DRIP DISTRIBUTION OF DOMESTIC WASTEWATER IN COLD AND/OR WET CLIMATES

James C. Converse[1]

Drip distribution has been used extensively in the more temperate/drier regions as a method of reusing/recycling or dispersing of the wastewater. In drier climates systems may be designed to meet the plant needs. In wet climates or during extended wet periods, the system must be designed to disperse the wastewater at all times. Drip distribution is becoming a viable method of dispersal in cold climates with design, installation and management modification to allow it to function independent of temperature. Many state and local codes have developed siting and design criteria. For example, the State of Washington has instituted a document entitled "Subsurface Drip Systems: Interim Recommended Standards and Guidance for Performance, Application, Design and Operation and Maintenance (Wash. State Department of Health, 2002). Other states may have similar guidelines/codes to follow. Commercial firms are actively involved in supplying components and complete systems ranging in size from individual homes and to serving very large community needs.

The advantages of drip distribution, over other dispersal units such as in-ground trenches, bed, at-grades and mounds, are that drip distribution 1) has the potential for distributing the effluent more uniformly over a larger area and in areas not suited for other systems, 2) promotes lower localized loading rates/dose, 3) provides longer contact time with the soil and 4) places the effluent in contact with the soil biota which are most active in the upper soil horizons.

The objective of this paper is to give a **brief overview** of drip distribution with emphasis on the design, installation and performance in cold climates and wet climates. **In designing a drip system for a particular area, you must follow the code requirements.**

System Components:

A drip distribution system consists of a 1) wastewater pretreatment unit, 2) pump tank, pump, hydraulic units/headworks and controls, and 3) a dispersal unit consisting of supply and return line (flush line), drip lines (tubing) with emitters and an air release valve (vacuum breaker) all of which are assembled into one or more zones. Other components include pressure regulators, solenoids, and check valves depending on the system design. System configuration and sizing is dependent on soil and site conditions. It is best to select a manufacturer/supplier that you are comfortable with and work with them on finalizing the system design. Management is an integral part of the system.

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[1] James C. Converse, Professor, Department of Biological Systems Engineering. College of Agricultural and Life Science, University of Wisconsin-Madison, 460 Henry Mall, Madison, WI 57706: jcconver@wisc.edu. Member of Small Scale Waste Management Project.
Note: Names of products and equipment mentioned in this publication are for illustrative purposes and do not constitute an endorsement, explicitly or implicitly.

1. Wastewater Treatment Unit:

There are two approaches to treating the wastewater prior to discharging the effluent to the dispersal
unit, namely, 1) mechanical filtration of septic tank effluent or 2) aerobic treatment via ATUs or packed beds such as sand filters, peat filters or biofilters. The vast majority of systems especially larger systems will use aerobically treated effluent because soil loading rates are typically higher using aerobically treated effluent than using septic tank effluent. Mechanical filtration will primarily be limited to smaller systems but have been designed for larger systems as well.

2. Pump chambers, pumps, hydraulic units, and controls

Pump chambers: The chambers must be sized according to the daily flow rate with or without reserve capacity. The size may be dictated by local code. The effluent can be applied to the dispersal area either by time dosing or demand dosing. With time dosing, which is highly recommended, the effluent is applied uniformly throughout the day independent of wastewater generation. If time dosing is utilized, then flow equalization must be included in the design of the pump chamber.

Pumps: There are two types of pumps used for drip distribution. The centrifugal effluent pump is a low head, high volume pump and may be used where pressures are quite low. The turbine pump, which is a modified well pump, is a high head, low volume pump. It is well suited for drip dispersal systems requiring high pressures for back flushing filters. Most drip systems are designed with zones resulting in relatively low flow rates.

Hydraulic units/headworks: The hydraulic unit or headworks contains one or more filters to protect the emitters in the drip lines from clogging with solids. The headworks may contain a water meter to measure flow and solenoids or manual values to allow for flushing the filters. Figure 1 and 2 show two different types of hydraulic units/headworks. Each manufacturer has one or more types of hydraulic units or headworks to accommodate various waste streams. A water meter incorporated into the hydraulic/headworks allows the operator to monitor flow rates to the drip field. Filters are required for both septic tank effluent and aerobically treated effluent. There are three types of filters available; disk, screen and a small pressurized media filter. This presentation will discuss only the disk and screen filter.

Disk filter: Disk filters consist of a stack of disks with a hollow core with a very narrow grooved spaces/ridges on the disks to allow flow between the disks. The filter comes in various sizes (gpm) and various spacing (microns). Typical spacing for drip dispersal is 100 to 150 microns. Wastewater passes from the outside to the inside of the disk with solids accumulating on the outside of the disk. Periodically, the flow is reversed with filtered water, from an adjacent disk, flushing the solids off the surface with the discharge entering the inlet pipe to the septic tank. Filters need to be inspected periodically and hand cleaned if necessary.

Vortex filters: Vortex filters consist of a screen cylinder enclosed in a casing. For small drip systems the screens range in size from 3/4" to 1.5" with a typical mesh size of 150 and micron rating of 104. Other sizes and openings are available. A prescribed effluent flow rate, dependent upon filter size, enters one end of the cylinder at an angle to create a turbulence, which helps keep the screen clean. There is a small ball valve at the end opposite the inlet, which is opened periodically (manually) with the accumulated solids flushed out of the cylinder and returned to the pretreatment unit. Replacing the ball valve with a solenoid valve and controls, the unit can be set to discharge solids automatically on a scheduled basis. The screen may need to be removed periodically for hand cleaning especially if it receives septic tank effluent.

