Water Efficiency Project

End of Year 1 Report: 2008 - 2009

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Executive Summary

The Water Efficiency Project is being undertaken by Radian in partnership with the Environment Agency from March 2008-2010 and researches how best to tackle water efficiency in new-build and existing homes. Recommendations are provided based on the first year's findings.

The South East of England, including South Hampshire, has been identified as a region of severe water stress: the region has low rainfall, a high population density and each individual is consuming high volumes of water. South Hampshire is a new growth point area with 80,000 new homes proposed over 2006- 2026 which will put further pressure on water resources. To accommodate the proposed growth in the sub-region, there needs to be sustainable demand management of water in the PUSH area with the aim of water neutrality.

Research undertaken in year 1:

New builds:

- Monitoring water consumption levels of 207 new-build flats and houses built to Ecohomes standard in Petersfield, Portsmouth and Southampton (built before 2008).
- Monitoring water consumption levels of 5 new-build houses in Liss built to Code for Sustainable Homes (CfSH) level 3. Each of the houses have dual flush toilets, aerated showerheads, restricted flow taps and water butts. Also 2 houses have rainwater harvesting systems, which feed 2 toilets in each dwelling.
- Monitoring water consumption levels of 2 new-build houses in Alton, built to Code for Sustainable Homes level 4 (completed December 2008). These houses have dual flush toilets, aerated showers, small baths, restricted flow taps, water butts and 1 house has a rainwater harvesting system, which feeds 1 toilet.
- Collecting 181 surveys about household behaviour, with water use, in the 207 Ecohomes and the 7 Code for Sustainable Homes properties.

Existing Homes:

- Data collection meters were installed in 28 existing homes to monitor water consumption levels (the homes were built in 1977).
- Retro-fitting of 8 existing homes with eco-beta dual flush toilet devices.
- Collecting 28 surveys about household behaviour in existing homes.
- 300 save-a flush bags were distributed within Radian properties and offices.

Findings from year 1:

New builds:

- An average water consumption of 143 litres per person per day for the new-build homes built to Ecohomes standard. There was a range of water consumption between 45 and 613 litres per person per day.

- An average water consumption of 58 and 86 litres per person per day for the homes in Liss built to Code for Sustainable Homes Level 3 with and without rainwater harvesting, respectively. This is significantly lower than the national average consumption of 150 litres per person per day and the South East average consumption of 160 litres per person per day and far exceeds Defra's target of 130 litres per day. It also exceeds the Code for Sustainable Homes Level 3 target of 105 litres per person per day.

- An average water consumption of 56 and 128.5 litres per person per day for the homes in Alton with and without rainwater harvesting, respectively. Again, these figures are significantly lower than the national and South East average consumption and Defra's target of 130 litres. However, only the home built with rainwater harvesting managed to succeed in reducing consumption below the Code for Sustainable Homes Level 4 of 105 litres per person per day.

- When considering installing rainwater harvesting systems, the resources and rainfall need to be taken into account. If the decision is made to install rainwater harvesting then this must be accounted for at the beginning of the project so that there is enough space inside to locate the pump. Additionally, a gravity-fed system needs to back the system up.

- Implementing water saving technology into new build homes to Code for Sustainable Homes level 3, costs about £300 per unit without installing rainwater harvesting and installing to Code level 3 with rainwater harvesting costs approximately £4,000 per unit. Both methods manage to achieve consumption levels below the Level 3 target by 47 and 19 litres with and without rainwater harvesting respectively.

- By building homes to the Code for Sustainable Homes level 3 residents can save up to £90 a year on their water bill.

Existing Homes:

- Retrofitting the eco-beta device reduced water consumption by 21%, from an average of 137 litres per person per day to 108 litres per person per day – 29 litres, achieving Defra's target of 130 litres.

- At the moment only water companies can purchase eco-betas and each ordinarily costs around £10 although this depends on how many devices are ordered. Labour to fit the 8 devices cost £320.

- It is estimated that one resident, who was on a meter and had an eco-beta installed, is saving £18 a month.

- Generally residents gave positive feedback about using the eco-beta, however some residents commented that they had to flush twice.

Recommendations:

Significant water savings are made when new homes are built to Code for Sustainable Homes Levels 3 and 4 such as the homes in Liss and Alton. Significant savings can also be made in the existing housing stock if existing homes were retro-fitted with eco-beta dual flush toilet devices. It is important to note that increased water efficiency is required in the existing housing stock to facilitate growth and enable water neutrality to be achieved.

Raising awareness on the importance of water conservation alongside fitting water efficient devices is required as the way water is used also contributes to further reducing water consumption.

Additionally, reducing usage of hot water in the home also contributes to lower fuel bills alongside traditional energy efficiency measures such as insulation.

Chapter 1- Introduction

Since March 2008, the Environment Agency and Radian have been working in partnership in order to clarify how best to tackle water demand management and efficiency. The Environment Agency have funded a full-time Water Conservation Projects Coordinator to work for Radian in order to carry out water conservation research in new build housing and the existing housing stock, of public and private housing.

About Radian

Radian is a group consisting of four housing associations-Drum, Longwood, Swaythling and Windsor- and a specialist care organisation, Turnstone. The majority of the stock is general needs housing, but also includes a significant portfolio of sheltered and supported housing, together with key worker accommodation, shared ownership, market rent and private sale properties.

Radian has a housing stock of over 15,500 homes in Dorset, Wiltshire, Hampshire, West Sussex, Surrey, Berkshire and Buckinghamshire.

Background

The Water Framework Directive (2000) ensures good ecological status for all water bodies, including adequate water levels and flows. Acknowledging pressure on water resources in the south east from growing populations and low rainfall, the UK government is increasingly promoting water conservation. Also, water companies now have a statutory duty to publish water resources management plans and to promote the sustainable use of water.

England and Wales have less water available than you may imagine: only 1,334m^3 of water is available per person a year. This is much less than is available in Spain, which has 2,775m^3 of water per person a year. The South East of England has an even lower amount of water available because the region receives less rainfall and has a high population density. Furthermore, each person in the South East of England uses an average of 160 litres per person per day, whereas the average water use for the rest of England and Wales is 150 litres per person per day. The Environment Agency has identified the South East of England as a region of severe water stress. To reduce the pressure on water resources, the Department for Environment, Food and Rural Affairs (Defra)'s vision is for all households in England and Wales is to be using 130 litres per person per day by 2030. However there is a need to research the best methods of tackling water efficiency both in new build homes and the existing stock in the region.

The Environment Agency

The Environment Agency's principal aims are to protect and improve the environment, and to promote sustainable development. The Environment Agency is responsible for the management of water resources which are becoming increasingly scarce in the South East.

The PUSH area

The Partnership for Urban South Hampshire (PUSH) is an affiliation of 11 local authorities in South Hampshire who are committed to sustainable, economic-led growth. The sub-region has also been selected as one of the New Growth Points areas, which means that it will receive long-term support from the government to facilitate extra growth. The area is a sprawl of suburban development, surrounding Southampton and Portsmouth, bordered to the west by the New Forest and to the east by the South Downs (see figure 1). The area is the largest urbanised area in the South of England, outside London. The same problem with water supply occurs as with the rest of the South East: South Hampshire is a water stressed area[1] and is surrounded by water dependent features designated for wildlife.

Diminishing water levels will not only cause public water shortages but also be detrimental to Hampshire's environment. This is particularly worrying as Hampshire's rivers form recreational assets and world-famous fisheries: also the River Itchen and River Test both are Sites of Special Scientific Interest (SSSIs)[2] .

