FACTSHEET

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ALTERNATIVE LIVESTOCK WATERING SYSTEMS

R.P. Stone, S. Clarke

INTRODUCTION

Grazing livestock drink from surface water sources such as streams, rivers, ponds or open ditches. Animal manure in and near surface water and sedimentation of the water from livestock disturbing the bed and banks of the watercourse can adversely affect water quality. Keeping livestock away from surface water can improve animal health and protect downstream water quality.

Water quality will improve if livestock are discouraged from entering surface water. Moving feed, salt and shade away from surface water reduces the risk of impact on the riparian areas. Providing alternative water can dramatically reduce the amount of time livestock spend in and around water. Livestock often show a preference to water troughs over surface water. Alternative water may come from streams, wells or ground water springs.

There are two main types of alternative watering systems that may be used:

- pumps
- gravity systems.

Electricity is not available on many pastures and it can be very expensive to install power lines for great distances. Alternative watering systems rely on a source of power other than electricity. Gravity systems utilize the force of gravity to move water. The type of system selected will depend on water requirements, site conditions, water source and cost.

ADVANTAGES OF ALTERNATIVE WATERING SYSTEMS

- Limiting or preventing livestock access improves surface water quality.
- Health of the herd improves by providing a clean water source.
- Better footing for livestock with a reinforced standing pad around watering tanks.
- Can service multiple watering locations, resulting in potentially more uniform pasture utilization.
- Reduced maintenance on ditch and stream banks.

PUMP SYSTEMS

These systems obtain their power on-site. Sources of power include the livestock, flowing water, wind and sun.

Nose (Pasture) Pump

A water bowl is filled by a diaphragm pump, which is activated when the animal's nose pushes down on a lever. Animals should be 180 kg (400 lbs) or more to operate the nose pump and training is required. Smaller animals can use the pump with the installation of a special stall. One nose pump can water a maximum of 30 animals; although 15–20 animals are recommended to reduce competition. (See *Figure 1*) The pump is capable of 6.1 m (20 ft.) of maximum lift from the source to the bowl. Both the vertical lift for the water as well as the horizontal distance from the water source to the nose pump must be taken into consideration.

Install the units on a solid surface to prevent upset when an animal drinks and to reduce erosion and muddy conditions around the waterer. Minimal plumbing experience is required to install nose pumps. No auxiliary power is required, and material and installation costs are minimal. Nearby surface water, i.e. watercourse, pond, etc. or ground water from a shallow well may be utilized as the source. Frost-free units are available. Standard pump prices range from $250–$500; frost-free around $1,000.

FIGURE 1: Nose pumps.

Sling Pump

A sling pump is a type of pump powered by the flow of moving water. It works by a propeller slowly making the entire pump rotate in a stream (*Figure 2*). While the pump is rotating, water and air enters the back of the pump and are forced through a coil of plastic tubes. The water is then pushed through a hose and into a stock tank (*Figure 3*).

For the sling pump to work properly it needs to be in a stream with a water velocity of at least 60 cm/s (2 ft./s). The depth of the stream needs to be at least 25–40 cm (10–16 in.), depending on the model of the sling pump. Usually, the sling pump feeds into a stock tank and because the pump is operating continuously, the stock tank has an overflow hose to a safe outlet. The maximum head of the pump varies with the models available and the number of pumps used but generally ranges between 8 m (26 ft.) and 25 m (83 ft.).

Floating debris in the water is a concern for these pumps. Sand, silt or water with high calcium may plug the tubes. The sling pump comes in various sizes with an output of 3,000–6,000 litres/day (650–1,300 imp. gallons/day). The cost for a sling pump ranges from $900–$1,600.

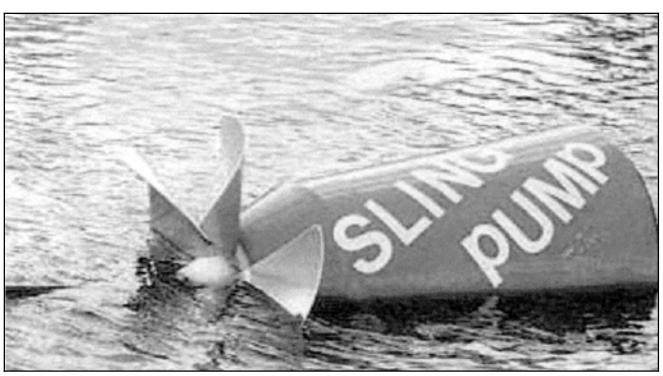

FIGURE 2. Sling pump working in a stream.

