2017 Air Quality Annual Status Report (ASR)

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

December 2017

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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].

In Cheshire West and Chester the pollutants of concern are nitrogen dioxide (NO_2), particulate matter and sulphur dioxide (SO_2). National government has set health-based objectives for a range of pollutants and, where these are not met, the local authority must declare an air quality management area (AQMA) and commit to improving air quality through action planning.

This annual status report (ASR) summarises monitoring results for 2016 and action that the Council has taken in a bid to improve local air quality since the 2016 ASR.

To date, the Council has declared four AQMAs: three in response to exceedances of the annual mean objective for NO_2 due to road traffic emissions and one for exceedances of the 15-minute objective for SO_2 the cause of which is industrial emissions.

The Council recently declared the Chester city centre AQMA, which covers a much larger geographic area than the now revoked Boughton AQMA. Since the last annual status report was published we have developed the air quality action plans (AQAP) for Fluin Lane, Frodsham and Thornton-le-Moors.

Work has also progressed on preparation of the borough-wide low emissions strategy, which is currently out for both internal and external consultation.

[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

Actions to improve air quality

The authority has pursued a number of measures with the aim of delivering air quality improvements in the reporting year of 2016 – 2017.

There has been significant progress with the production of the Council's low emissions strategy (LES). The LES aims to promote: the uptake of ultra-low emission vehicles; sustainable transport; an air quality neutral approach to new development; measures to prohibit poor practice and the dissemination of information to raise awareness of air quality issues. Through 2016 and 2017 both the detailed background document and the main strategy were developed through extensive inter-departmental working and the draft strategy was considered by the Council's Places Scrutiny Committee. The consultative draft of the LES has now been published with a view to adopting the strategy in early 2018.

The first draft of the AQAP for Frodsham was produced in November 2016. This was progressively refined and updated over time and a series of public engagement events was held in the summer of 2017. The final action plan is scheduled to be published in January 2018.

Following declaration of the AQMA for Thornton-le-Moors in September 2016, a draft AQAP has been developed. The source of emissions causing exceedances of the national objective, in contrast to other AQMAs in the borough, is the large oil refinery to the north of the village. As this is a process that is regulated by the Environment Agency, the AQAP has been developed by the Council in conjunction with the Environment Agency and the site operator, Essar. Supplementing the modelling study performed by environmental consultants, Cerc, which determined the geographical extent of the AQMA, a further study commissioned by Essar helped define the likely scale of emission reductions required in order to meet the objectives.

An AQMA for Chester city centre was declared in May 2017 following a review of monitoring and detailed modelling study in 2016 and 2017. The AQMA encompasses the whole of the inner ring road as well as sections of major roads feeding into it. The former Boughton AQMA has now been revoked although the area does form part of the new AQMA.

A supplementary planning document on parking standards, which was adopted by the Council in May 2017, has as a stated aim to address traffic congestion and poor

air quality through the appropriate control of the amount and design of car parking. Amongst the guidelines for parking provision in new developments are recommended minimum specifications for electric vehicle charging infrastructure. Also, the Borough's parking strategy for on-street parking and Council-run car parks includes the ambition to reduce parking charges for low emission vehicles in Chester.

The Council's park and ride contract with the operator Stagecoach was renewed in 2016. All buses utilised on the service are compliant with Euro VI standards, which is an improvement in terms of emissions over the previous Euro IV vehicles. A low emission bus scheme (LEBS) bid for fully electric buses on the park and ride was resubmitted to the office for low emission vehicles (OLEV) in early 2017. The bid was unfortunately unsuccessful.

In early 2016 two Euro II / III buses, which have been upgraded to a Euro VI standard equivalent, came into service. The retrofitted equipment was funded through the clean vehicle technology fund (CVTF). Remaining funds will be utilised for further retrofits in 2018.

The Council submitted a joint (with Cheshire East) bid for air quality grant funding for an Eco stars fleet recognition scheme. Eco stars aims to improve operators' fuel efficiency, reduce emissions and deliver financial savings for participants. Although commended for the monitoring, evaluation and knowledge transfer aspects, unfortunately, the bid was unsuccessful and placed on the reserve list.

Under a four-year programme from late 2016, 20mph zones are being introduced across the borough. While the main driver for the speed restrictions is road safety, studies show that 20 mph speed restrictions are beneficial in reducing oxides of nitrogen (NOx) from diesel engines and particulate matter for both diesel and petrol engines. They are also effective in reducing particulate matter due to fewer acceleration / deceleration events.

There is broad consensus amongst Council members that action needs to be taken to improve local air quality. In December 2016 the Council passed a notice of motion which states that "This Council recognises that traffic-related air pollution is a significant risk to the public's health and wellbeing, contributing to health inequalities in our borough as detailed in the council plan."

"Therefore, this Council reaffirms its commitment to improving air quality and resolves to review current practice including emerging NICE[4] guidelines to ensure council policies and strategies in planning, infrastructure, transport and public health reflect this advice in relation to external air quality."

"Council also confirms its commitment to the recommendations of the Health and Wellbeing Board of July 2015 regarding the impact on health from air pollution."

Note: NICE guidelines include recommendations such as including air pollution matters in strategic planning; provision of electric vehicle charging points; procurement of public sector low emission vehicles; introduction of 20mph zones and specifying emissions standards for licensed vehicles. The Health and Wellbeing Board report recognised the need to consider health impacts of air pollution through Council policies and endorsed the development of the low emissions strategy.

Local priorities and challenges

The Council has a number of local air quality management obligations to fulfil in the immediate future.

Once the consultation phase of the LES is completed in January 2018, the LES 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. Measures included in the LES will need to be prioritised for implementation through a strategic plan of action.

A significant piece of work for the coming months will be the development of an AQAP for the Chester city centre AQMA, which covers several major roads including the inner ring road. Although measures contained in the LES will greatly assist in delivery of air quality improvements within the AQMA, there is a need to produce a range of measures focused on the AQMA itself in order to work towards compliance of the objectives in the shortest possible time.

The AQAP for Frodsham includes a list of 11 potential measures which may benefit local air quality within the AQMA. Layout of the affected junction poses particular challenges for amelioration of the issue and further work will be required to ascertain which options will prove most beneficial.

[4] National Institute for Health and Care Excellence

The AQAP for Thornton-le-Moors includes measures centred on air quality monitoring for which the Council has responsibility. These will be progressed from 2018.

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. The easiest way of contributing to the improvement of air quality is to look at alternatives to the way you usually travel. 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. The Council's low emissions strategy (LES) is out to consultation until 12 January 2018 and can be accessed on the Council website.

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 during 2016. 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). 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.

This annual status report (ASR) is an annual requirement showing the strategies employed by the Council 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 18 in Appendix E.

The next scheduled LAQM report will be the 2018 ASR which is due to be submitted in June 2018.

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. A summary of AQMAs declared by the Council is shown in Table 1. Information relating to declared AQMAs, including maps of AQMA boundaries is available on the Council's website at www.cheshirewestandchester.gov.uk/aqmanagement .

There are four designated AQMAs in the borough, three of which relate to the annual mean NO_2 objective (road traffic sources) and one which was declared due to exceedances of the 15-minute objective for SO_2 (industrial sources). In May 2017, the Chester city centre AQMA was declared following a detailed modelling assessment of road traffic undertaken by environmental consultants Bureau Veritas (late 2016 to early 2017). The AQMA encompasses the whole of the inner ring road along with a number of major routes feeding into it. This supersedes the much smaller Boughton AQMA, originally declared in 2008 and extended in 2011, which is now revoked.

An air quality action plan (AQAP) has been produced for the Fluin Lane AQMA this year. The AQAP was developed with contributions from a broad range of Council departments, the support of independent traffic / environmental consultants, Atkins, and a comprehensive public consultation exercise.

Partnership working between the Council's Environmental Protection team, the Environment Agency and industrial operator, Essar has resulted in development of a draft AQAP for the Thornton-le-Moors AQMA. Currently out to public consultation, the AQAP is due to be finalised by the spring of 2018.

Production of an AQAP for the Chester city centre AQMA is a priority for the coming year and the Council has a stated commitment to update and revise the Ellesmere Port AQAP during 2018.

Table 1 Declared air quality management areas

AQMA name	Date of declaration	Pollutants and air quality objectives	City / town	Description	Air quality in the AQMA influenced by roads controlled by Highways England?	Level of exceedance (max monitored / modelled concentration at location of relevant exposure		Action plan (AQAP)
						At declaration	Now	
Whitby Road / Station Road	2005	NO_2 annual mean	Ellesmere Port	Residential properties on parts of Whitby Rd, Station Rd and Princes Rd	No	44.5 micrograms per cubic metre ($\mu g/m^3$)	40 $\mu g/m^3$	Ellesmere Port and Neston BC Air Quality Action Plan 2007 www.cheshirewestandchester.gov.uk/aqmanagement
Chester City Centre	May 2017	NO_2 annual mean	Chester	Area within inner ring road and sections of Liverpool Rd, Parkgate Rd, Hoole Way, Boughton gyratory and Watergate St	No	49.1 $\mu g/m^3$	50.3 $\mu g/m^3$	AQAP due to be completed in 2018
Fluin Lane	November 2015	NO_2 annual mean	Frodsham	Junction of A56 and Fluin La.	No	42.6 $\mu g/m^3$	44.2 $\mu g/m^3$	Frodsham Air Quality Action Plan 2018 www.cheshirewestandchester.gov.uk/aqmanagement
Thornton-le-Moors	September 2016	SO_2 15-minute mean	Thornton-le-Moors	An area around the oil refinery at Stanlow	No	56 exceedances (15-minute)	70 exceedances (15-minute)	Draft AQAP produced. Consultation exercise runs to 23/02/2018

☒ Cheshire West and Chester Council confirms that the information on the UK-Air website regarding our AQMA(s) is up to date

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

The Council has taken forward a number of measures during the current reporting year of 2016 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:

- Low emissions strategy (LES) – the detailed background document supporting the LES was completed in early 2017
- The main LES document was developed in 2016 – 2017. Work involving extensive inter-departmental liaison resulted in the production of the final consultative draft in late 2017
- A supplementary planning document on parking standards has been produced. This includes minimum specifications for the provision of on-site electric vehicle charging infrastructure in new developments
- The borough-wide 20 mph speed limit programme has commenced with speed limits being progressively introduced on a range of residential streets in a four-year programme to 2020
- Air quality reporting software has been trialled, allowing the oil refinery operator access to monitoring data in near real-time. The aim is to have this fully implemented in early 2018
- Clean vehicle technology funds have been utilised to retrofit exhaust emissions abatement technology on bus services in Chester
- Taxi and private hire vehicle age policy for both entry and exit is now fully implemented
- A number of cycling and walking promotion initiatives are ongoing
- The park and ride contract has been renewed with Euro VI buses in use

