Septic System Owner's Guidebook

For system performance

What you can do to care for your septic system

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The Robert B. Annis Water Resources Institute (AWRI) of Grand Valley State University is a multidisciplinary research organization. The mission of the Institute is integrating research, education, and outreach to enhance and preserve freshwater resources. For questions, more information, or additional guidebooks please contact:

Robert B. Annis Water Resources Institute
Grand Valley State University
Lake Michigan Center
740 West Shoreline Drive • Muskegon, MI 49441
Phone (616) 331-3749 • Fax (616) 331-3864
Muskegon Area Phone (231) 728-3601

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GVSU-AWRI Staff
John Koches, Kate Rieger, Nikki MacDonald
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Introduction

Onsite wastewater treatment systems*, more commonly called septic systems, treat sewage from homes and businesses that are not connected to a central wastewater collection and treatment system. Onsite systems include conventional onsite systems, cluster systems, and many different types of alternative wastewater treatment technologies. Whenever the toilet flushes or a faucet runs, the wastewater will be treated on the premises before being eventually released or removed.

Septic systems adjacent to water bodies are particularly likely to impact aquatic systems. Image courtesy of Psalms 30:11 Tours.

Onsite systems allow household wastewater to be treated when municipal sewer systems are not available. These systems have been used for many decades and when used and maintained properly, allow homeowners to live in areas with low population density by providing a relatively safe and inexpensive alternative to public sewage collection. They are generally individually purchased and controlled, poorly regulated by local government, and poorly understood by homeowners. When wastewater disappears down toilets and drains, it does not simply vanish but rather is treated through complex biological processes. In order to safely and effectively treat human waste, onsite systems must be cared for regularly.

*Terms in **bold** are defined in the glossary on page 17.

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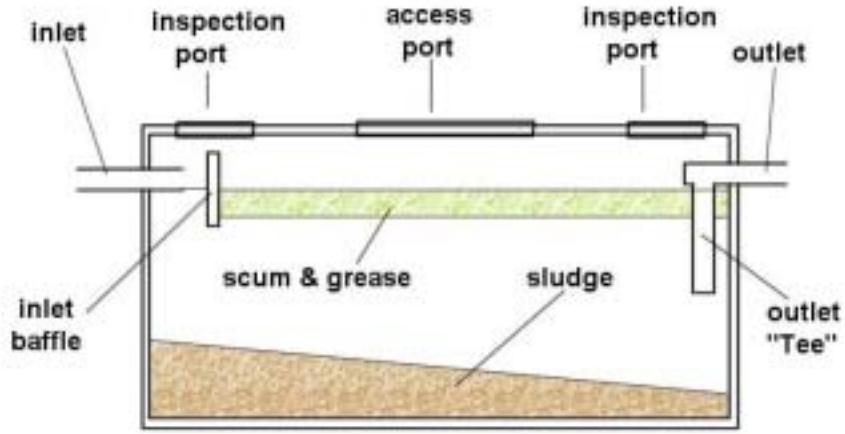
Unmaintained onsite systems can pose a threat to human health and the environment, as well as being expensive to repair. Therefore, it is important to understand how an onsite system functions in order for owners to continue to enjoy the benefits of living away from urban centers and reduce the need and or frequency of expensive system replacements.

This guidebook can help onsite system owners understand and care for their septic systems by explaining their basic components and function, techniques for caring for them, and where the waste goes when it is removed from the system.

