Environmental Justice Methodology

1. Introduction

1.1 Background

Within the Council's strategy is a commitment to develop an Environmental Justice Measure (EJM) which is designed to highlight inequalities in how people are impacted by/ impact climate change, and measure success against the 'Carbon Zero 2040' goals. The EJM is based on some of the pillars of Westminster's Climate Emergency Action Plan (CEAP) and provides a framework for achieving environmental justice via:

- Efficient Buildings
- Sustainable Travel and Transport
- Green and Resilient City

The Strategy and Intelligence team have developed the EJM in conjunction with colleagues in Policy and Projects to track progress on climate action and environmental justice. The EJM will be a useful tool in both policy development and service delivery at Westminster, with a non-exhaustive list of potential application shown below:

Policy/ Strategy	Delivery/ Engagement
Public Realm SPD	Housing retrofit schemes
Green Infrastructure Audit	Air quality monitoring
Climate Adaptation Plan	Tree planting schemes
Air Quality Action Plan	Schools' Clean Air Fund
Health & Wellbeing Strategy	Greening projects/ funding
Active Westminster Strategy	Public health interventions/ campaigns
Green Economy Strategy	

2. Data and Technology

The maps were produced using datasets available in tabular and vector format. 12 metrics were analysed in this study, including 10 environmental metrics and 1 socio-economic metric.

Details on the data sources update frequencies, publication years and rationale for inclusion are listed below (additional information on format, geographies and citations can be found in the Metrics Overview and Metadata section of this document). All spatial analysis for this project was conducted using ArcMap 10.4.

Environmental metrics	Data source	Year	Update frequency	Rationale
Proximity to cycling facilities	WCC and TfL (Transport for London)	2022	Irregular	Having public cycling facilities or bus stops within close proximity to residents provides options to travel more sustainably. Identifying the areas where these amenities are lacking will enable the council to lobby TFL to provide more cycling facilities and bus stops.
Proximity to bus stops	TFL	2022	Irregular	Having public cycling facilities or bus stops within close proximity to residents provides options to travel more sustainably. Identifying the areas where these amenities are lacking will enable the council to lobby TFL to provide more cycling facilities and bus stops. Understanding residents' propensity to commute via bike or public transport will enable more focused behaviour change campaigns to travel more sustainably and for the council to plan and lobby TfL for more effective sustainable transport infrastructure.
% Of people commuting by bike or walking	ONS (Office for National Statistics)	2011	Once every 10 years	
% Of people commuting by public transport	ONS	2011	Once every 10 years	Understanding residents' propensity to commute via bike or public transport will enable more focused behaviour change campaigns to travel more sustainably and for the council to plan and lobby TfL for more effective
Proximity to public open spaces	WCC	2016	Irregular	

				sustainable transport infrastructure. Proximity to public spaces can provide various health benefits. Identifying the areas with a lack of access to public space will allow for funding for open spaces/green space to be targeted to provide fairer access for residents.
Flood risk	Environmental Agency and WCC	2022	Quarterly	Flood risk areas show which residents are more vulnerable to flooding and identify where flood defences are needed.
Air quality	GLA (Greater London Authority)	2019	Once every 3 years	Poor air quality is associated with poor health conditions.
Tree canopy	GLA	2022	Irregular	Areas with higher tree canopy cover provide shade and cooling. To help mitigate against the impacts of hotter summers, it is important to identify the areas where there are a fewer number of trees. This should support future tree planting projects
Heat risk	GLA	2016-2020	Irregular	Heat risk maps the average summer daytime temperature and identifies the hottest parts of Westminster. This will support climate adaptation projects and where infrastructure should be placed to mitigate against severe heat.
Average EPC (Energy Performance Certificate) rating	Department for Levelling up, Housing	2022	Annually	Building energy efficiency indicates where residents will be consuming more energy

	and Communities			for heating, resulting in higher emissions and higher energy bills. This will show where energy efficiency projects and grants should be targeted.
Socio-economic metrics	**Data source**	**Year**	**Update frequency**	**Rationale**
Index of Multiple Deprivation	DLUCH	2019	Once every 4 years	The index of multiple deprivation has been included to take into account the socio-economic disparities in the borough.

3. Methodology

3.1 Gathering Data

Both publicly available and internal data were used for this project. The aim was to secure the smallest scale, most up to date datasets available for each of the 11 metrics, all of which needed to be aggregated by LSOA and cover the whole of Westminster. Teams across the council helped in securing these datasets, and the metrics were finalised based on the data that were available.

