





going
green
masterplan

Incorporation with:



UNIVERSITY OF
BIRMINGHAM



West Midlands
NATIONAL PARK



BIRMINGHAM CITY
University

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Introduction

A Manifesto for Going Green

Entering the early 2020s Birmingham faces a diverse range of challenges felt in urban centres across the globe;

- Covid-19 - Effects of the still ongoing pandemic and the slow release of restrictions by the government on employees/visitor confidence to return to inner-city places and their quality of life, businesses and their ability to trade and provide services.
- Decline of Highstreets and UK retail environment, ongoing for years but accelerated by lockdowns and restrictions.
- The exit from the EU and the associated changes around trade and freedom of movement and the impact on businesses and residents.
- Climate change impacts (e.g. flooding, heat-island-effect) and the need to address this via adaption and mitigation measures.
- World-wide loss of biodiversity, natural assets and habitats.
- Health and wellbeing impacts of Birmingham's residents and visitors by air and noise pollution, climate change, inactivity, diet, lack of access to Green Spaces, etc.

Creating a Green Infrastructure Masterplan for the City Core provides the unique opportunity to demonstrate the benefits of GI to play a significant role in addressing these global challenges, but also to reinstate the status of the city centre as a driver of commercial, creative, scientific, political and cultural life that influences way beyond its borders.

Now is the time to build back responsibly and sustainably.

Introduction



FROM MACRO TO MICRO

Key note introduction by
Prof Kathryn Moore

‘Discovering landscape where you thought it couldn’t be, it creates a spatial vision to engage communities and provide a compelling narrative to support convincing actions.’

‘The BIDs in the context of the West Midlands National Park (WMNP)

Written by Prof Kathryn Moore, Director of the West Midlands National Park Lab and Professor at Birmingham School of Architecture and Design of Birmingham City University.

The WMNP is a 30-year vision for a new kind of National Park. An integrated and holistic economic, social and environmental strategy, incorporating all of the land in the West Midlands and all aspects of land use, it is about transformation as much as conservation and preservation; working with local authorities, businesses, schools and communities to build self-confidence and a renewed identity.

The ethos of the WMNP, set out in the WMNP Awards programme, encourages working across silos, disciplines and practices – and beyond red-line ownership boundaries. Discovering landscape where you thought it couldn’t be, it creates a spatial vision to engage communities and provide a compelling narrative to support convincing actions. It integrates regional and local strategies and aspirations to create something that is more than the sum of its parts. It is already inspiring and provoking new ways of thinking across the region.

Mapping and research by the WMNP-Hub reveals the historical and geographical significance of the Colmore BID in Birmingham (fig.1). Located on the elevated, dry sandstone ridge that is the backbone of the city, focused on St Philip’s Cathedral, it is Birmingham’s civic, cultural and commercial heart. Occupying the high ground, the area would have once had a commanding views over three valleys, including the Tame and the Rae, and distant views of the surroundings and horizons including Gravelly Hill, Barr Beacon and beyond.

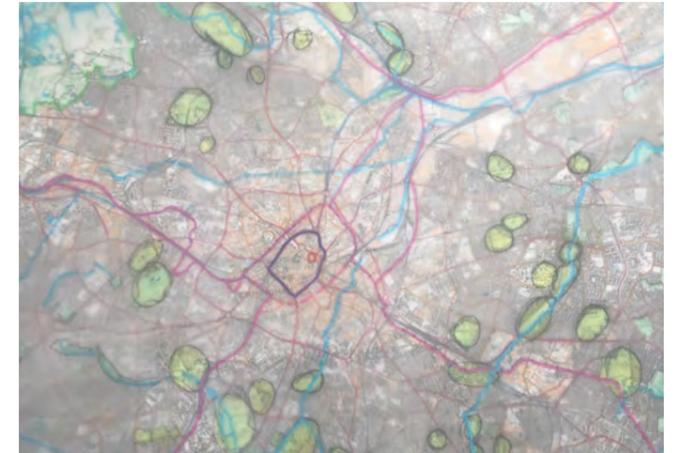
As the city transforms, and particularly in response to the pandemic, building densely and at such scale can no longer be seen as the default position to increase its economic basis. Rather than continuing to pack in development to support the city’s infrastructure needs, there is the opportunity to change mindsets, grow in a better way, build new models of finance and

‘Adopting such a visionary approach to transformation, preparing for the climate emergency and putting quality of life and quality of environment at the top of the agenda, will enable citizens to access, live and work in the city with pride.’

governance with selected partners (including the NHS, EA and others), and recognise the great advantage that could come with the territory – taking the high ground to lead the way both literally and metaphorically. Cutting through the critical spatial problems created by Inner Ring Road will enable the BID to stretch beyond the concrete collar and embrace the surrounding communities. Adopting such a visionary approach to transformation, preparing for the climate emergency and putting quality of life and quality of environment at the top of the agenda, will enable citizens to access, live and work in the city with pride. No more cosmetic cover ups. The Colmore BID is ideally placed to drive this agenda forward with its partners. It will change our global identity and benefit our economy.’

Birmingham comprises a series of rings of significant landscape infrastructure – the canals, rivers, its existing parks, the Edwardian Fringe Belt – in addition to its designation as a City of Nature, City of Trees and its international status as a Biophilic City. It also has significant swathes of land that will become available as the inner Ring Road is decommissioned. The BID is ideally placed to initiate the development and delivery of the Inner Ring Parks as part of the WMNP – a world class sequence of parks and squares, foot and cycle paths, to enable the city to transform.’

Refer to Appendix D for the full report by Prof Kathryn Moore (Birmingham City University & WMNP Lab)



Introduction

The Art of the Possible

Trends in Green Infrastructure

5 trends were identified that are relevant for the study area in the urban core of Birmingham's city centre.

- Climate Adaption and Mitigation
- Tactical Urbanism & Pop-up
- Enhanced Biodiversity
- Health and Wellbeing
- Green Recovery

Appendix E covers selected benchmark research on GI. This has been used to help develop the GI network and interventions schedule explained in the masterplan section in this report. The benchmarks covered in the following pages capture best practice examples in the delivery of Green Infrastructure.

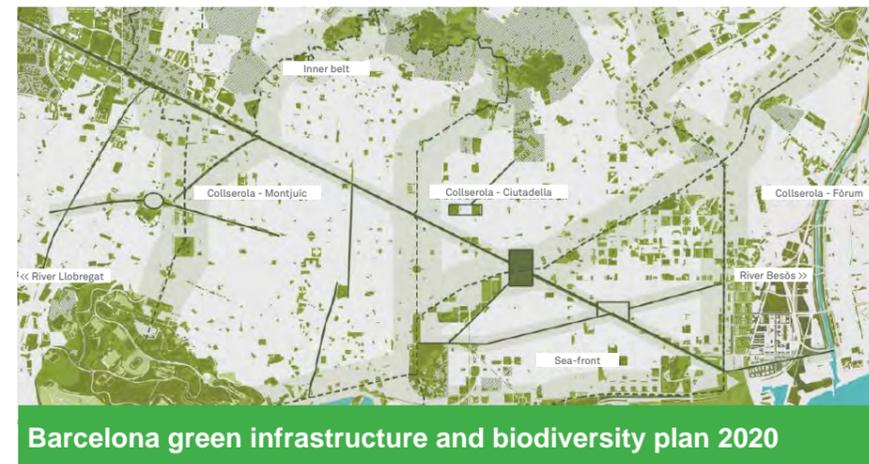
Assessing Benchmarks

Successful GI precedents around the world have been assessed. The lessons and outcome of the assessment primarily focuses on two core aspects: firstly GI strategies and benefits and secondly GI interventions. The GI strategies and benefits assessment captures best practice in approach, presentation and network proposals. The GI interventions assessment captures and highlights specific projects ranging from the audacious to the mundane across scales in similar urban locations. It illustrates that urban GI principles apply to many places, however, needs vary from city to city, setting to setting, with different mixes of land use; different levels of population, employment, and civic activity; and different scales of development. This is important because it re-enforces the need to have specific GI approaches tailored to the unique characteristics of the Birmingham City core.



Climate Adaption and Mitigation

- ✓ Building resilience to climate change issues
- ✓ Creating pleasant micro-climate through shelter, cooling etc.
- ✓ Replacing Grey with Green/Blue
- ✓ Sponge City concept
- ✓ Carbon reduction and sequestration



Barcelona green infrastructure and biodiversity plan 2020



City of Philadelphia Green Streets Design Manual 2014



Tactical Urbanism & Pop-up

- ✓ Try-before-you-buy & Quick wins
- ✓ Creating and engaging communities
- ✓ Community co-design
- ✓ Urban Farming
- ✓ Integrated urban art
- ✓ Temporary interventions



Enhanced Biodiversity

- ✓ Urban rewilding
- ✓ Habitat improvement and creation
- ✓ Target species
- ✓ Enabled nature experience
- ✓ Green Urban Living

ØsterGro, Stockholm



Pot Hole Gardener



Wild West End



Klimawald (Climate Woodland), Heilbronn/Germany

Urban Greenhouse



Bankside Urban Forest



Green Victoria



Health and Wellbeing

- ✓ Creating a health-supporting environment and enhancing quality of life
- ✓ Recreational green spaces
- ✓ Air quality improvement
- ✓ Encourage active travel and outdoor living



Green Recovery

- ✓ 15 Minute City - Access to quality Green Space
- ✓ Attractive, safe and welcoming city centre
- ✓ Creating enterprise opportunities e.g. business spill out

Nature Urbaine, Paris



Park 'n' Play, Copenhagen



Marble Arch Hill



High Line NYC



Sheffield Winter Garden



Paris Ville Verte



Little Island NYC



Oxford Broad Meadow

Introduction

The Masterplan Tool Kit

The Going Green toolkit An introduction

The application and development of innovative technology and processes in Green Infrastructure has been key to maximising the impact of the GI Masterplan and its delivery on ecosystem services. The strategy emphasises the placemaking role in GI not only adding environmental but also social and economic outputs through the creation of features with greater value to wildlife and people. It reimagines the traditionally retail and office dominated spaces as a nature first environment for climate-resilience, retail, leisure, play and healthy living.

Our proposed nature-based solutions and the 'rewilding' of the city are practical, cost-appropriate, popular, ecologically-functioning, sustainable and beautiful.

By forming a multi-functional green network that is contextual, policy responsive, climate resilient and future proofed, our proposals create and retrofit GI that is transformational and inspiring.

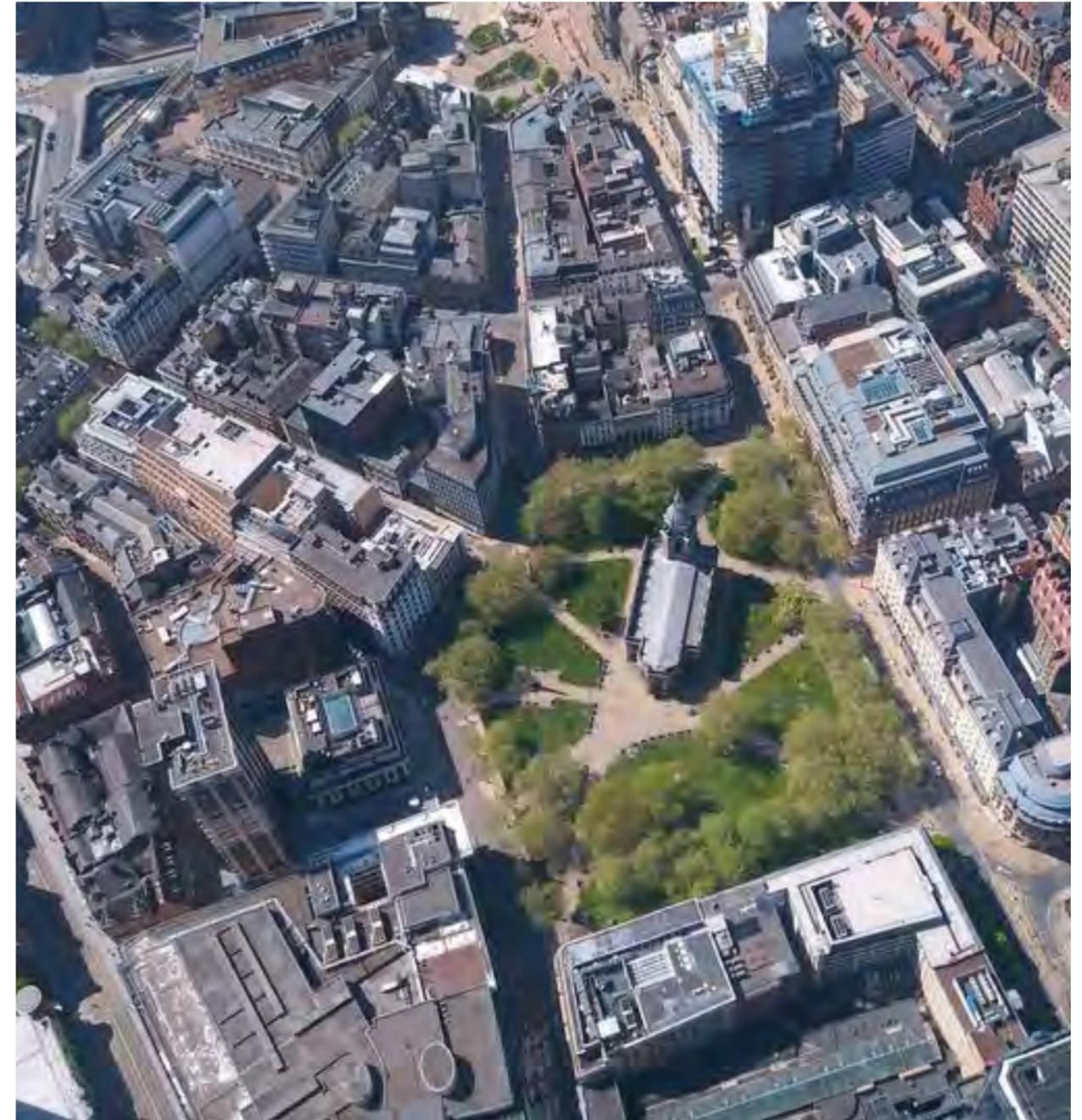
An incremental approach to installation scale and cost enables the BIDs/others to deliver interventions as and when resources, funding and desire allow.

Ongoing measuring and communicating success of the GI interventions (developed with Birmingham Universities) plays a vital role in demonstrating/celebrating success.

The strategic proposals are presented in a user friendly format that allows for easy selection of intervention, clear understanding of benefits and associated delivery considerations (to assist with application for funding) and ultimately implementation of GI on the streets of Birmingham.

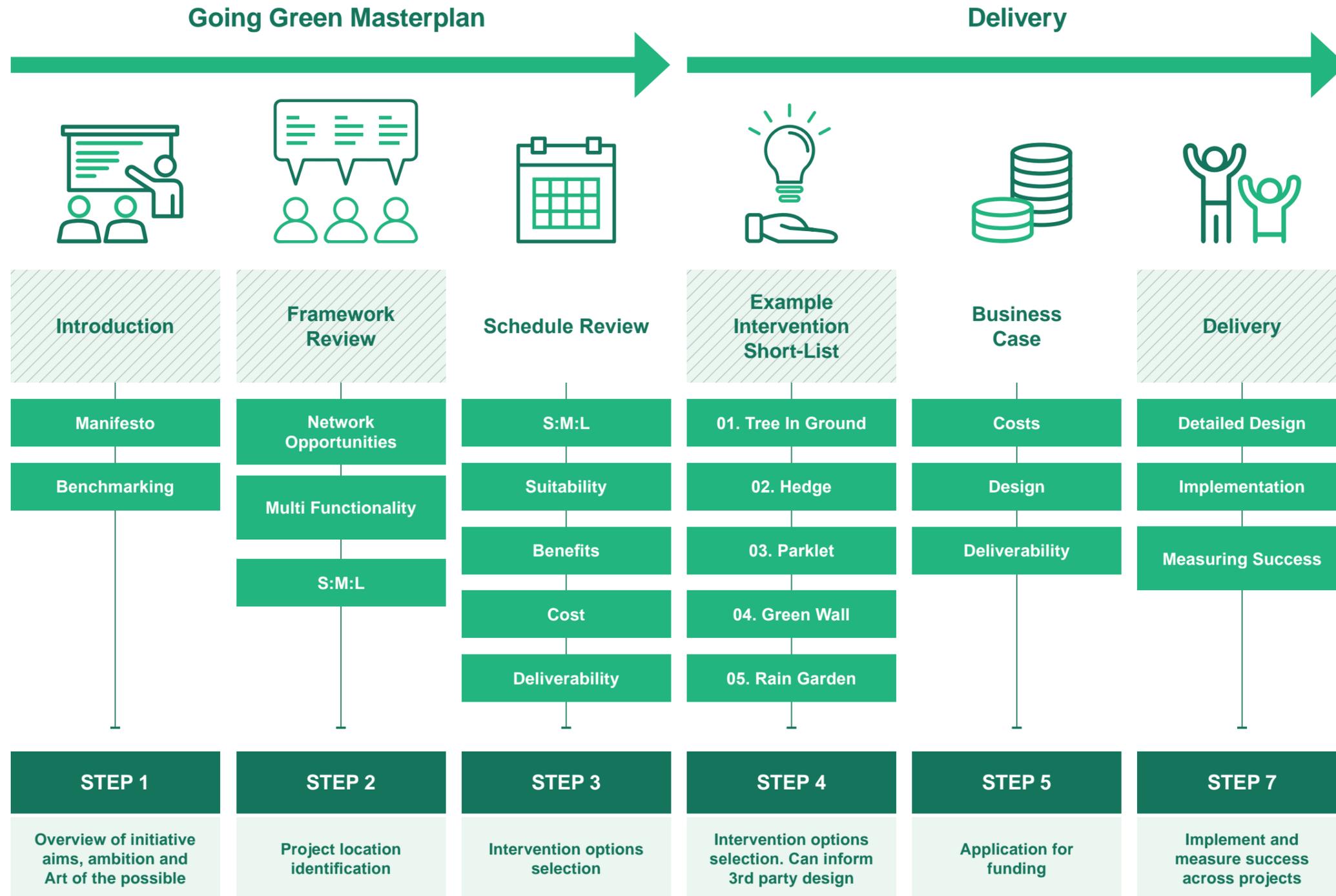
Promoting natural cycles visibly will increase education and awareness of climate issues/adaptation, stimulating and inspiring visitors, employees, employers, landowners and other decision makers within the BIDs boundaries to engage with the aims of the GI Masterplan and take action make positive change in the city.

Your journey starts here. We have assumed you are coming from two positions, either location or funding driven. The following two pages will help you to navigate the tool kit.



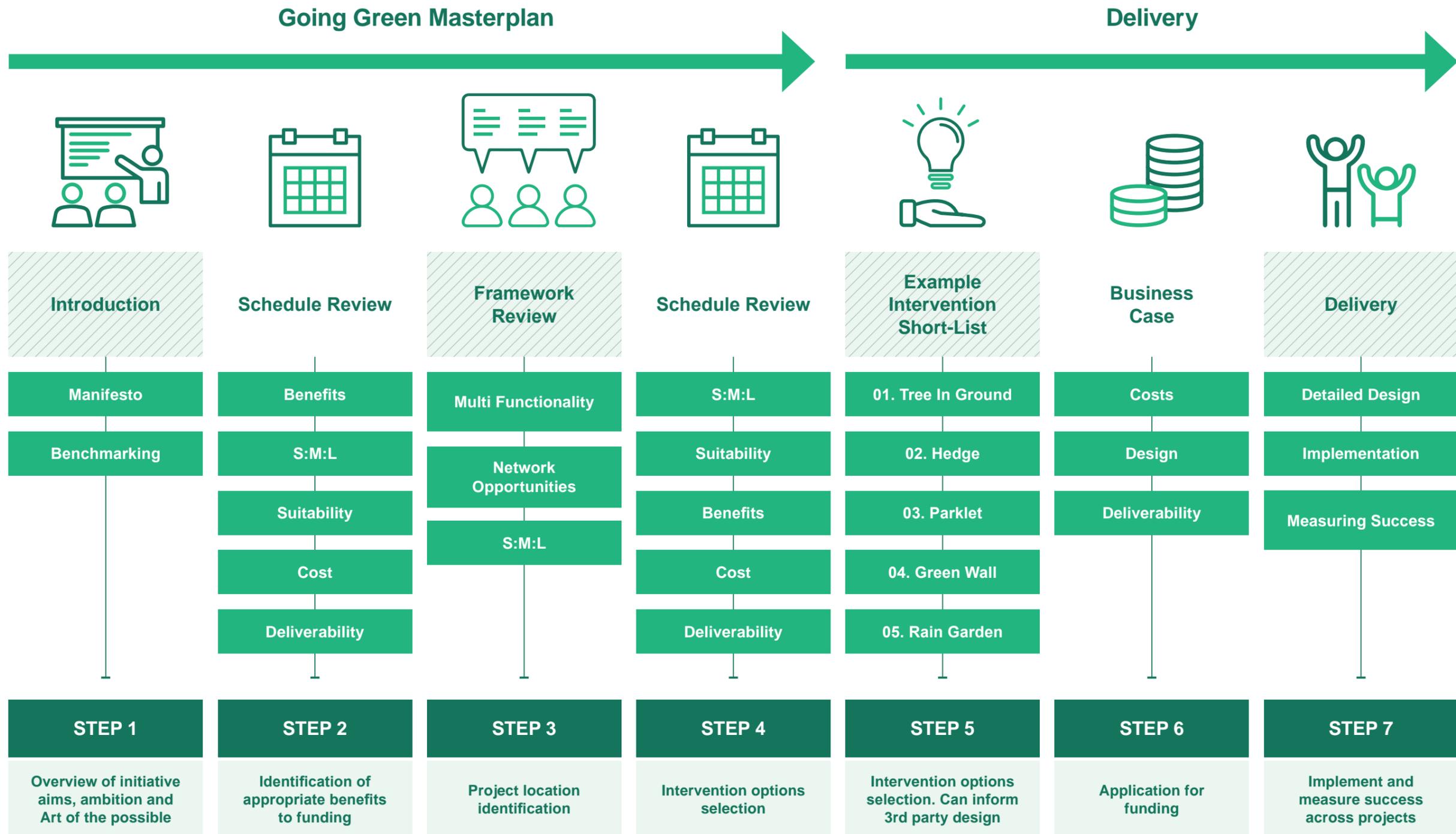
Document User Guide

User Guide 01: Location Driven



Document User Guide

User Guide 02: Funding Driven



The Green Infrastructure Masterplan

An Introduction

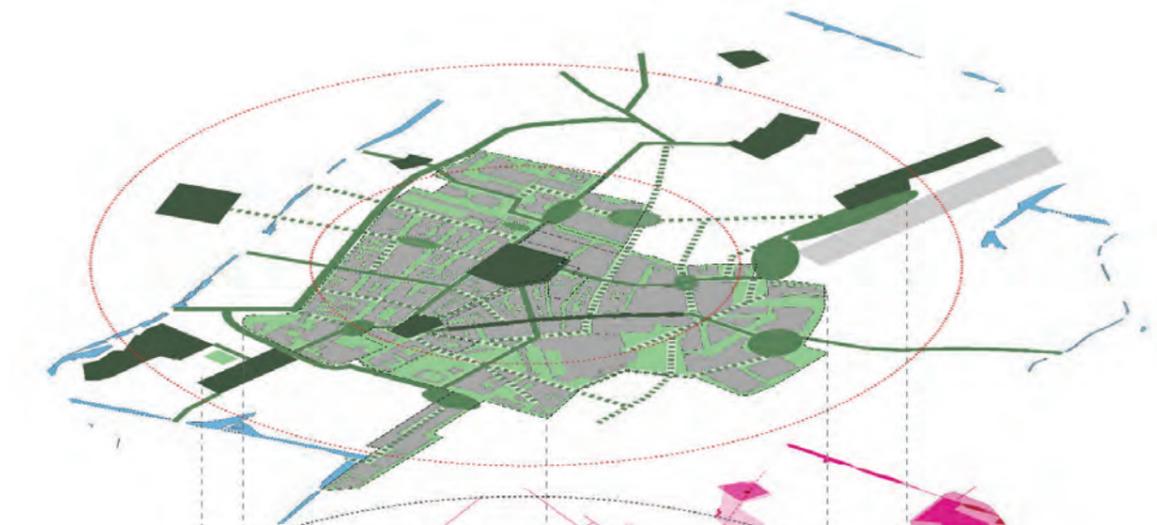
The Masterplan is made up of three framework layers:

- Network
- Multifunctionality
- S:M:L - Scale of Interventions

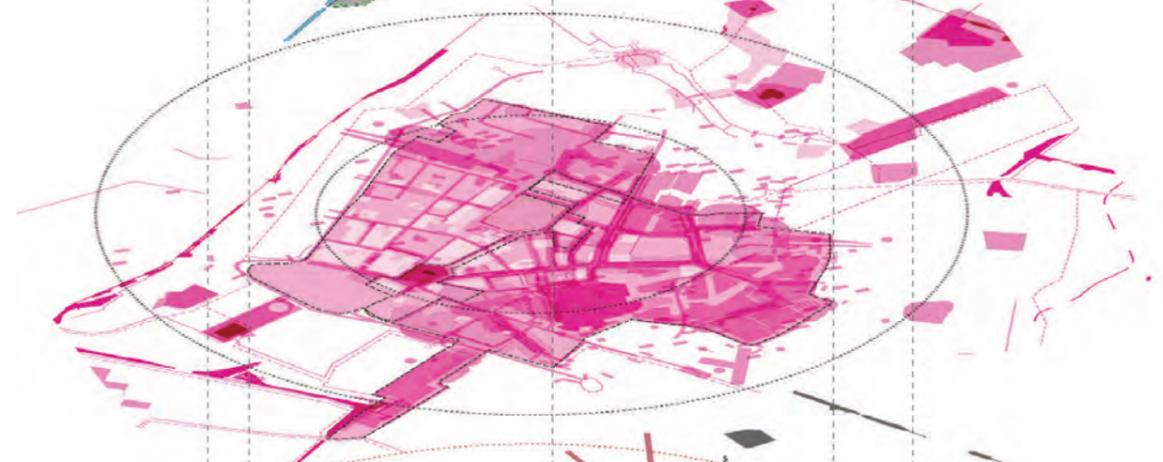
These layers are used in the approach described in the User Guides.

They are further explained on the following pages.

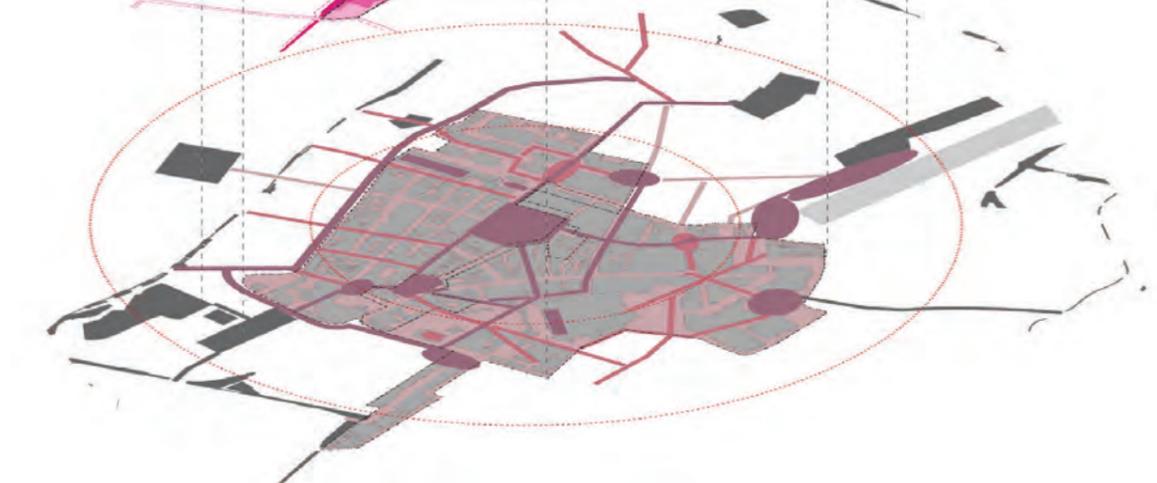
Network



Multifunctionality



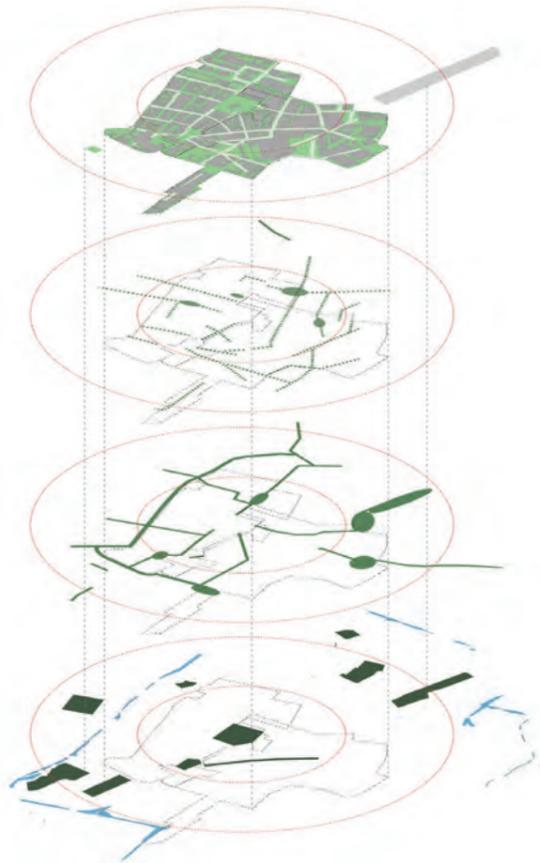
S:M:L



The Green Infrastructure Masterplan

Network Opportunities

Network Categories



3rd Network Tier
New Spaces and Links

2nd Network Tier
New Spaces and Links

1st Network Tier
New Spaces
(Base components)
and Links

1st Network Tier
Existing Green OS
(Base components)

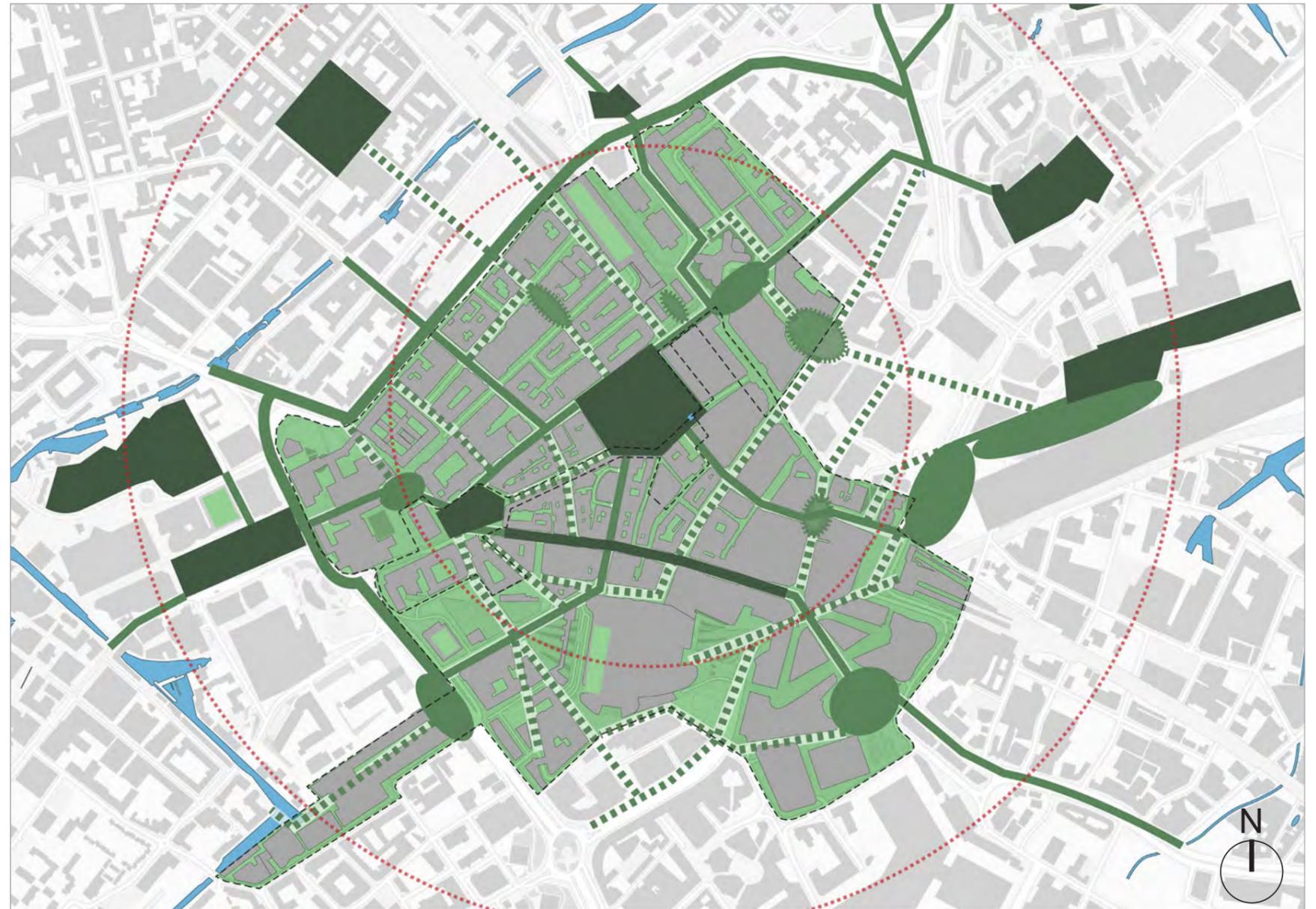
Design Principles:

- Base Components (Key green open spaces) identified in site diagnosis - existing & new;
- Connecting Components (either linear interventions or steppingstone interventions) linking Base Components;
- Network serves both habitats / wildlife & green places/people;
- Connectivity to GBI assets outside the study boundary.

Key



Outcome of this exercise will be identification of network tier associated with location. Aim is to prioritise **Tier 01** to plug primary network gaps (however projects in other category areas still provide benefit to network creation). The intervention schedule provides detail on network component type (e.g. base component / link components).



The Green Infrastructure Masterplan

Multifunctional Benefits Opportunities

Mapped and Unmapped Benefits

This includes delivery of Ecosystem Service and other benefits that Green Infrastructure can bring to a city centre and its users (Pedestrians, cyclists, workers, visitors, residents, wildlife (incl. bird, bat and invertebrates)).

The positive role of Green Infrastructure in Health and Wellbeing, addressing the current Climate Emergency, and providing for Resilience has been widely researched and documented.

Part of this work was linking Green Infrastructure to Place-making and Environmental benefits to ensure that the proposed interventions work for a city centre environment and the aim of creating a framework for a Green Recovery of the City Centre following the Covid-19 pandemic.

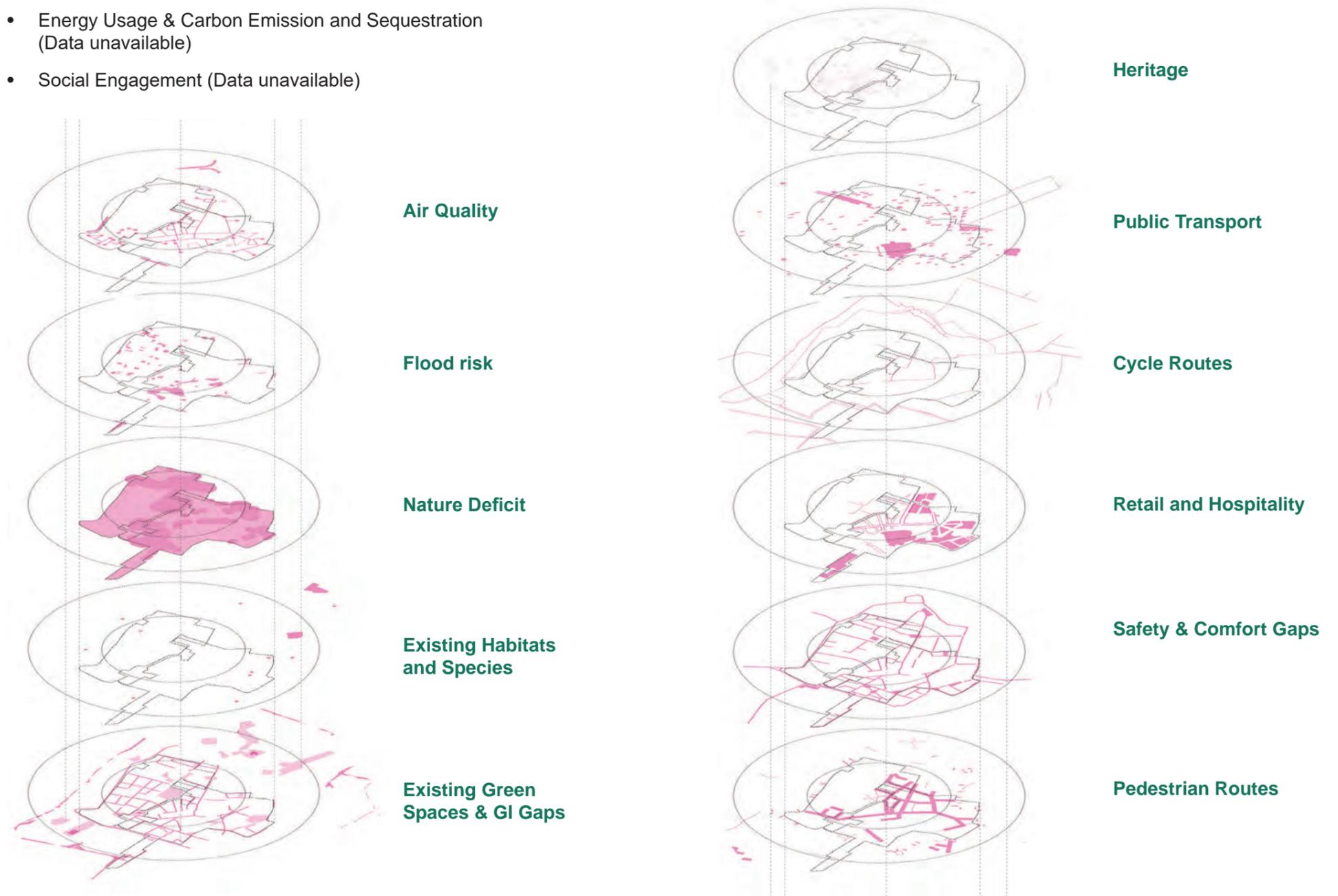
The following list sets out the Opportunities that were used to create the adjacent Multifunctionality map. Please refer to Appendix A.b for the detailed Opportunities mapping.

Mapped Opportunities (Data available):

- Air Quality
- Water Management (Data set: Flood risk)
- Habitat Provision & Connectivity (Data set: Existing Habitats and Species, Nature Deficit, Existing Green Spaces & GI Gaps)
- Active Wellbeing (Data sets: Public Transport, Cycle Routes, Retail and Hospitality, Safety & Comfort Gaps, Pedestrian Routes)
- Sensory Wellbeing (Data set: Comfort & Safety)
- Social Interaction (Data sets: Retail and Hospitality, Public Transport)

Unmapped Opportunities (Data unavailable):

- Thermal Comfort (Similar magnitude across the study area - Refer to Thermal mapping in Appendix A.b)
- Energy Usage & Carbon Emission and Sequestration (Data unavailable)
- Social Engagement (Data unavailable)



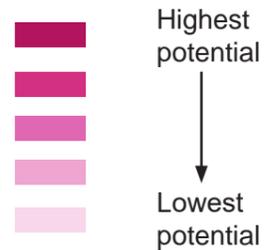
Multifunctionality Categories

- 01 Layer
- 02 Layers
- 03 Layers
- 04 Layers
- 05 Layers
- 06 Layers
- 07 Layers
- 08 Layers
- 09 Layers

Design Principles:

- Multifunctionality categories based on layering of benefit opportunity (Refer to Appendix A.b for more detail).
- Consideration of policy constraints e.g. Listed buildings.
- Places with high potential for multifunctional GI are dark pink through to places with less potential for multifunctional GI in pale pink.

Key



Interrogate framework (digital files) to establish which layers build up into the area selected (e.g. flooding), specific interventions that provide associated 'benefit', which then can be selected from the intervention schedule (refer to App B).

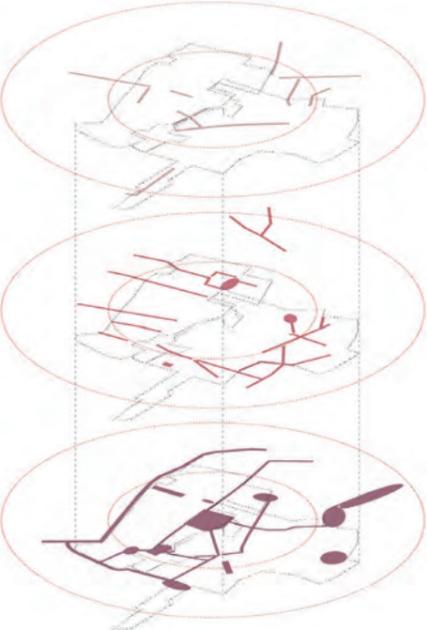
Aim to create multifunctional GI network and interventions in specific locations by prioritising minimum Category 04 areas (although other multifunctionality areas bring benefit).



The Green Infrastructure Masterplan

S:M:L - Scale of Interventions

Scale Categories



Small

Medium

Large

Design Principles:

Available space:

- Width of street / space (Building to building & Carriageway/pavement ratio)
- Any existing GI

Key	
	Large
	Medium
	Small
	GBI outside study area

Use to identify transformational potential (Larger have greater) and as filtering within the intervention schedule (see App B).



GI Interventions Schedule

An Introduction

At this stage you are looking at the Schedule (refer to App B) to identify what Interventions you might implement. The following pages are provided to help you visualise what this might look like.

