Hwy 14:16 Ribstone Creek Dewatering Project

In 2010 it was noted at km 48.6 on Hwy 14:16 that the Hwy was heaving due to ground frost in the winter and that the ditches were saturated with water till freeze up every year. Over the course of many years prior to 2010 the Hwy at this location had several paver patches to smooth out the roadway movement from the previous winter.

It was our intention to set up a drain system in the ditches to help dewater the roadway area in the hope that by removing the excess ground water the frost heaves would subside.

In June 2011, we installed 400 lm of 18" Multiflow pipe supplied by Nilex, 200 lm on each side of the roadway. This was done by using a small 24" bucket track hoe excavating at the ditch invert 1 metre deep and placing the Multiflow drainage system in the bottom centre of the excavation and backfilling with washed pea gravel back up to grade. We then reshaped the ditches to allow for positive drainage, re-seeded with Zone 5 seed and placed Georidge permeable plastic berms along the ditch invert to aid with sediment control and surface flow dissipation.

Because the drainage system had a 100 mm outflow pipe, and we were installing the system in an upstream direction, the water began to flow almost immediately as we were installing the Multiflow system.

At several locations during the install, it was noted that we had found 4 springs along the excavation. After the system was installed we were getting 7 litres per minute flow from the outfall pipe. In the winter, that slowed to about 4 litres per minute. Today, in 2015, the flow is still quite significant though no measurement was taken other than a visual check.

We completed our install of 200 lm Multiflow pipe on both sides of Hwy 14 on time and under budget and the first winter we noticed that the frost heaving had stopped.

We are confident that this process of dewatering the roadway by draining the ditch inverts has helped reduce or eliminate frost heaving in this area.

This test site has been a successful example of how the Multiflow drainage system works. We also did a similar project on Hwy 41:18 at Hwy 883 with complete success in 2010.

I recommend we use this product wherever we have roadway water issues that we can re-direct away from the problem sites.

The rest of this report includes information and photos of the project and the products used.

Tom Somerville, FST

Alberta Transportation

Vermilion

CONTINUED NEXT PAGE

Contractor's

Item No:	Description	Unit	Estimated Quantity	Quoted Unit Cost	Applicable Markup (1.00 or 1.15)	Marked-up Unit Price ($)	Estimated Cost ($)
1	Mob and Demob	L.S.	1	$2,500.00	1.15	$2,875.00	$2,875.00
2	Hitachi EX-60 BH w. 18" bucket or Equivalent trencher	Per/hr.	28.5	$119.00	1.15	$3,900.23	$3,900.23
3	Tracked Skidsteer CT332 or equivalent (including operator)	Per/hr.	27	$124.20	1.15	$3,856.41	$3,856.41
4	450mm (18") Multiflow Drainage pipe(46lm/roll)	LM	440	$12.00	1.15	$6,072.00	$6,072.00
5	S&I Nilex Shoremax-3'x5' panels (4)	m2	2.8	$120.00	1.15	$386.40	$386.40
6	J-Hook 18" + 4" V Bend for Shoremax	ea.	10	$1.00	1.15	$11.50	$11.50
7	12 metres 100mm PVC pipe (3.05m - 10' pieces)	ea.	4	$35.00	1.15	$161.00	$161.00
8	Nilex Biodegradable Formed Georidge (3 spaced at 4.6m)	Ea.	245	$9.00	1.15	$2,535.75	$2,535.75
9	10" Galvinized Spikes for Georidge	Ea.	1225	$0.00	1.15	$0.00	$0.00
10	Truck(s) to haul pea gravel (ARHCA rate)	Per/hr.	30	$157.00	1	$4,710.00	$4,710.00
11	**Supply CLEAN Pea Gravel**	tonne	300	$22.00	1	$6,600.00	$6,600.00
12	3 Labourers (on site hours) 3x10x3 (UPS)	Per/hr.	87	$34.02	1	$2,959.83	$2,959.83
13	1 Foreman (on site hours) (UPS)	Per/hr.	24	$47.00	1	$1,128.00	$1,128.00
14	Foremans Truck (on site hours) (UPS)	Per/hr.	24	$24.96	1	$599.06	$599.06
15	1 Ton Truck (on site hours) (UPS)	Per/hr.	40	$24.96	1	$998.44	$998.44
16	Traffic Control (UPS)	Per/hr.	30	$58.98	1	$1,769.46	$1,769.46
17	S & I Grass seed Zone 5	ha.	0.22	$3,200.00	1	$704.00	$704.00
18	Freight from Edmonton to Site	L.S.	1	$2,500.00	1	$2,500.00	$2,500.00
19	Loader (UPS)	Per/hr.	12	$163.41	1	$1,960.93	$1,960.93
19A	Extra Labourer from Viking plus Travel Time for 2	Per/hr.	30	$34.02	1	$1,020.63	$1,020.63

