Blue infrastructure

and how we can use green to manage blue

Jon Rowe CMLI | Design, Engineering, Assurance & Mobility | Sustrans Scotland

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Climate emergency

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1 What is the problem?

CSOs & urban environments

Climate emergency

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What is the problem?

CSOs & urban environments

CSO = Combined Sewer Overflow

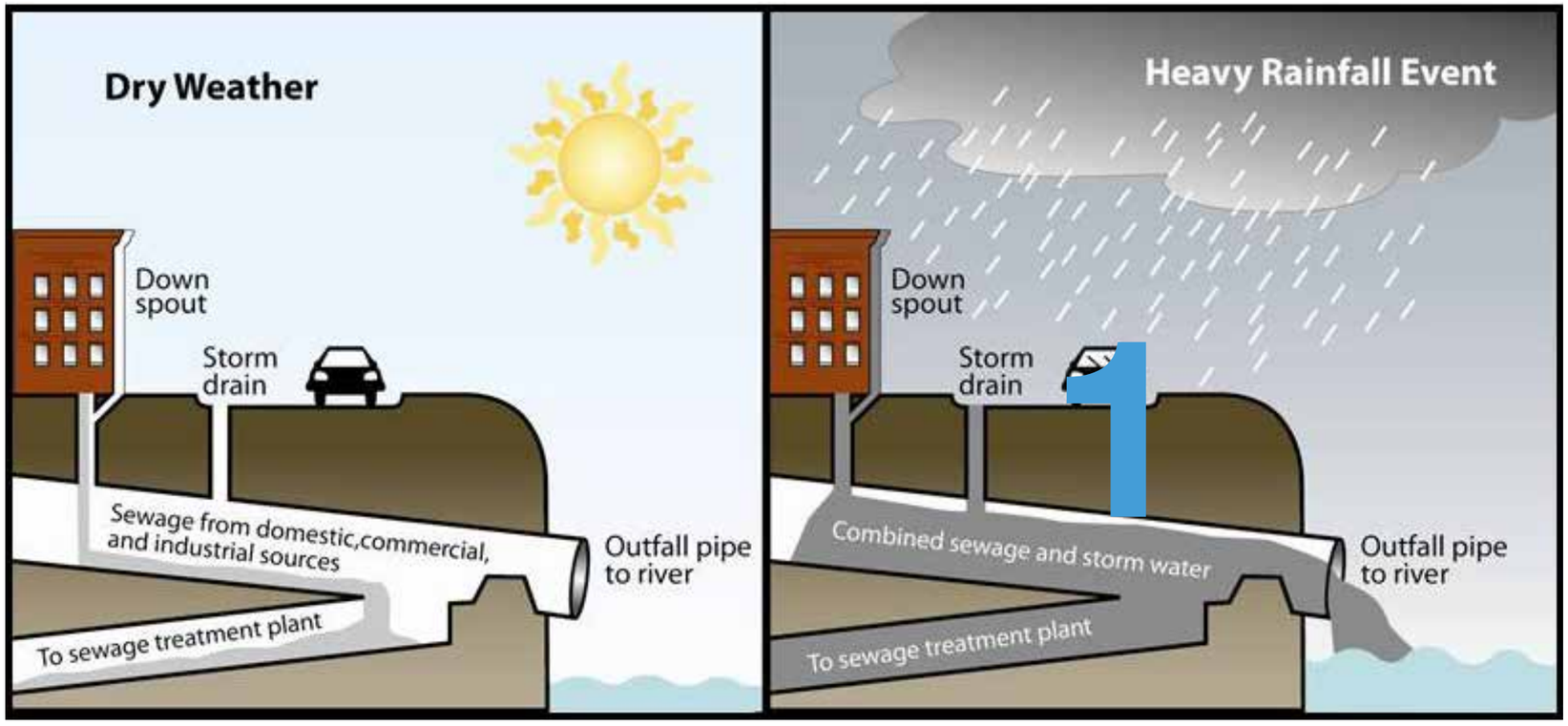

Image credit: Water of Leith Conservation Trust

Image credit: Surfers Against Sewage

“More than 384,000 discharges of raw sewage were reported by water companies across England and Wales in 2022”

Guardian newspaper, 12 September 2023

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What is the problem?

