

Abandoned Wells

Abandoned wells are wells that are no longer in use. Over the years, many wells and test holes around homes and farms throughout the province have been abandoned without being properly sealed and decommissioned. Abandoned wells or improperly decommissioned wells can pose a serious threat to groundwater quality and can also be a safety hazard. Therefore, all abandoned wells should be properly plugged to prevent contamination and to eliminate any safety hazards. When a replacement water well is drilled, the old well should be plugged.

Abandoned wells:

- Can allow surface runoff to directly enter an aquifer, contaminating the aquifer and potentially contaminating nearby wells.
- Can permit cross-contamination of different aquifers encountered by the well bore.
- Can be a physical safety threat, as they are often not marked or covered, and can pose a hazard to people or animals that might fall into them.



Figure 26: Bull in Well

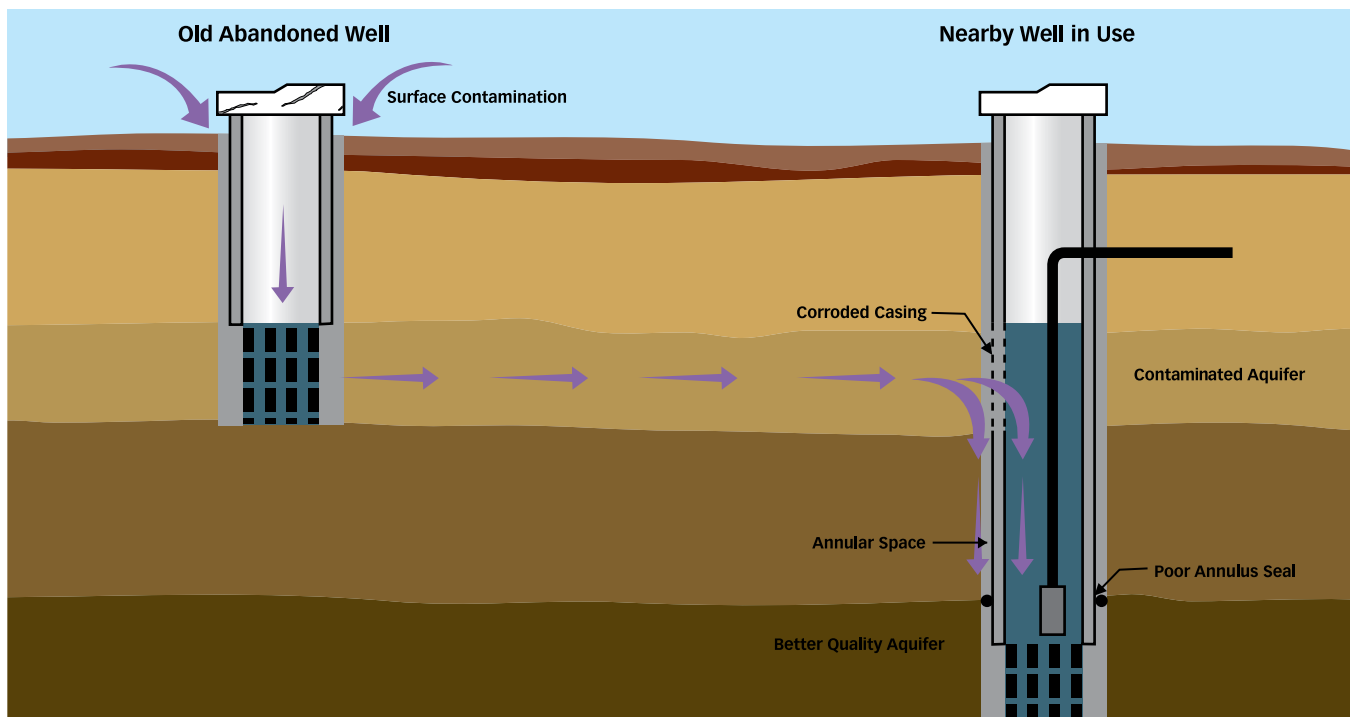


Figure 27: Contamination from an Abandoned Well

The same negative impacts can occur from test holes. For this reason, proper abandonment of test holes is also critical to the protection of groundwater quality.

