

OSWP Distance Learning - Technology Overview

Slide Notes

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Slide 5	<p>We will provide an overview of the following in this presentation: a conventional onsite wastewater treatment system, which consists of a septic tank and gravel drainfield; how both the septic tank and drainfield function; alternative drainfield technologies to conventional gravel trenches; and different methods for effluent distribution in a drainfield, both pressure and gravity.</p> <p>The conventional gravel drainfield, alternatives to gravel trenches, and different methods for effluent distribution will be discussed in more detail in later presentations.</p>
Slide 6	<p>We will provide an overview of the following in this presentation: a conventional onsite wastewater treatment system, which consists of a septic tank and gravel drainfield; how both the septic tank and drainfield function; alternative drainfield technologies to conventional gravel trenches; and different methods for effluent distribution in a drainfield, both pressure and gravity.</p> <p>The conventional gravel drainfield, alternatives to gravel trenches, and different methods for effluent distribution will be discussed in more detail in later presentations.</p>
Slide 7	<p>Treatment of wastewater occurs by a number of different physical, chemical, and biological processes. These processes include: filtration, sedimentation, aeration, flotation, adsorption, disinfection, and others. Different steps in the treatment process remove different contaminants of concern. Some steps provide the same type of treatment, such as septic tanks and drainfields. Both remove solids from the wastewater. Septic tanks are designed for solids to settle out in the tank (sedimentation), and we require effluent filters at the tank outlet to help remove additional solids. The soil in the drainfield also can act as a filter, removing solid particles from the effluent as it passes through.</p>
Slide 8	<p>Wastewater is treated to remove contaminants of concern prior to the effluent being discharged beneath the ground surface. Levels of treatment have been identified as primary, secondary, and tertiary.</p> <p>Primary treatment is generally just solids removal, a septic tank for example. It is the lowest level of treatment and the minimum that would be required on any site. Secondary treatment removes additional solids and BOD from the wastewater. Secondary treatment might be a sand filter or aerobic unit. Tertiary treatment removes nutrients and fecal coliforms and is sometimes considered to be a polishing step. A number of treatment options used for secondary treatment may also be used for tertiary treatment.</p> <p>Depending on what level of treatment you are trying to obtain, the treatment train might be a mix of aerobic (with oxygen), anaerobic (no oxygen available), and facultative (either with or without oxygen) treatment processes.</p> <p>The site will dictate the level of treatment required to protect the public health and the environment.</p>
Slide 9	<p>There are a number of different types of pretreatment units that can be used to treat wastewater. The septic tank is the most common form of pretreatment and can be</p>

