1. PREFABRICATED VERTICAL DRAINS (revised 2-1-2022)
	1. Description. This work consists of furnishing all necessary equipment, materials, and labor for installing Prefabricated Vertical Drains (PVD) and a drainage blanket at the plan locations prior to construction of embankments at the specified locations.

Materials.

All materials provided must meet the requirements of the Build America Buy America (BABA) special provision as applicable.

Drainage Blanket. Provide sand for a drainage blanket consisting of a non-plastic granular material, free from organics or other deleterious material, meeting the following gradation requirements:

|  |  |
| --- | --- |
| Sieve Size | Percent Passing |
| No. 4 (4.75 mm) | 90-100 |
| No. 10 (2.00 mm) | 65 max |
| No. 30 (0.60 mm) | 35 max |
| No. 40 (0.425 mm) | 20 max |
| No. 100 (0.15 mm) | 6 max |

Prefabricated Vertical Drains. Furnish PVD of newly manufactured materials consisting of a core enclosed in or integrated with a jacket and meeting the following requirements:

Band-shaped with an aspect ratio (width divided by thickness) not exceeding 50.

Resistant against dry rot, mildew, bacterial action, insects, salts in solution in the groundwater, acids, alkalis, solvents, and any other significant ingredients in the project site groundwater.

A jacket consisting of synthetic non-woven geotextile capable of resisting all bending, punching, and tensile forces imposed during installation and throughout the design life of the drain that allows free passage of pore water to the core without loss of soil material and piping.

A minimum discharge capacity of 1.5 gallons/minute tested in accordance with ASTM D4716.

A minimum permittivity of 0.7 sec-1 tested in accordance with ASTM D4491.

A minimum flow rate of 60 gallons/min/ft2 tested in accordance with ASTM D4491.

Sufficiently rigid to withstand lateral earth pressures due to embankment placement so that the vertical flow capacity through the core will not be adversely affected.

A core consisting of a continuous plastic material fabricated to promote drainage along the axis of the vertical drain.

Sufficiently flexible to bend smoothly during installation and induced consolidation settlement without damage.

Does not crack or peel during installation.

A minimum equivalent diameter of 2.4 inches using the following definition of equivalent diameter: d = (a+b)/2 where

 d = diameter of a circular drain equivalent to the band shaped drain,

 a = width of a band shaped drain

 b = thickness of a band shaped drain

PVD Identification, shipment, and storage.

Clearly label each roll of PVD material shipped to the project with the name and address of the manufacturer, full product name/number, quantity, and roll number.

Supply with each lot 2 copies of a manufacturer’s certificate of compliance signed by an authorized manufacturer’s official. Submit the Certificates of Compliance to the Project Manager when the material arrives on the project. The Project Manager will reject materials that are mislabeled or misrepresented.

Wrap each roll with a material that will protect the PVDs, including ends of the roll, from damage due to shipment, water, sunlight, and contaminants. Maintain the protective wrapping during periods of shipment and storage. Do not damage the PVD material or wrapping when unloading or transferring from one location to another.

During storage, elevate PVD material off the ground and adequately cover to protect from the following: site construction damage, precipitation, ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, temperatures in excess of 140 ºF (60 ºC), mud, dirt, dust, debris and any other environmental condition that may damage the physical property values of the PVD material. The Project Manager will reject damaged PVDs and PVD material.

PVD Sampling. Cut a sample from the PVD roll with a minimum length of 5 feet. After the sample and the required information have been submitted to the Project Manager, allow 30 calendar days for evaluation.

Construction.

Drainage Blanket. Prior to installation of the PVD, construct a drainage blanket of 2-ft un-compacted thickness as shown on the plans. Use the drainage blanket as a working platform for installing the PVD.

After placement of the drainage blanket and PVD, construct the overlying embankment in uniform horizontal layers not to exceed 8 inches in loose thickness, and compact to 90% of maximum dry density as determined by MT 210 in the lower 1 foot of embankment, and 95% thereafter, or as necessary to support the construction equipment, whichever is greater. Grade existing ground at the base of embankment fill to facilitate drainage away from the existing embankment.

Prefabricated Vertical Drains

Use installation equipment that causes a minimum disturbance of the subsoil during the installation operation.

