For every litre of milk produced, a cow needs to drink at least three litres of water. For high performing cows that's 150 litres of water a day. If consumption reduces, the amount of milk a cow produces decreases.

Lower water consumption can be caused by water having excess iron and/or manganese (common in Waikato and other high rainfall acid parts of NZ), being too hot, too cold, dirty, affected by electric shocks, bossy animals standing at the trough, an electric fence wire going over the trough, or insufficient supply.

Proper construction and continued maintenance are keys to the safety of your well or bore water supply. Your council water-well contractor licensing agency, local health department, or local water system professional can provide information on tank construction.

The well should be positioned on the surface and shaped so that rainwater flows away from it. Rainwater can pick up harmful bacteria and chemicals on the surface. If this water pools near your well, it can seep into it, possibly causing health problems.

Water-well drillers and pump-well installers are listed in your local phone directory. The contractor should be bonded and insured. Make certain your ground water contractor is registered or licensed for your area, if required. If there is no licensing/registration program contact the National Ground Water Association. They have a voluntary certification program for contractors. (In fact, some states in USA use the Association's exams as their test for licensing.)

To keep your well safe, you must be sure possible sources of contamination are not close. Experts suggest the following distances as a minimum protection.

- Septic Tanks, 20 metres. I'd prefer much further away.
- Livestock yards, Silos, Septic Leach Fields, 20 metres. I'd prefer much further.
- Petroleum Tanks, Liquid-Tight Manure Storage, Fertiliser Storage and Handling, 50 metres.
- Manure heaps or stacks, 100 metres. On concrete increases the distance, but can be a risk of water running off them, in heavy rain.

Many forget maintenance until a problem occurs which can be expensive. Keep up-to-date records of well installation and repairs, plus pumping and water tests. Such records can help spot changes and possible problems. If you have problems, ask a local expert to check your well construction and maintenance records. They can see what needs work, possibly before owners. Make sure that managers and share milkers are informed about necessities.

Regularly check underground storage tanks that hold home heating oil, diesel, or petrol. Make sure your well is protected from the wastes of livestock, pets, and wildlife.

Many companies today are making no profit, so beware of spammers in all fields who exaggerate to sell. Ask for names of five successful users. Firstly, ask them if they are agents.

Hamilton City Council water had 3 ppb of arsenic according to Hill Lab. Waikato River has 27 ppm of arsenic, 5 ppm of mercury, and E. coli that goes up and down depending on when dogs swim in the Waikato River at the Narrows where they are allowed to swim which is not allowed on farms - another farm rule, not applied in towns and cities. Some of these are averages are from several tests.

Water	Location	Compatibility	Hg	Cd	Mn	Al	Fl	Cl	NO3	Mg
Hamilton	Ellerslie Ave Tap from Crosby Rd	5	15	20	12	6	12	20	10	2
Hamilton	Ellerslie Ave $400 filter	50	15	20	12	6				
Hamilton	Te Rapa Tap as is	10	15	20	12	6				
Hamilton	Ellerslie Ave Tap hot	73	3	20	12	6	2	2	4	
Auckland	Mt Wellington Tap as is	10	10	10	15	5				
Hamilton	Ellerslie Ave Amway E-spring filter	70	0	0	0	0	0			13
Kaiapoi	NZNatural As is	80	0	0	0	0				5

After seeing the above I suggested that a very unwell friend change to the best bottled water after

which he wrote, “Things that improved after changing to good bottled water, are joints, heartburn, thinking, and less fatigue.”

Years ago, we checked most of the bottled waters available and chose Kaiapoi NZNatural that was perfect in compatibility and its heavy metals were zero, while it still had magnesium and other good minerals. Then in March 2016 it tasted horrible, and compatibility dropped from 80 to 25, so we stopped drinking it, and drank our Amway E-filter water which is filtered Hamilton water. Compatibility is 80 and all toxins including fluoride, are removed, but magnesium is not removed, which is very clever. It was developed in USA after they found that all their 300 rivers contained more mercury than suitable for human consumption.

Compatibility is for the person being checked. 1 is poison and 100 is perfect. Anything below 50 should not be consumed. The system even analyses the container. Glass is the best, followed by virgin clear plastic as used by Lewis Road Creamery, as opposed to recycled plastic, usually white, which can be from Roundup or similar used drums. Recycled, dark-coloured plastic containers are the worst, so avoid buying foods and liquid supplements such as honey in them. Glass is best and clear virgin plastic a close second.

Some cities that sell all water through metres find that 30 to 40% is lost in leaks. Some councils have a staff member whose sole job is finding leaks. Hamilton doesn’t, so I did so in our area where five million litres per annum were running to waste in the gulley behind us all year. Flow increased after rain, but didn’t get below five million in prolonged dry weather. Clothes washing froth every Saturday morning indicated that a couple both worked and had faulty plumbing. After notifyng and threatening fines to all home owners in the area, and explaining how bad plumbing was a cause, the leaks ceased completely.

Lake Taupo, has a thousand septic tanks around it. In 1999 the Waikato Regional Council in its usual manner blamed dairy farmers for the pollution of Lake Taupo. I checked and there were only five dairy farms that could possibly affect the lake, and they weren’t close or doing it. I asked Waikato Regional Council if they had checked the septic tanks around the lake, some of which were old. They had not, but still blamed farming. Their boss didn’t know that algal bloom is caused by a lack of aerating water which builing nine hydro dams on the Waikato River causes.

Not many know that the Blue Springs water comes underground from Taupo. If you buy it, muscle test it, and or get it analysed.

Farmers are being blamed for the Waikato River water’s algal boom, which is caused by the water not being aerated which rivers and streams flowing over rapids do. There were many rapids before the dams. Arapuni was all rapids. The government building the nine hydro dams on the cheap, didn’t do what most countries did, which is to aerate the used water. In many countries I’ve seen the water after generating power, sprayed up. One in Australia had created a rain forest next to it.

See hundreds aerating their water. Use the free Google Chrome. It is far better than Safari.

https://www.google.co.nz/search?q=Photos+of+hydro+dams&espv=2&biw=1011&bih=711&tbm=isch&tbo=u&source=univ&sa

Dairy and beef farmers are producing food, so clean drinking water is essential and, with today’s technology, this is possible on most farms, either by sourcing better water, or purifying it. Improved animal health and production can soon pay for its cost of improvement.

There are too many farms with dirty water troughs. Troughs should be cleaned several times a year, either manually or with a trough cleaner that may be able to be hired.

Acid water is not good for anyone, while slightly alkali water can be beneficial for some people, so also for some animals.

During droughts in some areas, farmers run out of water before they run out of pasture. These areas usually rely on a number of dams on the farm, but quite often it is better to install and extend reticulated water pumped from a bore or gravitated in pipes. To increase the flow of water into these dams, one can install water furrows. One on our Greytown, South Africa farm, came from a large permanent source a mile away into a dam at the top of our farm, from which we irrigated. Contour banks or diversions can feed dams. An erodible soil should have less fall and a higher bank to carry the water. A non-erodible soil can have 4% or more slope, so the water flows faster, and a smaller bank, making it cheaper to construct. A disc plough or grader blade can be used to make them. Before starting, seek advice and use a surveyor to ensure that falls are right and that there are no hollows

where water can run over and be wasted or cause erosion. In some areas, permission now has to be obtained before installing drains, dams, bores and water furrows.

Animals need more water

- Soon after milking.
- When their urine becomes stronger in colour, which can be caused by insufficient water and high nitrate and/or high potassium levels in pastures.
- When their urine burns the pasture excessively.
- When their dung gets too tight and dry, so could bind up in the animal.
- When eating hay, grain or especially palm kernel extract (PKE), which I would never feed because of its toxin levels of high manganese and high copper.

Animals avoiding water

If animals walk up to a trough and stand around without drinking - check everything. Reasons include polluted, hot or dirty water, or shocks. Sniffing the water is another sign that it is not quite right. They should immediately bury their muzzles in the water and gulp it down.

