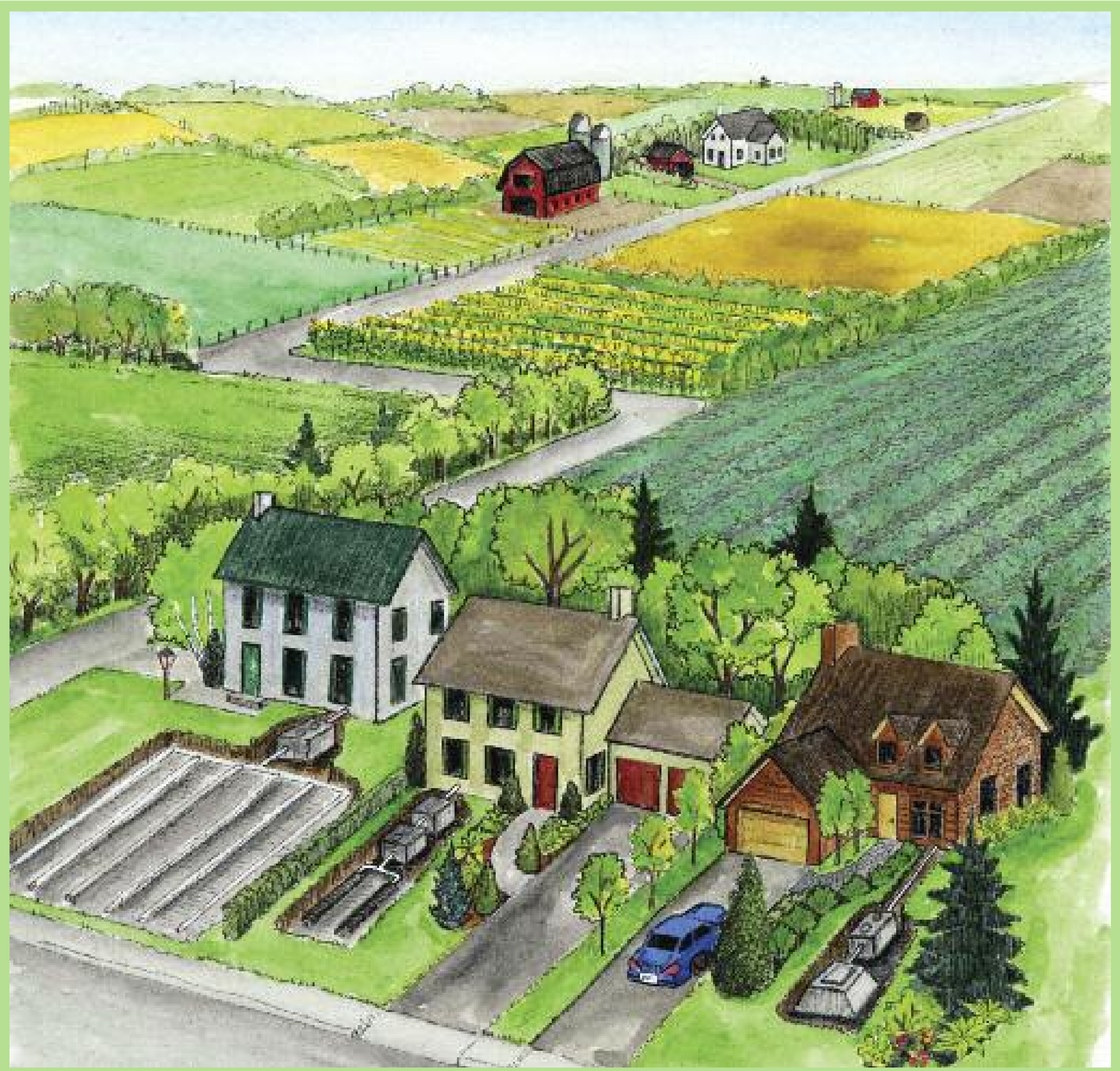
SepticSmart!

Advanced Treatment Systems — Alternatives to Conventional Septic Systems

Booklet Number 2 — AF146



Canada

Ontario

Almost all residents in rural homes depend upon onsite septic systems to treat household wastewater (sewage). The conventional septic system used across Ontario has two main components: a septic tank and a leaching bed. These conventional systems treat wastewater using sand, gravel and native soil. They are soil absorption systems that are economical and easy to maintain (to learn more about conventional septic systems and how they work, see Booklet 1: *Septic Smart! — Understanding Your Home's Septic System).*

In conventional septic systems, 30–50 percent of the wastewater treatment is done in the septic tank and 50–70 percent is done in the soil (ref. *US EPA,* Chapter 4.6.1). Conventional septic systems can perform very well in a variety of soil types and site situations; however, there are properties where conventional septic systems are not suitable. Some properties have inadequate conditions (e.g. heavy clay, shallow soil depth to bedrock, limited space, steep slopes or high water table) for a conventional septic system. In these situations, homeowners may turn to advanced treatment systems.

