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# Green Roofs

## What is a green roof?

A green roof is a low-maintenance, vegetated roof system that stores rainwater in a lightweight, engineered soil medium. The stored water is taken up by the plants on the rooftop and released back into the atmosphere through evaporation. As a result, compared to a conventional rooftop of the same area, much less water runs off of a green roof. Green roofs, which have been used in Europe for more than 30 years, are easy to incorporate into new construction and can be used on many existing buildings.

Like a conventional roof, the basic element of a green roof is a waterproof membrane over the roof sheathing. The system also includes a root barrier, a substrate consisting of inorganic absorbent material – such as perlite, clay shale, pumice, or crushed terracotta – and no more than 5% organic material. The top layer consists of carefully selected drought-tolerant vegetation. A green roof can also include insulation and a leak detection system. No single green roof system is suitable for all structures. While every green roof has similar components and minimum requirements, composition can vary greatly. Green roofs may be constructed using modular units or as an integrated system, in which the components are installed in a step-by-step process directly on the roof surface.



Green roofs can be extensive or intensive. Extensive green roofs require 2 to 6 inches of engineered soil medium and support a variety of low-growing, drought-tolerant plants.

Typically, these roof meadows are relatively light and thin, have no public access, require little maintenance, and are suitable for residential properties. Existing roofs on porches, garages, sheds, and sunrooms are good candidates for extensive green roof retrofits. In contrast, intensive green roofs are thicker and heavier and may include shrubs and small trees planted in more than 6 inches of growing material. Intensive green roofs are often designed as accessible building amenities and are more suitable for a commercial application.

Current waterproofing materials, root barriers, and rigorous design and construction standards have largely eliminated leaks, which were a source of concern for the first generation of green roofs. Low-cost electronic grids installed under the membrane during construction can also help pinpoint potential leaks and minimize repair costs.

## What are the benefits to property owners and communities?

Green roofs provide many benefits for communities, neighborhoods, and individual property owners by protecting and restoring local watersheds. By filtering, absorbing, and detaining rainwater, green roofs can help reduce the total amount of stormwater runoff as well as the sudden surges of runoff. As rainwater filters through the green roof's soil, it is taken in by plant root systems, which absorb pollutants. This improves water quality by reducing the pollutant volume entering nearby streams. Green roofs also create wildlife habitat, attracting pollinators, such as birds and bees.



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In addition to being aesthetically pleasing, commercial properties with green roofs can attract higher rents and maintain higher tenant retention. Green roofs cool and clean the air by filtering airborne particles such as smog and carbon dioxide through plant leaves. Green roofs also help to reduce the urban heat island effect. On a hot day, an urban area can be 10 degrees hotter than the surrounding area due to human activities; green roofs stay substantially cooler (up to 40 – 50 degrees cooler) than conventional roofs helping to reduce the surrounding air temperature. This practice may also increase property values and reduce property maintenance fees.

There are also energy saving benefits of green roofs. The life of the roof can be as much as doubled by adding a green roof, by protecting it from ultraviolet rays and thermal stress. Green roofs provide an extra layer of insulation that helps to reduce heating and cooling costs. By installing a green roof, you can help protect the environment and conserve water resources.

### **How can your green roof qualify for a rebate?**

The Rain Check Rebate Program offers a rebate to individuals, commercial businesses, multi-family dwellings, not-for-profit and nonprofit organizations (including housing cooperatives) that install green roofs on buildings within Prince Georges County. To be eligible for a rebate, a green roof retrofit project must be approved by the Department of the Environment prior to construction. Your green roof must be at least one-quarter of the roof area. The rebate for residential extensive green roofs (with no more than 6 inches of planting material) is \$10 per square foot (up to \$6,000). For commercial businesses, homeowner associations, condominium associations, civic associations, multi-family dwellings, nonprofits or not-for-profit organizations, the rebate is \$10 per square foot for an extensive green roof or \$20 per square foot (up to \$20,000) for an intensive green roof (with more than 6 inches of planting material). The green roof must replace an existing roof area rather than expanding the original roof footprint. A structural load analysis report from a licensed structural engineer (see below) is required for approval.

### **How can you determine if your property or home is suitable for a green roof?**

Green roofs work well on garages, sunrooms, and other roof areas that are mostly sunny with a gradual slope. Generally, a roof slope of less than 20% is ideal, although steeper slopes can be accommodated with a few more structural elements. Every green roof must be constructed on top of a sturdy roof structure. The additional weight of a green roof may require some existing buildings to be structurally reinforced. Your contractor should arrange for a licensed structural engineer to determine the building's load-bearing capacity.

### **What type and size of green roof should you install?**

A qualified green roofing contractor will help you determine the optimal type and size of green roof for your structure. You may also want to involve a landscape architect for design and plant selection. Plant selection should be based on climate, type and depth of planting material, load-bearing capacity, height and slope of your roof, and maintenance and irrigation requirements. Extensive green roof designs have an optimum depth of planting material for water storage of approximately 4 inches; however, it is important to consult with your contractor to determine the maximum allowable capacity of your roof. There is no optimum depth for intensive green roofs. For an intensive green roof, your contractor will help you determine the depth that will best meet your needs. Your contractor will provide a runoff calculation report to prove that the green roof will capture the required amount of runoff. The County may request a runoff calculation report for the proposed green roof design.

### **Which other techniques work well with green roofs?**

Rainwater that is not taken up by the plants or released into the atmosphere can be redirected to rain gardens or stored in rain barrels or cisterns to irrigate other landscaping. By connecting more than one stormwater reduction technique, you can help protect your community's streams and environment.

