Lakeland Agricultural Research Association

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Volume 4, Issue 1

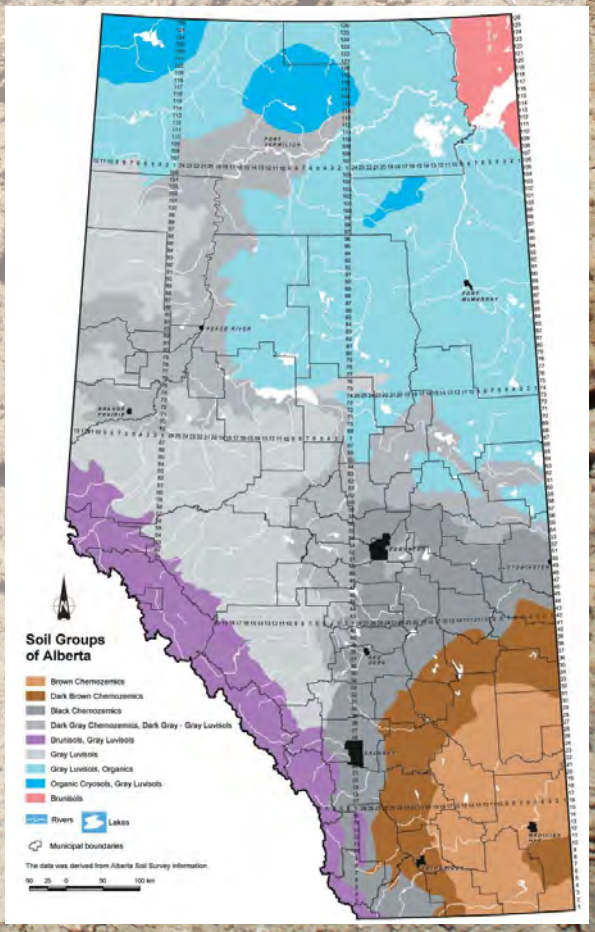
The Verdant Element

The Dirt On Soil

Have you ever really thought about what is under your feet? Do you remember when you were younger and running barefoot in the yard or covered in mud? Have you ever wondered about the micro-organisms, worms, insects, water, nutrients, gases, clay, sand and silt that make up what you are standing on? Most of us know that not all soil is created equal; but do we know how to improve our soil? The characteristics of soil type can greatly affect drainage, nutrients, anionic and cation exchange capacities, and potential for contamination. Here in Alberta we have moved to a reduced tillage system to conserve our soil, whereas in Australia I spent many hours in the tractor plowing (in a dust storm mind you) otherwise it would have been like seeding into cement. While I was in Africa, the land was hand tilled to plant drought resistant crops such as cassava as well as maize.

Alberta is roughly 661,000 square kilometers which is twice the size of Japan. Within Alberta there are several soil groups including Chernozemics, Luvisols, Brunisols, Cryosols and Organics.

On your operation your soils can change quarter by quarter and can also have a huge variation within the field itself. Soil testing is important not only for knowing what your field type and conditions are but also will help you make the most of your inputs and prevent excess nutrients from leaching away from your valuable crops and into the environment. [Photo Left: Cassava Plant]



Inside this issue:

Soils of the World; A Photo Essay

From top left clockwise: a field prepped for a crop of pumpkins in Victoria, Australia; a rocky field in southern Germany; a tea plantation in Malawi, Africa; women working in the field in Zambia, Africa; fields are burnt in preparation for the rainy season in Tanzania; a family home and field ready for planting in Malawi; people working the fields in Tanzania

Slope

Slope has a fundamental impact on the landscape. It is a large factor in erosion and contamination. Long slopes are associated with a higher risk of surface water contamination due to the large surface area to accumulate runoff. Whereas short slopes have a lower risk due to the small area of land that is exposed to runoff. However this does not apply to strong slopes as steeper areas lead to an increase in erosion. The outputs of slope (runoff) are the inputs to another area.