GI Interventions Schedule

List of Interventions*

Biodiversity Improvements to existing planting areas

Street Tree

Micro Woodland / Orchard

Urban Woodland

Vertical Forest

Habitat Pocket

Hedgerow

Wildflower Meadow

Amenity Grassland

Parklet

Rain Garden / Retention / Swale

Green / Biodiverse Roof

Green / Biodiverse Wall

Productive Garden

Living Lamp Post

Water Feature and Play

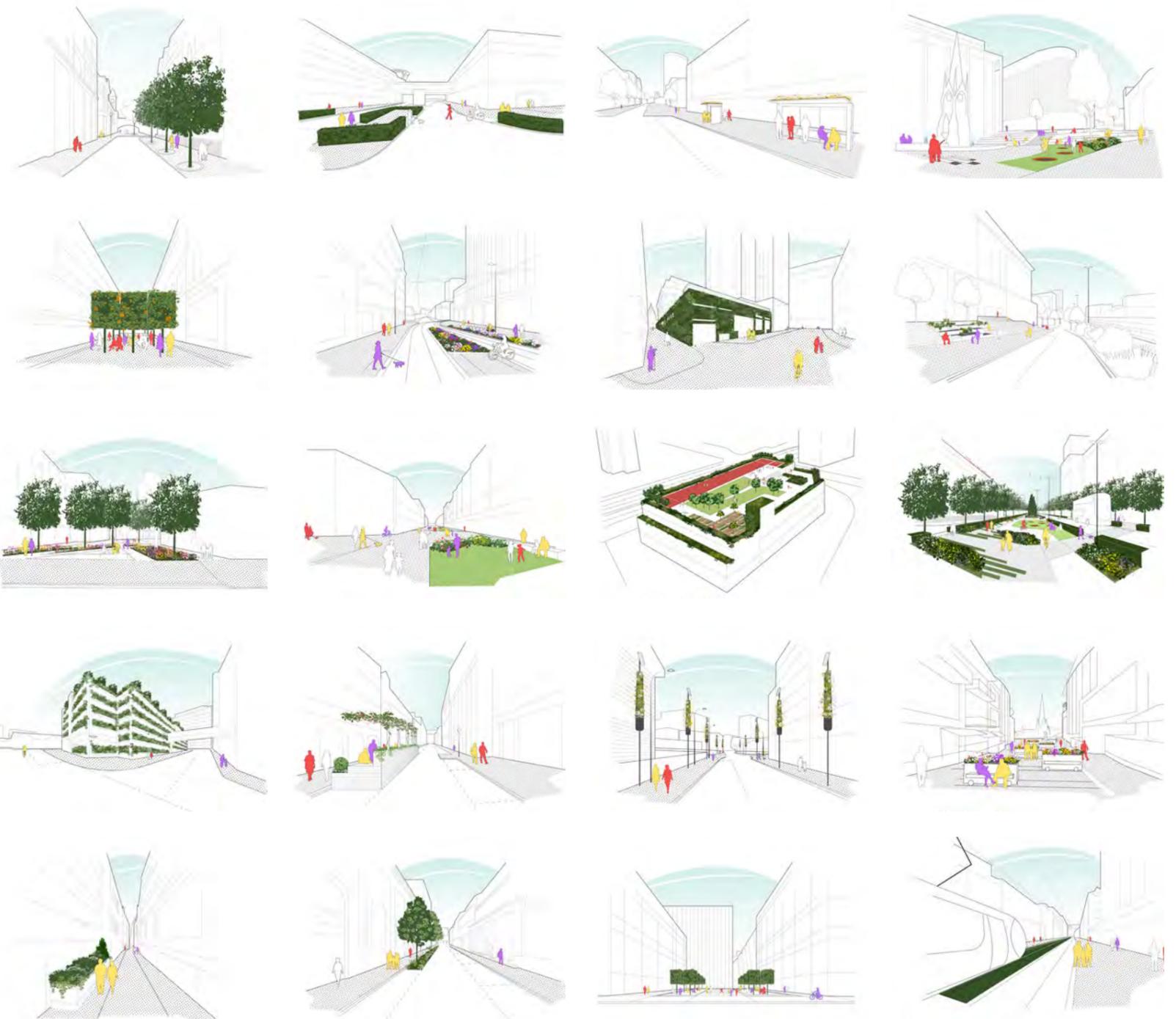
Green Play Space

Wildlife Pond

'Queensway Life Belt' (Urban Park)

Community Pockets Park

Tramway Greening



*For detailed description refer to App B.

GI Interventions Schedule

Attributes Summary

Size (S/M/L)	Small <input type="radio"/> Medium <input checked="" type="radio"/> Large <input checked="" type="radio"/>
Network component	Steppingstone <input type="checkbox"/> Linear <input checked="" type="checkbox"/> Base <input type="checkbox"/>
Multifunctionality benefits*	Habitat provision Biodiversity connectivity Water management Energy and carbon Thermal comfort Air quality Social Engagement Social interaction Sensory wellbeing Active wellbeing
Cost range (Capital cost)	£0-2,000 £2,001-10,000 £10,001+
Time to implement	Weeks Months Years
Maintenance considerations*	Low Medium High
Seasonality	Spring Summer Autumn Winter
Permanence	Temporary Permanent
Net carbon positive impact*	Low Medium High

*For more details refer to App B.

For details on Technical considerations, Potential Approvals, Stakeholder Consultation recommendation, Community engagement opportunities, Measuring success performance, refer to Appendix B.

GI Interventions Schedule

Biodiversity Improvements to existing planting areas

Size (S/M/L)
○

Network component
.....

Multifunctionality benefits
🌱 🐝

Cost range
£ £

Time to implement
📅 📅

Maintenance considerations
⚙️

Seasonality
☀️ ☀️ ☀️

Permanence
○

Net carbon positive impact
— =



GI Interventions Schedule

Street Tree

Size (S/M/L)



Network component



Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Micro Woodland / Orchard

Size (S/M/L)



Network component



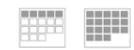
Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Urban Woodland

Size (S/M/L)



Network component



Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Vertical Forest

Size (S/M/L)



Network component



Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



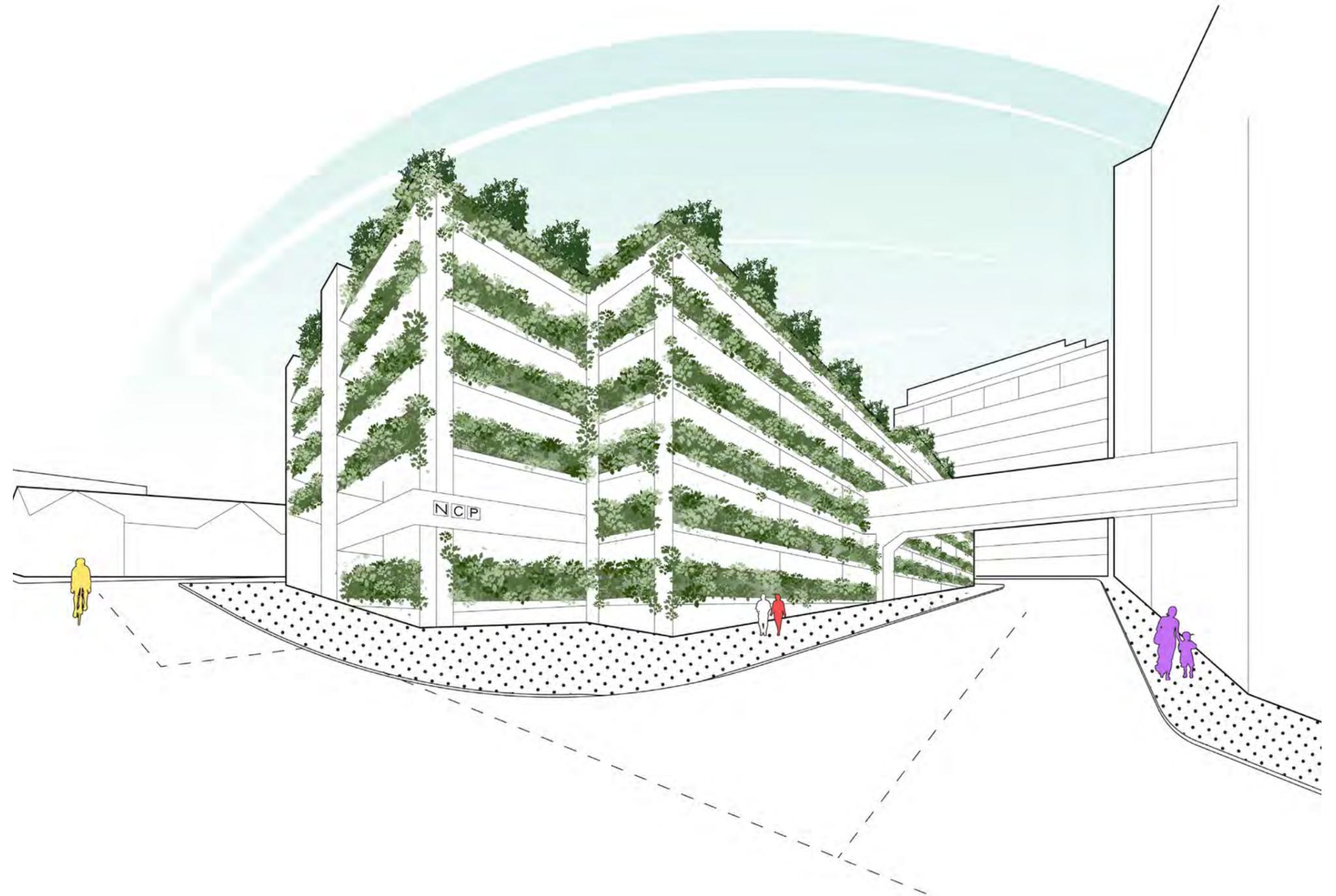
Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Habitat Pocket

Size (S/M/L)



Network component



Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



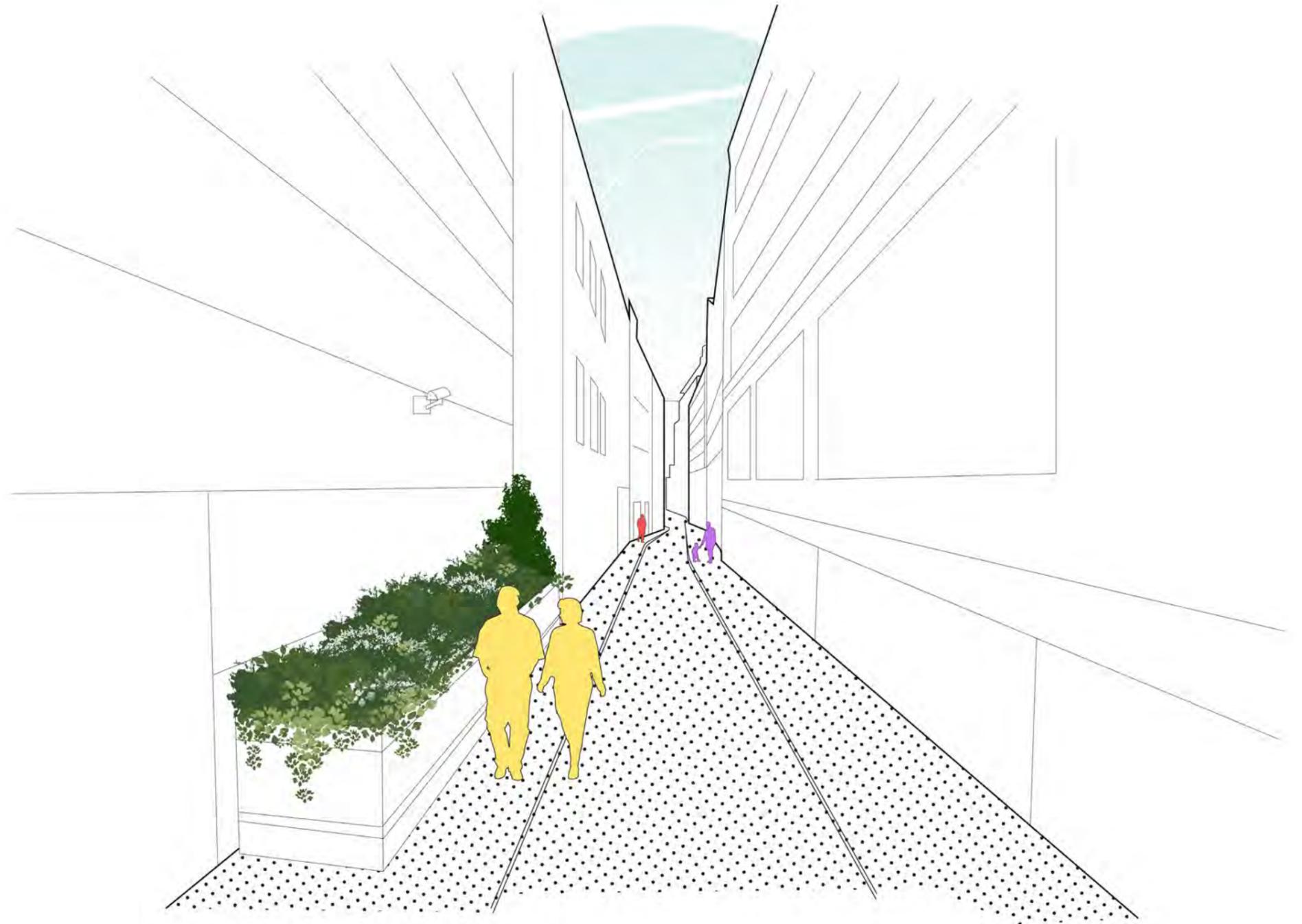
Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Hedgerow

Size (S/M/L)



Network component



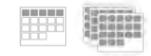
Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



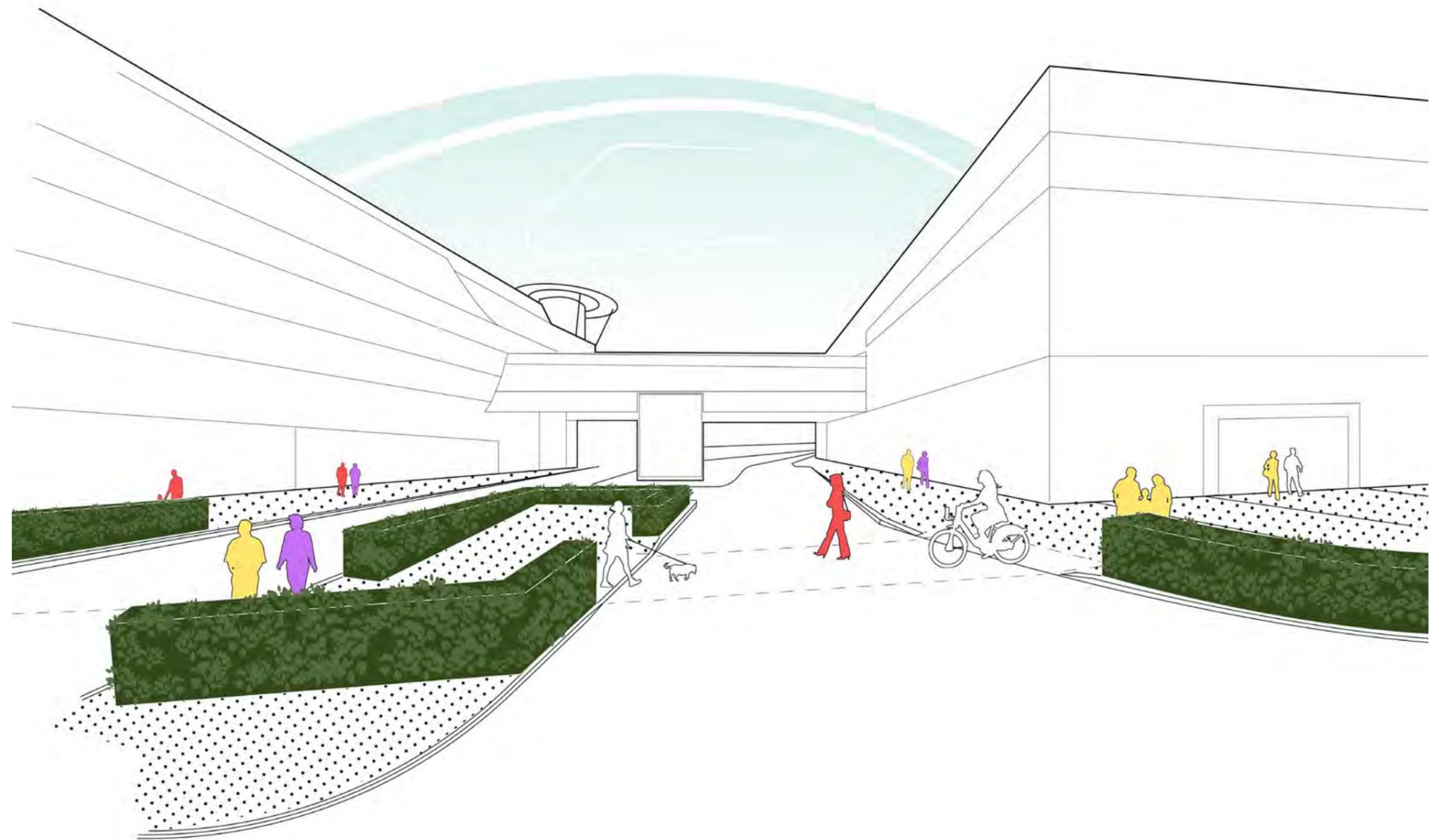
Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Wildflower Meadow

Size (S/M/L)



Network component



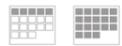
Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Amenity Grassland

Size (S/M/L)



Network component



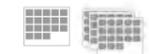
Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



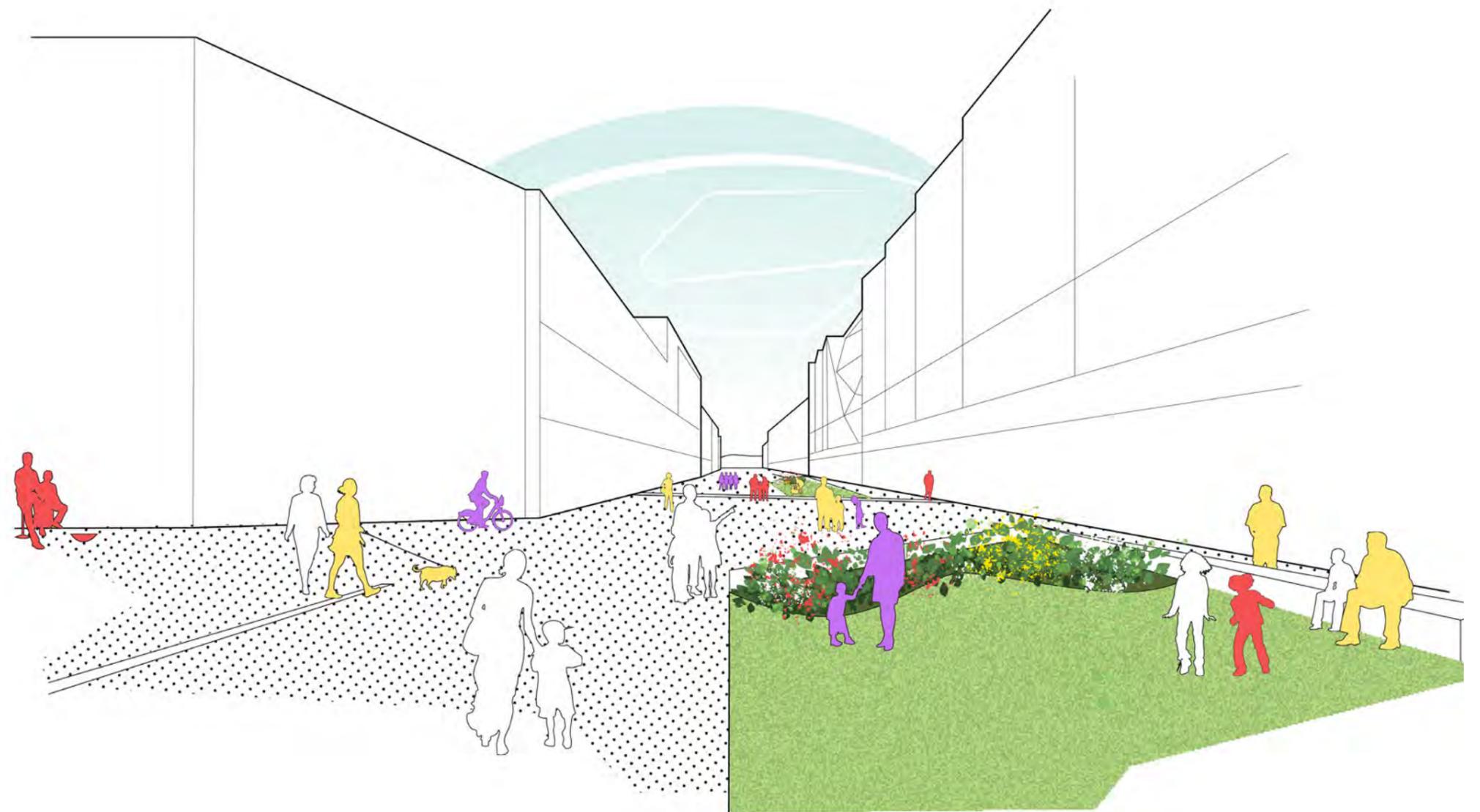
Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Parklet

Size (S/M/L)
○

Network component
.....

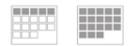
Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Rain Garden / Retention / Swale

Size (S/M/L)



Network component



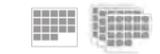
Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Green / Biodiverse Roof

Size (S/M/L)



Network component



Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



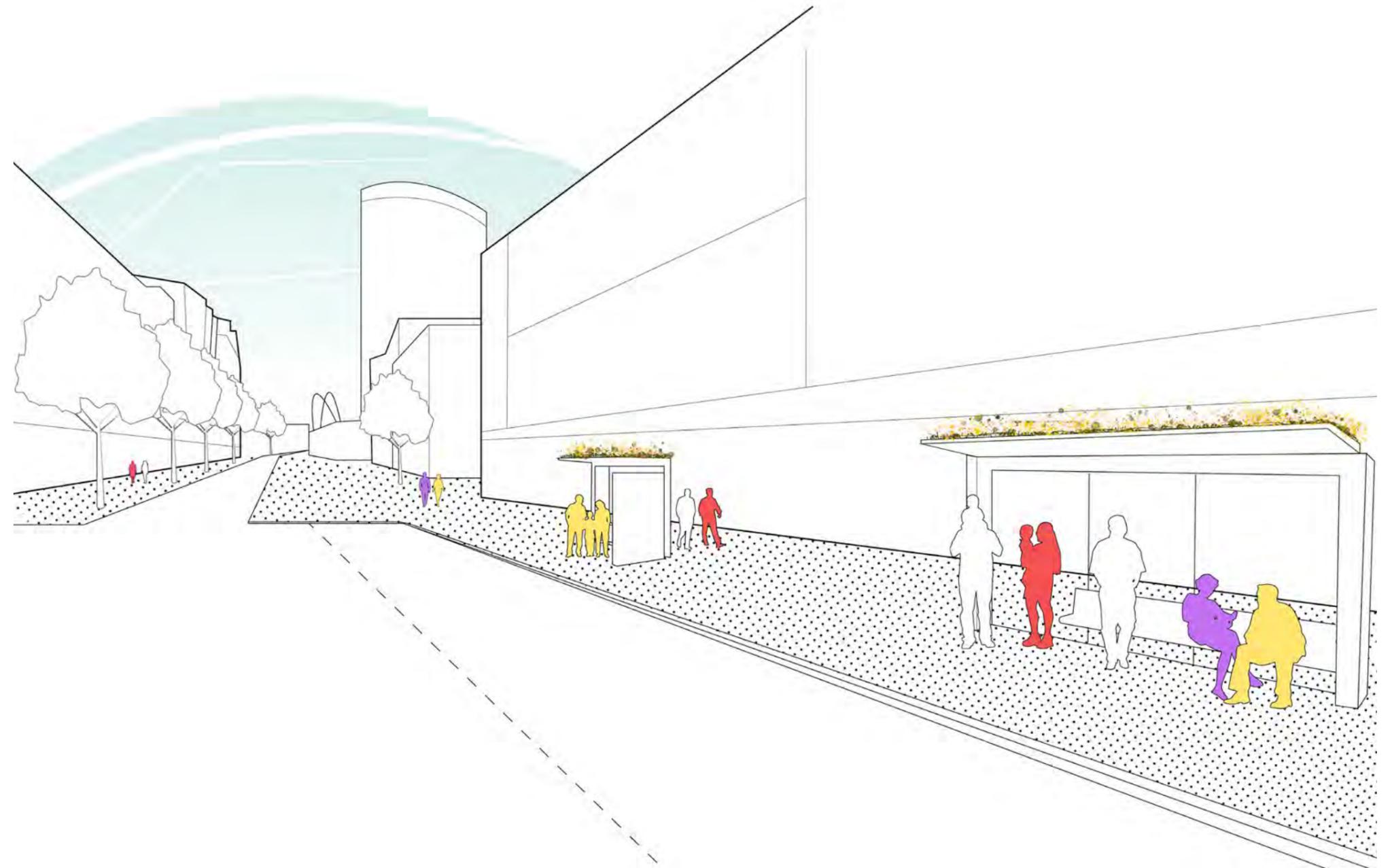
Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Green / Biodiverse Wall

Size (S/M/L)



Network component



Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Productive Garden

Size (S/M/L)



Network component



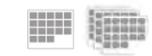
Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



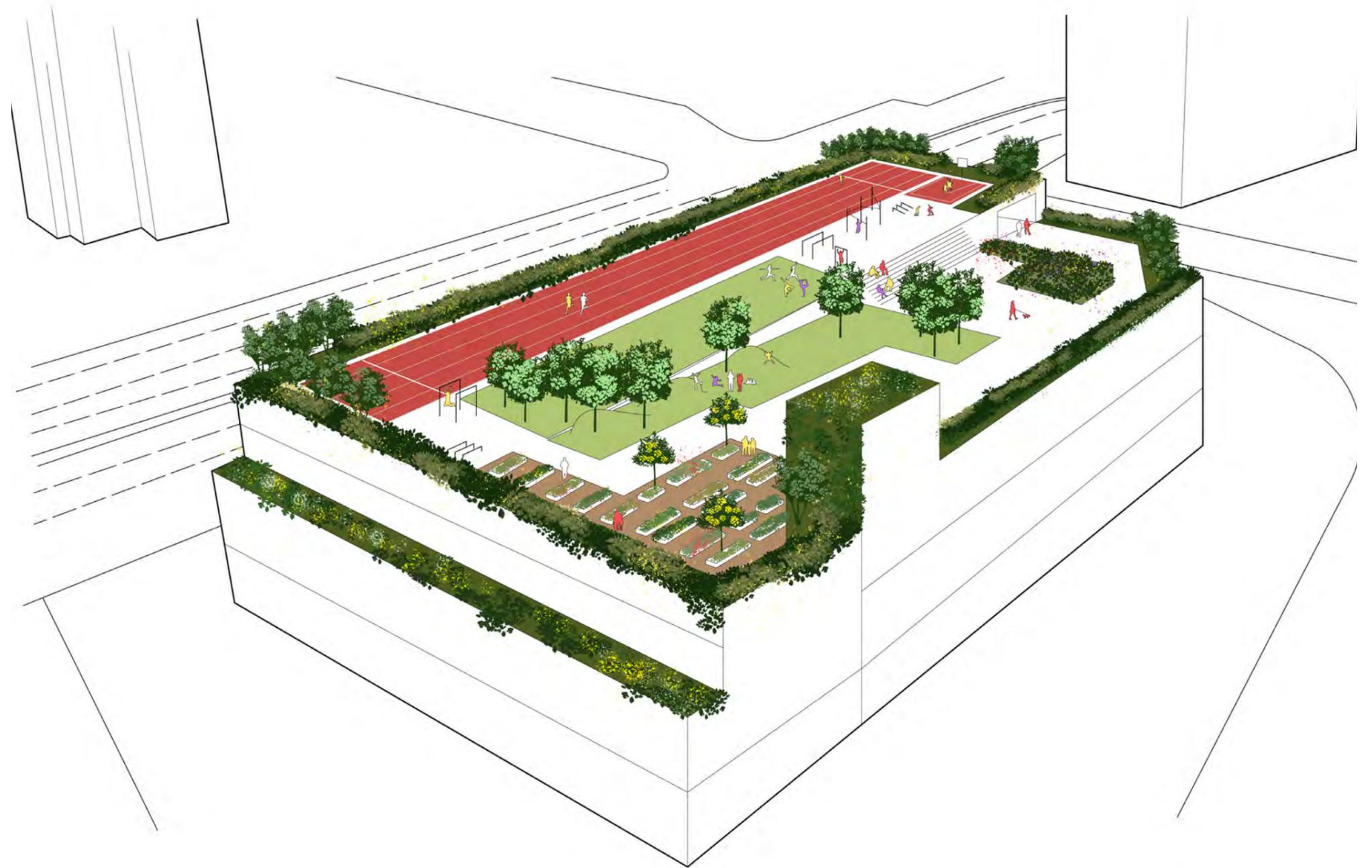
Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Living Lamp Post

Size (S/M/L)



Network component



Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Water Feature and Play

Size (S/M/L)



Network component



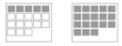
Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Green Play Space

Size (S/M/L)



Network component



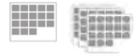
Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Wildlife Pond

Size (S/M/L)



Network component



Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

'Queensway' Life Belt (Urban Park)

Size (S/M/L)



Network component



Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule Community Pocket Park

Size (S/M/L)



Network component



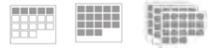
Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



Seasonality



Permanence



Net carbon positive impact



GI Interventions Schedule

Tramway Greening

Size (S/M/L)



Network component



Multifunctionality benefits



Cost range



Time to implement



Maintenance considerations



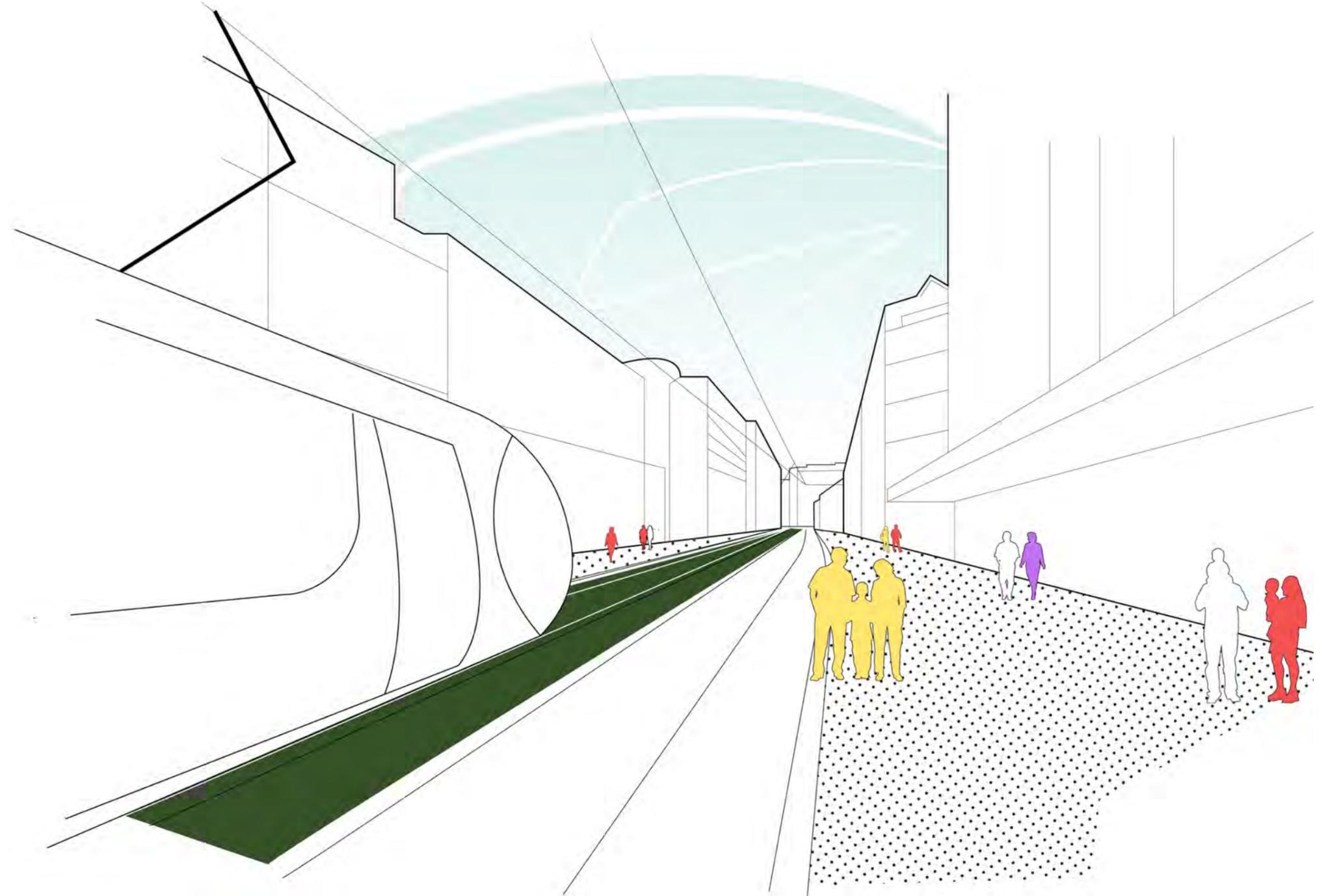
Seasonality



Permanence



Net carbon positive impact



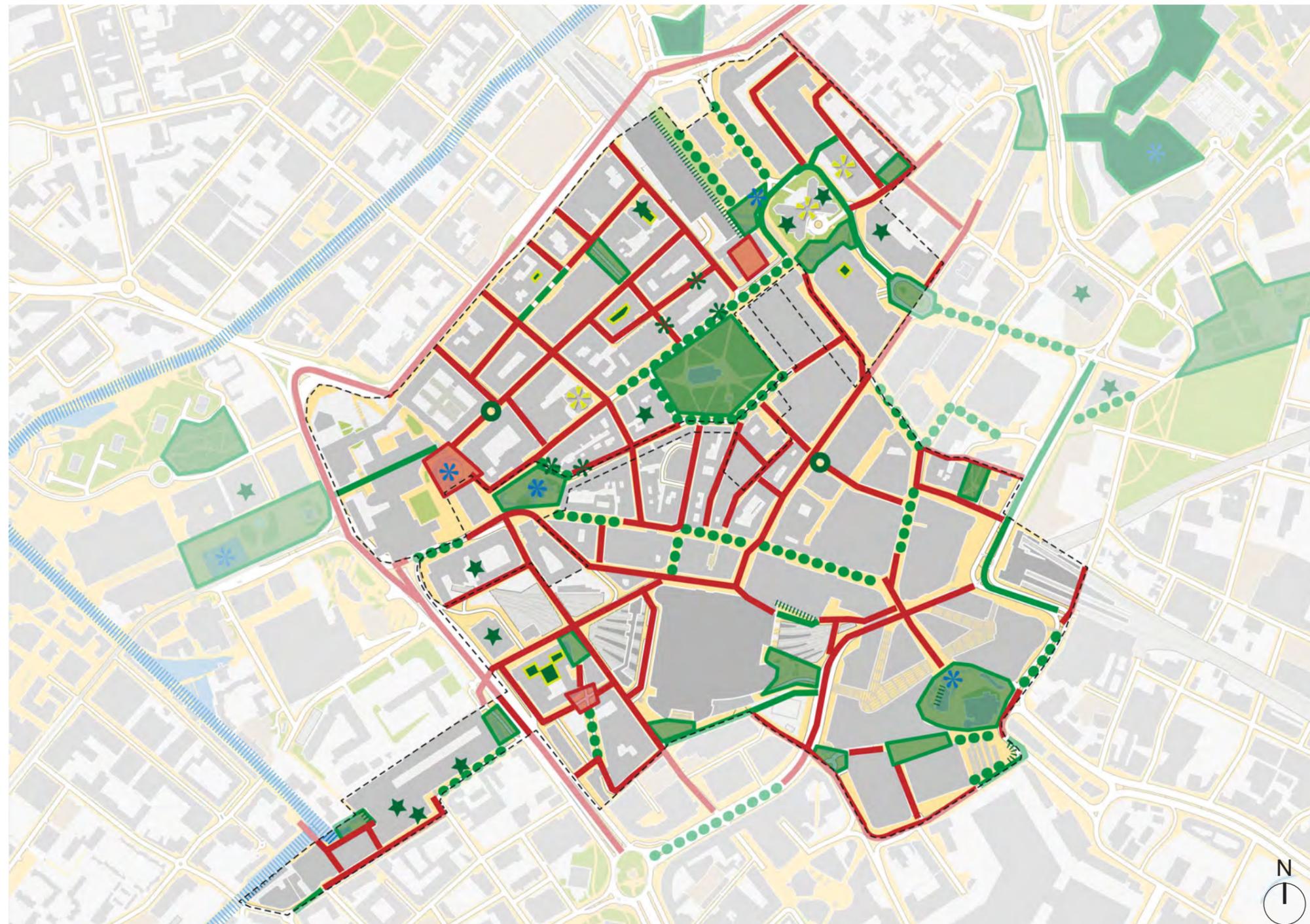
Appendices

Appendices Content

- A. Opportunities Mapping
 - a. Existing Green Infrastructure Gap Analysis
 - b. Opportunities Analysis
- B. Green Infrastructure Interventions List
- C. Proposed Scales of Measurement
- D. Context - WMNP
- E. Green Infrastructure Benchmarking Report
- F. Stakeholder engagement
- G. Existing Green Infrastructure and Urban Context Study – Wider context (habitats, designations and species, Public Open Spaces)
- H. Ecology and environmental conditions findings report (Greengage)
- I. Other relevant key projects and initiatives
- J. List of relevant policy (Local Plan)
- K. SWOT Analysis
- L. Roadside Air Quality Improvements Report by Dr James Levine

Appendix A.a

Existing Green Infrastructure Gap Analysis



KEY

- BIDs Boundary
- Street lacking GI
- ▭ Place lacking GI
- Greened street
- Tree lined street
- ▭ Green open space
- Future greened street
- ||||| Feature - Green wall
- ★ Feature - Green roof
- Feature - Tree
- ✱ Feature - Parklets
- ||||| Canals
- ✱ Water features
- ▭ Green Courtyards
- ✱ Landscaped Buildings

Appendix A.b

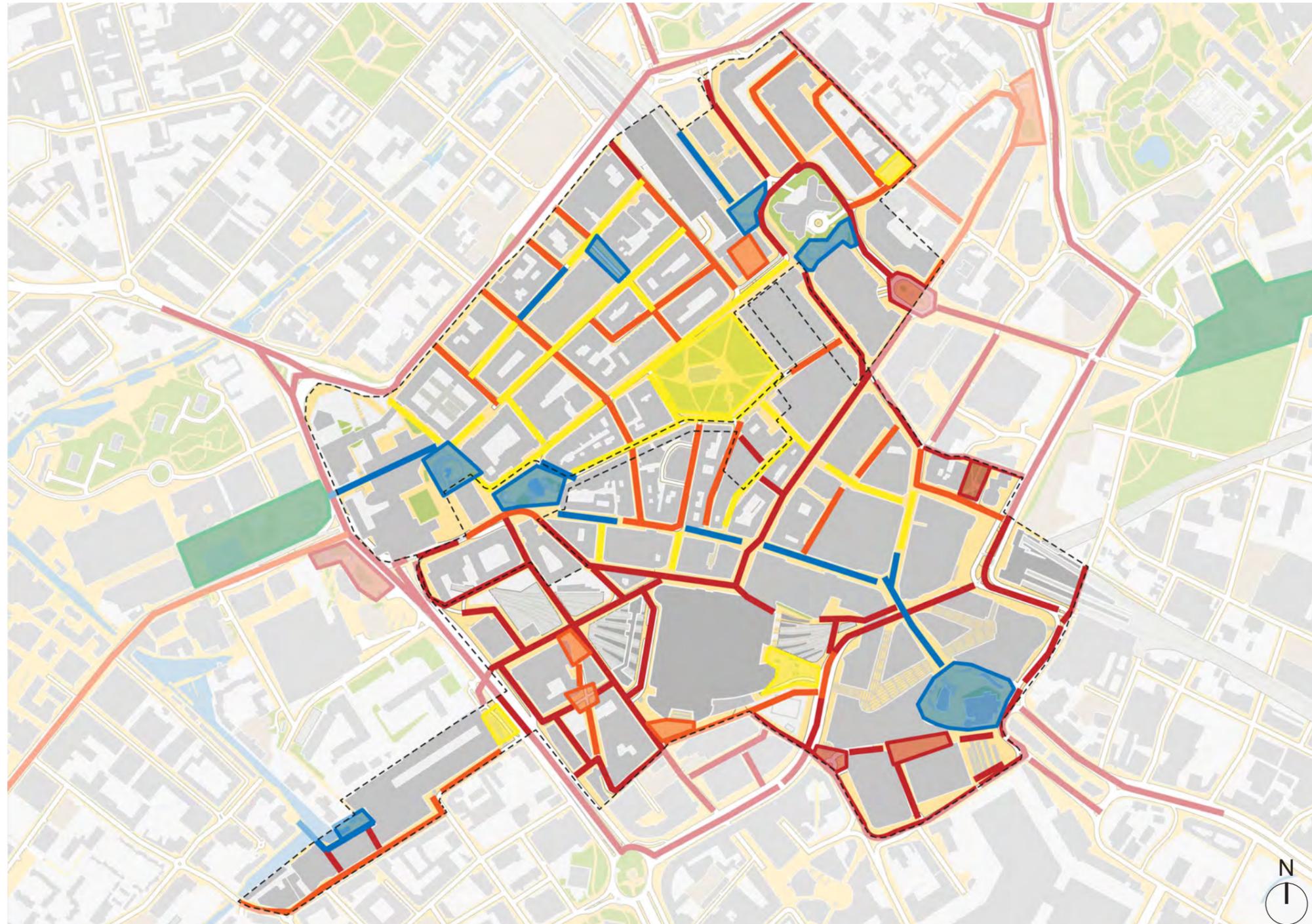
Opportunities Analysis

List of Opportunity Mapping Content

1. Public Realm Comfort & Safety - Gap Identification
2. Heritage: Historic mapping
3. Heritage: Assets & Conservation Areas
4. Movement: Walkability
5. Movement: Topography
6. Movement: Pedestrian
7. Movement: Footfall heat map
8. Movement: Cycling
9. Movement: Arrival - Public Transport and Car
10. Use: Retail & Destination
11. Environment: Air Quality
12. Environment: Air Quality Improvement Proposals
13. Environment: Thermal Imaging
14. Environment: Habitat/ Species & Flood Risk

Appendix A.b

Public Realm Comfort & Safety - Gap Identification



- Key
- Feels Unsafe / Unpleasant / Physically Difficult to cross
 - Can be uncomfortable / feels safe away from conflict points
 - Feels safe & comfortable
 - Pleasurable / Attractive Environment
 - High quality Space

Issues:

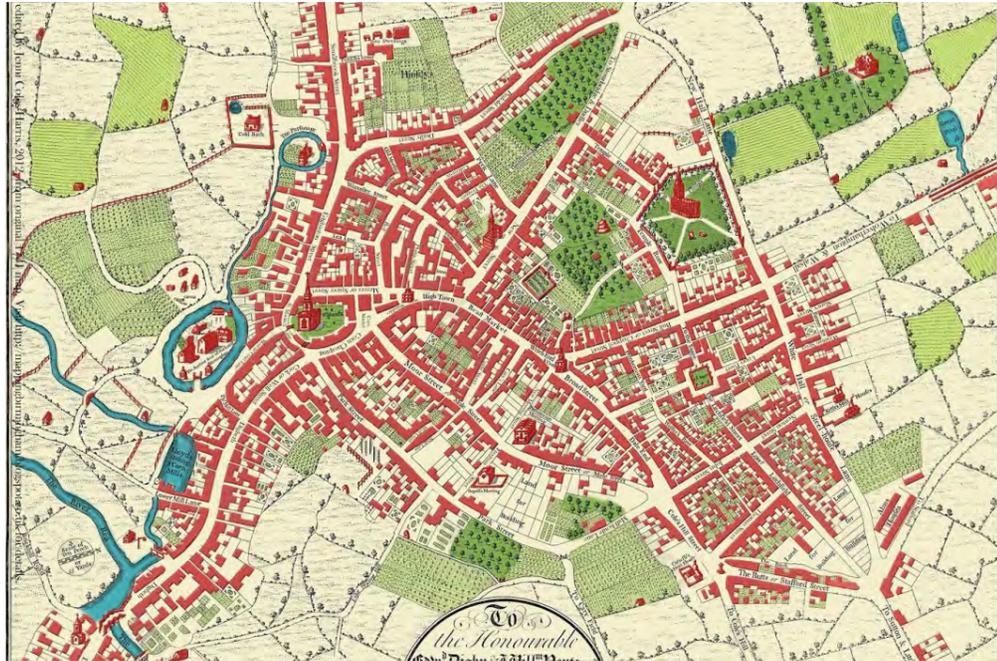
- Varying results across the study area.
- Large proportion of streets and some spaces with perception of 'can be uncomfortable/ feels safe to safe/comfortable' quality.
- Safe/comfortable/pleasurable/attractive perception in key spaces.
- No areas of high quality/delight identified.

