

# Green Infrastructure for Roadside Air Quality



Introducing free, prototype software to predict the site-specific impacts of 'GI4RAQ'

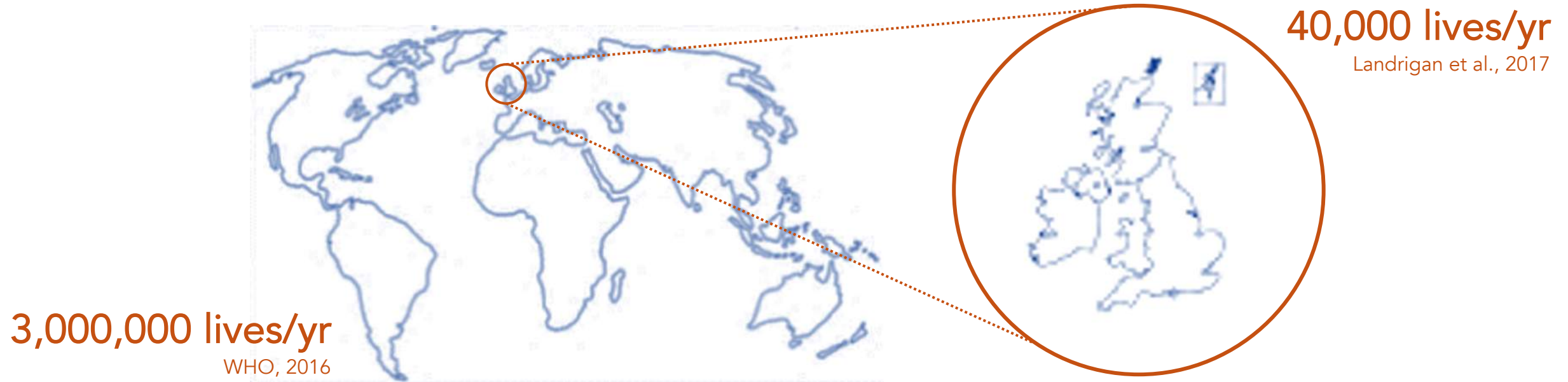
**James Levine** Rob MacKenzie, Xiaoming Cai & Helen Pearce

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# Outdoor Air Pollution and Human Health



Globally, only one in ten people live in a city meeting the WHO's guidelines  
WHO, 2016

5% UK adult mortality (10 life-yrs) due to fine particulate matter (PM<sub>2.5</sub>) alone  
PHE, 2014



# Road Transport - Main UK Urban Source

A **ban** on the sale of **petrol and diesel cars** could be brought forward by five years to accelerate the take-up of electric vehicles, according to the transport secretary. Grant Shapps said that **the government's target to ensure all new cars are zero-emission models by 2040 may be shifted to 2035 under new plans.** 1 Oct 2019

[Ban on petrol and diesel cars could be accelerated | News ...](#)

<https://www.thetimes.co.uk › article › ban-on-petrol-and-diesel-cars-could-b...>

Reducing road transport emissions is the best way to improve urban air quality



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Electric vehicles are not 'zero-emission': brake, tyre & road wear emit PM<sub>2.5</sub>



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We need to reduce *total vehicle movements* (as well as emissions/vehicle) towards a future of excellent public transport & widespread active travel

Meanwhile, for optimal *public health outcomes*, we should minimise both emissions from vehicles and the public's exposure to these emissions

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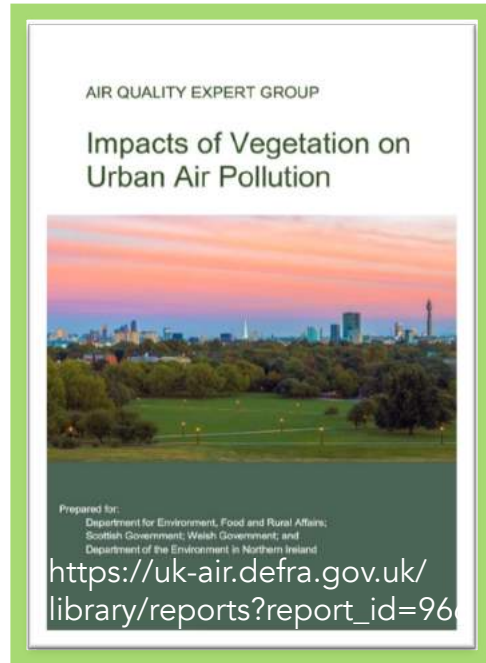
Meanwhile, for optimal *public health outcomes*, we should minimise both emissions from vehicles and the **public's exposure** to these emissions  
– a role for green infrastructure

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# Impacts of Vegetation on Urban Air Pollution

