SEWAGE TREATMENT SYSTEM INSTALLATION MANUAL

HIGHLAND COUNTY GENERAL HEALTH DISTRICT

2015 EDITION

Table of Contents

1. Introduction

This document contains information on the design, installation and maintenance of individual sewage treatment systems. It is meant to be a reference guide for all persons installing a sewage treatment system within Highland County. This manual was developed out of the need to establish standards of good construction practices for both conventional and alternative onsite systems.

All persons installing sewage treatment systems within Highland County must utilize the methods and practices offered in this manual. Following these standards should assure that installations result in competitively priced, quality systems. Alternative methods presented to achieve the objectives of this manual will be considered on a case by case basis. Any alternative method must be discussed and approved **prior** to installation of the system.

It is anticipated that this document will be periodically revised as better practices and technologies become available. This manual is not intended to replace the *Sewage Treatment System Rules* as adopted on January 1, 2015. The manual is expected to supplement existing regulation to eliminate any *vagueness* of the rules. The standards specified in this document will not reduce any onsite system options as granted by the *Sewage Treatment System Rules* or special device approvals from the *Ohio Department of Health*.

2. Site Preparation

Preparing a site for an onsite system installation may be a simple task or may be an extensive multiple step process depending on the site conditions as well as the type of system being installed. Having an accurate assessment of all work needing to be performed onsite is critical for proper job planning as well as quoting realistic installation costs. Every site produces its own challenges such as topography, over growth, and limited area. Therefore, an observation of the site should accompany the review of the approved design. When planning the job, the following should be considered:

- Confirm system design was approved and an installation permit has been issued
- Utilities should be marked prior to excavation
- Scheduling deliveries of materials and equipment
- Storage of materials on site (topsoil, sand, gravel, etc.)
- Weather conditions

<u>**2.1 Determining System Location:**</u>
During the site evaluation, areas for both the primary system and the replacement will be marked by flags onsite. Typically, these areas will be labeled as area ***A*** and area ***B***. The design should specify which area was selected for the initial installation. Care must be taken in preserving ***both*** areas from soil disturbance or compaction. Plans should be made to select an appropriate path to transport materials around these areas. All traffic

should be avoided down slope of the designated areas whenever possible. If the exact location of the proposed system is in doubt or if flags have been removed, contact our office immediately. Our sanitarians will be able to assist in re-marking the location for you.

2.2 Clearing the Site:

Clearing the site refers to the removal of vegetation such as trees, crops, brush, and high weeds, from the proposed soil absorption area. This process should not include movement of soils onsite. Any equipment used for site clearing should be light weight to prevent compaction at the site. Procedures are different between subsurface and mounded structures. For this purpose, all shallow trenches and at-grade systems with soil caps are considered a mounded structure.

Tree Removal:

- Trees are to be removed by cutting at ground level and leaving the stump.
- All trees shall be removed from the soil absorption area when installing mounded or shallow systems with soil caps.

Figure 1. Tree stump properly cut at ground level.

- When soil caps are not installed, it is recommended to remove all trees less than 6 inches in diameter.
- All fast growing, water loving (soft bark) trees should also be removed due to potential damage caused to the system. Hardwoods generally do not cause problems for systems.

Surface Preparation

- All vegetation such as crops, bush, or weeds shall be cleared by mowing with a bush hog or other similar equipment. Should be cut short enough to allow marks to be visible for system layout.

Figure 2. Area being cleared of high weeds with a bush hog in preparation for system installation.

- Excessive debris such as leaves and branches shall also be removed.

- When a mounded or shallow system with soil caps (mounded structures) are installed, vegetation must be cut as close to the ground as possible. Use a finish mower on a low setting.
- For any mounded structures, all loose cuttings must be raked or blown from the area.

2.3 Marking the System Layout:

Once the site has been cleared and the surface prepared, the layout of the system should be marked onsite. These marks will guide all excavation activities. Marking the layout will determine the contour of the site, the location of the components to be installed, and any spatial problems with the design before any excavation is preformed.

Items Needed:

- A transit or Total Station
- Marking paint, stakes, or flags
- A measuring device
- The approved system design

Figure 3. Items needed for system layout.

Step 1: Locate the building sewer line or planned location of the building sewer. This will determine the proper location and elevation of the septic tank. Plan path of sewer line with as few turns as possible - no 90° elbows.

Step 2: Determine the appropriate location of the tank or tanks. The tank location must meet all separation distances, and be accessible for installation and maintenance. Designs from the Highland County Health Department will display the suggested location of the tank. The elevation of the tank will be based on setting the proper slope of the building sewer line to the tank. Under no circumstance should the tank exceed 24 inches in depth. The location and elevation of a dosing tank is critical with pressure distribution systems. These systems will require locating a benchmark on the design to determine proper elevation.

Step 3: Locate area indicated for soil absorption system installation on the approved design. Flags may already be onsite indicating this location. If flags are not onsite or exact location is not known, contact our department before proceeding.

Step 4: Layout the soil absorption system.

For Leaching Trenches and Drip Tubing:

- Establish location of trenches along the contour. Check for proper spacing.

- Place markers indicating contour approximately every 15 feet for each trench.
- Layout the distribution system.

Figure 4. Contour is being marked with grade stakes within the distribution area.

For Mounded Systems:

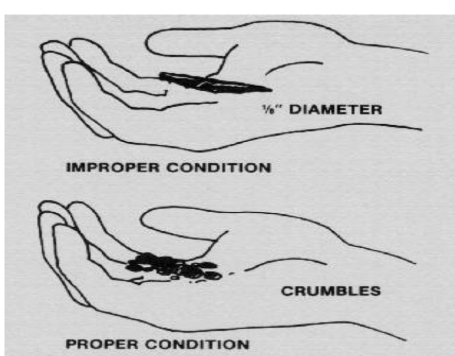
- Establish a level line following the contour of the area using the benchmark elevation as a guide and place stakes approximately every 15 feet. This will mark the center line of the mound.
- Using the center line as a guide, outline and stake the distribution area, basal area, and overall footprint of the mound. Contour stakes can then be removed.
- Mark stakes outlining the distribution area indicating the desired depth of sand. Stakes may be placed after chisel plowing is completed.

Step 5: Plan path for diversion ditches, subsurface drains, or discharge pipes if applicable. Make sure path avoids replacement areas, owners building plans, and terminates at the appropriate discharge location.

2.4 Wet Weather Installations:

One of the reasons for premature failure of sewage treatment systems that rely on soil absorption is construction of the system during poor weather or saturated soil conditions. Absorption of sewage effluent by the soil requires that the soil pores remain open at the infiltrative surface. These pores can be sealed /smeared during construction when the soil is above its plastic limit. Wet or damp conditions at the site can also lead to excessive compaction of the soil effectively reducing its permeability. Basal area preparation and leaching trench installation are extremely sensitive to these effects during damp conditions. In effort to prevent these effects, the following construction techniques are to be followed during wet weather conditions. These procedures are only a guide and following them does not guarantee smearing will not occur.

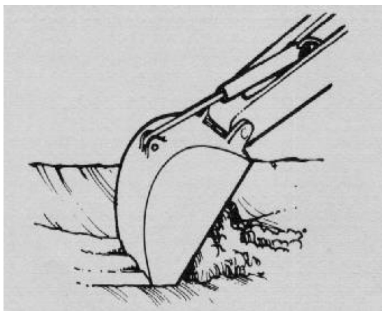
- No system excavation should occur when the soil's moisture content is above its plastic limit at the infiltrative surface. For mounded systems, the soil must not form a wire in the upper 12 inches to begin chisel plowing.



A simple field technique is attempting to roll a small amount of soil into a thread or wire. If soil fragments, taken from between the surface of the ground and the depth of the proposed infiltrative surface (trench bottom) can easily be rolled into a wire, then the soil is above its plastic limit and excavation should **not** occur. If the soil is dry, the soil will fall apart before a wire can be formed.

Figure 5. Illustration of recommend field technique to determine soil moisture content.

- To prevent unnecessary compaction, equipment traffic over absorption areas should always be minimized but must be avoided entirely if soil is above the plastic limit in the upper 12 inches.
- The bottom and sidewall areas of leaching trenches must be left with a rough open surface. Any smeared or compacted surfaces should be removed. This may require hand spading, raking, or scarifying to expose a new infiltrative surface. Remove any debris from trenches. **Trenches with smeared surfaces will not receive approval.** Please note that trenches may also smear during dry conditions. This usually occurs when clay content in soil exceeds 35%. Always be prepared to restore surfaces when necessary.



Tip: Another method to reduce smearing of trenches is to dig with bucket perpendicular to trench bottom.

Figure 6. Illustrates recommended excavation technique.

- Wind blown silt and rain can impact on unprotected infiltrative surfaces and lead to soil clogging. Accordingly, avoid the occurrence of long time periods between excavation and placement of aggregate. If rain does occur after excavation, do not complete the installation until the soil has dried out and can be scarified.
- Rain can allow silt to be washed into gravel and straw covered trenches. Arrange for inspection of the system as soon as the system is complete and backfill as soon as approval is granted.

Planning the installation should include contingencies for wet weather. Some recommended activities that an installer can perform to reduce problems caused by wet weather include but are not limited to:

- Placing tarps over the soil absorption area.
- Placing tarps over soil stockpiles. Soil must be dry (below its plastic limit) when placed over system. Stockpiles should shed water.
- Sand aggregate be available on site for immediate placement over basal area after Health Department approval.
- Install trenches one at a time. Place gravel and straw before excavating next trench. This limits the number of exposed trenches to the weather.
- Check weather forecast regularly. Limit weather sensitive activities during predicted rain events.
- Contact our office immediately to reschedule for an early inspection if weather begins to change.
- If it begins to rain, **stop all excavation activities**. All efforts should focus on getting inspection and covering completed portions of the system.

3. Aggregates and Soil Cover

Aggregates refer to all granular material needed to construct a sewage treatment system. This section provides guidance on selection of proper materials given system type. Always refer to Ohio Department of Health special device approvals for detailed specifications.

3.1 Gravel:

All gravel shall be washed according to ASTM C117. Four grades of gravel are typically approved for use in Highland County. They are as follows:

1. Washed ODOT# 57 crushed limestone (angular) – *For gravity fed applications only.*
2. Washed ODOT# 57 natural stone (rounded) – *For gravity fed or pressure distribution applications.*
3. Washed ODOT# 7 or #8 natural stone (rounded) - *For pressure distribution applications over sand beds or curtain drains.* ***Not*** *for use in leaching trenches.*
4. ODOT # 8 or finer (unwashed) – *For bedding purposes and pipe support only.*

Pictures showing washed ODOT #57 natural stone (top left) and washed #57 Crushed limestone (top right). Washed #8 is shown on bottom right and unwashed fines *for bedding purposes only* on the bottom left

Gravity fed/ flow applications include leaching trenches not Low Pressure Pipe (LPP's), and curtain or interceptor drains. Pressure distribution applications include mounds, LPP's, and sand filters (gravity fed sand filters are not permitted). Other grades of gravel may occasionally be approved for use for specific purposes. Consult our office for further guidance.

3.2 Sand:

Sand fill is needed in the construction of mound systems and sand filter systems. Its purpose is to provide a media in which biological treatment and dispersal of effluent can occur. Sand can be natural or manufactured by crushing larger aggregate.

Typically both are approved for use provided they meet the proper gradation requirements. All sand shall be washed according to ASTM C117.

The cleanliness and size of the sand is critical to ensure proper function as a filter. The sand particles must be fairly uniform in size to provide very small gaps (air space) to allow effluent to pass through under aerobic conditions. "Dirty sand" or sand not uniform in size will result in anaerobic conditions and a clogging of the filter. Dirty sand can also be compacted during construction leading to system failure. Only order sand that meets the following gradation requirements:

For Mounds:

Example of Clean Sand (Clermont County 08)

Sieve Size	% Passing
3/8	100
#4	95/100
#8	80/100
#16	45/85
#30	15/60
#50	3/10
#100	0/2
#200	0/1

- Concrete sand meeting ASTM C33 with an **effective size near 0.30mm** and a **uniformity coefficient between 1 and 4** is acceptable.
- Must have **less than 5%** passing #200 sieve.
- Must be clean enough to pass a field jar test.

For Sand Filters:
- Must be natural sand-not manufactured.
- If filter is buried (see ODH approval for time dosed sand filters), sand must have an **effective size between 0.5mm and 1.0m**m and a **uniformity coefficient between 1 and 4.**
- If filter is covered (see ODH approval for time dosed sand filters), sand must have an **effective size between 0.30mm and 1.0mm** and a **uniformity coefficient between 1 and 4.**
- Must have less than 5% passing the # 200 sieve.
- Must pass field jar test.

