Evidencing the Benefit-cost Value of Blue-Green Infrastructure Retrofit across London to Catalyse Greater Investment in Sustainable Drainage

4.6 Economic Valuation of Hybrid Infrastructure

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The Presenter

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The Importance of Retrofit Blue-Green Infrastructure (BGI)

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Pressures on Traditional Drainage Systems

Urbanisation & growth

Climate change

Affordability of replacement

Public perceptions & expectations

Drive to 'green' of our cities

- Low-carbon economies
- Climate change
- Biodiversity
- Social equality
- Air quality
- Improved mobility
- Mental welfare

The economic viability of capital investments in buried infrastructure in the face of climate change and growth is diminishing, along with the resiliency of our urban drainage systems.

BGI represents a diversification of drainage technologies, directly analogous to changes happening within the energy sector, aimed at reducing our unsustainable reliance on fossil fuels

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The Importance of Retrofit Blue-Green Infrastructure (BGI)

A recent white paper inferred that:

"at the current measured rate of replacement a new wastewater pipe installed today would need to last over 500 years before it is replaced. This clearly is unsustainable and highlights a potential major underlying problem in UK."

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The Importance of Retrofit Blue-Green Infrastructure (BGI)

What is Retrofit BGI?

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What is Retrofit BGI?

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Why Retrofitting is More Important as Sustainable Development

Why ‘Retrofitting’ is More Important than Sustainable Development

National SuDS Policies

Ministry of Housing, Communities & Local Government

Development locations

Time & rate of development

Development covers >0.01% urban area in UK (per year)

BGI retrofit creates an opportunity for incremental investment in a scalable & adaptable flood risk strategy.

BGI retrofit also provides a valuable engineering cornerstone to help address the progressive impacts of climate change and increased likelihood of complex and prolonged socio-environmental crises.

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The Financial Challenge Facing London

The Financial Challenge Facing London

Broad recognition that for many places the only practical opportunity to reduce flood risk in many places is the retrofit of small-scale BGI features at a neighbourhood / community level – 'Surface Water Management Plans (SWMP)'

Drivers:

- Constraints on public realm space *(narrow streets and busy public green spaces)*
- Government funding mechanisms can be ineffectual *(SuDS measures rarely deliver the necessary magnitude of benefit)*
- Uncertainty over CAPEX / benefits *(perceived to by risky investment)*

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The Financial Challenge Facing London

Addressing these issues:

- Demonstrating the return-on–investment (ROI) value at a catchment scale
- Accounting for the whole value of BGI = flood damage benefits + natural capital
- Developing scalable and non-catchment specific methods to evaluate cost-benefit and ROI
- Engagement of wider community of stakeholders and investors, incentivized through proving natural capital value

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The Projects

The Projects

Arcadis collaborated with Thames Water, the Environment Agency, Transport for London and several London Borough Councils to understand the financial benefits embodied by a long-term commitment to retrofitting BGI, providing an 'evidence base' as a catalyst for incentivising more robust and sustainable investment streams

Project Aim:

'To demonstrate that the strategic long-term delivery of small-scale retrofit SuDS features across London would be a robust, investable and, sustainable approach to mitigate current and future flooding'

Primary Project Objectives:

- Develop technical workflow to effectively and accurately evaluate flood risk benefits
- Calculation of associated natural capital value
- Evaluate eligibility for government funding within current mechanisms
- Explore options to more effectively enable investment in future BGI
- Develop robust financial case for long-term investment in BGI

