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Preston Water Efficiency Initiative

Final Report
March 2009

In partnership with

Sutton and East Surrey Water

Reigate & Banstead BOROUGH COUNCIL
Banstead | Horley | Redhill | Reigate

Raven Housing Trust

Environment Agency

SURREY COUNTY COUNCIL

On the cover

One of the Initiative's plumbers installing a new toilet.

Acknowledgments

Alister Peters was appointed as the liaison officer working with the Raven Housing tenants and all the other parties involved in the trial. His dedication to this trial has made a significant contribution to its success.

Author and reviewers

This report was written by Peter Boarder, Alison Murphy and Brian Hooper. The project was overseen by a Steering Group and Project Team (appendix 8), who also contributed to and reviewed this report.

About Waterwise

Waterwise is an independent, not-for-profit, nongovernmental organisation focused on decreasing water consumption in the UK, and on building the evidence base for large-scale water efficiency. In England, we sat on the Environment Minister's Water Saving Group, which came to a close in autumn 2008, alongside the water industry and regulators. We also convene the Saving Water in Scotland network.

Our aim is to reverse the upward trend in how much water we all use at home and at work by 2010. We are developing a framework supported by a robust social, economic, and environmental evidence base to demonstrate the benefits of water efficiency.

To achieve our aims we work with water companies, governments, manufacturers, retailers, non-governmental organisations, regulators, academics, agricultural groups, businesses, domestic consumers, the media and all other stakeholders.

We conduct our own research and also undertake work as consultants.

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Executive summary

The Preston Water Efficiency Initiative piloted an innovative water demand-management project that aimed to

- Reduce levels of water consumption of tenants living in social housing; and
- Provide recommendations for future retrofitting of water efficiency devices in existing stock.

The project was initiated and coordinated by Reigate and Banstead Borough Council with funding from the Government's New Growth Points Programme, and was delivered in partnership with Raven Housing Trust, Sutton and East Surrey Water, the Environment Agency, Surrey County Council and Waterwise.

The initiative was undertaken in Preston, Surrey, and had a number of key components:

- The installation of new dual flush toilets and water efficient showers to 160 dwellings as part of an enhanced Decent Homes programme;
- The retrofitting of water efficiency devices, such as a dual flush conversion product and a leakage alarm, to 205 properties that were not part of the Decent Homes programme;
- The installation of a pilot rainwater harvesting system to a block of twelve flats, which also received a bathroom refurbishment;
- The fitting of water efficiency devices in a school and leisure centre, including urinal controls, push taps and new dual flush toilets; and,
- A limited promotional and awareness campaign, including outreach work, information leaflets, giveaways and discount vouchers.

The initiative showed that

- Significant water savings can be achieved through the installation of water efficiency devices to existing social housing stock;
- These savings were made despite tenants not having any financial incentive to reduce their water consumption, for all tenants were unmeasured and paid for water as part of their rent;
- Retrofit devices reduced water use by 14 percent providing the best value for money savings;
- The installation of dual flush toilets and showers, as part of a Decent Homes programme, resulted in 25 percent water savings and provided relatively good value for money savings;
- Rainwater harvesting only showed an additional 5 percent savings, provided poor value for money and experienced a range of technical issues in installation and maintenance; and,
- All water savings made by tenants resulted from using devices that did not alter lifestyle and in most cases actually enhanced lifestyles.

The principal recommendations of the initiative are that

- The installation of water efficiency measures, such as showers and dual flush toilets, should be provided as standard, as part of any future Decent Homes programme;
- Registered Social Landlords and housing providers should, wherever possible, seek to install simple retrofit water efficiency measures that are quick and easy to fit and cost effective;
- Due to the technical and maintenance issues experienced and the relatively poor value for money, the installation of rainwater harvesting to existing housing is not recommended; and,
- Wherever possible aerated showerheads and tap inserts should also be installed to reduce both water and energy consumption.

Table of contents

Page 5 **Introduction**
5 Purpose
5 New Growth Points
5 Background to Preston
6 Aims of the Preston Water Efficiency Initiative
6 Partners
6 Timeframe
Page 6 **Programme delivery**
6 Bathroom refurbishment programme
7 Demand management retrofit programme
8 Rainwater harvesting trial
9 School and leisure centre retrofit programme
10 Communications
Page 11 **Findings: water savings achieved**
11 Original estimates of savings
11 Measurement and monitoring
12 Actual water savings
12 Refurbishment and retrofit programmes
14 Rainwater harvesting programme
14 School and leisure centre retrofit programme
Page 14 **Findings: value for money**
Page 15 **Findings: tenant feedback**
16 Tenant feedback: refurbishments
17 Tenant feedback: retrofits
18 Tenant feedback: rainwater harvesting
18 Tenants' attitudinal change
Page 19 **Findings: practitioner experience**
Page 20 **Conclusions**
Page 21 **Recommendations**

Page 22 **Appendix 1: detailed questionnaire and letter**
Page 29 **Appendix 2: rainwater harvesting system**
Page 30 **Appendix 3: products**
Page 30 **Appendix 4: Metering and monitoring**
Page 31 **Appendix 5: tenant questionnaire**
Page 33 **Appendix 6: structured interviews**
Page 33 **Appendix 7: structured interview main findings**
Page 35 **Appendix 8: steering group and project group**

Introduction

Purpose

This report seeks to evaluate the success of the Preston Water Efficiency Initiative. It outlines the aims of the initiative, how it was delivered and the lessons that have been learnt, and provides recommendations for the future refurbishment and retrofitting of water efficiency devices in social housing.

New Growth Points

In December 2005, the Government announced the launch of its New Growth Points (NGP) initiative. New Growth Points is designed to provide support to local communities who wish to pursue large scale and sustainable growth, including new housing, through a partnership with Government.

NGP status is not a statutory designation but a relationship between central government and local partners that is built on four key principles:

- early delivery of housing as part of the growth plans;
- supporting local partners to achieve sustainable growth;
- working with local partners to ensure that infrastructure and service provision keep pace with growth; and,
- ensuring effective delivery.

In 2006 local partners were asked to submit strategic growth proposals which were sustainable, acceptable environmentally and realistic in terms of infrastructure to be assessed by Government and its agencies.

Twenty-nine local authorities and partnerships across England were awarded NGP status, commencing a long-term partnership for growth with Government. Reigate and Banstead Borough Council was one of these partners and was awarded funding for three key projects:

- Redhill Accessibility, which included the refurbishment of Redhill bus station and the production of a microsimulation model;
- A23 Decongestion, which extended the Fastway 100 service from Horley to Redhill; and, the
- Preston Resource Demand Project, which later was renamed the Preston Water Efficiency Initiative.

Background to Preston

Located in the north west of the borough, Preston lies approximately two kilometres southwest of Banstead Village and three kilometres south east of Epsom town centre. Importantly, Preston is also situated within the London Fringe Sub-region, an area that has considerable development pressure, due to its proximity to London, its economic strength and the quality of the local environment.

Reigate and Banstead Borough Council has designated four regeneration areas, namely Horley, Redhill, Merstham and Preston. The Preston regeneration area encompasses a residential neighbourhood of circa 2,800 dwellings, many of which were built in the 1950s as social housing, but now includes a number of modern infill housing schemes.

The regeneration area includes approximately 500 dwellings that are owned and managed by Raven Housing Trust, a local registered social landlord. The dwellings include a combination of houses and flats, including semi detached and terraced houses and blocks of flats with either nine or twelve dwellings per block. These dwellings provided the focus for this initiative.

The Borough and Surrey County Council is committed to working with their partners including Raven Housing Trust, to bring about major social and physical regeneration in Preston. It is envisaged that this regeneration will include the upgrade of existing housing stock, the building of an exemplar sustainable

development of new homes and a community hub on two key sites, as well as significant environmental improvements.

