GEOFLOW DESIGN GUIDELINES

LANDSCAPE APPLICATIONS

CONTENTS

3
INTRODUCTION

LIMITATIONS

Geoflow, Inc recognizes that these specifications, designs and installation details have been prepared for a wide variety of conditions and applications. Modifications for particular site conditions and regional influences may be necessary and are the responsibility of the specifier.

GENERAL DESIGN PARAMETERS FOR GEOFLOW LS SUBSURFACE DRIP IRRIGATION SYSTEMS

GEOFLOW LS dripline is designed for use in subsurface applications using the grid concept with supply and flush manifolds at each end creating a closed loop system. The result of the grid design is a complete subsurface wetted area that is ideal for plant growth and root development. GEOFLOW LS Subsurface Dripline can also be installed on both sides of tree and shrub rows when the grid installation is not justified.

WATER AVAILABILITY AND QUALITY.

1. The allowable water flow (75% of available flow) and pressure are the determining factor for the maximum allowable zone flow. This is determined by the capacity at the point of connection and supply restrictions beyond the point of connection. Available flow and pressure can be obtained from the following sources.
   a. Water district in your area.
   b. Physical pressure and volume test (most reliable).
   c. Engineered calculations based on the size of the point of connection, meter and static pressure.

   Always make these determinations during the time of day at which the water pressure is at its lowest point!

2. Water quality is the factor that is used to determine what type of filter to use, what type of treatment is necessary (if any) and in the case of reclaimed or effluent water, which GEOFLOW LS drip emitter product to use. Water quality varies greatly according to the source. The general types of water sources are:
   a. Potable water.
   b. Irrigation district water.
   c. Gray or industrial recycled water.
   d. Effluent water.
   e. Recycled water.
   f. Well water.

3. Potable water, which is the most common type of water used in landscape applications, has relatively little debris and chemical contamination hence only needs to be filtered with a screen or disk filter as

supplied by GEOFLOW LS. With other water sources, it is advisable to obtain a water analysis prior to designing and installing the system. Some of the important parameters are:

a. Total dissolved solids (TDS).
b. Iron Content.
c. Calcium, Magnesium, Sulfates, Bicarbonates and hardness.
d. For gray water, industrial treated water and recycled water, it is important to know what chemical compounds are present, B.O.D and T.S.S.
e. The types and amount of sediment present in irrigation district and well water.

SOIL TYPES AND PREPARATION.

1. For design purposes soil, classifications of clay (heavy), loam (medium) and sand (light) are used in conjunction with plant types to determine the emitter and lateral spacings necessary to provide a uniform subsurface soil moisture regime for the plant material being irrigated.

2. As with all types of landscape irrigation systems, properly prepared soil is necessary to provide a homogenous bed for proper plant establishment, plant growth and uniform water distribution. Heavily compacted and layered soils should be ripped and tilled at a uniform eight to twelve inch depth to improve the consistency and tilt of the soil.

PLANT MATERIAL CLASSIFICATION AND PLANTING LAYOUTS.

1. Emitter and lateral spacings are determined by soil classification and plant material classification. For design purposes, two general plant classifications are used; 1) trees, shrubs and ground cover, and 2) turf. Turf plantings have a much more intense and compact root structure, thus requiring a closer emitter and lateral spacing to efficiently irrigate the areas.

2. Planting layouts determine the size and type of subsurface irrigation design necessary to provide uniform moisture distribution. Individual or isolated planting areas separated by large expanses of unplanted areas or hardscapes require individual grids that provide moisture within the foliage canopy of the landscaped area.

3. Narrow linear tree and shrub plantings require narrow linear subsurface grids consisting of two to four laterals.

4. More intense plantings that provide a complete foliage canopy at maturity require a grid design that applies uniform moisture levels within the foliage canopy (turf, groundcover, and dense shrub and tree plantings).
See Appendix 1, Table #9 "Spacing Guidelines" to determine the proper emitter and lateral spacings.

EMITTER AND DRIPLINE SELECTION.

Geoflow offers the following types of dripline products to choose from:

DRIPLINE	TUBING DIAMETER	FLOW RATE	PRESSURE COMP?	EMITTER SPACING	ROOTGUARD® PROTECTED
INPIPE 18	5/8"	1/2 & 1 gph	No	12" & 18"	Yes
PCLINE 16/18/20	5/8"	1/2 & 1 gph	Yes	12" & 18"	Yes
MICROLINE	1/4"	1/2 gph	No	6" & 12"	Yes

As a rule, Geoflow recommends using non-pressure compensating, turbulent flow dripline with ROOTGUARD® protection. This has proven to be very durable and easy to install. However, each site will have specific conditions for consideration. The following guide is to help you choose the most suitable emitter products.

1. *When to use Inpipe vs. PCLine in Subsurface Drip Irrigation*

Advantages of PCline 16/18/20 pressure compensating dripline.

a) Easy to design or install on-site without a formal design.
b) Lines can be run longer distances without losing uniformity (See Appendix 1, Table #1).
c) Steep slopes require fewer pressure regulators.

Advantages of Inpipe dripline

a) Less expensive than PCline 16/18/20

b) More durable because it contains no rubber diaphragm which is the weakest component of pressure compensating driplines.

c) Less prone to soil ingestion problems

Discussion

We recommend that PCline 16/18/20 be used when the advantages are of substantial economic value.

a) Very long runs.

Inpipe 18 (5/8" tubing) with 1/2 gph emitters regularly spaced 18” apart can be run 360 ft. on level ground. If longer runs than this are required use PCline 16/18/20.

b) Steep slopes.

Systems should be designed for the dripline lateral to follow the contour. If this is possible, the extra cost of pressure regulators required for Inpipe 16 and Inpipe 18 will likely be less than the incremental cost of PCline 16/18/20. If forced to run the dripline perpendicular to the contours, PCline 16/18/20 may be the only solution.

c) Rolling terrain.

This is the most difficult situation for subsurface drip due to the risk of soil ingestion. If the difference in height from trough to peak exceeds six feet then PCline 16/18/20 should be used. Vacuum relief valves must be placed at the top of each rise.

2. When to use MICROLINE in Subsurface Drip Irrigation.

Microline is ideal for small, tight areas because of it's flexibility. It can also be used to loop around trees and bushes. It is often used to retrofit sprinkler risers and bubblers to subsurface drip by easily attaching it to a multi-outlet manifold. The 1/4" tube diameter limits the length of run, but keeps the price of the product down. It is distinctly the most uniform and clog resistant 1/4" soaker style line on the market today.

DRIPLINE PLACEMENT FROM EDGES

Consideration of dripline location is necessary when laying out zone edges. Hardscape materials act as heat collectors and cause landscape edges to dry out before the center of the landscape making it essential to compensate by placing the first driplines no more than two to four inches from the landscape edge. In uncontained landscape areas, start the first dripline two to four inches outside of the planted area. In turf applications, add dripline over the supply and flush manifolds to ensure that these edges have adequate moisture coverage.

WIND

As with all total coverage irrigation systems, attention needs to be given to windward turf edges in high wind areas to prevent browning of those areas. Place the first dripline no more than two to four inches from the edge of hardscaped areas or two to four inches outside the turf edge in uncontained landscape areas and add an extra dripline six inches from the first line.

SLOPES

Driplines should be located parallel to the contour of slopes whenever possible. Since subsurface run-off occurs on sloped areas, consideration must be given to dripline density from the top to the bottom of the slope (Slopes of 3% +). The dripline on the top two thirds of the slope should be spaced at the recommended spacings for the soil type and plant material in question and on the lower one third the driplines should be spaced twenty five percent wider. The last dripline can also be eliminated on slopes exceeding 5%. **For areas exceeding ten feet in elevation change, zone the lower one third of the slope separately from the upper two thirds to help control drainage.**

ELEVATION DIFFERENCES

1. When utilizing non pressure-compensating (Inpipe 18, or Microline), elevation differences of five feet or more require separate zoning or individual pressure regulators for each six foot difference on uniform slopes. Please see detail number 207B.

