

ON-SITE WASTE DISPOSAL SYSTEMS

Types, Design, Inspection - Septic Systems

NY Metro Annual Seminar - Two Hours - September 11, 2010
 Daniel Friedman, Approved NYS Instructor - InspectApedia.com @
 Original course outline: by Victor Faggella - NY Metro ASHI



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Septic System Info-Live

- Handouts
http://inspectapedia.com/septic/Septic_Systems_Class_DF_Handouts.pdf
- Text
http://inspectapedia.com/septic/Septic_Systems_Class_DF_VF.pdf
- The Septic Systems Information Website
<http://inspectapedia.com/septbook.htm>
- *dfriedman* at *inspect-ny.com*

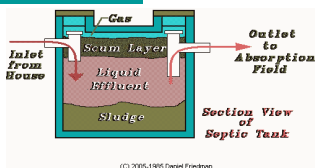


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SEPTIC SYSTEM SAFETY WARNINGS

- Collapse
- Infection
- Explosion
- Asphyxiation
- Prevent access, issue warnings, keep out



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Wastewater Basics

- Blackwater – toilets
- Graywater – other fixtures
- Wastewater – metals, pathogens, salts
- Biomat – bacteria/fungi around leachline
- Septic tank – retains solids, 45% treatment
- Absorption system – treat & dispose of effluent, remaining treatment to 95%



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Wastewater Basics

- Disposal – get rid of effluent
 - Discharge to soils
 - Evaporate to air
- Treatment – biological process to make effluent sanitary before discharge to environment
- Disinfection - chemical process to make effluent sanitary before discharge

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Basic Designs - Cesspools

- Dug pit, old=site built (block, stone) or modern=pre-cast concrete, accept **blackwater**
- May be the only system
- May be accompanied by drywells (graywater)
- Only liquids permeate soil
- Solids require frequent removal
- Periodic relocation required
- Old property = string of “extended” cesspools

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Cesspools Failures & Deaths

- Site built, risk of collapse, **fatality** (L.I.)
- Cannot adequately treat septic effluent (too deep, low oxygen)
- Failure criteria: waste within 12" of inlet; less than 1/2 days storage; too close to surface water; too close to well
- Cesspool restorers??
- Cesspool pumping? Can cause collapse.

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Cesspool Sinkhole



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Basic Designs: Seepage Pits

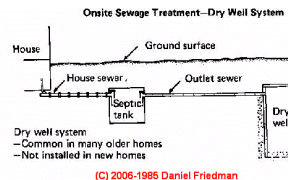
- Dug pit like a cesspool BUT
- Work **with an existing septic tank**
- Used when insufficient space for a drainfield
- Cannot adequately treat septic effluent (too deep, low oxygen)



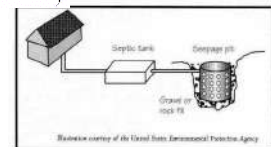
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Seepage Pits



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Schematic of a Seepage Pit (Dry Well)

Basic Designs - Drywells

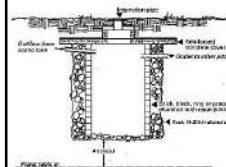


- Hand or machine dug pit for graywater, roof drainage &c
- W/ conventional tank & drainfield = clue about limited drainfield
- Reduces load on drainfield
- Extend life with input filter
- Drywells not "dry" in areas of seasonal wet soils or flooding

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Better Cesspools, Seepage Pits, Drywells



- Machine dug
- Gravel under & around
- Pre-cast concrete forms or rings (reduced collapse risk)
- Concrete cover

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Basic Designs: Septic Tank & Field

- Septic Tank Materials
 - Steel: 5-15 years, rustout, lost baffles, infection, collapse, unsafe covers
 - Concrete: long life, spalling, leaks-in?
 - Plastic/fiberglass: long life, float-up
 - Site-built: block, stone, brick: unsafe
 - Wood: no life



Basic Designs: Septic Tank Sizes

- 250 gal & 500 gal = obsolete, inadequate, not permitted
- 1000g to 5000g
- Size needed based on daily wastewater flow
- Net free area: subtract scum & sludge
- Settlement time depends on net free area size & system usage – incoming wastewater volume & frequency
- Too-small net free area sends solids into drainfield – reduced field life