Shocks in water troughs have caused substantial drops in milk production, sometimes greater than the loss caused by shocks in milking sheds. Troughs can become live if any earth, live or dead wire touches them from conductive pipes or fittings. For full information on shorts and shocks on farms and in dairies read Fencing. Meanwhile, avoid having your dairy farm along the line that shorts take from the majority of your fences to the earth (ground) system, because currents can flow through the dairy and through your cows without you knowing, but the cows will know, and reflect it in the lower quantity of milk produced.

As dairy herds get bigger, the flow of water to troughs becomes more important. Installing the pipes in a U around the farm achieves a flow to both sides of the trough. If the pipes are buried deeply through the paddocks, to the back of the farm and then up the other side to troughs in the centre of paddocks, they are less likely to get damaged than when next to, or under, the lane fence.

Joins must be perfect and marked on the farm plan. Water should be turned on for a day and checked for leaks, before burying the pipe about 60 cm deep. Gate valves should be installed every few hundred metres and taps in hollows. These allow you to check the flow, flush the pipe, blow the water out in freezing areas, and make additions and repairs, without having to turn off all the water.

Troughs placed in the corners of paddocks are the worst, as animals will have to queue to drink, during which time they'll damage the pasture and create mud, dust and parasite breeding areas, as well as transfer fertility to the area.

With large herds, more troughs may be necessary, especially if under fence lines. Exact numbers of troughs per herd can't be given, because there are so many variables, such as pressure, distance, pipe, trough sizes and locations. Some large herds in large paddocks go to the water source many times a day in mobs and frequently and hang around the water point. Some mobs start by following one animal, while some go in ones and twos as and when they want a drink, and return immediately to grazing or to the pasture. The latter is what they should do. If they don't, it can be because -

- The water is polluted, so they don't like it, don't drink enough and return frequently.
- There is electric current in the water, so they drink only when very thirsty - just enough to quench their immediate thirst - and return frequently.
- They are stressed in some way (predators, mineral deficiency, bad handling, poor pasture) so feel safer in a mob.
- The water source is a long way away from the grazing. The best way to avoid this problem is to have the water in the middle of the paddock and, of course, correct the cause of the stress. Read your animals.

In small paddocks, where animals don't have to walk far to the trough, they may drink individually several times a day. In very large paddocks, and where water troughs are up a lane, animals will graze in a group and drink as a group. This necessitates a larger trough, because they will fight over which drinks first, and some will start leaving before the last animals have drunk, causing others to follow without having a drink.

Adding elements to water for health reasons, such as bloat products (read Bloat for easy control) and zinc for facial eczema, (read Facial eczema to see that there is no need for zinc) can cause

animals to hesitate. Break them in to new additives gradually over a week or more. Good, complete, soluble minerals like Solmin, make water more palatable to most animals. It has nine elements, including salt, which most animals like in optimum amounts. Calves will rush up to drink after they see it added to a water trough.

Aims

Aim for minimum animal walking distance to water. Ideally this would mean troughs towards each end of each paddock, or in the centre, but this is seldom achievable and not always advisable, because, when break feeding, it can be beneficial if the trough is near the gate. Also, animals quite often like having a drink as they arrive and leave the paddock, so at least 15 metres in from the gate can be a good position, as long as it is elevated on a rise or by creating a mound for them.

Animals should be able to get right round troughs, so that more can drink at the same time. Troughs under fences (especially electric ones) limit the number that can drink. Small troughs under a fence can limit it to only one animal.

A crucial aim with water is to avoid polluting it and the areas above or near it. All excess water-soluble minerals in fertilisers, such as superphosphate, nitrogens and sulphates, run or leach into waterways and aquifers from soils, even when growing native forests, commercial trees, crops and/or pastures. Fertilising grazed pastures, even with low rates of artificial nitrogen, increases leaching, because more animals are grazed and most of the leaching occurs from their urine patches. It becomes a problem in pastures when animals are heavily stocked, too often or for too long.

In most countries, it is the urban areas that are polluting the most. It was found that more N leached from USA fertilised city lawns than from their farmed pastures. Milwaukee farmers were blamed for the crypto-bacteria in drinking water, until an analysis showed the crypto came from wild Canadian geese, not from farmed livestock. Ducks are causing pollution problems in New Zealand on Hamilton Lake, pastures, water troughs and small dams. Reducing their numbers is the only solution. The Waikato River in New Zealand is cleaner now than both 10 and 50 years ago, except for mercury from the Wairakei deep bore water generating and and from Kinleith paper plant. The Waikato River E-coli increases from dog pollution from the towns that rivers run through. Dogs are allowed to swim in Hamilton and other city rivers.

In Hamilton there are hundreds of human effluent leaks and storm water into sewerage (called ‘waste water’) pipes, but no prosections. Many urban organisations pollute, but are not fined, but farmers in many counties have been fined for polluting water just once, one $70,000 in 2012 for clean storm water running over the top of his Waikato Regional Council designed pond.

To reduce excessive N leaching from farm urine patches, avoid heavy irrigating or effluent application for three days after animals graze a paddock. LimePlus, is not a commercial product, just a name I use for agricultural lime and other elements shown to be deficient on the farm in leaf analyses, and helps deepen and keep soils moist, helps urine spread through the soil, so reduces its leaching effect and grows more pasture. For more information see Minerals > Calcium.

Before buying a farm, check the location of the farm’s and neighbours’ rubbish dumps and offal disposal sites; they should not be within 100 metres of any water supply, body of water or property boundary. Their bottom should be at least 0.6 metres above the winter ground water table. In peat and large fault areas this depth can be difficult to comply with. Also, check for locations of old dips, where cattle or sheep have been dipped or sprayed against flies, and where the old containers have been buried, as has occurred in the past.

Offal holes are not a good idea on peat. It is better to bury offal in a dry area below cultivation depth, keeping in mind that peat sinks. There are many cases where water is being polluted by offal holes, soak holes, septic tanks, barrier ditches and oxidation ponds. Avoid having these and wintering pads anywhere near bores or wells. Try to have them downstream, not upstream of yours and neighbours’ bores. Even under peat, water moves in specific directions, usually the same as the surface drains, but not always. Underground flows (water movement) usually move to valleys and rivers.

We drink Kaiapoi NZNatural water from Canterbury which is perfect with no toxic minerals, but it did fail in February 2016 and then got better after a few days. We emailed them, but got no reply, which is typical from large companies. It could have been from a bad batch of plastic.

Reservoirs

Install a visible float protruding above reservoirs and a pressure gauge where you'll see it several times a day, even if it means putting a T in the pipeline and a length of pipe to get the gauge to where you'll see it. There are systems that warn by cellphone of decreases in farm water pressure. A Waikato dairy farmer, driving over the Auckland harbour bridge, had his cell phone warn him that the water pressure on his farm had dropped. He phoned his neighbour who agreed to find and fix the problem and the farmer continued on his holiday.

Before installing troughs, draw a plan aiming for the optimum layout. If troughs are already installed, still draw up an optimum plan.

Troughs in the wrong place can be costly, causing -

- Lower animal production.
- Pasture damage from congregating around troughs, and from paths to and from them.
- Weed growth along the paths to troughs.
- Fertility transfer to troughs and paths.
- Animal manure at troughs and paths, soiling animals as they use them. Soiled animals attract flies and other parasites, and produce dirty meat and milk.
- Animals going in groups to drink, when troughs are some distance from the grazing. When they go in groups they congregate and pollute the area around the trough more than when troughs are, say, in the centre of a paddock. The polluted area breeds parasites, weeds thrive, the soil becomes bare and compacted, so subject to water and wind erosion, and production is lost.

Sewage & waste

This should be treated in septic tanks with soak-aways to the soil and local by-law standards.

Oxidation ponds should be at least 200 metres from any boundary. I'll write no more about these, because effluent irrigation is the only way on peat, and is best on all soil types, but when rain is excessive, effluent has to be stored and spread later.

Toxic wastes or hazardous substances (chemical residues or containers) must not be buried or disposed of in farm dumps or holes; they should be taken to appropriate depots.

Fence water sources to ensure no animal pollution enters and that no animal can die in or near the water.