Final Cost	**$47,263.30**
Original Total Quote	**$47,587.39**
Difference	**-$324.09**

Hwy 14:16 km 48.6 Multiflow Dewatering Project, East view of North and South Ditches, 9 June 2011

Hwy 14:16 km 48.6 Multiflow Dewatering Project, North Ditch west view before construction, 9 June 2013

Hwy 14:16, km. 48.6, Multiflow pre-installation south ditch (note the tall grass weeds and bull rushes), 9 June, 2011

Hwy 14:16, km. 48.6, Multiflow pre-installation north ditch, 9 June, 2011

Hwy 14:16, km. 48.6, Multiflow pre-installation south ditch, 9 June, 2011

Hwy 41:18 at Hwy 883, Multiflow install and 100mm outflow pipe, 13 October, 2010

Hwy 14:16, km. 48.6, Multiflow installation south ditch, adding washed pea gravel to ditch (note 2x2 stakes are holding Multiflow vertical and centrered in trench), 9 June, 2011

Hwy 14:16, km. 48.6, Multiflow installation south ditch, 100mm outfall and Shoremax protection, 9 June, 2011

Hwy 14:16, km. 48.6, Multiflow installation south ditch, setting terminal end 200 metres from outfall, 9 June, 2011

Hwy 14:16 km 48.6 Multiflow Dewatering Project, South Ditch showing growth 1 May 2013

Hwy 14:16 km 48.6 Multiflow Dewatering Project, North Ditch showing growth 1 May 2013

Hwy 14:16, km. 48.6, Multiflow installation inspection north ditch, 5 November, 2014

Hwy 14:16, km. 48.6, Multiflow installation inspection south ditch, 5 November, 2014

Hwy 14:16, km. 48.6, Multiflow installation inspection of 100mm outflow pipe, south ditch, 5 November, 2014

Hwy 41:18 at Hwy 883, Multiflow installed, 100mm outflow pipe on Shoremax, 13 October, 2010

1 Basic Principles of Artificial Drainage

The open trench is the most basic model for an artificial drainage system

This *Guide* assumes that you will be using Multi-Flow for a collector system.

length (feet) X width (feet) X .623 (gallons)

=

gallons of water produced by a 1-inch rainfall

Artificial drainage

Artificial drainage is the removal and relocation of excess soil water. Once soil has reached the point where it is holding all the water that it is capable of holding, additional water from rain or irrigation will pond on the surface or flow to a lower point. A drainage system provides a passageway for excess water to escape through as it leaves the saturated area.

Consider the open trench

For the most basic model of a drainage system, picture for a moment a field that is crisscrossed by narrow trenches. Water from neighboring saturated soils or from puddles on the surface will seep into these trenches and flow from the area. Drainage products hold the walls of the trench open while allowing the surface to be covered.

Gravity rules!

Like natural drainage systems, artificial drainage systems rely on gravity. They cannot draw water "uphill." Therefore, drainage systems are dependent on continuous natural or created slope. Water flows to a lower point whenever a lower point is available.