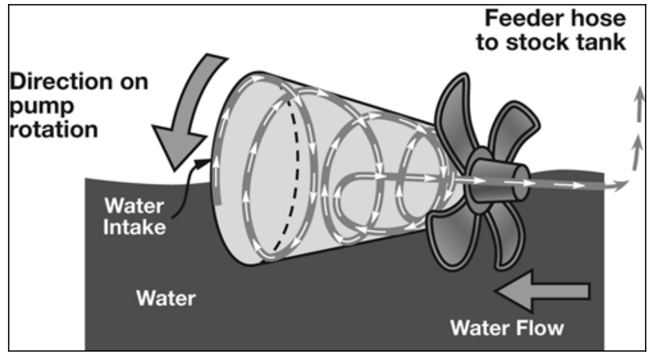

FIGURE 3. Conceptual diagram of how a sling pump works. (Source: The Stockman's Guide to Range Livestock Watering From Surface Water Source.)

Ram Pump

The energy produced by a large amount of water falling a small height (at least 0.6 m (2 ft.)) is used to pump a small quantity of water to a much higher elevation. Water flows down a drive pipe and out a waste valve. As the water flows out the waste valve it gains speed. When a desired speed is reached, the force of the running water closes the waste valve, forcing the water through a delivery valve into an air vessel. As the pressure increases in the air vessel, the delivery valve closes and the pressurized water is forced out of the pump into a storage tank and then to a stock tank. The waste valve reopens with the drop in pressure causing the process to begin again (*Figure 4*).

When a large amount of water has to be moved in a short time multiple pumps are used. When setting up the pump the drive pipe should be straight to maximize the speed of the water that powers the pump. The maximum lift capability of the pump is 10 times the height of the falling water, that is, for every 30 cm (1 ft.) of waterfall, water can be pumped 3 m (10 ft.) high. If the water-lifting ratio at the site is less than 10:1 the pump will achieve a greater output.

A major drawback with ram pumps is that they require a source of running water to operate. The pump requires a minimum flow rate of 4.5 L/min. (1 imp. gal/min.).

Ram pumps cost approximately $200–$600 excluding installation.

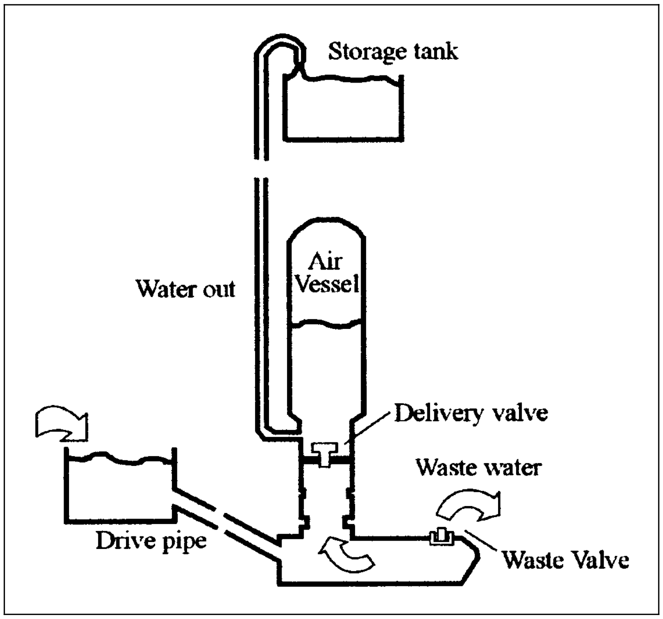

FIGURE 4. Diagram of how a ram pump operates. *(Modified picture from Lifewater Canada).*

Wind Generator

Windmills (*Figure 5*) have been used for hundreds of years to pump water but recently there have been major improvements in windmill technology. There are 3 distinct ways to pump water using a windmill — mechanical, air and electric. All windmill-pumping systems require a suitable tank that the livestock will drink from.

The traditional method of pumping water by wind has been the mechanical method. Multi-blades (3+ blades) are used to generate extra torque. The rotational energy is turned into an up and down motion by a gearbox. The up and down motion drives a piston pump located at the bottom of the well. The major disadvantage of this form of wind pumping is that it requires that the windmill be directly above the well.

