have propelled a national trend toward green roofs. By planting grasses and succulents on roof tops, storm water is absorbed, cleaned, and then discharged slowly into the natural environment. More than five percent of commercial and residential buildings in Germany are estimated to have green roofs.

Top: Creeping thyme grows in a three-inch deep mixture of slate and organic material placed in flats on the roof of the Center for Urban Ecology in Washington, D.C.



Top: Each two-foot-square plastic flat is placed directly on top of geotextile felt pads.

Bottom: Staff members from the Center for Urban Ecology place flats of plants onto the roof of the facility. Once established, the green roof will reduce storm water runoff, increase the building's energy efficiency, and help decrease the urban heat island effect.

Green roofs are divided into two categories, intensive and extensive. Intensive green roofs usually consist of a thick soil or substrate capable of supporting root growth for larger shrubs and trees. Such systems are heavy and can have major structural implications for a building. Extensive green roofs normally feature a thin layer of soil or substrate. Such lightweight systems possess minimal structural implications for a building.

One of the functional constraints of retrofitting a building with a green roof is the weight-bearing capacity of the existing roof structure. For this reason, lightweight, extensive green roofs (soil media usually two to four inches thick) are becoming increasingly popular for their ability to provide environmental benefits and extend roof life. However, before a green roof for an existing structure is considered, a professional structural engineer must conduct a structural analysis of the roof truss system to ensure that the structure can withstand the extra loading. The Center for Urban Ecology staff members were initially disappointed to learn that a section of the building with 2 x 12 in wood trusses would not support a green roof, but they were delighted to hear that the larger part of the building with steel web joists was strong enough to support the additional loading.

Green roofs consist of a wood deck overlying steel web joists, a rigid insulation board tapered to provide positive drainage to gutters, an 80 mm PVC roofing membrane, a drainage mat, and geotextile felt. Plants and soil media are contained in 2 x 2 ft plastic flats that hold three inches of planting media. The flats are placed directly on top of the geotextile and are heavy enough to weight the felt down in the wind. Planting medium consists of 75 to 85 percent inert, expanded slate with 15 to 25 percent organic material. This inert material is important to the long-term success of the green roof. Over time an all-organic soil will decompose and erode. To eliminate the burden for the continuing loss of soil, a durable, lightweight planting medium is used to prevent compaction and maintain the necessary void space for water retention and healthy plant roots. Green roofs are a long-term investment, so successful designs eliminate the need for ongoing maintenance such as replenishing soil and plants.

A compelling sustainable design argument for green roofs is that they prolong the life of conventional roofs by protecting them from ultraviolet radiation and extreme temperature fluctuations—the two primary sources of roof membrane degradation. On a conventional asphalt roof, for example, annual temperatures may fluctuate 170 degrees Fahrenheit. Green roofs,

however, dramatically reduce the temperature differential. A study conducted by the Chicago Department of Environment found that on a 100-degree day, the surface temperature of a blacktop roof reached 165 degrees Fahrenheit, while the temperature of a green roof remained only 85 degrees. Green roofs not only save money by lengthening the life span of roofing membranes, they also yield short-term savings by insulating buildings and reducing energy use. Research shows green roofs can cut energy costs in half in summer and by 25 percent in winter.

Ed Snodgrass of Emory Knoll Farms, the grower that provided plants for this project, has been testing and cultivating green roof plants for the past five years at his nursery north of Baltimore, Maryland. “The Germans have been testing and building green roofs for the past few decades,” says Snodgrass. “But their climate is milder than ours, and some plants that succeed in Germany often wither under the hot summer conditions here in the United States.” Snodgrass specified the soil and selected the plant palette for the Center for Urban Ecology green roof project. Seventeen species of plants were selected, including sedum, phlox, thyme, and succulents. About 14,000 plugs were installed at eight plants per flat. Certain plants were selected for their aesthetics and year-round interest; however, the most important variable guiding plant selection was long-term viability.

A green roof is easier to realize than most would believe. The weight of an extensive green roof is similar to that of gravel ballast, so structural upgrades are not always necessary. An extensive green roof with three to four inches of soil will reduce storm water runoff, enhance the energy efficiency of a building, and add green space.

The design simplicity of a green roof and its significant benefits offer great potential for many rooftops in U.S. cities. As people become more familiar with the technology and performance of green roofs, they can overcome their resistance to install green roofs because of unsubstantiated fears that they will leak or prove too heavy with the additional loading. The U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED™) green building rating system provides incentives for the use of green roofs. The program's “Sustainable Sites” category encourages the use of green roofs as an integrated component of storm water management, with additional benefits that can be gained for reducing the urban heat island effect. ■

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