Effects of polluted water

Fast algae growth in water troughs could mean the water has a nitrate content, or the algae is growing on the sediment, fertiliser, effluent when spreading it, and bird droppings. Having the water level far enough below the rim prevents small birds drinking from troughs and then turning around and polluting the water. Reduce duck numbers and don't allow dogs to jump in the troughs. Wash troughs out at least every six months.

Know the depth of your bore, cover the top, and check the casing is not rusted and leaking, which can allow surface water to run down the side with any pollutant and enter the bore water with air, which causes oxidation (oxygen entering water releasing iron so turning the water brown).

Feeding Solmin, a nine-element soluble mineral mix, through the watering system will keep your troughs and water cleaner. However, they should still be cleaned, preferably before young stock go into a paddock, and if not been used for months, because most algae which grows in them has endophyte and is toxic, especially to calves.

Cows drink a lot of water, so if it is dirty or toxic even slightly, they'll drink less and produce less. Some animals are fussier than others, so those that don't drink enough when bloat oil is being used can suffer bloat. Most animals prefer water containing a good soluble mineral mix, so don't drink from other sources such as rain.

Nitrate polluted water increases algae and weed growth in troughs, rivers and lakes, affecting the use of water for irrigation and recreation, and reduces fish numbers.

Calcium sulphate (gypsum) can clear murky water in small lakes or ponds, but would not be practical in large multimillion gallon dams. The quantity to use depends on the amount of water and degree of suspension. Do a trial in a portion of the lake.

It pays to get the farm water tested for all contents at least every five years. If in New Zealand, contact Hill Laboratories, who will give full instructions on taking samples. They have special

containers and a form to complete and send in with the water to ensure accuracy. Hill Laboratories, 1 Clyde St, PB 3205, Hamilton, New Zealand. Ph +64-7-858-2000 or email fiona.calvert@hill-labs.co.nz.

Otherwise, use a clean 2 to 4 litre glass or virgin clear plastic container, well washed with water drawn close to the source. Run it for a minute before sampling. Hill Laboratories supply them with full instructions.

Uses of water

Water on grazing farms has many uses - household, farm dairy, animal drinking and irrigation. Water needs to meet the standard for each purpose. Household and dairy water needs to be potable (suitable for human consumption); animal water needs to be as good, or nearly so; and irrigation water must not have salts or pollutants that will increase in soils over time and make them toxic and unproductive.

Rain Water

Homes can save rain water and, if insufficient, can get tankers to deliver it. Unfiltered rain water can contain E.Coli, Faecal Coliforms, Giardia, Cryptosporidium and other harmful contaminants. When considering our water supply, we measured ours off the roof. It had N from birds, and Zn from the galvanised iron.

Farm dairies (milking parlours) are producing and handling food, so must have good water for drinking by animals, cooling milk and washing.

Rain water for homes should come from clean roofs and gutters into cleaned tanks, and should have a system to divert the first rain after a period of no rain. Some hardware shops sell diverters.

Tank Vac is a product for keeping home rain water tanks clean. When overflowing during rain, it sucks the water from the dirty bottom. The system lowers the E-coli level in the water. See http://www.tankvac.co.nz .

A cow can produce over 30 litres of milk a day, but she will not do so unless she has access to about three times that amount of palatable water.

Water statistics

- Milking cows drink about two to six times a day, depending on accessibility, temperature, feed type and their milk production. Some robotic milkers use water to draw cows out of the paddock to be milked, with limited success.
- Farm dairies use about 25 litres per cow, per milking, or 50 litres per cow, per day.
- In temperate climates cows drink one to two litres of water for each litre of milk produced.
- Large North American cows have drunk 200 litres when in full milk in hot weather, most of it during the heat of the day, so water flow to day-time troughs must be higher than 100 litres per cow per day, depending on the level of milk production, heat and water temperature.
- 100 cows need 25 litres per minute flowing into paddock troughs, where paddocks are roughly square and cows drink one at a time, rather than move in a mob to the trough, as happens in long paddocks. In these cases larger troughs and a faster water flow are necessary.
- Heifers can drink 30 litres and yearlings 15 litres per day.
- For each kg of dry matter eaten, dry stock drink one litre of water in cold weather and up to three litres in hot weather.
- Heat, dryness, dry pasture and feeding hay increase water consumption.

Heat

When the air temperature in the shade exceeds 32 degrees celsius (90 F), feed intake drops, then animal production. When the water temperature gets above 32 degrees celsius, the amount of water drunk decreases, and animals' drinking behaviour can change to drinking between midnight and daybreak.

If it is not possible for animals to cool over night, body temperatures may still be so high in the morning that heat problems occur, such as metabolic and other illnesses. Heat stress in cows during the last few months before calving can lead to more metabolic problems after calving, and a reduction in milk produced in the subsequent lactation. Excessive heat also adversely affects reproduction.

High humidity also increases animal stress. Animals cool themselves by panting and perspiration, both of which use water.

Sources

Bores (deep wells) deeper than 40 metres (133 feet) usually provide contamination-free water. Christchurch City in New Zealand's South Island obtains most of its water from deep bores, and pumps it through the city without having to treat it. Even under peat, good water can sometimes be obtained from bores near the edges of mineral soil hills, or, if hills are not near enough, sometimes from deep bores into sand well below the peat.

If you have a water quality problem, before trying to improve it with filters, try to source better source, because treatment can be expensive and is a continuing cost. If town water is available or can be obtained by joining in with neighbours, it can be a saviour. All I know who have combined to get a good source of town water have been pleased with the system. Usually a large reservoir is required that fills slowly over 24 hours and a farm pump delivers water to the dairy and troughs. High volume tasks, such as cooling and yard washing, should use the farm water, to save the cost of town water, which is usually metered.

Also, you may be able to work in with neighbours to take power to a good source of water for you all to benefit, but, where good water is unobtainable for dairying, filtration will have to be used. Improved animal health and production can soon pay for improving water quality.

Enquire from neighbours about their success in getting good water, and ask well-drillers who cover the area. Also, ask a local well-driller to check with the regional council, which has records and statistics of bores and wells (depth, flow and quality).

In mineral soils in the Waikato, water quality is sometimes better at comparatively shallow depths, but on peat, the opposite applies. However, deep bores under peat, well into the mineral substrata, don't always give better water.

If you put a bore down, drill a hole larger than the pipe to allow concrete to be pumped down the pipe and back up the sides of the pipe, to make it last longer and to prevent surface water seeping in and running down the side to the water supply. Then drill further down into the water supply. Well-drillers should know the technique.

If bore pipes rust and allow surface water in, pollution can occur. Bore and well-screens are now available in PVC, which are much cheaper than stainless steel, and not subject to corrosion. Have the pipe protrude at least 30 cm (1 foot) above ground and keep it covered. This prevents contamination from flood water or anything else entering it.

Piping, power poles and wires to a good water source are usually cheaper, and are certainly better investments, than filtration systems.

In many intensely farmed and fertilised areas the nitrate levels are increasing, especially where bores or wells are shallow and effluent ponds are used. The desirable nitrate level is zero. If six or higher, it should be boiled for babies. If 10, it is questionable for washing milking machines.

Progressive well-drilling companies and water pump specialists recognise the importance of good water for farming. Phone them and the water filtration people, and decide which one is the best to use by checking their track records with as many farmers as possible in your area. Local ones usually have useful local experience.

Remember that regional council approval is necessary before installing a bore or even digging a well for water, and that dug, open wells are banned in some areas.

They should have fences to keep large animals from damaging and polluting them and have covers to prevent small animals falling in.

Troughs

The installation of water troughs in all paddocks (sometimes two or more troughs per large paddock and large herds) can pay for itself in increased production within a year, so can be a good investment.

In Missouri, USA they found that the maximum distance a milking beef cow could walk, without reducing milk yield, was about 270 metres from the water. It has also been found that pasture utilisation relates to distance from water; at a distance over 240 metres utilisation is reduced. A Wyoming, USA study found that, in paddocks of 800 hectares, over 65% of the forage is consumed

350 metres from the water.

Dry stock farms can get away with poor quality water, but animals don't do as well when water is high in impurities, especially iron, which lowers the animal absorption of some minerals. Filtering out iron improves animal health and milk production. An Indiana, USA trial showed that iron in water reduced milk yield.

