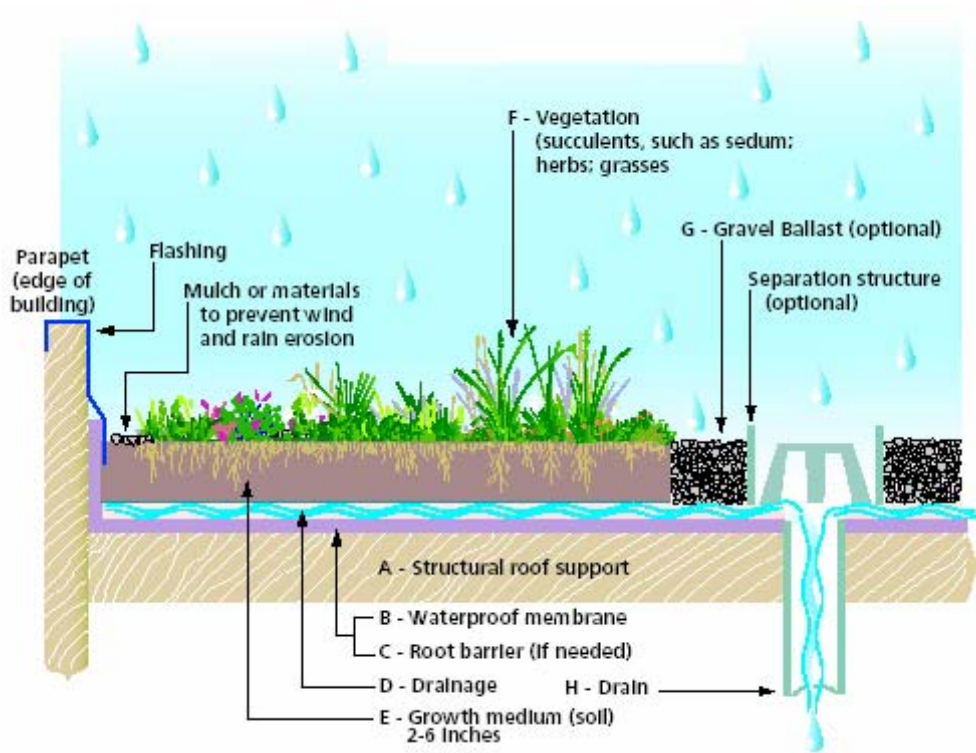


Eco-Roof & Roof Garden



<u>Stormwater Management Goals Achieved</u>	<u>Acceptable Sizing Methodologies</u>
√ Impervious Area Reduction.....	SIM
√ Pollution Reduction.....	SIM
√ Flow Control.....	SIM
Destination.....	NA
This facility is not classified as an Underground Injection Control structure (UIC).	
SIM=Simplified Approach, PRES= Presumptive Approach, PERF= Performance Approach	
Note: This facility is an impervious area reduction technique. Its applicability is limited to rooftops or decks above building structures.	

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Eco-Roof Description: An eco-roof is a lightweight roof system of waterproofing material with a thin soil/vegetation protective cover. The eco-roof can be used in place of a traditional roof as a way to limit impervious site area. The eco-roof captures and, depending on the season, evapotranspires 10 to 100 percent of the precipitation. Eco-roofs attempt to mimic pre-developed ground cover hydrology, reducing post-developed peak runoff rates to near pre-developed rates. Eco-roofs help mitigate runoff temperatures by keeping roofs cool and retaining most of the runoff in warm seasons. An underdrain system and overflow to an approved conveyance/destination method per **Section 1.4** will be required.



Roof Garden Description: A roof garden is a heavy weight roof system of waterproofing material with a thick soil/vegetation protective cover. The roof garden can be used in place of a traditional roof to limit impervious site area. The roof garden captures and then evapotranspires 50 to 100% of precipitation, depending on the season. Roof gardens attempt to mimic pre-developed hydrology, therefore reducing post-developed peak runoff rates to near pre-developed rates. They help mitigate runoff temperatures by keeping roofs cool and retaining most of the runoff in warm seasons. Roof gardens should not be used on slopes greater than 10%. A drain system and overflow to an approved conveyance/ destination method per **Section 1.4** will be required.

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Design Requirements:

General Specifications: Good quality waterproofing material must be used on the roof surface. Soil of adequate fertility and drainage capacity at depths of 2-6 inches, and weight of 10 to 30 pounds per square foot, shall be applied. The building structure must be shown to be adequate to hold the additional weight. Vegetation shall be self-sustaining plants, without the need for fertilizers or pesticides. Soil coverage to prevent erosion shall be established immediately upon installation by using mulch, vegetation mats, or other approved protection method. Ninety-percent plant coverage shall be achieved within 2 years. Temporary irrigation to establish plants is recommended. A permanent irrigation system using potable water may be used, but an alternative means of irrigation, such as air conditioning condensate or other non-potable sources, is recommended. Alternative sources should be analyzed to determine if the source has chemicals that might harm or kill the vegetation. Maximum roof slope shall be 25%, unless the applicant can provide documentation for runoff control on steeper slopes.

A. Structural Roof Support: The structural roof support must be sufficient to hold the additional weight of the eco-roof. For retrofit projects, check with an architect, structural engineer, or roof consultant to determine the condition of the existing building structure and what might be needed to support an eco-roof. This might include additional decking, roof trusses, joists, columns, and/or foundations. Generally, the building structure must be adequate to hold an additional 10 to 25 pounds per square-foot (psf) saturated weight, depending on the vegetation and growth medium that will be used. (This is in addition to snow load requirements.) An existing rock ballast roof may be structurally sufficient to hold a 10-12 psf eco-roof. (Ballast typically weighs 10-12 psf.)

