
Guidance for new building projects, refurbishment and facilities management

Procurement requirements for water efficiency



How to define performance in procurement documents in order to cut water use in new and existing buildings

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Contents

1.0	How can I ensure my building is efficient?	4
2.0	Why invest in water efficiency?	5
3.0	Cost savings	6
4.0	Opportunities to improve water efficiency	7
5.0	Practice levels for water efficiency	8
5.1	Component-level targets	9
5.2	Measuring water consumption as a building-level outcome.....	11
6.0	Water efficiency through procurement	13
6.1	Overview of the approach	13
6.2	Setting requirements at different stages of the procurement process	15
6.3	Keys to success.....	16
6.4	The role of a Water Efficiency Plan	18
7.0	Model wording for policy and targets	23
7.1.1	Action 1A: Corporate policy.....	23
7.1.2	Action 1B: Corporate targets	23
8.0	Model wording for new projects/refurbishments	24
8.1	Policy and targets stage.....	24
8.1.1	Action 1C: Project Brief	24
8.2	Preparation & Design stage.....	26
8.2.1	Action 2A: Design team tendering	26
8.2.2	Action 2B: Design/project team tendering	27
8.2.3	Action 2C: Design team / consultant appointment.....	29
8.3	Pre-construction & Construction stage.....	31
8.3.1	Action 3A: Contractor tendering	31
8.3.2	Action 3B: Contractor appointment.....	32
8.3.3	Action 3C: Subcontractor appointment.....	34
8.4	Handover, Post-completion & Use.....	34
8.4.1	Action 4A: Post-construction review	34
8.5	Minor works and similar building types	34
9.0	Model wording for appointing a facilities manager	35
9.1	Policy and target stage	35
9.1.1	Action 1D: Facilities Management Brief	35
9.2	Handover, Post-completion and Use.....	36
9.2.1	Action 4B: Facilities Manager tendering.....	36
9.2.2	Action 4C: Facilities Manager appointment	38
Appendix A: Water efficiency requirements in building regulations and environmental assessment tools		40
Appendix B: Principles of water efficiency		45
Appendix C: Levels of practice for water efficiency		48
Appendix D: Whole-building benchmarks for water use – guideline values		53
Appendix E: Water use behaviour		55
Appendix F: Sources of further information		56

This guidance is for those involved in:

- design and construction of **new buildings**; or
- management and refurbishment of **existing buildings**.

It deals with reducing water use of 'domestic-type' water fittings and appliances (i.e. toilets, taps, etc) by specifying target rates of consumption, and it provides **model wording** to use in your procurement documents. The wording can be copied or adapted as appropriate.

This document includes:

- an overview of the **benefits** of incorporating water efficiency measures in building design;
- **specifications** (flow rates etc) for water-efficient products; and
- guidance on how **facility managers** can maintain and improve performance.

You can use the model wording to select and appoint your designers, contractors and facilities managers. It is available in MS Word format at www.wrap.org.uk/waterefficientprocurement, where you can also download summary guides for specifying new build projects and facilities management (FM) services.

Water use in industrial production and the water embodied in products are not covered.

If you are dealing with **new build/ refurbishments**, go here:



Section 1: How can I ensure my building is efficient?
Section 2: Why invest in water efficiency?
Section 3: Cost savings
Section 4: Opportunities to improve water efficiency
Section 5: Practice levels for water efficiency
Section 6: Water efficiency through procurement
Section 7: Model wording for policy and targets
Section 8: Model wording for new projects/refurbishments

If you are dealing with **building management**, go here:



Section 1: How can I ensure my building is efficient?
Section 2: Why invest in water efficiency?
Section 3: Cost savings
Section 4: Opportunities to improve water efficiency
Section 5: Practice levels for water efficiency
Section 6: Water efficiency through procurement
Section 7: Model wording for policy and targets
Section 9: Model wording for appointing a facilities manager

1.0 How can I ensure my building is efficient?

Effective building design, construction and management can deliver major savings in water use and the associated costs of energy, water supply and wastewater treatment. This can be achieved without compromising the performance and user acceptability of installed products.

A proactive approach to water efficiency (outlined in Figure 1) needs to exert influence over:

- the design specifications applied to new construction (providing the potential); and
- the way in which a building is used, managed and maintained.

Through the procurement process, some organisations will have control over both aspects (e.g. owner occupiers or developers who manage the common parts of their properties), while others will only have control of design and construction (e.g. developers) or operations (e.g. property managers). The guidance and model approaches presented here can be applied to each type of organisation.

The model procurement wording is available to download at: www.wrap.org.uk/waterefficientprocurement.

References to Government policy generally refer to policy in England, and pre-date the planned White Paper on water use in England (expected 2011).

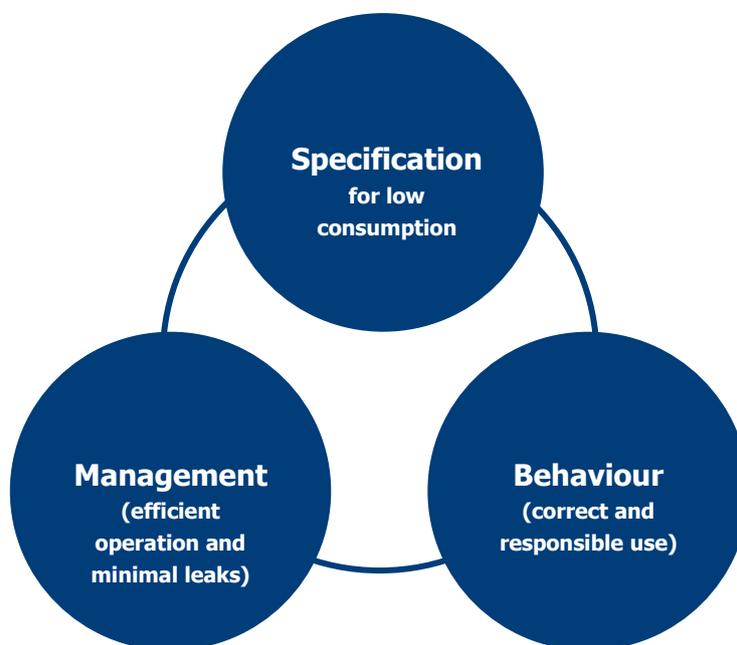


Figure 1: Key components of client requirements for water efficiency

Clients can also set requirements for water use in the actual construction process¹. The Strategic Forum for Construction's Construction Commitments set a target for the industry to reduce water use in the manufacturing and construction phase by 20% by 2012. The procurement requirements in this guide will help contractors fulfil this objective.

Water efficiency should be addressed at the same time as other objectives such as energy/carbon, materials use and waste.

¹ Clients in the public sector must ensure that tender evaluation criteria are relevant to the subject matter of the contract. For more information on industry actions to reduce water use associated with the construction and manufacturing processes, see the work of the Strategic Forum for Construction (<http://www.strategicforum.org.uk/Sustain.shtml>).

2.0 Why invest in water efficiency?

Each day over 11 billion litres of potable water are used in buildings in the UK. On average, each individual uses 150 litres of water per day. Only 7% of this water is used for drinking or cooking, while over a third is used to flush toilets. Supplying water that has been treated to potable water standards is costly and impacts on the environment – and even more so for hot water. If every UK home reduced their hot water use by just 5%, the CO₂ saving would be equivalent to taking nearly 600,000 cars off the roads.

There is a strong business case for reducing water use in buildings. Many opportunities to reduce consumption have little or no impact on capital costs, but will deliver significant cost savings throughout their life.

The key components of a water efficiency business case are outlined below. The significance of each component will vary between organisations and projects.

Cost savings	<ul style="list-style-type: none"> ■ Supplying potable water and treating sewage effluent costs between £1.50 and £4.00 per m³ (1000 litres)². ■ Investments in water-efficient products and management actions can offer a short payback. ■ Reducing the use of hot water achieves further savings in energy costs, and in carbon credit requirements for organisations subject to the CRC Energy Efficiency Scheme.
Environmental benefits	<ul style="list-style-type: none"> ■ Large parts of southern and eastern England are subject to “serious” water stress³. Climate change and the demand for housing will exacerbate this situation. Even where water resources are currently less stressed, there are seasonal shortages (e.g. leading to hose-pipe bans) and other environmental reasons to reduce use. ■ Water supply, treatment and domestic water heating (excluding space heating) comprise around 5% of the UK’s carbon emissions or 35 Mt of CO₂e per annum⁴. This is as much as the combined emissions from domestic aviation, rail, shipping, vans and busses. ■ Water and waste water treatment also uses a variety of chemicals, the most well-known being chlorine.
Improved environmental rating	<ul style="list-style-type: none"> ■ Specification of water-efficient fittings and appliances is a mandatory requirement for achieving BREEAM, LEED or Code for Sustainable Homes ratings. It is often worth going beyond the minimum requirement because the additional credits for water are less expensive than other options. (Appendix A provides further information on the water efficiency requirements and credit areas of the main environmental assessment methods in the UK.)
Reputational benefits	<ul style="list-style-type: none"> ■ Water efficiency is a key component of sustainability in the built environment. For example, previous Government policy documents in England (‘Strategy for Sustainable Construction’ and ‘Future Water’) defined the vision of reducing per capita water use from 150 l per day to 120 or 130 l per day by 2030⁵. ■ At a local level, water availability and the impacts of abstraction are increasingly important to planning authorities and local communities. A clear policy on water efficiency, together with quantified targets for improving performance, is therefore an important component of corporate responsibility / sustainability. Many property companies are already reporting annually on the water consumption of their portfolios.

² Current water pricing levels for each water region are available from Ofwat www.ofwat.gov.uk/pricereview/

³ Water stress occurs where the demand for water is a high proportion of the water available to meet that demand.

⁴ Water supply and waste treatment incurs approximately 1 tonne of CO₂ equivalent per 1000 m³. The carbon impact associated with the use of hot water in the home (excluding for space heating) is around seven times higher.

⁵ The Government has announced a new White Paper on water use in England will be issued in 2011.

3.0 Cost savings

In most cases, there are robust cost-effective opportunities to achieve significant savings in water use. In some instances, there may be a strong case to invest beyond good practice to secure further savings. The net cost savings will depend on the factors tabulated below.

New build or refurbishment	The extent to which performance can be improved and cost savings made will depend on whether new systems and fittings will be installed, or whether existing components are in place. For refurbishments, replacement may have already been planned and budgeted.
Usage	The technology options and the operational savings achieved are strongly influenced by the usage of each fitting. Usage varies with the building's occupation profile, i.e. domestic, office, retail, leisure, transport etc. Large volumes of visitor traffic using amenities will significantly influence the cost-effectiveness of different options.
Lifecycle period	A longer period between replacement of fittings or services will improve the cost-effectiveness of water-efficient fittings.
Target building rating (BREEAM, LEED, etc)	Water efficiency credits beyond the minimum requirement may have a lower capital cost than alternative credits that would be required to achieve the target rating.
System for water heating	The carbon and energy savings from reducing hot water demand are influenced by the efficiency of the heating system, the energy source (e.g. gas, electricity or renewables) and system losses.
Product choice	Enhanced Capital Allowances are available where buyers select products on the Government's Water Technology List.
Effective management in use	To achieve ongoing savings, proactive maintenance and leak awareness and timely repair is imperative. Tenant behaviour may need to be adapted to make sure certain products operate effectively. The two go hand-in-hand.
Behaviour	Action to promote water saving by building occupants is an important complement to changes in technologies.
Sharing costs and benefits with tenants	For multi-tenant buildings, the landlord may invest in water-efficient fittings without necessarily recouping the savings from reduced water use (if the tenant pays for their own water use), unless agreement is reached on sharing costs and benefits.
Location	Water charges vary significantly across the UK, affecting payback periods. The cost-effectiveness of rainwater harvesting systems varies with average rainfall levels across the country.
Building form	The operation and cost-effectiveness of rainwater harvesting and greywater recycling systems are strongly influenced by the ratio of roof area to water use, and building form. Cost-effectiveness quickly diminishes with increasing distance between the point of use and the collection point. A requirement for pumping will increase energy use.

It is therefore a good idea for the project team or facilities manager to prepare a **Water Efficiency Plan** (or equivalent) that sets out the proposed approach, quantifying the performance that will be achieved relative to industry benchmarks together with the supporting financial case⁶. This need not be an overly onerous process, but we stress here the importance of **documenting the business case** and technical information on water efficiency at the design stage to **ensure that savings are planned and ongoing**. You can decide the level of detail which is appropriate for your project/organisation, but we provide a model approach to water efficiency planning in Section 6.4.

⁶ For example, a Water Efficiency Plan that quantifies the benefits of investments, and measures the changes in performance, may be a valuable tool for a landlord in securing tenant support and contributions.

4.0 Opportunities to improve water efficiency

In new build projects, the options to reduce water use are much less constrained than in refurbishments. Nevertheless, refurbishments present significant potential for improvement, although measures such as greywater recycling are likely to be more expensive than for a new build and subject to space constraints.

Even where no major refurbishment of water-using fittings is planned, there may still be a case for bringing forward replacement of fittings where this will deliver net savings over the lifecycle period.

If it is not cost-effective (or practicable for operational reasons) to replace existing fittings, then retrofit devices that improve the performance of the existing fittings can deliver cost-effective savings.

Simply checking that the existing fittings are working effectively, valves are operating correctly and that there are no overflows or leaks (e.g. by checking the meter reading overnight) often saves significant amounts of money.

Any water efficiency programme should follow these principles:

- **monitor and manage** your current system, both to ensure equipment is performing to its full potential and to encourage responsible use;
- **reduce** use by using water-efficient technologies, fixing leaks, and influencing user behaviour;
- **minimise** water heating by using efficient heating, storage and distribution systems; and
- **replace** potable water with grey or rain water where practicable.

Appendix B explains these principles in more detail.

A wide range of water-using products are on the market and research has shown that the costs of procuring water-efficient versions are marginal compared to standard products.⁷ Water-efficient appliances are widely available and simply require careful selection and specification. Cost variations are due to materials and style rather than consumption rates.

More sophisticated approaches such as rainwater harvesting or greywater recycling can offer a commercial payback where building form and occupation are appropriate (particularly in new build projects). The local rainfall and building design, plus energy use implications of these technologies, will need to be assessed on a site-by-site basis.

⁷ Entec (2009) report for Defra, *Cost benefit analysis of procurement standards for water-using products*

5.0 Practice levels for water efficiency

Targets or practice levels for water use can be embedded in the procurement process. There are two approaches to setting practice levels for buildings:

- **component-level targets** – specifying the flow rate of individual fixtures and fittings; and/or
- **whole-building outcomes** – total water use, or use normalised to net lettable area or occupancy.

Previous Government consultation⁸ suggests a hybrid approach may be appropriate, defining target outcomes at both building and component levels.

This Section provides guidance on both approaches. However, it is generally considered that **component-level** targets are more applicable at **design and build** stage, particularly in non-domestic buildings⁹. Water efficiency is achieved at this stage by selecting the right products, and installing them in an efficient plumbing system that supports full product performance. For example, system design needs to consider pressure requirements, location of heating devices relative to the point of use, and drainage fall and pipe materials suitable for water-efficient amenities. Incorporating appropriate clauses into your procurement documentation is an effective way to ensure water efficiency is integrated into your project design from the outset. Model wording is provided in Section 8 of this guidance.

Whole-building outcomes can be appropriate at the **facilities management** stage. In contrast, they are hard to define accurately at the outset of a design and build project because they are so strongly influenced by:

- occupancy and behaviour – do employees often work out of the office, or are they in the office all day making drinks and using amenities? Do they often work late? Do they support cycling to work and take a lot of showers? How many people occupy a house?
- visitor profiles – for leisure/entertainment venues and shopping centres, the amount of visitor traffic and what they do when they are in the building is often hard to compare between similar building types. This may simply be due to customer demographics and physical location.

Whole-building outcomes are helpful to use when setting corporate targets to influence tenant behaviour in a building, such as “Working together to reduce our building use this year to 100 litres per person per day by reporting leaks and fixing them quickly”. They can also demonstrate the impact of investments in retrofit and refurbishment.

Whole-building outcomes can be really useful for commercial property managers with large estate portfolios. While occupancy, tenant behaviour and use patterns will vary between sites, comparing benchmarked water use across all sites is an effective way of prioritising where you spend resources on water efficiency. The most inefficient buildings will stand out as outliers (usually due to leaks), and will clearly tell you where your greatest opportunities for cost-effective savings are.

It is important to distinguish a whole-building outcome for:

- actual in-use consumption, which depends on the combined effect of design, building management and occupant behaviour – and hence is difficult to define (or agree contractually) for a new build project; versus
- the design stage forecast for building water use, calculated using a standard method (such as the BREEAM Water Consumption Tool) using fixed assumptions about occupant behaviour. This can be used more readily as a target in a new build contract, e.g. in conjunction with design specifications for water use by individual fittings.