Aims of the Preston Water Efficiency Initiative

The principal aim of the Preston Water Efficiency Initiative was to pilot an innovative water demand-management project in Preston, Surrey that

- Reduced levels of water consumption of tenants living in social housing through
    - the installation of a pilot rainwater harvesting system, refurbishing bathrooms and retrofitting water efficiency equipment and devices to existing properties; and
    - A small scale and complementary awareness campaign to help change people's attitudes towards water consumption.
- Provided a series of lessons learnt and recommendations for future retrofitting of water efficiency measures in social housing.

As such it is hoped that the initiative will help to provide increased headroom to support the delivery of new homes, as well as limiting the eco-footprint of new and existing development in order to minimise climate change.

Partners

The principal project partners in the Initiative were Reigate and Banstead Borough Council, Raven Housing Trust, Sutton and East Surrey Water, Waterwise, the Environment Agency and Surrey County Council.

A Project Steering Group was set up at the beginning of the Initiative to provide overall strategic guidance, ensure it achieved its aims and objectives and to oversee delivery. The Steering Group comprised of representatives from Reigate and Banstead Borough Council, Sutton and East Surrey Water, Raven Housing Trust, Waterwise and the Environment Agency.

A separate Project Team was formed to undertake the majority of the day to day delivery of the initiative including tendering out of work, liaison with contractors, tenant liaison and monitoring and review. The Project Team included representatives from Raven Housing Trust's Asset Management team, as well as a dedicated Water Conservation Officer to coordinate work and liaise with tenants. Representatives of the Project Team also included Sutton and East Surrey Water and Waterwise who provided specialist advice and analysis.

Timeframe

Project planning was carried out between January and March 2007, which firstly included the preparation of a development brief and feasibility document. The main delivery of the project commenced in April 2007 and was completed by May 2008. Monitoring of data took place until February 2009.

Programme delivery

The project had four key components:

- Bathroom Refurbishment Programme;
- Demand Management Retrofit Programme;
- Rainwater Harvesting Trial; and
- School and Leisure Centre Retrofit programme.

Bathroom refurbishment programme

The Government expects all councils and housing associations to meet the Decent Homes standard by 2010. To meet the standard, properties must have reasonably modern facilities, be warm and be weatherproof.

As part of their Decent Homes refurbishment programme, Raven were planning to refurbish the bathrooms of approximately 160 dwellings in Preston in the 2007/08 financial year. Raven's normal bathroom refurbishment included the fitting of a standard toilet, washbasin and bath. No showers have been used previously in Raven homes and these would not normally be included in the Decent Homes package.

As part of this Initiative the opportunity was taken to install two new water efficient products alongside the Decent Homes refurbishment programme. These were

- Dual-flush toilet: a new toilet, the Twyford Galerie flushwise WC, was installed. The toilet flushes with 4 litres for the full flush and 2.6 litres for the short flush and conforms with the UK Water Regulations 1999 and BS EN 997:2003 Class 2. The Initiative was the first large-scale trial of the Twyfords Galerie toilet, which has subsequently been awarded the Waterwise Marque.
- Shower and shower curtain: a shower and shower curtain were installed over the replacement baths. The majority of houses had adequate mains fed or gravity systems fed from a roof tank and as such a Mira Sport 9.0 kW shower was installed in these properties. Where houses or flats had a combination boiler, a Mira Element thermostatic mixer shower was installed.
- Water butts: tenants with gardens were also offered a water butt kit. The kit that was selected was manufactured by Blackwall from recycled materials. It comprised a 135 or 220 litre water butt, a stand and a diverter (which brings water from the down pipe into the water butt and returns it to the down pipe when the water butt is full). The kit was installed at a suitable point close to a rain water down pipe in the customer's garden.

The works were undertaken principally by Raven appointed contractors.

Demand management retrofit programme

Many of the dwellings in the project area (approximately 340 properties) were not due to be refurbished under the Decent Homes programme. Alternative means of achieving water savings were therefore necessary and as such a range of water efficiency devices were chosen.

In order to select which devices were suitable for each dwelling, it was necessary to determine what existing taps, toilets and other water devices were already installed and the type and needs of each household. To do this, a Water Conservation Officer was employed by Raven Housing Trust. The officer discussed with the tenant the suitability of each device and ascertained what could be physically fitted. Simultaneously a questionnaire was completed with the householder (appendix 1).

This initial consultation was then followed up by a visit from a plumber to fit the appropriate devices and to leave full instructions and a telephone contact number in case of any queries.

The package of measures included the following:

- Toilets: an initial check of each toilet's water level was made by the surveyor and adjustments were carried out to ensure that the level was not higher than that recommended by the manufacturer (usually a line is shown on the inside of the cistern). Each toilet was then assessed for suitability of installing an ecoBETA, which is a dual flush retrofit device that converts an existing 9-litre or 7.5-litre cistern into a dual flush cistern (e.g. typically 9/4.5 litres). A small number of high-level cisterns were found in the downstairs cloakroom of some properties. In these cases, the whole toilet was replaced with the Twyfords Galerie Flushwise 4/2.6 litre dual flush toilet.
- Taps: an initial check was made of each tap and those that were found to be dripping had their washers replaced by the surveyor. At this stage, it was planned to install a tap insert device to reduce the flow in the taps; however, on inspection it was found that the devices tested would not fit the taps, due to their small diameter outlet. As such, no further work was undertaken on taps.
- Wasted water and leakage: visual checks were carried out on pipes, fittings and toilet overflows to ascertain if there were any signs of water leakage. A leakage alarm was then offered to customers where it was practical to fit. The model chosen for the initiative was the Ecoflow. A leakage alarm

can be set to detect continuous water flows over one to four hour periods. As part of the Initiative, the alarms were set at three hours to detect any dripping or running of taps, leakage from overflows or from pipework that exceed this period.

- Garden watering: tenants with gardens were offered a water butt kit.

A day of training in fitting devices and in effectively liaising with tenants was provided for all staff involved.

It was originally estimated that 340 dwellings would receive a retrofit; however, at the end of the Initiative 205 properties had received a retrofit. This was mainly due to difficulties in contacting and accessing these properties rather than the residents refusing to have the devices fitted.

Rainwater harvesting trial

Another key part of the initiative was the piloting of a retrofit rainwater harvesting system in order to provide water that could be used in toilets. It was decided that the rainwater harvesting system would be installed on a block of flats. This enabled one system and one storage tank to be installed to serve all twelve flats. The block that was selected was also scheduled for a major bathroom refurbishment programme, which enabled the internal pipe work for connecting the toilets to the storage tank to be fitted at the same time as the refurbishment took place.

Two types of rainwater harvesting system were considered for possible retrofitting to this block. Both systems comprised of a large rainwater storage tank buried underground close to down-pipe feeds from the roof.

The first option involves pumping the rainwater, following filtration, to a roof tank where a top-up supply from mains water (complying with Water Regulations) is fed to the top of the tank. This water is then gravity-fed to supply toilets and potentially to washing machines.

The second type of system dispenses with the roof tank and water is pumped straight from the outside collection tank under pressure to toilets and potentially washing machines as well. Again mains water is available to top-up the system when the rainwater is depleted. It was decided that a pressurised system with direct feed from the collection tank to supply the flats was the most appropriate method of installation.

A number of specialist rainwater harvesting companies were invited to tender for providing the equipment and installation of the system. Aquality was chosen to supply the equipment and Owls Hall was appointed to install all fixtures and fittings external to the building to direct the rainwater to one point outside the building.

Raven, through their contractors, carried out the necessary internal pipe work to supply the toilets with rainwater. Further details of the rainwater harvesting system can be found in appendix 2.

Pupils from the local primary school with the old toilets that were replaced with efficient models

School and leisure centre retrofit programme

The initiative also involved work with the local primary school, Epsom Downs, and the Banstead Leisure Centre, both based in Preston.

In order to decide on which appropriate measures were necessary, a specialist contractor called Aqualogic was commissioned to undertake water saving audits at both venues. The devices were fitted by Aqualogic at the time of the survey.

Following Aqualogic's recommendations the following water efficiency devices were installed at the school:

- Urinal controls on flushing urinals;
- Push taps to replace existing taps;
- Flow restrictors on feeds to hot and cold taps;
- EcoBETAs in toilets to convert to dual flush;
- Replacement of high level cisterns with close-coupled dual flush cisterns; and,
- Water butts.

