Monitoring Your Water Well

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Preserving the water source on your farm or acreage is as vital as preserving the quality of your soil.

When we think of factors that limit farm production, what come to mind are land base, finances, time and energy. What doesn't always come to mind is how necessary water supplies are. Imagine having to reduce the size of a cattle herd or not being able to water your horses because of a lack of water. Water is key to our quality of life as well. Waiting an hour to take a bath or not having enough water to serve two bathrooms would be a change for many families.

Proper care and maintenance of your water source are key to protecting your water supply. An effective monitoring program will identify changes in water levels and water quality before they become serious problems. Just like a vehicle needs an oil change, tune up and inflated tires to run properly, your well needs to be monitored, checked and cared for. Regular, systematic inspections and treatment of problems will help a well to "last for generations". A drilling contractor may be required at times.
In this module you will learn several methods of monitoring your well. A worksheet where you can record your own information is included at the back.

The first step in preventative maintenance of your well is taking some simple measurements. Two measurements that you need to take on a routine basis are:

- Water level measurements
- Water quality measurements.

In some areas of Alberta, up to one-third of the new wells licensed are considered marginal or poor. Monitoring and maintaining these wells is key to maximizing the water available and preserving the quality.

Water Level Measurements

Taking water level measurements on a regular basis will tell you whether water levels have changed significantly. In turn, this can help you spot the following problems:

- Pumping the well at a greater rate than the aquifer is capable of producing (depleting the aquifer)
- Plugged screen (or slotted casing) which can diminish the well's efficiency and production rate
- Disturbance of the aquifer during the construction of sewers, drainage ditches and road cuts
- Reduced groundwater recharge due to land clearing and surface water drainage.

Take a water level reading monthly or quarterly as shown in the example below. Note in the example that readings were taken both with the pump on and the pump off. Readings taken with the pump on will alert you to any problems with the efficiency of the well (for example, a plugged screen). Readings taken with the pump off will alert you to any problems with the aquifer and the quantity of water available for pumping.

Water Level Measurements Example					
Month	**Water Level**	**Time**	**Pumping**	**Non-pumping**	**Comments**
Jan.	3.28 m	6:00 am			
Feb.	4.30 m	7:45 am			
March	3.31 m	6:10 am			
April	4.27 m	7:55 am			
May	3.26 m	6:00 am			

How to Measure Water Levels

There are several devices and methods for measuring water levels:

- Dip tube
- Water well sounder
- Air line method.

Dip tube

A dip tube can be constructed using a minimum 18 mm (3/4 in.) plastic pipe or hose that is lowered into the well, to below the pumping water level. It should be taped to the pump line with electrical tape and have a capped bottom with two, 6 mm (1/4 in.) holes perforated on the bottom to let water in and out, allowing it to fluctuate identically to the water inside of the well. The dip tube should extend to 1.5 m (5 ft.) above the top of the pump. A measuring device, such as a weighted line or a well sounder tape, can then be lowered inside of the dip tube to measure the water level, with no threat of getting it entangled in the pumping equipment (see Figure 1, Dip Tube).