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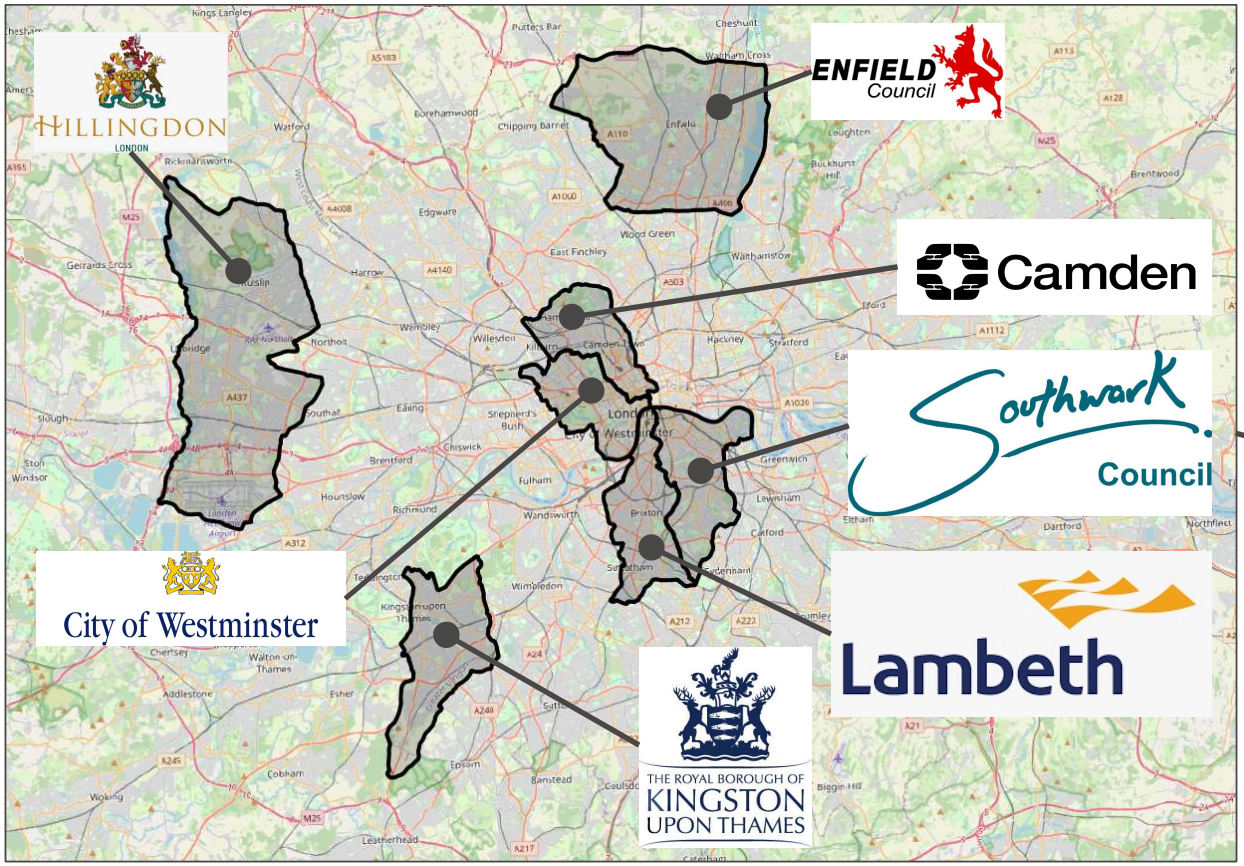
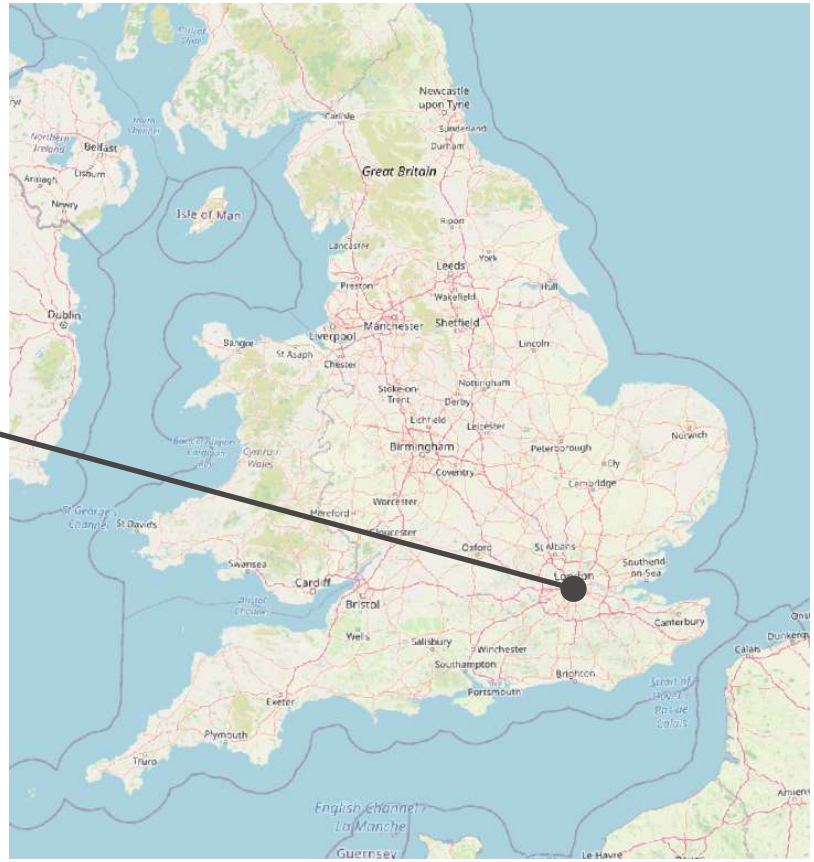
The Projects