Water efficiency devices were installed at the leisure centre following an audit and recommendations by Aqualogic:

- Existing taps were replaced by push taps (achieved by inserting a new top to the existing tap shank);
- In-line flow regulators were used to control the flow of the taps;
- Urinal controls were either repaired or replaced;
- EcoBETAs in were installed toilets to convert to dual flush; and
- Water butts were placed.

A full list of products is shown in appendix 3.

Communications

As part of the Initiative a small-scale and complementary promotional and awareness campaign was delivered in an attempt to encourage people to take up the Initiative and reduce their water consumption.

The initiative used a variety of methods to promote and raise awareness, including the following:

- Water Conservation Officer: a dedicated Water Conservation officer was appointed to visit people in their homes to explain the project, including the benefits of saving water, as well as completing household questionnaires.
- Literature: A5 leaflets were produced about the Initiative and were distributed to each household and in local venues. In addition, editorial was provided in local community newsletters such as *Raven Times*, *Borough News*, *Your Water* and the local press.
- Giveaways: residents were provided with a range of products including tea towels and fridge magnets, as well as digital shower timers.
- Washing machine offer: residents were offered a voucher that provided a discount on the purchase of a new washing machine. New washing machines use significantly less water than older models and for this Initiative the Steering Group chose models provided by Gorenje because the manufacturer's washing machine models are within the top ten most efficient machines identified by Waterwise and because they were prepared to offer a discount to participants. The cost of the discount was funded by both the Initiative and by Gorenje. The models chosen were the Gorenje WA 62121 (listed price £279, offered at £189) and the Gorenje WA 74163 (listed price £479, offered at £339).
- Neighbourhood shop**:** Raven's local neighbourhood shop based in Preston showcased the Initiative. Promotional leaflets, giveaways and examples of the washing machines were displayed at the shop.
- Educational work: Sutton and East Surrey Water undertook some educational work with all the pupils at Epsom Downs Primary who participated in the Initiative to teach them the importance of using water wisely.

The following lessons can be learnt from this communications aspect of the project:

- The Water Conservation Officer found it difficult to 'catch people in' for many of the visits which were during the day on weekdays when many people were at work.
- Tenants were very cooperative about the Initiative and the majority allowed access into homes in order to undertake the works. This was important since the work was not mandatory.
- At the end of the initiative only six new washing machines were supplied, which was less than expected; however, given the short timescale the offer was open to tenants this Initiative was successful in that it influenced the people who were ready to change their machines to purchase a water efficient one. It would also help if a range of manufacturers' washing machines could be offered.

Initiative display at neighbourhood shop

Findings: water savings achieved

In order to evaluate the water saving that had been made it was necessary to establish water usage both before and after water saving devices had been fitted. Domestic water use is normally measured in terms of per capita consumption (PCC), which represents the amount of water used per person per day. PCC varies according to many factors including the number of persons in the house, the age profile of the house and the water using appliances in the home.

It is therefore necessary to have detailed information on each household. This information was collected via a series of questionnaires (appendix 1). The questionnaire provided detailed information regarding the household, its occupants and water using devices, including attitudes to saving water.

A diary was also produced that tried to establish when people were away from the house (e.g. holidays), when any additional people were staying at the house and any new water using appliances purchased. Although the Project Team did provide incentives for tenants to complete these diaries, unfortunately none were returned.

Data derived from the questionnaires (table 1) showed that households were larger in those properties that were part of the refurbishment programme. The data also show that households in the blocks of flats where rainwater harvesting was installed were smaller and had no children.

Table 1: Household and property information based on resident questionnaires

Programme	People				House		
	Occupancy	% with children	% working	% retired	% flats	% terraced	% semi
Refurbishment	2.9	29.7	33.5	10.9	48	29	21
Retrofit	1.8	27.6	28.5	17.5	78	14	2
Rainwater	1.7	0.0	20.0	20.0	100	0	0
Average	**2.2**	**19.1**	**27.3**	**16.1**	**75.3**	**14.3**	**7.7**

Original estimates of savings

For the purposes of this study, it was calculated from the water use in the District Metered Areas (DMAs) supplying Preston that the homes within the area of the Initiative used slightly less than the average PCC for the rest of the water company's unmetered customers. This was likely to be because they did not have the same water using facilities and appliances as some of the private houses in the area.

The Project Team estimated that the water usage in Preston was 165 litres per person per day or 362 litres per property per day (assuming occupancy of 2.2 persons as taken from questionnaire data) at the start of the Initiative. Target water consumptions were estimated as shown in table 2.

Table 2: Target water consumption based on theoretical calculations

Programme	Predicted consumption	
	Litres / person / day	Litres / property / day
Retrofit	135	297
Refurbishment	120	264
Rainwater harvesting and refurbishment	90	198

Measurement and monitoring

One of the greatest challenges of the initiative was how to measure its success in reducing water demand. None of the houses and flats had water meters fitted to them and all water charging is on a flat rate basis,

paid as part of the rent to Raven. This gave the residents no financial incentive to save water because they could not save money.

Prior to the initiative, Sutton and East Surrey also had District Meters (fitted with data loggers) used to monitor leakage and cover large areas generally of 500 to 1,000 houses; however, as the Initiative covered homes in two DMAs this made it far more difficult to register relatively small changes in water usage when these could easily be masked by other events occurring in the DMA. Full details of the metering are shown in appendix 4.

In order to calculate water savings, as a consequence of the Initiative, Sutton and East Surrey Water installed a selection of metres:

- Blocks of flats: single meters and data loggers to each of five blocks.
- Small Area Meters: groups of houses were established where water supplied could be measured by installing one meter. These can either be cul-de-sacs or areas where supplies can be isolated through a single supply. Seven such areas were created.
- Individual household meters: fortunately new water mains had been laid in two roads serving some of the houses and meter boxes installed. Meters could then simply be inserted in the meter boxes without any disruption to the residents or excavation being required.

All meter readings were monitored for at least two months prior to fitting the devices (where possible) and then initially for six months following installation.

Actual water savings

Refurbishment and retrofit programmes

Each of the monitoring methods (as detailed in appendix 4) produced an estimated saving for both the bathroom refurbishment and the retrofit programme (table 3). These results were combined to produce an overall saving for the two types of programme (table 4).

Table 3 shows that both the refurbishment and retrofit components of the programme achieved considerable savings, very close to the original forecast. The retrofit savings are slightly less than forecast, which could be due to those homes where the devices could not be fitted. For example, ecoBETAs were fitted in 92% of homes, as some already had dual flush toilets.

Table 3: Measured water savings

	Number of properties	Monitoring	Monitoring period	% water savings for refurbished properties	% water savings for retrofit properties
Individual properties	27	Fortnightly	Oct 07 – Dec 08	23%	13%
Block of flats	30	Monthly / 15 minute	Apr 07 – Feb 09	28%	-
Small Area Monitors	139	15 minute	Oct 07 – Dec 08	23%	15%
Average of all methods of monitoring				24.2%	13.7%
Weighted average water savings				**25.0%**	**13.9%**

Table 4: Consumption after the work

	Refurbishment	Retrofit
Litres/property/day	271.50	311.54
Litres/person/day*	123.41	141.61
Reduction in litres/person/day**	**41.25**	**23.00**

* based on occupancy from questionnaires of 2.2; ** based on original estimate of 165 litres/person/day

The average is a straight mean of the methods of monitoring, whereas the weighted average places greater emphasis on those methods that are considered more reliable based on the range of dates, frequency of reads and number of households monitored. Several households monitored together produce more robust measurements since they are less prone to day-to-day fluctuations.

Properties with an increase in water use due to a change in tenancy were excluded from the analysis. One tenant was found to have a significantly higher water use (5,200 litres/day) as he was using a hose to top-up a leaky fish pond, so this data was also excluded. This left twenty-two properties in the final analysis.

