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MARINO CELL
OPERATIONS AND MAINTENANCE MANUAL

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1.0 Acknowledgments

We recognize and thank the many professionals, engineers, landscape architects, and municipal staff who provided input into the development, testing, and deployment of the Marino Cell system. Their commitment to advancing sustainable urban drainage and resilient infrastructure solutions is deeply appreciated.

2.0 Introduction

2.1 Purpose

This manual provides general guidance for the operation and maintenance (O&M) of Marino Cell installations, helping owners and operators maintain long-term system performance according to design intent. These guidelines are meant to inform site-specific maintenance plans but should be adapted to local conditions and regulatory requirements.

2.2 Permit Requirements

This manual provides general guidance for the operation and maintenance (O&M) of Marino Cell installations, helping owners and operators maintain long-term system performance according to design intent. These guidelines are meant to inform site-specific maintenance plans but should be adapted to local conditions and regulatory requirements.

2.3 How to Use This Manual

Section 3 outlines key maintenance considerations, activities, and general schedules. Sections 4 and 5 provide repair guidance and administrative tools. Successful maintenance requires understanding site-specific design, as-built conditions, and local regulatory obligations.

2.4 Definitions

- Best Management Practices (BMPs): Activities, designs, or structural controls that reduce pollutant loading or runoff impacts.
- Drawdown Time: The time required for water to fully infiltrate or drain from the storage system.
- Underdrain: Subsurface pipes that convey water away after storage or treatment.
- Infiltration Media: Gravel, sand, or engineered media placed within or around the system to assist infiltration.

3.0 Maintaining Marino Cells

3.1 Key Component Design Function and Maintenance Considerations

3.1.1 Inlet System

Inlet screens, catch basins, sediment forebays, and other similar devices, prevent debris and coarse sediment from entering the Marino Cell system. These must be inspected regularly, especially after large storm events. Maintenance: Remove accumulated trash, leaves, and sediments. Check for clogging or blockages.

3.1.2 Inlet Pipe

Conveys water into the Marino Cell system. Blockages can reduce performance. Maintenance: Inspect for clogs, sags, or collapsed sections. Flush as needed.

3.1.3 Outlet Pipe and Flow Control Devices

If present, underdrains remove excess water after storage or infiltration. Maintenance: Check outflows for blockage or reduced flow. Clean or flush pipes if needed.

3.1.4 Marino Cell Modular Units

The Marino Cell units themselves are structural plastic modules that require no internal maintenance under normal operation. Maintenance: sediment should be kept from entering the system, thereby eliminating the need for internal maintenance

3.1.5 Media (if used)

If the system includes gravel or soil media around or within the modules, its porosity and infiltration capacity must be preserved. Maintenance: Prevent compaction. Do not store heavy equipment or materials over planted or permeable surfaces unless properly designed.

3.1.6 Surface Treatment

Paved or landscaped surfaces above the system must be maintained to prevent surface drainage bypass or infiltration failure. Maintenance: Repair cracks or settlement in pavements; ensure landscaped areas are healthy and not eroding.

3.2 Maintenance Guidelines

- Inlet Structures: Monthly; after storms — Clean debris, inspect sediment buildup
- Distribution Pipes: Annual; after storms — CCTV or manual inspection; flush if needed
- Underdrain Pipes: Annual; after storms — Check outflows; clean or flush if necessary
- Surface Treatment: As needed — Repair pavement; maintain landscape health

3.3 Equipment and Materials

- Vacuum truck or manual tools for debris removal
- CCTV or pipe inspection equipment
- Flushing equipment for underdrains or distribution lines

3.4 Skills and Staffing

- Qualified maintenance staff familiar with stormwater BMPs
- Access to plumbing/pipe inspection contractors if needed
- Landscape or pavement maintenance teams for surface treatments

4.0 Repairing Marino Cells

If repairs are needed (due to excavation, settlement, or structural failure), contact the system designer or DeepRoot for guidance. Avoid unauthorized digging or modifications that could compromise structural integrity.

5.0 Programmatic and Administrative Guidance

5.1 Regulatory Requirements for LID BMP Maintenance Programs

Follow local stormwater permit rules, record maintenance activities, and document inspections as required.

