Water Security Agency

Decommissioning Abandoned Water Wells

There are plenty of reasons for you to decommission an abandoned well. First and foremost, all water wells can provide a direct pathway from the surface to the aquifer, which may result in groundwater contamination. When a well is no longer in use and is not being properly maintained, the risk of contamination from the surface increases.

Once a water supply is contaminated, remediation will be costly and time consuming, and is never completely effective. In addition, there is often only one aquifer in a given area that is suitable for development. This may limit a landowner's options for securing a safe water supply once contamination has occurred.

> **Abandoned wells** are water wells that are no longer used for withdrawing water from the ground.
>
> A **decommissioned well** refers to a well that has been properly sealed to prevent the vertical movement of water.

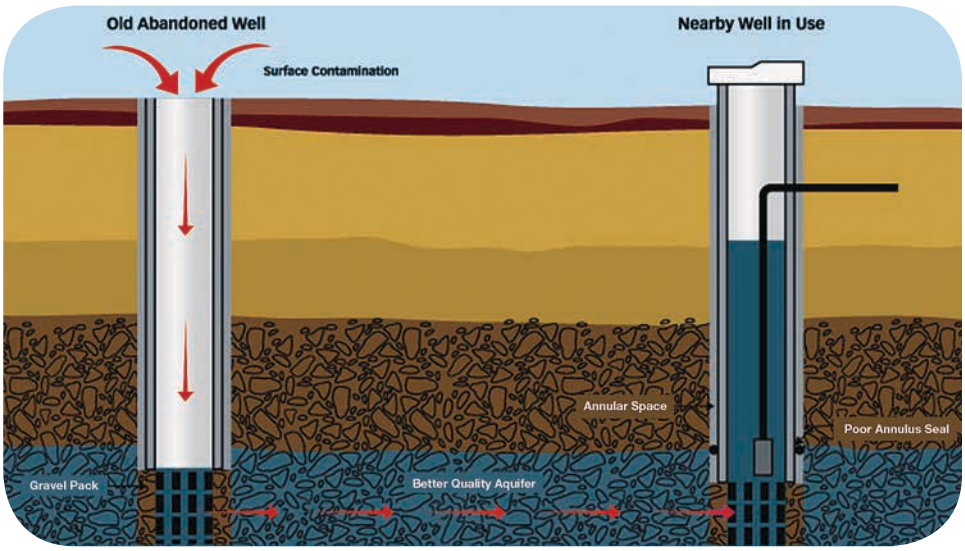
Abandoned wells (especially large diameter bored wells) also pose a significant threat to public safety as people, animals and farm machinery have been known to fall into them. Abandoned or improperly decommissioned wells can also affect property values and impede a real estate transaction.

Obviously there are numerous benefits to decommissioning any abandoned wells on your property. It will help keep your water supply safe, it removes a potential threat to your family's safety, and it reduces your liability and protects the value of your property.

As a landowner with an abandoned well, you are responsible for the proper decommissioning of that well. As stated in *The Ground Water Regulations*, "Where the well is no longer in use and is abandoned, the owner shall cause the well to be properly closed in a manner sufficient to prevent the vertical movement of water in it."

> You will need the expertise of a contractor when planning to decommission drilled wells, flowing (artesian) wells, contaminated wells, and wells located in high risk areas (in corrals, close to surface water or septic tanks, etc.).

In some situations the decommissioning of a well can be properly completed following the procedures outlined in this document. In other cases, the procedure is much more complex and requires a different methodology and specialized equipment, and should only be completed by a qualified contractor.



WELL DECOMMISSIONING - STEPS TO TAKE BEFORE STARTING

*There are four main things you need to do **before** decommissioning your well:*

1. **Disconnect the power and remove all equipment from the well.** This includes the pump, discharge piping, wiring, and any other items that have been installed. Be sure to disconnect the power to all equipment at the source before attempting to remove it.

