



## **PART 1 – GENERAL**

### 1.01 Related Documents

- A. Drawings, technical specification and general provisions of the Contract as modified herein apply to this section.

### 1.02 Description of Work Included

- A. Provide excavation and base preparation per geotechnical engineer's recommendations and/or as shown on the design drawings, to provide adequate support for project design loads and safety from excavation sidewall collapse. Excavations shall be in accordance with the owner's and OSHA requirements.
- B. Provide and install Rainsmart STM-01 Modular Tank system (hereafter called STM-01 Tank Module) and all related products including fill materials, geotextiles, geogrids, inlet and outlet pipe with connections per the manufacturer's installation guidelines provided in this section.
- C. Provide and construct the cover of the STM-01 Tank system including; stone backfill, structural fill cover, and pavement section as specified.
- D. Protect STM-01 Tank system from construction traffic after installation until completion of all construction activity in the installation area.

### 1.03 Quality Control

- A. All materials shall be manufactured in ISO certified facilities.
- B. Installation Contractor shall demonstrate the following experience:
  - 1. A minimum of three STM-01 Tank or equivalent projects completed within 2 years; and,
  - 2. A minimum of 25,000 cubic feet of storage volume completed within 2 years.
  - 3. Contractor experience requirement may be waived if the manufacturer's representative provides on-site training and review during construction.
- C. Installation Personnel: Performed only by skilled workers with satisfactory record of performance on bulk earthworks, pipe, chamber, or pond/landfill construction projects of comparable size and quality.
- D. Contractor must have manufacturer's representative available for site review if requested by Owner.

### 1.04 Submittals

- A. Submit proposed STM-01 Tank layout drawings. Drawings shall include typical section details as well as the required base elevation of stone and tanks, minimum cover requirements and tank configuration.
- B. Submit manufacturer's product data, including compressive strength and unit weight.
- C. Submit manufacturer's installation instructions.
- D. Submit STM-01 Tank sample for review. Reviewed and accepted samples will be returned to the Contractor.
- E. Submit material certificates for geotextile, geogrid, base course and backfill materials.



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- F. Submit required experience and personnel requirements as specified in Section 1.03.
- G. Any proposed equal alternative product substitution to this specification must be submitted for review and approved prior to bid opening. Review package should include third party reviewed performance data that meets or exceeds criteria in Table 2.01 B.

#### 1.05 Delivery, Storage, and Handling

- A. Protect STM-01 Tank and other materials from damage during delivery, and store UV sensitive materials under tarp to protect from sunlight when time from delivery to installation exceeds one week. Storage of materials should be on smooth surfaces, free from dirt, mud and debris.
- B. Handling is to be performed with equipment appropriate to the materials and site conditions, and may include hand, handcart, forklifts, extension lifts, etc.
- C. Cold weather:
  - 1. Care must be taken when handling plastics when air temperature is 40 degrees °F or below as plastic becomes brittle.
  - 2. Do not use frozen materials or materials mixed or coated with ice or frost.
  - 3. Do not build on frozen ground or wet, saturated or muddy subgrade.

#### 1.06 Pre-installation Conference.

- A. Prior to the start of the installation, a pre-installation conference shall occur with the representatives from the design team, the general contractor, the excavation contractor, STM-01 Tank installation contractor, and the manufacturer's representative.

#### 1.07 Project Conditions

- A. Coordinate installation for the STM-01 Tank system with other on-site activities to eliminate all non-installation related construction traffic over the completed STM-01 Tank system. No loads heavier than the design loads shall be allowed over the system and in no case, shall loads higher than a standard AASHTO HS20 (or HS25, depending on design criteria) load be allowed on the system at any time.
- B. Protect adjacent work from damage during STM-01 Tank system installation.
- C. All pre-treatment systems to remove debris and heavy sediments must be in place and functional prior to operation of the STM-01 Tank system. Additional pretreatment measures may be needed if unit is operational during construction due to increased sediment loads.
- D. Contractor is responsible for any damage to the system during construction.