2. When working with rolling landscapes with elevation differences of five feet or more within a zone, it is best to use PCline 16/18/20 pressure compensating dripline to equalize pressure differentials created by the elevation differences.

3. <u>Subsurface irrigation zones must have a vacuum relief valve at the highest point.</u> This will eliminate the vacuum created by low line drainage which causes soil ingestion. This is especially crucial when the dripline laterals must be placed perpendicular to the contour of the slope as in street medians or street set-back landscapes. It is also necessary to connect all dripline laterals within the elevated area with an air relief lateral. Please see Detail No. 203 for explanation.

4. Inline spring check or swing check valves should be used on slopes where low line drainage could cause wet areas in the lowest areas of an irrigation zone. Please see detail number 207.

TYPICAL DESIGN PROCEDURES FOR GEOFLOW LS SUBSURFACE DRIP IRRIGATION SYSTEMS

Use the **DESIGN WORKSHEET** below to follow **GEOFLOW LS's Typical Design Steps**.

Numbers in the Design worksheet DW1, DW2, DW3 etc. correspond to the same numbers found in **GEOFLOW LS's Typical Design Steps.**

DESIGN WORKSHEET

DW1
Allowable Water Supply ____________ GPM
DW2
Dynamic Pressure __________psi

ZONE	1	2	3	4	5	6
DW3 Soil Texture						
DW4 Plant Type						
DW5 Slope %						
DW6 GEOFLOW LS Item #						
DW7 Emitter Spacing						
DW8 Max. Dripline Lateral Spacing						
DW9 Nominal Flow Rate						
DW10 Actual Flow Rate						
DW11 Max. Run Length						
DW12 Exact Lateral Spacing						
DW13 Zone Flow (gpm)						

GEOFLOW LS'S TYPICAL DESIGN STEPS

1. Obtain or draw a scaled plan of the area to be irrigated.

2. Locate the point of connection on the scaled plan.

   a. Determine the water meter size and/or allowable volume of the water source______ gpm. (DW1)

   b. Verify the static and/or dynamic *water pressure*.______ psi (DW2)

3. Note the site and environmental parameters:

   a. Soil texture; clay, loam, sand? ____________ (DW3)

   b. Plant material(s); trees, shrubs, ground cover or turf? ____________ (DW4)

   c. Direction and degree of *slope*? ______________% (DW5)

4. Layout the laterals:

   a. Use the table below to determine GEOFLOW LS's dripline product necessary to fit the irrigation needs of the site. Pressure compensating (PCLINE 16/18/20 18), non-pressure compensating (INPIPE 16, INPIPE 18, or MICROLINE) dripline.

   GEOFLOW LS dripline product _______________ (DW6)

PRODUCT SELECTION TABLE

GEOFLOW LS PRODUCT	TUBING DIAMETER	FLOW RATE	PRESSURE COMP?	EMITTER SPACING	ROOTGUARD® PROTECTED
INPIPE 16/18/20	5/8"	1/2 & 1 gph	No	12" & 18"	Yes
PCLINE 16/18/20	5/8"	1/2 & 1 gph	Yes	12" & 18"	Yes
MICROLINE	1/4"	1/2 gph	No	6" & 12"	Yes

   b. Determine the maximum recommended spacing between drippers and spacing between driplines based on plant material and soil types from the "Spacing Guideline" table below.

Emitter spacing ________In. (DW7)

Maximum *dripline lateral spacing* ________In. (DW8)

SPACING GUIDELINES

	EMITTER SPACING	ROW SPACING	EMITTER FLOW	BURIAL DEPTH
MEDIUM SAND				
TREES/SHRUBS/GROUNDCOVER	12"	18"	1 gph	4"
GRASS	12"	12"	1 gph	6"
LOAM				
TREES/SHRUBS/GROUNDCOVER	18"	18"	1 gph	6"
GRASS	12"	18"	1 gph	6"
CLAY LOAM				
TREES/SHRUBS/GROUNDCOVER	18"	24"	1/2 gph	6"
GRASS	18"	18"	1/2 gph	6"
CLAY				
TREES/SHRUBS/GROUNDCOVER	18"	24"	1/2 gph	6"
GRASS	18"	18"	1/2 gph	6"

c. Determine the flow rate from the “Spacing Guideline” table on the following page.

Nominal *Flow rate*__________ gph (DW9)*

d. * Note. Actual flow is a function of pressure. Use the “Flow vs. Pressure” table on the following page to determine *actual flow per emitter* __________ gph (DW10)

EMITTER FLOW (IN GPH) VS. PRESSURE

GEOFLOW LS PRODUCT	NOMINAL FLOW	ACTUAL FLOW 15 PSI	ACTUAL FLOW 20 PSI	ACTUAL FLOW 25 PSI	ACTUAL FLOW 30 PSI	ACTUAL FLOW 35 PSI	ACTUAL FLOW 40 PSI	ACTUAL FLOW 45 PSI
INPIPE	0.5 gph	0.53	0.62	0.67	0.76	na	na	na
	1.0 gph	0.94	1.08	1.20	1.32	na	na	na
PCLINE	0.5 gph	0.53	0.53	.053	.052	0.53	0.53	0.54
	1.0 gph	1.02	1.02	1.02	1.02	1.02	1.03	1.03
MICROLINE	0.5 gph	0.50	0.60	0.70	na	na	na	na

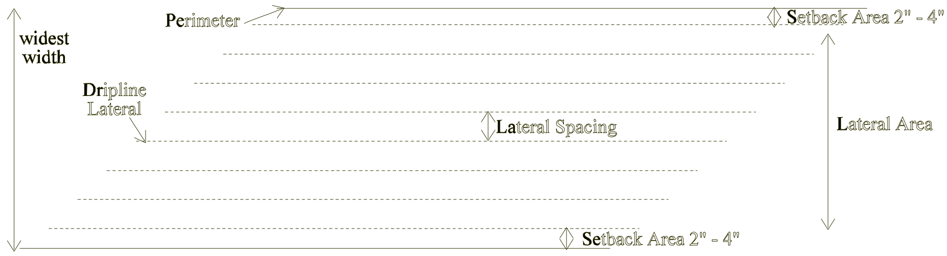
e. Determine the maximum recommended run length from the table below for the item number selected.

Ma*ximum length of run* __________Ft. (DW11)

MAXIMUM RECOMMENDED LENGTH OF RUN

GEOFLOW PRODUCT	TUBING DIA.	NOMINAL FLOW	INITIAL PRESSURE	SPACING BETWEEN EMITTERS 6"	12"	18"	24"
INPIPE	5/8"	0.5 gph	20 psi	na	255 ft	360 ft	450 ft
	5/8"	1.0 gph	20 psi	na	175 ft	240 ft	310 ft
PCLINE	5/8"	0.5 gph	15 psi	na	238 ft	336 ft	427 ft
	5/8"	1.0 gph	15 psi	na	157 ft	222 ft	281 ft
	5/8"	0.5 gph	25 psi	na	354 ft	502 ft	637 ft
	5/8"	1.0 gph	25 psi	na	234 ft	331 ft	420 ft
	5/8"	0.5 gph	35 psi	na	427 ft	604 ft	767 ft
	5/8"	1.0 gph	35 psi	na	281 ft	398 ft	505 ft
	5/8"	0.5 gph	45 psi	na	482 ft	683 ft	867 ft
	5/8"	1.0 gph	45 psi	na	318 ft	450 ft	571 ft
MICROLINE	1/4"	0.5 gph	20 psi	19 ft	33 ft	na	na

f. Calculate the exact lateral spacing based on the dimensions of the area to be irrigated with subsurface drip.



i.) Measure the subsurface drip area at its widest width in inches.

