



Functional Landscapes: Assessing Elements of Seattle Green Factor

2008 Internship Report

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Why Green Factor?

The focus of The Berger Partnership 2008 Summer Internship was Sustainable Strategies for Landscape Architecture. The research component sought out innovative strategies that blurred the line between aesthetic and functioning landscapes. We quickly honed in on Seattle Green Factor as a newly established, yet still developing, framework for assessing landscapes serving multiple purposes.

The first of its kind in the US, Seattle Green Factor provides a flexible approach to building the city's green infrastructure through development regulation. Basing its requirements on amount of functional systems rather than adherence to rigid standards is an innovative but untested approach, with unknown outcomes.

As Green Factor grows in scope and the program matures, the number of projects it influences will grow throughout the city. Using Green Factor as framework to create functioning sites can create a higher level of diversity in designs, further develop the connection between the form of architecture and landscape and improve ecological systems of the city.

While it will take time to understand the impact Green Factor will have on the city, it is actively being refined and is an ongoing experiment in designing our cities.

Understanding the system, the value, the costs of its elements and how it's going to change design will be important to each site. Graphically articulating the benefits of Green Factor and functional landscapes to clients and design partners is the goal of this project.

History

Seattle Green Factor (Green Factor) has been designed to allow development of new projects a higher degree of flexibility while increasing ecological function and aesthetic qualities of the landscape. The selected strategies encourage layers of vegetation and increased stormwater infiltration in order to shift the ecological function of the urban landscape toward pre-development conditions.

Green Factor has been modeled on established programs in Berlin, Germany and Malmo, Sweden. Seattle is the first city in the United States to implement a similar program, and as such is in the process of refining the system. Categories and point values from the Berlin Biotope Area Factor and the Malmo Quality Program were reviewed during development of Green Factor, but the unique environmental conditions of Seattle were the basis for Green Factors goals.

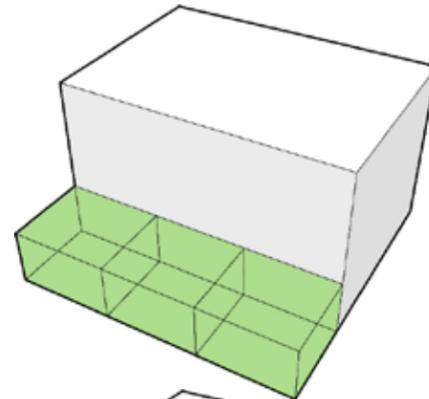
Updates

Green Factor was implemented in January 2007 and revised in early 2009. The revisions address criticisms of the previous requirements, change point values for some elements and add some new categories to the system. The revised score sheet has been annotated to show the recent changes in calculating point values.

Green Factor standards are also proposed for multifamily residential zones. While residential projects will earn the same credits and use the same score sheet, the required minimum score is proposed to be 0.6 (compared to 0.3 for commercial projects). Green Factor is also proposed as the landscaping standard for the Liveable South Downtown planning area.

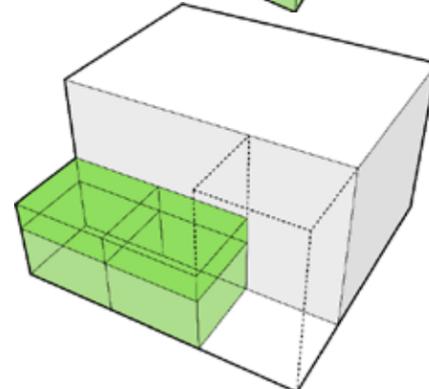
Functional Landscapes

The information contained in this report is a review of Green Factor, its functional elements and how the different elements can impact the proposed design of a project. The actual process of applying for Green Factor will not be discussed in depth, as it has been covered extensively by literature from the Seattle Department of Planning and Development (DPD). For further reading on Green Factor or related programs a list of sources has been included at the end of this document. It is also important to note that as of August 2008, no projects subject to Green Factor have completed construction. The impact of Green Factor on the public environment will take some time to fully assess.



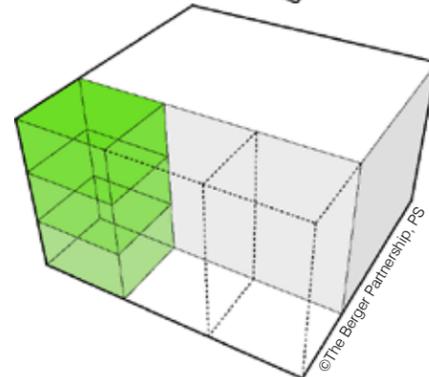
Green Factor Score -
0.3

Open Space -
30% of Site



Green Factor Score -
0.3

Open Space -
20% of Site



Green Factor Score -
0.3

Open Space -
10% of Site

Conceptual Green Factor Square Footage Diagram

Required Areas

-  Commercial Zones
-  Multifamily Zones (proposed)

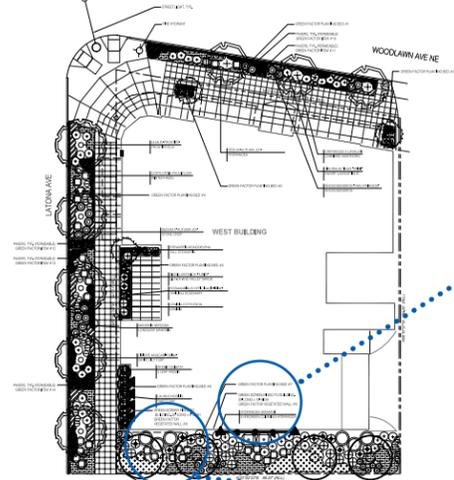


Green Factor requirements in these areas apply to:

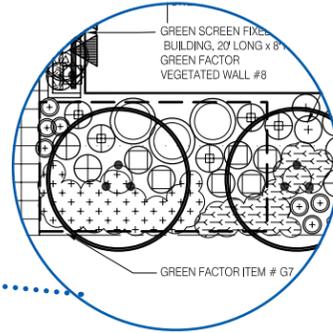
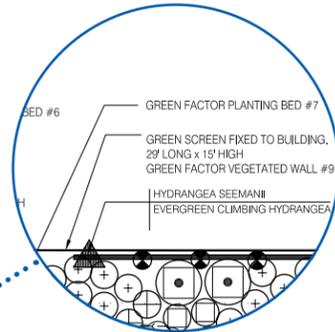
- Any new development containing more than 4 dwelling units
- Any new development containing more than 4,000 square feet of nonresidential uses
- Any new parking lot containing more than 20 parking spaces for automobiles

Calculating the Score

Example Green Factor Site Plan



©The Berger Partnership, PS



Green Factor Planting Area Spreadsheet

| Planting Area | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | TOTAL |
|---------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|-------|
| A1 | | | | | | | | | | | | | | | 178 |
| A2 | | | | | | | | | | | | | | | 10 |
| A3 | | | | | | | | | | | | | | | 10 |
| B1 | | | | | | | | | | | | | | | 2073 |
| B2 | | | | | | | | | | | | | | | 18 |
| B3 | | | | | | | | | | | | | | | 4 |
| B4 | | | | | | | | | | | | | | | 3 |
| B5 | | | | | | | | | | | | | | | 3 |
| B6 | | | | | | | | | | | | | | | 170 |
| B7 | | | | | | | | | | | | | | | 170 |
| C1 | | | | | | | | | | | | | | | 0 |
| C2 | | | | | | | | | | | | | | | 0 |
| D | | | | | | | | | | | | | | | 170 |
| E | | | | | | | | | | | | | | | 0 |
| F1 | | | | | | | | | | | | | | | 2000 |
| F2 | | | | | | | | | | | | | | | 0 |
| G | | | | | | | | | | | | | | | 2000 |
| H1 | | | | | | | | | | | | | | | 0 |
| H2 | | | | | | | | | | | | | | | 0 |
| H3 | | | | | | | | | | | | | | | 0 |
| H4 | | | | | | | | | | | | | | | 0 |
| H5 | | | | | | | | | | | | | | | 0 |

* See Green Factor score sheet for category definitions
** Enter values on the Green Factor score sheet

Green Factor Dynamic Spreadsheet

| Project title: | enter sq ft of parcel | minimum score determined by zone |
|--|-----------------------------|----------------------------------|
| Parcel size (enter this value first) * | 0 | SCORE |
| Landscape Elements** | Square Feet | Factor |
| A Landscaped areas (select one of the following for each area) | | |
| 1 Landscaped areas with a soil depth of less than 24" | enter sq ft 0 | 0.1 |
| 2 Landscaped areas with a soil depth of 24" or greater | enter sq ft 0 | 0.6 |
| 3 Bioretention facilities | enter sq ft 0 | 1.0 |
| B Plantings (credit for plants in landscaped areas from Section A) | | |
| 1 Mulch, ground covers, or other plants less than 2' tall at maturity | enter sq ft 0 | 0.1 |
| 2 Shrubs or perennials 2'+ at maturity - calculated at 16 sq ft per plant (typically planted no closer than 18" on center) | enter number of plants 0 | 0.3 |
| 3 Tree canopy for "small trees" in the Green Factor tree list or equivalent (canopy spread of 15') - calculated at 50 sq ft per tree | enter number of plants 0 | 0.3 |
| 4 Tree canopy for "small/medium trees" in the Green Factor tree list or equivalent (canopy spread of 20') - calculated at 100 sq ft per tree | enter number of plants 0 | 0.3 |
| 5 Tree canopy for "medium/large trees" in the Green Factor tree list or equivalent (canopy spread of 25') - calculated at 150 sq ft per tree | enter number of plants 0 | 0.4 |
| 6 Tree canopy for "large trees" in the Green Factor tree list or equivalent (canopy spread of 30') - calculated at 200 sq ft per tree | enter number of plants 0 | 0.4 |
| 7 Tree canopy for preservation of large existing trees with trunks 6"+ in diameter - calculated at 15 sq ft per inch diameter | enter inches DBH 0 | 0.8 |
| C Green roofs | | |
| 1 Over at least 2" and less than 4" of growth medium | enter sq ft 0 | 0.4 |
| 2 Over at least 4" of growth medium | enter sq ft 0 | 0.7 |
| D Vegetated walls | | |
| 1 | enter sq ft 0 | 0.7 |
| 2 | enter sq ft 0 | 0.7 |
| E Approved water features | | |
| 1 | enter sq ft 0 | 0.7 |
| F Permeable paving*** | | |
| 1 Permeable paving over at least 6" and less than 24" of soil or gravel | enter sq ft 0 | 0.2 |
| 2 Permeable paving over at least 24" of soil or gravel | enter sq ft 0 | 0.5 |
| G Structural soil systems*** | | |
| 1 | enter sq ft 0 | 0.2 |
| H Bonuses | | |
| 1 Drought-tolerant or native plant species | enter sq ft 0 | 0.1 |
| 2 Landscaped areas where at least 50% of annual irrigation needs are met through the use of harvested rainwater | enter sq ft 0 | 0.2 |
| 3 Landscaping visible to passersby from adjacent public right of way or public open spaces | enter sq ft 0 | 0.1 |
| 4 Landscaping in food cultivation | enter sq ft 0 | 0.1 |
| Green Factor numerator = | | |