### **PART 2 – PRODUCTS**

#### 2.01 R-Tank Units

- A. STM-01 Tank - Injection molded plastic tank plates assembled to form a 95% void modular structure of predesigned height (custom for each project).
- B. STM-01 Tank units shall meet the following Physical & Chemical Characteristics:



Table 2.01b

Item	Description	Value	Unit
<b>Void Area</b>	Area available for water storage vs. that made up of plastic	<b>&gt;95</b>	%
<b>Surface Void Area</b>	Open area where water may percolate in or out of the units	<b>&gt;95</b>	%
<b>Service Temperature</b>	Operating temperature where the units can be expected to perform adequately	<b>07 to 60°C (-44 to 140°F)</b>	°C (°F)
<b>Material Content</b>	90% Virgin Polypropylene + 10% proprietary mix Virgin in Nature (100% virgin)	<b>100%</b>	%
<b>Biological &amp; Chemical Resistance</b>	Unaffected by moulds, algae, Soil borne Chemical, bacteria and bitumen, polypropylene is very inert	<b>**</b>	<b>**</b>
<b>Short Term Compressive Strength</b>	Short Term Vertical Compressive Strength*	<b>85 (120.89)</b>	tons/sqm (PSI)
	Short Term Lateral Compressive Strength*	<b>8.00 (11.38)</b>	tons/sqm (PSI)
<b>Short Term Deflection</b>	Vertical Deflection	<b>65. kN/ m<sup>2</sup></b>	Per mm
	Lateral Deflection	<b>4.3 kN/m<sup>2</sup></b>	Per mm
<b>Long Term Deflection</b>	Estimated long term deflection ( <b>vertical creep</b> ) projected 50 yrs ** <i>applied test load of 172 kN / m<sup>2</sup></i>	<b>1.08% (3.88mm)</b>	172 kN/m <sup>2</sup>
	Estimated long term deflection ( <b>lateral creep</b> ) projected 50 yrs ** <i>applied test load of 32kN/m<sup>2</sup></i>	<b>1.41% ( 8.46 mm)</b>	32 kN/m <sup>2</sup>

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## 2.02 Geosynthetics

- A. Geotextile. A geotextile envelope is required to prevent backfill material from entering the R-Tank modules.
- Standard Application:** The standard geotextile shall be an 300 GSM nonwoven geotextile (or greater).
  - Infiltration Applications:** When water must infiltrate/exfiltrate through the geotextile as a function of the system design, a nonwoven needle punched permeable geotextile shall be used (300 GSM or greater) shall be used.
- B. Geogrid. For installations subject to traffic loads and/or when required by project plans, install geogrid (BX30/30 or equivalent) to reinforce backfill above the STM-01 Tank system. Geogrid is often not required for non-traffic load applications.



## 2.03 Backfill & Cover Materials

- A. **Bedding Materials:** Angular Stone (smaller than 20mm in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System) shall be used below the STM-01 Tank system (150mm minimum). Material must be free from lumps, debris, and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation. For infiltration applications bedding material shall be free draining.
- B. **Side and Top Backfill:** Free draining angular stone (smaller than 10-20mm diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System) shall be used adjacent sides to (300mm minimum) and above (for the first 300mm) the STM-01 Tank system. Material must be free from lumps, debris and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.
- C. **Additional Cover Materials:** Structural Fill shall consist of granular materials meeting the gradational requirements of SM, SP, SW, GM, GP or GW as classified by the Unified Soil Classification System. Structural fill shall have a maximum of 25 percent passing the No. 200 sieve, shall have a maximum clay content of 10 percent and a maximum Plasticity Index of 4. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.

## 2.04 Other Materials

- A. **Utility Marker:** Install metallic tape at corners of STM-01 Tank system to mark the area for future utility detection.

## **PART 3 - EXECUTION**

### 3.01 Assembly of STM-01 Tank Units

- A. On-site assembly of tanks shall be performed in accordance with the STM-01 Tank Installation Manual, Section 2.

### 3.02 Layout and Excavation

- A. Installer shall stake out, excavate, and prepare the subgrade area to the required plan grades and dimensions, ensuring that the excavation is at least 600mm greater than STM-01 Tank dimensions in each direction allowing for installation of geotextile filter fabric, STM-01 Tank modules, and free draining backfill materials.
- B. All excavations must be prepared with OSHA approved excavated sides and sufficient working space.
- C. Protect partially completed installation against damage from other construction traffic by establishing a perimeter with high visibility construction tape, fencing, barricades, or other means until construction is complete.
- D. Base of the excavation shall be smooth, level (variation of less than 1/2"), firm, flat, and free of



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lumps or debris and soft or yielding subgrade areas. A minimum 2,000 pounds per square foot bearing capacity is required.

