

CIBSE BSG

Designing for Better Indoor Environmental Quality Buildings:
A Mixed-Mode Office Building with Exemplary IEQ

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Background

Exposure to Air Pollutants

Air Quality Analysis for a Mixed-Mode Building

Summary

Background - Case study

- Office development in Kings Cross
- Floor area: 1,000,000 ft²
- 10 floors
- Client willing to push boundaries



Background - Client Targets

“Optimising capital and innovation to create a highly flexible, productive and healthy working environment, with low long-term operating costs and the smallest possible environmental impact”

“Environmental performance beyond anything else happening today or planned for tomorrow”



‘Aim: Outstanding’

- Representative of top 1% of non-domestic building stock
- > 85% total credits
- > 40% better than Part L as a minimum standard



‘Aim: Platinum’

- > 80% total credits
- Aiming for ~28% better than ASHRAE 90.1-2007 energy standard

Energy v's Indoor Environmental Quality

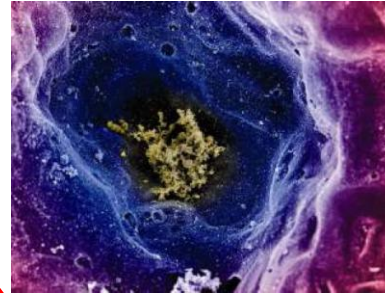
Mixed-mode



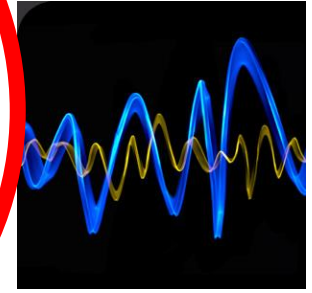
V's

Issues to consider

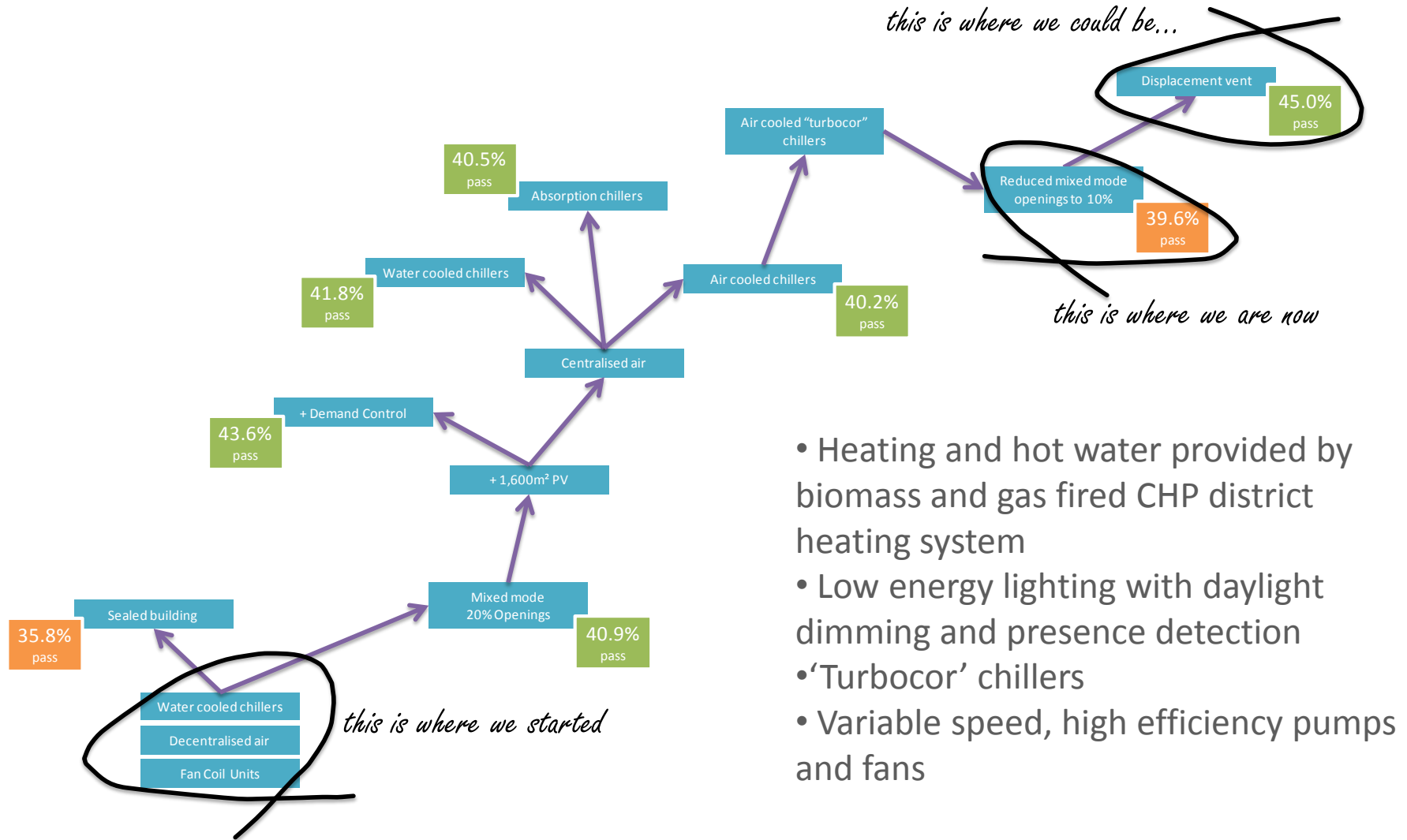
Air Quality



Acoustics



Other issues: Control scheme, Air tightness, Architectural considerations, Facade access, Maintenance, Cost and Complexity, etc.



AIR QUALITY

Concentration of
pollutants



Length of
exposure

(one without the other is meaningless)

Pollutant	Concentration Limit	Measured as..
Nitrogen Dioxide (NO ₂)	40 µg/m ³	Annual average
	200 µg/m ³	1 hour average
Particles (PM ₁₀)	40 µg/m ³	Annual average
	50 µg/m ³	24 hour mean
Ultra-Fine Particles (PM _{2.5})	25 µg/m ³	Annual average
Sulphur Dioxide (SO ₂)	125 µg/m ³ three times per annum	24 hour mean

NO₂ Standards

Standard	Limit (µg/m ³)	Measurement period
UK Air Quality Standard	40	Annual average (long-term)
	200 (not to be exceeded more than 18 times per year)	Hourly average (short-term)
European Union Standard	as above	
World Health Organisation	40	Annual average (long-term)
	200	98 th percentile averaged over 3 years
California Ambient Air Quality Standard	60	Annual average (long-term)
	360	Hourly average (short-term)
Historical Client Operational Performance Requirement (OPR)	40	Annual average (long-term)
	200	Hourly average (short-term)

PM₁₀ Standards

Standard	Limit (µg/m ³)	Measurement period
UK Air Quality Standard	40	Annual average (long-term)
	50 (not to be exceeded more than 35 times per year)	24-hour average (short-term)
European Union Standard	as above	
World Health Organisation	20	Annual average (long-term)
	50	24-hour average (short-term)
California Ambient Air Quality Standard	20	Annual average (long-term)
	50	24-hour average (short-term)
Historical Client Operational Performance Requirement (OPR)	20	Annual average (long-term)
	50	24-hour average (short-term)