With an air pumping system the windmill compresses air that pumps water. The air pump works by taking compressed air from the windmill and forces it down a pipe below the waterline in the well. The compressed air aerates some of the water in the pipe making it lighter than the surrounding water; this will make the aerated water rise in the pipe. Since this system uses compressed air the tower for the windmill can be located in a more suitable location than over the well.

The disadvantage with this form of pumping is that the discharge pipe needs to be placed deep into water and most wells do not have the required depth of standing water. Of the three types of windmills this type will pump the least water for an equivalent wind speed but is the most economical.

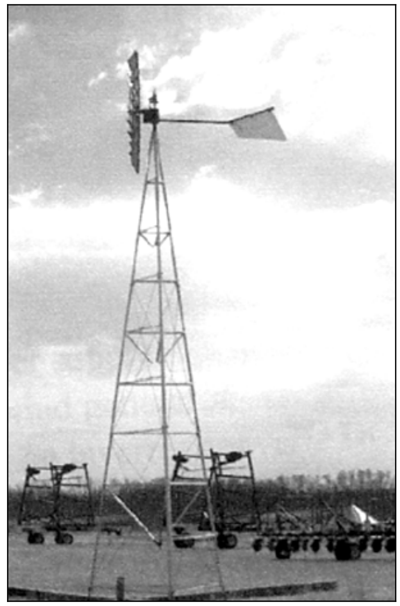

FIGURE 5: An air windmill. *(Source: Dutch Industries)*

With an electric system the windmill produces electricity that runs a pump. This is the most complex type for pumping water. Of the 3 types of windmill systems this one will pump the most water for the same wind speed. The electrical energy the windmill produces can either be used directly in a pump or stored in a battery system. For more information on battery systems, see *Solar Powered Pump* section in this Factsheet. Similar to solar powered systems this pumping system is limited to the type of DC electric pump purchased. Also like the air pump windmill this type can be located a distance away from the source of water.

There are important geographical and meteorological issues to consider when implementing a wind-based system. Before installing a windmill determine that there is enough wind blowing when pumping is required to operate the system. Investigate measurements taken by government, local airports or other farmers with windmills. But to be certain a windmill will operate properly, take onsite measurements using a wind-measuring device called an anemometer. To maximize the amount of wind speed the turbine receives it is recommended the windmill be at least 9 m (30 ft.) higher than any object within 90 m (300 ft.) of the windmill.

Be aware of the relationship between wind speed and the pumping power of a windmill. If the wind speed is doubled the power that goes to pumping is increased by a factor of 8. If the rotor size of the windmill is doubled the pumping power is increased by a factor of 4.

The prices of windmill systems can vary greatly depending on size and quality of components used. A very rough approximation is $3,000–$6,000.

Solar Powered Pump

Photovoltaic or solar panels (*Figure 6*) capture energy from the sun and convert it to DC current to charge batteries or directly power a pump to deliver water to a trough. The panel needs to be grounded in case of lightning and fenced to keep livestock away. If a system without batteries is used, a water holding tank with a capacity for 5 days of water is required to ensure a steady supply of water. The angle of the panels should be adjusted each season to maximize the amount of sun energy absorbed. A solar tracker can be added to maximize sunlight exposure daily and annually. A wide variety of pumping operations (*Figure 7*) such as deep well, stream or pond are possible with this system depending on the type of DC electric pump chosen.

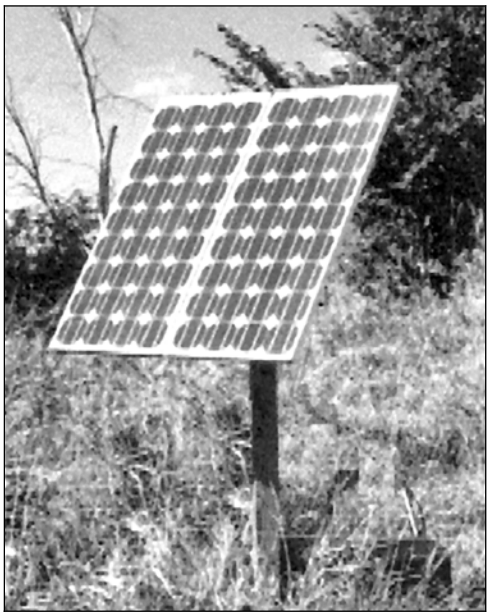

FIGURE 6. A solar panel providing power to a water pump.

PUMP SELECTION & BATTERY POWER SUPPLY

Electrically driven pumps operate on two types of power supply:

- a 12 or 24 volt DC supply directly powers the system; or an inverter converts DC to AC current to power the system
- a 12 or 24 volt DC to charge a battery, which powers the system.