How the Conventional System Works

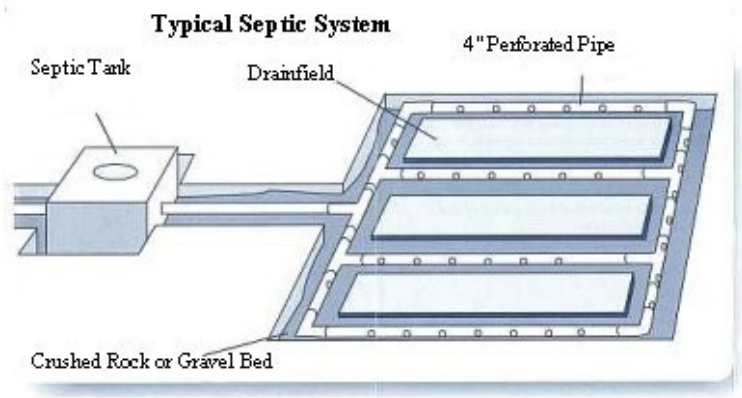
The conventional septic system is most common and is relatively inexpensive to install and maintain. It consists of household plumbing, a septic tank, and a **drainfield**. Water from showers, sinks, toilets, and washing machines enters the household plumbing system. The waste moves through the plumbing system, passes though the septic tank inlet, and collects in the septic tank.



Typical septic tank. Image courtesy of Maine Wastewater & Plumbing Control Program.

Here, solids are retained in two layers. The sludge sinks to the bottom and the scum and grease float. **Anaerobic** bacteria decompose the solids while liquids travel to the drainfield through the **outlet tee**. Though microorganisms can partially digest the solids in a septic tank by breaking them down into gases, dissolved chemicals and water, undecomposed material will gradually accumulate. A septic tank's function depends on its ability to release liquids into the drainfield without allowing significant amounts of solids to pass through the same pipe. Therefore, the solids within the tank must be periodically removed so that they do not reach the tank outlet.

Wastewater is slowly released into the soil through the drainfield piping. Microorganisms decompose biological material and the **nutrients** are **adsorbed** by soil particles where plants can take them up, much as nutrients and biological material are processed by soil in nature. As the water moves deeper through the soil profile, most of the biological material is gradually treated.



Septic systems use simple mechanisms to dispose of waste. Image courtesy of National Small Flows Clearinghouse.

A properly functioning septic system will result in far cleaner **effluent** when the wastewater reaches the groundwater and/or **surface water,** though it will still release excess nutrients and chemicals. While proper maintenance helps keep an onsite system running smoothly (see page 8), these systems have a maximum life of about twenty to thirty years in optimal sandy soil, with a low water table and an average domestic use. It is not uncommon for septic systems serving large families and/or in poor soil conditions to have a ten to fifteen year life expectancy. Attaching to a municipal waste collection system will eliminate both the need for a replacement system and the unavoidable pollutant release.

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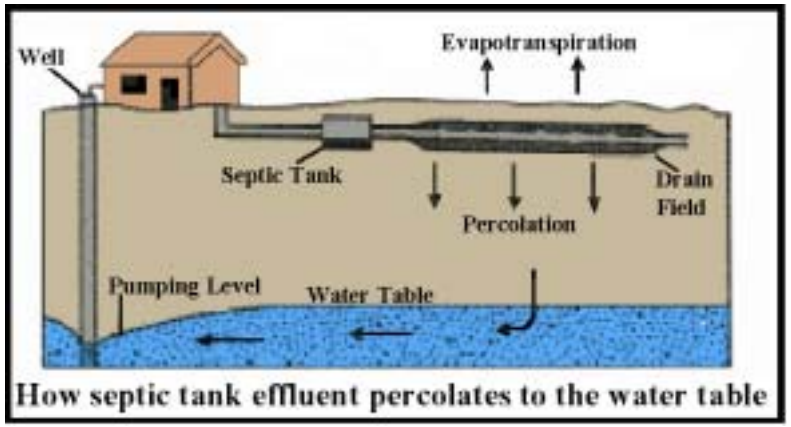

A properly maintained septic system minimizes pollution by using natural processes to treat wastewater. Image courtesy of Purdue Residential Onsite Wastewater Disposal.

As the above diagram shows, onsite system effluent will eventually enter either the **groundwater** or the surface water. The ultimate goal of treatment is to ensure that wastewater does not significantly pollute its final destination since this water will ultimately be reused for drinking, recreation, or wildlife.