Climate emergency

Some of the predicted changes:

warmer & wetter winters

hotter & drier summers

more frequent & intense weather extremes

Source: www.metoffice.gov.uk/weather/climate-change/effects-of-climate-change

Some of the expected impacts:

- By 2080, the number of **properties at risk** of coastal flooding will **increase by 90%**.
- **Flash floods will occur twice as often** by 2070 as the did in 1990.
- If emissions are high, it's estimated that **by 2050 rainfall in Scotland could increase by up to 42% in winter and 24% in summer**. Our drainage systems could be unable to cope, leading to flooding sudden and severe enough to cause **danger to life**.
- Estimated that **284,000 properties are at risk** of flooding and this is expected to increase by a further 110,000 with climate change by 2080.

Source: www.netzeronation.scot

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Derby following Storm Babet

Source: Christopher Furlong/Getty Images, in The Guardian

2 What is blue infrastructure?

Some definitions

Relationship to green infrastructure

What is blue infrastructure?

Some definitions

European Commission, in reference to Blue Green Infrastructure

> **“A strategically planned network of natural and semi-natural areas with other environmental features, designed and managed to deliver a wide range of ecosystem services, while also enhancing biodiversity.”**
>
> Such services include: water purification, improving air quality, space for recreation, climate mitigation and adaptation

National Planning Framework 4, Scottish Government, p.145

> **“Water environment features within the natural and built environments that provide a range of ecosystem services. Blue features include rivers, lochs, wetlands, canals, other water courses, ponds, coastal and marine areas including beaches, porous paving, sustainable urban drainage systems and raingardens.”**

Basically, we’re looking at:

how we can use green to manage blue

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3 Why is this relevant to active travel?

Policy imperative

Opportunity to do more

Why is this relevant to active travel?

Policy imperative

United Nations 2030 Sustainable Development Goals

SUSTAINABLE DEVELOPMENT GOALS

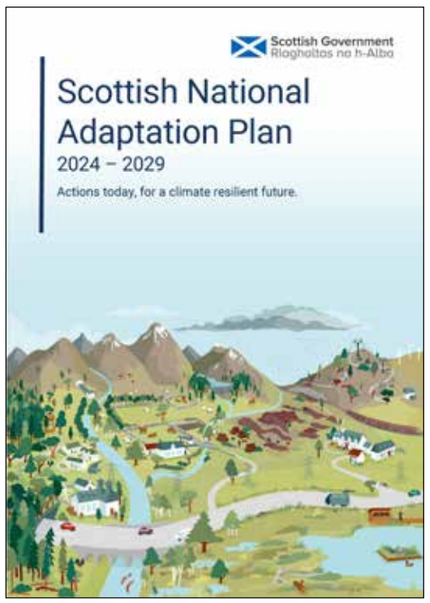
6.3, 6.4, 6.5, 6.A
11.5, 11.B
13.1, 13.2

National Planning Framework 4, 2023
Scottish Government

"Blue and green infrastructure are an integral part of early design and development processes; are designed to deliver multiple functions including climate mitigation, nature restoration, biodiversity enhancement, flood prevention and water management." p.70

Designing Streets, 2010
Scottish Government

"Streets should use appropriate SUDS techniques as relevant to the context in order to minimise environmental impacts" p.13



Scottish National Adaptation Plan, 2024
Scottish Government

An action plan to tackle the challenge.

The Water Environment and Water Services (WEWS) Act 2003 - Scotland
Flood and Water Management Act 2010 - England and Wales

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Why is this relevant to active travel?