Both the blocks of flats and Small Area Monitors (SAM) included some properties where no work took place because they were under private ownership or the tenant either opted out of having the work done or could not be contacted. It was assumed that water consumption at these properties did not change during the monitoring period. This factor may lead to errors in the calculations, although it is reasonable to conclude that the number of these properties with an increase in water use would be equal to the number with a decrease (e.g. due to change of occupancy) so that the overall effect is negligible. This was supported by the ten control properties whose average water use was similar throughout the monitoring period (4.6 percent reduction between pre and post periods). Data from two blocks (out of the five) were excluded due to a low percentage of properties having work done, which meant it was difficult to determine the effect on the whole block due to variations from the other flats. Results from all seven SAM areas were included in the data analysis.

It is important to start measuring properties early, several months before work is planned to commence. This allows any leaks detected to be found and fixed, as well as ensuring the data is robust. A leak was found on one of the blocks of flats, which delayed the start of the 'true pre' measurement period. In some areas, unfortunately, only a short timescale was available between the confirmation of which properties would be included in the programme of work, as this had to be verified from house-to-house visits and bathroom surveys (by Raven Housing) and the date the work was due to start. The ideal pre-monitoring period of at least three months could not be achieved in these cases. Therefore it was particularly important that different groups of properties were measured so that results could be verified.

Installation of rainwater harvesting tank beside block of flats

Rainwater harvesting programme

There were considerable problems is getting the system up and running, which was to be expected in a pilot initiative of this kind. Delays in getting all the pipework completed, pumps running effectively and electrical issues rectified meant the system was not operational until August 2008, although the tank itself was installed in March 2008.

Further issues with the pumps and switchover between rainwater and the mains top-up between September 2008 and March 2009 meant only selected periods could be included in the analysis (a total of fifty-four days). During these periods water consumption reduced by 5.2 percent compared to the post-refurbishment water use, resulting in water use of 91 litres/person/day or 154 litres/household/day (based on actual occupancy of 1.7). These figures are *not* comparable with the results from the general refurbishment and retrofit programmes, as the initial consumption is lower:

- Pre water use 117 litres / person / day
- Post refurbishment 96 litres / person / day
- Post rainwater harvesting 91 litres / person / day

This meant that the rainwater harvesting only reduced demand by 5.2 percent overall.

The results are again close to the predicted savings, although this was mainly because the initial PCC was lower. This may be explained from the household information data, in that all the properties are flats and no children are living in the block, and therefore are not typical compared to the estate as a whole. Water consumption to the block will continue to be monitored in order to establish savings over the whole year and beyond. The latest data is more promising, with savings of 11.4 percent compared to the post-refurbishment water use, as measured over February 2009. Clearly the savings would have been higher had the ultra low flush toilets not been fitted.

One issue found with the system is that because both the rainwater and mains water top-up has to be pumped from the tank to the toilets, in the event of a power cut the water to the toilets is cut off. It is not possible to have a back-up mains supply directly connected since this would contravene Water Regulations. A power cut did occur in August 2008, causing the tenants to contact Raven. This is a major drawback of the direct supply method of system, which was not made clear at the time the specification was finalised. It is recommended a back-up pump is available should the first pump fail, with an automatic switch-over.

School and leisure centre retrofit programmes

In addition to the household analysis, the school was monitored using a 15-minute interval flow logger since early January 2008. Work was completed at the end of January and beginning of February, so the pre-work monitoring period was limited to four weeks. The overall water use reduced by 30 percent, including term time and weekends, using data up to December 2008. This represents a decrease of over 1,000 litres per day. The reduction was greatest at the weekends and school holidays (36 percent), due to the changes made to the urinal controls, although the building is occupied during some of this time.

Although some work was carried out at the Leisure Centre, any reductions appeared to be masked by the variability in demand. Water consumption averaged 19,000 litres/day both before and after the work; however, this was based on monthly meter readings as no logger was fitted at this location and therefore differences would be more difficult to detect at this level of measurement.

Findings: value for money

The principal costs of the initiative are shown in table 5 below.

Table 5: Costs recorded on the project

	Total costs	Cost per property
Bathroom refurbishment		£1,386
Installation of showers	£131,585	
Electrical works	£90,234	
Retrofit programme	£41,532	£202
Rainwater harvesting	£35,471	£2,956
Schools and Education	£26,654	
Management & Consultancy	£51,275	
Total	**£376,751**	

Indicative costs (not including VAT) of the main water saving devices follow:

- Galerie flushwise toilet £75 (special trial price)
- Mira Element shower £130
- Mira Sport shower £187
- EcoBETA £8-50
- Shower timer £5
- Water butt £28
- Leakage alarm £13

It should be noted that the costs associated with the initiative may be considered to be relatively high, which is largely due to it being a pilot. It is anticipated therefore that with any roll out that costs would be reduced.

As can be seen from table 5, the cheapest option was the retrofit programme costing £202 per property. The bathroom refurbishment programme cost £1,386 per property and the most expensive was the rainwater harvesting system at £2,956 per property. This is further broken down in table 6 below.

Table 6 attempts to calculate a cost per cubic metre of water saved. Please note that in order to estimate this it is necessary to make assumptions about asset life and the sustainability of savings over that asset life. Also the calculation excludes the costs of maintenance and energy required for pumping, so will underestimate the cost per unit of water saved for the rainwater harvesting scheme.

Table 6: Cost-benefit analysis

	Retrofit	Refurbishments	Rainwater harvesting
Water saved (litres/property/day)	50	90	11
Cost (£ per property)	£202	£1,386	£2,956
Asset life	10 years	25 years	25 years
Total water saved (m^3 per property)	182	821	100
Cost (£ per m^3)	£1.10	£1.70	£30.00

Note: m^3 = cubic metre = 1000 litres

Findings: tenant feedback

Tenant feedback on the initiative was provided through a structured questionnaire that was undertaken by the Water Conservation Officer. Three questionnaires were designed to specifically target tenants who had

received the three different elements of the initiative: bathroom refurbishment, retrofit and rainwater harvesting. The questionnaire (appendix 5) covered three main areas:

- How the devices performed;
- Had the installation of the devices affected their lifestyles; and,
- Which devices were liked best.

Tenants feedback: refurbishments

Questionnaires were completed with eighty-six tenants, which represent just over half of the 160 participating households who received bathroom refurbishment.

Table 7 below summarises users' attitudes to each of the water saving devises that were fitted as part of the refurbishment. The table shows that the installation of a shower was the most popular feature, with 86 percent of respondents saying that they either liked or liked a lot this feature. Only 1 percent of respondents said that they disliked this feature.

Satisfaction with the dual flush toilet was significantly less than for the shower, although 56 percent of respondents did state that they either liked or liked this feature a lot.

Table 7: Opinion of the water saving devices fitted

	Dislike a lot	Dislike	No Opinion	Like	Like a lot	N/A
Toilet	12%	14%	16%	35%	21%	2%
Shower	0%	1%	10%	27%	59%	2%
Water Butt	0%	0%	1%	1%	4%	92%

Table 8 shows that around three quarters of tenants (83 percent) said that they were either happy or very happy with the overall quality of the fittings. 83 percent of tenants also said that they were happy or very happy with the service that had been provided by the contractors.

Table 8: Users satisfaction with quality of fittings and with contractors

	Very Unhappy	Not Happy	Happy	Very happy
Satisfaction with quality of fittings	5%	14%	58%	15%
Satisfaction with contractors	6%	5%	51%	31%

As highlighted above, satisfaction with the dual flush toilet was lower than expected. Table 9 shows the problems that had been experienced in relation to the toilets. As can be seen, 20 percent of users reported that the toilets did not flush properly, 15 percent that there were problems with the toilet lid and 7 percent that there was a leak.

Table 9: Types of problem experienced

None	Combi-Boiler Cutting Out	Décor	Other	Shower	WC flushing	WC lid	WC leak
35%	2%	5%	12%	1%	20%	15%	7%

*Only one problem allocated to each respondent.