⁸ *Communities and Local Government, 2007, <http://www.communities.gov.uk/publications/corporate/analysis-consultation-responses>*

⁹ *For domestic buildings subject to the Code for Sustainable Homes, procurement requirements may include threshold levels of whole building consumption as defined in the Code (calculated using a standard method). However, developers can also specify the maximum flow rates etc of key fittings such as showers needed to meet a target level in the Code.*

5.1 Component-level targets

The water use of major types of fitting or appliance can be classified against three 'practice levels' of efficiency, defined as follows:

- **baseline practice** – “fittings and appliances that meet legal requirements but do not offer appreciable water savings compared to others on the market”;
- **efficient practice** – “fittings and appliances offering reduced water consumption in comparison to baseline practice products, without materially impacting cost or performance for most types of use”; and
- **highly efficient practice** – “fittings and appliances offering reduced water consumption in comparison to efficient practice products, but which are not necessarily comparable in cost or performance”.

Indicative values for practice levels are listed in Table 1 and explained in Appendix C¹⁰. The values identify what is technically possible; the accompanying notes identify likely constraints on their acceptability for use in certain applications. The flow rate delivered by a fitting will be affected by water pressure, and can be adjusted using a flow or pressure regulator. Highly efficient flow rates may not be suitable in certain existing plumbing systems.

Fitting / appliance	Baseline practice	Efficient practice	Highly efficient practice
Shower (mixer)	12 l/min ¹¹	≤10 l/min domestic ≤8 l/min non-domestic	≤6 l/min
Shower (electric)	8 l/min	≤6 l/min	≤6 l/min
	An aeration device or advanced spray pattern may increase user satisfaction at a given flow rate, whilst reducing water use.	Government Buying Standard specifies ≤8 l/min. In domestic properties, some householders want a higher flow rate. ≤10 l/min allows a house to achieve levels 3 & 4 in the Code for Sustainable Homes.	These flow rates may be unacceptable to some householders, but acceptable in commercial property. The hot water flow from certain water heating systems (such as domestic combi boilers) may become unstable at these lower flow rates.
WC	6 l/flush	≤4.5 l/flush (effective flush ¹²)	≤3.5 l/flush (effective flush)
	6 l single flush is appropriate for male public WCs.	Either 6/4 l dual flush or 4.5 l single flush. A low volume single flush may be more appropriate in public buildings.	e.g. 4.5/2.6 l dual flush May be inappropriate for plumbing systems requiring higher flow. ≤4.5 l single flush may be more appropriate in public buildings.
Urinal	1.5 l/bowl/use 7.5 l/bowl/hour during building occupancy period (or 10 l/hour for single bowl). 0 l/hour otherwise with minimal water use in maintenance.	3 l/bowl/hour maximum during building occupancy with user-presence activated flush. 0 l/hour outside of occupancy and activation period, with minimal water use in maintenance.	0 l/hour with minimal water use in maintenance.
		Flush within the hour if one person activates the sensor.	May be inappropriate for high frequency of use (e.g. schools, sports venues).

¹⁰ For housing in England and Wales, building regulations require that the design estimate of total water consumption is less than 125 l per person per day (120 lppd internal and 5 lppd external). Achieving this standard requires the use of least some efficient practice components.

¹¹ For showers and taps, flow rate refers to the maximum value measured at operating pressures up to 5 bar.

¹² The Government's Enhanced Capital Allowances scheme defines the "effective flush" of a dual-flush action WC as the mean consumption of one full flush and three reduced flushes.

Fitting / appliance	Baseline practice	Efficient practice	Highly efficient practice
Tap (basin)	Up to 12 l/min	≤6 l/min	≤4 l/min
		Two-stage or Click taps may help to reduce the effective flow rate.	Two-stage or Click taps may help to reduce the effective flow rate. Sensor-actuated taps help to reduce use in public buildings.
Tap (kitchen)	12 l/min	≤8 l/min	≤6 l/min
		A higher flow rate is typically required for kitchen use than for basins, since kitchen demand is related more to volume than duration of flow.	User acceptability would need to be considered. Government Buying Standard is ≤5 l/min. Two-stage or Click taps may help to reduce the effective flow rate.
Bath	200 l capacity excluding body mass within the bath	≤180 l capacity excluding body mass within the bath	≤155 l capacity excluding body mass within the bath
			User acceptability would need to be considered; ergonomically-shaped tubs may be preferable to short or shallow tubs.
Washing machine	10 l/kg dry load	≤8.5 l/kg dry load	≤7 l/kg dry load
Dishwasher	1.2 l/place setting	≤1.0 l/place setting	≤0.7 l/place setting
	Older domestic models may use 20 l/cycle.	Equivalent to 12 l/cycle in a domestic dishwasher.	

Table 1: Indicative practice levels for water efficiency of common fittings and appliances

The practice levels are derived from published rating systems as described in Appendix C. They are consistent with Government Buying Standards¹³, although certain values in Table 1 differ to reflect use in a wider range of applications including households. Practice levels are expected to change over time as technology advances.

Technical considerations:

- Flow rates will be affected by pressure, so it's important to check that products meet the required specification when installed in your plumbing system. Many water-efficient products have regulators pre-installed in them, so correct installation should ensure this is not a problem, but it is important that actual flow rates are measured after installation.
- Different products with the same flow rate/capacity may give different levels of user satisfaction, depending on the technology used to make the fitting water-efficient. For example, a shower which achieves 6 l/min simply from the addition of a flow restrictor/regulator may not perform as well as a 6 l/min shower which includes an aeration device or advanced spray pattern.
- Highly efficient fittings may have implications on operational practice such as cleaning procedures and the ability of the drainage system to flush with lower volumes. These factors may pose issues for retrofit in existing buildings. An on-site survey may be required, including assessing where high flows may be needed (e.g. where hygiene is critical).
- Up-to-date waterless urinals are highly water-efficient and hygienic, and should be considered providing the circumstances allow adequate function. For example, careful scrutiny and survey should be undertaken in areas where usage rate is high or there are local drainage limitations. Furthermore the waterless system should always be installed with the full involvement of cleaning staff and implementation of the correct cleaning regime as recommended by the equipment suppliers.

¹³ Government Buying Standards (formerly known as Buy Sustainable Quick Wins) set out criteria that *must* be followed by central government departments and their related organisations (in England) when buying certain products and services. Government Buying Standards for water-using fittings and appliances are available at <http://www.defra.gov.uk/sustainable/government/advice/public/buying/products/construction/index.htm>. They apply primarily to non-domestic buildings typical of the government estate.

- A periodic (e.g. once every 12 hours) maintenance flush of urinals can cost-effectively help to avoid problems with scaling and hygiene, despite the water use.

To achieve a given design estimate of whole-building water use (e.g. for BREEAM) while satisfying user acceptance, the designer may select a mix of fittings at different practice levels. However, such decisions should also take account of carbon emissions – for example, offering a highly efficient WC in combination with a higher flow rate shower in new homes may help to achieve level 3 or 4 in the Code for Sustainable Homes, but would increase energy costs and carbon emissions by substituting cold water savings with hot water use. Moreover, if some fittings are selected with flow rates too low to be acceptable to users, there is a risk that users will retrofit alternative high-flow fittings, making the design estimate redundant.

5.2 Measuring water consumption as a building-level outcome

Monitoring performance over time and against comparable buildings requires the use of standard metrics and KPIs. For those organisations with an interest in a property post-construction, the key performance measure will be the actual, in-use consumption of water.

Comparison of actual performance with the design potential (including flow rates for fittings) is beneficial in helping to understand whether a) fittings and appliances are using water in line with expectations, or b) the design stage assumptions about usage were incorrect and should be reviewed for future projects.

The following metrics and KPIs are consistent with the most widely-adopted buildings assessment and benchmarking tools:

- metrics:
 - volume of potable water consumed – m³ per year;
 - occupancy – number of full-time equivalent occupants (commercial spaces), number of visitors (retail leisure or public spaces), number of residents (housing)¹⁴;
 - Net Lettable Area or NLA (m²);
- Key Performance Indicators:
 - potable water use – m³ per occupant per year, or m³ per m² NLA per year, or litres per person per day¹⁵; and
 - reduction in water use – % change in use relative to the previous year¹⁶.

These metrics can be used to assess either design stage or actual performance¹⁷. However, care should be taken to ensure that design stage and operational performance benchmarks are not combined, as the latter reflect occupant behaviour which is difficult to forecast accurately at design stage.

¹⁴ Some buildings will contain a mix of uses (e.g. office / staff areas and public spaces such as retail floors). In this instance, benchmarking should be based on the dominant use type (if clear), or independently for each type of space if each use is significant.

¹⁵ For new projects at the design stage, the targeted value of the KPI can be compared to the performance using baseline practice fittings.

¹⁶ This KPI is primarily relevant to buildings in use, and the calculation would need to take account of changes in occupancy. Property developers could also track improvements in design-stage consumption over time.

¹⁷ For future reference, Technical Committee CEN/TC 350 of the European Committee for Standardisation is working to develop standards for assessing the "Sustainability of Construction Works".

KPIs for different types of building

The following KPIs are commonly used:

- new households: litres/person/day (lppd);
- new and existing non-household buildings with a known occupancy (e.g. offices, schools etc): m³/person/year (person may be defined as FTE, pupil etc);
- other public buildings with a changeable occupancy (e.g. courts, libraries, museums, community centres) or office developments where future occupancy is unknown: m³/m² of Net Lettable Area, floor space, or per seat (e.g. in cinemas); and
- hotels (m³/room/day or litres/guest/day).

The Green Property Alliance has published advice¹⁸ on sustainability metrics for commercial property. They recommend using m² of Net Lettable Floor Area as the default denominator when normalising indicators, as occupancy-based indicators can be problematic and therefore less reliable as a basis for benchmarking.

Determining the correct target for new and existing buildings depends on their type. Appendix D provides guideline levels of water use defined in current rating schemes, and benchmark ranges of “designed-in” water use levels in different types of building.

For other building types, it may be necessary to develop a bespoke benchmark using estimated usage factors (e.g. using the Water Efficiency Calculator for New Dwellings), or to review monitored consumption data to understand water use in the buildings in question. It is important to assemble a sufficient period of baseline water use before setting reduction targets. This is particularly important where you may have seasonal fluctuations in water use, due to cooling or occupant numbers.

¹⁸ http://www.bpf.org.uk/en/files/bpf_documents/Common_Metrics_Paper_FINAL.pdf

6.0 Water efficiency through procurement

The procurement process is an effective opportunity for developers and building owners to save money and reduce environmental impacts by requiring water efficiency measures that go beyond minimum regulatory standards.

Whether your project is new build, refurbishment or ongoing management of a facility, the approach presented here will help you to clearly define your requirements for water efficiency and how you expect your supply chain to respond.

A new build designer or contractor cannot fully determine the performance of the building while in use, since this is significantly dependent on occupant behaviour. Likewise, the facilities management provider has limited influence over occupant behaviour. However, the designer, contractor and facilities management provider can influence three important aspects, which therefore should be the focus of procurement requirements:

- water use specifications of components installed during new build or retrofit/refurbishment;
- design and commissioning of an efficient system (including features designed to influence behaviour, such as auto shut-off taps); and
- building management and maintenance, including making occupants aware of the savings they can contribute.

Sections 7, 8 and 9 provide model wording to help you effectively incorporate these types of requirement into your policy, pre-qualification, briefing, tender and appointment documents. The wording can be copied or adapted as appropriate.

6.1 Overview of the approach

Figure 2 provides a summary of the key steps involved. You can begin by setting a corporate policy and targets (e.g. for improvement over time), or simply define requirements for a one-off project, contract or Service Level Agreement (SLA). In either case, you should specify outcomes for water efficiency when appointing designers, contractors and facilities managers.

We recommend preparing a Water Efficiency Plan (or equivalent), as this provides a common, structured approach that can be used progressively by each of these groups to forecast and benchmark performance, identify opportunities for improvement, and then track implementation and outcomes.

On larger projects, Building Information Modelling (BIM) provides the opportunity to embed water efficiency into the building design process. BIM is a 3D modelling system that involves data sharing between all the contractors on a project to create a digital model that can be used from a project's early design stages through to completion and monitoring of subsequent performance.

