SECTION 02273 - GEOTEXTILES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The Contractor shall provide geotextiles, complete and in place, in accordance with the Contract Documents.

1.2 DEFINITIONS

A. The following definitions apply to the Work of this section:

1. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.

2. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile provided, calculated as the typical minus two standard deviations.

3. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile provided, calculated as typical plus two standard deviations.


5. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.

6. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D 4884.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. Commercial Standards

1. ASTM International (ASTM)

   ASTM D 4355 Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)

   ASTM D 4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity

   ASTM D 4533 Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751 Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D 4884 Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Sewn Geotextiles
ASTM D 4873 Guide for Identification, Storage and Handling of Geotextiles
ASTM D 6193 Standard Practice for Stitches and Seams Standard Practice for Stitches and Seams
ASTM D 6241 Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

1.4 SUBMITTALS

A. General: Submittals shall be in accordance with the requirements of Section 01300 - Contractor Submittals.

B. Shop Drawings:
   1. Manufacturer material specifications and product literature.
   2. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.
   3. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.

C. Samples:
   1. Geotextile: One-piece, minimum 18 inches long, taken across full width of roll of each type and weight of geotextile. Label each with brand name and furnish documentation of lot and roll number from which each sample was obtained.
   2. Field Sewn Seam: 5-foot length of seam, 12 inches wide with seam along center, for each type and weight of geotextile.
   3. Securing Pin and Washer: One each.
D. Certifications:

1. Certification from the geotextile manufacturer that the furnished products satisfy the indicated requirements.

2. Field seam efficiency test results.

**PART 2 -- PRODUCTS**

2.1 GENERAL

A. Geotextile sheets shall be manufactured with polymeric material consisting of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins or polyesters.

B. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed.

C. Stabilizers and/or inhibitors shall be added to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure.

2.2 WOVEN GEOTEXTILE

A. Woven geotextile shall be composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.

B. Polymeric yarn shall be long-chain synthetic polymers (polyester or polypropylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.

C. Sheet Edges: Salvaged or finished to prevent outer material from separating from sheets.

D. Type WF-1 (Class 1 Woven Fabric): (Not Used)

E. Type WF-2 (Class 2 Woven Fabric):

   1. Physical Properties:
      
      a. Unseamed Sheet Width: Minimum 12.5 feet
      
      b. Nominal Weight: 4.8 ounces per square yard
      
      c. Nominal Thickness: Minimum 40 mils

   2. Mechanical Properties: Conform to requirements below.
### Mechanical Property Requirements for Woven Geotextile

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparent Opening Size (AOS)</td>
<td>No. 40 US Std. Sieve, MaxARV</td>
<td>ASTM D 4751</td>
</tr>
<tr>
<td>Water Permittivity</td>
<td>0.05 sec.(^{-1}), MinARV</td>
<td>ASTM D 4491 (Falling Head)</td>
</tr>
<tr>
<td>Water Flow Rate</td>
<td>4 gpm/ ft(^2), MinARV</td>
<td>ASTM D 4491 (Falling Head)</td>
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<tr>
<td>Grab Tensile Strength</td>
<td>315 lb, MinARV</td>
<td>ASTM D 4632</td>
</tr>
<tr>
<td>Grab Tensile Elongation</td>
<td>12 percent, MinARV</td>
<td>ASTM D 4632</td>
</tr>
<tr>
<td>Trapezoid Tear Strength</td>
<td>113 lb, MinARV</td>
<td>ASTM D 4533</td>
</tr>
<tr>
<td>CBR Puncture Strength</td>
<td>900 lb, MinARV</td>
<td>ASTM D 6241</td>
</tr>
<tr>
<td>Ultraviolet Radiation Resistance</td>
<td>70 percent strength retention, MinARV after 500 hours</td>
<td>ASTM D 4355</td>
</tr>
</tbody>
</table>

3. Manufacturers, or Equal
   a. **TenCate, Mirafi 600X**
   b. **Propex, Geotex 315ST**

F. Type WF-3 (Class 3 Woven Fabric):
   1. Physical Properties:
      a. Unseamed Sheet Width: Minimum 12.5 feet
      b. Nominal Weight: 4 ounces per square yard
      c. Nominal Thickness: Minimum 20 mils
   2. Mechanical Properties: Conform to requirements below.
### Mechanical Property Requirements for Woven Geotextile