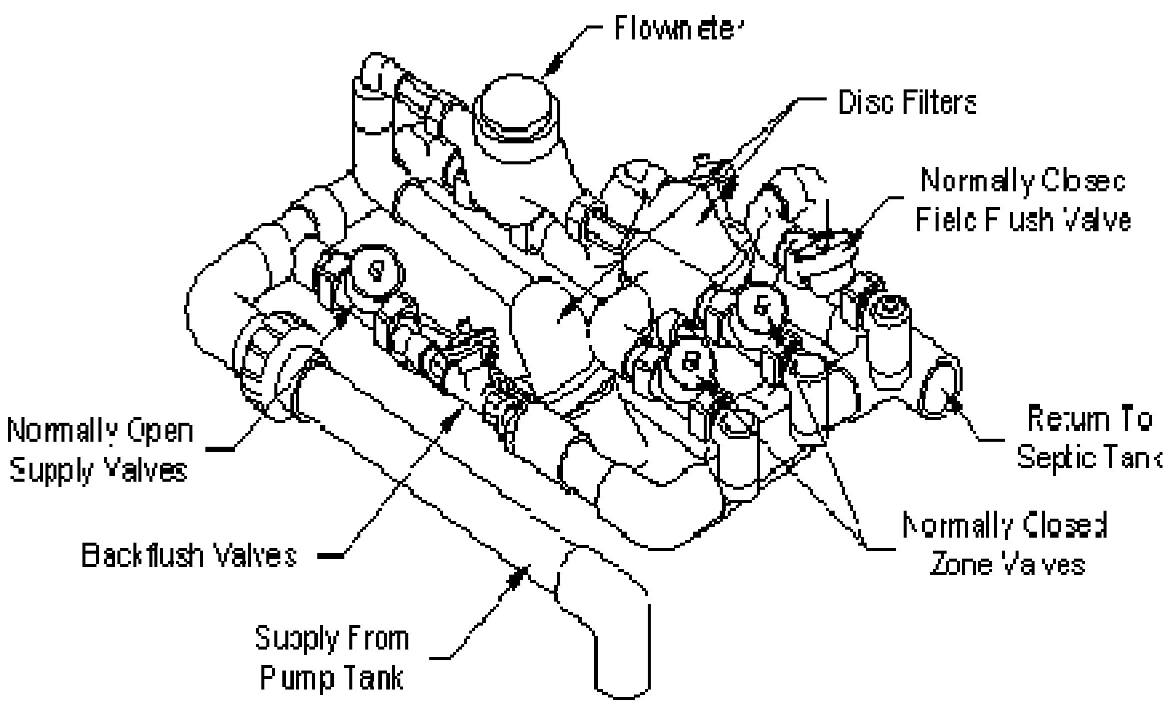

Fig. 1. Hydraulic unit used to filter either septic tank or aerobically treated effluent prior to introduction into the drip lines. Unit incorporates automatic back flushing of filters via a control panel. (American Manufacturing, 2003).

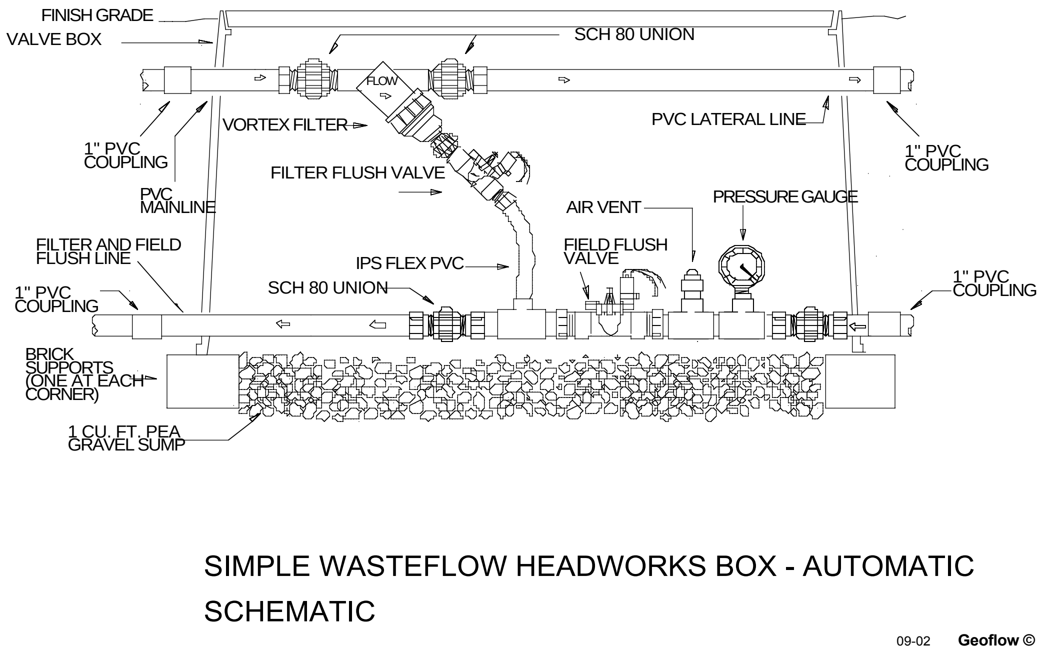

Fig 2. A headworks for filtering aerobically treated effluent. For manual flushing, manual values would replace the field flush valves. (Geoflow, 2003).

Controls: Controls will vary depending on the complexity of the system. For systems on demand dosing, manual filter and manual field flushing and one or two dispersal zones, the control panel is very simple, basically an on-off float and alarm. These systems require periodic manual flushing of the filters and drip lines and manually switching between zones. These systems are typically limited to small single-family residences and used with aerobically treated effluent.

For systems with time dosing, automatic filter back flushing, automatic field flushing and alternating between multiple dispersal zones, the system will be automatically controlled with a programmable logic controller which controls the amount and time of dose, alternates between zones, automatically flushes the lines and back flushes the filters. The panel may also include telemetry that allows the operator to monitor the system from a distance. These more complex control panels are very user friendly and are able to provide performance assessment of the unit. It is recommended that all systems be time dosed especially larger systems.

3. Dispersal unit

The dispersal unit configuration will be dependent upon the area available for dispersal. The dispersal unit consists of these basic components: supply line and manifold, drip tubing with emitters, return manifold and line and air relief valves. Depending on the system design, the following components may be incorporated into the design: solenoids check valves and pressure regulator. This discussion will be more generic and limited to the essential components. Refer to the manufactures literature for alternatives such as looped systems, zone loading with equal and unequal absorption fields.

Supply and return line: The supply line connects the hydraulic unit to the manifold serving the drip tubing. Some designs call for a supply line to each zone with a pump and filter system serving each zone. Some systems may have a single supply line with sub-supply lines branching off from the main supply line to each zone. Supply lines may be drained after each dose and others will remain full all the time. The return line connects the return manifold back to the treatment unit or pump chamber. It carries the flush waste back to the treatment unit and/or assists in drain back after dosing to the pump chamber. The return line will remain full or drain after each dose depending on the design.

Manifolds: The supply manifold connects the supply line to a series of drip lines containing emitters. The return manifold connects the drip lines to the return line. One type of manifold, known as a side manifold, is a single PVC line with drip lines connected along its length to both the supply manifold and the return manifold (Fig. 3). The supply line, manifolds and return lines all drain after each dose. Another type of manifold known as a top down manifold™ consists of a short manifold with small diameter (_ to 3/4") individual PVC pipes connecting the manifold to each drip line (Fig. 4). These supply and return manifolds are located on the upslope edge of the zone. For each manifold type, the return manifold is comparable to its counterpart supply manifold.

