Approved: 2013-06-01

SPEC NOTE: This guide specification is intended for use when specifying a vegetated (or green) roof assembly. Make any required selections where options are given. Where selection is indicated with a [OR] statement, select the appropriate statement. All SPEC NOTES written in blue text will not print.

Part 1 General

Part 1.1 SECTION INCLUDES

.1 All conditions of the Contract and Division 1 apply to this Section.

.2 Additional requirements may be specified in other sections.

SPEC NOTE: Edit to suit project requirements

Part 1.2 RELATED REQUIREMENTS

.1 Section 03 41 00 - Precast Structural Concrete.

.2 Section 07 27 11 - Air Barriers - Performance.

.3 Section 07 55 63 - Vegetated Protected Membrane Roofing (or modified bituminous membrane roofing 07 52 00).

.4 Section 22 00 00 - Plumbing.

.5 Section 11 01 00 - Fall Arrest Systems.

Part 1.3 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM C578-04a, Rigid Cellular Polystyrene Thermal Insulation.

.2 ASTM E2399-05, Standard Test Method for Maximum Media Density for Dead Load Analysis of Green Roof Systems.

.3 ASTM E2397-05, Standard Practice for determination of Dead Loads and Live Loads associated with Green Roof Systems.

.4 ASTM E2400 - 06 Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems

.5 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.6 ASTM D7003-03, Standard Test Method for Strip Tensile Properties of Reinforced Geomembranes.

.7 ASTM D7004-03, Standard Test Method for Grab Tensile Properties of Reinforced Geomembranes.

.8 ASTM D4533-11, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

.9 ASTM D751-06, Standard Test Methods for Coated Fabrics.

.10 ASTM C518-10, Standard Test Method for Steady State Thermal Transmission Properties by Means of the Heath Flow Meter Apparatus.

.11 ASTM D1621-10, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

.12 ASTM C272-01, Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions.

.13 ASTM D4632-08, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

.14 ASTM D4533-11, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

.15 ASTM D4833-07, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.

.16 ASTM D6241-04(2009), Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile Related Products Using a 50 mm Probe.

.17 ASTM D3786/D3786M-09, Standard Test Method for Bursting Strength of Textile Fabrics Diaphragm Bursting Strength Tester Method.

.18 ASTM D4355-99, Standard Test Method for Deterioration of Geotextiles by Exposure to Ultraviolet Light and Water (Xenon Arc Type Apparatus).

.19 ASTM D4491-99a, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

.20 ASTM D4751-04, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

.21 ASTM D5261-10, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

.22 ASTM D5199-12, Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.

.23 ASTM D5035-11, Standard Test Method for Breaking Force and Elongation of Textile Fabric (Strip Method).

.2 Underwriters' Laboratories of Canada (ULC).

.1 CAN/ULC-S701-[05], Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 German Landscape Research, Development and Construction Society (Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau), (FLL).

.1 2002 German FLL Guidelines for the Planning, Development, and Maintenance of Green Roofs.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

Part 1.4 SYSTEM DESCRIPTION

.1 Vegetated Roofing System:

.1 Electronic leak detection,

.2 Root barrier,

.3 Horizontal insulation,

.4 Drain inspection chambers,

.5 Vertical parapet insulation/protection panels,

.6 Drainage/water retention board,

.7 Filter fabric,

.8 Growing media,

.9 Vegetation,

.10 Roof pavers,

.11 Edging,

.12 Pre-cast concrete pavers,

.13 Paver hold-down system,

.14 Erosion netting,

.15 Irrigation.

.2 The Vegetated Layer shall be composed of a single-media system of fully integrated living and manufactured components which form a continuous cover over the designated roofing area.

.3 All components of the vegetated assembly system must be provided by one system supplier under a single, sole-sourced warranty.

Part 1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 Submittal Procedures .

.2 Submit samples, technical data sheets and MSDS sheets of each product specified.

.3 Submit testing data from Penn State University Agricultural Analytical Services Laboratory. Testing should be no more than one (1) year from the date of submission.

.4 Submit testing data from a certified laboratory of the growing media as per ASTM E2399-05. Testing should be no more than three (3) months from the date of submission.

.5 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 47 15 - Sustainable Requirements: Construction and Section 02 81 01 - Hazardous Materials .

.6 Coordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction .

.7 Product Data: provide technical data sheets for each product specified in the green roof assembly.

.8 Samples: Submit two (2) samples of each component in the green roof assembly

.9 Manufacturer's Certificate: signed by the Vegetated Roofing System Supplier verifying that the Installer is approved, authorized or licensed by Manufacturer to install specified products.

.10 Installer's Certificate: a letter, on company letterhead, signed by Installer verifying they have the specified qualifications described.

.11 Section 01 45 00 - Quality Control : maintenance reports.