Width ___________ inches

ii.) The first and last lateral set backs can be no further than <u>two to four inches</u> from the confining hardscape or <u>two to four inches</u> outside of unconfined landscapes.

iii.) Subtract the sum of the set back areas from the width to determine the lateral area to be covered by GEOFLOW LS Subsurface Driplines.

Width in inches - setback area = *Lateral area* ____________ inches

iv.) Divide the lateral area (as determined in step iii above) by the recommended lateral spacing (DW8) to obtain the total number of spaces between laterals. Round up to the next whole number to determine the exact number of spaces necessary to cover the subsurface drip area.

Lateral Area / Dripline Lateral Spacing = _______ *spaces between driplines*

v.) Calculate the actual lateral spacing by dividing the width of the subsurface drip area from step i above by the number of spaces (from step iv above).

Width of area in inches / No. of spaces = _______ *spacing between dripline laterals in inches* (DW12)

vi.) Add 1 to the number of spaces (from step iv above) to determine the total number of GEOFLOW LS driplines across the widest part of the zone.

1 + No. of spaces between driplines = _______ *total lengths of GEOFLOW LS dripline*

5. For slope applications <u>exceeding three percent slope</u>, place the GEOFLOW LS laterals parallel to the slope contour. Increase the calculated lateral spacing by twenty five percent on the lower one third of the slope to avoid excessive drainage.
For areas exceeding ten feet in elevation change, zone the lower one third of the slope separately from the upper two thirds to help control drainage.

7. Determine specific zone size and location based on available water supply, slope restrictions, plant water requirements, and sun verses shade exposures.

_________ *square footage of zone*

8. Calculate the amount of dripline needed in each zone by dividing the square footage of the area, by the GEOFLOW LS dripline spacing in feet (See DW12). Calculate the estimated length of the perimeter laterals (.75 x perimeter distance) and add to the sum of the previous calculation to determine the total GEOFLOW LS dripline needed.

(Square ft. of zone / Dripline Spacing in ft) + (.75 x area perimeter in ft) = _______ *ft. of dripline.*

9. Calculate the total estimated gallons per minute per zone by using one of the two following methods. Be sure to use the total estimated GEOFLOW LS dripline per zone (see No. 8 above).

_________ *gpm Zone Flow* (DW13)

a. Determine the total number of drip emitters in each zone, then calculate the zone flow based on the drip emitters flow.

Step i) Number of Drippers (within the zone) = Total ft of dripline x 12” / GEOFLOW LS Emitter Spacing (inches)

Step ii) *Flow per zone in GPM =* Total Number of Drippers x Dripper flow (GPH) / 60 (minutes)

or

b. Calculate zone flow by multiplying the total footage of GEOFLOW LS Dripline in hundreds (footage ÷ 100) by the flow per one hundred feet obtained from the following table.

FLOW RATE PER 100 LINEAR FEET

(At 20 psi)

				ACTUAL FLOW / 100 FT.	
GEOFLOW LS PRODUCT	**ITEM NUMBER**	**NOMINAL FLOW**	**EMITTER SPACING**	**GPH**	**GPM**
INPIPE 16/18/20	DIRG 18-2-12	1/2 gph	12"	62.00 gph	1.03 gpm
	DIRG 18-2-18		18"	41.33 gph	0.69 gpm
	DIRG 18-2-24		24"	31.00 gph	0.52 gpm
	DIRG 18-4-12	1.0 gph	12"	108.00 gph	1.80 gpm
	DIRG 18-4-18		18"	72.00 gph	1.20 gpm
	DIRG 18-4-24		24"	54.00 gph	0.90 gpm
PCLINE 16/18/20	PCRG18-2-12	1/2 gph	12"	58.00 gph	0.97 gpm
	PCRG18-2-18		18"	38.67 gph	0.64 gpm
	PCRG 18-2-24		24"	29.00 gph	0.48 gpm
	PCRG 18-4-12	1.0 gph	12"	112.00 gph	1.87 gpm
	PCRG 18-4-18		18"	74.67 gph	1.24 gpm
	PCRG 18-4-24		24"	56.00 gph	0.93 gpm
MICROLINE	MCRG 2-6	1/2 gph	6"	100 gph	1.66 gpm
	MCRG 2-12	1/2 gph	12"	50 gph	0.83 gpm

10. Locate and size both the supply and the flush manifold in each zone. Both manifolds should be sized to accommodate the entire flow of the zone.

11. Determine the number and location of the flush valves for each zone. One flush valve required for each fifteen gallons per minute of zone flow. Place the flush valves at the hydraulic center of the flush manifold(s).

12. Calculate the total number and size of air/vacuum relief valves from the following tables.

AIR VACUUM RELIEF VALVE REQUIREMENTS

Allowable dripline footage per air vacuum relief valve based on flow rates at 20 psi

1" AIR VACUUM RELIEF VALVE (ITEM No. APVBK-1)

DRIPLINE	NOMINAL FLOW	12" SPACING	18" SPACING	24" SPACING
INPIPE 16/18/20	1/2 gph	5,000'	7,500'	10,000'
INPIPE 16/18/20	1 gph	2,700'	4,100'	5,400'
PCLINE 16/18/20	1/2 gph	5,000'	7,500'	10,000'
PCLINE 16/18/20	1 gph	2,600'	3,900'	5,200'

Maximum flow of 50 gpm per 1" air vacuum relief

1/2" AIR VACUUM RELIEF VALVE (ITEM No. ARV-05)

DRIPLINE	NOMINAL FLOW	12" SPACING	18" SPACING	24" SPACING
INPIPE 16/18/20	1/2 gph	750'	1,125'	1,500'
INPIPE 16/18/20	1 gph	420'	630'	840'
PCLINE 16/18/20	1/2 gph	750'	1,125'	1,500'
PCLINE 16/18/20	1 gph	390'	585'	780'

Maximum flow of 7 gpm per 0.5" air vacuum relief

Place air vacuum relief valve(s) at the highest point(s) of each zone. Connect the air vacuum relief valve to all dripline laterals within the elevated area with an air vacuum relief lateral (See detail 203). If the supply and flush manifolds are at the same depth as the dripline and are at the highest point in the zone, they can be used as the air relief lateral.

13. Size pressure regulators based on zone flow using the table below.

PRESSURE REGULATORS

GEOFLOW LS PRODUCT	FLOW RANGE (GPM)	PRESET OPERATING PRESSURE (PSI)	INLET SIZE (NPT)	OUTLET SIZE (NPT)
PMR-25 LF	1/10 - 8 GPM.	25 PSI	3/4" FNPT	3/4" FNPT

PMR-25 MF	2 - 20 GPM	25 PSI	3/4" FNPT	3/4" FNPT
PMR-25 HF	10 - 32 GPM	25 PSI	1.25" FNPT	1" FNPT
PMR-40 LF				
PMR-40 MF				
PMR-40 HF				

14. Size zone filter according to the total zone flow (see DW13) using the filter sizing table below. It is recommended that one filter be used per zone, close to the dripline, to eliminate the chance of debris contamination in the event that a main or submain break occurs.

