ASSESSMENT OF WATER USE IN HOMES BUILT TO CODE FOR SUSTAINABLE HOMES LEVELS 3 AND 4

PROJECT REPORT

January 2012

Kent County Council

town&country housing

VEOLIA WATER

Thames Water

south east water

Southern Water

Executive Summary

The Code for Sustainable Homes (CSH) specifies a 'mandatory maximum' water use of 105 l/cap/d for Level 3 and 4 properties but the actual performance of these homes during their early years of occupancy remains largely uncertain. This report describes a project to assess the actual water use of 317 new homes built to CSH Level 3 or 4 within the housing stock of a Kent housing association, Town & Country Housing Group (TCHG).

The project was partnership between Kent County Council, Town & Country Housing Group, South East Water, Veolia Water SE, Southern Water and Thames Water. The approach used was to bring together existing TCHG data on properties and tenants with water company data on the water meter readings and to supplement this with data on household sizes, behaviours and attitudes obtained through a telephone survey.

Good quality water use data (accurate with minimum 6 months time series) was available for 208 of the homes identified and, of these, survey data was obtained for 95 properties. By including additional TCHG information on property occupancy a working sample of 164 households and 437 occupants was available for analysis in most cases. These were spread across a total of 14 separate housing schemes and included a range of flats and houses of varying sizes.

Average daily water use was determined over the full time series available and the average per capita consumption was 116 l/cap/d. Further analysis revealed a skewed distribution of per capita consumption values that ranged from 7 to 520 l/cap/d. Most people's water use (51%) fell within the range of 40 to 105 l/cap/d but the long tail of very high water users resulted in the average being some 10% higher than the level specified within the CSH.

Differences were found between houses and flats: The average per capita consumption was 97 l/cap/d in houses and 136 l/cap/d in flats. This appeared to be explained by the large differences in household size between houses (average 3.58 occupants) and flats (average 1.89 occupants). The overall household size was 2.65 which is higher than the Kent average and would normally be expected to give rise to lower levels of per capita consumption.

Considerable differences in water consumption were found between housing schemes and this was thought to be influenced by the type of housing as well as design, management and communication issues.

A large majority households (90%) were satisfied with the water fittings in their homes, however 11% complained of "low pressure" and 8% reported having changed the fittings (especially tap aerators). The complaint of about low pressure appeared to be a reaction to the low flow fittings rather than low mains water pressure.

Overall, for the project properties, the CSH has not delivered the specified maximum average per capita water use of 105 l/cap/d and it appears to have done little to influence very high levels of individual water use by a significant proportion of occupants. This may have implications for water resources management planning and the effectiveness of local spatial planning policies.

Table of Contents

1. Background 7
2. Introduction 8
3. Project partners, roles and responsibilities 8
4. The Project Area 9
5. Aims and Objectives 10
6. Methods 11
6.1 Project Properties 11
6.2 Household Survey 12
6.2.1 Anonymous Details 12
6.2.2 The Questionnaire 12
6.3 Identification of relevant water companies 13
6.3.1 Property and Household Water Consumption 13
6.2.2 Per Capita Consumption (pcc) 14
7. Analysis and Results 15
7.1 Sample selection 15
7.2 Variables considered in the analysis 16
7.3 Water use results 16
7.3.1 Household size / property occupancy level 16
7.3.2 Property type and number of bedrooms 20
7.3.3 Type of tenancy 24
7.3.4 Housing schemes 25
7.3.5 Behavioural differences between households 26
7.4 Survey Results 27
7.4.1 Household composition 27
7.4.2 Attitudes and Behaviour 28
8. Discussion and Conclusions 29
8.1 Sample sizes and sources of error 29
8.2 Project properties and households 30
8.3 Water use performance 30

Bibliography

Appendices

List of Tables

Table 1.1 CSH Levels and per capita water use figures

Table 7.1 Total Properties and Households in the Project

Table 7.2 Per Capita Consumption in Percentage Groups

Table 7.3 Water use per property

Table 7.4 Water Use in Flats and Houses

Table 7.5 Water Use per Household

Table 7.6 Bedroom to House Type Household Water Use

Table 7.7 Water use by housing scheme

Table 7.8 Household to Household PCC

Table 7.9 Composition of single parent households

Table 7.10 Household Satisfaction and Views

List of Figures

Figure 4.1 Scheme location map

Figure 7.2 Household size in relation to water consumption

Figure 7.3 Distribution of per capita water use across all occupants

Figure 7.4 Distribution of per capita water use for surveyed households only

Figure 7.5 Property and Household Consumption by Property Size

Figure 7.6 The distribution of pcc values in houses

Figure 7.7 The distribution of pcc values in flats

Figure 7.8 The relationship between pcc and occupancy for flats and houses

Figure 7.9 The relationship between pcc and type of tenancy

Figure 7.10 Number of adults and children within the total survey sample

List of Appendices

Appendix A: Newsletter

Appendix B: Questionnaire

Appendix C: Survey Timers

Appendix D: Project Schemes – Locations and Water Company Areas

Appendix E: Number of properties and households

Appendix F: Sample Sizes

Appendix G: Summary of Survey Results

Appendix H: Typical specification for water fittings and fixtures in project properties

Acknowledgements

This project was made possible by the strong collaboration and partnership working across all the organisations involved. Thanks in particular go to Paul White, Gemma Avory and Ian McAthy for their considerable input and support.

And special thanks go to Tom Abbotts for his hard work on this project.

1. Background

In May 2008 the Government introduced the Code for Sustainable Homes (CSH) to help improve the sustainability and environmental performance of new homes[1]. The CSH is a points awarded system that is designed to quantify the overall sustainability of homes whilst leaving housing developers with flexibility in deciding exactly what efficiency features should be included. A range of environmental factors have to be addressed to gain a CSH certificate, including, water and energy consumption and materials used in the construction of the house. CSH Level 1 represents the minimum requirement and Level 6 represents a 'zero carbon' home. In a later revision to the CSH the water efficiency requirements were simplified such that levels 1 and 2 represented the same water efficiency standard, and similarly for levels 3 and 4 and levels 5 and 6 as shown in Table 1.1 below[2].

CSH level	CSH maximum per-capita water use
Levels 1 and 2	120 litres/person/day
Levels 3 and 4	105 litres/person/day
Levels 5 and 6	80 litres/person/day

Table 1.1 CSH Levels and per capita water use figures

These per-capita water consumption figures were derived from water savings that could be expected relative to the current national average use of approximately 150 litres/person/day[3][4]. This figure obviously includes existing homes and does not take account of existing spatial variations in per-capita consumption across the country. The latter point is of particular importance for Kent as the county has some of the highest levels of water use in England and Wales[5].

It is unclear whether these regional variations reflect household behavioural characteristics that can be expected to similarly influence water use in new homes, or whether they are due to variations in the characteristics of existing homes (such as house size, garden size, prevalence of swimming pools etc.) that are less likely to apply to new homes built to national standards and within similar constraints on land availability.

From local experience it is known that the water saving fittings in new homes are sometimes removed by dissatisfied households, so there is also concern regarding the longevity of water savings.

In Kent, much has been done to promote water efficiency standards through the planning system and most Kent local authorities have for some time required compliance with CSH Level 3 or 4. For water efficiency measures, this represents the upper limit of what can be achieved without resorting to more expensive rainwater harvesting or greywater recycling.

[1] http://www.planningportal.gov.uk/uploads/code_for_sust_homes.pdf
[2] http://www.planningportal.gov.uk/uploads/code_for_sustainable_homes_techguide.pdf
[3] http://www.waterwise.org.uk/data/resources/6/ensuringwaterforall_final_repor.pdf
[4] http://www.nhbcfoundation.org/Researchpublications/WaterefficiencyinnewhomesNF20/tabid/426/Default.aspx
[5] http://publications.environment-agency.gov.uk/PDF/GEHO1208BPAS-E-E.pdf

So the uncertainties explained above have a considerable bearing on the effectiveness of local spatial planning policies as well as on the adequacy of future water supply infrastructure.

Because many of the private sector homes that are currently being built received planning permission before these CSH requirements came into effect, there is a lag in the new standards becoming effective and the actual water use of new homes built by the private sector is therefore not yet apparent. In contrast, housing associations have been building new homes to meet CSH Level 3 since 2008, so it is this sector that the project has turned to in order to assess the effectiveness of the water efficiency in new homes.

2. Introduction

The Town & Country Housing Group (TCHG) initially estimated that they have built over 200 homes in Kent to CSH Level 3 or 4 and was interested to evaluate the water use of these homes. Since these were new properties they could all be expected to have water meters installed and the water companies would therefore hold records of the water use, though the water companies would not be aware of which properties had been built to the CSH standards. This project was designed to overcome these problems, bringing together the information from the housing association and the water companies, and conducting a survey of the households living in the properties.

3. Project partners, roles and responsibilities

Without prior assessment of the information from TCHG it was not possible to know with certainty where all the properties were located and, therefore, which water companies needed to be involved in the project. However there were a few housing developments that were known and, on the basis of this, South East Water (SEW) and Veolia Water South East (VWSE) were engaged as project partners. It was later found that some properties fell within the Southern Water (SW) and Thames Water (TW) company areas and fortunately both companies were also willing to get involved in the project.

The project partners were:

Kent County Council – Alan Turner (project lead)

Town & Country Housing Group – Paul White

South East Water – Gemma Avory

Veolia Water SE – Ian McAthy

Southern Water – Rebecca Burgess

Thames Water – Lesley Tait

Tom Abbotts was the Project Officer.

The overall project management was provided by KCC. This included the project design and the recruitment and employment of the project officer which was the main project cost.

Because the project officer would need to have ready access to TCHG records and would need to contact their tenant households, it was decided to place the project officer within the housing association. TCHG therefore assisted with the recruitment and provided all the operational and day-to-day management requirements for the project officer.

The contribution of the water companies was to prepare the agreement that was needed to ensure proper protection of personal information and to provide the relevant water use data and advice. They also agreed to investigate any properties where the residents had experienced problems with the water efficiency fittings, with a view to rectifying problems where possible.

4. The Project Area

As explained above, the location of the specific housing developments that would be included in the project were not completely known initially. The project therefore did not start out with a specific area but rather accommodated appropriate housing developments as and when they became apparent. The following map (Figure 4.1) shows the location of the developments that were finally included.

Figure 4.1 Scheme location map

5. Aims and Objectives

The project set out to contribute to the aim of '*A robust evidence base on the actual water use by households living in new homes in Kent that have been built to higher sustainability standards*'.

Using the housing stock of Town and Country Housing Group the project set out to achieve the objective of '*A quantification of water use in about 150 homes built to Code for Sustainable Homes Level 3 or 4 and determination of the factors that may influence this*'.

