Effective Use Of Water On Dairy Farms

farm management

Milk Development Council
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Effective Use Of Water On Dairy Farms

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Introduction

Costed farm data (Promar) shows mains water supply costs on the average dairy farm to be £31/cow/year, but this can be over £100/cow/year on some units (Appendix 1).

Water company charges are set to run, on average, 4.2% above inflation between 2005 and 2010 (OFWAT). With climate change also having an effect on rainfall, rising water costs are likely to add increased pressure to the economic viability of dairy farming; therefore monitoring the use of water as a vital natural resource will become more important.

Furthermore, disposal of waste water can often cost as much as or more than mains water supply. Investigation has calculated that mains water typically costs £1/m^3, but disposal costs can be £0.50 to £1.50/m^3. Waste water disposal is therefore an important consideration when monitoring water use.

This booklet has been put together to increase awareness about water use on dairy farms, and it highlights some opportunities where water and money might be saved.

How to use this booklet

A general background to water use is given in the two sections 'How is water used on dairy farms?' on page 2 and 'Where does your water come from?' on page 5.

'Summary of figures associated with water use on farm' on page 6 provides a quick reference table of some costs and volumes mentioned in the first two sections of this booklet. It also includes typical farm values and the details of three farms where full water audits were carried out.

The remaining sections of the booklet help you evaluate how efficient the use of water is on your farm. It provides you with information to make checks to your systems and suggests some ways you could save costs and maximise efficiency of water use.

How is water used on dairy farms?

In brief

- Livestock drinking
- Plate cooler water
- Collecting yard and parlour washing down
- Plant washing – bulk tanks and parlour plant washing
- General water use
- Sprayer use
- Slurry flush systems
- Irrigation
- Domestic use

Livestock drinking

- This typically accounts for 50% to 75% of a dairy farms water use
- The National Dairy Farm Assured Scheme (NDFAS) requires drinking water to be 'fresh and clean', but not specifically from a potable source for stock drinking. If you are collecting roof water for drinking or stock have direct access to watercourses for drinking, you need to be aware of the animal health risks from potential contamination of this water (for example from bird or vermin droppings). Speak to your vet regarding specific risks to stock on your farm
- Many farm assurance schemes specify minimum trough space, typically 8cm/cow or 3''/cow, and space for up to 10% of the herd to drink at once
- Standard figures are used for calculating stock drinking requirements. These are related to the type and age of stock, dry matter % of the diet and air temperature. Stock on a particularly dry diet, eg, young stock reared on a straw and concentrate-based ration, will require nearly twice as much water as those on a wet grass silage diet. Dairy cow requirements are also related to milk yield (approximately 3 to 4 times the yield). Clearly, dirty and contaminated water troughs will reduce water intakes (cows have a sense of smell 17 times more sensitive than a human so if it smells a little to you it will be 17 times worse for the cow!), and reduced intakes will reduce stock performance.

REMEMBER!

- **Stock need to be given adequate clean water. There is no opportunity to reduce water use here, although alternative sources should be considered.**

Ensure your water tanks are cleaned out!

Plate cooler water

- This accounts for up to 25% of the total water use
- Plate cooler water should be effectively reused to produce no impact on overall farm water use. However, it is not uncommon for this water to drain to waste after overflowing from a water trough or other holding tank. Any water overflowing a tank is likely to drain to the waste store, adding to the cost of wastewater disposal.

The recommended flow rate to achieve optimum cooling is a rate of 2:1 of water: milk, so farms could be using 2x their annual production of milk just to cool it.

Collecting yard and parlour washing down

- This is an area of water use that can be hugely variable, ranging from 5 to 50 litres/cow/day, and can account for 5% to 17% of total water use
- Damping down a parlour prior to milking is common practice, which can speed washing after milking, but will obviously use more water
- Washing during milking will include udder and teat washing as well as washing away dung from the floors, clusters etc.
- Water volumes used for wash down of the parlour and collecting yard can be variable depending on methods. Volume hoses can be fast and effective for shifting loose dung, but can use 10 times the flow rates of pressure washers (reaching 80 to 150 litres/min). Pressure washers will be more effective for dried-on dirt, and typically use 8 to 12 litres/min.

Plant washing

- Typically this accounts for 4% to 10% of total farm water use and includes parlour plant and bulk tank washings
- Dairy hygiene regulations require that any water used for hand, udder, or plant washing must be from a potable source. The local authority's Environmental Health Officers will need to assess water quality if non-mains sources are used. This should be done on an annual basis.

Bulk tanks

Most tanks now have automatic tank cleaning. The manufacturer will set the wash cycle volumes. A call to your supplier with size and model of your tank will allow them to give you the pre-wash, wash and rinse volumes.

The single biggest variable here in water use will be whether you have a daily or every-other-day collection (it will double or halve the water use). Some of the most modern tanks have much faster wash times (to reduce the down time between collection and next milking). This is achieved by higher pressure washing but with lower volumes of water, thus these are more efficient from a water use point of view.

There is a large range in water use from small ice bank type tanks requiring up to 30% of the tank capacity to the largest tanks with fast wash systems, using as little as 1.5% of the tank capacity.

There is little a farmer can do about the wash volumes of their existing tank but they should consider the wash volumes when they are purchasing a new tank.

Parlour plant washing

The ISO standards set the wash volumes for milking plants at 18 litres/unit (4 gal/unit). However, these are now rather old standards and were originally designed for jar plants that typically required higher water volumes to wash. Modern direct-to-line plants have the ability to use less water to wash, but manufacturers are understandably reluctant to set wash volumes below this as the plant would then be non-compliant with the ISO standards. In practice, the hot wash volumes are set by the capacity of the hot water heater. This is sized in relation to the number of units to at least achieve the minimum ISO volumes. The pre-wash is designed to flush out the remaining milk and then bring the plant up to temperature with warm water prior to the hot wash. The hot wash volume must be sufficient to achieve the required wash temperature and fill the plant with sufficient water; the final rinse is designed to wash the cleaning fluids out of the plant.

REMEMBER!

- **Waste wash water can be reused, eg, for collecting yards wash-down or even as a footbath wash, but do check this with your vet**
- **Avoid using wash water with chemicals around electronic parlour equipment.**

Other general water use

- On specialist dairy farms this may account for only 1% to 2% of total water use
- It will include activities such as calf pen cleaning and feeding, machinery/tractor washing, bio-security, and other general cleaning.

Sprayer use

- A typical water requirement for crop spraying is 200 litres/ha. However, more specialist arable operators or contractors may use as little as 100 to 150 litres/ha due to lower volume nozzles.

Slurry flush systems

- Such systems are not common in the UK but there is increased interest in them for new units. Most make use of recycled separated slurry for the flush but some 'fresh water' may need to be added from time to time.

Irrigation

- Direct irrigation of grassland is not considered to be economic in the UK. However, some mixed farms with dairy and arable operations may use crop irrigation for high value crops such as potatoes and other high-value vegetable crops.

NOTE: Specific advice on crop irrigation has not been considered in this report.

Domestic use

- Water companies estimate average domestic water use for washing, toilet flushing, bathing, cooking and drinking etc to be approximately 149 litres/person/day.

Where does your water come from?

In brief

- **Mains water:**

Charged as either metered or un-metered, including individual field trough rates.

- **Other sources:**

Abstraction, from surface water (rivers, ponds, lakes, canals) and ground water (springs and bore holes).

Direct stock drinking from water courses, eg, rivers, ponds, streams etc.

Rain water harvest, eg, roof water collection.

Re-use, eg, re-use of water from plate coolers, or re-use of dairy plant washings for yard wash-down or footbaths.

Mains water

Individual water companies have their own charge rates. Obviously your geographic location determines who your supplier will be. Only those farms on the boundaries of the company regions could have any choice over their supplier.

The range and averages of UK water company charges are in the table below for the current year.

UK water charges 2006/07

	Standing charges £ (Minimum charge)	Charge £/m³	Trough charges £ each
Range in UK water company charges	17 to 46	0.76 to 1.2876	99 to 242
Average of UK water company charges	33	0.99	146

REMEMBER!

- **The water industry regulator OFWAT has agreed maximum water charge rises for the industry for the period 2005 to 2010. On average this will be a 4.2% above inflation use per year over this period.**

Other sources of water

The cost of water from non-mains sources will depend on individual farm situations, but the table below gives a broad guide to the likely cost range. Add your own estimated figures to the table below.

Typical costs for different sources of water

Source of water	Typical cost or range in cost £/m³	Water cost on your farm?	Notes
Ground water abstraction, eg, borehole	Typical range from £0.15 to £0.40/m³		Is ground water available on your farm?
Surface water abstraction, eg, river or canal	Typical range from £0.15 to £0.40/m³		Only relevant if you have water courses on your farm
Direct drinking from water courses	Range from nil to £0.15/m³		Only relevant if you have water courses on your farm
Rain water harvest	Typical range from £0.15 to £0.40/m³		Storage will be needed
Re-use of water, eg, parlour or dairy washings	Any water re-use saves the cost of purchase, eg, £1/m³ for mains supply plus the cost of waste water disposal at between £0.50 to £1.50/m³		Offers a double saving on each m³ of water reused. Some storage may be needed to make effective re-use possible

> **REMEMBER!**
> - Although water from other sources (if available) will typically be less expensive than mains supply, it is generally not free.

