Troubleshooting Water Well Problems

Causes of well problems | Troubleshooting guide

Water well problems result from many causes including equipment failure, depletion of the aquifer, corrosive qualities of the water and improper well design and construction. Correctly identifying the cause enables you to select appropriate treatment or maintenance to fix the problem rather than abandon the well. This troubleshooting module is designed to help you recognize the symptoms of the problem, identify the cause and select the appropriate course of action. Technical assistance from drilling contractors or groundwater consultants may be valuable. See Module 11 "Contacts for More Information."

Causes of Well Problems

There are several basic causes of well problems.

- Improper well design and construction
- Incomplete well development
- Borehole stability problems
- Incrustation buildup
- Biofouling
- Corrosion
- Aquifer problems
- Overpumping.

The first two causes relate to the expertise and performance of the drilling contractor. Borehole stability problems, incrustation, corrosion and aquifer problems are related to characteristics of the aquifer. The last cause, overpumping, is caused by well users.

Exercise
List any problems or symptoms with your well.

_____
_____
_____
_____
_____

Improper well design and construction
When designing a well, the drilling contractor must match the type of well construction with the characteristics of the producing aquifer. A well screen is a slotted column beneath the well casing that blocks fine sand particles from traveling with the water through the pump. Decisions must be made about:

- Perforated well casing/liner vs. well screen (see Figure 1, Perforated Well Liner and Well Screen)
- Slot size of well screen
- Placement of well screen or perforated liner
- Size and amount of sand pack around the well screen (if required)
- Location of the pump in the well.

If poor choices are made, you may experience problems with sediment in your water or reduced well yield. Provincial regulations require that a well must be completed to ensure no damage will be incurred to the pumping

system, plumbing or fixtures due to sediment in the water. For more information on well design and construction, see Module 3 "Design and Construction of Water Wells."

Incomplete well development

During drilling, mud and bore hole cuttings can partially plug the aquifer. This material must be fully removed by the drilling contractor to allow water to freely enter the well. This procedure is part of well development. If the well has not been fully developed, you may experience problems with sediment in your water or low well yield.

Borehole stability problems

Borehole stability problems can result from damaged casing and screens, borehole wall collapse, corrosion or excessive water velocities into the well. High water velocity can cause formation particles, like sand, to flow into the well, causing eventual collapse of the borehole wall.

It is essential that the proper materials be selected and installed to avoid such problems. A combination of poor materials, improperly placed screens and a poor well seal make it uneconomical to maintain and restore such a well. Often the most cost effective solution is to drill a new well that is properly designed and constructed.

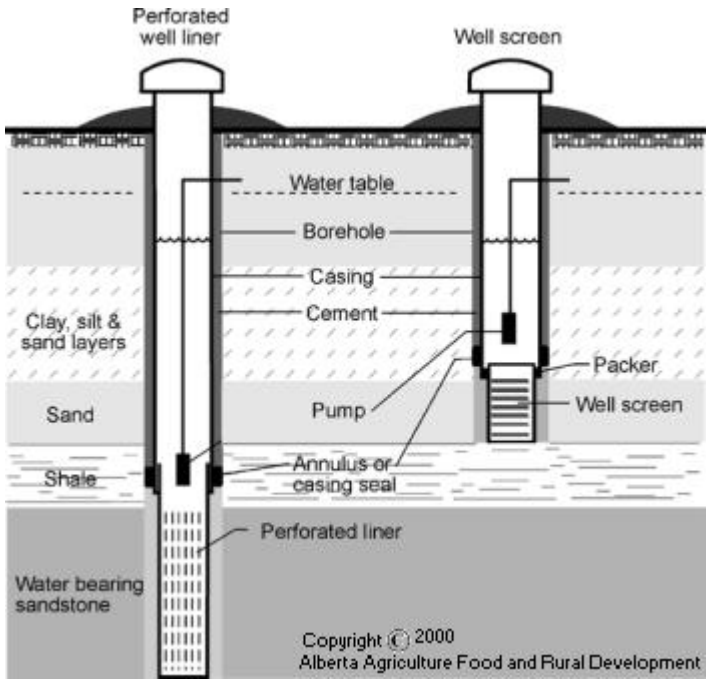

Figure 1: Perforated Well Liner and Well Screen

Mineral incrustation

Mineral incrustation is a common problem in some shallow water table type aquifers where there is an abundance of dissolved minerals including calcium, magnesium and iron, as well as iron bacteria. When water is pumped from the well, changes in pressure and temperature occur. This creates ideal conditions for minerals to precipitate or settle out, causing scale formation on the casing, liner and screens. Although incrustation or scale formation occurs mostly in the screen or slotted casing, it can also affect the formation around the well.

