



Towards a Sustainable Urban Environment (SUE)

Examining the role of the East London Green Grid in improving air quality

PurE launch event 24th June 2009

Impact of PM10 pollution

- PM10 originates from road traffic, industry and power production
- Elevated PM10 concentrations are linked to adverse health impacts
- Adverse health impacts have led to introduction of air quality standards
- Health costs from PM10 pollution in the UK of £9.1 to 21.4 billion
- Vegetation establishment is one measure for reducing PM10



East London Green Grid



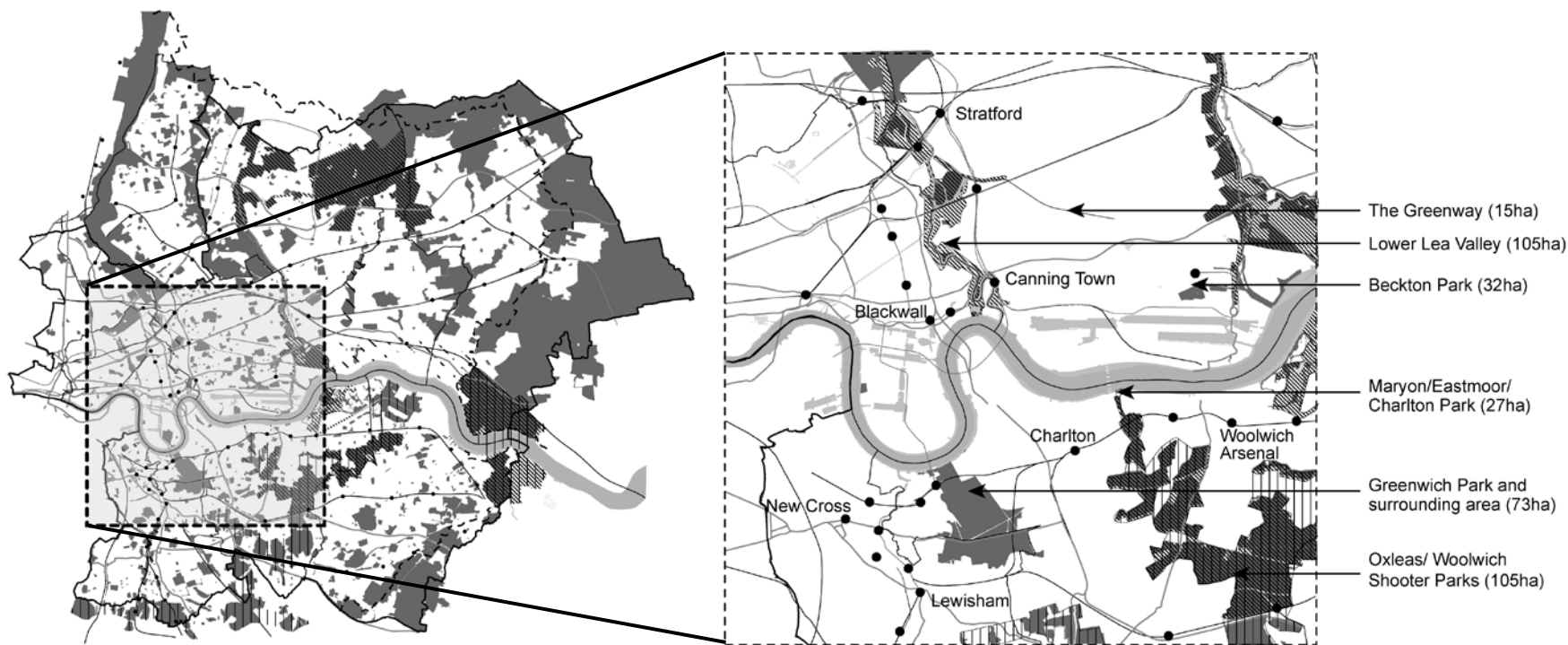
- ‘...network of interlinked, multi-purpose and high quality open spaces
- ...connect areas where people live and work with town centres, public transport, the countryside in the urban fringe and the River Thames.’

(GLA, 2006)

- East London Green Grid is the delivery mechanism for ‘Greening the Gateway’
- Air quality improvement is not a primary driver



ELGG Study area



- ELGGs
- ▨ Strategic projects (to be identified)
- ||| Regional Park Opportunities
- Transport Nodes

The PUrE Approach



PUrE Analysis : File View Help

Solution Explorer

- Problem Definition
 - Qualitative Description
 - Decision Criteria Selection

Problem Definition - Qualitative Description

Please enter qualitative data to help describe your PUrE Analysis.

