

# **REWARD**

*Regional and Welsh Appraisal of*

*Resource Productivity and*

*Development:*

*Key Industrial Environmental  
Pressures - Water Use*

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# 1 Introduction

The Environment Agency, the National Assembly of Wales (NAW) and a number of the Regional Development Authorities (RDAs) are working together to produce a quantitative tool for economic environmental modelling. The model requires input in the form of environmental information at the RDA/National level as well economic data. The environmental data that is being used in this model includes water use, waste arisings, energy use and emissions to air. The output of the model will then provide valuable support for local and regional agencies developing policies relating to sustainability as well as environmental protection.

The impetus for this work was the report presented by ECOTEC Research and Consulting Ltd<sup>1</sup> which described a two-phased approach to achieving the goal of creating an economic environmental modelling tool. Their recommendation was that a data gathering and analysis exercise would compile information on the four sectors above whilst a second stage would construct the modelling tool, using the gathered data as key input datasets.

The present report describes the compilation of the water use data for England and Wales. Water use was fundamentally divided into the two categories of household use and non-household use, i.e. industrial consumption. The industrial data was further disaggregated into sectoral use according to the definitions of the Standard Industry Classification System, SIC-92.

Water consumption data for this study was acquired from a variety of sources, as there is no single data source that covers all areas to the level of detail required. Sources of data included the Environment Agency, the Water Supply Companies WSC, The Office of Water Services OFWAT and The Government's Envirowise Initiative. Other statistics were employed to enable the distribution of the water consumption data across Wales and the English Regions. This information originated from the Office of National Statistics ONS in the form of regional population statistics and employment data derived from the Interdepartmental Business Register IDBR as well as from the Department for Environment, Food and Rural Affairs DEFRA.

The sections which follow detail the sources of the original data, how they were assessed, refined and then aggregated to RDA/National level. It should be noted that, for completeness, all RDAs and Wales are included in this study rather than only those currently subscribed to the WRERP project. This was decided to be the most appropriate course of action for several reasons - although primarily because it generated a complete dataset for England and Wales, other RDAs may choose to subscribe to the project in the future.

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<sup>1</sup> Regional and Welsh Economies Environmental Performance/Resource Productivity. Report E2-053 produced for the Environment Agency by ECOTEC Research and Consulting Ltd, August 2001.

# 2 Household Water Use

## 2.1 Methodology

Domestic water use data was made available for this project by the Environment Agency's National Water Demand Management Centre NWDMC. This dataset was compiled for the Agency's Water Demand Forecast Report<sup>2</sup>. It contains household consumption figures for the year 1997/1998 broken down into the following geographical areas;

- Water Supply Company Areas WCA
- Water Supply Company Resource Zones RZ

RZ are the internal boundaries used by the Water Supply Companies WSC to designate the areas that can be supplied from a set of sources. RZ therefore give greater detail on the spatial distribution of each WSC's total figure (allowing a more accurate aggregation of the numbers to a Regional Development Agency scale). It should be noted here however that there is a large variation in RZ size. For example, RZ can be small such as in North Wales and in South-East England, but can also be on the same scale as RDAs, as in the Midlands and North West of England.

Within the NWDMC data each RZ was attributed figures for both metered and unmetered water consumption, in ML/d<sup>3</sup>, along with associated population numbers.

- Unmetered Volume in ML/d - the volume of water supplied by the WSC in each RZ to properties which do not have a water meter.
- Unmetered Population figures - the number of people in the RZ who do not have a water meter fitted to their property who receive this specified volume of water.
- Metered Volume in ML/d - the volume of water supplied by the WSC in each RZ to properties which have a water meter.
- Metered Population figures - the number of people in a RZ who have a water meter fitted to their property who receive this specified volume of water.

However, as the above population figures have no distribution information associated with them (i.e. there is no data on the population distribution within the RZ), another source of population statistics was used. The most appropriate source was determined to be the ONS population distribution data<sup>4</sup>, which provides gridded population data at a 1km x 1km resolution.

First, the water volume data listed by RZ was spatially distributed according to the population distribution from the ONS. This generates a 1km x 1km resolution dataset, which indicates higher water use in cities and conurbations than in rural locations. Second, this dataset was spatially aggregated according to the RDA/National boundaries to give metered and unmetered totals for each RDA and Wales.

The intermediate 1km x 1km resolution data is not presented as a final dataset. Part of the reason for this is because this method of distributing the water use within each RZ assumes a spatially uniform split between metered and unmetered households. (It also assumes that measured and unmeasured households are of the same size, which is currently not true). It is unreasonable to assume that this holds across each 1km x 1km grid cell, and would therefore be misleading to present the data in this way. However, at the RDA/National level, suitably large areas are being used, and the differences at the 1km x 1km scale are likely to average out resulting in a small impact compared with other uncertainties.

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<sup>2</sup> Environment Agency "A Scenario Approach to Water Demand Forecasting"

<sup>3</sup> ML/d = megalitres per day, i.e. 1,000,000 litres per day, or 1,000m<sup>3</sup> per day.

<sup>4</sup> Generated from 1991 Census Data

The resulting datasets for each RDA and Wales are therefore;

- The volume of metered water used (ML/d) and the associated population figure.
- The volume of unmetered water used (ML/d) and the associated population figure.

The aim of the project is to deliver environmental datasets for 1999, and as these datasets were based on 1997/1998 data a correction was required. This involved a two-step process to incorporate:

- Changes in domestic water use arising from increases in population
- Increases in the number of metered households across England and Wales

For these two steps extra data was sourced from ONS on population statistics<sup>5</sup> and from OFWAT on the changes in the proportion of metered households<sup>6</sup>. It was assumed for this process that the average consumption of water per person would not change significantly over the intervening year and likewise the average consumption in metered and unmetered households would remain constant.

The average consumption per person is also known as the per capita consumption PCC. It equates to the average number of litres of water used per person per day and has been derived for this study from the two values of total RDA/National volume and population. This value in litres per head per day was calculated for both metered and unmetered properties to highlight the differences and potential water resource savings that can be made when using metered water. This is described in absolute terms of litres/head/day (L/h/d) and in relative percentage terms. An average PCC for each RDA and Wales was also calculated from the total volume and total population figures to place the metered and unmetered data in context. It must be borne in mind when looking at consumption *per household* however that the average occupancy in England and Wales in a metered house is 2.1 people, whereas in an unmetered household it is 2.6, the overall average for all households being 2.5.<sup>7</sup> The results from this process are shown below in Section 2.2.

Another method for correcting the data from 1997/1998 to 1999 was attempted initially, but proved to be unsuitable. Originally it was thought that using the original data at the RZ level would provide a greater degree of accuracy. However, this methodology proved unsuccessful due to discrepancies in the population datasets. This was particularly apparent for the smaller RZ, such as Capel Curig in North Wales. It was also evident that presenting the data by RZ would not be particularly useful due to the vastly different geographic sizes of the RZ across England and Wales<sup>8</sup>. Presenting the data at the RDA/National level was considered to be the most useful and robust way of delivering the household water use data.

A point to note is that domestic water use can be separated out from industrial use through company billing arrangements which identify the end user. This is especially evident in industry and business where nationwide some 94% of billed water use is metered<sup>9</sup>.

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<sup>5</sup> Wales Population Data: <http://www.statistics.gov.uk/statbase/Expodata/Spreadsheets/D4731.xls>  
England Population Data: <http://www.statistics.gov.uk/statbase/Expodata/Spreadsheets/D4724.xls>

<sup>6</sup> Metering Data: <http://www.ofwat.gov.uk/pdf/ofpdfinal.pdf>

<sup>7</sup> Office of Water Services "Leakage and the efficient use of water 2000-2001 report"

<sup>8</sup> E.g. there are many very small RZ in Wales and South East England, whereas East Anglia, the Midlands and the North of England comprise very large RZ in the main.

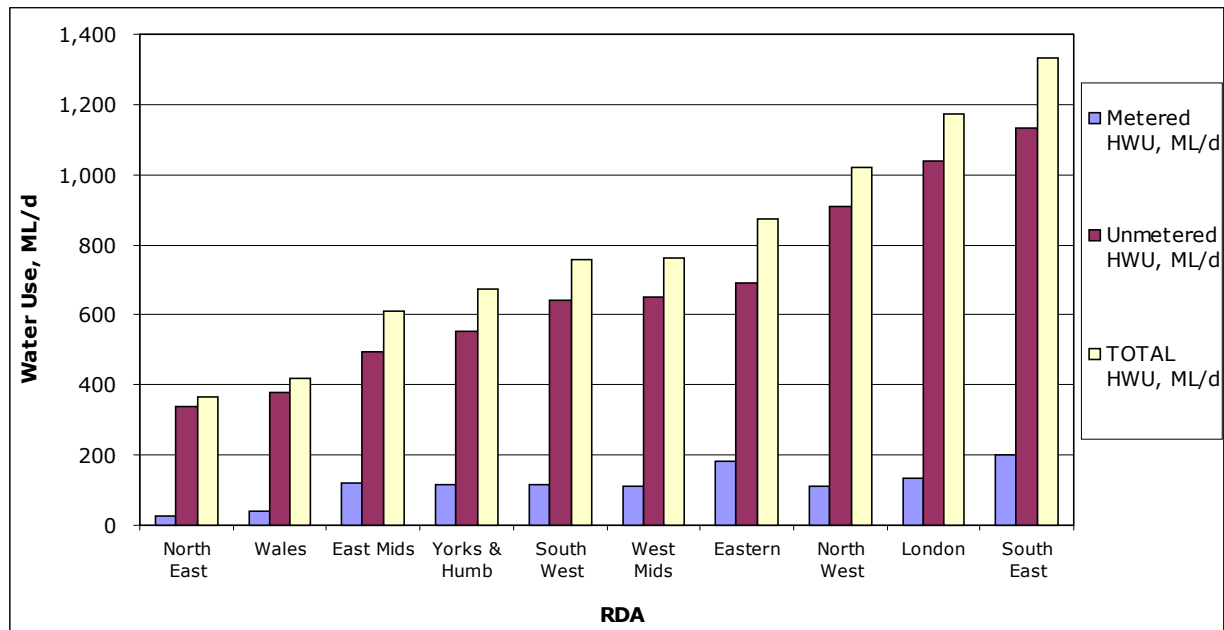
<sup>9</sup> Water Company Resource Plans, 1997/98, Environment Agency

## 2.2 Results

Table 1 and Figure 1 show the Metered and Unmetered Household Water Use by each RDA and Wales, given in megalitres per day after re-scaling from 1997/98 to 1999 for population growth and changes in the metering ratios. These volumes are household consumption i.e. they exclude supply pipe leakage.

RDA/Wales	1999 Metered HWU, ML/d	1999 Unmetered HWU, ML/d	1999 TOTAL HWU, ML/d
East Midlands	118.35	492.95	611.30
Eastern	184.07	689.71	873.77
London	131.73	1,039.80	1,171.53
North East	26.81	337.75	364.56
North West	111.49	910.54	1,022.03
South East	201.28	1,133.56	1,334.84
South West	117.01	640.88	757.89
Wales	40.61	380.49	421.11
West Midlands	111.03	653.06	764.10
Yorkshire & Humberside	117.54	554.03	671.58
TOTAL	1,159.93	6,832.78	7,992.71

**Table 1 . Metered and Unmetered Household Water Use, HWU, ML/d**



**Figure 1. Metered and Unmetered Household Water Use, HWU, ML/d**

On first inspection it appears that there is a disproportionate use of water in the Eastern, London, North West and South East RDAs, whereas the North East RDA and Wales have the lowest water consumption figures. This is simply due to the differing population numbers in these areas, as shown in Table 2. Similar to the water use figures these population data have been re-scaled from 1997/98 to 1999 for population growth and changes in the metering ratios.

<b>RDA/Wales</b>	1999 <b>Metered</b> Population	1999 <b>Unmetered</b> Population	1999 <b>TOTAL</b> Population <sup>10</sup>
East Midlands	850,198	3,340,802	4,191,000
Eastern	1,253,416	4,165,584	5,419,000
London	885,892	6,399,108	7,285,000
North East	207,323	2,373,677	2,581,000
North West	816,670	6,064,330	6,881,000
South East	1,304,504	6,773,496	8,078,000
South West	824,171	4,111,829	4,936,000
Wales	303,406	2,633,594	2,937,000
West Midlands	841,992	4,494,008	5,336,000
Yorkshire & Humberside	944,170	4,102,830	5,047,000
<b>TOTALs</b>	<b>8,231,741</b>	<b>44,459,259</b>	<b>52,691,000</b>

**Table 2. Metered and Unmetered Household Populations for each RDA and Wales**

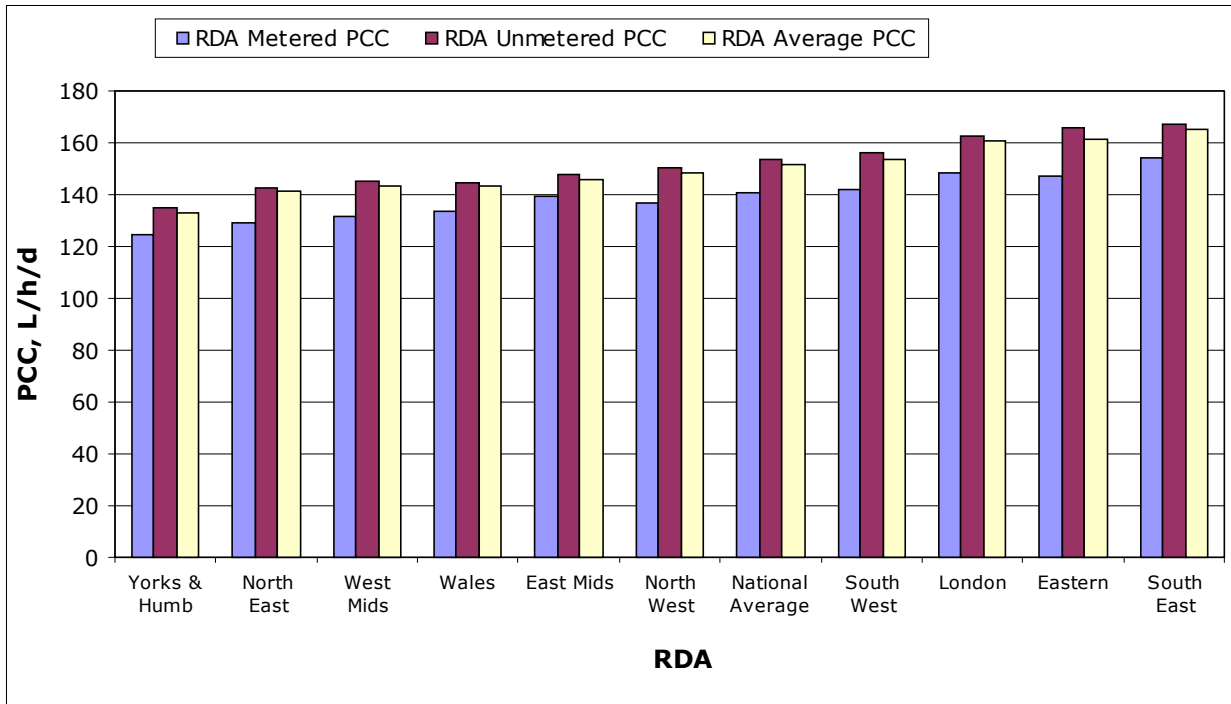
A more comparable way of presenting the water use figures is as Per Capita Consumption PCC denoted in Litres/head/day. Table 1 and Table 2 were used to calculate the PCC thus showing how it varies across England and Wales, giving an individual output for each RDA and Wales for metered, unmetered and average PCC, shown in Table 3. The National Average row is for England and Wales combined to provide an overall figure.