All aggregate delivery tickets should be retained for your records and should be available on site at time of inspection.

Field Test for Sand Cleanliness (Jar Test)

Testing sand "in the field" is necessary to ensure sand delivered to the site is clean enough for use as treatment media in the system. It is strongly recommended to perform this test upon delivery of the material onsite. This test will be repeated during initial inspection of the system.

Items needed for this test include:
- A clear quart jar with lid (mason jar works well)
- A ruler or tape measure (to 1/16 of an inch)
- A watch (to determine when 30 minutes has passed).

The following procedure is suggested:

1. Fill a quart jar half full of the sand to be tested.
2. Add clean water to within one inch to the top of the jar and secure lid.
3. Shake the jar vigorously to mix contents.
4. Allow contents to settle for **30 minutes**.
5. Measure depth of accumulated layer on top of sand. A visible layer of fines **greater than 1/8 inch** confirms sand is not clean enough and sand should be rejected or used for another purpose such as bedding or pipe support.

3.3 Soil Cover:

Soil caps must be installed over all sand mounds, at-grade systems, and shallow leaching trenches less than 14 inches in depth or any other trenches in which the gravel is less than 6 inches from the ground surface. All exposed gravel must have a geotextile fabric or straw covering in place before placing soil.

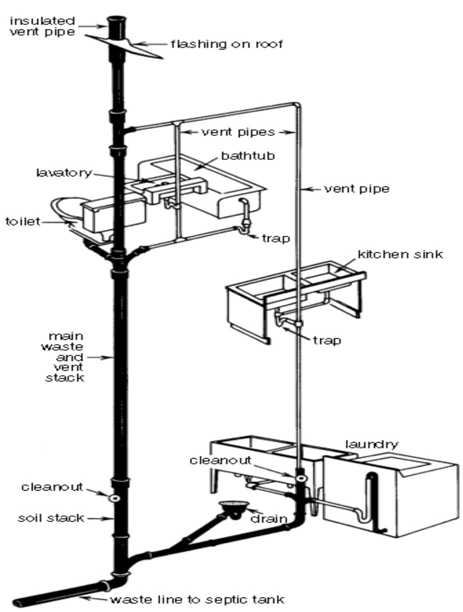
Specifications:

- Depth of soil cap must be sufficient to provide at least 6 inches of soil cover over gravel after settling (expect 1to 2 inches to settle).
- Soil cover shall be good quality top soil from site or hauled in. *Hint: You should harvest or stockpile soil onsite before beginning system installation.*
- Recommended procedures to harvest soils onsite are as follows:
    1. Select area to gather soil. Use only naturally formed soil (no fill). Discuss with homeowner possible areas to be used.
    2. If area has grass cover, mow at lowest setting.
    3. Till area to a depth of 6 inches to break up existing sod.
    4. Remove top 6 inches of soil from area and pile up onsite.
    5. Place tarps over pile to keep dry from rain. *Not necessary if harvesting soil same day as installation.*
    6. **Soil must be harvested under dry conditions.**
- Soil cover shall be of sufficient quality to allow for growth of vegetation and oxygen transfer.
- Soil must be free of clods (sod), roots, and rocks. Clods larger than approximately 2 inches should be broken up. If sod is tilled into the soil, it may be necessary to add 1 or 2 of additional soil due to increased potential to settle.

- Soil cover should be evenly spread to cover entire area over trenches so that no depressions are formed. Edges should taper nicely to original grade.
- Care must be taken when placing soil around risers to prevent damage. Risers must extend above finish grade. Grade should slope away from risers.

- Once finish grade is established, area should be seeded and have straw covering to establish a vegetative cover and to prevent erosion.

4. House Plumbing and Building Sewer



The house plumbing includes wastes pipes for grey and black water, water traps, and vent pipes. In general, the house plumbing is not regulated and therefore not inspected by the Highland County Health Department. An exception to this may include an upgrade of an old or non existent system serving an older home. A minor inspection of the house plumbing may be requested to ensure all plumbing is connected to the building sewer. It has been our experience to find most older homes discharge some or all grey water separately from toilet plumbing. It is required that all wastewater generated from a building discharges into the building sewer. Ironically, another exception would be when a buildings plumbing intentionally separates grey water drains from toilet drains by design of the sewage treatment system. Systems that require this separation are known as *grey water systems.* In this case, an inspection must be performed to ensure that a complete separation of the plumbing has been maintained and the proper fixtures in the home are connected to the system. An inspection of indoor plumbing would also be necessary when installing grease traps for a commercial restaurant or food prep facility, which is typically performed by the commercial plumbing inspector.

Most systems are designed prior to building the house or at least prior to installing the plumbing. There fore, plumbing installed after the design may not allow for proper installation of the building sewer without a modification of the system design. If you find that the location of the building sewer conflicts with the system design, contact our office to determine possible solutions. Remember, if plumbing is installed too low, simply moving the system to a lower area or installing leaching trenches deeper than designed may not be an option. The only remedy may be the installation of a pump. Always consult with our office regarding any changes prior to installing the system.

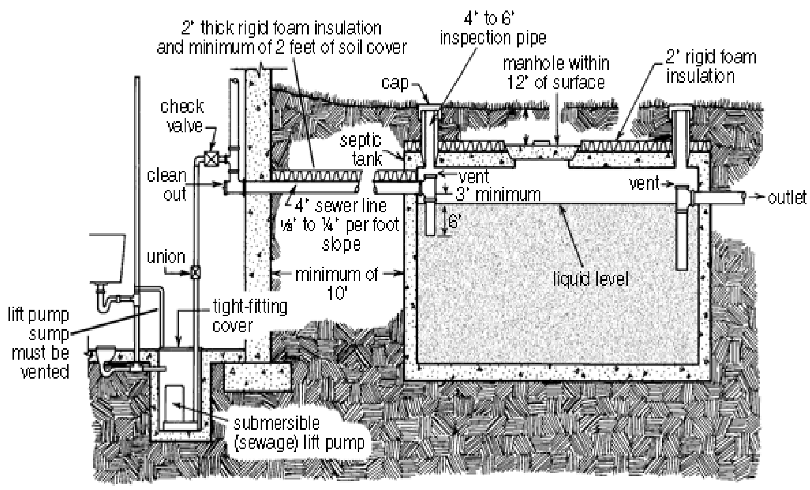


Figure 8. Shows interior grinder pump installation.

When the use of a pump is anticipated prior to construction, a grinder pump may be installed as a component of the buildings plumbing. This installation is common when all plumbing can be gravity fed except for basement plumbing. This component does not require inspection from our department.

Grinder pumps may be installed at an exterior location but only when it is not possible to gravity feed the building sewer to the septic tank. This type of installation is rare and typically used to correct error in building sewer elevation. Because of the need for the pump chamber to be installed deep, only products specifically designed for this application should be used. All products must be installed according to the manufacturer's instructions. This component would be inspected by our department.

Specifications for Installation:

- Building sewer must be constructed of 4 inch diameter schedule 40 PVC pipe from the foundation out.
- A cleanout extending to grade to be installed within 5 feet of building foundation (*if not provided inside*) and every 75 feet as necessary between building and tank.
- *Note: If a deck or patio is planned over location of building sewer, the cleanout may be installed at the edge of the structure to ensure access.*
- Pipe connections must be glued to prevent leakage and root intrusion.

- Pipe must be properly embedded on trench bottom while maintaining a constant slope between a minimum 1% (*1/8 inch per foot or 1 ¼ inches every 10 feet*) and a maximum 9%(*1 inch per foot or 10 inches every 10 feet*) – recommend slope approx. 2%(*1/4 inch per foot or 2 ½ inches every 10 feet*). A layer of sand or pea gravel may be placed on trench bottom to properly support and establish slope of pipe. *Recommended.*
- When a constant slope exceeding 10% cannot be prevented between building sewer at the foundation and the inlet of the tank, a different tank location should be considered.
- No 90° elbows to be installed in building sewer. If a 90° turn is necessary, use two long sweep 45° elbows. It is recommended to separate the elbows with at least one foot of pipe.
- Sewer pipe must not enter any tank at an angle. Plan tank location to allow for good alignment with building sewer.
- Pipes crossing a drive way or vehicle path must be cased with a minimum 6 inch diameter pipe with at least schedule 40 rating. Casing should extend past each side of the driveway. When trench containing building sewer is less than 18 inches deep under drive, a stronger casing should be considered. Trench under drive way should not be less than 12 inches deep under any circumstances.
- Sewer pipe must be cased when crossing an existing water line. Casing should be minimum 6 inches in diameter and extend at least 10 feet on each side of water line. Connections in casing must be glued.
- Pipes must be installed completely under finish grade.
- Under no circumstances shall footing drains or other clear water drain be connected to the building sewer.

5. Tanks

There is a wide variety of tanks available and approved for use in sewage treatment systems in the state of Ohio. They may function as septic tanks, pretreatment devices, holding tanks, pumping/dosing tanks, and grease traps. They are typically manufactured from materials such as precast concrete, plastic, or fiberglass. Although each type is similar, each does require specific installation procedures. This section offers general guidance on tank installation and does not take the place of manufacturers installation procedures. Always follow the manufacturers recommended installation instructions.

Tank Excavation:

- Depth and dimensions based on tank size and manufacturer requirements.
- A level and firm base free of debris (stones or roots) must be provided.

Tank Bedding:

Bedding refers to the material placed at the bottom of the excavation prior to installing the tank. Depth and type of bedding is based on soil conditions and type of tank installed. Typical bedding requirements are as follows:

Type of Soil at Bottom of Excavation	Type of Tank	
	Precast Concrete	Fiberglass or Plastic
Firm Stable Soil	None necessary. Place directly on bottom of excavation.	Place 4 to 6 inches of compacted sand or pea gravel. Always follow manufacturer's specifications.
Bedrock or Rocky Structure	Place sand or pea gravel 4 to 6 inches above bedrock and compact.	Place sand or pea gravel 4 to 6 inches above bedrock and compact. Always follow manufacturer's specifications.
Unstable Soil (Soft or Saturated)	Over excavate to firm soil if possible and place a compacted base of # 57 gravel 6 to 12 inches deep.	Over excavate to firm soil if possible and place a compacted base of # 57 gravel 6 to 12 inches deep. Then place a 4 to 6 inch layer of compacted sand or pea gravel. Always follow manufacturer's specifications.

Table 1. Typical bedding requirements are for general planning only. Always refer to manufacturer instructions.

Backfilling Concrete Tanks:

- Soil may be used to backfill precast concrete tanks.
- Soil should be placed and compacted in lifts (approximately every 2 feet) to minimize settling.
- To further minimize settling, you may back fill the tank with sand, pea gravel, or #57 to the inverts of pipe connections – *Recommended.*

- Tank typically does not need water added during back fill procedure.

Backfilling Plastic and Fiberglass Tanks:
- Tanks are backfilled in multiple steps with pea gravel.
- Water added to tank to a depth specified by the manufacturer (typically 16 inches).
- Then pea gravel is placed to water level in tank. Back fill must flow under the haunches of the tank. Rodding backfill is necessary to remove all voids between tank and backfill material.
- Each layer must be compacted before placing the next. A plate compactor or "jumping jack" should be used to ensure proper compaction. Procedure is repeated until reaching mid-seam of tank. *A watertight test is usually performed at this time.*
- Complete backfill procedure as instructed by manufacturer using proper materials. Backfilling with pea gravel up to inverts of pipe connections is recommended. Have a copy of the manufacturer's installation instructions onsite during installation and inspection. The sanitarian may ask to see them at the time of inspection.

Buoyancy Countermeasures:
Always backfill tank immediately after inspection to ensure tank is protected from floatation. Seeping ground water or water accumulation from a rain event can cause a tank to become buoyant. If ground water is present, steps may need to be taken to ensure the tank does not float after backfilling is completed. This is especially true for dosing and holding tanks when water levels in tank are low during normal operation. Countermeasures may include:
- Anchoring tank with straps.
- Pouring a concrete collar around the tank.
- Installing tank at a deeper depth to obtain proper soil cover.
- Filling tank with water.

Always use an approved method by the manufacturer.

Watertight Testing:
The Highland County Health Department currently does not require a watertight test. However, some tank manufacturers require this to be performed to validate the warranty. If you wish to have this test performed, follow the manufacturer's instructions and contact our office to schedule the inspection.