When a well is abandoned after the date of completion, the owner is immediately responsible for filling and sealing the well with suitable uncontaminated material in a manner as to prevent the vertical movement of water in the well. It is recommended that a well owner hire a registered drilling contractor to ensure that the well is properly decommissioned. A well contractor will have access to the necessary equipment, as well as an understanding of correct abandonment materials and procedures. Unless the right materials are used and are properly placed in the well, the well will be poorly sealed and may continue to allow contaminants to reach the groundwater.

Decommissioning Abandoned Wells

Procedures

Well decommissioning procedures vary, depending primarily on well construction, hydrogeology and the geology of the site. One set of well decommissioning procedures is not suitable for all wells. The following decommissioning procedures should only be used as general guidelines. Site-specific conditions will dictate the exact procedures that should be followed to properly decommission the well.



Figure 28: Abandoned well

Decommissioning procedures:

- **Removal of well equipment** (pumps, drop pipe, wiring, etc.)
- **Well Characterization** – the depth, diameter and non-pumping (static) water level of the well should be recorded. This information is used to calculate the amount of materials required to decommission the well. It can also be used to compare the original depth to the current depth of the well and determine if a portion of the well has collapsed or if an obstruction exists within the well column. If an obstruction does occur within the well, it should be removed prior to sealing the well whenever possible.
- **Disinfection** – enough chlorine should be added to bring the standing water in the well to a chlorine concentration of 250 mg/L. The amount of chlorine to be added will depend on the casing size and the amount of water in the well. The table on the following page will help determine the quantity of chlorine that should be added to achieve a concentration of 250 mg/L when using either 12% sodium hypochlorite, 70% granular calcium hypochlorite, or 5.25% household bleach. This chlorinated water is to be left in the well.
- **Remove casing** – the casing should be removed prior to plugging the well whenever possible, but only if the integrity of the borehole will not be affected. Removing the casing in domestic wells that have been in place for a substantial period of time is often very difficult. Any casing that is left in place should be cut off three meters (9.85 ft) below ground surface after the well is sealed.
- **Filling and sealing** – the most preferred materials for sealing wells are low permeability materials that prevent the vertical movement of water. Generally the best product for this purpose is a manufactured bentonite product (chips, pellets or grout). However, in some cases it may be acceptable to use a combination of bentonite, clay and granular material. The effectiveness of well decommissioning in maintaining the quality of groundwater is determined by the placement of these low permeable materials in key portions of the well. The table on page 33 provides volume calculations for filling the well.

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

Casing diameter		Volume per 1 foot (30 cm) of casing	* 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
inches	meters	Litres	Litres	Litres	Grams
4	0.100	2.47	0.012	0.005	0.9
5	0.125	3.86	0.018	0.008	1.4
6	0.150	5.55	0.026	0.012	2.0
7	0.175	7.57	0.036	0.016	2.7
8	0.200	9.89	0.047	0.020	3.5
24	0.600	89.00	0.424	0.185	31.7
30	0.750	140.00	0.667	0.292	50.0
36	0.900	200.00	0.952	0.417	71.3

* Domestic bleach has a relatively low concentration of 5.25%, and after sitting on store shelves, this concentration may decrease further. For this reason, its effectiveness for disinfection may be limited.

** If the dry chemical is used, it should be mixed with water to form a chlorine solution prior to placing it in the well.

For example, if the well is 30 inches in diameter and 12% Industrial Sodium Hypochlorite is to be used, 0.292 L of the chemical will need to be added per foot of water in the casing in order to obtain a chlorine concentration of 250 mg/L. If there is 20 feet of water in the casing, a total of 5.84 L of 12% Industrial Sodium Hypochlorite will be required (0.292 L/ft. x 20 feet = 5.84 L).