Main Analysis Definition

Main Driver: *

Key Question: *

Topic Category: *

Stakeholders

Stakeholders:

Spatial and Temporal Definition

Place Name:

Unit of Analysis:

System Boundary:

Timescale:

Spatial scale:

Key Assumptions

Key Assumptions:

* These fields must be completed.

Prev Next

Framework Explorer

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graph TD; Stakeholders --> Problem Definition; Stakeholders --> Main Drivers; Stakeholders --> Guidance Document; Problem Definition --> Decision Approach; Main Drivers --> Decision Approach; Main Drivers --> Problem Approach; Guidance Document --> Decision Approach; Guidance Document --> Problem Approach; Decision Approach --> Multi-Criteria Decision Analysis; Problem Approach --> Detailed Models and Tools; Problem Approach --> Specific Outcomes; Problem Approach --> Generic Outcomes; Multi-Criteria Decision Analysis --> Detailed Problem Analysis; Detailed Models and Tools --> Simple Models and Tools; Specific Outcomes --> Simple Models and Tools; Generic Outcomes --> Simple Models and Tools; Detailed Problem Analysis --> Output Information; Simple Models and Tools --> Output Information; Output Information --> Recommendation New Knowledge; Recommendation New Knowledge --> Stakeholders;
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Framework Help

Ready...

The PUrE Approach



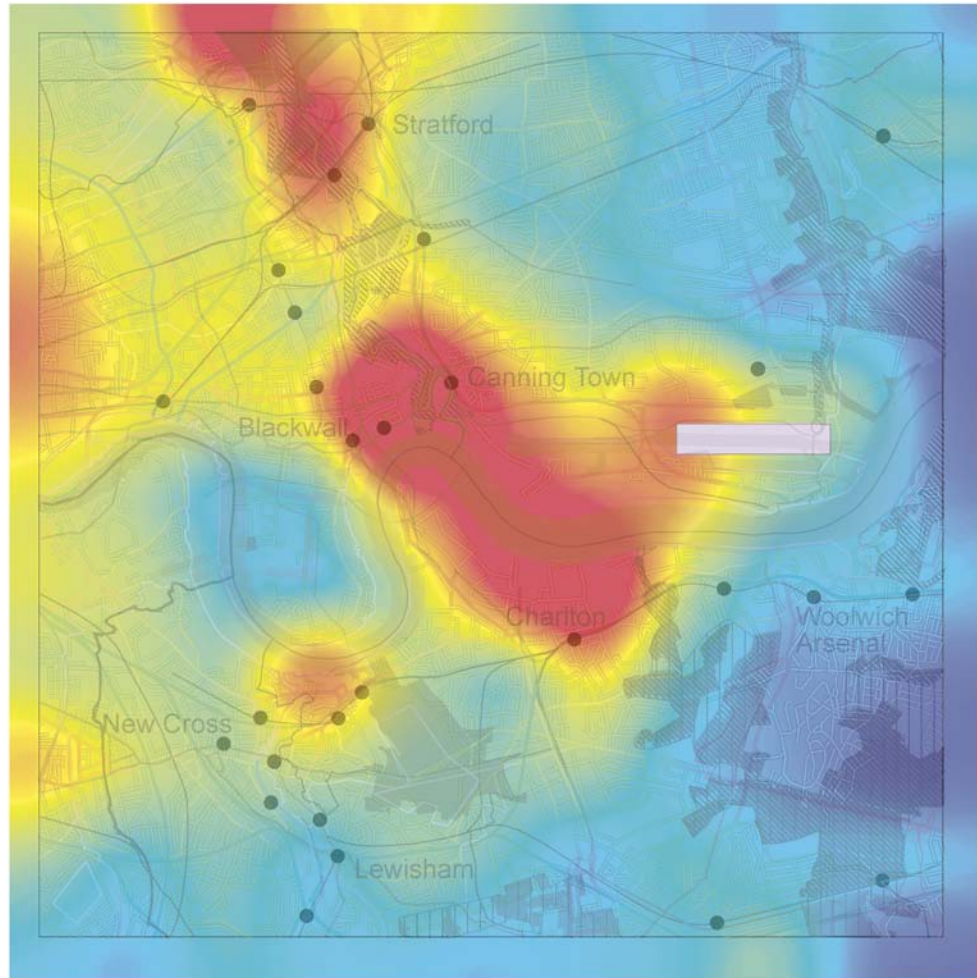
The screenshot displays the PUrE Analysis software interface. The main window is titled "Problem Definition - Sustainability Issues - Decision Criteria Selection". It contains the following elements:

- Solution Explorer (Left Panel):** Shows a tree view with "Problem Definition" expanded, containing "Qualitative Description" and "Decision Criteria Selection".
- Framework Explorer (Bottom Left Panel):** Displays a flowchart of the PUrE process, including steps like "Stakeholders", "Guidance Document", "Problem Definition", "Main Drivers", "Decision Approach", "Problem Approach", "Multi Criteria Decision Analysis", "Detailed Models and Tools", "Specific Datasets", "General Datasets", "Detailed Problem Analysis", "Simple Models and Tools", and "Output Information".
- Main Content Area:**
 - Text: "Please select the sustainability criteria you would like to assess within your PUrE Analysis. You can also add your own 'User Defined Indicators' within the social, environmental or economic context."
 - Text: "At this stage you should select all the criteria you may need as you will not be able to add more criteria after the problem definition stage is completed."
 - Social Indicators:** Includes "Human Health Impact - Mortality" (checked), "Human Health Impact - Morbidity" (checked), and "Life Cycle Toxicity - Human" (unchecked).
 - Environmental Indicators:** Includes "Ecological Impact" (checked), "Land Use", "Air Pollution", "Water Pollution", "Acidification", "Abiotic Resource Depletion", "Eutrophication", "Freshwater Aquatic Ecotoxicity", "Global Warming", "Marine Aquatic Ecotoxicity", "Ozone Layer Depletion", "Photochemical Oxidation", and "Terrestrial Ecotoxicity" (all unchecked).
 - Economic Indicators:** Includes "Capital Cost" and "Operating Cost" (both unchecked).
- User Defined Indicators:** Three input fields with "Add" buttons are provided for each category.
- Navigation:** "Prev" and "OK" buttons are located at the bottom right of the main content area.
- Footer:** A "Framework Help" section with navigation icons and a search bar is visible.

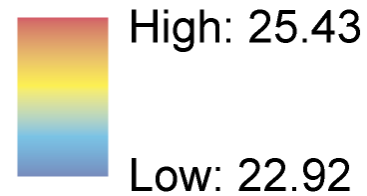
Air dispersion modelling

- Sources include traffic, industry and airport
- Data taken from:
 - London Atmospheric Emissions Inventory
 - Meteorological station at Heathrow airport
- ADMS-Urban used to model hourly PM10 concentrations
- Concentrations reported at 1.5 m receptor height
- 18 receptor locations were used to input concentrations over ELGG

Air dispersion modelling



PM₁₀ concentrations ($\mu\text{g m}^{-3}$)



PM10 interception modelling



- Based on the Urban Forest Effects model from the USDA
- Modified with published relationships between wind speed and deposition velocity for different species
- Input parameters:
 - Greenspace area
 - Leaf area index
 - Canopy height
 - Latitude of study area
 - Meteorological data
 - PM10 concentrations