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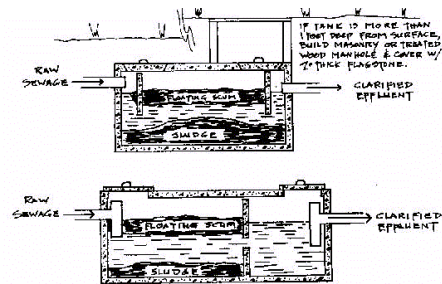
Basics: Tank Compartments

- Single compartment + baffles
- 2-Compartments
 - Improved separation of solids
 - Increased net free area
 - Longer drainfield life
 - Improved effluent treatment
 - Required for some designs (aerobic)
- 3+ - aerobics, clarifying, pumping

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Septic Tank Compartments



Two types of commonly used and approved precast-concrete septic tanks.
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Basics: D-Boxes

- Distribution box = junction box = drop box
- Connect tank to field lines
- Fan systems: multiple D-boxes
- Defects (dig up, open)
 - Tipped
 - Flooded
 - Adjust flow balancers
 - Sewage present

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D-Boxes



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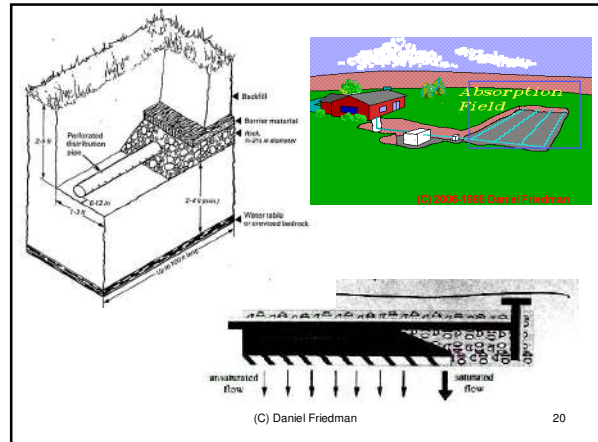
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Basics: Drainfields

- Drainfield = leach field = soakaway bed = drainage bed = septic field = gravel trench = galley system etc.
- 4" Perforated pipe in gravel-filled trenches holes "down" at 5 & 7 o'clock
- 2ft – 5ft deep, 8" – 36" wide, 6' spacing+
- Length depends on soil percolation & wastewater flow
- Inspection ports?
- Gravelless – no-rock: plastic galleys, wider, shorter

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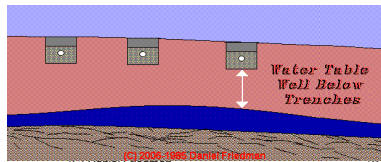
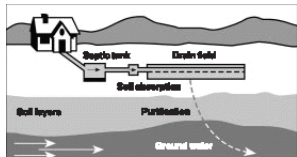
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Drainfield vs Water Table



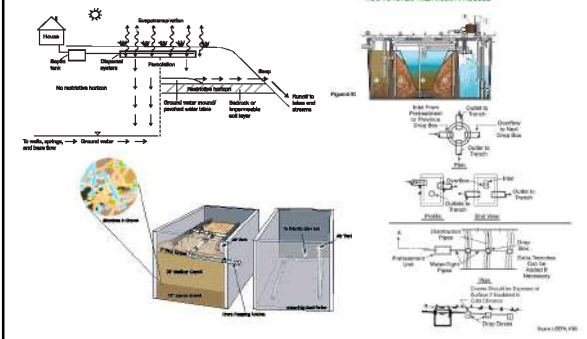
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Advanced / Alternative Septic Designs

(examples not discussed)