Summary of figures associated with water use on farm

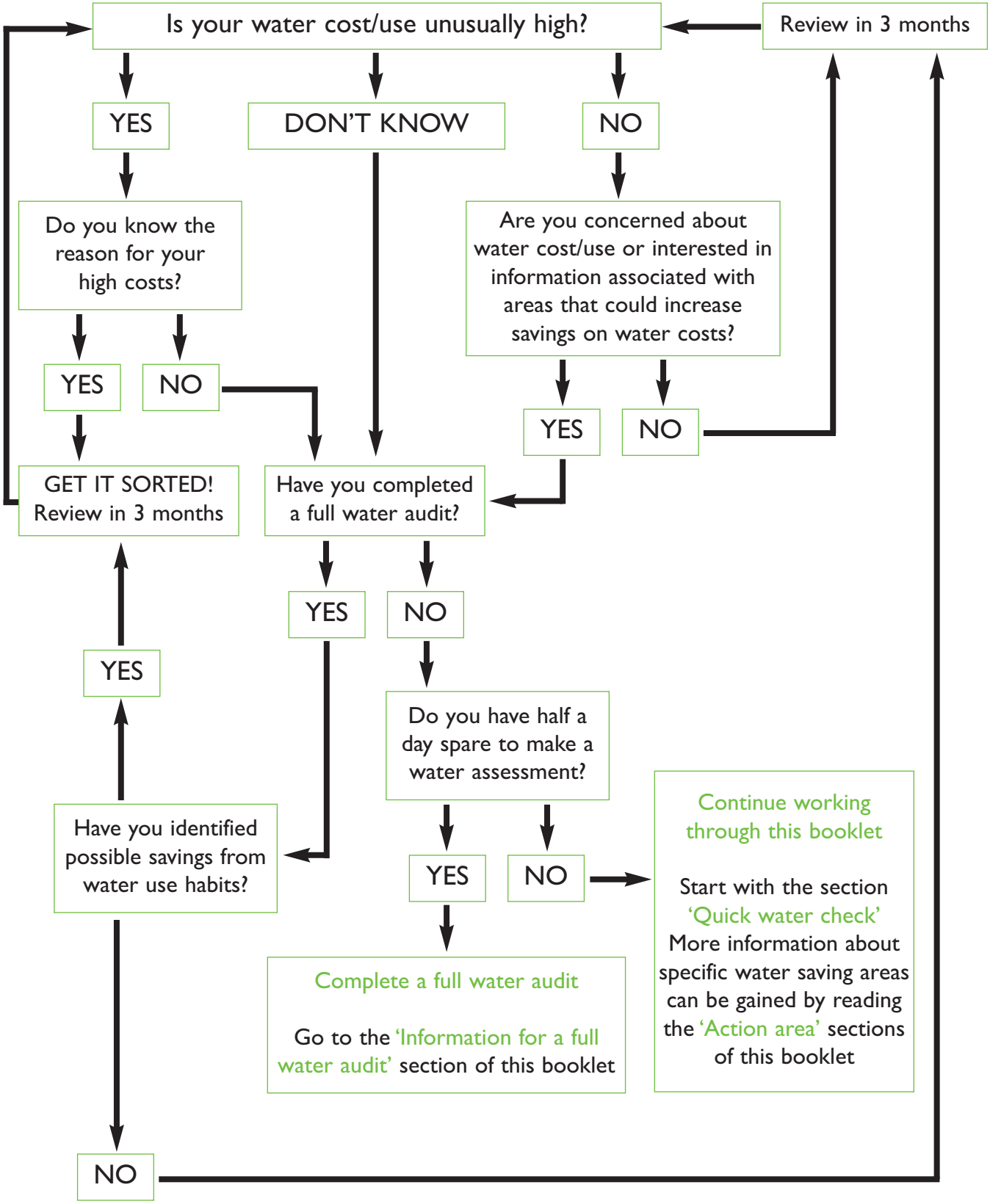
Detailed water audits were carried out on three dairy farms to help understand the range and amount of water used for different purposes on these farms. A summary of this data is shown in the table. Also listed is a 'typical dairy farm' based on a 160-cow dairy unit rearing some 80 head of young stock per year.

Summary of dairy farm water figures

** To do a full water audit for your own farm, please see the relevant section of this booklet for more information.*

Farm	Farm audit 1		Farm audit 2		Farm audit 3		Typical dairy farm		Typical range or costs	Your farm*	
Milking cow numbers	200		212		140		160				
Young stock numbers	nil		222		25		80				
Other stock	nil		400 pigs		nil		nil				
Water use:	m³	%	m³	%	m³	%	m³	%		m³	%
Livestock drinking	4727	68.9%	8297	77.1%	3614	60.80%	4718	52%	52% to 77%		
Plate cooler use	601	8.8%	0	0.0%	876	14.74%	2304	25%	nil to 25%		
Collecting yard & parlour wash down	370.1	5.4%	1572	14.6%	985	16.57%	1168	13%	5 to 17%		
Plant washing (internal milking plant & bulk tank)	676	9.9%	515	4.8%	359	6.04%	334	4%	4 to 10%		
Other general use	27.7	0.4%	47.4	0.4%	110	1.85%	27	0%	1 to 3%		
Sprayer use	19.2	0.3%	6.4	0.1%	0	0.00%	50	1%	nil to 1%		
Domestic use (est @ 149 litres/day)	435	6.3%	326	3.0%	0	0.00%	435	5%	3 to 6%		
Total of all water use	**6856**	100.0%	**10763.8**	100%	**5944**	100.0%	**9036**	100%			
Water reuse:											
Plate cooler water (m³)	601		0		876		2304	maximum			
Plant washing reuse (m³)	400		146		0		334	maximum			
Total of reused water savings (m³)	**1001**	**15%**	**146**	**1%**	**876**	**15%**	**2638**	**29%**			
Water use after adjustment for reuse savings	**5855**		**10617.8**		**5068**		**6398**				
Alternative water supplies:											
Roof water collection	597		0		0		0	depends on farm			
Direct stock drinking from water courses	0		5200		625		0	depends on farm			
Other figures of interest											
Parlour wash down water (not internal plant washing) litres/cow/day	6		20.3		19.28		20		5 to 20 litres/cow		
Volume of waste water disposed of m³	666		1988		1454		1195				
Estimated waste water disposal cost £/m³	1.02		1.35		1.45		1.25		0.75p to £1.50/m³		
Cost of waste water disposal	£679		£2683.8		£2108		£1494				

How does your water flow?



Quick water check

For many farmers, doing a full water audit may appear too time consuming and too complex so this quick and simple water check helps to prioritise key water issues and challenge current habits (a more detailed investigation may be needed for some farms).

In brief

- Check for leaks
- Water re-use
- 'Hose happy' people!
- Roof water collection
- Direct stock drinking from water courses
- Waste water disposal

Check for leaks

- Check your meter is not running at a time of low or no water use. Unfortunately this is likely to be in the very early hours of the morning
- Make a habit of recording and monitoring your water meters.

For further details go to the Action area: Leak detection section of this booklet on page 11.

What does a dripping tap cost you?

	Flow rate (litres/min)	Annual cost (assuming water cost of £1/m³)
One drip per second	0.003	Less than £2
Drip breaking in to a stream	0.063	£33
A stream 1.5mm width	0.222	£117
A stream of 3mm width	0.684	£360
A stream of 6mm width	2.430	£1,277

Water re-use

Plate coolers

- These can account or up to 25% of total water use
- Ensure all this water is reused efficiently, ie, it does not simply overflow from a drinking trough or storage tank.

For further details go to the Action area: Plate cooler water re-use section of this booklet on page 15.

Other water re-use

- Any water reused is a real double saving; you save on the cost of purchase (mains water this is typically £1/m³) and you save on the waste water (typically costing £1/m³ disposal cost)
- Plate cooler (see above), milking plant and bulk tank washings can be used for yard wash-down or stock footbathing
- If you have or can acquire inexpensive water storage, this offers more flexibility and makes this option even more attractive
- Using the information from summary of dairy farm water figures on page 6, if the typical dairy farm reused all the dairy and bulk tank washings, which is 334m³/year, at the cost of £1/m³, this saves £334/year. But re-use also saves on the disposal cost; at the disposal cost of £1/m³, double savings could be made which would total £668/year.

Are you or your staff 'hose happy'?

- From farms surveyed there is a wide range in parlour wash-down use from 5 to 50 litres/cow/day. This can have a big impact on water costs
- A simple trigger tap on the end of a hose will save water
- Evidence suggests little difference between general parlour cleanliness and the amount of water used.

Use appropriate cleaning methods

- Pressure washers only use 8 to 12 litres/min and are far more effective for dried-on dirt
- Volume hoses can have flow rate up to 10 times normal mains flow rates (typically 80 to 150 litres/min). Volume hoses can be very efficient for rapid washing of loose dung but if used for extended periods they can use huge volumes of water
- Make use of a yard scraper/squeegee before volume washing
- Brush and bucket can be very effective for some cleaning.

Trigger shut off on hoses – a simple way to help save water.

Are you 'hose happy?

How much does it cost to wash?

