Private Well Water Manual

(A quick users guide)

PUBLIC HEALTH
GREY BRUCE HEALTH UNIT

Grey Bruce Health Unit
www.publichealthgreybruce.on.ca

TABLE OF CONTENTS

DISCLAIMER

Please make sure to follow the most current Provincial legislation when constructing, maintaining or upgrading a well.

This guide is intended to provide a basic overview for property and/or home owners who have a private well. While it provides an overview, this guide is not comprehensive. Recommendations may change over time, so please make sure to have the most up-to-date information and be aware of the legal requirements for well owners.

For more information, call Public Health Inspector Help Desk at **1-800-263-3456** or **519-376-9420** press **3**

INTRODUCTION

If you are installing a new well on your property, or have questions about an existing well, this well-water guide is for you. Whether you have recently moved to a new home that is not on the municipal water supply and you are now on well water, or you are installing a new well, repairing an existing well, or sealing an old well, it is important to have a good idea of where your water comes from, what type of well or equipment you have/ need, and how to properly maintain your well.

Drinking, brushing your teeth, washing vegetables, etc. with contaminated water can make you sick with stomach cramps, diarrhea, vomiting or other problems which may become fatal.

A well can be thought of as a straw placed into the ground. If the straw is not properly installed/maintained or has cracks or openings, surface water that can have contaminants in it can enter the aquifer and your water. The contaminated aquifer can then affect other wells located within the same aquifer.

It is also important to conserve water by using it responsibly. Everyone can play a role in protecting our water sources. This guide will provide you with the basics to get started.

SOURCES OF WATER

In Ontario, we get our drinking water from two sources:

- Surface water – lakes, streams, or rivers
- Groundwater

Groundwater is water that is hidden underneath the earth's surface. It moves slowly through tiny spaces between particles of soil, sand, gravel, and rock formations – similar to how water soaks into a sponge (Alberta Environment, 2010). Groundwater begins as precipitation (rain, snow, sleet, or hail) and then it soaks into the layers of soil that are just beneath the ground. This area is called the **unsaturated zone**.
The unsaturated zone is where both air and water fill the small spaces between the soil and rock particles (Alberta Environment, 2010).

Some of the water continues to seep downwards (percolate) into the soil. It can seep hundreds of meters into the earth's crust. Finally, the water will reach the **saturated zone**. (The saturated zone is where only water fills the small spaces between the soil and rock particles (Alberta Environment, 2010).

The **water table** is the upper surface of this saturated zone. The water table may be higher or lower in the ground, depending on how much rain, snow, etc. has fallen in the area (Alberta Environment, 2010). The depth of the water table can vary from less than 1 meter to 50 meters or more (Ministry of Environment and Energy [MOEE], n.d.). In the spring and the fall, the water table is at its highest, and in the summer and winter it is at its lowest (Ontario Ministry of Agriculture and Agri-Food [OMAFRA], 2003).

Where do you find Groundwater?
Groundwater is contained within aquifers. An aquifer is a layer of material such as sand, gravel, or rock that stores water underground. Wells draw their water from these aquifers. According to OMAFRA (2003), there are three types of aquifers:

- **Unconfined aquifers:** Unconfined aquifers are found closer to the earth's surface. In eastern North America, this type of aquifer is usually found at a depth of between 2.5 and 14 meters (5 and 50 feet) (OMAFRA, 2003).
  They are usually not completely full of water. Surface water can easily seep into these unconfined aquifers, bringing contaminants into the water (Alberta Environment, 2010). These contaminants can include germs (bacteria, viruses, parasites), chemicals, etc.

- **Confined aquifers:** Confined aquifers are found deeper in the earth's crust. They are covered with a layer of soil or rock that helps prevent contaminated water from seeping into the water below (Alberta Environment, 2010).

- **Semi-confined aquifers:** Semi-confined aquifers exist where an otherwise non-permeable aquitard (e.g. a clay or shale bedrock layer), allows water from above to leak downward into the next aquifer. Drilling for a well can also cause this to happen (OMAFRA, 2003).

