GEORGIAN BAY
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Septic System Guide
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For more information and documents visit the GBA septic system webpage.

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1. Introduction to Septic Systems in Georgian Bay

1.1 Purpose and objectives

Audience: GBA members and members of other Georgian Bay communities

Objectives: Provide practical information about the types of septic systems permitted in the Georgian Bay area, including how to go about choosing an appropriate system, and how to inspect and maintain them. Provide information on the advantages and disadvantages of each system. Note: your township's bylaws and the Ontario Building Code will in most cases dictate which systems can be used.

Goal: Help cottagers understand: the available options; what is involved in selecting the system that is best for them; and how to properly monitor and maintain their septic system.

1.2 Acronym Table

Organization	Acronym	Term	Acronym
Georgian Bay Association	GBA	Advanced Treatment Unit	ATU
Ontario Building Code	OBC	Ontario Ministry of Municipal Affairs and Housing	MMAH
Chief building official	CBO	Metre	m
Township of the Archipelago	TOA	Litre	L
Township of Georgian Bay	TGB	Millilitre	mL
Town of Northeastern Manitoulin and the Islands	NEMI	Milligram	mg
Municipality of Killarney	MOK	Microgram	µg
Township of Carling	TOC	Milligrams per litre	mg/L
Federation of Ontario Cottagers' Associations	FOCA	Micrograms per litre	µg/L
National Sanitation Foundation	NSF	Biochemical oxygen demand Colony forming units	BOD CFU

1.3 General Considerations

If you have a home or cottage in the rural areas of eastern and northern Georgian Bay, it is more than likely that your wastewater is serviced by a septic system. A septic system is also referred to as an onsite wastewater disposal system, because the wastewater is managed adjacent to the building in which it is generated, rather than being transported through a sewer system to a treatment facility.

The two primary options for most properties in cottage country are:

- A Class 4 system, either conventional or ATU; or
- A composting toilet with a greywater pit - Class 1&2.

However, some residents have a Class 5 holding tank in place and are permitted to replace it with a new holding tank when necessary.

A Valuable Investment

It is common for people to first consider their pocketbooks when thinking about septic systems. Your septic system represents a significant financial investment in your property. The price tag for repairs or replacement varies depending on the specific features of each site, including access, drainage, size, and type of system. Be prepared to spend anywhere from $5,000 to $50,000 on the work needed.

Your septic system should also be considered an ecological investment on your property, as a properly maintained and functioning system is an act of environmental stewardship. Proper annual maintenance and routine care will decrease the likelihood of damage, leakage, and contamination of ground and surface waters. This will go a long way in protecting your home and property value, and your neighbours will thank you for respecting public health.

2. Septic System Types

All residential onsite wastewater treatment systems across Ontario are regulated by the Building Code Act, 1992[1] and the Ontario Building Code (OBC).[2] On eastern Georgian Bay, the OBC is enforced primarily through municipal government by the chief building official (CBO). In the municipalities of McDougall, Seguin, and Carling, permits are issued through the North Bay Mattawa Conservation Authority, and in Killarney they are issued through the Sudbury and District Health Unit. The Township of the Archipelago (TOA), Township of Georgian Bay (TGB), and the Town of Northeastern Manitoulin and the Islands (NEMI) all have their own CBO. There is no one-size-fits-all wastewater system, but there are options available to meet a variety of site conditions, locations, budgets, and degrees of usage.

There are five classes of septic systems in Ontario permitted under the OBC:[3]

In addition, you can augment a leaching bed system by using one of the advanced treatment unit (ATU) options that are approved for use in Ontario. See details in the Class 4 section below.

The major challenge in determining which system is the best for a location on the Canadian Shield is the soil level at the location, particularly on many islands in Georgian Bay where there tends to be less soil than at mainland locations.

This issue is encapsulated in this section of a manual issued by the Ontario Ministry of Municipal Affairs and Housing (MMAH) for designers, installers, and inspectors of septic systems:[4]

> At rocky sites, such as areas within the Canadian Shield, there is little or no soil cover. The possibility of constructing a soil mantle of leaching bed fill is, therefore, a judgment of whether or not it can be suitably constructed and tied into the surrounding soil cover. It is considered both impractical and inappropriate to place granular fill for a raised bed onto bare rock where there is no soil sustaining growth in the surrounding area. This is particularly true if the rock is smooth and sloping. Such a site may result in effluent travelling down through the imported soil and potentially along the rock surface, breaking out at the end of the mantle. Alternatively, the effluent may fall through fissures in the rock that will not allow any additional treatment of the effluent.

On difficult sites as described above, a 30-centimetre layer of pond clay, or other suitable material as determined by the approving authority, can be used over undulating bedrock, or to seal cracks and fissures in the bedrock.

The clay can also be useful as a berm to shape the flow of the effluent away from or around property boundaries, dwellings, etc., to mitigate leaching bed washout from stormwater.

3. Background on Health, Safety, and Chemical Processes

3.1 Introduction

When thinking of the blackwater and greywater that makes up sewage, people often assume that blackwater from toilets has the most potential to cause harm to the environment. This is true if we only consider the human safety factors from pathogens. However, greywater from your kitchen, bath, and sinks can be just as damaging to the environment. Both the biological (pathogens) and the chemical (nutrients and pharmaceuticals) composition of sewage pose threats to human health and the environment, including the health of animal and aquatic life, as outlined in the table below. In the following section, we review the potential risks that sewage poses to human health and the environment.

These are the outputs of primary concern from blackwater and greywater:[5]

Pathogens	Nutrients	Pharmaceuticals
• Viruses • Bacteria, such as E. coli • Parasites	• Phosphorous • Nitrates • Carbon	• All medication taken by those using the system

3.2 Safety for Humans

Human sewage waste contains pathogens that can be a risk to public health, as well as other organics and nutrients that can be harmful to the environment if not adequately treated. A properly functioning septic system is intended to provide basic treatment and soil filtration, with a focus on organic matter, solids, and pathogens through physical, chemical, and biological processes that occur naturally in the soil.

The amount of solids and organic material in sewage is typically measured as total suspended solids (TSS) and biochemical oxygen demand (BOD). Sewage can contain millions of pathogens such as E. coli, which are typically measured as a number of colony forming units (CFU) per 100 mL of liquid. Potable water would contain zero CFUs,[6] while water that is safe for swimming and bathing but not consumption must be less than 100 CFU per 100 mL,[7] in accordance with Provincial Water Quality Objectives.

Typical pathogen counts from a septic tank could be as much as tens of thousands to millions of CFU per 100 mL. Clearly there are important safety factors at stake here regarding the appropriate minimum level of bacteria for humans and different usages (drinking, swimming etc.) for septic systems in Georgian Bay.

3.3 Safety for the Environment

Nutrients (such as nitrogen and phosphorus) can be harmful to water quality in the vicinity of your property. These nutrients are not typically removed by a standard (Class 4) septic system and will usually require special treatment processes to provide any measurable level of treatment. It is the nutrients (nitrogen and phosphorus) that drive aquatic plant and algae growth in our waters and can cause algal blooms. The blooms can lead to reduced water clarity, loss of deep-water oxygen, altered taste and odour, and the production of toxins.[8]

The phosphorus levels in municipal sewage are expected to be in the 4 to 12 mg/L range,[9] but the phosphorus levels in your septic systems could be much higher, in the range of 10 – 25 mg/L.[9] This is because the sewage from a single dwelling is not mixed and diluted with other wastewater sources. In addition, the advances in water conservation measures over the last number of years have resulted in a more concentrated sewage compared to historical literature values for typical municipal wastewater. Testing has confirmed that phosphorus levels in private septic systems can be much higher than in municipal sewage.[9] The real concern with phosphorus is that scientific reports tell us that nutrients we bring into cottage country that are not taken up by plants in the soil (or reduced by some ATUs) could make their way into the waters in front of our cottages.[9]

For reference, the background levels of phosphorus in the water of Severn Sound, Georgian Bay are about 0.015 mg/L.[10] As you can imagine, if any of our sewage waste enters a system with a relatively low level of phosphorus, it can greatly increase the concentration in the water and could quickly have a negative impact on the environment.