Slope aspect will also contribute to soil characteristics. Shaded (north facing) slopes are often colder, wetter and have a greater accumulation of organic matter compared to sunny (south facing) slopes which have warmer soils, that are dryer and have more incorporated (broken down) organic matter.

Percent Slope	Approximate Degrees	Terminology
0-0.5	0	Level
0.5-2	0.3-1.1	Nearly Level
2-5	1.1-3	Very Gentle Slopes
5-10	3-5	Gentle Slopes
10-15	5-8.5	Moderate Slope
15-30	8.5-16.5	Strong Slopes
30-45	16.5-24	Very Strong Slopes
45-70	24-35	Extreme Slopes
70-100	35-45	Steep Slopes
>100	45	Very Steep Slopes

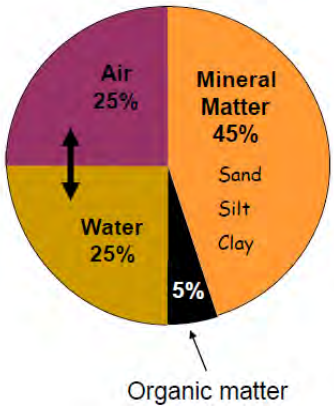
Soil Texture

Ever wonder why you are supposed to have at least 20% clay content in your silage pit liner? The texture of your soils has a large effect on the risk of runoff and leaching into your water supply. Soil texture is made up of three components; sand, silt and clay. Sand is visible to the naked eye and feels coarse and gritty to touch. Silt is smaller in size and feels powdery and slippery when wet. Clay has the smallest particle size with a very high water holding capacity and feels sticky when wet, and can be rolled into a rope like shape. Due to sands large size and non-porous surfaces, water and contaminants infiltrate the soil very quickly and pose a greater risk to groundwater contamination. Clay has a large water holding capacity and low infiltration rate therefore poses a greater risk for surface water contamination.

Organic Soils

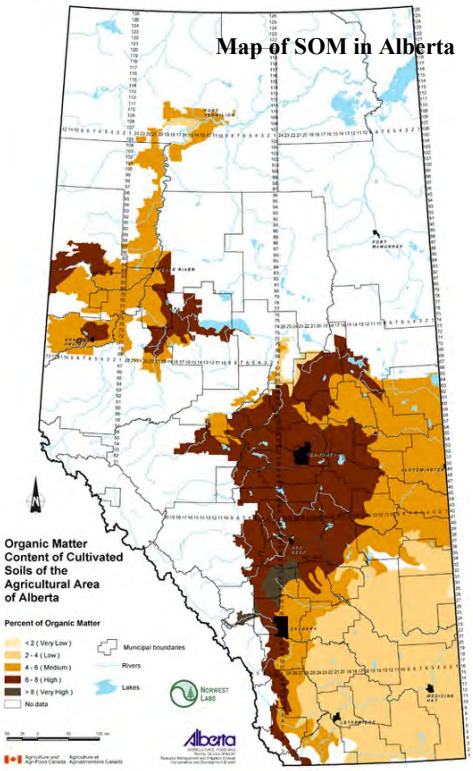
What is an organic soil? An organic soil is made up of over 17% organic carbon (about 30% or more organic matter). Organic or peat soils contains fibric materials such as woody materials, rushes, sedges, mosses and herbaceous plants in various states of decomposition. These nutrient rich soils are saturated with water, with the organic material going to depths below 40cm from the surface layer. These unique soils are important for our wetlands, especially in bogs and fens. However we do not farm vast quantities of organic soils, so what is important to you is the soil organic matter (SOM) content. SOM is the accumulation of plant residues in various states of decomposition and typically ranges from 0-17 % in our farmed mineral soils. The climatic conditions such as temperature and rainfall influence the amount of SOM as does soil aeration (tillage), pH and the soil microbes present. Decomposition (reduction in SOM) is greater in warmer and drier soils. Soil organic matter is important to soil production as it improves both the chemical and physical properties of the soil; decrease erosion, improving soil structure, supplies nutrients to plants, enhances aeration and water penetration and improves the soils water holding capacity.

