TMS-DD-102 PR24 WINEP EC supporting evidence - storm overflows green solutions benefits

1. Overview

In the deep dive of what they have considered as our green only solutions in the Draft Determination, Ofwat has raised significant concerns on whether these solutions represent the best option for customers. In particular, Ofwat states Thames Water did not provide "details of a cost benefit analysis to demonstrate that the chosen option is the right solution" as well as "evidence that the cost of the green solutions provides a positive benefit above that of the traditional grey solution alternative".

In this document we provide evidence of the positive benefits provided by green solutions, above that of traditional grey solutions.

2. Thames Water argument and supporting evidence

Publicly available industrial or academic literature well evidence that green, nature-based solutions (including sustainable drainage systems) can deliver multi-benefits, both individually and at a catchment scale to communities and the environment. Ensuring we deliver multi-benefit SuDS has already been a key component of our Surface Water Management Programme (SWMP) in AMP7, where we worked in partnership to co-fund and co-deliver SuDS schemes with a wide range of stakeholders in our region.

The wider benefit of SuDS has been researched and monetised, and tools such as the CIRIA "B£ST" tool enable this to be calculated on a project by project basis, according to the location-specific benefits provided. However, there is also a *strategic benefit* of green over grey, which is the ability to 'triangulate' and trade off cost/benefit/performance of green solutions with willing and active stakeholders.

Green solutions typically;

- are designed to achieve multiple benefits;
- can attract partnership co-funding (cost sharing), which reduces the cost to each partner;
- achieve an overall better value solution (i.e. lower cost, higher benefit) for bill paying (water bills and taxes) customers/residents/business owners.

Alternatively, grey solutions typically;

- achieve a single benefit/driver;
- are sole funded by a single organisation leading to systemic greater costs incurred and;
- are overall lower value solutions (higher cost, lower benefits).

Alignment of SuDS benefits with WINEP Wider Environmental Outcomes

The monetisation and assessment of benefits for our Storm Overflows programme followed the Environment Agency guidance for the development of PR24 WINEP. The Environment Agency developed the WINEP Wider Environmental Outcome Metrics to use in the WINEP Options Development and Appraisal. These metrics should be used to help measure the potential impact on and changes to natural assets, ecosystem services/goods and the benefits they provide. Metrics have been recommended for water companies to use to support water companies to use a natural capital approach in their options development and appraisal, promote consistency and comparability, as well as supporting a proportionate approach.

This methodology is appropriate for high level assessments or, similarly to the B£ST model, on a location- and project-specific basis. However, the benefits associated with the variety of interventions under the category of SuDS may not be accurately quantified and monetised according to these metrics and, considering the current uncertainty in the ability to deliver a large green programme and achieve the outcomes within the regulatory deadlines, may not necessarily deliver all the benefits intended. Therefore, in an attempt to make a conservative assessment and to err on the side of caution, we have not monetised in our options development and appraisal process the benefits for the widespread SuDS initiatives we intend to deploy in the catchment. We focussed on the main benefits provided by the achievement of our Storm Overflows outcomes, ensuring that they would have been delivered by the most cost-effective option.

Notwithstanding our approach of not monetising the additional benefits delivered by green solutions for option development and appraisal, these solutions generally provide the following additional benefits in the following categories:

- Biodiversity
- Water purification
- Climate regulation
- Recreation
- Air Quality
- Hazard regulation – flood
- Education