| Project title: | enter sq ft of parcel | minimum score determined by zone |
|--|-----------------------------|----------------------------------|
| Parcel size (enter this value first) * | 0 | SCORE |
| Landscape Elements** | Square Feet | Factor |
| A Landscaped areas (select one of the following for each area) | | |
| 1 Landscaped areas with a soil depth of less than 24" | enter sq ft 0 | 0.1 |
| 2 Landscaped areas with a soil depth of 24" or greater | enter sq ft 0 | 0.6 |
| 3 Bioretention facilities | enter sq ft 0 | 1.0 |
| B Plantings (credit for plants in landscaped areas from Section A) | | |
| 1 Mulch, ground covers, or other plants less than 2' tall at maturity | enter sq ft 0 | 0.1 |
| 2 Shrubs or perennials 2'+ at maturity - calculated at 16 sq ft per plant (typically planted no closer than 18" on center) | enter number of plants 0 | 0.3 |
| 3 Tree canopy for "small trees" in the Green Factor tree list or equivalent (canopy spread of 15') - calculated at 50 sq ft per tree | enter number of plants 0 | 0.3 |
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| 6 Tree canopy for "large trees" in the Green Factor tree list or equivalent (canopy spread of 30') - calculated at 200 sq ft per tree | enter number of plants 0 | 0.4 |
| 7 Tree canopy for preservation of large existing trees with trunks 6"+ in diameter - calculated at 15 sq ft per inch diameter | enter inches DBH 0 | 0.8 |
| C Green roofs | | |
| 1 Over at least 2" and less than 4" of growth medium | enter sq ft 0 | 0.4 |
| 2 Over at least 4" of growth medium | enter sq ft 0 | 0.7 |
| D Vegetated walls | | |
| 1 | enter sq ft 0 | 0.7 |
| 2 | enter sq ft 0 | 0.7 |
| E Approved water features | | |
| 1 | enter sq ft 0 | 0.7 |
| F Permeable paving*** | | |
| 1 Permeable paving over at least 6" and less than 24" of soil or gravel | enter sq ft 0 | 0.2 |
| 2 Permeable paving over at least 24" of soil or gravel | enter sq ft 0 | 0.5 |
| G Structural soil systems*** | | |
| 1 | enter sq ft 0 | 0.2 |
| sub-total of sq ft = | 0 | |
| H Bonuses | | |
| 1 Drought-tolerant or native plant species | enter sq ft 0 | 0.1 |
| 2 Landscaped areas where at least 50% of annual irrigation needs are met through the use of harvested rainwater | enter sq ft 0 | 0.2 |
| 3 Landscaping visible to passersby from adjacent public right of way or public open spaces | enter sq ft 0 | 0.1 |
| 4 Landscaping in food cultivation | enter sq ft 0 | 0.1 |
| Green Factor numerator = | | |

* Do not count public rights-of-way in parcel size calculation.

** You may count landscape improvements in rights-of-way contiguous with the parcel. All landscaping on private and public land must comply with the Landscape Standards Director's Rule (DR 6-2009)

*** Permeable paving and structural soil together may not qualify for more than one third of the Green Factor score.

Revision Changes

- 1 Point values included for commercial and multifamily projects
- A Soil depths are now calculated separate from their overlying plantings
- A3 Bioretention facilities credit raised from 0.7 to 1.0
- B Plant heights changed to comply with SDOT standards
- B7 Large existing tree credit raised from 0.4 to 0.8. This credit now captures trees 6" and greater in trunk diameter
- C1 Thin profile green roof category added
- E Water features must meet requirements of Director's Rule.
- F Permeable paving point values based on underlying material and no longer required to be self draining only
- G Structural soils category added
- H1 Native plants counted as a bonus
- H4 Landscaping in food cultivation counted as a bonus
- 2 Maximum point values specified for permeable paving and structural soils

Green Factor Composite Model

This composite model graphically describes the elements of Green Factor and how they might relate spatially to a building and landscape in a conceptual project.

Note: This model is designed to show as many Green Factor credits as possible, its actual score would greatly exceed required minimums.



- A1** - Landscaped Area <24" Soil Depth
- A2** - Landscaped Area >24" Soil Depth
- A3** - Rain Garden
- B1** - Groundcovers <2' Height
- B2** - Plants >2' Height
- B3** - Small Tree
- B5** - Medium Tree
- B6** - Large Tree
- B7** - Large Existing Tree
- C1** - Green Roof 2-4" Growth Medium
- C2** - Green Roof >4" Growth Medium
- D** - Green Wall
- E** - Water Feature
- F1** - Permeable Paving 6-24" Subgrade
- F2** - Permeable Paving >24" Subgrade
- G** - Structural Soil Systems
- H1** - Drought Tolerant/Natives
- H2** - Rainwater Cistern
- H3** - Public Visibility
- H4** - Food Cultivation

Example Element

Each functional element in Green Factor will be examined on the following pages. The description box below names and discusses each element, its functional benefits, resource considerations, costs and Green Factor score. Element imagery shows how examples of how each element could appear, with some of the more complex examples being broken down into each of its typical pieces for easier understanding of construction and function.

Stormwater Planters

Stormwater planters are containers which are designed to capture and either retain or infiltrate stormwater based on their design. The amount and frequency of water captured depends on storm events, so they should be populated with a variety of plants adapted to both wet and dry conditions. Visually they can be striking landscape feature which provides a high functional value. While more expensive than bioswales, stormwater planters provide many benefits and may be more appropriate for projects with space constraints.

Graphic Legend

- A Stormwater Source
- B Splash Block
- C Growth Medium
- D Filter Fabric
- E Gravel
- F Perf. pipe along planter bottom
- G Overflow Drain
- H Plantings
- I Pipe to stormwater system
- J Planter wall w/ waterproofing
- K Pedestrian area

A3

Element- Stormwater Planter

Functional Benefits-
Reduced runoff
Improved runoff quality

Resource Considerations-
Embodied energy and carbon in concrete

Cost - \$50-75/S.F.
Factor - 1.0

Green Factor Score Bar (1.0)

List of Functional Benefits

List of possible environmental impacts

Typical Images

Green Factor Score

Landscaped areas provide spaces for plants and all their associated benefits. Stormwater infiltration and increased plant growth are the results of properly designed soil conditions. Green Factor encourages planting at grade in part to optimize deep soil depths.

Landscaped areas are characterized by soil depth. 24" is the depth cutoff for deciding the point factor awarded to most landscaped areas. Factors for overlying shrubs and trees (from Section B on the worksheet) are counted in addition to the factor awarded for landscaped areas.



Landscaped Areas < 24"

Green Factor awards a factor of 0.1 for soil depth less than 24". While this number is low, the addition of vegetation and the use of bonuses can add significant points. This soil depth can be placed on structure if designed correctly, allowing previously unused space to count toward Green Factor.



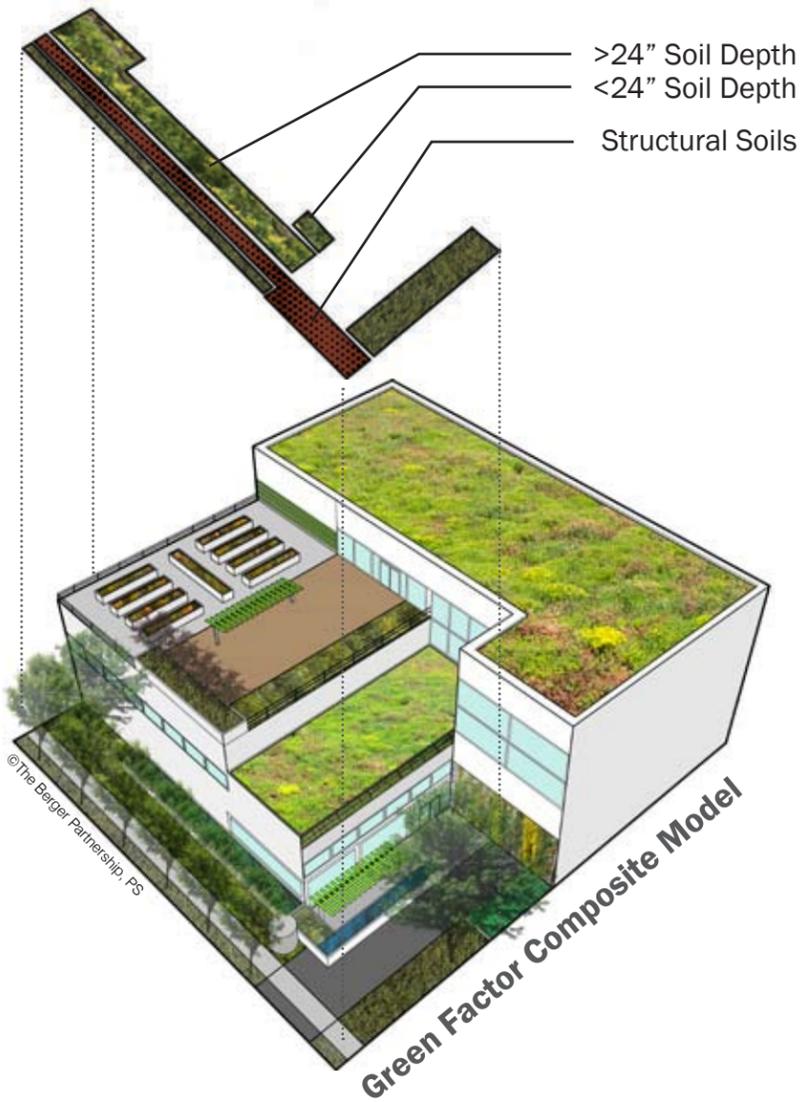
Landscaped Areas > 24"

Green Factor awards a high factor of 0.6 for soils greater than 24" in depth. One of the main goals of Green Factor is layering vegetation at street level, and this category addresses that goal. Utilizing a 24" soil profile with large shrubs, trees and bonuses can easily yield a factor over 1.5.