Below: The composition of soil



Soil organic matter is principally composed of plant residues in different stages of decomposition. Soil organic matter is typically low in Alberta soils ranging from 0-17% in mineral soils.

Map of SOM in Alberta



Cation Exchange Capacity

The micronutrients that are essential for healthy crop growth are dependant on the soils holding capacity, which is referred to as the cation exchange capacity (CEC). Cations, are positively charged ions such as calcium, magnesium, potassium, sodium, aluminum, iron, manganese, zinc and copper. You can fertilize to your hearts content, however if your soil has a low CEC, then the majority of what you are adding is leaching, which can lead to nutrient deficiencies.

The CEC of a soil is affected by soil texture and organic matter. Clay soils, and organic matter tends to be negatively charged which holds the cations in the soil, and can be exchanged with other cations and made available to the plants. These soils also have a larger water holding capacity.

Sandy soils have a low cation exchange capacity, so adding large quantities of fertilizers (such as potassium) will lead to large leaching losses, and can cause problems in areas that accumulate the runoff (nearby water bodies).

Soil Amendments

Soil amendments come in all different forms and functions. Below are some available amendments and characteristics.

Soil Amendment	Primary Function	Characteristics
Straw Bedding	Soil Conditioner	Low in nutrients, adds organic matter to soil
Compost	Fertilizer and Soil Conditioner	Slow nutrient release
Crop Residue	Fertilizer and Soil Conditioner	Variable nutrient content and C:N ratio
Manure (liquid)	Fertilizer	Variable nutrient content
Manure (solid)	Fertilizer and Soil Conditioner	Variable nutrient rate and OM content
Wood Waste	Soil Conditioner	High C:N ratio
Biochar	Soil Conditioner	Increases holding capacity of soil, improves soil structure
Liming Materials	Soil Conditioner	May contain metals, pH impact variable, improves plant nutrient uptake
Gypsum	Fertilizer and Soil Conditioner	Improves soil structure, improves plant uptake of nutrients, improved soil permeability

Growing Forward 2

Growing Forward 2 is now accepting applications for the following programs:

- Agri-Processing Automation and Efficiency
- Agri-Processing Product and Market Development
- Business Management Skills Development
- Business Opportunity
- Irrigation Efficiency
- On-Farm Energy Management
- On-Farm Stewardship
- On-Farm Water Management
- Food Safety Systems Producer

This includes funding for fuel tanks, used oil containers, chemical handling systems, low drift nozzles, portable shelters and windbreaks, riparian area fencing and management, year round or portable watering systems, and much more. For more information contact the LARA office or visit the Growing Forward Website:
http://www.growingforward.alberta.ca/index.htm

Growing Forward 2 Purpose Statement

GF2 provides programs and services to achieve a profitable, sustainable, competitive and innovative agriculture, agri-food and agri-products industry that is market-responsive, and that anticipates and adapts to changing circumstances and is a major contributor to the well-being of Canadians.Sustainable farming encompasses a wide range of practices and principles; combining environmental stewardship with profitability and ensuring that the family farm will be there for generations to come.

Environmental Farm Plans

The environment is becoming a more prominent issue. It is a large factor in marketing agriculture and food products in today's global markets. Consumers are demanding more transparency and are demanding high quality and safe products. Reputation of food safety is critical to retain and gain access to domestic and international markets.

Environmental Farm Plans (EFP) provide a tool for producers to self analyze their operation and identify environmental risks, current standards, areas for improvement and also highlight what they are doing well.

Having a completed EFP allows producers to access different funding opportunities, such as the Growing Forward Stewardship Program. It is also useful in product branding that demonstrates specific environmental standards.

The EFP Process

An EFP can be completed through workshops or one-on-one session(s). The EFP first identifies the soil and farm site characteristics. Following this, the producer completes only the relevant chapters that apply to their operation; such as wintering sites, fertilizer, pesticides, crop management etc. Upon completion the EFP is submitted to a Technical Assistant for review. Once reviewed the EFP will be returned along with a letter of completion.

The EFP is a living document and should be reviewed and updated periodically.

