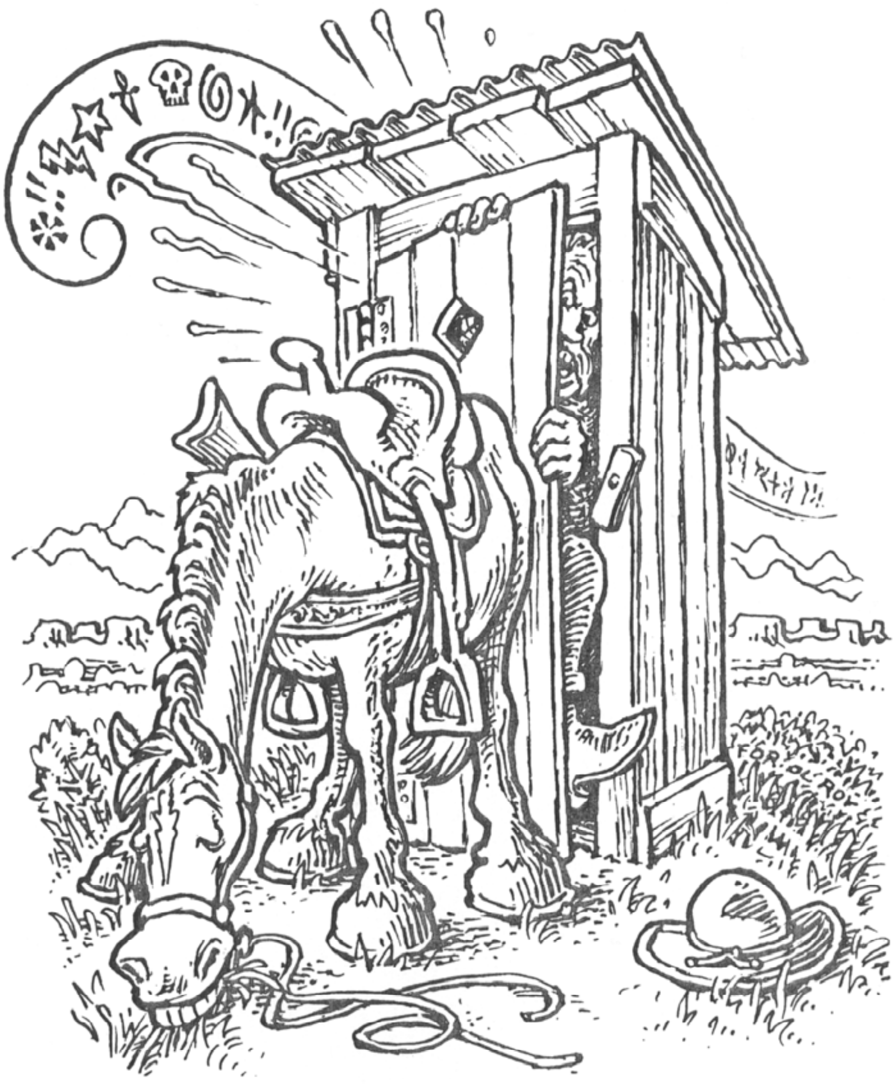
Onsite Sewage Treatment Systems



What is Onsite Sewage Treatment and Why is it Important

Onsite Wastewater Treatment Systems

What is it?

Proper treatment of wastewater is necessary for the health and well being of individuals, the environment and the communities in which we live.

Utilizing soils and the complex biological community living within the soils is a proven method of onsite wastewater treatment.

Why it is important

As we increasingly populate rural and suburban areas we move further from city centers that offer the community services of more populated regions. In many areas onsite wastewater disposal systems were intended to meet the short term need of those living on the outskirts of town until sewer lines showed up. And the systems were just that, disposal systems. However, after 20 to 30 years or more, many communities decided they were not interested in increasing community services and their associated fees. As populations continue to increase and our watersheds become further impacted, an emphasis from the out-of-site, out-of-mind sewage disposal process has been transformed to the science of onsite wastewater treatment. Improper treatment of wastewater can and has resulted in contamination of watershed systems and has resulted in serious health issues for individuals and communities.

