Transport Delivery , Overview and Scrutiny Committee, 22 January 2024

The role of green infrastructure in urban design

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Presentation on behalf of the WM-Air team and others…

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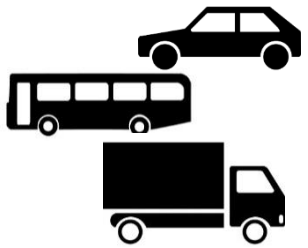
Urban Design determines air quality

- Urban areas are a source of emissions (e.g. cars, industry, homes)
- Urban areas contain people, who are exposed to emissions
- Urban design determines how pollution moves through an urban area
  - Roads and buildings channel wind
  - Compact form can reduce the wind moving through the area and reduce mixing – mixing is important for dispersing pollution
  - Urban form can also create eddies, which increases mixing
- Urban design determines where people are exposed to pollution

SOURCE

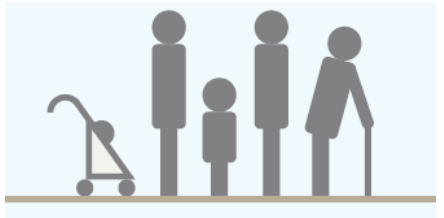


- Road transport
- Vehicle braking & accelerating
- Idling/congestion

PATHWAY

- Concentration highest closest to source
- Longer pathway = more mixing and dilution

RECEPTOR



- Young & old most vulnerable
- Health impacts with short-term and long-term exposure

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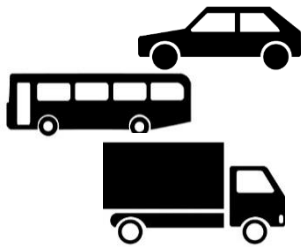
Reduce

SOURCE



- Road transport
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Extend

PATHWAY

- Concentration highest closest to source
- Longer pathway = more mixing and dilution

Protect

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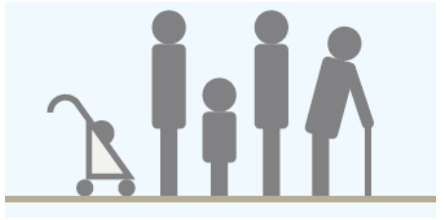

- Young & old most vulnerable
- Health impacts with short-term and long-term exposure

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The worst place for a pavement is roadside

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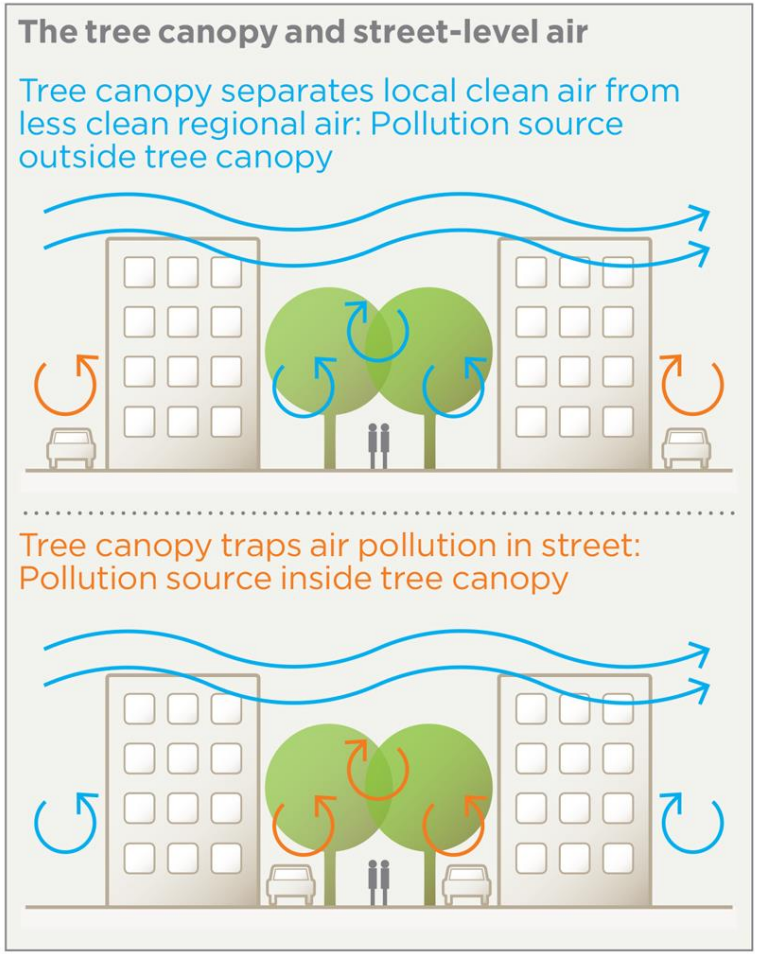
Green Infrastructure & Urban Design

- Parks have cleaner air because there is no pollution source
- Trees can trap pollution when there is a pollution source under their canopies (only if they are a lid)
- Hedges, when sufficiently thick and high can form a barrier between people and pollution
- Rough surfaces increase mixing
- Green infrastructure produces VOCs that combine with NOx to create ozone; this is slow, needs sunshine, and at distance from original GI



