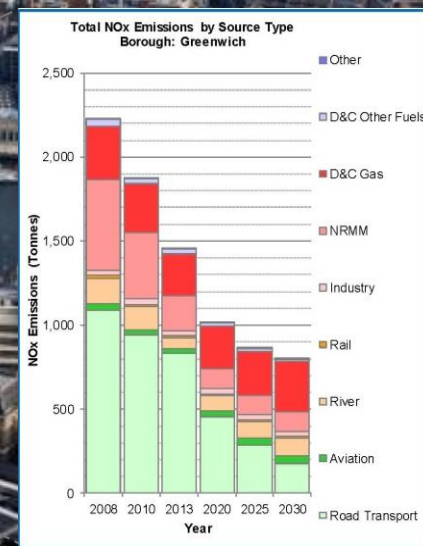
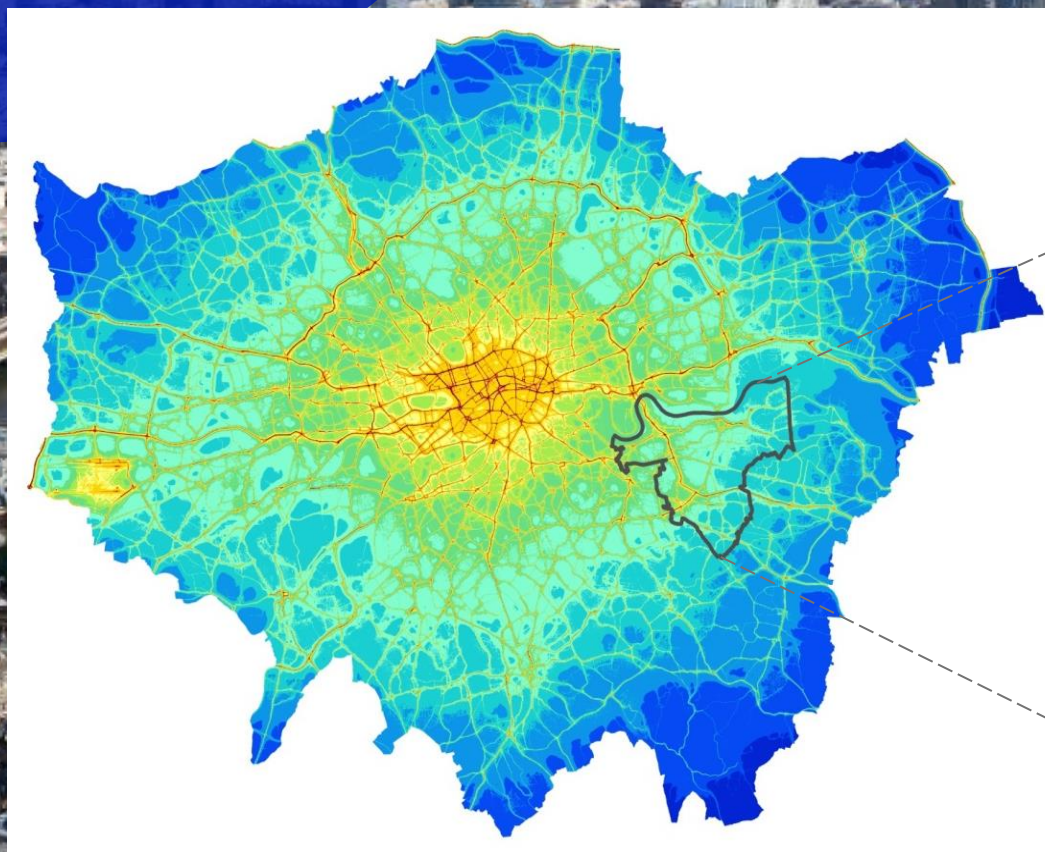


London Atmospheric Emissions Inventory (LAEI)

14th April 2016 Workshop



Agenda

Emission Sources – Data Type

1

Pollutants are emitted directly from a variety of sources enumerated in this section

LAEI Supporting Information

2

All emission datasets are split by area, by borough and by grid

Grid Emissions Summary – All Sources

3

Emissions for all sources are provided at grid level (Excel and GIS)

Detailed Road Transport – Link Emissions

4

Emissions for Road Transport are also provided at link level (Excel and GIS)

Concentration Maps

5

Concentrations are provided for NO₂ and PM

LLAQM Package

6

How the LAEI data has been used to assist Boroughs with their LLAQM duties

Next Steps

7

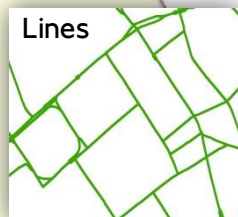
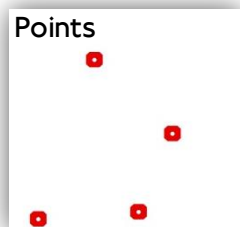
Next steps for TfL to work on

Data Manipulation Tips

8

How to use the LAEI data

I. Emission Sources – Data Type



Point Sources

- Part A Processes
- Part B Processes

Line Sources

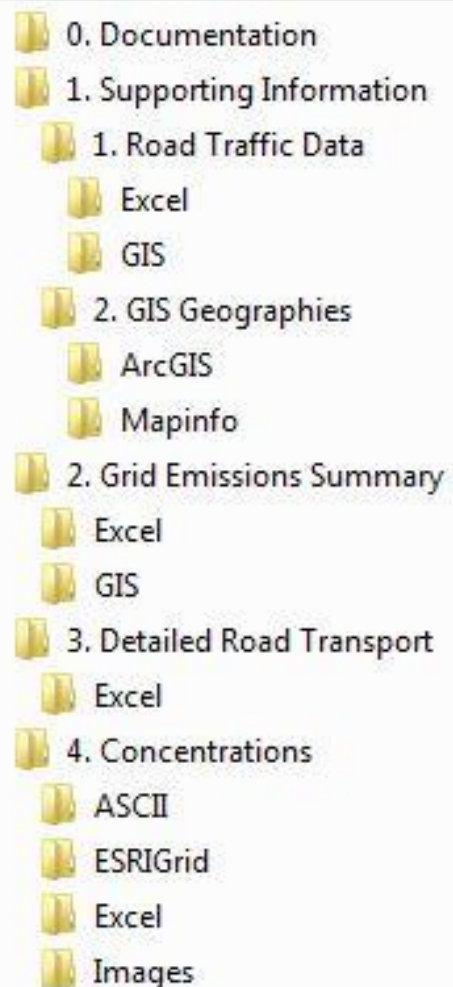
- Road Transport
- Rail
- Resuspension

- Motorcycle
- Taxi
- Car
 - Petrol
 - Diesel
 - Electric
- LGV
 - Petrol
 - Diesel
 - Electric
- TfL Bus
- Other Bus / Coach
- HGV
 - Artic
 - Rigid

