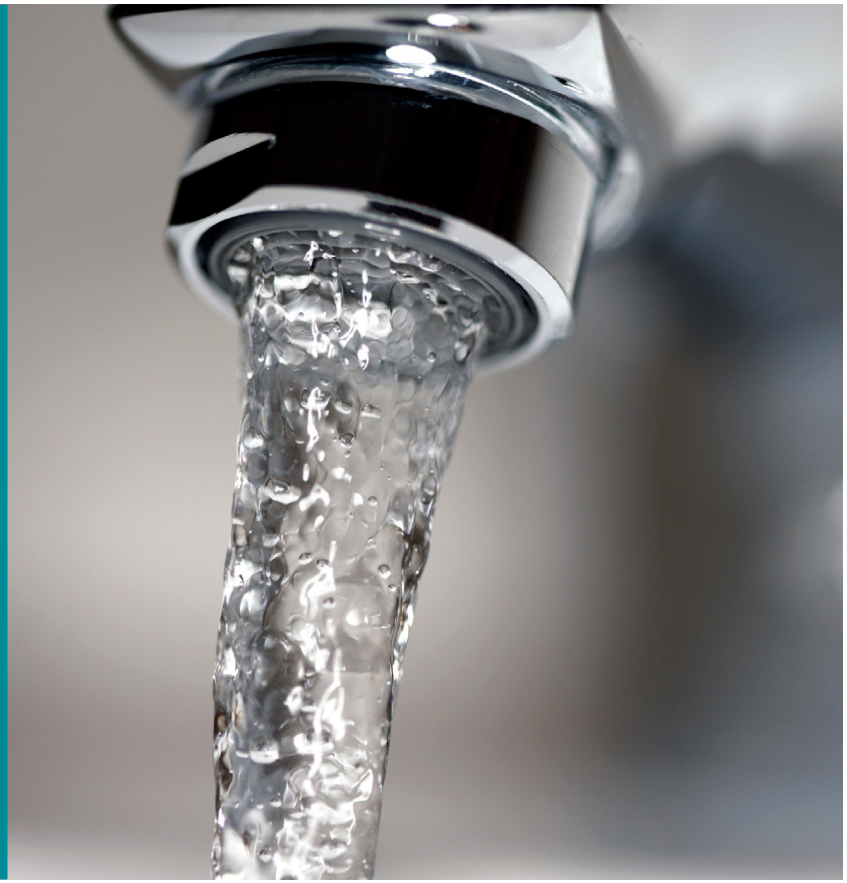
A guide to improving water efficiency

A 10-step good practice guide to support water management and efficiency improvements for Scottish organisations.



Resource Efficient Scotland is the Scottish Government funded programme that helps businesses and public and third sector organisations save money by using resources more efficiently.

By making more efficient use of energy, water and raw materials, Scottish organisations can deliver over £2bn of potential savings to the Scottish economy.

Resource Efficient Scotland provides the free, independent and specialist support to help organisations realise those savings. We offer telephone advice, online resources and onsite support. We also work in a number of priority sectors where the largest economic gains have been identified.

Resource Efficient Scotland is a programme delivered by Zero Waste Scotland.

Find out more at **www.resourceefficientscotland.com**

Acknowledgements

We wish to thank all of the organisations who participated in the trial that has informed the development of this guide.

Introduction

Implementing water efficiency measures is not yet standard practice across the public sector and wider organisations in Scotland. While there is considerable attention on improving energy efficiency and reducing carbon footprint, there appears to be a lack of focus on attributing responsibility for the management of water use. There is a perception that water is a free and limitless resource and a lack of appreciation of the potential savings achievable through effective water consumption.

This good practice guide has been developed to help organisations implement tried-and-tested water minimisation projects across their organisation. Written for all organisations, including the Public Sector, it follows a simple 10-step process proven to help minimise water consumption, maximise efficiency of use and cut associated costs. The guide also advises on application of the water hierarchy to inform decisions and helps identify the most sustainable and appropriate options. Information is provided on water saving devices, maintenance and the use of controls. Simple, low and no cost solutions are offered and importantly include how to change staff behaviour.

Where an organisation has already taken steps to reduce water use, this guide provides a useful refresher and checklist. It will help to assess progress and ensure that typical cost savings can be achieved. However it may also help identify new projects to help realise further water and cost savings.

By following the advice contained in this guide, organisations should be able to radically improve water efficiency and benefit from reduced water bills.

The guide considers the more generic areas of water use that are likely to be familiar to most individuals and organisations:

- Flushing toilets and urinals
- Cooling water
- Hand washing
- Showers
- Drinking water fountains
- Vehicle washing
- Boilers
- Irrigation of landscaped areas and gardens
- Humidification
- Catering

There will be other water uses that are unique to or more prominent at selected sites, but it is intended that this guide will provide the knowledge and confidence to allow organisations to identify other areas where water might be used in their organisation. It is also worth stressing that more specific and technical water usage, such as for clinical purposes, is *not* considered in this guide due to the different legislative drivers and health and safety requirements.

The guide is presented along the following categories.

Understanding current consumption and cost

To begin your water efficiency drive, you need to establish a baseline of how water is being used, by answering the following questions. Where and how is water currently being used in the organisation? What volume of water is being consumed and what is the cost of supply and disposal?

A water mass balance will help you to understand your current consumption and determine the most effective areas to target for intervention. By knowing your start point, what you're trying to achieve and monitoring progress, you will be able to assess the how effective actions have been in improving water efficiency.

Implementing efficiency improvements

To deliver change, it is important to consider the most effective way to minimise consumption and improve water efficiency. This could be through installation of water-saving technologies, adoption of good management practice, awareness-raising of the key issues, or a combination of all three.

The guide can save you money and help to reduce the amount of water you use by following a series of free or low cost solutions.

Staff engagement

Gaining commitment from all staff - from the most junior position through to senior management - is the first step towards improving water efficiency. Approaching this as an on-going process, rather than an isolated task, will help ensure staff change the way they do things. Gaining staff buy-in can also help motivate others and help identify new initiatives.

Continuous improvement

Developing an action plan to improve water efficiency is not the end of the process. An iterative approach is needed to evaluate the success (or otherwise) of the measures that have been put in place in order to continue to drive further improvements. This guide provides advice on how to review actions taken and assess the achieved benefits, and how these can be communicated to help identify additional or further opportunities to improve performance.

We aim to provide you with practical tools, technical know-how and confidence to benchmark current water use. You will be able to put in place measures to address barriers to improvement and assist in maximising efficiency while minimising costs.

Why improve water efficiency?

Reducing water consumption makes commercial and environmental sense: it saves money; can enhance your organisation's reputation; and helps to preserve natural resources. However, while improving water efficiency in itself is an attractive goal, many organisations unfortunately don't know how to take their first step on the journey towards improved performance.

This guide is designed to offer practical advice to organisations (private, public and third sector) based on a simple 10-step programme that has been applied successfully across both public and private organisations to minimise water consumption, maximising usage efficiency and cutting costs. When applied to your own organisation it will support you identify how water is used, the costs associated with its purchase and disposal, and support the implementation of opportunities to improve water use efficiency.