Opportunity to do more

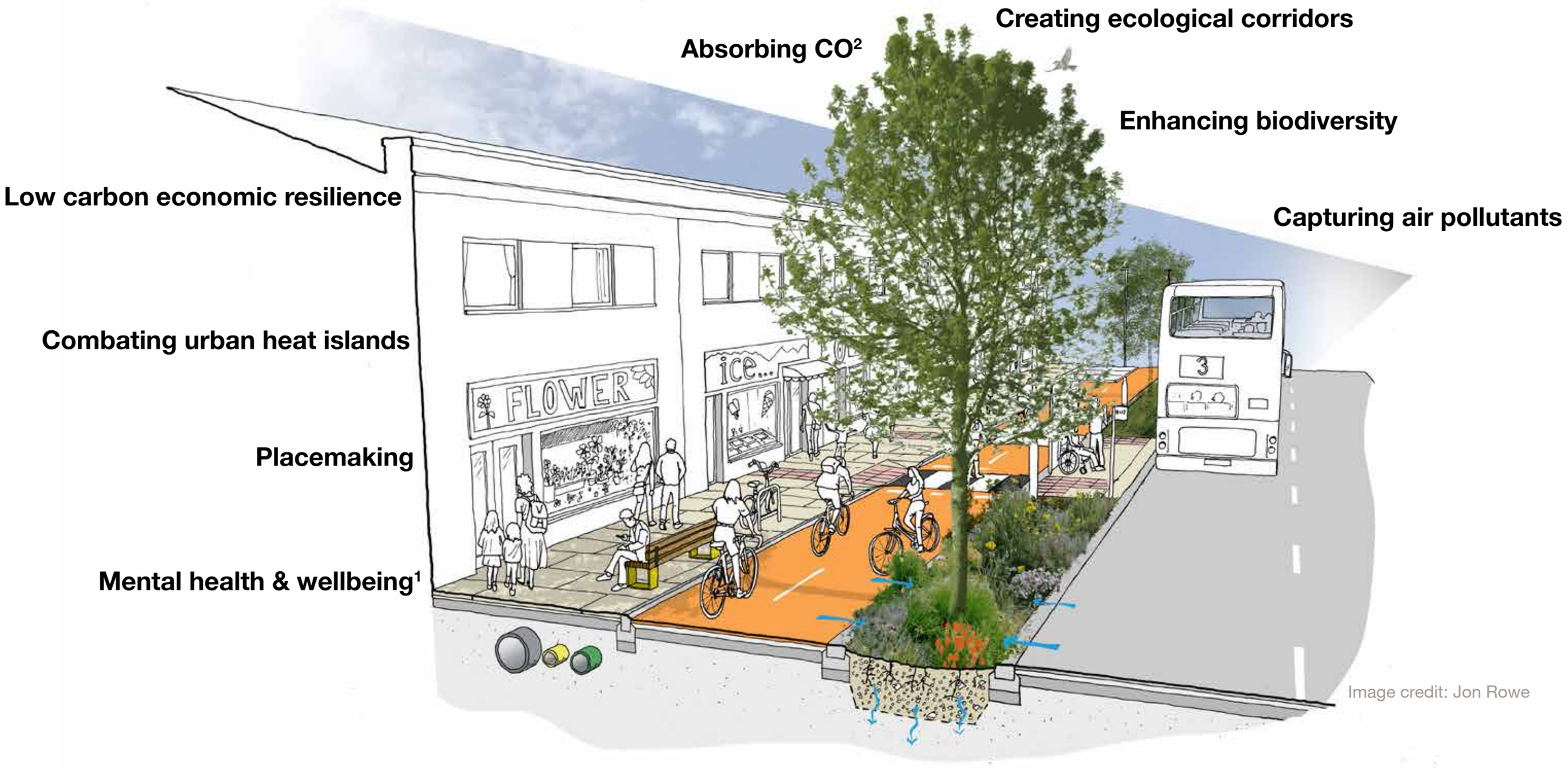

Image credit: Jon Rowe

1. Improving access to greenspace: a new review for 2020, Public Health England, March 2020

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4 What does blue infrastructure look like?

Sustainable drainage systems

Inspiring examples

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What does blue infrastructure look like?

Sustainable drainage systems (SuDS)

Why is it a good thing to do?

- Multiple benefits.

- Lower cost (vs. traditional drainage): maintenance is at the surface.

Basic principles

- Design it in from the beginning.

- Think about how water gets in / out.

- Protect outlets from blocking.

- Provide overflow route.

- Hold back water, slow it down, mimic natural systems!

