

*Reducing water costs in paper
and board mills*





Reducing water costs in paper and board mills

This Benchmarking Guide was produced by
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Enviros

Foreword



Water is essential to paper-making and at one time it could be assumed that paper mills would always have as much of this resource as they wanted. Those days have gone. Pollution control measures and new local housing and commercial developments have brought local pressures; some regions are seeing a pattern of an increasingly scarce seasonal resource and charges are rising everywhere.

This Guide shows that there are considerable variations in the specific water consumption of mills in different product sectors. Whilst this reflects variations in the manufacturing process for these different products, it should not disguise the potential that always exists for improvement.

Reviewing water use in mills and identifying opportunities to reduce water consumption are most effective when undertaken as part of a company's management system. This Guide shows that many mills are already using this approach successfully.

Whilst advances in technology can contribute to improvement, much can be gained by using simple, proven and low-cost techniques. This Guide from Envirowise helps you identify the potential for reducing your water use and costs as part of a systematic approach. It allows you to compare your performance with other mills in your sector and to calculate the true cost of water in your mill simply and effectively. I urge you to take advantage of this Guide and others from Envirowise for the practical, simple and down-to-earth advice they offer.

Dr Martin Oldman
Acting Director General
The Paper Federation of Great Britain

Summary

This Benchmarking Guide is intended to help you to identify the potential for achieving cost savings by reducing water and effluent costs at your mill. Although the cost of water entering a paper and board mill is relatively low, the costs of treating it for use in the process and prior to discharge add significant costs. If water is used unnecessarily, the money spent treating and handling it is also wasted. Controlling water consumption not only reduces water and effluent costs, but can also lead to better overall control of raw material, waste and energy costs within the mill.

The results of surveys conducted by Envirowise and The Paper Federation of Great Britain of water use in the UK paper and board industry show that specific water consumption (the amount of water used to produce one air-dried tonne of paper) varies considerably between mills in the different sectors of the industry. The survey also found that the implementation of many low-cost water reduction measures was as low as 20% to 50%. Improvement in water use has been shown to be possible by a number of mills that have implemented and benefited from water management programmes and water saving techniques. Whilst every mill is an individual concern, the combination of results shown here indicates that most mills could save money by targeting water usage.

This Guide is intended to help you reduce water consumption in your mill by:

- allowing you to compare your performance with that of other mills in your sector;
- showing you how to calculate the true cost of water in your mill;
- describing what mills are doing to reduce water use;
- presenting Industry Examples that illustrate how reducing water use can help your mill save money, comply with environmental legislation and remain competitive;
- signposting you to other Envirowise publications that can help your mill reduce water consumption.

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Water is a necessary component in the manufacture of paper and board products. However, it is often perceived as having zero or little value within the mill. Although the cost of the water entering the mill may be low, the costs of treating water to make it 'fit for purpose' and treating it again prior to discharge are significant and are not always taken into account.

An Envirowise survey carried out with assistance from The Paper Federation of Great Britain (see the Appendix) found considerable variations in water consumption in the different sectors of the UK paper and board industry. The survey also found significant scope for the uptake of low-cost water saving measures and examples of mills benefiting from a review of water use. This suggests that significant savings can be achieved by most mills by targeting water usage.

This Benchmarking Guide, which updates and replaces *Water Use in UK Paper and Board Manufacture* (EG69)¹, summarises the results of this survey and explains how to determine the true cost of water in your mill. It highlights the potential savings you could make and signposts you to other free Envirowise publications that will help you to implement a water reduction programme at your mill.

Reducing water consumption requires effort. However, many mills have already achieved significant savings by introducing no-cost and low-cost measures (see Section 4 for examples).

1.1 Why reduce water use?

Controlling water consumption can lead to better overall control of raw materials, waste and energy use within the mill.

The benefits of improved water management in paper and board mills include:

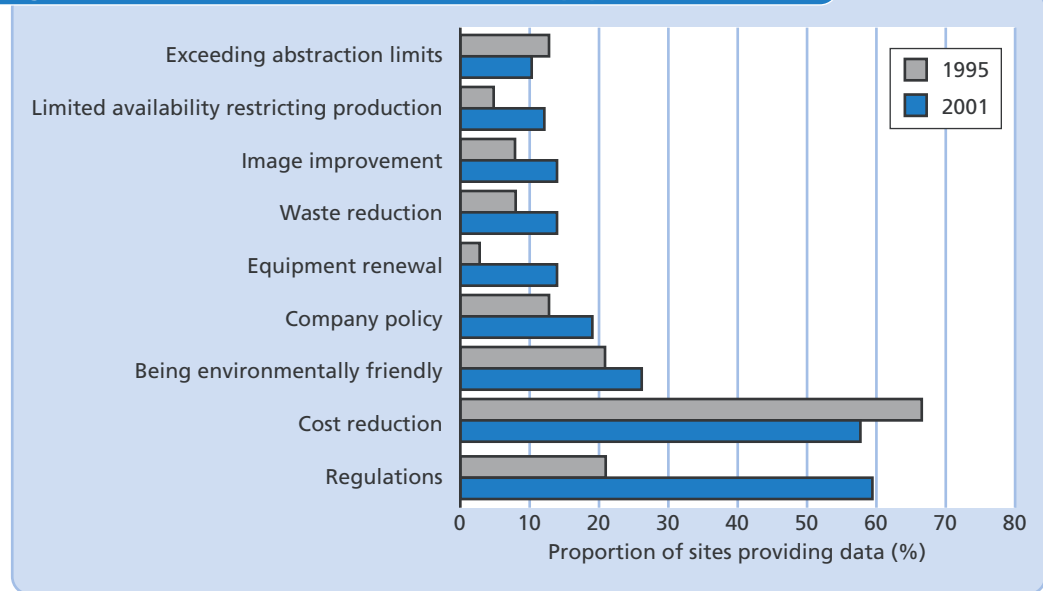
- reduced costs of:
 - water supply;
 - water treatment;
 - on-site effluent treatment;
 - off-site effluent disposal, eg trade effluent charges;
 - pump operation and maintenance;
- compliance with regulatory requirements such as the water use benchmarks demanded by the Pollution Prevention and Control (PPC) regime;
- improved environmental performance leading to improved relationships with stakeholders such as regulators, employees and the general public;
- improved security of supply, eg in times of drought.