Drivers and barriers

In Scotland, at times it can seem that water is all around us, from our world renowned lochs and rivers to our equally famous rainfall. However, as with all natural resources, overuse can have still have a detrimental effect on the environment and limit the sustainability of future generations. Excessive consumption of water or using it in a wasteful or inefficient manner also directly impacts on your organisation's bottom line.

Therefore, moving towards more sustainable water use is becoming a priority for organisations across all sectors of life. Whether for simple, domestic use or in more complex or intensive processes, there are wide-ranging benefits that can be gained by improving your water efficiency. These include:

Improved financial position

In simple terms, by using less water, purchase and disposal costs will go down, immediately improving your bottom line. However, by reducing your water consumption, you can also gain additional benefits such as minimising labour costs, reduced maintenance requirements, lowering energy costs, and so on.

Reduced carbon footprint

Minimising your consumption can help reduce your carbon footprint, assisting you to meet carbon reduction or other environmental and corporate social responsibility targets as well as helping to preserve the environment for future generations.

Effective environmental leadership

The public sector has historically played a leading role in the effective management of environmental initiatives. By taking a lead on improving water efficiency in your own organisation, you can demonstrate this commitment, encouraging your supply chain of customers, suppliers and partner organisations to improve their own status.

Did you know?

Water UK, a trade body representing the water industry, estimate that cutting one cubic metre of mains water results in indirect carbon emissions savings of 0.34 kg CO2 equivalent.

www.water.org.uk

However, despite the many tangible benefits to be gained from using water in a more efficient and sustainable manner, many organisations still lack the basic knowledge of how to design and implement a water efficiency upgrade programme. Common barriers that have prevented this in the past include:

Lack of commitment

Improving water efficiency will only be successful if participants are motivated and committed to achieving the end goals. Involving all relevant stakeholders such as internal and external staff, third-party contractors and suppliers and members of the general public from the start is critical to ensuring that improvement programmes are effective. Using this guide can help encourage ownership and increase the likelihood of successful implementation of improvement actions.

Lack of understanding

Many staff are not aware of the true cost of water to their organisation. Often, it is perceived to be a 'free' and infinite resource. This guide provides key information on costs that can be communicated to staff and other stakeholders to ensure they understand the importance of minimising wastage to maximise water use efficiency.

Low priority

In many organisations, particularly where there are limited staff resources to identify and implement resource efficiency measures, water can often be seen as less important than energy. Organisations may find it hard to justify the time, skill-set, funding or commitment to support a water efficiency programme.

However, one of the core objectives of this guide is to help you understand and encourage the development of these drivers and to provide practical advice on how to overcome the common barriers faced.

Take action now

Can you identify specific drivers for increasing water use efficiency within your own organisation or place of work? What are the barriers that are restricting or preventing their use?

1 Engage with your organisation

Engage all staff and senior management to maximise buy-in at all levels within your organisation. Staff buy-in ensures that changes are implemented and financial support to do so is made available. Engaged staff often achieve large savings through simple behaviour changes and can identify measures in their work areas.

Gaining commitment from all staff, from the most junior position through to senior management, is the first step in the journey towards improving your organisation's water efficiency. Buy-in at all levels, across all functions of your organisation, can help to ensure that you have a team of motivated staff to support the implementation of water efficiency initiatives. Furthermore, gaining the support of senior management is often critical to ensure that sufficient resources are allocated in order to guarantee success.

Engaging staff can be achieved through tried and tested methods, such as creating bonus schemes for creative water efficiency improvement suggestions that are implemented or the creation of cross-functional working groups, designed to identify and assess the merits of each opportunity. All staff, even those with non-technical backgrounds should be encouraged to participate as they can often provide a '*fresh-pair-of-eyes*' that can look beyond the current status-quo and ask questions that challenge the existing order.

Motivating staff to actively participate rather than forcing them to contribute will also achieve positive results. Proactive individuals should be encouraged to become programme '*Champions*', taking ownership of the projects and leading the identification and implementation of improvements. They can then provide the positive feedback and good news stories to help maintain focus, motivate their peers and colleagues to contribute and ensure greater commitment from the wider organisation.

However, always remember that input and commitment from staff must be retained on an ongoing basis. Without regular updates, continued engagement and ongoing motivation it can be easy for staff to lose focus on the role they play in ensuring water efficiency at your organisation does not slip over time.

2 Identify where, how much and why water is being used within your organisation

Before any meaningful progress can be made, an understanding of how water on your site is used is crucial. This will also feed into your water mass balance and should prevent any key areas being missed.

Once you have gained staff buy-in, the next step is to begin to identify how, where and why water is being consumed. You should start by considering the basics such as '*how is water is supplied to my organisation*', '*where and what is it used for*', '*why do I use it in this way*' and '*where does it go after it goes down the drain*' before moving on to more advanced considerations such as '*what is the size of the incoming mains meter*', '*who or what are the major users*' and '*where are the opportunities for improving efficiency*'.

Did you know?

The water supplied from the mains network is known as 'potable water' and is defined as 'water that has been treated to a pre-defined standard to allow it to be considered safe for consumption by humans'. Other sources of water, such as those from an onsite bore-hole or from rain-water harvesting are generally of a lower quality and while they can provide distinct benefits, they may not be suitable for all applications.

As a starting point, the following table outlines a number of generic water uses that will likely be familiar to most organisations.

Typical water uses	
Flushing toilets and urinals	Cooling water
Hand washing	Boiler system top-up
Showers	Landscaped areas
Drinking water fountains	Humidification
Washing vehicles	Catering

However, water use will vary widely depending on location and the site specific activities undertaken and so consideration should be given to identifying your own mix of water using areas, processes and activities.

Take action now

Can you build upon this basic list and identify all major water users relevant to your organisation?

3 Review your bills and determine how much water consumption and disposal is costing your organisation

Understanding your water bills is essential to identifying what savings can be made and where, allowing the formation of fully informed business cases for any expenditure required.

Water and effluent costs

The Water Services etc. (Scotland) Act 2005 established a framework for the future of water supply across the country which separated Scottish Water's wholesale services from its retail, supplier services. This move opened the market to enable new, licensed providers to compete for business customers in the retail market, meaning that unlike the rest of the United Kingdom, Scottish customers can select their mains water supplier.

The Water Industry Commission for Scotland sets maximum tariffs for default services provided by licensed providers. Generally, all organisations using mains water (referred to as '*non-domestic*' premises) will be charged based on whether they have a water meter fitted or not and also whether they are consented to discharge liquid waste (trade effluent), other than surface water and domestic waste (referred to as '*sewerage*'), to sewer.

There are three basic charge elements that apply to most organisations and contribute to the total incurred costs, namely water purchase, wastewater disposal and drainage.

Where an organisation has a water meter, water and wastewater charges will contain a variable element based on recorded usage and a fixed element based on meter size. Locations with no meter installed are billed based on the rateable value (RV) of the property. Drainage charges applicable to all customers are based on the rateable value of the property.