Area Sources

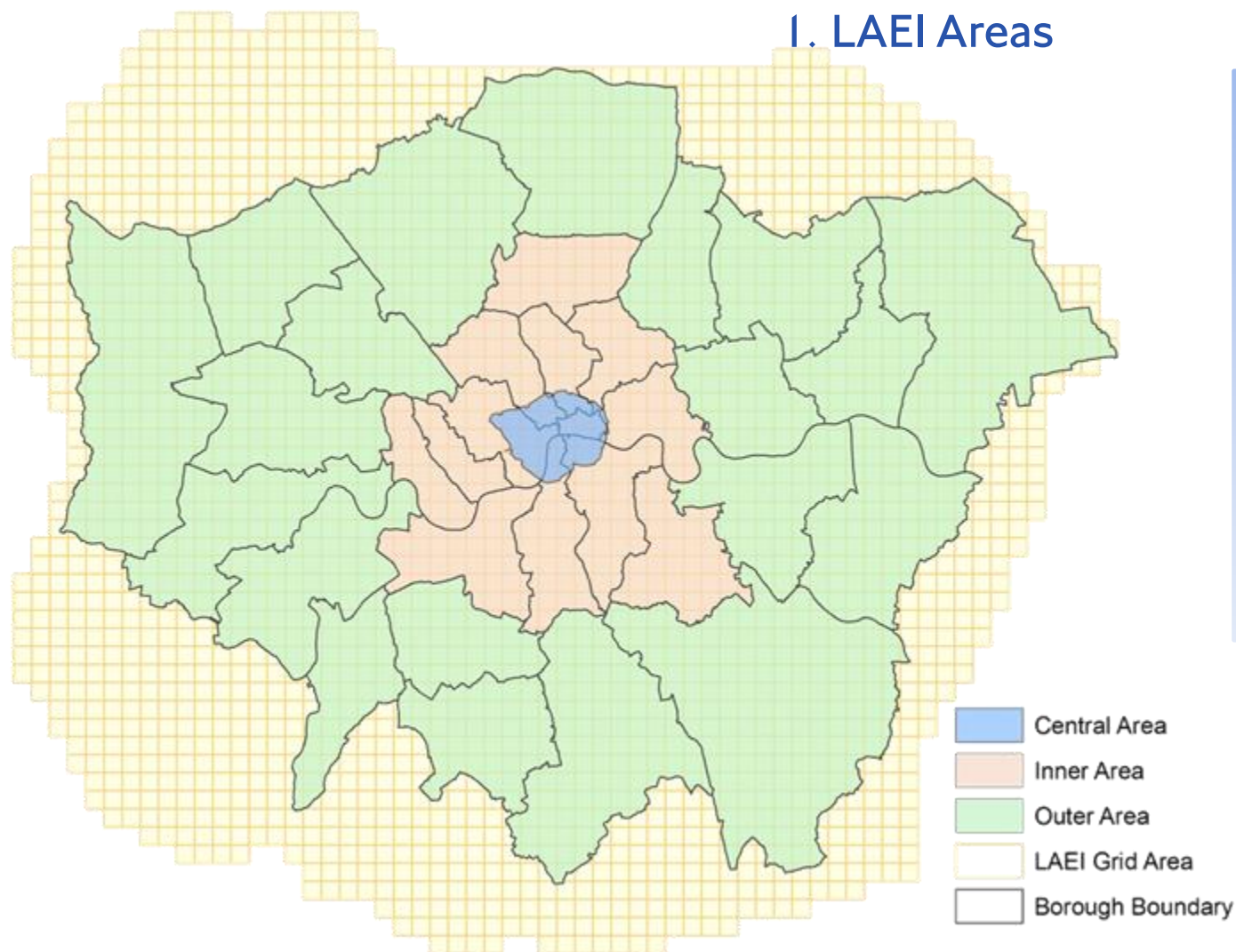
- Aviation
- River (Shipping)
- NRMM
- Domestic and Commercial Fuel
- Gas
- Other Fuels
- Agriculture
- Household and Garden
- Fires
- Sewage Treatment Work (STW)
- Waste Transfer Station (WTS)
- Landfill

London Datastore File Structure



2. LAEI Supporting Information - Geographies

1. LAEI Areas

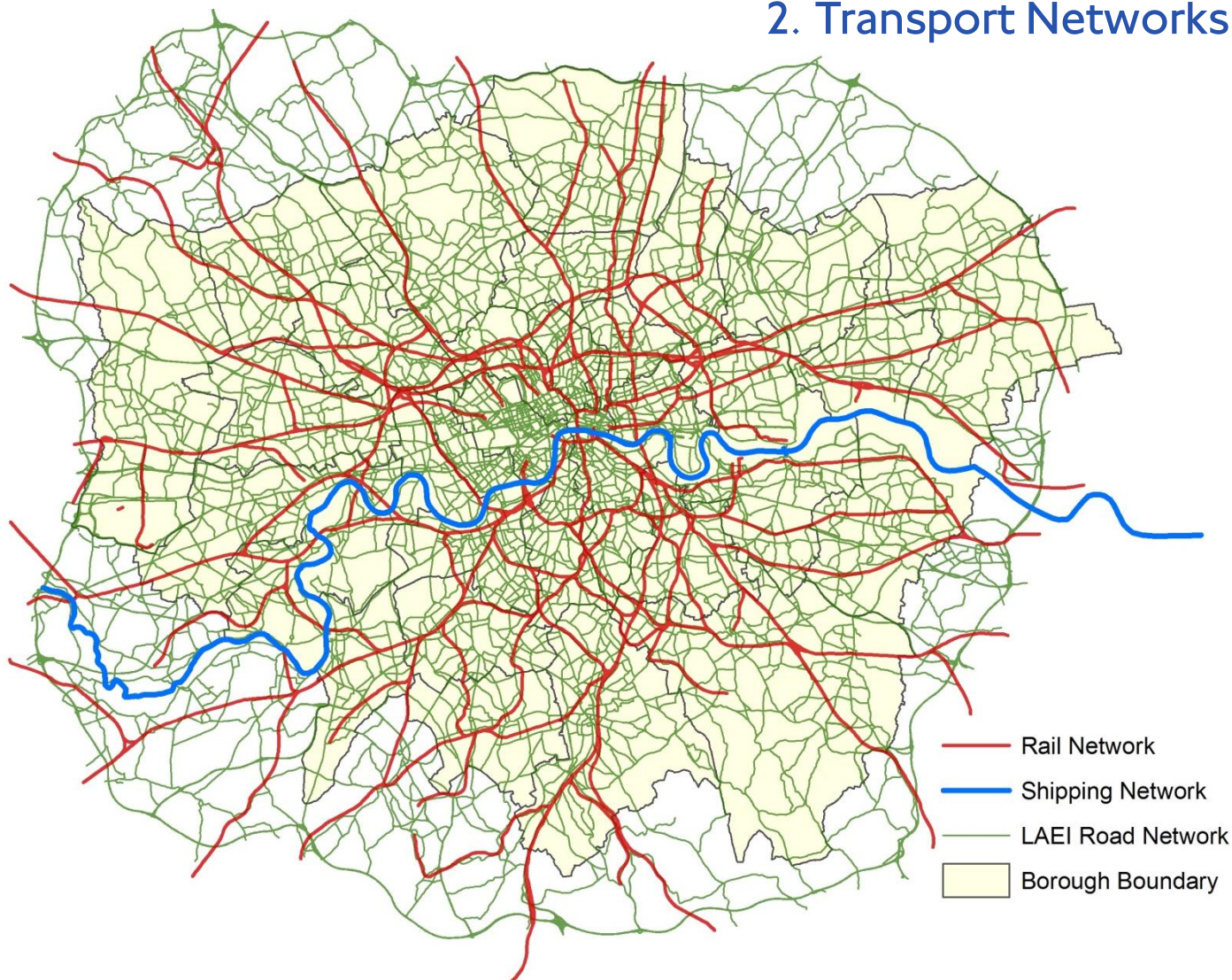


All links and grids are split by

- London Area
 - GLA
 - Central
 - Inner
 - Outer
 - Non GLA
- Grid
- Borough

2. LAEI Supporting Information - Geographies

2. Transport Networks



All links and grids are split by

- London Area
 - GLA
 - Central
 - Inner
 - Outer
 - Non GLA
- Grid
- Borough

2. LAEI Supporting Information – Road Traffic Data

AADT & VKm: The LAEI also contains Road Traffic data used to calculate the emissions

- For Major Roads (Links) → includes Annual Average Daily Traffic (AADT) flows, average traffic speed and road length. Vehicle kilometres (VKm) is also provided, based on the following:



Either from DfT count point
or TfL LTS traffic model link

- For Minor Roads (Grids) → includes Traffic Speed and VKm

2. LAEI Supporting Information – Road Traffic Data

The same data is provided both in Excel and GIS formats

Eg. Vehicle per Km for TfL Buses in 2013 – Major Roads (Link)