Some 12 volt (DC) pumps can operate directly from the generating source, which omits the cost of a battery system, but requires a water storage reservoir to ensure a steady supply of water for up to 5 days. Battery systems can power the pump directly or store energy produced by solar panels, hydro generators and wind generators to power the pump at a later point in time.

Pumping systems using only batteries to power a pump i.e. no solar panels, require batteries to be removed for recharging and replaced with fully charged batteries. A battery storage system can provide power for about 5 days water supply.

Do not use automobile batteries because they do not discharge or recharge as efficiently as other battery types; therefore, they need more frequent replacement. Use deep-cycle batteries (non-automotive) that allow for 50%–80% discharge and have 80%–90% efficiency. A battery regulator is required between the battery and power generator to prevent overcharging or over discharging.

FIGURE 7. A livestock solar watering system. *(Courtesy of Ottawa Solar Power)*

There are two choices of batteries:

- *Flooded*: These are lead acid batteries with lead plates immersed in a solution of sulphuric acid. Flooded batteries, used in a pumping application, must have **deep cycling** characteristics. This means they can be discharged lower than a non-deep cycle battery.

- *Gel:* Gel batteries are essentially the same as a lead acid battery except the lead plates are immersed in a gel-like substance. The gel is used to avoid any leakage of the battery if it punctures. Gel batteries, used in a water pumping system, must also be the deep cycle type. Gel batteries cost 30%–50% more than lead acid batteries and offer no added performance to the system.

When designing a water pumping system, the size of the battery bank must be large enough so that the batteries do not discharge to levels of more than 50% on a regular basis. Frequently lowering your battery voltage below 50% takes performance and years of service life away from the battery bank.

The price of solar powered pumping systems for livestock usually cost $2,000–$6,000. Winter operating solar systems are more expensive.

GRAVITY SYSTEMS

These systems take advantage of gravity to move water from a higher elevation to a lower elevation. If there is a reliable flow of water these systems are usually simple to install and easily maintained. Costs are quite reasonable, but vary widely, depending on site characteristics and materials used.

A collector tile collects water from a reliable spring, stream or flowing tile, and drains by gravity into a spring box (*Figure 8*). The spring box may have the collector such as a spring built into it (*Figure 9*). From the spring box, water moves to a stock-watering tank by an inlet pipe, as depicted in *Figure 10*. The spring box collects sediment and provides access for maintenance. An overflow pipe at the water trough directs excess water to an appropriate discharge area to prevent muddy conditions around the trough.

Before implementing a gravity system, examine the water source and terrain around it. Before installing a system ensure that the water source, i.e. spring, stream, pond, etc., does not dry up during the summer months. The slope of the terrain must be greater than 0.2% to have a gravity system. If the slope is > 1% use a 1¼ in. diameter pipe; use a 1½ in. diameter pipe for a terrain slope of 0.5%–1%. Also, it is advantageous to keep the piping below frost line.

The costs for this system vary greatly depending on what materials and construction methods are used.

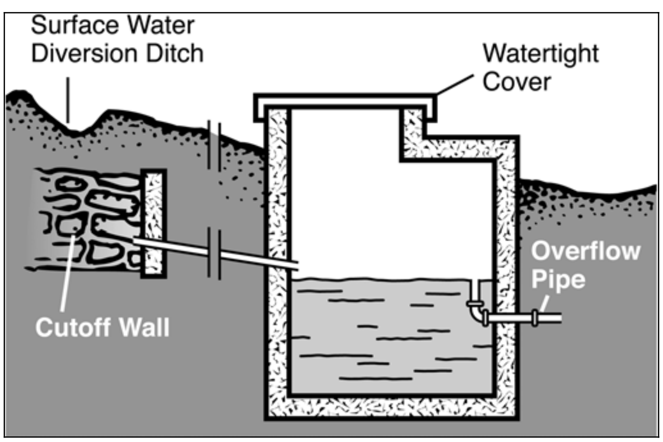

FIGURE 8: Spring box with a collector tile. *(Modified image from: EPA's Software for Environmental Awareness)*

