GEOFLOW Design and Installation Guidelines

State of New Hampshire

GEOFLOW, Inc. 506 Tamal Plaza, Corte Madera, CA 94925
Toll Free: (800) 828-3388 Fax: (415) 927-0120 www.geoflow.com

Local Representation:

J&R Sales and Service, Inc.
44 Commercial Street
Raynham, MA 02767
Toll Free: (877) 656-1814
Phone: (508) 823-9566
Fax: (508) 880-7232
Email: info@jrsalesandservice.com
www.jrsalesandservice.com

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NOTE:
This Design Manual is specific for use in New Hampshire. Please refer to the New Hampshire Env-Wq 1000 rules for additional requirements. Please note this manual is for GEOFLOW Drip Dispersal to be used for disposal of secondary treated effluent only. This manual may be used for reference in designing, installing, and maintaining both residential and commercial GEOFLOW Drip Dispersal systems.

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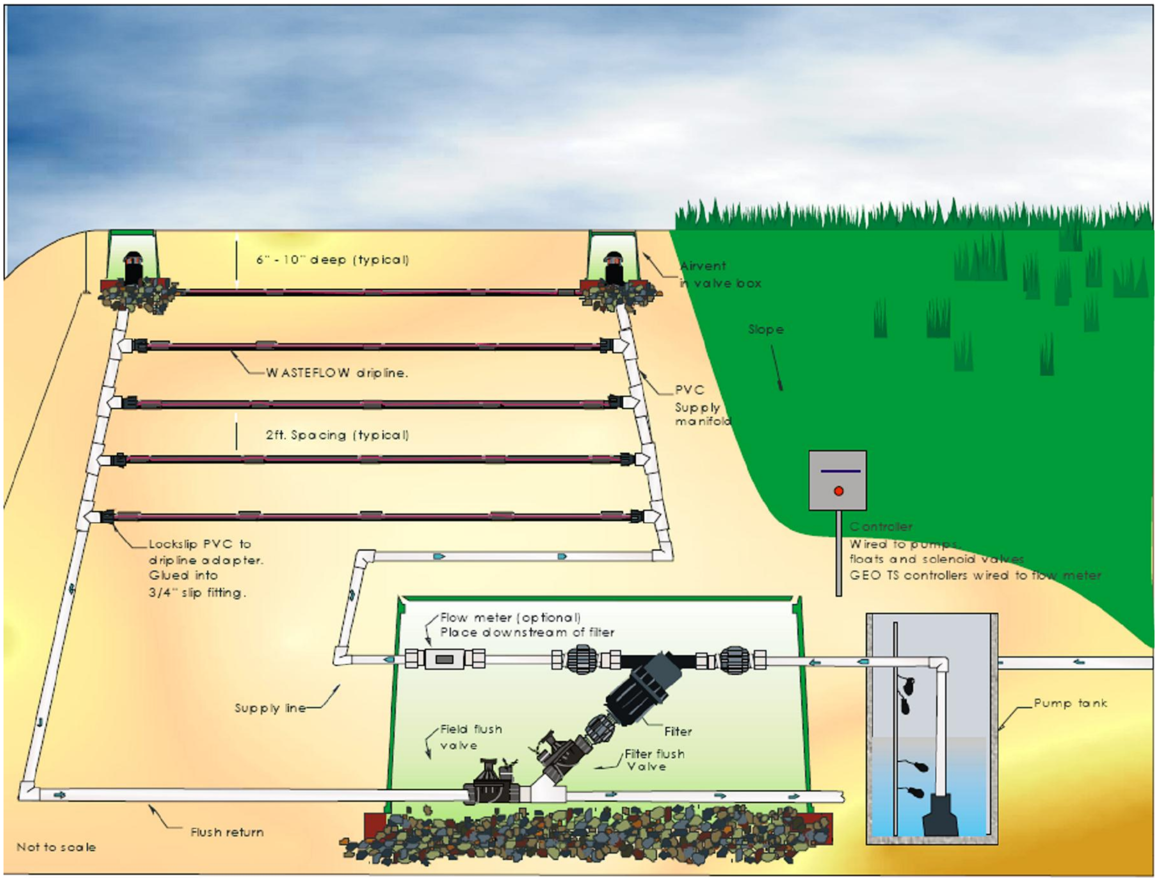
INTRODUCTION

GEOFLOWôs WASTEFLOW® drip system disperses effluent below the ground surface through ½ò pressurized pipes. It is designed using the grid concept with supply and flush manifolds at each end of the dripline creating a closed loop system. The grid design provides a complete subsurface wetted area. The objective with effluent dispersal is usually to disperse the effluent using the minimum area as quickly and safely as possible at an approximately uniform rate throughout the year. If the main purpose of the Geoflow system is to irrigate, then please use the standard irrigation manual for landscape available from Geoflow, Inc.

Subsurface drip is a highly efficient method to dispose of effluent. Small, precise amounts of water are uniformly applied under the soil surface from multiple points.
The main advantages of GEOFLOWôs subsurface drip system for effluent dispersal are:
ÅHuman and animal contact with effluent is minimized, reducing health risks.
ÅCorrectly designed systems will not cause puddling or runoff.
ÅIt can be used under difficult circumstances of high water tables, tight soils, rocky terrain, steep slopes, around existing buildings, trees or other vegetation, and on windy sites.
ÅDisposal of water is maximized by means of evapotranspiration.
ÅThe system requires no gravel. It is easy to install directly into indigenous soils and the natural landscape can be maintained.
ÅMinimizes deep percolation.
ÅConsumption of nitrates by the plant material is increased.
ÅInvisible and vandal proof installations.
ÅFifteen-year warranty for root intrusion, workmanship and materials. Systems are durable with a long expected life of approximately 30 years.
ÅNon intrusive. It allows use of the space while operating.
ÅEasily automated.

Diagram 1: Typical Dripfield layout



SYSTEM COMPONENTS

A typical drip system installation will consist of the elements listed below:

1. Wasteflow® Dripline

(See product sheet for specification)
WASTEFLOW dripline carries the water into the dispersal/reuse area. The dripline is connected to the supply and return manifolds with Compression or Lockslip fittings. Typical spacing between each dripline and between drip emitters is 24ò on center. Standard coil length is 500-ft.

Wasteflow dripline features:

a.) nano-Rootguard®
In 2008 Wasteflow dripline will have new nano-ROOTGUARD which has an extended expected life of 30 years. The risk of root intrusion with an emitter slowly releasing nutrient rich effluent directly into the soil is well known to anyone who has observed a leaking sewer pipe. All Geoflow drip emitters are guaranteed to be protected against root intrusion with nano-Rootguard. This patented process fuses the root-growth inhibitor, Treflan® into each drip emitter during manufacturing. Treflan is registered with the United States EPA for this application. The nano-Rootguard technology holds Treflan for extended time inside the plastic, slowly releasing it in minute quantities to prevent root cells from dividing and growing into the barrier zone. It is chemically degradable, non-systemic, and virtually insoluble in water (0.3 ppm). nano-Rootguard carries a **15-year warranty** against root intrusion.

b.) *Geoshield™* protection
GEOFLOWõs Wasteflow has an inner lining impregnated with an antimicrobial, Tributyl tin maleate, to inhibit adhesion of biological growth on the inside walls of the tube and on the emitters. It does not have any measurable biological effect on the effluent passing through the tube. This minimizes the velocity required to flush Wasteflow dripline. The velocity only needs to move out the fine particles that pass through the 130 micron filter that, if not flushed, will ultimately accumulate at the distal end of each lateral. It is not necessary to scour growth off the inside wall of Wasteflow tubing. Since all pumps deliver more volume given less resistance to flow, just opening the flush valve will usually achieve this degree of flushing. When a minimum flushing velocity is requested by regulators, 0.5 feet per second is used with Wasteflow dripline to get the settled particles at the bottom of the pipe back into suspension. This equates to 0.375 gpm per dripline when using standard WASTEFLOW dripline (0.55òID)

c.) Turbulent Flow Path
Wasteflow drip emitters are pre-inserted in the tube usually spaced 6ò, 12ò,

18ò, or 24ò apart with 24ò being the most popular. Angles in the emitter flow path are designed to cause turbulence in order to equalize flow between emitters and keep the emitters clean. Geoflow emitters boast large flow paths, which, coupled with turbulent flow, have proven over the years to be extremely reliable and dependable.

d.) Wasteflow Classic and Wasteflow PC Dripline
Both WASTEFLOW Classic and WASTEFLOW PC have turbulent flow path emitters with nano-ROOTGUARD and *Geoshield* protection. The WASTEFLOW PC has the added element of a silicone rubber diaphragm that moves up and down over the emitter outlet to equalize flows regardless of pressure between 7 and 60 psi. To ensure a long life the recommended operating range is 10 to 45 psi. For Wasteflow Classic, the flow rate delivered by the emitter is a function of the pressure at the emitter. The Classic dripline has the advantage of no moving parts or rubber that may degrade over time. Also, when minimum flushing velocities are required, the flows during a dosing cycle and flushing cycle are very similar with the Wasteflow Classic because when the flush valve is opened, the pressure is reduced, causing the flows from the emitters to decline. PC dripline requires significantly higher flow for flushing than dosing as the emitter flow does not go down during the flushing cycle. We generally recommend using WASTEFLOW Classic, unless the economic advantages to using PC is substantial.

i . Wasteflow PC can run longer distances than Wasteflow Classic.

ii. Steep slopes. Systems should be designed for the dripline lateral to follow the contour. When this is practical, the extra cost of installing pressure regulators required for Wasteflow Classic would likely be less than the incremental cost of Wasteflow PC.

iii. Rolling terrain. If the difference in height from trough to peak exceeds six feet Wasteflow PC be used. Vacuum relief valves must be placed at the top of each rise.