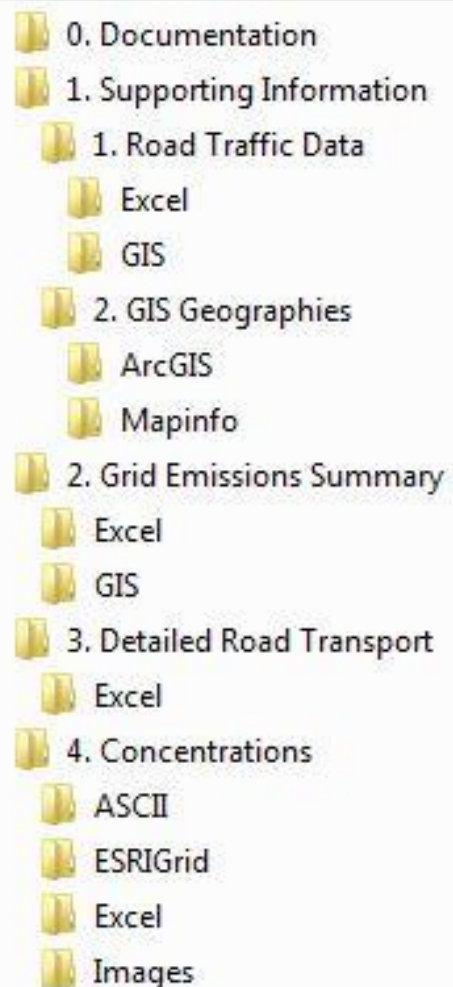
Excel

Year	Toid	GRID	Location	BoroughNa	AA	LTBus	AA	LTBus	Speed (kph)	Length (m)	VKM	LTBus	VKM	TOTAL
2013	4000000030472390	836	Outer	Hillingdon	235	8,314	36.9	5.5	470	16,605				
2013	4000000030478841	2217	Outer	Hillingdon	235	8,313	35.3	3.6	309	10,940				
2013	4000000030128707	282	External	NonGLA	53	19,212	49.1	113.6	2,216	796,735				
2013	4000000030132311	873	Outer	Hillingdon	17	14,745	49.2	52.8	323	284,144				
2013	4000000030132311	2930	Outer	Hillingdon	17	14,745	49.2	179.5	1,097	966,058				
2013	4000000030201914	910	Outer	Hillingdon	229	10,790	51.5	38.4	3,215	151,230				
2013	4000000030201914	2294	Outer	Hillingdon	229	10,790	51.5	23.8	1,991	93,677				
2013	4000000030202307	2930	Outer	Hillingdon	-	-	56.9	213.7	-	-				
2013	4000000030202308	2930	Outer	Hillingdon	67	28,317	16.8	95.4	2,340	985,715				
2013	4000000030202312	2930	Outer	Hillingdon	67	26,929	29.3	61.1	1,500	600,900				
2013	4000000030202335	869	Outer	Hillingdon	172	10,904	24.7	95.8	6,001	381,446				
2013	4000000030202426	1550	Outer	Hillingdon	153	8,231	50.6	136.5	7,611	410,169				
2013	4000000030202448	1550	Outer	Hillingdon	152	8,231	56.0	108.8	6,050	326,744				
2013	4000000030203089	307	External	NonGLA	79	15,060	34.8	63.6	1,845	349,634				
2013	4000000030309800	910	Outer	Hillingdon	229	10,790	55.7	55.0	4,603	216,521				
2013	4000000030309801	910	Outer	Hillingdon	228	10,789	58.5	61.5	5,120	242,079				
2013	4000000030309828	913	Outer	Hillingdon	626	20,512	52.0	39.3	8,988	294,563				
2013	4000000030309828	2970	Outer	Hillingdon	626	20,512	52.0	1.0	228	7,488				
2013	4000000030309829	913	Outer	Hillingdon	626	20,512	36.7	49.9	11,390	373,266				
2013	4000000030310167	2930	Outer	Hillingdon	67	26,929	37.4	33.7	828	331,665				
2013	4000000030310170	2930	Outer	Hillingdon	67	26,929	15.5	77.9	1,911	765,407				
2013	4000000030310172	2930	Outer	Hillingdon	67	26,929	17.2	32.1	787	315,092				
2013	4000000030310174	2930	Outer	Hillingdon	67	26,929	37.6	95.3	2,339	937,110				
2013	4000000030310176	2930	Outer	Hillingdon	67	26,929	25.2	32.5	798	319,647				
2013	4000000030310178	2930	Outer	Hillingdon	67	28,317	26.7	33.8	829	349,347				
2013	4000000030310183	2930	Outer	Hillingdon	-	-	16.4	54.0	-	-				
2013	4000000030310184	2930	Outer	Hillingdon	153	8,231	55.1	35.9	2,001	107,831				
2013	4000000030310186	2930	Outer	Hillingdon	-	-	22.5	48.8	-	-				
2013	4000000030310187	2930	Outer	Hillingdon	-	9,115	40.9	38.1	-	126,650				
2013	4000000030310188	2930	Outer	Hillingdon	-	9,115	4.7	42.4	-	141,187				
2013	4000000030310189	2930	Outer	Hillingdon	67	8,145	46.5	37.4	916	111,049				
2013	4000000030310190	2930	Outer	Hillingdon	67	8,145	32.2	34.3	842	102,043				
2013	4000000030399038	2930	Outer	Hillingdon	67	26,929	8.5	32.1	787	315,106				
2013	4000000030399040	2930	Outer	Hillingdon	-	-	14.6	40.9	-	-				
2013	4000000030399042	2930	Outer	Hillingdon	67	26,929	21.1	18.4	462	181,254				

GIS



London Datastore File Structure



3. Grid Emissions Summary – All Sources

Data is provided both in Excel and GIS formats

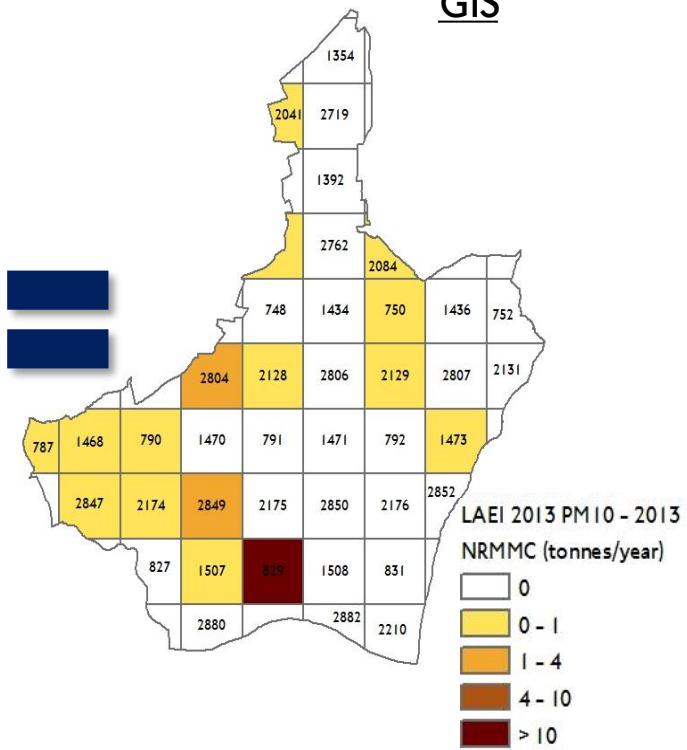
- Excel → 1 file per key pollutant (NO_x, PM₁₀, PM_{2.5}, CO₂) – Including all sources, all years
- GIS → 1 file per source type – Including all key pollutants, all years

