PENNSTATE
College of Agricultural Sciences Cooperative Extension
Agricultural and Biological Engineering

At-Grade and Shallow At-Grade On-Lot Systems

F 171

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The purpose of this fact sheet is to explain the components and function of the Alternate On-Lot Sewage Disposal Systems known as the At-Grade and Shallow At-Grade Systems. Pennsylvania has approved the use of these at-grade systems as an alternate wastewater disposal method for on-lot sewage. The at-grade system was developed and is designed for sites with restrictive soil conditions, especially limiting zones at less than 48 inches. Thus, the at-grade systems may serve as an alternative to placing an elevated sand mound on some sites.

Components of the At-Grade System

The at-grade systems have five components: a treatment tank, a filtration unit (if required), a disinfection unit, a dose tank, and an at-grade soil absorption area constructed on the soil surface. (see Fig. 1). Each of these components will be described below.

Treatment Tank. The wastewater flowing from your home first enters a treatment tank. The treatment tank is most often a two-chamber septic tank. The septic tank encourages the heavier solids to settle to the bottom of the tank and the lighter scum to float to the surface. The remaining liquid is discharged to the next stage of the system. In place of a septic tank, a properly sized aerobic treatment tank may be used in which case a stream of air containing oxygen is forced through the wastewater encouraging the biological breakdown of the carbonaceous waste material.

Filtration Units. The filtration requirements are dependent on the depth to the site's limiting zone as shown in Table 1. In all cases when the depth to the limiting zone is less than 48 inches, the septic tank effluent must be conveyed to a filtration unit where the wastewater is filtered to remove and biodegrade a large portion of the wastewater's biological components. If the limiting zone is 20 to 48 inches below the land surface, a secondary treatment unit is required (Table 1). If the limiting zone is less then 20 inches below the land surface, an advanced treatment unit is required. Each of these treatment units will be briefly described below. Check with your SEO to learn about other treatment unit options.

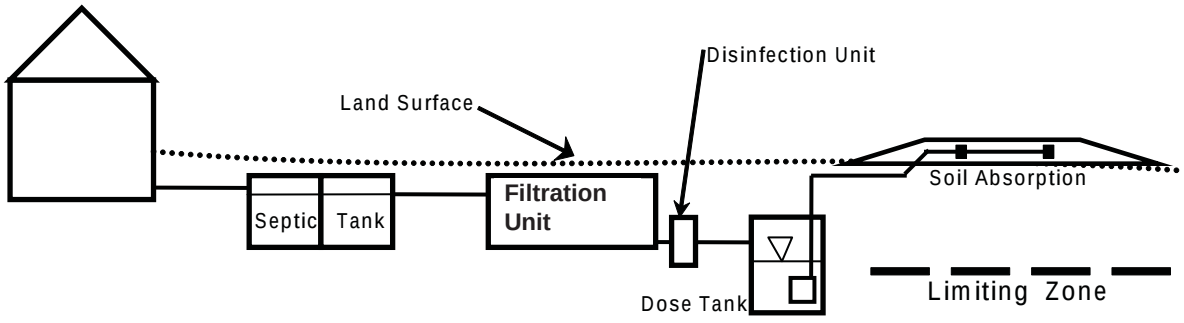

Figure. 1. Schematic of an At-Grade System.

Table 1. Depth to limiting zone and advanced filtration requirements for at-grade systems

Depth to Limiting Zone	Additional Treatment Requirements
≥ 48 inches	None
20 to 48 inches	*Secondary Treatment Unit* Aerobic Treatment Tank Free Access Sand Filter @ 5 gal/d/ft^2 (Max) Buried Media Filter @ 0.8 gal/d/ft^2 (Max)
Shallow At-Grade System ≥ 16 inches to Rock Limiting Zone ≥ 10 inches to Seasonal High Water Table Limiting Zone	*Advanced Treatment Unit* Re-Circulating Sand Filter @ 1.3 gal/d/ft^2 (Max) Free Access Sand Filter @ 1.25 gal/d/ft^2 (Max) Buried Media Filter @ 0.67 gal/d/ft^2 (Max) Peat Filter

Free Access Sand Filter. A free access sand filter is a large tank (or chamber) filled mostly with sand, into which the septic tank effluent flows by gravity or is pumped. The wastewater percolates slowly down through a 24- to 36-inch deep layer of sand and is collected at the bottom and piped to the dose tank. This unit can be accessed through ports in the top of the tank for maintenance and sand replacement. When the free access sand filter is loaded at 5 gal/d/ft^2 or less, it is classified as a secondary treatment system. When it is loaded at 1.25 gal/d/ft^2 or less it is classified as an advanced treatment unit.