Structural Soil Systems

Structural soils are an engineered soil mix designed to allow three functions: reduce sidewalk heaving and breakage; improve stormwater infiltration; and improve tree growth. By using a gap graded soil mix, tree roots are free to grow below sidewalks without pushing the slab upward. Trees planted in these soils have improved root and crown growth and increased lifespans. Structural soils can also improve stormwater infiltration if covered with a porous paving material.



A1 1.0

Element - <24" Soil

Functional Benefits
Stormwater detention
Plant growth area
Heat island reduction

Environmental Considerations
Amending on site soils
Import/export shipping

Factor - 0.1 0.1 GF

A2 1.0

Element - >24" Soil

Functional Benefits
Stormwater infiltration
Improved plant growth
Heat island reduction

Environmental Considerations
Amending on site soils
Import/export shipping

Factor - 0.6 0.1 GF

G 1.0

Element - Structural Soils

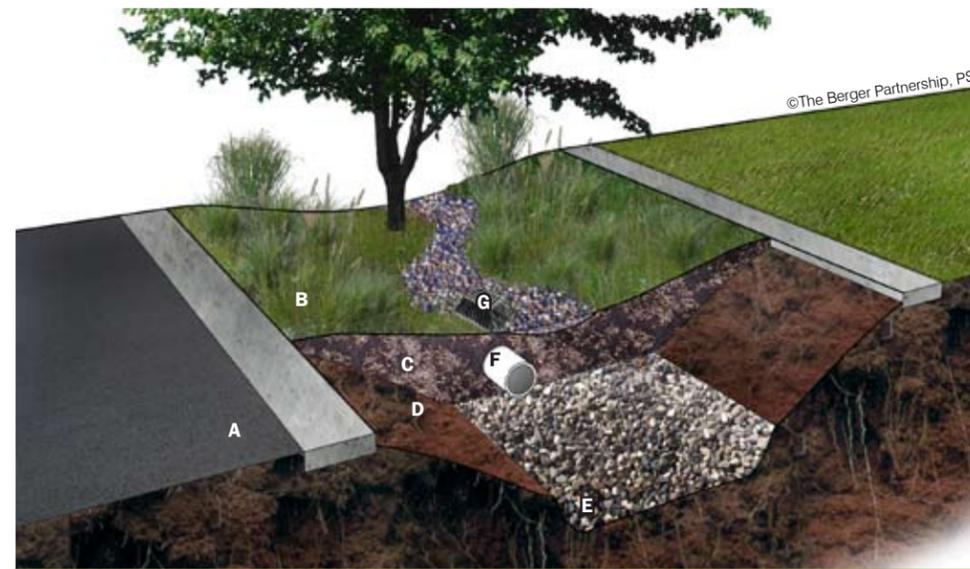
Functional Benefits
Improved tree growth
Reduced sidewalk heave
Possible stormwater infiltration

Environmental Considerations
Amending on site soils
Import/export shipping

Factor - 0.1 0.1 GF

Element: Bioretention Facilities

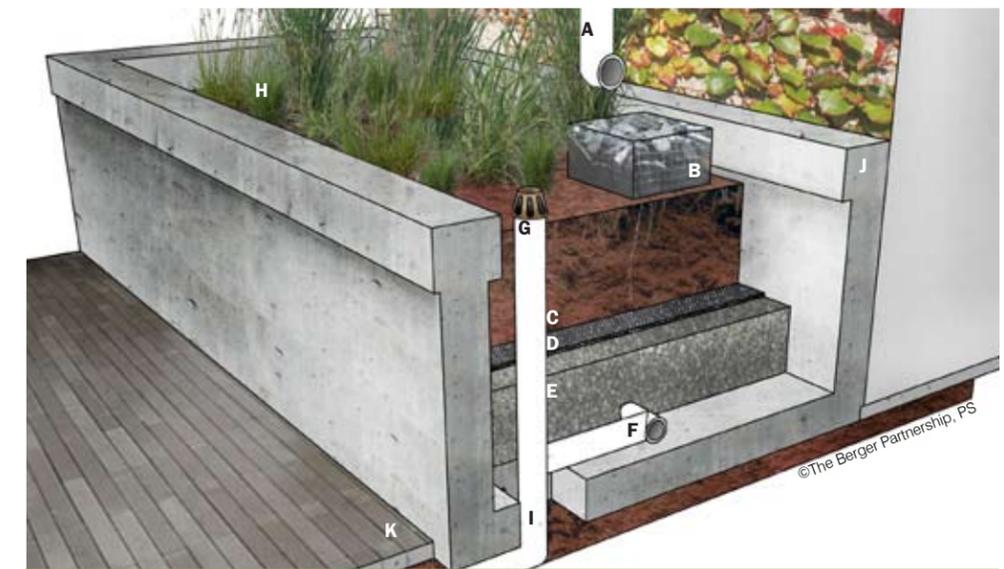
Bioretention facilities are the third category of landscaped areas defined by Green Factor. Their initial factor of 1.0 is the highest of any category and can be combined with planting factors and bonuses, for combined factors of over 1.8. These high factors reflect the functional benefits of stormwater cleansing and volume reduction, habitat creation, aesthetic improvement, and education opportunities that come with the construction of well designed bioretention areas.



Rain Gardens and Swales

Rain gardens and bioswales are typically vegetated depressions located on grade. Their main functional value is the retention and infiltration of stormwater. Acting as a filter for runoff from permeable surfaces, they reduce pollutants which enter storm systems. Often simple in design and construction, they create a high level of function for a low cost. Larger space on grade, with properly draining soils are required for the construction of these features. When calculating Green Factor values, only calculate the surface area of the rain garden.

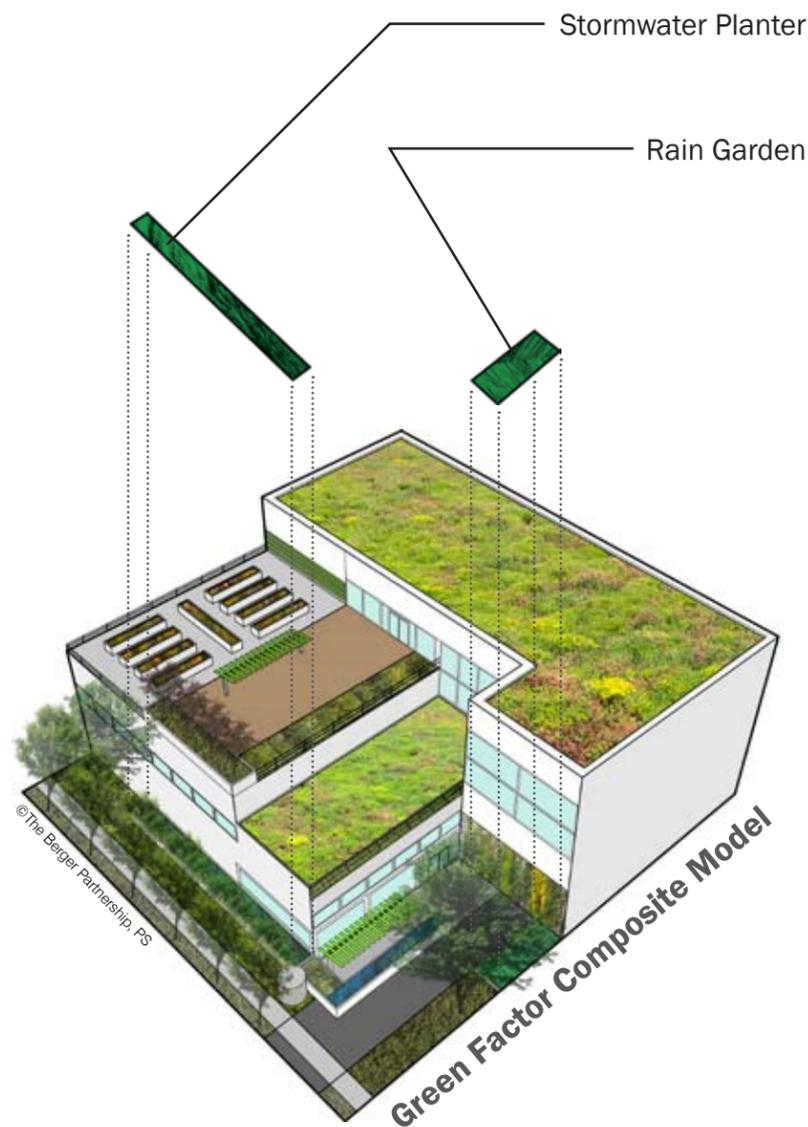
- GraphISO Legend**
- A= Impervious Surface
 - B= Infiltration Zone
 - C= Amended Soil
 - D= Existing Subgrade
 - E= Optional Gravel
 - F= Overflow Drain
 - G= Overflow Drain Inlet



Stormwater Planters

Stormwater planters are containers designed to capture and either retain or infiltrate stormwater based on their design. The amount and frequency of water captured depends on storm events, so they should be populated with a variety of plants adapted to both wet and dry conditions. Visually they can be striking landscape features providing a high functional value. While more expensive than bioswales, stormwater planters provide many benefits and are appropriate for areas with space constraints or on structure.

