2016 Air Quality Annual Status Report
Cheshire West and Chester Council

In fulfilment of Part IV of the
Environment Act 1995
Local Air Quality Management

October 2016

Cheshire West
and Chester

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Executive summary: air quality in our area

Air quality in Cheshire West and Chester

Air pollution is associated with a number of adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, air pollution particularly affects the most vulnerable in society: children and older people, and those with heart and lung conditions. There is also often a strong correlation with equalities issues, because areas with poor air quality are also often the less affluent areas[1,2].

The annual health cost to society of the impacts of particulate matter alone in the UK is estimated to be around £16 billion[3].

The main air quality issues within Cheshire West and Chester borough arise as a result of emissions from vehicles causing exceedances of the nitrogen dioxide (NO_2) national air quality objective. There are presently three air quality management areas (AQMA) within the borough declared for this reason: Ellesmere Port town centre; Boughton (Chester) and Frodsham. Monitoring has also identified further areas where emissions from vehicles are causing an exceedance of the nitrogen dioxide objective in Chester city centre.

In addition to traffic related emissions, the borough has a large industrial base and exceedances of the sulphur dioxide 15-minute mean objective have been identified at the village of Thornton le Moors in the west of the borough as a result of emissions from local industry.

Ongoing monitoring confirmed the need to undertake further detailed assessments within Frodsham, Thornton le Moors and Chester. As a result of the assessment undertaken for Frodsham, an AQMA was declared on 26 November 2015 due to exceedance of the annual mean nitrogen dioxide national objective.

Work commenced on a low emission strategy (LES) for the borough. The objective is to produce a council strategy to ensure air quality is owned by all departments and delivered consistently across the council, maximising improvements. The target completion date is March 2017.

[1] Environmental equity, air quality, socioeconomic status and respiratory health, 2010
[2] Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006
[3] Defra. Abatement cost guidance for valuing changes in air quality, May 2013

2016 Addendum

Further investigation of the exceedance at Frodsham has been undertaken and a draft action plan is due to be completed in November 2016.

A detailed modelling assessment of industrial sources has been undertaken in 2016 at Thornton le Moors. This resulted in declaration of an AQMA on 29 September 2016 due to exceedances of the sulphur dioxide 15-minute mean national objective. Discussions with the Environment Agency and Essar, the operators of Stanlow oil refinery, have commenced to aid development of an action plan.

A further detailed assessment was completed in October 2016 confirming the need to extend the existing AQMA in Chester city centre to cover the entire inner ring road. Work is now progressing on declaration of the AQMA.

Full copies of these reports plus others can be found on the Council website:

http://www.cheshirewestandchester.gov.uk/residents/pests-pollution-food-safety/pollution-and-air-quality/air-quality-review-and-assessm.aspx. Information on AQMAs nationwide is available at: https://uk-air.defra.gov.uk/aqma/

The LES was placed on hold at the start of 2016 due to resource issues and other demands placed on the service. However a steering group chaired by a director has recently been formed (September 2016) to ensure corporate ownership across the council of this and air quality in general and completion of the LES has been identified as a priority.

Actions to improve air quality

The authority has utilised a series of measures to try and deliver air quality improvements throughout 2015.

Park and ride – The park and ride contract operated by the council was revised and renewed in 2015 with the operator, Stagecoach. In October 2015, the council submitted a joint bid under the Office for Low Emission Vehicles (OLEV) low emission bus scheme (LEBS) for £3.7m part funding of a £6.5m scheme, to provide the infrastructure and buses for a fully electric park and ride scheme. This would have seen the introduction of 13 zero emission buses operating on the cross city routes. Unfortunately, the bid was unsuccessful. The new contract nonetheless

requires buses on the routes to comply with Euro VI standards, as compared to the previous Euro IV requirement. The new scheme commenced in June 2016.

Clean vehicle technology fund (CVTF) – The council was awarded £134,000 under the CVTF for retrofitting eight buses operating in Chester with selective catalytic reduction technology. To date, four buses have been retrofitted using these funds (supplementing the eight buses previously upgraded via the clean bus technology fund). Two Stagecoach Euro VI buses, retrofitted to Euro VI equivalent performance went into service in June 2015. Two Arrowebrook buses (Euro II / III) were adapted in late 2015, coming into service in early 2016.

Go ultra-low city scheme – The council submitted an expression of interest to OLEV in December 2014. A report was approved by the Council Executive on 04 February 2015 enabling officers to formally submit a bid under the scheme up to the value of £12million to install infrastructure for ultra-low emission vehicles in the borough with Chester as the focal point. A formal bid for £8.5million was submitted by the council that would form a local partnership between the council, Chester University, Chester Hospital Trust and Clinical Commissioning Group, City Car Club, Chester Taxi Operators Association, Stagecoach, Arriva and a range of other local business and service providers. The bid aimed to deliver a range of measures including an electric vehicle charging point network across Chester, promoting and incentivising the sale of low emissions vehicles and educate and inform residents about air quality and the impact on health. Unfortunately the council was notified on the 11 March 2015 that the bid was unsuccessful, although OLEV were pleased with the range and breadth of measures that were proposed in the bid.

The council was awarded an Air quality capital grant in 2014 to develop a low emission strategy. Whilst the Council has undertaken a range of activities to improve local air quality, efforts have not been corporately co-ordinated to ensure that the

maximum improvements are obtained. The low emission strategy is viewed as the tool to ensure a more co-ordinated and joined up approach is adopted by the council with greater senior management input to maximise improvements to air quality and ensure that they are sustained. Amec Foster Wheeler was appointed on 13 April 2015 to deliver the project for the council and work progressed throughout 2015 with input from a wide range of council departments including Highways, Strategic Transport, Economic Development, Local Plans, Development Control, Public Health and Environmental Protection. A detailed background document was produced in October 2015 which will form the basis of the emerging low emission strategy.

Local priorities and challenges

Cheshire West and Chester Council has a number of local air quality management obligations to fulfil in the immediate future. Following declaration of the Frodsham AQMA in November 2015, an air quality action plan (AQAP) now needs to be developed. Independent consultants were appointed in August 2016 to assist the council with this process and a modelling study has commenced to explore a number of traffic management scenarios. The inaugural working group meeting was held on 10 October 2016. A draft AQAP is due to be produced in November 2016.

Similarly, an AQAP needs to be produced for the recently declared AQMA in Thornton le Moors. Unlike other AQMAs in the borough the source of the issue is industrial emissions from the large petrochemical installation to the north of the village. The council has no control over this process as it is regulated under the Environmental Permitting Regulations by the Environment Agency. Collaborative working between the council, the Environment Agency and the plant operator, Essar, is therefore required to produce an AQAP within the next 12-18 months.

A draft modelling assessment of road traffic emissions in Chester city centre, undertaken by the council's appointed consultancy, was received in late October 2016. The report recommends the declaration of an additional / extended AQMA across major roads in Chester city centre. The next step will therefore be to demarcate the boundary of the new AQMA via official order and commence work on an AQAP.

A draft low emissions strategy (LES) has been developed, with the inaugural workshop being held in 2015. The LES now needs to be finalised and adopted,

which will assist with the challenge of securing corporate sign-up to the shared goals of improving local air quality and associated health outcomes in the borough.

Preliminary work has been undertaken on options for reducing the number of idling vehicles on the borough's roads. The challenge now is to explore ways in which the legislation may be enforced.

In common with other local authorities, Cheshire West and Chester Council is faced with significant budgetary pressures and the provision of services and initiatives aimed at improving local air quality will be a major challenge.

How to get involved

As many of the air quality issues in the borough relate to emissions from road vehicles, there are lots of things you can do to help improve local air quality. Examples include walking or cycling instead of using the car; catching the bus or train; sharing lifts to work, school and activities; adopting a smooth driving style to reduce fuel use; switching off your engine when stationary; choosing a low emission vehicle such as electric or hybrid for your next car; joining the city car club; using a 'walking bus' for the journey to school.

Adults and children with lung problems and adults with heart problems may be particularly affected by air pollution. Information on local air quality is available on the council's website www.cheshirewestandchester.gov.uk/monitoringstations and further information on forecasting and health advice is available on Defra's UK-air website https://uk-air.defra.gov.uk/

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1 Local air quality management

This report provides an overview of air quality in Cheshire West and Chester (CWAC) during 2015. It fulfils the requirements of local air quality management (LAQM) as set out in part IV of the Environment Act (1995) and the relevant policy and technical guidance documents.

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an air quality management area (AQMA) and prepare an air quality action plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This annual status report (ASR) is an annual requirement showing the strategies employed by Cheshire West and Chester to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England can be found in Table 16 in Appendix E.

2 Actions to improve air quality

2.1 Air quality management areas

Air quality management areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority must prepare an air quality action plan (AQAP) within 12-18 months setting out measures it intends to put in place in pursuit of the objectives.

A summary of AQMAs declared by Cheshire West and Chester can be found in Table 1. Further information related to declared AQMAs, including maps of AQMA boundaries are available online at http://www.cheshirewestandchester.gov.uk/residents/pests-pollution-food-safety/pollution-and-air-quality/air-quality-review-and-assessm.aspx.

The authority's third AQMA for road traffic was declared in November 2015 at the A56 / Fluin Lane junction in Frodsham. In September 2016 an AQMA was declared due to exceedances of the 15-minute objective for sulphur dioxide (SO_2) from industrial sources on the Stanlow oil refinery affecting the village of Thornton le Moors and adjacent areas. An assessment, which is due to be completed early November 2016, of air quality across Chester city centre recommends the declaration of a further AQMA in Chester.

Table 1 – Declared air quality management areas

AQMA name	Pollutants and air quality objectives	City / Town	Description	Action plan
Whitby Road / Station Road	NO_2 annual mean	Ellesmere Port	Residential properties on parts of Whitby Road, Station Road and Princes Road.	http://www.cheshirewestandchester.gov.uk/residents/pests-pollution-food-safety/pollution-and-air-quality/air-quality-review-and-assessm.aspx
Boughton	NO_2 annual mean	Chester	Residential properties on parts of Boughton, Tarvin Road, Christleton Road and Challinor Street.	Action plan pending declaration of a wider AQMA in Chester
Fluin Lane	NO_2 annual mean	Frodsham	Junction of A56 and Fluin Lane	Action plan under development
Thornton le Moors	SO_2 15-minute mean	Thornton le Moors	An area around the oil refinery at Stanlow. September 2016	Action plan under development

2.2 Progress and impact of measures to address air quality in Cheshire West and Chester

Cheshire West and Chester has taken forward a number of measures during the current reporting year of 2015 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2. Key completed measures are:

- Retrofitting four buses to Euro VI standard via clean vehicle technology fund (CVTF)
- Hosting a workshop for the low emissions strategy
- Erection of idling vehicles signage at bus stands and ranks, and exploration of options for enforcement with the Legal department
- Installation of electric vehicle (EV) charging infrastructure at railway station

- Planning policy for EV charging infrastructure in new developments

Progress with the CVTF retrofitting programme has been slower than expected due to a key partner pulling out. Progress with the LES has been slower than expected due to staffing and resource issues.

Cheshire West and Chester expects the following measures to be completed over the course of the next reporting year:

- Completion of the detailed assessment and declaration of an AQMA in Chester city centre
- Development of the AQAP for Frodsham
- Development of the AQAP for Thornton le Moors
- Development of the AQAP for Chester

Cheshire West and Chester's priorities for the coming year are:

- Local air quality management obligations, as detailed above
- Finalisation and adoption of the borough's low emissions strategy
- Incorporation of air quality policies into the local plan, part two.
- Installation of a real-time monitoring station at Chester's new bus interchange
- Options appraisal for idling vehicles enforcement

Table 2 – Progress on measures to improve air quality

	Measure	EU category	EU classification	Lead authority	Planning phase	Implementation phase	Key performance indicator	Target pollution reduction in the AQMA	Progress to date	Estimated completion date	Comments
1	Air quality supplementary planning document	Policy guidance and development control	Air quality planning and policy guidance	CWAC	2014	2015			Deferred as draft Local Plan consultation considerably extended.	2017	
2	Park and ride contract renewal	Alternatives to private vehicle use	Bus based park and ride	CWAC	2014-15	2016-21	Upgrade of buses from Euro IV to Euro VI		Contract awarded to Stagecoach	Complete	Bid for low emission bus scheme (LEBS) funding for full EV service was not successful
3	City car clubs	Alternatives to private vehicle use	Car clubs	CWAC	2012	2013-15	Chester facilities available to public, businesses and council staff			March 2016	Option to introduce EV cars to be explored
4	Electric vehicle charging points	Promoting low emission transport	Procuring alternative refuelling infra-structure	CWAC	2012	2015			Charging posts installed at Hooton station	June 2015	

	Measure	EU category	EU classification	Lead authority	Planning phase	Implementation phase	Key performance indicator	Target pollution reduction in the AQMA	Progress to date	Estimated completion date	Comments
5	Clean vehicle technology fund (CVTF) for eight bus engine retrofits	Vehicle fleet efficiency	Vehicle retrofitting programmes	CWAC	2014	2015	Services in operation in Chester	Yes. Services running though George and Dragon gyratory	Four buses upgraded: two Stagecoach and two Arrowebrook	2015	Supplements the eight buses retrofitted in the earlier clean bus technology fund (CBTF).
6	Low emissions strategy	policy guidance and development control	Low Emissions Strategy	CWAC	2014-15	2015-17	Adoption of strategy	Yes, borough wide	Draft report produced	2017	
7	Secure cycle storage	Transport and planning infrastructure	Cycle network	CWAC	2009-10	2011-16	Increase in number cyclists.	Yes, Boughton AQMA	Complete – infrastructure delivered. Chester city centre, Chester park and ride sites, Ellesmere Port town centre, selected railway stations.	2016 complete (and on-going, subject to funding applications being successful)	LSTF connect to job project (2011-2015) Connecting the Atlantic gateway project (2015-16). Sustainable travel transition year fund bid (2016-17) unsuccessful. Three-year joint authority bid has been submitted to the DfT for access funding.

	Measure	EU category	EU classification	Lead authority	Planning phase	Implementation phase	Key performance indicator	Target pollution reduction in the AQMA	Progress to date	Estimated completion date	Comments
8	Railway station parking expansion	Alternatives to private vehicle use	Rail based park and ride	CWAC	2012-13	2015	Increase in park and ride rail usage and reduction in private cars on strategic road network		100 new additional spaces provided at Hooton Railway Station	Complete	LSTF 1 (2011-2015) funded project - 100 additional car parking spaces provided at Hooton Railway Station
9	Bikeability campaign	Promoting travel alternatives	Promotion of cycling	CWAC	Annual programme	Ongoing	Increase in number cyclists.	Training is delivered borough wide. Benefits for all AQMAs	Ongoing subject to annual project review	Ongoing	DfT funded programme
10	Let's bike	Promoting travel alternatives	Promotion of cycling	CWAC	Annual programme	Ongoing	Increase in number cyclists.	Training delivered borough-wide. Benefits for all AQMAs	Ongoing subject to annual project review	Ongoing	Off-road cycle training course. Road Safety team
11	Let's walk	Promoting travel alternatives	Promotion of walking	CWAC	Annual programme	Ongoing	Improve pedestrian confidence to encourage more sustainable trips	Training is delivered borough wide. Benefits for all AQMAs	Ongoing subject to annual project review	Ongoing	Child training promotes independence

	Measure	EU category	EU classification	Lead authority	Planning phase	Implementation phase	Key performance indicator	Target pollution reduction in the AQMA	Progress to date	Estimated completion date	Comments
12	Anti-idling signs	Traffic management	Anti-idling enforcement	CWAC	2013	2015-2016	Reduction of idling frequency and complaints	Chester-wide	Signs erected at bus stands and taxi ranks	Ongoing	More prominent signs to be explored
13	EV charging points through planning conditions	Policy guidance and development control	AQ planning and policy guidance	CWAC	2014	2015-16		Yes, borough-wide	Conditions actively recommended	2017	Policy in local plan part one and draft part two
14	Taxi and private hire age policy	Promoting low emission transport	Taxi licensing conditions	CWAC	2012	2013-2014	Entry and exit ages of vehicles adopted	Yes	Implemented	2016	Transition period for licences under the terms of the former policy expires 2016
15	Improved park and ride signage on strategic road network (M53, M56 and A55)	Alternatives to private vehicle use	Bus based park and ride	Highways England in partnership with CWAC	2016-17	2017-18 Awaiting bid outcome	Increase in park and ride passengers, reduce number of private single occupancy vehicles in the city centre	Yes	Feasibility stage	2017-18 Awaiting bid outcome	Feasibility stage conducted to provide enhanced static signage and potential variable message signs at slip roads. Bid submitted to highways designated funds programme

	Measure	EU category	EU classification	Lead authority	Planning phase	Implementation phase	Key performance indicator	Target pollution reduction in the AQMA	Progress to date	Estimated completion date	Comments
16	Highway cycle improvement scheme at M53 Junction 9	Transport and planning infrastructure	Cycle network	Highways England in partnership with CWAC	2016-17	2017-18 Awaiting bid outcome	Reduce traffic between the E. Port waterfront developments and town centre via AQMA.	Yes. Ellesmere Port	Feasibility Stage	2017-18 Awaiting bid outcome	Providing crossing points and shared-use footpaths between residential and employment areas / railway station
17	Promote sustainable travel through educational establishments and workplaces	Promoting travel alternatives	Promotion walking / Promotion of cycling / School travel plans	CWAC, Cheshire East and Warrington	2016-17	2017-18 to 2019-20 Awaiting bid outcome	Reduction in car journeys		Bid submitted	2017-18 to 2019-20 Awaiting bid outcome	Access to employment and skills through sustainable travel – joint bid to the DfT access fund revenue competition
18	Improved cycling and walking routes	Transport planning and infrastructure	Cycle network	CWAC, Cheshire East and Warrington	2016-17	2017-18 to 2019-20 Awaiting bid outcome	Reduction in car journeys		Bid submitted	2017-18 to 2019-20 Awaiting bid outcome	Joint access fund capital bid. includes: Station View footbridge, Westminster Rd canal bridge; Chester - Ellesmere Port canal towpath; Sutton Way boulevard.