2. Controllers

(See product sheet for specification)
Controllers are used for time dosing and time flushing of the filter and dripfields. GEO controllers include a programmable logic controller to increase flexibility and reliability in the field. They can be used on systems ranging in size from one to eight zones at the time this manual was printed. All controllers include a surge arrestor, elapsed time meter and counter. In 2007 Geoflow added a new controller with a Touchscreen interface. It can vary dose times in each zone, monitor flow, ultraviolet, blower, and other optional inputs.

3. Pumps, Pump Tanks & Floats

Wasteflow drip fields depend on pumps to dose effluent under pressure to the field. These must be sized according to flow and pressure requirements. Look for submersible effluent pumps from a dependable source. Geoflow does not endorse a single manufacturer, but does advocate you use a pump that is readily serviced in your area. Two (duplex) pumps may be used. These will normally alternate at each signal from the control panel and are often used on commercial or large drip systems. Pump tanks should be sized according to NH Env-Wq 1000 rules and regulations. For residential systems, the dosing tank volume is suggested to be two-times the design flow. At least a 1,000 gallon pump chamber is suggested for residential applications. Geoflow controllers are set-up for 4 floats with the lowest one in the tank being the *redundant off float.* The *primary timer on/off float* is second from the bottom, followed by the *secondary timer float* third from the bottom and the *high level alarm float* on the top.

4. Filters

(See product sheet for specifications)
Geoflow systems require 120 mesh or 130 micron filtration to keep any oversized upstream contaminants from entering the dripline. Geoflow offers a full range of drip filters, with the tried and true Vortex screen filters for small commercial and residential systems, BioDisc filters with anti bacterial protection, and GeoVac suction cleaning filters for larger commercial and industrial systems.

5. Supply Manifold and Line

This carries the water from the dosing tank to the dispersal area. Rigid PVC schedule 40 is usually used. Schedule 80 is at times used to either avoid dips in the line that can collect water and freeze, or if pressure of at least 20 psi is required to pump water from the dose tank to the dripfield. To prevent water from freezing, the pipes should slope back to the pump tank, be buried below frost depth and/or be insulated. Refer to the PVC pipe sizing chart in the appendix to determine the best diameter for your application.

6. Return Manifold and Line

In order to help clean the system, the ends of the drip lines are connected together into a common return line, most often made of rigid PVC. This line will help equalize pressures in the system. Flushing should be done frequently during the installation period. Periodic flushing will help to keep the manifolds clean. Many designers use the same size return line as they do the supply line for simplicity, or some down size the return line since return flow is lower than supply. To prevent water from freezing, the pipes should slope back to the pump tank, be buried below frost depth and/or be insulated.

7. Pressure Regulator

(See product sheet for specification)
Pressure regulators fix the inlet pressure at a given rate. Under normal operating conditions, pressure in the drip lines should be 10 psi to 45 psi. With WASTEFLOW Classic it helps to know exactly what the pressure is in the dripline, so system flow can be easily calculated. With all dripline it is prudent to have a pressure regulator to avoid oversized pumps from blowing out fittings.

8. Air Vacuum Breaker

(See product sheet for specification)
Air vacuum breakers are installed at the high points, above dripline and below grade to keep soil from being sucked into the emitters due to back siphoning or backpressure. This is an absolute necessity with underground drip systems. They are also used for proper draining of the supply and return manifolds in sloping conditions. One is used on the high end of the supply manifold and one on the high point of the return manifold.
Additional air vents may be required in undulating terrain. Freezing conditions require the air vacuum breaker be protected with insulation.

9. Filter Flush Valves

(See product sheet for specifications)
Used to flush debris from the filter cleanout port back to the pretreatment or dosing tank, this can be an electronically activated solenoid valve or a manual valve. If manual, it should be opened for a full flushing at least every six months and left cracked open slightly to flush continuously. Cracking open a manual valve may be used to increase flow through the system to be within the efficient flow rate of the filter and/or pump, if necessary.

10. Field Flush Valves

(See product sheet for specifications)
Used to flush out fine particles that have passed through the filter and accumulated on the bottom of the tube at the end of each lateral, the field flush valve can be manual or electronic. If manual, it should be opened for full flushing at least every six months and left cracked open slightly to flush continuously and provide for drainage of the flush line in freezing conditions. Cracking open a manual valve can also be used to; increase the flow through the system to be within the efficient flow rate of the filter and/or pump, or to set system pressure instead of a pressure regulator.

11. Zone Valves

Used to divide single dispersal fields into multiple zones, these can be hydraulically activated index valves or electrical solenoid valves. Index valves are hydraulically operated, while solenoids use electricity.

12. Wasteflow Headworks

(See product sheet for specifications)
WASTEFLOW Headworks is a pre-assembled unit including the filter, valves and pressure gauge in a box or on a skid. It is installed between the pump and the field. Be sure to insulate the box in freezing climates.

DESIGN PARAMETERS

NH DES regulations for field sizing based on gallons per day apply to the GEOFLOW drip dispersal system (See Table 1008-1 Unit Design Flow Figures). Additional design parameters specific to New Hampshire requirements are found in the NH Code Env-Wq 1000. See also *Appendix II* for Design Changes for GEOFLOW in Cold Weather Climates and *Appendix III* for a Checklist for Choosing and Designing a GEOFLOW field. Installation depth for GEOFLOW drip shall be 8-inches below grade.

1. Select area

Select the area with careful consideration of the soil, the terrain and your NH State Regulations. Be sure the field is not in a flood plain or bottom of a slope where excessive water may collect after rain. Surface water should be directed away from the proposed field area.

2. Water Quality

The GEOFLOW system is to be preceded by a NH DES approved treatment system producing a minimum effluent quality of BOD/TSS of 30/30 mg/L.

3. Soil Application Design

Note: This section is based on Subsurface Trickle Irrigation System for On-Site Wastewater Disposal And Reuse by B. L. Carlile and A. Sanjines. The basis of the information is from the Texas Health Department regulations.

The instantaneous water application rate of the system must not exceed the water absorption capacity of the soil. A determination of the instantaneous water absorption capacity of the soil is difficult, however, since the value varies with the water content of the soil. As the soil approaches saturation with water, the absorption rate reduces to an equilibrium rate called the ñsaturated hydraulic conductivity.ò Wastewater application rates should be less than 10 percent of this saturated equilibrium. Even though the trickle irrigation system maximizes the soil absorption rate through the low rate of application, thus keeping the soil below saturation, there will be times when the soil is at or near saturation from rainfall events. The design must account for these periods and assume the worst case condition of soil saturation. *By designing for a safety factor of 10 or 12, based on the saturated hydraulic conductivity, the system will be under-loaded most of the time but should function without surface failure during extreme wet periods.*

By applying wastewater slowly for a few hours daily, particularly if applied in ñpulsesò or short doses several times per day near the soil surface where the soil dries the quickest would keep the soil absorption rate at the highest value and minimize the potential of water surfacing in poor soil conditions.

As stated previously, this design criterion will under-load the system at all times except when the soil is at or near saturation from rainfall. If designing for an efficient irrigation system, the water supply may not be sufficient to meet the demands of a lawn or landscaped area during peak water demand months. This problem can be overcome by either of two solutions: add additional fresh-water make-up to the system during the growing season to supply the needed water for plants in question; or split the system into two or more fields with necessary valves and only use one of the fields during the peak water demand months and alternate the fields during winter months or extremely wet periods, or use both fields simultaneously if the pump capacity will so allow.

Table 1 and *Table 2* show the recommended hydraulic loading rates for various soil conditions, using a safety factor of at least 12 with regard to the equilibrium saturated hydraulic conductivity rate of the soil. These loading rates assume a treated effluent with BOD and TSS values of less than 30 mg/l is produced in the pre-treatment system and that any anomalies such as iron bacteria have been removed prior to dosing.

4. Depth and Spacing

WASTEFLOW systems usually have emitter lines placed on 2 foot (600 mm) centers with a 2 foot emitter spacing such that each emitter supplies a 4 sq. ft (0.36 m2) area. This is a typical design for systems in sandy and loamy soils with a cover crop of lawn grass. Closer line and/or emitter spacing of 12 inches is used on heavy clay soils or very course sands where lateral movement of water is restricted. Using closer spacing should not reduce the size of the field.

The depth of installation per NH DES shall be 8-inches below grade for all systems. Separation to the seasonal high water table is two feet, separation to impervious layer shall be two feet; unless otherwise specified by permit.