Opportunities:

- Implementation of SHMP to rebalance the use of streets to enhance feelings of safety and delight for pedestrians/cyclists/slower modes.
- Implementation of GI interventions to positively address negative perceptions.

Appendix A.b

Heritage: Historic mapping



1731



1778



1888-1913



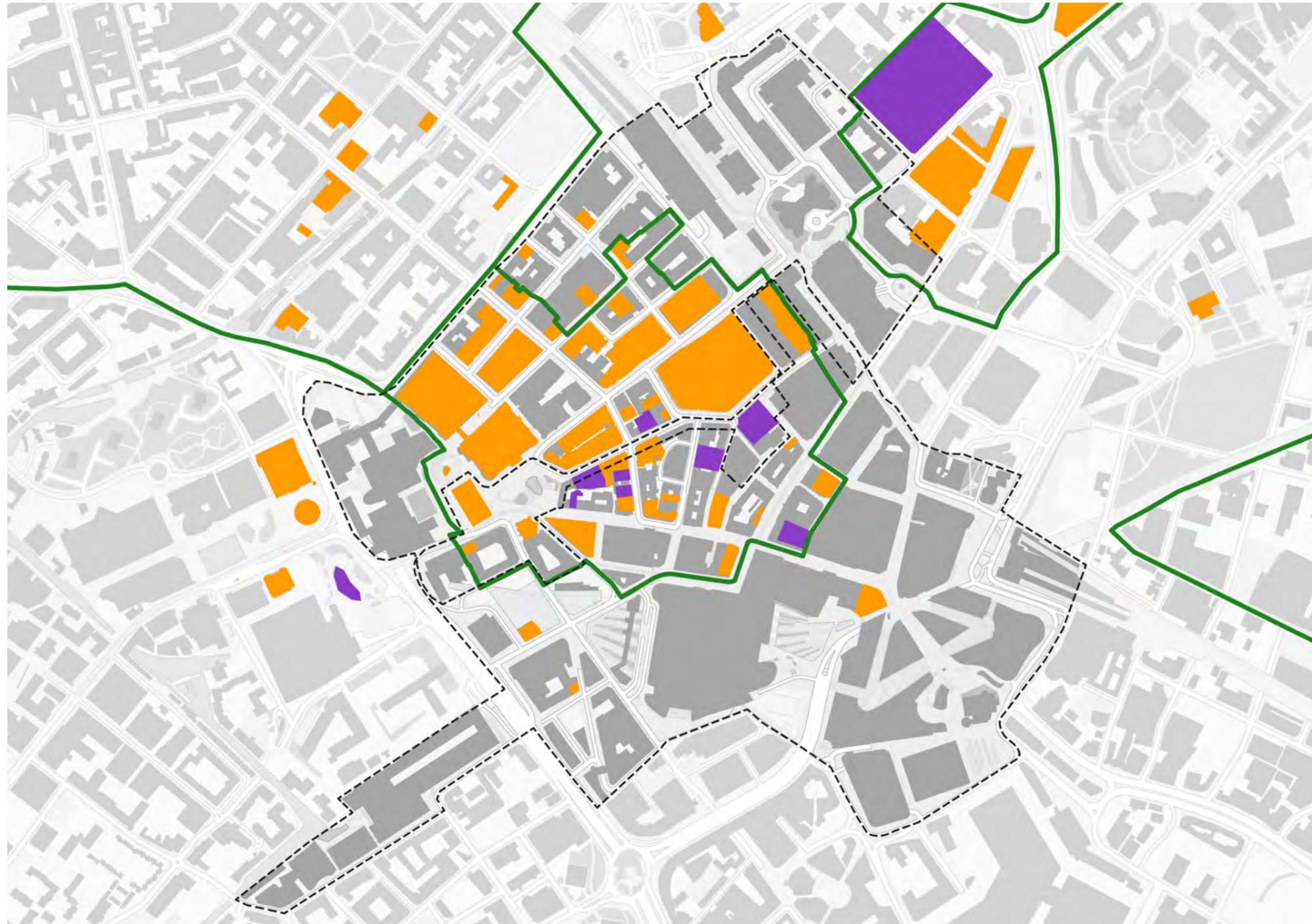
1945-1965

Opportunities presented

- Understanding of historical growth and urban morphology
- Identification of GI legacy e.g. St Philips churchyard
- Historic GI for inspiration e.g. cherry orchards, watercourses

Appendix A.b

Heritage: Assets & Conservation Areas



Opportunities presented

- Enhancement of setting of heritage assets
- Understanding and responding to Conservation Area character
- Potential constraints to GI interventions through Listed Building status
- Partnerships with heritage organisations

KEY

- BID Boundary
- Boundary of conservation area
- Locally listed buildings
- Statutorily listed buildings



Appendix A.b

Movement: Walkability



Opportunities presented

- Walkable city centre
- Creating a legible GI network to connect key green recreational spaces and key blue infrastructure assets.

KEY

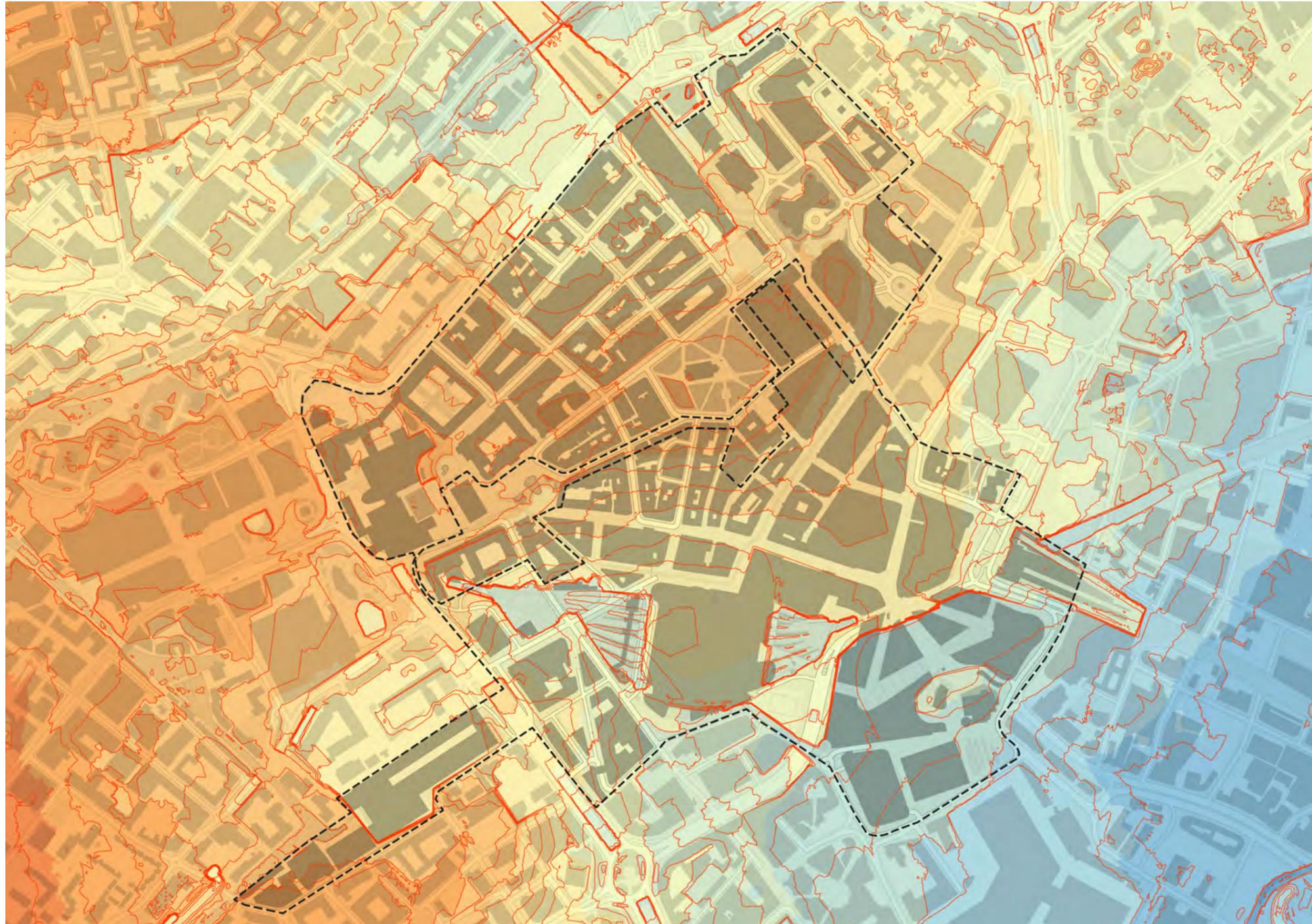
- - - BID Boundary
- Walking distance radii
- Key Blue Infrastructure assets
- Key Green Recreational Spaces
- Vacant /(Semi) Derelict/Disused

400m = 5min walking time
800m = 10min walking time



Appendix A.b

Movement: Topography



Opportunities presented

- Consideration of comfortable, accessible pedestrian and cycle routes for GI network
- Consideration of topography for SUDs design
- Consideration of slope orientation for shelter, shade and sun

KEY

- - - BID Boundary

— 2m contours

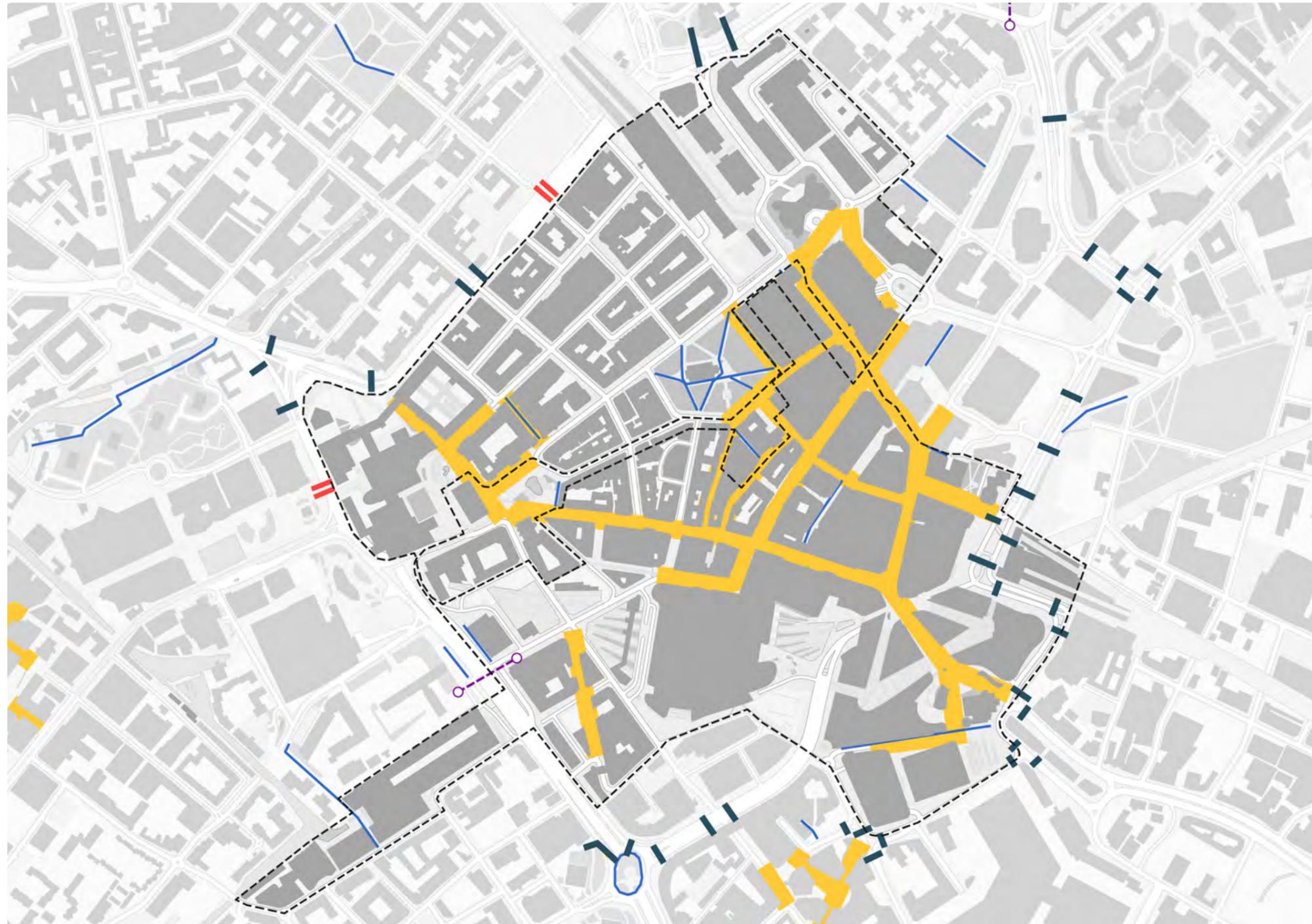
Elevation:

≤ 90.0000
90.0000 - 95.0000
95.0000 - 100.0000
100.0000 - 105.0000
105.0000 - 110.0000
110.0000 - 115.0000
115.0000 - 120.0000
120.0000 - 125.0000
125.0000 - 130.0000
130.0000 - 135.0000
135.0000 - 140.0000
140.0000 - 145.0000
145.0000 - 150.0000
150.0000 - 155.0000
155.0000 - 160.0000
> 160.0000



Appendix A.b

Movement: Pedestrian



Opportunities presented

- Enhancement of existing key pedestrian routes with GI
- Consideration of comfortable, accessible pedestrian routes for GI network
- Wider connectivity and GI linkages beyond the study area boundary

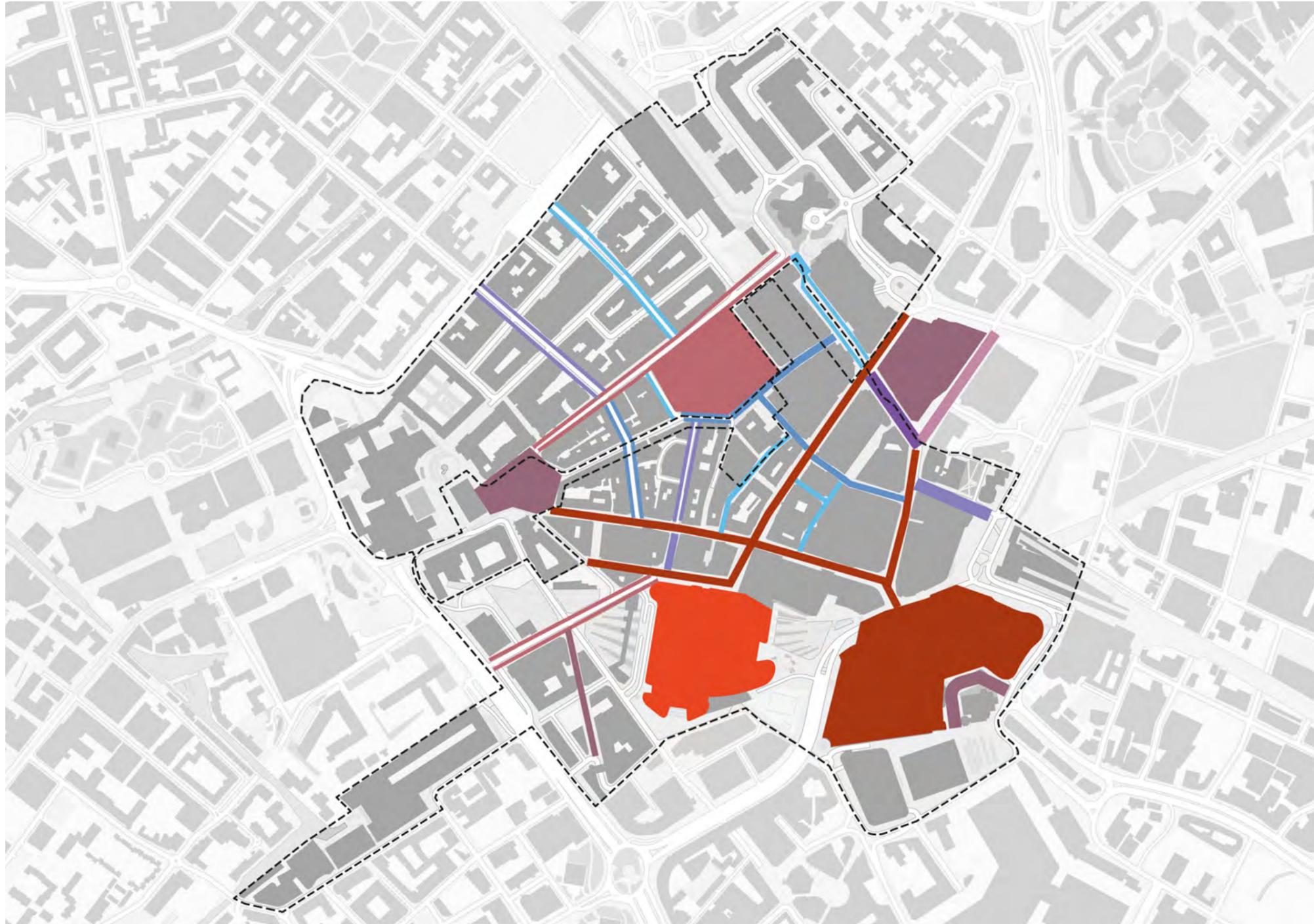
KEY

- - - BID Boundary
- PROW
- Pedestrianised street
- Level crossing
- Bridge
- — Underpass



Appendix A.b

Movement: Footfall heat map



Opportunities presented

- Identification of popular/best used routes to focus attention
- Source: TownAndPlace.AI by Place Informatics

KEY

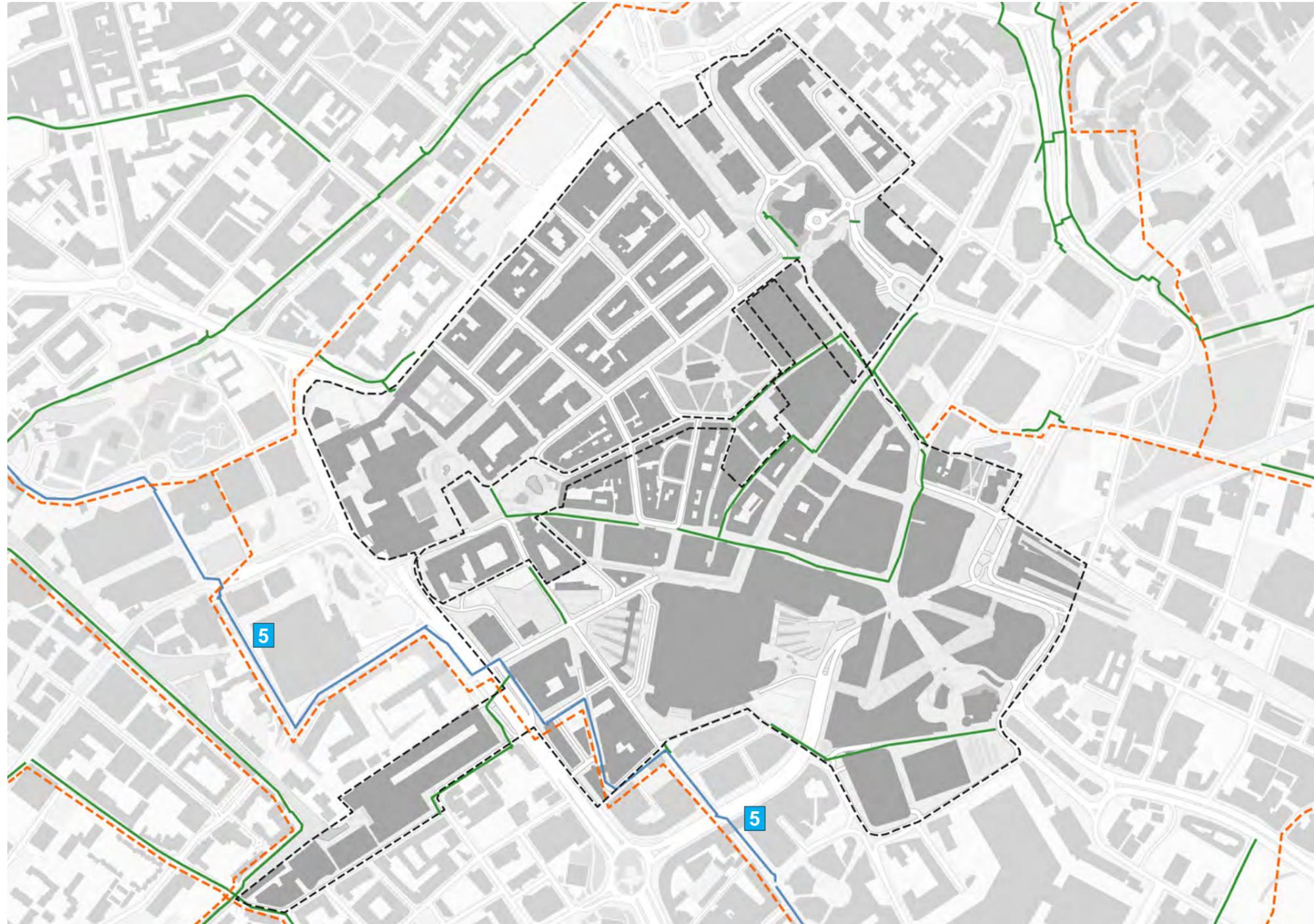
Busier streets are red through to quieter streets in blue

- - - BID Boundary
- Busy
- Quieter



Appendix A.b

Movement: Cycling



Opportunities presented

- Creating comfortable environment for cycle routes to make cycling into and in the city centre more attractive - Greenlinks

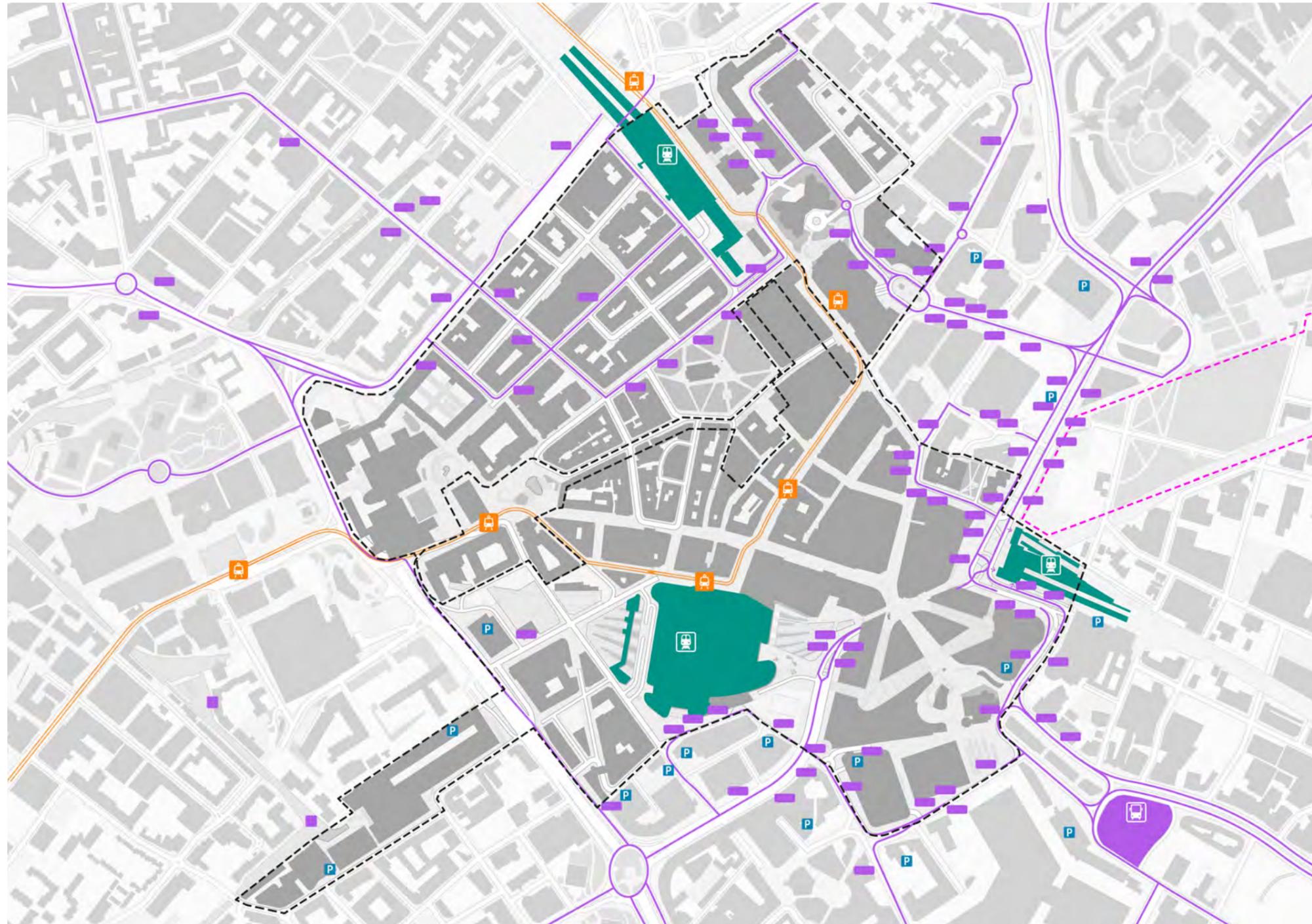
KEY

- - - BID Boundary
- Local Authority Cycle Routes
- - - Strategic Cycling Routes (BCC Development Plan)
- National Cycle Network Route



Appendix A.b

Movement: Arrival - Public Transport and Car



Opportunities presented

- Enhancement of bus 'hubs' waiting areas e.g. Colmore Row, Moor Street Station, Snowhill Queensway, Upper Dean Street, Priors Queensway
- Improving interchange routes
- Tying in of car arrival points (car parks)

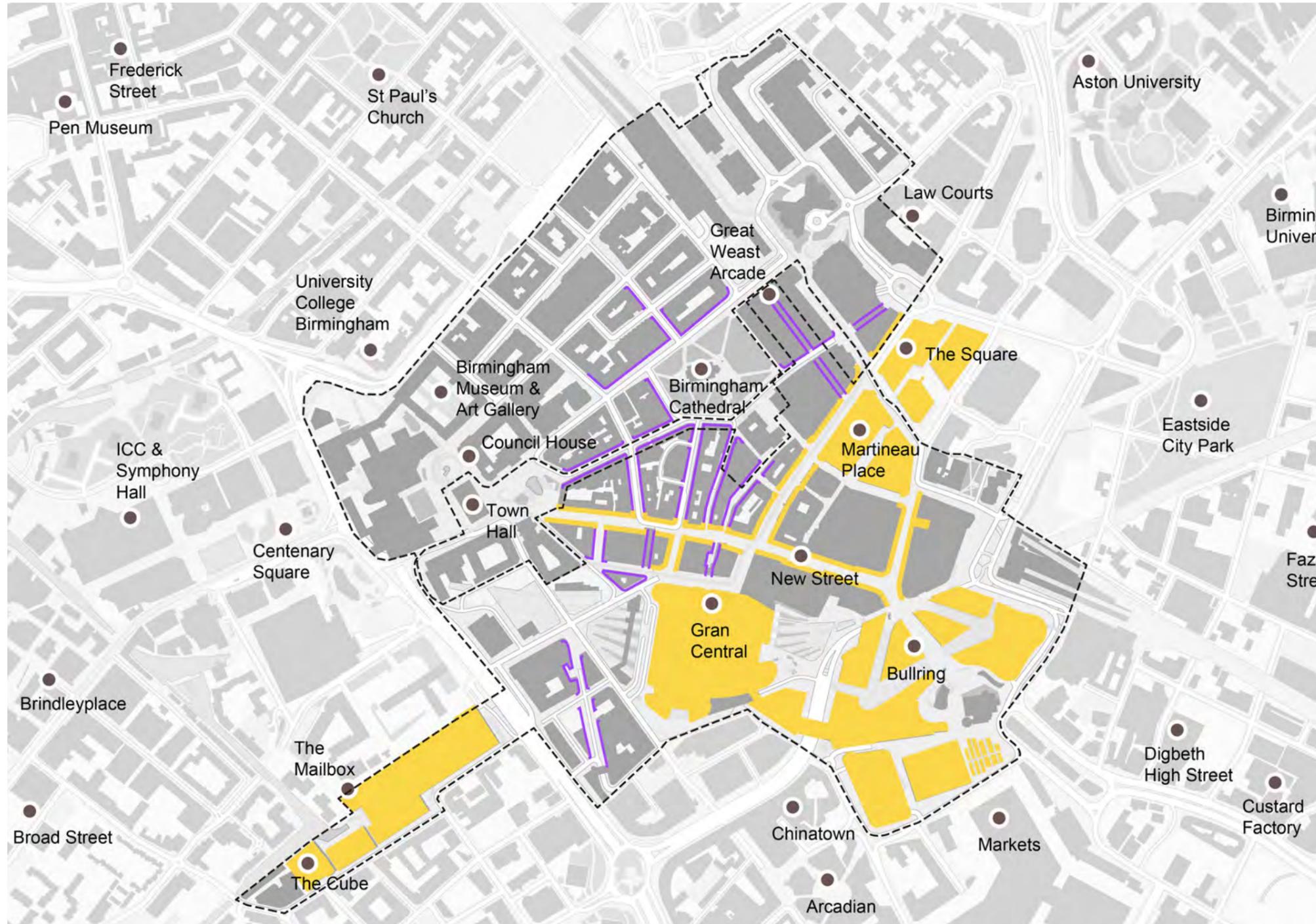
KEY

- BID Boundary
- Bus (Lines and stops)
- Train (Stations)
- Metro (Lines and stops)
- P Car parking
- Future HS2



Appendix A.b

Use: Retail & Destination



Opportunities presented

- GI interventions near retail destinations to create welcoming, attractive and comfortable environment to increase footfall and dwell-times
- Creating a GI hierarchy to support the different characters of retail in the city centre

KEY

- BID Boundary
- Destinations
- Retail destinations
- Retail destinations (Independents & arcades)



Appendix A.b

Environment: Air Quality



Opportunities presented

- Utilise GI to control Air Pollution along main road corridors.
- Design GI interventions to protect less polluted areas.

KEY

NO₂_BAU (µg m⁻³)

29.6 - 34.3
34.4 - 40.0
40.1 - 45.5
45.6 - 53.2
53.3 - 62.2
62.3 - 72.9
73.0 - 84.5
84.6 - 96.5
96.6 - 139

— Traffic_BIDs



Appendix A.b

Environment: Air Quality Improvement Proposals



Opportunities presented

- Roadside air quality improvements to key health facilities in and adjacent to the BIDs areas.
- Roadside air quality improvements to pedestrian only areas.
- Refer to Appendix L for full report by Dr James Levine from University of Birmingham.

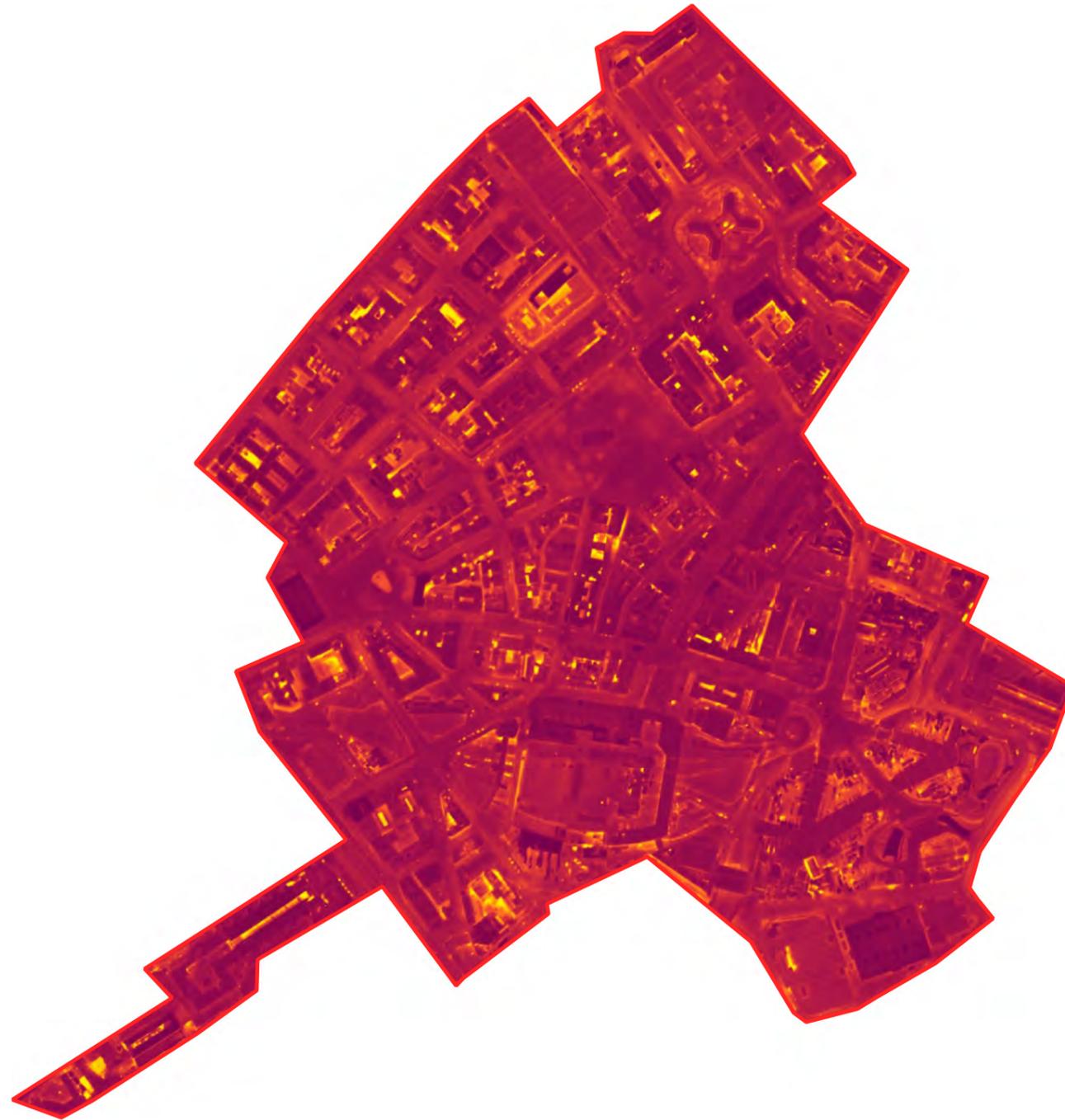
KEY

- - - BID Boundary
- 5m evergreen screen
- 2.5m evergreen hedge/ screen
- Streets with dense tree canopy and dense low-level vegetation



Appendix A.b

Environment: Thermal Imaging



Opportunities presented

- Use GI to cool in internal building courtyards where highest heat loss occurs
- Strengthen GI in areas with significantly lower heat loss, e.g. St Philip's Cathedral garden to increase urban cooling effects

KEY

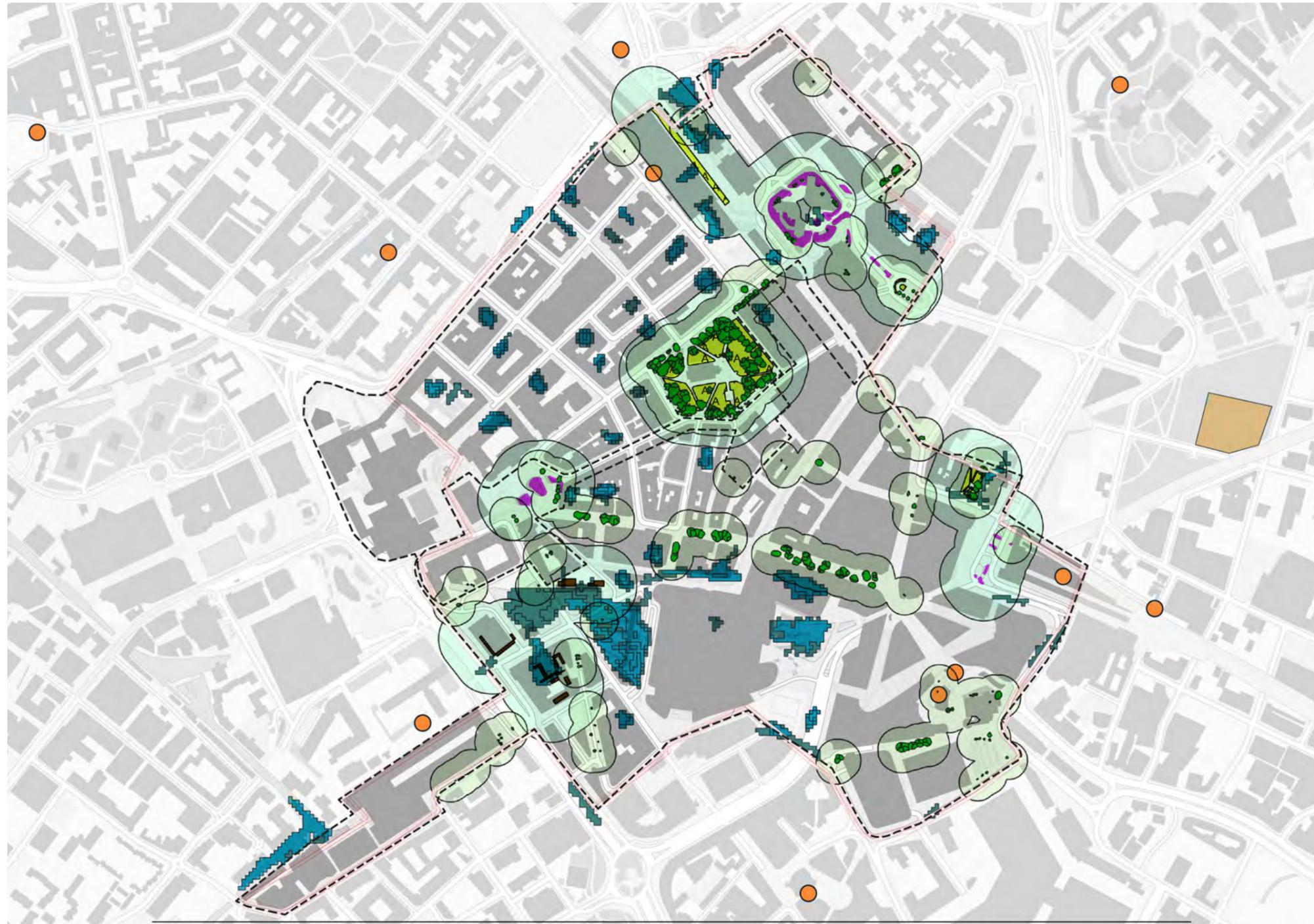
Highest building heat loss in yellow through to areas with lower heat loss in dark red

- BID Boundary
- Highest heat loss
- ↓ Lower heat loss



Appendix A.b.

Environment: Habitat/ Species & Flood Risk



- Opportunities presented**
- Improving existing habitats
 - Diversify habitats
 - Create new suitable habitats
 - Utilise SUDs to address surface water flooding issues in the future
 - Increase of tree canopy cover from 2% to 25% (BCC target)

KEY

Existing Habitats & Species

- - - BID Boundary
- Notable species record
- Open mosaic habitat

Nature Deficiency Plan

- 50m habitat buffer
- 25m canopy buffer

Flood Risk Areas

- Surface water 200 year return
- Surface water 1000 year return

Habitats

- Amenity grassland
- Introduced shrub
- Other habitat (Green roof)
- Tree Canopies



Appendix B

Green Infrastructure Intervention Schedule

No.	Name	Description	Network Component	Multifunctionality Benefits <i>Who (age, gender, cultural groups) / What: Attraction/ Wellbeing/ Biodiversity/ Climate Emergency/ Economic Recovery/ Inclusivity/ Pride/ Belonging/ Joy/ Sociability/ Resilience / Health outputs etc</i>	Size (S/M/L)	Cost range £ (>£2,000) ££ (2,001-10,000) £££ (>£10,001)	Time to implement		Level of Maintenance
1	Biodiversity Improvements to existing planting areas	<ul style="list-style-type: none"> Increasing planting density or adding species diversity, adding native nectar-rich wildlife planting and structural elements (shrubs or vertical planting) to create habitat and foraging opportunities; Opportunity of combining with other habitat elements such as loggeries or insect houses; Opportunity of tailoring areas of planting to particular target species or priority habitats e.g. night scented planting to attract moths for bats in a suitable area. 	stepping stone component	Biodiversity Connectivity, Habitat Provision	small	£-££	weeks to months	Medium <ul style="list-style-type: none"> Softscape maintenance following specific biodiversity/ habitat management plan; Includes inspections, treatments such as weed control, invasive species control, watering in dry periods, pruning, Softscape Management Strategy recommended; litter picking. 	
2	Street Tree	<ul style="list-style-type: none"> Optional in ground, in raised planter, in raised mobile planter, in raised HVM planter; Opportunity of combining with SuDs, for example using tree pits which can filter overland water flow from roads and improve water quality, as well as acting as holding area for storm water; Opportunity of combining with biodiverse planting to provide further habitat and foraging opportunities and to add aesthetic value to a street; Opportunity for dense canopies combined with for air pollution screening (refer to Appendix X); Contribution to Birmingham Urban Forest. 	linear link and stepping stone component	Biodiversity Connectivity, Habitat Provision, Water Management, Energy & Carbon, Thermal Comfort, Air Quality Extensive street tree planting may create multiple benefits to people's health and wellbeing including local air quality improvement, cooling and carbon sequestration benefits.	medium - large	££-£££	weeks (temporary) to years (permanent)	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as pruning, crown lifting, etc., replacement, weed control, watering etc. 5 Year Tree Management Strategy recommended. 	
3	Micro Woodland/ Orchard	<ul style="list-style-type: none"> Tree Bosque/ Grove of trees creating a unique area below the tree canopy; Optional in ground, in raised planters; Opportunity of combining with benches for a shaded and social amenity space with cooling effect, calming atmosphere in built up areas; Opportunity for community and interacting with nature via communal food production. Contribution to Birmingham Urban Forest. 	stepping stone component	Biodiversity Connectivity, Habitat Provision, Water Management, Energy & Carbon, Thermal Comfort, Air Quality, Sensory Wellbeing, Social Engagement, Social Interaction Great for habitat as well as placemaking,	medium	££-£££	weeks (temporary) to months (permanent)	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as pruning, crown lifting, etc., replacement, weed control, watering etc. 5 Year Tree Management Strategy recommended; litter picking; repair of street furniture. 	