.12 Reports: must be submitted quarterly, must be signed by an approved representation of Contractor/Subcontractor, must outline actions carried out as per maintenance requirements.

Part 1.6 QUALITY ASSURANCE

.1 Contractor/Subcontractor must have proven experience installing vegetated assemblies of a similar nature.

.2 Contractor/Subcontractor must have at least 5 years of proven experience in the application of growing media on elevated roof decks with a blower truck.

.3 Contractor/Subcontractor must have trained staff to facilitate maintenance of vegetated roof/system.

.4 Contractor/Subcontractor must be certified by manufacturer of vegetated roof system.

.5 All employees of Contractor/Subcontractor must maintain Fall Arrest Certificates on their person at all times while working on roof top.

Part 1.7 QUALIFICATIONS

.1 Manufacturer: company specializing in supplying of green roof systems with 5 years experience.

.2 Preference will be given to those system providers which produce their products from local sources.

.3 Installer: company specializing in performing the work of this section with 3 years experience and approved by membrane manufacturer.

Part 1.8 INSPECTION AND TESTING

.1 Product test reports: based on evaluation of comprehensive tests conducted by an independent testing agency of the specified products.

.2 Manufacturer field inspection reports: Manufacturer's written acceptance of vegetated roofing installation based on regular inspections.

SPEC NOTE: Electronic testing is an option. It may not be compatible with all conventional roofing products. If retaining, revise to include Project-specific requirements. Insert additional requirements to suit Project.

.3 Electronic testing: perform leak testing by an electronic detection process administered by a qualified testing agency. Flood testing is unacceptable as a testing procedure.

Part 1.9 PERFORMANCE REQUIREMENTS

.1 Growth media must meet FLL Guidelines for extensive media.

.2 Bulk density of growth media must be less than 1280 kg/m^3 (80 lb./ft^3). Calculations must be based on maximum media density at saturation of growing media per ASTM E2399-05.

SPEC NOTE: The dry weight of the growth media per ASTM E2399-05 is based on an oven drying procedure to remove all moisture. This is not possible in a natural environment. Dead load calculations should estimate at least

.3 Minimum dry weight of the growth media must be more than 640 kg/m^3 (or 40 lb./ft^3). Calculations must be based on dry weight of growing media per ASTM E2399-05.

.4 Entire vegetated assembly must retain at least 420 L/m^3 (3 US gallons/ft^3) of water. Calculations must include volume of water represented by difference in weight between dry and saturated weight of the growth media per ASTM E2399-05.

.5 Growth media must have a Saturated Hydraulic Conductivity of greater than 38 cm/hour (15 inch/hour) per ASTM E2399-05.

.6 All components must be made from 100% recycled materials and produced within an 800 km (500 mile) radius of project site.

.7 All materials involved in the making of the growing medium must be from recycled products.

.8 All plants and growth media must be sourced locally within an 800 km (500 mile) radius of project site.

.9 All vegetation must be verified for compatibility by the Growing Medium Manufacturer prior to acceptance.

Part 1.10 MOCK-UP

.1 Provide mock-up of vegetated roof membrane assembly and associated components and accessories to Section 01 45 00 - Quality Control .

.2 Mock-up Size: 3 x 3 m .

.3 Mock-up may not remain as part of the Work.

Part 1.11 PRE-INSTALLATION MEETINGS

.1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation in accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM) .

.2 Meeting: prior to commencement of roof installation, review and document methods and procedures related to roof deck and roofing system construction, including:

.1 Participants: authorized representatives of Contractor, Construction Manager , Owner , Consultant, Roofing Subcontractor, Roofing Manufacturer, Vegetated System Manufacturer, Vegetated System Installer.

.2 Review methods and procedures relating to vegetated roofing assembly, including Manufacturer's written installation instructions.

.3 Review construction schedule and confirm availability of products, Subcontractor personnel, equipment and facilities.

.4 Review roofing membrane type and system for conformance with vegetated assembly criteria.

.5 Review structural loading limitations of roof deck and identify temporary loading areas for storage.

.6 Review flashing details, roofing details, drains, penetrations, equipment curbs, and other conditions affecting vegetated system assembly.

.7 Review governing regulations, insurance and/or certificates where required.

.8 Review safety requirements, including fall arrest measures.

.9 Review field quality control procedures and review no-smoking policy.

.10 Prior to commencement of work obtain from the EFVM Contractor a report certifying the roof is watertight.

.11 Prior to commencement of work obtain a structural report from Consultant certifying dead load weight restrictions for the entire assembly.

.12 Prior to commencement of work, ensure coordination with related work specified in other Sections.

.13 Minutes of each meeting must be taken by a representative of Consultant and distributed to all parties within 24 hours of the meeting date.