2. **Gather as much information about the well as possible.** Two important sources of information about your well are water well driller's reports and e-logs. The Saskatchewan Water Security Agency maintains a database of driller's reports and e-logs. These reports have valuable information about the well's construction and local geologic conditions, such as depth of the well, what type of casing was used, the number and type of intake screens which were installed, and so on. This is valuable information when you are developing your plan to decommission the well.

   You can request copies of water well driller's reports and e-logs by contacting the Saskatchewan Water Security Agency Ground Water Services Branch in Moose Jaw at (306) 694-3900 or groundwater@wsask.ca.

   If no water well driller's report or e-log is available for the well in question, then you will have to base your decommissioning plan on the measurements you will collect in the next step.

Bored Well

3. **Verify the information and examine the well.** First you will need to measure the diameter of the well's casing and the height of the casing above the ground, along with the well's total depth and static (non-pumping) water level. The depth of the well can be measured by simply attaching a weight to the end of a line. Be sure to remove all possible obstructions within the casing prior to measuring the depth.

> **Bored wells** are 18 to 48 inches in diameter with fiberglass, galvanized or porous cement casing. They are relatively shallow wells completed into sands and clays. Instead of letting water in through a screen, the casing is perforated through the water bearing zone.

> **Drilled wells** vary from three to 18 inches in diameter. They are usually constructed of PVC or steel and are commonly referred to as a small diameter well. Water enters the well through a screen that is installed in the aquifer.

Special care must be taken when dealing with a well that was constructed in a well pit. Well pits are confined spaces that may contain dangerous gases and low oxygen levels.

> **Entering a well pit is a hazardous situation that can potentially result in injury or death.** Decommissioning a well located in a well pit should always be handled by an experienced contractor with training in confined space entry.

Next, take a moment to examine the well casing. If you have a copy of the driller's report for the well, confirm that the casing material specified matches the casing that was actually installed. If you don't have a copy of the report, try to determine what material the casing is made of.

Record the information you've gathered on the Well Decommissioning Worksheet attached to this fact sheet, and then compare it to the information contained in the water well driller's report and/or e-log, or with what is known about the well. If the measured depth of the well is different than what is shown on the report or than what

you anticipated it would be, then the well casing and/or screens may have collapsed. If this is the case, you may not be able to completely fill and seal the casing below the point of collapse. This may leave a void at the bottom of the well. Water will still be able to move around within this void, and it may also collapse in the future and destabilize the fill material and seals above it.

4. **Determine what materials you will need to fill and seal the well, and have them ready at the job site.** The materials and quantities you'll need will depend on what type of well is being decommissioned. Some of the suitable materials you might need include: Bentonite pellets/ chips are all processed dry forms of bentonite clay.

   Bentonite pellets or chips and powdered bentonite are processed dry forms of bentonite clay. The clay has a high swelling potential when water is applied, and is used to form a water-tight seal in the well.

   Bentonite chips are commonly available in 50 pound bags (approximately 0.7 cubic feet). The chips are graded and available in ⅜ to ¾ inch sized chips.

   Bentonite pellets are compressed and hydrate faster than chips. They are available in a variety of sizes and are commonly distributed in 50lb pails.

Drilled Well

Both pellets and chips are suitable for use below the water table. Powdered bentonite, meanwhile, is suitable for use above the water table. That is because pellets and chips are heavy enough to sink through any water present in the casing. Granular bentonite, meanwhile, is not heavy enough to sink, and will simply remain suspended on the surface of the water.

> **Bentonite** clay products should never be poured directly down a drilled well, as there is a good chance that the material will bridge partway down the casing. If that happens, it will prevent the well from being completely and properly sealed.

Clean **sand or gravel** that is free of lumps and has little silt and clay present is often used to fill the casing of bored wells. Sand or gravel must be used in combination with bentonite clay in order to properly seal the well. **Filling the casing with sand or gravel alone will not provide a low permeable seal in the casing.** A coarse sand or small gravel works well. The use of fine sand is not ideal, since this material has a tendency to float on the water surface.

