GREEN ROOF TOOLKIT

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GREEN ROOF OVERVIEW

There are three types of green roofs: extensive, semi-intensive and intensive. Although the design will differ, the basic layers remain the same.

Green Roof Types

Extensive
3 - 4" of growing medium
15 - 30 pounds per square foot (additional roof load)
less variety of plants | usually Sedum
requires little irrigation | drought resistant
low maintenance
costs about $10.00 to $30.00 per square foot (above the cost of a conventional roof)
few design elements

Semi - intensive
4 - 8" of growing medium
25 - 50 pounds per square foot (additional roof load)
more plant variety | wildflowers, drought-tolerant herbacious perennials
requires periodic irrigation
periodic maintenance
costs about $20.00 - $40.00 per square foot (above the cost of a conventional roof)
incorporates design elements

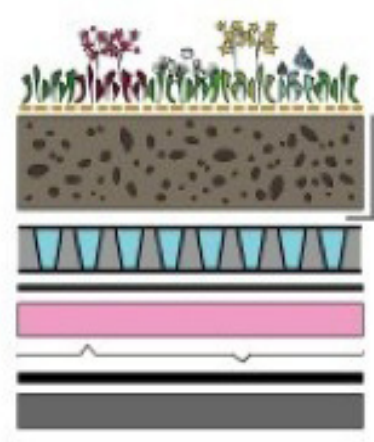
Intensive
8 - 12" of growing medium
40 - 150+ pounds per square foot (additional roof load)
high variety of plants | includes shrubs and trees
requires consistant irrigation (summer months)
regular maintenance
costs about $40.00 + per square foot (above the cost of a conventional roof)
highly designed usable green space

Green Roof Composition

A green roof is not simply plants placed on a rooftop, but rather a highly-engineered, contiguous system of plantings designed to protect the structural integrity of the building while providing significant environmental, economic and aesthetic benefits.

No one green roof system fits all. While every green roof has the same components and minimum requirements, manufacturers can vary greatly.

Green Roof cross section



information from
www.dcgreenworks.org

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GREEN ROOF BENEFITS

Green roofs are a highly sustainable roofing technology, providing numerous economic, environmental and social benefits.

ECONOMIC

Reduce the life cycle cost of the roof | Green roofs may last 3 times as long as a conventional roof.

Reduce waste and decrease the need for land-fill expansion The extended life of green roofs reduces construction waste and cost.

Increase property values | As an added amenity, green roofs attract higher rents and maintain higher tenant retention**.**

Save on energy costs | Green roofs may reduce energy costs 10-20% by keeping the floor directly below 3-4 degrees (F) cooler and reducing need for expansive HVAC systems.

Provide sound insulation | 4" of substrate reduces noise pollution by 40 decibels adding to the desirability of the building.

Decrease need for stormwater infrastructure expansion | Green roofs provide on-site retention, saving vital public resources

Cedits for stormwater impact fees | Green roofs provide possible credits for stormwater impact fees, saving money on regulatory fees.

ENVIRONMENTAL

Reduce the urban heat island effect | On a hot day, an urban area can be 10 degrees (F) hotter than the surrounding area, green roofs stay 40-50 degrees (F) cooler than conventional roofs reducing the ambient air temperature.

Reduce stormwater runoff | In the summer, green roofs retain 70-100% and in the winter they retain 40-50% of stormwater, reducing the volume and velocity and reducing erosion and sedimentation of our water sources.

Improve water quality | Through filtration, green roofs prevent nitrogen, phosphorus, and toxins from entering streams and waterways**.**

Improve air quality | Green roofs ilter airbourne particles such as smog, sulpher dioxide and carbon dioxide through vegetation foliage.

Create wildlife habitat | Green roofs provide urban green infrastructure for native species repatriation and maintaining species biodiversity.

SOCIAL

Education opportunities | Green roofs provide areas for instruction in ecology, science and math.

Provide space for food production | Green roofs create opportunities for urban agriculture and help increase food security in urban areas.

Provide aesthetic appeal | The vegetitation and natural beauty of green roofs provide respite from the concrete hard-scape of urban areas.

Creates usable green space Green roofs may provide green space throughout urban ares where open space is limited.

Create jobs and economic security | The establishment of a green roofing industry creates new jobs in manufacturing, construction, design, installation, maintenance and horticulture.

Visit www.dcgreenworks.org for more information.

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ARE YOU GREEN ROOF READY?

All buildings are NOT green roof compatible. If your building meets the following criteria, you are green roof ready!

