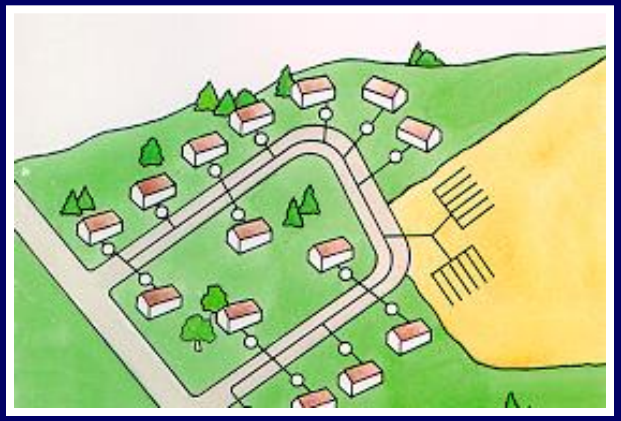
On-Site Wastewater Treatment Systems

What are Decentralized Wastewater Systems?

A.K.A. . . .

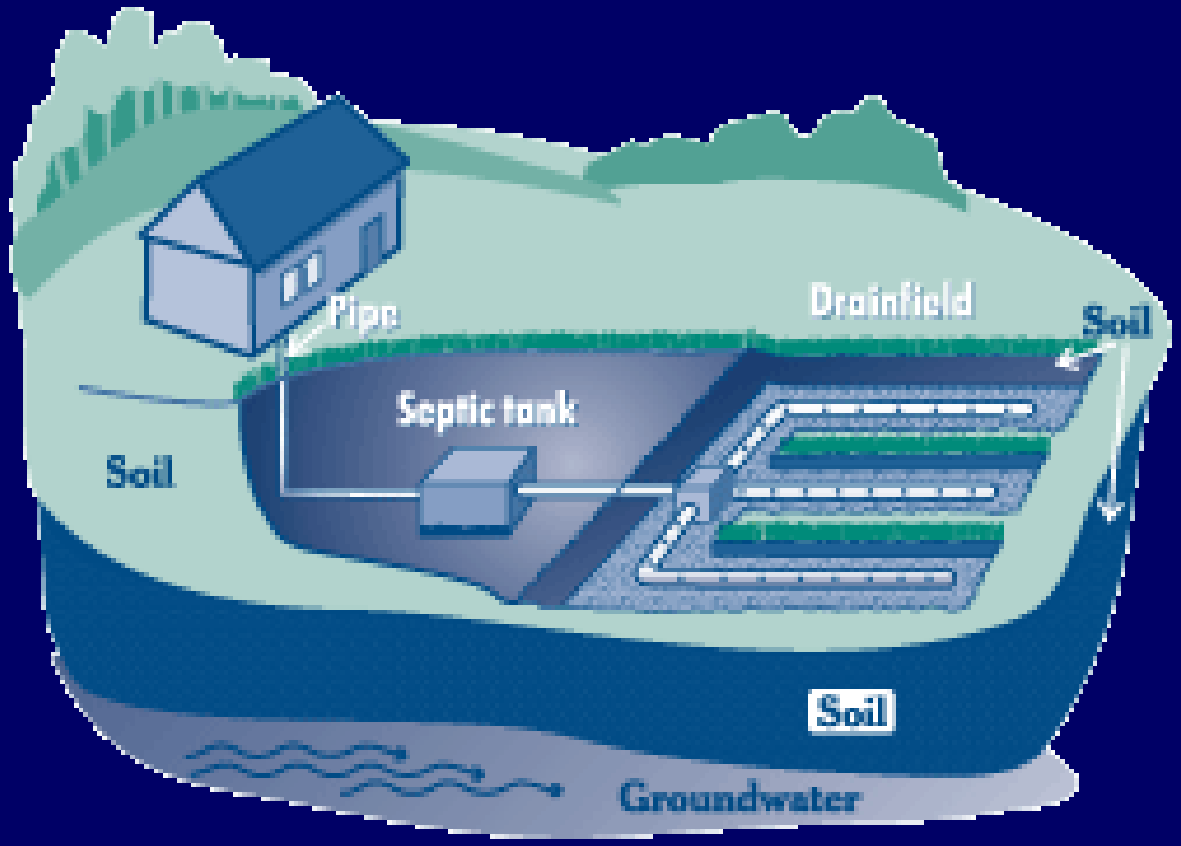
- Septic Systems,
- Onsite Systems,
- Individual Systems,
- Cluster Systems,
- Package Plants
- Large Capacity Septic Systems



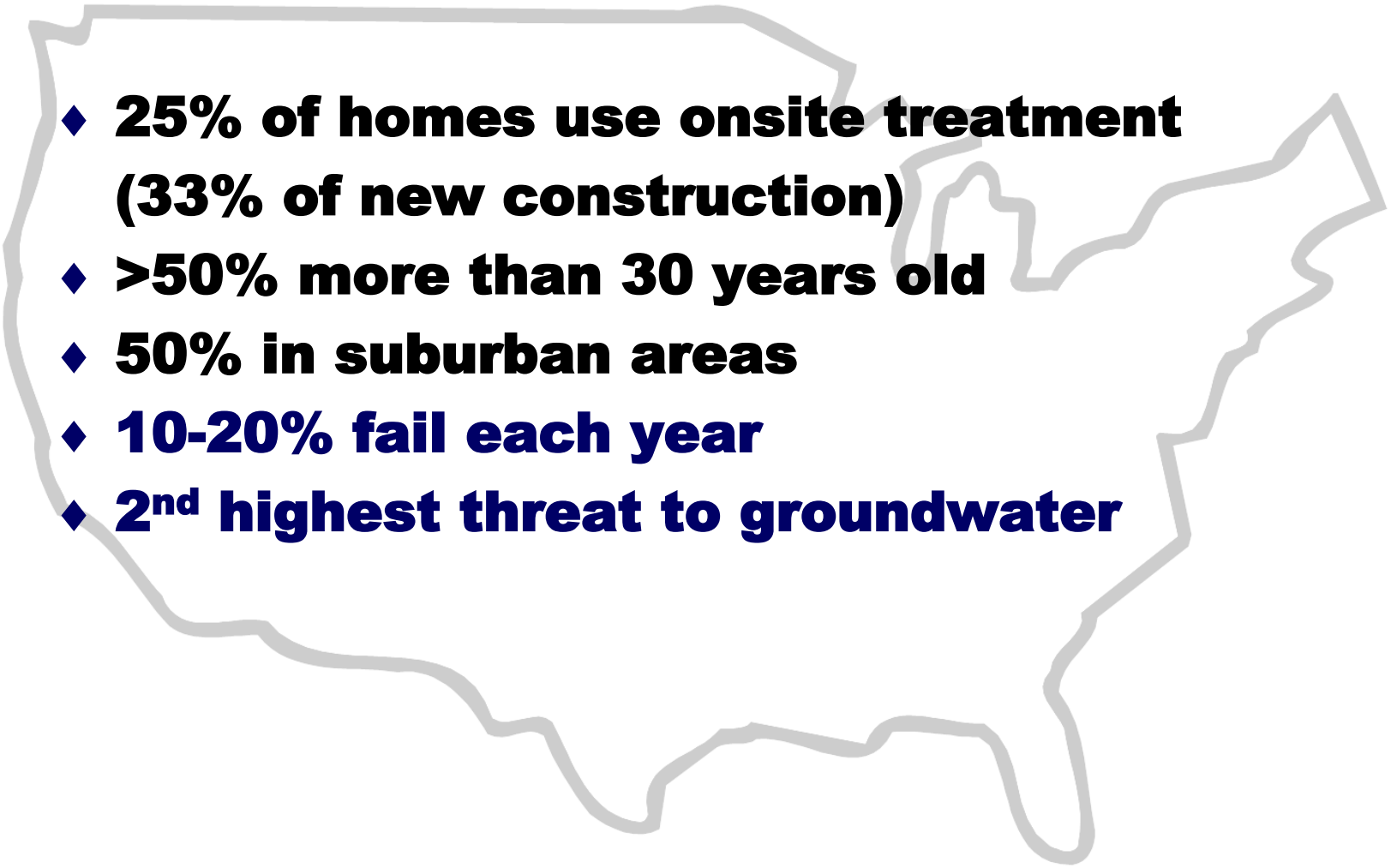
OSWTS

Name
Septic System

Aliases
Onlot System
On-Site System
Individual Sewage Disposal System
Onsite Wastewater Treatment System
Cluster System
Decentralized System



A Significant Issue Nationally



- **25% of homes use onsite treatment (33% of new construction)**
- **>50% more than 30 years old**
- **50% in suburban areas**
- **10-20% fail each year**
- **2nd highest threat to groundwater**

Water Quality Problems

Estuaries

Groundwater

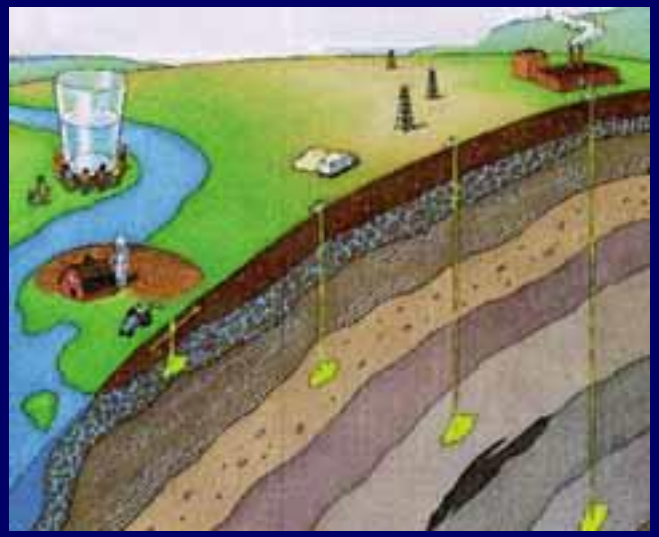
Shellfish Beds

Impaired Waters

Who Regulates OSWTS?

- State, Tribal, or Local Jusrisdiction
  - In Washington: 246-272A small systems
  - 246-272B LOSS
  - 246-273 Additives
- EPA provides information and guidance
- However some systems are regulated by EPA
  - Serve 20 or more people
  - Receive industrial or commercial wastes

UICs



- Class I-deep into isolated rock formation
- Class II-oil and gas production/brine disposal
- Class III-mineral extraction wells
- Class IV-hazardous waste disposal-*BANNED*
- **CLASS V**-shallow wells such as septic systems, and dry wells

Examples of Class V UIC

- Gas Station
- Apartment Building
- Rest Stop with Cesspool
- Stripmall (e.g. w/ photoprocessor, dry cleaner)
- Carwash

States Regulate Onsites . . . So Why is EPA Getting Involved??

- **Clean Water Act goals not being met**
- **Major nonpoint source of pollution**
- **Lack of funding: Need alternatives to costly centralized WWT**
- **Regulatory Issues, e.g., UIC, stormwater phase II, NPDES**

Underground Injection Control Program

- Lawsuit addressed large septics
- Cesspools banned
- Large Capacity Septic Systems
  - 20 or more people/day, sanitary waste only
  - Estimated 300,000 systems in U.S.
  - Determination acknowledges Management Guidelines as primary tool
  - No rulemaking at this time

What is Needed?

Improved Management, including:

- Improved owner awareness
- Licensed/certified practitioners
- Appropriate application of technology to the receiving environment
- Routine O&M
- Effective and affordable options for difficult sites
- Consideration of all options (decentralized and centralized)

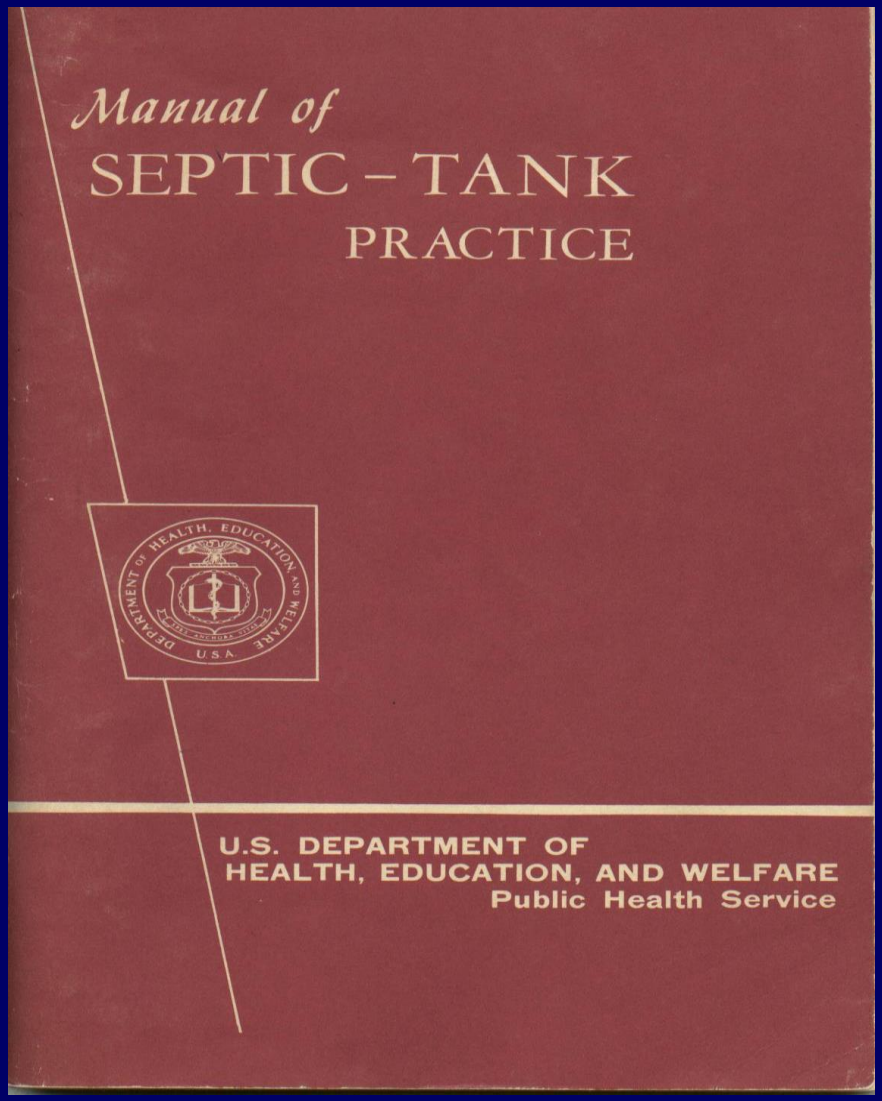
In the beginning . . . .