	Measure	EU category	EU classification	Lead authority	Planning phase	Implementation phase	Key performance indicator	Target pollution reduction in the AQMA	Progress to date	Estimated completion date	Comments
19	Chester western relief road (proposed new road to the west of Chester)	Traffic management	Strategic highway improvements	CWAC	2016-17	2018-19	Reduced journey times, relief of the inner ring road, improved access to key employment sites		Bid submitted	2018-19 Awaiting bid outcome	Bid submitted through large local major fund
20	Chester city gateway road (proposed scheme on Hoole Road corridor)	Traffic management	Strategic highway improvements	CWAC	2016-17	2018-19	Reduced journey times, relief of the inner ring road, improved access to key employment sites		Bid submitted to the DfT through large local major fund	2018-19 Awaiting bid outcome	Replacement of Hoole Way Bridge, new junction bridge to existing road network, new car parking facilities at station, footbridge linking car park to station, public realm improvements
21	A51 Tarvin Road – A51/A54 roundabout and A51/B5132 junction	Traffic management	Strategic highway improvements	CWAC	2016-17	2018-19	Reduction of highway congestion, improved local air quality, improved access to jobs, road capacity forward planning		Bid submitted	2018-19 Awaiting bid outcome	Bid submitted to the DfT through local growth fund (LGF)

	Measure	EU category	EU classification	Lead authority	Planning phase	Implementation phase	Key performance indicator	Target pollution reduction in the AQMA	Progress to date	Estimated completion date	Comments
22	Chester coach strategy	Alternatives to private vehicle use	Other	CWAC	Complete	Ongoing	Increase coach visitors, while reducing single occupancy car journeys		Part of the Council service delivery plan	To be confirmed	Improvements in coach facilities
23	Borough-wide parking strategy	Promoting travel alternatives	Promotion of sustainable travel modes; walking, cycling, public transport and car share	CWAC	2016-17	2017-18 pending Council endorsement of policy		Reduce congestion in AQMA	Draft recommendation report, ready for public consultation in Nov 2016	2017-18 Policy adopted Delivery to be confirmed	Improved off-street enforcement measures to keep traffic following. Seek alternative car parking enhancement for the Boughton corridor.
24	20mph limits on residential streets	Traffic management	Reduction of speed limits, 20mph zones	CWAC	2015	2016-2020	Successful rollout of scheme over four year programme		Scheme approved Jan 2016. Rollout scheduled from Dec 2016 on	2020	Promotes smoother driving style. Emissions reduction from diesel vehicles should lead to overall emissions reduction

2.3 $PM_{2.5}$ – Local authority approach to reducing emissions and or concentrations

As detailed in policy guidance LAQM.PG16 (Chapter 7), local authorities are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5µm (micrometres) or less). There is clear evidence that $PM_{2.5}$ has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases. The public health outcomes framework (PHOF) indicates that the fraction of mortality attributable to particulate matter in Cheshire West and Chester is 4.4%.

Cheshire West and Chester does not currently monitor $PM_{2.5}$ as it is not currently a requirement of LAQM. However, PM_{10} is recorded at three monitoring stations in the borough and, as $PM_{2.5}$ is a subset of PM_{10}, it is possible to estimate the probable local levels by considering the ratio of the two fractions of particulate matter, as detailed in the technical guidance LAQM.TG(16). Applying the nationally derived correction ratio of 0.7 to local data suggests that local $PM_{2.5}$ levels at background sites lie in the range 9.1 to 10.5, which is well below the national annual mean objective of 25$\mu g/m^3$. In recognition of the close association between particulates and health, this figure may be used as a benchmark against which to gauge local improvements over time.

Measures listed in Table 2 above will contribute in general to improvements in levels of $PM_{2.5}$. In particular, the council's low emissions strategy, currently under development, will seek to secure emissions reductions. The Environmental Protection team has a close working relationship with the Director of Public Health and will continue to work collaboratively to determine how air quality can be prioritised across a wide range of policy areas as well identifying specific measures to address $PM_{2.5}$.

3 Air quality monitoring data and comparison with air quality objectives and national compliance

3.1 Summary of monitoring undertaken

3.1.1 Automatic monitoring sites

Cheshire West and Chester undertook automatic (continuous) monitoring at eight sites during 2015. Table 3 in Appendix A shows the details of the sites. Monitoring ceased at our original site in Thornton le Moors (TLM, SO_2 only) in February 2015, when the building housing the monitor ceased to be viable. Monitoring (of NO_x, PM_{10}, and SO_2) at the new location in the village, TLP, began in December 2014. In June 2015, a new monitoring station (SO_2 only) was established in the village of Elton (ELT), which lies to the East of the Stanlow oil refinery. The primary purpose of each monitoring site is to assess the impact of industrial emissions on the two villages and to inform possible declaration of an AQMA. As of September 2016, an AQMA has now been declared (on the basis of both monitoring and detailed dispersion modelling) for exceedance of the 15-minute objective.

NO_2, NO and NO_x were measured using chemiluminescent analysers at the two roadside sites (BO and WH) and the two groundhog cabins (FMH and TLP), and using the Opsis differential optical absorption spectrometer (DOAS) system at one urban background site (LR-JG).

SO_2 was measured using UV fluorescence at ELT, FMH, TLM, and TLP and using Opsis, as above, at LR-JG.

PM_{10} was measured using tapered element oscillating microbalances (TEOM) at FMH and LR and using a beta attenuation monitor (BAM) at TLP.

There are no national network sites in the borough but results for nearby sites are available at https://uk-air.defra.gov.uk/ .

Maps showing the location of the monitoring sites are provided in Figure 1 to Figure 6 in Appendix D. Further details on how the monitors are calibrated and how the data has been adjusted are included in Appendix C.

3.1.2 Non-automatic monitoring sites

Cheshire West and Chester undertook non-automatic (passive) monitoring of NO_2 at 52 locations during 2015. Table 4 shows the details of the sites. Maps showing the locations of the monitoring sites are provided in Figure 7 to Figure 18 in Appendix D. These are also available on the Cheshire West and Chester website at: http://www.cheshirewestandchester.gov.uk/residents/pests-pollution-food-safety/pollution-and-air-quality/air-quality-monitoring/diffusion-tube-map.aspx .

Further details on quality assurance / quality control (QA/QC), bias adjustment and distance correction for the diffusion tubes are included in Appendix C.

Additionally, non-automatic (passive) monitoring of benzene was undertaken at one location in Cheshire West and Chester throughout 2015. The LAQM policy guidance (2016) states that there is no longer a requirement to monitor or report on benzene for LAQM purposes, except where local levels may be relatively high. Monitoring at the location in Thornton le Moors, adjacent to the Stanlow refinery, had already been curtailed when the new guidance was released. For completeness, details of the diffusion tube's location, TM, is included in Table 4 in Appendix A and the 2015 annual monitoring result is shown in Table 13 in Appendix B.

3.2 Individual pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias and distance correction. Further details on adjustments are provided in Appendix C.

3.2.1 Nitrogen dioxide (NO_2)

3.2.1.1 Automatic monitoring

Table 7 in Appendix A compares the ratified and adjusted monitored NO_2 annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3. In 2015, NO_2 at the Whitby Road monitoring site (WH), which lies within an AQMA, was 40µg/m^3, which represents a slight decrease from previous years. All other real-time sites complied with the objective.

Table 8 in Appendix A compares the ratified continuous monitored NO_2 hourly mean concentrations for the past 5 years with the air quality objective of 200µg/m^3. None of the automatic monitoring stations recorded exceedances of the hourly objective for NO_2.

Diffusion tubes are collocated with the automatic stations at Boughton, Chester (BO) and Whitby Road, Ellesmere Port (WH). The latter is a triplicate set, the results for which are submitted to Defra annually to contribute to the calculation of national bias adjustment factors.

Five-year trends in annual mean levels of NO_2 at automatic monitoring sites within Cheshire West and Chester are shown in Figure 19. None of the sites exhibit a significant change in NO_2 concentrations across this time period, with results remaining fairly static. A very slight downwards trend is apparent in data for the background sites FMH, and also at the roadside site, BO – neither of which exceeds the national objective. In contrast, at the roadside site WH, which lies within the Ellesmere Port AQMA street canyon, concentrations remain just above the national objective.

In Figure 24, time-series plots of hourly NO_2 from local sites are presented alongside plots for automatic urban and rural network (AURN) sites in the region.

3.2.1.2 Non-automatic monitoring

Diffusion tubes were used to monitor NO_2 at 51 sites in 2015. Results presented in Table 12 in Appendix B have been adjusted for bias using Defra's national factor for 2015 and, where necessary, corrected for distance to relevant exposure. The full dataset of monthly averages for 2015 is also displayed in Table 12. Details of quality control and any adjustments that have been applied are given in Appendix C.

No recorded annual means exceeded 60µg/m^3 at any of the non-automatic monitoring locations and it is therefore unlikely that any exceedances of the hourly mean objective occurred at any of these sites during 2015.

Diffusion tube levels as a whole, when compared to 2014 results, have generally fallen (note, see data adjustments C.4.5). In 2014 12 sites were above the objective and a further 17 were within 10%, compared to six and ten respectively in 2015.

Chester

The five highest levels of NO_2 were all recorded in Chester. Out of 33 diffusion tube monitoring sites in Chester, five produced results that were above the annual objective for NO_2. Three of these sites (C11, C36 and T6) are within the extant Boughton AQMA, and the other two (PG and WG) lie close to the inner ring road/Upper Northgate Street gyratory for which a detailed assessment is almost completed, with the declaration of an AQMA the most likely outcome. All the remaining sites in Chester were below the objective. Five-year monitoring trends in NO_2 at a selection of Chester monitoring sites are shown in Figure 20.

Most sites experienced a slight decrease in NO_2 when compared to the previous year, although there is no clear long-term trend. Several sites in Chester achieved compliance with the objective level only after the application of distance correction and/or bias adjustment, and nine sites were within 10% of the objective following these corrections. Of these nine, one lies within the extant Boughton AQMA and seven lie within the area of the AQMA likely to be declared around Chester's inner ring road. The other site within 10% of the objective was MCC. During 2014 this tube was above the objective and levels at this location will continue to be monitored in 2016.

Ellesmere Port

Results from diffusion tube monitoring locations in Ellesmere Port (including the outlier at WT, to the west of the town) were all compliant with the national annual mean objective in 2015. Results for tubes located in the street canyon part of the AQMA may have been higher had the local adjustment factor been used (see Appendix C). Figure 21 presents five-year trends in NO_2 at a selection of the town's monitoring locations.

Frodsham

The diffusion tube at FJ was the only location within the borough outside Chester at which results exceeded the annual national objective. This tube location is within the Frodsham AQMA declared in November 2015. All other tubes in the town returned annual means below the objective after bias adjustment. The background site at FV,

set up in response to planning applications for large industrial developments in the area, returned an annual mean result substantially below the objective.

Northwich

Results for all sites around Northwich (BA2, KR, QS and TG) were all comfortably below the annual objective level.

Sproston

Results for the single tube (HC) on the A54 in the hamlet of Sproston was also well below the annual objective level.

3.2.2 Particulate matter (PM_{10})

Table 9 in Appendix A compares the ratified and adjusted monitored PM_{10} annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3.

In 2015, all sites monitoring PM_{10} returned results comfortably below the annual objective, all three recording levels of less than half the target figure. Table 10 in Appendix A compares the ratified, continuously monitored PM_{10} daily mean concentrations for the past 5 years with the air quality objective of 50µg/m^3 (not to be exceeded more than 35 times per year).

The 24-hour mean objective was exceeded in the Borough on a single occasion in 2015 at FMH. As the national objective allows for 35 exceedences per year (per location), this standard has been complied with at all monitoring locations within Cheshire West and Chester.

Figure 22 shows trends in annual PM_{10} at local sites. There is no discernible overall trend as annual averages have remained fairly static over the the last five years. The time series plots in Figure 25 show how the local results compare to the national AURN site at Liverpool Speke where datasets for 2015 were 94% complete. There is good agreement between the various sites.

3.2.3 Sulphur dioxide (SO_2)

Table 11 in Appendix A compares the ratified continuously monitored SO_2 concentrations for the year 2015 with the three air quality objectives for SO_2.

In 2015, there were 56 occasions when the 15-minute objective of 266µg/m^3 was exceeded in Thornton le Moors. Fifty of these were recorded at the new TLP monitoring site where SO_2 monitoring commenced in February 2015. The objective allows for 35 such exceedances, so the standard has been breached for the second year running. The other six occasions were recorded at the TLM monitoring location, which was decommissioned in February 2015. Annual data capture at this location was only 11.7%, but the 99.9th percentile level for the 15-minute mean during the period was 446µg/m^3.

Exceedances of the 15-minute objective were recorded by the continuous analysers at LR-JG and the new location at ELT, although the numbers of exceedances at both locations were substantially less than the number permitted in the objective.

There were also four exceedances of the hourly objective recorded at the TLP location, although, as the allowable number of exceedances per year is 24, this standard is complied with.

There were no recorded exceedances of any of the SO_2 objectives at FMH.

Figure 26 shows how the local results compare with regional AURN sites

As of September 2016, an AQMA has now been declared (on the basis of both monitoring and detailed dispersion modelling) for exceedance of the 15-minute objective in Thornton le Moors on more than 35 occasions per year.

3.2.4 Benzene

In 2015, benzene was monitored using a diffusion tube at a single location (TM) in Cheshire West and Chester in close proximity to the petrochemical refinery at Stanlow. Details of this tube are shown in the diffusion tube information in Table 4 in Appendix A.

The annual mean result returned from this location was 1.9µg/m^3 for 2015, and this is presented along with the results of previous years' monitoring in Table 13 in Appendix B. The 2015 annual mean was less than half the national objective of 5µg/m^3 and was therefore comfortably compliant.

Five-year trends of benzene from 2011 to 2015 plotted in Figure 23. The graph shows a general decline in ambient benzene concentrations over the period.

Monitoring of benzene has consequently been discontinued within Cheshire West and Chester, in line with the guidance set out in the revised LAQM policy guidance, which removes the requirement to do so for LAQM purposes.

3.3 Summary

In 2015 Cheshire West and Chester Council measured concentrations of nitrogen dioxide above the annual mean objective at relevant locations outside of extant AQMAs. As noted in earlier reviews, it was necessary to proceed to a detailed assessment for Upper Northgate Street gyratory / inner ring road in Chester for vehicle emissions, and to declare an AQMA around the junction of Fluin Lane with High Street in Frodsham for vehicle emissions.

None of the diffusion tubes within the Ellesmere Port AQMA recorded nitrogen dioxide levels that exceeded the annual objective in 2015. The result for the real-time continuous analyser was 40$\mu g/m^3$.

In 2015, Cheshire West and Chester Council measured concentrations of sulphur dioxide above the 15-minute mean objective on more than 35 occasions at one monitoring location in the borough. It has therefore been necessary to proceed to a detailed assessment for the area around Thornton le Moors, with subsequent declaration of an AQMA (in September 2016), for industrial emissions.

Appendix A: Monitoring results

Table 3 – Details of automatic monitoring sites

Site name / code	Site type	Grid reference		Pollutants	Monitoring technique	In AQMA ?	Relevant exposure? distance (m)	Distance to kerb (m)	Worst-case location?
		Easting	Northing						
Whitby Rd (WH)	Roadside	340197	376363	NO_2, NO_x	Chemiluminescence	Yes	Yes (15)	2.5	No
Central library (LR)	Urban background	339947	375889	PM_{10}	TEOM	No	No	Not applicable	No
Opsis (LR-JG)	Urban background	340258 339947	376602 375889	NO_2, SO_2	DOAS	No	No	Not applicable	No
Chester (BO)	Roadside	341864	366444	NO_2, NO_x	Chemiluminescence	Yes	No	3.0	No
Frodsham (FMH)	Industrial	352445	378031	NO_2, NOx SO_2, PM_{10}	Chemiluminescence UV-fluorescence TEOM	No	No	7.0	No
Thornton le Moors (TLM)	Industrial	344174	374461	SO_2	UV-fluorescence	No	Yes (20)	Not applicable	Yes
Thornton le Moors (TLP)	Industrial	344103	374330	NO_2, NOx SO_2, PM_{10}	Chemiluminescence UV-fluorescence Beta Attenuation	No	Yes (38)	Not applicable	Yes
Elton (ELT)	Industrial	345642	375522	SO_2	UV-fluorescence	No	Yes (0)	Not applicable	Yes

Table 4 – Details of non-automatic monitoring sites

Site ID	Site name	Site type	Grid reference		Pollutants monitored	In AQMA?	Collocated with analyser?	Relevant exposure?	Distance to relevant exposure (m)	Distance to kerb of nearest road (m)	Worst-case location?
			East	North							
BA2	Warrington Road	Roadside	360514	377144	NO_2	No	No	Yes	0.0	1.5	Yes
BE	Bedward Row	Roadside	340239	366418	NO_2	No	No	Yes	0.5	2.4	Yes
BJ	Backpackers/ jade	Roadside	341401	366512	NO_2	No	No	Yes	0.5	2.5	Yes
BO	Boughton RTA	Roadside	341864	366444	NO_2	Boughton	Yes	No	25.0	2.0	No
C11	11 Christleton Road	Roadside	341915	366427	NO_2	Boughton	No	Yes	0.0	1.0	Yes
C36	Christleton Road (36)	Roadside	342000	366374	NO_2	Boughton	No	Yes	0.5	1.5	Yes
C75	Christleton Road (75)	Roadside	342056	366354	NO_2	No	No	Yes	0.5	2.0	No
CFL	Church Street (lower)	Roadside	351762	377862	NO_2	No	No	Yes	5.0	1.0	Yes
EB	Boughton edgeley	Roadside	341658	366487	NO_2	No	No	Yes	0.0	2.0	Yes
FH	High Street (72)	Roadside	352146	378139	NO_2	No	No	Yes	0.2	2.0	No
FJ	Fluin junction	Roadside	352171	378140	NO_2	No	No	Yes	0.5	2.0	Yes
FM	Fluin Lane (Manor Farm Court)	Roadside	352189	378094	NO_2	No	No	Yes	0.3	2.0	No
FT	Fluin Lane (Terrace)	Roadside	352176	378105	NO_2	No	No	Yes	0.2	1.7	No
FV	Frodsham Weaver Vale	Roadside	352302	378596	NO_2	No	No	No	-	1.0	No
GD	George and Dragon	Roadside	340331	366998	NO_2	No	No	No	10.0	0.5	No
GE	George Street	Roadside	340657	366730	NO_2	No	No	Yes	0.4	3.6	Yes
GI	St Giles	Roadside	341951	366396	NO_2	Boughton	No	Yes	3.0	3.0	No
GSW	Gorse Stacks (Waterside)	Roadside	340700	366687	NO_2	No	No	Yes	3.0	3.2	No
HB	Hoole Lane - Boughton	Roadside	341605	366527	NO_2	No	No	Yes	3.0	1.2	Yes
HC	Holmes Chapel Road (5)	Roadside	373375	366928	NO_2	No	No	Yes	3.0	1.0	Yes