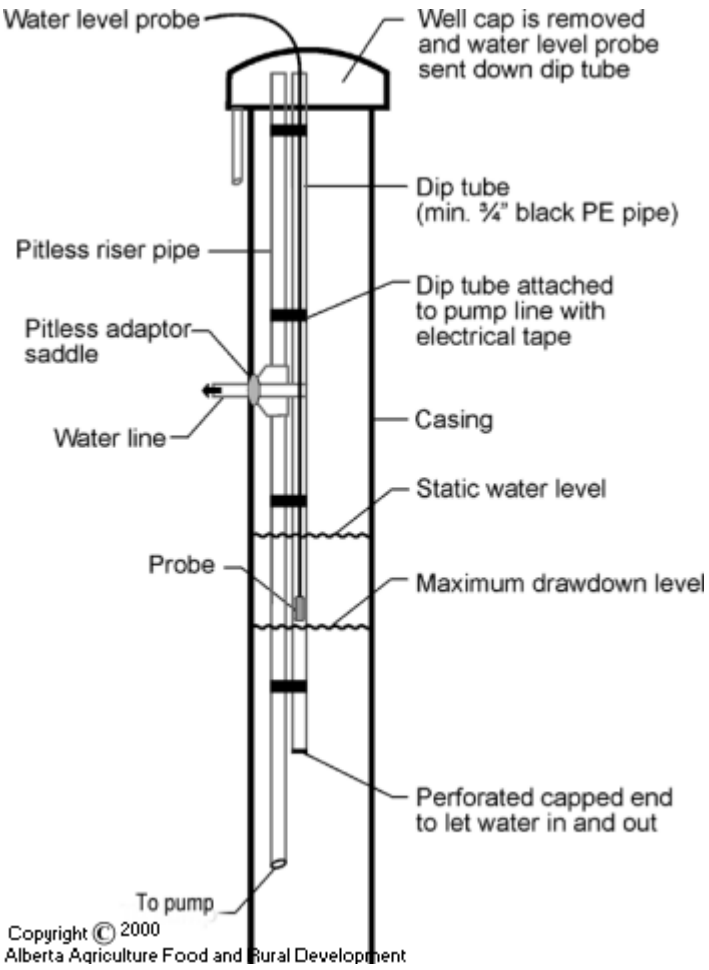

Figure 1 *Dip Tube*

Water well sounder

A convenient method for measuring the water level is to use a water well sounder (also called a water tape). You can purchase one from various suppliers in the province. Although it is relatively expensive, it is a good investment. It's an accurate and convenient way to take water level measurements.

Water well sounders are available for sale or rent from water well drilling contractors and suppliers and water treatment equipment suppliers.

Air line method

The air line method of monitoring water levels is simple and low cost. It is suitable for permanent installations so that water levels can be measured regularly. The cost of set up is about $60. This system has several components:

- A small diameter 6 mm (1/4 in.) plastic pipe permanently attached to the water pipe above the pump intake
- A pressure gauge and tire valve attached to the plastic pipe at the top of the well
- An air pump.

Lower the plastic pipe down the well until the bottom of the pipe is about 0.6 m (2 ft.) above the pump intake. If possible, tape the plastic pipe to the pump drop line. Measure the total length of the plastic pipe when you install it. Attach a pressure gauge and tire air valve to the plastic pipe at the top of the well (see Figure 2, Air Line Method).
There are two pieces of information you need to calculate the water level:

L = Length of plastic pipe or air line (in feet or metres)
H = Height of water above the lower end of the air line (in feet or metres)

You have the first piece of information (L) because you measured the length of the air line when it was installed. The second piece of information (H) is calculated using the air pump and the pressure gauge. Follow the steps below:

1. Pressurize the air line by pumping the air pump until all the water is forced from the line. You will know this has happened when the pressure reaches its maximum reading. Record the gauge reading.
2. If your gauge reads in lb./sq. in. (psi), multiply your reading by 2.31 to calculate H (in feet).
3. If your gauge reads in kilopascals (kPa), divide your reading by 9.8 to calculate H (in metres).

To arrive at the water level in your well, calculate the difference between L and H.

Imperial Measure Example
L (Length of plastic pipe air line) = 100 ft.
H (height of water above lower end of air line) =
Pressure gauge reading 15 psi x 2.31 = 34.7

ft. of water
H = 34.7 ft.
Water level (D) = L - H
= 100 ft. - 34.7 ft.
= 65.3 ft.

Metric Measure Example
L (Length of plastic pipe air line) = 30.0 m
H (height of water above lower end of air line) =
Pressure gauge reading 105 kPa ÷ 9.8 = 10.7 m of water
H = 10.7 m
Water level (D) = L - H
= 30.0 m - 10.7 m
= 19.3 m

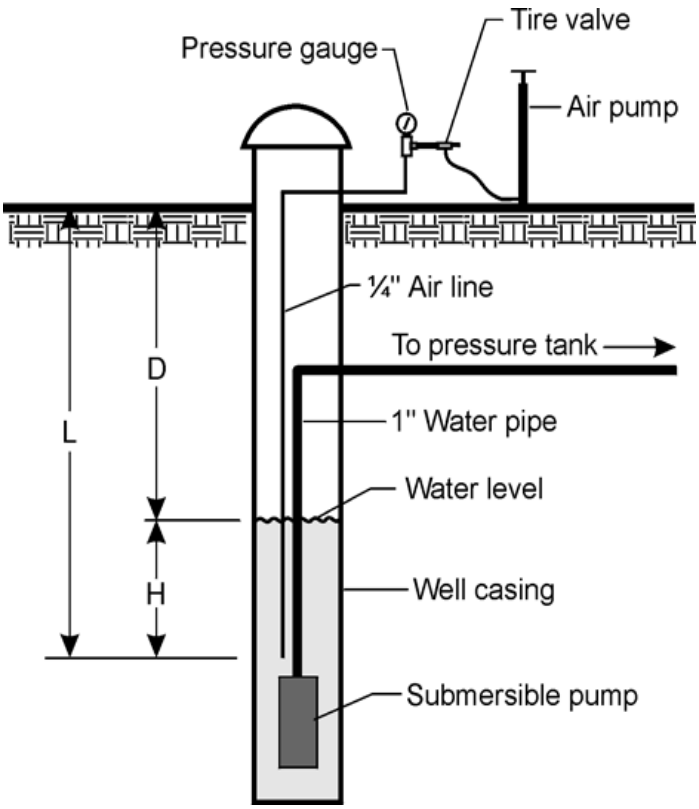

Figure 2 *Air Line Method*

Interpreting Water Levels

Once you have an accurate method for measuring water levels, you need to be able to interpret two types of water levels — non-pumping (static) and pumping.