The Council expects the following measures to be completed over the course of the next reporting year:

- Finalisation and adoption of the AQAP for Frodsham
- Completion of the consultation exercise on the AQAP for Thornton-le-Moors and progress with a number of the plan's measures
- Completion of the consultation exercise on the (LES) and prioritisation of measures
- With third-party support, undertake an appraisal of electric vehicle charging infrastructure in the borough and carry out a feasibility study on rollout of equipment across a variety of sectors
- Development of the AQAP for Chester city centre

The Council's air quality priorities for the coming year are:

- local air quality management obligations, as detailed above
- finalisation and adoption of the Council's LES
- to formulate a plan of action for the adoption of measures listed in the LES
- incorporation of air quality policies into the local plan, part two
- to promote and enable the uptake of ultra low emission vehicles both internally and externally
- appraise options idling vehicles enforcement
- to apply for and take advantage of central funding opportunities for the introduction of air quality improvement measures
- to produce the 2018 annual status report

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	The Council	2014	2015 - 2016			Complete	Complete	The SPD has been produced pending completion of the Local Plan part two in early 2018
2	Park and ride contract renewal	Alternatives to private vehicle use	Bus based park and ride	The Council	2014 - 15	2016 - 21	Upgrade of buses from Euro IV to Euro VI		Contract awarded to Stagecoach	Complete	Second bid for low emission bus scheme (LEBS) funding for EV buses **unsuccessful**
3	Park and ride. New infrastructure at Boughton Heath and Sealand Rd	Alternatives to private vehicle use	Bus based park and ride	The Council	2017 / 2018	2018 and beyond phased stages	Upgrade of existing park and ride waiting facilities to include toilets	Chester-wide	Draft detailed design drawings produced	2018 and beyond phased stages	New modern enhanced waiting facilities, providing a gateway to park and ride in Chester
4	Electric vehicle (EV) charging points	Promoting low emission transport	Procuring alternative refuelling infra-structure	The Council	2012	2015			EV charging posts installed at Hooton station	Complete	Complete

	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	Ultra low emission vehicles accelerator	Promoting low emission transport	Procuring alternative refuelling infra-structure	The Council	2017	2017 / 2018 up to 2022 / 2023		Yes, borough wide	Feasibility study funding identified	2018 / 2019 main project delivered with ongoing support up to 2022 / 2023	Commission EV infrastructure feasibility study; awareness campaign; capital investment in electric vehicle charging infrastructure
6	Clean vehicle technology fund (CVTF) for eight bus engine retrofits	Vehicle fleet efficiency	Vehicle retrofitting programmes	The Council	2014	2015 / 2016 / 2018	Services in operation in Chester	Yes. Services running though Chester AQMA	Four buses upgraded: two Stagecoach and two Arrowebrook	2018	Further retrofit / portable emissions monitoring tests will be carried out in 2018
7	Low emissions strategy	policy guidance and development control	Low emissions strategy	The Council	2014 - 15	2015 - 18	Adoption of strategy	Yes, borough wide	Draft report produced	2018	Broad consultation on draft report. Aim for adoption of final LES early 2018. Numerous mitigation measures included

	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	Secure cycle storage	Transport and planning infrastructure	Cycle network	The Council	2009 - 2010	2011 - 2016	Increase in number cyclists.	Yes, Chester AQMA	Complete – storage installed at Chester city centre and park and ride sites, Ellesmere Port town centre and selected railway stations.	2016 complete (and on-going, subject to funding applications being successful)	Local sustainable transport fund (LSTF) (2011 - 2015) utilised. Subsequent sustainable travel fund bid (2016 - 2017) **unsuccessful**. Three-year joint bid to Department for Transport (DfT) (2017 - 2020) **unsuccessful**.
9	Bikeability campaign (schools and adults only schemes)	Promoting travel alternatives	Promotion of cycling	The Council	Annual programme	Ongoing	Increase in number cyclists.	Training is delivered borough wide. Benefits for all AQMAs	Ongoing Subject to annual project review	Ongoing	DfT / Council funded programmes ongoing – road safety team. LSTF connect to jobs scheme complete.
10	Let's bike	Promoting travel alternatives	Promotion of cycling	The Council	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 proficiency training course. Road Safety team

	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
11	Let's walk	Promoting travel alternatives	Promotion of walking	The Council	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
12	Schools crossing patrols	Promoting travel alternatives	Promotion of walking	The Council	Annual programme	Ongoing	Improve pedestrian confidence to encourage more sustainable trips	Yes, borough-wide. Provided at hazardous school crossing points	Ongoing subject to annual project review	Ongoing	Supporting vulnerable road users cross the highway – when arriving and leaving educational establishments
13	Anti-idling enforcement	Traffic management	Anti-idling enforce-ment	The Council	2018	2018 - 2020	Reduction of idling frequency and complaints	Borough-wide	Signs erected at bus stands and taxi ranks	Ongoing	Included as measure in draft LES. To be pursued 2018.
14	EV charging points through planning conditions	Policy guidance and development control	AQ planning and policy guidance	The Council	2014	2015 - 2017	Planning conditions on applications	Yes, borough-wide	Supplementary planning document introduced	2018	Local Plan part two due to be adopted 2018
15	Taxi and private hire age policy	Promoting low emission transport	Taxi licensing conditions	The Council	2012	2013 - 2014	Entry and exit ages of vehicles enforced	Yes	Complete January 2017	Complete	Transition period ended 2016. Age policy fully implemented.

	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	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 the Council	2016 - 2017	2017 - 2018	Increase in park and ride passengers, reduce number of private single occupancy vehicles in the city centre	Yes	Complete June 2017	Complete	Provides enhanced static signage and potential variable message signs at slip roads.
17	Highway cycle improvement scheme at M53 Junction nine	Transport and planning infrastructure	Cycle network	Highways England in partnership with the Council	2016 - 2017	2017 - 2018 to be constructed	Reduce traffic between the E. Port Waterfront developments and town centre via AQMA.	Yes. Ellesmere Port	Detailed design stage	2017 / 2018	Providing crossing points and shared-use footpaths between residential and employment areas / railway station
18	Promote sustainable travel through educational establishments and workplaces	Promoting travel alternatives	Promotion walking / Promotion of cycling / School travel plans	The Council, Cheshire East and Warrington BC	2016 - 2017	2017 - 2018 to 2019 - 2020 revenue bid	Reduction in car journeys		Bid submitted	2017 - 2018 to 2019 - 2020. Bid **unsuccessful**	

	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	Improved cycling and walking routes	Transport planning and infrastructure	Cycle network	The Council, Cheshire East and Warrington	2016 - 2017	2017 - 2018 to 2019 - 2020 Awaiting bid outcome	Reduction in car journeys		Bid submitted	2017 - 2018 to 2019 - 2020 Awaiting bid outcome	Joint access fund capital bid. Includes various routes around Ellesmere Port including canal Towpath and green loop
20	Chester western relief road (proposed new road to the west of Chester	Traffic management	Strategic highway improvements	The Council	2016 - 2017	2018 - 2019	Reduced journey times, relief of the inner ring road, improved access to key employment sites		Bid submitted		Funding bid **unsuccessful**
21	Chester city gateway road (proposed scheme on Hoole Road corridor)	Traffic management	Strategic highway improvements	The Council	2016 - 2017	2018 - 2019	Reduced journey times, relief of the inner ring road, improved access to key employment sites		Bid submitted to the DfT through the large local major fund		Funding bid **unsuccessful**

	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	Borough-wide parking strategy	Traffic management	Other	The Council	2016 - 2017	2017 Council adopted strategy	Rebalance parking priorities against supply and demand while promoting sustainable transport modes	Reduce congestion in AQMA	Final parking strategy adopted in 2017	2017 - 2032 15-year delivery time frame	Improved off-street enforcement measures. Promote Chester park and ride over other parking offers in Chester
23	20mph limits on residential streets	Traffic management	Reduction of speed limits, 20mph zones	The Council	2015	2016 - 2020	Successful rollout of scheme over four year programme		Scheme approved January 2016. Rollout commenced late 2016	2020	Promotes smoother driving style. Emissions reduction from diesel vehicles should lead to overall emissions reduction

	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
24	Smart and integrated ticketing across public transport in the north of England (all rail, tram and bus operators)	Promoting travel alternatives	Other	Transport for the North (TfN), Council lead on behalf of Cheshire and Warrington LEP	2017	2019 - 2023 2019 –major conurbations bus and light rail 2020 – minor conurbations bus and light rail 2021 – towns and trains 2022 - 2023 Full roll out across the north.	Successful rollout of scheme throughout the north of England	Yes, borough-wide.	Policy, processes and back office functionality specified, with consultation	2023 roll-out across the whole of the north of England (including Cheshire West and Chester)	TfN working with the DfT, 19 local authorities, five light rail operators, three train operators and over 400 bus operators.
25	Route and branch public transport review	Promoting travel alternatives	Other	The Council	2017	2018 / 2019	Increase in bus passengers, reduce number of private single occupancy vehicles	Yes, borough-wide.	2017 Baseline review and bench marking, appraisal and options appraisal	2018 review complete with implementation of preferred options from 2019	Council project lead, working with other LAs, commercial bus operators and other providers.

	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
26	Bus lane enforcement in Chester using automatic number plate recognition (ANPR)	Traffic management	Strategic highway improvements, selective vehicle priority, bus priority, high vehicle	The Council	2017	2017 / 2018 Implemented in phased stages (subject to trail phase/period)	Increase in bus passengers, reduce number of private single occupancy vehicles	Chester-wide	Policy review and bench marking for permitted vehicle use in Chester bus lanes	From 2017 / 2018. Implemented in phased stages (subject to trial phase)	Council to review existing policy and benchmark against other LAs prior to writing any new traffic regulation orders for bus lanes.
27	Eco stars fleet recognition scheme	Promoting low emission transport	Company vehicle procure-ment - prioritising uptake of low emission vehicles	The Council / Cheshire East	2016		Adoption of Eco stars scheme	Yes, borough-wide	Air quality grant bid submitted 2016		Bid **unsuccessful**
28	Bus interchange conditions of use	Traffic management	Anti-idling enforce-ment	The Council	2016	2017 onwards	Compliance with conditions	Yes, facility is within Chester AQMA	2017 policy introduced	Ongoing	Drivers must switch off engines unless a departure is imminent

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 indicates that the fraction of mortality attributable to particulate matter in Cheshire West and Chester is 5.2%.