¹ Published in 1997 by the Environmental Technology Best Practice Programme (now Envirowise).

1.1.1 Reasons why mills have taken action to reduce water use

As part of the Envirowise survey, mills were asked which issues had acted as drivers in their campaign to save water. Their responses are summarised in Fig 1, which also provides a comparison with the views expressed in 1995. The responses showed that cost saving is still a major driver for reducing water consumption; almost 60% of mills gave this as a key reason for reducing water consumption. However, Fig 1 shows that the industry now considers the new PPC regulations to be as important, with a swing from 21% to 60% of mills giving regulation as a key driver for more efficient water use.

Fig 1 Drivers for more efficient water use in UK paper and board mills



Specific water consumption

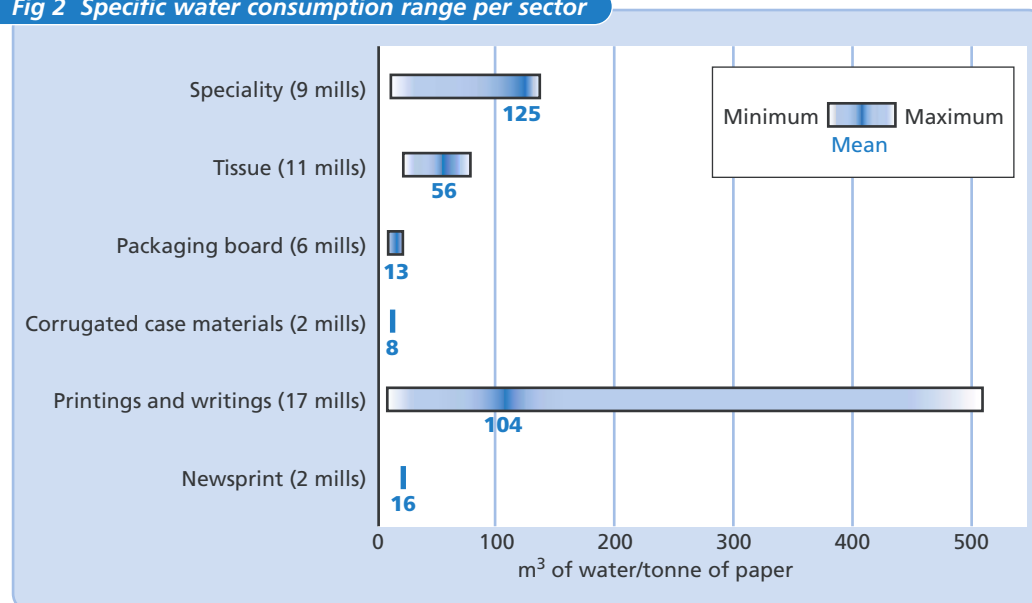
The key performance indicator used by the industry to measure water consumption is specific water consumption (SWC). This is defined as the amount of water used by a mill to produce one air-dried tonne (ADt) of paper and is a measure of the efficiency of water use. Specific water consumption is also used by the Environment Agency, the Scottish Environment Protection Agency and the Environment and Heritage Service (Northern Ireland) to set the water use benchmarks² required under the PPC regime.

The amount of water used in production varies from mill to mill and depends on factors such as:

- the type of paper manufactured by the mill;
- the water quality required in the manufacturing process;
- the source of the fibre used to make the final product.

Fig 2 shows the range of specific water consumption for different sectors found by the survey, together with the mean value. Where data are only available for a few companies within a sector, only the mean is quoted to ensure confidentiality. The large range for printings and writings is because the data include several mills producing security papers where the specific water consumption can be significantly higher than in other mills.

Fig 2 Specific water consumption range per sector



² See IPPC S6.01: *Technical Guidance for the Pulp and Paper Industry* published by the Environment Agency (www.environment-agency.gov.uk).

2.1 The specific water consumption in your mill

How does your specific water consumption compare with the performance of other mills in your sector? Calculating your specific water consumption will allow you to:

- find out whether your company uses water as efficiently as it thought;
- find out whether your company is achieving the water use benchmarks required under the PPC regime;
- compare your performance with that of your competitors;
- estimate the potential savings you could make;
- monitor progress in reducing water use.

Collecting the data needed to calculate your specific water consumption more often and plotting the results on a graph against time will allow you to identify trends and unexpected variations in water use.



What is the specific water consumption for your mill? Unless you are at the lower end of the range for your sector (see Fig 2), there may be scope to reduce water use at little cost to the company. What action can you take to improve your performance against that of your competitors?

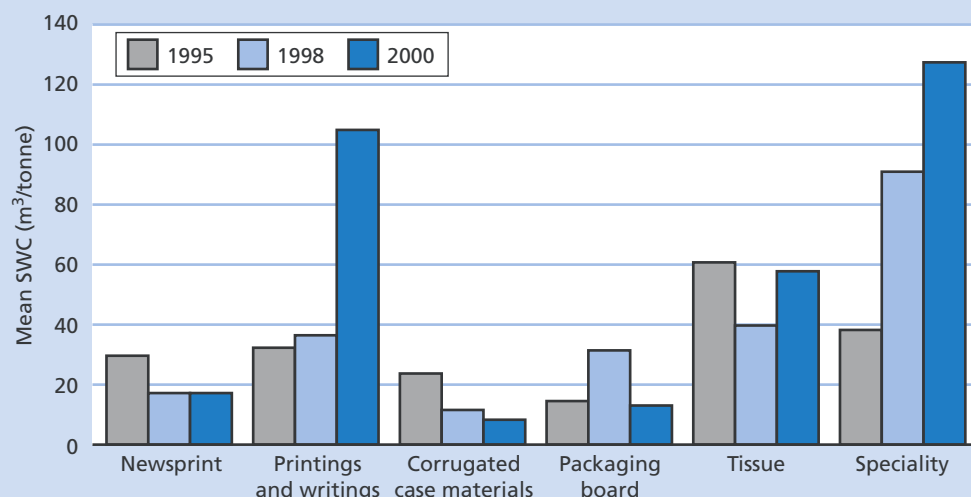
Measure your specific water consumption regularly. Plot the values against time to identify trends and improvements from your water reduction programme.