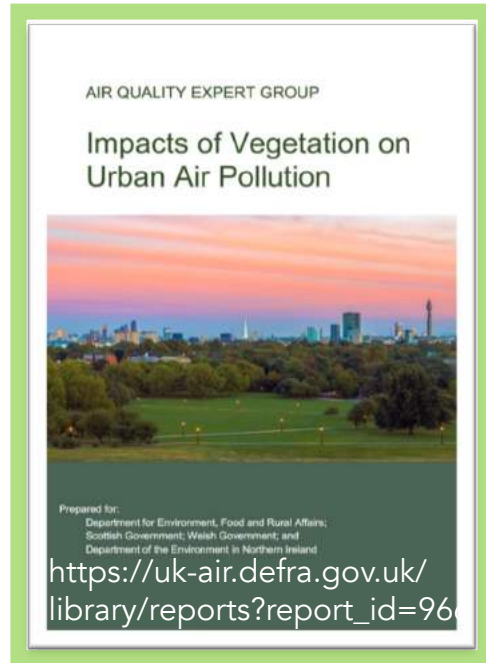


At the scale of realistic urban planting, vegetation **removes little pollution**: typically only a few percent of PM (and a smaller fraction of nitrogen dioxide)

AQEG, 2018



# Impacts of Vegetation on Urban Air Pollution



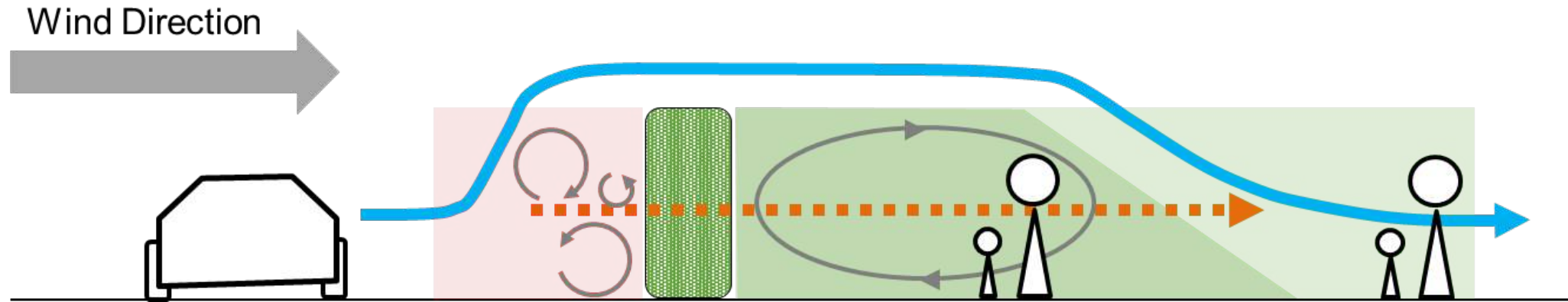
Vegetation barriers can, however, **effectively** alter the flow of polluted air and reduce *local* exposure to *local* sources of pollution by as much as 50%

AQEG, 2018





# Impacts of Vegetation on Urban Air Pollution

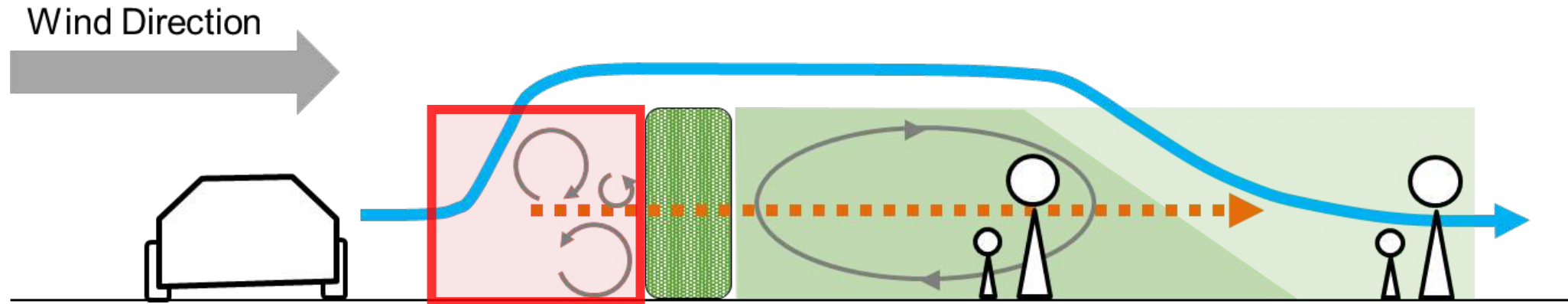


Under the right conditions, a *dense* vegetation barrier can divert a significant fraction of polluted air up and over people in its *immediate wake* (small vortex)