Putting more pressure on Hampshire's water resources, 80,000 new homes are proposed within South Hampshire over 2006- 2026. To accommodate the proposed growth in the sub-region, there needs to be sustainable demand management of water in the PUSH area with the aim of water neutrality[3].

Figure 1: Map showing Hampshire (shown in purple) and the PUSH area (shown in orange)

[1] www.push.gov.uk
[2] www.environment-agency.gov.uk
[3] Water Neutrality means that any new development does not raise the demand for water. For example there would be retrofitting of a nearby area to achieve this.

The Project

Radian is aware that there are problems facing the South East of England, including the PUSH area, in terms of water supply. With a housing stock of over 15,500 homes, and more development planned to help meet the increasing demand for housing, Radians impact on regional resources is immense. Therefore in line with Radian's environmental agenda, *Eco-Action 2008-12: A strategy for low eco footprint living*, Radian is keen, and has a responsibility, to research methods of conserving water and identify how best to reduce demand[4] both in new build and in the existing housing stock.

With their partners the Environment Agency is keen that we can learn how to maintain a decent standard of living whilst using substantially less water and wished to implement a research project that would provide useful lessons in how to achieve water consumption targets as set out in the Code for Sustainable Homes (see below) and the Defra target of 130litres per capita per day consumption by 2030.

This study is a partnership between Radian and the Environment Agency. The study draws upon new and existing housing sites, owned by Radian in South Hampshire. However, where appropriate other locations and organisations may be used in order to build up more evidence about water conservation measures.

Ecohomes and the Code for Sustainable Homes (the Code or CfSH)[5]

New build homes that were monitored for the purpose of this project have been either built to Ecohomes or the Code for Sustainable Homes. A description of both is given below:

Ecohomes

Ecohomes was the environmental assessment method for new build before the Code for Sustainable Homes was introduced in April 2007. EcoHomes did not set any mandatory requirements for maximum water use, although credits could be gained by implementing water efficiency measures. Publicly funded homes tied to the Housing Corporation requirements (now the Homes and Communities Agency-HCA) were required to achieve EcoHomes 'good' and then 'very good' which often meant that these homes had some water efficient devices installed. For example dual-flush toilets, showers and water butts.

Code for Sustainable Homes

The Code for Sustainable Homes is an environmental assessment method of new build homes ranging from level 1 to level 6 (the best performance). All new homes receiving public funding under the HCA approved development programme between 2008-11 must achieve a minimum of level 3. To achieve certain levels of the code, there are mandatory requirements for water and energy. The levels for water are shown in table 1.

[4] www.radian.co.uk
[5] For more information please see www.communities.gov.uk

Table 1: Code for Sustainable Homes: Mandatory requirements for Water

Code for Sustainable Homes	Maximum Water Consumption (litres per person per day)
Level 0	No assessment
Level 1	120
Level 2	120
Level 3	105
Level 4	105
Level 5	80
Level 6	80

The predicted maximum water consumption levels, shown in table 1, are worked out using the Code water calculator tool. For a given property, the calculations assume a certain frequency of use for the water using appliances. For example the calculator assumes that when a tap is turned on it is used at two thirds of the full flow and for forty seconds. This means that achieving different levels of the Code purely depends on the volumes of water the devices use. For example a 2 litre flow tap is assumed to use less water than a 4 litre flow tap and consequently help in achieving higher levels of the Code.

Acknowledgements

We are grateful to the Environment Agency, who have provided funds and support throughout the project. Without their help the project would not have happened.

We are also grateful to the following organisations (listed in alphabetical order) who contributed to the project:

- East Hampshire District Council, who have provided financial support towards the rainwater harvesting system equipment for the case studies featured in this report
- Ecocamel, who provided aerated showerheads for our new homes case study free of charge
- Petersfield Housing Association, who allowed access to vital water consumption data and provided useful information for new homes.
- Portsmouth Water, who installed water meters, provided eco-beta devices and the training of how to install an eco-beta.
- Portsmouth Water, South East Water and Southern Water, who provided vital water consumption data for households.
- Portsmouth Water, South East Water and Thames Water, who provided save-a flush bags

We are extremely grateful to all residents who have helped with our research.

Steering Group

Name	Job Title	Organisation
Charlotte Stride	Project Manager	Environment Agency
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Paul Ciniglio	Sustainability & Innovations Manager	Radian Group
Stephanie Beggs	Water Conservation Projects Coordinator	Radian Group
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Chapter 2 - Aims and Objectives

The main purpose of this project is to examine a range of water conservation initiatives. From doing this, the coordinator and the project will serve as a resource from which to provide recommendations on how best to tackle water efficiency in the built environment.

Specific aims for year 1 were:
New Homes:

- To find out the average water consumption of new-build properties, in relation to occupancy and specification of water devices.
- To find out whether the Code for Sustainable Homes targets for water consumption are effective and realistic to achieve in practice.
- To find out how the water consumption of homes built to Ecohomes compares to the water consumption of homes built to Code for Sustainable Homes.
- To find out if there is a relationship between household behaviour and water consumption levels.
- To trial different methods of saving water.

Existing Homes:

- To gather data on household water consumption.
- To gather information on household behaviour with regards to water use.
- To determine the impact, on water use and lifestyle, of installing eco-beta dual flush retro-fit devices into toilets.

General:

- To raise awareness about the importance of water conservation and how to save water, also encouraging consumers to use water more wisely

Specific aims for year 2 are to:

- Investigate reasons for and provide water efficiency advice to households with high water use in new build properties
- Trial other water efficiency devices in new and existing homes
- Provide information about their water use to residents in the existing homes.
- Continue to raise awareness about the need to save water and therefore reduce demand for water overall
- Raise the profile of the project and its findings

The long term objective of the project is to develop a toolkit for planners, policy planners, developers and others involved in the construction or planning process that will provide information on water efficiency methods. The toolkit will aim to be a practical resource providing a cost-benefit analysis of different methods of water efficiency and other useful information. It is hoped that the project will lead on to a long-term programme of investment of retro-fitting homes to help improve water efficiency across South Hampshire and will influence the construction industry approach for new builds.

Chapter 3 - Methodology

It was important to collect as much primary data as possible, so that the findings were objective and accurate. However secondary data was used where there were gaps in primary data. Quantitative and qualitative methods were both needed to complement each other and build a more detailed idea of water use for both new and existing homes.

New Homes Project

Ecohomes

In this section, the new-build properties that were monitored were built between 2000 until 2008 and therefore assessed under EcoHomes. At the time of starting this project, there were not any homes that were built against the Code for Sustainable Homes.

A quantitative approach was used to find out how much water is being used by households in newly built properties. Information was requested for a total of 555 properties in Petersfield, Portsmouth and Southampton. However, water usage data has only been received for 207 properties, so far. Also information on household water usage behaviour was received for 181 properties.

Meters that were already used to determine household water bills provided a helpful tool to collect water usage data. It was felt that finding out reasons behind this water consumption data would offer a better understanding of water use. So a qualitative approach was taken by surveying the households about their behaviour with using water. For example “do you use a washing machine on full load?” The aim was to receive as many responses as possible therefore the questionnaire was kept short (see appendix A for questionnaire).

Initially letters were sent out to selected new build sites in Petersfield. These letters explained why this research was being carried out and asked for the questionnaire to be sent back. The letter also advised them that the Water Coordinator would be calling to collect information on their water use from their water bills. However, calling at the door received a low response rate due to the fact that residents were not in or they could not find their water bill.

Phone calls and follow-up letters were then used but the response rate was still low. Letters requesting water consumption data along with the questionnaire were also sent to selected new-build sites in Portsmouth and Southampton. Again the response rate was still low (see tables 2 and 3).