The Council does not currently monitor $PM_{2.5}$ as it is not currently a requirement of LAQM. However, PM_{10} (particulate matter with an aerodynamic diameter of 10µm (micrometres) or less) 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.TG16. 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 8.3 to 11.2, which is well below the national annual mean objective of 25$\mu g/m^3$ (micrograms per cubic metre). 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 $PM_{2.5}$. A significant amount of effort has been made to produce a low emission strategy (LES) for the Borough which will tackle NO_2, PM_{10} and $PM_{2.5}$. It is focused on reducing emissions from road vehicles and supporting more sustainable modes of transport with the ambition of improving the health of residents and reducing the number of deaths that arise every year attributable to poor air quality. The action toolbox, table A.1 in LAQM.TG16 lists a range of measures that can be implemented to tackle $PM_{2.5}$ and many of these are incorporated into the draft LES. 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

The Council undertook automatic (continuous) monitoring at six sites during 2016. Details of the sites are shown in Table 3 in Appendix A.

NO_2, NO (nitric oxide) and NO_x (oxides of nitrogen) were measured using chemiluminescent analysers at the two roadside sites in Chester and Ellesmere Port (BO and WH) and the two groundhog cabins in Frodsham and Thornton-le-Moors (FMH and TLP), and also using the Opsis differential optical absorption spectrometer (DOAS) system at the Ellesmere Port urban background site (LR-JG).

Sulphur dioxide (SO_2) was measured using UV fluorescence at monitoring stations in Elton (ELT), Frodsham FMH, Thornton-le-Moors (TLP) and Ellesmere Port (LR-JG, as above).

PM_{10} was measured using tapered element oscillating microbalances (TEOMs) at Frodsham (FMH) and Ellesmere Port (LR-JG) and Thornton-le-Moors (TLP) using a beta attenuation monitor (BAM).

There are no national network sites in the borough but results for sites in neighbouring / nearby districts 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

The Council carried out non-automatic (passive) monitoring of NO_2 at 52 locations during 2016. Table 4 shows the details of the sites. Since last year's report, nine NO_2 diffusion tube sites and one benzene site have been discontinued and nine new ones established, either at the start of 2016 or part way through the year (Table 5 and Table 6). The former monitoring location AP adjacent to the M6 motorway in Allostock was re-established in 2016 in response to long-term, extensive carriageway

realignment works. Maps showing the locations of the monitoring sites are provided in Figure 7 to Figure 14 in Appendix D. These can also be accessed along with annual mean data on the Council website at: www.cheshirewestandchester.gov.uk/airquality .

All tubes are prepared and analysed by Gradko International Ltd. Gradko's performance in the AIR-PT NO_2 proficiency testing scheme scored 100% satisfactory rating in all rounds for 2016. Further details on quality assurance / quality control (QA/QC), bias adjustment and distance correction for the diffusion tubes are included in Appendix C.

3.2 Individual pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias, distance correction and annualisation. 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 NO_2 annual mean results over the past five years with the air quality objective of 40µg/m^3. In 2016, NO_2 at monitoring station WH in Ellesmere Port was 40µg/m^3, which is the same as in 2015. Results for all other automatic monitoring stations were comfortably below the annual objective. It should be noted, however, that real-time monitoring stations are not necessarily in worst-case locations because of siting constraints.

Table 8 in Appendix A compares the ratified continuous monitored NO_2 hourly mean concentrations for the past five years with the air quality objective of 200µg/m^3. In common with previous years there were no recorded exceedances of the one-hour standard at any of the monitoring sites in 2016.

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 from 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 presented in Figure 15. A slight downwards trend is discernible for the roadside sites, WH and BO.

In Figure 21, time series plots of hourly NO_2 from local sites are presented alongside plots for the 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 52 sites in 2016. Results presented in Table 12 in Appendix B have been adjusted for bias using Defra's national factor for 2016 and, where necessary, corrected for distance to relevant exposure. The full dataset of monthly averages for 2016 is also displayed in Table 12. Details of quality control and any adjustments that have been applied are given in Appendix C.

There were no recorded annual means in excess of 60μg/m^3 at any of the non-automatic monitoring locations and it is therefore unlikely that there were any exceedances of the hourly mean objective at any of these sites during 2016. 12 tubes were above the annual objective, although all were below 50μg/m^3 (after correction), with the exception of location T6 (50.3μg/m^3).

Diffusion tube levels, as a whole, when compared to 2015 results, have generally risen (see data adjustments Appendix C.4.3 to 4.6). In 2015, six sites were above the objective and a further ten were within 10%, compared to 12 above the objective and 12 within 10% in 2016.

Chester

Diffusion tubes were deployed at 40 locations in Chester in 2016. The four highest levels of NO_2 in the borough were all recorded in Chester, and ten out of the 12 sites in the borough that exceeded the annual objective were in Chester. Three of these ten sites (C11, C36 and T6) are within the Boughton AQMA , and six more (LVR, OW, PG, RM, UN and WG) are within the extended Chester AQMA which was declared in May 2017 as a result of the detailed assessment completed in late 2016. All the remaining sites in Chester were below the objective, with the exception of MCC on the A41 in the village of Christleton which returned an annual mean of

43.4μg/m^3. This location returned an annual mean above the objective level in 2014 and was within 10% in 2015. Additional monitoring has commenced around this location in 2017 to assess whether it is necessary to proceed to an AQMA declaration in this area.

Several sites in Chester achieved compliance with the objective level only after application of bias adjustment and/or distance correction and a further ten sites were within 10% of the objective in Chester following these corrections. Of these ten, one lies within the Boughton AQMA extant in 2016 and the other nine lie within the extended Chester AQMA declared in May 2017.

Several sites were established in 2016 to assess more locations within the likely extended Chester AQMA. Of these, location LVR exceeded the objective, and LVS and NIN were within 10%.

Most sites experienced a slight increase in NO_2 when compared with 2015, although there is no clear long-term trend. Five-year monitoring trends in NO_2 at a selection of Chester monitoring sites are shown in Figure 16.

Ellesmere Port

Results from diffusion tube monitoring locations in Ellesmere Port were all compliant with the national annual mean objective in 2016 after bias-adjustment and distance correction. Only one site (SR) was within 10% of the objective. Results for the tubes located in the street canyon part of the Ellesmere Port AQMA may have been higher had the local bias-adjustment factor been used (see Appendix C).

Most sites in Ellesmere Port experienced a slight increase in NO_2 when compared with 2015, although there is no clear long-term trend. Figure 17 shows five-year trends in NO_2 at a selection of the town's monitoring sites.

Frodsham

The diffusion tube at FH returned the fifth-highest result within the borough (43.7μg/m^3), and this and FJ were the only locations outside Chester where results exceed the national annual mean objective. Both tube locations are within the Frodsham AQMA. The other two tubes in the AQMA were compliant with the

objective following bias-adjustment and distance correction, although FT was within 10%. The other tube in the town, CFL, was comfortably below the objective.

Most sites in Frodsham experienced a slight increase in NO_2 when compared to 2015, although there is no clear long-term trend. Figure 18 shows five-year trends in NO_2 at a selection of the town's monitoring sites.

Northwich

Results for the single tube in Northwich, on the A530 at Rudheath, was comfortably below the annual mean objective following bias-adjustment and distance correction.

Allostock

Monitoring on either side of the M6 in the village of Allostock commenced in 2016 (site AP recommencing) in response to concerns about the ongoing conversion of sections of the M6 to a so-called smart motorway that could result in traffic being brought closer to existing residences through periodic use of the hard shoulder by traffic. Levels at both sites (AHH and AP) were comfortably below the objective, but monitoring will continue as construction work continues.

3.2.2 Particulate matter (PM_{10})

Table 9 in Appendix A shows how the ratified and adjusted annual mean PM_{10} concentrations over the past five years compare with the air quality objective of 40µg/m^3.

In 2016, all sites monitoring PM_{10} returned results comfortably below the annual objective. Table 10 in Appendix A compares the ratified, continuously monitored PM_{10} daily mean concentrations for the past five 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 not exceeded at any monitoring station in the borough during 2016.

Figure 19 shows trends in annual PM_{10} at local sites over the last five years. Although the overall trend at the Ellesmere Port site is downwards, there is insufficient data from the other monitoring sites to determine a trend. The time series plots in Figure 22 show how the local results compare to the national AURN site at Liverpool Speke.

3.2.3 Sulphur dioxide (SO_2)

Table 11 in Appendix A compares the ratified continuously monitored SO_2 concentrations for the year 2016 with the three SO_2 air quality objectives.

In 2016, there were 70 occasions, spread over 17 days, when the 15-minute objective of 266$\mu g/m^3$ was exceeded in Thornton-le-Moors (at monitoring site TLP). The objective allows for 35 such exceedances, so the standard has been exceeded again this year. Annual data capture at this location was 95.8%.

A single exceedance of the 15-minute objective was recorded at the Elton monitoring station (ELT).

The hourly mean standard was exceeded on four occasions at Thornton-le-Moors. However, as there is an annual exceedance allowance of 24 hourly periods, the objective was not exceeded.

The 24-hour limit was exceeded on one day in Thornton-le-Moors but the annual exceedance allowance of three 24-hour periods was not exceeded.

No exceedances of any of the SO_2 objectives were recorded at either Ellesmere Port (LR-JG) or Frodsham (FMH).

A graph showing five-year trends of SO_2 (as 99.9^{th} percentiles of the 15-minute average) from the real-time automatic monitors is presented in Figure 20. The graph includes plots of data for former monitoring stations that are no longer operational: HE was located on Mountain View, Helsby; SG was located at The Oaks Primary School, Ellesmere Port and TLM was the initial monitoring site in Thornton-le-Moors at the parish hall. The latter was relocated to the current site, TLP, in 2015 because of extensive refurbishment works. Details of the monitoring results for each of these sites is available in earlier assessment reports. For most sites the monitoring period has not been long enough to determmine an overall trend. However, at LR-JG in

Ellesmere Port, the 99.9th percentiles have been relatively static over time and remain comfortably below the national objective.