The benefits rapidly diminish with increasing distance downwind of the barrier



# Impacts of Vegetation on Urban Air Pollution

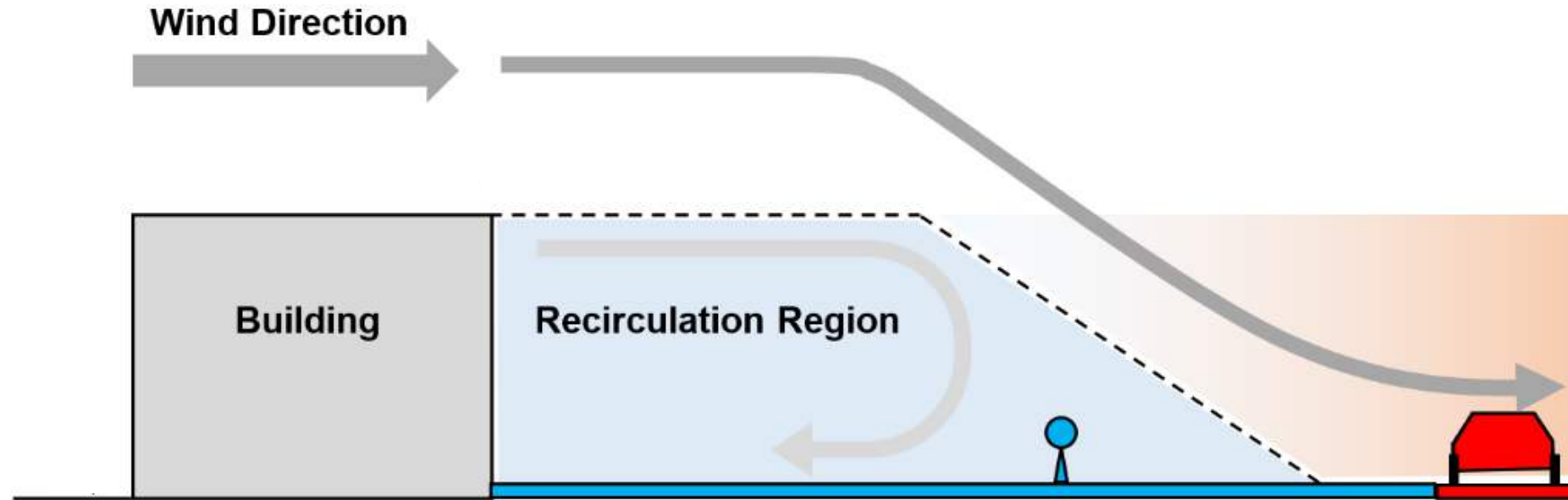


Immediately upwind of the barrier, the 'blocking' of polluted air flow presents a potential disbenefit: *strategic & selective* use for net public health benefit

And... local conditions of wind and urban form introduce further complexity...



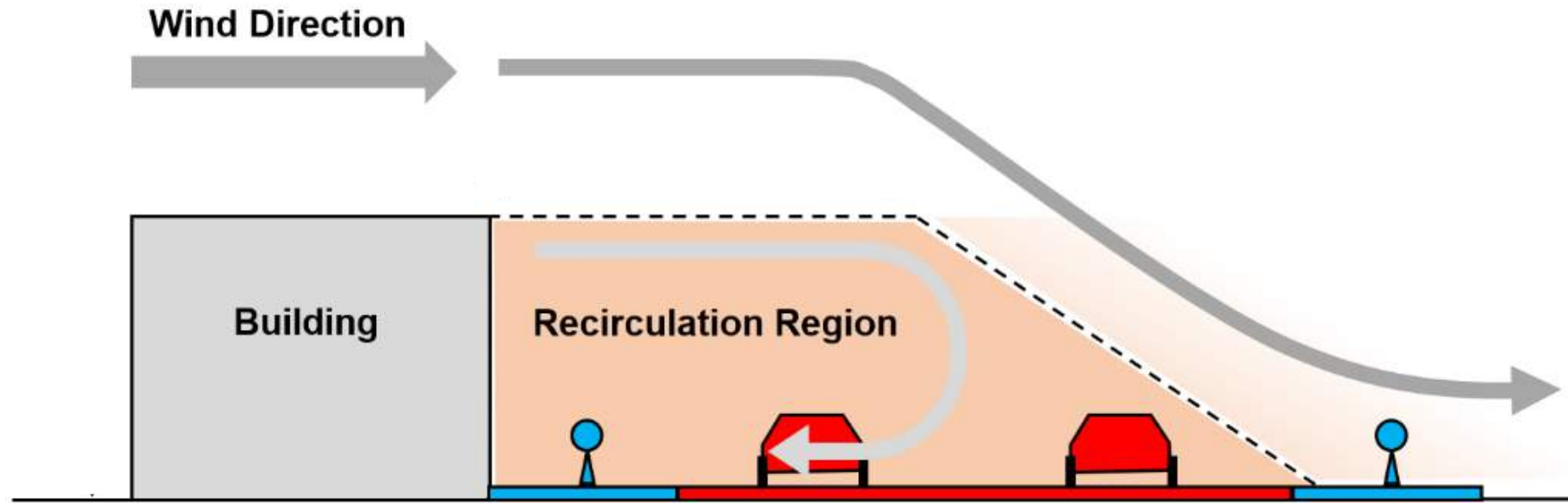
# Impacts of *Urban Form* on Urban Air Pollution



