HELPING TO AVOID FUTURE FLOODS & DROUGHTS

An overview of the water re-use sector in the UK

UK Rainwater Management Association

ABOUT THE ASSOCIATION

1. The UK Rainwater Harvesting Association (UKRHA) was founded by its members in 2003, becoming an incorporated non-profit-making limited company the following year.

2. The handful of initial members formed the Association in response to existing pressures on water-supplies in the southern half of England, coupled with Environment Agency forecasts that changing weather patterns over the next 50-years would lead in the UK to a greater incidence of both floods and droughts. The three main purposes of the Association at that time were: to establish standards for rainwater harvesting (RWH) systems in the UK; to promote what still largely remains an embryonic concept in the UK; and to establish professional standards aimed at maintaining the reputation of the technology.

3. In a market driven by the Government's commitments to the water consumption requirements of the Code for Sustainable Homes (C4SH), the sector, and the manufacturers supplying into it, grew rapidly until the 2010 banking crisis which, coupled with the abandoning of the C4SH, caused the sector to regress.

4. This is reflected in the membership of the Association which is now down to 14 manufacturing members compared to 42 in 2010. The Association also has a large number of Academic members with an interest in water re-use, and offers free membership to installers and maintenance businesses.

MARKET-DRIVERS

5. The modern concept of harvesting rainwater for non-potable re-use in Europe was mainly first exploited by Germany, where a combination of even greater pressures on water supplies and very much higher water prices provides a good payback period on the capital cost of domestic systems; this payback period reduces still further for commercial systems due to the even higher cost of water to industry.

6. UK water pricing policies in the UK extend this payback, except for commercial systems serving buildings that combine large roofs, that will harvest large volumes of non-potable water, with usage that can use the volumes of water being collected. With domestic systems, however, it is the developer who incurs the non-recoverable capital costs as a water re-use system does not significantly increase the price at which a house can be sold.

7. Prior to 2010, there were therefore two main drivers of the water re-use market, namely the mains-water consumption targets in the C4SH, and the ranking in the national Sustainable Drainage (SuDS) Standard of harvesting for re-use the preferred way of preventing downstream flood-risks; both these drivers have now been abandoned (except in Wales where the latter still pertains).

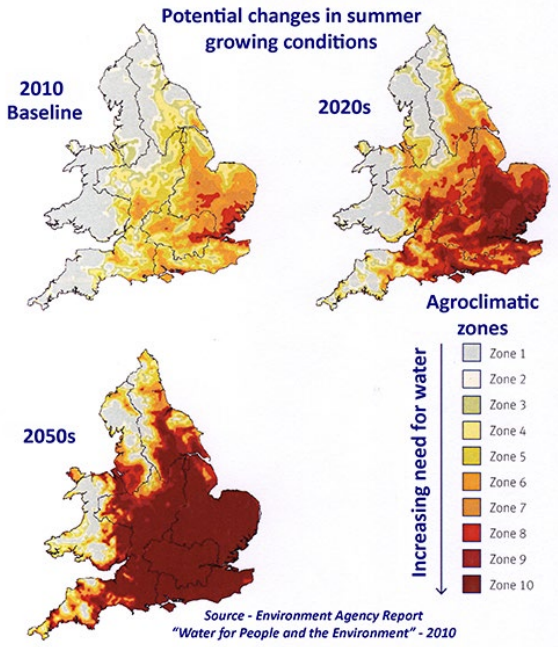
ATTENUATION

8. With the loss of the two main drivers for water re-use, and in the light of the much greater publicity given to floods, in late 2014 the Association changed its emphasis from straightforward RWH, to one of storing water for re-use as a means of helping to prevent both floods and droughts. At the same time, it was re-named the UK Rainwater Management Association (UKRMA), and also started to represent the greywater recycling (GWR) sector.