1. **Standard Applications:** Compact subgrade to a minimum of 95% of Standard Proctor (ASTM D698) density or as required by the Owner's engineer.
  2. **Infiltration Applications:** Subgrade shall be prepared in accordance with the contract documents.
- E. **Unsuitable Soils or Conditions:** All questions about the base of the excavation shall be directed to the site engineer, who will approve the subgrade conditions prior to placement of stone. The owner's engineer shall determine the required bearing capacity of the STM-01 Tank subgrade; however, in no case shall a bearing capacity of less than 2,000 pounds per square foot be provided.
1. If unsuitable soils are encountered at the base, or if the base is pumping or appears excessively soft, repair the area in accordance with contract documents and/or as directed by the owner's engineer.
  2. If indications of the water table are observed during excavation, the engineer shall be contacted to provide recommendations.
  3. Do not start installation of the STM-01 Tank system until unsatisfactory subgrade conditions are corrected and the subgrade conditions are accepted by the owner's engineer.

### 3.03 Preparation of Base

- A. Place a thin layer (75mm unless otherwise specified) of bedding material (Section 2.03 A), over the subgrade to establish a level working platform for the STM-01 Tank modules. Level to within ½" (+/- ¼") or as shown on the plans. Native subgrade soils or other materials may be used if determined to meet the requirements of 2.03 A and are accepted by the owner's engineer.
  1. **Standard Applications:** Static roll or otherwise compact bedding materials until they are firm and unyielding.
  2. **Infiltration Applications:** Bedding materials shall be prepared in accordance with the contract documents.
- B. Outline the footprint of the STM-01 Tank system on the excavation floor using spray paint or chalk line to ensure a 600mm perimeter is available around the STM-01 Tank system for proper installation and compaction of backfill.

### 3.04 Installation of the STM-01 Tank

- A. Where a geotextile wrap is specified on the base of the excavation, cut strips to length and install in excavation, removing wrinkles so material lays flat. Overlap geotextile a minimum 300mm or as recommended by manufacturer.
- B. Where an impervious liner (for containment) is specified, install the liner per manufacturer's recommendations and the contract documents. The STM-01 Tank units shall be separated from impervious liner by a non-woven geotextile fabric installed accordance with Section 3.04A.
- C. Install STM-01 Tank Units by placing side by side, in accordance with the design drawings. No lateral connections are required. It is advisable to use a string line to form square corners and straight edges along the perimeter of the STM-01 Tank system. The modules are to be oriented as per the design drawing (600mm L x 600mm W) with required depth as shown on plans. If this is not shown in the construction drawings, it is a simple field adjustment that will have minimal effect on the overall system footprint. Refer to STM-01 Tank Installation Guide for more details.
- D. Wrap the STM-01 Tank top and sides in specified geotextile. Cut strips of geotextile so that it will





- cover the sides and top, encapsulating the entire system to prevent soil entry into the system. Overlap geotextile 300mm or as recommended by manufacturer. Take great care to avoid damage to geotextile (and, if specified, impervious liner) during placement.
- E. Identify locations of inlet, outlet and any other penetrations of the geotextile (and optional liner). These connections should be installed flush (butted up to the STM-01 Tank) and the geotextile fabric shall be cut to enable hydraulic continuity between the connections and the STM-01 Tank units. These connections shall be secured using pipe boots with stainless steel pipe clamps. Support pipe in trenches during backfill operations to prevent pipe from settling and damaging the geotextile, impervious liner (if specified) or pipe. Connecting pipes at 90 degree angles facilitates construction, unless otherwise specified. Ensure end of pipe is installed snug against STM-01 Tank system.
  - F. Install Inspection and Maintenance Ports in locations noted on plans. At a minimum one maintenance port shall be installed within 1m of each inlet & outlet connection, and with a maximum spacing of one maintenance port for every 250 sqm tank foot print. Install all ports as noted in the STM-01 Tank Installation Guide.
  - G. If required, install ventilation pipes and vents as specified on drawings to provide ventilation for proper hydraulic performance. The number of pipes and vents will depend on the size of the system. Vents are often installed using a 90-degree elbow with PVC pipe into a landscaped area with 'U' bend or venting bollard to inhibit the ingress of debris. A ground level concrete or steel cover can be used.