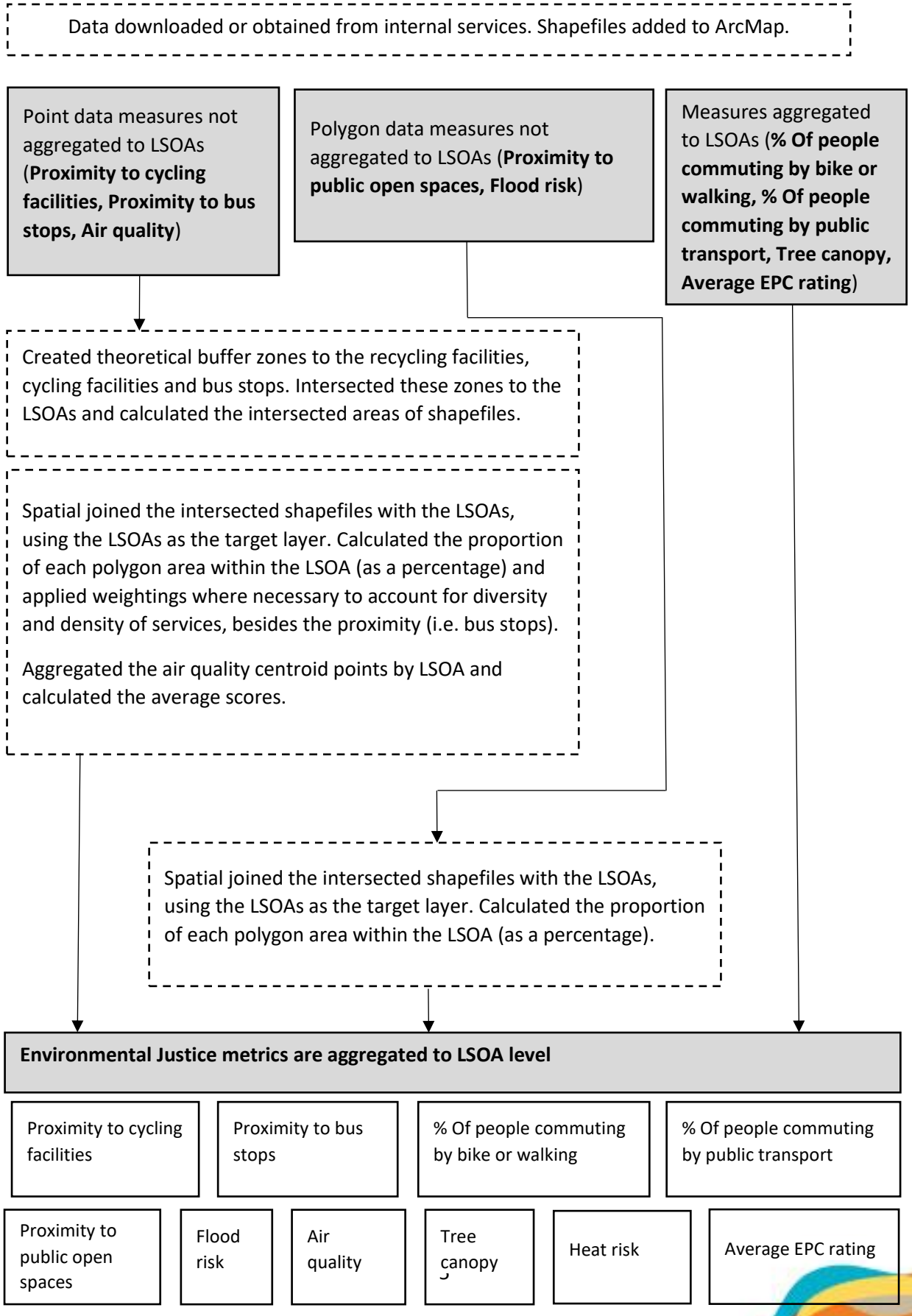
3.2 Preparing input layers

Upon obtaining all datasets, each was prepared for generating the 10 environmental justice metrics and the Environmental Justice map. Using ArcMap, metrics were mapped to their respective small-scale geographies or visualised in their original vector format before re-aggregating them to the LSOAs. The diagrams on the following pages outline the steps taken to convert data to the LSOAs.

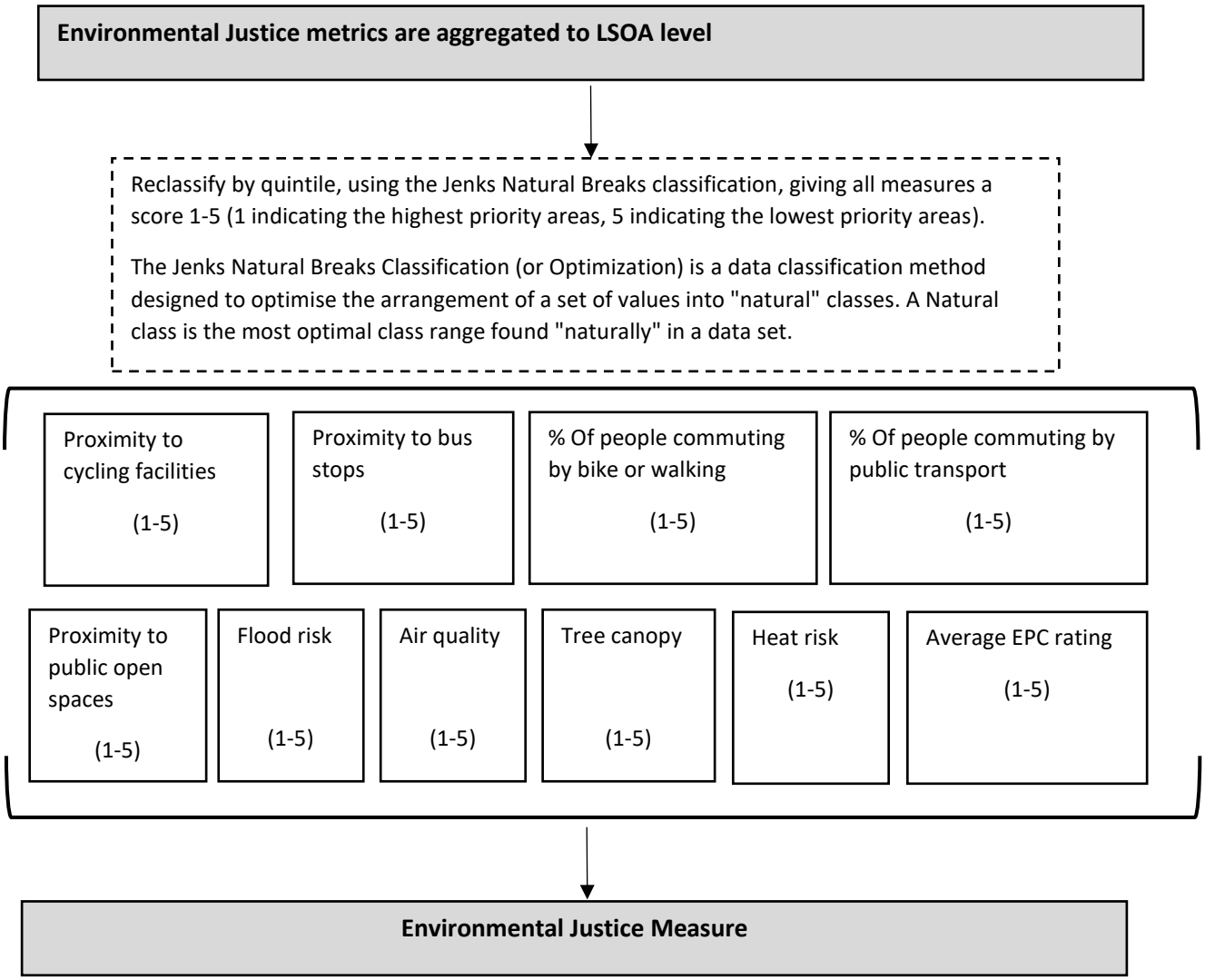
3.3 Producing maps

Map Algebra was used to combine the input metrics and produce the output maps. After creating each metric, the values of each LSOA were reclassified into five quintiles, each of which was reassigned with a value of 1 - 5 (1 indicating the highest priority areas, 5 indicating the lowest priority areas). In the final maps, each LSOA has a resultant score created by the addition of these reclassified input layers. Different combinations of the 11 metrics were used to create the final map.

