

Green Roof Maintenance

Welcome

Thank you for purchasing a green roof from Columbia Green Technologies. We have compiled the enclosed recommendations for successful establishment of your roof and ongoing maintenance activities thereafter. Health, vigor and beauty of the roof can be increased by careful attention to these guidelines. Please note that this is general information and that every roof will require customized care. If you require technical assistance please contact us at info@columbia-green.com or (503) 327.8723.



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Introduction

The green roof offers many benefits to this building and the larger environment. Green Roofs have been shown to:

- Reduce heating and cooling costs
- Extend the life of the roof membrane by 2x-3x
- Provide on-site stormwater management
- Increase rents/decrease turnover in commercial buildings
- Provide Habitat and Reduce Urban Heat Island effects

The green roof will no-doubt generate lots of interest, so it is important to create a site-specific maintenance plan to keep it looking and functioning properly. WHILE EXTENSIVE* GREEN ROOFS ARE GENERALLY CONSIDERED 'LOW MAINTENANCE' LANDSCAPES, THEY DO REQUIRE SPECIALIZED CARE AT REGULAR INTERVALS, ESPECIALLY DURING THE PERIOD OF ESTABLISHMENT. IN CONTRAST, GARDEN-LIKE INTENSIVE* GREEN ROOFS WILL REQUIRE A LEVEL OF MAINTENANCE COMPARABLE TO AT-GRADE LANDSCAPES. This document is intended to be a resource for the creation of a maintenance plan and for documenting the activities. Because a green roof is a living system, the maintenance plan may require a certain amount of modification over time as the roof matures and you come to know its idiosyncrasies.

**If you aren't familiar with these terms, check out the glossary at the back.*

Documentation

Consistent, high-quality documentation of maintenance activities is vital to a successful green roof. DIGITAL PHOTOGRAPHS SHOULD BE TAKEN EACH VISIT. Taken together, these records provide the building owner, maintenance contractor and manufacturer with a valuable record should problems ever arise. Being able to demonstrate that maintenance was performed in accordance with warranty specifications is vital to ensuring that repairs or replacements are covered as intended. **SAMPLE FORMS CAN BE FOUND IN THE APPENDIX**

MINIMUM RECOMMENDED MILESTONES TO DOCUMENT

Final Project Completion

Establishment Period

Monthly Maintenance Reports

Annual Inspections

About this System.

Use this space to record basic roof info for future reference.

Manufacturer:	Columbia Green Technologies
Warranty Period:	_____
Green Roof Installer:	_____
General Contractor:	_____
Date of Installation:	_____
Initial Maintenance Period thru:	_____
Long Term Maintenance Provider:	_____
System Type (Tray or Layered System):	_____
Depth of Growing Media:	_____
Irrigation System, if provided:	_____

Maintenance Providers

The green roof installer frequently covers maintenance of the roof for a period of time specified by the contract documents. After this period (ranging from anywhere from 30 days to 6-months or even 1-year) ends, it is up to the owner to maintain the roof. This may be accomplished by hiring a landscape maintenance contractor that specializes in green roofs, or by in-house groundskeepers. If you choose to hire an outside maintenance contractor you will want to make sure that they are experienced in maintaining green roofs.

How much should I budget?

THE LEVEL OF MAINTENANCE DEPENDS GREATLY ON THE OWNER’S EXPECTATIONS, SO IT IS IMPORTANT THAT ALL PARTIES ARE IN ALIGNMENT FROM THE START. For example, some owners desire a green roof that looks green and highly manicured at all times. Other owners will be more tolerant of a naturalistic roofscape that is allowed to, for example, go dormant certain times of the year. It often depends on the visibility of the green roof.

Significant factors influencing maintenance cost are travel time, overall green roof size, & accessibility to the roof. Complexity in design doesn’t play that much of a role unless you have different plant mixes that need to stay bound within a certain delineation which is not separated by a physical barrier such as an edger or a planter wall.

At a minimum, you should plan for (8) ongoing maintenance visits per year. Some people say this translates into approximately \$.50/Square Foot/Year, although this obviously depends on labor rates in your area.

