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# WHAT HAPPENED TO THE PASSIVE ONSITE WASTEWATER SYSTEM? [1]

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## ASTRACT

Passive systems use position to transport wastewater through system components and energy from wastewater or the environment for treatment. An active system uses external energy sources for transport and movement. Improvements or abandonment of the passive system should be based on data relating public health and environmental quality. Lacking data justification for change is difficult.

## INTRODUCTION

We can always do better. Do we need to?

The passive system is quickly being replaced by systems with active, energy using components. What has been gained? The simplicity of the passive system makes them ideal for the general population and use of active systems should be justified with measurable improvements in health and the environment.

## OBJECTIVES

This paper presents an evaluation of the need for changing from passive onsite wastewater treatment systems.

## SYSTEMS

Onsite wastewater systems and their components parts have been classified in many ways. Generally, the location of treatment or type of treatment is used to name the entire system. Names such as a septic system or soil-based system are common. Onsite wastewater treatment systems can be classified according to the number of mechanical parts and the consumption of energy. Generally, in this case some component uses electricity. For this discussion onsite wastewater treatment systems will be classified into two classes: passive or active.

### Passive System

A passive system uses the position of the wastewater as generated at the source to transport wastewater through various processes and wastewater or environmental energy for treatment processes. Commonly the system consists of a wastewater source at a higher elevation than a receiving treatment component which in turn is higher than each of the succeeding components. Energy needed for treatment processes is from wastewater or the wastewater constituents utilized by organisms or from the environment. A septic tank wastewater infiltration system is passive.

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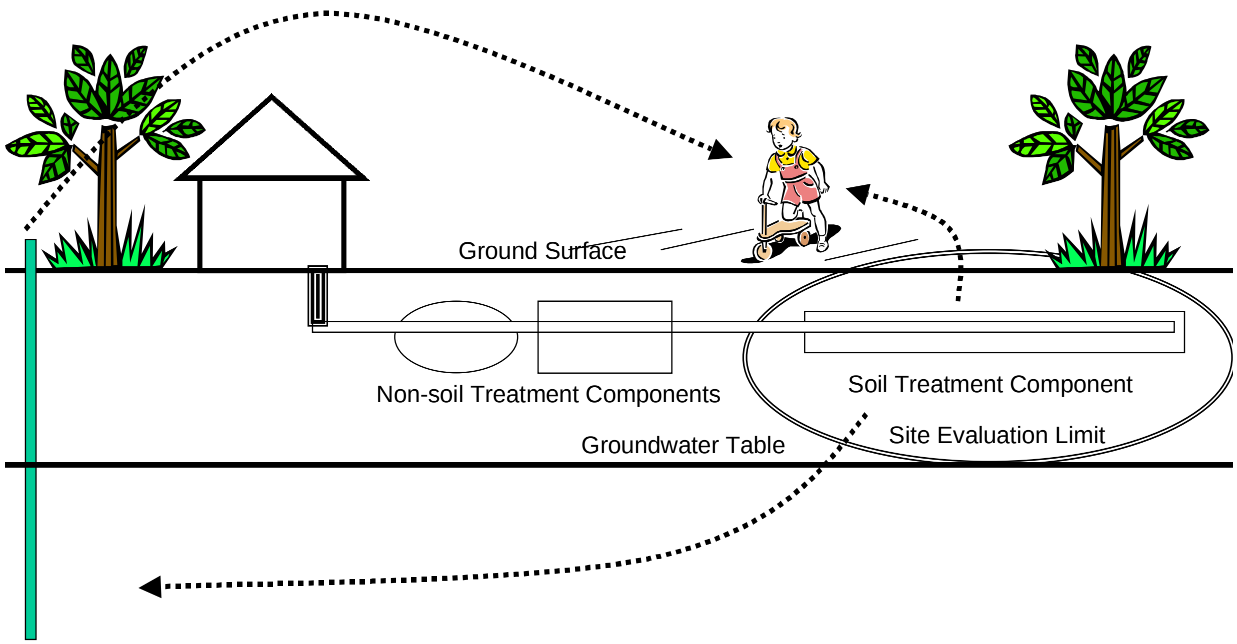


Figure 1. Diagram showing a house as a wastewater source, non-soil treatment components and a soil treatment component. The soil treatment component extends only to the site evaluation limit. Pathways for wastewater and wastewater constituents affecting human health and the environment are shown with dotted arrows

### Active System

An active system is one that uses energy inputs to elevate or distribute wastewater and/or enhance treatment processes. Generally active systems require external energy and have moving mechanical parts. Most energy is used to lift wastewater and introduce oxygen into the wastewater. Active systems usually have an electric energy source. A recirculating sand filter discharging to soil is an active system.

## INFORMATION FOR DECISIONS

Developing a system design is selecting technologies and processes to meet wastewater treatment goals. Selecting designs without adequate information may result in systems that do more treatment than necessary. These systems may cost citizens considerable more effort and money than needed. Conversely, selecting design without adequate information may result in subjecting citizens to higher risk than necessary. Information needs include data linking health with onsite wastewater treatment systems and performance data about the sum of system components.

### System Goals

The ultimate goal of onsite wastewater treatment systems is to protect human health and the environment. Once meeting these goals it is then possible to consider the secondary goals of reuse, cost, maintenance and aesthetics. Probably, but not necessarily, the most basic system meeting the health and environmental goals will be the lowest cost and require the least maintenance. The most basic system will likely be favored by citizens.