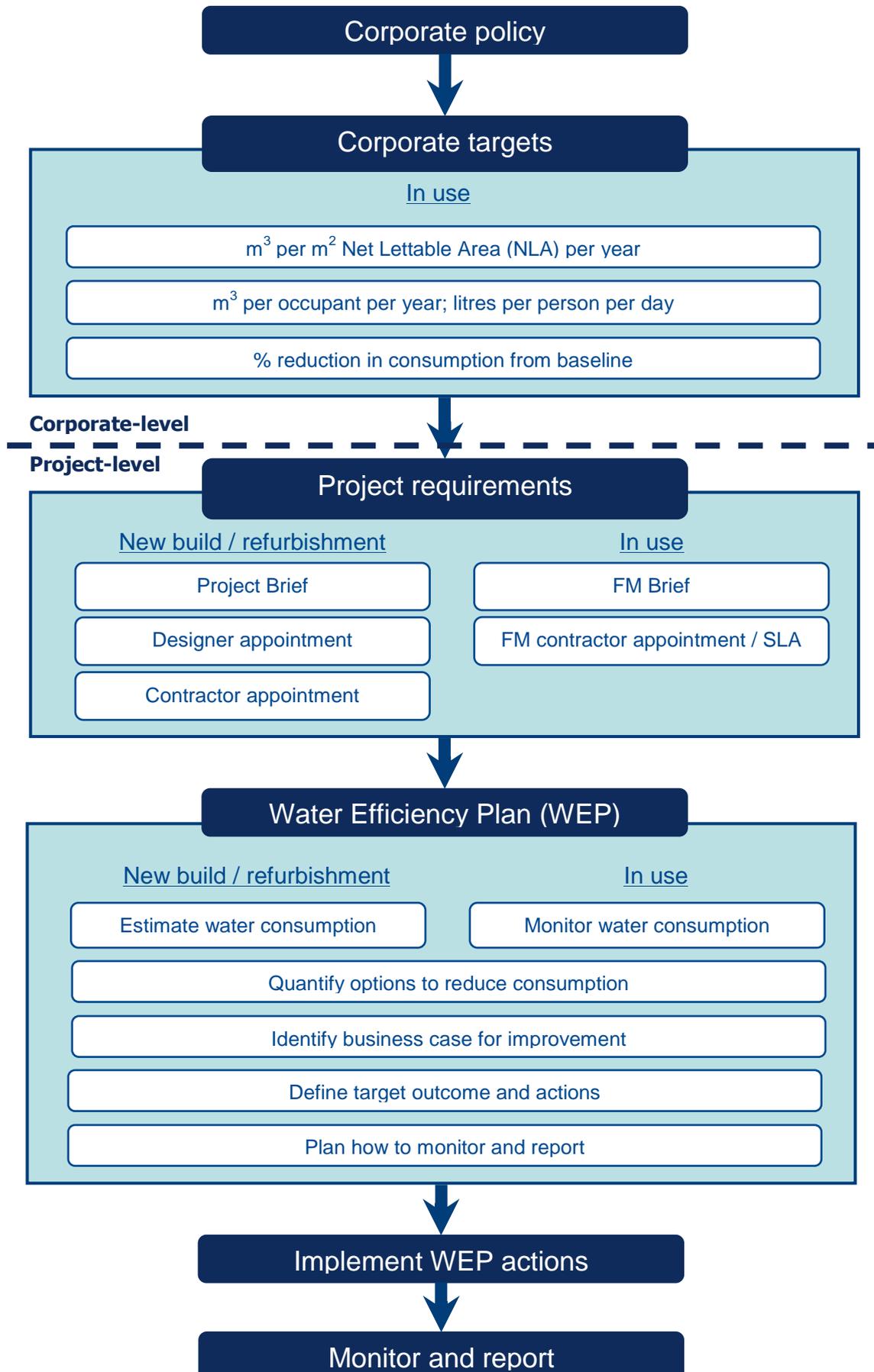


Figure 2: Summary of approach

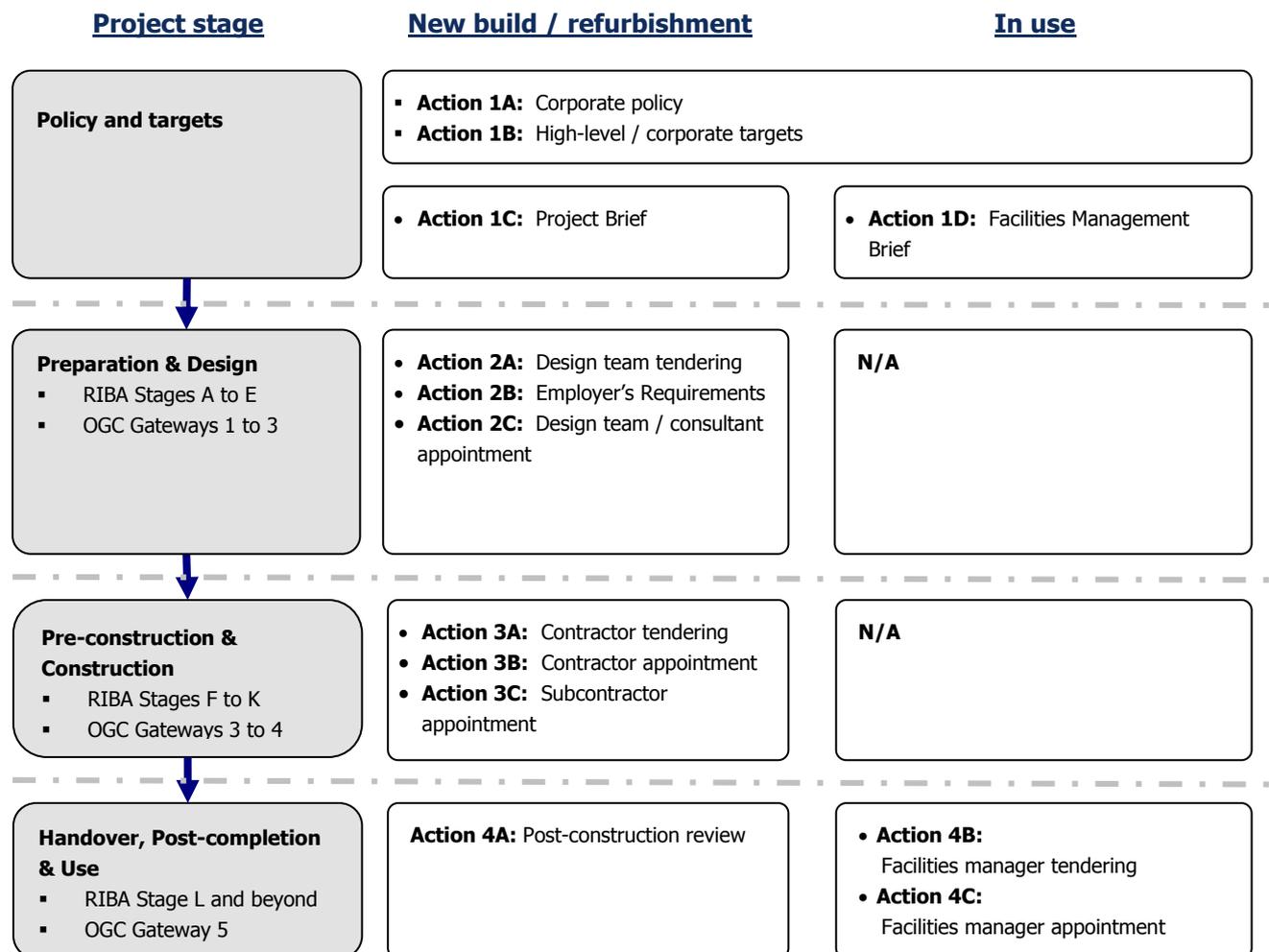
6.2 Setting requirements at different stages of the procurement process

Figure 3 summarises where to include water efficiency in the procurement of new construction / refurbishment and facilities management. Procurement actions are set by **project stage** rather than **procurement route**. This means that, irrespective of the procurement route adopted for a project – for example Traditional, Design and Build (D&B), Private Finance Initiative (PFI), and Framework and Term contracts for maintenance or long-term asset management, etc – actions and model wording should be selected according to project stage.

A critical stage for specifically addressing water efficiency requirements is the Project or FM Brief (Actions 1C and 1D). Once the Brief is defined, it is more difficult to add water efficiency outcomes at a later stage.

A likely consequence of not including water efficiency in the Brief and subsequent documentation is higher operational costs from water and energy use, and the possibility of needing to retrofit to higher standards in the future.

Requirements for water use should not be set in isolation, but applied alongside action on energy/carbon, waste etc. (You can find procurement advice on these topics on the WRAP web site.)



Acronyms:

- RIBA: Royal Institute of British Architects
- OGC: Office of Government Commerce

Figure 3: Project stages and associated model wording for incorporating water efficiency into procurement

It is rarely necessary to generate new documentation to set requirements; it is likely to be easier simply to modify existing documentation. The approach set out here reflects the typical procurement documents and processes used by construction clients; however the model wording should be sufficiently flexible to allow it to be customised to your specific documentation, and you should take your own legal advice where appropriate.

Organisations subject to the public procurement regime should ensure that their water efficiency requirements are clearly explained within their tender documents and/or technical specification, as well as ensuring that the manner of assessment and the relative importance of these criteria in any evaluation process are clearly set out. Such organisations should also consider whether it is necessary to consult their legal advisers, particularly to ensure that, within the context of a specific project, any evaluation criteria are suitably clear, proportionate and verifiable.

For construction or refurbishment projects, water efficiency planning should be initiated by clients in their Project Brief; the concept/scheme design team (client’s or contractor’s) will then develop a proposed approach for achieving these requirements. Plans will be developed further during detailed design, and the selected actions should be included in the finalised WEP and incorporated in the Project Specification / Contractor’s Proposals for client approval.

Table 2 summarises the key information / activities being requested at each stage of the procurement process.

	New build / refurbishment	In use
Policy and targets	<ul style="list-style-type: none"> “You will need to support our ambition to construct water-efficient buildings.” 	<ul style="list-style-type: none"> “You will need to support our ambition to operate water-efficient buildings.”
Project Brief	<ul style="list-style-type: none"> “You will need to meet our target to reduce end-use cold and hot water use, and specify appropriate water-efficient fittings and appliances.” 	<ul style="list-style-type: none"> “You will need to meet our target to monitor and reduce cold and hot water use, and specify appropriate water-efficient fittings and appliances during life-cycle replacement.”
Pre-qualification questionnaire	<ul style="list-style-type: none"> “What is your ability to estimate end-use water consumption (based on design parameters), identify and prioritise actions to reduce cold and hot water use, and assess the net costs and benefits of water-efficient fittings and appliances?” 	<ul style="list-style-type: none"> “What is your ability to estimate and monitor water use, identify and prioritise actions to reduce cold and hot water use, and assess the net costs and benefits of replacement with water-efficient fittings and appliances?”
Invitation to tender	<ul style="list-style-type: none"> “Tell us how you will measure and forecast water use, identify and prioritise options to reduce cold and hot water use, demonstrate the net costs and benefits of installing water-efficient fittings and appliances, and document decisions and actions to help meet our water efficiency objectives.” 	
Appointment/contract documents	<ul style="list-style-type: none"> “Agree what actions you will take to increase end-use water efficiency and to ensure your plans are implemented during the construction phase and handover phase.” 	<ul style="list-style-type: none"> “Agree what actions you will take to monitor and increase water efficiency and to ensure your plans are implemented during the operation of the building.”

Table 2: Information requested at each project stage

6.3 Keys to success

Client experiences in using the procurement process to cut construction waste suggest the following success factors will apply when asking for water efficiency:

- Timing** – the benefits from water-efficient fittings, appliances and distribution are likely to be greater when they are planned earlier on in the project, from the design stage. This will particularly be the case if more sophisticated approaches such as rain or greywater systems are to be included, as these will require space and additional distribution systems.

- **Consistency** – it is important that your requirements are stated throughout the procurement process and not solely within contracts. You might find it useful to map out your procurement process and evaluate which documents should be amended to include water efficiency requirements.
- **Outcomes** – focus on what you want to achieve from your project (such as a specific level of building performance) and ensure the requirements reflect this. Make it clear in your tender documents how the water efficiency aspects of tenders will be evaluated and the relative importance of those requirements in any overall tender evaluation.
- **Proportion** – ensure the extent of wording on water efficiency is proportional to the procurement document and scale of the project, particularly in relation to other areas such as carbon reduction and health & safety.
- **Progressive** – the requirements should build through successive stages of procurement. Start by asking for capability in Pre-Qualification Questionnaires, then define outcomes in the Invitation to Tender, and finally secure agreement to achieve these outcomes in the Contract or order.
- **Performance targets** – embed your company and/or project-level targets in your requirements or preamble. Where appropriate, set water efficiency targets to achieve specific credits within a BREEAM or Code for Sustainable Homes assessment.
- **Measurement and reporting** – the requirements should enable you to collect robust data and manage your performance using common KPIs and comparison against benchmarks.
- **Be inclusive** – requirements should be used as a basis for engagement with suppliers so that all parties can work to increase water efficiency. Rigidly imposing new standards on suppliers without giving them adequate opportunity to understand and respond can be counter-productive and with disproportionate impacts on smaller businesses.

Your design team and contractor will then need to consider a number of questions when they specify and procure water-efficient products that are appropriate and suit your needs:

- Is the product accredited / compliant with all requirements (e.g. Water Efficient Products Labelling Scheme)?
- Is the product certified as water efficient? What accreditation scheme is being used?
- How has the product been tested? For example, how does it work at different pressures?
- What is the availability?
- Can the supplier provide case studies of where the product has been installed with testimonials about tenant satisfaction, product performance and maintenance requirements?

6.4 The role of a Water Efficiency Plan

A Water Efficiency Plan is a **brief document** that describes and quantifies the approach to making efficient use of water and minimising the associated costs and carbon emissions.

In this guide, the procurement requirements hinge on defining **water efficiency outcomes**, not on mandating a process of water efficiency planning. Nevertheless, the Water Efficiency Plan is an effective hub to capture intentions and key considerations, and ensure that information is passed between the different parties throughout the design, construction, handover and operational phases of a building. This will ensure that facilities management actually delivers the intended savings.

In this Section we set out the model process and core elements of a Water Efficiency Plan. It is not the aim to add a rigid reporting burden onto the sector. You should choose the level of documentation appropriate to your project.

Key activities in preparing and implementing a Water Efficiency Plan through the project life cycle are outlined in Figure 4 – note that a Plan may be initiated for an existing building as part of a facilities management contract, and does not only apply to the design of new build projects.

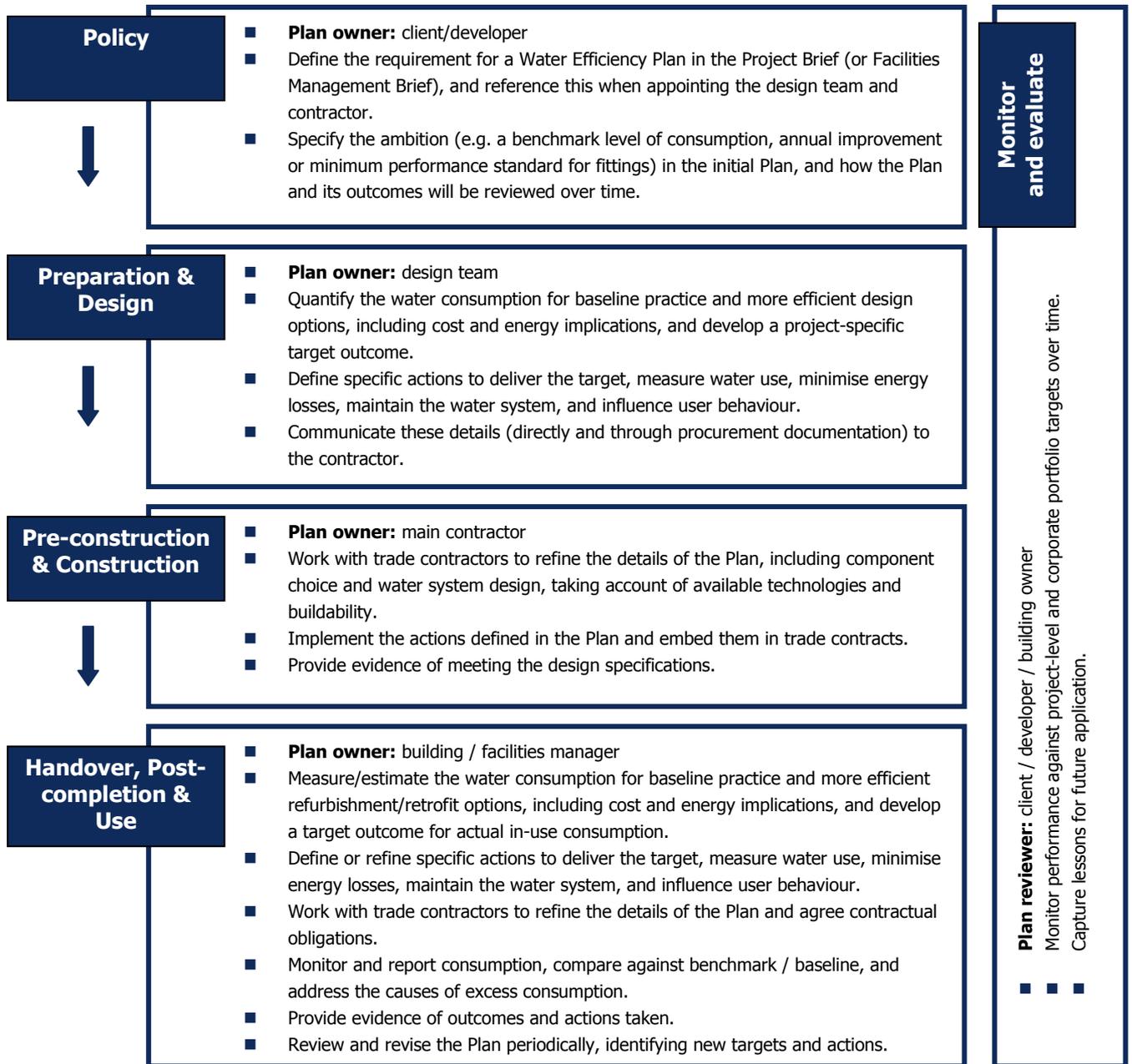


Figure 4: Developing and implementing a Water Efficiency Plan through the project life cycle

Typical content of a Water Efficiency Plan

A Water Efficiency Plan for a new or existing building may contain the following information:

- description of the project/building, its current or projected installation of water-consuming fittings and appliances and their current or likely usage;
- the client/project **objective or requirement** (e.g. maximum consumption level, or corporate target for improvement), which may have been defined in the Project/FM Brief and contract;
- **forecasts of alternative building outcomes** for end-use water consumption¹⁹ arising from the use of components with different practice levels of water efficiency (estimates should be on a per person or per m² basis, and overall);
- **a building-specific target** for potable water use (design intent or in-use), and/or water use specifications for different types of fitting and appliance, that meet or exceed the client requirement;
- **projected financial, water and energy savings** and associated financial costs from going beyond the minimum client requirement [and, if appropriate, the contribution to meeting the building's target environmental rating for BREEAM or the Code for Sustainable Homes];
- **specific cost-effective actions** to:
 - reduce the risk of uncontrolled water use (e.g. by installing motion-sensor operated taps);
 - minimise the risk of leakage (e.g. through leak monitoring equipment and auto shut-off of flow to toilet areas when unoccupied);
 - minimise use of potable water by installing water-efficient components;
 - replace potable water with water from other sources (e.g. rainwater or greywater) where appropriate;
 - minimise energy and carbon emissions associated with the generation, storage and supply of hot water (within the property);
 - enable monitoring of water use (e.g. sub-metering on site);
 - influence user behaviour through design and building management;
 - ensure effective operation of the system over time;
- **a data log of designed-in and actual water use** (recorded over time), supported by evidence of actions taken;
- **a procedure for monitoring and review of performance** against the target, together with a timetable for updating the Water Efficiency Plan and capturing lessons learned; and
- the **identity of who "owns" the Plan** at each stage of the building life-cycle (inception, design, construction, use) and who is responsible for implementing the actions.

The Water Efficiency Plan should take account of wider sustainability objectives – for example, showers that support a cycle-to-work initiative should not be excluded from a building in an effort to minimise the calculated design consumption.

The client should ensure that contract documents make clear who takes responsibility for developing the Water Efficiency Plan at each stage of the project and reporting outcomes. Depending on the procurement route, this may be the lead designer initially, who then passes the responsibility onto the main contractor as part of the Employer's Requirements.

In addition to selecting water-efficient fittings and appliances (e.g. as listed in Table 1), project teams should consider the measures listed below for inclusion in the Water Efficiency Plan. Appendix F signposts some sources of further information.

¹⁹ For dwellings, consumption should be estimated using the methodology set out in the Water Efficiency Calculator for New Dwellings available at www.communities.gov.uk. For non-dwellings, consumption should be estimated using a defined assessment method such as the BREEAM Water Consumption Tool, or WRAP's Water Cost Saving Tool.