5. Soil Layers and Types

The shallow depth of installation is an advantage of the subsurface Dripfield since the topsoil or surface soil is generally the most biologically active and permeable soil for accepting effluent. The topsoil also dries the fastest after a rainfall event and will maintain the highest water absorption rate. The quality and homogeneity of the soil may present a problem. If the soil was not properly prepared and there are pieces of construction debris, rocks and non-uniform soils, it is very difficult to obtain uniform water spread.

6. Adding Fill to the Dispersal Field

Some dispersal sites require additional soil be brought in for agronomic reasons or to increase separation distances from the restrictive layer. Restrictive layers stop or greatly reduce the rate of downward water movement, as a result surfacing may occur during part of the year. In soils with high water tables treatment is minimized due to a lack of oxygen. Placing drip lines in selected fill material above the natural soil provides an aerated zone for treatment. Dispersal however still occurs in the natural soil and the field size must be based on the hydraulic capability of the natural soil to prevent hydraulic overload. Any time fill material is to be used, the area to receive the fill should have all surface grasses and other organic material removed and the fill material must be incorporated into the natural soil to prevent an organic layer from forming and restricting downward water movement. Removal must be performed under dry conditions. Divert surface and subsurface water prior to adding fill. When removing and replacing soils septic sand is recommended. The fill material should be applied in shallow layers with the first 3 inches incorporated into 3 inches of the natural soil to prevent an abrupt textural interface. Placement of fill should be uniform so preferential bypass flows do not occur. Soil should not be compacted. Continue this process until all fill has been incorporated. Sand shall be brought in up to the installation level of the GEOFLOW drip, dripline is installed, then 4-6ò of sand, then topsoil should be added to desired depth of cover. The fill area should be left crowned to shed surface water and may need diversion ditches or some other devices to prevent surface water from infiltrating. The entire fill area should have a vegetative cover to prevent erosion. It is generally agreed that fill should not be used on slopes greater than 20% unless means for controlling erosion, such as netting, are used. Consult a soils engineer on a case by case basis.

7. Slopes or Hilly Sites

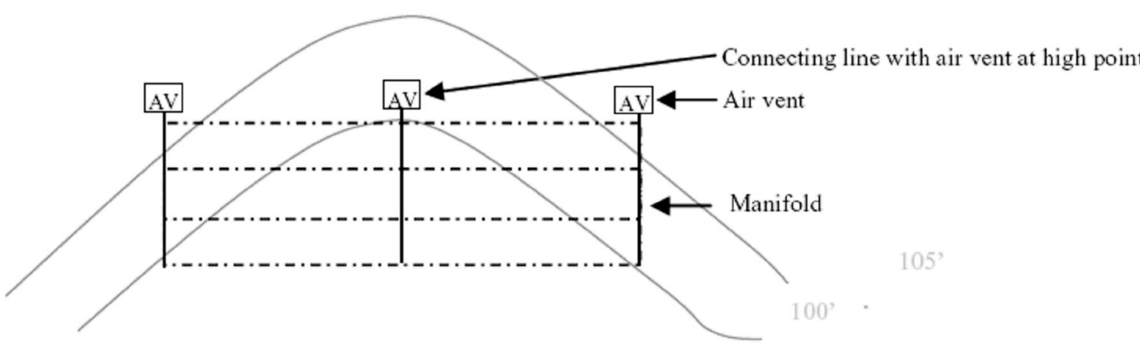
a.) High Points and siphoning

A potential problem with buried drip lines is siphoning dirt into the emitters when the pump is switched off. For this reason:

i) At least one vacuum breaker should be installed at the highest point in each zone. It is best practice to install one at the high point of the supply and one at the high point of the return manifold.

ii) Drip lines should be connected at the end to a common return line with a flush valve.

iii) Run dripline along a contour if at all possible. Avoid installing lines along rolling hills where you have high and low points more than 3 ft. off contour along the same line. If the dripline is installed over a ridge, as shown below, connect all the high points together and install a vacuum breaker on the connecting line.



b.) Dripline Pressure Tolerances

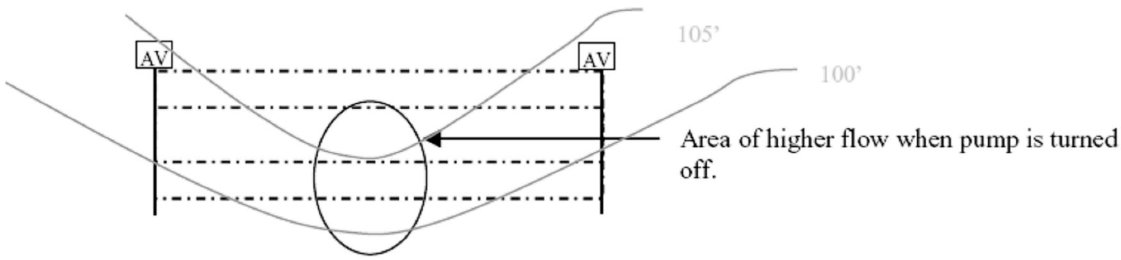
As water travels through a manifold or uphill, pressure decreases, or conversely, if water moves downhill pressure increases, which can affect the flow variation between the first dripline and the last dripline on the manifold. WASTEFLOW

Classic: The Classic dripline can be operated in a range of 10 to 45 psi, however too wide a variance in the pressure in a single field will result in too high a variance in flow within that field. WASTEFLOW PC: PC dripline can tolerate very large height variations provided the pressure remains within the 7 to 60 psi range, and preferably within 10 to 45 psi.

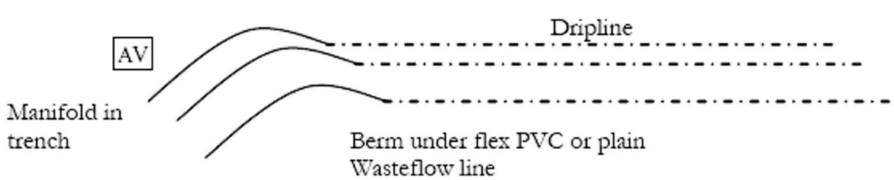
c.) Low Head Drainage

At the end of each dosing cycle, consideration must be taken for gravity. Where is the water going to drain when the pump shuts off? Water in the dripline will flow down to the lowest point within the drip zone. This is called ñlowhead drainage.ò Use the following precautions to mitigate lowhead drainage.

i. The dripline should run along the contour if at all possible because water will run to the lowest point of the line every time the pump is turned off. If the lowest point in the line is in the middle of the lateral, there will be excess flow at this point. See Diagram below.



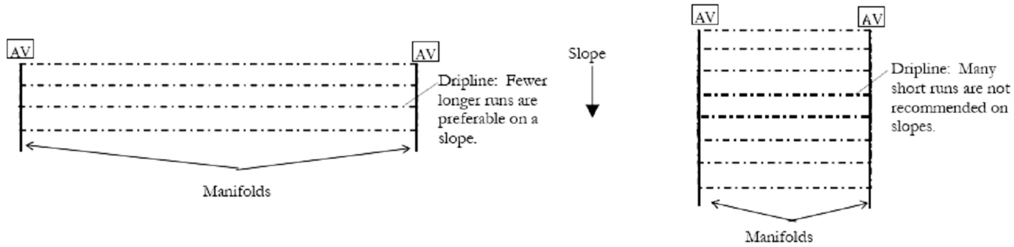
ii. Have the dripline pass over an elevated berm between the manifold and beginning of the tubing to reduce gravity flow out of the lateral. In looped systems, elevating the loop will keep the effluent in its respective run.



iii. Use check valves or multiple zones to isolate the drip laterals. Check valves should only be used if there is no risk of freezing in the manifolds. They are placed on the supply and return manifolds coupled with an airvent on the downhill side. If unsure, as a rule of thumb, use a maximum of 1500 ft of Geoflow dripline within each zone or section.

iv. Install short manifolds with fewer longer dripline runs.

v. Slope the supply and return manifolds down to the pump tank so the effluent drains back down to the tank when the pump is turned off. Open the zone valves fully to drain the lines quickly.



Concentrate drip lines at the top of the hill with wider spacing towards the bottom. In the case of compound slopes consult a professional irrigation designer or engineer.

