SUBSURFACE DRAINS

TYPAR
GEOTEXTILES

TOUGH OVER TIME

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TYPAR GEOTEXTILES

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1.0 FEATURES OF SUBSURFACE DRAINS

Subsurface drains are drains built with a permeable conduit such as corrugated plastic, a geotextile fabric, tubing, tile, pipe or any combination thereof installed beneath the ground surface to collect and/or convey drainage water to an outlet. Subsurface drains are used for a wide variety of purposes including:

- Edge-of-pavement drains (Figure 1)
- Interceptor drains (Figure 2)
- Subsurface structure drains (Figure 3)
- Blanket drains (Figure 4)

Effective subsurface drains are essential to prevent the harmful and destructive force of uncontrolled water. Most infrastructure failures in applications such as highways, airfields, railroads, parking lots, buildings, retaining structures, mines and dams are attributed to the harmful effects of uncontrolled water.

With the use of Typar geotextiles, subsurface drains are simple to design and inexpensive to construct. Typar geotextiles filter water flowing to the drain and minimizes soil particles from passing, reducing the chance of system clogging. Typar 3401 is by far the most widely used grade for subsurface drains. As Typar

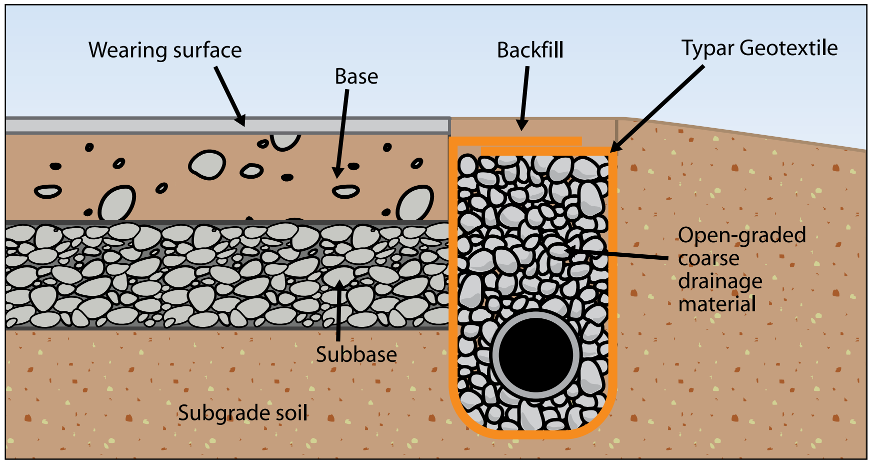

Figure 1: Edge of the pavement drain system.

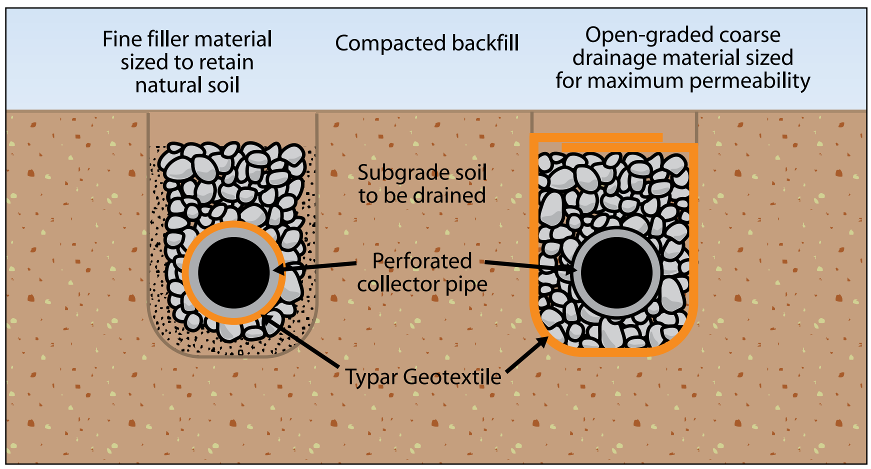

Figure 2: Interceptor drain systems.