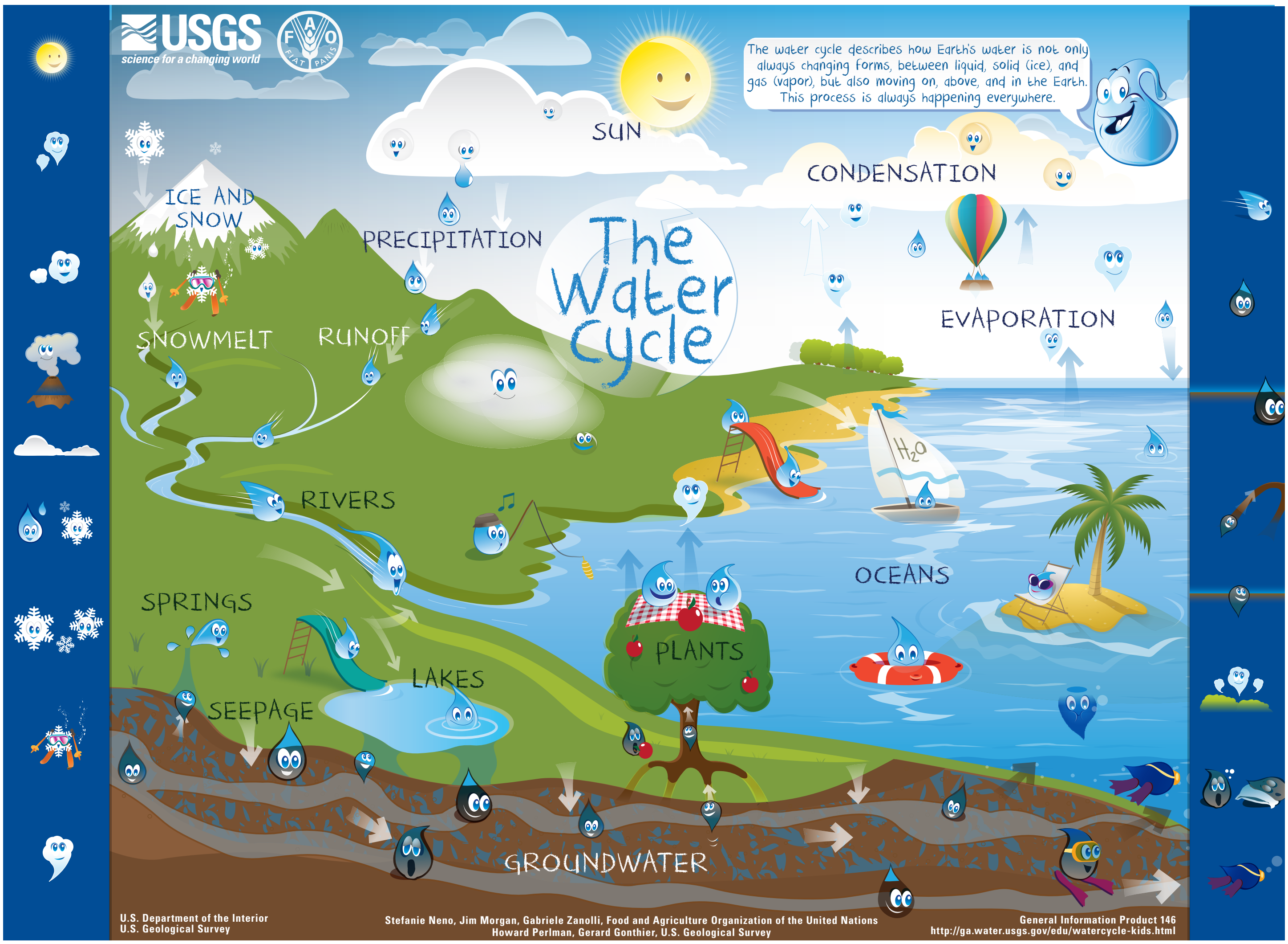
THE WATER CYCLE

Groundwater is continually flowing throughout the earth's crust. It can exit the earth's crust and become surface water when it reaches streams, rivers, ponds, or lakes.

Water that is drawn from the ground may have been there for a very short time or a very long time. If you think about a dug or sand-point well, the water being taken from the ground has been there a relatively short time as compared to a very deep drilled well in a confined aquifer.

GROUNDWATER QUALITY

The natural environment and human activities can both affect the quality of groundwater. The natural environment may have a positive effect or a negative effect on the quality of groundwater. Human activities almost always have a negative effect on the quality of groundwater.



Reprinted from The water cycle for schools: beginner ages. Retrieved from https://water.usgs.gov/edu/watercycle-kids-beg.html. Copyright 2016 U.S. Department of the Interior/U.S. Geological Survey.

According to OMAFRA (2003), when water is travelling downwards through the soil, several things can happen to it along the way:

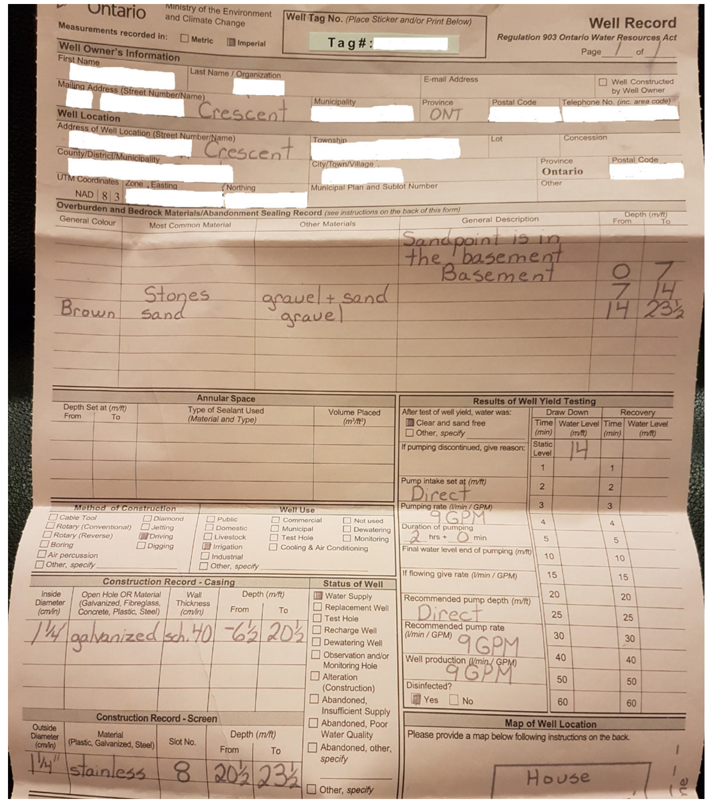
- Water can dissolve minerals that are present in the materials that it is passing through.
- Germs such as bacteria, viruses and parasites that could be present in the water at the surface may get left behind in the soil, or they may die off as the water moves downwards.
- Certain substances that are in the water may cling to soil particles and be removed from the water.

Generally, the water quality depends on the type of soil or rock the water is moving through, the length of time that the water is in contact with these materials, and if there are any contaminants present. The quality of your well water can change as a result of changes in the season, or if anything happens to the aquifer that the water is coming from (OMAFRA, 2003).

LEGISLATION

In Ontario, there are a number of acts, regulations and guidelines that aim to protect water quality and guide its use. The Ontario Ministry of the Environment and Climate Change (MOECC) regulates the minimum standards needed for the construction of wells.
The legislation includes:

- Who is qualified to construct a well or install well pumps
- Specific locations where wells can be constructed (set-back distances from potential contamination sources such as septic systems, chemicals, etc.)
- What materials can be used to construct a well
- How the well needs to be constructed
- Responsibilities of the well owners, and
- When/how a well must be abandoned/decommissioned


Ontario Ministry of the Environment and Climate Change
Well Record
Regulation 903 Ontario Water Resources Act
Page 1 of 1
Measurements recorded in: ☐ Metric ☒ Imperial
Well Tag No. (Place Sticker and/or Print Below) Tag#:
Well Owner's Information
First Name | Last Name / Organization | E-mail Address | ☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name) Crescent | Municipality | Province ONT | Postal Code | Telephone No. (inc. area code)
Well Location
Address of Well Location (Street Number/Name) Crescent | Township | Lot | Concession
County/District/Municipality | City/Town/Village | Province Ontario | Postal Code
UTM Coordinates Zone, Easting, Northing NAD 83 | Municipal Plan and Sublot Number | Other
Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
			Sandpoint is in the basement		
			Basement	0	7
	Stones	gravel + sand		7	14
Brown	sand	gravel		14	23½

Annular Space: Depth Set at (m/ft) From, To | Type of Sealant Used (Material and Type) | Volume Placed (m³/ft³)
Method of Construction: ☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☐ Air percussion ☐ Other, specify ☐ Diamond ☐ Jetting ☒ Driving ☐ Digging
Well Use: ☐ Public ☐ Domestic ☐ Livestock ☒ Irrigation ☐ Industrial ☐ Other, specify ☐ Commercial ☐ Municipal ☐ Test Hole ☐ Cooling & Air Conditioning ☐ Not used ☐ Dewatering ☐ Monitoring
Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
1¼	galvanized	sch. 40	-6½	20½