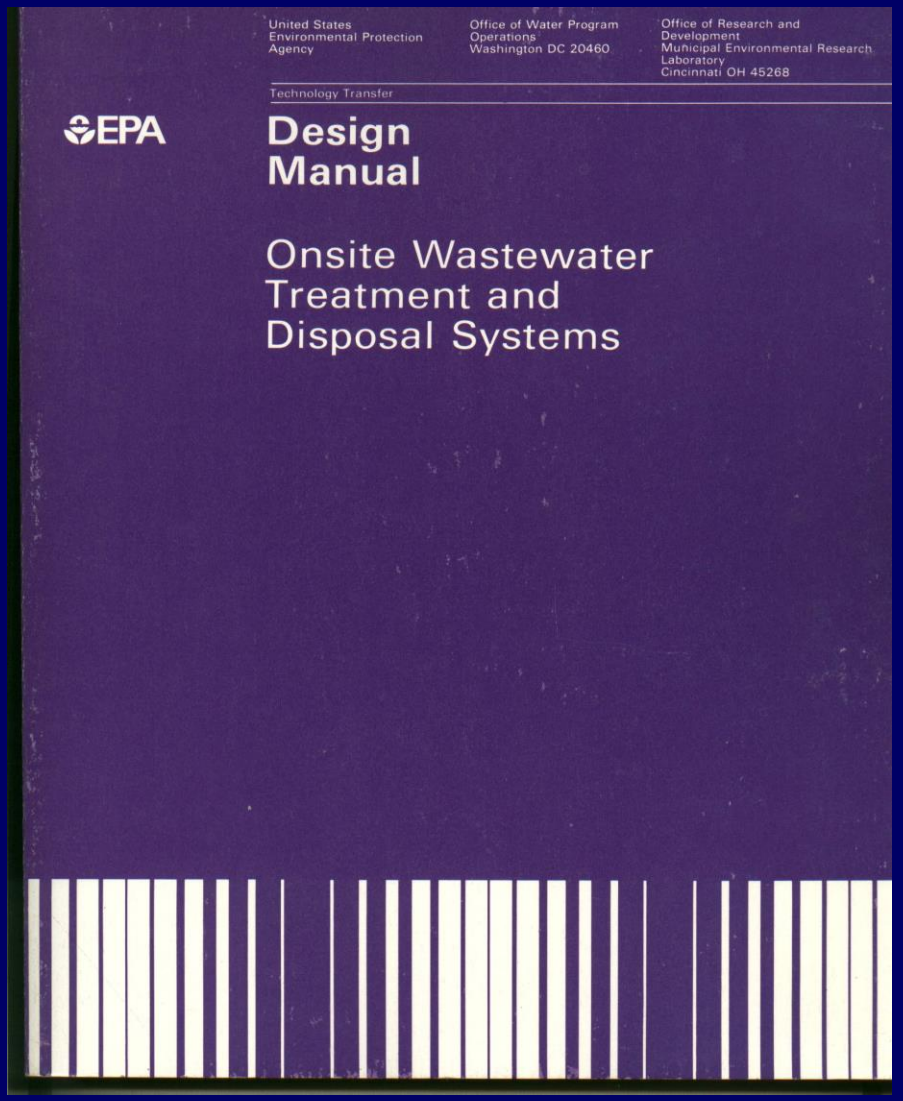
And thou shalt have a paddle upon thy weapon, and it shall be:

> when thou wilt ease thyself abroad, thou shalt dig therewith,
>
> and shalt turn back and cover that which cometh from thee

Deuteronomy 23:13

Where we've been . . .





2002 USEPA Onsite Manual

- Complements 1980 Design Manual
- Promotes use of performance requirements
- Advocates management of all systems
- Focuses on risk-based assessments
- Available on the Internet and CD

How to access the OWTS Manual

CDs are available at the NEHA 2002 Conference.
The online version is available at:

http://www.epa.gov/ORD/NRMRL/

To order a printed version, send a request to:

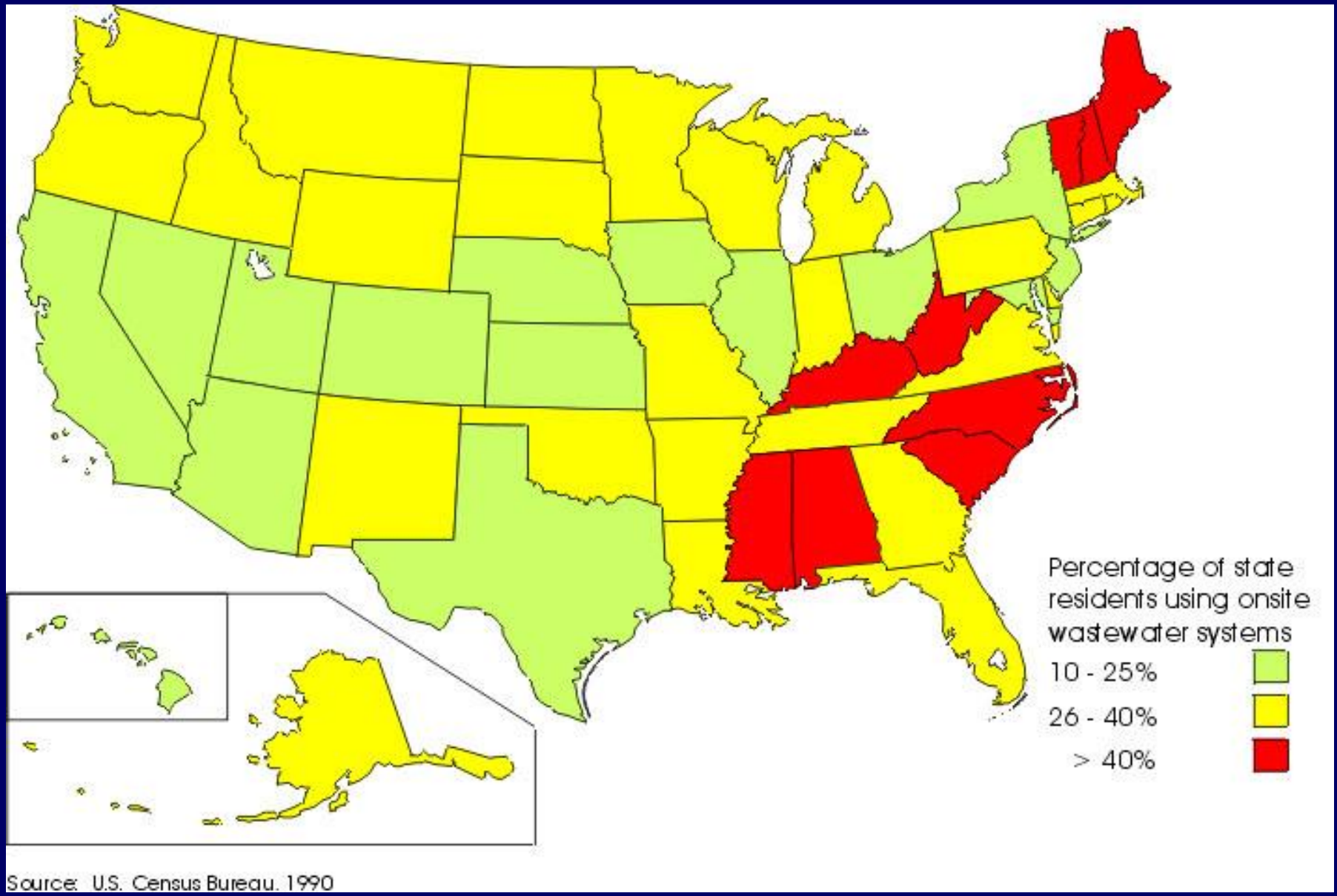
U.S. EPA/NSCEP
P.O. Box 42419
Cincinnati, Ohio 45242-0419

Send an email to ncepimal@one.net
or call 1-800-490-9198 or (513) 489-8190

Summary of manual contents

- Background and use of OWTSs
- Management of onsite systems
- System performance requirements
- Treatment processes and technologies
- Treatment system selection

Background and use of OWTSs



Current shortcomings

- Lack of clear performance requirements
- Few O&M or management programs
- Watershed/regional impacts often ignored
- Poor public outreach and education
- Little coordination with planning, zoning, water resource, and other agencies and stakeholders

Reasons for concern

- Public health
- Water quality
- Property values
- Community quality-of-life

OWTS pollutants of concern

Pollutant	Reason for Concern
Pathogens	Parasites, bacteria, and viruses can cause communicable diseases through direct/indirect body contact or ingestion of contaminated water or shellfish. Pathogens pose a particular threat when partially treated sewage pools on ground surfaces or migrates to recreational waters. Transport distances for some pathogens in surface or ground waters can be significant.
Nitrogen	Nitrogen is an aquatic plant nutrient that can contribute to eutrophication and depletion of dissolved oxygen in surface waters, especially in estuaries, and coastal embayments. Excessive nitrate-nitrogen in drinking water can cause methemoglobinemia in infants and pregnancy complications for humans. Livestock can also suffer health impacts from drinking water high in nitrogen.
Phosphorus	Phosphorus is an aquatic plant nutrient that can contribute to eutrophication of inland fresh waters and eventual depletion of dissolved oxygen.

Nutrients and bacteria from a variety of sources are primary pollutants in the U.S.

Leading Pollutants and Sources* Causing Impairment in Assessed Rivers, Lakes, and Estuaries

	Rivers and Streams	Lakes, Ponds, and Reservoirs	Estuaries
Pollutants	Siltation	Nutrients	Pathogens (Bacteria)
	Pathogens (Bacteria)	Metals	Organic Enrichment/ Low Dissolved Oxygen
	Nutrients	Siltation	Metals
Sources	Agriculture	Agriculture	Municipal Point Sources
	Hydromodification	Hydromodification	Urban Runoff/Storm Sewers
	Urban Runoff/Storm Sewers	Urban Runoff/Storm Sewers	Atmospheric Deposition

*Excluding unknown, natural, and "other" sources.

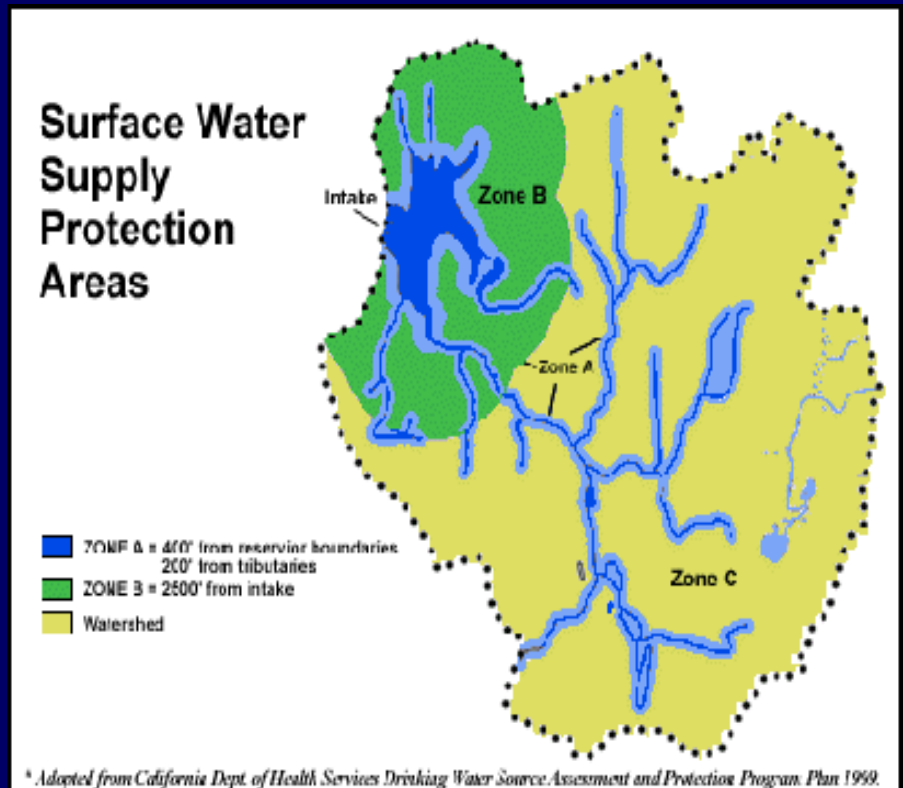
Onsite systems are a source of nutrients and bacteria

Onsite system failure rates

- U.S. Census Bureau Reports — 7-10%
- Nat'l Small Flows Clearinghouse — 10%
- Nelson, Dix, Shepard Survey — up to 70% ???