- GraphISO Legend**
- A= Rainwater Source
 - B= Splash Block
 - C= Amended Soil
 - D= Filter Fabric
 - E= Gravel
 - F= Perf. pipe along planter bottom
 - G= Overflow Drain
 - H= Plantings
 - I= Pipe to stormwater system
 - J= Planter wall w/ waterproofing
 - K= Pedestrian area



A3

Element- Bioswale or Rain Garden

Functional Benefits

- Increased infiltration
- Reduced runoff
- Improved runoff quality
- Pollution reduction
- Public education

Environmental Considerations

Factor - 1.0

1.0

0.1 GF



A3

Element- Stormwater Planter

Functional Benefits

- Reduced runoff
- Improved runoff quality

Environmental Considerations

- Embodied energy and carbon in concrete

Factor - 1.0

1.0

0.1 GF



Increasing size and quality of planted areas is a main focus of Green Factor. Using a layered approach to planting enhances the functional benefits of these areas. Benefits include providing stormwater retention or infiltration, creating habitat and reducing heat island effect. Planted areas also create aesthetic interest and can make temperatures of surrounding areas more comfortable through evapotranspiration.



Groundcovers < 2' tall at maturity

This category includes low planted groundcovers, turf and vegetated paving such as Grasspave. Cheap and easy to use, groundcovers can be combined with overlying plant materials described in Green Factor categories B2 through B7 to contribute to a higher score.

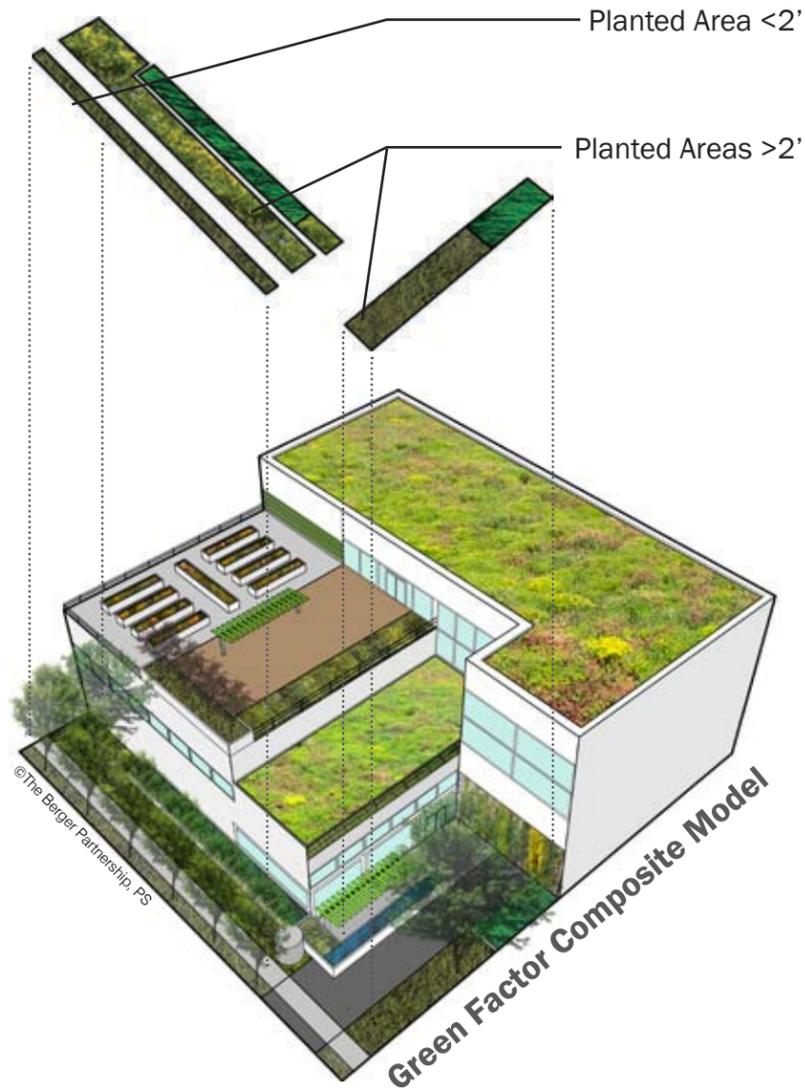
Many groundcovers are tough and drought tolerant, making them well suited for use in right-of-way planting buffers. Seattle Master Use Permits require these plantings to be 50% drought tolerant.



Plants > 2' tall at maturity

Larger shrubs, grasses and perennials are an important component of any landscape. Their increased functional benefits over groundcovers are reflected in the larger score awarded by Green Factor. Larger plants provide all the same functional benefits of groundcovers, but on a larger scale. Their growth requirements are reflective of their increased function, and they require adequate space and regular maintenance to meet their full potential.

A wide variety of plants are available to meet the requirements of any site, with Pacific Northwest natives being well suited to most applications.



B1

Element - Groundcovers < 2'

Functional Benefits
Evapotranspiration
Habitat creation
Vegetation decreases stormwater runoff

Environmental Considerations
Possible irrigation
Possible imported soils
Planter materials

Factor - 0.1

1.0

0.1
GF



B2

Element- Plants > 2'

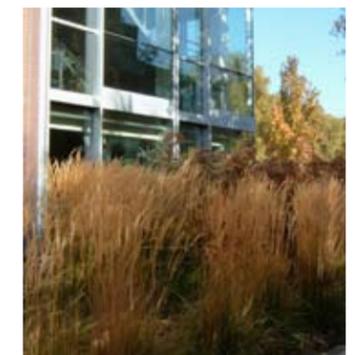
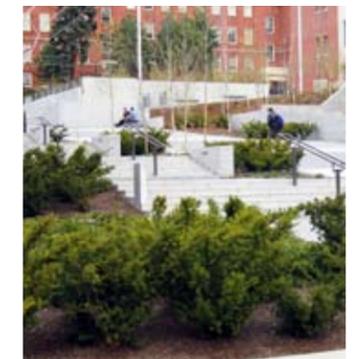
Functional Benefits
Increased evapotranspiration
Habitat creation
Vegetation decreases stormwater runoff

Environmental Considerations
Possible irrigation
Possible imported soils
Planter materials

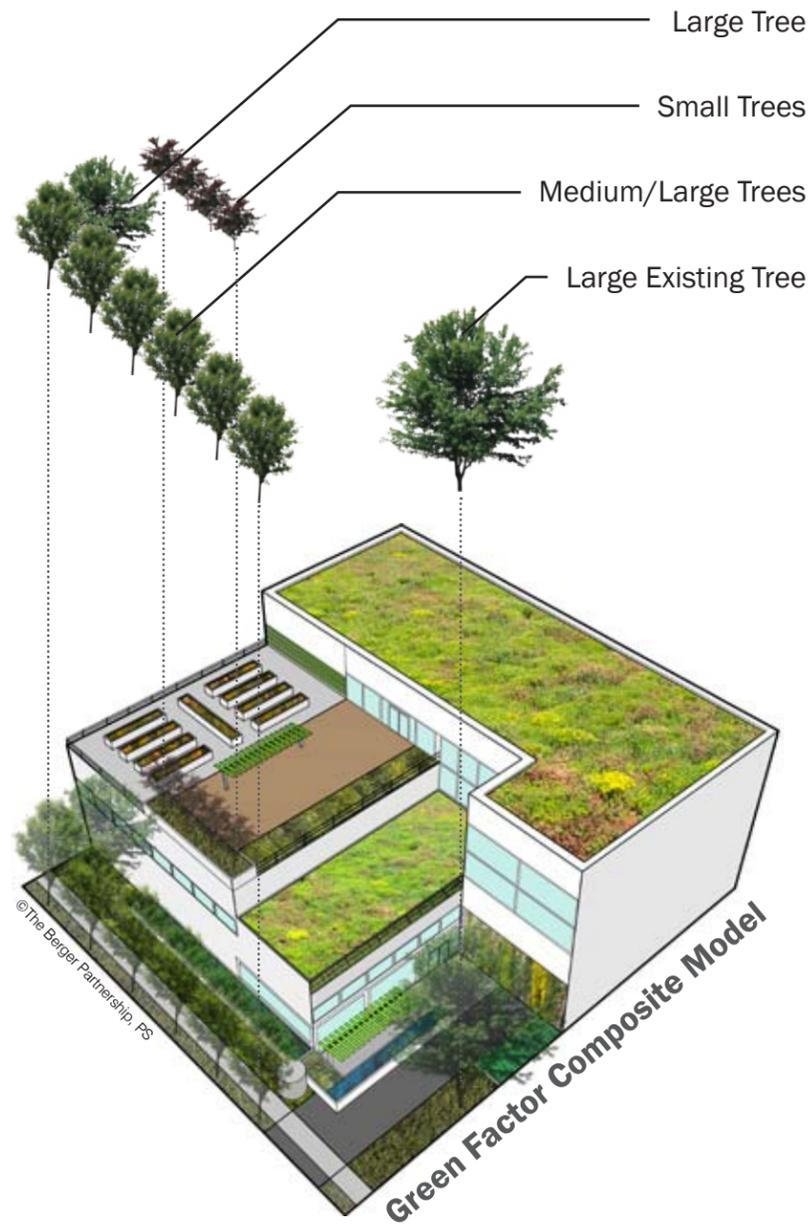
Factor - 0.3

1.0

0.1
GF



More than any other component, trees provide the functional benefits needed to create livable cities. Fresh air, shading and cooling all enhance the feeling of areas near trees. Their use in defining space can bring the urban experience down to human scale and make everyday places more interesting. Plus, all of their functional benefits increase with age. Growing and maintaining an exceptional urban forest can be achieved by including trees in every project.



Small Trees

All trees should be 2" cal. at installation. Green Factor requires a minimum mature height of 15' for small trees and a minimum of 25' for medium/small trees.



Medium Trees

Mature height for a tree to be categorized as medium/large is 40'.



Large Trees

Large trees must be over 40' in height when mature.



Large Existing Trees

Preserving trees helps define the character of a site and retain the functions the trees already perform. The updated Green Factor worksheet has raised the points awarded to existing trees from 0.4 to 0.8. A tree must be 6" DBH to qualify for this credit.