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
1¼"	stainless	8	20½	23½

Status of Well: ☒ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify
Results of Well Yield Testing
After test of well yield, water was: ☒ Clear and sand free ☐ Other, specify
If pumping discontinued, give reason:
Pump intake set at (m/ft) Direct
Pumping rate (l/min / GPM) 9GPM
Duration of pumping 2 hrs + 0 min
Final water level end of pumping (m/ft)
If flowing give rate (l/min / GPM)
Recommended pump depth (m/ft) Direct
Recommended pump rate (l/min / GPM) 9GPM
Well production (l/min / GPM) 9GPM
Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	14		
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Map of Well Location
Please provide a map below following instructions on the back.
House

After a new well has been constructed, a Water Well Record must be submitted to the owner of the well and the Ministry of Environment and Climate Change. This record will provide you with important details about your well.

If any form of payment takes place to construct, repair or upgrade a well in Ontario, a licensed well contractor/ well technician must be used. The MOECC licenses these contractors and well technicians in regards to drilling, boring, digging, and installing pumps (OMAFRA, 2003).

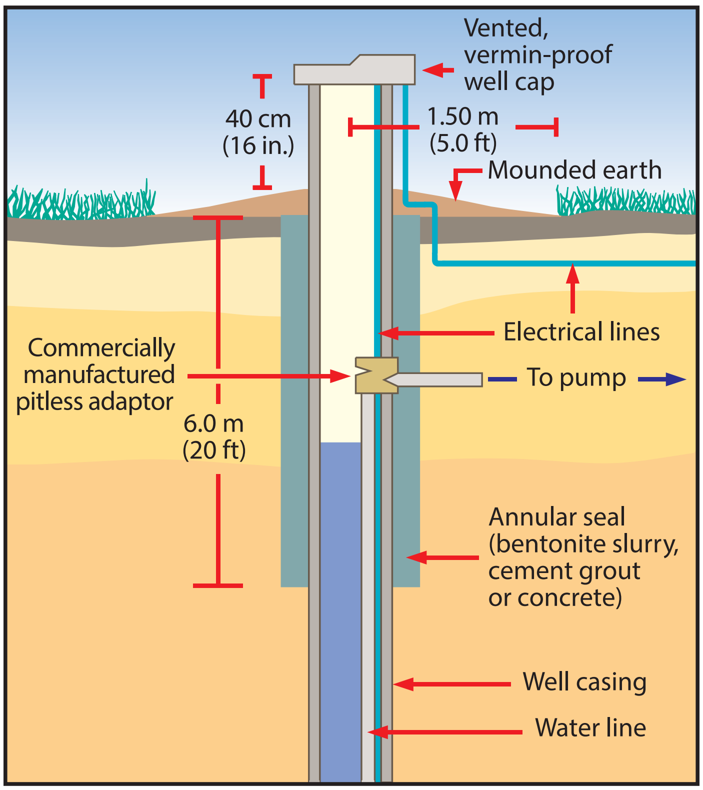
After a new well has been constructed, a Water Well Record must be submitted to the owner of the well and the Ministry of Environment and Climate Change. This record will provide you with important details about your well.

To request a copy of a well record for a specific property, contact the Ministry of Environment and Climate Change (MOECC). This request can be made online through the MOECC.

WELL DESIGNS

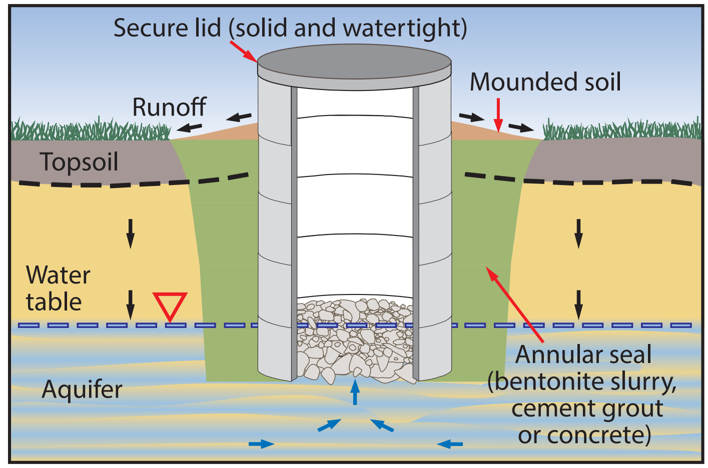
According to OMAFRA (2003), there are three main types of wells. A cross-sectional picture of each is shown below. The advantages and disadvantages of each type of well are provided in the table on the next page.

- **Drilled Wells:** Most new wells constructed today are drilled. They are commonly drilled with a rotary or cable tool. These wells can be shallow or deep. They have a casing with a small diameter (usually 10-20 cm).



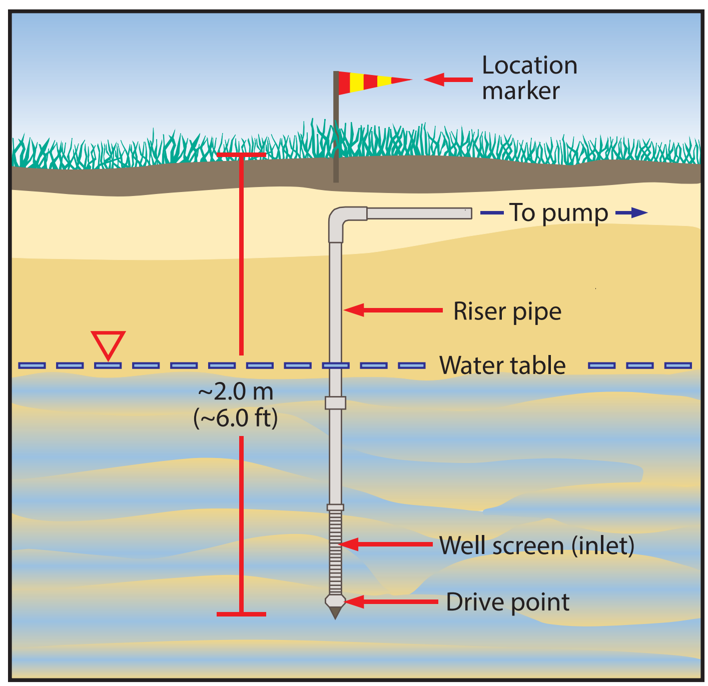
Cross-sectional illustration of a drilled well with a pitless adapter. Reproduced with permission from the Ontario Ministry of Agriculture, Food and Rural Affairs, 2016.