In the end, contacting water companies seemed to be the most effective method of obtaining household water consumption information[6]. However, one water company required written consent from householders for us to

[6] Please note that only water consumption information was obtained and this data will be kept anonymous and will only be used for the purpose of this research.

obtain this information. This significantly reduced the response rate as it was hard to obtain the written consent, even though there were letters and follow-up phone calls to these households. Even if residents appeared interested on the phone and were sent another form, a response was not often received. Attempts are still being made to increase the response rate in this area.

It was found that carrying out the questionnaire over the phone was most successful in obtaining answers. Water consumption information was not collected as residents invariably did not have their bill to hand.

Table 2: Total response rate from using all attempts to collect information (i.e. letters, phone calls, contacting water companies)

Site location	**Number of households**	Total bill response to collect data from water bills	*Response rate (bills) %*
Petersfield 1	**47**	38	*81*
Petersfield 1a	**28**	25	*14*
Petersfield 2	**34**	21	*62*
Petersfield, privately owned properties	**207**	0 (43)	*0*
Portsmouth 1	**28**	26	*93*
Portsmouth 2	**28**	27	*96*
Portsmouth 3	**64**	55*	*86*
Southampton	**119**	15	*13*
TOTAL	**555**	207 (250)	*32.8*

*Some flats are not yet occupied ( ) Awaiting results

Table 3: Total response rate for questionnaire on household water use behaviour

Site location	**Number of households**	Total Questionnaire response	*Response rate (questionnaire)*
Petersfield 1	**47**	21	*45*
Petersfield 1a	**28**	4	*14*
Petersfield 2	**34**	16	*47*
Petersfield, privately owned properties	**207**	43	*21*
Portsmouth 1	**28**	11	*39*
Portsmouth 2	**28**	12	*43*
Portsmouth 3	**64**	34	*53*
Southampton	**119**	40	*34*
TOTAL	**555**	181	*32.6*

Costs

For this year, there were not any costs endured because there were not any water efficient devices supplied or installed for the purposes of this project.

Code for Sustainable Homes

This section looks at homes built since 2008 and consequently have had to meet the Code for Sustainable Homes. In particular, this section talks about rainwater harvesting in these properties.

Rainwater Harvesting Systems

Rainwater harvesting systems collect rainwater for use usually in the garden, washing cars, flushing toilets and to supply washing machines (pictured in figures 2 and 3). These systems range from a water butt to large tanks buried underground. A water butt is a small tank, usually about 100-220 litres volume and is typically used for the purposes of external irrigation e.g. to water plants. It can also be used to wash down hard standings and patios or cars. The larger tanks that are stored underground can range from 1,000 to 13,000 litres. These tanks are usually used to collect rain water from roofs. The rainwater is filtered, stored and used to flush toilets but can also be used for caution for washing machines or for garden use. Rainwater harvesting systems are increasingly being used as it is believed that they are beneficial in reducing the demand for mains water. In the event of no rainfall for a long period the larger systems, used for toilet flushing, will revert to mains water so that toilets can still be flushed.

Grey water reuse

Grey water recycling usually involves reusing bath, shower or basin water. This can be a system which collects and treats the water to flush the toilet. Alternatively a bucket can be used to collect the water for watering plants although not for any plants that are edible. Grey water reuse, because of concerns over the water quality, is perhaps less common than rainwater harvesting. It should be noted that the Environment Agency does not recommend any particular manufacturer or system for Rainwater or Grey water.

Figure 2: Photograph of a rainwater harvesting tank (1,600 litres)
Figure 3: A cross-section of a rainwater harvesting system (provided my manufacturer WPL)

New Homes Case Study: Lipscombe Rise, Alton: Code for Sustainable Homes Level 4 (Please refer to Appendix A)

This is a new development of two semi-detached houses in Alton, East Hampshire. The aim was to try to achieve CfSH level 4. As stated in table 1, the mandatory requirements for water are still the same as level 3; the properties had to achieve a maximum of 105 litres per person per day.

Both houses were fitted with dual flush toilets (4/2.6 litres), flow restricted taps, some reduced flow showers, some smaller baths and water butts. Drum Housing Association is keen to try new technologies in preparation for meeting higher levels of the CfSH such as level 5 or level 6. Therefore one rainwater harvesting system was installed to supply one toilet in one house. Calculations revealed that it would not have been worthwhile for the system to feed both toilets in this house as not enough rain would be collected.

The rainwater harvesting system cost approximately £3,000 to install.

New Homes Water Conservation Case Study: Five Trees, Liss: Code for Sustainable Homes Level 3 (Please refer to Appendix B)

Radian selected a new development of five houses at Five Trees, Inwood Road in Liss to trial different methods of water conservation (see figures 4 & 5). Each of the five houses had separate, innovative methods of saving water installed from a list of: dual-flush toilets, aerated showerheads, restricted flow taps, water butts, water/energy efficient white goods and rainwater harvesting systems. At this project two rainwater harvesting systems were installed to supply the two end of terrace houses. The rainwater harvesting systems feed both toilets in each dwelling.

In addition, as well as the standard revenue meters that measure overall water consumption, water inlet meters were installed in 3 of the houses. These meters are enabling more in-depth analysis about where water is used in a property.

The basic total costs of the water conservation equipment installed in the properties at Five Trees were:

Rainwater harvesting equipment £2,200
Basic installation costs £5,000
Meters-equipment and installation £2,800
Water/energy efficient white goods and installation £1,400
Water butts, tap restrictors, aerated showerheads and dual flush toilets £1,500

Figure 4: Photograph of the five houses at Five Trees
Figure 5: Photograph of the top of the rainwater harvesting tank at one of the houses at Five Trees

It was decided to use rainwater harvesting rather than grey water in both Lipscombe Rise and Five Trees. This was because there is more acceptability by occupants for rainwater use rather than using grey water. The installation of a grey water system was considered but inadequate space was available for it to fit inside the bathroom, where it needed to be installed. It is essential that the provision of both rainwater harvesting and greywater innovation is considered at the earliest possible stage in the design process. From installing rainwater harvesting in both developments, a few issues have arisen:

1) Communal rainwater harvesting systems

Originally a communal system was envisaged for the development at Five Trees. One thought being that costs could be saved from economies of scale-installing and maintaining one pump and one filter as opposed to five of each. However it was quickly realised that one tank would also cause problems for apportioning the mains water bills. This is because some households would be using the rainwater, some the mains, or a combination of both, and all using different amounts. Individual systems therefore still seemed a much easier option for the first trial installation and are likely to become Radian's standard future policy.

2) Rainfall

Simply, there is not enough rain! In order for the systems to be more efficient, the roof needs to be large, the roof material needs to be impermeable and there needs to be a high frequency and quantity of rainfall. However, Hampshire has a high density of housing resulting in relatively small roof sizes. Also Hampshire receives a low amount of rainfall compared to the rest of England. This means that housing developments like Lipscombe Rise and Five Trees have used large amounts of resources to install these rainwater harvesting systems only to supply one or two toilets and brings into question the cost benefit. Even if larger tanks were installed; if it did not rain the systems would not work. Also, when there is a drought the system will not work and demand for mains water will increase.

3) Reliable resources

The pump that transfers water from the tank to the toilets uses electricity, therefore if there is a power cut the system will not work. To provide back up for this event, it was found that rainwater harvesting system design needs to allow a gravity fed supply for at least one toilet to be served with a gravity fed supply. A gravity fed supply means that there would be a small tank in the roof, acting as medium between the underground tank and the toilet[7].