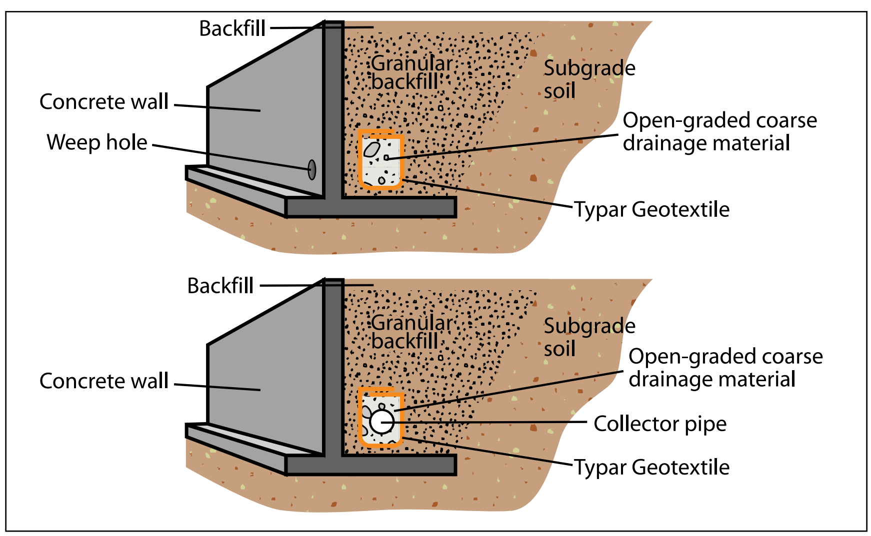

Figure 3: Subsurface structure drain system.

geotextiles are available in a wide variety of opening sizes, the appropriate grade can be selected depending on the soil particle size in critical applications.

A Typar geotextile is recommended in all subsurface drains to provide a separator to prevent intermixing of the drainage aggregate materials with the subgrade soil and therefore protect the drainage system from clogging.

2.0 HOW TYPAR GEOTEXTILES WORK

The failure of a drainage system is caused by the intermixing of the free-draining aggregate materials with the subgrade soil, which leads to clogging of the aggregate. Typar geotextiles separate soil from the aggregate stone, which minimizes intermixing, helping to maintain the integrity of the drain, and preserving the original design and design life of the drain. Typar's tensile strength, puncture resistance, tear resistance, opening size and hydraulic properties make it an ideal filter fabric for drainage systems.

The primary design requirement of a drainage system is the development of a natural graduated filter layer (Figure 5). Typar promotes the development of such layers because the unique bonded fibers create a pathway that resembles a well-graded aggregate filter. Typar provides an effective drainage structure since it has both high permeability and the ability to retain soil particles adjacent to the Typar, which effectively minimizes the piping of the natural soils and reduces fine particles from entering and clogging the drain.

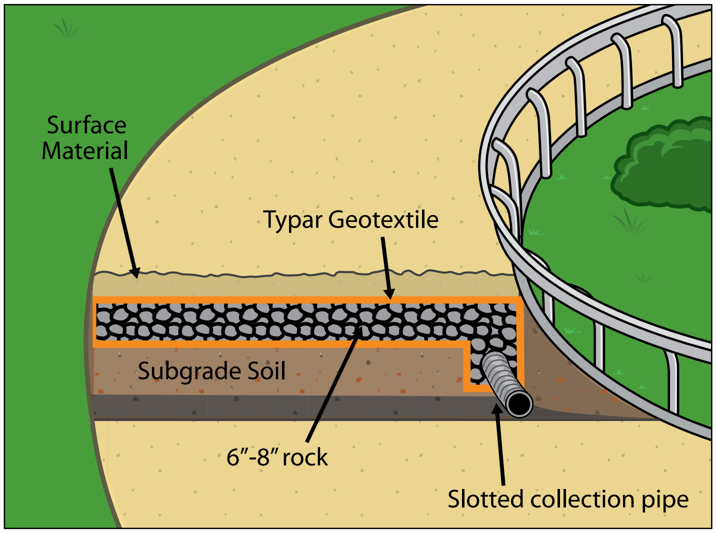

Figure 4: Blanket drain application for athletic fields, under roads, playgrounds, horse training and race tracks, etc.