Evaporation Transpiration, Filters, Greywater, Hoot, Dropbox & Media Filters



SEPTIC SYSTEM DESIGN ALTERNATIVES	http://inspectapedia.com/septic/septals.htm
AEROBIC SEPTIC SYSTEMS	http://inspectapedia.com/septic/Aerobic.htm
ALTERNATING BED SEPTIC SYSTEMS	http://inspectapedia.com/septic/Alternating_Bed_Septic.htm
BIGGAS PRODUCTION & USE	http://inspectapedia.com/biggas/Biggas_Production.htm
CLISSPOOLS	http://inspectapedia.com/septic/septicpools.htm
DISINFECTION SYSTEMS, SEPTIC EFFLUENT	http://inspectapedia.com/septic/Effluent_Disinfection_Septic.htm
DRYWELL, DESIGN & USES	http://inspectapedia.com/septic/drywell.htm
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GRAVEL-LESS SEPTIC SYSTEMS	http://inspectapedia.com/septic/gravelless.htm
GRAVITY/SIPHON DOSING SYSTEMS	http://inspectapedia.com/septic/GravityDose.htm
GREYWATER SYSTEMS	http://inspectapedia.com/septic/graywater.htm
LAGOON SEPTIC SYSTEMS	http://inspectapedia.com/septic/Lagoons.htm
MEDIA FILTER SEPTIC SYSTEMS	http://inspectapedia.com/septic/almmedia.htm
MOUND SEPTIC SYSTEMS	http://inspectapedia.com/septic/mound.htm
CULTIVATORS & L ATREMS	http://inspectapedia.com/septic/Driftless_Lattinse.htm
PRESSURE DOSING SEPTIC SYSTEMS	http://inspectapedia.com/septic/pressuredose.htm
RAISED BED SEPTIC SYSTEMS	http://inspectapedia.com/septic/raisedbed.htm
SAND BED SEPTIC SYSTEMS	http://inspectapedia.com/septic/sandbed.htm
SEWAGE PITS	http://inspectapedia.com/septic/Sewage_Pit.htm
SEPTIC SYSTEM PUMPS	http://inspectapedia.com/septic/SepticPumps.htm
BIOLOGIC/BATCH SEPTIC SYSTEMS	http://inspectapedia.com/septic/Seawater_Batch_Septic.htm
BENEFIC TREATMENT SYSTEMS	http://inspectapedia.com/septic/beneficial.htm
TOILET ALTERNATIVES	http://inspectapedia.com/septic/composting.htm
TOILET TYPES	http://inspectapedia.com/flushing/Toilet_Types.htm
TRAPS and PLUMBING FIXTURES	http://inspectapedia.com/flushing/Plumbing_Fixtures_Trap.htm
VEGETATED SUBMERGED SEPTIC BEDS	http://inspectapedia.com/septic/Submerged_Septic_Beds.htm

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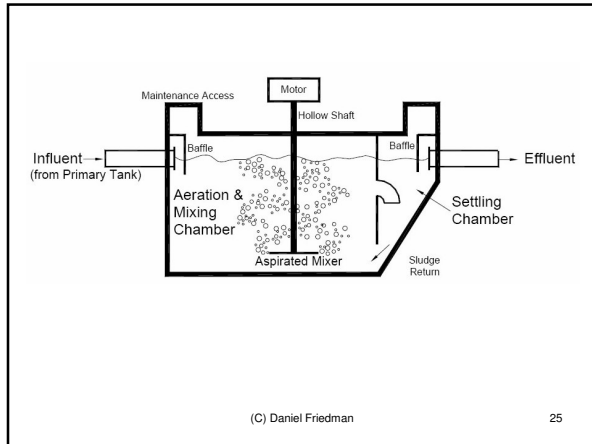
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Aerobic Septic Systems ATUs

- Septic tank aerator (pump, electrical power), pre-packaged / retrofit
- 3 chamber tank (trash tank, aeration, clarification chamber)
- 4 chamber tank (sewage receiver, aeration, settling, pumping)
- High level of treatment (to 95%)
- Effluent dispersed conventionally or by surface spray
- Suspended-growth (dead bacteria suspended) vs Attached-growth (fabric media)
- AKA saturated wastewater treatment system (oxygen-saturated wastewater)
- Retrofit aerobics promise drainfield rejuvenation (doubtful in short term & possible issue with single-chamber tanks)

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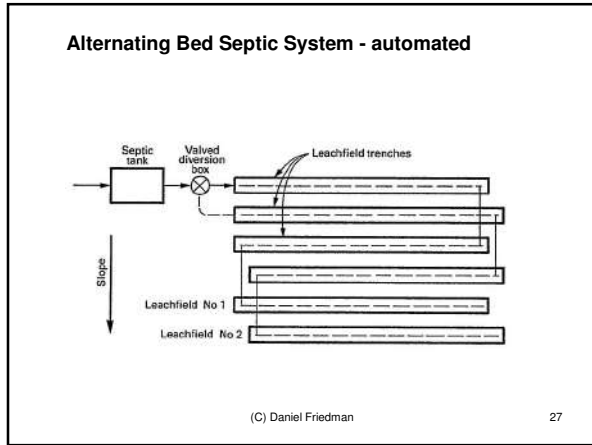
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Vic's Alternating Bed Septics

- Used when field area is limited with no room for expansion
- Field life is prolonged due to resting periods
- May be either gravity fed or a dosing system
- Required diverter valve may be either manual (coffee cup) or automatic