<b>RDA/Wales</b>	<b>Metered</b> PCC, L/h/d	<b>Unmetered</b> PCC, L/h/d	<b>Average</b> PCC, L/h/d	Difference between metered & unmetered, L/h/d	% Diff
East Midlands	139.2	147.6	145.9	8.3	5.7
Eastern	146.9	165.6	161.2	18.7	11.3
London	148.7	162.5	160.8	13.8	8.5
North East	129.3	142.3	141.2	13.0	9.1
North West	136.5	150.1	148.5	13.6	9.1
South East	154.3	167.4	165.2	13.1	7.8
South West	142.0	155.9	153.5	13.9	8.9
Wales	133.9	144.5	143.4	10.6	7.4
West Midlands	131.9	145.3	143.2	13.4	9.3
Yorkshire & Humberside	124.5	135.0	133.1	10.5	7.8
<b>NATIONAL AVERAGE</b>	<b>140.9</b>	<b>153.7</b>	<b>151.7</b>	<b>12.8</b>	<b>8.3</b>

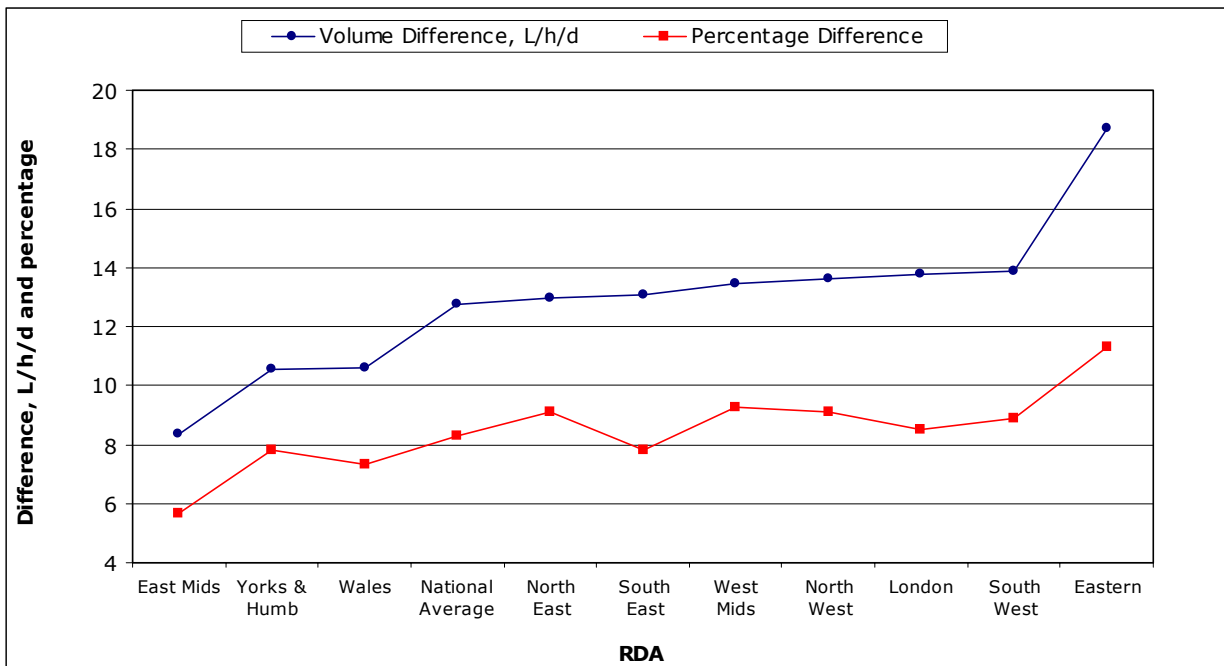
**Table 3. Per Capita Consumption for Metered and Unmetered Households, Litres/head/day, L/h/d.**

The following figures depict the results in Table 3. Figure 2 shows the metered, unmetered and average PCCs for each RDA and Wales, ordered in rising numerical order of the *average* PCC. The National Average columns are for England and Wales combined. Figure 3 shows the difference between metered and unmetered water use in litres per head per day and in percentage terms.

<sup>10</sup> Wales Population Data: <http://www.statistics.gov.uk/statbase/Expodata/Spreadsheets/D4731.xls>  
England Population Data: <http://www.statistics.gov.uk/statbase/Expodata/Spreadsheets/D4724.xls>



**Figure 2. Metered, Unmetered and Average PCCs, L/h/d**



**Figure 3. The Percentage Difference Between Metered and Unmetered per Capita Water Consumption**

The headline result is that the southern and eastern portions of England (Eastern, London, South East and South West RDAs) use more water daily per head of population on average than in Wales and the rest of England (North West, North East, Yorkshire & Humberside, West and East Midlands RDAs). This is not surprising and has been noted elsewhere<sup>11</sup>. It has been attributed to variables such as warmer weather and a higher level of affluence / socio-economic status on average giving rise to greater ownership and use of white goods such as washing machines and larger gardens that require more watering during the summer months. These figures compare reasonably well to the industry estimates produced by each Water Supply Company as reported by OFWAT<sup>12</sup>.

One interesting result is the difference in PCC between metered and unmetered households across the RDAs & Wales - the ratio between the two is quite consistent across England and Wales. On average, people in metered households use approximately 13 litres less water per day than people in unmetered households, which equates to a saving of 8 – 9% of the water consumed in unmetered houses. This would imply that the introduction of meters in households does play a significant role in homeowners actively reducing their daily water consumption, driven by cost awareness. The largest of these differences, almost 19 litres, occurs in the Eastern RDA, probably the driest part of the UK.

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<sup>11</sup> Environment Agency "A Scenario approach to water demand forecasting" and references therein.

<sup>12</sup> Office of Water Services "Leakage and the efficient use of water 2000-2001 report", October 2001.

# 3 Industrial Water Use

## 3.1 Methodology

Calculating industrial water use was not as straightforward as for the domestic sector for several reasons, one of the most significant being the number of industry types which use significant volumes of water. The best available dataset with a good level of disaggregation by two-digit SIC-92 (Standard Industrial Classification) was determined to be the Envirowise report from June 2001 "Review of Water Use in UK Industry and Commerce"<sup>13</sup>. The majority of the data within this report originally came from the NWDMC at the Agency and from Water Supply Companies, which is considered to be the "official" distribution point for water use data. Other data on industrial water use was available directly from the NWDMC, which was also incorporated into the calculations undertaken for this study.

An attempt was made to rationalise the data obtained directly from WSCs (via the Agency). However, it did not prove possible to disaggregate the data by industrial sector and then aggregate it up to RDA/National level in a consistent manner which matched the SIC reporting structure. This was primarily for two main reasons. Firstly data was absent for a third of all the WSCs (accounting for 35% of England and Wales' land area) including Severn Trent, Thames and United Utilities. Secondly each WSC has its own unique categorisation system of water use, which reflects the industrial make-up of that part of the country, each at a different level of detail. Therefore direct comparisons were made more difficult as there were only a few common categories, and even those would have had underlying assumptions as to which precise businesses were included. Consequently it was decided not to use the information directly.

The Envirowise data is presented as the total of public water supply and directly abstracted water used by the major industries and agriculture. Like household water use, volumes represent consumption i.e. they exclude supply pipe leakage. Data is presented by WSCs and the following SIC-92 classifications, as shown in Table 4.

SIC-92 Sector		SIC-92 Sector		SIC-92 Sector	
<b>01.1</b>	Agriculture Arable	<b>25</b>	Rubber & Plastic	<b>45</b>	Construction
<b>01.2</b>	Agriculture Livestock	<b>26</b>	Non-metal mineral products	<b>52</b>	Retail
<b>15</b>	Food & Drink	<b>27</b>	Foundries	<b>55</b>	Hotels
<b>17</b>	Textiles	<b>28</b>	Metal Finishing	<b>75</b>	Public Admin & Defence
<b>19</b>	Leather	<b>30</b>	Office machinery & PCs	<b>80</b>	Education
<b>21</b>	Paper & board	<b>31</b>	Electrical machinery	<b>85</b>	Health & Social
<b>22</b>	Printing & Publishing	<b>32</b>	Radio, TV equipment etc.	<b>92</b>	Recreation, Culture & Sport
<b>24</b>	Chemicals	<b>36</b>	Furniture		

**Table 4. Industrial Sectors covered and their SIC-92 code**

It should be noted that the energy production sector is not included in the Envirowise dataset, nor is it in many WSC returns, a large factor being that the water is primarily used for cooling, the water being recycled or returned relatively unchanged.

Using spatially resolved employment statistics from the IDBR at ONS, it was possible to distribute the number of employees for each of the industrial sectors in Table 4 across each Water Company Area, WCA. As the total water consumption by SIC and WCA is given in Envirowise, and the number of employees is known, it is possible to assign a water use figure per employee in ML/d/person to the employee distribution. This information is then summed by using the RDA/National boundaries to give a water consumption value by SIC for each RDA and Wales. It should be noted that the assumption

<sup>13</sup> "Review of Water Use in UK Industry and Commerce". Ashact Ltd, 2001, Unpublished.

inherent in this calculation from the Envirowise core data is that each employee within one particular industry class uses the same volume of water on average per year across the country. This assumption had to be made, as there was no information to assess any variations within the WCAs. This therefore precludes any inter-regional comparison based on employee numbers but does not prevent comparison by any another normalising factor, such as production tonnages or the economic analysis used later in this report, section 3.3.

The figures used in the Envirowise report were based on 1998 consumption data. This information therefore had to be scaled to the 1999 baseline year for this study. To achieve this, financial input-output statistics<sup>14</sup> from ONS were referred to in order to obtain a percentage change from 1998 to 1999 in each of the SIC-92 sectors, which was then incorporated into the Envirowise base data. Most changes were minimal and thus did not have a great effect on the overall usage figures. A few sectors however did exhibit significant alterations; Foundries' financial performance declined by 14% between 1998 and 1999 whereas the Radio, TV and Communications Equipment manufacturing sector expanded by over 9% during the same period.

Importantly an integrity check was conducted on the data. The results generated from the base Envirowise data were compared with countrywide totals held by the NWDMC on industrial water use from the public water supply and directly abstracted supplies. This latter data source was regarded as a key reference point due to it being derived from original data (the Envirowise data being used in this study as it was in a more internally consistent and complete format).

Significant disagreement was found for the Chemicals, Non-metal mineral products, Foundries, Metal Finishing and Retail sectors. Data from these sectors were therefore rescaled to bring them into line with the NWDMC national water use figures. Other sectors comprising Agriculture, Textiles, Leather, Paper & Board, Printing & Publishing required less adjustment from the Envirowise data.

These disagreements could have arisen because of the differing classification systems used for the NWDMC data and the Envirowise data – the former being based upon WSC returns that have their own inherent coding formats and the latter being presented as SIC codes. The methodology employed by Envirowise to transform the various raw data sources and the choice of what is included in a particular classification may have also allowed for variation.

## 3.2 Results

Table 5 shows the water consumption figures in ML/d for each RDA and Wales divided into the twenty-three industrial sectors. Totals for each RDA and Wales are given as well as by industrial sector.

Graphs depicting the data in Table 5 can be seen in the Appendices, grouped into two main types. Firstly Appendix 1 shows the results by RDA and Wales to enable comparison of water use across different industrial sectors within an individual RDA and Wales. Secondly the results are shown in Appendix 2 by Industrial Sector to allow comparison between different RDAs' and Wales' water use.

The results listed below were checked against the Water Company Resource Plans<sup>15</sup>, which detail the industrially used water supplied by WSCs and were found to be in agreement. The headline figures from the results are unsurprising in that the London and North East RDAs and Wales use the least water for industrial purposes. This will be due to the lower levels of industrial activity present in these areas compared with the English Midlands and North West, as well as the fact that Wales and the North East have the lower populations, see Table 2. The Eastern and East Midlands RDAs have high totals largely attributable to the arable agricultural predominance in those parts of the country.

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<sup>14</sup> "United Kingdom Total Output at market prices for 1992 to 1999" located at <http://www.statistics.gov.uk/themes/economy/Articles/NationalAccounts/inputoutput.asp>

<sup>15</sup> Water Company Resource Plans, 1997/98, Environment Agency

**Table 5. RDA and Welsh Industrial Use of Water in ML/d by RDA and Wales and Industrial SIC-92 sector (PWS and NALD) 1999**

SIC-92	RDA/Wales	Eastern	East Midlands	London	North East	North West	South East	South West	Wales	West Midlands	Yorks & Humb	Total by SIC
<b>Agriculture Arable 01.1</b>		264.00	185.72	0.72	7.77	20.09	73.78	48.03	12.73	49.08	68.59	730.50
<b>Agriculture Livestock 01.2</b>		27.42	26.50	0.20	14.60	39.75	29.29	67.98	72.76	32.56	39.43	350.49
<b>Food &amp; Drink 15</b>		64.19	99.39	48.32	40.32	108.62	61.91	71.81	33.34	69.71	118.26	715.87
<b>Textiles 17</b>		1.60	21.30	2.84	1.94	20.39	2.76	3.37	2.82	4.60	15.10	76.73
<b>Leather 19</b>		4.67	32.26	7.47	2.94	11.80	18.76	11.70	2.94	3.00	4.02	99.57
<b>Paper &amp; board 21</b>		9.92	10.74	2.64	18.49	103.99	118.50	22.80	37.89	7.62	19.03	351.62
<b>Printing &amp; Publishing 22</b>		2.35	1.64	5.62	0.45	1.87	3.00	1.84	0.65	1.17	1.86	20.46
<b>Chemicals 24</b>		96.27	131.34	89.96	147.64	344.82	286.44	94.92	66.01	89.37	216.42	1,563.20
<b>Rubber &amp; Plastic 25</b>		18.48	25.30	9.16	12.49	30.35	24.04	21.95	12.84	30.23	19.06	203.90
<b>Non-metal mineral products 26</b>		8.03	33.37	4.53	6.27	22.98	17.02	13.15	10.01	38.97	21.90	176.23
<b>Foundries 27</b>		13.08	77.16	13.24	23.32	39.75	20.79	13.56	88.91	118.09	155.24	563.14
<b>Metal Finishing 28</b>		8.32	13.16	5.66	6.22	13.89	12.55	9.51	7.68	26.38	15.64	119.01
<b>Office machinery &amp; PCs 30</b>		0.13	0.04	0.09	0.01	0.11	0.24	0.13	0.03	0.08	0.01	0.87
<b>Electrical machinery 31</b>		31.82	35.00	25.63	23.82	48.13	54.76	32.51	24.21	61.07	28.18	365.13
<b>Radio, TV &amp; Communications equipment 32</b>		23.13	13.04	13.44	17.00	12.13	48.84	39.32	34.46	23.03	12.68	237.08
<b>Furniture 36</b>		0.51	0.76	0.44	0.25	0.71	0.75	0.46	0.44	0.62	0.77	5.71
<b>Construction 45</b>		2.17	2.19	3.14	1.32	3.11	3.76	2.47	1.38	2.14	2.75	24.44
<b>Retail 52</b>		44.32	36.72	80.24	21.45	63.38	75.38	51.54	25.22	40.31	47.31	485.87
<b>Hotels 55</b>		27.96	25.14	66.10	14.96	45.45	51.92	39.76	17.28	28.38	31.74	348.70
<b>Public Admin &amp; Defence 75</b>		2.02	2.01	5.55	1.72	3.85	4.09	3.59	1.90	2.44	2.89	30.06
<b>Education 80</b>		26.64	23.74	42.63	13.97	37.47	58.35	34.34	16.75	31.96	31.23	317.07
<b>Health &amp; Social 85</b>		6.05	6.52	10.98	4.56	10.98	12.37	8.62	5.18	7.50	8.63	81.38
<b>Recreation, Culture &amp; Sport 92</b>		1.53	1.18	4.84	0.70	2.01	2.71	1.53	0.89	1.37	1.65	18.41
<b>RDA/WALES TOTALS</b>		<b>684.62</b>	<b>804.19</b>	<b>443.44</b>	<b>382.23</b>	<b>985.65</b>	<b>981.98</b>	<b>594.92</b>	<b>476.32</b>	<b>669.69</b>	<b>862.39</b>	<b>6,885.43</b>

To be able to account for other SIC codes not included above we must look at the industrial water use totals for England and Wales in a top-down approach.