Site ID	Site name	Site type	Grid reference		Pollutants monitored	In AQMA?	Collocated with analyser?	Relevant exposure?	Distance to relevant exposure (m)	Distance to kerb of nearest road (m)	Worst-case Location?
HSN	Hunter Street (north)	Roadside	340447	366531	NO_2	No	No	No	10.0	1.6	No
HW	Hoole Way	Roadside	340881	366826	NO_2	No	No	Yes	1.0	1.9	Yes
IC	Ingham Close	Roadside	342068	366332	NO_2	No	No	Yes	2.0	2.0	No
KR	King St. Rudheath	Roadside	368432	372988	NO_2	No	No	Yes	4.5	2.2	Yes
LH	Lincoln House	Roadside	341126	366540	NO_2	No	No	Yes	3.0	2.0	Yes
LI2	Liverpool Road	Roadside	340354	367034	NO_2	No	No	Yes	7.0	2.5	No
MCC	Christleton (Mill Cottages)	Roadside	343785	365502	NO_2	No	No	Yes	0.5	3.0	Yes
NS	Newsagent Station Rd	Roadside	340406	376724	NO_2	Whitby	No	Yes	2.0	4.0	No
OB	Boughton (105)	Roadside	341633	366510	NO_2	Boughton	No	Yes	0.6	2.5	No
OF	St Oswalds - Fountains	Roadside	340453	366853	NO_2	No	No	No	17.0	4.8	Yes
OW	St Oswalds Way	Roadside	340623	366823	NO_2	No	No	Yes	2.3	2.3	Yes
PA	Parkgate Rd (19)	Roadside	340313	367014	NO_2	No	No	Yes	2.4	0.8	Yes
PG	Parkgate Road (5)	Roadside	340322	366989	NO_2	No	No	No	0.2	1.8	Yes
QS	Queen Street - Chester Way	Roadside	365813	373580	NO_2	No	No	Yes	5.0	1.0	Yes
RM	Rock Mount	Roadside	340291	367108	NO_2	No	No	Yes	0.0	3.8	No
RR	Richfield recruitment	Roadside	340180	376338	NO_2	Whitby	No	Yes	3.0	2.1	No
SA	Samaritans	Roadside	340364	366929	NO_2	No	No	Yes	0.2	2.5	Yes
SCS	Sutton Causeway south	Roadside	352947	378393	NO_2	No	No	Yes	0.0	2.3	Yes
SM	St Martins Way	Roadside	340224	366599	NO_2	No	No	Yes	1.2	2.2	Yes
SR	Station Rd	Roadside	340435	376790	NO_2	Whitby	No	Yes	0.0	1.6	Yes
SZ	Specialized	Roadside	341819	366475	NO_2	Boughton	No	Yes	0.5	2.0	No
T44	Tarvin Road (44)	Roadside	342085	366446	NO_2	Boughton	No	Yes	3.5	1.0	No

Site ID	Site name	Site type	Grid reference		Pollutants monitored	In AQMA?	Collocated with analyser?	Relevant exposure?	Distance to Relevant exposure (m)	Distance to kerb of nearest road (m)	Worst-case location?
T6	Tarvin Road (6)	Roadside	341926	366446	NO_2	Boughton	No	Yes	0.2	2.0	Yes
TB	The Bars	Roadside	341202	366470	NO_2	No	No	Yes	2.0	1.0	Yes
TG	The Green	Roadside	363743	372186	NO_2	No	No	Yes	2.4	1.0	Yes
TM	Thornton le Moors	Industrial	344221	374755	Benzene	No	No	No	46.0	5.0	Yes
UN	Upper Northgate St (44)	Roadside	340357	366960	NO_2	No	No	Yes	0.2	3.0	Yes
WG	Watergate St	Roadside	340217	366209	NO_2	No	No	No	0.2	1.5	Yes
WGW	Watergate – walls	Roadside	340165	366198	NO_2	No	No	Yes	0.0	2.4	Yes
WH1-3	Whitby Road	Roadside	340196	376363	NO_2	Whitby Rd	Yes	No	32.0	1.2	No
WT	Welsh Road	Roadside	334872	374007	NO_2	No	No	Yes	3.4	2.2	Yes
WW	Whitby Wetherspoons	Roadside	340106	376220	NO_2	Whitby	No	Yes	3.0	2.4	Yes

Table 5 – Details of non-automatic monitoring sites discontinued prior to 2015

Site Code	Site name	Town	Pollutant	Reason for discontinuing
BA	Bartington	Bartington	NO_2	House opposite has more relevant exposure (see BA2)
CE	Frodsham CE primary school	Northwich	NO_2	Sufficient data capture
FW	Woolley Close	Frodsham	NO_2	Sufficient data capture
HT	Hawthorne Road (b)	Frodsham	NO_2	Sufficient data capture
NA	Naylor Court	Northwich	NO_2	Well below objective
NT	Neston Town Hall	Neston	NO_2	Well below objective
SB	Station Birkdale	Northwich	NO_2	Well below objective
SCN	Sutton Causeway north	Frodsham	NO_2	Bridge refurbishment complete
SL	St Luke's Primary School	Frodsham	NO_2	Sufficient data capture
T25	Tarvin Road (25)	Chester	NO_2	Well below objective

Table 6 – Details of non-automatic monitoring sites established for 2015

Site Code	Site Name	Town	Pollutant	Reason for monitoring
BA2	Bartington (2)	Bartington	NO_2	House closer to carriageway than previous tube (BA) is more relevant exposure
GE	George Street	Chester	NO_2	Background: houses adjacent to site of new bus exchange
GSW	Gorse Stacks (Waterside)	Chester	NO_2	Background: apartments adjacent to site of new bus exchange

Table 7 – Annual mean NO_2 monitoring results

Site Code	Site Type	Within AQMA?	Valid data capture for period of monitoring %	Valid data capture in 2015 (%)	Annual mean concentration µg/m³				
					2011	2012	2013	2014	2015
WH	Roadside	Yes	89.7	89.7	**41**	**44**	**41**	**41**	**40**
LR-JG	Urban background	No	98.6	98.6	24	24	23	22	20
BO	Roadside	Yes	85.4	85.4	32	33	33	32	30
FMH	Urban background	No	92.0	92.0	-	-	-	19	15
TLP	Industrial	No	87.1	87.1	-	-	-	-	16

Notes: Exceedances of the NO_2 annual mean objective of 40µg/m³ are shown in **bold**.

NO_2 annual means exceeding 60µg/m³, indicating a potential exceedance of the NO_2 hourly mean objective are shown in **bold and underlined.**

Table 8 – Hourly mean NO_2 monitoring results

Site ID	Site type	Within AQMA?	Valid data capture for period of monitoring %	Valid data capture 2015 %	Hourly means > 200µg/m³ (3)				
					2011	2012	2013	2014	2015
WH	Roadside	Yes	89.7	89.7	0	0	0	0	0
LR-JG	Urban background	No	98.6	98.6	0	0	0	0	0
BO	Roadside	Yes	85.4	85.4	0	0 (120)	0	0	0
FMH	Urban background	No	92.0	92.0	-	-	-	0 (99.8)	0
TLP	Industrial	No	87.1	87.1	-	-	-	-	0

Notes: Exceedances of the NO_2 hourly mean objective (200µg/m³ not to be exceeded more than 18 times per year) are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for six months, the maximum data capture for the full calendar year is 50%).

(3) If the period of valid data is less than 85%, the 99.8th percentile of hourly means is provided in brackets.

Table 9 – Annual mean PM_{10} monitoring results

Site ID	Site type	Valid data capture for monitoring period (%) (1)	Valid data capture 2015 (%) (2)	PM_{10} annual mean concentration (µg/m^3) (3)				
				2011	2012	2013	2014	2015
LR	Urban background	100	100	17.1	16.8	17.8	16.0	13.0
FMH	Urban background	99.1	99.1	-	-	-	15.0	15.0
TLP	Industrial	75.3	75.3	-	-	-	-	15.0

Notes: Exceedances of the PM_{10} annual mean objective of 40µg/m^3 are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for six months, the maximum data capture for the calendar year is 50%).

(3) All means have been 'annualised', as per technical guidance LAQM.TG16, where valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Table 10 – 24-hour mean PM_{10} monitoring results

Site ID	Site type	Valid data capture for monitoring period (%) (1)	Valid data capture 2015 (%) (2)	PM_{10} 24-hour means > 50µg/m^3 (3)				
				2011	2012	2013	2014	2015
LR	Urban background	100	100	6	7	6	1	0
FMH	Urban background	99.1	99.1	-	-	-	0	1
TLP	Industrial	75.3	75.3	-	-	-	-	0 (22)

Notes: Exceedances of the PM_{10} 24-hour mean objective (50µg/m^3 not to be exceeded more than 35 times/year) are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for six months, the maximum data capture for the full calendar year is 50%).

(3) If the period of valid data is less than 85%, the 90.4th percentile of 24-hour means is provided in brackets.

Table 11 – SO_2 monitoring results

Site ID	Site type	Valid data capture for monitoring period (%) (1)	Valid data capture 2015 (%) (2)	Number of exceedances (percentile in bracket) (3)		
				15-minute objective (266 µg/m^3)	Hourly objective (350 µg/m^3)	24-hour objective (125 µg/m^3)
LR-JG	Urban background	98.4	98.4	**6**	**1**	0
FMH	Urban background	95.5	95.5	0	0	0
TLM	Industrial	97.9	11.6	**6** (446)	0 (189)	0 (86)
TLP	Industrial	86.5	97.9	**50**	**4**	0
ELT	Urban background	86.8	50.7	**2** (136)	0 (104)	0 (49)

Notes: exceedances of the SO_2 objectives shown in **bold** (15-minute mean = 35 allowed a year, hourly mean = 24 a year, 24-hour mean = three a year)

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the calendar year (e.g. if monitoring was carried out for six months, the maximum data capture for the full calendar year is 50%)

(3) If the period of valid data is less than 85%, the relevant percentiles are provided in brackets.

Appendix B: Monthly diffusion tube results for 2015

Table 12 – NO_2 monthly diffusion tube results – 2015

Values that exceed the published annual mean objective concentration for NO_2 after bias adjustment and distance correction have been applied are highlighted in **bold**.

Site ID	NO_2 mean concentrations (µg/m^3)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual mean (1)		
													Raw data	Bias adjusted (2)	Distance corrected (2)
BA2	34.4	32.8	34.0	32.6	26.4	28.8	29.3	31.8	31.7	38.5	27.0	31.8	31.6	28.8	28.8
BE	45.4	38.2	45.2	42.7	45.8	missing	42.3	46.7	44.6	missing	33.9	36.4	42.1	38.3	37.5
BJ	void	40.7	54.0	44.0	41.1	37.5	37.9	37.8	46.5	49.0	33.8	30.7	41.2	37.5	37.5
BO	39.9	34.6	38.8	34.3	30.2	28.4	28.7	24.9	36.9	42.4	32.7	30.2	33.5	30.5	30.5
C11	46.8	48.9	55.8	46.4	44.1	44.4	45.0	39.5	54.4	60.5	44.2	37.7	47.3	43.0	**43.0**
C36	55.4	51.0	56.6	50.2	58.4	60.6	64.5	55.5	58.5	54.5	47.5	54.9	55.6	50.6	**48.4**
C75	34.3	32.5	35.5	32.8	27.9	26.5	27.1	26.1	31.5	38.5	25.1	27.2	30.4	27.7	27.7
CFL	36.3	31.4	37.0	37.1	31.6	28.9	31.4	31.6	36.5	27.3	30.4	27.6	32.3	29.4	24.7
EB	47.4	41.7	46.6	39.0	35.2	30.3	34.5	33.1	33.5	40.7	35.8	33.5	37.6	34.2	34.2
FH	43.6	43.3	42.9	43.4	41.3	missing	40.5	47.8	46.7	51.3	36.1	43.3	43.6	39.7	39.3
FJ	53.8	46.4	54.7	44.2	43.5	41.8	41.9	46.1	47.0	44.8	40.3	40.3	45.4	41.3	**40.2**
FM	37.3	missing	42.4	43.2	29.7	32.3	31.7	37.9	38.1	46.5	28.4	30.6	36.2	32.9	32.5
FT	45.5	43.0	41.4	39.6	33.9	33.4	34.2	36.4	38.1	36.5	34.5	30.4	37.2	33.9	33.9
FV	30.5	27.7	26.1	21.4	17.6	16.1	17.9	18.0	22.9	43.3	21.4	18.2	23.4	21.3	21.3
GD	38.2	missing	43.6	missing	29.1	27.4	27.8	32.8	37.7	50.6	31.2	36.1	35.4	32.3	32.3
GE	38.4	28.9	34.5	27.0	29.6	24.9	28.1	27.6	35.1	missing	25.5	32.2	30.2	27.4	27.0
GI	40.7	38.2	missing	35.4	19.6	34.5	35.7	31.8	42.4	50.1	33.8	31.6	35.8	32.6	32.6
GSW	34.0	35.3	missing	29.2	missing	25.5	28.7	28.1	31.1	36.2	24.8	29.6	30.2	27.5	26.7

Site ID	NO_2 mean concentrations (µg/m^3)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual mean (1)		
													Raw data	Bias adjusted (2)	Distance corrected (2)
HB	43.8	36.2	41.4	32.0	31.4	31.6	33.2	33.6	38.1	44.5	41.2	35.9	36.9	33.6	29.5
HC	46.4	41.2	41.7	50.0	35.7	36.6	41.4	41.2	44.3	32.3	31.0	33.2	39.4	35.9	29.8
HSN	38.3	missing	42.6	35.3	35.2	32.6	33.4	35.4	29.0	40.8	35.4	32.3	35.5	32.3	32.3
HW	45.4	43.4	53.7	39.4	36.7	33.1	36.6	39.1	40.2	52.8	38.0	40.6	41.6	37.8	36.1
IC	49.0	41.1	43.1	42.0	38.9	35.1	40.1	36.9	39.5	46.8	40.9	38.9	41.0	37.3	33.9
KR	46.2	36.9	38.8	39.1	31.0	32.1	31.5	38.7	31.2	41.0	void	39.1	36.9	33.6	28.9
LH	44.0	36.7	51.3	43.0	41.3	36.9	40.5	37.2	43.0	47.7	39.1	28.3	40.7	37.0	32.9
LI2	48.1	35.0	47.0	38.4	35.5	30.3	37.1	39.5	33.7	49.3	37.0	36.6	39.0	35.5	29.1
MCC	50.2	missing	54.0	42.8	41.9	42.1	41.4	41.6	29.8	50.6	31.9	34.9	41.9	38.1	36.7
NS	41.1	43.3	54.4	41.6	34.6	31.2	34.0	40.9	40.6	missing	34.2	37.4	39.4	35.9	34.1
OB	53.1	44.2	54.8	41.8	40.5	39.9	missing	missing	43.5	54.6	38.9	35.5	44.7	40.7	39.5
OF	43.0	37.4	39.6	39.6	36.8	28.4	38.8	42.9	41.2	43.9	41.7	37.4	39.2	35.7	35.7
OW	52.7	45.8	49.7	42.8	46.6	46.7	45.8	46.5	46.1	45.0	45.6	56.2	47.4	43.2	39.3
PA	49.9	44.3	50.5	missing	missing	34.5	38.9	40.6	45.6	57.8	44.8	44.3	45.1	41.1	34.4
PG	missing	44.8	50.4	48.3	43.9	44.4	43.5	46.8	46.7	61.1	38.0	41.8	46.3	42.2	**42.2**
QS	34.2	32.3	31.3	33.9	20.6	26.4	20.9	20.7	29.8	40.5	34.6	28.0	29.4	26.8	22.7
RM	40.5	42.3	46.4	41.6	36.9	missing	37.4	40.8	51.8	69.2	32.4	43.1	43.9	39.9	39.9
RR	45.7	45.3	49.1	49.5	41.5	33.6	38.8	43.2	45.4	47.4	40.2	36.2	43.0	39.1	35.0
SA	39.2	39.1	49.6	41.2	38.6	35.2	41.2	43.1	46.1	56.6	36.2	41.3	42.3	38.5	38.5
SCS	37.7	36.1	38.4	36.3	28.2	27.6	29.0	34.4	34.9	39.1	32.7	31.2	33.8	30.8	30.8
SM	32.2	33.4	missing	29.4	27.0	missing	28.6	30.4	36.5	43.6	32.8	30.6	32.4	29.5	29.5
SR	42.2	43.3	44.4	43.1	36.8	33.1	36.4	39.1	39.0	44.1	36.4	32.9	39.2	35.7	35.7
SZ	45.6	43.9	55.5	44.6	missing	32.7	36.0	32.6	43.8	51.7	32.0	26.6	40.5	36.8	35.8
T44	48.2	45.8	50.8	42.6	44.1	42.1	44.7	42.7	44.3	55.9	40.4	45.5	45.6	41.5	33.9
T6	55.8	55.9	54.7	54.4	51.6	48.0	55.6	50.2	52.1	53.9	58.5	57.3	54.0	49.1	**49.1**
TB	47.0	45.1	48.1	44.4	39.4	38.0	42.3	40.9	missing	48.2	42.0	49.0	44.0	40.1	35.2
TG	40.2	35.1	41.6	34.0	30.8	missing	27.6	missing	33.1	40.8	31.9	33.3	34.8	31.7	27.1

Site ID	NO_2 mean concentrations (µg/m^3)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual mean (1)		
													Raw data	Bias adjusted (2)	Distance corrected (2)
UN	45.2	42.8	49.4	39.5	37.4	32.8	39.7	42.0	36.6	58.9	38.8	44.3	42.3	38.5	38.5
WG	46.9	42.0	53.5	50.1	48.4	40.7	41.8	42.5	45.9	56.6	missing	30.7	45.4	41.3	**41.3**
WGW	38.2	33.1	44.2	38.1	33.7	33.8	35.8	35.4	45.3	48.7	31.0	25.4	36.9	33.6	33.6
WH	41.8	40.3	43.7	43.8	32.8	31.9	35.5	38.0	38.4	42.1	32.8	35.9	38.1	34.7	34.7
WT	40.2	42.8	48.0	46.9	37.9	37.6	35.7	46.0	46.3	61.0	39.5	38.4	43.4	39.5	33.6
WW	35.5	32.4	37.2	35.0	25.1	24.0	26.2	30.7	32.9	35.0	31.8	31.1	31.4	28.6	28.6

(1) Data capture for all tube locations was 10 months out of 12 (83%) or above, and no annualisation correction has been made to any of the above data.
(2) See Appendix C for details on analysis, bias adjustment and distance correction.