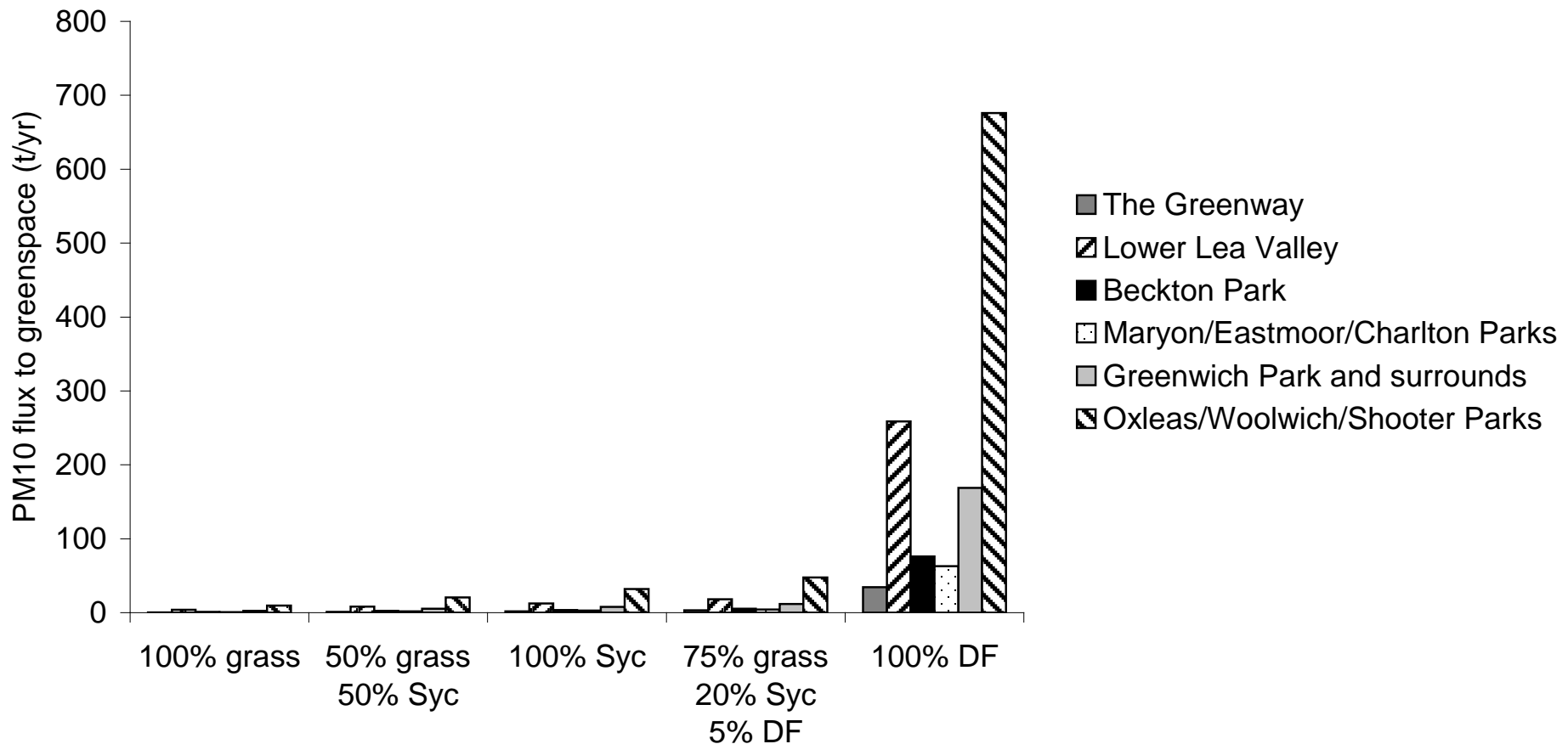


PM10 interception modelling



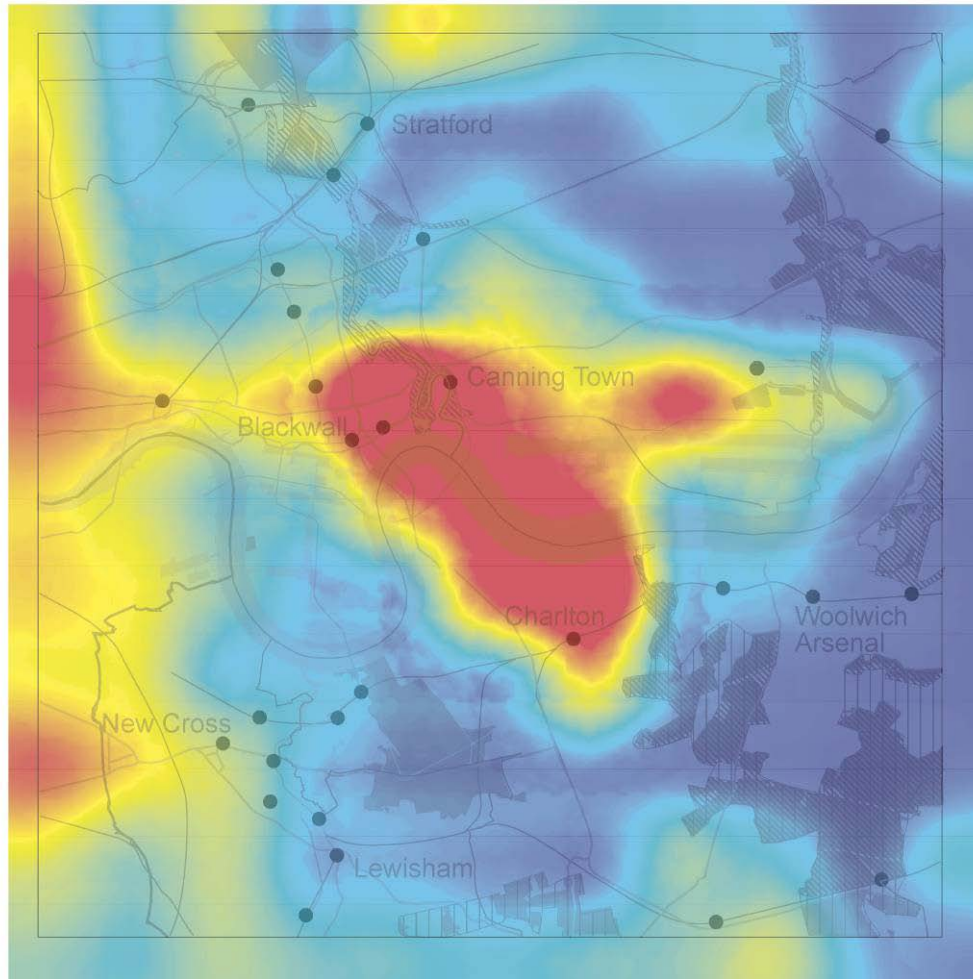
- Modelled five scenarios of vegetation composition
 - 100% grassland
 - 50% grassland
50% sycamore maple
 - 100% sycamore maple
 - 100% Douglas fir
 - 75% grassland
20% sycamore maple
5% Douglas fir