FILTERS

ITEM NUMBER	**SIZE (MIPT)**	**FLOW (GPM)**	**MAX. PRESSURE**	**ELEMENT TYPE**	**MESH SIZE**	**MICRON RATING**	**AREA OF FILTRATION**
AP4E-75	3/4"	0-11	80 psi	Stainless screen	150	104	23.4 $inch^2$
AP4E-100	1"	0-28	80 psi	Stainless screen	150	104	28.4 $inch^2$
AP4E-150	1.5"	0-55	100 psi	Stainless screen	150	104	60.8 $inch^2$

IRRIGATION SCHEDULING

Irrigation scheduling with GEOFLOW LS Subsurface Drip uses the same methods of calculation as overhead irrigation. The subsurface grid system is designed to completely wet the irrigated area in a similar method as overhead irrigation, supplying water in inches per hour. For efficient water application, it is necessary to apply water rates equal to or less than the rate at which the plants use water (evapotranspiration rate; ETo). The ET rate is expressed in inches per unit of time thus our application rates are expressed in *inches per hour.*

APPLICATION RATE FORMULA

The following formula is used to determine application rates for subsurface drip irrigation.

$$\text{Application Rate (In./Hr.)} = \frac{231.1 \times \text{Emitter Flow (Gph)}}{\text{Emitter} \times \text{Dripline Spacing in Inches}}$$

Or use the Application Rate Table on the following page.

WATER APPLICATION RATE TABLE IN INCHES PER HOUR

INPIPE 1/2 GPH				
ITEM NUMBER	**DRIPLINE SPACING**			
	12 "	**15"**	**18"**	**24"**
DIRG18-2-12	1.00	0.80	0.66	0.50
DIRG18-2-18	0.66	0.53	0.44	0.33
DIRG18-2-24	0.50	0.40	0.33	0.25

INPIPE 1 GPH				
ITEM NUMBER	**DRIPLINE SPACING**			
	12 "	**15"**	**18"**	**24"**
DIRG18-4-12	1.73	1.39	1.16	0.87
DIRG18-4-18	1.16	0.92	0.77	0.58
DIRG18-4-24	0.87	0.69	0.58	0.43

PCLINE 1/2 GPH				
ITEM NUMBER	**DRIPLINE SPACING**			
	12 "	**15"**	**18"**	**24**
PCRG18-2-12	0.80	0.64	0.53	0.27
PCRG18-2-18	0.53	0.43	0.36	0.18
PCRG18-2-24	0.40	0.32	0.27	0.13

PCLINE 1 GPH				
ITEM NUMBER	**DRIPLINE SPACING**			
	12 "	**15"**	**18"**	**24**
PCRG18-4-12	1.60	1.28	1.07	0.53
PCRG18-4-18	1.07	0.86	0.71	0.36
PCRG18-4-24	0.80	0.64	0.53	0.27

MICROLINE 1/2 GPH				
ITEM NUMBER	**DRIPLINE SPACING**			
	6"	**12"**	**18"**	**24"**
MCRG2-06	3.21	1.60	1.07	.80
MCRG2-12	1.60	0.80	0.53	0.27

ZONE RUN TIME SCHEDULING WORKSHEET

To determine zone run times one must know the following;

a. Monthly Evapotranspiration value for the location.
b. Irrigation application rate.
c. Applications necessary per week.

The following formulae can be used to determine run times.

$$\text{Run time per week} = \frac{\text{Weekly Evapotranspiration Rate}}{\text{Application Rate}}$$

$$\text{Run time per day} = \frac{\text{Run time per week}}{\text{Days per week}}$$

MONTH(S) ___________________

ZONE	1	2	3	4	5	6	7	8	9	10	11	12
DAY												
Mon.												
Tues.												
Wed.												
Thurs.												
Fri.												
Sat.												
Sun.												

RECOMMENDED INSTALLATION INSTRUCTIONS

GEOFLOW LS Dripline is designed for use in subsurface applications using the grid concept with supply and flush manifolds creating a closed loop system. The result of the grid design is a complete subsurface wetted area that is ideal for plant growth and root development. GEOFLOW LS Subsurface Dripline can also be installed on both sides of tree and shrub rows when the grid installation is not justified.

If you are working from a professional irrigation design, please refer to the Designers specifications for specific instructions.

PRODUCT SELECTION

GEOFLOW LS dripline is available in two nominal emitter flow rates, 0.5 Gallons Per Hour (GPH) and 1.0 Gallons Per Hour (GPH) with emitters spaced at 12" & 18" intervals in pressure compensating (PCline 16/18/20) and non-pressure compensating (Inpipe) products. Please consult the specific product flow charts for actual flows. The product choice is dependent on site conditions and soil types.

The choice of dripper spacing, dripline lateral spacing, and depth is dependent on the soil type and plant type being used. The following Spacing Guidelines Table gives the recommended spacings for landscape and turf applications.

SOIL PREPARATION

1. As with all types of landscape irrigation systems, properly prepared soil is necessary to provide a consistently homogenous foundation for proper plant establishment, root growth and water

distribution. Heavily compacted and layered soils should be ripped and tilled at a uniform twelve inch depth to improve the homogeneity and tilth of the soil.

2. Soil and water analyses are recommended when the soil texture, soil Ph, and water quality are in doubt. This is necessary for recommendations for soil amendments and water treatment when necessary.

3. If possible, pre-irrigate the installation site when the soil is too dry to till and trench. This makes tilling and installation much easier and trouble free.

SPACING GUIDELINES

	EMITTER SPACING	**ROW SPACING**	**EMITTER FLOW**	**BURIAL DEPTH**
MEDIUM SAND				
TREES/SHRUBS/GROUNDCOVER	12"	18"	1 gph	4"
GRASS	12"	12"	1 gph	6"
LOAM				
TREES/SHRUBS/GROUNDCOVER	18"	18"	1 gph	6"
GRASS	12"	18"	1 gph	6"
CLAY LOAM				
TREES/SHRUBS/GROUNDCOVER	18"	24"	1/2 gph	6"
GRASS	18"	18"	1/2 gph	6"
CLAY				
TREES/SHRUBS/GROUNDCOVER	18"	24"	1/2 gph	6"
GRASS	18"	18"	1/2 gph	6"

INSTALLATION

1. Typical recommended pipe depth for GEOFLOW LS dripline is 6" below finished grade.

2. For turf areas where aerifying is part of normal maintenance operations, the tubing must be buried below the reach of aerifying equipment in compacted soil.

3. Use series 710 compression fittings for INPIPE 16/18/20 and PCLINE 16/18/20 connections to ensure the integrity of the connection. Use series 250 barbed fittings for MICROLINE connections.

4. It is imperative that GEOFLOW LS dripline is installed at a uniform depth and width according to specifications.

   Dripline can be installed using one of the following methods:

INSERTION METHOD	**ADVANTAGES**	**DISADVANTAGES**
a) Hand trenching or backfilling.	- Handles severe slopes and confined areas - Uniform depth	- Slow. - Labor intensive. - Disrupts existing turf and ground.
b) Oscillating or Vibrating plow (cable or pipe pulling type).	- 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.
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.
e) Tractor mounted 3-point hitch, insertion implement.	- Fastest. Up to four plow attachments with reels. - A packer roller compacts soil over the pipe.	- Only suitable for area large enough to maneuver a small tractor.

5. When possible, pressure test the system before covering trenches or when plowing pre-test for leaks prior to planting.

PLANTING

1. Pre-irrigate to ensure that the soil is hydrated to field capacity before planting begins. This is especially important when planting sod or hydroseeding.

2. When planting container plants with pot sizes wider than the dripline lateral spacing, there are two choices:

   a. Plant the oversized plants prior to installing the dripline laterals and plant the smaller plants after installing the dripline laterals.

   or

   b. Plant all plants after installing the dripline taking care to pre cut and tape the open ends of the dripline when planting the oversized plants. Re-connect the severed dripline after planting.

3. As with all types of irrigation, it is critical that the root balls are not allowed to dry out during the plant establishment period. The initial post-planting irrigation is critical making it necessary to over-irrigate to ensure water transfer between the landscape soil medium and container plant root balls.