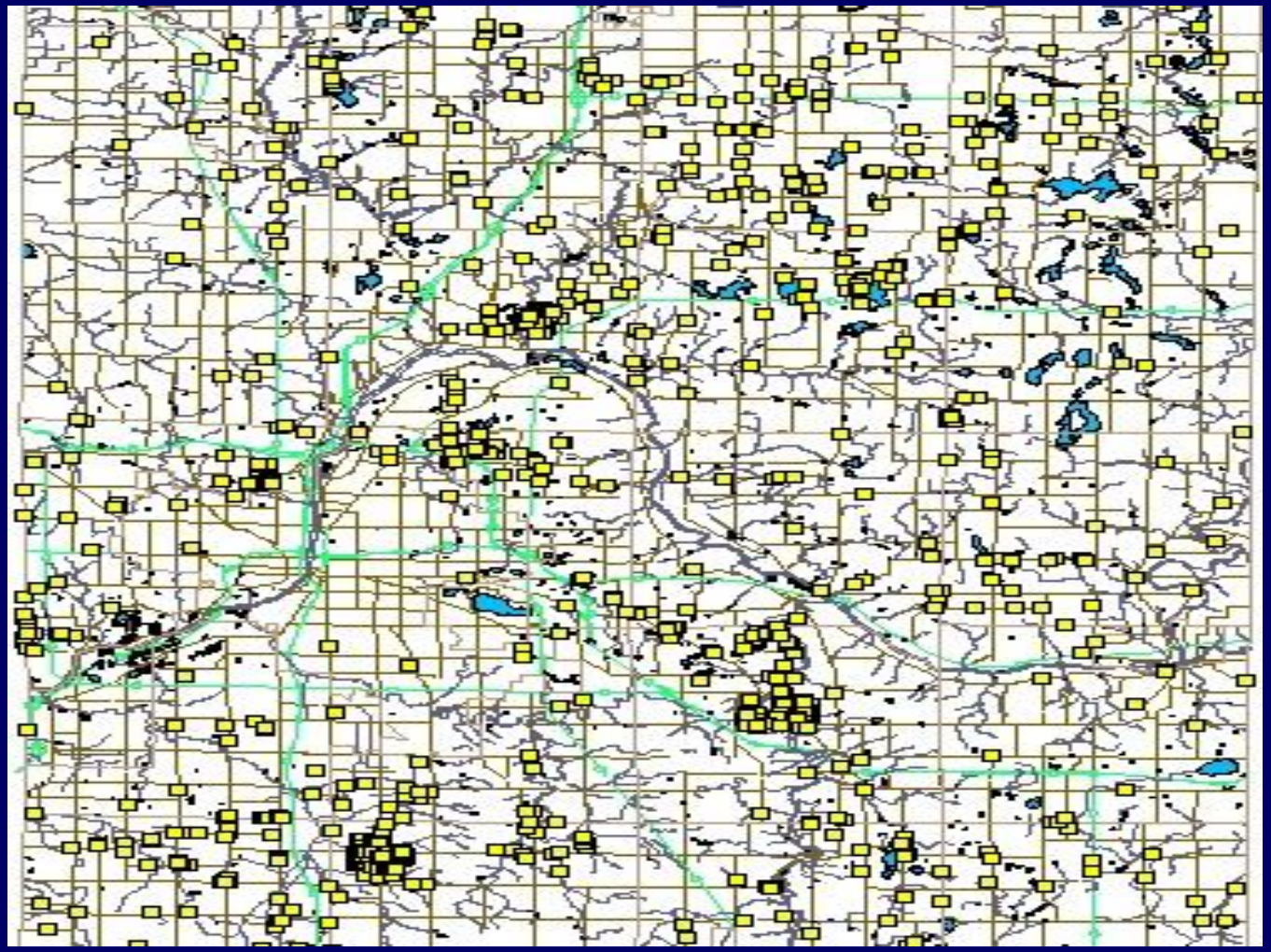
  - *Best professional judgement; failure definitions varied*

A significant number of community water systems list onsite systems as a potential contaminant source for drinking water supplies



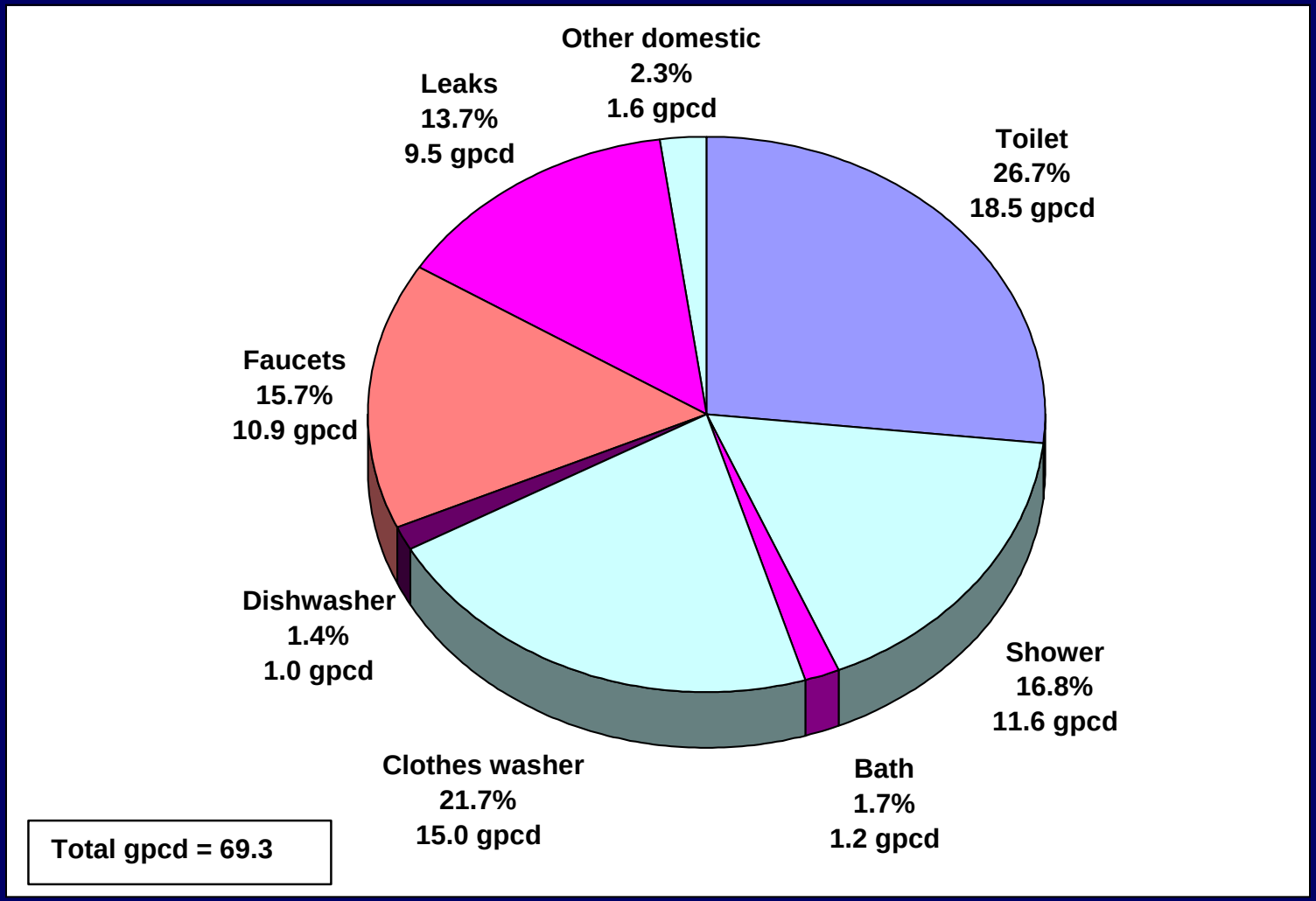
* Adapted from California Dept. of Health Services Drinking Water Source Assessment and Protection Program Plan 1999.

Elevated nitrate concentrations in groundwater in Kent County, MI



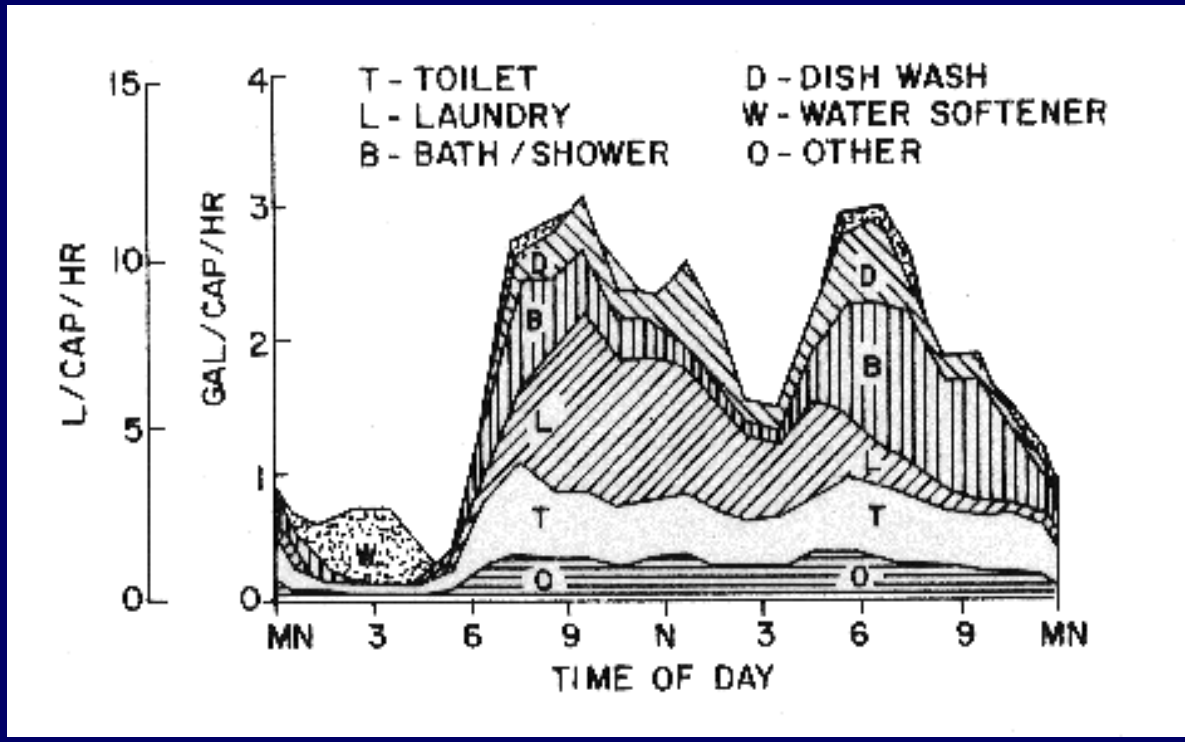
Source: Kent County Health Dept.

Residential wastewater sources/flows



Residential wastewater characterization: flow and strength analyses

- Estimate:
  - average daily flows (or use meter info)
  - hourly and instantaneous peak flows
  - wastewater strength (composition) using similar-facility comparisons or sampling info