Buried Media Filter. The buried media filter is much like the free access sand filter except the sand filled chamber is buried and not accessible for maintenance. When the buried media filter is loaded at 0.8 gal/d/ft^2 or less, it is classified as a secondary treatment system. When it is loaded at 0.67 gal/d/ft^2 or less it is classified as an advanced treatment unit.

Re-Circulating Sand Filter. This type of sand filter is a large tank (or chamber) filled mostly with sand, into which the septic tank effluent flows. The wastewater percolates slowly down through the sand layer. The filtered wastewater is piped to a pump tank where 91% of the filtered wastewater is pumped back to and re-circulated through the sand filter. The remaining 9% of the filtered wastewater is piped to a dose tank and on to the absorption area.

Peat Filter. A peat filter is a large tank, filled mostly with peat, into which the septic tank effluent is pumped. The wastewater percolates slowly down through a layer of peat, where the biological treatment occurs. The treated wastewater is collected at the bottom and piped to the dose tank and on to the absorption area.

UV Disinfection. The effluent leaving all advanced treatment units must receive ultraviolet disinfection (Fig.1) to reduce fecal coliform concentrations to less than 200/100ml before it is discharged to the absorption area.

Dose Tank. After the wastewater has been treated in the secondary or advanced treatment unit (assuming secondary or advanced treatment is required), it is piped to and collected in a small single-chamber tank known as a pump or dose tank. When a preset volume of wastewater has been collected, float switches in the dose tank excite the pump, which transfers a prescribed volume of wastewater to the at-grade system's soil absorption area. Generally the wastewater is dosed twice daily.

Absorption Area. The absorption area required will differ depending on whether the limiting zone is less than or greater than 20 inches below the land surface.

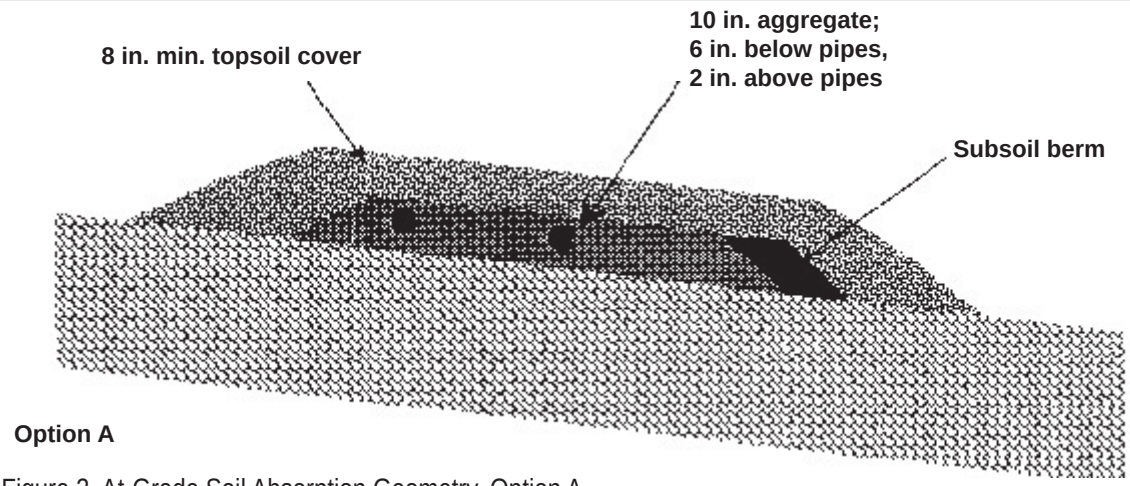

Figure 2. At-Grade Soil Absorption Geometry, Option A.