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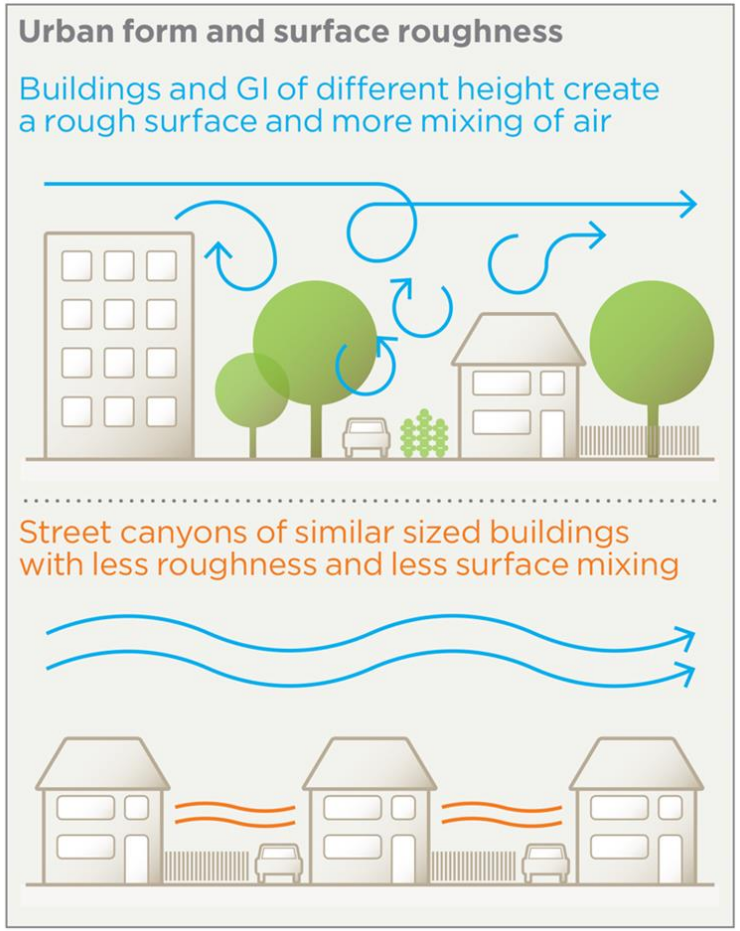

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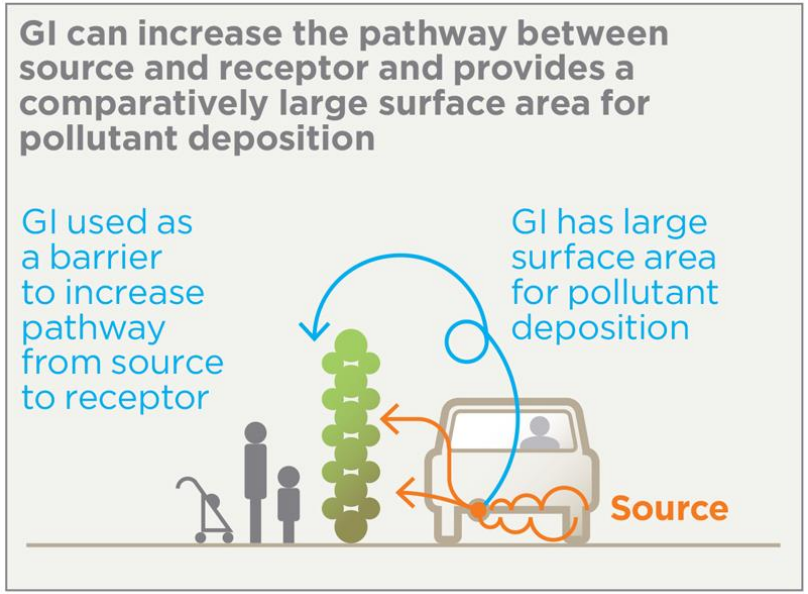

Reduce
Extend
Protect

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Trees DO NOT clean the air

- Particles are deposited on leaves – but the quantity of particles is so small it makes a negligible impact on air pollution concentrations in urban areas.
  - If you add up all the particles on all the trees/vegetation in an urban area, then this does accrue (but it makes no difference to what we breath in on the street)

- Some NOx (nitrous oxides) can be taken in by plant leaves, but some of this is released by roots, no evidence for improving urban air quality
  - If you add up all the particles on all the trees/vegetation in an urban area, then this does accrue (but what about that which is released by soil and roots?)

- On the scale of realistic urban planting, trees have a negligible impact on air pollution (AQEG, 2018). Large forests are deposition sinks for they have no sources.

Trees DO NOT clean the air

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URBAN DESIGN FOR AIR QUALITY

Urban design influences where air pollution is produced, how it disperses through streets and neighbourhoods, and where, when, and how much people are exposed. Good urban design improves air quality.

