



AIR QUALITY ASSESSMENT READING METROPOLITAN, READING APPENDICES

REC REFERENCE: AQ104162R1

**REPORT PREPARED FOR: HERMES INVESTMENT
MANAGEMENT**

DATE: DECEMBER 2018



National Consultancy, Locally Delivered

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APPENDIX

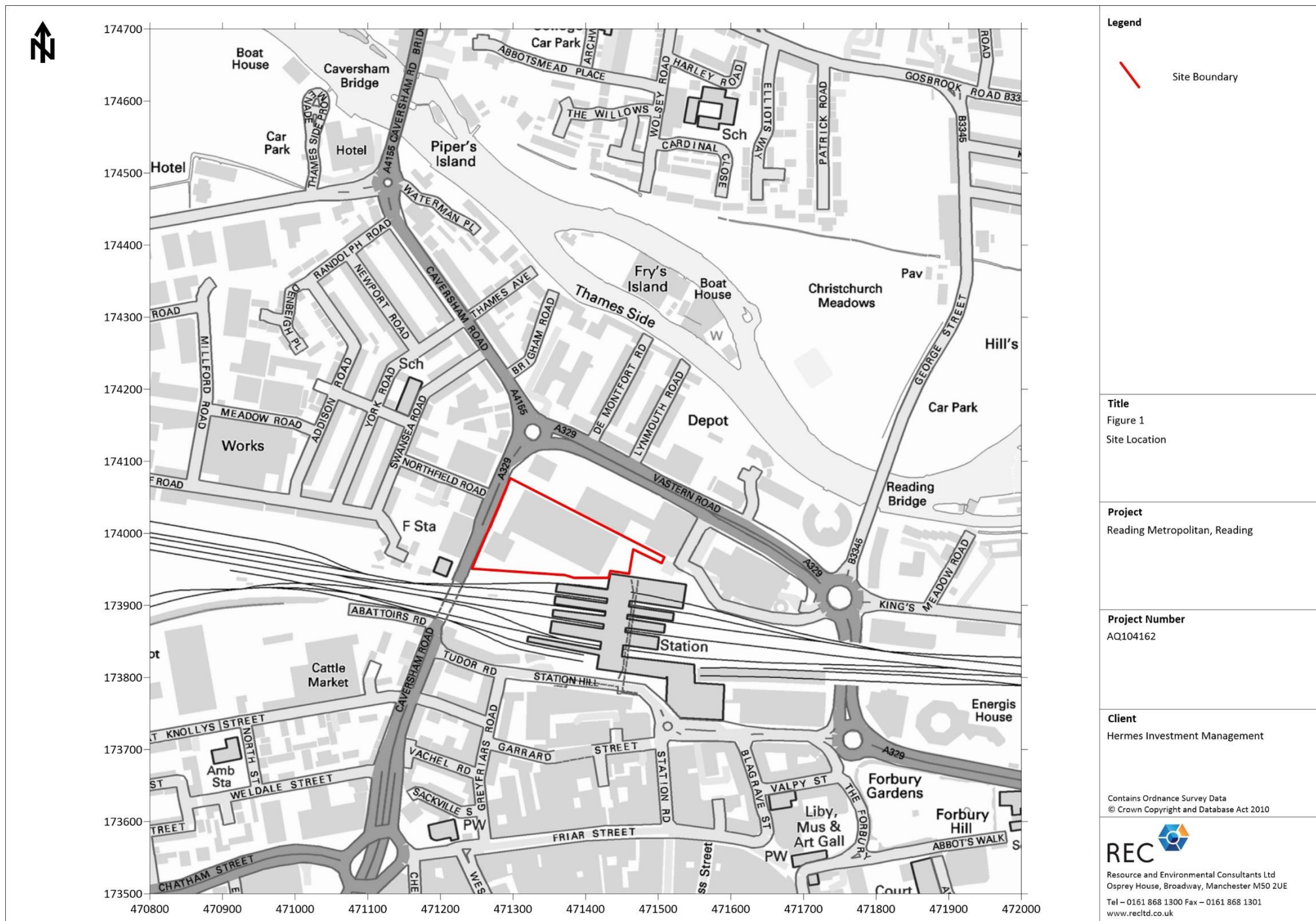
Appendix I	Figures
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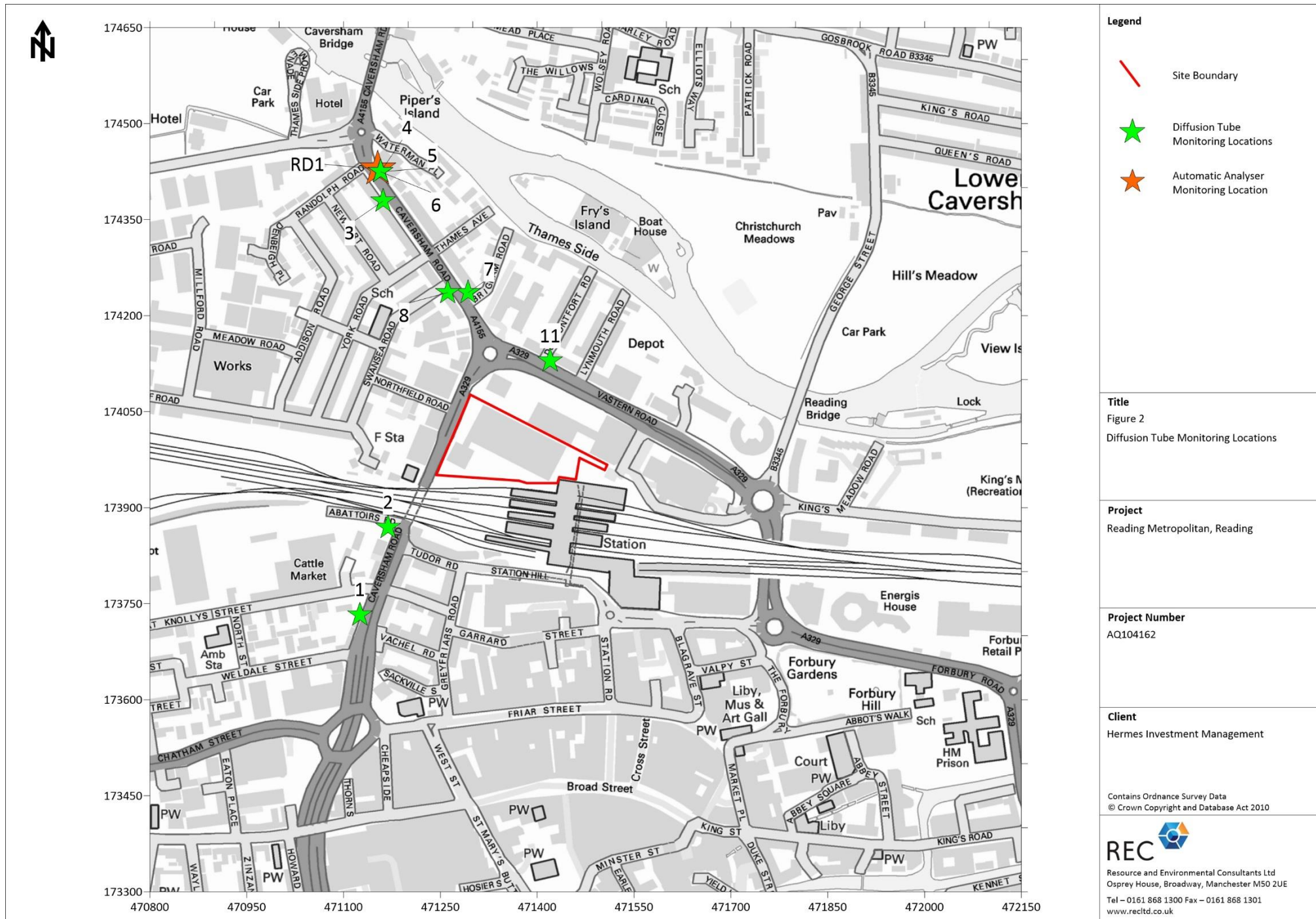