A septic system depends on a drainfield that is adequately sized to treat the effluent that enters it. The necessary size of a drainfield will depend on the number of users, the amount of waste produced, soil texture, and the depth of the soil before reaching the water table or an impervious material. A larger drainfield will generally last longer due to the lesser strain that is placed upon it. Prolonged flooding of the drainfield due to heavy use may encourage the growth of biological mats that clog the pipes releasing wastewater, making it difficult for waste to move through the system. The use of a series of septic tanks prior to the effluent reaching a tile field or a second or third drainfield will greatly extend the expected life of the septic system and result in overall financial savings.

Siting

Homeowners whose properties have high water tables are likely to see their traditional septic systems fail quickly. Image courtesy of the Division of Onsite Sewage and Water Services, Virginia.

A conventional septic system depends on a specific set of conditions to function properly. In order for the effluent water to be properly treated by the soil in the drainfield, the drainfield must be sufficiently far from surface or groundwater. Soils that flood seasonally or are too wet are unsuitable for septic systems. Additionally, the soil texture must not be too coarse or too fine. Coarse soils may drain wastewater before it is properly treated and fine soils may not allow the wastewater to infiltrate, leading to ponding. Residences in areas that are environmentally sensitive may be better served by an alternative system that is designed to produce higher quality effluent.

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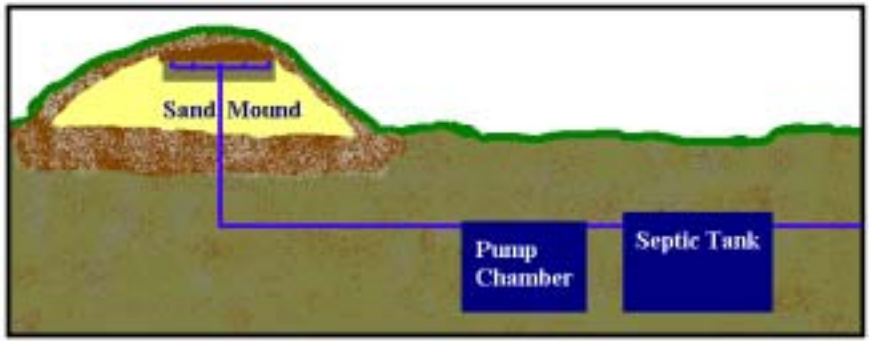
Alternative Systems

Mound Systems

While use of a conventional system may be limited by these criteria, it is possible to install a system that will be better suited to the site. For instance, the limitations of seasonally wet soils, high water tables, or bedrock near the soil surface may be overcome by the use of a mound system. This system employs an elevated drainfield constructed from soils brought to the site. Effluent may be pumped into the drainfield, unlike a conventional system where it normally moves by the force of gravity. A mound system is meant to provide treatment equal to or better than that of a typical system in areas where the classic septic system would not be able to function.



Mound systems raise the drain field so that it is protected from floodwaters. Image courtesy of GVSU-AWRI.