Advanced treatment systems, although less well known, may offer reliable, approved treatment of household wastewater. The difference with advanced treatment systems is that approximately 90 percent of the wastewater treatment is done in the pre-treatment tank and advanced treatment unit and 10 percent is done in the soil (ref. *US EPA,* Chapter 4.6.1). Cleaner effluent exiting the advanced treatment unit makes the advanced treatment system more versatile than a conventional septic system.

This booklet will help you become familiar with advanced treatment units that provide a higher level of treatment than septic tanks as well as the type of final distribution and soil treatment that could be used with them in Ontario, namely:

1) aerobic treatment units (ATUs);
2) filtration units.

Advanced Treatment Systems: Advantages and Disadvantages

Advantages

- provide the opportunity to service sites not suited for conventional septic systems
- have the potential to remove significantly more bacteria and organic material than a conventional septic system
- may extend the life of an existing leaching bed
- take up less room in the yard
- require mandatory maintenance (ensures the unit is functioning properly)
- may reduce nutrient output (depending on type)

Disadvantages

- may be more expensive to purchase and install depending on site characteristics
- are more expensive to operate than a septic system (e.g. yearly electrical costs, media replacement)
- includes more mechanical parts that can break down or need replacement
- requires mandatory maintenance (increases costs)

Homeowners may want to consider advanced treatment systems when:

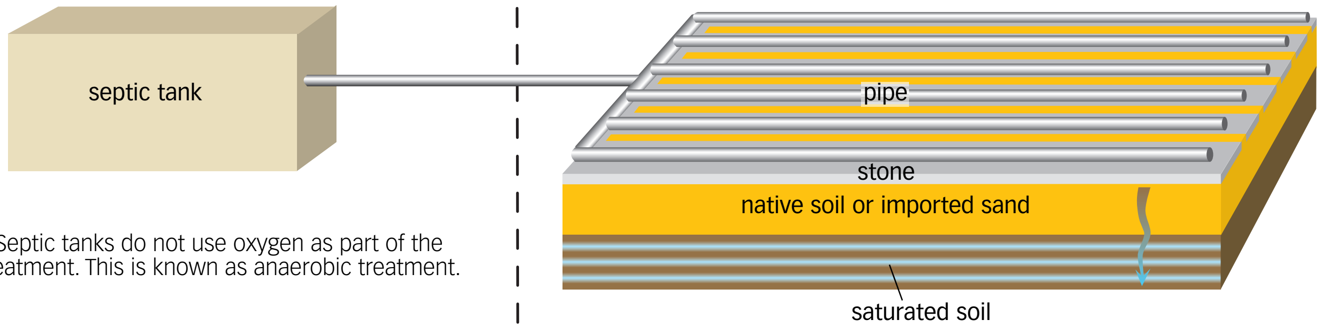
- dealing with properties with inadequate conditions for conventional systems
- coping with small lots that can't accommodate the size of a conventional leaching bed
- replacing a failed septic system
- rejuvenating failing conventional leaching beds
- building on hard-to-access properties where finding and/or transporting traditional materials for conventional systems is costly or difficult
- wanting to provide additional protection to groundwater by additional nitrate reduction which some of the treatment units could provide

Comparing Conventional Septic System and Advanced Treatment Systems

Conventional Septic System

Pre-treatment | **Final Distribution and Soil Treatment**

Absorption Trench or Filter Bed



Septic tanks do not use oxygen as part of the treatment. This is known as anaerobic treatment.