	Your farm	Typical flow rate (litres/min)	Cost (£/5 mins)	Cost (£/ 30 mins)	Annual cost of an extra 5 mins/day everyday	Annual cost of an extra 30 mins/day everyday
Typical mains pressure tap (range from 15 to 30 litres/min)		20	0.1	0.6	36.5	219
Pressure washer (typical range from 8 to 15 litres/min)		12	0.06	0.36	21.9	131
Volume washer (typical range from 80 to 150 litres/min)		80	0.4	2.4	146	876

Using a squeegee before the volume hose will help use less water.

Volume hoses use 80 to 150 litres/min, this is typically 10 times more water than a pressure washer.

Pressure washers typically use only 8 to 12 litres/min.

Alternative water sources - consider and cost alternative water supplies, but remember alternative sources may be cheaper but are usually not free. Don't increase your use just because it is cheaper.

Roof water collection

- If you have or can acquire some inexpensive water storage then the economics of collecting roof water looks very much more attractive.

Direct stock drinking from water courses

- If you have ditches, ponds or rivers that stock can drink from, consider using them – but be aware of the disease risks from contaminated water, pollution risks, bank erosion and habitat damage from stock access to water courses.

For further information on alternative water sources, go to the following 'Action point' sections of this booklet:

- **Rain water harvest on page 18**
- **Alternative water sources on page 27**

Waste water disposal

A double saving! Disposal of waste water can often cost as much or more than mains water supply. (Mains water typically costs £1/m³; disposal costs can be £0.50 to £1.50/m³). Any reduction in use has a double saving if it also reduces the dirty water disposal volumes.

Dirty water disposal by tanker - probably costs you £0.50 to £1.50/m^3

Do you want to look at your farm's water use in more detail?
Having quickly considered the above points, you may feel you need to have a more detailed look at water issues on your farm. You should consider doing a **full water audit**. A template to help you through the process has been produced and is available from the MDC. Call 01285 646500 and ask for 'The Dairy Farm DIY Full Water Audit pack' or download it from our website. Go to the **full water audit** section in this booklet on page 34 to see what information you will need to prepare to do this on your farm.

Action area: Leak detection

In brief

Key points

- Leaks can cost you twice - you will pay for any water leaking out of your supply network, but if this water finds its way to your slurry or waste water system you will also have the additional cost of water disposal.

Key steps in detecting leaks

1. Sketch a map of your farm water supply
2. Read and note down your water meter readings
3. Check your meter at a time of low or no use
4. Isolate sections of your supply
5. Walk your water supply route
6. Contact your local water company
7. Hire leak detection equipment or find a company specialising in leak detection
8. Log water use with data logger

Points to consider with leak detection

Step by step approach to detecting a leak

1. Sketch a map of your farm water supply. Note location of pipes, meters, stop-valves, troughs, taps and other outlets. You may need to ask for help from family, existing and retired farm workers, previous occupants or companies/contractors that may have installed pipework. Keep a record of this map even if it is not 100% complete. Others may be able to add to it later.

2. Read and note down your water meter readings, including the date. Regularly read the meter, at least until you believe the leak has been found and fixed. Ideally read your meter every one to three months.

3. Check your meter at a time of low or no use. Unfortunately this is likely to be during the very early hours of the morning when no equipment is using water and minimal stock will be drinking. Be prepared; clear the manhole cover, have a torch handy, ensure the meter is not submerged in water, and have a pen and notebook to record the reading. If you find the meter running when you would expect no water use, this may indicate a leak. A digital camera with a flash can also be a useful tool to take a meter reading in a dark, inaccessible manhole.

4. Isolate sections of your supply. If you have stop-valves to shut off sections of your supply, try to identify which section may have a leak.

5. Walk your water supply route. Make use of your sketch map to walk your system looking for tell-tale signs of leaks. Try to do this after a dry period then look for damp patches in fields or areas where the grass/crop is growing particularly well. Ask yourself why is that corner of the yard always flooded? Why is that ditch or drain always damp or running even after no rain?

6. Contact your local water company. If after trying all the above you still cannot detect a leak but still believe you have one, contact the local water company. Some of the water companies do provide free leak detection, eg, Wessex Water will check for a suspected leak once in five years on your side of the supply; Anglia provides a free service if the farmer has already tried to detect and failed; Southwest Water provides an hour of free time for leak detection.

7. Hire leak detection equipment or find a company specialising in leak detection. Commercial companies also provide leak detection services, but obviously charge for these services. Leak detection equipment can also be hired from most hire centres. To make effective use of these services or equipment you need to have a fairly clear idea of where your pipes run (having a map of your pipe network is important).

8. Log water use with a data logger. Use a water logger, which is a device that can be connected to some types of meter to record flow rates. More information about data loggers is in the sub-section below. Also, see case study Oxenford Farm as an example of when and how the use of a data logger can be useful.

Reading a water meter

Planning for the future

- Ensure your water meter is easy to read. You may want to install your own meter in an easy-to-read position
- When installing new pipework or putting in new troughs always install a stop-valve to isolate sections. Do record where it is and ensure it is easy to access.

Water use data loggers

- A data logger is an electronic device that can be fitted to certain types of water meter (with the consent of the water company) that will record the water flow rates at set intervals over a period of time. The information the data logger collects can then be downloaded on to a computer for analysis
- The type of water meter can be determined from the model number and digital photographs. This will help determine if the meter is suitable to be fitted with a data logger and the type of data logger needed.

Data loggers usually require specialist knowledge to set up. Typical charges are £250 to £300 a day and it will take approximately 1.5 days to set up the logger then collect the data and analyse it.

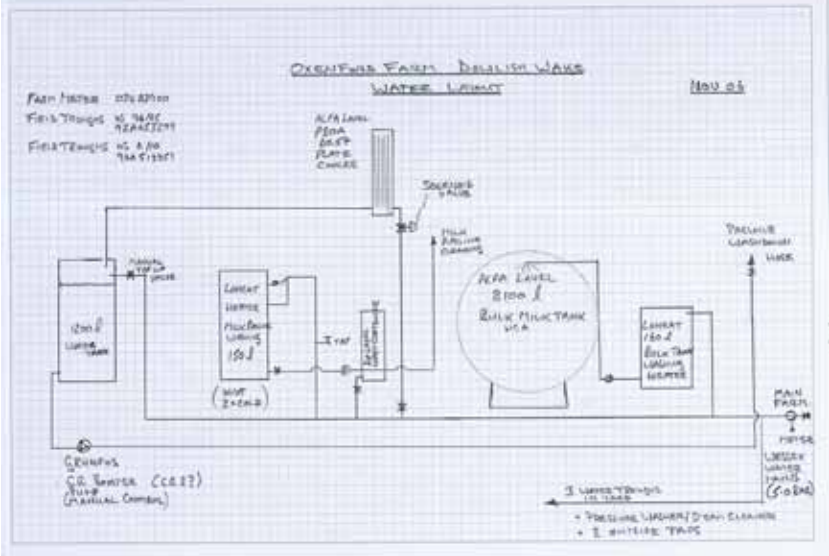
Case Study: Water use analysis or leak detection using a data logger

Farm business profile:

Farmer:	David Osbourne
Farm:	Oxenford Farm, Dowlish Wake, Ilminster, Somerset
Cows:	140 cow dairy herd
Yield:	7500 litres per cow
Young stock:	Some reared at the farm but most are contract reared off the farm
Land:	80 ha
Crops:	All grassland
Other:	A family dairy farming partnership

Water notes and issues at this farm

- Water supply is all mains from Wessex Water
- The domestic supply is on a separate meter that was not considered in this case study
- Cows will take some water from ditches although all fields are provided with large troughs
- Local rumour is that there used to be a borehole supplying a reservoir used for soft fruit frost protection
- Mr Osbourne was concerned his water costs were too high and that he may have a leak from his water supply.



A sketch map of Oxenford Farm water supply

Action

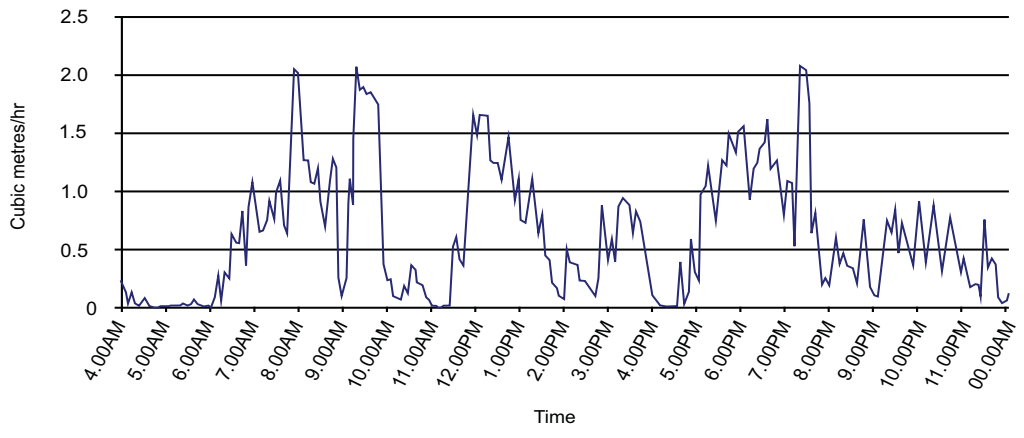
Fitting a data logger

Data logger information being collected on to the computer

A data logger was used on this farm to help determine average daily water use and investigate the possibility of a leak at the farm. The correct data logger was identified for the meter at Oxenford Farm. This was installed on 1 November 2006 by Peter Mitchell of Quicksilver Water Consultancy. The data logger was left in place for just over a month and removed on 6 December 2006.

