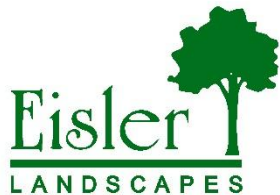


# Green Roof Maintenance

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President, Eisler Landscapes Inc.





Krauss Campo Carnegie Mellon University

We have three basic categories of green roofs:

- 1) **Extensive** - Light weight soil matrix < 6" deep  
10-35 lbs / sq ft
- 2) **Semi - Intensive** - Moderate weight soil 5" to 8"  
35 - 50 lbs / sq ft
- 3) **Intensive** - Any weight soil 6" deep or greater  
50-300+ lbs / sq ft

We also are seeing **ultra light weight** green roof systems being developed with synthetic substrates and non conventional vegetation.



**Extensive** green roofs are typically planted with a mix of low growing sedums and other drought tolerant plants.





**Extensive** green roofs can also be installed as tray systems. Trays come anywhere from pre-vegetated to non planted.



**Semi intensive** greens roof evolved as the aesthetic benefits of green roofs became more apparent and more flexibility of plant pallet is desired.







9/17/2015



**Intensive green roofs** are generally elaborately planted and commonly used as habitable spaces.



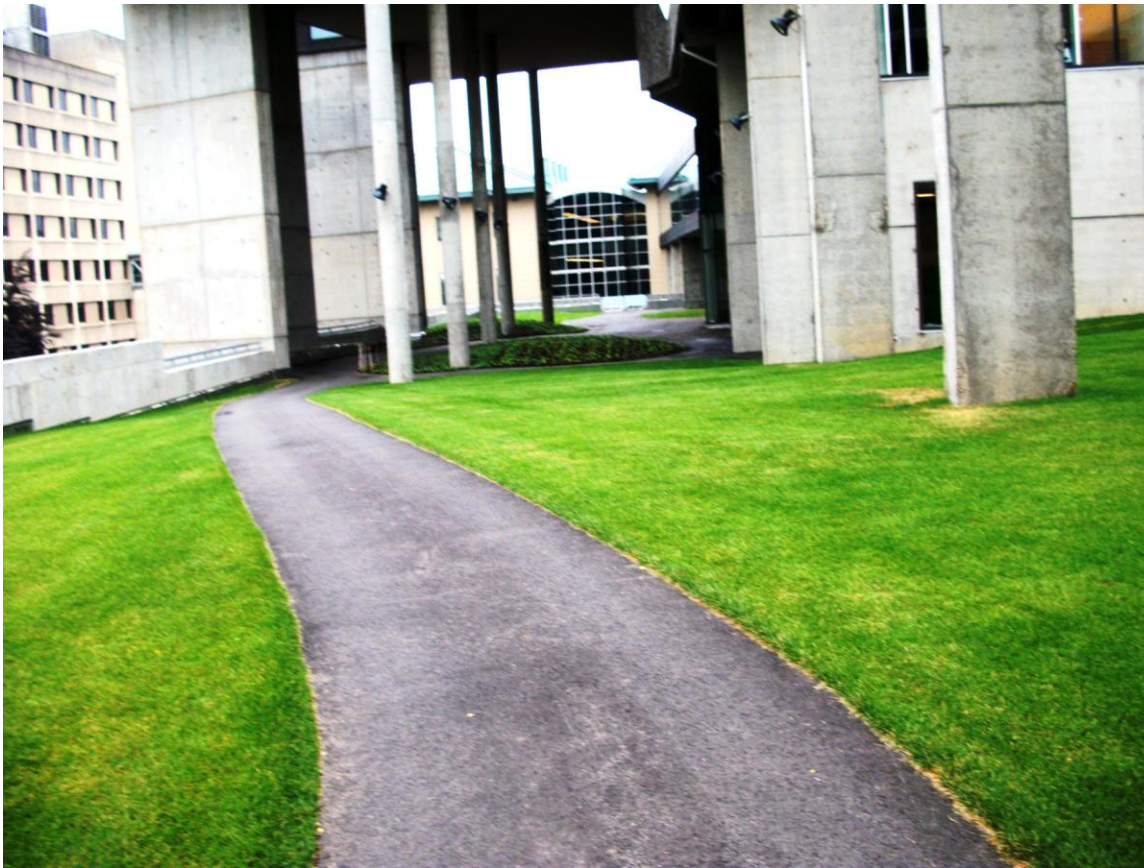


# Roof top meadows



9/17/2015

# Even Lawns





- As you can see, there is no single type of green roof. Each roof is different; all green roofs have several factors in common:

1. Green roofs are installed over the waterproofing membrane of a manmade structure.
2. All green roofs utilize living plants from moss to shade trees to perform important but varied functions.
3. Green roofs rely on a growing medium installed over a protection layer and drainage matrix to keep the plants healthy and the waterproofing system intact.