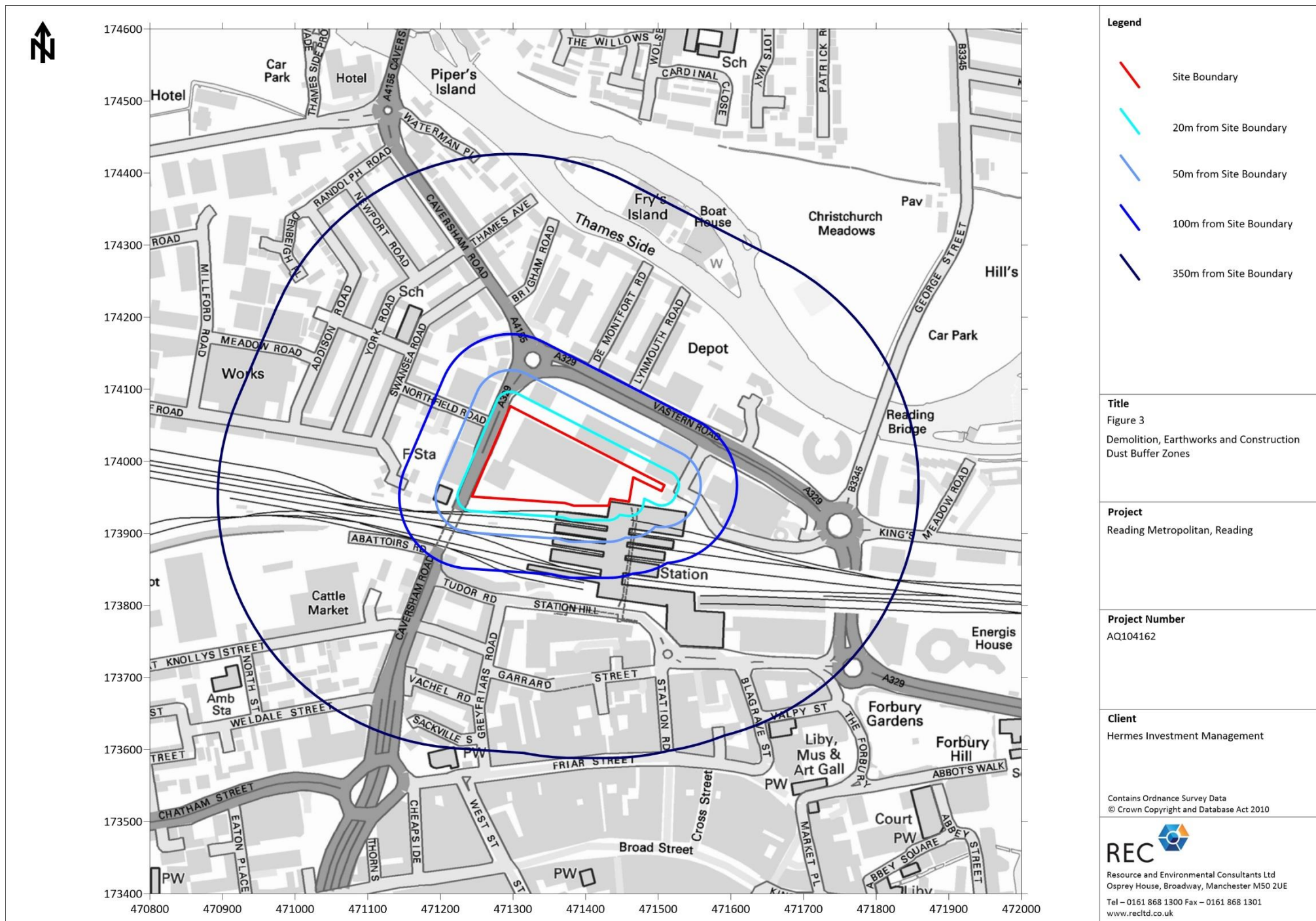


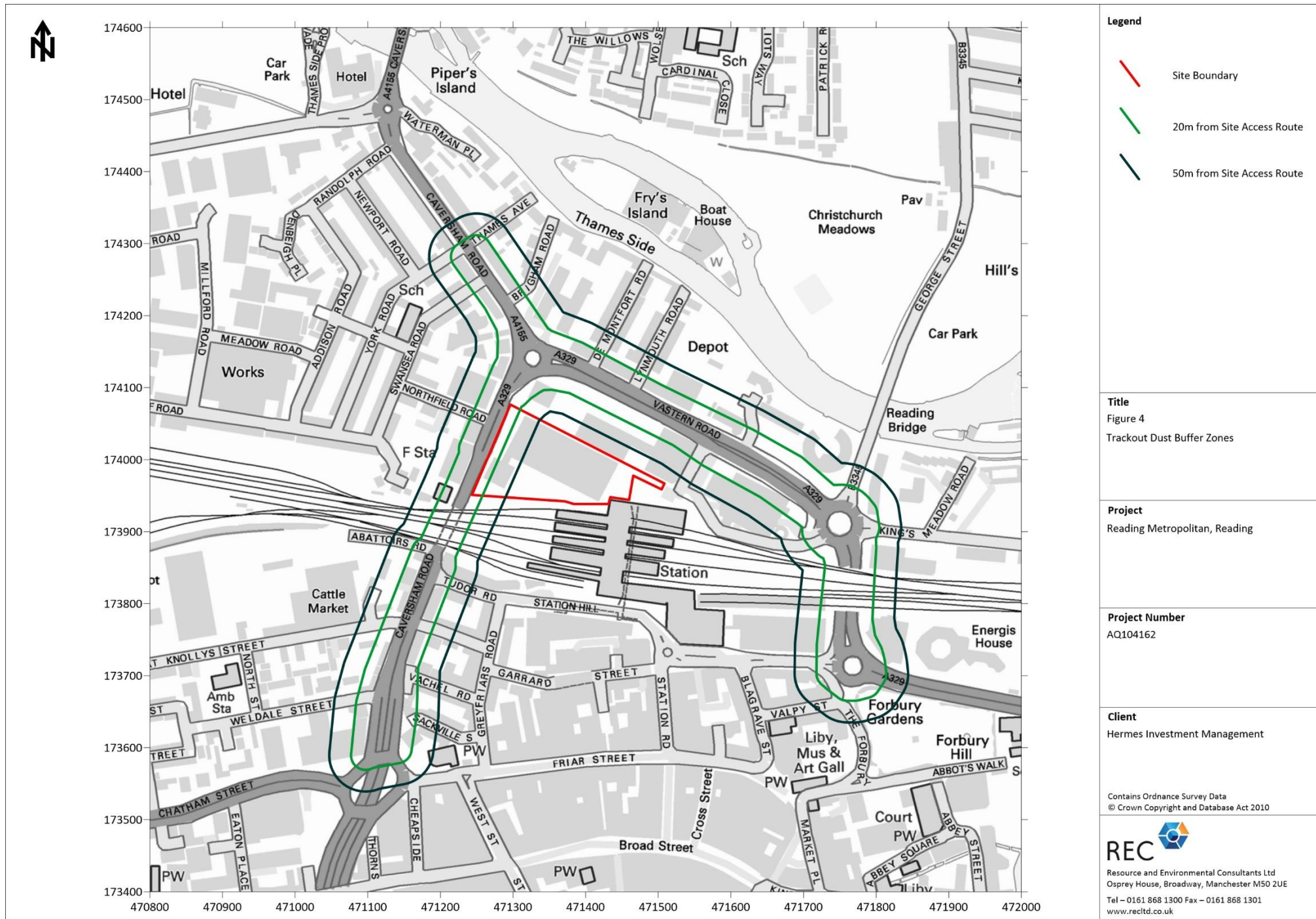
APPENDIX I - FIGURES

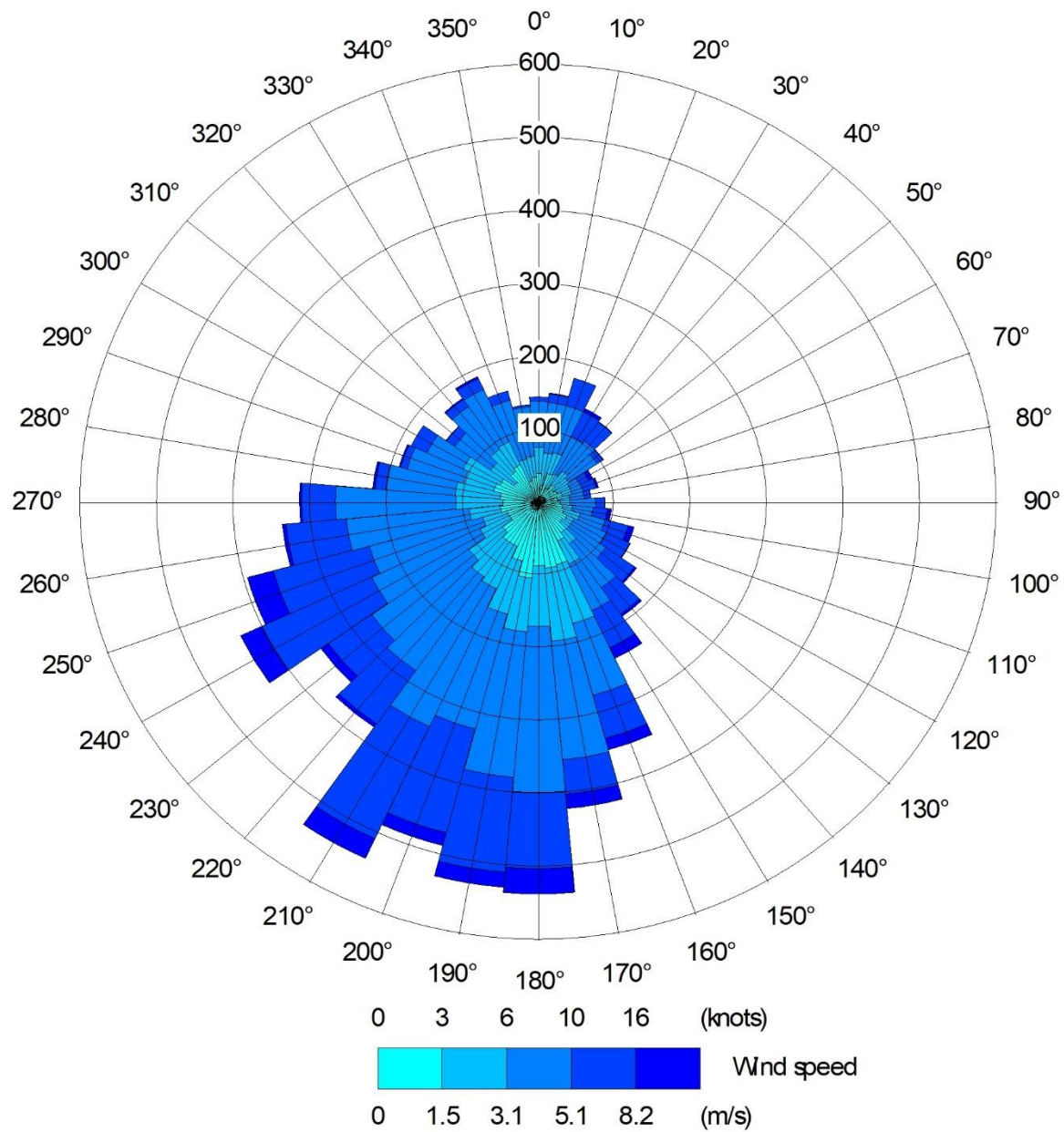












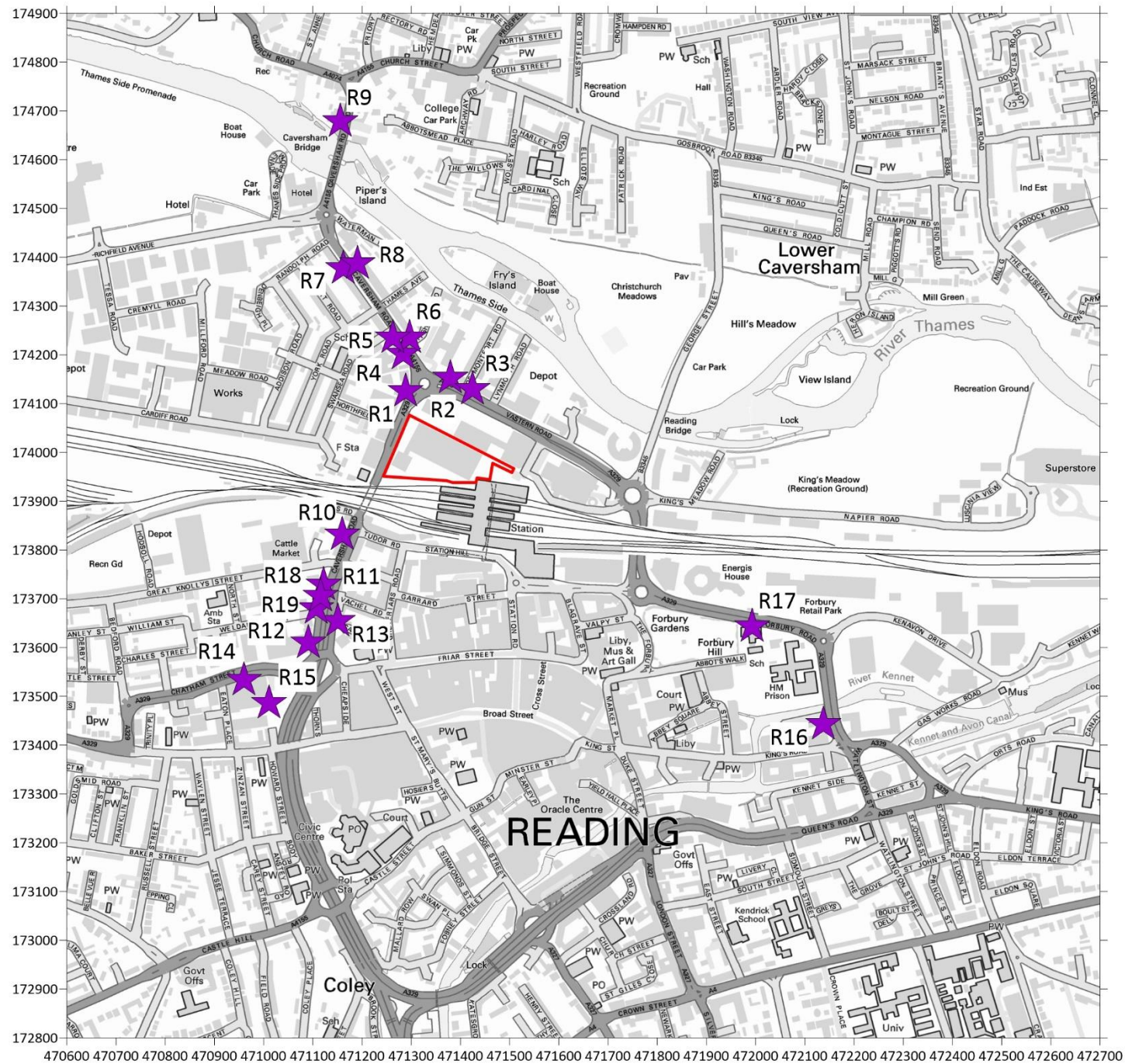
Title
Figure 5
Wind Rose
Benson Meteorological Station 2017

Project
Reading Metropolitan, Reading

Project Number
AQ104162

Client
Hermes Investment Management

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Legend

-  Site Boundary
-  Sensitive receptor

Title

Figure 6
Sensitive Receptor Locations

Project

Reading Metropolitan, Reading

Project Number

AQ104162

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Contains Ordnance Survey Data
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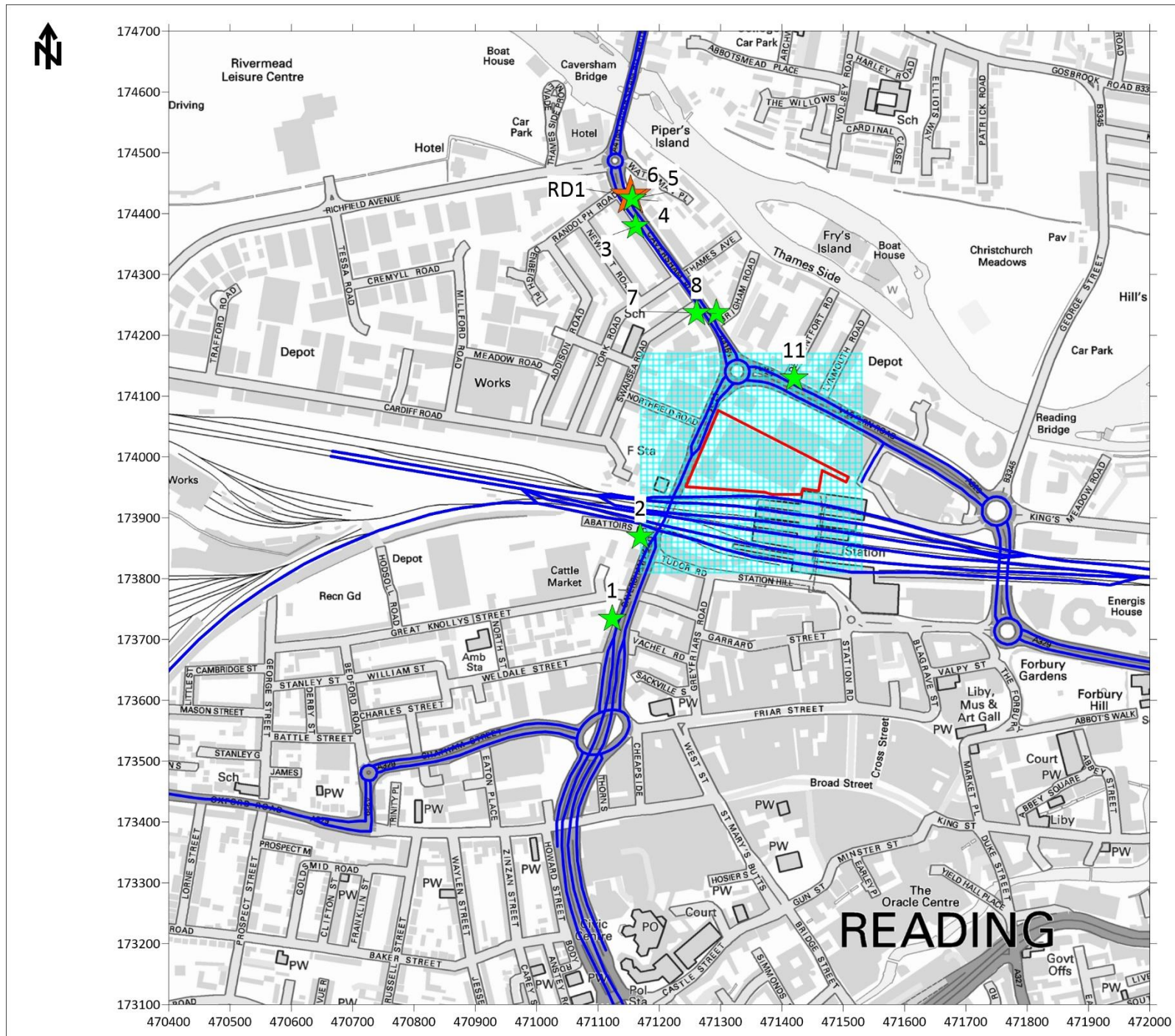
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Legend

-  Site Boundary
-  Modelled Road Link
-  Diffusion Tube Monitoring Location
-  Sensitive Receptor Locations

Title

Figure 14
ADMS-Roads Input

Project

Reading Metropolitan, Reading

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APPENDIX II - ASSESSMENT INPUTS



Assessment Inputs

The proposed development has the potential to introduce future site users to poor air quality, as well as the potential to cause impacts during the construction and operational phases of the development. Dispersion modelling using ADMS Roads was therefore undertaken to predict NO₂, PM₁₀ and PM_{2.5} concentrations across the site and at sensitive locations both with and without the development in place, to consider potential impacts and assess site suitability for the proposed end-use.