Table 13 – Annual benzene diffusion tube results, 2011 – 2015

Site ID	Location	Within AQMA?	Data capture 2015 (months)	Benzene annual mean (µg/m^3)				
				2011	2012	2013	2014	2015
WF	Wood Farm, Ince	No	-	2.5	1.2	1.2	-	-
MV	Meadow View, Elton	No	-	2.3	0.8	0.8	-	-
TM	Thornton le Moors	No	12	2.2	1.6	1.9	1.2	1.9

Values that exceed the published annual mean objective concentration for benzene are highlighted in **bold**.
See Appendix C for details on analysis of benzene diffusion tubes

Appendix C: Supporting technical information

C.1

As detailed in previous assessments, planning permission for a new bus interchange between Gorse Stacks and St Oswald's Way in Chester was approved in 2014. Greater vehicle numbers are expected to use the new facility, but the detailed air quality assessment submitted with the application did not identify any receptors at which air quality objectives would be exceeded. However, as residences are relatively close on two sides of the interchange, diffusion tube monitoring commenced at locations GE and GSW in January 2015 in order to establish background NO_2 concentrations in the area prior to the exchange opening in 2017. Real-time monitoring of NO_2 and PM_{10} is a requirement of the planning permission.

C.2

The detailed assessment that informed the declaration of the AQMA in Frodsham in November 2015 can be found on the Cheshire West and Chester Council website here: https://www.cheshirewestandchester.gov.uk/residents/pests-pollution-food-safety/pollution-and-air-quality/air-quality-review-and-assessm.aspx

C.3

The Air quality action plan for the Ellesmere Port AQMA can be found on the Cheshire West and Chester Council website here: https://www.cheshirewestandchester.gov.uk/residents/pests-pollution-food-safety/pollution-and-air-quality/air-quality-review-and-assessm.aspx

An AQAP for the Frodsham AQMA is in the process of being drawn up.

An AQAP for the Thornton le Moors AQMA is due to be commenced.

An AQAP for Chester will be developed following declaration of the AQMA

C.4 Data ratification, bias adjustments and distance corrections

C.4.1 Automatic monitoring

In-house staff perform fortnightly span and zero calibrations on the chemiluminescent analysers at the BO and WH roadside sites, and four-weekly span and zero calibrations on the remaining chemiluminescent and UV-fluorescent analysers, using BOC spectra-seal certified gas standards. The resultant span and offset values are used in the ratification of datasets. Automated internal zero checks are run overnight every day. Data from different sites is compared on a regular basis for the purposes of QA/QC. Ratification is performed by an independent contractor, AQDM Ltd. The ratification process also involves comparison against national network sites to identify regional patterns and trends. In 2015 the analysers were serviced and calibrated at six-monthly intervals by Easy Technical Services Ltd (for Opsis) and ESU1 Ltd (all other sites).

C.4.2 Particulate matter monitoring adjustment

PM_{10} monitoring data recorded by the BAM analyser based at Thornton le Moors (TLP) has been adjusted by the factor (0.833) recommended in the UK equivalence programme for monitoring of particulate matter report. The volatile correction model (VCM) was used to correct TEOM monitoring data. The mean VCM adjustment factors applied to the monitoring data were: 1.22 for the Ellesmere Port site and 1.23 for Frodsham.

C.4.3 Short-term to long-term data adjustment

Monitoring studies should ideally be in situ for at least a year in order to compare the results against the annual mean objectives. All diffusion tube locations completed 10 months or more monitoring during 2015. All sites therefore exceeded the 9-month minimum data capture set out in section 7.171 of the technical guidance. No short-term to long-term ‘annualisation’ adjustments have been made.

C.4.4 Diffusion tube bias adjustment factors

A triplicate set of diffusion tubes is collocated with the sampling inlet of the real-time analyser WH on Whitby Road, Ellesmere Port. Data from this exercise is used for checking diffusion tube precision and accuracy against real-time results in both a local comparison and to contribute to the national bias adjustment programme. Bias

adjustment factors derived from collocation studies undertaken at various locations across the country are available on the Defra website.

Results from 16 national collocation studies, which use the 20 percent triethanolamine (TEA) in water preparation are shown in Table 14 below. The national bias adjustment factor for 2015 is 0.91. The local comparison of diffusion tubes against the real-time data is shown in Table 15, below – the local bias adjustment factor for 2015 is 1.05. Clearly, applying the national bias adjustment factor will reduce the mean and applying the local factor will increase it, so choice of which factor to apply could have a significant bearing on whether a site complies with the objective or not.

C.4.5 Discussion of choice of factor to use

The overall accuracy and precision of the local study was good, but real-time data capture in September and October was poor. The monitoring station WH is situated within a street canyon so the bias adjustment may not be applicable to sites with a more open aspect. Taking these points and the factors stated in Section 7.175 of the technical guidance into account, it has been decided to use the national bias adjustment factor (0.91) for the adjustment of all diffusion tube data as it is likely to be more reliable. It should be noted, however, that this approach may underestimate the concentrations at some sites. At WH, for example, the real-time result was 40μg/m^3 and the locally adjusted diffusion tube result would also be 40μg/m^3, whereas application of the national factor gives a reading of just 34.7μg/m^3. There may have been merit therefore to use the local factor for sites with canyon-like characteristics (such as C11, C36, FM, FT, GI, PA, PG, RR, T6, WG, WGW, WH and WW) and the national factor at the remainder.

Table 14 - National diffusion tube bias adjustment factor

National Diffusion Tube Bias Adjustment Factor Spreadsheet							Version Number: 03/16			
Analysis by	Method	Year	Site type	Local authority	Length of study (months)	Diffusion tube mean (Dm) (µg/m^3)	Automatic mean (Cm) (µg/m^3)	Bias (%)	Tube precision	Bias adjustment factor (Cm/Dm)
Gradko	20% TEA in water	2015	Roadside	Ards and North Down	12	38	26	48.6	Good	0.67
Gradko	20% TEA in water	2015	Urban Centre	Breckland	12	30	29	1.5	Good	0.99
Gradko	20% TEA in water	2015	Roadside	Cheltenham	12	35	35	2.7	Good	0.97
Gradko	20% TEA in water	2015	Roadside	Lisburn and Castlereagh	10	36	29	24.8	Good	0.80
Gradko	20% TEA in water	2015	Roadside	Luton	12	46	44	6.0	Good	0.94
Gradko	20% TEA in water	2015	Roadside	Monmouthshire	12	41	37	11.0	Good	0.90
Gradko	20% TEA in water	2015	Background	Pembrokeshire	10	4	3	36.7	Good	0.73
Gradko	20% TEA in water	2015	Roadside	City of Lincoln	12	39	33	17.9	Good	0.85
Gradko	20% TEA in water	2015	Roadside	King's Lynn and West Norfolk	12	29	22	32.5	Good	0.75
Gradko	20% TEA in water	2015	Roadside	Cheshire West and Chester	10	38	40	-5.2	Good	1.06
Gradko	20% TEA in water	2015	Roadside	Dudley	12	47	50	-5.9	Good	1.06
Gradko	20% TEA in water	2015	Roadside	Dudley	12	40	35	14.0	Good	0.88
Gradko	20% TEA in water	2015	Roadside	Dudley	12	34	31	10.0	Good	0.91
Gradko	20% TEA in water	2015	Background	Dudley	11	23	19	20.9	Good	0.83
Gradko	20% TEA in water	2015	Kerbside	Glasgow	12	60	61	-0.9	Poor	1.01
Gradko	20% TEA in water	2015	Background	Glasgow	10	25	25	3.3	Poor	0.97
Gradko	20% TEA in water	2015	Roadside	Glasgow	9	30	31	-2.8	Poor	1.03
Gradko	20% TEA in water	2015	Roadside	Glasgow	12	43	38	14.0	Poor	0.88
Gradko	20% TEA in water	2015	Kerbside	Marylebone Road	12	102	81	26.2	Good	0.79
Gradko	20% TEA in water	2015	Background	Liverpool	12	20	22	-9.0	Good	1.10
Gradko	20% TEA in water	2015	Roadside	Preston	12	29	27	8.9	Good	0.92
Gradko	20% TEA in water	2015	Roadside	Thurrock	12	28	45	-37.1	Good	1.59
Gradko	20% TEA in water	2015	Roadside	Gateshead	11	33	33	-0.8	Good	1.01
Gradko	20% TEA in water	2015	Roadside	Gateshead	10	36	33	11.2	Good	0.90
Gradko	20% TEA in water	2015	Roadside	Gateshead	12	28	25	9.2	Good	0.92
Gradko	20% TEA in water	2015	Kerbside	New Forest	11	47	36	31.1	Poor	0.76
Gradko	20% TEA in water	2015	Roadside	New Forest	11	33	25	31.7	Good	0.76
Gradko	20% TEA in water	2015	Roadside	Wokingham	11	36	33	-69.0	Good	0.93
Gradko	20% TEA in water	2015	Urban centre	Southampton	12	28	29	-3.5	Good	1.04
Gradko	20% TEA in water	2015		Overall Factor (29 studies)				Use		**0.91**

Table 15 – Calculation of local bias adjustment factor

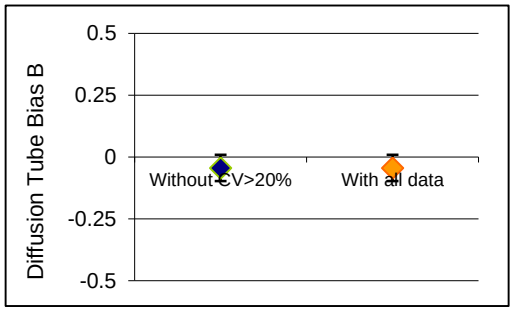
Diffusion tubes measurements										Automatic method		Data quality check	
Period	Start date	End date	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate mean	Standard deviation	Coefficient of variation (CV)	95% CI of mean	Period mean	Data capture (% DC)	Tubes precision check	Analyser data capture check
1	06/01/2015	04/02/2015	37.7	45.9	41.9	41.8	4.1	10	10.1	42.7	98.8	**Good**	**Good**
2	04/02/2015	03/03/2015	42.1	38.7	40.1	40.3	1.7	4	4.2	52.0	98.8	**Good**	**Good**
3	03/03/2015	02/04/2015	43.6	44.8	42.8	43.7	1.0	2	2.6	47.3	98.7	**Good**	**Good**
4	02/04/2015	01/05/2015	41.6	44.2	45.6	43.8	2.0	5	5.1	47.0	75.6	**Good**	**Good**
5	01/05/2015	27/05/2015	34.0	33.1	31.3	32.8	1.4	4	3.5	31.7	98.7	**Good**	**Good**
6	27/05/2015	03/07/2015	31.1	31.8	32.8	31.9	0.9	3	2.1	33.6	98.8	**Good**	**Good**
7	03/07/2015	30/07/2015	36.5	33.8	36.2	35.5	1.5	4	3.6	33.5	98.8	**Good**	**Good**
8	30/07/2015	25/08/2015	37.5	38.9	37.4	38.0	0.8	2	2.1	34.3	97.0	**Good**	**Good**
9	25/08/2015	29/09/2015	39.6	38.1	37.7	38.4	1.0	3	2.5	36.3	43.2	**Good**	**Poor**
10	29/09/2015	29/10/2015	41.3	42.8	42.1	42.1	0.8	2	1.9	43.2	59.3	**Good**	**Poor**
11	29/10/2015	02/12/2015	31.7	33.1	33.6	32.8	1.0	3	2.4	38.2	98.6	**Good**	**Good**
12	02/12/2015	07/01/2016	35.5	36.7	35.3	35.9	0.7	2	1.8	36.9	98.9	**Good**	**Good**
It is necessary to have results for at least two tubes in order to calculate the precision of the measurements										Overall survey -->		Good precision	Poor overall DC

Site Name/ ID:	Whitby Road, WH

Precision	12 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)	
without periods with CV larger than 20%	
Bias calculated using 11 periods of data	
Bias factor A	1.05 (0.98-1.14)
Bias B	-5% (-12%-2%)
Diffusion tubes mean:	38 μgm^{-3}
Mean CV (precision):	4
Automatic Mean:	40 μgm^{-3}
Data capture for periods used:	96%
Adjusted tubes mean:	40 (37-43) μgm^{-3}

Accuracy (with 95% confidence interval)	
With all data	
Bias calculated using 11 periods of data	
Bias factor A	1.05 (0.98-1.14)
Bias B	-5% (-12%-2%)
Diffusion tubes mean:	38 μgm^{-3}
Mean CV (precision):	4
Automatic mean:	40 μgm^{-3}
Data capture for periods used:	96%
Adjusted tubes mean:	40 (37-43) μgm^{-3}