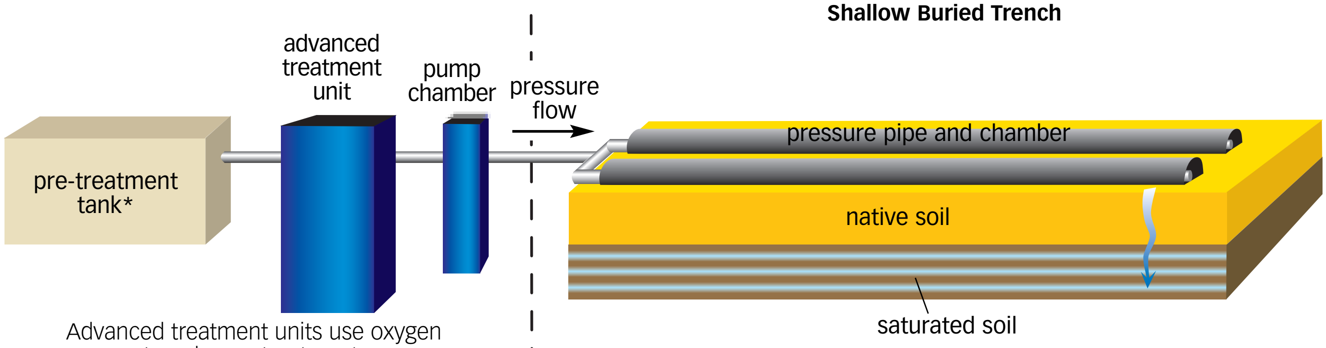
Approximately 30–50 percent of wastewater treatment takes place in the septic tank.

Approximately 50–70 percent of wastewater treatment takes place in the soil.

Advanced Treatment Systems

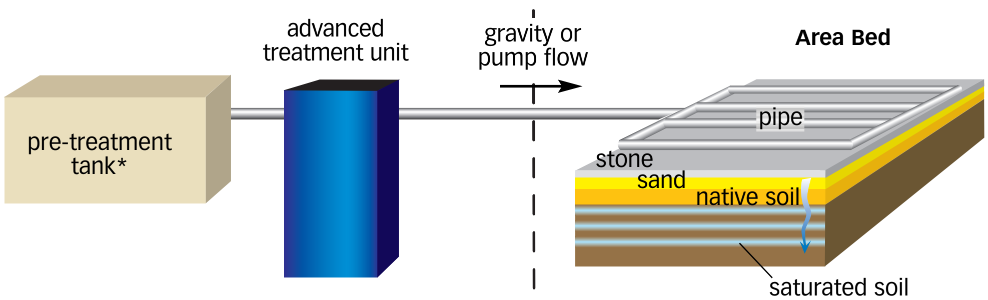
Pre-treatment | **Final Distribution and Soil Treatment**

Shallow Buried Trench



Advanced treatment units use oxygen to enhance treatment.

Area Bed



Approximately 90 percent of wastewater treatment takes place in the pre-treatment tank and advanced treatment unit.

Approximately 10 percent of wastewater treatment takes place in the soil.

* the pre-treatment tank could be a septic tank or a chamber within the treatment unit itself

1. Aerobic Treatment Units (ATUs)

ATUs treat wastewater by adding air. ATUs inject and circulate air so that oxygen-dependent bacteria can thrive. The bacteria break down organic matter, reduce pathogens and transform nutrients (e.g., ammonia to nitrate).

ATUs receive wastewater from household plumbing fixtures (toilets, showers, sinks, etc). These units often have a pre-treatment tank where the scum and solids are separated and stored before the effluent is passed to an aeration chamber. At the aeration chamber, air is added to the effluent, which allows the bacteria to feed on the contaminants thereby producing cleaner effluent.

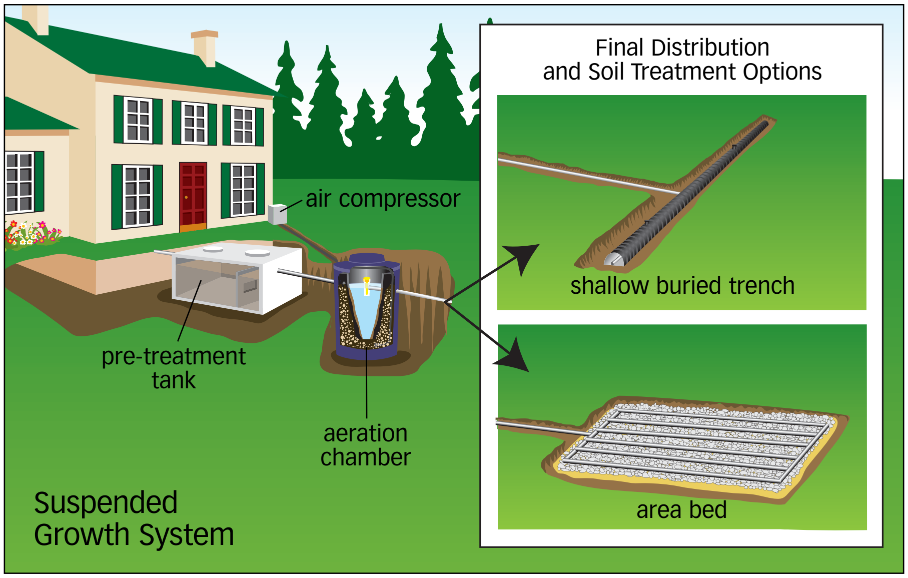
Generally, ATUs are classified based on the status of bacteria in the wastewater within the treatment unit. Bacteria are either suspended in the liquid or attached to some media.