8. Multiple Zones

Drip dispersal fields can be divided into multiple zones or sections with solenoid valves or index valves for the following reasons:

a.) Steep slopes with a risk of lowhead drainage can be subdivided to distribute the water at system shut-down more uniformly in the field.
b.) Smaller zones reduce the required flow per minute which consequently reduces the size of the pump ,valves filters, supply and return lines.
c.) Subdividing the field is a tool used to achieve the optimum ranges required to efficiently operate the pumps, filters and valves.
d.) If the dispersal field is located in multiple areas on the property.
e.) To accommodate varying soils or vegetation on a single site.
Note. On multiple zones, a single Wasteflow Headworks can be used for filtration and flushing by placing zone valves downstream of the Headworks box. All zones would require a check valve on the individual flush lines upstream of each line joining a common flush line to keep flush water from one zone entering any other zone during the flush cycle. (See Geoflow Design Detail No. 588. The list of design details is available from the GEOFLOW website at: http://www.geoflow.com/design_w.html)

9. Winterization

Buried drip systems are not prone to frost damage because, in their design, vacuum release and drain valves are provided. The dripline itself is made of polyethylene and not susceptible to freezing. It drains through the emitters so it will not be full of water after pumps are turned off. Please follow these precautions, (see also *Appendix II*):

a.) Manifolds, supply lines and return lines must be sloped back to their respective dosing or treatment tanks or buried below frost depth and or insulated. These lines need to drain rapidly. Be sure drain valve on flush line remains open long enough for entire field to drain.
b.) Remove the check valve at the pump.
c.) Insulate equipment boxes, including Headworks box or filter and field flush valve boxes as well as zone dosing valves, pressure regulator and air vacuum relief

valves. Use closed-cell insulation such as Perlite in a plastic bag. Place metal pins near, or in, the boxes to help locate them when under snow.
d.) In severe freezing conditions, use heat tape or small heater in the Headworks box.
e.) When installing PVC supply and return lines and manifolds be sure there are no dips in the lines. This can be avoided by using large diameter pipes (over 2ò) or by using schedule 80 pipe.
f.) The top of air vacuum relief valves must be no higher than soil surface.
g.) If using an index valve to split field zones, be sure it is capable of self-draining.
h.) WASTEFLOW lines will self-drain through the emitters into the soil. If the cover crop over the Dripfield is not yet adequately established, add hay or straw over the field for insulation.
i.) Mark the valve box with a metal pin so you can find it in the winter when covered in snow.
j.) Fields dosed with relatively small quantities of effluent are more likely to freeze than those dosed with design quantities. If winter use is less than summer use, then only use proportional number of fields to maintain water application rates in the field being dosed.

10. Lightning Protection

A direct lightning strike on your valve, controller or wire is going to cause unpreventable damage. It is difficult to completely prevent electricity from spreading as it jumps across air, runs along electrical wires and may even travel along your water pipes. Power fluctuations can be prevented. The controllers are built to take some electrical surge and pass it through to the ground without damage. This requires a ground wire connected to a grounding stake driven deep into the ground. The best protection would be to use a separate ground wire or rod, do not rely on the third ground wire in the buildingõs electrical wiring circuits. If you are installing this system in an area with frequent lightning storms, we advise you to install a separate grounding rod. Each field controller must have at least one eight foot copper clad steel ground rod 5/8ò in diameter, driven all the way into the ground, as close as possible to the controller. This is to be connected to the grounding lug on the back-plate of the panel. If the rod canõt be driven in all the way, cut if off and drive in the remaining piece 2-3ô from the other rod and connect the rods together with 6 AWG solid copper wire. Follow local electrical codes. Inputs to the controller are more sensitive than outputs, so Geoflow offers a metal oxide varistor that protects the incoming power. It includes a metal strip for the controller power and relays for the floats. If hit, the metal or the relays are merely replaced. These are wired into the Geo controller.

11. Reuse for Irrigation

A good vegetative cover is an advantage to prevent erosion from the field and utilize water applied to the rooting zone. Sites should be planted or seeded immediately after installation. Grasses are particularly suitable for this application. Most lawn grasses will use 0.25ò to 0.35ò (6.3-8.9mm) of water per day during the peak growing season. This calculates to be about 0.16 to 0.22 gal/ft2/day. By over-seeding lawns with winter ryegrass, this use efficiency can be continued through much of the year. For vegetation using 0.16 to

0.22 gal/ft2/day by evapotranspiration, a sewage flow of 1000 gallons per day would supply the water needs of a landscaped area of 4600 to 6400 sq. ft. without having to add fresh water. For areas larger than this, the plants will suffer water stress during the hot months unless additional fresh water is applied.

12. Water Application Formula

To determine the rate of application for various drip irrigation designs, use the following formula:
Water application (inches per hour) = (231 x (emitter flow rate gph)) / ((Emitter spacing inches) x (dripline spacing inches))
Example: Dripline with 1.3 gph flow rate emitters spaced 24" apart and dripline spaced 24" apart.
Water application = (231x1.3)/(24x24) = 0.52 inches of water per hour.

For field sizing, refer to Worksheet provided in the GEOFLOW Design Manual, or use Excel spreadsheet which can be found at www.geoflow.com. Or see example in enclosed *Worksheet 1* and *Worksheet 2*.

Worksheet:
The enclosed worksheet is a simplistic guideline and is available as an Excel spreadsheet. It can be downloaded from GEOFLOW's homepage at www.geoflow.com. If you would like a copy sent to you at no charge, phone 800-828-3388.
To calculate the area required for your drip dispersal system you must know:
1. the quantity of effluent to be disposed of (in gallons per day) and
2. the soil acceptance rate (i.e. gallons per day per square foot).
Make a sketch of the dispersal area with contour lines.

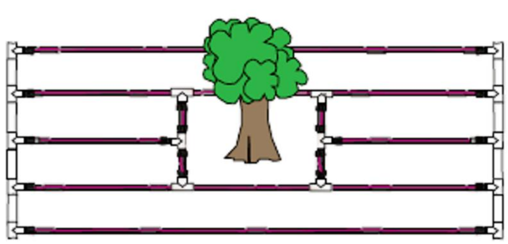
SYSTEM INSTALLATION

1. Installation Guidelines

All Geoflow drip systems require:
- Filtration with 120 mesh/130 micron
- Filter flush valve
- Field flush valve
- 2 Air vents in each zone
- All Wasteflow Classic drip systems require pressure regulation

Handle your dripline and components with care. nano-ROOTGUARD® is temperature sensitive. To assure a long life, store the dripline out of direct sunlight in a cool place. Refer to *Appendix IV* for additional GEOFLOW Installation Guidelines.

a) All Dripfield construction shall be done in accordance with Local rules and regulations.
b) Protect the site prior to installation. Construction traffic and material stockpiling can change the soil profile. Fence off entire Dripfield prior to any construction. No utilities, cable wire, drain tile, etc shall be located in Dripfield.
c) System is not to be installed when ground is wet or frozen. When the moisture in the soil is near the plastic limit (soils will ribbon and not easily crumble), it will be prone to smearing.
d) Prior to construction note if any water is accessing the location of the Dripfield. Dripfield should not be located at the low point of a site. Divert all downspouts and surface waters away from Dripfield. If a curtain drain is to be used be sure it is serviceable and properly screened.
e) Excavation, filling and grading should have been finished prior to installation of the subsurface drip system. Be sure to minimize soil disturbance when clearing and grubbing the Dripfield. Preserve as many trees as possible. Use light track equipment for tree removal and grind out roots to below dripline depth rather than fully removing the entire root.



Loop dripline around trees

f) Be sure you have everything required for the installation before opening trenches. Pre-assemble as many sets of components as practical above ground and in a comfortable place. Compression or Lockslip adapters should be glued to PVC tees, riser units should be pre-assembled, and the sub-main manifold with tees can be pre-assembled and used to mark the beginning and end of WASTEFLOW lines.

g) For particularly tough soil conditions, add soil moisture the day before opening trenches or installing WASTEFLOW. Remember it is much easier to install the system in moist soil. The soil should be moist but still allow the proper operation of the installation equipment and not cause smearing in the trenches. The soil surface should be dry so that the installation equipment maintains traction.
h) Mark the four corners of the field. The top two corners should be at the same elevation and the bottom two corners should be at a lower elevation. In freezing conditions the bottom dripline must be higher than the supply and return line elevation at the dosing tank.
i) Install the dosing tank. It is critical that the tank is waterproof. If installing a riser, check that it is watertight, and the entry and exit ports are completely sealed. In freezing conditions the dosing tank should be at the lowest elevation of the entire system. Lid should be placed at grade and water should be able to shed over it. Refer to *Appendix V* for additional Watertight Requirements for GEOFLOW Systems.
j) Install zone valves; solenoid or hydraulic index valves.
k) Install the PVC supply line from the dosing tank, up hill through one lower and one upper corner stake of the dispersal field. The two vented manifolds are pitched to drain back to the pump chamber.
l) Paint a line between the two remaining corner stakes.
m) Install the Geoflow Wasteflow dripline from the supply line trench to the painted line, approximately 8ò deep as specified. Upon reaching the painted line, pull the plow out of the ground and cut the dripline 1ô above the ground. Tape the end of the dripline to prevent debris from entering. The tubing expands in warm temperatures and contracts in cold temperatures. If installing during the warmer months, be sure to allow some play in the tubing so it will not pull out of the fittings when it gets cold. Continue this process until the required footage of pipe is installed. Geoflow dripline must be spaced according to specification (2 ft. is standard). Depth of burial of dripline must be consistent throughout the field. Take care not to get dirt into the lines.
n) If the system is looped, install the looped ends with Geoflow tubing. If in a cold climate be sure to pitch these slightly so they do not hold water and freeze. The loops are to be installed on the outside of the measured field.
o) Install the supply header with tees lined up at each Geoflow line. Hook up the Geoflow lines to the supply header. Do not glue Wasteflow dripline.
Lockslip Fittings Installations:

i. Hold the fitting in one hand and position the tubing with the other hand.
ii. Move the sleeve back, and push the tubing onto the exposed stem as far as possible.
iii. Push the sleeve out over the tubing and thread the sleeve onto tubing, as though tightening a nut to a bolt. Hand tighten. Do not use tools.
iv. Test the connection to make sure the sleeve threads have gripped the tubing tightly.