4. When planting sod or hydroseeded grasses, establishment can be accomplished without supplemental overhead watering by:
   a. Making sure the soil is hydrated to field capacity prior to planting.
   b. Thoroughly rolling the sod to ensure optimum contact between the sod and the soil medium. Use multiple start run times (up to 10 times per day) until the sod has knit into the soil. Take care not to let the sod dry out during this period
   c. Use multiple start times as described above to establish seeded or hydroseeded grasses.

INSTALLATION STEPS

1. Assemble and install filter, remote control valve, and pressure regulating valve assembly(s) in accordance with detail number 165 .

2. Assemble and install supply header(s) in accordance with detail number(s)104,105A,105B,250,252 or 301. Tape and or plug all open connections to prevent debris contamination.

3. Assemble and install exhaust header(s) in accordance with detail number(s) 104.105A, 105B, 251,253 or 301. Tape or plug all open connections to prevent debris contamination.

4. Install dripline laterals. Tape or plug all open ends while installing the dripline to prevent debris contamination.

5. Install air vacuum relief valve(s) at the zones highest point(s) in accordance with detail number(s) 122, 120, 121A, 121B, 202, 203 or 254.

6. Thoroughly flush supply header(s) and connect dripline laterals while flushing.

7. Thoroughly flush dripline laterals and connect to exhaust header(s) or interconnecting laterals while flushing.

8. Thoroughly flush exhaust header(s) and install line flushing valves in accordance with detail numbers 121A, 121B or 133.

NOTE: Thorough flushing of each installation segment is necessary to ensure that no debris contamination occurs.

ROUTINE PREVENTATIVE MAINTENANCE

SYSTEM INSPECTION

Physical inspections are necessary as follows:

1. At the beginning of each irrigation season.

2. After any landscape planting operation or renovation.

3. After any maintenance function requiring digging at or lower than GEOFLOW LS dripline depth.

4. It is also advisable to conduct periodic physical inspections of the system components (remote control valves, filters, automatic flush valves, and flush end pressure checks) on a routine basis as determined from historical experience.

5. Base zone flow readings, supply manifold pressures, and flush end pressure readings should be recorded with all system components operating at their optimum capacity. This should be determined during the final system inspection at initial startup after installation, but can be determined as long as all system components are operating properly. Record this data on the system data form for permanent referral records.

Routine inspections should include:

1. Turning each zone on for 5 to 10 minutes and walk the area looking for excessively wet areas that might indicate leaks.

2. Inspect automatic flush valves and air/vacuum relief valves for proper operation.

3. Check the pressures at the supply manifold and flush ends of each zone and compare them with the base information on the system data forms. The flush end pressure should be at least 10 psi for proper flushing.

4. Check the operational flow of each zone and compare it with the design flows or the flows on the system data form. High flows could indicate leaks or malfunctioning automatic flush valves. Flows lower than expected could indicate clogged drippers, drippers with excessive salt build-up, kinked GEOFLOW LS dripline or a clogged filter. Low flows might also indicate that the capacity of the installed remote control valves, filters, or pressure regulators are too low thus restricting the flow to the zone.

COMPONENT MAINTENANCE

REMOTE CONTROL VALVES:

1. Upon initial inspection, check to see if the valve is properly sized for the zone flow. Refer to the manufacturers specification. Oversized valves may not close properly and undersized valves will restrict flow and cause excessive pressure loss.

2. Follow the manufacturer’s recommended procedures for repair and general maintenance.

3. Inspect for proper operation when opening or closing. A weeping valve can cause excessively wet areas at the low points in the zone.

FILTERS:

1. Filters must be inspected and cleaned periodically. The frequency of inspection is dependent on the water source. Municipal potable water may require less frequent cleaning than irrigation district water, pond water, or well water. The frequency will be determined by historical experience as new systems are operated.

2. Commercial installations should include pressure gauges or facilities to connect pressure gauges immediately upstream and downstream of each filter. Filters should be cleaned when the pressure drop across the filter is 8 psi or greater or when the downstream pressure falls below the designed working pressure of the system.

3. Filters without pressure gauges should be inspected monthly until the necessary frequency is determined.

4. Filters should always be inspected when any system break occurs ahead of the filter.

5. If filters are plugging too frequently, a larger filter (two times the highest zone flow) may need to be installed as a system master filter upstream of the zone filters to pre-filter the water supply.

PRESSURE REGULATORS:

1. Annually check the pressure output just downstream of the regulators annually to insure that the valve is operating at designed pressures.

GEOFLOW LS DRIPLINES:

1. Inspect driplines at the air vent and/or flush valve locations for salt build-up after the first year of operation. If necessary, inject commercially available cleansing solutions through the system at the recommended rates and continue with annual treatment. Consult with local fertilizer distributors for recommended materials and rates.

2. Prior to digging in planted areas, turn the system on long enough time to create wet areas on the surface which will locate the subsurface driplines.

3. After cultural or maintenance activities, turn the system on for 5 to 10 minutes to inspect for leaks that might have been caused by these operations.

FLUSH VALVES:

1. Automatic flush valves operate by automatically flushing a small amount of water each time the system is activated.

2. Observe the flush operation annually to ensure that flushing is occurring properly.

3. The system must be flushed thoroughly after repairs or alterations are made to the irrigation components. Automatic flush valves do not allow enough water to pass excessive debris through, therefore must be removed in order to effect a manual flush.

4. Manual flush valves should be flushed three times each irrigation season for a period of thirty to sixty seconds or until the flush water is visibly clean. More frequent flushing may be required under extremely dirty water conditions. Flushing is also necessary any time the system is repaired.

TROUBLESHOOTING

EXCESSIVELY WET SOIL AREAS

1. Determine if the wet area is caused by damaged dripline. Carefully dig up the area and expose the GEOFLOW LS dripline. Make a clean cut when cutting through the damaged area. If the system is a subsurface "grid" system as illustrated in the GEOFLOW LS catalog, water will flow from both sides of the cut automatically flushing any debris that may have worked its way into the dripline. While the water is running, flush both sides of the cut and repair with the proper size coupling.

2. If the wet area is at the low side of a slope or mound and a leak is not found, the wet area is probably caused by subsurface run-off. To remedy the problem, expose the lowest line in the area and eliminate it using figure eight line ends at both the inlet and flush manifold.

3. Localized wet areas are sometimes caused by differences in soil depth or uneven dripline depths. If uneven dripline depth is the problem, the line must be excavated and re-installed at a uniform depth. If it is caused by shallow soil conditions, it will be necessary to correct the shallow condition or wrap some of the dripper outlets in the area with electrical tape to cut off flow.

4. Localized wet areas can be caused by leaky fittings. If this is the case, the fittings are either the incorrect size or not properly secured.

5. Area wide wet areas are probably due to improper scheduling. Set the controller to apply water at rates that correspond to local evapotranspiration data. Use the application rate table and the scheduling form provided in this manual

EXCESSIVELY DRY SOILS

1. Check the system flows and pressures to see if the system is operating at designed pressures. If excessively low pressures are detected, troubleshoot the system to see what is causing the pressure drop and correct it.

2. Localized dry soil conditions are sometimes caused by kinked or pinched dripline or upstream leaks. Dig the dry area up and correct the situation.

3. Massive dry areas can be caused by improper scheduling. Set the controller to provide the application rate that corresponds to the local evapotranspiration data. Use the application rate table and scheduling form provided in this manual.

SYSTEM DATA

Station Number: ______

GEOFLOW LS Dripline Model Number: ___________________

Emitter Spacing: _______ inches

Emitter Flow:_______ gph

Dripline Spacing: ________ inches

Initial Supply Manifold Pressure: __________ psi

Initial Flush Valve Pressure: _________psi

Application Rate: ________inches per hour

Evapotranspiration Rate: Inches per week.