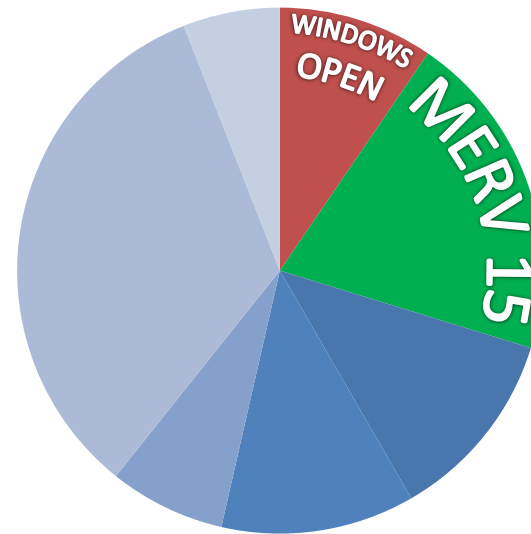
PM_{2.5} Standards

Standard	Limit (µg/m³)	Measurement period
UK Air Quality Standard	25	Annual average (long-term) to be achieved by 2015
World Health Organisation	10	Annual average (long-term)
	25	24-hour average (short-term)
California Ambient Air Quality Standard	12	Annual average (long-term)
Historical Client Operational Performance Requirement (OPR)	10	Annual average (long-term)
	25	24-hour average (short-term)

Exposure to Air Pollutants



Approx 30% of our annual exposure is at work



for roughly 1/3 of that time the windows will be open....

...for the other 2/3 of that time the air quality will be very highly controlled

- CitySorb: 90% removal efficiency for NO₂
- 95% removal efficiency of PM₁₀

Carbon and Chemical Filters
Compact Carbon Filter
CitySorb



Advantages

- Range of standard sizes
- Rigid design concept
- High efficiency
- Large air flow capacity

Application: Adsorption of odours and gases in air conditioning applications.
Type: Rigid pleated filter.
Case: Polypropylene.
Media: Multi-layered carbon.
Sealant: Polyurethane.
Separation: Pleated.

Bag and Compact Filters, Class F5 to F9
Bag Filters Glass Fibre
Hi-Flo® U-Series



Advantages

- Large surface area
- Comprehensive range of standard sizes
- Robust construction
- Controlled media spacing
- High dust holding capacity
- Certified performance

Application: Comfort air conditioning applications, pre filter applications.
Type: Multi pocket bag filter.
Case: Galvanneal steel.
Media: Glass Fibre.
EN 178-2002 efficiency: F5 (40-50%), F6 (55-60%), F7 (60-80%), F8 (90-95%), F9 (95-99%)
EN 178-2002 efficiency: E10, E16, E17, E18.
Eurovent 4/5 efficiency: 450 Pa (suggested economical charge point 250 Pa)
Recommended final pressure drop: 450 Pa (suggested economical charge point 250 Pa)
Temperature: 70°C maximum in construction services.
Holding frames: Front and side access housings and frames are available, Type B, Type L, and FC Housings.

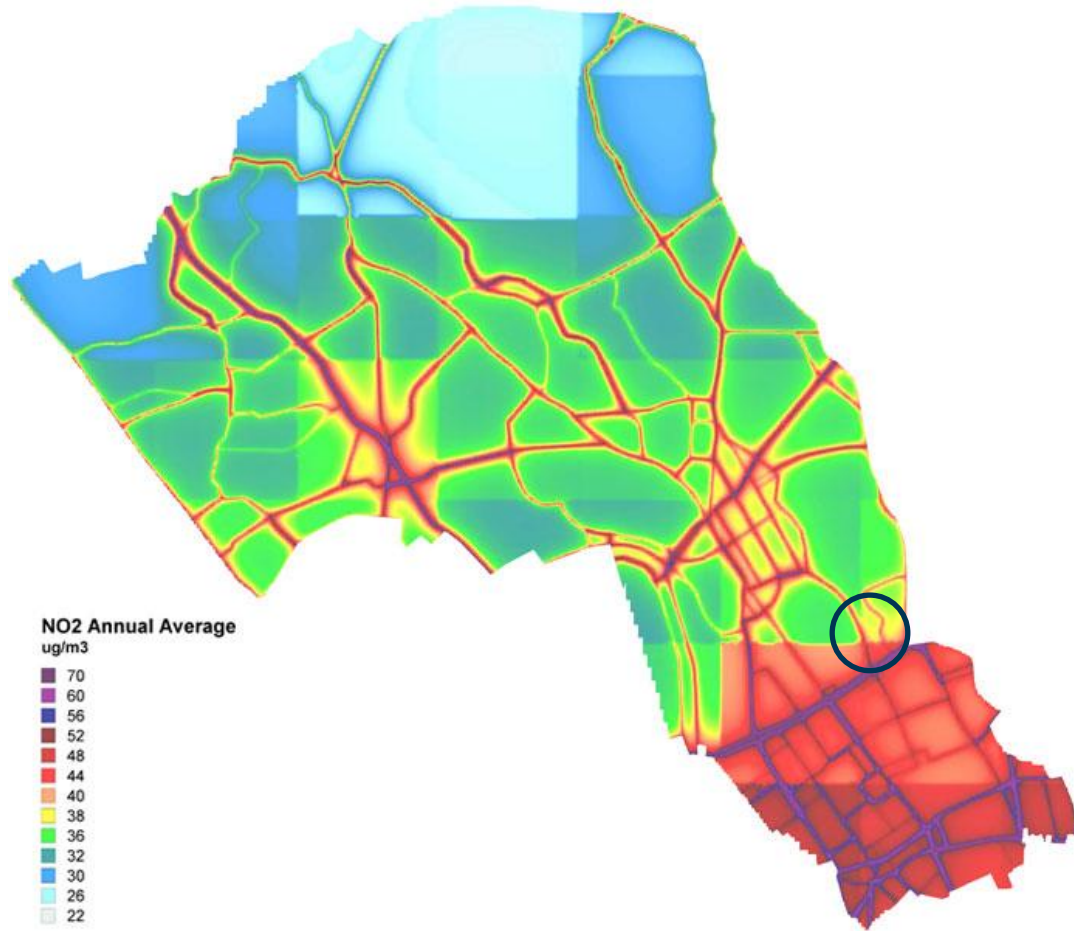
ENERGY & AIR QUALITY RATING

Reference	Type	Media	Dimensions (mm)	Filtration efficiency (%) EN 178-2002	Number of pockets	Media area (m ² /m ³)	Flow resistance (Pa/m ³)	Unit weight (kg/m ³)	Unit volume (m ³ /m ²)	Energy factor
*2000000U	H-Flo	*3U-4000000000	502x502x400	F5	8	6.0	340050	2.8	0.05	C
*2000000U	H-Flo	*3U-4000000000	502x502x380	F5	6	4.6	280550	2.4	0.05	C
*2000000U	H-Flo	*3U-4000000000	400x502x400	F5	6	2.9	220550	1.9	0.05	C
*2000000U	H-Flo	*3U-4000000000	400x502x380	F5	4	1.9	130075	1.6	0.03	C
*2000000U	H-Flo	*3U-4000000000	287x502x400	F5	4	1.9	130075	1.6	0.03	C
*2000000U	H-Flo	*3U-4000000000	287x502x380	F5	3	1.4	90050	1.2	0.03	C
*2000000U	H-Flo	*3U-4000000000	287x502x400	F6	8	3.8	210080	2.4	0.05	B
*2000000U	H-Flo	*3U-4000000000	287x502x380	F6	6	2.9	160060	1.9	0.05	B
*2000000U	H-Flo	*3U-4000000000	287x502x400	F7	4	2.0	110040	1.4	0.03	B
*2000000U	H-Flo	*3U-4000000000	287x502x380	F7	4	1.9	100030	1.4	0.03	B
*2000000U	H-Flo	*3U-4000000000	287x502x400	F8	4	1.9	100030	1.4	0.03	B
*2000000U	H-Flo	*3U-4000000000	287x502x380	F8	4	1.9	100030	1.4	0.03	B
*2000000U	H-Flo	*3U-4000000000	287x502x400	F9	4	1.9	100030	1.4	0.03	B
*2000000U	H-Flo	*3U-4000000000	287x502x380	F9	4	1.9	100030	1.4	0.03	B

camfil
Knolesley Road, Haslingden, Lancashire, BB4 4EG
Tel: +44 (0) 1706 238000, Fax: +44 (0) 1706 226730
www.camfilair.co.uk