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Dosing Septic Systems

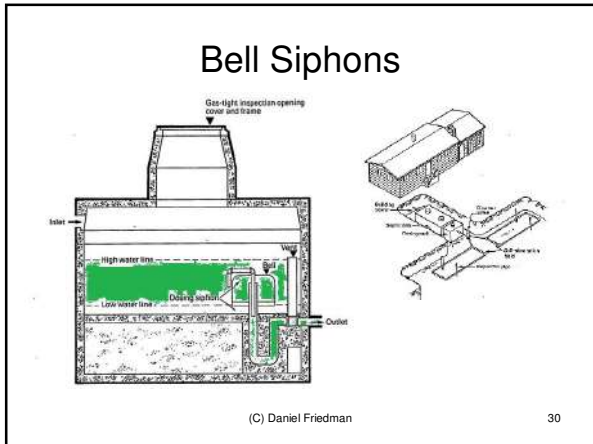
- Uphill sites
- Mounded systems
- Longer field life due to resting periods
- Allows system on otherwise unusable sites (nearby lake, rock, mound needed)
- More expensive to install and maintain; more complex tank, pump, alarm
- Require electrical power

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Dosing: Gravity

- Effluent lines: single, multi, serial, looped
- Float Control
- Tipping or Dipping Control
- Bell Siphon Control

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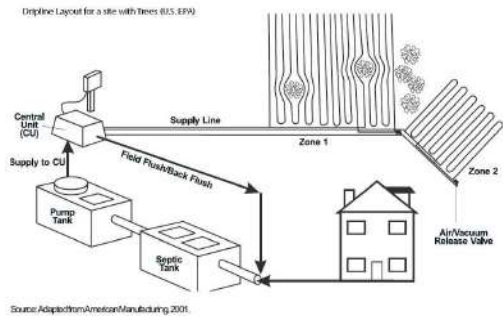
Drip / Irrigation Septics

- Used when there is lack of earth surface over bedrock
- Landscaping concerns
- Small perforated tubing slowly emits wastewater through a system of electronics and valves through small disposal tubing
- Provides water for lawns and plants
- Requires annual pumping and filter cleaning to prevent clogging of tubing Perforations

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Drip Irrigation



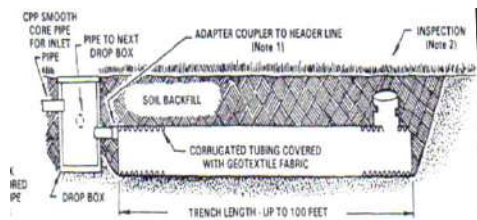
Gravelless / No-Rock Septics

- 3 Common designs
 - Chambers: Plastic chambers in series, set in soil with no gravel
 - Polystyrene-wrapped perforated pipe
 - Geotextile wrapped perforated pipe
- Cheaper, faster, more profitable for installers (but wider excavation)
- Wide footprint to obtain absorption area
- Shorter length, may fit on smaller site than gravel-trench system, but up to 100'
- Used on rolling land, uneven slopes?
- Life expectancy: TBD.

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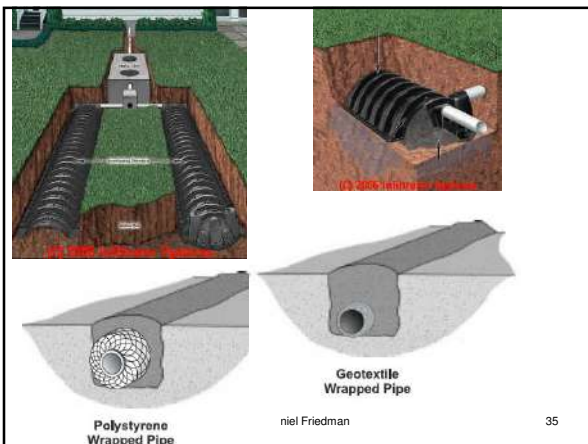
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Gravelless Septic Layout



NOTE: 1. CPP adapter to 4" coupler used to connect to solid headers; the 4" adapter is rotated to top of pipe.
 2. CPP Bump The used for anti-cap; spool part can be cut out for inspection

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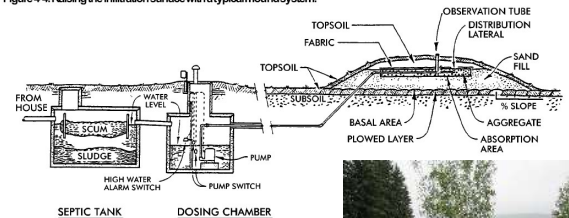


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Mound Septic Systems

Figure 4-4. Raising the infiltration surface with a typical mound system.