Preparing Metrics

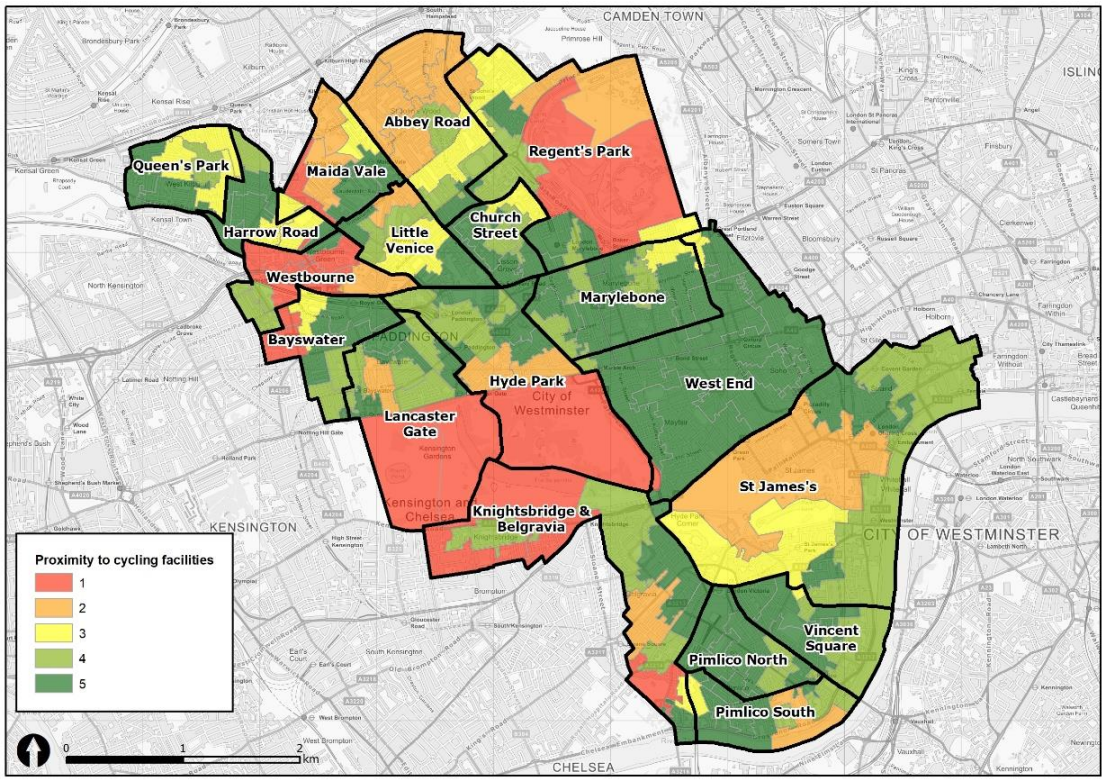


Creating Indices

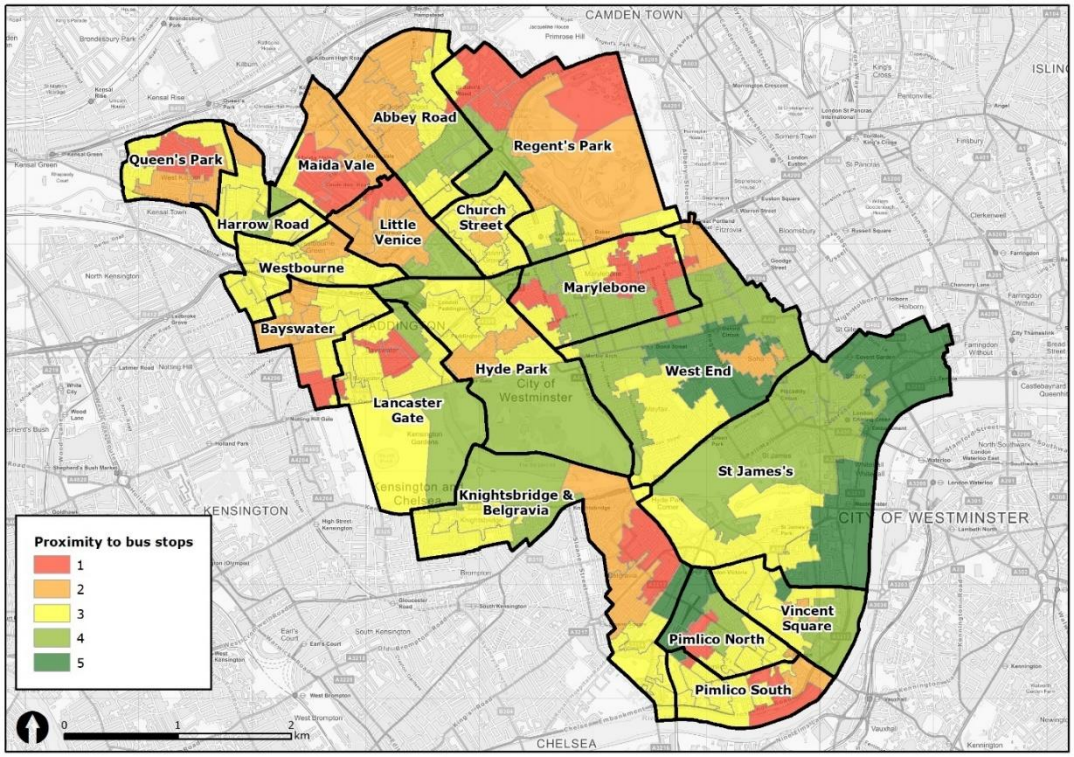


Metric Overview & Metadata

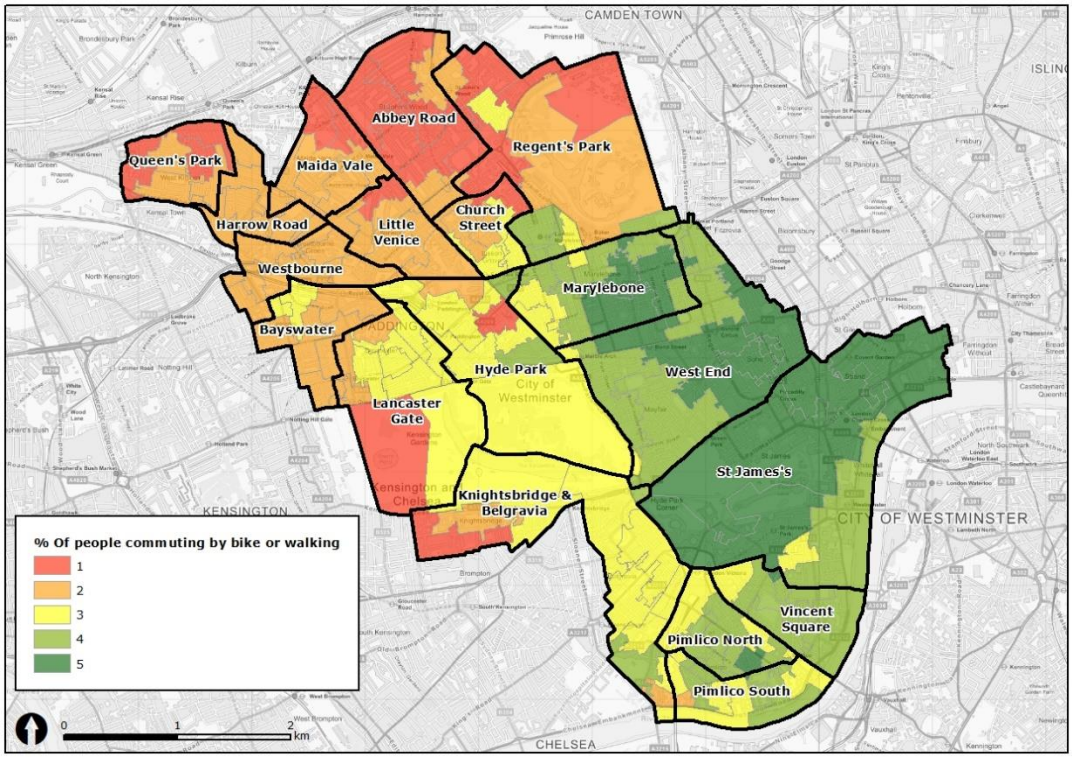
Metric Creation: Proximity to cycling facilities	
Measure Theme	Sustainable Transport
What is measured	Percentage of households in proximity to cycling facilities
Unit of measurement	Percentage of households
Method for LSOA aggregation	The raw data contained the locations of cycling hangars, estate cycling hangars, cycle stands, cycling docking stations and e-scooter docking stations in Westminster. A buffer of 100m was applied to the cycle hangar locations, 25m to the cycle stands and 200m to the docking stations. Those were merged and intersected with the LSOAs and calculated the coverage for each as a percentage.
Data Sources	
Source	Westminster City Council, Transport for London
Citation	Crown copyright and database rights 2022 OS 100021668
Data type	Vector
Geographic resolution	Not applicable
Year of publication	Not applicable
Temporal resolution	2022