Appendix D: Maps of monitoring locations

Figure 1 Location of automatic monitoring station in Chester

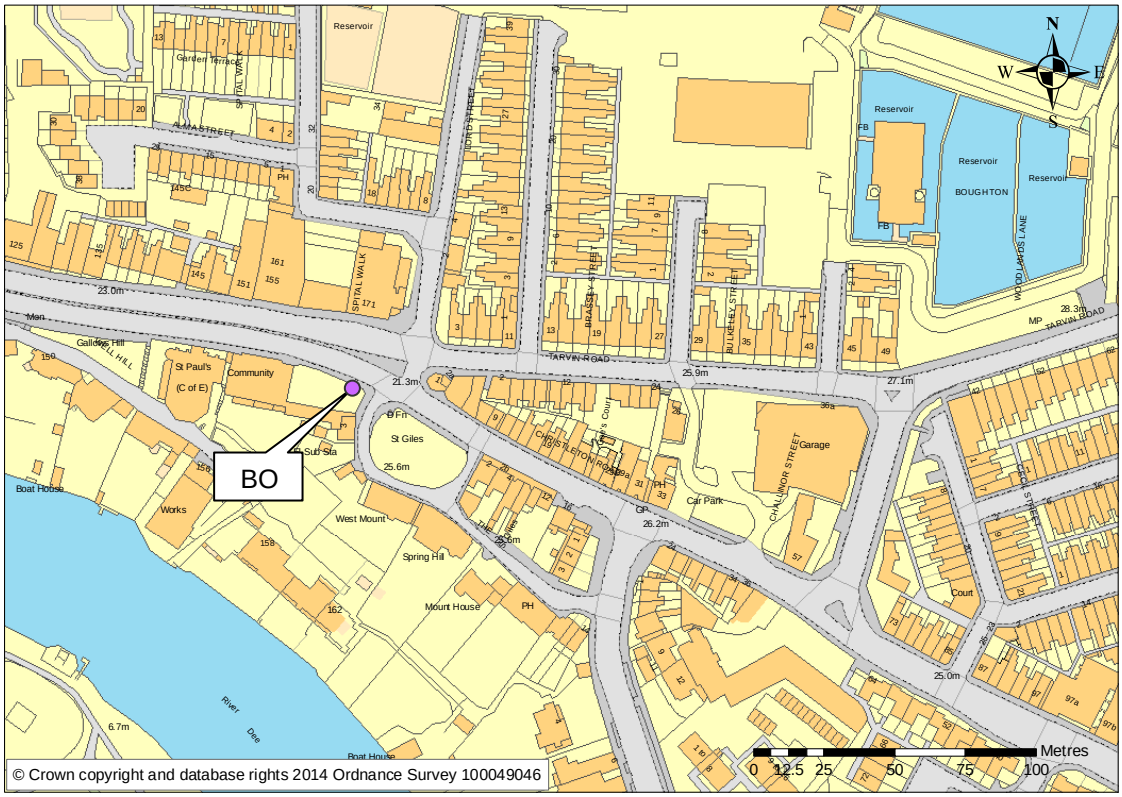


Figure 2 Location of automatic monitoring station in Ellesmere Port

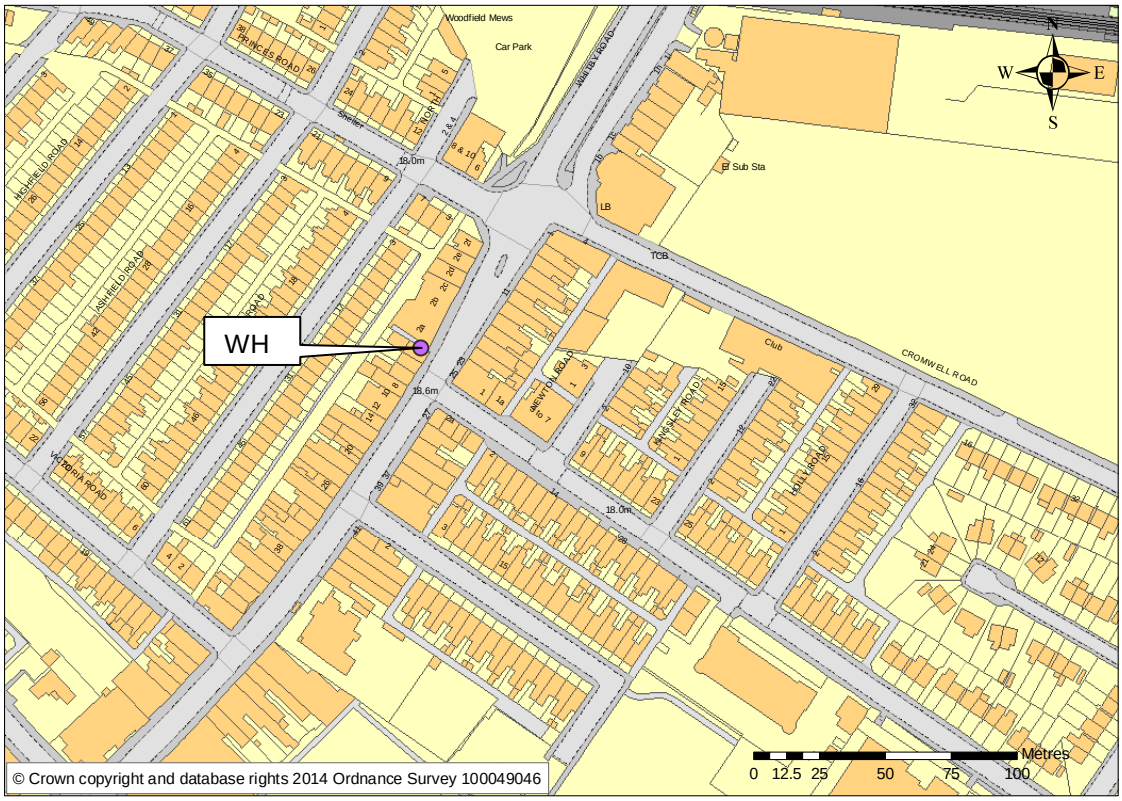


Figure 3 Location of automatic monitoring stations in Thornton le Moors

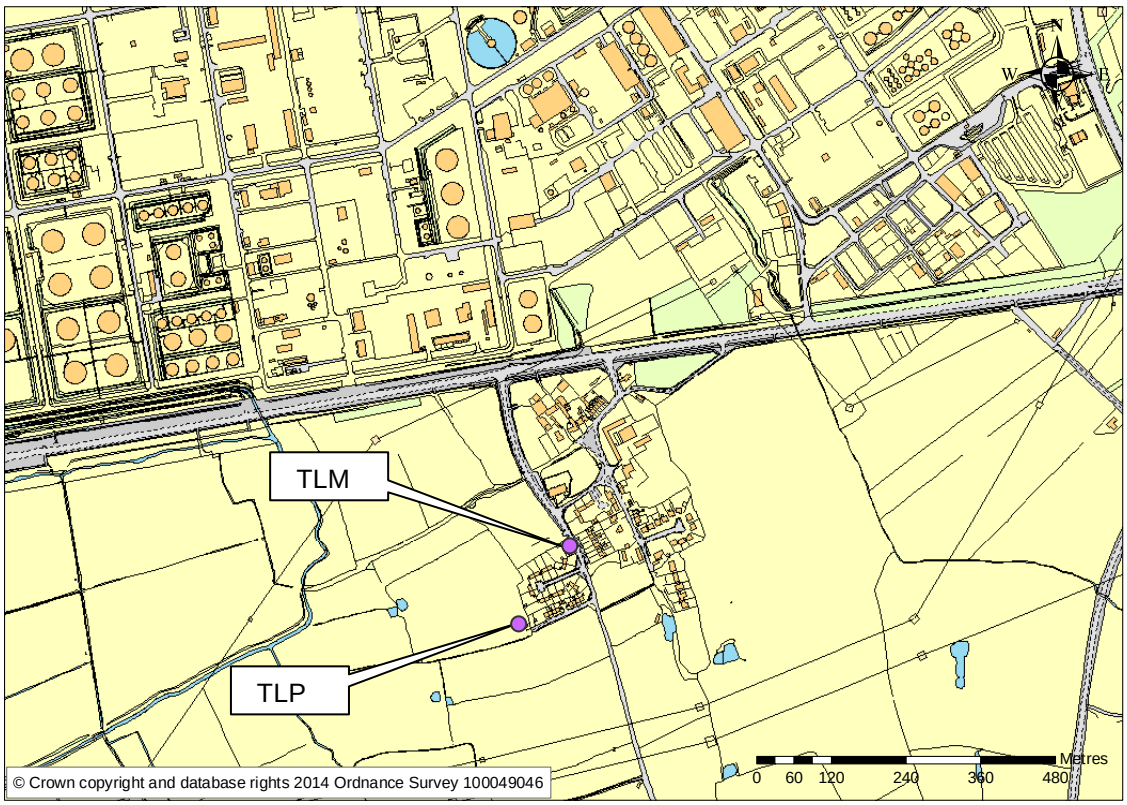


Figure 4 Location of automatic monitoring station in Ellesmere Port

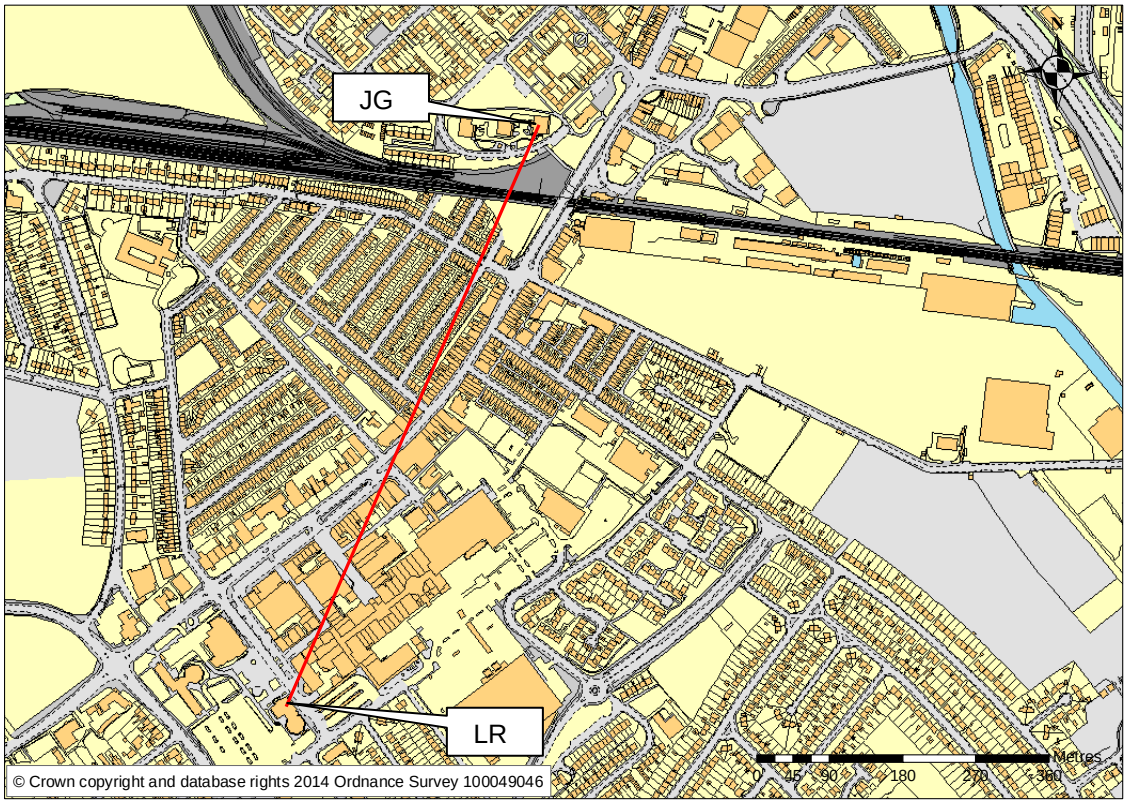


Figure 5 Location of automatic monitoring station in Frodsham

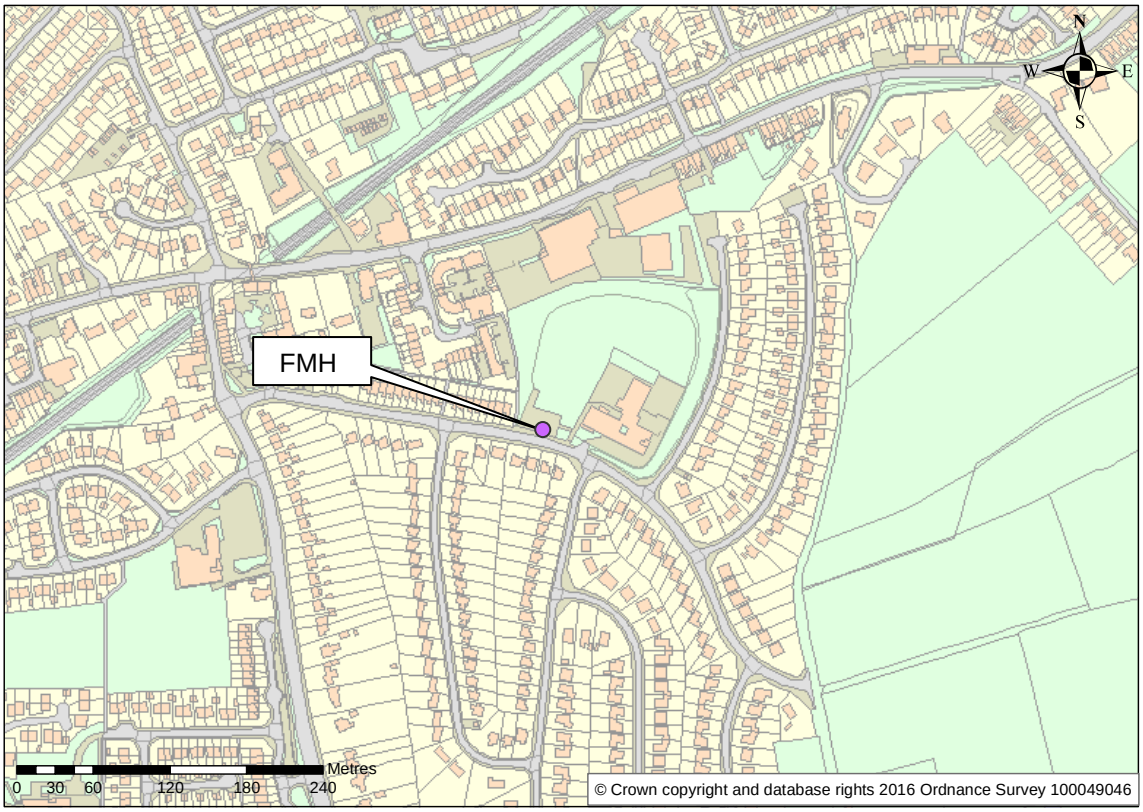


Figure 6 Location of automatic monitoring station in Elton

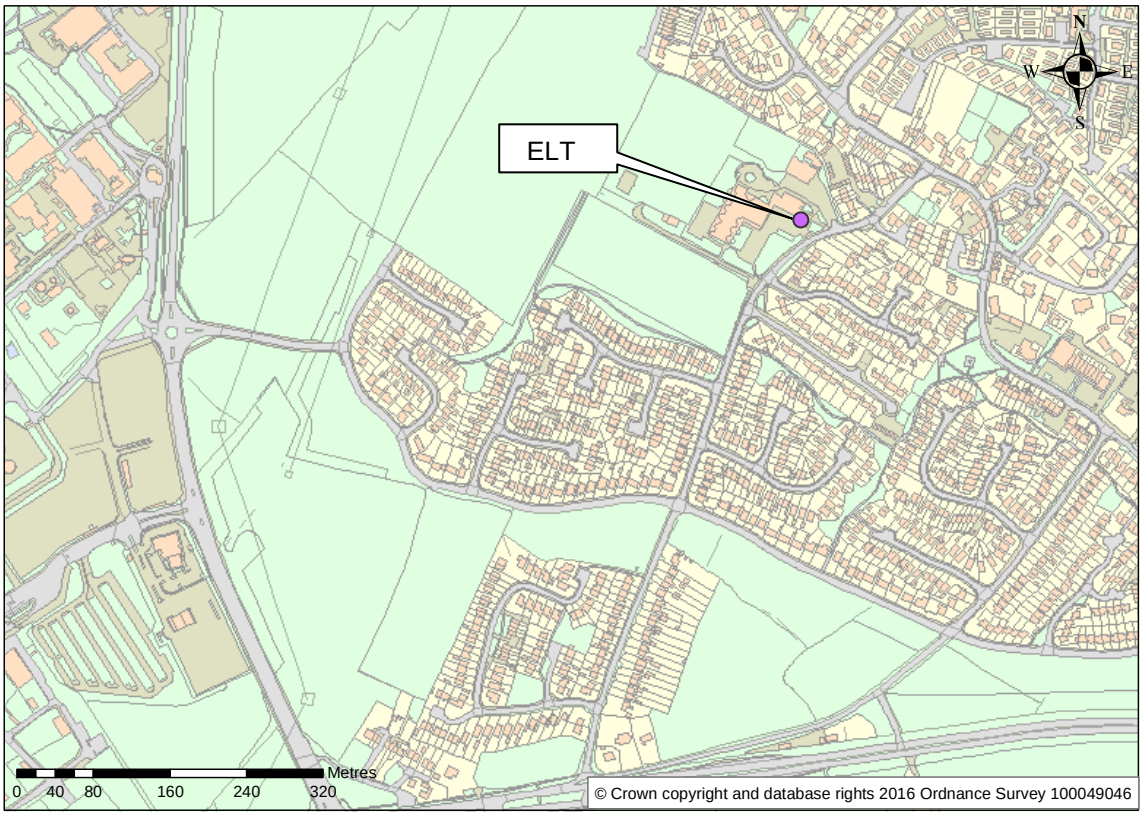


Figure 7 Location of NO_2 diffusion tubes in Chester

