System Specification – Flex MSE Vegetated Wall System

PART 1 – GENERAL

1.01 Description of Work Included:

.1 Safety Monitoring & Response.

.2 Protection of Existing Features and Work in Progress.

.3 Review of the existing site conditions including soil, groundwater, geometry and loading conditions.

.4 Survey for horizontal and vertical control of all work of the Contract.

.5 Excavation and Foundation Soil Preparation.

.6 Supply, Placement, and Compaction of backfill materials to Engineering Specifications.

.7 Supply, Placement and Compaction of free draining material near Flex MSE installation (if specified).

.8 Supply and Placement of Bag fill medium in Flex MSE modular Bags.

.9 Supply and Placement of the Flex MSE System components.

.10 Supply and Placement of geogrid or other reinforcement (if specified).

.11 Supply and Placement of vegetation materials.

1.02 Related Sections:

.1 Section [ ] - Site Preparation

.2 Section [ ] – Earthwork, Excavation and preparation

.3 Section [ ] - Fill and Backfill

.4 Section [ ] – Geotextile

.5 Section [ ] - Drainage

.6 Section [ ] - Hydro seeding for Lawn Areas

.7 Section [ ] - Landscape Plantings

1.03 Submittals:

.1 In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
.2 Shop drawings sealed by a registered professional Engineer in the [province] [state] (5 sets) submitted in accordance with Section [ ]. Shop drawings to include:

a. Retaining wall profile
b. Cross sections
c. Site Specific details (if applicable) [corners, steps, etc]
d. Segmental retaining wall unit dimensions and details
e. Project notes

.3 Sieve analysis of granular base and backfill materials.

.4 Segmental unit System:

a. Samples of segmental units to indicate product standards.
b. Accepted samples become the standard of acceptance for work.
c. Test results from an independent testing laboratory for compliance of **Flex MSE** unit requirements.
d. Manufacturer's product data, installation manual and material safety data sheets for the safe handling of the specified materials and products.

1.03 References:

.1 **Trexiana Wholesale & Distribution Ltd.** Website: www.FlexMSE.com

.2 **Flex MSE** System materials meet the requirements of the following American Standards Test Methods:

(For **Flex MSE** Geotextile)

a) Weight (typical) ASTM D5261,
b) Grab Tensile ASTM D4632,
c) Grab Elongation ASTM D4632,
d) Trap Tear ASTM D4533,
e) CBR Puncture ASTM D6241,
f) Mullen Burst ASTM D6786 (modified),
g) A.O.S. ASTM D 4751,
h) Permittivity ASTM D 4491,
i) Water Flow ASTM D 4491,
j) U.V. Resistance ASTM D4355,
k) ASTM D256

1.04 Engineering Requirements:

.1 Engineered specifications will be considered in the design and construction of any **Flex MSE System** application exceeding the local regulations for total or exposed vertical height or where used in any water related sites.

.2 Engineering considerations, depending on the **Flex MSE** application, should include but not be limited to:

Application height, wall or slope face angle/ batter, site soils, backfill soils, slope above structure, slope below structure, surcharge loading, hydrostatic loading, seismic qualifications, site drainage & run off patterns, wave action, current flow velocities, stream scour depths, anticipated settlement, geogrid soil reinforcement or other mechanical soil stabilization devices included in the design of the wall.

.3 Provide Engineer drawings and specifications prepared by a qualified Engineer for the construction of all **Flex MSE** structures shown on the construction drawings and as described by the Contract Specifications.

.4 Provide geotechnical soils report from a qualified Geotechnical Engineer to ascertain that the site soils can be compacted to specification. Should site soil be used to fill the **Flex MSE** Bags, the soil will be analyzed to ensure that sufficient nutrients exist to sustain the chosen vegetation and meet the minimum mineral specification outlined in Section 2.5.

.5 Provide a combined Sieve/Nutritional analysis for the Bag Fill Medium guaranteeing it meets minimum, or Engineer specific mineral requirements, as well as local Landscape Materials specifications for the specified vegetation.