Usually the pumps can be stored inside, although space and noise may be an issue. At Five Trees space was not available inside so the pumps were stored in outside cupboards. However during extreme cold weather a pump froze and the system stopped working. It was necessary to provide additional insulation to the cupboard enclosure, but with ventilation.

[7] The situation was reported to the local building control authority who are to consider if an amendment is required to the building regulations to make provision similar to when a macerating toilet is installed.

Existing Homes Project

Invitations to participate in the project were sent to 101 households in Horndean and Rowlands Castle, these properties were all built between 1950 and 1970s. Thirty one properties originally chose to participate. The Decent Homes Standard[8], that all public sector landlords must comply by 2010, means that kitchens and bathrooms are refurbished every 20 and 30 years, respectively. Therefore most of these properties will have had relatively modern kitchens and bathrooms installed. Although this may not be representative of all existing housing it is likely to be an accurate representation for housing associations and other public sector landlords.

The eco-beta

An eco-beta is a retrofit device that turns a single flush toilet into a dual flush toilet (shown in figure 6). Figures 7 and 8 show the installation of an eco-beta device into a toilet. Figure 9 shows the toilet after the eco-beta device has been fitted. To use the toilet, with the eco-beta device: for a short flush the handle does not need to be held down. Whereas for a full flush the handle would be held down, but only for how long it takes to flush the waste away. Installation of the eco-betas could perhaps have been more wide-spread if there was more emphasis on fitting eco-technology, such as the eco-beta, for the labour force, compared to other priorities.

Figure 6: Eco beta retrofit device

Figure 7: Installing an eco-beta device

Figure 8: Paul Sansby, Portsmouth Water and David Leach, Radian Services fitting an eco-beta device

[8] For more information please go to www.communities.gov.uk and search " A Decent Home: Definition and guidance for implementation-June2006 update"

Figure 9: After the eco-beta device has been fitted

It was found that to install the eco-beta device, which included drilling a hole in the toilet siphon, took about 15 minutes. However 15% of the toilets were more difficult to fit because they had a more modern flush system[9]. One toilet was found to have an old and large toilet cistern where the eco-beta could not be fitted. Therefore an order was raised to replace the toilet with a new dual flush toilet, as part of standard maintenance works.

For the first year, the main aim was to trial the eco-beta device. To determine a clear-cut result for this, it was necessary to use a quantitative approach. At the start of the project most households paid their water bills on a rateable basis. For the purpose of this project, Portsmouth Water installed water meters that collect data on how much water each household uses. However, the households continued to pay their water bill as they were doing before, unless they requested otherwise. To determine the impact of the eco-beta, water consumption before and after the installation of the device was compared. Table 4 shows the figures for the set-up of this existing homes project.

Similar to the new homes project a qualitative approach, in the form of a short questionnaire, was also used to find out what devices were already in their properties and about residents behaviour with these water appliances.

Table 4: Showing the response and uptake rates for the existing homes project

	Letters of invitations sent out	Original Responses to participate	Questionnaires received	Meters installed	Eco-betas installed	Toilets replaced
Number	101	31	28	22	8	1

<u>The Cost</u>

Portsmouth Water provided the eco-betas free of charge. At the moment, only water companies can purchase eco-betas. Ordinarily an eco-beta costs about £10, but this depends on how many devices are ordered. The total cost of the labour to fit the devices was £320.

[9] Turbo flush system

Raising awareness in new and existing homes

It was felt that the aim should be to work with resident behaviour as well as fitting appliances to further enable reductions in water consumption for all residents. Articles about the importance of water conservation were published in quarterly residents' magazines. As a result of these articles, three responses were received regarding water issues, such as how should a resident apply for a meter.

Further, it was found that in some of our new homes where water efficient technology was installed, residents felt that they were more aware of the way they use water.

Chapter 4 - Outcomes

Water consumption data was gathered over 9 months and will continue to be gathered during year 2.

New Homes

Ecohomes

From the water conservation data already gathered from the 207 new-build properties in Petersfield, Portsmouth and Southampton the average water consumption is 143 litres per person per day, with an average occupancy of 2.5 people per property[10] (shown in table 5). This is encouraging in comparison with the national average of 150 litres per person per day. However, it does not meet Defra's target of 130 litres per person per day. Raising the awareness of water conservation to these householders may help to reduce their water consumption.

Table 5: Summary of average consumption, with average occupancy for all sites

Site location	Average water consumed per person per day (litres)	Average occupancy
Petersfield 1	149	1.6
Petersfield 2	151	3.1
Petersfield 1a	168	2.7
Petersfield, privately owned properties	N/A	N/A
Portsmouth 1	145	2.2
Portsmouth 2	152	1.6
Portsmouth 3	122	3
Southampton	115	3.4
TOTAL	**143**	**2.5**

Example of a block of new build flats in Portsmouth, Eco homes 'very good'

Included in the study of 207 new-build homes is a block of 64 flats that were completed in April 2008[11]. Each flat has 2 bedrooms and the average occupancy is 2.2 people per flat. Table 6 shows the volumes of water used by each appliance in the flat:

[10] These were assessed as Ecohomes 'very good'
[11] Some were unoccupied during the year

Table 6: Profile of water using devices in flats

Toilet	Kitchen Taps	Bathroom Taps	Shower	Bath	Washing Machine	Dishwasher
Dual flush, 6/4 litres	Full flow -12 litres per min: Two thirds of flow- 8lpm)	Full flow-6 litres per min: Two thirds- 4lpm)	9 litres per min	standard	Space provided for resident to fit but appliance not provided by Landlord	No space provided, but resident has option to remove a base unit cupboard and fit their own appliance

Table 6 shows that the flats should be relatively water efficient. Below, table 7 shows the average consumption for the flats throughout April 2008 and April 2009.

Table 7: Average water consumption for a block of flats in Portsmouth over 2008- 2009

Apr-Aug	Aug-Nov	Nov-Feb	Feb-Apr	YEAR AVERAGE
136	139	150	148	145

The average water consumption for these flats is 145 litres per person per day, for the year. This level of water use is lower than the England and Wales average water consumption so if favourable. The data collected also shows the variation in water consumption through the year.

Table 8: Range of average water consumption for the flats

Minimum value for average water consumed over the year	64.6 litres per person per day
Maximum value for average water consumed over the year	240.8 litres per person per day

Across the 207 new-build homes that were monitored, there is a wide range of values for the average water consumption: the lowest figure noted was 45 litres of water per person per day and the maximum value noted for another household was 613 litres per person per day (possibility of a leak and is currently being investigated). This wide range shows that household behaviour has a large influence upon water use. For example, shown in table 8, in the block of flats featured above, the same water appliances were fitted but water usage varied from 65 litres to 241 litres per person per day.

It appears from the varying amounts of water used that household behaviour affects water use. Even though each of the new-build sites were installed with exactly the same 'water using appliances' there was a high variation of water consumption.

However so far, analysis of household behaviour with water use has not revealed any definitive reasons for extreme amounts of water use. It seems that there are a range of possible reasons why some households use varying

volumes of water; such as low occupancy, not employed and therefore more often at home, children, more cleaning, or perhaps there are leaks which have not yet been identified. Table 9 compares the behaviour of households where water consumption was 90 litres or less (per person per day) with households with water consumption more than 160 litres (per person per day) was compared. It was identified that the low consuming households, on average, used their washing machine and bath less often than high consuming households did. The low consuming households generally have a higher occupancy.

Table 9: Comparison of household habits for low and high water consuming households

	Occupancy	Number of people aged less than 18 years	Washing Machine Use	Shower Use	Bath Use
LOW water consuming households (less than 90 litres pppd)	3.2	1.2	3.8	72	28
HIGH water consuming households (more than 160 litres pppd	1.95	1	4.6	66	34

Code for Sustainable Homes

This section outlines interim results of the water consumption of both case studies for Code for Sustainable Homes, Lipscombe Rise and Five Trees.