Identifying BGI Opportunities

Identifying BGI Opportunities

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The Effective use of Hydraulic Network Modelling

The Effective use of Hydraulic Network Modelling

InfoWorks ICM

1D-2D Modelling

- Sewers
- Highway drainage
- Surface runoff
- Infiltration
- Land use
  - *Complex to build*
  - *Accurate*
  - *Long simulation times*

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The Effective use of Hydraulic Network Modelling

1D-2D Modelling

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The Effective use of Hydraulic Network Modelling

InfoWorks ICM

1D-2D Modelling	2D Modelling
• Sewers • Highway drainage • Surface runoff • Infiltration • Land use	• Surface runoff • Infiltration • Land use
○ *Complex to build* ○ *Accurate* ○ *Long simulation times*	○ *Simple to build* ○ *No network connections* ○ *Medium simulation time*

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The Effective use of Hydraulic Network Modelling

2D Modelling

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The Effective use of Hydraulic Network Modelling

InfoWorks ICM

1D-2D Modelling	2D Modelling	1.5D Modelling
• Sewers • Highway drainage • Surface runoff • Infiltration • Land use	• Surface runoff • Infiltration • Land use	• Sewers • Highway drainage • Surface runoff
○ *Complex to build* ○ *Accurate* ○ *Long simulation times*	○ *Simple to build* ○ *No network connections* ○ *Medium simulation time*	○ *Represent all networks* ○ *Short simulation times*

Minimum modelling requirements:

- Enable large-scale assessment of SuDS opportunities
- Suitable for running extensive 'scenarios' to identify optimal strategies
- Conceptual representation of BGI sites provide reasonably accurate predictions for floodwater storage

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The Effective use of Hydraulic Network Modelling

1.5D Modelling

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Deriving Economic Value

Deriving Economic Value

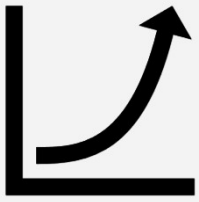
Demonstrating the inherent value of nature-based solutions can be an effective catalyst to unlocking robust and diverse sources of funding

1. **Where to invest** – where are the most optimal locations across the catchment?
2. **How much investment is required** – what is the minimum & maximum scale that generates benefit?
3. **Justify its benefit** – can the assessment provide valuable economic information?

Cost

- Construction
- Design
- Maintenance
- Refurbishment

Damages Prevented (benefit)