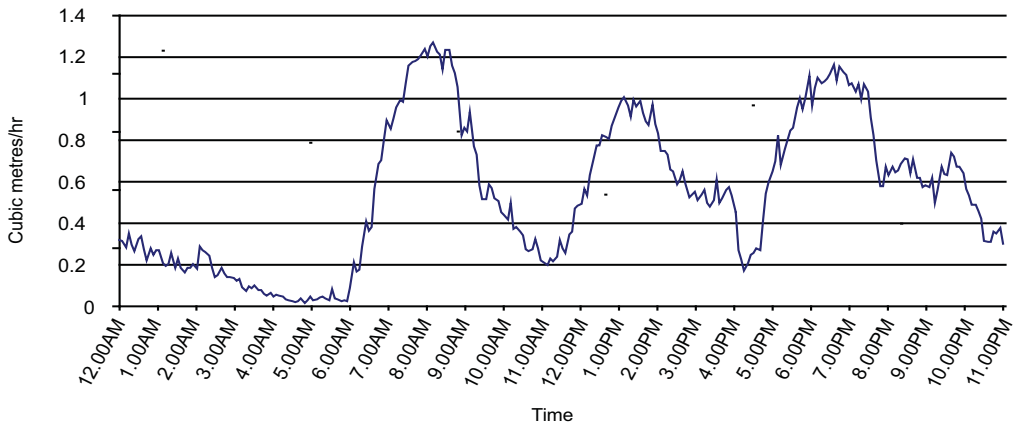
The data was then analysed with a computer. A summary of the data collected is shown below:

Table 1: This table shows water use during a single 24hrs period



It can be noticed that water use does fall away to nil at certain times of the day and night. This therefore confirms that the farm does not have a leak.

Table 2 This shows average daily (24hr) water use over a month period



Peaks at milking time are a result of plate cooler water use, stock drinking, parlour and dairy washdown and bulk tank washing after milk collection in the evenings.

'Desk top or map based' borehole investigation

A 'desk-top' or 'map-based' borehole investigation was carried out at the farm to help determine if there was any potential to use a borehole at this farm. This was followed up by a field investigation. They revealed that there was indeed an old borehole but unfortunately this was located on the neighbour's property. It may be possible to reinstate the borehole if agreement can be reached with the neighbour.

Results

- The data logger helped to determine the farm did not have a leak
- The desk-top borehole investigation determined that there was an old borehole in the area. Unfortunately it is not on Oxenford Farm land
- A site investigation also revealed a spring that may be able to provide the farm with an alternative water supply.

Action area: Plate cooler water re-use

In brief

Key points

- Plate cooler water is often as much as 25% of annual water use so small daily losses here can add up to significant waste annually
- Pre-cooling of milk with cold water is intended to make significant savings on milk cooling costs. However, if the water that has run through the plate cooler is not reused then what is saved in energy costs can be lost by increased water costs and waste water disposal costs
- If the warm plate cooler water can first be linked back to top-up a hot water cylinder, this can save energy. However, the water for parlour plant washing has normally already been heated to temperature at the time the plate cooler water is flowing
- To achieve optimum milk cooling, a ratio of 2:1 of water to milk is generally recommended. This generates a significant volume of water to use each day (twice your daily bulk tank volume!)
- Always ensure all plate cooling water is reused efficiently. If this water is drained to the waste system the cost of disposal can be as much as the cost of purchasing mains water. This is important even where water is considered to be free or very cheap, eg, from a borehole or other abstraction.

Key steps to take if already using or considering using a plate cooler

1. Check that all the water is currently reused. Some of the water may be reused directly for washing or stock drinking but any surplus must be able to be stored
2. Consider linking to your hot water cylinder only if this is appropriate to make further energy savings
3. Work out how much tank storage you will need. What is your peak daily milk production? On twice a day milking your maximum storage needs could be as much as your daily milk production.

Points to consider with plate coolers

Advantages

- Re-use of plate cooler water saves water use and disposal cost but all the water must be reused
- There is some evidence to suggest cows prefer to drink warm water, especially in cold weather. Cows typically drink 3 to 4 times their daily milk yields and they consume a significant volume immediately after milking
- Warm plate cooler water can be used as a top up for your hot water boiler thus making further energy savings.

Disadvantages

- All water must be reused. If not the cost of supply and disposal can negate much or all of any energy savings made by pre-cooling your milk
- Timing of re-use can be a problem for warm plate cooler water if trying to make further energy savings by adding this to your hot water cylinder. The hot water normally needs to be at full temperature for wash down at the end of milking. Adding warm plate cooler water to the hot cylinder during milking may reduce the tank temperature
- Plate cooler water is often piped to a cattle drinking trough but the stock will often not drink the water fast enough and if it drains to waste this is a double cost to you, first the cost of the water and second the cost of disposal of the waste water
- Warm water is more prone to bacterial growth if not used immediately.

Regulation and Legislation

- Dairy hygiene regulations require that any water used for hand, udder, or dairy plant washing must be from a potable source. If this is not a mains supply then the water needs to be assessed annually by the local authority's Environmental Health Officers to ensure its purity
- National Dairy Farm Assurance Scheme (NDFAS) requires water for drinking to be 'fresh and clean'
- Water supply (water fittings) regulations 1999 must be complied with on all premises with mains supply. In essence the back flow of potentially contaminated water must not be allowed to enter a mains supply network. Air gaps are needed between mains supply and non-potable water.

Typical plate cooler

Not an uncommon sight? Plate cooler water over flowing a water trough – a double waste

Further information

Additional information associated with plate coolers can be supplied by the following contacts (please see the 'Contacts' section of this booklet on page 33 for full details.)

- **Water Regulation Advisory Scheme** – Regulations apply to premises that have a mains supply of water. These regulations come under the 'Water Supply (Water fittings) Regulations 1999'
- **MDC Factsheet: Energy Efficiency On-Farm** – This includes notes on plate cooler use and milk cooling
- **Enhanced Capital Allowance Scheme** – A Defra & HM Revenue & Customs scheme that allows you to save tax on certain products that encourage sustainable water use.

Case study: Identifying the inefficiencies of a typical plate cooler and how it could be changed

Farm business profile

Farmer:	John and Debbie Tilbee
Farm:	Bow Farm, near Wedmore in Somerset
Cows:	150 flying herd
Yield:	5500 litres per cow
Youngstock:	nil
Land	92 ha
Crops	All grassland – much of the land is within Environmental Sensitive Areas (ESA)
Other:	John and Debbie are tenant farmers. Their son Paul has recently finished school and now works on the farm while attending a local Agricultural College. With Paul returning home to farm, the plan is to increase milk yield per cow and move to a year-round calving pattern to spread the workloads and maximise milk prices from their buyer through a more level daily milk profile.

Water notes and issues at this farm

John Tilbee beside the volume washer tank that collects some of the plate cooler water

- Water supply is all mains water from Wessex Water
- Cows will take some water from ditches, although all fields are provided with large troughs and cows tend to appear to prefer to drink from the troughs
- The farm has a milk plate cooler that has the recommended water throughput of 2:1 to achieve optimum milk cooling. However, there is insufficient water storage to collect all the plate cooler water, so the water feed to the plate cooler is manually turned off approximately half way through milking to avoid the water running to waste
- Optimum energy efficiency is not achieved with the way the plate cooler is currently operated.

How the existing system works

Mains water is piped directly into the plate cooler. The water flow rate is approximately 15 litres/min, which is very close to the recommended optimum of 2:1. The outflow water drains to a holding tank at the front of the parlour (capacity 1005 litres). This tank is connected to the volume washer pump, which is used for parlour wash down at the end of milking. The volume washer has a high capacity pump giving a throughput of some 150 litres/min. Parlour wash down at the end of each milking is approximately five to seven minutes which is adequate for the farm's compact 'Somerset type parlour' where there is no large covered area of collecting yard to wash down. The 1005 litre tank will be emptied within this seven minute wash-down time. To prevent water draining to waste, the plate cooler water feed is turned off once this 1005 litre tank is full; this will be approximately half way through milking.

Annual milk production ranges currently from 1500 to 2700 litres/day or approximately 750 to 1350 litres/milking. Water use for the plate cooler ideally needs to be 2:1, ie, between 1500 to 2700 litres/milking. To maximise energy efficiency and minimise milk cooling costs, the aim must be to run the plate cooler for the entire length of milking thus achieve the target 2:1 water to milk flow rates. To ensure no water runs to waste all this plate cooler water must be stored for effective re-use.

Action

Additional tank

Simply providing additional tank storage capacity for the volume washer may not necessarily provide the answer. The current parlour wash-down time appears adequate and uses only 1005 litres (15 to 20 litres/cow/day depending on numbers in milk). Additional tank capacity could provide water for other cleaning tasks, but may simply encourage longer cleaning times that are not necessary and produce more waste water that is also costly to dispose of – a double whammy!

Using plate cooler water for cow drinking

This is a common practice on many farms. Indeed, many years ago when a plate cooler was first installed at Bow Farm the water drained to a drinking trough in the collecting yard. However, if the cows' drinking did not keep up with the water flow then it would overflow and drain to waste again leading to the double impact of wasted water and increased slurry disposal cost which would cancel out any gain in energy saving. The siting of the water trough in the collecting yard also interfered with the cow flow into the parlour and cows do not drink large volumes of water just prior to milking.