Governing Bodies

The local agency, which governs residential wastewater, is the Humboldt County Division of Environmental Health (DEH). For larger systems, averaging 1,500-gallons or more, the State of California Regional Water Quality Boards are the primary governing bodies. Currently in California there exist 9 regional boards. Each regional board provides some general regulations and defers many of the specifics to the local governing agency, typically the local county health department. As a result, each county has its own specific guidelines, and they do vary. Therefore, if you are working in multiple counties, it is important to understand the local jurisdictions regulations.

Locating a Leachfield - Before You Act!

For many people, when developing a home site emphasis is placed on where the home will go, what views they will have and where access to the home will be. However, there are times when requirements for **locating the leachfield take precedence**. Due to the limitations on locating a leachfield and setback requirements from steepness of slopes, springs, wells and groundwater, etc. locating a leachfield can take precedence over locating a home site or road way. All too often landowners have destroyed the only suitable leachfield site by bringing in heavy equipment and altering the original ground surface or creating additional obstacles.

It is important to have a firm understanding of the local geology, and how water, both surface and subsurface, interacts with the local geology. Additionally, much of Humboldt County has been logged at least once. The effects of logging, road building and the use of heavy equipment on the land can have serious effects on site suitability for a leachfield. Finding a suitable site for a leachfield can make the difference between a buildable parcel and a non-buildable parcel.

Before you act, call someone!

How Treatment of Wastewater is Accomplished Onsite

Typically, household wastewaters, whether flushed down a toilet along with human waste, showers/ baths, or kitchen, leave the residence through gravitational forces and enter into a septic tank. Typical septic tanks are two compartment tanks with a 2/3 (for solid retention), 1/3 (liquid) split, where solids settle out from the mix and the fluids, or effluent, continue to the drainfield. The drainfield is often commonly referred to as the leachfield or disposal field and that is where the real treatment of effluent occurs.

Soil is classified based on its Sand-Silt-Clay content. Coarse grained soils tend to percolate water at a faster rate than soil rich in clay. However, if a soil is too sandy, it may percolate too fast and thereby not provide adequate treatment of effluent before it enters into the local water systems. Soils very rich in clay may not percolate at all and thereby provide no treatment. Continuing to add effluent to a leachfield that does not percolate could result in raw sewage surfacing to ground level, a considerable health hazard.

Soils plotting within Zones 3 and 4 of the Soil Percolation Suitability Chart (Fig. 1) require wet-weather percolation testing. Soils plotting in Zone 1 of the Soil Percolation Suitability Chart may not have enough fine grained materials to adequately filter effluent and therefore a separation to ground water of up to 40 feet may be required. Soils plotting within Zone 2 of the Soil Percolation Suitability Chart are preferred for onsite sewage treatment.