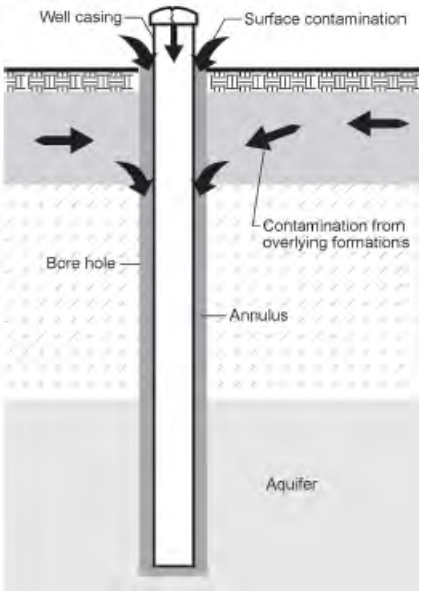
If you wish to complete an EFP or have any questions regarding EFP please contact the LARA office at 780-826-7260

Plugging Abandoned Wells

Water Wells … that last for generations, Alberta Agriculture, Food and Rural Development

When a well is no longer being used or maintained for future use, it is considered abandoned. Abandoned wells pose a serious threat to the preservation of groundwater quality. They are also a serious safety hazard for children and animals. There are approximately 59,000 farmsteads in Alberta and most of these have at least one well. In addition there are a great number of non-farming rural residents that rely on water wells. The exact number of abandoned wells in Alberta is unknown but is estimated to be in the tens of thousands. Plugging an abandoned well prevents:

Figure 1 Well Contamination



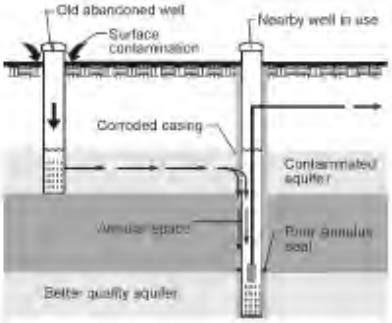
- Downward movement of water in the well or well annulus
- Surface contamination from reaching aquifers
- Intermixing of water between aquifers of different water quality
- Serious accidents from happening.

Unfortunately, groundwater contamination and its effects are usually not recognized until groundwater quality is seriously affected and nearby wells have been contaminated. Surface contaminants can enter a well several ways:

- Directly through the surface opening if the cap is loose, cracked or missing
- Through unsealed spaces along the outside of the casing (see Figure 1, Well Contamination).

When the steel casing of an abandoned well starts to corrode, holes will develop. When this takes place, surface contaminants or poor quality water from shallow aquifers may migrate into the deeper aquifers of nearby operating wells (see Figure 2, Contamination From an Abandoned Well).

Figure 2 Contamination From an Abandoned Well



Who is Responsible?

In Alberta, responsibility for plugging a water well is defined by legislation. The well owner is responsible for plugging the well when:

- The well is no longer being used as a water supply;
- The well is in a poor state of repair and the pumping equipment has been removed or cannot be repaired or replaced;
- The well produces water that is unsuitable for drinking.

The licensed water well contractor is legally responsible for immediately plugging a well when it is not completed due to construction problems or inadequate yield. Before you sign a contract with a driller, ask questions about what materials are going to be used to plug the well and associated costs. It is generally best to hire a licensed water well contractor to complete the plugging of your well. This person has the expertise and equipment to do a proper job. Unless you use the right plugging materials and have them properly placed in the well, you will end up with a poorly sealed well that will continue to allow contaminants to enter into the groundwater. When a replacement well is drilled, your old well should be immediately plugged.

Process of Plugging a Well

There are several steps to take before actually plugging the well. Some steps you will be able to do yourself and others you may want to consult with, or hire, a licensed water well contractor to complete.

Preparation

To know exactly how much plugging material is needed, measure the total depth and diameter of the well, plus the non-pumping water level (the depth to the standing water in the well). If possible, compare these measurements to the information on the drilling report from when the well was originally constructed. The only time you should even consider plugging a well yourself is when the well is open to its original depth.