Warranty Provisions

There are several types of green roof warranties. It is important to understand the terms, conditions and exclusions that apply to your warranty, if applicable. Please read through your warranty (a separate document).

Full System Warranty

Covers the manufactured green roof components for a specified period (often 20years). Excludes overburden removal and repair of the roof membrane system. Typical offered as a direct Columbia Green Technologies sale. Extended overburden warranty may be purchased separately.

Single-Source Warranty

Covers the roof membrane system and the green roof components for a specified period (often 20-30years). Typically offered through the roofing manufacturer.

Extended Plant Warranty

A separate extended plant warranty may be purchased to cover the ability of the green roof vegetation to thrive and achieve a certain coverage during a specified period of time (often within 2 years of installation). [Documentation of maintenance activities is required- please see the terms and conditions for specifics.](#)

Safety Notes

Maintenance staff should review safety precautions prior to starting any work. Rules differ according to state or local regulations and type of use. It is extremely important that these access and safety standards are adhered to for the life of the roof and future maintenance and performance verification. OSHA 29 CFR 1910 Subpart D (General Industry Standards) and 29 CFR 1926 Subpart M, N, X, V and CC (Construction Standards) are the U.S. Federal standard and can provide guidelines to accessibility and safety requirements. In Canada, labor safety is under provincial jurisdiction.

Green Roof Components

The Green Roof contains the following components:

Growing Media- An engineered, lightweight soil.

Vegetation

Plant species vary from project to project. Consult the original project drawings for the plant list. An intensive garden-like roof is usually planted with 4" pots, 1-gallon, or 2-gallon containers of nursery stock plant material. An extensive sedum-based green roof may be planted using the following methods:

Unrooted Sedum Cuttings

Sedum Plugs

Pregrown Sedum Tiles

Nursery-Grown Trays

The Green Roof may contain one or both of the following systems:

Tray System

2'x2' Polypropylene Trays

Pins

Metal Edging

Drip Irrigation (Optional)

Layered System aka Built-in-Place System

Drainage Layer- (Black) Polypropylene Matrix

Filtration Layer- (Gray) Spun-bond polyester fabric.

Water Retention- (White) Non-woven polyester fibers

Metal Edging

Post-Installation Inspection

Final Inspection and Acceptance

Make arrangements for final inspection of the installed green roof within 14 days following Substantial Completion with owner, architect, contractor, installer, and others as requested to be present.

- Verify conformance to Manufacturer's instructions and warranty provisions and identify any and all issues that may impact the establishment of a healthy vegetative roof system.
- The owner will assume maintenance and care of vegetated roof try system following acceptance, except as modified by a maintenance service agreement.
- All pertinent and valid information regarding this inspection shall be documented and submitted to the warranty provider.

Establishment Period

The establishment period is the first full summer growing season following planting. Careful watering and attention to your new green roof system especially during the first two months

and the first full growing season after installation is key to maintaining a healthy roof and heading-off maintenance difficulties down the road. If you have any concerns, please contact your Columbia Green representative or Green Roof Contractor. **Remember: An ounce of prevention is worth a pound of cure!**

Installation Season:	Establishment Period:
Fall	Spring and Summer of the following Year
Winter	Spring and Summer of the following Year
Spring	Until onset of cool fall weather
Summer	Through summer of the following year

Watering during Establishment

The amount of water required during the establishment period depends on the planting technique and the current weather conditions. Water may be applied via an automatic irrigation system (recommended), or by hand-watering. *Columbia Green recommends irrigation as a management tool during the establishment period and prolonged hot dry weather.*

Below are some recommendations for establishment during mild weather.

Sedum Cuttings

- Overhead watering twice daily for the first two (2) weeks
- Once a day for the third week
- Once a week for the next four (4) weeks
- For the duration of the establishment period: As-needed, check weekly.

Sedum Plugs

- Once a week for the first four (4) weeks
- For the duration of the establishment period: As-needed, check at least weekly.

Pregrown Sedum Tiles

- Once a week for the first four (4) weeks
- For the duration of the establishment period: As-needed, check at least weekly.

Nursery-Grown Trays

- Once a week for four (4) weeks
- For the duration of the establishment period: As-needed, check at least weekly.

But if at any time the plants are wilting, it is time to irrigate!

