



Sustainable Agriculture Facts Growing for tomorrow

Technical Information for Conservation Farmers

Guide for Sealing Abandoned Water Wells in Manitoba

An abandoned well is defined as a well that currently is not used and is not intended to be used in the future for water supply purposes.

The earliest recorded water wells in Manitoba were drilled during the late 1800's to provide water supplies for an expanding rural population. Since that time, more than 200,000 water wells, monitoring wells and test holes to explore for groundwater have been drilled throughout the province. While most test holes were sealed immediately after being drilled, thousands of water wells have been improperly abandoned in both urban and rural areas of the province over the past century.

The proper sealing of abandoned wells is of considerable importance if we are to maintain and protect the integrity of our groundwater supplies.



A typical abandoned well. There are likely more than 5,000 abandoned wells in both rural and urban areas of Manitoba. (Photo courtesy of B. Lussier, Cooks Creek Conservation District.)

Unsealed abandoned wells may:

- act as conduits for the movement of near-surface contaminants such as bacteria and nutrients into underground aquifers,
- flow uncontrollably at the surface resulting in water waste, nuisance or flooding problems,
- interconnect fresh water and saline water aquifers, allowing saline water to enter into fresh water zones,
- pose a threat to children or animals who may fall into large diameter openings and become trapped, and
- present a hazard to farm machinery and vehicles.

The Landowner's Responsibility

According to The Ground Water and Water Well Act, the responsibility to seal an abandoned well rests with the owner of the well (the landowner). The owner must **"...fill and seal it in a manner sufficient to prevent the vertical movement of water in it."** A well which is not currently in use but may be used for water supply purposes in the future is not considered to be abandoned. Such wells should be properly capped so that no foreign materials may enter the well, but need not be permanently sealed.

In some cases, landowners may properly seal abandoned wells on their own property using simple methods and materials. In other cases, proper sealing may be a complex procedure and should only be carried out by a licensed water well driller or other experienced individual.



An aquifer is defined as a saturated, permeable geological material which is capable of producing economically useful quantities of water to wells or springs.

Landowners should not attempt on their own to abandon:

- flowing wells
- wells that are known to be contaminated
- wells that contain obstructions, or
- wells that produce saline water in areas where fresh water aquifers are also present.

This publication provides an overview of the most common well construction methods used in Manitoba and outlines procedures for the proper sealing of abandoned wells that can be employed by many landowners.

AQUIFERS IN MANITOBA

Aquifers can be formed by loose materials such as sand and gravel, or by bedrock materials such as limestone, sandstone, fractured shale or granite.

Some familiar aquifers in Manitoba include the extensive sands in the Carberry and Birds Hill areas and the limestone bedrock which underlies the Interlake.

The Carberry Sand Hills form an extensive sand aquifer in southcentral Manitoba. This aquifer is a major source of irrigation water supply.



The Carbonate Rock Aquifer of Manitoba's Interlake region. This is the largest aquifer in the province and is formed by limestones and dolomites from 375-450 million years old.



TYPICAL WELL CONSTRUCTION

Water wells are constructed to allow groundwater to flow into the well while using casings or screens to keep loose material out.

Most small diameter wells (4-6 inches) completed in sand and gravel are screened wells. A well screen is a section of finely slotted pipe attached to the bottom of a plastic or steel well casing which allows water into the well while excluding the surrounding sand or gravel. The typical construction of a screened well is shown in Figure 1.

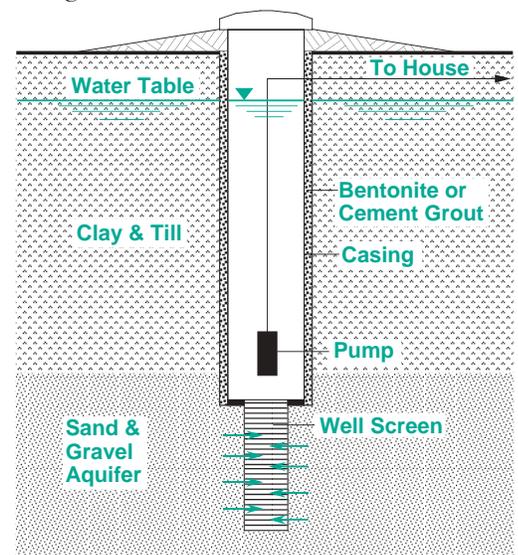


Figure 1: Typical construction for a well completed in a sand and gravel aquifer. The well screen allows water to enter the well but prevents the passage of sand.