Nitrogen can exist in several forms, including organic nitrogen, ammonia, nitrate, and nitrite. In a septic system, the nitrogen exists primarily in the form of ammonia and may convert to nitrate and nitrite, either in the soil of a leaching bed, or in an ATU. Ammonia in its un-ionized form is toxic to fish, and if not properly treated can cause impacts to surface water quality and aquatic life.

Some providers of advanced treatment units have developed nutrient reduction modules, which may be available to residential septic system users (see section 6.5). There continues to be a need to find better solutions to reduce those nutrients that we load into our septic systems which find their way into our waters.

A simple conclusion here is that our septic systems pose a potential risk to the waters and environment around our cottages that needs to be mitigated. By providing you with practical information about choosing the best system for your property, and subsequently inspecting and maintaining that system, this guide aims to help mitigate those potential risks.

3.4 Septic System Performance Factors

The OBC does not contain performance or treatment standards for most septic systems. These systems are not required to meet a certain level of removal, nor is there a requirement for performance verification of these systems. It is generally assumed that if a system provides the required area and depth of soil, the sewage will be sufficiently treated to an acceptable level. In reality, there are many site-specific factors that influence whether or not a septic system is indeed providing the necessary level of treatment for organics, solids, nutrients, and pathogens.

Advanced treatment units (ATUs) on the other hand, are required to be certified to meet a certain minimum level of treatment performance for organic and solids material, but are not required to meet any pathogen removal standards. Nutrient removal (nitrogen or phosphorus) is not required by the OBC, but may be a site-specific requirement based on the potential for impacts to local water resources.

4. Class 1 & 2: Composting Toilet With or Without a Greywater System

Outhouses have been the traditional composting toilet method used for properties with no septic system, and are still used at many rural and cottage locations. Outhouses can still be an option today, especially for properties that are not low lying (as they could get flooded) or for properties with water supply issues.

Today, a popular alternative to the outhouse is a composting toilet, of which many varieties exist. Outhouses and composting toilets are referred to as Class 1 systems under the framework of the OBC. Residences with an outhouse or composting toilet and running water still require a system to collect the water from other drains (called greywater). One option is a Class 2 greywater system (see the following section), usually comparable to a vastly scaled-down septic system.

When purchasing a composting toilet, it is important to understand its capacity, your household needs (the amount of people, the frequency and duration of stays, etc.), and the disposal procedure of that model, so that you can select the best option and fit for your property and your needs. For instance, having no requirement for disposal of material (pump-outs, separate disposal facility, transportation by boats/car, etc.) could be a better option for Georgian Bay properties.

4.1 Types of Composting Toilets

Composting toilets can be used as an alternative septic system in areas where installing a Class 4 septic system is not feasible or ideal, such as a property with little to no soil coverage. The goal of composting toilets is to produce a safe by-product that can go back into the environment with no harmful pathogens. Over the years, new technologies have been developed for composting toilets and there are a variety of options available to consumers depending on their needs.

The following section highlights some of the options available, the technology used, and brands that offer these toilets. These options have been compiled from the available information online, but please note that GBA has no affiliation or endorsement of these companies/products.

4.1.1 Outhouse

An outhouse is the most basic form of composting toilet, with 3 types available: an earth privy (pit latrine), a vault privy, or a portable privy. There is no water for flushing, urine separation, or electricity needed.[11]

An outhouse must be built out of durable weatherproof materials, with a solid and supported floor. It is equipped with a toilet seat with a lid, an optional urinal, a self-closing door, and a ventilation system. An earth privy requires a minimum of 900 mm of soil between the bottom of the pit and the water table. A vault privy requires a watertight collection bin and the soil or leaching bed around the base of the structure must be raised at least 150 mm above ground level. A portable privy must be built with materials that can withstand transportation.

Vault and portable privies are used in areas with inadequate soil depths, such as Georgian Bay.[11] The OBC sets out the standards and setbacks required for Class 1 systems.[12]

4.1.2 Low-water Composting Toilets

Low-water composting toilets are similar to a regular toilet in the sense that there is a small amount of water used when flushing the toilet. The water and waste travel through a gravity-fed pipe into an external waste collection compartment, which is generally located below the bathroom or toilet in a basement or crawl space.

Brand	Type	Electricity	Self-contained waste collection	External waste collection	Distributor
Sun-mar	Low-water flush	Option	No	Yes	• Sun-Mar Distribution List

4.1.3 Dry-flush Composting Toilets

With dry-flush composting toilets the waste travels by gravity to a self-contained or external waste collection container; there is no water used in this process. Electric or non-electric options are available depending on the brand. Electric options generally have a fan and/or a heater that helps dry out the waste, reduces the smell, and improves the composting process, which can be solar powered.

Brand	Type	Electricity	Self-contained waste collection	External waste collection	Distributor
Sun-mar	Dry-flush	Option	Option	Option	• Sun-Mar Distribution List
Phoenix	Dry-flush	Yes	No	Yes	• Phoenix

4.1.4 Urine-diverting Composting Toilets

Urine-diverting composting toilets simply separate liquid waste from solid waste using a gravity-based diverting mechanism in the toilet bowl. The purpose of this separation is to limit the amount of liquid in the solid waste before it is broken down into compost. Excess liquid can lead to reduced productivity of the composting process, increased smell, and additional mass in the composting system.

Urine-diverting systems can be divided into electric or non-electric. The electric systems have a fan that aids in the drying processes and smell reduction. Additionally, there are differences as to where the liquid and solid waste go. The urine can be diverted into a collection vessel, piped out to the outside, or sent to a natural filtration system. Generally, self-contained waste collection systems for the solid waste have a collection bag that can be removed after a set amount of time/uses (specified by the manufacturer). External waste collection systems have a separate compartment that is gravity fed.

Brand	Type	Electricity	Self-contained waste collection	External waste collection	Distributor
Nature's Head	Urine diverting	Required	Yes	No option	• The Cabin Depot • Nature's Head Canada Distribution List • Harbour Chandler
Separett	Urine diverting	Required	Model option	Model option	• Composting Toilets Canada • The Cabin Depot • Canadian ECO Products • RONA • Lowe's
Sun-Mar	Urine diverting	Required	Yes	No	• Sun-Mar Distribution List
Thinktank waterless toilet	Urine diverting	Required	Yes	No option	• Composting Toilets Canada
OGO	Urine diverting	Yes	Yes	No	• The Cabin Depot

4.1.5 Incinerator Toilet

Incinerator toilets have a separate compartment that has a heating mechanism below the toilet that heats up the waste product, burns it, and converts it to ash. The ash produced has no harmful pathogens and is safe to dispose of in the environment; it can even be used as a fertilizer. This system deals with liquid and solid waste without the need for separation or urine diversion. There are both propane incineration and electric incineration options.

Brand	Type	Electricity	Self-contained waste collection	External waste collection	Distributor
Cinderella	Propane gas incineration	Required	Yes	No	• The Cabin Depot
Cinderella	Electric incineration	Required	Yes	No	• The Cabin Depot

Cinderella Comfort incinerating toilet

4.2 Maintenance and Waste Disposal

Each model and type of composting toilet has its own set of requirements for installation, setup, upkeep, and waste removal. It is important to understand what can and cannot be used in the composting process, such as specific additives or restricted materials for each system. Depending on the system type (self-contained or external), there will be differences in time, capacity, and waste removal processes. The configuration and placement of the system on the property is important for effective use, (e.g., a gravity-fed external collection system will need to be placed properly for proper use) so understand the dimensions, mechanisms, and installation processes of each system and how they relate to your property. Make sure you are up to date with your toilet's manuals and instructions for proper use.

