European Commission

Natural Water Retention Measures

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Individual NWRM

Soakaways

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Office International de l'Eau

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Environment

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I. NWRM Description

Soakaways are buried chambers that store surface water and allow it to soak into the ground. They are typically square or circular excavations either filled with rubble or lined with brickwork, pre-cast concrete or polyethylene rings/perforated storage structures surrounded by granular backfill. The supporting structure and backfill can be substituted by modular, geocellular units.

Soakaways provide storm water attenuation, and storm water treatment. They also increase soil moisture content and help to recharge groundwater, thereby offering the potential to mitigate problems of low river flows. They store rapid runoff from a single house or from a development and allow its efficient infiltration into the surrounding soil. They can also be used to manage overflows from water butts and other rainwater collection systems, or can be linked together to drain larger areas including highways.

As a sub-surface infiltration device, a soakaway requires no net land take. They can be built in many shapes and can often be accommodated within high-density urban developments, and can also be retro-fitted. Soakaways are easy to integrate into a site, but offer very little amenity or biodiversity value as they are underground features and water should not appear on the surface.

II. Illustration

Principle of a soakaway

III. Geographic Applicability

Land Use	Applicability	Evidence
Artificial Surfaces	Yes	Soakaways are potentially applicable to all artificial surfaces, subject to consideration of the suitability of underlying soils and geology to infiltrate water and

		consideration of the potential to mobilise contamination or act as a vector for poor quality water to enter groundwater.
Agricultural Areas	Possibly	Soakaways are most effective when receiving runoff from impermeable surfaces and providing retention to allow water to infiltrate. They are less likely to be applicable to other low-permeability surfaces such as field runoff, since high sediment loading will reduce the effectiveness of the soakaway. However soakaways can be used with pre-treatment to reduce sediment loading, and may be applicable for artificial surfaces in agricultural areas, such as farmyards. Environment Agency (2012) recognises soakaways as a measure relevant to 'rural SuDS'.
Forests and Semi-Natural Areas	No	
Wetlands	No	

Region	**Applicability**	**Evidence**
Western Europe	Yes	
Mediterranean	Yes	
Baltic Sea	Yes	
Eastern Europe and Danube	Yes	

IV. Scale

	0-0.1km²	**0.1-1.0km²**	**1-10km²**	**10-100km²**	**100-1000km²**	**>1000km²**
Upstream Drainage Area/Catchment Area	✓					
Evidence	Soakaways are generally designed to collect and infiltrate runoff from a small area such as an individual house or car-parking area. Although multiple soakaways can be connected to serve a larger drainage area, it is unlikely to exceed 0.1 km^2.					

V. Biophysical Impacts

Biophysical Impacts		Rating	Evidence
Slowing & Storing Runoff	Store Runoff	Medium	Soakaways are generally designed to capture and infiltrate runoff up to the 1 in 30 year event (CIRIA, 2007). CIRIA (2009) concluded that any failure of soakaways to perform to their design standard is generally attributable to inadequate protection from debris in runoff.
	Slow Runoff	None	
	Store River Water	None	
	Slow River Water	None	
Reducing Runoff	Increase Evapotranspiration	None	
	Increase Infiltration and/or groundwater recharge	High	Soakaways function by collecting runoff and infiltrating it to the underlying soils. They are generally designed to infiltrate all water from the contributing drainage area up to a 1 in 30 year event (CIRIA, 2007).
	Increase soil water retention	Low	Soakaways consist of a sub-surface structure with enhanced infiltration capacity, As such they could be considered to effectively increase soil water retention, although as this is achieved through introduction of a new medium, it does not, strictly speaking, change the soil itself.
Reducing Pollution	Reduce pollutant sources	Low	Runoff with significant concentrations of sediment should not be discharged directly to a soakaway, because the sediment deposition over time may significantly reduce the performance capacity of the soakaway. Pre-treatment (such as an oil and sediment collector) should be applied to reduce the sediment loading. Nevertheless, soakaways can provide additional improvements to water quality prior to infiltration to soil or groundwater, by filtration through the soakaway substrate. The potential for pollution to groundwater needs to be considered. CIRIA (2009) concluded that "the potential for contamination of groundwater from SuDS schemes appears to be low, except from industrial areas. The potential for serious pollution is associated with accidents rather than the continuous background pollution from these areas". However it might be considered that soakaways could pose a higher risk than some other infiltration measures, since they bypass the vegetation and soil layers. Pre-treatment prior to the soakaway will help to manage this risk, but site-specific
	Intercept pollution pathways	Low	

			assessments must always be undertaken, and soakaways avoided for areas with a higher risk of pollution in runoff.
Soil Conservation	Reduce erosion and/or sediment delivery	None	
	Improve soils	None	
Creating Habitat	Create aquatic habitat	None	
	Create riparian habitat	None	
	Create terrestrial habitat	None	
Climate Alteration	Enhance precipitation	None	
	Reduce peak temperature	None	
	Absorb and/or retain CO_2	None	