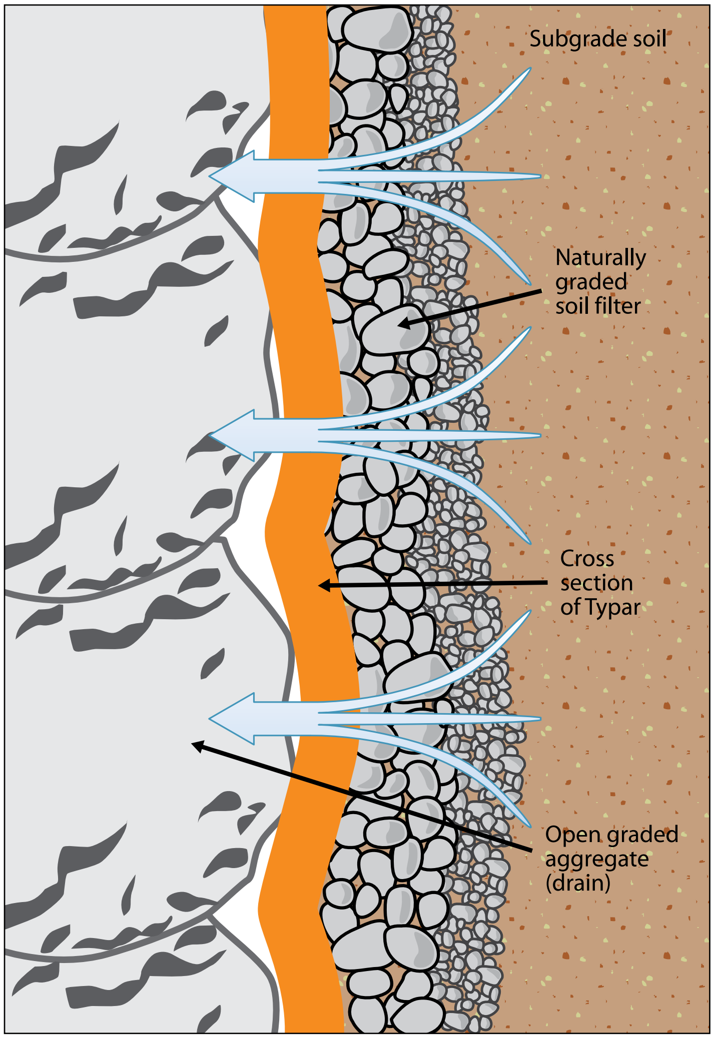

Figure 5: Graded soil filter formed next to the Typar.

SOIL NAME	DIAMETER		US STANDARD SIEVE SIZE	FAMILIAR EXAMPLE
	mm	inches		
Boulders	Over 300	Over 12	> 12″	Larger than basketball
Cobbles (rounded)	76-300	3-12	3-12″	Grapefruit
Coarse gravel	19-76	0.75-3.0	0.75-3″	Orange or lemon
Fine gravel	4.75-19	0.19-0.75	No. 4-0.75	Grape or pea
Coarse sand	2.0-4.75	0.08-0.19	No. 10-No. 4	Rock salt
Medium sand	0.42-2.0	0.016-0.08	No. 40-No. 10	Sugar or table salt
Fine sand	0.074-0.42	0.003-0.016	No. 200-No. 40	Powdered sugar
Silt sizes	0.002-0.074	0.0008-0.003	Rock flour and finer; particles cannot be distinguished with naked eye at distances of 20cm (8″).	
Clay sizes	< 0.002	< 0.00008		

Figure 6: Soil description based on typical grain size.