The model requires input data that details the following parameters:

- ▶ Assessment area;
- ▶ Traffic flow data;
- ▶ Vehicle emission factors;
- ▶ Spatial co-ordinates of emissions;
- ▶ Street width;
- ▶ Meteorological data;
- ▶ Roughness length; and
- ▶ Monin-Obukhov length.

Assessment inputs are described in the following subsections.

Dispersion Model

Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 4.0.1.0). ADMS-Roads is developed by Cambridge Environmental Research Consultants (CERC) and is routinely used throughout the world for the prediction of pollutant dispersion from road sources. Modelling predictions from this software package are accepted within the UK by the Environment Agency and DEFRA.

Assessment Area

Ambient concentrations were predicted over the proposed development site and surrounding highway network. One Cartesian grid was included in the model over the area NGR: 391740, 415020 to 392490, 415770 at the following heights for 2025 opening year scenario.

- ▶ 1.5m – Ground Floor
- ▶ 4.5m – First Floor Town House
- ▶ 6.5m – First Floor Apartments Southern Side
- ▶ 9.5m – Second Floor Apartments Southern Side
- ▶ 12.5m Third Floor Apartments Southern Side

Results were subsequently used to produce contour plots within the Surfer software package.

It should be noted that although the grid only covered the proposed site, road links were extended in order to ensure the impact of all relevant vehicle emissions in the vicinity of the development were considered.

Reference should be made to Figure 14 within Appendix I for a graphical representation of the



assessment grid extents.

Traffic Flow Data

For this assessment, traffic data was not available therefore 24-hour Annual Average Daily Traffic (AADT) flows and fleet composition as HDV proportion, was provided by Steer, the appointed Transport Consultant for the project for the baseline year (2017), and the future year 2025 with and without the development in place. Additional data was downloaded from the Department for Transport (DfT) Matrix. This web tool enables the user to view and download traffic flows on every link of the A-road and motorway network in Great Britain for the years 1999 to 2017. It should be noted that the DfT matrix is referenced in DEFRA guidance LAQM (TG16) as being a suitable source of data for air quality assessments and is therefore considered to provide a reasonable representation of traffic flows in the vicinity of the site.

Growth factors provided by the Trip End Model Presentation Program (TEMPO) software package were utilised to allow for conversion from the obtained 2018 traffic flow to 2017, which was used to represent the baseline and verification year. On advice from Steer Group, there was no predicted growth in baseline traffic for future year 2025.

Vehicle speeds were estimated based on the free flow potential of each link and local speed limits. Road widths were estimated from aerial photography and UK highway design standards. A summary of the verification traffic data is provided in Table AII.1 and the traffic data used in the DM and DS scenarios 2025 opening year scenario is provided in Table AII.2.

Reference should be made to Figure 14 within Appendix I for a graphical representation of the road link locations.

A summary of the traffic data used in the verification scenarios is provided in Table AII.1.

Table AII.1 2017 Traffic Data

Road Link		Road Width (m)	24-hour AADT Flow	HDV Prop. (%)	Mean Vehicle Speed (km/h)
L1	Roundabout Caversham/Vastern Road	10.5	28,240	6	32
L2	Caversham Road Northbound (Adjacent Site) Slowdown	10.2	16,568	6	16
L3	Caversham Road Northbound	6.5	16,568	6	48
L4	Caversham Road Tunnel (under railway)	13.7	32,280	6	48
L5	Caversham Road Northbound (South of Site)	6.8	16,568	6	48
L6	Caversham Road Northbound Traffic Lights	6.8	16,568	6	16
L7	Speed up onto Caversham Road Northbound	6.2	3,314	6	40
L8	Caversham Road/Chatham Street Roundabout	6.8	10,238	3	32



Road Link		Road Width (m)	24-hour AADT Flow	HDV Prop. (%)	Mean Vehicle Speed (km/h)
L9	Caversham Road Northbound Roundabout Slowdown	6.5	3,314	6	16
L10	Caversham Road Under Roundabout Northbound (elevation change)	7.8	13,254	6	40
L11	Caversham Road Northbound (Adjacent Site)	7.3	16,568	6	64
L12	Caversham Road Speed up (North of Site)	7.7	15,712	5	32
L13	Caversham Road Southbound (Adjacent Site)	6.1	15,712	5	48
L14	Caversham Road Southbound (South of Site)	6.4	15,712	5	48
L15	Caversham Road Traffic Lights	6.0	15,712	5	24
L16	Caversham Road Under Roundabout Southbound (elevation change)	7.4	12,570	5	64
L17	Caversham road Southbound	7.7	15,712	5	64
L18	Slow down onto Caversham Roundabout	5.8	3,142	2	48
L19	Speed up onto Caversham Road Southbound	8.1	3,142	2	48
L20	Slowdown Vastern Road/Caversham Road Roundabout	10.8	11,857	6	16
L21	Vastern Road Westbound	6.5	11,857	6	32
L22	Vastern Road Westbound Traffic Lights	6.8	11,857	6	24
L23	Speed Up off Vastern Road/ Roundabout	6.3	11,857	6	32
L24	Vestern Road/George Street Roundabout	10.1	11,768	4	40
L25	Vastern Road Speed up	7.7	13,074	5	32
L26	Vastern Road Eastbound	4.9	13,074	5	48
L27	Vastern Road Eastbound Traffic lights	5.9	13,074	5	24
L28	Vastern Road Eastbound	5.7	13,074	5	40
L29	Vastern Road/George Road Roundabout Slowdown	9.3	13,074	5	16
L30	Slowdown Vastern Road Northbound	11.7	10,462	2	16
L31	Vastern Road Northbound	11.1	10,462	2	40
L32	Speed up Vastern Road Northbound	13.3	10,462	2	24
L33	Roundabout A329	11.2	10,462	2	40
L34	Vastern road south Speed up	8.9	10,462	2	24



Road Link		Road Width (m)	24-hour AADT Flow	HDV Prop. (%)	Mean Vehicle Speed (km/h)
L35	Vastern road Southbound	11.1	10,462	2	40
L36	Vastern Road South Slowdown	11.9	10,462	2	16
L37	Speed up Forbury Road East	9.5	10,462	2	24
L38	Forbury Road East	6.8	10,462	2	40
L39	Forbury Road East Traffic Light	6.8	10,462	2	40
L40	Forbury Road/ Roundabout Slowdown	8.7	10,462	2	16
L41	Forbury Road slowdown Westbound	7.7	10,462	2	16
L42	Forbury Road Westbound	7.0	10,462	2	40
L43	Forbury Road Westbound Traffic Lights	7.7	10,462	2	40
L44	Forbury Road Speed up Westbound	8.2	10,462	2	32
L45	Forbury Road Roundabout	10.9	10,577	2	32
L46	Troopers Potts Way	6.7	1,967	7	32
L47	Troopers Potts Way Slowdown	7.6	1,967	7	16
L48	Caversham Road Roundabout Speed up (North of Site)	7.8	13,936	3	32
L49	Caversham road Northbound (North of Site)	5.5	13,936	3	48
L50	Caversham Road Northbound Traffic Light	5.2	13,936	3	40
L51	Caversham Road Northbound	5.1	13,936	3	48
L52	Caversham road/Caversham Bridge Street Roundabout Slowdown	8.3	13,936	3	24
L53	Caversham road southbound Slowdown (North of site)	9.9	13,936	3	16
L54	Caversham Road Southbound (North of Site)	5.4	13,936	3	48
L54	Caversham Road Southbound (North of Site)	5.4	13,936	3	48
L55	Caversham Road Southbound Traffic Lights	5.4	13,936	3	24
L56	Caversham Road Southbound	5.2	13,936	3	48
L57	Caversham Road Southbound Speed up (North of Site)	8.2	13,936	3	40
L58	Caversham road/Caversham Bridge Street Roundabout	11.1	13,936	3	40
L59	Caversham Bridge Northbound Speed up	5.7	13,936	3	40
L60	Caversham Bridge Northbound	4.8	13,936	3	48