- Property flooding
- Vehicular damage
- Other

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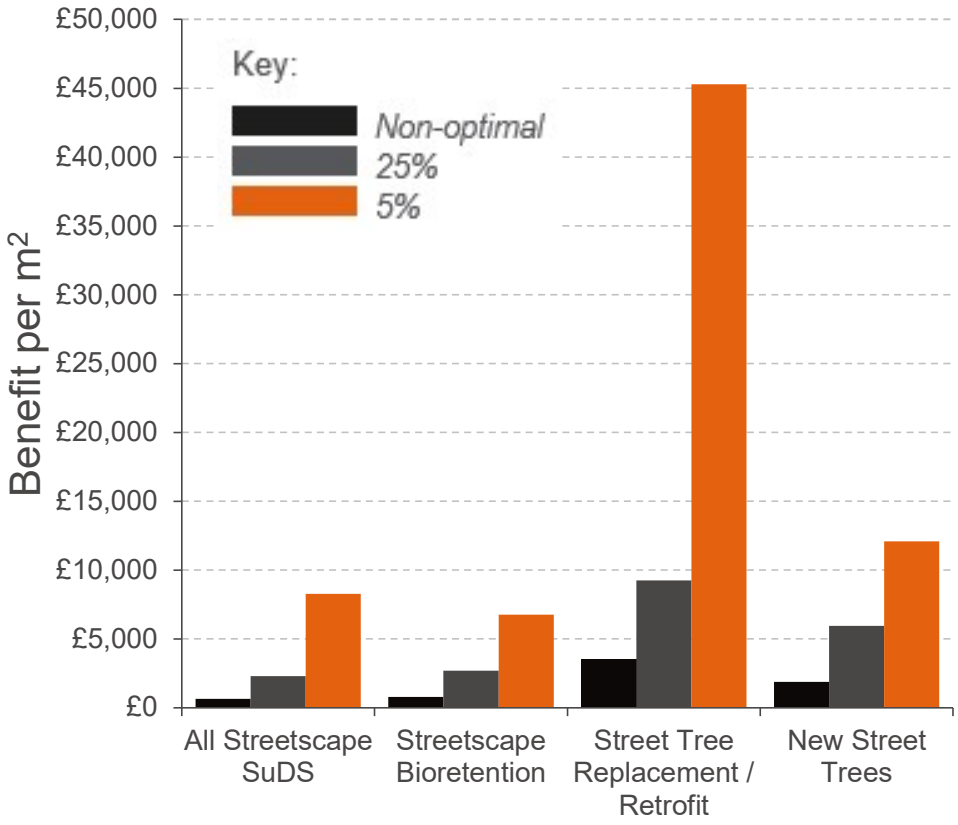
Deriving Economic Value



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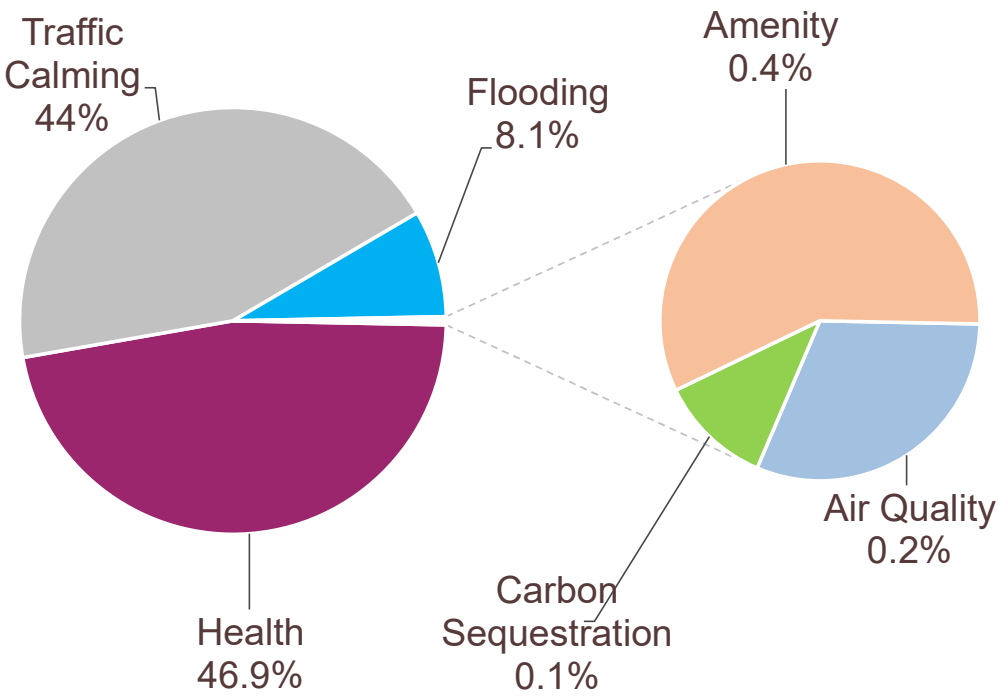
Recognising Natural Capital Value

Recognising Natural Capital Value

- Generated from local case studies
- Incorporated uncertainty ranges
- Derived ‘unit costs’ to allow scalability of assessment