MAJOR DIVISIONS	SUBDIVISIONS	TYPICAL NAMES	LABORATORY CLASSIFICATION CRITERIA
Coarse-grained soil (More than 50% retained on No. 200 sieve)	Gravel (More than 50% of coarse fraction retained on No. 4 sieve)	Well-graded gravel or gravel-sand mixture, little or no fines	Less than 5% fines*
		Poorly-graded gravel or gravelly sand, little or no fines	Less than 5% fines*
		Silty gravel, gravel-sand-salt mixtures	More than 12% fines*
		Clay-like gravel, gravel-sand-clay mixtures	More than 12% fines*
	Sand (50% or more of coarse fraction passes through No. 1 sieve)	Well-graded gravel or gravelly sand, little or no fines	Less than 5% fines*
		Poorly-graded sand or gravelly sand, little or no fines	Less than 5% fines*
		Silty sand, sand-silt mixtures	More than 12% fines*
		Clay-like sand, sand-clay mixtures	More than 12% fines*
Fine-grained soil (50% or more passes No. 200 sieve)	Silt and clay (Liquid limit less than 50)	Inorganic silt, rock flour, silt of low plasticity	Inorganic soil
		Inorganic clay or low plasticity, gravelly clay, sandy clay	Inorganic soil
		Organic silt and organic clay or low plasticity	Organic soil
	Silt and clay (Liquid limit 50 or more)	Inorganic silt, micaceous silt, silt of high plasticity	Inorganic soil
		Inorganic, highly plastic clay, fat clay, silty clay	Inorganic soil
		Organic silt and organic clay or high plasticity	Organic soil
Peat	Highly organic	Peat and other highly organic soil	Primarily organic matter, dark in color and organic color

Figure 7: Unified soil classification system sieve.
Courtesy of McGraw Hill and Robert W. Day, Soil Testing Manual, pg. 81.

*Fines are those soil particles that pass the No. 200

3.0 DESIGN CONSIDERATIONS AND SELECTION OF GEOTEXTILES

The primary function of the geotextile in subsurface drainage applications is filtration. The design of sub-surface drains using geotextile separators requires the evaluation of two criteria:

- Retention criteria that ensures the geotextile openings are small enough to minimize migration of soil particles (piping).
- Permeability criteria that ensures the geotextile is permeable enough to allow liquids to pass freely though. "Permeability" of a geotextile is measured by way of its permittivity (or cross-plane flow rate).

3.1 RETENTION CRITERIA

Soil identification based on grain size is a useful indicator of the soil behavior when filtered by a geotextile. The selection of a geotextile is normally based on the percent of the in-site-specific soil passing through a 0.075 mm sieve (No. 200 sieve). Figure 6 describes the different types of soil based on typical grain size.

SOIL TYPE	PERMEABILITY COEFFICIENT K (CM/SEC)
Uniform coarse sand	0.4
Uniform medium sand	0.1
Clean, well-graded sand and gravel	0.01
Uniform fine sand	0.004
Well-graded silty sand and gravel	0.0004
Silty sand	0.0001
Uniform silt	0.00005
Sandy clay	0.000005
Silty clay	0.000001
Clay	0.0000001
Colloidal clay	0.000000001

Figure 8: Typical permeability of soil types.

3.2 PERMEABILITY CRITERIA

The default geotextile selection is based on the simple premise that permeability of the geotextile is greater than permeability of the soil based on the predominant particle size of the soil. All grades of Typar geotextiles are more permeable than clean well-graded sand and gravel (Figure 8 and Figure 9).