VI. Ecosystem Services Benefits

Ecosystem Services		**Rating**	**Evidence**
Provisioning	Water Storage	Low	Soakaways store runoff and infiltrate it to groundwater. Through this impact, they enhance the potential of the landscape to store water during floods and make this water available for other purposes (e.g. recharge to groundwater, offering soil moisture to support terrestrial ecology).
	Fish stocks and recruiting	None	
	Natural biomass production	None	
Regulatory and Matinenance	Biodiversity preservation	None	
	Climate change adaptation and mitigation	Low	By helping to limit urban runoff and flooding, and recharging groundwater, soakaways provide a contribution to adaptation to the higher intensity storm events expected due to climate change.

	Groundwater / aquifer recharge	High	Soakaways can provide full infiltration from areas of hardstanding that would otherwise runoff to sewers or surface water. As a result they provide a significant, although localised, contribution to groundwater recharge.
	Flood risk reduction	High	Soakways contribute to reducing the rate of surface runoff from artificial surfaces. They can reduce the risk of surface runoff flooding and contribute to a reduction in peak river flows in small catchments.
	Erosion / sediment control	None	In themselves, soakaways are not effective measures of erosion or sediment control. Where necessary, soakaways should include suitable pre-treatment to remove suspended solids and silt.
	Filtration of pollutants	Low	Soakaways provide a contribution to reducing urban diffuse pollution, primarily through reducing total runoff, as well as (in combination with pre-treatment) preventing/reducing infiltration of pollutants to groundwater.
Cultural	Recreational opportunities	None	
	Aesthetic / cultural value	None	
Abiotic	Navigation	None	
	Geological resources	None	
	Energy production	None	

VII. Policy Objectives

Policy Objective		Rating	Evidence
Water Framework Directive			
Achieve Good Surface Water Status	Improving status of biology quality elements	None	
	Improving status of physico-chemical quality elements	Low	Through contributing to reduction in diffuse pollution through interception of surface runoff, soakaways can make a small contribution to improving water quality in receiving waters.
	Improving status of	None	

	hydromorphology quality elements		
	Improving chemical status and priority substances	Low	Through contributing to reduction in diffuse pollution through interception of surface runoff, soakaways can make a small contribution to improving water quality in receiving waters.
Achieve Good GW Status	Improved quantitative status	Medium	Soakaways are designed to store and infiltrate runoff. As such, they enhance recharge to groundwater and thereby contribute to improving quantitative status of underlying groundwater bodies. The volume contribution from each individual soakaway is, however, small.
	Improved chemical status	None	
Prevent Deterioration	Prevent surface water status deterioration	Low	By intercepting a potential diffuse pollution vector from the contributing catchment, soakaways can help to protect the receiving water body from deterioration as a result of new diffuse pollution sources.
	Prevent groundwater status deterioration	Low	Soakaways may contribute to preventing deterioration in groundwater status where they maintain the overall level of recharge to groundwater in areas where the extent of hardstanding is increasing.
Floods Directive			
Take adequate and co-ordinated measures to reduce flood risks		High	Soakaways make a significant contribution to reducing surface runoff flood risks, particularly in urban areas.
Habitats and Birds Directives			
Protection of Important Habitats		None	
2020 Biodiversity Strategy			
Better protection for ecosystems and more use of Green Infrastructure		Low	As an effective component in sustainable urban water management, soakaways provide a contribution towards improved green infrastructure and protection of ecosystems. However in isolation the contribution is limited, particularly because a soakaway itself does not contribute any new habitat.
More sustainable agriculture and forestry		None	
Better management of fish stocks		None	
Prevention of biodiversity loss		None	

VIII. Design Guidance

Design Parameters	Evidence
Dimensions	CIRIA (2007) state that 'with adequate void support, soakaways can be designed to suit any available geometry'.
Space required	Soakaways are subsurface devices and as such require no net land take. They can be built in many shapes and are therefore appropriate to integrate within high-density urban developments.
Location	Siting restrictions on soakaways primarily relate to the properties of the underlying soil and groundwater and their proximity to building foundations. Soakaways should not be used: • too close to groundwater drinking water catchments. • Within 5m of building foundations or roads and within 3m of any shrub or tree. • In areas of unstable land without full consideration of the impact of the infiltrating water. This should be confirmed with site investigations prior to construction • Where the groundwater table reaches a level within 1m of the base of the soakaway at any time of year • In close proximity to other soakaways or infiltration features where the combined level of infiltration would exceed the local soil moisture capacity and therefore reduce the overall effectiveness of all infiltration devices • Within or overlying waste fill materials • Where the risk of contamination to underlying groundwater is high. (CIRIA, 2007)
Site and slope stability	Soakaways should not be used on unstable ground: ground stability should be verified by assessing site soil and groundwater conditions prior to construction. On sloping sites, an assessment should be made to ensure that infiltrating water will not cause raised groundwater levels further downslope or waterlogging of downhill areas, and that slope stability would not be affected. (CIRIA, 2007)
Soils and groundwater	Systems designed for infiltration should allow at least 1m clearance between the base of the soakaway and the seasonally high groundwater table. Soakaways are not acceptable in areas of contaminated soils or groundwater and care must be taken in design and construction to ensure that contaminants are not mobilised. The site infiltration rate should be verified with appropriate site investigations, and an appropriate factor of safety should be applied when calculating the soakaway dimensions for design.
Pre-treatment requirements	Runoff should be pre-treated before entering the soakaway to allow for removal of particulates and oils in order to avoid clogging of the soakaway itself that will reduce performance over time.