Water purchase costs

A fixed standing charge makes up the first element of your water purchase cost, and is based on the internal diameter of the water supply meter, measured in mm. As the diameter increases, the fixed charge also increases. This fixed charge is an annual fee that is charged pro-rata over 365 days and will vary depending on your water provider. The following approximate data for 2013/14 data is presented for reference.

Meter size	Approximate 2013/14 Annual fixed water charge
<20 mm	£150
25 mm–30 mm	£430
40 mm	£1,200
50 mm–63 mm	£2,680
80 mm	£6,960
100 mm	£16,840
150 mm	£47,380
200 mm	£103,270

The second element of your water costs is a variable charge which is calculated using a set unit price for each cubic meter of water multiplied by the total volume of water consumed over a set period, typically a month or quarter. For meter sizes greater than 20 mm the following approximate charges per cubic meter apply although it is worth noting that for some very large or very small consumers, the applied rate may vary.

Annual volumetric consumption	Approximate charge (2013/14)
0–100,000 m^3	£0.81/m^3
100,001 m^3–250,000 m^3	£0.69/m^3
> 250,001 m^3	£0.66/m^3

For non-metered locations that are charged on the rateable value of their property, the following approximate charges apply.

Fixed charge	Charge per £ of rateable value
£158/year	£0.03050

Take action now

Significant fixed cost savings can be realised by ensuring the size of your meter is appropriate for your needs. Check the size of your incoming meter(s) and ensure they are suitable to service your demand profile; in most cases, the size of your meter(s) should be clearly marked on your bills but if not your water provider will be able to provide you with the details.

Although guidance is available to assist you identify the correct meter, the actual size required can vary depending on a number of location specific factors. It is recommended that you engage with your water provider to ensure that any reduction meets all applicable legislation and maintains the required level of supply to your organisation under all circumstances.

Wastewater disposal costs

Fixed charges for wastewater are similarly based on the water supply meter size (internal diameter measured in mm) and, like water purchase costs, as the meter diameter increases a higher charge is applied. Charges vary by licensed provider, the following are approximations for reference.

Meter size	Approximate 2013/14 Annual fixed wastewater charge
≤ 20 mm	£140
25 mm–30 mm	£450
40 mm	£1,265
50 mm–63 mm	£2,800
80 mm	£7,065
100 mm	£17,200
> 150 mm	£41,200

Remember, not all of the water that you purchase will go down the drain. Typically, for most non-industrial organisations, it is estimated that around 95% of the total incoming volume will be discharged to the public sewer network with the remainder, known as the '*non-return to sewer*' allowance, assumed to leave through other means such as evaporative losses and underground leaks.

Did you know?

Wastewater is commonly defined as 'any water that has been adversely affected in quality by man-made activities arising from domestic residences, commercial properties, industry, and/or agriculture' and can encompass a wide range of potential contaminants and concentrations.

Similar to water purchases, the second element of the wastewater charge is variable and relates to the volume discharged over a given time. For those locations with a meter size greater than or equal to 20 mm, the variable cost per cubic metre of wastewater discharged is approximately £1.44.

Take action now

The 'non-return to sewer' allowance can vary depending on the location and activities undertaken so check your bills and identify the non-return to sewer allowance that is currently applied to your organisation. Ensure this is accurate for your organisation, location and the specific activities undertaken.

Trade effluent disposal

Although more common for industrial manufacturing companies certain circumstances, for organisations such as hospital laundries, can generate '*trade effluent*' as opposed to '*wastewater*'.

Did you know?

Under the Water Industry Act 1991, any wastewater produced on trade premises and in pursuit of a trade or business is defined as 'trade effluent'. This does not include domestic sewage arising from these premises which is defined as wastewater.

Where your organisation generates trade effluent as opposed to wastewater, an alternative charging mechanism, known as the Mogden formula is used to determine the costs. The Mogden formula is associated with the control, reception, treatment and final disposal of the trade effluent from the receiving treatment works, and it consists of two elements; '*availability*' and '*operating*' charges.

The availability element is charged as a daily rate and reflects the capacity of the local wastewater treatment works to handle the effluent you discharge. The operating charge is calculated according to the nature and composition of the trade effluent generated and varies by the total volume discharged.

Working to optimise your trade effluent discharges can reduce the charges calculated through the Mogden formula and a wide variety of tried and tested management techniques and technologies are available although as most will be location and/or activity specific, detailed guidance is out with the scope of this document.

However, most of the licensed providers in Scotland can now offer specialist technical support to assist you to optimise your trade effluent discharges. If you feel additional support is required, then you should open discussions with your customer account manager to identify how they can assist.

4 Develop a water mass balance for your site

All water entering a site must leave somewhere. The production of a water mass balance allows all incoming and outgoing water to be accounted for which provides a useful starting point when identifying priority areas to target.

A water mass balance is based on the simple concept that what goes in must come out. Ideally your water balance will numerically account for the types and sources of water entering your organisation, where water is used and how water is exiting your organisation.

It is a '*dynamic*' tool that should be revised and updated regularly as new data and site water use knowledge becomes available. Its complexity generally relates to the complexity of the water using activities on-site and the scale of your organisation. Ideally it should look to capture upwards of 90% of the incoming consumption.

The following example outlines the basic components and principles of a water mass balance and can be used as a starting point for you to construct your own.

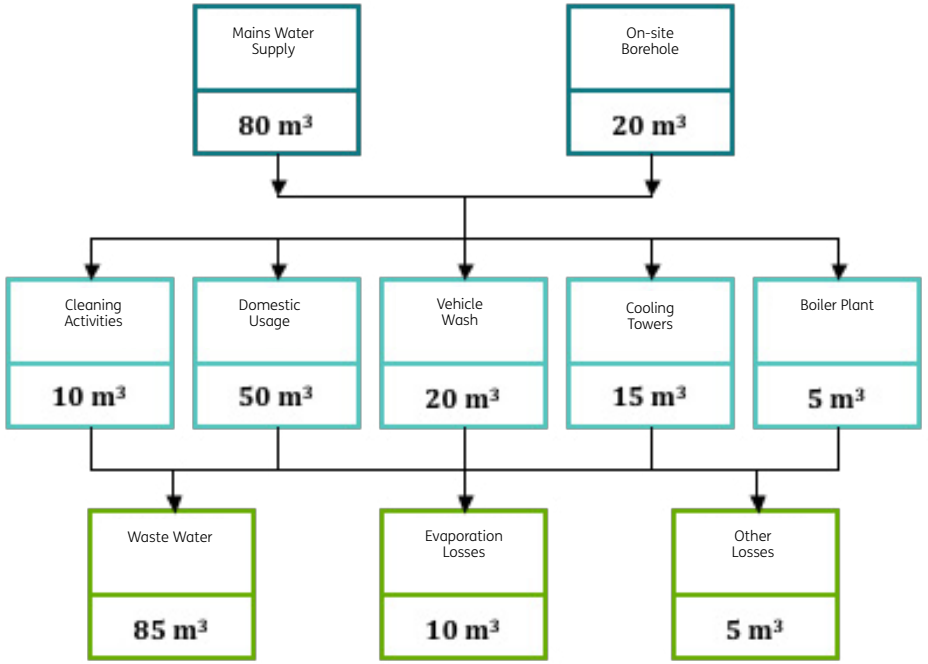


Figure 1 Example water mass balance.

