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Scoping Document for a Study into the Cost-Effective Delivery of **Communal Rainwater Harvesting** and **Communal Greywater Recyling** - Draft 3 -

Background

In consequence of anticipated climate change, the availability of water in areas of the UK is expected to change over the coming years.

The impact of changing rainfall patterns also has implications for flood risk, and while some areas may suffer from more intense deluges, other areas may experience reduced rainfall, resulting in potential water shortfalls, and leading to water stress.

Projections of these changes, as well as population growth, have led the UK government to introduce legislation to mitigate the effects of such changes.

In regard to buildings, the UK government is seeking to change the pattern of water use, through the Building Regulations and other means. As a first step, a new Approved Document to the Building Regulations (Part G: 2010) came into effect on 6th April 2010, and introduces a water efficiency target as a requirement for the first time.

Previously, the average domestic water use in the UK was 150 litres per person per day. Part G now requires a strategy to reduce this level to 125 litres per person per day, but in 2013 and 2016 the targets are currently set to reduce respectively to 90 and 80 litres per person per day.

Various methods are available to meet these targets:

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- The use of reduced flow appliances (taps and showers), and/or
- The use of low capacity appliances (wcs, baths, washing machines and dishwashers), and/or
- Rain Water Harvesting (RWH - using rainwater from the roof to flush toilets etc), and/or
- Grey Water Recycling (GWR - using water from baths and showers to flush toilets, etc)

Unless Local Planning Authorities set particular requirements, developers and designers will generally be free to choose which solutions to use, but by 2016, for new housing developments, some form of RWH and/or GWR will be inevitable.

Since toilet flushing accounts for some 45% of water use, RWH offers an immediate way of achieving up to 100% of the target water efficiencies.

The Cost of Sustainability

Under the Code for Sustainable Homes, achieving water efficiency is one of a number of sustainability targets for new homes. In England, the Code is mandatory for affordable homes, but only voluntary for market homes.

However, the carbon reduction and water efficiency elements of the Code will be made mandatory under changes to the Building Regulations in 2010, 2013 and 2016.

In Wales, the Code is mandatory, with zero carbon being targeted for 2011.

A report to government in 2008 (Cost Analysis of The Code for Sustainable Homes: Final Report) indicated that the cost of achieving Code level 6 (the zero carbon level) for each new dwelling would be in the region of £19k to £47k.

The cost of implementing just the mandatory carbon reduction and water efficiency elements of the Code is a major proportion of these costs, and any means of delivering higher levels of sustainability with a lower capital spend is expected to be welcomed by housing developers and homebuyers.

Housing developers will only usually do what the law compels them to do, and installing expensive RWH or GWR kit so that householders can benefit from lower water bills is difficult to justify, because developers generally have a perception that they will be unable to recover the additional cost incurred through increased dwelling prices.

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However, if organised communally, harvested rainwater and/or recycled greywater could be sold to householders, and the revenue stream arising could provide a funding mechanism to meet the cost of maintenance, and to partially meet the capital cost of installing the kit.

What is the motivation for a study and why is it needed?

We support the government's rationale for water efficiency targets, but have concerns about the mounting costs of making housing more sustainable. Our motivation in suggesting this study therefore is to demonstate that:

- Communal Rainwater Harvesting (CRH) and Communal Greywater Recycling (CGR) can be a more cost-effective way of achieving the government's water efficiency targets in new housing developments than other methods

- There can be ready-made paths to the adoption of CRH and CGR by Operational Vehicles (OVs), once appropriate regulatory changes have been put in place.

The main long-term benefits of implementing CRH and CGR would accrue to:

- Consumers
- Housing developers
- Manufacturers, merchants and installers
- OVs
- Water companies

In the short term, the consultants involved with the proposed study will benefit from the expertise they will develop in this area, in relation to any pilot schemes which flow from the study.

The technology for rainwater harvesting, which has been used extensively in parts of Europe, America and Australia, is already in place, and a British Standard on the subject was recently published (BS 8515: 2009). Please note however that this standard is geared to the installation of systems for individual dwellings, and does not cover communal installations.