In relation to the problems that had been identified with the toilets, the Project Team investigated the issues and took the following action: it was identified that there was initially a lack of pressure to the toilets in some locations, which meant that they did not flush adequately. As a consequence the toilets had to be connected to the mains instead of storage to rectify the pressure problem. Twyford and Raven are also investigating whether this problem is ongoing and whether it is due to inappropriate items being placed in the toilet, e.g. nappies. If this is the case, although this was a problem, it was not related to the design of the toilet.

The Project Team found that the toilet leaks were attributed to the initial problems found with the ball-valves, which were rectified quickly, with different components used for subsequent installations.

In relation to toilet lids, it was found that there were inadequate fixing screws to hold the lid on securely. This issue has now been rectified by Twyford.

Two residents reported that their combi-boiler was cutting out, presumably due to the low hot water flows required by the shower. This problem has been reported elsewhere following the installation of low flow shower and tap inserts.

The majority of the other issues that were reported were due to the internal finishing of the tiling and painting and other problems that were not related to the water devices.

Tenants feedback: retrofits

Questionnaires were completed with sixty-six tenants, which represents about one third of the 205 participating households who received retrofits.

Table 10 summarises users' attitudes to each of the water saving devises that were installed as part of the retrofit. The table shows that the installation of the ecoBETA was the most popular feature, with 41 percent of respondents saying that they either liked or liked a lot this feature. The table also shows that the leak alarm was liked or liked a lot by 21 percent of people.

Generally, however, tenants were more ambivalent about the new fittings compared to those who had received a bathroom refurbishment. This ambivalence may be due to the fact that the retrofit devices are small, easily fitted and so did not have such a visual or user impact.

Table 10: Opinion of the water saving devices fitted

	Dislike a lot	Dislike	No Opinion	Like	Like a lot	N/A
ecoBETA	9%	2%	29%	30%	11%	17%
Leak alarm	17%	5%	49%	18%	3%	3%
Water butt	0%	0%	2%	0%	5%	88%

Table 11 shows that around three quarters of tenants (73 percent) said that they were either happy or very happy with the overall quality of the fittings. 82 percent of tenants also said that they were either happy or very happy with the service that they had been provided by the contractors.

Table 11: Opinion of standards

	Very Unhappy	Not Happy	Happy	Very happy
Satisfaction with quality of fittings	5%	14%	58%	15%
Satisfaction with contractors	6%	5%	51%	31%

Around a third of users said that they had experienced some problems with the devices as highlighted in table 12 below. The most significant problem that 22 percent of respondents raised was with the leakage alarm and the other was the ecoBETA. Again the Project Team investigated the issues and took action.

For example, some tenants stated that the alarm kept going off; in most of these cases the tenant or Raven removed the device. One tenant stated the alarm did not go off despite a leak, whilst another said the alarm did detect a leak.

Regarding the ecoBETA, one tenant found it difficult to obtain the full flush due to arthritis (the handle must be held down) and two others stated the toilet lid no longer fitted properly.

Table 12: Types of problem experienced

None	ecoBETA	Leak alarm	Other
68%	9%	22%	2%

*Only one problem has been allocated to each respondent.

Tenants feedback: rainwater harvesting

Completed questionnaires were obtained from four of the twelve residents who had participated in the rainwater harvesting. Since these tenants also had their bathrooms refurbished, their responses regarding this work have been included above; however, two additional questions were asked.

Tenants were asked whether they were happy with the appearance of the water used to flush the toilet; all four said that they were satisfied. Tenants were also asked whether they had experienced any problems with the rainwater harvesting system; two said that they had experienced problems but no reasons were provided. One of the other tenants stated some colour change in WC water. Despite this, the tenant was still happy with the appearance of the water as confirmed by their response to the first question.

Tenants' attitudinal change

The tenants were also asked whether they believed their participation in the initiative had made a difference to the way they use water.

Table 13 shows that nearly three quarters of tenants who had received refurbishment and 100 percent of tenants who had received rainwater harvesting thought that the project had influenced their use of water in some way; however, only 50 percent of those had received retrofitting thought it had made a change to the way in which they used water.

The answers may partly reflect research that shows that most people do not believe they waste water in the first place, and have not truly considered where savings can be made; however, it does also suggest that some of the savings found could be attributed to changes in behaviour and not just the effect of the devices.

Table 13: Has the project made a difference to the way you use water (e.g. are you more likely to turn off taps)?

	No Difference	A Little Difference	Some Difference	A Lot of Difference
Refurbishment	26%	20%	43%	9%
Retrofit	50%	20%	22%	6%
Rainwater	0%	0%	100%	0%

For the retrofit programme residents were asked whether they agreed or disagreed with a variety of statements in relation to water savings, both before and after the delivery of the initiative.

The surveys showed that the vast majority agreed that it was important to save water (table 14), although between one half and one third run the tap when brushing their teeth. Around two-thirds appreciate the link between their water use and the environment. Around half believe metering is the fairest way to pay for their water.

Table 14: Attitudes to saving water

	No need to save water*		Never run tap*		Metering fairest way*		Effect on Environment*		Important to save water**	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post

Refurbishment		8%		48%		54%		58%		92%
Retrofit	13%	13%	64%	64%	53%	39%	72%	75%	90%	87%
Rainwater***		33%		67%		100%		67%		100%

* Respondents could choose either 'strongly' or 'slightly' agree; **Respondents could choose either 'Very' or 'Fairly' Important; *** Based on only 3 residents, results will not be statistically significant

Findings: practitioner experience

To evaluate practitioner experience key participants who had been involved were interviewed. A semi-structured questionnaire was used (appendix 6) and related to

- What had worked/not worked well?
- What they would recommend should be done again / what should not?
- What problems were encountered?
- What were the lessons learnt and what would be recommended in the future?

Full details of the responses to the semi structured questionnaires are given in appendix 7; however, the main comments can be summarised as follows:

- The hopes and aspirations of the project were generally achieved;
- Many lessons were learnt and can be applied to the implementation of future schemes;
- The scope and complexity of the project was underestimated;
- Good water savings were achieved;
- The most successful product for refurbishment were the new first time showers;
- The new low flush toilets used in the refurbishment saved water and were generally well accepted given that they were the first production models to be supplied from the manufacturer;
- The ecoBETA was the most successful retrofit product and provided the best value for money water savings;
- The schools project was very successful with good water savings;
- The rainwater harvesting caused difficulties throughout the project with poor value for money water savings;
- The face to face approach was the most successful way of communicating with the tenants;
- There was a good buy-in from tenants;
- A good awareness of "using water wisely" already existed with Raven's tenants;
- Communications in the running of the project could have been better, reflecting the large number of organisations involved;
- The Council's understanding of how people react to this type of project has been greatly improved; and,
- Environmental goals have been achieved through water savings.

Training plumbers for the Initiative

Conclusions

- The initiative has shown that significant water savings can be achieved through the installation of water efficiency devices to existing social housing stock.
- These water savings were achieved despite tenants not having any financial incentive to reduce their water consumption, for all tenants were unmeasured and paid for their water as part of their existing rent charges to the Registered Social Landlord.
- 25 percent water savings were achieved in households that had water efficiency devices fitted as part of a Decent Homes refurbishment programme.
- Two devices were particularly effective in reducing water consumption as part of the bathroom refurbishment, the dual flush toilet and shower.
- The dual flush low volume toilets that were installed used only 4 litres for full flush and 2.6 litres for short flush. The toilets proved to be water efficient and were generally acceptable to tenants. This was despite some teething problems that were encountered with the early versions of the toilets.
- The bathroom refurbishment also included the installation of the first time low volume showers as part of Raven's Decent Homes programme. The showers were very popular with tenants and had the added benefit of reducing the energy used by households in heating hot water.
- 14 percent water savings were achieved in households that received retrofit water efficiency devices that were not part of the Decent Homes programme and provided the best value for money.
- The most successful retrofit device was the ecoBETA, which converts a single flush siphon to a dual flush. This device was responsible for the majority of water savings through the retrofit and was generally liked by tenants; however, it must be fitted correctly.
- Only 5 percent water savings were achieved in the households that received the rainwater harvesting system and this provided the least value for money.
- The rainwater harvesting system was technically difficult to install and had many technical installation and maintenance issues that have had to be resolved.