2.2 Trends in specific water consumption

Fig 3 shows changes in the mean specific water consumption for the different sectors between 1995 and 2000. However, the results must be viewed with caution because:

- the mean value for each sector is calculated from the mean values for each mill that responded to the survey;
- the same mills have not necessarily provided data in each survey year.

Fig 3 Trends in specific water consumption by sector



* 1995 data: *Water Use in UK Paper and Board Manufacture (EG69)*.
1998 data supplied by The Paper Federation of Great Britain.

How much could your mill save?

Simple extrapolation from the survey data indicates that, in 2000, the UK paper and board industry used approximately 220 million m³ of water to manufacture 6.6 million air-dried tonnes of paper and board at a cost of supply of £12.8 million.

The Industry Examples summarised in Table 1 and described in more detail in Section 5 show how five mills have reduced water consumption by between 10% and 50%, and achieved significant cost savings and other benefits. These results suggest that there is scope for other mills to save significant amounts of money by reducing water use.

For example, by reducing total water and effluent costs by 20%, many mills could be saving £1 per tonne of product - that's £50 000/year for a mill with say 50 - 100 employees producing 50 000 tonnes/year.

Gaining control over water consumption has also enabled many mills to achieve significant savings in material and energy costs. To identify these savings, you need to understand the true cost of water at your mill.


Table 1 Industry Examples summary

Company	Mill	No. of employees	Water saving measures	Benefits
Inveresk plc	Caldwells Mill	172	<ul style="list-style-type: none"> ■ Set up a utility monitoring and targeting programme. ■ Installed five new meters. 	<ul style="list-style-type: none"> ■ Identified a significant leak, thus reducing water consumption and costs by 50%. ■ Better control of water across the mill.
Charles Turner & Co Ltd	Springside Mill	175	<ul style="list-style-type: none"> ■ Installed new paper machine, a recycled paper and deinking plant, and water recycling systems. 	<ul style="list-style-type: none"> ■ Improved productivity. ■ Reduced SWC by 30%. ■ Future savings in effluent disposal volumes and costs expected.
BPB Paperboard Ltd	Davidsons Mill	250	<ul style="list-style-type: none"> ■ Set up a mill-wide environmental management system (EMS). ■ Introduced a waste minimisation programme with a key objective of reducing wastewater. 	<ul style="list-style-type: none"> ■ Reduced SWC by 16% from 5.1 m³/tonne to 4.3 m³/tonne. ■ Success has resulted in a team of people keen to continue reducing the mill's water consumption.
SCA Hygiene Products	Chesterfield Paper Mill	70	<ul style="list-style-type: none"> ■ Introduced re-use of recovered treated effluent to dilute thick stock. 	<ul style="list-style-type: none"> ■ SWC reduced by over 10%.
Iggesund Paperboard	Workington Paperboard Mill	475	<ul style="list-style-type: none"> ■ Introduced a mill-wide project aimed at reducing SWC and the loss of raw material to effluent. 	<ul style="list-style-type: none"> ■ Reduced SWC by 38% from 40 m³/tonne to around 25 m³/tonne. ■ Reduced fresh water use by 30%. ■ Reduced loss of raw materials to effluent by 50%. ■ Achieved substantial cost savings and greater control of effluent quality.

3.1 The true cost of water

The cost of water is not only the cost of purchasing water from the supplier. It also includes the costs involved in treating and handling that water. Reducing the amount of water you use will also reduce the volume of effluent requiring treatment and discharge. Table 2 lists the possible components making up the true cost of water.

Table 2 *Cost components of water use*

Cost component	Comments
Supply	If mains water, paid as either a standing charge or in pence/m ³ . Costs expected to continue to increase significantly.
Disposal	If discharged to sewer, usually charged per m ³ on the basis of the Mogden formula, which takes account of the pollutants present. Trade effluent charges are rising steeply to meet higher wastewater treatment standards.
Treatment	This includes the cost of the chemicals and plant to clean water to: <ul style="list-style-type: none"> ■ make it fit for purpose within the mill; ■ ensure it meets the conditions of discharge consents.
Material losses	Use of water in a mill can lead to losses of fibre and treatment chemicals. For example, high water make-up in white water systems can lead to greater discharges to effluent and hence a loss of raw materials to effluent and increased effluent treatment costs.
Energy	Pumping water into the mill, around the mill and through the effluent treatment plant can lead to significant electricity charges. The amount of electricity used by the pumps is a function of flow rate, distribution pressure and pumping efficiency.
Maintenance	This is associated with pumps, flow meters and the corrosion and build-up of deposits in pipework. The less water flowing round the mill and effluent treatment plant, the less need for maintenance to ensure efficient operation of the water distribution system.
Capital expenditure	Unnecessary capital expenditure may be incurred during the installation of new plant or the extension of existing plant if action has not been taken to minimise water use. For example, a water reduction programme may avoid the need to build expensive new plant to treat the higher water or effluent volumes associated with an increase in production.
Labour	All the tasks involved in keeping the water system functioning within the mill require labour in some form.

3.2 Survey results

The mills that responded to the survey obtain most of their water (63%) from surface water; the remainder comes almost equally from mains supply (20%) and boreholes (17%).

The survey data show that the cost of water supply (see Fig 4) and effluent treatment and discharge (see Fig 5) in relation to production varies widely within the industry. Nearly all mills operate some form of effluent treatment plant (ETP).

Fig 6 shows the wide variations in total water and effluent costs in relation to production - the mean is £13/tonne and the worst is nearly £80/tonne. On average, the cost of effluent treatment and discharge is approximately five times the cost of supply.