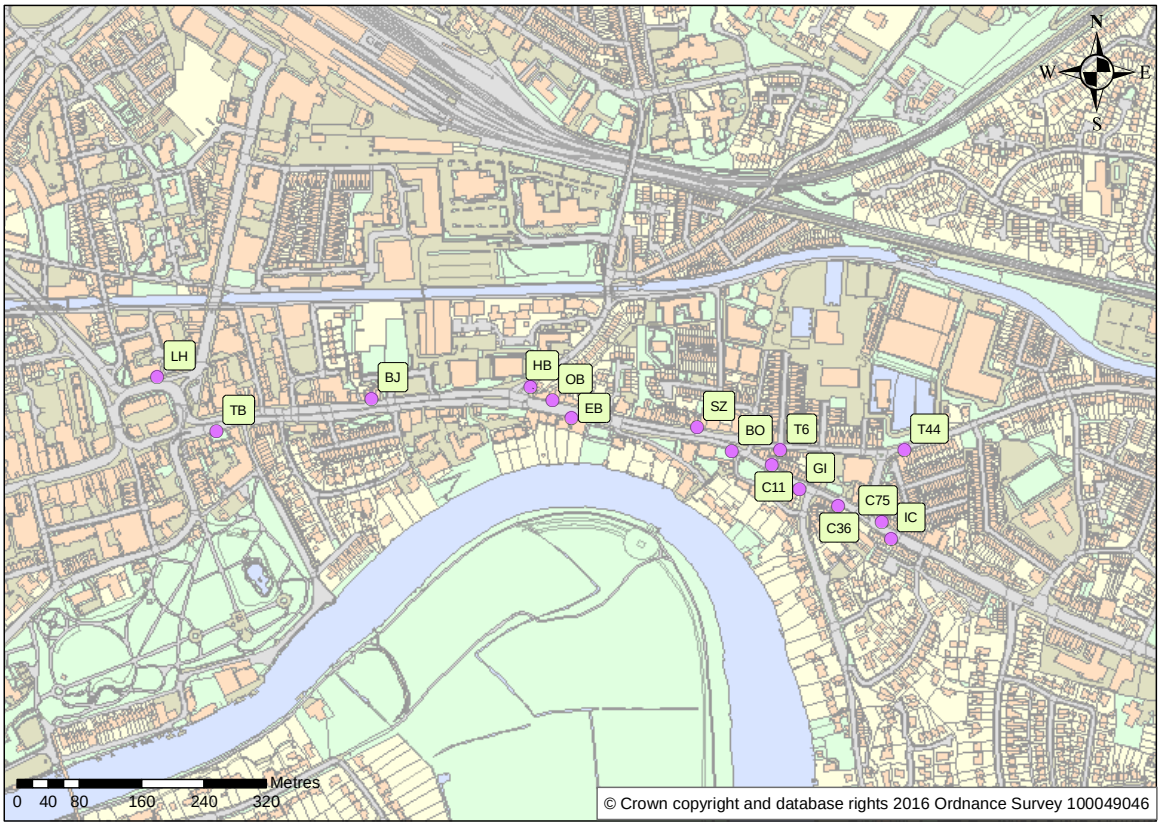


Figure 8 Location of NO_2 diffusion tubes in Chester

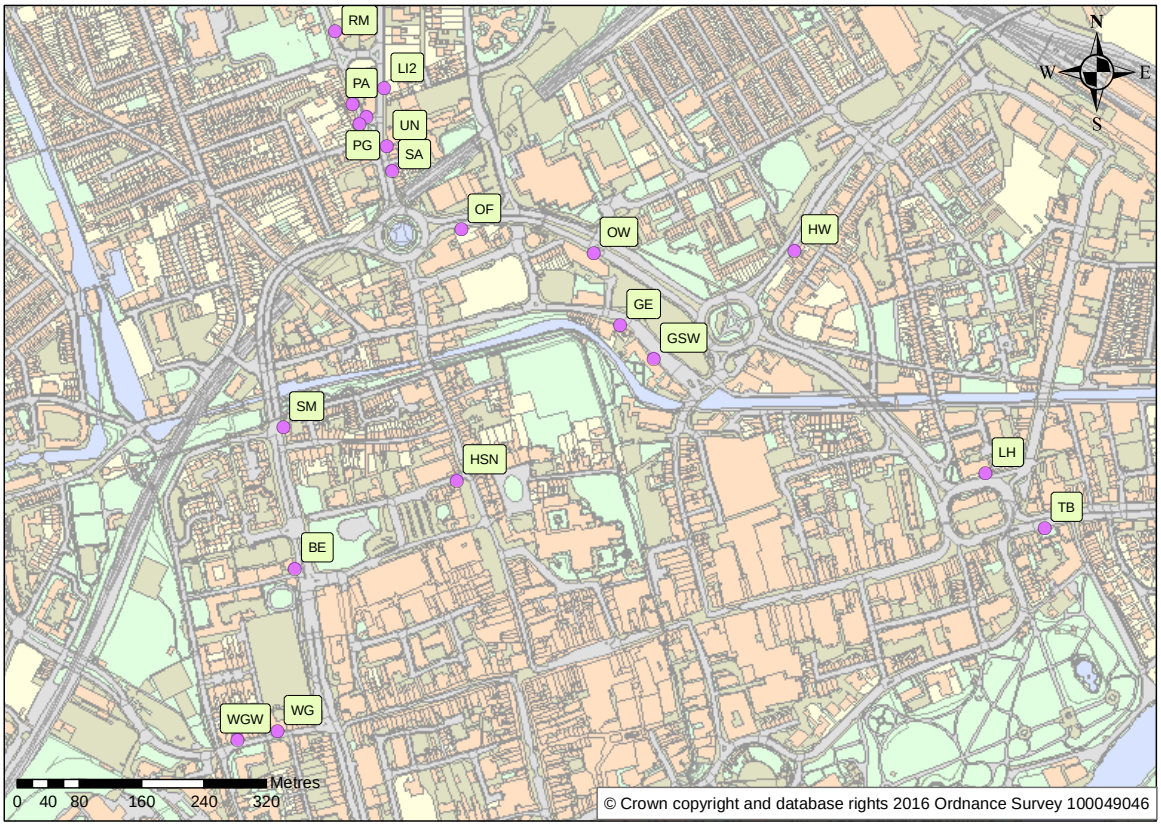


Figure 9 Location of NO_2 diffusion tubes in Ellesmere Port

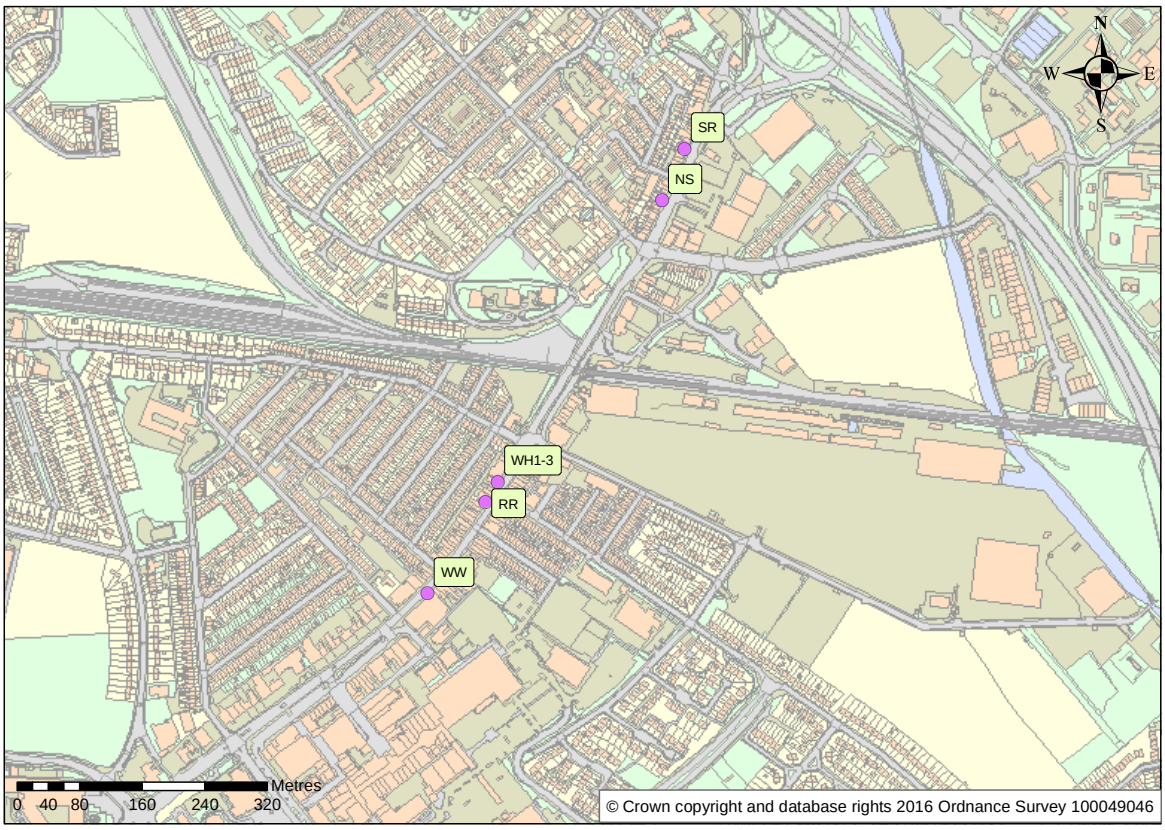


Figure 10 Location of NO_2 diffusion tubes in Frodsham

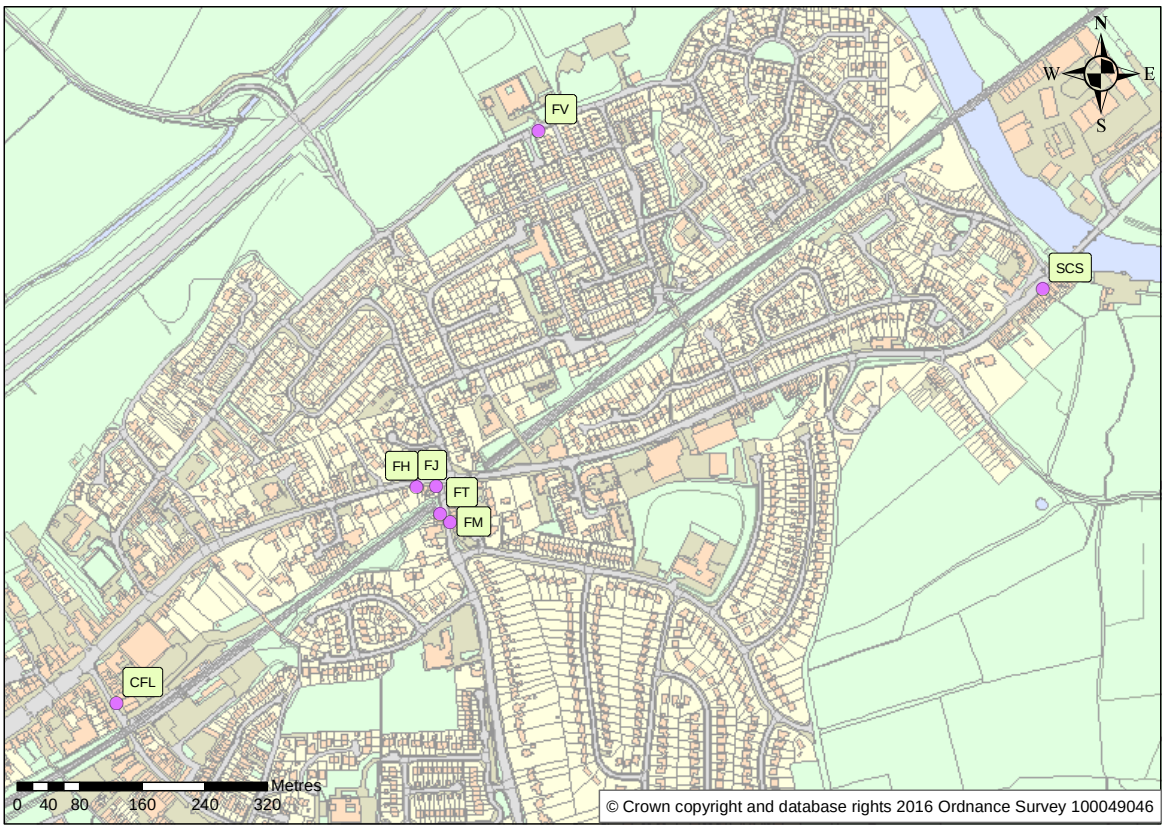


Figure 11 Location of NO_2 diffusion tube, Bartington

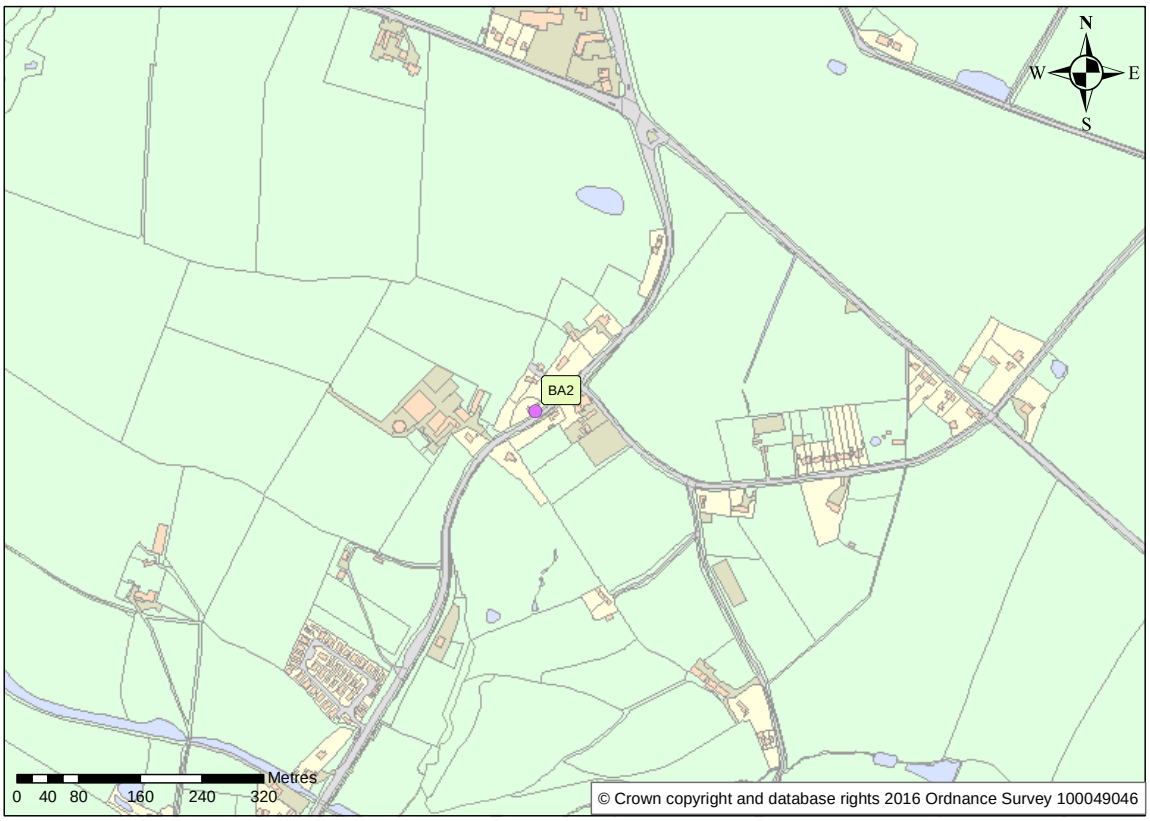


Figure 12 Location of NO_2 diffusion tube, Christleton

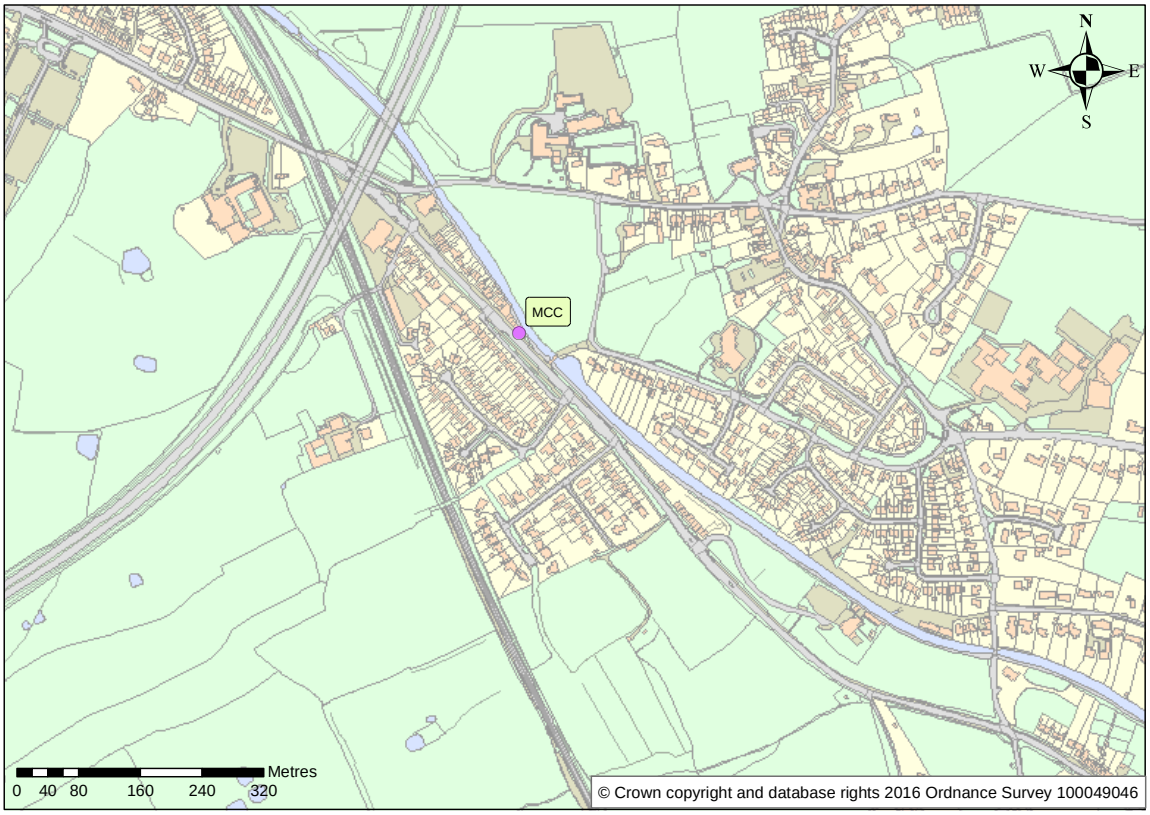


Figure 13 Location of NO_2 diffusion tube in Hartford.

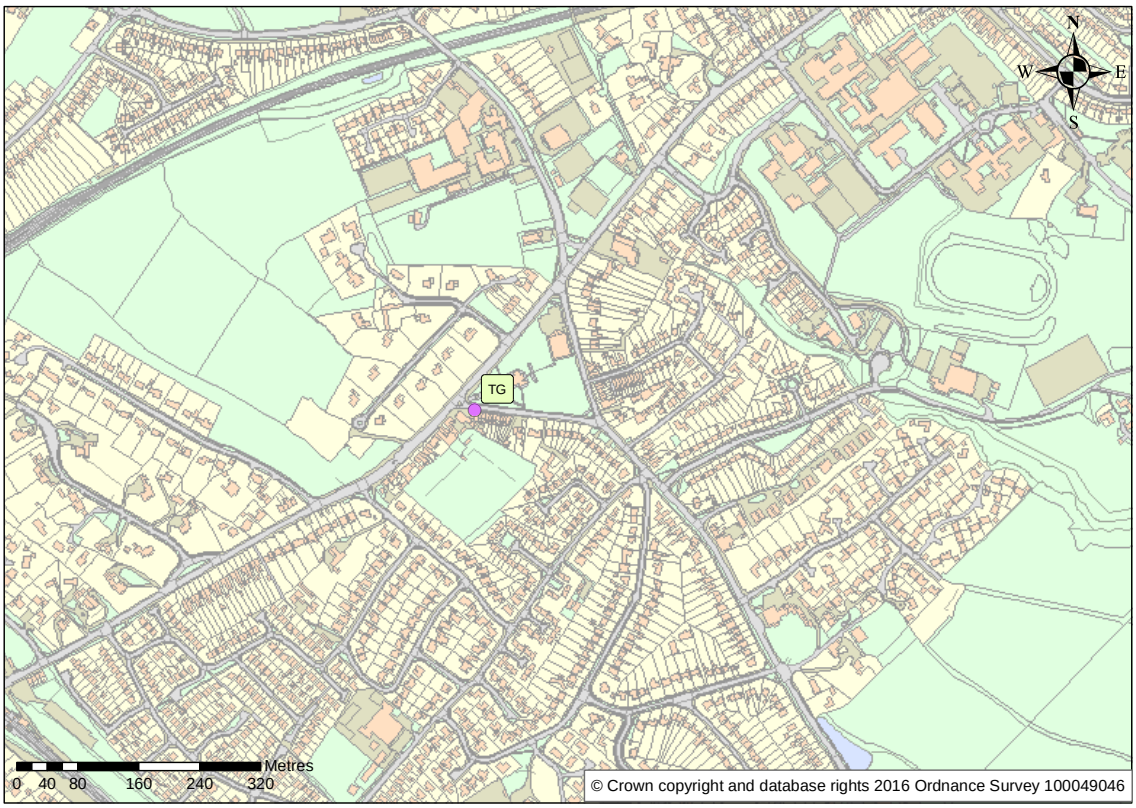


Figure 14 Location of NO_2 diffusion tube, Northwich

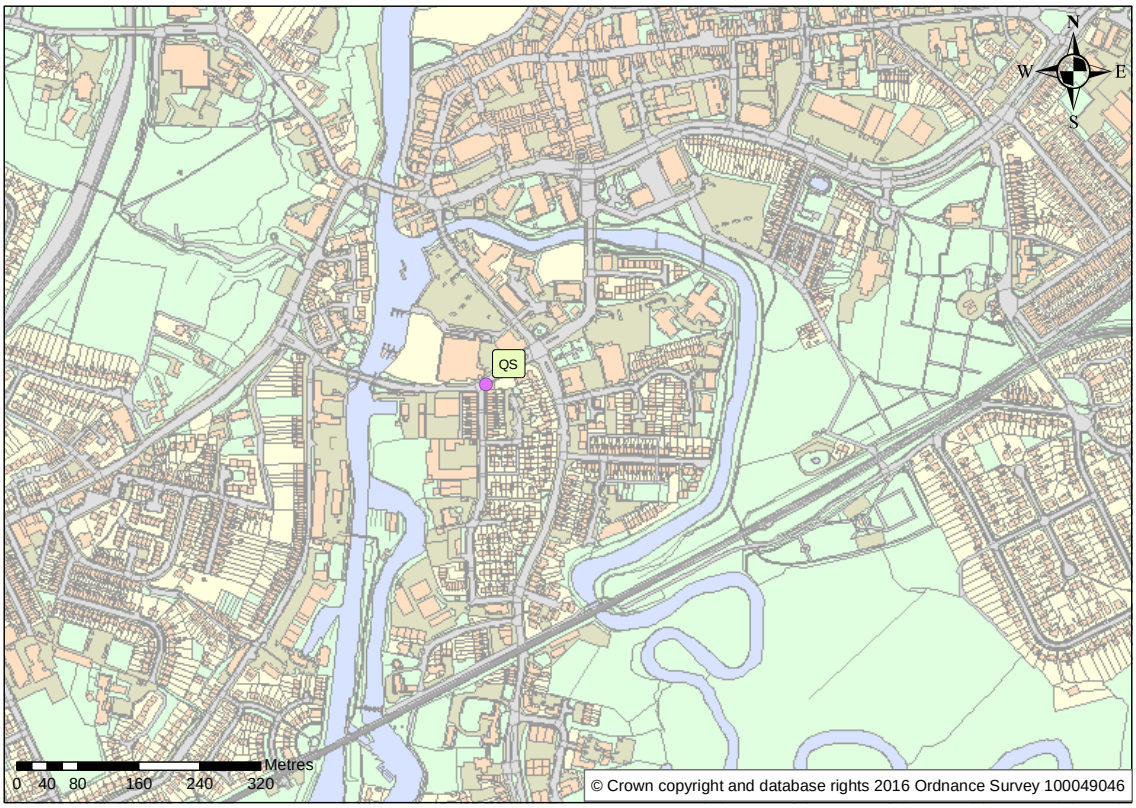


Figure 15 Location of NO_2 diffusion tube, Rudheath.