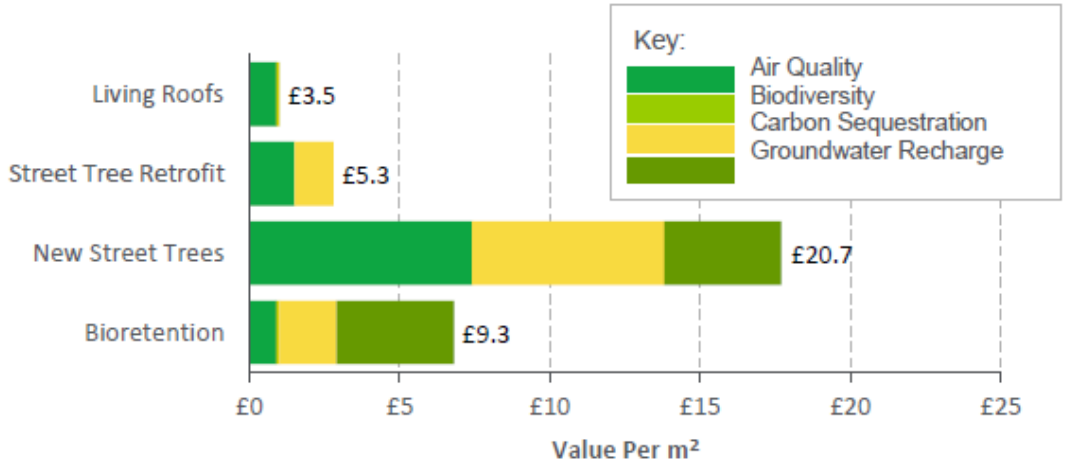
The below table lists each of the WINEP WEO Metrics and aligns them against the industry recognised wider benefits attributable to SuDS (taken from the CIRIA BEST tool). There is good alignment, however notably a number of industry recognised SuDS benefits, mostly those related to social capital, are not captured by the WINEP WEO.

Table 1 – Comparison of WINEP benefit to Ciria B3ST benefit to Capital Type

Metric (WINEP WEO)	SuDS benefits (CIRIA B£ST)	Capital Type
Biodiversity	Biodiversity	Env
Water Supply	Water quantity, groundwater recharge, rainwater harvesting	Env
Water purification	Water quality	Env
Climate regulation	Carbon sequestration	Env
Recreation	Amenity, Health	Socio-econ
Recreation – angling	N/A	N/A
Food – shellfish	N/A	N/A
Air Quality	Air Quality	Env
Hazard regulation – flood	Water quantity	ALL*
Volunteering	N/A	N/A
Education	Education	Socio-econ
N/A	Traffic calming	Socio-econ
N/A	Urban cooling	Socio-econ
N/A	Noise	Socio-econ
N/A	Property value	Socio-econ
N/A	Asset performance	
N/A	Enabling development	

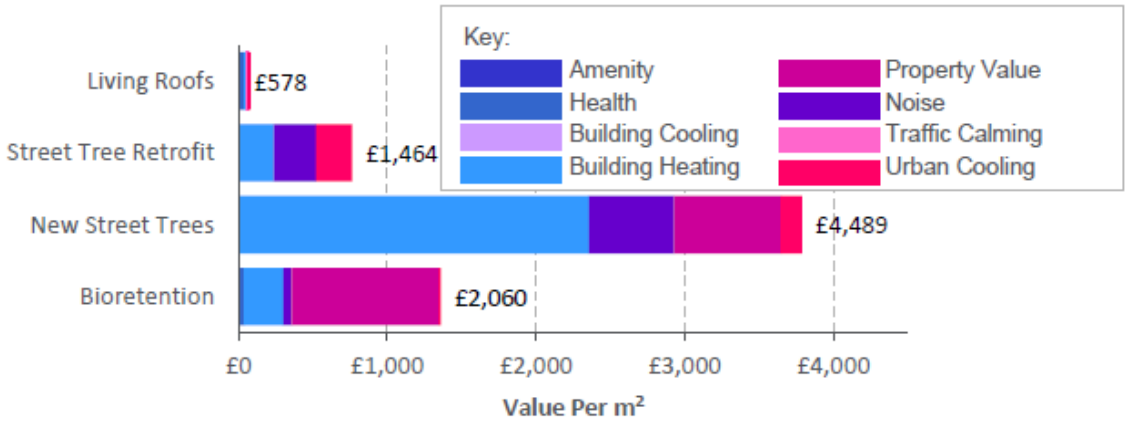
This is important because research we part funded and delivered (London Strategic SuDS Pilot Study) found that the sum of these social capital benefits far outstripped the environmental capital benefits as well as the flood damage reduction benefit. For example, new street trees typically provide £20 per m2 in environmental value (air quality, carbon and groundwater recharge) but provide £4,489 per m2 in social value (see figures 1 and 2 below).

Figure 1 – Natural Capital, Environmental value of SuDS features by m^2



Source: London Strategic SuDS Pilot Study

Figure 2 – Natural Capital, Socio-economic value of SuDS features by m²



Source: London Strategic SuDS Pilot Study

Most importantly, green solutions can also directly address the root cause of hydraulic and stormwater management issues such as related to the Storm Overflows programme. Additionally, these solutions generally provide resiliency against systemic change and therefore are better suited to adaptive plans in an uncertain future. This additional benefit is not included in the Environment Agency Wider Environmental Outcomes and there isn't a standardised methodology to quantify this benefit.