Large diameter wells, usually 30 inches or more in diameter, are commonly constructed in shallow sand aquifers or in clay-rich sediments that will produce only very low yields of groundwater. Older large diameter wells generally do not contain a screen but rely on water entering the well through perforations and joints in culvert sections, or spaces between rock or brick cribbing. Modern wells of this design may include a well screen. The construction of a typical older large diameter well is shown in Figure 2.

Wells drilled into bedrock aquifers are not normally screened. In these situations a plastic or steel casing (usually 4-6 inches in

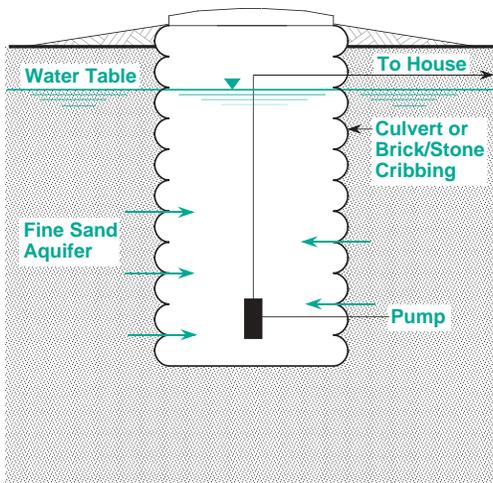


Figure 2: Typical construction for a large diameter well. Most older large diameter wells do not have a well screen but rely on seepage through joints in sections of culvert or spaces between rock or brick cribbing.

diameter) is installed to the top of, or some distance into, the bedrock and the well is deepened until sufficient water is encountered. Wells drilled into bedrock aquifers may pass through more than one water producing zone, separated by low-permeability zones which produce little or no water. Wells constructed in this manner are referred to as open hole wells (see Figure 3).

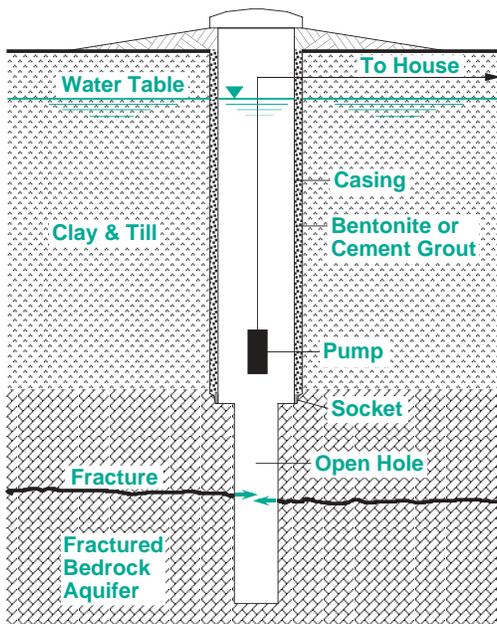


Figure 3: Most wells constructed into bedrock aquifers are completed as open holes. Casing is extended to the top of the aquifer to prevent the unconsolidated overburden materials from collapsing into the well.

THREE STEPS TO SEALING YOUR ABANDONED WELL

In many instances the proper sealing of abandoned wells can be accomplished by many landowners by using appropriate techniques and materials to fill the well.

It must be emphasized that if well sealing is not done properly, the well may continue to act as an unrecognized environmental liability far into the future. If you are unsure about sealing your abandoned well properly, contact an individual or agency with proper training and experience for advice. If you choose not to seal your own well, you may wish to contract the services of a licensed water well contractor. These professionals have the materials and equipment to properly abandon all types of wells in the province.

STEP 1 - Do Your Homework

Gather information on how the well was constructed including: its depth, diameter, the amount of casing, and details on whether it was screened or constructed as an open hole below the casing.