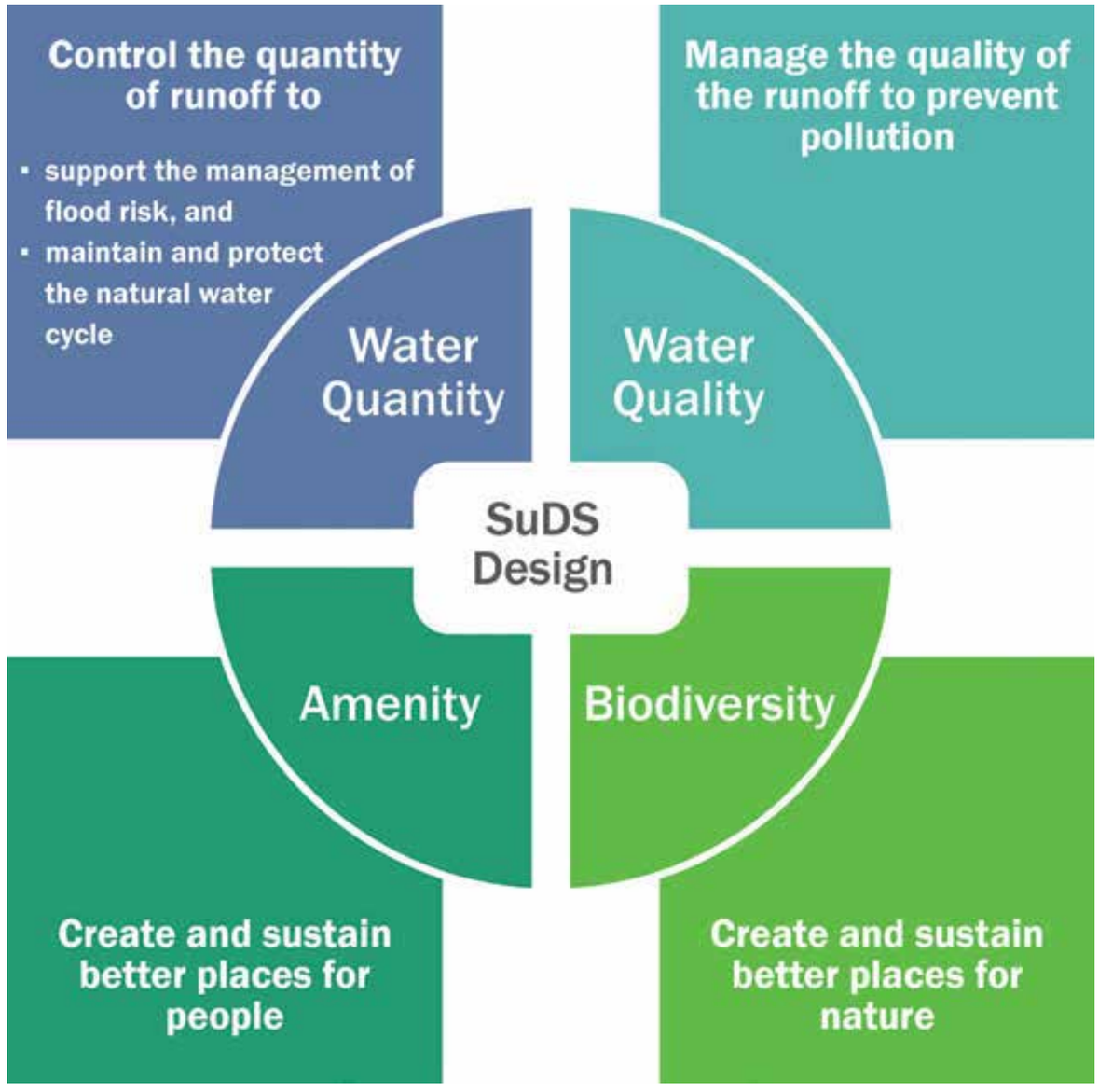

Image credit: CIRIA SuDS Manual 2015, p.6

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What does blue infrastructure look like?

Sustainable drainage systems (SuDS)

90-95% rainfall events are less than 10mm, so addressing ‘just’ those events is very helpful

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What does blue infrastructure look like?

SuDS: surfacing

Self-binding aggregate
Image credit: Jon Rowe

Resin bound aggregate
Image credit: Sustrans

- Handles a lot of volume.
- Maintenance is at surface e.g. sweep joints every 5 years.
- Construction detailing critical: consider volume of water to be held in sub-base (30% porosity) and loading.
- Construction traffic can significantly impact permeability / compaction.

Permeable block paving
Image credit: Jon Rowe

Porous asphalt
Image credit: NYC Department of Transportation

grass, grasscrete.....and more

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What does blue infrastructure look like?

SuDS: bioretention tree pits

Image credits: left - Green Blue Urban, right - Sustrans

- Great opportunity: SuDS, CO^2 capture, air quality and solar shading, biodiversity.

- Biggest cause of tree deaths is lack of soil volume: single tree needs 20-30m^3 of growing medium.

- Construction detail critical: 25% void space to provide 5-7.5m^3 attenuation.

- In raingardens, in particular, species choice is really important: tolerance of occasional inundation and leaves that break down easily.

“Bioretention is the process in which contaminants and sedimentation are removed from stormwater runoff.”

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Light Air Water Nutrients

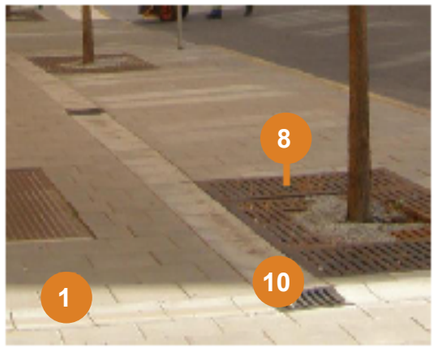
What does blue infrastructure look like?

SuDS: bioretention tree pits

Stockholms stad

Structural Soil

A method for building with stability and to create good growing conditions for trees in paved areas with the use of stormwater and the added value of decreasing the risk roots damaging paving or underground pipes.