Collection and transport

Modern artificial drainage systems are comprised of:

- ✓ collector lines to gather the water
- ✓ a transport system to carry the water away

This ***Design and Installation Guide*** assumes that you will be using Multi-Flow for a collector system and a smooth, solid, rigid pipe for a transport system. (See FAQs for rationale)

When planning the layout of drainage collector lines consider these factors:

- ✓ Drainage lines that are spaced more closely together provide a more thorough and rapid response. In many situations 10 foot spacings are ideal.
- ✓ Drainage lines that are placed closer to the surface will generally respond more quickly. Drainage lines that are placed deeper will generally drain a wider area but will take a longer time to do so.
- ✓ Soil particle size will dramatically affect the speed at which water moves through the soil. Coarse, loosely-packed soils allow for fast water movement. Fine, compacted soils yield water at a slower rate. Placing collectors closer together and closer to the surface is helpful in porous soils because water in these soil types reaches the collectors quickly and extra carrying capacity is required. It is helpful in dense soils because closer spacings mean that water need not travel so far to get to the collectors.
- ✓ Soil is often not uniform. Layers of clay or hard pan will affect the flow of water significantly.
- ✓ Collector line length is often limited by the carrying capacity of the product. For example, if you wish to be able to stay ahead of one inch of rainfall per hour, and you have installed 6-inch Multi-Flow (capable of carrying 1020 gallons per hour) on 12 foot centers, the line should not exceed 136 feet in length. (One square foot of water one inch deep is .623 gallons. 136 X 12 X .623 = 1017 gal.)

Avoid blockage

Flowing water carries soil particles with it. Safeguards must be taken to halt the migration of silt and other fines or the collectors will become blocked. A geo-textile filter will prevent blockage of the collectors. Coarse, clean sand will prevent blockage of the geo-textile filter.

Vertical Applications of Multi-Flow in Landscape Settings

A. Equipment needed:

- four-inch chain trencher and/or trenching spade
- wheelbarrow and/or turf utility vehicle such as a Gator™ or Mule™
- utility knife
- laser level or hand level
- centering device(s) (optional)
- water hose (optional)

B. Materials needed:

- appropriate size of Multi-Flow pipe for collector system
- appropriate Multi-Flow connectors
- clean, very coarse, sand
- PVC or ABS pipe for transport system
- PVC or ABS adaptors if needed
- PVC tape

C. Procedure

1. Trenching

Plot a path through your problem area to your discharge point marking the path with paint or flags. The discharge point can be a ditch, the street, a catch basin, another drain line or a declining hillside. Begin trenching at the discharge point and proceed toward the highest point of the problem area. Stop periodically to ensure that you are maintaining proper grade. Remove all excavated material from the site.

2. Laying out your drain

Roll out your drain along side the trench. At the ends, pull back the geotextile filter and snap the connectors in place. They slip on more easily if you pre-stretch them. Push fittings, such as end caps, couplers, side outlets or end outlets, firmly over the pipe to ensure a secure fit. Then pull the fabric over the fitting and hold it in place with wide water-proof tape. This ensures that soil will not enter behind the fabric and block the drain core.

3. Connecting to transport system

Smooth, solid, rigid pipe makes for the most reliable transport system. Three-inch pipe is used with 6-inch Multi-Flow; four-inch pipe is used with 12 and 18-inch Multi-Flow.

✓ Frequently connection to the transport system will be made with a multi-purpose connector. Most commonly this will be a 0600M, 1200M, or 1800M. These connectors empty from the bottom. A standard PVC or ABS elbow or T can be slipped over the Multi-Flow connector. Pipe glue will ensure a lasting connection.

✓ In some situations it is best to discharge the water through an end outlet or side outlet. In these cases, cut the plastic membrane covering the opening of the outlet. Cut the hole so that the exit pipe fits snugly and is located at the bottom of the fitting. Insert the exit pipe into the opening and seal the joint using wide waterproof PVC tape.

4. Backfilling

Use clean very coarse sand to fill the trench. Hold Multi-Flow in the center of the trench while backfilling. Bring the sand to the surface or near to it. Jetting the sand-filled trench with water will help to settle the sand in place quickly. The trench can be topped off with topsoil or rock. Never cap the trench with clay or other dense material.