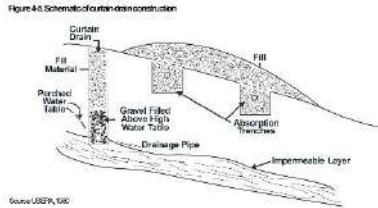
Source: ASAE, Converse and Tyler, 1998b.

EastMound.com



Mound vs Raised Bed

- Raised bed: soil fill atop natural soil, both treat & absorb
- Mound: fill over rock or non-usable soil



Sand Bed Septic Systems

- Sand "mound" or bed, may use a dosing system
- Sand covered with soil may not be obvious
- Intermittent Sand Bed – intermittent distribution
- Recirculating sand bed – recirculates through the sand back to tank etc.
- Disinfection system common as final treatment
- Direct discharge of effluent to a body of water is not approved (but common)
- Expensive to maintain, re-rake sand; rarely properly maintained
- Alternative design may be required at time of replacement or major repair

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BREAK TIME
FIVE MINUTES

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Septic Inspection & Testing

- Options: No inspection – warn of visually apparent hazards, advise expert inspection, not just tank pumping
- I - Visual inspection
- II - Visual + loading & dye test
- IV - Visual, loading & dye, Tank Pump
- V - Visual, loading & dye, pumout, D-box, Field exploration

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Septic Inspection Worries

- **Septic Inspection Safety**
 - Avoid fatalities & explosions
 - Never fail to warn, restrict access &c



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Visual Warnings

- Subsidence – rope off and prevent near access
- Steel tanks – old, rust, collapse risk
- Unsafe, missing covers – rope off, prevent access
- Obvious site limitations



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Smell Warnings

- Bacterial hazards
- Explosion hazards
- Methane gas asphyxiation hazards – don't lean over and never enter a septic tank
- No Smoking, no brush fires



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Information Warnings

- Cesspools – old, site built, high risk of collapse, do not water-jet, pump out, agitate (Long Island fatality case)
- Old properties, possible series of tanks, cesspools, improperly abandoned? Later collapses.
- Location unknown
- No service record
- Pumped before inspection
- Bleach (well shocking)
- Sinkholes?

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What *Can* be Detected?

- Collapse, visible subsidence
- Smells, operation problems
- Drainfield failures: wet, odor, growth, context: too small, old, flooded area, unknown, no maintenance, lost baffles, paved over, driven over, deck over, house over
- Tank failures (open tank): baffles, leaks in, leaks out, too small, site built, unsafe cover, impacted,
- Wet around pipes, tank, field

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How to Inspect a Septic

- [Collect Historical Information](#) about the Onsite Waste Disposal System
- [Visual Site Inspection](#) of the Septic System:
- [Locate the Septic System](#)
- [Performing Septic Loading & Dye Tests](#)
- [Pumping Septic Tanks](#) for Further Investigation of System Condition
- [Excavating & Inspecting Septic Distribution Boxes](#)
- [Inspecting the Soil Absorption System](#) of an Onsite Wastewater Disposal System

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Septic History

- Where is the septic tank
- Where is the drainfield
- What type, size, materials were used (concrete, steel, plastic, etc)
- What is the maintenance history of the system

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Visual Inspection

- Possible component locations
- Unlikely locations
- In-building waste piping
 - Exit points – indicate direction piping leaves building
 - History – conversion from septic to municipal – old system abandoned?
 - Multiple exits – multiple tanks, drywells, seepage pits
 - Evidence of backups, burst pipes, sewage contamination
 - Do not run water for a dye test without also checking immediately for in-building leaks or backups

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Initial Outside Septic Checks

- Storm drains
- Open bodies of water, stream, lake, etc (check again with dye)
- Location of well
- Property boundaries
- Roads, culverts (effluent piped under roads)
- Location of the flood plain
- High water tables that may flood the drainfield
- Algae growth in nearby water

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Find the Septic Tank

- Walk the known or most likely septic tank area
 - Subsidence
 - Evidence of recent work (tire tracks, excavation, pump out just before inspection)
 - Wet areas



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Mini septic tank, pump, dye, reactor