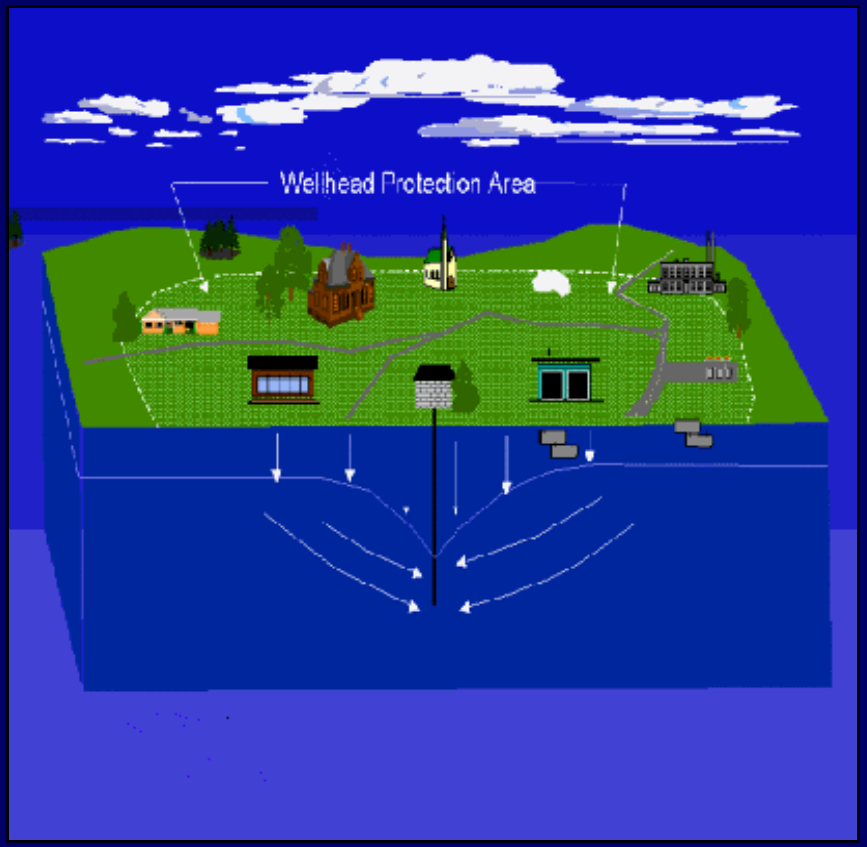


Wastewater strength can vary considerably

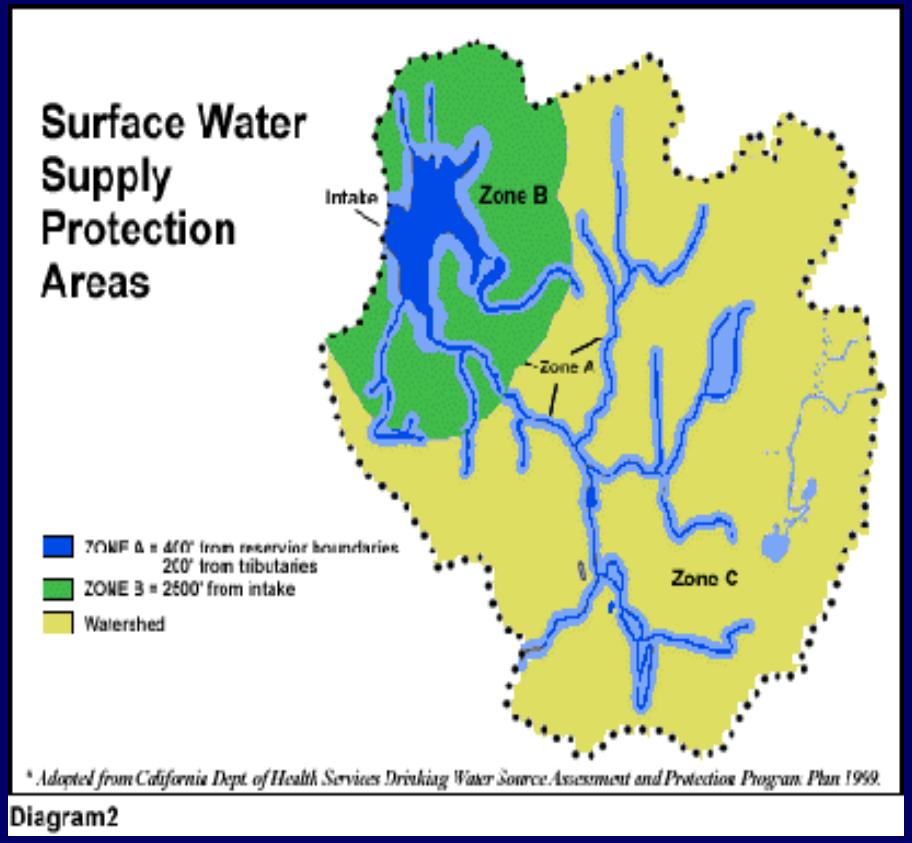
Constituent	Mass loading (grams/person/day)	Concentration[b] (mg/L)
Total solids (TS)	115–200	500–880
Volatile solids	65–85	280–375
Total suspended solids (TSS)	35–75	155–330
Volatile suspended solids	25–60	110–265
5-day biochemical oxygen demand (BOD_5)	35–65	155–286
Chemical oxygen demand (COD)	115–150	500–660
Total nitrogen (TN)	6–17	26–75
Ammonia (NH_4)	1–3	4–13
Nitrites and nitrates (NO_2-N; NO_3-N)	<1	<1
Total phosphorus (TP)[c]	1–2	6–12
Fats, oils, and grease	12–18	70–105
Volatile organic compounds (VOC)	0.02–0.07	0.1–0.3
Surfactants	2–4	9–18
Total coliforms (TC)[d]	–	10^8–10^{10}
Fecal coliforms (FC)[d]	–	10^6–10^8

Consider source water protection areas when establishing performance requirements

Ground Water



Surface Water



Onsite Regulation in Washington

- http://www.doh.wa.gov/ehp/ts/waste.htm
- http://www.doh.wa.gov/ehp/ts/ww/Prop-Treatment-Prod-RSG-1-10-2005.pdf
- http://www.doh.wa.gov/ehp/ts/WW/246-272a-wac-final.pdf

Regulatory Jurisdictions For On-Site Wastewater

Systems design flow:	Jurisdiction
0 - 3,500 gallons per day	Local Health Officer
3,500 - 14,500 gallons per day	Washington State Department of Health
Above 14,500 gallons per day	Washington State Department of Ecology

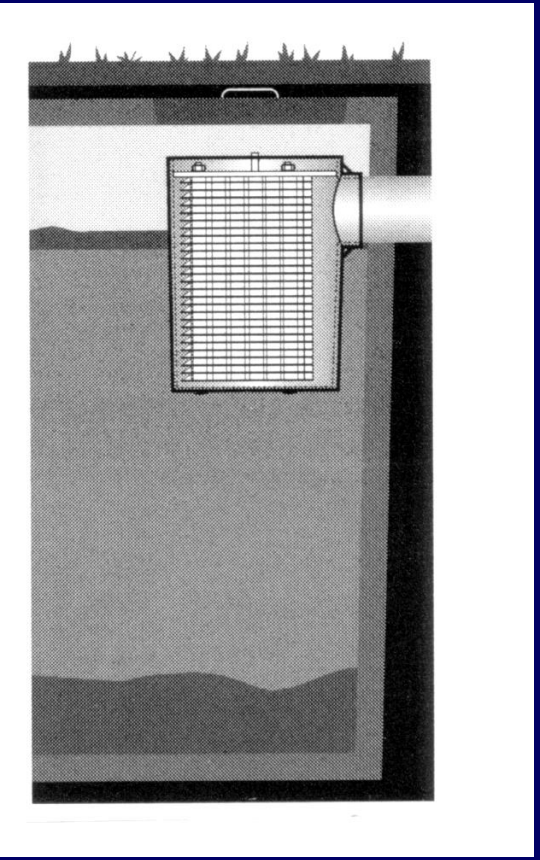
- The **Local Health Officer** has authority and approval over;
  - (a) Systems with design flows through any common point up to 3,500 gallons per day.
  - (b) Any Large On-site Sewage System for which jurisdiction has been transferred by the department to a local health jurisdiction by contract. Counties with such agreements currently include Clallam, King, Kitsap, Thurston and San Juan.
- The **Washington State Department of Health** (Large On-Site Program) has authority and approval over:
  - (a) Sewage systems with design flows through any common point between 3,500 to 14,500 gallons per day.
  - (b) Any Large On-site Sewage System for which jurisdiction has been transferred to the department of health under conditions of memorandum of agreement with the Department of Ecology.
- The **Washington State Department of Ecology** has authority and approval over:
  - (a) Domestic or industrial wastewater under chapter 173-240 WAC.
  - (b) Sewage systems using mechanical treatment, or lagoons, with ultimate design flows above 3,500 gallons per day.
  - (c) Sewage systems with subsurface disposal with ultimate design flows above 14,500 gallons per day.
  - (d) Any system utilizing subsurface disposal which has received a federal or state construction grant administered by Ecology.

Washington LOSS

- LOSS WAC, Chapter 246-272**B**

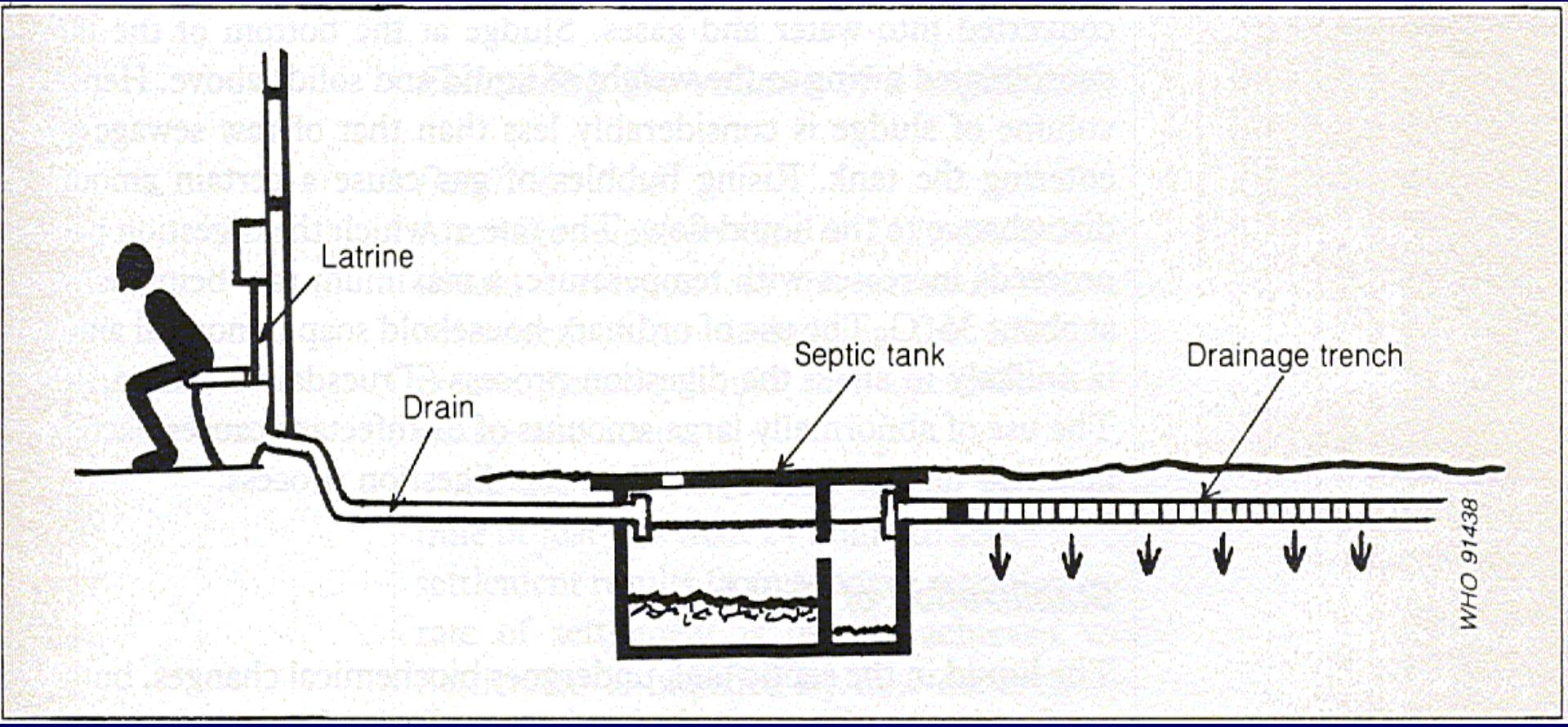
- Reviews and approves LOSS project applications.
- Performs "pre-site" (soils) inspections and "final" (post construction) inspections for LOSS projects.
- Issues and tracks operating permits for LOSS projects approved or constructed after July 1, 1984.
- Conducts enforcement actions (for LOSS failures).
- Provides LOSS project-related technical assistance.
- Reviews and approves septic tank applications.

Typical treatment train components



- Septic tank(s)
  - Single or multiple compartments
  - Watertight; sized for peak flows
  - Equipped with effluent screen to protect SWIS
- Subsurface wastewater distribution
  - Trenches filled with gravel
  - Gravelless trenches (chambers)
  - Pressure-dosed systems
- Alternative systems

On-Site Waste Disposal Systems



On-site Septic Tank-Soil AbsorptionSystem

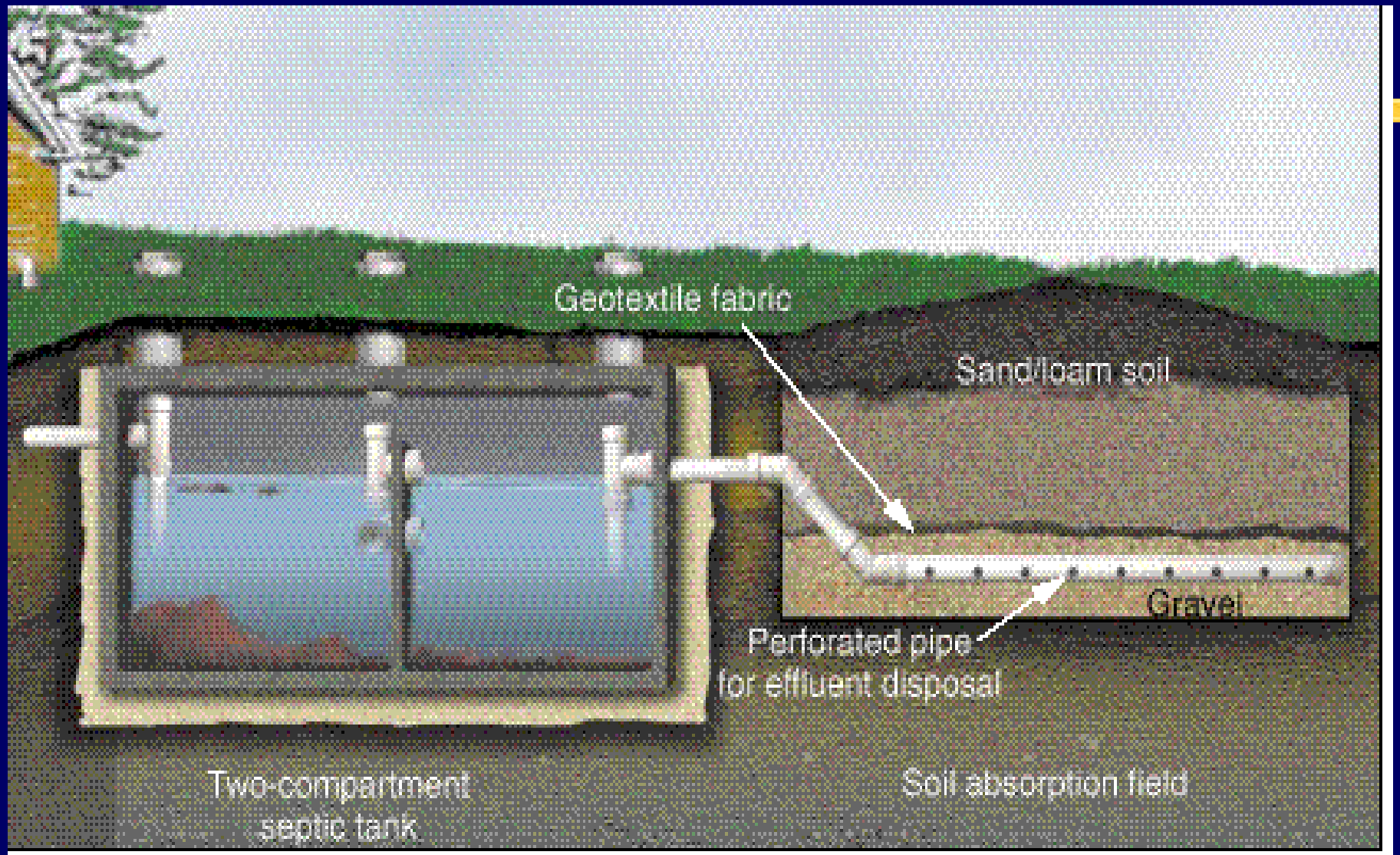


Figure 1: A septic tank and soil absorption field system.