Jan _______	May _______	Sept _______
Feb _______	June ______	Oct. _______
Mar _______	July ______	Nov _______
Apr _______	Aug ______	Dec _______

PRODUCTS

ESSENTIAL COMPONENTS AND SPECIFICATIONS

A. DRIPLINE

Dripline products comprised of polyethylene tubing with emitters pre-bonded on or into the line are the most popular choice for irrigating the area. You have a choice of tubing diameter, and emitter spacings. For more information see “Emitter and Dripline Selection” on page 6.

(1) INPIPE 16/18/20

ITEM NUMBER	TUBE DIAMETER	FLOW RATE	EMITTER SPACING	ROOTGUARD® PROTECTED	STANDARD COIL SIZE
DIRG 18-2-12	5/8" (0.620" x 0.710")	1/2 gph	12"	Yes	500 ft.
DIRG 18-2-18	5/8" (0.620" x 0.710")	1/2 gph	18"	Yes	500 ft.
DIRG 18-2-24	5/8" (0.620" x 0.710")	1/2 gph	24"	Yes	500 ft.
DIRG 18-4-12	5/8" (0.620" x 0.710")	1.0 gph	12"	Yes	500 ft.
DIRG 18-4-18	5/8" (0.620" x 0.710")	1.0 gph	18"	Yes	500 ft.
DIRG 18-4-24	5/8" (0.620" x 0.710")	1.0 gph	24"	Yes	500 ft.

Inpipe 16/18/20 Specification

The dripline shall consist of nominal sized five-eighth inch linear low density polyethylene tubing, housing turbulent flow, integral drip emitters. The tubing shall have an outside diameter (O.D.) of approximately .71-inches and an inside diameter (I.D.) of approximately .62-inches. The turbulent flow path emitters shall be molded from virgin polyethylene resin with no moving parts. The turbulent flow path emitters shall have nominal discharge rates of 1.0 or 0.5 gallon per hour (GPH) with a coefficient of variation (Cv of .03). The dripline shall be available with regular spacing between emitters (12", 18" or 24") as specified in the irrigation design. The emitters shall be impregnated with Treflan® to inhibit root intrusion for a minimum period of ten years and shall be guaranteed by the manufacturer to inhibit root intrusion for this period. Inpipe dripline shall be GEOFLOW LS model number DIRG 18 - ___ - ___.

(3) PCLINE 16/18/20

ITEM NUMBER	TUBE DIAMETER	FLOW RATE	EMITTER SPACING	ROOTGUARD® PROTECTED	STANDARD COIL SIZE
PCRG 18-2-12	1/2" (0.520" x 0.620")	1/2 gph	12"	Yes	500 ft.
PCRG 18-2-18	1/2" (0.520" x 0.620")	1/2 gph	18"	Yes	500 ft.
PCRG 18-2-24	1/2" (0.520" x 0.620")	1/2 gph	24"	Yes	500 ft.
PCRG 18-4-12	1/2" (0.520" x 0.620")	1.0 gph	12"	Yes	500 ft.
PCRG 18-4-18	1/2" (0.520" x 0.620")	1.0 gph	18"	Yes	500 ft.
PCRG 18-4-24	1/2" (0.520" x 0.620")	1.0 gph	24"	Yes	500 ft.

PCline 16/18/20 Specification

The dripline shall consist of nominal sized one-half inch linear low density polyethylene tubing, with turbulent flow, drip emitters bonded to the outside wall. The tubing shall have an outside diameter (O.D.) of approximately .63-inches and an inside diameter (I.D.) of approximately .53-inches. The pressure compensating emitters shall be molded from virgin polyethylene resin with a silicone rubber diaphragm. The pressure compensating emitters shall have nominal discharge rates of 1.0 or 0.5 gallon per hour (GPH). The dripline shall be available in regular (12", 18" or 24") spacing between emitters. The emitters shall be impregnated with Treflan® to inhibit root intrusion for a minimum period of ten years and shall be guaranteed by the manufacturer to inhibit root intrusion for this period. PCline 16/18/20 pressure compensating dripline shall be GEOFLOW LS model number PCRG 16 - ___ - ___ .

(4) MICROLINE

ITEM NUMBER	TUBE DIAMETER	FLOW RATE	EMITTER SPACING	ROOTGUARD® PROTECTED	STANDARD COIL SIZE
MCRG 2-06	1/4" (0.170" x 0.250")	1/2 gph	6"	Yes	100 ft.
MCRG 2-12	1/4" (0.170" x 0.250")	1/2 gph	12"	Yes	100 ft.

Microline Specification

The dripline shall consist of nominal sized one-quarter inch linear low density polyethylene tubing, housing turbulent flow, integral drip emitters. The tubing shall have an outside diameter (O.D.) of approximately .25-inches and an inside diameter (I.D.) of approximately .17-inches. The turbulent flow path emitters shall be molded from virgin polyethylene resin with no moving parts. The turbulent flow path emitters shall have nominal discharge rates of 0.5 gallon per hour (GPH) with a coefficient of variation (Cv of .07). The dripline shall be available with regular spacing between emitters as specified in the irrigation design. The emitters shall be impregnated with Treflan® to inhibit root intrusion for a minimum period of ten years and shall be guaranteed by the manufacturer to inhibit root intrusion for this period. Microline dripline shall be GEOFLOW LS model number MICRG 2 - ___ .

B. FILTERS

A screen or disc filter is always required to keep large pieces of debris from entering the system. A media or sand filter is only required when working with non-city water or non-sedimented reclaimed water. It will remove large particles from the water. Size 16 or 20 silica sand is required.

ITEM NUMBER	SIZE (MIPT)	FLOW (GPM)	MAX. PRESSURE	ELEMENT TYPE	MESH SIZE	AREA OF FILTRATION
AP4E-75	3/4"	0-11	80 psi	Stainless screen	150	23.4 $inch^2$
AP4E-100	1"	0-28	80 psi	Stainless screen	150	28.4 $inch^2$
AP4E-150	1.5"	0-55	100 psi	Stainless screen	150	60.8 $inch^2$

(1) AP4E-75

AP4E-75 Specification

The Y filter body shall be molded from glass reinforced black plastic with a 3/4 inch male pipe thread (MIPT) inlet and outlet. The two piece body shall be capable of being serviced by unscrewing and shall include an O-ring seal. An additional 3/4 inch MHT outlet shall be capable of periodic flushing. The 150 mesh filter screen is all stainless steel, providing a 23.4 square inch filtration area. The screen collar shall be molded from vinyl.

(2) AP4E-100

AP4E-100 Specification

The Y filter body shall be molded from glass reinforced black plastic with a 1 inch male pipe thread (MIPT) inlet and outlet. The two piece body shall be capable of being serviced by unscrewing and shall include an O-ring seal. An additional 3/4 inch MHT outlet shall be capable of periodic flushing. The 150 mesh filter screen is all stainless steel , providing a 28.4 square inch filtration area. The screen collar shall be molded from vinyl.

(3) AP4E-150

AP4E-150 Specification

The Y filter body shall be molded from glass reinforced black plastic with a 1.5 inch male pipe thread (MIPT) inlet and outlet. The two piece body shall be capable of being serviced by unscrewing and shall include an O-ring seal. An additional 3/4" MHT outlet shall be capable of periodic flushing. The 150 mesh filter screen is all stainless, providing a 60.8 square inch filtration area. The outer support shell shall be woven stainless steel wire, and the inner screen shall be made of stainless steel cloth. The inner and outer screens shall be soldered together. The screen collar shall be molded from vinyl.

C. PRESSURE REGULATORS

Under normal conditions pressure in the driplines should be between 15 and 30 psi to control flow and guard against pressure surges. If pressures are too high, barbed connectors may leak and driplines fail. Flow regulators work on a different principal from pressure regulators and should be used with caution as they respond to differential pressure rather than absolute pressure.