Concentration of Pollutants

Nitrogen Dioxide - Camden

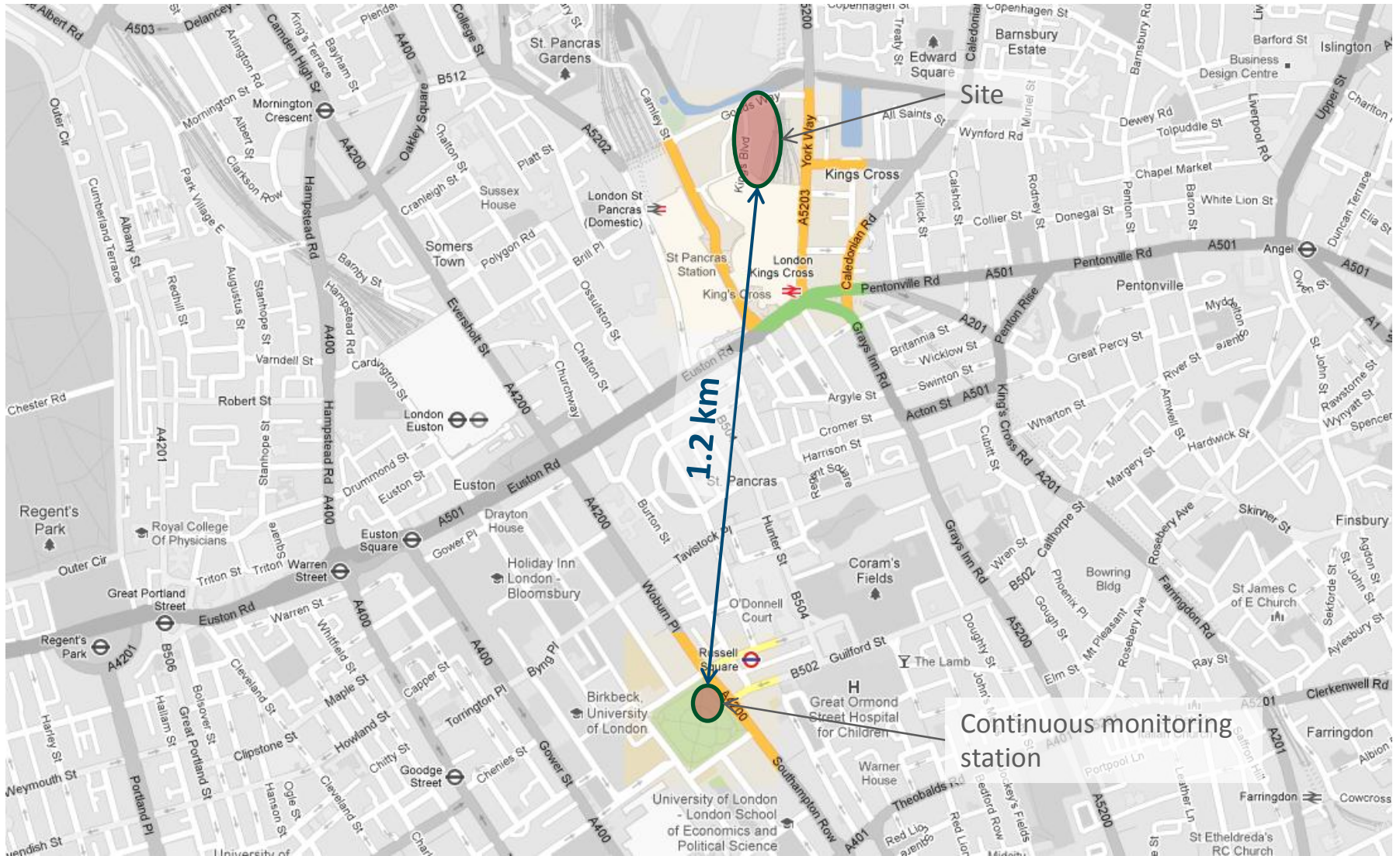


Concentration of Pollutants

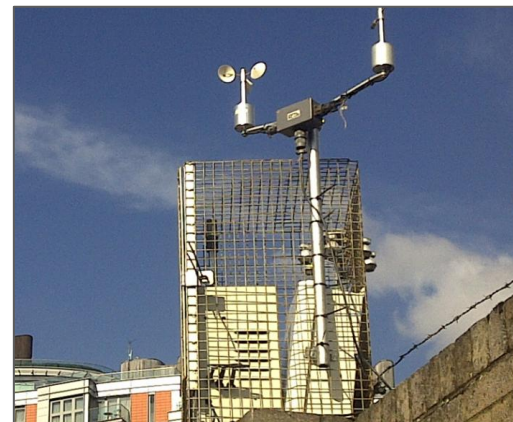
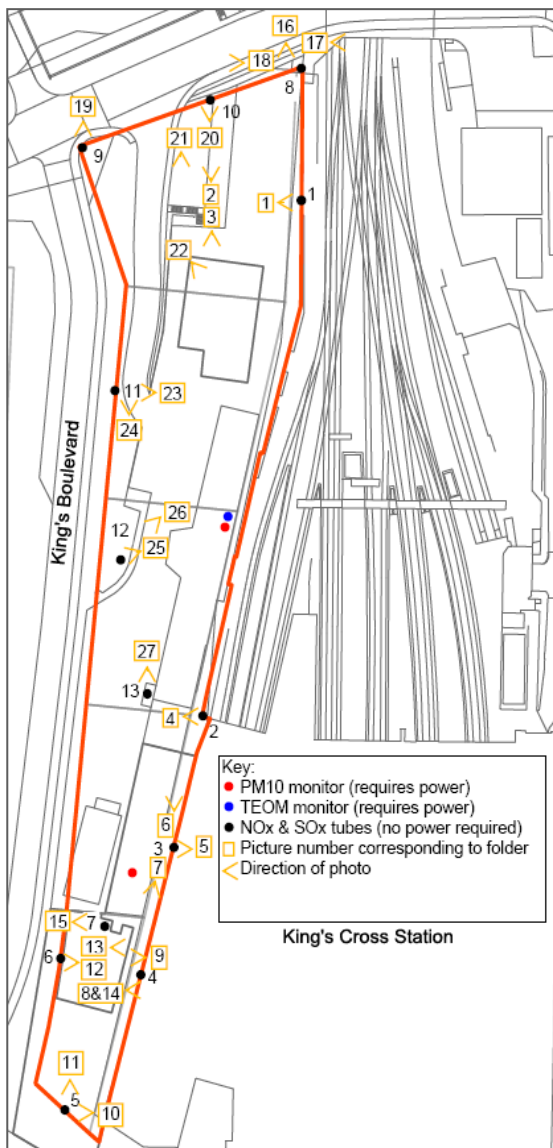
PM₁₀ Particulate Matter - Camden