	PERMITTIVITY (D4491) sec^{-1}	PERMEABILITY (D4491) cm/sec	WATER FLOW (D4491) gal/min ft^2	APPARENT OPENING SIZE (MAX) (D4751)	
				mm	US Sieve
TYPAR 3801	0.1	0.01	8	0.09	170
TYPAR 3631	0.2	0.01	20	0.10	140
TYPAR 3601	0.1	0.01	15	0.10	140
TYPAR 3501	0.5	0.03	50	0.20	70
TYPAR 3401	0.7	0.03	60	0.21	70
TYPAR 3341	0.7	0.03	85	0.25	60
TYPAR 3301	0.8	0.03	95	0.30	50
TYPAR 3201	1.0	0.03	190	0.59	30
TYPAR 3151	1.5	0.04	235	0.84	20

Note: The ability of a geotextile to pass water is indicated by the permittivity–therefore it should be used to compare the ability of various types (needlepunched, SRW, and heatbonded), NOT PERMEABILITY. For comparisons, permittivity of fabrics should be measured UNDER_LOAD. See ASTMD-4491. To get permeability, you multiply permittivity by the fabric thickness. Therefore, if the fabrics pass the same amount of water and one is twice as thick, it will appear to pass water twice as fast which could be misleading.

Figure 9: Hydraulic properties of Typar Geotextiles (Minimum average roll values except AOS).

IN SITU SOIL PASSING .075 mm (No. 200 sieve)	MINIMUM PERMITTIVITY sec^{-1}	MAXIMUM AOS mm	TYPAR GEOTEXTILE SELECTION AASHTO M288 CLASS						
			-	-	3	2	1	1	1
<15%	0.5	0.43	3301	3341	3401	3501			
15% - 50%	0.2	0.25		3341	3401	3501		3631	
>50%	0.1	0.22			3401	3501	3601	3631	3801

Figure 10: Selection of TYPAR Geotextiles (Adopted from AASHTO M288).

3.3 SELECT THE GEOTEXTILE

AASHTO M288 is the applicable specification for the use of geotextiles for subsurface drainage, allowing for the long-term passage of water into a subsurface drain system while retaining the soil. Selection of the appropriate geotextile or Typar style is dependent on the subgrade soil.

Use Figure 10 as a guide to select the appropriate Typar geotextile. The engineer should always refer to the full AASHTO M288 specification for final selection of the geotextile.

4.0 INSTALLATION GUIDE

Successful use of geotextiles in subsurface drain design requires proper installation. Follow the sequence of installation in Figure 11.

5.0 OVERLAP AND JOINING

Overlaps provide continuity between adjacent geotextile rolls. Sufficient overlap is required to prevent fabric separation during backfilling. A minimum overlap of 12 inches is recommended.

Pins or piles of stone may be used to maintain geotextile overlaps during installation. Geotextile overlaps at the end of rolls should be in the direction of the aggregate placement with the previous roll on top.

6.0 SETTING SPECIFICATIONS

Specifications should generally follow the design considerations in sections 3.0 to 3.3. Primary considerations include the minimum geotextile requirements for design retention, filtration and survivability.

For subsurface drains, the engineer should specify an AASHTO M288 Class of geotextile as follows:

AASHTO M288 Class 1 or TYPAR 3631,
AASHTO M288 Class 2 or TYPAR 3501, or
AASHTO M288 Class 3 or TYPAR 3401.

Additional requirements should reference the AASHTO M288; i.e. "for certification, sampling, testing and acceptance, shipment and storage requirements of AASHTO M288."

When specifying Typar geotextiles for edge-of-pavement drains, interceptor drains, subsurface structure drains and blanket drains, specify the appropriate Typar grade with the confidence that all Typar geotextiles are manufactured to the high quality standards required by the subsurface drainage industry.

