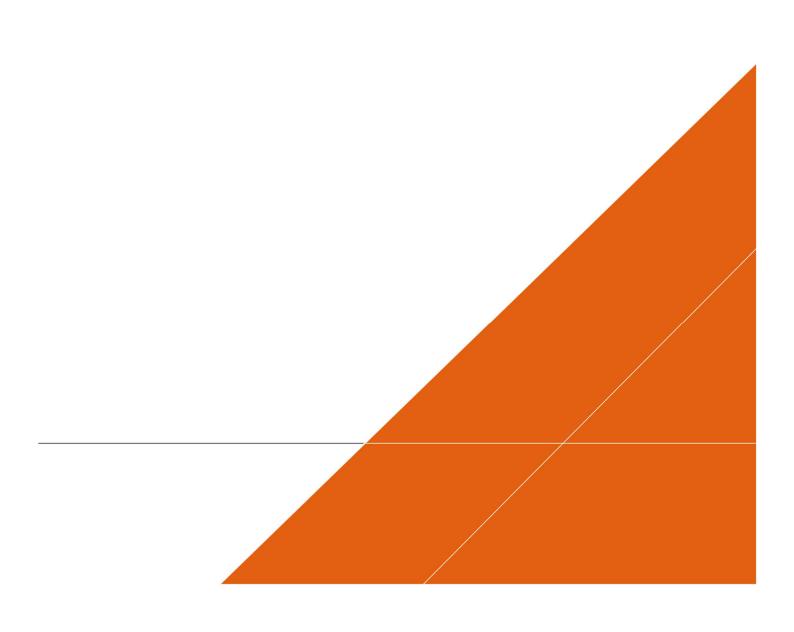# LONDON STRATEGIC SUDS PILOT STUDY

Natural Capital Accounting, Technical Note

DECEMBER 2020

1 Summary

This technical note covers the process and assumptions used to derive natural capital value.

The CIRIA BEST tool was used to derive value for the majority of benefits, supplemented by additional information and assumptions where necessary. During Stage 1, BEST version 3.02 (February 2018) was used. For Stage 2, BEST version 4.1.2 (May 2019) was used, which includes the rationalisation of benefits and updated costs.

2 Stage 1, Preliminary Conceptual Development

2.1 Selected Benefits

There are 21 defined 'benefits' for which a monetised valuation could be derived in the BEST Tool. The Distributed SuDS features have relatively specific designs that limit many of the benefits to their more immediate surroundings, except those associated with general environmental quality.

The benefits selected from the list of available calculatable benefits in the BEST Tool were as follows:

- **Air Quality** – Improvement in air quality due to creation of vegetative areas (e.g. streetscape bioretention rain garden features) and planting of trees
- **Amenity** – Resident views over enhanced public space
- **Carbon Sequestration** – Carbon removal due to the planting of trees
- **Health** – Providing resident views over new green spaces
- **Traffic Calming** – Reduction in accidents by using SuDS to create traffic calming measures

2.2 Omitted benefits

The benefits selected were those which could be efficiently calculated on a site-by-site basis, collated to generate a combined financial benefit. The Distributed SuDS concept is predicated on the delivery of large-scale catchment Green Infrastructure (GI) features which are likely to provide more extensive but generalised benefits that are harder to calculate. Other potential benefits within the BEST Tool which were not considered during the evaluation are listed below:

- **Biodiversity and Ecology** – Although GI will provide enhanced biodiversity the derivation of actual benefit for small-scale disconnected features was considered impractical
- **Flows in Watercourse** – The strategic attenuation of runoff will reduce peak flows discharging to receiving watercourses but without more extensive modelling and information calculating net benefit was not possible
- **Groundwater Recharge** – The potential benefits were considered negligible
- **Water Quality of Receiving Water** – The net effect of pollutant removal using Streetscape SuDS is difficult to calculate but will represent a contributing factor in improving receiving water quality, when implemented in separate catchments

An additional factor not included in the BEST Tool but likely to provide measurable benefit is the urban heat island effect. A sufficiently large-scale realisation of Distributed SuDS could help suppress high urban temperatures during summer by increasing absorption of radiative energy by realising moisture into the atmosphere. However, the evaluation of this effect and derivation of potential benefit is complex and was considered (during Stage 1) to require a disproportionate level of technical evaluation.

2.3   Assumptions

The key assumptions applied to the process of evaluating BEST monetised benefits are shown in Table 1.