- **Dug/Bored Wells:** A hole that has a diameter of several feet. Constructed by digging or excavating until you reach the water table. Can also be constructed using a boring machine. These wells can be shallow or deep. Many older wells will be of this kind.



Cross-sectional illustration of a large diameter well. Reproduced with permission from the Ontario Ministry of Agriculture, Food and Rural Affairs, 2016.

- **Well Point (Sand Point):** A pointed steel pipe is driven into the ground. The steel pipe is screened throughout its length to allow water to flow into the pipe. Driven into the ground until the point of the pipe is beneath the water table. This type of well is shallow only.



Cross-sectional illustration of a well point (sand point). Reproduced with permission from the Ontario Ministry of Agriculture, Food and Rural Affairs, 2016.

Each type of well has its own advantages and disadvantages, these are provided in the table below.

Table 1: The advantages and disadvantages of each type of well

<table>
<tr><th colspan="4">ADVANTAGES</th></tr>
<tr><th>DRILLED</th><th>DUG</th><th>BORED</th><th>WELL POINT</th></tr>
<tr><td>Can enter deeper aquifers
Less likely to get contaminated
Easily sealed for protection
Temperature is likely to remain constant
Machines can get through bedrock to reach water below</td><td>Inexpensive and easy to construct
Large diameter can allow for good storage of water
Can be used in areas with minimal water available</td><td>Construction is more controlled than digging/ excavating
Large diameter can allow for good storage of water
Can be used in areas with minimal water available</td><td>Inexpensive and easy to install</td></tr>
<tr><th colspan="4">DISADVANTAGES</th></tr>
<tr><th>DRILLED</th><th>DUG</th><th>BORED</th><th>WELL POINT</th></tr>
<tr><td>Susceptible to contaminants that may be present in deep aquifers
Some deep aquifers may have poorer natural water quality (e.g. sulfur, iron)</td><td colspan="2">Susceptible to contamination from the surface (e.g. germs, chemicals, and pests)
During dry periods, insufficient water supplies may be present in shallow wells
Requires large amounts of construction materials
Seasonal water temperature fluctuations</td><td>Susceptible to contamination from the surface (e.g. germs, chemicals, and pests)
During dry periods, insufficient water supplies may be present in shallow wells
Only works in areas where the water table is high
Only works when driven into permeable materials (e.g. sand and gravel)</td></tr>
</table>

Adapted with permission from Best Management Practices: Water Wells (2003), by Ontario Ministry of Agriculture, Food and Rural Affairs, 2016.

WELL PUMPS

There are a variety of different pumps that may be installed on your well.

Shallow Well Pumps

These types of pumps can only lift water about 7 meters. They often sit on the ground surface, beside the well. Shallow well pumps create a vacuum/suction in the pipe and the water is forced up the pipe by the pressure change (OMAFRA, 2003). According to the MOECC, common types of shallow well pumps include:

- **Reciprocating (piston) pumps:** A vacuum is created by a piston. The piston moves up and down continuously which allows water to move into the discharge pipe.
- **Centrifugal pumps:** Water is propelled by rotating impellers using a centrifugal force. The water then moves into the discharge pipe.
- **Centrifugal-jet pumps:** Similar to the centrifugal pump. Suction power is higher because it forces water into narrow jets before it enters the distribution system.

A well point (sand point) with a pump and pressure tank on the ground. These types of wells work in areas where the water table is high as they are not very deep. They are susceptible to surface contamination and changes in water table level. This well is used during the warmer months and winterized for colder months. Plumbing can also be installed below the frost line for year round use.

Deep Well Pumps

Common types of deep well pumps include:

- **Deep well jet pumps:** A centrifugal pump is located at the top of the well (ground level). Used in deeper wells because it can lift the water about 30 meters.

- **Reciprocating (piston) pumps:** Has a motor or hand-powered mechanism at the top of the well. Used in deeper wells because it can lift the water about 122-152 meters.

- **Deep well submersible pumps:** The pump and the motor is submerged into the water in the well. Used in deeper wells because it can lift the water about 300 meters. Most common type of pump used in deep wells in Ontario.

A submersible pump in a drilled well casing model.

WELL LOCATION

The location of a well is very important. All wells need to be placed in a location that has the required minimum separation distances from potential sources of contamination. These may include utilities, existing buildings, and other potential sources of contamination, such as manure piles, animal enclosures, waterways and septic systems. It is ideal to construct wells at a higher elevation than these potential sources of contamination and to have greater separation distances whenever possible (OMAFRA, 2003).

Septic systems can be a potential source of contamination.

Wells can and are used for agriculture. Depending on the type of well, it may be more or less likely to be at risk of contamination. These cows are drinking from a water trough that is fed directly from a well below it; make sure that the well is protected from potential sources of contamination.

This picture shows the gap in the concrete well cap and its location in relation to the ground and potential sources of contamination.

WELL RECORDS

After a new well has been constructed, a Water Well Record must be submitted to the owner and the Ontario Ministry of the Environment and Climate Change. The well record may include:

- Completion date of the well
- Location on a property
- The original well owner's name
- Geologic log (soil types and bedrock types)
- Depth that the water was found at
- Materials used in the construction
- Annular space details
- Pumping test
- Final status of the well
- Type of water use
- Construction method
- Plugging/sealing details
- Contractor information

It is important to keep all the documents you received about your well and well maintenance in one place so they are easily accessible when needed.

WELL CONSTRUCTION

Only licensed well contractors/technicians can construct, repair or upgrade wells and install well pumps. The following information will give you an idea of some of the components of your well and the construction process.

Well Casing

Newly constructed drilled wells are lined with a steel or fibreglass pipe. These casings are typically 12-15 cm in diameter (OMAFRA, 2003). Dug or bored wells may have food grade plastic, PVC piping, or concrete casings. These casings create a connection from the earth's surface to the groundwater. The casings prevent surface water from entering the well and also prevent the well from collapsing. The casing also prevents loose soil, sediments, rocks, and contaminants from entering the well.

Well Screen

When well water is pumped from a sand or gravel aquifer, it will require a well screen. The stainless-steel screen is attached to the bottom of the well casing. It is cylindrical shaped with strainer-like holes in it. The screen stops sand and gravel from entering the well and damaging equipment. The slot size of the screen depends on the size of the sand or gravel particles present in the aquifer and need for one is determined on a case-by-case basis. Screens may not be necessary if your well is drilled into bedrock (OMAFRA, 2003).