- 30 percent water savings were achieved in a school that received retrofitting of water efficiency devices. The measures included the fitting of urinal controls, push taps, new dual flush toilets and ecoBETAs.
- All homes in the area were not metered. As such, in order to monitor water savings special meters had to be fitted and regularly read, which was both expensive and time consuming.
- All water savings made by tenants came from using water efficient devices and equipment that did not alter the lifestyle of tenants and in some cases actually enhanced it.
- Part of the trial involved fitting first time showers, which reduced hot water usage and therefore lowered energy use. Other retrofit devices that can help to reduce water and energy use include aerated showerheads and tap inserts.

Recommendations

- The installation of water efficiency measures such as showers and dual flush toilets should be provided as standard as part of any future Decent Homes programme, for they reduce both water and energy consumption.
- When planning Decent Homes refurbishment programmes Registered Social Landlords and other housing providers should consider all new product ranges that are being developed by manufactures. For bathrooms this equipment should include lower volume replacement baths and wash basins (if one is to be provided), a shower, dual flush toilet and aerated taps.
- Registered Social Landlords and other housing providers should consider retrofitting of selected water efficiency devices, which are the easiest, quickest and most cost effective to install.
- Registered Social Landlords and other housing providers should consider how they can fit these devices quickly and efficiently to homes in order to minimise disruption to occupants.
- Registered Social Landlords and other housing providers should consider the best ways in which they can best gain access to properties in order to undertake any works.
- This trial has shown that converting an existing single flush toilet to dual flush has obtained good value for money savings and should be installed by Registered Social Landlords and other housing providers. A number of retrofit toilet devices are on the market and the one used in this initiative was the ecoBETA.
- A number of devices are available to reduce hot water use including aerated showerheads and tap inserts. Unfortunately this trial was not able to fit either of these devices to existing houses; however, it is strongly recommended that they are fitted in future projects.
- The installation of rainwater harvesting to existing social housing is not recommended due to the significant technical issues that have to be resolved and because it provides poor value for money.
- It is important to engage tenants of social housing with the new initiative, which should include explanations of how they work and their benefits.
- Contractors should be fully trained both in how to install the equipment and the benefits of the devices.

Appendix 1: Detailed questionnaire and letter

Raven Housing Trust
Working with

Sutton and East Surrey Water

And

Reigate and Banstead Borough Council

Water Efficiency Trial
Surveyor Questionnaire

If you wish to enter into our prize draw for a chance to win a super new water- and energy-efficient washing machine by Gorenje please enter your name and address below.

Name..... **Contact Phone Number**.....

Address.....

.....

Details of the lucky winner plus any runners up (prizes to be announced) will be released in 'Preston Pride' and advertised at the Neighbourhood Shop. Would you be happy for us to contact you regarding the results of the questionnaire? If not please circle "No" here.

Q1 Household Occupancy

a) 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	65-74yrs	>74yrs
☐	☐	☐	☐	☐	☐	☐	☐

b) **How many** occupants are students living away from this property during term-time? ☐

c) **How many** occupants are working away from this property for a substantial amount of the year (excluding students)? ☐

Q2 Occupation

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? ☐

Q3 Your property

a) Which category best describes this property?

☐ Detached House	☐ Semi-Detached House
☐ Terraced/Link House	☐ Detached Bungalow
☐ Semi-Detached Bungalow	☐ Terraced/Link Bungalow
☐ Maisonette or Flat	☐ Other

Q4 Fixtures / Appliance Ownership

a) Do you have the following fixtures and appliances at this property?

(Please tick the box and specify if you have more than one.)

Inside Toilet		
Outside Toilet		
Bath		
Basins (include all sinks & washbasins, e.g. in kitchen, bathroom, utility room, etc)		
Shower, plumbed over bath (excluding "power showers")		
Shower, in separate cubicle (excluding "power showers")		
"Power Shower" (i.e. a shower with a booster pump)		
Bidet		
Waste Disposal Unit		
Children's Paddling Pool		
Ornamental / Fish Pond		
Outside Tap		

Hot Water System
Some modern hot water systems use unvented hot water cylinders. These supply hot water under mains pressure to your taps and do not require a cold water storage tank.

b) What type of hot water system do you have at this property?

Conventional cold water storage tank (usually in loft) and hot water cylinder	Combination boiler or multi-point heater (No cold water tank and cylinder)	Not sure
☐	☐	☐

Q5 Outdoor Water Use

a) Does this property have a garden / courtyard / balcony (please tick as appropriate)?

Garden / Courtyard	Balcony only	None
☐	☐	☐

If this property does not have a garden / courtyard or balcony, please proceed to Q6, otherwise please answer Q5 part (b)

b) Garden watering appliances and use during dry spells

Do you use a **watering can**?	Yes ☐	No ☐
Do you use a **hosepipe**?	Yes ☐	No ☐
Do you use a **sprinkler**?	Yes ☐	No ☐
Do you use an **irrigation system**?	Yes ☐	No ☐
Do you use a **water butt**?	Yes ☐	No ☐
Is there a **greenhouse** at the property that is in use?	Yes ☐	No ☐

Q6 Car Washing

a) How many cars do you own / are kept at this property? (Include private cars, company cars and light vans.) ☐

If you answered zero to Q6 part (a), please proceed to Q7, otherwise please answer Q6 parts (b) and (c).

b) By what method do you generally wash your car(s)?

Bucket	Hosepipe	Pressure Washer	Don't wash at home
☐	☐	☐	☐

c) How often do you generally wash your car(s)?

Weekly	Monthly	Less frequently
☐	☐	☐

Q7 Other Outdoor Water Use

a) Do you use a pressure washer? **Yes** ☐ **No** ☐

Q8 Washing Machine Ownership and Use

a) How do you generally wash your clothes?

By Hand at Home	Home Washing Machine	Launderette
☐	☐	☐

If you do not have a washing machine, please proceed to Q9, otherwise please answer Q8 parts (b) to (d).

b) Is your washing machine:

Automatic Front Load	Automatic Top Load	Twin Tub	Other (please specify)
☐	☐	☐	☐

c) What is your washing machine's approx. age (in years) ☐

d) How many times **per week** do you typically use your washing machine?

(Please circle frequency, or specify actual frequency if necessary.)

On full load:	0	1	2	3	4	5	6	7	>7 (please specify):

On half load:	0	1	2	3	4	5	6	7	>7 (please specify):

Q9 Dishwasher Ownership and Use

a) Do you have a dishwasher? **Yes** ☐ **No** ☐

If you do not have a dishwasher, please proceed to Q10, otherwise please answer Q9 parts (b) and (c).

b) How many times **per week** do you typically use your dishwasher?

(Please circle frequency, or specify actual frequency if necessary.)

On full wash:	0	1	2	3	4	5	6	7	>7 (please specify):

On "rinse & hold"	0	1	2	3	4	5	6	7	>7 (please specify):

c) Do you ever use your dishwasher when it is only part full?

Part Load Frequency	Never	1	2	3	4	5	6	7	>7 (please specify):

d) How many Baths are taken in the Household per week?

None	1-3	4-8	8-10	11-15	15-20	20-25	More than 25

e) How many Showers are taken in the Household per week?

None	1-3	4-8	8-10	11-15	15-20	20-25	More than 25

Q10 Views on water use

a) In this region we have plenty of water and there is no need to save it.

Strongly Disagree	*Disagree*	*Not sure*	*Slightly Agree*	*Strongly Agree*

b) I think about the effect of my water use on the environment.

Strongly Disagree	*Disagree*	*Not sure*	*Slightly Agree*	*Strongly Agree*

c) How important is saving water to you personally?

Very important	*Fairly important*	*Not very important*	*Not at all important*

d) When there is a water shortage do you agree that there should be restrictions on use, such as a hosepipe ban?