B3

Element - Small Tree

Functional Benefits
Reduces heat island
Evapotranspirative cooling
Decreases runoff
Habitat creation

Environmental Considerations
Maintenance
Irrigation

Factor - 0.3 x 50'

1.0

0.1 GF

B5

Element - Medium Tree

Functional Benefits
Reduces heat island
Evapotranspirative cooling
Decreases runoff
Habitat creation

Environmental Considerations
Maintenance
Irrigation
Planting area requirements

Factor - 0.4 x 150'

1.0

0.1 GF

B6

Element - Large Tree

Functional Benefits
Reduces heat island
Evapotranspirative cooling
Decreases runoff
Habitat creation

Environmental Considerations
Maintenance
Irrigation
Planting area requirements

Factor - 0.4 x 200'

1.0

0.1 GF

B7

Element - Large Existing Tree

Functional Benefits
Reduces heat island
Evapotranspirative cooling
Decreases runoff
Habitat creation

Environmental Considerations
Maintenance
Irrigation

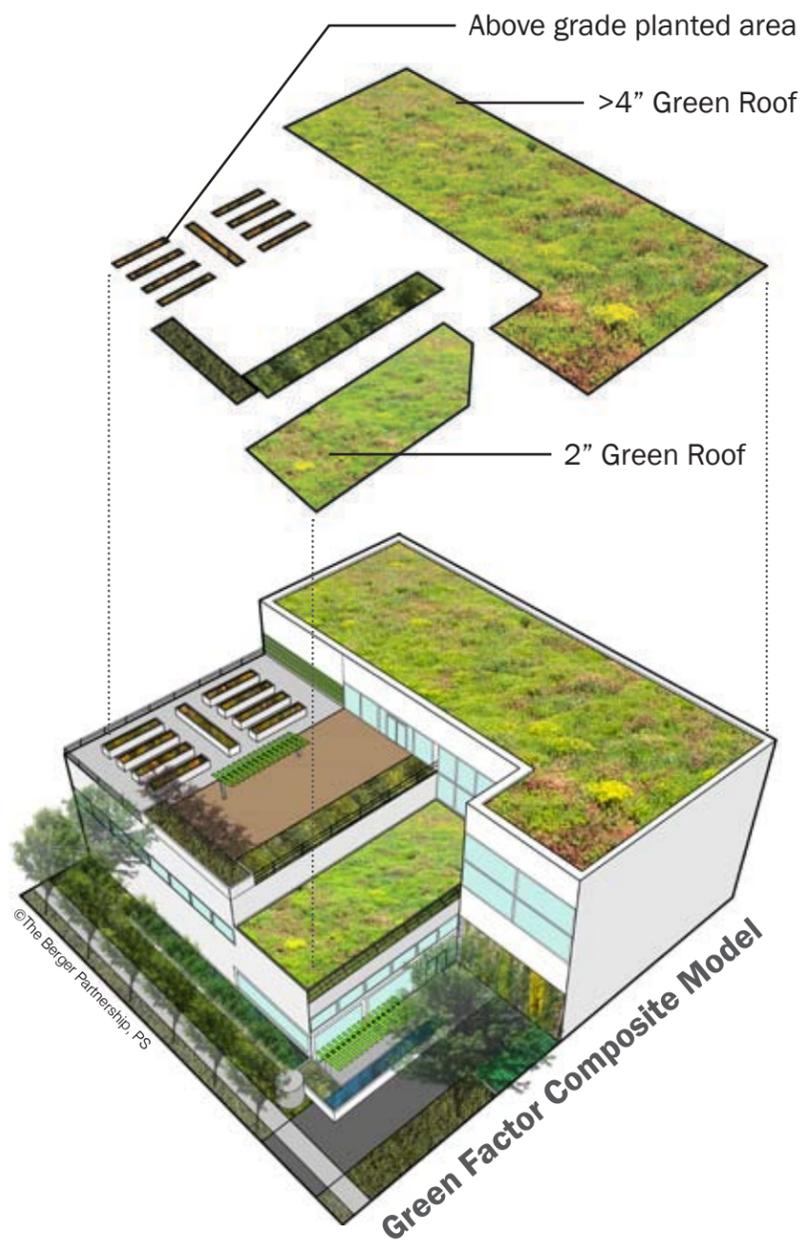
Factor - 0.8 x 250'

1.0

0.1 GF

Element: Green Roofs

Green Roofs offer a dramatic functional improvement over conventional roofs. They provide habitat for insects and birds, improve stormwater quality while reducing runoff quantity, and they reduce the heat island effect. Their use in building design can count toward LEED® certification, reduce heating and cooling costs, and almost double the lifespan of the roof. They are becoming more common and can be useful in educating the public about the benefits of green building practices.



2" to 4" of growth medium

Thin profile green roofs have the advantage of reduced structural load on a building, while offering many of the benefits of a thicker profile roof. Even thin profile roofs can capture and retain 60% of the precipitation that falls on them. Green Factor defines green roofs as any planting which is on top of a structure at least one floor above the level of the at grade entrance. Green roofs with less than a 2" soil profile will be categorized as landscaping areas with less than 24" of soil.

- Graphilo Legend**
- A Sedum Mat
 - B 2" Growth Medium
 - C Filter Fabric
 - D Drainage Layer
 - E Waterproofing Layer
 - F Roof

C1

Element - 2-4" Green Roof

Functional Benefits

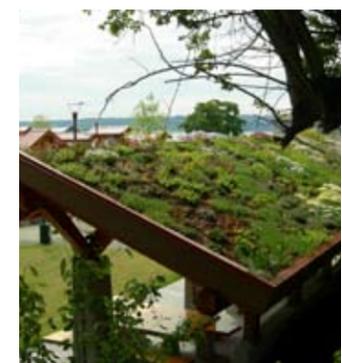
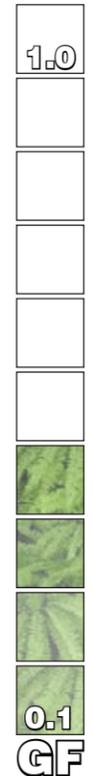
- Reduction of runoff
- Reduction of heat island
- Habitat creation
- Improved insulation

Environmental Considerations

- Petroleum products
- Requires irrigation

Note - Green Roof can extend roof lifespan to 50-100 Years

Factor - 0.4



Over 4" of growth medium

Green roofs with a thicker soil profile can support a wider range of plants than a roof with a 2" profile. The increased plant diversity can create a wider range of possible habitats for native insects and birds. Heating and cooling benefits are increased due to increased insulation, and the stormwater are improved. While a wide variety of roof systems are available, proper design, installation and maintenance are crucial to a successful project.

- Graphilo Legend**
- A Plant Material
 - B 4" Growth Medium
 - C Filter Fabric
 - D Drainage Layer
 - E Waterproofing Layer
 - F Roof

C2

Element - >4" Green Roof

Functional Benefits

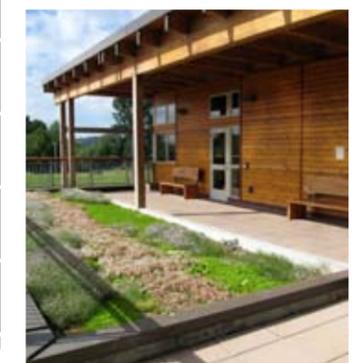
- Further runoff reduction
- Reduction of heat island
- More diverse habitat
- Improved insulation

Environmental Considerations

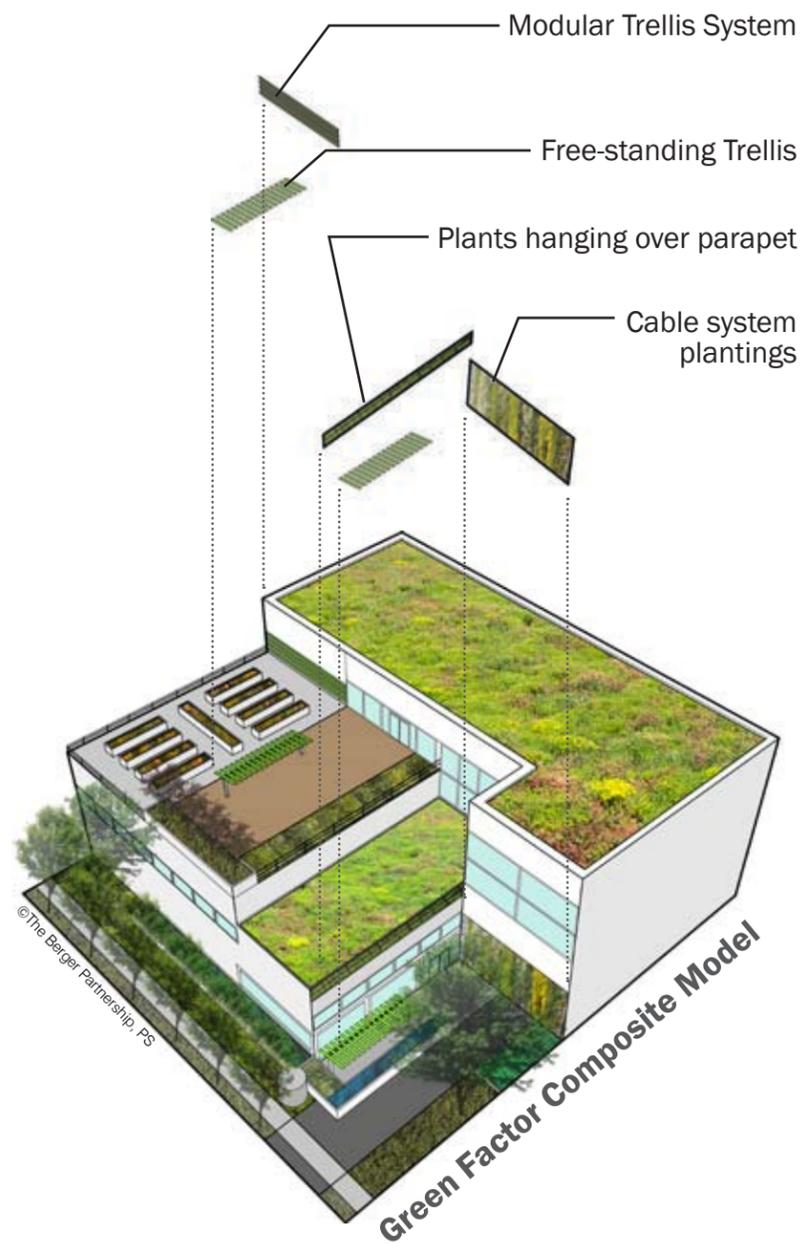
- Petroleum products
- Requires irrigation

Note - Green Roof can extend roof lifespan to 50-100 Years

Factor - 0.7



Green walls have historically been used for ornamental rather than functional purposes, but if designed properly they can benefit the natural environment, building performance and aesthetic qualities of a space. While green walls are currently not a common landscape element, their range of costs and ability to raise a Green Factor score without reducing a building's footprint means they may be selected for many projects in the future.