9. Due to the much tighter and longer-standing regulations relating to sustainable drainage, the development sector was accustomed to including SuDS within their schemes, and assimilating the associated costs. In many instances, SuDS incorporate the principle of "attenuation", ie storing the rainfall during peak weather events for later slow-release at a rate that can be accommodated by downstream drainage infrastructure. Additionally incorporating the means to re-use the water instead of it simply flowing to waste, therefore makes obvious logical sense – particularly as approached in this way (ie as an incremental add-on to the cost of SuDS), a good payback period is achieved.

AGRICULTURE "CASE-STUDY"

10. As depicted opposite, one of the first sectors to be severely affected by stresses on water supplies is predicted to be agriculture throughout England south of the Humber estuary. This will arise through a combination of changing weather patterns, and limitations on traditional abstraction sources.



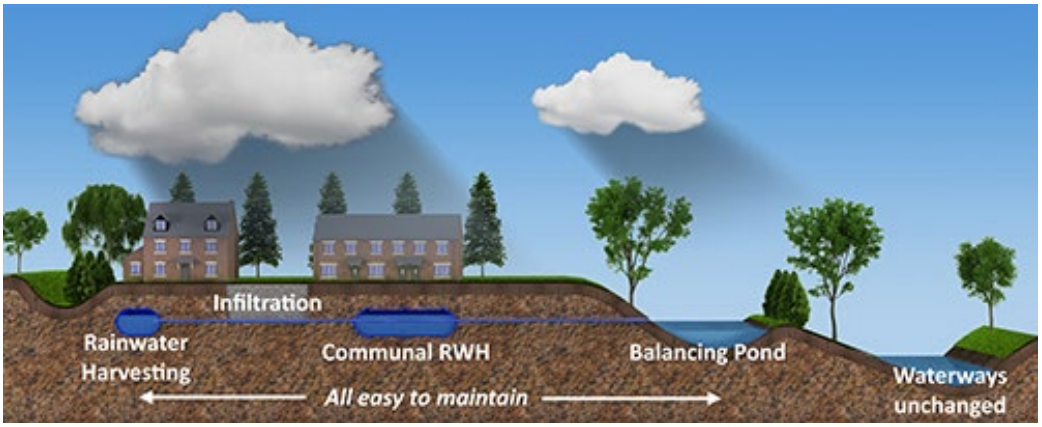
11. The sector's response to this is becoming increasingly visible as farmers install farm-level storage of winter rainfall for summer re-use to maintain the productivity of their land.

12. This development has the potential to have a favourable impact on down-stream flood risks, a potential that is currently not being realised. Farmers who simply store sufficient water for their own purposes will have no impact on down-stream flood risks as the storage capacity is likely to be full by late Autumn, thereafter overflowing as fresh rain falls. If, however, farmers were to incorporate a calculated attenuation capacity in their storage, then downstream flood risks would be ameliorated. As the farmers themselves would gain no extra benefit from the additional cost of the attenuation capacity, this would need to be borne from general flood-protection funds, rather than by farmers.

URBAN "CASE-STUDY"

13. The simple case-study above illustrates the natural interaction between both sides of the surface water management coin where, the making of arrangements to address water-shortages can, if properly managed at national policy level, have a beneficial impact on the mitigation of flood risks.

14. Conversely, taking the urban case where the emphasis is on avoiding new developments exacerbating flood risks, measures taken to avoid floods can have a beneficial impact on mitigating water shortages; the schematic below illustrates how this concept works on housing developments, and applies similarly to commercial developments.



15. Unlike the open countryside, where impending water shortages drive the need for farm level storage, with a potential for the secondary benefit of addressing floods, the prime driver on urban developments is usually a Planning Requirement for an approved SuDS to avoid increasing downstream flood-risks; however, by taking into account water shortages at the same time, and from the outset incorporating water re-use in the SuDS system, a single system can address increasing both future flood and drought risks similtaneously, at a small incremental cost compared to a stand-alone SuDS system.