There is anecdotal evidence that water infrastructure companies are not currently interested in providing CRH, because they would view it as a standalone profit centre, and water is simply too cheap to make it viable.

Providing CRH or CGR, where the developer installs the kit and then sells on the installation to an OV for adoption, for whatever competitive price he can obtain, would be a way of mitigating his costs, while enabling him to meet the Building Regulations and/or to score points under the Code for Sustainable Homes.

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An alternative way might be for the OV to tender to the house builder for installing the kit for a discounted price, on the basis that they would automatically adopt it on completion or occupation.

The main obstacles to CRH and CGR are:

1. Potable water is much too cheap (and this is not expected to improve significantly) and the cost of grade B water arising from CRH and CGR will be linked to this (possibly around 80% of the potable price)

2. The capital and running costs for CGR are expected to be significantly higher than those for CRH

3. Regulatory changes are needed

4. The lack of a guide to assist developers in:

   - identifying CRH and/or GWR solutions appropriate to a site's characteristics

   - identifying appropriate OVs and contractual models for maintenance and billing

   - clarifying the cost model for construction

   - clarifying the adoption process for transfer of assets to OVs

The purpose of our study would be to address the obstacles that can be removed, namely obstacles 3 and 4.

What are the regulatory obstacles?

Developers need to be confident that if they install CRH and/or CGR, they can get the equipment adopted by an Operational Vehicle, once complete and the development is occupied. This is particularly important at feasibility stage, when developers are bidding for land.

OVs need to be confident in the level of pricing of the harvested or recycled water, and that they can collect the maximum level of billable revenue.

It may be necessary to have dual metering for each dwelling. Ideally, the existing potable water supplier would read both potable and rainwater meters, and deal with billing. The money for CRH and/or CGR water could be collected on an agency basis by the potable water supplier, but this money needs to be protected to ensure that it is passed on to the OV.

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By collecting both meter readings, the potable water supplier would benefit from being able to deal with other issues:

- For CRH only: to increase their sewerage charge to cater for all outgoing water (Note: without dual metering, the potable water supplier loses out because his charge is based only on the potable water used).

- For CGR only: charging needs to reflect the reduced outflows.

- For mixed CRH / CGR systems: this is more complex and would need to be addressed in the study.

An appropriate mechanism needs to be in place for fault reporting, billing queries and customer service.

The remits of Ofwat and Ccwater may need to be expanded.

All of the above would need existing regulations to be adjusted, to ensure that OVs would have the confidence to bid as a prospective adopting OV.

The current regulatory framework for delivering CRH and/or CGR would make it difficult for OVs to have the confidence to bid for adoption, and housing developers would therefore not have the confidence to consider installing these important water efficiency measures.

Other issues

Where RWH and/or GWR is installed on an individual dwelling basis, there is concern about the long term quality of harvested and/or recycled water arising from the potential attitude of individual householders to their responsibility for maintenance of the kit installed, and about the scope for liability claims further down the track.

CRH and/or CGR, with adoption by an OV, offers long-term water quality on a more robust footing, achieved through an accountable method.

There is expected to be consumer resistance to various aspects of water efficiency, and attitudes need to be measured and balanced. Housing developers will have concerns about such attitudes, which they fear may impact on the attractiveness of their housing product at point of sale. The following issues may put customers off:

- Water that has an odour or is discoloured, even for flushing toilets, but particularly for washing clothes.

- Recycled water that may contain pathogens, especially those emanating from other households.

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- Spray taps and low flow rates generally could be perceived as annoying, and actually lead to increased water use in some instances, such as in the case of showers.

- Low capacity baths

Consumers may prefer to opt for one water efficiency solution rather than another, and it will be important to determine what those preference are. For those consumers who dislike all water efficiency measures, they may choose to buy an older property, impacting on the overall demand for sustainable new homes.

Attitude surveys are therefore an essential part of the study.

Who would undertake the study?