4.2.1 Outhouses

An outhouse system is the most basic form of a composting toilet and requires little maintenance. You must make sure the structure meets the Ontario building code standards and setbacks, and provide upkeep to the structure as required. Additives such as lime (calcium hydroxide), sawdust, and wood ash can be used for odour control.

To decommission an outhouse, you can cover the opening with stones or soil. When a new outhouse is built, make sure it is far enough away from an existing outhouse so the excavation of the soil doesn't cause the walls of the old one to collapse.

If your outhouse has a container that holds the waste (e.g., a vault privy), you must arrange for the storage container to be taken to a proper facility for waste treatment, per your municipality's bylaws.[12] This option for waste removal can pose considerable challenges for cottage owners on Georgian Bay without road access, particularly those with boat access only.

4.2.2 Self-contained vs External Composting Toilet Systems

A self-contained waste collection system collects liquid and solid waste within the composting toilet unit. Generally, there is a collection bag, tray, or access panel beneath the toilet seat to collect solid waste and, if applicable, a separate container for urine collection. The collection method for liquid and solid waste can vary from model and make, so it is important to understand these features when purchasing a composting toilet.

An external waste collection system has a separate collection tank from the composting toilet unit. For external waste collection systems, the liquid and solid waste travel from the toilet unit to the external collection tank where the composting process occurs. Often the external collection unit has a tray or drawer that collects the composted material, which can be removed so proper disposal can occur.

Self-contained waste collection systems have a smaller holding waste capacity than external waste collection systems. The holding capacity limits the amount of uses before waste disposal is needed. Therefore, it is very

important to understand your household's needs when purchasing a composting toilet (family size, duration of stay, frequency of use, etc).

Generally, the containers in self-contained waste collection systems are removed after a set amount of time or uses specified by the manufacturer. For systems that use electricity, a fan helps speed up the composting process. The collection and drying process for self-contained systems is significantly shorter and removal is more frequent than for external collection systems, but the period of time varies from brand to brand. External collection systems have a larger, separate collection system from the toilet that allows for longer-term collection and a larger capacity.

For self-contained waste collection systems, the composted material from the collection unit is removed and disposed of into a secondary composting bin or into landfill, or used as fertilizer. For an external collection system, the removal of composted waste occurs less frequently, but the mass is larger. Regardless of the system, be sure to follow your local municipal regulations for proper disposal procedures.

Given that a set amount of time must pass to ensure that the waste material has adequately composted, if this toilet is being used full time on a regular basis, there might not be enough time to allow for the materials to compost before the bin is full. In this case, you may need to put in place a back-up method to allow the waste to fully compost before it enters back into the environment.

4.2.3 Urine-diverting Composting Toilet Systems

Depending on the system, urine-diverting systems may have collection vessels that would require emptying, or a pipe that moves the urine into a leaching system outside (e.g. a class 3 system).[13] It is important to ensure you dispose of all waste materials properly and in accordance with the regulations in your municipality.

4.3 Aerobic vs Anaerobic Comparison

The most common forms of composting (breaking down of organic matter) for toilets are aerobic (with oxygen) and anaerobic (without oxygen). It is important to understand how your system functions and whether it composts using aerobic or anaerobic processes, because maintaining the environment of the composting toilet is critical to keeping the system functioning properly.

For the aerobic composting process, temperature, moisture, oxygen, and healthy bacteria are the main components of a functioning system. Each aerobic composting toilet has requirements and restrictions on how to maintain the environment to ensure aerobic composting is occurring.

Urine-diverting toilets prevent excess liquids entering into the system that might lead to too much moisture, which can lead to inefficient composting. Toilets that have fans allow for drying and air circulation.

Anaerobic composting toilets require an oxygen-depleted environment that allows anaerobic bacteria to survive. Again, each anaerobic composting toilet has requirements and restrictions on how to maintain the proper environment.

4.4 Greywater Systems

Greywater systems are used to treat and dispose of greywater and are regulated under the OBC as Class 2 systems.[14] Greywater is wastewater that does not contain human waste (also known as blackwater). Sources of greywater include water from sinks, showers, laundry machines, and dishwashers. As defined in the OBC, greywater is "sanitary sewage of domestic origin that is derived from fixtures other than sanitary units."[14]

Greywater systems can be used if proper piping systems are in place to remove greywater from your residence separately from blackwater. These requirements are regulated by the OBC. Using a greywater system is required if you are using a composting toilet and is a sensible option to reduce the load when used in conjunction with a holding tank (Class 5 system). If you have a Class 4 septic system, separating greywater from blackwater for treatment is not permitted and, in any event, would not provide any benefit.

The maximum permissible flow rate to any single greywater system is 1000 L per day, and there are restrictions on the loading rates to the sidewalls. The OBC provides an equation that will calculate the loading rate on the sidewalls, and it is likely that the building inspector from your municipality will make this determination and limit the number of inputs into the greywater system, if not already calculated by your system designer/installer.

The OBC sets out several requirements for determining if a greywater system can be used on your property. The OBC also outlines all the requirements for building a greywater system, including maximum flow, building materials, setbacks, soil / ground cover conditions, and height above the water table. It is important to understand setbacks and regulations that your municipality may also have in place as they may supersede OBC regulations if they are stricter. The ideal environment for a greywater system is an area that is elevated and has good drainage – a low-lying area with saturated soils would not meet OBC requirements.

The requirements for the size and depth of the pit are very important for properties on Georgian Bay that have shallow soil depths.

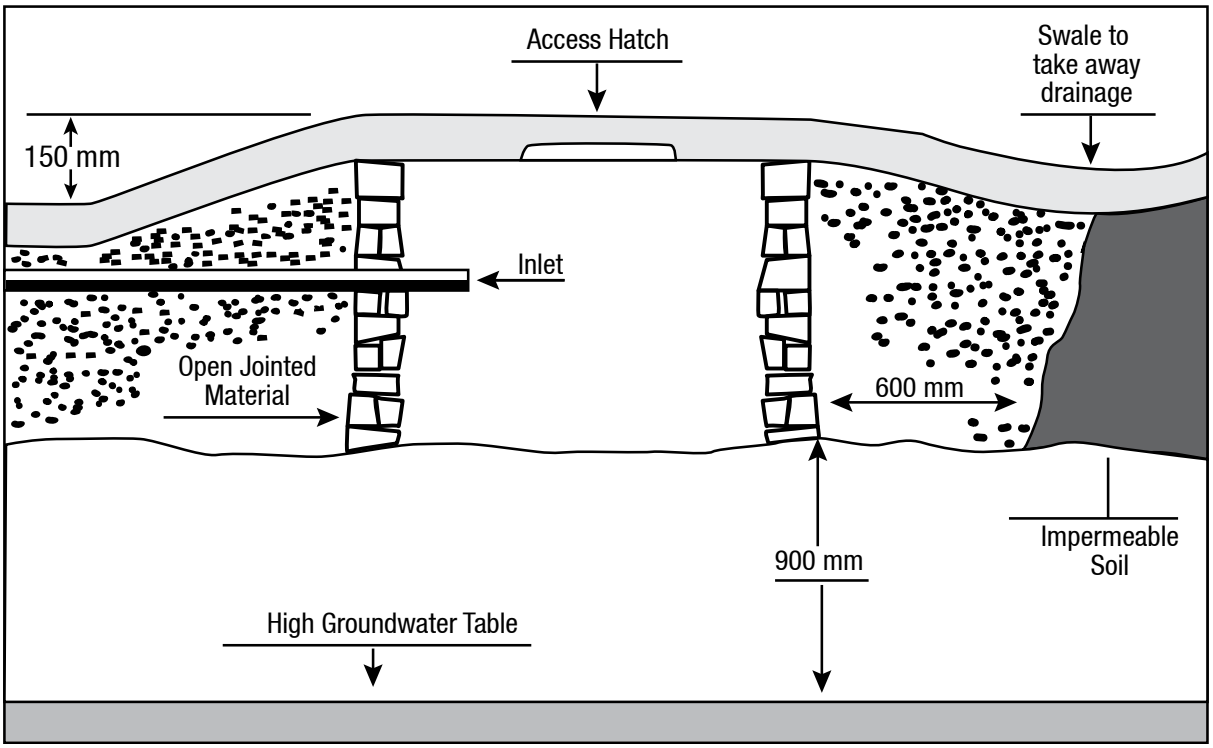
- The minimum height from the bottom of the pit to the high groundwater table is 900 mm.
- The minimum height of material above ground level (and top of the pit) is 150 mm (this is raised or mounded material).
- The minimum width of the material on all sides and the depth below the pit must be 600 mm of soil that has a percolation time of less than 50 min.*

The other requirements for the construction of a greywater system include the following:

- The sidewalls must be built in such a way that they do not collapse.
- The sidewalls must be composed of material that is open jointed to allow leaching.
- The pit must have a tight, strong cover (access hatch) on top of the pit which can be removed for maintenance purposes.
- The ground area above the pit must slope away as shown in the diagram below to allow for surface water to flow away from the pit.