Begin trenching at the lowest point. Always check with utilities before digging.

Cut Multi-Flow collector lines to the desired length using a utility knife.

A standard PVC elbow can be slipped over the Multi-Flow connector.

Hold Multi-Flow in the center of the trench while backfilling.

Planters are one of several applications easily and effectively drained using a horizontal installation.

This multi-purpose outlet is one way to connect to the transport system in a horizontal application. It connects to a 3-inch PVC or ABS elbow.

Cover with clean, very coarse sand before bringing in fill.

Horizontal Applications of Multi-Flow in Landscape Settings

A. Equipment needed:

- spade and/or walk behind loader
- wheelbarrow and/or turf utility vehicle
- utility knife
- laser level or hand level

B. Materials needed:

- appropriate size of Multi-Flow pipe for collector system
- appropriate Multi-Flow connectors
- clean, very coarse, sand
- PVC or ABS pipe for transport system
- PVC tape

C. Procedure

1. Trenching

Usually horizontal installations do not require trenching. When used in new constructions settings such as in planters, under playground equipment, in golf greens, or under synthetic turf, Multi-Flow is laid out over the prepared site prior to bringing in fill. Mark a path from the system high point to the discharge point. The discharge point can be a ditch, the street, a catch basin, another drain line or a declining hillside. If trenching is required, use a walk behind loader and begin excavation at the lowest point and proceed toward the highest point. Maintaining grade is especially critical in horizontal installations. Remove excavated material from the site.

2. Laying out your drain

Roll out your Multi-Flow drain. At the ends, pull back the geo-textile filter and snap the connectors in place. They slip on more easily if you prestretch them. Push fittings, such as end caps or couplers firmly over the pipe to ensure a secure fit. Then pull the fabric over the fitting and hold it in place with wide water-proof tape. This ensures that soil will not enter behind the fabric and block the drain core.

3. Connecting to the transport system

Smooth, solid, rigid pipe makes for the most reliable transport system. Three-inch pipe is used with 6-inch Multi-Flow; four-inch pipe is used with 12 and 18-inch Multi-Flow.

Connection to the transport system will usually be made with a multi-purpose outlet (taking in water from one side) or a multi-purpose connector (taking in water from two sides). In the six inch line, horizontal double Ys and horizontal crosses also make good outlets. A standard PVC or ABS elbow or T will slide onto the Multi-Flow connector. Pipe glue will ensure a lasting connection. Side outlets are also occasionally used for this.

4. Backfilling

Use clean very coarse sand to cover the Multi-Flow drain. One to two inches of sand should be spread over the drain and sand should extend three to six inches on each side of the Multi-Flow. Never bring in fill containing clay or other dense material.

Quality backfill means a longer lasting system

At Varicore, we regularly receive questions about backfill. We sometimes even encounter the misconception that select backfill is a concept linked exclusively to Multi-Flow drainage. Your backfill choice will have no greater and no less effect on the life of a Multi-Flow system than it will on any other drainage system. Multi-Flow systems, and all other drainage systems enjoy longer life when quality backfill is used.

French drains block

It is a well known fact that French drains frequently block up, sometimes in a remarkably short amount of time. This blockage typically occurs on the trench liner. Small particles of clay or silt are carried by moving water until they are intercepted by the filter, which eventually reaches fills in. The actual life span of a French drain depends on the soil type and the rainfall amounts. This same blockage can occur with round pipe or panel drain wrapped in geo-textile. Highway departments and golf course managers have wrestled with this issue for many years.

Very coarse sand

The best solution to this problem is to surround the geo-textile filter with very coarse sand. Sand is an excellent filter of clay and silt. As the water containing these contaminants moves through the sand, it slows down and the particulate matter drops out. An inch or more of sand is a very effective filter.