We have assembled a team of suitably experienced consultants for the study:

Arup

Arup is a renowned international engineering consultancy, with a substantial track record in sustainable design. The following staff would be involved:

- **Martin Shouler** (Associate Director): has a particular interest in water services, and contributed to the 2010 Approved Document to Part G of the Building Regulations

- **Siraj Tahir:** is undertaking a EngD on rainwater harvesting at UCL in collaboration with Arup

Cyril Sweett

Cyril Sweett is a renowned international cost consultancy, and reported to government on the costs of implementing the Code for Sustainable Homes.

Cyril Sweett has a team of expert specialists working on sustainability in the built environment. The Team's expertise includes environmental assessment, eco-efficiency (waste, water, energy and materials), materials sourcing and procurement, green design, travel planning, social responsibility, and planning and regeneration.

Cyril Sweett was the first cost consultancy to offer sustainability services, and although other practices are now following, they are still leading the market by enabling the commercial delivery of more sustainable projects. The following staff would be involved:

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- **David Ribbands** (Cost and Sustainability Consultant): is a registered BREEAM Assessor, who has a vested interest in sustainable strategies and innovative systems, which can be utilised in the built environment.

- David's team appreciate the requirement for enhancing and delivering sustainable innovations and technologies within our built environment. Whilst achieving this they also never loose focus on working with the designers to develop the solutions in an efficient and cost effective manner, which ultimately demonstrates value for money for the client and end user.

Hasker Architects

Hasker Architects is an award-winning practice with wide ranging architectural design experience, including the design of a zero carbon dwelling. The following staff would be involved:

- **Bruce Hayball** (Consultant): has significant experience with residential design, and is responsible for the idea of chargeable harvested rainwater, as a means of mitigating Code for Sustainable Homes build costs.

Waterwise

Waterwise is a UK NGO focused on decreasing water consumption in the UK and building the evidence base for large scale water efficiency, and is the leading authority on water efficiency in the UK. The following staff would be involved:

- **Jacob Tompkins** (Managing Director)**:**

- **Sally Bremner**: advises consumers, manufacturers, installers, retailers and consumers on the use of water efficiency products.

What would be the outcome of the study?

The team would produce the following:

1. A report to government on the prospective regulatory changes needed, and detailing the consultations made and the responses received thereto.

2. A report to government on the costed alternative methods of providing CRH and/or CGR systems, to establish thresholds for alternative solutions to suit a variety of rainfall and flooding scenarios.

3. A guide to help housing developers in the selection of site-specific CRH and/or CGR solutions, and OVs for adoption. The guide could include paid entry

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directories of kit providers and OVs, to assist with funding publication of the study.

What would the study look at?

To inform the intended outcomes, we would:

1. identify what water quality standards are relevant to grade B / non-potable water (as appropriate to the intended uses), and what water efficiency methods can be employed.

2. look at two residential schemes of significantly different size, and re-engineer these in a variety of different ways to suit the analyses referred to below as well as different rainfall and flooding scenarios.

3. investigate the costs of alternative ways of providing rainwater harvesting and / or greywater recycling, as against not doing either, and within the context of alternative rainfall and flooding scenarios.

4. examine whether the cost of cleaning rainwater or greywater up to potable standard for direct re-injection into the potable mains water system may be more cost effective than a dual supply / dual metering solution.

5. investigate and report on the alternative costs for delivering water efficiency in the other various ways identified in the Approved Document to Part G, so that housing developers can recognise the potential cost benefits that CRH and CGR can offer, so that they can make informed decisions about all the alternatives on offer.

6. identify why housing developers, infrastructure companies and water companies would resist CRH and CGR, and attempt to address these issues in the study

7. consult relevant parties (consumers, Ofwat, Ccwater, etc)

8. identify whether and how the current regulatory framework makes it difficult to deliver CRH and CGR, and what changes are needed to make it happen in a way that is attractive to consumers, housing developers and OVs.

Literature search

Appropriate research papers would be identified and consulted, to avoid re-inventing the wheel.

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As a few pilot CRH and CGR installations have already been implemented in the UK, it will be appropriate to investigate whether and how the water is being charged to householders on these particular developments. It is believed that these projects are mainly housing association developments, and that the grade B water is generally being charged through management companies' service charges.

While these installations may be fully compliant, the regulatory compliance of these installations is something that should be considered as part of this study, so that any lessons can be learned.