** This soil depth below the pit is lower than the soil depth required for Class 4 systems (see below).*

The diagram below shows some of the construction requirements of the OBC:[15]



Source: North Bay-Mattawa Conservation Authority Information Sheet Class 2 Sewage Systems – Greywater system

4.4.1 Inspection and Maintenance

Greywater systems require minimal to no maintenance. The main requirements are to keep the pipes clean, keep large debris out, and reduce grease build-up within the pit. A screen and/or grease interceptor tank could be installed to help manage this, as it is a good idea to intercept solids if possible (e.g., food scraps, fats, hair,) to prolong the life of the system. Keep such additional features accessible and secure (to reduce the potential for animals to cause damage).

A system inspection should include:

- Assessing how the water is flowing into and out of the greywater system; this could be tested by running water through the system and observing where it flows, and then monitoring the surrounding area for saturation
- Looking for any clogging or build-up of solids and removing them if found
- Inspecting and cleaning any screen or interceptor tank
- Looking for any signs of saturation in the area around the system

4.4.2 Pros and Cons of Composting Toilets

The **advantages** of composting toilets with or without a greywater system are as follows:

- They do not require an expensive annual pump-out.
- They are relatively easy to maintain at minimal cost.
- They should last a long time for most Georgian Bay cottagers who are only in residence for part of the year – i.e. low annual usage.
- They limit the potential environmental footprint of blackwater discharge through a leaching bed system.
- In most cases, the installation costs will be substantially lower than new or replacement leaching bed systems, or replacing your leaching bed. However, installation costs vary among systems, and you need to determine whether or not you have an existing building that can accommodate the system or need to build/modify one.

The **disadvantages** of composting toilets with or without a greywater system are as follows:

- They do not accommodate a flush toilet.
- Because Class 2 greywater systems are required to have less soil depth underneath the bed than Class 4 blackwater systems, pathogen removal in Class 2 systems may not be as thorough. This disadvantage could be mitigated by increasing the soil depth.
- Therefore, in areas with shallow soil over bedrock, there is a risk that there is not enough soil to adequately filter the nutrients and pathogens, and they could migrate into the water around your cottage.
- For cottages without road access, it may not be ideal to choose a composting toilet where waste must be taken off site to be properly treated

5. Class 3: Cesspool

A Class 3 system is not a stand-alone sewage system and can only be used to receive the effluent from a Class 1 system. In some cases, this type of system could be used with a pail privy or a composting toilet equipped with an overflow device. The design and construction requirements for a Class 3 system are similar to those of a Class 2 greywater system requiring 900 mm soil depth above the high groundwater table, and are usually used in conjunction with a separate Class 2 system.[16] However, cesspools are generally discouraged because the solids in the effluent will cause the soil to clog and reduce the system's life expectancy.[5]

6. Class 4: Leaching Bed System

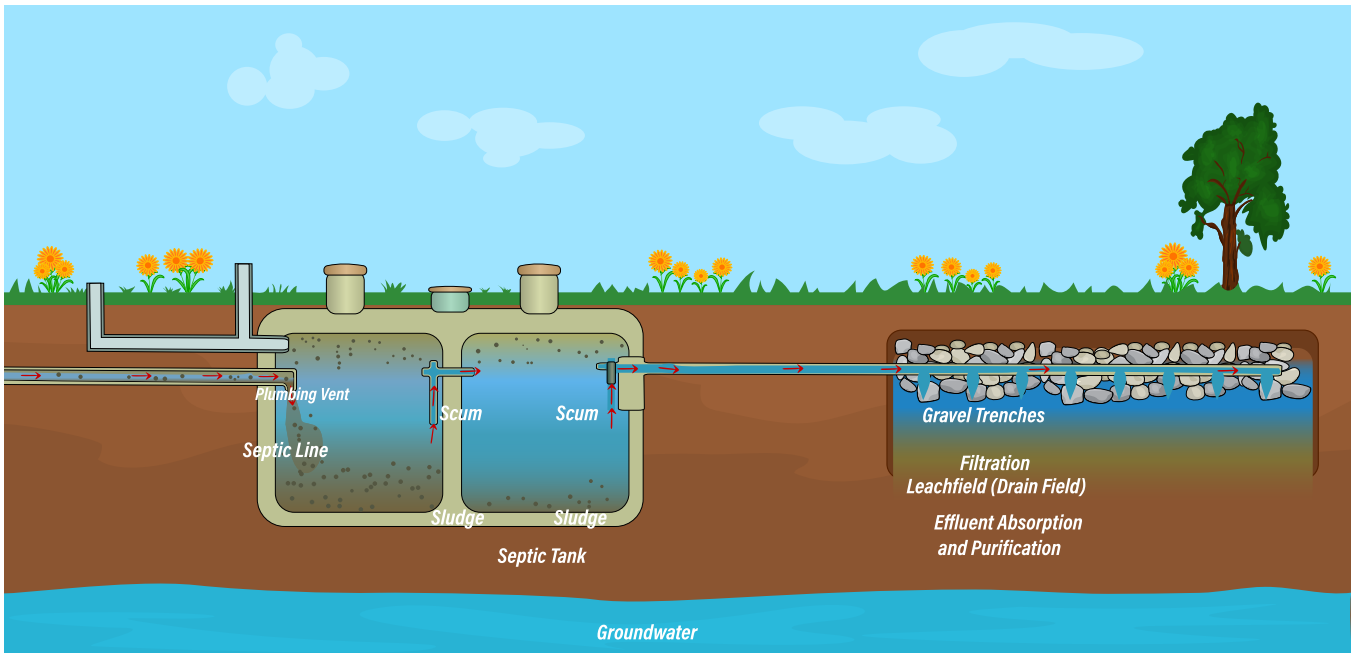
In this section we examine issues regarding a leaching bed system installed in Georgian Bay. Please note that there is more information on these systems in the appendix: Septic Smart![5]

6.1 Description

Most residences and cottages in rural areas have a leaching bed septic system consisting of two main components: a tank and a bed. In order to best understand how to maintain your leaching bed septic system and evaluate other system options, it helps to know how a leaching bed works.

The tank collects wastewater discharged from the residence and provides settling and storage of the solid materials in the sewage. Solids settle to the bottom of the tank (called a sludge layer) and fats float on the surface (called scum). Within the tank, anaerobic bacteria partially digest the sewage. The liquid wastewater leaves the tank and flows into a leaching bed for further soil-based treatment. The outlet of the septic tank is often fitted with an effluent filter, which serves to keep solids in the tank, thereby protecting the leaching bed from clogging. Some older tanks may not include an effluent filter, but they are now required to comply with the OBC and can usually be retrofitted onto your system to help improve system function and lifespan.

The leaching bed is a series of horizontal, underground pipes or chambers. The effluent flows either through the pipes or in the chambers and into the sand or gravel bed below. The treated effluent will eventually seep into groundwater. Some of the nutrients will be drawn up by vegetation, mainly by trees. The less soil there is, the lower the nutrient uptake.