6. Methods

The housing association, TCHG, holds data on the property designs, utility infrastructure and a significant level of information about the tenant households. The project set out to supplement this information with data from a survey of the tenants and to combine this with data from the water companies in order to develop a thorough understanding of water use within these properties. To facilitate this and to protect personal or confidential data, data sharing agreements were set up between the relevant organisations (TCHG, SEW, VWSE, SW, TW and the project officer). This was mainly a protective measure whilst exchanging addresses and the possible names of some customers to gather the water meter readings based on the address list at TCHG.

In summary, the project methods were as follows:

- To identify and gather information on properties built to CSH Level 3 or 4.
- To conduct a survey of household occupancy levels, behaviours and attitudes.
- The collection and analysis of data on actual water use.

6.1 Project Properties

Working with TCHG, the project officer examined records to identify all the properties that had been built to CSH Level 3 or 4 dating back as far as November 2008. One scheme was also included that had been built to the earlier BREEAM Eco-Homes Excellent standard using very similar water saving measures. All properties had had post- completion checks by TCHG surveyors.

TCHG provides housing for a range of needs and categorises their properties and types of tenancy accordingly. These different tenancy types are explained below.

Social Housing

A social housing property is only rented. TCHG refers to these as 'General Needs' properties and further breaks these down according to their locations as **General Needs East (GNE)** and **General Needs West (GNW)**.

Shared Ownership

In the **Shared Ownership Group (SOG)** the tenant has some financial equity in the property from the outset. A variation on this is **'Rent to Home Buy' (RTH)** whereby the tenant rents the property while building up their equity in it over time.

This distinction is significant for this project because the SOG and RTH properties are built with higher quality fittings, and because having a stake in the property could influence the household's water use behaviour.

It was initially hoped that the TCHG data would include details of the specific water efficiency fittings and fixtures that had been installed in each property, but unfortunately this information proved to be too inaccessible and time consuming to collect. Instead Appendix H provides a typical specification for the water efficiency measures that were included in the project properties.

6.2 Household Survey

6.2.1 Anonymous Details

The TCHG database (Genero) holds a range of details about their tenants. This includes personal details, the tenancy contracts, financial and welfare information.

Having collected all of the addresses from the TCHG database, the contact details were made anonymous for the analysis, results and report. This enabled protection of personal data and the removal of any bias.

6.2.2 The Questionnaire

In advance of the survey a newsletter was produced and posted to all the properties involved to alert the households to the project and to explain a prize draw designed to encourage everyone to take part and increase the survey feedback (Appendix A).

TCHG have Block Champion residents who take an active role in encouraging other residents to become active in their communities. They also act as the 'eyes and ears' of their block or road giving feedback to TCHG if issues arise. TCHG also provided a number of other residents who acted as Ambassadors for the project. These Ambassadors and Block Champions promoted the start of the survey to each of their areas and helped make some adjustments to the questionnaire.

Eight Ambassador Households were contacted to help improve the survey questions and find out if the length and telephone process worked correctly and efficiently, gain tenant reactions and responses to the survey and check the internal planning and organisation of phone calls.

The survey collected information on the type and level of occupancy, the facilities within the property and the tenant's water usage both inside and outside of the properties. Comments were also gathered about the acceptability of the water fittings and suggestions for improvements (Appendix B).

The survey was telephone based to increase time efficiency. It was carried out between 27th July 2011 and 22nd August 2011 (not including weekends). Calls were made between

1000hours and 1900hours. As it was a telephone based survey it was kept down to a short 5-10 minute conversation, keeping it simple and effective for accurate and quick results. Previous householders of the properties were not contacted.

Answer phone messages and follow up phone calls were made when no one answered. This was managed using a contact sheet (Appendix C). Appointments were set up as necessary and a postal version of the questionnaire enabled tenants with less time the ability to still take part.

6.3 Identification of relevant water companies

During the design of the project it was not clear where all the housing schemes that had been built to CSH Level 3 or 4 were located as the identification of these formed one of the initial project tasks. This considerably complicated the partnership arrangements for the project and meant that the involvement of additional water companies (Southern Water and Thames Water) needed to be sought during the early stages. Fortunately both these companies were willing to get involved and support the project by providing data.

The housing schemes that formed part of the project were widely distributed across Kent and even included one scheme outside the county. This made it necessary to have several water companies involved. Using the TCHG dataset, properties were categorised by their water company according to the map boundaries and table presented in Appendix D. Some properties were close to water company area boundaries and these were checked by the relevant water company to find out how many properties were in each area.

6.3.1 Property and Household Water Consumption

As each water company records their data in a different format, it required careful merging and management with data integrity and accuracy prominent.

All water companies provided m^3 actual readings (estimates did exist but were removed for analysis purposes), SEW also provided the six monthly property consumption figures (litres/property/day or l/prop/d).

Detailed micro-component analysis of household specific usage was not used in this project. Instead the emphasis was on examining average water use over longer periods of time to remove, as far as possible, the seasonal fluctuations in water use that arise from changing weather conditions.

For housing association properties there is generally a significant turnover of tenants. One property may have had a number of different households living in it and therefore ‘property’ and ‘household’ consumption periods need to be considered independently of each other.

‘Property Consumption’ was defined as the actual water use within a house from new (normally with an initial meter reading of zero) until the most recent actual water meter reading. This could cover more than one household that had lived in the same house. To obtain property consumption in litres per day an accurate start date was needed, however

there were sometimes significant discrepancies between the start dates given by TCHG and those from the relevant water company. TCHG commonly moves tenants into several properties within a new block on the same day and the dates are derived from their contract with the tenants. Whereas the water company relies on the tenant informing them of the date they moved in and this is sometimes only resolved at the time of the first water bill. For this reason TCHG start dates were taken as more accurate and were used unless there was an earlier start date from the water company, in which case the water company's start date was used.

In contrast, 'Household Consumption' covers the tenancy for each household based on TCHG data of when each household moved in or out of the property, coupled with the recorded meter readings at the change of occupier. There could, therefore, be several household consumption figures for the same property and it was hoped that this would allow water use to be compared between previous and current households within the same property. Once again, there were some discrepancies between the two sources of dates for the change of occupier but in this case they were mostly within a day or two of each other. The TCHG data was used as the more accurate date.

Derived in this way, property consumption figures would include void periods between tenants, whereas household consumption would not. Expressed on a 'litres per day' basis this would mean that property consumption would normally be expected to be slightly less than household consumption.

Properties and households where readings did not exist or where permissions were not gained were removed from the dataset.

6.2.2 Per Capita Consumption (pcc)

The household consumption data provided the starting point for assessing per capita consumption but the calculation of pcc obviously requires the number of people in a household to be known. The primary source of occupancy details was the survey data however not all households responded to the survey. TCHG also holds occupancy data on their database and, following an accuracy check, this was used in some parts of the analysis where survey data was not available.

The survey data was assumed to be 100% accurate as it was the most up to date information. The TCHG database was compared to the survey results to check the accuracy rate of the database. In 77% of cases it matched the survey data exactly and in no case did it differ by more than one occupant.

7. Analysis and Results

7.1 Sample selection

To begin with 317 potential properties were identified that had been built to CSH Level 3 or 4. Appendix D provides the complete details and the number of properties involved according to the relevant TCHG housing schemes. As further investigation into the TCHG database and communication with the four water companies continued, fewer properties became usable in the analysis. The main reasons for this were:

- **Insufficient length of data.** If properties were registered with the water company within the last six months the water data available was insufficient to be analysed. At least six months data, preferably a year was required. In the case of the Tunbridge Wells Town Centre site all 58 properties had to be excluded for this reason.

- **Missing data.** Some properties and households did not have complete records and were removed.

- **Block metering.** This meant that a few properties did not have individual water meters and therefore had to be excluded.

After liaising with the four water companies and checking the TCHG database across all the TCHG Schemes, 208 of the 317 properties were found to have adequate water data.

Of the 208 properties, a number of tenants had moved in and out. In particular the 'YMCA, Maidstone' scheme had a high turnover of tenants. This meant that there were a total of 223 households for the 208 properties.

Category	Properties	Households
All TCHG properties built to CSH Level 3 or 4	317	> 330
Units with usable water data	208	223
Units surveyed	112	129
Units with usable water data AND survey data	95	95

Table 7.1 Total Properties and Households in the Project.

Appendix E presents the full details for each housing scheme showing how many properties and households were surveyed and assessed for water consumption. The number of households where both water use and survey data could be obtained was 95. Out of this final 95 there were no cases where both previous and present households for the same property could be interviewed.

It is important to note that the sample sizes differ in each analysis. Sample sizes for all tables and graphs are presented in Appendix F.

7.2 Variables considered in the analysis

There are a number of variables that could be considered in attempting to understand the most important influences on domestic water consumption. These were analysed on the basis of average daily property consumption (l/prop/d), average daily household consumption (l/Hhold/d) and average daily per capita consumption (l/cap/d) as appropriate. The main variables were considered to be:

- **Household size / property occupancy**. Household size has an obvious bearing on water use and the analysis of water use on a per capita basis is essential to allow comparison with the Code for Sustainable Homes.

- **Property type and number of bedrooms**. It is sometimes assumed that water use might be lower in flats than in houses as flats generally do not have a garden. This analysis would test this assumption. The number of bedrooms is often used as a proxy for occupancy and was included to aid comparison to other data sources.

- **Type of tenancy**. As explained in Section 6.1, Shared Ownership (SOG) and Rent to Home Buy (RHB) properties benefit from higher quality fittings and the tenants also have some equity in the property. This analysis was included to test whether this might influence water use.

- **Housing schemes**. Each housing scheme has a different style of houses with different room sizes and slight differences in the water fitting specifications. Perhaps more importantly the contractors would be different, management arrangements would vary and external factors such as the mains water pressure would also be different. This analysis by housing scheme would consider the significance of these factors.

- **Behavioural differences between households.** Although survey data was not available to help this analysis, the project presented a limited number of opportunities to compare the water use of different households living in the same property.

7.3 Water use results

7.3.1 Household size / property occupancy level

Based on the survey data and the TCHG occupancy data, there were a total of 437 occupants within the project households. Average household size was determined from the 129 surveyed households, they ranged from 1 to 7 and the average was 2.65. This compares to the Kent average of 2.38[6]

Figure 7.1 shows the relationship between household water use and household size. For one to four occupants the sample sizes were good and a clear relationship can be observed. However for 5 and 6+ occupant households there were only nine and seven samples respectively and consequently the relationship is less clear.