Extreme Weather

PROLONGED HOT DRY WEATHER is generally defined as periods of 75 degree weather, with less than 1 inch of rainfall per month. This “ballpark” time period will likely be less if the temperatures are hotter, or on sloping roofs and roofs exposed to persistent winds or reflected sunlight. Such conditions can dry out the soil and cause the plants to go dormant, or in extreme cases, to dry up and die.

Inspections

During establishment, it is important to check on your green roof frequently to ensure that the automatic irrigation system (if installed) is functioning properly, to hand-water (if necessary), and to keep tabs on weed germination. Remember to document your activities! A sample form can be found in the appendix.

Ongoing Maintenance Activities

After the initial establishment period outlined in the previous section, the roof will become more mature and resilient due to a strong root system and vegetation that is acclimated to the local climate. Therefore, maintenance activities will become more focused on upkeep and observation, especially during the active spring and summer growing seasons. VISITS MIGHT OCCUR MONTHLY, AND ALSO FOLLOWING MAJOR WEATHER EVENTS (HEAVY RAINFALL OR HIGH WINDS) WHEN IT IS NECESSARY TO DOUBLE CHECK THAT DRAINS HAVE NOT BECOME OBSTRUCTED. The following activities should be part of an ongoing maintenance regimen:

Inspect Vegetation-Free Zones

Vegetation-free zones (VFZs) are typically found at green roof perimeters and around roof penetrations to prevent vegetation from encroaching on at sensitive points. They may be delineated with metal edging and filled with aggregate. All VFZs, including roof drains should be inspected at least every two weeks. Errant green roof vegetation *and* any debris (pebbles, sticks, leaves, trash, etc.) should be removed from the drainage system and drain paths in order for the roof drains to function properly. Impaired drainage is a very serious condition; not only can it lead to damaged or dead plants, but it can cause serious damage to the roofing system, add structural loads beyond the building’s design limits, and may ultimately lead to structural failure.

Remove Debris

Remove trash, pebbles, sticks, fallen leaves etc. from the green roof on a regular basis, as they can smother the green roof plants.

Control Weeds

Take care to address any weeding issues during the first few months of establishment, and during the first year of growth to coverage. During your monthly inspections, be sure to check for weeds and remove any that you find. REMOVING TREE SEEDLINGS IN A TIMELY MANNER IS VERY IMPORTANT TO PREVENT THEIR STRONG ROOT SYSTEMS FROM COMPROMISING THE WATERPROOFING SYSTEM. Once the green roof grows into a dense cover, weed germination will become less significant. Occasionally, perennial weeds like clover can become problems if not removed quickly. In those circumstances, a careful, spot-spray of a glyphosate herbicide may be used. Care should always be taken to prevent weeds from setting seed.

Deadhead

Most sedum species flower in the spring or summer. Spent flower stalks may remain throughout the fall and winter. While they pose no danger, they may not be aesthetically desirable. You may choose to “deadhead” – trim off spent flowers by hand or with scissors or pruners – as necessary.

Check Irrigation/Moisture Levels

GENERALLY SPEAKING, IT IS BETTER TO USE THE MINIMUM AMOUNT OF IRRIGATION NECESSARY, AS DRY SOIL ENCOURAGES TOUGHER GREEN ROOF PLANTS THAT RESIST EXTREMES.

The irrigation system, whether drip or overhead spray, should be visually inspected at each visit to ensure that it is functioning properly. Check all valve locations and joints to look for signs of leaks or breaks in the piping. Visually inspect spray heads and drip emitters to ensure they have not become clogged. Check moisture levels on the roof and adjust run times on the controller if using an automatic system. Special care will be required to winterize and reactivate the system (see below).

If hand-watering, focus most of your irrigation efforts during the summer, and periods of prolonged hot dry weather. Supplemental water may not be needed during periods of rain or milder temperatures. Hotter or dryer climates may require more ongoing attention. Be prepared to irrigate during periods of extreme heat as described below.

PROLONGED HOT DRY WEATHER is generally defined as periods of 75 degree weather, with less than 1 inch of rainfall per month. This “ballpark” time period will likely be less if the temperatures are hotter, or on sloping roofs and roofs exposed to persistent winds or reflected sunlight. Such conditions can dry out the soil and cause the plants to go dormant, or in extreme cases, to dry up and die.

