Introduction to Onsite Wastewater Treatment

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Introduction
- What is an On Site Sewage Facility (OSSF)?
- Why are we concerned about wastewater?
- Evolution of onsite wastewater treatment
- Function of a septic system
- Evaluation of septic tank operation
- When should a septic tank be pumped?
- How to live with a septic system

Permitting Wastewater Treatment Systems in Texas
- Texas Commission on Environmental Quality (TCEQ), Chapter 285, 5000 gallons per day or less
  - Local Authorized Agent – Usually local Health Department
  - TCEQ Regional Office
- TCEQ, Chapter 217, Greater than 5000 gallons per day.

Malfunction
- Malfunctioning OSSF – An on-site sewage facility that is causing a nuisance or is not operating in compliance with the 285 OSSF regulations.

Hard Malfunction
Soft Malfunction

Nuisance
- sewage, human excreta, or other organic waste discharged or exposed in a manner that makes it a potential instrument or medium in the transmission of disease to or between persons
- an overflow from a septic tank or similar device, including surface discharge from or groundwater contamination by a component of an on-site sewage facility; or
- a blatant discharge from an OSSF.

Onsite wastewater treatment systems?
- Rural and Exurban wastewater infrastructure
- Water Quality Protection
- 25 - 40%, Wastewater Infrastructure
- What is the system called?
  - OWTS: Onsite Wastewater Treatment System; Nationally
  - OSSF: On-Site Sewage Facility; Texas
  - Septic System

Rural and Exurban wastewater infrastructure
- Water Quality Protection
- 25 - 40%, Wastewater Infrastructure
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Evolution of wastewater management

- From outdoor plumbing to water reuse
- We need to review the history to understand the present

Outdoor plumbing: the pit privy

- Goal: designated place
- No carrier needed to convey waste
- Waste applied directly to the soil
- Public health concerns addressed
- Management: relocate

Indoor plumbing

- Convenience
- Water carrier to convey waste out of facility
- 'Collection system'
- Public health and pathogens
- Management: keep pipe flowing

Disposal

- Goal: limit human contact
- Keep wastewater below ground
- Disposal options
- Public health
  - ‘Disposing’ of pathogens
  - Treatment?
- Environment: groundwater contamination
- Management: install, flush and forget

Septic tank & soil treatment area

- Evolving goal:
  - Disposal: effluent goes away versus treatment
  - Disposal: TREATMENT
- Public health AND environmental issues addressed
- Management:
  - Disposal: often no management at all
  - Dispersal: system management is critical

Public health

- Wastewater can contain disease causing pathogens
- Bacteria
  - E-coli
  - Salmonella
- Viruses
  - Hepatitis A
- Parasites
  - Giardia
  - Cryptosporidium
  - Roundworms
Environmental protection

- Treat contaminants before they reach surface water or groundwater
- Nutrients
  - Phosphorus
  - Nitrogen
- Organic loading
- Pathogens

Goal: TREATMENT AND DISPERSAL

- Starting to address both environmental concerns in addition to public health concerns
- Technological advancements now allow removal of:
  - Bacteria - Pathogens
  - Solids – Organic matter
  - Nutrients
- System management is vital to treatment
- Goal is now DISPERSAL
  - Hydrologic cycle

Changes in goals means:

- Approach must also change
  - Siting requirements
  - Choice of components and systems
  - System O&M
  - Management program
  - Industry needs

Decentralized Approach

Education

What is an onsite wastewater treatment system?