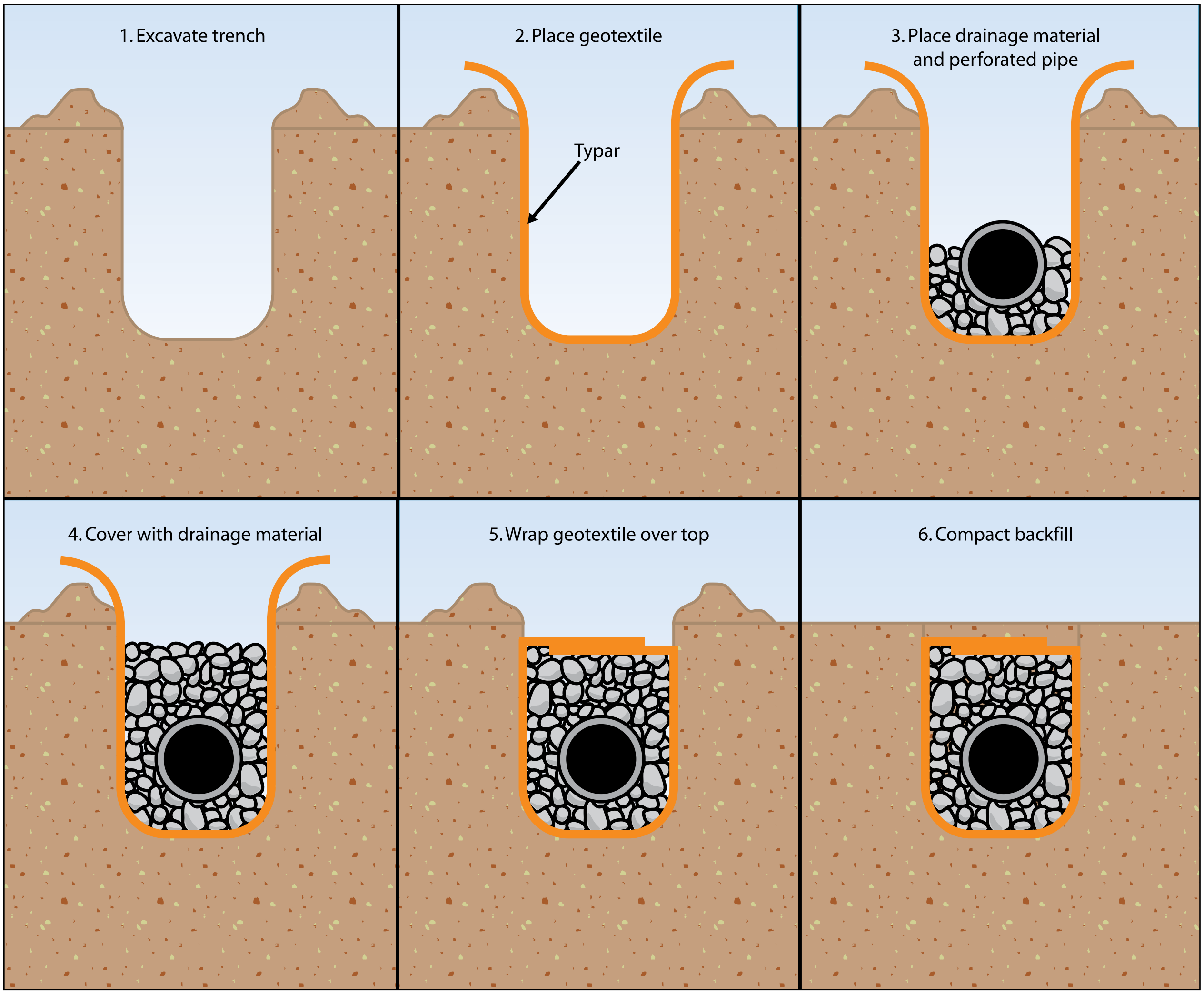

Figure 11: Installation guide for underdrain construction.