Eg. NRMM Construction emissions by grid in Barking & Dagenham in 2013

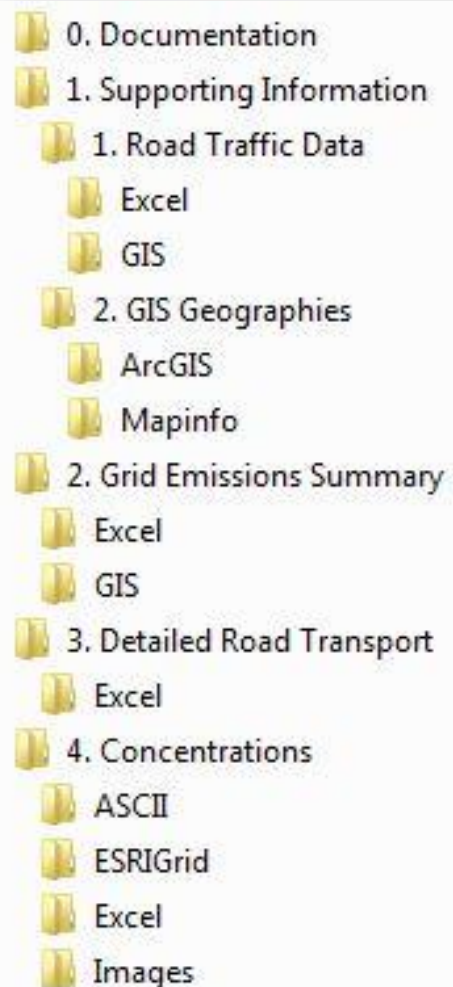
Excel

	A	B	C	D	E	F	G	H
1	PM ₁₀ Emissions by Grid							
2	All Sources - Tonnes/Year							
3								
4	Year	LAEI 1km2 ID	GRID_ExactCut_IC	Easting	Northing	Borough	Zone	NRMM Construction
5	7376	2013	8183	662	547500	190500	Barking and Dagenham	Outer
6	7377	2013	8185	663	549500	190500	Barking and Dagenham	Outer
7	7416	2013	8527	702	547500	188500	Barking and Dagenham	Outer
8	7418	2013	8529	704	549500	188500	Barking and Dagenham	Outer
9	7462	2013	8871	748	547500	186500	Barking and Dagenham	Outer
10	7464	2013	8873	750	549500	186500	Barking and Dagenham	Outer
11	7466	2013	8875	752	551500	186500	Barking and Dagenham	Outer
12	7501	2013	9211	787	543500	184500	Barking and Dagenham	Outer
13	7504	2013	9213	790	545500	184500	Barking and Dagenham	Outer
14	7505	2013	9215	791	547500	184500	Barking and Dagenham	Outer
15	7506	2013	9217	792	549500	184500	Barking and Dagenham	Outer
16	7507	2013	9219	793	551500	184500	Barking and Dagenham	Outer
17	7541	2013	9557	827	545500	182500	Barking and Dagenham	Outer
18	7543	2013	9559	829	547500	182500	Barking and Dagenham	Outer
19	7545	2013	9561	831	549500	182500	Barking and Dagenham	Outer
20	8068	2013	8184	1354	548500	190500	Barking and Dagenham	Outer
21	8106	2013	8528	1392	548500	188500	Barking and Dagenham	Outer
22	8146	2013	8870	1432	546500	186500	Barking and Dagenham	Outer
23	8148	2013	8872	1434	548500	186500	Barking and Dagenham	Outer
24	8150	2013	8874	1436	550500	186500	Barking and Dagenham	Outer
25	8182	2013	9212	1468	544500	184500	Barking and Dagenham	Outer
26	8184	2013	9214	1470	546500	184500	Barking and Dagenham	Outer
27	8185	2013	9216	1471	548500	184500	Barking and Dagenham	Outer
28	8187	2013	9218	1473	550500	184500	Barking and Dagenham	Outer
29	8220	2013	9556	1506	544500	182500	Barking and Dagenham	Outer
30	8221	2013	9558	1507	546500	182500	Barking and Dagenham	Outer
31	8222	2013	9560	1508	548500	182500	Barking and Dagenham	Outer
32	8223	2013	9562	1509	550500	182500	Barking and Dagenham	Outer
33	8755	2013	8355	2041	547500	189500	Barking and Dagenham	Outer
34	8757	2013	8357	2043	549500	189500	Barking and Dagenham	Outer
35	8795	2013	8639	2081	547500	187500	Barking and Dagenham	Outer
36	8798	2013	8701	2084	549500	187500	Barking and Dagenham	Outer
37	8799	2013	8703	2085	551500	187500	Barking and Dagenham	Outer
38	8841	2013	9041	2127	545500	185500	Barking and Dagenham	Outer
39	8842	2013	9043	2128	547500	185500	Barking and Dagenham	Outer
40	8843	2013	9045	2129	549500	185500	Barking and Dagenham	Outer

GIS



London Datastore File Structure



4. Detailed Road Transport – Link Emissions

For Road Traffic datasets, detailed emissions are also provided for major roads, minor roads and cold starts, split by vehicle type (Excel format)

- Emission datasets for **major roads** available at **link level**, based on the Ordnance Survey ITN, with unique link identifiers (=TOID number).
- Emissions in tonnes per year are available by link in Excel format

Excel

	B	C	D	E	I	J	K	L
1	Toid	GRID	Location	BoroughName_Exact	Year	Pollutant	Emissions U	Motorc
14217	4000000030239011	3300	Central	City of Westminster	2013	CO2	tonnes/year	2.075
14228	4000000030344035	3316	Central	Camden	2013	CO2	tonnes/year	-
14238	4000000030418898	3300	Central	City of Westminster	2013	CO2	tonnes/year	0.108
14244	4000000030418900	3300	Central	City of Westminster	2013	CO2	tonnes/year	0.161
14252	4000000030459292	3300	Central	City of Westminster	2013	CO2	tonnes/year	0.402
14260	4000000031051824	3300	Central	City of Westminster	2013	CO2	tonnes/year	0.056
14289	4000000030239018	3284	Central	Camden	2013	CO2	tonnes/year	-
14291	4000000030239122	3284	Central	Camden	2013	CO2	tonnes/year	0.175
14292	4000000030239186	3284	Central	Camden	2013	CO2	tonnes/year	0.456
14295	4000000030239194	3284	Central	Camden	2013	CO2	tonnes/year	0.062
14296	4000000030239222	3284	Central	Camden	2013	CO2	tonnes/year	0.160
14307	4000000030418912	3284	Central	Camden	2013	CO2	tonnes/year	0.137
14311	4000000031032483	3284	Central	Camden	2013	CO2	tonnes/year	0.308
14320	4000000030147372	3302	Central	Camden	2013	CO2	tonnes/year	0.303
14321	4000000030239215	3302	Central	Camden	2013	CO2	tonnes/year	0.377
14330	4000000030239218	3302	Central	Camden	2013	CO2	tonnes/year	0.503
14331	4000000030239219	3302	Central	Camden	2013	CO2	tonnes/year	0.310
14332	4000000030239220	3302	Central	Camden	2013	CO2	tonnes/year	0.953
14333	4000000030239221	3302	Central	Camden	2013	CO2	tonnes/year	0.397
14334	4000000030239223	3302	Central	Camden	2013	CO2	tonnes/year	0.419
14344	4000000030239616	3302	Central	Camden	2013	CO2	tonnes/year	0.428
14347	4000000030344263	3302	Central	Camden	2013	CO2	tonnes/year	0.294
14354	4000000030344336	3302	Central	Camden	2013	CO2	tonnes/year	0.065
14366	4000000030344344	3302	Central	Camden	2013	CO2	tonnes/year	0.340

GIS



4. Detailed Road Transport – Grid Emissions

For Road Traffic datasets, detailed emissions are also provided for major roads, minor roads and cold starts, split by vehicle type (Excel format)

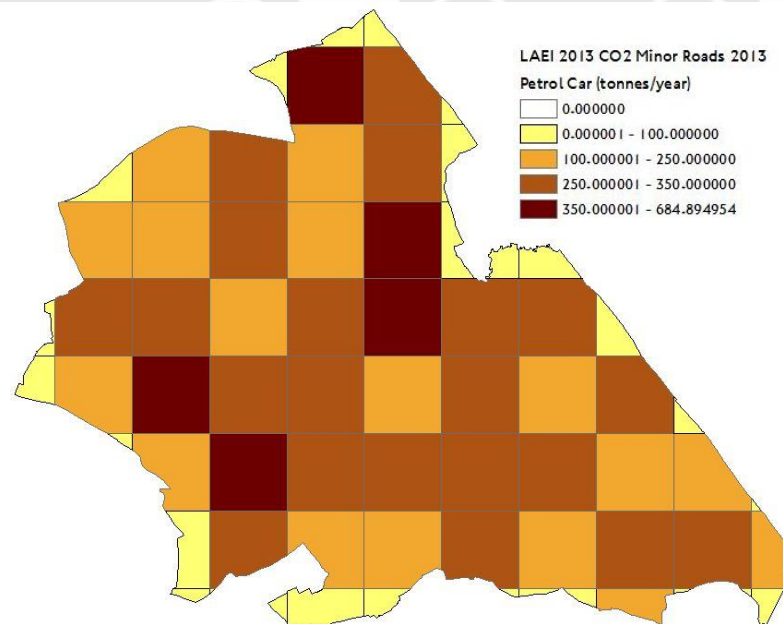
- Emission datasets for minor roads and cold starts are only available at grid level in Excel format