Water used by industry that is supplied by WSCs in England and Wales is quoted<sup>16</sup> at 3,938 ML/d for the year 1999/00. Direct abstractions for the same year total 2,667 ML/d for the major primary industries<sup>17</sup>, which would take the majority of abstracted water. These two figures total 6,605 ML/d. A figure for the direct abstraction of water for agricultural use that includes compensation for trickle irrigation under-recording has been estimated at 786 ML/d. Combined with the previous sub-total this makes 7,391 ML/d.

The total in Table 5 is 6,885 ML/d, which would imply a shortfall of over 500 ML/d for unaccounted industry and business water use. It would not be prudent however to apportion this volume of water either across the remaining SIC codes or indeed across the RDAs and Wales as there is no evidence to direct such action.

It is concluded therefore that where local knowledge is available on industries not included in Table 5 that the SIC code and associated volume of water should be added for a particular RDA and Wales as appropriate.

### 3.3 Economic Analysis

In order to be able to give the results an economic application, data was acquired from Cambridge Econometrics CE. This information consisted of the Gross Value Added GVA on a yearly basis by each industrial sector, given in £ million. Gross Value Added is a way of describing the added benefit from each industry to the Nation's Gross Domestic Product.

The GVA data was taken for the baseline year of 1999 for each of the nine RDAs and Wales. All SIC categories had a corresponding GVA statistic except for the following four sectors; Office machinery & PCs, Electrical machinery, Furniture and Recreation, Culture & Sport. These subsequently have no GVA analysis. Ultimately, to calculate the economic figure of the water used in each sector per unit of GVA, i.e. *Water Use/GVA*, the water use statistics in Table 5 were divided by the GVA figures from CE. This produced the amount of water used per day per pound of value added, denoted by L/d/£.

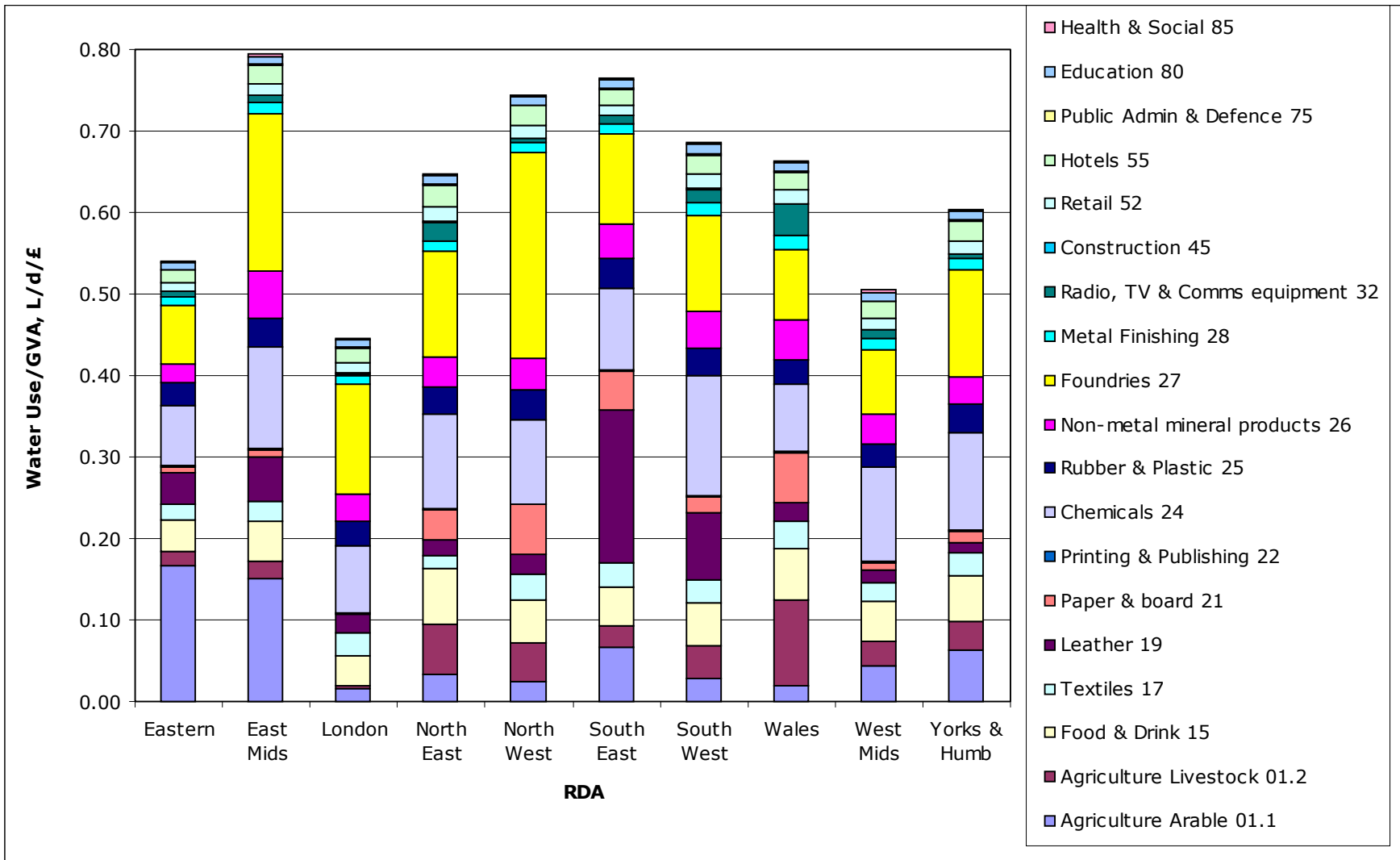
As stated in section 3.1 the assumption behind the core water use data is that each employee within a particular industry class uses the same volume of water on average. This will impact at the RDA/National level where data is taken from several WCAs. It should be noted however that within industrial classes there will be variation between the sub-types, sizes and methods of each business across the RDAs/Wales. Therefore the differences in *Water Use/GVA* between RDAs/Wales may reflect genuine differences in water usage.

Figure 4 and Table 6 depict the economic results by RDA and Wales and SIC code, whereas the graphs in the Appendices break this out to show the individual GVA contributions by RDA and Wales (Appendix 1) and by SIC code (Appendix 2), overlaid on the water use figures.

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<sup>16</sup> Office of Water Services "Leakage and the efficient use of water 1999-2000 report", September 2000.

<sup>17</sup> Chemicals, Construction, Extraction, Food & Drink, Machinery/Electronics, Minerals, Metals, Paper & Printing, Refuse & Recycling, Rubber, Textiles & Leather. Source; NALD, Environment Agency.



**Figure 4. Water Use per GVA, Litres/day/pound, for each RDA and Wales, by SIC code**

<b>Table 6. Water Use/GVA, (L/d/pound) by RDA and Wales and Industrial SIC-92 sector (PWS and NALD) 1999</b>												
<b>SIC-92</b>	<b>RDA/Wales</b>	<b>Eastern</b>	<b>East Midlands</b>	<b>London</b>	<b>North East</b>	<b>North West</b>	<b>South East</b>	<b>South West</b>	<b>Wales</b>	<b>West Midlands</b>	<b>Yorks &amp; Humb</b>	<b>Total by SIC</b>
<b>Agriculture Arable 01.1</b>		0.1667	0.1501	0.0157	0.0332	0.0240	0.0660	0.0280	0.0186	0.0444	0.0625	0.6091
<b>Agriculture Livestock 01.2</b>		0.0173	0.0214	0.0045	0.0623	0.0474	0.0262	0.0397	0.1062	0.0294	0.0359	0.3904
<b>Food &amp; Drink 15</b>		0.0388	0.0501	0.0364	0.0671	0.0534	0.0475	0.0536	0.0637	0.0498	0.0555	0.5159
<b>Textiles 17</b>		0.0201	0.0241	0.0272	0.0165	0.0311	0.0308	0.0280	0.0323	0.0215	0.0279	0.2595
<b>Leather 19</b>		0.0381	0.0537	0.0227	0.0186	0.0247	0.1883	0.0824	0.0226	0.0168	0.0122	0.4800
<b>Paper &amp; board 21</b>		0.0063	0.0094	0.0006	0.0383	0.0608	0.0473	0.0195	0.0621	0.0089	0.0143	0.2676
<b>Printing &amp; Publishing 22</b>		0.0015	0.0014	0.0012	0.0009	0.0011	0.0012	0.0016	0.0011	0.0014	0.0014	0.0128
<b>Chemicals 24</b>		0.0745	0.1251	0.0825	0.1154	0.1036	0.0995	0.1466	0.0836	0.1159	0.1196	1.0663
<b>Rubber &amp; Plastic 25</b>		0.0275	0.0348	0.0311	0.0334	0.0357	0.0367	0.0345	0.0294	0.0282	0.0360	0.3273
<b>Non-metal mineral products 26</b>		0.0238	0.0576	0.0325	0.0367	0.0400	0.0429	0.0457	0.0486	0.0365	0.0330	0.3973
<b>Foundries 27</b>		0.0708	0.1928	0.1344	0.1303	0.2525	0.1104	0.1170	0.0866	0.0786	0.1318	1.3053
<b>Metal Finishing 28</b>		0.0109	0.0139	0.0111	0.0117	0.0117	0.0123	0.0150	0.0167	0.0142	0.0129	0.1304
<b>Radio, TV &amp; Communications equipment 32</b>		0.0063	0.0089	0.0025	0.0233	0.0044	0.0104	0.0171	0.0384	0.0108	0.0057	0.1277
<b>Construction 45</b>		0.0005	0.0009	0.0007	0.0010	0.0009	0.0007	0.0009	0.0010	0.0007	0.0010	0.0083
<b>Retail 52</b>		0.0101	0.0138	0.0131	0.0178	0.0150	0.0121	0.0172	0.0174	0.0132	0.0156	0.1454
<b>Hotels 55</b>		0.0166	0.0228	0.0179	0.0277	0.0246	0.0190	0.0235	0.0213	0.0209	0.0242	0.2184
<b>Public Admin &amp; Defence 75</b>		0.0006	0.0010	0.0012	0.0013	0.0012	0.0007	0.0008	0.0011	0.0010	0.0011	0.0101
<b>Education 80</b>		0.0077	0.0102	0.0088	0.0097	0.0098	0.0119	0.0131	0.0100	0.0106	0.0110	0.1028
<b>Health &amp; Social 85</b>		0.0015	0.0022	0.0018	0.0019	0.0021	0.0019	0.0023	0.0021	0.0019	0.0021	0.0198
<b>RDA/WALES TOTALS</b>		<b>0.5397</b>	<b>0.7942</b>	<b>0.4458</b>	<b>0.6471</b>	<b>0.7441</b>	<b>0.7656</b>	<b>0.6867</b>	<b>0.6628</b>	<b>0.5045</b>	<b>0.6038</b>	<b>6.3943</b>

## 4 Abstracted Water Usage

The data used in the industrial section above comprised the sum of the water supplied by the WSCs through the public network and water directly abstracted by businesses from private sources, such as boreholes and rivers. The initial aim was to be able to present these two primary sources of industrial water use separately. This was to be achieved by subtracting the volume of water abstracted from the total volume of water used, as calculated in the previous section.

We feel however that with the level of detail existing in the current datasets, along with the conflicts of different categorisation systems and the issue of **licensed versus actual** water use that we are unable to provide satisfactory results for both industrial public water supply use and self-abstracted water to the two-digit SIC level *and* by RDA and Wales (as required for subsequent modelling). Further explanation of this is outlined below. We are willing to provide the results that we have generated but with the caveat that we believe that their reliability and quality is not high.

The Agency are responsible for all abstraction licences in England and Wales the information for which is held at the National Abstraction Licensing Database, NALD, at Twerton. Licences are recorded by address, six-digit grid reference and water purpose, for which NALD has its own categorisation system.

We were provided with this dataset for our work on industrial water use. However, the information did not come with any associated volumes, as there was a concern that double-counting may occur when calculating usage figures. Double-counting can arise as licences are often multi-point and/or multi-use. For instance there may be two licences allocated to one particular source, which cover for example process and cooling waters separately, each with their own maximum volume. An added complication is that the source will have its own separate maximum volume that may be taken which may well be lower than the sum of the two individual licensed usage volumes. Conversely one licence may cover several sources, again each with their own maxima.

From the NALD dataset we extracted the locations of total **licensed** water usage by the associated grid references for the NALD categories given. Thus we could map all abstraction points across England and Wales by NALD sectoral use.

The NWDMC were able to provide us with **licensed** abstraction volumes for 31 of the NALD categories by Agency Region, given in Table 7. These **licensed** volumes were subsequently mapped against the appropriate grid references in each Agency Region for each NALD sector. The number of licences held by a particular company was used as a surrogate for volume apportionment between licences as no other suitable alternative was available. Finally, the volume distribution for each NALD sector was aggregated along RDA/National boundaries. Two important issues play their part at this juncture.

Firstly, **licensed** volumes do not represent what is being used in reality. This is because the owner of a licence may choose to use either public water supply or their own source depending on many factors. Cost, purity requirements, time of year and subsequently the volume available are all critical factors. The latter point is highly dependent on rainfall, which in turn is dependent upon geographical location, the East of the country receiving far less rain than the West. It is therefore obvious that **actual** volumes of abstracted water are required, which can then be compared with that taken from WSCs.

Secondly, ratios of **licensed** to **actual** volumes have been previously calculated for eleven of the NALD categories based upon nationally gathered data on water use. Ratios for Electricity supply and 'Other Industry' came indirectly from the Agency via DEFRA<sup>18</sup>. Therefore under half of the NALD categories have a derived ratio.

Two points must be stressed here. The average ratio for all 'industry' lies in the region of 40%, but this will depend on each industry's water use characteristics, the chemicals industry for example uses 77%

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<sup>18</sup> <http://www.defra.gov.uk/environment/statistics/des/inlwater/ch034548.htm>

of its licensed water volume. Calculated ratios for *each* industry are themselves averages across that particular industry type and the country - the real ratio will differ from company to company, depending upon local circumstances and the factors listed above. Those sectors with a calculated ratio are highlighted in blue italics in Table 7.