Abandoning Existing Tanks:
It is typically not necessary or practical to remove the tank from the site. A tank can be abandoned properly by following a few simple steps. At this time, no permit is required to abandon existing tanks but an inspection is required. A completed pumping report and a STS abandonment report must be submitted during the inspection or submitted to the board of health within 30 days of abandonment. They are as follows:

Step 1: Locate and uncover all tank access lids. Contact a registered septage hauler to pump out contents of tank.

Step 2: Remove all pipe connections from tank and temporarily cap the building sewer to prevent spills. Remind homeowner not to run water during process.

Step 3: Remove soil cover to expose entire tank. Remove or crush in the top of the tank. Also remove or fracture at least one side to the bottom of the tank. This will prevent the tank from collecting water.

Step 4: Fill to top of tank with pea gravel or #57. Make sure aggregate flows around all debris and all voids are filled.

Step 5: Have abandoned tank inspected by our department prior to covering. Submit pumping and abandonment reports to the inspector.

Step 6: After inspection is complete proceed to cover tank with topsoil. Soil should be placed to provide a minimum depth of 6 inches after settling.

5.1 Septic Tanks:

Minimum septic tank size will be based on GPD flows as follows:

System Designed Flow (GPD)	Number of Bedrooms (If Applicable)	Minimum Tank Capacity (In Gallons)
Up to 240	1 to 2	1000
241 to 360	3	1500
361 to 600	4 to 5	2000
601 to 720	6	2500
721 to 840	7	2750
841 to 1000	8 to 9	3000

*Tanks can be installed in series to meet minimum capacity requirement.

Specifications for Installation:

- Tank(s) must meet or exceed minimum capacity requirement.
- Tank must have two compartments when installing only one tank.

- When installing two tanks in series, the first tank must be larger than or equal to the second tank. All sewage must enter the first tank. Tanks may be one compartment.
- Tank must be provided with an inlet and outlet baffle. Baffles must be centered under access lids or risers to ensure adequate access for maintenance and inspection.
- If building sewer is not installed at time of system, an inlet pipe must be installed on inlet connection and extend beyond the tank excavation to rest on undisturbed soil. End of pipe must be fitted with a cap to prevent intrusion of water and debris and have proper slope to tank.
- Watertight risers are to be installed over the inlet and outlet baffles and extend above finish grade.
- An effluent filter must be installed in the outlet tee baffle. Filter should be rated for the GPD flow and use of the system (residential or commercial).
- Tank must be set level and according to manufacturer's specifications.
- Location and depth of tank must be based on achieving proper slope for the building sewer.
- Top of tank must be set between 6 inches and 24 inches below finish grade unless otherwise approved.
- Tank excavation shall be constructed to manufacturers recommended dimensions (usually between 12 and 24 inches from edge of tank) and have a firm, uniform and level base of undisturbed soil.
- Tanks shall be properly bedded and backfilled.

5.2 Holding Tanks:

Holding tanks provide a means to collect and temporarily store sewage from a facility or dwelling, for subsequent removal and transport to an approved disposal site or treatment facility. Holding tanks are highly restricted to sites with very special and limited applications. Permits for residential installations can only be obtained through our office, and **REQUIRE a Highland County Board of Health Variance and a signed Pumpers Agreement**. All commercial and non residential applications must seek permission from the Ohio Environmental Protection Agency. They are only approved for new construction on a temporary basis. Holding tanks typically require weekly or biweekly pumping and are sized to accommodate weekly (7 day) storage at the design flow, and a reserve storage capacity (above alarm activation) of at least 3 days at the design flow.

Holding Tank Storage Requirements				
Number of Bedrooms	Daily Design Flow (gallons per day)	Operating Capacity (gallons)	Reserve Capacity (gallons) *above alarm setting*	Total Tank Capacity (gallons)
1	120	840	360	1200
2	240	1680	720	2400
3	360	2520	1080	3600
4	480	3360	1440	4800
5	600	4200	1800	6000
6	720	5040	2160	7200
7	840	5880	2520	8400

Tanks can be installed in series to meet holding capacity requirement. Care must be taken when properly setting high water alarm. Holding tanks are by far not a cost effective means of sewage disposal. This is one reason they are limited to repairs with no means of soil absorption and without an option to discharge. Water conservation is critical with this system.

Specifications for Installation:

- Tank must be located (less than 50 feet) near a driveway or parking area that provides easy access to a septage hauler truck.
- Elevation drop between plumbing fixtures in home and top of tank must be minimized to prevent sewage overflows when tank is operated beyond the reserve capacity. Tank will therefore be limited near the dwelling (typically 10 to 20 feet). A drop in the building sewer of more than ¼ inch per foot is prohibited.
- Tank must be properly vented by building sewer or external vent pipe. Vent pipe must extend above building roof line.
- Tank must be provided with at least one cast in place riser extending above grade and be secured with a <u>watertight lid</u> to prevent infiltration of surface water or leaking of sewage. Larger tanks may need more than one riser for proper access for pumping.
- Tank must be fitted with a 4 inch inlet pipe connection. An outlet pipe connection/knockout is prohibited. When using more than one tank, this applies to only the last tank in series.
- A high water alarm is required. A float tree is to be installed in the tank so that the alarm activates when the operating capacity of the tank is exceeded (see chart above).
- Alarm control panel must be mounted in an exterior location on house or on a post beside the tank.
- Speak with the homeowner. Determine upfront who is responsible for supplying a dedicated electrical circuit for the system installation. If home owner wishes to supply the circuit, make sure the breaker has the appropriate amperage required by the manufacturer. All wires must be protected by conduit in exterior, above grade, locations. An acceptable circuit must be available prior to installation.

<u>5.3 Pretreatment Systems:</u>

Pretreatment devices and advanced treatment systems are typically installed similar to septic tanks but have special features and components which may complicate installation. These systems include aerators, peat moss filters, and other fixed media treatment systems. *Some fixed media treatment systems such as sand filters and wetland systems are not packaged in the form of a tank or module and therefore is not the focus of the section.* Like septic tanks, self contained pretreatment systems may also be constructed from concrete, fiberglass, or plastic. Most systems operate with electrical components so a dedicated electrical circuit is required. Due to the vast differences of systems on the market, installation procedures will be unique to the system being installed. Again, always follow the manufacturers' installation instructions.

Things to Consider:

- Speak with the homeowner. Determine upfront who is responsible for supplying a dedicated electrical circuit for the system installation. If home owner wishes to supply the circuit, make sure the breaker has the appropriate amperage required by the manufacturer. All wires must be protected by conduit in exterior locations.

- All control panels must be mounted in an exterior location near the system. This may be on the side of the house or on a treated post installed next to the system.
- Wiring buried below grade does not require conduit if the proper exterior grade wire is used. Wire should be placed in conduit when passing through risers or other similar connections to protect wire from damage.
- These systems must be inspected for proper function before final approval is given and the home occupied. Aeration tanks and dosing tanks may need to be filled with water in order to test system at time of inspection. Water may need to be hauled if a water supply is not available at time of installation. Ask the home owner if a water supply is available.
- Schedule with the service provider the time for final component installation. Preferably, this would be the same day as the system installation. Some distributors for aerators require water in the tank when installing the motor and control panel. Discuss this with the distributor when placing an order.
- These systems require extensive maintenance in order to properly operate. Risers must be installed over all compartments to provide access for all required maintenance including inspections and tank pumping. Rule of Thumb: No component of the system should have to be dug up to perform routine inspections and maintenance.
- If the home is not yet constructed or if an electrical supply is not available at time of system installation, determine from the home owner when it will be available so you can complete the installation. As the installer, it is your responsibility to make all arrangements in order to complete the system. Contact our office for a start up inspection when the installation is complete.

5.4 Dosing Tanks, Basins and Pumps:

Dosing Tanks:

A Dosing tank is a necessary component of a sewage treatment system requiring pressure distribution or transport of effluent to a higher elevation when gravity flows are not an option. The tank contains one or more pumps, controls, etc. and receives effluent from a septic tank or other system component. The pumps deliver a dose to a soil absorption or pretreatment system. These tanks are installed very similar to septic tanks.

Specifications:

- Tank should have only one compartment. Recommended 300-500 gal. minimum.
- Tank must be sized to accommodate:
    1. Volume below maximum drawdown (pump off switch). This is the minimum amount of water required to keep the pump submerged.
    2. Volume of the design dose (between pump-on and pump-off). *For demand dose systems, adjust floats to set volume between 1/8 (13%) and 1/4 (25%) of the daily design flow when dosing a soil absorption system.*
    3. Volume of drain back.
    4. Volume of surge capacity (volume between pump-on and high water alarm activation). Alarm should activate when water level is 2 inches above pump-on setting when demand dosing.

5. Volume of reserve capacity (volume between alarm activation and invert of inlet pipe of tank) must be not less than half of the daily design flow. Recommended to be 100% of daily design flow.
6. Time dosed systems shall accommodate combined reserve and surge capacities of not less than 150% of the daily design flow.

- Tank must have a watertight riser and lid and extend above grade. Riser should be placed over pump assembly.
- Must have a high water alarm installed in an **exterior** location near the dose tank that provides both visual and audible signals. May also install an interior alarm if owner wishes.

Pump Basins:
Basins are typically installed to collect clear water from subsurface drains (curtain drains) or discharging pretreatment systems and pump to surface outlet when gravity flow is not an option. Pump basins may also be used to collect effluent from a time dosed component of a treatment system and pump the effluent to the next component in the system.

Specifications:

- Must have a minimum inside diameter of 18 inches.
- Must provide sufficient volume to submerge the pump, receive dose from the previous component, collect drain back, and provide a reasonable dose *(at least one minute pump run time)* while maintaining a minimum 6 inches of freeboard between inlet pipe invert and pump-on switch.
- Provided with a <u>secured</u> lid.
- Basin <u>must</u> be pre-manufactured and watertight when pumping effluent in a soil absorption system.
- Basin can be pre-manufactured or site built when pumping to discharge.
- When pumping to discharge, basin can be constructed from rigid, plastic corrugated culvert pipe as follows:
    1. Excavate to proper depth to install culvert vertically.
    2. Pour concrete to a depth of 12 inches. Make sure concrete pad extends 6 inches beyond outside diameter of pipe.
    3. While concrete is still wet place end of culvert pipe 6 inches into the concrete. Make sure pipe remains suspended in the concrete and not sink to bottom. Bracing may be required if concrete is not firm enough to support the pipe.
    4. With a hole saw, cut opening in culvert to allow for schedule 40 PVC pipe connections. Pipe should fit tight in connection. May seal minor gaps with tar strips or rubber caulk. Four inch minimum diameter of inlet pipe.
    5. When concrete is firm, place a 6 inch block to rest pump on.
    6. If outlet is placed in basin, it must be at grade or placed at highest possible location. Wire connections shall be properly sealed.
    7. Install lid designed specifically for connection to culvert pipe and secure to basin.
- Inlet pipe must be 4 inch schedule 40 and extend a minimum of 10 feet out of basin before connecting to corrugated pipe and extend minimum of 2 inches into interior of basin. Outlet /discharge pipe should have minimum diameter of 1¼ inches.

Pumps and Floats:

Specifications:

- o Pump must meet flow rate at total dynamic head (vertical lift plus friction losses) as required in the design. *Only necessary with pressure distribution systems.*
- o Pump set on a block a minimum of 6 inches off the tank bottom. *Does not apply to pre-manufactured turbine pump assemblies.*
- o Discharge pipe must have quick disconnect (union) installed and be within 1 foot from top of riser.
- o Minimum size of discharge pipe shall be 1¼ inches.
- o Lift rope secured to pump and tied off.
- o Gate valve installed on discharge pipe downstream of pipe disconnect. *Only necessary with pressure distribution systems.*
- o Weep hole drilled in pump discharge line at a proper elevation to allow complete drainback of all lines not protected from freezing (at least 24 inches below finish grade).
- o Pumps serving pressure distribution systems (mounds, sand filters, LPPs, drip tubing, etc.) must have flow rates verified.
- o Floats should be placed on a float tree secured to riser in only one position (tree should not be able to slide up or down).
- o Floats should be able to move without obstruction.
- o Tether cord lengths should be set as per manufacturers' specifications and as per the system design.
- o When demand dosing, the high water alarm float must be set to activate when water level is 2 inches above the "on" position.

Sample Wells:

Sample wells are installed were access is needed to observe or sample water flow in a sewage treatment system. Typically found following a discharging system or subsurface drainage. They may be pre-manufactured or constructed on site similar to pump basins.

Specifications:

- o Should have a minimum inside diameter of 12 inches. *Unless otherwise approved.*
- o Pipe connections must be 4 inch schedule 40 PVC.
- o Must provide a minimum freeboard of 6 inches between inverts of inlet and outlet pipes.
- o Outlet pipe should be installed at lowest possible location (within 2 inches from bottom) to allow well to drain out.
- o Pipes should extend into well 2 inches.
- o Install at a maximum depth of 4 feet. *Unless otherwise approved.*
- o Well should extend above finish grade and be fitted with a secured lid.