.14 Review limits of traffic by other trades on vegetated assembly and outline procedures for compensation due to damage.

.15 Review procedure for Manufacturer's inspection visit to assess compatibility with warranty requirements.

.16 Contractor must complete a photographic record of site prior to commencement.

Part 1.12 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements .

Part 1.13 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store Products in original packaging with Manufacturer's labels and materials list intact and signed off.

.2 Store Products in designated weather protected areas, elevated from ground and protected from environmental damage.

.3 Avoid storage of products on site to prevent contamination. Install vegetation immediately upon delivery to site.

Part 1.14 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal .

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.7 Clearly label location of salvaged material's storage areas and provide barriers and security devices.

.8 Ensure emptied containers are sealed and stored safely.

.9 Divert unused metal materials from landfill to metal recycling facility as approved by [Departmental Representative, DCC Representative, Consultant .

.10 Divert unused aggregate materials from landfill to local quarry, facility for reuse as reviewed by Departmental Representative, DCC Representative, Consultant .

.11 Unused paint, coating material must be disposed of at official hazardous material collection site as reviewed by Departmental Representative DCC representative, Consultant .

.12 Unused adhesive, sealant and asphalt materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.13 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative, DCC Representative, Consultant .

.14 Dispose of unused sealant material at official hazardous material collections site approved by Departmental Representative, DCC Representative, Consultant .

.15 Dispose of unused asphalt material at official hazardous material collections site approved by Departmental Representative, DCC Representative, Consultant .

.16 Divert unused gypsum materials from landfill to recycling facility as reviewed by Departmental Representative, DCC Representative, Consultant .

.17 Fold up metal banding, flatten and place in designated area for recycling.

Part 1.15 SUSTAINABLE REQUIREMENTS

.1 Concept Design Strategy:

.1 Concept Design strategy requirements detailed in Section 01 47 13 - Sustainable Requirements: Concept Design form an integral part of this project including materials and products of this Section. Sustainable design concepts include:

.1 Holistic green design framework.

.2 Descriptions of design criteria.

.3 Setting sustainable goals based on projects design decisions.

.2 Sustainability goals are delineated with measurable performance targets.

.3 Operational requirements are specified to transform design requirements into physical (site and building) requirements.

.2 Construction:

.1 Construction requirements detailed in Section 01 47 15 - Sustainable Requirements: Construction form an integral part of this project including materials and products of this Section. Sustainable construction requirements include:

.1 Specific construction requirements for project.

.2 Specification text to ensure that project will comply with PWGSC green design process and sustainability requirements.

.3 Administrative, temporary and procedural requirements for the use of materials and methods of construction.

.3 Verification:

.1 Contractor’s verification established in Section 01 47 17 - Sustainable Requirements: Contractor's Verification form an integral part of this project. Verification requirements include:

.1 Verification of performance requirements and expected results included in Concept Design and specified in Section 01 47 15 - Sustainable Requirements: Construction .

.2 Compliance with sustainable requirements specific to this technical section.

.4 Operation:

.1 Operation requirements specified in Section 01 47 19 - Sustainable Requirements: Operation form an integral part of this project. Operation requirements include:

.1 Products, materials, services, and methods used in operation and maintenance of building consistent with procurement policy of eco-purchasing that reduces volume of wastes, material costs, toxicity of products and supports recycling.

Part 1.16 ENVIRONMENTAL REQUIREMENTS

.1 Vegetation must be installed according to optimal conditions, conducive to plant establishment and survival.

.2 All other components and growing medium may be installed at any time provided adequate protection is provided to prevent damage and erosion.

.3 Traffic is prohibited on vegetated assembly during the establishment period.

Part 1.17 MAINTENANCE

.1 Maintenance: conducted annually in accordance to this specification for entire warranty period.

.2 Initial maintenance: include weekly inspection of entire green roof for the first eight (8) weeks, providing irrigation as required to ensure survival of new plantings. Conduct bi-weekly inspection for further eight (8) visits, including irrigation, re-planting and weeding out of non-intended plantings as required.

.3 Regular maintenance: commence following initial maintenance period. Visit site month during each active growing season. This schedule includes: removal of unintended species, replacement of dead plantings, plant-appropriate pruning, cleaning of drains and maintenance free areas, programming and opening/closing of irrigation system, watering, repair or replacement of components due to normal wear and tear as required.

.4 All products in the maintenance of the green roof must be certified organic and approved by Green Roof System Supplier. Use of chemical fertilizers or pesticides is strictly prohibited.

Part 1.18 SUBSTITUTION PROCEDURES

.1 Submit requests for alternates to this specification a minimum of fifteen (15) working days prior to tender closing for evaluation in accordance with Section XXXXXX .

.1 Submit evidence that alternate materials meet or exceed performance characteristics as set out in this specification.