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
<th>Test Method</th>
</tr>
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<tbody>
<tr>
<td>Trapezoid Tear Strength</td>
<td>75 lb, MinARV</td>
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<td>CBR Puncture Strength</td>
<td>700 lb, MinARV</td>
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<tr>
<td>Ultraviolet Radiation Resistance</td>
<td>70 percent strength retention, MinARV after 500 hours</td>
<td>ASTM D 4355</td>
</tr>
</tbody>
</table>

3. Manufacturers, or Equal
   a. **TenCate, Mirafi 500X**
   b. **Propex, Geotex 200ST**

G. Type WF-4 (Silt Fence Woven Fabric):

1. Physical Properties:
   a. Unseamed Sheet Width: Minimum 3 feet
   b. Nominal Thickness: Minimum 15 mils
   c. Nominal Weight: 3.2 ounces per square yard

2. Mechanical Properties: Conform to requirements below.

### Mechanical Property Requirements for Woven Geotextile

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparent Opening Size (AOS)</td>
<td>No. 30 US Std. Sieve, MaxARV</td>
<td>ASTM D 4751</td>
</tr>
<tr>
<td>Water Permittivity</td>
<td>0.1 sec.(^{-1}), MinARV</td>
<td>ASTM D 4491</td>
</tr>
<tr>
<td>Water Flow Rate</td>
<td>8 gpm/ft(^2), MinARV</td>
<td>ASTM D 4491</td>
</tr>
<tr>
<td>Grab Tensile Strength</td>
<td>124 lb, MinARV</td>
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<tr>
<td>Grab Tensile Elongation</td>
<td>15 percent, MinARV</td>
<td>ASTM D 4632</td>
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<tr>
<td>Trapezoid Tear Strength</td>
<td>65 lb, MinARV</td>
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<tr>
<td>Puncture Strength</td>
<td>60 lb, MinARV</td>
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<td>Ultraviolet Radiation Resistance</td>
<td>70 percent strength retention, MinARV after 500 hours</td>
<td>ASTM D 4355</td>
</tr>
</tbody>
</table>
3. Manufacturers, or Equal
   a. TenCate, Mirafi, 100X
   b. Propex, Geotex 2130

2.3 NONWOVEN GEOTEXTILE

A. Nonwoven geotextile shall be composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.

B. Polymeric yarn shall be long-chain synthetic polymers (polyester, polypropylene, or polyethylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.

C. Sheet Edges: Selvaged or finished to prevent outer material from separating from sheets.

D. Type NF-1 (Class 1 Nonwoven Fabric):
   1. Physical Properties:
      a. Unseamed Sheet Width: Minimum 12.5 feet
      b. Nominal Thickness: Minimum 72 mils
      c. Nominal Weight: 8 ounces per square yard
   2. Mechanical Properties: Conform to requirements below.

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparent Opening Size (AOS)</td>
<td>No. 80 US Std. Sieve, MaxARV</td>
<td>ASTM D 4751</td>
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<tr>
<td>Water Permittivity</td>
<td>1.1 sec. (^{-1}), MinARV</td>
<td>ASTM D 4491 (Falling Head)</td>
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<tr>
<td>Water Flow Rate</td>
<td>95 gpm/ft(^2), MinARV</td>
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<td>Grab Tensile Strength</td>
<td>205 lb, MinARV</td>
<td>ASTM D 4632</td>
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<tr>
<td>Grab Tensile Elongation</td>
<td>50 percent, MinARV</td>
<td>ASTM D 4632</td>
</tr>
<tr>
<td>Trapezoid Tear Strength</td>
<td>80 lb, MinARV</td>
<td>ASTM D 4533</td>
</tr>
<tr>
<td>CBR Puncture Strength</td>
<td>500 lb, MinARV</td>
<td>ASTM D 6241</td>
</tr>
<tr>
<td>Ultraviolet Radiation Resistance</td>
<td>70 percent strength retention, MinARV</td>
<td>ASTM D 4355</td>
</tr>
<tr>
<td></td>
<td>after 500 hours</td>
<td></td>
</tr>
</tbody>
</table>
3. Manufacturers, or Equal
   a. TenCate, Mirafi 180N
   b. Propex, Geotex 801

E. Type NF-2 (Class 2 Nonwoven Fabric):
   1. Physical Properties:
      a. Unseamed Sheet Width: Minimum 12.5 feet
      b. Nominal Thickness: Minimum 65 mils
      c. Nominal Weight: 6.5 ounces per square yard
   2. Mechanical Properties: Conform to requirements below.