	<p>required just by itself or in conjunction with other pretreatment units.</p> <p>Grease traps and interceptors remove fats, oils, and grease from wastewater. They are required at all food service facilities, including restaurants, meat markets, grocery stores, and food stands. The traps are designed to remove the grease from the wastewater and to keep it from going further downstream into the treatment units or drainfields.</p> <p>Aerobic treatment units, media filters, constructed wetlands, and other pretreatment units provide secondary or tertiary treatment to the wastewater. The strength and characteristics of the wastewater to be treated can help determine the best pretreatment option to be used.</p>
Slide 10	<p>We are going to discuss the septic tank in this presentation, the most common form of pretreatment in North Carolina. Other pretreatment options will be discussed in another presentation.</p> <p>A septic tank is a watertight buried receptacle from which wastewater enters through an inlet pipe from the building. The most common type of septic tank in North Carolina is a rectangular concrete tank.</p>
Slide 11	<p>Septic tanks remove the solids from the wastewater, while the fats, grease, and toilet paper float to the top. Wastewater exits through an effluent filter that helps retain solids and scum in the tank. All new tanks installed in North Carolina are required to have an effluent filter on the outlet end of the tank and have two compartments. On average, septic tanks reduce BOD by 30 to 50% and TSS by 60 to 80%.</p> <p>Older septic tanks, installed prior to 1999, do not have an effluent filter on the outlet end of the tank. Instead, there is an outlet baffle to keep the scum layer from leaving the septic tank.</p> <p>Septic tanks are pumped when the amount of sludge and scum in the tank is equal to one third the volume of the tank, when the bottom of the scum layer is within 3 inches of the bottom of the inlet baffle or effluent filter, or when the level of sludge is within 12 inches of the bottom of the inlet baffle or effluent filter.</p>
Slide 12	<p>Risers are required for pump tanks to bring the access opening above grade. The risers must be at least six inches above grade. Septic tanks can be approved with or without risers. The top of the septic tank or the top of the riser must be brought to within six inches of grade. So, if a septic tank is approved without a riser it can not be installed deeper than six inches.</p> <p>Approved risers are both plastic and concrete.</p>
Slide 13	<p>Effluent filters are required at the outlet end of a septic tank. The filters help to remove solid particles in the wastewater that were not removed by settling in the septic tank. There are a variety of manufacturers and models of effluent filters. Effluent filters need to be cleaned on a regular basis, and will clog up if not cleaned. If an effluent filter is not cleaned, eventually wastewater could back-up into the house.</p> <p>The On-Site Wastewater Branch approves effluent filters and the approvals are listed on our web page.</p>
Slide 14	<p>Septic tanks should be installed level, with wastewater being able to flow from the inlet to the outlet. (There is a 2-inch height difference between the inlet and the outlet.) The septic tank should have an effluent filter, risers (if installed more than 6 inches deep), and a cast-in-place boot on the outlet end of the tank. Tanks can be subject to a water tightness test.</p>
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Slide 16	In an on-site wastewater treatment system, effluent is disposed of beneath the ground surface. Depending upon the level of treatment prior to disposal, the soil can further treat the effluent as it travels beneath the ground. Generally, systems are installed with the trench bottom at a three-foot depth. However, trenches can be installed at a shallower or deeper depth, depending upon site conditions. Trenches have been installed as shallow as 6 inches and as deep as five feet.
Slide 17	There are a number of different trench types and systems used in North Carolina. The types used include: conventional gravel trench, shallow systems, gravelless trenches, prefabricated permeable block panel system, sapolite systems (which will be discussed at a later time), low pressure pipe, fill systems and drip irrigation.
Slide 18	A shallow trench system is going to be the same as a conventional gravel trench, except that the trench bottom will be at a shallower depth than for the standard conventional trench. Normally, for shallow systems, the trench bottom is installed at a depth of 24 inches or less while the conventional trench is installed at depths of 36 inches.
Slide 19	There are three types of gravelless trenches that have been approved for use in North Carolina: chambers, large diameter pipe, and non-gravel trenches, which use another media in place of gravel in the trench. Gravelless systems can be used in both gravity and pressure distribution systems. Each of the different types of gravel systems have their own specific sizing and installation criteria, including under what site conditions the gravelless system can be used, and how the installation must be modified when used with a pump.
Slide 20	Chamber systems are made of plastic. The bottom is open to the soil while the sides of the chambers have louvers or other openings that allow the effluent to move away from the chamber. The side openings should be designed to allow effluent out but not allow soil back into the open chamber space.
Slide 21	§Large diameter pipe consists of eight or ten inch (inside diameter) corrugated, polyethylene tubing encased in a synthetic filter fabric. Large diameter pipe systems are seen mainly in the western part of the state, in the mountains. The pipe is installed in narrow trenches, 12 inches to 18 inches wide, and is ideal for steep slopes and shallow soils.
Slide 22	Another example of gravelless trenches is shown above. This is a non-gravel media gravelless trench system. The polystyrene aggregate comes in bundles of three, with the center bundle having the distribution pipe for the system.
Slide 23	Prefabricated permeable block panel systems are a network of prefabricated, porous block panels containing horizontal and vertical air chambers and lined with a coarse sand fill. The block and sand take the place of the gravel and drain tile in a conventional trench system.
Slide 24	Low-pressure pipe systems are shallow dosed soil absorption systems. When a predetermined level in the pump tank is reached, the pump forces effluent through the distribution lines under pressure. The effluent is uniformly distributed over the entire drainfield area. Dosing frequencies will vary based on site and soil conditions.
Slide 25	This drawing of an LPP system shows the house, septic tank, pump tank, force main from the pump tank to the distribution laterals, the distribution manifold and laterals, and the control panel.
Slide 26	As shown in this picture, LPP systems provide uniform distribution over the entire drainfield area. Looking closely, you can see the individual water sprays from the orifices and that they are all approximately the same height.
Slide 27	Fill systems are a system in which all or part of the trenches is installed in fill, with the file being either new or existing. The requirements for fill systems are located in Rule .1957(b).
Slide 28	Drip irrigation applies wastewater slowly and uniformly through a network of plastic tubing, installed at shallow depths, usually within six to 12 inches of the ground

