The information contained in this technical specification includes patented product information, materials, and construction practices associated with installation of the GreenGrid® green roof system. This specification is intended to assist Design Professionals, Architects and Specifiers of green roof systems. Additional information is available at www.greengridroofs.com

SECTION 07 33 63 – VEGETATED GREEN ROOF SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section specifies all labor, materials, equipment and services necessary to furnish and assemble a Vegetated Green Roof System, as provided by GreenGrid® and as shown on the Drawings and described herein.

B. SCOPE OF WORK:

1. Section describes Vegetated Green Roof Systems for modular ultra-extensive trays (2.75-inch depth), extensive trays (4-inch depth), semi-intensive trays (6-inch), and intensive trays (8-inch).

C. RELATED SECTIONS AND DOCUMENTS:

1. Section 075563 - Waterproofing or Membrane Roofing for Green Roofing Systems
2. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this section.
3. GreenGrid® green roof technical specifications at: www.greengridroofs.com
4. Section 072113 – Lightweight Expanded Polystyrene
5. Section 328000 – Irrigation Systems for Green Roof

1.2 REFERENCES

A. Standards for Vegetated Green Roof Systems:

1. Vegetated Green Roof System Manufacturer's specifications, plans and guides
2. ASTM E2396 Standard Testing Method for Saturated Water Permeability of Granular Drainage Media for Green Roof Systems
3. ASTM E2397 Standard Practice for Determination of Dead Loads and Live Loads Associated with Green Roof Systems
4. ASTM E2398 Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Green Roof Systems
5. ASTM E2399 Standard Test Method for Maximum Media Density for Dead Load Analysis
6. ASTM E2400 Standard guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems
7. ASTM D5261: Standard Test Method for Measuring Mass per Unit Area of Geotextiles
8. Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V.(abbreviated as "FLL" guide), [aka Landscaping and Landscape Development Research Society], German Green Roof Guidelines for planning, execution and upkeep of Green Roofs
9. ANSI/SPRI VF-1 External Fire Design Standard for Vegetative Roofs

10. ANSI/SPRI RP-14 Wind Design Standard for Vegetative Roofing Systems

1.3 DEFINITIONS

A. Contract Documents: All specifications and Drawings that collectively describe the requirements for construction of the Project.

B. Vegetated Green Roof: An area of landscaped planting constructed over a waterproofed substrate and separated from the natural ground by a structure.

C. Vegetated Green Roof System: The complete system of materials and components which are installed above the waterproofing and result in a vegetated green roof surface.

D. Ultra-Extensive Green Roof: Specifically designed for lightweight applications where structural requirements are calling for <20lbs/sf. These systems only allow for a limited selection of sedums in temperate climates (Northeast, Upper Mid-Atlantic, Upper Midwest, Pacific Northwest). Irrigation is recommended, and may be required for long term success due to reduced drought tolerance.

E. Extensive Green Roof: These extensive green roof systems are constructed in shallow soil depths nominal 4-inches with hearty, drought-tolerant plants such as sedums, herbs and groundcovers. In northern climates, extensive green roofs typically do not require permanent irrigation systems. However irrigation may be needed in semi-arid and arid climates. Extensive green roof systems are low-maintenance and typically require occasional weeding or plant maintenance on an annual basis.

F. Semi-intensive Green Roof: The semi-intensive green roof systems are planted in 6-inch (15.24 cm) depths to support a wider array of plant varieties such as sedums, perennials and ornamental grasses. The semi-intensive systems require more maintenance associated with perennial plantings and often utilize drip-irrigation systems for watering especially in arid or humid climates.

G. Intensive Green Roof: A complex landscaping ecosystem requiring regular maintenance consisting of soil depths of 8- inches (29.32 cm) or deeper and planted with a wide variety of plant species that may include herbaceous perennials, ornamental grasses, and small shrubs that are suited to the regional climate. Roof top gardens are often assembled using intensive green roof systems. Intensive green roof systems will require irrigation systems in most climates and depending on plantings. Intensive green roof maintenance is more labor-intensive and similar to ground-level landscapes using advanced horticultural care.

H. Growing Medium or Substrate: An engineered, blended mixture composed of composted organic matter and lightweight, coarse and porous aggregate. The substrate is blended to be lightweight and conducive to vigorous plant growth.

I. Sedum Tile or Mat: An integrated layer of sedum which covers the entire surface of growing media in the green roof modules. The sedum may be grown in the modules from plugs or cuttings, or alternatively pre-grown in a production field and harvested into tiles or mat and then rooted in the modules.