Plants on Facade

Vines growing on or overhanging a building facade qualify as a green wall for the purposes of Green Factor. A well established vine can produce many of the same benefits as a more expensive engineered system, including evapotranspiration, stormwater slowing and aesthetic improvement. However, providing for the needs of the plant does require some important design considerations. Most vines require some additional support to climb a building facade. Any green wall system designed to receive points from Green Factor, should be calculated for area of coverage after 5 years growth with a maximum height of 30'.

D

Element - Facade Plants

Functional Benefits

- Evapotranspirative cooling
- Vegetation slows stormwater events
- Air cleansing
- Habitat creation
- Reduced heat island effect

Environmental Considerations

- Requires adequate planting area
- Some plants may be difficult to remove

Factor - 0.7

1.0

0.1 GF



Plants on Cable System

Cable systems can provide support to climbing plants, and allow for a wider range of design flexibility. Cable systems can be aesthetically striking because the component parts are usually of high quality, and are adaptable to a variety of design styles. Budget should be a consideration in the design of a commercial system due to possible high costs. Custom built systems are an option which can be much lower in cost and provide even more flexibility in design, but may not be able to work in larger scale applications.

Plants which are able to climb a facade without support should not be specified for use with a cable system. Plants which use twining and tendrils for support are appropriate. Scrambling plants can be used if the cable systems are designed properly.

D

Element- Plants on Cable System

Functional Benefits

- Improved climbing plant growth
- Evapotranspirative cooling
- Vegetation slows stormwater events
- Air cleansing
- Habitat creation
- Reduced heat island effect

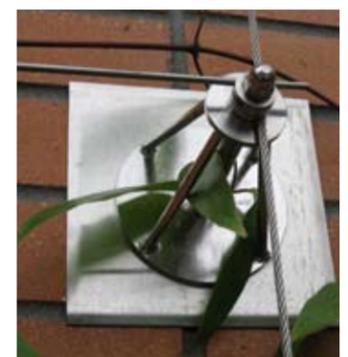
Environmental Considerations

- Requires adequate planting area
- Cable materials

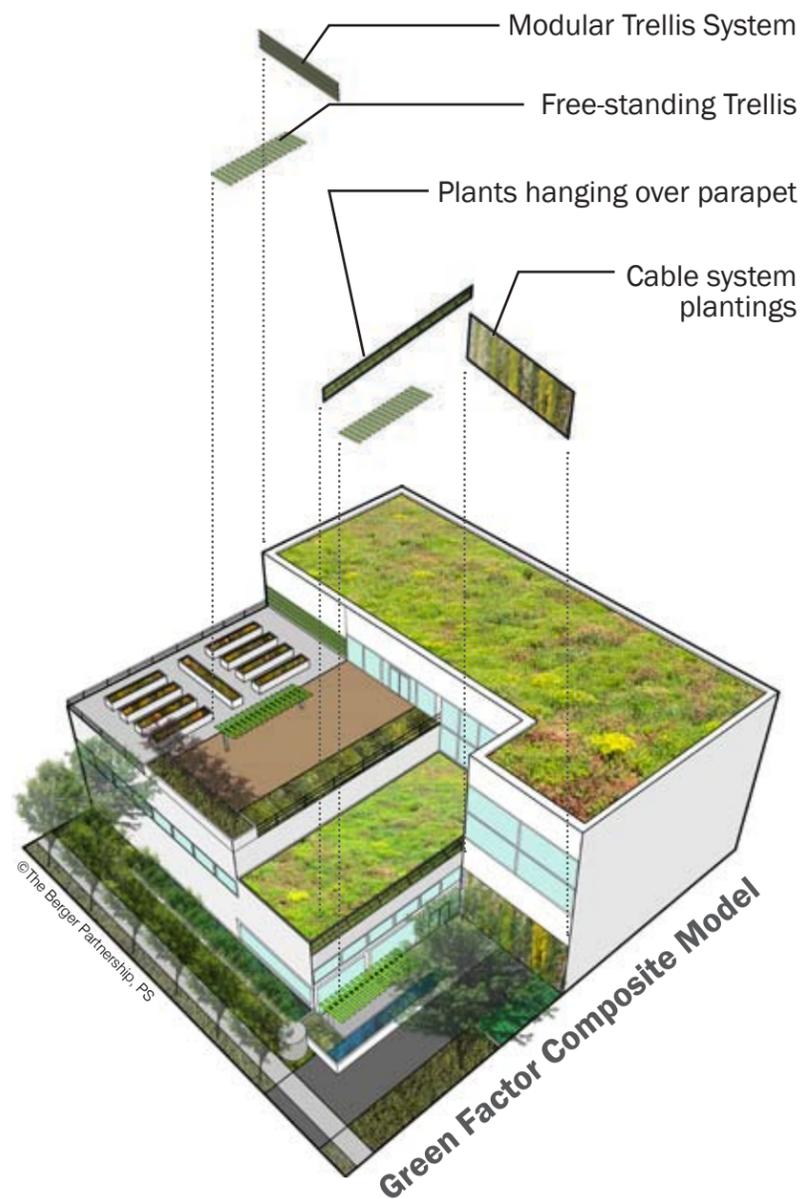
Factor - 0.7

1.0

0.1 GF



Green walls can provide buildings with facade protection and climatic benefits if designed well. The human experience can be improved through their use, both by reducing noise and creating microclimates through evapotranspiration. Green walls may also play a role in temporarily holding stormwater after rain events, reducing peak loads on drainage systems. Most green wall benefits will grow over time, but modular living walls, such as the G-Sky system, can offer these benefits immediately after installation.



Modular Trellis System

Modular trellis products come in a variety of sizes and shapes to fit almost any project. Their design creates support for a wide range of plant types, and they can be installed as a free standing structure or next to a building facade. Both sides of a freestanding green wall can be counted, as long as there is 5' of clearance with any adjacent walls. Their modular nature makes them easy to combine with cables or other climbing mechanisms. Being able to support a variety of plants allows a higher degree of flexibility in planting design. This means that shorter plants can be combined with more vigorous growers, for a higher level of coverage and seasonal variety. Plants which support themselves through twining, tendrils and some scrambling plants can grow on most modular trellis systems.

D

Element - Plants on Modular Trellis

Functional Benefits

- Improved climbing plant growth
- Evapotranspirative cooling
- Vegetation slows stormwater events
- Air cleansing
- Habitat creation

Environmental Considerations

- Module materials

Factor - 0.7

1.0

0.1 GF



Modular Green Wall

Modular green walls consist of a support framework populated by pre-planted trays. The functional and aesthetic benefits of green walls are near their maximum the day they are constructed. Though they do provide "instant green", the associated maintenance and resource usage, as well as the high cost, should be considered when designing a modular green wall. They provide the benefits of cooling the surrounding areas and can be adapted to use stormwater in their irrigation system. A growing variety of plants are available for use in these systems, including native, fragrant and flowering plants.

As these systems have only recently begun to be constructed, their long term viability and maintenance requirements are still being assessed.

D

Element- Modular Green Wall

Functional Benefits

- Evapotranspirative cooling
- Vegetation slows stormwater events
- Air cleansing
- Habitat Creation

Environmental Considerations

- Plastic & Stainless steel components
- Irrigation
- Fertilizer

Factor - 0.7

1.0

0.1 GF



Water features make a space more enjoyable for people. Also, they can use stormwater, reducing the load on drainage systems. However, they must meet functional goals including the use of harvested rainwater to count toward points for Green Factor. The change of phrasing on the new worksheet from “water features” to “approved water features” indicates an increased scrutiny toward points awarded for water features.