1 Paved surface with dished stormwater gutters
2 Geotextile
3 Levelling layer (crushed rock 8-16mm) - also used for concrete bunker and waterfair inlet
4 Aerated bearing layer (crushed rock 32-83mm)
5 Structural soil (crushed rock 100-150mm) with planting soil hosed into the structural volume
6 Concrete bunker
7 Surface grid / tree grille
8 Planting soil
9 Inlet for air and water supply

Light Air Water Nutrients

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What does blue infrastructure look like?

SuDS: bioretention raingardens

- Reduce run-off rates and volumes.

- Treat pollution (through use of engineered soils and vegetation).

- Attractive, useful spaces that are self-irrigating.

- Provide habitat and biodiversity.

- Cooling of local micro-climate due to evapotranspiration.

- Spend most of their time dry.

Image credits: left & top-right - Jon Rowe, bottom-right - Arup

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What does blue infrastructure look like?

SuDS: bioretention raingardens

For planting, **consider**:

- Generally herbaceous perennials and grasses.

- Trees and shrubs for larger areas (noting trees to avoid!).

- Native species usually preferable, but urban context may necessitate non-native.

- Weeds = heroes = resilience

- Leaf size and density influences usefulness in capturing air pollutants.

For trees in raingardens, some species to **consider**:

- Birch
- Hornbeam
- Yellow Buckeye
- Hop Hornbeam
- Alder
- Lime
- Ginkgo
- Liquidambar
- Field Maple

...and some to **avoid**:

- Plane
- Beech
- Sycamore
- Indian Bean Tree

Source: CIRIA Designing SuDS course

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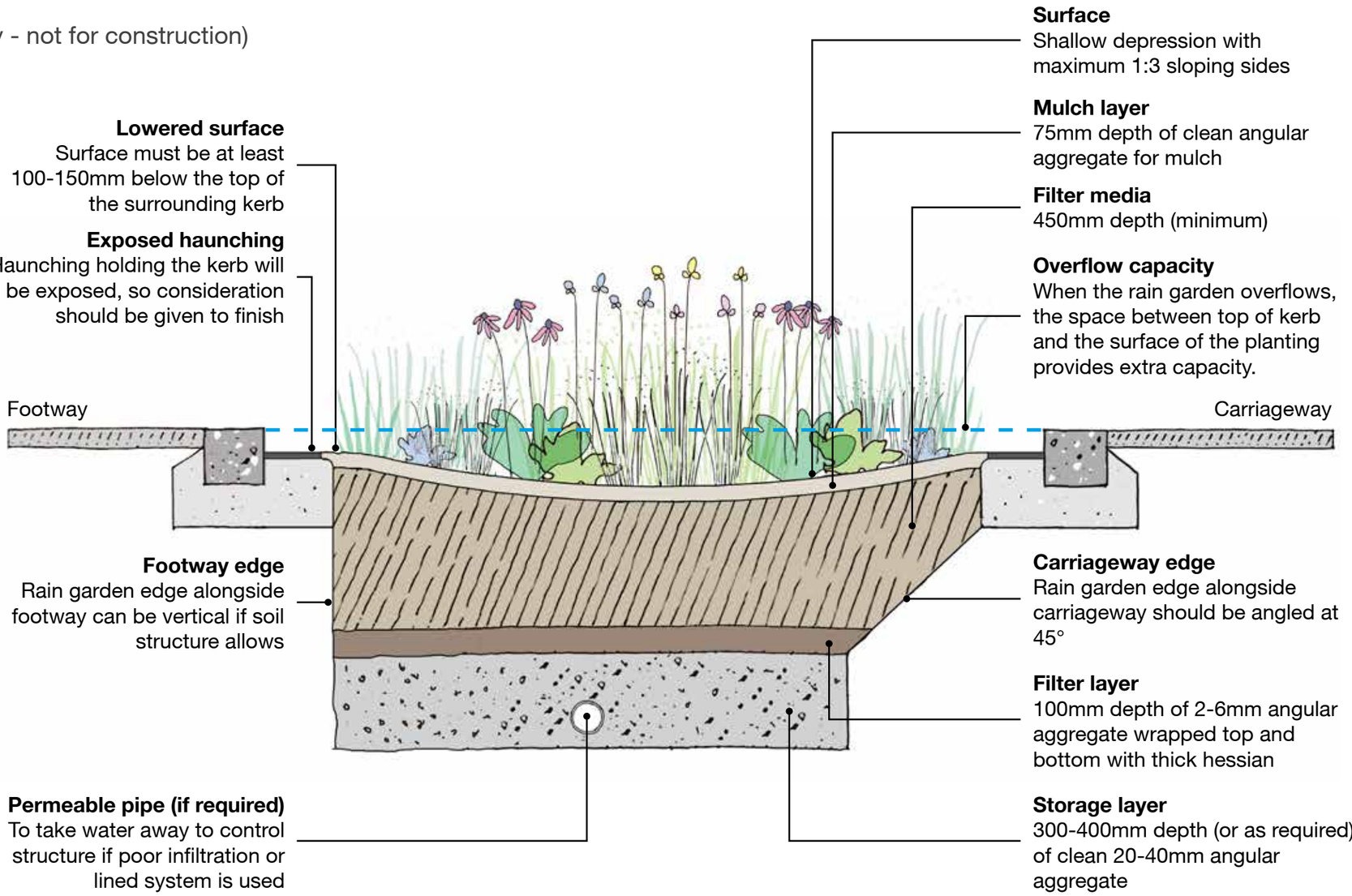
What does blue infrastructure look like?