Finally, local initiatives based on SuDS can be implemented faster/sooner than grey, engineered solutions which may require planning permission (e.g. increasing network capacity by installing a below ground storage tank vs equivalent storage through provision of water butts and/or rainwater disconnection upstream).

Our AMP7 Surface Water Management Programme

Our AMP7 Surface Water Management Programme Call for Projects was inundated by initiatives and submissions seeking funding. We developed a robust and fair means of assessing the huge variety of SuDS project we received (types, scale, location, partner). We assessed all projects and scored them against three principles, with principle 3 focussing solely on wider benefits;

1. Need for capacity - we want to focus on areas where we know our existing sewer systems have lower capacity. We will utilise information generated as part of our Drainage and Waste Management Plans (DWMP) programme as well as known flooding and pollution hotspots
2. Collaboration - we want to partner with those who are already improving the streets and places where we live, so we can achieve mutual benefits through common means. We want to learn from collaborative opportunities in AMP7 and establish a model for future collaborative working.
3. Generate public value - We want to go beyond regulatory compliance to demonstrate long-term stewardship of the environment and deliver social good for communities.

The scoring applied was made publicly available to our stakeholders and favoured projects that

- Consisted mainly of Blue Green Infrastructure over Grey Infrastructure

- Incorporated water re-use elements
- Fully disconnecting surface water from the sewer network over just attenuation (i.e. returning rainwater straight back to the environment),
- Brought additional public realm enhancements,
- Collaborated with more than one other partner.

Susdrain Awards 2024 - Industry recognised, award winning, multi-beneficial SUDS schemes

The success of this strategic benefit has been reflected by the success of a number of TW backed SuDS projects at the CIRIA Susdrain Awards 2024.

Seven SuDS projects backed by Thames Water were recently recognised at the CIRIA Susdrain Awards 2024.

- TW part or solely funded 4 winning projects
- TW part funded 3 highly commended projects
- TW projects recognised in 5/9 categories
- One of the projects won the 'overall winner' out of the 9 categories.

Case Study: SuDS in Schools – William Austin Junior School, Luton

Partnered with: Luton Borough Council

TW Role: Co-funder (£143,118)

Project Partners: William Austin Junior School, Environment Agency, Department for Education

Project Summary: This is a retrofit scheme at William Austin Junior School, Luton, to help them harvest rainwater in clever new ways. The project includes SuDS planters that redirect rain from roof downpipes and through the bedding soil to help plants flourish. Tree pits in the playground capture rain run-off in a storage tank buried nearby. A 12,000 litre rainwater harvesting system collects rainwater from the roofs of the school and uses this to flush toilets in one of the blocks. This is estimated to save over 300,000 litres of fresh water every year and if there's ever any overflow, it's redirected to the surface water sewer. A crucial part of this project was to resolve flooding issues at the school, reduce flood risk from more frequent storm events (1 in 10 year).

https://www.susdrain.org/SuDSAwards/SuDSAwards2024/Nominationfiles/22_Cat8_LutonBC_SuDSinSchool.pdf

Case Study: Thames Water waterbutt planter

We developed and refined our own, award winning waterbutt planter. Designed to be a multi-beneficial, low maintenance solution which we have deployed as part of our award winning Community Centric Rainwater Management project. It is multi-beneficial in 3 ways:

- Stormwater attenuation: Providing passive storm water storage and fitted with a hydrobrake so that capacity is available the next time it rains
- Water re-use: Maintains 30L of water for re-use
- Amenity and biodiversity: Integrated planter trays on top for planting

Figure 3 – Example of rainwater planter

Public Value

Green infrastructure schemes provide public value. This is demonstrated across 13 of our 28 public value measures, presented in the table below.

In the document “TMS26 Enhancement Case: WINEP” it is possible to find more details of our Public Value Framework and the scoring of our WINEP programme.

Sources of Evidence

Ignition Project

Urban nature-based solutions like green walls and roofs, sustainable drainage systems and street trees have the potential to provide around 30% of the adaptation needed to protect our towns and cities from increased rainfall, flooding and heatwaves by 2030. They can also increase property value, provide insulation, improve air quality, capture carbon, enhance health and well-being and help create healthy, vibrant, active green towns and cities.