ATUs used in conjunction with an area bed or shallow buried trench are well-suited for replacement systems on mature, landscaped lots with limited space.

Aerobic Treatment Units:

- can be part of a new system, a replacement system or added to an existing conventional system to prolong the life of the leaching bed
- require air compressors and in most cases pumps
- can use an area bed or shallow buried trench for final distribution and treatment
- can be used for residential, communal and commercial applications
- require a maintenance agreement

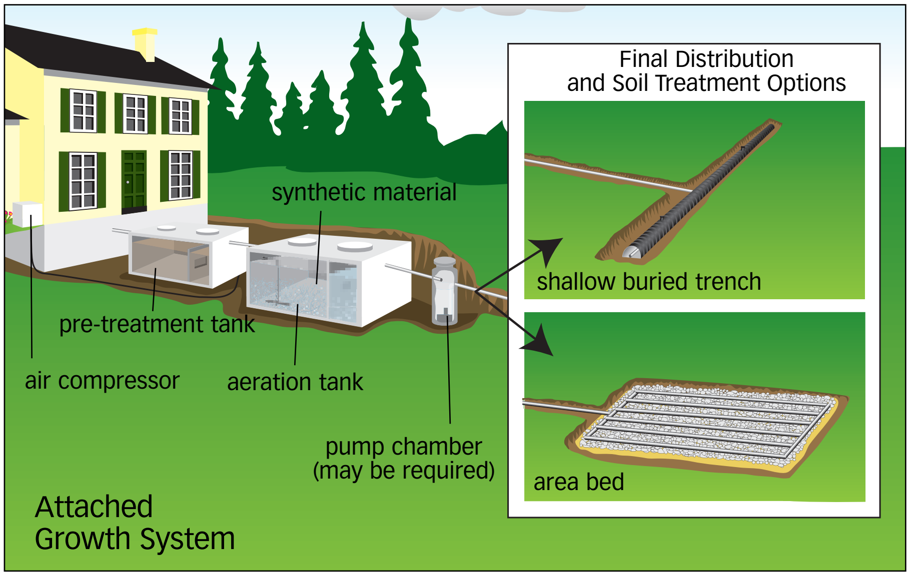
In **suspended growth treatment units,** wastewater flows from the pre-treatment tank into the aeration chamber where an air compressor and air diffuser supply oxygen and mix the liquid waste. The air keeps the bacteria "suspended" or floating in the liquid waste. It does not attach to any surface. The oxygen supports the growth of the bacteria and other micro-organisms that break down the wastewater and solids. The effluent then flows into a shallow buried trench or area bed.



Effluent treated by a suspended growth unit can be distributed back into the native soil through a shallow buried trench or an area bed.

Large sewage design flows may require more than one aeration chamber.

In **attached growth treatment units,** wastewater from the pre-treatment tank flows into an aeration tank that contains pieces of plastic or other synthetic material. Attached growth units rely on oxygen-dependent bacteria to break down wastewater and solids similar to suspended growth units. The difference is that attached growth units let the bacteria attach, grow and thrive on the synthetic material (e.g., plastic shavings, balls, etc.). An air diffuser provides continuous aeration around the synthetic material to enhance bacterial activity and waste treatment. Some attached growth treatment units require an air compressor. The effluent then flows to a shallow buried trench or area bed.