Septic Tank-Soil Absorption System for On-Site Sewage Treatment

- Used where there are no sewers and community treatment facilities: ex.: rural homes
- Septic tank: solids settle and are digested
- Septic tank effluent (STE) is similar to primary sewage effluent
- Distribute STE to soil via a sub-surface, porous pipe in a trench
- Enteric microbes are removed and retained by the soil and biodegraded along with STE organic matter; extensive enteric microbe reductions are possible
- Viruses and other smaller pathogens can migrate through soil and reach ground water if the soil is too porous (sand) and the water table is high
- STE and pathogens can migrate to surface if soil is too impervious (clay soils)

On-Site Septic Tank-Soil Absorption Systems

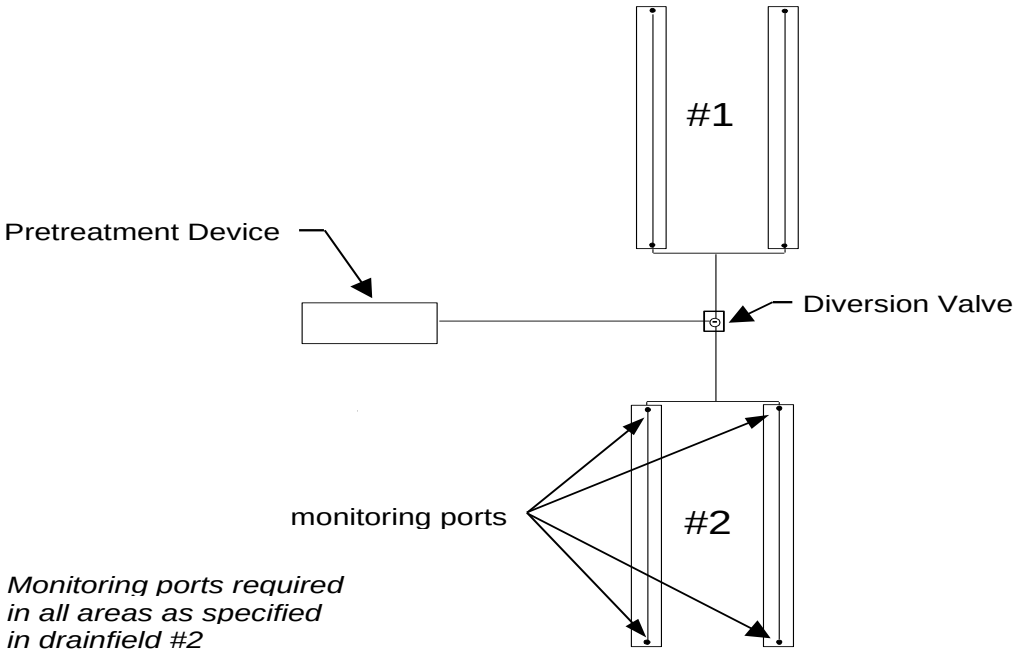
- Septic Tank:
- Receives sewage from household
- Two compartments: increase residence time & prevent short-circuiting
  - first compartment for solids sedimentation
  - second compartment for additional solids settling and effluent discharge
- Absorption System: Distribution lines and drainfield
- Septic tank effluent flows through perforated pipes located 2-3 feet below the land surface in a trenches filled with gravel, preferably in the unsaturated (vadose) zone.
- Effluent discharges from perforated pipes into trench gravel and then into unsaturated soil, where it is biologically treated aerobically.

Treatment train components (cont.)

- Alternative systems
  - Mounds, at-grades, intermittent or recirculating filters
  - Aerobic units
  - Vegetated submerged beds

More on treatment processes and systems after lunch!

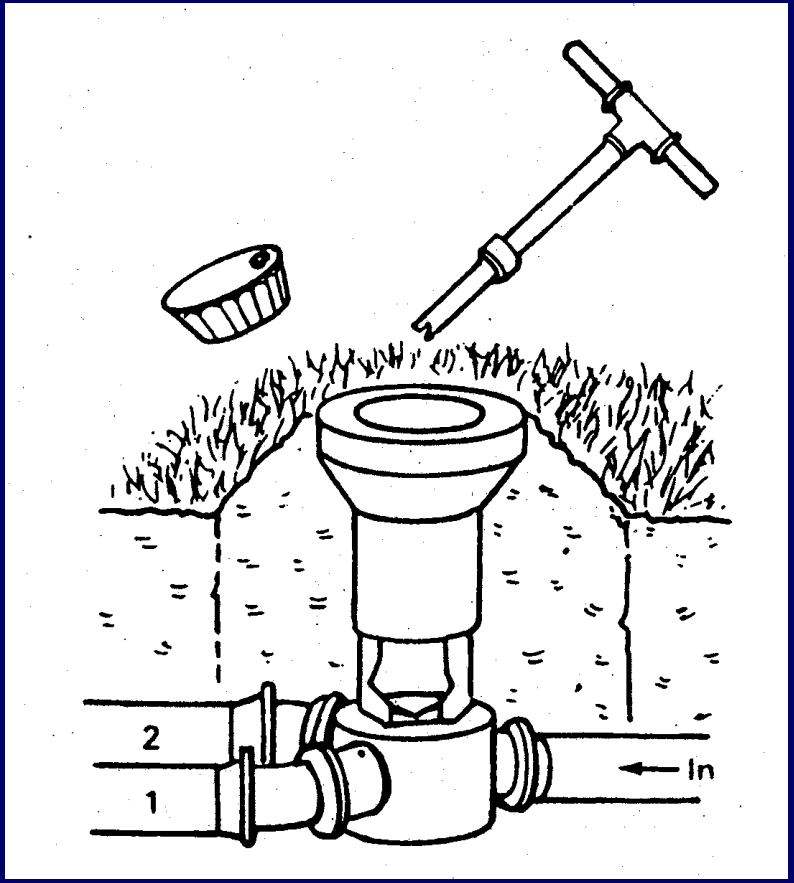
Alternating Drainfields



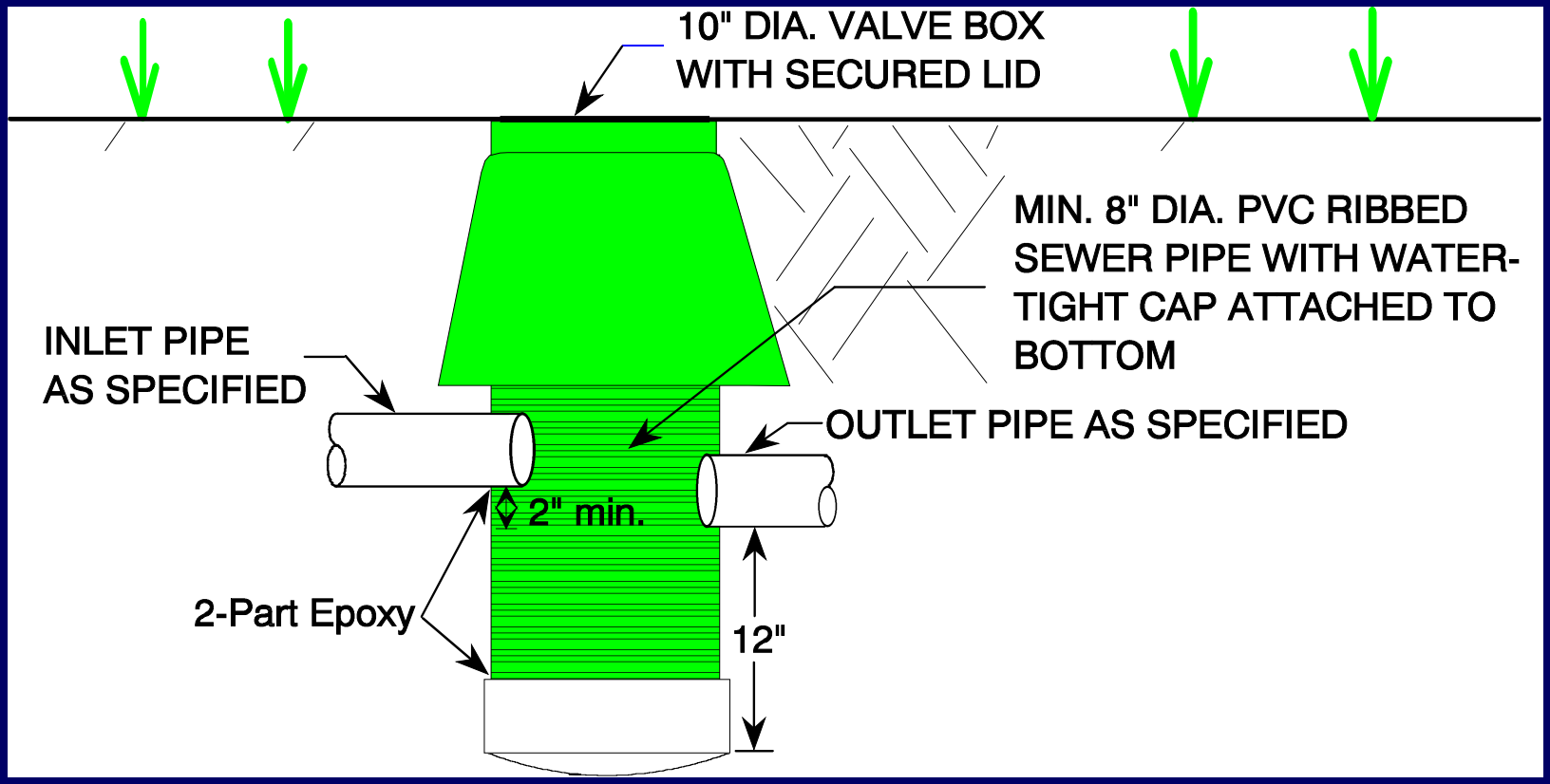
NOTE: #1, and #2 each represent 100% of the drainfield area required.

Example of Alternating Drainfields

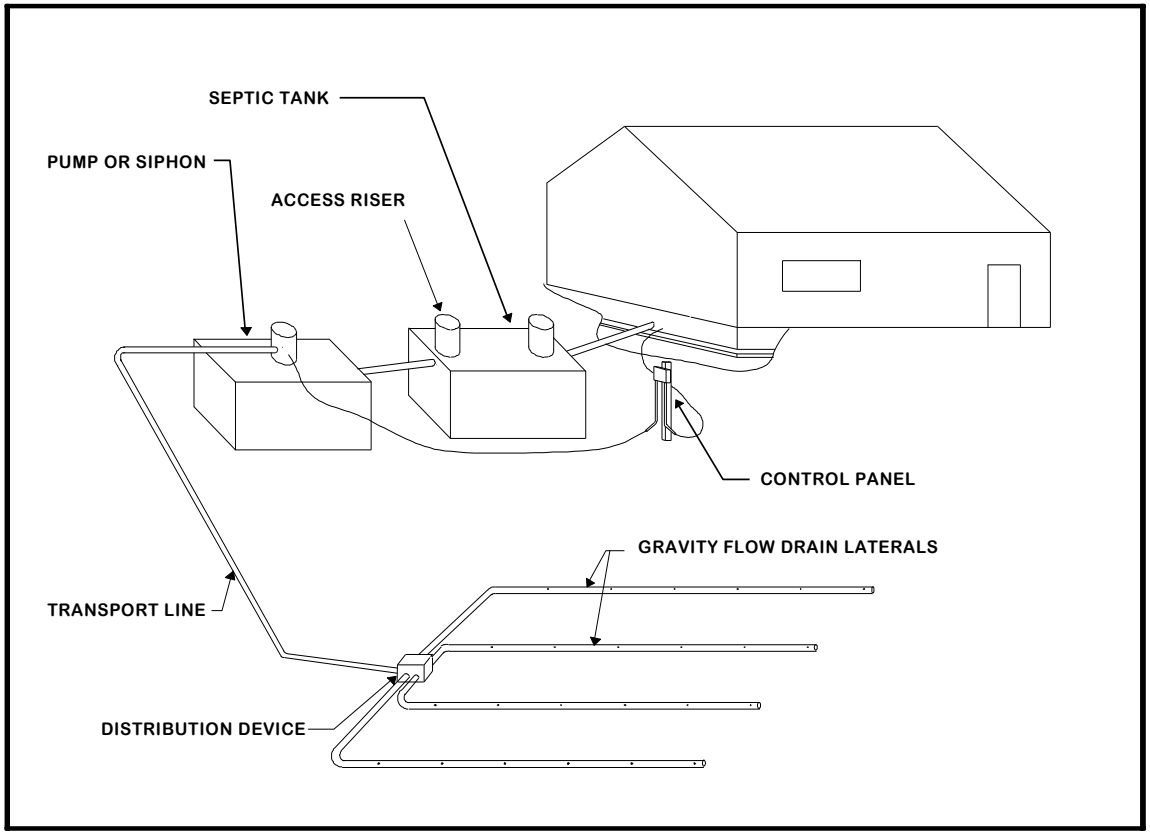
Typical Diversion Valve



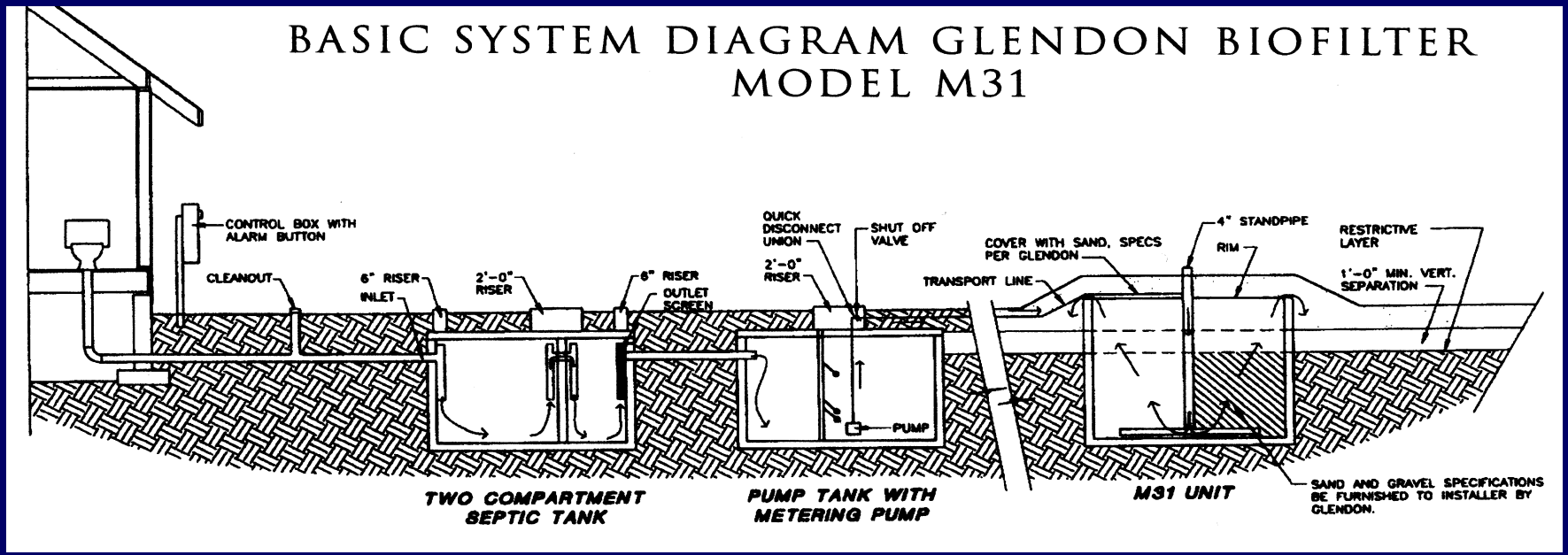
Inline Sampling Port for ATU, UMF, and Proprietary Packed Bed Systems



