

G-SKY

Extensive Green Roof

Master Specification

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Application:

G-SKY Extensive Green Roof System

Extensive Green Roof – Section XXXXX



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RECOMMENDED SPECIFICATION FOR G-SKY EXTENSIVE GREEN ROOF ASSEMBLY

THIS SPECIFICATION IS INTENDED ONLY TO PROVIDE A GENERAL UNDERSTANDING OF THE G-SKY EXTENSIVE GREEN ROOF SYSTEM ASSEMBLY. IT IS RECOMMENDED THAT A GREEN ROOF TOPS REPRESENTATIVE CONDUCT A TECHNICAL ANALYSIS BEFORE SYSTEM COMPOSITION, PLANT SELECTION AND PLANT LAYOUT ARE DETERMINED TO IDENTIFY ANY ADJUSTMENTS OR ADDITIONS TO SPECIFICATION REQUIREMENTS.

VARIOUS ROOF WATERPROOFING SYSTEMS FROM VARIOUS ROOF WATERPROOFING SYSTEM MANUFACTURERS CAN BE SPECIFIED FOR USE WITH G-SKY EXTENSIVE GREEN ROOF SYSTEMS. BUT FOR ANY ASPHALT-BASED MEMBRANE SYSTEM ROOT GUARD™ MUST BE ALWAYS BE INSTALLED:

- 1) DIRECTLY OVER THE CAP SHEET OR ACT AS THE CAP SHEET ON THE MEMBRANE SYSTEM
- 2) DIRECLTY OVER THE CONCRETE PROTECTION LAYER

THIS REQUIREMENT ENSURES THAT ROOT GUARD™ WILL BE THE FIRST LAYER BETWEEN THE MEMBRANE SYSTEM AND THE G-SKY EXTENSIVE GREEN ROOF SYSTEM.

NOTE: ASPHALT BASED MEMBRANES CANNOT WITHSTAND PLANT ROOT GROWTH AND WILL FAIL WITHOUT BEING PROTECTED BY ROOT GUARD™. POLYETHYLENE AND NON-WOVEN POLYPROPYLENE FABRICS (CHEMICALLY TREATED OR NOT), WHICH ARE COMMONLY USED AS ROOT PROTECTION SHEETING, ARE NOT ADEQUATE ROOT PROTECTION BARRIERS FOR THE ROOF'S WATERPROOF MEMBRANE. THEY HAVE A WELL DOCUMENTED HISTORY OF FAILURE IN TESTS AND REAL-WORLD APPLICATIONS AND WILL EVENTUALLY ALLOW ROOTS TO PENETRATE INTO THE BUILDING CAUSING LEAKS. ROOT GUARD™ IS THE ONLY PRODUCT AVAILABLE WITH A SUCCESSFUL TRACK-RECORD IN TESTS AND REAL-WORLD APPLICATIONS AND WILL NOT ALLOW ROOTS TO PENETRATE INTO THE BUILDING.

FOR A COMPLETE DESCRIPTION OF PRODUCTS AND APPLICABLE STANDARDS, PLEASE REFER TO THE PRODUCT DATA SHEETS (GREEN ROOF TOPS – GREEN ROOF SPECIFICATIONS, CD-ROM OR ON-LINE AT WWW.GREENROOFTOPS.COM).

PART I GENERAL

1.01 SUMMARY

- A. This specification serves as a guideline and should be adapted to suit the needs of each individual project by the architect. It is prepared in accordance with the NMS three-part section format and should be included as a separate section under DIVISION 7 – Thermal and Moisture Protection. Improvements and other changes to the contents may be made only with the written approval of the architect.

1.02 SCOPE

- A. Furnish all labour, materials, tools and equipment to furnish and install G-SKY Extensive Green Roof System provided by GREEN ROOF TOPS including soil and plants, as shown on the Drawings or as directed by the Engineer. This work shall also include irrigation systems, if required, on the drawings.

1.03 RELATED WORK (Edit to project requirements)

NOTE: Specific Provisions: Edges must be protected by a 500mm band of gravel, raised flagstone or mineral based coating, and upstands, parapets and other peripheral elements by at least a 300mm band. The protective band should then be separated from the G-SKY Extensive Green Roof System using L-shaped, aluminum, zinc or galvanized steel sections (such as the G-SKY Wall products), or a concrete border (such as GR Wall products), interlocking paving stones or treated wood rafters. These separating materials must be either perforated or installed on pedestals. Consult a GREEN ROOF TOPS representative to draw up a plan illustrating where the abovementioned items are located.

A permanent drip irrigation system is highly recommended for all G-SKY Extensive Green Roof Systems.

The G-SKY Green Roof System, if installed on an asphalt-based roof membrane, must first have Root Guard™ installed above the membrane before the G-SKY Green Roof System is installed. Membranes that have adequate inherent root protection against the plants used in the G-SKY Extensive Green Roof System include PVC and Liquid-applied Fiberglass membranes. EPDM and Polyurethane roof membranes are not root resistant and are not compatible with Root Guard™. They should be substituted for an asphalt-based membrane where Root Guard™ can be applied to protect the roof from plant roots.

- A. Section 02050 – Demolition
B. Section 02660 – Water Distribution

- C. Section 02810 – Irrigation System
- D. Section 02900 – Landscaping
- E. Section 03300 – Concrete
- F. Section 04100 – Masonry
- G. Section 06100 – Carpentry
- H. Section 07600 – Sheet Metal
- I. Section 07710 – Roofing Accessories
- J. Section 07900 – Caulking & Sealants