There may be objections to the concept of direct re-injection into potable water mains. As there are examples of this method already in existence in the UK, we would seek to identify the scope of such examples to give confidence in this method, should it prove to be a cost effective alternative.

Comparative housing schemes

Engineering

The starting point is to look at two housing schemes of significantly different size, so that the cost analyses can consider scaling factors and potential viability thresholds. Various rainfall and flood risk levels should also be considered, again to identify viability thresholds.

By charging for CRH and CGR, the reduced capital cost of installation may make these methods feasible at lower levels of the Code for Sustainable Homes, enabling the water-efficiency benefits to be achieved at an earlier date.

For each scheme, we need to look at what a developer could incorporate into a scheme to achieve relevant water efficiencies, possibly at the 2010, 2013 and 2016 target efficiency levels. The items could / should include:

1. No water efficiency measures at all
2. Individual Rainwater Harvesting (IRH), on an individual dwelling basis
3. CRH
4. Individual Greywater Recycling (IGR), on an individual dwelling basis
5. CGR
6. Use of water efficient products with low flow / low capacity characteristics
7. The potential impact of CRH on the sizing of SUDS drainage
8. The implications of using direct re-injection in lieu of dual metering and supply

[We are already aware that some of these issues are addressed by "WaND: Guidance on water cycle management in new development."]

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The original idea was to compare only items 1, 2 and 3, but for a fully authoritative report applicable to any site in the UK, and to cover the wide range of likely rainfall and flood scenarios, we would also include 4, 5, 6, 7 and 8.

It will be appropriate to look at a range of different sized dwellings on each sample development site.

We should consider whether to rule out IGR, on the assumption that it will be too hard to achieve either long term water quality or a cost-effective system or an effective system within the constraint of small plot sizes.

There is an assumption that CGR may usually be too expensive to deliver. However, it may be appropriate to deliver this in areas of the UK where water stress is greater or flood risk is more significant, or where CRH will be difficult to deliver for spatial reasons or will be too expensive to achieve on account of low rainfall.

It will be appropriate to include a sensitivity analysis to identify a rainfall threshold or range of thresholds under which CRH and CGR become unviable.

It is important to ensure that the criteria set out in the new Approved Document to Part G and in the Code for Sustainable Homes are properly satisfied so that the relevant points scores can be obtained.

Costings

Apart from evaluating the engineering costs, it will be necessary to look at the revenue implications from supplying the water (commensurate with the water quality), as well as the costs of maintenance, billing and collection (if applicable). Incentives, taxation and something similar to electricity Feed-in-Tariffs should also be considered.

Regulation

The study will need to consider the following additional regulatory issues:

1. Whose water is it?

2. The supply of chargeable water for domestic purposes (i.e. toilet flushing), potentially by non-regulated companies

3. Can the water be billed through the current water company, but with responsibility for maintenance firmly resting with the adopting OV?

4. Is intelligent metering feasible (see: www.imi-metering.co.uk)

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5. The validity of washing machine guarantees, if the water does not meet their guarantee requirements.

There may well be other areas, only identifiable through work on the study and consultation responses received.

Delivery models

The developer guide should look at the merits of different delivery models, alternative OVs and adoption procedures, and provide a directory of prospective OVs.

Report and publication

The format and content of the reports and guide, and how it will be disseminated, will need to be agreed.

In principle, all of the reports and guide need to be available to housing developers, designers, engineers, installers and manufacturers, so that they can choose an appropriate system for their development.

It also needs to be made available to government, with a view to the necessary regulatory changes being put in place.

The cost of producing the reports and guide needs to be ascertained, and a publisher identified.

Consideration should be given to whether the reports and guide are made available on a chargeable basis, possibly through CIRIA, or whether it should be made freely available, perhaps through Waterwise and relevant professional institutes?

Does the subject merit an individual website. If so, who will create and maintain this, and where will the funding come from?

Should the consultant team be represented at relevant trade exhibitions and/or present the concept at relevant conferences?

In view of the likely resistance from developers, consumers and potential OVs, we would strongly advocate a freely available method of distribution, but this will only be possible if the level of sponsorship and other funding is adequate.

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