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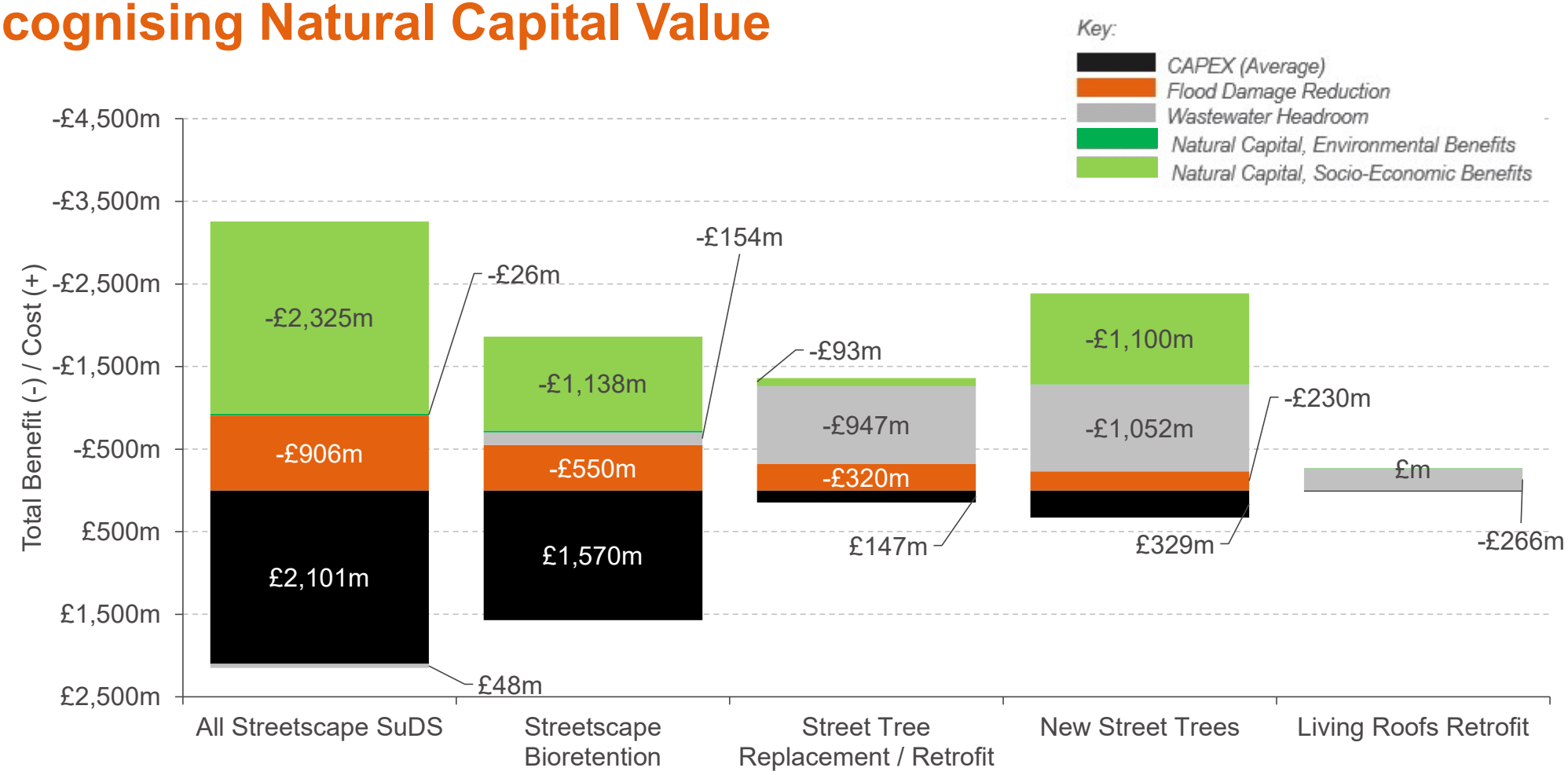
Recognising Natural Capital Value



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Identifying the Optimal Investment

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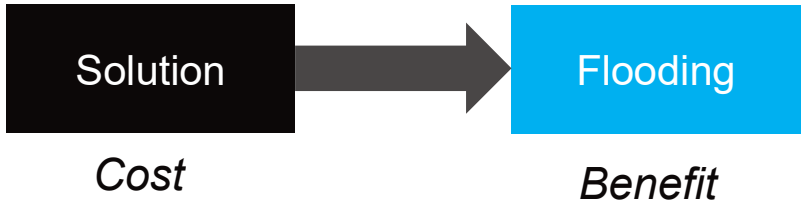
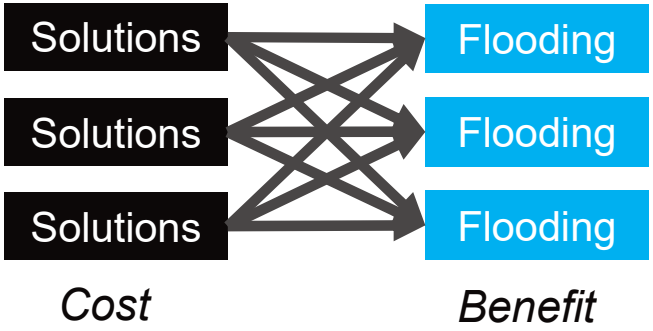
Traditional Drainage Project

