Water Well Decommissioning

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Key Concept:

Water well decommissioning is important in protecting groundwater supplies from contamination.

Desired Outcome:

- Understanding why unused water wells must be properly decommissioned,
- Basic understanding of what is involved in water well decommissioning, and
- Knowledge of who to contact for help

Outline:

1 Why Should Unused Water Wells be Properly Sealed?
2 How Can Unused Water Wells Threaten Groundwater?
3 Who is Responsible?
4 When Should Unused Water Wells be Sealed?
5 How Should Unused Water Wells be Sealed?
6 Challenges
7 Costs
8 Who to Contact

1 Why Should Unused Water Wells be Properly Sealed?

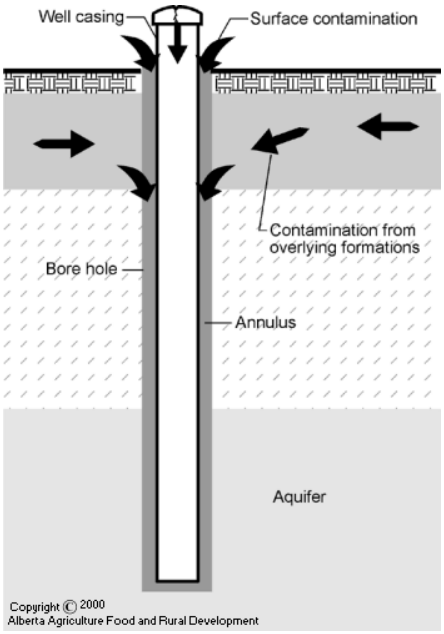
Water wells that are no longer in use pose a significant threat to groundwater quality. If not properly filled with impermeable material, an unused (abandoned) well can act as a direct conduit for contaminated surface water to enter the groundwater. Surface water that enters an abandoned well bypasses the purifying action that normally takes place in the upper layers of the soil. In many cases, a newer well has been drilled in the vicinity of an old well. Contaminants that enter old wells can move to nearby active wells. Large diameter wells pose a physical threat in that humans or animals can fall down a well that has inadequate surface protection.

2 How Can Unused Water Wells Threaten Groundwater?

Undesirable surface water or small rodents can enter the well directly through the top of the casing if the well has not been capped and if the casing pipe does not extend high enough above the ground surface. Open wells offer tempting disposal sites for liquid or solid wastes. Wells located in low areas may be subject to contamination by bacteria-laden flood waters.

Not all hazards are visible from the surface. Depending on the age and construction of the well, there may be unsealed spaces between the outside of the casing and the original

drill hole that can allow undesirable surface water to seep down alongside the casing pipe. An old well may have a rusted out casing below ground which can allow surface contaminants from septic systems, barnyards or fuel tanks to be carried by shallow groundwater into the well. Poor quality groundwater from one aquifer can mix with good quality groundwater in another aquifer through holes in the well casing or unsealed gaps along the outside of the casing pipe.



3 Who is Responsible?

In Alberta, the landowner is responsible for decommissioning a well that is no longer being used as a water supply. The only exception is that for a new installation, the drilling contractor is legally responsible for immediately decommissioning the well if it turns out that the well cannot be completed due to construction problems or inadequate yield.

4 When Should Unused Water Wells be Sealed?

A well is defined as "abandoned" when: 1) it is currently not in use, and 2) is not intended to be used in the future for water supply purposes. After wells are taken out of service they are seldom used. If cut off and buried, they can be very difficult to find at a later date for proper decommissioning, especially in the case of a property transfer. Large diameter open wells are a significant physical safety hazard. Wells should be properly filled when they are removed from service or at the time a replacement well is drilled.

5 How Should Unused Water Wells be Sealed?

The single main objective of proper well decommissioning is to restore the geology at the well site to its original condition. When this is done successfully, significant vertical movement of water within the former well bore will be prevented. A water well is said to be "reclaimed" or "decommissioned" if it is properly sealed. It is generally recommended that a licenced water well driller be hired to complete the well plugging process. A licenced water well driller has the expertise and proper equipment. Well plugging procedures must comply with Section 66 (Reclamation) of the Water Act – Alberta Ministerial Regulation 205/98. Requirements for well decommissioning vary from province to province.

The first step in decommissioning a well is to obtain information on the construction and condition of the well. Pertinent information includes: diameter of casing, year drilled, well depth, and land location. This information is useful in matching up a Water Well Drilling Report for the well which may be on file in the Alberta Environment Groundwater Information Centre database (see Session 2 – Water Well Drilling Reports). Any information on why the well is no longer in use, whether or not the pump has been removed or if a pump jack had ever been installed, knowledge of previous attempts to plug the well and a recent static water level reading could prove to be very helpful to the decommissioning process.

There may be cases where a landowner is aware that a well exists on a property but the well casing is not visible at ground surface. It's important to note that for proper decommissioning to occur, the well casing will need to be accessible. In the past, wells were commonly constructed in concrete vaults or basements to provide protection against freezing. Old wells are also likely to be located below out-of-use windmills. A well that has been cut off, capped and buried can be exposed with a backhoe or shovel. A metal detector is helpful, as is any historical information that can be used to pinpoint the location of the well such as old photographs or knowledge of previous landowner(s).

The initial on-site procedure for decommissioning an unused water well involves setting up a drill rig over the well, removing the pump, liner casing and any obstructions from within the well casing, sounding the well depth to ensure that it is clear to bottom, thoroughly flushing and cleaning the well of all foreign materials and disinfecting the well with a 200 mg/L chlorine solution. Ideally the surface casing should be removed from the well before the plugging process begins. The well casing may be left intact if it is too difficult to remove or subject to tearing apart near surface due to the age of the casing material. A downhole camera can be used to investigate the condition of the inside of the casing or the type of obstruction, if present. Obstructions can be retrieved by hooking on/pulling or by drilling them out. If the surface casing is left in place, the inside of the casing should be ripped or mechanically perforated at several locations to

allow the subsequent grouting process to squeeze out and fill any gaps that may be present along the outside of the casing.