Proposed solution

- Link the plate cooler water to another water trough that the cows can access directly after milking as well as continuing to use the tank for the volume washer
- A ball valve will be needed on the volume washer tank so that once this is full the flow is diverted to a new drinking trough
- A large capacity trough will ensure none drains to waste, even when stock drinking may be reduced. The farm has a redundant water trough available of approximately 1000 litre capacity.

Results

In this case study at Bow Farm the cost saving proposed will come from:

1. Energy savings from the plate cooler running for longer
2. Reduced water wastage because the volume hose tank will no longer overflow

Action area: Rain water harvest eg, roof water collection

In brief

Key points

- Rainwater harvest/collection off roofs or other clean areas can make a significant contribution to water supply
- Higher rainfall areas or large catchment areas obviously have greater potential
- Small volumes can contribute to yard wash-down which requires minimal filtration, but if collecting larger volumes you will need to use it for stock drinking and it is advisable to filter/treat this water to avoid potential contamination
- Water storage can be a significant cost with these systems. If you have, or can acquire, inexpensive water storage (a pond or storage tanks), this will make the economics much more attractive.

Key steps to take if considering roof water collection

1. Find out your local rainfall data
2. Calculate roof areas available for collection
3. Consider what is an acceptable return period for your business
4. Work out the maximum you can afford to spend to achieve your target return or payback period
5. Work out your store size and cost your project

Points to consider with rain water harvest

Advantages

- Significant potential cost saving compared with mains supply
- Security of own supply
- No licences required
- Capital costs can be modest
- Easy to incorporate on a new building for minimal extra capital cost
- On average your water collection volumes are predictable and you can plan for a known payback period.

Disadvantages

- Potential contamination from bird/vermin droppings entering the store is perhaps the biggest risk. If water is only to be used for yard wash down this may not be an issue
- Filtration/treatment is recommended for drinking water or if used for dairy plant cleaning; this will add to the capital costs, but not significantly
- Water storage will typically be the largest cost
- Finding a site for a tank, pond or lagoon can be an issue on existing units
- Running costs: there will be some running costs for pumps, filters etc but this will be modest if spread over sufficient volume of collected water
- Don't forget the hidden disposal cost from excessive water use. Collected roof water is often regarded as 'free' however the cost per m^3 of harvested water will be significantly less than mains supply, but not 'free'. (See 'Typical costs for different sources of water' in the 'Where does your water come from?' section of this booklet on page 5)
- More importantly, the cost of disposal of dirty water can be significantly more expensive than the cost of water purchased from a water company. So, if harvested water is used excessively, for example for parlour wash down or plate cooling (without re-use), then the cost of dirty water disposal must also be taken into account.

Regulation & Legislation

- Rainwater harvest/collection is not regulated indeed it is encouraged by the Environment Agency
- Planning permission may be needed for structures such as tanks, lagoons, or pump sheds, depending on size and location. You are therefore recommended to speak to your local planning authority before you proceed
- Dairy hygiene regulations require that any water used for hand, udder or dairy plant washing must be from a potable source. If this is not a mains supply then the water needs to be assessed annually by the local authority's Environmental Health Officers to ensure its purity. Collected rainwater will need to be filtered/treated to achieve the required standard if it is to be used for hand, udder or dairy plant cleaning
- National Dairy Farm Assurance Scheme (NDFAS) requires water for drinking to be 'fresh and clean'
- Water supply (water fittings) regulations 1999 must be complied with on all premises with mains supply. In essence the back flow of potentially contaminated water must not be allowed to enter a mains supply network. Air gaps are needed between mains supply and non-potable water.

Rain water harvest volume calculator

Enter your figures below

Roof area or yard area for collection	Length	Width	Area m^2
Sub total of areas m^2		a	
Annual rainfall est. mm/1000 = metres	Rainfall mm/1000	b	
Total potential annual rain water harvest (m^3)		a x b =c	
Less run off losses (or drainage coefficient) (see below)	eg, x 0.9	d	
Sub total		c - d = e	
Less filter efficiency factor (see overleaf)	eg, x 0.9	f	
Total harvested water available (m^3)		e - f = g	

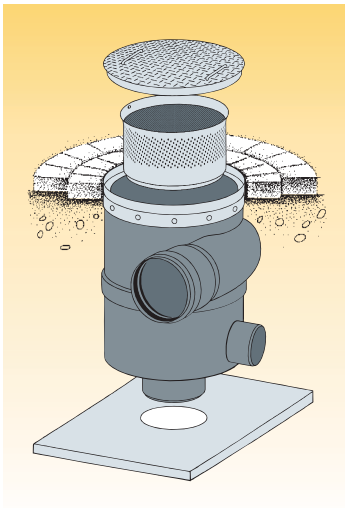
Run off factor or drainage coefficient

Not all rain falling on a roof or collection area will be collected: light rainfall will only wet the roof and then evaporate, heavy rainfall can overflow from the gutters and not be captured therefore a 'run off factor' or 'drainage coefficient' is used to adjust the rainfall volumes collected. The table below shows which drainage coefficient to use for different roof types.

Drainage coefficient (run off factor)

Roof type	Drainage coefficient
Pitched roof - tiles or fibre cement corrugated sheets (typical of most agricultural buildings)	0.75 – 0.9
Flat roof smooth tiles	0.5
Flat roof with gravel layer	0.4 – 0.5

Filter efficiency



Example of rainwater filter
(Wisy vortex filter - www.wisy.de)

The amount of water captured also depends on the efficiency of filtration if any is used. If a filter system is incorporated, most manufacturers recommend that a factor of 90% of the potential input be used. This means that a filter efficiency factor of 0.9 is also included in the calculation.

Rain water harvest volumes

Potential annual collection volumes (m^3) after deduction of drainage and filter factors

Collection area m^2	Annual average rainfall (mm)										
	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500
250	101	122	142	162	182	203	223	243	263	284	304
500	203	243	284	324	365	405	446	486	527	567	608
750	304	365	425	486	547	608	668	729	790	851	911
1,000	405	486	567	648	729	810	891	972	1053	1134	1215
1,250	506	608	709	810	911	1013	1114	1215	1316	1418	1519
1,500	608	729	851	972	1094	1215	1337	1458	1580	1701	1823
2,000	810	972	1134	1296	1458	1620	1782	1944	2106	2268	2430
2,500	1013	1215	1418	1620	1823	2025	2228	2430	2633	2835	3038
3,000	1215	1458	1701	1944	2187	2430	2673	2916	3159	3402	3645
3,500	1418	1701	1985	2268	2552	2835	3119	3402	3686	3969	4253
4,000	1620	1944	2268	2592	2916	3240	3564	3888	4212	4536	4860
4,500	1823	2187	2552	2916	3281	3645	4010	4374	4739	5103	5468
5,000	2025	2430	2835	3240	3645	4050	4455	4860	5265	5670	6075

Drainage factor	0.9
Filter factor	0.9

Store size

Tank size or lagoon/pond size for water collection will depend on a number of factors, including:

- Local annual rainfall and storm intensity
- Catchment area
- Run off factor or drainage coefficient
- Filter efficiencies factors
- Average water usage rates and daily use fluctuations
- Potential future increase in catchment area.

As a rule of thumb a store with capacity to collect approximately 1% to 3% of the annual volume will ensure it has sufficient capacity to collect rainfall during heavy rainfall conditions, assuming consistent daily usage. If usage is less regular, a 5% capacity may be more appropriate.

Other important notes

- Collection off a large single roof area will generally be simpler and cheaper than collection off separate smaller roofs.
- Water storage is a potentially significant cost. If you have a pond or can acquire any inexpensive tanks for storage this will make a project more cost effective.

Inexpensive rain water collection in an old milk tanker body.

The capital or one-off cost of a rainwater harvest system

The tables below are to help you calculate the capital or one-off cost of a rainwater harvest system. Fill in your own figures below.

Typical capital one off items	Notes	Your costs £
Alteration of gutters and down pipes	Likely to be minimal on new buildings. £15 to £30/m run	
Filters for down pipes	DIY or proprietary models available, from £150 each	
Laying and diverting rainwater pipes to rain water store	DIY or contractor cost at £25 to 35/m run	
Rain water store eg, tank or lagoon	Storage should be approx. 1% to 3% of annual collection. Storage can be second hand tanks, ponds or lagoons. Plastic/GRP tanks cost from £150 to £300/m^3 depending on size. Earth banked lagoons/ ponds from £5 to £10/m^3 excavated	
Pump shed	To house pumps, filters, pressure vessels etc. A garden shed or second hand container body	
Electrics, tanks, pumps, pressure vessels, pipework, filters etc	Cost depends on what is needed. Pumps £250 to £750. Filter systems £500 to £1000	
Other one off costs		
Total one off costs		
Annual depreciation cost	eg, total capital £5000/25 years = £200/year	
Average annual interest charge on capital spent	Use amortisation tables, or cost of interest on half the capital spend eg, £2500 @ 7% =£175	
Average annual depreciation and interest cost	Transfer to table below eg, £375/year	

Annual running costs of rain water harvest (Continued)

Typical annual running costs	Notes	£
Average annual depreciation and interest cost	Transferred from table overleaf	
Cost of electricity to run pumps	Pump kw x cost p/ kwh eg, 2kw x 8.5 = £0.17/hour run time x 5hour/week = £44/year	
Cost of disposable filters		
Service and maintenance requirements		
Labour input to maintain	eg, 6 hours x £8/hour = £48/year (assumed 0.5 hours/month)	
Other annual running costs		
Total annual cost		
Estimate of rainwater harvest m^3		
Average cost per m^3 of harvested rainfall	Range in cost could be £0.15 to £0.40/m^3	

Return on capital

A simple way to consider return on capital is to set yourself an acceptable return or payback period, perhaps a 25% return or payback over 4 years? From the table above of water volumes collected, you can set yourself a maximum total investment to achieve your target return. For example, if you live in a 1000mm rainfall area and have 1500m^2 of roof area you have the potential to collect 1215m^3 of rainfall (after deduction of drainage and filter factors). If your local water company charges you £1/m^3 you have scope to save £1215/year on your water bill. As long as you spent no more than £4860 to set up your rainfall collection system this would give you a payback of approximately 25% or four years. This is a better return than many capital investments.