Volume Calculation for Well Decommissioning

Casing diameter	Radius casing	Radius casing	Volume per meter casing	Volume per foot casing	Volume per foot casing	Volume per foot casing
inches	inches	meters	Litres	gallons	cubic feet	cubic yards
4	2	0.0508	8.1	0.544	0.087	0.0032
5	2.5	0.0635	12.7	0.851	0.136	0.0050
6	3	0.0762	18.2	1.225	0.196	0.0073
7	3.5	0.0889	24.8	1.667	0.267	0.0099
8	4	0.1016	32.4	2.178	0.348	0.0129
24	12	0.3048	291.9	19.600	3.136	0.1161
30	15	0.381	456.0	30.625	4.900	0.1815
36	18	0.4572	656.7	44.099	7.056	0.2613

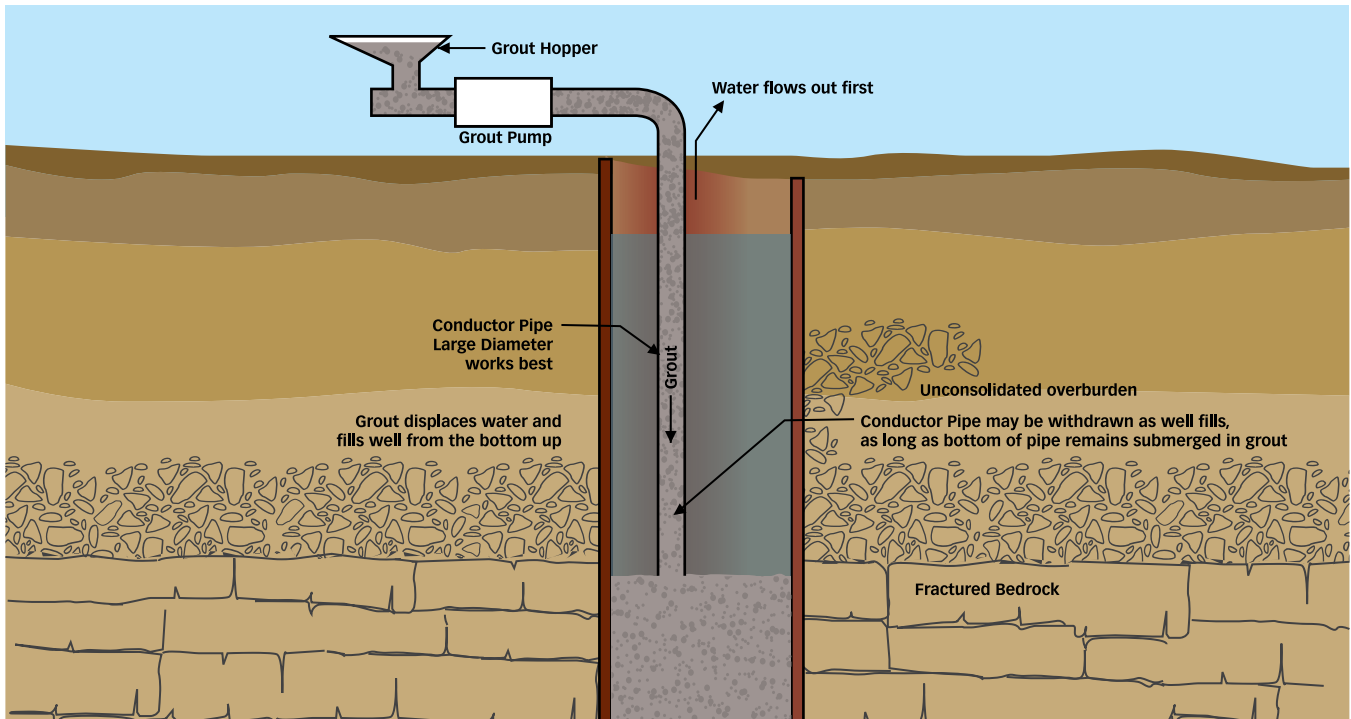


Figure 29: Pumped Method for Well Abandonment

Small Diameter Wells (drilled)

Small diameter wells should be decommissioned with a grout seal. The grout must be introduced at the bottom of the well and placed progressively upwards to ground surface. The use of a grout pump and tremie pipe is the preferred method for placing the grout. This will ensure the positive displacement of water in the well and minimize dilution or separation of the grout. The tremie pipe should be removed after the well has been grouted.

Large Diameter Wells (bored)

These wells are usually 0.3 meters (12 in.) to 1.2 meters (48 in.) in diameter and less than 30 meters deep.