Fig 4 Variations in water supply costs per tonne of paper produced

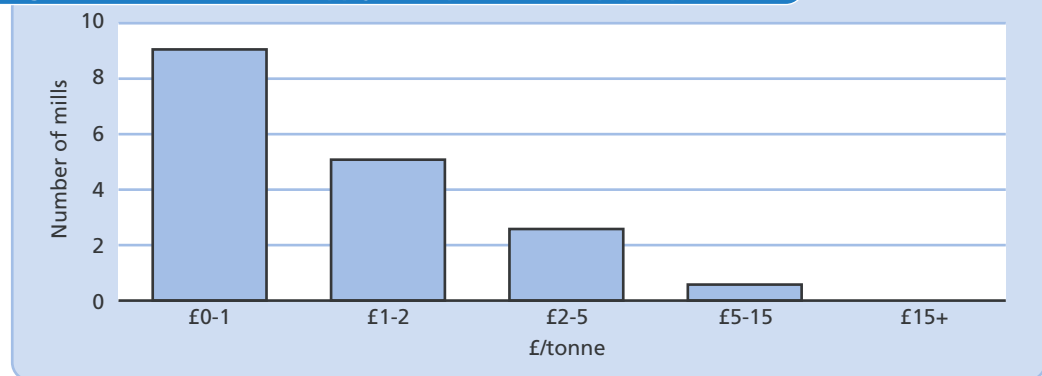


Fig 5 Variations in effluent treatment and discharge costs per tonne of paper produced

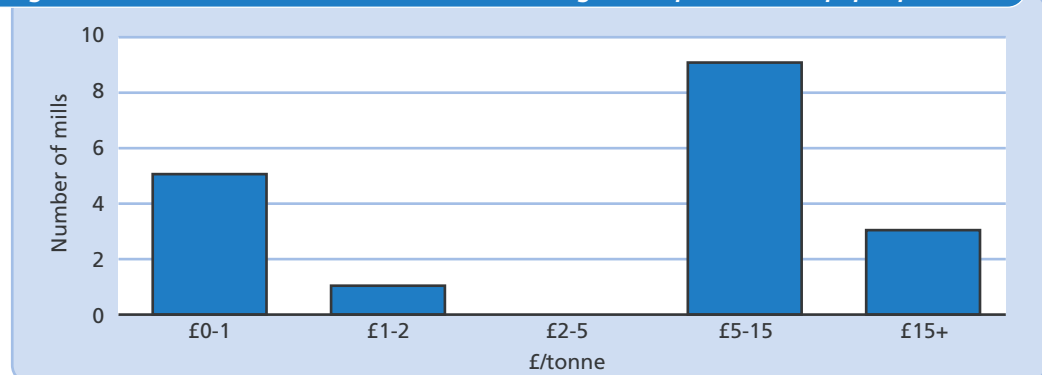
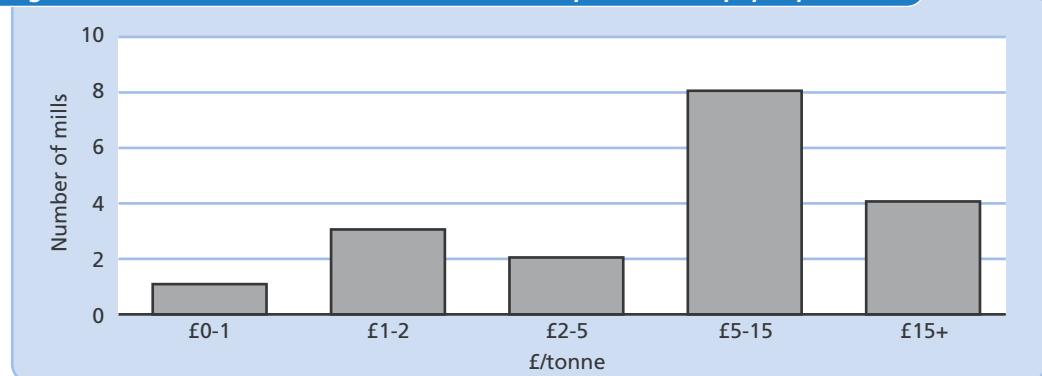


Fig 6 Variations in total water and effluent costs per tonne of paper produced



How much does your mill pay for water supply and effluent disposal per tonne of production? How do your water and effluent costs compare with those of other mills?



3.3 What does water cost in your mill?

Calculating your true cost of water will allow you to:

- find out how much water is costing you;
- calculate the cost of water per tonne of product;
- identify potential savings from water reduction measures;
- focus your efforts on cost-effective measures.

What is the true cost of water for your mill? Use Table 3 overleaf to calculate your true cost of water. Please photocopy this table for use as required to monitor your progress in reducing the true cost of water in your mill.

Use your water bills and other records to fill in the boxes relevant to your operations.



To estimate the value of material losses in effluent, you need to know the average value of chemical oxygen demand (COD) in the effluent entering your effluent treatment plant from the mill. This value is usually provided by the mill laboratory in mg/m³. To determine the total annual amount of COD discharged from your mill, multiply this figure by the annual volume of effluent discharged in m³ and then divide by 1 000 000 to convert from mg to kg. This will give you the amount of oxygen required to oxidise the organic materials present in the effluent. If you then use the rough 'rule of thumb' that 1 kg of organic material (eg fibre or starch) requires 1 kg of oxygen to oxidise it, then your annualised figure for COD equates to the mass of fibre or other organic material lost from the mill. You can then assign a value to this loss based on your estimate of what contributes to this loss and its raw material cost.

3.4 Understanding water use

Before you can decide the scope and priorities for your water reduction programme, you need to know where and how water is used in your process. A useful way of doing this is to prepare water balances for the site as a whole and for individual items of equipment. This will allow you to target your efforts on areas where the largest savings can be made both rapidly and cost-effectively.

For more information on preparing water balances, see *Practical Water Management in Paper and Board Mills* (GG111)³.

Examples of measures already taken by mills are described in Section 4 and details of recent successful water reduction programmes in UK paper mills are given in Section 5. An Action Plan to help you reduce water use in your mill is given in Section 6.

³ Available free of charge through the Environment and Energy Helpline on freephone 0800 585794 or via the Envirowise web site (www.envirowise.gov.uk).