Check the Well Driller's Reports

If you are the original well owner, you may have been provided with a well driller's report when the well was drilled. If not, this information may have been filed with Manitoba Conservation, Water Branch and can be obtained by contacting the Branch, the Manitoba Water Services Board or PFRA offices listed on the back of this pamphlet.

If no report is available, information on the well may be able to be obtained from the driller or the previous land owner.

Several agencies have copies of water well records for the province and can also provide advice on well sealing methods. Contact any of the agencies listed on page 6 for information on wells you are planning to seal and for assistance on designing proper sealing methods.

While filling an abandoned well, check the well depth regularly. Be careful not to leave your measuring device near the bottom of the well for too long - it will invariably become stuck.

Examine the Well

Confirm that any electrical service to the well is disconnected at the source. If a pump or hoses still remain, these must be removed. The well should then be plumbed to determine its depth, the water level and if any obstructions remain in the well. This can be done by tying a heavy weight securely to a rope and carefully lowering it down the well. Record the current well depth and depth to water.

Compare the measured depth to the expected depth from the information gathered above. If the well is significantly more shallow than expected there may be an obstruction which would have to be removed prior to sealing. This may require the services of a well driller. Sealing of an obstructed abandoned well should not be carried out until the obstruction is removed. Finally, measure the diameter of the well casing so that the volume of material required to fill the well can be calculated (see Table).

Considerable caution should be exercised if it is necessary to enter a well pit in the process of sealing an abandoned well. The walls of some pits may be unstable and subject to collapse or, in some instances, the air in a pit may have decreased oxygen content or contain toxic gasses.

Do not enter a pit if you are uncertain about its stability or air quality. In these instances, a contractor trained and equipped for confined entry work should be contracted to carry out the inspection and sealing of the well.

STEP 2 - Plan and Seal

Sealing an abandoned well requires that key portions of the well are filled with impermeable materials. Other portions of the well may be filled using locally available materials such as clean sand. All materials used must be free of contaminants.

The most important well sealing materials are low-permeability substances that prevent the movement of water. The most commonly used materials are bentonite chips and clay.

Bentonite Chips (or pellets) are a processed form of bentonite, which is a clay that swells eight to ten times its dry volume when wet. Bentonite chips are generally available in 50 pound (0.7 cubic feet) bags. Only medium to coarse (1/4 to 3/4 inch) sizes should be used. Suppliers are listed under Water Well Equipment and Suppliers in the yellow pages or contact the agencies given on page 6.

Clay should be excavated from below the root zone so that it is free of organic matter. Clay must be carefully shoveled into the abandoned well and tamped continually. The need for tamping limits the use of native clay to the top portion of the well only (approximately the top 12 feet).

The use of cement to seal abandoned wells should only be considered by an experienced well driller. Specialized equipment is required to properly place the cement below the water level.

Although the easiest and most effective way to seal a well is to fill it completely with low-permeability material, the cost may be prohibitive. If a well has a large diameter or is very deep, then the use of low cost filler material such as sand, carefully placed in certain portions of the well, is acceptable.

Sand should be free of lumps coarser than 1/4 inch in diameter and include about ten percent silt and clay. Sand must be used in combination with either clay or bentonite chips to reduce the potential for vertical movement of groundwater in the abandoned well.

Caution

Sealing your well may cause a temporary silty or cloudy appearance to the water in nearby wells, particularly in areas where wells are constructed in fractured bedrock aquifers such as limestone. Bacteria may also be introduced into the subsurface when adding sealing materials.

Volume of Materials Required		well diameter (inches)	one cubic yard of clay	100 lb. (1cu. ft.) of sand	50 lb. (0.7 cu. ft.) bag bentonite chips
Knowing the well depth and diameter and the method of sealing, the amount of each material required can be estimated using the table below. For example, 1 cubic yard of clay will fill 8.6 feet of a 24 inch diameter well.	2		41.7	31.30	
	4		10.4	7.90	
	5		6.7	5.10	
	6		4.6	3.50	
	8	77.4	2.6	2.00	
	10	49.5	1.7	1.30	
	12	34.4	1.2	0.89	
	18	15.3	0.5	0.39	
	24	8.6	0.3	0.22	
	30	5.5	0.2	0.14	
	36	3.8	0.1	0.10	

Sealing Small Diameter Wells

Caution

In situations where neighbouring wells may be affected, shock chlorinate the abandoned well by adding approximately one gallon of household bleach for every 50 gallons of water in the well prior to adding the sealing materials.