<table>
<thead>
<tr>
<th>Mechanical Property Requirements for Nonwoven Geotextile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property</td>
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<tr>
<td>Apparent Opening Size (AOS)</td>
</tr>
<tr>
<td>Water Permittivity</td>
</tr>
<tr>
<td>Water Flow Rate</td>
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<td>Grab Tensile Strength</td>
</tr>
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<td>Grab Tensile Elongation</td>
</tr>
<tr>
<td>Trapezoid Tear Strength</td>
</tr>
<tr>
<td>CBR Puncture Strength</td>
</tr>
<tr>
<td>Ultraviolet Radiation Resistance</td>
</tr>
</tbody>
</table>

3. Manufacturers, or Equal
   a. TenCate, Mirafi 160N
   b. Propex, Geotex 601

F. Type NF-3 (Class 3 Nonwoven Fabric):
   1. Physical Properties:
      a. Unseamed Sheet Width: Minimum 12.5 feet
      b. Nominal Thickness: Minimum 40 mils
c. Nominal Weight: 4.8 ounces per square yard

2. Mechanical Properties: Conform to requirements below.

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparent Opening Size (AOS)</td>
<td>No. 70 US Std. Sieve, MaxARV</td>
<td>ASTM D 4751</td>
</tr>
<tr>
<td>Water Permittivity</td>
<td>1.5 sec.(^{-1}), MinARV</td>
<td>ASTM D 4491 (Falling Head)</td>
</tr>
<tr>
<td>Water Flow Rate</td>
<td>120 gpm/ft(^2), MinARV</td>
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</tr>
<tr>
<td>Grab Tensile Strength</td>
<td>120 lb, MinARV</td>
<td>ASTM D 4632</td>
</tr>
<tr>
<td>Grab Tensile Elongation</td>
<td>50 percent, MinARV</td>
<td>ASTM D 4632</td>
</tr>
<tr>
<td>Trapezoid Tear Strength</td>
<td>50 lb, MinARV</td>
<td>ASTM D 4533</td>
</tr>
<tr>
<td>CBR Puncture Strength</td>
<td>300 lb, MinARV</td>
<td>ASTM D 6241</td>
</tr>
<tr>
<td>Ultraviolet Radiation Resistance</td>
<td>70 percent strength retention, MinARV after 500 hours</td>
<td>ASTM D 4355</td>
</tr>
</tbody>
</table>

3. Manufacturers, or Equal
   a. TenCate, Mirafi 140N
   b. Propex, Geotex 451

2.4 SEWING THREAD
   A. Sewing thread shall be polypropylene, polyester, or Kevlar thread with durability equal to or greater than durability of geotextile sewn.

2.5 SECURING PINS
   A. Securing pins shall be Type 304 stainless steel rods or bars conforming to the following:
      1. 1/16-inch diameter.
      2. Pointed at one end; head on other end sufficiently large to retain washer.
   B. Steel washers for securing pins shall be Type 304 stainless steel conforming to the following requirements:
      1. Outside Diameter: Not less than 1 1/2 inches.
      2. Inside Diameter: 1/4-inch.
C. Steel wire staples shall be Type 304 stainless steel conforming to the following requirements:

1. U-shaped.
2. 10-gauge.
3. Minimum 6 inches long.

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Geotextile labeling, shipment, and storage shall comply with ASTM D4873. Deliver each roll with sufficient information attached to identify manufacturer’s name, and product name, style number, roll number, roll dimensions (length, width, and gross weight), and date manufactured.

B. Handle products in manner that maintains undamaged condition. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

C. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure.

D. Storage

1. Do not store products directly on ground.

2. Protect rolls of geotextile from construction equipment, chemicals, sparks and flames, temperatures in excess of 160 degrees F or any other environmental condition that may damage the physical properties of the geotextile.

3. Store geotextile in a way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

3.2 SUBGRADE PREPARATION

A. The surface underlying the geotextile shall be smooth and free of ruts or protrusions, which could damage the geotextile. Subgrade materials and compaction requirements shall be as indicated and conform to the requirements of Section 02200 - Earthwork.

3.3 LAYING GEOTEXTILE

A. Notify the Construction Manager whenever geotextiles are to be placed. Do not place geotextile prior to obtaining Construction Manager’s approval of underlying materials.

B. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

3.4 ORIENTATION ON SLOPES

A. Orient geotextile with long dimension of each sheet parallel to direction of slope.
B. Geotextile may be oriented with long dimension of sheet transverse to direction of slope only if sheet width, without unsewn seams, is sufficient to cover entire slope and anchor trench and extend at least 18 inches beyond toe of slope.