Air quality mitigation strategies fit broadly into three categories:

1. REDUCE

Reducing air pollution emissions is the most effective way to improve air quality. Road transport is one of the largest sources of air pollution in urban areas. Mitigation measures include facilitating active transport by creating walkways and cycleways, providing links to public transport, electric car charging points, and discouraging wood/coal combustion.

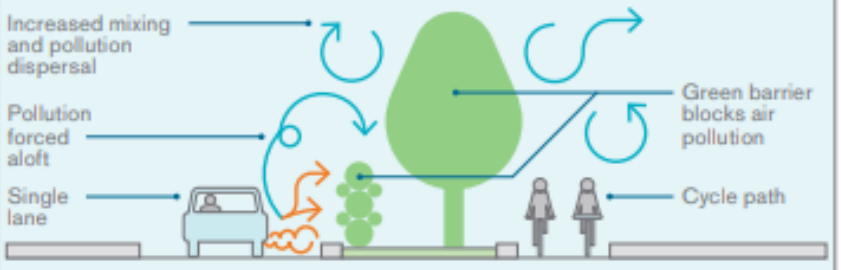
2. EXTEND

Increasing the distance between pollution source and human receptor allows for air pollution to disperse (mix into cleaner air), and can reduce exposure. This can be actual distance, or an "effective" distance, when barriers force polluted air to take a longer path, or via a heterogeneous surface that creates eddies and encourages mixing.

3. PROTECT

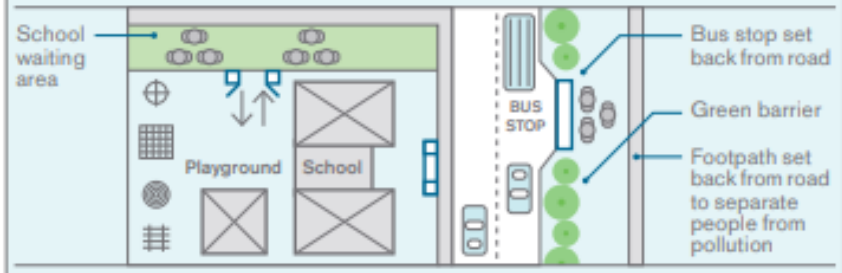
Older adults (>65), children (<12) and those with certain pre-existing health conditions (e.g. asthma, COPD) are most vulnerable to air pollution. Extra care must be taken to separate people and pollution in places where these vulnerable groups gather and wait, such as in front of hospitals, schools or at bus stops.

Reconfiguration of road to reduce emissions and extend distance between people and pollution



One lane of dual carriageway removed to create green space between roadside and pre-existing pavement to discourage car use (**REDUCE**) and increase the distance between people and pollution (**EXTEND**). Lane removed as part of strategic planning to reduce pollution and carbon emissions from road transport

Redevelopment to create waiting areas away from pollution sources



Redevelopment of land adjacent to school allows a new school entrance away from roadside (**EXTEND**) and enables a car-free waiting area for child drop off/collection (**PROTECT**). Bus stop re-situated back from road (**EXTEND**)

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.

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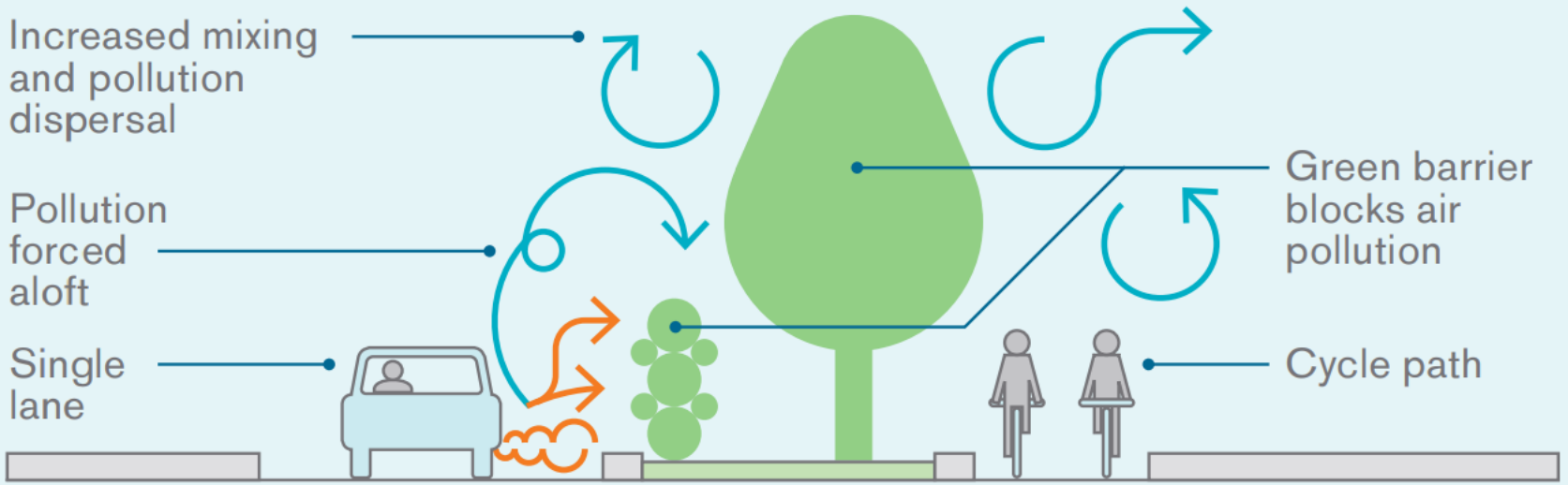