Checklist of design actions

- Reduce potable water use:
 - pressure reduction valves;
 - flow regulators/restrictors;
 - the use of aerated and spray tap/shower fittings which improve perceived user experience, and two-stage taps with water brakes;
 - grey / rain water systems (which should follow the Codes of Practice BS8515 for rainwater harvesting and BS8525-1 for greywater systems) – generally only feasible for new build;
 - irrigation systems which follow the method defined in BS7562-3 “Planning, design and installation of irrigation schemes”;
- Minimise energy and carbon emissions associated with hot water:
 - reduce pipe lengths and dead legs in the plumbing system;
 - reduce pipe bores below the standard 15mm where appropriate;
 - ensure hot water pipes are insulated and position hot pipes above cold pipes, to minimise heat loss and heat exchange to cold water pipes;
 - distributed hot water generation;
 - efficient (low carbon) hot water generation systems;
 - insulated water stores;
- Enable monitoring of water use:
 - install meters which are easy to read, e.g. pulsed meters for connecting to a Building Management System;
 - sub-metering (pulsed) of areas of major water use;
- Reduce the risk of uncontrolled water use:
 - sensor-actuated devices (such as infra-red actuated taps and occupancy sensors);
- Minimise the risk of leakage:
 - leak detection equipment;
 - ensure valves and overflows are visible for early detection of water loss and easy to access for maintenance;
- Influence user behaviour:
 - provision of information on appropriate use of fittings and appliances (prompts in toilets etc);
 - awareness raising of the costs and environmental importance of water efficiency (e.g. fact sheets with examples of environmental and monetary savings);
 - guidance on processes for identifying and reporting water leakage / poorly-performing fittings;
 - method for providing feedback to building occupants on water use;
- Design for effective operation:
 - consider the pros and cons of using a water softening system (which actually increases water use) to minimise scaling of water-efficient fittings with small flow apertures in hard water areas;
 - design waste water plumbing to work with lower water volumes (e.g. from low-flush WCs); and
 - avoid the over-provision of facilities relative to expected building occupancy and patterns of use (while complying with industry standards for the provision of sanitation).

Note:

1. *Early Contractor Involvement (e.g. using two-stage procurement) will be helpful in considering these options.*
2. *It is important that design teams consider the impact of design choices on the behaviour of building occupants, and select options accordingly (e.g. sensor-controlled taps to avoid taps being left running in public buildings). They should also consider and specify the maintenance requirements for technologies (e.g. grey/rain water systems and waterless urinals).*

On a new build project, the Water Efficiency Plan should be initiated from an early design stage in order to maximise savings in the most cost-effective way. The level of detail contained within a Plan should be proportionate to the scale of the project and the water efficiency opportunities. In some instances (e.g. a volume house-builder), it may be more efficient to produce a template plan that includes the company's standard fitting specifications as a start point.

By the time the Water Efficiency Plan has progressed to the facility management stage, the Plan will look quite different to that prepared for the contractor. In the design and build phase, the focus will be on a list of specifications for fittings and appliances. In the facilities management phase, the plan may contain:

- an asset register or list of water-using fixtures;
- product specifications (flow rates/capacities);
- product operational protocols and maintenance requirements;
- supplier details;
- locations of meters, sub-meters and shut-off valves;
- instructions for building management system/online monitoring;
- any explanation for expected baseflow (cooling for a data centre, for example);
- basis for targets set;
- records to track use against targets;
- checklist of actions to address increases in flow rate; and
- proactive maintenance schedule.

The Water Efficiency Plan should be included in the environmental management system of an organisation and follow the same processes. This will most likely be the ISO process (PDCA: Plan, Do, Check, Act):

Plan – understand the problem

Develop and implement a Water Efficiency Plan (or equivalent), to include:

- tracking water use;
- defining measures to reduce hot and cold water use:
 - short-term measures (no big technical, operational or economic impacts);
 - long-term measures (bigger impacts but also bigger savings);
 - behavioural change measures (information and prompts); and
- planning a schedule and property-specific target to reduce water use per period.

Do – execute the plan

Implement defined measures.

Ensure employees are informed about implementing measures.

Check – follow-up

Ensure implementation of measures or adjust schedule if needed.

Measure and report actual water use on a periodic (e.g. quarterly) basis using defined key performance indicators:

- potable water use – m³ per full-time equivalent occupant, visitor or resident (as appropriate) per year, or m³ per m² net lettable area per year, or litres per person per day; and/or
- reduction in water use – % change in use (normalised to occupancy) relative to the previous period.

Fix any leaks; check regulators and urinal solenoids are still operating correctly.

Act – standardize

Adjust and/or set new targets.

Include Water Efficiency Plan in Environmental Management System.

7.0 Model wording for policy and targets

Use the Policy stage to signal your intent to your own organisation and to members of your supply chain, and to provide a clear simple basis for measuring (and hence managing) overall performance. The model wording below can be used in your corporate strategy documents. If you incorporate this wording within your environmental policy and procurement policy, rather than having a separate statement on water efficiency, this will provide a more holistic approach to resource efficiency.

On a one-off project, Actions 1A and 1B may be omitted.

7.1.1 Action 1A: Corporate policy

Corporate Social Responsibility (CSR) policy document

We aim to develop and operate water-efficient buildings and foster water-efficient behaviour by users. We will use water-efficient fittings and appliances that exceed regulatory requirements and will look for opportunities to achieve further savings wherever appropriate. We will minimise the carbon emissions associated with water use by reducing consumption, generating hot water efficiently and minimising heat losses during storage and distribution.

We will:

- set a target for reducing water use in our buildings, with further more stringent requirements for all new build and major refurbishment projects;
- embed the targets within corporate policy and processes;
- set corresponding requirements in project procurement and engage with our supply chain;
- measure performance at a building level relative to a corporate baseline; and
- report annually on overall corporate performance.

7.1.2 Action 1B: Corporate targets

CSR policy document

By [20xx], [name of organisation] aims to reduce actual water use [to/by] [*state target based on preferred KPIs below*] for all of our developments and buildings. We will report progress annually using the following KPI(s):

- [m^3 per m^2 Net Lettable Area per year]; or
- [m^3 per FTE / resident / visitor / person per year]; or
- [litres per person per day]; and/or
- [% reduction in use relative to 20xx].

and / or

In all of our new build projects or refurbishments, we will seek more stringent requirements so that the estimated water use is:

- [$X\text{m}^3$ per m^2 Net Lettable Area per year]; or
- [$X\text{m}^3$ per FTE / resident / visitor / person per year]; or
- [X litres per person per day]; or
- [$X\%$ below the level that would have been achieved had baseline practice products been used].

Appendix D provides indicative guidance on benchmarks of water use for different building types.

Note: The Green Property Alliance has recommended volume per unit area as a more reliable KPI than volume per occupant. A target for reduction over time is most readily applied to consumption in use, but could also be defined for a reduction in design consumption across successive new build projects.

8.0 Model wording for new projects/refurbishments

This wording relates to the procurement of designers and contractors for a new build project or for a refurbishment project where replacement of water-using fittings and appliances is within the scope of work.

8.1 Policy and targets stage

8.1.1 Action 1C: Project Brief

Project Brief – wording on water efficiency

As part of our commitment to achieving a low environmental impact in all of our developments, we require that all new buildings/refurbishments use water efficiently.

[If a building-level outcome has been defined, use]

This project must achieve our minimum design requirement for predicted potable water use of [insert requirement for building-level outcome from policy document, e.g. X m³ per m² Net Lettable Area per year or X litres per person per day].

[Use/add the following if appropriate, particularly where a building-level outcome has not been defined]

We require that all of the installed water-consuming fittings and appliances achieve, as a minimum, [efficient practice levels as set out in the table below / standards defined by XXX e.g. the Bathroom Manufacturers Association Water Efficient Product Labelling Scheme, Government Buying Standards, or the AECB Water Standards].

[Where appropriate, insert a table of water efficiency practice levels for components here, for example using values from Table 1 in this guidance document as illustrated below. If a building-level outcome has been defined, the Project Brief would not normally set minimum practice levels for components, so that the design team has flexibility to mix practice levels across different components.]

Fitting/appliance	Water use practice level (at pressures up to 5 bar)
Shower (mixer)	≤8 l/min
Shower (electric)	≤6 l/min
WC	≤4.5 l/flush (single flush or effective flush)
Urinal	≤3 l/bowl/hour during building occupancy with user-presence activated flush, 0 l/hour outside of occupancy and activation period, with minimal water use in maintenance
Tap (basin)	≤6 l/min
Tap (kitchen)	≤8 l/min
Bath	≤180 l capacity excluding body mass within the bath
Washing machine	≤9 l/kg dry load
Dishwasher	≤0.7 l/place setting

[If an environmental rating is sought, use/add]

For this project, we aim to achieve [BREEAM / LEED / Code for Sustainable Homes rating of X]. We require the project to achieve, as a minimum, the mandatory water efficiency standards required for this rating.

In addition, we require the project team to take further steps to reduce potable water use and the carbon emissions associated with hot water supply, e.g. by implementing highly efficient components, where these provide value for money.

The project team is required to develop a Water Efficiency Plan (or equivalent) for the project commencing at the concept design stage or before. The plan should include:

- alternative design estimates of water use²⁰ arising from the use of components with different practice levels of water efficiency;
- a project-specific target for the design level of potable water use, and/or water use specifications for different types of fitting and appliance, that meet or exceed the minimum requirements set for the project;
- the projected financial, water and energy savings and associated financial costs from going beyond our minimum requirements for the project [and, *if appropriate*, the contribution to meeting the project's environmental rating target];
- specific cost-effective actions to:
 - reduce the risk of uncontrolled water use (e.g. by installing motion-sensor operated taps);
 - minimise the risk of leakage (e.g. through leak monitoring equipment and auto shut-off of flow to toilet areas when unoccupied);
 - minimise use of potable water by installing water-efficient components;
 - replace potable water with water from other sources (e.g. rainwater or greywater) where appropriate;
 - minimise energy and carbon emissions associated with the generation, storage and supply of hot water (within the property);
 - enable monitoring of water use (e.g. sub-metering on site);
 - influence user behaviour through water system design; and
 - ensure effective operation of the system over time.

Project teams shall include the Water Efficiency Plan within both Scheme and Detailed design reports [or comparable documents as appropriate] for client RIBA Stage and/or project Gateway reviews, with the final Plan presented within the Contractor's Proposals. The project team shall ensure that the requirements, including levels of water efficiency for fittings, are applied and clearly communicated to relevant subcontractors.

The project team shall submit evidence that the minimum requirements and any other measures specified in the Water Efficiency Plan have been implemented during design, procurement and installation. This may take the form of the certified post-construction environmental rating for the building or evidence that components meeting the standards specified in the Water Efficiency Plan have been installed.

[Optional] The project team shall also reduce water use associated with the construction process and site activities.

Note: Action 1D: Facilities Management Brief is addressed in Section 9.1.1.

²⁰ For dwellings, consumption should be estimated using the methodology set out in the Water Efficiency Calculator for New Dwellings available at www.communities.gov.uk. For non-dwellings, consumption should be estimated using a defined assessment method such as the BREEAM Water Consumption Tool. WRAP's Water Cost Saving Tool uses a calculation method that is consistent with both these approaches and also enables design estimates to be determined for buildings other than housing and offices.

8.2 Preparation & Design stage

Construction clients should use the model wording in this Section when procuring a design team. The objective is to include water efficiency as a systematic consideration from an early design stage – rather than leaving it until detailed design when the opportunity to reuse water or provide alternative water supplies will have been missed.

The wording needs to be applied to those charged with design²¹ responsibility for your project. Irrespective of procurement route adopted, the model wording can be inserted in design team Pre-Qualification Questionnaires (PQQs), Invitation to Tender (ITT) documents, and consultant appointment contracts.

8.2.1 Action 2A: Design team tendering

Pre-Qualification Questionnaire (PQQ) and Invitation to Tender (ITT)

PQQ questions

These questions probe the general capability of a design team to design cost-effective levels of water efficiency and estimate the associated water use. The third question (on water efficiency planning) may be appropriate for more complex projects or where a high standard of performance is sought. (Initially, relatively few designers and contractors may be able to offer detailed experience of water efficiency planning.)

As part of our commitment to achieving a low environmental impact in all of our developments, we require that all new buildings/refurbishments use water efficiently. Specific targets for this project are to [insert relevant targets from Project Brief]. Further detail is provided in the Project Brief.

1. Detail your understanding, experience and achievements in cost-effectively minimising water use in buildings.
2. Detail your understanding, experience and achievements in designing water systems that cost-effectively minimise carbon emissions associated with hot water supply.
3. Detail your understanding and experience in developing water efficiency plans (or equivalent) that provide a robust forecast of water use together with defined and costed proposals for achieving high standards of water efficiency without compromising value for money.

An ideal PQQ response would provide the following details:

- evidence illustrating how the bidder has previously identified opportunities to reduce water use together with evidence that they understand the financial and performance factors that influence decision-making;
- evidence illustrating that the bidder understands the range of design options, including water-efficient fittings and appliances, metering, grey/rain water systems, leak detection equipment, sensor-actuated devices, pipe runs and pressure reduction devices;
- evidence of understanding how hot water use is linked to carbon emissions, the various design and specification options that can be pursued to reduce emissions, and their cost-effectiveness – including the use of efficient and low carbon heating sources, effective insulation of storage and distribution systems, and the choice between a distribution system versus localised water heating; and
- evidence of having developed Water Efficiency Plans (or equivalent) to inform clients about the options available to them to reduce environmental impact and save money.

ITT wording

These clauses ask designers to explain how they will estimate end-use water use, identify and prioritise actions to reduce cold and hot water consumption, and assess the net costs and benefits of water-efficient fittings and appliances as part of the design development process.

²¹ Design should be defined broadly and includes all consultant services that impact on the nature, extent, quality and cost of the project.

As part of our commitment to achieving a low environmental impact in all of our developments, we require that all new buildings/refurbishments use water efficiently. Specific targets for this project are to [insert relevant requirements from Project Brief]. Further detail is provided in the Project Brief.

Please describe your approach to:

1. achieving our minimum requirements; and
2. preparing a Water Efficiency Plan (or equivalent) in line with the requirements set out in the Project Brief and working with other members of the project team where appropriate.

Please identify any factors that you believe to be significant to the cost-effective achievement of the water efficiency requirements set for this project.

An ideal ITT response would provide the following details:

- an outline of their proposed approach to water efficiency planning, which should include all of the areas listed in the Project Brief;
- a clear method for developing the most cost-effective combination of efficiency measures to meet the project minimum requirements, and for quantifying and evaluating opportunities to go beyond the minimum requirements where these provide value for money to the client;
- consideration of the links between water efficiency and other specific project goals, such as a BREEAM / Code for Sustainable Homes rating, carbon target or renewable energy requirement; and
- how the bidder will evaluate development, lifecycle and operating costs in the context of (a) the tenant/occupier motivation to be water-efficient and (b) the allocation of costs and savings between client/developer and tenant/occupier.

8.2.2 Action 2B: Design/project team tendering

Employer's Requirements at design stage, and for Design & Build or PFI contracts

The client can issue these Employer's Requirements when tendering directly for a design team (alongside the ITT wording above), or when tendering for a D&B/PFI contractor who, depending on procurement route, may appoint their own design team.

These clauses ensure that D&B/PFI contractors and their design teams will systematically consider water-efficient outcomes as part of the design development process.

As part of our commitment to achieving a low environmental impact in all of our developments, we require that all new buildings/refurbishments use water efficiently.

[If a building-level outcome has been defined, use]

This project must achieve our minimum design requirement for predicted potable water use of [insert requirement for building-level outcome from policy document, e.g. X m³ per m² Net Lettable Area per year or X litres per person per day].

[Use/add the following if appropriate, particularly where a building-level outcome has not been defined]

We require that all of the installed water-consuming fittings and appliances achieve, as a minimum, [efficient practice levels as set out in the table below / standards defined by XXX e.g. the Bathroom Manufacturers Association Water Efficient Product Labelling Scheme, Government Buying Standards, or the AECB Water Standards].

[Where appropriate, insert a table of water efficiency practice levels for components here – for example, using the values from Table 1 in this guidance document. If a building-level outcome has been defined, the Project Brief would not normally set minimum practice levels for components, so that the design team has flexibility to mix practice levels across different components.]

[If an environmental rating is sought, use/add]

For this project, we aim to achieve [BREEAM / LEED / Code for Sustainable Homes rating of X]. We require the project to achieve, as a minimum, the mandatory water efficiency standards required for this rating.

In addition, we require the project team to take further steps to reduce potable water use and the carbon emissions associated with hot water supply, e.g. by implementing highly efficient components, where these provide value for money.