SuDS: bioretention raingardens

Example cross-section:

(illustrative purposes only - not for construction)



Note: the rain garden also needs to consider what happens if total capacity is exceeded (not shown above).

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What does blue infrastructure look like?

SuDS: bioretention raingardens

Detail is **really** important!

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Grey to Green, Sheffield

Client Sheffield City Council
Landscape architect Sheffield City Council with Robert Bray Associates, planting design by Nigel Dunnett and Zac Tudor

Image credit: Nigel Dunnett

"**24,000 bathtubs**' worth of water is prevented from entering Sheffield's sewage treatment works each year by the sustainable drainage built into these planting beds."

Phase 2 shows a **561% increase in biodiversity** value when assessed using the BREEAM calculator.

Source: https://www.greytogreen.org.uk/

Avenues, Glasgow

Client Glasgow City Council
Landscape architect Urban Movement

Image credit: Jon Rowe

Greener Grangetown, Cardiff

Client City of Cardiff Council, Dwr Cymru Welsh Water, Natural Resources Wales (Cyfoeth Naturiol Cymru)
Landscape architect Arup

Image credit: Sustrans

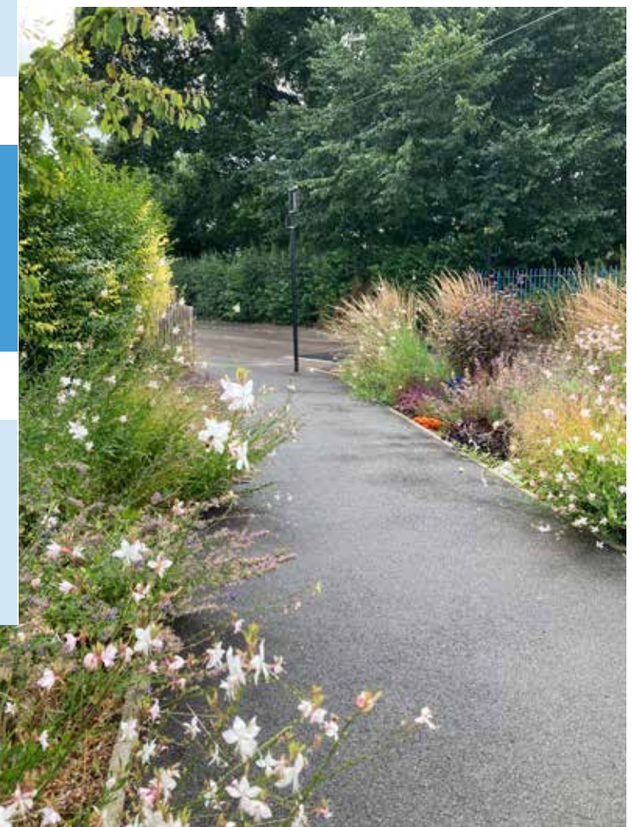
"The scheme....demonstrates a different approach to managing our natural resources - one that looks at the **whole picture** rather than focusing on single solutions or individual parts of our environment. Not only does this scheme contribute to a healthy and resilient local environment, it also supports economic and social prosperity"