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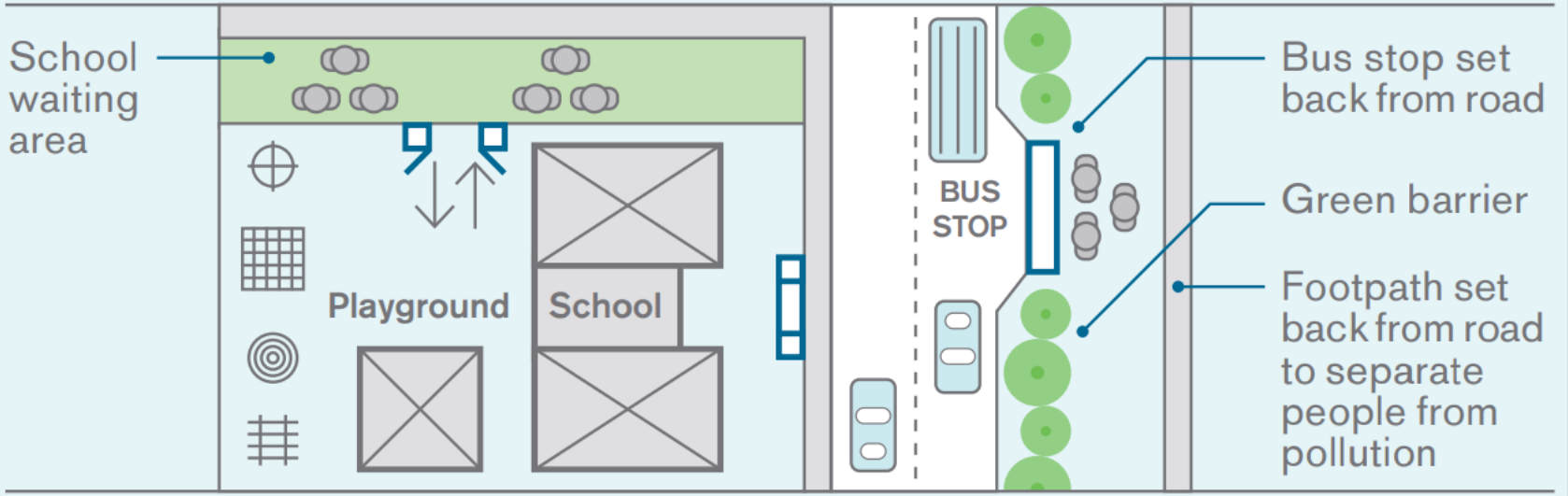

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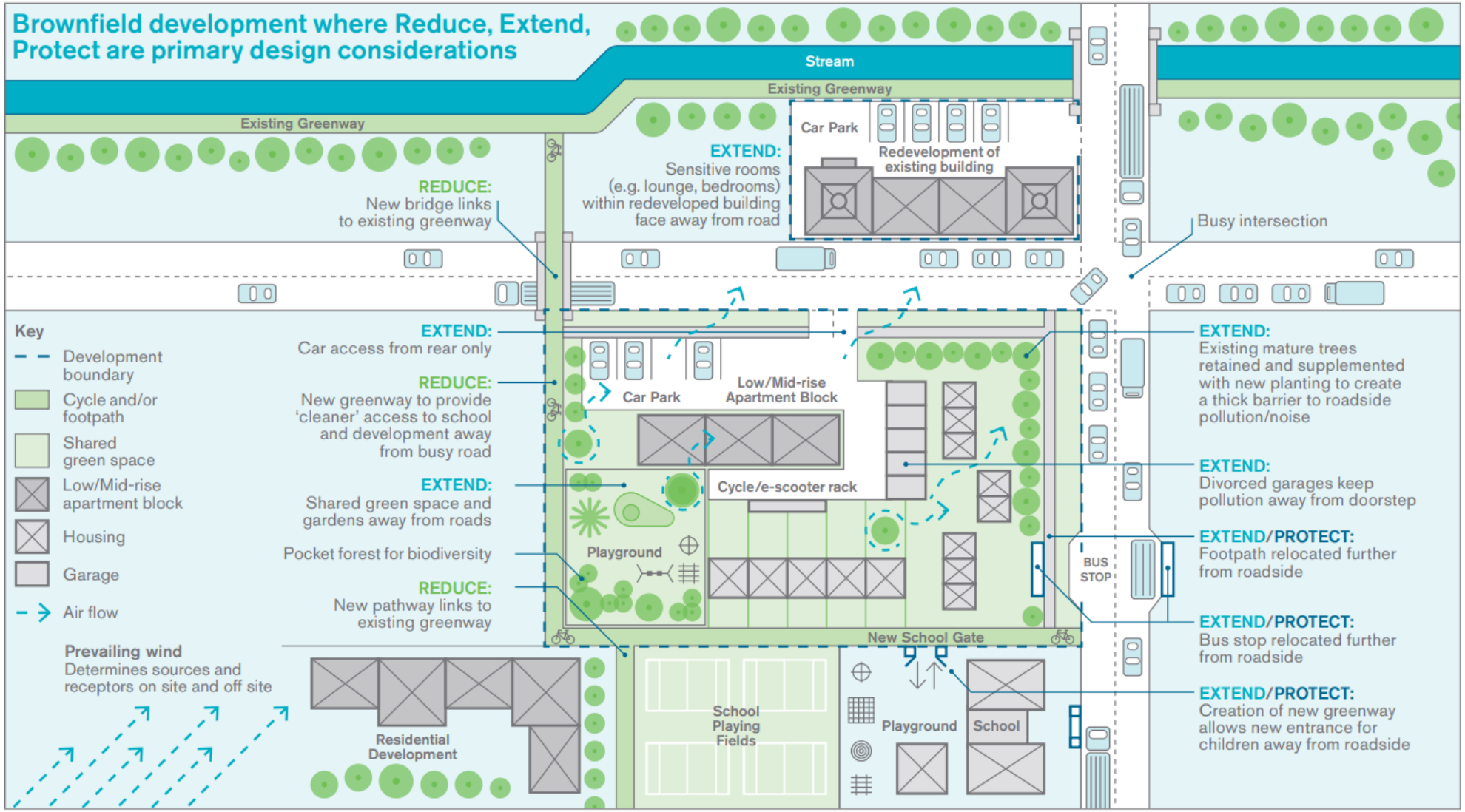