Buildings, like dense vegetation barriers, create vortices or 'recirculation regions': their impacts on public exposure depend on the positioning of vehicles & people



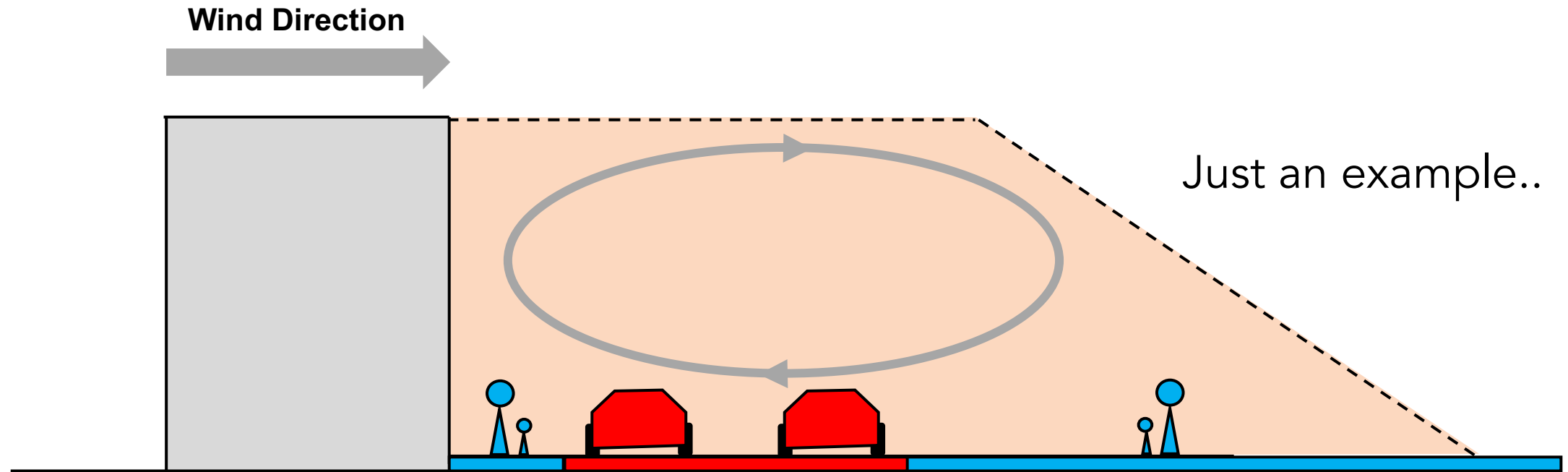
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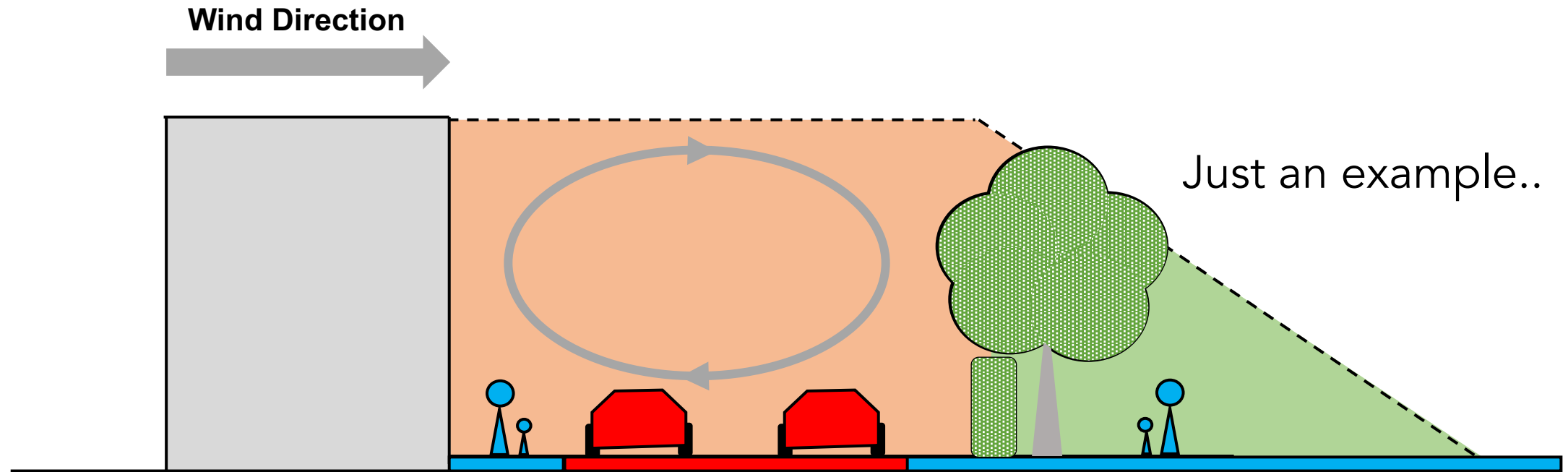
# Impacts of *Urban Form* + *Green Infrastructure*