Install PVD using a mandrel or sleeve that is advanced through the drainage blanket and compressible soils to the required depth using either static and/or vibratory methods. Use a mandrel that protects the PVD material from tears, cuts, and abrasions during installation, can be withdrawn after the installation of the PVD, has an anchoring rod or plate at the bottom that prevents soil from entering the bottom of the mandrel during PVD installation, and anchors the bottom of the PVD at the required depth when the mandrel is removed. Do not use a mandrel with a cross-sectional area greater than 12 in2.

Submit details of the method and sequence of installing the PVD to the Project Manager a minimum of 30 calendar days prior to installation. Include the following information in the submittal:

Size, type, weight, maximum pushing force, vibratory energy, applied ground force of the wheels or tracks, and configuration of the installation rig.

Dimensions and length of the mandrel.

Details of the PVD anchorage, including size, shape, type of material, and the connection to the vertical drains.

A detailed description of the proposed installation, including the construction sequence.

The proposed method for addressing obstructions.

The proposed method for splicing PVD material.

The proposed method of extracting the mandrel.

Alter the method and/or equipment used as necessary to comply with the plans and specifications and as directed by the Project Manager.

Locate, number, and stake the PVD locations to the satisfaction of the Project Manager. Do not vary more than 6 inches from the locations indicated on the plans, or as directed by the Project Manager.

Carefully check equipment for plumbness prior to advancing each PVD. Do not deviate more than 0.6 in per foot from vertical.

Install trial PVD at the locations shown on the plans.

After the Project Manager has approved installation of the trial PVD in writing, begin installation of the remaining PVD as shown on the plans. PVD that are out of tolerance, damaged during construction, or improperly completed will be rejected by the Project Manager.

Provide the Project Manager with a suitable means of verifying the plumbness of the mandrel and determining the depth of the drain at any time. Rejected drains may be removed or abandoned in place. Offset replacement drains approximately 2 feet from the location of the rejected drain. Replace all rejected drains at no additional cost to the Department.

Install the PVDs from the working surface to the depth shown on the plans, or as directed by the Project Manager.

After installation, cut the PVD so that a minimum of 6 inches of PVD material extends above the top of the working surface. If the drainage blanket is fully in place, cut the PVD off 1 foot above the ground surface, fold them over, and staple them shut.

Use augering or other methods, as necessary, to loosen stiff or dense upper soils prior to installation of the PVD. Do not extend augering or other methods more than 2 feet into the underlying compressible soils. Complete pre-augering or other methods before installation of the drainage blanket.

If pre-augering or other methods are performed before installation of the drainage blanket, leave a minimum length of 3 feet of PVD material extending above the working surface. Backfill all pre-augered borings to the original ground elevation.

If obstructions are encountered that cannot be penetrated by the PVD installation equipment, including pre-augering or other methods as specified above, notify the Project Manager. Under the supervision of the Project Manager, attempt to install an alternative PVD within a 2 foot radius of the original design location. If the PVD still cannot be installed to the design tip elevation, remove the obstruction or abandon the drain location and move the installation equipment to the next location as directed by the Project Manager.

The Project Manager may vary the depths, spacing, or number of PVDs to be installed, and may revise the plan limits for this work.

Splice or connect the PVD material as necessary to ensure continuity of the PVD. Use a minimum overlap of 6 inches for splices and connections.

Method of Measurement.

Prefabricated Vertical Drains are measured by the linear foot, complete and in place.

Drainage Blanket Material is measured by the cubic yard, complete and in-place.

Pre-augering or other methods used to facilitate installation of Prefabricated Vertical Drains is not measured for payment and is considered incidental to completion of the work in accordance with the Contract.

Basis of Payment. Payment for the completed and accepted work is made in accordance with the following:

 Pay Item Pay Unit

 Prefabricated Vertical Drains Lineal Foot

 Drainage Blanket Material Cubic Yard

Obstruction removal is paid as Extra Work in accordance with Section 109. Payment is full compensation for all tools, labor, materials, and equipment necessary for the completion of PVD installation, including altering the equipment and methods of installation in order to produce the required end result in accordance with the plans and specifications.