Backed by €4.5 million from the EU’s Urban Innovation Actions initiative, the IGNITION project compiled evidence, developed business cases and ran pilots to provide a robust case for how, why and where this needs to be done in Greater Manchester, alongside insight into how our approach could be applied elsewhere.

https://gmgreencity.com/projects-and-campaigns/ignition/

Evidence database: https://hub.salford.ac.uk/ignition-living-lab/green-infrastructure-evidence-database/

Table 2 – Comparison of benefit values from various SuDS interventions

Benefit	No of Studies included in database	Physical flow	Storage facilities	Filter strips and swales	Infiltration	Unit	Comments
Air quality	0	Pollution removal	No data				There is no data for this at present, although data could potentially be taken from green spaces database where appropriate.
Carbon	15	Annual carbon sequestered	0.183 [Rng. 0.09-0.31]	0.27 [Rng. 0.034 - 0.62]	No data	Avg. kg C m^2 yr	Only strong data on SuDS carbon storage focusses on detention ponds, it would not be appropriate to generalise this across SuDS due to the difference in hydrology influence. Outlying data reporting 17kg m2 yr sequestration was not included.
		Carbon storage	1.57 - 2.28	3.05 - 5.04	No data	Avg. kg C m^2	
Water Quantity	26	Peak flow reduction	70% [Rng. 36-99%]	57% [Rng. 52-61%]	40%* [Rng. 40-85%]	Avg. % reduction	An abundance of research is available for this benefit, covering many measurable units, the three included here were found to be most common. Less data on infiltration SUDS.
		Peak flow delay	16mins	33-34mins [mid point 33.5mins]	No data	Minutes	
		Runoff reduction	72% [Rng. 35-100%]	69% [Rng. 50-88%]	60%*	Avg. % runoff retained	
Water Quality	26	Total nitrate removal	51% [Rng. 30-79%]	19-70% [mid point 44.5%]	65%*	% Nitrate removal	All but one study report nitrate removal. (One reports increased oxidisable nitrate in effluent in an infiltration SUD)
		Total suspended solids removal	68%*	79% [Rng. 56-95%]	43% [Rng. 36-50%]	% Total suspended soilds removal	All studies found reported removal
		Total phosphate removal	55% [Rng. 50-60%]	62% [Rng. 40-85%]	48% [Rng. 45-51%]	% Phospohate removal	All but one study reports phosphate removal. (One reports increase in phosphate in filter strip & swale SuDS)
Temperature	4	Reduction in air temperature	Sparce data, 3 studies reported blue space has the potential to increase air temperature, 1 study reports lower temperature above blue space in city in daytime.				Qualitative data with differing units requiring interpretation. Definitive studies need to be found.
Energy Use	0	Energy consumption for cooling	No data				There are potential energy reductions from decreased requirements to treat waste water.
		Total energy consumption					
		Energy consumption for warming					
		Thermal resistance					
Health and Wellbeing	0	Attention	No data				There is no data for this at present, although data could potentially be
		Memory and recall					
Noise	0	Reduction in noise levels	No data				There is no data at present and unsure if this would show any positive benefit
Land and Property	4	% house price premium	0.9%*			Avg. % house price premium with a small blue space within 200m of a	Data listed in summary based on 3 studies that make reference to generic "blue space", other data in database on varying measurable aspects exists. 1 study concludes that in the absence of green and blue spaces, property prices in Great
		% property premium close to water	3.6%*			Avg. % house price premium with a large blue space close to	
Amenity	2	No consistent physical flow data	One UK willingness to pay study shows a positive value, one South African study shows a negative value due to badly designed and maintained suds				Summary figure based on 2 studies, other studies available in database with differing measuring units.
Biodiversity	12	No consistent physical flow data	Strong qualitative data on increase in biodiversity in storage facilities, with many studies in the UK. One UK study reports that SuDS ponds have 60-80% species richness as a natural pond				Multiple qualitative data entries, mostly UK based.
Local economic growth	0	Staff turnover	No data				
		Sick leave					
		Productivity					

Table 3 – Comparison of benefit values from street trees and SuDS-enabled street trees