J. Green Roof System Installer (or ‘Installer’): Company retained to install the green roof system as per a specification or purchase contract.

K. Green Roof System Provider: Company (Weston Solutions, Inc.) that is the exclusive owner and manufacturer of the GreenGrid® green roof system and furnishes and delivers the green roof system to the project site.

L. Waterproofing Provider: Company that provides and/or certifies all materials required for installation of the building/roof waterproofing, furnishes and verifies installation and water tightness and confirms acceptability prior to installation of the Green Roof System.

M. Polystyrene Insulation: The Green Roof System must be fully supported. On roof surfaces that are uneven or require different profiles, rigid polystyrene insulation can be used beneath the green roof modules.

1.4 VEGETATED GREEN ROOF SYSTEM DESCRIPTION

A. Design Considerations:

1. The plants are grown in a growth media layer contained within a module which is designed to promote drainage and distribute moisture.

2. The weight of the system at Maximum Water Capacity as per ASTM E2399. The green roof system dead load, measured according to ASTM D2397, when added to the weight of the waterproofing system, shall not exceed the maximum allowable dead load for the roof. The Owner, Design Professional, Architect or Specifier shall review and verify the adequacy of the building or structure to support the green roof system in all conditions.

3. The Owner or designated Representative shall verify the integrity of the waterproofing surface prior to installation of the green roof system.

4. Building codes are beyond the purpose and intent of this specification. The Owner, Design Professional, Architect or Specifier shall review applicable federal, state, regional and local building codes in regard to green roof installations and limitations.

B. Performance Requirements: Vegetated roof covering system shall:

1. Support sedums, herbs, perennials, moss and other vegetated groundcovers as selected by the owner;

2. Provide efficient drainage of moisture that is in excess of that required for the vigorous growth of the installed vegetation;

3. Protect roof waterproofing materials from damage caused by exposure to ultraviolet radiation, physical abuse, and rapid temperature fluctuations

4. Retain moisture in accordance with ASTM E2398.

1.5 SUBMITTALS

A. Shop Drawings: Submit to the Green Roof Provider a scaled plan or Drawing illustrating the green roof layout, location of roof drains, and roof details such as walkways, mechanical equipment, and accessories. Such documentation is required to support the warranty.

B. Product data for vegetated green roof systems, components with descriptive data, plant lists, technical data bulletins, and specifications, indicating limitations.

C. Product substitutions or components that vary from the specification shall be submitted in advance for review and approval.

D. Green Roof Provider Information: Technical product data or bulletins, specifications, LEED® submittals, installation guide and maintenance protocols.

E. Certifications (optional): Verification that Installer is qualified to perform work of this Section.

F. Warranty: Submit product warranty and insure Owner is registered with Provider.

G. Maintenance Guide: Written recommendations for maintenance of the vegetated green roof system that describes a maintenance schedule for watering, weeding and plant care.

1.6 QUALITY ASSURANCE

A. Single Source Responsibility: Vegetated green roof components shall be from a single source, the GreenGrid® green roof system. Installer may request inspection or oversight during installation from the Green Roof Provider. Plants may be sourced from local commercial nurseries in locations where GreenGrid does not offer pre-grown systems.

B. There shall be no deviation from this Specification or the Drawings. Installer assumes liability for any deviations from Specifications and/or Drawings.

C. Installer Qualifications: Installer shall be qualified to install the vegetative green roof system. If Installer does not meet the minimum requirements, Green Roof Provider technical representative shall be present for at least 1 work day to verify training and module handling.

D. Roofing Inspection: By Owner or designated Waterproofing Provider to verify that the waterproofing surface is approved for installation of the vegetated green roof system.

1. At a minimum, a slip sheet or protection layer (6 ounce non-woven geotextile or equivalent) may be required to protect the work surface and waterproofing warranty. Verify and document the need for a slip sheet or protection layer.

2. Verify existing roof loads and roof load limitations prior to hoisting green roof materials.

E. Once the green roof installation is complete, an inspection shall be conducted by a technical representative of the Green Roof Installer and/or the Green Roof Provider to verify that the green roof system was installed properly.

1.7 PRODUCT DELIVERY, HANDLING, STORAGE, PROTECTION

A. Green roof modules are to be delivered in good condition. Green roof modules are to be handled carefully and to prevent damage to the plants. Modules shall have plastic unwrapped (if shipped on pallets) the same day as delivery to avoid plant damage caused by overheating.

B. Conduct roof top staging of green roof system components after verifying roof loads and acceptable staging areas. Stage green roof modules over plywood panels or protective sheeting.

