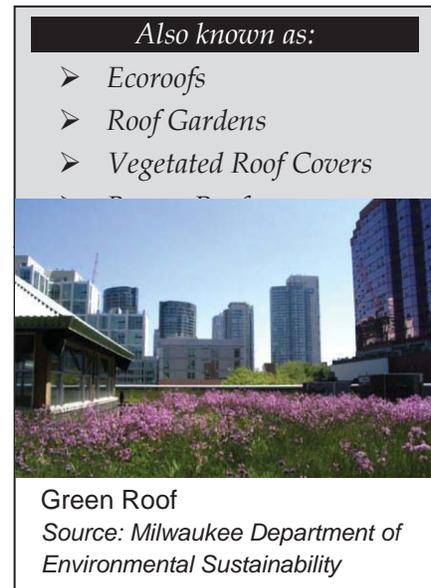


HSC-5: Green Roof / Brown Roof

Green roofs are also known as ecoroofs, roof gardens, or vegetated roof covers. Green roofs are roofing systems that layer a soil/vegetative cover over a waterproofing membrane. There are two types of green roofing systems; extensive, which is a light weight system and intensive, which is a heavier system that allows for larger plants but requires additional maintenance. A green roof mimics pre-development conditions by limiting the impervious area created by development. Green roofs filter, absorb, and evapotranspire precipitation to help mitigate the effects of urbanization on water quality and delivery of excess runoff to the local storm water conveyance systems.

Brown roofs are essentially a type of green roof designed to maximize biodiversity. Brown roofs typically utilize natural soil and locally available substrates to create a protected biodiverse habitat for specific species of local flora and fauna. Rather than landscaping the roof during construction, plants are left to germinate and grow on their own in the native soils, thus the “brown” (i.e., initially unvegetated) designation. Hand-seeding may be implemented where self-colonization via airborne seeds is unlikely.



Feasibility Screening Considerations

- Green roofs should be selected with consideration for their impacts on irrigation during the dry season and during dry periods of the wet season.

Opportunity Criteria

- Green roofs can be applied to multi-family residential, commercial, or institutional land uses including rooftops and decks above building structures (e.g., parking structures, outdoor eating area roofs, or storage facilities).
- Roofs are ideally multi-story with significant structural over-design to support the additional weight of the soil, retained water, and plants, as confirmed by a licensed structural engineer.
- Roofs are ideally relatively flat.

OC-Specific Design Criteria and Considerations

- Saturated soil will weigh approximately 10 – 25 lbs/square foot. If the building and roof are not designed to hold this weight (such as in a retrofit situation), a licensed structural engineer should be consulted.
- Soil depth should be consistent with minimum depths provided in [Appendix IX](#).
- A drain pipe (gutter) is required to convey runoff safely from the roof.
- Depending on the design of the roof, a drainage layer may be required to move the excess runoff off of the roof.

- A waterproof membrane, preventing the roof runoff from penetrating and damaging the roofing material, should be used. There are many materials available for this purpose; they come in various forms (i.e., rolls, sheets, liquid) and exhibit different characteristics (e.g., flexibility, strength, etc.). Depending on the type of membrane chosen a root barrier may be required to prevent roots from compromising the integrity of the membrane.
- Green roofs should be about 90% vegetated with a mix of erosion resistant plant species that effectively bind the soil and can withstand the extreme environment of rooftops (i.e., heat, cold, and high winds).
- A diverse selection of low growing plants that thrive under the specific site, climatic, and watering conditions should be specified. A mixture of drought tolerant, self-sustaining (perennial or self-sowing without need for fertilizers, herbicides, and or pesticides) is most effective. Native or adapted sedum/succulent plants are preferred because they generally require less fertilizer, limited maintenance, and are more drought resistant than exotic plants. When appropriate, green roofs may be planted with larger plants; however, this depends on structural support, soil depth, and irrigation requirements.
- Irrigation is required if the seed is planted in spring or summer. Use of a permanent smart (self-regulating) irrigation system, or other watering system, may help provide maximal water quality performance. Drought-tolerant plants should be specified to minimize irrigation requirements. For projects seeking “High Performance Building” recognition, ASHRAE Standard 189.1 states that potable water cannot be used for irrigating green roofs after they are established.
- Locate the green roof in an area without excessive shade to avoid poor vegetative growth. For moderately shaded areas, shade tolerant plants should be used.
- Project-specific planting recommendations should be provided by a landscape professional including recommendations on appropriate plants, fertilizer, mulching applications, and irrigation requirements (if any) to ensure healthy vegetation growth.

Sizing

Appendix IX provides minimum criteria for green roofs to be considered self-retaining and shall be the governing sizing basis for green roofs.

Configuration for Use in a Treatment Train

- If implemented in a treatment train, green roofs are typically at the most upstream end. A green roof placed upgradient of a cistern can improve the quality and reduce the rate and volume of water flowing to the cistern. Alternatively, a planter box could be placed downstream of a downspout that drains the green roof.

Additional References for Design Guidance

- Los Angeles Unified School District Stormwater Technical Manual, 2009. http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850
- City of Santa Barbara, Technical Guidance Manual for Post-Construction Storm Water Management, 2008. http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf
- Portland Stormwater Management Manual. <http://www.portlandonline.com/bes/index.cfm?c=35122&a=55791>
- San Diego County – Low Impact Development Fact Sheets. <http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf>

- Brown Roofs. <http://www.brownroofs.co.uk/brown-roof-maintenance.php>