Benefit	No. of evidence sources	Physical Flow	Street trees	SuDS-enabled street trees	Unit	Comments
Air quality	17	Pollution removal	0.17 [Rng. 0.002-0.39]	No data use street trees	Avg. NO_2 removed kg/yr./per tree	As trees can alter air movement, especially in restricted spaces such as urban "canyons," they can affect the physical transportation of polluted air masses. This can reduce ventilation of street canyons and increase air pollution, or in other contexts enhance ventilation by increasing surface roughness and turbulence, thus reducing pollution.
			0.11 [Rng. 0.09-0.12]	No data use street trees	Avg. PM10 removed kg/yr./per tree	
Carbon	11	Annual carbon sequestered	5.5 [Rng. 3.5-10]	No data use street trees	Avg. C sequestered kg/yr./per tree	The capacity of trees to store carbon varies naturally depending on the type of tree, the size of the tree and the stage of growth. It also greatly dependents on management regimes and human induced disturbance. Report figures for carbon storage vary greatly between studies, use with caution.
		Total carbon storage	231.6 [Rng. 7.6 - 852]	No data use street trees	Avg. C stored kg/per tree	
Water quantity	14	Rainwater runoff reduction	43% [Rng. 5.2% - 79%]	78%*	Avg. % runoff volume retained	Good range of studies except for SuDS-enabled street trees which only has one study available.
			3.2 [Rng. 0.14-11.3]	No data use street trees	Avg. rainfall intercepted m3 per annum/tree	
			No data	81% [68min delay in peak flow]	Avg. % peak flow attenuated	The summary figures reported here are based only on one study, other studies are available in the database.
Water quality	2	Pollution removal	70%*	No data use street trees	Avg. % reduction in nitrate concentrations	The summary figures reported here are based only on one study, other studies are available in the database.
Temperature	14	Cooling or insulating	11°C [Rng. 10 - 12°C]	No data use street trees	Avg. reduction in surface temperature °C	The summary figures reported here are based only on one study, other studies are available in the database.
			3°C [Rng. 0.9 - 5.2°C]	No data use street trees	Avg. Underlying air temperature reduction °C	Good range of studies.
			3 °C*	No data use street trees	Max reduction in indoor air temperatures °C [summer].	Based only on one study,.
			3.8 - 15°C [Mid 9.4 °C]	No data use street trees	Global temperature reduction °C	Good range of studies. Globe temperature is the same as physiologically equivalent temperature or PET. A measure of human comfort.
Energy use	8	Energy savings	0 - 288 kWh [mid point 144]	No data use street trees	kWH savings per tree/annum from cooling energy savings	The summary figures reported here are based on one meta-analysis study, other studies are available in the database.
			30%	No data use street trees	% Avg. annual seasonal cooling-energy savings per tree	Few studies only
			18%*	No data use street trees	% heating savings through insulation from a shelter belt of trees	The summary figures reported here are based on one UK study, other studies are available in the database. Refers specifically to a shelter belt of trees.
Health and wellbeing	13	Health and well being	Each additional tree per km of street was associated with 1.38 fewer antidepressant prescriptions per 1000 population per year.		Number of fewer antidepressant prescriptions per 1000	A range of qualitative and quantitative studies mainly from the US, UK and the Netherlands, cover a wide range of topics not suitable for easy quantitative synthesis.
			An increase in tree density of 1 standard devisation led to a 29% lower early childhood prevalence of asthma.		% prevelance of early childhood asthma	
Noise	4	Reduction in noise levels	4dB [Rng. 4-8db]	No data use street trees	Avg. decibels [dB] reduction per tree	The summary figures reported here are based two studies, other studies are available in the database.
Amenity	5	Improvement in road safety	Qualitative evidence not suitable for quantitative synthesis	No data use street trees	% increase per tree	The summary figures reported here are based on one study, other studies are available in the database.
		Reduction in crime levels	1.2% decrease in crime levels for every 1% increase in tree canopy	No data use street trees	% decrease in crime with increase in tree canopy	Quantitative figures based only on one study but this benefit is supported by three other studies which provide only association data.
Land and property	10	Property value uplift	4.7% [Rng. 4.27 - 5%]	No data use street trees	% uplift in property price from the presence of street trees	Based on a range of international and UK studies.
		Rent value uplift	6.15% [Rng 5.3 - 7%]	No data use street trees	% uplift in rent uplift from the presence of street trees	The summary figures reported here are based two studies, other studies are available in the database.
Biodiversity	4	Biodiversity	Qualitative evidence not suitable for quantitative synthesis	No data use street trees	n/a	Range if qualitative studies not suitable for quantitative synthesis in this format.
Local economic growth	5	Increase willingness spend on products	10-50% [mid 30%]	No data use street trees	% increase per customer based on the presence of street trees in central business districts	Based only on one researcher, with two separate studies. Varies depending on the type of good purchased e.g. convenience vs. luxury items
		Increased patronage of restaurants	30-50% [mid 40%]	No data use street trees	% increase in restaurant patronage	Lower figure for weekday, higher for weekends. Based only on one study.
		Decreased sick leave of workforce	23%	No data use street trees	% reduction in sick leave taken by workforce who have a view of nature	The summary figures reported here are based on one study, other studies are available in the database.