The second issue is that of classification of the industries. On comparison with the Envirowise dataset it can be seen that only roughly 50% of the NALD categories are similar to the SIC-92 codes used. Some of the SIC codes have to be combined in order to match a NALD category, see Textiles and Leather, whereas others only partially fit, such as Metals and Rubber.

<b>NALD Sector Category</b>	<b>"Best fit" SIC-92</b>	<b>NALD Sector Category</b>	<b>"Best fit" SIC-92</b>
Business parks	-	<i>Metals</i>	<i>Metal Finishing 28 + Foundries 27</i>
<i>Chemicals (incl. petrochemicals)</i>	<i>Chemicals 24</i>	Municipal	-
<i>Construction</i>	<i>Construction 45</i>	Navigation	-
Crown & government	-	<i>Other industrial commercial</i>	-
<i>Electricity</i>	-	Public administration	<i>Public Administration &amp; Defence 75</i>
<i>Extraction</i>	-	<i>Paper &amp; printing</i>	<i>Paper &amp; board 21 + Printing &amp; Publishing 22</i>
<i>Food &amp; drink</i>	<i>Food &amp; Drink 15</i>	Racecourses	-
Golf	<i>Recreation, Culture &amp; Sport 92</i>	<i>Refuse and recycling</i>	-
Holiday resorts	-	Research non-university	-
Hospitals	<i>Health &amp; Social 85</i>	Retail	<i>Retail 52</i>
Hotels	<i>Hotels 55</i>	<i>Rubber</i>	<i>Rubber &amp; Plastic 25</i>
<i>Industrial commercial</i>	-	Schools & colleges	<i>Education 80</i>
Laundry	-	Sport	<i>Recreation, Culture &amp; Sport 92</i>
<i>Machinery / electronics</i>	<i>Office mach &amp; PCs 30, Electrical mach 31. Radio, TV &amp; Comms equip 32</i>	Transport	-
Mechanical non-electrical	-	<i>Textiles &amp; leather</i>	<i>Textiles 17 + Leather 19</i>
<i>Minerals</i>	<i>Non-metal mineral products 26</i>		-

**Table 7. Categories used for Abstraction Licences by NALD**

Attempts were made on calculating a public water supply figure for each SIC-92 code used in the Envirowise dataset. This was done by calculating an **actual** abstraction volume from the **licensed** volume using a ratio if available. The answer was then subtracted from the total industrial water use figure as gained from the Envirowise data.

However, due to the lack of reliable ratios taken from industry data taken with the mismatch between NALD categories and those used by the Envirowise data it was decided that the results were not trustworthy. Even for those categories that do have both the criteria mentioned, such as Chemicals and Food & Drink, there still remain discrepancies.

As outlined above, these results can be made available but it is felt that they are not suitable for further modelling at this stage. Therefore the industrial water use is given by SIC and RDA/Wales as a single total rather than self-abstraction and public water supply components. Recommendations for the improvement of this situation are made in the next section.

The reverse approach was also considered in separating the public water supply volumes from the directly abstracted amounts. This was attempted by subtracting the information given by the WSCs

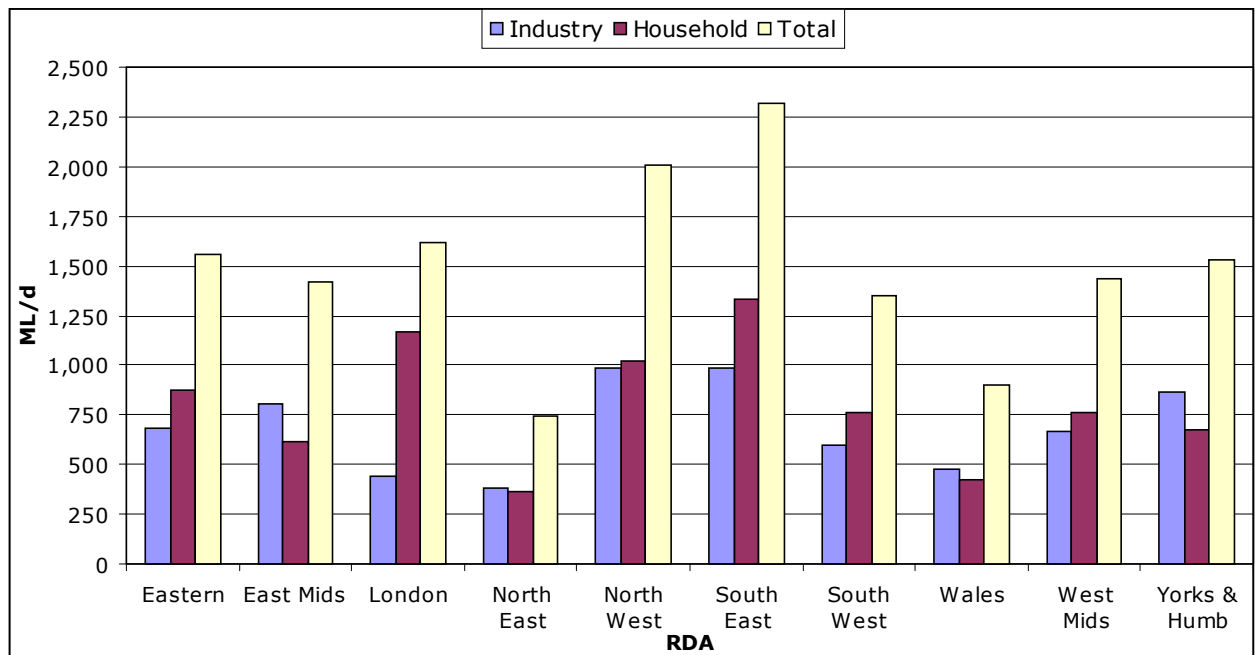
from the Envirowise data to generate the directly abstracted volumes. This route was not taken for the reasons outlined in section 3.1.

# 5 Total Water Usage

It will be of interest and use to many RDAs and the NAW to know their total water usage, i.e. of household and industrial combined. These are presented here in tabular and graphic form. Table 8 shows the combined totals by RDA and Wales in alphabetical order and Figure 5 shows this graphically.

RDA/Wales	Industry	Household	Total
<b>Eastern</b>	684.62	873.77	<b>1,558.40</b>
<b>East Midlands</b>	804.19	611.30	<b>1,415.49</b>
<b>London</b>	443.44	1,171.53	<b>1,614.98</b>
<b>North East</b>	382.23	364.56	<b>746.79</b>
<b>North West</b>	985.65	1,022.03	<b>2,007.68</b>
<b>South East</b>	981.98	1,334.84	<b>2,316.82</b>
<b>South West</b>	594.92	757.89	<b>1,352.80</b>
<b>Wales</b>	476.32	421.11	<b>897.43</b>
<b>West Midlands</b>	669.69	764.10	<b>1,433.78</b>
<b>Yorkshire &amp; Humberside</b>	862.39	671.58	<b>1,533.96</b>
<b>Total</b>	<b>6,885.43</b>	<b>7,992.71</b>	<b>14,878.14</b>

**Table 8. Total Water Use By RDA and Wales, ML/d**



**Figure 5. Total Water Use by RDA and Wales, ML/d**

# 6 Data Revision and Recommendations

Potential users must note that the data presented here is of an aggregated nature. The source data for household consumption is recognised as being of "Very Good" quality (a data quality rating of "A"). The original data for some of the larger industries is described as Good quality (quality rating "B"); Food and Drink, Textiles, Leather, Paper & Board and Chemicals. The quality of the data of the remaining industrial sectors was however judged as being Fair to Poor (quality rating "C" to "D").<sup>19</sup> The process of secondary reapportionment of water use to the RDA/National level is not believed to have added any further error due to the geographical scale being considered. Therefore the users of this dataset are advised that it is not definitive and consultation with local Water Supply Companies and relevant industry is recommended in order to obtain a more detailed picture of regional water use.

At the time of writing this report there were no known plans for an annual update of water use statistics. The previous data gathering exercise was conducted in 1997/1998 and was only partially successful both in terms of receiving data from all WSCs and in obtaining the data in sufficient detail to enable rigorous two-digit SIC disaggregation.

Much of the difficulty behind this piece of work has been the availability of data and the form of categorisation in which it has come. Therefore to allow future revision to be performed to a more preferable level of detail and reliability we recommend the following points;

- SIC-92 codes are used throughout for conformity and ease of comparison between water that is supplied through the WSC network and that which is directly abstracted by private undertakings.
- Although it would be ideal for WSCs to deliver information annually by SIC-92 coding on the water supplied through their network, it is probably more realistic if high level out-turn data is provided every year with a more detailed review being conducted every five years. This could be aligned with Asset Management Programmes AMP and could be done through Water UK as was done in 1997/98 finally being fed through to the Agency.
- Improved data is gathered on the actual volumes of water that are directly abstracted by private concerns. This could be through the NALD system (a large task) or via the calculated ratios of licensed:actual.
- If ratios are the chosen route for calculating the actual volume of water abstracted it would be better and more appropriate on a regional, i.e. RDA/National, basis.

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<sup>19</sup> "Review of Water Use in UK Industry and Commerce". Ashact Ltd, 2001, Unpublished.

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# Appendix 1 Industrial Water Use by RDA and Wales

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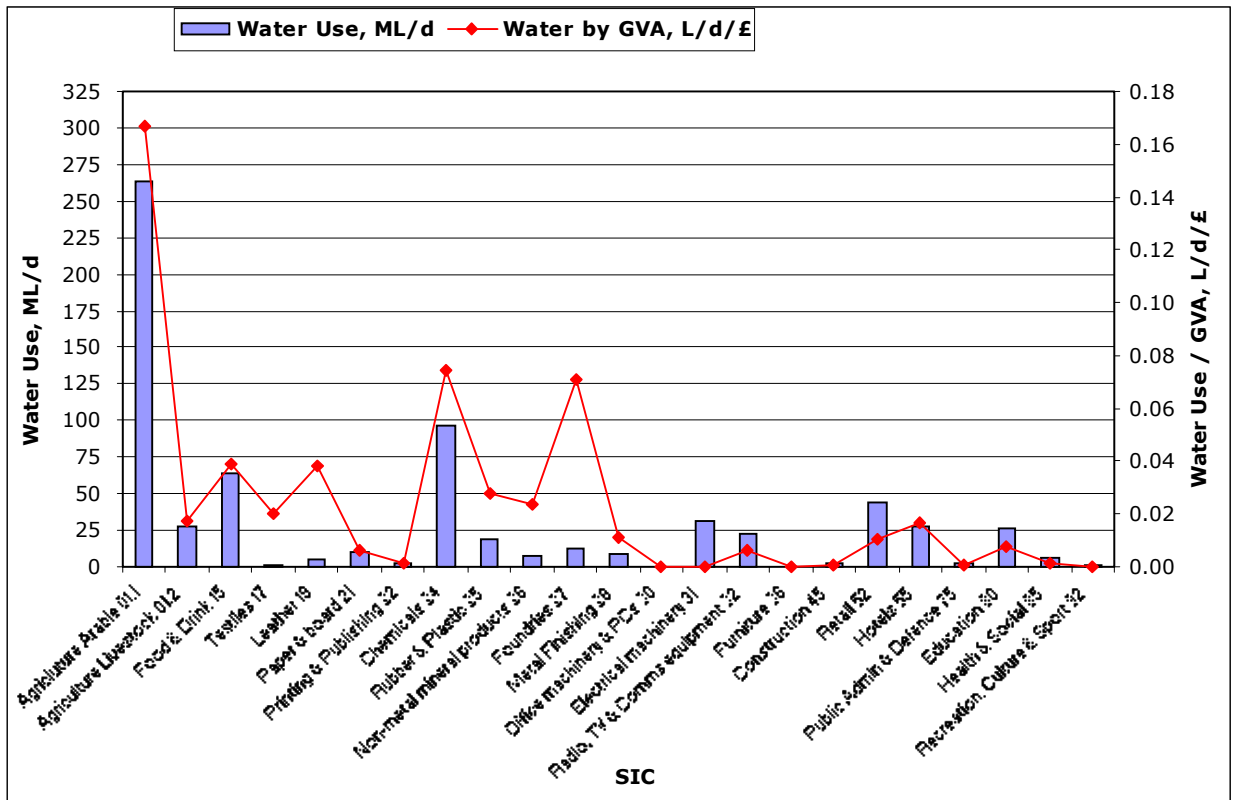