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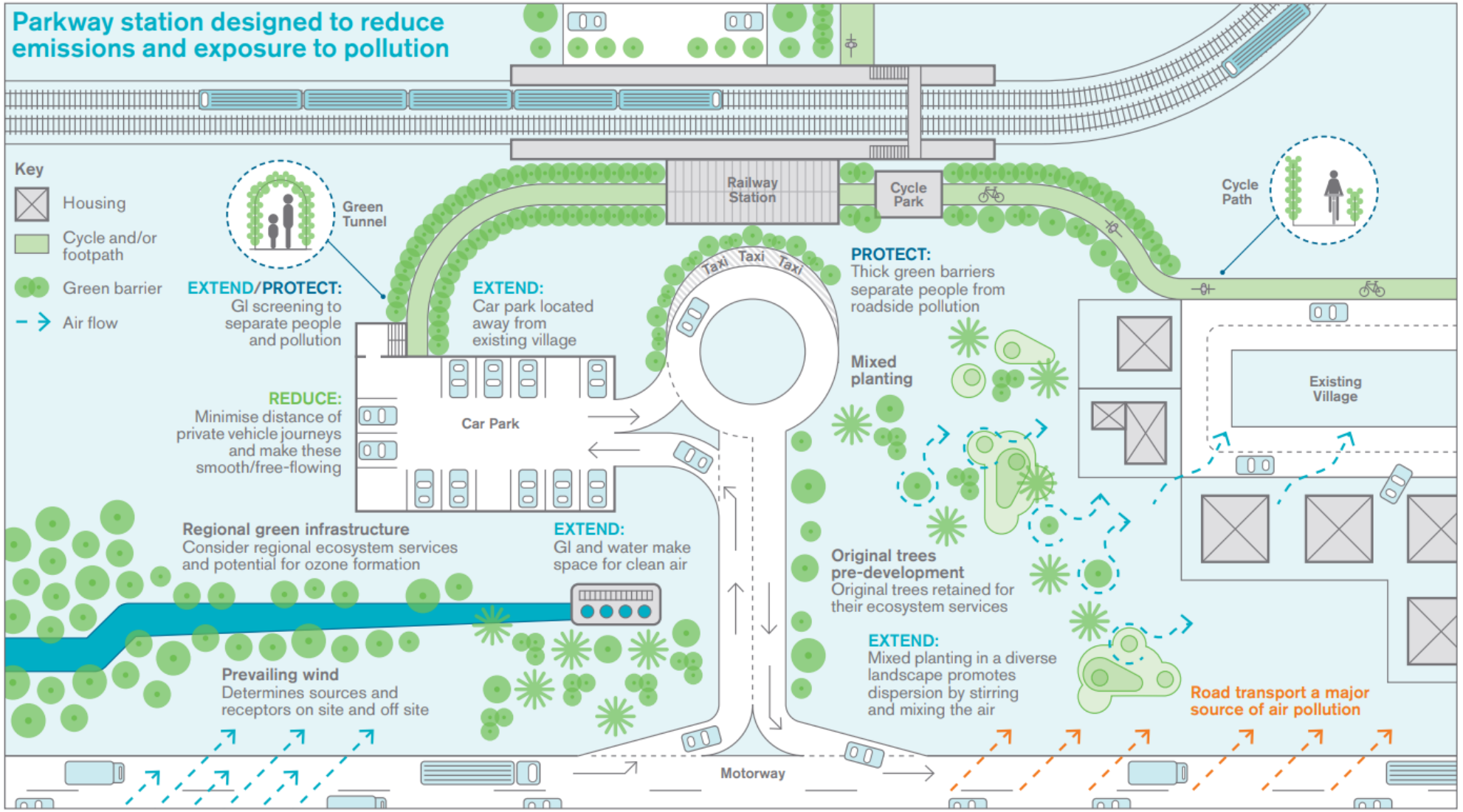

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Climate resilience, air pollution, green infrastructure

In 2 minutes..