[Insert name] [*defined as appropriate to the procurement route, e.g. architect, main contractor*] shall [develop a Water Efficiency Plan (or equivalent) / review and develop the existing Water Efficiency Plan] to include:

- alternative design estimates of project-level water use²² arising from the use of components with different practice levels of water efficiency;
- a project-specific target for the design level of potable water use (at the design level of water pressure), and/or water use specifications for different types of fitting and appliance, that meet or exceed the minimum requirements set for the project;
- the projected financial, water and energy savings and associated financial costs from going beyond the minimum requirements for the project [and, if appropriate, the contribution to meeting the project's environmental rating target];
- specific cost-effective actions to:
 - reduce the risk of uncontrolled water use (e.g. by installing motion-sensor operated taps);
 - minimise the risk of leakage (e.g. through leak monitoring equipment and auto shut-off of flow to toilet areas when unoccupied);
 - minimise use of potable water by installing water-efficient components;
 - replace potable water with water from other sources (e.g. rainwater or greywater) where appropriate;
 - minimise energy and carbon emissions associated with the generation, storage and supply of hot water (within the property);
 - enable monitoring of water use (e.g. sub-metering on site);
 - influence user behaviour through water system design; and
 - ensure effective operation of the system over time;

[Insert name] shall include the Water Efficiency Plan within both Scheme and Detailed design reports [or comparable documents as appropriate] for client RIBA Stage and/or project Gateway reviews, with the final Plan presented within the Contractor's Proposals. [Insert name] shall ensure that the requirements, including levels of water efficiency for fittings, are applied and clearly communicated to relevant subcontractors.

[Insert name] shall submit evidence that the minimum requirements and any other measures specified in the Water Efficiency Plan have been implemented during design, procurement and installation. This may take the form of the certified post-construction environmental rating for the building or evidence that components meeting the standards specified in the Water Efficiency Plan have been installed.

²² For dwellings, consumption should be estimated using the methodology set out in the Water Efficiency Calculator for New Dwellings available at www.communities.gov.uk. For non-dwellings, consumption should be estimated using a defined assessment method such as the BREEAM Water Consumption Tool. WRAP's Water Cost Saving Tool uses a calculation method that is consistent with both these approaches and also enables design estimates to be determined for buildings other than housing and offices.

8.2.3 Action 2C: Design team / consultant appointment

Appointment document (e.g. consultant contract)

These clauses ensure that designers will agree what actions they will take to increase end-use water efficiency as part of the design development process, and will inform the client and principal contractor of design decisions and intended outcomes.

As part of our commitment to achieving a low environmental impact in all of our developments, we require that all new buildings/refurbishments use water efficiently.

[If a building-level outcome has been defined, use]

This project must achieve our minimum design requirement for predicted potable water use of [insert requirement for building-level outcome from policy document, e.g. X m³ per m² Net Lettable Area per year or X litres per person per day].

[Use/add the following if appropriate, particularly where a building-level outcome has not been defined]

We require that all of the installed water-consuming fittings and appliances achieve, as a minimum, [efficient practice levels as set out in the table below / standards defined by XXX e.g. the Bathroom Manufacturers Association Water Efficient Product Labelling Scheme, Government Buying Standards, or the AECB Water Standards].

[Where appropriate, insert a table of water efficiency practice levels for components here – for example, using the values from Table 1 in this guidance document. If a building-level outcome has been defined, the Project Brief should not normally set minimum practice levels for components, so that the design team has flexibility to mix practice levels across different components.]

[If an environmental rating is sought, use/add]

For this project, we aim to achieve [BREEAM / LEED / Code for Sustainable Homes rating of X]. We require the project to achieve, as a minimum, the mandatory water efficiency standards required for this rating.

In addition, we require the project team to take further steps to reduce potable water use and the carbon emissions associated with hot water supply, e.g. by implementing highly efficient components, where these provide value for money.

[Insert name] will [develop a Water Efficiency Plan (or equivalent) / review and develop the existing Water Efficiency Plan] to include:

- alternative design estimates of project-level water use²³ arising from the use of components with different practice levels of water efficiency;
- a project-specific target for the design level of potable water use (at the design level of water pressure), and/or water use specifications for different types of fitting and appliance, that meet or exceed the minimum requirements set for the project;
- the projected financial, water and energy savings and associated financial costs from going beyond the minimum requirements for the project [and, if appropriate, the contribution to meeting the project's environmental rating target];
- specific cost-effective actions to:
 - reduce the risk of uncontrolled water use (e.g. by installing motion-sensor operated taps);
 - minimise the risk of leakage (e.g. through leak monitoring equipment and auto shut-off of flow to toilet areas when unoccupied);
 - minimise use of potable water by installing water-efficient components;
 - replace potable water with water from other sources (e.g. rainwater or greywater) where appropriate;

²³ For dwellings, consumption should be estimated using the methodology set out in the Water Efficiency Calculator for New Dwellings available at www.communities.gov.uk. For non-dwellings, consumption should be estimated using a defined assessment method such as the BREEAM Water Consumption Tool. WRAP's Water Cost Saving Tool uses a calculation method that is consistent with both these approaches and also enables design estimates to be determined for buildings other than housing and offices.

- minimise energy and carbon emissions associated with the generation, storage and supply of hot water (within the property);
- enable monitoring of water use (e.g. sub-metering on site);
- influence user behaviour through water system design; and
- ensure effective operation of the system over time.

[Insert name] will include the Water Efficiency Plan within both Scheme and Detailed design reports [or comparable documents as appropriate] for client RIBA Stage and/or project Gateway reviews, with the final Plan presented within the Contractor's Proposals. [Insert name] shall ensure that the requirements, including levels of water efficiency for fittings, are applied and clearly communicated to relevant subcontractors.

[Insert name] will submit evidence that the minimum requirements and any other measures specified in the Water Efficiency Plan have been implemented during design, procurement and installation. This may take the form of the certified post-construction environmental rating for the building or evidence that components meeting the standards specified in the Water Efficiency Plan have been installed.

8.3 Pre-construction & Construction stage

The wording below can be used when procuring a contractor. Depending on the procurement route, the contractor may have already been appointed and involved in the pre-construction activities. In such situations, the water efficiency targets will have been set at an earlier stage using 'Action 2C' model wording.

Where the contractor's appointment includes design responsibility, then appropriate wording from Actions 2A to 2C should be incorporated.

Irrespective of the procurement route adopted, the following model wording can be inserted in Pre-Qualification Questionnaires (PQQs), Invitation to Tender (ITT) documents and works contracts²⁴.

The approach proposed here is in line with JCT guidance ("Building a Sustainable Future Together", 2009, <http://www.jctltd.co.uk>) which advises that "*The specific and detailed sustainability requirements should be set out in the contract documentation [i.e. preliminaries, preambles, specification, or schedule specifically prepared for the project], but if users prefer these can be set out in a schedule to the contract conditions*".

8.3.1 Action 3A: Contractor tendering

Pre-Qualification Questionnaire (PQQ) and Invitation to Tender (ITT)

PQQ questions

These questions probe the general capability of a contractor to review, optimise and implement the proposed design solution for water efficiency.

As part of our commitment to achieving a low environmental impact in all of our developments, we require that all new buildings/refurbishments use water efficiently. Specific targets for this project are to [*insert relevant targets from Project Brief or design-stage Water Efficiency Plan*]. Further detail is provided in the Project Brief.

1. Detail your understanding, experience and achievements in cost-effectively minimising water use in buildings.
2. Detail your understanding, experience and achievements in cost-effectively delivering water systems that minimise carbon emissions associated with hot water supply.
3. [Optional] Detail your approach to reducing water use associated with the construction process and site activities.

An ideal PQQ response would provide the following details:

- evidence of how the bidder has identified and effectively installed water-efficient products including fittings, appliances, controls, metering, pressure/flow regulation and leak detection equipment; and
- evidence that the bidder understands how hot water use is linked to carbon emissions and the role of the contractor in ensuring that pipe runs are minimised and effectively insulated.

ITT wording

These clauses ask contractors to explain the steps they will take on the specific project to review, optimise and implement the proposed design solution for water efficiency.

As part of our commitment to achieving a low environmental impact in all of our developments, we require that all new buildings/refurbishments use water efficiently. Specific targets for this project are to [*insert relevant targets from Project Brief or design-stage Water Efficiency Plan*]. Further detail is provided in the Project Brief and Water Efficiency Plan.

²⁴ Under management contracts procurement, the client should ensure the management contractor cascades waste requirements down to works contractors. Under construction management procurement, the client should ensure waste requirements are also placed on specialist contractors.

You will be expected to take ownership of the Water Efficiency Plan [*or equivalent*], finalise the agreed approach and manage its implementation (including by relevant subcontractors).

Please describe your approach to implementing the Water Efficiency Plan for this project, including:

1. any difficulties you foresee in achieving the required targets and complying with the specified actions;
2. any opportunities to further enhance performance in terms of water or carbon savings or value for money;
3. your proposals for ensuring and demonstrating that the completed building complies with the targets and actions agreed in the finalised pre-construction Water Efficiency Plan;
4. [*optional*] your proposals for reducing water use associated with the construction process and site activities.

An ideal ITT response would provide the following details:

- a commitment to delivering the Water Efficiency Plan and achieving the targets contained within;
- a clear plan for owning, managing and delivering the Water Efficiency Plan; this will include review of the plan, finalising the specifics and incorporating the requirements into the appointment of appropriate subcontractors;
- constructive commentary on the design-stage Water Efficiency Plan together with proposals for improving value for money; and
- information on how and when information will be provided to the client and their representatives to demonstrate that the Water Efficiency Plan has been implemented.

8.3.2 Action 3B: Contractor appointment

The approach recommended here is to include a high-level requirement in the main construction contract, with more detailed information included in the contract preliminaries.

Main Construction Contract (general conditions)

This clause should be inserted into the main contract. It could form part of a broader requirement to work in accordance with the Employer's objectives for 'resource efficiency' or 'sustainable construction', provided the requirements are clearly defined (e.g. in the Project Brief).

The Contractor and his supply chain shall carry out and complete the works in compliance with the Employer's objectives for water efficiency.

Preliminaries

These clauses set out the contractor's responsibilities for achieving and reporting water efficiency.

As part of our commitment to achieving a low environmental impact in all of our developments, we require that all new buildings/refurbishments use water efficiently.

[If a building-level outcome has been defined, use]

This project must achieve our minimum design requirement for predicted potable water use of [*insert requirement for building-level outcome from policy document, e.g. X m³ per m² Net Lettable Area per year or X litres per person per day; add a project-specific target if already defined in the Water Efficiency Plan at the design stage*].

[Use/add the following if appropriate, particularly where a building-level outcome has not been defined]

We require that all of the installed water-consuming fittings and appliances achieve, as a minimum, [*efficient practice levels as set out in the table below / standards defined by XXX e.g. the Bathroom Manufacturers Association Water Efficient Product Labelling Scheme, Government Buying Standards, or the AECB Water Standards*].

[Where appropriate, insert a table of water efficiency practice levels for components here, as illustrated below – for example, stating the values selected by the design team in the Water Efficiency Plan to achieve the client's requirement.]

Fitting/appliance	Water use practice level (at pressures up to 5 bar)
Shower (mixer)	≤8 l/min
Shower (electric)	≤6 l/min
WC	≤4.5 l/flush (single flush or effective flush)
Urinal	≤3 l/bowl/hour during building occupancy with user-presence activated flush, 0 l/hour outside of occupancy and activation period, with minimal water use in maintenance
Tap (basin)	≤6 l/min
Tap (kitchen)	≤8 l/min
Bath	≤180 l capacity excluding body mass within the bath
Washing machine	≤9 l/kg dry load
Dishwasher	≤0.7 l/place setting

[If an environmental rating is sought, use/add]

For this project, we aim to achieve [BREEAM / LEED / Code for Sustainable Homes rating of X]. We require the project to achieve, as a minimum, the mandatory water efficiency standards required for this rating.

In addition, we require the project team to take further steps to reduce potable water use and the carbon emissions associated with hot water supply, e.g. by procuring and implementing highly efficient components, where these provide value for money.

Specific actions by which our requirements for water efficiency will be achieved are detailed in the project Water Efficiency Plan.

The contractor shall:

- take ownership of the Water Efficiency Plan;
- review and finalise the Water Efficiency Plan, ensuring that the above targets are achieved as a minimum;
- ensure that the completed construction is in line with the actions set out in the finalised Water Efficiency Plan, including:
 - levels of water efficiency for each water-consuming fitting and appliance;
 - pressure and flow regulation to achieve the design specification;
 - design and installation of the water heating, storage and distribution system; and
 - measures to minimise uncontrolled water use, monitor use and detect leakage;
- provide evidence to demonstrate the effective implementation of the Plan – this can include:
 - certified achievement of credit requirements to meet the environmental rating assessment;
 - invoices / delivery records for products meeting the specific levels of water efficiency required; and
 - photographic or other evidence (e.g. inspection records from the Employer’s Agent) to demonstrate installation and effective operation of the specified fittings and technologies.

[If the client/developer is seeking to benefit from Enhanced Capital Allowances, use/add]

Where purchased products are listed on the Government’s Water Technology List for Enhanced Capital Allowances, the contractor shall provide written evidence including the model name and date purchased.

The contractor can also be asked to minimise water use during the construction process as part of their environmental management system.

8.3.3 Action 3C: Subcontractor appointment

Where the activities of a subcontractor (such as a plumbing and heating contractor) will have an influence on the delivery of the Water Efficiency Plan, then it is important for the Principal Contractor to require that their suppliers work in line with the steps set out in the Plan. This might focus on the procurement and installation of specified products, or fittings and appliances that meet defined levels of use (where specific products are not defined). In other cases, their role may involve ensuring the effective installation of hot water distribution pipework with minimal pipe runs and effective insulation.

The relevance of procurement requirements to specific trade packages will vary with the actions that are contained within the Plan. As a result, the procurement wording proposed below includes the caveat that the requirements **are only applicable to subcontractors with an influence over the delivery of the Water Efficiency Plan**.

Specialist subcontractors are required to work in accordance with the Water Efficiency Plan for this project. The Water Efficiency Plan specifies the design levels of water use and water pressure that must be achieved for water-consuming fittings and appliances. The Plan also details any additional actions to minimise water use, generate and supply hot water efficiently, detect and prevent leakage, and make use of rain or grey water.

Specific actions that are applicable to [Subcontractor name] are:

- [insert relevant actions and a schedule of fittings where appropriate]

[Subcontractor name] will contribute to the achievement of the above actions by ensuring that appropriately performing products are used and are correctly installed.

The requirements can be included in the Invitation to Tender and contract agreement, and discussed at the post-tender interview or start-up meeting. Specific actions agreed with the subcontractor can be recorded in the Water Efficiency Plan.

8.4 Handover, Post-completion & Use

8.4.1 Action 4A: Post-construction review

At this stage the client, or their representative, should be satisfied that the new build or refurbishment work has been conducted in line with the requirements of the Water Efficiency Plan. If the model wording described in Actions 3A to 3C has been applied, this information should be presented as part of the handover / project completion process.

8.5 Minor works and similar building types

Where the opportunities for water efficiency are likely to be similar from project to project, such as a programme of minor works or volume house building, it may be more effective to develop a standard specification rather than requiring a Water Efficiency Plan in every instance. If a model specification is developed, it should be regularly reviewed against evolving levels of efficient and highly efficient practice.

9.0 Model wording for appointing a facilities manager

As part of their responsibility for maintaining a building, facilities managers have an important role to:

- ensure that water is not wasted because of poor maintenance or management;
- benchmark and report performance to the property manager, building owner or tenants; and
- advise on opportunities to reduce water use through retrofit measures, bringing forward replacement of poorly performing fittings and appliances, introducing water efficient fittings and associated plumbing as part of the planned refurbishment cycle, and taking action to influence the behaviour of building occupants.

This model wording addresses the selection and appointment of facilities management providers. It may also be possible to include the clauses when FM contracts are up for review. For existing buildings, the client can ask their FM provider to develop a Water Efficiency Plan; in the case of new build projects, the FM provider should take over and refine the Plan resulting from the design and construction phases. The Plan may form part of the FM provider's Environmental Management System.

In some FM contracts, the facilities manager is responsible for water saving/management, whereas in others the client retains responsibility for monitoring water use and identifying remedial/proactive actions.

Tenant/lease requirements should also be consistent with client/FM provider requirements.

9.1 Policy and target stage

9.1.1 Action 1D: Facilities Management Brief

Facilities Management Brief – wording on water efficiency

As part of our commitment to reducing environmental impacts, we require that all of our buildings use water as efficiently as possible. Our targets for water use in [*insert building type / our portfolio*] are to achieve average annual use of [*insert target, e.g. X m³ per m² Net Lettable Area per year, X m³ per FTE / resident / visitor / person per year, or X litres per person per day*] by [*insert date*] [and/or a X% reduction in use relative to 20xx].