Figure 23 shows how the local results compare with regional AURN sites. The frequency and scale of peak SO_2 readings at Thornton-le-Moors and, to a lesser degree, Elton, contrasts markedly with those at other monitoring stations.

3.3 Summary

In 2016 the Council measured concentrations of nitrogen dioxide above the annual mean objective at relevant locations outside of extant AQMAs.

In Chester, this led to the declaration of the city centre AQMA in May 2016. In Christleton, a single tube exceeded the objective so monitoring was expanded in 2017 to determine the likely area of exceedance.

Within the Ellesmere Port AQMA a single tube location recorded nitrogen dioxide at the annual objective level. The result for the real-time continuous analyser was 40$\mu g/m^3$.

In 2016, the Council measured concentrations of sulphur dioxide above the 15-minute mean objective on more than 35 occasions at Thornton-le-Moors. An AQMA was declared for the area around Thornton-le-Moors in September 2016 for industrial emissions.

Appendix A: Monitoring results

Table 3 Details of automatic monitoring sites

Site ID	Site name	Site type	Easting	Northing	Pollutants monitored	In AQMA?	Monitoring technique	Distance to relevant exposure (m) (1)	Distance to kerb of nearest road (m)(2)	Inlet height (m)
WH	Whitby Rd	Roadside	340197	376363	NO_2,	Yes	Chemiluminescent	15	2.5	3.5
LR-JG	Central library	Urban background	340258 339947	376602 375889	NO_2, SO_2 PM_{10}	No	DOAS TEOM	10	n/a	11.0
BO	Boughton	Roadside	341864	366444	NO_2	Yes	Chemiluminescent	25	3.0	1.0
FMH	Frodsham	Urban background	352445	378031	NO_2, SO_2, PM_{10}	No	Chemiluminescent UV-fluorescent TEOM	24	7.0	2.5
TLP	Thornton-le-Moors	Industrial	344103	374330	NO_2, SO_2, PM_{10}	Yes	Chemiluminescent UV-fluorescent Beta attenuation	38	n/a	2.5
ELT	Elton	Industrial	345642	375522	SO_2	No	UV-fluorescent	0	n/a	2.0

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on the façade of a residential property).

(2) N/A if not applicable.

Table 4 Details of current non-automatic monitoring sites

Site ID	Site name	Site type	Easting	Northing	Pollutants monitored	In AQMA?	Distance to relevant exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Collocated with analyser	Height (m)
AHH	Allostock holly	Other	373255	371475	NO_2	No	0.0	68.0	No	2.0
AP	Pine Cottage	Roadside	373386	371500	NO_2	No	0.0	34.0	No	1.8
BE	Bedward Row	Roadside	340239	366418	NO_2	Chester	0.5	2.4	No	2.4
BJ	Backpackers / jade	Roadside	341401	366512	NO_2	Chester	0.5	2.5	No	2.4
BO	Boughton RTA	Roadside	341864	366444	NO_2	Chester	25.0	2.0	Yes	2.5
C11	11 Christleton Road	Roadside	341915	366427	NO_2	Chester	0.0	1.0	No	2.0
C36	Christleton Road (36)	Roadside	342000	366374	NO_2	Chester	0.5	1.5	No	2.5
C75	Christleton Road (75)	Roadside	342056	366354	NO_2	Chester	0.5	2.0	No	2.5
CFL	Church Street (lower)	Roadside	351762	377862	NO_2	No	4.8	1.0	No	2.2
CIN	City Road (north)	Roadside	341219	366768	NO_2	No	1.5	3.0	No	2.5
CIS	City Road (south)	Roadside	341219	366692	NO_2	No	0.5	4.0	No	2.1
EB	Boughton Edgeley	Roadside	341658	366487	NO_2	Chester	0.0	2.0	No	2.5
FGS	Foregate St	Roadside	340859	366388	NO_2	Chester	>50	1.0	No	2.2
FH	High Street (72)	Roadside	352146	378139	NO_2	Frodsham	0.2	2.0	No	2.5
FJ	Fluin junction	Roadside	352171	378140	NO_2	Frodsham	0.5	2.0	No	2.5
FM	Fluin La (Manor Farm)	Roadside	352189	378094	NO_2	Frodsham	0.3	2.0	No	2.5
FT	Fluin Lane (terrace)	Roadside	352176	378105	NO_2	Frodsham	0.2	1.7	No	2.0
GD	George and Dragon	Roadside	340331	366998	NO_2	Chester	10.0	0.5	No	2.0
GE	George Street (S)	Roadside	340657	366730	NO_2	Chester	1.0	5.0	No	2.4
GI	St Giles	Roadside	341951	366396	NO_2	Chester	3.0	3.0	No	2.5
GSW	Gorse Stacks	Roadside	340700	366687	NO_2	Chester	1.0	1.6	No	2.1
HB	Hoole Lane - Boughton	Roadside	341605	366527	NO_2	Chester	3.0	1.2	No	2.4

Site ID	Site name	Site type	Easting	Northing	Pollutants monitored	In AQMA?	Distance to relevant exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Collocated with analyser	Height (m)
HW	Hoole Way	Roadside	340881	366826	NO_2	Chester	1.0	1.9	No	2.4
IC	Ingham Close	Roadside	342068	366332	NO_2	Chester	2.0	2.0	No	2.0
KR	King St. Rudheath	Roadside	368432	372988	NO_2	No	4.5	2.2	No	2.0
LH	Lincoln House	Roadside	341126	366540	NO_2	Chester	3.0	2.0	No	3.0
LI2	Liverpool Road	Roadside	340354	367034	NO_2	Chester	7.0	2.5	No	2.2
LVR	Love St residential	Roadside	340980	366315	NO_2	Chester	0.0	1.8	No	2.2
LVS	Love St school	Roadside	340990	366317	NO_2	Chester	8.0	1.8	No	2.2
MCC	Christleton(Mill Cottage)	Roadside	343785	365502	NO_2	No	0.7	2.3	No	2.0
NIN	Nicholas St (north)	Roadside	340284	366199	NO_2	Chester	0.0	3.0	No	2.3
NIS	Nicholas St (south)	Roadside	340329	366114	NO_2	Chester	0.0	4.3	No	2.2
NS	Newsagent Station Rd	Roadside	340406	376724	NO_2	Ellesmere Port	2.0	4.0	No	2.0
OB	Boughton (105)	Roadside	341633	366510	NO_2	Chester	0.6	2.5	No	2.5
OF	St Oswald's - fountains	Roadside	340453	366853	NO_2	Chester	11.0	4.8	No	3.0
OW	St Oswald's Way	Roadside	340623	366823	NO_2	Chester	2.3	2.3	No	2.3
PA	Parkgate Rd (19)	Roadside	340313	367014	NO_2	Chester	2.4	0.8	No	2.4
PG	Parkgate Road (5)	Roadside	340322	366989	NO_2	Chester	0.2	1.8	No	2.0
RM	Rock Mount	Roadside	340291	367108	NO_2	Chester	0.0	3.8	No	2.2
RR	Richfield recruitment	Roadside	340180	376338	NO_2	Ellesmere Port	3.0	2.1	No	2.5
SA	Samaritans	Roadside	340364	366929	NO_2	Chester	0.2	2.5	No	2.5
SM	St Martins Way	Roadside	340224	366599	NO_2	Chester	1.2	2.2	No	2.4
SR	Station Rd	Roadside	340435	376790	NO_2	Ellesmere Port	0.0	1.6	No	2.5
SZ	Specialized	Roadside	341819	366475	NO_2	Chester	0.5	2.0	No	2.5
T44	Tarvin Road (44)	Roadside	342085	366446	NO_2	Chester	3.5	1.0	No	2.5

Site ID	Site name	Site type	Easting	Northing	Pollutants monitored	In AQMA?	Distance to relevant exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Collocated with analyser	Height (m)
T6	Tarvin Road (6)	Roadside	341926	366446	NO_2	Chester	0.2	2.0	No	2.0
TB	The Bars	Roadside	341202	366470	NO_2	Chester	2.0	1.0	No	2.5
UN	Upper Northgate St (44)	Roadside	340357	366960	NO_2	Chester	0.2	3.0	No	2.2
WG	Watergate St	Roadside	340217	366209	NO_2	Chester	0.2	1.5	No	2.0
WGW	Watergate - walls	Roadside	340165	366198	NO_2	Chester	0.0	2.2	No	2.2
WH	Whitby Road	Roadside	340196	376363	NO_2	Ellesmere Port	32.0	1.2	Yes	3.5
WXP	Wrexham Rd	Roadside	339641	363499	NO_2	No	>50	8.0	No	3.0

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on/adjacent to the facade of a residential property).

(2) n/a if not applicable.

Table 5 Details of non-automatic monitoring sites discontinued prior to 2016

Site ID	Site name	Town	Pollutant	Reason for discontinuing
HC	5 Holmes Chapel Road	Sproston	NO_2	Below objective
QS	Queen Street	Northwich	NO_2	Below objective
TG	The Green	Hartford	NO_2	Below objective
BA2	A49, Bartington	Bartington	NO_2	Below objective
FV	Frodsham weaver vale	Frodsham	NO_2	Below objective
SCS	Sutton Causeway (south)	Frodsham	NO_2	Below objective
WW	Wetherspoons Whitby	Ellesmere Port	NO_2	Below objective
WT	Welsh Road	Two Mills	NO_2	Below objective at facade
HSN	Hunter Street (north)	Chester	NO2	Redevelopment pending
TM	Thornton-le-Moors	Thornton-le-Moors	Benzene	Below objective, requirement to report on benzene discontinued

Table 6 Details of non-automatic monitoring sites established for 2016

Site ID	Site name	Town	Pollutant	Reason for monitoring
FGS	Foregate Street	Chester	NO_2	Adjacent to bus stands
NIN	Nicholas St (north)	Chester	NO_2	Residential – adjacent to queuing traffic
NIS	Nicholas St (south)	Chester	NO_2	Residential – adjacent to ring road
WXP	Wrexham Rd park and ride	Chester	NO_2	Baseline prior to large scale development
LVR	Love St (residential)	Chester	NO_2	Residential – queuing traffic
LVS	Love St (school)	Chester	NO_2	School – queuing traffic
AHH	Holly House	Allostock	NO_2	Residential – baseline prior to commencement of M6 smart motorway
AP	Pine Cottage	Allostock	NO_2	Residential – baseline prior to commencement of M6 smart motorway
CIN	City Road (north)	Chester	NO_2	Residential – adjacent to busy road
CIS	City Road (south)	Chester	NO_2	Baseline prior to care home development