All mass balances work on the principle of '*what comes in must go out*'. The first stage is to match the incoming water supply with the total output volumes. That is input volume from your mains meter(s) and any other applicable supplies matched against the total water volume discharged to drains or elsewhere. At most locations some water will be '*lost*', leaving your site through unmeasured or hard to identify routes such as underground leaks and evaporation. As such, a good practice target is to reconcile around 95% of the incoming volume.

Once you've identified and quantified the incoming and outgoing flows, you can start to break consumption down into the component processes or areas, outlined in the middle tier of the example above.

This exercise helps you to identify and target the main areas of water consumption and to assess how you can operate more efficiently and reduce improve water management. This level of detail helps you identify gaps in knowledge where additional investigation can be undertaken to explore 'lost' water and fully populate the water mass balance for improved accuracy.

Did you know?

You can estimate domestic consumption using rules of thumb which state that each full time equivalent member of staff typically uses between 25 and 40 litres per person per day (depending on whether the site has a full food preparation canteen). Water leaks and losses are often estimated to account for around 5% of the incoming load.

The key benefits of preparing and maintaining a site-wide water mass balance include:

- Improved understanding of where, how and why water is used on site
- Identification of inefficiencies, leaks and losses
- Helps to build a business case for implementing improvement actions
- Assist to verify accuracy of your water and waste-water bills

Take action now

Create your own water mass balance and identify what percentage of water is accounted for. Where a significant volume of water is 'missing' what tools and techniques can you apply to find it?

5 Develop a measuring and monitoring programme for your organisation

A regular measuring and monitoring programme will allow any changes due to faulty equipment or new processes to be identified and remedied quickly and effectively.

Why measure and monitor?

Measuring and monitoring how water is used over time allows organisations to target resources on improvement actions. The preparation and maintenance of a robust measuring and monitoring system is therefore a useful management technique that can be applied universally across all organisations. Essentially, the system will provide baseline information to allow for ongoing performance analysis to support your water management activities. In addition it should update and complement data previously collated for the water mass balance.

The benefits of a robust system include:

Identification of inefficient water use

Closely monitoring water use against an anticipated value will assist in identification of inefficiencies, leaks and losses that may be impacting on consumption.

Continuous improvement

Establishing performance improvement targets can maintain focus and help drive your organisation to achieve higher levels of efficiency.

Quantify improvement projects

Monitoring water use before and after the implementation of water efficiency improvement projects will provide quantification of the savings from particular actions.

What to measure

Organisations should look to record a range of information to help drive improvements. On the most basic level, water consumption should be tracked over time to identify any underlying trends, ideally through the use of automatic meter reader (AMR) technology although old fashioned manual readings, if undertaken on a regular and consistent basis can be just as useful.

However, measuring total consumption alone won't provide a true representation of how efficiently water is being used. Additional information on key metrics such as staff head count, visitor numbers or floor space are useful and enables an assessment of the true level of water process efficiencies.

How to measure

A wide variety of techniques are available to assist water use data. The following are common methods:

Bucket and stopwatch approach

At the most basic level, using a container of known volume (e.g. a bucket) and stop-watch approach can be used to measure the volume discharged from a tap or a shower head over a given time period. When used in combination with an estimate on usage, that is, the number of showers taken per day, this method can provide an approximate volume for most domestic type fittings and fixtures.

For toilets and urinals, the cistern volume is typically marked on the inside of the unit, just about the fill line. Taking this volume, typically in the range of between 6

and 9 litres (although some older types can be as high as 12 or even 15 litres) and again multiplying it by the number of flushes over a set period will provide good data on consumption.

Manufacturer and model data

Data from the manufacturer can be used to estimate consumption for some more complex processes. For example, the instruction manual for large-scale dishwashers (used for catering in schools or canteens) will likely contain details of the consumption per wash cycle. Multiplying this value by the number of cycles per day can provide a good approximation of total water demand. This method can be applied for other common equipment such as ice machines, vehicle wash stations, cooling towers and so on.

Non-invasive ultra-sonic flow meters

These can be fitted to the outside of water distribution pipework to gather data on the volumetric flow rates moving along any given pipeline. These systems are useful for monitoring flow rates that vary over time as the demand profiles can be recorded in addition to simply generating a total consumption value.

Non-invasive flow-meters are not however designed for permanent installation. Therefore if longer term (or permanent) monitoring is required, consider using a fixed sub-meter. A wide variety of types exist ranging from simple in-line manual reading turbines through to '*smart*' meters which record and transmit measured data to a centralised database automatically. However, all sub-meters require breaking into the pipeline so this has to be factored into their selection.

Shutdown check

To determine water use during periods of inactivity, such as overnight, weekends or holidays, a shutdown check can be carried out. By recording the water meter reading when the building is vacant and again immediately before it is reoccupied, it is possible to establish how much water is used when the site is unoccupied and identify leaks and unexplained usage.

Did you know?

From UK Government published data, it is estimated that reductions of between 2% and 5% of total site water use can typically be achieved through improved water monitoring, using these techniques in conjunction with the development and use of a site wide water mass balance.

When to measure

Generally speaking, in terms of data, more is better than less. Consideration must be given to the cost (in terms of time, allocation of resource and expenditure) of gathering information on water use and the other key metrics associated with your organisation. Automatic meter reading and automatic sub-meters can be used to provide instantaneous consumption data. However, where manual systems are used, you should aim to measure daily, with readings at a consistent time to allow accurate and robust assessment.

6 Benchmark your organisation against internal and external KPIs, and target improvements.

Benchmarking allows you to see how your organisation stands in comparison to similar organisations and competitors. Good practice is often a useful goal to set when producing your action plan.

Measuring and monitoring of consumption data on its own, can provide only limited information on the true level of water use efficiency. The analysis process can be significantly improved by developing Key Performance Indicators (KPIs) that reflect the specific processes and activities undertaken. KPIs allow organisations to assess water efficiency performance over a period of time with greater accuracy. External factors that can influence consumption are taken into account and, as such, can help management set realistic targets for targeting resources to improve efficiency.

For example, only measuring a relative value, such as consumption, might provide an insight into variations in usage but won't necessarily provide any detail on what is influencing the increase or decrease; for example, increasing consumption could be related to an increase in staff rather than a decrease in efficiency.

The use of '*weighted*' KPIs should be encouraged to better monitor performance and control any location specific variations that might increase or decrease demand. A weighted KPI breaks down water consumption (or other key metrics like wastewater generation) for specific processes and provides a better indication of the true water efficiency of the chosen activity.

KPIs should directly link to the organisation, location/s and/or specific activities undertaken. Further details of location specific (e.g. offices, prisons, schools museums) KPI values for water use can be found on the Environment Agency Website.