5.2 Tools for Implementing an LID Maintenance Program

Develop a site-specific plan using:

- Inspection checklists
- Maintenance logs
- Annual performance reviews
- Staff training programs

6.0 Additional Resources

Appendix A

- DeepRoot Marino Cell Technical Specifications

This guide specification was prepared utilizing a 3-part format recommended by the Construction Specifications Institute (CSI) and generally incorporates recommendations from their SectionFormat™/Page Format™, and MasterFormat®, latest Editions, insofar as practicable.

Carefully review and edit the text to meet the Project requirements and coordinate this Section with the remainder of the Specifications and the Project plans.

Where bold, bracketed text is indicated, e.g. **[text]**, make the appropriate selection and delete the remainder of text within additional brackets, highlighting, and boldface type, if any.

This specification defines material and performance requirements for the "Marino Cell System". The Specifier should adapt these specifications to reflect specific Project requirements.

Consult the manufacturer for assistance in editing this guide specification for specific Project applications where necessary, including conventional applications, and for assistance evaluating and sizing design elements for Marino Cell stormwater applications.

This Specification was current at the time of publication but is subject to change. Please confirm the accuracy of these specifications with the manufacturer prior to use.

Some elements in these specifications require coordination with Project plans; these items are noted "according to the Project plans and specifications" or similar phrases.

Refer to the DeepRoot website, www.deeproot.com for additional information.

SECTION 33 46 23

MARINO CELL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Marino Cell system for low-profile stormwater storage and related applications, including associated products and aggregates.
   2. Other materials include, but are not limited to, pipe and appurtenant fittings, geotextile, geogrid, aggregate, and wicking materials.

B. Related Requirements:
   1. Project plans and general provisions of the Contract, including General and Supplementary Conditions as well as Division 01 Specification Sections, apply to this Section.
   2. Section 01 33 00 - Submittal Procedures
   3. Section 01 77 00 - Closeout Procedures
   4. Section 32 12 16 - Asphalt Paving

5. Section 32 13 13 - Concrete Paving
6. Section 32 14 00 - Unit Paving
7. **[ ]**

1.02 REFERENCES

A. Definitions:
1. AGGREGATE COVER: Aggregate material placed directly above the Marino Cell deck, used with or without pavement, to provide cover for the Marino Cell system.
2. AGGREGATE BEDDING: Aggregate material placed directly below the Marino Cell system to create a stable and supportive base.
3. AGGREGATE FOUNDATION: Aggregate material placed between the bottom of the aggregate bedding and the top of the prepared subgrade to ensure proper load distribution and stability.
4. BACKFILL: Aggregate or native soil used to replace, or the act of replacing, earth in an excavation next to the Marino Cell system to provide support and stability.
5. DRAIN PIPES: Pipes that are components of a drainage system, designed to collect and transport water away from a source to a point of distribution or disposal.
6. DISTRIBUTION PIPES: Pipes that are components of a drainage system, designed to deliver and distribute water throughout the system.
7. FINISHED GRADE: The elevation of the final cover or surface treatment, including, but not limited to, pavement.
8. GEOGRID: A two-dimensional polymer grid utilized in constructing the Marino Cell system to enhance soil stability and facilitate load distribution.
9. GEOTEXTILE: A nonwoven permeable fabric used in constructing the Marino Cell system to enhance soil stability and provide soil separation.
10. IMPERMEABLE LINER: A barrier, usually composed of synthetic materials, designed to stop liquids from penetrating soils or structures.
11. MARINO CELL: One or more Marino Cell frames stacked vertically, with one Marino Cell deck placed on top of the uppermost frame.
12. MARINO CELL SYSTEM: Two or more Marino Cells used together, along with all required component parts and accessories.
13. SUBGRADE: The surface or elevation of the subsoil that remains after excavation, prepared to provide a stable and level base for the long-term stability of the overlying layers.
14. WICKING MATERIALS: Fabrics designed to pull moisture away from a structure or surface through capillary action.

B. Reference Documents:
1. Marino Cell Technical and Loading Data Sheet

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequencing and Scheduling:
1. General: Before beginning Work in this Section
   a. Prepare a detailed schedule of the Work involved for coordination with other trades.
   b. Schedule utility installations.
   c. Where necessary to prevent damage, protect the installed system if Work must occur over or adjacent to the installed Marino Cell system(s).