Table 7 Annual mean NO_2 monitoring results

Site ID	Site Type	Monitoring type	Valid data capture for monitoring period (%) (1)	Valid data capture 2016 (%) (2)	NO_2 annual mean concentration μg/m³ (3)				
					2012	2013	2014	2015	2016
WH	Roadside	Automatic	99	99	**44.0**	**41.0**	**41.0**	**40.0**	**40.0**
LR-JG	Urban background	Automatic	90	90	24.0	23.0	22.0	20.0	22.0
BO	Roadside	Automatic	86	86	33.0	33.0	32.0	30.0	29.0
FMH	Urban background	Automatic	96	96			19.0	15.0	16.0
TLP	Industrial	Automatic	96	96				16.0	16.0
AHH	Other	Diffusion tube	75	50					21.5
AP	Roadside	Diffusion tube	75	50	**41.3**	36.2			31.2
BA	Roadside	Diffusion tube				**41.9**	**41.3**		
BA2	Roadside	Diffusion tube						28.8	
BE	Roadside	Diffusion tube	92	92	**44.5**	**43.8**	**41.9**	38.3	**40.2**
BJ	Roadside	Diffusion tube	92	92	37.2	39.3	38.3	37.5	39.0
BN	Roadside	Diffusion tube			27.4				
BO	Roadside	Diffusion tube	83	83	30.9	34.7	32.5	30.5	30.5
BR	Roadside	Diffusion tube			28.2				
C11	Roadside	Diffusion tube	92	92	**46.8**	**46.4**	**45.4**	**43.0**	**43.3**
C36	Roadside	Diffusion tube	75	75	**55.6**	**55.9**	**54.1**	**50.6**	**51.5**
C75	Roadside	Diffusion tube	83	83	29.5	31.5	29.0	27.7	30.4
CA	Roadside	Diffusion tube			**40.4**	35.7			
CC	Roadside	Diffusion tube			24.2	22.9			
CD	Roadside	Diffusion tube			34.7	32.3			
CE	Roadside	Diffusion tube				14.7	14.5		
CFL	Roadside	Diffusion tube	92	92		33.1	31.9	29.4	31.3
CFU	Roadside	Diffusion tube				27.4			
CIN	Roadside	Diffusion tube	80	33					29.1
CIS	Roadside	Diffusion tube	80	33					30.9
CN	Kerbside	Diffusion tube			30.6	29.4			
CP	Kerbside	Diffusion tube			37.0	33.5			

Site ID	Site Type	Monitoring type	Valid data capture for monitoring period (%) [1]	Valid data capture 2016 (%) [2]	NO_2 annual mean concentration μg/m^3 [3]				
					2012	2013	2014	2015	2016
CV1	Roadside	Diffusion tube			31.6				
CVC	Roadside	Diffusion tube				36.9			
CY	Roadside	Diffusion tube				35.0			
DL	Rural	Diffusion tube			12.4	13.7			
EB	Roadside	Diffusion tube	92	92	36.1	38.1	36.7	34.2	34.8
FB	Roadside	Diffusion tube			34.6	32.3			
FC	Roadside	Diffusion tube			34.5	33.3			
FGS	Roadside	Diffusion tube	92	92					31.7
FH	Roadside	Diffusion tube	83	83	**45.5**	**40.3**	**41.9**	39.7	**44.2**
FJ	Roadside	Diffusion tube	92	92	**47.6**	**44.7**	**42.6**	**41.3**	**42.2**
FM	Roadside	Diffusion tube	92	92	**40.9**	36.8	36.6	32.9	36.5
FT	Roadside	Diffusion tube	83	83			36.3	33.9	34.9
FV	Roadside	Diffusion tube				20.6	21.4	21.3	
FW	Roadside	Diffusion tube				20.8	19.1		
FX	Kerbside	Diffusion tube			36.3	37.3			
GD	Roadside	Diffusion tube	75	75	34.2	37.5	34.1	32.3	33.9
GE	Roadside	Diffusion tube	92	92				27.4	24.8
GH	Roadside	Diffusion tube			34.3				
GI	Roadside	Diffusion tube	83	83	34.5	36.8	35.4	32.6	34.8
GR	Roadside	Diffusion tube			26.6	26.0			
GSW	Roadside	Diffusion tube	75	75				27.5	27.8
HB	Roadside	Diffusion tube	92	92	32.7	38.5	37.7	33.6	33.7
HC	Roadside	Diffusion tube			**44.4**	**43.4**	**42.2**	35.9	
HSN	Roadside	Diffusion tube					36.1	32.3	
HT	Roadside	Diffusion tube				23.5	22.9		
HW	Roadside	Diffusion tube	92	92	**40.6**	**41.8**	**41.2**	37.8	39.9
IC	Roadside	Diffusion tube	75	75	**40.2**	38.2	37.1	37.3	38.5
IS	Industrial	Diffusion tube			20.8	21.6			
KR	Roadside	Diffusion tube	83	83	**41.0**	37.6	35.0	33.6	35.2

Site ID	Site Type	Monitoring type	Valid data capture for monitoring period (%) [1]	Valid data capture 2016 (%) [2]	NO_2 annual mean concentration μg/m^3 [3]				
					2012	2013	2014	2015	2016
LH	Roadside	Diffusion tube	92	92	**41.1**	**43.1**	38.0	37.0	38.4
LI2	Roadside	Diffusion tube	92	92	39.4	38.9	37.8	35.5	39.4
LN	Roadside	Diffusion tube			30.2	31.0			
LP	Roadside	Diffusion tube			32.6	31.7			
LVR	Roadside	Diffusion tube	75	75					**40.8**
LVS	Roadside	Diffusion tube	75	75					39.1
LW	Roadside	Diffusion tube			37.7	31.0			
M15	Roadside	Diffusion tube			34.3	30.4			
M55	Roadside	Diffusion tube			26.9	25.4			
MC	Roadside	Diffusion tube				20.5			
MCC	Roadside	Diffusion tube	83	83			**41.8**	38.1	**44.5**
MN	Roadside	Diffusion tube			32.6	33.4			
MV	Roadside	Diffusion tube			22.1				
NA	Roadside	Diffusion tube			37.0	33.8	31.1		
NB	Roadside	Diffusion tube			24.6	25.6			
NIN	Roadside	Diffusion tube	92	92					39.1
NIS	Roadside	Diffusion tube	75	75					22.6
NR	Roadside	Diffusion tube			24.2				
NS	Roadside	Diffusion tube	83	83	39.4	38.5	39.4	35.9	36.2
NT	Roadside	Diffusion tube			32.2	32.5	28.6		
OB	Roadside	Diffusion tube	75	75	39.5	**47.2**	**43.2**	**40.7**	**41.2**
OF	Roadside	Diffusion tube	92	92	33.8	36.4	37.4	35.7	38.8
OG	Roadside	Diffusion tube			**40.0**	**43.8**			
OW	Roadside	Diffusion tube	83	83	**45.7**	**46.1**	**42.0**	**43.2**	**51.0**
PA	Roadside	Diffusion tube	92	92	38.9	**42.2**	**41.8**	**41.1**	**42.3**
PC	Roadside	Diffusion tube			31.9	32.3			
PF	Roadside	Diffusion tube			31.5				
PG	Roadside	Diffusion tube	75	75	**47.2**	**49.5**	**48.0**	**42.2**	**46.9**
PM	Roadside	Diffusion tube				31.6			

Site ID	Site Type	Monitoring type	Valid data capture for monitoring period (%) [1]	Valid data capture 2016 (%) [2]	NO_2 annual mean concentration μg/m^3 [3]				
					2012	2013	2014	2015	2016
PW	Roadside	Diffusion tube			31.5				
QS	Roadside	Diffusion tube			**41.5**	37.1	30.4	26.8	
RH	Kerbside	Diffusion tube			30.2				
RL	Roadside	Diffusion tube			30.6	30.1			
RM	Roadside	Diffusion tube	83	83	**42.8**	**46.8**	**45.6**	39.9	**43.1**
RR	Roadside	Diffusion tube	92	92	**43.0**	**42.2**	**42.1**	39.1	39.9
RS	Roadside	Diffusion tube			31.2				
SA	Roadside	Diffusion tube	92	92	**40.8**	**43.6**	**42.1**	38.5	39.8
SB	Roadside	Diffusion tube			36.9	34.1	31.8		
SCN	Roadside	Diffusion tube				26.8	22.5		
SCS	Roadside	Diffusion tube				34.6	34.5	30.8	
SL	Roadside	Diffusion tube				17.0	17.6		
SM	Roadside	Diffusion tube	75	75	30.8	30.1	30.9	29.5	32.1
SR	Roadside	Diffusion tube	83	83	39.1	39.8	38.4	35.7	36.5
SV	Roadside	Diffusion tube			26.0				
SZ	Roadside	Diffusion tube	83	83	39.6	**41.8**	39.0	36.8	36.3
T25	Roadside	Diffusion tube			32.0	32.1	30.6		
T44	Roadside	Diffusion tube	92	92	**46.4**	**48.0**	**46.1**	**41.5**	**42.8**
T6	Roadside	Diffusion tube	83	83	**57.9**	**58.4**	**53.0**	**49.1**	**50.3**
T67	Roadside	Diffusion tube			33.2	33.0			
T97	Roadside	Diffusion tube			34.2	33.8			
TB	Roadside	Diffusion tube	75	75	**40.8**	**42.9**	**41.2**	**40.1**	38.7
TG	Roadside	Diffusion tube				32.1	32.8	31.7	
TH	Roadside	Diffusion tube			26.4				
UN	Roadside	Diffusion tube	92	92	**40.2**	**43.5**	**41.1**	38.5	**40.1**
UV	Roadside	Diffusion tube			23.9				
WC	Roadside	Diffusion tube			34.2				
WG	Roadside	Diffusion tube	83	83	**51.6**	**47.1**	**44.9**	**41.3**	**43.5**
WGW	Roadside	Diffusion tube	92	92		**44.8**	38.8	33.6	37.1

Site ID	Site Type	Monitoring type	Valid data capture for monitoring period (%) (1)	Valid data capture 2016 (%) (2)	NO_2 annual mean concentration μg/m^3 (3)				
					2012	2013	2014	2015	2016
WH av	Roadside	Diffusion tube	92	92	38.2	36.6	36.3	34.7	34.4
WS	Roadside	Diffusion tube			39.8				
WT	Roadside	Diffusion tube				**43.2**	39.7	39.5	
WV	Kerbside	Diffusion tube			33.2	32.1			
WW	Roadside	Diffusion tube			35.7	33.7	32.1	28.6	
WXP	Roadside	Diffusion tube	92	92					20.1

☒ Diffusion tube data has been bias corrected

☒ Annualisation has been conducted where data capture is <75%

Data has not been distance corrected for relevant exposure. See Table 12 for these data.