Example KPIs that might be applicable could be:

- m^3 / full time equivalent staff member
- m^3 / m^2 office floor space

Once KPIs are selected, the resultant value needs to be assessed in terms of what the value says about water use in the organisation. A comparison of performance against internal and external standards will give the numbers meaning. Many examples exist of what constitutes good practice in relation to water consumption but based on using the first KPI noted above, the UK '*Greening Government Commitment*' suggests the following targets for each full time equivalent member of staff, per year:

Poor practice	Good practice	Best practice
> 6 m^3 per person	4 to 6 m^3 per person	< 4 m^3 per person

Take action now

Assess your own organisation's water use and identify where you sit in terms of the suggested targets. It can also be useful to assess your performance against internal (i.e. comparing similar use buildings within a single, large estate) and external benchmarks (i.e. comparing a similar building across multiple locations such as in different local authorities or sites).

Using your data

How data is used will often be location or activity specific. However, in many cases the simplest method to visualise the key messages contained in the information is to graph it over a timeline. While time consuming for large data sets or for organisations with multiple locations, it can often help to quickly identify possible inefficiencies. The following example consumption trend is representative of a secondary school which has hourly readings taken over two consecutive days.

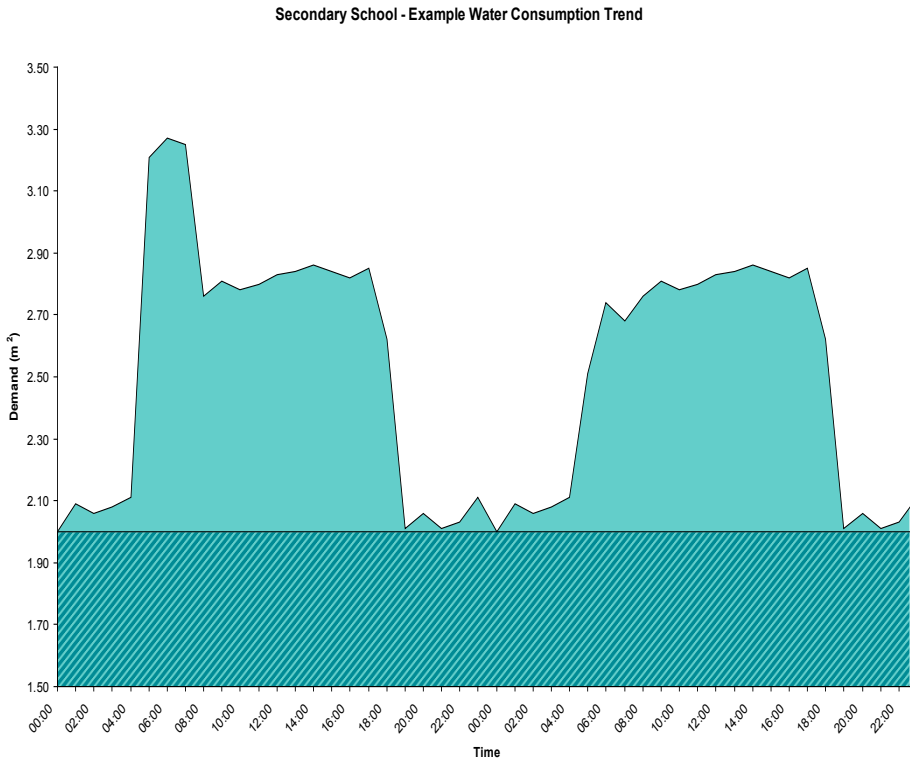


Figure 2 Example of a water use profile

This graph outlines two key areas that might warrant further investigation. Firstly, the hatched area suggests a round-the-clock baseload of approximately 2.0 m^3. While a baseload can be attributable to any number of valid reasons, this profile is for a secondary school and, as such, the presence of significant consumption during the night, when activity should be at or close to zero, is unusual.

Secondly, a sharp peak can be seen to the left hand side of the trend, around 06:00 on the first day. While there may be a valid reason for this peak such as cleaners filling mop buckets, the fact it isn't present on the second day's trend could indicate inefficient usage. As before, ensure you can identify the root cause of any peaks, and where necessary, allocate resource to resolve inefficiencies.

Take action now

A baseload analysis is a simple exercise that involves monitoring the incoming water load during periods of zero activity, e.g. at night time or weekends, to identify if water is being used unnecessarily. Measure your meter reading at close of business immediately prior to the period of zero activity (e.g. last thing on a Friday night) and then again immediately prior to routine activity picking up again (e.g. first thing the following Monday) and any significant demand over this period may be representative of potentially wasteful consumption and should be targeted for elimination on a priority basis.

7 Developing a Water Efficiency Improvement Action Plan (WEAP)

A WEAP will make it more likely that the identified measures are implemented as it provides ownership to individual tasks and prevents water efficiency being forgotten if staff move on or responsibilities change.

After a robust mechanism for capturing data on how water is used in your organisation has been developed, the next step is to identify where the potential for water efficiency improvement actions exist and to realise their benefits by implementing them. By placing these actions into a plan with assigned priorities and costs, key stakeholders can quickly review each on its merits and assist with the implementation phase.

While there is not a one-size-fits-all approach, the following sections highlight a number of proven water saving technologies and good management practices that you can use to minimise consumption and improve water efficiency.

It should also be noted that in certain circumstances, preparing a formal Action Plan may be too complex or too time consuming, such as for a small rural school and other isolated or low occupancy locations. For these locations, while achieving water efficiency improvements is still the aim, the mechanism used should reflect the likely saving. In which case a '*pick and mix*' approach to choose the most applicable actions and implement informally may work better than systematically developing Action Plans.

Water management hierarchy

The water management hierarchy is a framework for systematically assessing and prioritising the most preferable options for water management and should be at the heart of any water efficiency programme. Levels of the hierarchy move from the highest to the lowest in terms of the priority for water efficiency, prompting the user to think about how to eliminate water use, opportunities for offsetting potable water consumption, opportunities to reduce, reuse and/or recycle water and finally the identification of sustainable options for disposal.