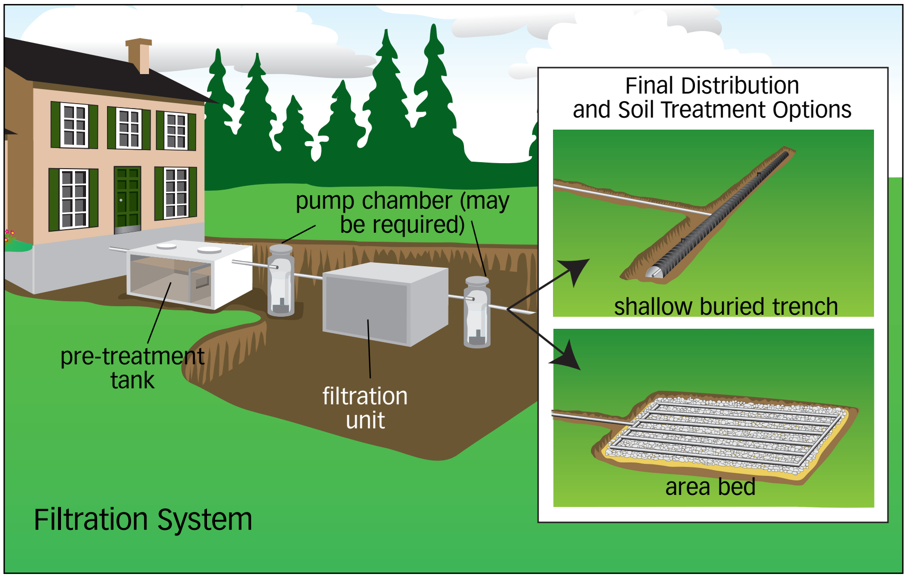


Effluent treated by an attached growth unit can be dispersed back into the native soil through a shallow buried trench or an area bed.

Pre-treatment tank followed by an aeration tank and area bed.

2. Filtration Units

Filtration units utilize trickling filter technology. Wastewater flows from the home to a pre-treatment tank. Wastewater then flows from the pre-treatment tank into the filtration unit that is filled with materials such as peat moss, sand or a synthetic medium. As the wastewater trickles or percolates down through the filtration unit, a bacterial slime grows and thrives. Typically, trapped air fills the voids in the medium and encourages aerobic conditions where bacteria break down the waste as it slowly moves through the filter medium. The effluent then flows to a shallow buried trench or an area bed for final distribution and treatment in the soil.



Effluent from a filtration unit can be distributed back into the native soil through a shallow buried trench or an area bed.

Synthetic media — geotextile sheets.

Synthetic media — foam cubes (top view).

Sand filter.

Peat moss.

Filtration Units:

- can be part of a new system, a replacement system or added to an existing conventional system to prolong the life of the leaching bed
- require pumps for in-ground installation
- can use a shallow buried trench or an area bed for final distribution and treatment
- can be used for residential, communal and commercial applications
- require a maintenance agreement
- require replacement of filter material (peat, sand or synthetic material) approximately every 8 to 15 years

Homeowner Tips

- Always check with the distributor to ensure that your installer is licensed to install their product.
- Always check that the installer has the required qualifications, i.e., Building Code Identification Number (BCIN).
- Put all your approvals, construction information, and pumping, service and maintenance agreements in a safe place.
- Keep accurate and up-to-date records on maintenance, pumping and repairs.
- If selling a property with an advanced treatment system, ensure that the purchaser is aware of maintenance requirements.
- If used seasonally, check with the manufacturer for recommendations on disconnecting the power supply to the air compressor and/or pumps as well as start-up recommendations.
- After a power outage or when restarting a system, ensure the system's components (e.g., pumps, compressors) are functioning.

Care and Maintenance of Your Advanced Treatment Unit

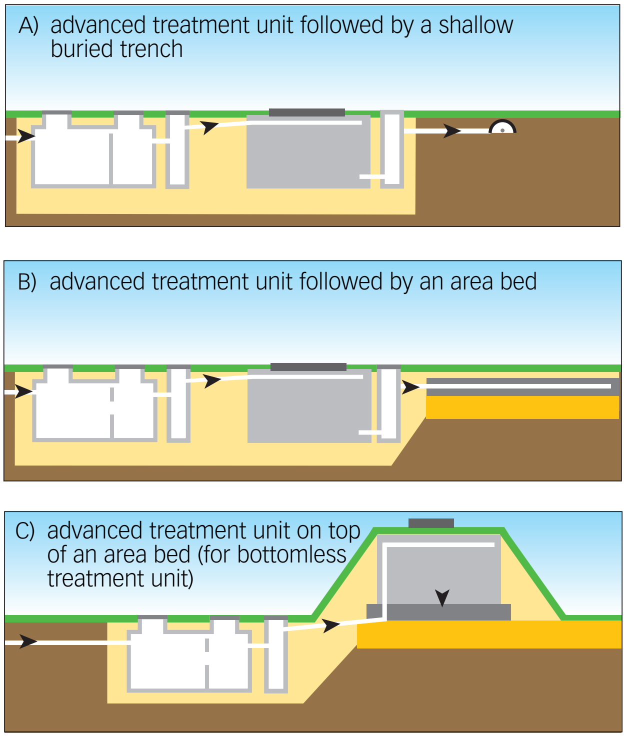
Routine care and maintenance are key elements to the safe and efficient operation of advanced treatment units. These units require more attention and care than conventional septic tanks. **Homeowners with an advanced treatment unit must have a maintenance contract with an authorized representative of the manufacturer of the treatment technology.** Be sure to know precisely who is providing maintenance so that you will feel confident that your maintenance/service agreement will meet regulatory requirements. Maintenance agreements will outline the schedule of the inspection of the treatment unit components as well as the effluent sampling requirements to ensure the system is performing in compliance with the basis upon which it was approved. Following the maintenance requirements and schedules outlined by the manufacturer in the operations manual will ensure that the advanced treatment system operates effectively and efficiently. **All technologies will require some type of regular pre-treatment tank maintenance — removing sludge or replacement/cleaning of filters.**