London Strategic SuDS Pilot

https://www.susdrain.org/resources/evidence.html

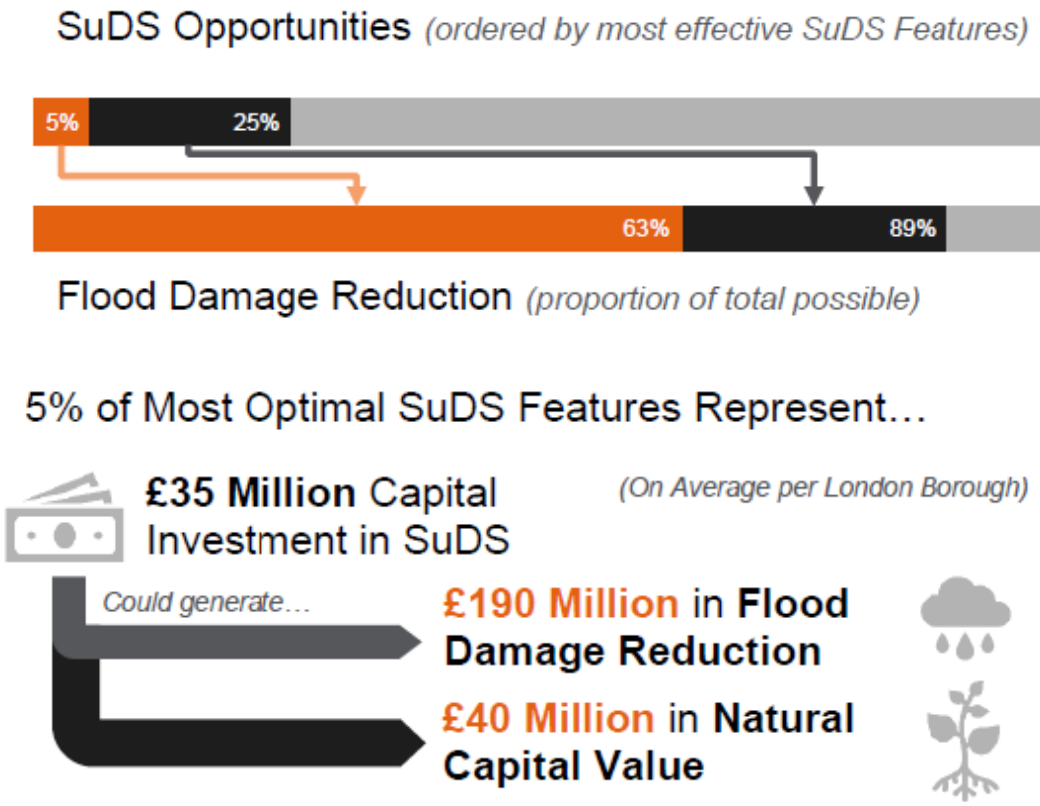
The pilot had five objectives, two of these specifically researched the benefits attributed to SuDS:

• Determine the flood risk benefits of strategic SuDS within an urban environment using hydraulic modelling

• Identify and evaluate the wider social and health benefits of green infrastructure

The project demonstrated that retrofitting small SuDS features can deliver greater benefits when using hydraulic modelling to target key locations. This was applied with small-scale SuDS dispersed across a catchment, called 'distributed' SuDS, or when integrating SuDS measures into wider public works. It identified that 65% of the flood damage reduction benefit could be achieved by delivering SuDS in the 5% most effective locations and nearly 90% of the benefit if 30% of the most effective locations were addressed.