Ideally the casing should be removed from the well before the plugging process begins. Often only the liner casing is removed and the surface casing is left intact because it is more difficult to remove and it could separate down hole. The older the well, the more difficult it will be to successfully remove the casing. If the casing is left in place, it should be perforated, particularly if there is evidence of water movement in the annulus of the well. Any casing left in place must be cut off 0.5 m (20 in.) below ground surface after the well is plugged.

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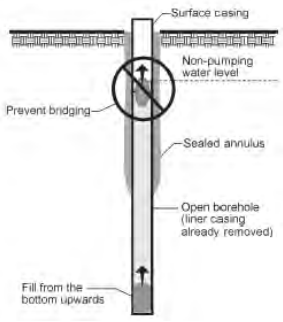
Water Wells … that last for generations, Alberta Agriculture, Food and Rural Development

Figure 3 Bridging



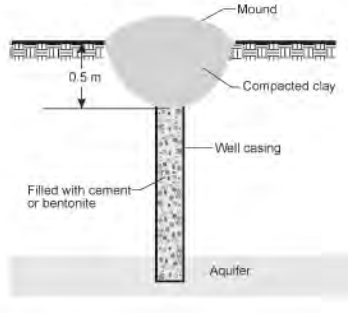
Materials that are used to plug a well must be uncontaminated and impervious. They must prevent any movement of water. See the chart below for acceptable and unacceptable materials.

High yield bentonite is a special type of clay that swells when wet to provide a very effective impervious seal. It comes in a powder that when mixed with water produces a slurry that can be pumped into the well. It is also manufactured in pellet or granular form that is designed to pour into the well. This type of bentonite when mixed with water will actually swell to about eight times its original size and will form a water-tight plug. It is important to understand that bentonite cannot be used as a plugging material in some situations. When the chloride level in the well water is greater than 4000 mg/L, or the calcium level is greater than 700 mg/L, bentonite will not swell properly, so then it is best to use a cement grout.

Acceptable Materials	Unacceptable Materials
• grout - neat cement (cement mixed with water) - sand cement (cement, sand and water)	sand
• concrete (cement, sand and aggregate mixed with water)	gravel
• manufactured high yield bentonite products	drilling mud or fluid
• clean, uncontaminated clay (for large diameter wells)	

Large diameter or bored wells pose special problems because of their size and the volume of material required to fill them. A lower cost alternative for the plugging material is clean, uncontaminated clay that can be shovelled into the well until it is filled. This must be done carefully, however, to ensure the clay reaches the bottom of the well and seals off all empty space. The cribbing must be cut off below ground surface and the well should be topped up with high yield bentonite to make a water-tight seal. Cement grout and concrete may shrink after setting so may not create as good a seal as bentonite.

Figure 4 Cutting Off the Casing and Mounding the Clay



Method

Aside from choosing the appropriate plugging material, the method of placing material into the well is most critical. Regulation requires

Steps to Plugging a Well

Step 1 Remove all pumping equipment from the well. Thoroughly flush out the well using a bailer or air compressor.

Step 2 Measure the total depth of the well, the diameter and the non-pumping water level. If possible, compare these figures with the information on the original drilling report. Confirm whether the well is open to its original depth.

Step 3 Use these figures to decide which plugging material is appropriate and how much you will need. A licensed water well contractor can help you decide. Whether or not the casing can be successfully pulled out will also determine which material to use and what method is appropriate for placing it into the well. If the casing cannot be removed, choose a slurry that can be pumped under pressure into the well so that any space around the outside of the casing will also get filled in.

Step 4 Disinfect the well. Add enough chlorine to bring the water standing in the well to a chlorine concentration of 200 mg/L. For every 450 L (100 gal.) of water in the well, add 2 L (0.4 gal.) of household bleach (5.25% chlorine). See Module 6 "Shock Chlorination—Well Maintenance" to calculate how much water is in your well. Leave this chlorine in your well.

Step 5 If possible, remove the well casing.