The leaching bed septic system at most residences is designed for sites offering a level area with well drained soils, conditions that are normally created by clearing an area and bringing in aggregate (sand). The size of the overall system needed relates to the size and number of buildings creating wastewater and the number of fixtures, such as toilets, sinks, and showers you have or plan to have.

Some properties do not have the option to bring in aggregates and clear an area to create a septic system. Island properties with a lot of exposed Canadian Shield, small parcels of land, low-lying areas with poor drainage, or remote access locations all present challenges for leaching bed septic systems.

6.2 Nutrient Removal

In a standard septic tank system, carbon and nutrients that are in solid form are retained in the tank. Any contaminants that remain dissolved in the liquid effluent that goes out of the tank into the leaching bed have the potential to impact water quality around your property. This may include dissolved carbon, nitrogen, and phosphorus.

Often in Georgian Bay systems where there is minimal depth of natural soil, imported sand must be used to construct a leaching bed system. A study found that iron-rich sand allows for phosphorus adsorption, but the long-term fate of phosphorus in the sand is unknown due to environmental influences (rain, wind, erosion, etc).[17,18] Therefore, this may only provide a temporary reprieve from nutrients entering the water around your cottage.

One alternative is an advanced treatment unit, sometimes referred to as a tertiary treatment system. These systems require less leaching bed space because most of the sewage treatment occurs in the treatment unit and there is less reliance on the soil-based treatment that would normally occur in the leaching bed (see links to the different ATU systems in section 6.5). The leaching bed used in conjunction with a treatment unit provides a final treatment step and disperses the effluent into the ground. Depending on the characteristics of your property and required system, the cost of an advanced treatment unit can range significantly; depending on the site, they can be less or more expensive than conventional septic systems (see section 6.5 below for more details).

6.3 Regular Inspection and Maintenance

When a leaching bed septic system is installed, it must be built to code and pass an inspection. For the next 20 years or more, it is the responsibility of the home or cottage owner to ensure that it is not ignored. A widely cited report by the Federation of Ontario Cottagers Associations (FOCA)[19] in 2019 found that in a sample of over 370 Ontario leaching bed septic systems on waterfront properties, "41% had major deficiencies in significant/extreme ways that impeded function and performance." Of the systems with major deficiencies, 86% shared the most significant risk factor: age. They were 20 years old or more.

Eastern and northern Georgian Bay regions were not included in FOCA's study but it did include the Township of Tiny at the southern end of the Bay. The key message remains the same: it is crucial that leaching bed septic system maintenance is top of mind for home and cottage owners.

A septic system backup is an unsightly and costly occurrence that can occur as a result of lack of maintenance. It is noticeable by black, smelly water coming up from your toilet and drains. Regular inspections and proper maintenance should avoid backups.

Signs and symptoms of leaching bed and tank failure include:[5]

- Water pools on or near the bed
- Toilets back up
- Household drains slow down
- Odours are noticeable around the tank or bed
- Grass over the bed is unusually green and/or spongy
- Grass over the bed is growing only in strips or in uneven patches
- Bacteria or nitrate contamination shows up in well water

These symptoms usually mean a failed or failing leaching bed septic system, and a building inspector can shut down the use of the property until it is fixed.

The exact issues you experience will depend on which part of the system is faltering and how advanced the issue is. Most failures occur from problems with the leaching bed, although issues can arise in any part of the system. It is important to note that disregarding flooding and effluent overflows on older or incorrectly installed systems can lead to effluent migration into watercourses. Also, since cottages can heave with frost, sewer pipe connections may break or dislodge, allowing wastewater to drain out around the buildings. These problems can continue undetected for years, unless the system is properly inspected and maintained.

If you observe a problem with the system, call a licensed septic system service provider immediately. The problem will only become worse and, if left uncorrected, can result in the entire system needing replacement.

Think of this maintenance as divided into two key strategies: annual and routine care.

Here are some of the key annual maintenance steps for the leaching bed and tank:

- Inspect the sludge level in tank; see section 6.4 for more detail
- Clean the effluent filter.
- Remove vegetation encroaching on the leaching bed and tank. Note: It is very important to ensure that your leaching bed is only covered in grass. Do not allow vegetation with deep roots to grow on your leaching bed. The roots will burrow down and clog up the pipes or chambers.
- Conduct your own visual inspection for water pooling on the bed and walk across it to check for soft spots, grass strips, and smells.

Here is some key guidance for routine care:

- Start by keeping the bacteria in your tank happy by ensuring only toilet paper and human waste are flushed down the drains.
- Avoid overuse of chemicals (including disinfectants, paints, cleaners, and more) and adding too many solids from things like food waste.
- Many hardware stores sell a variety of septic additives, all marketed as improving the function and wellbeing of your leaching bed system. However, these products should be used with extreme caution or generally avoided. Few septic experts believe they are helpful in the long term, and some could pose health risks if they leach out of a failed leaching bed septic system and into water sources.
- Finally, never park or store vehicles, trailers, or other heavy machinery on the bed. Similarly, never build a structure, or put concrete or pavement on the bed.

The leaching bed septic system sizing standards have been in place for several decades, long before low-volume plumbing fixtures were required. This means that in general, with these new low-flow fixtures, less water is entering the leaching bed septic system than the sizing regulations expect. This in turn means that, with lower water flows, your septic tank is releasing higher-strength effluent into your leaching bed which can put a strain on it.

Leaching bed septic systems can be adversely affected by large amounts of soaps, detergents, cleaning agents, and pharmaceuticals so it's crucial to try and limit the amount entering your septic system.[5]

The good news is that because most cottage leaching bed septic systems are used only periodically and sit idle for much of the year, the bacteria have much more time to digest the contents than they would in a system that is used year-round. Septic installers have told us that when you carefully manage what goes into your leaching bed septic system, these systems should easily last 20, 30 or more years.

6.4 Inspections and Pump-Outs

When was the last time your leaching bed septic system was inspected by a professional? If you are not sure, it might be time to schedule an inspection.

Remember that inspections and pump-outs are not the same thing. An inspection should take place at least every three to five years by a qualified professional who will look at available records, measure sludge and scum levels, proper functioning, and structural integrity. If you have an advanced treatment unit installed, you need to arrange for an annual maintenance agreement. Much like a car that needs to see the mechanic to keep it running well, an ATU needs regular upkeep. Your septic system inspector may advise you to have the septic tank pumped out, which means physical removal of the tank contents by a qualified professional.

Over time, a sludge layer will form in the tank and will require pumping out to prevent excessive sludge build-up, as follows:

- Pump-outs should be scheduled when the sludge layer reaches 1/3 of the tank capacity, which is dependent on frequency and volume of use as well as size.
- Pump-outs should not be done before the sludge layer reaches 1/3 of the tank capacity, because pumping out too frequently negatively impacts performance by removing the bacteria that process your sewage waste.

Regular tank pump-outs remove the accumulated sludge and scum, which prevents these materials from flowing out of the tank and clogging the leaching bed. While pump-outs and professional inspections are important to your system, remember that failures can be prevented through proper system use and routine maintenance and care. Professional inspections should not be viewed as an alternative to doing regular maintenance, but a sensible precaution to ensure that your system is functioning properly in all respects.

6.5 Advanced Treatment Units

An advanced treatment unit (ATU), sometimes called a tertiary treatment system, is intended to do just that: provide advanced treatment.

The key to understanding these systems is that those that have been approved for use in Ontario have been certified to the CAN/BNQ 3680-600 Standard. Treatment units that have been certified to this standard have been proven to perform under cold climate conditions.