1.04 ALTERNATES

- A. The following Green Roof materials may come from different suppliers but must meet the standards outlined in the Product Specification Sheets provided by GREEN ROOF TOPS. The materials must meet the following approval schedule before they can be substituted:
1. Soil – five (5) soil tests from five (5) unique soil samples taken at different times from different soil batches must be provided to GREEN ROOF TOPS. An approved soil laboratory must clearly identify the soils chemical and physical characteristics using the soil evaluation chart available at:
www.greenrooftops.com/specs/Soil_Eval_Chart.xls
This chart outlines the following characteristics that must be identified for third party supplier growth medium approval.
 - i. pH (H₂O + KCl)
 - ii. EC (mS/cm)
 - iii. Inorganic Nitrogen Condition (immediately after mixing growth medium / NH₄-N & NH₃-N in mg/100g)
 - iv. Inorganic Nitrogen Condition (measured after 4 weeks in an incubator at 30°C / NH₄-N & NH₃-N in mg/100g)
 - v. Forced Nitrogen (mg/100g)
 - vi. Effective Phosphoric Acid Condition (mg/100g)
 - vii. Cat ion Exchange Capacity (me/100g & me/100l)
 - viii. Exchangeable Cat ion (CaO, MgO, K₂O in mg/100g)
 - ix. Cat ion Fatigue (%)
 - x. Compressibility (%)
 - xi. Carrying/Dry Weight (t/m³)
 - xii. Fully Saturated Weight (t/m³)
 - xiii. Effective Water Content (L/m³)
 - xiv. pF curve (pF1.5 ~ 3.0 & pF3.0 ~ 3.8)
 - xv. Permeability Coefficient (cm/s & mm/hour)
 - xvi. Three phase circuit distribution, Solid phase, Liquid phase & Vapour phase (%)
 - xvii. Total porosity (%)
 - xviii. Rough porosity (%)
 2. Plants – A certificate of warranty must be provided by the third party nursery warranting the plants health for one (1) year after installation.

Since installation bears a large factor in the health and viability of the plants survival, the nursery is allowed to inspect the planting quality during and after planting to ensure that they can responsibly support the plant warranty.

3. Red Lava Rock – Red Lava Rock that meets a 9~15mm sieve size measurement may be alternated. Bright red "Sunrise" colour is preferred due to its reduced UV absorption characteristics.

1.05 TECHNICAL DOCUMENTS

- A. Provide two [2] copies of the G-SKY Extensive Green Roof System maintenance guidelines as set out by GREEN ROOF TOPS (Appendix A).

1.06 VERIFICATION OF STRUCTURAL CAPACITY

- A. Obtain prior, written confirmation from an owner-mandated professional engineer certifying that the structure is capable of bearing the additional load of a G-SKY Extensive Green Roof System. The owner understands that GREEN ROOF TOPS is absolved of any and all liability in the event of collapse.

1.07 QUALITY ASSURANCE

- A. There should be no deviation made from this specification or the detail drawings without prior written approval fourteen (14) days prior to the start of the project.
- B. The Waterproofing Contractor must be an approved member of the regional Roofing Contractors Association and must qualify for the Roofing Contractors Association Roofing Guarantee or Warranty.
- C. Before installation of the G-SKY Extensive Green Roof System, the roof shall be inspected by a technical representative of the roofing installer/manufacturer to determine the adequacy of the roof surface to accept the G-SKY Extensive Green Roof System.
- D. Verification of the integrity of the roof for water tightness shall be the responsibility of the Owner if the G-SKY Extensive Green Roof System is installed on an existing roof system.
- E. The G-SKY Extensive Green Roof System components will be purchased from GREEN ROOF TOPS.
- F. Pre-Construction Conferences. A representative from GREEN ROOF TOPS will meet with the necessary parties at the jobsite to review and discuss project conditions.

1.08 GREEN ROOF TOPS REPRESENTATIVE

- A. During installation, the contractor must permit and facilitate reasonable access to the work site and roof at all times for a Technical Representative from GREEN ROOF TOPS.
- B. Upon completion of the installation, an inspection shall be conducted by a Technical Representative from GREEN ROOF TOPS to ascertain that the G-SKY Extensive Green Roof System has been installed according to these specifications and details. This inspection is not intended to be a final inspection for the benefit of the owner but for the benefit of determining whether a warranty shall be issued.

1.09 EQUIVALENCY REQUESTS

- A. Equivalency requests for products specified in this section must be presented in writing to the project architect at least fourteen [14] days prior to the last date of tendering.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original, unopened containers of original packaging, clearly labeled with manufacturer's name, brand name, instruction for use, all identifying numbers, and related standards.
- B. Before installation, materials must be stored in a dry and ventilated shelter that protects against freezing, inclement weather and any and all harmful substances. It is recommended that in winter months, the material be stored inside, at a temperature of +10°C (50°F). Rolls of Root Guard™ E must be stored on end. Remove from the storage room only the rolls required for immediate use.
- C. Plants must be stored in an area that will provide a healthy environment before installation. Depending on weather conditions, this may be outside or inside a temporary Greenhouse shelter.
- D. Determine the area where the installation will begin. Leave the area clear and unobstructed when loading the roof with materials. Ensure that the weight is evenly distributed to prevent overloading in one area. Cover walls with tarps when hoisting materials.
- E. If installation is not performed within two (2) days of delivery to the site, the plants must be stored in their original containers and watered every two (2) days through the entire balance of the storage period. A GREEN ROOF TOPS representative must also be consulted about any additional instructions.

1.11 PROJECT CONDITIONS

- A. Comply with GREEN ROOF TOPS requirements regarding weather, substrate and other project conditions as specified in the Product Data Sheets.
- B. Regularly clear the work site of any debris or other material that can hinder installation or system performance.
- C. When moving materials on roofs or installing the G-SKY Extensive Green Roof System, protect exposed work surfaces to avoid damage. [Use sturdy paneling to erect footpaths so as to cover materials installed and permit foot traffic and movement of new materials.] The contracted installer is fully responsible for any damage.

1.12 WARRANTY (Edit to project requirements)

- A. Pre-planted G-SKY Tray 500 Units, G-SKY Sedum Plugs and G-SKY Grand Plants includes a one (1) year vegetation warranty starting the date of work acceptance. If the owner signs a two (2) year maintenance contract with GREEN ROOF TOPS this warranty will be extended for one (1) additional year, totally a two (2) year plant warranty. GREEN ROOF TOPS must be consulted before the specification of plants for a G-SKY Extensive Green Roof in order to assess the climatic conditions and viability of the plants on the roof in order to determine if the warranty shall be issued.
- B. Upon completion of the work, the contractor must supply the owner with a warranty direct from their regional Roofing Contractors Association covering the watertightness of the membrane and, material integrity of the other system components.
- C. Warranties available from GREEN ROOF TOPS:
 - a. **Material Warranties**, excludes labour.
Duration: 5-, 10, Years
 - b. **Total System Warranties**. Covers root protection of the roof membrane (labour and material) and material integrity of the G-SKY Extensive Green Roof System components.
Duration: 5-, 10, Years
- D. Each warranty varies in scope and terms. **Contact GREEN ROOF TOPS for exact warranty terms and conditions to meet the specific project requirements.**

1.13 G-SKY EXTENSIVE GREEN ROOF SYSTEM MAINTENANCE

- A. G-SKY Extensive Green Roof System must be maintained as per the instruction in Appendix A.