New Construction

By incorporating a green roof into the original design of new construction and additions you will save time and money. Ensuring that the roof is built to hold at least 30 pounds per square foot for the added weight of the green roof, incorporating safe and legal roof access into the design and ensuring there are suffiicient funds will faciliate the installation.

Retrofits to small buildings and single family residential

Are you planning to replace your roof or waterproofing membrane within the next year?

Does your building have LEGAL roof access or a roof veranda or deck?

> If you do not have a roof deck, was your building built after 1960?
>
> If your building was built before 1960 and doesn't have a roof deck, have you had structural reinforcing or new roof joists installed in the last 10 years?

Is your rooftop sunny with relatively few or no trees growing above?

Can you afford to spend $10-30 per square foot, in addition to replacing your roof with a specialized waterproofing membrane, approximately $7-12 per square foot?

Green roof retrofits to commercial and multi-family residential buildings

Are you planning to replace your roof or waterproofing membrane within the next year?

Is your rooftop relatively flat with no more than 30 degrees of pitch?

Do you have an IRMA or ballasted roof systemc currently?

> If not, does your roof have public roof access, a roof veranda or deck?
>
> If not, can the building support 25 pounds per square foot, beyond snow and wind loading?

Is your rooftop sunny with reatively few or no trees growing above?

Can you afford to spend approximately $8-15 per square foot, in addition to replacing your roof with a specialized waterproofing membrane approximately $7-15 per square foot?

Information found on DC Greenworks Website:
www.dcgreenworks.org

If the answers to the questions above are "NO", green roofing may not be right for your building or might not be feasible at this time.

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WATERPROOF MEMBRANE

Green roofs are defined as the vegetation and additional layers above the waterproof membrane. However, choosing the right waterproof membrane is important to the proper function of the green roof.

Waterproof Membranes and Green roofs

Installing a green roof over a waterproof membrane will significantly extend the life of the membrane and the life cycle cost of the roof.

There are several factors to consider when choosing a waterproof membrane to be used in conjunction with a green roof beyond waterproofing such as durability, environmental friendliness, tensile strength and root resistance. To be used in conjunction with a green roof, the waterproof membrane should be made of an inert material that cannot be penetrated by roots or an additional root barrier must be installed with the green roof. Waterproof membranes that are commonly used in conjunction with green roofs are:

PVC (45-90 single-ply)

TPO (Thermoplastic Polyolefin single-ply)

EPDM (Ethylene Propylene Diene Monomer single ply)

built-up hot applied high-polymer asphalt

2 layers of high polymer SBS modified bitumen with root barrier

Based on widespread installations and a reliable service record, modified bituman and PVC membranes are the best for use in conjunction with a green roof.

Is your membrane ready for green roofing?

In addition to ensuring the compatibility of the waterproof membrane, the age of the membrane at the time of green roofing is important. A green roof should not be installed on a membrane more than a couple of years old and in good condition.

For a membrane that is a couple of years old, check throroughly for leaks prior to green roof installation.

Flood testing prior to installation may be used to discover any breaches in the membrane. This method is used on flat roofs and requires water to be pooled on the roof for 24 hours to see if there are any punctures in the membrane which could lead to leaks in the future.

EFVM (electronic field vector monitoring) technology may be utilized after a green roof is installed to detect any breaches in the membrane which might lead to leaking. This technology works on both flat and sloped roofs and reduces the possibility of overlaoding the roof.

A **Leak Detection Layer** may also be installed with the green roof to further ensure leaks are detected and located imediately.

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GREEN ROOF PERMIT PROCESS

All green roof projects require a building permit. Permits are obtained through the Department of Consumer and Regulatory Affairs (DCRA).

Pre-Application and Application

Find out the property's zoning district
Are you in a zoning overlay district? (zoning overlay districts have additional requirements and restrictions that must be met to receive a permit.) Visit the ***DC Office of Zoning*** website for a complete list of overlay zones.

Obtain a plat
A plat is a scaled drawing of a lot, showing lot lines and record dimensions.
You wil need the Square, Suffix and Lot (SSL) number for each property.
Cost of a regular plat is $30.00. Turnaround time is a minimum of 10 working days.
To order you must go IN PERSON to the Office of the Surveyor:

941 North Capitol Street, NE, Suite 2700
Washington, DC 20002
(p) 202.442.4566

Fill out permit application and Environmental Intake Form (EIF)
Make sure that all required information is provided and applicable boxes are checked.