The side (single line) manifold interconnects all drip lines within the zone while the Top Down Manifold^tM isolates the drip lines from one another. When the pump shuts off the effluent remaining

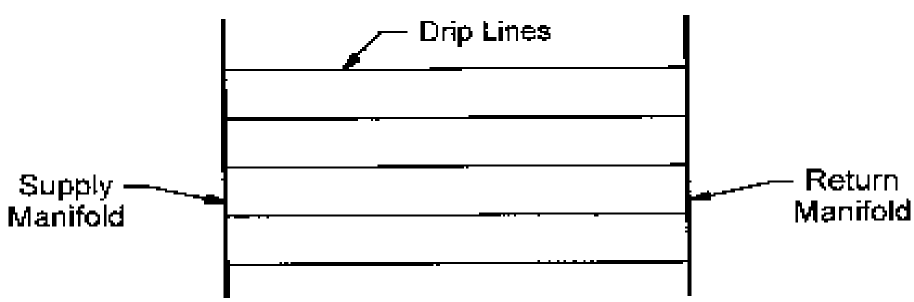

Fig. 3. Single supply and return side manifold with drip line connecting along its length.

in the manifolds and tubing will seek the lowest level. The designer must design to minimize the drain down to the lower part of the unit. The advantage of the Top Down manifold is that it eliminates flow from an upslope drip line to a lower drip line thus reducing overloading in the lower portion of the system. This drain down can be minimized using side manifold (Fig 3) if the supply and return manifolds and lines drain after each dose back to the pump chamber. In non-freezing environments, check-valves can be installed in the side manifolds to minimize drain down. Sub-manifolds can also be used.

Drip Line: The drip line is a 1/2" diameter polyethylene tube that comes in large coils that is easily placed in the soil. Internal emitters are typically embedded every 24" along the length of the drip line. Drip lines with internal emitters spaced at 6 and 12" and external emitters, which “plug” into the drip line, are also available. Drip line can be purchased with or without an internal impregnated bactericide on the interior to minimize bacterial growth.

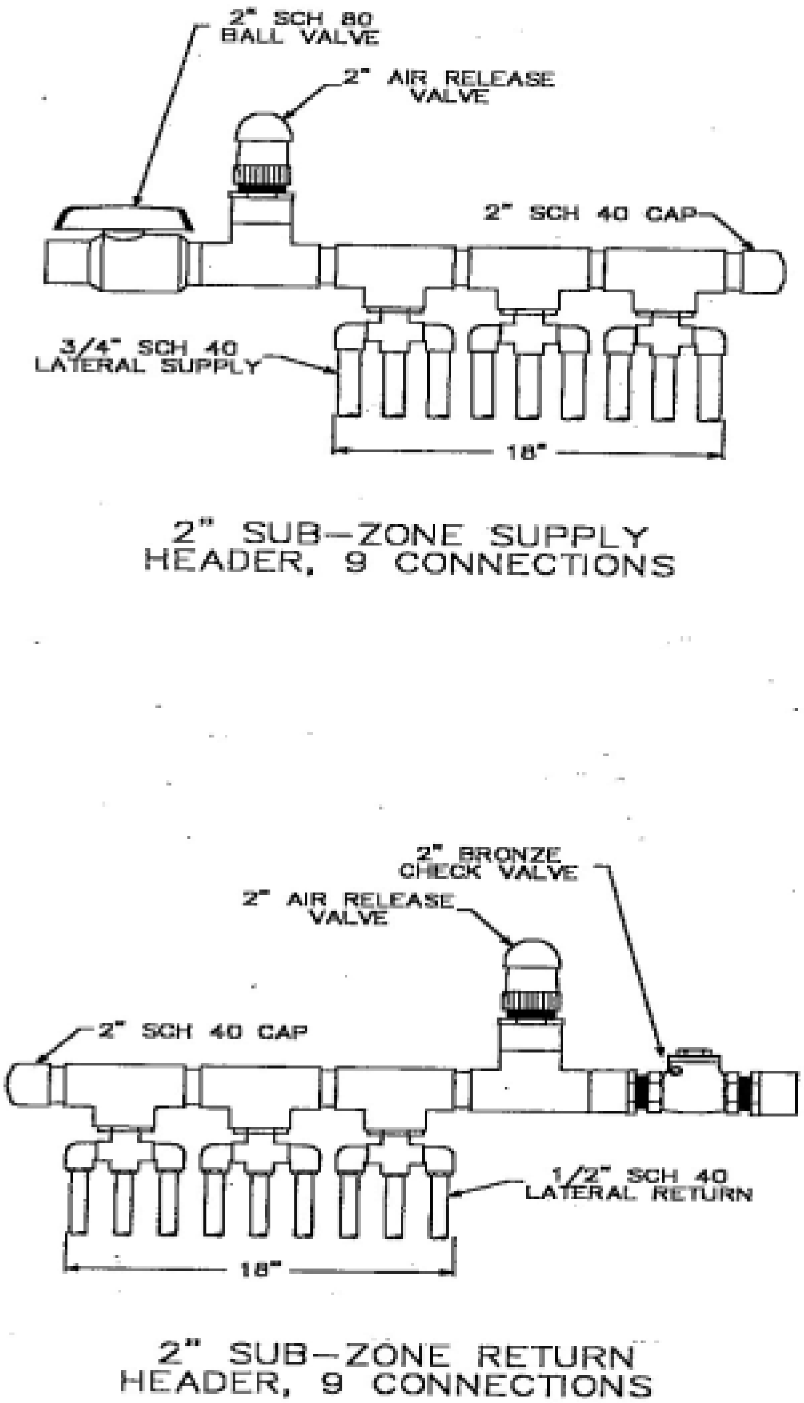

Fig. 4. Top Down Manifold™ supply and return manifold (American Manufacturing, 2003)

As with any tube or pipe, each type has its friction loss characteristics. Drip lines are limited to a certain length between the supply and return manifolds so as to maintain a certain pressure in the line. Curves and tables, from the manufacturers, are available for estimating pressure loss along the length of the drip line. For example, the pressure drop in tubing for flushing velocities (1.6 gpm and 2 fps) is 26 ft in 250 linear feet of tubing (American Manufacturing, 2003). Lower flushing velocities recommended by another manufacturer will result in lower head loss (Geoflow, 2003).