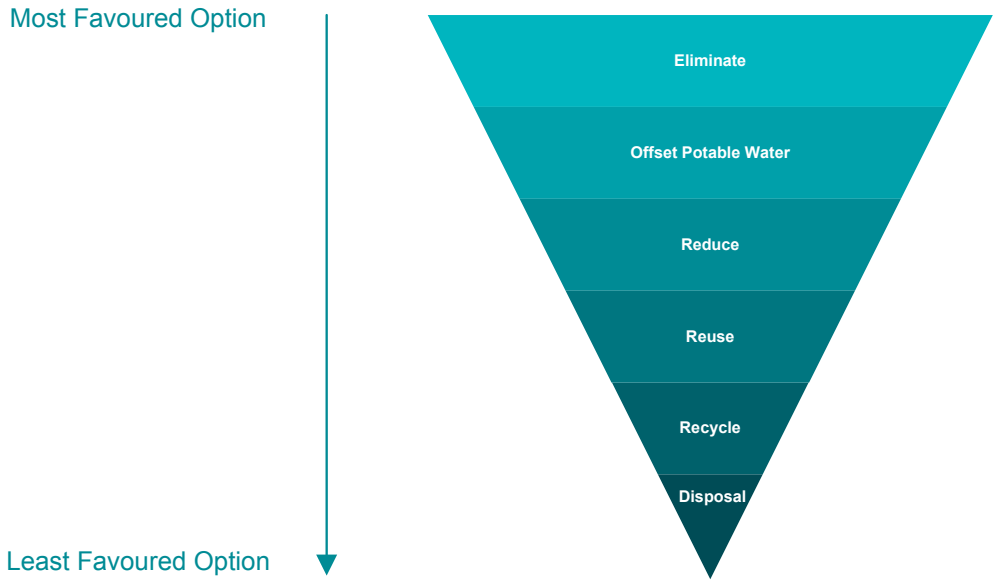


Figure 3 The water management hierarchy

As you move down the levels it becomes obvious that some opportunities can be discounted immediately for technical or economic reasons, such as eliminating domestic water use or installing a borehole at a city centre office location. However, as you progress from the most to the least favourable level, it is likely that sensible opportunities for improving water use will be identified that can be further investigated.

As a tried and tested tool, the water management hierarchy can be applied universally across organisations although the improvement opportunities and scale will vary depending on the activity and location. Possible areas to consider are presented below for each of the levels:

Eliminate

With regard to the water management hierarchy, step one is identifying if water is actually needed for a particular activity in the first place. Opportunities for completely eliminating water use are likely to be limited, being better suitable to industrial manufacturing applications, but one example could be linked to the installation and use of waterless urinals.

Waterless urinals are a relatively new technique and while not currently widespread, they are gaining market share as organisations become more aware of the need to minimise water use. Two main types are currently available. A siphonic trap system which operates using a low density barrier fluid, designed to float on top of the trap and which allows liquid waste to pass through to drain. A deodorising pad system uses an absorbent material placed into a modified u-bend to maintain hygiene and eliminate odour problems.

Both are proven to reduce water consumption but careful management and maintenance of the two designs are required to prevent odour and hygiene problems.

Offset potable use

Potable quality mains water supplied from the mains distribution network is the most common source of water used across organisations. However, many applications do not necessarily need water of such a high quality, e.g. toilet flushing, irrigation systems, vehicle washing and many other uses where the water is not for drinking or ingestion.

As such identifying alternative water sources to meet these non-potable demands can often be a highly effective method of cutting mains consumption. While this might not directly improve efficiency, simple off-setting one source for another, the benefits of using an alternative supply can include:

Saving money

Reducing the demand on your mains water supply can cut costs. In almost all cases the use of non-potable alternatives provides a reduced unit cost over the cost of mains supplied water.

Security of supply

Although uncommon, disruptions in supply can and do happen, and having access to an alternative supply of water can mitigate the potential issues associated with loss of the mains supply.

Reduced environmental impact

By reducing consumption of mains water through increased use of local alternatives, your organisation can improve its environmental sustainability position and minimise the carbon impact associated with the delivery of potable water to your premises.

Although often location specific, the main alternative water supply options for organisations include:

Borehole abstraction	Water taken from subterranean aquifers through deep vertical wells installed in relatively close proximity to the location.
Water harvesting	Precipitation such as rain or snowfall that can be captured from a suitable location, commonly roofs, car parks or landscaped surfaces.
Surface water abstraction	Water abstracted from above ground sources local to the site such as rivers or lochs.
Water recovery and reuse	Water collected from buildings or processing activities that can be recycled or reused directly elsewhere.

Alternative water sources can bring benefits to your organisation, but it is important that they are managed appropriately to maintain compliance with applicable legislation and hygiene requirements, as well as to ensure the long-term viability of the source. Consideration must therefore be given to the identification of how and where the alternative source will be used. For example, without significant treatment, water captured through a rain-water harvesting system would not be suitable to off-set drinking water or for staff showers but could be used to directly off-set potable water used for toilet flushing or the watering of plants and lawns.

Take action now

Consider the key uses of water in your organisation - do you have an alternative water source which could be used to displace mains water and save your organisation money?

Reduce

A number of proven techniques to reduce consumption are available that can be universally applied across organisations , ranging from low and no-cost water saving devices to more in-depth engineered solutions and management practices.

The following suggestions may be considered as part of a targeted water efficiency improvement drive with consideration given to location-specific opportunities in order to fully realise best practice. However, they are not exhaustive and many other commercially available techniques and equipment are available to assist you to drive improvements further.

Staff training

All staff should receive environmental awareness training that includes discussions on the importance of maximising water use efficiency and the provision of practical hints and tips to drive improvements. Ideally this should be covered during staff inductions and periodically thereafter as part of refresher training, although the exact depth and detail would be job-role and/or location specific. The provision of regular training on environmental issues relevant to your organisation is considered to be good practice and should be encouraged.

By holding short workshops and interactive sessions that highlight the importance of using water in a sustainable manner, you can make sure that staff are aware of current costs, planned improvement targets and their role in helping to meet the organisation's wider goals. All levels and job-roles should be included as this approach can often provide a 'fresh-pair-of-eyes' and identify simple fixes that may have been historically overlooked. Sessions should be focused, to the point and undertaken regularly, for example with monthly updates.

Planned preventative and reactive maintenance

All organisations should ensure that they have an adequate programme of planned preventative maintenance in place for water using equipment, including provision for the identification of leaks. If left unidentified and unattended for a period of time, even perceived 'minor' leaks can cost your organisation significant sums of money.

Fixing one faulty toilet cistern could save £100 a year.

Just one continuously passing toilet cistern could potentially result in an annual loss of up to 88 m^3 of potable water, based on a round-the-clock flow rate of 10 litres per hour. Based on standard water purchase costs at this time this would cost around £100 per year and in many instances the root cause of these wastages is simply a worn washer or non-aligned float/ball valve which can be fixed quickly and at low cost.

Sinks and hand washing

On average, the bulk of water used across organisations will be in relation to domestic requirements such as hand washing and toilet flushing. Most locations will therefore be characterised as having significant numbers of wash hand basins whose use could range from private facilities used by a handful of staff through to high-volume public access toilets.

Where older style 'turn' or 'lever' style taps are present, they can often be easily left running or dripping if the user does not fully return them to the off position. While this can be accidental or due to passing washers, the fact is that taps left dripping or running can result in a significant waste of water.

A small, 3 mm diameter stream from one running cold tap can waste over 330 m^3 of water per year, relating to a cost of approximately £580.

It is unlikely that any one tap would be left running constantly for this length of time, but this fact highlights the potential for significant water wastage, with associated cost, that could be occurring when you take into account the number of taps in a location or across an organisation with multiple locations. To counter this, replacement taps can be rolled out as part of a longer term repair or refurbishment plan. A suitable alternative is to install 'push' or 'percussion' type taps, with flow-reducers that can be adjusted to deliver a set volume of water, sufficient for hygiene purposes, before shutting off the water supply.