.6 The **Flex MSE System** Bag and Bag Fill Medium is Engineered for water permeability and therefore drainage systems are usually not required if adjacent soils are free draining & no abnormal hydrostatic pressure exists. Should a drainage system be required by a Design Engineer, construct a drainage system as specified.

.7 **Flex MSE** System's **"Tie Back"** design can be used for no surcharge gravity walls under 2.0m in height where geogrid is not specified. Depending on the dimensions of the wall/slope and surcharge, the Engineer may specify rotating some or all of the **Flex MSE** Bags 90 degrees. This is typical for repairs/upgrades of road side slips/erosion and culvert headwalls. For culvert headwalls with a 1H:2V slope it is recommended to rotate 90 degrees every 2nd Bag on every 2nd row for up to 1.5m height. For heights up to 2m, rotating 90 degrees every 2nd Bag on every row is recommended. For steeper slopes, rotating every Bag may be required.

PART 2 – COMPONENTS

2.01 Flex MSE Vegetated Wall System Components:

Purchasing:

Purchase warrantied **Flex MSE** materials and suitable geosynthetic reinforcement from your nearest authorized Flex MSE agent or dealer. Visit http://www.flexmse.com/find-a-flex-mse-dealer-global/ to find a local dealer.

Flex MSE System Description:

Flex MSE uses industry standard soil stabilization practices and Engineered components to create near vertical 'soft armour' faced segmental walls that accept and integrate vegetation into the system's performance.

.1 **Flex MSE Plate**

.1 The patented and branded **Flex MSE** Plate is composed of 100% polypropylene (100% recycled post industrial content), must be weather resistant to minus 30 Degrees Celsius and must be 100% recyclable. 3 conical spikes protrude from the top and 8 conical spikes protrude from the bottom of the unit to interlock a total of three filled **Flex MSE** Bags. 2 'Friction Strips' with Geogrid Hooks cross the width of the top of the Plate, providing additional shear strength and frictional contact. The **Flex MSE** Plate is to be used in all applications, including those using geogrid for reinforced walls and slopes, gravity walls, and erosion control applications.

.2 **Flex MSE Bags**

.2 The labeled **Flex MSE GTX Bag** is sewn from a proprietary non-woven geotextile that will not rot or mildew, is non-biodegradable and able to withstand significant cutting or tearing without negatively affecting system performance. **Flex MSE** Bags provide a filtering functionality and are water permeable and root friendly. **Flex MSE** Bags have met all applicable ASTM standards for geotextile testing (pursuant to Section 1.03.2).

2.02 Geosynthetic Soil Reinforcement:

.1 Engineer recommended geosynthetic reinforcement is available from authorized Distributors or Dealers in your region.

.2 Install geosynthetic reinforcement layers according to the manufacturer's guidelines.

.3 Spacing and length of reinforcement is to be specified on Engineer Drawings. The **Flex MSE System** can accommodate minimum reinforcement spacing of 15cm (6in).

.4 **Reinforcement in the form of the Tie Back Method or appropriate geogrids must be used in all Flex MSE installations greater than .6m (24") exposed height**.

2.03 Reinforced Backfill:

.1 Shall consist of granular or low plastic site soils
.2 A plasticity index less than 10 per ASTM D4318
.3 An effective internal angle of friction > 28º per ASTM D2166 or D3080 at the compaction standard
.4 Less than 0.5% organic material
.5 Material can be site-excavated soils where the above requirements can be met. Unsuitable soils for backfill including ML, CL, MH, CH, OH or Pt shall not be used in the backfill or in the reinforced soil mass.
.6 Use of an effective friction angle greater than 34 degrees for design shall be verified by appropriate testing submitted to and approved by the owner's Engineer prior to construction.

2.04 Flex MSE Bag Fill Material:

.1 Bag fill material is selected with the desired vegetation and application in mind. Bag fill soils must be approved by the designing Engineer and/or Trexiana.

.2 **Walls, Slopes and above High Water line applications**

.1 Freely draining soils and granular materials cleaned of all debris, roots, branches, stones in excess of 20 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products.