Local urban form (and its interaction with the wind) governs the local air quality impacts of adding vegetation barriers – there is no ‘one size fits all’ solution



# Impacts of *Urban Form* + *Green Infrastructure*



For example, the truncation of a recirculation region by a tall vegetation barrier (hedge + dense line of trees) could benefit some people at a disbenefit to others



# GI4RAQ Platform – Cutting through Complexity



We have developed the **first prototype software** to enable urban practitioners to estimate *what* green infrastructure, *where*, will be roughly *how* beneficial to *who*



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*Quantitative estimates  
of site-specific impacts  
via changes in dispersion*

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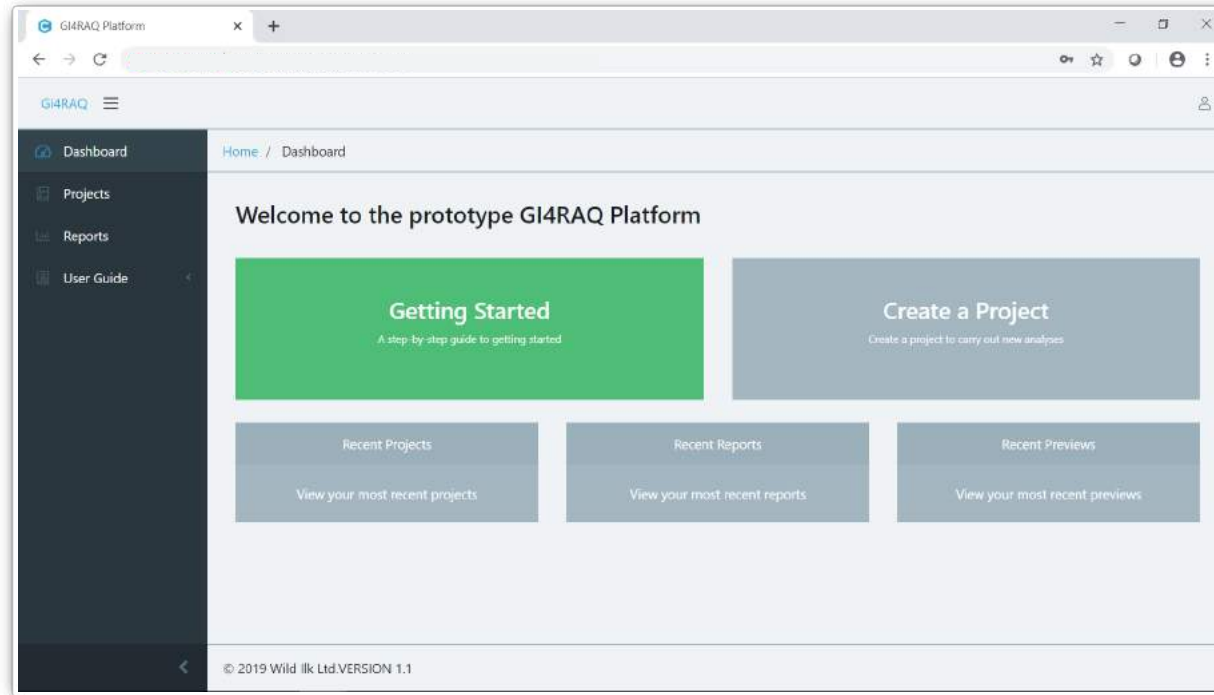
It will enable and inform a new discourse re GI4RAQ in support of national and regional policies: e.g. **Environmental Net Gain & Air Quality Positive**