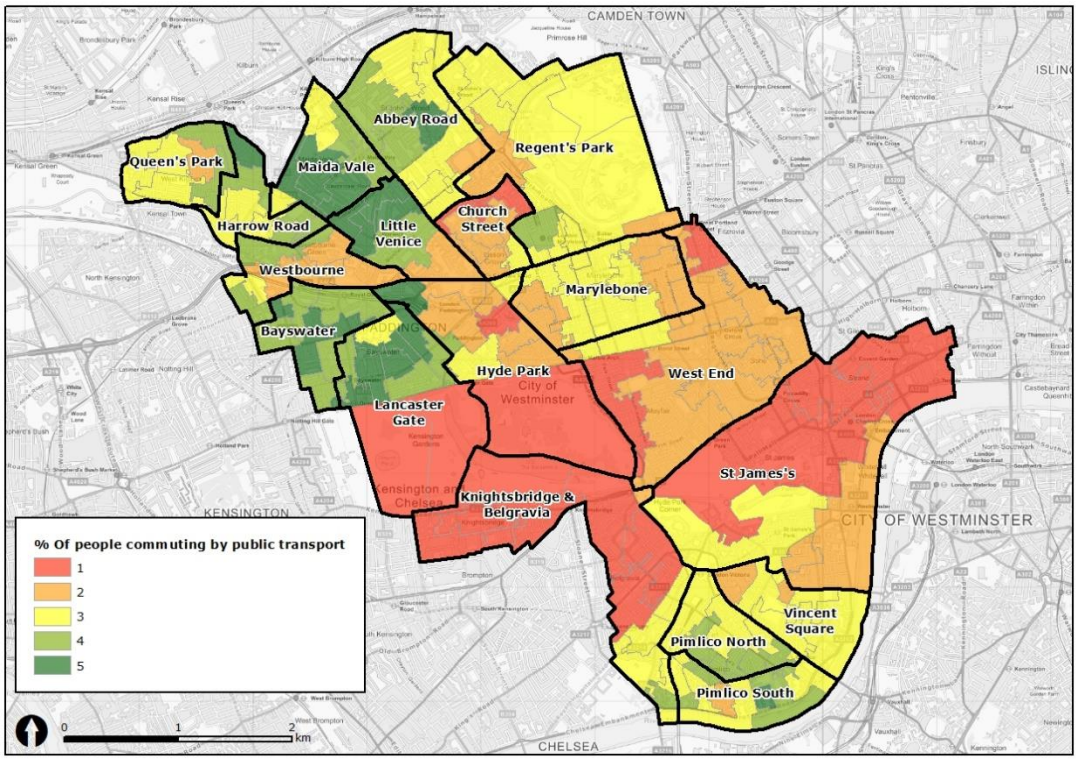
Metric Creation: Proximity to bus stops	
Measure Theme	Sustainable Transport
What is measured	Percentage of households in proximity to bus stops
Unit of measurement	Percentage of households
Method for LSOA aggregation	The raw data contained the locations of all bus stops in Westminster. A buffer of 200m was applied to the locations, which was subsequently intersected with the LSOAs and calculated the coverage for each as a percentage. This allowed for the proximity of the bus stops to be accounted for. Lastly, a weighting was applied to those percentages depending on the density of the bus stops within each LSOAs, which allowed for the range of bus options to be attributed.
Data Sources	
Source	Transport for London
Citation	Crown copyright and database rights 2022 OS 100021668. Data available here: TfL Bus Stop Locations and Routes - London Datastore
Data type	Vector
Geographic resolution	Not applicable
Year of publication	2015
Temporal resolution	2015



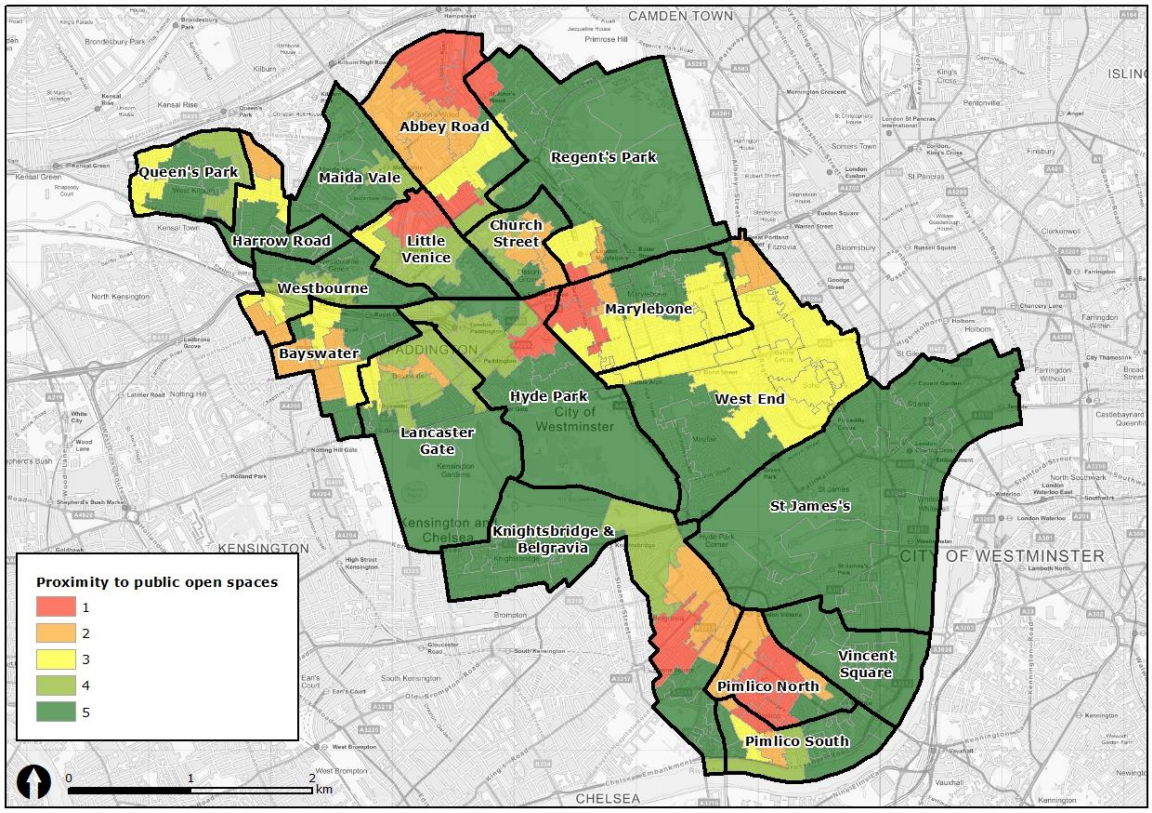
Metric Creation: % Of people commuting by bike or walking	
Measure Theme	Sustainable Transport
What is measured	Percentage of people commuting by bike or on foot
Unit of measurement	Percentage of people
Method for LSOA aggregation	The raw data were a table of different commuting modes of transport at the LSOA level in Westminster. Created a new field and calculated the addition of the columns for bike and walking, which was stored there. Subsequently, that was divided by the total number of usual residents aged 16 to 74 for each LSOA, to show the percentage of people commuting by bike or on foot. The table was linked to the LSOA shapefile using the codes as the key identifier.
Data Sources	
Source	Census 2011, Office of National Statistics.
Citation	ONS Crown Copyright Reserved Available from: http://www.nomisweb.co.uk/
Data type	Tabular
Geographic resolution	Lower Super Output Area
Year of publication	2011
Temporal resolution	2011