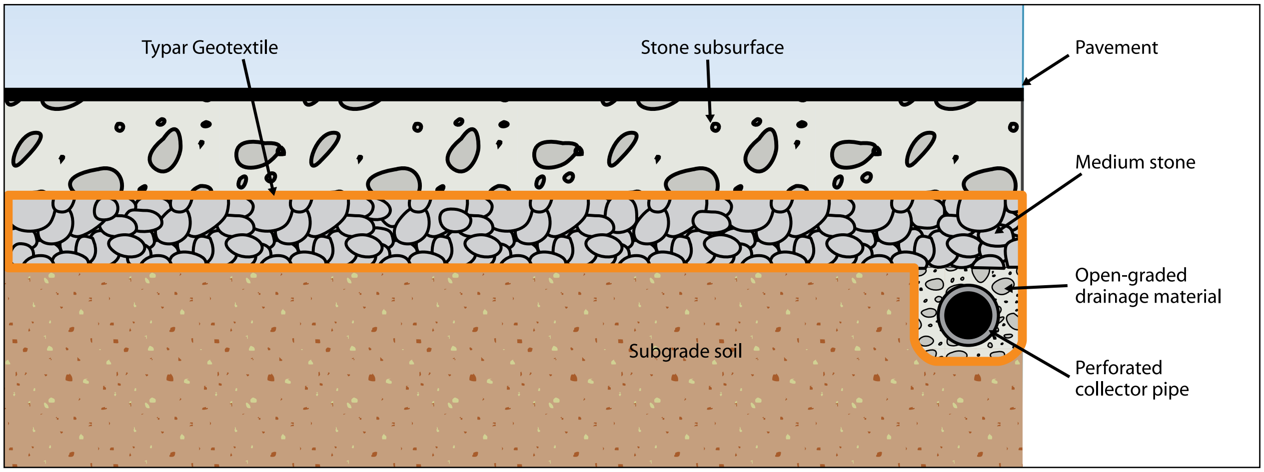

Figure 12: Blanket drain for paved system.

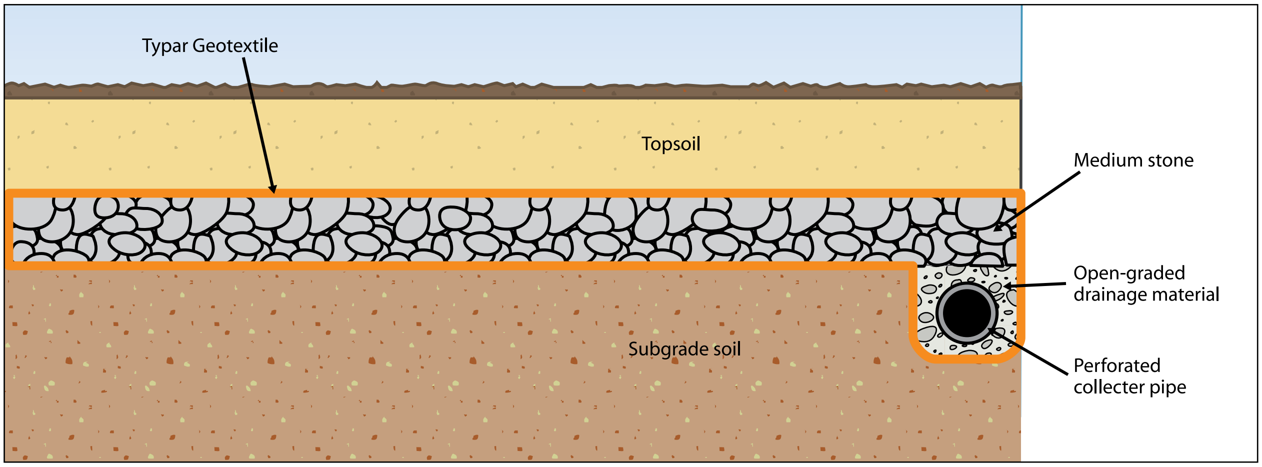

Figure 13: Blanket drain for unpaved system.