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Future extreme weather & climate change

- Increased future flood risk (p*luvial, fluvial, coastal)*

"The risk of flooding to people, communities and buildings is one of the most severe risks from climate hazards for the UK population – both now and in the future" CCRA 2021

Source: GETTY IMAGES
https://www.bbc.co.uk/news/uk-england-shropshire-59401743

- Increased future overheating risk

"*There is still little preventative action being taken to address health risks from overheating in buildings. In England, ~20% homes risk of overheating" CCRA 2021*

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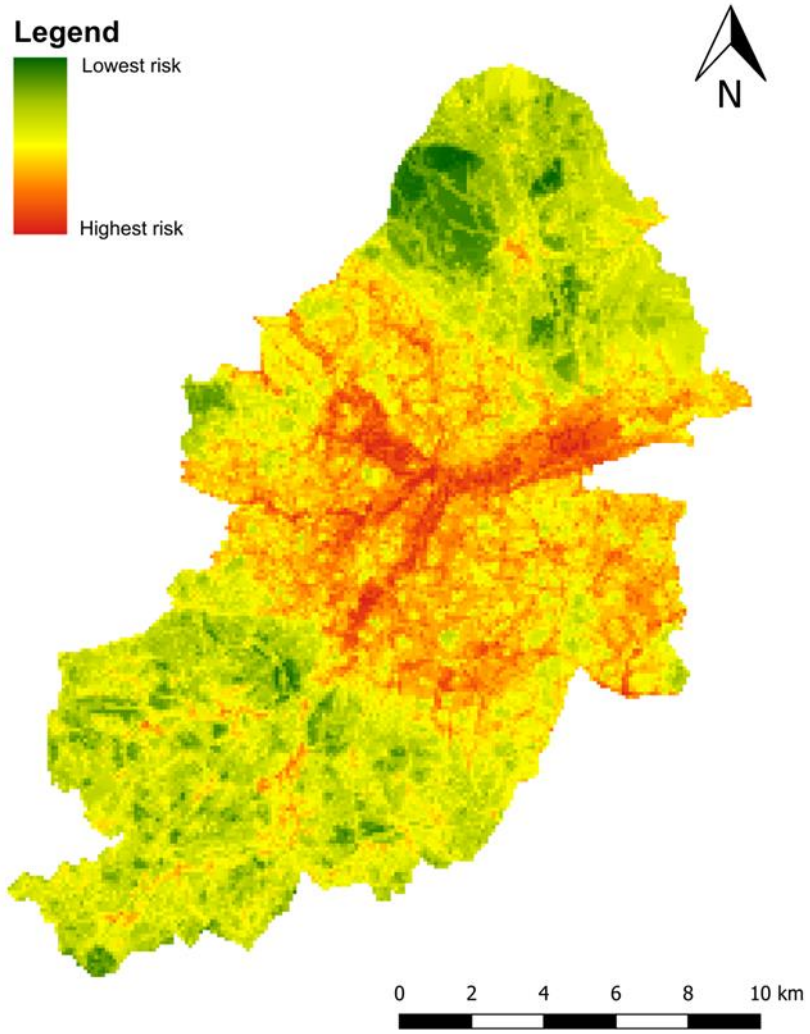
Planning must consider future climate risk

- All aspects of planning – built environment, infrastructure, transport
- Considering future risk reduces long-term costs
- Prevents maladaptation and lock in, e.g.
  - Building homes in the Urban Heat Island that will need air-con in 20 years time when you are trying to meet Net-Zero targets or address fuel poverty
- Joins up multiple agendas, e.g.
  - Climate mitigation (net zero/decarbonisation)
  - Climate adaptation (being ready for extreme weather and a different climate)
  - Biodiversity decline
  - Levelling up

How can we map climate risk in Birmingham?