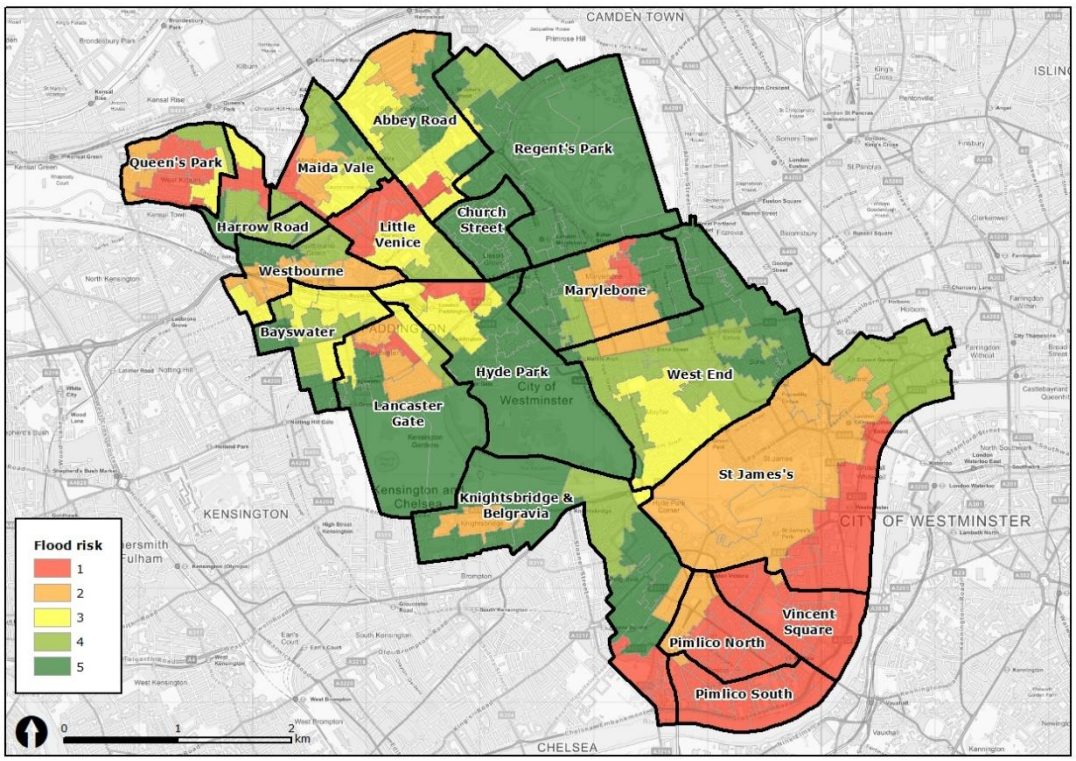
Metric Creation: % Of people commuting by public transport	
Measure Theme	Sustainable Transport
What is measured	Percentage of people commuting by public transport
Unit of measurement	Percentage of people
Method for LSOA aggregation	The raw data were a table of different commuting modes of transport at the LSOA level in Westminster. Created a new field and calculated the addition of the columns for underground, train and bus, which was stored there. Subsequently, that was divided by the total number of usual residents aged 16 to 74 for each LSOA, to show the percentage of people commuting by public transport. The table was linked to the LSOA shapefile using the codes as the key identifier.
Data Sources	
Source	Census 2011, Office of National Statistics.
Citation	ONS Crown Copyright Reserved Available from: http://www.nomisweb.co.uk/
Data type	Tabular
Geographic resolution	Lower Super Output Area
Year of publication	2011
Temporal resolution	2011



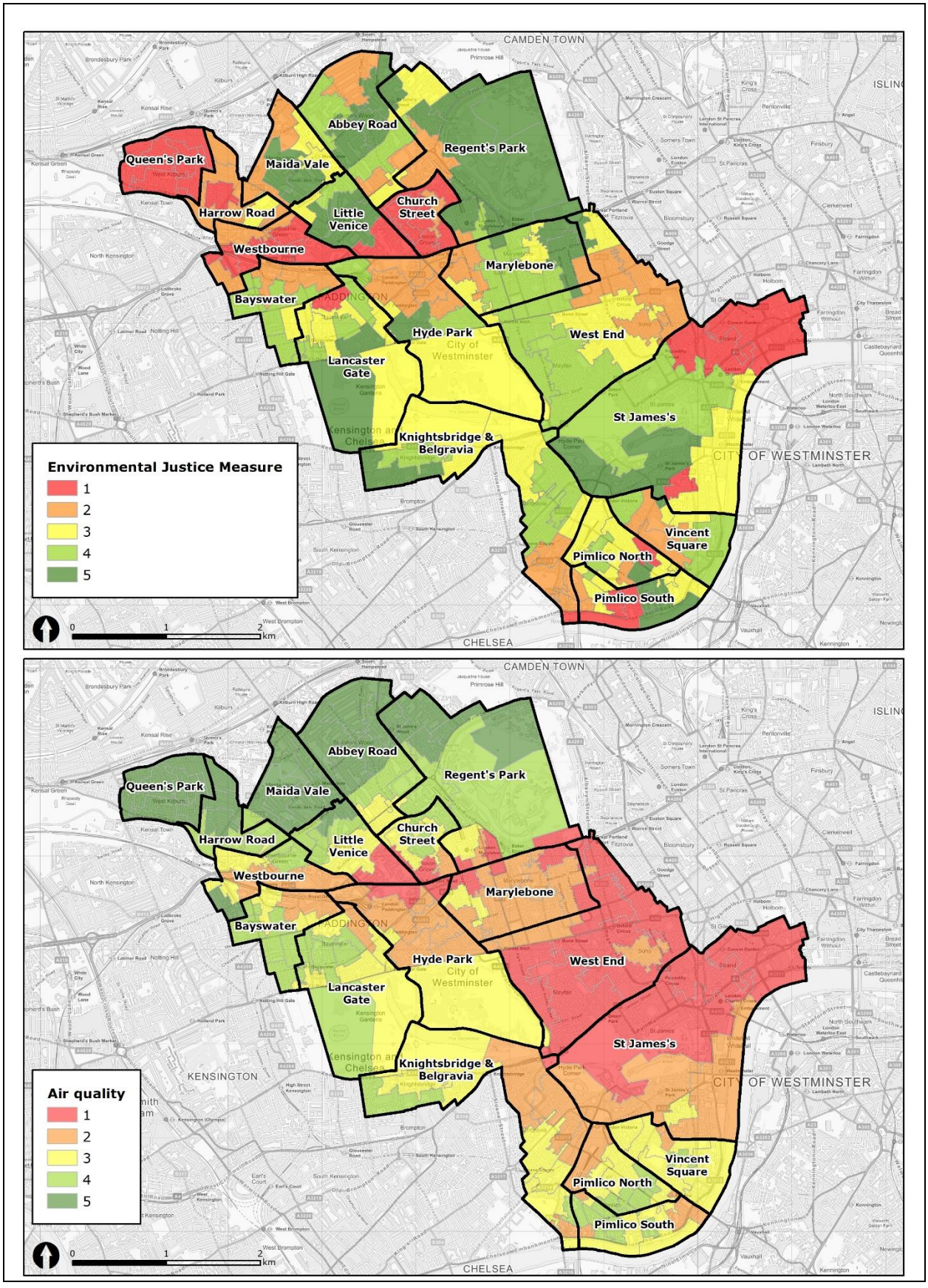
Metric Creation: Proximity to public open spaces	
Measure Theme	Green & Resilient City
What is measured	Percentage of households in proximity to public open spaces
Unit of measurement	Percentage of households
Method for LSOA aggregation	The dataset was created using an existing vector layer that was created from the Audit of Open Spaces. The areas of public open space were divided in to five groups through using the size and type of space as a determining factor. The following criteria was used to split the areas of public open space in to five groups and assigned a buffer distance according to the specification below: 1) Greater than 0.1ha and equal to/ less than 0.4ha = 120m buffer 2) Greater than 0.41ha and equal to/ less than 1.9ha = 280m buffer 3) Greater than 2ha = 400m buffer 4) Smaller or equal than 0.1 ha = no buffer 5) River Thames and the canals = 120m buffer Those were merged and intersected with the LSOAs and calculated the coverage for each as a percentage.
Data Sources	
Source	Westminster City Council
Citation	© Crown copyright and database rights 2022 OS 100021668 Available from: https://www.westminster.gov.uk/media/document/en-env-008---audit-of-open-spaces and https://www.westminster.gov.uk/media/document/ev-env-007---a-partnership-approach-to-open-spaces-and-biodiversity
Data type	Vector
Geographic resolution	Not applicable
Year of publication	2016
Temporal resolution	2014