1.04 SUBMITTALS

A. Action Submittals: Submit in accordance with Section **[01 33 00] [other]**:

[OR]

A. Action Submittals: Submit these to the **[Landscape Architect] [Architect] [Engineer]** for review and acceptance prior to the start of installation of materials and products specified in this Section.
   1. Product Data: For each type of product, submit the manufacturer's product literature with technical data sufficient to demonstrate that the product meets these specifications.
   2. Test and Evaluation Reports:
      a. Aggregate analysis verifying materials meet Project-specified gradation requirements.
   3. Samples:
      a. One full-size sample of an assembled Marino Cell (a copy of the manufacturer's brochure with product images may be accepted in lieu of a product sample).
      b. Manufacturer's product data/specification sheet for geogrid.
      c. Manufacturer's product data/specification sheet for geotextile.
      d. Installer:
         1) Submit documentation of the qualifications of the Marino Cell system installer and their field supervisor, sufficient to demonstrate that both meet the requirements specified in Section 1.05 Quality Assurance.

B. Closeout Submittals: Submit in accordance with Section **[01 33 00] [other]**:

[OR]

B. Closeout Submittals: Submit these to the **[Landscape Architect] [Architect] [Engineer]** at the completion of installation.
   1. Warranty: Submit a copy of the manufacturer's warranty.

1.05 QUALITY ASSURANCE

A. Comply with the relevant laws, codes, ordinances, and regulations established by Federal, State, and Municipal authorities that have jurisdiction. Secure the required permits and approvals from these authorities.
B. Manufacturer Qualifications:
   1. A manufacturer whose product is manufactured in an ISO/TS 16949 compliant and ISO 9001 - 2008 registered factory.
C. Installer Qualifications: A qualified installer with a minimum of 5 years of successful experience in installing subsurface drainage, stormwater detention products, or related materials and products.
D. Installer's Field Supervisor: A full-time supervisor employed by the installer, with a minimum of 5 years of successful experience in compliance with Section 1.05 Quality Assurance, who is present at the Project site when Work is in progress. Utilize the same field supervisor throughout the Project unless a substitution is submitted to and approved in writing by the **[Landscape Architect] [Architect] [Engineer]**.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Marino Cell System: Protect the Marino Cell system components from damage during delivery, storage, and handling.
   1. Store components on smooth surfaces, free from dirt, mud, and debris. Store components under a tarp to protect them from sunlight.
B. Aggregate:
   1. Do not deliver or place backfill or aggregate material in frozen, wet, or muddy conditions.
   2. Store aggregates to prevent contamination during future handling.

1.07 FIELD CONDITIONS AND EROSION CONTROL

A. Do not proceed with Work when subgrades or soils are in a wet, muddy, or frozen condition.
B. Implement erosion control measures to prevent the erosion or displacement of bulk materials and discharge soil-bearing water runoff or airborne dust to nearby properties, water conveyance

systems, and walkways. Ensure that sediment control is provided to retain excavated material and backfill within the Project limits as necessary.

1.08 WARRANTY

A. The Contractor shall warrant that the Marino Cell system is free of faults and defects in accordance with the General Conditions, except that the warranty shall be extended by the manufacturer's written warranty against defects in materials and workmanship as follows:
   1. DeepRoot® warrants to the original purchaser of its Marino Cell™ product that such product will be free from defects in materials and workmanship, and perform to DeepRoot's written specifications for the warranted product, when installed and used as specifically provided in the product's installation guidelines for a period of 20 years from the date of purchase. This warranty does not cover wear from normal use, or damage caused by abuse, mishandling, alterations, improper installation and/or assembly, accident, misuse, or lack of reasonable care of the product. This warranty does not apply to events and conditions beyond DeepRoot's control, such as ground subsidence or settlement, earthquakes and other natural events, acts of third parties, and/or Acts of God. If this warranty is breached, DeepRoot® will provide a replacement product. Incurred costs, such as labor for removal of the original product, installation of replacement product, and the cost of incidental or other materials or expenses are not covered under this warranty.
   2. Deeproot® makes no other warranties, express or implied, and specifically disclaims the warranty of merchantability or fitness for a particular purpose. Deeproot® shall not be liable either in tort or in contract for any direct, incidental or consequential damages, lost profits, lost revenues, loss of use, or any breach of any express or implied warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturers:

USA - Head Office DeepRoot Green Infrastructure, LLC 1032 Irving Street, #614 San Francisco, CA 94122-220	DeepRoot Canada Corp. 2242 Kingsway #428 Vancouver British Columbia - V5N 5X6	DeepRoot Urban Solutions, Ltd. Suite 51 101 Clapham High Street London SW4 7TB

B. Substitutions: Manufacturers seeking approval for their products must comply with the Owner's Instructions to Bidders, generally found in the Project Manual. If these instructions are not included in Division 00 or Division 01, submit requests as specified herein.
   1. Submit proposed substitutions to the **[Landscape Architect] [Architect] [Engineer]** not less than **[7] [other]** days prior to the date for receipt of Bids.