Strongly Disagree	*Disagree*	*Not sure*	*Slightly Agree*	*Strongly Agree*

e) If there was a hosepipe ban during a drought and I saw someone locally using a hose to water their lawn, I would probably report them.

Strongly Disagree	*Disagree*	*Not sure*	*Slightly Agree*	*Strongly Agree*

f) I never leave the tap running when brushing my teeth

Strongly Disagree	*Disagree*	*Not sure*	*Slightly Agree*	*Strongly Agree*

g) Have you ever looked at ways to reduce your families' water use?

Yes	*No*

h) Which of these statements comes closest to how much you save water?

I always save water	*I often (but not always) save water*	*I save water a bit.*	*I do not save water*

i) Which of these statements best describes your attitude to saving water?

I save water even if it requires additional effort	*I save water if it does not require additional effort*	*I do not save water*	*I don't know*

j) I feel that water metering is a fairer way to charge for the water a home uses.

Strongly Disagree	*Disagree*	*Not sure*	*Slightly Agree*	*Strongly Agree*

k) If I had a meter and had to pay for what I use, this would reduce my water use

Strongly Disagree	*Disagree*	*Not sure*	*Slightly Agree*	*Strongly Agree*

l) I feel that the water companies do enough to prevent leaks and save water

Strongly Disagree	*Disagree*	*Not sure*	*Slightly Agree*	*Strongly Agree*

m) I feel that Raven Housing Trust as a local landlord is doing its bit to save water.

Strongly Disagree	*Disagree*	*Not sure*	*Slightly Agree*	*Strongly Agree*

n) Please state what other action either Raven or Sutton and East Surrey Water should take

.....

.....

.....

Dear Resident

It may not feel like it, particularly with the amount of rain we have received recently, but the south-east England with its high population is drier than many

other countries in Europe including Spain, Italy and Greece. Our own personal demand for water has been rising by about 1% a year over the past 30 years. On average in the UK our daily consumption is over 150 litres (35 gallons) a day. In the south-east England demand is at its highest with up to 170 litres used by each person per day.

We need your help to carry out some research on how water can be saved in your home without affecting your quality of life. As well as helping us and doing your bit for the environment, you could benefit from some of the incentives being made available to resident in the area.

Raven Housing Trust together with Sutton and East Surrey Water and Reigate and Banstead Council hope to work with the residents in the Preston Ward and neighbouring areas in a trial to raise awareness of our water use. By doing so and with your help it is hoped that we will reduce the amount of water used. The study will involve a brief customer survey and the fitting of a variety of water conservation devices in your house, such as a water butt or modification to the toilet cistern (almost a third of our water use is in flushing the toilet). All of these works would be undertaken by a Raven's Partner Contractor, Higgins Construction Ltd at no cost to Raven Housing Trust residents.

Please refer to my earlier letter "Preston Water Efficiency Project-Works Programme letter" (ref:-AP/Quest/Retro/MRWL) for further details on the trial and the works proposed, if you have further queries please contact me, Alister Peters, the Water Conservation Officer based at Marbles Way on 272493 on Mondays and Tuesdays.

We would greatly appreciate it if you and your household could help in the trial by completing the following questionnaire.

Yours sincerely

Alister Peters
Water Conservation Officer

Thank you for completing the questionnaire

Please return it to Alister Peters the Water Conservation Officer based at The Neighbourhood Shop, Marbles Way or The Surveyor.

Appendix 2: rainwater harvesting system

A rainwater harvesting system was installed to a block of twelve flats. This appendix gives details of the calculation made to size the system and the equipment installed.

The block of flats chosen was scheduled to have bathroom refurbishments carried out to include installation of the Twyford Galerie toilet, which has a dual flush of 4/2.6 litres:

- assumed average toilet flush volume = 3 litres/flush
- average number of flushes = 5/person/day
- assumed number of people in block = 24

- quantity of water used for toilet flushing in block = 360 litres day

Sizing the system to provide a supply for five weeks without rainfall would mean providing a tank of 12,600 litres. The final size of the tank installed was 12,500 litres.

The following equipment was supplied by Aquality Trading and Consulting Ltd:

- 12,500 litre PE Tank
- Aqua-Control 500
- Connection set Aqua-Control 500
- Duplex connection set (Aqua-Control 500)
- Expansion vessel 100 litres
- Domestic filtration pit – pedestrian duty
- Mains water backwash filter 1½ inch

Costs were as follows:

Equipment	Aquality system	£6,511.20
Installation	Pims pumps	£2,380.00
	Owls Hall Groundwork and drainage alterations	£18,540.00
Other	Pump housing	£2,040.00
	Higgins distribution pipework / supplies etc.	£6,000.00
	TOTAL	£35,471.20

Appendix 3: products

Waterwise sourced the water efficient products which were suitable for use in this project. All products were well tried and tested and would contribute to making savings in each of the households. In no particular order, the following companies and products were chosen for use in this project:

- Twyford Galerie Flushwise 4/2.6 litre dual flush toilets;
- Mira Sport 9.0 kW Electric shower;
- Mira Element thermostatic shower;
- ecoBETA retrofit toilet device from Denmark;
- Ripple products shower timers from Australia;
- Gorenje efficient washing machine;
- Ecoflow leakage alarm;
- Blackwall water butt made from recycled materials; and,
- Aqualogic urinal controls and washbasin taps for the school and leisure centre.

Appendix 4: metering and measurement

In order to calculate the effectiveness of the project it was essential that sufficient monitoring of water consumption was in place. Three levels of monitoring were in place:

- Individual properties/blocks of flats;
- Small area meters; and,
- District Meter Areas.

Individual property

There were five large blocks of flats included in the project: Merton, Southwark, Alnod, Merefield and Hansard, each housing either nine or twelve flats. All of the blocks had meters fitted with automatic logging devices at the beginning of April 2007. Southwark block was fitted with rainwater harvesting equipment as well as the bathroom refurbishments taking place. The remaining blocks underwent bathroom refurbishments only, within those flats occupied by Raven residents.

In addition, thirty-seven individual properties had a meter installed to monitor consumption. Fourteen of these had their bathroom refurbished; thirteen had retrofit devices installed; and ten acted as controls to take into account seasonal effects. These meters were read fortnightly by the Water Conservation Officer.

Other properties already metered were also monitored, including Epsom Downs School and the leisure centre.

Small area meters

To provide additional data seven meters were fitted to areas undergoing the refurbishment and retrofit programmes to supplement the individual property readings. These meters measured water consumption through a section of the network fed from one point only, such as a cul-de-sac or a small number of no-through roads. These have the benefit of being less affected by changes in individual households, although the results had to take into account those properties supplied by the meter that are not included in the project. These meters take flow and pressure readings every fifteen minutes and are downloaded manually on a periodic basis.

District Meter Areas (DMA)

The water supply network was divided into separate areas, known as DMAs. The water supplying each DMA was measured by one or two meters, which record flow and pressure at 15-minute intervals. The area included in the project covers two DMAs each supplying approximately 1,200 properties. It was hoped that the results from the individual and small area meters, as well as pre-existing metered premises, could be aligned with the DMA flows to calculate an overall reduction in water use across the estate. In reality this was not possible because changes were masked by other effects such as the weather. Fifteen minute flow and pressure readings can be downloaded remotely.

Appendix 5: tenant questionnaire

Questionnaire for retrofit residents

1. What do you think of the water saving devices fitted to your house?

	1	2	3	4	5	6
Ecobeta toilet retrofit	dislike a lot	dislike	no opinion	like	like a lot	not installed
Leakage alarm	dislike a lot	dislike	no opinion	like	like a lot	not installed
Water butt	dislike a lot	dislike	no opinion	like	like a lot	not installed

2. Were you happy with the standard of fitting of the devices?

1	2	3	4	5
very unhappy	not happy	no opinion	happy	very happy

3. Were you happy with the fitter who called at your house?

1	2	3	4	5
very unhappy	not happy	no opinion	happy	very happy

4. Has this made a difference to the way you use water (for example, now turn off taps)?

1	2	3	4	5
no difference	a little	some difference	quite a difference	a lot of difference

5. Have there been any problems with the devices?

_____ Yes _____ No

If YES, please describe the problems: _____

6. Has the water butt been fitted?

_____ Yes _____ No

Questionnaire for bathroom refurbishment and rainwater harvesting residents

7. Please give the number of people normally resident at this property who are in the following age groups. Please include those who are sometimes absent, for example those who are away at college.