.2 Properties should include:

Approximate Organic Content: 30% by total mixed volume

Granular Content smaller than 20 mm - larger than .075mm: 70% by volume (less than 5% Fines by mass)

*Total Fines of mixed Bag medium: Less than 8% by mass

Percolations shall be such that no standing water is visible 60 minutes after at least 10 minutes of moderate to heavy rain or irrigation.

.3 Organic additive materials must be a viable commercial compost product and/or a native soil tested for nutritional content. Flex MSE Bag Fill properties are to be confirmed with an up to date combined sieve and nutritional analysis.

.4 Thoroughly mix all constituents of the Flex MSE Bag Fill material.

.5 Other criteria may be required in project specific Engineer Drawings. Refer to Contract Documents.

.3 **Below Water line Applications**

.1 Poorly Graded Clean Granular material; maximum 20 mm gravel - minimum particle size 2 mm.

.2 Vegetation: Bag medium may be preseeded at specified rates with appropriate species to promote vegetation of **Flex MSE** Bags below the high water line. Brush layering or Live Staking around Bags may also be accomplished, paying care to not puncture the face of any Bags below high water line.

2.05 Flex MSE System Vegetation

.1 Vegetation can be applied through a variety of planting methods. Vegetation is selected with consideration to the environmental and application conditions, as well as the desired end result. A vegetation specialist is recommended to assist in the selection of plant materials. Trexiana Wholesale is available to provide vegetation resources and references to parties involved in the Contract.

Depending on location, climate, and overall slope, an irrigation system may need to be incorporated into the **Flex MSE** installation. For best results, use soaker hoses, spray heads, or drip irrigation located with appropriate spacing. Engage a qualified irrigation professional for design and installation on all engineered installations.

.2 Approved vegetation methods include:

.1 Seeding – Hydroseeding & Pre-Seeding the **Flex MSE** Bag

.2 Live Planting

.3 Live Staking

.4 Brush Layering

See Section 3.09, Flex MSE Vegetation Best Practices and Contract Design Notes for full descriptions of methods.

PART 3 - INSTALLATION

Verify Project Engineer Drawings are consistent with on-site conditions prior to starting construction. Any additional or changed conditions that may affect the project design are the sole responsibility of the Contractor to report.

3.01 Site Preparation

.1 Clear and grub existing area.

.2 If site soil is to be used as fill, test native soils for suitability as **Flex MSE Bag** and back fill material.

.3 If **Flex MSE** Bags are filled on site, prepare a suitable "work area" located in close proximity to the site that allows for safe stockpiling.

3.02 Subgrade

.1 Refer to Engineer drawings for specified excavation, embedment depths and compaction for each application type and comply with requirements.

.2 Excavate to depths shown on drawings allowing for specified number of below grade **Flex MSE** Bag layers on top of specified depth of compacted granular base or compacted native mineral layer.

.3 Prepare a stable, reasonably level base and proof compact to specified density.

3.03 Granular Base

.1 Where specified by Geotechnical Engineer, place granular base materials to lines and depths as shown in contract drawings and compact as specified. Minimum **Flex MSE** system requirements for the wall facing are a 300mm deep trench at the toe, lined with 150mm of 20mm clear crush for drainage and leveling. 'At grade' installations will have the equivalent of

one **Flex MSE** course high and 600mm wide of approved fill compacted to 95% Standard Proctor (SP) in front of the initial course.

3.04 Preparation of **Flex MSE** Bags

.1 Ensure the Bag Fill Material is thoroughly mixed with any required additives. Recommended mix is 70% clean sandy/granular material and 30% organic material by volume. Mix constituents may vary dependent on the application, plant/vegetation selection, site location and climate, and Engineer/Designer specifications.

.2 Fill the **Flex MSE** Bags completely, to a consistent weight and size, allowing just enough geotextile material for the secure closure of the Bag.

.3 Secure the closure at a consistent place on every Bag. Bag closure methods include but are not limited to cable or rebar ties, hog rings, or machine sewing with appropriate hardware and industrial threads.