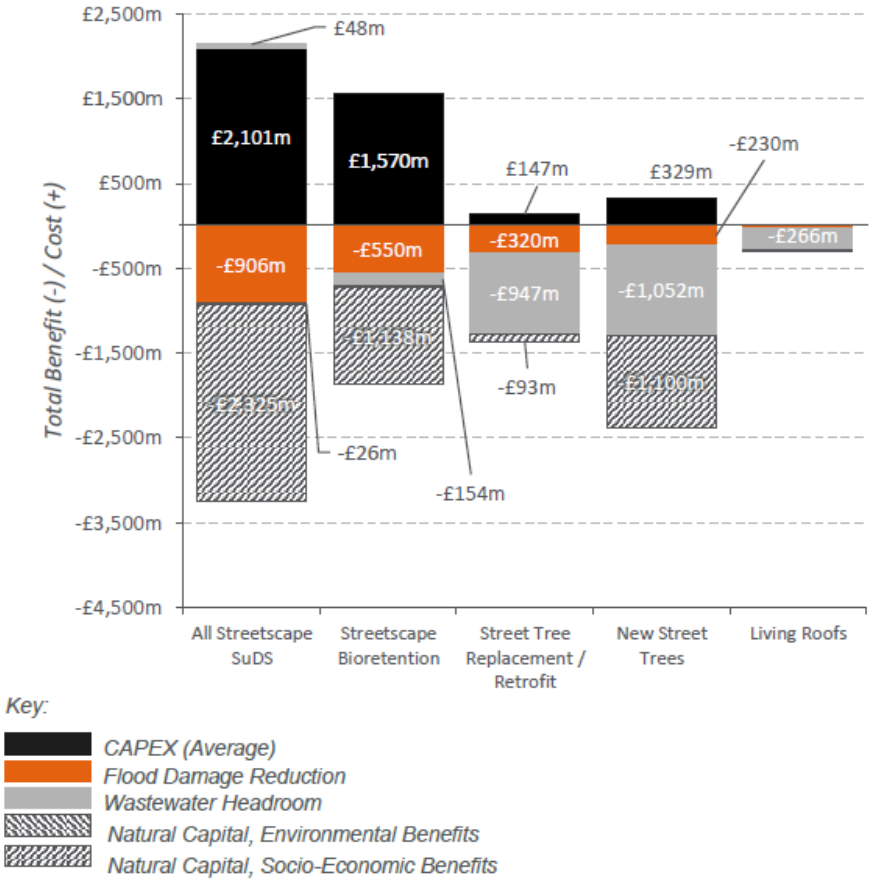
Figure 4 – SuDS opportunities ordered by most effective SuDS features



Source: https://www.susdrain.org/files/resources/evidence/4_appendix_2_lssps_modelling_report.pdf

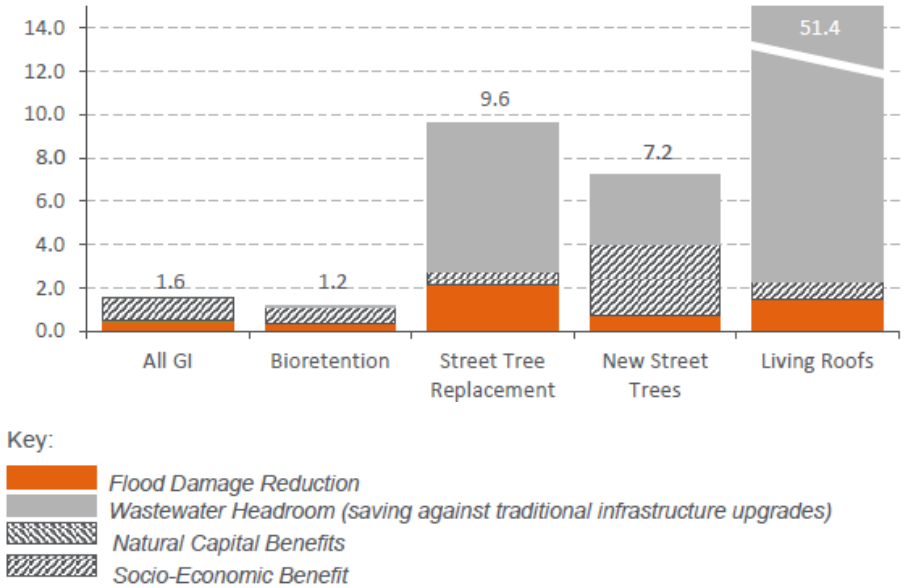
Another key finding of this research was the socio-economic benefits calculated by the modelling outweigh all other benefits by up-to a magnitude of 10 times for some scenarios evaluated. This demonstrates the underlying holistic value of SuDS as a key component of investing in Green Infrastructure.