Zones: The drip lines are configured into zones with the number of zones dependent on the design flow and size of system. Zones can be configured in several ways with the supply line and return lines on opposite ends of the zone or on the same end. Systems are designed for 1 to a multiple number of zones, depending on the size of the system and site conditions and other factors.

Run: A run is defined as the distance between the supply and return manifolds when they are on opposite ends of the zone with no looping or it is the length of one tube along the length of the zone if both manifolds are on the same end (Fig. 5).

Lateral: The lateral is defined as the length of tubing extending from the supply manifold to the return manifold. If manifolds are on the opposite end of the zone, then the run equals a lateral with no looping. If both manifolds are on the same end of the zone and the drip tube extends out and loops back to the return manifold, then the lateral equals two runs (Fig. 5). The tubing can be looped several times with the length limited due to acceptable pressure loss along its length.

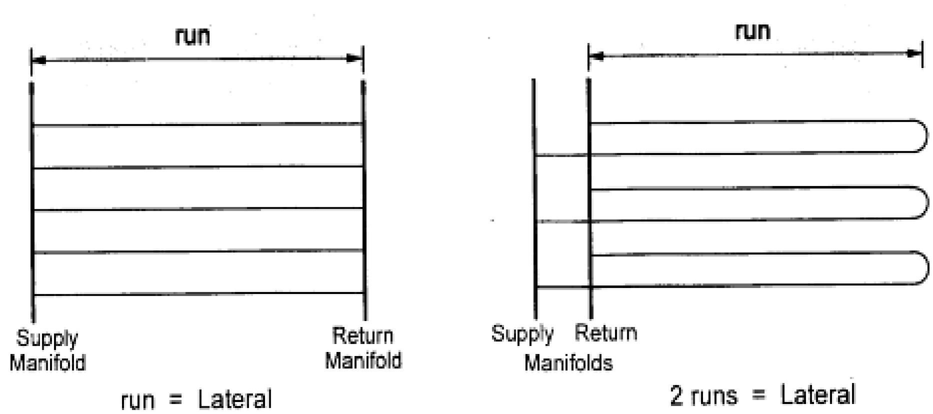

Fig. 5. Run is identified as one drip line the length of the zone while a lateral is defined as one drip line from the supply manifold to return manifold.

Emitters: There are two types of emitters, namely, 1) pressure compensating or 2) turbulent or non-pressure compensating.

Pressure compensating emitters: This emitter is designed to compensate for different pressures with the discharge rate the same for pressures of 7 psi to 70 psi (American Manufacturing, 2003) (Fig. 6). The performance curve is flat for pressures ranging from 7 to 70 psi with the discharge rate dropping off as pressure drops off below 7 psi at which time the emitter acts as a turbulent flow emitter. A typical flow rate is 0.61 gph with emitters available for higher or lower discharge rates. Pressure compensating emitters will provide uniform application on both sloping and level sites while under pressure. Some emitters are impregnated with a bactericide to reduce slimes and regrowth.

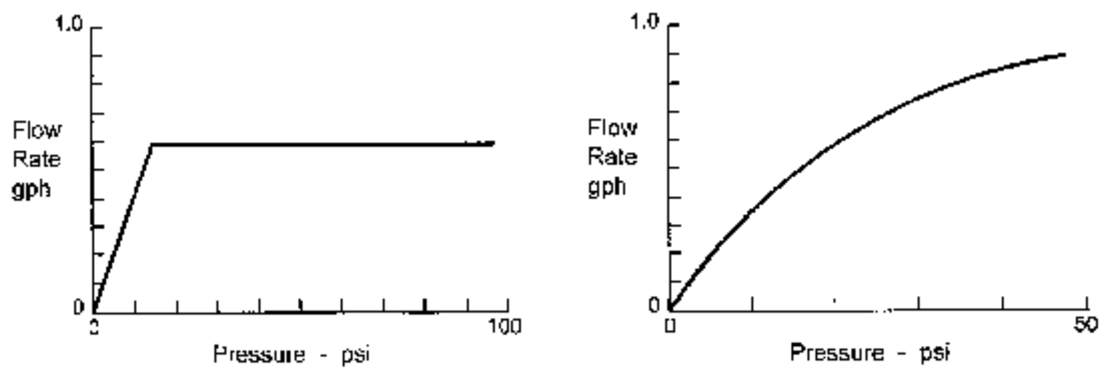

Fig.6. Flow rates vs. pressure for pressure compensating (left) and turbulent emitters (right). These curves illustrate the difference and do not represent specific emitters.

Turbulent or non-pressure compensating emitters: The discharge rate will vary with the in-line pressure (Fig. 6). Emitters are available with different flow characteristics. If emitters are installed at different elevations, the discharge rates will be higher in the emitters at the lower elevations than those at higher elevations. However, the difference may be minimal if the in-line pressures are high and the elevation difference is small.

For both the turbulent and the pressure compensating emitters on sloping sites, the lower emitters will discharge more effluent following the dose cycle as the upper lines will drain down to the lower lines unless they are isolated or the manifolds drain after each dose. Methods are available to minimize the movement of effluent between emitters. Emitters are also available with a herbicide impregnated to reduce root penetration into the emitters. Inline filters, impregnated with herbicide, are available that emit small amounts of herbicide to help control roots in emitters. Pressure compensating emitters controls root penetration by mechanical means.

Air Relief Valve/Vacuum Breakers: When the pump shuts off, effluent will flow to the low point of the zone or laterals creating a suction on part of the system. Air relief valves/vacuum breakers, installed at the high point in each zone, release the suction after the pump shuts off which in turn minimizes the amount of soil pulled into the drip tube via the emitters. Even with the air relief valve/vacuum breaker located at the high point, some localized suction will occur resulting is some soil being pulled into the unit via the emitters. Regular flushing will remove the soil particles and remove bacterial slime build-up on the tubing wall, which if left unchecked may slough off and enter the emitters.

Solenoids: When dosing multiple zones individually, solenoids are used to isolate one zone from another so that a single pump can dose multiple zones. Solenoids are operated at 12 or 24 volts via a control panel. They can be located at the inlet to the zone (remote) if a single supply line serves multiple zones or they can be located near the hydraulic unit with a supply line going to each zone.

Check valves: When a common return line is used for multiple zones, a check valve is used at the outlet of the return manifold to isolate zones from being back fed when a particular zone is being dosed or flushed. Check valves are also used in manifolds on sloping sites to control drain down.