	<p>surface in the plant root zone. Emitters instead of orifices regulate the flow of wastewater from the tubing. Wastewater is generally pretreated and filtered prior to subsurface disposal in a drip system. One advantage to these systems is minimal site disturbance due to the flexible tubing that can be placed around trees and shrubs.</p> <p>The above drawing shows all the different components of a drip irrigation system: septic tank, pump tank, drip zones, supply lines, return lines, and the central unit, which contains the filters and control panel.</p>
Slide 29	The plastic tubing used in drip irrigation systems has an emitter located where the hole in the tubing is. The wastewater is forced through the emitter. This emitter is known to dose at a specified amount. The wastewater normally is discharged drop by drop.
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Slide 31	<p>Effluent can be disposed of by two different methods, gravity distribution and pressure distribution. Gravity distribution can be done either in parallel or serial distribution. Pressure distribution is done either just with a pump, a pressure manifold, LPP, drip irrigation, or a siphon.</p> <p>Most of the trench types listed previously can be used with either gravity or pressure distribution.</p>
Slide 32	<p>Gravity distribution is when effluent flows out of one component and into the next downstream component by gravity. In a gravity system, elevations must be such that the inlet elevation of the downstream component is lower than the elevation of the outlet of the upstream component.</p> <p>How frequently the system is dosed depends upon the water usage pattern in the facility. Whatever amount of wastewater is disposed of down the drain, will be pushed through the system and ultimately discharged to the drainfield. So, if a washing machine is operating and discharges 60 gallons of water at one time, 60 gallons of water will be pushed through the septic tank and into the drainfield.</p> <p>Gravity distribution is not uniform over the entire drainfield. The effluent enters the perforated pipe and exits the pipe as soon as it reaches a hole.</p> <p>Gravity distribution is the simplest and least expensive means of distribution for a wastewater treatment system.</p>
Slide 33	For parallel distribution, the wastewater is evenly split among all the trenches.
Slide 34	<p>Distribution boxes are the most common method for splitting effluent. Tees, wyes, and headers can also be used to split the flow.</p> <p>Distribution boxes can be made out of plastic or concrete. Level installation of a distribution box is critical to evenly split the flow. When uneven, or unequal, distribution between trenches is occurring, a distribution box that is tilted could be the cause of the problem.</p>
Slide 35	In serial distribution, the effluent is discharged to the first trench in the system. After that first trench has reached saturation, the effluent will spill over from the first trench to the second trench. After the second trench has reached saturation, the effluent will spill over to the third trench.
Slide 36	The above diagrams represent different methods for installing a serial distribution system. The diagram on the left shows a pipe connecting the two trenches, so that when the upper pipe is saturated, the effluent will flow downhill to the second trench. The drop box, shown on the right, has the pipe discharging to the next level at a higher elevation in the box than the lines going out to the trenches. When the effluent in the trenches has ponded enough to allow the effluent level to meet the

	<p>elevation of the pipe going to the next lower line, effluent will overflow into the lower line.</p> <p>The drop boxes used can be concrete or plastic.</p>
Slide 37	<p>Pressure distribution uniformly discharges the effluent over the entire drainfield area. A float triggers the pump to turn on and discharge a predetermined amount of effluent from the pump tank into the drainfield.</p> <p>Pumping the effluent to the drainfield allows the drainfield to rest between doses and to receive approximately the same amount of effluent every time.</p> <p>The cost to pump is more than for just a conventional gravity system. Also, pump systems require routine operation and maintenance to ensure the pump is operating correctly and that the lines or orifices have not clogged. And, alarms are needed to notify the owner when there is a problem with the system.</p>
Slide 38	Pressure distribution can be one of two types: on demand dosing or time dosing.
Slide 39	<p>Demand dosing is when the pump turns on demand, when the wastewater discharged into the pump tank has reached a specified level. So, if a homeowner is running the washing machine, the dishwasher, and someone is taking a shower, that is a lot of wastewater being discharged down the drain, and a lot of wastewater that will be discharged to the drainfield. As long as the float is up and notifying the pump to continue to run, effluent will be discharged to the drainfield.</p>
Slide 40	The above pictures show some different examples of floats that are used to turn the pump on and off.
Slide 41	<p>Time dosing controls the amount of effluent discharged to the drainfield. Instead of effluent being discharged whenever there is enough wastewater in the pump tank, the effluent is discharged on a schedule. If there is enough wastewater in the pump tank, the pump will turn on and discharge a predetermined amount of effluent to the drainfield. Some panels are designed to require not only that there is enough wastewater in the pump tank, but also that the control panel recognizes that it is time for the pump to send a dose to the drainfield.</p> <p>Using this method of pumping protects the drainfield from overloading due to a lot of water being used in the facility all at one time.</p> <p>Time dosed systems are also used for equalizing peak flows over a longer period of time.</p>
Slide 42	An analog timer is on the left; a digital programmable logic controller (PLC) is on the right. The programmable timer will provide the operator with more options and flexibility in operating the system.
Slide 43	<p>Pressure manifolds distribute the effluent evenly among the trench lines. After leaving the manifold (unless in an LPP or drip irrigation system), the flow changes from pressurized to gravity, so the entire length of the pipe is not pressurized, just the manifold.</p> <p>Valves are placed on each line to be able to isolate a line for repair or other maintenance.</p>
Slide 44	The above picture of a pressure manifold shows a valve on each line leaving the manifold box. At the far right, on the manifold is a small cap/hole that allows the operator to verify the pressure head at the manifold.
Slide 45	A siphon is a passive pumping device that does not require power. When the effluent reaches a specific height in the dosing tank, the siphon is triggered, effluent is discharged from the dosing tank, and the effluent in the tank drops by a predetermined specified amount. For a siphon to work properly, it must be installed correctly, which includes being level. Some common problems when trying to

operate a siphon are from incorrect or improper installation.

For a siphon to work, the siphon must be located at a higher elevation than the final drainfield/disposal area.

Two or more siphons can be used in one siphon-dosing tank. If installed correctly the siphons will alternate dosing the drainfields.