1. Wastewater source
2. Collection and storage
3. Pretreatment components
4. Final treatment and dispersal components

Wastewater source

- Facility type
  - Domestic
  - Commercial
- User
  - Owner/family
  - Employees
Collection
- Piping from facility with cleanout
  - Blackwater
  - Graywater
- Collection Options
  - Holding tanks
  - Composting toilets
  - Incinerating toilets

Pretreatment
- Pre-treating waste before it reaches the soil
  - Septic tanks
  - Aerobic treatment units
  - Media filters
  - Constructed wetlands
  - Disinfection

Final treatment and dispersal
- Final treatment occurs in the soil
  - Conventional trench or bed distribution
  - Low pressure distribution
  - Drip field
  - Spray field
  - Evapotranspiration beds

How do we make the OSSF work?
- Evaluate the wastewater source:
  - Hydraulic and organic loading
- Evaluate site
  - Wastewater treatment
  - Wastewater acceptance
- Choose a final treatment and dispersal component
- Choose the appropriate pretreatment system
- Operation and maintenance

Choices of distribution for various soil types

Minimum required separation distances
Roles with septic system management

- Site evaluation
- Design
- Installation
- Startup
- Inspection
- Operation
- Maintenance
- Monitoring
- Pumping

Site evaluation

- Comprehensive evaluation of soil and site conditions for a given land use.
  - Wastewater treatment
  - Wastewater acceptance

Licensed OSSF Site Evaluator, Professional Engineer

Design

- The process of selecting, sizing, locating, specifying and configuring treatment train components that match site characteristics and facility use, as well as creating the associated written documentation.
- A design is also the written documentation of size, location, specification, and configuration.

Professional Engineer, Registered Sanitarian

Installation

- The assembly and placement of components of a system, including final grading and establishment of an appropriate cover
- Startup

Licensed OSSF Installer I or OSSF Installer II

Inspection

- The evaluation of and reporting on the status of a wastewater treatment system

Designated Representative

Operation and maintenance

- Operation
  - Assessing whether each component of the system is functioning properly
- Maintenance
  - taking care of the pieces
- Monitoring
  - verifying performance for a regulatory authority or a manufacturer

Licensed OSSF Maintenance Provider
Pumping

- The action of removing septage from a wastewater treatment system component
- Necessary to prevent accumulated solids from moving into downstream components
  - Drain fields
  - Pumps
- TCEQ Registered Sludge Transporter

What is a conventional septic system?

What is a septic tank?

- Water tight containers
  - Concrete
  - Plastic / Fiberglass
  - NOT Metal
- Detention time
  - Typically 2-3 days
  - Calm conditions
- Gravity separation
  - Heavy sinks
  - Lighter floats
- Anaerobic digestion

What is a Grease Tank?

- Baffles extend lower in the tank to help retain grease and oil
- Typically not needed in most residential systems
- Necessary for restaurants

Conventional septic tank system

Soil Treatment Area

- Biomat
- Backfill
- Native Soil
- Aerobic
### Physical treatment processes

- Sedimentation
  - Settling of the solids
- Filtration
  - Aerobic conditions required, wastewater flows through smaller pores
  - Removes large particles, bacteria, suspended solids
- Dispersion and dilution
  - Wastewater mixes with groundwater
  - Less concentrated, lower hazard
  - But dilution doesn't remove pollutants

### Chemical treatment processes

- Cation exchange and adsorption
  - Positively charged waste constituents bond with soil particles
  - Slows rate of movement through soil
  - Allows use by plants and microorganisms
  - Typically occurs in soils

- Precipitation
  - Solids that form due to reactions of solutions and/or solids
  - Important for phosphorus removal in soils, where P reacts with calcium carbonate, iron and aluminum in soils
- Chemical oxidation
  - Chlorination

### Biological treatment processes

- Natural die-off
  - Occurs when pathogens are held in nutrient poor aerobic conditions
- Predation
  - Natural soil organisms attack and destroy pathogenic bacteria and viruses

- Biological oxidation
  - Bacteria break down organic matter into water and CO₂
  - Reduces BOD, removes pathogens
  - Works best in aerobic conditions

### Gravel-less pipe distribution

- Soil absorption field
A healthy cover crop is essential for the system to function properly.