Table 3 Calculating the true cost of water

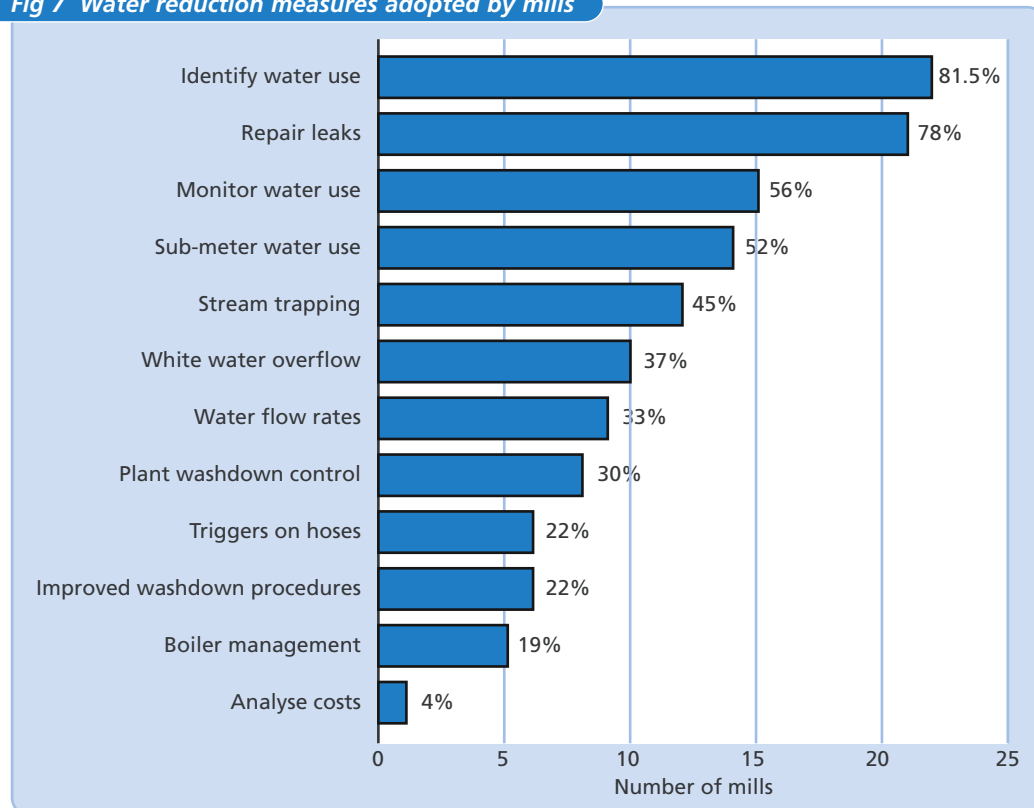
Cost item	Units	Annual amount	Unit cost (£/unit)	Annual cost (£/year)
Raw water:				
Mains water	m ³			
River or surface water	m ³			
Borehole water	m ³			
Environment Agency abstraction licence	£			
Raw water treatment:				
Chemicals	tonnes			
Equipment	£			
Energy for pumping water:*				
Raw water:	kWh			
Treated water:	kWh			
Recycled water:	kWh			
Effluent:	kWh			
Effluent treatment:				
Discharge	m ³			
Chemicals	tonnes			
Equipment	£			
Material losses (estimated value):**				
COD	mg/m ³			
Volume of effluent	m ³			
Amount of material lost	kg			
Other:				
Maintenance	£			
Monitoring and control	£			
Labour	hours			
True cost of water				
* Amount of energy used for pumping water (kWh) = number of pumps x size of pumps (kW) x hours of operation (hours).				
** See box on page 9.				

What are mills doing to reduce water use?

The survey found that many mills have introduced a range of measures to reduce water consumption (see Fig 7). The two most popular measures were identifying where water is used within the mill and repairing leaks to reduce water consumption.

Analysing the cost of water was the least popular. No particular reasons for this emerged from the survey, but it is perceived to be a complex and involved process. However, as shown in Section 3, it is not difficult and, by identifying the hidden costs associated with water use, can highlight areas for priority action where savings can be made rapidly and cost-effectively.

Fig 7 Water reduction measures adopted by mills



The survey findings suggest that there is considerable scope for achieving cost savings by implementing low-cost measures such as controlling flow rates and plant washdown, fitting triggers on hoses and improving boiler management. For more details on no-cost and low-cost measures to reduce water and effluent costs, see *Practical Water Management in Paper and Board Mills* (GG111) and other free Envirowise publications.

4.1 The importance of sub-metering

The use of meters to measure water use and effluent generation by different parts of the production process allows you to obtain an accurate breakdown of water use and costs. The Industry Example in Section 5.1 describes how Caldwell's Mill in Fife realised significant savings by implementing a water metering programme.

The survey findings suggest that sub-metering of water is not widespread in mills. Steam raising and distribution was the main area where sub-meters are used (63% of mills had sub-meters for steam).



The amount of water fed directly into production processes is a key parameter for controlling water use and is the second most commonly metered area of water use in mills. However, only 37% of mills surveyed meter water use for production processes and 48% did not know how much water is used in production. The worst metering record was for washdown - an activity where the volume of water used can vary dramatically.

Could you reduce your water and effluent costs by improving the metering and management of water at your mill by installing sub-meters?

4.2 Recycling water

Reducing fresh water consumption by recycling cooling water and re-using it within another operation is very common; 93% of mills responding to the survey claimed to recycle some water. On average 64% of the fresh water brought in to a mill is recycled into another process; for some mills this figure can be as high as 99%.

The Industry Example in Section 5.4 describes how Chesterfield Paper Mill reduced water consumption and saved money by improving water recycling in its processes.

4.3 Management and control

Key issues for water management and control are summarised in Table 4.

