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# Water Key Performance Indicators and benchmarks for offices and hotels

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# Summary

With the increasing requirement to safeguard water supplies in the UK and implement sustainable water use, managers of offices and hotels need to know what the indicators are of national trends and what benchmarks are appropriate for their buildings.

This report describes a study that has used data from a number of water companies to establish the ranges of usage at present and to set benchmarks for better practice. It will enable managers to understand whether their office or hotel is performing well or poorly in comparison with other similar buildings in the UK. Guidance is provided on actions that can be taken to reduce usage. It will also inform designers about target usage and will be of value to those who wish to carry out similar benchmarking studies and future researchers.

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Waggett, R; Arotsky C

*CIRIA*

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# Acknowledgements


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**Steering group** Following CIRIA's usual practice, the research project was guided by a Steering Group which comprised:

| | | |
|---|---|---|
| **Chair** | Martin Osborne | Ewan Group<br>(formerly Earth Tech Engineering) |
| **Members** | Darren Cook | Hilton Hotels Group |
| | David Calderbank | Environment Agency |
| | Alan Daw<br>(*previously Sue Craddock*) | Thames Water |
| | Nigel Foster | Bournemouth and West Hampshire Water |
| | Meyrick Gough<br>(*previously Magda Styles*) | Southern Water |
| | Gordon Hall | Dwr Cymru |
| | Adrian Jackson-Robbins<br>(*previously Lawrence Mbugwa*) | Davis Langdon Consultancy (for DTI) |
| | Ian Newberry | Three Valleys Water |
| | Clare Ridgewell<br>(*previously Sarah Bowerman*) | Essex and Suffolk Water |
| | Sue Roaf | Oxford Brookes University |
| | Martin Shouler | Arup (formerly BRE) |
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| | Alastair Wright | Scottish Water Solutions<br>(formerly East of Scotland Water) |

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# Executive summary

Increasingly, there is a requirement to safeguard water supplies in the UK and implement sustainable water use. Practitioners working to advise the office and hotel sectors on reductions in water consumption had identified a lack of suitable benchmarking information that would allow a simple method of comparing the water consumption of a particular property with national trends.

This report describes how suitable benchmarks have been found for water use in offices and hotels across England and Wales that will enable managers to understand whether their property is performing well or poorly in comparison with other similar buildings in the UK. It will also inform designers about target usage.

This detailed report should be read by those who are interested in how the research was carried out, or who wish to carry out similar benchmarking studies. It also includes details of the information gained by the research team that may be of use to future researchers.

**Guidance reports**

For those who do not require the detail in this report, the benchmarks and some guidance to assist improvement in water consumption have been provided in separate guidance reports freely available to download from the internet:

W10 – *Key Performance Indicators for water use in hotels*
**www.ciria.org/downloads/01/w010.pdf**

W11 – *Key Performance Indicators for water use in offices*
**www.ciria.org/downloads/01/w011.pdf**

CIRIA encourages wide dissemination of these guidance reports.

The Key Performance Indicator chosen for hotels is **cubic metres of water per bedspace per annum**. Although the occupancy rate for the hotel is the main defining factor for water consumption, it was found that few small and medium sized hotels (the main target of this research) have the facility to easily collect guest night information. Subsequently, bedspaces were used as a proxy.

The analysis showed a major correlation between the "star" rating of the hotel and the water consumption. However, "star" rating is a voluntary exercise and many hotels choose not to have "star" ratings. In this case they have been grouped as "other" hotels.

Key Performance Indicators for offices have been provided both for water consumption in **cubic metres per person per year**, and **cubic metres per square metre per year.** Occupancy was again thought to be the main determinant of water consumption, but it was recognised that occupancy can be a difficult and ambiguous figure to find for a typical office building. The alternative was to define a KPI based on floor area, recognising that this is not as accurate a measure, but one that can be readily determined.

Suitable benchmarks have been compiled from this research project for office and hotel buildings across the UK. However the available data was limited and CIRIA and the sponsoring water companies hope that by making the data available with this report (see the attached CD-ROM at the back of the book), others will be able to build on the current research and refine the proposed benchmarks.