New Homes Case Study: Lipscombe Rise, Alton

Since September 2008, overall household consumption has been monitored for the houses. For the house with rainwater harvesting, as well as with other water efficient devices, the average water use is 56 litres per person per day. Whereas, the houses with water efficient devices but without rainwater harvesting have an average use of 128.5 litres per person per day. From this monitoring it can be provisionally assumed that rainwater harvesting reduces water consumption by approximately 50%, however a full year of data is required before accurate conclusions can begin to be formed.

The data collected from monitoring the 2 properties was used to estimate the payback for installing a rainwater harvesting system. Therefore it was estimated that it would take approximately 59 years to recover the cost of installing a rainwater harvesting system. This figure does not include the energy cost for powering the pump. Current water rates are assumed but even if they do increase, the affect is likely to be minimal because water remains very cheap. Of particular interest, it is expected that rainfall will decrease in the future. If this were to happen then the payback of installing the rainwater harvesting system would further increase because the consumer would be paying for more mains water. An alternative method is to use the manufacturers assumptions of rainwater use, from these it was estimated that the payback period could be 152 years. These projections are concerning from an economic viewpoint if rainwater harvesting is to be encouraged in the drive towards water conservation.

Financial Savings

A water bill for a household of 3 who live in a home built to Ecohomes and where the average water consumption is 143 litres per person per day (see page 15) would be approximately £129 a year, on a water meter[12]. In comparison with this, the household at Lipscombe Rise with 3 people and with rainwater harvesting could save approximately £68 a year on their water bill; this is 50% of their estimated water bill.

A water bill for a household of 7 who live in a home built to Ecohomes and where the average water consumption is 143 litres per person per day would be approximately £300, on a meter. In comparison with this the household at Lipscombe Rise with 7 people, without rainwater harvesting, could save approximately £30 a year: 10% of their estimated water bill. However if the households at Lipscombe Rise were compared to the average for the South East of England of 160 litres per person per day then clearly savings would be much greater.

New Homes Water Conservation Case Study: Five Trees, Inwood Road, Liss

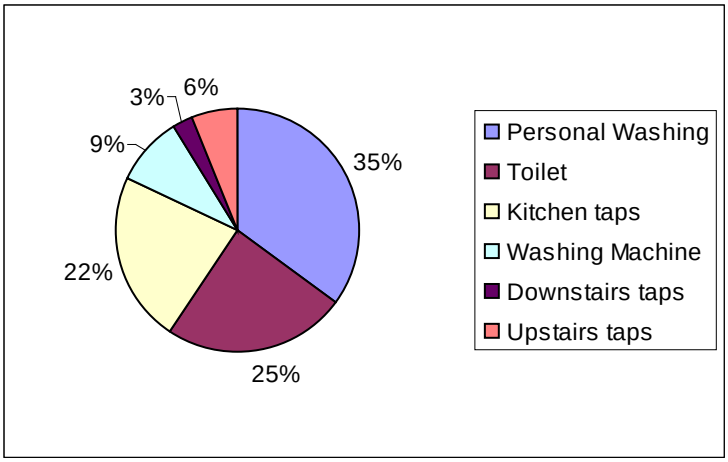
Interim results from the 5 houses in Liss has shown that water usage levels can be lower than that assumed by CfSH level 3's target of 105 litres per person per day. Overall usage for the first 3 months across the 5 houses was 75 litres per person per day. The houses without rainwater harvesting have been using an average of 86 litres per person per day compared to the houses *with* rainwater harvesting which were using an average of 58 litres per person per day. This far exceeds the target of CfSH level 3 of 105 litres although a full year's data will take seasonal variations in consumption into account.

For the homes at Five Trees in Liss, the homes without rainwater harvesting but with other notable water efficient devices appear to have reduced water consumption by 44 litres per person per day compared below Defra's target of 130 litres per person per day. Furthermore, the properties where rainwater harvesting systems have been installed seem to be saving an extra 30 litres per person per day (72 litres per person per day).

The information collected from the water inlet meters is displayed in figure 10. The main water use for the 3 houses is for personal washing (35%) also water use for toilet (25%) and kitchen taps (22%) is quite high. A year's data is needed to provide more reliable results.

[12] This uses local, current charges

Figure 10: Pie Chart to show Where Water is Used (across 3 houses at Five Trees, Liss)



Residents in all homes at Five Trees were asked about their water usage habits and for their comments about the water efficient technology. Table 10 shows the questions with a summary of the responses from 4 of the households. The main problem that was identified by all households was that the downstairs tap flow rate was very low and this is also evident from figure 10, where the downstairs taps accounts for 3% of total use. In order to comply with the CfSH in this instance there was no other option than to install 1 litre flow taps in the downstairs toilets. It was felt that installing a low flow rate tap in the downstairs cloakroom would mean that elsewhere; both the kitchen taps and upstairs taps, there could be higher flow rates. However, 1 litre flow rates means that it takes a very long time for the boiler to start for the hot water tap. Therefore this wastes a lot of water because the tap needs to be run for a long time. Alternatively, the taps are not used at all.

On a positive note, the impression was that householders had become more aware of their water use. One resident said that the water efficient devices "make you realise and stop to think of ways to use water [less] and not take it for granted".

Table 10: Results from questionnaire about the water using devices for 4 homes at Five Trees, Liss

Does your household take more showers than baths?	Does enough water come out of the shower?	Does enough water come out of taps?	How many times a week do you use the washing machine?	If you have a dishwasher, how often do you use it?	Have you used the water butt yet?
Averaged 80% shower use	yes	All residents said no, that water was very slow from downstairs taps- particularly took ages to get hot water	7	Not applicable to most, one household used it once a day on the economy setting	Some households had, one resident used it a lot- for plants, vegetables, paddling pool and to wash the patio

Financial Savings

As mentioned in page 16 the water bill of a household of 3 people in an Ecohomes property, with an average consumption of 143 litres per person per day, would be approximately £129 a year, on a water meter. In comparison with this the households at Five Trees with 3 people and rainwater harvesting could save approximately £77 a year on their water bill: 54% of their estimated water bill.

A water bill for a household of 5 people in an Ecohomes property, with an average consumption of 143 litres per person per day would be approximately £215 a year. In comparison with this the houses at Five Trees, with an average occupancy of 5 and without rainwater harvesting, could save approximately £86 a year on their water bill: 40% of their estimated water bill.

The Code compared to Ecohomes

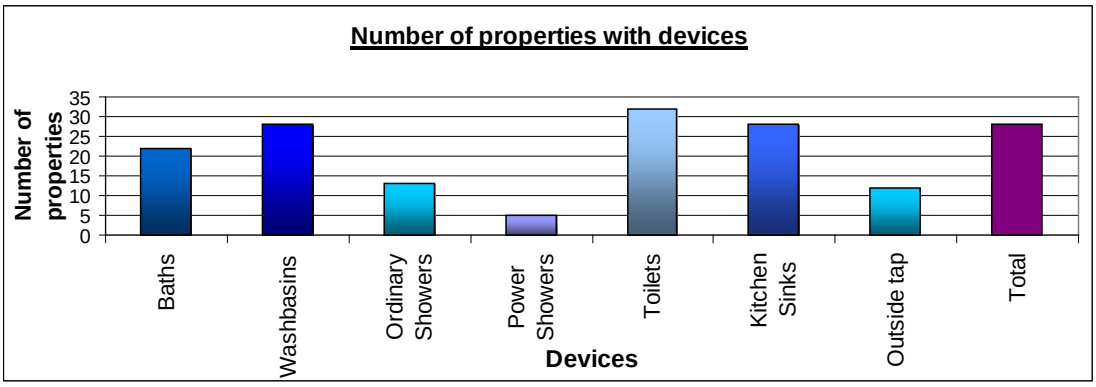
The Code homes are clearly designed to a lower water consumption performance level than Ecohomes and the results are evident of that. Therefore it appears that the Code does reduce water consumption. However, care needs to be taken when selecting the measures to achieve levels of the Code, such as with tap flow rates. It seems that water efficient devices may reduce the optimum amount of water a household uses, but household behaviour varies the amount as well. More monitoring of homes that are assessed against the Code are needed, but from both CfSH case studies featured in this report, there are already positive results.