Regular maintenance will help ensure that small problems won't become larger, resulting in more expensive repairs. For more tips on caring for your septic system, see Booklet Number 1: *Septic Smart! — Understanding Your Home's Septic System.*

Final Distribution and Soil Treatment

Advanced treatment units are very effective in treating wastewater. With cleaner effluent leaving these units, the size of the soil component (leaching bed) that is needed to complete the treatment is smaller than for those using septic tanks only. Advanced treatment units could use one of two small leaching bed systems that are currently approved or authorized in Ontario: shallow buried trench and area bed.

Advanced treatment units can be used with a variety of above ground and in-ground distribution options. They also offer several unique final distribution options.

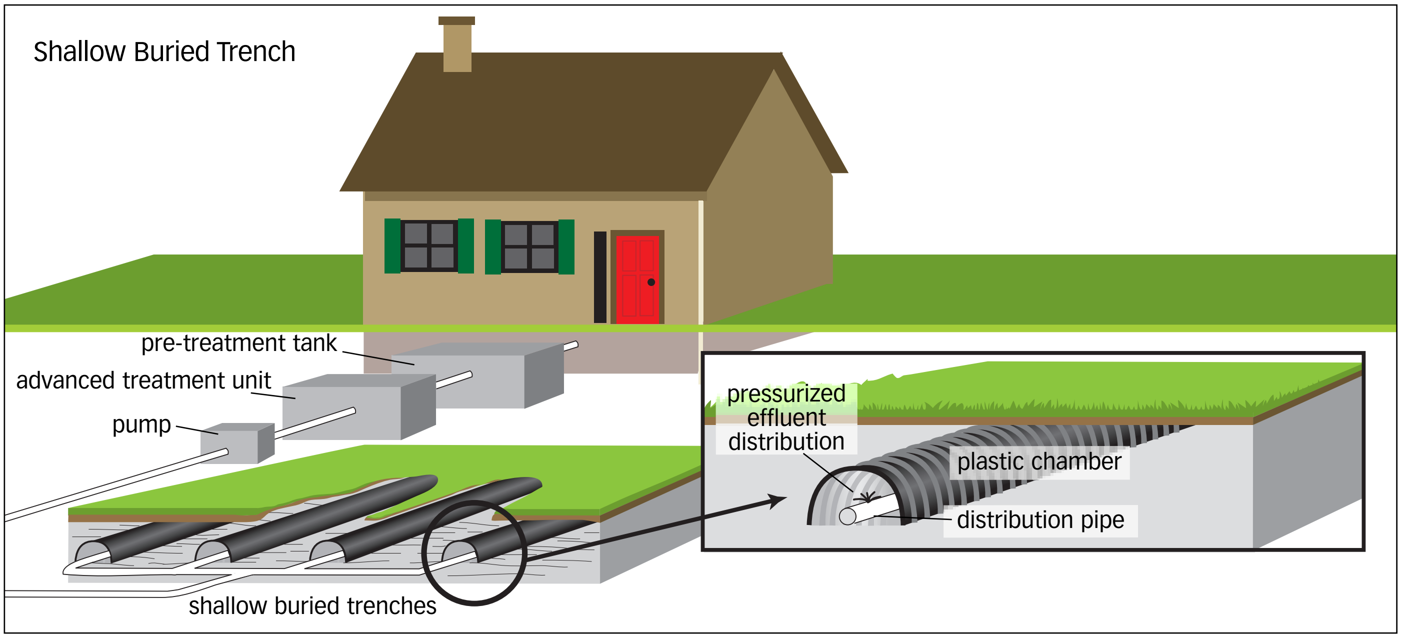


Side views of three distribution and soil treatment options for advanced treatment units.

Shallow Buried Trench

A shallow buried trench consists of small-diameter pipes running through open-bottom plastic chambers. Effluent from the advanced treatment unit is pumped under pressure through distribution pipes at regular intervals (time-dosed). The pressurized piping has small holes on the top that allow for even distribution of the effluent on the soil surface under the plastic chamber. This pressurized distribution allows for small doses to be evenly distributed along the entire length of the trench. This greatly enhances the soil's ability to receive and treat the effluent. Shallow buried trenches are typically installed in the natural soil close to the surface of the ground, allowing plant roots and bacteria in the soil to take up additional nutrients.