Connections of Drip Line to Manifold and Looping: Care must be taken when making the connection between the manifolds and the drip line so as not to kink the drip line. Some designers/manufacturers recommend using flexible PVC pipe to make the connection from the manifold to the drip line. Other designers/manufacturers recommend connecting the drip tubing directly to the manifold. Rigid PVC pipe can be used for connecting the tubing to the supply and return manifolds but is very labor intensive. Kinking must also be avoided when looping from one drip line to the next. Again, some recommend flexible PVC while others indicate it can be done with the drip line. In any case the loops should be elevated slightly when installing so they drain after each dose.

Drain down:

Drain down occurs after every dose. Effluent will flow to the lowest point in the landscape via the drip tubing and manifolds. It will continue to flow out the emitters until the drip tubing empties. Design considerations must be implemented to minimize overloading a down slope area of the dispersal area otherwise surfacing of effluent may occur.

Design:

For a successful operation the system design is dependent upon the loading rate and the soil and site conditions. In the cold climates and the wet climates additional design considerations must be met. Drip dispersal systems must be designed for use in freezing climates. Systems must also be designed for areas where the soils are very wet for extended periods of time. **However, the**

designer must be cognizant of the fact that the wastewater must go somewhere and most codes require separation distance from tubing to the limiting condition.

This paper will not attempt to present design parameters as those can be found elsewhere. If one decides to design a drip system, seek out the various manufacturers of equipment and work with them on the design. Each manufacturer has their own design criteria for their particular equipment. Some provide components that can be assembled to form a system while others provide complete designs. The designer must make sure that the manufacturer specializes in wastewater drip dispersal, as there are differences between wastewater dispersal and agricultural drip irrigation systems. There are a number of manufacturer/suppliers available. Your state code may have an approved list of suppliers/manufacturers.

Cold weather performance of onsite systems:
During the 2002-2003-winter season, there was very little snow cover and extended periods of cold temperatures in much of the Upper Midwest including Minnesota, Wisconsin and Michigan. As a result, many systems froze including in-ground, at-grades and mounds. Based on conversations with people it was not so much the soil portion freezing but the various components such as:

- Condensate from furnace froze in sewer line from house to septic tank while family was on vacation
- Septic tank liquid freezing
- Pump chambers freezing
- Force main to mound freezing
- Heater in the hydraulic unit of a drip system burned out allowing the hydraulic unit to freeze.

Generally speaking for all onsite systems it is difficult to tell exactly what component froze in many systems. The goal was to get the systems back into service or use the septic tank as a holding tank until the "system" thawed. Excluding the winter of 2002-2003, the winters in the Upper Midwest have been quite mild with sufficient snow for a number of years and as a result designers, installers and homeowners may have been a little lax in attention to design, installation and management details.

Cold Climate Drip Distribution Monitoring: Drip distribution systems are being used in the cold climate region. Several studies have been conducted measuring temperatures in the drip dispersal area around the emitters.

Bohrer and Converse (2001) monitored 4 drip distribution systems during 1998-1999 and 5 systems from during 1999-2000. Temperatures were monitored 4" below the emitter, at the emitter and 4" above the emitter at several locations in each dispersal area. Both winters were considered mild winters but air temperatures did fall below 0 ^{O}C for extended periods. Negative soil temperatures were found in the soil at the drip line as well as 4" below the drip lines with temperatures as low as –12 ^{O}C at 4” below the drip line in the northern part of Wisconsin and –1 ^{O}C in the southern part of the state. None of the systems studied during those two years had operational problems due to cold temperatures.

Wallace (2001) monitored the temperatures in 4 drip distribution systems in Minnesota during winter of 2000/2001. He found soil temperatures at the emitter line (7.5 –30 cm of cover) were below freezing throughout the winter. He also found temperatures at the emitter line tended to be slightly colder than the soil temperature at a comparable depth between emitter lines. He theorized that it might be the cold air that was drawn in via the air release valve after each dose. The supply and return lines on all of these systems drained after each dose.

McCarthy (2003) monitored temperatures for 6 winters (winters of 1996-01 and 2002-2003) around one drip system in northern Minnesota with drip lines placed at 6, 12, 18 and 24” deep. The drip system was located on a west-facing, grassy hill in a silt loam over sandy soil, sized for a single-family home using septic tank effluent. Temperature of the effluent in the winter (in the drip dose tank) was typically 6-8 ^{O}C. Freezing of the 6-12” drip tubing occurred during those winters with little snow cover, when the tubing was not insulated with straw, while the 18 – 24” drip tubing continued to function. During the winter of 2002-2003, when all types of on-site systems froze in Minnesota due to a lack of snow cover, all 4 drip lines were non-functional by the end of January, when the frost was 3-4 ft deep. The supply and return lines were installed 6-7 ft deep and do not drain after each dose.

Mokma et al. (2001) monitored soil temperatures for several years in the late 1980s and early 1990s. They concluded in wooded sites, where trees are not removed, shallow on-site systems would function without freezing. Soil temperatures above and around three shallow on-site systems in SE Michigan were above freezing through out the winter. They concluded snow and late season vegetative cover is important for system functioning.

Cold Weather Drip Distribution Performance in Winter of 2002-03. For drip units specifically the author surveyed most of the installers/designers in Wisconsin and contacted some from Minnesota and one in Pennsylvania. The following comments are based on my interpretation of what they reported.

- Drip unit became inoperative because of freezing in the force main just outside the pump chamber with the supply line normally draining after dosing. It is surmised that there is a dip in the supply line near the pump chamber that caused the problem. Had not been a problem for the previous 5 yrs.

- The heater in the hydraulic unit burned out. It was thawed and put back into operation. The flow to the zone had slowed down significantly. The unit was put back on line with time dosing but the flow was so slow that the alarm eventually went off and the owner put unit on manual until the liquid level in the pump chamber dropped significantly, then put system back on automatic. It was operated for the rest of the winter in this fashion. Had the heater not burned out, would the system have continued to function?

- Approximately 20 systems in Minnesota ranging of various sizes including 6 residences, operated all winter because the designer and installers paid close attention to freezing. All supply and return lines and manifolds drain rapidly after each dose (Fig. 7).