Table 4 Key issues for water management and control in paper and board mills

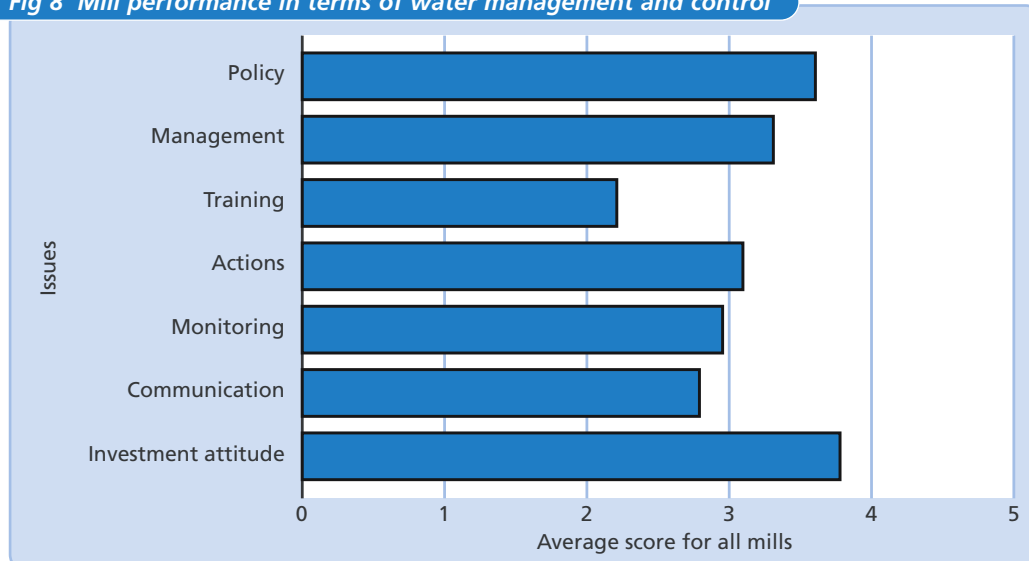
Issue	Best practice
Policy	A statement of intent (usually documented) designed to demonstrate what the mill hopes to achieve in terms of water management. The document needs to be communicated to stakeholders and implemented.
Management	Responsibilities are clearly defined, delegated and communicated so everyone knows who is accountable for managing water issues. Water management is fully integrated into management systems.
Training	Training needs have been determined. Training is provided, evaluated and followed up in the workplace to ensure good practices are reinforced.
Actions	The mill has action plans for improvement setting out clear objectives and targets. Achievements are reported to senior management, employees and all other stakeholders.
Performance measurement (monitoring)	A comprehensive weekly monitoring programme is carried out for each process/building/unit. Performance indicators (eg specific water consumption) are calculated to show improvement and trends in consumption.
Communication	Water use data are communicated to all stakeholders via staff briefing meetings, notice-boards, updates, newsletters, annual reports, etc.
Investment attitude/ allocation of resources	Resources are routinely committed to achieve policy objectives to reduce water consumption across the mill.

In the survey, mills were asked to assess their performance in terms of the seven issues listed in Table 4. For each issue, mills were asked to choose which of five statements best described their performance with regard to each issue. Answers that demonstrated good practice were awarded a score of 5 points; other answers were allocated points on a descending scale (1 point = no action taken or no interest in controlling water issues). Table 5 shows the maximum, average and minimum points obtained by the mills that participated in the survey. Fig 8 shows the average score for all mills for the seven management and control issues. The lower score for training could indicate an opportunity for improvement by focusing on this area.

Table 5 Results from the self-assessment of mill performance

	Number of points
Highest possible score by a mill (5 x 7)	35
Maximum by a mill in the survey	29
Average from the survey	21.4
Minimum by a mill in the survey	7
Lowest possible score by a mill (5 x 1)	5

Fig 8 Mill performance in terms of water management and control



To assess your mill's performance in terms of water management and control, visit www.envirowise.gov.uk/paper_board and decide how you would answer the survey questions.



4.3.1 Environmental management systems

One way of improving your water management is to make it part of an environmental management system (EMS). *Environmental Management Systems in Paper Mills* (GG151)⁴ provides advice to paper mills on how to design, implement and maintain an effective EMS.

The Industry Example describes how Davidsons Mill in Aberdeen benefited from developing an EMS in Section 5.3.

⁴ Available free of charge through the Environment and Energy Helpline on freephone 0800 585794 or via the Envirowise web site (www.envirowise.gov.uk).

Industry examples

5.1 Water monitoring programme results in significant savings

Inveresk plc's Caldwell's Mill in Fife produces graphic papers, including security papers which use significant quantities of fresh water. Most of this is mains water and, in 2000, the mill used more than 600 000 m³ of mains water. The mill employs 172 people.

The introduction of the Climate Change Levy prompted the management team to look more closely at utility consumption at the mill. The team, therefore, initiated a monitoring and targeting (M&T) programme and, to maximise the benefits of this work, decided to include water as well as all types of energy. This decision was partly because water use is inextricably linked with energy efficiency in paper manufacture, but also because the team hoped to achieve cost savings from reducing water use as well.

The M&T programme involved determining current consumption relative to production by collecting utility meter readings from around the mill. The mill had collected meter readings over the last few years, but had never analysed them fully. By adding these historical data, the mill was able to use the M&T programme to establish patterns and trends in utility consumption over longer periods of time.

When the management team looked at water consumption trends, they noticed a significant increase in water use over the past couple of years; in fact, the mill was now using almost twice as much fresh water as it had done previously. An investigation revealed an underground leak on one of the incoming water mains. The leak, which was estimated to be wasting over 300 000 m³/year at a cost of approximately £140 000/year, was quickly repaired.

Since identifying the leak, the mill has continued to save money through smaller M&T projects and has installed five new meters around the site. The mill is also working with the local water company in testing a water meter that monitors water consumption continuously.