Maintenance requirements	Soakaways are effective only as long as the infiltration rate remains high. Even if pre-treatment is used, sediments or debris may still build up, so regular inspection and maintenance is very important. Maintenance of pre-treatment devices should be carried out once or twice a year (removal of vegetation, debris or sediments). If the soakaway is empty, sediment should be removed and filters cleaned. If the soakaway is full, it might be necessary to unclog the filling material, or to replace it.
Synergies with Other Measures	Soakaways may be incorporated in to a development as part of a wider SuDS scheme, for example in conjunction with other measures such as permeable paving.

IX. Cost

Cost Category	Cost Range	Evidence
Land Acquisition		The land requirements for soakaways are minor and should generally be able to be incorporated in to developments without additional space requirements.
Investigations & Studies	€0.5-€10k	Geotechnical investigations are required to confirm the land stability and underlying soil/geology conditions prior to construction. These may need to be intrusive and require analysis of land contamination to determine the suitability of infiltration techniques.
Capital Costs	>€90 / m^3 stored volume	Soakaway costs are indicated to be greater than €130 per cubic metre of storage volume by CIRIA (2007). This is corroborated by Atkins (2010), indicating a slightly higher minimum cost of €140 / m^3 stored volume. On the other hand, Chocat et al (2008) indicate a lower cost around 90€/m^3 stored volume
Maintenance Costs	€0.25-€1.25 per m^2 treated area	CIRIA (2007) indicates that the maintenance cost for soakaways is €0.25 /m^2 treated area, while Chocat et al (2008) indicate a cost of 1.25 €/m^2 treated surface. The maintenance costs can therefore vary, depending on the exact nature of the soakaway design, size and location.
Additional Costs		

X. Governance and Implementation

Requirement	Evidence
Stakeholder involvement	The effective planning, design, construction and operation of urban NWRM requires the involvement of a wide range of stakeholders. This may include local planning authorities, environmental regulators, sewerage undertakers, highways authorities, private landowners and land managers, and other bodies with responsibilities for drainage and water management (e.g. irrigation bodies, drainage boards, etc). Effective planning is essential to delivering urban NWRM, since they must be delivered within the constraints of the urban environment. This requires alignment between stakeholders from planning authorities through to developers and land owners.
Ensuring clear responsibility for maintenance	The adoption of SuDS has historically been a major issue in ensuring their long-term effectiveness.
Ensuring that appropriate design standards and effective designs are implemented appropriately at each location	The preparation of planning guidance and/or SuDS guidance documents that set out planning and design criteria, as well as local technical information (e.g. on soil types and underlying geology) can assist in this.

XI. Incentives supporting the financing of the NWRM

Type	Evidence
National and local legislative and regulatory requirements	Some countries and territories encourage and/or require the use of Sustainable Drainage systems in new development. For example, in England the use of SuDS is required through planning policy for new developments over a certain size. National and local instruments are the most widely effective for SuDS due to their wide-scale application at the household or very local level. The possibility of local incentives should always be explored (since they cannot be covered here comprehensively).
National and local charging incentives	The uptake of SuDS may be achieved by tax or water charging incentives. For example, in England households can receive a reduction on their water bills if their surface water discharges to a soakaway rather than to the sewerage network.
CAP funding for rural SuDS	Where applied in agricultural areas, it is possible that soakaways (most likely as part of a wider sustainable drainage scheme) may be eligible for the European Agricultural Fund for Rural Development (EAFRD) in relation to improving water management.

XII. References

Reference	Comments
Atkins (2010) Bath and North East Somerset Flood Risk Management Strategy Report (www.bathnes.gov.uk)	
CIRIA (2009) Overview of SuDS performance: Information provided to Defra and the EA.	
Woods-Ballard, B, Kellagher, R, Martin, P, Jefferies, C, Bray, R and Shaffer, P (CIRIA) (2007) The SuDS Manual, CIRIA C697.	
Chocat, Abirached, Delage, Faby (2008), Etat de l'art sur la gestion urbaine des eaux pluviales et leur valorisation, Tendances d'évolution et technologies en développement, ONEMA, OIEau	Manual about SuDS components in France.