Delivery Challenges							Measuring success – Minimum proposed performance measures (qualitative and quantitative)
Seasonality	Permanence	Technical considerations e.g. Impact on accessibility/ mobility; encroaching on existing assets (pavements, cycle lanes, public spaces); technical constraints such as underground utilities	Potential Approvals Planning requirements and Council sign-off	Stakeholder Consultation recommendation	Community engagement opportunities	Net carbon positive impact low / medium / high (carbon sequestration capability minus carbon cost)	
all year	permanent	<ul style="list-style-type: none"> Existing planting areas on private and public land - funding and maintenance considerations. 	n/a if on private land; BCC for Arboriculture / Green Spaces	Landowners and occupiers; BCC for adopted highways/ planning/ heritage/ urban design/ arboriculture/ green spaces/ maintenance; EA, TfWM, Local groups, BIDs, Network Rail, Diocese	Occupier/Land owner's staff involvement in design, planting and maintenance	Low - Medium (dependent on area and extent / type of planting)	<ul style="list-style-type: none"> Measuring Biodiversity Net Gain (BNG) using the Defra Biodiversity Metric 3.0; Pollinator count comparison; Pollinator provision: Over 15 species flowering at any one time; Habitat structure for invertebrates (shrub planting, pond, log piles, insect hotel, beetle banks/dry earth etc) - over 2 features per 10m2; Floral species present across ≥50% of planting area, which provide flowering throughout spring/summer (at least April to September) and provide invertebrate overwinter opportunities; Absence of invasive species; Presence of S41 or local BAP species.
all year	temporary/ permanent	<ul style="list-style-type: none"> Available space in pavements to ensure accessibility. Available space next to existing buildings. Clashes with underground utilities. Rebalancing street space by reducing carriageway widths to create space for tree planting and slow modes increases costs and timescales. 	BCC for Highways / Arboriculture / Green Spaces	Landowners; BCC for adopted highways / heritage / arboriculture / maintenance; TfWM; BIDs; The Public etc.	Adopt-a-tree-Schemes	Medium	<ul style="list-style-type: none"> % increase in number of trees & tree canopy cover in given area; Meets condition criteria of Defra Biodiversity metric 3.0 condition assessment for 'urban trees', with a score of 'Good'; Ambient temperature comparison; Air quality measurements (PM, NO2, CO); Footfall data comparison; Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison).
all year; orchards esp spring/ summer/ early autumn	temporary/ permanent	<ul style="list-style-type: none"> Available space in pavements and open spaces to ensure accessibility. Available space between existing buildings and other GI. Clashes with underground utilities. Consider rebalancing vehicular and pedestrian movement including pedestrianisation in order to create spaces. 	Highways / Arboriculture / Green Spaces	Landowners; BCC for adopted highways / heritage / arboriculture / maintenance; TfWM; BIDs etc.	Adopt-a-tree-Schemes	Medium - High (dependent on number of trees used / area of micro-forest)	<ul style="list-style-type: none"> % increase in number of trees & tree canopy cover in given area / area of habitat created; Meets condition criteria of Defra Biodiversity metric 3.0 condition assessment for 'urban trees', with a score of 'Good'; Ambient temperature comparison; Air quality measurements (PM, NO2, CO); Footfall data comparison; Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison).

4	Urban Woodland	<ul style="list-style-type: none"> As above but with a greater cluster of trees providing greater opportunities for biodiversity (bird, bat and invertebrate habitat); Preferably in ground; Opportunity of combining with permeable ground area and use for brownfield spaces; Contribution to Birmingham Urban Forest. 	base component	Biodiversity Connectivity, Habitat Provision, Water Management, Energy & Carbon, Thermal Comfort, Air Quality, Sensory Wellbeing, Social Engagement, Social Interaction Multiple benefits to people's health and wellbeing including local air quality improvement, cooling and carbon sequestration benefits. Ground permeability can contribute to flood alleviation, providing climate resilience.	large	££-£££	years	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as pruning, crown lifting, etc., replacement, weed control, watering etc. 5 Year Tree Management Strategy recommended; litter picking; repair of street furniture.
5	Vertical Forest	<ul style="list-style-type: none"> Usually high-rise buildings with tree and shrub planting integrated in facades, wintergardens and roofs providing habitats for wildlife and a green living environment for residents / workers / visitors. 	stepping stone or base component	Biodiversity Connectivity, Habitat Provision, Energy & Carbon, Thermal Comfort, Air Quality, Sensory Wellbeing Multiple benefits for internal building microclimate, carbon sequestration and oxygen production, air filtering of microparticles; Some wildlife habitat creation on lower levels;	large	£££	years	High <ul style="list-style-type: none"> Maintenance is responsibility of landowner/building owner
6	Habitat Pocket	<ul style="list-style-type: none"> Optional in ground, in raised planter, in raised mobile planter, in raised HVM planter, windowboxes, vertical planter beds; Rewilded wildlife habitat pockets / micro habitat, Floral display designed to boost the area's biodiversity with bee- and insect-friendly plants. Option to combine with beehives and bug hotels. Option for temporary installations, flexible planting strategies and community driven initiatives creating opportunities to turn under-used public spaces such as streets or 'leftover' spaces along infrastructure into joyful and biodiverse places. Option for potted planters associated with seating providing amenity value or shaded meeting places etc. 	stepping stone component	Biodiversity Connectivity, Habitat Provision, Water Management, Thermal Comfort, Sensory Wellbeing, Social Interaction Vertical planter beds - can provide shading, habitat, visual feature, air purification	small to medium	£-££	weeks (temporary) to years (permanent)	Low <ul style="list-style-type: none"> Includes inspections, treatments such as pruning, replacement, weed control, watering etc. 5 Year Softscape Management Strategy recommended; litter picking.
7	Hedgerow	<ul style="list-style-type: none"> Optional in ground, in raised planter; Opportunity for 2.5m high and 1m wide evergreen hedge for air pollution screening (refer to Appendix L); Can provide safe pedestrian environment on busy roads and prevent pavement parking; Opportunity to use native species. 	linear link component	Biodiversity Connectivity, Habitat Provision, Water Management, Energy & Carbon, Air Quality	small to medium	£-££	weeks (temporary) to years (permanent)	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as pruning, replacement, weed control, watering etc. 5 Year Softscape Management Strategy recommended; litter picking.

all year	permanent	<ul style="list-style-type: none"> · Available space in pavements to ensure accessibility. · Available space inbetween existing buildings and to other GI. · Clashes with underground utilities. Brownfield land remediation may increase costs and timescales. 	BCC for Highways / Arboriculture / Green Spaces	Landowners; BCC for adopted highways / heritage / arboriculture / maintenance; TfWM; BIDs; The Public; Wildlife Trust etc.	Adopt-a-tree-Schemes	High	<ul style="list-style-type: none"> · % increase in number of trees & tree canopy cover in given area / area of habitat created; · Meets condition criteria of Defra Biodiversity metric 3.0 condition assessment for 'woodland', with a score of 'Good'; · Absence of invasive species; · Presence of S41 or local BAP species; · Ambient temperature comparison; · Air quality measurements (PM, NO2, CO); · Footfall data comparison; · Observational monitoring of social benefits (e.g. use, users, length of stay, interaction).
all year	permanent	<ul style="list-style-type: none"> · Large land-take; · Heritage and urban design considerations; 	Planning application required	The public; BCC for adopted highways / heritage / urban desing / arboriculture; TfWM; BIDs etc.	Shared communal areas on green roofs and wintergardens; Residents involvement in design, planting and maintenance	Medium (high maintenance / irrigation requirement pulls this down)	<ul style="list-style-type: none"> · Species diversity; · Area of green coverage; · Air quality / air pollution reduction in proximity to feature; · Ambient temperature comparison; · Insulation effect (internal heating / cooling requirement); · Footfall data comparison; · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison).
spring to autumn	temporary/ permanent	<ul style="list-style-type: none"> · Available space in pavements to ensure accessibility. · Available space inbetween existing buildings and to other GI. · Clashes with underground utilities. · Rebalancing street space by reducing carriageway widths to create space for habitat pockets and slow modes increases costs and timescales. 	BCC for Highways / Arboriculture / Green Spaces	Landowners; BCC for adopted highways / heritage / arboriculture / maintenance; TfWM; BIDs, Network Rail, Diocese etc.	Involvement in design, building, planting and maintenance	Low	<ul style="list-style-type: none"> · Pollinator provision: Over 15 species flowering at any one time; · Habitat structure for invertebrates (shrub planting, pond, log piles, insect hotel, beetle banks/dry earth etc) - over 2 features per 10m2; · Floral species present across ≥50% of planting area, which provide flowering throughout spring/summer (at least April to September) and provide invertebrate overwinter opportunities; · Absence of invasive species; · Presence of S41 or local BAP species; · Footfall data comparison.
all year	temporary/ permanent	<ul style="list-style-type: none"> · Available space in pavements to ensure accessibility. · Available space inbetween existing buildings and to other GI. · Clashes with underground utilities. · Rebalancing street space by reducing carriageway widths or utilising car parking spaces to create space for hedgerow planting and slow modes increases costs and timescales. 	BCC for Highways / Arboriculture / Green Spaces	Landowners; BCC for adopted highways / heritage / arboriculture / maintenance; TfWM; BIDs etc.; WMAir	n/a	Medium	<ul style="list-style-type: none"> · Meets the minimum requirements for favourable condition from the Defra Biodiversity metric 3.0 condition assessment criteria for 'hedgerow', with a score of moderate-good; · Air quality measurements (PM, NO2, CO); · Footfall data comparison.

8	Wildflower Meadow	<ul style="list-style-type: none"> Optional in ground, in raised planter; Wildflower area - providing a place to be with connection to nature and supporting pollinators; Easy to establish in existing amenity grassland; Opportunity to provide permeable land for flood alleviation and increase in biodiversity. 	stepping stone component	Biodiversity Connectivity, Habitat Provision, Water Management, Energy & Carbon, Thermal Comfort, Sensory Wellbeing, Social Interaction	small to medium	£	weeks to months	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as mowing max. twice a year, invasive species control, watering in dry periods; 5 Year Softscape Management Strategy recommended; litter picking; repair of street furniture.
9	Amenity Grassland	<ul style="list-style-type: none"> Intensively managed lawn in parks, public gardens, sport grounds and around buildings. 	stepping stone component	Water Management, Thermal Comfort, Social Interaction	small to medium	££-£££	months to years	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as mowing, repair, weed control, watering in dry periods, Softscape Management Strategy recommended; litter picking; repair of street furniture.
10	Parklet	<ul style="list-style-type: none"> In planters or small areas of open space - tree pits or unused land / reclaiming hard landscaping. Inclusion of nectar rich planting to provide foraging ground. Inclusion of tree species with large crown spreads can provide shade and visual impact for street users and contribute to sense of place / amenity / cultural value; Opportunity to use on-street parking spaces. 	stepping stone component	Biodiversity Connectivity, Habitat Provision, Water Management, Thermal Comfort, (Air Quality), Sensory Wellbeing, Social Interaction	small	££	weeks to months	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as weed control, watering in dry periods, pruning, Softscape Management Strategy recommended; litter picking; repair of street furniture.
11	Rain Garden / Retention / Swale	<ul style="list-style-type: none"> Optional in ground, in raised planter; Used in order to reduce and slow down surface water run-off - mitigating risks of flooding and filtering pollutants - protecting water quality. Green stormwater infrastructure can include bio-swales, stormwater planters, raingardens on corners or along pavements, wall mounted stormwater planters; Plants and associated soil areas slow the movement of water and act as retention areas. They can also break down/ sequester water pollutants; The space can be multifunctional - also providing areas of biodiverse planting (habitat /foraging). 	linear link or stepping stone component	Biodiversity Connectivity, Habitat Provision, Water Management, Thermal Comfort	small to medium	££-£££	months to years	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as weeding, invasive species control, watering in dry periods, tree pruning/ crown lifting, remove and replace diseased or dead plants; 5 Year Softscape Management Strategy recommended; Remove excess sedimentation; Repair signs of erosion; Litter picking; Repair of street furniture.

spring to autumn	temporary/ permanent	<ul style="list-style-type: none"> · Available space in pavements to ensure accessibility. · Available space inbetween existing buildings and to other GI. · Clashes with underground utilities. · Rebalancing street space by reducing carriageway widths or utilising car parking spaces to create space for meadows and slow modes increases costs and timescales. 	BCC for Highways / Arboriculture / Green Spaces	Landowners; BCC for adopted highways / heritage / arboriculture / maintenance; TfWM; BIDs; Diocese etc.	Involvement in design, building, planting and maintenance	Medium (large areas of meadow grassland can provide positive carbon sequestration capability quickly)	<ul style="list-style-type: none"> · Meets condition criteria of Defra Biodiversity metric 3.0 condition assessment for 'grassland' habitat (medium-v high distinctiveness), with a score of 'Moderate-Good'; · Pollinator provision: Over 15 species flowering at any one time; · Floral species present across ≥50% of area, which provide flowering throughout spring/ summer (at least April to September); · Absence of invasive species; · Presence of S41 or local BAP species; · Footfall data comparison; · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison).
all year	permanent	<ul style="list-style-type: none"> · Available space in movement corridors to ensure accessibility. · Available space inbetween existing buildings and to other GI. · Clashes with underground utilities. · Rebalancing street space by reducing carriageway widths or utilising car parking spaces to create space for meadows and slow modes increases costs and timescales. 	BCC for Highways / Arboriculture / Green Spaces	Landowners; BCC for adopted highways / heritage / arboriculture / maintenance; TfWM; BIDs; Diocese etc.	n/a	Low	<ul style="list-style-type: none"> · Plant species diversity of >5 species; · Footfall data comparison; · Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison).
all year	temporary / permanent	<ul style="list-style-type: none"> · Available space in pavements to ensure accessibility. · Available space inbetween existing buildings and to other GI. · Clashes with underground utilities. · Rebalancing street space by reducing carriageway widths to create space for habitat pockets and slow modes increases costs and timescales. 	BCC for Highways	Landowners; BCC for adopted highways / heritage / arboriculture / maintenance; TfWM; BIDs; Diocese; The Public etc.	Involvement in design, building, planting and maintenance	Low - Medium (dependent on inclusion of / number of trees, mature shrubs or meadow)	<ul style="list-style-type: none"> · Footfall data comparison; · Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison) · Pollinator provision: Over 15 species flowering at any one time; · Habitat structure for invertebrates (shrub planting, pond, log piles, insect hotel, beetle banks/dry earth etc) - over 2 features per 10m2; · Floral species present across ≥50% of planting area, which provide flowering throughout spring/summer (at least April to September) and provide invertebrate overwinter opportunities; · Absence of invasive species; · Presence of S41 or local BAP species; · % shade cover provided by trees; · S41 or local BAP.
all year	permanent	<ul style="list-style-type: none"> · Available space in pavements to ensure accessibility. · Available space inbetween existing buildings and to other GI. · Clashes with underground utilities. · Rebalancing street space by reducing carriageway widths to create space for rain gardens/retention/swales and slow modes increases costs and timescales. 	BCC for Highways/Drainage	Landowners; BCC for adopted highways / heritage / arboriculture / maintenance; TfWM; BIDs; Diocese; The Public etc.	Involvement in design	Low	<ul style="list-style-type: none"> · Meets condition criteria of Defra Biodiversity metric 3.0 condition assessment for 'urban - raingarden / Bioswale / SuDs', with a score of 'Good'; · Footfall data comparison; · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison).

12	Green / Biodiverse Roof	<ul style="list-style-type: none"> · On new and existing roofs; · Living roofs of varied substrate depths with habitat features such as log piles, provide a variety of microhabitats encouraging biodiversity. A habitat for invertebrates and foraging ground for birds. Can target priority species through good design/planning. Can provide connectivity to other green spaces through strategic planning, providing better functioning network of wildlife. · Opportunity for cooling / insulating effect for buildings; · Opportunity for water retention function for enhanced flood resilience; · Opportunity for accessible roofs to provide amenity value of benefit to wellbeing; · <i>Buzz stops</i> (bus shelters) and other green canopies/overhead structures e.g. bin storage, covered courtyards; · Can provide shade and visual impact, cultural service / sense of place, opportunity for socialising/recreation, provide habitat and soundscape and contribute to cleaning air; · Covered courtyards - immersive experience, cooling, habitat, connection to nature habitat on unused flat 	stepping stone component	Biodiversity Connectivity, Habitat Provision, Water Management, Thermal Comfort, Sensory Wellbeing, Social Engagement, Social Interaction (Type dependant)	small to large	£-£££	months to years	Low to medium (Type dependant) <ul style="list-style-type: none"> · Includes inspections, treatments such as mowing, pruning, crown lifting, replacement, weed control, invasive species control, watering in dry periods etc. 5 Year Softscape Management Strategy recommended; litter picking; repair of street furniture/surface materials; outlets maintenance.
13	Green / Biodiverse Wall	<ul style="list-style-type: none"> · Green walls & Greened facades systems, moss walls, evergreen screens (varying heights); · Optional in ground, in raised planter; · Larger structural installations with climbers provide a new green space with multiple wellbeing benefits for users; · 5m high with evergreen species for air pollution screening (refer to Appendix L). 	stepping stone component	Biodiversity Connectivity, Habitat Provision, Thermal Comfort, Air Quality Air purification and cooling benefits, Nesting and foraging opportunities for birds.	small to large	£-£££	months to years	Medium - High (Type dependant) <ul style="list-style-type: none"> · Includes inspections, treatments such as weed/invasive plants control, replace any diseased or dead plants to achieve maximum coverage; Softscape Management Strategy recommended; top up fertiliser tank; check irrigation system and drainage; litter picking.
14	Productive Garden	<ul style="list-style-type: none"> · In the form of Allotment Planters/ Productive gardens /Growing Space / Shared garden; Rooftop or groundfloor level; · Great opportunity for social cohesion and community, benefits for mental and physical health and tackling feelings of loneliness and isolation. Creation of sense of place. Interacting with nature with psychological relaxation, physical exercise, socialising and immunity benefits; · Opportunity for multiple micro habitats for enhancing biodiversity. 	stepping stone component	Biodiversity Connectivity, Habitat Provision, Water Management, Thermal Comfort, Active Wellbeing, Sensory Wellbeing, Social Engagement, Social Interaction	small to medium	££-£££	months to years	Medium <ul style="list-style-type: none"> · Can be carried out by community groups or businesses. · Includes inspections, treatments such as weed control, watering in dry periods, pruning, Softscape Management Strategy recommended; litter picking; repair of street furniture.
15	Living Lamp Post	<ul style="list-style-type: none"> · Greening existing urban infrastructure: 'Living Pillar™' is a smart greening system designed by the Scotscape Smartscape team to retrofit London's lamp-posts or other column structures with biodiverse planting to support pollinators and improve air quality. (Pilot Scheme in Belgravia by Grosvenor) 	stepping stone component	Biodiversity Connectivity, Habitat Provision, (Air Quality), Sensory Wellbeing	small	££	months	Medium <ul style="list-style-type: none"> · Includes inspections, treatments such as weed/invasive species control, replace any diseased or dead plants; Softscape Management Strategy recommended; check smart irrigation recirculation system, top up water tank; litter picking. - Refer to supplier's recommendation.

all year	permanent	<ul style="list-style-type: none"> · Implement in designs of new buildings from the outset; · Structural survey (roofs, walls and foundations) for existing buildings required; · Consider constraints by slope/pitch of roofs; · Consider accessibility; · Consider drainage strategy; · Consider fire safety; · Can aid with BREEAM certification. 	Permitted development rights may be withdrawn in Conservation Areas	Landowners; BCC for adopted highways / heritage / arboriculture / maintenance; TfWM; BIDs; Network Rail; NCP etc.	Occupier / Land owner's staff involvement in design, planting and maintenance	Low - Medium (dependent on area /size and level of planting achieved - productive meadow grassland could provide sequestration capability)	<ul style="list-style-type: none"> · Meets condition criteria of Defra Biodiversity metric 3.0 condition assessment for 'urban - intensive green roof', with a score of 'Good'; · Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); · Measuring economic impact (e.g. Business occupancy rates comparison).
all year	temporary / permanent	<ul style="list-style-type: none"> · Implement in designs of new buildings from the outset; · Structural survey (walls and foundations) for existing buildings required; · Ensure 1.8m pavement is maintained throughout; · Consider interface with public realm; · Consider fire safety; · Can aid with BREEAM certification. 	Permitted development rights may be withdrawn in Conservation Areas	Landowners; BCC for adopted highways / heritage / arboriculture / maintenance; TfWM; BIDs; Network Rail; NCP; WMAir etc.	Occupier / Land owner's staff involvement in design	Medium (dependent on area / size)	<ul style="list-style-type: none"> · Meets condition criteria of Defra Biodiversity metric 3.0 condition assessment for 'urban - green wall', with a score of 'Good'; · Air quality measurements (PM, NO2, CO); · Footfall data comparison; · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison).
all year	temporary / permanent	<ul style="list-style-type: none"> · Implement in designs of new buildings from the outset; · Structural survey (walls and foundations) for existing buildings required; · Consider interface with public realm; · Consider fire safety. 	BCC for Highways / Green Spaces	Landowners; BCC for adopted highways / heritage / arboriculture; TfWM; BIDs; Network Rail; NCP etc.	Involvement in design, building, planting and maintenance	Low	<ul style="list-style-type: none"> · Meets condition criteria of Defra Biodiversity metric 3.0 condition assessment for 'urban - allotments', with a score of 'Good'; · Footfall data comparison; · Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison).
all year	permanent	<ul style="list-style-type: none"> · Available space in pavements to ensure accessibility. · Available space inbetween existing buildings and to other GI. · Clashes with underground utilities/ foundations. · Rebalancing street space by reducing carriageway widths to create space for Living Lamp Posts and slow modes increases costs and timescales. 	BCC for Highways/Lighting	Landowners; BCC for adopted highways / heritage / urban design / arboriculture / maintenance; TfWM; BIDs etc.	n/a	Low (unlikely to provide significant amount of planting - small space)	<ul style="list-style-type: none"> · Pollinator count comparison; · Footfall data comparison; · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison).

16	Water Feature and Play	<ul style="list-style-type: none"> Community space / recreation; Can be associated with naturalised water features and aquatic planting; Multifunctioning as water retention / flood alleviation. 	stepping stone component	Water Management, Thermal Comfort, Active Wellbeing, Social Engagement, Social Interaction	medium	£££	months to years	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as cleaning/silt & dead plants removal, water plants replacement, weed/algue control, invasive species control, water level refill, repair leaks, ice control in winter, ensure correct aeration levels and water quality, etc. 5 Year Water feature Management Strategy recommended; check pumps, filters, lines and fountains; repair/replace play equipment; litter picking.
17	Green Play Space	<ul style="list-style-type: none"> Optional in ground, in raised planter; Community space, recreation, chance for people to interact and socialise; Provision of a play space combined with high quality greening (vertical planting, trees, biodiverse wildflower planting); Opportunity for Public Art. 	stepping stone component	Biodiversity Connectivity, Habitat Provision, Thermal Comfort, Active Wellbeing, Social Engagement, Social Interaction Encourage people to spend time in green spaces with multiple benefits for wellbeing (social, shaded, improved local air quality, immunity benefits, biodiversity education)	medium to large	£-£££	months to years	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as mowing, pruning, crown lifting, replacement, weed control, invasive species control, watering in dry periods etc. 5 Year Softscape Management Strategy recommended; litter picking; cleaning/repair of play equipment/ street furniture/surface materials. - Refer to ROSPA guidelines.
18	Wildlife Pond	<ul style="list-style-type: none"> Optional in ground, in raised planter; New GI typology that is not existing in the city core; Community space, recreation, chance for people to interact and socialise; Provision of aquatic habitat with enhance biodiversity by creating habitat and foraging opportunities; Opportunity for urban cooling; Opportunity for rainwater / surface water attenuation / flood risk reduction; Opportunity for nature education / experience. 	stepping stone component	Biodiversity Connectivity, Habitat Provision, Water Management, Thermal Comfort, Sensory Wellbeing, Social Engagement, Social Interaction	medium	££	months to years	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as cleaning/silt & dead plants removal, water plants replacement, weed/algue control, invasive species control, water level refill, repair leaks, ice control in winter, ensure correct aeration and water chemistry levels, etc. 5 Year Pond Management Strategy recommended; check pumps, filters, lines and fountains; litter picking.
19	Queensway Life Belt (New Urban Park)	<ul style="list-style-type: none"> New urban park in an area with lack of large green spaces; Accommodation of all slow modes (walking / cycling) and public transport, making walking and cycling and public transport use more attractive as a preferred mode of transport; Bold statement to extent the Green City vision for Birmingham into the dense city core; Removal of the concrete collar restricting access between the city core and adjacent neighbourhoods; Opportunities for biodiversity / amenity / climate resilience; Opportunity for Public Art; Contribution to Birmingham Urban Forest. 	base component	Biodiversity Connectivity, Habitat Provision, Water Management, Thermal Comfort, Air Quality, Sensory Wellbeing, Social Engagement, Social Interaction	large	£££	years	Medium <ul style="list-style-type: none"> Includes inspections, treatments such as mowing, pruning, crown lifting, replacement, weed control, invasive species control, watering in dry periods etc. 5 Year Softscape Management Strategy recommended; litter picking; repair of street furniture/surface materials.

spring to autumn	permanent	<ul style="list-style-type: none"> · Available space in pavements and open spaces to ensure accessibility. · Available space inbetween existing buildings and to other GI. · Clashes with underground utilities/foundations; · Pump equipment and water tank room. 	BCC for Highways / Green Spaces and as appropriate; ROSPA.	Landowners; BCC for adopted highways / heritage / urban design / arboriculture / maintenance; TfWM; BIDs; The Public etc.	Involvement in design	Low (dependent on planting associated with the water play area)	<ul style="list-style-type: none"> · Footfall data comparison; · Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Staff return data, Local job creation data comparison); · Aquatic planting present; · Native, diverse, surrounding planting present; · Ambient temperature comparison.
all year	temporary / permanent	<ul style="list-style-type: none"> · Available space in pavements and open spaces to ensure accessibility. · Available space inbetween existing buildings and to other GI; · Clashes with underground utilities. 	BCC for Highways / Green Spaces and as appropriate; ROSPA.	Landowners; BCC for adopted highways / heritage / urban design / arboriculture / maintenance; TfWM; BIDs, The Public etc.	Involvement in design	Low - Medium (dependent on planting associated with the play area)	<ul style="list-style-type: none"> · Footfall data comparison; · Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison); · Ambient temperature comparison.
all year	permanent	<ul style="list-style-type: none"> · Available space in pavements and open spaces to ensure accessibility. · Available space inbetween existing buildings and to other GI. · Clashes with underground utilities/foundations. 	BCC for Highways / Green Spaces and as appropriate.	Landowners; BCC for adopted highways / heritage / urban design / arboriculture / maintenance; TfWM; BIDs; Wildlife Trust etc.	Involvement in design	Low	<ul style="list-style-type: none"> · Meets condition criteria of Defra Biodiversity metric 3.0 condition assessment for 'pond', with a score of 'Moderate-Good'; · Footfall data comparison; · Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison).
all year	permanent	<ul style="list-style-type: none"> · Ensure accessibility throughout. · Available space inbetween existing buildings and to other GI; · Clashes with underground utilities/foundations; · Rebalancing street space by reducing carriageway widths to create space for a new urban park, slow modes, public transport requirements and traffic management may increase costs and timescales. 	BCC for Highways / Green Spaces and as appropriate; TfWM.	Landowners; BCC for adopted highways / heritage / urban design / arboriculture / maintenance; TfWM; BIDs; The Public etc.	Friends of the Queensway Life Belt; Involvement in design, planting and maintenance	High	<ul style="list-style-type: none"> · Footfall data comparison; · Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison); · Ambient temperature comparison; · Air quality measurements (PM, NO2, CO); · Pollinator provision: Over 15 species flowering at any one time; · Habitat structure for invertebrates (shrub planting, pond, log piles, insect hotel, beetle banks/dry earth etc) - over 2 features per 10m2; · Floral species present across ≥50% of planting area, which provide flowering throughout spring/summer (at least April to September) and provide invertebrate overwinter opportunities; · Absence of invasive species; · Presence of S41 or local BAP species; · % increase in shade/canopy cover provided by trees.

20	Community Pocket Park	<ul style="list-style-type: none"> In planters or small areas of open space, tree pits or unused land / reclaiming hard landscaping. Inclusion of nectar rich planting to provide foraging ground. Tree species with large crown spreads can provide shade and visual impact for street users and contribute to sense of place / amenity / cultural value. Run by volunteer/ NPO community groups integrating residents/workers in community activities and provide a platform for exchange/ interaction/ education/ relaxation. Contribution to Birmingham Urban Forest. 	stepping stone component	Biodiversity Connectivity, Habitat Provision, Water Management, Thermal Comfort, Air Quality, Sensory Wellbeing, Social Interaction	Small	££	Weeks to years	Medium <ul style="list-style-type: none"> Can be carried out by community groups. Includes inspections, treatments such as mowing, pruning, crown lifting, replacement, weed control, invasive species control, watering in dry periods etc. 5 Year Softscape Management Strategy recommended; litter picking; repair of street furniture/surface materials.
21	Tramway Greening	<ul style="list-style-type: none"> Retrofit grass or sedum mats inbetween and alongside tram track; Opportunity for urban cooling and rainwater / surface water attenuation / flood risk reduction. 	linear link component	Biodiversity Connectivity, Water Management, Thermal Comfort	large	£££	Years	Low <ul style="list-style-type: none"> Includes inspections, treatments such as mowing, replacement, weed control, invasive species control, watering in dry periods etc. 5 Year Softscape Management Strategy recommended; litter picking.
Other recommended interventions to accompany GI interventions								
1	Interpretation	<ul style="list-style-type: none"> Education QR code - scan for access to manifesto and educational information about habitats/species/natural history; Promotion of informative walking routes through the city core; Opportunity for public art. 	n/a	Social Engagement ; Creating a strong sense of place/ belonging, nature awareness and experience	Small	£-££	weeks to months/years	Low <ul style="list-style-type: none"> Repair or replacement if necessary
2	Loggeries, bee posts / bricks / habitat panels, bird and bat boxes / bricks	<ul style="list-style-type: none"> Habitat features in areas of planting / large planters (bee bricks, loggeries, insect hotels) and onto trees, urban micro forests, sides of buildings, roof eaves (bird and bat boxes / bricks), in parklets (bee posts, habitat panels), vertical planting (livings walls / trellises can have insect hotels or bird/bat boxes incorporated); Variety of items on the market or built in community events; Opportunity for public art. 	n/a	Habitat provision to be incorporated where appropriate/ in most proposed interventions above.	small	£	weeks to months	Low <ul style="list-style-type: none"> Repair or replacement if necessary

all year	temporary / permanent	<ul style="list-style-type: none"> · Available space in pavements, open spaces, 'left-over' land or brownfield land to ensure accessibility; · Available space inbetween existing buildings and to other GI; · Clashes with underground utilities/foundations; · Rebalancing street space by reducing carriageway widths to create space for · Community Pocket Parks, slow modes, public transport requirements and traffic management may increase costs and timescales. 	BCC for Highways / Green Spaces and as appropriate; TfWM.	Landowners; BCC for adopted highways / heritage / urban design / arboriculture / maintenance; TfWM; BIDs; The Public etc.	Involvement in design, building, planting and maintenance	Low - Medium (dependent on planting associated with the play area)	<ul style="list-style-type: none"> · Footfall data comparison; · Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison) · Pollinator provision: Over 15 species flowering at any one time; · Habitat structure for invertebrates (shrub planting, pond, log piles, insect hotel, beetle banks/dry earth etc) - over 2 features per 10m2; · Floral species present across ≥50% of planting area, which provide flowering throughout spring/summer (at least April to September) and provide invertebrate overwinter opportunities; · Absence of invasive species; · Presence of S41 or local BAP species; · % shade/canopy cover provided by trees.
all year	permanent	<ul style="list-style-type: none"> · Ensure accessibility across; · Available space inbetween existing buildings and to other GI; · Clashes with underground utilities/foundations; · Rebalancing street space by reducing carriageway widths to create space for greening along the tram tracks, slow modes, public transport requirements and traffic management may increase costs and timescales. 	TfWM; BCC Highways	BCC for adopted highways / heritage / urban design / arboriculture / maintenance; TfWM; BIDs; The Public etc.	Involvement in design	Medium	<ul style="list-style-type: none"> · Footfall data comparison; · Observational monitoring of social benefits (e.g. use, users, length of stay, interaction); · Measuring economic impact (e.g. Spending data comparison, Business occupancy rates comparison, Local job creation data comparison) · Plant species diversity of >5 species · Ambient temperature comparison.
all year	permanent	<ul style="list-style-type: none"> · Ensure pedestrian movement not compromised; · Integrated into intervention design from the outset. 	BCC Highways	BCC for adopted highways / heritage / urban design / maintenance; TfWM; BIDs etc.	Involvement in design, building and maintenance	n/a	n/a
all year	permanent	<ul style="list-style-type: none"> · Ensure pedestrian movement not compromised; · Integrated into intervention design from the outset; 	n/a	BCC for adopted highways / heritage / urban design / ecology / maintenance; TfWM; BIDs etc.	Involvement in design, building and maintenance	low	n/a

Appendix C

Proposed Scales of Measurement

Monitoring and Measuring for 'Going Green'

Any effects of the proposals in the Going Green Masterplan may be measured and evaluated based on 3 different approaches to data gathering and recording, which are as follows:

1. After installation of intervention(s) - No comparison with the 'before' possible. This, however, can still provide information on the intervention(s)' quality.
2. Before and after installation of Intervention(s) - Comparison will provide information on positive change.
3. Before and after installation of Intervention(s) and comparison with a control site (similar street/space with no interventions) providing information on positive change.

Additionally, the data gathering/ measurements after installation of intervention(s) can be undertaken at specific mile stones in the life of the intervention(s), e.g. year 1, 5, 15, 30 of maturing tree planting, or after removal of temporary installations.

The following methods of measuring success of the proposed Going Green Masterplan and the Green Infrastructure intervention(s) are optional and provide more detail on the scales of measurement in the Green Infrastructure Intervention Schedule in Appendix B.

Impact on Biodiversity

Ecological surveys establish the presence of specific species and habitats in the study area and give information about the value of installation(s) in the context of biodiversity increase/net gain and target species.

Surveys can include:

- Measuring Biodiversity Net Gain (BNG)

using the DEFRA Biodiversity Metric 3.0 and achieving minimum score '(Moderate-) Good';

- Pollinator count comparison;
- Pollinator provision: Number of species flowering at any one time;
- Habitat structure for invertebrates (shrub planting, pond, log piles, insect hotel, beetle banks/dry earth etc.) - over 2 features per 10m2;
- Floral species present across ≥50% of planting area, which provide flowering throughout spring/summer (at least April to September) and provide invertebrate overwinter opportunities;
- Absence of invasive species;
- Native, diverse, surrounding planting present;
- Presence of S41 or local BAP species.

Impact on Climate and Microclimate

- Offsetting of Carbon through Carbon sequestration and storage in biomass can be established by using Carbon

Performance Certificates of tree species for plant selection e.g. by the Barcham Carbon Performance Project (<https://www.treeconomics.co.uk/projects/barchamcarbonperformanceproject/>)

- Environmental Product Declarations (EPDs) (ISO 14025) of products used for proposed interventions can help to quantifiably demonstrate the environmental performance of a product, including carbon footprint.
- The free online tool Pathfinder by Climate Positive design (<https://climatepositivedesign.com/pathfinder/>) helps to design projects to remove more carbon from the atmosphere than they emit by reducing carbon footprints and increasing sequestration.

The following activities have been developed in consultation with the WM-Air team and UoB colleagues, outlining what could be undertaken as part of the design phase, to monitor and measure air quality and urban heat in relation to green infrastructure, along with some areas to discuss as part of the next phase.

It also summarises the approach outlined by the university for on-site monitoring and measuring of the direct impacts of green infrastructure (GI) interventions, which would need to be designed for specific locations to ensure that results are attributable to the GI intervention.

This is based on email correspondence from the University of Birmingham and the document produced by the university and provided as part of the correspondence ('Colmore BID & Retail BID 'Going Green Programme': Air Quality, Urban Heat and Green Infrastructure input from WM-Air').

1. Desk-based assessment: The following

activities represent desk-based, modelling, quantitative and qualitative assessments which can be used to predict the impact / benefits of green infrastructure interventions at specific locations.

This currently relates to air quality, but guidance is currently being developed relating to urban heat island effect. This work does not include site-based measurements at this stage.

- Air Quality Monitoring:

Generate air quality (NO2 and PM2.5) maps for the area of interest, to identify the regions with higher air pollution levels, by running a baseline ADMS-Urban (Atmospheric Dispersion Modelling System) model.

This could be applied to specific areas by running the ADMS model zoomed in to area of interest.

- Green Infrastructure Guidance:

WM-Air Urban Design and GI Strand in collaboration with the University of Birmingham can provide general guidance on green infrastructure, including:

1. Understanding the impact of green infrastructure on air quality in and around specific interventions.
2. Practical guidance to designing interventions for specific locations to achieve better air quality.
3. The application of Green Infrastructure for Roadside Air Quality (GI4RAQ).

The GI4RAQ Platform software (www.GI4RAQ.ac.uk) can be used to help towns and cities use street-planting / green infrastructure to reduce citizens' exposure by redistributing pollution by changing air currents within streets and beside



open roads.

This software can provide quantitative estimates of the site-specific impacts of particular roadside interventions (e.g. hedges beside select lengths of a subset of suitable streets).

In addition, the GI4RAQ Guidance & Decision Tree, developed with Transport for London, (now publicly available at <http://epapers.bham.ac.uk/3398/>) can be used to explore and justify, on a qualitative basis, potential interventions lying outside the scope of the GI4RAQ Platform.

2. Monitoring on Site

The following activities presents an approach to measuring environmental benefits on site, before and after GI intervention installation, outlined by the UoB.

- The WM-Air/Urban Observatories project currently have a number of sensors measuring air quality and weather across Birmingham (<https://birminghamurbanobservatory.com>), however, none located within the Colmore BID.
- A long-term monitoring station (e.g. 20-30 years) in the city centre would provide a valuable resource for the city, particularly as high temperature and intense / heavy rainfall events are likely to become more common. This would require some long-term maintenance to make sure the measurements remain valid.

Further to the above work around air quality with WMAir and UoB, the consultant team developed the following proposals for measuring impact of the Going Green Masterplan:

- Noise monitoring from roads and other

emitters is needed to control noise levels in the city core and can help to set limits for different times of the day. Also, the perception of urban noise can be influenced by Green Infrastructure and Green Spaces.

- Climate resilience and adaption of urban streets/spaces creates a future-proof environment that is required to protect the city core from the effects of climate change.
- The measurement and comparison of ambient temperature outdoors and inside buildings adjacent to GI intervention(s) would provide information on the Heat-Island-Effect in Birmingham's city core. It would highlight the impact the GI interventions (e.g. green roofs/walls and tree planting) have by shading and decreasing hard surfacing in streets/spaces and buildings façades.
- Water quality monitoring in SUDS can provide the assurance that SUDS are beneficial in filtering surface water run-off before releasing it into the soil/water cycle.

Monitoring Equipment required	Indicative Cost
Air quality Zephyrs. NB: An AQ intervention would require at least 4 sensors	Approx. £5k (plus £1600 per year renewal fee) per instrument
Weather stations (heat, rainfall etc.)	Approx. £5k (plus £500 per year renewal fee) per instrument.
'e-motes' - air quality and noise pollution monitors	UoB have 5 of these available for monitoring

Impact on Wellbeing

The BIDs could initiate staff/visitor surveys on mental health and wellbeing based on the assessment tools below.

- WHO (5) Wellbeing Index (<https://www.psykiatri-regionh.dk/who-5/who-5-questions/Pages/default.aspx>)
- The Warwick-Edinburgh Mental Well-being Scale (WEMWBS) (<https://warwick.ac.uk/fac/sci/med/research/platform/wemwbs/>)

The WHO has developed a range of tools to analyse the wellbeing of city dwellers:

- Health economic assessment tool (HEAT) for walking and for cycling (World Health Organization 2017)
- Health Impact Assessment Toolkit for Cities (World Health Organization 2005)

Social Impacts

Behaviour and user experience analysis or Social Impact analysis could be carried out before and after implementation of interventions.

- Urban designers and researchers Gehl have developed a range of Public Life Tools (<https://gehlpeople.com/tools/how-to-use-the-public-life-tools/>) that are suitable to establish any change in use, demography of users or how a street/space is perceived. Survey methods include mapping (e.g. street furniture, assets, etc.), counting (e.g. footfall alongside age and gender, modes of movement, at different times of the day, short or long timescales) or undertaking interviews about the street's/space's quality and perception. It is recommended to complete the findings with community

engagement and partners to ensure local knowledge supports the analysis results.