Benefit	Values Defined	Assumptions
Air Quality	Area of other intervention *(i.e. area of green space created)*	Set to surface area specified
	Tree type (small)	-
	Tree type (medium)	-
	Tree type (large)	-
Amenity	Public open green space enhancement	Specified assumption of number of residents in proximity to SuDS feature, varying depending on size
Carbon Sequestration	Deciduous - Small	-
	Deciduous – Medium	-
	Deciduous – Large	-
Health	Est. No. adults having view of green space	Specified assumption of number of residents in proximity to SuDS feature, varying depending on size
Traffic Calming	All injury accidents	Derivation and assumptions detailed in Section 2.4
	Damage only	1 per annum per road section

Table 1 – BEST Benefit Derivation Variables & Assumptions

2.4   Traffic Calming Benefits Derivation

The derivation of traffic calming benefits has been undertaken with reference to national accident statistics from 2012 (House of Commons Reported Road Accident Statistics)[1] and using the road layout in the Enfield Town Centre CDA as a representative sample area for a typical London residential catchment, which could be applied to the other CDAs. The derivation of number of accidents per section of road is outlined in Table 2.

Attribute / Assumption	ID *(for calculation)*	Value	Source	Calculation
No. Accidents involving slight injury	A	171,000	House of Commons	-
No. Accidents involving serious injury	B	23,000	House of Commons	-
Population of the UK	C	63,700,000	Office of National Statistics	-
No. subcatchments in CDA *(from model)*	D	6,305	InfoWorks ICM model	-

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[1] Reported Road Accident Statistics, House of Commons (SN/SG/2198), 2013
http://researchbriefings.files.parliament.uk/documents/SN02198/SN02198.pdf

Attribute / Assumption	ID *(for calculation)*	Value	Source	Calculation
Average Residential Occupancy	E	2.47	Assumption	-
Est. Approximate Population of CDA	F	18,915	*(Calculation)*	D x E
Proportion of UK population	G	0.03%	*(Calculation)*	F / C
Approximate No. Road sections in CDA	H	150	Assumption made with reference to OS MasterMap	-
No. Accidents involving slight injury in CDA	I	51	*(Calculation)*	A x G
No. Accidents involving serious injury in CDA	J	7	*(Calculation)*	B x G
Av. No Accidents	K	29	*(Calculation)*	Average (I,J)
All injury accidents	-	0.19	*(Calculation)*	K / H

Table 2 – Derivation of Road Traffic Accident Reduction from Streetscape SuDS

Based on the set of assumptions and proportional calculations outlined in Table 2 an estimate of 0.19 accidents per discrete road section has been calculated (i.e. approximately 1 accident every 5 years). Benefit has been calculated based on the assumption that traffic accidents could be reduced by 60% following the implementation of SuDS features that could be designed to include traffic calming functionality, based on information provided in a traffic calming note from 2010 (House of Commons Roads: traffic calming)[2].

A proportional adjustment was also applied to account for the multiple SuDS features which would be required along a single section of road as part of traffic calming measures, sufficient to realise the 60% reduction.

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[2] Roads: traffic calming, House of Commons (SN/BT/3437), 2010
http://researchbriefings.files.parliament.uk/documents/SN03437/SN03437.pdf

3 Stage 2

3.1 Selected Benefits

There are 18 defined 'benefits' for which a monetised valuation could be derived in the BEST Tool. For this stage a broader selection of benefits was considered, enabled by the better understanding of their calculation (from Stage 1) and recognition of the larger scale of opportunities in central London that could enable the realisation of other benefits.

The technical approach in Stage 1 calculated natural capital value for each SuDS feature, based pre-defined physical size. For Stage 2, SuDS opportunities sites where delineated individually so to enable an assessment of natural capital based on unit benefit values (i.e. per m^2 of SuDS feature constructed).

It was considered pragmatic and informative to split the benefits into Environmental and Socio-economic groups.

3.1.1 BEST Benefits

Two of the benefits omitted in Stage 1 (Biodiversity and Groundwater Recharge) were re-introduced, plus the addition of benefits associated with living roofs (which were not considered as a SuDS feature in Stage 1). The benefits selected from the list of available calculatable benefits in the BEST Tool are as follows:

- **Environmental**
    - *Air Quality* – Improvement in air quality due to creation of vegetative areas (e.g. streetscape bioretention rain garden features) and planting of trees
    - *Biodiversity* – Addition to the biodiversity of local and regional ecosystems
    - *Carbon Sequestration* – Carbon removal due to the planting of trees
    - *Groundwater Recharge* – Contribution to the replenishment of local groundwater aquifers through the increase in permeable land and net infiltration
- **Socio-Economic**
    - *Amenity* – Resident views over enhanced public space
    - *Health* – Providing resident views over new green spaces
    - *Building Cooling* – The reduction in internal building heat through the insulating effect of living roofs
    - *Building Heating* – The maintenance of internal building heat through the insulating effect of living roofs
    - *Noise Reduction* – Reduction in external noise through the insulating effect of living roofs

3.1.1.1 Assumptions

The key assumptions applied to the process of evaluating BEST monetised benefits are shown in Table 3.