A combination of good preventive maintenance and good management practices can minimize the effect of incrustation. Management practices that reduce water pumping rates can reduce the effects of mineral incrustation. A strategy of reduced pumping rate with longer pumping intervals helps prevent incrustation of screens and perforated liners.

Biofouling

Installing and pumping a well increases the level of oxygen and nutrients in the well and in the surrounding aquifer. Bacteria, such as iron bacteria, may thrive under these conditions. They can form a gel-like slime or biofilm that captures chemicals, minerals and other particles such as sand, clays and silts. Minerals, such as iron, oxidize and get trapped in the biofilm. "Biofouling" occurs where biofilm accumulations are sufficient to reduce water flow. This can mean reduced well yield and water quality.

Regular shock chlorination can reduce the buildup of biofilms.

Corrosion

Chemical substances found in water can eat away or corrode metal well casings. To avoid corrosion, the drilling contractor must choose a casing material that is suitable for the water supply. For example, drilling contractors usually select plastic casing liners and stainless steel well screens for corrosive water.

Aquifer problems

While most well problems are related to the construction, development or operation of the well, the formation can also be a source of problems. Sulfate-reducing bacteria can also cause corrosion. Shock chlorination can keep these bacteria in check.

Reduced aquifer yield can be caused by lack of recharge. For example, the

amount of water withdrawn can exceed the recharge from rain and snow melt. This is referred to as "mining the aquifer." Sometimes the decline in water level is seasonal. Typically water levels are higher in spring and lower in the fall. Extended dry periods can also impact water levels, especially in shallow water table type aquifers.

Checking the water level in your well is an important maintenance procedure. You will be able to identify water level trends and identify well problems or aquifer depletion before the problem becomes serious.

Overpumping

A well is overpumped if water is withdrawn at a faster rate than the well was designed for or the aquifer is able to produce. Overpumping is the most common well problem that leads to premature well failure. Overpumping not only depletes the groundwater aquifer (or source), but it rapidly increases the rate of corrosion, incrustation and biofouling related problems. Overpumping also increases the rate of sediment particles moving toward the well, causing plugging of the perforated area where water flows into the well. It can also cause the aquifer to settle and compact which further restricts water flow to the well.

If you are pumping water at a rate close to the well's capacity, excessive pump cycling can increase the problem of biofouling.

Now go back to the exercise at the start of this module. Try to identify possible causes for each problem you identified.

Troubleshooting Guide

There are four common symptoms associated with most water well problems:

- Reduced well yield
- Sediment in the water
- Change in water quality
- Dissolved gas in the water.

The guide on the next four pages refers to these four symptoms. To use the guide, find the section that identifies the symptom you are experiencing. Look down the left hand column for possible causes of the problem. Beside each cause is listed some indicators you can check for and ways to correct the problem.

Be aware that in many cases the well problem can be the result of a combination of causes and therefore correction may be a combination of actions as well.

Symptom # 1 - Reduced Well Yield

Possible causes:	What to check for:	How to correct:
Pump and/or water system	Low pump production in spite of normal water level in well. Leak in system; worn pump impeller.	Have a licenced drilling contractor/pump specialist or plumber check the pump and water system.
Aquifer depletion - rate of withdrawal exceeds rate of recharge -periods of drought can	Compare current non-pumping static water level with the level at the time of well	Reduce the water use. Install cistern to meet peak water requirements. Drill a deeper well or one

temporarily deplete shallow groundwater zones	construction. A lower level confirms aquifer depletion. Contact Provincial Government groundwater agency to see if water levels are declining.	that taps into another aquifer.
Biofilm buildup in well casing, well screen or pump intake.	Slime buildup on household plumbing fixtures and livestock waterers. Inspect pump and use down-hole camera to check for slime build-up.	Shock chlorinate the well and water system as required—usually once or twice a year. See Module 6 "Shock Chlorination—Well Maintenance."
Neighboring well interference.	Check for significant drop in water levels in nearby wells. Contact Provincial Government groundwater	Identify other nearby wells located in the same aquifer. Reduce pumping rates as required.