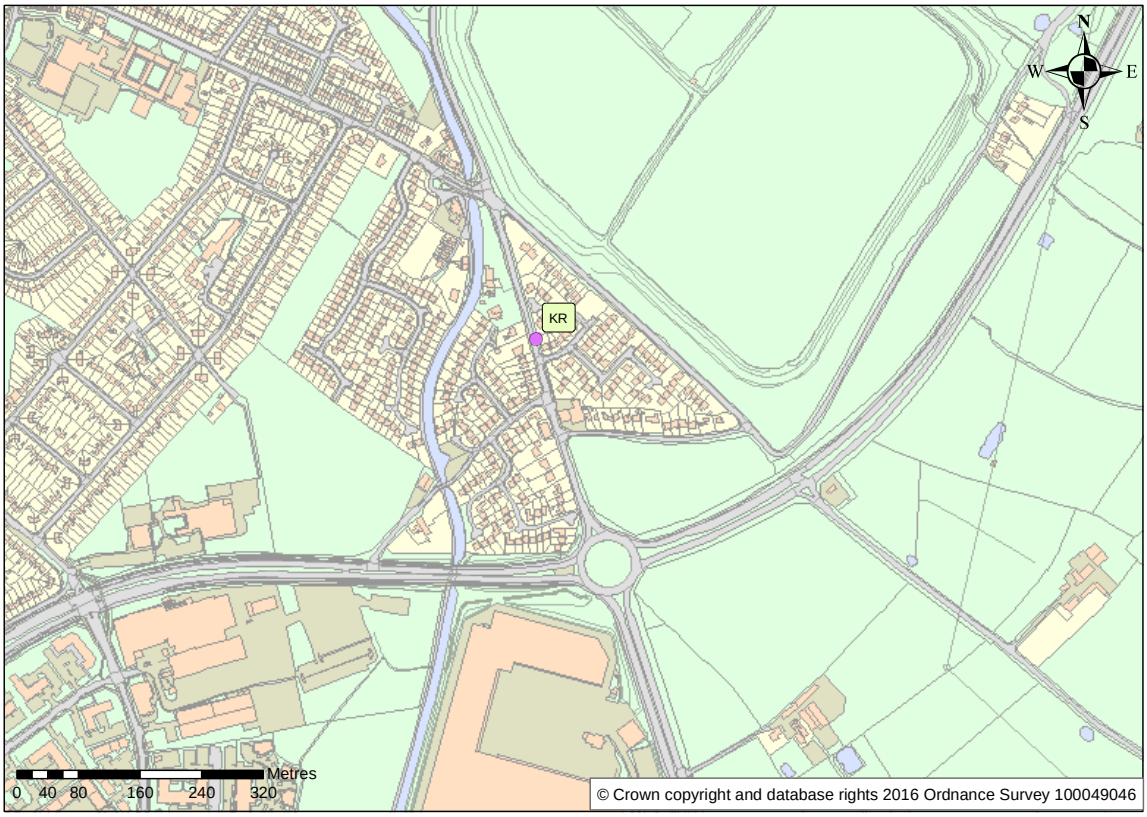


Figure 16 Location of NO_2 diffusion tube in Sproston

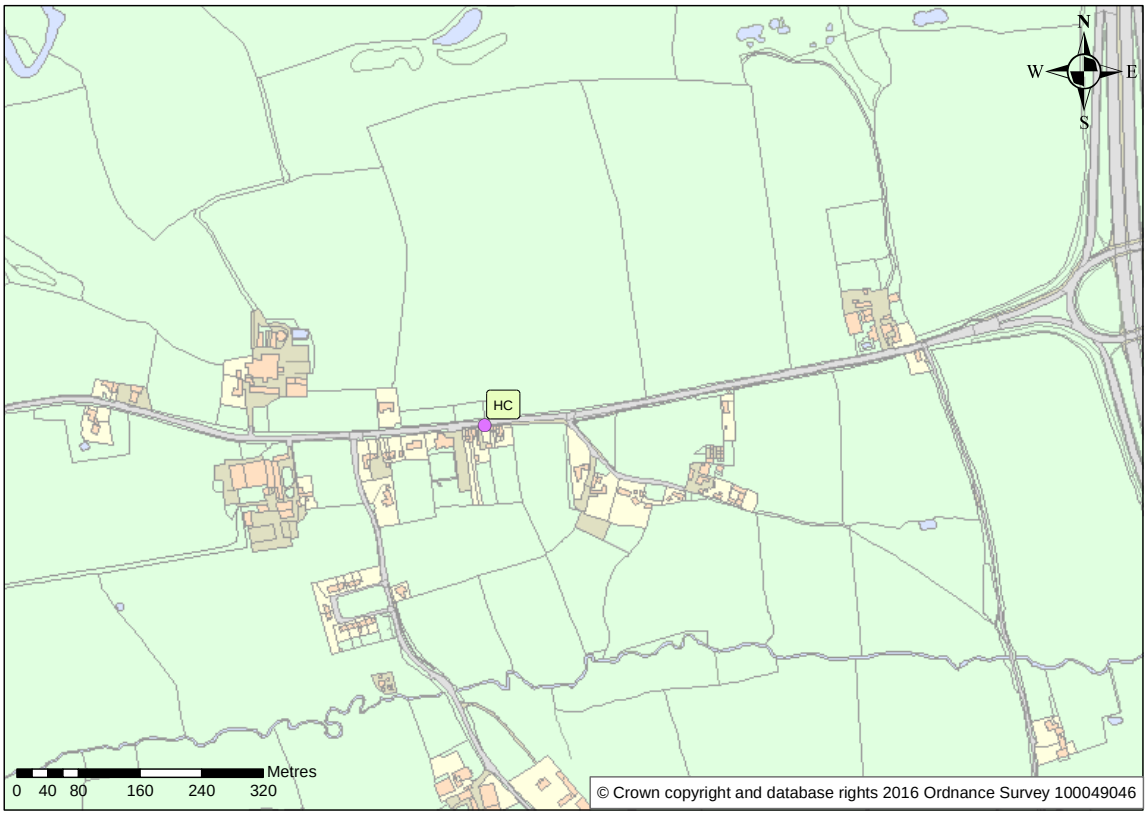


Figure 17 Location of NO_2 diffusion tube Two Mills.

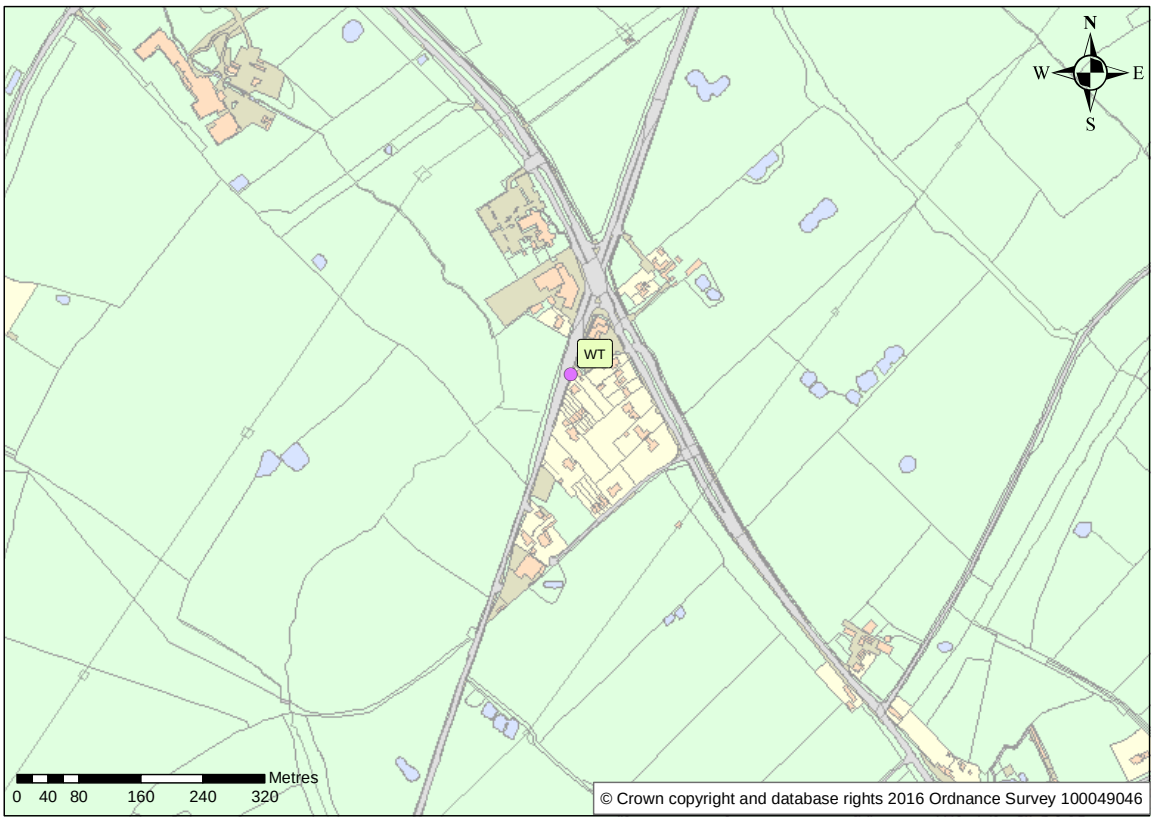
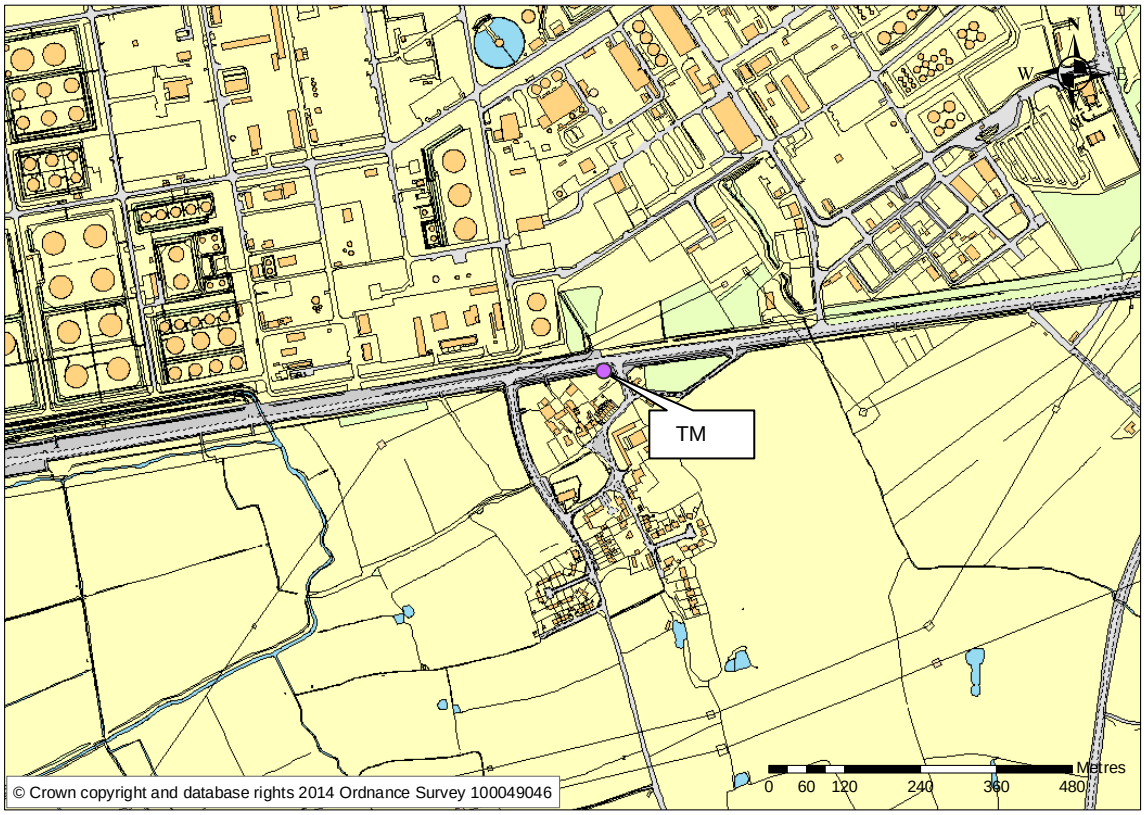


Figure 18 Location of benzene diffusion tube in Thornton le Moors



Appendix E: Summary of air quality objectives in England

Table 16 – Air quality objectives in England

Pollutant	Air quality objective[4]	
	Concentration	**Measured as**
Nitrogen dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	hourly mean
	40 µg/m^3	annual mean
Particulate matter (PM_{10})	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean
	40 µg/m^3	annual mean
Sulphur dioxide (SO_2)	350 µg/m^3, not to be exceeded more than 24 times a year	hourly mean
	125 µg/m^3, not to be exceeded more than three times a year	24-hour mean
	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean

[4] The units are in micrograms of pollutant per cubic metre of air (µg/m^3).