ITEM NUMBER	OUTLET PRESSURE	FLOW RANGE	MAX. INLET PRESSURES	INLET SIZE	OUTLET SIZE
PMR-15LF	15 psi	1/10 - 8 gpm	150 psi	3/4" FIPT	3/4" FIPT
PMR-20LF	20 psi	1/10 - 8 gpm	150 psi	3/4" FIPT	3/4" FIPT

PMR-25LF	25 psi	1/10 - 8 gpm	150 psi	3/4" FIPT	3/4" FIPT
PMR-15MF	15 psi	2 - 20 gpm	150 psi	3/4" FIPT	3/4" FIPT
PMR-20MF	20 psi	2 - 20 gpm	150 psi	3/4" FIPT	3/4" FIPT
PMR-25MF	25 psi	2 - 20 gpm	150 psi	3/4" FIPT	3/4" FIPT
PMR-15HF	15 psi	10 - 32 gpm	150 psi	1.25" FIPT	1" FIPT
PMR-20HF	20 psi	10 - 32 gpm	150 psi	1.25" FIPT	1" FIPT
PMR-25HF	25 psi	10 - 32 gpm	150 psi	1.25" FIPT	1" FIPT

Pressure Regulator Specification

Pressure regulator shall be designed to handle steady inlet pressures of 150 psi and withstand severe water hammer extremes. It shall handle a number of flow rates between ___ and ___ gpm. Flow restriction shall be negligible until the factory preset operating pressure of ___psi is reached. Regulating accuracy shall be within +/- 6%. Inlet size shall be ___ FIPT. Outlet size shall be ___FIPT. Pressure regulator shall be constructed of high impact engineering grade thermoplastics for strength and durability. Regulation shall be accomplished by a fixed stainless steel compression spring which shall be enclosed in a chamber separate from the normal water passage. Each regulator shall be water tested for accuracy. Preset pressure regulators shall be GEOFLOW LS model number PMR___-___.

D. AUTOMATIC FLUSH VALVES

These valves are used to flush out debris that may enter the system. The dripline should be connected together into a common flushing line with either a manual or automatic flush valve at the point of lowest pressure. A manual flush valve is basically a ball valve at the end of a hose (See detail No. 133). Automatic flush valves are normally open, and will close after the system has reached a given pressure.

Specification

The automatic flush valve shall be molded from ultra high heat 18% glass polypropylene with compression adapter to fit tubing diameter specified. Fittings such be assembled using ultra sonic welding process. The flush valve shall be normally open, and shall close when pressure reaches 1 psi.

E. AIR VENT AND VACUUM RELIEF VALVE

Air needs to escape from the system at start up, and air must enter the system when the system is turned off in order to avoid vacuum. This may cause soil particles to enter the emitters and alter the flows. The air vacuum relief valve must be placed at the highest point of each zone, preferably on either the feeder or flush manifold.

(1) ARV-05 (new item)

Specification

The air vacuum relief valve shall be constructed of molded plastic with an internal valve and 1/2 inch male pipe thread (MPT) The air vacuum relief valve shall operate at a minimum of 7 psi and a maximum of 130 psi.

(2) APVBK-1

The air vacuum relief valve provides instant and continuous vacuum relief and non-continuous air relief. Both the body and the removable dirt cover shall be constructed of molded plastic. The body and the dirt cover shall be connected with a 3/4 inch hose thread. The ball shall be constructed of low density plastic and the internal seat shall be constructed of vinyl. The air vacuum relief valve shall seal at 5 psi. Inlet size shall be a 1 inch male pipe thread.

OPTIONAL COMPONENTS

F. IRRIGATION CONTROLLER

To maximize the efficiency of your subsurface drip system, choose a controller which allows multiple start times. For small one valve installations there are battery operated timers that mount directly onto the supply line. For larger multi-valve installations an irrigation controller may be rewired. Typical controllers have six to twelve stations. Some controllers have a battery backup in case there is a power failure. Solar powered controllers are also available. Choose a controller you and your landscape can grow with.

G. FERTILIZER INJECTOR

One of the main advantages of subsurface drip irrigation is that fertilizers and other chemicals can be safely applied through the system. Injectors must be applied downstream of the backflow prevention device and upstream of the filter. An injector can be used to keep driplines clean by injecting cleaning solutions.

H. WATER METER

This can be used to diagnose problems and to schedule irrigation times.

I. SOIL MOISTURE SENSOR

They over-ride the timer if there is too little or too much water in the soil. No need to adjust watering schedules to climate changes. Moisture sensors can be attached to control individual valves or to over-ride the whole irrigation controller. Sensors should be installed at the driest areas in the field.

TABLES

TABLE #1 MAXIMUM RECOMMENDED LENGTH OF RUN

GEOFLOW LS PRODUCT	TUBING DIAMETER	NOMINAL FLOW	INITIAL PRESSURE	SPACING BETWEEN EMITTERS 6"	12"	18"	24"
INPIPE 18	5/8"	0.5 gph	20 psi	na	255 ft	360 ft	450 ft
	5/8"	1.0 gph	20 psi	na	175 ft	240 ft	310 ft
PCLINE 18	5/8"	0.5 gph	15 psi	na	238 ft	336 ft	427 ft
	5/8"	1.0 gph	15 psi	na	157 ft	222 ft	281 ft
	5/8"	0.5 gph	25 psi	na	354 ft	502 ft	637 ft
	5/8"	1.0 gph	25 psi	na	234 ft	331 ft	420 ft
	5/8"	0.5 gph	35 psi	na	427 ft	604 ft	767 ft
	5/8"	1.0 gph	35 psi	na	281 ft	398 ft	505 ft
	5/8"	0.5 gph	45 psi	na	482 ft	683 ft	867 ft
	5/8"	1.0 gph	45 psi	na	318 ft	450 ft	571 ft
MICROLINE	1/4"	0.5 gph	20 psi	19 ft	33 ft	na	na

TABLE #2 FLOW RATE PER 100 LINEAR FEET

				ACTUAL FLOW / 100 FT.	
GEOFLOW LS PRODUCT	**ITEM NUMBER**	**NOMINAL FLOW**	**EMITTER SPACING**	**GPH**	**GPM**
INPIPE 16/18/20	**DIRG 18-2-12***	1/2 gph	12"	62.00 gph	1.03 gpm
	DIRG 18-2-18*		18"	41.33 gph	0.69 gpm
	DIRG 18-2-24*		24"	31.00 gph	0.52 gpm
	DIRG 18-4-12*	1.0 gph	12"	108.00 gph	1.80 gpm
	DIRG 18-4-18*		18"	72.00 gph	1.20 gpm
	DIRG 18-4-24*		24"	54.00 gph	0.90 gpm
PCLINE 16/18/20	**PCRG 18-2-12**	1/2 gph	12"	58.00 gph	0.97 gpm
	PCRG 18-2-18		18"	38.67 gph	0.64 gpm
	PCRG 18-2-24		24"	29.00 gph	0.48 gpm
	PCRG 18-4-12	1.0 gph	12"	112.00 gph	1.87 gpm
	PCRG 18-4-18		18"	74.67 gph	1.24 gpm
	PCRG 18-4-24		24"	56.00 gph	0.93 gpm

FLOW PER FOOT

				ACTUAL FLOW PER FT.	
MICROLINE	**MCRG 2-6**	1/2 gph	6"	1 gph	0.0166 gpm
	MCRG 2-12	1/2 gph	12"	.5 gph	0.0083 gpm