PART II PRODUCTS

2.01 ROOT PROTECTION SHEETING

- A. Description: a peel-and-stick root protection sheeting comprised of a weather-resistant matte-finish UV-resistant coating, PET (polyethylene terephthalate) sheeting with a high-tack rubberized asphalt adhesive made of at least 60% recycled asphalt secured by a paper backing.
- Specified product: ROOT GUARD™ E by GREEN ROOF TOPS.

2.02 ROOT PROTECTION SHEETING SEAM TAPE

- A. Description: Tape for the seams of root protection sheeting which is comprised of a weather-resistant matte-finish UV-resistant coating, PET (polyethylene terephthalate) sheeting and modacrylic adhesive.
- Specified product: ROOT GUARD™ TAPE by GREEN ROOF TOPS.

2.03 SECURING TAPE FOR DRAINAGE LAYER AND RETENTION WALLS

- A. Description: a double-faced tape used to adhere drainage layer and retention walls to root protection sheeting to protect the system against wind and allow for sloped installations up to 30%.
- Specified product: GR TAPE 20 by GREEN ROOF TOPS.

2.04 DRAINAGE LAYER

Based on the roof description chart below, either A. G-SKY Drain with Cones or B. G-SKY Drain without Cones will be specified for the project.

A. G-SKY DRAIN WITH CONES	B. G-SKY DRAIN WITHOUT CONES	G-SKY Tray 500	SLOPE		BUILDING HEIGHT		SOIL DEPTH	
			<5%	≥5%	<3 STORIES	≥3 STORIES	30mm	>30mm
X				X			X	
X				X		X	X	
X				X	X		X	
X			X			X	X	
X		X						
	X		X		X		X	
	X		X		X			X

- A. Description: a three-dimensional profile recycled HIPS (high-impact polystyrene) panel (not to be confused with expanded polystyrene) that performs three functions, drainage, water retention and aeration with 60mm

high cones attached at 6 points exactly 500mm apart through the panel for a) tray installations b) netting and c) soil supports to be secured in the system using washers and screws. These features allow the green roof's soil and plants to be secured against wind and slopes. Clearance above the roof is 10mm.

1. Specified product: G-SKY DRAIN WITH CONES by GREEN ROOF TOPS.

B. Description: a three-dimensional profile recycled HIPS (high-impact polystyrene) panel (not to be confused with expanded polystyrene) that performs three functions, drainage, water retention and aeration. Clearance above the roof is 10mm.

1. Specified product: G-SKY DRAIN WITHOUT CONES by GREEN ROOF TOPS.

2.05 PRE-PLANTED TRAYS

A. Description: a pre-planted tray of sedums that is 500mm wide x 500mm long and 50mm deep to fit within the cone system of the drainage layer. The tray also has a throughway formed in the bottom of the tray to allow for standard 17mm irrigation hose to pass underneath the tray. The tray also has a precut hole for a subterranean drip irrigation emitter. The tray is made of polypropylene and is filled with 30mm of Roof Soil (see 2.06.A.1 or approved alternate, see 1.04.A.1), 20mm of G-SKY Red Lava Rock Mulch (see 2.07.A.1, or approved alternate, see 1.04.A.3), 500x500mm of 25mm mesh polypropylene netting, and 12 G-SKY Sedums (or approved alternate, see 1.04.A.2). Recommended species are Sedum mexicanum (Mexican Sedum), Sedum ruprestre (Spruce Sedum), Sedum senanense (Japanese Sedum), Sedum album (Coral Carpet). Alternate plant species (see section 1.04.A.2) may be planted at the owners own risk.

1. Specified product: G-SKY TRAY 500 by GREEN ROOF TOPS.

2.06 SOIL (GROWING MEDIUM)

A. Description: an engineered lightweight blend of inorganic and organic components. The composition is specially formulated by GREEN ROOF TOPS for G-SKY EXTENSIVE GREEN ROOF SYSTEMS to provide optimal water retention, permeability, structural stability and density.

1. Specified product: ROOF SOIL™ by GREEN ROOF TOPS

2.07 INORGANIC MULCH

A. Description: a red lava rock mulch with a maximum particle size of 9 ~ 15mm used to retain moisture in the soil, prevent soil erosion and secure plants against strong winds.

1. Specified product: G-SKY RED LAVA ROCK by GREEN ROOF TOPS

2.08 DRAIN WAY AGGREGATE

- A. Description: on non-tray installations a red lava rock mulch with a maximum particle size of 9 ~ 15mm. On G-SKY-N and G-SKY-L installations 60mm high and 60mm wide layer of red lava rock is filled in along the wall edges to facilitate drainage to drainage points in walls and to prevent soil outflow from the system. On G-SKY-L-100 installations a 120mm high and 120mm wide layer of red lava rock is required.
1. Specified product: G-SKY RED LAVA ROCK by GREEN ROOF TOPS

2.09 VEGETATION

NOTE: Vegetation is selected for its resistance to cold and dry extreme conditions. For growing medium depths of 30mm, low-growing sedums are the only recommended plant genus (see PDS-22 - G-SKY Sedum Plugs.pdf that GREEN ROOF TOPS produces each year in large numbers). and the growing medium surface must be covered by 20mm of red lava rock. For growing medium depths of 100mm the plants allowed for it is composed of herbaceous perennials (succulent, ground-cover, flowers, grasses and bulbous plants) and may include several hardy shrubs (see PDS-27 - G-SKY Grand Plants.pdf that GREEN ROOF TOPS produces each year in large numbers). Again, 20mm of red lava rock is required on soil depths of 100mm. Consult GREEN ROOF TOPS for advice on appropriate plant types for the project and to order plants for a project. GREEN ROOF TOPS can produce almost any plant species known in nurseries located across the United States and Canada, please consult us for more details on contract growing.