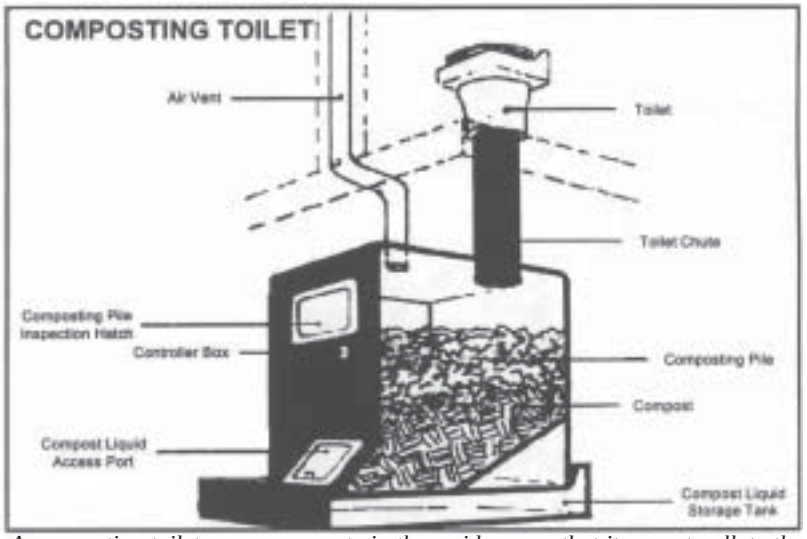
Sand Filters

For environmentally sensitive areas or areas where the land available for a drainfield is unsuitable or too small, an intermittent sand filter may be used. This system employs engineered soil and rock layers where effluent from the septic tank is released and treated before being discharged, either directly to the soil or to a drainfield. Intermittent sand filters require a pump, and therefore use some electricity.

Recirculating sand filter. Image courtesy of the University of Minnesota.

Composting Toilets

Composting toilets can be employed in areas that are extremely sensitive to nutrients or areas where water must be conserved. With this system, little or no water is needed. Bacteria decompose human and kitchen waste without water or chemicals. Instead the waste is aerated to improve decomposition. The end product is a soil-like material that must legally be burned or removed by a septage hauler. This results in a **zero discharge system**.



A composting toilet processes waste in the residence so that it cannot pollute the groundwater. Image courtesy of Clivus Multrum, Inc., 1994.

Alternative systems have both advantages and disadvantages. They may be more expensive to install due to the need for imported soils, pumps, or mechanisms. The proper functioning of these systems may require moderate to high levels of maintenance, without which they will not process waste material adequately. Though all systems release some nutrients and chemicals, many alternative systems produce higher quality effluent than the typical septic system and may be suited to sites where the classic septic systems cannot function properly. In slightly unsuitable conditions, there may be a better financial option than a conventional system, which may fail quickly and need replacing if it is functioning under poor conditions. The choice of system should be dictated by site specifications, financial constraints, environmental sensitivity of the surroundings, and local health department regulations. Many more types of alternative systems are available. Check with your local health department before making a decision, or check the alternative technology fact sheet on National Small Flows Clearinghouse's website for more information (see page 16).

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Onsite System Care

There are many practices that will help you get the maximum efficient life out of your septic system. Septic tanks that are not pumped regularly will release solid waste into the drainfield. When this happens, the pipes can become clogged or the soil can cease to properly treat wastewater, possibly ruining the drainfield. Repairing this damage can cost many thousands of dollars and may require additional room for a new drainfield. Just because the onsite system appears to be working within the home does not mean that it's providing proper treatment, since the initial problems can go undetected. Some beneficial practices include:

Using chemicals sparingly will help preserve the septic system. Image courtesy of GVSU-AWRI.

- Conserving water routinely
- Installing low flow showerheads and other water saving devices
- Diverting other sources of water away from the drainfield through the use of roof drains, sump pumps, etc.
- Minimizing the use of harsh cleaners and chemicals such as bleach and ammonia
- Limiting the amount of antibacterial soaps that are used
- Using low phosphorus detergents and laundry soap
- Knowing the capacity and location of your septic system
- Not applying fertilizer on or near the drainfield
- Not paving or building over a drainfield, and keeping vehicles and tree roots away from the septic tank and drainfield
- Inspecting the septic tank at least every two to three years, depending how heavily it is used
- Pumping the septic tank every three to five years, or as needed

Additive Products

Products are available that claim to increase the measurable efficiency of septic systems or enable the owner to avoid pumping the septic tank. Some products add bacteria or enzymes to the septic tank to help with the digestive process. At best, many of these products are of limited benefit; at worst they can be very harmful. Enough bacteria are present in human waste to support the decomposition process. Adding bacteria will introduce competition for existing microorganisms that are already ideal for the system. Enzymes that break down biological material can lead to this material entering the drainfield. This interferes with the soil's natural ability to process waste and can clog the pipes, ruining the drainfield. Any chemical that claims to kill bacteria should not be purchased since these bacteria are needed to decompose the waste. Onsite system additives are not recommended since a properly maintained system functions well on its own. Be sure to check with your local health department before purchasing any new product that claims to aid onsite system function, regardless of its advertised value. Remember that no product will eliminate the need to pump septic tanks periodically.