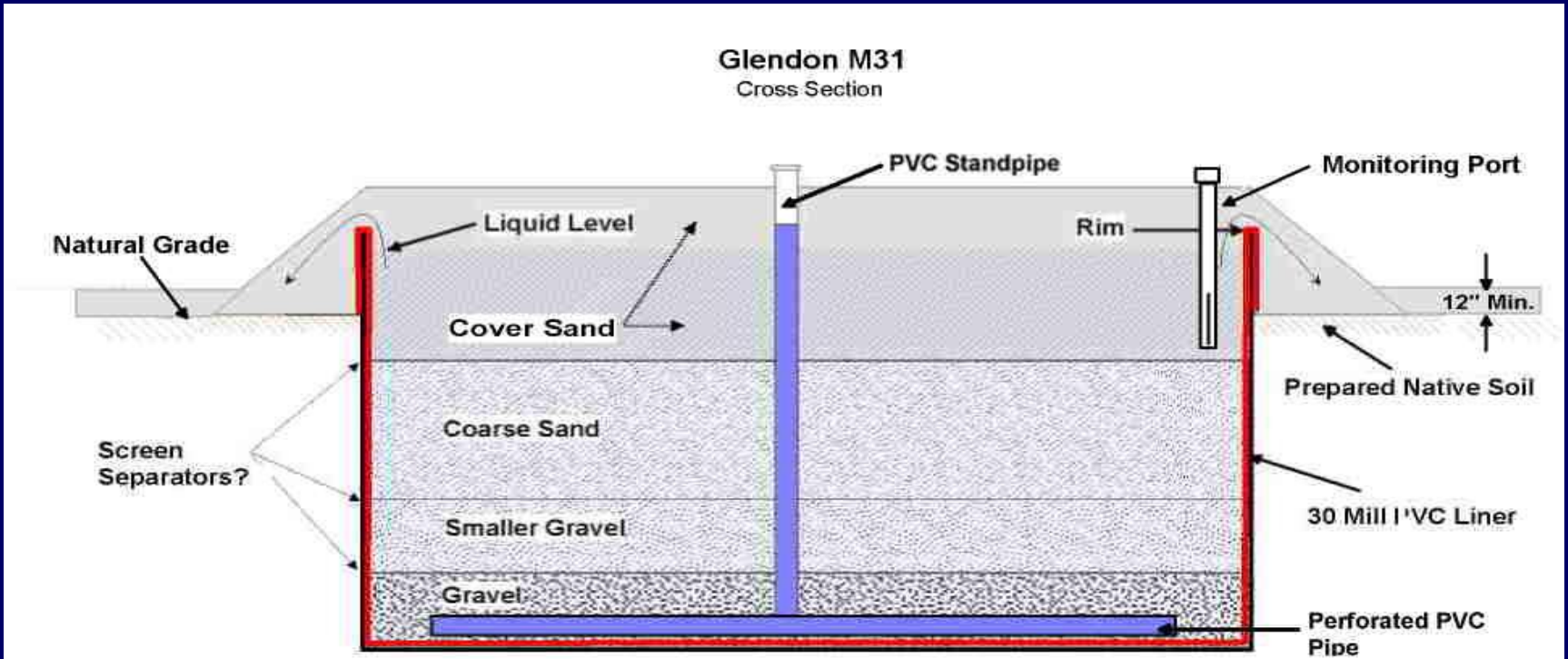
Typical Setup for Dosing Gravity Drainfields