- A large 6-zone drip unit with a large RSF as pretreatment unit froze during 2002-2003 winter. The supply and return lines remain full and are buried deep with sub lines coming up to insulated valve boxes which contains a solenoid and/or a check valves and air release valves but the boxes were not heated. The subdivision is 25% built out but yet the complete RSF operated all winter. The effluent was dispersed via time dosing to all 6 zones with all 6 freezing. If heaters had been placed in the valve boxes and only 2 zones were used with shorter/more frequent doses, would the system have frozen? (Modification of Fig. 8)

- Another large system of similar design to the previous example but received a full wastewater load operated all winter. The number of active zones were reduced from 6 to 4 and the operator changed the off time from 96 minutes to 52 minutes doses. (Modification of Fig. 8)

- Several single-family systems designed to have the supply and return lines and manifolds drain after each flush failed. System is periodically flushed manually. However, to provide a small continuous flush during dosing, a 1" ball valve with 1/4" hole is located at the outlet end of the return manifold. Failure was attributed to the slow draining of the return manifold and line because of the ball valve.

- Drip unit in north central Minnesota serving a restaurant with supply and return lines continuously full has 6 zones with 4 shallow zones with tubes buried at 4" and 2 zones with lines buried at 12". The 4 shallow zones were shut down with the remaining two receiving the effluent. System is located in the woods with very heavy plant growth. System functioned throughout the winter (Modification of Fig. 8).

- Andress and Cosgrove (2003) evaluated 46 residential American Manufacturing drip distribution systems in Pennsylvania for evidence of freezing. The study went from Jan. 21 – Feb. 10, 2003. For the 3 month period (Dec. – Feb) average temperatures ranged from 25.8 to 30.8 ^{O}F with many average lows below freezing, a substantial amount of rain and snow melt resulted in saturated soils and there was very little snow cover insulation. Eight systems were found to have early stages of freezing based on slow dosing rates. Two systems were frozen based on no dosing rates. Factors that may have contributed to poor performance were: 1) no vegetation cover on supply and return lines (6 of the 8 in early stages of freezing), no insulation in remote zone valve boxes (2 in early stages of freezing), 3) minimal vegetation over drip tubing (1 frozen system) and 4) open northern exposure with little vegetative cover (one frozen system). No system located in wooded sites froze. Inspection of the two systems that froze showed that the soil directly beneath the drip tubing was not frozen but it was frozen between the drip lines to a depth greater that the drip lines, which were, installed 6-12". They concluded for their area that precautions should be taken for 1)late season installations with little or no vegetative cover, 2) open northern exposure installations and 3) grazed pasture installations.

Design types: Relative to cold weather, drip distribution designs can be divided into two basic systems with a lot of variations on each basic system. The two basic types are: 1) supply and return lines full all the time or 2) supply and return lines and manifolds drain after each dose. Each has their advantages and disadvantages.

Figure 7 shows a drip system where the supply and return lines and manifold drain rapidly after each zone. This system uses a side manifold (Fig. 3). The drip tubing drains out through the emitters. An electric solenoid is activated at the end of the dose cycle to open the supply line for rapid draining. The return line drains through a throttle valve. System can be designed for multiple zones with multiple pumps sharing the same tank with controls to alternate the pumps. There is a supply and return line for each zone.

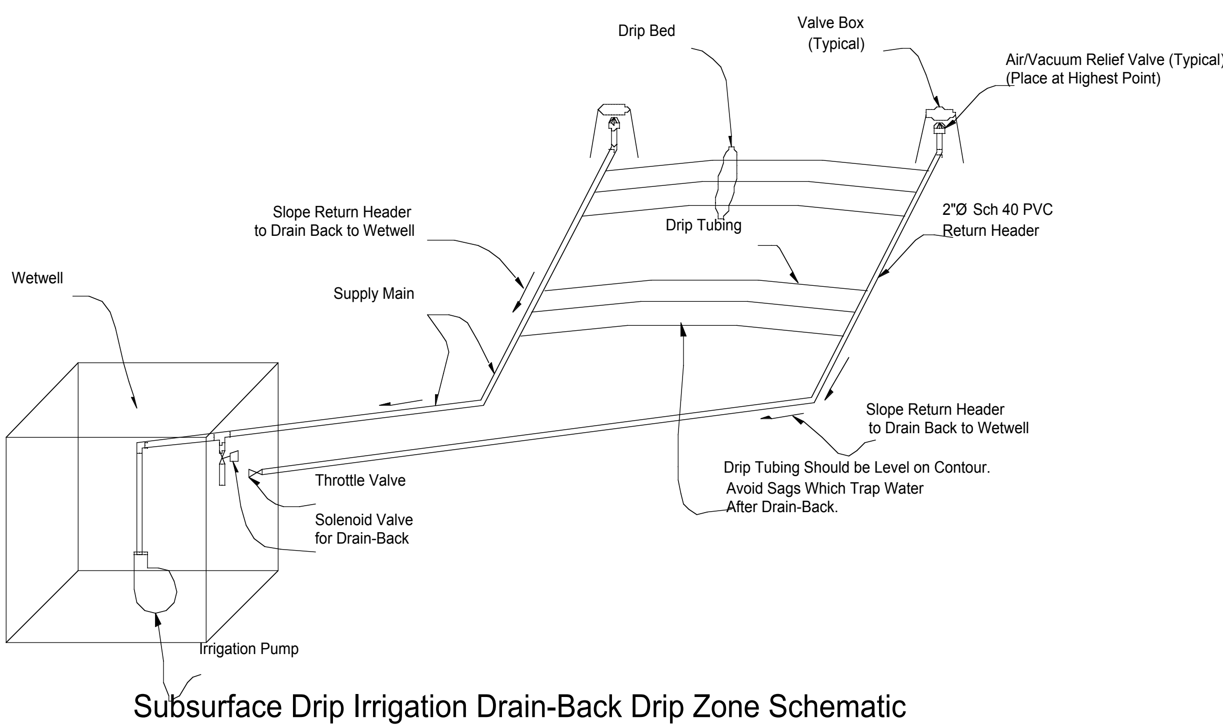

Fig. 7. Schematic of a drip design for cold climates that utilize drain back after each dose (Wallace, 2001).

Figure 8 shows a design where the supply and return lines remain full all the time. Other designs such as the zone valve (solenoid) in the hydraulic unit and single supply line to each zone and common return line are also available. This system uses a Top Down Manifold™ (Fig. 4) on sloping sides. After each dose, the supply and return manifolds drain into the individual laterals.

Figure 9 shows a detail of the valve box incorporating a supply and return manifold on the same end of the zone. For systems with the supply and return manifold on each end of the zone, the valve box would contain only the solenoid or check valve. A low watt heater is placed in each insulated valve box to maintain temperature above freezing.

Some considerations for cold weather drip: The following suggestions if incorporated into the design, installation and management of the drip system should minimize freezing problems.