Simple Relationship



Retrofit BGI Projects

Complex Relationship



Solution

- Run lots of simulations
- Use random selection of opportunities
- Connect BGI site with all possible benefit locations (i.e. flooding)
- Data analytics to distribute benefit

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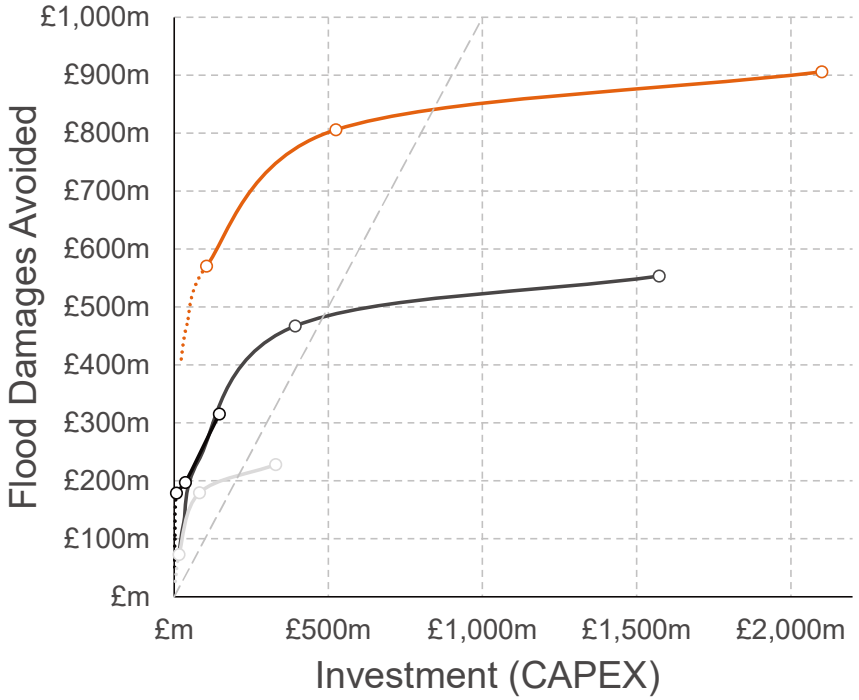
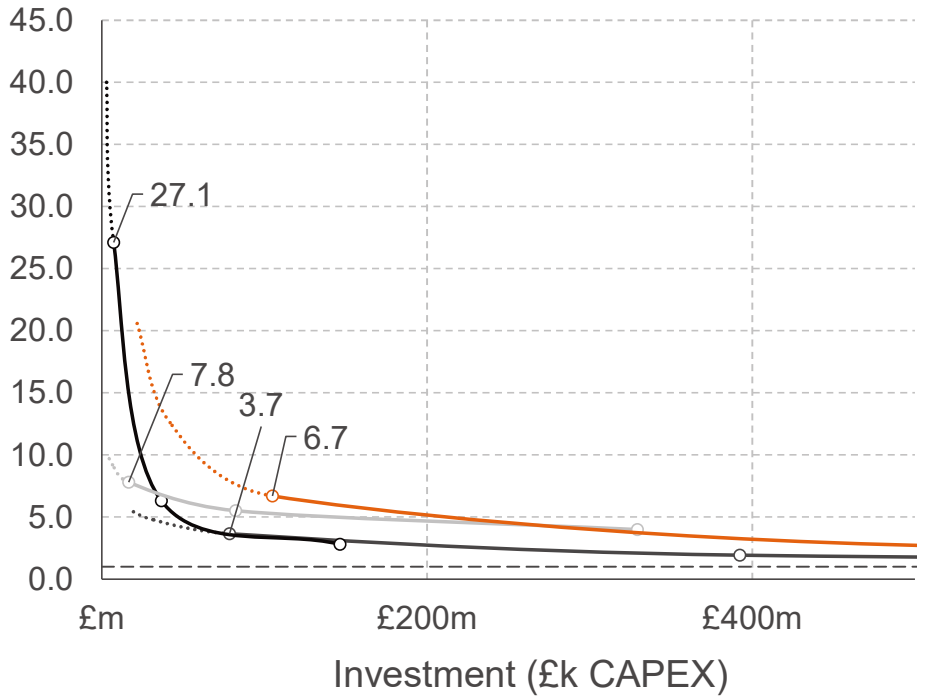
Identifying the Optimal Investment