Well Sealing

The holes created when drilling or boring a well are usually made to be wider than the well casing. Therefore, there will be a space between the soil and the casing. This is the annular space (OMAFRA, 2003). The annular space must be properly sealed to stop surface water and other contaminants from getting into the well. Grout (for this purpose), bentonite slurry, cement, or concrete is used. Surface water contamination issues associated with a drilled or bored well are in part due to contaminants entering the aquifer when this space is not properly sealed (OMAFRA, 2003).

A properly constructed drilled well. The well cap should be upgraded to make the well more secure (pictured at left).

Developing a well

After a well is installed, construction materials and loose sediments must be removed from the bottom of the well. Development of the well means that fine particles are dislodged from the screen (MOEE, n.d.). There are two common methods: water or air is pushed down into the well and out through the well screen or water is pumped out of the well at faster than normal speeds (OMAFRA, 2003). Development continues until the water in the well is clear and colourless (MOEE, n.d.).

A dug well that is over 100 years old. Moisture seen on the concrete and tile casings indicates that surface water is getting into the well. Ensure that the well is constructed and maintained properly to reduce potential contamination from entering the well.

WELL MAINTENANCE

All wells require routine maintenance to keep your drinking water safe. As a responsible well owner, you should ensure that:

- Your well is easily accessible. No plants should be planted around the well. You should be able to access your well to check the cap and the inside of the well at least once a year.
- You test your water regularly and more often if contamination is suspected. Test for chemicals if you have any concerns. For example, test for nitrates if you have infants under six (6) months of age, or when chemical spills occur in the area.
- You pay attention to changes in the colour, odour, or taste of your water; these changes may indicate a problem with your well water.

Wells require regular maintenance. The well should be easily accessible, maintained/repaired/upgraded/decommissioned as needed and tested regularly. It is helpful to keep records of what you have done (e.g. by whom, when, why and how).

- Set back distances are always maintained.
- Your well cap is at least 40 cm above the ground's surface.

Properly constructed drilled well shown with a vented and vermin proof well cap, electrical conduit for submerged pump (to left of well casing), identification tag (linked to Water Well Record), casing extends at least 40 cm above the ground, and ground that is mounded away from well casing.

- The well cap is tightly sealed and in good repair.
- The air vent in the cap is kept screened and not blocked or damaged.

An inadequate well cap may allow pests and other types of contamination to enter into the well, and may not allow for proper ventilation.

• The ground (grassed) around the casing is sloped so that water is directed away from the well.

• No debris is piled around your well. For example, snow, leaves, etc.

• There is no debris floating in your well. If there is, steps are taken to correct the problem.

• You are not handling or storing chemicals near the well (e.g. fertilizers, pesticides, motor oil, etc.).

Hazardous materials/solvents should not be used or stored near a well (e.g. fertilizers, pesticides, gasoline, etc.).

• No cracks or openings have formed in the well casing. You should also look for water seepage and/or staining on the inside of the casing.

• Where the discharge pipe or electrical lines enter the well, the connections are sealed properly and water is not seeping in. Make sure this area is water tight and appears dry.

• The annular space around the well casing is properly sealed.

• Anti-backflow devices are installed where necessary. Back-siphonage of dirty water can occur when a tap or hose is submerged into water. The dirty water may flow back up the tap or hose, into your well, and contaminate it.

• You plug and seal your well properly when you are no longer using it.

GENERAL HEALTH CONCERNS

Groundwater is normally clean and safe for consumption. The soil that is over top of the groundwater is a natural filter that removes contaminants. When wells are not installed or maintained properly, they can cause the groundwater in the well to become contaminated. Contaminated groundwater can also be present in aquifers that do not have enough protective soil above them (Health Canada, 2008). Some common contaminants that may be present in your well are discussed in more detail throughout this manual.

WHAT MIGHT BE IN YOUR WELL

Some things are harmful to your health, while others may only cause aesthetic problems, such as odours or staining. Some common issues that a well owner may face:

Coliforms are a group of bacteria that are commonly present in the environment. If you have coliforms in your well water, this indicates that surface water has likely contaminated the well. We test for coliforms because they are easy and inexpensive to test. Their presence can indicate that there are other different types of contaminants present as well. For this reason, we call them indicator organisms (Health Canada, 2008). If your well water has more than 5 coliform units per 100 ml of water, your water is considered to be contaminated (OMAFRA, 2003).

Escherichia coli (E. coli) are a type of coliform bacteria that are often present in animal or human feces. If E. coli is found in your water in any amount, it means that there has been a recent fecal contamination to your well. This could also mean that there are other harmful organisms present in your water, such as disease causing bacteria, viruses, protozoa, or other contaminants. Water that has E. coli in it is not safe to drink. Steps to solve the problem need to be taken right away.

Nitrates often come from plant fertilizers, decomposing plants, and bacterial action on animal wastes. If there are both E. coli AND nitrates in your well water, they are likely coming from a malfunctioning septic system (MOEE, n.d.). If nitrate levels are above 10 mg/L, they can cause methemoglobinemia also known as blue baby syndrome in infants under 6 months of age. Nitrates cause infants' blood to have lower levels of oxygen, which can cause them to have shortness of breath and turn a bluish colour. If you find that nitrate levels in your well water are above 10 mg/L, do not use the water directly or in formula for infants under 6 months of age (if you have made an informed decision to formula feed your infant).

Iron and iron bacteria are naturally present in groundwater. When dissolved in water, iron will appear colourless; when iron comes in contact with air, the iron metal precipitates out and this may cause rusty coloured staining to your laundry and plumbing fixtures (MOEE, n.d.). Iron bacteria can form a slimy, foul smelling film that may clog pipes and well screens. It is important to note that iron and iron bacteria are not a health concern (OMAFRA, 2003).

Sulphate & Sulphur Bacteria. Sulphate is a naturally occurring substance that may be present in groundwater (OMAFRA, 2003). Sulphate levels above 500 mg/L may produce a laxative effect and potentially lead to dehydration (Health Canada, 2014). Sulphur bacteria may also be present in groundwater. They produce hydrogen sulfide gas in the water, which has a characteristic "rotten egg" smell (OMAFRA, 2003).

Fluoride may naturally occur in groundwater. Fluoride concentrations of about 1.5 mg/L can help in the formation of human teeth and prevent cavities (Health Canada, 2014).