Trenches can be installed as one row or several rows to meet minimum trench length standards as required by the *Ontario Building Code.* This method is versatile because the trench can follow an irregular pattern (e.g., around trees).

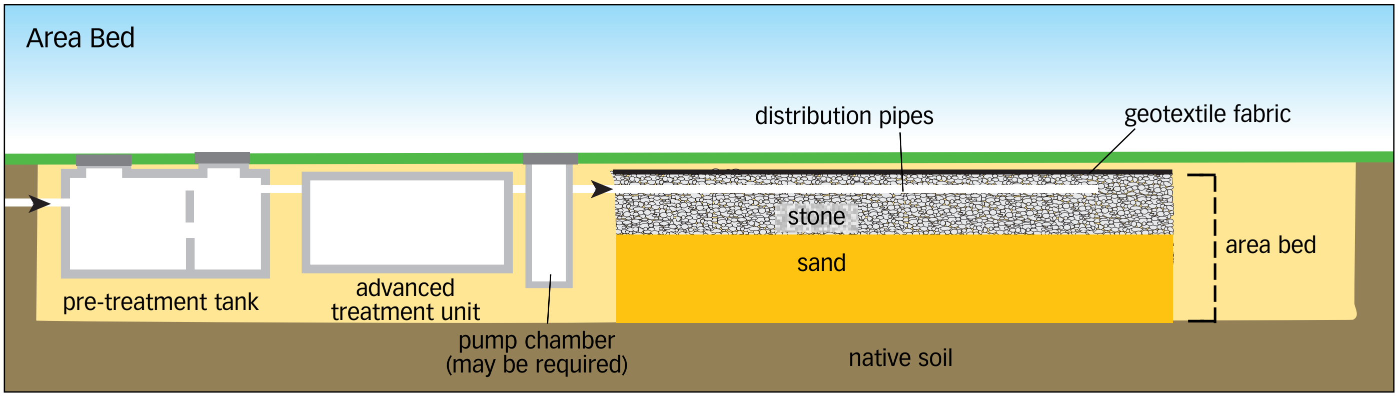


Shallow buried trenches showing equal distribution methods. Note: before placement of chambers.

Single line shallow buried trench.

Area Bed

An area bed consists of a stone layer overlying a sand layer. The sand layer may vary in depth and size depending on the treatment unit being used. Some advanced treatment systems have open bottoms that sit right on top of the stone layer while others have distribution pipes placed in the stone layer for effluent distribution. Typically effluent from the advanced treatment unit will flow by gravity to an area bed. However, some systems have a pump as an integral part of the system, and sometimes a pump is added to overcome an elevation difference between the advanced treatment unit and the area bed.



A side view of an area bed following an advanced treatment unit. Note: some system designs allow for the treatment unit to be located on top of the area bed.

An area bed showing stone layer, pipes and geotextile fabric.

An area bed in a small space.

Cost Considerations

There are numerous ways to compare the costs associated with advanced treatment systems versus conventional septic systems. There are times where your site limitations will require the use of an advanced treatment system to meet the requirements in Ontario's *Building Code*. Conventional septic systems would normally cost less than those using advanced treatment units. However, in some cases where construction of a conventional septic system would require a raised bed, this difference may not be significant, and the use of the treatment unit with a smaller leaching bed would be more economical.

Other Considerations

Site conditions are not the only factor when comparing costs. For new home construction, you may have plans for pools, decks, wells, sheds, gardens and trees. How will it all fit and look on your property? Conventional systems may limit your options in terms of how you use your space. Advanced treatment systems may give you more options with your property. Homeowners should consult with their builder and septic contractor to ensure the final product will suit their property objectives.

Treatment systems can be incorporated into your property's landscape features.

Approval of Advanced Treatment Units in Ontario

Advanced treatment units must meet the effluent standards set out in Part 8 of the *Ontario Building Code*. Units listed in SB-5 of the Code are deemed to meet these requirements. Advanced treatment units that produce tertiary quality effluent could be used with the shallow buried trench system which is regulated under the *Ontario Building Code* or with an area bed pursuant to an authorization issued by the Building Materials Evaluation Commission (BMEC). Authorizations issued by the BMEC can be found on the Ontario Ministry of Municipal Affairs and Housing web site at www.ontario.ca/buildingcode.