# CONTENTS


Summary . . . . . 2
Acknowledgements . . . . . 3
Executive summary . . . . . 5
List of figures . . . . . 7
List of tables . . . . . 8
Glossary . . . . . 9

**1 Introduction and background . . . . . 10**
1.1 The project need . . . . . 10
1.2 Who should read this report? . . . . . 11
1.3 Guidance report . . . . . 11
1.4 Definitions of benchmarking and Key Performance Indicators . . . 11

**2 Summary of key points . . . . . 13**
2.1 Summary of proposed benchmarks and Key Performance Indicators . . . . . 13
2.1.1 Summary of hotels sector . . . . . 13
2.1.2 Summary of offices sector . . . . . 14
2.2 Further work/lessons learned . . . . . 15
2.2.1 Further work. . . . . 15
2.2.2 Lessons learned . . . . . 16

**3 Methodology . . . . . 18**
3.1 Developing the Key Performance Indicators . . . . . 19
3.2 Obtaining data . . . . . 20
3.3 Data manipulation and cleaning . . . . . 21
3.4 Benchmarks . . . . . 21
3.5 Analysis . . . . . 21
3.6 Lessons learned . . . . . 22
3.6.1 Obtaining and cleaning water company data . . . . . 22
3.6.2 Correlation between benchmarks . . . . . 24

**4 Benchmarking hotels . . . . . 25**
4.1 Water use in hotels . . . . . 25
4.1.1 Thames Water . . . . . 25
4.1.2 Welsh hotels water demand management . . . . . 26
4.1.3 International Hotels Environment Initiative (IHEI) . . . . . 26
4.2 Defining a Key Performance Indicator . . . . . 26
4.3 Other water consumption variables . . . . . 28
4.4 Obtaining data . . . . . 29
4.4.1 Separating data into water company areas. . . . . 29
4.5 Hotel data analysis . . . . . 30
4.5.1 Initial correlation and aggregated analysis. . . . . 31

4.5.2 Dividing hotels into types for further analysis . . . . . 32
4.6 Hotel water consumption by star rating . . . . . 34
4.7 Hotel water consumption by star rating and presence of swimming pool . . . . . 35
4.8 Hotels with swimming pools by category . . . . . 38
4.9 Recommended hotel benchmarks . . . . . 42
**5 Benchmarking offices . . . . . 46**
5.1 Water use in offices . . . . . 46
5.1.1 Thames Water . . . . . 46
5.1.2 Government estate. . . . . 47
5.1.3 Watermark . . . . . 47
5.2 Defining a Key Performance Indicator . . . . . 47
5.3 Other water consumption variables . . . . . 48
5.4 Obtaining data . . . . . 49
5.5 Office data analysis (floor area) . . . . . 50
5.6 Office data analysis (occupancy) . . . . . 51
5.6.1 The method of calculating personnel numbers. . . . . 53
5.6.2 The type of building used in the research. . . . . 54
5.7 Recommended office benchmarks . . . . . 55
**7 References . . . . . .56**

## Figures

Figure 3.1 Project methodology . . . . . 18
Figure 4.1 Chart showing frequency distribution of water consumption per bedspace for consumption in 2002 . . . . . 32
Figure 4.2 Chart showing frequency distribution of water consumption for hotels with swimming pools for consumption in 2002 . . . . . 33
Figure 4.3 Chart showing the frequency distribution of water consumption per bedspace for those hotels without swimming pools for 2002 . . . . . 33
Figure 4.4 Water consumption of hotels up to three star rating . . . . . 34
Figure 4.5 Water consumption of four and five star hotels . . . . . 34
Figure 4.6 Chart showing frequency distribution of water consumption per bedspace for “other” category hotels . . . . . 35
Figure 4.7 Frequency distribution of water consumption ($m^3$) per bedspace for category 1 hotels . . . . . 36
Figure 4.8 Frequency distribution of water consumption ($m^3$) per bedspace for category 2 hotels . . . . . 37
Figure 4.9 Frequency distribution of water consumption ($m^3$) per bedspace for category 3 hotels. . . . . 38
Figure 4.10 Frequency distribution of water consumption ($m^3$) per bedspace of hotels with no stars and with swimming pools. . . . . 39
Figure 4.11 Chart showing frequency distribution for water consumption per bedspace for hotels with no star and with no swimming pool for consumption in 2002 . . . . . 39
Figure 4.12 Chart showing frequency distribution for water consumption per bedspace for hotels with one star and no swimming pool for consumption in 2002 . . . . 40

