

11.0 Post Construction BMPs Standards and Specifications

11.4 Vegetated Roofs

11.4.1 Vegetated Roofs are defined as practices on top of buildings that capture and store rainfall in an engineered growing media, which is designed to support plant growth. A portion of the captured rainfall evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites. Design variants include:

11.4.1.1 Extensive Vegetated Roofs which contain shallow growth media with drought resistant plants, such as Sedum.

11.4.1.2 Intensive Vegetated Roofs which contain deep growth media with a wide range of plant varieties and typically include irrigation.

11.4.2 Vegetated Roofs receive annual runoff reduction credit (RR) for the contributing roof area, along with associated pollutant removals as follows:

11.4.2.1 The R_{Pv} runoff reduction performance credit for Extensive Vegetated Roof is 50% annual runoff reduction.

11.4.2.2 The C_v runoff reduction performance credit for Extensive Vegetated Roof is 5% of the R_{Pv} allowance.

11.4.2.3 The F_v runoff reduction performance credit for Extensive Vegetated Roof is 1% of the R_{Pv} allowance.

11.4.2.4 The R_{Pv} runoff reduction performance credit for Intensive Vegetated Roof is 75% annual runoff reduction.

11.4.2.5 The C_v runoff reduction performance credit for Intensive Vegetated Roof is 8% of the R_{Pv} allowance.

11.4.2.6 The F_v runoff reduction performance credit for Intensive Vegetated Roof is 2% of the R_{Pv} allowance.

11.4.2.7 The total nitrogen pollutant reduction performance credit for Extensive Vegetated Roof and Intensive Vegetated Roof is 0%.

11.4.2.8 The total phosphorus pollutant reduction performance credit for Extensive Vegetated Roof and Intensive Vegetated Roof is 0%.

11.4.2.9 If the phosphorous (P) content of mature growth media is 2 mg/l (Saturated Paste Extraction), or less, then the Vegetated Roof will be assumed to be neutral with respect to P loadings. If the P content of mature growth media exceeds 2 mg/l, a supplemental phosphorus-reducing BMP, such as an activated alumina or hematite filter, will be required.

11.4.3 Vegetated Roof Feasibility Criteria

11.4.3.1 The designer shall demonstrate that the building will be able to support the additional live and dead structural load. Structural capability of the

roof must be assessed by a qualified licensed professional and included with building permit documentation.

11.4.3.2 Safe access to the Vegetated Roof shall be available to allow for delivery of construction materials and performance of routine maintenance reviews and maintenance operations.

11.4.3.3 A permanent source of water shall be provided to all Vegetated Roof areas.

11.4.3.4 A minimum 1-foot wide vegetation-free zone is required along the perimeter of all Vegetated Roofs and around all roof penetrations.

11.4.3.5 The Vegetated Roof design must comply with all federal, state and local building codes.

11.4.4 Vegetated Roof Conveyance Criteria

11.4.4.1 The Vegetated Roof drainage layer shall convey flow from under the growth media layer to an outlet or overflow system.

11.4.4.2 All drains and scuppers shall be accessible through enclosures that include lids that are level with the surface of the growth media layer.

11.4.4.3 Emergency drains or emergency scuppers shall have inverts that are high enough above the waterproofing surface to prevent discharge during the RPv event.

11.4.5 Vegetated Roof Design Criteria

11.4.5.1 All Vegetated Roof systems must include an effective and reliable waterproof membrane to prevent water damage to the building structure.

11.4.5.2 Protection Layer shall have a puncture resistance in accordance with ASTM D4833 >220 lbs.

11.4.5.3 Waterproof membranes designed for burial in Vegetated Roofs do not require supplemental root barriers; however root barriers are required in combination with some waterproof membranes.

11.4.5.3.1 Chemical root barriers or physical root barriers that have been impregnated with pesticides, metals or other chemicals shall not be used as those chemicals can leach into stormwater runoff and will slowly lose effectiveness over time.

11.4.5.3.2 To insure that a building is adequately protected against damage from roots, the waterproof membrane or the root-barrier shall be certified as root-resistant based on the two-year ANSI/SPRI VR-1; Procedure for Investigating the Root Penetration Resistance of Vegetated Roofs or the two-year European FLL root-security test (Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V., Richtlinien fuer die Planung, Ausfuehrung und Pflege von Dachbegruenung). If certification is not available at the time the system is permitted, a root barrier shall be provided as follows: HDPE membrane, 30 mil or thicker, with seams overlapped at least 3 inches and continuously hot-air welded.

11.4.5.4 A drainage layer shall underlie the growth media to control the release of water that percolates into the Vegetated Roof assembly.

11.4.5.5 Roof drains and any emergency overflow shall be designed in accordance with state and local building codes.

11.4.5.6 Growth Media

11.4.5.6.1 The growth media shall be the uppermost layer in a Vegetated Roof assembly.

11.4.5.6.2 The designer shall certify that growth media meets or exceeds all required specifications prior to placement.

11.4.5.6.3 The growth media must maintain minimum 6% air filled porosity (ASTM E2399) to avoid anoxic conditions when wetted.