PM10 interception modelling

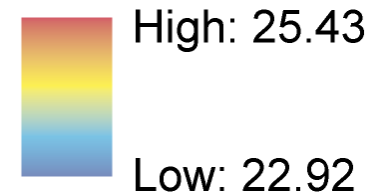


- Used the 75% grassland, 20% sycamore maple and 5% Douglas fir scenario in the human health modelling
- Outputs from PM10 interception modelling input into ADMS-Urban

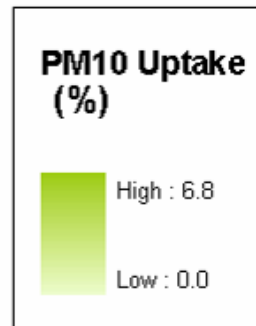
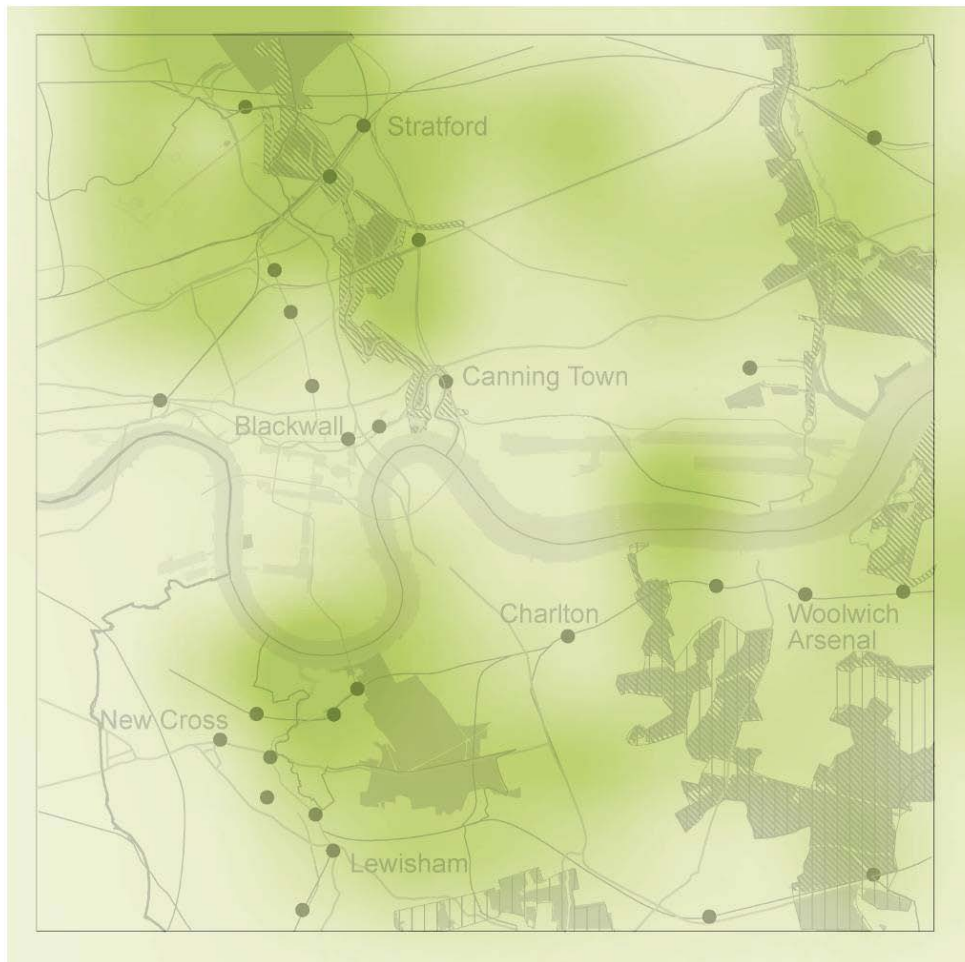
PM10 interception modelling