- A. Description: sedums, perennial plants, or pre-planted sedum trays. Plants should be drought tolerant and have a USDA plant zone rating matching or exceeding that of the projects geographic location.
1. Specified products: G-SKY SEDUM PLUGS by GREEN ROOF TOPS, G-SKY TRAY 500 (PRE-PLANTED) & G-SKY GRAND PLANTS by GREEN ROOF TOPS.
 - a. Minimum planting density – Sedums should be planted at a density of 50 plants per m². G-SKY Grand Plants should be planted at their recommended plant densities as specified in the most recent version of the G-SKY Price List.

2.10 NETTING

- A. Description: 25mm mesh polypropylene netting which is green in color is used to secure plants, mulch and soil against wind and slopes. 500mm x 500mm cut squares of netting are used on trays to secure the materials in the trays.

1. Specified products: G-SKY NETTING by GREEN ROOF TOPS

2.11 RETENTION GRID (optional)

- A. Description: stainless steel grid with 100mm mesh installed within soil layer to secure system on sloped applications.
 1. Specified products: GR SUPPORT by GREEN ROOF TOPS

2.12 WASHER

- A. Description: aluminum washers with 4 corner hooks to secure trays or netting to the cones of G-SKY Drain (with cones) in order to secure the system against wind and slopes
 1. Specified products: G-SKY WASHER & SCREW by GREEN ROOF TOPS

2.13 RETENTION WALLS

- A. Description: aluminum wall system with main wall piece, inside and outside corner pieces, joints and screws used to hold soil and trays within the green roof system. Also an aluminum L-piece of equal length to the main wall piece designed to secure the netting to the wall on G-SKY-N applications.

G-SKY-L, G-SKY-N & G-SKY-T Systems

1. Specified products: G-SKY Wall 80A, G-SKY WALL 80A OUTSIDE CORNER, G-SKY WALL 80A INSIDE CORNER, G-SKY WALL 80A JOINT, G-SKY ANGLE 30L (G-SKY-N only) and G-SKY ANGLE SCREWS (G-SKY-N only) by GREEN ROOF TOPS

G-SKY-L-100 System

1. Specified products: GR WALL GRC 150 + CORNERS OR G-SKY WALL 150A + CORNERS by GREEN ROOF TOPS

2.14 RETENTION WALL CORNER TAPE (optional)

- A. Description: fiberglass mesh tape used to tape the corners of the aluminum retention walls when placed at greater or less than 90° angles to each other on non-square green roofs. Also used to tape the seams of roof drain covers and other wall products placed at non-square angles.
 1. Specified products: GR WRAP TAPE by GREEN ROOF TOPS

2.15 TRAY SUPPORTS FOR SLOPED APPLICATIONS (optional)

- A. Description: aluminum stops for the cones on drainage panels with cones to support the weight of the trays on steep slopes.
 1. Specified products: G-SKY STOPPER by GREEN ROOF TOPS

2.16 DRAIN INSPECTION COVERS (optional)

- A. Description: stainless steel covers with aluminum feet with removable lids used to prevent soil from flowing into the roof drain and to allow easy access for inspection and maintenance of the drain within the green roof system.
1. Specified products: GR COVER C & GR COVER W by GREEN ROOF TOPS

2.17 DRIP IRRIGATION SYSTEM (optional)

- A. Description: 17mm black polystyrene tubing with internal (G-SKY-L, G-SKY-N & G-SKY-L-100) or external flow controlling emitters (G-SKY-T). Emitter rate for complete irrigation per 500mm x 500mm x 50mm depth area is 2L/hr. Emitter rate for complete irrigation per 500mm x 500mm x 120mm depth area is 4L/hr. Irrigation controller and water supply requirements vary based on the size of the irrigated area. Requires a water supply to be installed on the roof.
1. Specified products: GR DRIPLINE SYSTEM by GREEN ROOF TOPS

2.18 DECKING SYSTEM (optional)

- A. Description: FSC-Certified cedar decking panels that are 550mm when installed. Panels are 545mm x 545mm x 50mm and are installed on slope-adjustable pedestals and interlocked using precut polyethylene interlocking crosses. When installed with GR Stands with 4.5mm separation tabs, the total area covered by a single panel is 550mm x 550mm.
1. Specified products: SKY DECKS, SKY LOCKS & GR STANDS by GREEN ROOF TOPS

PART III EXECUTION

NOTE: Take all necessary action to maintain the roof waterproofing warranty. The roofing contractor must always be informed of the green roof system to be installed on the roof.

3.01 INSTALLATION SEASON

- A. Unless otherwise permitted, green roof installation shall be done between April 1 and October 15, but not when the outside ambient temperature is below 10°C.

3.02 INSPECTION AND PREPARATION

- A. Before beginning the installation, the owner's representative and the roofer and the contracted installer's representatives must inspect and approve the roof conditions, including the waterproofing membrane, roof drains, construction joints, etc.
- B. The area to be greened shall be a smooth free draining and even surface.
- C. The area shall be thoroughly cleaned of debris that might interfere with the installation of Root Guard™ E.
- D. Examine finish surfaces, grades and roof quality. Do not start Root Guard™ E installation work until unsatisfactory conditions are corrected.
- E. In the event of non-compliance, a notice is to be provided to the contractor listing the corrective action to be taken. Starting the work will be taken to signify approval of the work conditions.
- F. Ensure that all waterproofing, plumbing, woodworking and other work has been duly completed.

NOTE: Retain the following item for warranty.

3.03 SUPERVISION OF WORK BY CONTRACTED ROOFER

- A. The contracted roofer must supervise the installation of the G-SKY Extensive Green Roof System to ensure that no damage occurs to the roof that could affect the waterproofing warranty.
- B. Immediately notify [the consultant] and [the owner] in writing in case of damage to the roof.

3.04 METHOD OF INSTALLATION

- A. Install temporary roof walkways over clean surfaces, as specified and recommended by the waterproof membrane supplier.
- B. Ensure that the work site ambient temperature is at least 10°C and that the site ambient temperature is high enough after the vegetation is installed to prevent frost damage.

3.05 WORK EXECUTION RECOMMENDATIONS

- A. Maintain equipment and tools used to install the vegetation in good condition.
- B. Ensure that during use of equipment and tools, waterproofing membranes will not be damaged.

3.06 ROOT GUARD™ E INSTALLATION

NOTE: Coordinate with the roofing contractor to install Root Guard™ E over the membrane or the concrete protection layer.