Figure 5– Total cost (Capex) and value, full realisation of SuDS opportunities



Source: https://www.susdrain.org/files/resources/evidence/4_appendix_2_lssps_modelling_report.pdf

Figure 6– Benefit-cost ratios, full realisation of SuDS opportunities (note: y-axis capped at 15)



Source: https://www.susdrain.org/files/resources/evidence/4_appendix_2_lssps_modelling_report.pdf

Our DWMP

Source: DWMP ODA Technical Appendix

The Options Development Appraisal Technical Appendix shows the difference in value between green and grey engineering solutions. It includes the work we have undertaken to understand the difference in outcomes and costs between implementing green and grey solutions in the Deephams catchment.

Of the 244 catchments where Generic Sub-Option B1.1 Source Control SuDS has been proposed, it is clear that implementation of source control SuDS measure has the potential to provide significant benefits across a majority (77%) of these catchments. While no Major Beneficial effects have been identified, Moderate beneficial effects for over 50 catchments are anticipated against Objectives 1 – 6, 9 and 11 (covering topics of Biodiversity, Population and Human health, Material Assets, Water and Landscape/Townscape). Moderate beneficial effects are also identified for a smaller number of catchments (18) against Objective 7 (Soil) and for a single catchment (Newbury STW) against Objective 10 (Historic Environment).

The assessment has shown that the benefits anticipated largely stem from reduced capacity pressures on wastewater networks, wastewater resources and, consequently, reduced flooding events (including out of sewer flooding). In catchments that are highly sensitive in respect of population, biodiversity and water, such consequences have the potential to return the greatest benefits. For catchments particularly sensitive in respect of landscape, soil and historic environment, reduced flooding, soil erosion and amenity impacts (e.g. installation of green roofs) also contribute to tangible benefits within the respective catchments. Importantly, these effects are anticipated during the operational phase and are therefore long term, permanent in duration.

Source: DWMP Environmental Assessment

Table 4 – Number of catchments identified with Likely Significant Effects (LSE) against Strategic Environmental Assessment (SEA) objectives (taken from DWMP)

GSO Description: B1.1: Source Control SuDs measures

Installation of surface water management devices to collect, store and infiltrate surface water from buildings and surrounding impermeable areas such as driveways and car parks. This option includes residential properties, schools and other public buildings, commercial and industrial buildings.

Installation of surface water management devices to collect, store and infiltrate surface water from roads, pavements and pedestrianised areas.

No. of Catchments where GSO is promoted	No. of Catchments with LSE (Beneficial)	No. of Catchments with LSE (Adverse)	Percentage of all Catchments where GSO proposed result in LSE
244	190	190	77%

Significance of Effect	SEA Objective										
	Objective 1: To protect and enhance biodiversity, ecological functions, capacity, and habitat connectivity within water company' s operating area	Objective 2: To strengthen the connections between people and nature and realise the value of biodiversity	Objective 3: To improve human health and well-being of the area, improve access to recreation and the environment, and reduce inequalities	Objective 4: To reduce, and make more efficient, the domestic, industrial and commercial consumption of resources, minimise the generation of waste, encourage its re-use and eliminate waste sent to landfill	Objective 5: To maintain or improve the quality of rivers, lakes, groundwater, estuarine and coastal waterbodies	Objective 6: To reduce and manage flood risk	Objective 7: To protect and enhance geology, the quality and quantity of soils and promote a catchment-wide approach to land	Objective 8: To reduce air pollutant and greenhouse gas emissions	Objective 9: To adapt and improve resilience to the threats of climate change	Objective 10: To conserve and enhance the historic environment, the heritage assets therein and their setting	Objective 11: To protect, enhance the quality of, and improve access to designated and undesignated landscapes, townscapes and the countryside
+++	0	0	0	0	0	0	0	0	0	0	0
++	**79**	**79**	**110**	**106**	**53**	**53**	**18**	0	**68**	**1**	**100**
---	0	0	0	0	0	0	0	0	0	0	0
--	**79**	**79**	**110**	**53**	**53**	**53**	**18**	**33**	**68**	**1**	**100**