Martyn Evans, Senior Policy Advisor, Natural Resources Wales

Enfield, London

Client Enfield Council
Landscape architect Enfield Council

Image credit: Sustrans



Easter Bush Campus

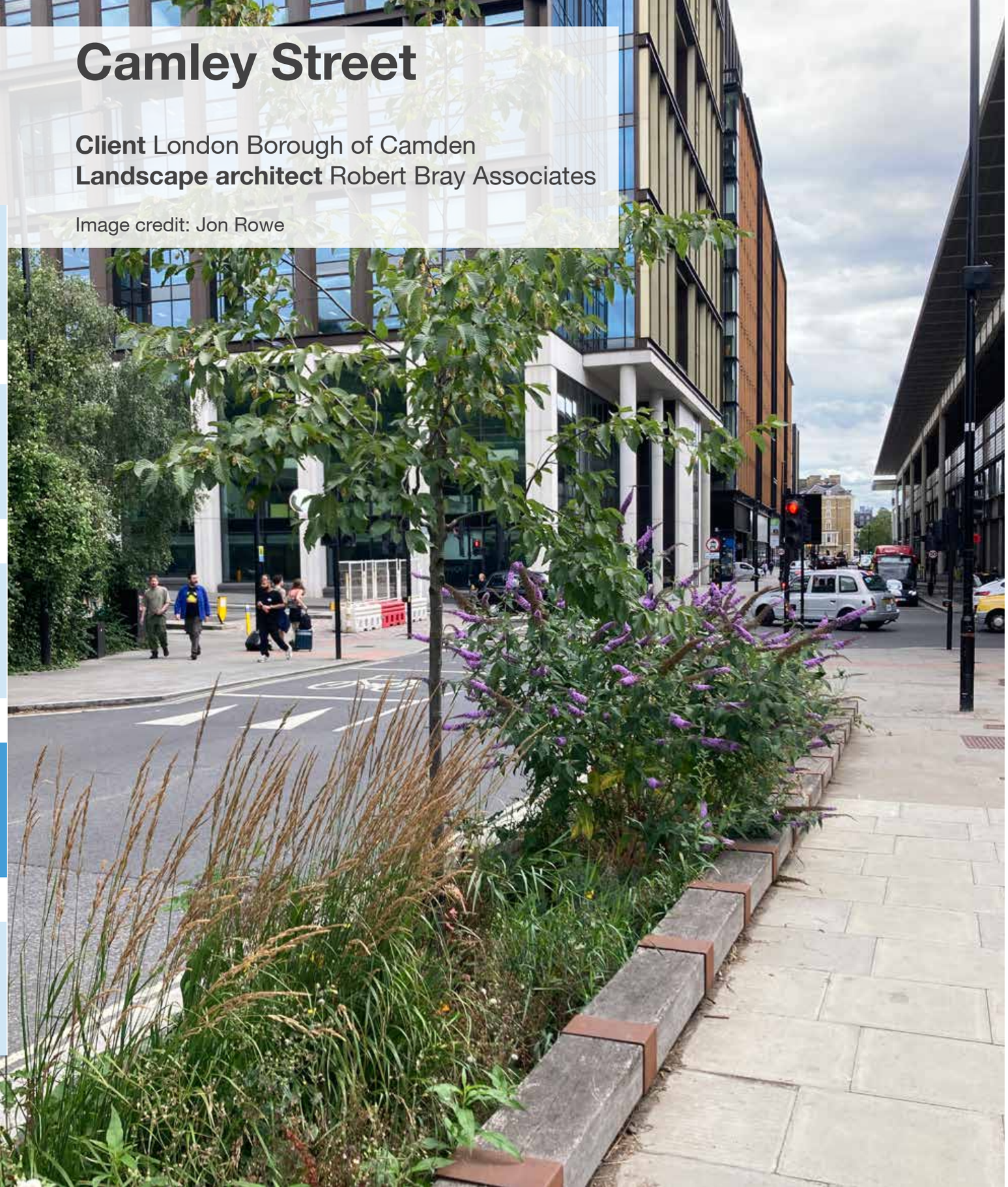
Client University of Edinburgh
Landscape architect Wardell Armstrong