Figure 4.13 Chart showing the frequency distribution of water consumption in hotels with two or three stars with swimming pool for consumption in 2002 . . . . . 40
Figure 4.14 Chart showing frequency distribution of water consumption per bedspace for hotels with two or three stars without a swimming pool for consumption in 2002 . . . . . 41
Figure 4.15 Chart showing frequency distribution of water consumption per bedspace for hotels with four or five stars and a swimming pool for consumption in 2002 . . . . . 41
Figure 4.16 Chart showing frequency distribution of water consumption per bedspace for hotels with four or five stars and no swimming pool for consumption in 2002 . . . . . 42
Figure 4.17 Chart showing benchmarks for each category of hotel without pools . . 43
Figure 4.18 Chart showing benchmarks for each category of hotel with pools . . . 43
Figure 4.19 Chart showing CIRIA benchmarks for hotels with pools against Thames Water study benchmarks. . . . . 44
Figure 5.1 Chart showing frequency distribution for consumption by floor area . . 51
Figure 5.2 Chart showing frequency distribution for consumption per total employee. . . . . 52

## Tables

Table 2.1 Benchmarks for hotels with swimming pools . . . . . 13
Table 2.2 Benchmarks for hotels without swimming pools . . . . . 14
Table 2.3 Benchmarks for offices . . . . . 14
Table 3.1 Preferred sample size for analysis . . . . . 20
Table 3.2 Standards of water usage for benchmarking . . . . . 21
Table 4.1 Thames Water hotels benchmarks . . . . . 25
Table 4.2 Water companies and hotels allocated to each . . . . . 30
Table 4.3 Hotel sample sizes . . . . . 31
Table 4.4 Overall hotel water usage . . . . . 32
Table 4.5 Benchmarking outputs for hotels . . . . . 42
Table 4.6 Recommended benchmarks for hotels with swimming pools . . . . . 44
Table 4.7 Recommended benchmarks for hotels without swimming pools . . . . 45
Table 5.1 Thames Water study outputs for offices . . . . . 46
Table 5.2 Water companies and offices allocated to each . . . . . 50
Table 5.3 Recommended benchmarks for offices by floor area . . . . . 51
Table 5.4 Recommended benchmarks for offices by employee numbers . . . . . 53
Table 5.5 Table showing comparison of proposed benchmark and other research benchmarks . . . . . 53
Table 5.6 Recommended combined office benchmarks . . . . . 55

# Glossary

| | |
|---|---|
| **Benchmark** | The "best in class" level of performance achieved for a specific business process or activity. It is used as a reference for comparison in benchmarking. |
| **Co-efficient of determination** | See R-squared value below. |
| **Correlation co-efficient** | See R-squared value below. |
| **Histogram analysis tool** | This analysis tool calculates individual and cumulative frequencies for a range of data and data bins. It generates data for the number of occurrences of a value in a data set. A histogram table presents the chosen boundaries and the number of scores between the lowest bound and the current bound. The single most frequent score is the mode of the data. |
| **Key Performance Indicator (KPI)** | The measure of performance associated with an organisation's activity or process. This information provided by a KPI can be used to determine how an organisation compares with the benchmark and is therefore a key component in an organisations move towards best practice. |
| **R-squared value** | Also known as the **coefficient of determination** or the **correlation coefficient.** An indicator that ranges in value from 0 to 1 and reveals how closely the estimated values for the trendline correspond to actual data. A trendline is most reliable when its R-squared value is at or near 1. |
| **Regression line** | See trendline. |
| **Trendline** | A graphical representation of the trend or direction of data in a series. Most valuable when at or near to 1. |
| **Net Internal Area (NIA)** | A common figure used to represent commercial space that excludes core and plant (non-lettable) space. Also known as Net Lettable Area (NLA). |

# 1 Introduction and background

This report summarises an approach to find suitable benchmarks for water use in offices and hotels across the UK. The aim is to enable managers of offices and hotels to understand whether their property is performing well or poorly in comparison with other similar buildings in the UK, and to inform designers about target usage.

## 1.1 The project need

The project need was identified from the increasing requirement to safeguard water resources and supplies in the UK and implement sustainable water use. Practitioners working to advise the office and hotel sectors on reductions to water consumption had identified a shortage of useful data. In particular there was a lack of suitable benchmarking information facilitating a simple method of comparing the water consumption of a particular property with national trends.

Similar information is available for energy use in offices and other buildings, and is regularly used at both the design and operation/management phases of buildings to identify whether action is required. The aim of this project was to provide similar data for water consumption which is accessible for use by interested parties including property managers, owners and operators.