	agency to determine if groundwater use in the area has decreased.	
Mineral scale (incrustation) buildup on perforated well casing, well or pump screen.	Scale formation on plumbing fixtures and livestock waterers. Inspect pump. Use down-hole video camera to check for mineral build-up. Calculate the Ryznar Stability Index to determine the water's incrusting potential.	Once the type of mineral scale has been identified, the well should be cleaned by a licenced water treatment specialist. Treatment could include both physical agitation and chemical/acid treatment..
Sediment plugging on outside of perforated casing or screen.	Sediment in water, followed by sudden decline in yield.	Have a licenced drilling contractor redevelop the well.
Collapse of well casing or borehole due to age of well.	Compare current depth of well with original	Recondition the well. If repair is not economical, plug the

	records. A collapsed well will show a shallower depth than the original well.	well and redrill. See Module 9 "Plugging Abandoned Wells" for more information on plugging a well.

Symptom #2 - Sediment in Water

Possible causes:	What to check for:	How to correct:
Improper well design or construction.	Sediment appears in water shortly after well completion. Remove pump and use down-hole video camera to inspect well casing and screen.	Have a licensed drilling contractor repair the construction problem.
Insufficient well development after construction.	Sediment appears shortly after well completion. Well production may improve with pumping.	A licensed drilling contractor should redevelop the well.
Continuous overpumping of well.	Sediment appears in water shortly after well completion.	Compare current discharge rate of well with the driller's recommended rate. If the current flow rate is higher, install a flow restrictor on pump. If required,

		install cistern to meet peak water requirements.
Corrosion of well casing, liner or screen causing holes.	Sudden appearance of sediment in water when there was no previous problem. Often coupled with a change in water quality. Calculate the Ryznar Stability Index to determine the water's corrosion potential.	Consult a licensed drilling contractor. Depending on the well construction, repair or replace well. Alternate construction materials may be required.
Failure of the annulus or casing seal.	Sudden appearance of sediment, coupled with a change in water quality.	Consult a licensed drilling contractor. It may be possible to re-establish the seal. Test water quality regularly and investigate when quality changes occur.

Symptom #3 - Change in Water Quality

Possible causes:	What to check for:	How to correct:
Corrosion of well casing, liner or screen,	Change in water quality, often	Consult with a licensed drilling contractor about possible

causing holes. Holes can allow water of undesirable quality to enter the well.	coupled with sudden appearance of sediment in water. Calculate the Ryznar Stability Index to determine the water's corrosion potential.	repair. Alternate construction materials may be required.
Failure of the annulus or casing seal.	Change in water quality and possible appearance of sediment.	Consult with a licensed drilling contractor about possible repair.
Iron bacteria or sulfate-reducing bacteria (biofouling).	Change in water quality such as color, odor (e.g., rotten egg) or taste. Check inside of toilet tank for slime buildup and inspect pump. (See note 2 below)	Shock chlorinate the well. For more information on shock chlorination, see Module 6 "Shock Chlorination—Well Maintenance." (See note 1 below)
Contamination from man-made sources.	Changes in water quality as indicated by	Identify and remove contamination source. Have water analyzed through local

	color, odor or taste. Compare results from regular water analyses for changes. (See note 3 below)	health unit to ensure it is safe to drink.
Limited Aquifer Extent/Reduced Aquifier Recharge	Increase in constituents such as hardness, iron, manganese and sulphate. Compare results from original water analyses for changes. Taste and colour changes in the water may also occur.	For surficial aquifers trapping snor or impounding surface water can enhance aquifer recharge and improve water quality.