- Footfall data (collected pre/during Covid/post return to work date) and post installation based on electronic footfall counters (e.g. Springboard, <https://www.spring-board.info/>) or mobile signal data (e.g. <https://townandplace.ai/>) would provide an insight of the city centre's recovery and any change of use of streets and spaces following the implementation of specific interventions or groups of interventions.
- Review of local crime rates including anti-social behaviour (e.g. <https://crimerate.co.uk/west-midlands/birmingham>) and Perception of personal safety statistics (e.g. Data from the Opinions and Lifestyle Survey (OPN) on perceptions of personal safety in different settings).

Economic Impacts

- Measuring business activity (by e.g. consumer purchasing habits or spending data through credit card data)
- Additionally, the BIDs could undertake BID members surveys to monitor changes in land and property values, rents, or impact on sick leave, employee retention/job creation and productivity.
- There is the option to engage a consultant to undertake a calculation of the economic values of the ecosystem services of the proposed interventions, e.g. monetary values. It is assumed that only economic value of human benefits can be assessed in monetary terms. This then can be used to communicate the economic value and scarcity of nature in cities.

Appendix D

Context - WMNP



West Midlands National Park Lab
Awards Programme



Context

Projects being considered for the West Midlands National Park Awards will be assessed against the following categories and ethos developed by the WMNP Lab:

- IMPROVING QUALITY OF LIFE
- EXPRESSION OF IDEAS TO SHAPE THE QUALITY OF EXPERIENCE
- DEMONSTRATION OF INNOVATION, EXPERTISE AND DESIGN QUALITY
- PRODUCTIVE USE OF ALL LAND
- ADDRESSING CLIMATE EMERGENCY
- SEEING THE BIGGER PICTURE
- CREATING COMMUNITY RESILIENCE
- ADDRESSING INSTITUTIONAL GOVERNANCE

Appendix D

Context - WMNP



CONTEXT The West Midlands National Park (WMNP) is a 30-year vision for a new kind of National Park. An integrated and holistic economic, social and environmental strategy, incorporating all of the land in the West Midlands and all aspects of land use, it is about transformation as much as conservation and preservation; working with local authorities, businesses, schools and communities to build self-confidence and a renewed identity.

Figure 1

Topography, rivers, canals: the centre of Birmingham on the high ground overlooking the Rea and the Tame valleys.

© Kathryn Moore



Appendix D

Context - WMNP

ETHOS

The ethos of the WMNP, set out in the WNNP Awards programme (see below), encourages working across silos, disciplines and practices – and beyond red-line ownership boundaries. Discovering landscape where you thought it couldn't be, it creates a spatial vision to engage communities and provide a compelling narrative to support convincing actions. Integrating regional and local strategies and aspirations to create something that is more than the sum of its parts, and is already inspiring and provoking new ways of thinking across the region.

Mapping and research by the WMNP-Hub reveals the historical and geographical significance of the Colmore and Retail BIDs in Birmingham (fig.1). Located on the elevated, dry sandstone ridge that is the backbone of the city, focused on St Philip's Cathedral, it is Birmingham's civic, cultural and commercial heart. Occupying the high ground, the area would have once had commanding views over three valleys, including the Tame and the Rae, and distant views of the surroundings and horizons including Gravelly Hill, Barr Beacon and beyond.

The undulating topography of the city, subsumed over the decades by development, was heavily obscured by the Inner Ring Road completed in 1971 (fig. 2).

Although removal of the Masshouse Circus section in 2002 and other interventions "broke" the concrete collar, it still physically and conceptually isolates the BIDs from the surrounding city. Impacting dramatically on the quality of the air, accessibility, identity and environment of the city centre, limiting the leverage to bring in high quality development and to attract global talent. We were asked recently – "why would I want to live in Birmingham – it is so ugly?".

As the city transforms, and particularly in response to the pandemic, building densely and at such scale can no longer be seen as the default position to increase its economic basis. Rather than continuing to pack in development to support the city's infrastructure needs, there is the opportunity to change mindsets, grow in a better way, build new models of finance and governance with selected partners (including the NHS, EA and others), and recognise the great advantage that could come with the territory – taking the high ground to lead the way both literally and metaphorically. Cutting through the critical spatial problems created by the Inner Ring Road will enable the BIDs to stretch beyond the concrete collar and embrace the surrounding communities. Adopting such a visionary approach to transformation, preparing for the climate emergency and putting quality of life and quality of environment at the top of the agenda, will enable citizens to access, live and work in the city with pride. No more cosmetic cover ups. The Colmore and Retail BIDs is ideally placed to drive this agenda forward with its partners. It will change our global identity and benefit our economy.

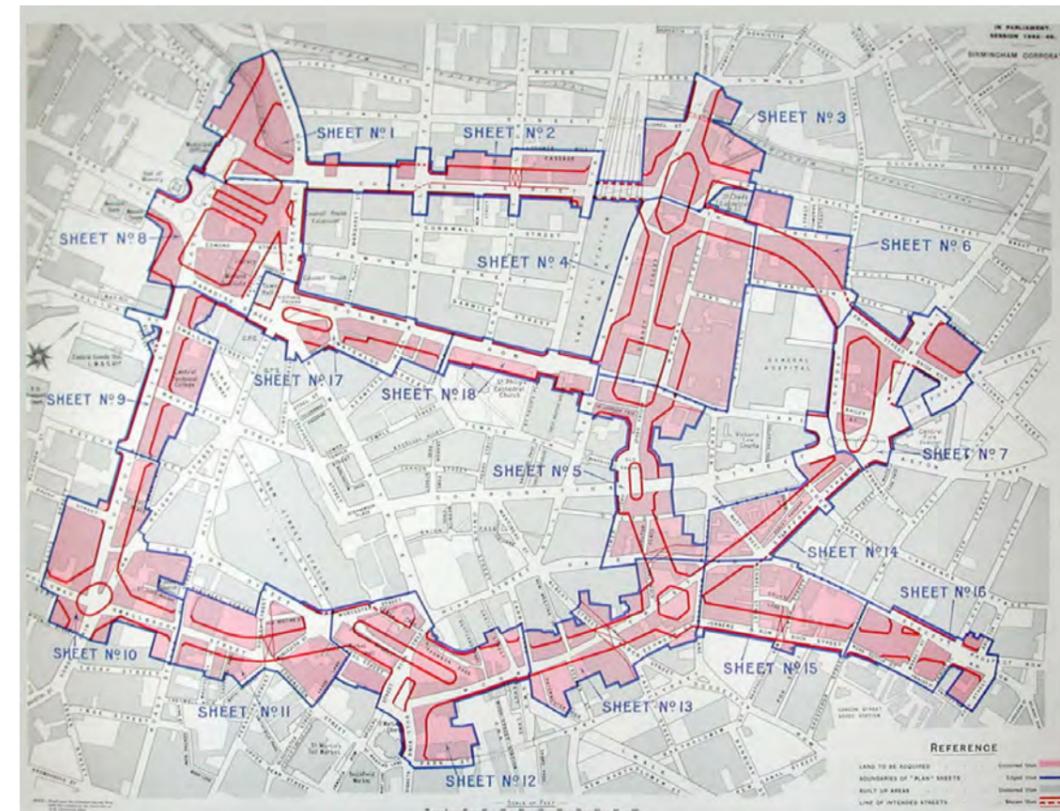


Figure 2
Inner Ring Road route and property to be purchased (darker shading) The road was completed in 1971.
© Birmingham City Council

SPECIFIC PROPOSALS

THE RING PARKS

Birmingham comprises a series of rings of significant landscape infrastructure – the canals, rivers, its existing parks, the Edwardian Fringe Belt – (fig.3) in addition to its designation as a City of Nature, City of Trees and its international status as a Biophilic City. It also has significant swathes of land that will become available as the inner Ring Road is decommissioned. The BIDs is ideally placed to initiate the development and delivery of the Inner Ring Parks as part of the WMNP – a world class sequence of parks and squares, foot and cycle paths, (see <https://www.researchcatalogue.net/view/1088641/108871>), to enable the city to transform.

CLIMATE EMERGENCY

Preparing the city for the climate emergency through a series of detailed measures including the Mayors Round Table (through NULA), urban tree planting, and a substantive system of sustainable urban drainage that takes advantage of the slopes that encircle the BIDs (see fig.4 overleaf. These will help cleanse Birmingham's endangered aquifer, reduce flooding downstream, and address problems created by combined sewers. Other measures demonstrated by NULA <https://www.bcu.ac.uk/architecture-and-design/research/catid/projects/new-landscape-alliance>)



Figure 3
Detail of the Ring Parks proposal, with the Birmingham City Centre Park, the Inner Ring Parks, the encircling Canal system (pink), the river network (blue) and the remnants of the Edwardian Fringe Belt (olive ellipses).

© Kathryn Moore

Appendix D

Context - WMNP

CREATING IDENTITY

A series of protected views looking up and across to the city centre will make visual connections with its locale and reinforce the city's topography. In turn, views out from the city centre to the surrounding horizons (including the north west) help reconnect communities with the forgotten landscape. Layered and annotated historical maps, and an interactive app bringing together audio and visual narratives will attract visitors to undertake self-guided walking tours around the city centre (fig. 4).

CHARACTER, CULTURE AND TOPOGRAPHY

Celebrating and upgrading the quality and character of the BID's green infrastructure will provide shade and increase biodiversity. Connecting to local and regional long-distance paths and improving access to and from the city centre for surrounding communities will help address physical and mental health concerns. Celebrating the culture, history and topography of the BIDs, and responding to the agricultural hinterlands to the north, south, east and west of the region also gives people a renewed and grounded sense of identity. The WMNP vision helps address health inequalities and improve environmental, social and spatial justice of the city as a whole. The city centre can expand as was envisaged a decade ago, but this time with the benefit of hindsight we can do so through a careful curation of its landscape and the creation of a new identity to attract inward investment.



Figure 4
Existing infrastructure - the impermeability of the concrete collar and the middle ring road, the canal system (dashed red line) HS2 Curzon Street, St Philip's, with its uneasy spatial relationship to St Pauls, and the very difficult relationship between New Street Station and Eastside. The viewshed

6 COLMORE AND RETAIL BIDS IN THE CONTEXT OF THE WMNP

THE DISLOCATED CITY

The critical spatial dislocations created by the remaining sections of the 'concrete collar' and past planning decisions need to be addressed as a matter of urgency if we are to revitalise the city centre. These should include: connecting the four stations; dealing more robustly with the tunnel from New Street station to Eastside; and the entrance to the city centre from HS2. Strategic connections need to be re-thought, including: connecting the Mailbox, Alpha Tower and the Council House; the City Centre to the Jewelry Quarter; and the Gun Quarter, Lancaster Circus, Digbeth and Eastside to the heart of the city. It's vital that these are seen not as peripheral to, but integral to the Colmore and Retail BIDs. Integral in fact, to the success of the city – its levelling up agenda, the green recovery and future prosperity (fig. 5).

Activating this vision will involve targeted research, visioning workshops, and events to show how the Colmore and Retail BIDs puts quality of life and quality of environment at the top of the agenda. Strategic leadership from the WMNP-lab's team of specialists will direct and support the translation of ideas and vision into tangible transformation of the Colmore and Retail BIDs as part of an integrated city.

Proposals beyond the current scope and footprint of the Colmore and Retail BIDs remain commercially confidential and subject to Birmingham City University copyright.

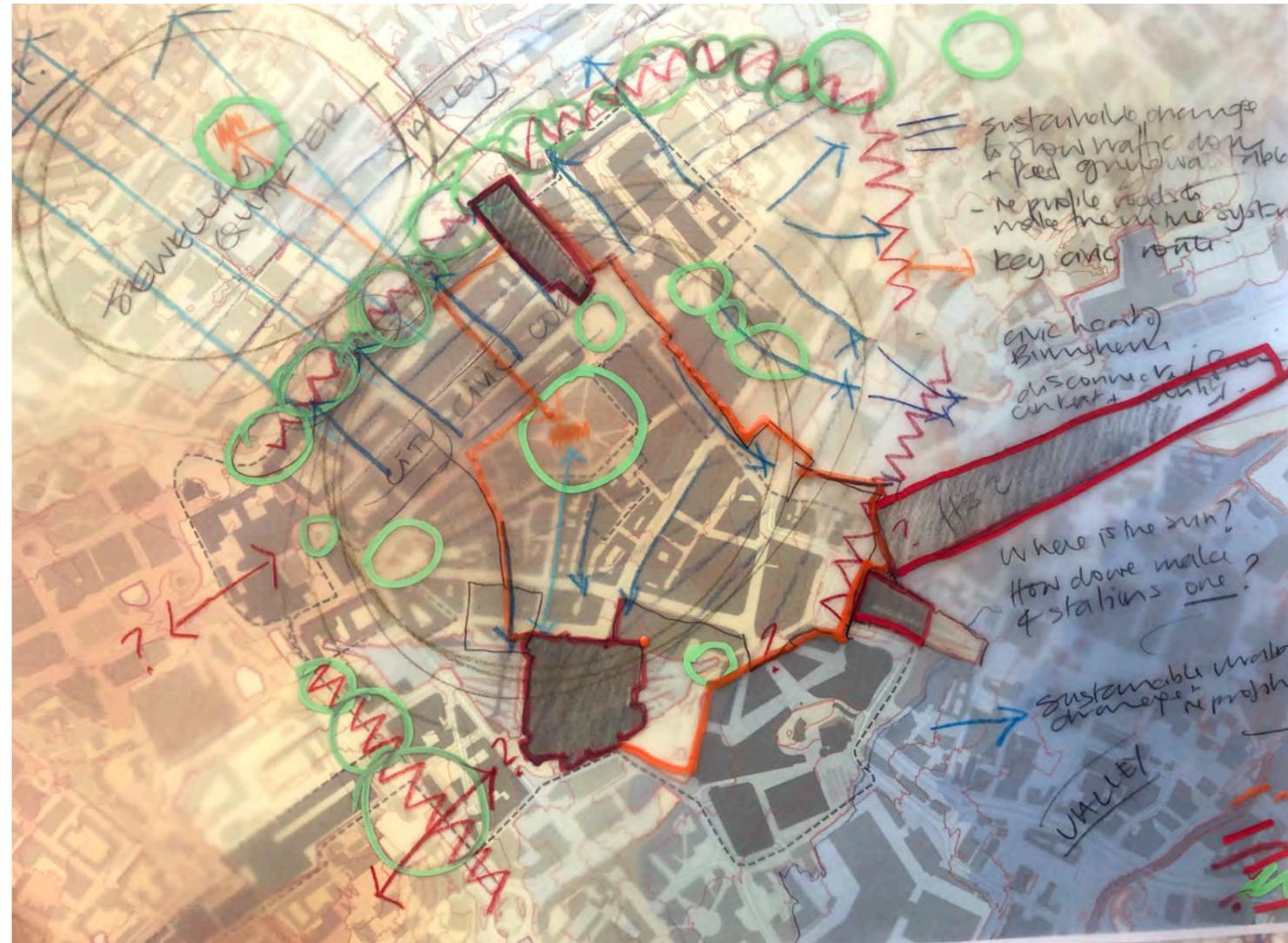


Figure 5

(Red zig zags) show the hemming in of the BIDs by the concrete collar and the alternative possibility of using the space of the to create a sequence of parks and squares, improving access, permeability of the BIDs, reducing air pollution, improving biodiversity, physical and mental well being and embracing local communities currently detached by the "city wall". Conceptualising the 4 separate stations as one for Birmingham. (The blue lines indicate views to the horizons. The topography gives ample opportunity for comprehensive SUD/ revised drainage system at scale in the heart of the city hand in hand with the planting of linear urban forests.

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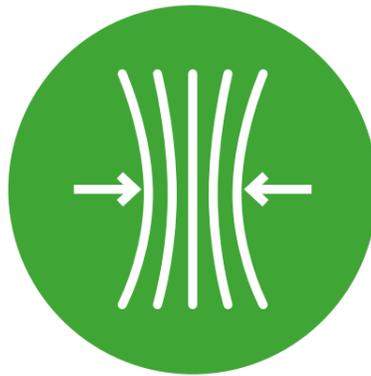
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Appendix E

Green Infrastructure Benchmarking Report

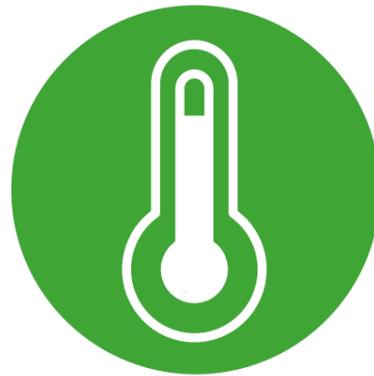
Green Infrastructure Trends - Top 5



Resilience
(Pandemic impacts/
Changes to
Highstreet/ City
Centre)



Health and Wellbeing



**Climate Adaption and
Mitigation**



**Increasing
Biodiversity**



Creating Communities

Green Infrastructure Trends

Benchmarking



Green Victoria

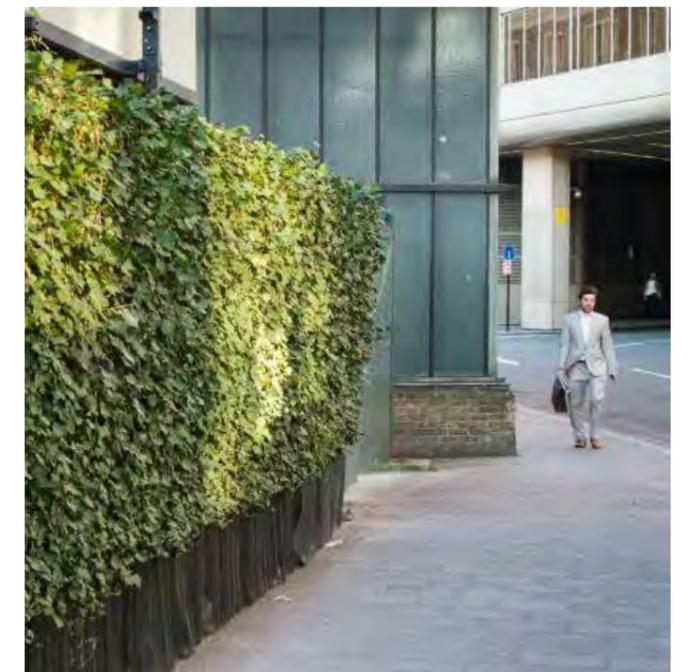
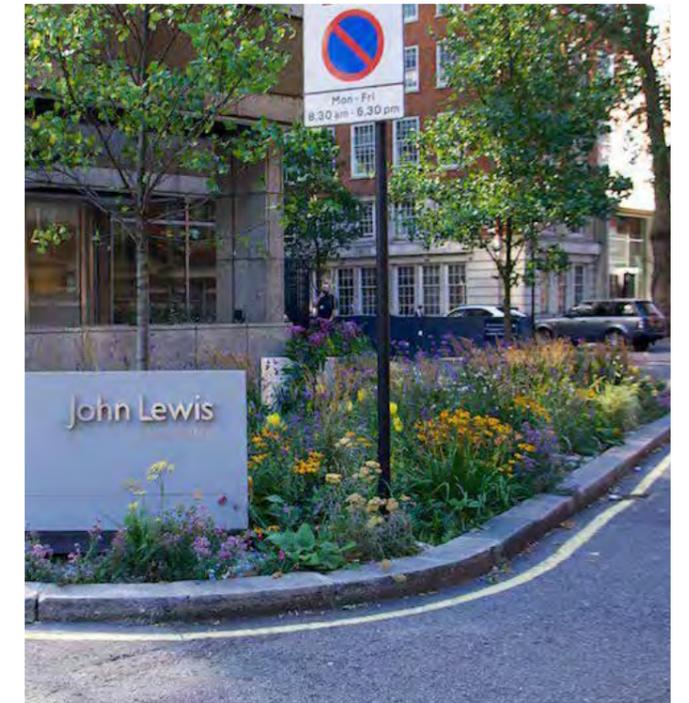
Improving the environment was identified as a fundamental goal of a regenerated Victoria in our original Business Plan for 2010 – 2015. One of the key environmental challenges in the Victoria BID area is the risk of surface water flooding during periods of heavy rain. Overheating is also a problem in summer due to the density of buildings and large areas of hard surfaces that trap and reflect heat. We help our partner businesses to establish projects that benefit people and wildlife.

Relevant strategies/concepts/ideas

- Victoria BID Green Infrastructure Audit 2010
- The Green Infrastructure Audit Best Practice Guide 2013
- Green Benefits in Victoria Business Improvement District: An Analysis of the benefits of trees 2012
- Biodiversity and Climate research projects in collaboration with universities, NGOs and government bodies

Relevant Projects

- The Diamond Garden includes pollinator-friendly plants.
- The John Lewis Rain Garden will tap into a water downpipe and make better use of water to feed garden plants.
- The Rubens at the Palace Hotel living wall comprises 450m² and uses rainwater harvesting.
- Bridge Place ivy screen
- Parklets at Spenser Street, Belgrave Road by the Passport Office, and at the Gillingham Street/Wilton Road junction.
- Victoria Street Living Wall.
- Blooming Marvellous event



Green Infrastructure Trends

Benchmarking

London National Park City

In July 2019, the National Park City Foundation confirmed London as the world's first National Park City.

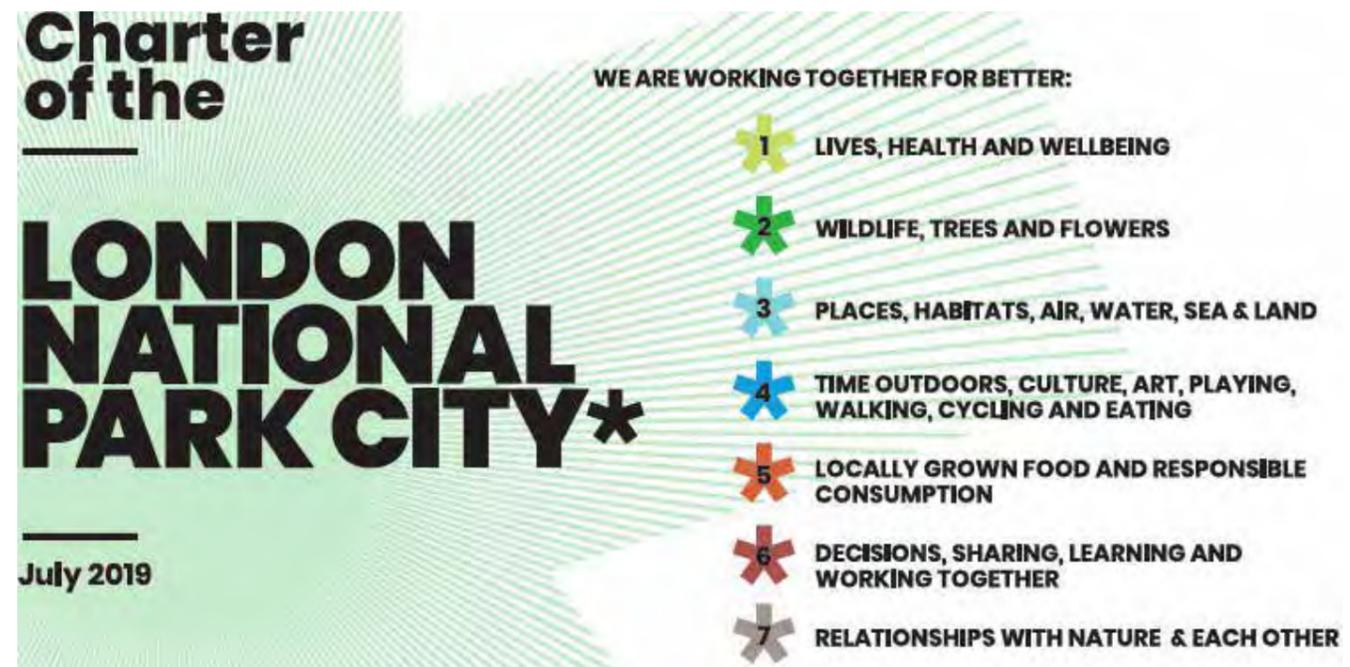
London National Park City is a large-scale and long-term challenge to improve our connection with nature and the outdoors through many small and achievable actions.

We are working with residents, visitors and partners to encourage people to:

- *Enjoy London's great outdoors more*
- *Make the city greener, healthier and wilder*
- *Promote London's identity as a National Park City*

Relevant strategies/concepts/ideas/projects

- Over 50 National Park City Rangers - enthusiastic and talented volunteers who want to make their bit of London greener, healthier and wilder for all the residents of their Boroughs.
- Prize to Transform the Future of the London city region in partnership with Ordnance Survey, Culture Declares and some protected landscapes that surrounds the city.
- Creation of a 100-person People's Assembly, representing the diversity of London to advise and guide on activities to improve life in London by making it greener, healthier and wilder.



Green Infrastructure Trends Benchmarking



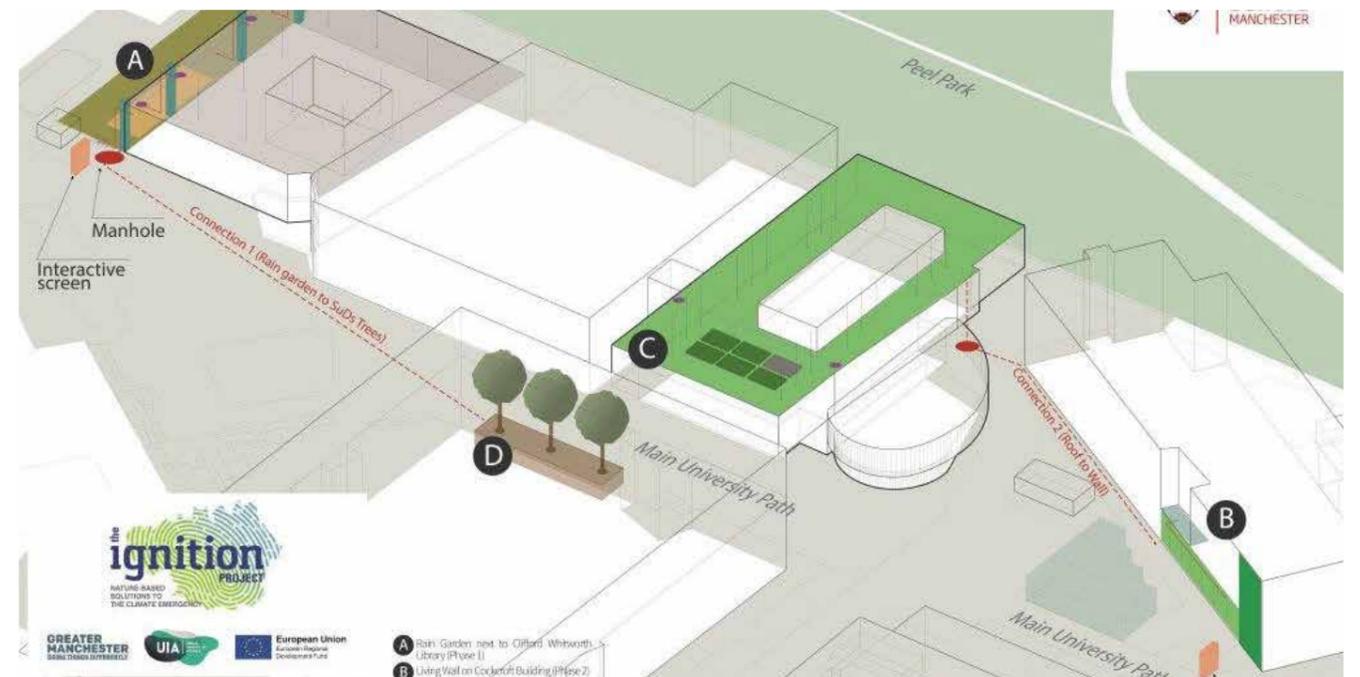
IGNITION Project Greater Manchester

The IGNITION project is a ground-breaking project that aims to develop innovative financing solutions for investment in Greater Manchester's natural environment. This investment will help to build the city region's ability to adapt to the increasingly extreme impacts of climate change.

Working with nature, solutions such as rain gardens, street trees, green roofs and walls and development of green spaces can help to tackle socio-environmental challenges including an increase in flooding events, water security, air quality, biodiversity and human health and wellbeing.

Relevant strategies/concepts/ideas/projects

- Establish evidence of environmental benefits:
 - A greenspace baseline for Greater Manchester
 - An evidence base for NBS
 - Nature-Based Solutions Living Lab
- Funding research: Identify potential finance streams, develop the case for investment, raise initial investment, mainstream private investment and replication
- A diverse plan of stakeholder engagement to build confidence and knowledge around NBS and the systemic change required to move towards a situation where investment in and roll-out of functional green and blue space is the norm.



Green Infrastructure Trends

Benchmarking

Barcelona green infrastructure and biodiversity plan 2020

Barcelona Green infrastructure and Biodiversity Plan of Barcelona is envisioned as a strategic instrument which sets out the challenges, goals and commitments of the local government when it comes to preserving green infrastructure and biological diversity and defining how people can discover their natural heritage and benefit from it whilst taking great care of it.

Relevant strategies/concepts/ideas

- Diagnosis of green infrastructure and biodiversity
- A model of an urban green network including green corridors and opportunity areas
- Plan of action



Green Infrastructure Trends Benchmarking



City of Philadelphia Green Streets Design Manual 2014

Green streets utilize green stormwater infrastructure (GSI) to capture stormwater at its source and minimize the amount of pollutants that reach the Delaware River, the Schuylkill River, and the many tributary streams within the city. Green streets are a key component of the City of Philadelphia's Green City, Clean Waters initiative, an innovative program to achieve federal water quality mandates by managing stormwater from impervious surfaces citywide utilizing green stormwater management practices.

Relevant strategies/concepts/ideas

- Retrofit green SUDs
- Rebalancing of space between carriageways/vehicle access, GI and public realm
- Multiple benefits including surface water/stormwater management, regeneration of neighbourhoods and aesthetic improvements of streets and spaces



Dimensional View of a Stormwater Planter



Green Infrastructure Trends

Benchmarking



Belfast One Million Trees

Belfast City Council is working with city partners to plant one million native trees across Belfast by 2035. This project is one of their major programmes to support climate adaptation across the city and it will make a substantial contribution to DAERA's Northern Ireland-wide Forest of our Future initiative. It is also one of 30 projects in the city's Resilience Strategy that is focused on climate change and mitigation and developing a connected, zero-emissions economy within a generation.

Relevant strategies/concepts/ideas

- Yearly citizen engagement in identifying tree planting locations
- Community engagement through volunteering, and education and training opportunities, series of business engagement events, Tree-giveaway-event,
- Reduced Carbon
- Partnering with range of public and private stakeholders/landowners/institutions/community groups/schools



Green Infrastructure Trends

Benchmarking



Pocket Parks

Pocket parks are considered to be small areas of inviting public green space where people can relax, exercise, socialise and play. They must be openly accessible for the communities they will serve, and ideally offer open access for anyone wishing to use them. (MHCLG Pocket Parks, October 2019)

- 100 Pocket Parks London (2013-15)
- UK Government Pocket Parks Plus programme (2019)

Relevant strategies/concepts/ideas

- Reuse of derelict/unused/undeveloped land
- Rebalancing of space between carriageways/vehicle access, GI and public realm
- Ranging from temporary to permanent
- Variety of community involvement and activities

Relevant Projects

- Derbyshire Street (Bethnal Green); Eastern Curve Garden (Dalston); Arboretum, Barking Town Square; Hoskin Street/ Meller Street/ Pelton Road (Greenwich), Artizan Street (London), Pimlico Road (Belgravia), Stockport Parklet, etc.



Green Infrastructure Trends

Benchmarking



Bankside Urban Forest

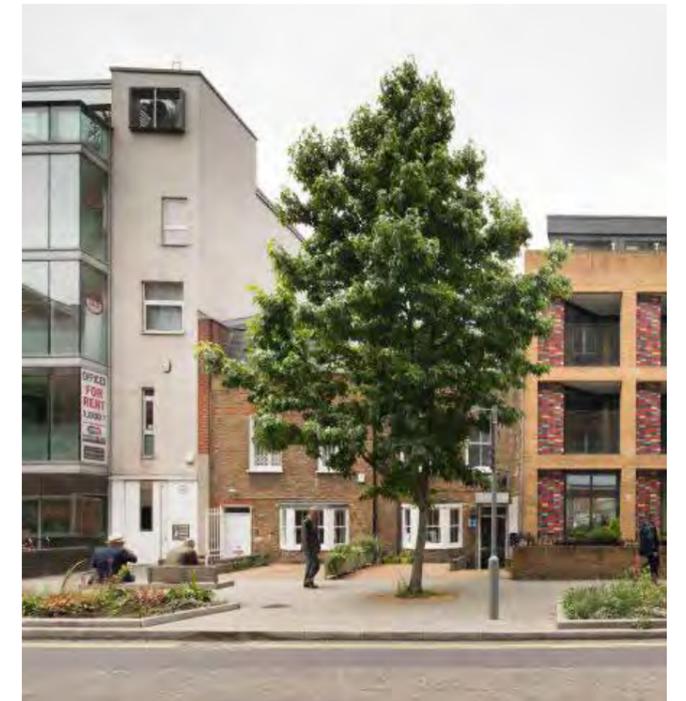
Launched in 2007, Bankside Urban Forest is Better Bankside's placemaking strategy for the area. It is a long-term partnership and strategy which is transforming the network of streets and spaces across Bankside to deliver more and better public space for people and wildlife and to support more active travel.

Relevant strategies/concepts/ideas

- Permanent and temporary Green Infrastructure projects
- Community engagement opportunities
- Network of 'clearings' to create node spaces
- Raise climate awareness through public art
- Retrofit into urban fabric

Relevant Projects

- Flat Iron Square
- Great Suffolk Street: Union Parade
- Better Air Benches
- Union Street Urban Orchard



Green Infrastructure Trends

Benchmarking



Klimawald (Climate Woodland), Heilbronn/Germany

The Wollhausplatz is considered a central traffic junction, characterised by high volumes of traffic, concrete and asphalt surfaces, little green and no places to stop and stay. The combination of urban green and a social meeting point were implemented in a small space and are maximising the positive experience for the citizen. The design creates interest of passers-by and makes it possible to walk through the woodland. The benches and tables invite you to linger. The trees create a pleasant climate, especially on hot summer days. Citizens can find out here directly, which positive impact urban greenery can have. The place is actively used and is particularly well attended at lunchtime. There are now plans to extend the timeline of this temporary urban pocket park.

Relevant strategies/concepts/ideas

- Temporary installation
- Council funded
- Creating footfall and dwell time
- Urban cooling
- Screening traffic and road noise
- Sustainable materials



Green Infrastructure Trends

Benchmarking



Temporary Community Gardens

Transformation of derelict sites into pop-up community built gardens celebrating plants, which may host on-site cafes, performance spaces and events. The gardens can be host to a range of invited artists projects, a free programme of events, talks and workshops exploring plants and the health and well being of urban environments.

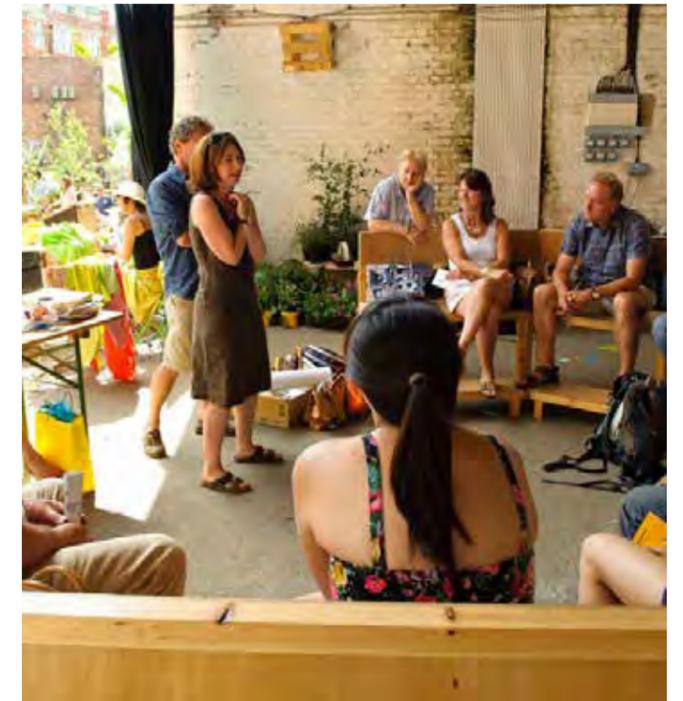
Having been selected as the Official Reuse Partner of the RHS Chelsea Flower Show 2016, Farmopolis used reclaimed plants from the show to construct a lush green oasis. The metamorphosis was created using high-tech polytunnels, made with materials similar to those used for The Eden Project.

Relevant strategies/concepts/ideas

- Using reclaimed materials and plants, as well as innovative materials to create structures and features
- Community engagement from the onset - planning, delivery, maintenance, education, enjoyment
- Temporary use of unused site

Relevant Projects

- Urban Physics Garden
- Farmopolis
- Union Street Urban Orchard



Green Infrastructure Trends

Benchmarking



Oxford Broad Meadow

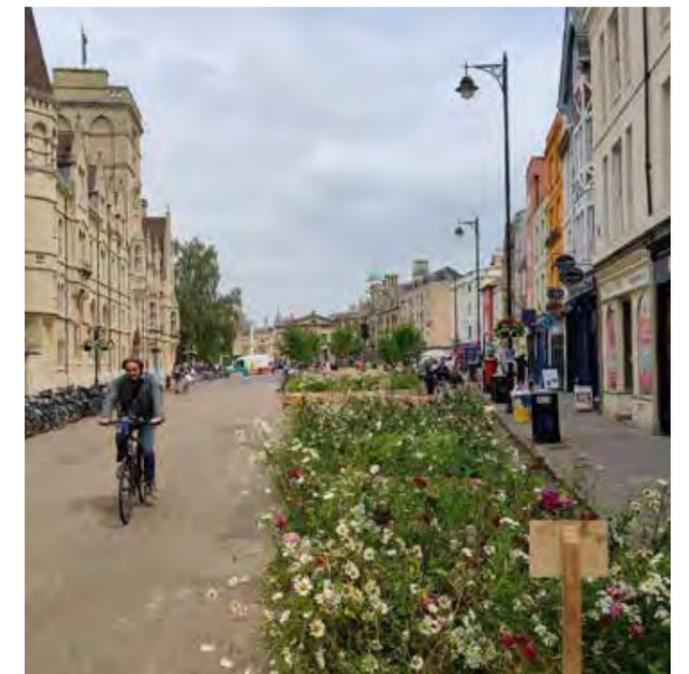
Oxford City Council, has turned iconic Broad Street into 'Broad Meadow' for the summer. Temporarily pedestrianising the western half of Broad Street has created one of the largest civic spaces in the city centre, with wildflower meadows and lawns. A two-way cycle route remains open throughout Broad Street. The space features wooden seating and planters made from recyclable materials, including pallets used to transport vaccines and protective equipment during the pandemic. Installation took just four days.

Muralist Bryony Benge-Abbott has created a stunning nature-inspired floorscape to add definition and colour, and to make people smile.

A full programme of community and arts events is planned for the space over the summer.

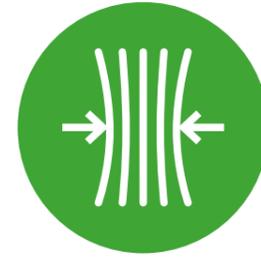
Relevant strategies/concepts/ideas

- Rebalancing of space between carriageway/vehicle access, slow modes, GI and public realm
- New opportunities for sitting, meeting, play, idling
- Temporary installation with a try-before-you-buy approach
- Public consultation on future of the street
- Sustainable and recyclable materials
- Pollinator friendly planting
- Integrated public art



Green Infrastructure Trends

Benchmarking



Altrincham Floral Shop Front Competition

Altrincham Unlimited, Altrincham's Business Improvement District, which is funded by the businesses in Altrincham, yearly coordinates the 'Best Dressed Window Competition'. The 'Best in Show' will be chosen by RHS judges on Wednesday 18th July and the 'People's Choice' will be voted for on social media. The People's Choice element of the competition gives the town's businesses the opportunity for exposure to thousands of people who will see their floral business fronts on social media. Judging criteria: Display/Originality, Plants/Colour scheme, Overall effect/Wow factor.