.2 Submit documentation from an approved independent testing laboratory certifying the performance of vegetated roof system and its components in accordance with testing methods cited in Part 1.8 Inspection and Testing of this section.

.3 Submit references clearly indicating that Vegetated Roof Installer has successfully completed projects on an annual basis of similar scope and nature for a minimum of five (5) years.

.4 Submit Manufacturer's complete set of standard details for extensive vegetated roof system.

.5 Submit a list of five (5) projects executed over the past twelve months and any related case studies.

Part 1.19 WARRANTY

.1 Warranty commences at substantial completion of project.

.2 Installer's warranty: a standard two year workmanship warranty covering supply and installation of all components of vegetated assembly as specified in this Section.

.3 System Supplier's extended warranty: a written warranty that System Supplier will replace, at no cost to Owner, any portion of vegetated assembly which does not perform adequately for a specified period beyond standard workmanship warranty (Part 1.19.2).

.1 Installer must make application and obtain extended warranty from System Supplier.

.2 System Supplier's warranty will outline their maintenance requirements for extent of warranty period.

.3 System Installer will supply a list of certified Maintenance Contractors to conduct the maintenance program.

.4 System Supplier's warranty will run concurrently with all other warranties.

Part 2 Products

Part 2.1 SYSTEM SUPPLIER

.1 Supplier of vegetated roof assembly having systems and/or products approved for use:

.1 Bio-System Green Roof System by Bioroof Systems Inc., www.bioroof.com, 1-866-377-5177

Part 2.2 MATERIALS

SPEC NOTE: Where a protected roofing membrane configuration is used, the root barrier must be placed on the membrane prior to installation of insulation.

.1 Root Barrier:

.1 Material: Heavy duty re-inforced polymer film, 10 mil thick, three-ply laminate with high strength cord grid, flame-retardant.

.2 Flame Spread Index-Class A ASTM E84: 5.

.3 1" Tensile Strength ASTM D7003: 6.9 kg/m (50 lb./ft).

.4 Elongation at break ASTM D7003: 600%.

.5 Grab Tensile Strength ASTM D7004: 10.7 kg/m (78 lb./ft).

.6 Trapezoid Tear ASTM D4533: 7 kg/m (52 lb./ft).

.7 Hydrostatic Resistance ASTM D751: 510 kPa (74 psi).

.8 Mullen Burst ASTM D751: 1165 kPa (169 psi).

.9 Product approved for use: Bio-Rootstop FR by Bioroof Systems Inc.

.1 Accessory: Bio-Tape by Bioroof Systems Inc.

SPEC NOTE: Remember to eliminate insulation from membrane roofing section (Section 07 55 63) where a protected membrane assembly is used.

.2 Horizontal Insulation:

.1 Material: Polystyrene extruded foam board, conforming to ULC-S701-05 (ASTM C578), Type IV with shiplapped edges.

.2 Thickness as specified and/or as shown on drawings.

.3 Thermal Resistance ASTM C518: 2 per cm at 23.8 degrees C (5 per inch at 75 degrees F).

.4 Compressive Strength ASTM D1621: 275 kPa (40 psi).

.5 Water Absorption ASTM C272: 0.1% average.

.6 Product approved for use: Roofmate by Dow Chemical.

SPEC NOTE: Choice of depth of Drainage/Water Retention Panel is based on water holding capacity and dead load restrictions.

Pick ONE option only.

○ .3 Retention/Drainage Panel :

.1 Retention/Drainage Panel Material: 100% recycled HDPP, moulded into a three-dimensional sheet with filter fabric attached to form an integrated drainage/water retention system.

.2 Water retention: 7 L/m^2 (0.172 US gallon/ft^2).

.3 Roll dimensions: 2 m x 20 m (6.6 ft x 65.6 ft).

.4 Product approved for use: Bio-Retention Panel 0.5 by Bioroof Systems Inc.

[OR]

◉ .3 Drainage Layer :

.1 Drainage Layer Material: three-dimensional woven polypropylene mat, open weave with filter fabric laminated to top surface.

.2 Mechanical properties:

.1 Tensile strength ASTM D5035 (modified): 215.7 kg/m (145 lb./ft).

.2 Thickness ASTM D5199: 19 mm (0.75 inch).

.3 Mass/unit area ASTM D5261: 406 g/m^2 (12.0 oz/yd^2).

.4 UV stability ASTM DG53/ASTM D5035 (modified): 80% strength retained.

.3 Performance properties:

.1 Permissible velocity:

.1 Product only flume test 1: 6.1 m/second (20 ft/second).

.2 30 minute, vegetated flume test 1: 5.8 m/second (19 ft/second).

.3 50 hour, vegetated flume test 1: 4.3 m/second (14 ft/second).