We expect our Facilities Manager and their maintenance teams to play a proactive role in helping us to reduce potable water use and minimise the carbon emissions from the supply of hot water. This will include working with us to:

- understand our major sources of water use and the opportunities for reducing use and associated energy use through improved management, metering, benchmarking, and retrofitting or replacement of specific fittings, controls and appliances;
- develop [*or, where a new build Plan exists, refine the existing*] an operational Water Efficiency Plan (or equivalent) that includes:
 - management actions and investment priorities for:
 - reducing water use through management and maintenance of water-consuming fittings and appliances;
 - reducing use through targeted replacement or retrofitting of fittings or appliances;
 - reducing use by raising awareness of water efficiency and encouraging responsible water use; and
 - generating, storing and supplying hot water efficiently;
 - a financial case for action based on the estimated capital and lifecycle costs of any work required and the value of reduced water and energy use. Consideration should be given to the timing of any investment so that it matches existing plans for expenditure. The Facilities Manager should identify circumstances where bringing forward expenditure would demonstrate improved value for money in comparison to retaining the existing facility;
 - SMART (i.e. Specific, Measurable, Achievable, Relevant and Time-based) targets for reducing water use and associated carbon emissions; and
 - a timetable for review and updating the Plan to reflect trends in actual performance and available technologies;
- implement actions and investments in line with the agreed Plan;

- ensure that water-using fittings, appliances, controls, pressure/flow regulation and monitoring systems are adequately maintained and work safely and in line with their design performance;
- (*where appropriate*) ensure that any systems for the capture, storage, treatment and supply of rain or grey water are maintained and serviced in line with the manufacturer's instructions and by appropriately qualified professionals;
- check for and respond promptly to, identified leaks or malfunctions;
- monitor potable water use in line with the following metrics
 - volume of potable water consumed – m³ per year;
 - occupancy – number of full-time-equivalent occupants (*commercial spaces*), number of visitors (*retail, leisure or public spaces*), number of residents (*housing*)²⁵;
 - Net Lettable Area (NLA, m²)²⁶;
- report performance on an [monthly/quarterly/annual] basis, against the following key performance indicators
 - potable water use – m³ per occupant, visitor or resident (*as appropriate*) per year, or m³ per m² NLA per year, or litres per person per day;
 - reduction in water use – % change in use relative to the previous year²⁷;
- if requested, provide evidence to substantiate reported use, for example in the form of utility bills or readings from a building management system;
- report water efficiency to building occupants highlighting the potential for improvement (e.g. with reference to past performance, design expectations, corporate targets and sector benchmarks), and identifying consequent actions to change patterns of use;
- propose and implement actions to resolve any increases in use that are not attributable to changes in occupancy.

9.2 Handover, Post-completion and Use

9.2.1 Action 4B: Facilities Manager tendering

Pre-Qualification Questionnaire (PQQ) and Invitation to Tender (ITT)

PQQ questions

These questions probe the general capability of a Facilities Manager to prepare and implement a plan for water efficiency.

As part of our commitment to reducing environmental impacts, we require that all of our buildings use water as efficiently as possible.

Our targets for water use in [*insert building type / our portfolio*] are to achieve average annual use of [*insert relevant targets from Facilities Management Brief*]. Further detail is provided in the Facilities Management Brief.

1. Detail your understanding, experience and achievements in cost-effectively minimising hot and cold water use in buildings.

²⁵ Some buildings will contain a mix of uses (e.g. office / staff areas and public spaces such as retail floors). In this instance, benchmarking should be based on the dominant use type (if clear) or independently for each type of space if each use is significant.

²⁶ The Green Property Alliance has published advice on sustainability metrics for commercial property. They recommend using m² of Net Lettable Floor Area as the default denominator when normalising indicators, as occupancy-based indicators can be problematic and therefore less reliable as a basis for benchmarking.

²⁷ This KPI is useful for buildings in use, provided the analysis takes account of changes in occupancy.

2. Detail your understanding, experience and achievements in communicating the importance of water efficiency to building occupants and catalysing changes in behaviour.
3. Detail your understanding and experience in developing Water Efficiency Plans (or equivalent) that provide a robust forecast of water use together with defined and costed proposals for achieving high standards of water efficiency without compromising value for money.
4. *[If relevant]* Detail your understanding and experience in managing water harvesting and reuse systems so that they operate efficiently and safely.

An ideal PQQ response would provide the following details:

- evidence of having achieved reduced water use in buildings using effective management, behavioural change and appropriate replacement / retrofitting;
- evidence of understanding how water is used in buildings and the influence of occupant behaviour on use; and how unnecessary use can be minimised through design (e.g. push taps) and through awareness raising (i.e. the correct use of dual flush toilets);
- evidence of having prepared improvement strategies and cost-benefit analysis in relation to water efficiency; this might include development and management of ISO14001 certified processes; and
- *[if question 4 is used]* evidence of understanding the key management requirements of water harvesting or reuse systems, ideally with examples of having previously managed these technologies (although many providers will not currently have done so, as their use in the UK is relatively rare at present).

ITT wording

These clauses ask Facilities Managers to explain how they will forecast end-use water consumption, identify and prioritise actions to reduce cold and hot water use, and assess the net costs and benefits of water-efficient fittings and appliances as part of their FM strategy.

As part of our commitment to reducing environmental impacts, we require that all of our buildings use water as efficiently as possible.

Our targets for water use in *[insert building type / our portfolio]* are to achieve average annual use of *[insert relevant targets from Facilities Management Brief]*. Further detail is provided in the Facilities Management Brief.

Please describe your approach to:

1. helping us achieve our target for operational water use; and
2. preparing a Water Efficiency Plan (or equivalent) in line with requirements set out in the Facilities Management Brief.

Please identify any factors that you believe to be significant to the cost-effective achievement of the water efficiency targets set for this building/portfolio.

An ideal ITT response would provide the following details:

- a commitment to developing and implementing a Water Efficiency Plan that achieves the client's corporate targets;
- commentary on the key issues to be addressed in relation to the building / portfolio in question, which might include identifying the major sources of water use and suggesting measures by which water could be saved;
- evidence of a clear method for prioritising and targeting actions so that quick win opportunities are rapidly secured and a focused medium-term plan is put in place to implement efficiency measures at the appropriate time in the building's maintenance cycle; and
- information on how and when information will be provided to the client and their representatives to demonstrate that the Water Efficiency Plan has been implemented and to provide information against the agreed KPIs.

9.2.2 Action 4C: Facilities Manager appointment

The Facilities Management (FM) Provider will work with [*company name, department*] to plan and implement a suitable Water Efficiency Plan (or equivalent) and report on performance in line with our targets for water use in [*insert building type / our portfolio*] – which are to achieve average annual use of [*insert target, e.g. X m³ per m² Net Lettable Area per year, X m³ per FTE / resident / visitor / person per year, or X litres per person per day*] by [*insert date*] [and/or a X% reduction in use relative to 20xx].

Preparation of the Water Efficiency Plan

The Contractor will prepare a Water Efficiency Plan [*or, where a Plan exists, refine the existing Water Efficiency Plan*]. This will include:

- assessment of key sources of water use based on metered water use and analysis of the fittings and appliances in place;
- identification of the opportunities for reducing water use and associated energy use through improved management, pressure/flow regulation metering, retrofitting or replacement of specific fittings, controls and appliances;
- management actions and investment priorities for:
 - reducing water use through management and maintenance of water-consuming fittings and appliances;
 - reducing use through targeted replacement or retrofitting of fittings or appliances;
 - reducing use by raising awareness of water efficiency and encouraging responsible water use; and
 - generating, storing and supplying hot water efficiently;
- a financial case for action based on the estimated capital and lifecycle costs of any work required and the value of reduced water and energy use. Consideration should be given to the timing of any investment so that it matches existing plans for expenditure. The facilities manager should identify circumstances where bringing forward expenditure would demonstrate improved value for money in comparison to retaining the existing facility;
- SMART (i.e. Specific, Measurable, Achievable, Relevant and Time-based) targets for reducing water use; and
- a timetable for review and updating the plan to reflect trends in actual performance and available technologies.

Standards for water-using fittings

We require that replacement fittings and appliances achieve, as a minimum, [efficient practice levels as set out in the table below / standards defined by XXX *e.g. the Bathroom Manufacturers Association Water Efficient Product Labelling Scheme, Government Buying Standards, or the AECB Water Standards*].

[Where appropriate, insert a table of water efficiency practice levels for components here, for example using values from Table 1 in this guidance document as illustrated below.]

Fitting/appliance	Water use practice level (at pressures up to 5 bar)
Shower (mixer)	≤8 l/min
Shower (electric)	≤6 l/min
WC	≤4.5 l/flush (single flush or effective flush)
Urinal	≤3 l/bowl/hour during building occupancy with user-presence activated flush, 0 l/hour outside of occupancy and activation period, with minimal water use in maintenance
Tap (basin)	≤6 l/min
Tap (kitchen)	≤8 l/min
Bath	≤180 l capacity excluding body mass within the bath
Washing machine	≤9 l/kg dry load
Dishwasher	≤0.7 l/place setting

Implementation of the Water Efficiency Plan

The FM Provider will work in line with the measures agreed in the Water Efficiency Plan (and any agreed revisions thereof). This will include:

- implement water efficiency actions and investments in line with the agreed plan;
- ensure that water-consuming fittings, appliances, controls, pressure/flow regulation and monitoring systems are adequately maintained and work safely and in line with their design performance; *[NB. Where appropriate, the client should commit to providing building systems information provided by the new build contractor or previous landlord or FM contractor.]*
- (where appropriate) ensure that any systems for the capture, storage, treatment and supply of rain or grey water are maintained and serviced in line with the manufacturer's instructions and by appropriately qualified professionals; and
- check for, and respond promptly to, identified leaks or malfunctions.

Monitoring and reporting

The FM Provider will:

- report *[monthly/quarterly/annually]* (within *[2]* weeks of the end of the reporting period) the total potable water consumed by each facility, together with the following key performance indicators:
 - potable water use – m³ per occupant per year, or m³ per m² NLA per year, or litres per person per day;
 - reduction in water use – % change use relative to the previous year;
- if requested, provide evidence *[bills / Building Management System output]* to substantiate reported use *[or, where appropriate, the client should commit to providing utility bills to the FM Provider];*
- propose and implement actions to address any increases in use that are not attributable to changes in occupancy; and
- report water efficiency to building occupants highlighting the potential for improvement and identifying consequent actions to change patterns of use.

Review of the Water Efficiency Plan

The FM Provider will review the Water Efficiency Plan for each facility in line with the timetable specified in the Plan, and identify the need for revisions to the Plan to reflect performance, changes in occupancy and use patterns, and the availability of new technologies and systems.

Revisions to the Plan must be agreed in writing before implementation.

Where the appointed FM Provider needs to appoint a subcontractor (such as a specialist plumbing and heating contractor) to undertake work associated with the delivery of the Water Efficiency Plan, the model wording included in Section 8.3.3 (Action 3C) can be used.

Appendix A: Water efficiency requirements in building regulations and environmental assessment tools

1.0 Regulatory requirements

1.1 Building Regulations – England & Wales

In April 2010, Part G of the Building Regulations was amended to contain a new provision for water efficiency in domestic new build construction (or where there is a material change in use of a building). Note that these requirements do not apply to the refurbishment of existing dwellings. The overarching requirement for low water consumption is referenced to a standard calculation method which focuses on the performance of a defined set of fittings and appliances²⁸.

*Part G – Sanitation, Hot Water Safety and Water Efficiency - 17K – (1):
The potential consumption of wholesome water by persons occupying a dwelling to which this regulation applies must not exceed 125 litres per person per day calculated in accordance with the methodology set out in the document "The Water Efficiency Calculator for New Dwellings".*

Currently, no requirements for water efficiency exist for non-domestic buildings in England and Wales.

1.2 Water Supply (Water Fitting) Regulations 1999

"The Water Fittings Regulations (or Byelaws 2000 in Scotland) are national requirements for the design, installation and maintenance of plumbing systems, water fittings and water-using appliances. Their purpose is to prevent misuse, waste, undue consumption or erroneous measurement of water and, most importantly, to prevent contamination of drinking water. They replace the former Water Supply Byelaws which each water supplier had administered for similar purposes for many years.

Since 1 July 1999 in England and Wales, and 4 April 2000 in Scotland, all plumbing systems, water fittings and equipment have come under these regulations. This applies to systems in all types of premises. The regulations apply from the point where water enters the property's underground service pipe. Premises without a public water supply connection are not governed by these regulations."²⁹

These regulations set threshold performance standards for the fittings and installations (such as the maximum allowable stored volume of a toilet cistern). However, they do not impose requirements for the overall water efficiency of a building. **For domestic dwellings, the new Part G standard will require some fittings to be more water efficient than the regulatory minimum.**

Table A1 (below) identifies the water consumption levels defined in the Regulations.

²⁸ The 125l pppd maximum level includes 120l pppd internal to the dwelling and 5l pppd externally.

²⁹ Extract from The Water Regulations Advisory Scheme (WRAS): www.wras.co.uk/PDF_Files/WRAS%20Regs%20leaflet.pdf

Table A1: Current standards for water consumption

Water fitting	Water Supply (Water Fittings) Regulations
Single flush WC	Maximum 6 l/flush
Dual/reduced flush WC	Lesser flush must not exceed two-thirds of the larger flush volume
Retrofit flush device	
Single stall urinal	Manual or automatically operated pressure flush must not deliver more than 1.5 litres per bowl each time the device is operated. Automatic flush system must not deliver more than 10 litres per hour for a cistern serving a single urinal.
Multi stall urinal	Automatic flush system must not deliver more than 7.5 litres per hour per urinal bowl or stall
Basin taps	Minimum flow rates, no criteria for maximum flow rate
Kitchen taps	Minimum flow rates, no criteria for maximum flow rate
Shower	More than 12 l/min requires notification to the water supply undertaker
Bath	Notify water undertaker if installing bath with a capacity of 230 litres or more
Washing machine	27 litres per kilogram of washload (48 litres per washer drier). This is considerably higher than is achievable with modern machines.
Dishwasher	4.5 litres per place setting (domestic)
Plumbing: pipe lengths	Water consumption element not considered
Plumbing: pressure reduction	Water consumption element not considered
Plumbing: rainwater harvesting	Not specified. However, designs incorporating non-potable supplies must demonstrate that these are in line with relevant standards (e.g. BSI standard for rainwater harvesting).
Water meter	Not specified
Leak detection equipment	Not specified

2.0 Environmental assessment tools³⁰

2.1 Code for Sustainable Homes

The Code for Sustainable Homes sets out a national standard for the development of new dwellings – assessed against 9 categories of sustainable design – one of which is water use. The assessment provides buildings with a rating from Levels 1 (low) to 6 (high). Government has set a minimum threshold of Level 3 for all publicly-funded construction (as a funding requirement).

Five credits are available for water efficiency (Wat 1, with a further credit relating to external water use in Wat 2). These are based on a whole house assessment of the efficiency of internal fittings and are measured using the methodology set out in “The Water Efficiency Calculator for New Dwellings” (i.e. the same as that used for compliance with Part G2 of Building Regulations). Credits are awarded as below.

Water consumption (litre/person/day)	Credits	Mandatory levels
<120	1	Levels 1 and 2
<110	2	
<105	3	Levels 3 and 4
<90	4	
<80	5	Levels 5 and 6

2.2 BREEAM – non domestic

The BREEAM suite of accreditation standards includes variables for different building types. However, central to these is a common approach. BREEAM Offices 2008 is used to illustrate the principles below; however, BREEAM schemes other than Offices 2008 do not include overall potable water consumption benchmarks as available credits.

There are various credits available for water in BREEAM Offices:

Water consumption

- Credits available = 3
- Available “where evidence provided demonstrates that the specification includes taps, urinals, WCs and showers that consume less potable water in use than standard specifications for the same type of fittings.”
- Credits assessed using BREEAM Water Calculator Tool
- Benefits achieved through grey water recycling – assessed using above tool
- The credits are awarded as follows:
 - 1 credit where consumption is 4.5 - 5.5 m³ per person per year
 - 2 credits where consumption is 1.5 - 4.4 m³ per person per year
 - 3 credits where consumption is <1.5 m³ per person per year
- Evidence required:
 - design – specification, drawings and output from BREEAM Water Consumption Tool
 - post-construction – photographs and manufacturer’s information on products supplied.

There is a **mandatory requirement that at least one credit is achieved for water consumption** to achieve any BREEAM rating above a Pass. To achieve an Outstanding rating, at least two credits must be achieved in this category.

Water metering

- Credits available = 1 (although an innovation credit is available for sub metering and linkage to Building Management System)

³⁰ Abridged from text prepared by WRAP and Davis Langdon

- Available “*where evidence provided demonstrates that a water meter with a pulsed output will be installed on the mains supply to each building/unit.*”
- Evidence required:
 - design – specification
 - post-construction – assessor’s report showing location and type.

Leak detection

- Credits available = 1
- Available “*where evidence provided demonstrates that a leak detection system is specified or installed on the buildings water supply.*”
- Evidence required:
 - design – specification or manufacturer’s information
 - post-construction – assessor’s report showing location and set up.