A sand filter is far more feasible with a Multi-Flow system than with a traditional French drain. It would be very difficult, if not impossible, to insert a layer of sand between the trench wall and the geo-textile liner in a French drain. However, it is relatively easy and affordable to use sand as a backfill medium surrounding Multi-Flow in a four inch wide trench. With sand as a primary filter and the 4-ounce needle-punched geo-textile as a secondary filter, a Multi-Flow system will provide long-lasting, effective drainage.

Perfect sand

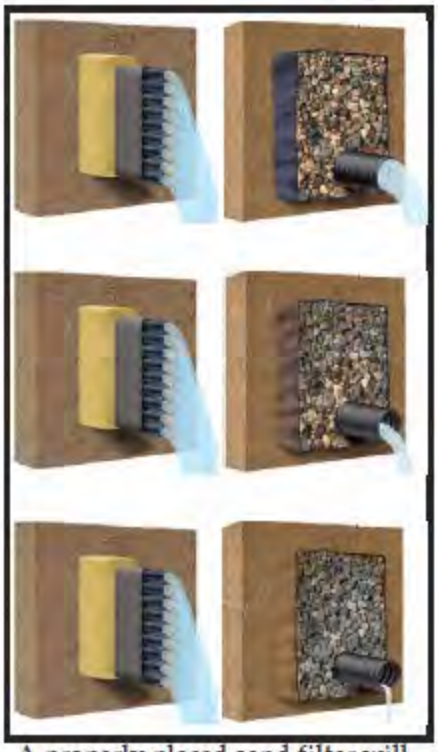
According to the USDA system of classification, very coarse sand has an approximate particle size of between 1.0 and 2.0 mm. Some designers have used this for a sand spec:

When passed over a sieve, very coarse sand will have:

- less than 5% retained on a #10 U S standard sieve,
- less than 5% passing a #30 U S standard sieve
- in no case should more than 1 % pass through a #50 U S standard sieve.

Unfortunately, good quality sand is not uniformly available. The closer installers come to this recommendation, the longer their system will last. Absolute conformity is frequently not practical. On one hand, sand contaminated with clay or silt will impede the movement of water as well as accelerate the blinding of the drainage system. On the other hand, pea rock and mixed particle size gravel allow for rapid movement of water in the beginning, but are susceptible to infiltration by fines. They might not be aggressive enough in protecting the fabric filter. Buck shot or washed medium sand are better choices, but will not perform as well as clean, very coarse sand. When the perfect sand cannot be found, look for an alternative following these two criteria and in this order:

1. Look for sand that is clean
2. Look for sand that is coarse



A properly placed sand filter will dramatically extend the life of a drainage system.

Very coarse sand makes for the best backfill.

Backfill estimation guideline:

trench depth (inches) X trench width (inches) X trench length (feet) ÷ 3888 =

yards³ of backfill
(total volume of trench)

4 Frequently Asked Questions

Why is drainage so important for healthy turf?

Walking on, maintaining, or driving over soil that is saturated will compact the soil, washing suspended soil particles into air voids. This will inhibit the growth of healthy grass and other plants as well as making the surface hard and uneven.

Is it possible to over drain my site?

Drainage cannot and will not remove all water from the soil. It only reduces it from the unacceptable "saturation point" to the desired level of "field capacity." At this point, water clings to surrounding soil particles which refuse to yield any more moisture to gravity. Fortunately, plants can still access this remaining soil water. Due to plant usage, combined with evaporation, soil moisture levels will eventually fall to a "wilting point" at which time additional water becomes mandatory.

Why use Multi-Flow for a collector system?