## Design Selection and Data

Selecting design components to meet the wastewater treatment process is a cybernetic decision process. Several iterations may be needed to select appropriate components to treat the source wastewater to meet health and environmental goals without far exceeding design needs.

Wise decisions concerning onsite wastewater treatment systems should be based on data. Data are needed from each portion of the system. Unfortunately, decisions concerning the selection of components offering specific treatment should be based on the final link between the treated wastewater and public health and the environment. Therefore, the final discharge point and the link to human health and the environment is the most important data. These data are difficult to develop and usually lacking. Component performance data is of little value if the final goal is unknown or undefined.

The pathways linking human health and environmental quality is illustrated in Figure 1 with dotted lines. The link to the environmental quality is easier to determine than the link to public health. Since sensitive or protected resources can legally exist at the limit of the soil treatment component, the portion of the landscape defined by the soil and site evaluation or the soil treatment component must meet the health and environmental goals or treatment goals must be met at the limit or fringe of the soil and site evaluation. One way to reduce risk is to increase the volume of soil for treatment. Increasing the amount of soil requires that site evaluation determine the qualities of a larger volume of soil.

Wastewater coming to the ground surface present a health threat. There seems to be little data from this country to demonstrate the general health effects of surfacing onsite wastewaters. Certainly, contact with raw waste is correlated with general health in other countries (World Health Organization, 1997). The risk of wastewater surfacing can be lowered greatly by using conservative infiltration and hydraulic linear loading rates. To reduce risk of problems from surfacing wastewater, wastewater constituents may be reduced prior to the leakage at the surface. This may necessitate an active system.

Eliminating the surfacing of wastewater will reduce the health problems. Lowering hydraulic loading rates to below the clogged soil infiltration rate is one way to eliminate surfacing. Instead of supplying oxygen from the soil, non-soil active wastewater treatment components to reduce biochemical oxygen demand (BOD) can reduce potential clogging of soil and therefore reduce the potential for surfacing. This can be done when land area is limiting. A discussion of oxygen supply from the soil around wastewater infiltration systems is presented by Erickson and Tyler, 2000.

If wastewater remains below ground then the transport of wastewater constituents is important. For this discussion, nitrogen and bacteria will be used as examples. Although not discussed here other wastewater constituents are important.

In most cases nitrogen, N, will ultimately form gaseous or water soluble compounds. In some situations N will be utilized by plants. A primary concern is nitrogen as nitrate-N, $NO_3^-$, reaching groundwater. The current drinking water standard is 10 mg $L^{-1}$ nitrate-N and is commonly considered the goal for treatment of onsite wastewater. Since it is legal to have groundwater at the fringe of soil and site evaluation the 10 mg $L^{-1}$ nitrate-N becomes the standard. In free draining soil with groundwater meeting the standard is important. However, in regions with flow restricting horizons within the depth of soil evaluation, wastewater does not flow downward but moves horizontally through surface soil horizons over the flow restricting horizons. The nitrogen is ultimately consumed by vegetation or lost as a gas. This nitrogen may also discharge to surface waters. Therefore, in free draining soil, nitrogen would need to be reduced prior to infiltrating the soil. This may take an active system. However, in soil with flow restricting horizons reduction of nitrogen is probably not necessary and a passive system would be adequate. Many populated areas of the United States have soil with vertical flow restricting horizons. Flow restricting horizons necessitate close attention to infiltration and hydraulic linear loading rates to reduce the risk of wastewater surfacing.

Flow restricting horizons also prevent the vertical movement of pathogens. As mentioned previously, flow-restricting horizons protect some elements of the environment but make design for hydraulics difficult. Bacteria can travel long distances in some soil if loading volumes are high and the soil contains cracks. This situation should be recognized during soil and site evaluation and design. Generally, bacteria travel short distances in normally loaded and operated systems (Converse and Tyler, 1998). Distances may range from several centimeters to over a meter before fecal indicator counts are below detection limits. The differences in travel distance are often below the variability of determining limiting soil conditions. Soil clogging is a major inhibitor of bacteria transport. Background counts of fecal indicators are usually reached within several centimeters when soil clogging is present (unpublished data, 2000). However, there is insufficient bacterial information related to public health to base decisions concerning the adequacy of passive systems.

## Changes

Goals need identification and definition. Based on goals the standards for the final wastewater treatment component can be established. If the goal is to protect human health then we should be able to measure differences in human health in areas of different wastewater treatment. Is there a measurable difference between human health in sandy and loamy soil regions or a difference in jurisdictions using 30 cm separation distance and those using 90 cm?

The passive system might be improved through changing of some attitudes and regulations. For example, flow restricting horizons have been avoided because of the episaturation or perched water table created and the potential for surfacing of wastewater. Closer attention to wastewater loading rates and system design could solve many of the wastewater surfacing problems and allow use of sites that are naturally more effective at protecting health and environment. However, changes in criteria for passive systems or abandonment of passive systems should be justified based on data showing an improvement over current conditions. This will be difficult since our current condition is not defined.

## REFERENCES

1. Converse, J.C. and E.J. Tyler. 1998. Soil treatment of aerobically treated domestic wastewater with emphasis on modified mounds. In: Onsite Wastewater Treatment. Proceedings of the Eighth National Symposium on Individual and Small Community Sewage Systems. ASAE, St. Joseph, MI 49085

2. Erickson, J. and E.J Tyler. 2000. Soil Oxygen Delivery to Wastewater Infiltration Surfaces. IN: This Publication.

3. World Health Organization. 1997. Environmental Matters: Strategy on sanitation for high-risk communities. World Health Organization