If the plants are wilting, it is time to irrigate.

During prolonged hot dry weather or when plants become drought stressed, supplemental water should be applied, temporarily, to re-wet the soil to the point of saturation. This will keep plants from going dormant, keep them plump and healthy so they can cover the soil effectively, and optimize their appearance. It also enhances the evaporative cooling effect of the green roof.

Thoroughly irrigating, as indicated above, will pay off significantly. Not only will the plants be healthier and fuller, bringing reduced maintenance costs, but the actual cost of irrigation is minimal compare to the energy savings derived from enhancing the evaporative cooling of the green roof.

Drip Irrigation Winterization

Step 1: When freezing weather is anticipated, simply turn off your main water supply to the irrigation system and make sure that the backflow device, valves, filter, pressure regulator, pipe, sprinklers, drip hose, and drippers are free of water.

Step 2: After the main water supply is shut down, run the timer/ controller through its normal watering cycle. This will allow each of the valves to open and relieve water pressure on the main line and valves. Allow the lines to drain slightly. After the timer/controller runs through its cycles, turn the controller off, or to Rain Off position.

Step 3: Ensure that all exposed pipe is wrapped with insulating tape. The insulation should cover everything exposed up to the risers; however, it is unnecessary to wrap sprinkler heads or hose bibs.

Step 4: Through the height of winter leave the system off and drained. If needed, water the green roof with a hose only. In most cases, there is enough moisture from rain to sustain the plants during the winter.

Drip Irrigation Spring Startup

Step 1: After the last frost danger has passed and you are ready to turn on the system in the spring, the first step is to flush it out. During the winter small insects may take up residence in the emitters, tubes and pipes. Open the ends of drip tubes and flush them out by turning on the water. Make sure that standing water doesn't drain back into the pipes, taking dirt back in with it.

Step 2: After flushing, check the system out by running it. Look for clogged emitters or nozzles, check for leaking valves and make any necessary repairs.

Step 3: Check the controller to ensure that it is properly programmed for each station. If it has a back-up battery replace it with a fresh one.

Overhead Spray Winterization and Spring Startup

If you have spray (overhead) irrigation it has been provided by another manufacturer. Please consult the manufacturer or an experienced landscape contractor for their recommendations.

Fertilizing

An established green roof should need little if any fertilizer, but there may be merit in fertilizing in small amounts to encourage faster establishment. All fertilizers can be water pollutants, so care should be used to keep fertilizer applications to a minimum. Also, excessive fertilizer encourages soft growth, which is more vulnerable to damage from drought or temperature extremes. It is better to use slow release and balanced organic fertilizers, with one application in the spring being adequate. And never fertilize during fall. It too may stimulate tender growth and compromise the hardiness of the plant material.

Sedums do not require high levels of fertility to do well. Maintaining a green roof in a state of low fertility, after establishment, also discourages weed growth.

Trouble-shooting

Plant Coverage

Coverage Expectations –

Here is a growth chart that details the extent of growth you should expect within the first several years of owning your new green roof system. COVERAGE DEPENDS ON THE METHOD OF INITIAL PLANTING.

Coverage	Per square foot	After one full year	After two full years	After three years
72 Cell Plugs	2	60%	80%	90%
	2.4	70%	85%	95%
	3	75%	90%	100%
	4	80%	95%	100%
Bulk Cuttings	4# per 100 sf	25%	50%	70%
	10# per 100 sf	50%	70%	90%
	15# per 100 sf	70%	80%	95%
	20# per 100sf	80%	90%	100%
Sedum Tiles	0.5	90%	100%	100%

If your roof does not meet these guidelines, follow the irrigation and fertilizing recommendations above.