Eg. Minor Roads Emissions by grid in Brent in 2013

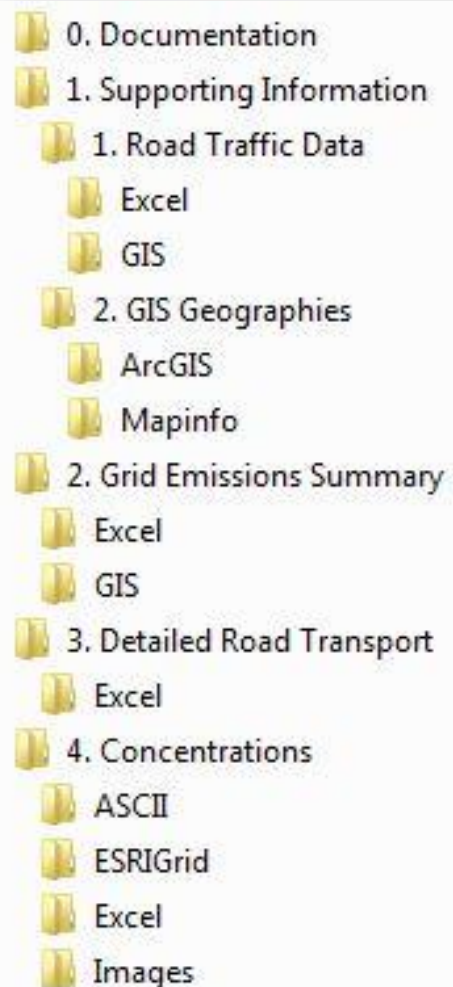
Excel

1	B	C	D	E	F	G	H	I
1	Grid Id	Location	Exa	Borough	Year	Pollutant	Emissions Unit	Petrol Car
7294	1492	Outer		Brent	2013	CO2	tonne/year	40.312
7298	818	Outer		Brent	2013	CO2	tonne/year	102.686
7306	1497	Outer		Brent	2013	CO2	tonne/year	4.435
7307	2786	Outer		Brent	2013	CO2	tonne/year	27.390
7309	773	Outer		Brent	2013	CO2	tonne/year	2.722
7343	820	Outer		Brent	2013	CO2	tonne/year	56.589
7930	2160	Outer		Brent	2013	CO2	tonne/year	144.248
8375	2830	Outer		Brent	2013	CO2	tonne/year	267.764
8376	1455	Outer		Brent	2013	CO2	tonne/year	192.995
8388	2157	Outer		Brent	2013	CO2	tonne/year	274.478
8389	772	Outer		Brent	2013	CO2	tonne/year	246.331
8391	2107	Outer		Brent	2013	CO2	tonne/year	313.217
8393	726	Outer		Brent	2013	CO2	tonne/year	76.114
8420	2828	Outer		Brent	2013	CO2	tonne/year	199.051
8421	1453	Outer		Brent	2013	CO2	tonne/year	299.845
8422	2785	Outer		Brent	2013	CO2	tonne/year	246.262
8423	1413	Outer		Brent	2013	CO2	tonne/year	282.236
8426	2739	Outer		Brent	2013	CO2	tonne/year	17.023
8452	814	Outer		Brent	2013	CO2	tonne/year	0.651
8453	2154	Outer		Brent	2013	CO2	tonne/year	301.702
8455	771	Outer		Brent	2013	CO2	tonne/year	344.296
8456	2104	Outer		Brent	2013	CO2	tonne/year	254.676
8457	724	Outer		Brent	2013	CO2	tonne/year	314.379
8460	2060	Outer		Brent	2013	CO2	tonne/year	49.986
8462	685	Outer		Brent	2013	CO2	tonne/year	73.996
8463	2023	Outer		Brent	2013	CO2	tonne/year	22.019
8807	2099	Outer		Brent	2013	CO2	tonne/year	49.151
8810	719	Outer		Brent	2013	CO2	tonne/year	25.740
8846	1449	Outer		Brent	2013	CO2	tonne/year	7.295
8848	2781	Outer		Brent	2013	CO2	tonne/year	244.499
8850	1409	Outer		Brent	2013	CO2	tonne/year	304.234
8853	2735	Outer		Brent	2013	CO2	tonne/year	114.187
8854	1369	Outer		Brent	2013	CO2	tonne/year	58.198