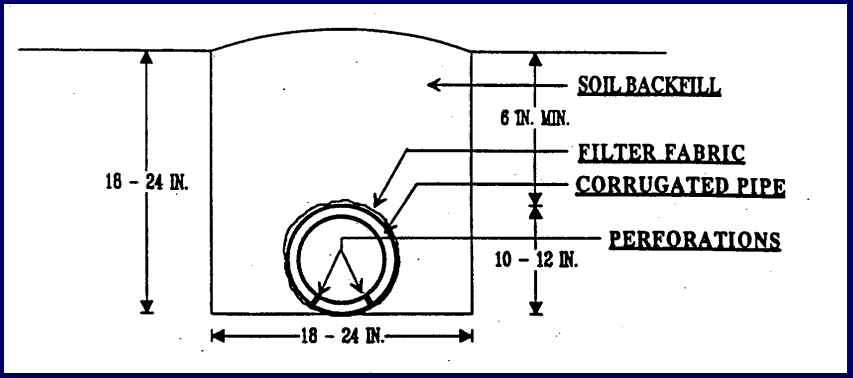
Glendon Biofilter

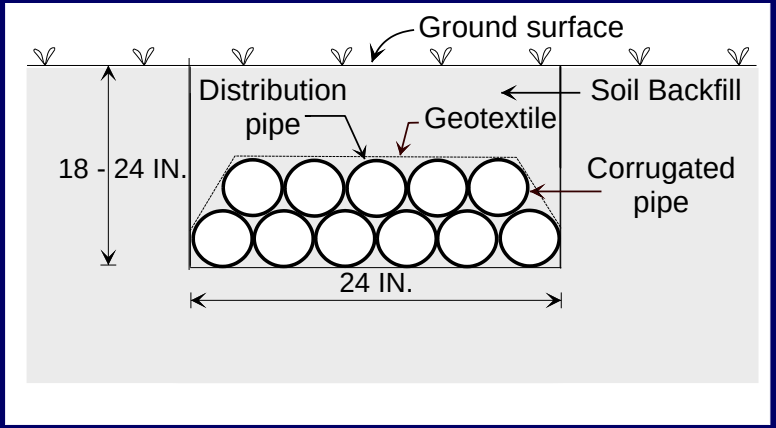


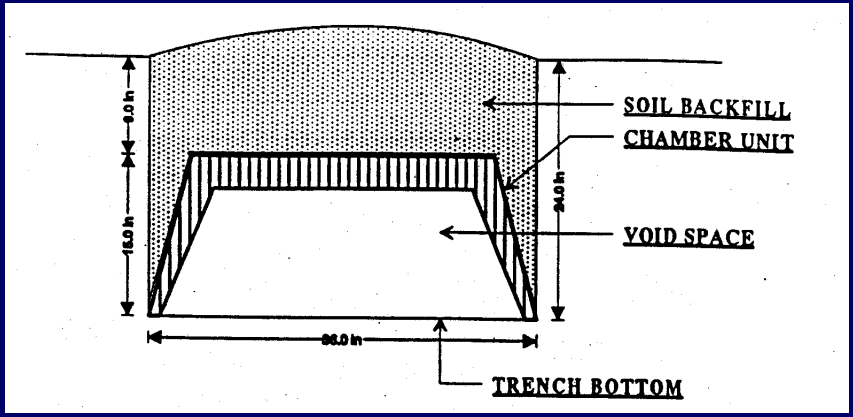
Glendon Biofilter



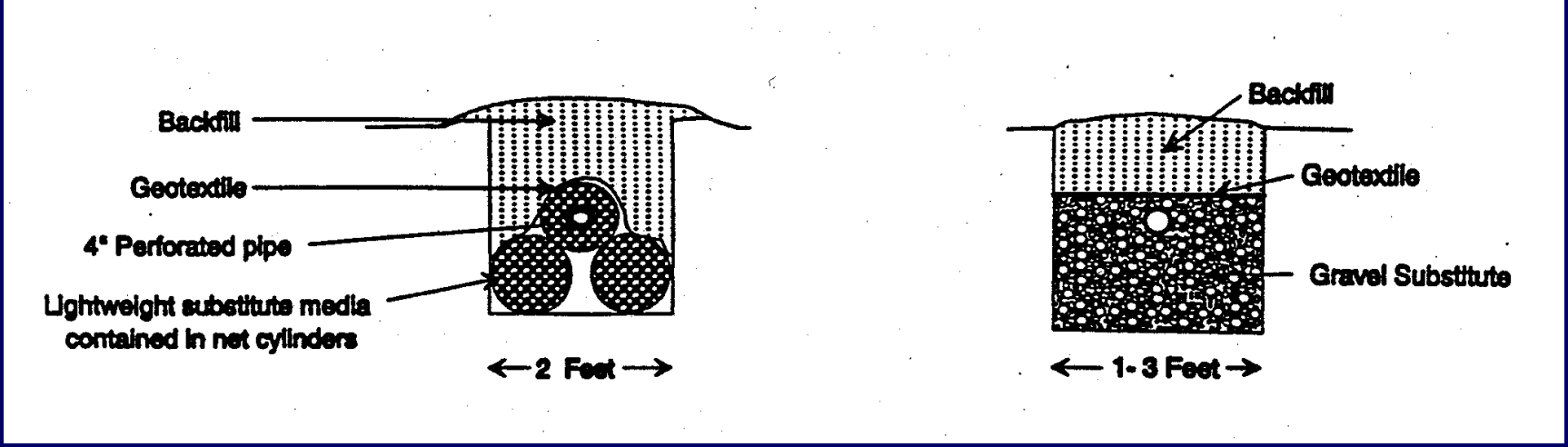
Gravelless Drainfields



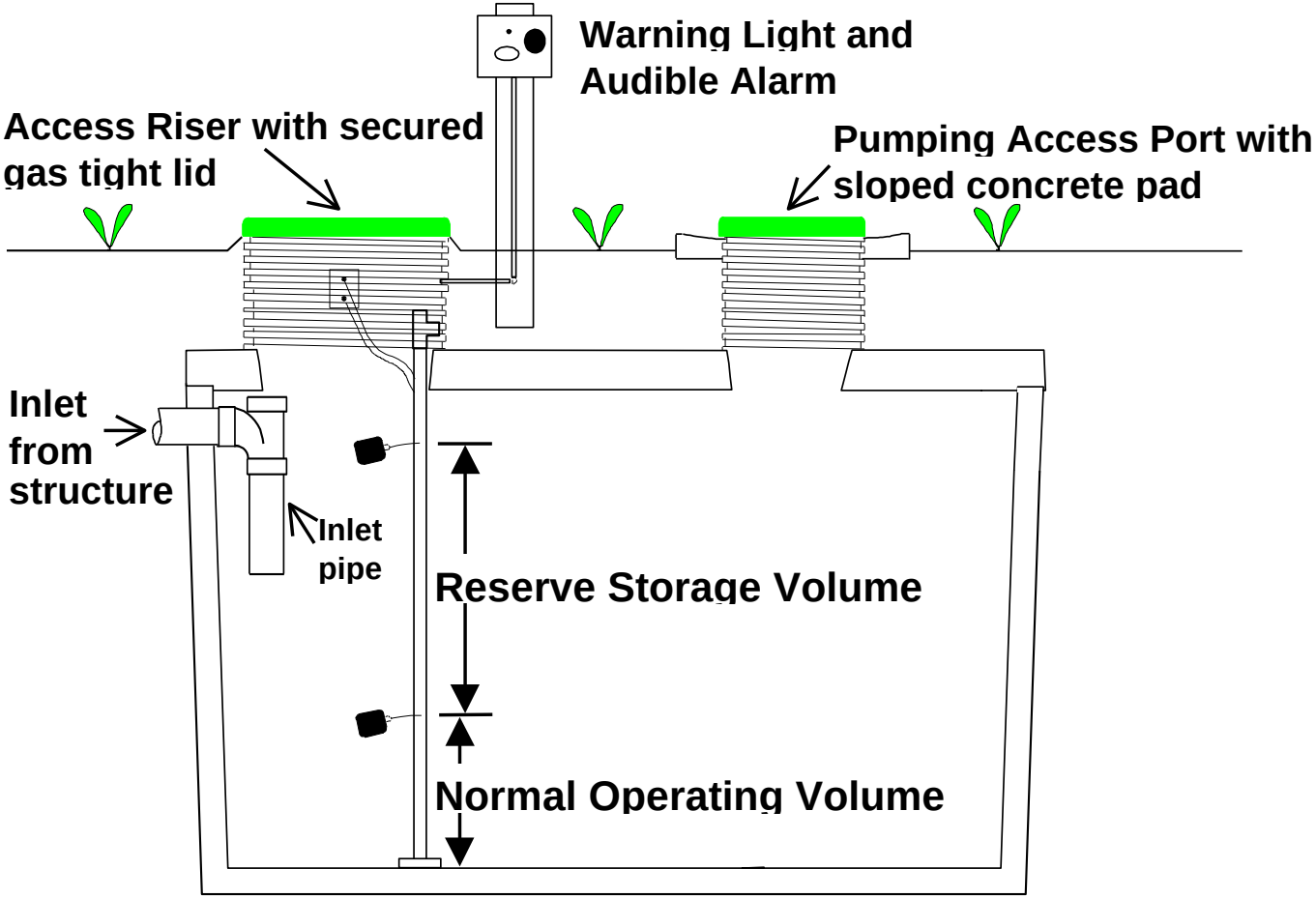




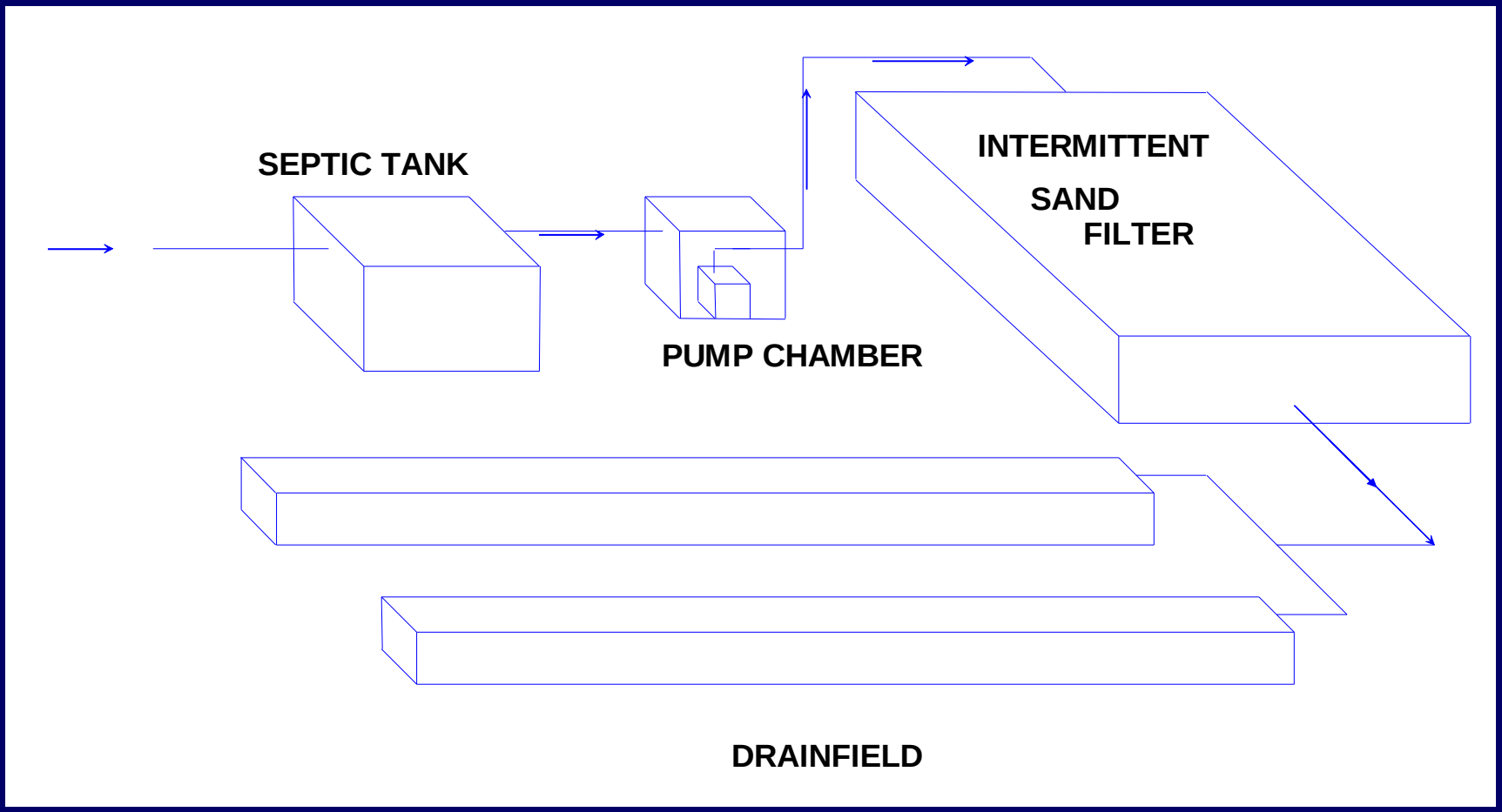
Gravel Substitutes



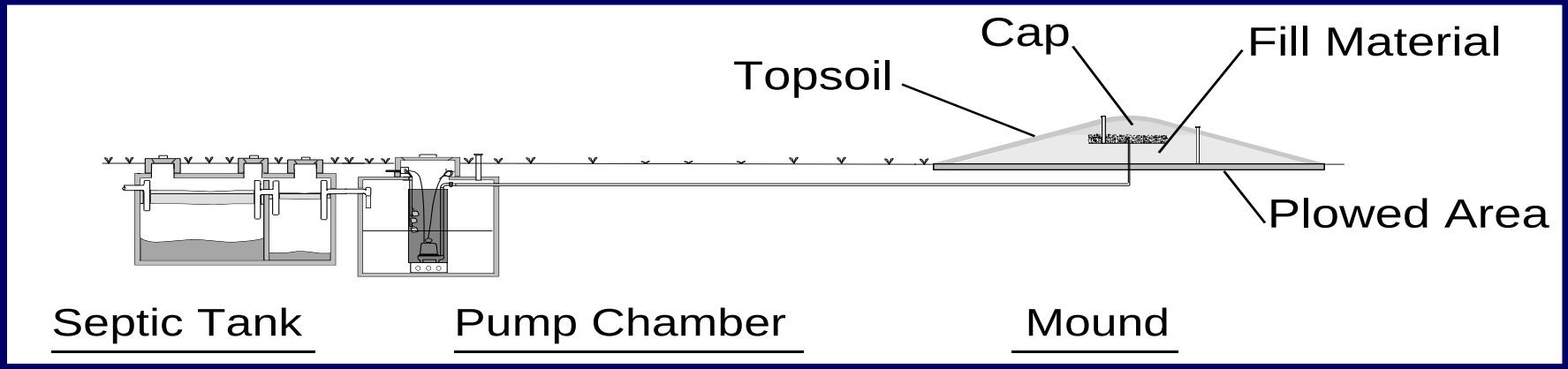
Holding Tank System

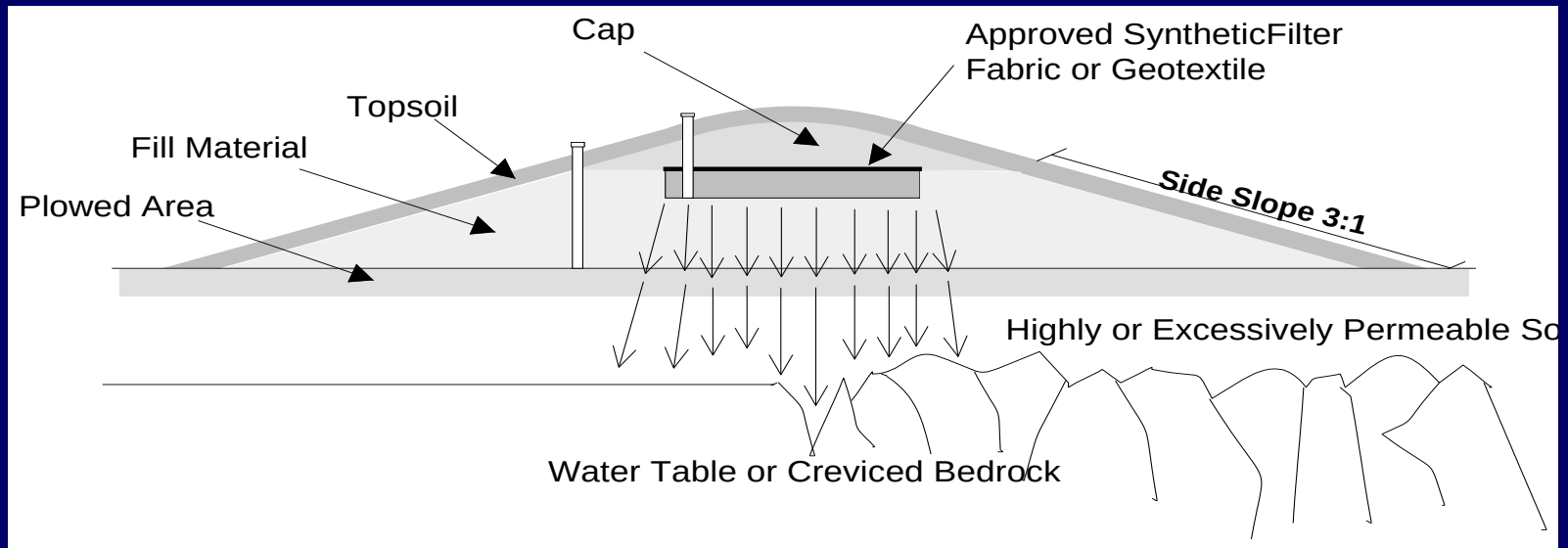


Intermittent Sand Filter

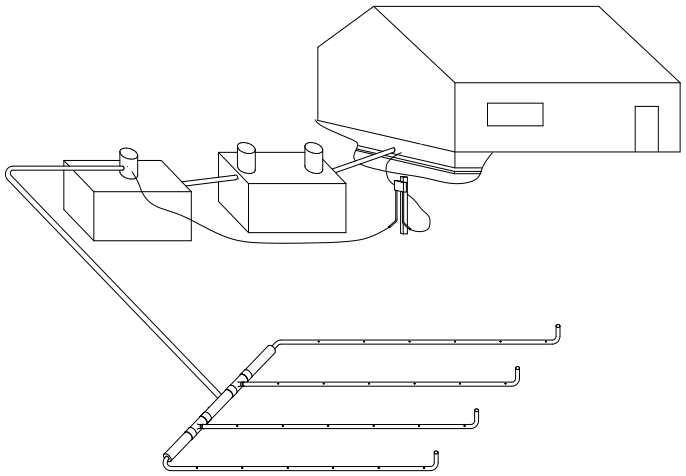


Mound Systems

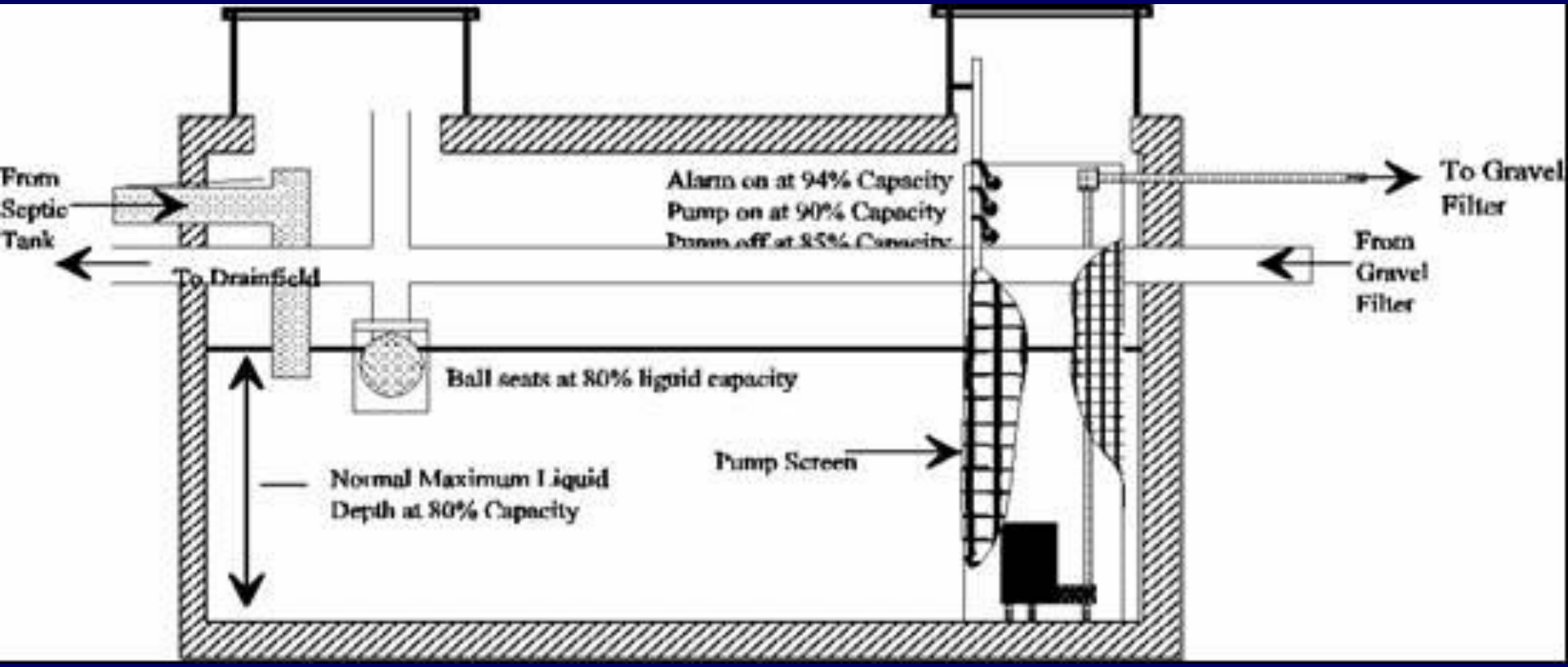