Figure 6. Eastern RDA Industrial Water Use and Water Use/GVA

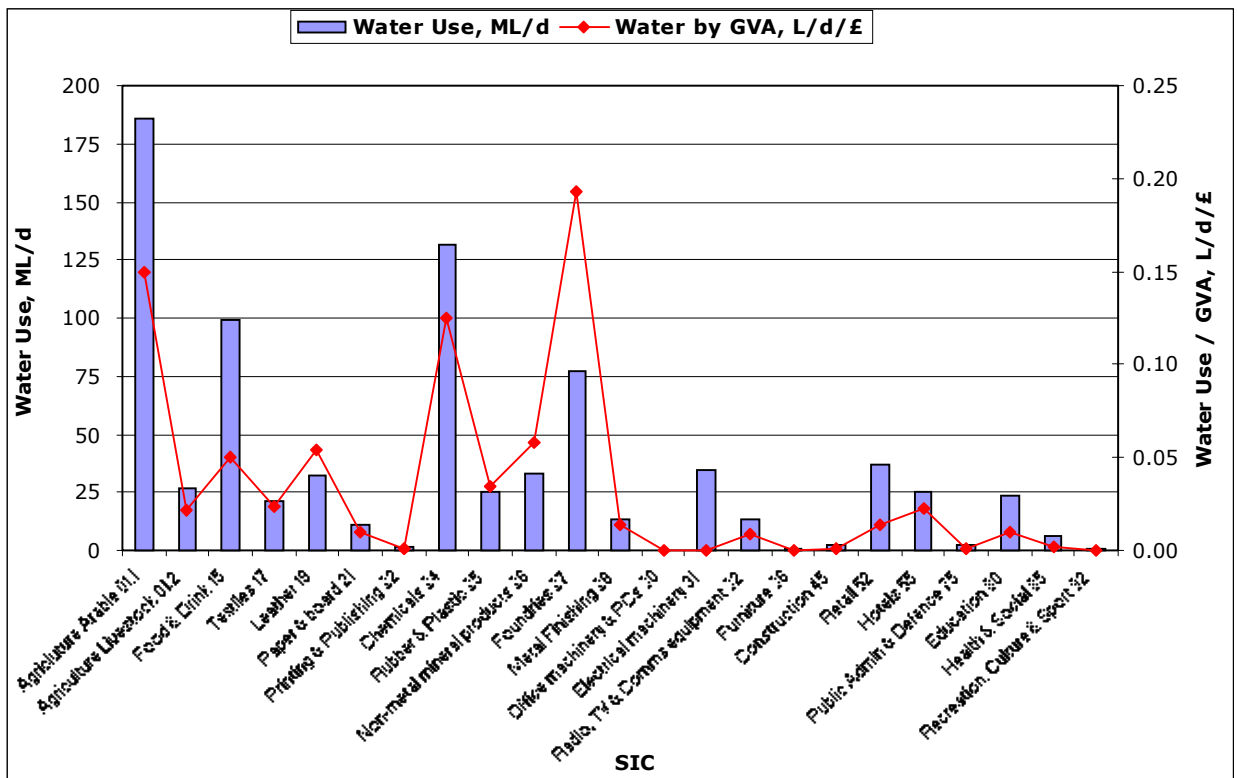


Figure 7. East Midlands RDA Industrial Water Use and Water Use/GVA

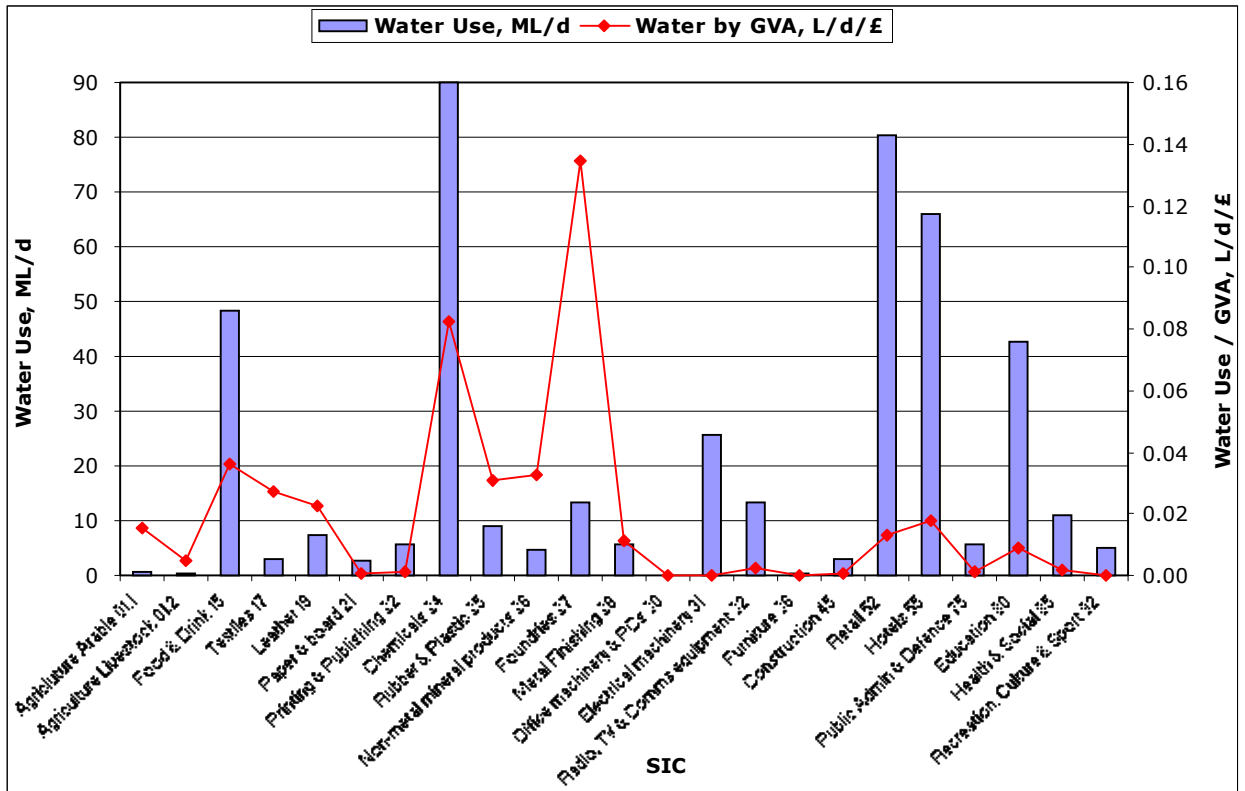


Figure 8. London RDA Industrial Water Use and Water Use/GVA

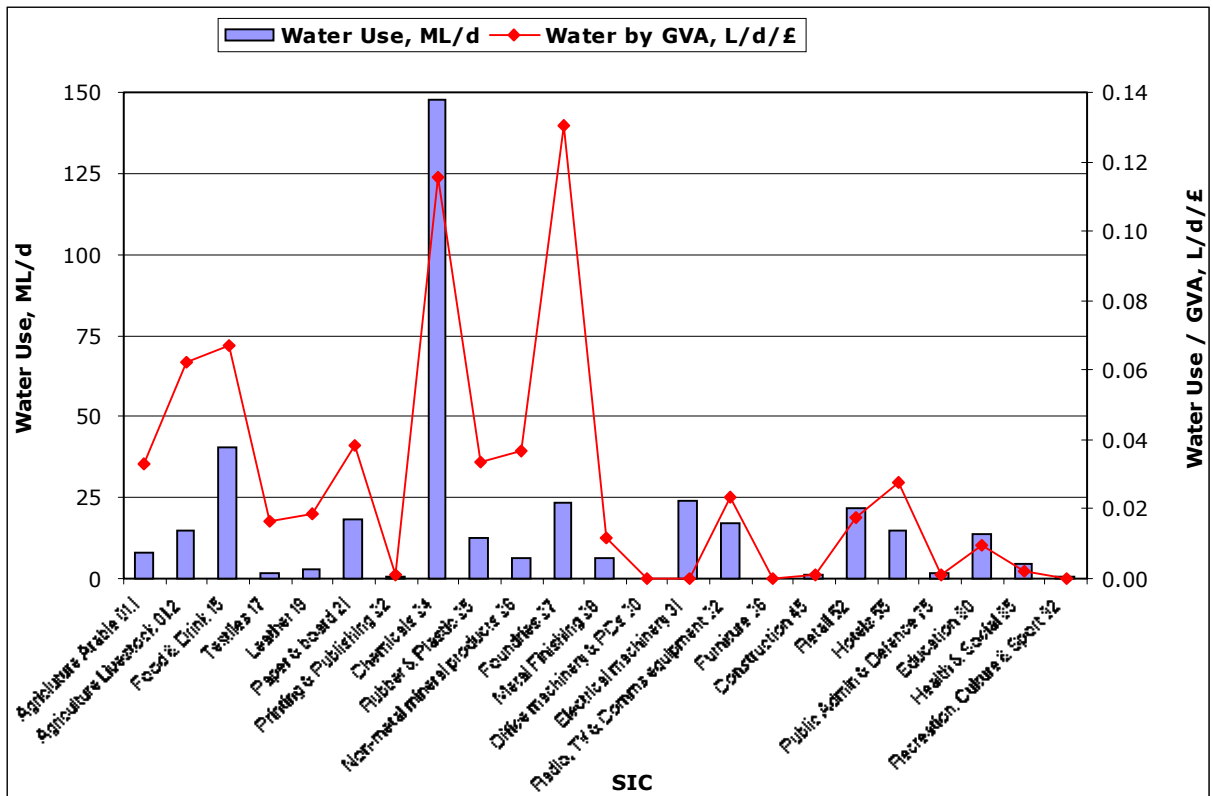


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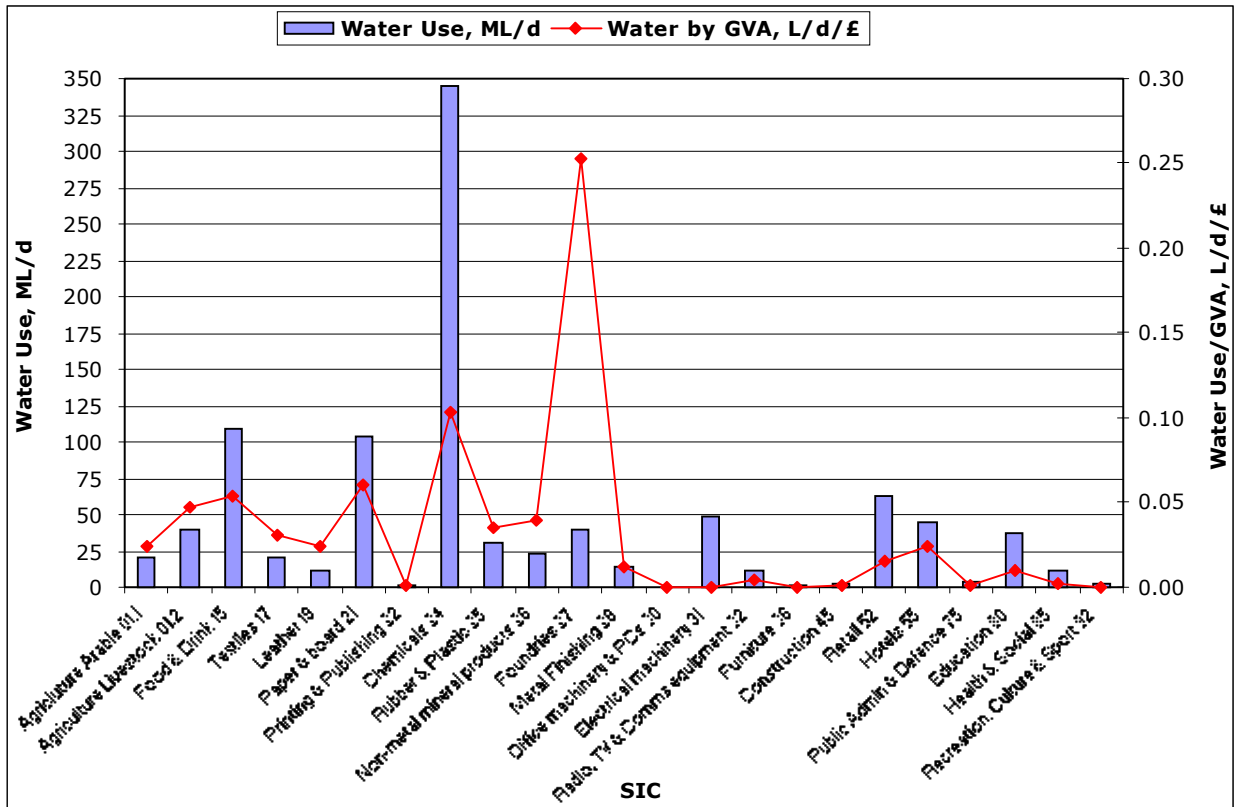