For New Construction the project architects and structural engineers shall address the structural requirements of the eco-roof during the design process. Greater flexibility and options are available for new buildings than for re-roofing. The procedures for the remaining components (B through H) are the same for both re-roofing and new construction.

B. Waterproof Membrane (Impermeable Material): Waterproof membranes are made of various materials, such as modified asphalts (bitumens), synthetic rubber (EPDM), hypolan (CPSE), and reinforced PVC. Some of the materials come in sheets or rolls and some are in liquid form. They have different strengths and functional characteristics. Some of these products require root inhibitors (refer to C) and other materials to protect the membrane. Numerous companies manufacture waterproofing materials appropriate for eco-roofs.

Protection Boards or Materials: These materials protect the waterproof membrane from damage during construction and over the life of the system, usually made of soft fibrous materials.

C. Root Barrier (If needed): Root barriers are made of dense materials that inhibit root penetration. The need for a root barrier depends on the waterproof membrane selected. Modified asphalts usually require a root barrier, while synthetic rubber

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(EPDM) and reinforced PVC generally do not. Check with the manufacturer to determine if a root barrier is required for a particular product. Note: membranes impregnated with pesticides are not allowed. Manufacturers shall disclose the concentration of leach out for membranes impregnated with copper.

- D. Drainage Layer (If needed):** There are numerous ways to provide drainage. Products range from manufactured perforated plastic sheets to a thin layer of gravel. Some eco-roof designs do not require any drainage layer other than the growth medium itself, depending on roof slope and size (for example, pitched roofs and small flat roofs).
- E. Growth Medium (Soil):** The growth medium is generally 2 to 6-inches thick and well drained. It weighs from 10 to 25 pounds per square-foot when saturated. A simple mix of one-fourth topsoil, one-fourth compost, and one-half pumice perlite may be sufficient for many applications. Some companies have their own growth medium specifications. Other components could include digested fiber, expanded clay or shale, or coir.
- F. Vegetation:** Eco-roof and roof garden vegetation should have the following attributes:
- Drought-tolerant, requiring little or no irrigation after establishment
 - Growth patterns that allow the plants to thoroughly cover the soil (at least 90% of the overall surface shall be covered)
 - Self-sustaining, without the need for fertilizers, pesticides, or herbicides
 - Able to withstand heat, cold, and high winds
 - Very low-maintenance, needing little or no mowing or trimming
 - Perennial or self-sowing
 - Fire resistant

A mix of sedum/succulent plant communities is recommended because they possess many of these attributes. Herbs, forbs, grasses, and other low groundcovers can also be used to provide additional benefits and aesthetics; however, these plants may need more watering and maintenance to survive and keep their appearance.

Installation: Four methods (or combinations of them) are generally used to install the vegetation: vegetation mats, plugs/ potted plants, sprigs, and seeds.

- 1. Vegetation mats** are sod-like, pre-germinated mats that achieve immediate full plant coverage. They provide immediate erosion control, do not need mulch, and minimize weed intrusion. They also need minimal maintenance during the establishment period and little ongoing watering and weeding.
- 2. Plugs or potted plants** may provide more design flexibility than mats. However, they take longer to achieve full coverage, are more prone to erosion, need more watering during establishment, require mulching and more weeding.
- 3. Sprigs** are hand-broadcast. They require more weeding, erosion control, and watering than mats.
- 4. Seeds** can be either hand-broadcast or hydraseeded. Like sprigs, they require more weeding, erosion control, and watering than mats.

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G. Gravel Ballast (If needed): Gravel ballast is sometimes placed along the perimeter of the roof and at air vents or other vertical elements. The need for ballast depends on operational and structural design issues. It is sometimes used to provide maintenance access, especially to vertical elements requiring periodic maintenance. In many cases, very little, if any, ballast is needed. In some situations a header or separation board may be placed between the gravel ballast and adjacent elements (such as soil or drains). If a root barrier is used, it must extend under the gravel ballast and growth medium, and up the side of the vertical elements.

H. Drain: As with a conventional roof, an eco-roof must safely drain runoff from the roof to an approved stormwater destination. See **Section 1.4** for stormwater destinations.

Checklist of minimal information to be shown on the permit drawings:

- 1) Facility dimensions and setbacks from roof lines
- 2) Profile view of facility, including typical cross-sections with dimensions
- 3) Growing medium specification, including weight
- 4) Filter fabric specification
- 5) Drainage layer specification
- 6) Waterproof membrane specification, including root barriers
- 7) Planting and irrigation plan
- 8) Final stormwater destination
- 9) Roof framing
- 10) Structural dead load & live load
- 11) Load path to foundation with verification that structure (beams, headers, etc.) will support additional loads.

Inspection requirements and schedule: The following table shall be used to determine which stormwater facility components require City inspection, and when the inspection shall be requested. Please note that, while not all facility components may require an inspection call, inspectors will inspect for all required components in the field.

Facility Component	Inspection Requirement
Roof Structure	Call for inspection
Waterproof membrane	Call for inspection
Drainage layer/ plumbing & pipes	
Plantings	Call for inspection

Operations and Maintenance requirements: See **Chapter 3.0**.

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