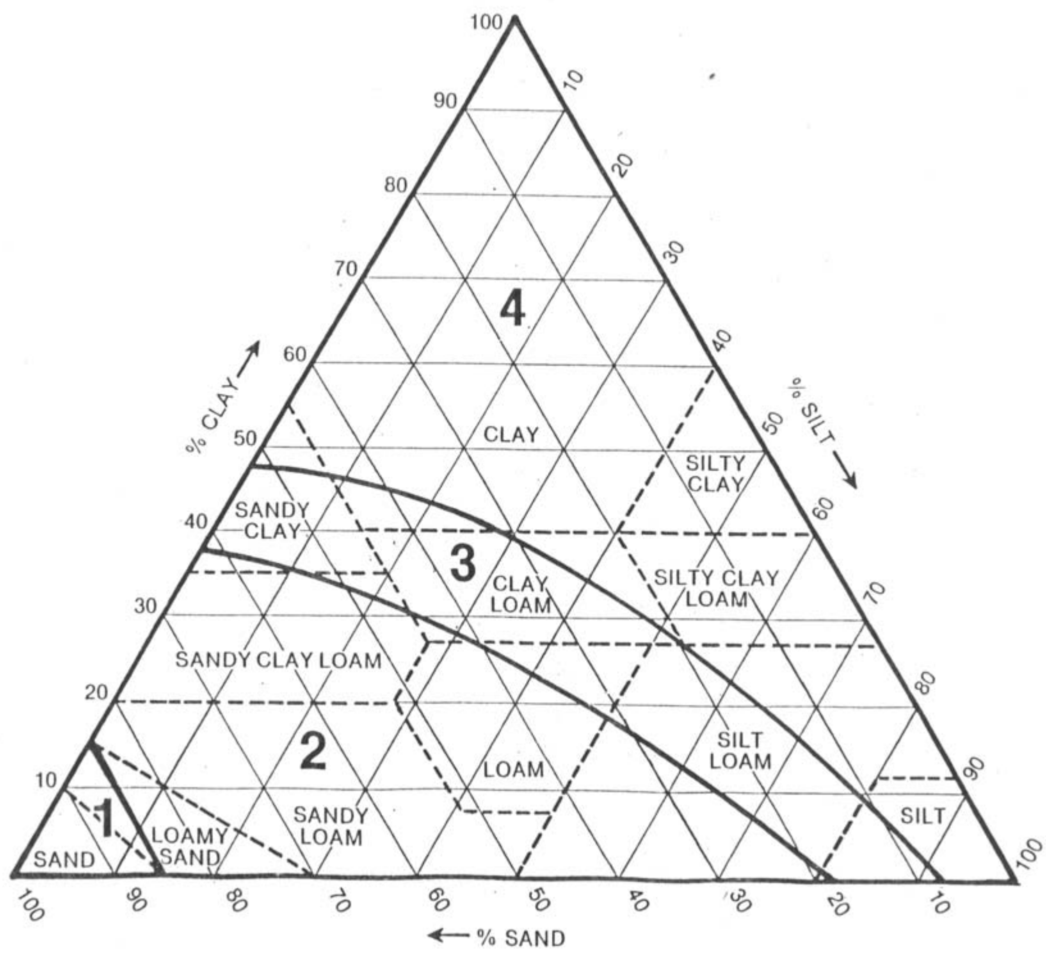


Figure 1: Soil Percolation Suitability Chart

Introduction to Site Investigations

Current County and State of California regulations require that ample space is designated for both a primary and a reserve, or replacement leachfield for each proposed and existing structure. The primary leachfield will be constructed for treatment of the proposed wastewater load, and the replacement area is designated for leachfield use if the proposed primary leachfield fails. It will be required that the reserve leachfield area(s) remain unimproved through the placement of permanent structures, roads, parking areas, etc. However, reserve areas can be improved through the use of vegetation, occasional light recreational use such as picnic areas, unimproved camping, day use activities, etc.

Step 1: Initial Site Investigations
The initial step in determining a suitable leachfield site is a thorough investigation and evaluation of the site. There are a number of setback requirements that should be met when determining a suitable leachfield area before subsurface investigations begin (Table 1). Initial site investigations and the final site map should include: measurements from any springs, wells and/or watercourses that may exist on, or near, the property. Additionally, slope gradients measured in percent, proposed and/or existing building site location(s), existing septic systems, breaks in slopes, property lines, road ways, right of ways, easements (PG&E or otherwise), and any other distinguishing feature which may be used for relocating where testing should be located and or to relocate where testing was originally performed.

Table 1: Setback Requirements (based of the North Coast Regional Water Quality Control Board (NCRWQB) Basin Plan)

	If parcel is on a Public Water system		**If parcel is on a Private Water system, such as a well.**	
	Septic Tank	**Leachfield**	**Septic Tank**	**Leachfield**
Property Lines	5 Feet	10 Feet	25 Feet	50 Feet
Foundations of buildings or outside wall of mobile Home	5 Feet	10 Feet	5 Feet	10 Feet
Wells, springs, lake, reservoir	50 Feet	100 Feet	50 Feet	100 Feet
Perennial stream (one that does not dry up within a few weeks after it stops raining for the season)	50 Feet	100 Feet	50 Feet	100 Feet
Ephemeral Streams (Dries up within a few weeks after seasonal rains have stopped)	25 Feet	50 Feet	25 Feet	50 Feet
Fill area, top of cuts, or edge of steep slopes (>30%)	25 Feet	25 Feet	25 Feet	25 Feet
Unstable Land Forms	50 Feet	50 Feet	50 Feet	50 Feet
Swimming Pools	25 Feet	50 Feet	25 Feet	50 Feet

Step 2: Subsurface Investigations

Typically subsurface investigations are conducted through the use of a backhoe excavated test hole. Test holes typically range between eight (8) and ten (10) feet in depth and are usually backfilled that same day. Subsurface investigations are necessary to determine the nature and suitability of the soil for onsite wastewater treatment. Subsurface investigations often can provide important information as to the expected depth to groundwater during the wet weather season as well as to determine at what depths percolation testing should be performed.