If neighbouring wells do become silty or cloudy, impacts are generally short-term and can be mitigated by pumping to waste. A bacterial analysis should be carried out. If bacteria are present, these wells should be shock-chlorinated.

The biggest challenge with sealing small diameter wells is adding the sealing material to the well without having it bridge and create an obstruction. It is best to add material slowly, a shovel-full or less at a time, and pause frequently to allow the materials to settle to the bottom of the well. Remember, you can always add more material to the well but you cannot remove material once it has been added.

The simplest method of sealing a small diameter well is to fill it from bottom to within 4 feet of ground surface with bentonite chips. This is relatively inexpensive for shallow wells up to 6 inches in diameter. For example, a 50 foot deep well that is 4 inches in diameter could be sealed with 6 to 7 bags of bentonite chips. The top 4 feet of the well casing should be removed and the remainder of the hole filled with clay, tamped in one foot layers. Finally, topsoil should be mounded slightly over the top of the well to allow for some settlement.

If the well is deep (greater than 100 feet) or more than 6 inches in diameter, a significant amount of material will be required to fill the well and sand can be used as a filling material. In the case of an open-hole well, fill the well slowly with sand to a depth approximately 10 feet below the bottom of the casing. It is good practice to add a 3 foot layer of bentonite chips after every 10 to 15 feet of sand. This creates a series of impermeable layers which will prevent inter-aquifer flow.

After filling the well to approximately 10 feet below the bottom of the casing, slowly add bentonite chips until the level of chips is about 10 feet above the bottom of the casing.

The rest of the hole, to within about 4 feet of ground surface, can then be filled with alternating layers of 10 to 15 feet of sand and 3 feet of bentonite chips. Remove the top four feet of casing and fill the remainder of the hole with tamped clay and topsoil. Sealing an open hole well in this manner is illustrated in Figure 4.

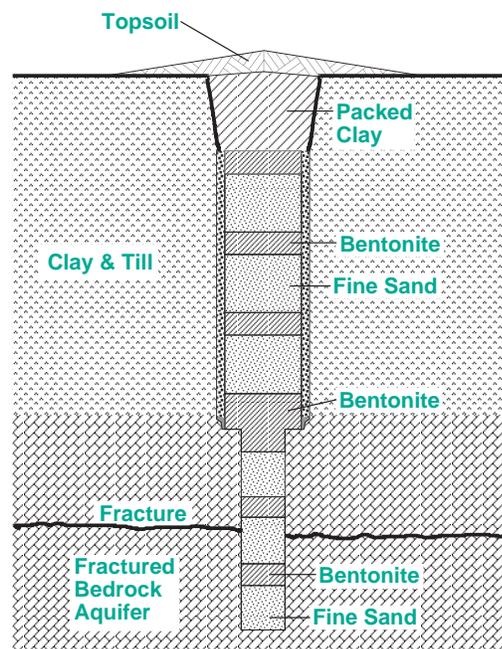


Figure 4: Sealing a small diameter screened or open hole well. Alternating layers of sand and bentonite are used. It is important to have a bentonite seal at the base of the casing.

If sealing a screened well, add alternating layers of sand and bentonite chips to within about 4 feet of ground surface then complete the abandonment procedure as discussed above.

Sealing Small Diameter Wells within Pits

In the past it has been common practice to construct a large diameter pit around a small diameter well. The pit provides winterized access to the well head. In these situations, the small diameter well should be sealed with bentonite or bentonite and sand as discussed above. If possible, the cribbing forming the large diameter pit should be removed and the pit filled with local clay, compacted by tamping every foot. In sandy areas where it is difficult to find clay locally, the bottom foot of the pit should be filled with a layer of bentonite chips and the rest of the pit filled with sand. The well should be covered with a layer of topsoil, mounded and graded to promote runoff and to provide for settlement.