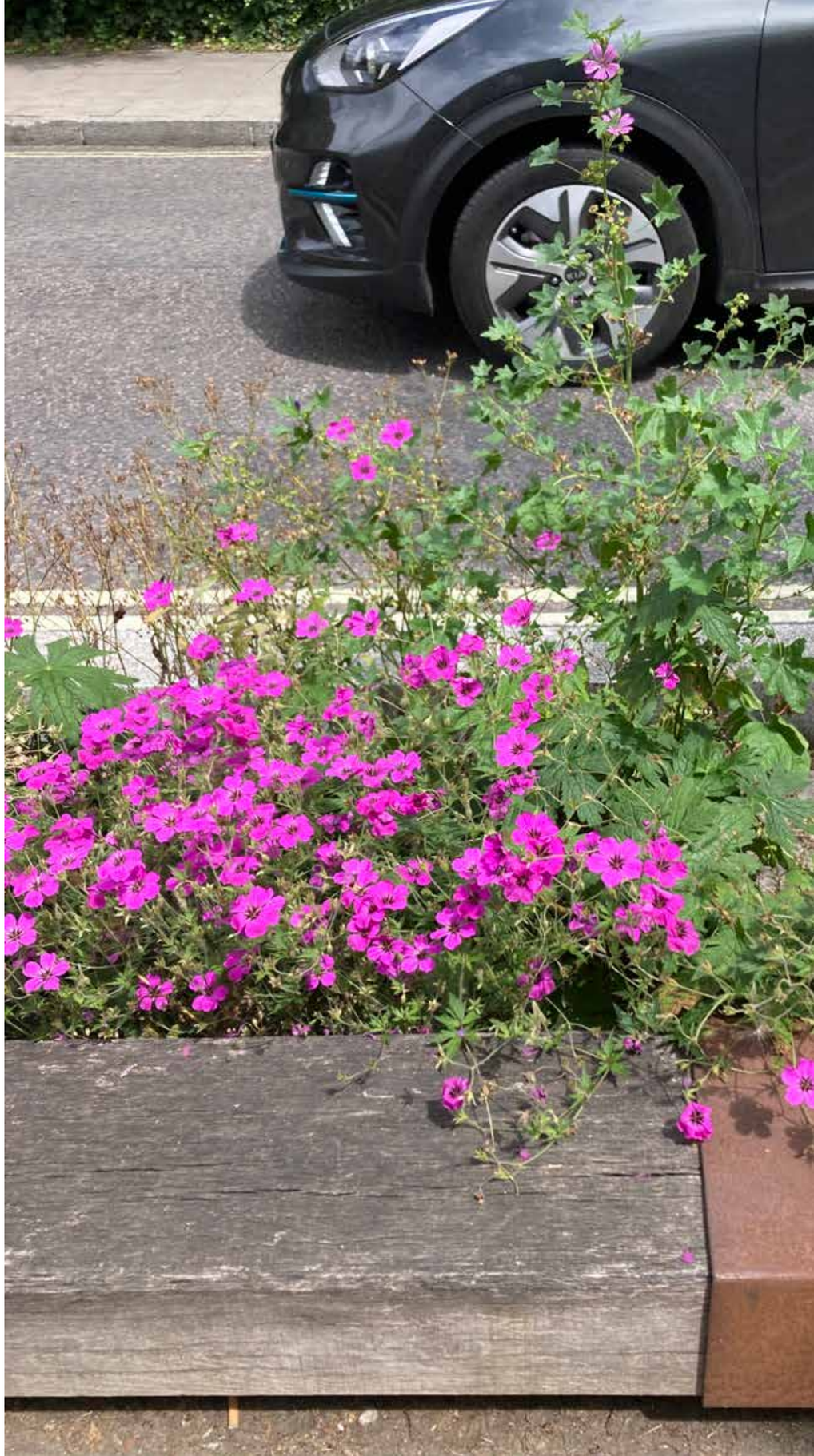
Image credit: Jon Rowe

Camley Street

Client London Borough of Camden
Landscape architect Robert Bray Associates

Image credit: Jon Rowe





Stobswell

Client Dundee City Council
Landscape architect Dundee City Council

Image credit: Dundee City Council

5 How do you get it built?

Potential barriers

Solutions

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How do you get it built?

Potential barriers

1 Funding objectives

2 Project team composition

3 Maintenance

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How do you get it built?

Solutions

1 Funding objectives

Encourage project partners to align/amalgamate funding sources > deliver multiple benefits.

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2 Project team composition

“...it is important that, where appropriate, an interdisciplinary team including planners, landscape architects, architects and drainage engineers should work together from the outset.”

CIRIA SuDS Manual, p. 19.

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3 Maintenance

Think creatively. Deal in fact not assumption.

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Further information

Information, case studies, guidance
https://www.susdrain.org/

Good introduction to blue infrastructure in urban areas
https://www.tdag.org.uk/first-steps-in-urban-water.html

Tools for the design and evaluation of Sustainable Drainage Systems (SuDS)
https://www.uksuds.com/

CIRIA SuDS Manual: a fantastic resource
https://www.ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductCode=C753

Landscape Institute article
https://issuu.com/landscape-institute/docs/pioneering_the_park_of_the_future_-_autumn_2023/44

Sheffield case study
https://www.greytogreen.org.uk/

UN Sustainable development goals
https://www.un.org/sustainabledevelopment/

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