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## What are the costs?

Depending on the type of green roof you choose to install, the cost can be between \$10 and \$30 per square foot, with annual maintenance cost ranging from \$0.75–\$1.50 per square foot. To cover the roof of a typical 2,000 square foot home, this would amount to between \$20,000 and \$60,000 to install and between \$1,500 and \$3,000 for annual maintenance. For a 10,000 square foot business, multifamily home, or apartment building, the cost to install can be expected to range between \$100,000 and \$300,000 to install and between \$7,500 and \$15,000 for annual maintenance. Cost per square foot depends on many factors, including size and slope of the roof; depth and complexity of the system; height and accessibility from the ground; labor costs; and the need for specialized elements, like drains, railings, pavers, and slope stabilization measures. By far the highest costs associated with green roof creation are the growth medium and the plants. Commercial green roof retrofit projects may interfere with business operations during construction. But remember, the upfront cost does not take into account the savings related to increases in energy efficiency, property value, or roof longevity. Approval of your green roof project through the Rain Check Rebate Program can help reduce costs.

## Can you do this project yourself?

A green roof retrofit is not recommended as a do-it-yourself project. To be eligible for a rebate a certified green roof contractor must install your green roof.

## How should you choose a contractor?

In choosing your contractor, ask about their experience designing and installing green roofs. Find out whether the company's experience is in modular systems or integrated systems (in which all components are installed directly on the roof), if they can provide a structural load analysis by a licensed engineer and a runoff calculation report. Your potential contractor should be insured and bonded and should be able to provide portfolios and references from previous clients. Ask your potential contractor to explain what is included in their services, how long the project should take, whether any subcontractors will be used, and what type of guarantees are provided. Find out what the potential contractor envisions for your roof, including the type of green roof system, specific details on components, and what plants they would recommend. Ask if they provide ongoing maintenance or can provide information on another company that provides such maintenance. Finally, be sure that the contractor you choose is certified by a national organization for roofing contractors, such as the National Roofing Contractors Association, and by Green Roofs for Healthy Cities, the only organization to offer a nationally recognized Green Roof Professional certification.

## Is a permit required?

Installing a green roof may require structural or mechanical modification to the roof's structure. Based on a review of your application you will be advised of any/all permit requirements. Contact the County's Department of Permitting, Inspections and Enforcement for more information: (301) 636-2000 or [www.princegeorgescountymd.gov/1024/Permitting-Inspections-and-Enforcement](http://www.princegeorgescountymd.gov/1024/Permitting-Inspections-and-Enforcement).

## What maintenance will be required?

Extensive green roofs, when properly installed, require relatively limited maintenance, but they are not maintenance-free. Green roofs require some attention during establishment and yearly maintenance thereafter. Intensive green roofs have irrigation needs and require more maintenance than extensive green roofs. Green roofs require irrigation during the 18-month to 2-year establishment phase, and as needed during drought conditions. Be sure to check gutters and downspouts annually and remove any accumulated sediment or debris. Check surface vegetation and remove undesirable weeds annually; plant replacement is best done in the spring and fall. Weeds and native grasses are carried to the roof by wind, birds, and insects and can compete with roof plants for sunlight, moisture, and nutrients; therefore, they should be weeded annually. Once a year, lightly apply a specially blended, organic, slow-release fertilizer to help keep your green roof functioning efficiently.



MAINTENANCE SCHEDULE FOR GREEN ROOFS												
	Spring			Summer			Fall			Winter		
Irrigation (until established)												
Irrigation (during drought)												
Weeding												
Plant replacement												
Fertilizing												

 Required
  Required at Low Frequency
  Required as Necessary

**For more information**

While Prince George’s County does not endorse any one method of building or installing a green roof or any particular green roof installer or vendor, the following information is supplied for your consideration.

General Information on Green Roofs

**Green Roofs for Healthy Cities (premier national organization for information on green roofs)**

<https://greenroofs.org/>

**Emory Knoll Farms (a good local source for green roof plants as well as information on green roofs)**

<https://www.greenroofplants.com/>

**District Department of the Environment, Green Roof Toolkit (adapted from DC Greenworks)**

<https://doee.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/GR%20Toolkit%2012.22.11.pdf>

**Montgomery County Maryland, RainScapes: Environmentally-Friendly Landscapes for Healthy Watersheds, Green Roofs**

<https://www.montgomerycountymd.gov/DEP/Resources/Files/downloads/rainscapes/fact-sheets/greenroofs.pdf>

**EPA, Green Roof Benefits and Costs of Installing and Maintaining Green Roofs**

<https://www.epa.gov/heat-islands/using-green-roofs-reduce-heat-islands>

<https://www.epa.gov/heat-islands/using-green-roofs-reduce-heat-islands#costs>

International Standards

**ASTM International. Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems. Standard E2399M-15**

<https://www.astm.org/Standards/E2399.htm>

**ASTM International. Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Vegetative (Green) Roof Systems. Standard E2398-05**

<https://www.astm.org/Standards/E2398.htm>

**ASTM International. Standard Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems. Standard E2397-05**

<https://www.astm.org/Standards/E2397.htm>

**ASTM International. Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems. Standard E2400/E2400M**

<https://standards.globalspec.com/std/9896998/astm-e2400-e2400m>

*For more information, call 410-974-2941 or visit The Chesapeake Bay Trust (cbtrust.org).*