p) Install the filter headworks between the field and the pump tank on the supply line. Insulate the box in freezing conditions. When using an open bottom headworks box, place a rodent barrier down first. This can be made from bricks, paving stones, chicken wire, 3 layers of filter fabric or a 6ò minimum depth of

1ò gravel. Support the pipes entering and exiting the headworks with gravel.
q) If using a pressure regulator, install it downstream of the filter headworks, just ahead of the dispersal field, on the supply line. Although the pressure regulator can be buried directly into the soil, it is preferable to install it inside a small valve box for easy access. Insulate the box in freezing conditions.
r) Install the floats in the dosing tank and wire up to the timer control. The timer control should be set to pump no more than the design flow, do not set to match the treatment capacity.
s) Install the pump. Fill the dosing tank with fresh water and turn on the pump. Check for flow out the ends of all of the Geoflow lines. Let the pump run for about five minutes to flush out any dirt. Shut off the pump and tape the ends of the lines.
t) Dig the return header ditch along the line painted on the ground and back to the pre-treatment or dosing tank. Start the return header at the farthest end from the dosing tank. The return line must have slope back to the pump tank.
u) Install the return header and connect all of the Geoflow lines. Care must be taken not to kink the dripline.
v) Install air vacuum breakers at the highest points in the dispersal field. Use pipe dope or Teflon tape and hand tighten. Use a 6ò minimum depth of 1ò gravel below the boxes to keep rodents out. Insulate in freezing climates.
w) Install solenoid field flush valve on the return line to the pretreatment or pump tank unless a preassembled Wasteflow Headworks is being used. If a Headworks was installed on the supply line, connect the return line back through the Headworks box. Support the return pipe before it enters the Headworks with gravel. When using electric solenoid valves, connect the valve common and an individual output wire to the solenoid leads using watertight electrical connectors.
x) Solenoid Valve Installation and Operation

  i. Wrap male adapters with 2 wraps of Teflon tape and thread the adapters into the valve inlet and outlet 1 turn past hand tight. CAUTION: over tightening may cause damage to the valve. The solenoid is located on the downstream side of the valve.
  ii. Flush the laterals by opening the internal manual bleed lever on the downstream side of the solenoid. Turn the flow control stem fully open (counterclockwise) for flow control models.
  iii. Check that solenoid valves are functioning.

y) Allow glue fittings 1 ï 2 hours to set. Open the field flush valve and turn on the pump to flush lines then close the valve and check the field and all piping and connections for leaks. Turn off the system
z) Turn on the pump and check:

  i. Pressure at the air vacuum breaker(s) against design pressure. Check the pressure in the **Wasteflow Headworks.** It should be five psi or higher. If pressure gauges are on each side of the filter, note these for benchmark differential pressure across the filter.
  ii. Flow rates from flow meter or draw down on tank. Compare to design flow.
  iii. Wet spots in the field. If any sections are particularly wet, determine if they are caused by faulty connections, drippers or shallow burial.

iv. Check that solenoid valves are functioning. Close the internal manual bleed after flushing the system. If solenoid will not close, first clean the solenoid with caution not to lose small spring, and if this fails, open the bonnet and clean the inside.

aa) Open filter and solenoid valves to remove construction debris

bb) Establish vegetation cover as specified.

cc) Provide owner with final as-built diagrams flow measurements and pressure readings at startup.

dd) Provide controller records at startup, including elapsed time meter, pump counts, secondary override counts, high water counts and primary float counts.

For Subsurface Drip Installation Methods, please refer to *Table 3 in the Appendixes*.

SYSTEM MAINTENANCE

The best way to assure years of trouble free life from your system is to continuously monitor the system and to perform regular maintenance functions. For large systems or systems with a BOD > 30 mg/l automation of maintenance is essential. For smaller systems with a BOD < 30 mg/l inspection and maintenance should be performed every six months.

Routine and Preventative Maintenance

1) Clean the filter cartridge. This may be done with a pressure hose. The screen filter cartridge should be cleaned from the outside inwards, while the discs in the disc filter cartridge should be separated and then cleaned. If bacteria buildup is a problem, we advise first trying lye, and if the problem persists, soak the filter cartridge in a chlorine bath - a mixture of 50% bleach and 50% water.
2) Open the field flush valve and flush the field for 3-5 minutes by activating the pump in ñmanualò position. Close the flush valve. On automatic solenoid valves the manual bleed lever should always be in the closed position and the dial on top should be free spinning. This allows it to open when pulsed electrically. Clockwise rotation closes valve.
3) With the pump in the ñmanualò position, check the pressure in the drip field by using a pressure gauge on the Schrader valve located on the air vents and by reading the pressure gauge located in the Wasteflow Headworks box. The pressure should be the same as shown on the initial installation records.
4) Remove the lids on the vacuum breaker and check for proper operation. If water is seen leaking from the top of the vacuum breaker, remove the cap of the vacuum breaker and press down on the ball to allow any debris to be flushed out. Be careful not to come in contact with the effluent.
5) Turn off the pump and reset the controller for auto mode.
6) Periodically remove and clean the air vents, field flush and filter flush valves.
7) Visually check and report the condition of the drip field, including any noticeable wetness.
8) Treatment and distribution tanks are to be inspected routinely and maintained when necessary in accordance with their approvals.
9) Record the elapsed time meter, pump counter, override counter, high-level alarm and power failures. This information can be obtained from the controller.

GEOFLOW systems in NH are required to be under an Operations and Maintenance (O&M) Agreement at all times. Service of the pretreatment system and GEOFLOW drip should be, whenever possible, on the same O&M Agreement. For the life of the system, there shall be an O&M Agreement in place at all times, which provides service a minimum of two times per year.

APPENDIX

Appendix I

Equipment List

The following is a list of materials used for GEOFLOW installations, and each site can be different, depending on the engineerôs design and site conditions. As a minimum for each installation, the following list of items will be provided by Geoflowôs local representative, J&R Sales and Service.

.

1. GEOFLOW drip tubing
2. GEOFLOW time dosed control panel
3. High head pump
4. Floats
5. GEOFLOW Headworks containing Vortex or BioDisc filter, pressure gauge, and automatic or manual flush valves.
6. GEOFLOW Lockslip drip fittings used to connect drip tubing to PVC, including couplings, adapters, elbows and tees.
7. GEOFLOW Airvents and access boxes
8. GEOFLOW check valves
9. System Startup

Other parts required. Available from J&R or from local suppliers:

10. Pump tank and misc pump tank components per specifications such as pump housing, and float tree
11. PVC pipe
12. PVC fittings
13. Float tree

Appendix II

Design Changes for GEOFLOW in Cold Weather Climates

1. Designs with design flow of 2,000 gpd or greater must be reviewed by GEOFLOW.
2. 1 ¼ò PVC should be used for the Supply and Return manifolds
3. Maintain a minimum of 2% slope on the trench bottom from the top of the manifold to the pump chamber to allow system to drain
4. Supply and Return manifolds should be covered with flexible insulation before system is backfilled; ½ò ï ¾ò washed stone should be used in the trench(es) as a base for manifolds
5. Air vents must be located at the high points in the field, again to allow the system to drain correctly. The air vents are required to be insulated.
6. Two feet of ½ - ¾ò washed stone should be used under the air vent boxes to encourage the warmer air from below to travel up
7. Air vent boxes should be lined with a flexible insulation; Styrofoam peanuts may also be used as additional insulation
8. The dosing tank should be at the lowest elevation of the entire system.
9. If using pressure regulator, install it inside a small valve box and insulate box.

Appendix III

Checklist for Choosing and Designing a GEOFLOW Field

1. Field must be dry 12 months of the year
2. No runoff into the field
3. 2ô Groundwater offset required, 2ô separation to impervious layer
4. Air vents at high point in field
5. Tubing must follow the contours of the land
6. 2 percent slope back to pump chamber for supply and return manifolds
7. Follow NH DES regulations for Subdivision and Individual Sewage Disposal System Design Rules (Env-Wq 1000)
8. Follow GEOFLOWôs Cold Weather Climates design suggestions
9. Follow GEOFLOWôs Watertight System requirements

Appendix IV

Installation Guidelines

1. Dripline installation depth should be 8ö
2. No GEOFLOW installations December thru March
3. When using the remove/replace method, 3 inches of sand must be incorporated into the first 3 inches of existing soil
4. A minimum of 6ö of hay/straw should be placed on the field if installed after October 1st.. This is done for all installation methods to discourage freezing or erosion of the dripfield.
5. Control panel must be mounted in an accessible location for system maintenance
6. Electrical junction boxes should be sealed and use watertight electrical connections
7. It is the contractorõs responsibility to ensure GEOFLOWõs Watertight requirements are met
8. Field and Manifolds must remain exposed until startup is completed