WATER RE-USE ISSUES

16. The above case studies illustrate the paradoxes underlying the UK's approach to water re-use, in that:

    a. Farmers will increasingly need to store water for re-use during dry spells which, if it were Government policy, could have a beneficial impact on future increasing flood-risks

    b. There is a long-standing requirement for Developers to avoid increasing flood risks which, if it were Government policy, could have a beneficial impact on future increasing stresses on water supplies

17. Some of the issues faced by Government in formulating such pro-water re-use policies are briefly touched upon below.

The Need for integrated Policies

18. Currently, flood and drought issues are considered separately within Government and its numerous relevant water-related agencies, the overwhelming majority of which approach their tasks from the perspective of avoiding floods. Interestingly, however, according to recent IPCC reports, so far as the UK is concerned, water shortages are likely to pose the greater social, environmental and economic future threats.

19. As outlined above, from a surface water management perspective floods and droughts are inextricably linked, making the appointment of a "Water Czar" with policy responsibilities for both a potentially useful initiative, as would giving combined responsibilities to bodies such as the Flood Management Authorities.

Long-termism & Retro-fitting

20. Although some off-grid and other specialist water re-use systems bring the associated water up to a potable standard, usually water re-use is predominantly for non-potable services such as toilets, clothes washing machines, irrigation and industrial processes. Where non-potable water is being supplied to such services, this must be achieved via separate dedicated pipework which, realistically, limits the application of domestic water re-use systems to low density new-build homes.

21. A desk-study calculation was undertaken around 2005 that suggested that if all new-build low density homes (ie excluding flats and apartment-blocks) were to be fitted with RWH systems, under the impetus of the C4SH water consumption requirements, the domestic demand on mains water would be reduced by c10% by 2050.

22. This figure could be substantially increased if systems were to be retro-fitted to commercial and industrial building which are good candidates for water re-use if they combine large roofs and a high potential usage of non-potable water. Compared to residences, such building are much more suitable for retro-fitting as pipework is usually carried in service-ducts, rather than behind plaster.

23. In projects where a combination of factors make RWH an inferior option, typically where there is a mismatch between the collection capability of the roof area and the potential usability of non-potable water within it (hotels and University accommodation blocks being good examples), greywater recycling (GWR) is the preferred option.

24. On the above basis, it would be reasonable to suggest that urban, commercial and industrial use of mains water could, if applied consistently over a 30-year period, incrementally build-up national water re-use capacity sufficiently to reduce the demand on mains water by up to 30%.

Market Forces

25. The general public have no difficulty with the concept of flushing toilets with re-used water, rather than drinking water, provided the aesthetic appearance of the water is

satisfactory. If anything, quite the reverse, there generally being an element of bewilderment that we use scarce drinking water for such a low-grade purpose. This attitude to the use/misuse of water is reflected in self-builders who often including water re-use systems in their projects.

26. When encouraged to do so by BREAM, or by their own environmental policies, businesses and other enterprises have also been enthusiastic for water re-use technology when the economic climate permits. In straightforward financial terms this is explained by the important factor that the client and end-user are one and the same, so the benefit of the savings made accrue directly to the funder.

27. With one or two specialist exceptions, housebuilders do not favour including water re-use on their projects, for a raft of practical reasons; they add cost which is not reflected in a higher selling price, involve for many the first-time installation of a new technology, and involve additional negotiations with the water utility company supplying the development. This extra cost and administration is not usually reflected in the sales price which is driven by other consumer-facing factors such as location, amenities, services and transport connections. This may change over time as environmental considerations move higher up the factors which drive house-purchase decisions.

Regionality & Appropriateness

28. National Standards, Building Regulations and Planning Policies are driven through on the basis that they apply equally to all parts of the UK; this approach is at odds, however, where water management is concerned because the future risks of droughts varies greatly between the regions of the UK, and even quite locally in the case of flood risks. This makes surface water management best-suited to national guiding principles that must be applied locally, rather than national "one-size fits all" policies.

29. This is exemplified by the disrepute into which the higher levels of the C4SH fell, in relation to its water consumption requirements, in that Developers were being required to address issues that did not pertain in their locality. Conversely, developments now taking place in highly water-stressed areas are not benefiting from the relatively straightforward consumption economies that continuation of the Code would have provided.

