PROBLEMS WITH WATER SUPPLIES

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A good water supply is extremely important on a modern dairy or cattle farm. The system supplying the water must be good enough to supply adequate water needs in the paddocks, housing facilities, for wash-down and the dwelling. On most farms the water system consists of a series of expansions or additions carried out over the years as requirements changed. Only when the system fails to cope, such as during a dry summer, do people realise how marginal their system has become. Common problems on most farms centre on inadequacies in areas such as, water source, pumping plant, pipe sizes, ballcocks and troughs.

Water Source

A bored well is the most common source on farms. If the well is unable to meet peak demand, the installation of a reservoir of about 9,000 litres (2000 gallons) which can be a pre-cast concrete tank, costing approximately €900 will rectify the situation. The tank can be buried in the ground or placed overground.

A booster pump is then used to pump the water from the reservoir into the water supply system, at whatever flow rate and pressure are necessary. Frequently, this booster pump can double as the pump for a wash-down system as well.

Pumping Plant

Submersible or overground pumps may be used in water supply systems. In general, only submersible pumps should be used to pump from boreholes. The running costs of an overground pump can be up to five times higher than for a submersible pump because water has to be pumped down into the well to bring water to the surface. Maintenance costs are higher also.

In deciding on pump size, take into account the depth of the well, the output of the well and the working pressure required to overcome any rise in ground level from the well to the top of the system. Where a new pump replaces a previous unit, the size of the electric cable used to supply the pump must be taken into consideration. Poor standards of installation lead to bad performance and unreliability. Lack of starter switches or wrongly adjusted starters fail to give motors adequate protection. Experienced pump suppliers will be able to help you in planning the system to suit your requirements.

Small Pipe Sizes

This is probably the commonest problem on farms. Even on farms where piping was laid in the recent past under-sizing of pipes still occurs. This is illustrated in table 1. At a flow rate of $1m^3$ per hour (220gal/hr or 3.66gal/minute) with different pipe sizes and lengths the pressure is reduced by the psi (pounds per square inch) values in table 1. In practice the flow rate reduces because of the effect of the pressure loss. Table 1

doesn't take into account the extra pressure required if you are pumping uphill or the pressure gained when pumping downhill.

12.5mm (1/2 inch) pipes are not shown on the table because at this flow rate the pressure loss would be in the order of 300psi making there use totally impractical. Where people are using 12.5mm pipes the flow rate reduces to a trickle due to the effect of the pressure loss.

Table 1 Pressure loss (psi) for different pipe sizes and lengths of polyethylene pipe for a flow rate of $1m^3$ per hour (220gal/hr).

Pipe length (metres)	**Pressure loss (psi) for different pipe sizes at a flow rate of $1m^{3/}$hour**			
	20mm	25mm	31mm	38mm
250	36	8	1.6	0.8
500	71	16	3.2	1.6
750	106	24	4.8	2.4
1000	142	32	6.4	3.2

The pressure loss and the resultant reduced flow rate is directly proportional to the length of the pipe, i.e. if you double the length of the pipe you double the pressure loss. The size of the pipe has a much greater effect on pressure loss. Halving the size of the pipe has the effect of increasing the pressure loss by approximately 38 times. With regard to pipe size it's the size (diameter) of the pipe in relation its cross-sectional area that's important. It is easy to overlook the fact that a 20mm pipe has approximately twice the cross-sectional area of 12.5mm pipe. Similarly, a 25mm pipe has four times the cross-sectional area of 12.5mm pipe.

Increasing system pressure to maintain flow rate is not a good solution. It would be extremely energy inefficient and give rise to damaging levels of pressure. The problem can be solved using the right pipe size.

In practice, all new systems installed on farms, should use at least a 25mm pipe for the main line. The main line may need to be even bigger for large installations, for long runs or where ground is rising. A rule of thumb often used is to use 25mm for up to 100 cows and 38mm for over 100 cows. Connections from the main line to the water troughs should be 12.5 or 20mm depending on the length. The additional costs will be recouped through lower energy costs incurred in pumping water.

If you are installing a new main line, incorporate the existing line as well if it's in good condition and not too difficult to do. Connecting up the ends of two main lines to form a ring main will give increased flow rates. This is worthwhile where pressure is low or the main line is long and the end of the new line and the existing line are not too far apart.

There is no need to use heavy gauge piping unless the pressure is likely to exceed 6 bar (90 psi) and then only for the high pressure part of the system. If you are using a mole plough to lay the pipe, do it in stages, using a digger to make holes at intervals to ideally where connections are going to be made. Try to get the pipe down to a

depth of 450mm or more. Tractors with double-acting rams on the arms can add enough weight to the mole plough to get the depth. Do a “dummy run" first before feeding in the pipe and allow the pipe time to recover from the stretching before making connections.