PM₁₀ concentrations ($\mu\text{g m}^{-3}$)



Reductions in PM10 concentration

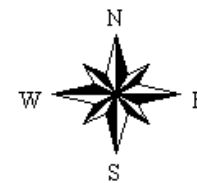
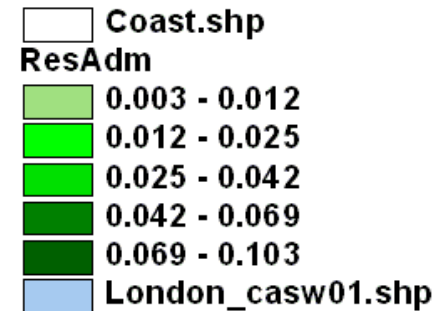
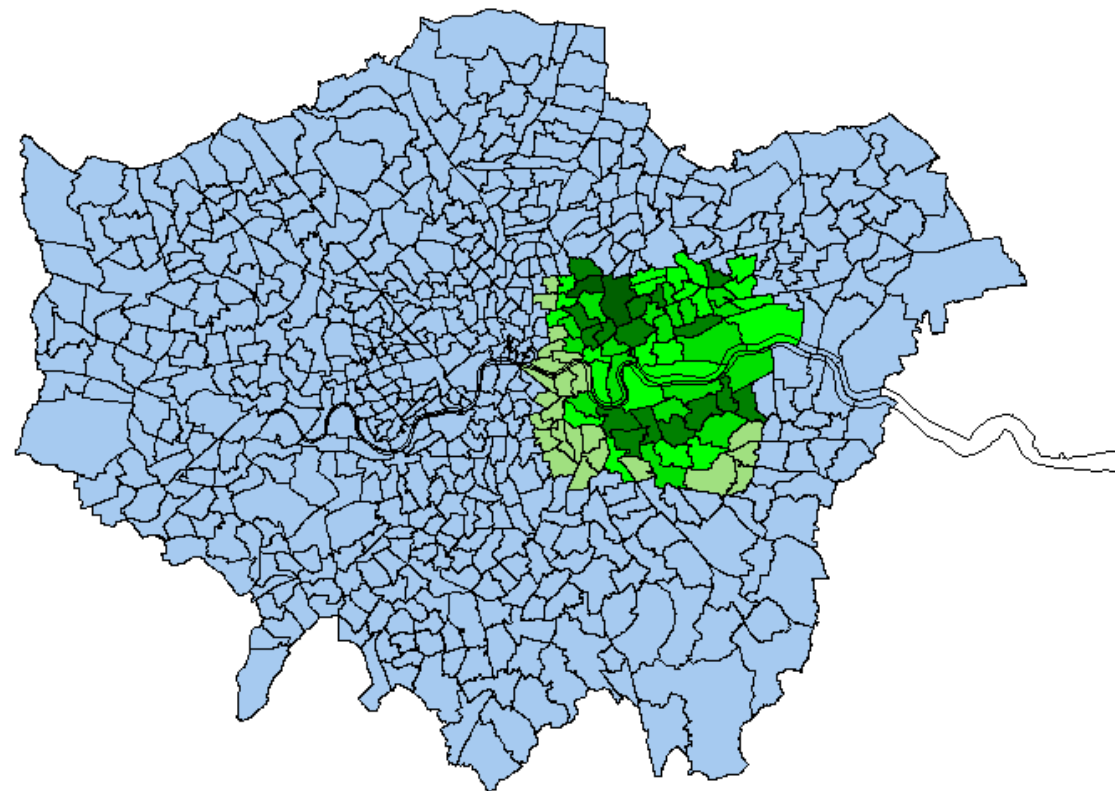


Human health modelling

- Based on exposure-response relationships between PM10 concentrations and mortality and respiratory hospital admissions
- Models the short-term health effects of exposure
- Carried out at a ward level and the results for the whole study area calculated