The main reason for installing an ATU is to enable you to use a smaller footprint for your leaching bed.[20] According to the MMAH, the liquid that comes out of the bottom of the disposal bed of an ATU is deemed to be of the same content as the liquid that comes out of the bottom of a conventional leaching bed septic system.[4] In other words, what is entering the environment is deemed the same, but it happens within a much smaller footprint. The treatment mechanisms that occur within the leaching bed of a conventional system occur within the treatment unit of the ATU, which is a more controlled environment designed to promote microbial treatment activity. The basic treatment units provide advanced treatment of the solids and organic carbon, and may provide enhanced nutrient (nitrogen and phosphorus) or pathogen removal. Some treatment systems can be modified with additional equipment or components to enhance nutrient or pathogen removal.

You might want to consider an ATU because it could:

- Allow you to install a leaching bed system where a conventional one would not work
- Provide an option for upgrading an existing conventional leaching bed system to address a problem such as flooding from storms and/or high water levels

As noted above, the current low-flow fixtures that are required by the plumbing code reduce water flows and create a much stronger/heavier effluent than before. As a result, some ATU manufacturers have been looking for ways to pre-process the effluent so that when it gets into the ATU it performs better.

There are currently six advanced treatment unit technologies that are certified to meet treatment standards to be used in conjunction with a reduced-size leaching bed:

- Premier Tech Aqua (Ecoflo)
- Waterloo Biofilter
- Norweco
- Enviro-Septic
- Bionest Technologies
- Bio-microbics

6.6 Pros and Cons of Leaching Bed Systems

The **advantages** of a leaching bed septic system include the following:

- It accommodates a flush toilet.
- Requires a pump-out less frequently than a holding tank system, approximately every 3-5 years depending on usage, instead of at least annually
- It is relatively easy to maintain.
- It should last a long time for most Georgian Bay cottagers who are only in residence for part of the year and therefore have low annual usage.
- A wide range of information and resources are available to ensure that you can keep inspection and maintenance current and your system in good shape.
- Now that ATUs are approved under the OBC, there is more flexibility on installing this type of system in challenging locations due to the smaller ATU footprint.
- ATUs provide an improved level of treatment, such as removing organic carbon, solids, and some of the nutrients and pathogens, over a conventional Class 4 septic system.
- Because ATU contracts require an annual maintenance contract, your system will be inspected and maintained annually, rather than having to do it yourself.
- Because Class 4 systems are required to have more soil depth underneath the bed than greywater systems, they should remove pathogens more effectively than greywater systems.

The **disadvantages** of a leaching bed septic system are:

- You need to be on top of all the inspection and maintenance issues to ensure that there is no failure of the system.
- Particularly in areas with limited soil cover, it is possible that nutrients will not be captured by the system and will flow into the water around your cottage.
- Inspection and maintenance is usually carried out by professionals, which is expensive, particularly for water-access-only locations.
- If there is a system failure, the environmental consequences can be severe and the solution expensive.
- Costly pump-out required approximately every 3-5 years depending on usage.
- Installation or replacement of the bed is very expensive.
- ATUs require more energy input to operate than a conventional septic system.[20]

7. Class 5: Holding Tank

7.1 Description

A holding tank is a large tank that collects your wastewater and requires pumping out annually, or when the level inside approaches capacity.

Holding tanks are generally not permitted under the OBC for new septic systems, except for very specific circumstances. If it is impossible to install a leaching bed septic system on a particular site, or to do so would pose an unacceptable risk to the environment and water quality, a holding tank is a permitted solution. Municipalities may also declare a high-water-levels state of emergency and allow collection tanks as a temporary measure to avoid water quality issues from flooded leaching bed septic systems.

In the past, many tanks were constructed of steel, but this is no longer permitted. Steel tanks are known to degrade in the corrosive environment of a septic tank, and they will eventually leak into the surrounding environment. Concrete, plastic, or fiberglass are now used to replace a steel tank or, in some exceptional circumstances (see below), install a new holding tank. Your municipality should allow for the replacement of existing steel tanks with plastic ones, but you need to check with their building department to ensure that this is permitted.[22]

Georgian Bay residents who still have steel holding tanks are likely to be at risk because they might be rusting out, particularly around the lid. They should be replaced either with plastic or fiberglass holding tanks or with a different system.

Since the primary purpose of a holding tank is to collect your blackwater, it could be used in conjunction with a greywater system (Class 2) in order to reduce the amount of wastewater collected and minimize expensive pump-outs.

Holding tanks may be a good system for some Georgian Bay properties because they avoid the potential environmental issues with leaching bed systems and are more resistant to rising water levels.

7.2 Inspection and Maintenance

Other than ensuring that the tank does not get punctured or overflow, there really is no maintenance requirement for holding tanks. A high water alarm can be installed in the tank to alert the owner when the tank is nearing capacity.

7.3 Pros and Cons of Holding Tank Systems

The **advantages** of a holding tank system include the following:

- It accommodates a flush toilet.
- It is easy to maintain and manage, but you need to monitor the level in the tank to guard against overflows.
- It should last a long time for most Georgian Bay cottagers, particularly plastic tanks (steel tanks have a limited lifespan).
- It avoids the potential environmental impacts of a leaching bed septic system.
- Installation or replacement cost is low.

The **disadvantages** of a holding tank system are as follows:

- It requires an expensive ongoing pump-out.
- The local municipal sewage system needs sufficient capacity to accommodate all holding tank pump-outs.
- Most steel tanks still installed anywhere in Georgian Bay are likely to be near or past the date at which they must be replaced to avoid leakage from rusting out.
- If you also have a greywater system, then the potential environmental issues associated with a greywater system apply.
- The OBC limits the acceptable use of holding tanks, so they can only be approved in very specific circumstances.

8. Setbacks and Elevations

The setbacks set by the OBC are a minimum of 15 m from a lake. TGB and MOK have specific setbacks that require buildings to be placed farther back from the shoreline. Certain municipalities have site-specific setbacks, depending on the site conditions which are specified in their official plans and/or comprehensive zoning bylaws.

It is important to check with your contractor and/or your municipality to determine setback requirements for a new septic system. The table below is a summary of the setbacks and high water marks for the municipalities that fall within the GBA member area.

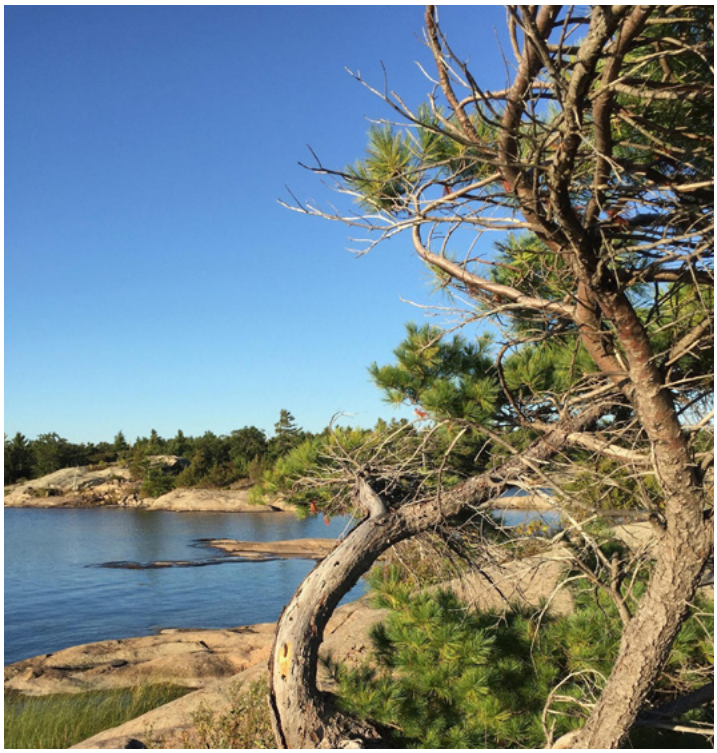


Table 1: Summary of Septic System setbacks and elevations

Requirement	ToA	ToC	TGB	NEMI	MoK
High water mark above sea level	176.44 m	176.44 m	177.4 m	Not specified	"The high water mark is to be determined by an Ontario Land Surveyor."
Shoreline Setback Requirement from high water mark	15 m	15 m	30 m	15 m	20 m
Elevation above high water mark	Not specified	Not specified	1 m above high water mark	Not specified	Not specified

TOA,[23, 24] TOC,[25, 26] TGB,[27,28] NEMI,[29,30] MOK[31,32]

9. Summary and Conclusions

Assessing the best system for your property requires an understanding of your property's soil conditions and ability to accommodate the system you choose. Class 4 systems are the most popular as they provide facilities similar to those you have at home. A composting toilet, for instance, is not always viewed favourably, despite the significant advances in technology and options now available.