Hardness is normally caused by calcium and magnesium in the water, but may also be caused by iron and manganese in the water. It can lead to scaling on appliances, plumbing fixtures and pipes (OMAFRA, 2003). The harder the water, the more soap is required to lather, which can cause problems with laundry and soap scum build-up. Hard water is not a health concern (OMAFRA, 2003).

It is important to regularly inspect and maintain your well and test the water. This is a drilled well located in a pit (these are no longer allowed to be constructed). If you have a well located in a pit, you could upgrade it so that the well casing extends at least 40 cm above the ground. NEVER ENTER A PIT.

WELL MONITORING AND TESTING

Even if your water looks fine it may have harmful bacteria and other contaminants in it that you cannot see, taste or smell. The only way to be sure is to have it tested. Year round well water testing for total coliforms and E. coli bacteria is provided free of charge in Ontario to private residences and homes. Other tests are provided at various laboratories for a fee. You should test your well water regularly in order to monitor the water quality. Deep aquifers do not usually have significant changes in water quality from season to season, but shallow wells will have more noticeable changes (OMAFRA, 2003).

According to OMAFRA (2003), there are three ways to monitor water quality:

- **Physical monitoring:** Sometimes physical changes in the water can warn you of possible contamination. You want to pay attention to its odour, taste, colour, and turbidity. If you notice any changes in your water, you may want to investigate the cause and/or take a water sample for testing.
- **Biological monitoring:** Involves testing for bacteria, viruses, and/or parasites. Even if your water looks fine it may have harmful bacteria and other contaminants in it that you cannot see, taste or smell. The only way to be sure is to have it tested. The most commonly used tests are the Total Coliform and E. coli bacteria tests. These tests should be done regularly. You may want to test more often depending on the type of well

you have (e.g. dug wells are typically more prone to contamination than drilled wells) or if you have opened or done any maintenance on the well, or the conditions around the well could lead to contamination of the well water. Year round well water testing for total coliforms and E. coli bacteria is provided by Public Health Ontario laboratories free of charge to private residences and homes.

• **Chemical Monitoring:** Chemical tests should be done when you have any concerns that there might be some unwanted chemicals in your well. You may want to test for nutrients (e.g. nitrates), hardness, gasoline/oil, etc. Samples must be sent to a private lab, and costs for chemical tests will vary.

The soil is cracked, evidence that water has entered the well pit (not to be constructed this way anymore) and dried. One way to prevent this from happening is to upgrade the well by installing a pit-less adapter and extending the well casing at least 40 cm above the ground; and ensuring that construction/maintenance is conducted properly. New construction wells cannot be located in well pits. NEVER ENTER A PIT.

A drilled well located in a well pit (these are not to be newly constructed anymore) can be contaminated when the pit is exposed to surface water (that comes through the casing or through gaps in the cap). These wells can be upgraded to have a pit-less adapter that makes the well more secure and less likely to be contaminated. You can see evidence of water entering the well around the concrete casing joints. New construction wells cannot be located in well pits. NEVER ENTER A PIT.Wells located

near the road or parking lots may be at risk of salt (sodium) and vehicle related contamination. Know what can get into your well and take measures to minimize the potential contamination and the risks.

NOTE: Even if your water seems fine, it may have harmful bacteria and/or other contaminants in it that you cannot see, taste or smell. The only way to be sure is to have it tested. Year round Total Coliform and E. coli bacteria tests are provided free of charge for private residences and homes in Ontario. Other tests are available at various laboratories for a fee.

HOW TO TAKE A WATER SAMPLE FOR BACTERIOLOGICAL TESTING

Water samples can sometimes become contaminated during sampling if the correct procedure is not used. The following sampling procedure is recommended:

1. Obtain a 200-ml.-sample bottle from the Health Unit. Keep the bottle sealed, clean and dry until ready to fill. The bottle is sterile and should not be opened until immediately prior to filling. Also, the bottle contains a neutralizing chemical in pellet or powder form. Do not rinse out the bottle before filling.

2. The sample should be taken the same day it is to be submitted for testing. Take the sample at a tap such as the kitchen sink. Do not take a sample from a hose.

3. Remove aerators and other attachments from your tap. Disinfect the discharge opening of the tap by wiping with alcohol, a sanitizer or by passing a match or lighter flame under the discharge opening.
4. Let the cold water run for two to three minutes before sampling.
5. Fill the bottle to the "fill line" directly from the tap without changing the flow rate of the water. Do not remove the cap until immediately before sampling and do not place the cap on the counter. Be careful not to touch the inside of the cap or lip of the bottle with your fingers.
6. Replace the cap snuggly.
7. Fill out the form attached to the water bottle being sure to provide all the information requested. If information is missing the provincial laboratory will not test the sample.
8. Keep the sample under refrigerated conditions until it reaches the laboratory.

For a map of water bottle pickup and drop off locations and times visit:

www.publichealthgreybruce.on.ca/Your-Environment/Safe-Water/Private-Drinking-Water

RESULT INTERPRETATION

Biological water samples are taken in 200 mL bottles, and the lab will analyze 100 mL of the water in the bottle. The lab counts how many colony forming units (cfu) are in 100 mL of water.

Table 2: Understanding your water sample test results for total coliforms and E. coli

E. COLI (CFU/100 ML)	TOTAL COLIFORM (CFU/100 ML)	WHAT DOES THIS MEAN?	WHAT SHOULD YOU DO?
0	5 or less	No significant bacterial contamination was found	Continue to test your drinking water on a regular basis to determine if there are any changes in your drinking water quality
0	More than 5	Indicates bacterial contamination	Do not drink your well water. Contact your local health unit for further assistance
1 or more	1 or more	Indicates contamination from animal or human fecal waste	Do not drink your well water. Contact your local health unit for further assistance
NO DATA: OVERGROWN		**WHAT DOES THIS MEAN?**	**WHAT SHOULD YOU DO?**
No data: Overgrown with Non-target		Indicates heavy bacterial contamination	Do not drink your well water Contact your local health unit for further assistance
No data: Overgrown target		Indicates heavy bacterial contamination and total coliforms and/or E. coli (indicator organisms) are present.	Do not drink your well water Contact your local health unit for further assistance

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A dug well. The well cap is located close to the ground and the well is prone to contamination. Know where your well is, how it is constructed and maintained, and how vulnerable it is to contamination.