3.05 Drainage

.1 Certain projects may require Engineered drainage solutions depending on variable site conditions as stated in section 1.04 of this guideline, or due to characteristics of the **Flex MSE** Bag fill medium.

.2 Refer to Engineering Drawings and Specifications for drainage structures, and comply with all requirements.

3.06 **Flex MSE** Construction

.1 Refer to Engineer drawings for layout dimensions and installation techniques.

.2 Begin by placing a **Flex MSE** Plate between the base layer (eg: crush, native material, or leveling pad) and first row.

.3 Install the base course of filled **Flex MSE** Bags as per Engineer drawings. Start installation at the lowest point and dig Bags into the material at appropriate elevation changes. Leave no more than an inch between each Bag to allow for spread during compaction. Place Bags with the seam level and facing inwards towards backfill material. Hand tamp or machine compact each layer. There shall be no gaps between tamped/compacted Bags to ensure backfill material containment. Place a **Flex MSE** Plate equally over the juncture of each bag in the row. Plate placement must be set back specific so that Plates are fully enveloped by successive Bags and gain full reinforcement engagement. For successive layers, lay **Flex MSE** Bags over the Plate and joint of the two Bags underneath, maintaining the typical Segmental Retaining Wall 'running bond' pattern. If the ends of Bags on the working layer get within 8 inches (200mm) of the Bag joints underneath, lay a spacing Tie-Back unit down to reset the running bond pattern (refer to the *Flex MSE Tie Back CAD* for illustration). Hand tamp or lightly (1000lb) machine compact each layer to fully engage the spikes of the **Flex MSE** Plate to the Bags on top and underneath.

.4 Install drainage system per drawings if required.

.5 Place and compact backfill to Specification every two courses of compacted **Flex MSE** Bags (280 mm) or per Engineer's specification. Structures with lower slopes and greater setback may require placement and compaction of backfill every row to prevent slumping of Bags backwards. Bags are hand tamped every Row or machine compacted every two rows with light weight compaction equipment.

.6 Maintain the specified batter or slope as rows of **Flex MSE** Bags and Interlocking Plates are placed through measurement, Batter Board/Jig or level. Any change in batter from the drawing must be approved by the Designing Engineer. Account for changes in Unit set back and profile as a result of **Flex MSE** Bag compaction.

3.07 Backfill

.1 Back fill shall be placed in maximum 10 inch (250mm) uncompacted lift thickness and compacted to 98 percent Standard Proctor density as determined in accordance with ASTM D-698. The in-place moisture content shall not exceed the optimum moisture content as determined in accordance with ASTM D-698 and shall be no lower than 3 percentage points below optimum moisture content.

.2 Backfill shall be placed, spread, and compacted from the facing units toward the back of the fill zone to maintain reinforcement tension.

.3 Only light weight hand operated compaction equipment shall be operated with 3 feet (1m) of the back of the Flex MSE units.

.4 Tracked equipment shall not be operated directly on the reinforcing. A minimum thickness of 6 inch (150mm) of fill is required prior to operating tracked equipment over the reinforcing.

.5 Rubber tired equipment may be operated on the reinforcing, avoiding sudden braking and sharp turns.

.6 At the end of each workday, the Contractor shall grade the backfill away from the wall area to Engineer's specifications and direct runoff away from the wall area. Surface runoff from adjacent areas must be directed away from the work area.

3.08 Geogrid

.1 To secure a geogrid reinforcement layer to the **Flex MSE** unit, extend the geogrid 1 inch (25mm) over the unit edge for inspection purposes. Lay the geogrid into the embedment area in the appropriate strength orientation and press the **Flex MSE** Plate firmly on top of the Bag and geogrid, locking the geogrid into place. The Geogrid Hook on the top of Plate may also be used to secure geogrid into place. Lay backfill from the back of the Bag to the furthest excavated point to maintain tension between the geogrid layer and the facing unit.

.2 Install geogrid to the manufacturer's specifications and in accordance with Engineer's drawings and Specifications.