5.5 Grease Traps:

Grease traps, or grease interceptors, are a necessary component of a building sewer when levels of fats, oils, and grease (FOG) in the effluent are expected to be higher than residential levels. Grease traps will be common in small flow onsite sewage treatment systems (SFOSTS) serving food prep facilities. SFOSTS by definition have sewage flows of 1000 gallons per day or less. Wastewater flows at this rate can typically be handed by an indoor or *at source* interceptor. These are devices mounted on the floor or under the three compartment sink and separate FOG from the wastewater before entering the building sewer. At source interceptors would be a good, cost effective option for FOG reduction at deli's, convenient stores, or small restaurants serving less than 50 meals per day. At source interceptors can be either passive (requiring regular manual removal of grease) or automatically controlled by a sensor or timer to skim off grease.

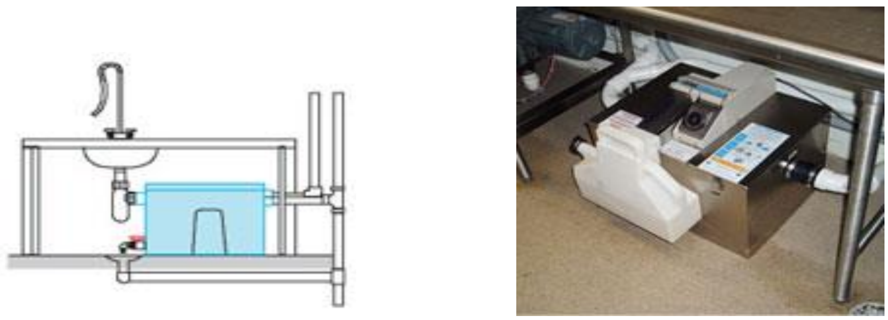
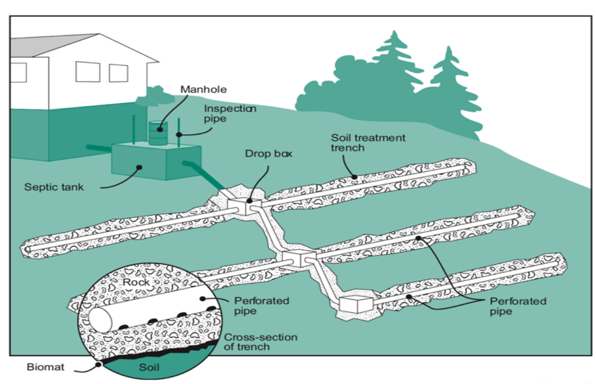


Figure 11. Typical at source grease interceptor. An automated device is shown on the right.

Larger restaurants serving more than 50 meals a day should consider an in ground grease trap. This type of installation will require all drains serving food prep or dishwashing sinks (or dishwashing machines) to be plumbed separately out of the building into the grease trap. There is not a lot of guidance on proper tank sizing for intercepting FOG from restaurants with a wastewater flow under 1000 GPD. Therefore the Highland County General Health District will accept the installation of a 1000 gallon, two compartment tank fitted with entrance an exit baffles and a commercial effluent filter to serve as a grease interceptor. Specify tank is to be used as a grease trap when ordering because baffles may need to be installed differently to provide proper storage of FOG accumulation. This tank must be installed as close to the building as possible (must keep 10 ft separation) to limit amount of unprotected pipe from FOG. Other devices may be approved as products become available. Tanks manufactured specifically for use as a FOG interceptor is recommended. Lids must extend above grade to provide access for monitoring and maintenance.

6. Leaching Trenches (LT)

A leaching trench system is a sub-surface soil absorption sewage system that consists of excavated trenches containing gravel and pipe or an approved gravel-less product for the purpose of distributing sewage effluent from a septic tank or approved pretreatment device into the natural soil for final treatment and disposal. This system can only be utilized in soils with adequate depth to allow for the trench construction while preserving the appropriate separation distance between the infiltrative surface (trench bottom) and the limiting condition.



The required separation distances are stated in rule 3701-29-15 of the *Sewage Treatment System Rules*. The Highland County Health Dept. takes this separation in consideration by assigning a trench depth in the design of all leaching trench systems. Therefore the installation of the trenches along the surface contours is critical to ensure the trenches are excavated level at the designed trench depth.

The size of the absorption system is determined by the minimum daily design flow of each structure the system serves and the soils' infiltrative and hydraulic loading rates. These rates are calculated from information in the soil report submitted by the Soil Scientist and the loading rate tables from rule 3701-29-15. A daily design flow of at least 120 gallons per day per bedroom, or as otherwise justified for daily peak flow variations, is required for all household sewage treatment systems (HSTS). Small flow onsite sewage treatment systems (SFOSTS) shall be sized in accordance with Table A-1 of **Rule 3745-42-05** of *The Ohio Revised Code.* Additional leaching area may be required to allow for resting portions of the absorption system. The amount of additional area required may depend on the type of distribution system used in the design.

6.1 Leaching Trench Specifications:

- Leaching trench (LT) must follow natural surface contours. A variation of plus or minus 3 inches from contour is permitted.
- LT must avoid drainage features and depressions *unless otherwise approved.*

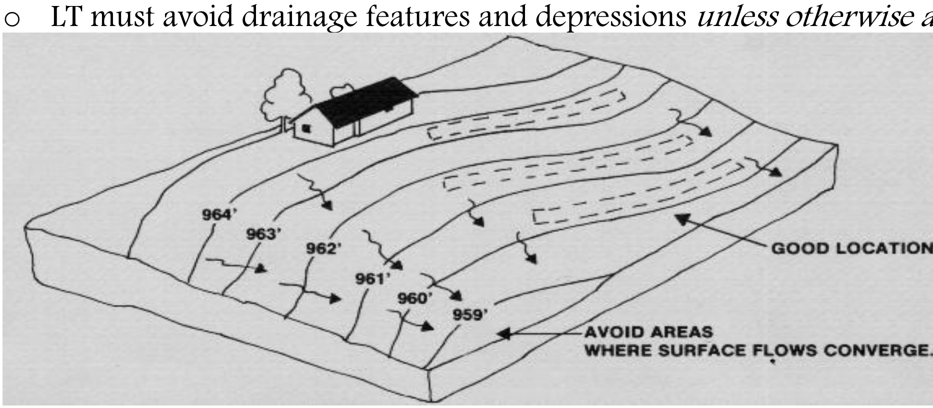


Figure 12. Trenches shown following contour while avoiding depressions.

- Be excavated at the designed depth (measure from the up slope edge of trench).This depth is also the **maximum** depth and must not be exceeded by any portion of the LT excavation.
- LT bottom must be level (beginning and end at same elevation).
- Maximum trench length is 150 feet. Longer trenches as a result of hydraulic linear loading rate (HLLR) calculations are permitted. The manifold must be placed in the center for trenches longer than 150 feet.
- Minimum trench length is the HLLR calculation. *Partial trenches that do not provide the required length along contour are not permitted.*
- LT width may be optional but must be between one and two feet for new construction. Three foot wide trenches are permissible only under extreme space limiting conditions. *Typical designs set width at 12, 18, 24, or some occasions 36 inches.*
- LT shall not be installed on slopes greater than 15% *unless otherwise approved.*

- Construction of an LT must not cause smearing or compaction of the infiltrative surface (applies to trench bottom and side walls).
- Trenches must utilize approved methods and components for distribution.
- Distribution system must include a mechanism(s) extending above finish grade for flow diversion and resting of each trench. (Ex. drop boxes)
- For resting of trenches, a shut off mechanism shall be installed in distribution or drop boxes to allow for segregation of flows to each trench. When using a diversion device to divide two equal split fields, this may not be required for each trench. (Ex. speed levelers or caps)
- A means for determining the liquid level or capacity of each leaching trench shall be provided. This may include one of the following:
    1. A drop box extended above finish grade. This option also allows access for flow diversion. *Recommended.*
    2. An inspection port extending above finish grade. This option does not allow for flow diversion.
        - Must be constructed of 4 inch schedule 40 PVC.
        - Must be properly secured to prevent easy removal.
        - May extend to grade from trench bottom or from a tee installed and properly secured on the LT pipe. Must be constructed in one of three ways:

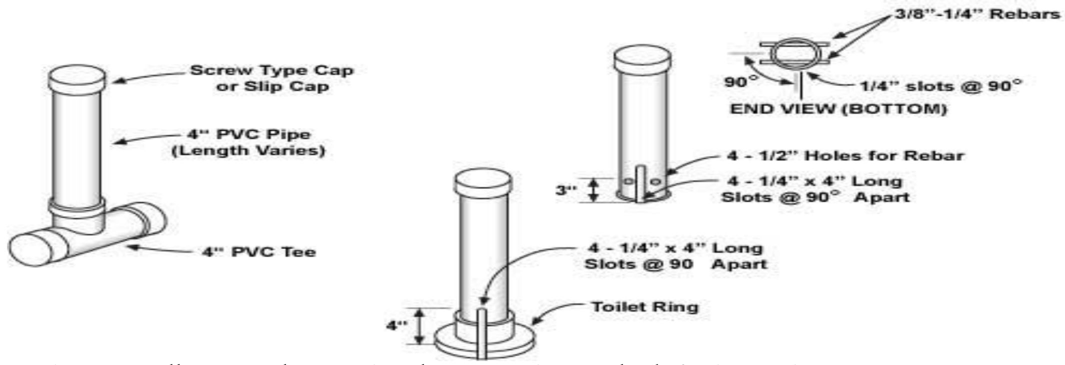


Figure 13. Illustrates three optional construction methods for inspection ports.

*Pipe may terminate below grade in a valve cover that extends to grade, which are commonly seen in mounds, LPP s and drip systems.

Figure 14. Valve cover

Gravel Depth:

Gravel depth may be different between conventional depth and shallow leaching trenches. All trenches require a minimum gravel depth of 8 inches with at least 2 inches of gravel above and 2 inches of gravel below the pipe. Where deeper trenches are permitted, additional gravel may be placed below the pipe. Such trenches may allow a 12 inch gravel depth extending 6 inches below and 2 inches above a 4 inch pipe. Gravel depths may vary in low pressure pipe (LPP) system designs. Typical gravel profile of a LPP trench would be similar to a shallow trench. LLP's should have a gravel depth of 8 inches extending 2 above and 4 to 5 inches below a 1 to 2 inch pipe.

Gravel -less Products:
Gravel-less products must have a minimum height of 8 inches and proper width that fills the designed trench width to within 2 inches. Chambers and bundled polystyrene products are types of currently approved gravel-less products.

6.2 Distribution Options:

Pressure Distribution
The use of a pump to disperse effluent to trenches is an effective method of ensuring even distribution. To accomplish this, effluent must be under pressure the entire length of the distribution area (as in mound systems). Trenches designed with this type of distribution system is known as low pressure pipe (LPP) systems. The Highland County Health Department currently does not design LPP systems. Refer to Rule 3701-29-15.1 Of the Sewage Treatment Rules for specifications.

Gravity Distribution
Effluent can be distributed by gravity to trenches by two methods: parallel and sequential distribution.

1. **Parallel distribution** is defined as pressure or gravity distribution of effluent that proportionally and simultaneously loads multiple sections of a final treatment and dispersal component. By gravity, this type of distribution is mostly limited to flat areas in which all trenches are installed at the same elevation. Parallel distribution can be utilized on mildly sloping sites by the use of a distribution box.

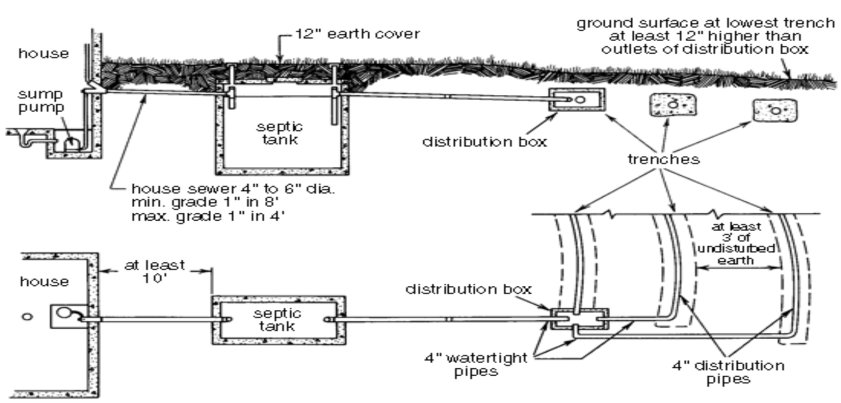


Figure 15. Illustrates use of a distribution box. This is an example of parallel distribution.