No installation should take place below -10°C (14°F). Always ensure that installation takes place under dry weather conditions.

- A. Prepare the surface.
 - 1. On all non-insulated concrete decks evenly apply a primer that consists of either:
 - i. petroleum asphalt modified with thermoplastic polymers and volatile solvents, or
 - ii. a comparable water-based primerInstall primer at a rate of 1 L/m² (1 gallon/200 ft²). Follow the primer manufacturers instructions and wait the proper amount of time for the primer to dry before adhering Root Guard™ E. (NOTE: Concrete decks must be completely dried and cured before installation of Root Guard E begins. Fins and sharp protrusions may have to be ground smooth prior to the application of Root Guard E.)
 - 2. Exposed asphalt membranes require no further preparation if the surface is clean of dust and debris. In rare conditions, the waterproof membrane may not be able to be cleaned satisfactorily to allow good adhesion of the self-adhering layer of Root Guard™ E, in this situation, apply a primer to the surface of the membrane first (see above).
- B. Root Guard™ E is self-adhering. It is installed in a similar manner to typical self-adhered asphalt based membranes.
 - 1. **POSITIONING ROLL:** Begin by unrolling Root Guard™ E along the lowest of the roof and position in place. On a roof deck sloped more

than 5%, the first row of Root Guard™ E should run horizontally along the roof edge. The remaining rows will be installed vertically up the slope, perpendicular to the first row. On flat roof decks, unroll the first row of membrane with the roll edge centered through the drain holes. The remaining rows will run parallel to the first row. On exposed membranes, align Root Guard™ E parallel to the underlying cap sheet and offset side laps a minimum of 300mm (12") and end laps a minimum of 450mm (18") from those of the underlying cap sheet. Under no circumstances superimpose the laps of Root Guard™ E over those of the underlying cap sheet. Carry Root Guard™ E to the bottom edge of the cant when installing the Green Roof edge off of the parapet. Carry Root Guard™ E to the termination point of the waterproof membrane when the Green Roof edge will carry up to the parapet.

2. **PREPARING ROLL:** Backroll Root Guard™ E to allow you to work out from the centre to the edges in both directions. All Root Guard™ E laps should offset the underlying cap sheet by a minimum of 300mm (12"). Ensure Root Guard™ E is laid smooth and is free of air pockets and wrinkles.
 3. **ADHERING:** Peel off release paper from the back as you unroll and position Root Guard™ E. Collect the release paper as you are removing and adhering Root Guard™ E to the prepared surface.
 4. **PRESS INTO PLACE.** All misaligned rolls must be cut off and reset. Cut out and patch all fishmouths and buckles.
 5. Ensure that all side laps are overlapped a minimum of 100mm (4") along the guidelines of Root Guard™ E and end laps are also overlapped a minimum of 100mm (4").
- C. Centre Root Guard™ Tape directly over the side and end laps of Root Guard™ E. Tape the seams of Root Guard™ E with Root Guard™ Tape. Ensure that Root Guard™ Tape is laid smooth and is free of air pockets and wrinkles.

3.07 G-SKY WALL 80A AND/OR G-SKY WALL 150A INSTALLATION

- A. According to the drawings, measure and chalk out the edges of the green roof system.
- B. Adhere GR Tape 20 down the inside of the chalk line. Do not overlap GR Tape 20.
- C. Remove release paper as you install G-SKY Wall 80A, G-SKY Corners and G-SKY Joints. (substitute G-SKY Wall 150A products as needed)

3.08 GR TAPE 20 FOR G-SKY TRAY 500 INSTALLATIONS (G-SKY-T)

- A. Measure in 200mm outside from the edge of GR Tape 20 that was used for G-SKY Wall and chalk a line for the first line of GR Tape 20 running equidistance (200mm) from the G-SKY Wall GR Tape 20 to the next corner.
- B. Measure 300mm from the edge of the GR Tape 20 that was just installed and run another line of GR Tape 20. Continue until lines of tape cover the entire inside area of the green roof area.

3.09 GR TAPE 20 FOR ALL INSTALLATIONS OTHER THAN G-SKY TRAY 500 INSTALLATIONS (G-SKY-N, G-SKY-L, G-SKY-L-100)

- A. Measure in 150mm from the inside of edge of G-SKY Wall 80A (50mm inside of the edge of GR Tape 20 used for G-SKY Wall 80A) chalk a line for the first line of GR Tape 20 running equidistance (150mm) from the G-SKY Wall80A to the next corner. G-SKY Drain without cones is butted up inside the edge of G-SKY Wall 80A and does not sit off of the edges of the wall to compensate for the trays (see 3.12).

3.10 G-SKY STOPPER INSTALLATION (for 10 to 30% slope applications)

- A. As you are removing the release paper from GR Tape 20 to install G-SKY Drain (with cones), remove the release paper from the back of G-SKY Stopper install a G-SKY Stopper to the base of each cone beneath G-SKY Drain (with cones)

3.11 G-SKY DRAIN WITH CONES INSTALLATION FOR G-SKY TRAY 500 (G-SKY-T)

- A. Measure in 50mm from the edges of GR Tape 20 that was used for G-SKY Wall80A and chalk a line for the first line of G-SKY Drain (with cones) running equidistance (50mm) from the G-SKY Wall 80A's GR Tape 20 to the next corner.
- B. Align the corner of G-SKY Drain (with cones) 50mm from the edges of GR Tape 20 that was used for G-SKY Walls (line should be chalked). Remove the release paper from GR Tape 20 and adhere G-SKY Drain (with cones) to GR Tape 20. If available, use two empty G-SKY Tray 500's to position G-SKY Drain (with cones) off of G-SKY Wall80A.
- C. Continue to remove the release paper from GR Tape 20 and butt G-SKY Drain (with cones) up against the previously installed panel until the roof is fully covered.
- D. If the roof is sloped, position G-SKY Drain (with cones) so that the drainage dips on the sides of the panel are pointing down with the downward slope to the drain.

- E. G-SKY Drain (with cones) can be cut to fit around penetrations, etc. with a heavy duty utility knife or small toothed saw.