Sanitary supply shut-off

- Credits available = 1
- Available “*where evidence provided demonstrates that proximity detection shut-off is provided to the water supply to all toilet areas.*”
- Evidence required:
 - design – specification plus drawing showing location of facilities
 - post-construction – assessor’s report showing location of controls and as-built drawings showing controls.

2.3 DREAM

The Ministry of Defence’s Defence-Related Environmental Assessment Method (DREAM) addresses environmental performance for four types of facilities:

- hangars and workshops;
- kitchen and dining facilities;
- living accommodations; and
- commercial space.

Building performance may be assessed through four stages of the building’s life cycle:

- survey;
- design;
- construction; and
- operation.

With respect to water consumption, the DREAM rating system relies on a varying number of yes/no questions related to industry best practice, such as the use of dual-flush toilets, presence of rainwater harvesting, water metering, etc. These questions are first addressed during design stage, and are followed through for the construction and operational assessment stages. Questions in the DREAM rating system are very similar to BREEAM credits; however the answers are mostly yes/no and hence the calculation of overall score is a lot simpler than for BREEAM. Rating levels are as follows:

- Pass 25%;
- Good 40%;
- Very Good 55%; and
- Excellent 70%.

2.4 LEED

LEED is an alternative assessment methodology developed in the US by the US Green Building Council. It differs in approach to BREEAM, but at its core still applies a common principle of credits for specific mitigation measures resulting in a score that returns a rating from certified (low) to platinum (high). As LEED is US-based, measurement is often in imperial metrics (US gallons, PSI).

There are 4 categories that address water:

- Water Use Reduction – prerequisite;
- Water Efficient Landscaping – 2–4 points;
- Innovative Wastewater Technologies – 2 points; and
- Water Use Reduction – 2–4 points.

Water Use Reduction (prerequisite)

This is achieved by developing a design that uses 20% less than a baseline building. The baseline is calculated by applying defined water efficiency rates for different fittings (e.g. 1.6 gallons per flush for a commercial toilet) matched to estimated occupancy rates. This is therefore achieved by using fittings that are, on average, 20% more efficient than the baseline figures quoted.

Water Efficient Landscaping

- Option 1 (2 points) – achieved by reducing the use of potable water for irrigation by 50% compared to a baseline; or
- Option 2 (4 points) – eliminating the use of potable water for irrigation either through water capture systems or through avoidance of need for irrigation.

Innovative Wastewater Technologies

This focuses on reducing wastewater generation and reducing potable water demand. Again, there are two options:

- Option 1: Reduce potable water for building sewage by 50% either by low-flow fittings or use of grey water etc; or
- Option 2: Treat 50% of waste water to tertiary standards on site for infiltration or reuse.

Water Use Reduction

This allows additional credits by further reducing water consumption beyond 20%. The thresholds and available points are as below.

Percentage reduction	Points
30%	2
35%	3
40%	4

Appendix B: Principles of water efficiency

1.0 Monitor and manage current system

Effective management of water consumption involves:

- ensuring that the installed fittings are operating at their potential design level (flow rate, pressure etc);
- identifying and eliminating leaks;
- working with building occupants to encourage responsible use; and
- regularly reviewing the potential to improve performance by retrofitting or replacing specific components.

Effective monitoring and investigation of changes in use are key to being able to manage water effectively, enabling problems to be addressed quickly and providing feedback to users on the impacts of their behaviour.

Water use is best monitored using water meters which are compatible with building / water management systems (i.e. they have a pulsed output). Submetering of different areas can provide further resolution on performance, e.g. by differentiating performance by floor or between office areas and catering facilities. This additional detail can be a powerful influence on behaviour as it provides specific tenants or groups of users with feedback on the direct impact of their activities.

Monitoring performance over time and against comparative buildings requires the use of standard metrics and KPIs. For those organisations which have an interest in a property post-construction, the key performance measure will be the actual, in-use consumption of potable water. However, it is also useful to estimate/predict design stage performance, as this can be compared against design benchmarks, and enables compliance with procurement requirements to be assessed.

The following metrics and KPIs are consistent with the most widely-adopted buildings assessment and benchmarking tools:

- metrics:
 - volume of potable water consumed – m³ per year;
 - occupancy – number of full-time equivalent occupants (commercial spaces), number of visitors (retail leisure or public spaces), number of residents (housing)³¹;
 - Net Lettable Area or NLA (m²);
- Key Performance Indicators:
 - potable water use – m³ per occupant per year, or m³ per m² NLA per year, or litres per person per day³²; and
 - reduction in water use – % change in use relative to the previous year³³.

These metrics can be used to assess either design stage or actual performance. However, care should be taken to ensure that design stage and operational performance benchmarks are not combined.

Comparison of actual performance with the design potential is beneficial in helping to understand whether a) fittings and appliances are using water in line with expectations, or b) the design stage assumptions about usage were incorrect and should be reviewed for future projects.

³¹ Some buildings will contain a mix of uses (e.g. office / staff areas and public spaces such as retail floors). In this instance, benchmarking should be based on the dominant use type (if clear), or independently for each type of space if each use is significant.

³² For new projects at the design stage, the targeted value of the KPI can be compared to the performance using baseline practice fittings.

³³ This KPI is primarily relevant to buildings in use, and the calculation would need to take account of changes in occupancy. Property developers could also track improvements in design-stage consumption over time.

2.0 Reduce consumption by using water-efficient technologies

Table 1 (Section 5.1) and Appendix C demonstrate the potential to achieve significant reductions in use for each of the major water-consuming components of buildings.

3.0 Minimise water heating

Carbon emissions from heating domestic hot water are five times greater than for water treatment and supply. Significant cost and environmental savings can be realised by reducing demand for hot water, by heating water as efficiently as possible, and by reducing heat losses in storage and distribution.

'Domestic' hot water use is largely linked to the use of taps, showers and baths, therefore steps taken to reduce use in these areas will have more significant benefits because of the value of the associated energy and carbon savings.

In addition to cutting hot water demand, the following further steps will help to optimise the efficiency of a building's hot water system:

- **Generation** – the efficiency of the hot water system together with its fuel source will have a significant impact on the cost and carbon emissions associated with hot water supply. In most buildings (particularly housing) the hot water source is linked to the strategy for space heating. Table B1 provides a summary of some of the advantages and drawbacks of different approaches. There are efficiencies in providing centralised hot water systems. However, for buildings with large footprints or multi-building sites, the costs and heat losses from distribution may mean that localised hot water systems are the preferred option.
- **Storage** – hot water storage should be well insulated and sized appropriately; oversized water storage will result in additional heat loss.
- **Distribution** – minimising the extent of distribution piping and losses from the system will save energy/carbon needed to heat water and will also reduce water wastage from 'run off' of cooler water when usage is infrequent. Where distribution distances are significant, localised generation may be preferable. Careful system design and use of insulated pipes will minimise distribution losses.
- **Controls** – time and temperature controls should be commissioned to respond to building occupation.

System	Advantages	Drawbacks
Gas-fired boilers	<ul style="list-style-type: none"> ■ New boilers have efficiencies of over 90% ■ Highly responsive to heating demand ■ Currently have lower cost and carbon emissions per kWh than electrical systems 	<ul style="list-style-type: none"> ■ Less flexible in location because they require both a gas supply and flue ■ Typically require more maintenance than electrical systems (but less than biomass)
Electrical heating	<ul style="list-style-type: none"> ■ Highly efficient (close to 100%) and can be located more flexibly ■ Can provide instantaneous hot water in areas of low demand 	<ul style="list-style-type: none"> ■ Electricity is currently more expensive and has higher carbon emissions per kWh than gas ■ Slower response times when demand for hot water is too high for instantaneous heating.
Biomass / biofuels	<ul style="list-style-type: none"> ■ Low / zero carbon emissions ■ A renewable energy source thereby helping to meet planning requirements 	<ul style="list-style-type: none"> ■ Space requirement for fuel storage ■ Slower response times ■ Flue height may be significant for larger systems ■ Higher maintenance costs ■ Production of some liquid biofuels has its own environmental impact

System	Advantages	Drawbacks
Solar hot water systems	<ul style="list-style-type: none"> ■ Provides 'free' hot water even on cloudy days ■ Low / zero carbon emissions ■ A renewable energy source thereby helping to meet planning requirements 	<ul style="list-style-type: none"> ■ Requires a hot water store (i.e. a cylinder) and physical connection between the collection area (typically the roof) and the store ■ Hot water generation may not be well matched to peak demand ■ Additional maintenance costs (as the system is additional to rather than a replacement for conventional systems)

Table B1: Overview of different options for hot water generation

The design of a heating and hot water system will be specific to the design, size and use of the building in question. Asking your design team to prepare a Water Efficiency Plan (see Section 6) will provide you with confidence that the approach proposed is suitable.

4.0 Replace potable water where practicable

Greywater (water from showers, sinks and baths) and rainwater can be used for flushing toilets, irrigation of gardens/greenspace and for other purposes where potable water is not essential. The effectiveness of systems using greywater and rainwater is dependent on:

- **the availability of 'replacement' water** – for rainwater systems, this depends on the roof area and average rainfall, while for greywater it reflects the extent and usage of the fittings from which water is collected;
- **storage capacity** – this influences the proportion of the replacement water that can be used;
- **distribution network** – rain and greywater must be distributed separately from potable water with a further requirement for piping to transport the collected grey/rainwater to the store; and
- **usage of the fittings consuming the rain/greywater** – higher usage allows more of the available water to be used with a smaller storage vessel. It is also important that grey or rain water is used regularly to minimise storage time.

Rainwater systems are typically most cost-effective on buildings with large roof areas but with relatively densely packed service cores, e.g. a distribution warehouse. This is because a significant quantity of water can be collected and the costs of distribution are relatively low. Even where the quantity collected is insufficient to meet the demand for flushing WCs, it would still have uses for e.g. vehicle washing and irrigation.

Greywater systems are more effective in buildings that generate a reasonably high level of greywater (e.g. they include showers) and where the water distribution systems are compact with little horizontal distribution, e.g. multi-storey office buildings with vertically stacked washrooms. Systems are more effective where the quality of greywater is appropriate to its use (so that treatment is minimised), and the volume produced is similar to the volume used (to minimise issues with storage of e.g. soapy water).

Businesses can use the Government's Enhanced Capital Allowances scheme to reduce the impact of the initial investment cost of greywater and rainwater systems.

Appendix C: Levels of practice for water efficiency

This Appendix summarises the suggested practice levels of water efficiency for fittings and appliances (identified previously in Table 1), and the basis for these values.

We have used the following terminology for classifying the water efficiency levels of fittings and appliances:

- **baseline practice** – “fittings and appliances that meet legal requirements but do not offer appreciable water savings compared to others on the market”;
- **efficient practice** – “fittings and appliances offering reduced water consumption in comparison to baseline practice products, without materially impacting cost or performance for most types of use”; and
- **highly efficient practice** – “fittings and appliances offering reduced water consumption in comparison to efficient practice products, but which are not necessarily comparable in cost or performance”.

The practice levels are based on published industry-led targets and standards, and compliance with regulatory minimum requirements. Where published evaluation systems are incomplete, we have proposed new practice levels.

The practice levels refer to the consumption that water-using fittings and appliances can achieve technically. Where some specific performance measure is set (e.g. tamper proof), there are equally efficient fittings available. Likewise, where appliances are concerned, higher performance specifications for speed and capacity do not impact on the water efficiency level.

However, the more efficient practice levels may not be acceptable to users in certain applications (e.g. domestic use of showers), and the design team or FM provider would need to consider this when selecting components. Higher use by one component may be offset by installing a more efficient version of another component (e.g. taps) to achieve a whole-building target outcome. (However, if for example a power shower is installed and offset with efficient taps and WCs, the higher consumption of hot water will incur carbon and cost penalties not compensated by the lower use of cold water.)

The flow rate actually delivered by a fitting will be affected by water pressure, and can be adjusted using a flow or pressure regulator.

Recommendations

Table C1 summarises the practice levels of water efficiency and units of measure adopted for each appliance and fitting. The subsequent text provides further detail of the relevant industry-wide guidance and specific reasons behind our recommended set of levels. They have been set on the basis of technology and fittings that are currently available, and should therefore be reviewed on a regular basis to keep in step with ongoing product innovations.

The main sources of information on practice levels have been:

- the Bathroom Manufacturers’ Association (BMA) Water Efficient Product Labelling Scheme (WEPLS);
- the Association for Environment Conscious Building (AECB) Water Standards;
- the criteria³⁴ for the Water Technology List (WTL) for the Government’s Enhanced Capital Allowances (ECA) scheme, also used in the Government Buying Standards (GBS)³⁵; and
- data on water consumption used in the EU Energy Labelling Scheme.

³⁴ The WTL criteria may be revised annually.

³⁵ <http://www.defra.gov.uk/sustainable/government/advice/public/buying/products/construction/index.htm>

Table 1 in Section 5.1 identifies potential constraints on the acceptability of higher practice levels in certain applications.

Table C1: Practice levels of water efficiency in fittings and appliances

Fitting / appliance	Schemes on which proposed practice levels are based	Baseline practice	Efficient practice	Highly efficient practice
Shower	AECB, GBS, WEPLS and WTL	12 l/min ³⁶	≤10 l/min domestic ≤8 l/min domestic	≤6 l/min
Shower (electric)	Proposal based on advice from Waterwise and Energy Saving Trust	8 l/min	≤6 l/min	≤6 l/min
WC (effective flush ³⁷)	AECB, GBS, WEPLS and WTL	6 l/flush	≤4.5 l/flush	≤3.5 l/flush
Urinal	Proposal based on available technologies, Entec micro-component modelling and GBS/WTL criteria	1.5 l/bowl/use 7.5 l/hour during building occupancy period (or 10 l/hour) for single bowl) 0 l/hour otherwise with minimal water use in maintenance	3 l/bowl/hour maximum during building occupancy with user-presence activated flush 0 l/hour outside of occupancy and activation period, with minimal water use in maintenance	0 l/hour with minimal water use in maintenance
Tap (basin)	AECB, GBS, WEPLS and WTL	Up to 12 l/min	≤6 l/min	≤4 l/min
Tap (kitchen)	AECB, WEPLS and WTL	12 l/min	≤8 l/min	≤6 l/min
Bath	WEPLS	200 l capacity excluding body mass within the bath	≤180 l capacity excluding body mass within the bath	≤155 l capacity excluding body mass within the bath
Washing machine	EU Energy Labelling Scheme and advice from Waterwise and Energy Saving Trust	10 l/kg dry load	≤8.5 l/kg dry load	≤7 l/kg dry load
Dishwasher	EU Energy Labelling Scheme	1.2 l/place setting	≤1.0 l/place setting	≤0.7 l/place setting

³⁶ For showers and taps, flow rate refers to the maximum value measured at operating pressures up to 5 bar.

³⁷ The Government's Enhanced Capital Allowances scheme defines the "effective flush" of a dual-flush action WC as the mean consumption of one full flush and three reduced flushes.

Fitting / appliance: Shower

Practice levels: Adapted from the WTL, AECB and WEPLS criteria with consideration to Water Fitting Regulations.

Reason for levels adopted: The baseline level of 12 l/min is in line with the Water Fittings Regulations (which require written approval from the water undertaker for a pump or booster to provide over 12 l/min), and is also consistent with information in the WEPLS.

The efficient practice level of 10 l/min for domestic use is adapted from the WTL and WEPLS criteria (both at 9 l/min), taking account of user acceptance. Calculations indicate that a 10 l/min shower in combination with other fittings still allows Level 3 and 4 in the Code for Sustainable Homes to be met.

The efficient practice level of maximum 8 l/min for non-domestic use is based on the GBS and AECB criteria.

The highly efficient practice level of 6 l/min is achievable without incurring significant additional costs, and matches the GBS and AECB best practice standards. The BMA web site carries a link to such products. There are also various products on the market, including automated shut-off devices, which can be included with standard shower head fittings to meet additional performance needs (such as perceived shower experience and use time) in domestic or high-intensity use. Aeration devices and innovative spray patterns may enhance the perceived performance / user satisfaction at a given flow rate.

Fitting / appliance: WC

Practice levels: Based on the WEPLS (efficient practice set at 4.5 l per effective flush, very efficient practice 3.5 l or less) and the GBS, WTL and AECB good and best practice criteria.

Reason for levels adopted: The levels adopted for WCs are based on the "effective flush" of the device, therefore giving a standard approach for both standard WCs and those with a reduced flush device (e.g. hippo bag) or dual-flush capacity. Most systems are now dual-flush with many products on the market available to meet the criteria.

The baseline practice (6 l per flush) is compliant with the Water Regulations Advisory Scheme (WRAS) and is therefore deemed the minimum outcome.

The efficient practice level of 4.5 l effective flush can be met by single-flush and dual-flush devices and helps meet Levels 3 and 4 of the Code for Sustainable Homes.