Water Charging Mechanisms

30. As mentioned previously, mains-water is inexpensive in the UK (compared to other similar countries such as Germany), and it is Government policy that it should remain so. This policy works counter to reducing mains-water consumption, unless parallel policies are put in place that encourage water re-use.

31. An example of this would be the introduction of charges, particularly for commercial users, tied (for example) to the roof and hard-standing areas which generate the volume of water leaving the site via the storm-drain system (which themselves are under stress in many areas). Introducing a "storm-drain charge" would fundamentally

affect the economics of harvesting the water for re-use, rather than incurring the charge. For the businesses concerned, they would be making savings on both the water supply and storm-drain charges, thus incentivising investment in a water re-use system.

Legislation

32. The 2010 Flood and Water Management Act is potentially key legislation from a water re-use perspective. Although aimed at managing surface water from a flood-avoidance perspective, Schedule-4 of the Act introduces a requirement for SuDS to be adopted on new developments, at a cost to the developer which would cover future upkeep of the system. This places a premium on the design of SuDS that require minimum maintenance, in order to minimise the adoption costs.

33. In a combined SuDS/water re-use system, the water re-use element would need its own separate user-funded maintenance regime as it forms part of the water-supply to the properties concerned. If that principle were to be accepted nationally, the adoptable element of the system would be limited to the relatively simple pipe-runs and surface features (as illustrated in the schematic above), substantially reducing adoption costs, whilst enhancing the cost-effectiveness of the water re-use element. It would also make adoption a much more straightforward process, and thus help to make Schedule-4 implementable.

Installation, Maintenance & Use

34. Until the use of water re-use systems achieves critical mass, there are issues around the quality of installations, the local availability of affordable maintenance support, and the capability of consumers to understand and monitor the systems.

35. The manufacturers and suppliers of systems have largely addressed the installation aspects of water re-use, through the services they offer and the highly detailed instructions provided, but the extent to which accredited plumbers are able to provide local maintenance support remains unclear.

36. Consumer understanding of the systems in their properties should not be an issue for commercial users who should have well-established maintenance in-place for their buildings across all its technologies. For domestic users, simple guides are provided by the individual system suppliers, but these often remain unheeded. This issue is likely to diminish in importance with familiarity, and with consumers' need to understand the growing complexity of other systems in modern new homes.

Carbon Footprint Considerations

37. Water re-use, of course, is not a technology designed to address carbon footprint, but a technology aimed at alleviating flood and drought risks. However, a September 2020 Ricardo Report to Waterwise concluded that *"RWH installations across all building sizes emit less CO_2 when compared to the CO_2 emissions embedded in mains water over a 20-year lifetime."* The report goes on to add *"The amount of CO_2 embedded within a RWH*

system does not grow significantly as the size increases, however the amount of CO_2 saved, through reduced water demand can increase significantly with the size and demand of the system".

38. Similar conclusions are reached by the Report in relation to the net social impact, which includes CO2 impacts as well as reduced stresses on water infrastructure, which are assessed as beneficial on all multi-dwelling developments, and developments involving larger buildings

THE PERFORMANCE OF WATER RE-USE SYSTEMS

Rainwater Harvesting Systems

39. The performance of RWH systems is very straightforward to calculate, being a function of local rainfall (usually based upon historical norms), the size and nature of the collecting area (roof usually), unavoidable expected losses in the hydraulic chain, and the anticipated usage. These factors are all taken into account to size a storage tank for the system that will result in aesthetically clean-looking water suitable for non-potable use.

40. Notwithstanding calculated values, the water saved in a given year will vary according to the actual patterns of rainfall experienced in the year, and the actual patterns of usage over the same timeframe. Typically however, as reported by a fully instrumented trial undertaken jointly by the Environment Agency and Severn Trent Water at the turn of the century, a correctly-sized domestic RWH system in operational use can be expected to reduce mains-water consumption by around 50%. In use, they need only rarely to be topped-up by mains-water during long dry spells, following which the storage tanks will be almost empty to help accommodate any drought-breaking heavy rainfalls.