Water polluted in any way is not satisfactory for livestock, as they drink less and take longer to do so. This reduces their grazing time and production severely when water is badly polluted. Canadian studies found that clean water did make a difference in performance in the weaning weight of calves.

Adding a soluble mineral mix designed for your farm can help reduce ill effects and benefit animals tremendously.

Large earthmover or similar large tyres, with holes cut so that animals can put their heads in to drink, make low-cost water troughs that don't freeze over as quickly as open troughs. This design also reduces the sun heating the water so much in summer, and keeps out ducks, dogs and most of the dust and broadcast fertilisers. Heat and dirt pollute water, which reduces animal consumption. If they drink less they'll eat less and produce less.

Wash the tyres thoroughly so that animals don't drink antifreeze or other toxins. Put a plug in the bottom to allow draining when washing and to prevent freezing. In this case they would need to be mounted up on something to allow drainage and getting at the plug, unless it is in the tyre. Old baths can also be used.

In freezing areas where water has to be heated, use something like an old household freezer, half buried, as a trough. This will reduce electricity use, as you can close the lid at night. Anything that can burst if frozen should be protected or drained.

If your water comes from a public supply, then you should have a non-return valve (one way valve), to stop water returning into the supply system from half open ballcocks. Or, if it is your own supply, to stop water running from troughs back into the house and dairy supplies.

When laying the water pipes, to save having to blow the water out before winter freezes, it is advisable to have breather taps on the tops of all the rises, and drain taps in the bottom of all the hollows, so that these can be opened, rather than having to blow the water out. Where the pipe is buried, use self-draining taps in the low places - taps which can be opened and closed with an extension handle through a 15 cm diameter (six inch) pipe, to allow access and drainage. The vertical access pipes in these situations will all have to be covered to reduce the risk of cold air getting down and freezing the tap. If dirty water with a high iron and/or manganese (Mn) content blocks pipes, include valves and outlets for using compressed air to blow the sludge out.

Test the pipes for leaks before burying them. If you suspect leaks but can't find them, add red food grade colouring through your dispenser, then, a few hours later, walk the pipe lines looking for coloured water.

Always have a larger protector pipe or cover under roads and lanes, otherwise the weight can flatten and/or damage the water pipe. A mole or worm can be used to bore under roads, or a spear point can be made to go in the end of a PVC pipe to drive it under the road.

Trough sizes & types

Large paddocks need large troughs because animals will move in groups to drink. Small paddocks should have small troughs, because animals will drink individually when required, and not cause all the others to follow and drink at the same time. Two small troughs in any size paddock are better than one large one, because they reduce animal walking, are easier to clean, don't get as hot, and pugging and dust is reduced around them.

Water troughs can be made from large old tyres with one side cut off at its thinnest point with a chain saw. Don't try this with wire filled tyres. Lay the pipe so it comes up through the centre of the trough. Also, install an overflow pipe a few inches below the top and have it take overflow away, so mud is not created around the trough. It should be 38 mm (1.25 inches) or larger. Create a crowned (inverted saucer) pad with gravel, or, if not available, use soil. Pour concrete at least 15 cm (6 inches) thick to fill the base. Pack the concrete down well so that it is strong and tight against the tyre to prevent leaks.

Inlet pipe size depends on your water supply and animal numbers. Low pressure gravity may need 25 mm (1 inch), while a high pressure system would be better with 20 mm (0.75 inch) or less.

Ballcocks or valves should be full-flow ones, but most of them can block or jam with sand, so screening would be necessary. With low pressure, you can make a full-flow valve using a rubber ball in a cage which floats up to the pipe, which must face down.

Small troughs of about 250 litres (55 gallons) with a high pressure water supply and placed away from fences can supply about 100 milking cows.

Trough ballcocks

There are a large variety of ballcocks available, and generally the simple ones provide the best service. There are high or low pressure ballcocks, and some which can have a centre unscrewed to convert from high to low pressure.

When setting the height of the water in the trough, ensure that it is about seven to 10 cm below the top of the trough, to prevent small birds drinking the water, and then turning round and messing in it, as this is a way of spreading coccidiosis and growing algae in the water.

Discourage your dogs from jumping in the water troughs, because they can damage ballcocks and make the water dirty, causing animals to drink less, with obvious results. Dirt left behind will encourage the growth of algae.

Position of troughs

When animals queue at troughs, bossy ones tend to drink first, then relax at the trough, preventing others from drinking. I witnessed this example at Ruakura where the first animal took 12 minutes to move away, which lead to a 45 minute wait for the last cow. Cows should not have to queue like this to drink, especially in hot weather.

Small troughs under electrified wires can also cause this. Even if wires over troughs are not electrified, cows accustomed to electrified wires may avoid them, which reduces drinking space. A shock while drinking is severe and the animal may think it came from the water in the trough. Using double insulated cable or threading the wire through black (lasts longer in the sun) polythene water piping protects the animals.

Troughs are best placed in the centre of paddocks to reduce walking, allow four to drink at once, and eliminate the need for a live wire over the trough to shock and frighten animals. Placing the trough in the centre of the paddock also helps when mowing, fertilising, etc., as it's easier to go around. The pipes will have to be trenched in deeply so that cultivation doesn't damage them. Trenchers can sometimes be hired, or a farm grader blade on an angle can do it in several cuts.

Troughs should be 30 metres or more from a lane and/or gate to avoid increased pasture trampling.

Set the troughs on a very slight slope facing the lane so that any overflow is visible from the lane.

Trough cleaners

A yard broom and an old four metre soft siphoning hose from a milk tanker can be used, but a vacuum-type liquid manure spreader is better. There are motorbike driven and tractor power take off driven pumps which empty water troughs. Complete trough cleaning units can be hired.

Gold fish or similar in large water tanks and troughs keep insects and algae down, but in small troughs they can suffer from water getting low, over heating in summer and freezing in winter.

Copper blocks in water troughs help keep the water clean, but don't use them in sheep troughs because sheep are allergic to high copper levels, and don't overdo them in any drinking water, especially if feeding Palm Kernel Extract because it is very high in copper. See Copper.

Feeding Solmin through a dispenser reduces algae buildup, but not if the water is bad, the troughs are not cleaned, fish oil or other oil feeds are added, or effluent enters from travelling irrigators.

Water trough covers can be used when spreading effluent. They are available from some farm stores or manufacturers, Sweetmans Ltd, 12 Main Street, Huntly, New Zealand. Ph 07-828-7462. Fax 07-828-6589, sweetmans.of.huntly@xtra.co.nz or http://www.sweetmans.co.nz

If you and your staff won't clean troughs, then get a commercial cleaner, or there are lots of unemployed, and or children wanting income.

Analysing water

A mineral water analysis measures the levels of minerals such as iron, sodium, potassium, chlorine, copper, zinc and boron, as well as nitrate nitrogen and manganese, an excess of which can cause Parkinson's disease or similar. A Waikato farmer friend died of it, possibly because his farm water was high in it. Most who work in Mn mines get Parkinson's. In New Zealand, avoid taking as a supplement, or feeding to animals, anything containing Mn. Too much Mn can cause stress in animals (which has then stressed farmers), and it can be high in some soils, especially if acid and under-drained. Most of USA and UK are low in Mn. See Elements in Soils, ... Manganese and Human Health Elements > Manganese for full details.

An analysis also determines water hardness, pH and conductivity, which are all factors in human and animal health, and in determining the likelihood of water being corrosive to pipe fittings and water heater elements, or to the possibility of pipe scale build up. Build up on heater elements slows down their speed of heating, which then uses more electricity.

Testing laboratories prefer a litre of water to come in a sterilised bottle, kept cool in a chilly bin to reduce pollution and effects after sampling. However, if you boil the bottle, then collect the sample from a tap (run it first) close to the source and get it to them fairly soon after, the results should be accurate. Good testing laboratories will comment on test results to assist in their interpretation of microbe and mineral levels.