Humboldt County DEH requires that a minimum of one (1) backhoe excavated test pit be advanced within each proposed leachfield area. If subsurface investigations determine that a particular area is unfavorable, it may require multiple test holes to find a suitable location. If the site is particularly sensitive to ground disturbance or compaction by heavy equipment, with prior permission from County Regulators, three hand auger subsurface exploration holes may be exchanged for one backhoe pit.

Step 3: Groundwater Monitoring

Depth to groundwater, along with soil type, is one of the most important factors in determining suitability for treatment of wastewater onsite. A stabilized depth to groundwater is most often determined by installing a groundwater observation well and conducting regular measurements to determine a stable groundwater level during the wet season. Understanding where the highest stabilized groundwater level is important when designing a healthy onsite sewage treatment system. A failure may be caused by flooding or by infiltration of groundwater into the leach trenches by seasonally high groundwater levels. Therefore a poorly designed system may contaminate groundwater and not allow sufficient filtration of effluent through soils beneath the leach trench prior to encountering any sensitive receptors (water, ground or surface).

Under current Humboldt County DEH regulations groundwater must be measured during a period of a minimum of three (3) consecutive weeks during the wet weather-testing season. Additionally, during that time there must be a minimum of one (1) ½-inch or greater rainstorm as measured at the national Weather service (NWS) on Woodly Island, Eureka, California. Groundwater observation wells must be installed for a minimum of 24-hours before the first readings can be taken.

In Humboldt County, DEH officially opens the wet weather testing season once the NWS, located in Eureka, California records a total of 19-inches of rainfall for that season. Typically that occurs by late December – early January. PWA has experienced seasons that opened earlier and seasons that did not open at all.

Additionally, DEH has a groundwater observation well notification fee. Current fees are at a rate of $141 for the first two (2) wells on a project site and $17 for every well thereafter. Fees are typically in addition to any PWA proposed budget.

Groundwater setback requirements:

Conventional Gravity Feed Distribution Systems require a minimum 3-foot separation between the bottom of the leach trench and the highest stabilized groundwater level. Past regulations and potentially future regulations may increase the separation to groundwater to five (5) feet below the leach trench.

Alternative or Pressurized systems require a 2-foot separation between the bottom of the leach trench and the highest stabilized groundwater level. The minimum trench depth is 12-inches below the ground surface. Therefore a measured stabilized saturated soil conditions must exist 36-inches or greater below the ground surface in order for an in-ground pressurized distribution (leachfield) system to be utilized.

Mounded Leachfields can be utilized where groundwater and or unfavorable soil conditions exist between 24-inches and 36-inches below the ground surface.

Step 4: Percolation Testing
If required, percolation testing should be performed at: 1) the level in which the bottom of the leach trench will be and 2) at the most restrictive (poorly permeable) layer. Percolation test results are used to determine the infiltrative properties of soils. In other words, how readily will soils accept effluent? Percolation test results are used, in part, to determine the size of the leachfield required. See Tables 2 and 3 for examples of percolation (infiltration) rates and the associated maximum allowable soil loading rates. Soil infiltration rates and their associated loading rates are directly related to the sizing of the leachfield system. The faster the percolation rate, the higher the loading rate, the smaller the distribution system

Table 2. North Coast Regional Water Quality Control Board Basin Plan table 4-2

Soil Texture	**Percolation Rate (mpi)**	**Maximum Loading Rate (gpd/ft^2)**
Gravel, course sand	<1	Not Suitable
Course to medium Sand	1-5	1.2
Fine Sand, Loamy Sand	6-15	1.1 - 0.8
Sandy Loam, Loam	16-30	0.7 - 0.6
Loam, porous Silt Loam	31-60	0.5 - 0.4
Silty Clay Loam, Clay Loam	61-120	0.4 - 0.2

Table 3. North Carolina LPP Design and Installation Manual Table 1*

Soil Texture	Percolation Rate (mpi)	Maximum Loading Rate (gpd/ft^2)
Sand, Loamy Sand	20	0.50-0.40
Sandy Loam, Silt Loam, Loam	20-40	0.40-0.30
Sandy Clay Loam, Loam, Clay	40-60	0.30-0.20
Silty Clay Loam, Sandy Clay	60-90	0.20-0.10
Silty Clay, Clay	90-120	0.10-0.05

* These values are used when designing for an alternative low-pressurized pipe distribution system. Note that they are considerably lower that those of the NCRWQCB maximum loading rates.