Appendix V

Watertight Requirements

1. GEOFLOW design plans MUST require watertight tanks
2. No plastic tanks should be used; only monolithic concrete tanks
3. Risers are to be E-Z set, cast in place polypropylene risers, or concrete risers sealed with hydraulic cement
4. No polyethylene plastic risers should be used
5. Please include the following sealant requirement on job plans: Contractor shall supply preformed butyl rubber preformed flexible gasket in accordance with ASTM C-990. Supply sufficient cross section to achieve at least 50% compression of the gasket in the completed joint. Supply at least three test reports from independent third party sources to show compliance with ASTM C-990 section 6.2.1 (Physical Requirements) and section 10.1 (Performance Requirements for Joints) (i.e. Con Seal or EZ-Stick).
6. Inlet/Outlet to field must also be watertight
7. If entering through an E-Z set riser, a bulkhead fitting can be used
8. If entering through the side of the tank, two holes can be drilled (one for supply line, one for return line) and sealed with hydraulic cement
9. Press Seal boots can be cast in place for the inlet/outlet and are the preferred method of sealant when entering through the side of the tank

Table 1

Minimum Surface Area Guidelines To Dispose Of 100 GPD of Secondary Treated Effluent

Soil Class	Soil Type	Soil Absorption Rates: Est. Soil Perc. Rate minutes/in	Soil Absorption Rates: Hydraulic Conductivity inches/hr	Design Hydraulic Loading Rate (gal / sq. ft. per day)	Total Area Required sq. ft./ 100 gallons per day
I	Coarse- sand	<5	>2	1.400	71.5
I	Fine sand	5-10	1.5-2	1.200	83.3
II	Sandy loam	10-20	1.0-1.5	1.000	100.0
II	loam	20-30	0.75-1.0	0.700	143.0
III	Clay loam	30-45	0.5-0.75	0.600	167.0
III	Silt-clay loam	45-60	0.3-0.5	0.400	250.0
IV	Clay non-swell	60-90	0.2-0.3	0.200	500.0
IV	Clay - swell	90-120	0.1-0.2	0.100	1000.0
IV	Poor clay	>120	<0.1	0.075	1334.0

Dispersal field area calculation:
Total square feet area of dispersal field = Design flow divided by loading rate

NOTES:
1) Check your State guidelines and consult with your local health department for additional sizing requirements.
2) Problems with drip dispersal fields occur when soils are misinterpreted. If in doubt, choose the more restrictive soil type from the table above.
3) "Soil type" should be based on the most restrictive layer within two feet of the dripline.
4) Table 1 above, with only minor modifications over the years, has served us well since 1990 with tens of thousands of systems operating successfully based upon this data. However, thanks to work by Jerry Tyler and his associates at the University of Wisconsin-Madison soil structure has become better understood and can now be used as a comprehensive tool to determine optimal hydraulic loading rates as seen in Table 2.

Table 2

Drip Loading Rates Considering Soil Structure

Table 2 is taken from the State of Wisconsin code and was prepared by Jerry Tyler.

Soil Textures	Soil Structure	Maximum Monthly Average BOD_5<30mg/L TSS<30mg/L (gallons/ft^2/day)
Course sand or coarser	N/A	1.6
Loamy coarse sand	N/A	1.4
Sand	N/A	1.2
Loamy sand	Weak to strong	1.2
Loamy sand	Massive	0.7
Fine sand	Moderate to strong	0.9
Fine sand	Massive or weak	0.6
Loamy fine sand	Moderate to strong	0.9
Loamy fine sand	Massive or weak	0.6
Very fine sand	N/A	0.6
Loamy very fine sand	N/A	0.6
Sandy loam	Moderate to strong	0.9
Sandy loam	Weak, weak platy	0.6
Sandy loam	Massive	0.5
Loam	Moderate to strong	0.8
Loam	Weak, weak platy	0.6
Loam	Massive	0.5
Silt loam	Moderate to strong	0.8
Silt loam	Weak, weak platy	0.3
Silt loam	Massive	0.2
Sandy clay loam	Moderate to strong	0.6
Sandy clay loam	Weak, weak platy	0.3
Sandy clay loam	Massive	0.0
Clay loam	Moderate to strong	0.6
Clay loam	Weak, weak platy	0.3
Clay loam	Massive	0.0
Silty clay loam	Moderate to strong	0.6
Silty clay loam	Weak, weak platy	0.3
Silty clay loam	Massive	0.0
Sandy clay	Moderate to strong	0.3
Sandy clay	Massive to weak	0.0
Clay	Moderate to strong	0.3
Clay	Massive to weak	0.0
Silty clay	Moderate to strong	0.3
Silty clay	Massive to weak	0.0

Table 3

Installation Methods

NOTE: Disturbing the soil may affect the pore structure of the soil and create hydraulic conductivity problems. Please consult with your soil scientist or professional engineer before making the installation technique decision.

INSTALLATION METHOD *	ADVANTAGES	DISADVANTAGES
a) Hand Trenching*	• Handles severe slopes and confined areas • Uniform depth	• Slow • Labor intensive • Disrupts existing turf and ground • Back fill required
b) Oscillating or vibrating plow . Use the type that inserts the dripline directly in place, not one that pulls the dripline through the soil.	• Fast in small to medium installations • Minimal ground disturbance • No need to back fill the trench	• Depth has to be monitored closely • Cannot be used on steeper slopes(>20%) • Requires practice to set and operate adequately • Tends to "stretch" pipe. Shorter runs are required
c) Trenching machine: Ground Hog, Kwik-Trench, E-Z Trench*	• Faster than hand trenching • May use the 1" blade for most installations • Uniform depth	• Slower, requires labor • Disrupts surface of existing turf • Back fill required
d) Tractor with dripline insertion tool - see diagram 2.	• Fast • Little damage to existing turf because of the turf knife • Minimal ground disturbance • Does not stretch drip line • Adaptable to any tractor	• The installation tool is designed specifically for this purpose.
e)Tractor mounted 3-point hitch insertion implement	• Fastest. Up to four plow attachments with reels • A packer roller dumps back soil on top of the pipe	• Suitable for large installations only

* Installation methods are left to the discretion of the contractor and/or the engineer. Other installation methods may be used as long as care is taken to protect the tubing and the soil.

For remove/replace installations:

- Existing soils are excavated, taking care not to smear or compact soils
- Fill material/septic sand is brought in, incorporating first few inches of fill/sand with existing soils
- Fill/Sand is brought up to installation elevation of drip tubing
- Drip is laid on surface
- Fill/Sand is used to cover dripline 4-6ò
- Topsoil is added to desired cover
- Seed drip field

Worksheet 1 – Dispersal Field Design For Single Zone

Worksheet Dispersal Field	Formula
A. Quality of effluent to be dispersed per day ___________ *gpd*	
B. Soil type or hydraulic loading rate ___________ *loading rate (gal/sq.ft./day)*	*Based on soil analysis* *Refer to Table 1 and 2 for hydraulic loading rates for GEOFLOW WASTEFLOW*
C. Determine the total area required __________ *square ft*	*Divide gpd by loading rate A/B*
D. Chose the spacing between each WASTEFLOW line and each WASTEFLOW emitter *i)______ft. between WASTEFLOW lines* *ii)_______ft. between WASTEFLOW emitters*	*Standard spacing is 2 ft.*
E. How many linear feet of dripline in the total area? __________ *ft.*	*(Area / 2) for 2 ft. spacing C / 2.0 or* *(Area/1) for 1 ft. spacing C/1.0 or* *(Area/1.5) for 1.5 ft. spacing C/1.5*
F. Calculate the number of emitters __________ *emitters*	(*Linear ft. of dripline / 2) for 2ft. emitter spacing. E / 2 or* *(Linear ft. of dripline/1) for 1ft. emitter spacing. E/1 or* *(Linear ft. of dripline/1.5) for 1/5ft emitter spacing. E/1.5*
G. Chose pressure compensating or Classic dripline ________ *WASTEFLOW Classic dripline or* ________ *WASTEFLOW PC ½ gph dripline or* ________ *WASTEFLOW PC 1 gph dripline*	*See System Components: 1d) WASTEFLOW Classic and WASTEFLOW PC Dripline* *or* *Chart 1*

H. Determine Dripfield pressure __________ *psi*	*Standard pressure is 20 psi.* *WASTEFLOW Classic systems need between 15 and 45 psi at the start of the Dripfield.* *WASTEFLOW PC systems need between 10 and 45 psi at the start of the Dripfield.*
I. Determine feet of head required at Dripfield __________ *ft. of head*	*Multiply pressure by 2.31 to get head required* *H x 2.31*
J. What is the flow rate per emitter? __________ *gph / emitter*	*See WASTEFLOW flow rates in Chart 1*
K. Determine total flow for the area __________ *gph* __________ *gpm*	*Number of emitters multiplied by the emitter flow rate at the design pressure.* *Gph = No of emitters (F) x gph per emitter (J)* *Gpm = gph / 60*
L. Select pipe diameters for manifolds and submains __________ *inches*	*Based on total flow from (K) above, in gpm. See Chart 2 for friction loss charts. Optimum velocity is between 2 and 5 ft. per second.*
M. Select Filter or WASTEFLOW Headworks __________ *Filter* __________ *WASTEFLOW Headworks*	*Based on total flow from (K) above, in gpm. See minimum and maximum flow recommendations from each filter in Chart 3.*
N. Sketch a layout of the WASTEFLOW lines in the dispersal plot to make sure that the maximum lateral length of each WASTEFLOW line is not exceeded.	*See Maximum Length of Run in Chart 1*