[OR]

B. No substitutions are allowed.

2.02 DESCRIPTION

A. The term Marino Cell shall refer to a single Marino Cell.
   1. A Marino Cell consists of one frame.
   2. Marino Cell frames can be stacked vertically, one above the other.
   3. The uppermost Marino Cell frame on each stack receives one deck.
B. Marino Cells shall be modular, structural systems designed to create a void underground.
C. Each Marino Cell shall be structurally independent from all adjacent Marino Cells to facilitate the incorporation of utilities and other site features and ease future repairs.

D. Marino Cell 10 shall be manufactured from 100% post-industrial recycled high-density polyethylene (HDPE).
   1. Marino Cell 10 has the following compressive yields and deflection strengths:

Marino Cell 10

DESIGN FEATURES	IMPERIAL UNITS	SI UNITS
Vertical compressive yield	62 psi	427 kPa
Vertical deflection strength	80 psi/inch	217 kPa/cm

E. Marino Cell 20 shall be manufactured from 100% post-industrial recycled high-density polypropylene (HDPP).
   1. Marino Cell 20 has the following compressive yields and deflection strengths:

Marino Cell 20

DESIGN FEATURES	IMPERIAL UNITS	SI UNITS
Vertical compressive yield	120 psi	827 kPa
Vertical deflection strength	336 psi/inch	912 kPa/cm

2.03 RELATED PRODUCTS

A. When required per the Project plans and specifications
   1. Geogrid / Geotextile
   2. Impermeable Liner
   3. Distribution Pipes
   4. Drain Pipes
   5. Wicking Components

2.04 AGGREGATE AND SOILS

A. When required per the Project plans and specifications
   1. Aggregate Foundation
   2. Aggregate Bedding
   3. Aggregate Cover
   4. Backfill

2.05 COVER / PAVEMENT

A. When required per the Project plans and specifications
   1. Refer to the Marino Cell Technical and Loading Data Sheet to determine cover and pavement profiles to meet Project needs.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the conditions under which the Marino Cells are to be installed.
   1. Carefully check and confirm dimensions, quantities, and grade elevations.
   2. Carefully review the Project plans to understand the existing underground conditions before digging. Confirm the locations of aboveground and underground utility lines, infrastructure, and other improvements.
   3. Notify the Contractor and the **[Landscape Architect] [Architect] [Engineer]** in writing about any conflicts between existing and new improvements, discrepancies, or any other conditions detrimental to the proper and timely completion of the installation.

4. Obtain written approval of changes to the Work prior to proceeding. Proceed with installation only after changes have been made and unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Take necessary precautions to avoid damaging existing improvements and plantings.
B. Before beginning Work, lay out and stake the limits of excavation along with the horizontal and vertical control points necessary to install the complete Marino Cell system.
C. Coordinate the installation with other trades that may affect the completion of the Work.

3.03 TEMPORARY PROTECTION

A. Protect open excavations and the Marino Cell system from access and damage during construction and after completion by using highly visible construction tape, fencing, or other measures until all related construction is finished.
B. Refer to the Marino Cell Technical and Loading Data Sheet to identify which types of equipment can be operated over the Marino Cell during construction.

3.04 GEOTECHNICAL REQUIREMENTS

A. The Marino Cell application shall be deemed appropriate for the site by the Project Engineer.
B. The subgrade must not be frozen, wet, or muddy during installation.
C. Soils at the bottom of the excavation must have a minimum of 5% California Bearing Ratio (CBR) and be suitable for the Marino Cell application.
D. Foundation requirements will vary based on the specific application of the Marino Cell system and the subgrade conditions. Further enhancements to the foundation and/or subgrade may be necessary as determined by the Project engineer.