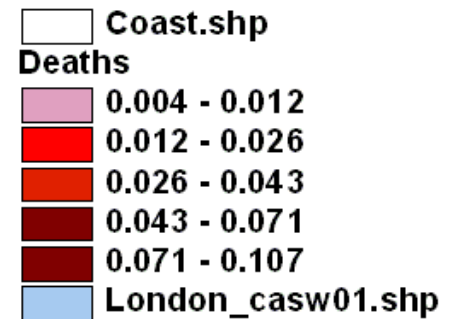
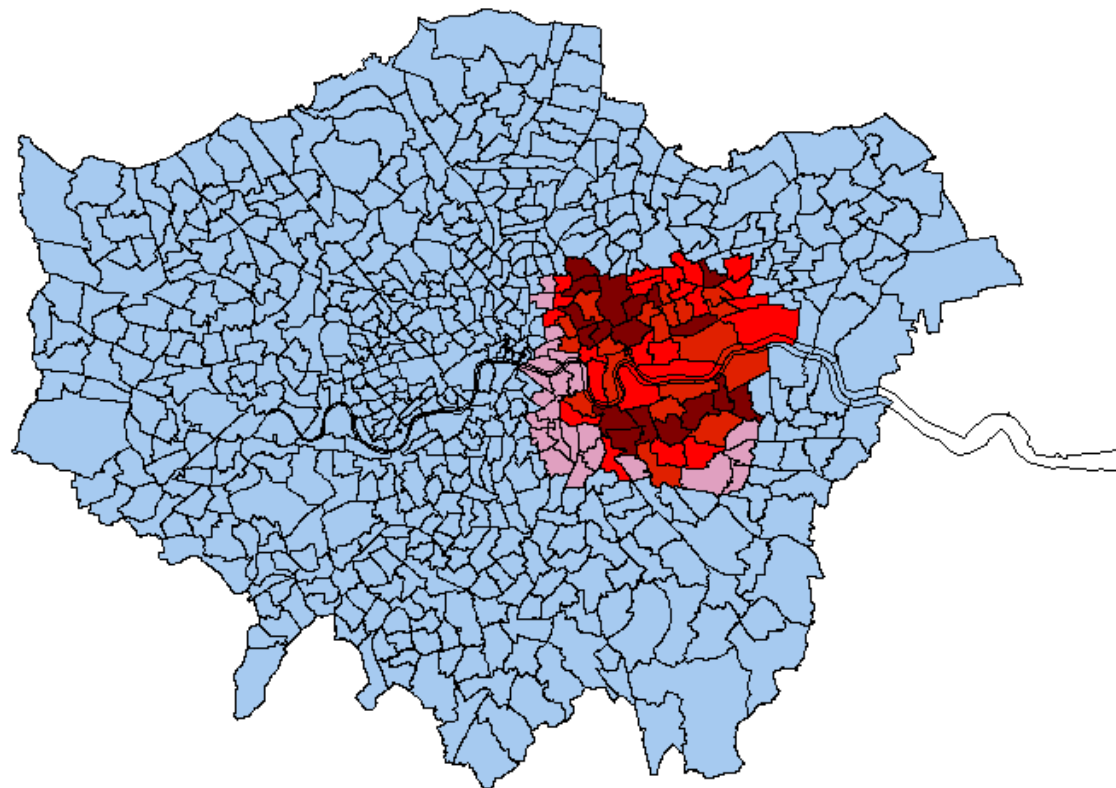
Health Impact Assessment – 1