If you live in a house that has copper piping, take a sample in the morning and get the copper level measured. People have died from copper poisoning after repeatedly drinking water that sat in the copper piping over night. Also measure iron, manganese, etc, using Hill Laboratories, 1 Clyde St. Hamilton.

Microbes

These can have more serious affects for stock and human health than mineral excesses. A major cause of scours in dairy calves is the activity of the microorganism Cryptosporidium, which is a water borne parasite. It can cause diarrhoea in humans, so particular care should be taken to wash hands after tending animals.

A standard microbial water test does not test for every potentially harmful microbe, but measures a range of them, the presence of which indicates the likelihood and source of others. For example, some indicate pollution from surface water runoff, while others are from ground water sources which could be from a leaking bore casing. Some microbes can cause relatively minor problems, such as taints and odours, while others can indicate high risk problems such as salmonella.

Where a problem in bore water is due to surface water entering the casing, a well driller might only have to grout some concrete around the pipe and chlorinate the bore.

Ensure that all water sources are protected from animal pollution.

Iron bacteria

Iron can be present in water, either in a completely dissolved (soluble) form, or in an oxidised (rusted) form. In its dissolved state, the water is usually clear, but, once exposed to air, it oxidises and gets a rusty brown tinge. In its oxidised form, iron is no longer soluble and should settle, but, where water has a high suspended-solids content of very fine clay or organic matter, as in peat water and some others, the iron oxides will stay in suspension and not settle or even filter out, so needs filtering.

Iron bacteria live on the dissolved iron present in water, creating a slimy sludge that blocks pipes and stains things. The slime is a mixture of both the iron oxide and the by-products of iron bacteria.

If you don't filter out the Mn and iron, animals will stress from high Mn and lowered Cu.

Minerals in water

Some waters have to have iron and other mineral deposits filtered out of them, and some have to be aerated. Before investigating water treatment, investigate a better source of water, a deeper bore, or one in a better position. It could be cheaper and far better in the long run. Treating poor water is seldom straightforward, because waters vary so much. There are many ways in which to improve waters, including ultra violet systems to kill bacteria.

There are many filtering and aeration systems on the market - check them ALL and don't believe

the sales people. Ask for half a dozen users names and check with them before deciding.

There are two ways to treat iron waters. One is to prevent the iron from oxidising in the water by keeping air out of it. The second is to oxidise the iron present and then remove the precipitate to prevent iron in water from oxidising (combining with air) further. The water supply is dosed as near to the source as possible with a completely harmless chemical, by means of a precision dosing meter. A polyphosphate chemical works by 'crowding around' unoxidised iron molecules in the water, therefore preventing oxidation from occurring. This treatment is suitable for iron contents lower than 5 ppm.

Oxidising the iron by spraying water through air and filtering out the precipitate is an effective system, except where water is of low or high pH. Aeration is a relatively inexpensive and simple method of iron removal, requiring low maintenance. The water must be atomised, because fine water particles give the greatest iron oxidation. This means using spray nozzles to match the flow.

Mist sprinklers are ideal; use more for higher flows. The aeration chamber into which the water is sprayed must have a good air flow, to allow carbon dioxide to escape and oxygen laden air, necessary for oxidising the iron, to enter. Avoid water running down the outside of the system and causing unsightly stains.

There are chemical oxidation systems using strong oxidants, such as sodium or calcium hyperchlorite, or potassium permanganate followed by sand filtration. However, these systems are usually complicated, and a malfunction could result in poisoned stock.

With iron bacteria and iron concentrations of less than 1 ppm, disinfecting to reduce the iron bacteria populations is usually all that is needed to rectify the problem. A household chlorine bleach is a powerful bactericide. Mix one litre per 200 litres of water and pour it all down the well at a time when you can leave it without pumping for 12 hours (over night in winter). Then pump the water to waste until chloride levels drop. Install a valve and tap before the pressure tank to prevent chlorinated water getting into it.

Calcium hypochlorite (HTH) can also be used at 15 ml per 200 litres, but be very careful with mixing and follow manufacturers' instructions, or violent reactions can occur.

Algae

When producing food, it is illegal to add unapproved items to the animal's drinking and dairy wash water. If algae are a problem, try approved copper sulphate at low rates. Avoid using too much, especially if sheep could drink the water. Young animals are more susceptible to excesses, and can scour badly. To see if it works, and how much is needed for your water, try it in a drum or bucket of water.

Algae can kill. They contain endophyte, as in some grasses, are worse in hot weather, in dirty troughs, in water from drying-up dams, and in some drains. Already polluted water that gets warm from travelling long distances in pipes on or near the surface is worse. Burying the pipes reduces this, but can be a nuisance when adding to the system or looking for leaks.

Laying pipes under fences, and allowing grass to grow over, helps keep water a bit cooler.

Wash water troughs regularly and use a soluble mineral mix. A copper block can help, but not in sheep troughs because they are allergic to high copper levels. Adding a soluble mineral, such as Solminix, can help reduce this with absolutely no detrimental effects, and can benefit optimum animal health and production. Troughs must still be cleaned though, especially before young animals drink from them. Don't expect your animals to drink water that you wouldn't.

In summer, troughs should be cleaned more often, and should always be cleaned before calves go in to a paddock. If salmonella, or similar, gets into troughs from ducks or other birds, it can multiply in the warmer and often dirtier water. The dirty condition of water in drinking troughs will cause animals to drink less than is required for production and health.

E-coli has been found in water troughs on numerous farms in USA. It can persist for months in trough sediments and can even multiply, so troughs should be washed thoroughly and regularly.

Hay blown into this trough caused severe coffee-like scours (diarrhoea) in four-month old calves. After cleaning it, the scouring stopped.

Fast algal growth in water troughs can indicate nitrates in the

water, or sediment, fertiliser and/or bird droppings. Reduce duck numbers and avoid fertiliser entering troughs. Fertiliser should not be spread near high fertility areas such as around troughs and gateways.

Not all algae are toxic, but most are to a degree. It depends on the age of the animal (young ones are more susceptible), time of year (it is worse in hot weather), age of water in troughs, dams and slow running, drying rivers, and the concentration. As the water becomes more polluted with algae and warms up in summer, nitrate toxicity becomes an additional problem. Algae can have toxic endophyte, like some grasses have. Cattle sometimes die in Queensland, Australia, when they drink from rivers which stop running in summer droughts and algae increase.

Some waters are satisfactory at the source, but deteriorate when stored and/or pumped, especially if air is sucked in through a worn out, leaking reciprocating pump gland and mixed with the water, which feeds the iron and causes sludge growth, which can block pipes. Tanks and drinking troughs can then become filthy, slimy, infectious messes.

Algae is also increasing slightly in the Waikato River Hyro dams because the water is aerated only once in the Huka Falls. In most other countries hydro dams aerate their water. See

Waterways, swamps & lakes

Avoid animals drinking from dams and waterways because they damage banks and pollute the water, which increases algae growth. Boggy drinking areas breed and spread liver fluke and leptospirosis.

In the 1970s, in Italy, it was shown that planting deep rooting poplars along waterways took up some of the nitrogen from soil levels lower than pastures could reach, which reduced it entering aquifers and lakes. One row can be planted initially and another planted some time later, but well before the first row is harvested. They can help reduce pollution and algae growth. See Elements > Nitrogen.

In USA, it was found that from adjacent wooded areas with livestock excluded, nitrates in surface runoff were nearly twice as high as from pasture. Also 25% of the rainfall in the wooded area ran off, while only 17% ran off in pasture, so it appears that sparse trees, with a pasture base, are likely to do the best job in reducing nitrates entering water. Applying this theory could help reduce the pollution of lakes.

Trees are claimed to hold banks of waterways, but many farmers have reported that grass does it better, because trees, especially too close together, can shade and kill surface vegetation and increase surface erosion.

Some local bodies have requirements which should be checked and obeyed, but in the long term, all are likely to require waterways to be fenced off.

Filtration

A low price filter is not likely to work very well, but some high priced ones are over-priced, so before spending a cent, try to get better water, which could be cheaper and better in the end.