Water can be made safe to drink by using the following procedure:

1. Bring the water to a full rolling boil for at least one minute. This treatment will kill parasites. Or disinfect water using household bleach, if you can't boil water. Only use regular, unscented chlorine bleach that is suitable for disinfection and sanitation as indicated on the label. Do not use scented, color safe, or bleaches with added cleaners. If water is cloudy, let it settle and filter it through a clean cloth, paper towel, or coffee filter.

- Locate a clean dropper from your medicine cabinet or emergency supply kit.
- Locate liquid chlorine bleach that is stored at room temperature for less than one year. The label should say it contains 8.25% of sodium hypochlorite.
- Add 6 drops of bleach to each gallon of water. Double the amount of bleach if the water is cloudy, colored, or very cold.
- Stir and let stand for 30 minutes. The water should have a slight chlorine odor. If it doesn't, repeat the dosage and let stand for another 15 minutes before use.
- If the chlorine taste is too strong, pour the water from one clean container to another and let it stand for a few hours before use. (US Environmental Protection Agency, 2017)

2. Refrigerate boiled or treated water until used.

A water treatment filter. Equipment requires regular inspection and maintenance. This filter needs to be replaced.

WELL WATER TREATMENT SYSTEMS

There are a variety of different treatment systems that can be installed on your well. Different treatment systems are needed to solve different problems, so you want to make sure that the system(s) you install is right for your needs.

Table 3: Common types of treatment systems

TREATMENT SYSTEMS	ADVANTAGES	DISADVANTAGES
Chlorine	Kills bacteria and viruses Inexpensive	Needs filtration (to remove microbes and parasites that are hiding in dirt particles) Needs careful handling (ensure that appropriate personal protective equipment is used) Must test chlorine levels Dosing pump requires regular maintenance
Ultraviolet (UV) Light	Kills bacteria and viruses Inexpensive	Needs filtration (to remove microbes and parasites that are hiding in dirt particles) Needs a slow water flow UV lamp and sleeve must be clean to work properly UV light bulbs must be replaced regularly
Ozonation	Kills most microbes Removes organic compounds (e.g. pesticides)	Needs filtration (to remove microbes and parasites that are hiding in dirt particles) Varies in how effective it is depending on how it is used and the manufacturer
Reverse Osmosis	Removes most microbes, nitrates, sulphates, hardness, dirt particles, and small amounts of some pesticides	Hard water may cause plugged membranes Expensive Membranes need to be replaced Needs pre-filtration and pre-softening of hard water

Adapted with permission from Best Management Practices: Water Wells (2003), by Ontario Ministry of Agriculture, Food and Rural Affairs, 2016

An example of a filter and ultraviolet disinfection system.

Make sure that the ultraviolet light bulb sleeve is cleaned on a regular basis. If the sleeve is dirty, the ultraviolet rays cannot properly inactivate the germs in the water, allowing contaminated water to flow through untreated.

WELL ABANDONMENT AND SEALING

It is the well owner's responsibility to ensure that a well is properly sealed (OMAFRA, 2003). Wells may be sealed by a licensed well contractor, or by the owner of the property where the well is located (Ontario Ministry of the Environment and Climate Change [MOECC], 2011).

Unsealed wells may be poorly maintained. Cracks in the casing or the well cap can allow for contaminants such as pests or surface water to enter the well. These wells can also be a safety hazard for children, pets, and livestock who may be able to access it. Contaminants that enter a well can contaminate an entire aquifer, and this can cause other wells in the same aquifer to have contaminated water (OMAFRA, 2003).

After sealing a well, an updated water record must be submitted to the MOECC and to the owner of the well (if they did not do the sealing themselves). This record must be sent within 30 days after the construction equipment has been removed from the site.

TROUBLESHOOTING

The following table shows some of the common problems that you may have with your well, and how you may be able to solve these problems.

Table 4: Troubleshooting the common problems

	WHAT MIGHT BE THE PROBLEM?	HOW DO I FIX IT?
Bacteria	• Setback distances from contamination sources are not maintained • Well casing not properly sealed or not water tight • Well cover is cracked or not installed properly (e.g. not 40 cm above ground, loose) • Well not shock chlorinated after maintenance or installation • Contaminated aquifer	• Boil water before consumption (bring water to a rolling boil for 1 minute. Do not boil water if chemical contamination is suspected) • Remove possible contamination source(s) and then disinfect the well • Shock chlorination of well • Install a long-term treatment system (UV, chlorine, ozonation)
Nitrates	• Setback distances from contamination sources are not maintained • Well casing not properly sealed or not water tight • Contaminated aquifer	• Install a long-term treatment system (reverse osmosis) • Use an alternative water source for infant consumption
Iron	• Naturally present in the groundwater	• Install a long-term treatment system (aeration and settling, or filtration, water softeners, greensand/potassium permanganate ion exchangers)
Sulphates	• Naturally present in the groundwater	• Install a long-term treatment system (reverse osmosis, activated carbon filtration, gravity separation system)
Iron/ Sulphur Bacteria	• Setback distances from surface water sources are not maintained (e.g. lakes and ponds) • Well casing not properly sealed or not water tight • Well cover is cracked or not installed properly • Well not shock chlorinated after maintenance or installation • Contaminated aquifer	• Install a long-term treatment system (chlorination-filtration system) • Shock chlorination of well
Sodium*	• Naturally present in the groundwater • Road salt is getting into the aquifer • Water softener uses sodium	• Minimize amount of salt getting into aquifer, secure the well. • Use water softener system that does not use sodium • Install a long-term treatment system (reverse osmosis, ion exchange, distillation unit)
Fluoride	• High levels may be naturally present in the groundwater	• Install a long-term treatment system (reverse osmosis)
Hardness	• Naturally present in the groundwater	• Install a long-term treatment system (water softeners) • Soluble phosphate additives

*Adapted with permission from Best Management Practices: Water Wells (2003), by Ontario Ministry of Agriculture, Food and Rural Affairs, 2016; and *from Sodium in Drinking Water Factsheet (2013), by Elgin Area Primary Water Supply System, Elgin St. Thomas Public Health, and the Middlesex-London Health Unit.*

SHOCK CHLORINATION

Shock chlorination involves adding a high amount of chlorine (bleach, which should be 5.0 - 5.25% sodium hypochlorite - avoid using scented products such as those with lemon scent and make sure that the product is fresh as it loses its strength over time) to the water in a well. Water is then pumped through the plumbing system and is left to sit in the pipes to allow for adequate disinfection. See the next section titled 'How to Shock Chlorinate Your Well' for detailed steps.