The highly efficient practice level of 3.5 l effective flush is lower than the criterion set for the Water Technology List (WTL) while remaining affordable and achievable. This practice level is taken from the WEPLS and GBS and is supported by numerous products available in the market place incurring no or low additional costs. Through discussions with a product manufacturer, we understand the majority of the fittings are suitable for both domestic and non-domestic environments.

Low volume single-flush toilets, with an inlet pressure compensating valve, may more appropriate in public buildings than dual-flush toilets. Also, the plumbing system must be capable of working with lower flows (which is a particular consideration when retrofitting or refurbishing existing buildings).

Fitting / appliance: Urinal

Practice levels: Proposal based on available technologies, Entec micro-component modelling and WTL/ criteria.

Reason for levels adopted: Water use by the urinals available on the market is widely dependent on an integrated water supply and control system, which takes account of variables (e.g. frequency of use of each unit and occupancy periods of the building) to maintain hygiene levels in a range of use environments.

It is common for urinal systems to provide a maximum water use per hour per stall in continuous use scenarios. If this water use is continuous, with no controls to account for building occupancy periods or use, usage can

waste vast volumes of water. A set flush frequency of 7.5 litres per hour (and a maximum of 1.5 l/bowl/flush) with no user intervention, but active only over a defined occupancy period, will comply with regulations and WTL criteria and represents the baseline practice level.

The introduction of a user-based intervention (for instance an infra-red sensor) is recommended at efficient practice to prevent unnecessary flushing. For highly efficient practice, a waterless urinal device can be used with negligible water for cleaning, although this may be inappropriate where frequency of use is high (e.g. in schools and sports venues). Flushes and water use for maintenance purposes in low use periods and for waterless urinals are not considered in the practice level, but may need to be considered when estimating total water use in specific buildings.

The water efficiency practice levels proposed mean that an estimate of daily water use needs to take into account the technology, use frequency and periods of occupation.

Fitting / appliance: Tap (basin)

Practice levels: 6 l/min for efficient practice based on WTL and AECB good practice, and 4 l/min for highly efficient practice based on AECB best practice and WEPLS. Practice levels consistent with GBS.

Reason for levels adopted: We have used the range of WEPLS levels, adapted at efficient practice level to 6 l/min. The highly efficient practice level defined is based on available technology (e.g. under WEPLS) and the AECB best practice standard.

The minimum design requirement from the Water Fitting Regulations for a mixer tap is 4.2 l/min (based on 70% of the 6 l/min capacity of standard taps) and this is reflected in the highly efficient practice level. Other factors also need to be considered when using these standards, such as how hot water is supplied (from a tank or from an immersion heater), as this will also impact on the minimum design flow rates.

Fittings are available such as infrared sensors or push tap fittings to activate / deactivate the taps thus preventing user errors (i.e. accidentally leaving a tap running), and devices to further reduce the flow volume through fittings such as spray taps. Two-stage taps offer an intermediate setting with reduced flow rate. The WEPLS details many types of taps which can be fitted with various types of fittings (e.g. infrared, standard turn and push fittings for non-domestic use), but still able to meet the practice levels.

Given the great variety of taps on the market, and the range of strategies available to manufacturers to tailor the flow rate of any given tap design to the requirements of the specifier, developers and specifiers should talk to tap manufacturers regarding the best solutions for water-efficient plumbing systems to fit the purpose.

AECB proposes 4 l/min or less (per pillar tap or per mixer outlet) for best practice, with a water brake, spray or some other means of ensuring that default flow is lower. The Standard also suggests considering single lever taps that deliver cold water only when in central (default) position. An easily fitted 6 l/min regulator or regulated outlet should be provided as an option so that users can fit this if the lower flow rate is not sufficient. This is to discourage users simply removing the original regulator.

Fitting / appliance: Tap (kitchen)

Practice levels: The efficient practice level of 8 l/min is supported by the AECB, whilst the highly efficient practice level of 6 l/min is promoted by the WEPLS and WTL. However, the Government Buying Standard is lower at 5 l/min.

Reason for levels adopted: Water use in kitchens is more often related to volume required (e.g. filling kettles, pans, cleaning equipment) rather than duration (e.g. handwashing, teeth cleaning etc). The lower flow rates of basin taps are less likely to be accepted for kitchen use. Therefore the suggested practice levels are higher for kitchen taps than for basin taps. Rinsing practice may require flow rates ranging from a slow trickle to a short rapid blast, depending on the application.

AECB proposes 6 l/min or less for best practice, with a water brake, spray or some other means of ensuring that default flow is lower. The Standard also suggests considering single lever taps that deliver cold water only when

in central (default) position. An easily fitted 8 l/min regulator or regulated outlet should be provided as an option so that users can fit this if the lower flow rate is not sufficient.

Fitting / appliance: Bath

Practice levels: Based on the WEPLS and AECB.

Reason for levels adopted: We have adopted practice levels detailed within the WEPL Scheme (185/170/155 l) and the AECB level of 180 l. We advise caution, however, as different manufacturers specify maximum volume using different calculation methods.

Bath operational volume is measured to the bottom of the overflow with only water in the bath, but some manufacturers provide bath volume data assuming someone in the bath. Bath efficiency is governed by the size and shape of the bath, and bath actual water usage would be dependent on the users.

We have adopted levels based on operational volume for consistency. These data can be obtained from the manufacturer and product specifications giving an effective volume.

There are numerous products available on the marketplace (and detailed within the BMA web site) which meet the baseline, efficient and highly efficient practice levels without incurring significant cost. Ergonomically-shaped baths are generally more acceptable than either short and/or shallow bath tubs.

Fitting / appliance: Washing machine

Practice levels: EU Energy Labelling Scheme – information published by Waterwise 2007, and advice from Waterwise and the Energy Saving Trust.

Reason for levels adopted: The EU Energy Labelling Scheme provides a consistent measure for water used per washing cycle for each appliance based on a standardised wash setting (cottons, 60°C full load cycle). In order to be able to compare different appliances in a consistent, like-for-like manner, the volume of water per cycle needs to be normalised against the washing machine capacity (quoted in kg). This gives the recommended practice level figures of litres/kg. Total water use in a building can be determined by estimating the average mass of washing load per person per day.

The Waterwise washing machine spreadsheet has been used as a starting point for finding products which meet the practice levels. The levels have been set with a mean level based around the Code for Sustainable Homes water calculator's assumed water usage of 8.17 l/kg. Highly efficient practice levels are taken from the same spreadsheet with over 45 products in 2007 providing 7 l/kg or under. The spreadsheet uses the data detailed on the product's Energy Label.

Fitting / appliance: Dishwasher

Practice levels: EU Energy Labelling Scheme – information published by Waterwise 2007

Reason for levels adopted: From reviewing the available appliance product data sheets, we have recommended the use of the Energy Labelling Scheme for the practice levels, with baseline, efficient and highly efficient practice levels at 1.2, 1.0 and 0.7 litres per place setting respectively.

There is no industry-recognised system of ratings for water use as there is for the energy efficiency of appliances. The Energy Labelling Scheme however, details the water used per cycle. This does not form part of the A to E rating scheme but appears as an item on the Energy Label to help inform decisions. Total water use in a building can be determined by estimating the average number of place settings per person per day.

Like-for-like comparisons can be obtained by detailing the litres of water used per cycle. This will need to be normalised by the number of place settings capacity which that particular appliance can accommodate.

Appendix D: Whole-building benchmarks for water use – guideline values

This Appendix provides indicative benchmarks to inform efficiency initiatives. As explained previously, actual usage for commercial buildings may vary significantly from benchmarks for valid reasons such as visitor usage patterns. These site-specific reasons will become apparent if you are actively comparing your water use with similar buildings on an ongoing basis, and you can then amend your target accordingly.

Determining the correct target for new and existing buildings depends on their type; for example, Table D1 identifies levels of water use defined in current rating schemes, while Table D2 estimates the range of “designed-in” practice levels in different types of building. For other building types, it may be necessary to develop a bespoke benchmark using estimated usage factors (e.g. using the Water Efficiency Calculator for New Dwellings), or to review monitored data to understand water consumption in the buildings in question.

Project type	Target	Comments
New build / refurbishment		
Housing	105 litres per person per day 80 litres per person per day (lpppd) (design levels)	These targets reflect the minimum requirements of the Code for Sustainable Homes at levels 3&4 and 5&6 respectively. The target of 105 lpppd can be achieved solely through the use of highly water-efficient fittings and appliances while the lower target of 80 lpppd is likely to require the use of either a grey water recycling system or rainwater harvesting.
Offices	4.5 - 5.5 m³ per person per year 1.5 - 4.4 m³ per person per year <1.5 m³ per person per year (design levels, equivalent to thresholds of 12-15, 4-12, <4 lpppd)	These targets reflect the thresholds for 1 to 3 credits awarded under the BREEAM Offices 2008 scheme. For any BREEAM rating (above Pass), it is necessary to achieve less than 5.5 m ³ per person per year, while for an Outstanding rating consumption must be reduced below 4.4 m ³ per person per year. It is possible to reduce consumption to below 4.4 m ³ per person per year through the use of water-efficient fittings and appliances; however, reducing consumption to below 1.5 m ³ per person per year will typically require the use of either a grey water recycling system or rainwater harvesting.
In use		
Public	Reduce water consumption by 25% (office and non-office estate) by 2020, relative to 2004/05 levels	This target for Sustainable Operations on the Government Estate aims to reduce consumption through replacement of inefficient fittings and controls and effective management, and by raising awareness of water efficiency in Government offices and other buildings. The target will be updated after FY2010/11.

Table D1: Targets for water efficiency in current environmental rating schemes

Table D2 provides benchmark values for the “designed-in” levels of water efficiency that could be achieved in new buildings, based on modelling the water fittings and anticipated patterns of demand for water.

The benchmarks are categorised as follows:

- **standard practice** – “consumption typical of buildings fitted with current baseline practice fittings and appliances”;
- **enhanced practice** – “consumption typical of buildings where a majority of fittings and appliances would be classified as efficient (on average)”;
- **leading-edge practice** – “consumption typical of buildings where a majority of fittings and appliances would be classified as highly efficient, and where additional measures are taken to minimise and substitute demand for potable water”.

The benchmarks can be achieved using different combinations of component practice levels (although some combinations will have a higher carbon and energy cost). For example, enhanced building practice could be achieved using fittings both above and below the “efficient practice” level of consumption. The building-level design outcome (illustrated in Table D2) can be calculated as a weighted average across the different fittings and their patterns of use.

Building type	Standard practice	Enhanced practice	Leading-edge practice
New offices (excluding canteen) (litres/person/day)	41	27 Assumes taps and shower have flow rates below efficient practice, but dishwasher has baseline consumption	8 Assumes highly efficient fittings, with 75% of flush demand met by rainwater harvesting
Schools (litres/pupil/day, 190 days per annum)	21 without pool 26 with pool	14 to 20 (without/with pool) Lower consumption levels may be achieved through rainwater harvesting, but ultra low volume fittings are not recommended in schools.	
Hotels (room only, excluding staff use, pool, laundry and restaurant) (litres/room/day)	110	98 Assumes 6/4 l dual flush WCs and low flow basin taps, offsetting a full-sized bath and high flow rate shower	58 Assumes 4.5/2.5 l dual flush WCs, with 75% of flush demand met by rainwater harvesting; 10 l/min shower
Museums/libraries/courts etc (litres/m ² floor area/day)	Approximately 1 litre per m ²	Less than 1 litre per m ²	
New retail buildings (visitor use, excluding restaurant) (litres/person/day)	5.2	3.7 Assumes 6/4 l dual flush WCs and autoflush urinals	2.5 Assumes 4.5/2.5 l dual flush WCs, with 75% of flush demand met by rainwater harvesting; waterless urinals
New cinemas and theatres (excluding bar and kiosk) (litres/seat/day)	5.9	4.3 Similar to retail except for urinal flushing frequency/activation	1.1 Similar to retail except for urinal flushing frequency/activation
New pubs, clubs, bars (bar only, excluding restaurant) (litres/person/day)	8.5	6.9 Similar to retail except for urinal flushing frequency/activation	0.9 Similar to retail except for urinal flushing frequency/activation

Table D2: Calculated benchmarks for water-efficient design outcomes in different types of new build project³⁸

³⁸ Values calculated by Entec using detailed micro-component modelling

Appendix E: Water use behaviour

Occupant behaviours play a significant role in the total water and energy use of a building. Tables E1 and E2 outline some simple water efficiency actions that can be communicated by facilities managers and companies to help educate staff and save water.

Table E1: Simple generic water use tips for facilities managers to communicate to building occupants

Faulty equipment	<ul style="list-style-type: none"> Report any water fittings which appear faulty such as constantly running urinal cisterns, WC overflows, storage tank or warning pipe overflows, dripping taps and showers or any potential source of waste observed throughout the site.
Shower	<ul style="list-style-type: none"> Just one minute less in the shower each day can save up to £10 a year on gas bills and a further £15 on water bills, for each person.
Taps	<ul style="list-style-type: none"> Don't leave taps running when preparing vegetables. Don't leave the taps running when you're cleaning the kitchen area, or using the bathroom such as when brushing your teeth. Use cold water wherever possible – for example, rinse plates in cold water instead of hot water, as this helps to save energy bills. A dripping tap wastes around 5,500 litres of water a year. Turning off the tap to stop the drips could save £10 a year.
Washing machine	<ul style="list-style-type: none"> Choose the eco setting or lowest temperature setting when using the washing machine. Washing clothes at 30 degrees rather than higher temperatures will save around £10 on energy bills.
Dishwasher	<ul style="list-style-type: none"> Wait until you have a full load before turning on the dishwasher. This saves water and energy by doing fewer loads. Scrape all food wastes into the food waste bin instead of rinsing the dishes.

Table E2: Simple actions for facilities managers

WC	<ul style="list-style-type: none"> Ensure that staff understand how a dual flush toilet works, and understand the difference in flush volumes.
General	<ul style="list-style-type: none"> Include simple water efficiency policies and procedures in staff induction and training programmes. Display charts/information about water and energy savings related to specific measures in the toilets and kitchen. Provide staff with water usage updates once a year (possibly including updates of savings in other areas such as waste, energy, paper and carbon emissions). Send water-saving ideas and progress reports to staff in newsletters, emails and bulletins. Establish an ideas box to share water-saving and general sustainability ideas across the workplace.

Appendix F: Sources of further information

Sources of advice on good practice include:

- WRAP's / Zero Waste Scotland's Envirowise programme (<http://envirowise.wrap.org.uk/uk/Topics-and-Issues/Water.html> and www.envirowise-scotland.org.uk/water);
- Waterwise (www.waterwise.org.uk and www.water-efficient-buildings.org.uk);
- Energy Saving Trust (www.energysavingtrust.org.uk/water);
- Bathroom Manufacturers' Association (www.water-efficiencylabel.org.uk);
- Association for Environment Conscious Building (www.carbonlite.org.uk/carbonlite/waterstandards.php);
- Government Buying Standards (www.defra.gov.uk/sustainable/government/advice/public/buying/products/construction/index.htm);
- Construction Industry Research and Information Association, CIRIA (www.ciria.org);
- Business Link (www.businesslink.gov.uk) including www.businesslink.gov.uk/wtl; and
- Environment Agency (www.environment-agency.gov.uk/business/topics/water/32040.aspx and www.netregs.gov.uk/netregs/89554.aspx).

Envirowise publications include:

- EN662 "Understanding leaks, water pressure and meters";
- EN895 "A guide to developing a water balance";
- EN934 "Developing an action plan to reduce water usage: five simple steps";
- EN663 "Reducing water use in washrooms: showers";
- EN664 "Reducing water use in washrooms: taps";
- EN665 "Understanding water and waste water bills";
- EN666 "Reducing water use in washrooms: urinals";
- EN667 "Reducing water use in washrooms: WCs"; and
- EN896 "Reducing mains water use through rainwater harvesting".

Waterwise publications include:

- "Water efficient buildings: a design guide for developers"; and
- "Water efficiency in new developments: a best practice guide".

Other public sector resources include:

- the water efficiency calculator for new dwellings, available at www.communities.gov.uk/publications/planningandbuilding/watercalculator;
- Energy Saving Trust water energy calculator for homes, available at <http://www.smarter-driving.com/watercalculator/flashcalculator>; and
- "HTM 07-04: Water management and water efficiency – best practice advice for the healthcare sector", available via www.spaceforhealth.nhs.uk.

Information on water-efficient products is available at:

- the Water Technology Product List of the Enhanced Capital Allowances water scheme (www.businesslink.gov.uk/wtl);
- the Bathroom Manufacturers' Association Water Efficient Product Labelling Scheme (www.water-efficiencylabel.org.uk); and
- the Waterwise Marque product lists and brochures (www.waterwise.org.uk).

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