Reference Materials

Average First and Last Frost Dates

Most green roof maintenance activities will fall between these two dates. It is also important to keep these dates in mind when planning for irrigation winterization. This list is not exhaustive, for other locations visit: www.plantmaps.com

Location	Average First Frost	Average Last Frost
Baltimore, MD	Nov 11 – Nov 20	Mar 21 – Mar 31
Boston, MA	Nov 1 – Nov 10	April 11 – April 20
Chicago, IL	Oct 21- Oct 31	April 11 – April 20
Cincinnati, OH	Oct 21- Oct 31	April 11 – April 20
Nashville, TN	Oct 21- Oct 31	April 11 – April 20
New York, NY	Nov 1 – Nov 10	April 1 – April 10
Philadelphia, PA	Nov 1 – Nov 10	April 1 – April 10
Portland, OR	Nov 21 – Nov 30	Feb 21 – Feb 29
San Francisco, CA	Rare	Rare
Toronto, Ontario	Nov 1- Nov 10	April 11 – April 20
Vancouver, B.C.	Nov 5th	March 21- March 31
Washington, D.C.	Nov 1- Nov 10	April 1 – April 10

Glossary of Terms

Intensive- A green roof system with a growing medium depth of 6" or more.

Extensive- A green roof system with a growing medium depth of 6" or less.

Growing Media- An engineered combination of organic and inorganic matter that anchors vegetation on a green roof, drains water from the roof, and sustains plant growth.

Establishment Period- The period of time during which the green roof grows in and acclimates to the particulars of a given rooftop environment. Particular care should be given through the first complete growing season.

Ongoing Maintenance- Maintenance that occurs after the establishment period.

Green Roof- An assembly consisting of a deck, waterproofing system (membrane and associated components), root barrier, drainage layer, filter layer, growing medium and vegetation.

Overburden- A term used to refer to anything placed on top of the membrane. i.e. growing medium, vegetation, ballast, etc.

Compaction- Light compression of growing media used to increase growing media density.

Sedum/Succulent- A water-retaining plant that has evolved in arid climates and soils and frequently used on green roofs.

Flashing- The system used to seal the edges of a membrane at walls, expansion joints, drains, gravel stops, and other areas where the membrane is interrupted, penetrated or terminated.

Layered Green Roof System- A green roof which is constructed with one component (drainage, filtration, water retention) installed upon the next.

Built-up Green Roof System- See Layered System

Loose-Laid Green Roof System- See Layered System

Vegetation-Free-Zone- An area of the green roof that is designed to be kept free of vegetation. Examples include around drain, vents, HVAC units, etc.

Weed- Any unwanted plant.

POST-INSTALLATION CHECKLIST

Date:

Participants:

Weather Conditions:

Yes	No	N/A	Plants
			Plants are green and appear to be healthy
			Plants show no signs of wilting or stress
			Pregrown trays or tiles meet specified coverage (usually 80%+)
			Plugs are showing evidence of root growth and are spaced appropriately
			Cuttings (if used) show evidence of root and leaf growth
			Minimal weed presence
			Growing Media
			Depth is commensurate with quoted level
			Growing media is even and level
			Growing media has been lightly compacted
			Loose growing media has been cleaned from walkways and other roof surfaces
			Irrigation
			Water source is 'on'
			Backflow Prevention device is in place and has been tested
			Each zone has been tested and is performing as designed
			Automatic controller has been programmed
			Drip emitters are unclogged
			Overhead spray nozzles are 'popping'
			If hand watering, a hose-bib and hose are available
			Metal Edgers
			Pieces are fitted together correctly
			No gaps are present
			Tray edging (if used) conceals tray edges
			Corners are properly formed
			Trays (if installed)
			Fitted together in interlocking fashion for monolithic installation
			Pins, where used, are properly secured. (Post-planted Trays Only)
			Layered Components (if installed)
			Filter Fabric turned up at all sides, inside and below height of edge flashing
			Drainage
			Water flows under the system to drains/scuppers/gutters
			Vegetation-Free-Zones around drains and at perimeters are free of potential obstructions
			Maintenance
			Debris (leaves, trash and other non-garden materials) have been removed
			A maintenance plan is in place
			Digital Photography
			Document any areas of concern and average conditions.
Other Notes:			

Establishment Period Log

Instructions: Refer to the ESTABLISHMENT PERIOD and ONGOING MAINTENANCE sections of the Green Roof Maintenance Guide for recommendations on plant establishment and general care. Record your activities and observations below. You may wish to make additional blank copies, as needed.