We recommend that the primary consideration should be to determine which system best protects the environment and minimizes the risk of water pollution around your property. Now that ATU options are available, Class 4 systems can be accommodated on smaller footprints and/or properties with limited soil cover, providing more flexibility and options as compared to conventional Class 4 systems. However, if the depth of soil cover on the property is too shallow, a composting toilet and greywater pit may be the best option, provided the soil depth under the greywater pit is increased sufficiently to remove pathogens.

In the above sections we listed the advantages and disadvantages of each system to help you decide what is best for you, but please note that you probably will not be able to use a holding tank unless you fit very specific criteria, or you already have one in place. Your system must comply with the OBC.

Therefore, the two primary options for most properties in cottage country are:

- A Class 4 system, either conventional or ATU; or
- A composting toilet with a greywater pit.

Unless you have a very good grasp of what your property can accommodate, it is recommended that you consult an expert such as an engineer to determine the best septic system for your needs. If you are working with a contractor, they may have sufficient expertise, but be sure to ask them for their qualifications. Your municipal planning staff can also provide useful information and guidance.

10. Appendix

10.1 In-text References

1. Government of Ontario. Building Code Act, 1992, S.O. 1992, c. 23. Updated June 08 2023. Accessed January 16 2023. https://www.ontario.ca/laws/statute/92b23
2. Government of Ontario. O. Reg. 332/12: Building Code under Building Code Act, 1992, S.O. 1992, c. 23. Updated May 12 2023. January 16 2023. https://www.ontario.ca/laws/regulation/120332
3. Government of Ontario. Ontario Building Code Section 8.1.2.1. Classification of Systems. Updated 2018. January 16 2023. https://www.buildingcode.online/1151.html
4. Ministry of Municipal Affairs and Housing. Learners Manual: Training Program for Installers, and Inspectors of On-Site Sanitary Sewage Systems of Less Than 10,000 L/day. No date. June 20 2022. https://georgianbay.ca/wp-content/uploads/2023/05/MMAH-training-manual.pdf
5. Rideau Valley Conservation Authority and Government of Ontario. Smart Septic! Understanding Your Home's Wastewater System. Revised 2022. Accessed February 10 2023. https://georgianbay.ca/wp-content/uploads/2023/06/Septic_Smart_III_EN_AODA.pdf
6. Government of Ontario. O. Reg. 169/03: Ontario Drinking Water Quality Standards under Safe Drinking Water Act, 2002, S.O. 2002, c. 32. Updated January 01 2020. Accessed June 15 2023. https://www.ontario.ca laws/regulation/030169
7. Ontario Ministry of the Environment. Water Management Policies, Guidelines and Provincial Water Quality Objectives. Published 1994. Accessed June 15 2023. https://www.ontario.ca/page/water-management-policies-guidelines-provincial-water-quality-objectives
8. Castro V. Protecting the Water Quality of Ontario's Inland Lakes: Evaluating impacts of shoreline development'. Ontario Ministry of the Environment: Eastern Region.
9. Tom Bain, Eastern Georgian Bay Protective Society. Performance Comparison Class IV Secondary & Tertiary Treatment Systems. Presentation December 09 2013. June 20 2022. https://georgianbay.ca/wp-content/uploads/2023/05/Tom-Bain-Eastern-Georgian-Bay-Protective-Society-2013-Performance-Comparison-Class-IV-Secondary-Tertiary-Treatment-Systems.pdf
10. SGS Canada. Certificate of Analysis Final Report. Reported July 14 2017. Accessed June 12 2023. https://georgianbay.ca/wp-content/uploads/2023/06/SGS-Report-July-14-20-2017.pdf
11. North Bay Mattawa Conservation Authority. Information Sheet Class 1 Sewage System. No date. Accessed February 10 2023. https://www.nbmca.ca/media/1271/class-1-information-sheet-oss.pdf
12. Government of Ontario. Ontario Building Code Section 8.3.2.1 - 8.3.5.1 Construction Requirements. Updated 2018. Accessed January 16 2023. https://www.buildingcode.online/1166.html
13. Sewage System Classifications. canadianecoproducts.com. No date. Accessed February 10 2023. https://canadianecoproducts.com/sewage-system-classes/
14. Government of Ontario. Ontario Building Code Class Section 8.4.1. Updated 2018. Accessed January 16 2023. https://www.buildingcode.online/1170.html

15. North Bay Mattawa Conservation Authority. Information Sheet Class 2 Sewage System. No date. Accessed February 10 2023. https://www.nbmca.ca/media/1016/oss-class-2-information-sheet.pdf?v=636910165480000000
16. Government of Ontario. The Ontario Building Code 8.5.2.1. Construction Requirements. Updated 2018. Accessed January 16 2023. https://www.buildingcode.online/1177.html
17. Hutchinson NJ, Jowett EC. Nutrient abatement in domestic septic systems: research initiatives of the Ontario Ministry of Environment & Energy. Proceedings, Septic Odour, Commercial Wastewater and Phosphorus Removal. 1997:81-102. https://georgianbay.ca/wp-content/uploads/2023/07/Copy-of-Hutchinson-Jowett-1997-Nutrient-Abatement-in-Domestic-Septic-Systems-Muskoka-.pdf
18. Pipeline. Phosphorus and Onsite Wastewater Systems. Published 2013. Accessed. July 05 2023. https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/environmental_health/pdf/PipelineWastewaterIssuesExplainedtothePublicpdf.pdf
19. Rick Esselment. Cottage Country Septic System: Insights into what is out of sight and out of mind. Federation of Ontario Cottage Associations. Presentation March 03 2018. Accessed June 20 2022. https://georgianbay.ca/wp-content/uploads/2023/05/Rick-Esselment-2018-Cottage-Country-Septic-System-Insights-into-what-is-out-of-sight-and-out-of-mind.-Federation-of-Ontario-Cottage-Associations..pdf
20. Government of Canada, and Government of Ontario. Septic Smart! Advanced treatment Systems - Alternatives to Conventional Septic Systems. No Date. Accessed June 12 2023. https://www.nvca.on.ca/Shared%20Documents/Septic%20Smart%20Advanced%20Systems.pdf
21. Reducing the impact of septic system through advanced nitrogen treatment. nwdistrict.ifas.ufl.edu. Published April 09 2021. Accessed July 06. https://nwdistrict.ifas.ufl.edu/nat/2021/04/09/reducing-the-impact-of-septic-systems-through-advanced-nitrogen-treatment/
22. Government of Ontario. Ontario Building Code Section 8.2.2.2 tanks. Updated 2018. Accessed January 16, 2023. https://www.buildingcode.online/1161.html
23. Township of the Archipelago. Township of the Archipelago Official Plan. January 01 2019. Accessed March 04 2022. https://archipelago2021.municipalwebsites.ca/ckfinder/connector?command=Proxy&lang=en&type=Files&currentFolder=%2FDOCUMENTS%2FPLANNING%2FOfficial%20Plan%2F&hash=c245c263ce0eced480effe66bbede6b4d46c15ae&fileName=2019_January_Consolidation_final%20text.pdf
24. Township of the Archipelago. Township of the Archipelago Comprehensive Zoning By-law A2000-07, amended. Published June 22 2007. Accessed March 04 2022. https://archipelago2021.municipalwebsites.ca/ckfinder/connector?command=Proxy&lang=en&type=Files&currentFolder=%2FDOCUMENTS%2FPLANNING%2F&hash=c245c263ce0eced480effe66bbede6b4d46c15ae&fileName=CZBL_December31_2020.pdf
25. Township of Carling. Township of Carling Official Plan. Updated January 11 2011. Accessed March 04 2022. https://www.carling.ca/wp-content/uploads/6a.-Official-Plan-Jan-11-11-Consolidated_with-Appendix-1.pdf?_ga=2.161908281.446682200.1637692453-415027858.1635798326
26. Township of Carling. Township of Carling Consolidated Comprehensive Zoning By-laws. Updated December 06 2021. Accessed March 04 2022. https://carling.ca/wp-content/uploads/Zoning-By-law-C500-2011-Consolidated-December-06-2021.pdf