2. **Sequential distribution** is defined as a distribution method in which effluent is loaded into one trench and fills it to a predetermined level before passing through a relief line or device to the succeeding trench. The effluent does not pass through the distribution media before it enters succeeding trenches using this method. Drop

boxes or earth dams are placed in the middle of the trenches or at one end of the trenches while the opposite ends of the trenches are capped. Drop boxes are most commonly used by this method. This is the recommended method for sloping sites. This method of distribution promotes anaerobic conditions (saturation) and creeping failure of the absorption system. Therefore, it is necessary to include additional resting area.

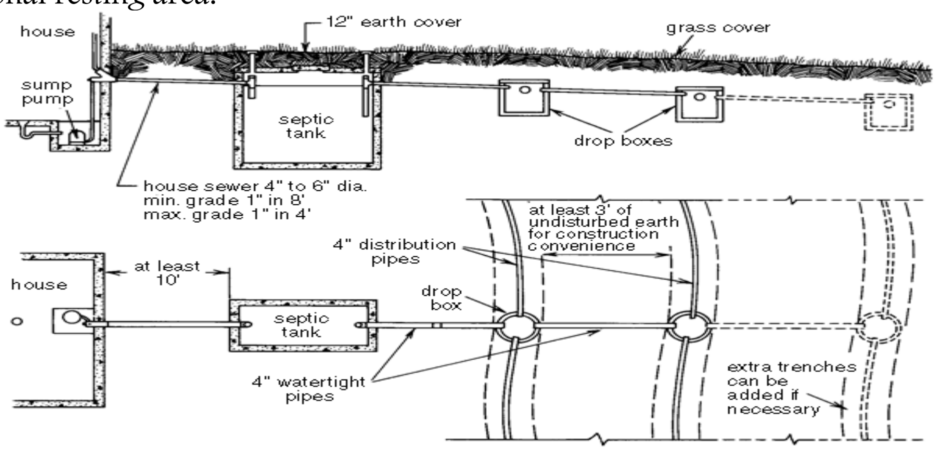


Figure 16. Illustrates the use of drop boxes. This is an example of sequential distribution.

3. **Serial distribution** is defined as a distribution method in which effluent is loaded into one trench and fills it to a predetermined level before passing through a relief line or device to the succeeding trench. Unlike sequential distribution, the effluent is forced to pass through the distribution media before entering succeeding trenches. An example would be earth dams placed on alternating ends of the trenches providing a continuous flow while only the end of the last trench is capped. **This option is no longer permitted.**

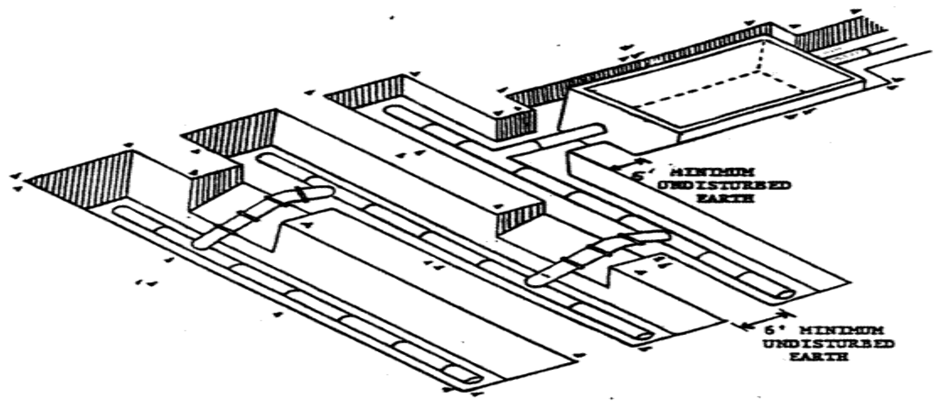


Figure 17. Illustrates the use of earth dams. Serial distribution occurs when dams are installed on alternating ends. Note: Layout as shown does not provide a flow diversion mechanism. This type of distribution is no longer permitted.

Once a distribution method has been selected, it must then be determined what components will be used to construct the distribution system. LT regulations allow for the installation of either two equally divided sections split by a diversion device (a distribution box with only two outlets); or one continuous series of trenches connected to a distribution box (for level areas) or drop boxes (for sloping areas).

The Diversion Device

In the past, a diversion device was installed to equally split the required drain field into two sections- one for use and one for resting. Its installation did not require an increase in the drain field size and as a result, the intended soil loading rate was doubled when only half of the system was used. Modern LT systems are required to be sized to meet the soil loading rates; therefore it is required that the calculated square footage needed, be doubled to ensure the loading rates are met when half of the system is in use.

Figure 18. A 4-hole distribution box with plug (one knockout not removed) is used as a diversion device.

Specifications for Installation:

- o Device must be installed level on a firm packed base and extend above finish grade. **Finish grade must slope away from box**.
- o When effluent is pumped to the box, then last 2 feet of pipe is transitioned to a 4 inch schedule 40 pipe sloping toward the box.
- o Riser connections must be sealed watertight with tar or silicone sealant.
- o Device must include connections for one inlet pipe and two outlet pipes. Inlet pipe connection should be at a higher elevation (usually two inches) than the outlet connections. *A 3-hole or 4-hole distribution box with plug works well.*
- o A device(s) to divert flow from one drain field to the other must be installed on outlet pipe(s).This shut off device may include:
    1. A removable 90° elbow vertically installed on one outlet. *Recommended.*
    2. A removable cap or plug inserted on one outlet.
    3. Speed levelers or flow dials inserted into both outlet pipes. One with opening positioned at bottom and the other at the top.

Figure 19. Speed levelers installed on both outlets as flow diverter.

Figure 20. A 90° elbow used as a flow diverter.

- o Pipes must be 4 inch schedule 40 PVC and properly embedded on virgin or well compacted soil.
- o The invert elevation of the outlet pipes should be the same.
- o Pipes must not enter box at angle. Penetration should provide a watertight seal.

- o All pipes must extend into box at least two inches and outlet pipes must extend out of box at least 24 inches.
- o The pipes should not interfere with proper function of the shut off device.
- o Soil backfill around box should be solidly compacted.

Advantages

- o Allows an entire drain field to rest during use.
- o Provides a simple, easily to use mechanism for flow diversion.
- o Controls the accumulation of the bio-mat more efficiently.
- o Provides a longer life expectancy of the drain field.

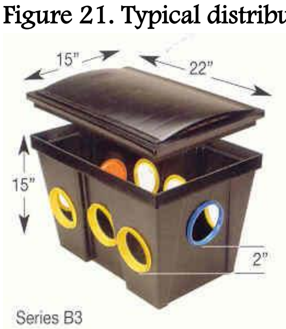
Disadvantages

- o Requires more area for system installation.
- o Requires additional trenches to be installed.
- o More expensive than other options.
- o Does not eliminate the need for flow control access to each trench.

*Our office no longer anticipates incorporating the diversion device into LT designs.

The Distribution Box

Figure 21. Typical distribution box (8-hole).



This application provides an outlet in the distribution box for each trench in the distribution system. All outlets must be set at the same elevation to ensure proper distribution, thus having a packed base under the box to keep it level is very important. However, in practice, due to backfilling or frost action, keeping all outlets at the same elevation through out the life of the system is virtually impossible. For this reason, distribution boxes are not recommended and may only be used where the elevation of the lowest trench is high enough to back up into the distribution box without surface seepage occurring (elevation change between the top and bottom trenches no more than four inches).

Specifications for Installation:

- o Device must be installed level on a firm packed base and extend <u>above</u> finish grade. **Finish grade must slope away from box.**
- o When effluent is pumped to the box, then last 2 feet of pipe is transitioned to a 4 inch schedule 40 pipe sloping toward the box.
- o Riser connections must be sealed watertight with tar or silicone sealant.
- o Device must include connections for one inlet pipe and an outlet pipe for each trench.

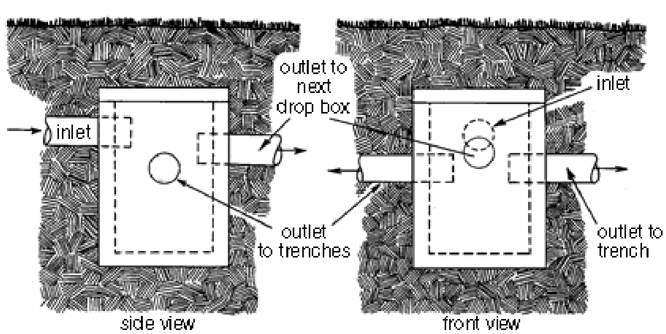
- o A device(s) to divert flow away from the resting trenches must be installed on outlet pipe(s). This shut off device may include:
    1. A removable 90° elbow vertically installed on outlet(s) - for resting portion.
    2. A removable cap or plug inserted on outlet(s) - for resting portion.
    3. Speed levelers or flow dials inserted into all outlet pipes. Trenches receiving effluent will have opening positioned at bottom and trenches in rest will have opening positioned at the top. See figure 19. This also allows additional control of distribution if outlet pipes become unlevel. *Recommended.*
- o Pipes must be 4 inch schedule 40 PVC and properly embedded on virgin or well compacted soil.
- o The invert elevation of the outlet pipes should be the same.
- o Pipes must not enter box at angle. Penetration should provide a watertight seal.
- o Pipes must extend into box at least two inches and out of box at least 24 inches.
- o Soil backfill around box should be solidly compacted.
- o The pipes should not interfere with proper function of the shut off device.
- o Elevation difference between top and bottom trenches must not exceed four inches.

Advantages
- o Only one lid (not including tank lids or inspection ports) needed to extend above grade.
- o Eliminates the need to use drop boxes or earth dams on mildly sloping sites.
- o Although slightly more complex, provides an easily to use mechanism for flow diversion.
- o Does not require doubling the size of the drain field.

Disadvantages
- o Limited to level or nearly level terrain.
- o Difficult to maintain even distribution.

Drop Boxes

Figure 22. Drop box with overflow elevation of 2inches.



Drop boxes are commonly made from concrete or plastic and are the preferred method of distribution on sloping terrain. They can be used as a means for distribution or can also serve as a flow diversion mechanism and an inspection port when extended above finish grade.

Specifications for Installation:
- o Box must be installed level on a firm packed base.
- o Box must extend <u>above</u> finish grade when serving as a flow diversion mechanism or an inspection port. **Finish grade must slope away from box.**
- o When effluent is pumped to the box, then last 2 feet of pipe is transitioned to a 4 inch schedule 40 pipe sloping toward the first box in series.

- When used, riser connections must be sealed watertight with tar or silicone sealant.
- Pipes in headline trench (pipe between boxes) must be properly embedded on virgin or compacted soil. Pipes should not be suspended above trench bottom. Gravel is not permitted in headline trench.
- Soil backfill around boxes should be solidly compacted.

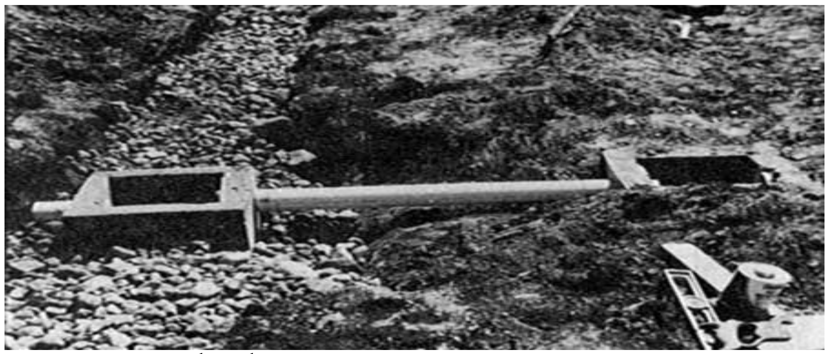


Figure 23. Concrete drop boxes.