List of Approved Advanced Treatment Units Listed in Supplementary Standards SB-5

Treatment Units	Treatment Method	Requires Hydro	Can Sit on Area Bed	Media Requires Cleaning or Replacement
Aquarobic Canada	suspended growth	constant	no	no
Aqua Safe and Aqua Air	suspended growth	constant	no	no
Biocycle Aerated Wastewater System	suspended growth	constant	no	no
Bio-Microbics — FAST® Wastewater Treatment Systems	attached growth	constant	no	no
Bionest Technologies Inc.	attached growth	constant	no	no
Clearstream Treatment Systems	suspended growth	constant	no	no
Nayadic Wastewater Treatment Systems	attached growth	constant	no	no
Norweco Singulair Treatment Systems	suspended growth	intermittent	no	no
Orenco AdvanTex® Wastewater Treatment System	synthetic media filter	intermittent	no	yes
Orenco Treatment Systems	sand filter	intermittent	no	yes
Premier Tech Environment — Ecoflo Biofilter Treatment Systems	peat filter	if required — intermittent	yes	yes
Puraflo® Peat Fiber Biofilter Treatment Systems	peat filter	intermittent	yes	yes
Rotordisk Wastewater Systems	attached growth	constant	no	yes
Waterloo Biofilter Treatment Systems	synthetic media filter	intermittent	yes	yes
Whitewater Treatment Systems	suspended growth	constant	no	no
WSB® Clean Treatment Systems	suspended growth	constant	no	no

Approved units as listed in the *Supplementary Standards* to the *Ontario Building Code* may change over time. The reader is advised to check the current SB-5 listing. This information can be obtained from Service Ontario Publications: www.publications.serviceontario.ca. To see samples of aerobic treatment units, visit one of two Ontario Rural Wastewater Centre Demonstration Sites (Guelph and Ottawa). Visit www.uoguelph.ca/orwc to learn more.

Special Approval for Other Treatment Systems

Other treatment units and distribution systems do exist, such as subsurface constructed wetlands, drip dispersal systems and membrane technology. However, at this time they are not specifically addressed in the *Ontario Building Code.* You can seek special approval for any of these systems from the local authority that enforces the *Ontario Building Code.* Local authorities (municipalities, health units, conservation authorities) have the authority to approve the use of such systems as alternative solutions to the *Ontario Building Code* regulated systems if you can demonstrate that the technology you would like to use meets or exceeds the level of performance of the *Ontario Building Code* regulated systems. Some systems may be regulated under the *Ontario Water Resources Act* (OWRA) and therefore an approval from the Ontario Ministry of the Environment may be required.

Subsurface constructed wetland.

Subsurface Constructed Wetland

Subsurface constructed wetlands are designed and built to simulate the cleaning functions of natural wetlands. Wastewater from the house goes directly to a septic tank where solids and liquids are allowed to separate. The wastewater then flows to the wetland that is filled with pea stone and emergent plants, like bulrushes, cattails, reeds, rushes and sedges. Plant roots aerate the subsurface wastewater, allowing bacteria to thrive in aerobic conditions. Bacteria attach to both the roots and pea stone and feed on the waste products in the water. The plants also absorb nitrates and phosphorus, lessening their impact on the receiving environment.

Drip dispersal system.

Drip Dispersal Systems

Subsurface drip dispersal systems are an option to consider. Drip dispersal systems deliver an even and slow distribution of effluent into the soil. Wastewater goes from the house to the septic tank and then to an advanced treatment unit. Effluent is then pumped through a network of small-diameter plastic pipes that are placed in the top soil. The treated effluent helps sustain grass growth and in turn recycled nutrients.

Membrane Technology

Membrane technology is currently being used for commercial buildings (resorts, hotels, schools), but the technology is moving towards smaller units designed for single homes.

Pumps are used to gently pull the wastewater through thousands of membrane fibre. Each fibre is filled with billions of microscopic pores that physically block suspended solids, bacteria and viruses from passing through.

These options are only three examples. Other systems are likely to be developed in the future.

Cover Illustration

- From left to right: conventional system, advanced treatment system with shallow buried trench and advanced treatment system with area bed.

Sources of Additional Information:

- *Septic Smart! — Understanding Your Home's Septic System (Booklet Number 1)*
- *Ontario Building Code 2006*
- Canadian Mortgage and Housing Corporation
- Ontario Onsite Wastewater Association
- Ontario Rural Wastewater Centre (Guelph and Ottawa)
- National Sanitation Foundation, NSF40

Document References:

- Based on original *Septic Smart! New Ideas for Household Septic Systems on Difficult Sites*, 1999.
- *Pipeline Newsletter,* National Small Flows Clearing House, National Environmental Service Centre (800) 624-8301.
- *Onsite Wastewater Treatment Systems Manual,* United States Environmental Protection Agency, February 2002.

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