The objectives of this project were to:

- collate and analyse existing data and information that is representative of UK water use
- provide facility managers, building engineers and designers with Key Performance Indicators (KPIs) from which benchmarks for water efficiency in domestic, commercial and hotel environments can be set
- help improve water efficiency and encourage the sustainable use of water within buildings
- set up and manage a network of stakeholders – including developers, engineers, regulators, water utilities, government and consumers – to share information and disseminate guidance to end users
- make recommendations for further work.

These original objectives included the production of a KPI for commercial buildings which would include factory buildings. However this was modified following discussion with the project steering group at an early stage, given that factory process use is difficult to predict and already adequately covered by Envirowise guidance information[1]. Non-process use would be essentially office based and could be dealt with by the provision of an office benchmark from this project.

It was also originally intended to include residential use within the study, but the availability of data for the residential element proved extremely problematic and it was agreed that the study should analyse just the hotels and offices sectors. These sectors are described in detail in this report.

## 1.2 Who should read this report?

This project report provides a detailed summary of the project methodology and results, and should be read by those who want to understand how the research was carried out, or wish to carry out similar benchmarking studies. This document also includes details of the lessons learned by the research team that it is felt will be of considerable use for future research.

The questions raised by the study will not only be of interest to those involved in benchmarking for water consumption, but many of the lessons learned are also applicable to energy benchmarking, or those involved in any type of benchmarking in the offices and hotels sectors. It is hoped that by considering these issues while planning future benchmarking studies, many of the difficulties experienced during this project can be overcome by future researchers.

This report contains the following principal sections:

**Section 2: Summary of key points;** summarises the main points of the study and the findings, including lessons learned.

**Section 3: Methodology;** outlines the method followed by the research team and the reasons for the methodology chosen, where appropriate. Describes the process of KPI development and how data was obtained and analysed. A more detailed discussion of lessons learned is also included.

**Section 4: Benchmarking hotels;** describes the approach taken to produce information on water consumption in hotels including details of published and unpublished studies that helped to inform the research team. Proposes benchmarks for hotels and outlines the suggested split of hotels into typologies to assist benchmarking.

**Section 5: Benchmarking offices;** describes the approach taken to produce benchmarks for offices including a review of benchmarks currently utilised in the offices sector. The process of obtaining and analysing data is described, and proposed benchmarks explained.

## 1.3 Guidance reports

For those who do not require the detail in this report, the benchmarks and some guidance to assist improvement in water consumption have also been provided as separate guidance for hotels and for offices. It is intended that the content of the guidance reports can be used by third parties within specifications, guidance documents and information leaflets, for example, and therefore wide dissemination is encouraged. Further guidance can be found in the CIRIA publications *Rainwater and greywater use in buildings. Decision-making for water conservation* (D Leggett *et al*, 2001), *Rainwater and greywater use in buildings. Best practice guidance* (D Leggett *et al* 2001) and *Sustainable water management in land use planning* (P Samuels *et al*, 2005).

The guidance reports can be downloaded from the internet at:
**www.ciria.org/downloads/01/w010.pdf** and **www.ciria.org/downloads/01/w011.pdf**

## 1.4 Definitions of benchmarking and Key Performance Indicators

Benchmarking involves comparing and measuring performance against others in key business activities and then using lessons learned from the best to make targeted improvements. It requires answering two questions – who is better and why are they better? With the aim of using this information to make changes that will lead to vital improvements.

Definitions of terms used within this report are contained in the glossary, but to aid understanding it is useful to define these two important terms at this point:

- a **Key Performance Indicator** (KPI) is the measure of performance associated with an activity or process. This information provided by a KPI can be used to determine how an organisation compares with the benchmark and is a key component in a move towards good practice. An example of a KPI used in this report is water consumption per employee per annum.
- a **benchmark** is a level of performance achieved for a specific business process or activity. It is used as a reference for comparison in benchmarking.

The distinction between Key Performance Indicators and benchmarks is that the KPI is the actual measure of performance whereas the benchmark is a target performance.

A CD-Rom accompanies this report which contains two excel files; one for data used in hotel analysis and the other for data in offices. All identifying information has been removed from this data following data protection requirements. However the structure of the data will enable it to be used for further analysis.

The remainder of this report discusses the results of the analyses currently performed.

# 2 Summary of key points

## 2.1 Summary of proposed benchmarks and Key Performance Indicators

### 2.1.1 Summary of hotels sector

The Key Performance Indicator for hotels was chosen as **cubic metres of water per bedspace per annum**. Previous studies described below found that occupancy of the hotel is the main defining factor for water consumption. It was determined that few small and medium sized hotels (the main target of this research) have the facility to easily collect guest night information (which would provide a more accurate KPI figure) therefore bedspaces were used as a proxy. More information on the selection of this benchmark is provided in Section 4.2. Cubic metres of water were used to enable easy comparison with bills.