- Pipe (outlet to trenches) must be supported on virgin or compacted soil and extend not less than 24 inches into leaching trench. **Pipe elevation must remain level through entire length of trench**.
- Transition to leach line pipe should use a coupler that is compatible to both pipe materials. This connection does not need to be glued but must be properly secured to prevent separation.
- When connecting to a gravel trench or 12 inch diameter bundled expanded polystyrene pipe, drop boxes are to be installed so that the **invert of the overflow pipe is set between level (0) and 4 inches below the top of the gravel or bundle**. This should translate as an elevation difference of 2 to 6 inches between the inverts of the LT and overflow outlets. *Note: When setting invert elevation change at 2 inches, speed levelers installed in LT outlets should function as a proper diversion device. Invert changes between 4 to 6 inches will require a cap or 90° elbow to properly divert flow.*
- When connecting to chambers, drop boxes are to be installed so that the **invert of the overflow pipe is 2 inches below the top of the chamber**. *For most chambers, this should be 2 to 4 inches between inverts of LT and overflow outlets.*

Earth Dams:

Like drop boxes, pipe fitting distribution can also be installed sequentially. This method uses a solid 4 inch pipe installed over a raised earth dam set between trenches. Earth dams can be constructed at any depth between 2 and 6 inches above the invert elevation of the LT pipe. When installed properly, earth dams are as effective as drop boxes at effluent distribution. This method is not recommended for shallow trench systems. *Due to the requirement that each trench be provided with a means to shut off/divert flow, our office anticipates this option will become obsolete. Therefore, our office no longer anticipates incorporating earth dams into LT designs. However, if an opportunity presents itself to utilize an earth dam while complying with the sewage treatment system rules, our office will allow this option.

Specifications for Installation:

- Earth dams must be constructed from undisturbed soil. Do not over excavate. *Note: If over excavation does occur, clean soil (soil with <u>no</u> porous material such as sand or gravel) should be placed on dam and rigorously compacted to the desired elevation and set elevation at least 2 inches above minimum to allow for settling.*
- Earth dams must be constructed at a minimum length of two feet.
- Pipe must be solid (no perforations) and be 4 inches in diameter. Recommend using schedule 40° PVC pipe especially when installed shallow (6 inches or less from original surface).
- Pipe must be properly embedded on earth dam and backfilled with clean soil. Soil backfill should be solidly compacted.
- Dams must be constructed between trenches, perpendicular to the surface contours. Dams installed in line with trenches (parallel to surface contour) are **not** permitted.
- Dams installed at alternating ends (serial distribution) are not permitted.
- When connecting to a gravel trench or a 12 inch diameter bundled expanded polystyrene pipe, earth dams are to be installed so that the **invert of the overflow pipe is set between level (0) and 4 inches below the top of the gravel or bundle**. This should translate as an elevation difference of 2 to 6 inches between the inverts of the LT and overflow outlets if gravel is placed properly.
- When connecting to chambers, earth dams are to be installed so that the **invert of the overflow pipe is 2 inches below the top of the chamber**.

<u>6.3 Backfilling:</u>

When backfilling over leach lines, traffic from equipment should be minimized as much as possible to prevent compaction of the area. This is especially true for wheeled vehicles. Equipment should always be driven in a perpendicular direction to the trenches. Care must be taken not to damage installed components such as lids, inspection ports, and earth dams. Mounding soil cover over conventional trenches as well as alternative trenches is an accepted practice to combat settling. Soil will need to be “finished” graded once the soil over the trenches has had several months or a few hard rains to settle. However, around all risers on drop boxes, and tank lids should have finish grade established when backfilling. This will prevent depressions around riser lids from collecting surface water. Consult with homeowner who is responsible for establishing finish grade over trenches after settling has occurred. It may be to your benefit to provide this service as part of the installation in effort to protect the system.

7. Mound Systems

A mound system is an above grade soil absorption system consisting of pressure distribution of effluent over sand fill mounded to a specified shape above natural soils onsite. The sand functions to both treat and distribute the effluent over the soil interface. The depth of the sand is determined by the difference between the depth to the limiting layer in the soil and the required separation distance. Length and width of the mound is based on the expected daily design flow and the permeability rate of the soil. Mounds systems are fairly easy to construct because most of the components are above grade. Constructing a mound system, however, requires more time due to the amount of materials to be installed and shaped. This section is to provide guidance for planning a mound system installation.

7.1 Chisel Plowing:

Chisel Plowing refers to the process that loosens the soil surface by breaking up the sod. This process creates an area where the sand and soil surface mesh together which improves both the infiltration of effluent into the soil as well as stabilizing the sand fill. Chisel plowing is the most critical step during mound construction. Tracked equipment is recommended for this procedure.

Specifications:

- Not performed when soil is wet or frozen.
- Plowing to occur in basal area only.
- Plowing must be parallel to surface contour (along length of mound).
- Must not overlap passes to avoid excessive soil disturbance.
- Must not allow loose soil to flow back into grooves. *Grooves should remain open. Proper spacing between shanks should prevent this from occurring.*

- Must be plowed using one of these two methods:
  1. Plow basal area along contour allowing grooves to remain open.
  2. Place an even two inch layer of sand over the basal area. Then chisel plow the basal area along the contour allowing sand to fall into the grooves. *Must first test for smearing by plowing an area without sand an inspect grooves. The tested area should be visible for inspection.*

Figure 15. Shows a thin sand layer being plowed into soil surface (method #2). Note: equipment was driven perpendicular to length of mound (see tracks).

- Plowing device must meet the following specifications.
  1. Shanks are long enough to penetrate soil 6 inches.
  2. Shanks have adequate width to create open groves while avoiding excessive soil disturbance. *A width of 1 to 2 inches is recommended.*
  3. Shanks should be spaced between 6 and 12 inches.
  4. Use of bucket teeth or tiller is not permitted.
  5. Width of hitch mounted devices must plow beyond track of tires on a single pass.
  6. Excavator arm mounted devices are acceptable.

Figure 14. Typical arm mounted device.

- Plowed grooves must remain open for inspection (test area is acceptable when using method #2).

<u>**7.2 Sand and Gravel Installation:**</u>

Sand Placement

- Perform jar test **(see section 3.2)** prior to placement of sand. Install clean sand only.
- Sand can only be applied by heavy equipment (backhoe /trackhoe) from outside the basal area on the upslope side. **Heavy equipment is not permitted inside the basal area at any time**. Lighter tracked equipment (skid steers and mini

excavators) may place sand while inside the basal area using the following procedure:

1. Initial sand must be placed from outside the basal area to a depth of at least 6 inches (unless designed sand fill is less – minimum is 4 inches) on the upslope side as far as equipment can reach. This depth is necessary to prevent compaction of the basal soils when shaping sand. **No traffic permitted inside basal area after completion of chisel plowing without this protective layer of sand in place.**
2. Sand can then be placed further into the basal area by driving equipment on to sand previously placed to extend its reach. Equipment should drive on and back off from the upslope side – **DO NOT TURN INSIDE BASAL AREA**. Keep direction or traffic perpendicular to the length of the mound.
3. Repeat this procedure until the basal area is covered with 6 inches of sand.

- If the mound is too wide for equipment to reach across, the mound can be chisel plowed in narrow sections running the length of the mound. Two sections are usually sufficient. Perform procedure as follows:
  1. Plow lower section (down slope side) of basal area along entire length to between 1/3 to 1/2 the total width of the basal area.
  2. From undisturbed upslope side, place sand to a depth of at least 6 inches over plowed area (unless designed sand fill is less- minimum is 4 inches).
  3. Complete chisel plowing of upslope section and place sand as before*. All plowed areas require inspection prior to sand placement. This process would require multiple inspections.*
- If designed depth of sand fill is greater than 6 inches, the remaining depth of sand can be placed from inside the basal area (with lightweight equipment only) once the first 6 inch layer has been installed. Again, equipment should always be driven perpendicular to length of the mound.
- Shaping the sand should be done by hand raking. Final shape of sand should meet the required dimensions, provide at least a 3 to 1 side slope, and allow area for gravel placement.

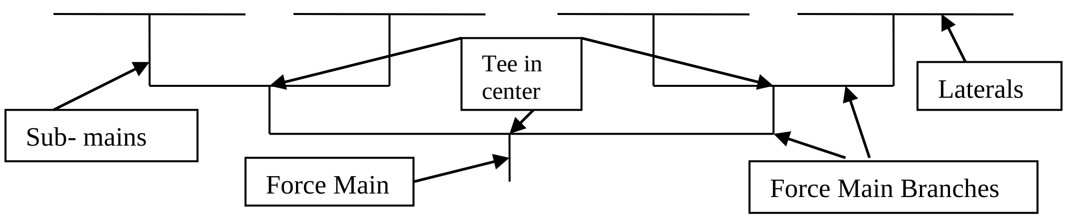
Gravel Placement

- Inspect gravel for cleanliness. Fines should not be seen. Install clean gravel only.
- Place gravel on leveled area on top of sand fill to dimensions specified in the design.
- Always work from upslope side of the mound. Equipment traffic should always be avoided on the down slope side of the mound.
- Design should specify grade of gravel. Washed ODOT #8 natural stone is common.
- Inspection ports need to be installed when placing gravel. Ports should be secured in the gravel and extend from sand surface to finish grade.
- Gravel should properly support the lateral piping and shields. At least 1 inch of gravel should cover the laterals and at least 3 inches of gravel should extend beneath the pipe.
- Top of gravel must be covered by geotextile fabric or minimum 3 inch straw layer to protect from fines in the soil cover. The design should specify material to be used.

7.3 Distribution System:

Specifications for the orientation, size, and location of all piping will be found in the design of the system. Things to consider when installing:

- As a general rule, no excavation should take place inside the basal area.
- Excavate a trench from the dosing tank to the upslope edge of the basal area to install the pressure pipe (force main). Trench should provide slope to allow drain back to the dosing tank. *No sand or gravel base is permitted in this trench between the mound and the interceptor drain.*
- Also install the force mains branches and sub mains to allow drain back. Pipes should be firmly supported. Movement of pipes may cause breakage.
- Each installation of a tee (force main to force main braches and force main branches to sub mains) must be installed so that pipe lengths from each outlet are **equal**. First tee should always be installed at center (along the length) of the mound. This ensures even distribution as designed.



- Make sure all pipe is rated for the maximum pressure the system can generate.
- Use compatible cleaner and solvent on all pipe connections.
- Clean all cuttings (from cutting or drilling) from each pipe before connecting to the distribution system. Flush any remaining debris from pipes at system start up. If possible flush mains and sub mains before connecting laterals.
- Laterals must be level. Check repeatedly when installing.
- All orifices require some form of shielding. If design calls for lateral to be installed in a 4 inch leach pipe, it is also critical that this pipe is also level.
- Flushing ports / turn ups should be properly supported with gravel and extend to grade.

Squirt Test

During system start up, perform a “squirt test” on the distribution system to measure pressure head of the system. This should be very similar with pressure head in the design. The pressure head must be within the tolerance of the pump. Check pump curve to confirm. If pressure head is different than in design, double check that elevations of the system are consistent with the design. If elevations are okay and correct pump has been installed, then there may be a problem in the distribution system. A reading lower than the expected pressure head may indicate a broken pipe or connection leak. A reading higher than expected may indicate debris clogging orifices.

Squirt test procedure:

1. Fill dosing tank with clean water if needed.
2. Remove caps from flushing ports and run pump for about 30 seconds to flush any remaining debris. Best to flush one lateral at a time for maximum pressure.
3. Refill dosing tank if needed.
4. Install clear tubes or modified caps on <u>all</u> flushing ports. *Tubes should be clear (to observe water level), at least 5 feet in length, similar diameter as lateral, and fitted with a threaded connection compatible with flushing port. Caps can be made by drilling a hole in center of standard treaded plug. Hole must be the* same size as in the laterals.
5. Completely open gate valve and run pump. Measure height (in inches) of squirt from flushing port. Always measure from top of the lateral.
6. Adjust gate valve to achieve desired squirt height. Once adjustments are completed, record final squirt height in as built records.
7. Remove all tubes or caps used during test. Reinstall caps on all flushing ports.

<u>7.4 Recommended Procedures for Constructing a Mound System:</u>

1. Review the system design and conditions of the installation permit thoroughly. Designs are very specific and oversights could be costly. Always consult our office with any questions regarding the design.
2. Determine the locations of all components to be installed (check elevations) and mark the layout of the system. Follow procedures outlined in section 2.3.
3. Prepare the surface in the basal by mowing, raking clippings, and removing trees as needed. Follow procedures outlined in section 2.2.
4. Test soil onsite to ensure it is dry enough to proceed with construction. Use technique as seen in section 2.4. If soil crumbles in top 12 inches, proceed to step 5. *Soil test must be observed onsite by inspector during wet season (November 15 thru April 15).*
5. Have sand delivered to the site and perform jar test to determine if sand is clean. Install clean sand only. Make sure enough clean sand is onsite to cover entire basal area at least 6 inches <u>before</u> chisel plowing. *This ensures sand can be placed immediately after inspection to protect from weather*
6. Chisel plow the basal area. Follow specifications in section 7.1.
7. **STOP! Have basal area inspected before proceeding to add sand fill**. This inspection will cover chisel plowing procedure and sand quality (jar test). Plan ahead for inspection. Inspection should be scheduled before chisel plowing begins.
8. Place sand fill over plowed basal area immediately after inspection. A protective layer of sand (6 inch minimum) should be placed on basal area the same day chisel plowing occurred. Follow procedures outlined in section 7.2.
9. Place clean gravel on top of sand as per approved design (see section 7.2).