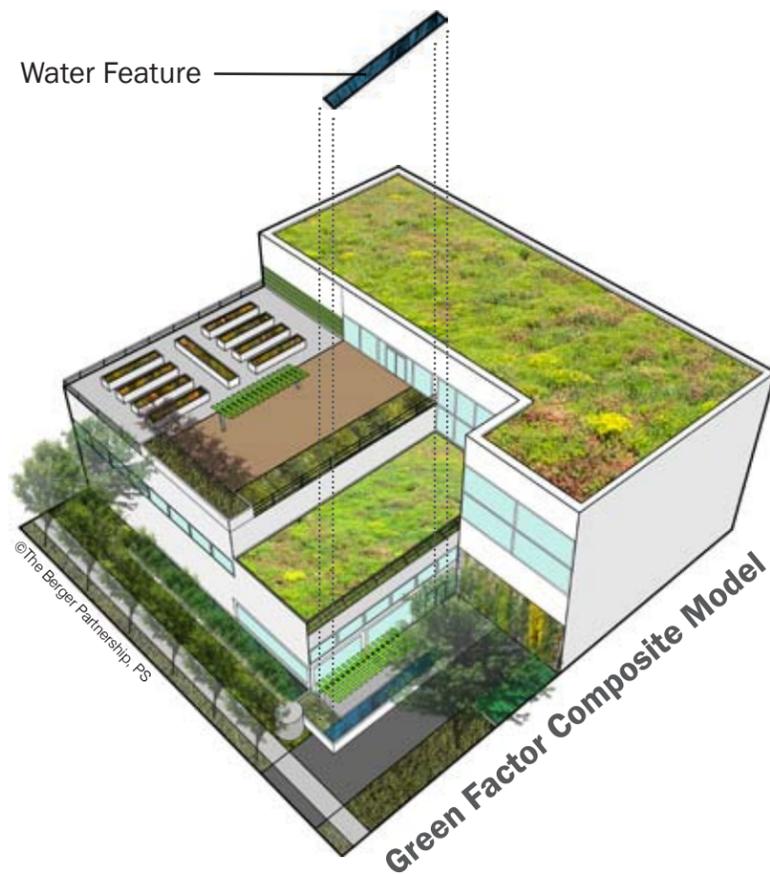
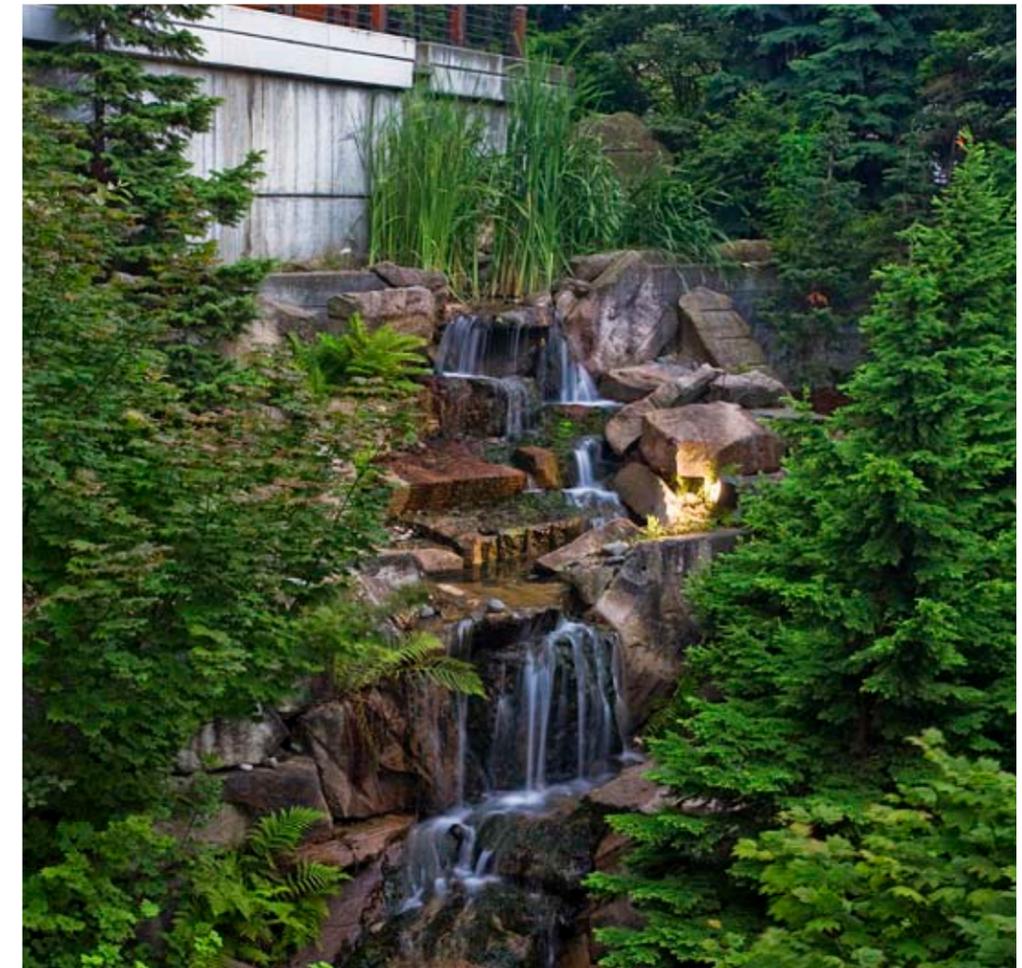
While the factor of 0.7 may initially seem high in comparison to other elements, the opportunity to add plants or use bonus factors is difficult to do with water features, making them an element with a low final value.



Water Feature

Water features are often the defining element in a landscape. Their contribution in many cases will be a small component in a Green Factor score, but their wide range of design styles and possible functional attributes can make them useful elements for aesthetic as well as habitat purposes.

To qualify for Green Factor, a water feature must use roof runoff or on-site stormwater for at least 50% of its annual flow, as well as keep water in the feature for at least six months of the year. Drainage or plumbing documents which demonstrate compliance are required to count the points toward Green Factor.



E

Element - Water Feature

Functional Benefits
Use of stormwater on site
Cools immediate area
Muffles nearby sounds

Environmental Considerations
Use of additional water to supplement flow
Impacts of materials used to construct the water feature
Mechanical and electrical requirements

Factor - 0.7

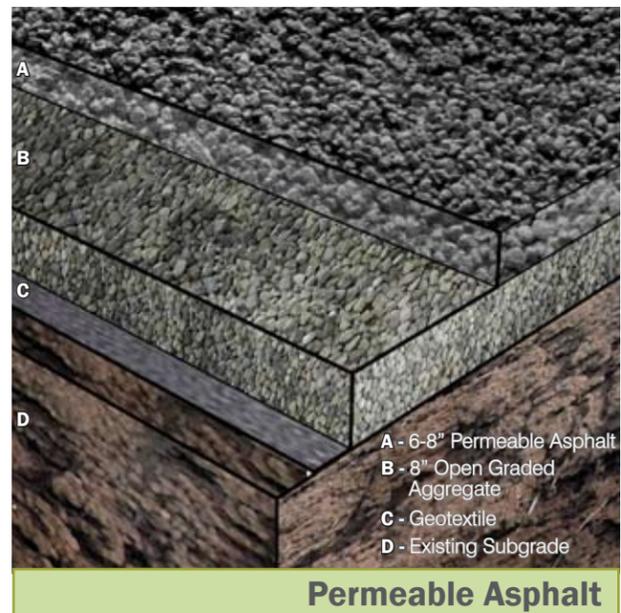
1.0

0.1
GF



Element: Permeable Paving

The inclusion of a permeable paving credit in Green Factor addresses the need for sites to infiltrate stormwater in a way similar to natural systems. Reducing and slowing the amount of runoff from sites significantly reduces the peak load on engineered stormwater systems. Permeable pavements also restrict non-point source pollution from entering surface water bodies, which helps keep our streams clean. Permeable pavements can also help contribute towards healthier plantings, and can earn LEED® credits.



Permeable Asphalt
Permeable asphalt can be used in some cases to replace traditional asphalt and allow for infiltration of stormwater.

Points awarded by Green Factor are based on the underlying material depth of the permeable paving (0.2 points for 6-24" and 0.5 points for depths over 24") Permeable paving should not be used in areas which store or process hazardous waste.

F 1.0

Element - Permeable Asphalt
Functional Benefits
Increased infiltration
Reduced runoff
Reduced stormwater facility requirements
Healthier plantings

Environmental Considerations
Petroleum products

Factor - 0.2 or 0.5

0.1 GF



Permeable Concrete
Permeable concrete can be used in place of impervious concrete in many non-driving situations. Its use in parking lots can help reduce the amount of stormwater runoff and non-point source pollution reaching our streams. Its design and use is in some ways more complex than traditional concrete and it is not always appropriate in some situations. However, the high functional benefits should be considered along with the higher complexity and cost.

Points awarded by Green Factor are based on the underlying material depth of the permeable paving (0.2 points for 6-24" and 0.5 points for depths over 24") Permeable paving should not be used in areas which store or process hazardous waste.

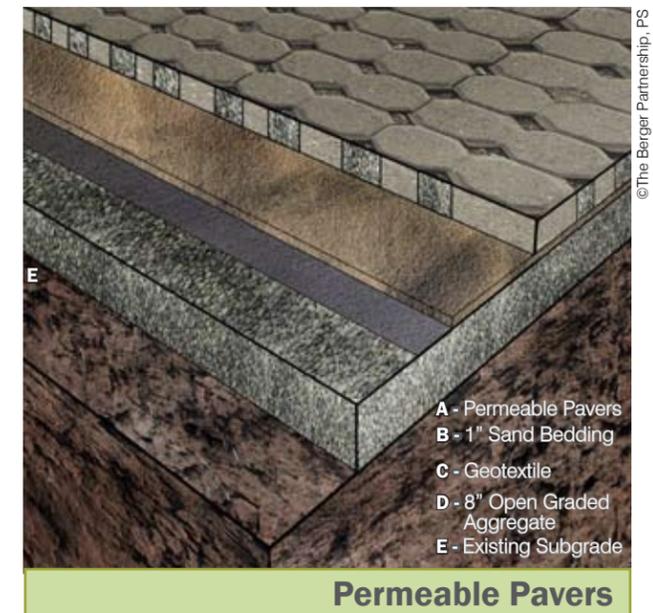
F 1.0

Element - Permeable Concrete
Functional Benefits
Increased infiltration
Reduced runoff
Reduced stormwater facility requirements
Healthier plantings

Environmental Considerations
Embodied energy

Factor - 0.2 or 0.5

0.1 GF



Permeable Pavers
Green factor allows designed permeable pavers, as well as non-permeable unit pavers placed on top of water-holding materials, to be considered as permeable paving (provided water can flow to the water holding material).

An overflow drain must be installed in storage areas to allow capacities which exceed the storage area to escape.