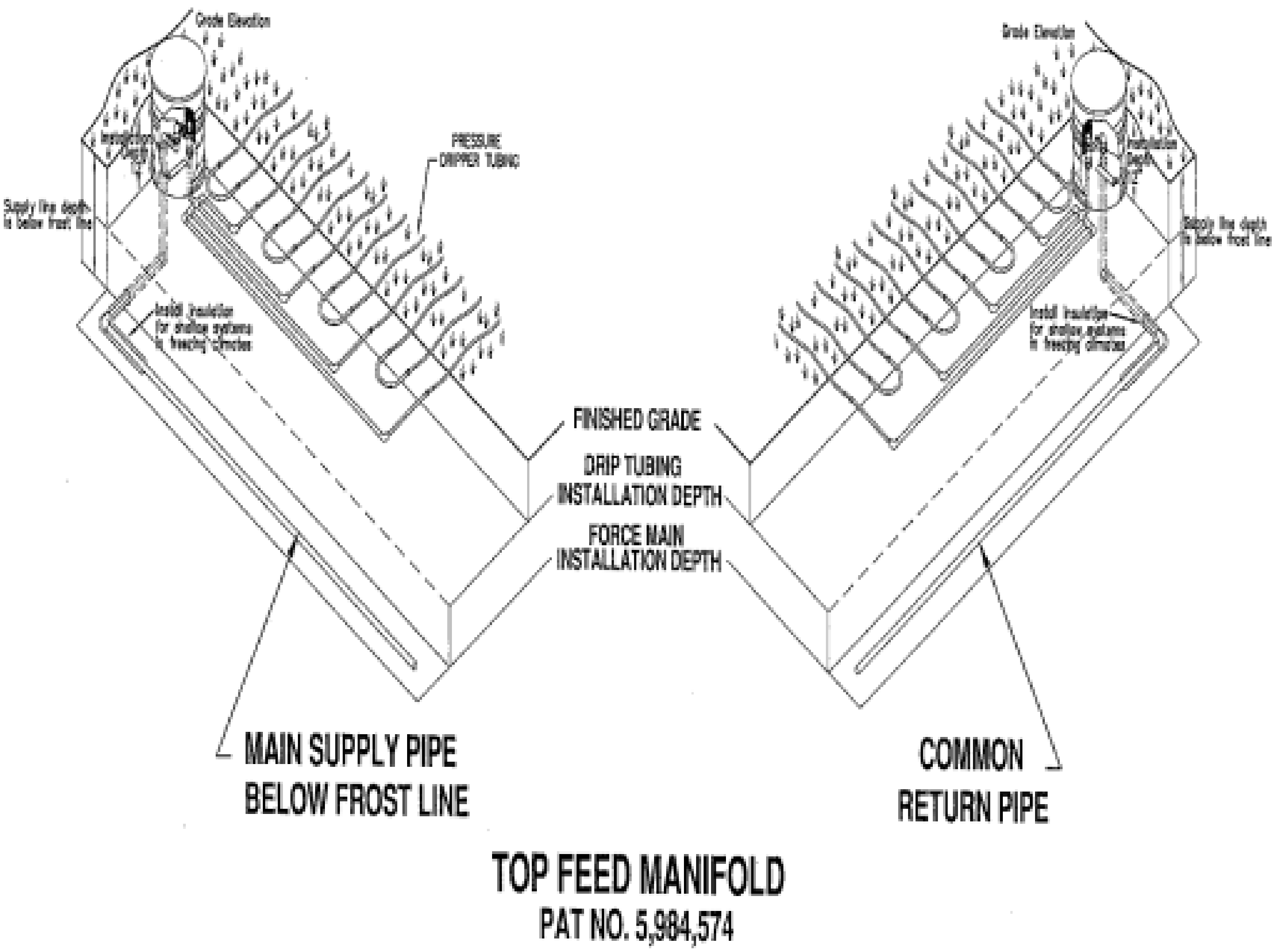

Fig. 8. Drip distribution unit with supply and return manifold remains full after each dose. Top down manifold is used on sloping sites. (American Manufacturing Inc., 2003).

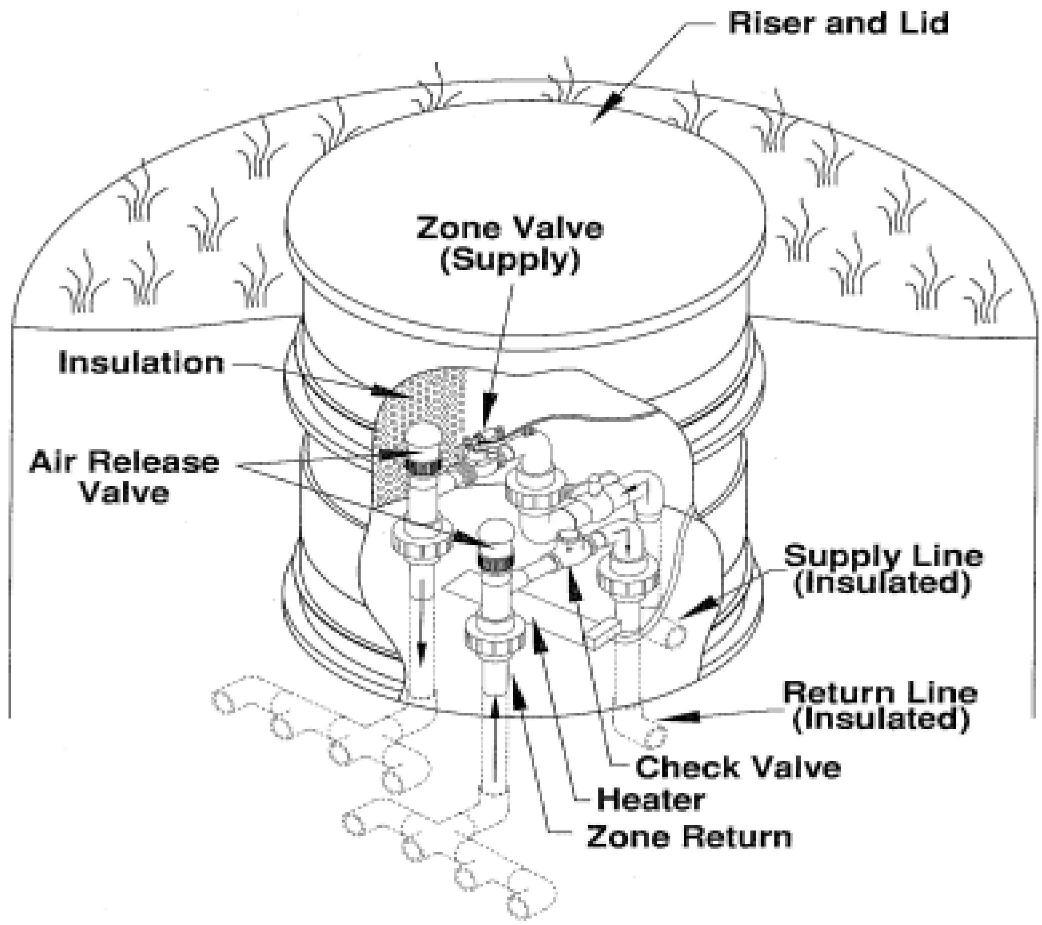

Fig. 9. Detail of valve box for systems described in Fig. 8 (American Manufacturing, 2003)