_____ Under 2 years
_____ 2-4 years
_____ 5-17 years
_____ 18-29 years
_____30-44 years
_____45-64 years
_____65-74 years
_____ Over 74 years

8. Please indicate the main occupation for all residents at this property who are 18 years and over.

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

If other, please specify: _____

9. Please indicate the type of property you reside in:

_____ Detached house
_____ Semi detached house
_____ Terraced/Link house
_____ Detached bungalow
_____ Semi detached bungalow
_____ Terraced/Link bungalow
_____ Maisonette or flat

10. What do you think of the water saving devices fitted to your house?

	1	2	3	4	5	6
New Twyford toilet	dislike a lot	dislike	no opinion	like	like a lot	not installed
New shower	dislike a lot	dislike	no opinion	like	like a lot	not installed
Water butt	dislike a lot	dislike	no opinion	like	like a lot	not installed

11. Were you happy with the standard of fitting of the devices?

1	2	3	4	5
very unhappy	not happy	no opinion	happy	very happy

12. Were you happy with the fitters who called at your house?

1	2	3	4	5
very unhappy	not happy	no opinion	happy	very happy

13. Has this made a difference to the way you use water (for example, now turn off taps)?

1	2	3	4	5
no difference	a little	some difference	a difference	a lot of difference

14. Have there been any problems with the devices ?

____ Yes _____ No

If YES, please describe the problems: _____

15. Has the water butt been fitted?

_____ Yes ____ No _____ Not applicable

For rainwater harvesting residents only

16. Are you happy with the appearance of the water being used to flush your toilet?

_____ Yes _____ No

17. Have you had any problems associated with the rainwater harvesting system?

_____ Yes _____ No

If YES, please describe the problems: _____

Thank you for your participation!

Appendix 6: structured interview

1. **Do you think we have achieved what you had hoped for from the project?**
2. **Have the Technical goals in the following areas been achieved?**
    a. Bathroom refurbishments
    b. Retrofit of water efficient devices
    c. Rainwater harvesting
    d. School programme
3. **Have the Social / People / Environmental goals been achieved?**
4. **Were the communications for running the project successfully achieved?**
5. **What was the most successful part of the project from your viewpoint?**
6. **What was the least successful part of the project from your viewpoint?**
7. **The way forward – suggestions on how to take this forward**

Appendix 7: structured interview main findings

The following staff who worked on the project took part in the structured interviews after the project was completed.

1. Raven Housing Trust

Alister Peters was appointed to be the main link with the tenants. He also liaised with contractors and the school and leisure centre.

Stuart Harman is the Asset Management Surveyor for Raven Housing Trust and the main link for all the work that had to be undertaken in the properties.

2. Sutton & East Surrey Water

Alison Murphy is the SESW Distribution Engineer with responsibility for water efficiency matters.

John Burbedge works for Surrey House Corporate Communications which handles media and public relations for SESW.

3. Reigate & Banstead Council

Justine Chatfield was Project Manager for a large part of the project.

Answers to the structured interview questions are summarised below:

1. **Hopes and aspirations of the project**

- it was thought they were generally achieved by all parties
- good buy-in from tenants
- monitoring was very much an afterthought
- large hold-ups in both identifying locations and fitting devices
- scope and complexity of project underestimated
- good water savings

2. Technical goals – Bathroom refurbishments

- the addition of a shower to the bathroom is seen as a basic essential
- the shower has worked well and been very well received
- the new 4/2.6 litre toilet has caused some problems mostly related to the fact that the toilets installed were the first off the production line and not to its performance
- pressure of water from gravity fed system was not high enough and in some cases a mains feed had to be installed
- problems with the toilet seat
- supply of toilets slow at the start of the project
- the cisterns were designed to take 6 litres and should be re-designed to take 4 litres
- a wall hung version was sometimes needed
- some problems with the flushing of solids
- more explanation of the new devices should have been given to the tenants

3. Technical goals – Retrofits

- ecobetas generally good. Small flush occasionally does not clear paper otherwise no complaints
- leakage alarm was giving a lot of what appeared to be false alarms. Several had to be taken out
- water butts were not pushed hard enough. They should be made available all year around.
- washing machines vouchers were a good idea and should be offered all year around
- shower timers given out on bathroom refurbishments were received well
- training of fitters was given at a time when Raven were changing contractors – hence the wrong people were trained
- better records needed to be kept as to which devices were fitted to each house

4. Technical goals – Rainwater harvesting

- in principal this was a good idea however it has caused a lot of problems
- used the wrong block of flats / selected because there were no leaseholders in the block
- should have had a drainage area study sooner to map out utility services
- needed a ground condition survey as there are a lot of natural springs in area
- should have started with more sites and gone through a more rigorous selection
- too many contractors involved (over 12 Companies in total)
- difficulty finding the right contractor, in the end two main contractors were used - Aquality supplied the equipment / Owls Hall main installer performed well but needed one overall contractor.
- Needed to coordinate the internal bathroom refurbishment with the rainwater installation – houses had to be revisited to install internal rainwater pipes

5. Technical goals – Schools project

- very much a success story – school very keen / new fittings worked well
- fittings used were urinal controls, ecobeta's and push tap fittings into existing tap base
- 22 high level toilet cisterns were replaced with new dual flush cisterns
- Aqualogic was the main contractor and there were initial problems with the installations involving leakage and incorrect fitting – these were quickly corrected
- worked with children and incorporated into the eco-schools curriculum
- very successful outcome

6. Social /People / Environmental goals

- school was good selection as it was working towards an eco-school standard
- tenants were very co-operative and there were no people problems generally
- face-to-face contact was the most successful approach
- the odd refusal was caused by misunderstanding

- not enough time set aside for surveys
- questionnaire in initial survey was too long
- problems catching people in
- generally people were aware of "using water wisely"
- it would have been easier working in an area with a stronger community group
- the Councils understanding of how people react to this type of project has been greatly increased
- environmental goals have been achieved through water savings

7. Communications for running project

- could have been better structured, but suffered from personnel changes
- needed to work from a plan that was agreed and coordinated
- neighbourhood shop display, leaflets, fridge magnets, tea towels assisted awareness
- should have linked to events and got Councillors more involved
- photographic record of project could have been better

8. Most successful part of project

- every aspect of the schools project
- first time showers were very popular
- best value water saving from ecobeta toilet retrofit device

9. Least successful part of project

- planning of data collection and monitoring
- sequencing the programme
- washing machine vouchers
- rainwater harvesting

10. The Way Forward

- look for quick wins – need to fit water saving devices like ecobetas when visiting houses for other purposes (e.g. gas inspections)
- fit more showers – they improve the quality of life and use less water
- subsidised washing machines should be offered all year around
- monitoring the water used is the first essential – it has shown up leaks and provided actual water use for the first time
- need to set up a spreadsheet to collect accurate data from the start of the project
- ecobetas most cost effective part of project
- budget for an agreed publicity programme

Appendix 8: steering group and project group

Steering group members

Peter Boarder	Reigate and Banstead Borough Council	From May 08
Justine Chatfield	Reigate and Banstead Borough Council	Pre-Jan 07 and from Oct 07
Lucia Deere	Reigate and Banstead Borough Council	Jan 07 to Oct 07
Alison Murphy	Sutton and East Surrey Water	
Stuart Harman	Raven Housing Trust	
Alister Peters	Raven Housing Trust	
Laurence Nasskau	Raven Housing Trust	
John Burbedge	Surrey House	
Brian Hooper	Waterwise	
Ann Symonds	Environment Agency	

Project team members

Stuart Harman	Raven Housing Trust
Alister Peters	Raven Housing Trust
Alison Murphy	Sutton and East Surrey Water
Brian Hooper	Waterwise