Road Link		Road Width (m)	24-hour AADT Flow	HDV Prop. (%)	Mean Vehicle Speed (km/h)
L61	Caversham road/Church Street Junction Slow down	7.2	13,936	3	16
L62	Caversham Bridge Southbound slowdown	7.4	13,936	3	24
L63	Caversham Bridge Southbound	4.7	13,936	3	48
L64	Caversham Bridge Southbound Speedup	6.3	13,936	3	40
L65	Chatham Street East Slowdown	10.4	8,901	3	16
L66	Chatham Street East	4.8	8,901	3	64
L67	Chatham Street East Traffic Lights	16.5	8,901	3	24
L68	Chatham Street East	7.7	8,901	3	64
L69	Chatham Street East Speedup	12.0	8,901	3	32
L70	Chatham Street Roundabout	4.0	8,901	3	40
L71	Chatham Street/ Caversham Road Roundabout Speed up	4.1	8,901	3	24
L72	Chatham Street West	4.2	8,901	3	32
L73	Chatham Street West Traffic Lights	5.0	8,901	3	24
L74	Chatham Street West	4.0	8,901	3	32
L75	Chatham Street West Slowdown	4.0	8,901	3	16
L76	Chatham road R Roundabout /Traffic lights	5.5	8,901	3	24
L77	Oxford Road East Speed up	6.5	6,861	4	32
L78	Oxford Road	9.3	13,721	4	48
L79	Oxford Road West Slowdown	5.7	6,861	4	32
L80	Chatham Road Roundabout Slow down	6.5	6,861	4	16
L81	Forbury road North/Roundabout slowdown	10.4	10,691	2	16
L82	Forbury road North	7.6	10,691	2	48
L83	Forbury Road/ Watlington Street	5.9	10,691	2	48
L84	Watlington Street/ Queens Road	7.5	10,691	2	48
L85	Forbury Road Speed up	8.0	10,691	2	32
L86	Forbury Road	7.3	10,691	2	32
L87	Forbury Road/ Watlington Street Speed up	5.5	10,691	2	16



The road width and mean vehicle speed shown in Table AII.1 remained the same for the 2025 scenario. A summary of the 2025 traffic data is shown in Table AII.2.

Table AII.2 2025 Traffic Data

Road Link		DM		DS	
		24-hour AADT Flow	HDV Prop. (%)	24-hour AADT Flow	HDV Prop. (%)
L1	Roundabout Caversham/Vastern Road	32,676	5	32,926	5
L2	Caversham Road Northbound (Adjacent Site) Slowdown	18,616	6	18,759	6
L3	Caversham Road Northbound	18,616	6	18,759	6
L4	Caversham Road Tunnel (under railway)	39,063	6	39,349	6
L5	Caversham Road Northbound (South of Site)	18,616	6	18,759	6
L6	Caversham Road Northbound Traffic Lights	18,616	6	18,759	6
L7	Speed up onto Caversham Road Northbound	3,723	6	3,752	6
L8	Caversham Road/Chatham Street Roundabout	11,317	4	11,361	4
L9	Caversham Road Northbound Roundabout Slowdown	3,723	6	3,752	6
L10	Caversham Road Under Roundabout Northbound (elevation change)	14,893	6	15,007	9
L11	Caversham Road Northbound (Adjacent Site)	18,616	6	18,759	6
L12	Caversham Road Speed up (North of Site)	20,447	5	20,590	5
L13	Caversham Road Southbound (Adjacent Site)	20,447	5	20,590	5
L14	Caversham Road Southbound (South of Site)	20,447	5	20,590	5
L15	Caversham Road Traffic Lights	20,447	5	20,590	5
L16	Caversham Road Under Roundabout Southbound (elevation change)	16,357	5	16,472	5
L17	Caversham road Southbound	20,447	5	20,590	5
L18	Slow down onto Caversham Roundabout	4,089	5	4,118	5
L19	Speed up onto Caversham Road Southbound	4,089	5	4,118	5
L20	Slowdown Vastern Road/Caversham Road Roundabout	16,021	6	16,200	6
L21	Vastern Road Westbound	16,021	6	16,200	6
L22	Vastern Road Westbound Traffic Lights	16,021	6	16,200	6
L23	Speed Up off Vastern Road/ Roundabout	16,021	6	16,200	6



Road Link		DM		DS	
		24-hour AADT Flow	HDV Prop. (%)	24-hour AADT Flow	HDV Prop. (%)
L24	Vestern Road/George Street Roundabout	13,785	4	13,892	4
L25	Vastern Road Speed up	15,510	5	15,689	5
L26	Vastern Road Eastbound	15,510	5	15,689	5
L27	Vastern Road Eastbound Traffic lights	15,510	5	15,689	5
L28	Vastern Road Eastbound	15,510	5	15,689	5
L29	Vastern Road/George Road Roundabout Slowdown	15,510	5	15,689	5
L30	Slowdown Vastern Road Northbound	12,059	2	12,095	2
L31	Vastern Road Northbound	12,059	2	12,095	2
L32	Speed up Vastern Road Northbound	12,059	2	12,095	2
L33	Roundabout A329	12,059	2	12,095	2
L34	Vastern road south Speed up	12,059	2	12,095	2
L35	Vastern road Southbound	12,059	2	12,095	2
L36	Vastern Road South Slowdown	12,059	2	12,095	2
L37	Speed up Forbury Road East	12,059	2	12,095	2
L38	Forbury Road East	12,059	2	12,095	2
L39	Forbury Road East Traffic Light	12,059	2	12,095	2
L40	Forbury Road/ Roundabout Slowdown	12,059	2	12,095	2
L41	Forbury Road slowdown Westbound	12,059	2	12,095	2
L42	Forbury Road Westbound	12,059	2	12,095	2
L43	Forbury Road Westbound Traffic Lights	12,059	2	12,095	2
L44	Forbury Road Speed up Westbound	12,059	2	12,095	2
L45	Forbury Road Roundabout	12,020	2	12,055	2
L46	Troopers Potts Way	2,177	7	2,891	6
L47	Troopers Potts Way Slowdown	2,177	7	2,891	6
L48	Caversham Road Roundabout Speed up (North of Site)	14,377	3	14,430	3
L49	Caversham road Northbound (North of Site)	14,377	3	14,430	3
L50	Caversham Road Northbound Traffic Light	14,377	3	14,430	3



Road Link		DM		DS	
		24-hour AADT Flow	HDV Prop. (%)	24-hour AADT Flow	HDV Prop. (%)
L51	Caversham Road Northbound	14,377	3	14,430	3
L52	Caversham road/Caversham Bridge Street Roundabout Slowdown	14,377	3	14,430	3
L53	Caversham road southbound Slowdown (North of site)	14,377	3	14,430	3
L54	Caversham Road Southbound (North of Site)	14,377	3	14,430	3
L54	Caversham Road Southbound (North of Site)	14,377	3	14,430	3
L55	Caversham Road Southbound Traffic Lights	14,377	3	14,430	3
L56	Caversham Road Southbound	14,377	3	14,430	3
L57	Caversham Road Southbound Speed up (North of Site)	14,377	3	14,430	3
L58	Caversham road/Caversham Bridge Street Roundabout	14,377	3	14,430	3
L59	Caversham Bridge Northbound Speed up	14,377	3	14,430	3
L60	Caversham Bridge Northbound	14,377	3	14,430	3
L61	Caversham road/Church Street Junction Slow down	14,377	3	14,430	3
L62	Caversham Bridge Southbound slowdown	14,377	3	14,430	3
L63	Caversham Bridge Southbound	14,377	3	14,430	3
L64	Caversham Bridge Southbound Speedup	9,163	3	9,172	3
L65	Chatham Street East Slowdown	9,163	3	9,172	3
L66	Chatham Street East	9,163	3	9,172	3
L67	Chatham Street East Traffic Lights	9,163	3	9,172	3
L68	Chatham Street East	9,163	3	9,172	3
L69	Chatham Street East Speedup	9,163	3	9,172	3
L70	Chatham Street Roundabout	9,163	3	9,172	3
L71	Chatham Street/ Caversham Road Roundabout Speed up	9,163	3	9,172	3
L72	Chatham Street West	9,163	3	9,172	3
L73	Chatham Street West Traffic Lights	9,163	3	9,172	3
L74	Chatham Street West	9,163	3	9,172	3
L75	Chatham Street West Slowdown	9,163	3	9,172	3



Road Link		DM		DS	
		24-hour AADT Flow	HDV Prop. (%)	24-hour AADT Flow	HDV Prop. (%)
L76	Chatham road R Roundabout /Traffic lights	7,122	4	7,131	4
L77	Oxford Road East Speed up	14,245	4	14,262	4
L78	Oxford Road	7,122	4	7,131	4
L79	Oxford Road West Slowdown	7,122	4	7,131	4
L80	Chatham Road Roundabout Slow down	11,980	2	12,016	2
L81	Forbury road North/Roundabout slowdown	11,980	2	12,016	2
L82	Forbury road North	11,980	2	12,016	2
L83	Forbury Road/ Watlington Street	11,980	2	12,016	2
L84	Watlington Street/ Queens Road	11,980	2	12,016	2
L85	Forbury Road Speed up	11,980	2	12,016	2
L86	Forbury Road	11,980	2	12,016	2
L87	Forbury Road/ Watlington Street Speed up	32,676	5	32,926	5

Rail Flow data

A desk-top study was undertaken in order to identify the number of daily diesel locomotive movements along the railway line adjacent to the proposed development site. The data was sourced from the Realtime Trains website, which uses data provided by Network Rail to show rail timetables for specific rail networks.