Enhanced Capital Allowance

The Enhanced Capital Allowance Scheme enables businesses to claim 100% first year capital allowances on investments in technologies and products that encourage sustainable water use. Businesses are now able to write off the whole cost of their investment against their taxable profits of the period during which they make the investment. This includes rainfall harvest technology. Products must be on an approved list to be eligible for the scheme.

Further information

Addition information associated with rain water harvest can be supplied by the following contact (Please see 'Contacts' section on page 33 for full contact details):

- **Water Regulation Advisory Scheme** Regulations apply to premises that have a mains supply of water These regulations come under the **'Water Supply (Water fittings) Regulations 1999'**
- **Environment Agency** Notes are provided for water rainfall harvest
- **Filters** Commercial company selling rainwater harvest equipment and filters
- **Enhanced Capital Allowance Scheme** A Defra & HM Revenue & Customs scheme that allows you to save tax on certain products that encourage sustainable water use
- **Rainfall data from the Met Office.**

Case Study: Roof water collection on new dairy unit and water extraction from local canal

Farm business profile

Farmer:	Rob Warren of RSW Farming
Farm:	Oakey Farm, Moreton Valence, Gloucestershire
Cows:	430 cows, with year-round calving herd
Yield:	7800 litres per cow
Youngstock:	No young stock are reared at this farm
Land/Crop:	95ha of owned land, 32ha rented and a further 49ha of contract grown forage maize
Other:	A new dairy unit was established and came in to operation in May 2006. This allowed the herd to be expanded from a 200 cows to the current 430-cow dairy unit.

Rob Warren beside his water storage vessel & 'pump room' container.

Water notes and issues at this farm

Prior to the development of the new dairy unit, all the water on the unit was mains supplied. Five or six years ago, a test bore investigation was carried out. Water was found but it was saline and so this project was abandoned. With the development of the new dairy unit, roof water collection was planned at the outset.

Action

Collecting roof water

Roof areas collecting rainfall at Oakey Farm

Building	Dimensions	Area m^2
New cubicle accommodation building	109m x 30m	3270
New parlour, dairy, collecting yard building	48m x 22m	1056
Existing dry stock shed	18m x 90m	1620
Total		5946m^2

- The annual average rainfall is 750mm (30"). There is always some loss of water in a roof water collection system called the drainage factor. This loss is due to absorption by the roof material and evaporation off the roof. This is assumed to be approximately 10% in this case, a drainage factor of 0.9.

The down pipes collecting rainfall off the cubicle building – no filtration at this stage as the water is drained direct to a lagoon

	Water m^3
Roof area 5946m^2 x annual rainfall 0.75m	4459.5m^3
Drainage factor	0.9
Collected roof water	4013m^3
Plus water falling on the lagoon top of banks 18m x 28m = 504m^2 x annual rainfall of 0.75m	378m^3
Total rainfall collected	4392 m^3

Lagoon for roof water collection beside the cubicle building

- The roof water is drained directly to an earth banked lagoon (newly excavated for this purpose when the building was constructed) with approximate average dimensions of 15m x 25m x 4m = 1500m^3. This collection lagoon was deliberately made of a significantly larger capacity than the rainwater needs alone. This is to accommodate water that will be abstracted from the canal. In future, additional roof water off other existing buildings may also be drained to this lagoon.

Water filters and UV water treatment at Oakey Farm

- A submersible pump suspended below a floating raft lifts the water to the 'pump room'. The pump room is a second hand steel container body. The water passes initially through a 120-micron filter then through 20-micron paper filters before going through UV treatment. This is then pumped to an above ground plastic tank of approximately 18,000 litre capacity. This tank also has a mains water supply as a back up. Note that the main supply has to (and does) comply with the Water Supply (water fittings) regulations 1999. This is to prevent backflow or cross-contamination. See the section on regulations for further details.

Pumps and pressure vessels in the Oakey Farm 'pump room container body'

- This water is used for stock drinking in the buildings, parlour wash down and for the initial milk plate cooling. Mains supply is still used for field trough drinking, for udder washing and milking plant and bulk tank washing. The reasoning behind this is that the farmer did not want to risk any contamination of the milking plant with the collected roof water.

Other points to note

Some erosion problems have been experienced as the rainwater drains in to the lagoon

- No filtration off the roof. The water is drained directly to the lagoon.
- Clay lined lagoon. There have been some issues of clay sediment build up in the filters. This reduces filter life and effectiveness and it may be due to the new lagoon and current low water levels.
- Erosion. There has been erosion of the lagoon bank where roof water flows in. This has been reduced by attaching a flexible pipe to the end of the inlet pipe so this will float on the water surface and thus avoid bank erosion in the future. This erosion may have contributed further to the clay sediment.

Savings

The rain water collection saves on average 4392m^3 of mains water/year. The total estimated cost savings are shown overleaf.

Canal abstraction

The farm is in the process of establishing an abstraction from the local canal. The farm is bound on one side by the Gloucester to Sharpness Canal. The canal is managed by British Waterways. Mr Warren has negotiated an abstraction for less than 20m^3/day from British Waterways. Because this is below the 20m^3/day limit no abstraction license is required.

A canal is another potential source for water abstraction

British Waterways will make a connection into the canal under the tow path and to the boundary of Mr Warren's land. This will then be piped back across the fields to the water collection lagoon. A pump will be needed from the low point on this route, but this is a point where a power supply is already available.

Once installed this will have the capacity to abstract up to maximum of 7300m^3/year.

There is a requirement from British Waterways and the Environment Agency that this water is metered.

Costs

Much of the water installation equipment (tank, pumps, pressure vessels and pump room) would have been installed at the new unit even if the rainwater or the canal water were not collected because of the low mains water pressure.

Equipment the farm already has:

Tank – needed due to low mains pressure

Pumps and pressure vessels – to pressurise the supply system

Pump room/shed – to house the equipment

Total estimated cost savings at Oakey Farm

Estimate of one off set up costs:	
British Waterways fee to install connection to canal	£950
Installation of pipe from canal to water storage lagoon	£3000
Pump to lift from canal to lagoon	£500
All rainwater collection costs including fenced lagoon, filters, lagoon pump etc	£5000
Total one off costs	**£9450**
Depreciated over 25 years, average cost per year	£378
Interest on one-off capital @ 6%	£359
Estimated annual running costs	
Electricity for pumps	£750
Pump maintenance and filter cost	£1000
Labour costs for maintenance 1hour/month @ £8/hour	£96
Depreciation and interest on one off capital	£737
Total annual cost	**£2583**
Estimate of annual water collected off roof	4392 m^3
Estimate of annual water to be abstracted from canal	7300 m^3
Total roof and abstracted water	11692 m^3
Estimated of annual cost of water from roof and canal £/m^3	£0.22/m^3
Saving compared to Seven Trent water supply @ £1.0877/m^3	£0.867/m^3
Saving on 11692m^3 of water @ 0.867 £/m^3 =	£10137/yr

Result

- The total annual savings for Oakey Farm from the roof water collection and planned canal abstraction will be over £10,000/year.

Action area: Alternative water sources (abstractions from ground and surface water)

In brief

Key points

- **Alternative supply options**

1. Borehole
2. Springs
3. Canals
4. Rivers
5. Lakes

- Abstracted water will normally be cheaper than water company water but is not free and inefficient water use can significantly add to waste water disposal costs
- Test bores are not inexpensive and there is no guarantee of finding suitable quality or quantities of water
- An abstraction license may not be needed if abstracting less than 20m^3/day.

Key steps if considering an abstraction

1. Contact the Environment Agency to check who is currently abstracting from the source and if you can get up to 20m^3/day without a licence
2. Contact your local borehole driller
3. Get a geologist report
4. Prepare draft costings of capital and running costs
5. Work out potential savings
6. Assess risks

Points to consider with alternative water sources

Advantages

- Significant potential cost saving on water purchase cost compared with mains supply
- If abstracting less than 20m^3/day you may not need a licence
- You have security of your own supplies.