Existing Homes

Existing Homes Project

It would be expected that the older homes would be less efficient and therefore consume large volumes of water. However it was found that, without making any changes, the average water consumption for the properties is 129.3 litres per person per day and the average occupancy is 1.7 people per property. This meets Defra's target of 130 litres per person per day. This figure is surprisingly low in comparison with the assumed average for the South East of England of 160 litres per person per day. One reason for this may be because of the requirement Radian has, under the Decent Homes standard, to refurbish bathrooms so the appliances may not be as old and inefficient as other existing homes. Figure 11 shows a profile of the houses to show what water using appliances are in the properties at the moment.

Figure 11: Profile of water appliances in existing homes



Eight properties have so far had eco-betas fitted. The feedback has been mixed; although most comments have been positive, a few residents found that they had to flush the toilet twice. These properties will be visited to find out the problems. One resident said that eco-beta means that "[the toilet] uses less water, but working on the original lever rather than pressing a smaller knob to flush the loo makes it a lot easier!" However one resident found that "[they had] to keep pushing [the] handle loads of times before it flushes".

As shown in table 11, before installing the eco-betas into the 8 properties, average water consumption was 137 litres per capita per day. After installing the eco-betas the average water consumption reduced to 108 litres per person per day. This means that an average of 29 litres of water has been saved per person per day in each of the 8 properties. This works out to be a saving of about 12,200 litres a month. Clearly, over a year, if the devices continue to work, a substantial amount of water could be saved.

Table 11: Average water consumption (litres pcc) for properties participating in existing homes project

Properties participating in existing homes project	Average Consumption (litres pcc)
All properties in project	129.3
Properties with Dual flush toilets	144.8
Other properties	139.9
Properties with eco-beta fitting	
Average consumption *before* eco-beta was fitted	137
Average consumption *after* eco-beta was fitted	108.2
% Reduction of average consumption	21%
Estimated average water saving per person per day	29

Financial savings for residents

As most residents are not on metered water bills, they have not yet received any financial benefit from installing the eco-beta. It is estimated that one resident, who was on a meter and had an eco-beta installed, is saving £18 a month[13].

Water saving bags project in existing housing stock

Distributing save-a-flush bags was hoped to be an instant and simple way to save water in more properties. The save-a-flush bag, shown in figure 12, can be fitted to older and therefore larger cisterns that are single-flush toilets. The bag is dropped into the cistern and the crystals inside the bag swell. When fully inflated, the bag should displace 1 litre of water every time the toilet is flushed. When carrying out other routine inspections to properties, Radian's labour force have been fitting save-a-flush bags. Also, adverts were placed in the residents magazines to collect at reception. However this has received a low response.

Approximately 300 save- a flush bags have been fitted in homes and offices across the Radian group. There has been a difficulty with encouraging the labour force to install this and finding the correct toilets to install them in. Ordinarily, 1 save-a-bag costs about £1.

Figure 12: Picture of save-a flush bag

[13] Based on water charges and a saving of 40% of water consumption

Chapter 5- Conclusions and Lessons Learnt

This first year of research has found that by implementing water efficient technology, in new build homes, water consumption can be lower than current national averages. However, the project in its first year has also highlighted a number of issues that could affect large-scale uptake of water efficient technology for new build homes. Most notably with rainwater harvesting: when considering installing rainwater harvesting systems, the resources and rainfall need to be taken into account. If the decision is made to install rainwater harvesting then this must be accounted for at the beginning of the project so that there is enough space inside to locate the pump. Additionally, a gravity-fed system needs to back the system up. Aside from these problems rainwater harvesting does substantially reduce water use.

It is evident that homes that meet level 3 of the Code for Sustainable Homes use less water than homes that were built to Ecohomes “very good”. However care needs to be taken to install technology that reduces water use and does not reduce quality of life. For example too low a flow for supposedly “water efficient taps” is both unacceptable to occupants and is not using resources efficiently: there needs to be adequate flow to start the boiler and to be able to use the tap. Otherwise, taps may be run longer than necessary. Therefore taps of at least 2 litres per minute should be fitted, especially to hot taps.

For unknown reasons, this year’s research has revealed a disparity in how much water households use. This indicates that there is a need to look at household behaviour and lifestyles such as whether householders are at home all day and consequently using more water at home. In order to encourage water efficiency more work needs to be done to raise awareness about the importance of water conservation.

For any new eco-technology both in new-build homes and existing homes it is important to have the technical know-how of how to install the technology and the awareness of the environmental issue. This means that eco-technology can be installed, and used, more effectively.

To implement water saving technology into new build homes, which meet Code for Sustainable Homes level 3, costs about £300 per unit without installing rainwater harvesting. Also installing rainwater harvesting into new build homes costs approximately £4,000 per unit. Through residents saving up to 74 litres of water per person per day, householders are going to save up to £90 a year on their water bill.

Saving hot water also saves electricity or gas and can help to reduce residents’ energy bills. Particularly in times of economic stress, bills are more noticeable to everyone, and Radian is keen to help residents reduce their bills, wherever possible.

Reducing cold and hot water use is of increasing importance in reducing the carbon footprint of water supply, use and disposal –water companies need power to supply water and treat effluent, but in our homes we use eight times this amount of energy to heat water. Water demand management will

therefore reduce greenhouse gas emissions and help to achieve the UK Carbon Reduction Commitment.

Notably, by implementing water saving technology, such as aerated showerheads, restricted flow taps, dual flush toilets and water butts, in new build homes water use as little as 86 litres per person per day. Further, a home built with water saving technology including a rainwater harvesting system can use as little as 58 litres per person per day. Replicating these water efficient homes for all new build homes would dramatically reduce demand for water for years to come.

Water efficient technology in new build must be complemented by retrofitting existing homes as these form the majority of the housing stock. This report has shown that by installing just one dual-flush device into 1 toilet can save 29 litres of water per person per day. Clearly, if this was implemented on a large-scale then the impact on water demand would be more significant. Therefore it is important to start installing water efficient technology into both new and existing homes as there is large potential to reduce the pressure on already water stressed regions and facilitate more growth.

In summary, the installation of water efficient devices does reduce water use in both new build and existing homes, assuming that they are correctly installed. In addition, to fully tackle water efficiency behavioural change towards more water conservation needs to happen.

Implications:

It is hoped that the lessons learnt from this project can be applied in driving water efficiency across South Hampshire. It is important to focus on both the new-build and existing housing stocks, for both private and public organisations. For interested parties, future quarterly updates and presentations about the project are available.

In future, when installing water efficient devices into new build, it is hoped that the problems featured in this report will be looked at by other organisations before they embark on their new projects. With the existing housing stock, it would be useful to increase the number of properties across South Hampshire, where water efficient technologies are implemented.