Relevant strategies/concepts/ideas

- BID organised event coupled with RHS Tatton Flowershow
- Promotion of local businesses
- Encourage local businesses to use greening permanently in their business setting



Green Infrastructure Trends

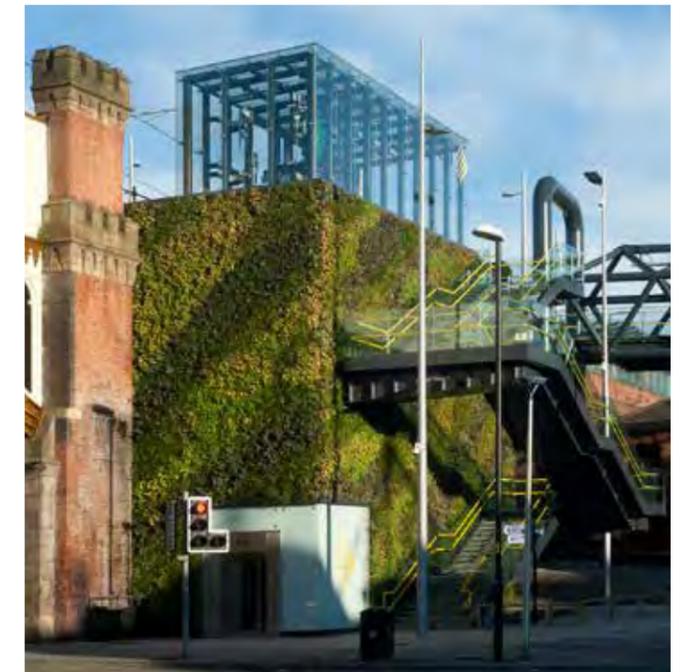
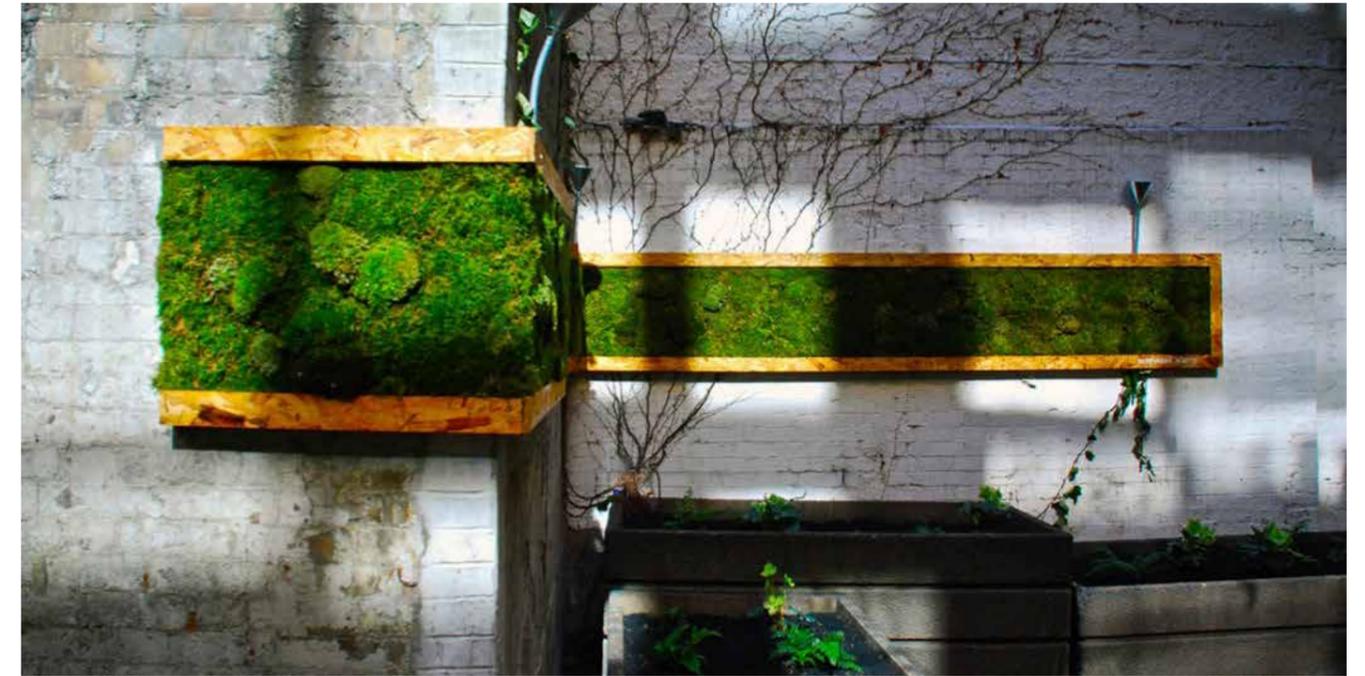
Benchmarking



Permanent GI features

Moss Wall at Google Campus

Green Wall and sedum tram tracks at Manchester Metrolink Deansgate Station



Green Infrastructure Trends Benchmarking

Garden Bridge London

The 367-metre pedestrian bridge, which consists of two fluted piers supporting a promenade planted with trees, was proposed to span the River Thames between the South Bank and Temple Station.

Relevant strategies/concepts/ideas

- Iconic architecture
- New pedestrian connectivity
- Potential biodiversity route across the Thames



Green Infrastructure Trends

Benchmarking



Marble Arch Hill

Marble Arch Hill is a temporary installation next to London's Marble Arch that will add a new attraction to the area beginning in 2021. A hollowed-out mountain based on a scaffolding structure, Marble Arch Hill will redefine the connection between Oxford Street and Hyde Park while giving visitors rare views over the park and Marble Arch. The great Hall in the heart of the hill, a hollowed-out space, will be used for events, exhibitions, and other happenings.

Relevant strategies/concepts/ideas

- Create renewed interest in the area following Covid-19 pandemic measures and their impact on main shopping streets
- Feature with park-like landscape of grass and trees
- Multi-functional use
- Sustainable construction and recyclable materials



Green Infrastructure Trends

Benchmarking

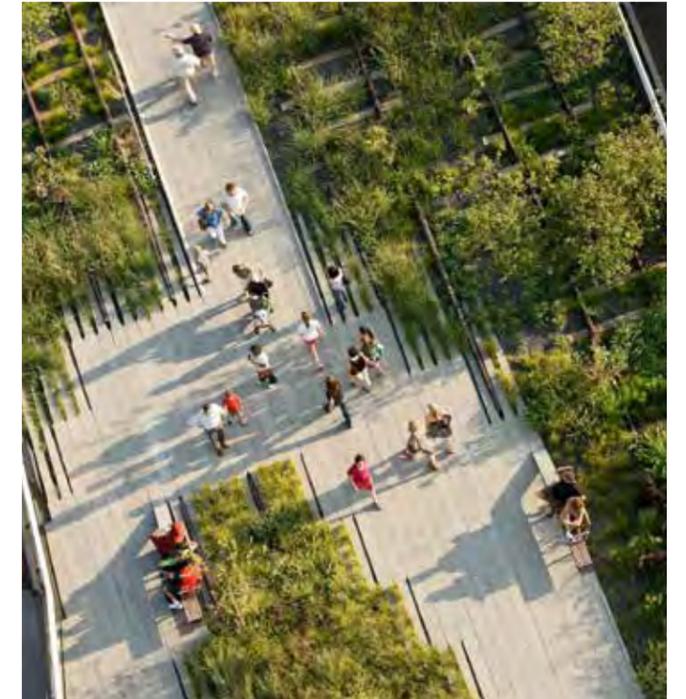


High Line NYC

The High Line is a public park built on a historic freight rail line elevated above the streets on Manhattan's West Side. Saved from demolition by neighborhood residents and the City of New York, the High Line opened in 2009 as a hybrid public space where visitors experience nature, art, and design.

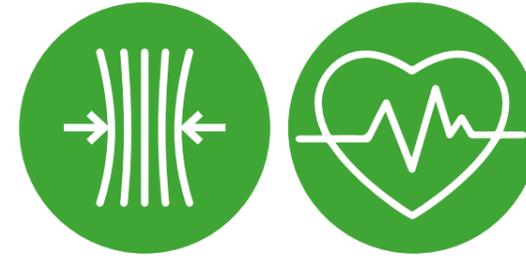
Relevant strategies/concepts/ideas

- Repurposing of redundant city infrastructure and structures
- Visitor magnet, internationally acclaimed
- Integrated Public Art exhibitions
- Promotion of surrounding local businesses and neighbourhoods
- Community Parks Initiative



Green Infrastructure Trends

Benchmarking

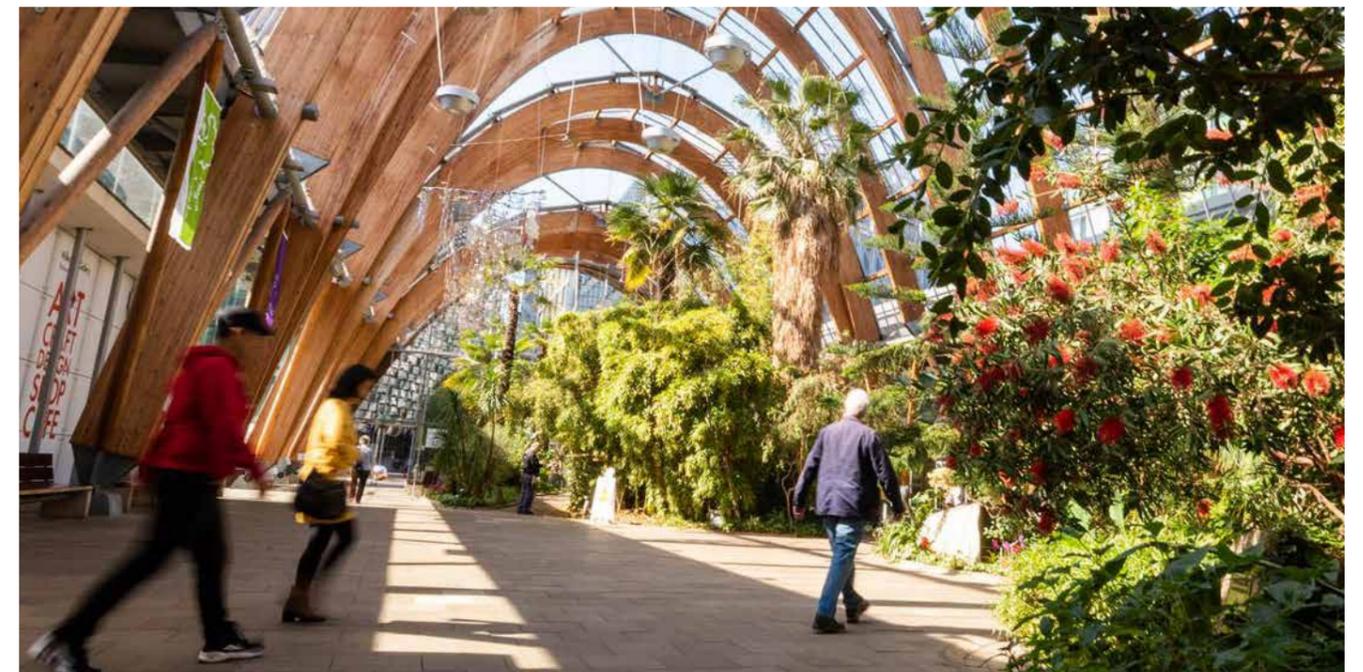
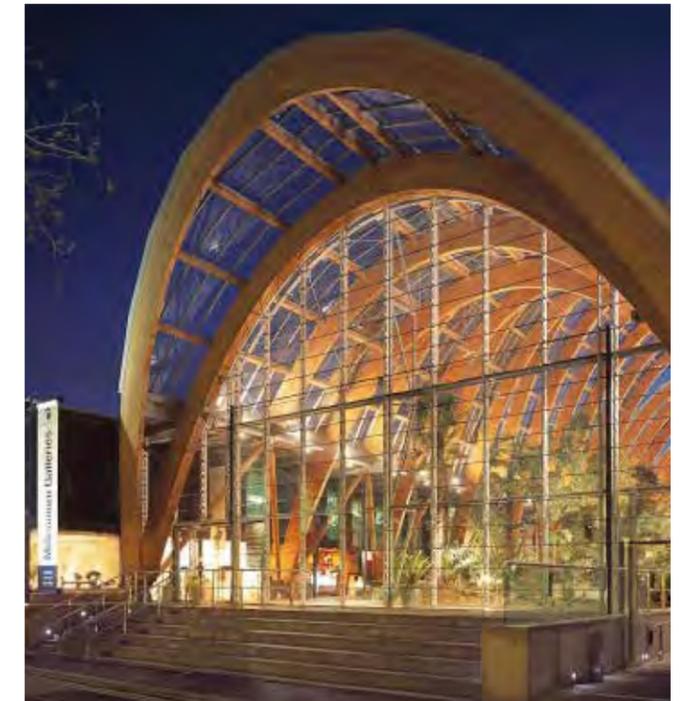


Sheffield Winter Garden

One of the largest temperate glasshouses to be built in the UK during the last hundred years has created a stunning green world in the heart of the city. Next to the Peace Gardens and the Millennium Galleries, the Winter Garden provides visitors with a unique experience in the city centre. There are more than 2,500 plants from around the world creating a superb display.

Relevant strategies/concepts/ideas

- Accessible to all: Integral part of the network of pedestrian streets and the cultural route through to the city centre
- Unusual covered meeting, exhibition and event space
- Educational potential for the public about climate and plants
- World-class design



Appendix F

Stakeholder Engagement Summary

It is vital to involve major external and internal stakeholders from the outset to make sure there is support. Early involvement of stakeholders identifies concerns and allows them to be addressed through the design. Collaborative engagement gives stakeholders a direct hand in the future whilst communicating key messages.

Key Stakeholder Plan

The below plan was created with input from the BIDs on key stakeholders to be consulted at key stages of the project, as part of the baseline work and opportunity identification.

We have used Stakeholder maps to identify areas of convergence and difference and manage expectation. The maps measure the likely impact on the stakeholder, their interest, influence and impact and identifies mitigating actions. These were updated throughout the life of the project.

The consultant team sought engagement with the following stakeholders via two workshops (see overleaf schedule for attendance details):

- BID members
- BID board directors
- BID team
- BCC officers
- TfWM officers

The Workshops

Both workshops were held online in one large stakeholder group. Both workshops were open to all invited stakeholders as we were keen to have continuity on one hand and enable interested stakeholders to attend as and when available on the other hand. The

presentation slides were afterwards issued out to all stakeholders that received an invitation to the workshops with the request for comments/feedback.

The workshops aimed to establish a thorough understanding of the baseline GI in the study area and to identify local needs and opportunities (see adjacent page of the presentation for reference).

Workshop 1 questions:

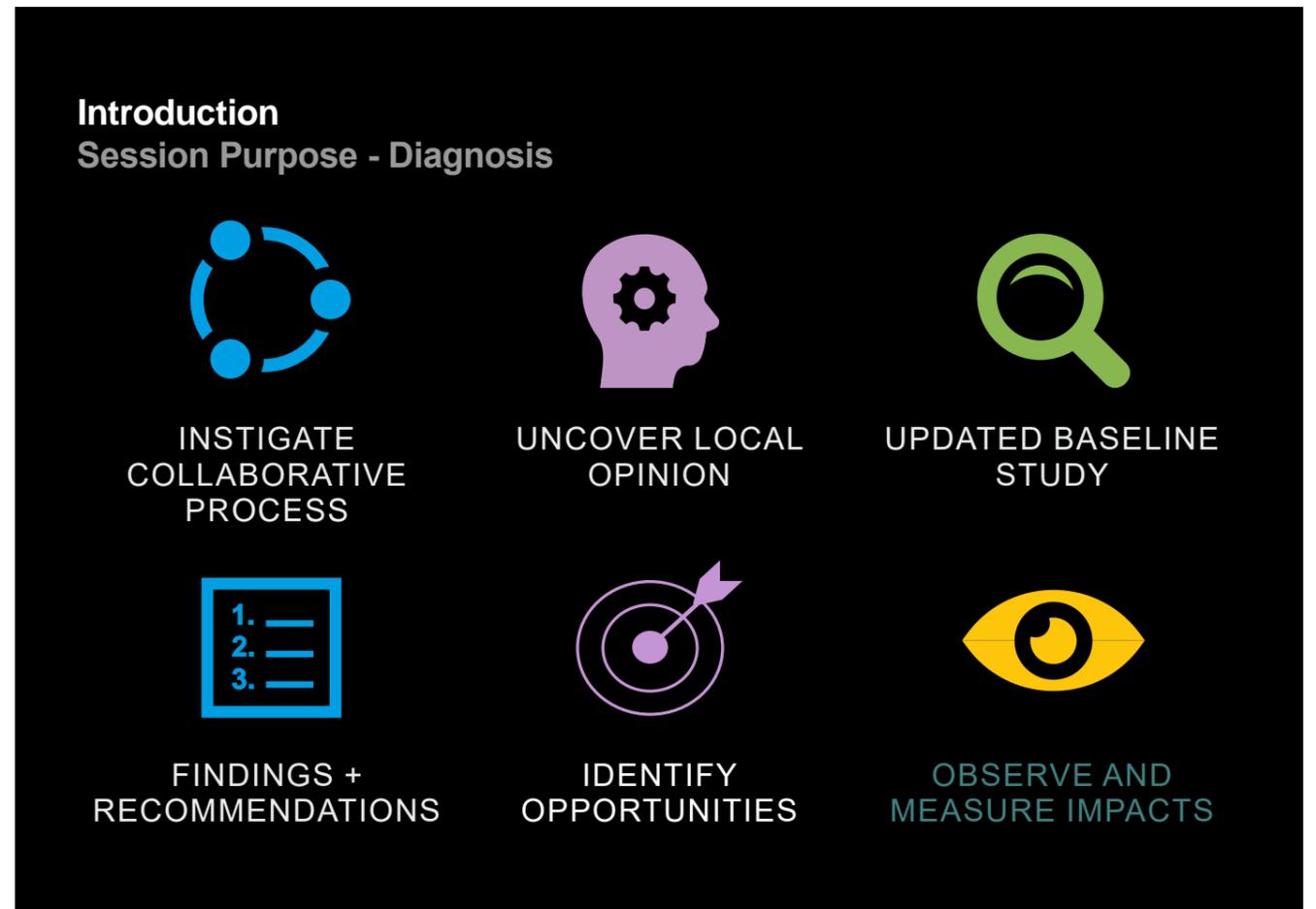
- Question 01 - What existing GI (existing/ planned) have we missed?
- Question 02 & 03 - Is our Public Realm Comfort & Safety mapping correct?
- Question 04 - Add your SWOT contributions.

Workshop 2 questions:

- Question 01 - What are other possible GI benefits?
- Question 02 - What are other possible typical suitable site types found in the study area?
- Question 03 - Where are your GI hotspot locations and why?
- Question 04 - What are your ideas for GI interventions/solutions? Be BOLD!!

Collaboration with the Universities

Prof. Kathryn Moore (Birmingham City University) and the West Midlands National Park Lab were asked by the BIDs to set the overarching context of this project with the WMNP and its aims and objectives in the region and aid the integration of those into the proposals of this masterplan. In the form of



a design review and presentation, emerging opportunities for GI and their spatial distribution were explored. Refer to the Lab's report (Appendix D) for more detail.

WM-Air collaborated and provided expertise on air quality, urban heat and Green Infrastructure (GI) to the design team, which informed the opportunities analysis and proposals around the measuring of impact. Refer to Appendices C and L for more information.

Key Stakeholder	Organisation	Relevance/ Role/ Power/ Interest	Contact email	Form of consultation	Priority	Work stages	Attended VW1 on 01.07.2021	Attended VW2 on 26.7.2021	W2 email sent 28.08.2021	Virtual meetings and design reviews
Group 1										
BIDs levy members - list held by BIDs										
Shivaji Shiva	Veale Wasbrough Vizards LLP	Partner	sshiva@vww.co.uk	Virtual workshop Email	1	1&2	y	n	y	n/a
Paul Bagshaw	Cushman & Wakefield	CBD	paul.bagshaw@cushwake.com	Virtual workshop Email	1	1&2	y	y	y	n/a
Paul Delany	Cushman & Wakefield	Associate Director	paul.delany@cushwake.com	Virtual workshop Email	1	2	n	n	y	n/a
Ruth Jeffs	Waterman Infrastructure and Environment	Director	ruth.jeffs@watermangroup.com	Virtual workshop Email	1	1&2	n	n	y	n/a
Tariq Shaikh	Gensler	Principal Managing Director	Tariq_Shaikh@gensler.com	Virtual workshop Email	1	1&2	y	y	y	n/a
Elspeth McLelland	Gensler	Associate	Elspeth_McLelland@gensler.com	Virtual workshop Email	1	1&2	n	n	y	n/a
Harbir Kaur	Willis Towers Watson	Facilities Service Manager	harbir.kaur@willistowerswatson.com	Virtual workshop Email	1	1&2	y	y	y	n/a
Nicola Fleet-Milne	FleetMilne	CBD: Colmore Row	nicola@fleetmilne.co.uk	Virtual workshop Email	1	1&2	y	y	y	n/a
Jane Watts	Birmingham City University	Lecturer	Jane.Watts@bcu.ac.uk	Virtual workshop Email	1	1&2	y	y	y	n/a
Steve Bulcock	Birmingham City University	Deputy Head of Institute of Creative Arts	steve.bulcock@bcu.ac.uk	Virtual workshop	1	1&3	n	n	y	n/a
Kaldev Sidhu	Serenity The Beauty Clinic		serenitybc@hotmail.co.uk	Virtual workshop Email	1	1&2	n	n	y	n/a
Dan Smyth	BDP	CBD: Edmund St	dan.smyth@bdp.com	Virtual workshop Email	1	1&2	y	y	y	n/a
Mike Ferguson	Smithsonia Gifts	Owner; RBID: Piccadilly Arcade	smithsoniashop@gmail.com	Virtual workshop Email	1	1&2	n	n	y	n/a
Paul Brasier	Purity Brewing	Head of Marketing	paul.brazier@puritybrewing.com	Virtual workshop Email	1	2	n	y	y	n/a
Nina Meeks	Hortons Estate	Management Surveyor	nmeeks@hortons.co.uk	Virtual workshop Email	1	2	n	n	y	n/a
Justin Ford	Bruntwood	Commercial Manager	justin.ford@bruntwood.co.uk	Virtual workshop Email	1	2	n	y	y	n/a
Mark Hipwell	Systra	HS2 design interface manager	markhipwell84@gmail.com	Virtual workshop Email	1	2	n	n	y	n/a
Kate Bailey	Squire Patton Boggs	Director & CBD Outstanding Places	kate.bailey@squirepb.com	Virtual workshop Email	1	2	n	n	y	n/a
David			david@mailboxlife.com	Virtual workshop Email	1	2	n	n	y	n/a
Isabelle Ford	Jacobs	Environmental Consultant	isabelle.ford@jacobs.com	Virtual workshop Email	1	2	n	n	y	n/a

BIDs boards and employees

Philip Singleton	CBD	Projects Manager	philip.d.singleton@colmorebid.co.uk	Virtual workshop Email	1	1&2	y	y	y	y
Alan Bain	Mott Mac	CBD Board Director	alan.bain@mottmac.com	Virtual workshop Email	1	1&2	y	y	y	n/a
Michele Wilby	CBD	Chief Executive Officer	michele.wilby@colmorebid.co.uk	Virtual workshop Email	1	1&2	y	y	y	n/a
Mike Mounfield	CBD	Projects Manager	mike.mounfield@colmorebid.co.uk	Virtual workshop Email	1	1&2	y	y	y	n/a
Nicola Fleet-Milne	FleetMilne	CBD Board Director	nicola@fleetmilne.co.uk	Virtual workshop Email	1	1&2	y	y	y	n/a
Melanie Williams	DWF	Head of Real Estate & CBD Board Director	Melanie.Williams@dwf.law	Virtual workshop Email	1	2	n	n	y	n/a
Steve Hewlett	Retail BID Manager	RBID	steve.hewlett@retailbirmingham.co.uk	Virtual workshop Email	1	1&2	n	n	y	n/a

Group 2 - Others

Gary Woodward	BCC	Development Planning Manager – City Centre Team	gary.woodward@birmingham.gov.uk	Virtual workshop Email	2	1&2	n	n	y	n/a
Nick Grayson	BCC	Biophilic Cities, Sustainability Officer	nick.grayson@birmingham.gov.uk	Virtual workshop Email	1	1&2	n	n	y	n/a
Simon Needle	BCC	Principal Arboriculturist/ Principal Ecologist	simon.needle@birmingham.gov.uk	Virtual workshop Email	1	1&2	n	y	y	y
Richard Booth	TfWM	Rail Development Manager	richard.booth@tfwm.org.uk	Virtual workshop Email	1	1&2	y	y	y	n/a
Brian Hughes	Neighbourhood Forum	Local community group	pb_hughes@hotmail.com	Virtual call Email	2	2	n/a	y	y	n/a
Catherine Muller	University of Birmingham	Project manager for WM-Air, Air Quality data & measurement	c.l.muller@bham.ac.uk	Virtual call Email	1	1&2	n/a	n/a	n/a	y
Bill (William) Bloss	University of Birmingham	Professor of Atmospheric Science, Air Quality data & measurement	w.j.bloss@bham.ac.uk	Virtual call Email	1	1&2	n/a	n/a	n/a	y
Emma Ferranti	University of Birmingham	Senior Lecturer in Civil Engineering	e.ferranti@bham.ac.uk	Virtual call Email	1	2	n/a	n/a	n/a	y
Joe Acton	University of Birmingham	Impact Fellow	w.j.f.acton@bham.ac.uk	Virtual call Email	2	1&2	n/a	n/a	n/a	y
Kathryn Moore	Birmingham City University	Professor & Director West Midlands National Park	kathryn.moore@bcu.ac.uk	Virtual call Email	1	1&2	n/a	n/a	y	y

Appendix G

Existing Green Infrastructure and Urban Context Study



Green Heart



Great Street



Active Streets



Main access routes



Main access routes



Main access routes



Heritage + Contemporary



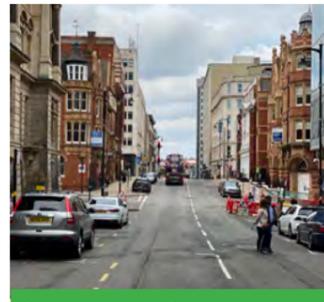
City Gateway



Public Square



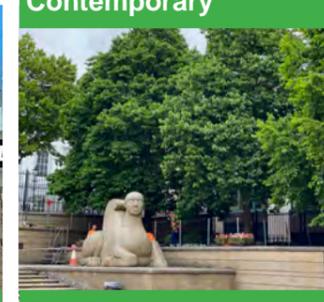
Heritage Buildings



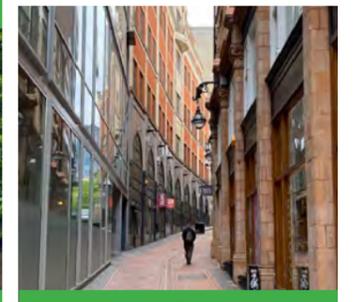
Connector Streets



High Street / Retail Core



City Square



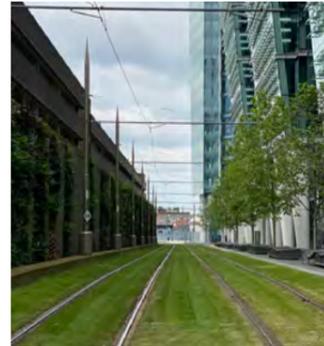
Connector Streets



Established Trees/Parks



Green Walls/Streets



Green Walls/Streets



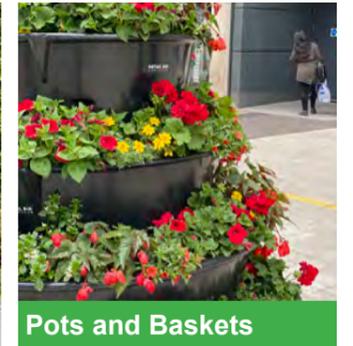
Street Trees



Pocket Park



Pots and Baskets



Pots and Baskets



Pocket Parks



Parklet



Pots



Street Trees



Green Walls

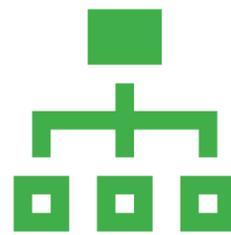
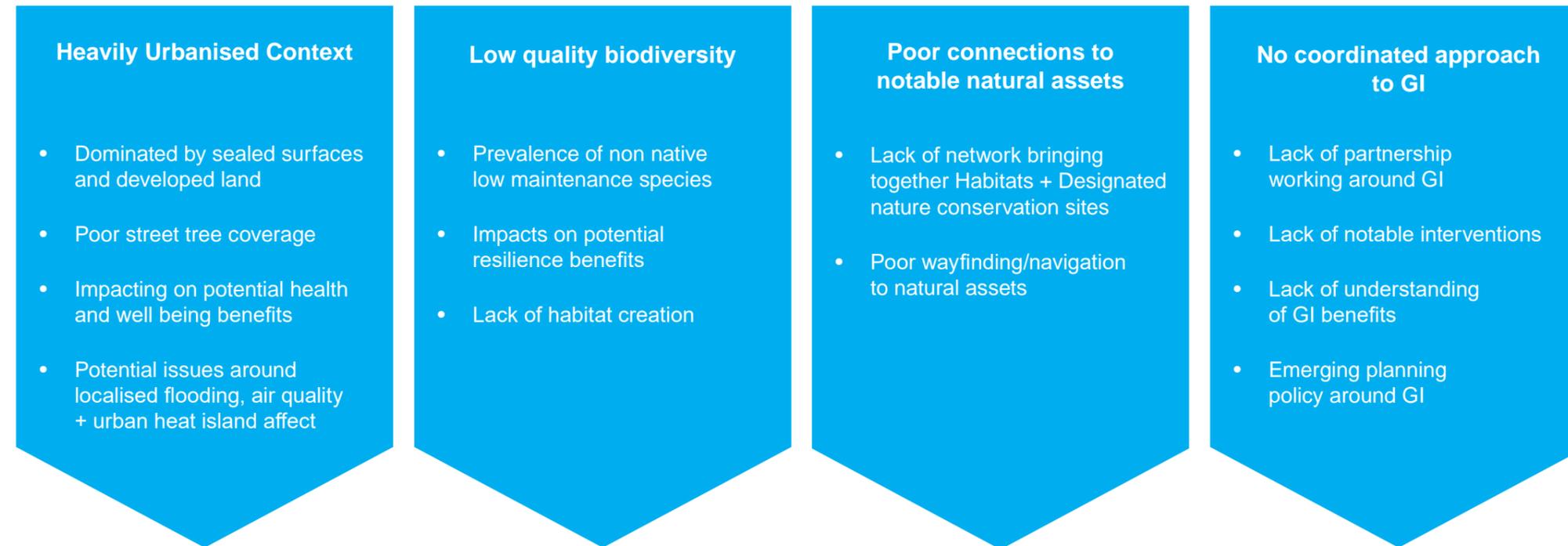


Green Walls

Appendix G

Existing Green Infrastructure and Urban Context

Key Findings



Recommendations

1. Increase weighting of Green to Grey infrastructure
2. Improve quality of existing GI
3. Create green network across the city core. Connect to ex/prop natural assets
4. Diversity of GI types. Multifunctional interventions
5. Tactical (Temp) & Permanent
6. Macro to Micro scale
7. Traditional to Audacious solutions
8. Private and Public land
9. Green and Blue
10. Coordinated, multi sectoral partnership approach to GI
11. Interventions to support carbon reduction, improve air quality, reduce heat island affect and assist in Covid recovery

Appendix H

Existing Ecology and Environmental Conditions Report



Ecological Context

The Colmore BID is situated in a heavily urbanised context with poor connections to notable and/or protected habitats, or sites designated for nature conservation. The closest notable habitats to the site (i.e. Biodiversity Action Plan (BAP) priority habitats) are urban in character and typical of former industrial areas, such as Open Mosaic Habitat on Previously Developed Land.

There are two statutory designated sites present within 2km of the Colmore BID. These are Edgbaston Pool Site of Special Scientific Interest (SSSI) and Edgbaston Reservoir Local Nature Reserve (LNR). Both are designated for freshwater habitats and value for bird life. Beyond the presence of open mosaic habitats and these two designated sites, there are woodpasture and parkland habitats present within 5km of the Colmore BID, which are typically present on golf courses in the area.

An environmental records search from Ecorecord: The Ecological Database for Birmingham and the Black Country was undertaken. Notable species records received within 2km of the Colmore BID are unsurprisingly dominated by mobile species known to be present in urban environments. These include:

- Birds such as black redstart (*Phoenicurus ochruros*), house sparrow (*Passer domesticus*), peregrine falcon (*Falco peregrinus*), starling (*Sturnus vulgaris*), tawny owl (*Strix aluco*), song thrush (*Turdus philomelos*), mistle thrush (*Turdus viscivorus*), numerous gull species (*Larus spp.*) and swift (*Apus apus*);
- Bats including common noctule (*Nyctalus noctula*), soprano pipistrelle (*P. pygmaeus*) and Daubenton's (*Myotis daubentonii*);
- Moths including latticed heath (*Chiasmia clathrata*), dusky brocade (*Apamea remissa*), cinnabar (*Tyria jacobaeae*); and
- Butterflies including wall (*Lasiummata megera*) and silver-spotted skipper (*Hesperia comma*).

Habitats within the Colmore BID

The Colmore BID is dominated by sealed surfaces and developed land. Natural/semi-natural habitats are few and far-between and are characterised by typical urban planting for recreational use.

Amenity grassland was recorded in garden areas around St Philip's Cathedral and along the tram line adjacent Snowhill Station. Other minor areas of grassland have been incorporated in minor soft-landscaping areas. These grassland areas (with the exception of the tram lines) are



heavily used by the public, therefore creation of more diverse grasslands is difficult. The cathedral gardens features areas where the mowing regime is relaxed, however the absence of propagules of wildflower species will likely limit the value of these areas without further intervention.

Figure 1.1 Amenity grassland at Old Square roundabout (left) and St Philip's Cathedral gardens (right)



There is extensive shrub planting around Colmore Circus Queensway which varies in age and species, although it predominantly includes low-maintenance non-native planting. Certain areas were noted as having high presence of pollinators.

Figure 1.2 Introduced shrub planting at Colmore Circus



Some green roofs were identified via satellite images, however these have not been confirmed. These are predominantly located in the southwest of the BID on buildings off Suffolk Street Queensway. Their quality or type are unknown.

Street trees are present in select locations, although coverage is relatively poor. Pedestrianised shopping areas such as New Street, Lower Temple Street and Edgbaston Street, in addition to St Philip's Cathedral gardens are the areas with the highest provision.

However, by far the most dominant habitats on site are buildings and hardstanding, which are generally of negligible ecological value and provide no ecosystem service delivery.



Approximately 97.63% of the Colmore BID is composed of sealed surfaces, therefore 'softening' the site should be a key objective.

Environmental Conditions

Flood Risk

Given the distance from the nearest watercourses or coast, the Colmore BID is not within the flood risk zone of rivers or sea level rise.

However, given the dominance of hard surfaces, surface water flooding is likely to pose a risk. Digital Terrain Modelling (DTM) is a generated height profile of bare earth (with vegetation and structures removed) which allows for modelling of flow rates and flood risk areas due to elevation profiles. An assessment of 3rd party data indicates that surface water flood risk areas within the Colmore BID are typically associated with transport infrastructure (particularly around New Street Rail Station) which will manage surface water flows. Additionally, internal courtyards of properties within the Business District are apparently at risk in a 200- and 1000-year return period.

Urban Heat Island Effect

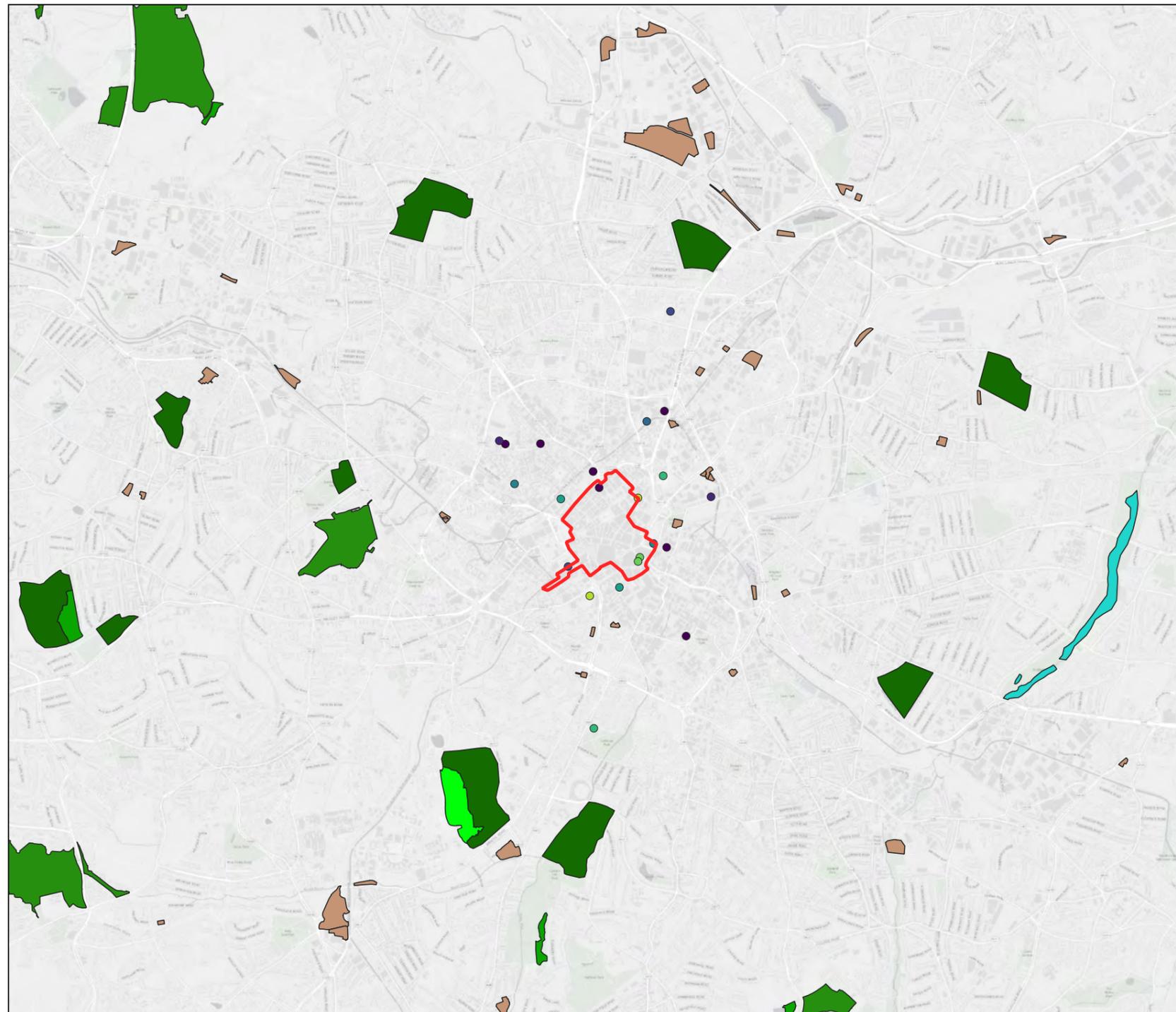
Thermal imaging of the Colmore BID has been purchased from a 3rd party to show building heat loss. Internal building courtyards within both the commercial and business districts appear to be the culprits where the highest heat loss occurs. Unsurprisingly, the largest area with significantly lower heat loss is the St Philip's Cathedral garden.

Air Quality

At present, data resolution with regards to air quality is limited to Lower Layer Super Output Area (LSOA), a defined geographical area with consistent population sizes. This data includes levels of nitrogen dioxide (NO₂), PM10 and sulphur dioxide (SO₂), although it is not currently understood where and over what period these levels were monitored.

One LSOA is entirely within the Colmore BID boundary and a further four are partially within the boundary.

All five of the LSOAs within the Colmore BID rank amongst the worst in Birmingham for NO₂, PM10 and SO₂ levels.