GIS

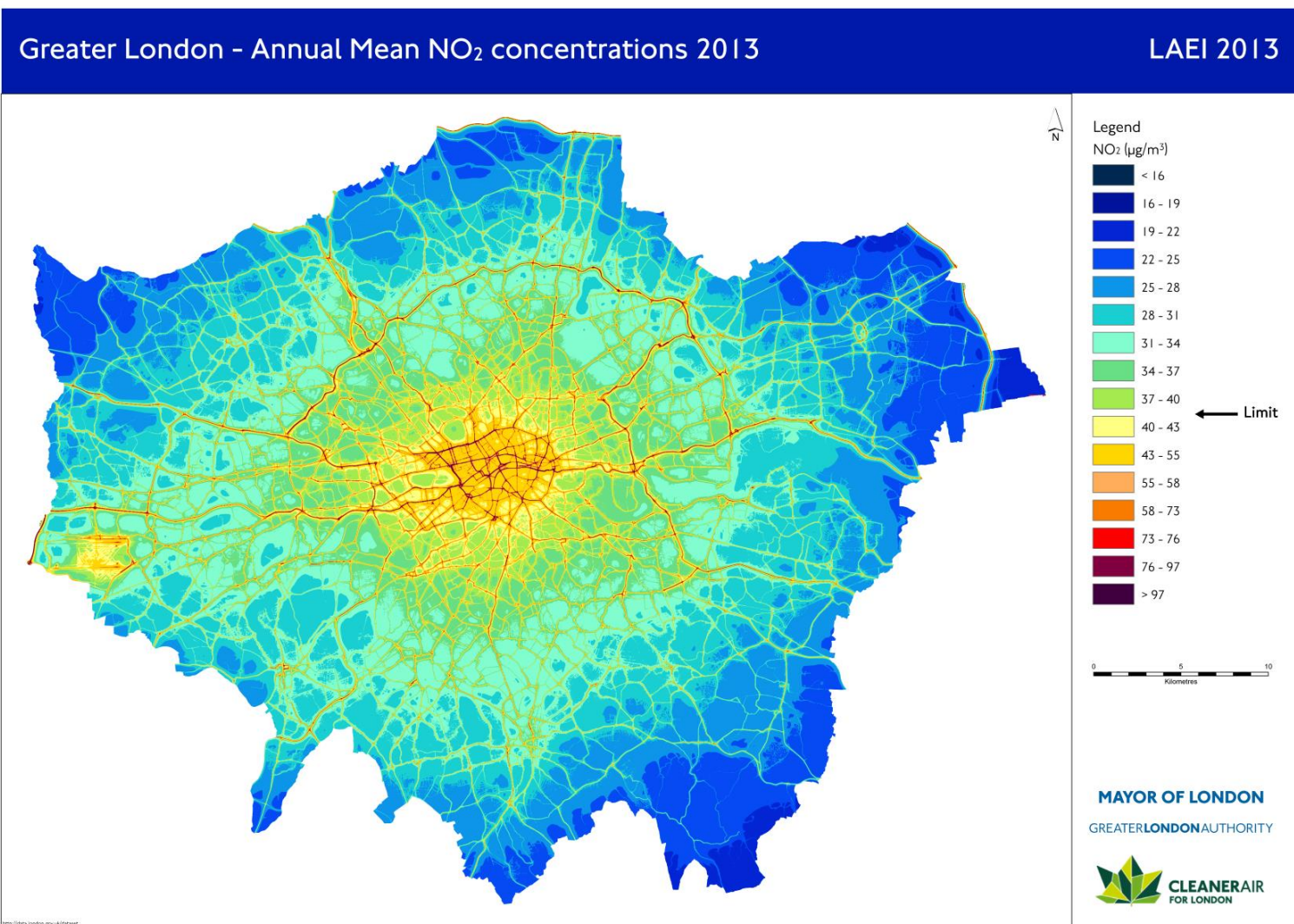


London Datastore File Structure



5. Concentrations

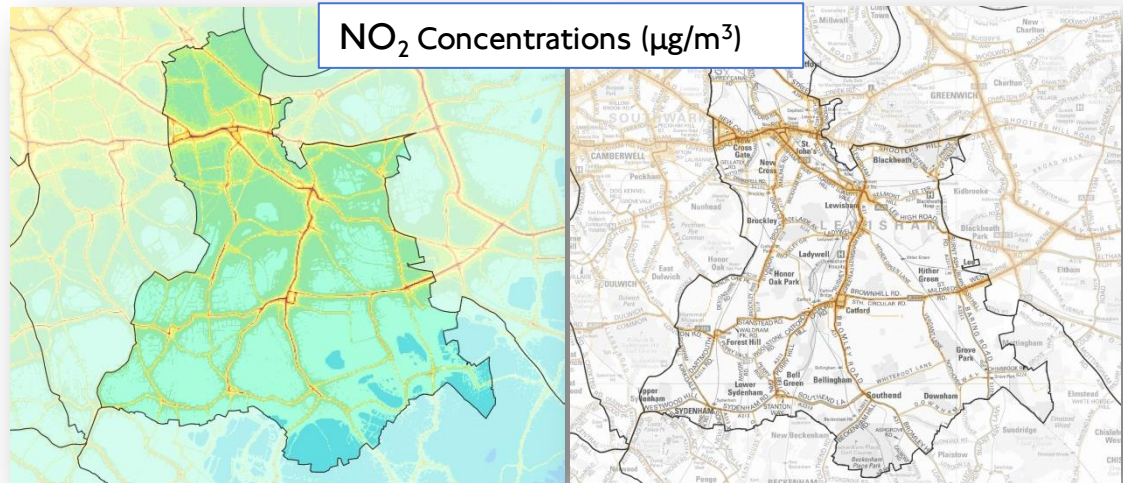
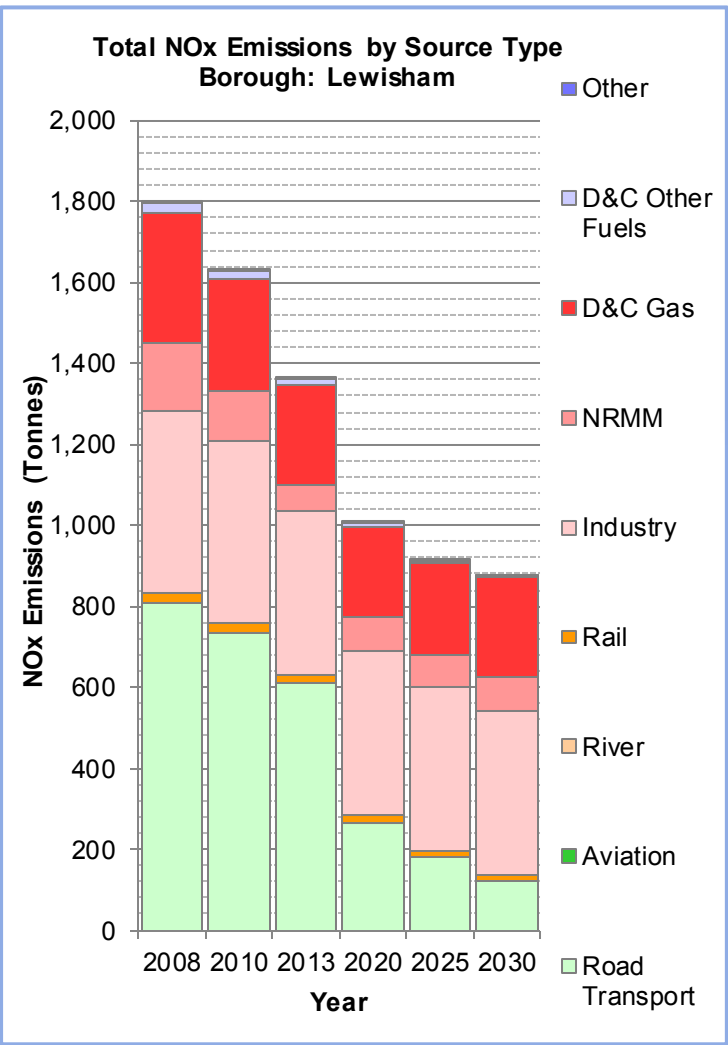
Dispersion modelling of LAEI emissions → Concentrations of NO_2 , PM_{10} and $\text{PM}_{2.5}$ (Year = 2013)



- Concentrations provided across the whole LAEI area
- Modelled at 20m resolution
- Data format = Text (ASCII), Excel (CSV), GIS (ESRI Grid) and Images (PDF/PNG)
- Maps also provided at Borough level as part of the LLAQM package

6. LLAQM Package – Maps and Dashboards

Eg. Borough of Lewisham



Emissions (Tonnes) by	2008	2010	2013	2020	2025	2030
Road Transport	810	736	609	266	179	120
Aviation	0	0	0	0	0	0
River	1	1	0	0	0	0
Rail	22	21	20	18	18	18
Industry	451	451	405	405	405	405
NRMM	169	125	67	84	81	81
D&C Gas	322	278	244	225	225	248
D&C Other Fuels	21	18	16	7	5	4
Other	4	4	3	3	3	4
Total	1,798	1,632	1,364	1,007	916	878

6. LLAQM Package - Source Apportionment

Excel tool developed to provide source apportionment of NO_x , PM_{10} and $\text{PM}_{2.5}$ at:

- Borough Level
- Specific location (nearest 1km² grid LAEI emissions)

1

Select Year
2013

2

Enter X and Y coordinates	
X	Y
530010	183872
Click to view location in streetmap.co.uk	
Nearest LAEI Grid (1km ²):	
530500	183500
LAEI Borough	Camden
LAEI Area	Inner

Borough summary tables and charts are also provided. Select a Borough to update the "Source Apportionment - Borough Totals" tables. Associated charts are provided in separate worksheets.

Select Borough
Camden

- User Input data = Year, OS X,Y coordinates and/or Borough
- Output:
 - Tables of emissions by source
 - All sources
 - Road Transport only (breakdown by vehicle category)
 - Pie Charts of emissions (%) by source

6. LLAQM Package - Source Apportionment

1 **Select Year**
2013

2 **Enter X and Y coordinates**

X	Y
530010	183872

[Click to view location in streetmap.co.uk](#)

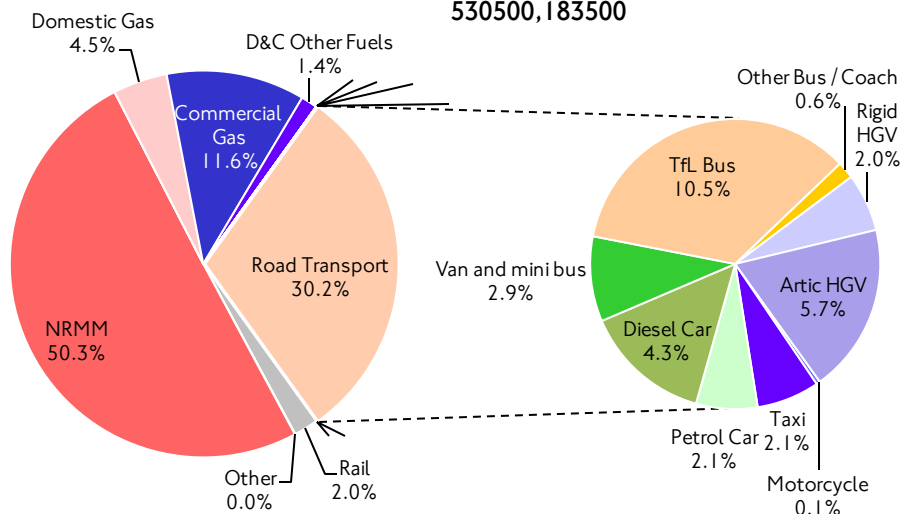
Nearest LAEI Grid (1km²):