Non-pumping water levels
The non-pumping water level is recorded before the pump is turned on and the water level in the well has been allowed to fully recover. A good time to take a non-pumping reading is first thing in the morning before there has been any water use.

After you have recorded several measurements over a period of time, you can determine if the water level in the well has changed significantly. Some change will occur due to seasonal fluctuations. For example, in shallow wells, water levels are usually highest in June or July and gradually decline in late September or October.

Deep wells of 60-90 m (200-300 ft.) do not experience seasonal fluctuations like shallow wells.

Let's look at some examples and how the results might be interpreted.

Example 1 **The table below shows four non-pumping water level readings.**				
Month	**Time**	**Water Level***	**Pumping**	**Non-pumping**
January 1, 1996	6:00 am	3.28 m		
April 3, 1996	5:45 am	3.27 m		
August 1, 1996	5:30 am	3.30 m		
December 1, 1996	6:10 am	3.29 m		

*Distance from the top of the casing to water level.

Interpretation: It would appear that there have been no significant changes in the water level over the year so no action is required. The aquifer seems able to supply water to the well at the rate you have been pumping.

Example 2 **You look back over your records for the past year and note the following non-pumping water level readings.**				
Month	**Time**	**Water Level**	**Pumping**	**Non-pumping**

February 1, 1995	6:05 am	10.35 m		
April 1, 1995	5:45 am	12.48 m		
June 1, 1995	6:00 am	11.53 m		
August 3, 1995	6:05 am	16.31 m		
October 1, 1995	5:50 am	20.22 m		
December 2, 1995	6:00 am	26.57 m		
February 1, 1996	5:55 am	30.34 m		

Interpretation: In this case, you should be concerned. The water level has dropped 20 m over the past year. To address the drop in water level, reduce the amount of water you draw from the well. You can do this by reducing the pumping rate and cutting back on the amount of water use.

Take another measurement in a month to see if the water level is recovering. If you find that the water level begins to rise again, you have been overpumping your well, producing more water from the well than the aquifer can supply. To prevent your well from going dry, you will need to pump your well at a reduced rate.

If the water level does not recover, you will need to:

- Further reduce water use
- Look for other possible water sources.

Pumping water level

Record the pumping water level while the pump is operating. If you take several readings over time, you will have data that can help you assess the efficiency of the well. When you take pumping water level measurements, you need to be consistent about when the measurements are taken. For example, you might take the measurement after the pump has been on for 2 hours. Being consistent allows you to compare the readings (see Figure 3, Pumping Water Level Drawdown).

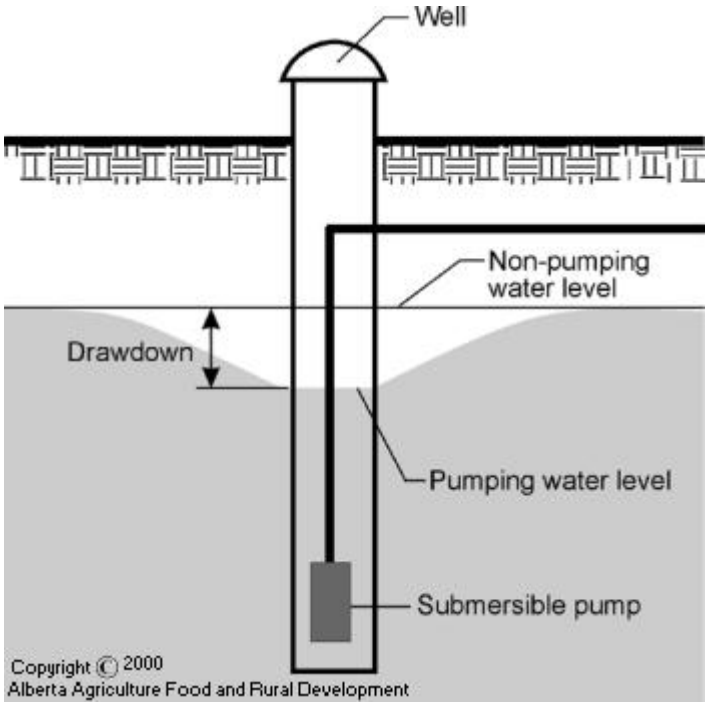

Figure 3 *Pumping Water Level Drawdown*

A good time to take a pumping water level reading is during the day when the pump is pumping, for example, at noon. By then there has been significant water use. Taking the reading at the same time of day will give you comparable water levels, unless water use varies considerably between seasons.