Abbey Road
Regent's Park
Queen's Park
Maida Vale
Church Street
Harrow Road
Little Venice
Westbourne
Marylebone
Bayswater
Hyde Park
West End
Lancaster Gate
St James's
Knightsbridge & Belgravia
Vincent Square
Pimlico North
Pimlico South
CAMDEN TOWN
KENSINGTON
CITY OF WESTMINSTER
CHELSEA
Proximity to public open spaces
1
2
3
4
5
0
1
2
km

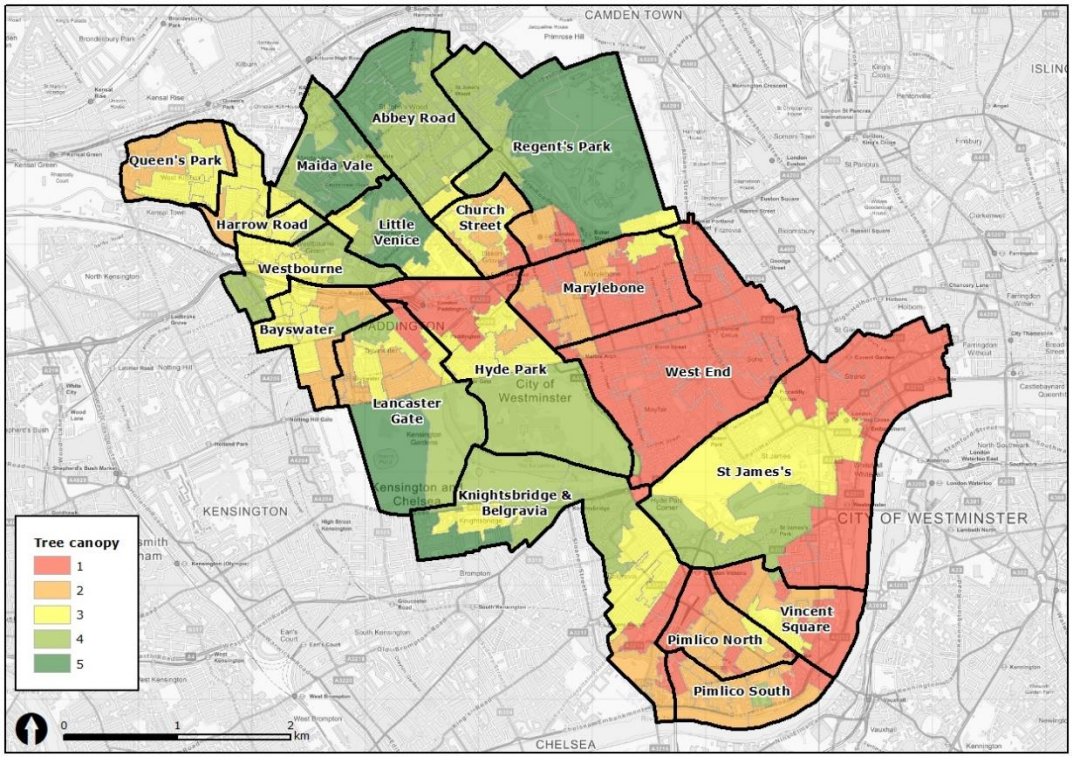
Metric Creation: Flood risk	
Measure Theme	Green & Resilient City
What is measured	Percentage of households in flooding risk
Unit of measurement	Percentage of households
Method for LSOA aggregation	The dataset was created by merging the flood risk zones 2 and 3, with the surface water flood risk hotspots. Those were then intersected with the LSOAs and the coverage for each was calculated as a percentage.
Data Sources	
Source	Westminster City Council, Environment Agency
Citation	© Crown copyright and database rights 2022 OS 100021668 © Environment Agency copyright and/or database right 2022 Available from: Datasets – Defra Data Services Forum
Data type	Vector
Geographic resolution	Not applicable
Year of publication	2019, 2022
Temporal resolution	2019, 2022