There are current eight rail tracks situated within Reading Station each track has an estimated width of 2m based on aerial photography and the height of the track was measured to be 6m. It has been assumed that rail movements throughout the station will be split equally through the platforms, based on the current layout to the station. Figure 14 within Appendix I shows the modelled rail links used within the DM and DS scenario.

A summary of the locomotive details utilised within the assessment are shown in Table AII 3.

Table AII 3: Rail Traffic Data

Destination	Train Classification	Type of Locomotive	Weekly Movements		
			Weekday	Saturday	Sunday
Reading	Diesel Multiple Unit	Class 165/1 or 166	110	52	26
Newbury	Diesel Multiple Unit	Class 165/1 or 166	15	12	7



Destination	Train Classification	Type of Locomotive	Weekly Movements		
			Weekday	Saturday	Sunday
Acton TC	Diesel Locomotive	Class 66	4	1	0
Bedwyn	Diesel Multiple Unit	Class 165/1 or 166	16	9	6
Gatwick Airport	Diesel Multiple Unit	Class 165/1 or 166	17	0	0
Basingstoke	Diesel Multiple Unit	Class 165/1 or 166	35	37	6
Didcot Fuelling Point	Diesel Locomotive	Class 66	2	2	0
Moreton in Marsh	High Speed Train	HST125	1	2	0
Redhill	Diesel Multiple Unit	Class 165/1 or 166	15	0	0
Swansea	High Speed Train	HST125	15	9	0
Shalford	Diesel Multiple Unit	Class 165/1 or 166	3	0	0
Manchester Piccadilly	Diesel Multiple Unit	Class 220/221 (Voyager)	15	2	13
Worcester Forge Gate Street	High Speed Train	HST125	5	1	0
Oxford	Diesel Multiple Unit	Class 165/1 or 166	17	3	0
London Paddington	High Speed Train	HST125	103	69	0
Newcastle	Diesel Multiple Unit	Class 220/221 (Voyager)	9	0	0
London Paddington	Diesel Multiple Unit	Class 165/1 or 166	18	12	6
Oxford	High Speed Train	HST125	6	15	0
Bristol Temple Meads	High Speed Train	HST125	18	6	0
Penzance	High Speed Train	HST125	6	2	0
Great Malvern	High Speed Train	HST125	4	4	0
Paignton	High Speed Train	HST125	3	1	0
Cardiff Central	High Speed Train	HST125	8	0	0
Bournemouth	Diesel Multiple Unit	Class 220/221 (Voyager)	14	6	0
Cheltenham Spa	High Speed Train	HST125	7	2	0
Guildford	Diesel Multiple Unit	Class 165/1 or 166	2	0	0



Destination	Train Classification	Type of Locomotive	Weekly Movements		
			Weekday	Saturday	Sunday
Southampton Central	Diesel Multiple Unit	Class 220/221 (Voyager)	7	0	0
Newbury	High Speed Train	HST125	1	0	0
Hereford	High Speed Train	HST125	4	2	0
Reading Traincare Depot	Diesel Multiple Unit	Class 165/1 or 166	7	13	1
Plymouth	High Speed Train	HST125	5	6	0
Reading Traincare Depot	Diesel Locomotive	Class 66	2	1	0
Theale ARC	Diesel Locomotive	Class 66	1	0	0
Bristol Freightliner Trml	Diesel Locomotive	Class 66	1	0	0
Weston Super Mare	High Speed Train	HST125	5	0	0
Felixstow North F.L.T	Diesel Locomotive	Class 66	1	0	0
Garston F.L.T	Diesel Locomotive	Class 66	1	0	0
Edinburgh	Diesel Multiple Unit	Class 220/221 (Voyager)	1	0	0
Whateley Quarry	Diesel Locomotive	Class 66	3	1	0
Dagenham Docks ARC	Diesel Locomotive	Class 66	1	0	0
Maidenhead	Diesel Multiple Unit	Class 165/1 or 166	1	0	0
Taunton	High Speed Train	HST125	2	0	0
Banbury	Diesel Multiple Unit	Class 165/1 or 166	1	0	0
Exeter St.Davids	High Speed Train	HST125	2	0	0
Carmarthen	High Speed Train	HST125	1	0	0
Purfleet Deep Wtr Wf (Rfd)	Diesel Locomotive	Class 66	1	0	0
York	Diesel Multiple Unit	Class 165/1 or 166	1	0	0
London Gateway	Diesel Multiple Unit	Class 165/1 or 166	1	0	0



Destination	Train Classification	Type of Locomotive	Weekly Movements		
			Weekday	Saturday	Sunday
Birmingham New Street	Diesel Multiple Unit	Class 220/221 (Voyager)	4	0	0
Worcester Shurb Hill	High Speed Train	HST125	2	2	6
Slough	Diesel Multiple Unit	Class 165/1 or 166	0	1	0
Twyford	Diesel Multiple Unit	Class 165/1 or 166	0	1	0
Eastleigh Trsm	Diesel Multiple Unit	Class 66	0	1	0
Leeds FLT	Diesel Locomotive	Class 66	0	1	0
Hayes and H'ton Tarmac	Diesel Locomotive	Class 66	0	1	0
Churchyard Sdgs	Diesel Locomotive	Class 66	0	1	0
Moreton-on-Lugg	Diesel Locomotive	Class 66	0	1	1
Swindon	High Speed Train	HST125	0	1	0

Emission Factors

For the 2017 Verification and 2025 Opening Year scenarios, emission factors for each road link were calculated using the relevant traffic flows and Emissions Factor Toolkit (version 8.0.1) released in 2017, which incorporates updated COPERTv5 vehicle emissions factors for NO_x and vehicle fleet information.

Emission factors for the 2025 Future Year scenarios were calculated using the Calculator Using Realistic Emissions for Diesels (CURED, version V3A), developed by Air Quality Consultants Ltd. This calculator gives realistic, worst case emission factors for diesels for future years which utilise recent real-world emissions test data. This calculator was used exclusively for the future year 2025 Future Year Scenario for NO_x.

It should be noted that PM₁₀ emission factors were calculated using the Emission Factor Toolkit (version 8.0.1) for the 2017 Verification scenario and the future years scenarios.

Time Varied Emissions

Locomotive emission factors were calculated based on the number of daily train movements, power output and information obtained from the following sources of data:

- ▶ Realtime Trains Website; and
- ▶ Estimation of Rail Environmental Costs, AEA Energy & Environment, 2007

A summary of emissions factors utilised in the assessment is shown in Table All 4.



Table All 4 Diesel Locomotive Emissions Factors

Train Classification	Pollutant	Weekday Emission Factors (g/km/s)	Saturday Emission Factors (g/km/s)	Sunday Emission Factors (g/km/s)
Class 66	NO _x	0.00600	0.07989	0.00333
	PM ₁₀	0.00012	0.00165	0.00007
	PM _{2.5}	0.00012	0.00165	0.00007
Class 165	NO _x	0.09604	0.04860	0.01990
	PM ₁₀	0.00196	0.00099	0.00041
	PM _{2.5}	0.00196	0.00099	0.00041
Class 220	NO _x	0.05752	0.00902	0.01466
	PM ₁₀	0.00121	0.00019	0.00031
	PM _{2.5}	0.00121	0.00019	0.00031
HST125	NO _x	1.41739	0.86850	0.04169
	PM ₁₀	0.06141	0.03763	0.06141
	PM _{2.5}	0.06141	0.03763	0.04169

Emissions from the locomotives were modelled utilising daily movement conditions as specified on the Realtime Trains website. As such, a time-varied file was applied to represent the number of daily movements of diesel locomotives for the weekday, the number of movements of diesel locomotives for Saturday and the number of daily movements of diesel locomotives for Sunday. This again provides a realistic assessment scenario reflecting actual operating timetables.

It should be noted that it was considered that the entire particulate matter emission factor for the locomotives consisted of only PM₁₀ and PM_{2.5}. This allowed the maximum impacts, with respect to the relevant criteria, to be assessed. Actual emissions of particulate matter are unlikely to only consist of only one particulate matter fraction and as such, resulting in a worst-case assessment.