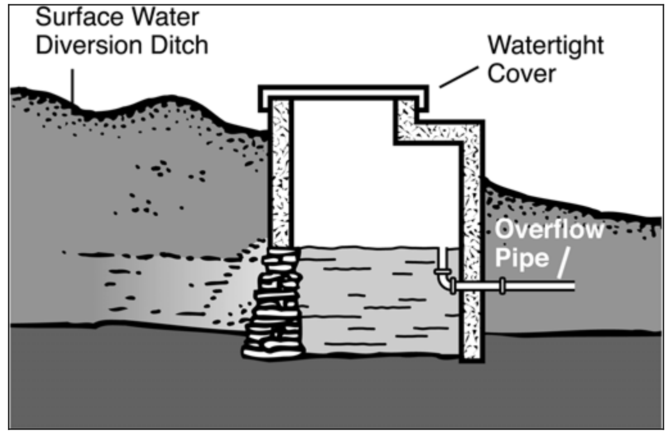

FIGURE 9: Spring box with collector built in. *(Modified image from: EPA's Software for Environmental Awareness)*

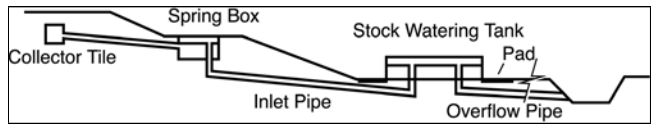

FIGURE 10. Spring box plan, sectional view.

FUEL PUMPS OR GENERATORS

In some situations a gasoline/diesel pump or generator is better suited for pumping operations. The advantage of fuel/generator-powered systems is that the centrifugal pumps that they use move large volumes of water very quickly. As well, these systems are quite common and readily available at most hardware and farm equipment stores. The disadvantage is that they require considerable maintenance. The motor needs to be started manually to begin pumping, the gas tank needs refilling and periodic motor maintenance is required. Another disadvantage is that in addition to the cost of the fuel pump or generator there is the cost of fuel for each gallon of water pumped.

HAULING WATER

Hauling water is a very flexible option for supplying water for livestock but can be time consuming. When hauling water it is practical to move enough water for a group of cattle in one trip that they will consume in a day. Most farm vehicles, pickup trucks, tractors and wagons can carry 4.5 tonnes (5 tons) or 4,500 L (1,000 gal.). This is about the quantity of water that 50 beef cows drink in a day. The disadvantages with this system are the time required to move the water and the cost of fuel for the vehicles. Also in hot weather the water requirement can triple, meaning more trips.

LIVESTOCK WATERERS

Frost Free Waterers

In locations where livestock require water during freezing conditions, use insulated energy free or heated waterers. Energy free waterers rely on ground heat and water flow to prevent freezing. If sized too small, herd competition and inadequate water supply may result. If too few cattle use the waterer, freezing may occur. Heated waterers require a power source to heat the pipes and water tank. Initial cost of heated waterers is less than energy free, but operating costs make these units more expensive. Also, power must be available to operate the heated waterers.

Water Tanks

Many of the systems discussed earlier will require a water tank or trough for livestock to drink from. Use the livestock water requirements indicated in Table 1 as a guide for tank sizing.

TABLE 1. Livestock Watering Requirements

	L/day	Imp. gal/day
Dairy cow	68–136	15–30
Beef cow	68–114	15–25
Ewe	9–14	2–3
Horse	55	12

Source: Water Management Guide: For Livestock Production, Water Quality and Wildlife Habitat, Version 2, Fall 1998

Considerations

- Galvanized steel, polymer plastic and concrete tanks may be used.
- Determine the tank size used in continuous grazing systems as follows:
  - has ability to hold one quarter of the herds' daily water intake and
  - has a capacity that can be refilled in 1 hour or less.
- Locate tanks away from surface water on level well-drained ground to minimize contamination and reduce muddy conditions around the tank.
- Provide shade for water tanks to help control algae growth and maintain water quality.
- Fit tanks with proper overflow devices to direct excess water away from the watering site to a stable outlet.
- Frost-free watering systems are available for winter use.
- Reinforce the ground around the water tank to prevent soil erosion and keep the area dry. Reinforced systems include:
  - 15 cm (6 in.) depth of gravel over a geotextile fabric (*Figure 11*)
  - 13 cm (5 in.) depth of concrete with roughened surface over 15 cm (6 in.) gravel and geotextile fabric (*Figure 12*).

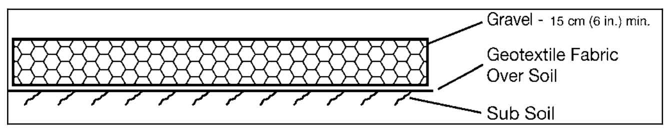

FIGURE 11. Gravel pad around stock tanks and nose pumps.