Ask locals and farm stores for the name of the best water diviner in the area or do a Google search for your town and country, plus “farm water filtering” or “farm water treatment”. Remember the rule that if a contractor, technician, etc., can start tomorrow, they may not be as good as one who is booked up for a week or a month.

I didn’t believe in water diviners until we bought a second farm, which had excellent water, and noticed several un-used bore pipes around the pump shed, so asked neighbours, and found out that water had been drilled for several times with no success, and then a diviner used who found excellent water only 20 metres from the pump. Our first farm had dreadful manganese and iron water. The new owner got a diviner, found good water half a kilometre from the cow shed and put power back to the site, which worked very well.

Giardia is a microscopic creature which infects about 200 million people worldwide each year, making it one of the most common causes of waterborne illnesses. According to the Environmental Protection Agency, Giardia may be found in practically every lake, stream, river, or pond on the planet. That's enough to give pause to backpackers everywhere. Even more worrisome, the parasite threatens the water supply of many cities, towns, and villages throughout the world.

Filters

For farms, a $14,000 one for less than 200 cows, or two of them for more, which an owner is happy with.

Aeration and sand filtration has benefits other than just the removal of iron.

The aeration process will gas off dissolved carbon dioxide, helping raise the water pH. Carbon dioxide dissolved in water creates carbonic acid, which is very corrosive to hot water cylinders and copper fittings. The blue tinge in water seen when a hot water tap is first turned on is due to dissolved copper, a sign of a corrosive water situation. Acid water is not good for animals.

Aeration and sand filtration also help remove bad odours and tastes from water, because of the gassing off of sulphurous odours and the removal of suspended solids.

Manganese (seen as black sludge) behaves similarly to iron and can also be removed from water.

Iron sand filters require regular back-washing. The overflow will start running when the filter bed gets too clogged, indicating the need for back-washing. Leaving back-washing too long will drive the iron oxide too far into the filter bed, making removal of the oxide sludge very difficult. With time, this decreases the filtration capacity, requiring more frequent back-washing. If iron oxide sludge is found any deeper than 10 cm in the filter bed, increase the frequency of back-washing.

Requirements for back-washing are high water volume and low water pressure. A single stage 2.2 kW (3 hp) wash-down pump operating on open discharge is ideal. High pressure can blast a hole in the filter bed and cause reverse tracking.

Fully automatic back-washing of filtering systems using a simple time clock that starts the back-wash pump.

Home Filters

There are many household filters advertised in New Zealand. We bought an expensive at the time ($600) one from a large reputable company, that has two filters and claimed to remove fluoride, mercury, chloride, giardia and other minerals, and the smell of town chlorinated and fluoridated water. However, it didn't, nor did it remove all the mud which showed in a testing system.

Mn can be filtered out by an eFilter Amway water filter. We have one and several farmers I know have them couriered from Te Awamutu Ph 07 870 2102. They remove more than 140 contaminants including fluoride, chlorine, mercury, lead, pesticides, giardia and cryptosporidium yet retain the beneficial magnesium and calcium. Email kirkmarg@xtra.co.nz

We have an e-Filter and would not like to be without it.

We tested its water and was amazed at how it removed heavy metals from Hamilton City water, which had mercury, E coli and manganese, but left good ones like magnesium in.

We tested its water after a year when its beeper indicated to install a new filter, and its water was still perfect.

Two local farmers with very bad iron and manganese bore water are very pleased with theirs.

It was designed in USA after they found that all 300 USA rivers had become unsuitable to drink because of USA mercury pollution.

An Electronic E-Spring water filter from Margaret Kirk, 502 Cambridge Road, Te Awamutu, 3800. Ph 07 870 2102

We bought Amway E-Spring water filter 22 August 2013 $1,600.

Installing cost $100.

Removes E coli, fluoride, mercury, giardia, etc., out of Hamilton water.

Plumber Installing cost $100 or Margaret guides installation by phone at no charge.

eSpring removes more than 140 contaminants including chlorine, mercury, lead, pesticides, giardia and cryptosporidium yet retains the beneficial minerals magnesium and calcium. Installing the unit will give you 5,000 litres of filtered water for 19c per litre in the first year and 5c per litre in subsequent years after just the filter is replaced. There is an under bench model for $1,647 or $1,565 for one that sits on top of the bench. Both include free postage around NZ including rural deliver using your normal rural postal service.

Water Treatment

Chloride is added to some town waters at a maximum of 1 ppm. The maximum safe level is 3 ppm. It can release methane, too much of which can cause health problems, but there is, to my knowledge,

no more thorough or better long term water treatment chemical. It lasts in water, so keeps it more bug free than, say, hydrogen peroxide, which is not good on mineral organisms, dissipates, and doesn't kill many sub- species of bacteria. It is, however, reputed to control sulphide odours, and be safer and less of an environment problem, but is not as effective in bad waters.

After researching filtration systems, one will see the cost and work involved in filtering water, and realise good water is an asset. In the long term, many areas are going to run out of water before they run out of pasture, so check the supply, and ensure that it can match the requirements of the number of animals the farm can graze. Remember these things when buying a farm, and don't wear rose tinted glasses, i.e., don't be influenced into buying a farm because of the extravagant house, beautiful trees, good location, or any other superficial non-profiting attraction.

See the following for ultrasound water treatment -

http://lgsonic.com/cms/wp-content/uploads/whitepaper_uploadfile_12.pdf

Contact your local body and all water specialists for options in your area.

Building a farm filtration unit

The surface area of the filter is more important than the depth of sand, as most filtration occurs in the top few centimetres. The depth of the filter need be no deeper than 0.6 m. The flow capacity of units will vary with different waters, but they generally work with a flow-to- surface-area ratio of less than 1,500 litres per hour, per square metre of filter surface area. A filter with a diameter of 1.5 m will usually cope with flows of 2,500 litres per hour. Graded sand filter material should be placed so that the coarsest is at the bottom of the filter and the finest at the top. Automatic units are available which back-wash at night.

Treatment options

Start by getting an expert to look at your water and system. You could waste a lot of time and do the wrong thing.

Water can be murky from clay particles or algae. To check which, fill a clear gallon jar and leave it standing for a few days. If the water clears up, and you see sediments at the bottom, then it is sediments clouding the water. If it is still cloudy then it may be algae.

Filtering out clay particles is not easy, because the filter will clog up quickly. Try broadcasting 2.5 tonnes of very finely ground agricultural lime per surface hectare (one ton per acre) over the water, from a boat if necessary. Gypsum does an even better job, but is dearer and harder to get. If unsure, try them in a drum or bucket of water. Don't use alum (aluminium sulphate) because we, and possibly animals, can get too much aluminium, which has been reported to increase the likelihood of Alzheimer's disease in humans.

If treatment must be resorted to, get all the advice possible. All filter suppliers are likely to say that their system will fix your water, but some won't. Some use UV, chlorine, hydrogen peroxide, Ozone (electronic forcing of air into water), or a mixture of processes. Tell them about your water and its analysis, and ask what system they recommend. Try your water through their system to check its efficiency before you spend large sums of money. Either have them install a miniature plant - some will lend you their equipment to try, or make your own by using a small mister garden sprinkler and a 200-litre plastic drum, part filled with filter sand. Slit small drainage outlets in the bottom of the drum. See 'Water Tracking' and 'Inoculating' below. Leave the system going for a few days before testing a sample of the filtered water.

Water tracking

A common problem with sand filtration is 'tracking'. Water takes the easiest path and, if the sprayed (aerated) water is allowed to fall on to one spot of the sand filter, water will track directly down one path with only a fraction of the sand filter surface area being utilised. Use an even sprinkler to ensure that the aerated water falls evenly over the entire surface of the filter.

Inoculating

When starting up a system for the first time, the efficiency of filtration may initially seem disappointing but it usually improves with time. Sand filtration appears to work by attracting dirt and iron oxide at a microscopic level. Once the sand gets a 'coating', this coating then attracts more dirt

and iron oxide. One way to start the process is to inoculate the sand with household chlorine bleach. A litre of this trickled in while the system is running has helped.