Worksheet 2 - Select Pump

Worksheet ï Pumps	**Formula**
O. Minimum pump capacity ____________ *gpm*	*From (K)*
P. Header pipe size ____________ *inches*	*From (L)*
Q. Pressure loss in 100 ft. of pipe __________ *psi*	*Refer to Chart 2*
R. Friction head in 100 ft. of pipe ________*ft. of head*	*Multiply psi from (Q) above by 2.31*
S. Static head i) Height from pump to tank outlet _________*ft.*	*Number of ft.*
ii) Elevation increase or decrease _________*ft.*	*Height changes from pump to Dripfield*
T. Total static head __________*ft.*	*Add (Si) + (Sii)*
U. Friction head i) Equivalent length of fittings __________*ft.*	*Estimate loss through fittings – usually inconsequential for small systems.*
ii) Distance from pump to field x 2 ________*ft.*	*Measure length of sub-main supply & return*
iii) Total equivalent length of pipe ________*ft.*	*Add (Ui) + (Uii)*
iv) Total effective feet ________*ft.*	*(Uii) / 100 x (R)*
v) Head required at Dripfield _______*ft.*	*See line (I) in Worksheet 1*
. vi) Head loss through filter or Headworks ______*ft.*	*See pressure loss for filters in Chart 3*
vii) Head loss through zone valves _______*ft.*	*See pressure loss in Chart 4 for electric valves or hydraulic valves. Multiply pressure by 2.31 to get head loss.*
V. MINIMUM Total friction head ________*ft.*	*Add (Uiv) + (Uv) + (Uvi) + (Uvii)*
W. MINIMUM Total Dynamic Head ________*ft.*	*Add (T) + (V)*
X. Minimum pump capacity ________ *gpm*	*From line item (O) above*
Y. Choose the pump. Model Number ____________________ Manufacturer ____________________	

Chart 1 – Dripline

Dripline Tables

Refer to Geoflow's Flow and flushing worksheet for further hydraulic details

Wasteflow Classic

Flow Rate vs. Pressure

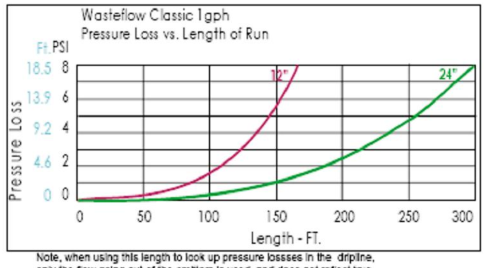
Pressure psi	Pressure ft.	Dripline WF16-4-24	Dripline WF16-4-12
10 psi	23.10 ft	0.90 gph	0.90 gph
15 psi	34.65 ft.	1.13 gph	1.13 gph
20 psi	46.20 ft.	1.30gph	1.30gph
25 psi	57.75 ft.	1.47 gph	1.47 gph
30 psi	69.30 ft.	1.62 gph	1.62 gph
35 psi	80.85 ft.	1.76 gph	1.76 gph
40 psi	92.40 ft		
45 psi	103.95 ft	1.89 gph	1.89 gph

Maximum Length of Run vs. Pressure

Flow variation +/- 5%

Pressure psi	Pressure ft.	Emitter Spacing 24"	18"	12"
10 psi	23.10 ft	170	165	100
15 psi	34.65 ft.	170	165	100
20 psi	46.20 ft.	170	165	100
25 psi	57.75 ft.	170	165	100
30 psi	69.30 ft.	170	165	100
35 psi	80.85 ft.	170	165	100
40 psi	92.40 ft	170	165	100
45 psi	103.95 ft	170	165	100

kd = .9, cv = <.05



Note, when using this length to look up pressure lossses in the dripline, only the flow going out of the emitters is used, and does not reflect true pressure loss during flushing. Pressure loss during flushing is self calculated in the cell below, or can be obtained from Geoflows Flushing spreadsheet.

Wasteflow PC 1/2 gph

Flow Rate vs. Pressure

Pressure	Head	Dripline WFPC16-2-24	Dripline WFPC16-2-12
7–60 psi	16 –139 ft.	0.53 gph	0.53 gph

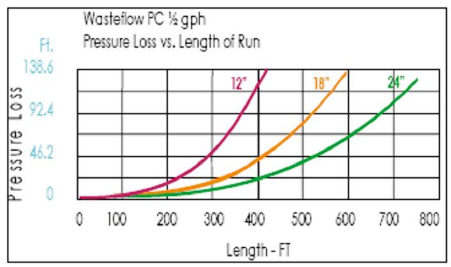
Maximum Length of Run vs. Pressure

Allows a minimum of 10 psi

Pressure psi	Pressure ft.	Emitter Spacing 6"	12"	18"	24"
10 psi	23.10 ft				
15 psi	34.65 ft.		174	260	321
20 psi	46.20 ft.	120	229	330	424
25 psi	57.75 ft.		260	377	478
30 psi	69.30 ft.	150	288	415	535
35 psi	80.85 ft.		313	448	576
40 psi	92.40 ft	172	330	475	612
45 psi	103.95 ft		354	501	651
50 psi	115.5 ft.		363	523	675
55 psi	127.05 ft.		377	544	700
60 psi	138.6 ft.		403	563	727

kd = 2.070

Not recommended with pressures greater than 45 psi



Note, when using this length to look up pressure lossses in the dripline, only the flow going out of the emitters is used, and does not reflect true pressure loss during flushing. Pressure loss during flushing is self calculated in the cell below, or can be obtained from Geoflows Flushing spreadsheet.

Wasteflow PC 1 gph

Flow Rate vs. Pressure

Pressure	Head	Dripline WFPC16-4-24	Dripline WFPC16-4-12
7–60 psi	16 –139 ft.	1.02 gph	1.02 gph

Maximum Length of Run vs. Pressure

Allows a minimum of 10 psi

Pressure psi	Pressure ft.	Emitter Spacing 6"	12"	18"	24"
10 psi	23.10 ft	50	95	140	175
15 psi	34.65 ft.	63	115	172	211
20 psi	46.20 ft.	74	146	210	265
25 psi	57.75 ft.	88	171	242	315
30 psi	69.30 ft.	94	180	266	335
35 psi	80.85 ft.	103	199	287	379
40 psi	92.40 ft	110	211	305	385
45 psi	103.95 ft	116	222	321	429
50 psi	115.5 ft.		232	334	431
55 psi	127.05 ft.		240	347	449
60 psi	138.6 ft.		249	360	465

kd = 2.070

Not recommended with pressures greater than 45 psi

Note, when using this length to look up pressure lossses in the dripline, only the flow going out of the emitters is used, and does not reflect true pressure loss during flushing. Pressure loss during flushing is self calculated in the cell below, or can be obtained from Geoflows Flushing spreadsheet.

Wasteflow PC 0.75 gph

Flow Rate vs. Pressure

Pressure	Head	Dripline WFPC16-4-24	Dripline WFPC16-4-12
7–60 psi	16 –139 ft.	0.75 gph	0.75 gph

Maximum Length of Run vs. Pressure

Allows a minimum of 10 psi

Pressure psi	Pressure ft.	Emitter Spacing	12"	18"	24"
10 psi	23.10 ft				
15 psi	34.65 ft.		140	200	257
20 psi	46.20 ft.				
25 psi	57.75 ft.		208	299	383
30 psi	69.30 ft.				
35 psi	80.85 ft.		251	350	462
40 psi	92.40 ft				
45 psi	103.95 ft		284	407	522
50 psi	115.5 ft.				
55 psi	127.05 ft.				
60 psi	138.6 ft.				