Following best management practices, the Multi-Flow drainage system excels in a number of ways. Shape, function, strength and design combine to make Multi-Flow an unparalleled product:

- Multi-Flow provides a large surface area that interfaces with saturated soils. This allows water to enter the system rapidly.
- Multi-Flow's narrow shape allows for insertion into a narrow trench resulting in minimal excavation.
- Multi-Flow's enclosed, circular, flow channels allow for extraordinary flow rates.
- Multi-Flow's strength allows it to be installed in shallow applications where it might be subjected to the weight of surface traffic as well as in extra deep installations where it may bear the weight of many tons of soil.
- Multi-Flow comes wrapped in a premium, needle-punched, geo-textile filter preventing sand and soil from entering and blocking the system.
- A large array of connectors allows the Multi-Flow system to be configured in limitless designs. Horizontally or vertically, Multi-Flow can be laid out in almost any pattern using 45° or 90° alignments. It can combine 6", 12" and 18 "products and can empty from the end, side, or bottom.
- Multi-Flow is pliable, making it suitable for tight corners and assisting in connecting fittings conveniently.

What are the requirements of a transport system?

Transport systems need to be able to carry water away from the site as fast as the collector system can accumulate it. Furthermore, the transport system must be at least as strong as the collector system. PVC, ABS, and dual wall corrugated HDPE pipe are good options.

Flow rate requirements will vary depending on the number of collector lines that are being fed into a given transport pipe. 6-inch, 12-inch, and 18-inch Multi-Flow collectors are capable of delivering 17, 29, or 45 gallons per minute, respectively. (Added slope and or head pressure would increase these rates.) Multiply the number of collector lines times the appropriate gpm to determine the maximum expected rate.

Why does Multi-Flow incorporate a geo-textile filter?

Without a geo-textile filter, drainage products can fill with soils. When rainfall is heavy, drainage systems tend to wash clean inside, but during drier periods, blockage is common. Systems that do not employ a geo-textile tend to use crushed rock or similar backfill. The voids in these fills are prone to wash full of soil as well. Geo-textiles are a very effective way of keeping these particles out of the pipe.

Not all geo-textiles are equally effective at this task. First of all, geo-textiles with larger openings do not blind as quickly as those with smaller openings. Of course those with larger openings are also less effective as filters. Secondly, those with a needle-punched surface last longer than those with a smooth surface because they have more surface area for collecting fines. Multi-Flow employs a heavy needle-punched polypropylene filter with openings as large as a # 70 U.S. standard sieve. Its openings are of optimum size and its "fuzzy" surface provides more filter area.

Should the seam in the filter be placed up or down?

Multi-Flow is reversible. There is no top or bottom.

If I cannot find the recommended backfill medium should I select another drainage system?

Obviously we would not want to see installers backfill Multi-Flow, or any other drainage product for that matter, with native soil. The system would quite likely suffer premature failure. The customer might then blame the drainage product instead of the real culprit, the fines, for that failure. We know that sometimes customers must settle for less than the very best. Any kind of select backfill is to be preferred over the native excavated soil. Multi-Flow's size and shape makes premium backfill a more realistic possibility than in a French drain system. However, that is only one of many attractive Multi-Flow features. Superior strength, increased surface area, faster flow rates, better quality filter, professional and speedy service, and an unparalleled connector system all combine to put Multi-Flow head and shoulders above the competition with or without the very best backfill. It would be unfortunate if someone chose to install an inferior drainage product because of the illusion that it could be safely backfilled with inferior backfill.

Will my choice of backfill void Multi-Flow's warranty?