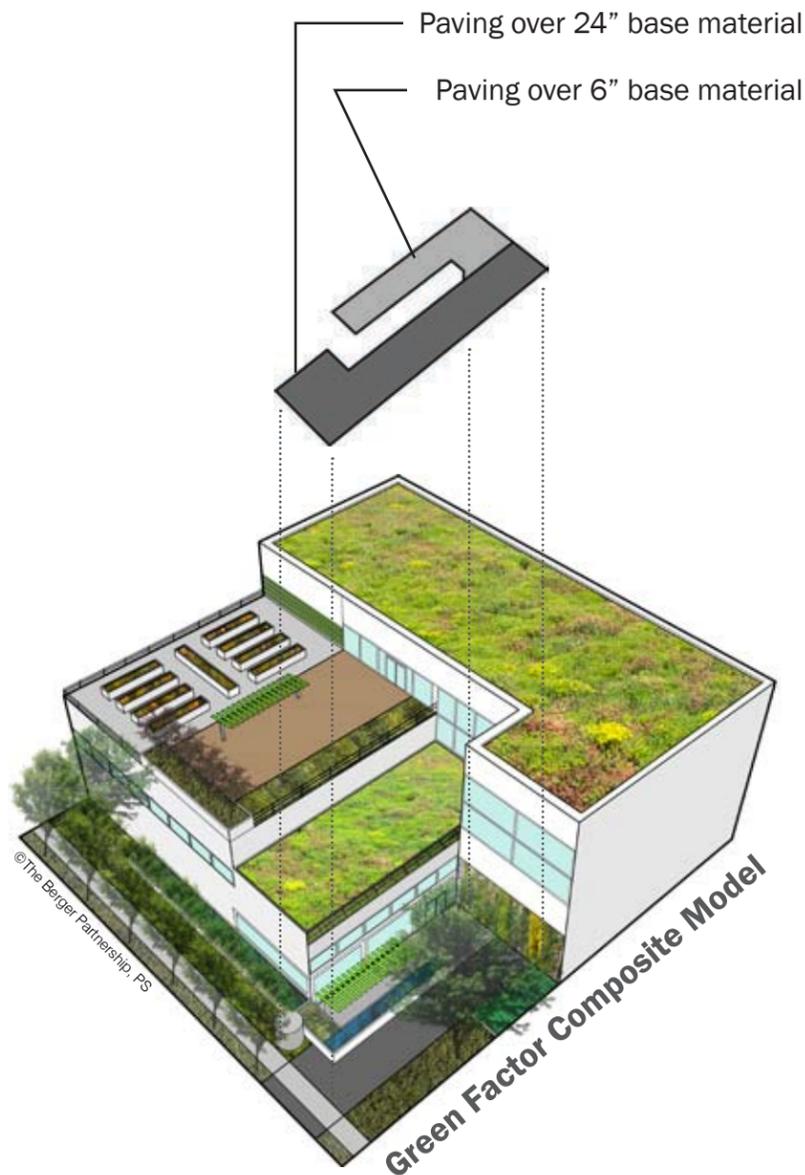
F 1.0

Element - Permeable Pavers
Functional Benefits
Increased infiltration
Reduced runoff
Reduced stormwater facility requirements
Healthier plantings

Environmental Considerations
Embodied energy

Factor - 0.2 or 0.5

0.1 GF



Recommendations for Achieving Green Factor

- Have open space situated on-grade when possible. Doing so allows spaces to be awarded much higher point values as well as reducing costs for some elements.
- Using drought tolerant and native plants is the easiest way to increase function and gain points on Green Factor.
- The relatively low cost of rain gardens, coupled with high functional benefits and point values, make them a good choice for Green Factor.
- Flexibility of design and cost makes green walls suitable for use in many projects. Their aesthetic and functional benefits, coupled with a high Green Factor score means they can be a useful choice for meeting project goals.
- Permeable paving is a functional low cost alternative to traditional paving. If placed on grade it provides an additional 0.5/S.F. factor.

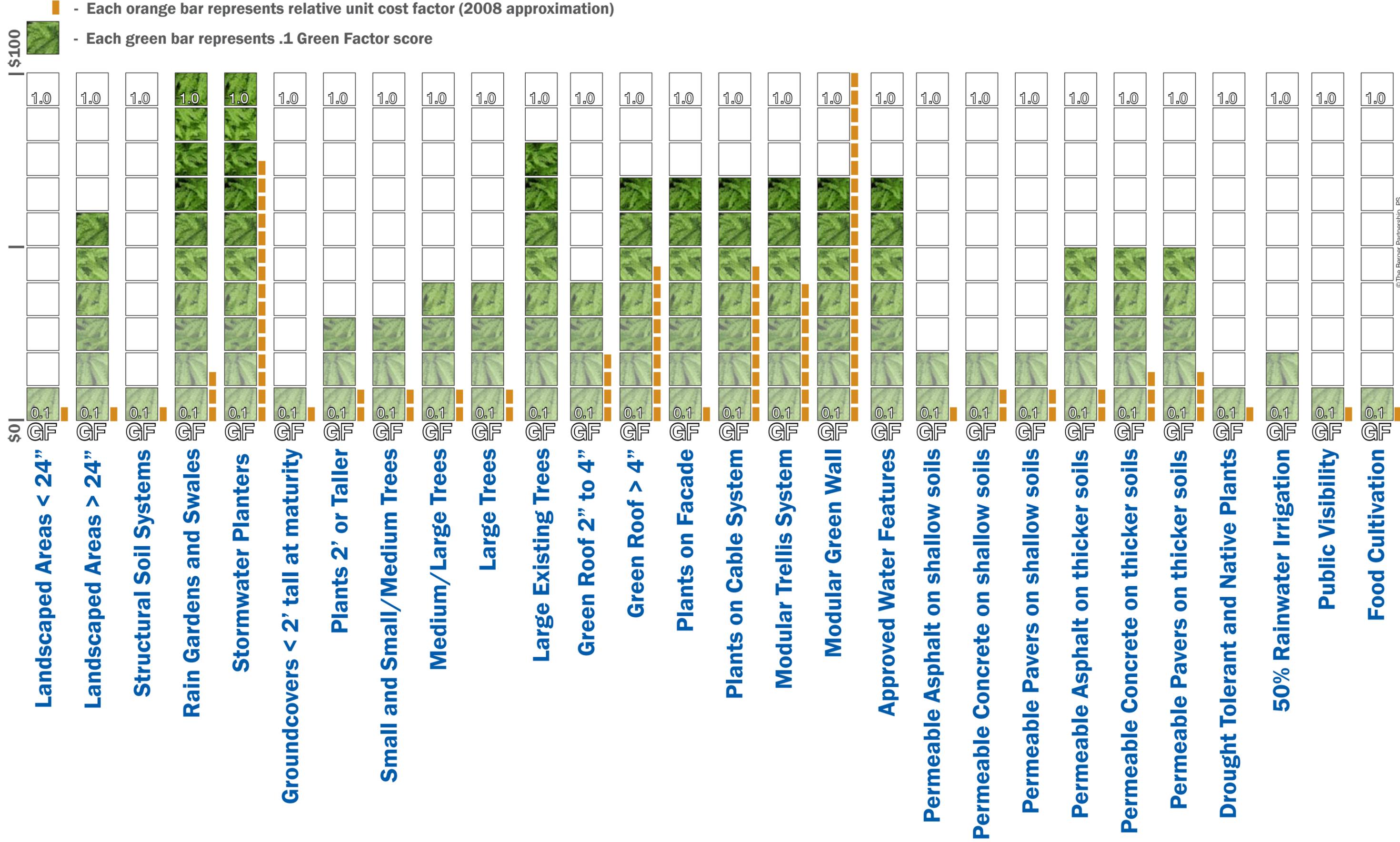
Conclusions

Currently Green Factor is changing how projects in Seattle are designed. In the future, its influence will cause functional elements to feature more prominently in the landscape. While this can be a good thing, Green Factor only addresses the quantity, not the quality of these elements. The same points are awarded for features regardless of whether they are designed well or designed poorly. So, while Green Factor can be a framework for creating a functional landscape, the responsibility for improving functional value and human experience lies with the people who design and build these projects.

So how does Green Factor impact the rest of the city? Industrial areas, pieces of infrastructure and private residences make up large portions of the city that are not subject to its regulations. These portions of the city could be designed to integrate ecological processes as well as be experientially meaningful. Hopefully, Green Factor will improve the development of commercial and multifamily projects and be an example for similar guidelines in the rest of Seattle and elsewhere.



Comparative Points and Costs



Additional Resources

Seattle DPD Green Factor

<http://www.seattle.gov/dpd/Permits/GreenFactor/>

Seattle DPD Draft Directors Rule - Landscape Standards

http://www.seattle.gov/dpd/cms/groups/pan/@pan/@permits/@greenfactor/documents/web_informational/dpds015951.pdf

Berlin Biotope Area Factor

http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/bff/index_en.shtml

Malmo Quality Programme

<http://www.map21ltd.com/scan-green/bo01.htm#points>

Planting Green Roofs and Living Walls

By Nigel Dunnett and Noel Kingsbury - Timber Press

Water Management Strategies: A case study based exploration of local projects

By Matt Martenson and The Berger Partnership

Seattle Flow Control Technical Requirements Manual

<http://www.ci.seattle.wa.us/dclu/Codes/dr/DR2000-26.pdf>

Native Plants

<http://www.wnps.org/>

Food Cultivation

<http://www.cityfarmer.org/>

Product Manufacturers

G-Sky

<http://www.g-sky.com/>

ELT

<http://www.eltlivingwalls.com/>

Xero Flor

<http://www.xeroflora.com/>

Jakob

<http://www.jakob.ch/12/>

Greenscreen

<http://www.greenscreen.com/>

Project Credits

Green Factor Page

Malmo Western Harbor

Various Designers

Photo by Guy Michaelsen

Stormwater Planters

Broadview Library - Top Photo

Arch. - Miller Hayashi Architects

L.A. - Karen Kiest Landscape Architects

Kitsap County Administration Building - Bottom Photo

Arch. - Miller/Hull

L.A. - Site Workshop

Eng. - SVR

Medium Trees

University of Washington School of Medicine -SLU

Arch. - Perkins + Will

L.A. - Gustafson Guthrie Nichol

Green Roof 2”

Bertschi School - Top Photo

Arch. - Miller/Hull

L.A. - Weisman Design Group

Photo by Matt Martenson

Plants on Facade

Columbia and Yesler Building - Main Photo

Designer Unknown

Belltown P-Patch - Top Photo

Designer Unknown

OHSU Center for Health and Healing - Bottom Photo

Arch. - GBD Architects

L.A. - Walker/Macy

Acknowledgements

Thank you to:

Dave LaClergue and

Steve Moddemayer of Seattle DPD

Special thanks to:

The staff of The Berger Partnership for welcoming me into the office and making my internship a great experience. And in particular Jonathan and Katie, for guidance and assistance throughout the summer.

Plants on Cable System

Providence Regional Cancer Center - Main Photo

Designer Unknown

MFO Park - Top Photo

Burckhardt + Partner AG

Raderschall Landschaftsarchitekten AG

Modular Trellis System

Boeing Plaza - Top Photo

L.A. - Gustafson Guthrie Nichol

Borealis Apartments - Bottom Photo

Arch. - Runberg Arch. Group

L.A. - Macdonald Environmental Planning

Modular Green Wall

Starbucks Green Wall - Main Photo

Starbucks Design

ELT Green Wall - Top Photo

Designer Unknown

Vancouver Aquarium - Bottom Photo

Designer - Sharp & Diamond L.A.

Water Features

Sculptural Water Feature - Bottom Right Photo

“Groundswell”

by Laura Hadad and Tom Drugan

Project Designers - Mithun