3.12 G-SKY DRAIN WITH CONES OR G-SKY DRAIN WITHOUT CONES INSTALLATIONS THAT DO NOT USE G-SKY TRAY 500 (G-SKY-N, G-SKY-L, G-SKY-L-100)

- A. Butt G-SKY Drain (with or without cones) into the corner of G-SKY Wall 80A or G-SKY Wall 150A.
- B. Remove the release paper from GR Tape 20 and adhere G-SKY Drain (with or without cones) to GR Tape 20.
- C. Continue to remove the release paper from GR Tape 20 and butt G-SKY Drain (with or without cones) up against the previously installed panel until the roof is fully covered.
- D. If the roof is sloped, position G-SKY Drain (with or without cones) so that the drainage dips on the sides of the panel are pointing down with the downward slope to the drain.
- E. G-SKY Drain (with or without cones) can be cut to fit around penetrations, etc. with a heavy duty utility knife or small toothed saw.

3.13 GR DRIPLINE INSTALLATION

- A. Install the GR Dripline system in accordance with the system type.
 - 1. For G-SKY Tray 500 (G-SKY-T) systems, install a polypropylene hose (with no emitters embedded) to fall equidistance between the cones on G-SKY Drain with cones (250mm from each cone). Install emitters as trays are installed, punch hose with and push emitter to fit inside the pre-cut emitter hole on the bottom of the tray. Do not bend the hose to fit, use T and L fittings to install hose.
 - 2. For non-tray systems, install a polypropylene hose with embedded 2L/hr emitters every 450 ~ 500mm or 18 ~ 20". Do not bend the hose to fit, use T and L fittings to install hose.
- B. Install the GR Dripline Controller in a location where it can be easily accessed and is near the water supply line. Set the controller to respond to moisture settings (requires an optional moisture sensor line be installed) or on a timed schedule.
- C. Test system and check all points for leaks.

3.14 G-SKY TRAY 500 INSTALLATION (G-SKY-T)

- A. Place G-SKY Tray 500's between the cones and secure with G-SKY Washer and screw to the cone on G-SKY Drain using a Phillips screwdriver (hand or electric).
- B. If an irrigation system is installed, align the trays center with the poly line, punch the line using an irrigation line punch tool, insert the emitter into the poly line, remove the pre-cut emitter hole on the back of the tray and then drop the tray onto the emitter so it is pointed up into the soil base. Emitters are 2L/hr emitters from Netafim. Poly hose is standard 17mm irrigation poly hose.

3.15 G-SKY RED LAVA ROCK INSTALLATION

- A. On non-tray installations, G-SKY-N and G-SKY-L, spread a 60mm x 60mm layer of G-SKY Red Lava Rock around the edges of G-SKY Wall 80A for drainage and soil outflow prevention. On G-SKY-L-100 installations, spread a 120mm high x 120mm wide layer up against the edging (G-SKY Wall 150A or GR Wall GRC 150).
- B. On tray installations, spread a 10~20mm layer of G-SKY Red Lava Rock on the edges of the trays to allow for lateral plant movement and to hide the edges of the trays.

3.16 ROOF SOIL™ INSTALLATION

- A. On non-tray installations, supply and install Roof Soil™ to the specified depths, either 30mm or 100mm deep. Rake to distribute evenly. Thickness must be checked at multiple locations.
- B. Fully saturate the growing medium layer with water and allow it to sit overnight.

3.17 GR SUPPORT INSTALLATION (for sloped applications)

- A. Install GR Support at the desired depth in the soil or directly on top of G-SKY Drain (with cones). Butt the edges of the mesh to the cones of G-SKY Drain (with cones) to go with the slope so no future slippage will occur.

3.18 PLANT INSTALLATION

- A. Plant G-SKY Sedum Plugs individually by hand (or with the careful use of a trowel) at a density of 50 plugs/m². Plant G-SKY Grand Plants (or alternatively specified plants) individually by hand (or with the careful use of a trowel) at a density appropriate for each plant.

3.19 G-SKY RED LAVA ROCK INSTALLATION

- A. Spread G-SKY Red Lava Rock around the plants and then evenly distribute at a thickness of 20mm around the plant stems by hand. Be careful not to allow the plants crown to stick out from the soil, it should be buried below the soil.
- B. **ALTERNATIVE INSTALLATION METHOD:** Spread G-SKY Red Lava Rock first and then plant after. Spread G-SKY Red Lava Rock over the soil and spread out into an even layer with a rake. Plant plugs individually being careful to bury the plants below the soils surface.

3.20 G-SKY NETTING INSTALLATION

- A. Roll G-SKY Netting over the surface of the planted area. Secure to G-SKY Wall using G-SKY Angle 30L and then secure to G-SKY Drain (with cones) using G-SKY Washer and screw.
- B. Walk across the entire surface and carefully handle plants that are matted down by the netting (most will spring out by themselves while installing).

3.21 HARDSCAPE/ACCESSORY INSTALLATION

- A. Install strips/areas of stone/paver/decking ballast for walkways and maintenance paths and at all roof perimeters, building walls, penetrations, and access hatches to act as vegetation barriers for the flashings as well as safety strips (wind, fire).
- B. All drains should be fitted with GR Cover inspection/maintenance boxes and grills, built up to ensure access at soil level.

3.22 POST-INSTALLATION IRRIGATION AND INSPECTION PERIOD

- A. Fully saturate the soil once a day for the first week of installation. Thereafter, water as needed.
- B. Diligently maintain the plants for thirty (30) days post-installation and acceptance of installation. Thereafter, adhere to the maintenance schedule outline in Appendix A.

3.23 ACCEPTANCE

- A. Inspection to determine acceptance of installation will be made by the Owner, upon Contractor's request. Provide notification at least seven (7) working days before requested inspection date.

- B. Upon acceptance, the Owner will assume maintenance tasks unless a maintenance contract is entered into forthwith.

3.24 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove all excess materials, debris and equipment from the site. Repair any damage that has resulted from installation. .

NOTICE: GREEN ROOF TOPS reserves the right to alter the composition and conditions of use of its materials without notice as knowledge and techniques evolve.

END OF SECTION

APPENDIX A - MAINTENANCE

The first year of a Green Roofs life is the most important. Roots are established and the Green Roof layers settle into each other to provide a healthy and secure environment for the plants.