Step 6 Place the plugging material into the well. It must be introduced at the bottom of the well and placed progressively upwards to ground surface. The only exception to this rule is when the plugging material being used is a bentonite pellet that has been designed and manufactured for pouring into the well from the ground surface.

Step 7 If the casing was not already removed, dig around it and cut it off a minimum of 0.5 m (20 in.) below the ground surface (see Figure 4, Cutting Off the Casing and Mounding the Clay).

Step 8 Backfill and mound this portion of the hole with material appropriate for intended use of the land (i.e., clay) (see Figure 4, Cutting Off the Casing and Mounding the Clay).

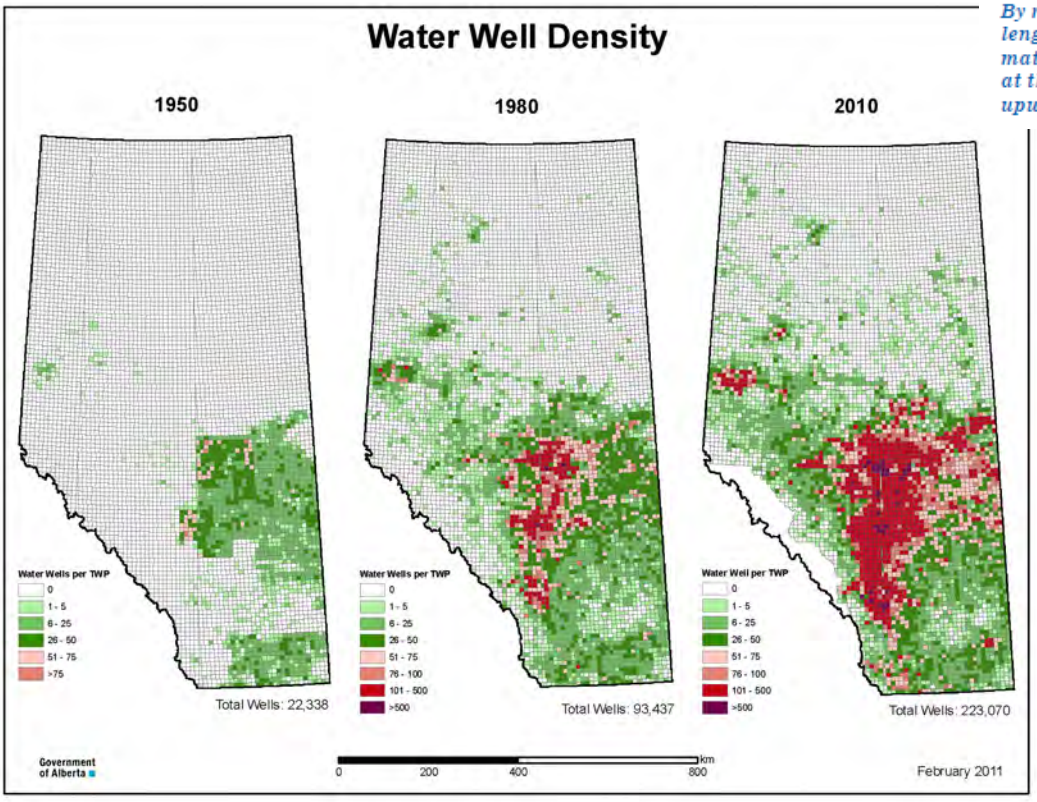
Step 9 Use the worksheet at the end of this module to record the details of your well plugging. Include the well owner name, legal land description, GPS location, total depth, casing diameter, type and amount of plugging material used, date and method of placing material into the well. Send a copy of this record to:

Alberta Environment
Groundwater Information Centre
11th Floor, Oxbridge Place, 9820-106 Street
Edmonton, Alberta T5K 2J6

Wells that are no longer being used should be plugged. They are a serious public safety and environmental hazard.