### 3.05 Backfilling of the STM-01 Tank Units

- A. Backfill and fill with recommended materials as follows:
  1. Place freely draining backfill materials (Section 2.03 B) around the perimeter in lifts with a maximum thickness of 300mm. Each lift shall be placed around the entire perimeter such that each lift is no more than 600mm higher than the side backfill along any other location on the perimeter of the STM-01 Tank system. No fill shall be placed over top of tanks until the side backfill has been completed.
  2. Each lift shall be compacted at the specified moisture content to a minimum of 95% of the Standard Proctor Density until no further densification is observed (for self-compacting stone materials). The side lifts must be compacted with walk behind compaction equipment. Even when "self-compacting" backfill materials are selected; a walk behind vibratory compactor must be used.
  3. Take care to ensure that the compaction process does not allow the machinery to come into contact with the modules due to the potential for damage to the geotextile and STM-01 Tank units.
  4. No compaction equipment is permissible to operate directly on the STM-01 Tank modules.
  5. Following placement of side backfill, a uniform 300mm lift of the freely draining material (Section 2.03 B) shall be placed over the STM-01 Tank and lightly compacted using a walk-behind trench roller. Alternately, a roller (maximum gross vehicle weight of 4 tons) may be used. Roller must remain in static mode until a minimum of 750mm of cover has been placed over the modules. At all times, a forward dump process has to be maintained, such that there is 500mm cover between machine contact and top of the tank. Sheep foot rollers should not be used.
  6. Install a geogrid (required for traffic applications) over the initial 300mm lift of backfill. Geogrid shall extend a minimum of 1.0m beyond the limits of the excavation wall.



7. Following placement and compaction of the initial cover, subsequent lifts of structural fill (Section 2.03 C) shall be placed at the specified moisture content and compacted to a minimum of 95% of the Standard Proctor Density and shall cover the entire footprint of the STM-01 Tank system. During placement of fill above the system, unless otherwise specified, a uniform elevation of fill shall be maintained to within 300mm across the footprint of the STM-01 Tank system. Do not exceed maximum cover depth of 2.3m
  8. Place additional layers of geotextile and/or geogrid at elevations as specified in the design details. Each layer of geosynthetics reinforcement placed above the STM-01 Tank system shall extend a minimum of 1.0m beyond the limits of the excavation wall.
- B. Only low-pressure tire or track vehicles shall be operated over the STM-01 Tank system during construction. No machinery should drive on top of the tank until a minimum of 750mm of backfill and compaction is achieved. Dump Trucks and Pans shall not be operated within the STM-01 Tank system footprint at any time. Where necessary the heavy equipment should unload in an area adjacent to the STM-01 Tank system and the material should be moved over the system with tracked equipment.
  - C. Ensure that all unrelated construction traffic is kept away from the limits of excavation until the project is complete and final surface materials are in place. No non-installation related loading should be allowed over the STM-01 Tank system until the final design section has been constructed (including pavement).
  - D. Place surfacing materials, such as groundcovers (no large trees), or paving materials over the structure with care to avoid displacement of cover fill and damage to surrounding areas.
  - E. Backfill depth over STM-01 Tank system must be within the limitations as shown above of 2.3m maximum. If the total backfill depth does not comply, contact engineer or manufacturer's representative for assistance.

## **PART 4 – USING THE SYSTEM**

### **4.01 Maintenance Requirements**

- A. A routine maintenance effort is required to ensure proper performance of the STM-01 Tank system. The Maintenance program should be focused on pretreatment systems. Ensuring these structures are clean and functioning properly will reduce the risk of contamination of the STM-01 Tank system and Stormwater released from the site. Pre-treatment systems shall be inspected yearly, or as directed by the regulatory agency and by the manufacturer (for proprietary systems). Maintain as needed using acceptable practices or following manufacturer's guidelines (for proprietary systems).
- B. Inspection and/or Maintenance Ports in the STM-01 Tank system will need to be inspected for accumulation of sediments at least quarterly through the first year of operation and at least yearly thereafter. This is done by removing the cap of the port and using a measuring device long enough to reach the bottom of the STM-01 Tank system and stiff enough to push through the loose sediments, allowing a depth measurement.
- C. If sediment has accumulated to the level noted in the STM-01 Tank Maintenance Guide or beyond a level acceptable to the Owner's engineer, the STM-01 Tank system should be flushed.
- D. A flushing event consists of pumping water into the Maintenance Port and/or adjacent structure, allowing the turbulent flows through the STM-01 Tank system to re-suspend the fine sediments. If multiple Maintenance Ports have been installed, water should be pumped into each port to maximize flushing efficiency. Sediment-laden water can be filtered and reused or disposed off through the network or approved equivalent if permitted by the locality.

**END OF SECTION**