Green Roofs are often praised as being low-maintenance and for the most part, this is true. However, just like any other roof, they require regular inspection and knowledge of how to fix any problems that might arise. A scheduled inspection and maintenance program is essential to obtain maximum life from the roof. Most large roofing problems start as small problems then grow due to neglect. Too many roofs are out of sight and out of mind until they leak. By that time there is often considerable damage apart from that to building finish and contents:

- wet insulation is useless and difficult or impossible to dry out
- moisture migrates into most felts from the break in the membrane thus enlarging the faulty area
- patching only traps the moisture already in the system allowing the faulty area to increase in size

Well conducted inspections by knowledgeable people on regular basis and prompt correction of weaknesses add years to the effective life of a well designed and applied roof.

The G-SKY Green Roof System has three maintenance categories:

1. Building Inspection and Maintenance
2. Plant Inspection and Maintenance
3. Drainage and Irrigation Inspection and Maintenance

1. Building Inspection and Maintenance

The security of the waterproof membrane is the most essential element to a successful Green Roof. Should plants die, they can easily be replaced, but should the roof leak, repairs are difficult and expensive.

Building Inspection Items (for all G-SKY Buildups)

	Inspection Items	Recommendations	Necessary Actions
Waterproof Membrane	Check along G-SKY Wall or GR Wall edges for physical damage, water seepage or membrane peeling.		Repair any and all damage to membrane without delay.
	Outside of Green Roof area, check for physical damage, water seepage or membrane peeling.		Repair any and all damage to membrane without delay.
	Check for root penetration into the waterproof membrane	Remove roots and all invasive plant species. Replace plant species with non-invasive plant species.	Repair any and all damage to membrane and Root Guard™ without delay.
Drains	Check for accumulation of fallen leaves, mud, soil and weeds in the drain.	Remove and clean.	
Eaves	Check for the accumulation of fallen leaves, mud, soil and weeds in the drain.	Remove and clean.	

Building Inspection Schedule

	G-SKY-T	G-SKY-N	G-SKY-L	G-SKY-L-100
Inspection 1	March or April	March or April	March or April	March or April
Inspection 2	September or October	September or October	September or October	September or October

It is generally agreed that an approved roof and flashing membrane reasonably applied under normal working conditions, might have some flaws. For this reason, the industry accepts a "testing out period" of two full years. Long experience confirms that two complete weather cycles will bring out most flaws. Inspections can be reduced to once a year after the first year, but it is still necessary to continue inspections and maintenance to ensure and to obtain the maximum life possible from the roof.

Building Inspection Costs

For buildings with up to two (2) roof areas (of any size) there is a minimum charge from Green Roof Tops to inspect the waterproof membrane of \$250.00 per inspection, or \$500.00/year. If a building has three (3) or more roofs, the charge is \$100/roof/inspection. This price is based on roofs with a 0~5% slope maximum. 5%+ sloped roofs, etc have safety and access considerations that require a customized quotation.

If repairs are covered by warranty, there will be no costs associated with repairs. In all non-warranty cases, a detailed repair quotation will be drawn up and presented to the owner.

2. Plant Inspection and Maintenance

Plant Inspection Items (for all G-SKY Buildups)

	Inspection Items	Recommendations	Necessary Actions
General Gardening	Check for weeds growing among the plants.	Remove by hand. If necessary use a chemical to destroy the weed.	
	Check plant growth condition. Are the plants healthy?		Fertilize them and/or complimentary planting
	Check for dead plants.	If negligible, remove the Plants.	Remove the defeated species and re-plant with different species.
	Check for signs of disease or pest damage	Remove and clean.	Introduce a natural predator (i.e. ladybugs) or if problem is severe, spray with chemical insecticide.
	Check soil depth for erosion and for signs of soil overflow at retention walls	Add erosion controls. i.e. additional mulching.	If erosion is affecting plant growth, supplement soil base to compensate.
	Check for uncontrolled or over-growth.	Prune and train accordingly as to control and not promote growth.	Remove excess plant Material.
	Are there any additional concerns?		

Plant Inspection Schedule

	G-SKY-T	G-SKY-N	G-SKY-L	G-SKY-L-100
Inspection 1	March or April	March or April	March or April	March or April
Inspection 2	June or July	June or July	June or July	May or June
Inspection 3	September or October	September or October	September or October	July or August
Inspection 4	Not required	Not required	Not required	September or October

The plants from the G-SKY plant lists are specially selected to require very little maintenance. During the first two years of plant establishment in their new roof environment, it is necessary that three (3) visits per year be made to ensure a healthy and self-sustaining plant environment is created. Thereafter, visits may be reduced to two (2) visits a year, one in the spring and one in the fall. Only one of these visits need perform the fertilization and intensive plant care, the other visit can simply be a quick inspection to make sure no pests or disease have set in.

Plant Inspection and Maintenance Costs

First 2 Years Maintenance Costs	Grade 1 (G-SKY-T, G-SKY-N, G-SKY-L)		Grade 2 (G-SKY-L-100)	
	m ²	ft ²	m ²	ft ²
Up to 100m ² (Up to 1076ft ²)	\$450/year	\$450/year	\$750/year	\$750/year
100m ² ~200m ² (1076ft ² ~2153ft ²)	\$4.00	\$0.38	\$10.50	\$0.98
200m ² ~400m ² (2153ft ² ~4306ft ²)	\$3.50	\$0.33	\$9.00	\$0.84
More than 400m ² (More than 4306ft ²)	\$3.00	\$0.28	\$7.50	\$0.70
Fertilization	\$1.00	\$0.09	\$1.00	\$0.09

Subsequent Years Maintenance Costs	Grade 1 (G-SKY-T, G-SKY-N, G-SKY-L)		Grade 2 (G-SKY-L-100)	
	m ²	ft ²	m ²	ft ²
Up to 100m ² (Up to 1076ft ²)	\$225/year	\$225/year	\$375/year	\$375/year
100m ² ~200m ² (1076ft ² ~2153ft ²)	\$2.00	\$0.19	\$5.25	\$0.49
200m ² ~400m ² (2153ft ² ~4306ft ²)	\$1.75	\$0.17	\$4.50	\$0.42
More than 400m ² (More than 4306ft ²)	\$1.50	\$0.14	\$3.75	\$0.35
Fertilization	\$1.00	\$0.09	\$1.00	\$0.09

Plant Inspection and Maintenance Comprehensive

Weeds

By definition a weed is a plant that grows where you do not want it to. The G-SKY Extensive Green Roof System consists of a thin layer of soil where it is difficult for weeds to take root; however, it is still possible that weeds may grow. Weeds can be carried to the Green Roof on the wind or by birds that visit the roof. Weeding must take place on a regular basis. Weeding is performed either by hand or through the use of an herbicide.