Layer	Data type
Fluvial flood risk (Flood zones 2 & 3)[7,8]	Physical
Pluvial flood risk (3.3 year return period)[9]	Physical
Open green space deficit[10]	Physical
Other green space deficit[11]	Physical
Tree canopy cover deficit[12]	Physical
Local climate zones[13]	Physical
Annual nitrogen dioxide (NO_2) concentration[14]	Environmental
Annual fine particulate ($PM_{2.5}$) concentration[14]	Environmental
Surface temperature (summer daily max)[15]	Environmental
Indices of Multiple Deprivation (IMD)[16]	Social
Excess years life lost[17]	Social



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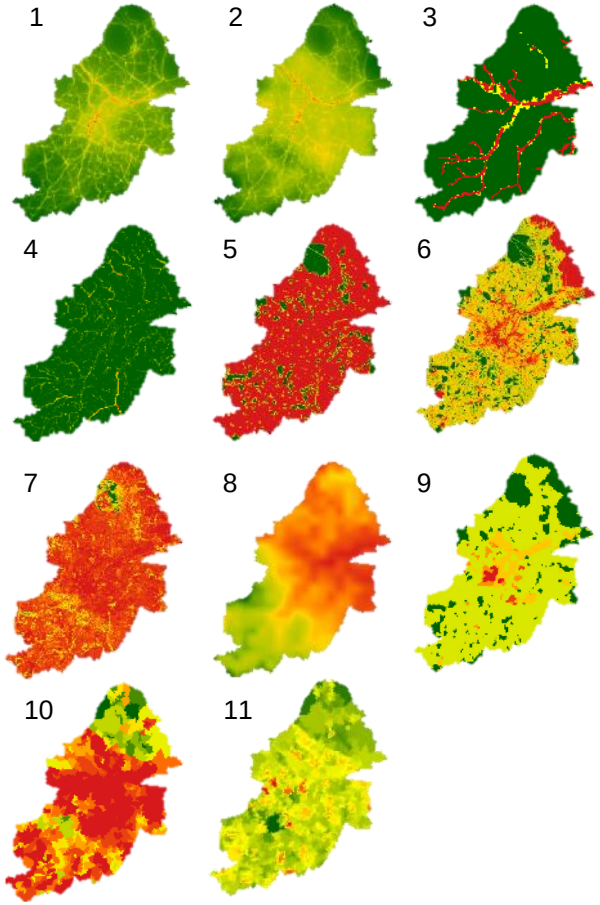
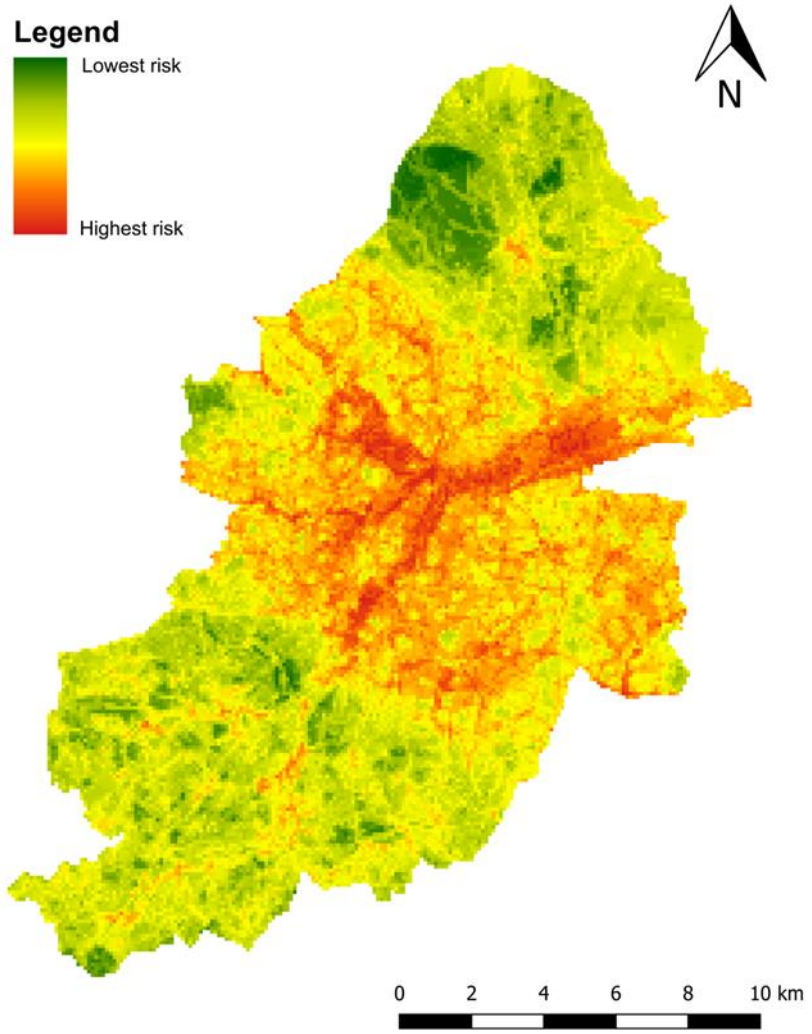
Climate Risk and Vulnerability Assessment



1. Mean $PM_{2.5}$ 2016
2. Mean NO_2 2016
3. Fluvial flood risk
4. Pluvial flood risk
5. Open green space
6. Other green space
7. Tree canopy cover
8. Surface temperature
9. Local climate zones
10. IMD 2019
11. Excess years life lost