Good maintenance practices are critical with green roofs for several reasons.





**Drains** and vegetative free gravel zones must be kept free of debris and checked annually at the very least. Drainage failures can lead to over accumulation of water and over load the weight of the roof leading to building collapse.



This vegetative free zone is getting over run with sedum. This will slow down water getting off of the roof in a severe storm and possibly cause weight problems.





Vegetative free zones can be a large areas on some projects.



**Accumulation** of dead and dry vegetation needs to be kept in check for fire prevention, especially on publicly accessed roofs.





Soil fertility needs to be checked annually. Engineered soils used in green roof construction are very free draining and water soluble nutrients get flushed out of the soil quickly.



Agricultural Analytical Services Laboratory  
College of Agricultural Sciences  
The Pennsylvania State University  
University Park, PA 16802

Phone: 814-863-0841  
Fax: 814-863-4531  
Web: www.aasl.psu.edu

### GREEN ROOF MEDIA Sample Submission and Chain of Custody Form

Send copy of analysis to:

Name: \_\_\_\_\_ Company: \_\_\_\_\_ Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_ Telephone: \_\_\_\_\_ Fax: \_\_\_\_\_ Email: \_\_\_\_\_

### Sample Information

Sample Identification (To be printed on report): \_\_\_\_\_ Date sampled: \_\_\_\_\_

Intended sample use: (Check one)

Intensive System: Sites with growing medium greater than 6 inch depth

☐ Intensive system

Extensive System: Sites with growing medium less than 6 inch depth

☐ Multi-course extensive system: System using two or more distinct types of media, one of which is optimized for drainage

☐ Multi-layer extensive system: Single medium system with a high-efficiency synthetic drainage layer instead of a separate drainage course

☐ Single-layer extensive system: Single medium system without a high-efficiency drainage layer

☐ Drainage course: Aggregate material used for drainage course in multi-course system

Other, Please describe: \_\_\_\_\_

### Analysis Request

#### Green Roof Test Package\*

☐ GR01A \$ 260.00

☐ GR01B \$ 235.00

☐ GR02 \$ 210.00

☐ GR03 \$ 180.00

#### Optional or Individual Tests\*

☐ Calcium carbonate equivalence (CCE) \$ 25.00

☐ Mehlich 3 extractable nutrients \$ 20.00

☐ EPA 503 Contaminants \$130.00

☐ Saturated Paste pH, salts and nutrients \$ 40.00

☐ Saturated Paste tests plus pet solids and organic matter \$ 54.00

☐ Saturated permeability (ASTM F2396) \$ 85.00

☐ Maximum Media Density (ASTM D2399) \$ 95.00

☐ Particle size distribution (0.002 - 12.5 mm) \$ 100.00

\* See back for description of tests and sample size required.

Total Cost: \$ \_\_\_\_\_

### Payment Method

☐ Payment enclosed. Make checks payable to: Penn State University.

☐ Please bill. (Bill will be sent to address listed on top left, above. If different, please specify.)

☐ Charge my credit card: Name on Card: \_\_\_\_\_ (Please print)

Type: ☐ Visa ☐ MasterCard (Check one)

Number: \_\_\_\_\_

Expiration Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

### Chain of Custody

Relinquished by:	Date:	Time:	Received by:	Date:	Time:
Relinquished by:	Date:	Time:	Received by:	Date:	Time:

### Green Roof Media Test Packages

Test	Description	Cost
GR01A	Samples are analyzed for particle size distribution (< 0.002 to > 12.5 mm) with graphical display of results relative to FLL limits, dry weight density, density at maximum water-holding capacity, total porosity, air-filled porosity at maximum water-holding capacity, water permeability factor (hydraulic conductivity), pH, total soluble salts, organic matter, phosphorus, potassium, calcium, magnesium, nitrate and ammonium. Methods followed are those specified in the FLL Guideline for the Planning, Execution and Upkeep of Green-Roof Sites <sup>1</sup> or equivalent ASTM methods (ASTM D2399) with the exception of total porosity which is determined using a measured, not estimated, particle density. This test package meets the FLL requirement for intensive and extensive multi-course and multi-layer systems.	\$260
GR01B	Test GR01B is the same as Test GR01A but provides results for pH, total soluble salts, phosphorus, potassium, calcium, magnesium, nitrate-nitrogen and ammonium-nitrogen using the saturated media test procedure instead of FLL test methods. Saturated media test results for boron, copper, iron, manganese, sodium, and zinc are also provided.	\$235
GR02	Test GR02 is the same as Test GR01A but without the plant nutrients phosphorus, potassium, calcium, magnesium, nitrate and ammonium. This test package meets the FLL requirement for single layer extensive systems.	\$210
GR03	Samples are analyzed for percentage of silt-sized (< 0.05 mm) particles; dry weight density; density at maximum water-holding capacity; total porosity; water permeability factor (hydraulic conductivity), pH, and total soluble salts. Methods followed are those specified in the FLL Guideline for the Planning, Execution and Upkeep of Green-Roof Sites <sup>1</sup> or equivalent ASTM methods (ASTM D2399) with the exception of total porosity which is determined using a measured, not estimated, particle density. This test meets the FLL requirement for drainage courses for extensive multi-course systems.	\$180

Sample size required for tests GR01A, GR01B, GR02 or GR03: approximately 5 gallons (20 liters)

### Individual and Optional Tests

Test	Description	Cost
Calcium carbonate equivalence (ASTM Method C-25)	Test for measuring a material's neutralizing value expressed as calcium carbonate equivalence. CCE (ASTM Method C-25).	\$20
Mehlich 3 nutrients	Test for extractable phosphorus, potassium, calcium, and magnesium by the Mehlich 3 method.	\$20
EPA 503 contaminants	Test for total sorbed arsenic, cadmium, copper, mercury, molybdenum, nickel, lead, selenium, and zinc following EPA SW-846 methods (acid digestion by EPA Method 3051 and analyte measurement by ICP or graphite furnace).	\$130
Saturated paste pH, salts, nutrients	Test for pH, nitrate-nitrogen, total soluble salts, phosphorus, potassium, calcium, magnesium, sodium, boron, copper, iron, manganese, and zinc using the saturated media extract method with DTPA.	\$40
Saturated Water Permeability-Drainage media	Test for measuring the water permeability of coarse granular materials used in the drainage layers of green roof systems (ASTM Method F2396). 1 gallon (4 liter) sample size required.	\$85
Maximum Media Density	This test determines the density, percent moisture and water permeability at maximum water-holding capacity (ASTM Method D2399). Results for total and air-filled porosity are also provided. Three gallon (12 liter) sample size required.	\$95
Particle size distribution	Samples are analyzed for particle size distribution (< 0.002 to > 12.5 mm) with graphical display of results relative to FLL limits. 1/2 gallon (2 liter) sample size required.	\$100

<sup>1</sup>Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V., Guideline for the Planning, Execution, and Upkeep of Green-Roof Sites, January, 2002 edition.

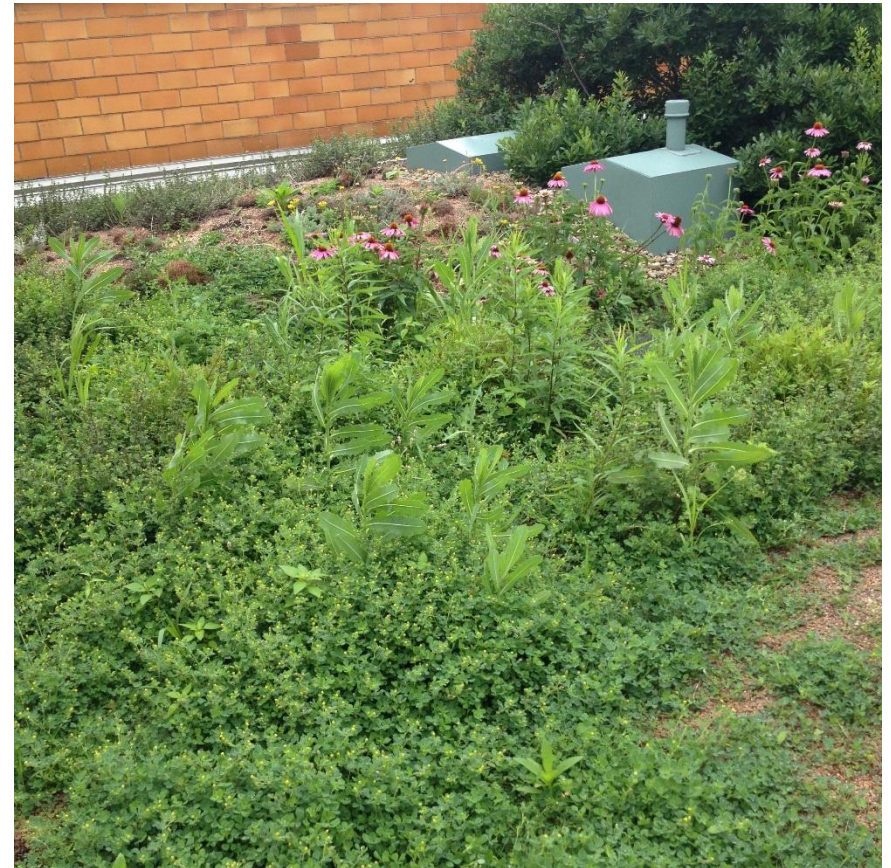
Send Sample to:  
Agricultural Analytical Services Laboratory  
Tower Road  
Penn State University  
University Park, PA 16802