C. Green roof modules are to be conveyed to the roof surface with equipment that is designed and certified to hoist the associated weights safely and in accordance with equipment capacity, and local codes and regulations.

D. Protect the roof deck and waterproofing membranes using appropriate materials such as plywood sheeting. Avoid using sharp tools and keep the roof surfaces clean and free of soil, grit, or debris.

1.8 WARRANTY

A. Module Warranty: The Product is warranted for a period of twenty years from the date of shipment. The Product is defined as the GreenGrid® module(s) and excludes media and plants or any accessories.

B. Standard Plant Warranty: Plants shall be pre-grown and shipped in a healthy condition and specified plant coverage depending on planting schedule, season and anticipated growth. All plants found to be dead or damaged during shipment will be replaced at no additional charge during the initial 30 days from shipment. The 30-day plant warranty covers those plant species selected. The warranty is not effective for installations completed outside of the recommended installation season (April 15th to October 15th).

C. Extended Plant Warranty: Extended plant warranty may be available for 1-year and 2-year periods, upon request, or when and as specified, with documented proof of maintenance required.

D. Overburden Removal: A ‘wrap-around’ or total system warranty that combines the Waterproofing Provider and Green Roof Provider warranties and provides for overburden removal may be available, on request, or when and as specified. Requires use of the GreenGrid® system with Carlisle waterproofing products.

1.9 MAINTENANCE

A. The vegetated green roof system Installer shall maintain the modules for at least 30 days following installation.

B. Maintenance during the initial 30-days shall follow industry accepted horticultural practices.

1. Watering: two watering events per week to sufficiently saturate the growing medium.

2. Provide spot weeding (by hand), as needed, to maintain plant health and prevent weed to flower and set seed, and to prevent woody plants to establish. Do not use any pesticides which include herbicides.

3. Repair, rework and replant, if necessary, areas where wash out caused erosion, and replace dead plants.

C. Maintenance protocols:

1. Provide the GreenGrid® maintenance guide and protocols to the Owner for extended maintenance of the green roof system.

2. Provide a report(s) to the Owner outlining post-installation green roof conditions and observations about plant care and the initial maintenance period.

PART 2 - PRODUCTS

2.1 GREENGRID® GREEN ROOF SYSTEM

A. General: The green roof components for this system are specifically the GreenGrid® green roof system. The use of other products is not the responsibility of GreenGrid® and is expressedly disclaimed by the warranty. No substitutions allowed.

B. Provided By: Weston Solutions, Inc. and GreenGrid
Product Technical Information and Sales: (888) 404-4743 or www.greengridroofs.com

2.2 GREENGRID® COMPONENTS

A. Modular Trays: The tray or module with built-in water retention and drainage channels shall eliminate the need for additional drainage material and root barriers, except where required by the Waterproofing Provider.

1. Material: Modules are formed from 100% pre-consumer linear low density or medium density polyethylene. Protected with UV inhibitor and stabilizers. Black color. Thickness standards as follows:
    a. Ultra-Extensive: 100 mil
    b. Extensive: 100 mil
    c. Semi-Intensive: 110 mil
    d. Intensive: 110 mil

2. Modules size (L x W): 2 ft. (60.96 cm) x 2 ft. (60.96 cm). Module outside diameter (OD) is +/- 1/8 inch (0.318 cm). Drainage clearance above roof surface 0.75-inch (1.91 cm). Depth of modules as follows:
    a. Ultra-Extensive 2.75-inch (6.99 cm)
    b. Extensive 4-inch (10.16 cm)
    c. Semi-Intensive 6-inch (15.24 cm)
    d. Intensive 8-inch (20.32 cm)

3. Weight (bulk density at maximum water holding capacity) – note may vary by region
    a. Ultra-Extensive: 12 to 15 lbs/sf (58 to 73 kg/ m^2)
    b. Extensive: 26 to 30 lbs/sf (126 to 147 kg/m^2)
    c. Semi-Intensive: 39 to 44 lbs/sf (190 to 215 kg/m^2)

d. Intensive: 52 to 60 lbs/sf (254 to 293 kg/m^2)

B. Growing Media or Substrate: Provide in accordance with ASTM references. Growing media is available in different blends based on geographic availability of resources and as follows:

1. Shall be engineered light-weight materials consisting of inorganic aggregate and organic components blended to satisfy FLL guidelines.
2. Blended media shall have high water holding capacity while maintaining air porosity within the growth media. Available in bulk and smaller 1.5 CF sacks.
3. Custom blends may be available to meet project-specific requirements.