Figure 10. North West RDA Industrial Water Use and Water Use/GVA

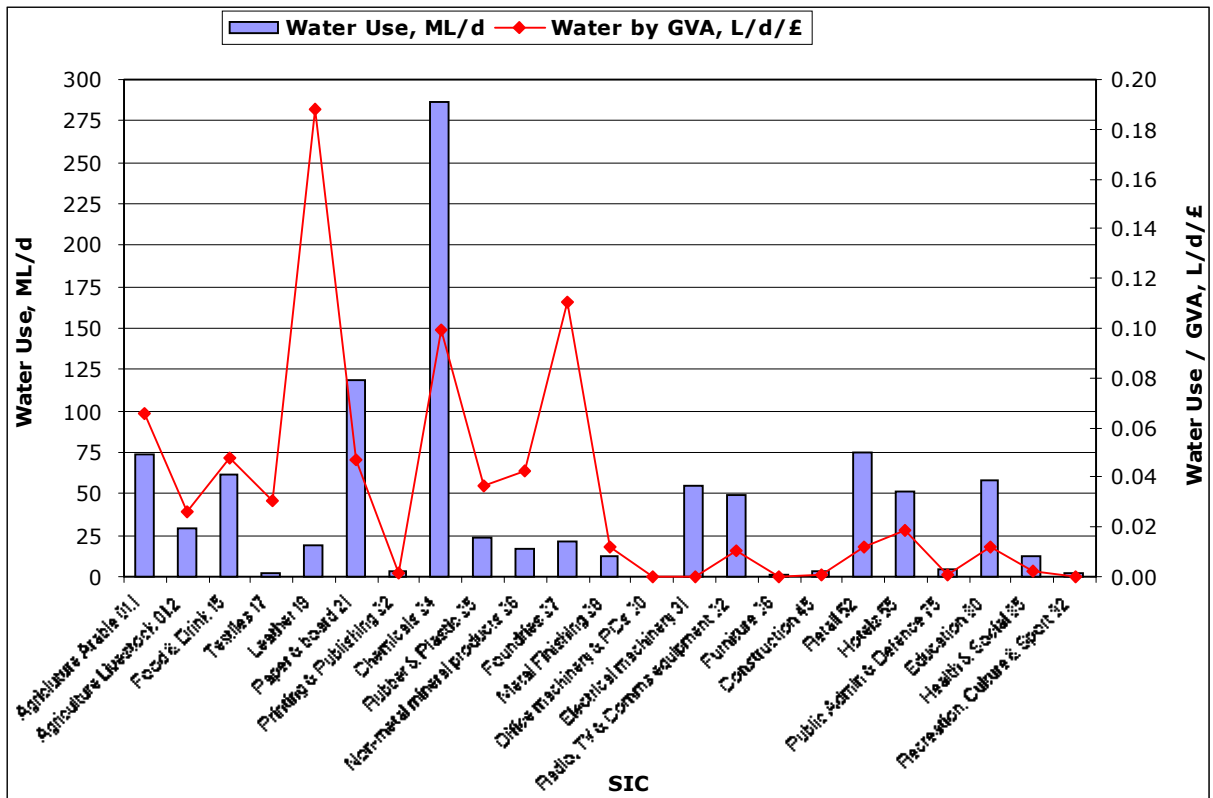


Figure 11. South East RDA Industrial Water Use and Water Use/GVA

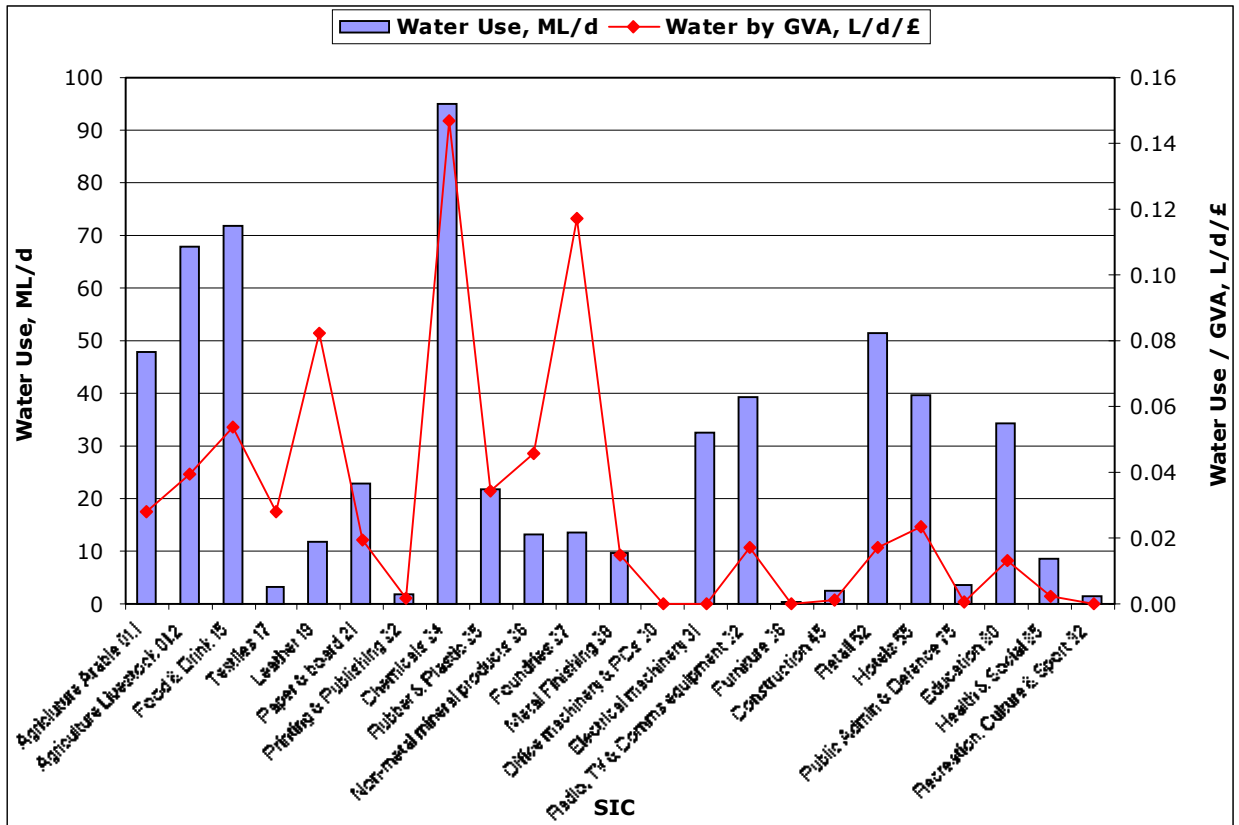


Figure 12. South West RDA Industrial Water Use and Water Use/GVA

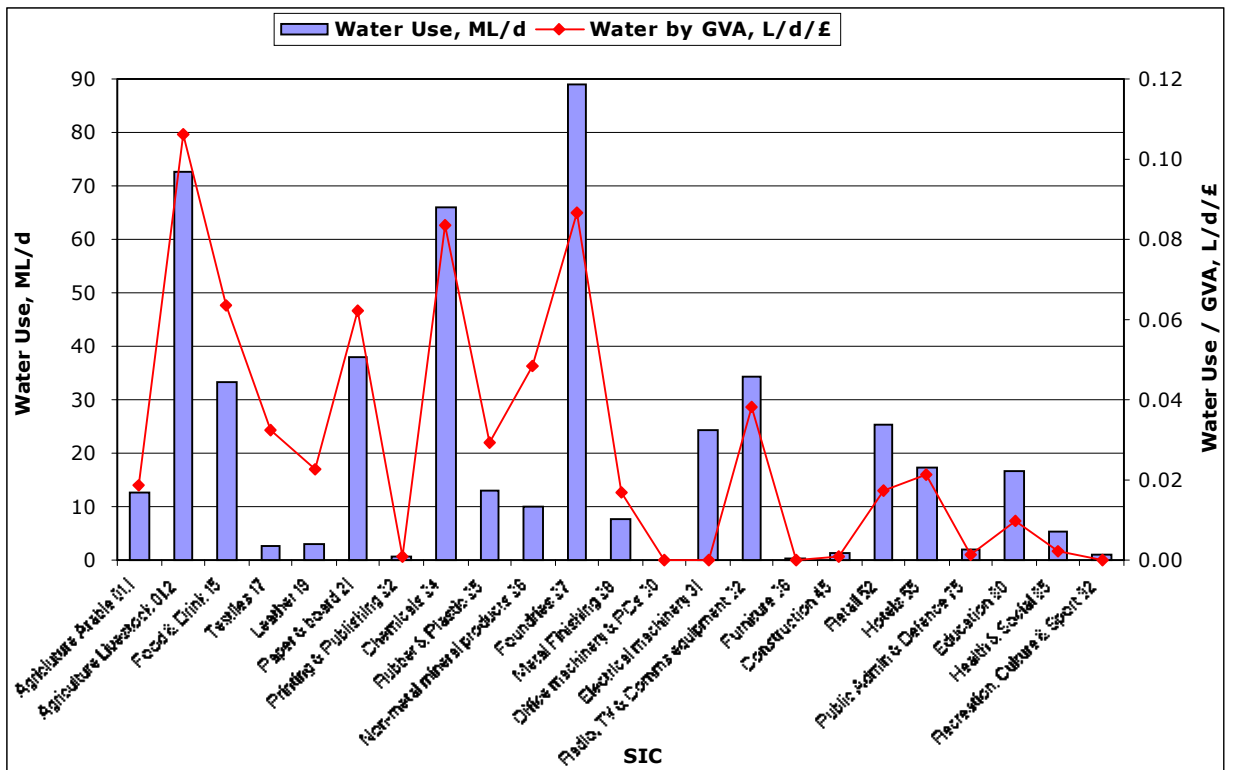


Figure 13 Welsh Industrial Water Use and Water Use/GVA

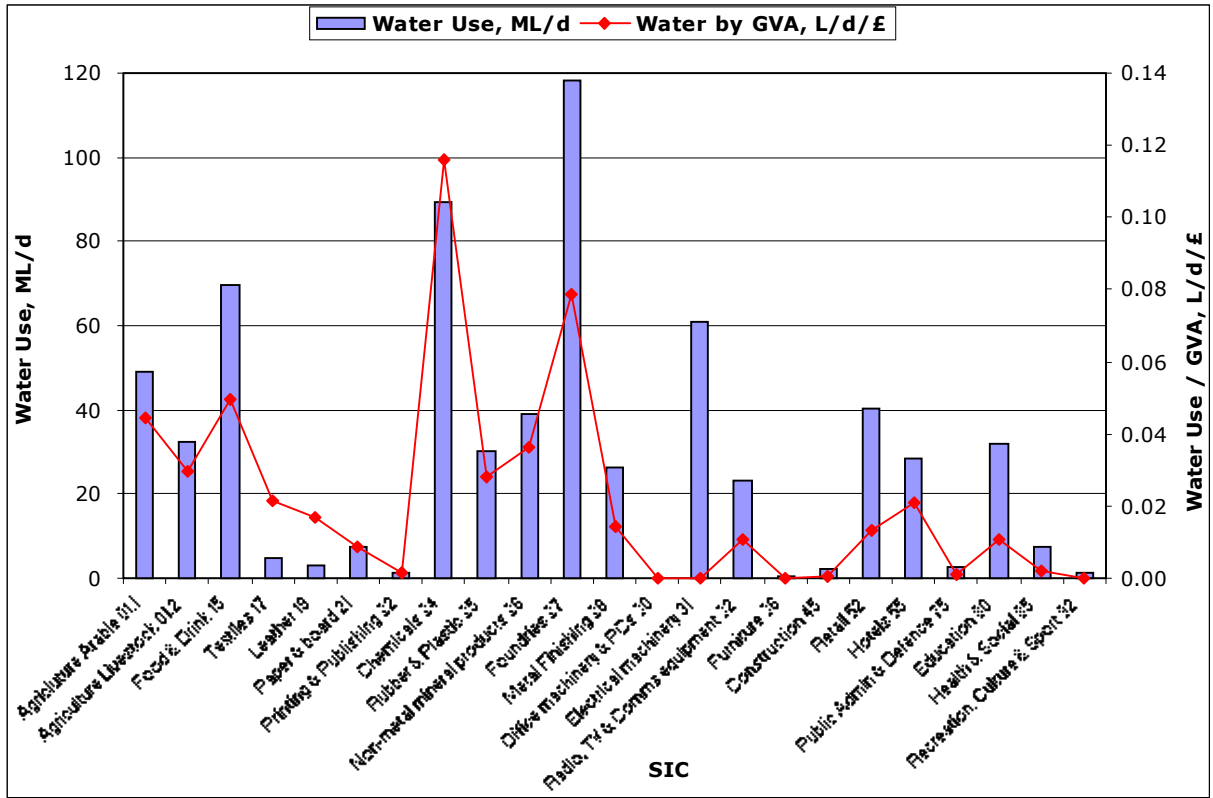


Figure 14. West Midlands RDA Industrial Water Use and Water Use/GVA

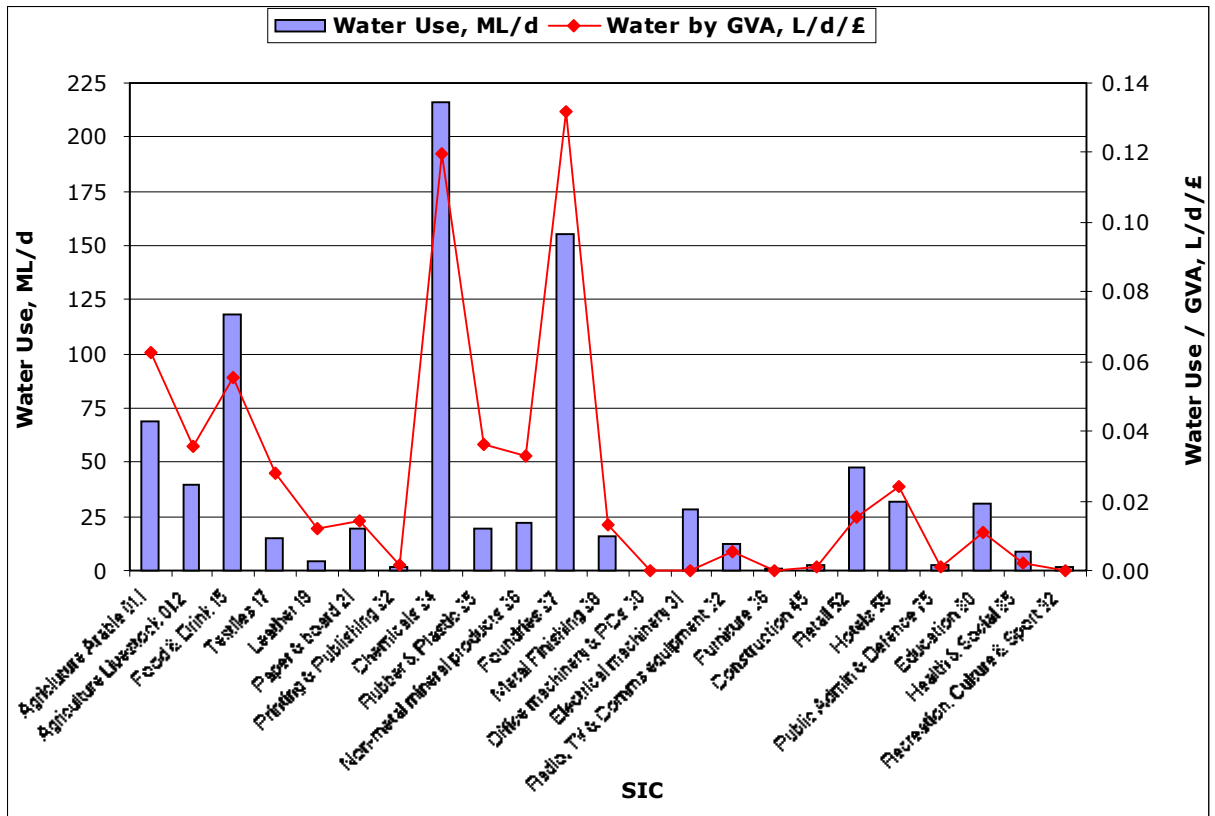
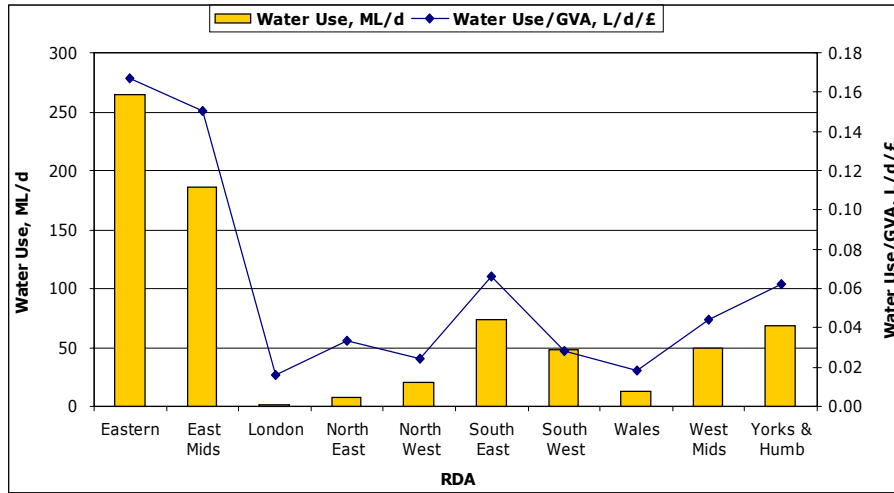


Figure 15. Yorkshire & Humberside RDA Industrial Water Use and Water Use/GVA

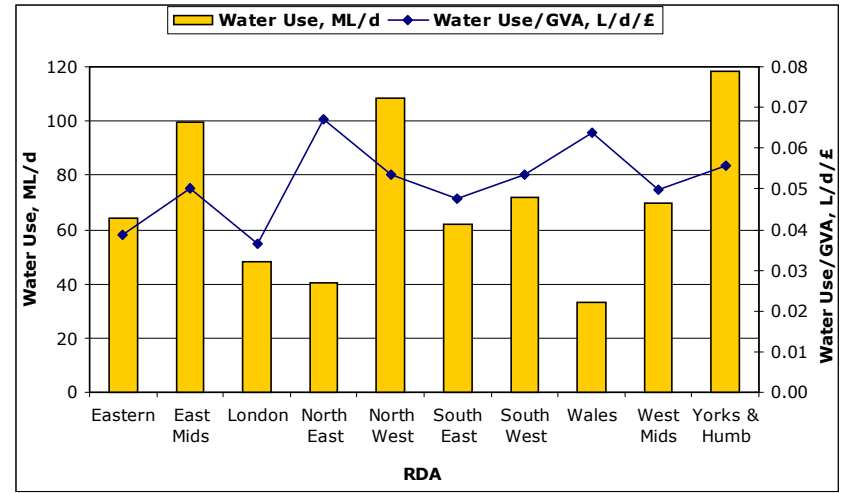
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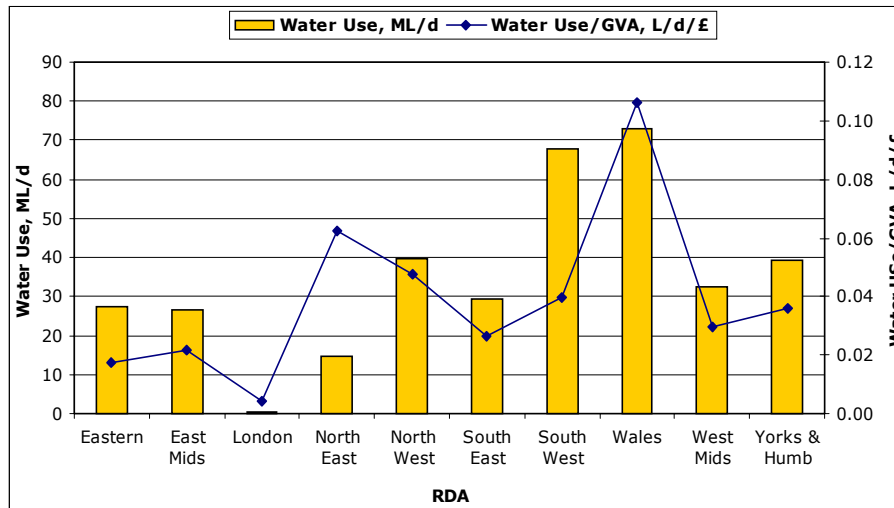
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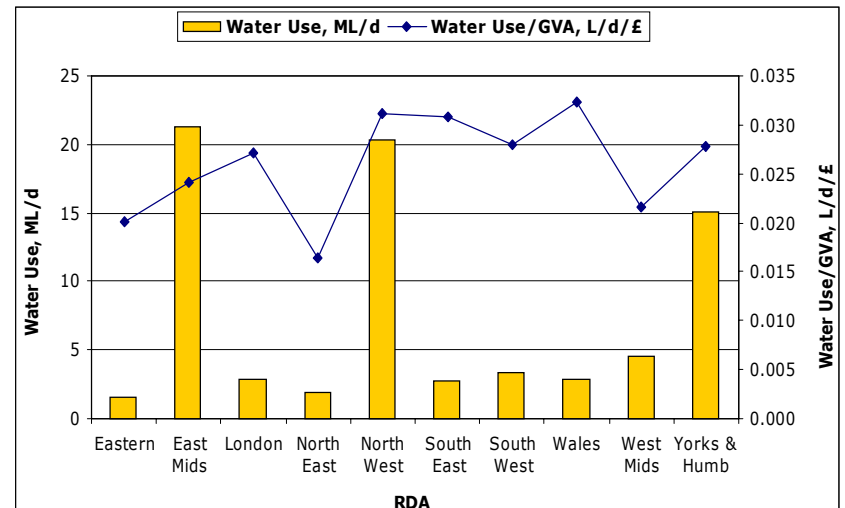
**Figure 16. Agriculture Arable 01.1 Water Use**