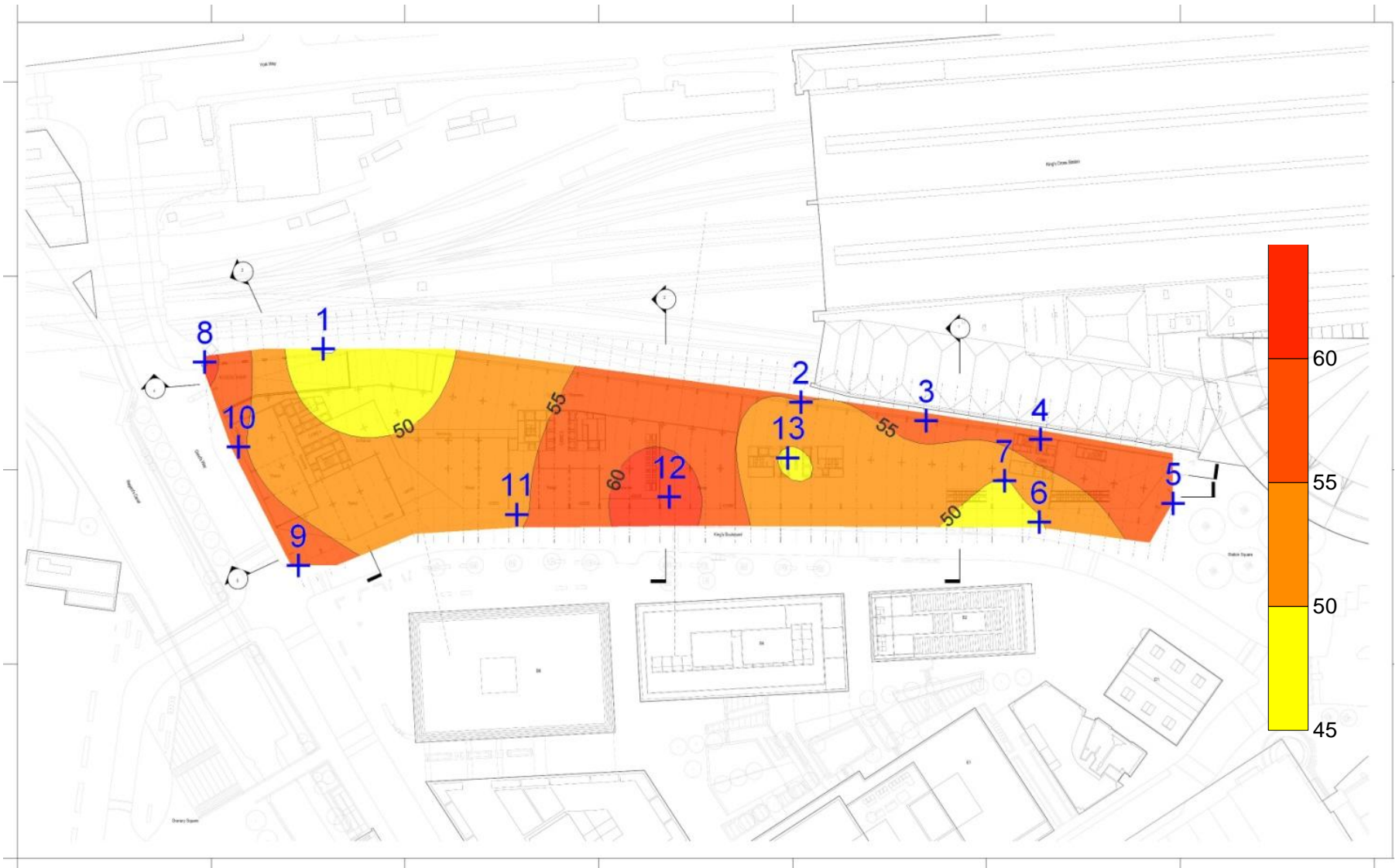
Nearby Monitoring Station



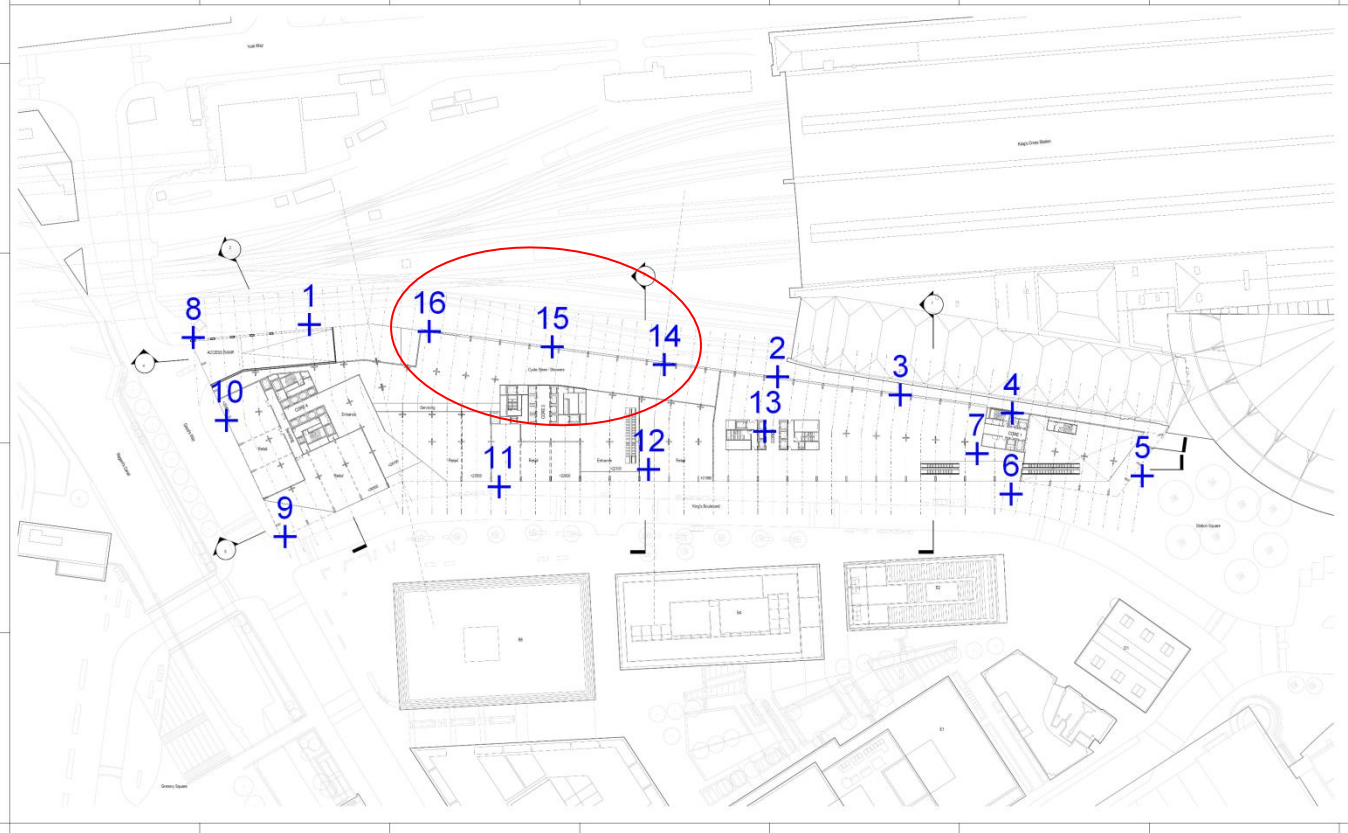
Onsite Monitoring



Monitoring Results – NO2



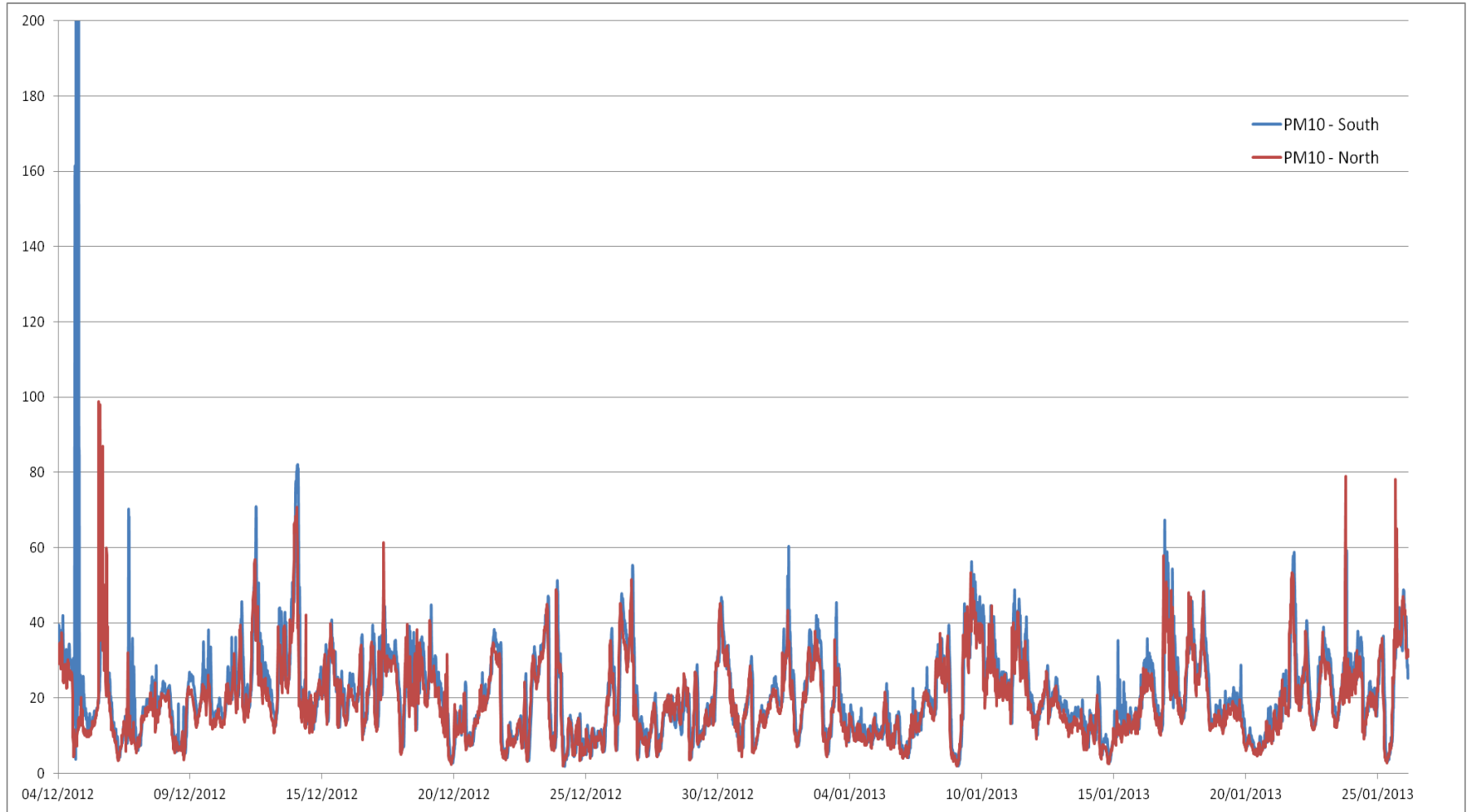
Monitoring Results – SO2



Location	SO2 Average (µg/m³)
1	1.5