DEFRA, 2018

GLA, 2020



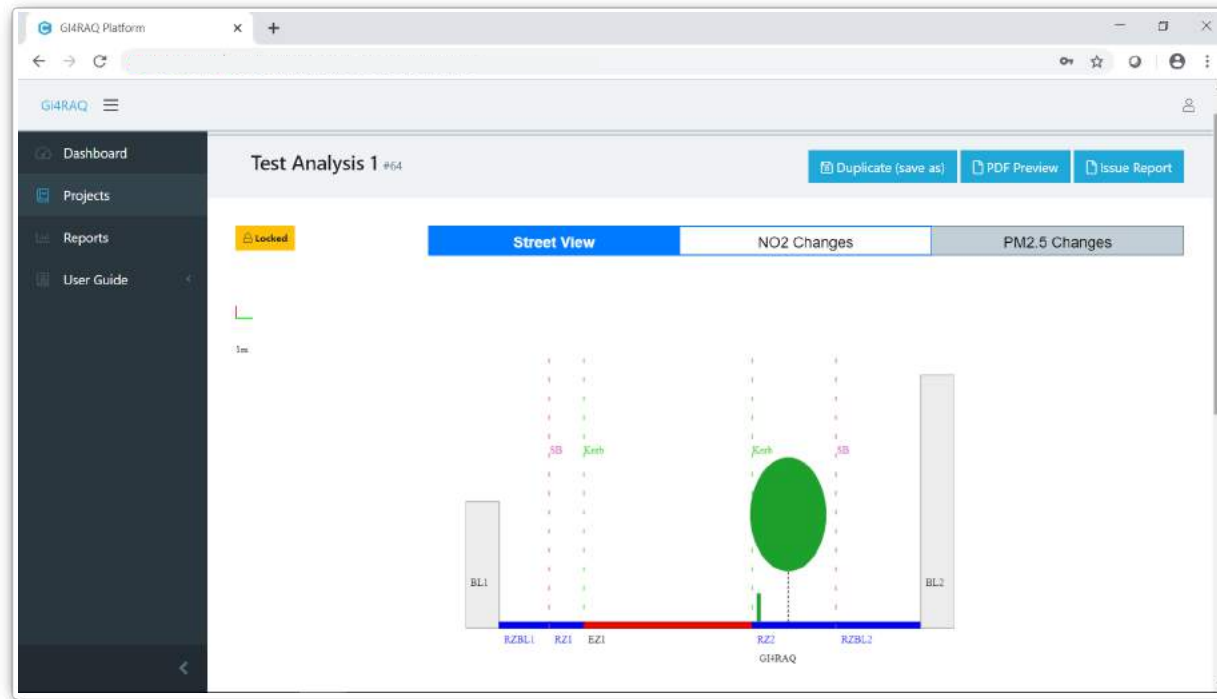
# GI4RAQ Platform – Cutting through Complexity



Now in user testing, the **web-based** prototype will be made **freely available** summer 2020 – and **open source** enabling continued community development



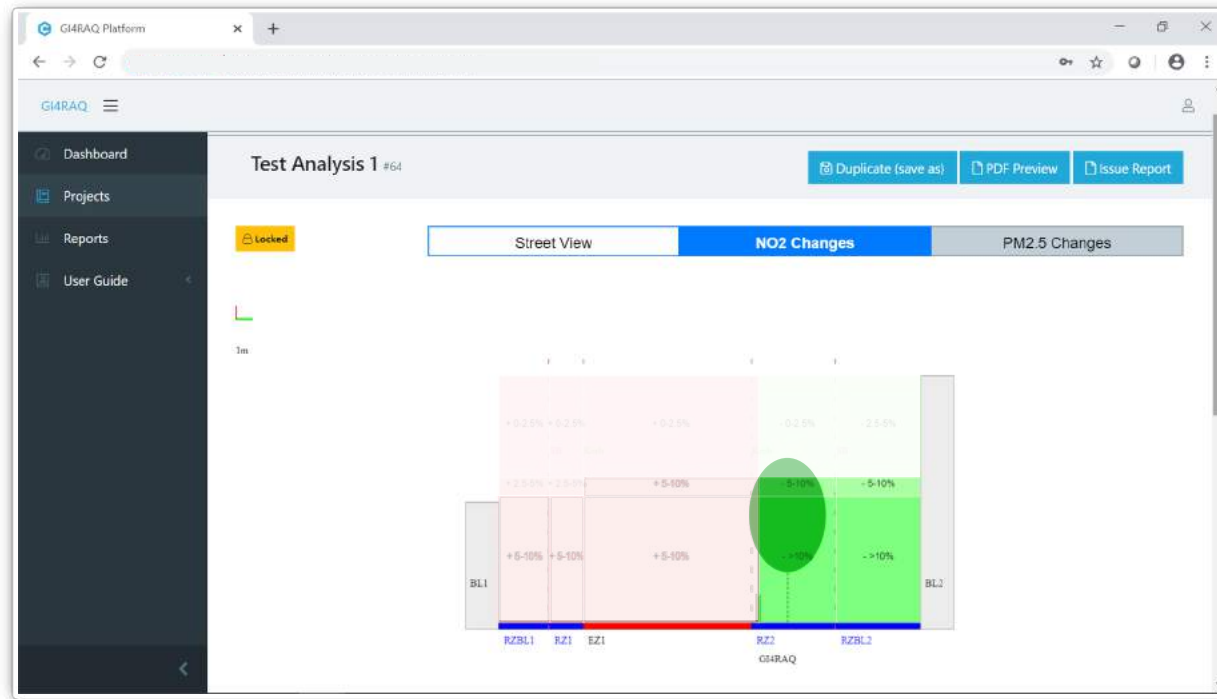
# GI4RAQ Platform – Cutting through Complexity