that the plugging material must be introduced from the bottom of the well and placed progressively upward to ground surface. If the plugging material is cement grout, concrete or bentonite slurry, special equipment is needed. The material must be placed into the well through a tremie pipe that is usually about 3 in. in diameter. At all times this pipe must be kept below the surface of the plugging material to prevent it from diluting or separating. It is recommended that you hire a licensed water well contractor when a slurry is chosen as the plugging material because they will have the proper equipment and experience to do the job correctly.
When bentonite pellets are chosen for the plugging material, they can be poured into the well from the ground surface. These pellets have a weight material added to help them sink to the bottom of the hole. They are also coated to prevent immediate swelling on contact with water. When poured slowly, they should reach the bottom of the well before swelling. If you are not careful, however, these pellets will bridge off down hole and the well will be only partially plugged (see Figure 3, Bridging).

Before you pour in the pellets, you can determine how many feet of well casing can be filled with the size of pellets you have chosen. As the well is being filled, measure the depth to the top of the plugging material quite frequently. Then you will know if the plug is rising faster than expected indicating a bridge has formed. If this happens, be sure to break it up before adding more material to the well.



By regulation, a well must be filled full length with impervious material. That material must be introduced into the well at the bottom and be placed progressively upward to ground surface.

Since the 1800s water wells have been drilled in Alberta and today 90% of rural Albertans rely on groundwater for their water supply. That equates to roughly 700,000 people relying on groundwater. The submission of water well drilling reports only became mandatory in 1978, so the actual number and location of wells in the province is unknown.

Over time wells can run into several issues, especially if not maintained properly. Casings, especially metal can corrode, or low producing wells can be over pumped and cause many different issues which can lead to well failure. Not maintaining your well can also lead to contamination of the aquifer, and if serious enough will make the well unusable.

Above: A well pit

The Dangers Of A Well Pit

Well pits were a common practice, but construction of new well pit is now prohibited by provincial regulations. Well pits were an attractive system as they provided a frost free location and easy access to the pressure system and distribution lines. However they can be deadly as methane that can come from the groundwater will collect in the pit and can cause asphyxiation to people entering the pit.
Well pits are at a greater risk of groundwater contamination if flooding occurs or if the water table rises. Water and contaminants (including garbage, dead insects and rodents, nearby chemical spills etc) can collect there and flow down into your well contaminating your groundwater source if the well is not securely capped or if the seals are degraded.
Funding is available to install a pitless adaptor and remove a well pit.

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Sustainable farming encompasses a wide range of practices and principles; combining environmental stewardship with profitability and ensuring that the family farm will be there for generations to come.

Like us on Facebook: https://www.facebook.com/pages/Lakeland-Agricultural-Research-Association/316266591732449

Above: An interesting use of your outbuildings. Have your shed work for you! This is an innovative farmer in Germany, providing not only his farm with solar energy, but also providing for the grid. In Alberta we have far more available solar energy than Germany, as solar panels work more efficiently in sunny and cooler temperatures.

Stuck in the Mud?

Come and talk to us about funding for an offsite watering system and fencing off riparian areas.

Beaver River Watershed Alliance

Alberta WPACs

Chilly Waters

2013 WPAC Summit in Cold Lake, Alberta

September 23rd-26th
Lakeland Inn
5411 55 St
Cold Lake, Alberta

Registration Costs
Registration-$225
Student-$65
Single Day Registration-$50
Banquet Tickets-$40

For More Information
Contact Harry Keess, Program Manager, at 780.812.2182 or hk.brwa@lica.ca

The Beaver River Watershed Alliance would like to invite you to join us at the 2013 WPAC Summit. This event is open to anyone who has an interest in watershed protection and planning. For more information, visit www.beaverriverwatershed.ca.

Themes
-Watershed Science and Knowledge
-Local Stewardship Successes
-Promoting Partnerships
-Watershed Planning and Policy

Field Tours
-Cold Lake Fish Hatchery
-Husky Energy
-Sand-Beaver Confluence
-Dupre Fire Site
-Moose Lake Provincial Park

Please make all cheques payable to Beaver River Watershed Alliance, and mail to Beaver River Watershed Alliance c/o Lakeland Industry and Community Association, Box 8237, Bonnyville, AB T9N 2J5