Clay from a local source can be used for backfilling the top 10 to 12 feet of the excavation and for mounding over the area. This clay must be free of organic matter such as grass, roots, etc. The clay should be tamped continually to minimize amount of settling that will occur.

Grouting material, such as neat cement grout and high solids bentonite grout, must be used to decommission drilled wells.

Neat cement grout is a mixture of portland cement and powdered bentonite clay. Mixing bentonite with the cement reduces the amount of shrinkage that will occur as it hardens. The mix should contain 3-5 per cent bentonite.

High solids bentonite grout is a commercially available product that is a mixture of bentonite clay and water. The mix should contain at least 20 per cent bentonite clay (by dry weight) to be suitable for use. Both of these materials must be pumped down the well using a tremie line and applied from the bottom up.

HOW TO DECOMMISSION A WELL

The proper procedure for decommissioning a well depends on the type of well, its condition, and the hydrogeology and geology of the site. One set of ***well decommissioning*** *procedures is not suitable for all wells. The following well decommissioning procedures should only be used as general guidelines for domestic waterwells.*

More detailed procedures may be required for industrial or municipal wells.

Bored Wells

1. Disinfect the well by adding enough chlorine to bring the water present in the well to a chlorine concentration of 250 milligrams per litre (mg/l). Table 2 includes the quantity of chlorine required to achieve a concentration of 250 mg/l.
2. Pour enough bags of bentonite chips/pellets into the casing to form a one foot thick seal at the bottom of the well. The bentonite should be added slowly and evenly. The amount of bentonite chips/pellets can be calculated by multiplying the volume in a bag with the volume per foot of casing. Table 1 lists the volume of space for various casing diameters.
3. Backfill the well casing with clean granular material such as sand or gravel. Make sure the material is free of silt and fine material. If possible, tamp down the fill material. The casing should be backfilled to a depth of 10 feet below the ground surface. If the water well driller's report indicates that multiple zones have been screened then a 1 foot thick bentonite seal should be installed at the top and bottom of each perforated zone.

Example of a bentonite topseal installed during the decommissioning of bored well

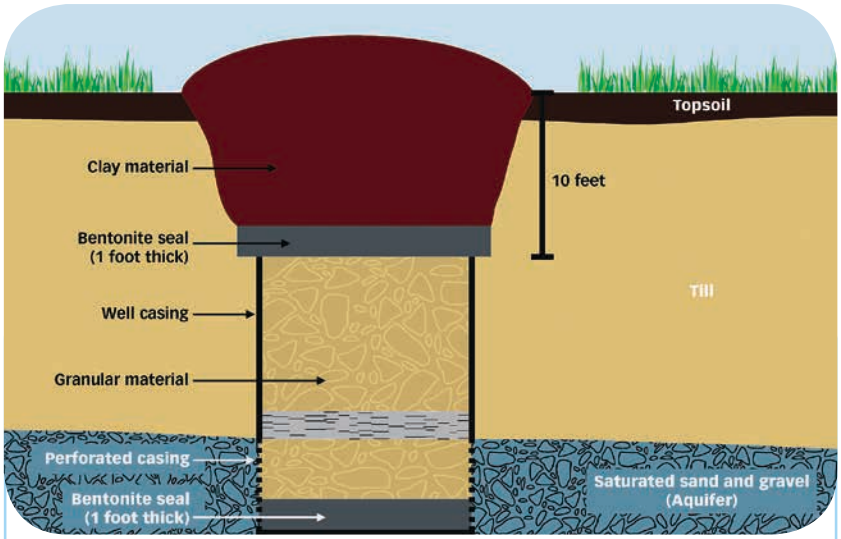


Illustration of a typical decommissioned bored well

4. If there is no water well driller's report available for the well then additional bentonite seals should be installed at 20 foot intervals.
5. Remove the remaining portion of the casing (approximately the top 10 feet) and the pitless adaptor.
6. Install another one foot thick bentonite seal. It is important that this seal extend approximately one foot beyond the outer edges of the casing to seal the top of the borehole. Bored wells are typically 42 inches in diameter. Be prepared to hydrate the bentonite if there is insufficient water present in the hole.
7. Backfill the excavation with clean, impervious material such as clay. The backfill material should be compacted at one foot intervals. The area should be backfilled beyond the outer extent of the well annulus. The area over the well should be built-up by 12 to 24 inches to allow for settling and adequate drainage away from the area.