10. Install pressure distribution system. Laterals must be level. Details will be provided in the design. All pressure feed lines must enter the mound on the upslope side.
11. Tanks can be installed before or after mound construction. Our office recommends connecting the tank to the building sewer as the last step to prevent use of the system prior to approval.
12. Complete all pump installation and wiring. Fill pump tank with clear water to prepare for system start up and "squirt test".
13. Flush debris from laterals before performing the squirt test. *Make sure weep hole is drilled* ***before*** *performing squirt test or measuring flow rates.*
14. Prepare as-built drawing of system. This should include:
    a. Elevations of components and a benchmark
    b. Squirt height (in inches) on both ends of each lateral (before and after gate valve adjustment)
    c. Calculate drainback and measure flow rate. Record all information on dose sheets
    d. Pump (timer)and float settings
    e. Installer name and start up date
15. **STOP! Have mound inspected before proceeding to cover.** This inspection will cover all components in the system, the sand quality (if not performed during first inspection), and the squirt test. *One purpose of this test is to check for leaks in the distribution system, therefore it is very important* *<u>not</u>* *to cover any pressurized piping to allow visual inspection during the test.*
16. When system passes inspection, proceed to install soil cover. Install cover to meet specifications in section 3.3.
17. **Call for final system inspection** when soil cover is complete and seed and straw is in place.

8. Drains and Diversion Ditches

Interceptor drains, perimeter drains, engineered drains, diversion ditches and berms are additional components to a system designed to reduce or overcome effects from surface or shallow ground water flows caused by topography or geology of a particular site. These are considered part of the sewage treatment system and are required to be completed by the system installer. These components must be completed at time of the final inspection.

Interceptor Drains:
The purpose of this drain is to intercept shallow (perched) subsurface water flowing from a higher elevation toward the soil absorption system. These are used on sloping sites with a shallow limiting layer. The trench must be constructed as follows:

- Must be placed between 8 and 12 feet upslope of the soil absorption system.
- Trench bottom must slope toward outlet(s). 1% slope recommended.
- Minimum trench width is 6 inches.
- For mounded and at-grade systems minimum trench depth is 24 inches*. Trench depth must extend at least 6 inches deeper than depth of nearest leaching trench. **The trench should be excavated no deeper than 2 inches into a flow restricting horizon if present.*
- Pipe must be 4 inch corrugated drainage pipe (slotted).Do not use leaching pipe.

- Pipe must be installed on trench bottom.
- Gravel depth must extend to within 12 inches from surface. Minimum depth is 10 inches.
- May have one or two outlets. Outlet pipe(s) must be 4 inch schedule 40 PVC with an animal guard.
- Outlet must extend at least 10 feet down slope of the soil absorption system and 10 feet away from any property line.

Perimeter Drains:
The purpose of a perimeter drain is to remove ground water from the soil absorption area. These are used on near level sites with poor natural drainage and a high water table. These do **not** uniformly lower the water table to increase vertical separation distance. The trench must be constructed as follows:

- Must be placed between 8 and 12 feet from the soil absorption system. Trenches must completely surround the soil absorption system.
- Trench bottom must slope toward outlet. 1% slope recommended.
- Minimum trench width is 6 inches.
- For mounded and at-grade systems minimum trench depth is 24 inches. Trench depth must extend at least 6 inches deeper than depth of nearest leaching trench. **The trench should be excavated no deeper than 2 inches into a flow restricting horizon if present.*
- Pipe must be 4 inch corrugated drainage pipe (slotted). Do not use leaching pipe.
- Pipe must be installed on trench bottom.
- Gravel depth must extend to within 12 inches from surface. Minimum depth is 10 inches.
- Outlet pipe(s) must be 4 inch schedule 40 PVC with an animal guard.
- Outlet must extend at least 10 feet down slope of the soil absorption system and 10 feet away from any property line.
- Outlet must be free flowing at all times. The invert of the pipe outlet should be at least 4 inches above any ditch bottom or water level of stream. Sump pumps should discharge to an approved location.
- A sample port is required when outlet pipe is not easily accessible.

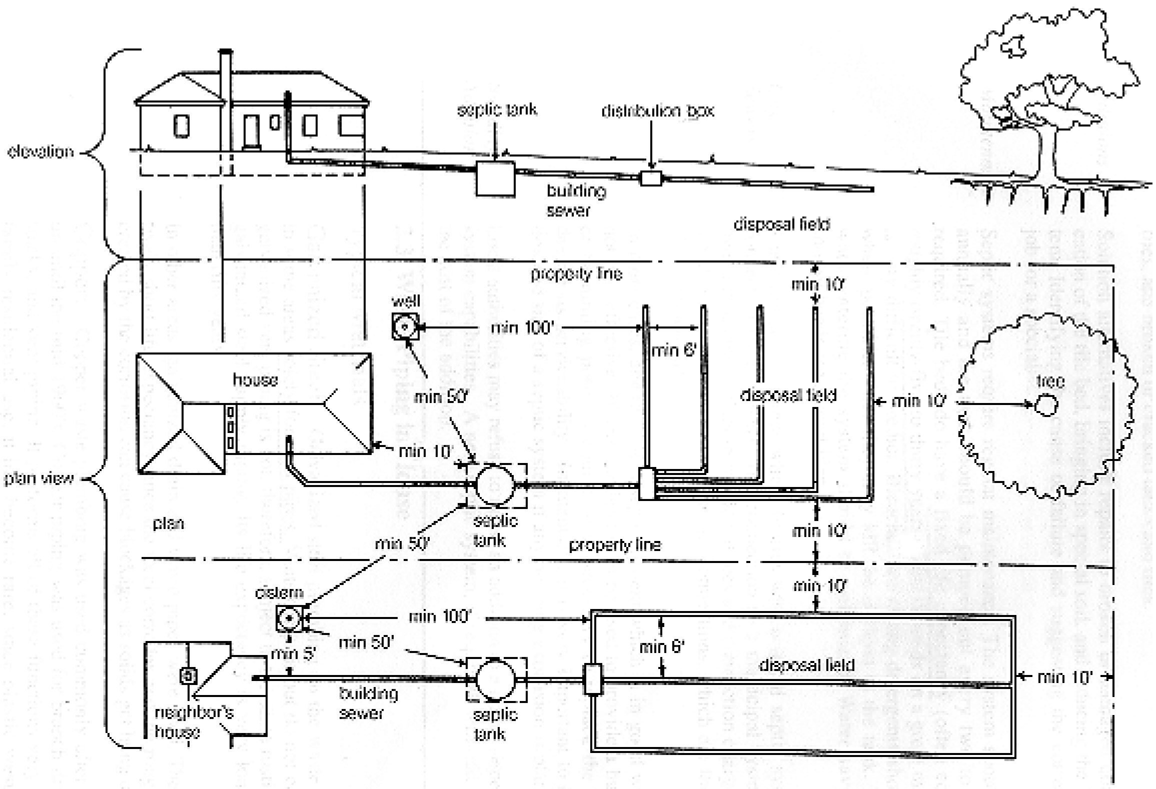
Engineered Drains:
The purpose of an engineered drain is to uniformly lower the water table to provide a sufficient thickness of unsaturated soil to meet vertical separation distance requirements. For design and installation specifications, see Rule 3701-29-16 Appendix A of the Sewage Treatment System Rules.

Diversion Ditches and Berms:
The purpose of installing ditches or berms is to redirect surface water flows away from the soil absorption system. This is sometimes necessary when a system cannot avoid the natural path of water on a site. Ditches are commonly installed above mounded systems on sloping sites or when a soil absorption system passes through a swale or mild depression. They should be constructed as follows:

- Ditches should be at least 12 inches deep and be wide enough to maintain a 3:1 side slope.

- Should be sloped or shaped to allow complete drainage of surface water (no ponding in ditch or against berm).
- All ditches must terminate at least 10 feet down slope of the system and at least 10 feet from all property lines.
- Berms must be very well compacted and shaped to provide a 3:1 side slope.

9. As-Built Drawings



As- built drawings are required to be submitted at the time of the system inspection. Drawings can be prepared by the installer with the inspector during the inspection or prepared by the installer prior to the inspection. During the inspection, the inspector can assist the installer in recording all necessary information when time allows. *Pressure distribution systems require additional information to be recorded such as dose volumes and drain back. This information should be recorded on the as-built prior to the inspection due to time constraints.* If the installer cannot be at the site during the inspection, a copy of the completed as-built drawing must be left at the site.

All as-built drawings should be on 8 ½ x 11inch paper or larger with copies provided to the homeowner and the local health department and shall include:

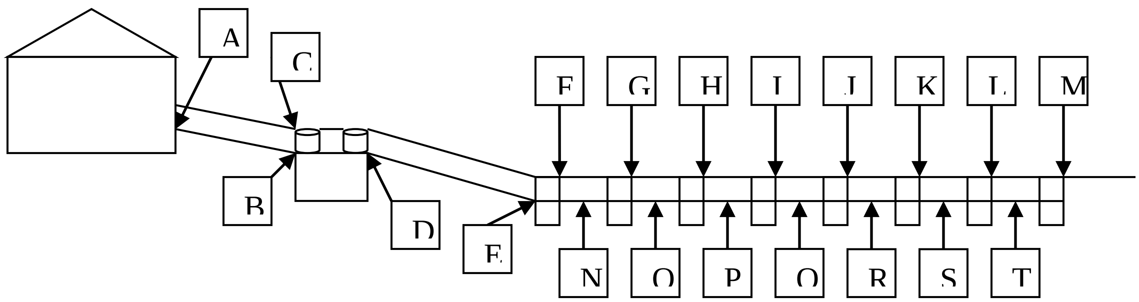
- Installer name and date of installation
- Service & parts provider contact information (for systems or components requiring maintenance contracts)
- Location and elevations of components installed
- Dimensions (length & width) of the system

- List of installed components (name of manufacturer) for tanks, pumps, etc.
- Float settings and dose sheets (for systems with dosing tanks only)
- Any changes to the approved design (prior approval required)

9.1 Elevations:

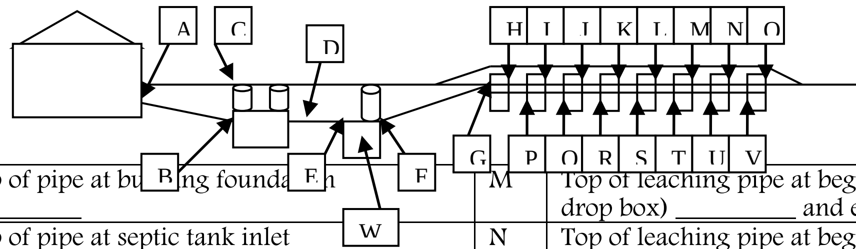
Elevations should be recorded at the following locations:

- For gravity fed leaching trenches



A	Top of pipe at building foundation __________	K	Top of leaching pipe at beginning (outlet of drop box) __________ and end __________
B	Top of pipe at tank inlet __________	L	Top of leaching pipe at beginning (outlet of drop box) __________ and end __________
C	Top of riser lid as a benchmark __________	M	Top of leaching pipe at beginning (outlet of drop box) __________ and end __________
D	Top of pipe at tank outlet __________	N	Top of pipe over earth dam _______
E	Top of pipe at distribution or drop box __________	O	Top of pipe over earth dam _______
F	Top of leaching pipe at beginning (outlet of drop box) __________ and end __________	P	Top of pipe over earth dam _______
G	Top of leaching pipe at beginning (outlet of drop box) __________ and end __________	Q	Top of pipe over earth dam _______
H	Top of leaching pipe at beginning (outlet of drop box) __________ and end __________	R	Top of pipe over earth dam _______
I	Top of leaching pipe at beginning (outlet of drop box) __________ and end __________	S	Top of pipe over earth dam _______
J	Top of leaching pipe at beginning (outlet of drop box) __________ and end __________	T	Top of pipe over earth dam _______