Meteorological Data

Meteorological data used in the assessment was taken from Benson Airport meteorological station over the period 1st January 2017 to 31st December 2017 (inclusive). Benson Airport meteorological station is located at NGR: 462250, 191600 which is approximately 20.2km north-east of the site.

All meteorological records used in the assessment were provided by Atmospheric Dispersion Modelling (ADM) Ltd, which is an established distributor of data within the UK. Reference should be made to



Figure 5 for a wind rose of utilised meteorological data.

Roughness Length

A roughness length (z_0) of 1m was used in this dispersion modelling study. This value of z_0 is considered appropriate for the morphology of the assessment area and meteorological station location and is suggested within ADMS-Roads as being suitable for 'Cities, woodlands'

A z_0 of 0.3m was utilised to represent the morphology of the meteorological station location and is suggested as being suitable for 'agricultural areas (max)'.

Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30m was used in this dispersion modelling study. This value is considered appropriate for the nature of the assessment area and is suggested within ADMS-Roads as being suitable for 'cities and large towns'.

A Monin-Obukhov length of 30m was also used to represent the meteorological station location and is suggested within ADMS-Roads as being suitable for 'small towns <50,000'.

Background Concentrations

Table AII.5 displays the specific background concentrations as predicted by DEFRA, utilised to represent the condition across the development site and the monitoring locations used within the verification process.

Table AII.5 Predicted Background Pollutant Concentrations

Monitoring Location	1km Grid		Monitoring Location	Predicted Background Concentration ($\mu\text{g}/\text{m}^3$)
	X	Y		2017
RD1, T3, T4, T5, T6, T7, T8, T9, T10, T11	471500	174500	NO ₂	34.96
			NO _x	23.12
			PM ₁₀	15.25
			PM _{2.5}	9.90
T1, T2	471500	173500	NO ₂	45.32
			NO _x	28.47
			PM ₁₀	15.64
			PM _{2.5}	9.89



Monitoring Location	1km Grid		Monitoring Location	Predicted Background Concentration ($\mu\text{g}/\text{m}^3$)
	X	Y		2017
T12	472500	173500	NO ₂	37.74
			NO _x	24.63
			PM ₁₀	15.12
			PM _{2.5}	9.60

Since the receptor locations used in the operational phase assessment were located in several grid squares, predicted concentrations from their respective grid squares were used to represent their respective background concentrations for the modelling process.

Table All 6 displays the predicted background concentrations by DEFRA used in the operational phase assessment for the sensitive receptor locations.

Table All.6 Predicted Background Pollutant Concentrations for Receptors

Monitoring Location	1km Grid		Monitoring Location	Predicted Background Concentration ($\mu\text{g}/\text{m}^3$)
	X	Y		2017
R1 to R9	472500	173500	NO ₂	34.96
			NO _x	23.12
			PM ₁₀	15.25
			PM _{2.5}	9.90
R10 to R13, R15, R17 to R18	471500	173500	NO ₂	45.32
			NO _x	28.47
			PM ₁₀	15.64
			PM _{2.5}	9.89
R14	470500	173500	NO ₂	40.90
			NO _x	25.98
			PM ₁₀	15.00
			PM _{2.5}	9.29



Monitoring Location	1km Grid		Monitoring Location	Predicted Background Concentration ($\mu\text{g}/\text{m}^3$)
	X	Y		2017
R16	472500	173500	NO ₂	37.74
			NO _x	24.63
			PM ₁₀	15.12
			PM _{2.5}	9.60

Similar to emission factors, background concentrations for 2017 were utilised in preference to predicted background concentrations for the development opening year. This provided a robust assessment and is likely to overestimate actual pollutant concentrations during the operation of the proposals.

NO_x to NO₂ Conversion

Predicted annual mean NO_x concentrations from the dispersion model were converted to NO₂ concentrations using the spreadsheet provided by DEFRA, which is the method detailed within LAQM (TG16)**Error! Bookmark not defined..**

Verification

The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons, including:

- ▶ Estimates of background concentrations;
- ▶ Uncertainties in source activity data such as traffic flows and emission factors;
- ▶ Variations in meteorological conditions;
- ▶ Overall model limitations; and
- ▶ Uncertainties associated with monitoring data, including locations.

Model verification is the process by which these and other uncertainties are investigated and where possible minimised. In reality, the differences between modelled and monitored results are likely to be a combination of all of these aspects.

For the purpose of this assessment model verification was undertaken for 2017, using traffic data, meteorological data and monitoring results from this year.

RBC undertakes monitoring of NO₂ concentrations at eight locations suitable for verification purposes within the assessment extents. The road contribution to total NO_x concentration was calculated from the monitored NO₂ result for use in the verification process. This was undertaken following the methodology contained within DEFRA guidance LAQM (TG16)².

The dispersion model was run with the traffic input data previously detailed for 2017 to predict the NO_x concentration at the monitoring locations. The results are shown in Table AII.7.



Table AII.7 NO₂ Verification Results

RBC ID	Monitoring Location	Modelled Road NO _x Concentration (µg/m ³)	Monitored Road NO _x Concentration (µg/m ³)	Difference (%)
RD1	Caversham Road	25.84	26.64	3.01
T1	33 Caversham Road	29.13	44.83	35.01
T2	59a Caversham Road	39.14	40.11	2.43
T3	197 Caversham Road	17.47	26.57	34.25
T4/5/6	Caversham Co-location	28.42	29.64	4.11
T7	108 Caversham Road	27.96	36.41	23.21
T8	131 Caversham Road	19.96	26.71	25.26
T11	31a Vastern Road	29.73	30.43	2.29

The monitored and modelled NO_x road contribution concentrations were graphed and the equation of the trendline based on the linear progression through zero was calculated as shown on Graph 1. This indicated that a verification factor of **1.1769** was required to be applied to all NO_x modelling results, showing the model had a tendency to underestimate pollutant concentrations throughout the assessment extents.



Graph 1 - NO_x Verification Factor

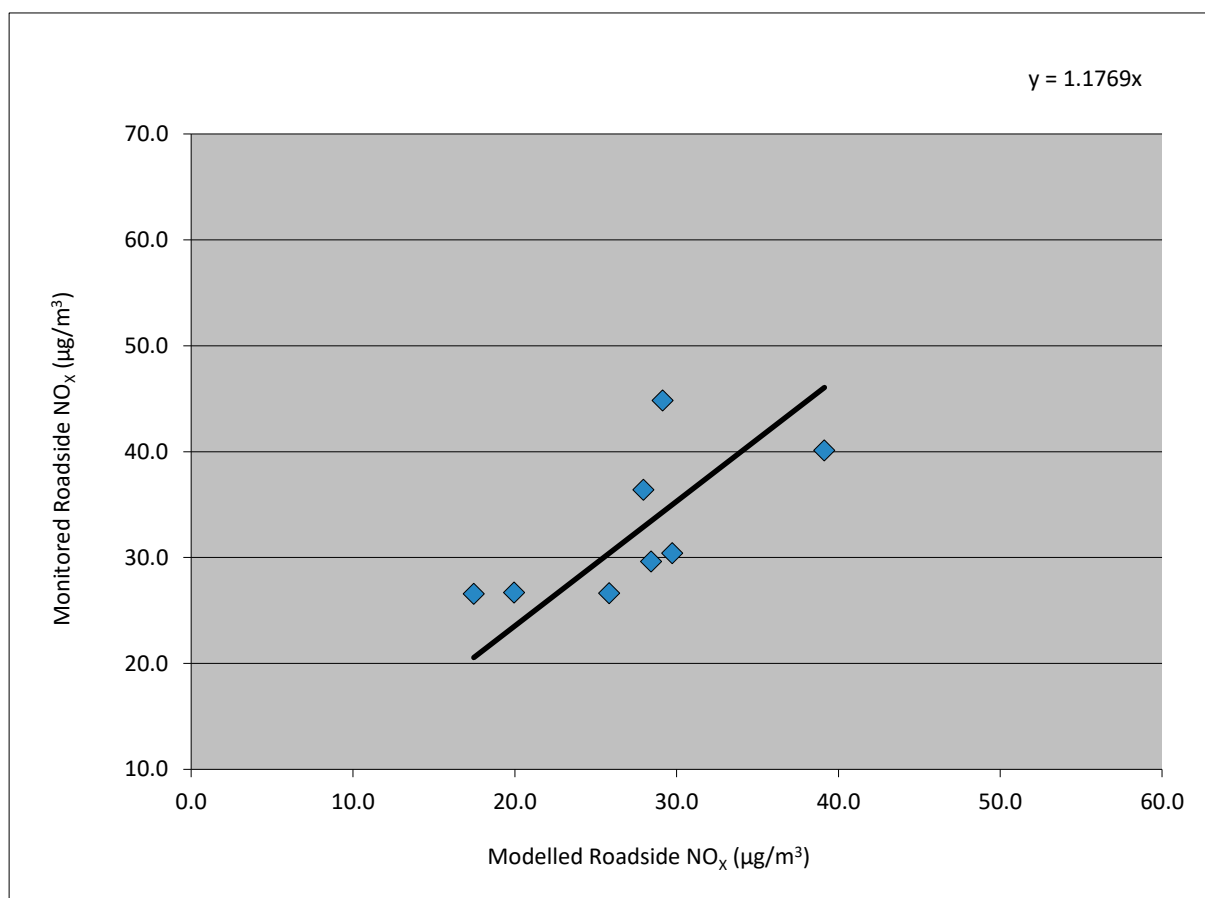


Table AII.8 presents the monitored annual mean NO₂ concentrations and the adjusted modelled total NO₂ concentration based on the above verification factor. Exceedances of the relevant AQO are highlighted in **bold**.