Notes:

Exceedances of the NO_2 annual mean objective of 40μg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60μg/m^3, indicating a potential exceedance of the NO_2 one-hour mean objective are shown in **bold and underlined.**

(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) Means for diffusion tubes have been corrected for bias. If valid data capture for the full calendar year is less than 75% means have been annualised as per boxes 7.9 and 7.10 in LAQM.TG16. See Appendix C for details.

Table 8 Hourly mean NO_2 monitoring results

Site ID	Site type	Monitoring type	Valid data capture for period of monitoring % (1)	Valid data capture 2016 % (2)	Hourly means exceedances of 200µg/m^3 (3)				
					2012	2013	2014	2015	2016
WH	Roadside	Automatic	99.0	99.0	0	0	0	0	0
LR-JG	Urban background	Automatic	89.6	89.6	0	0	0	0	0
BO	Roadside	Automatic	85.6	85.6	0 (120)	0	0	0	0
FMH	Urban background	Automatic	96.2	96.2			0 (99.8)	0	0
TLP	Industrial	Automatic	95.6	95.6				0	0

Notes: Exceedances of the NO_2 hourly mean objective (200µg/m^3 not to be exceeded more than 18 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 was 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 2016 (%) (2)	PM_{10} annual mean concentration (µg/m^3) (3)				
				2012	2013	2014	2015	2016
LR	Urban background	89.9	89.9	16.8	17.8	16.0	13.0	11.8
FMH	Urban background	96.8	96.8			15.0	15.0	14.0
TLP	Industrial	97.1	97.1				15.0	16.0

☒ Annualisation has been conducted where data capture is <75%

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

(3) Where valid data capture for the full calendar year is less than 75% means have been annualised, as per technical guidance LAQM.TG16. 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 2016 (%) (2)	PM_{10} 24-hour means > 50µg/m^3 (3)				
				2012	2013	2014	2015	2016
LR	Urban background	89.9	89.9	7	6	1	0	0
FMH	Urban background	96.8	96.8			0	1	0
TLP	Industrial	97.1	97.1				0 (22)	0

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 2016 (%) (2)	Number of exceedances 2016 (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	90.7	90.7	0	0	0
FMH	Urban background	93.4	93.4	0	0	0
TLP	Industrial	95.8	95.8	**70**	4	1
ELT	Industrial	96.0	96.0	1	0	0

Notes: exceedances of the SO_2 objectives are shown in **bold** (15-minute mean = 35 allowed a year, one-hour 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: Full monthly diffusion tube results for 2016

Table 12 NO_2 monthly diffusion tube results – 2016

Site ID	NO_2 mean concentrations (µg/m^3)														
													Annual mean [4]		
	January	February	March	April	May	June	July	August	September	October	November[3]	December	Raw data	Bias adjusted (factor = 0.92) and annualised[1]	Distance corrected [2]
AHH	-	-	-	-	missing	20.8	12.3	19.6	19.1	28.2	void	29.1	21.5	21.5	21.5
AP	-	-	-	-	32.2	void	34.6	31.4	32.9	25.0	void	31.9	31.3	31.2	31.2
BE	47.9	46.6	47.2	45.6	42.0	43.6	36.8	35.5	42.1	46.0	void	47.2	43.7	**40.2**	39.2
BJ	39.6	44.7	53.2	47.1	42.6	42.9	33.8	35.6	41.4	42.2	void	43.6	42.4	39.0	39.0
BO	33.9	42.5	38.9	36.2	32.7	28.1	24.0	28.2	26.9	missing	void	40.7	33.2	30.5	30.5
C11	43.7	57.1	57.2	48.0	44.2	47.5	34.1	38.7	39.0	55.9	void	52.4	47.1	**43.3**	**43.3**
C36	68.1	void	66.1	55.4	46.8	51.6	51.8	51.7	void	49.2	void	62.8	56.0	**51.5**	**49.2**
C75	31.3	37.9	34.8	36.6	34.1	32.2	21.9	27.2	void	37.4	void	36.7	33.0	30.4	30.4
CFL	28.5	37.2	31.6	38.6	31.4	34.5	28.1	31.0	34.8	39.7	void	39.4	34.1	31.3	26.5
CIN	-	-	-	-	-	-	-	25.9	29.0	32.0	void	39.6	31.6	29.1	27.9
CIS	-	-	-	-	-	-	-	27.2	26.8	38.3	void	42.2	33.6	30.9	30.9
EB	46.7	46.2	47.8	37.5	34.6	30.6	30.2	32.4	32.3	36.4	void	41.0	37.8	34.8	34.8
FGS	42.8	51.4	43.2	47.5	49.3	38.7	13.7	15.6	18.4	29.0	void	29.5	34.5[5]	31.7	31.7
FH	missing	51.5	44.2	42.2	42.8	44.2	35.0	40.3	67.2	54.0	void	59.2	48.1	**44.2**	**43.7**
FJ	45.2	52.9	47.8	47.4	41.7	42.4	39.5	41.2	46.3	47.9	void	52.2	45.9	**42.2**	**41.0**
FM	37.8	45.2	41.2	36.9	38.9	42.7	28.2	30.2	34.9	52.1	missing	48.0	39.6	36.5	35.9
FT	missing	45.5	39.4	32.5	36.4	34.5	34.0	35.6	40.7	39.0	void	42.1	38.0	34.9	34.9
GD	36.2	45.0	43.4	35.2	34.7	void	24.5	26.8	missing	40.1	void	45.9	36.9	33.9	33.9
GE	32.0	35.9	33.6	28.0	24.7	21.5	17.6	18.4	21.1	27.7	void	35.8	26.9	24.8	24.6
GI	44.6	43.2	47.6	35.3	29.5	37.0	28.5	missing	31.8	39.3	void	41.3	37.8	34.8	34.8
GSW	35.4	37.2	35.6	31.3	28.6	missing	19.9	18.7	missing	30.7	void	34.4	30.2	27.8	26.3
HB	41.4	44.5	39.1	33.0	28.8	31.2	28.5	30.8	34.5	41.3	void	49.3	36.6	33.7	29.4

Site ID	NO_2 mean concentrations (µg/m^3)														
	January	February	March	April	May	June	July	August	September	October	November[3]	December	Annual mean [4]		
													Raw data	Bias adjusted (factor = 0.92) and annualised[1]	Distance corrected [2]
HW	43.3	48.8	53.4	41.7	41.9	40.0	31.7	33.2	41.7	53.2	void	48.3	43.4	39.9	37.9
IC	42.7	49.2	52.0	42.9	38.7	missing	33.4	missing	35.7	37.2	void	44.8	41.8	38.5	34.8
KR	38.3	41.5	44.4	40.1	34.6	33.7	29.4	35.2	39.8	45.7	void	missing	38.3	35.2	29.9
LH	34.0	49.4	45.4	46.7	41.1	45.1	37.0	35.3	41.4	41.8	void	42.1	41.7	38.4	33.9
LI2	41.0	45.9	44.4	45.7	37.3	42.2	34.1	34.7	47.0	46.7	void	52.5	42.9	39.4	31.5
LVR	49.4	52.1	46.3	48.6	missing	42.0	missing	33.7	40.7	41.5	void	45.3	44.4	**40.8**	**40.8**
LVS	40.8	49.8	45.9	40.2	missing	missing	40.4	35.5	37.5	44.6	void	48.2	42.5	39.1	39.1
MCC	45.1	51.6	57.9	51.4	47.0	41.6	41.5	41.6	void	52.8	void	53.6	48.4	**44.5**	**43.4**
NIN	42.1	52.1	44.2	47.7	41.2	41.5	36.2	35.1	38.7	40.6	void	48.3	42.5	39.1	39.1
NIS	missing	30.1	28.7	22.1	24.0	25.3	19.7	19.4	22.3	29.8	void	missing	24.6	22.6	22.6
NS	34.9	42.1	40.8	38.6	38.2	36.2	missing	31.4	38.0	43.2	void	49.9	39.3	36.2	34.2
OB	31.6	void	59.3	53.2	53.6	48.4	34.3	36.9	40.5	missing	void	45.0	44.8	**41.2**	39.9
OF	44.4	45.8	47.1	43.4	39.1	37.6	35.5	44.0	40.7	43.7	void	42.8	42.2	38.8	38.8
OW	60.8	63.4	64.4	50.6	48.2	45.6	49.4	missing	61.1	48.8	void	62.1	55.4	**51.0**	**45.7**
PA	52.0	52.1	48.4	43.6	40.3	42.2	37.2	42.6	49.2	48.7	void	50.1	46.0	**42.3**	35.2
PG	53.3	58.6	missing	missing	48.2	49.0	41.6	35.6	59.6	52.4	void	60.3	51.0	**46.9**	**46.9**
RM	48.4	58.9	53.6	50.7	void	42.4	33.0	35.5	41.4	58.1	void	46.9	46.9	**43.1**	**43.1**
RR	43.0	50.1	44.3	46.3	42.2	44.1	36.6	32.4	42.8	45.3	void	49.5	43.3	39.9	35.5
SA	47.6	53.8	42.0	33.3	40.7	40.5	32.8	35.0	44.3	49.5	void	56.0	43.2	39.8	39.8
SM	34.9	38.5	36.2	33.5	32.3	28.4	missing	missing	30.2	38.5	void	41.3	34.9	32.1	32.1
SR	37.4	44.2	39.1	42.1	39.1	39.3	32.7	void	40.4	40.2	void	42.7	39.7	36.5	36.5
SZ	35.4	49.7	46.0	45.4	41.0	39.4	30.4	32.9	32.9	missing	void	41.3	39.4	36.3	35.3
T44	48.1	54.4	48.8	45.1	38.7	41.4	36.6	36.5	44.9	55.0	void	62.3	46.5	**42.8**	34.6
T6	58.7	61.8	61.9	50.3	void	45.3	43.0	49.6	58.1	51.9	void	66.5	54.7	**50.3**	**50.3**
TB	44.9	missing	49.6	40.9	37.0	37.2	34.2	missing	41.1	44.9	missing	49.1	42.1	38.7	34.0
UN	42.3	48.9	45.5	45.9	42.0	39.7	30.1	36.0	44.2	51.8	void	52.9	43.6	**40.1**	**40.1**
WG	39.6	void	49.6	56.2	46.8	52.9	38.1	36.9	39.0	58.8	void	55.2	47.3	**43.5**	**43.5**