[6] https://shareweb.kent.gov.uk/Documents/facts-and-figures/kssp-2007-ceds.xls

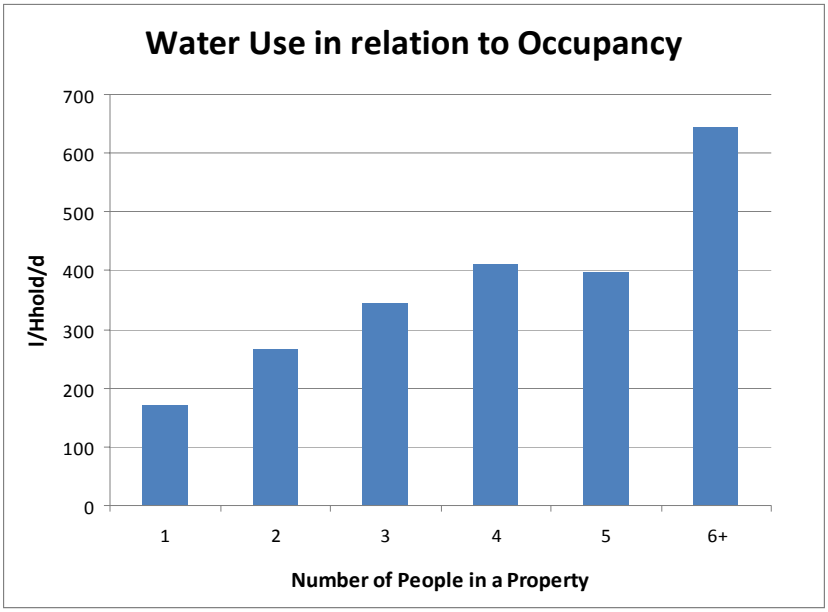

Figure 7.1 Household size in relation to water consumption.

In order to compare the water use within the project households with the figures adopted in the Code for Sustainable Homes, the data needs to be presented on the basis of per capita consumption (pcc). Figure 7.2 presents the same data as Figure 7.1 but on a per capita basis and it shows more clearly how per capita use tends to decline as household size increases.

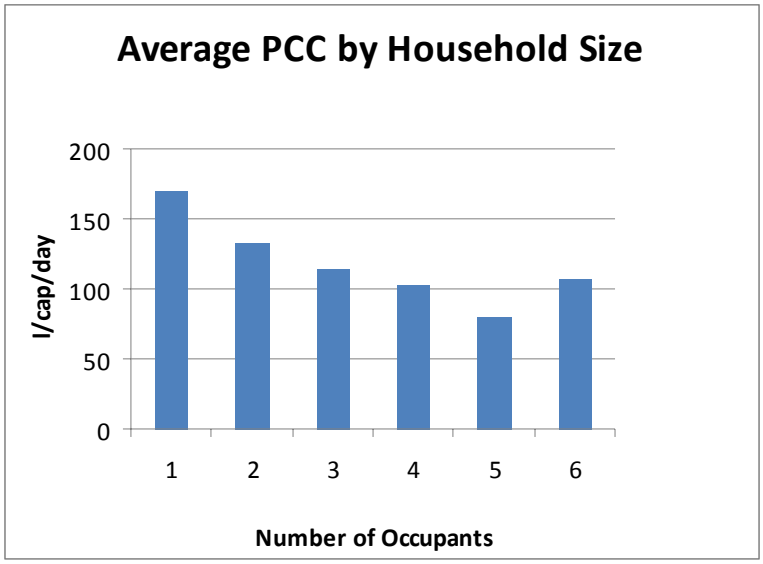

Figure 7.2 Per capita water use in relation to household size.

The overall average pcc for all the project households was 116 l/cap/d. This is somewhat higher than the maximum figure of 105 l/cap/d used in the CSH for Level 3 or 4 properties. Furthermore, given that the average household size of 2.65 is higher than the Kent and national figures of 2.38 and 2.36 respectively[7], one would expect pcc in the project properties to be lower than that assumed in the CSH.

[7] https://shareweb.kent.gov.uk/Documents/facts-and-figures/kssp-2007-ceds.xls

This assessment of pcc was based on household water use data and, consequently, any void periods between tenants would not be taken into account. This would be consistent with the way water companies assess pcc.

Distribution of per capita consumption

Figure 7.2 shows the average pcc but it is also useful to understand the nature of the distribution that exists around this average.

There were 95 households for which occupancy data was known from the survey and which also had water use data. For this analysis additional occupancy data from the slightly less accurate TCHG database (See Section 6.2.2) was used to increase this figure to 164 households with a total of 437 occupants. A distribution analysis was then performed on the 437 pcc values to produce the histogram shown in Figure 7.3. (Note that, for ease of presentation, the final column represents all the pcc values above 250 l/cap/d).

Results show that, although the average is higher than the maximum specified for CSH Level 3 or 4 of 105l/cap/d, for 54% of occupants their pcc falls below that value and the highest number of households falls within the 70 to <80 l/cap/d band (52 occurrences). This situation is made possible by the skewed distribution with a long tail of very high water users and a much shorter tail of very low users.

These extreme values were investigated further, cross checked and validated, where possible, with information from the survey. In a number of cases the survey data provided explanation: For example, one survey record for an extremely low pcc figure revealed a single person who only slept at home, eating and showering at work or the gym.

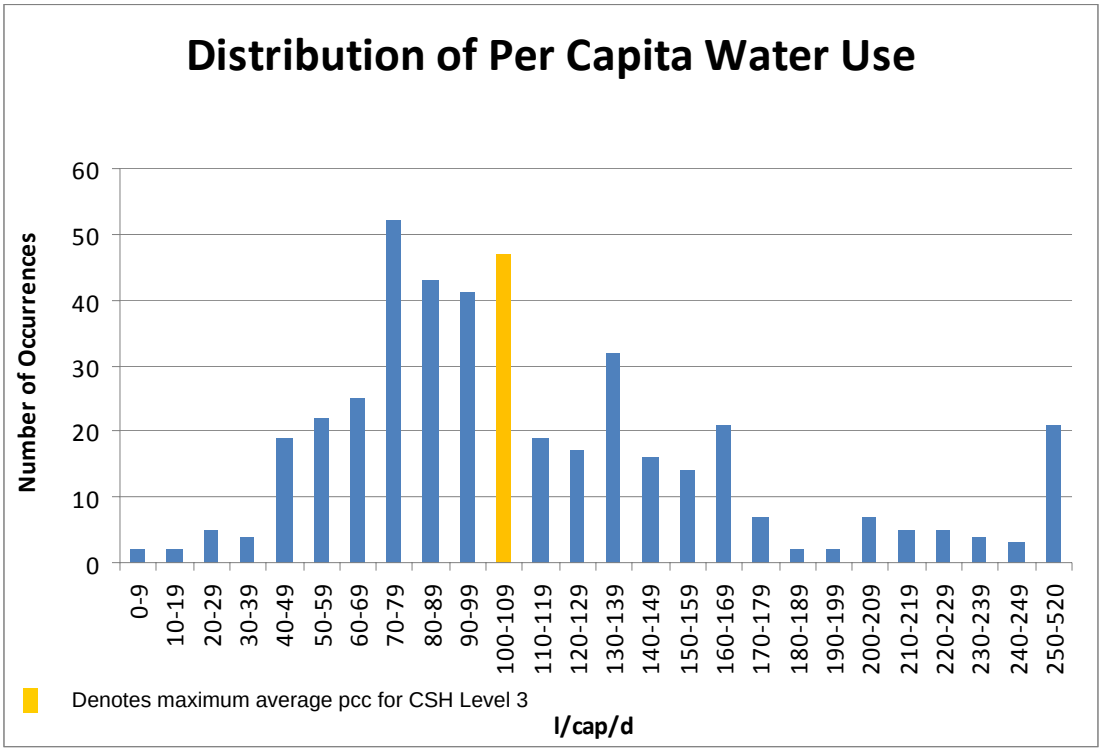

Figure 7.3 Distribution of per capita water use across all occupants.

The actual pcc values ranged from 7 to 520 l/cap/d, the median was 102 l/cap/d and the mode 103 l/cap/d. For 18% of occupants their pcc was higher than the Southeast England regional average of 160 l/cap/d which applies to all properties, new and old[8].

To further investigate the extreme pcc values, households were grouped into five pcc bands as shown in Table 7.2 below.

Water Consumption		Percentage of occupants
Very Low Users:	<40 l/cap/d	3%
Low Users:	40 to <105 l/cap/d	51%
Above CSH 3 Level:	105 to <160 l/cap/d	28%
High Users:	160 to <250 l/cap/d	13%
Very High Users:	250 to 520 l/cap/d	5%

Table 7.2 Per Capita Consumption in Percentage Groups.

Out of all the occupants with pcc levels above 160 l/cap/d, none lived in households larger than 4 people. For those using more than 250 l/cap/d, none lived in households larger than 3 people. However, within the 'low' and 'very low users' the relationship between pcc and household size is less pronounced as a third of all the single occupants fell within this group.

To check whether the limited accuracy of the TCHG occupancy data had introduced any systematic error, the above analysis was repeated using only the surveyed households (See Figure 7.4 below). Because of the smaller sample size the distribution pattern is less clear but it does confirm the relationship. Furthermore the average pcc differed by just 2% at 113 l/cap/d. The full dataset can therefore be used with reasonable confidence.

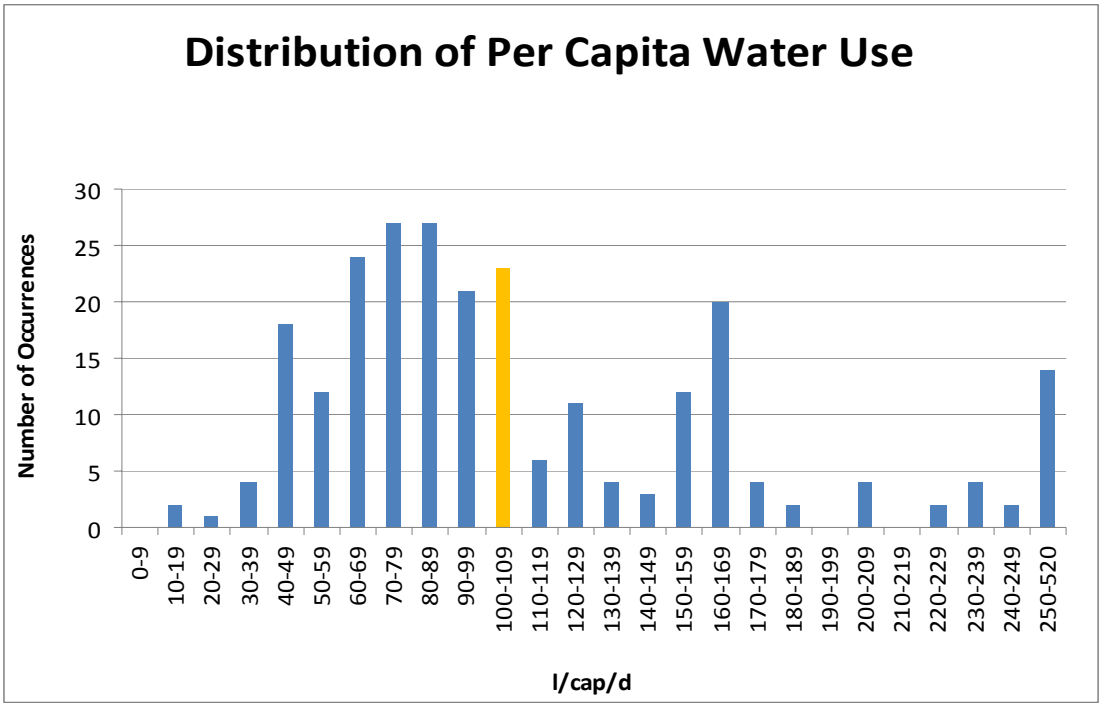

Figure 7.4 Distribution of per capita water use for surveyed households only.