Table AII.8 2017 NO₂ Monitoring Results

Site ID	Monitoring Location	Monitored NO ₂ Concentration (µg/m³)	Adjusted Modelled Total NO ₂ Concentration (µg/m³)	Difference (%)
RD1	Caversham Road	36.00	37.70	9.88
T1	33 Caversham Road	45.30	40.82	-5.73
T2	59a Caversham Road	43.32	45.80	7.68
T3	197 Caversham Road	35.97	33.21	-4.51
T4/5/6	Caversham Co-location	37.35	39.04	3.80
T7	108 Caversham Road	40.33	38.80	4.07



Site ID	Monitoring Location	Monitored NO ₂ Concentration (µg/m ³)	Adjusted Modelled Total NO ₂ Concentration (µg/m ³)	Difference (%)
T8	131 Caversham Road	36.03	34.57	-5.34
T11	31a Vastern Road	37.70	39.72	-4.71

RBC also undertakes monitoring of annual mean PM₁₀ concentrations at one monitoring location within the assessment extents, it was therefore possible to provide a separate PM₁₀ verification factor.

Table AII.9 2017 PM₁₀ Monitoring Results

Site ID	Monitoring Location	Monitored PM ₁₀ Concentration (µg/m ³)	Adjusted Modelled Total PM ₁₀ Concentration (µg/m ³)	Difference (%)
RD1	Caversham Road	22.00	17.25	13.75

The monitored and modelled roadside concentrations were compared to calculate the associated ratio. This indicated a verification factor of **1.2757** was required to be applied to all PM₁₀ modelling results.

As PM_{2.5} monitoring is not undertaken within the assessment extents, the verification factors applied for PM₁₀ were also used to adjust model predictions of PM_{2.5} in accordance with the guidance provided within LLAQM (TG16).



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Appendices

APPENDIX III - ASSESSOR'S CURRICULUM VITAE



CONAL KEARNEY

Head of Air and Noise

BEng(Hons), MSc, MIAQM, MEnvSc

KEY EXPERIENCE:

Conal is a Principal Consultant with specialist experience in the air quality and odour sector. His key capabilities include:

- ▶ Advanced atmospheric air dispersion modelling of road vehicle and industrial emissions using ADMS-ROADS and AIRVIRO.
- ▶ Preparation of factual and interpretative Air Quality Assessment reports and Air Quality Environmental Statement chapters in the vicinity of proposed schemes and developments in accordance with DEFRA, Environment Agency and Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) methodologies.
- ▶ Management and delivery of project work on key, land development and urban regeneration projects.
- ▶ Assessment of road vehicle exhaust emissions using the Design Manual for Roads and Bridges (DMRB) calculation spreadsheet.
- ▶ Assessment of dust impacts from construction sites to the Institute of Air Quality Management (IAQM) methodology.
- ▶ Dust and Odour impact assessments from minerals and waste sites
- ▶ Representing clients at public enquiries and planning hearings.

QUALIFICATIONS:

- ▶ Bachelor of Engineering
- ▶ Master of Science
- ▶ Member of Institute of Air Quality Management
- ▶ Member of the Institute of Environmental Science (IES)

SELECT PROJECTS SUMMARY:

Industrial Developments

Buck Park, Denholme - AQA and dust assessment for proposed mineral extraction and site restoration project.

Messingham Quarry, North Lincolnshire - AQA and dust impacts for proposed new sand extraction site.

Arden Quarry, Derbyshire - AQA for proposed mineral extraction and site restoration

Calder Brick Works, Yorkshire - AQA for proposed site restoration plan

Coopers Moss, St Helens AQA and dust assessment for materials import and site restoration.

Clayton Hall Landfill, Chorley - AQA and odour assessment for proposed landfill extension and mineral extraction.

Highways Developments

Alderley Edge Bypass, Cheshire - AQA for major new road scheme.

South Heywood – EIA for new link road and mixed use joint development

Residential Developments

Beck's Mill, Silsden – AQA and emissions calculation for proposed residential development

Bredbury Curve, Stockport - AQA assessment for proposed residential development in AQMA.

Hollin Lane, Middlewich – AQA for large scale residential development.

Friars School, Southwark, London. School development for mixed use education and residential building in AQMA.

Abbotsford House, Bearsden, Scotland – AQA and dust assessment for residential development

Kelvedon Street, Newport, South Wale – AQA for new housing development

Westcraig, Edinburgh - EIA for residential development

Public Sector

Technical advisor on Manchester Airport Consultative Committee - advise members on environmental technical matters in relation to the airport's operations.

Cheshire County Council - compile AQ chapters for Local Transport Plan

Cheshire East Council - specialist AQ advice on highways, minerals and waste projects

Local Air Quality Management

Broughton Gyratory, Chester - dispersion model for City Centre detailed assessment report

Congleton town centre - dispersion modelling assessment for detailed and further assessment reports.

Disley - dispersion modelling assessment for detailed and further assessments

Holmes Chapel - dispersion modelling assessment for detailed and further assessment reports for road and rail sources.

Crewe - town centre dispersion modelling for detailed and further assessment reports.

Commercial Developments

Granta Park Daycare Centre, Oxfordshire. AQA for new build daycare centre adjacent to major road.

Curzon Cinema, Colchester. Air quality assessment for town centre new build cinema.

Newfoundland Circus, Bristol - AQA for hotel development in city centre

Salesians School, Chertsey - AQA for school extension near M25



Rachael Harrison

Graduate Air Quality Consultant

BSc (Hons).

KEY EXPERIENCE:

Rachael is a Graduate Environmental Consultant with specialist experience in the air quality sector. Her key capabilities include:

- ▶ Production of Air Quality Assessments to the Department for Environment, Food and Rural Affairs (DEFRA), Environment Agency and Environmental Protection UK (EPUK) methodologies for clients from the residential, retail and commercial sectors.
- ▶ Detailed dispersion modelling of road vehicle emissions using ADMS-Roads. Studies have included impact assessment of pollutant concentrations at various floor levels and assessment of suitability of development sites for proposed end-use.
- ▶ Assessment of road vehicle exhaust emissions using the Design Manual for Roads and Bridges (DMRB) calculation spreadsheet.
- ▶ Assessment of dust impacts from construction sites to the Institute of Air Quality Management (IAQM) methodology.
- ▶ Production of air quality mitigation strategies for developments throughout the UK.
- ▶ Defining baseline air quality conditions and identification of sensitive areas.

QUALIFICATIONS:

- ▶ Bachelor of Science

SELECT PROJECTS SUMMARY:

Environmental Impact Assessment:

Warburton Lane, Trafford – EIA for a large scale residential development of 473 dwellings

Old Kent Road, Southwark – ES chapter for major residential development in London.

Liverpool Waters, Liverpool – ES Chapter for major residential development in Liverpool.

Residential Development:

Smithy Bridge, Rochdale Air Quality Assessment in support of a proposed development comprising of 200 residential dwellings in close proximity to the A58. Dispersion modelling of road vehicle exhaust emissions was completed using ADMS-Roads to consider site suitability for the proposed end-use a constraint to planning consent

Minster Way, East Yorkshire AQA for a Large scale residential development comprising a two phase development of circa 400 residential units.

Hucknall, Nottinghamshire AQA In support of a residential development of the site to provide 60 residential dwelling.

Vaughan Way, Leicester AQA in support of an extension to an existing building to provide 39 residential units across four additional floors.

Thame Park Road, Thame AQA in support of 175 residential dwellings with an additional 25 residential dwellings for a second phase

Christie Way, Manchester – AQA in support of 13 residential units.

Strawberry Field, Stockport - AQA in support of proposed residential development in Stockport.

Mixed Use Development:

Rotherhithe Street, Southwark - Air Quality Assessment in support of a proposed mixed use scheme mixed use development comprising of circa 7 residential units and one commercial unit.

St Andrew's Street, Cambridge – Air quality assessment for a proposed boutique hotel and café.

Commercial Development

132 Broughton Street, Manchester - AQA in support of a proposed Cash and carry Warehouse located in the vicinity of Great Manchester AQMA.

Weston Hall Farm, Crewe AQA in support of the proposal comprising the change of use of current agricultural buildings to form a new commercial warehouses.

Holloway Road, Islington AQA in support of a two storey extension above the existing site to provide approximately 430m² of additional floor space for office use Concerns were raised as the site was located within the London Borough of Islington AQMA

Long drive, Greenford – AQA In support of proposed warehouse development measuring