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Carbon Reduction Through Sustainable Drainage Systems

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March 2021

On the 4th of December 2020, the Prime Minister announced ambitious new emissions target setting the UK on the path to net zero emissions by 2050. This new plan aims for at least 68% reduction in greenhouse gas emissions by the end of the decade, compared to 1990 levels.

Drainage design and sustainable drainage systems have typically been concentrated on the management of surface water run-off at the outfall. While this focus is currently shifting to the four pillars of sustainable drainage (water quantity, water quality, biodiversity, and amenity), there is still not enough attention paid to the role sustainable urban drainage systems can play in helping to meet climate change targets.

The scope to reduce carbon footprint and greenhouse gas emissions through refinement of typical underground drainage systems themselves is not significant. The carbon footprint and embodied energy for materials such as PVC and Clayware are well documented though their lifecycle and can only really be significantly improved with the sourcing of sustainable and recycled materials by the developer.

There is sometimes a choice of systems to use, such as with a new soakaway being either a crate system or concrete ring system (or something else entirely). With this choice comes the opportunity to evaluate the potential environmental impact of the design over its full lifecycle. Variables such as embodied energy, materials, sourcing, delivery, installation, excavation, design life, maintenance, replacement, can all be evaluated to provide the best option for the environment overall.

A conscientious design choice should evaluate and specify locally sourced and recycled materials where possible. Innovative product selection (reduced excavation for example) can help to improve the overall carbon footprint of the design with consideration of all environmental factors.

Similarly, the design life, maintenance and replacement processes should be evaluated to ensure that the selected system is one which has the least environmental impact. There is always the possibility that a less immediately sustainable product may have double the design life and therefore be a better choice for the whole design life of the development.

Reducing Water Demand

Based on my experience, the overall demand by the developer for, and implementation of, rainwater harvesting systems is typically low in new developments and drainage designs. This is also true for schemes that introduce a significant amount of sustainable drainage and they are often shoehorned in due to planning requirements.

Rainwater harvesting is often discounted when undertaking a hydraulic design as it should be considered full in a heavy rainfall event, so there is typically no considered contribution to the water attenuation on site for the extreme storms. This is a reasonable assumption to make in a hydraulic design of a drainage system, but it takes no account of the relationship between the demand and supply of the harvesting unit.

The principle which allows rainwater systems to be designed efficiently to prevent site runoff relies on the water demand being greater (on average over a certain time), than the supply to it from rainfall. This is something that is not possible in an extreme storm but may be considered for lower order storm events.

It is becoming more documented that a rainwater harvesting system can manage typical rainfall events over a standard year with no outfall and only water re-use. This can be easily checked on a specific site by assessing if the demand volume from the harvester is greater than a typical rainfall event over a few days.

This is important, as the revised SuDS manual puts more emphasis on interception control. Being able to manage the first 5mm of rainfall on a site without any discharge is becoming a prominent design criterion on sustainable sites. It is generally accepted that, under certain circumstances, a rainwater harvester can meet this criterion and manage the first 5mm of rainfall on a site. In such, it provides a significant sustainability benefit.

There is a noted environmental cost for the manufacture, installation, and operation of a conventional harvesting system, so the added sustainability benefits should factor in the assessment of whether the system has a net positive impact on the scheme.

Introducing SuDS Systems

The design and installation of SuDS considers all four pillars of sustainable drainage and should offer multiple benefits to a site. It comes as no surprise that the key to environmental improvement on a site is through the implementation of large-scale green/blue drainage systems, where the planting will provide benefit. Whilst the actual carbon offset is not large from these elements, this comes in addition to the other benefits SuDS offers.

Local plans and strategies have embraced SuDS technology and often have specific policy relating to the Non-Statutory SuDS Standards (NSTS) and SuDS Manual from CIRIA. A study in Coventry (Warwick, Charlesworth 2013) identified that green roofs and new build green blue infrastructure offered the greatest carbon reduction, but surprisingly tree planting has less impact in terms of carbon offset.

Green roof systems appear to offer the greatest potential for carbon reduction as a sustainable drainage device, both for new build and retrofit in urban areas. This is consistent with its position at the top of the sustainable drainage hierarchy as the preferred device to manage surface water and comply with as many of the SuDS pillars as possible.

In areas where there is a significant potential for landscaped SuDS and blue/green infrastructure, consideration should be given to the potential for carbon reduction in the spatial planning and habitat selection (planting).

Surface water management is undergoing a change in focus with the pillars of SuDS becoming more prominent and designers looking into a multiple benefit approach. This naturally encourages designs that will be more green and therefore environmentally friendly, so the outlook for carbon reduction in SuDS is a good one.

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The Foul Water Problem

The Environment Agency have published a paper stating that without intervention, increased wastewater treatment under the Water Framework Directive (WFD) is likely to increase CO2 emissions by over 110,000 tonnes per year. This is due to the increase in foul water discharge from new developments, as the population grows the net zero target grows with it, up to the year 2050.

The Environment Agency have outlined key strategies to manage carbon emissions on a strategic scale, but also indicate that the first of their five-point strategy is to aim to increase foul water treatment at source. This is identified as having a significant impact, as treatment of the water downstream in the large stations is not required.

Foul water treatment systems for development sites can be considered, but there is a trade-off between the carbon saving from the water treatment itself and the carbon footprint generated from the sourcing and use of a water treatment unit.

New technologies for treatment and processing of foul water will need to be developed to enable a significant carbon benefit to treating water on site. These would use low or zero electricity to run, while recovering heat and raw materials for use on the site (agriculture or fuel).

Changing the disposal of foul water from a traditional "into the nearest sewer" solution may have constraints. There is still potential to obtain an overall net benefit and introduce systems that are more environmentally sound.

Summary

The Environment Agency publications quite correctly indicate that the reduction in carbon emissions through drainage design is something that must be instigated through a significant step change in design approach and carefully considered national and local policy.

While the reduction of carbon footprint is likely to occur naturally with the shift towards more sustainable surface water design and green/blue infrastructure, there are other areas that should be examined in more detail. Treatment and management of foul water is an area demanding new research and ideas to meet the net zero target.

Patrick Parsons has outlined its policy on declaring a climate emergency and is actively reviewing design approaches in all disciplines to minimise carbon footprint, as well as introducing a corporate carbon reduction policy.

References

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