Designing an Onsite Wastewater Treatment System (OWTS)

The sizing of an onsite wastewater treatment system is determined by the design flow for a household, office, school or other facility, the rate at which a soil can absorb effluent and the surface area of soil available to absorb effluent. This last factor can be modified by changing the depth of gravel beneath the leach pipe, thereby increasing the sidewall area of the leach trench.

Step 1: Determining Wastewater Loads and Sizing a Septic Tank
Determining the size of an OWTS is directly related to the volume of wastewater produced from the residence, business, school, office building, etc. For typical residential development current regulations state that the sizing of a system should be based on the maximum daily wastewater load of 150 gallons per day (gpd) per bedroom. This assumes 2 people per bedroom; everybody is at home, taking showers, doing laundry and believe it or not, doing the dishes. Wastewater loads for non-residential development such as hotel/motels, schools, campgrounds/RV parks, etc are located in Table K-3 of the State of California Uniformed Plumbing Code.

Humboldt County DEH requires that the sizing of the septic tank should be equal to or exceed three (3) times the daily maximum wastewater load. For residential design wastewater loads and septic tank requirements see Table 4.

Table 4: Residential Wastewater Loads and Septic Tank Sizing

Bedrooms	Wastewater Load (gpd)	Tank Size (gal)
1	150	750
2	300	1200
3	450	1500
4	525	1500
Each Additional Bedroom	75 additional	200 additional

Step 2: Determining the Required Leachline Length.
For example: A 3-bedroom single-family residence has a design flow rate of 450 gallons per day (150 gallons per day per bedroom). A 3-bedroom residence requires a 1500-gallon septic tank. Site investigations have determined that there is sufficient space for an OWTS, all required setbacks have been met, and suitable soils exist for an OWTS.

Wastewater Load – 450 gpd
Soil Type – Sandy Loam soils which plot in Zone 2 of the Soil Percolation Suitability Chart
Stabilized groundwater – 5.5 feet below the ground surface (bgs)
Percolation rate – 45 minutes per inch (mpi)
Depth of Gravel Beneath Leach Pipe – 24-inches
Absorption Area – 4 ft^2 per linear foot (2 ft for each side of the leach trench)

Field investigators find that the percolation rate was slower than expected for a Sandy Loam soil. Humboldt County DEH regulations and good science require that the system be designed using the most conservative values. Since stabilized saturated soils exist at 5.5 feet bgs during the wet weather season, there is sufficient space to allow for a 3-foot separation between the bottom of a leach trench and the top of the measured water table. Additionally, current DEH regulations require a minimum of 12-inches of soil cover above the leach trench. Therefore this system may be gravity feed system.

A 3-bedroom residence has a wastewater load of 450 gpd. A percolation rate of 45 mpi will allow for a design infiltration or maximum loading rate of 0.45 gpd/ft^2. The bottom of the leach trench can be 36-inches below the ground surface which will allow for 24-inches of gravel beneath the leach pipe. 24-inches of gravel beneath the leach pipe will result in 4 feet of absorption area per linear foot of leach trench (Fig. 2). Therefore, the total leach line required for this OWTS is:

Wastewater Load $\div$ Maximum Daily Loading Rate $\div$ Absorption Area

450 gpd $\div$ 0.45 gpd/ft^2 $\div$ 4 ft^2 = 250 Linear feet of leach line

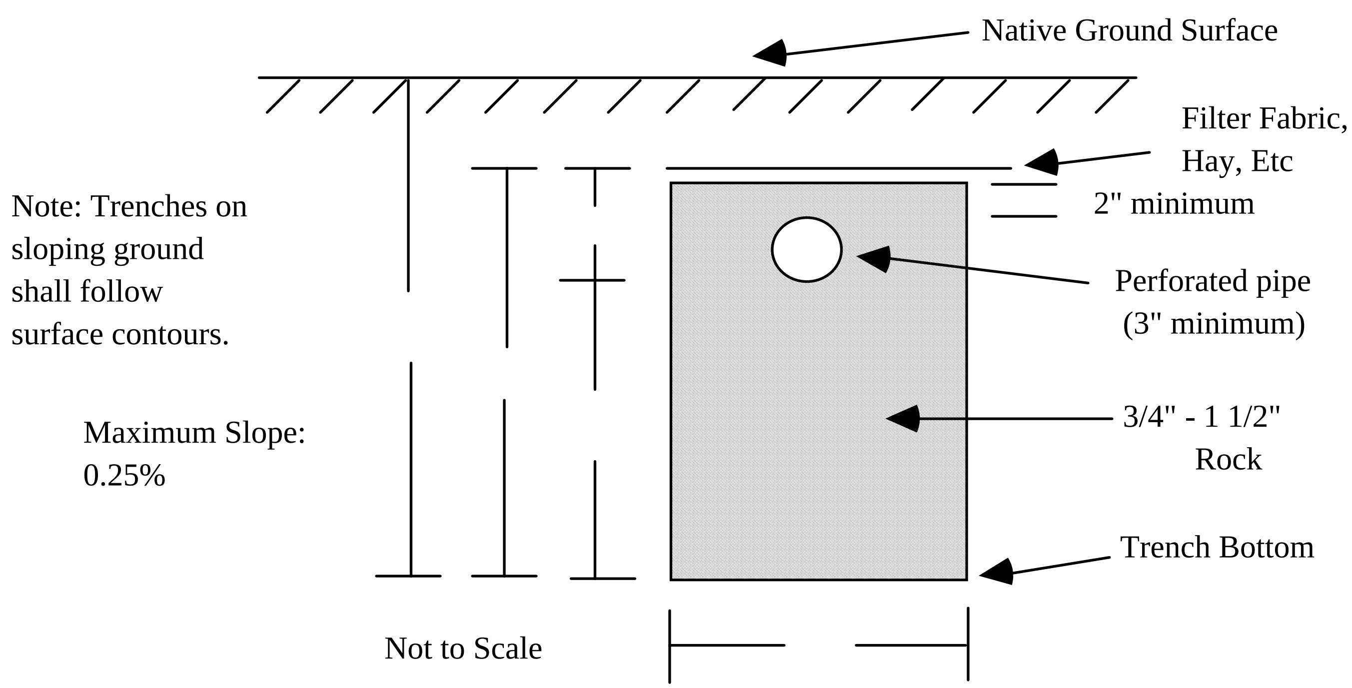


Figure 2

Step 3: Lay-out of the Leachfield
Once the required leachline length is known, the next phase this phase of designing the OWTS is to make it fit. This is where the site measurements taken during the field investigations portion of this investigation are utilized to lay out the required 250 feet of leachline. Depending on available space this leachfield can be constructed utilizing

Five (5) 50-foot leachlines or Four (4) 62.5-foot leachlines

This information is drafted onto a site Map which shows the location of the leachfield, slope gradients measured in percent, proposed and/or existing building site location(s), existing septic systems, breaks in slopes, property lines, road ways, right of ways, easements (PG&E or otherwise), and any other distinguishing feature on the site. We at PWA draft our maps in AutoCAD.

Step 4: Compile all the Data
During this phase of the project all of our field noted, which are typically dirty from taking notes while working in test pits in the rain are transposed into tables and charts and and attached to the end of a report.

Step 5: Write the Report
The report writing phase summarized the purpose of the project, the site conditions and test results and includes an OWTS design. The report includes a General Location Map which enables someone to find the site, and one or more site maps which show where on the site the leachfield is located and what the design (lay-out) of the system should be. The report also includes any specifications for parts, dimensions or monitoring requirements which may be necessary for the proper use of the OWTS.

More and more as prime residential areas are occupied it becomes harder and harder to find a suitable location for a simple gravity distribution system as described above. Pressure distribution systems are becoming common as are mounded leachfield systems. Even still, older residences that were constructed in areas that would not meet with todays regulations have older systems in failure. Science and technology are expanding at an ever increasing rate in the onsite wastewater treatment world. Septic systems are no longer out-of-site, out-of-mind. Just like your car or you home or any other operating system they require regular monitoring and maintenance and care to insure their proper functioning for decades to come.