.2 Permissible shear stress:

.1 Product only flume test 1: 54.7 kg/m^2 (11.2 lb./ft^2).

.2 30 minute, vegetated flume test 1: 48.8 kg/m^2 (10.0 lb./ft^2).

.3 50 hour, vegetated flume test 1: 39.1 kg/m^2 (8.0 lb./ft^2).

.4 Product approved for use: Bio-Void FF by Bioroof Systems Inc.

.4 Filter Fabric:

.1 Use for trimming around perimeter and projections.

.2 Mechanical properties:

.1 Grab tensile strength ASTM D4632: 11.1 kg/m (80 lb./ft).

.2 Elongation ASTM D4632: 50%.

.3 Trapezoid tear ASTM D4533: 4.8 kg/m (35 lb./ft).

.4 Puncture ASTM D4833: 6.2 kg/m (45 lb./ft).

.5 CBR puncture ASTM D6241: 30.4 kg/m (220 lb./ft).

.6 Mullen burst ASTM D3786: 1103 kPa (160 psi).

.3 Endurance properties:

.1 UV stability ASTM D4355: 70% @ 500 hours.

.4 Hydraulic properties:

.1 Permittivity ASTM D4491: 2.2 seconds.

.2 Water flow rate ASTM D4491: 60oz./min/m^2 (160 gpm/ft^2).

.3 Permeability ASTM D4491: 0.22 cm/second.

.4 Opening size ASTM D4751 US sieve number: 70.

.5 Physical properties:

.1 Weight ASTM D5261: 0.108 kg/m^2 (3.2 oz/yd^2).

.2 Thickness ASTM D5199: 45 mil.

.6 Product approved for use: Bio-Filter Fabric TR by Bioroof Systems Inc.

.5 Growing Medium:

.1 Material: lightweight, biologically populated, soil-less mix of organic and inorganic material that will support a wide variety of plant growth, retain and remediate storm water run-off.

.2 As per FLL Guidelines.

.3 Depth: 50 mm (2 inch) [OR] 75 mm (3 inch) compacted depth.

.4 Product approved for use: Bio-Mix Euro-Blend by Bioroof Systems Inc.

.6 Vegetation: SPEC NOTE: Vegetation can come in 1) Plugs, 2) Cuttings, or 3) Mats.

Pick ONE option only. ◉

.1 Plug plants are to be provided in 72-plug tray with well-established rooting.

.1 Spacing: 23 cm (9 inch) on centre.

.2 Product approved for use: Bio-Plugs by Bioroof Systems Inc.

[OR]

- .1 Cuttings are to be provided in bulk bags.
  - .1 Spread Rate: 12 kgs./100m^2 (25 lb./1000 ft^2)
  - .2 Product approved for use: Bio-Clippings by Bioroof Systems Inc.

[OR]

- .1 Pre-grown sedum succulents in Mat Form
  - .1 Three dimensional filament mat pre-grown with succulent vegetation and growing media to form a cohesive vegetated blanket.
  - .2 Species contained in mat are as follows: Sedum album “Coral Carpet”, Sedum album “Orange Ice”, Sedum acre “Aureum”, Sedum floriferum “Weihenstephaner Gold”, Sedum kamtschaticum “Variegatum”, Sedum reflexum “Blue Spruce”, Sedum spurium “Tricolour”, Sedum spurium “Green Mantle”, Sedum spurium “John Creech”, Sedum spurium “Red Carpet”, Sedum spurium “Summer Glory”, Sedum rupestre “Angelina”.
  - .3 Product approved for use: Bio-Mat by Bioroof Systems Inc.

Part 2.3 ACCESSORIES

SPEC NOTE: Other finishes are available. Check with Paver Manufacturer.

.1 Pre-cast Concrete Pavers:

- .1 Natural colour with shot blast finish.
- .2 Built-in pedestals.
- .3 610 mm x 610 mm x 57 mm (24 inch x 24 inch x 2 $^3/_4$ inch).
- .4 Product approved for use: Pedslab by Brooklin Concrete Products.

.2 Drain Inspection Chambers:

- .1 Material: aluminium, form bent from solid sheet.
- .2 Must be perforated at the drainage course level to allow for free drainage and solid at the growing layer to prevent rooting and plant growth through the edging.
- .3 Height: 25 mm (1 inch) higher than the finished growing medium height.
- .4 Shape: box-shaped, with a solid lid fitted with locking mechanisms.
- .5 Total exterior dimensions: 381 mm x 508 mm x 150 mm (15 inch x 15 inch x 6 inch)
- .6 Product approved for use: Bio-Chamber AL-M by Bioroof Systems Inc.

.3 Edging:

- .1 Material: extruded aluminium edging.
- .2 Must be perforated at the drainage course level to allow for free drainage and solid at the growing layer to prevent rooting and plant growth through the edging.