C. Green Roof Vegetation (Plants):

1. Vegetation shall be pre-grown and in healthy condition rooted in the modules prior to shipment and delivery in most cases. An alternative approach is noted below using sedum mat or tile. Vegetation shall be installed in accordance with the landscape design or GreenGrid® layout Drawing.

2. Plant selection shall conform to the USDA Plant Hardiness Zone and classification. Refer to the Provider's technical bulletins and data. Plants shall be composed of drought resistant ground covers such as sedums, herbs, succulents, perennials and grasses. Plant varieties shall be suited to the local or regional climate and conditions. Horticulturalists and Landscape Architects can be helpful for consultation.

3. Plant Density and Coverage: Plant stock and selection shall consider the timeframe for pre-growing and the percent of coverage desired at installation. A fully mature, pre-grown module typically requires 4 to 6 months of growing to attain 95% plant coverage or better upon delivery and installation. Shorter timeframes between ordering and installation will result in lower plant coverage. Non-groundcover plant types may also require more time to reach full coverage depending on planting density and starter size.

4. Planting Methods

a. Pre-Grown at nursery: using cuttings, plugs, or pots, depending on plant type at planting density or spacing as shown on the Drawings.

b. Sedum Mat or Tile: Sedum mat or tile are grown to maturity and can be installed in modules at the nursery prior to shipping, or can be shipped to the work site and rooted in modules. Typically sedum mat is harvested in larger pieces similar to sod and then rolled for shipping. Mat can then but cut into sedum tile. Sedum tiles measure 2 square feet and typically weigh about 4.5 pounds. Sedum tile are pre-grown using 12 or more sedums and rooted in the prefilled modules. Timeframe between ordering and installation can be shortened using sedum mat or tile.

2.4 GREEN ROOF ACCESSORIES

A. Slip Sheet or Protection Layer: Protection slip sheet as recommended or approved by the waterproofing Provider for use during installation of the vegetated green roof modules. In the absence of a recommendation from the waterproofing Provider, we recommend using:

1. Nonwoven needle-punched geotextile of 6 ounce/square yard (weight) in accordance with ASTM D5261. Geotextile manufactured for subsurface drainage and separation.

B. Walkway Pavers (optional): Access to the green roof to conduct roof maintenance or if arranged as an accessible, garden-style roof can be accomplished using walkway pavers. Numerous options are commercially available such as:
   a. Textured concrete pavers – 2'x2'x2" precast concrete plaza pavers weighing approximately 18-25 psf with a minimum compressive strength of 6,500-8,500 psi. Available in several standard colors. Use a pedestal.
   b. Brazilian hardwood ipe´ pavers (2'x2' squares). Use a pedestal.
   c. Rubber pavers – (2'x 2' squares), many are manufactured from recycled rubber. Lay flat on roof surface (no pedestal).

C. Module Connectors (optional): The modules can be interconnected, if desired, using nylon/plastic panel fasteners or zip ties. Small holes 0.25-inch (0.64 cm) can be drilled in the side of the modules to assemble fasteners.

D. Polystyrene Insulation (optional): Used to taper uneven surfaces or build up underneath the green roof modules and provide support. Many products available from Insulfoam, Dow Roofmate, Foamular and others. Typical compressive strength of 40 psi, moisture resistant, closed cell expanded polystyrene with ¼-inch crossing drainage channels. Available in many board sizes, 4'x4', 2'x8' and 4'x8' and varying thicknesses.

E. Irrigation (optional): If required, allow for drip irrigation lines to be inserted through an integrated irrigation channel in the module during installation. Drip irrigation lines can be installed on top of the pre-grown modules. Water shall be delivered directly and evenly to plants for uniform plant growth. Drip Lines for irrigation shall contain emitters on 12" spacing. Other pop-up sprinklers and spray systems are commercially available. Consult a qualified irrigation specialist to determine appropriate design, system details and configuration, materials and maintenance requirements.

F. Edge Treatment (optional): Decorative edge treatment is available from Permaloc, or equivalent suppliers, in multiple sizes, and color for use as landscape edging around the perimeter of the vegetated green roof system in all depths.

G. Stone Ballast (optional): Clean stone or 'river rock', nominal 1-1/2" diameter (#4) rounded stone can be used to infill around roof drains or along irregular-shaped areas.