COLMORE BID

□ Approximate Boundary

Notable Species Record

- Black redstart
- Common noctule
- Common pipistrelle
- Daubenton's bat
- House sparrow
- Peregrine falcon
- Soprano pipistrelle
- Starling
- Swift

■ Sites of Special Scientific Interest

■ Local Nature Reserves

■ Ancient Woodland Sites

■ Floodplain Grazing Marsh

■ Woodpasture and Parkland

■ Open Mosaic Habitat



Greengage Environmental Ltd
9 Holyrood Street, London SE1 2EL

www.greengage-env.com

Fig 1.0 Existing Designations, Habitats and Species

Project Number 551757
July 2021
1 to 40,000 at A3
Basemap Data: ESRI



COLMORE BID

- Approximate Boundary
- Habitats**
- J1.2 - Amenity grassland
- J1.4 - Introduced shrub
- J5 - Other habitat (Green roof)
- Tree Canopies

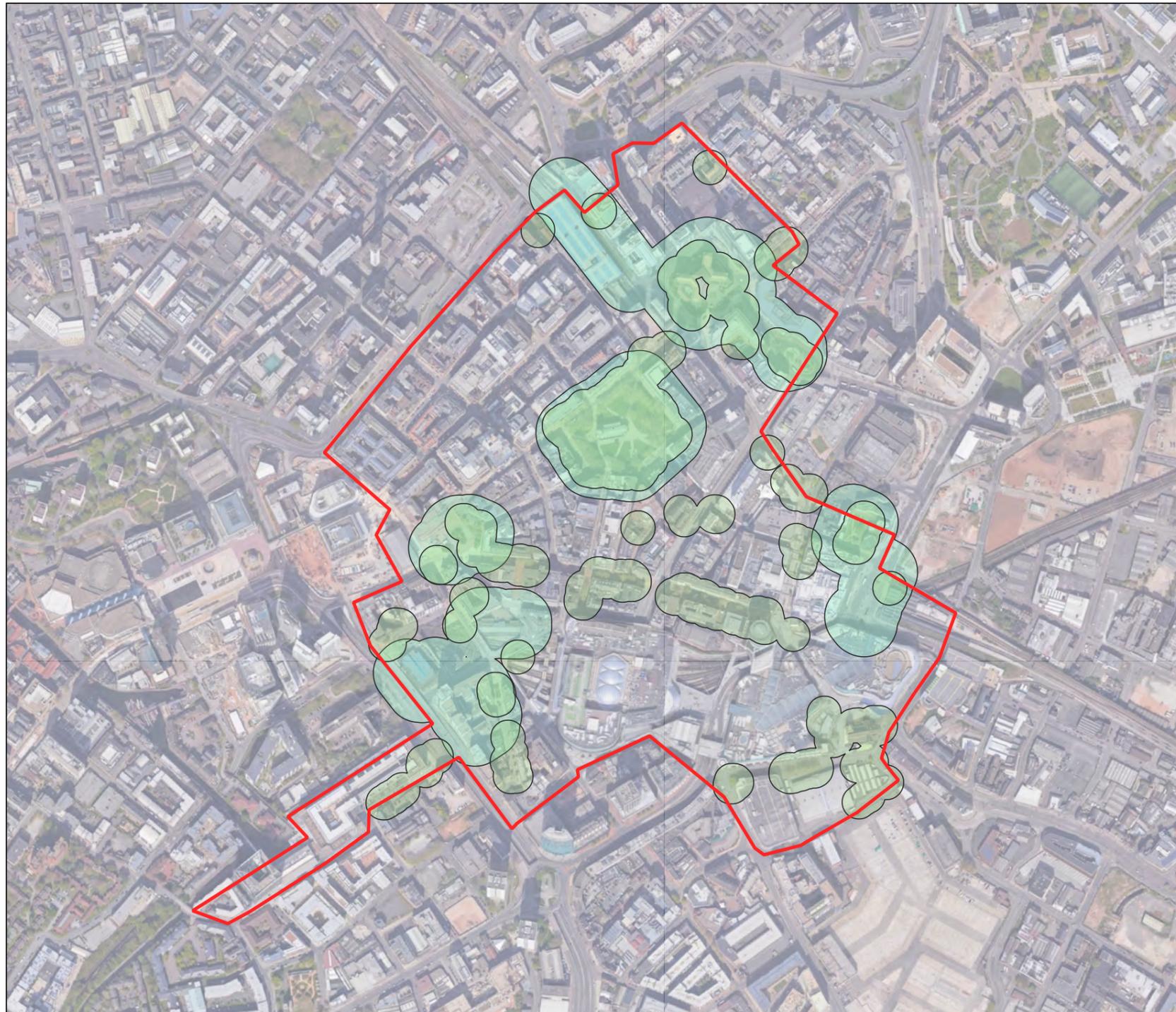


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Fig 2.0 Site Plan and Habitat Map

Project Number 551757
July 2021
1 to 6,000 at A3
Basemap Data: ESRI



COLMORE BID

- Approximate Boundary
- 50m habitat buffer
- 25m canopy buffer

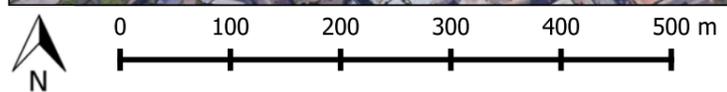


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Nature Deficiency Plan

Project Number 551757
July 2021
1 to 6,000 at A3
Basemap Data: Google Earth



COLMORE BID

 Approximate Boundary

Flood Risk Areas

 Surface Water 200 Year Return

 Surface Water 1000 Year Return

Google Satellite

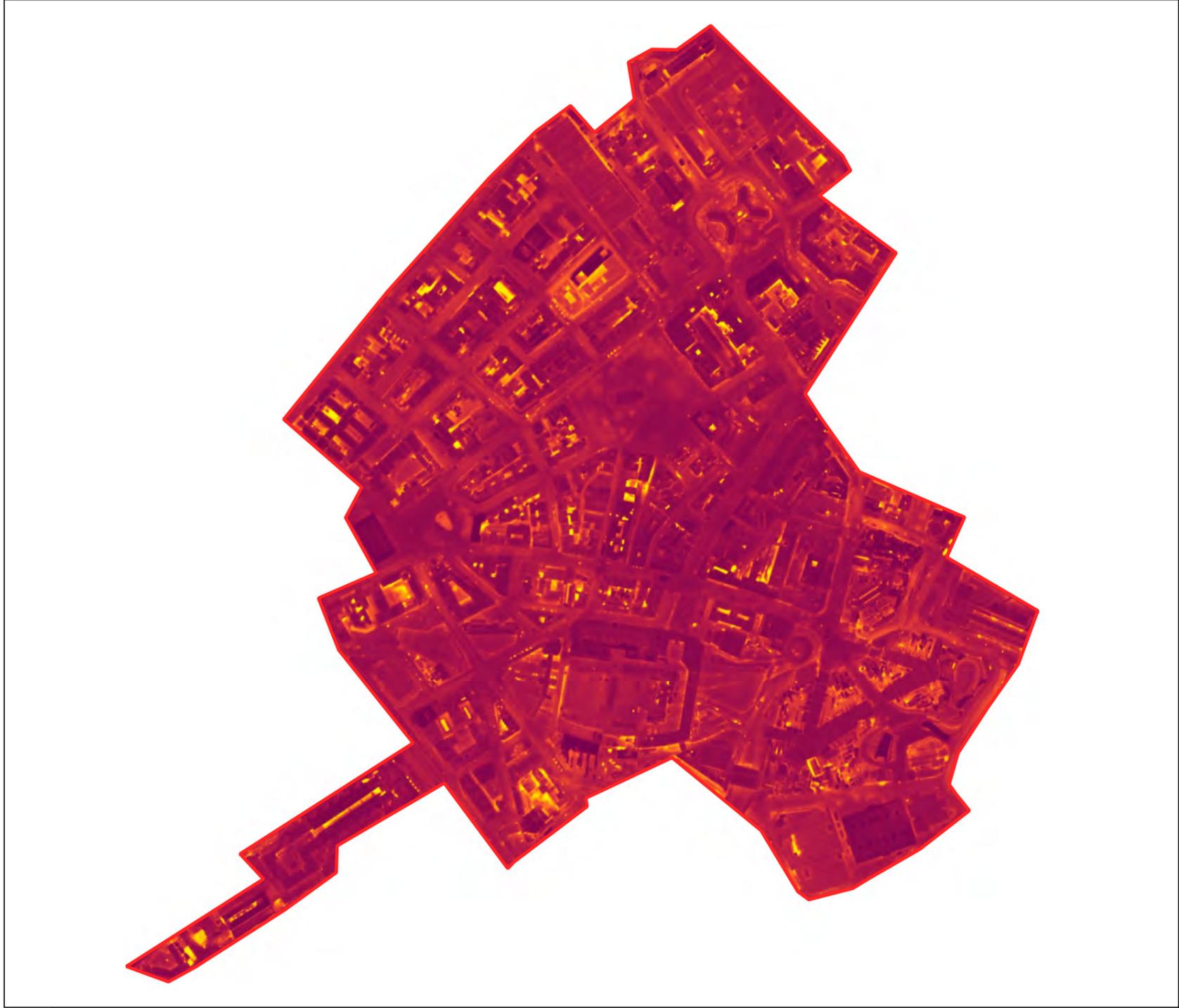


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Fig 3.0 Flood Risk Map

Project Number 551757
July 2021
1 to 5,000 at A3
Basemap Data: Google Earth



COLMORE BID

Approximate Boundary



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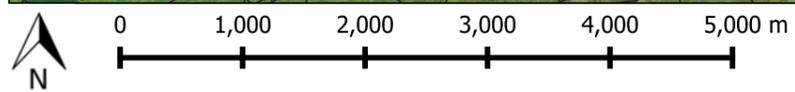
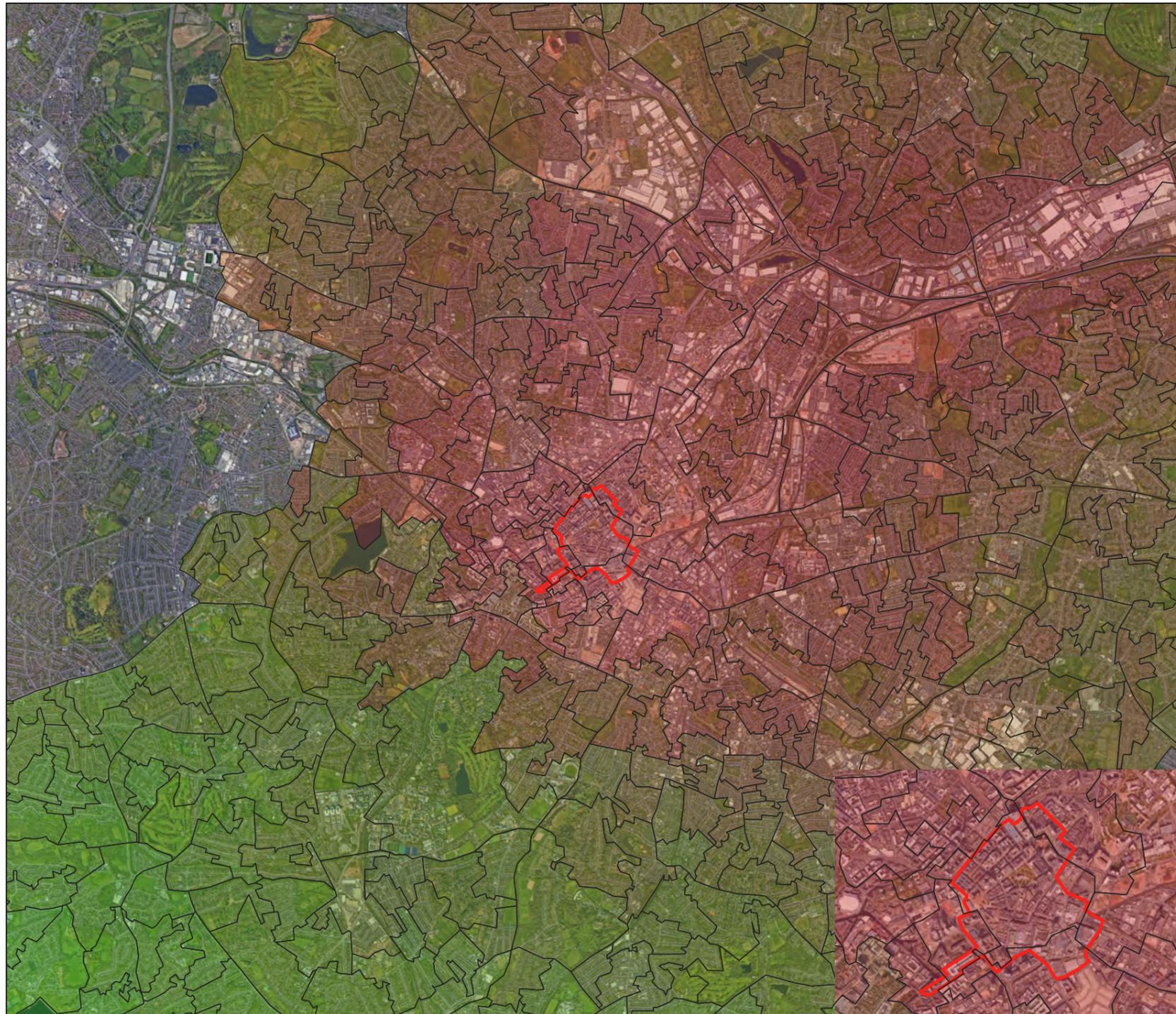
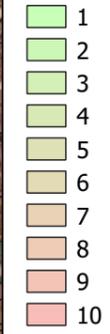
Thermal imaging

Project Number 551757
July 2021
1 to 5,000 at A3
Basemap Data: Google Earth

COLMORE BID

Approximate Boundary

NO2 levels per LSOA

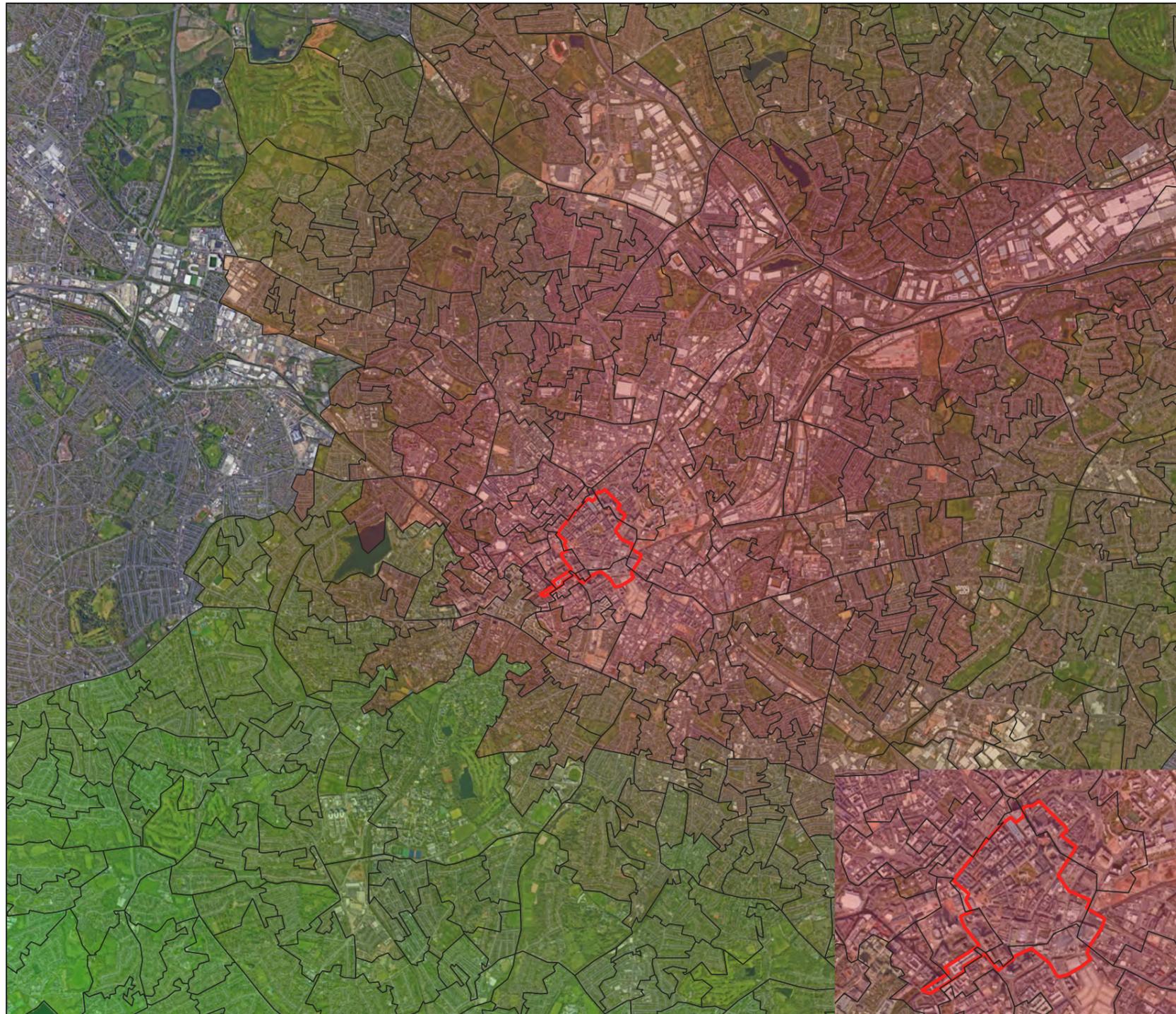


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Fig 1.0 NO2 levels per LSOA

Project Number 551757
July 2021
1 to 45,000 at A3
Basemap data: Google Earth



COLMORE BID

Approximate Boundary

PM10 levels per LSOA

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

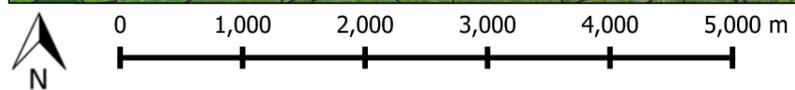


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Fig 1.0 PM10 levels per LSOA

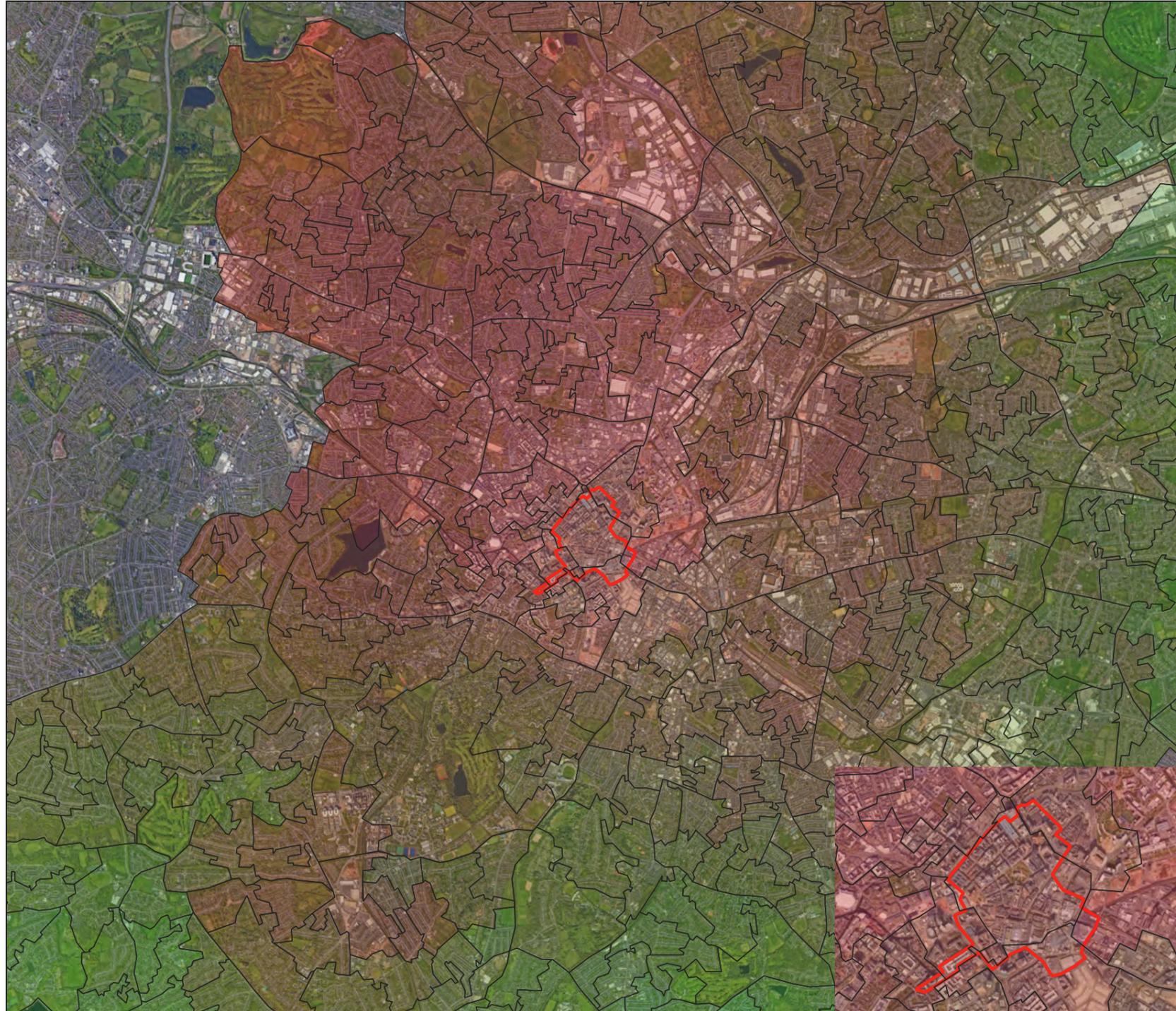
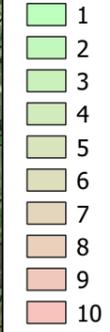
Project Number 551757
July 2021
1 to 45,000 at A3
Basemap data: Google Earth



COLMORE BID

 Approximate Boundary

S02 levels per LSOA

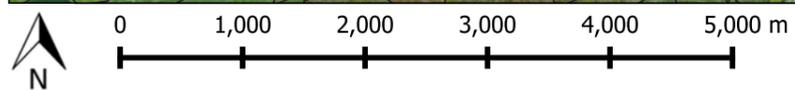


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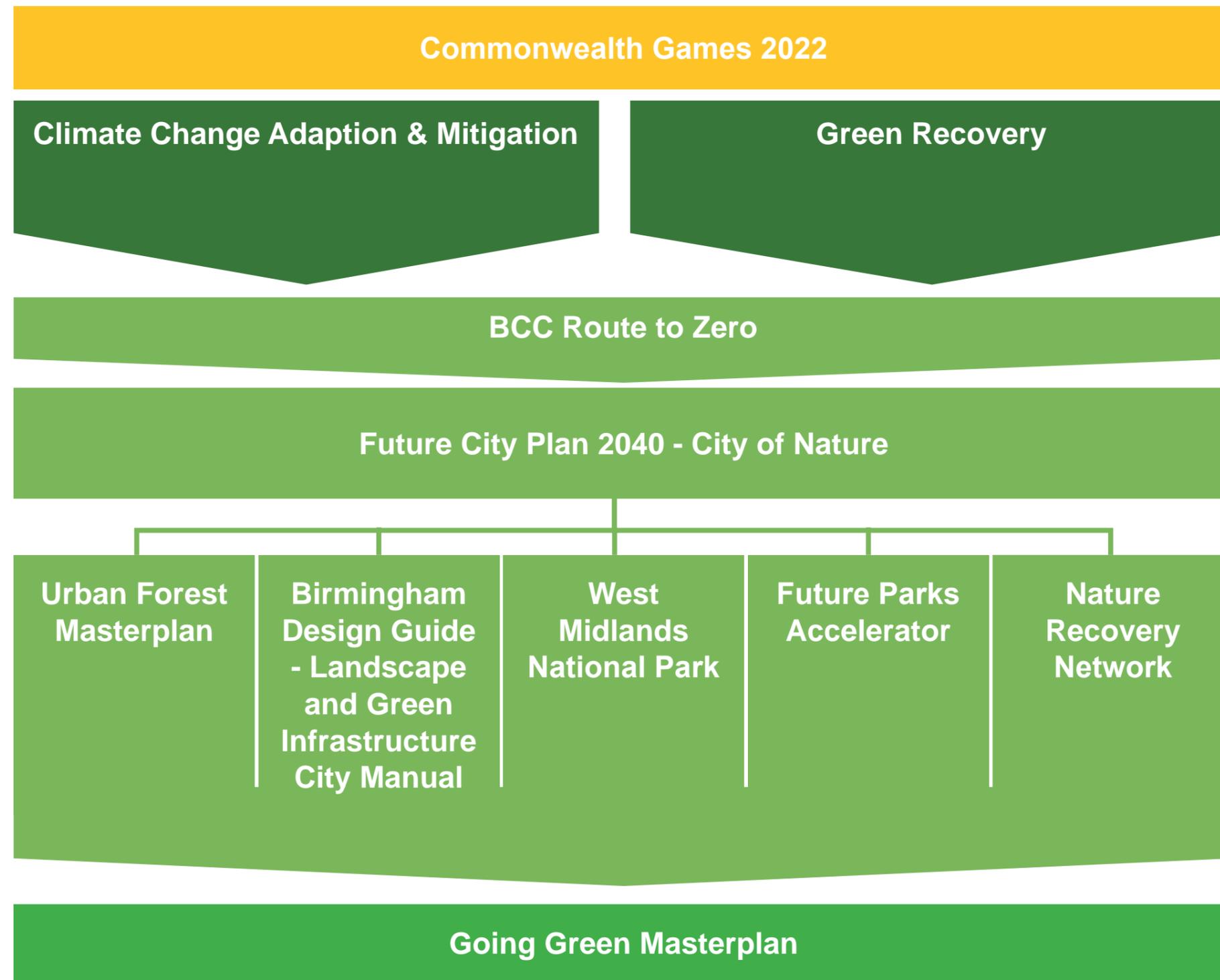
Fig 1.0 S02 levels per LSOA

Project Number 551757
July 2021
1 to 45,000 at A3
Basemap data: Google Earth



Appendix I

Other relevant key projects and initiatives



Public Realm Works in Snow Hill (Snow Hill Public Realm Masterplan by Broadway Malyan)

‘Colmore Business Improvement District and Birmingham City Council are working together to deliver the Snow Hill Public Realm programme. The programme includes a number of projects to improve public transport interchange and connectivity, enhance the public realm and prioritise pedestrian movement, reallocate the unused on-street parking and encourage on-street activities.’

Currently, the Colmore Row East and Livery Street, and Cornwall Street projects are on site.

Source: https://www.birmingham.gov.uk/info/50082/transport_improvement_schemes/1770/snow_hill_public_realm

City Centre Public Realm Improvements

Consultation closed on 21 February 2020. Further consultation planned for early 2022.

‘Birmingham City Council, alongside Retail and Colmore Business Improvement Districts (BIDs), are consulting on plans to enhance the public realm in the city centre and create an attractive, welcoming and safe environment to attract more visitors to Birmingham city centre which will facilitate economic growth.’

Source: <https://www.birminghambeheard.org.uk/economy/citycentrepUBLICREALM/>

Birmingham Urban Forest

‘The city of Birmingham is taking a strategic approach to its urban forest, engaging experts and key stakeholders to help it prepare an Urban Forest Master Plan.’

The project is the first of its kind in the UK

and follows a model widely used in the US and Canada. The plan is intended to help Birmingham work towards a vision for its trees that is sustainable into the future.'

Source: <https://www.forestryjournal.co.uk/news/19198352.birmingham-first-uk-city-develop-urban-forest-master-plan/>

Biophilic City

Biophilic Cities Member since 2013

'Birmingham has declared its intent to be the United Kingdom's first "natural capital city," and has been a leading city in developing "natural capital metrics" to evaluate the ecological impacts of development projects. Birmingham has declared its intention to be green and sustainable city, and is a leader in making connections between health and nature.'

Source: <https://www.biophiliccities.org/birmingham-uk>

City of Trees

'The Food and Agriculture Organization of the United Nations (FAO) along with the Arbor Day Foundation has today (February 4) recognised Birmingham with Tree Cities of the World designation.

The international programme celebrates cities across all continents that meet core standards for the care and planning of urban trees and forests.

To achieve recognition, Birmingham met the five core standards: establish responsibility, set the rules, know what you have, allocate the resources and celebrate achievements.'

Source: https://www.birmingham.gov.uk/news/article/531/birmingham_earns_prestigious_tree_cities_of_the_world_status

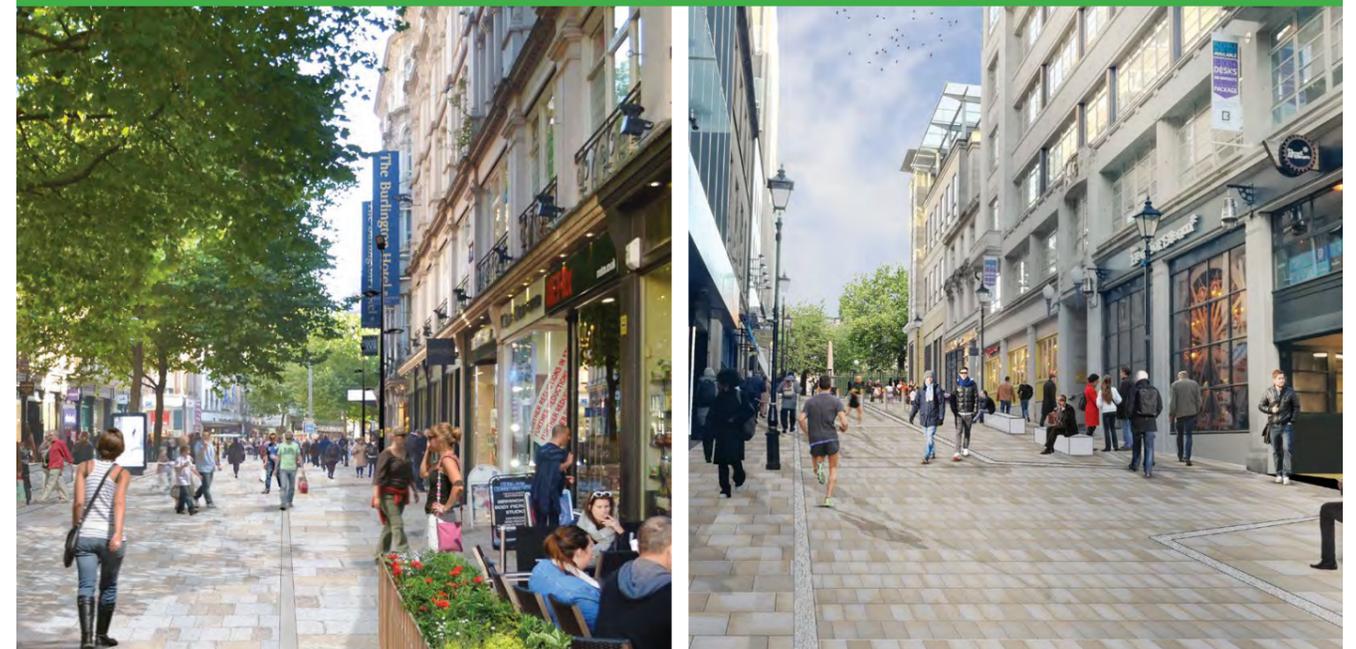
Birmingham and Black Country NIA

'In 2012 Birmingham and the Black Country was one of twelve areas designated a Nature Improvement Area (NIA) by the government - uniquely, our NIA is wholly urban. NIAs are one of the government's flagship approaches to tackling the problems that the natural environment of England is facing. They were introduced to 'enhance and reconnect nature on a significant scale' It represents a massive change, away from site-focused nature conservation to a joined up landscape scale approach.'

Source: <https://www.bbcwildlife.org.uk/nia>



Snow Hill Public Realm Masterplan and projects



City Centre Public Realm Improvements: Consultation Feb 2020

Appendix J

Relevant policy

NPPF 2021

'Green infrastructure: A network of multi-functional green and blue spaces and other natural features, urban and rural, which is capable of delivering a wide range of environmental, economic, health and wellbeing benefits for nature, climate, local and wider communities and prosperity.'

Birmingham Plan 2031, Birmingham Development Plan, Adopted January 2017

'Policy TP7 Green infrastructure network

The City Council will seek to maintain and expand a green infrastructure network throughout Birmingham. The integrity of the green infrastructure network will be protected from development and where possible opportunities will be taken to extend and enhance the network and to improve links between areas of open space.

Any development proposal that would sever or significantly reduce a green infrastructure link will not be permitted. New developments will be expected to address green infrastructure issues in an integrated way and to take advantage of new opportunities such as green and brown roofs.

It is important that all new green infrastructure features and assets are designed to help the City adapt to a changing climate.

The City Council will also seek to conserve and enhance Birmingham's woodland resource (collectively known as 'The Birmingham Forest').

Particular attention will be given to protecting the City's ancient woodlands as irreplaceable semi-natural habitats. All trees, groups, areas and woodlands will be consistently and

systematically evaluated for protection and all new development schemes should allow for tree planting in both the private and public domains. The importance of street trees in promoting the character of place and strengthening existing landscape characteristics will be recognised.'

The Big City Plan, 2010

'The Big City Plan is a 20-year City Centre Masterplan. It's a vision to encourage and support Birmingham's continuing transformation into a world class city centre. It covers every aspect of the built environment. The Big City Plan isn't a statutory planning document, but it has been endorsed as a framework for the future development and regeneration of the city centre.'

Green Living Spaces Plan, 2013

This Plan introduces a new approach of valuing all the city's natural spaces and features as Natural Capital, by applying the latest scientific thinking behind the National Ecosystem Assessment.

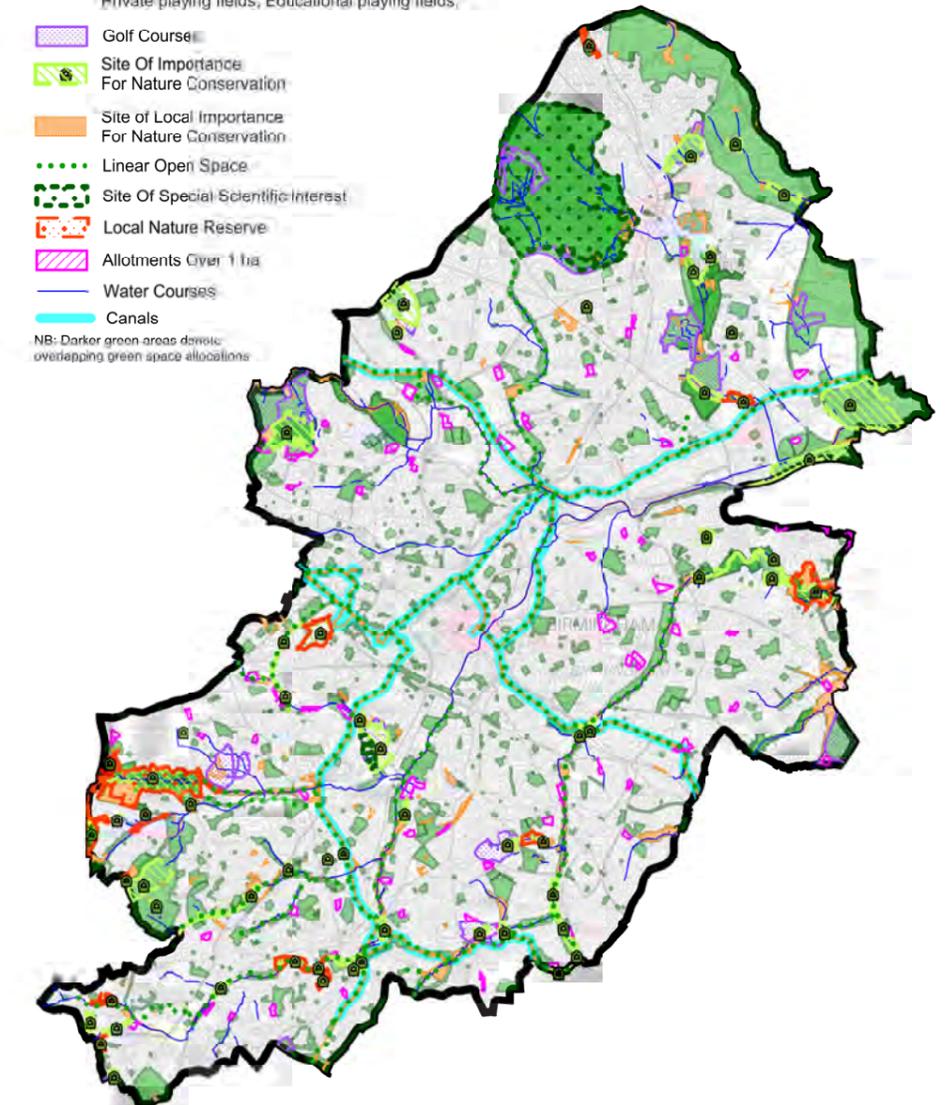
Emerging:

- Birmingham Design Guide SPD
- Our Future City Plan, Central Birmingham 2040



Green Infrastructure

- Green Spaces: Made up of Greenbelt, Public open space, Public playing fields, Private open space, Private playing fields, Educational playing fields.
 - Golf Course
 - Site Of Importance For Nature Conservation
 - Site Of Local Importance For Nature Conservation
 - Linear Open Space
 - Site Of Special Scientific Interest
 - Local Nature Reserve
 - Allotments Over 1 ha
 - Water Courses
 - Canals
- NB: Darker green areas denote overlapping green space allocations



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The Going Green Masterplan could be key in delivering the goals and high level actions of the City of Nature proposals in Our Future City Plan as outlined below.

Our Future City Plan, Central Birmingham 2040 (Consultation 2021)

'The ability to easily access nature within our city is essential to providing a high quality of life, tackling climate change, and creating attractive places to live in.

Our 2040 goals are to:

- Create a connected and diverse network of green and open spaces meeting a spectrum of community needs.
- Encourage children and young people to be connected to nature through education and play and provide opportunities to take part in sport and exercise that are accessible for all.
- Ensure delivery of nature-based solutions to support environmental, social and economic outcomes including improving citizen's health and well-being, reduced energy costs, improved drainage and water quality, and removing pollutants from the atmosphere.
- Deliver biodiverse landscapes that create new opportunities, protect and enhance existing habitats and support vulnerable species and their movements across the city.
- Restore urban waterways to become major destinations not only for development, but also for leisure and open space.

What actions could we take?

- The Brummie urban forest

Grow our Tree City status by expanding the urban canopy throughout the city environment creating a 'forest' of quality, well designed range of planting within and beyond Central Birmingham linking to the city-wide and regional network. Children and young people will be involved to support education and ownership of these new green spaces. Diverse and sustainable tree planting will need to be both at ground level and atop buildings providing a multistorey canopy and vertical and horizontal habitat connectivity.

- City Greenways

Identify opportunities to transform arterial routes and remodel highway infrastructure into linear 'Greenways' to connect communities with new open spaces, cycleways and walkways. These routes will be lined by trees and diverse range of plants attracting pollinators - supporting movement and access for people, insects and animals. Remodelling highway infrastructure will also reconnect under-used sites that have been severed and isolated for over 50 years - providing opportunities for new homes and commercial activity.

- The park web

Identify proposals for a network of new and improved green spaces throughout Central Birmingham. This will involve proposing a range of opportunities from courtyards within new development, local pocket parks and the improvement of existing parks and open spaces, to address the gaps in areas with low coverage of green spaces by proposing new and improved parks.

- Edible Brum

Give local people the opportunity to grow

their own food in urban environments. Identify public and private spaces on walls, roofs and underutilised spaces for growing of edible fruit and vegetables, bee keeping, hydroponic crops, fish farming and brewing. This could be supported by building networks and supply chains to local businesses.

- Reviving our waterways

Support the ongoing renaissance and restoration of canals and rivers throughout Central Birmingham to ensure access to new and improved green and blue space, habitat creation, reduction of flood risk and improved drainage - as well as supporting viability and improving the setting of surrounding development where appropriate.

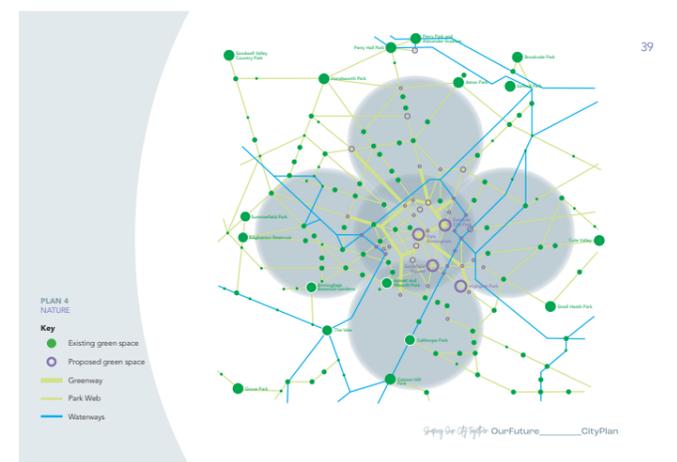
- Building greener

Promote opportunities to provide multifunctional green infrastructure and renewable energy as an integral part of new and existing building designs.

- Green guardianship

We need to address the challenges of how we look after open spaces by working together across a range of organisations - and not just those responsible for parks, canals, rivers and wildlife but also to include those involved in healthcare, education and skills, heritage and culture.

Community involvement and 'ownership' of our green spaces shall be developed, and new ways to look after our natural environments explored.'



Appendix K

SWOT Analysis

Strengths

- Active BID in support for improved GI incl. proven track record in delivering GI projects.
- Key spaces with existing quality/established GI, e.g. St Philips/ New Street.
- Varied GI typology existing in study area.
- Established partnering with other organisations, e.g. Universities (research), BCC.
- Opportunity to partner with other organisations, e.g. Wildlife Trust, Canal and River Trust, Groundwork UK, universities (students).
- Increasing independent retailers and F&B offers.
- Vehicular control allows for pedestrian enjoyment of GI (Retail BID).
- Existing trees in Conservation Areas or TPOs are specifically protected.

Weaknesses

- Poor GI network in study area. - Low level of biodiversity and habitats in study area.
- Currently uncoordinated GI planning between organisations and investments not joined up
- Adopted highway or private landownership means lack of control for delivery?
- Limited understanding of GI benefits to business and people - Lack of educational programme around GI and its benefits to city.
- Benefits of GI currently not valued or quantified - Green book/BC
- Engineering community has limited expertise in designing ecosystems, e.g. SUDS adoption
- Delivery of biodiverse and climate focused GI could be better through the planning system.
- Poor legibility of public realm and wayfinding to GI assets.
- Limited extent of study area - GI network to extend beyond boundaries

Opportunities

- Create connected network of greened streets and spaces and link existing assets and tie in with adjacent areas/create gateways.
- Improvement in air quality, health and well-being, and urban climate (heat, wind, shade, shelter).
- Increasing recreation options - for workers, visitors, residents - extension of time spent in the city centre and encouraging return to city centre post-Covid19.
- Offers opportunities to boost the local economy through increased footfall and dwell times and create a positive setting for business.
- Improving urban realm quality including heritage assets.
- Enhancing habitats and biodiversity.
- Micro to macro scale, from traditional to audacious approaches.
- Quick wins.
- Opportunity to strengthen the city's character and provide a source for identity.
- Boosting the image of the BIDs and city.
- BCC City of Nature initiatives and WMNP - Partner opportunity.
- The development and planning policy framework includes policies for the promotion of green infrastructure in the city centre.
- Innovative active local stakeholder participation in the design and operation/ maintenance of the GI solution.
- Support from private sector to connect business and natural environment.

Threats

- Limited space available for GI in dense city centre - utilities/servicing/access etc.
- Potential lack of engagement from key stakeholders.
- Perception of installation costs and lack of control/ understanding natural cycles can limit support of GI.
- Lack of maintenance funding.
- Fragmented design standards and policy.
- May require time (years) to mature and to provide the required functionality and deliver benefits.
- Can pose challenges to obtain planning approvals.
- Further highstreet store closures and empty units - Slow recovery?
- Capital funding cuts for many organisations and reduction in resources to deliver projects.
- Heritage protection policies require extensive consultation with authorities and may restrict many GI typologies and interventions.

Appendix L

GI4RAQ Report by Dr James Levine

Green Infrastructure for Roadside Air Quality for Colmore & Retail BIDs 'Going Green Masterplan'

1. Purpose of this Report

This report, and the underlying analysis, are the products of four days' consultancy work in August 2021 by Dr James Levine (University of Birmingham; UoB) for Colmore Business District Ltd, via UoB Enterprise Ltd, in relation to the Going Green Masterplan. Its purpose is to identify opportunities within the Colmore & Retail BIDs in Birmingham (approximate boundary indicated by the dashed blue line in Figure 1) to reduce local exposure to proximate sources of vehicular pollution via *Green Infrastructure for Roadside Air Quality (GI4RAQ)* interventions. The underlying analysis exploits software and guidance developed by the author in collaboration with his colleagues at the UoB and a wide range of urban practitioners. You can find Dr Levine's contact details under Final Word (p20).



Figure 1. Map of Colmore & Retail BIDs (dashed blue line marks their approximate boundary): combines graphics from Greengage's Going Green Masterplan 'Stakeholder Engagement 01 Mapping & Diagnosis July 2021' PDF.

2. Background

2.1 The Author

Dr Levine led the development of Transport for London's (TfL) first evidence-based approach to GI4RAQ¹ that calls for the selective and strategic use of vegetation to reduce roadside exposure to vehicular pollution in response to site-specific conditions of wind and urban form. The approach built on simpler guidance he wrote with the Greater London Authority (GLA)² and previous guidance written by his UoB colleague, Dr Emma Ferranti, in partnership with the Trees and Design Action Group (TDAG)³. These resources were developed in affiliation with the UoB's Birmingham Institute of Forest Research (BIFoR).

With BIFoR's Inaugural Director, Prof Rob MacKenzie, Dr Levine has since led the development of the GI4RAQ Platform⁴ (www.GI4RAQ.ac.uk): prototype software – scoped, co-designed and tested with TfL, the GLA, Birmingham City Council and AEA Ricardo – to enable urban practitioners (not limited to air quality specialists) to estimate the site-specific impacts of proposed GI4RAQ interventions via changes in pollution *dispersion* (see later).

In addition to almost 20 years' academic research in the field of atmospheric science, between the University of Cambridge (MSci, MA, PhD), the British Antarctic Survey and the University of Birmingham, Dr Levine has a first-class bachelor's degree in architecture from the University of Lincoln (RIBA Part I) and has spent two years in local architectural practice. In the latter, he initiated development of the practice's first capacity for building information modelling and led a small project from planning through detailed design, tender and construction – receiving a RIBA East Award 2021 and RIBA East Small Project of the Year 2021.

2.2 The Science

In the last few years, there has been a major shift in understanding regarding the impacts of vegetation on urban air pollution; for a full summary, please refer to the introduction to our recent publication⁴. Essentially, vegetation at the scale of realistic urban planting schemes does not remove much pollution, but can significantly alter its distribution close to source. It does so by changing the flow of polluted air, and the degree to which the polluted air is mixed with cleaner surrounding air (i.e., diluted), which we collectively refer to as dispersion.