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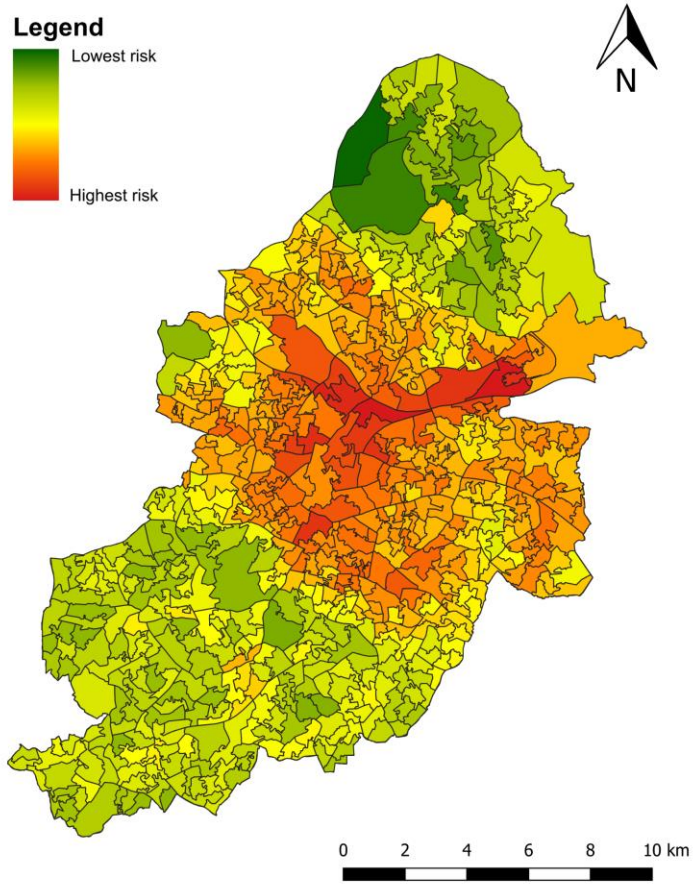

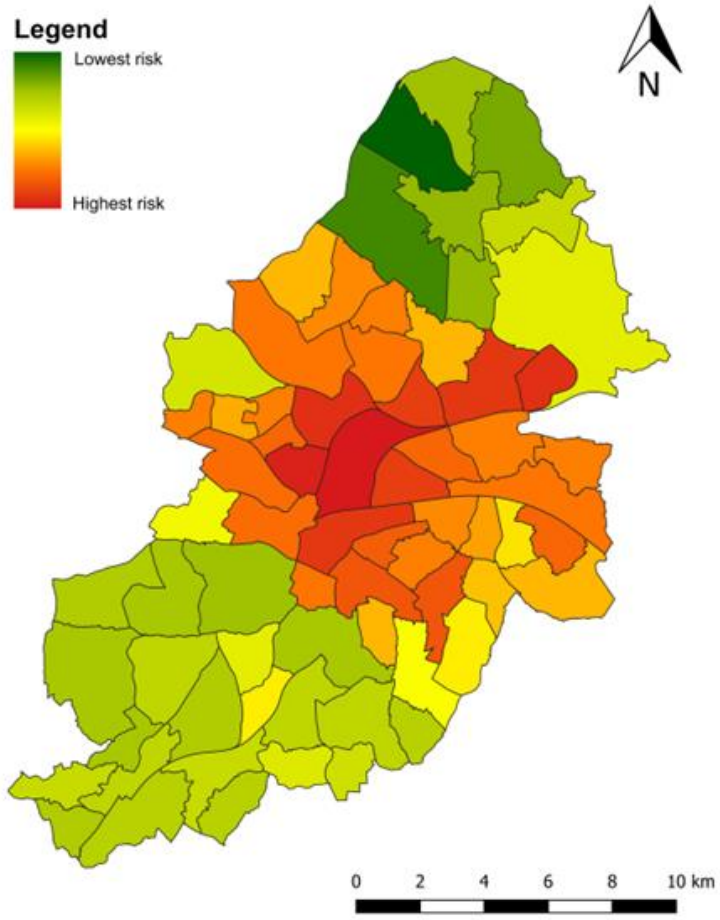

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Greenham et al., 2023 http://epapers.bham.ac.uk/4259/

In summary

- Urban design determines where people are exposed to pollution
- **Reduce** emissions, **Extend** the distance, **Protect** vulnerable people
  - First Steps in Urban Air Quality http://epapers.bham.ac.uk/3069/
  - Urban Design for Air Quality http://epapers.bham.ac.uk/3493/
- **Trees do not clean the air**
  - Trees and Urban Air Quality http://epapers.bham.ac.uk/4112/
  - Impacts of Vegetation on Urban Air Pollution (2018) Air Quality Expert Group
- Infrastructure and built environment planning must consider future climate
  - First steps in Urban Heat http://epapers.bham.ac.uk/3452/
  - First Steps in Urban Water http://epapers.bham.ac.uk/4284/
  - Climate Risk and Vulnerability Assessment http://epapers.bham.ac.uk/4259/
- Currently mapping climate risk for the WM region and developing a transport-focused CRVA map (with WMCA).

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