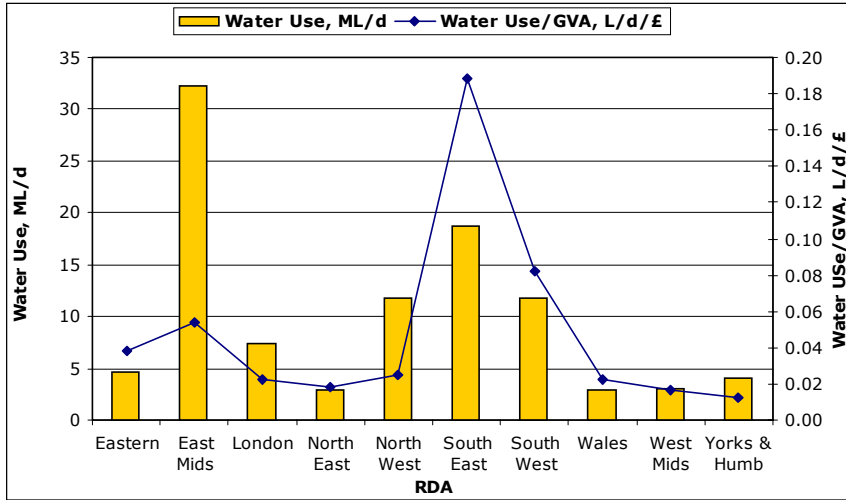
**Figure 18. Food & Drink 15 Water Use**



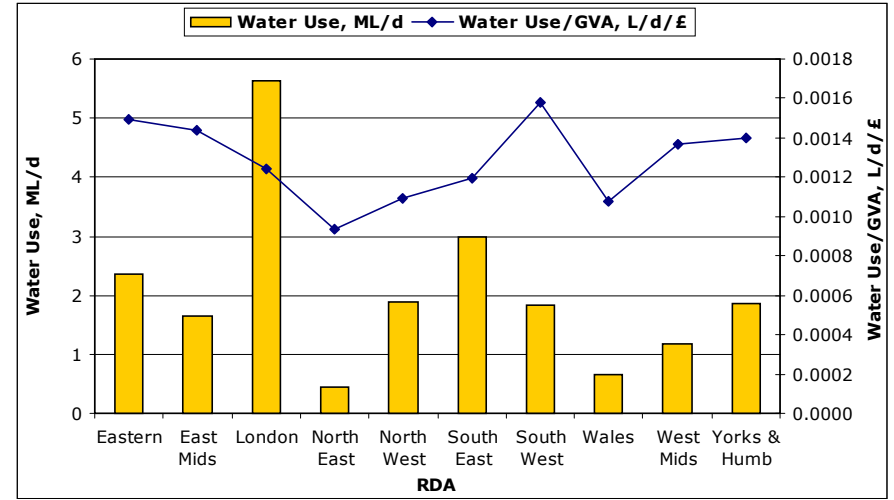
**Figure 17. Agriculture Livestock 01.2 Water Use**



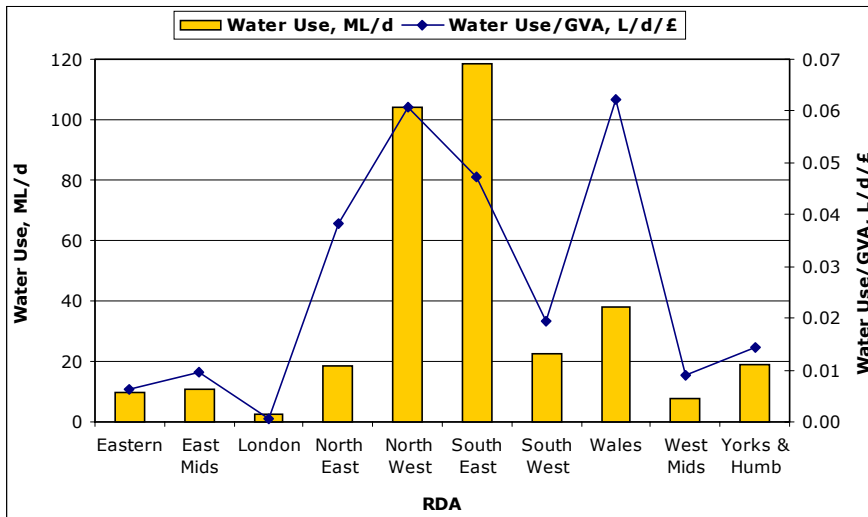
**Figure 19. Textiles 17 Water Use**



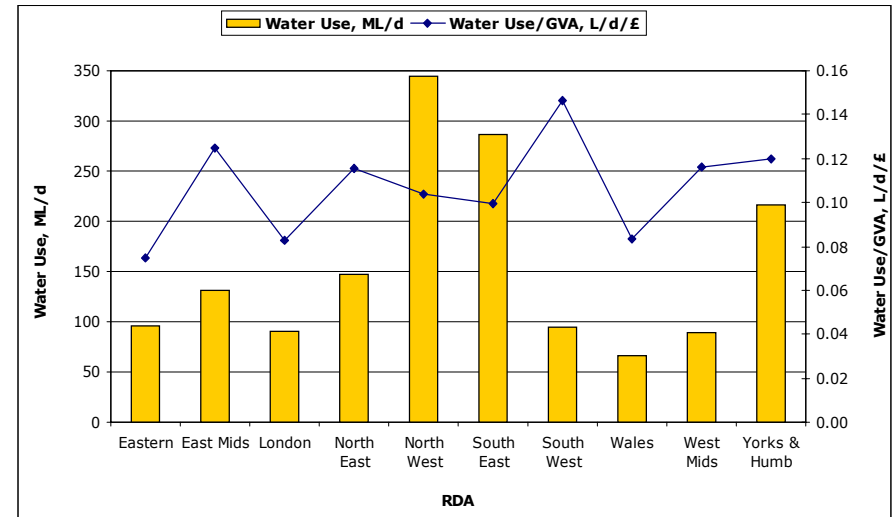
**Figure 20. Leather 19 Water Use**



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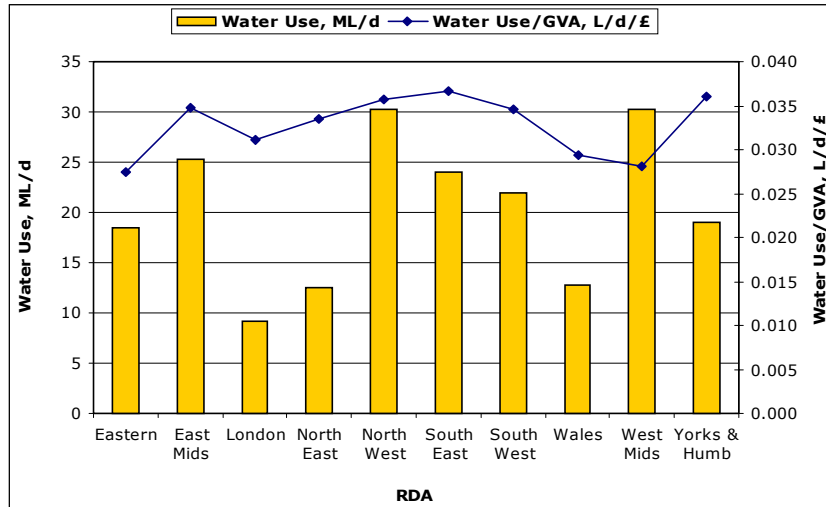


Figure 24. Rubber and Plastic 25 Water Use

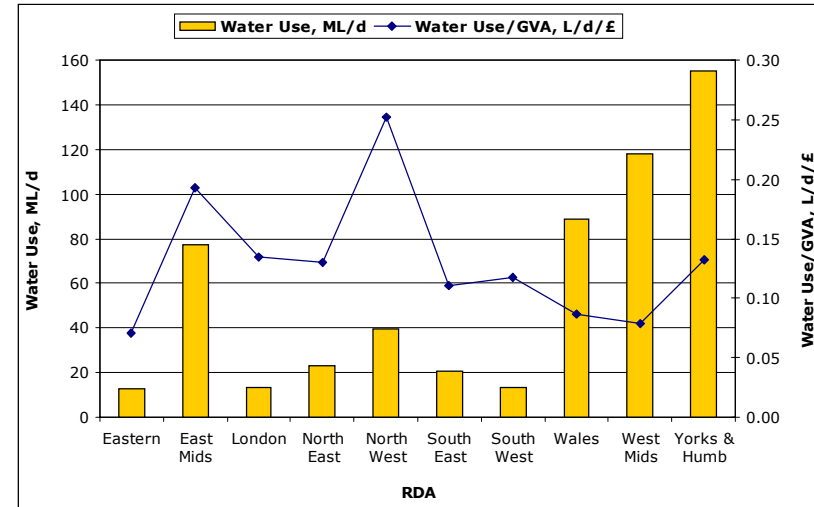


Figure 26. Foundries 27 Water Use

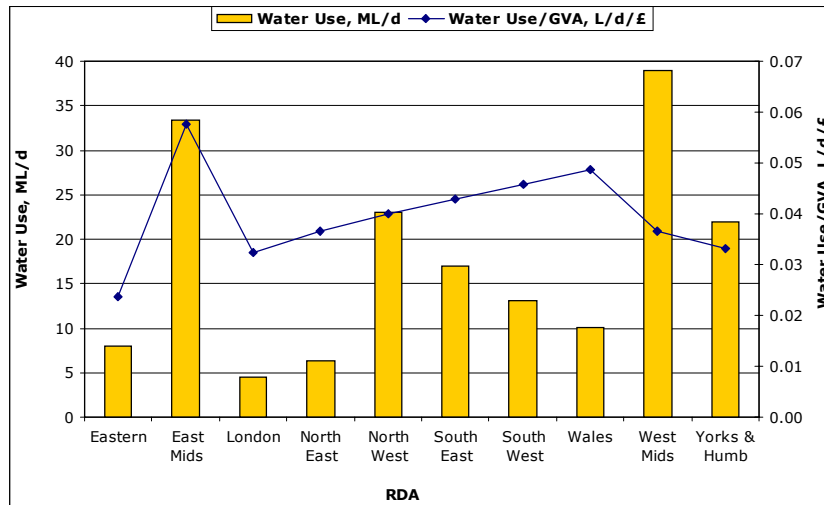


Figure 25. Non-metal mineral products 26 Water Use

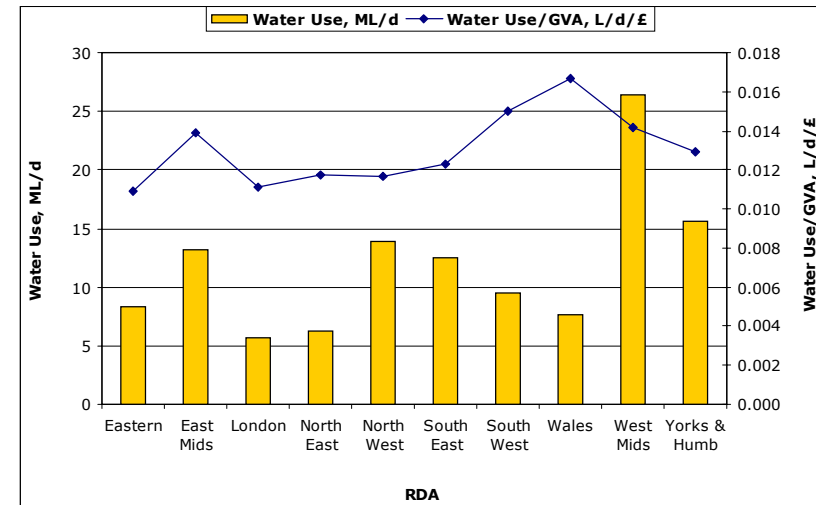
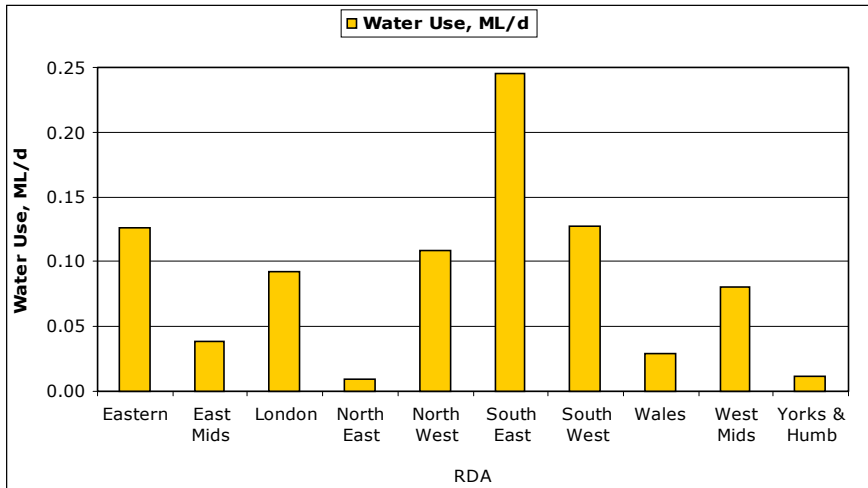
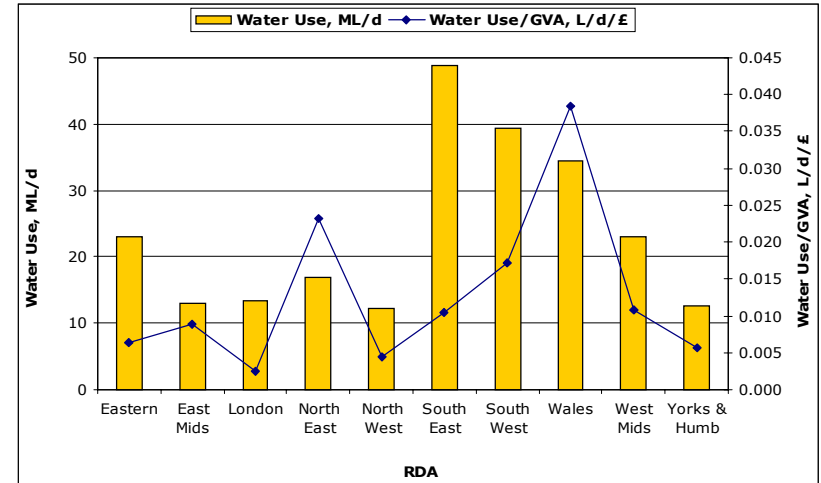