Purifying additives

When the best soluble mineral mixes are added into a water system through a dispenser, troughs are kept much cleaner, because algae and bacteria growth are discouraged. See Animal Health for their benefits. There are also products made to place in troughs, specifically to control algae, but they do nothing else. The most reliable and simplest form of adding soluble minerals to drinking systems is an on-line dispenser, which is charged twice a day with the herd's requirements. This system ensures that the herd get their daily requirements without fail, and are not subject to variations in water intake caused by hot and then cold weather.

If a metering system is used, then a double check should be made by calculating how much of each element should be fed each week or fortnight, and a check kept on the meter, to ensure correct supplementation. Facial eczema has occurred in herds where metering systems have not been double monitored.

Sometimes it is necessary to add bicarbonate of soda or chlorine to water systems to improve the water. In North America, some say they are getting increased milk production from treating some waters with hydrogen peroxide, but, as mentioned, it doesn't kill all bugs, and doesn't last.

Be careful with all of these products, because they can poison - some quickly and some slowly.

0.5 ppm of chlorine can reduce algae growth, but soluble minerals are better because they are beneficial and not at all toxic.

Monitor your water flow & quality

Place a pressure gauge in the water pipe where you can see it several times a day to quickly detect an inadequate or failed supply, or low pressure from leaks. The cost of saving one failure is worth it to prevent lowered milk production. Sometimes a gauge in two places can be worth while.

It pays to get water tested for the items listed in the Water Analysis spreadsheet. Considering the time and complexity involved in testing, the cost for a standard microbial and mineral water test represents good value for money. Testing water supplies at least every five years is recommended.

Coliforms and mineral levels should be as in the Water Analysis spreadsheet. However, where some minerals are low in pasture, having some in the water may be an advantage, but not if too high, and not if they make the water too hard, toxic or corrosive.

High nitrates in water will cause algae in water troughs to grow faster than normal.

Pumping systems

There are many types of pumps, but a 1960s design that is becoming more popular is the stator type (rubber compound corkscrew), which can pump reasonable volumes and requires less maintenance than most. It doesn’t suck air into the water, so doesn’t increase sludge. Where sand can enter the water supply, pump maintenance increases, so fitting a sediment tank in the suction line can reduce costs.

Where electricity is not available, there are windmills, hydraulic rams and solar powered pumps. Windmills obviously need wind, but can pump from deep bores or wells. A large reservoir is needed to allow for no wind periods.

Hydraulic rams need a large flow of water and height. They can pump straight into pipe lines, and reservoirs are seldom necessary.

A petrol engine used to drive a pump, which has to be switched off when the tank or reservoir is full, can have an insulated wire coupled to the spark plug and lead to the reservoir. Ensure that the engine is in good contact with the water. Bare the end of the cable and set it at the water switch-off height. When water makes contact it will switch off the engine. This will only work if the engine has coil ignition.

Float switches are available, and work better than the home made system when long distances are involved.

For hand pumps for most purposes see http://www.nzpump.com

If you are unfamiliar with the options, then employ a water specialist or two. The cost can be well recouped by installing the best system. No one person knows all.

Piping

25 mm (1") inside diameter, black, alkathene plastic piping should suffice on farms with under 200 cows. If the water pressure is low, and for larger numbers of cows, increase the pipe and trough sizes. Larger herds need 32 mm (1.25") and very large need 38 mm (1.5").

Having a ring main pipe (water coming from both sides) where possible will give a better flow to the distant drinking troughs and with ballcocks in the line, allow repairs to be done on one side of the farm without affecting the other (assuming valves have been installed), so animals can still get water.

If there is a possibility that you might want to have another cable or water pipe through a long culvert or drain pipe, leave a wire (or non-rust nylon rope) through it, for pulling the new one through.

I prefer the pipes under fences to be on top of the ground because laying is cheaper, easier to add to, blow out, check for leaks, drain and repair. Inform and remind all staff where pipes are so they don't put a spade though them. Grass soon grows over the pipe, which helps keep it cool. If heating becomes a problem because of slow flow and long distances, it may have to be buried deeper than 20 cm.

Piping that is not black (is white or clear plastic) lets in light which can cause algal growth and slow the flow, or even block it, and pollute the water. Carbon in piping makes it black which gives UV protection against the sun's rays, which are very strong in New Zealand's pollution-free air. Carbon conducts electricity, so is a reason why black plastic pipe is not always a good insulator. Small amounts of carbon are used in some electric fence insulators to extend their life in the sun. In New Zealand, the good quality black polythene pipes have lasted for 40 years so far. A clear water pipe laid on our farm in 1956 went brittle and had to be replaced after seven years.

If the pipe is buried in areas which freeze badly, drain taps will have to be down a six inch diameter pipe, to allow access and drainage. The pipes in these situations will all have to be covered to reduce the risk of cold air getting down and freezing the tap. To save having to blow the water out to prevent freezing, it could be advisable to have breather taps on the tops of all the rises, and drain taps in the bottom of all the hollows, so that these can be opened, rather than having to blow the water out.

It costs more to bury pipes, so, if you do, make sure that the diameter is big enough for the future of your farm, because replacing with a larger pipe later is very costly. Also consider -

- Larger diameter pipes are less likely to get blocked.
- Larger pipes have thicker walls which will last longer.
- Objects in the soil can rub against the pipe walls during freeze-thaws.
- She stones can wear holes in thin-walled pipes more quickly.
- Black pipe is more likely to be chewed by gophers, coyotes, rodents, etc., so large pipes are best as they are thicker and harder to chew through.
- White PVC pipe is more expensive but is apparently not damaged by animals as much.

Get advice from your government department or water pipe supplier regarding water flows, pipe sizes, etc., relative to your water pressure and farmed animal numbers. You'll need to know the water pressure at the paddock, the flow in litres or gallons per minute, number and type of animals to supply. See Water Statistics above.

Aim for a fast flow in pipes to reduce heating, which occurs in large pipes with a slow flow. This means having good pressure. Remember, pipe size must be large enough to supply the number of animals concerned. When deciding pipe sizes, allow for a flow of at least 15 litres per cow per hour.

Where tees are fitted to go to troughs, reduce the pipe size to 20 or 25 mm diameter so that if the pipe or trough leaks (most damage occurs near the trough), less water is wasted and the pressure is maintained better in the main line going to other paddocks.

In areas that freeze, polythene piping to all paddocks can be on the surface, and one mobile trough connected in each paddock with quick attachments. Before freezing, all joins should be disconnected and removed because freezing water expands, causing breakages.

Finding leaks in buried pipes and repairing them are big jobs, so leaving them on the surface under fence lines allowing pasture to grow over them can be the best. Putting coloured bloat oil or food colouring through the system can help find leaks.

If piping is buried, install water drains at the lowest points in all pipe lines to allow drainage of sand and to protect freezing in cold winters when water is not used.

When laying water pipes in stony ground, they can be laid through a larger diameter pipe or Novaflo. Bend the end of the pipe over and tie it back to create a V which will push through the Novaflo more easily than a flat cut end. Also, use high density piping in rough, stony areas.

There are fittings and systems to indicate water flows.

Portable water

If piping can't be laid, such as on small farms, leased land, farms with no water source, or where freezing is a problem, a tank on a trailer or old truck can be used as a portable trough. Because the water pressure will be low, the diameter of the delivery pipe must be large enough to cater for reasonable numbers of animals drinking without having to wait. Most fast-flow, low-pressure ballcocks won't supply water fast enough, so a home made system consisting of a rubber ball, held by a wire or plastic mesh frame over the end of the pipe, positioned vertically in the trough can be used. The wire mesh frame can be held on the pipe with a hose clip. Use a protective guard or live wire to prevent animal damage.

Water alternatives

If water is not available, or when dry animals (not milking) are rationed by block grazing, with only one water trough at the other end of the paddock, solutions include -

- No water, if on lush pasture, grazed in the morning while dew is still on, or after heavy rain.
- Feed silage instead of hay, which is drier. Water is essential if feeding hay.
- Portable water.
- Have access to snow, ditches or puddles, all of which animals may prefer to pumped water. This is because pumped water below ground can have minerals, such as iron and manganese, and in reservoirs can become stale and grow algae. We can become accustomed to it, but animals with a choice avoid it and drink from puddles of rain water.