Symptom #4 Dissolved Gas in the Water

Possible causes:	What to check for:	How to correct:
Dissolved gases in well water including: • carbon dioxide • methane	Spurting household water taps Milky color to the water which lasts only a few seconds Cautions:	For low concentrations of gas: • Install an air volume release valve on the

	1. Carbon dioxide is an asphyxiant 2. Methane can be flammable and explosive	pressure tank, if the tank does not have an air bladder. Also ensure the tank is properly vented outside of building. • Spray water from the well into a sealed storage tank that is properly vented to the outside. For higher concentrations of gas: • Determine the depth that the gas is entering the well. • If possible, lower the pump intake to below where the gas is entering. A licensed drilling contractor could install a plastic

		gas-sleeve over the pump intake so the gas will be forced out of the water as it enters the intake. The gas will accumulate at the top of the well, so properly vent the well head so the gas is directed to the outside.
Malfunctioning pump or overpumping the well.	Refer to troubleshooting guide for your particular pumping system. Compare the rate at which you are pumping the well with the rate recommended by the driller.	Have a licensed drilling contractor/pump specialist or plumber check the pump and pressure system equipment for malfunction. Make sure that any new pumping equipment is sized correctly to meet the production capability of the well. Reduce well pumping rate if necessary and install cistern to meet peak

		water requirements.

1. Shock chlorination is effective as a regular maintenance technique to kill bacteria and limit its ability to create biofilm. However, shock chlorination is not effective at penetrating biofilm. If biofilm buildup is suspected, the introduction of appropriate chemicals and physical agitation is required to remove the biological plugging material. Studies conducted as part of the Sustainable Water Well Initiative have shown that preventative maintenance should be applied before a biofouled well has lost about 20 percent of its original specific capacity and well rehabilitation should be conducted before the specific capacity has declined 40 percent. Also, once the specific capacity of a biofouled well has declined 60-80 percent from its orginal specific capacity, it becomes increasingly difficult to restore the well's original specific capacity (City of North Battleford Well Treatment Evaluation report: http://www.agr.gc.ca/pfra/water/uab/nb00rpt.pdf; Town of Qu'Appelle Well Treatment Project: http://www.agr.gc.ca/pfra/water/swwi/qawell5.pdf).
2. The presence and aggressiveness of nuisance bacteria, such as iron-related (IRB), sulfate-reducing bacteria (SRB) and heterotrophic bacteria (HAB), can be determined by the use of Biological Activity Reaction Tests (BARTs). These bacteria are naturally present in most groundwater environments and can result in biofouling of the water well and associated infrastructure. Studies conducted as part of the Sustainable Water Well Initiative (SWWI) have shown that about 70 percent of wells in any given area may contain highly aggressive levels of these nuisance bacteria (Rural Municipality of Mount Hope #279 Water Well Inventory and Microbiological Assessment: http://www.agr.gc.ca/pfra/water/swwi/rmmh279.pdf; Biofouling and

Water Wells in the M.D. of Kneehill, Alberta: http://www.agr.gc.ca/pfra/water/knee_e.htm; Microbiological Activity and the Deterioration of Water Well Environments on the Canadian Prairies: http://www.agr.gc.ca/pfra/water/swwi/iah2000t.pdf). Another SWWI study indicated that wells with high levels of nutrients, such as dissolved organic carbon (DOC) and nitrates, in the source water are at a greater risk of biofouling than wells with low levels of nutrients (Sustaining Water Well Infrastructure in an Agricultural Setting – Rural Municipality of Mount Hope: http://www.agr.gc.ca/pfra/water/swwi/MountHope.pdf). The factors that cause or accelerate water well biofouling are not well understood and additional research is still required in this area. Well capture zone studies are recommended to investigate the factors that may contribute to biofouling.

3. In many cases, variations in water quality will not result in observable changes in odor, taste or color. For instance, in situations where nitrate levels are increasing, there may be no apparent change in the odor, taste or color of the water. In addition, an increase in nitrate levels may also signal the presence of coliform bacteria or other pathogenic bacteria. A SWWI field study indicates that wells with high levels of nitrates often have high levels of coliforms (Sustaining Water Well Infrastructure in an Agricultural Setting – Rural Municipality of Mount Hope: http://www.agr.gc.ca/pfra/water/swwi/MountHope.pdf). New technologies are available that permit rapid onsite testing of coliform bacteria. A SWWI study, conducted in partnership with Saskatchewan Health, evaluated a new and innovative technology that can be used to determine the presence of coliforms and E. coli in drinking water (Evaluation of the Aquasure Pro 3000 Single Test Precision Portable Incubator Technology:

http://www.agr.gc.ca/pfra/water/swwi/aqua3000.pdf)