3.5 JOINTS

A. **Un-seamed Joints**: Successive sheets of geotextiles with un-seamed joints shall be overlapped to the following dimensions with the upstream sheet overlapping the downstream sheet unless otherwise indicated:

1. **Foundation/Subgrade Stabilization**: Minimum 18 inches.
2. **Riprap**: Minimum 18 inches.
3. **Drain Trenches**: Minimum 18 inches, except overlap shall equal trench width if trench width is less than 18 inches. Where the trench is less than 4 inches wide, the geotextile overlap shall be sewn or otherwise bonded.
4. **Other Applications**: Minimum 12 inches.

B. **Sewn seams**: Successive sheets of geotextiles with sewn seams shall be used wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by Construction Manager, also may be used instead of overlap at joints for applications that do not require stress transfer.

1. **Seam efficiency** shall be minimum 70 percent, verified by preparing and testing minimum of one set of nondestructive samples per acre of each type and weight of geotextile provided. Test according to ASTM D4884.
2. **Type**: "J" type seams are preferred, but flat or butterfly seams are acceptable.
3. **Stitch Count**: Minimum three (3) to maximum seven (7) stitches per inch.
4. **Stitch Type**: Double-thread stitch, Type 401, ASTM D6193.
5. **Stitch Location**: 2 inches from geotextile sheet edges, or more, if necessary to develop required seam strength.
6. **Sewing Machines**: Capable of penetrating four layers of geotextile.

3.6 SECURING GEOTEXTILE

A. Secure geotextile during installation as necessary with sand bags or other means approved by Construction Manager.

B. **Securing Pins**:

1. Insert securing pins with washers through geotextile, midway between edges of overlaps and 6 inches from free edges.
2. **Spacing**:
### Slope Maximum Pin Spacing

- Steeper than 3:1: 2 feet
- 3:1 to 4:1: 3 feet
- Flatter than 4:1: 5 feet

3. Install additional pins across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.

4. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.

#### 3.7 INSTALLING GEOTEXTILE IN TRENCHES

- **A.** Place geotextile in a way that will completely envelope granular drain material to be placed in trench and with indicated overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.

- **B.** After granular drain material is placed to grade, fold geotextile over top of granular drain material, unless otherwise indicated. Maintain overlap until overlying fill or backfill is placed.

#### 3.8 RIPRAP APPLICATIONS

- **A.** Overlap geotextile at each joint with the upstream sheet of geotextile overlapping the downstream sheet.

- **B.** Sew joints where wave run-up may occur.

#### 3.9 GEOTEXTILE-REINFORCED EARTH WALL APPLICATIONS

- **A.** Sew exposed joints; extend sewn seams minimum 3 feet behind face of wall.

- **B.** Protect exposed geotextile from damage and deterioration until permanent facing is applied.

#### 3.10 SILT FENCE APPLICATIONS

- **A.** Install geotextile in one piece or continuously sewn to make one piece, for full length and height of fence, including portion of geotextile buried in toe trench.

- **B.** Install bottom edge of sheet in toe trench and backfill in a way that securely anchors geotextile in trench.

- **C.** Securely fasten geotextile to a wire mesh backing and each support post in a way that will not result in tearing of geotextile when fence is subjected to service loads.

- **D.** Promptly repair or replace silt fence that becomes damaged.
3.11 PLACING PRODUCTS OVER GEOTEXTILE

A. Before placing material over geotextile, notify Construction Manager. Do not cover installed geotextile prior to receiving authorization from the Construction Manager to proceed.

B. Place cover materials in a manner that prevents the cover materials from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, backfill shall be placed from the bottom of the slope upward.

C. Cover materials shall not be dropped onto the geotextile from a height greater than 3 feet.

D. No equipment shall be operated directly on top of the geotextile without approval of the Construction Manager. Use equipment with ground pressures less than 7 psi to place the first lift over the geotextile.

E. A minimum of 12 inches of fill material shall be maintained between full-scale construction equipment and the geotextile. Cover material type, compaction, and testing requirements shall be as indicated and conform to the requirements of Section 02200 - Earthwork.

F. Equipment placing cover materials shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 5 mph.

G. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as indicated below.

3.12 REPAIRING GEOTEXTILE

A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile. Repair damaged geotextile by placing patch of undamaged geotextile over damaged area plus at least 18 inches in all directions beyond damaged area. Remove interfering material as necessary to expose damaged geotextile for repair. Sew patches or secure them with pins and washers, as indicated above for securing geotextile, or by other means approved by Construction Manager.

3.13 REPLACING CONTAMINATED GEOTEXTILE

A. Protect geotextile from contamination that would interfere, in Construction Manager's opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

- END OF SECTION 02273 -