kd = 2.070

Not recommended with pressures greater than 45 psi

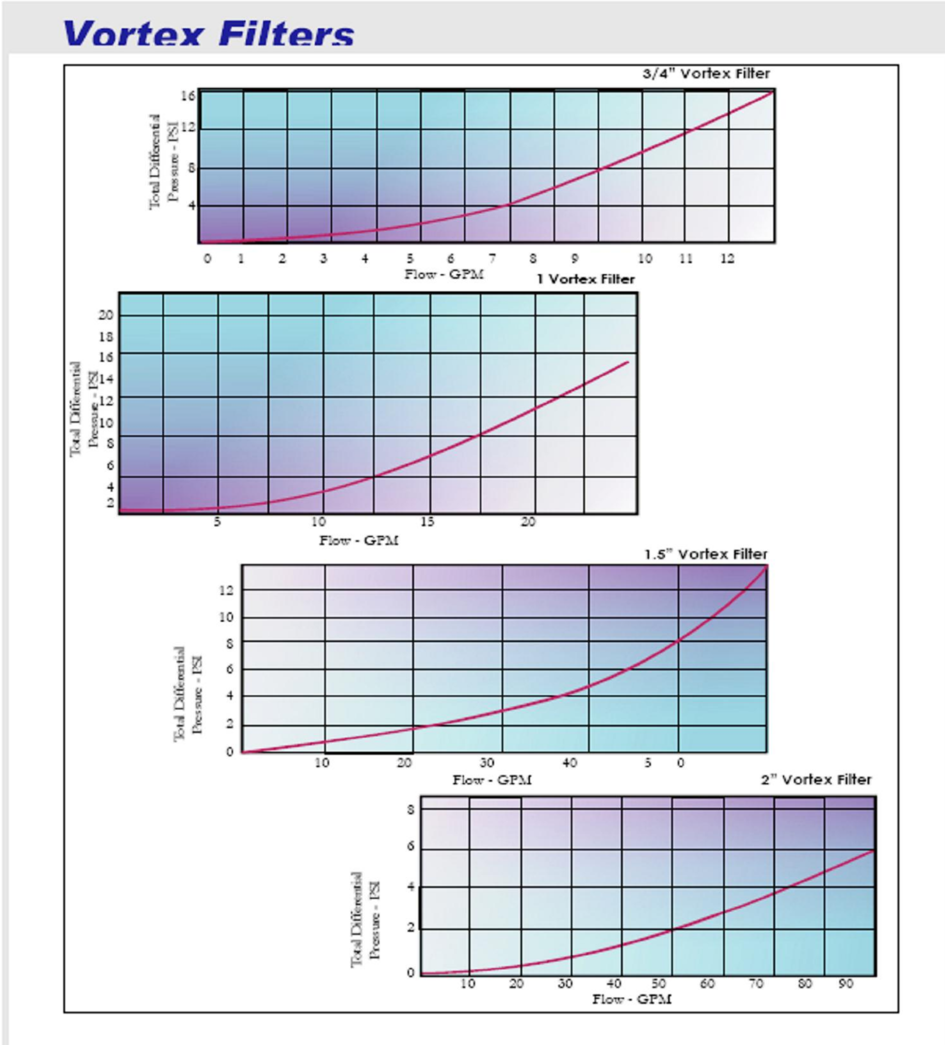
Note, when using this length to look up pressure lossses in the dripline, only the flow going out of the emitters is used, and does not reflect true pressure loss during flushing. Pressure loss during flushing is self calculated in the cell below, or can be obtained from Geoflows Flushing spreadsheet.

Chart 2 – PVC Pressure Loss Charts

PVC 40 FRICTION LOSS CHART

	½" pipe		¾" pipe		1" pipe		1 ¼" pipe		1 ½"pipe	
	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI
1	1.05	0.43	0.60	0.11	0.37	0.03				
2	2.11	1.55	1.2	0.39	0.74	0.12	0.43	0.03		
3	3.17	3.27	1.8	0.83	1.11	0.26	0.64	0.07	0.47	0.03
4	4.22	5.57	2.41	1.42	1.48	0.44	0.86	0.11	0.63	0.05
5	5.28	8.42	3.01	2.15	1.86	0.66	1.07	0.17	0.79	0.08
6	6.33	11.81	3.61	3.01	2.23	0.93	1.29	0.24	0.95	0.11
8	8.44	20.10	4.81	5.12	2.97	1.58	1.72	0.42	1.26	0.20
10	10.55	30.37	6.02	7.73	3.71	2.39	2.15	0.63	1.58	0.30
15			9.02	16.37	5.57	5.06	3.22	1.33	2.36	0.63
20					7.42	8.61	4.29	2.27	3.15	1.07
25					9.28	13.01	5.36	3.42	3.94	1.63
30					11.14	18.22	6.43	4.80	4.73	2.27
35							7.51	6.38	5.52	3.01
40							8.58	8.17	6.30	3.88
45							9.65	10.16	7.09	4.80
50							10.72	12.35	7.88	5.83
60									9.46	8.17
70									11.03	10.87
	2" pipe		2 ½" pipe		3" pipe		4" pipe		6" pipe	
	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI
6	0.57	0.03								
8	0.76	0.06	0.54	0.02						
10	0.96	0.09	0.67	0.04						
15	1.43	0.19	1.01	0.08	0.65	0.03				
20	1.91	0.32	1.34	0.13	0.87	0.05				
25	2.39	0.48	1.67	0.20	1.08	0.07				
30	2.87	0.67	2.01	0.28	1.30	0.10				
35	3.35	0.89	2.35	0.38	1.52	0.13	0.88	0.03		
40	3.82	1.14	2.64	0.48	1.73	0.17	1.01	0.04		
45	4.30	1.42	3.01	0.60	1.95	0.21	1.13	0.05		
50	4.78	1.73	3.35	0.73	2.17	0.25	1.26	0.07		
60	5.74	2.42	4.02	1.02	2.60	0.35	1.51	0.09		
70	6.69	3.22	4.69	1.36	3.04	0.47	1.76	0.12		
80	7.65	4.13	5.36	1.74	3.47	0.60	2.02	0.16		
90	8.60	5.13	6.03	2.16	3.91	0.75	2.27	0.20		
100	9.56	6.23	6.70	2.63	4.34	0.91	2.52	0.24	1.11	0.03
125	11.95	9.42	8.38	3.97	5.42	1.38	3.15	0.37	1.39	0.05
150			10.05	5.56	6.51	1.93	3.78	0.51	1.67	0.07
175					7.59	2.57	4.41	0.68	1.94	0.09
200					8.68	3.40	5.04	0.90	2.22	0.12

Chart 3 – Filters



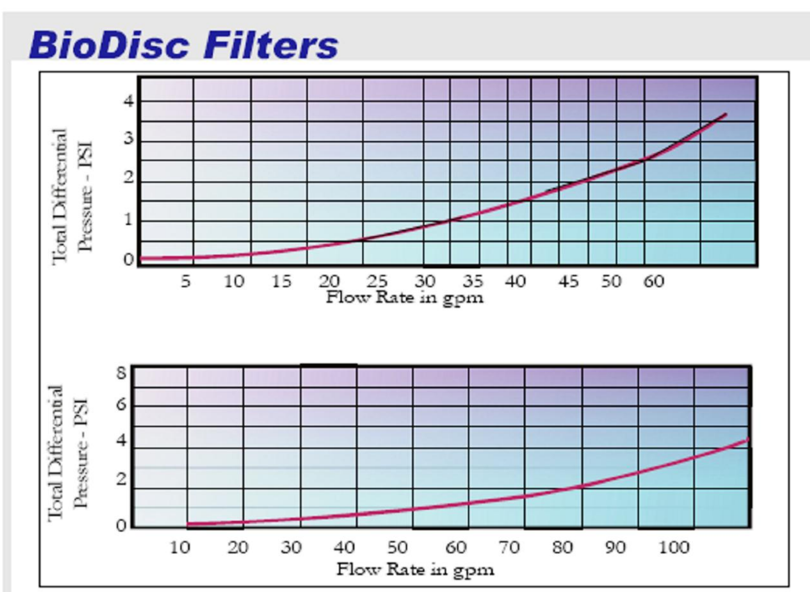
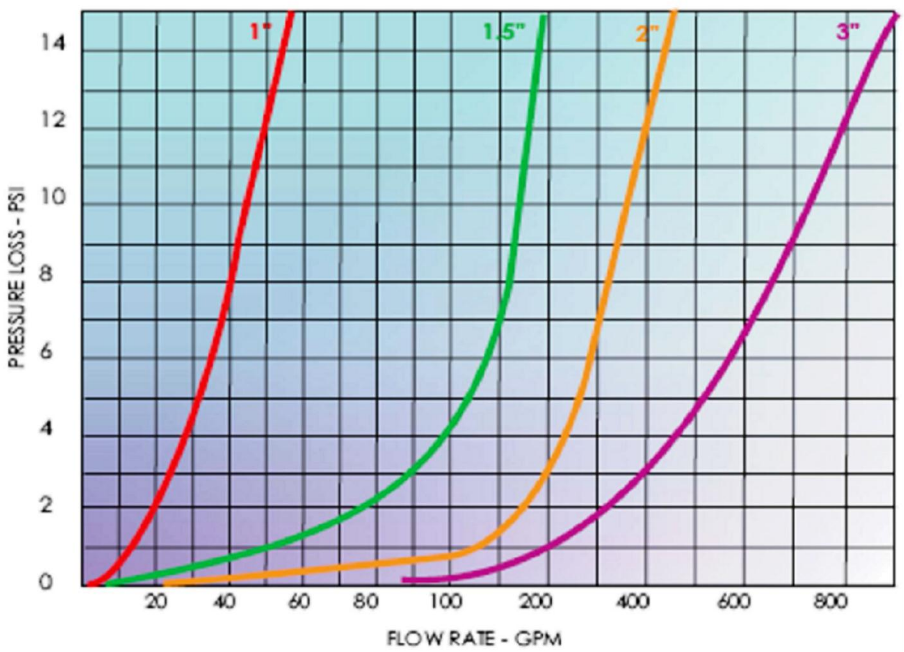


Chart 4 - Valves

Solenoid valves

Part Numbers	Size
SVLVB-100	1"
SVLVB-150	1.5"
SVLVB-200	2"
SVLVB-300	3"

Flow vs Pressure



Hydraulic Valves

Flow vs. Pressure

Part No.	No. of Zones	Flow 10 gpm psi	Flow 10 gpm ft	Flow 20 gpm psi	Flow 20 gpm ft
4402	2 zone	2	4.62	3	6.93
4403	3 zone	2	4.62	3	6.93
4404	4 zone	2	4.62	3	6.93
4405	5 zone	2.5	5.8	4.5	10.4
4406	6 zone	2.5	5.8	4.5	10.4