Initial Date of Green Roof Installation:
 This log pertains to the following Dates:
 Work Overseen by:

Weekly Visit #: <i>(Or daily visits if establishing cuttings)</i> Indicate Date of visit	Example: 07/01	1	2	3	4	5	6	7
Conditions During past week: (Indicate all that Apply) M = Mild C = Cold R = Rain D = Dry W = Windy	M, D							
Moisture Levels Checked?	✓							
Water Applied? <i>(if needed)</i>	✓							
Vegetation Free Zones Inspected?	✓							
Debris Removed?	✓							
Weeds Removed?	✓							
Digital Photos Taken?	✓							
Any Concerns Noted? <i>(If so, document separately)</i>	No							
Work By:	EK							

Report Authored By: _____
 Issue Date: _____

Ongoing Maintenance Log

Instructions: Refer to the ONGOING MAINTENANCE section of the Green Roof Maintenance Guide for recommendations on general care. Record your activities and observations below. You may wish to make additional blank copies, as needed.

This log pertains to the following Dates:
 Work Overseen by:

Visit Date:							
Conditions During past week: (Indicate all that Apply) M = Mild C = Cold R = Rain D = Dry W= Windy							
Moisture/ Irrigation System Checked?							
Water Applied? (if needed)							
Vegetation Free Zones and Drains Inspected?							
Debris Removed?							
Weeds Removed?							
Spent Flowerheads Deadheaded?							
Digital Photos Taken?							
Any Concerns Noted? (If so, document separately)							
Work By:							

Report Authored By: _____
 Issue Date: _____

Annual Inspection

Instructions: Complete this form on the yearly anniversary of the green roof installation. Record your observations and any corrective actions below. You may wish to make additional blank copies, as needed.

Inspection Date:

Work Overseen by:

Note the condition of the following items and take corrective action as needed:

Yes	No	N/A	Plants
			Plants are green and appear to be healthy; Neat and Tidy Appearance
			Plants show no signs of wilting or stress
			Plants appear to have adequate available nutrients
			Plants meet coverage expectations. Please note the Estimate % Coverage:
			Minimal weed presence
			Growing Media
			Growing media is even and level
			Growing media is not migrating into Vegetation Free Zones
			Loose growing media has been cleaned from walkways and other roof surfaces
			Irrigation
			Water source is 'on'
			Backflow Prevention device is in place and testing is up-to-date.
			Each zone has been tested and is performing as designed
			Automatic controller is properly programmed
			Drip emitters are unclogged
			Overhead spray nozzles are 'popping' and coverage is complete
			If hand watering, a hose-bib and hose are available
			Metal Edgers
			Pieces are fitted together correctly
			No gaps are present
			Tray edging (if used) conceals tray edges
			Corners are properly formed
			Trays (if installed)
			Fitted together in interlocking fashion for monolithic installation
			Pins, where used, are properly secured. (Post-planted Trays Only)
			Layered Components (if installed)
			Filter Fabric turned up at all sides, inside and below height of edge flashing
			Drains
			Water flows under the system to drains/scuppers/gutters
			Free from potential obstructions

Report Authored By: _____

Issue Date: _____

			Vegetation-Free-Zones: Clear of Roots and Debris
			Perimeter Zones
			Penetrations (Vent Pipes, etc.)
			HVAC Equipment
			Abutting Vertical Surfaces
			Exposed Roof Membrane
			Maintenance
			Debris (leaves, trash and other non-garden materials) have been removed
			A maintenance plan is in place. Make adjustments as needed.
			Digital Photography
			Document any areas of concern; average conditions.

Note additional Supplies/Actions Needed.

Yes	No	N/A	Additional Supplies Needed
			Replacement Growing Media
			Additional Trays, Layered components or edgers
			Supplemental Drain Rock or Aggregate
			Pavers
			Replacement Plants: Plugs, Cuttings, Tiles

Actions	Done in the past year? Note Date	To Be Completed in the Upcoming Year?
Soil Testing/ Monitoring		
Slow-Release Fertilizer Application		
Pesticide Application- Proceed with Caution!		
Herbicide Application- Proceed with Caution!		
Replanting		

Notes:

Report Authored By: _____
Issue Date: _____