The following items should not be put down a toilet or drain:

Feminine hygiene products	*Cat litter*
Paper towels	*Hair combings*
Disposable diapers	*Cigarette butts*
Condoms	*Coffee grounds*
Dental floss	*Gauze bandages*
Fat, grease, or oil	*Paints*
Varnishes	*Thinners*
Photographic solution	*Pesticides*

Solids and Chemicals

Solids that do not decompose may clog pipes or fill the septic tank, while harsh chemicals may kill the bacteria that treat septic system waste. Trash should be disposed of in the trash can rather than the toilet. Using a garbage disposal can reduce the life of a septic system or necessitate more frequent pumping. **Composting** this waste will spare the septic system. Many household chemicals do not decompose and therefore ultimately are released into ground or surface water. Avoid the use of the items listed above and use minimal amounts of non-toxic or organic household chemicals whenever possible.

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Wastewater

Generally a septic system will function best when it processes small amounts of wastewater. It is helpful to space laundry throughout the week so that the system has time to process the water. Other techniques include taking shorter showers and turning off water when brushing teeth.

Water softeners

The use of water softeners has not been proven to be either a benefit or detriment to a septic system. Homeowners may use their discretion when deciding if a water softener is needed.

Signs of a Failing System

What does a failing system look like? Regular upkeep will delay problems, but eventually all systems reach the end of their natural life. If your septic system is older or has been subject to risk factors like infrequent pumping or heavy use, it is particularly important to be aware of what a failing system looks like.

Signs of a failing system include:

- *Sewage odors in your house or yard*
- *Slowly draining sinks and toilets*
- *Sounds in the plumbing like gurgling or plumbing back ups*
- *Soggy soil surrounding the septic tank or drainfield*
- *Lush green grass or excessive plant growth near the drainfield*
- *Excessive algae growth in nearby waters*

These signs are a lot like the oil light coming on in a car. Though they can indicate a major problem, promptly pumping the tank and repairing any broken components as well as following recommended practices may prolong septic system life.

Effects of a Failing System

Coliform Bacteria. Image courtesy of University of Iowa Central Microscopy Research Facility.

The most dramatic outcome to result from a failing onsite system is that waste may back up into the home. This exposes the inhabitants to harmful bacteria and creates an unsightly, expensive mess. However, subtle problems also may arise that the owner may not be aware of. Failing onsite systems release human pathogens as well as excessive nutrients. Coliform bacteria from human waste can enter surface water, leading to possible human exposure.

Nutrients enter the groundwater when wastewater passes through drainfields, but can enter in greatly increased amounts when the system is failing. While this has few consequences for adults, it can harm human and animal infants when polluted groundwater is used for drinking. Excessive nitrate in drinking water impairs the ability of babies to transmit oxygen and can cause "blue baby" syndrome.

Healthy babies such as the one shown above need to drink only unpolluted water. Image courtesy of John D. Matthews, Jr.

The release of nutrients may "sound" fine, however excessive nutrients are harmful in aquatic systems. Too much nitrogen and phosphorus can lead to premature aging of streams and rivers. Excessive nutrients encourage plant growth and previously clear water can become choked with weeds. As these plants decay, they give off unpleasant odors and decomposition uses the oxygen needed for fish and other aquatic life. Along with other poor management practices, malfunctioning systems around lakes degrade the very resource that attracted the residents to the location in the first place. These negative environmental and economic consequences are preventable with proper management.

It is far safer and less expensive to take care of the onsite system before any of these symptoms appear. Failed systems can be expensive to repair or replace, and also lower property value. Once you begin seeing these warning signs, damage may have already been done.