[8] http://www.waterwise.org.uk/data/resources/6/ensuringwaterforall_final_repor.pdf

7.3.2 Property type and number of bedrooms

Table 7.3 below shows the average daily water use per property for all the properties where water use data was available.

House/Flat	Property Consumption (l/prop/d)	Property Consumption Sample Size
House	329	86
Flat	237	122
Overall Average	275	208

Table 7.3 Water use per property.

For the properties analysed in this project, average water use in the flats was significantly lower than for houses, however this seems to simply reflect the fact that the flats were smaller (ie had less bedrooms) than the houses. It is more useful to make comparison between properties with the same number of bedrooms as in Table 7.4 below. TCHG has a deliberate policy of trying to avoid under-occupancy of properties so the number of bedrooms is a reasonable proxy for the number of occupants.

	Water consumption (l/prop/d)			
House Type	**1 Bed**	**2 Bed**	**3 Bed**	**4 Bed**
House	164*	242	323	522
Flat	175	245	745	n/a
Average	175	244	365	522

Table 7.4 Water Use in Flats and Houses. (*Sample size of one)

Due to inconsistencies in sample sizes care must be taken in drawing any conclusions from this data other than to state that water use clearly increases with the number of bedrooms. There were no 4 bedroom flats in the sample, just one 1 bedroom house and only five 3 bedroom flats. Comparison between flats and houses is therefore only possible for 2 bedroom properties (sample sizes 68 and 26 respectively). Water use in 2 bedroom properties does not appear to vary between flats and houses.

It is interesting to note that three bedroom flats only exist in the Orpington Scheme. On further investigation, the scheme has been designed as a mix of one, two and three bed flats within a block. All of the Orpington flats had a higher than average consumption of 517 l/prop/d. This also makes Orpington the highest scheme consumer. The accuracy of the water data for this scheme was confirmed by Thames Water and the very high usage remains unexplained.

Property type and size was also examined on the basis of household consumption. The key results are shown in Tables 7.5 and 7.6 below.

House/Flat	Household Consumption (l/Hhold/d)	Household Consumption Sample Size
House	368	94
Flat	256	129
Overall Average	303	223

Table 7.5 Water Use per Household.

Household Water Consumption (l/Hhold/d)				
	1 Bed	**2 Bed**	**3 Bed**	**4 Bed**
House	176*	263	361	585
Flat	188	272	745	n/a
Overall Average	187	270	395	585

Table 7.6 Bedroom to House Type Household Water Use. (*Sample size of one)

Similarly to property consumption, household water use is higher in houses and increases with the number of bedrooms. Once again small sample sizes make it impossible to draw conclusions except in the case of 2 bedroom properties which differ only slightly in household water use between houses and flats. Nevertheless a relatively clear relationship can be seen in Figure 7.5.

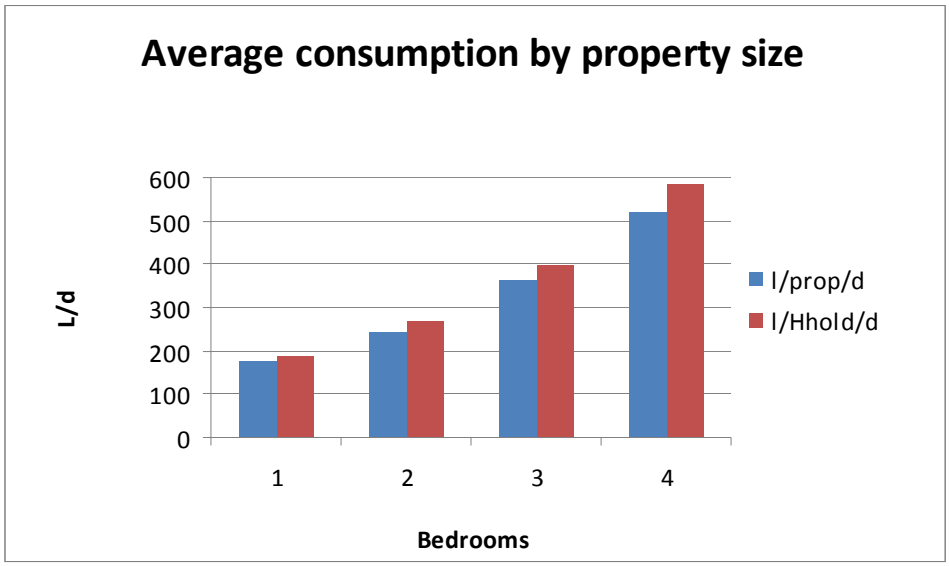

Figure 7.5 Property and Household Consumption by Property Size.

Properties can remain vacant for short periods when households take time between moving in and out. Property consumption includes these void periods and therefore tends to be lower than household consumption when considered on an average daily basis (See section 6.2.1).

A more interesting picture emerges when examining property size and type on the basis of per capita consumption, as shown in Figures 7.6 and 7.7 below.

The average pcc was 97 l/cap/d for houses compared with 136 l/cap/d for flats. The medians were 88 l/cap/d and 121 l/cap/d respectively. Differences are also apparent in the shape of the distribution curve: Water use in flats has a wider range with considerably more high users; 62% of occupants in flats were found to use more than 105 l/cap/d, this compares with just 31% for houses.

Based on the survey data, the average household size for flats and houses were also found to differ significantly at 1.89 for flats and 3.58 for houses. This household size for houses is unusually high and is likely to go some way to explaining these differing pcc distributions.

To examine this further, trend lines have been fitted to the project data on pcc and occupancy in Figure 7.8. The sample sizes are shown in Appendix F and were adequate except for four person, five person and six person households in flats (8, 0 and 4 occurrences respectively) and six person households in houses (2 occurrences). The graph shows that the observed differences in pcc for flats and houses might be entirely explained by the differing average household size.

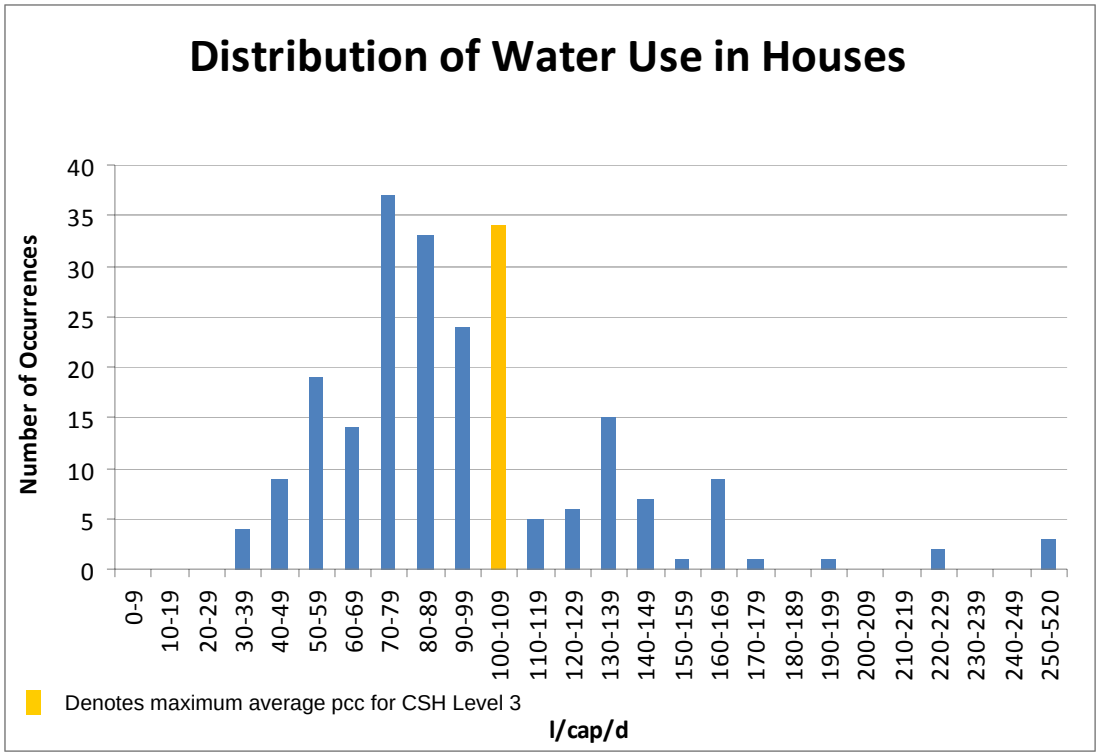

Figure 7.6 The distribution of pcc values in houses.

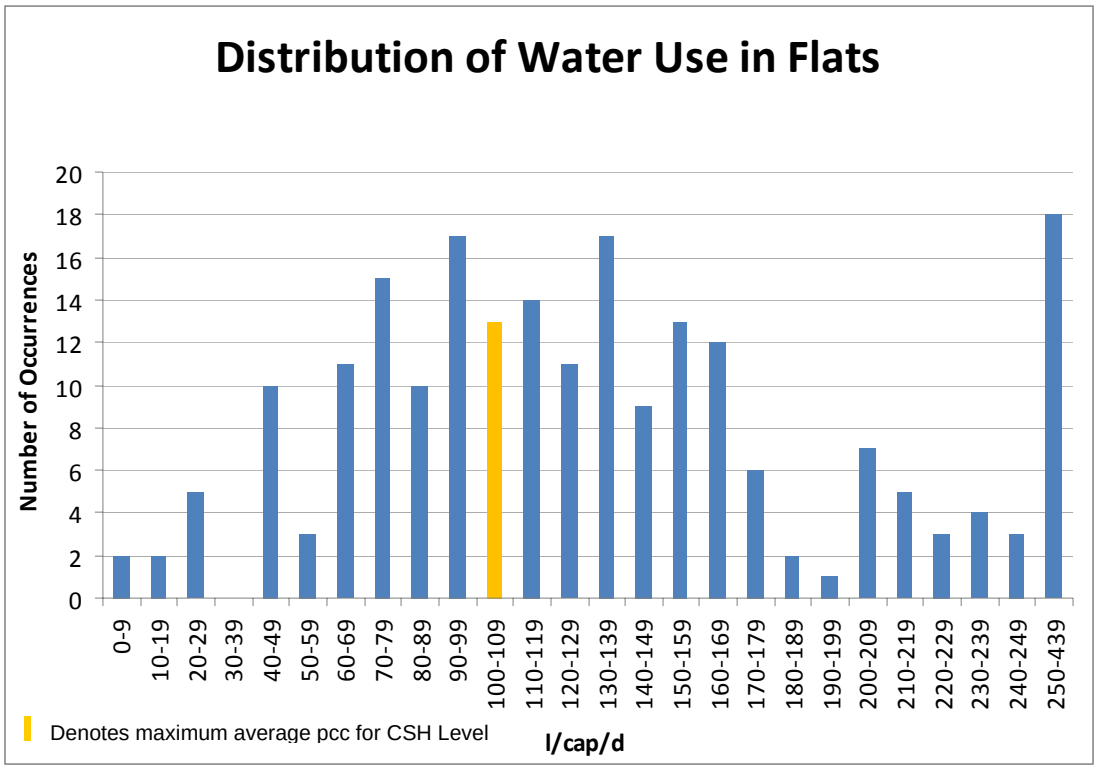

Figure 7.7 The distribution of pcc values in flats.