Users can 'draw' a street in cross section, add a GI4RAQ barrier, explore the **site-specific impacts** on PM and NO<sub>2</sub>; and share their analyses with other users



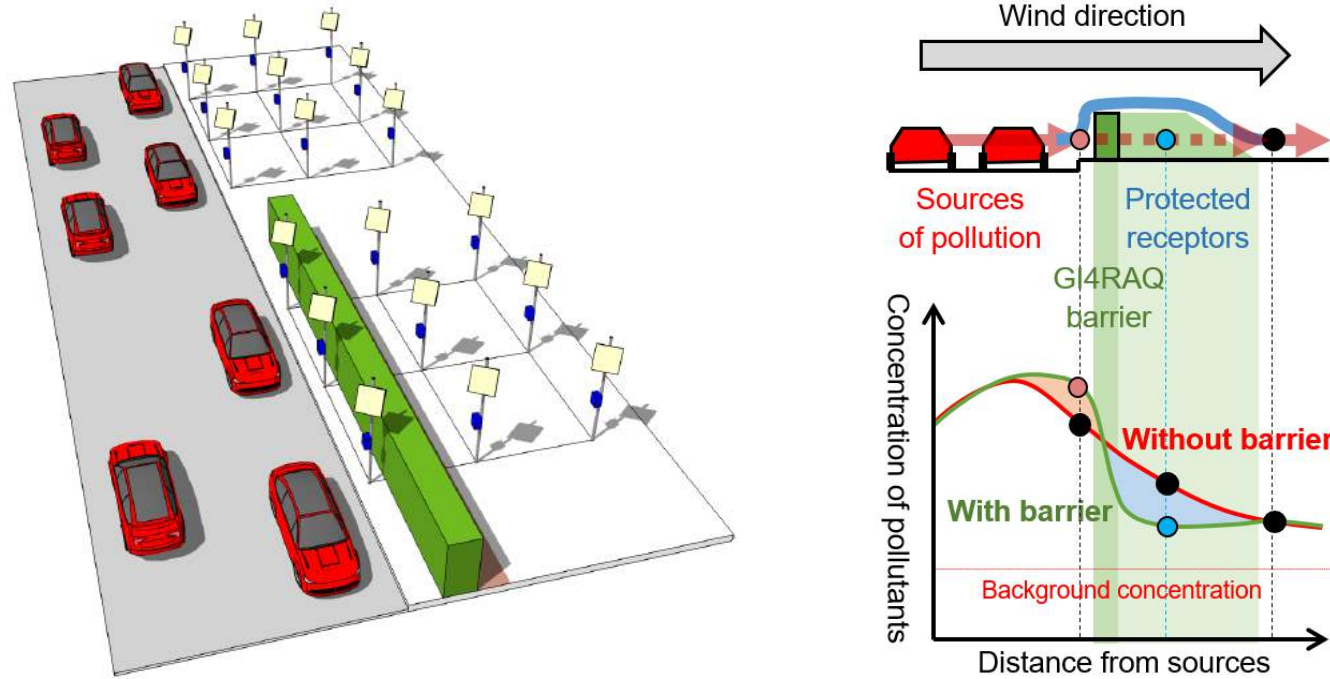
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The underlying air quality algorithms will need refining: we are proposing the rigorous measurements needed to test and improve these over the next 5+ yrs



# GI4RAQ Platform – Summary and Contact Info.

~~'Green infrastructure is always good for air quality'~~

The right green infrastructure, in the right place, can effectively control the distribution of pollution and reduce public exposure



# GI4RAQ Platform – Summary and Contact Info.

~~'Green infrastructure can remove some pollution but it isn't a silver bullet'~~

Green infrastructure removes little air pollution but, if used strategically and selectively, can effectively alter the flow of polluted air close to source



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Green infrastructure removes little air pollution but, if used strategically and selectively, can effectively alter the flow of polluted air close to source

First priority to improve urban air quality is reducing emissions at source, but reducing exposure to what is emitted will further improve public health