Materials that are used to seal a well must be impervious. Sand and gravel are not acceptable materials because water can easily move through them. Bentonite grout is one of the most common materials used to seal wells. It can be mixed as a slurry and pumped into the well. Cement (no aggregate) is another material that can be used particularly if natural gas is present in the well. Cement grout sets up structurally stiff and is hard whereas bentonite grout remains in a semi-solid or plastic state. Large diameter bored wells (typically 600 – 750 mm diameter) are usually filled with clean, uncontaminated clay due to the large volume of material required. Other acceptable materials that prevent vertical movement of water include manufactured bentonite pellets (chips) and concrete.

The grouting process involves lowering metal tremie pipe, plastic pipe or drill stem to the bottom of the well from the back of a rig or a grout truck, mixing up a batch of grout and pumping the slurry into the well from the bottom up until the well is completely filled. The tremie line may be pulled up as the well is filled but the bottom of the tremie pipe must be kept submerged in the material during filling. Water in the well will be displaced by the grout. Pouring or dumping the filling material into the well from the top or through a tremie pipe that is not long enough could cause the plugging material to become diluted or bridge off in the well part way down. If dilution occurs, the fill material will not be impermeable. If bridging occurs, the well will only be partially filled.

Lifewater Drilling Grouting Unused Well near Wrentham, AB
Photo Courtesy of AAFC-PFRA, Medicine Hat

The only exception to pumping material down a well is to use coated bentonite pellets (chips). They are designed and manufactured for the purpose of being introduced into the well from the ground surface. These pellets have a weight material added to ensure they

sink to the bottom of the hole. They are also coated to prevent swelling on contact with water. When poured slowly into the well, they reach the bottom before swelling and closing off the hole. If poured too quickly, bridging can occur where the bore hole closes off some distance above the bottom of the hole. When pouring bentonite chips into small diameter wells, the chips should be poured over a 6 mm (1/4 inch) screen to allow the fines to drop out before reaching the well opening.

Finally, if the casing was not already removed, it should be cut off a minimum of 0.5 m below the ground surface and covered with compacted clay.

6 Challenges:

Obstacles such as overhead power lines can be managed. The power company will need to be contacted in advance to shut off the power. Arrangements will also need to be made for alternate power supply during the decommissioning procedure. Wells located in pits can be safely worked on by extending the casing to ground surface and filling in the pit prior to the well plugging procedure. Small buildings can be removed to provide access to wells, however large buildings may prevent access by a drilling rig.

One of the greatest challenges for properly decommissioning a well occurs when the well casing cannot be pulled and there is an obstacle encountered within the casing that cannot be removed or drilled out. Hollow stem auger overdrilling, which involves fitting auger flights over the casing and drilling out the formation around the casing, could be considered at this stage but the costs can be quite expensive.

Flowing wells present special problems for plugging but can be properly sealed off. Before a flowing well can be plugged, the flow must be controlled, often by introducing high specific gravity fluids into the well. It is best to use the services of a licenced water well driller with experience in plugging flowing wells.

7 Costs:

Costs of water well decommissioning vary widely because there are many factors involved. Water well drillers usually charge a mobilization fee to cover the costs of travel to the site with their equipment. The drilling rig is then charged out at an hourly rate for the time needed on site. This rate may include other equipment such as a water truck. There can also be charges for manual labour (hourly) and materials per bag or per kg. Water well drillers may be reluctant to quote an exact price for the work beforehand because of the unpredictable nature of the work, however the rates for drill rig, labour and material can all be established prior to well plugging. The final cost of decommissioning the well would then depend on the actual drill rig time, labour and material needed. The time spent with the drill rig is usually the largest component of the cost.

8 Who to Contact:

For water well driller's reports:

Alberta Environment
Groundwater Information Centre
11th Floor, Oxbridge Place
9820 – 106 Street
Edmonton, Alberta
T5K 2J6
Phone: (780) 427-2770
http://www.telusgeomatics.com/tgpub/ag_water/

Who to Contact for Help:

Local well drillers - Check phone directory (yellow pages) under "Water Well Drilling"

Alberta Agriculture, Food and Rural Development
Water Specialists

Edmonton	(780) 427-2963
Grande Prairie	(780) 538-5606
Red Deer	(403) 340-5324
Lethbridge	(403) 381-5846

Alberta Environment – Regional Offices

Calgary	(403) 297-7602
Edmonton	(780) 427-7617
Lethbridge	(403) 382-4254
Red Deer	(403) 340-7052
Spruce Grove	(780) 960-8600

Agriculture and Agri-Food Canada
Agri-Environment Services Branch (Prairie Farm Rehabilitation Administration) - District Offices

Lethbridge	(403) 327-4340	Vegreville	(780) 632-2919
Medicine Hat	(403) 526-2429	Westlock	(780) 349-3963
Hanna	(403) 854-4448	Peace River	(780) 624-3386
Red Deer	(403) 340-4290	Dawson Creek, BC	(250) 782-3116

REFERENCES

Alberta Agriculture Food and Rural Development, Water Wells that Last for Generations, 1996.
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/wwg404?opendocument

International School of Well Drilling
http://www.welldrillingschool.com/courses/pdf/WellAbandonment.pdf

Wisconsin Department of Natural Resources, Bureau of Drinking Water and Groundwater http://www.dnr.state.wi.us/org/water/dwg/abandon.htm