Ballcock Problems

Very often the ballcocks are the weak link in an otherwise satisfactory water supply system. Ballcocks are frequently over restrictive, even on systems where the pipe sizes are adequate. A high pressure 12.5mm ballcock in the drinking trough is not capable of allowing an adequate flow rate i.e. in most situations up to 16 to 18 litres per minute (3.5 to 4gal/min).

In general terms, ballcocks can be described by their size and pressure. The size is usually 12.5mm, but a 20mm one is available. Three different pressures of ballcock are available; high, up to 9 bar (130 psi), medium, up to 4.75 bar (70psi) and low, up to 2 bar (30 psi). The high, medium and low pressure refers to the pressure the ballcock can withstand without leaking when the trough is full. A restricted inlet is usually the method used to withstand this pressure. Different sizes of inserts or jets are used to restrict the inlet and make it into, either a high, medium or low-pressure type of ballcock. The high-pressure jet has the smallest hole and the low-pressure jet the biggest.

In most systems medium pressure ballcocks will provide an adequate flow rate (see table 2). In practice, as most ballcocks come with high pressure jets in them and so many farms end up with high pressure ballcocks, which greatly reduce flow rate.
High or medium pressure jets will fit into all 12.5mm ballcocks. The low pressure jet will not fit up against the gasket in standard 12.5mm ballcocks. If you want the option of using a low-pressure jet get the 12.5mm ballcock that can take any size of jet. It has a bigger plunger and a bigger gasket.

Using a longer float arm or a larger float can solve the problem of leaking ballcocks by increasing the force on the gasket with the extra leverage. Longer float arms are available or they can be lengthened by braising on a piece.

Bigger ballcocks (20mm) can be used, although they are not generally recommended because they are expensive, not readily available and are difficult to install in standard troughs. They may have a place for large herds and where big troughs are used.

Ballcock jets should be checked from time to time to see that they are free flowing because they can become encrusted with lime scale or partially blocked with dirt.

Table 2 Flow rate l/min (gal/min) with a 12.5mm ballcock and a system pressure of 3.6 bar (52psi) for different jet sizes.

	12.5mm(½") Ballcock			
Jet Size/Pressure	Low	Medium	High	High one drilled out *
Flow Rate l/min (gal/min)	42 (9.25)	32 (7)	8 (1.75)	32 (7)

* High pressure jet drilled out to increase bore size

Table 2 shows the effect of using different jet sizes on flow rate. I put the four different jets in turn into the same 12.5mm ballcock at one of the troughs in the paddocks in Kildalton. The system pressure at the trough with no water flowing was 3.6 bar (52psi). The most striking finding is the massive increase in flow rate between the high and medium pressure jets, going from 8 to 32 litres per minute. Although the system pressure is high we can determine the flow rate at a quarter of this pressure, because there is a fixed relationship between pressure and flow rate; if you quarter the pressure you half the flow rate. This means that if the system pressure at the trough was only 0.9 bar (13psi) the flow rate from the medium jet would still be 16 litres per minute.

Water Troughs

Cows can drink anything from 10 litres of water on a cold, wet day to 60 to 90 litres on a really hot day. They can typically drink 14 litres a minute from a trough. Allow cattle 10 to 15 litres per 100kgs of body weight per day. Carefully consider trough location, cows don't like to walk more than about 250 metres to get a drink. Check troughs each time you count the cattle, ballcock valves can get stuck leaving an empty or overflowing trough.

Flow rate should be considered before trough size in ensuring adequate supply. However, large troughs can, compensate for poor flow rate especially at peak drinking times. They are also useful because they give more space for drinking. For large herds large troughs will not compensate for poor flow rates.

Leaks

Pipes can leak, make a mess and add considerably to water bills. Electric motors are very expensive to run if running continuously. Use quality fittings and install isolation valves on pipelines for isolation of different sections of the paddock system.
To provide a portable trough use frost-proof gate valves and good quality quick-couplers. These can be connected up near the fixed troughs or at other suitable locations, e.g., under fences etc. If these are connected up near the fixed troughs a good standard of installation and protection from being damaged by livestock is required. You want to avoid leaks in the vicinity of water troughs at all costs.

Costs

The water supply system should be cost efficient so that the cost of providing a water supply does not become excessive.

The cost of water from various sources varies considerably:

Deep well (over ground pump)	about 70 cent per 4,500 litres
Deep well (submersible pump)	about 14 cent per 4,500 litres
Shallow well (over ground pump)	about 14 cent per 4,500 litres
Mains water	varies from €2.53 to €4.75 per 4,500 litres.

The deep well, submersible pump option is the most cost efficient for most situations and should pay for itself in about 3 years. Although, savings to be made are not as great as a few years ago because now there is an allowance for the water used for domestic purposes from a mains supply.

Grant Schemes

Grants are available from Local Authorities for the provision or necessary improvement of well water supply to houses in rural areas. These grants are for boring wells and providing pumps in situations where a public or group scheme water supply has not been provided or cannot reasonably be provided in these areas.
Individuals are eligible for a grant of €2031.58 (or 75% of the cost) to assist with the provision of a new supply or the upgrading of an existing one.