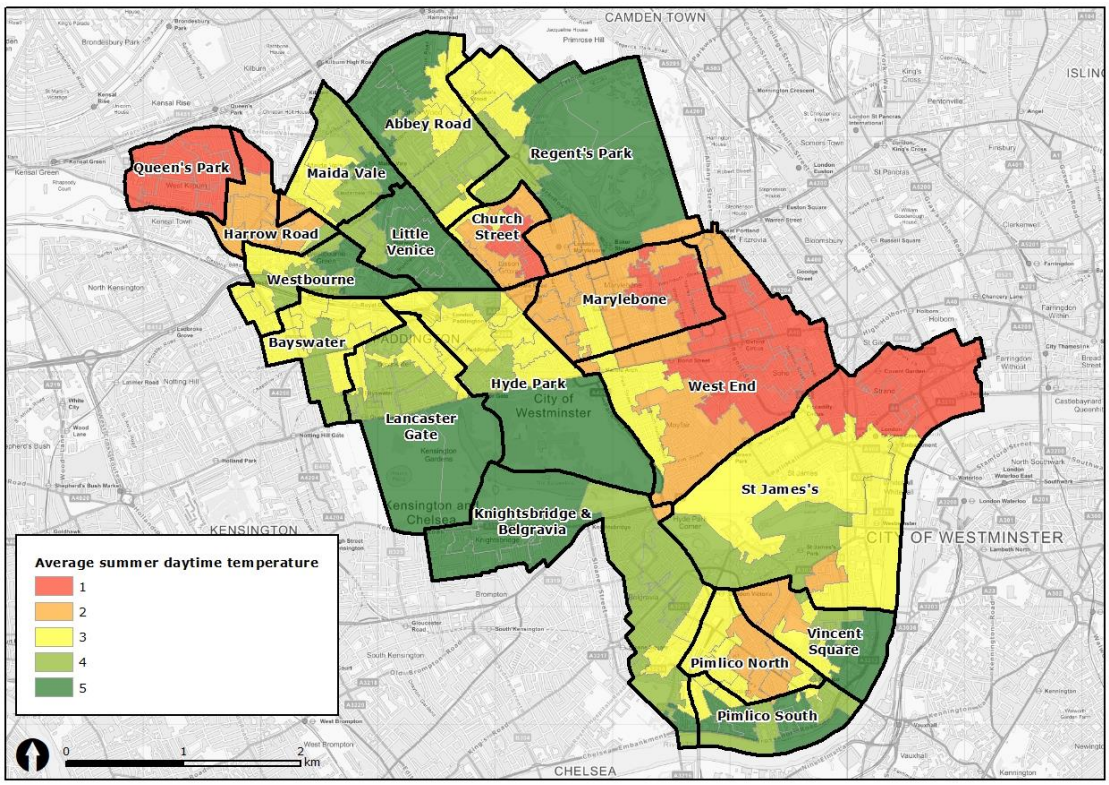
Metric Creation: Air quality	
Measure Theme	Green & Resilient City
What is measured	The ground level concentrations of NO2 and PM10
Unit of measurement	Micro gramme per cubic metre
Method for LSOA aggregation	The data was provided in raster format at 20m grid resolution, which was converted with the "Raster to Point" tool into points. It was then spatially joined to the LSOAs, summarizing the mean point values, resulting in the mean NO2 and PM10 values aggregated to the LSOAs. The two pollutants were reclassified with scores 1-5 separately and calculated an air quality composite.
Data Sources	
Source	GLA and TFL Air Quality
Citation	GLA and TFL Air Quality (2019). London Atmospheric Emission (LAEI) 2016. London DataStore. Dataset. Available from: London Atmospheric Emissions Inventory (LAEI) 2019 - London Datastore
Data type	Raster
Geographic resolution	20m grid resolution
Year of publication	2022
Temporal resolution	2019


CAMDEN TOWN
Abbey Road
Regent's Park
Queen's Park
Maida Vale
Harrow Road
Little Venice
Church Street
Westbourne
Marylebone
Bayswater
Hyde Park
City of Westminster
West End
Lancaster Gate
St James's
Knightsbridge & Belgravia
CITY OF WESTMINSTER
Vincent Square
Pimlico North
Pimlico South
CHELSEA
Environmental Justice Measure
1
2
3
4
5
0
1
2
km
CAMDEN TOWN
Abbey Road
Regent's Park
Queen's Park
Maida Vale
Harrow Road
Little Venice
Church Street
Westbourne
Marylebone
Bayswater
Hyde Park
City of Westminster
West End
Lancaster Gate
St James's
Knightsbridge & Belgravia
KENSINGTON
CITY OF WESTMINSTER
Vincent Square
Pimlico North
Pimlico South
CHELSEA
Air quality
1
2
3
4
5
0
1
2
km

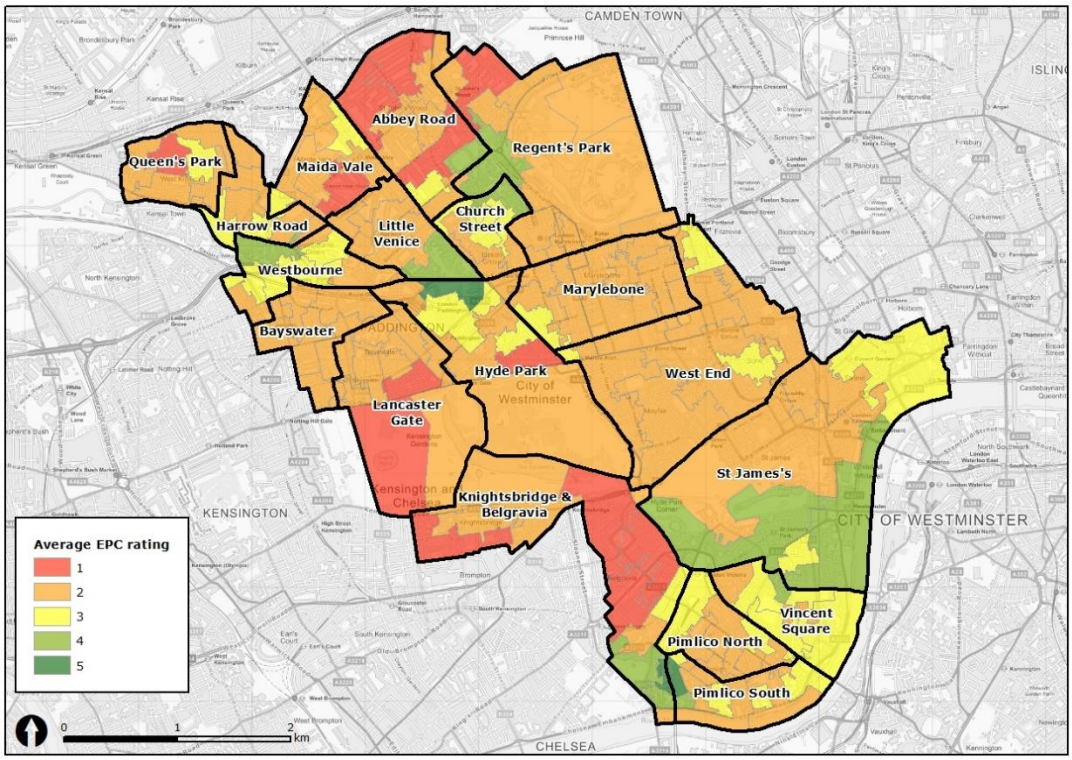
Metric Creation: Tree canopy	
Measure Theme	Green & Resilient City
What is measured	Tree canopy cover for Westminster
Unit of measurement	Percentage of households
Method for LSOA aggregation	The data was provided in tabular format aggregated by LSOA in Westminster. The table was linked to the LSOA shapefile using the codes as the key identifier.
Data Sources	
Source	Curio (Breadboard Labs Limited) and GLA
Citation	Breadboard Labs (2018). Curio Canopy - London Tree Canopy Cover. London DataStore. Available from: Curio Canopy - London Tree Canopy Cover - London Datastore
Data type	Tabular
Geographic resolution	Lower Super Output Area
Year of publication	2018
Temporal resolution	2016