Recommendations/Next Steps

From the first year of research, this report makes the following recommendations for follow-up:

1) Awareness raising and behaviour change with residents is as important as installing water efficient technology
2) Labour force needs to be trained about why and how to install green technology
3) Water demand management is necessary in the South East in order to relieve water stress in the region

For more information about the Water Project please use the contact details:
Email: water@radian.co.uk
Address: Drum Court, The Spain, Petersfield, Hampshire, GU32 3NG

Appendix A

New Homes Case Study

Lipscombe Rise, Alton (SECBE Low Carbon Homes Project)

Need for renewable energy at Level 4

As a registered social landlord, Drum Housing Association is required to achieve at least Level 3 under the Code for Sustainable Homes (CSH). In these houses, they are striving for the highest achievable target within site constraints. Although initially aspiring to Code Level 5, Lipscombe Rise proved to be unsuitable for a radical departure from familiar technologies. The strategy is to increase insulation and reduce permeability while making modest use of micro generation technologies to deliver the Code to level 4.

This pair of semi-detached houses replaces another destroyed in an electrical fire. There was some urgency to stem the loss of rent and one of the houses required specific attention to disabled access.

Drum is pushing the boundaries towards Code Level 5 construction. But a switch from gas to wood-pellet fuel and a further 23% cut in water consumption were found to be impractical for this reconstruction in an established neighbourhood. Insufficient roof space of suitable orientation for both solar water and PV panels obliged designers to adopt a PV-only system for on-site renewables.

PLANNING PERMISSION

Lipscombe Rise is a neighbourhood with a variety of house designs, so the new brick-clad duplex does not look out of place, even with its PV panels. The position on the block is governed by the need for off-street parking. The local authority has adopted the Merton Rule, which requires the use of renewable energy onsite to reduce annual carbon dioxide (CO_2) emissions by 10%. No other significant planning issues arose.

KEY OUTCOMES

- This Code Level 4 design yields CO_2 emissions approximately 9-14% less than Code Level 3 and 37% less than a 2006 Building Regulations compliant house.*
- The estimated saving in energy bills is 9% compared to a 2006 Regulations house.*
- This experience puts Drum well on the way to achieving Code Level 5 in future.

* Based on NHER SAP 2005 calculations

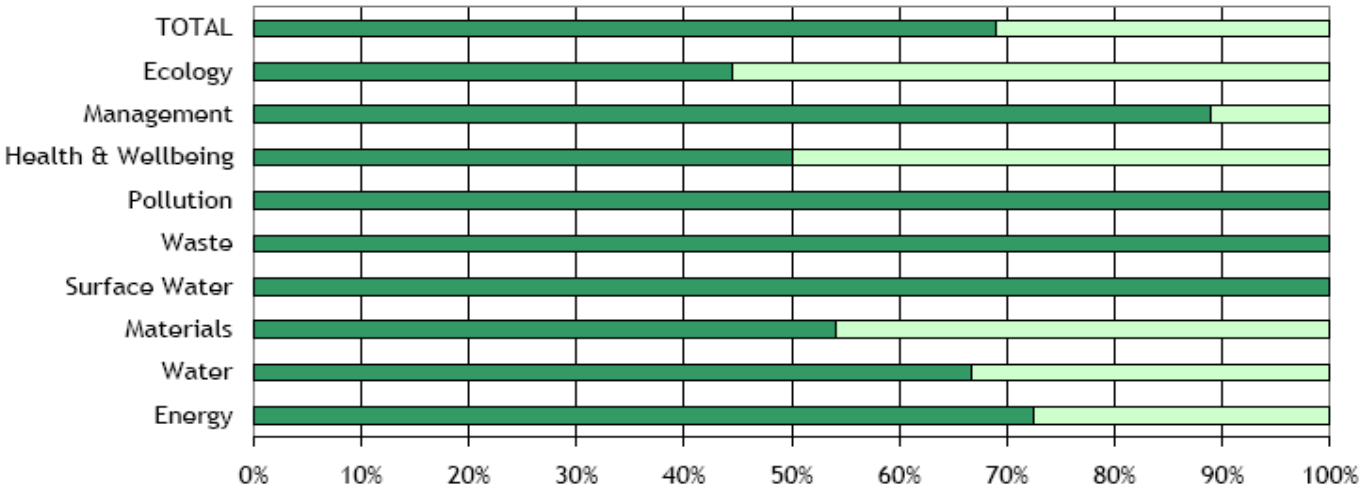
COST

Building to Code Level 4 on this project costs about 20% more than to the 2006 Building Regulations. The PV installation alone (for both houses) was £31k. The £3k rainwater harvesting system is needed to offset consumption in

the 4 bed house.

ACTIONS AND OUTCOMES (by CSH category)

The chart on page 1 compares the predicted and achievable scores for each of the nine CSH categories.



Code for Sustainable Homes: Predicted and Achievable Scores

Category 1: Energy/CO_2

The main upgrades were:

- Extra insulation in the roof and floor
- Change from cavity brick to a low permeability, proprietary timber-framed system with mechanical ventilation throughout
- Improved windows
- PV panels
- 75% low-energy lighting
- Combi boiler without tank.

The SAP calculations at Lipscombe Rise show a 44% improvement over Target Energy Emissions Rate, satisfying the key qualification for Code Level 4.

The existing gas supply will be used as the site is too small for a biomass alternative. Nevertheless, photovoltaic (PV) panels will be used to gain some renewable energy.

During the design, a feasibility study compared various combinations of improved insulation and permeability, window specification, boilers with and without tanks, and sizes of PV panels and solar water panels. Although solar water delivers renewable energy at a lower unit cost than PV, the amount of energy needed, together with the limited space for collectors, tipped the balance in favour of PV panels only.

Further energy points were earned by providing outdoor clothes drying, energy-efficient security lighting, cycle storage and accommodation for a home office.

Category 2: Water

The development achieves the stringent 105 litres/person/day needed for Code Level 4 with flow taps and appliances, water butts, and a rainwater harvesting system for the larger house.

Category 3: Materials

80% of the roof, walls and floors will have an 'A' rating by the Green Guide 2007. Responsible sourcing will be verified sufficiently to achieve half the allowable points.

Category 4: Surface water run-off

As a brownfield site, it is not difficult to achieve no worse run-off than before. In addition, hard surfaces will be specified to achieve 50% reductions in peak flows. Flood risk is low. Hence it earns full points for run-off.

Category 5: Waste

On-site waste provision and municipal collections will fully comply with the CSH standard.

Category 6: Pollution

Pollution controls on insulants and NOx gas will fully comply with the CSH standard.

Category 7: Health and well-being

There is scope to improve day lighting, airborne sound and private space. While no specific account has been taken of the Lifetime Homes standard, the larger unit is designed to wheelchair user standards to take account of a returning resident's disability.

Category 8: Management

Construction management and security standards cover all the bases in CSH, except performance to the highest level under the Considerate Constructors Scheme.

Category 9: Ecology

The site is deemed to be of ecological value, prompting the appointment of a suitably qualified ecologist. Further points could be earned by actions to

enhance the ecological value. No credit is sought for achieving a high ratio of floor area to footprint because the structure is only two storeys.

LESSONS

- Although the energy provisions are tough, they are by no means the only difficult ones to achieve.
- Much depends on the quality of the builders' workmanship and attention to paperwork.
- Rainwater harvesting is an effective way to mitigate the higher per capita consumption expected in larger families where conservation can be difficult to enforce.
- Rainwater run-off controls will be more difficult to achieve on greenfield sites.
- The method for assessing energy used in cooking can create some unexpected answers.
- At this early stage in the learning curve, compliance with the CSH is challenging, expensive to achieve and administer.