.3 Shape: L-Shaped with a lip at the top

.4 101.60 mm wide x 114 mm tall (4 inch x 4 1/2 inch), 9.525 mm lip (3/8 inch).

.5 Drainage hole radius: 19 mm (3/4 inch).

.6 Product approved for use: Bio-Edge AL 5 by Bioroof Systems Inc.

SPEC NOTE: Paver strips are used to secure pavers to edging and modules for superior uplift resistance. Choose stainless steel option (Bio-Edge SST-WUC) if installing in a coastal area where salt contamination may occur.

.4 Paver Hold-Down System:

.1 Material: extruded aluminium.

.2 System includes paver edge aluminium strip, aluminium paver strip cup, and connector tabs.

.3 Paver edge aluminium strip:

.1 Dimensions: 610 mm x 38 mm x 3.2 mm (24 inch x 1 ½ inch x 1/8 inch).

.2 4 holes along strip with diameter 4.8 mm (3/16 inch).

.4 Paver strip cup:

.1 Dimensions: 102 mm x 76 mm 12.7 mm (4 inch x 3 inch x ½ inch).

.2 3.18 mm (1/8 inch) deep groove runs, centred, along length of strip cup.

.3 When paver strip cup is used, paver pedestal is unnecessary.

.5 Product approved for use: Bio-Paver WUC by Bioroof Systems Inc.

.5 Tape:

.1 Material: Film backing lined with acrylic adhesive.

.2 Self--adhered, waterproof flashing membrane with acrylic pressure sensitive adhesive.

.3 Temperature tolerant and adheres to damp surfaces.

.4 50 m (2 inch) wide x 22.8 m (75 ft) roll.

.5 Product approved for use: Bio-Tape S by Bioroof Systems Inc.

SPEC NOTE: The decision to use erosion netting is dependent on a number of variables, including, but not limited to, building's location, orientation, design, height, parapet wall height, vegetation selection, in areas of exceptional

.6 Erosion Netting:

.1 Material: polymer netting, 5 mm fused grid with 1-inch holes.

.2 Colour: black.

.3 To be used in applications where more than one (1) year and less than three (3) years of erosion control is required.

.4 Product approved for use: Bio-Net by Bioroof Systems Inc.

SPEC NOTE: The installation of a leak detection system is recommended for all vegetated roofs. Some roofing systems may not be compatible. Consult with Manufacturer.

.7 Leak Detection System:

Insert Leak Detection System Specification here.

SPEC NOTE: The installation of an irrigation system is dependent on the design of the entire vegetative assembly as well as local climate. Consult with Manufacturer.

.8 Irrigation:

.1 Sprinklers:

.1 Sprinkler bodies must be Schedule 80. Add extensions as required to accommodate plantings.

.2 Sprinkler nozzles must be rotary-type and inserted into the sprinkler bodies as per system supplier's literature and instructions. Add extensions as required to accommodate plantings

.3 Products approved for use: Hunter PS bodies and MP Rotator 2000 nozzles.

.2 Pipe:

.1 All pipes must be continuously and permanently marked with the following information: Manufacturer's name or trademark, size, schedule and type of pipe, working pressure at 21 degrees C (72 degrees F). Polyethylene pipe: 19 mm ($^3/_4$ inch) or larger and be of high, medium or low density with a minimum pressure rating of 517 kPa (75 psi). All polyethylene pipe should be a minimum schedule 40-standard.

.2 P.V.C. pipe: class 160, SDR 26 direct burial pipe conforming to CS – 256-63 and homogeneous throughout and free from visible cracks, dents, hole or foreign materials. All plastic pipe fittings to be installed shall be schedule 40 moulded fittings manufactured for the same material as the pipe and shall be suitable for solvent weld, slip joint ring tight seal, or screwed connections. No fittings made of other material shall be used except brass saddle tees and crosses as hereinafter specified. Slip fitting socket taper shall be so sized that a dry unsoftened pipe end, conforming to these special provisions, can be inserted no more than halfway into the socket. All threaded connections under pressure should be teflon taped or an equivalent substitute. Compressive strength ASTM D1621: 275 kPa (40 psi).

.3 Automatic control valves:

.1 All automatic valves: of current design and manufacturing date, and 24-volt electric solenoid or hydraulically controller. Material: P.V.C. plastic, or brass construction featuring slow opening and closing operation, with a manual bleed device.

.2 All manual and automatic valves: enclosed in thermo plastic boxes with covers, of size as required to permit "ease of access" for service purposes. The term "ease of access" means that every solenoid and manual valve should have adequate access for all types of maintenance. All valve access boxes: installed on a suitable base for stability and drainage.

.3 Products approved for use: Hunter PGV Series or Rainbird JTV Series.