Disadvantages

- An initial search for water can be quite expensive. Typically you would commission a geologist's report which may cost between £500 and £1000. Test bores (used in the first instance to see if you can find water, check flow rates and purity) may cost £1500 to £3000 depending on the site.
- So an initial investment of £2000 to £4000 may be needed and there is no guarantee that water of sufficient flow rates or purity will be found
- There is a capital cost to installing a borehole. The total cost for drilling a bore (additional to the test bore), installing a pump, electrical supply, filters, pressure vessels, tanks or reservoirs etc could cost between £10,000 and £20,000
- Running costs include electricity or fuel cost for the pump, service and maintenance cost for pumps, filters etc, labour cost to keep it running, and an annual EA license if this is required
- Don't forget the hidden disposal cost from excessive water use. Borehole water is often regarded as 'free' on many farms. (See 'Typical costs for different sources of water' in the 'Where does your water come from?' section of this booklet)
- The cost per m^3 abstracted will be significantly less than mains supply but it is not 'free' (see 'Table costs for different sources of water' in the section 'Where does your water come from?' in this booklet).

REMEMBER!

The cost of disposal of dirty water can be at least as expensive as the cost of mains water purchase from a water company. So if abstracted, borehole water is used excessively, for example, for parlour wash down or plate cooling (without re-use), then the cost of dirty water disposal can eliminate much of the savings you hope to achieve.

- Once you have an abstraction licence you forfeit the 20m^3 exempt right. An abstraction licence will normally have conditions, eg, a restriction during drought periods. Once you have a licence you cannot go back to the 'exempt status' without giving up the licence.

Regulation & legislation

- From 1 April 2005, an amendment was made to the Water Act 2003 that deregulates abstractions of less the 20m^3/day. The law now permits you to abstract up to a max of 20m^3/day without the need for a 'Licence to Abstract Water'. This is subject to two important conditions. (1) You have a legal right to the source of supply (ie, it is on your land). (2) The abstraction is not part of a series of abstractions from the same source totalling a quantity greater than 20m^3/day
- If you already abstract 10m^3/day from a spring and you put in another well or borehole that draws from the same source then that new borehole must take less than 10m^3/day ie, a total of no more than 20m^3/day
- If you want to abstract more than 20m^3/day from a water source you will need to apply to the Environment Agency for an abstraction licence (for further details on obtaining an abstraction licence see signposting below)
- It is important to note the 20m^3/day is a maximum daily rate and cannot be averaged, so every day you do not pump, you forego 20m^3 of water
- Planning permission may be required for wells and bore holes and even test bores. Different planning authorities appear to interpret the planning guidance differently. You are therefore strongly recommended to speak to your local planning authority before you proceed
- Dairy hygiene regulations require that any water used for hand, udder, or dairy plant washing must be from a potable source. If this is not a mains supply then the water needs to be assessed annually by the local authority's Environmental Health Officers to ensure its purity
- It is recommended you put a meter on your own supply, firstly to monitor your own use but also to demonstrate to the EA that you are complying with your licence or the 20m^3 exemption
- Water supply (water fittings) regulations 1999 must be complied with on all premises with mains supply. In essence the back flow of potentially contaminated water must not be allowed to enter a mains supply net work. Air gaps are needed between mains supply and non-potable water (see our further information section for more details).

Capital costs

A borehole is used in this example to show the typical capital and running costs of this option. Similar principles apply to abstractions from the other alternative sources.

Item	Typical range of costs £	Estimate your costs £
Capital/one off item cost:	For abstractions of 4000m^3 to 20,000m^3/yr	
Geologists' report	500 to 1000	
Abstraction licence application fee	If required 135	
Admin fee	100	
Advertising cost	150 to 350	
Test bore	500 to 1500	
Main borehole	5000 to 10,000	
Bore hole pump	500 to 1000	
Pump shed	150 to 500	
Electrics, tanks, pumps, pressure vessels, pipework, filters etc	2000 to 5000	
Total estimated range in capital or one off costs	**9035 to19,585**	
Annual running costs		
Annualised capital costs	675 – 1500	
EA abstraction license fees	Over 25 years @ 7% APR (If required £170 to £2500)	
Borehole maintenance/service cost	250 to 1000	
Labour costs	50 to 150	
Electricity costs	250 to 750	
Total annual running costs	1395 to 5900	
£/m^3 range	**0.19 to 0.38**	

Return on capital

A return on capital can be calculated from your figures on previous page.

Issues associated with direct stock drinking

Direct stock drinking from river, streams, ponds, ditches and lakes is common on many farms. This can amount to a significant saving in drinking water costs. However, there are certain risks and issues that must be considered.

- Ensure the stock have access to a sufficient supply of clean water from the water course
- Allowing uncontrolled stock access to water courses can cause bank erosion, contamination and damage to habitats and this is a concern to the Environment Agency in certain river catchments. Dedicated and properly constructed access points for stock drinking can reduce some of these risks
- Indirect drinking with the use of pumps to troughs or stock operated drinkers such as pasture pumps can also overcome the problems above. New technology in solar operated pumps may also be an option to consider
- There can be health risks to stock from access to water courses. Consult your vet regarding specific risks to your stock on your farm.

A well constructed water course drinking point, with a hard stone base

Stock operated pasture pump

Further information

Additional information associated with rain water harvest can be supplied by the following contacts. (Please see 'Contacts' section of this booklet for full contact details)

- **Water Regulation Advisory Scheme** – Regulations apply to premises that have a mains supply of water. These regulations come under the **'Water Supply (Water fittings) Regulations 1999'**
- **Environment Agency** – Environment Agency Water Abstraction Licences. Ask for the booklet 'Investing in a better place' – water abstractions charges 2006 –2007. This gives details of how charges apply.

Case study: Borehole abstraction and running costs

Also see the case study in the rainfall harvest fact sheet which includes a case study on an abstraction from a canal.

Farm business profile

Business:	FJ & RF Banfield
Farmer:	Francis Banfield
Farm:	Church Farm Keevil, Trowbridge, Wilts
Cows:	230
Yield:	7300 litres
Youngstock:	Dairy replacements are reared
Land:	Totals 162ha with 100ha rented and 62ha owned
Crop:	Grass and maize silage forage based system
Other:	A family dairy farming partnership between Francis, Rosemary and their son Paul

Paul & Francis Banfield

Water notes and issues at this farm

- The farm has had a borehole and underground reservoir since 1926. These supply all the farm's water (except one isolated field water trough and the farmhouses)
- The reservoir has approximate dimensions of 8m x 5m x 3m depth, giving a capacity of up to 120m^3
- The original bore was a 4" unlined bore. With increased water demand from the farm, the decision was taken in 2000 to upgrade the borehole supply
- A new 6" plastic lined bore was installed adjacent to the existing bore. The bore is to a depth of approximately 27m
- The bore is plastic-lined to allow the borehole pump to be extracted for maintenance.
- An electrical supply has been in place since 1960s (prior to this, a wind-powered pump with a back-up petrol generator was used).

How the existing system works

The borehole pump abstracts direct to the block-built covered reservoir. This is the original reservoir. Although modern borehole pumps have the power and capacity to draw large volumes on demand and therefore can reduce the need for large capacity reservoirs (and therefore can save significant costs), this bore does not have a high flow rate and so suits the continued use of the reservoir.

The source of the water is also high in sedimentary iron deposits. The reservoir acts as an excellent settlement tank, so the water drawn from the reservoir only passes through a simple in-line grit filter before being distributed to the farm supply network. A pressure vessel also ensures a good pressure for the farm supply. The water is drawn from the reservoir by a pump in the adjacent pump house.

Borehole maintenance under way

Points to note and other issues

- The water is tested annually by the local authority to ensure its purity for use in the dairy plant and for hand and udder washing; there have been no issues with contamination (this is a statutory requirement for non-mains water that is used for hand, udder and plant cleaning)
- The water has also been tested for any excessive levels of minerals (particular concern over iron) however the results have not shown any excessive levels
- The iron sediment is an issue for the borehole pump. Over a period of approximately six months or so the efficiency of the pump falls due to build up of deposits in the pump. The farm now has a spare borehole pump and the farm policy is to remove the pump every 5 to 6 months for cleaning and maintenance and to rotate the use of the pumps
- The water is metered as it comes from the borehole
- There is an option to reconnect the mains to the existing system should there be a contamination or shortage from the borehole. This has not been needed
- There is a light on the front of the pump shed to warn of low water levels in the reservoir
- The borehole pump is designed to run on cheaper night electricity rates
- The farm has an historic abstraction licence for up to 20m^3/day.

Costs

An estimation of the capital and running costs at Church Farm are listed below:

Capital Item	£
Installation of new lined borehole with pump and electrical upgrade and new pressure vessel in year 2000	10,000
Total capital items	**10,000**
Estimated annual running cost Annual off peak electricity cost for pumps	770
Annual pump service/maintenance	1000
Annual labour cost to check maintain @ 2hour/man @ £8/hour	192
Depreciation on capital over, say, 25 years (from above)	400
Average Interest on capital (from above)	380
Total annual cost	**2742**
Estimate of annual supply no more than m^3/year	7300
Cost £/m^3	0.38
The local water company is Wessex Water and current charges are £1.2876/m^3 so if using all mains water the costs would be	9399
Annual cost saving is therefore	**6657**

Results

The annual saving for the borehole system at Church Farm compared with purchase from the mains supply is £6657/year.