3.05 EXCAVATION

A. General: Excavate to the specified depths and dimensions indicated in the Project plans. Ensure the excavated base is smooth and level, free from lumps and debris.
B. If unsuitable subgrade soils are encountered, consult the Owner's geotechnical consultants for guidance on how to proceed.
C. Confirm that the excavation depth is accurate and includes the entire section of materials necessary for installing the foundation, bedding layer, Marino Cell system, and cover/pavement as outlined in the Project plans and specifications.
D. Over-excavate beyond the perimeter of the Marino Cell system to ensure a stable base and proper compaction of backfill around the system's perimeter.
E. If conflicts arise during excavation, notify the **[Landscape Architect] [Architect] [Engineer]** in writing and provide action recommendations. Proceed with the work only upon receiving written approval for the action.

3.06 SUBGRADE PREPARATION

A. Prepare the subgrade according to Section 3.04 Geotechnical Requirements.

3.07 INSTALLATION OF GEOGRID / GEOTEXTILE OVER SUBGRADE (WHEN REQUIRED)

A. Install the specified geogrid / geotextile according to the Project plans and specifications.

3.08 INSTALLATION OF IMPERMEABLE LINER (WHEN REQUIRED)

A. Install an impermeable liner according to the Project plans and specifications.

3.09 INSTALLATION OF AGGREGATE FOUNDATION BELOW MARINO CELL BASES (WHEN REQUIRED)

A. Install the aggregate foundation according to the Project plans and specifications.
B. Extend the aggregate foundation a minimum of 6 inches (150 MM) beyond the base of the Marino Cell layout.

3.10 INSTALLATION OF AGGREGATE BEDDING LAYER (WHEN REQUIRED)

A. Install the bedding layer according to the Project plans and specifications.

3.11 INSTALLATION OF MARINO CELL SYSTEM

A. Install the Marino Cell system strictly according to the manufacturer's instructions and as specified herein. If requirements conflict or contradict, adhere to the more stringent requirements.
B. Ensure layout and elevation control during the installation of the Marino Cell system to align with the Project plans and specifications.
C. Locate and mark additional Project features within the Marino Cell system layout (e.g., light pole bases, utility pipes, etc.). Refer to the Project plans and specifications for the required offsets between these features and the Marino Cells.
D. Inspect each Marino Cell frame and deck for damage before placement. Reject any cracked or chipped units.
E. Follow the Marino Cell layout plan as outlined in the Project plans.
F. Install Marino Cell frames so that adjacent frames touch.
G. Level each Marino Cell frame as necessary.
H. Place the Marino Cell deck on the uppermost frame of each stack.

3.12 INSTALLATION OF DISTRIBUTION PIPES (WHEN REQUIRED)

A. Install distribution pipes according to the Project plans and specifications.

3.13 INSTALLATION OF DRAINAGE PIPES (WHEN REQUIRED)

A. Install drainage pipes according to the Project plans and specifications.

3.14 INSTALLATION OF WICKING MATERIALS (WHEN REQUIRED)

A. Install wicking materials according to the Project plans and specifications.

3.15 INSTALLATION OF BACKFILL

A. Ensure the perimeter geotextile fabric is in place before adding backfill material.
B. Carefully backfill around the perimeter of the Marino Cell system.
C. Keep excavation equipment at a safe distance from the Marino Cell system installation to avoid collapsing the excavation.
D. Backfill material and compaction must follow the Project plans and specifications, including geotechnical requirements.

3.16 INSTALLATION OF GEOTEXTILE OVER THE MARINO CELL DECK

A. Install geotextile over the Marino Cell deck as required in the Project plans and specifications.
    1. The geotextile placed over the Marino Cells shall overlap with the perimeter geotextile fabric by a minimum of 12 inches (300 MM).

3.17 INSTALLATION OF COVER / PAVEMENT

A. Install cover/pavement over the Marino Cells according to the Project plans and specifications.

3.18 PROTECTION

A. Operate only equipment approved for use over the Marino Cells when placing cover and/or pavement.
   1. Do not operate equipment directly on top of the Marino Cell system until a minimum of 4 inches (100 MM) of cover has been placed. At that point, rubber-tracked equipment from the approved equipment list may be used.
   2. Install fencing and/or other barriers to prevent vehicles and equipment from entering the Marino Cell system installation area until adequate cover is in place over the Marino Cell decks.

3.19 CLEAN UP

A. Ensure clean-up during installation and upon completion of the Work. Keep the site free of soil, sediment, trash, and debris. Remove excess soil materials, debris, and equipment from the site after completing the Work in this section.
B. Repair any damage resulting from the installation of this Work by utilizing skilled installers experienced in construction-type remedial Work and the relevant trades.

END OF SECTION