A 0.3-meter (12 in.) layer of bentonite chips/pellets should be placed at the bottom of the well. The remainder of the well should be backfilled to a depth 3 meters (120 in.) below the ground surface with layers of uncontaminated coarse sand/gravel not more than 3 meters (120 in.) thick, with a 0.15 meter (6 in.) layer of bentonite chips between backfill layers.



Figure 30: Filling the well with uncontaminated coarse sand or gravel

- **Remove casing and capping** – casing that was left in place before sealing the well should be removed to a depth 3 meters (120 in.) below ground surface. The excavation should be backfilled with local uncontaminated clay, compacted and mounded to prevent water from ponding near the abandoned well site.



Figure 31: Removal of well casing

Flowing wells have unique characteristics and should only be decommissioned by an experienced water well contractor.

The effectiveness of the well decommissioning procedures in protecting groundwater from surface contamination is primarily determined by the method used to decommission the well and the materials used to seal the well. Exact procedures may differ for each circumstance, which is why it is important that the person responsible for performing the well decommissioning be knowledgeable about well construction practices and good groundwater protection principles.

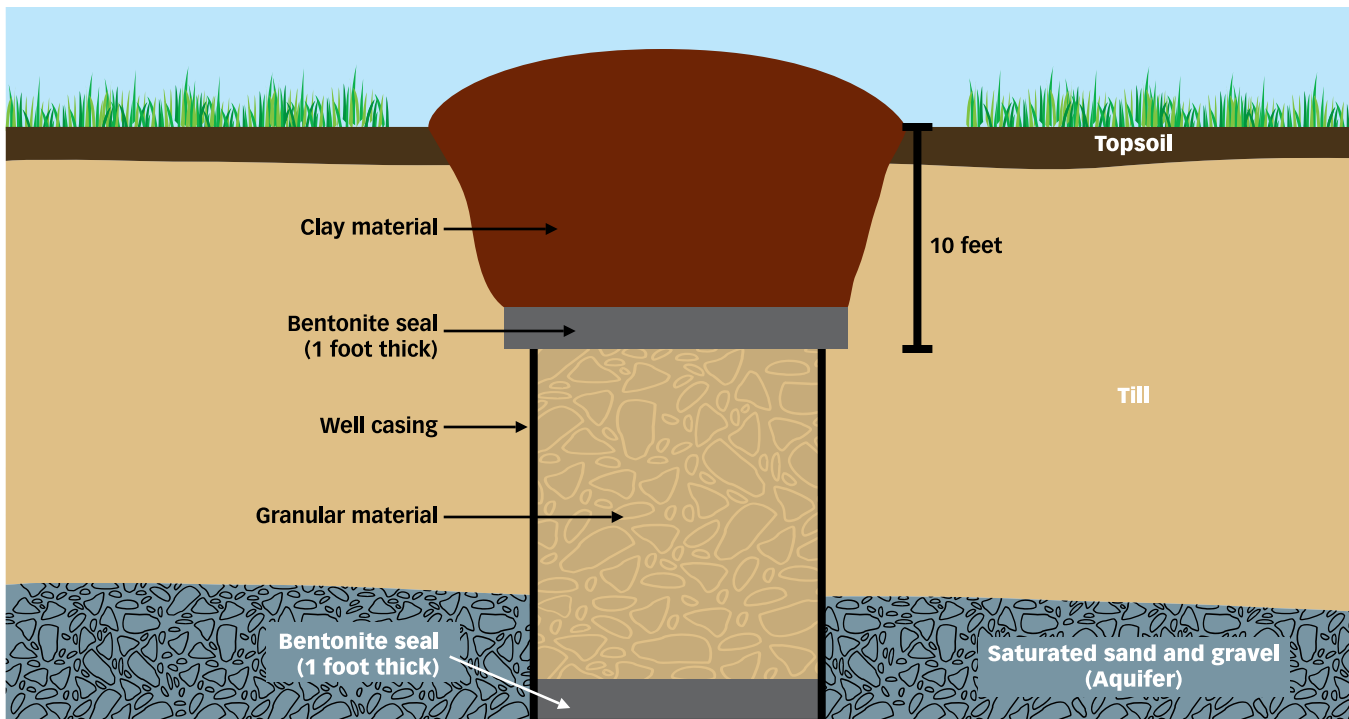


Figure 32: Well decommissioning for large diameter wells