Freezing areas

How severe is the freezing?

Solmin or salt-based soluble mineral mixes reduce freezing if not severe. Peta trough dispensers float in the trough. See www.peta.co.nz for information and your nearest international supplier.

In areas where freezing is not severe, and ample running water from a dam or spring is available, one can consider having water trickle over troughs and out the end of pipelines to prevent freezing. Ditches must be dug so that the water can run away and not create mud, and troughs need to be on raised areas.

There should be freeze resistant valves available in cold countries.

Snow

Horses and sheep can survive winters without water, provided there is sufficient suitable snow available. Cattle need more moisture to keep the rumen working. If fed silage, most can eat snow and do without water. When fed hay and/or standing dry grass, they need water, especially if the hay is of poor quality. Poor hay will bind and kill cattle, even in mild climates (no snow) with plenty of good clean tepid water. Molasses and soluble minerals help cattle digest the poor hay better.

Watching cud chewing (or lack of) is a way of evaluating ruminant health and comfort. All must learn to consume snow, which may take time. A few may not learn. Watch for them.

If the top freezes over, breaking it with a tractor allows animals get to soft snow.

In theory, it takes more calories of heat energy to raise snow one degree than it does water. However, ruminants produce excess heat, which can be used for this purpose as it is generated. An animal in poor condition, under stress or off their feed, can get into a negative energy spiral and lose body temperature, which adds further stress, which reduces eating and rumen function, and can cause death fairly quickly. Some healthy people take longer than others to adapt to winter, so watch for animals not adapting, and handle them as required, for example, in a sheltered paddock with water, and or more soluble minerals.

Snow is fresher, usually cleaner and not as cold to consume as water in freezing conditions. As it's

all around the animals, they can eat a little at a time as required. This uses less animal energy and doesn't lower body temperatures as much as walking to the supply and drinking almost freezing water in large amounts. Try doing both and see for yourself, then you'll be ready for anyone complaining about your not providing water for stock. Don't be fooled by animals walking to the trough. They can do this from habit, take a sniff or lick and eat the snow next to it.

Alberta researchers have found that snow is suitable once animals are trained, and that the surplus heat generated from digestion melts the snow eaten without much energy loss, mainly because it is eaten in frequent small amounts. Calves from beef cows on snow only, were only very slightly lighter than those getting water.

Watch that they are actually consuming snow. Also monitor animals in the spring when the snow freezes and/or is muddy. Watch all animals, their urine and their dung, and try to look at each animal each day. If the herd or flock is large, then take a different route each day.

When they start making milk and when feeding young, they will need more liquid than snow can provide. Place a portable trough near them and watch them.

Mob stocking on a small area pollutes the snow and reduces consumption.

In very cold (below -18 degrees C which is zero F) the snow can be very dry and light (more air in it), so have less moisture, which is another thing to watch. Animals have to consume more of this, but it is easier to lick. Heavy frozen lumps have a higher moisture content, but take more vigorous licking.

The benefits of wintering animals out in sheltered areas are so great, not just labour and profit wise, but also animal health wise, that it is the thing to do, provided it is done right. Feeding poor quality hay on top of a wind swept hill in freezing climates is not right.

Wintering out allows you to stack and feed hay and/or silage on the windward side in valleys or sheltered areas that need their fertility improved.

Other things to do include

- If you can't supply a good soluble mineral mix in the drinking water, have a good mineral mix in a trough that's kept fresh, not with month old leached (by rain) wet or hardened minerals.
- If you have a guard dog, give it shelter, water and food.
- Don't ignore grazing animals just because they are at the back of the farm. When in barns, you'd spend hours each day tending them, so allocate a time to visit them daily. The number of sick animals will drop to a fraction of barn housed ones, but will not be zero, especially if they run out of water or are hungry.
- If you haven't made a complete change to pasture farming, so don't have good quality lush pasture and silage, or if you feed hay, and have to feed lambs grain, then they are likely to need moist feed or water, as will lactating ewes on dry feed and in hot climates.
- If supplying water and it can freeze over, which can happen suddenly when over-night temperatures drop without noticing it from heated homes, then check it every morning. If visible from a vantage point or with binoculars, one can tell by seeing animals standing around the water source, something they'll do in summer, but not in winter. Have ice breaking tools at each point or with you.
- Keep in mind that silage is cheaper and a better feed, and can eliminate the necessity for water in winter, as long as there is moisture or snow, but, if feeding hay, water is likely to be required.
- Beware of some do-gooders who can snoop around and report you to authorities for not supplying water to livestock in winter, when they may not need it. Have documented evidence like the above ready to prove them wrong. Stories by farmers in the USA Stockman Grass Farmer monthly about how animals don't drink in wet winters are evidence. Don't give animal rights people the opportunity of finding fault with your management - keep it squeaky clean. Most animal rights people are excellent, do a good job and unfortunately, because there are a few people who don't treat animals as well as they should, they are needed.

UK pest problems from

http://www.thefishsite.com/fishnews/6309/aquaculture-major-cause-of-alien-invasions

"Alien species are wreaking havoc on the world's oceans and river systems", say scientists, and "governments are having to spend millions of pounds trying to get rid of them", writes Paul

Eccleston.

A study by Nature Conservancy, reported in the Telegraph, shows that marine invasive species damage waters and land that native species and plants rely on to survive. Examples in the UK include floating pennywort (hydrocotyle ranunculoides), a native of North America which was brought to Britain in the 1980s as a garden pond plant, but which quickly spread to the wild.

Invasive and predatory marine animals which cause massive problems for our native creatures on waterways include the American mink, American crayfish, and the zebra mussel from the Caspian sea. Once in the wild, these aquatic invaders cause massive disruption and, with no natural predators and benign climates, they expand rapidly to nuisance proportions.

Waikato information from -

There is a booklet on it with information and suitable exotic and New Zealand native plants for planting on stream edges such as -

- Ribbonwood - Plagianthus regius.
- Cabbage Tree - Cordyline australis or Te Kouka.
- Lower level stream edge: Swamp sedge - Carex secta or pukio (open area) or Bush Sedge - Carex dissita for shaded areas.
- Varieties of poplars with their cheapness and deep roots can be best for your purpose.

Also, phone the Land Management Officer at 0800 800 401.

New Zealand is a land of mostly evergreen trees, but remember, deciduous ones let the warmth through in winter. A group of yellow flowering New Zealand Kowhai is a good example. Plant a group to give a show, and because single ones can get killed by insects.

Check all plant nurseries in your area.

Last, but very important, poplars are cheap or free from conservation organisations or neighbours. See Waterways, swamps & lakes above for more information on poplars and other trees.

Things polluting water

The irony is that Hamilton City Council wrongly sprays with glyphosate (Roundup) the few weeds that grow along road edges and road gutters, which are waterways. This adversely affects allergic people and infants in the womb, fishes and pollutes underground water. Australia has banned the spraying along all waterways because their underground water already has too much in it. Some countries have banned all glyphosates completely because of ill effects on people and especially pregnant women and animals.

Don't believe the manufacturers' propaganda saying that Roundup and glyphosates are harmless. It was known from the beginning in about 1980, to cause children and animals to be born with severe problems. It was kept secret even after six children on one road were born affected.

Google for glyphosate poisoning. I know of two middle age strong men who had underlying health problems, and died following exposure to Roundup, showing the risk of Double Whammies.

The Rhine River has changed from a sewage channel to a living river. This took more than 50 years of significant investments and political commitments of five well economically developed countries. This shows what can be done.

I've read that USA loses 2.8 billion tonnes of topsoil each year from erosion.

There have been water quality studies done for the Gippsland Lakes catchments where it was found that agriculture was one of the lowest polluters, with forest run off and town run off taking turns at the top.

In USA nitrogen leaching from city lawns is a major pollutant.

Waters for most purposes such as drinking and irrigation should be tested by a reputable laboratory such as Hill Laboratory who will send you instructions and containers to do it correctly.

Some think it is good that we've reduced the cases of Down Syndrome outside the womb by killing 90% of those inside the womb.