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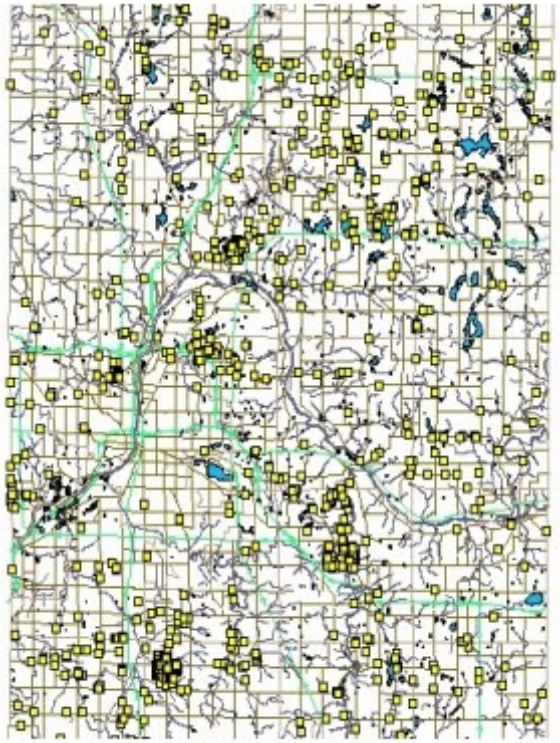
Community Management

Community-managed onsite systems are encouraged, given that groundwater is a community resource and a few malfunctioning systems can pollute water supplies for many users. Discussing septic system maintenance with your neighbors is a good way to promote appropriate upkeep.

Clean water: an important resource. Image courtesy of John O'Fallon.

A community-wide septic system maintenance program implemented by local units of government can protect community resources by ensuring that septic systems function properly. This may include system inspection or require tank pumping, either when a home is sold, or on some regular basis. The frequency of inspection may depend on the type of system a home employs. For instance, many alternative systems require professional servicing, whereas traditional systems may need less frequent examination than alternative systems to ensure that they are functioning properly and that the septic tank is not full.

Other maintenance program options could require homeowners to pay a monthly fee, and in return they would have their systems replaced or repaired when such actions were necessary. Contact your local township or county offices if you have questions or comments about how septic systems are cared for in your community. Community maintenance programs are being recommended to prevent nitrate contaminated wells such as those reflected in the Kent County Health Department's map.



A map of 1971-1991 nitrate contaminated wells within Kent County, Michigan. Yellow squares indicate contamination. Image courtesy of the Kent County Health Department.

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Septage Disposal

As previously stated, bacteria partially decompose the solids that accumulate in a septic tank, but over time undecomposed material accumulates. This material, called septage, must eventually be removed by a licensed septage hauler. Septage can either be taken to a landfill, a wastewater treatment plant, or an approved non-public contact site. Landfilling septage is expensive and therefore fairly uncommon. According to Michigan law, all septage pumped within fifteen miles of a wastewater treatment plant that accepts septage must be disposed of at this plant. The third alternative is for septage haulers to dispose of the waste themselves. The non-public contact sites they use are often farm fields, where septage is recycled as fertilizer. Here, steps are taken to reduce **pathogen vectors** and the crop harvesting is restricted. Septage must be applied to agricultural fields in amounts that do not exceed crop nutrient requirements.

A septage hauler pumps a tank. Image courtesy of Roger Darr.

There is an economic incentive to take shortcuts that may negatively impact public health or the environment. Historically, the laws governing septage disposal have been poorly enforced. Reputable haulers are forced to compete with others who may be tempted to save money by getting rid of the septage illegally. Septage that is improperly disposed of can have the same effect as failing septic systems, creating environmental and health risks. Ask your septage hauler where the waste will be taken and what will be done with it. Septage haulers can be regulated at a local level as well as by the state, and your county may have a program that determines how septage must be discarded.