CREDITS

Developer: Drum Housing Association, a member of the Radian Group

Architect: Parnell Design Partnership

Sustainability and Renewable Energy Consultant: SRE Ltd

Employer's Agent: Boulter Mossman

Constructor: Austin Builders

PV supplier: Dulas

Grant towards CSH upgrade: BERR's Low Carbon Buildings Programme and East Hants District Council.

Appendix B

New Homes Water Conservation Case Study

Five Trees, Inwood Road, Liss

Radian, a major provider of social housing and support in the south of England, brings together experience of building, regenerating and managing sustainable homes and environments.

Radian recognise that there are problems facing the south east of England in terms of water supply. It is an area that is already densely populated and with more development planned, responsibility to research methods of conserving water was required. In partnership with the Environment Agency and East Hampshire District Council, Radian is conducting a significant trial in Liss.

The Facts

More water is consumed on average per person in the south east than in the rest of England and Wales. Climate change poses further challenges as it has been predicted that lower levels of rainfall will increase the long term threat of water shortage.

With additional housing in the region, water will become an increasingly valuable resource and the demand and supply will need to be carefully balanced.

Research

With the support of the Environment Agency, Radian has embarked on a water efficiency project and has employed a coordinator. They will spearhead research into methods of water management to reduce demand from households.

As part of this research, Radian selected a new development of five houses at Five Trees, Inwood Road in Liss to trial different methods of water conservation. Each property had separate, innovative methods of saving water installed so that they could be monitored for cost efficiency, economy, ease of use and compared.

The Experiment

With the support of the Environment Agency, Radian has embarked on a water efficiency project and has employed a coordinator. They will spearhead research into methods of water management to reduce demand from households.

As part of this research, Radian selected a new development of five houses at Five Trees, Inwood road in Liss to trial different methods of water conservation. Each property had separate, innovative methods of saving water installed so that they could be monitored for cost efficiency, economy, ease of use and compared.

The Technology

The five houses were equipped as follows:

Technology	No 35 **EoT	No 35a ** MT	No 37 MT	No37a MT	No 39 EoT
Water Butt	✓	✓	✓	✓	✓
Dual Flush WCs	✓	✓	✓	✓	✓
Aerated Shower Heads	✓	✓	✓	✓	✓
Aerated Taps	✓	✓	✓	✓	✓
Rainwater Harvesting Tank	✓				✓
Water Efficient Washing Machine		✓		✓	
Water inlet meters		✓		✓	✓
Water Efficient Dishwasher					✓

The Methodology

The monitoring period started when the new occupants moved into their homes at the beginning of December 2008. The project will run for a full year and during that time, the meters on the inlets inside the property will be checked every three months.
The rainwater harvesting tanks installed in two of the properties supply two toilets per dwelling and have a capacity of 1600 litres. Originally a communal system was planned but the team quickly realised that a very large tank would be required and it would also cause problems in apportioning the mains water bills. This is because some households would be using rainwater, some mains water and all using different amounts.

The Challenges

Although the project is still in its early stages, there have already been a number of challenges posed by the rainwater harvesting systems:

• The size of the roof and the amount of rainfall has an impact on the level of water harvested. During times when rainfall harvested is insufficient to effectively service the WCs the system will revert to the mains supply.

• If there is a power cut, a separate gravity feed will supply the WCs.

• In the extreme cold weather experienced this winter, the external pump system froze and ceased working. This has now been resolved by insulating the external stores. This is the second site where Radian has installed rainwater harvesting systems and will soon be able to establish how effective they are in reducing residents' water bills.

The Costs

The basic total costs of the water conservation equipment installed in the properties at Five Trees were: (refer to Table above)

- Rainwater harvesting equipment £2200
- Basic installation costs £5000
- Meters – equipment and installation £2,800
- Water/ energy efficient white goods and installation £1,400

Additional installation costs are not quoted as they are unlikely to be incurred on future projects. The cost of the project was match funded by East Hampshire District Council and Radian.

The Outcome

The standard meters fitted by the water company for billing purposes will identify how much water in total each house is using. The additional meters installed on the inlets of some of the properties will allow a more in-depth analysis of water usage patterns.

The Building Research Establishment (BRE) is carrying out research to assess whether the Code for Sustainable Homes water consumption standards are reasonable in practice. The Code for Sustainable Homes is an environmental assessment of 'new build' properties ranging from level 1 to level 6 (the best, carbon neutral with a consumption level of 80 litres of water per person per day). Five Trees aims to achieve level 3 of the code which requires, among other environmental standards, a water consumption level of 105 litres per person per day.

Radian will be working with the BRE and will provide evidence from the Five Trees project for this research. The BRE in turn will help analyse the results so that Radian can look at how the information gained from this project can be used in future developments to reduce the amount of domestic water used.

The Learning Experience

Understanding the desirability of these water conservation systems to residents and whether they offer a practical solution for water efficiency is key. In order to develop best practice for future developments, the residents of Five Trees will be fully consulted.

Resulting data will become available at the end of the monitoring period and will be disseminated and will form the basis of presentations be the Water Conservation Projects Coordinator.

EAST HAMPSHIRE EHDC Partners www.easthants.gov.uk

Appendix C
Questionnaire sent to householders in EcoHomes

Property Address:

Household Occupancy

1) Please give the **number** of people normally resident at this property who are in each of the following **age groups** (include those who are sometimes absent, perhaps working away or at college):

<2yrs	**2-4yrs**	**5-17yrs**	**18-29yrs**	**30-44yrs**	**45-64yrs**	**65-74yr**	**>74yrs**

Occupation

2) a) Please indicate the main occupation of all occupants at this property who are **aged 18 years and over**. Please enter the relevant numbers in the boxes below.

Example: [*2*] *Student* [*1*] *Full time employed* [*1*] *Retired*

☐ Full time employment	☐ Part time employment
☐ Retired	☐ At home
☐ Other	☐ Student

If other, please specify:

b) Do any of the above occupants work from home, if so how many? ☐

Using the appliances in your property

3. Does your household take more showers than baths? - What proportion of showers to baths (out of 100%) e.g. 60%/40% showers/baths?

4. Does enough water come out of the shower?

5. Does enough water come out of the taps?

Please turn over

6. Do you have a dual-flush toilet?

7. Do you always use the washing machine on full load?
   -How often?

8. If you have a dishwasher, do you always use the dishwasher on full load? -How often?

9. Do you have a water butt? How often do you use it?

10. a) Do you find your water bills affordable?

    b) How do they compare with your last house?

11. What would make you save more water?

12. Any other comments?

Please return in the pre-paid envelope. Thank you.

Appendix D
Existing Homes Project Questionnaire

Please answer each question below as accurately as possible. We guarantee to treat the information with the strictest confidence.

1. How many of the following appliances or fittings are there in the property?

a. Baths……_____

b. Washbasins……_____

c. Ordinary Showers……_____

d. Power Showers……_____

e. Toilets……_____

f. Kitchen Sinks……_____

g. Outside tap (if relevant)……_____

2. Does your household take more showers than baths? - What proportion of showers to baths (out of 100%) e.g. 60%/40% showers/baths? _____

3. Do you have a washing machine? _____

How many times a week do you use it? _____

Do you use it on full load? _____

4. Do you have a dishwasher? _____

How many times a week do you use it? _____

Do you use it on full load? _____

5. Do your toilets have one or more of the following? _____

A Save-a-Flush bag? _____

Dual flush? _____

Any other water saving device? _____

6. If you have a garden, do you water it? _____

Do you use a watering can? _____

Do you use a hosepipe? _____

Do you have a sprinkler? _____

Do you have one or more water butts? - do you use them? _____

Please return in the pre-paid envelope. Thank you.