Respiratory hospital admissions averted

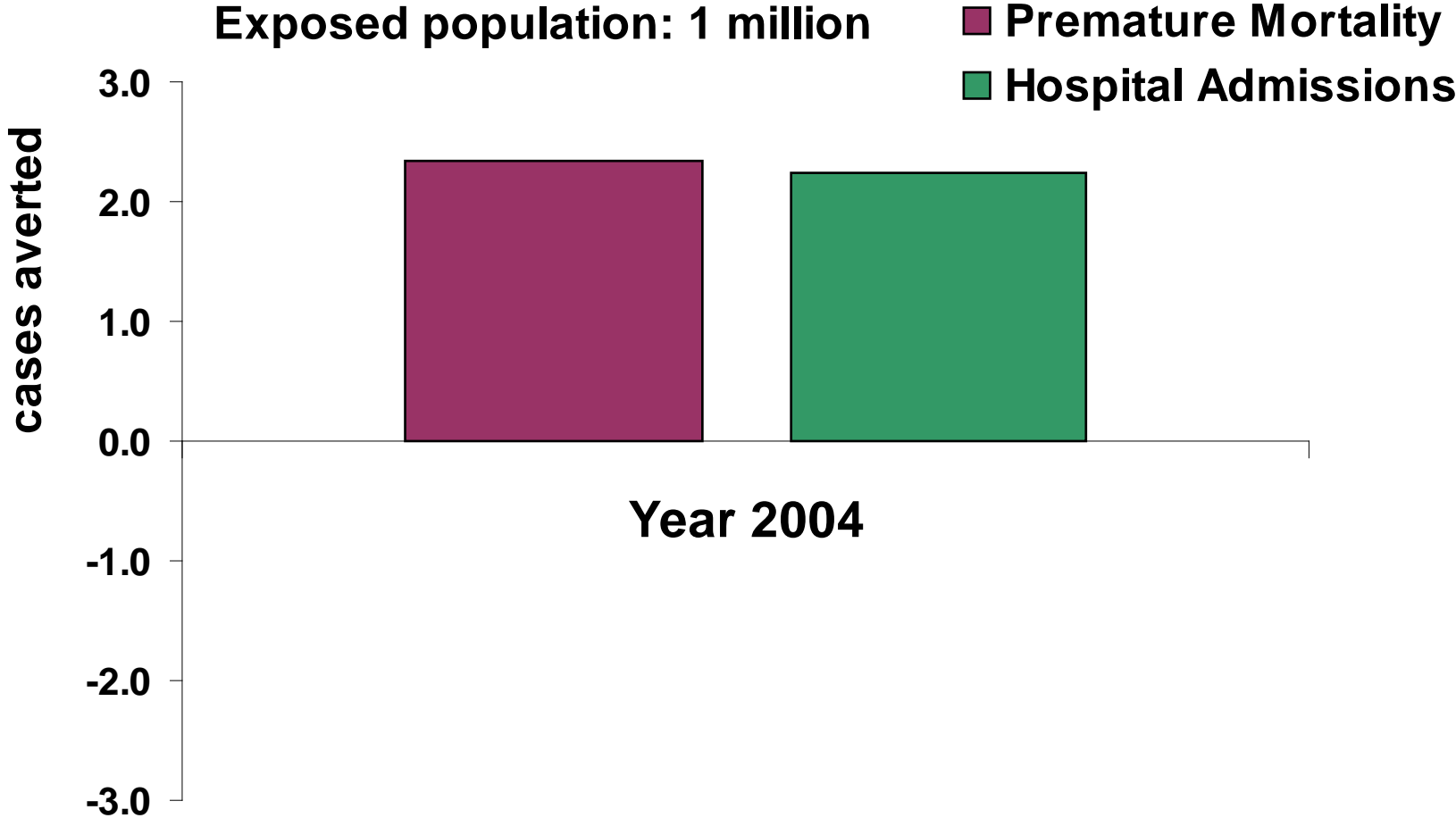


Health Impact Assessment – 2

Premature deaths averted



Health Benefits East London Green Grid



Practical considerations



- Greenspace design must take account of a diverse range of drivers
- Species selection could be targeted around 'hot spots' of pollution
- Health benefits could include long-term effects, improvements in physical activity and mental health
- Adverse effects of greenspace could include pollen and VOC emissions and damage to property
- PurE can be used to estimate the improvements in air quality from such schemes

Output: Recent publication



ARTICLE IN PRESS

Environmental Pollution xxx (2009) 1–9



Contents lists available at [ScienceDirect](#)

Environmental Pollution

journal homepage: www.elsevier.com/locate/envpol



An integrated tool to assess the role of new planting in PM₁₀ capture and the human health benefits: A case study in London

Abhishek Tiwary^a, Danielle Sinnett^{b,*}, Christopher Peachey^b, Zaid Chalabi^c, Sotiris Vardoulakis^c, Tony Fletcher^c, Giovanni Leonardi^d, Chris Grundy^c, Adisa Azapagic^a, Tony R. Hutchings^b

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A combination of models can be used to estimate particulate matter concentrations before and after greenspace establishment and the resulting benefits to human health.

ARTICLE INFO

Article history:

Received 20 January 2009

Received in revised form

21 April 2009

Accepted 3 May 2009

Keywords:

Air quality

Green grid

Urban greenspace

Particulate matter

Health impacts

ABSTRACT

The role of vegetation in mitigating the effects of PM₁₀ pollution has been highlighted as one potential benefit of urban greenspace. An integrated modelling approach is presented which utilises air dispersion (ADMS-Urban) and particulate interception (UFORE) to predict the PM₁₀ concentrations both before and after greenspace establishment, using a 10 × 10 km area of East London Green Grid (ELGG) as a case study. The corresponding health benefits, in terms of premature mortality and respiratory hospital admissions, as a result of the reduced exposure of the local population are also modelled. PM₁₀ capture from the scenario comprising 75% grassland, 20% sycamore maple (*Acer pseudoplatanus* L.) and 5% Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) was estimated to be 90.41 t yr⁻¹, equating to 0.009 t ha⁻¹ yr⁻¹ over the whole study area. The human health modelling estimated that 2 deaths and 2 hospital admissions would be averted per year.

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