Benefit	Values Defined	Assumptions
Air Quality	Area of other intervention *(i.e. area of green space created)*	Set to surface area specified
	Tree type (small)	-
	Tree type (medium)	-
	Tree type (large)	-
Biodiversity	Changes to biodiversity and ecology land use / type	Intervention type set to 'Improved grassland'
Carbon Sequestration	Deciduous - Small	-

Benefit	Values Defined	Assumptions
	Deciduous – Medium	-
	Deciduous – Large	-
Groundwater Recharge	Additional amount of groundwater (m³/s)	m³/yr, adjusted to replicate annual London rainfall (SAAR 557mm)
Amenity	Public open green space enhancement	Specified assumption of number of residents in proximity to SuDS feature, varying depending on size
Health	Est. No. adults having view of green space	Specified assumption of number of residents in proximity to SuDS feature, varying depending on size
Building Cooling	Annual number of heating degree days	-
Building Heating	Annual number of cooling degree days	-
Noise Reduction	Noise level before Noise level after	-

Table 3 – BEST Benefit Derivation Variables & Assumptions

3.1.2 Non-BEST Benefits

Several additional socio-economic benefits were identified during Project Steering Group (PSG) consultations, which were not included in the BEST tool or accounted for in Stage 1. The benefits identified are shown below, while an overview of how they were derived is provided in Sections 3.1.2.1 to 3.1.2.3.

- **Property Value** – Incidental increase in property value resulting from the improvement in streetscape visual appeal and perceived environmental value
- **Traffic Calming** – Reduction in accidents by using SuDS to create traffic calming measures (update of Stage 1 calculation)
- **Urban Cooling** – Contribution to reducing the severity of the urban heat island effect by increasing the proportion of green space (increasing the effective albedo of urban areas)

3.1.2.1 Property Value

The derivation of property value increase associated with streetscape SuDS utilises information from a number of sources, including The Economic Value of Green Infrastructure (2008)[3], The evidence base for the Mayor's Housing Strategy (2015)[4], Foxtons estate agents, and the Office for National Statistics (ONS).

This calculation required the definition of a zone of influence, defining the effective spatial extent that any of the benefits of an individual SuDS feature extent. Combining this with average property density and valuation figures enabled to derivation of benefit per m² of SuDS feature implemented.

The derivation of property value is outlined in Table 2.

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[3] http://www.greeninfrastructurenw.co.uk/resources/The_Economic_Value_of_Green_Infrastructure.pdf
[4] https://www.london.gov.uk/sites/default/files/housing_in_london_2015.pdf

Attribute / Assumption	ID (for calculation)	Value	Source	Calculation
% Increase property value (split into property type)	A	0.6-4.7%	The Economic Value of Green Infrastructure / ONS statistics	-
% split of property type	B	-	The evidence base for the Mayor's Housing Strategy	
Weighted net % property value increase	C	1.3-2.9%	-	A x B
Average property value (split into Camden, Westminster & Southwark)	D	£1.2-1.4m	Foxtons estate agents	-
Average property value increase	E	£15-40k	-	C x D
SuDS influence 'zone of influence'	F	0.04 p/m^2		
Occupancy rate	G	2.47	The London Plan	
Residential property density (within zone of influence)	H	0.02 prop/m^2		F / G
Adjustment factor (accounting for distributed nature of SuDS along streetscape)	I	30%	-	-
Value increase per m^2	J	£78-213	-	(E x H) x I
Catchment-scale adjustment factor	K	10-50%	-	-
Net property value increase per m^2 SuDS	-	£8-106	-	J x K

Table 4 – Derivation of Property Value Increase Generated from Streetscape SuDS

3.1.2.2 Traffic Calming

For Stage 2, the calculation was based on national reported incident statistics and traffic figures (vehicle km travelled) for Camden, Westminster and Southwark. This approach enabled the accounting for actual traffic figures, rather than just national accident statistics.

The derivation of traffic calming value is outlined in Table 5.

Attribute / Assumption	ID (for calculation)	Value	Source	Calculation
No. Accidents involving slight injury	A	171,000	House of Commons	
No. Accidents involving serious injury	B	23,000	House of Commons	
Total study area vehicle km travelled	C	1.95b km		
Total UK vehicle km travelled	D	528b km		
Study area proportion	E	0.4%		C / D

Attribute / Assumption	ID *(for calculation)*	Value	Source	Calculation
Accidents classed as 'slight'	F	3,259	ONS Statistics (2014)	
Accidents classed as 'serious'	G	258	ONS Statistics (2014)	
Total road length in study area	H	1,008 km	ONS Statistics	
Slight accidents per road length (m)	I	0.0032	-	F / H
Serious accidents per road length (m)	J	0.0003	-	G / H
Slight accidents per road length (m) per 50 yr	K	0.16	-	I x 50
Serious accidents per road length (m) per 50 yr	L	0.01	-	J x 50
Est. reduction factors (%)	M	20-60%	-	
Slight accident per road length (m) per 50 yr benefit		0.03-0.1	-	K x M
Serious accident per road length (m) per 50 yr benefit		0.003-0.008	-	L x M

Table 5 – Derivation of Traffic Calming Value Generated from Streetscape SuDS

The calculated accident benefit per road length values are multiplied by the average length of Streetscape SuDS features to derive traffic calming value per SuDS feature, then converted to m^2 unit benefit values.