H. Drain Covers (optional): Stainless steel drain enclosure and cover to enclose roof drains. Provide standard 24-inch by 24-inch or custom sizes as necessary to fit roof drains and fit within modular green roof system. Drain covers shall have L-shaped tabs at the bottom edges to anchor beneath the modules.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Qualified Installers including General Contractors, Roofing Contractors and Landscape Contractors can install the GreenGrid® system by following the Installation Guide. A pre-installation conference call/meeting may be appropriate for new Installers. Install the vegetated green roof system according to specifications, applicable codes and regulations.

B. Safety: Installers are solely responsible to comply with all applicable safety and fall protection codes, laws and regulations as required by federal, state and local codes and regulations.

3.2 INSTALLATION SEASON

A. When plants are properly adapted and acclimated to the local weather conditions. In northern climates and unless otherwise permitted, modules shall be installed between April 15th and October 1st, except when temperatures are below 35° F. In more southern climates, the installation season will depend on seasonal weather conditions.

3.3 WORK AREA PREPARATION

A. Prepare Surface:

1. All surfaces to be smooth, free of debris, soil, and grit prior to placing modules. All surfaces shall be maintained clean and free of debris, soil, and grit during installation. Never walk upon such materials as they may damage waterproofing membrane. If required, clean the surface as recommended by Waterproofing Provider.

B. Protect Roof Surface and Structures:

1. Traffic over the working area shall be restricted and controlled to qualified personnel only. Provide safety signage, barriers and safety equipment, as appropriate.

2. Protect heavily traveled areas or use protected layers during mobilization of materials and equipment to the work area, as recommended by the Waterproofing Provider.

3. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

C. Inspect the Work Area

1. Perform a pre-installation inspection of the work areas.

2. Install slip sheet or protection layer above the roof membrane waterproofing in accordance with manufacturer's guidance. The roof surface shall be smooth, free of debris and grit before installing a slip sheet or protective layer.

3. Perform module installation only after appropriate roof waterproofing system has been installed, tested for leaks, and certified to be ready for installation of green roof system. Verify that roof assembly is watertight and free draining.

3.4 INSTALLING GREEN ROOF MODULES

A. Handle the modules with care. Do not drop, kick or point-load the modules during installation.

B. Place modules above the slip sheet or protective layer in accordance with the landscape design or layout Drawing. Modules shall be placed in straight rows, positioned tight beside each module and in proper orientation according to the landscape design.

C. After installation, modules shall be immediately watered so as to thoroughly moisten growing media throughout. Water shall be free of substances harmful to plant growth.

D. Do not install modules directly in low sections of roof where water ponds or where modules will block flow of drainage, or on saturated roof surface or during freezing weather conditions.

E. If required, install an irrigation system according to the manufacturer specifications and instructions. If an irrigation system is not required, provide hoses/sprayers for temporary irrigation, as needed, to conduct initial watering for plant maintenance.

F. Cut modules, only if necessary, to offset structures or roof edges, or around obstructions. Install partial or cut planter modules with the cut edge facing another module or edging.

3.5 QUALITY CONTROL

A. The Installer shall inspect roof conditions daily and document in writing and with photographs all work during handling and installation of the Vegetated Green Roof System.

B. As-built records should include all variations to plans, any variation in layout because of roof obstructions or other changes and installation rate.

3.6 CLEAN UP AND PROTECTION

A. Excess waste material shall be removed daily. Keep roof clean and work area in an orderly condition. Protect landscaped materials and green roof system work from damage. Maintain protection during maintenance periods.

B. Protect and insure, if necessary, staged or installed materials is the responsibility of the Installer. Work area concerns may include, but not be limited to, fire, theft, and vandalism. The Installer is responsible for all costs incurred in replacing materials prior to date of substantial completion.

3.6 MAINTENANCE

A. Maintain modules, including watering, spot weeding, application of herbicides, fungicides, insecticides, fertilizers, and replanting until a full, uniform stand of plants free of weeds, undesirable species, disease, and insects is achieved and accepted by the Architect.

1. Water modules/plants as required to establish proper rooting.
2. Repair, rework, and replant all areas that have not become established.
3. Conduct plant care and maintenance according to the maintenance guide and recommendations.

3.7 ACCEPTANCE

A. Inspection to determine acceptance of modules will be made by the Owner or designated Representative, upon notification by the Installer. Advanced notification shall be provided at least 5 working days before a requested inspection.

1. Modules will be acceptable, provided all requirements, including maintenance period, have been complied with, and healthy plants are established.

B. Owner will assume maintenance and care of vegetated green roof system following acceptance, except as modified by a maintenance service agreement between Owner and Green Roof Provider or Installer.

END OF SECTION