Building permit application
Environmental Intake Form

Ensure all requirements are met
Follow requirements in link below for type of permit applying for:

Building Permit Application Requirements by Permit Type (DCRA document)

Permit issuance

Timeline (DCRA's goal to review)
1 - 999 SQ FT | within 24 hours
1000 - 2999 SQ FT | within 14 days
3000 + SQ FT | within 30 days

Permit Fees:
There are different fees for new construction or additions, alterations or repairs to existing construction. There are also reduced permit fees for green building, such as green roofs.

Please view link below to determine the cost of the building permit for your green roof project.

Building Permit Fees

Obtaining the permit
you will be contacted when the permit is ready for pick-up

First get an invoice from Issuance Counter and pay for the permit in the Cashier's office

Show your Cashier's receipt to obtain the permit

For additional information please visit
DCRA's Permit Website or contact
info@dcgreenworks.org

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EXTENSIVE GREEN ROOF PLANTS

Extensive green roofs have growth medium depth from 2" - 6" inches, limiting the design and plant variety suitable for the system.

Choosing extensive green roof plants

Although there are numerous choices for extensive green roof plants due to different design considerations such as stormwater management, energy conservations, habitat formation, heat island mitigation, aesthetics and creation of usable green space, there are basic qualities in certain plants that make them ideal for extensive green roofs.

Ideal extensive green roof plant characteristics

low growth height | helps plants withstand high winds and lowers fire hazard
rapid growth and spreading | ensures complete coverage, increased stormwater retention, elimination of viable space for weed establishment and helps anchor growth medium
high drought tolerance | reduces need for costly irragation systems and plant replacement
fibrous root system | protects roof membrane
low maintenance | reduces the time and financial costs of the roof year after year
non-invasive | no airborne seed generation to prevent green roof plants from invading other landscaping
self propogating | reduces number of plants needed to cover a green roof, reducing the cost of the roof

Preferred extensive green roof plant list

The following plants thrive on green roofs. At least 5 or 6 different varieties of plants should be incorporated into each roof design to create diversity of color and flowering times. Please click on links below to find out additional information about each plant, such as flower color and blooming period.

plants for green roof areas with full sun exposure

Allium schoenoprasum (chives)
Sedum album
Sedum album 'Murale'
Sedum floriferum 'Weihensterphaner Gold'
Sedum reflexum
Talinum calycinum

plants for green roofs with shaded areas

Delosperma nubigenum 'Basutoland'
Sedum acre 'Aureum'
Sedum kamtschaticum
Sedum sexangulare
Sedum spurium 'Fuldaglut'
Sedum spurium 'John Creech'
Sedum spurium 'Roseum'
Sedum spurium 'White Form'

information from **www.greenroofplants.com** & Snodgrass, Edmond C. and Lucie L Snodgrass. ***Green Roof Plants.*** Portland: Timber Press, 2006

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GREEN ROOF MAINTENANCE

Extensive green roofs, when properly installed, should require relatively limited maintenance. They are NOT maintenance free.

What a green roof needs

Weeding
Weeds and native grasses are carried to the roof by wind, birds and insects. These invasive plants can be problematic, as the compete with the gree roof flora for moisture, nutrients and sunlight.
In order to keep the green roof healthy, all invasive plants (weeds) must be removed regularly, *When weeding be sure to pull out the roots.*

Water
For sedum-planted roof, rain is often adequate.
Water 1X a week for a newly planted roof. Water 1X a month for an established green roof in times of extreme draught. Supplemental watering can often be done through a sprinkler attached to a garden hose.
For green roofs planted with more traditional landscaping, more frequent watering may be needed.

Nutrients
1X a year, lightly apply a specially blended organic fertilizer to help keep a green roof looking at its peak,
Sometimes, due to wind shear and other factors, some green roofs' soil media is blown away. Supplemental soil media may be needed, preferably with jute netting as wind protection.

Safety during green roof maintenance

Wear sun protection, protective eyewear, closed toe shoes, hard hat and gloves.

Wear a harness and tieback system if there is no railing or if working outside of a railing system.

Never walk backward on a roof.

Drink plenty of water (especially on hot days).

Never work on the roof alone.

Ensure ladders are well secured and held by someone when in use.

"NEVERs" of green roof maintenance

Never use chemical weed killers.

Never use a sharp or pointy weeding tool - the point may damage the green roof system.

Never cover a green roof with a protection tarp for more than 3-4 hours - they can smother or "bake" green roof plants.

Never use a flame-based weed torch system - the flame can damage the system layers.

Never place stakes deeper than the soil depth directly down through green roof

Never over-water - mold can be caused by excess irrigation