3.09 Vegetation

Consistent vegetation growth is integral to the long term success of **Flex MSE** structures. Attention is paid to environmental, structural, and aesthetic parameters to achieve consistent results. Vegetation is completed through single or combined methods of propagation during or after construction. Thoroughly water the installation prior to undertaking any vegetation method. Refer to the ***Flex MSE*** *Vegetation Best Practices* and contact Trexiana for additional information.

.1 Seeding:

Hydroseeding is the preferred method of seeding. Apply hydroseeded material to the face of the **Flex MSE** structure in a manner that achieves complete coverage of all contours of the exposed Bag face. **Mulch type must be consistent with the application's Slope. Engineered hydroseed products for Extreme Slopes must be used in applications steeper than 1H:2V. Contact Trexiana Wholesale for recommendations of proprietary BFM (Bonded Fibre Matrix) and FGM (Flexible Growth Medium) products.**

Pre-Seeding of **Flex MSE** Bags may be undertaken in certain situations, but is typically not employed as the primary method of vegetation. Proper mixing at Specified weight/volume rates must be followed to expose as much seed as possible to surface light, warmth, and moisture. Preseed mixture rates for seed/m3 of Bag Fill Medium are typically 5 times the m2 hydroseed application rates for the chosen blend but may vary.

On Slopes greater than 1H:4V, seed varieties with mature heights below 18 inches (460mm) are used to prevent lodging. Seed mixtures are purchased from accredited sources with guaranteed standard germination rates.

.2 Live Planting:

Live Planting with locally viable native plants or cultivars that are proven performers in the site area may be used to vegetate the structure. The **Flex MSE** Bags can be cut to accommodate live planted 2-3 inch plugs directly into the Bag medium. Up to three inverted 'T-cuts' measuring 3"x3" can made in each Bag. A planting tool such as a dibble may also be used. Depending on the chosen plants and site location, a 10gm fertilizer tablet sitting on top of the root ball may be required. Refer to construction documents for plant list, spacing and placement instructions.

.3 Live Staking:

Live staking with viable native species such as willows may be used to vegetate the structure. Proper harvest and storage are critical to ensure viable live stakes. Live staking is achieved by punching the stake/branch directly into the **Flex MSE** Bags or in between the Bags into the back fill. Inserting the stake downward into Bags underneath is permitted. 80% of the stake's length should be embedded in the soils to prevent dehydration, and stakes should be a minimum of 1" (25mm) in diameter at the base. Bags under the high water mark are not to be punctured. See *Flex MSE Vegetation Best Practices* for further information on Live Staking.

.4 Brush Layering:

The root ball of a more established plant can be positioned behind the **Flex MSE** Bags, pointing down into the backfill with the stem protruding between Bags. This method is recommended with applications near water. If Brush Layering is to be used, it is recommended that a well graded soil be selected for Backfill.

3.10 Field Review

.1 Pursuant to the Contract, **field review** should be undertaken at regular intervals to ensure satisfactory germination and/or coverage of the **Flex MSE** Bags.

.2 At six months, if selected plants have performed below optimal rates in the **Flex MSE** Bags, it is recommended that regular watering, reseeding or remedial planting be performed. Some spray on liquid fertilizer or fertilizer added to the existing irrigation system may also be warranted.

3.11 Field Quality Control

.1 Field Quality Assurance - The Owner shall engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. As a minimum, quality assurance testing should include foundation soil inspection, inspection for the need for any additional drainage, soil and backfill testing, verification of design parameters, and observation of construction for general compliance with design drawings and specifications. The Contractor will also secure the necessary construction quality control testing during construction.

.2 The Contractor's quality control testing and construction inspection services shall only be performed by independent, qualified and experienced technicians and Engineers. The Contractor's quality control testing shall include:

.1 Field density testing

.2 Sub grade: one test for every 2500 square feet (230 m2) of sub grade. Reinforced Backfill: one test for every 2500 square feet (230 m2) per lift with a minimum of one test for every other lift.

.3 Retained and Foundation Soil: per Section 02200.

.4 Laboratory Moisture Density - minimum one test per soil type.

.5 Gradation Analysis

a) Unit Fill: one test per 500 CY (400 cm)

b) Backfill: one test per 1000 CY (800 cm)

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