3.1.2.3   Urban Cooling

Accounting for the urban heat island effect was based on DEFRA figures presented in the Scoping UK Urban Natural Capital Account report (2018), which provide an estimate of the annual value of cooling from greenspace split into:

- Annual value from avoided labour productivity
- Annual value from air conditioning savings

3.2   Accounting for Uncertainty

For Stage 2 it was decided that uncertainty would be accounted for using three bands (lower, central and upper) to bound the expected range of benefits. These bands have been calculated in several different ways, as shown in Table 1.

For those benefits derived in the BEST tool the quantity and valuation assumptions were used to calculate the three values (Lower - 25% / Central – 50% / Upper – 75%).

Benefit	Calculation
Air Quality	Derivation of valuation using the quantity and valuation assumptions in the BEST Tool
Biodiversity	Derivation of valuation using the quantity and valuation assumptions in the BEST Tool
Carbon Sequestration	Derivation of valuation using the quantity and valuation assumptions in the BEST Tool
Groundwater Recharge	Derivation of valuation using the quantity and valuation assumptions in the BEST Tool

Amenity	Derivation of valuation using the quantity and valuation assumptions in the BEST Tool
Health	Derivation of valuation using the quantity and valuation assumptions in the BEST Tool
Building Cooling	Derivation of valuation using the quantity and valuation assumptions in the BEST Tool
Building Heating	Derivation of valuation using the quantity and valuation assumptions in the BEST Tool
Property Value	Upper and lower estimates were derived from the average land values across all three London boroughs, estimated value increases, and included an adjustment factor (accounting for the valuation estimates being associated with strategic SuDS features)
Noise Reduction	Derivation of valuation using the quantity and valuation assumptions in the BEST Tool
Traffic Calming	Derivation of valuation using the quantity and valuation assumptions in the BEST Tool
Urban Cooling	Upper and lower estimates were calculated as +/- 35% of the central estimate

Table 6 – BEST Benefit Derivation Variables & Assumptions

3.3 Defined Valuation

The derived natural capital figures are shown in Table 7.

SUDS Feature Type	Uncertainty Band	Air Quality (m²)	Amenity	Biodiversity & Ecology (m²)	Building Temperature (Cooling) (m²)	Building Temperature (Heating) (m²)	Carbon Sequestration (per tree)	Groundwater Recharge (m³/yr)	Health View over green space (per person)	Noise (per property)	Property Value	Traffic Calming	Urban Heat Island (Cooling)
Streetscape Bioretention	Lower	£0	£13	£0	-	-	£0	£0	£31	-	£8	£370	£8
	Central	£1	£53	£0	-	-	£2	£4	£267	-	£57	£987	£16
	Upper	£3	£131	£0	-	-	£7	£14	£926	-	£106	£3,332	£23
Living Roofs	Lower	£0	£8	£0	£0	£1	-	-	£2	£3	-	-	£8
	Central	£1	£33	£0	£2	£4	-	-	£13	£11	-	-	£16
	Upper	£3	£75	£0	£5	£12	-	-	£42	£25	-	-	£23
New Street Trees	Lower	£1	-	-	-	-	£1	£0	£1,179	-	£78	£270	£60
	Central	£7	-	-	-	-	£6	£4	£2,358	-	£571	£719	£141
	Upper	£41	-	-	-	-	£22	£14	£3,537	-	£1,065	£2,426	£256
Street Tree Replacement	Lower	£0	-	-	-	-	£0	-	£118	-	£39	-	£95
	Central	£1	-	-	-	-	£1	-	£236	-	£286	-	£243
	Upper	£8	-	-	-	-	£4	-	£354	-	£532	-	£475
All SuDS Features Average	Lower	£0	£11	£0	£0	£1	£0	£0	£333	£3	£42	£320	£43
	Central	£3	£43	£0	£2	£4	£3	£4	£719	£11	£305	£853	£104
	Upper	£14	£103	£0	£5	£12	£11	£14	£1,215	£25	£568	£2,879	£194

Table 7 – Stage 2 Natural Capital Valuation Figures

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