Site ID	NO_2 mean concentrations (µg/m^3)														
	January	February	March	April	May	June	July	August	September	October	November[3]	December	Annual mean [4]		
													Raw data	Bias adjusted (factor = 0.92) and annualised[1]	Distance corrected [2]
WGW	32.7	39.8	44.9	40.2	47.0	43.7	33.7	32.4	36.3	50.9	void	42.0	40.3	37.1	37.1
WXP	23.7	24.4	24.6	20.6	20.5	22.0	13.8	14.0	19.3	26.8	void	31.0	21.9	20.1	20.1
WH	36.8	42.5	38.3	36.6	37.2	38.2	30.0	30.7	36.4	39.9	void	45.0	37.4	34.4	34.4

☒ Local bias adjustment factor used

☒ Annualisation has been conducted where data capture is <75%

☒ If applicable, all data has been distance corrected for relevant exposure

Notes:

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 one-hour mean objective are shown in **bold and underlined.**

(1) See Appendix C for details on bias adjustment and annualisation.

(2) Distance corrected to nearest relevant public exposure.

(3) November's tubes had been exposed to unrefrigerated room temperatures for three days prior to exposure due to a storage error upon delivery. As this is contrary to good practice advice received from the tube laboratory, results from this month have been discounted

(4) Data capture for all tube locations was nine months out of 12 (75%) or above, apart from sites AHH and AP (50.0%), and CIN and CIS (33.3%). Annualisation corrections have been made to the raw annual mean data for these four sites prior to bias adjustment and/or distance correction.

(5) Between January and the end of June, this location was a bus stop on a road busy with buses. The mean for January - June is 45.5µg/m^3. Between July and the end of the year, major roadworks meant that no traffic came along this part of the highway. The mean for July - December is 21.2µg/m^3.

Appendix C: Supporting technical information

C.1 New developments

Planning permission was granted on appeal for 77-room student accommodation on Hunter Street, Chester, that had a significant facade on St Martin's Way, in June 2016. Residential rooms were removed from the initial plans for the ground floor in order to reduce residents' exposure to NO_2 from on St Martin's Way.

Planning permission was granted for three two-megawatt combined heat and power (CHP) units, powered by natural gas, to replace existing oil-fired heating at CF Fertilisers, Grinsome Road, Ince in October 2016. Combustion processes at this site are already regulated by the Environment Agency via extant permits issued as per the Environmental Permitting (England and Wales) Regulations 2016, and this development will be regulated under the same regime.

Monitoring commenced at location CIS in August 2016 in order to establish background NO_2 concentrations in the area prior to commencement of the approved development of a residential care home.

C.2 Detailed studies

Prior to declaration of the AQMA in Thornton-le-Moors and the Chester city centre AQMA, detailed modelling studies were carried out by consultants, Cerc and Bureau Veritas respectively. Also, the consultancy Atkins was appointed for a detailed study in support of the AQAP for Frodsham. The reports are available from the Council's website at www.cheshirewestandchester.gov.uk/aqmanagement

C.3 Air quality action plans

Copies of the Council's AQAPs for Ellesmere Port and Frodsham are available at: www.cheshirewestandchester.gov.uk/aqmanagement

The AQAP for Thornton-le-Moors is currently in its public consultation phase (available from the consultations section of the Council website) and the final version should be completed in the spring of 2018.

An AQAP for Chester city centre needs to be prepared and the intention is to have the draft document finalised by June 2018.

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 daily. Data from different sites is compared on a regular basis for the purposes of QA/QC. Data management and ratification is performed by an independent contractor, AQDM Ltd. This includes production of weekly, quarterly and annual summaries as well as ad hoc notifications of any exceedance episodes where necessary. The ratification process also involves comparison against national network sites to identify regional patterns and trends. In 2016 the analysers were serviced and calibrated at six-monthly intervals by Easy Technical Services Ltd (LR and LR-JG) and Enviro Technology Services plc (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 VCM adjustment factors applied to the monitoring data are: 1.27 for Frodsham and 1.34 for Ellesmere Port.

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. Monitoring sites with less than nine months' worth of data should be annualised using short-term to long-term adjustments as set out in section 7.171 of LAQM.TG16. Just four sites; AHH and AP in Allostock, and CIN and CIS in Chester required annualisation in 2016. The factor (Ra) shown in Table 13 has been applied to the results for AHH in Allostock, the factor shown in

Table 14 has been applied to the results for AP in Allostock, and the factor shown in Table 15 has been applied to the results for CIN and CIS in Chester. The annualised and subsequently bias-adjusted results are shown in Table 12.

Table 13 Short-term to long-term adjustment 2016 (location AHH)

Site	Site type	Annual mean 2016 (Am)	Six-month period mean June - October and December 2016 (Pm)	Ratio (Am/Pm)
Liverpool Speke	Urban background	23.0	20.5	1.122
Stoke centre	Urban background	27.7	25.0	1.106
Warrington	Background	25.0	22.5	1.113
Wirral (Tranmere)	Urban background	22.1	21.8	1.016
			Average (Ra)	1.089

Table 14 Short-term to long-term adjustment 2016 (location AP)

Site	Site type	Annual mean 2016 (Am)	Six-month period mean May, July - October and December 2016 (Pm)	Ratio (Am/Pm)
Liverpool Speke	Urban background	23.0	20.8	1.106
Stoke centre	Urban background	27.7	24.8	1.117
Warrington	Background	25.0	22.8	1.098
Wirral (Tranmere)	Urban background	22.1	21.9	1.013
			Average (Ra)	1.084

Table 15 Short-term to long-term adjustment 2016 (locations CIN and CIS)

Site	Site type	Annual mean 2016 (Am)	Four-month period mean August - October and December 2016 (Pm)	Ratio (Am/Pm)
Liverpool Speke	Urban background	23.0	22.6	1.020
Stoke centre	Urban background	27.7	26.6	1.042
Warrington	Background	25.0	24.2	1.033
Wirral (Tranmere)	Urban background	22.1	24.5	0.905
			Average (Ra)	1.000

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 32 national collocation studies, which use the 20 percent triethanolamine (TEA) in water preparation are shown in Table 16 below. The national bias adjustment factor for 2016 is 0.92. The local comparison of diffusion tubes against the real-time data is shown in Table 17, below – the local bias adjustment factor for 2016 is 0.99. Clearly, applying the national bias adjustment factor will reduce the mean and applying the local factor will also reduce the mean, but by a lesser margin, 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, as was real-time data capture. There were, however, two periods of poor precision for the tubes triplicate and one period in which two tubes were missing. 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 LAQM.TG16 into account, it has been decided to use the national bias adjustment factor (0.92) for the adjustment of all diffusion tube data as it is likely to be more statistically 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 40$\mu g/m^3$ and the locally adjusted diffusion tube result would have been 37.1$\mu g/m^3$, whereas application of the national factor gives a reading of just 34.4$\mu g/m^3$. There may therefore have been merit therefore to use the local factor for sites with canyon-like characteristics and the national factor at the remainder.

C.4.6 Distance Correction

Distance corrections, using version 4.1 of the Bureau Veritas 'NO_2 fall-off with distance calculator', have been applied to the bias-adjusted annual means for the following diffusion tube results: BE, C36, CFL, CIN, FH, FJ, FM, GE, GSW, HB, HW, IC, KR, LH, LI2, MCC, NS, OB, OW, PA, RR, SZ, T44 and TB. The final results are shown in Table 12.

Table 16 National diffusion tube bias adjustment factor (v0917)

Analysis by	Method	Year	Site type	Local authority	Length of study (months)	Tube mean (Dm) (µg/m^3)	Auto mean (Cm)(µg/m^3)	Bias (%)	Tube precision	Bias factor (Cm/Dm)
Gradko	20% TEA in water	2016	Roadside	Gateshead	12	29	26	10.5%	Good	0.90
Gradko	20% TEA in water	2016	Roadside	Gateshead	11	35	37	-6.0%	Good	1.06
Gradko	20% TEA in water	2016	Roadside	Gateshead	12	37	31	19.0%	Good	0.84
Gradko	20% TEA in water	2016	Roadside	Wokingham	11	45	41	9.0%	Good	0.92
Gradko	20% TEA in water	2016	Roadside	Wokingham	11	37	34	9.5%	Good	0.91
Gradko	20% TEA in water	2016	Roadside	Cheshire West and Chester	12	37	39	-5.3%	Good	1.06
Gradko	20% TEA in water	2016	Roadside	Thurrock	12	29	26	11.0%	Good	0.90
Gradko	20% TEA in water	2016	Roadside	King's Lynn and West Norfolk	11	30	25	18.2%	Good	0.85
Gradko	20% TEA in water	2016	Urban	Eastleigh	11	29	30	-4.7%	Good	1.05
Gradko	20% TEA in water	2016	Roadside	Eastleigh	12	44	42	2.9%	Good	0.97
Gradko	20% TEA in water	2016	Roadside	Brighton and Hove	12	52	48	8.8%	Good	0.92
Gradko	20% TEA in water	2016	Roadside	Eastleigh	11	29	37	-22.0%	Good	1.28
Gradko	20% TEA in water	2016	Kerbside	Marylebone intercomparison	12	99	79	25.2%	Good	0.80
Gradko	20% TEA in water	2016	Roadside	Monmouthshire County	11	39	34	16.6%	Good	0.86
Gradko	20% TEA in Water	2016	Roadside	Preston	10	30	27	10.0%	Good	0.91
Gradko	20% TEA in water	2016	Roadside	Dudley	12	37	34	11.0%	Good	0.90
Gradko	20% TEA in water	2016	Urban	Dudley	12	26	22	18.6%	Good	0.84
Gradko	20% TEA in water	2016	Roadside	Dudley	11	43	38	12.4%	Good	0.89
Gradko	20% TEA in water	2016	Roadside	Dudley	12	51	54	-5.6%	Good	1.06
Gradko	20% TEA in water	2016	Background	Waltham Forest	12	31	30	2.3%	Good	0.98
Gradko	20% TEA in water	2016	Roadside	Nottingham	12	37	39	-5.4%	Good	1.06
Gradko	20% TEA in water	2016	Roadside	Hounslow	9	75	58	28.0%	Good	0.78
Gradko	20% TEA in water	2016	Urban	Hounslow	9	33	33	0.1%	Good	1.00
Gradko	20% TEA in water	2016	Roadside	Lisburn and Castlereagh	12	39	26	46.4%	Good	0.68
Gradko	20% TEA in water	2016	Background	Pembrokeshire	11	4	3	27.5%	Good	0.78
Gradko	20% TEA in water	2016	Roadside	Cheltenham	11	32	32	-0.9%	Good	1.01
Gradko	20% TEA in water	2016	Roadside	Lancaster	11	33	32	2.8%	Good	0.97
Gradko	20% TEA in water	2016	Roadside	Lincoln	11	46	38	20.9%	Good	0.83
Gradko	20% TEA in water	2016	Roadside	Fareham	12	33	26	27.0%	Good	0.79
Gradko	20% TEA in water	2016	Roadside	Fareham	12	39	37	5.3%	Good	0.95
Gradko	20% TEA in water	2016	Roadside	Fareham	9	27	32	-16.2%	Good	1.19
Gradko	20% TEA in water	2016	Roadside	Nottingham	12	34	38	-10.0%	Poor	1.11
Gradko	20% TEA in water	2016		Overall factor (32 studies)				Use		**0.92**