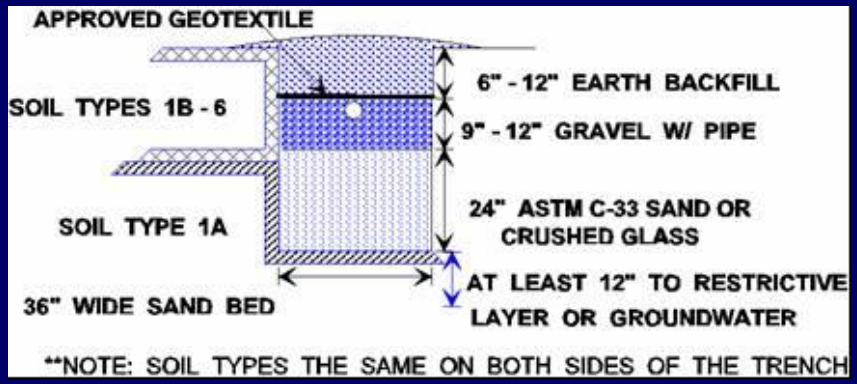
Pressure Distribution Systems

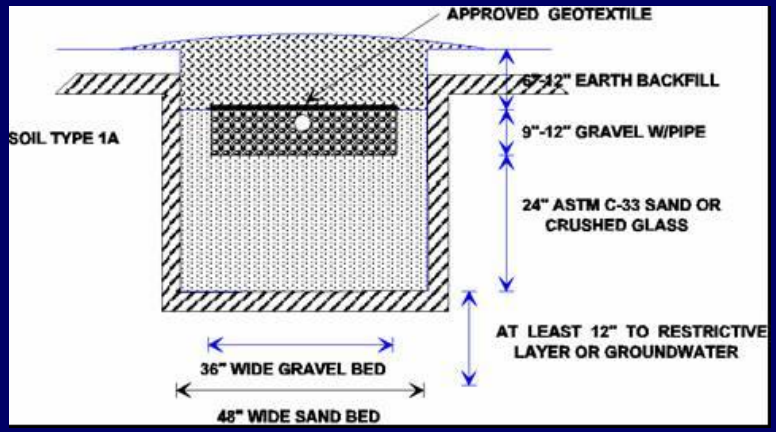


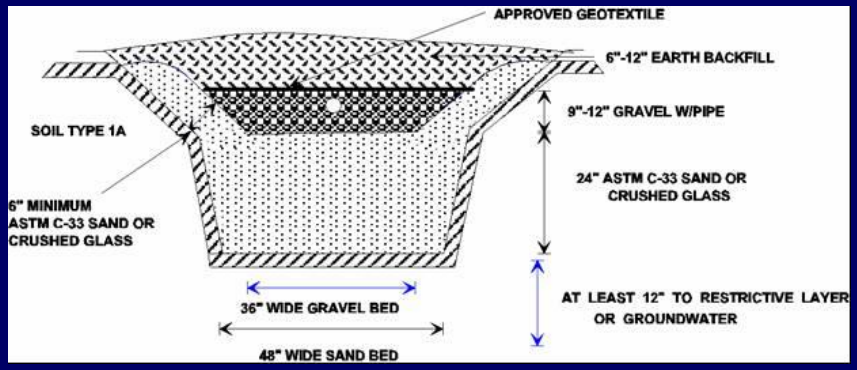
Recirculating/Mixing Systems

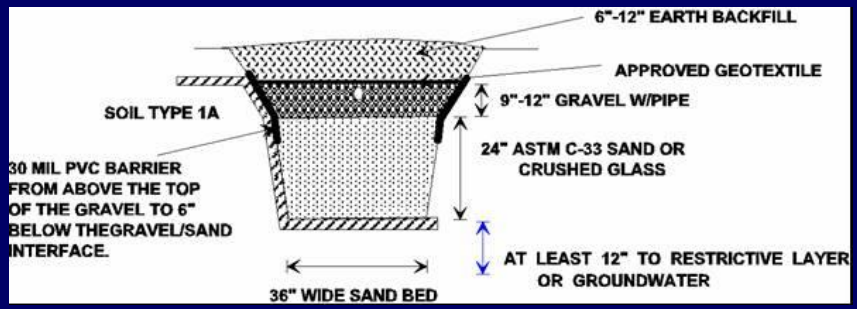


Sand Lined Trench Systems

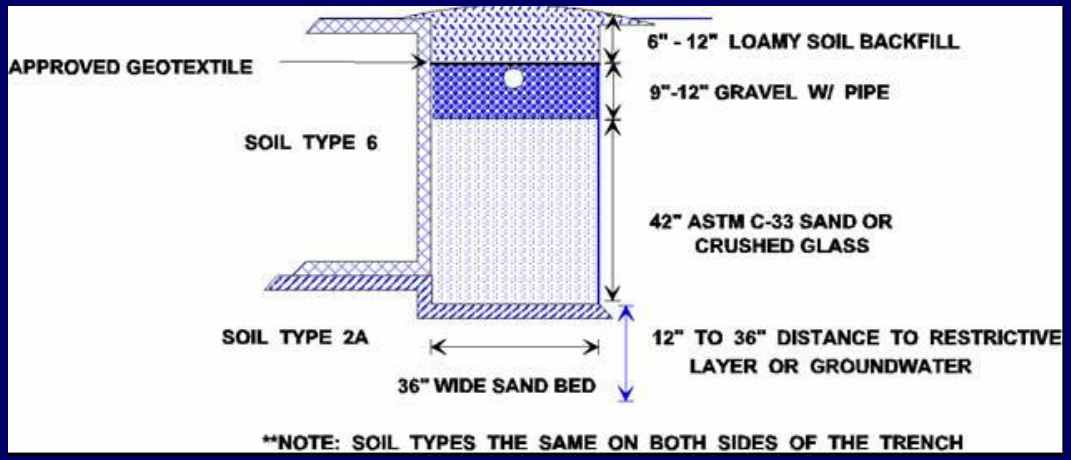


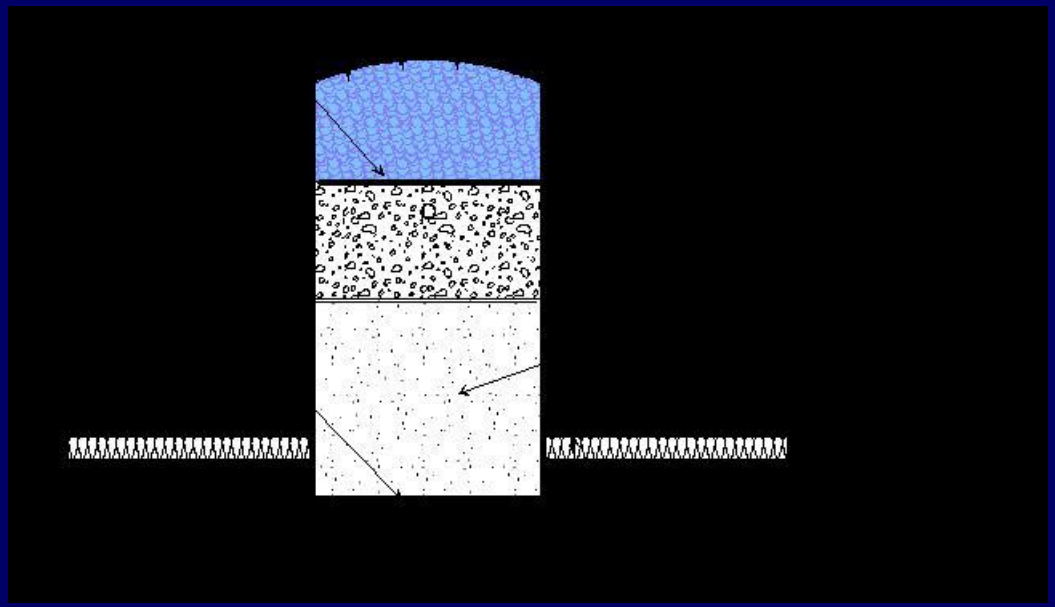




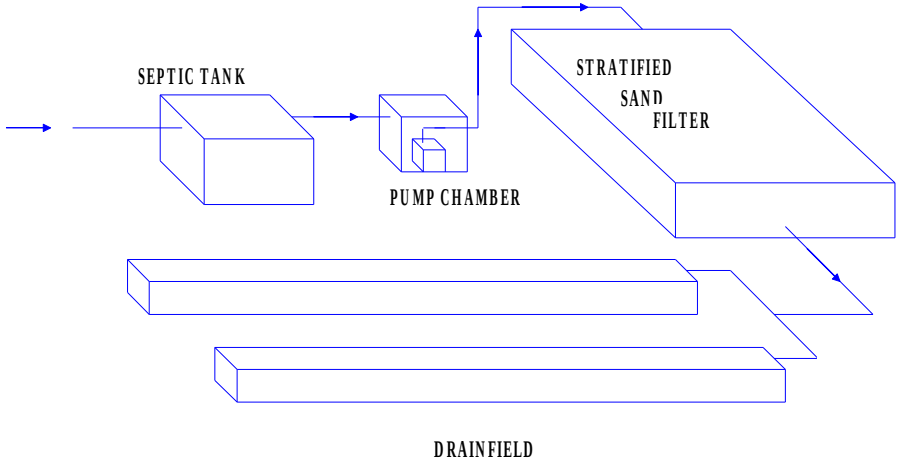


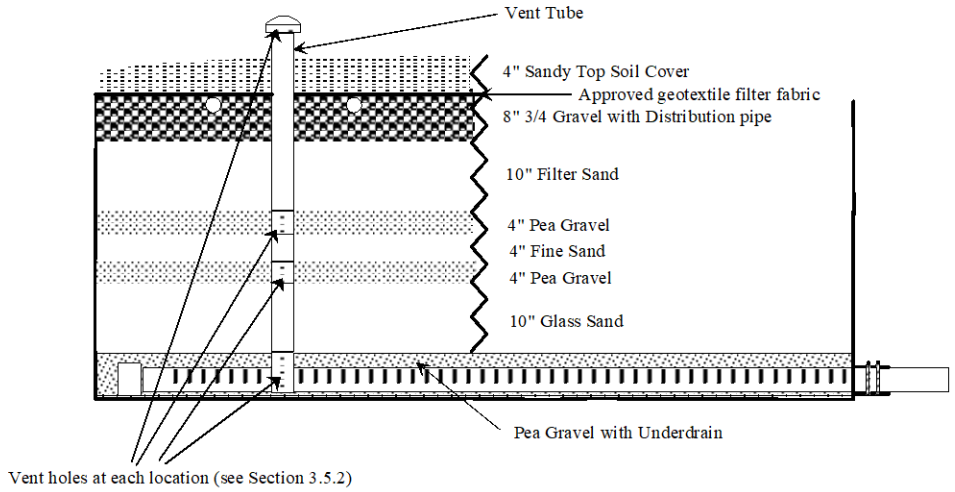
Other Sand Lined Trenches



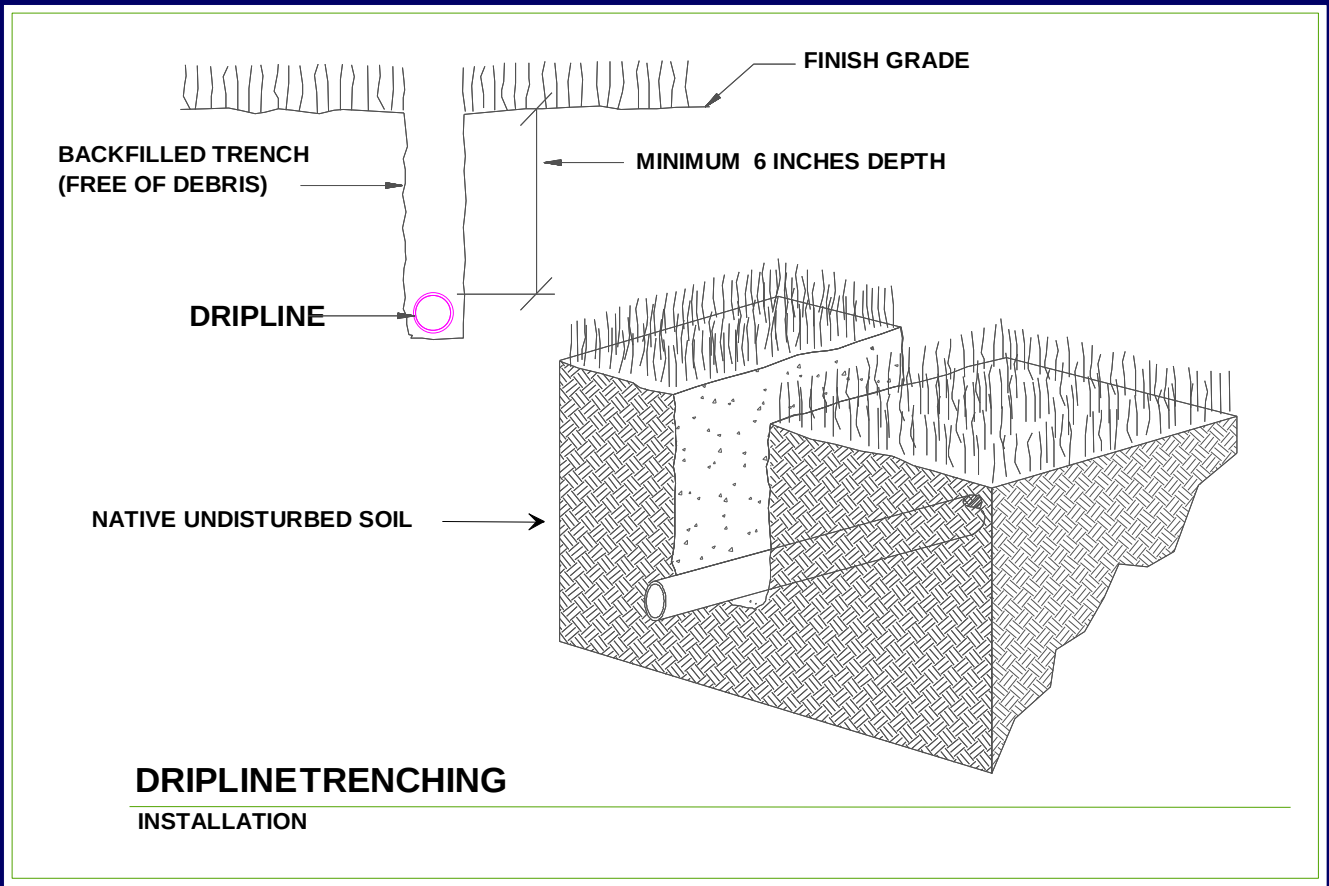


Stratified Sand Systems





Drip Systems



Cluster System