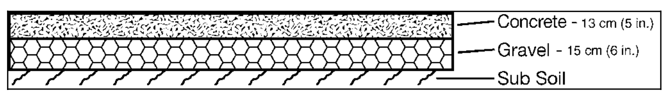

FIGURE 12. Concrete pad around stock tanks and nose pumps.

PUMP INFORMATION AND SUPPLIERS

TYPE	RAM PUMPS	NOSE PUMPS	SLING PUMPS	SOLAR PUMPS	WIND PUMPS
Pump Lift and Flow Rate	Can lift water 3 m (10 ft.) for every 0.3 m (1 ft.) of water drop from source. Low flow.	Can lift water 6 m (20 ft.). Flow depends on animal's aggressiveness.	Can lift water 8–25 m (26–83 ft.) depending on the pump models and number of pumps used. Flow ranges from3,000–6,000 L/day (650–1300 gal/day).	Depends on system purchased and environmental conditions but approximately 900–5,500 L/day (200–1200 gal/day).	Depends on system purchased and environmental conditions but approximately 700–7200 L/day (150–1600 gal/day).
Suppliers	Rife Water Pumps, (U.S.) *www.riferam.com*	Rife Water Pumps, (U.S.) *www.riferam.com*	Rife Water Pumps, (U.S.) *www.riferam.com*	Rife Water Pumps, (U.S.) *www.riferam.com*	Free Breeze. (Can.) Mechanical windmills *www.freebreeze.com*
	The Ram Company. (U.S.) *www.theramcompany.com*	Frostfree Nose Pumps. (Can.) *www.frostfreeno sepumps.com*	Real Goods, U.S.A. *www.realgoods.com*	Kelln Solar, (Can.) *www.kellnsolar.com*	Soltek Powersource, (Can.) Electrical windmills. *www.spsenergy.com*
	Green and Carter, (U.K.) *www.greenandcarter.com*	Jad-Vent, (Can.) (519) 632-7471		Generation Solar, (Can.) *www.generationsolar.com*	Trillium Windmills, (Can.) Electrical and air. *www.trilliumwindmills.com*
	Aquatic Ecosystems, (U.S.) *www.aquaticeco.com*	Ketchum Manufacturing, (Can.) *www.ketchum.ca*		Soltek Powersource, (Can.) *www.spsenergy.com*	Dean Bennett Supply, (U.S.) Mechanical Windmill *www.deanbennett.com*
				Sunmotor International, (Can.) *www.sunpump.com*	Dutch Industries Ltd, (Can.) Air windmills. *www.dutchind.com*
				Ottawa Solar Power *www.ottawasolarpower.c om*	
				T.P.S. Industries Inc. (Can.) (519) 842-7351	

Note: Non-Canadian Companies list prices in their native currency.

REFERENCES

- Agriculture and Agri-Food Canada, Prairie Farm Rehabilitation Administration *www.agr.gc.ca/pfra/water/wpower_e.htm*
- Environment Protection Agency, Private Water Systems *www.epa.gov/seahome/private/src/surface4.htm*
- Water Management Guide: For Livestock Production, Water Quality and Wildlife Habitat, Version 2, Fall 1998
- Watering Systems for Grazing Livestock, Great Lakes Basin Grazing Network and Michigan State University Extension
- Livestock Watering Options in Non-freezing Conditions, B.C. Ministry of Agriculture, Food & Fisheries, Order #590.300-8

OMAF Factsheets

- *Farm Fencing Systems*, Order No. 99-057
- *Fencing of Watercourses to Control Erosion,* Order No. 00-049

This Factsheet was written by **Robert P. Stone**, P. Eng., Engineer, Soil, Resources Management Branch, OMAF, Brighton and **Steve Clarke**, P. Eng., Engineer, Rural Environment, Resources Management Branch, OMAF, Kemptville.

Do you know about Ontario's new Nutrient Management Act?

The provincial Nutrient Management Act (NMA) and the Regulation 267/03, as amended, regulates the storage, handling and application of nutrients that could be applied to agricultural crop land. The objective is to protect Ontario's surface and groundwater resources.

Please consult the regulation and protocols for the specific legal details. This Factsheet is not meant to provide legal advice. Consult your lawyer if you have questions about your legal obligations.

For more information on the NMA call the Nutrient Management Information Line at 1-866-242-4460, e-mail nman@omaf.gov.on.ca or visit www.omaf.gov.on.ca.

Factsheets are continually being updated so please ensure that you have the most recent version.

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