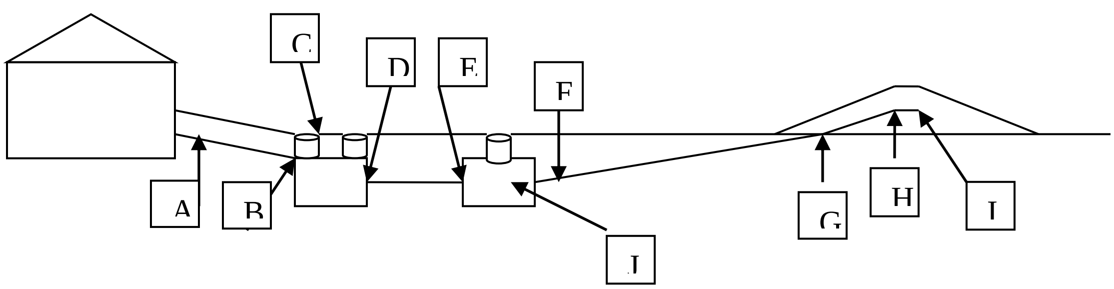
- Dosed shallow leaching trenches



A	Top of pipe at building foundation ______	M	Top of leaching pipe at beginning (outlet of drop box) ______ and end ______
B	Top of pipe at septic tank inlet ______	N	Top of leaching pipe at beginning (outlet of drop box) ______ and end ______
C	Top of riser lid as a benchmark ______	O	Top of leaching pipe at beginning (outlet of drop box) ______ and end ______
D	Top of pipe at septic tank outlet ______	P	Top of pipe over earth dam ___
E	Top of pipe at dosing tank inlet ______	Q	Top of pipe over earth dam ______
F	Top of pipe at dosing tank outlet ______	R	Top of pipe over earth dam ______
G	Top of pipe at distribution or drop box ______	S	Top of pipe over earth dam ______
H	Top of leaching pipe* at beginning (outlet of drop box) ______ and end ______	T	Top of pipe over earth dam ______
I	Top of leaching pipe at beginning (outlet of drop box) ______ and end ______	U	Top of pipe over earth dam ______
J	Top of leaching pipe at beginning (outlet of drop box) ______ and end ______	V	Top of pipe over earth dam ______
K	Top of leaching pipe at beginning (outlet of drop box) ______ and end ______	W	Float Controls: Bottom of tank [ ], pump off [ ], pump on [ ], high water alarm [ ], inlet pipe invert [ ]
L	Top of leaching pipe at beginning (outlet of drop box) ______ and end ______		

* Elevation of bottom of trench (at beginning and end) may be substituted for top of pipe measurement when using gravel-less products.

- Mounded systems



A	Top of pipe at building foundation [ ]	F	Top of pipe at dosing tank outlet [ ]
B	Top of pipe at septic tank inlet [ ]	G	Top of pipe at force main to sub-main connection [ ]
C	Top of riser lid as a benchmark [ ]	H	Top of pipe at sub-main / sub sub-main to lateral connections [ ] [ ] [ ] [ ]
D	Top of pipe at septic tank outlet [ ]	I	Top of pipe at each end of laterals [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]
E	Top of pipe at dosing tank inlet [ ]	J	Float Controls: Bottom of tank [ ], pump off [ ], pump on [ ], high water alarm [ ]

9.2 Calculating Drainback:

All pipe sections that drain back to the dose tank must be included in this calculation. Laterals are not included because they drain into the mound not back to the dose tank. Use field measurements (lengths and diameter of pipe sections) and these charts to calculate total drainback.

Pipe Section	Pipe Diameter (in)	Length of Pipe (ft)	Volume Per Foot* (gallons/ft)	Water Volume (gallons)
Force Main				
Force Main Branches				
Force Main Branches				
Force Main Branches				
Sub-Mains				
Other				
Total Drainback in gallons				

*Use this table to determine volume per foot of pipe (Orenco 97).

Pipe Diameter (in)	Volume per Foot (gallons/ft)
1/2	0.016
3/4	0.028
1	0.045
1 ¼	0.078
1 ½	0.106
2	0.174
2 ½	0.249
3	0.384
3 ½	0.514
4	0.661

9.3 Measuring Flow Rate:

The most common way to measure the flow rate is to measure the amount of water pumped during set amount of time. This is limited to constant volume tanks (straight sides). Follow this procedure for constant volume tanks:

1. Fill tank with water. Water level should be within the operating range (between “pump on” and “pump off” settings).
2. Measure distance to the water level from a fixed point to the nearest 1/8 inch in decimals.
3. Run pump for a set amount of time (at least one minute). A longer run time will be more accurate.
4. Re-measure distance immediately after set amount of time expires and before drain back occurs.
5. Determine gallons pumped by multiplying measured distance (inches) by tank volume (gallons/ inch). *Get tank volume from manufacturer.*
6. Flow rate = gallons pumped divided by set amount of time.

To measure flow rate in varying capacity tanks (rounded sides), the standard volume must be used. This test measures the amount of time to pump a known amount of water between to preset points (the start and stop level). Follow this procedure for varying capacity tanks:

1. Fill tank with water to the start level. *Level is predetermined from the manufacturer.*
2. Measure the time it takes for water to drop to the stop level. Record this time in minutes.
3. Divide the standard volume (between preset points) by time.

9.4 Dose Sheets:

Dose sheets will be required to be submitted with as built drawings when dosing tanks are installed. Dose sheets are available for demand dosed trenches, demand dosed mounds, and time dosed mounds.

Float Tree Assembly

Measure from the invert of the inlet pipe of the tank to set and record elevations of float switches. Determine from tank manufacturer the volume (gallons per inch) of the model being installed. *Rounded tanks have a varying volume which must be measured by the standard volume. The standard volume is a known volume set between two points. Receive guidance from manufacturer how to calculate the volume.* Use chart to calculate proper float settings.

Demand Dosed Trenches:

Fill In Blanks

A	Design Flow (DF) *see design*		Gallons Per Day
B	Required Reserve (100% of DF) *enter # from line A*		Gallons
C	Dose Volume *must be between 1/8 & 1/4 of DF*		Gallons
D	Drainback Volume *calculate after installation**		Gallons
E	Total Dose Volume *line c + line D*		Gallons
F	Flow Rate *calculate after installation***		Gallons Per Minute
G	Pump Run Time *divide line F by line E ****		Minutes

* See Calculating Drainback.
** See Measuring Flow Rate .
*** Pump should run for at least one minute (> 1.0)

H	Dose Tank Manufacturer, Model, & Size		
I	Pump Manufacturer, Model, & Horsepower		
J	Tank Volume (straight sides) *get form manufacturer*		Gallons Per Inch
K	Tank Volume (rounded sides) *get form manufacturer Locate standard volume in tank*		Gallons (Standard Volume)
L	High water alarm float setting /Reserve setting *Divide line B by line J or check standard volume. May be more if room allows*		Inches below top inside edge of tank
M	Pump "on" float setting *Line L plus 2 inches*		Inches below top inside edge of tank
N	Pump "off" float setting Must completely submerge top of pump *Line E divided by line J then add line M or check standard volume*		Inches below top inside edge of tank

Demand Dose Mound:

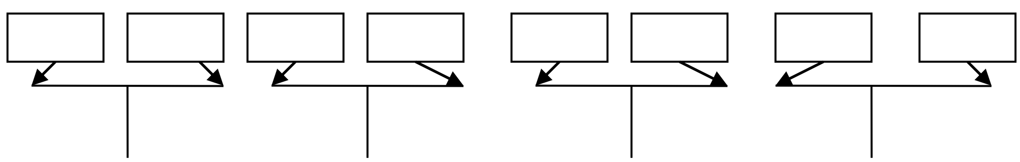
Fill In Blanks

A	Design Flow (DF) *see design*		Gallons Per Day
B	Required Reserve (100% of DF) *enter # from line A*		Gallons

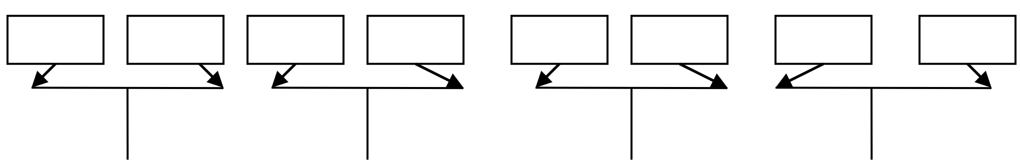
C	Dose Volume *see design*		Gallons
D	Drainback Volume *calculate after installation**		Gallons
E	Total Dose Volume *line c + line D*		Gallons
F	Flow Rate *see design*		Gallons Per Minute
G	Measured Flow Rate *calculate after installation***		Gallons Per Minute
H	Flow Rate Check *Divide line G by line F* *Should be within 10%(0.9 to 1.10)*		
I	Operating Pressure Head (Squirt Height) *see design*		Inches
J	Dose Tank Manufacturer, Model, & Size		
K	Pump Manufacturer, Model, & Horsepower		
L	Tank Volume (straight sides) *get form manufacturer*		Gallons Per Inch
M	Tank Volume (rounded sides) *get form manufacturer* *Locate standard volume in tank*		Gallons (Standard Volume)
N	High water alarm float setting /Reserve setting *Divide line B by line L or check standard volume of tank. May be more if space allows*		Inches below top inside edge of tank
O	Pump "on" float setting *Line N plus 2 inches*		Inches below top inside edge of tank
P	Pump "off" float setting Must completely submerge top of pump *May be more if space allows* *Line E divided by line L then add line O or check standard volume of tank*		Inches below top inside edge of tank

* See Calculating Drainback.
** See Measuring Flow Rate .

Record squirt height results from squirt test **with gate valve completely open** in diagram below. Cross out or re-sketch laterals as necessary. *For baseline measurements.*



Record squirt height results from squirt test **after gate valve adjustment** in diagram below. Cross out or re-sketch laterals as necessary. Should meet designed squirt height.



Time Dosed Mounds:

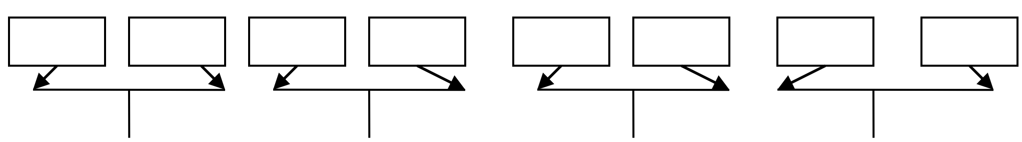
A	Design Flow (DF) *see design*		Gallons Per Day
B	Reserve Volume *see design*		Gallons
C	Surge Volume *see design*		Gallons
D	Dose Volume *see design*		Gallons
E	Drainback Volume *calculate after installation**		Gallons
F	Total Dose Volume *line D+ line E*		Gallons
G	Flow Rate *see design*		Gallons Per Minute

H	Measured Flow Rate *calculate after installation***		Gallons Per Minute
I	Flow Rate Check *Divide line G by line F* *Should be within 10%(0.9 to 1.10)*		
J	Operating Pressure Head (Squirt Height) *see design*		Inches
K	Dose Tank Manufacturer, Model, & Size		
L	Pump Manufacturer, Model, & Horsepower		
M	Tank Volume (straight sides) *get form manufacturer*		Gallons Per Inch
N	Tank Volume (rounded sides) *get form manufacturer*		Gallons (Standard Volume)
O	High water alarm float setting /Reserve setting *Divide line B by line M or check standard volume of tank. May be more if space allows*		Inches below top inside edge of tank
P	Pump "overide" float setting *Line C divided by line M or check standard volume of tank (if surge is not specified in the design then use line O plus 2 inches)*		Inches below top inside edge of tank
Q	Pump "enable" float setting *Line E divided by line M then add line O or check standard standard volume of tank*		Inches below top inside edge of tank
R	Pump "off" float setting Must completely submerge top of pump *May be more if space allows*		Inches below top inside edge of tank
S	Timer "on" setting *Divide line F by line H then multiply by 60*		Seconds
T	Convert line S to Minutes and Seconds (example 94 seconds would be 1 minute and 34 seconds)	:	Minutes : Seconds
U	Timer "off" setting for regular operation (60% of DF) *Line A x 0.6 then divide by line D*		
V	Convert to hours *24 divided by line U*		Hours
W	Convert line V to Hours and Minutes	:	Hours : Minutes
X	Timer "off" setting for emergency/ override operation (100% of DF) *Line A divided by line D*		Periods
Y	Convert to hours 24 divided by line Y		Hours
Z	Convert line Y to Hours and Minutes	:	Hours : Minutes

* See Calculating Drainback.

** See Measuring Flow Rate .

Record squirt height results from squirt test **with gate valve completely open** in diagram below. Cross out or re sketch laterals as necessary. *For baseline measurements.*



Record squirt height results from squirt test **after gate valve adjustment** in diagram below. Cross out or re sketch laterals as necessary. Should meet designed squirt height.