**Weeding** is critical and the most common maintenance issue on green roofs.



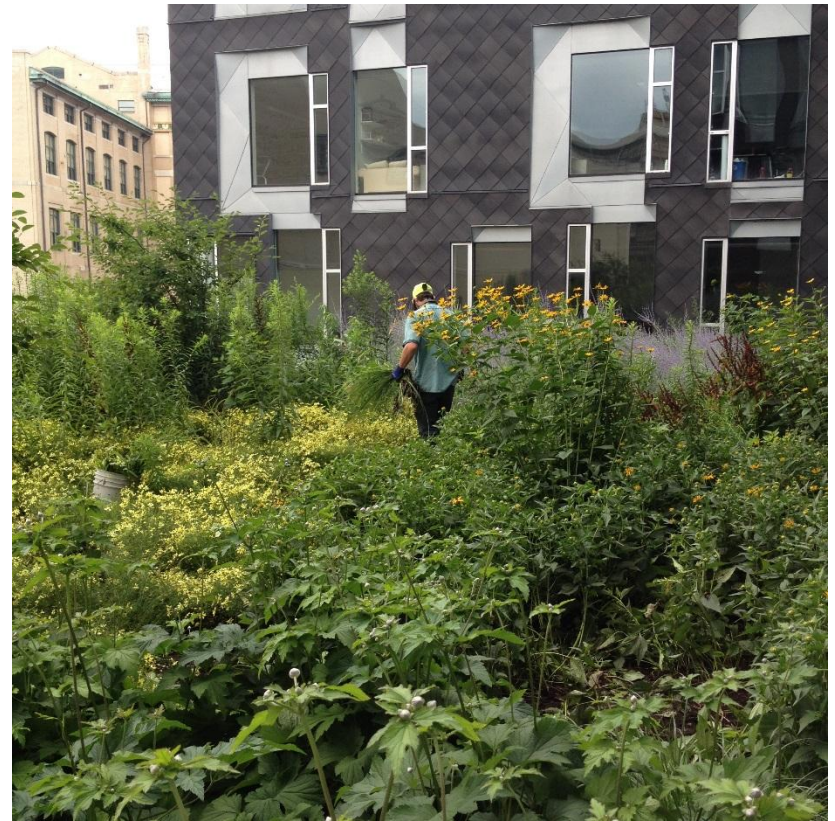


Clovers and other nitrogen fixators are indicative of low soil nutrition.





No soil nutrient issues on this roof, in fact the plants are doing almost too well. Time to turn back the irrigation.





**Gone wild.** Sedum roofs that are left for several years with out proper maintenance revert back to the wild. This green roof was left for 6 years with no maintenance.



**Mulches** are not commonly recommended on green roofs. They can blow away under the right conditions. Mulch also burns.





**Irrigation** is not necessary on extensive roofs but increases in importance as the plant community becomes more varied or for ultra light weight systems



Drip systems work well on extensive green roof when laid under the sedum sod. The good news is there are no rabbits to chew up the drip tubes!





This project had both a wild flower meadow and an extensive sedum planting on the same roof. The counter intuitive issue arose that the sedum invaded the wild flowers not vice versa.



Its important to get this right the first time!



Everyone is watching!