Alternatively consider the use of flow aerator nozzles which mix air with water under pressure, and when the flow exits the tap, the air expands providing the impression of an increased flow rate. This doesn't eliminate the potential for taps to be left running but helps maintain user satisfaction while reducing the volume of water required.

Not only do running taps cost money in terms of water and wastewater disposal, but if the hot tap is left running then significant energy losses will also be incurred, with the true cost of each lost cubic metre of water that has been heated to 65°C for distribution being around 3–4 times higher than that for water at ambient temperature.

Reducing the volume of water used should never be at the expense of hygiene or the user requirements. Therefore consideration should be given to a trial of the suggested actions before fully rolling them out across all areas or across a wider property portfolio.

Toilet flushing

Historically toilet cisterns were designed with a single flush mechanism, delivering the same volume of water for disposal of solid and liquid wastes regardless. This type of fitting does not represent current good practice and upgrading or retrofitting any single flush cisterns with dual flush mechanisms should be considered where practicable.

However, the cost associated with the retrofit/upgrade process (such as labour and parts) does not always represent value for money and if this is the case the installation of Cistern Volume Adjusters (CVAs) into the cisterns can be used as an easy step to reduce unnecessary water use. Typically CVAs reduce the volume of the water used in each flush by 1 to 2 litres depending on the type installed and the style of cistern. Although the saved volume is relatively low per flush, the implementation cost is negligible and therefore the payback period is short; cisterns smaller than seven litres should not be fitted with CVAs to ensure a sufficient flush volume is maintained.

Urinal controls

For locations that contain urinals, Passive Infra-Red (PIR) sensors should be used to detect activity and control water supply to better match flushing to actual usage. Typically, the sensor controls a solenoid valve to allow a pre-set amount of water into the urinal cistern - in this way, water flow into the cistern should coincide with periods of actual usage, and flushing will only be initiated once the cistern is full.

Typically, where PIRs are not installed, the urinals are flushed on a timed basis, linked to the time taken to fill the cistern and activate the float value or control switch. These systems continue to fill and flush round the clock, even during periods of no usage. Although a periodic hygiene flush is essential, this continuous operation can result in a significant waste of water and excessive costs.

As an example of the potential wastage, if a 15 litre urinal flushes every ten minutes round the clock, annual consumption could be around 800 m^3. Although some of this will be associated with flushing after use a significant portion is likely to be simply wasted, especially during night times and weekends/holidays. Based on the assumption that half of the water required can be eliminated, you could realise savings of around 400 m^3 per year, equivalent to a cost saving in excess of £800 per year for purchase and disposal costs.

Another common method for improving the water efficiency of urinals is to install push buttons that the user can press to activate the flush. While good at minimising water they do rely on the user to manually push the button and so may present hygiene issues.

Water efficient showers

In locations where shower facilities are available for use, a lack of proper controls can result in significant wastage. To counter this, a number of shower designs are available which can reduce water used by automatically closing the shower off or by minimising the flow rate during use:

Push button tap operated systems require the user to activate the flow of water and after a predetermined duration has elapsed or when a predetermined volume has been delivered the water automatically shuts off.

Occupancy detectors use passive infrared technology to detect the presence of the user. Once no presence is detected the control system automatically shuts off the flow of water to the shower head.

Flow limiters such as aerators and regulators can be installed to limit the volume of water used, often as a low cost retrofit to most existing systems. Regulators limit the pressure which in turn cuts the total volume of water used while flow aerators mix air with water under pressure, and when the flow exits the shower head, the air expands providing the impression of an increased flow which can maintain user satisfaction while reducing consumption.

Additional benefits of improving water use efficiency

The actions noted earlier in this guide will assist you reduce consumption, increase efficiency and directly improve your organisation's bottom line. However, it is also worth remembering that reducing water consumption has numerous other, less

quantifiable positive effects such as: reduced environmental impact; improved cost savings from reduced energy costs in heating and transporting water; reduced consumption of treatment chemicals; reduced wear and tear on fittings and fixtures and so on.

The 'iceberg' principle visualises some of these hidden benefits.

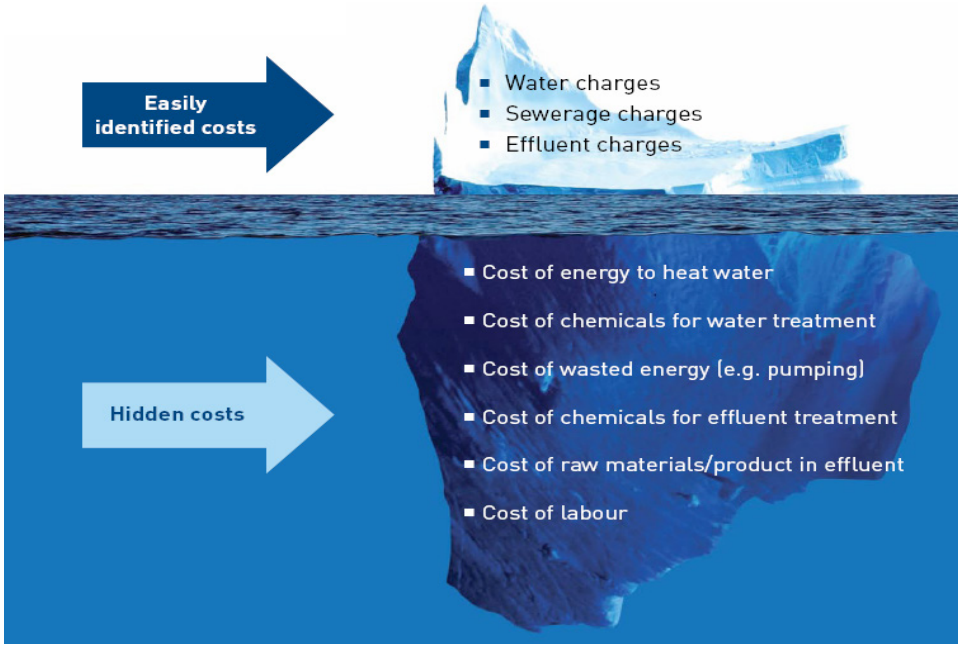


Figure 4 The iceberg principle

By following this guide you should develop a good understanding of the direct costs associated with water use (i.e. those above the water line). You should now start to consider if any of hidden costs (i.e. those below the water line) are applicable at your own organisation.

These examples are not exhaustive and other hidden costs may be applicable depending on your location and/or activities carried out. Once identified, consideration should be made to those that are more relevant than others.

Take action now

What improvement actions can be applied to your own organisation? Can you identify any hidden costs associated with how water use within your own organisation?

Reuse

The reuse of water can often be an important method for maximising efficiency but tends to be more applicable for industrial manufacturing organisation. However, some applications such as reusing water for washing fleet vehicles or irrigation of plants may be possible.

Recycle

Recycling is commonly referred to as the use of engineered solutions to return wastewater to an acceptable level for use elsewhere. Due to the relatively high costs of the plant and equipment, application is mainly used in industrial manufacturing. Consideration could however be given to the possibility of recycling boiler feed water or recycling grey water sources for use in toilet flushing.