The analysis determined that there was a significant correlation between the "star" rating of the hotel and water consumption. A concern with this system is that the star rating is a voluntary exercise and therefore many hotels do not have "star" ratings. In this case they have been grouped as "other" hotels, or those which are "undefined". The star ratings are also awarded for hotel facilities that will not affect water use, such as disabled facilities. Nevertheless a clear correlation was found and the benchmarks were defined for each of the four categories of hotel identified, as follows:

**Category 1:** 1 star rated establishments.

**Category 2:** 2 or 3 star rated establishments.

**Category 3:** 4 or 5 star rated establishments.

**Other:** Undefined establishments.

Further analysis determined that there was still at least one major factor unidentified, and the analysis indicated that this could largely be accounted for by sorting the data by the availability of a swimming pool at the hotel.

Benchmarks have been split into two distinct types: those with a pool and those without. They have further been split into the respective category of hotel. The benchmark figures shown below have also been rounded to provide ease of use.

**Table 2.1 Benchmarks for hotels with swimming pools**

| Category | Hotel rating | Benchmarks ($m^3$/bedspace/annum) | | |
|---|---|---|---|---|
| | | Best practice | Typical | Above average |
| Cat 1* | 1 star | 9 | 25 | 60 |
| Cat 2 | 2 or 3 star | 20 | 60 | 185 |
| Cat 3 | 4 or 5 star | 60 | 130 | 220 |
| Other | No rating | 40 | 90 | 170 |

* These figures have been derived as there were no category one hotels with pools

**Table 2.2 Benchmarks for hotels without swimming pools**

| Category | Hotel rating | Benchmarks ($m^3$/bedspace/annum) | | |
|---|---|---|---|---|
| | | Best practice | Typical | Above average |
| Cat 1 | 1 star | 5 | 10 | 15 |
| Cat 2 | 2 or 3 star | 10 | 20 | 50 |
| Cat 3 | 4 or 5 star | 15 | 30 | 65 |
| Other | No rating | 10 | 30 | 70 |

## 2.1.2 Summary of offices sector

The KPI for the offices sector was difficult to define. There was a conflict between two of the essential components of a KPI; namely the need for the information to define it being easily available and unambiguous, and the need to reflect the main defining factor of an office building. In this case, the main defining factor was thought to be occupancy, but for various reasons it was realised that this is a difficult and ambiguous figure to find for a typical office building. The alternative KPI was office floor area, but this is not as accurate a measure as occupancy. Further details of the pros and cons of each KPI are provided in Section 5.2.

It was decided that both indicators should be tested by analysis to see which was the more appropriate: **water consumption in $m^3$ per person per year** or **water onsumption in $m^3$ per square metre per year**. There was a preference for benchmarks to be stated in addition, as litres per day. To calculate the number of litres per day, a business year of 253 days was assumed, excluding weekends and bank holidays.

Analysis determined that both of these indicators had a strong correlation with the water consumption of the office buildings analysed, and both were suitable indicators. Analysis showed that there were no discernable additional factors that would need to be taken into account, and a single benchmark could be provided. Benchmarks were provided both by area and by total number of employees as shown in the table below. Where these could be verified, they compare favourably with previous research studies.

It was suggested that in order to provide appropriate guidance to the offices sector, it would be most useful to provide the typical benchmark only, encouraging facility managers to aim for a lower figure than this. This benchmark is highlighted in the table below.

**Table 2.3 Benchmarks for offices**

| | | Cubic metres per year | Litres per day (assuming 253 days per business year) |
|---|---|---|---|
| Typical use | By employee* | 4.0 $m^3$/employee/annum | 15.8 litres/employee/day |
| | By area | 0.6 $m^3/m^2$/annum | 2.4 litres/$m^2$/day |
| Best practice use | By employee* | 2.0 $m^3$/employee/annum | 7.9 litres/employee/day |
| | By area | 0.4 $m^3/m^2$/annum | 1.6 litres/$m^2$/day |
| Excessive use | By employee* | 7.0 $m^3$/employee/annum | 27.7 litres/employee/day |
| | By area | 0.8 $m^3/m^2$/annum | 3.2 litres/$m^2$/day |

* Total employee numbers should be used even if full time equivalent employee figures are available.

Note: Figures have been rounded to form more usable benchmark figures.