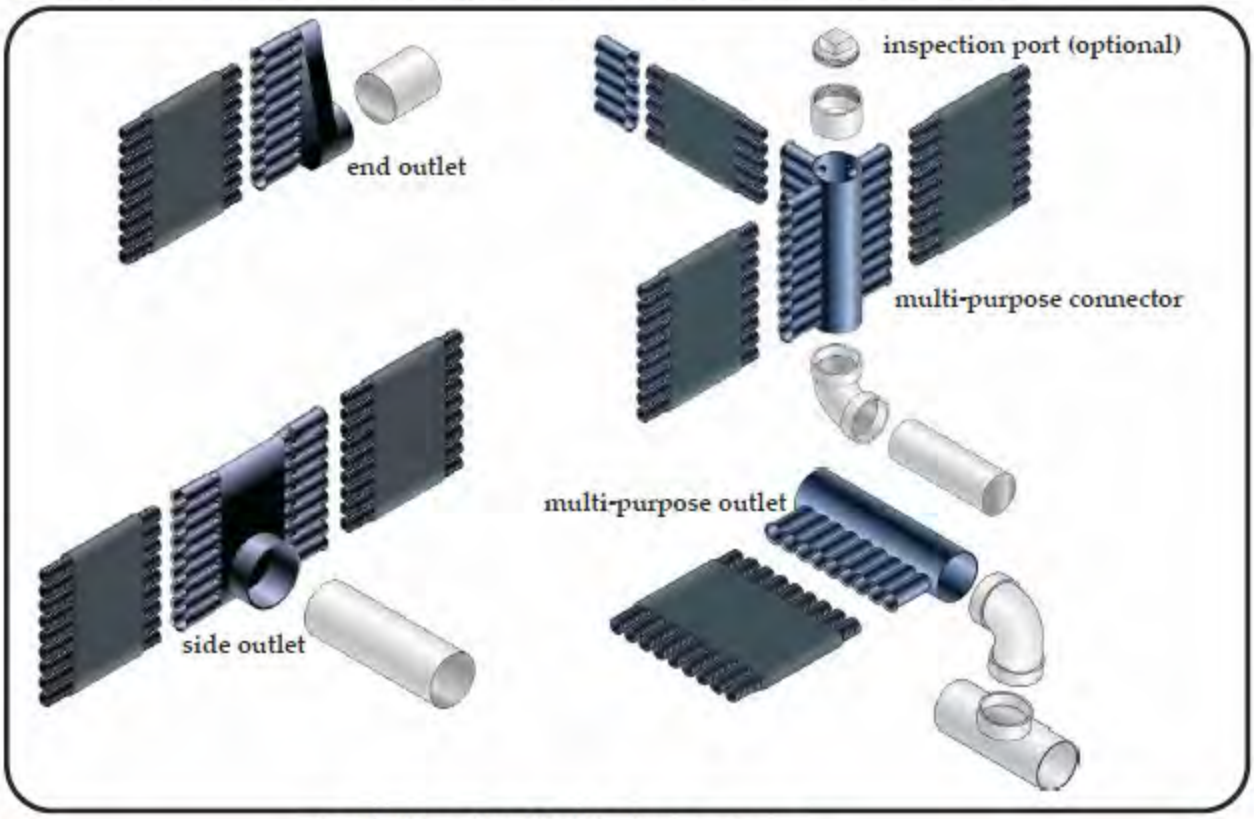
Multi-Flow's warranty is not affected by backfill choices. Varicore Technologies guarantees that each roll of pipe leaving our factory meets the high standard laid out on our product spec sheet. Choice of backfill and installation techniques will in no way affect this warranty. Varicore manufactures the highest quality drainage products. So, it encourages the end user to insist on installation practices that insure the longest possible life and the highest level of performance from the drainage system.

How do I decide whether to install Multi-Flow horizontally or vertically?

The unique features of your drainage site will determine the drainage profile. Vertical installations are most common. They allow for installation in a narrow trench with less excavation, less spoil, and less backfilling. Horizontal installations are used when the situation calls for a low profile or to avoid trenching altogether. Typical horizontal applications include: planters, playgrounds, golf greens, and under synthetic turf or pavers.

How do I connect my Multi-Flow collector system to my transport system?

You can exit the Multi-Flow system, from an end outlet, a side outlet, or from any multi-purpose connector. In most situations, exiting from a multi-purpose connector is advised. A standard PVC or ABS elbow or T easily and securely makes the transition. Multi-purpose connectors attach to 3-inch schedule 40 pipe. Industry standard bushings can be used to connect to 4-inch or other schedule 40 pipes. In a horizontal application, you can also exit from a 6-inch horizontal cross or double Y.