Drilled Wells

1. As noted earlier, you will need the expertise of a qualified contractor and specialized equipment to decommission a drilled well. So your first step should be to find a contractor who will be able to assist you.
2. To properly seal the well the casing should be filled with a suitable grout up to a depth of 10 feet below ground surface. The grout must be pumped down a tremie line and placed from the bottom up in order to ensure the positive displacement of the water in the well and minimize the dilution or separation of the grout.
3. The top 10 feet of the casing and the pitless adaptor should be removed. A well cap should be permanently installed on the casing and a one foot thick bentonite seal should be installed over the capped well at the base of the excavation. It is important that this seal covers both the well casing and the annulus.
4. The excavation should be backfilled to surface with clean, impervious material such as clay. To minimize the excavation from settling the backfill should be compacted at one foot intervals.

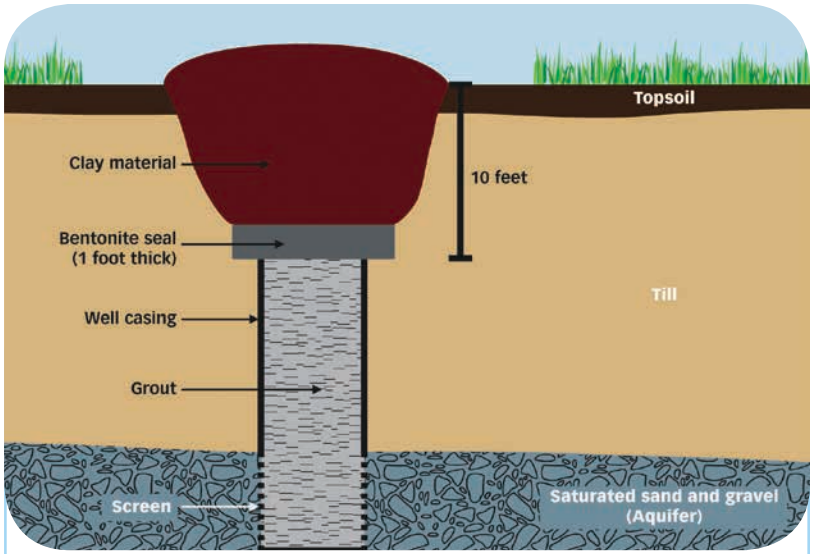


Illustration of a typical decommissioned drilled well

Table 1 – Volume Within Various Casing Diameters

Casing Diameter (Inches)	Volume per foot casing (Cubic Feet)
24	3.136
30	4.900
36	7.056
42	10.045

Table 2 – Amount of Chlorine Required to Obtain a Chlorine Concentration of 250mg/L

CASING DIAMETER (Inches)	* 5.25% Domestic Chlorine Bleach	12% Industrial Sodium Hypochlorite	** 70% Granular Calcium Hypochlorite
	Litres Needed per 1 Foot (30 cm) of Water in Casing	Litres Needed per 1 Foot (30 cm) of Water in Casing	Grams Dry Weight Needed per 1 Foot (30 cm) of Water in Casing
8	0.047 L	0.020 L	3.5 g
24	0.424 L	0.185 L	31.7 g
30	0.667 L	0.292 L	50.0 g
36	0.952 L	0.417 L	71.3 g

* Domestic bleach has a relatively low concentration of 5.25%, which decreases over time as the product is stored. For this reason, its effectiveness for disinfection may be limited.
** If dry chemical is used, it should be mixed with warm water to form a chlorine solution prior to placing in the well.

NEED MORE INFORMATION?

Call the Water Security Agency's Ground Water Services staff at (306) 694-3900, or e-mail groundwater@wsask.ca.