Even when the pumping water level remains relatively steady, you need to do regular annual maintenance, including shock chlorination, to control bacteria buildup. If you allow a well to deteriorate for too long, it may not be possible to restore its original capacity.

Now let's look at the significance of some pumping water level measurements.

Example 3 **In the table below, six readings were taken after the pump was on for 2 hours.**				
Month	**Time**	**Water Level**	**Pumping**	**Non-pumping**
February 2, 1996	11:30 am	6.67 m		
March 1, 1996	11:15 am	5.23 m		
May 1, 1996	11:35 am	6.34 m		

June 1, 1996	11:20 am	5.35 m		
September 2, 1996	11:25 am	6.29 m		
December 2, 1996	11:15 am	7.02 m		

Interpretation: Since the levels are relatively constant, there does not seem to be a problem with the efficiency of the well and no action is required.

Example 4
You look back over your records and find that, although the original non-pumping water level has remained constant, the pumping water level has declined.

Month	Time	Water Level	Pumping	Non-pumping
February 1, 1995	11:30 am	20.15 m		
April 2, 1995	11:20 am	21.56 m		
June 1, 1995	11:35 am	26.26 m		
August 3, 1995	11:45 am	28.37 m		
October 1, 1995	11:30 am	33.45 m		
December 2, 1995	11:40 am	37.20 m		
February 1, 1996	11:50 am	40.16 m		

Interpretation: The screen (or slotted casing) may be plugged with sand, bacterial growth or mineral incrustation. When this happens, the efficiency of the well is diminished and the production rate (yield) drops.

If the well yield declines, yet the non-pumping water level remains constant, the well may need to be serviced by a drilling contractor.

To correct the problem, hire a drilling contractor to determine exactly what is causing the reduced efficiency of the well. The screen (or slotted casing) may need to be surged to remove sediment or in some cases may need to be replaced. You may need to shock chlorinate the well to reduce bacteria or acidize it to remove incrustation on the casing or screen.

Water Quality Measurements

Noting changes in water quality is an effective way to monitor your water well. Aquifer contamination, problems with a well's structure, or lack of routine maintenance could each lead to a change in water quality.
Use the following checklist as a starting point to determine if a problem exists.

Checklist to Determine a Water Quality Problem

Unpleasant odor or taste Red discoloration on plumbing fixtures and fabric Cloudy, dirty water Soap curd on dishes and fabrics Scale in pipes and water heater Salty alkali taste

Some changes in water quality are not detected by changes in taste, smell or appearance. For this reason it is important to sample and analyze your water on a routine basis.

Bacterial analysis
Bacterial analysis determines the total coliform and faecal coliform bacteria in the water. Coliform bacteria are usually present in soil and surface water. Faecal coliform are present in animal and human waste. Both are indicator organisms for the potential presence of pathogenic (disease causing) bacteria.
A bacterial analysis does not test for iron bacteria or sulphate-reducing bacteria which are commonly found in well water. A bacterial analysis should be done annually.

A bacterial analysis can be done for minimal cost through your local health unit. This should be done annually.

Chemical analysis
A routine chemical analysis tests for the most common chemical parameters found in water, such as iron, sodium, sulfates, nitrates and nitrites. In some cases, you may need to request testing for additional parameters when a regional health concern is identified (such as arsenic or fluoride).

A routine chemical analysis should be done every three to five years.

Non-routine testing
Non-routine testing is necessary when unusual situations occur. Unexplained illnesses, obvious contamination situations such as pesticide or hydrocarbon spills, or flooding are examples. Occurrences on neighboring properties may also provide reason for non-routine testing. Since specialized testing is expensive, get advice on which parameters are worth testing.

Sampling
How you collect a water sample is as important as the analysis. Proper sampling bottles and procedures are imperative and can be obtained through your health unit or private laboratory.
Important considerations are:

- Length of time well is pumped prior to sample taken
- How sample is stored
- Length of time for sample to be delivered to a laboratory.

Collect the sample as close to the well head as possible to avoid any effect the water treatment or distribution system may have on the sample. If you want to assess the effectiveness of your treatment system, you will have to take an additional sample.

Interpreting results
Whenever an analysis is done, you will receive a written copy of the results. Keep this information in the front pocket with your other important papers. It helps to create a history of your well to use for comparison should the water quality ever change.

You can also use the analyses to help you decide whether or not any water treatment equipment is needed to improve your water quality.

Local health units are responsible for identifying whether water is fit for human consumption. The Canadian Drinking Water Quality Guidelines published by Health Canada are used to establish when the parameters exceed established maximum acceptable concentrations.

The groundwater use information provided in this publication was written from a Canadian prairie perspective, specifically focusing on the resources available and legislation within the Province of Alberta as of August, 2000. For more information on local conditions, people from other jurisdictions should contact appropriate agencies and water well experts in their area.