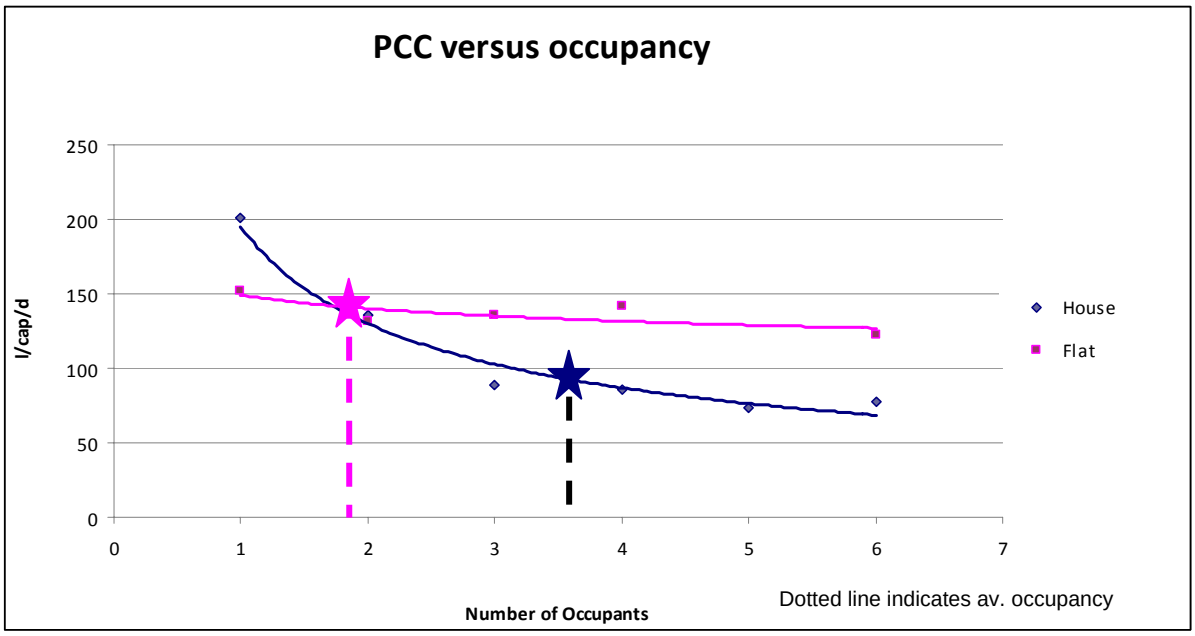

Figure 7.8 The relationship between pcc and occupancy for flats and houses

7.3.3 Type of tenancy

Data was also examined to investigate whether the different types of tenancy (see Section 6.1) might have some influence on water use as it appeared feasible that tenants who have some equity in their property might behave differently and might be more representative of the general population of owner-occupiers. There were also differences in the quality of the fittings used according to tenancy type. The results are shown in Figure 7.9 below. No particular patterns could be observed and the differences between the two categories of social housing (GNW and GNE) were generally greater than the differences between social housing and those where tenants have some equity in the property (RTH and SOG).

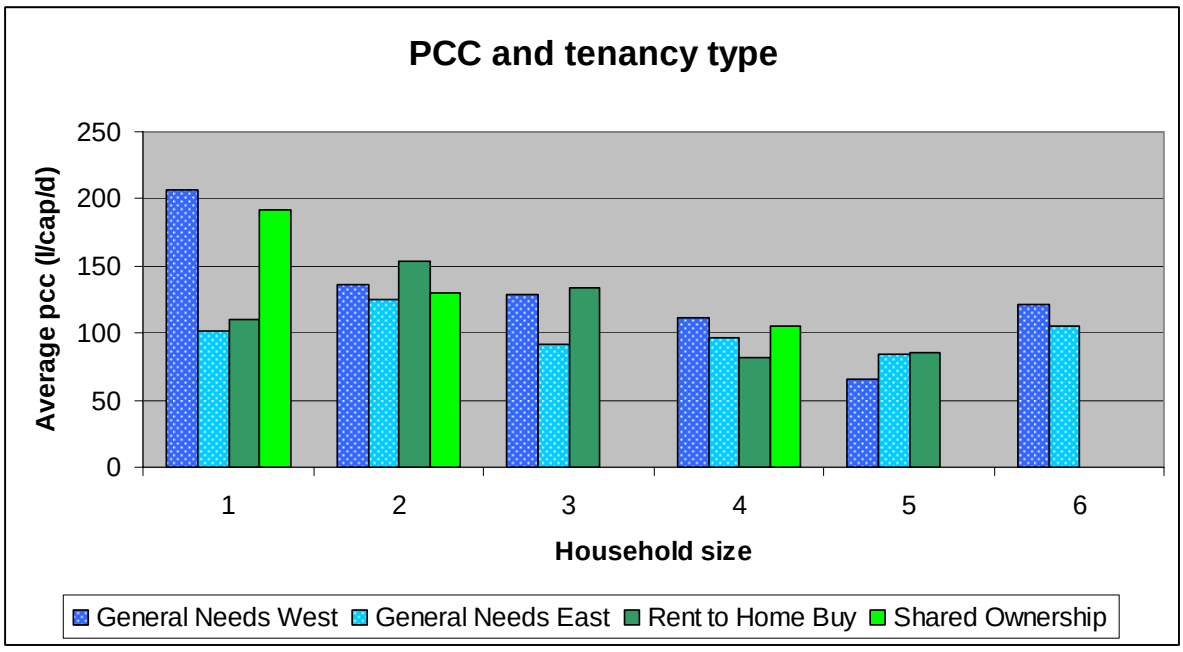

Figure 7.9 The relationship between pcc and type of tenancy.

7.3.4 Housing schemes

It is likely that differences between the specific housing schemes may have a significant bearing on the results. Some schemes comprise mainly houses and others only flats, for a project of this scale it is therefore impossible to separate out differences between schemes from differences between property types.

Table 7.7 shows the average household consumption, occupancy and pcc for each of the schemes where water data was available and Appendix E provides details of the number of properties involved within each scheme.

Discussion with TCHG reveals that some of the schemes with high average pcc values (notably Parkwood Tavern and Snodland) experienced post-occupancy problems with some of the water fittings. The contractor received numerous complaints that the taps and showers were running very slowly and it is believed that many of the flow controls may have been removed within these schemes. The Snodland scheme showed particularly wide spread of pcc results with a high proportion of both high and low water users.

TCHG Scheme Name	Property Type	Water Company Area	Av. Household water consumption l/Hhold/d	Average occupancy	Average PCC l/cap/d
Deal	Houses	Southern Water	314	2.00	157.14
Parkwood Tavern	Flats	South East Water	271	1.85	146.46
Snodland	Flats & Houses	South East Water	391	3.46	113.02
YMCA, Maidstone	Flats	South East Water	174	1.71	101.39
Gravesend	Houses	Southern Water	374	3.75	99.81
Otford	Houses	South East Water	360	3.75	96.01
Hersden	Houses	South East Water	411	4.29	95.86
Herne Bay	Flats & Houses	South East Water	202	2.16	93.65
Folkestone	Flats	Veolia Water SE	219	2.44	89.94
Tunbridge Wells Sherwood Site	Houses	South East Water	265	3.00	88.27
Southborough	Houses	South East Water	359	4.40	81.64
Buxted	Houses	South East Water	140	2.00	69.98
Matfield	Flats & Houses	South East Water	167	2.50	66.67
Orpington*	Flats	Thames Water	520	N/A	N/A

Table 7.7 Water use by housing scheme. * Note: this scheme had insufficient occupancy data

7.3.5 Behavioural differences between households

There were 17 properties that had had more than one household living in them and it was hoped that this would allow comparison between the water use of different households living within the same property. Unfortunately though there were only 7 cases where household size data was available for both the first and second households and it had not been possible to survey any of these households. Comparison of pcc between households therefore had to be done relying entirely on the less accurate occupancy data from the TCHG database (as described in Section 6.2.2).

Property Number	First Household (l/cap/d)	Second Household (l/cap/d)
1	168	126
2	39	275
3	380	160
4	131	73
5	212	520
6	149	95
7	137	272

Table 7.8 Household to Household PCC

Table 7.8 presents the results of the household to household comparisons that could be made. The results show that in every case the pcc figures differ greatly. This tends to suggest that the primary influence on pcc is the water use behaviour of household members rather than the water saving fittings installed within these properties. However there is a low level of confidence in this finding.

7.4 Survey Results

The main purpose of the household survey was to determine household sizes, however the opportunity was also taken to ask questions about water use practices and to gauge the level of satisfaction with the water fittings and fixtures.

7.4.1 Household composition

The survey results cover 129 households all of which had current tenancy periods according to TCHG. A total of 46% of all contacted households responded to the survey. These households comprised 209 adults and 115 children (children were defined as under 16).

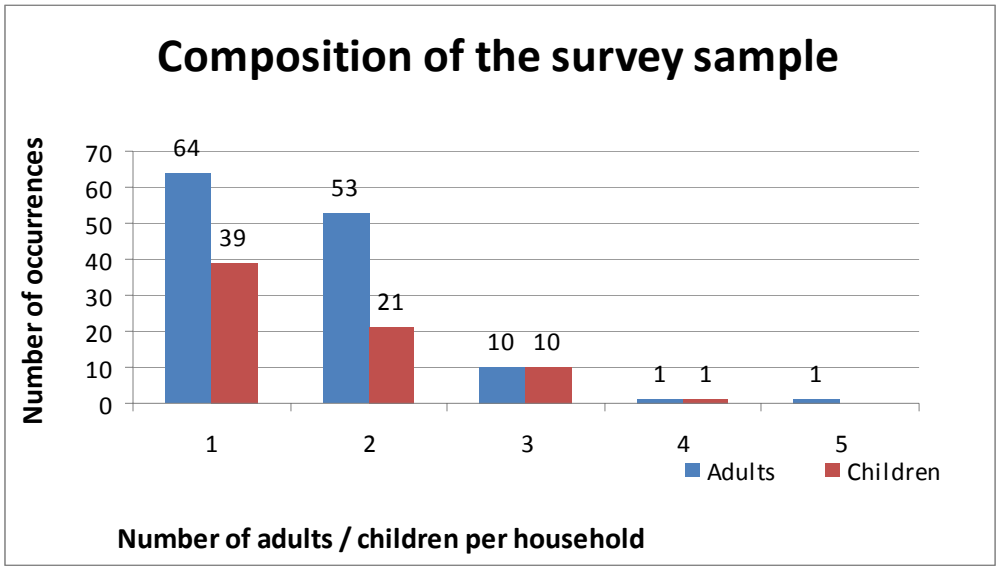

Figure 7.10 Number of adults and children within the total survey sample.