2	1.2
3	1.1
4	1.2
5	1.2
6	1.1
7	1.0
8	4.1
9	1.7
10	2.2
11	1.2
12	1.2
13	1.2
14	1.7
15	1.3
16	1.2
Average:	1.5

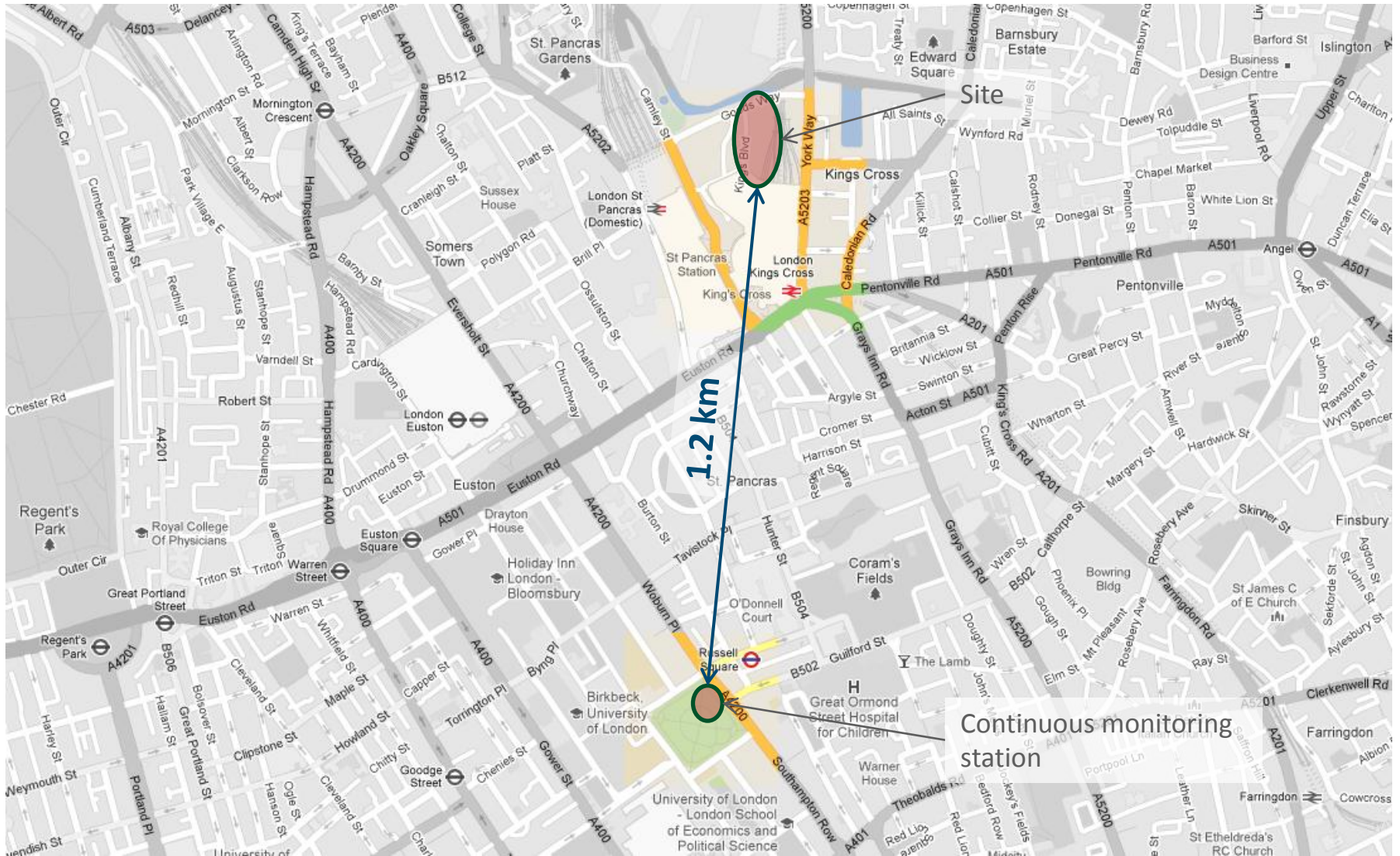
	Oct-12	Nov-12	Dec-12	Jan-13	AQLV
15-min Peak	14	18	19	33	266
1-hour Peak	8	11	11	20	350
24-hour Peak	3	4	4	7	125