Greywater Recycling Systems

41. The majority of the explanation above applies narrowly to RWH and its integration with SuDS to help minimise the risks arising from future floods and droughts. RWH, however, is not suitable to every application relying, as it does, on a good match between the water that can be collected (in a particular location the variable being roof size and local rainfall), and the non-potable water consumption of the building concerned.

42. In high-density buildings, such as University hostels and hotels for example the poor match between collection and potential usage makes GWR a better option, with a very good match between the "greywater" likely to result from bathing/showering broadly being similar as the requirement for toilet-flushing. This enhances the cost-effectiveness of the systems and shorten investment payback timescales.

43. GWR systems have a double-benefit where the capacity of the foul-drainage system is also a concern, as it effectively halves the waste-water discharge per person. The systems are therefore in relatively common (but not yet widespread) use in hostels and

hotels, a notable example being the commitment of the Premier Inn chain to the technology.

Cost vs Benefit

44. The capital costs of water re-use system are very straightforward to identify. Installation costs are less straightforward as the majority of the work involved takes place in the context of other groundworks, plumbing and electrical works, and in the context of integrated SuDS and water re-use systems.

45. The benefits of systems, in terms of the non-potable water they supply (and hence the mains-water they save) is also straightforward to calculate using industry sheets (see example at Enclosure-3), or the calculation methods provided by national/international standards.

46. However, there are substantial additional benefits that result from water re-use, in terms of their contribution to the avoidance of future floods and droughts; these benefits hinge to a great degree on whether it becomes widespread UK practice to re-use water (which would have substantial benefits), or not.

ANALYSIS

47. Modern water re-use in the form of rainwater harvesting is well-established in Germany where a combination of stresses on water supplies and the resulting high cost of mains-water drive a market demand for the installation of systems on a straightforward payback basis.

48. Since the turn of the century, the Environment Agency (EA) has been predicted that changes in weather patterns over the UK will substantially increase the proclivity of the British Isles to flood and drought risks over the coming decades. Two decades into the 50-year horizon of the EA's predictions, period, there is growing evidence that they are well-founded.

49. British industry responded to the EA's early warnings by introducing the concept, of fitting RWH systems to new housing and commercial developments, to the UK market in the early 2000s. Subsequent growth in this market was steady, the main driver being BREAAM and the Code for Sustainable Homes, rather than consumer or developer demand in the housing market; the commercial market was Client-driven to a much greater extent.

50. This steady growth stalled around 2010 due to disruptions to the development markets caused by the financial crisis; the slow recovery in these markets coincided with Government abandonment of the C4SH scheme, leaving only modest encouragement for water re-use in commercial projects through BREAAM.

51. Subsequently/consequently the market for water re-use systems has largely stalled, but the fundamental growing requirement to supplement mains-water supplies in the southern half of England remains, as do flood risks.

Going Forward

52. With water-pricing policies in the UK acting as a counter-driver for water re-use, the only way in which widespread advantage can be taken of water re-use technology, as part of the national response to increasing flood and drought risks, is through Government non-financial intervention; this might take the form of:

    a. Making all agencies with "water management" on their agenda, from the policy level downward, responsible for both sides of the equation, ie both flood and drought avoidance

    b. Appointing a "Water Czar", to give focus to the water-related issues across the UK

    c. Legislate/establish water-related policies nationally, that can be sensibly applied locally, where they relate to flood and drought risks

    d. Lower the domestic water consumption requirements of Building Regulations to the levels envisaged by the C4SH level-5

    e. Increase the BREAAM points awarded for water re-use on commercial development

    f. Restore to its previous position in the SuDS Standard, water re-use as the top measure

    g. Encourage and evaluate water re-use in the context of combined systems with SuDS, rather than as stand-alone systems

    h. Integrate urban SuDS/water re-use thinking with the wider retention (source-control) of surface water for subsequent agricultural re-use, and grant-aid farmers who include approved attenuation capacity in their farm-level storage.

    i. Consider the role of other charging mechanisms, such as a storm drain discharge levy on commercial properties, to encourage widespread retrofitting of water re-use systems