Disposal

Disposal is the final stage in the hierarchy and should be viewed as the option of last resort, although, in most instances it is simply unavoidable. Where discharge is the only option, you should ensure that it is disposed in a legal and environmentally responsible manner. Where possible you should consider the use of Sustainable Urban Drainage Systems (SUDS) to minimise your impact.

Take action now

What improvement actions from the water management hierarchy can be applied at your own organisation to increase efficiency?

Case study

- Resource Efficient Scotland has supported a number of organisations with water efficiency projects. These case studies demonstrate the scale of water reduction and related potential cost savings that organisations can realise.

	Key outcomes

live active	**Site:** *Perth Leisure Pool, Perth*
	
	Key outcomes:
	
	■ Significant reduction in water use identified via installation of aerated shower fittings;
	■ The site are also investigating an additional roll-out of water-efficient push taps and in-line flow restrictors;
	  ■ 25% reduction in annual water consumption identified;
	  ■ £27,000/year in cost savings;
	  ■ Expected payback on investment of 2 months.

8 Water Efficiency Improvement Action Plan (WEAP)

This will often be undertaken by a qualified plumber or maintenance staff, it is important that they understand how their role fits into the wider organisational aims and objectives.

Implementation

Once the initial investigation phase is complete, and you have identified the improvement actions you want to implement, you should look to prepare a Water Efficiency Action Plan (WEAP) to summarise and prioritise the opportunities and to assist develop a business case to support their roll-out. A WEAP will assist you unlock the required resource and allow you to reap the benefits of improved water use efficiency.

The WEAP should be dynamic and evolve to account for improvements in best practice and your own increased understanding but the following summary template should provide a good starting point. You should look to develop this template to suit your own location and site specific requirements:

The allocated priority should be based on the location specific requirements, particularly the potential savings (in terms of volume and cost) and cost benefit analysis, but generally no- and low-cost actions should be prioritised over more intensive capital projects. This approach will allow you to reinvest the savings achieved from easy wins into the higher cost actions to maximise your overall return on investment.

A more detailed business case can then be developed to assist senior management to make a reasoned commercial decision on whether to accept the suggested improvement actions. A suggested template is provided below, but as before, you should look to develop this initial guide to better suit your own location specific requirements.

Case study

- Resource Efficient Scotland has supported a number of organisations with water efficiency projects. These case studies demonstrate the scale of water reduction and related potential cost savings that organisations can realise.

Key outcomes	

POLICE SCOTLAND	**Sites:**
	Former Lothian Police HQ, Edinburgh
	Former Fife Police HQ, Glenrothes
	
	Key outcomes:
	■ Substantial water wastage by urinal cisterns identified;
	■ Installation of PIR controls to eliminate wastage and deliver savings;
	■ Water use data analysis exercise uncovered potential for reduced meter size and reduced fixed annual costs;
	  ■ 65% reduction in water consumption identified at Fife;
	  ■ £28,000/year in cost savings identified across both sites;
	  ■ Expected payback on investment of 6 months.

Water Efficiency Improvement Action Plan - Summary template (WEAP)

Improvement action	Estimated annual financial saving (£)	Estimated annual resource saving (tCO_2e, m^3 e.t.c.)	Implementation costs (£)	Payback period (years)
1. Staff training (example)	£400	1,000 m^3	£800.	2 years
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
Totals:				

Improvement action:	e.g. Staff training			
Estimated annual saving			Implementation cost (£)	Payback period
	tCO_2e	m^3		
Description:				
Rationale:				
Project risk:				
Next steps:				
Guidance:				

9 Review, evaluate and communicate

Review and evaluate the actions taken and assess the achieved benefits. Communicate successful improvements to all staff and senior management to maintain their engagement.

Once the implementation stage is complete, you should look to monitor the impact that the chosen actions have on water used over a period of time - sufficient enough to assess performance. The monitoring programme you should have developed as part of Step 5 will assist this process by helping you to identify and track these efficiency improvements over time.

The relative success of the measures taken can then be assessed against the time and resource required to implement them and where the overall cost benefit is positive, these can be further rolled out e.g. across multiple buildings or to similar locations to further increase the improvements.

The positive results achieved can then be communicated back to the staff and other stakeholders to highlight the good work undertaken and the positive improvements made to date. You should use these '*good-news-stories*' to further reinforce the message of how important improving water use efficiency is for your organisation and to help gain further resources to continue your improvement campaign.

Case study

- Resource Efficient Scotland has supported a number of organisations with water efficiency projects. These case studies demonstrate the scale of water reduction and related potential cost savings that organisations can realise.

	Key Outcomes
Scottish Courts	**Sites:** *Glasgow Sheriff Court, Glasgow* *Edinburgh Sheriff Court, Edinburgh* **Key Outcomes:** ■ Wide scope for optimisation of WCs, taps and showers was identified; ■ Meter downsize is being progressed at Edinburgh Sheriff Court; ■ £18,000/year of cost savings identified across the two sites; ■ Business case and priority action plan developed and will be implemented in a phased approach over the next year.

10 Continuous improvement

Return to step 2; follow the 10 step guide to identify new opportunities and further improvements on a continuous basis.

Improving your water efficiency is not a one-time project. It should be viewed as being a process of continual improvement and the water efficiency action plan should be used as a tool to drive efficiency across the organisation over the long term.

Once you reach step 9, reassess water use, using the lessons learned and additional knowledge gained from the previous round of actions. This will assist you to identify additional or hitherto unknown opportunities that can further improve performance.

Case study

- Resource Efficient Scotland has supported a number of organisations with water efficiency projects. These case studies demonstrate the scale of water reduction and related potential cost savings that organisations can realise.

	Key Outcomes
North Lanarkshire Council	**Sites:** *St. Andrew's High School, Coatbridge* **Key Outcomes:** ■ Rising water consumption and 1.6 m^3/hr baseload prior to project; ■ School fully implemented Resource Efficient Scotland's action plan; ■ Widespread installation of water saving devices; ■ Post-installation, the baseload was completely eliminated; ■ £35,000/year in cost savings now being achieved.

Checklist – The 10-step process to water efficiency

1	Engage with all staff and senior management to maximise buy-in at all levels.	
2	Identify where, how much and why water is being used within your organisation.	
3	Review your bills and determine how much water consumption and disposal is costing your organisation.	
4	Develop a location specific water mass balance for your organisation.	
5	Develop a measuring and monitoring programme for your organisation.	
6	Benchmark your organisation against internal and external KPIs, and target improvements.	
7	Prepare a Water Efficiency Action Plan (WEAP) to summarise and prioritise improvement actions and plan their implementation to improve efficiency.	
8	Implementation of identified efficiency improvements.	
9	Review and evaluate the actions taken and assess the achieved benefits. Communicate successful improvements to all staff and senior management to maintain their engagement.	
10	Return to step 2; follow the 10 step guide to identify new opportunities and further improvements on a continuous basis.	

For further information about support available visit
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