530500	183500
LAEI Borough	Camden
LAEI Area	Inner

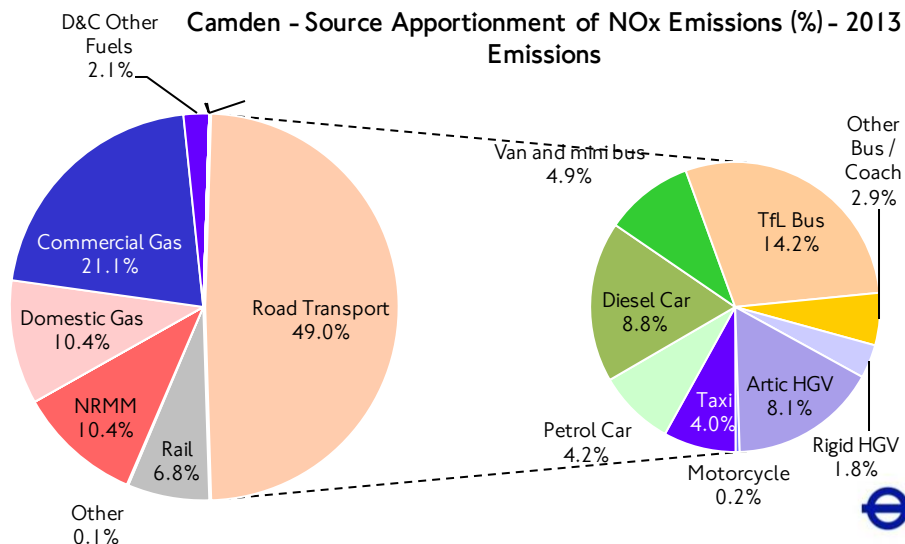
Borough summary tables and charts are also provided. Select a Borough to update the "Source Apportionment - Borough Totals" tables. Associated charts are provided in separate worksheets.

Select Borough
Camden

NOx Emissions (%) - 2013 - Borough: Camden - Location (X,Y): 530500,183500



Camden - Source Apportionment of NOx Emissions (%) - 2013 Emissions



6. LLAQM Package – Population Exposure Analysis

Estimate of population exposed to NO₂ concentrations in exceedance of the Air Quality Strategy (AQS) objective (40µg/m³) for 2013:

Inputs

- Annual average air quality concentrations of NO₂ across London in 2013 at a 20m resolution, based on the latest 2013 LAEI emissions estimates
- Population statistics by borough (GLA borough projections)
- Population statistics by Post Code (data from GLA projections has been disaggregated and assigned to Post Codes to get a better distribution of the population)

Procedure

- Selected areas where NO₂ concentrations exceed the 40µg/m³ objective
- Combine areas of exceedance with population data within each borough

Output

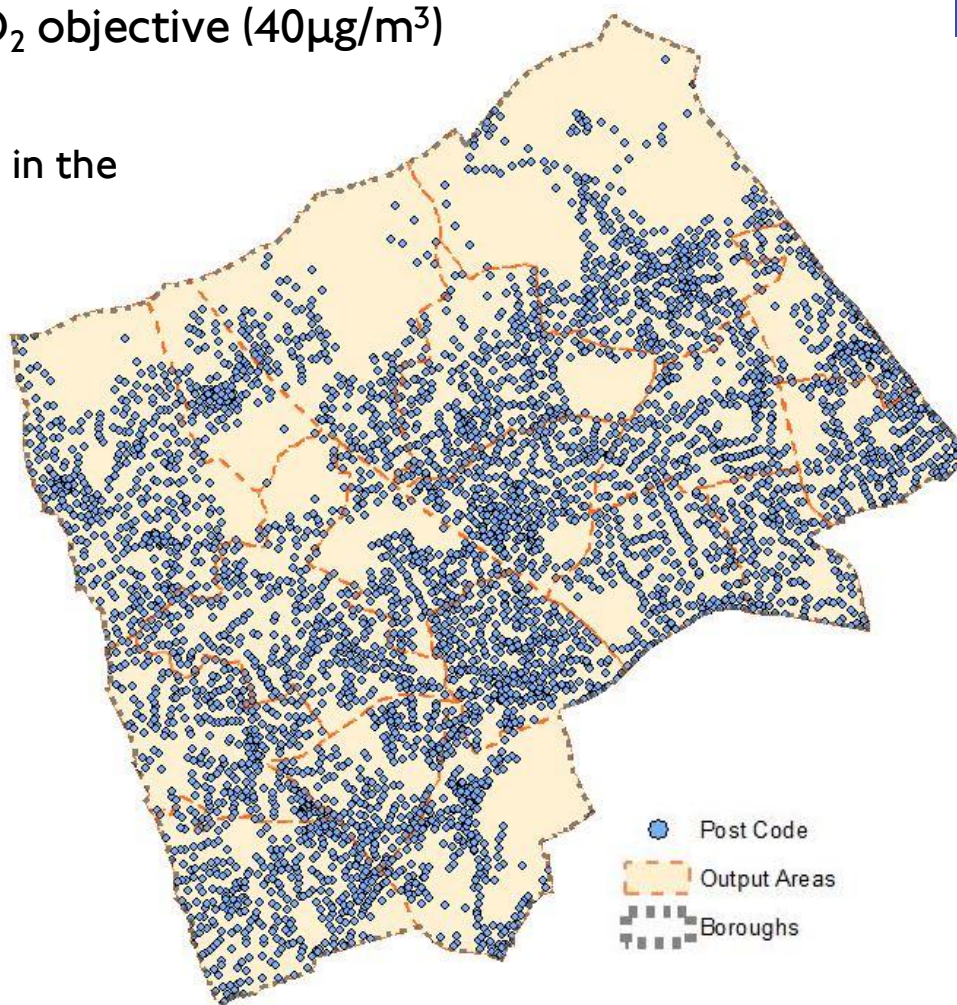
- Table showing 'Total borough population', 'population in areas of exceedance' and '% population in areas of exceedance'

6. LLAQM Package – Population Exposure Analysis

Number of people living in areas exceeding the annual mean NO_2 objective ($40\mu\text{g}/\text{m}^3$)