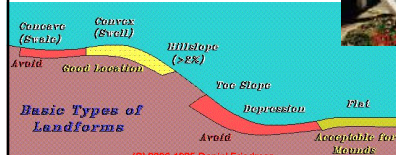


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Find the Drainfield

- Walk the known or most likely septic field area
 - Excessive grass growth
 - Wet or "boggy" areas
 - "Collapsing" fields
 - Odor
 - Evidence of recent work



Septic Loading & Dye Test

- Definitely finds some problems
- Definitely does not find all problems
- Value: risk reduction, not risk elimination
- **Watch out:**
 - no tank pumping before
 - Owner permission
 - Don't spill dye (flush the toilet first)
 - Use enough dye & water
 - Put the dye in the right fixture



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Septic Dye Breakouts



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Septic Dye Breakout



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Septic Dye Test Lawsuit



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Effluent loading breakout, no dye



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Dye Test Inspection Points

- Building DWV before starting test
- Toilet flushes ok before starting test
- Presence of a drywell (laundry sink?)
- Follow fixture piping to main DWV to exit
- Outside waterways: immediately on test start & periodically
- Probe? Wet areas for increased flooding over seen before starting test

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Septic Test Inspection Points

- Check tank alarms if present
- Monitor & compute flow quantity
- Watch for well run-dry
- Stop test immediately on overflow, breakout, ejector pump failure, owner request
- Check drainfield inspection ports

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Septic Tank Pumpout Inspection

- After loading & dye test
- Not part of loading/dye test
- Useful but incomplete if done without loading & dye test (fields not checked)



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Septic Tank Inspection Points

- Septic tank location & thus maintenance history
- Septic tank cover material, condition, safety
- Tank materials & condition
- Effluent level (leaks in to or out of tank?)
- Condition of baffles, lost, broken, overflowed
- Measure scum and sludge thickness
- Evidence of groundwater entering/flooding the tank
- Effluent pump or backup pump not working
- Tank alarm not working
- Septic tank cracks, holes, rust-out
- Dosing siphons not working
- Backflow from outlet pipe (to fields) during pumping?

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Septic Tank Pumpout Inspection



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Septic D-box Inspection

- Septic tank location & thus maintenance history
- Septic tank cover material, condition, safety
- Tank materials & condition
- Effluent level (leaks in tank?)
- Condition of baffles
- Measure scum and sludge thickness
- Evidence of groundwater entering/flooding the tank
- Effluent pump or backup pump not working
- Tank alarm not working
- Septic tank cracks, holes, rust-out
- Dosing siphons not working

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D-Box interior trouble



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Septic Maintenance

- Pump the septic tank on schedule
- Use a standard schedule or
- Open, inspect, measure scum & sludge levels & pump per specs

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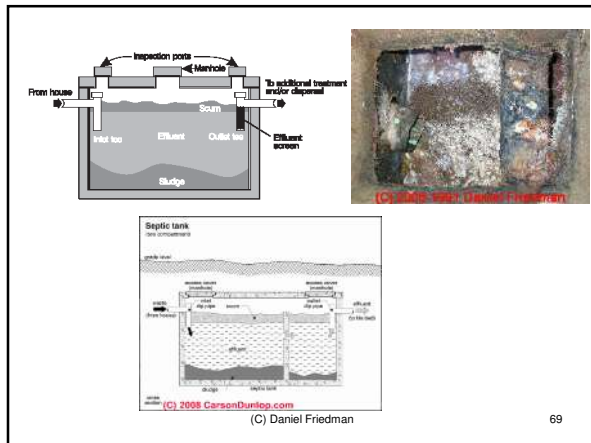
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When to Pump the Septic Tank

- Use the pumping freq. table
- 2-4 years on average
- When 400mm scum or 200mm sludge
- When scum + sludge = 1/3 of tank depth
- Less than 3" from outlet tee to scum bottom
- Less than 6" from outlet tee to sludge top (late?)
- 20% to 40% More often if Garbage Grinder
- 95% of failures blamed on failure to pump

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Don't Flush

- Grease, garbage, sanitary napkins, baby wipes, toys, cat litter, condoms
- Solvents, paints, chemicals, drugs
- Additives and magic septic restorers, potions
- Cats

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Keep Off of Drainfields

- Trees, deep-rooting plants
- Grazing Land & livestock
- Paving, patio blocks
- Vehicles
- Parking lots, roads
- Buildings
- Swimming Pools



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Septic System Info Live

- The Septic Systems Information Website
<http://inspectapedia.com/septbook.htm>
- dfriedman at inspect-ny.com
- 914-489-1635 – **home inspectors ONLY**

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