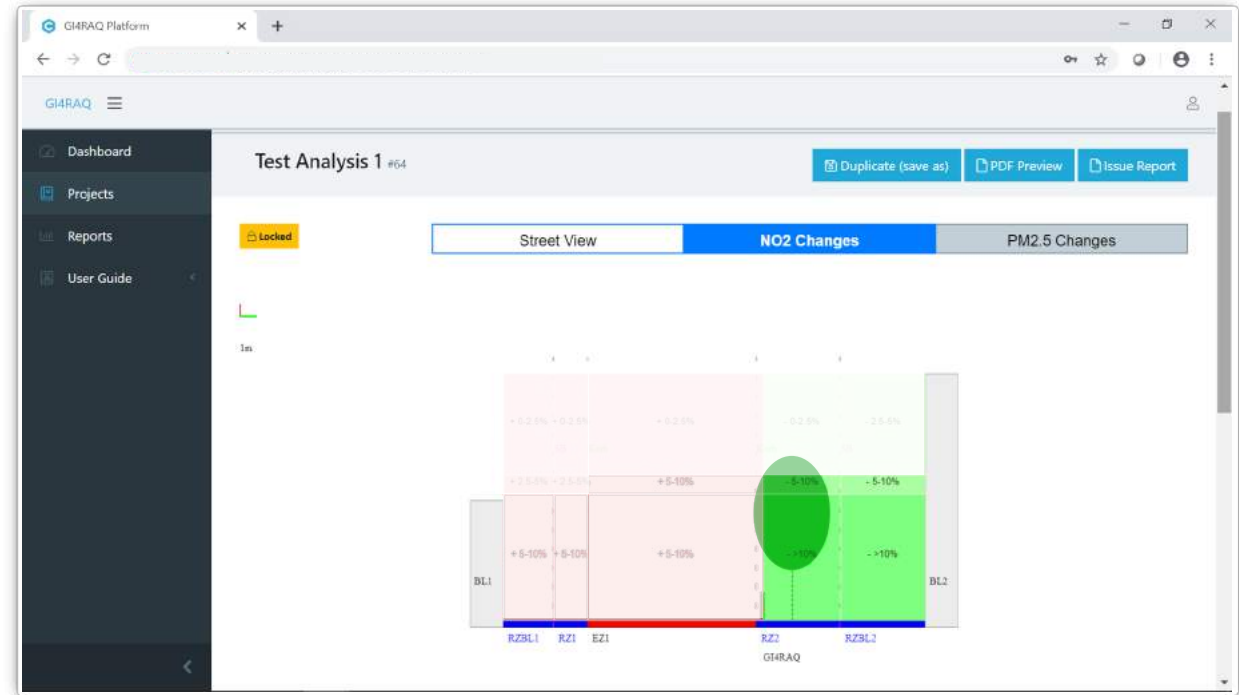




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## Prototype GI4RAQ Platform

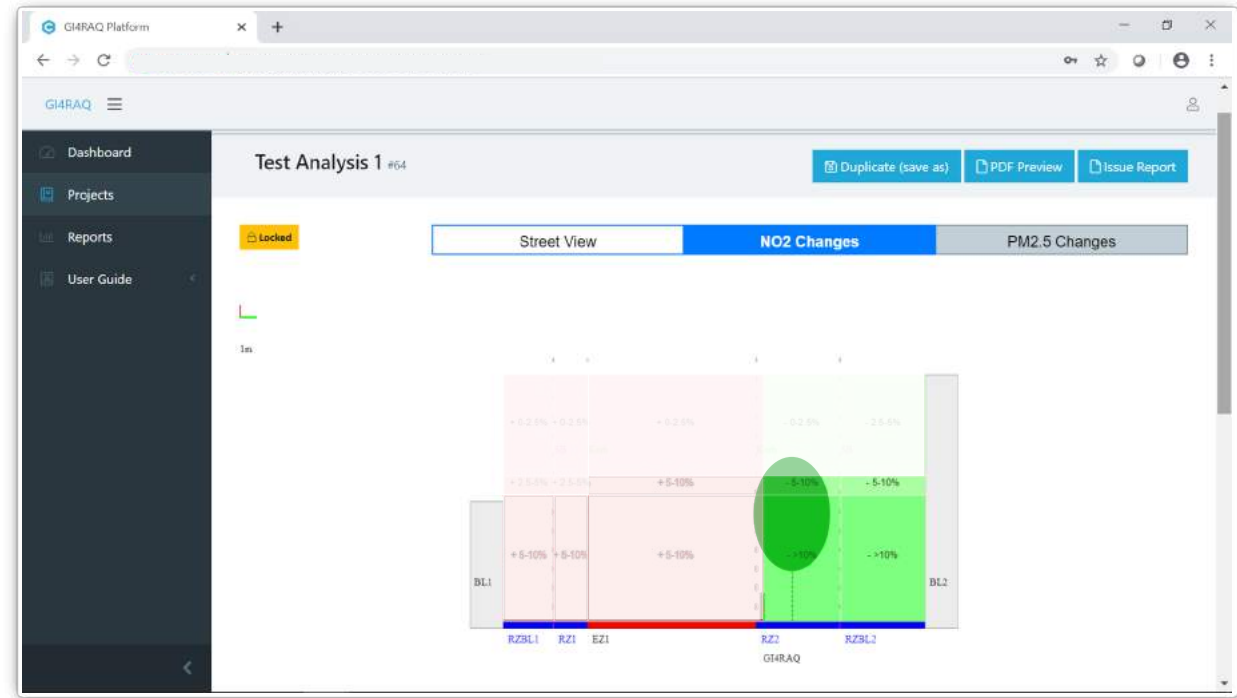
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ENVIRONMENT



Thank you

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**Birmingham City Council**

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