Action area: New water technologies and other innovative ideas

In brief

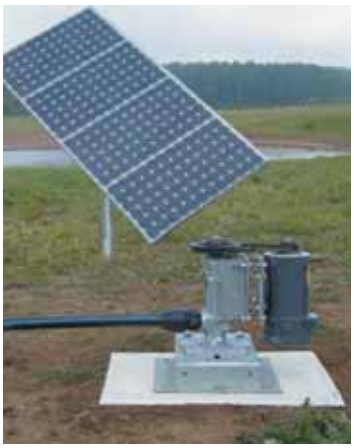
Key points

- New developments and technologies can provide opportunities for water use saving
- Certain products/technologies involving water use may deliver positive benefits for example for herd health, energy saving, or labour saving, but may result in more water use.

Points to consider with new technologies and innovative ideas

Examples of options that may save water usage

- Low volume foot baths, mats or washing footbaths
- High-pressure bulk tank washing systems can save 30% to 60% over older bulk tank wash systems. This is highly relevant when you are due to change your bulk tank
- Solar-powered water pumps. Drinking water is typically 50% to 75% of a dairy farm's water use. If a significant proportion of summer drinking water could come from a farm's water course (rivers, ditches, ponds or lakes) this could have a significant impact on water costs. New innovation in solar technology may provide a solution here. The Environment Agency is concerned about bank erosion and contamination from stock drinking direct from rivers, ditches, ponds, lakes etc. This technology may provide a solution to reduce bank erosion and contamination as well as reducing the use and cost of main supply water.



An example of solar pump system

Examples of options that may increase water usage

- Teat wash system by 'Puli-systems' – an auto brush wash system for udder cleaning
- Parlour auto floor wash systems – may be very effective for parlour cleanliness and labour saving, but may lead to more water use
- Water use in slurry flushing systems. Slurry flushing systems are common in the US, and a number of UK units have incorporated slurry flush systems. Volumes of water use are large and so re-use of water is vital on such systems. These systems can provide benefits in terms of labour saving and cow foot health, but can provide challenges for water re-use, slurry separation and odour.

Contacts for further information

Enhanced Capital Allowance Scheme
Helpline: 0800 58 57 94
E-mail: wtl@envirowise.gov.uk
Website: www.eca-water.gov.uk

Environment Agency
Rio House
Waterside Drive
Aztec West
Almondsbury
Bristol
BS32 4DU

Phone: 08708 506506
E-mail: enquiries@environmentagency.gov.uk
Website: www.environmentagency.gov.uk

Environment Agency Wales
Head Office
Cambria House
29 Newport Road
Cardiff
CF24 0TP

Phone: 08708 506506
E-mail: enquiries@environment-agency.gov.uk
Website: www.environment-agency.gov.uk

Met Office
FitzRoy Road
Exeter
Devon
EX1 3PB
United Kingdom

Phone: 0870 900 0100
Fax: 0870 900 5050
E-mail: enquiries@metoffice.gov.uk
Website: www.metoffice.gov.uk

Rainharvesting Systems Ltd
Unit S2 Inchbrook Trading Estate
Bath Road
Woodchester
Stroud
Gloucestershire
GL5 5EY

Phone: 0845 223 5430
Fax: 01453 839260

Scottish Environmental Protection Agency
SEPA Corporate Office
Erskine Court
Castle Business Park
Stirling FK9 4TR

Phone: 01786 457700
Fax: 01786 446885
Website: www.sepa.org.uk

Water Regulations Advisory Scheme
Fern Close
Pen-y-Fan
Industrial Estate Oakdale
Gwent
NP11 3EH

Phone: 01495 248454
E-mail: info@wras.co.uk
Website: www.wras.co.uk

Other useful information

'Waterwise on the farm - a simple guide to implementing a water management plan, Version 2' (available from the Environment Agency catchment co-ordinators, LEAF, and NFU regional environment advisors).

The Code of Good Agricultural Practice for the Protection of Water (available from Defra publications - 08459 556 000)

Information for a full water audit

Full water audit templates have not been included with this booklet but are available from the MDC. 'The Dairy Farm DIY Full Water Audit Pack' can be downloaded from the MDC web site at www.mdc.org.uk or can be posted to you if you call the MDC on 01285 646500.

Information you will need to prepare

1. Draw a simple sketch map of your farm and where water sources and water outlets are. Note where the main water supplies are and where the main water outlets or uses are.
2. You will need to know approximate average stock numbers/types over the period of the audit.
3. You will need to know the flow rates of some of your key water outlets eg, pressure washer, parlour hose, volume washer etc. Simply use a watch with a second timer to record the time it takes to fill a container of known volume such as a bucket.
   - For example. it takes 45 seconds to fill a 10-litre container with water from your parlour hose (10 litres/ 45 seconds) x 60 = 13.33 litres/second flow rate
4. You will need to make your best estimate of time of operation of your various water outlets, eg, how many minutes per day do you use your parlour volume hose?
5. Water bills or meter readings for at least a 12-month period.

Once you have the full water audit pack, follow its simple step-by-step guidance for the templates.

Appendix

Appendix 1 Benchmark data of mains supply water cost on dairy farms

Promar International's aggregate data from fully costed dairy farms was used to look at a benchmark for mains water supply costs on dairy farms.

Key parameters of the data were as follows

- Over 100 dairy farms in the sample
- The water cost is that paid to the water company. It will not include the cost of a farmer's own supply (for example a farm borehole)
- The sample includes farms that use mainly their own water supply to those that use 100% mains supply from the local water company.

Benchmark data for the average sample farm are as follows

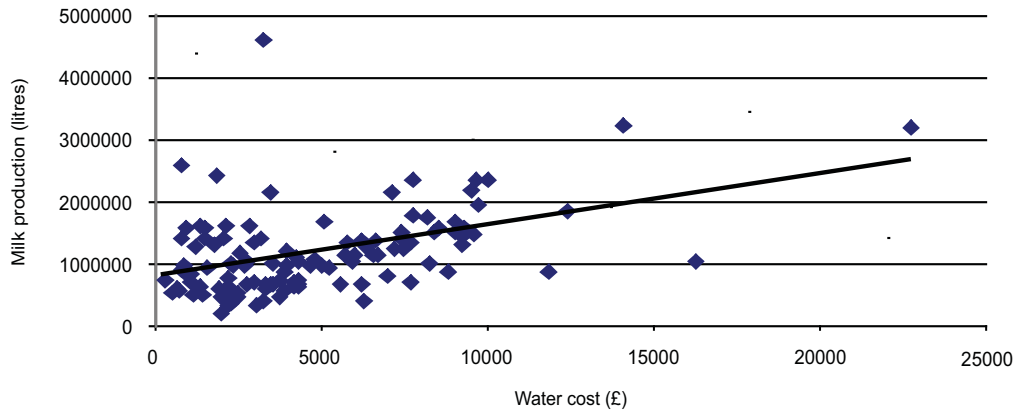
- They have on average a herd size of 162 cows
- They have on average a yield per cow of 7234 litres
- The average farm mains supply water cost is £4825/year
- The average main supply water cost per cow is therefore £31.

The range within the sample is as follows

- Costs per farm range from £300 to £22,000
- Herd size from 36 to 451 cows
- Cost per cow £3/cow to £104/cow.

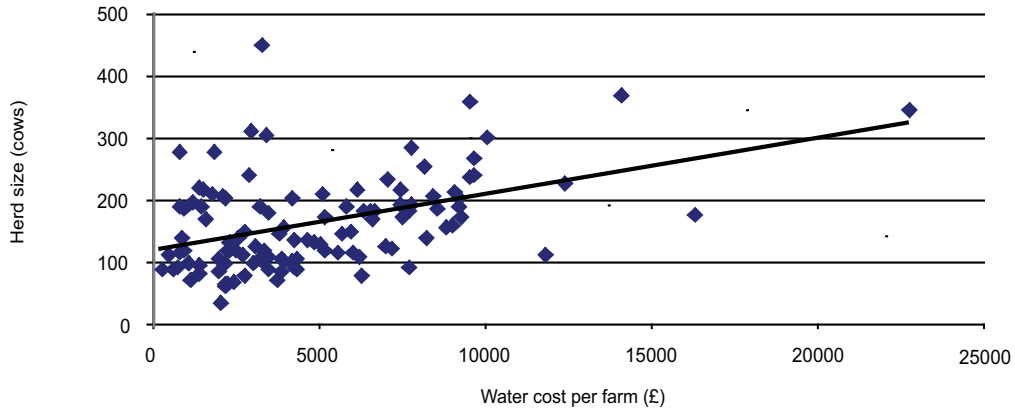
Graphs of data below.

Water costs £ v milk production (l)



- Unsurprisingly there is a relationship between size of business (by milk produced) and cost of paid water, but there is a large range within these figures.

Water costs - Water cost £/farm V herd size



- Again perhaps unsurprisingly there is relationship between size of business (by herd size) and paid water costs, although the range within this is large.

Within this sample of data no significant relationship could be found between yield per cow and water use. Although it is a fact that higher-yielding cows will drink more water, within this sample other factors (such as other stock use and other water use or supply) were more important and did not allow this trend to show through.

Appendix 2 Water use monitor sheet

A simple template such as below can be used to monitor water use.

Name:
Address:

Meter no. or name	Date of reading	Meter reading	Days between readings	Average daily water use (m^3/day)	Notes
Dairy meter 3366677	25 Nov 2006	002467			
Dairy meter 3366677	5 Jan 2007	002569 difference 102m^3	41	2.488	

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Stroud Road, Cirencester GL7 6JN
Telephone: 01285 646500
www.mdc.org.uk

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