- Plants will:
  - Take up water and nutrients
  - Stabilize the soil & prevent erosion
  - Support beneficial soil organisms
- Do NOT park vehicles on drainfield
- Do NOT construct decks, driveways or buildings over drainfield
- NO woody vegetation over drainfield
What is an Aerobic Treatment Unit?

- Aerobic bacteria require O₂ to live and grow
- Aerobic treatment processes require O₂ to proceed
- Common condition in soil treatment, media filters, MATUs

- Anaerobic bacteria grow in absence of free oxygen, O₂
- Anaerobic treatment processes do not use oxygen, but consumption of items, breaks oxygen bonds Ex. SO₄, NO₃
- Common condition in septic tanks, processing tanks, and usually any saturated environment

Aerobic treatment unit

- Aerobic Microbes
  - Require O₂ to live and grow
  - Consume waste and bacteria
- Air supply
  - Compressor / Aerator
  - Diffusers
  - Oxygen transfer to wastewater
  - Mixing of food and organisms
- Clarifier

Aerobic treatment unit system

- Disinfection
  - Disinfection, NOT Sterilization!
  - Chlorinator
    - NOT SWIMMING POOL TABLETS!
  - UV light
- Distribution
  - Pump tank
  - Spray field

Water Quality – Spray Field

- High potential for human contact with water
- Secondary Quality Effluent
  - Remove 85-98% of solids and organic matter
  - Remove pathogens?
- Soil microbes are the final treatment!
- This is effluent — NOT DRINKING WATER!!!!

Spray Field Vegetation

- A healthy cover crop is essential for the system to function properly.
  - Take up water and nutrients
  - Stabilize the soil and prevent erosion
  - Provide food and habitat for beneficial soil organisms
- Clear area around spray head — 10 feet in the direction of spray from the head.
- Dead vegetation should be reseeded to establish vegetation.
Subsurface drip distribution

Feeding the System
Conventional and Aerobic Systems

Sewage composition
- Hydraulic Loading - water carrying waste
- Organic Loading
  - BOD
  - TSS
- Pathogens
- Nutrients
  - Phosphorus
  - Nitrogen
- Chemicals
- Fats, oils, grease

Fats, oils and grease

<table>
<thead>
<tr>
<th>Constituent</th>
<th>State at room temperature</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fats</td>
<td>Solid</td>
<td>Non-toxic to the system, origin – animals, will separate in water</td>
</tr>
<tr>
<td>Oils</td>
<td>Liquid</td>
<td>Non-toxic to the system, origin – plants, trouble separating in water</td>
</tr>
<tr>
<td>Grease</td>
<td>Solid</td>
<td>Residual material on appliances; solid material on pans/equipment; petroleum products; moisturizers; bath oils; tanning oils: Toxic to the wastewater system</td>
</tr>
</tbody>
</table>

In-Home Businesses/Hobbies
- Add stronger waste
- Add chemicals
- Increase flow

Examples of Businesses:
- Barber shops
- Day care
- Bakery
- Dog grooming
- Taxidermy
- Artist
- Home photography developing lab

Prescription drugs & antibiotics
- Can kill microbes living in system
- Won’t discriminate against organisms living in the system
- Additional treatment components may be necessary
- Increase maintenance
- Do not pour unused medicines down the drain
Dishwasher

- Adds surges of wastewater
  - Hydraulically overload system
  - Homeowner should space out loads
- Organic load
  - Clean/scrape dishes

Garbage Disposal

- Increases scum by 20%
- System should be pumped 1-2 years sooner than without a garbage disposal
- Increases Organic Loading
  - Smaller particles will take longer to settle
  - Organic matter had not been digested, so it will take longer to break down
  - Potential for fats and oils
- More water is used to wash out sink

Laundry

- Use should be spread out
  - Returning from vacation
- Liquid soap is recommended
  - Use less
  - Remove risk of fillers in powders
- Install High Efficiency appliances