- For Fig. 7 type systems make sure all lines drain rapidly after each dose.
    - Insulate the air release valve box well and possibly supply heat.
    - Avoid dips in the supply and return lines that may retain water
- For Fig. 8 type systems make sure lines are buried below frost line.
    - Make sure that sub-supply lines and return lines rise vertically from beneath the valve boxes containing the solenoid/check valves and are insulated and have a heater.
    - Provide heat in the insulated valve boxes, as there is standing water in the vertical supply and return lines.
- Insulate the septic tank and pump chamber including risers on smaller systems.
- Insulate and heat hydraulic and headworks boxes.
- All loops need to be raised slightly during construction so they drain after each dose.
- Reduce the number of zones used in the winter, especially if flows are lower.

- Increase dosing frequency by shortening the off time between doses and reducing number of zones dosed but don't overload soils.

- Provide some insulating cover over drip field such as allowing the vegetation to grow which will trap snow. In woods, let the grass and brush grow. In lawns, let the grass grow after August. Owner may want to consider mulching the drip dispersal field if there is little or no vegetative cover.

- Consider installing the drip lines at 12-14" instead of 6 –8" but best to have shallow drip lines for nutrient removal etc.

- Eliminate all traffic, including foot traffic, over the onsite system particularly if there is snow on the ground.

- Install heater in pump chamber if it is extremely cold.

- Free standing water in pipes unless protected from freezing this increases the potential for freeze up of system.

These and other common sense practices should allow the drip distribution system to function satisfactorily throughout most winters. All onsite systems should be designed to minimize freezing. As stated earlier, it is the consensus of those interviewed that for the most part it was not the drip field that caused the problem but some of the other components to the on-site system.

Wet soils:
Will drip distribution work on sites that are saturated or have heavy annual rains? A basic premise must be followed**: the wastewater must go somewhere**. One needs to keep this premise in mind when designing on-site systems. For soil based systems if the soil is saturated or very wet around the drip lines where will the wastewater go? It will probably breakout on the ground surface.

Field experiences have shown that the drip lines serve as great conduits of conveying ground water back to the pump chamber where the soils become temporarily saturated after a heavy rain especially in slowly permeable soils. Soil water, under saturated conditions along with wastewater, can be carried from the upslope portion of the zone to the down slope portion of the zone thus over loading the lower portion of the zone. Drip distribution systems can be designed to eliminate these situations from occurring. Each manufacturer should have developed techniques for doing so. If this condition exists in a cold weather situation, do not comprise cold weather design concepts to solve this problem but find a design solution that will take care of both conditions. Most codes require a separation distance from the drip line to the seasonal saturation.

Overcoming wet weather conditions: The following are some considerations that should be incorporated to over come wet soil conditions.

- Provide required separation distance, consider utilizing a modified mound by adding sand to the soil to elevate the drip lines above the more slowly permeable soil. This can be done by tilling the surface, placing the proper depth of sand, placing the drip tubing on the sand, covering with sand and covering with soil. Consider installing the drip lines closer together but provide enough basal area for infiltration to the native soil. Works well for single family residences but may be quite costly or impractical for larger systems.

- If proper separation distance is available with shallow burial of drip line in the original soil and the soil becomes temporarily saturated due to heavy rains, design the system with top down manifolds which will isolate the laterals and avoid flow back to the pump chamber and also eliminate drain down within the zone (Fig. 4 and 8). The system in Fig. 5 can be designed with top down manifolds (Fig. 4) if freezing conditions are of concern with the supply and return lines draining. If freezing is not a consideration, check valves can be installed in the supply and return lines to keep effluent and soil water from entering the pump chamber. Check valves along with sub-manifolds can be used to minimize drain down within the zone.

Summary:

Drip distribution in cold weather and wet weather conditions is a viable and reliable method of distributing of septic tank effluent and aerobically treated effluent to the soil for both small and large systems. Proper design, installation and management must be incorporated for cold weather and wet weather drip systems to function properly.

References:

American Manufacturing Inc. 2003. P.O. Box 549. Manassas, VA. 800-345-3132. www.americanonsite.com

Andress, M. and T. Cosgrove. 2003. Power point presentation. ProDoC, Inc., Kimberton, PA meghan_predoc@nni.com.

Bohrer, R.M. and J.C. Converse. 2001. Soil treatment performance and cold weather operation of drip distribution systems. In: On-site Wastewater Treatment. Proceedings of the Ninth National Symposium on Individual and Small Community Sewage Systems. ASAE. 2950 Niles Road, St. Joseph, MI. www.asae.org. Publication also available at www.wisc.edu/sswmp publication no. 10.24.

Geoflow Inc. 2000. Design and installation manual for small systems. Subsurface Drip Onsite Wastewater Reuse and Disposal. (800-828-3388). Web: http://www.geoflow.com.

Mokma, D.L., T.L. Loudon and P. Miller. 2001. Rational for shallow trenches in soil treatment systems. In: On-site Wastewater Treatment. Proceedings of the Ninth National Symposium on Individual and Small Community Sewage Systems. ASAE. 2950 Niles Road, St. Joseph, MI. www.asae.org.

McCarthy, B.J. 2003. Natural Resources Research Institute, University of Minnesota, Duluth. bmcarth@nrri.umn.edu

Wallace, S.D., 2001. Design and performance of drip dispersal systems in freezing environments. In: Proceedings of the 0th Annual Conference and Exhibit. NOWRA. P.O. box 1270, Edgewater, MD 21037. www.nowra.org

Washington State Department of Health. 2002. Subsurface drip systems. Interim Recommended Standards and Guidance for Performance, Application, Design and Operation and Maintenance. www.doh.wa.gov/ehp/ts/waste.htm.