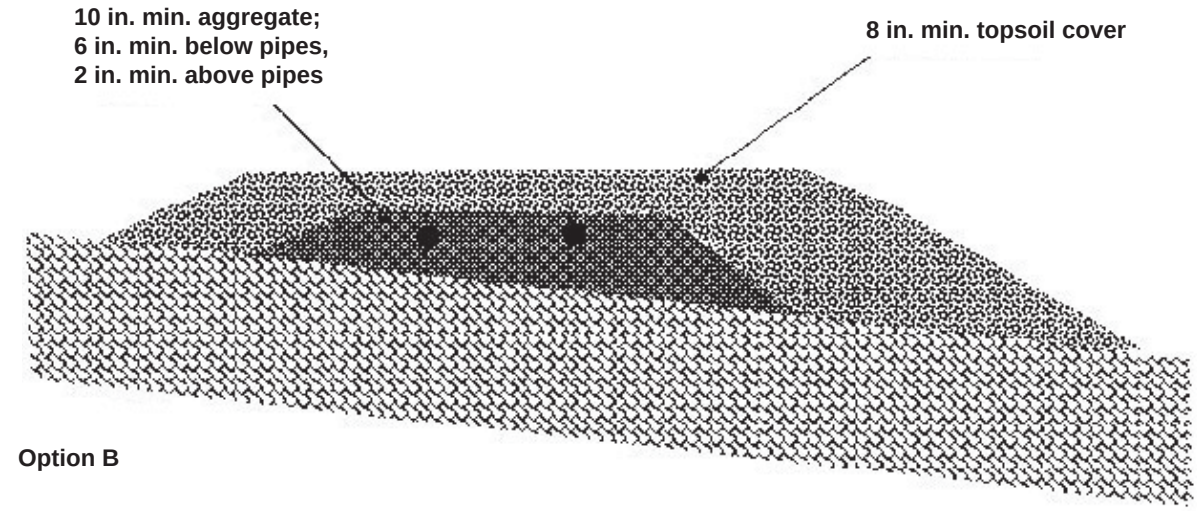

Figure 3. At-Grade Soil Absorption Geometry, Option B.

Greater than 20 inches If it is more than 20 inches to the limiting zone, the wastewater is dosed to a bed-type absorption area. The absorption area is sized according to the results of a standard Perc Test using the absorption area sizing guidelines given in Table 2. There are two similar, but different approved pipe-aggregate-backfill configurations. The absorption area is a pair of pipes located in a bed of aggregate placed on the soil surface after the soil has been chiseled across the slope. In the first case, Option A (Fig. 2), a 10-inch deep bed of aggregate is placed parallel to the soil surface with the two distribution pipes located off-center and at the up slope edge of the bed. In Option B (Fig. 3), the aggregate bed is placed on the soil surface with the top of aggregate level and has a minimum depth of aggregate of 10 inches. Here the two distribution pipes are centered in the aggregate.

Less then 20 inches If the limiting zone is less then 20 inches below the land surface (Shallow At-Grade System), the wastewater is dosed to a trench-type absorption area. The trench is much like the Options A or B described above, but only one pipe is used and the elevated area is smaller. The trenches may not overlap each other on a sloping area. The absorption area is sized according to guidelines determined by a professional soil scientist.

Summary

The at-grade alternate on-lot sewage disposal system was created as an alternative to requiring an elevated sand mound on some sites with a limiting zone between 20 and 48 inches and provide additional flexibility on sites where a limiting zone exists at less than 20 inches. The at-grade system is a very shallow mound with a maximum height of between 16 and 42 inches depending on the slope. The at-grade mound has a lower profile and is less intrusive than the elevated sand mound alternative. The at-grade system also yields better quality effluent. The disadvantage of the at-grade system is that you will most likely be required to include a secondary or advanced filtration unit between the septic tank and the absorption area and regular maintenance is required. If you have questions about the at-grade system contact your local Sewage Enforcement Officer or your County Agent.

Table 2. Absorption area sizing requirements for at-grades systems with limiting zones ≥ 20 inches.

Perc Rate (Min/In)	Aggregate area required (Ft^2/Gpd)
< 3.0	Unsuitable
3 to 30	1.50
31 to 45	(Perc. Rate - 30) (0.026) +1.50
46 to 60	(Perc. Rate - 45) (0.022) +1.89
61 to 90	(Perc. Rate - 60) (0.020) +2.22
91 to 120	(Perc. Rate - 90) (0.017) +2.82
121 to 150	((Perc. Rate -120)(0.015)+3.33) (1.05)
151 to 180	((Perc. Rate -150)(0.014)+3.78) (1.10)
> 181	Unsuitable

Penn State's current coordinator of On-Lot Sewage Disposal Programs is
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