Appendix F provides full details of the composition for the all the surveyed households.

On average there were 2.65 occupants per household. The majority (54%) of households comprised one or two occupants.

There were a number of households living as single parents as shown in Table 7.9 below.

Household Composition	Frequency
Single Occupancy	35
1 Adult & 1 Child	17
1 Adult & 2 Children	8
1 Adult & 3 Children	4

Table 7.9 Composition of single parent households

7.4.2 Attitudes and Behaviour

Despite some of the specific problems that have already been reported, there was a generally high level of satisfaction with the water fittings and fixtures: 90% of surveyed households said that the water fittings and fixtures were suited to their needs. However 14 respondents (11%) complained about low pressure and a total of 8 respondents (6%) reported having removed tap aerators or changed showerheads. It appears that complaints about low pressure are most likely a negative reaction to the low flow fittings rather than an issue of low mains supply pressure. A slightly higher proportion (13%) felt the need to save water and said that they are planning to make additional savings in future.

Answers to some general questions are given in Table 7.10 below and a summary of the full survey responses is provided in Appendix G.

Question Asked	Low	Medium	High
Thinking about your water related fixtures and appliances overall, how would you rate them?	12%	49%	39%
How would you describe your families' water usage?	31%	56%	13%
Thinking about yourself, how would you describe your own water usage?	44%	53%	3%

Table 7.10 Household Satisfaction and Views

In some earlier housing schemes the Resident Information Packs supplied to TCHG tenants may not have made it completely clear that the purpose of the low flow fittings is to help them save water and this may have contributed to a few cases of dissatisfaction and complaints of 'low pressure'. This issue was had been quickly rectified in later schemes.

8. Discussion and Conclusions

The project was conceived primarily to bring together two sources of existing data, namely the TCHG records of properties and water company records of water use. The fact that these data sources already existed meant that there was no risk of the project activities inadvertently influencing household water use behaviour and the project results provide a useful insight into the actual water use of households living in new homes built to Code for Sustainable Homes Level 3 or 4.

The project was intended to pilot this approach to obtaining and analysing data on the performance of new homes and it has been successful in achieving this: it has provided useful learning on a number of points at the same time as delivering valuable results.

8.1 Sample sizes and sources of error

To begin with the number of properties involved in the project appeared to be sufficient to give strong results and allow robust conclusions, however the number of properties was gradually eroded by data availability and data quality issues. This meant that sample sizes were too small to allow some types of analysis. In particular, the analysis of water use in relation to bedroom numbers was constrained by this, as was the analysis of different households within the same property. In addition, one of the water companies suggested separating out data for one complete year so that the results could be compared with other water company data for the same period, but this also proved impossible as sample sizes became too small to give meaningful results.

Both the water companies and the housing association held records of the 'start dates' when a property was first occupied but these two data sources were seldom in agreement. Usually this was only a matter of a few days difference but there were cases where the water company's start date was several months later than TCHG records. It is thought that, by adjusting the start date to take the earlier of the two dates, this source of error was reduced overall, but it is also possible that this introduced errors in specific cases.

There is a high level of confidence in the accuracy of the results that are presented in Section 7, however it is clear that there are also significant variations between housing schemes. So the results reflect the water use performance within these 14 housing schemes with a reasonable level of accuracy but care needs to be taken in drawing conclusions regarding the water use performance of new housing association properties in general. Whether these housing association properties will be representative of private sector housing developments built to the same standards is a further area of uncertainty, however the findings from this project can provide some useful indications in this respect.

It would be useful to undertake a larger scale assessment across a number of housing associations to build on these results and increase the level of confidence in the high level findings. It would also be useful to conduct a similar assessment of private sector housing built to CSH Level 3 or 4 as soon as at least 500 such homes can be identified that have been occupied for at least a year. It might be useful to also include assessment of the actual energy use within these homes although this would probably necessitate a different approach using each households' own energy bills to determine usage.

8.2 Project properties and households

The fact that the properties were largely social housing does not appear to have had a significant bearing on the results in itself, however it does clearly influence the average household size within the properties and this in turn has a considerable influence on per capita water consumption.

As TCHG tenants, there are restrictions on households making changes to their property themselves. TCHG has a first year defects policy where changes or damaged items can be fixed by a TCHG maintenance team in the first year of a property's life. On the one hand this might encourage tenants to request changes but, on the other hand, it might make them cautious about reporting changes that they might have made themselves. An under-reporting of changes to the water fittings is therefore a possibility.

The overall level of satisfaction with the water saving measures (90%) is moderately encouraging and reflects the high degree of commitment and considerable efforts that TCHG has made to delivering high quality homes. However, that 10% are dissatisfied and a similar proportion has made changes to the fittings is of concern. Whether these changes have led to increased water use is not clear. Dissatisfaction appears to have been concentrated within specific housing schemes and this suggests that there may be design and / or management issues involved (TCHG has already committed to investigate and respond to this). It is also possible that dissatisfaction with the fittings might have in part resulted from communication failures as, despite the clear information provided by TCHG, some tenants may not realise that the low flow rates were designed to help them save water and wrongly interpret this as a 'low pressure' problem.

It would be useful to further investigate the Snodland scheme in particular. This could include using micro-component analysis to better understand the wide range of pcc within this scheme and to see how this relates to the issues raised by the survey respondents.

The key findings from this project should be presented within the TCHG newsletter that goes out to their tenants to provide the participating households with feedback and thanks for their involvement.

8.3 Water use performance

The headline average pcc in the project homes has been found to be approximately 10% higher than the maximum level specified in the Code for Sustainable Homes. However there are a number of issues that have a bearing on whether or not this should be cause for concern.

The CSH applies to the whole country and does not take into account existing regional variations in per capita consumption. Existing pcc levels for metered homes in Kent are about 10% above the national average and are particularly high in the west of the county. It could therefore be argued that the CSH water efficiency measures are performing as expected. However metered pcc, as reported by the water companies, includes older properties that have opted to go onto a water meter, so it is possible that the higher Kent pcc figure is a factor of the characteristics of the existing Kent homes (generally less dense developments, houses with larger gardens, swimming pools etc.) and is not representative of new homes.

Data from an earlier project undertaken in Ashford with South East Water called 'Savings on Tap' can help in this discussion[9]. That project assessed the water use in new homes built by a private developer. The homes pre-dated the Code for Sustainable Homes but were later judged to meet Level 1 or 2. The project also included a control group of 50 new homes that did not have any water efficiency measures. Surveys of occupancy have been repeated at regular intervals along with detailed assessment of water consumption. Over the years 2008, 2009 and 2010 the average pcc in the control properties was 127 l/cap/d and in the water efficient properties it was 119 l/cap/d (a 7% reduction). When compared to South East Water's base pcc for metered homes of 158 l/cap/d for the same period it appears that, even without water efficiency measures, new homes perform significantly better than the current metered housing stock. This suggests that the impact of water efficiency measures may be less significant than other characteristics of new homes such as smaller gardens and improved plumbing systems.

Caution is needed in making direct comparisons between these two different projects, however the data suggest that there may be diminishing savings from simply reducing flow rates to water fittings and that this approach may not be sufficient to deliver the levels of per capita consumption that have been assumed in the Code for Sustainable Homes: Despite these water saving measures some people still manage to use huge quantities of water and, for these households, it must be concluded that the Code for Sustainable Homes is ineffective. A re-examination of the pcc distribution data presented in Figure 7.3 shows that an overall average pcc of 105 l/cap/d would be achieved if all those households with 'high' and 'very high' pcc levels were to limit their consumption to 165 l/cap/d.

CSH Level 1 and 2 can be achieved with fittings that do not impact significantly on the occupants. However CSH Level 3 and 4 require flow rates for taps and showers that some people find unacceptable especially for any activities that require a certain volume of water (e.g. filling cooking pots, dish washing basins, baths and wash basins) and it appears that this may be limiting the water savings that can be achieved. Indeed the typical specification for water use fittings used by TCHG (Appendix H) includes two stage 'click' type kitchen taps with a standard flow rate of 2.5 l/min and a second stage flow rate of 5 l/min that can be obtained by holding the tap lever against a spring. Both these flow rates are low for a tap that will predominantly be used to deliver specific water volumes and it is possible that this was the main cause of the cases of dissatisfaction and modification of the taps. Trade-offs can be made with other fittings to allow slightly higher flow rates for the kitchen tap - for example by decreasing the bath size - but CSH Level 3 and 4 demands some difficult choices for the water fittings[10].

The average household size within the project homes was some 15% above the Kent average. This would normally be expected to give rise to lower pcc levels, so the fact that the average pcc was found to be above the CSH figure of 105 l/cap/d is cause for concern.

The comparison between flats and houses provides some interesting results. The primary issue here appears to be that the lower household sizes generally found in flats is driving higher levels of pcc, however the distribution of the results was also more extreme than for houses and one particular scheme (Orpington) showed very high usage.

The results show that the water fitting requirements of the CSH do lead to reduced water use, however the very wide range of per capita consumption identified in this project indicates that people's water use behaviour has a larger bearing on their actual volumetric use. The specification and introduction of water saving fittings is clearly much simpler than influencing water use behaviour, but both are needed to achieve sustainable levels of water

[9] Personal communication with Gemma Avory, South East Water, October 2011.

[10] Department for Communities and Local Government (2009), The Water Efficiency Calculator for new dwellings. http://www.communities.gov.uk/publications/planningandbuilding/watercalculator

use in new homes. Most of the households in this project were found to use relatively modest quantities of water but the overall average was increased by a significant number of very high water users. Further work would be useful to better understand the attitudes and values of both these groups and to develop communication messages that can reinforce the desirable behaviour of the modest water users and challenge the behaviour of the very high water users.

Given the skewed shape of the pcc distribution curve, communication based on 'social norms' might prove useful: It has been found elsewhere that merely telling people that most other people use less energy than they do tends to make those households reduce consumption to closer fit the norm[11]. The same is likely to apply to water use. In this project it was found that most people use less than 105 l/cap/d and this might form a useful basis for communications targeted at the high water using households.

Water use within the project properties was 10% higher than that specified in the Code for Sustainable Homes for Level 3 or 4 despite the average household size of 2.65 people. Regional variations in pcc levels may have some bearing on this, however the main issue appears to be that the water saving measures alone are not effective at preventing very high levels of water use – the water use behaviour of households appears to be more significant.