Appendix F: Long-term trends

Figure 19 Five-year trends of NO_2 at local real-time sites

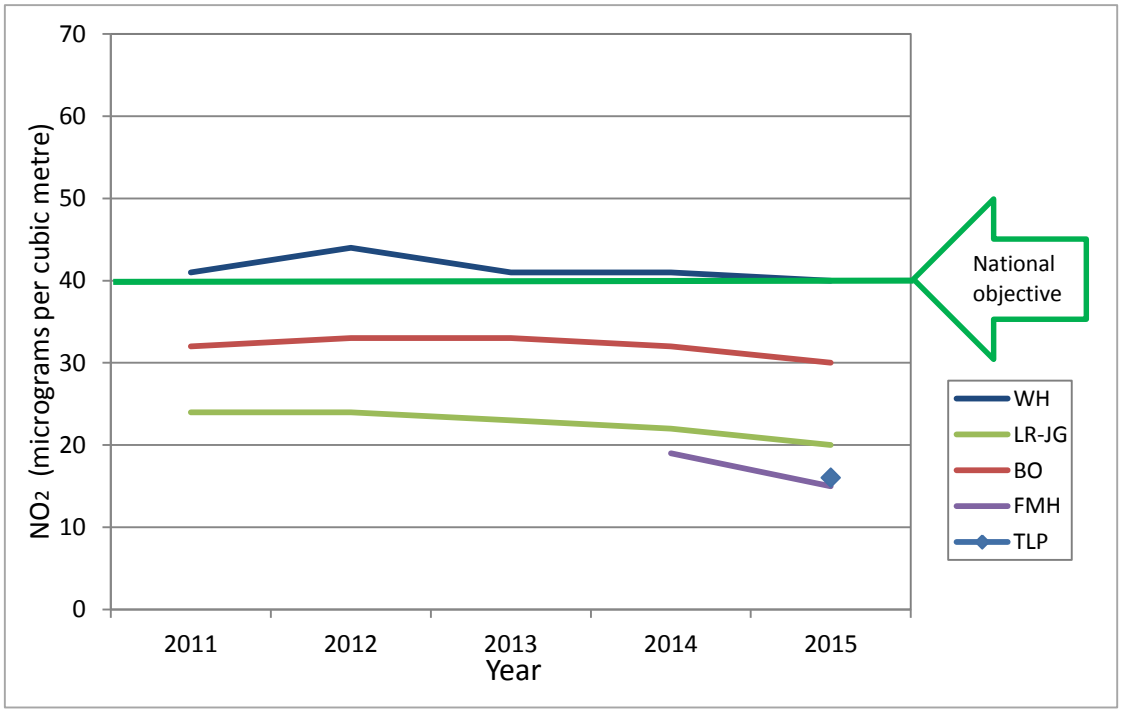


Figure 20 Five-year trends of NO_2 in Boughton, Chester

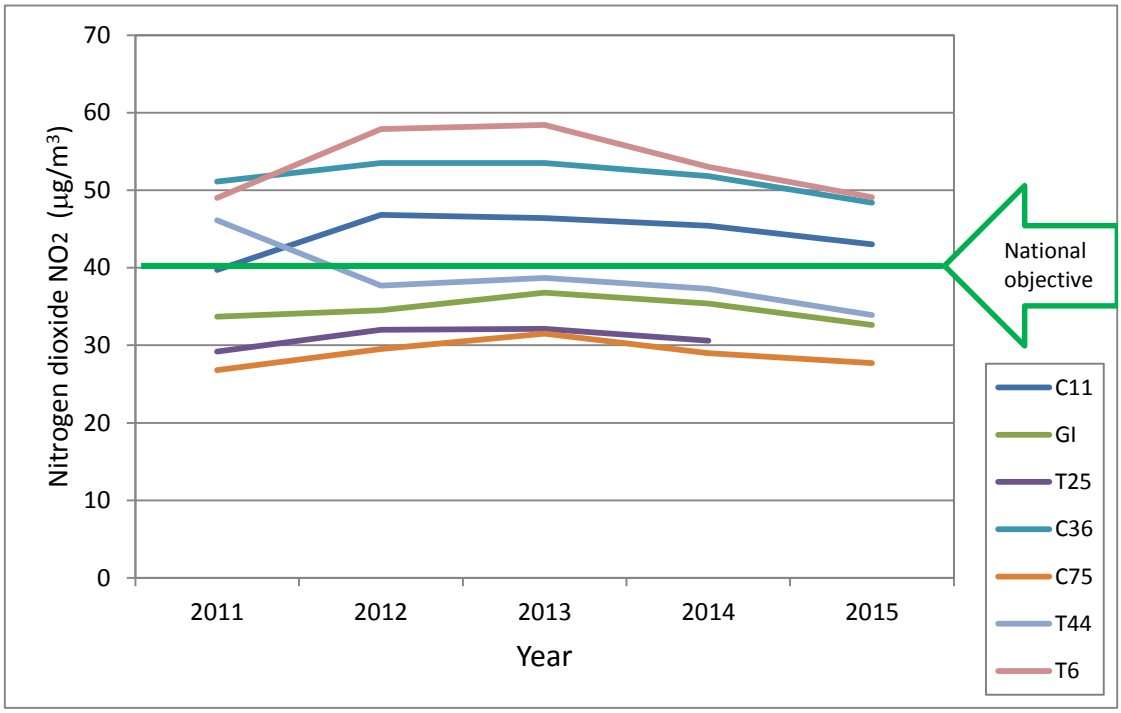


Figure 21 Five-year trends of NO_2 in Ellesmere Port

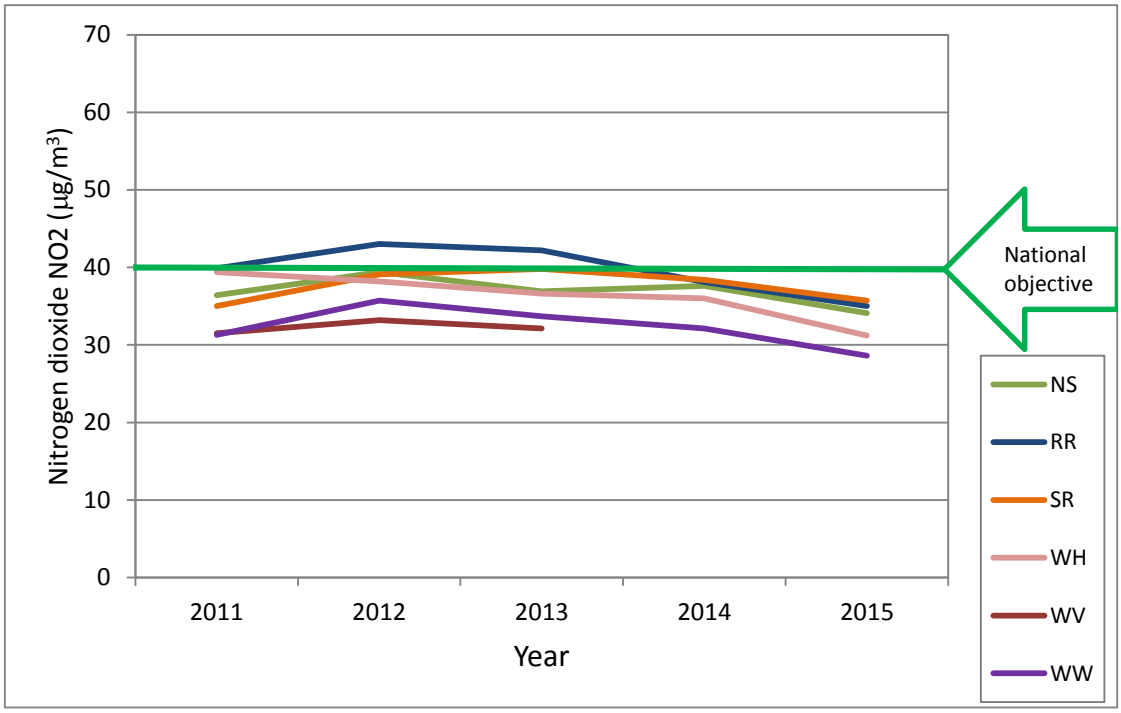


Figure 22 Five-year trends of PM_{10} in Cheshire West

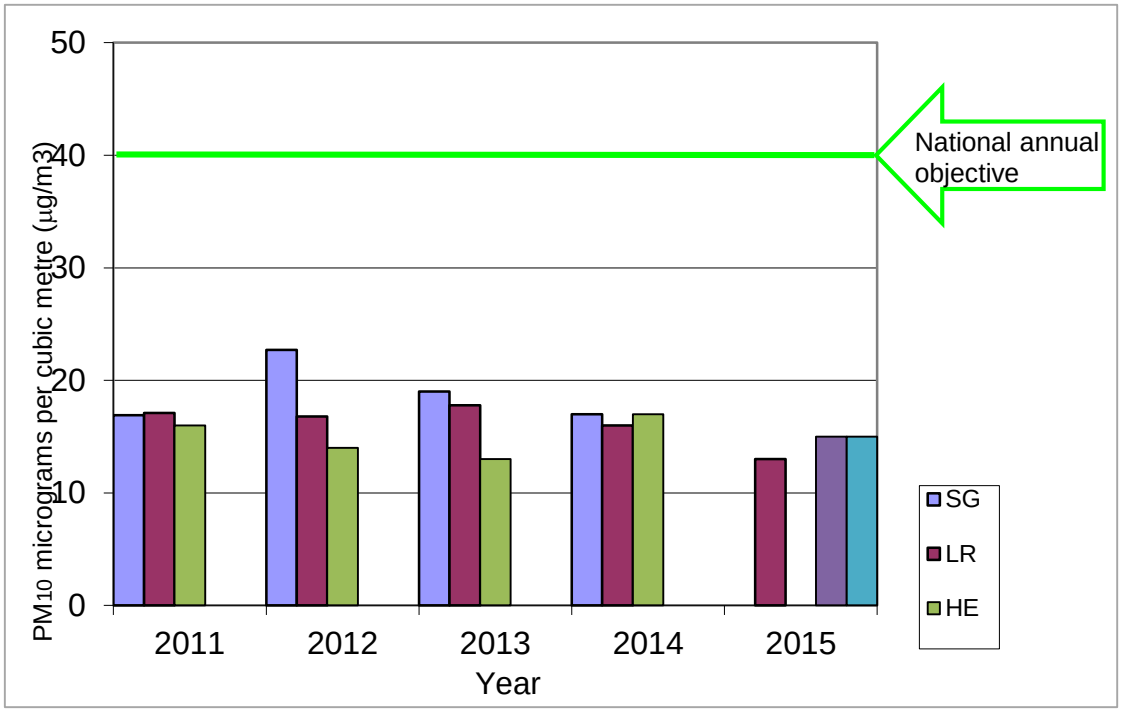
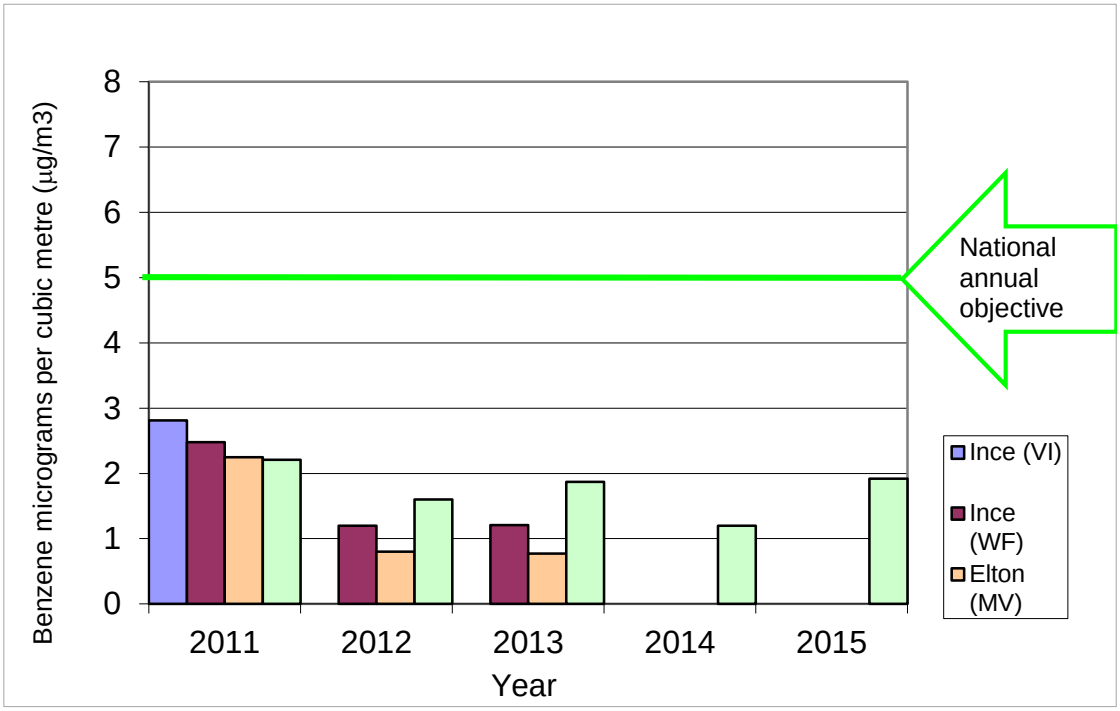


Figure 23 Five-year trends of benzene in Cheshire West



Appendix G:Inter-site comparisons

Figure 24 Inter-site hourly NO_2 comparisons 2015 (AQDM Ltd.)

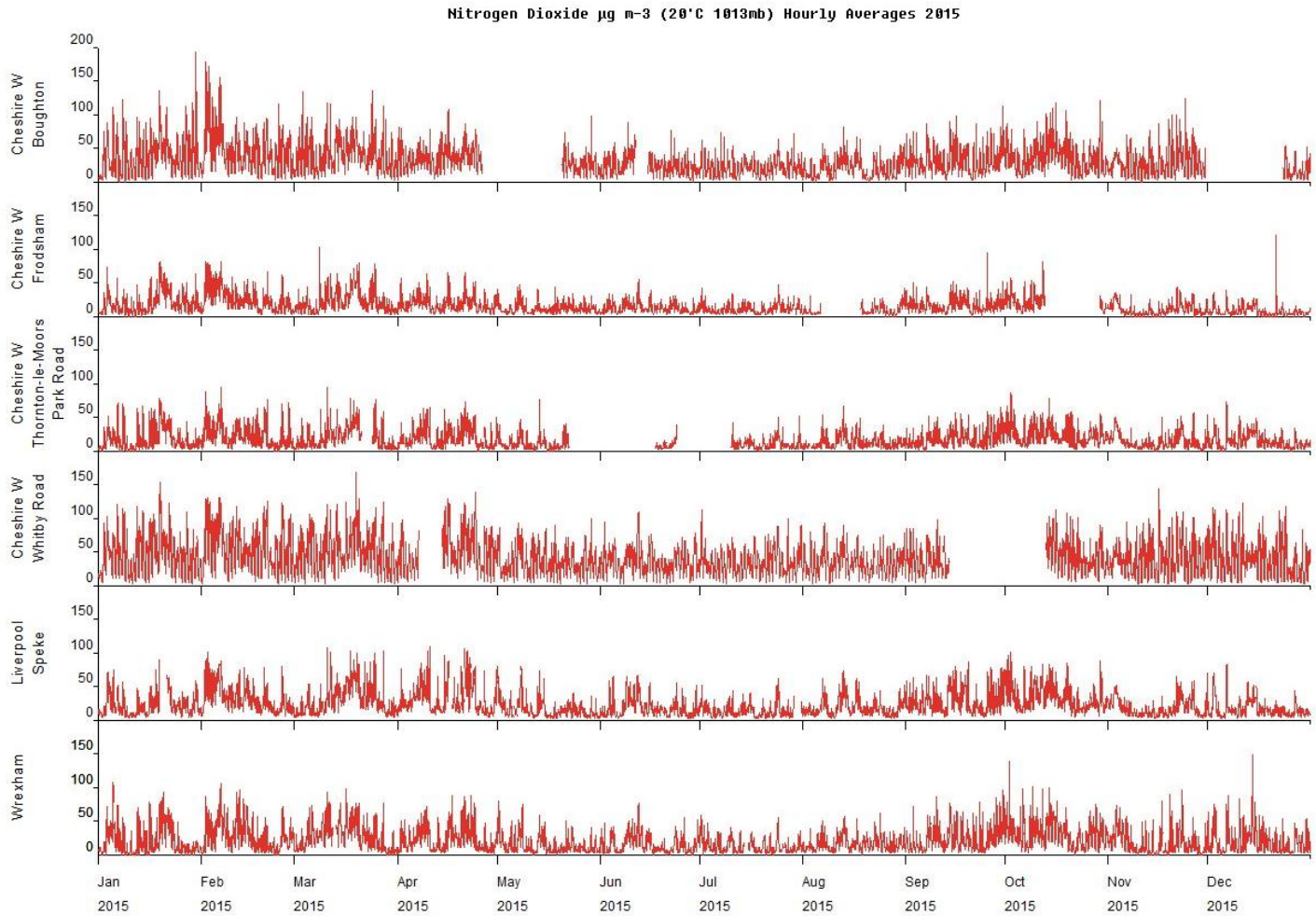


Figure 25 Inter-site daily PM_{10} comparisons 2015 (AQDM Ltd.)

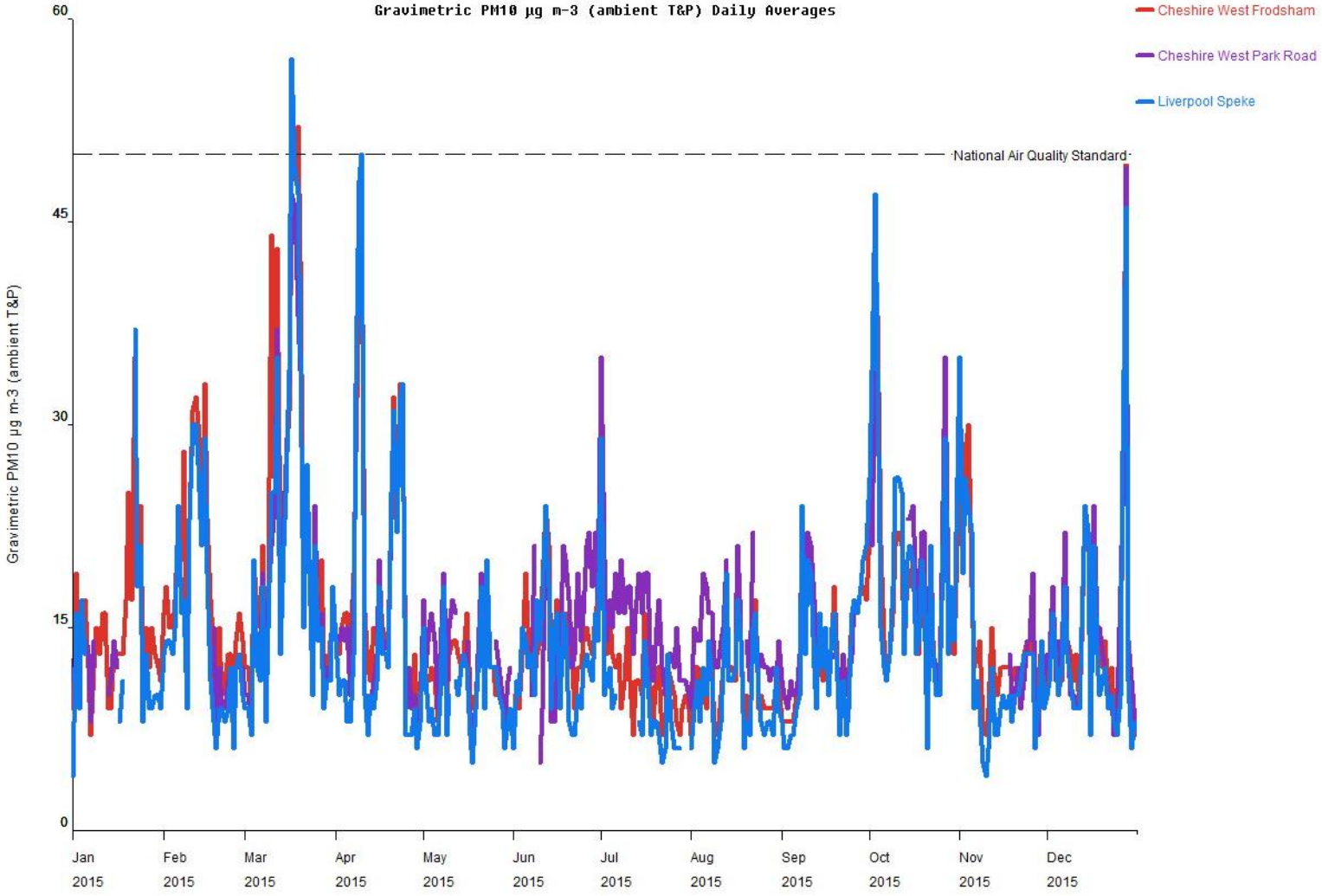
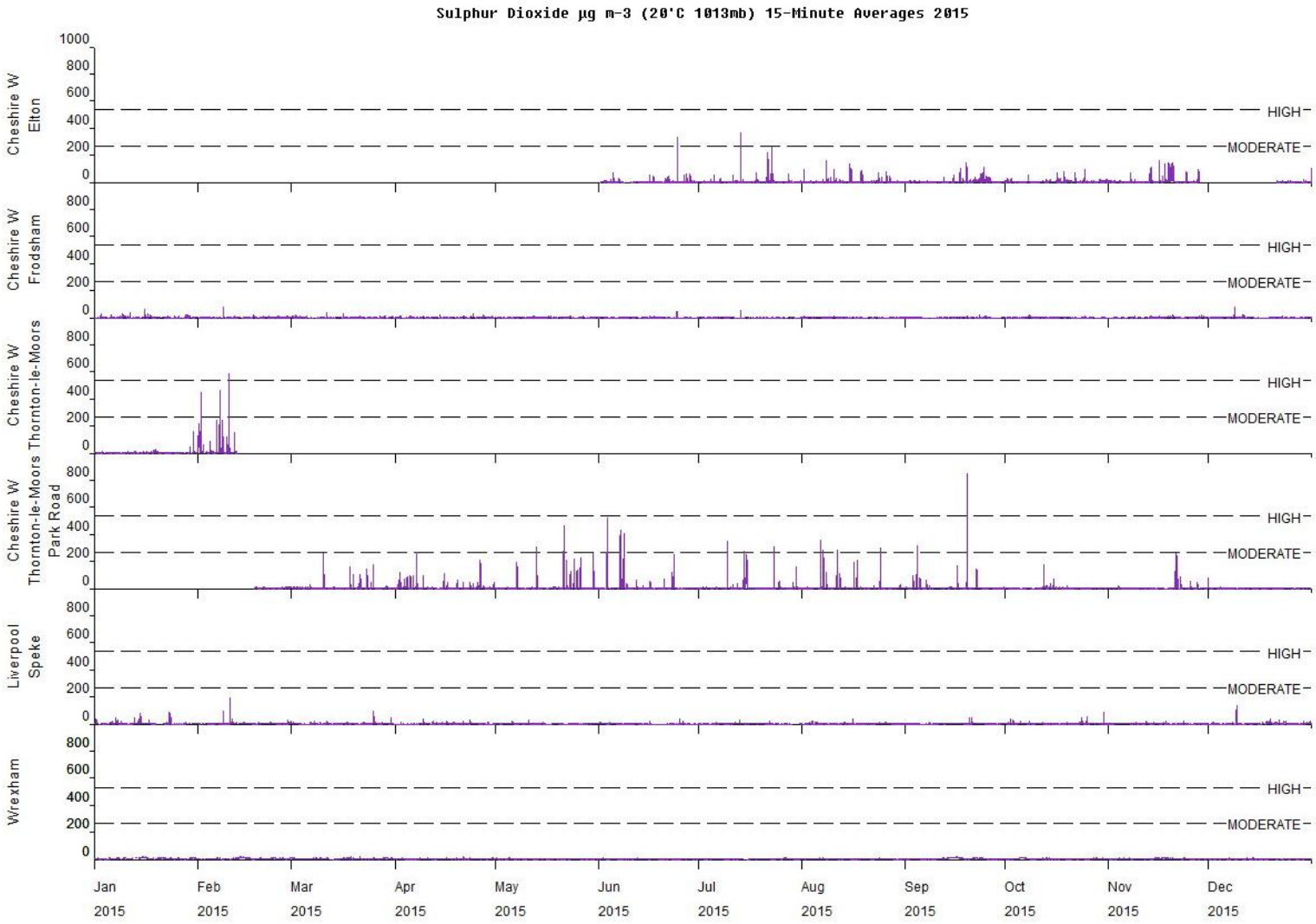


Figure 26 Inter-site 15-minute SO_2 comparisons 2015 (AQDM Ltd.)



Glossary of terms

Abbreviation	Description
AQAP	Air quality action plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values'
AQMA	Air quality management area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
ASR	Annual status report for air quality
AURN	Automatic urban and rural network
Defra	Department for Environment, Food and Rural Affairs
CBTF	Clean bus technology fund
CVTF	Clean vehicle technology fund
CWAC	Cheshire West and Chester Council
EU	European Union
EV	Electric vehicle
LAQM	Local air quality management
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality assurance and quality control
SO_2	Sulphur dioxide
TEA	Triethanolamine
$\mu g/m^3$	micrograms per cubic metre

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