Contacts

ADDRESSES

City of Grand Rapids Wastewater Treatment Plant
1300 Market Ave. SW
Grand Rapids, MI 49503
Phone: (616) 456-3625

Department of Environmental Quality
State Revolving Fund - Chip Heckathorn
33 South Capitol Avenue
P.O. Box 30457-Town Center
Lansing, MI 48909
Phone: (517) 373-4725
Fax: (517) 335-0743

Kent County Health Department
700 Fuller Ave., NE
Grand Rapids, MI 49503-1996
Phone: (616) 336-3030
Fax: (616) 336-3884

Muskegon County Health Department
209 East Apple Ave., Suite D104
Muskegon, MI 49442
Phone: (231) 724-6311
Fax: (231) 724-6674

Muskegon County Wastewater Management System
8301 White Road
Muskegon, MI 49442
Phone: (231) 724-3440
Fax: (231) 724-3558

National Small Flows Clearinghouse
West Virginia University/NRCCE
P.O. Box 6064
Morgantown, WV 26506-6064
Phone: (800) 624-8301
Fax: (304) 293-3161

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Wyoming Clean Water Plant
2350 Ivanrest
Wyoming, MI 49509
Phone: (616) 261-3552
Fax: (616) 261-3590

WEBSITES

Access Kent
http://www.accesskent.com/

All Septic System Information Website
http://www.inspect-ny.com/septbook.htm

Coastal Information Clearinghouse
http://www.ncnerr.org/ccs/clearinghouse/septic_health/sh_alternative/

Kent County Septage Management Program
http://www.gvsu.edu/wri/isc/septage/index.htm

Local Public Health Department Locator
http://www.malph.org/page.cfm/108/

National Small Flows Clearinghouse
http://www.nesc.wvu.edu/nsfc/

Principles and Design of On-Site Waste Disposal with Septic Systems
http://www.epa.gov/seahome/septics/src/title.htm

Purdue Residential Onsite Wastewater Disposal
http://www.ces.purdue.edu/onsite/

U.S Environmental Protection Agency Onsite/Decentralized Wastewater Treatment Systems
http://www.epa.gov/owm/mtb/decent/index.htm

Glossary

Adsorb (Soil) - To accumulate on the surface of soil particles.

Anaerobic - Capable of living in the absence of atmospheric oxygen.

Compost - The process of decomposing waste such as kitchen scraps into a material that can be used to improve soil structure and provide plant nutrients.

Drainfield - An area into which septic waste is transported by a series of perforated pipes. Liquid waste moves out of these pipes and into the soil, where it is treated through adsorbtion, plant and microbial uptake, and chemical processes.

Effluent (Septic) - The liquid waste that leaves a septic system.

Enzyme - An organic molecule that initiates a chemical reaction.

Groundwater - Water beneath the ground surface, filling space between soil particles and supplying springs and wells.

Nutrients - Chemicals needed by organisms for proper growth and development.

Onsite Wastewater Treatment System - A system designed to treat residential sewage on location.

Outlet Tee - The pipe through which domestic waste leaves the septic tank.

Pathogen Vector - Anything that can transport a pathogen, such as surface water runoff or animals that are in contact with the pathogen.

Surface Water - Water that remains on the land surface, such as lakes, streams, and wetlands.

Texture (Soil) - The size of the soil particles. Coarse textured soils have more large grains such as sand while fine textured soils are dominated by small particles such as silt or clay.

Zero Discharge System - A system that does not release waste, treated or untreated, into the environment.

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Kent County Septage Program

Partners: Tetra Tech, Inc. and Prein & Newhof

Project goals are to limit septic system use and septage disposal to those areas where it is appropriate, upgrade onsite system maintenance and septage disposal procedures throughout Kent County, and encourage septic system and septage disposal alternatives where such alternatives prove economical and technically sufficient.

GRAND VALLEY STATE UNIVERSITY

Do your part to protect our ground and surface water

Residents enjoy our freshwater resources. Image courtesy of GVSU-AWRI.

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Annis Water Resources Institute
Lake Michigan Center
740 West Shoreline Dr.
Muskegon, MI 49441

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Grand Valley
State University