11.4.5.6.4 The upper 1 inch of a growth media profile shall consist of an engineered mineral soil. To minimize the potential for clogging of fabrics and migration of fine particles, the silt-size fraction (0.063mm) of engineered mineral soils shall not exceed 15% and the clay fraction (2 micron) shall not exceed 5%

11.4.5.6.5 Organic amendments used in preparing growth media must be stable. The respiration rate of organic ingredients must be 3 mg CO₂-C/g OM/day (TMECC 05.08.B), or less.

11.4.5.6.6 For a Vegetated Roof to be regarded as neutral with respect to phosphorous (P) loading in runoff, the P content of the growth media must be controlled.

11.4.5.6.6.1 The initial available P content of the growth media may not exceed 200 ppm dry weight (Mehlich III).

11.4.5.6.6.2 Chemical fertilizers containing phosphorous may not be added to the growth media during blending or used subsequently during maintenance unless a phosphorus deficiency in the plants has been documented. Only nitrogen fertilizers may be used and these must be applied according to soil test. If the P limit for the media layer cannot meet compliance, the Vegetated Roof must be treated as a P source and a supplemental water quality BMP must be introduced.

11.4.5.6.7 If trees are included in the Vegetated Roof landscape plan, the growth media must be at least 30 inches deep.

11.4.5.7 Plant cover

11.4.5.7.1 Initial planting plan shall be designed such that mature plant coverage within 24 months of initial planting shall be:

11.4.5.7.1.1 Minimum 75% warm season plant coverage for Extensive Vegetated Roofs.

11.4.5.7.1.2 Minimum 90% plant coverage for turf intensive Vegetated Roofs.

11.4.5.7.1.3 Uniform cover with vigorous plants conforming to the design plant density for non-turf Intensive Vegetated Roofs.

11.4.5.7.2 The planting plan for Vegetated Roofs must be certified by a qualified professional.

11.4.5.8 Vegetated Roof sizing

11.4.5.8.1 The size of the Vegetated Roof, both Extensive and Intensive, shall be a minimum 66% of the total contributing drainage area.

11.4.5.8.2 No runoff reduction credit shall be given for runoff from bare areas of the roof that do not come in contact with root zone.

11.4.6 Vegetated Roof Landscaping Criteria

11.4.6.1 Irrigation is required for Vegetated Roofs for the first year after planting.

11.4.6.2 The minimum plant coverage shall be achieved 24 months after initial planting and maintained throughout the life of the Vegetated Roof.

11.4.7 Vegetated Roof Construction

11.4.7.1 Construction reviews are required during the following stages of construction, and shall be noted on the plan in the sequence of construction:

11.4.7.1.1 Pre-construction meeting

11.4.7.1.2 During placement of the waterproof membrane, to ensure that it is properly installed and watertight;

11.4.7.1.3 During placement of the drainage layer and drainage system, to prevent future ponding water;

11.4.7.1.4 During placement of the growing media, to confirm that it meets the approved plan;

11.4.7.1.5 Upon installation of plants, to ensure they conform to the planting plan;

11.4.7.1.6 Final construction review including development of a punch list for facility acceptance.

11.4.7.2 Post Construction Verification Documentation

11.4.7.2.1 Upon facility completion, the owner shall submit post construction verification documents to demonstrate that the Vegetated Roof has been constructed within allowable tolerances in accordance with the approved Sediment and Stormwater Management Plan and accepted by the approving agency. Allowable tolerances for Vegetated Roofs are as follows:

11.4.7.2.1.1 Growth media thickness within 15% of design thickness.

11.4.7.2.1.2 Plant density no less than specified on the planting plan.

11.4.7.2.1.3 No less than 66% of the total contributing drainage area shall be Vegetated Roof.

11.4.7.2.2 The post construction verification shall confirm that temporary or permanent irrigation has been installed in accordance with the approved plan.

11.4.7.2.3 Certification of growth media shall be submitted with post construction verification.

11.4.8 Vegetated Roof Maintenance Criteria

11.4.8.1 Maintenance Reviews

11.4.8.1.1 A minimum of one maintenance review is required each year for Vegetated Roofs.

11.4.8.1.2 Maintenance reviews shall be performed by a qualified reviewer.

11.4.8.1.3 The completed maintenance review report shall be sent to the Department or the appropriate Delegated Agency.

11.4.8.1.4 Vegetated Roofs must be reviewed at the end of the first 24 months to confirm minimum vegetated surface cover specified in the Operation and Maintenance Plan has been achieved, and to look for leaks, drainage problems and any rooftop structural concerns.

11.4.8.2 Growth media shall be routinely tested for P as part of the Operation and Maintenance Plan. Phosphorous-removing BMPs (e.g., activated alumina or hematite filters) must be installed for Vegetated Roofs, 24 months and older, with phosphorous concentrations that are consistently higher than 2 mg/l.