Outletting the Multi-Flow system

Drainage Core

Property	Test Method	Value
Thickness, inches	ASTM D-1777	1.0
Flow Rate, gpm/ft *	ASTM D-4716	.29
Compressive Strength, psf	ASTM D-1621 (sand method)	.6000

Geo-textile Filter

Property	Test Method	Value
Weight (oz/yd²)	ASTM D-3776	.4
Tensile Strength, lb.	ASTM D-4632	.100
Elongation, %	ASTM D-4632	.50
Puncture, lb.	ASTM D-4833	.50
Mullen Burst, psi	ASTM D-3786	.200
Trapezoidal Tear, lb.	ASTM D-4533	.42
Coefficient of Perm, cm/sec	ASTM D-4491	.0.1
Flow Rate, gpm/ft²	ASTM D-4491	.100
Permittivity, 1/sec.	ASTM D-4491	.1.8
Apparent Opening Size,	ASTM D-4751	.70 maximum US std. sieve opening
UV Stability, % Strength	ASTM D-4355	.70 retained at 500 hours
Seam Strength, lb/ft	ASTM D-4595	.100
Fungus	ASTM G-21	No Growth

Notes:

Values given represent minimum average roll values.
*at gradient = 0.1, pressure = 10 psi for 100 hours in horizontal installation

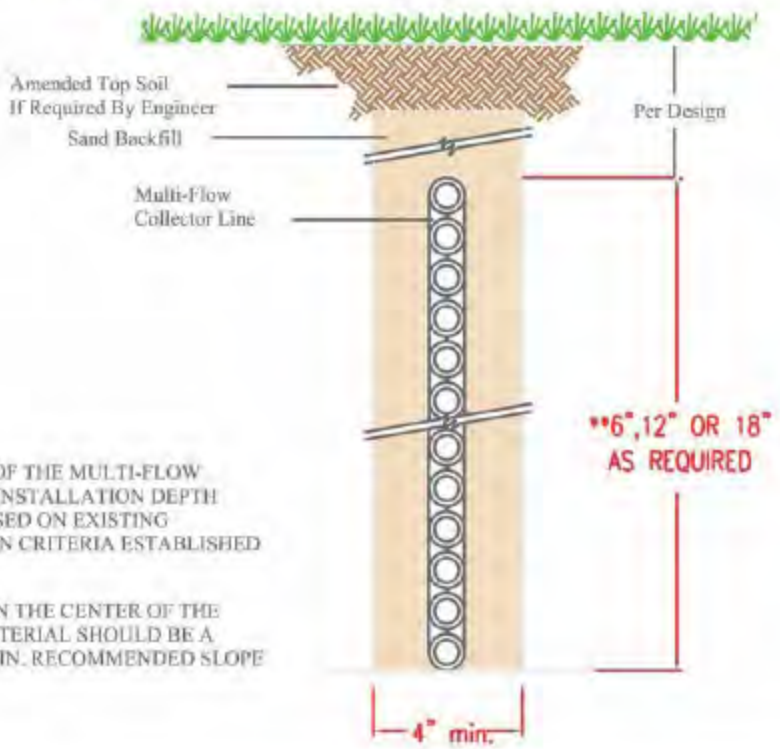
Multi-Flow is available in three sizes: 6-inch, 12-inch, and 18-inch. Standard 150-foot length rolls are shipped in 55 inch diameter rolls.

For purposes of project design, assume the following flow rates:

6-inch ---------- 17 gpm
12-inch ---------- 29 gpm
18-inch ---------- 45 gpm

Rates will rise as slope and head pressure are increased and fall as they are decreased.

UNDER TURF INSTALLATION



THE VERTICAL HEIGHT OF THE MULTI-FLOW SYSTEM(6",12",18") AND INSTALLATION DEPTH SHOULD BE CHOSEN BASED ON EXISTING CONDITIONS AND DESIGN CRITERIA ESTABLISHED BY THE ENGINEER.

INSTALL MULTI-FLOW IN THE CENTER OF THE TRENCH. BACKFILL MATERIAL SHOULD BE A VERY COARSE SAND. MIN. RECOMMENDED SLOPE 1%.

TURF TO ASPHALT OR CONCRETE INSTALLATION