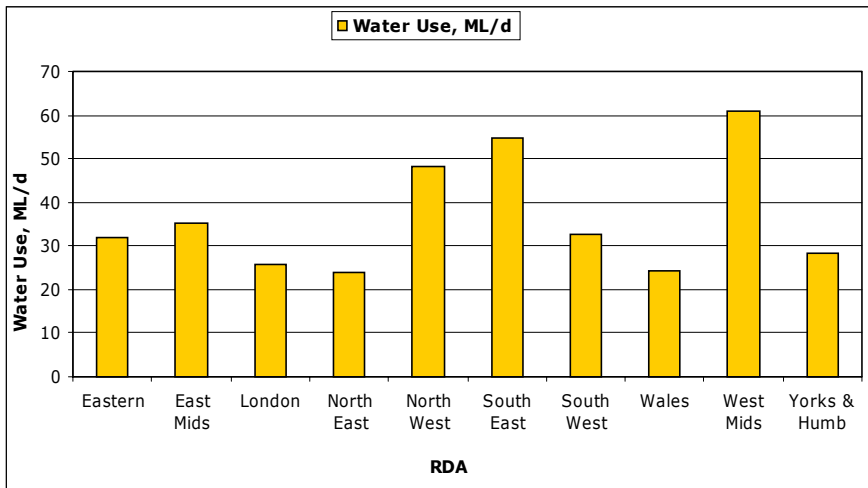
Figure 27. Metal Finishing 28 Water Use



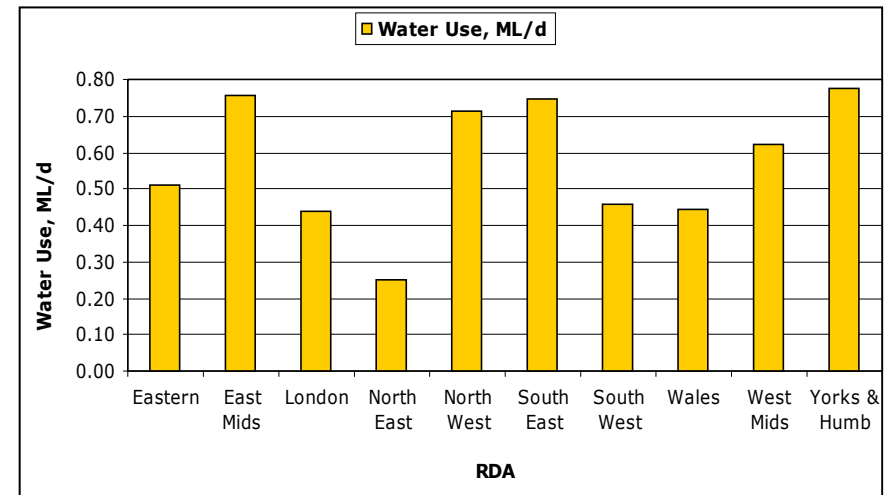
**Figure 28. Office Machinery 30 Water Use**



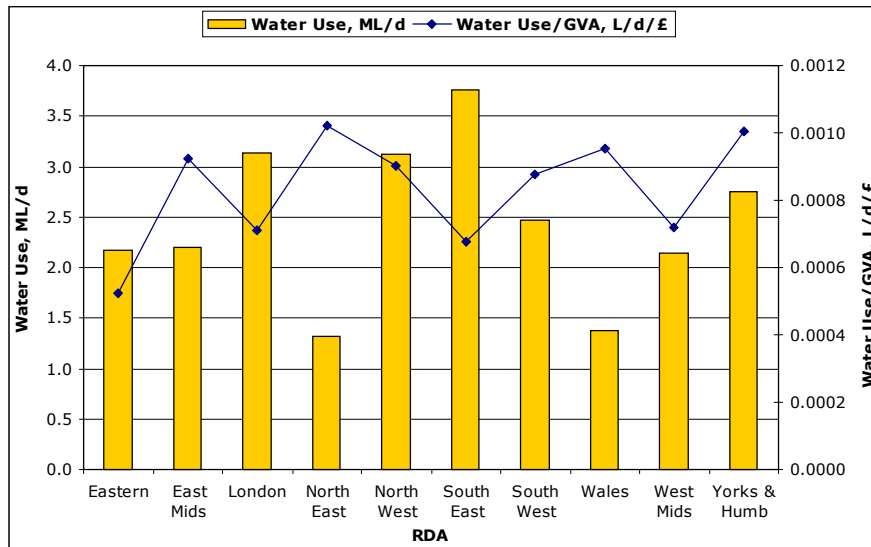
**Figure 30. Radio, TV & Communications Equipment 32 Water Use**



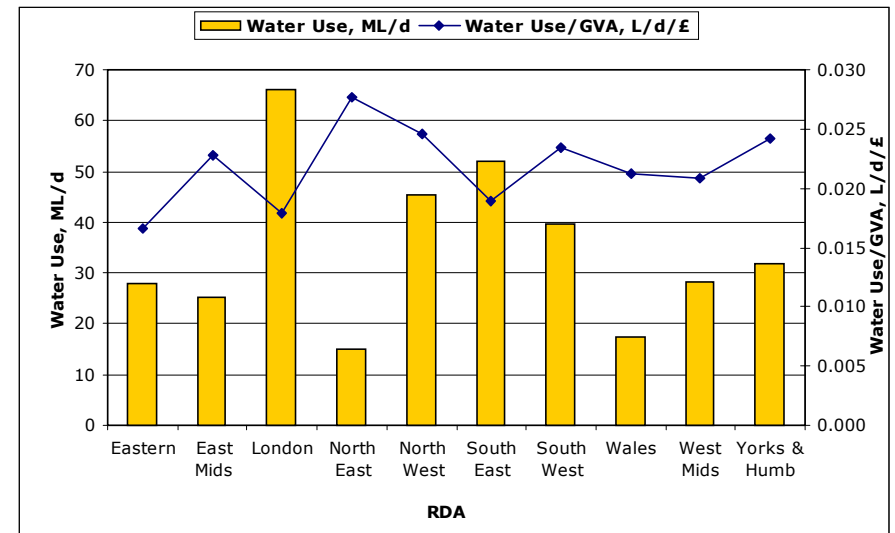
**Figure 29. Electrical Machinery 31 Water Use**



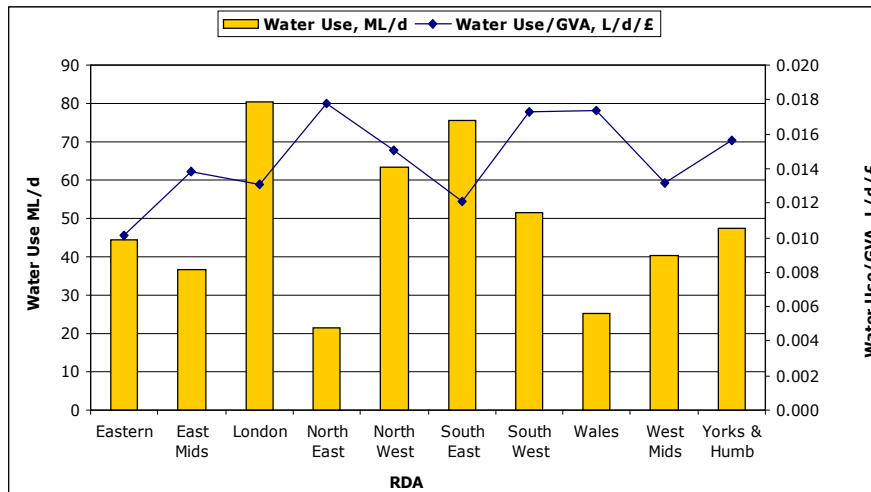
**Figure 31. Furniture 36 Water Use**



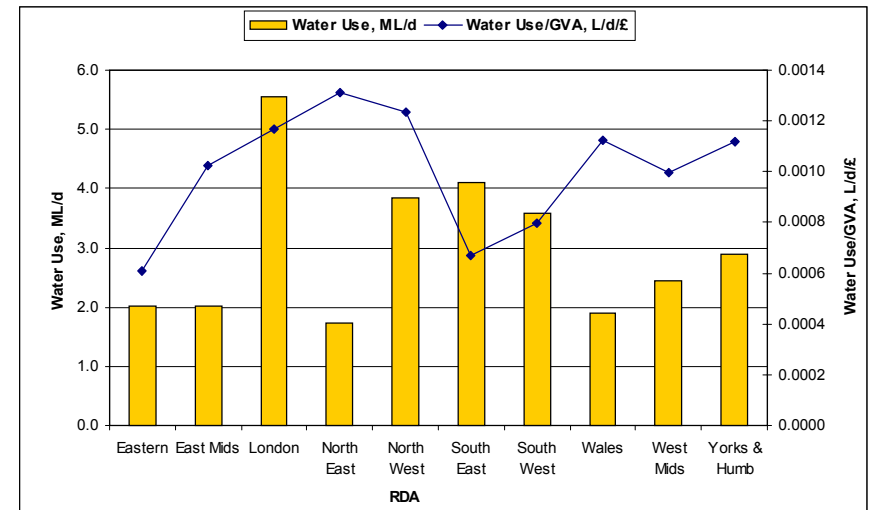
**Figure 32. Construction 45 Water Use**



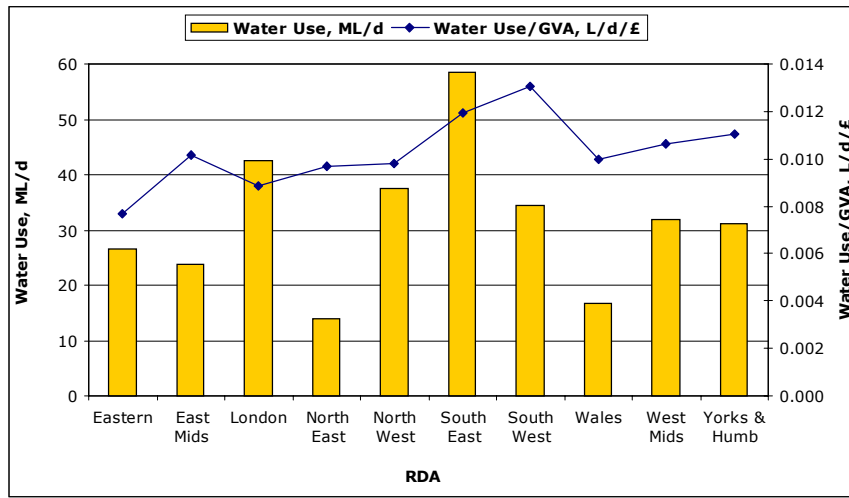
**Figure 34. Hotels 55 Water Use**



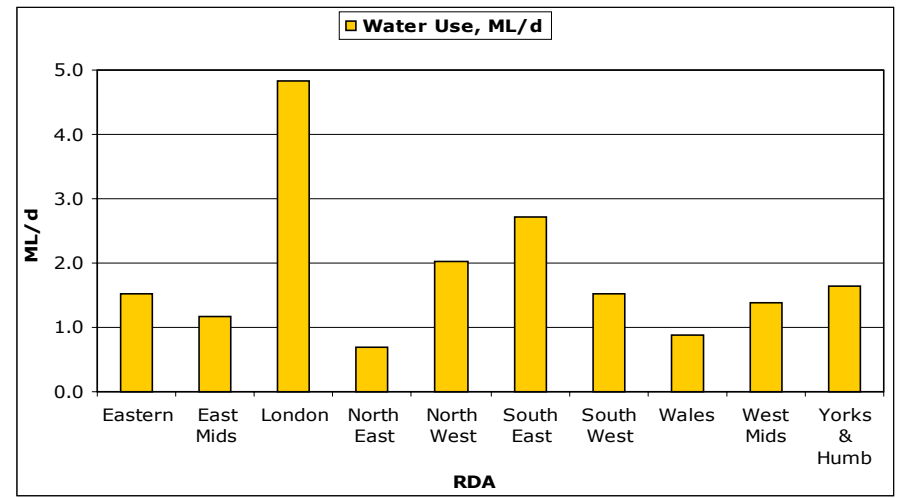
**Figure 33. Retail 52 Water Use**



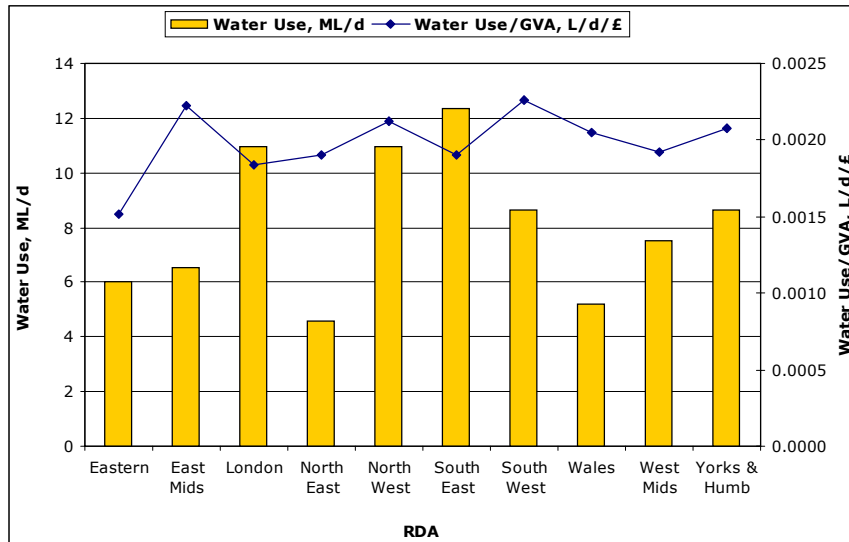
**Figure 35. Public Administration and Defence 75 Water Use**



**Figure 36. Education 80 Water Use**



**Figure 38. Recreation, Sport and Culture 92 Water Use**



**Figure 37. Health and Social 85 Water Use**

# Abbreviations

AMP	Asset Management Programme
CE	Cambridge Econometrics
DEFRA	Department for the Environment, Food and Rural Affairs
GVA	Gross Value Added
IDBR	Interdepartmental Business Register
ML/d	Megalitres per day
NALD	National Abstraction Licensing Database
NAW	National Assembly of Wales
NWDMC	National Water Demand Management Centre
OFWAT	Office of Water Services
ONS	Office forational Statistics
PCC	Per Capita Consumption
RDA	Regional Development Authority
RZ	Resource Zone
SIC	Standard Industry Classification
WCA	Water Company Area
WRERP	Welsh and Regional Economies' Resource Productivity Project
WSC	Water Supply Company