27. Township of Georgian Bay. Township of Georgian Bay Approved Official Plan. Updated March 02 2021. Accessed March 04 2022. https://www.gbtownship.ca/en/business-and-development/resources/Documents/Georgian-Bay-Official-Plan---Consolidated-March-3-2021---Final-Text-Only.pdf

28. Township of Georgian Bay. Township of Georgian Bay Zoning By-law. Updated March 08 2021. Accessed March 04 2022. https://www.gbtownship.ca/en/living-here/resources/Documents/Township-of-Georgian-Bay-Zoning-By-law-Consolidated_March-8-2021.pdf

29. Town of Northeastern Manitoulin and the Islands. Town of Northeastern Manitoulin and the Islands Official Plan. Updated March 15 2016. Accessed March 04 2022. https://nemi.municipalwebsites.ca/ckfinder/connector?command=Proxy&lang=en&type=Files&currentFolder=%2F&hash=c245c263ce0eced480effe66bbede6b4d46c15ae&fileName=Town-of-NEMI-Official-Plan-Ministers-Modified-Version.pdf

30. Town of Northeastern Manitoulin and the Islands. Town of Northeastern Manitoulin and the Islands Comprehensive Zoning By-laws. Updated March 2022. Accessed March 04 2022. https://nemi.municipalwebsites.ca/ckfinder/connector?command=Proxy&lang=en&type=Files&currentFolder=%2F&hash=c245c263ce0eced480effe66bbede6b4d46c15ae&fileName=NEMI%20Zoning%20By%20Law.pdf

31. Sudbury East Planning Area. Official Plan for the Sudbury East Planning Area. Published September 28 2010. Accessed March 04 2022. http://sepb.org/wp-content/uploads/2017/02/OP2010_SEPAOfficialPlan.pdf

32. Sudbury East Planning Area. Zoning By-law Municipality of Killarney. June 17 2014. Accessed March 04 2022. http://sepb.org/wp-content/uploads/2017/02/Final-By-law2014-29_Killarney-June-17-2014-Adopted-by-Council.pdf

10.1 Additional Resources

1. Thunder Bay District Health Unit. A Practical Guide to Class 1 Sewage Treatment System (Pit Privy). Published March 17 2016. Accessed December 06 2022. https://www.tbdhu.com/sites/default/files/files/resource/2016-03/A%20Practical%20Guide%20to%20Class%201%20Sewage%20System%20booklet.pdf

2. Thunder Bay District Health Unit. A Practical Guide to Class 2 Sewage Treatment System (Leaching Pit). March 17 2016. Accessed December 06 2022. https://www.tbdhu.com/sites/default/files/files/resource/2016-03/A%20Practical%20Guide%20to%20Class%202%20Sewage%20System%20booklet.pdf

3. Aerobic Composting vs anaerobic composting. globalcomposting.solutions. Updated 2022. Accessed December 06 2022. https://www.globalcomposting.solutions/aerobic-vs-anearobic-composting#:~:text=Anaerobic%20composting%20is%20decomposition%20that,material%20is%20released%20as%20methane

4. Brandes M. Characteristics of effluents from gray and black water septic tanks. Journal (Water Pollution Control Federation). 1978 Nov 1:2547-59. https://georgianbay.ca/wp-content/uploads/2023/05/Marek-Brandes-1978-Characteristics-of-Effuents-from-Gray-and-Black-Water-Septic-Tanks-.pdf

5. Class 2 – Greywater Leaching Pit. algomapublichealth.com. Published June 01 2015. Accessed December 06 2022. https://www.algomapublichealth.com/environment-inspections/sewage-system-building-permits/class-2-greywater-leaching-pit/

6. North Bay-Mattawa Conservation Authority. Information Sheet Class 1 Sewage Systems. No Date. Accessed December 06 2022. https://www.nbmca.ca/media/1271/class-1-information-sheet-oss.pdf

7. North Bay-Mattawa Conservation Authority. Information Sheet Class 2 Sewage Systems – Greywater Pit. No Date. Accessed December 06 2022. https://www.nbmca.ca/media/1016/oss-class-2-information-sheet.pdf?v=636910165480000000#:~:text=Greywater%20pits%20are%20regulated%20under,than%201%2C000%20Litres%20per%20day
8. Composting Explained. toiletrevolution.com. Published July 30 2016. Accessed December 06 2022. https://www.toiletrevolution.com/news/composting-explained/?v=fa868488740a
9. Greywater systems. level.org.nz. Published November 05 2028. Accessed March 04 2022. https://www.level.org.nz/water/wastewater/on-site-wastewater-treatment/greywater-recycling/greywater-systems/#:~:text=Building%20Code%20requirements.-,How%20a%20greywater%20system%20works,or%20by%20using%20a%20pump
10. Ontario Onsite Wastewater Association. oowa.org. Updated 2023. Accessed March 04 2022. https://www.oowa.org/
11. Patterson RA. Temporal variability of septic tank effluent. Future Directions for On-site Systems: Best. 2003;295. https://georgianbay.ca/wp-content/uploads/2023/05/Robert-A-Patterson-2003-Temporal-Variability-of-Septic-Tank-Effluent-.pdf
12. Federation of Ontario Cottagers Association. Septic Re-inspection programs in Ontario: A guide for Lake Associations. Published 2019. Accessed March 04 2022. https://foca.on.ca/wp-content/uploads/2014/02/FOCA-Septic-Reinspection-Project-Report-FULL-DOCUMENT-2019-1.pdf
13. Town Services - Septic Systems 101. thearchipelago.on.ca. Updated 2023. Accessed March 04 2022. https://www.thearchipelago.on.ca/p/septics
14. Water Reuse Systems Certification. nsf.org. Updated 2023. Accessed March 04 2022. https://www.nsf.org/water/onsite-wastewater-systems/water-reuse
15. What is a compositing toilet, and how do they actually work. greenmatters.com. Updated October 21 2020. Accessed March 04 2022. https://www.greenmatters.com/p/how-do-composting-toilets-work
16. What the heck is a leaching pit?.ontario-waterfront-cottages.com. No date. Accessed March 04 2022. https://www.ontario-waterfront-cottages.com/leaching-pit.html
17. Government of Ontario Population and Public Health Division, Ministry oof Health and Long-term Care. Operational Approaches for Recreational Water Guidelines, 2018. Published January 01 2028. Accessed March 04 2022. https://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/protocols_guidelines/Operational_Approaches_to_Rec_Water_Guideline_2018_en.pdf
18. Types of Septic Systems. epa.gov. Updated August 23 2022. Accessed July 05. https://www.epa.gov/septic/types-septic-systems
19. Government of Canada and Government of Ontario. Septic Smart! Understanding Your Home's Septic System. No date. Accessed July 06 2023. https://www.nvca.on.ca/Shared%20Documents/SepticSmart!%20Understanding%20Your%20Home%27s%20Septic%20System.pdf
20. Centre Septic System Basics. ontarioruralwastewatercentre.ca. Updated 2023. Accessed July 6, 2023. https://ontarioruralwastewatercentre.ca/homeowner-information/septic-system-basics/