Eg. Population analysis in the borough of Harrow

Inputs

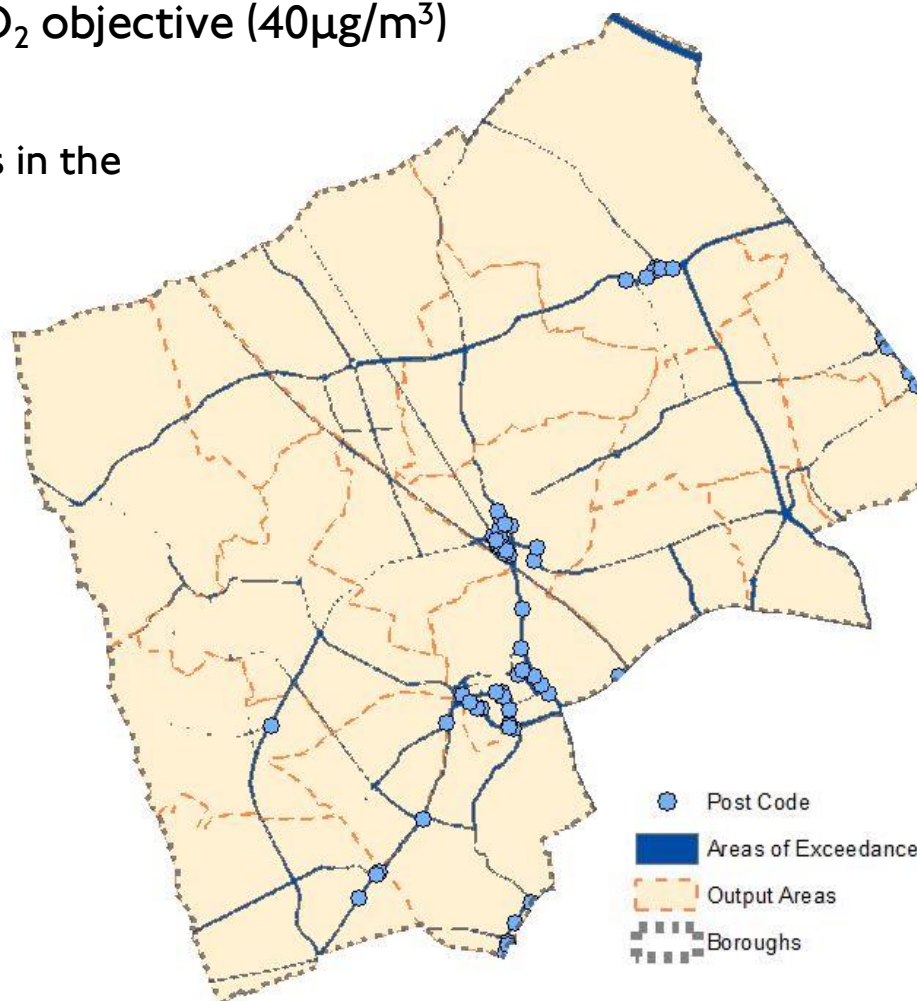


6. LLAQM Package – Population Exposure Analysis

Number of people living in areas exceeding the annual mean NO_2 objective ($40\mu\text{g}/\text{m}^3$)

Eg. Population analysis in the borough of Harrow

Procedure



6. LLAQM Package – Population Exposure Analysis

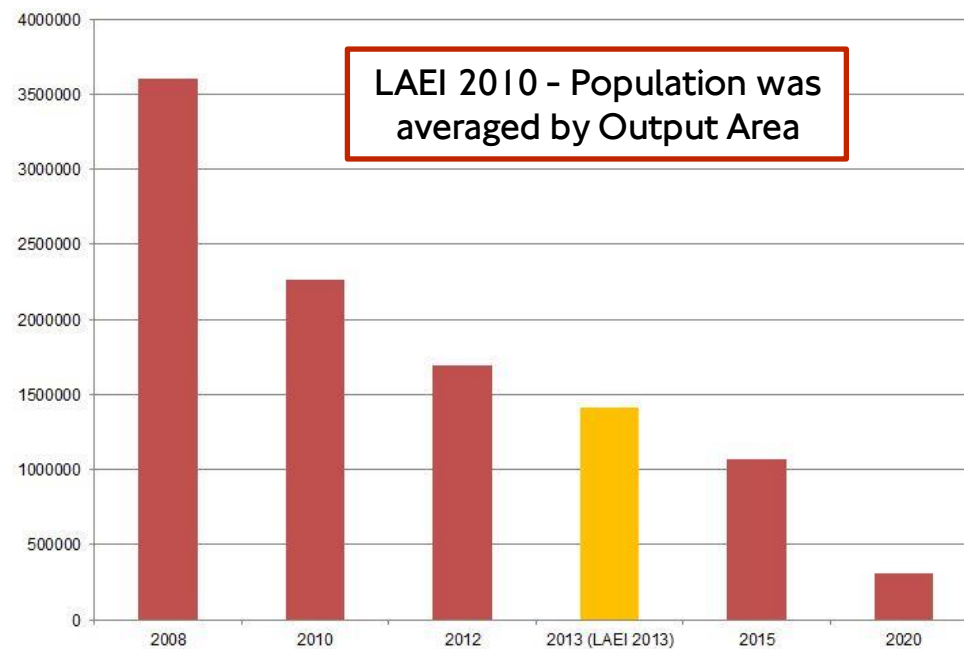
Output

List of Boroughs which intersect the 40 or above	Population per Borough	Population over 40 per Post Code	% Population in the Borough over 40ug/m ³
Borough Name	BoroughPop2013	LTSPop13PostCode	PopExc2013 %
Barking & Dagenham	192250	2373	1.23
Barnet	366623	22185	6.05
Bexley	233842	3674	1.57
Brent	316010	14335	4.54
Bromley	313411	18186	5.80
Camden	222722	124234	55.78
City of London	7612	7612	100.00
Croydon	368576	14112	3.83
Ealing	342822	4137	1.21
Enfield	315070	7854	2.49
Greenwich	262753	11036	4.20
Hackney	250699	52897	21.10
Hammersmith & Fulham	185380	71782	38.72
Haringey	259915	26726	10.28
Harrow	242373	6398	2.64
Havering	241947	1081	0.45
Hillingdon	279267	16887	6.05
Hounslow	257229	14385	5.59
Islington	210658	123719	58.73
Kensington & Chelsea	159956	135228	84.54
Kingston upon Thames	162380	12145	7.48
Lambeth	309269	105307	34.05
Lewisham	281706	28329	10.06
Merton	202493	1123	0.55
Newham	319471	38949	12.19
Redbridge	284759	13306	4.67
Richmond upon Thames	189033	24694	13.06
Southwark	295570	131683	44.55
Sutton	192618	7260	3.77
Tower Hamlets	263987	107602	40.76
Waltham Forest	263262	17248	6.55
Wandsworth	313200	63001	20.12
Westminster	223046	185080	82.98

6. LLAQM Package – Population Exposure Analysis

LAEI 2010 Analysis						
Local Authority name	2008	2010	2012	2013 (LAEI 2013)	2015	2020
Barking and Dagenham	27,000	4,000	-	2373	-	-
Barnet	58,000	30,000	14,000	22185	2,000	-
Bexley	5,000	1,000	-	3674	-	-
Brent	166,000	84,000	49,000	14335	21,000	-
Bromley	2,000	-	-	18186	-	-
Camden	214,000	192,000	164,000	124234	125,000	49,000
City of London	7,000	7,000	7,000	7612	7,000	7,000
Croydon	41,000	8,000	4,000	14112	-	-
Ealing	141,000	68,000	46,000	4137	35,000	-
Enfield	31,000	5,000	2,000	7854	-	-
Greenwich	90,000	38,000	13,000	11036	3,000	-
Hackney	220,000	154,000	99,000	52897	40,000	7,000
Hammersmith and Fulham	182,000	143,000	81,000	71782	57,000	5,000
Haringey	121,000	32,000	13,000	26726	4,000	-
Harrow	-	-	-	6398	-	-
Havering	-	-	-	1081	-	-
Hillingdon	26,000	4,000	-	16887	-	-
Hounslow	76,000	29,000	19,000	14385	5,000	-
Islington	205,000	175,000	146,000	123719	99,000	39,000
Kensington and Chelsea	159,000	159,000	149,000	135228	118,000	17,000
Kingston upon Thames	11,000	3,000	-	12145	-	-
Lambeth	268,000	178,000	137,000	105307	61,000	15,000
Lewisham	150,000	64,000	31,000	28329	4,000	-
Merton	39,000	-	-	1123	-	-
Newham	224,000	66,000	38,000	38949	19,000	-
Redbridge	36,000	12,000	5,000	13306	3,000	-
Richmond upon Thames	38,000	1,000	-	24694	-	-
Southwark	278,000	221,000	176,000	131683	115,000	36,000
Sutton	-	-	-	7260	-	-
Tower Hamlets	254,000	245,000	208,000	107602	139,000	59,000
Waltham Forest	84,000	23,000	12,000	17248	2,000	-
Wandsworth	230,000	108,000	82,000	63001	41,000	2,000
Westminster	219,000	211,000	200,000	185080	171,000	73,000
TOTAL	3,602,000	2,265,000	1,695,000	1,414,570	1,071,000	309,000

LAEI 2013 vs LAEI 2010



LAEI 2013 - Population now apportioned according to Post Code point data
→ More accurate

A background collage of various transport icons in shades of grey, including a Formula 1 car, a delivery van, a bus, a truck, a car, a sedan, a pickup truck, a minivan, a car with a bicycle rack, a motorcycle, a long bus, a car with a bike rack, a car, a large truck, a van, a truck, and a truck.

Thank you!

PaulaMartin@tfl.gov.uk