* Initial pressure of 20 psi. with an emission uniformity of +/- 5%

TABLE #3   EMITTER FLOW (IN GPH) VS. PRESSURE

GEOFLOW LS PRODUCT	TUBE DIAMETER	NOMINAL FLOW	ACTUAL FLOW AT 15 PSI	ACTUAL FLOW AT 20 PSI	ACTUAL FLOW AT 25 PSI	ACTUAL FLOW AT 30 PSI	ACTUAL FLOW AT 35 PSI	ACTUAL FLOW AT 40 PSI
INPIPE 18	5/8"	0.5 gph	0.53	0.62	0.67	0.76	na	na
	5/8"	1.0 gph	0.94	1.08	1.20	1.32	na	na
PCLINE 18	5/8"	0.5 gph	0.53	0.53	.053	.052	0.53	0.53
	5/8"	1.0 gph	1.02	1.02	1.02	1.02	1.02	1.03
MICROLINE	1/4"	0.5 gph	0.50	0.60	0.70	na	na	na

TABLE #4 APPLICATION RATES IN INCHES PER HOUR

INPIPE 16/18/20 1/2 GPH

ITEM NUMBER	DRIPLINE SPACING 12 "	15"	18"	24"
DIRG18-2-12	1.00	0.80	0.66	0.50
DIRG18-2-18	0.66	0.53	0.44	0.33
DIRG18-2-24	0.50	0.40	0.33	0.25

INPIPE 16/18/20 1 GPH

ITEM NUMBER	DRIPLINE SPACING 12 "	15"	18"	24"
DIRG18-4-12	1.73	1.39	1.16	0.87
DIRG18-4-18	1.16	0.92	0.77	0.58
DIRG18-4-24	0.87	0.69	0.58	0.43

PCLINE 16/18/20 1/2 GPH

ITEM NUMBER	DRIPLINE SPACING 12 "	15"	18"	24
PCRG18-2-12	0.80	0.64	0.53	0.27
PCRG18-2-18	0.53	0.43	0.36	0.18
PCRG18-2-24	0.40	0.32	0.27	0.13

PCLINE 16/18/20 1 GPH

ITEM NUMBER	DRIPLINE SPACING 12 "	15"	18"	24
PCRG18-4-12	1.60	1.28	1.07	0.53
PCRG18-4-18	1.07	0.86	0.71	0.36
PCRG18-4-24	0.80	0.64	0.53	0.27

MICROLINE 1/2 GPH

ITEM NUMBER	DRIPLINE SPACING 6"	12"	18"	24"
MCRG2-06	3.21	1.60	1.07	.80
MCRG2-12	1.60	0.80	0.53	0.27

APPLICATION RATE FORMULA:

Application rate in inches per hour =

$$\frac{231.1 \times \text{Emitter flow in gph}}{\text{Emitter spacing} \times \text{Dripline Spacing in inches}}$$

TABLE #5 AIR VACUUM RELIEF VALVE REQUIREMENTS

Allowable dripline footage per air vacuum relief valve
Based on flow rates at 20 psi

1" AIR/VACUUM RELIEF VALVE (ITEM No. APVBK-1)

DRIPLINE	NOMINAL FLOW	12" SPACING	18" SPACING	24" SPACING
INPIPE 16/18/20	1/2 gph	5,000'	7,500'	10,000'
INPIPE 16/18/20	1 gph	2,700'	4,100'	5,400'
PCLINE 16/18/20	1/2 gph	5,000'	7,500'	10,000'
PCLINE 16/18/20	1 gph	2,600'	3,900'	5,200'

1/2" AIR/VACUUM RELIEF VALVE (ITEM No. ARV-05)

DRIPLINE	NOMINAL FLOW	12" SPACING	18" SPACING	24" SPACING
INPIPE 16/18/20	1/2 gph	750'	1,125'	1,500'
INPIPE 16/18/20	1 gph	420'	630'	840'
PCLINE 16/18/20	1/2 gph	750'	1,125'	1,500'
PCLINE 16/18/20	1 gph	390'	585'	780'

NOTE

Air vacuum relief valves must be placed at the highest point(s) of the zone or zone section

TABLE #6 PRESSURE REGULATORS

GEOFLOW LS PRODUCT	FLOW RANGE (GPM)	PRESET OPERATING PRESSURE (PSI)	INLET SIZE (NPT)	OUTLET SIZE (NPT)
PMR-25 LF	1/10 - 8 GPM.	25 PSI	3/4" FNPT	3/4" FNPT
PMR-25 MF	2 - 20 GPM	25 PSI	3/4" FNPT	3/4" FNPT
PMR-25 HF	10 - 32 GPM	25 PSI	1.25" FNPT	1" FNPT
PMR-40 LF				
PMR-40 MF				
PMR-40 HF				

TABLE #7 INSERTION METHOD

INSERTION METHOD	ADVANTAGES	DISADVANTAGES
a) Hand Trenching or backfilling	- Handles severe slopes and confined areas - Uniform depth -	- Slow - Labor intensive - Disrupts existing turf and ground
b) Oscillating or Vibrating plow. Of the cable or pipe pulling type.	- 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.
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.
e) Tractor mounted 3-point hitch insertion implement	- Fastest. Up to four plow attachments with reels. - A packer roller compacts soil over the pipe.	- Only suitable for area large enough to maneuver a small tractor.

TABLE #8 FILTERS

ITEM NUMBER	SIZE (MIPT)	FLOW (GPM)	MAX. PRESSURE	ELEMENT TYPE	MESH SIZE	MICRON RATING	AREA OF FILTRATION
AP4E-75	3/4"	0-11	80 psi	Stainless screen	150	104	23.4 $inch^2$
AP4E-100	1"	0-28	80 psi	Stainless screen	150	104	28.4 $inch^2$
AP4E-150	1.5"	0-55	100 psi	Stainless screen	150	104	60.8 $inch^2$

TABLE #9 SPACING GUIDELINES

INPIPE 16, INPIPE 16/18/20 AND MICROLINE

	EMITTER SPACING	ROW SPACING	EMITTER FLOW	BURIAL DEPTH
MEDIUM SAND				
TREES/SHRUBS/GROUNDCOVER	12"	18"	1/2 or 1 gph	4"
GRASS	12"	12"	1/2 or 1 gph	6"
LOAM				
TREES/SHRUBS/GROUNDCOVER	18"	18"	1/2 or 1 gph	6"
GRASS	12"	18"	1/2 or 1 gph	6"
CLAY LOAM				
TREES/SHRUBS/GROUNDCOVER	18"	24"	1/2 gph	6"
GRASS	18"	18"	1/2 gph	6"
CLAY				
TREES/SHRUBS/GROUNDCOVER	18"	24"	1/2 gph	6"
GRASS	18"	18"	1/2 gph	6"

PCLINE 16/18/20

	EMITTER SPACING	ROW SPACING	EMITTER FLOW	BURIAL DEPTH
MEDIUM SAND				
TREES/SHRUBS/GROUNDCOVER	12"	18"	1 gph	4"
GRASS	12"	12"	1 gph	6"
LOAM				
TREES/SHRUBS/GROUNDCOVER	18"	18"	1 gph	6"
GRASS	12"	18"	1 gph	6"
CLAY LOAM				
TREES/SHRUBS/GROUNDCOVER	18"	24"	1 gph	6"
GRASS	18"	18"	1 gph	6"
CLAY				
TREES/SHRUBS/GROUNDCOVER	18"	24"	1/2 gph	6"
GRASS	18"	18"	1/2 gph	6"

TABLE #10 PRODUCT SELECTION TABLE

GEOFLOW LS PRODUCT	TUBING DIAMETER	FLOW RATE	PRESSURE COMP?	EMITTER SPACING	ROOTGUARD® PROTECTED
INPIPE 16/18/20	5/8"	1/2 & 1 gph	No	12", 18", 24"	Yes
PCLINE 16/18/20	1/2"	1/2 & 1 gph	Yes	12", 18", 24"	Yes
MICROLINE	1/4"	1/2 gph	No	6" & 12"	Yes
INLINE	3/8"	1.0 gph	No	15"	Yes