5.2 New machine reduces specific water consumption

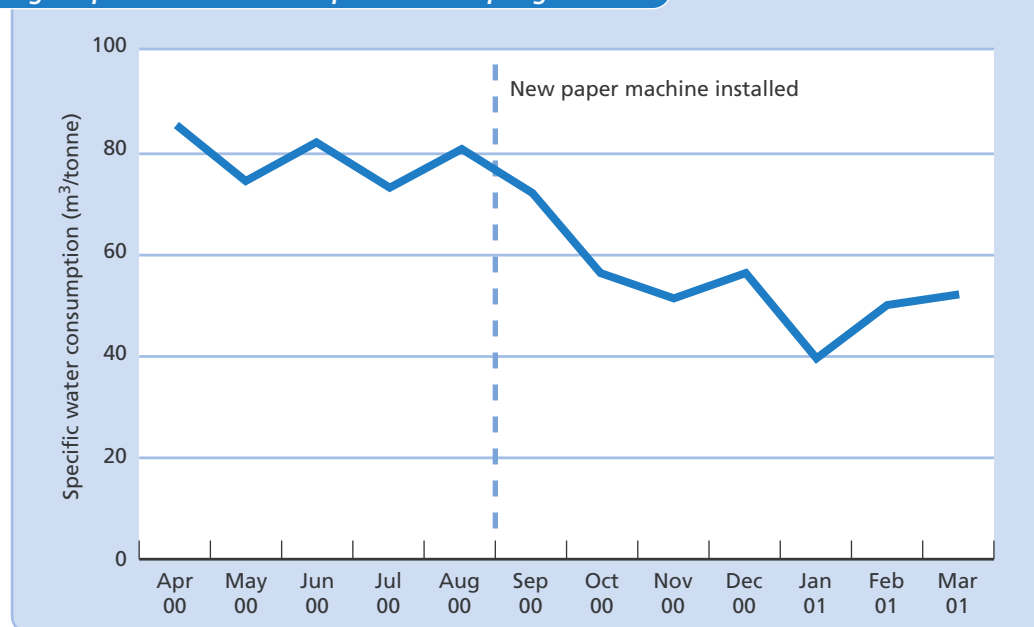
Charles Turner & Co Ltd in Bolton employs 175 people at the Springside Mill in the manufacture of tissue paper. During the 1990s, the company realised that in order to remain competitive it would have to invest in a new paper machine. Changes in the market for tissue meant that the company needed to produce better quality tissue and to a standard width compatible with modern converting machines. The mill needed to upgrade its old machines and to invest in further converting capability.

In 2000, the company invested several million pounds in a complete new system consisting of a paper machine, a deinking plant for recovered paper and water recycling systems. The new paper machine has improved productivity and reduced both water and energy consumption.

The new system is fitted with two clarifiers, one on the paper machine and the other on the deinking plant. Each clarifier is designed to float off sludge using dissolved air flotation (DAF) technology. As much water as possible is recycled - particularly all sealing water, low pressure spray water and water for hosepipes. Fig 9 shows the approximately 40% reduction in the mill's specific water consumption since the new machine was installed.

The mill expects to achieve substantial savings in its effluent discharge costs in the future as a result of the introduction of the new paper machine and an on-going project to increase the recycling of treated effluent.

Fig 9 Specific water consumption at the Springside Mill



5.3 Environmental management system drives water reduction programme

BPB Paperboard Ltd operates two multi-ply paperboard machines at its Davidsons Mill in Aberdeen. The mill, which employs 250 people, manufactures 250 000 tonnes/year of paperboard, almost entirely from recovered fibre. The finished product is used for cartons, fibreboard cases and plasterboard liners.

The mill extracts water from the nearby River Don and, since the 1980s, has successfully reduced water consumption across the mill through a variety of projects. Initially, projects focused on recycling water throughout the mill, eg modifying the recirculation of vacuum pump seal water via cooling towers or heat exchangers. The mill estimates that these initial projects reduced the amount of wastewater by over 40% from about 7 000 m³/day to 4 000 m³/day.

The mill began developing an EMS in 1998 and achieved certification to ISO 14001 in October 2000. The reduction of wastewater was a key objective in the waste minimisation programme set up as part of the EMS. The targets set to encourage improved water management resulted in the implementation of a number of water reduction projects.

- A gravity strainer was introduced to clarify process water from the wet end of the larger paper machine (60 - 65% of production). This means that certain roll sprays (the turning roll and wire return roll) and wire cleaning showers are now supplied by recycled water. Fresh water use has been reduced to a minimum and is only used for the breast roll cleaning shower and the deckle edge sprays. This change has resulted in a significant reduction in water consumption of about 225 000 m³/year.
- The fresh water used for flushing the starch emulsifiers and starch cookers is now directed back into the production process instead of going to drain. This has reduced water consumption by approximately 13 000 m³/year.
- A water pressure control system has been added to the pumps on the smaller paper machine to reduce and optimise the use of sealing water.

- The mill has adopted a policy of converting pump seals to mechanical seals, where possible, and ensuring that cleaning and lubrication shower nozzles are not worn and are the optimum size.

The mill estimates that specific water consumption in 1998 and 1999 was constant at 5.1 m³/ADt. In 2000, the specific water consumption fell by 16% to 4.3 m³/ADt.

Although there are numerous water meters across the mill, the monthly wastewater reduction targets set through the EMS have proved difficult to sustain - partly due to a need for more water flow data. The design team has therefore proposed adding new flow meters (particularly in the backwater system) to:

- provide additional water flow data;
- enable process water imbalances to be minimised;
- maintain a constant flow to the effluent treatment plant.

Several other water reduction projects are planned as continued reductions in water use are integral to the EMS. The planned improvements to the monitoring systems will provide the necessary data to encourage and support the implementation of future projects.

5.4 Water recycling reduces effluent costs

The Chesterfield Paper Mill is owned by SCA Hygiene Products and employs approximately 70 people in the manufacture of tissue-based products from recovered fibre. The mill uses fresh water from a nearby reservoir.

During 2000, the mill undertook a project to reduce the use of fresh water to dilute thick stock from 12% solids to 5% solids by replacing it with recovered water, ie effluent that had received primary treatment.

At the beginning of the project, the mill estimated it was using 17 m³/ADt of product. Using recovered effluent instead of fresh water has allowed the mill to reduce its specific water consumption by just over 2 m³/ADt, a reduction of nearly 12%.

There was no reduction in water supply costs as a result of this project because the company pays an annual fixed fee for water from the reservoir. However, the project has significantly reduced the volume of effluent discharged by the mill, resulting in a substantial reduction in trade effluent and the associated charges.

5.5 Millennium project reduces mill costs

The Iggesund Paperboard mill in Workington, which has a workforce of 475 and a production capacity of 235 000 tonnes/year, uses 100% virgin fibre to manufacture folding box board. Product uses include graphical applications and as packaging for food, pharmaceuticals, toys, chocolate and tobacco products.

As part of its Millennium project, the mill carried out significant process and product development during 1999 and 2000 with the aim of improving product quality and increasing mill capacity. The main investment was a comprehensive rebuild of the mechanical pulp mill, including the introduction of a new hydrogen peroxide bleaching plant.

One of the project's objectives was to reduce both specific water consumption and the loss of raw material to effluent. The main drivers for reduced water consumption were to:

- allow the mill to develop new products and increase production capacity while utilising the existing effluent treatment system;
- reduce the potential to breach the volume limits in the mill's authorisation to discharge effluent.