Growth Conditions

Slow or diseased growth must be removed to ensure the healthy growth of the Green Roof. Each Green Roof is different; the underlying roof surface, microclimate, physical size all affect how the plants grows. The Green Roof needs to be checked regularly in order to ensure healthy growth.

Plant Loss

There are many circumstances under which plant loss may occur. During a period of plant loss, the cause of the loss will be investigated and a measure devised to avoid further loss. If a large section of planting or a particular species is lost, complementary planting will be performed.

Fertilizer

Sedums are very hardy plants, but still need nutrients to stay healthy. A G-SKY Extensive Green Roof should be fertilized once a year with a low-concentration, slow-release, coated fertilizer. The amount of fertilizer added for the sedums that are on the roof should be on the mid to low fertilization recommended level to control growth.

Pruning

Trimming back over-growth of the garden will help to ensure that all the plants have enough room to grow without crowding. If a single sedum exceeds 200mm in length it has usually over-grown its desired size and needs to be cut. Trimming sedums also helps to promote transpiration. However, trimming can also promote growth in sedums, so great care must be taken when selecting the plants that need to be trimmed.

Disease and Pests

Pests:

The "Black Vine Weevil" is the primary pest for sedums. Roof soil is pre-treated with insect pathogenic nematodes to control their larvae in the fall. However, should adults be introduced to the system a chemical treatment will need to be applied in order to prevent pests from destroying the entire Green Roof. This is a last resort however; often the pests will not harm the system to the extent that makes this necessary and will die out through the winter.

Diseases:

The diseases "Bacterial Soft-Rot", "Grey Mould", "Leaf Spots", "Rust", "Stem or Crown Rot" and "Powdery Mildew" can affect sedums. They are avoided through effective soil design by allowing for proper water drainage to ensure that the conditions for these diseases to thrive are never developed. Should they develop, however, each disease has different treatment options which will be explored upon detection. Guaranteeing permeability in the plants through spring trimming is the primary measure to prevent these diseases from forming.

NOTE: Diseased plants will not be replaced with the same species since the disease may still exist in the soil structure and affect the replaced plant resulting in an additional plant loss.

Different sedums that are known to be resistant to the detected disease will be planted to ensure survival.

3. Drainage and Irrigation Maintenance

Drainage and Irrigation Inspection Items (for all G-SKY Buildups)

		Inspection Items	Recommendations	Necessary Actions
Drainage Points		Check for accumulation of fallen leaves, mud, soil, and weeds at all drainage points along the Green Roof system walls and at roof drains.	Remove and clean.	
Watering and Irrigation	Automated	Check for blocks or breaks in the irrigation hose.	Inspect the line flushing valve.	Exchange faulty irrigation timers and valves with new ones.
		Check to ensure the electromagnetic valve is operating properly.	Perform a general operation test.	
		Check for problems with the filter, low volume control and pressure regulator.	Perform a general operation test.	
		Check for problems with the air/vacuum relief valve and line flushing valve.	Perform an general operation test	
		Check for problems with the timer, power and battery system	Perform an general operation test	
		Check to ensure the irrigation timing is set correctly for proper health growth	Perform an general operation test	
	Manual	Is the faucet operating correctly?	Perform an general operation test	Exchange faulty units and modify schedule to suit the plants health.
		Is the watering schedule being upheld and properly executed?	Discuss with person in charge of maintenance.	

Drainage and Irrigation Inspection Schedule

	G-SKY-T	G-SKY-N	G-SKY-L	G-SKY-L-100
Inspection 1	March or April	March or April	March or April	March or April
Inspection 3	If required, July or August	If required, July or August	If required, July or August	July or August
Inspection 4	Before first frost, September or October	Before first frost, September or October	Before first frost, September or October	Before first frost, September or October

Drainage and Irrigation Inspection and Maintenance Costs

Each drainage and irrigation inspection has a fixed cost of \$75.00/visit, no matter what the site size. The cost of water will be dictated by the size of the job and number of hours of required irrigation for healthy plants.

Irrigation Schedule

	G-SKY-T, G-SKY-N, G-SKY-L, G-SKY-L-100
Irrigation Schedule	Once or twice every two weeks with no rainfall
Irrigation details	By hand irrigation: 1 hour/100m ² (1076ft ²) Automatic: 1 hour/200m ² (~2153ft ²)

Drainage and Irrigation Inspection and Maintenance Comprehensive

Plant Selection

Sedums are very hearty plants that need little irrigation, their watering needs are unlike any other plant. Sedums (like cacti, agaves, aloes, and other succulents) have special features:

- They have thick, fleshy, water storing leaves and stems
- They have the ability to limit their water consumption.
- Surfaces exposed to the drying effects of the sun and winds are small in proportion to their total mass.
- Their thick waxy cuticle layers help their outer surfaces seal in moisture.
- Smaller than normal number of pore openings in leaves and stems further restrict moisture loss.
- Roots of sedums are shallow and widespread, extending out a distance several times their height allowing them to draw in water even when the soil directly surrounding them is dry.

Rules for sedum irrigation

- Irrigating sedums when they show signs of stress in their skin is the way to ensure their survival; however, if you want them to thrive and stay healthy, some regular watering will be necessary.
- Established sedums will benefit from twice-monthly watering when temperatures are consistently around 30°C+ (90°F).
- Newly planted sedums will establish quicker when watered on a weekly basis during hot weather.
- Non-native types of sedums, even those well established, will perform better when provided water on a weekly basis.
- Roof soil is a well-draining soil medium, requiring the sedums to be watered on a more regular basis than if they were in a poorly draining soil base.
- During hot weather periods, the soil should be allowed to dry between watering.
- More errors are made by over-watering sedums than by under-watering.
- Injury from lack of water develops gradually and is easy to correct, however, over-watering injury occurs rapidly and is usually irreversible.

System Barriers

The barrier of the system is checked for damage and over-growth of roots, soil loss or compaction and proper drainage.

Drains and garbage

Ensure that the drains are not clogged and that there is no rubbish around the drain. Damaged or dead plant material will be cleared from the roof.