Monitoring Results – PM10



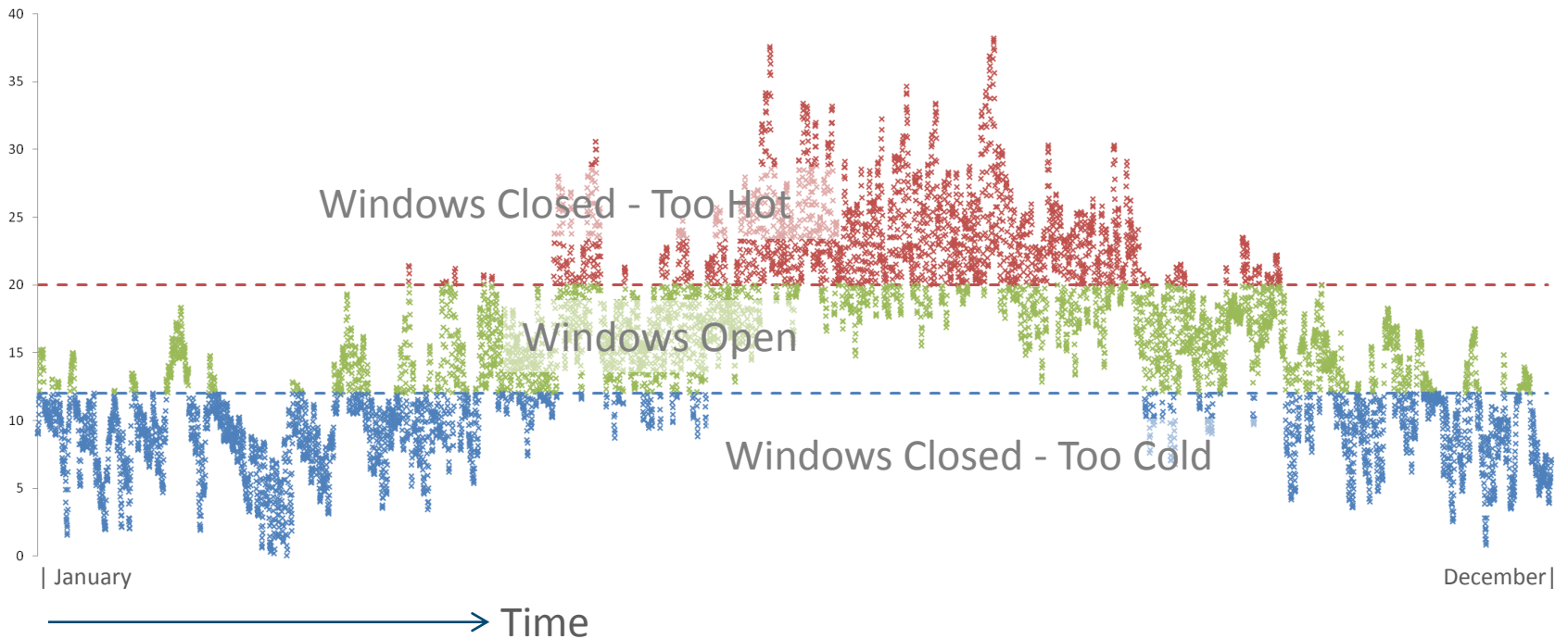
Can we achieve *good air quality* levels within a
mixed-mode building in central London?

Air Quality Analysis for a Mixed-Mode Building



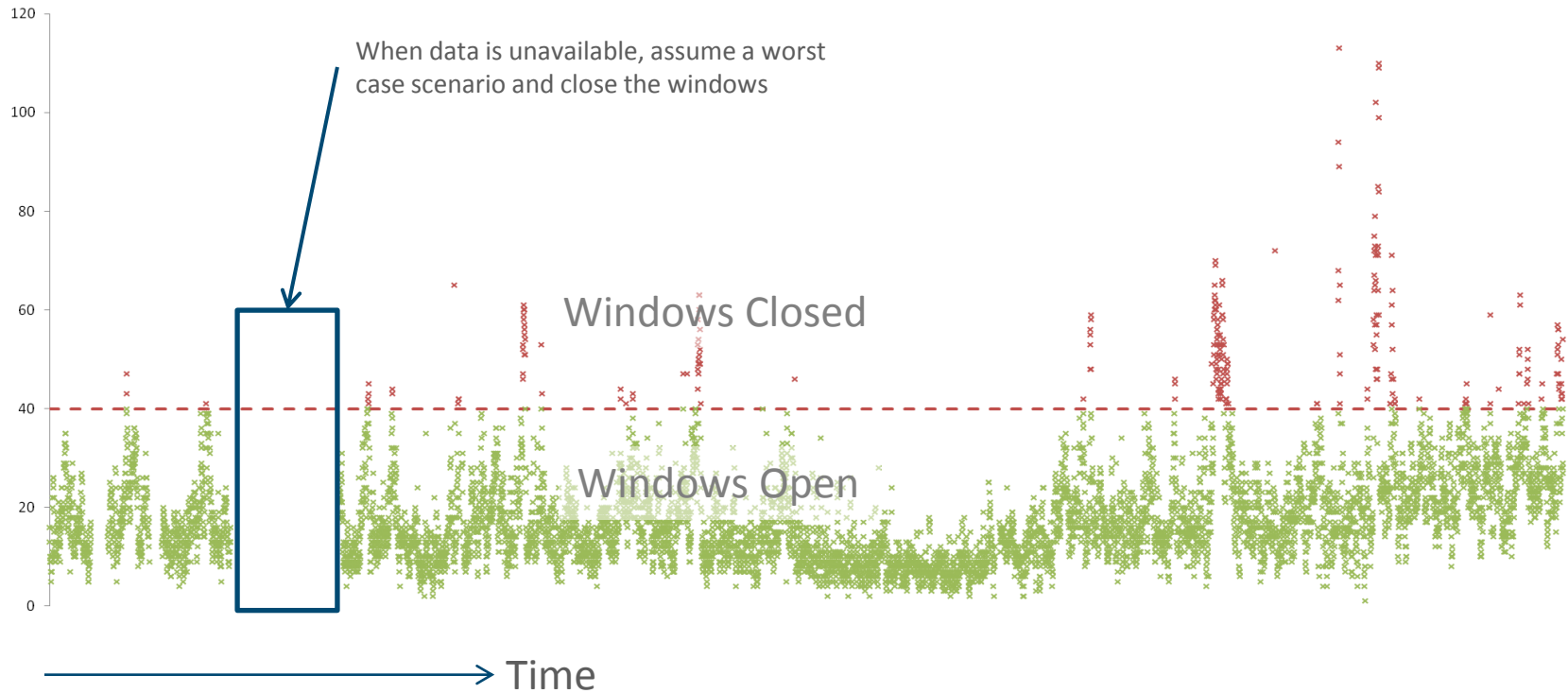
Air Quality Analysis for a Mixed-Mode Building