Throughout the project, care was taken to protect the process and the product from any potentially detrimental effects of using less water.

During the design stage of the project, a comprehensive audit was carried out to characterise the mill water system. The quality and quantity of all water streams (incoming fresh water to final treated effluent) were determined, including all internal water circuits in the pulp mill and board machine. The heat balance in all process areas and the water balance in terms of pulp mill, board machine, white water and broke storage capacities were studied.

Water use at the mill has been reduced through:

- the introduction of two drum filters to recover fibres and water of a suitable quality to be used for dilution and washing in the pulp mill;
- increased storage capacity for white water;
- heat recovery from cooling waters to allow their re-use in the machine shower systems;
- mechanical seals on pumps to reduce fresh water leakage;
- the introduction of silo and tank buffer capacity to reduce the demand for fresh water use during periods of process instability.

In addition, the mill operation has been significantly changed to integrate the water systems. Prior to the project, two board machines were provided with pulp from two dedicated pulp mills. The white water systems from each board machine were also independent. The Millennium project included closing the older pulp mill and integration of the white water between each board machine.










The measures introduced as part of the Millennium project have reduced fresh water use by over 30% and reduced raw material losses by 50%. Specific water consumption has fallen by around 38% from 40 m³/tonne to around 25 m³/tonne.

The following initiatives have been implemented to maintain improvements:

- new water meters have been installed to improve measurement of water use in critical process areas;
- the mill-wide computer operating system and database have been updated to provide pulp mill and board machine operators with a more comprehensive overview of the process;
- an analysis system has been developed to monitor water quality with regard to the specific process requirements.

What can your mill do to reduce water use?

There are a number of practical steps you can take to help overcome possible obstacles to reducing water use.

- 
Obtain commitment. Use this Guide and its Industry Examples to convince senior management of the benefits (cost savings, compliance with environmental regulations, improved environmental performance, etc) of reducing water use. Develop a water reduction policy if your mill does not have one and review it periodically. Remember to state your aims and objectives.
- 
Calculate your specific water consumption. Do this every week to provide a key performance indicator for water use. If you make more than one type of product, try calculating a value for each type. This may help you to identify which areas or production processes use the most water. Compare your specific water consumption with that of other mills in your sector and determine the scope for improvement in your mill.
- 
Calculate the true cost of water in your mill. Use Table 3 to work out how much water costs your mill. You may need to do more work to find out some of the data, but remember you can revisit these calculations at any time.
- 
Identify where water is used in your process. Undertake a comprehensive water audit of the site and prepare a water balance to establish where and how water is used. For more details, see *Practical Water Management in Paper and Board Mills* (GG111).
- 
Set targets for reducing water use. Set realistic targets for reducing water use and effluent discharge according to the advice given in *Practical Water Management in Paper and Board Mills* (GG111).
- 
Implement measures to reduce water use. *Practical Water Management in Paper and Board Mills* (GG111) describes a range of measures to reduce water use including low-cost improvement options, improvement through process modification and improvement through process redesign.
- 
Review mill systems for managing water. Assess your performance in managing and controlling water use. Consider ways of improving your water management including more monitoring, training and integration of water management into your management systems.
- 
Implement an environmental management system. Consider setting up an environmental management system (EMS) to help you manage water and effluent issues on a day-to-day basis. Find out more by looking at *Environmental Management Systems in Paper Mills* (GG151).
- 
Contact Envirowise to obtain free advice and free copies of *Practical Water Management in Paper and Board Mills* (GG111) and *Environmental Management Systems in Paper Mills* (GG151). Other Envirowise publications and services designed to help mills improve their competitiveness by reducing operating costs are signposted in *Support for the Paper and Board Industry* (EN315). To contact Envirowise:
 - phone the Environment and Energy Helpline on freephone 0800 585794;
 - visit the Envirowise web site (www.envirowise.gov.uk).

This Guide has been compiled using the results of two surveys of the UK paper and board industry conducted in 2001.

- A postal survey, Water Use in UK Paper and Board Manufacture in 2000, carried out in September 2001 by The Paper Federation of Great Britain.
- A telephone survey carried out in May 2001 as part of an Envirowise Impact Assessment project.

The profile of respondents for each survey is summarised in Table A1.

Specific water consumption data for 2000 were obtained from both the Envirowise telephone survey and The Paper Federation of Great Britain postal survey. All other data were obtained from one or other of these surveys. Not all mills responded to all the questions posed by the surveys.

Where mills responded to both surveys, the specific water consumption was calculated from the postal survey data. Comparison of the overlapping data from the two surveys showed that the specific water consumption calculated for individual mills differed by about 30% between the two surveys. This difference could have been due to a number of possible factors, including the phrasing of the questions, the potential for less accuracy in an oral rather than a written response and potential confusion about the period for which data were required among people responding on the telephone.

Table A1 Survey responses according to sector

Sector	Number of mills in sector*	Mills responding to Paper Federation survey		Mills responding to Envirowise telephone survey	
		Number	% of respondents	Number	% of respondents
Newsprint	3	2	7.4	2	3.5
Printings and writings	29	14	51.8	11	19.3
Packaging**	27	5	18.5	17	30.0
Tissue	20	4	14.8	9	15.8
Speciality	18	2	7.4	18	31.6
Total	97	27	100	57	100

* Source: The Paper Federation of Great Britain, 2001.

** Packaging board and corrugated case materials.

Envirowise - Practical Environmental Advice for Business - is a Government programme that offers free, independent and practical advice to UK businesses to reduce waste at source and increase profits. It is managed by AEA Technology Environment and NPL Management Limited.

Envirowise offers a range of free services including:

- ✔ Free advice from Envirowise experts through the Environment and Energy Helpline.
- ✔ A variety of publications that provide up-to-date information on waste minimisation issues, methods and successes.
- ✔ Free, on-site waste reviews from Envirowise consultants, called *FastTrack* visits, that help businesses identify and realise savings.
- ✔ Guidance on Waste Minimisation Clubs across the UK that provide a chance for local companies to meet regularly and share best practices in waste minimisation.
- ✔ Best practice seminars and practical workshops that offer an ideal way to examine waste minimisation issues and discuss opportunities and methodologies.



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