As per OMAFRA (2003), recommendations for shock chlorination of your well water are as follows:

- Immediately after any construction, maintenance, repair, inspection, or upgrading.
- If your water sample results show 0 E. coli, but greater than 5 total coliforms. If this is the case, make sure to sample again 3-4 days after shock chlorinating (once all the chlorine is out of the system so that you don't get a false negative test result).
- If your water sample results show greater than 0 E. coli.
  - → DO NOT drink the water.
  - → First, take a new water sample and then shock chlorinate.
- → If the new water sample results show greater than 0 E. coli or any total coliforms then you should inspect your well or hire a licensed well contractor (remember to shock chlorinate after the inspection).

When you are inspecting your well keep in mind the possible causes of potential contamination.

> Not all wells are the same size, so not all wells will need the same amount of chlorine (bleach) for shock chlorination. In order to determine how much chlorine will be required, you will need to use the following steps:

- First, you will have to determine the diameter and the depth of your well. You may be able to find this information in your well record, but if not, you will need to measure your well yourself.
  - → The materials you will need include a measuring tape and long length of non-stretchy string attached to a relatively heavy weight.
  - → To get the diameter of your well, you will have to measure across the widest part of your well casing.
  - → A few more steps are involved in finding the depth of your well. You will have to securely attach a relatively heavy weight to the end of a string.
    - Make sure that you do not use a string that is stretchy or is plastic (e.g. fishing line).
    - You will then lower the weight into the well until you can feel that it has reached the bottom of your well. Then, remove the string and weight from the well.
    - Measure the length of the string that appears to be wet. This will indicate how deep the water is in your well.

Now that you have found the diameter and depth of your well, you can use the following table to determine how much bleach you will need for the shock chlorination of your well. Follow the steps provided in the next section titled 'How to Shock Chlorinate Your Well'.

Table 5: Amount of bleach required for the shock chlorination of your well depending on the depth of your well.

Volume of unscented bleach added for every 3 metres (10 ft.) of water in the well.

DIAMETER OF CASING		BLEACH VOLUME (5.0-5.25%)
millimeters (mm)	inches (")	milliliters (mL)
50	2	6
100	4	30
150	6	60
200	8	100
250	10	200
300	12	250
400	16	400
500	20	650
600	24	900
900	36	2000 (2 Litres)
1200	48	3600 (3.6 Litres)

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HOW TO SHOCK CHLORINATE YOUR WELL (AS ADAPTED FROM OMAFRA (2003))

After you have added the required amount of bleach to your well, follow the last few steps below as per the recommendations by OMAFRA, 2003:

1. Continue using another safe source of water for drinking/cooking/brushing teeth, etc. until the appropriate number of test results show that the water is safe.
2. Add the calculated amount of bleach to the well.
3. Make sure to remove carbon filters located on the well system (these filters remove chlorine). Put in a new filter after shock chlorination so that the old one does not re-contaminate the system.
4. Run the water at every faucet that is supplied by the well until a strong chlorine odour is detected. If your nose is not a good indicator, you can get a pool test kit to verify that you have chlorine in the water.
5. You should be able to smell chlorine. If you cannot, or it is very weak, add more bleach to the well.
6. Drain your water heater and fill it with this newly chlorinated water.
7. Backwash any water softeners or filters (with the exception of carbon filters) on your treatment system.
8. Let the chlorinated water sit in your plumbing system for 12 hours. Ideally you would do this overnight.
9. Remove the chlorinated water from the well by running water from a hose outside onto the ground surface until you no longer smell or detect chlorine. Make sure that you do not run all of the water through faucets in your house into your septic system. Do not run the hose water over the ground of your septic system, you do not want to kill the bacteria needed for proper operation of your septic system. It is best to drain it from a hose outside of your house into a nearby ditch. Do not run the hose to the storm sewers as they often run into waterways. NOTE: Be aware of any local by-laws regarding discharging chlorinated water into the environment or storm sewers.

10. A bacteriological water sample should be taken 3-4 days after you shock chlorinate. If the test shows that your water is safe, wait 1 week and test it again. Two safe test results in a row show that your treatment has worked. If bacteria are still present, shock chlorinate the well again and re-sample your well water. Check your well, the equipment and surrounding area, and fix the issue that is causing the contamination if you can. The aquifer and not just the well may be contaminated. You may need to contact a licensed well contractor. You may need to install a continuous treatment system, or construct a new well (ensure to plug the old one).

Let's take a look at Bob's well:

Bob's well is 300 mm in diameter. Using the string method he found out that his well is 6 m deep.

- Since Bob's well is 300 mm in diameter, he will need to add 250 mL of bleach for every 3 m of water in his well.
- Since his well is 6 m deep in total, he will need to divide the 6 m by 3. This equals 2.
- He must then multiply the 250 mL of bleach by 2, which will equal 500 mL of bleach.
- So, Bob will need to add 500 mL of bleach for the adequate shock chlorination of his well.

Let's take a look at Judy's well:

Judy's well is 500 mm in diameter. Her well is 40 m deep.

- Since Judy's well is 500 mm wide in diameter, she will need to add 650 mL of bleach for every 3 m of water in her well.
- She takes the 40 m depth and divides by 3. This equals 13.33.
- She then multiplies the 650 mL of bleach by 13.33, which equals 8664.50 mL of bleach.
- Rounding up, Judy will need to add 8665 mL (or 8.665 L) of bleach for the adequate shock chlorination of her well.

Bored wells with proper casings and sturdy well caps will help to prevent accidental falls into the well and reduce the amount of contamination that can enter the well. As with any type of well, they must be constructed and maintained properly to reduce the risk of contamination and injury.

A dug well with an upgraded sturdy lid (that is properly vented and vermin proof) reduces the amount of contamination that can enter the well. Older wells of this type may have been constructed with stones, bricks, or other materials. The coloured portion of this well lid allows for observation of the well without having to removing the heavy concrete lid. The concrete lid can be removed if maintenance is required.

The access riser (green lid) of the septic tank (where heavier solids settle and start to decompose) is the only component visible on this properly installed septic system. The distribution box and leach field/drain field (where the wastewater is further 'cleaned' via soil filtration and further decomposition by bacteria) is located towards the tree line. It is important to properly install and regularly inspect and maintain your septic system to prevent potential groundwater contamination. Look for back-ups at plumbing fixtures or 'ponding' on the grass where the septic system is located.

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Grey Bruce Health Unit
101 17th Street East
Owen Sound ON N4K 0A5
1-800-263-3456 / 519-376-9420
www.publichealthgreybruce.on.ca