Temperature



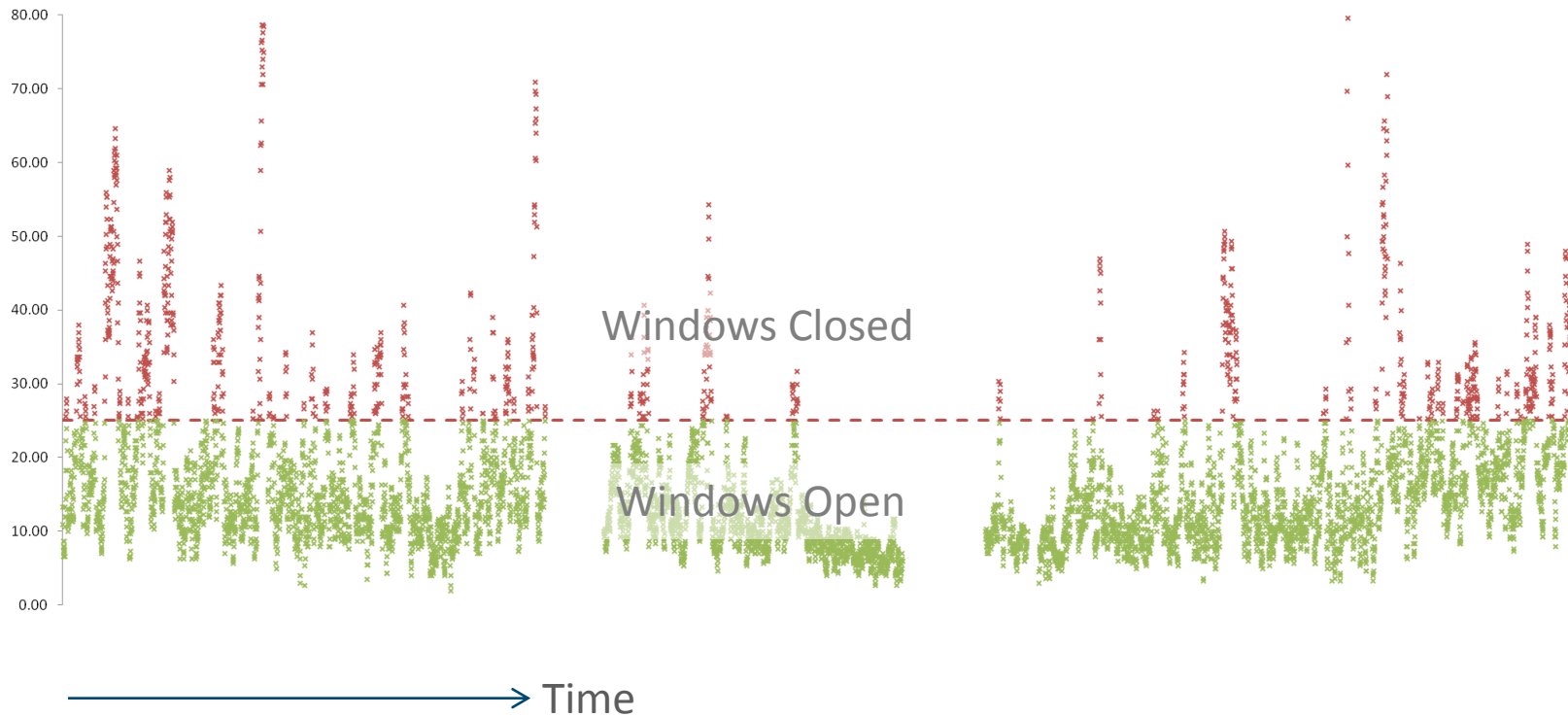
Air Quality Analysis for a Mixed-Mode Building

PM₁₀



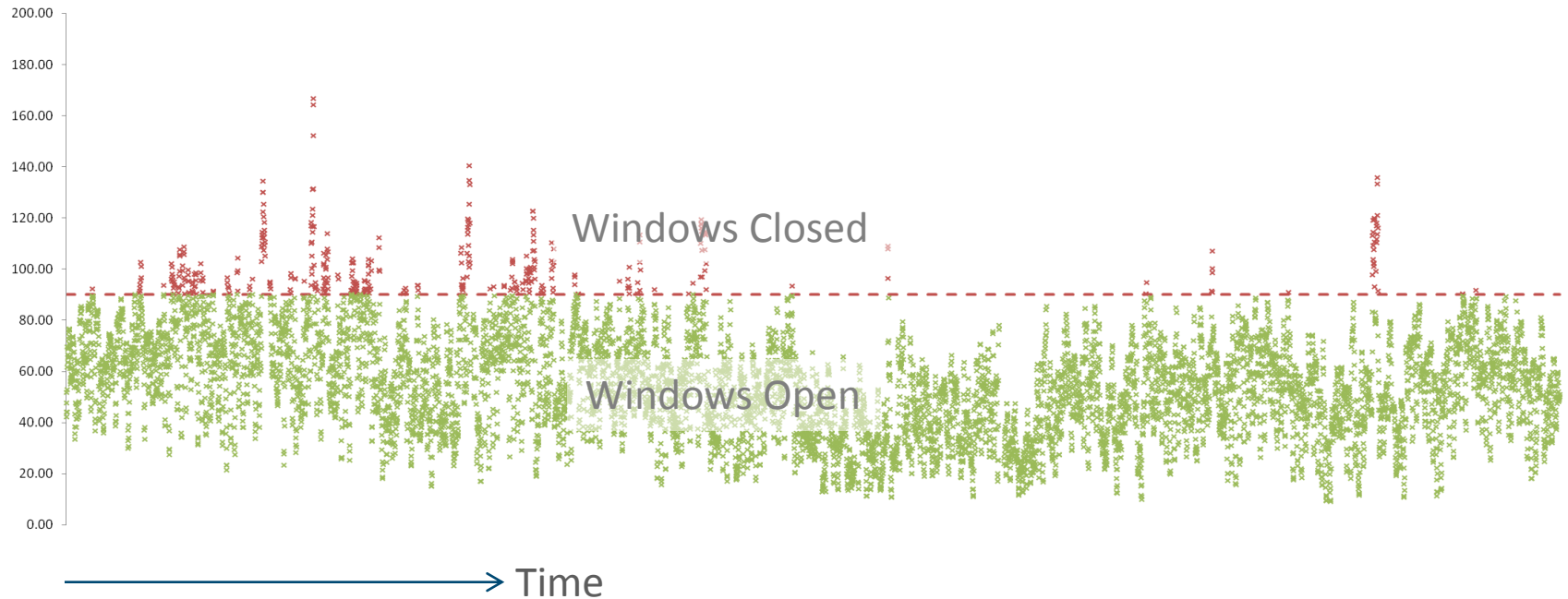
Air Quality Analysis for a Mixed-Mode Building