.4 Automatic controllers:

.1 All automatic irrigation controllers: of current design and manufacturing date by a name brand manufacturer or irrigation supplier. They may be

of solid state or electro-mechanical construction, to operate from a conventional 115 volt service.

.2 Minimum features that the unit offers:

.1 Four stations of independent duration settings,

.2 24 hour clock,

.3 Rainy weather shutdown mode,

.4 Seven or fourteen day calendar cycle,

.5 Master valve or pump start circuit,

.3 Products approved for use: Hunter or Rainbird Automatic Controllers.

.5 Wiring:

.1 All 115 volt wiring: conform to local electrical codes.

.2 All 24 volt control wire between solenoid valves and controllers: Number 14 gauge TWU-40o solid conductor, white jacket for the common wire, and coloured for the power wire. For runs less than 150 m (500 ft), and single valve operation: Number 16, Number 18, Number 20 gauge multi-coloured and conductor wire may be used. If two controllers are used, each unit must have its own common wire.

Part 3 Execution

Part 3.1 EXAMINATION

.1 Examine surfaces and report any adverse conditions which may negatively impact appearance or performance of vegetated roof system. Ensure all unacceptable conditions are corrected before proceeding.

.2 Ensure adequate provisions have been made for loading, unloading, storage, parking and access to roof site.

.3 Execute work in accordance with the specification, drawings and details.

.4 Report any imbedded object or obvious damage to Consultant.

.5 Ensure all equipment is in good working order. Protect all equipment which comes into contact with roofing membrane, flashings and related work.

.6 Ensure adequate safety equipment has been obtained for all operations.

Part 3.2 SYSTEM INSTALLATION

SPEC NOTE: Installation of Electronic Leak Detection is optional and may not apply in all conditions.

.1 Electronic Leak Detection:

Insert Leak Detection System specification here.

.2 Root Barrier:

.1 Install root barrier continually over finished membrane surface, including all vertical surfaces and projections.

.2 Overlap and seal with Manufacturer's tape all side and end laps a minimum of 100 mm (4 inch) and allow for root barrier to reach up all verticals 25 mm (1 inch) above the intended soil line and secure.

SPEC NOTE: Remember to eliminate insulation from membrane roofing section (Section 07 55 63) where a protected membrane assembly is used.

.3 Horizontal Insulation:

.1 Lay insulation in parallel courses, staggering end laps and side laps. Do not force into place.

.2 Cut insulation to fit neatly at projections and terminations with less than 1-inch tolerance.

.4 Edging:

.1 Install edging along perimeter border between vegetation-free area and vegetated area.

.2 Ensure base flange is pointed towards the vegetated areas.

.3 Make sure edging includes 2-inch adhesive strip along top of edge, below lip, to accept filter fabric.

.4 Secure edge of foot-wide filter fabric trim to edging surface.

Pick ONE option only.

○ .5 Retention/Drainage Panel :

.1 Lay retention/drainage board panels over insulation up to vertical edging.

.2 Cut tightly around any projections, drains, etc.

.3 Bond fabric surface to filter fabric with Manufacturer's tape. Allow for 1-inch of excess filter fabric.

[OR]

◉ .5 Drainage Layer :

.1 Lay 3 dimensional drainage mat, pointed surface down, over insulation up to vertical edging.

.2 Cut tightly around any projections, drains, etc.

.3 Bond fabric surface to filter fabric with Manufacturer's tape. Allow for 1-inch of excess filter fabric.

.6 Inspection Chambers:

.1 Install inspection chamber centred over drains directly on the insulation board. Ensure the bottom inner edge of the chamber is outside of the outer edge of the drain flange.

.2 Install vertical drains around outside of inspection chamber.

.3 Install filter fabric over vertical drains and over lip of inspection chamber.

.4 Cut slits in fabric to fit around locking pins and adhere to top inside edge with Manufacturer's tape.

.7 Irrigation Lines and Sprinkler Bodies

.1 Lay lateral lines per zone as per irrigation drawings.

.2 Install sprinkler bodies in locations as per irrigation drawings.

.3 Install main lines, valves, valve boxes and controller wires in accordance with irrigation drawings.

.8 Roof Pavers:

Pick ONE option only.

○ .1 Roof Pavers:

.1 Place filter fabric over polystyrene insulation and cut to fit.

.2 Place roof pavers over filter cloth. Push pavers against edging and ensure there is a tight fit between parapet wall and edging.

[OR]

SPEC NOTE: For superior wind uplift resistance, choose roof pavers with Paver Hold-Down System.

◉ .1 Roof Pavers with Paver Hold-Down System:

.1 Place Paver strip cups beneath two adjacent roof pavers. Line up the edges of the pavers with the outside edge of grooved center of strip cups.

.2 Place Paver Edge Aluminium Strip on top of the seam between the two pavers, lined up with the strip cups.