Both efficient water fittings and behaviour change appear to be necessary to achieve sustainable water use in new homes. Communications based on 'social norms' may be effective at influencing behaviour when targeted at high water using households.

Per capita consumption was generally higher in flats than in houses and most of the very high water users were in flats. This suggests that messages about water saving within the home from water companies and others might be best targeted at those living in flats.

The flats within the Orpington scheme were found to use considerably more water than other schemes and some further investigation of the causes of this would be useful.

Cases of dissatisfaction with the water fittings are likely to be linked to the specifications used, especially for kitchen taps.

This project has successfully examined the water use performance of a sample of housing association properties built to the Code for Sustainable Homes Levels 3 and 4 and has been able to draw some high level conclusions.

Overall, for the project properties, the CSH has not delivered the specified maximum average per capita water use of 105 l/cap/d and it appears to have done little to influence very high levels of individual water use by a significant proportion of occupants. This calls into question whether the CSH will deliver the anticipated level of water savings within new homes in general and could have implications for water resource planning and the adequacy of Local Development Framework policies regarding water efficiency.

The approach taken by the project has proved successful, however its scale proved slightly too small and this prevented some lines of analysis.

[11] Gifford, R. (2011). *The Dragons of Inaction: Psychological Barriers that Limit Climate Change Mitigation*. American Psychologist, May – June 2011.

Bibliography

Department for Communities and Local Government (2006). Code for Sustainable Homes: A step-change in sustainable home building practice. http://www.planningportal.gov.uk/uploads/code_for_sust_homes.pdf

Department for Communities and Local Government (2009), The Water Efficiency Calculator for new dwellings. http://www.communities.gov.uk/publications/planningandbuilding/watercalculator

Department for Communities and Local Government (2008). Code for Sustainable Homes: Setting the Standard in Sustainability for New Homes, Department for Communities and Local Government, London.

Department for Communities and Local Government (2010). Code for Sustainable Homes, Technical Guide November 2020. http://www.planningportal.gov.uk/uploads/code_for_sustainable_homes_techguide.pdf

Environment Agency (2008). Water Resources in England and Wales – current state and future pressures. http://publications.environment-agency.gov.uk/PDF/GEHO1208BPAS-E-E.pdf

Environment Agency (2009) Water for People and the Environment: Water Resources Strategy for England and Wales, Bristol. Figure 1.9, p22.

Environment Agency et. al (2010) Ensuring Water for All: Scoping Study Final Report, Figure 1.1 p6-8.

HM Government (2010) The Building Regulations 2000, Sanitation, Hot Water Safety and Water Efficiency, NBS, London.

Kent County Council (2011). 2001 Census Area Profiles. https://shareweb.kent.gov.uk/Documents/facts-and-figures/kssp-2007-ceds.xls

NHBC Foundation (2010). Water Efficiency in New Homes. http://www.nhbcfoundation.org/Researchpublications/WaterefficiencyinnewhomesNF20/tabid/426/Default.aspx

Appendices

Appendix A: Newsletter

town & country housing

your own space

Town & Country Housing Group
Monson House, Monson Way,
Tunbridge Wells, Kent TN1 1LO
Phone 0845 873 1 321
Email info@tchg.org.uk
www.tchg.org.uk

Take part in this water use survey and you could win £50 in Vouchers!

We are contacting residents who live in homes which have been built in the last five years, to talk about water use and how satisfied they are with the items such as taps sinks and showers at their home.

We will telephone you and ask you a few simple questions such as, "How would you describe your family water usage?" And, "Do you wash your car at home?" This will take no more than ten minutes of your time. There are no survey forms for you to complete. However, if you would like us to visit you to complete the survey we will be happy to do this.

The information you give will be used by Kent Country Council, the local water companies and ourselves to understand how residents use water so that we can make improvements and plan for the future.

Everyone who completes the survey will be eligible to be entered into a prize draw.

The 1st prize is £50 in Argos Vouchers; 2nd Prize £30 in Argos Vouchers and the 3rd Prize £20 in Argos Vouchers.

We will telephone residents during July and August. The prize draw will be made in September. More information on the survey is available on our website: www.tchg.org.uk.

Thank you for your help with this.

Yours sincerely

Tom Abbotts
Project Officer - Development

Appendix B: Questionnaire

Question Number	Question	Definitions
1. Personal Details	Anonymous Number	Anonymous Identification Code
1A.	How many adults live at the property?	All those aged over 16
1B.	Does that include anyone who lives away? **(Yes, 1C, No 1D.)**	For example, armed forces, university students
1C.	How many people live away from home?	
1D.	Do you have any children living at home? **(Yes 1E, No, 1F.)**	Yes/No
1E.	How many children live with you?	All those aged under 16
1F.	When did you move in to your property? (DD/MM//YYYY)	Date of Property Move
1G.	Has your household/family changed in size since you moved in?	Yes/No To help assist in measuring water consumption changes.
1H.	Increased by, decreased by	
2. Property Type		
2A.	Is your Property Detached/Semi Detached/Flat/Terrace/Studio?	Building type: is it connected to another building.
2B.	How many bathrooms do you have?	
	Separate	
	En-suite	
2C.	Do you have a cloak room?	
2D.	How many toilets do you have?	
2E.	Do you have a bath shower area?	
2F.	Do you have a separate shower from your bath? **(Yes 2F, No 2G.)**	
2G.	How many?	
2H.	How many sinks are in your property?	
	Do you own a washing machine?	
2J.	How often do you use your washing machine? (per week)	
2K	Do you own a dishwasher?	
2L.	How often do you use your dishwasher?	
3. Facilities' Satisfaction		
3A.	Thinking about your water related fixtures and appliances overall, how would you rate them?	High/Medium/Low
3B.	Do you think your water fixtures and appliances are suited to your needs? **(Yes, 3D, No 3C.)**	Yes/No
3C.	What would you suggest would help improve the facilities?	

Question Number	Question	Definitions
3D.	Have you made any changes to your fixtures and fittings? **(Yes 3E, No 4A).**	Yes/No
3E.	What changes have you made?	
4. Water Use		
4A.	How would you describe your families' water usage?	High/Medium/Low
4B.	Is it something that you think about? **(If Yes, go to 4C, No 4E).**	**Low:** Never Really think about it.
4C.	Would you say you are careful with your water use? **If Yes, 4D, No 4E).**	**Medium:** Careful with water use but can't give examples of specific behaviour.
4D.	Can you give examples of things you do to save water?	**High:** Very Conscious of water use and able to give examples of specific water saving behaviour.
4D1	Examples:	
4E.	Are you planning any water saving techniques? **(If Yes go to 4F.)**	Yes/No
4F.	What would you like to do?	
	Skip 4G to 4M if there is only one occupant.	
4G.	Thinking about yourself, how would you describe your own water usage?	High/Medium/Low
4H.	Is it something that you think about? **(If Yes, go to 4J, No 4L).**	**Low:** Never Really think about it.
4J	Would you say you are careful with your water use? **If Yes, 4K, No 4L).**	**Medium:** Careful with water use but can't give examples of specific behaviour.
4J1	Comments:	
4K.	Can you give examples of things you do to save water?	**High:** Very Conscious of water use and able to give examples of specific water saving behaviour.
4K1.	Examples:	
4L.	Are you planning any water saving techniques? **(If Yes go to 4M, No, 5.)**	
4M.	What would you like to do?	
5. Fixtures & Fittings		
5A.	Do you have a garden? **(Yes 5B, No, 5D.)**	Yes/No
5B.	**How often do you water your garden?**	Daily, Weekly, Fortnightly Monthly, never.
5C.	Is that during any particular season?	Spring, Summer, Autumn, Winter
5D.	Do you have any water butts?	Yes/No
5E.	Do you have an outside tap?	Yes/No
5F.	Do you have other outdoor water uses	Yes/No

Question Number	Question	Definitions
	E.g. Paddling pool?	
5G.	Do you own a car? **(Yes go to 5H, No, 6A.)**	Yes/No
5H.	Do you wash your car at home? **(Yes 5J, No, 6A.)**	Yes/No
5J.	How often do you wash you car?	Daily, Weekly, Monthly, yearly never.
6. Competition Number & Data Protection		
6A.	As part of the wider project can I collect your water meter readings from your water company?	Yes/No
6B.	As a thank you for taking part in the survey we would like to enter you into the prize draw. Are you happy for us to do this?	Yes/No to entering the competition
6C.	Your Raffle Ticket Number is:	Raffle Ticket Number

Appendix C: Survey Timers

Anonymous Number					**Key:**	Appointment	
						Visit	
						Completed	
						Refusal	
Attempt/Call Time	0800-1000	1000-1200	1200-1400	1400-1600	1600-1800	1800-2000	2000-2100
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
Notes							

Table C1: A Survey Time Sheet for each Household to be contacted.

Day (A)	Add Property (B)	Add Total (C)	Subtract Property (D)	Subtract Total (E)	Completed Interview (F)	Completed Interview Total (G)	Non Contactable (missing telephone number) (H)	Refusal (I)	Total Left to Survey
Date	New Property to Survey	Total of the day added to the previous day	Properties to no longer include	Total of the day added to the previous day	Interviews Completed in the day	Total Interviews added to the previous day	People without telephone numbers (increasing tally added to the previous day)	All refusals (increasing tally added to the previous day)	Properties left to complete in survey (C-D-E-G-H-I)
01/01/11	100	100	5	5	10	10	12	1	72
02/01/11	1	101	0	5	10	20	3 (15)	1 (2)	61

Table C2: Working example of Survey Tally Sheet

Appendix D: Project Schemes – Locations and Water Company Areas

TCHG Scheme Name	Borough	Water Company	Type
YMCA, Maidstone	Maidstone	South East Water	Flats
Snodland	Tonbridge & Malling	South East Water	Flats & Houses
Folkestone	Shepway	Veolia Water SE	Flats
Parkwood Tavern	Maidstone	South East Water	Flats
East Farleigh	Maidstone	South East Water	Houses & Bungalows
Buxted	Wealdon	South East Water	Houses
Hersden	Canterbury	South East Water	Houses
Gravesend	Gravesham	Southern Water	Houses
Otford	Sevenoaks	South East Water	Houses & Bungalows
Southborough	Tunbridge Wells	South East Water	Houses
Orpington	Bromley	Thames Water	Flats
Herne Bay	Canterbury	South East Water	Flats & Houses
Hartfield	Wealdon	South East Water	Houses
Matfield	Tunbridge Wells	South East Water	Flats & Houses
Tunbridge Wells Sherwood Site	Tunbridge Wells	South East Water	Houses
Deal	Dover	Southern Water	Houses
Tunbridge Wells Town Centre Site	Tunbridge Wells	South East Water	Flats