PM_{2.5}

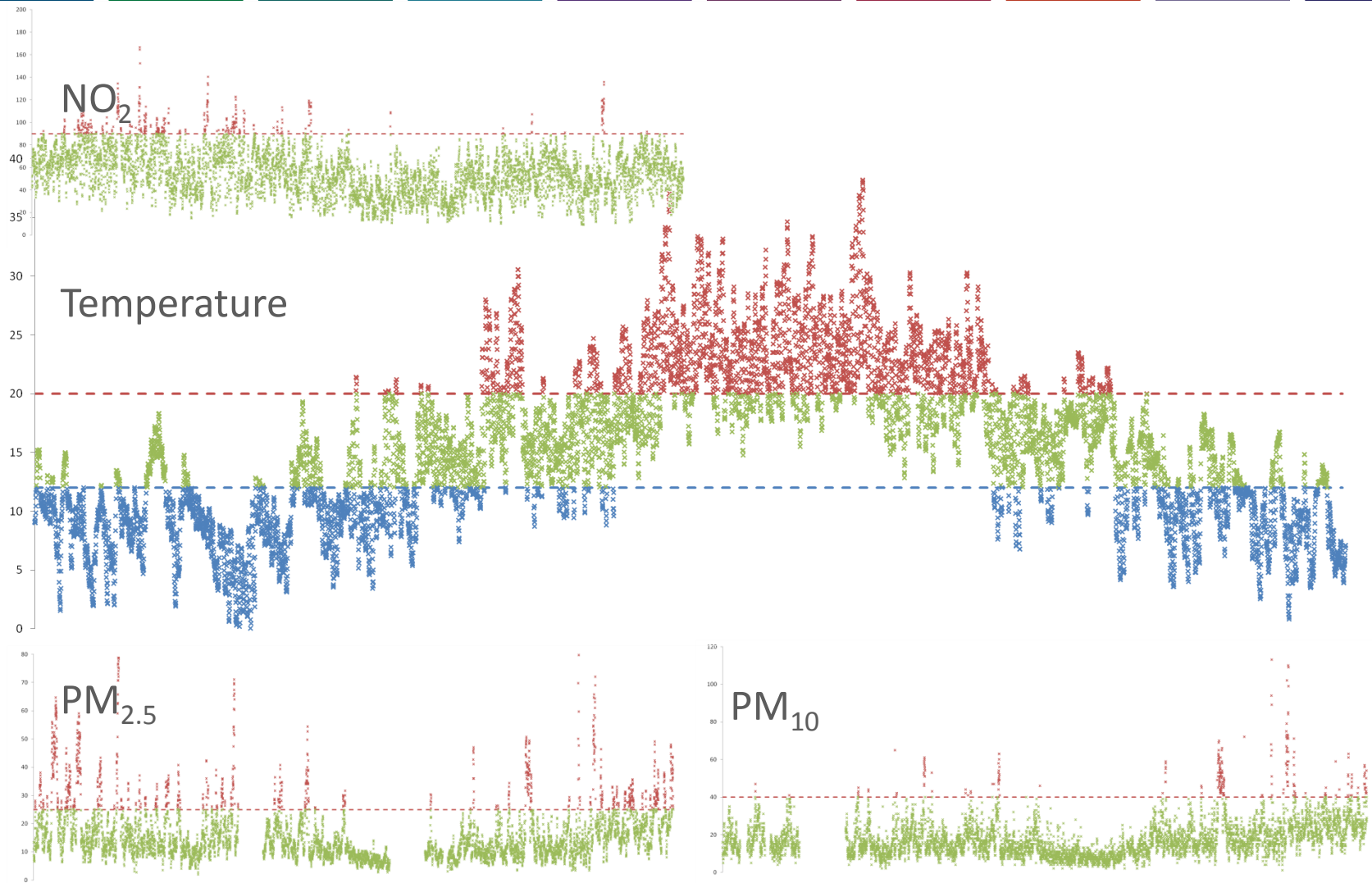


Air Quality Analysis for a Mixed-Mode Building

NO₂

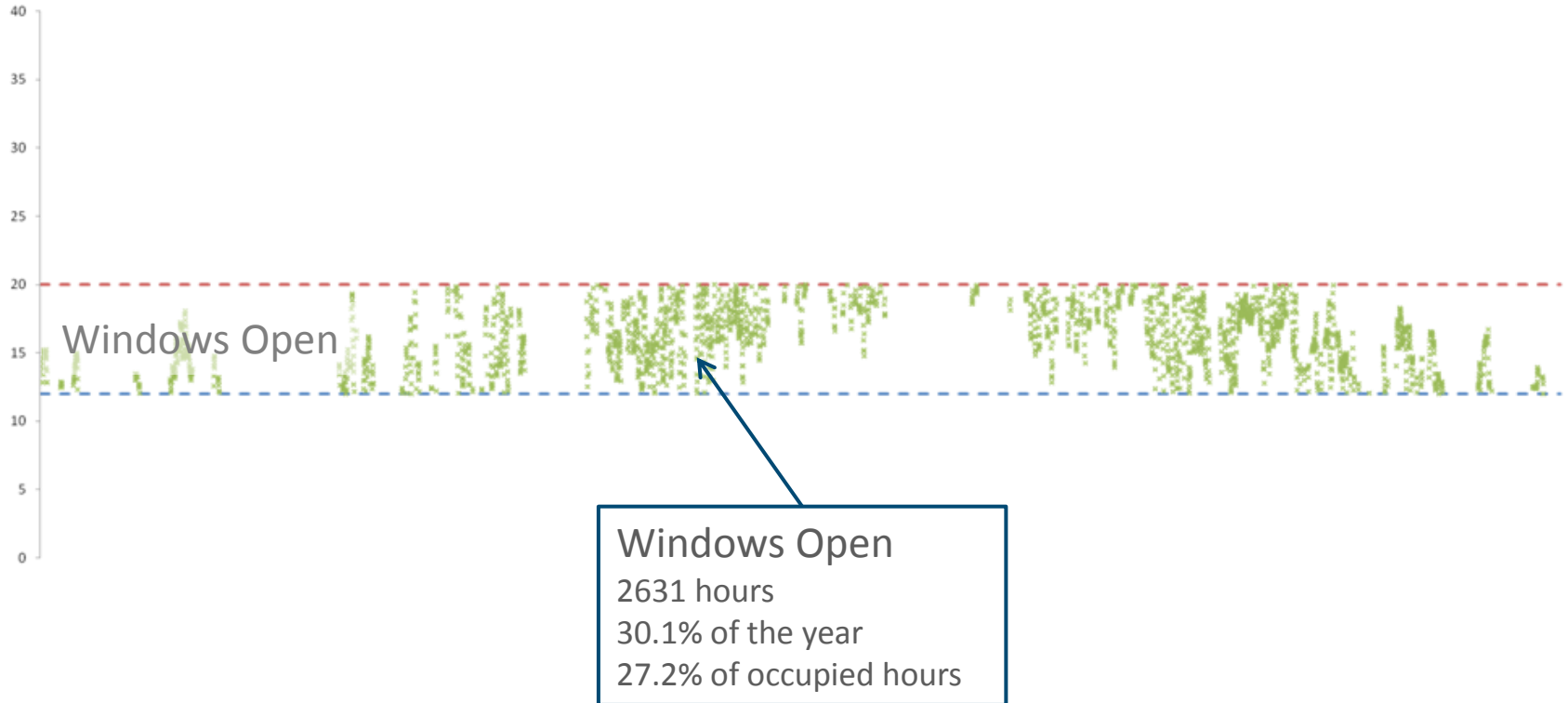


Air Quality Analysis for a Mixed-Mode Building



Air Quality Analysis for a Mixed-Mode Building

All Parameters (Temperature + PM₁₀ + PM_{2.5} + NO₂)



Spreadsheet analysis...

	Estimated Annual Concentration ($\mu\text{g}/\text{m}^3$)	UK Limit ($\mu\text{g}/\text{m}^3$)
NO ₂	29	40
PM ₁₀	9	40
PM _{2.5}	8	25

Good air quality levels *are* achievable within a mixed-mode building in central London...
...in theory!

But is the concept of a mixed-mode building lost?

To be continued....

Any Questions?