Flood Damages Avoided



Cost Benefit



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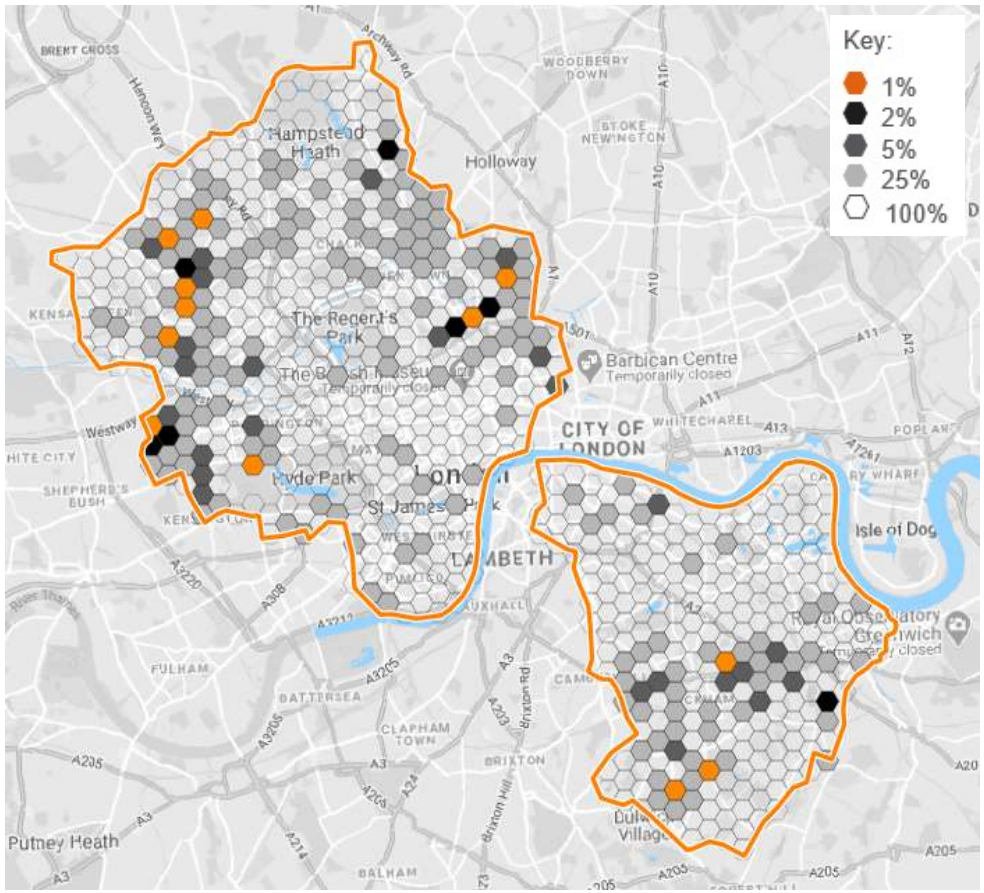
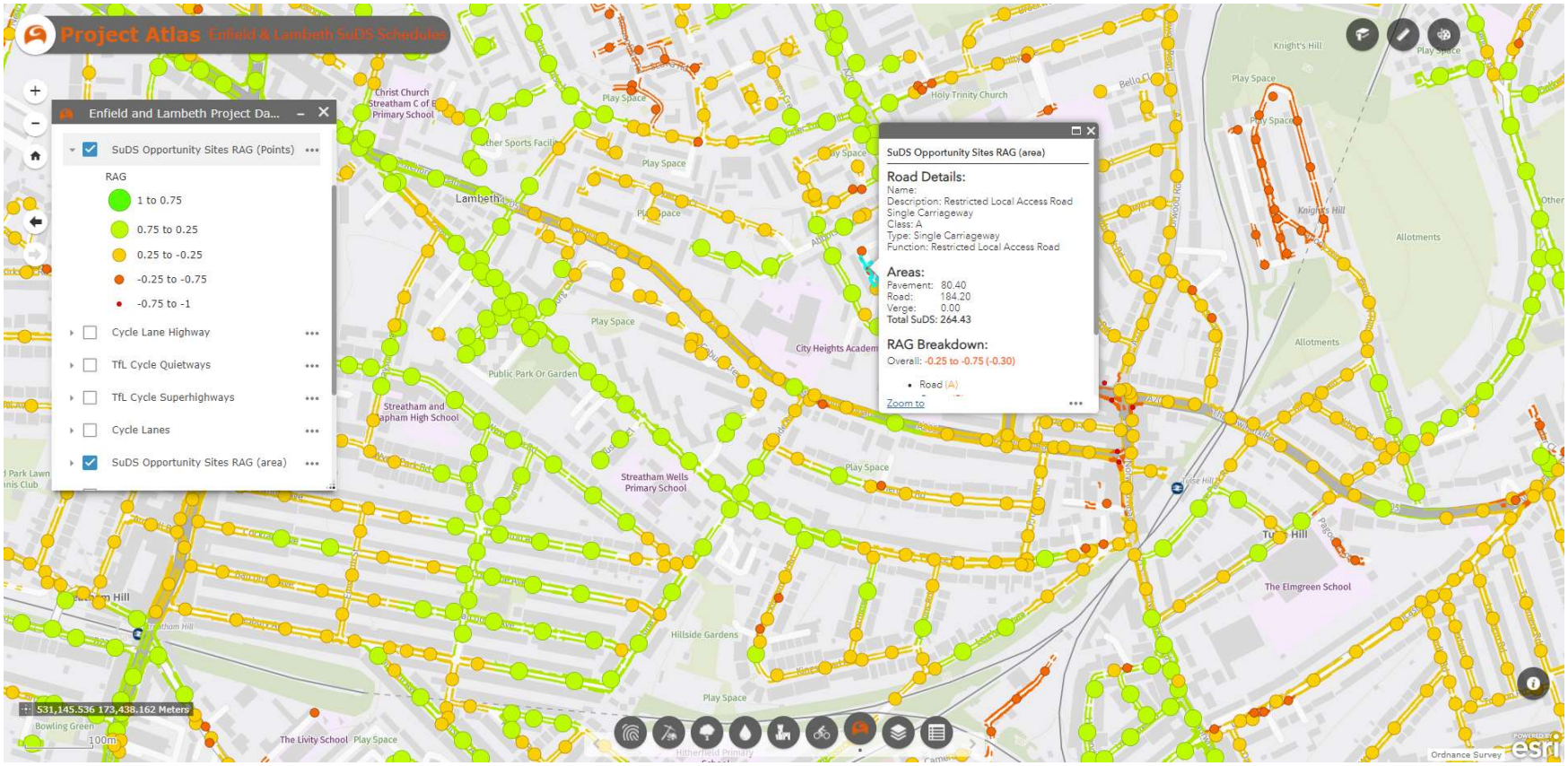
Supporting Funding & Investment

Supporting Funding & Investment



Supporting Funding & Investment



Key Insights of our Work

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- Significance of location on flood mitigation
- Relevance of hydraulic modelling & optimization
- Potential for long-term flood damage reduction
- Can address long-term strategy sewerage capacity challenges
- External contributions will remain key for securing funding
- Realisation of catchment-scale benefit only possible through long-term multi-partner investment
- Natural capital benefits can outweigh flood damage reduction (unless optimized)
- CAPEX cost estimation contains significant uncertainty
- Effectiveness of different BGI approaches

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Key Insights of our Work

SuDS Opportunities *(ordered by most effective SuDS Features)*

Flood Damage Reduction *(proportion of total possible)*

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What Could we Achieve

What Could we Achieve

- Change to government funding mechanisms to account for long-term investment in BGI interventions
- Delivery of BGI through multi-agency investment partnerships
- Sharing awareness of 'value' of BGI to non-infrastructure authorities (inc. Public Health authorities)
- BGI becoming standard design considerations for all highways / public space projects
- Use of BGI to supplement traditional engineering approaches to generate greater resilience to threats
- London to become an exemplar site for BGI retrofit in Europe

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Thanks for Listening

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