.3 Screw four (4) stainless steel, self-tapping, pan head Phillips Drive screws with diameter 1/8-inch through each of the holes in the Paver Edge Aluminium Strip so it attaches to the Strip Cup beneath. Length of screws should be of sufficient length to attach to strip cup beneath.

.4 Use corner connector tabs for edges of vegetation-free zone adjacent to modules. Clean surface of connector tab. Peel backing off of adhesive strip on connector tab and adhere it to edging.

.5 In the case where vegetation-free zone is wider than one-paver's width:

.1 Insert straight connector tabs between the two pavers if necessary. Attach next two connected pavers to connector tab.

.9 Growing Media:

.1 Growing media must be installed using a truck-mounted, integrated, pneumatic blower unit. In order to ensure accuracy, the unit should be powered by its own separate diesel power unit, not PTO driven, and equipped with at least one computer-controlled supplemental granular injection system.

.2 The unit must be capable of uniformly applying materials and injected products at a rate greater than 11 m^3/hour (15 yd^3/hour) at least to a vertical limit of 45 m (150 ft) and must also be equipped with an application hose capable of extending 90m (300 ft) from the blower truck.

SPEC NOTE: Installation of erosion netting is optional and based on site conditions. Erosion netting should be installed AFTER seeding applications but BEFORE planting applications.

.10 Vegetation:

Pick ONE option only.

○ .1 Plug plants:

.1 Erosion netting to be installed as indicated on drawings and details. After growing media is installed, stretch netting over growing media and fasten

to edging at 50.8 mm (2 inch) intervals. Fasten all seams with tie wrap fasteners at 2.44 m (8 ft) intervals.

.2 Where plug plants are used, dig a hole in excess of the size of the root ball after extracting it from the pot. Lightly cover root ball, ensure plants are planted to their full root depth and gently tamp in place.

.3 If netting is used, cut holes sufficient in size to plant through. pre-vegetated mats over the growing media, ensuring edges are firmly butted together.

[OR]

○ .1 Cuttings:

.1 Spread cuttings over growth media at the prescribed rate. Water thoroughly.

.2 Erosion netting to be installed as indicated on drawings and details. After growing media and cuttings are installed, stretch netting over growing media and fasten to edging at 50.8 mm (2 inch) intervals. Fasten all seams with tie wrap fasteners at 2.44 m (8 ft) intervals.

[OR]

◉ .1 Pre-grown sedum succulents in Mat Form:

.1 Lay pre-vegetated mats over the growing media, ensuring edges are firmly butted together.

.2 Trim to fit neatly around projections and edges.

.3 Dispose of excess mat.

Part 3.3 FIELD QUALITY CONTROL

.1 Contractor/Subcontractor must have proven experience installing vegetated assemblies of a similar nature.

.2 Contractor/Subcontractor must have trained staff to facilitate maintenance of vegetated roof/system.

.3 Contractor/Subcontractor must be certified by manufacturer of vegetated roof system.

.4 All employees of Contractor/Subcontractor must maintain Fall Arrest Certificates on their person at all times while working on roof top.

.5 Require site attendance of roofing materials manufacturer's representative during installation of Work.

.6 Field quality control is under control of Contractor. Field quality assurance is monitored by Departmental Representative, DCC Representative, Consultant independent inspection .

.7 Inspection and testing of roofing application through electronic field vector mapping will be carried out by Departmental Representative, DCC Representative, Consultant .

.8 Departmental Representative, DCC Representative, Consultant will pay for tests as specified in Section 01 45 00 - Quality Control .

.9 Correct identified defects or irregularities.

Part 3.4 VERIFICATION

.1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification , include:

.1 Materials and resources. Storage and collection of recyclables.

.2 Construction waste management.

.3 Resource reuse.

.4 Recycled content.

.5 Local/regional materials.

.6 Low-emitting materials.

Part 3.5 OPERATION REQUIREMENTS

.1 Operational requirements in accordance with Section 01 47 19 - Sustainable Requirements: Operation , include:

.1 Cleaning materials and schedules.

.2 Repair and maintenance materials and instructions.

Part 3.6 CLEANING

.1 Gather and dispose all debris upon completion of work of this section.

.2 Clean all surfaces and inspect final assembly for approval.

Part 3.7 REPORTS

.3 Submit maintenance reports quarterly to Owner and Green Roof System Manufacturer (to maintain warranty).

.4 Maintenance reports must be signed by an approved representative of Contractor and/or Subcontractor.

.5 Maintenance reports must outline actions carried out in accordance with maintenance requirements of this specification, as well as dates, personnel at each visit and notes on growing conditions.

.6 Subcontractor not conforming to the above maintenance requirements will be replaced, however, will still be held responsible for the results and costs of the replacement Subcontractor.

END OF SECTION