Metric Creation: Heat risk	
Measure Theme	Green & Resilient City
What is measured	Average summer daytime temperature for Westminster
Unit of measurement	Percentage of households
Method for LSOA aggregation	The data correspond to summer months (i.e. June, July and August) and are derived from Landsat-8 thermal infrared images. They were provided aggregated at a city block level, and they were clipped to Westminster's boundary. Those were then intersected with the LSOAs and the average temperature for each was calculated.
Data Sources	
Source	ARTi-Analytics and GLA
Citation	Major Summer Heat Spots using Landsat-8 Thermal Satellite data (2021). London DataStore. Available from: Major Summer Heat Spots using Landsat-8 Thermal Satellite data - London Datastore
Data type	Vector
Geographic resolution	City blocks
Year of publication	2021
Temporal resolution	2016-2020



Metric Creation: Average Energy Performance Certificate (EPC) rating	
Measure Theme	Building Efficiency
What is measured	Average Energy Performance Certificate (EPC) rating
Unit of measurement	Average rating Energy Efficiency (%)
Method for LSOA aggregation	The data was provided in a table that included all addresses in Westminster with their current EPC ratings. The addresses were geocoded and spatial joined to the LSOAs, and the mean rating was calculated for each LSOA.
Data Sources	
Source	Department for Levelling up, Housing and Communities
Citation	Energy Performance of Buildings Data: England and Wales (2022). Department for Levelling up, Housing and Communities Available from: https://epc.opendatacommunities.org/
Data type	Tabular
Geographic resolution	Postcode level
Year of publication	Not applicable
Temporal resolution	2022

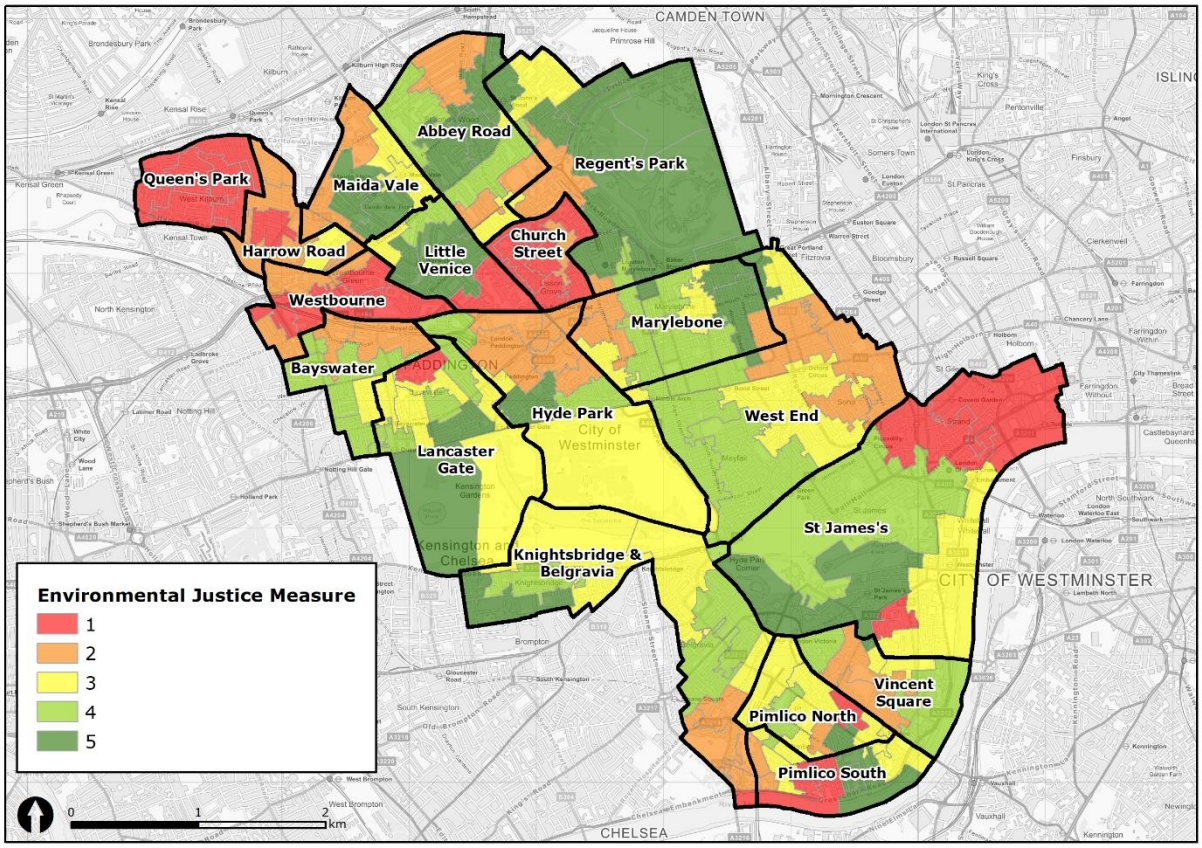


4. Outputs

The primary output for this project is the Environmental Justice map, with scores assigned to each LSOA, which is aimed to highlight areas of higher and lower priority, relative to the values mapped across Westminster's LSOA network. This was created by applying weighting to each of the measures with the total then multiplied by the Index of Multiple Deprivation score, to account for the population profile and their barriers.

It is important to note that these scores have not been normalized or manipulated to hold significant meaning on their own. It is not recommended that raw scores be displayed to the general public, as when taken out of context, the scores hold little meaning.

Environmental Justice Map



The Environmental Justice map is made up of all 10 environmental metrics, weighted, and multiplied by the Index of Multiple Deprivation. This highlights the areas where the population has particular barriers and is, therefore, disproportionally affected by climate change and poor environmental conditions. The ward that seems to have a cumulative low score is Queen's Park, with the entirety of its area being scored 1. Church Street and Westbourne wards also seem to be scoring low overall, with the majority of their neighbourhoods being scored 1.

5. Limitations

The methodology used for this study allows for the analysis and combination of multiple metrics across Westminster. However, given that there are no distinct thresholds applied to the metrics and because the 5 themes are dependent on the range and distribution of the data, the outputs are providing a comparative tool for the borough's neighbourhoods, rather than absolutes. This means that although some neighbourhoods might be appearing as high risk in the EJM map, that is merely a score in relation to the rest of the borough.

Some degree of accuracy is always lost when manipulating spatial data from one geography to another. All datasets used in this study were converted to LSOAs from different statistical boundaries or other data types, with the exception of four datasets that were already aggregated to the LSOAs. However, the methodology does not require all inputs to be aggregated to the same geography. The same study could be conducted using datasets aggregated to their original geographies. While this would increase the geospatial accuracy of the outputs, it would be more difficult to highlight and analyse trends at a wider scale.

The temporal resolution of the datasets used for the project is not uniform. Although this might mean that the different datasets are processed in various frequencies, the majority of the data used for the study are unlikely to change significantly between the updates. The LSOA geographies used currently will change with the 2021 Census release, so the index would likely need updating in 2023 to properly reflect this.

The selection of the metrics is somewhat arbitrary, guided by the Council's current priorities, and the outputs of this work are not validated. The input metrics have not been tested for potential correlations, which might be skewing the results. This could be avoided, and the study could be reinforced by incorporating primary research evidence to the metrics selection rationale and the output validation, for example through an environmental resident survey.