Sealing Large Diameter Wells

A report on sealing of an abandoned well should include:

- ✓ **Measured well depth and diameter**
- ✓ **Type of well casing**
- ✓ **Depth to water in the well**
- ✓ **Sealing method used (include sketch)**
- ✓ **Location of the well (sketch map with legal location)**
- ✓ **Copy of the well driller's report if available**
- ✓ **Name of the original well owner**
- ✓ **Your name and phone number**

It is often not economical to seal a large diameter well in the manner discussed above due to the large volume of bentonite chips that would be required. The initial step in sealing a large diameter well should be to carefully fill it with sand to a depth approximately 12 feet below ground surface. The upper 12 feet of casing or cribbing should then be removed, if possible. This will generally involve excavation with a back hoe. If removal of the casing or cribbing to this depth is impractical, then at least the upper 4 feet should be excavated and removed.

The well should then be filled to slightly above ground surface with local clay. The clay should be shoveled carefully into the hole and compacted by tamping every foot. In some very sandy areas of the province, it may be difficult to obtain clay locally. In these areas, a one foot thick layer of bentonite or compacted clay should be placed at the 12 foot depth and the well filled with sand up to about 4 feet below ground. A second one foot layer of bentonite chips or compacted clay should be placed at this depth and the rest of the well filled with sand or, if possible, compacted clay. Mound topsoil over the well to prevent ponding of surface water and provide for some settlement.

A method for abandoning a large diameter well is shown in Figure 5.

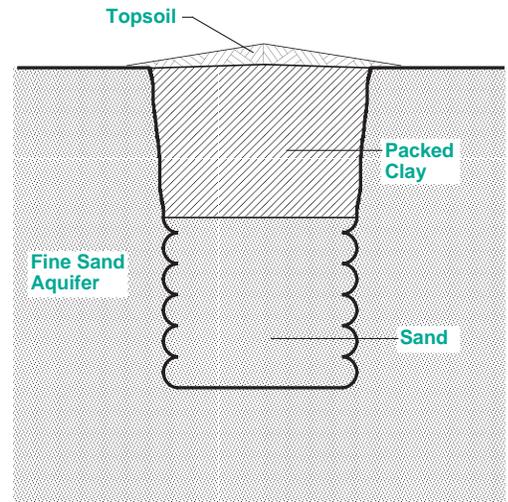


Figure 5: Typical abandonment method for a large diameter well. The native clayey materials should be tamped every foot or so.

STEP 3 - Reporting

Once the well has been filled, prepare a report on the sealing method and send it to the Manitoba Water Branch at the address provided at the end of this publication. Blank Abandoned Well Report forms can be obtained from any of the agencies listed below. The Water Branch maintains a province-wide file of all well driller's reports in Manitoba. It is important to update these records so that in future, if there are questions about the status of wells in your area, records are available as to which wells have been abandoned and the method of abandonment.

For more information contact:

Manitoba Conservation Water Branch

Box 18
200 Saulteaux Crescent
Winnipeg, Manitoba
R3J 3W3
☎ 1-204-945-7425
Fax: 1-204-945-7419

Manitoba Water Services Board

Brandon ☎ 1-204-726-6078
Dauphin ☎ 1-204-622-2116
Beausejour ☎ 1-204-268-6059

Prairie Farm Rehabilitation Administration

Beausejour ☎ 1-204-268-3233
Dauphin ☎ 1-204-638-6108
Brandon ☎ 1-204-726-7584
Morden ☎ 1-204-822-7273

You may be eligible for financial assistance in sealing your abandoned well under the Rural Water Development Program administered by the Prairie Farm Rehabilitation Administration. Contact your nearest PFRA office for information.

In addition, several **Conservation Districts** have active well abandonment programs and experience in local conditions.

Professional water well services are available from licensed **water well contractors** in Manitoba. Names and locations are listed in the yellow pages under Water Well Drilling.