Bathroom fixtures

- Garden tubs
  - Use large volumes of water
  - Add hydraulic surges
  - How often it is used?
- Multi-head showers
- No every-use shower cleaner

Bath and body oils

- Increases Fats, Oils and Grease
- If usage is great, may need more maintenance

Hand Washing Soap

- Antibacterial soap affects biology of tank
- Liquid soaps tend to be overused
Toilet
- Only urine, feces, soap, toilet paper and limited amounts of cleaner should be going down drain
- No feminine products, prophylactics, cigarette butts, etc.
- No every-flush toilet bowl sanitizers

Septic Safe?

Toilet paper
- Excessive use results in faster sludge build up
- Treated toilet paper (with lotions) prevents paper from settling
- Wet wipe disposal is discouraged

Cleaning products
- Cumulative effects on system performance
- Look at Labels!
  - **DANGER**: Means the chemical will kill the bacteria, and its use should be minimized or eliminated.
  - **WARNING**: Means limited use should have a minimal impact on the system.
  - **CAUTION**: Typically means the product will have little effect.

Drain cleaner
- Toxic drain cleaners can impact ability to properly treat wastewater
- Affect bacteria activity

Septic system additives
- **Not** been proven to be beneficial to system performance
- **Not recommended**
- Break up particles that are settled at the bottom and make them suspended
- Potential solids loading to downstream components

Operation & Maintenance of Septic Systems
Gases and chemicals of concern

- Hydrogen Sulfide
- Sulfuric Acid (converted from H₂S)
- Chlorine Gas
- CO(X)’s
  - Carbon Dioxide
  - Carbon Monoxide
- Methane

Common biological hazards around the site

- Kids
- Pets
- Insects
- Snakes
- Vegetation

Restricting access

Conditions at the tank

- Odors?

Tank Material

Tank Configurations
Tank Access
Access Location:
- Inlet
- Outlet
- Center

Accessibility issues
- Accessibility = ease of maintenance
  - Depth of installation
  - Inspection ports & risers
  - Encroachment

Operating condition
- Liquid level in respect to outlet (inches):
  - At
  - Above
  - Below

Septic tank pumping recommended?
- Should be pumped when total solids reach 25-33% of tank capacity
  - If 'A' is less than 3'
  - If 'B' is less than 12'
- Typically required every 3 to 5 years
- Pump during dry seasons to reduce the risk of tank floatation

Measuring solids
- Scum Layer
- Clear Layer
- Sludge Layer

Septic tank pumping recommended?

<table>
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<tr>
<th>Tank Size</th>
<th>Householder Size / Number of People</th>
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<tbody>
<tr>
<td>5,000</td>
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<tr>
<td>7,500</td>
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<td>45,000</td>
</tr>
<tr>
<td>25,000</td>
<td>50,000</td>
</tr>
</tbody>
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Note: More frequent pumping needed if a garbage disposal is used.
Baffles

- Critical to retention of solids in the septic tank
- Determine if baffles are in place

- Inlet baffle
- Compartment baffle
- Outlet baffle

Tees

- Installed at the septic tank outlet
- Trap solids trying to leave the septic tank
- Protect the drainfield

Effluent screens

- Screen is washed off directly into the septic tank
- This is being done at the inlet end of the tank to protect against cleanings going directly out the outlet
- Some units have protection against outflow or an extra screen that that operates during cleaning.

Tank structural condition

- Watertight (no visual leaks)
- Rebar exposed
- Root intrusion
- Corrosion or spalling present
- Cracks
- Flex
Site conditions

- Divert rainwater from system components
- Trees in distribution field
- Excessive vegetation
- Uneven vegetation
- Poor vegetation
- Saturated soils
- Odors

Why perform maintenance?

- Keep systems functioning properly
- Maintain effluent quality
- Early detection of problems
- Public health
- Environmental Protection
- System reliability

Participant survey

Thank you

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