Figure D1 List of Project Schemes

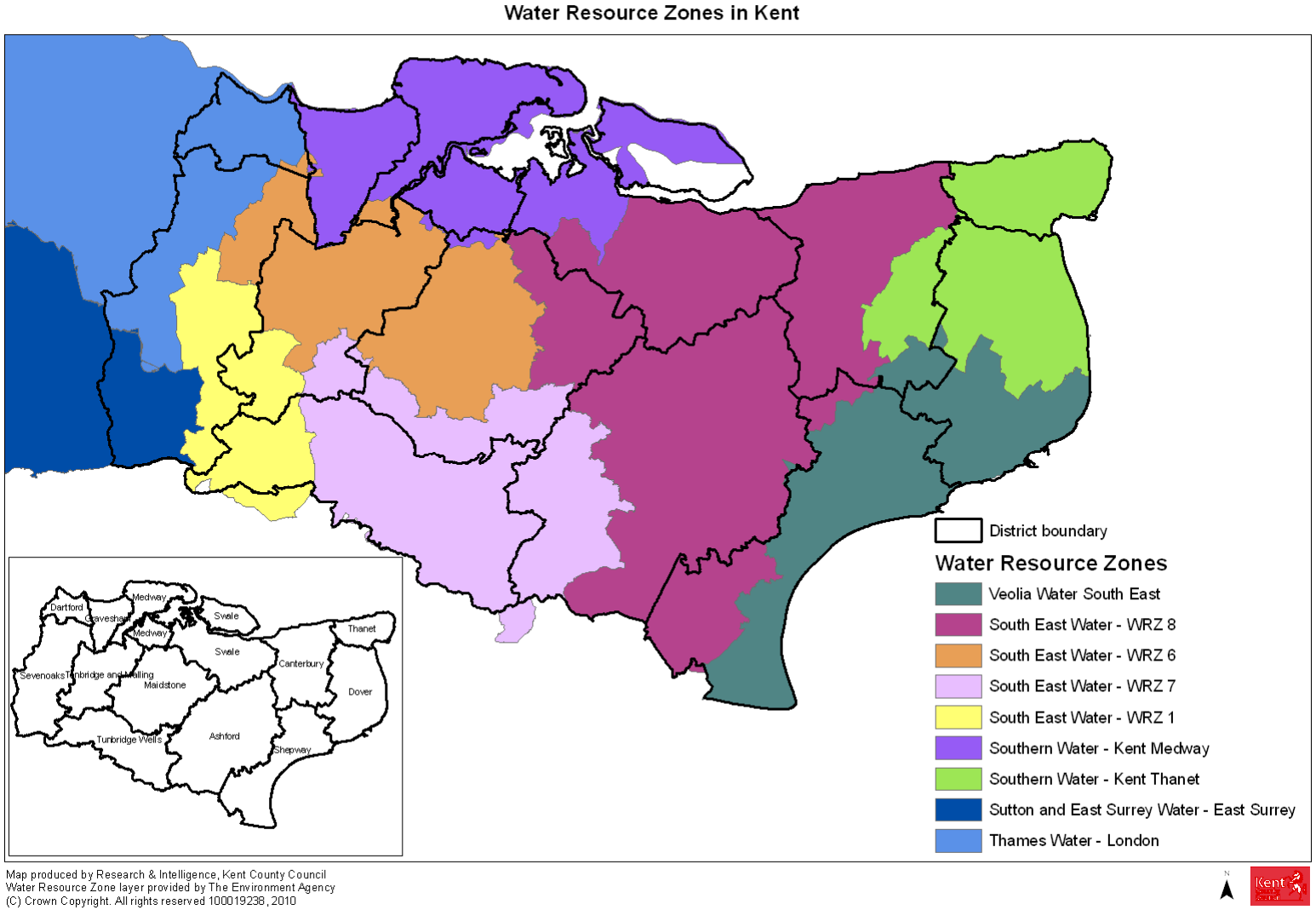

Figure D2 Water company areas

Appendix E: Number of properties and households

TCHG Scheme Name	Total Property Quantity	Properties with Potential Water Data	Properties with Water Data	Usable Water Data (l/prop/d)	Usable Water Data (l/Hhold/d)	Total Households to Survey	Total Households to Surveyed	Water Data Properties that have Surveys
YMCA, Maidstone	34	34	27	26	31	34	19	15
Snodland	41	41	41	40	49	41	13	13
Folkestone	37	37	37	36	36	36	18	18
Parkwood Tavern	26	26	26	25	27	26	8	8
East Farleigh	5	5	5	0	0	5	2	0
Buxted	2	2	2	1	1	2	2	1
Hersden	11	11	11	11	11	11	7	7
Gravesend	16	16	10	6	6	16	10	7
Otford	8	8	8	7	7	8	3	3
Southborough	5	5	5	5	5	5	3	3
Orpington	20	20	20	19	19	18	3	3
Herne Bay	29	29	21	19	18	22	12	10
Hartfield	9	9	0	0	0	9	6	0
Matfield	6	6	6	6	6	6	4	4
Tunbridge Wells Sherwood Site	6	6	6	6	6	6	2	2
Deal	4	4	1	1	1	4	1	1
Tunbridge Wells Town Centre Site	58	58	0	N/A	N/A	30	16	N/A
Total	317	317	226	208	223	279	129	95

Appendix F: Sample Sizes

House Type	No. Of 1 Bed Properties	Occupants in 1 Bed Properties	No. of 2 Bed Properties	Occupants in 2 Bed Properties	No. Of 3 Bed Properties	Occupants in 3 Bed Properties	No. Of 4 Bed Properties	Occupants in 4 Bed Properties
House	1	No Data	26	50	45	144	14	70
Flat	49	45	68	121	5	7	n/a	n/a
Total	50	45	94	171	50	151	14	70

Table F1 Occupant and Property Quantities for House Type.

Survey Size for Household Consumption (l/Hhold/d)				
	1 Bed	**2 Bed**	**3 Bed**	**4 Bed**
House	1	26	52	15
Flat	52	72	5	n/a
Total	53	98	57	15

Table F2 Sample Size for Number of Bedrooms as Household Consumption.

Household Composition of Survey	Household Size
1	35
2	35
3	28
4	22
5	7
6	2

Table F3 Household Composition in the Survey.

Category	Family Type
Single Occupancy	35
1 adult & 1 child	17
1 adult & 2 children	8
1 adult & 3 children	4
1 adult & 4 children	0
1 adult & 5 children	0
2 adults only	18
2 adults & 1 child	17
2 adults & 2 children	12
2 adults & 3 children	5
2 adult & 4 children	1
3 adults only	3
3 adults & 1 child	5
3 adults & 2 children	1
3 adults & 3 children	1
3 adults & 4 children	0
4 adults only	1
4 adults & 1 child	0
4 adults & 2 children	0
4 adults & 3 children	0
4 adults & 4 children	0
5 adults only	1

Table F4 Family Composition.

	House (l/cap/d)	House Sample Size	Flat (l/cap/d)	Flat Sample Size	Overall (l/cap/d)
Overall	107	68	137	93	116
1 Occupant	257	3	163	36	170
2 Occupants	150	6	130	37	266
3 Occupants	103	23	131	17	345
4 Occupants	103	23	103	3	412
5 Occupants	80	9	N/A	N/A	399
6+ Occupants	107	7	N/A	N/A	645

Table F5 Average PCC by Occupant with Number in Sample.

House Category	Property Quantity	No. of occupants in properties surveyed	Total No. of occupants (TCHG and Survey)	No. of Occupants Maximum allowed (Proxy)
Shared Ownership	14	12	12	41
General Needs West	98	100	237	379
General Needs East	67	99	130	229
Rent to Homebuy	29	31	33	114
Total	208	242	412	763

Table F6 Sample sizes for Occupants and Properties by House Category.

Number In Sample, Average PCC						
House Category/Occupancy	**1**	**2**	**3**	**4**	**5**	**6+**
Shared Ownership	2	6	N/A	4	N/A	N/A
General Needs West	23	44	69	60	10	6
General Needs East	10	31	45	24	30	37
Rent to Homebuy	3	6	6	16	5	N/A

Table F7 Total Occupants by House Category, PCC.

Appendix G: Summary of Survey Results

Questions	Total Number	Yes	No	No Response	Percentage (Yes)
How many bathrooms do you have?	155	129	0	0	100.0
separate	127	124	0	5	97.6
ensuite	16	13	116	0	10.1
Do you have a cloak room?	134	53	81	0	40.0
How many toilets do you have?	205	129	0	0	100.0
Do you have a bath shower area?	129	121	8	0	93.8
Do you have a separate shower from your bath?	129	17	112	0	13.2
Do you own a washing machine?	129	122	6	1	95.3
Do you own a dishwasher?	129	15	113	1	11.7
Do you think your water fixtures and appliances are suited to your needs?	129	116	12	1	89.9
Are you planning any water saving techniques? (family)	129	15	110	4	13.0
Are you planning any water saving techniques? (single occupant)	63	4	56	3	6.35
Do you have any water butts?	129	59	70	0	45.7
Do you have an outside tap?	129	30	99	0	23.3
Do you have other outdoor water uses E.g. Paddling pool?	129	13	111	5	10.5
Have you made any changes to your fixtures and fittings?	129	17	111	1	13.3

Appendix H: Typical specification for water fittings and fixtures in project properties

BRE Guidance to Reach Code Level 3 Water efficiency requirement.

Wash hand basin taps

1.7 litres/min - **Monobloc** with spray insert (available online from the Green Building Store - http://www.greenbuildingstore.co.uk/water-taps.php)

Shower

7 litres/min electric shower – generally available

Kitchen sink taps

2.5 litres/min - **Monobloc** with spray insert (available online from the Green Building Store). Full flow rate is double (5 l/min) but 50% rate is taken due to 'click' design

Bath

140 litre capacity to overflow – **Twyfords Tribune**

WCs

Impulse Tribune SP dual flush WCs 4.5 / 3 litres capacity (WRAS approved)

****

NB: Options to the above guidance

An alternative to the WCs stated above is the **Twyfords Ecoflush Galerie Plan WC** which are even more efficient – 4 / 2.6 litres capacity and preferred. Twyfords Link:

http://www.twyfordbathrooms.com/default.asp?path=1;50;86;87;97531

This would allow slightly higher flow rates for kitchen taps of 3 litres/min and capacities for other items above. Therefore a **149 litre capacity** bath would comply and would be preferred if possible.

Weblink for alternative baths to Twyfords:

http://www.water-efficiencylabel.org.uk/view_products.asp?id=1 – Bath Sandringham S159701

****

It is also possible to go for a lower flow rate shower – 6 litres / min – with the Galerie WCs and taps as above and then have a 165 litre capacity bath (even with 3 l/min taps in kitchen).

****

Also used to flow rates mentioned above :

Bristan taps: Bristan 3inch Spray Lever Basin Taps With Ceramic Disk- L1/2CCD
Bristan 3inch Spray Lever Basin Taps Chrome Plated With Ceramic Disc Valves

Or Ideal with click cartridges or Hansgrohe taps as an option to Monobloc taps.