¹ Levine, J. G., Y. Brown, and A. R. MacKenzie, 2021. Green Infrastructure for Roadside Air Quality (GI4RAQ) Guidance & Decision Tree: An evidence-based approach to reducing roadside exposure to road transport pollution. Developed by the Birmingham Institute of Forest Research, University of Birmingham, and Transport for London. DOI: <https://doi.org/10.25500/epapers.bham.00003398>

² GLA, 2019. Using Green Infrastructure to Protect People from Air Pollution, written in consultation with Birmingham Institute of Forest Research, University of Birmingham, Global Centre for Clean Air Research, University of Surrey, and Transport for London, available at https://www.london.gov.uk/sites/default/files/green_infrastructure_air_pollution_may_19.pdf

³ Ferranti, E. J. S., MacKenzie, A. R., Levine, J. G., Ashworth K., and Hewitt C. N. 2019. First Steps in Urban Air Quality. Second Edition. A Trees and Design Action Group (TDAG) Guidance Document. UK: London. Available from: <http://epapers.bham.ac.uk/3069/>

⁴ Pearce, H., J. G. Levine (joint-first author), X. Cai and A. R. MacKenzie, 2021. Introducing the Green Infrastructure for Roadside Air Quality (GI4RAQ) Platform: Estimating site-specific changes in the dispersion of vehicular pollution close to source, *Forests*, 12, 769, <https://doi.org/10.3390/f12060769>

According to the Air Quality Expert Group's (AQEG) 2018 review of the scientific literature for Defra and the devolved authorities⁵, vegetation of this scale typically removes only a few percent of the primary pollutants from road transport (largest single source of urban outdoor air pollution) that are harmful to human health: nitrogen dioxide (NO₂) and fine particulate matter (PM_{2.5}). Headline figures can be confusing. For example, the removal, or deposition of pollution to vegetation is estimated to save the UK £1 billion/year in health-damage costs avoided⁶, but this is £1 billion out of an estimated total annual cost of just over £26 billion⁷.

Importantly, however, AQEG's review also concludes that, in the right locations, vegetation barriers can reduce people's exposure to proximate sources of pollution by as much as 50% in their immediate wake - via changes in pollution dispersion (i.e., distribution)⁵. Note, this does not amount to a 50% reduction in absolute pollutant concentrations immediately downwind of the barrier, but rather reductions of up to 50% in the local elevations in pollutant concentrations (i.e., above their average background concentrations) due to nearby sources.

Road transport accounts for 35% of the UK's NO_x (NO + NO₂) emissions and 12% of its PM_{2.5} emissions⁸, and large numbers of people spend a significant amount of time in close proximity to polluting vehicles – at the roadside. Despite the majority of air quality management areas currently arising due to high NO₂ concentrations, PM_{2.5} is the more harmful of the two pollutants for public health. Vehicular emissions of PM_{2.5} will not be reduced to the same extent as those of NO₂, and they could even increase, as a result of the move from petrol and diesel vehicles to electric ones: over half of current PM_{2.5} emissions come from brake, tyre and road wear, as opposed to exhaust, and these non-exhaust sources could increase due to the increased weight of electric vehicles laden with heavy batteries⁹. Interventions to reduce roadside exposure to PM_{2.5} (as well as NO₂) will therefore be of value for many years beyond the 2030 ban on sales of petrol and diesel vehicles, as we seek to transform our transport systems to reduce vehicle movements: i.e., modal shift to public transport and active travel.

It is also important to note that *any and all* reductions in NO₂ and PM_{2.5} concentrations at point of exposure will help improve public health outcomes. Despite legislated limits and 'targets' for NO₂ and PM_{2.5} concentrations, recent research reveals that there are no safe thresholds for exposure to these pollutants: statistically significant relationships between

⁵ AQEG, 2018. Impacts of Vegetation on Urban Air Pollution. Available online: https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1807251306_180509_Effects_of_vegetation_on_urban_air_pollution_v12_final.pdf (accessed on 7 June 2021)

⁶ Office for National Statistics, 2019. UK Air Pollution Removal: How Much Pollution Does Vegetation Remove in Your Area? Available online: <https://www.ons.gov.uk/economy/environmentalaccounts/articles/ukairpollutionremovalhowmuchpollutiondoesvegetationremoveinyourarea/2018-07-30> (accessed on 5 February 2021)

⁷ Royal College of Physicians, 2018. Reducing air pollution in the UK: Progress report 2018. Available online: <https://www.rcplondon.ac.uk/news/reducing-air-pollution-uk-progress-report-2018> (accessed 13 August 2021)

⁸ Defra, 2018. Air quality: explaining air pollution – at a glance. Available online: <https://www.gov.uk/government/publications/air-quality-explaining-air-pollution/air-quality-explaining-air-pollution-at-a-glance> (accessed 20 August 2021)

⁹ Timmers, V. R. J. H., and P. A. J. Achten, 2016. Non-exhaust PM emissions from electric vehicles, *Atmospheric Environment*, 134, pp 10-17, doi.org/10.1016/j.atmosenv.2016.03.017

long-term exposure to air pollution and, for example, incidences of chronic obstructive pulmonary disease (COPD)¹⁰ and adult-onset asthma¹¹, persist to very low concentrations.

2.3 The Remainder of this Report

In section 4, opportunities are explored for two types of GI4RAQ intervention to reduce exposure to NO₂ and PM_{2.5} from nearby vehicles: (1) vegetation barriers obstructing the horizontal flow of air between heavily trafficked roads and people in their immediate vicinity; and (2) extended tree canopies impeding the vertical exchange of air in zero-traffic streets between relatively clean air at ground level and relatively polluted air above the surrounding buildings (e.g. influenced by emissions from surrounding trafficked roads). (1) is the focus of the qualitative approach developed with TfL¹ and our recently launched quantitative software, the GI4RAQ Platform⁴. (2) was originally proposed in the TDAG guidance³ and elaborated on in the subsequent guidance the author wrote with the GLA².

We start in section 3, however, by identifying destinations attracting vulnerable receptors (i.e., the people most vulnerable to the health impacts of air pollution) that coincide with areas of above-average pollutant concentrations – consistent with the 1. *Reduce*, 2. *Extend*, 3. *Protect* principle introduced by Ferranti et al. (2019)³:

1. Reducing emissions is the best way to improve air quality and reduce the health impacts of air pollution; the author must assume every step is being taken by local stakeholders to reduce vehicular emissions in the Colmore & Retail BIDs.
2. We should secondly focus on extending the 'source-receptor pathway', the distance between the source(s) of these emissions and people, particularly vulnerable people; on average, the longer this pathway, the greater the mixing of polluted air with cleaner surrounding air between the two, and the lower the pollutant concentrations at point of exposure.
3. Where it is not possible to distance one from the other geographically, we should do all we can to protect the most vulnerable, for example, via GI4RAQ interventions that work in part by forcing a fraction of polluted air to take a longer (more circuitous) path from source to receptor.

For greatest public health benefit and, hence, to make best use of resources, we should prioritise interventions where the greatest number of people and/or those most vulnerable to the impacts of air pollution (the young, the elderly and those with pre-existing medical conditions, such as COPD) are exposed to the highest pollutant concentrations for longest.

¹⁰ Liu, S., et al., 2021. Long-term exposure to low-level air pollution and incidence of chronic obstructive pulmonary disease: The ELAPSE project. *Environment International*, 146, 106267, <https://doi.org/10.1016/j.envint.2020.106267>

¹¹ Liu, S., et al., 2020. Long-term exposure to low-level air pollution and incidence of asthma: the ELAPSE project. *European Respiratory Journal*, DOI: 10.1183/13993003.030992020

3. Exposure and Vulnerability

Figures 2, 3 and 4 illustrate readily identifiable locations attracting vulnerable receptors from the point of view of their (ill)health, youth and (old) age, respectively. Figure 5 superimposes these locations (undifferentiated) on a map of annual-mean NO₂ concentrations simulated as part of the UoB-led West Midlands Air Quality Improvement Programme's (WM-Air) 'business as usual' analysis; elevations in PM_{2.5} are expected to correlate with high NO₂ concentrations.



Figure 2. Combined map of Colmore & Retail BIDs (using graphics from Greengage's Going Green Masterplan) with locations of destinations attracting potentially vulnerable receptors on account of their (ill)health.



Figure 3. Combined map of Colmore & Retail BIDs (using graphics from Greengage's Going Green Masterplan) with locations of destinations attracting potentially vulnerable receptors on account of their youth.



Figure 4. Combined map of Colmore & Retail BIDs (using graphics from Greengage's Going Green Masterplan) with locations of destinations attracting potentially vulnerable receptors on account of their (old) age.

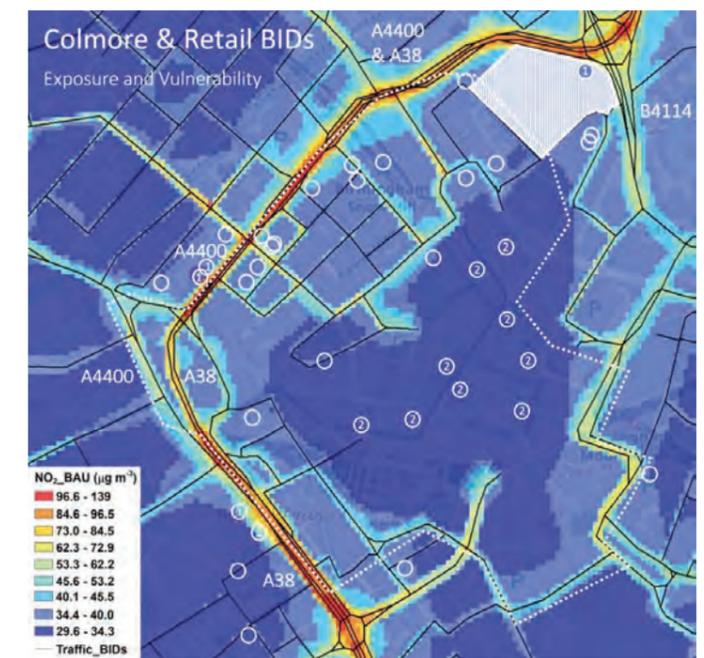


Figure 5. Map of annual-mean NO₂ concentrations spanning the Colmore & Retail BIDs, simulated as part of the West Midlands Air Quality Improvement Programme's (WM-Air) 'business as usual' analysis (courtesy of Dr Jian Zhong, UoB), superimposed with locations of destinations attracting vulnerable receptors identified in Figures 2-4 (white circles and, in the top right corner, the white hashed area marking the Birmingham Children's Hospital).

Figure 5 suggests people encounter the highest concentrations of NO₂, and by implication the highest elevations in PM_{2.5} as a result of road transport, beside the A38/A4400 bounding (and understood to be included within) the Colmore & Retails BIDs to the west and to the north. Here, the simulated annual-mean concentrations of NO₂ in places exceed 90 µg m⁻³ (cf. legal annual-mean limit of 40 µg m⁻³). In the absence of data on footfall, we will focus initially on potential GI4RAQ interventions where vulnerable people – irrespective of the total number of people – are likely exposed to very high concentrations of NO₂ and, by implication, PM_{2.5}.

Looking at this stretch of the A38/A4400 via Google Street View reveals multiple constraints on the implementation of GI4RAQ interventions, assuming wholesale re-design of these (e.g. moving or removing lanes of traffic) is out of scope. Note, this also applies to many of the more minor trafficked roads encroaching into the BIDs from their perimeter. These constraints include, but are not limited to: access required at the kerb (e.g. to bus stops and stands, taxi ranks and parking bays); insufficient space (e.g. due to the narrowness of the pavement and/or pinch points created by street furniture); and the need to preserve safety-critical sightlines and vision splays (e.g. in the vicinity of road junctions).

Three opportunities for GI4RAQ interventions of type (1) warranting further exploration* are identified in the next section, however, that might reduce the exposure of vulnerable people attracted to the following five destinations marked with the number '1' in Figure 5: *Birmingham City Council Adults and Communities and Services for Older People* (both in the bottom left corner); *Birmingham Chest Clinic* and *Regional NHS Occupational Lung Disease Service* (both in the top left corner); and *Birmingham Children's Hospital* (top right corner).

Meanwhile, the exposure of a very large number of people (including, but not limited to, vulnerable people) to lower but still harmful pollutant concentrations in the large region of the BIDs comprising zero-traffic streets could be reduced via a more extensive GI4RAQ intervention of type (2) subsequently explored in section 4.2. This region includes nine destinations attracting vulnerable receptors, marked with the number '2' in Figure 5: *Priory Wellbeing Centre*; *Immunisation and Medical Centre*; *Halcyon Medical Centre (NHS)*; *Birmingham NHS Walk In Centre*; *Frankley Health Centre*; *Pre-school Learning Alliance*; *Early Learning Centre*; *UKCIL Home Care Service*; and *The Nurse International Ltd – Home Health Care Service*.

***Please note, the author is not qualified to assess the feasibility of GI4RAQ interventions, for example, from a safety perspective. The feasibility of all interventions proposed in this report, including but not limited to their safe and secure installation, and the preservation of safety-critical sightlines and vision splays, must be assessed by those suitably qualified.**

4. Opportunities for GI4RAQ

4.1 GI4RAQ Interventions of Type (1)

4.1.1 Birmingham City Council Adults and Communities and Services for Older People

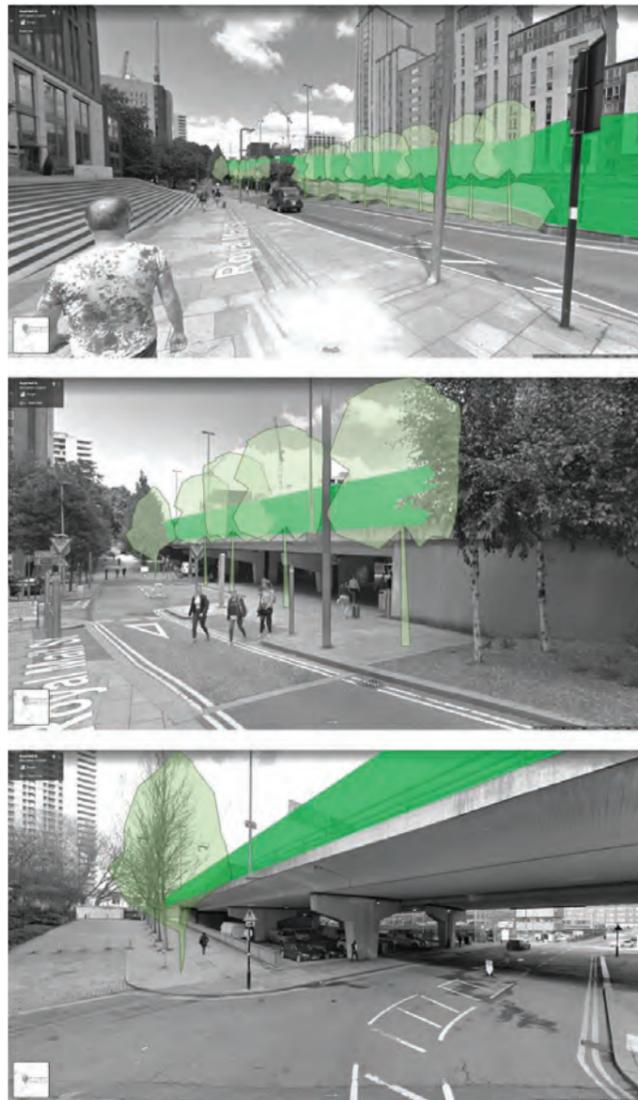


Figure 6. Potential GI4RAQ intervention between A38 and Birmingham City Council Adults and Communities and Services for Older People: 'essential' evergreen screen (deep green) and optional 'additional' planting (light green).

Figure 6 illustrates a potential GI4RAQ intervention intended to reduce roadside exposure to emissions from the A38 in the vicinity of the Mailbox, including but not limited to the exposure of vulnerable receptors accessing *Birmingham City Council Adults and Communities and Services for Older People*. It comprises: (i) an evergreen screen (e.g. living ivy screen) bounding the increasingly elevated A38, from its junction with Severn Street (to the south east) to its junction with Holliday Street (to the north east); and (ii) additional planting (trees and lower-level shrubs) to augment the existing planting to the west of the evergreen screen.

(i) is the essential component: only evergreen vegetation presents a year-round obstruction to polluted air flow from the A38 towards people on Royal Mail Street (top and middle panels of Figure 6) and pedestrian/cyclist access from Holliday Street (bottom panel of Figure 6). The question is if and how the requisite infrastructure could be safely constructed and maintained; a grey-infrastructure alternative could be considered if, for example, there is insufficient space to accommodate a growing medium and such like. (ii) is an optional component, which could bolster the obstruction presented by (i) and render the overall landscaping intervention much more attractive. Note, the existing trees are deciduous (see bottom panel of Figure 6) and simply planting more of the same is expected to have much less impact than adding (i).

The prototype GI4RAQ Platform can currently only be applied to streets, in which all cross-sectional elements (besides the buildings either side) are essentially level with each other in the vertical. It can therefore be applied to the stretch of the proposed GI4RAQ intervention towards Severn Street (top panel of Figure 6) but not to those stretches where the A38 is significantly elevated relative to its surroundings (middle and bottom panels of Figure 6).

Towards Severn Street, the prototype software estimates* that a 5m tall, 0.6m wide evergreen screen with 70% leaf coverage (strictly optical porosity), could reduce annual-mean NO₂ and PM_{2.5} concentrations between the screen and the buildings pictured leftmost in the top panel of Figure 6 by 5-10% and 2.5-5% respectively (see Figure 7). In all other parts of the street's cross section, the estimated changes in annual-mean NO₂ and PM_{2.5} concentrations are within +/-2.5%. Please note, in 'street canyon' environments of this sort (street width/height <3), the GI4RAQ Platform may systematically underestimate the impacts of roadside barriers⁴ – both the benefits, for example in the immediate wake of the barrier, and the accompanying disbenefits (as we change the distribution of pollution) in other parts of the street's cross section. For comparison, the combination of deciduous trees (planted 2.5m apart; 3m wide crowns extending from 2.5m to 6.5m above the ground, with 80% leaf obstruction when in leaf) and low-level deciduous shrubs (2m tall, 1m wide, with 80% leaf coverage when in leaf) is estimated to yield at most a 2.5-5% reduction in annual-mean NO₂ concentrations, and changes in those of PM_{2.5} of within +/-2.5% (see Figure 8).

***All GI4RAQ Platform estimates are subject to large (currently unspecified) uncertainties – whether or not the input data to the software, used to calculate these estimates, are marked 'accurate'. All estimates assume the corresponding GI4RAQ interventions are fully realised: i.e., suitable vegetation is planted and maintained in the location specified so as to meet the specified dimensions, seasonality and coverage of foliage. NB It may take years for trees to mature. Meanwhile, partially-realised interventions are expected to deliver disproportionately lower benefits due to non-linearities in the impacts of physical obstructions on air flow. They are based on climatological wind conditions in the region, including variability therein (i.e., not limited to those of air flow from source to receptors).**

Prototype GI4RAQ Analysis Report

Author Name: James Levine
 Unique ID: #589
 Analysis Name: Evergreen Screen (5m tall, 0.6m wide, 70% obstruction)
 Latitude: 52.476654
 Longitude: -1.902897



Changes in annual mean NO2 concentrations due to GI4RAQ



Changes in annual mean PM2.5 concentrations due to GI4RAQ



Figure 7. Percentage changes in annual-mean concentrations of NO₂ (top) and PM_{2.5} (bottom) estimated using the prototype GI4RAQ Platform, in response to the 'essential' GI4RAQ intervention beside the A38, towards Severn Street: a 5m tall, 0.6m wide evergreen screen with 70% leaf coverage (green rectangle). See Appendix 1 for full details of the intervention and all user-input data underlying these estimates.

Prototype GI4RAQ Analysis Report

Author Name: James Levine
 Unique ID: #590
 Analysis Name: Deciduous trees (2.5m apart; 3m wide crowns extending from 2.5m to 6.5m above the ground, 80% obstruction) and shrubs (2m tall, 1m wide, 80% obstruction)
 Latitude: 52.476654
 Longitude: -1.902897



Changes in annual mean NO2 concentrations due to GI4RAQ



Changes in annual mean PM2.5 concentrations due to GI4RAQ



Figure 8. Percentage changes in annual-mean concentrations of NO₂ (top) and PM_{2.5} (bottom) estimated using the prototype GI4RAQ Platform, in response to the optional 'additional' GI4RAQ intervention beside the A38, towards Severn Street: a dense line of deciduous trees planted 2.5m apart with 3m wide crowns extending from 2.5m to 6.5m above the ground, with 80% leaf coverage when in leaf (green ellipse), accompanied by a lower-level green barrier comprising deciduous shrubs 2m tall, 1m wide, with 80% leaf coverage when in leaf (green rectangle). See Appendix 2 for full details of the intervention and all user-input data underlying these estimates.

4.1.2 Birmingham Chest Clinic and related Regional NHS Occupational Lung Disease Service



Figure 9. Potential GI4RAQ intervention between A4400 and Birmingham Chest Clinic and related Regional NHS Occupational Lung Disease Service: as close as possible an approximation to a continuous evergreen hedge, with gaps permitting the minimum access required at the kerb (e.g. to disabled parking bays and bus stops/stands).

Figure 9 illustrates a potential GI4RAQ intervention to reduce the roadside exposure of vulnerable receptors – accessing the *Birmingham Chest Clinic* and related *Regional NHS Occupational Lung Disease Service* – to emissions from the A4400. It comprises a series of evergreen hedges on the north western side of the road, from where it converges with Summer Row (to the south west) to its junction with Newhall Street (to the north east). This should constitute as close as possible an approximation to a continuous hedge, permitting just the minimum access required at the kerb (e.g. to disabled parking and buses; Figure 9).

The prototype GI4RAQ Platform is designed to estimate the local air quality impacts of a vegetation barrier that extends continuously along a significant length of a street: it does not resolve the ‘edge effects’, where polluted air can escape around the ends of a barrier (as opposed to being forced up and over it). We can therefore use it to estimate the air quality impacts in the vicinity of the longer stretch of hedge proposed towards Summer Row (see middle panel of Figure 9) but not in the vicinity of large and/or frequent gaps (see top and bottom panels of Figure 9), where a less predictable pattern of localised reductions in exposure in some places, accompanied by increases in exposure in other places, may result.

Towards Summer Row, the prototype software estimates that an evergreen hedge 2.5m tall (NB it must exceed head height), 1m wide and with 80% leaf coverage, could reduce the annual-mean concentrations of NO₂ and PM_{2.5} between the hedge and the buildings pictured rightmost in the middle panel of Figure 9 by 5-10% and 2.5-5% respectively (see Figure 10). Note, the 5-10% reduction in annual-mean NO₂ concentration behind the barrier is accompanied by a 2.5-5% increase in annual-mean NO₂ concentration across the two carriageways (‘emission zones’ EZ1 and EZ2) and the central reservation (‘neutral zone’ NZ1). In all other parts of the street’s cross section, the software estimates that the changes in annual mean NO₂ and PM_{2.5} concentrations would be between +/-2.5%. As was the case beside the Mailbox, this is a street canyon environment, and we note that the GI4RAQ Platform may systematically underestimate the impacts of roadside barriers here⁴ – including the benefits, for example in the immediate wake of the barrier, but also the accompanying disbenefits, expected to be greatest in the vicinity of the two carriageways (as we change the *distribution* of pollution within the street). Potential impacts on drivers, including professional drivers, should be considered; a recent evidence review highlights the higher concentrations of air pollutants often experienced in motorised transport compared to cycling and walking¹².

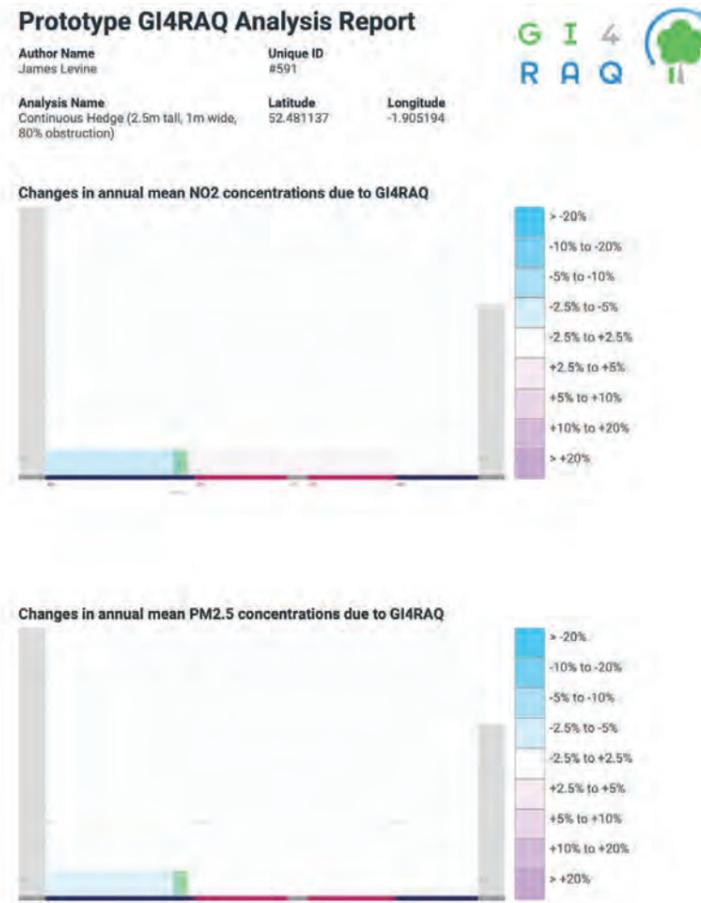


Figure 10. Percentage changes in annual-mean concentrations of NO₂ (top) and PM_{2.5} (bottom) estimated using the prototype GI4RAQ Platform, in response to the intervention beside the A4400, towards Summer Row: a 2.5m tall, 1m wide continuous evergreen hedge with 80% leaf coverage (green rectangle). Please see Appendix 3 for full details of the proposed intervention, including all user-input data on which these estimates are based.

¹² Mitsakou, C., J. P. Adamson, A. Doutsis, H. Brunt, S. J. Jones, A. M. Gowers, and K. S. Exley, 2021. Assessing the exposure to air pollution during transport in urban areas – Evidence review. *Journal of Transport & Health*, 21, 101064, <https://doi.org/10.1016/j.jth.2021.101064>

4.1.3 Birmingham Children’s Hospital

In section 3, *Birmingham Children’s Hospital* was identified as a destination attracting vulnerable receptors with respect to both their (ill)health (Figure 2) and youth (Figure 3): i.e., people with compound vulnerabilities. Whilst Colmore BID’s boundary coincides with the hospital’s south western perimeter, it is the opposite side of the hospital site – to the north east – that is exposed to the highest concentrations of air pollutants due to its proximity to the A38/A4400 and B4114 dual carriageways; see Figure 11. If a GI4RAQ intervention on the periphery of the Colmore & Retail BIDs could be included in the Going Green Masterplan, one here should be prioritised due to the coincidence of high exposure and very high vulnerability.

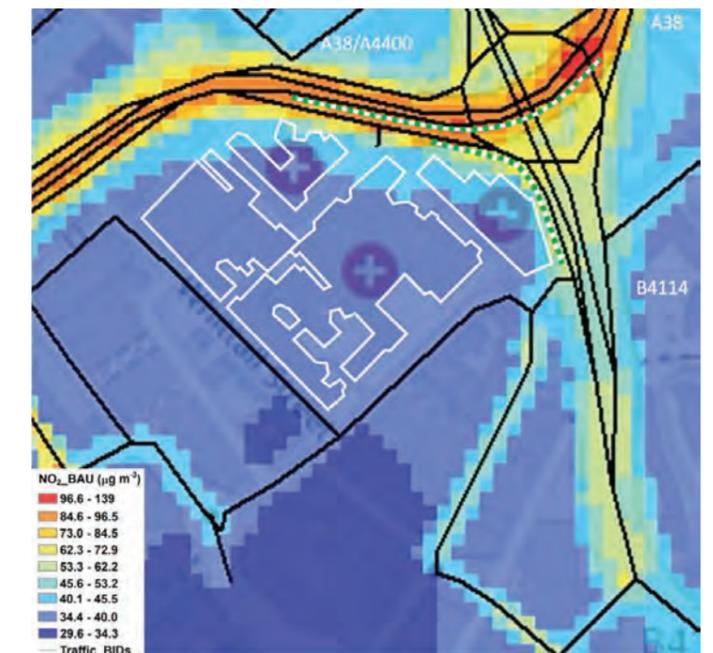


Figure 11. Map of annual-mean NO₂ concentrations in the vicinity of *Birmingham Children’s Hospital*, simulated as part of the UoB-led West Midlands Air Quality Improvement Programme’s (WM-Air) ‘business as usual’ analysis (courtesy of Dr Jian Zhong, UoB); the hospital buildings (crudely rendered) are outlined in white and the approximate locations of the proposed green (or grey) infrastructure screens are marked by dotted green lines.

Figure 11 (an enlargement of Figure 5 in the vicinity of the hospital) suggests that those accessing the site via the pedestrian/cycle way at its north eastern perimeter may be exposed to concentrations of NO₂ in the range of around 50-90 µg m⁻³ (cf. annual-mean legal limit of 40 µg m⁻³) and, by implication, elevated concentrations of PM_{2.5} too. Furthermore, hospital buildings on this side of the site may be opening their windows onto regions of very high NO₂ and PM_{2.5} concentrations. Two evergreen screens (or grey infrastructure alternatives if space/secure installation precludes green infrastructure) flanking the elevated A38 and B4114/A38 slip road (see dotted green lines in Figure 11) could help reduce local exposure.

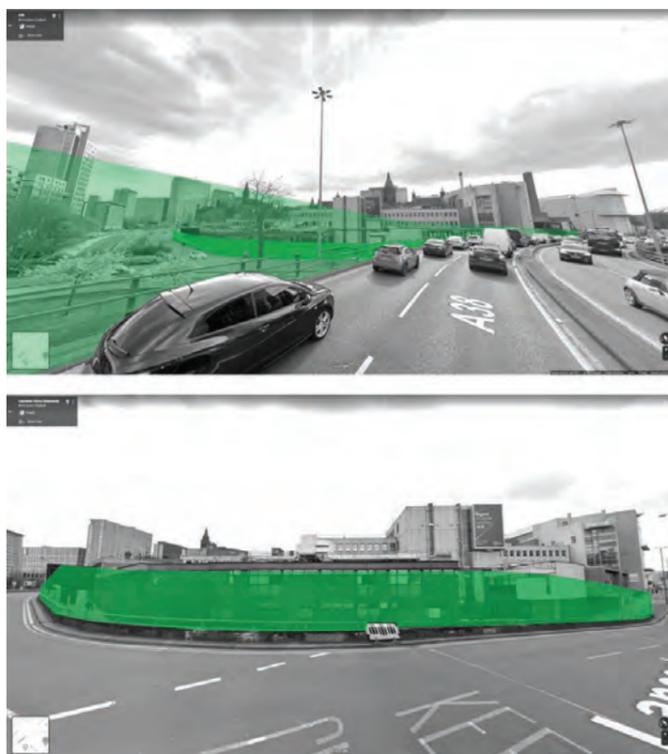


Figure 12. Potential GI4RAQ intervention between A38, B4114 and Birmingham Children's Hospital: two evergreen screens (or grey infrastructure alternatives if space/secure installation precludes green infrastructure) to obstruct the flow of polluted air from the elevated A38 (top panel) and across the retaining wall between the B4114/ A38 slip road and the pedestrian/cycle way at the hospital's north eastern perimeter (bottom panel).

This is a complex environment in terms of the spatial distribution and dispersion of vehicular emissions. As pictured in the top panel of Figure 12, the A38 flies over the B4114 here, and elevated roads are currently beyond the scope of the GI4RAQ Platform. Only very recently did the author learn of Cambridge Environmental Research Consultants' (CERC) recent project funded by Highways England to extend the capacity of its software (ADMS-Urban and ADMS-Roads), used to assess the impacts of the UK's national Strategic Road Network, to capture the air quality impacts of such roads; Figure 13 is a screengrab of CERC Principal Consultant, Mark Jackson's presentation at the Highways England Innovation Showcase for Digital Roads and Air Quality (7th July 2021). Schematically, it shows how the plume of emissions from an elevated road broadens (in the vertical) with increasing distance downwind but, if the mean flow remains horizontal, peak pollutant concentrations in the plume remain level with the road – the source of pollution. A screen obstructing the flow of polluted air to the south west from the elevated A38 (top panel of Figure 12) might increase the effective height of this source, and reduce the pollutant concentrations encountered at the hospital's north east perimeter, provided this increase in height is not offset by enhanced turbulent mixing in the screen's wake (TBC).

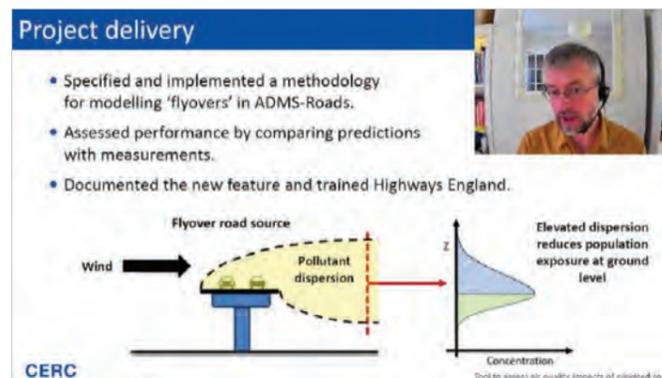


Figure 13. Screengrab of Cambridge Environmental Research Consultants' Principal Consultant, Mark Jackson's presentation at the Highways England Innovation Showcase for Digital Roads and Air Quality (7th July 2021) on CERC's recent project to extend the capacity of its ADMS-Urban and ADMS-Roads software w.r.t. elevated roads.

Installation of a second screen, essentially in line with the retaining wall between the B4114/ A38 slip road and the adjacent pedestrian/cycle way at this north east perimeter (bottom panel of Figure 12), could: further reduce the exposure of those accessing the hospital by this active-travel route; and, if sufficiently high, improve the air quality in the region onto which the most northerly/easterly hospital buildings open their windows. Both screens should be as tall and impermeable as space and secure installation allow. A 2.5m high screen (min) would likely offer some protection to pedestrians and cyclists, whilst a 5m+ high screen might start to extend the benefits to the occupants of adjacent buildings.

Whilst the author is unable to use the GI4RAQ Platform to estimate the impacts of these screens, owing to the complexity of this environment, he has introduced Philip Singleton (via email; 18th August 2021) to his ex-UoB colleague and now Director of SurveyAR, Dr Rick Thomas, regarding an opportunity to gain unprecedented insights into the current air quality in this priority location. This would require no monetary input, just the support of local stakeholders. If any reader of this report is interested in exploring this opportunity, please contact the author, who would provide light touch support in the capacity of an academic 'critical friend'.

Dr Thomas' expertise lies in the development and application of Unmanned Aircraft Systems (UAS) for intelligent surveying and management of environmental assets, including air quality. SurveyAR has recently been awarded a DfT grant (via the Connected Places Catapult) to demonstrate the feasibility of its micro-swarm drone UAS sensing solutions for land-managers, industry, and regulatory authorities, focussing in particular on urban air quality and weather. He recently reached out to the author as he is looking for priority environments to survey, and thereby demonstrate the value of their approach and technology, as soon as October 2021. The region where the A38 flies over the B4114 is just such an environment owing to its complexity (very difficult to characterise with conventional, land-based air quality instruments) and potential to reduce exposure of highly vulnerable receptors. Dr Thomas has Operational Authorisation with the Civil Aviation Authority and the necessary insurance, and local stakeholders would be given free and full access to the measurements.

4.2 GI4RAQ Interventions of Type (2)

Figure 14 illustrates the many streets in the Colmore & Retail BIDs understood to carry zero traffic*, where public exposure to air pollution (including, but not limited to, many vulnerable receptors; see Figure 5) could be reduced via an extensive GI4RAQ intervention of type (2): extended tree canopies (green lines) to reduce the exchange of relatively clean air at ground level with relatively polluted air above the surrounding buildings (e.g. influenced by vehicular emissions from surrounding trafficked roads), terminated with dense low-level vegetation at their extremities (green spots) to impede the horizontal ingress of polluted air thereunder. *If these streets carry a relatively small number of delivery vehicles, and do so outside the hours they receive significant footfall, this intervention might still be beneficial (and possible with carefully arranged planting): where, and only where, largely unpolluted air is trapped for long periods within the confines of vegetation ('green oases'¹³), the usually modest benefit of pollutant deposition to leaf surfaces is enhanced.

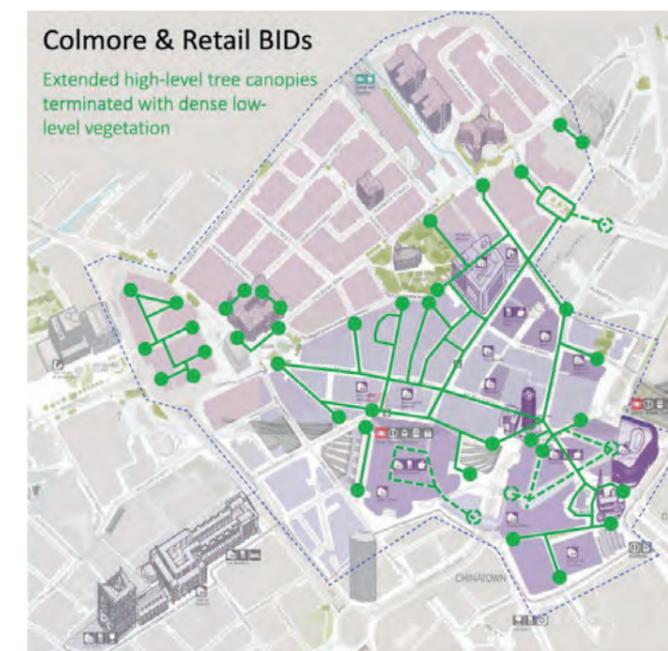


Figure 14. Combined map of Colmore & Retail BIDs (using graphics from Greengage's Going Green Masterplan) showing streets believed to carry zero traffic, where extended tree canopies (green lines) terminated with dense low-level vegetation (green spots) could reduce public exposure to air pollution from nearby trafficked roads.

To implement all of the planting proposed in Figure 14 would be hugely ambitious, but the intervention is scalable: the BIDs could, in principle, establish extended tree canopies throughout any number of zero traffic streets, provided all of their extremities were also

¹³ Hewitt, C. N., K. Ashworth, and A. R. MacKenzie, 2019. Using Green Infrastructure to Improve Urban Air Quality (GI4AQ), *Ambio*, pp.1-12

terminated with low-level vegetation. At one end of the spectrum, we could envisage what would truly resemble an ‘urban forest’; at the other, a single road used to trial the approach. Note, whilst these zero-traffic streets unsurprisingly correspond to the areas of lowest simulated annual-mean NO₂ concentrations in Figure 5 (29.6-34.3 µg m⁻³), the public health benefits of further reducing these concentrations should not be underestimated. Recall, recent research reveals that there are no safe thresholds of exposure to air pollutants^{10,11}. Figure 15 illustrates the density of tree crowns needed to create an extended tree canopy.

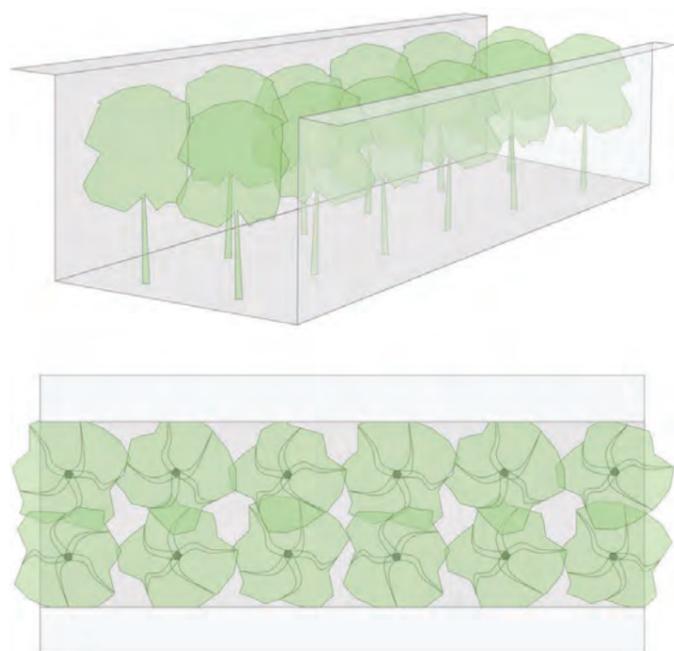


Figure 15. Illustration, offering a visual impression only, of the density of tree crowns needed to create an extended tree canopy, as proposed, to reduce public exposure to air pollution in zero-traffic streets.

Estimating the size of concentration reductions possible, however, is not straightforward; the GI4RAQ Platform was designed to estimate the impacts of interventions of type (1), not type (2). What we would like to do is estimate how much of the concentrations presently encountered in these streets is attributable to the import of pollution from surrounding ones: i.e., the difference between current ambient concentrations with and urban average background concentrations in this region. Defra’s UK Air Information Resource (AIR; <https://uk-air.defra.gov.uk/data/gis-mapping/>) suggests the 2019 (i.e., pre-pandemic) annual-mean background NO₂ concentrations here were around 30 µg m⁻³. It is tempting to subtract this figure from the 29.6-34.3 µg m⁻³ concentrations simulated as part of WM-Air’s ‘business as usual’ analysis (Figure 5), suggesting an upper limit on NO₂ reductions of around 4 µg m⁻³ or approximately 10%. However, this would be to difference two numbers, each of which are subject to uncertainties, and nuances as to what sources of pollution they include, not to mention potential differences with respect to their reference years.

Final Word

Dr Levine hopes the Colmore & Retail BIDs find this report helpful and will gladly attend a 1-hour meeting with those who have commissioned these four days of work (and/or others contributing to the Going Green Masterplan) to: offer any clarifications sought; and consider if and how the proposed interventions may be modified to maximise the co-benefits of green infrastructure (e.g. for mitigation of the urban heat island effect for improved thermal comfort, and sustainable urban drainage in the face of increasingly frequent high-rainfall events).

Of the GI4RAQ interventions explored in section 4, Dr Levine would encourage the Colmore & Retail BIDs to prioritise, in this order, those in the vicinity of: (1) *Birmingham Children’s Hospital* (section 4.1.3) on account of the coincidence of high exposure beside the A38/B4114 and very high vulnerability of those exposed; (2) the Mailbox (section 4.1.1), where it could reduce the exposure of, not only vulnerable receptors accessing *Birmingham City Council Adults and Communities and Services for Older People*, but the many further members of the public accessing the shopping centre, beside a heavily polluted stretch of the A38; and (3) the region of the BIDs comprising zero-traffic streets, or a fraction thereof (section 4.2), in view of the large number of people, including but not limited to vulnerable receptors, who spend a significant amount of time in this area.

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