Table 17 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	07/01/2016	03/02/2016	37.7	36.4	36.3	36.8	0.8	2	2.0	38.7	100.0	**Good**	**Good**
2	03/02/2016	01/03/2016	41.3	44.1	42.2	42.5	1.4	3	3.5	46.7	100.0	**Good**	**Good**
3	01/03/2016	30/03/2016	missing	38.3	missing					46.4	99.9		**Good**
4	30/03/2016	28/04/2016	40.9	40.8	28.2	36.6	7.3	**20**	18.1	39.7	100.0	**Poor**	**Good**
5	28/04/2016	26/05/2016	38.0	36.6	36.9	37.2	0.7	2	1.8	39.0	100.0	**Good**	**Good**
6	26/05/2016	30/06/2016	38.2	38.9	37.6	38.2	0.6	2	1.6	38.0	94.4	**Good**	**Good**
7	30/06/2016	27/07/2016	30.3	30.1	29.4	30.0	0.5	2	1.2	29.0	98.0	**Good**	**Good**
8	27/07/2016	25/08/2016	31.4	29.4	31.3	30.7	1.1	4	2.8	25.0	100.0	**Good**	**Good**
9	25/08/2016	29/09/2016	36.2	37.8	35.3	36.4	1.2	3	3.1	31.0	100.0	**Good**	**Good**
10	29/09/2016	27/10/2016	39.1	40.2	40.4	39.9	0.7	2	1.7	41.0	100.0	**Good**	**Good**
11	27/10/2016	01/12/2016	48.1	29.5	30.0	35.9	10.6	**30**	26.3	52.4	100.0	**Poor**	**Good**
12	01/12/2016	05/01/2017	45.4	44.7	44.9	45.0	0.3	1	0.9	44.9	100.0	**Good**	**Good**
It is necessary to have results for at least two tubes in order to calculate the precision of the measurements												Good precision	Good overall DC

Overall survey -->

Site Name/ ID:	Whitby Road, WH

Precision	9 out of 11 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	0.99 (0.92-1.08)
Bias B	1% (-7% to 9%)
Diffusion tubes mean:	37 μgm^{-3}
Mean CV (precision):	2
Automatic Mean:	37 μgm^{-3}
Data capture for periods used:	99%
Adjusted tubes mean:	37 (34-40) μgm^{-3}

Accuracy (with 95% confidence interval) With all data	
Bias calculated using 11 periods of data	
Bias factor A	1.04 (0.95-1.15)
Bias B	-4% (-13% to 5%)
Diffusion tubes mean:	37 μgm^{-3}
Mean CV (precision):	6
Automatic mean:	39 μgm^{-3}
Data capture for periods used:	99%
Adjusted tubes mean:	39 (35-43) μgm^{-3}

Appendix D: Maps of monitoring locations

Figure 1 Location of automatic monitoring station in Chester

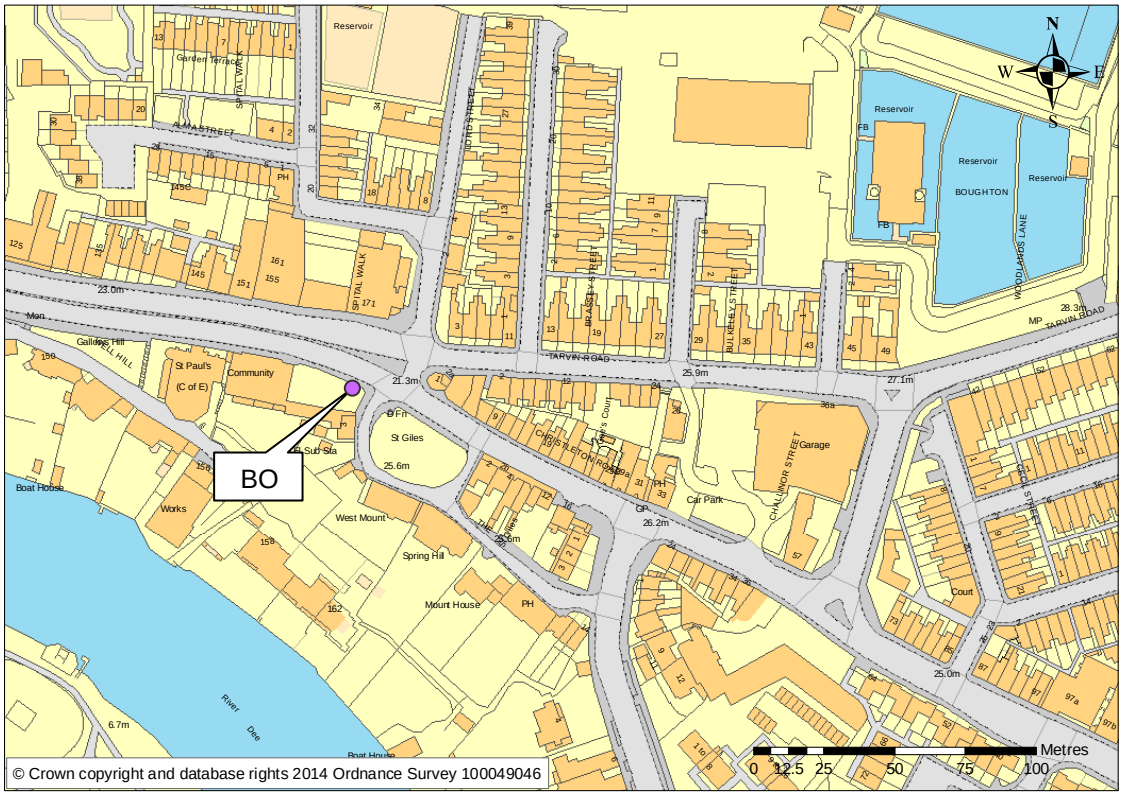


Figure 2 Location of automatic monitoring station in Ellesmere Port

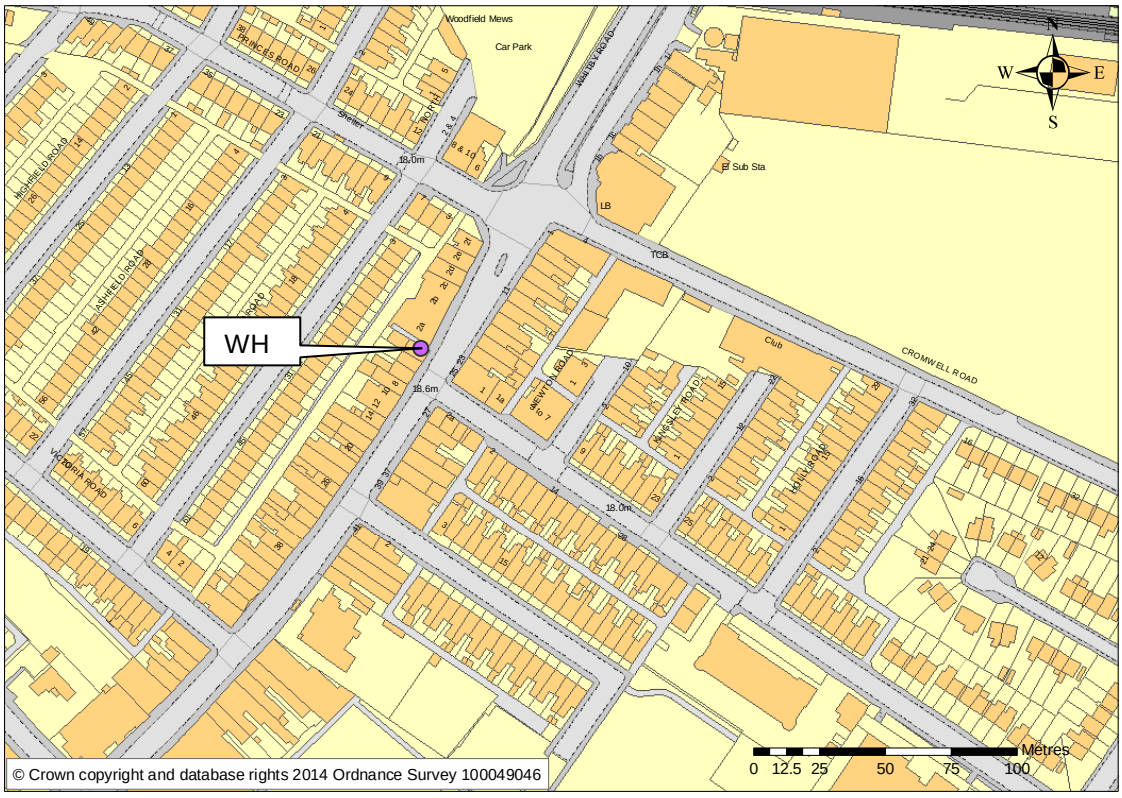


Figure 3 Location of automatic monitoring stations in Thornton-le-Moors

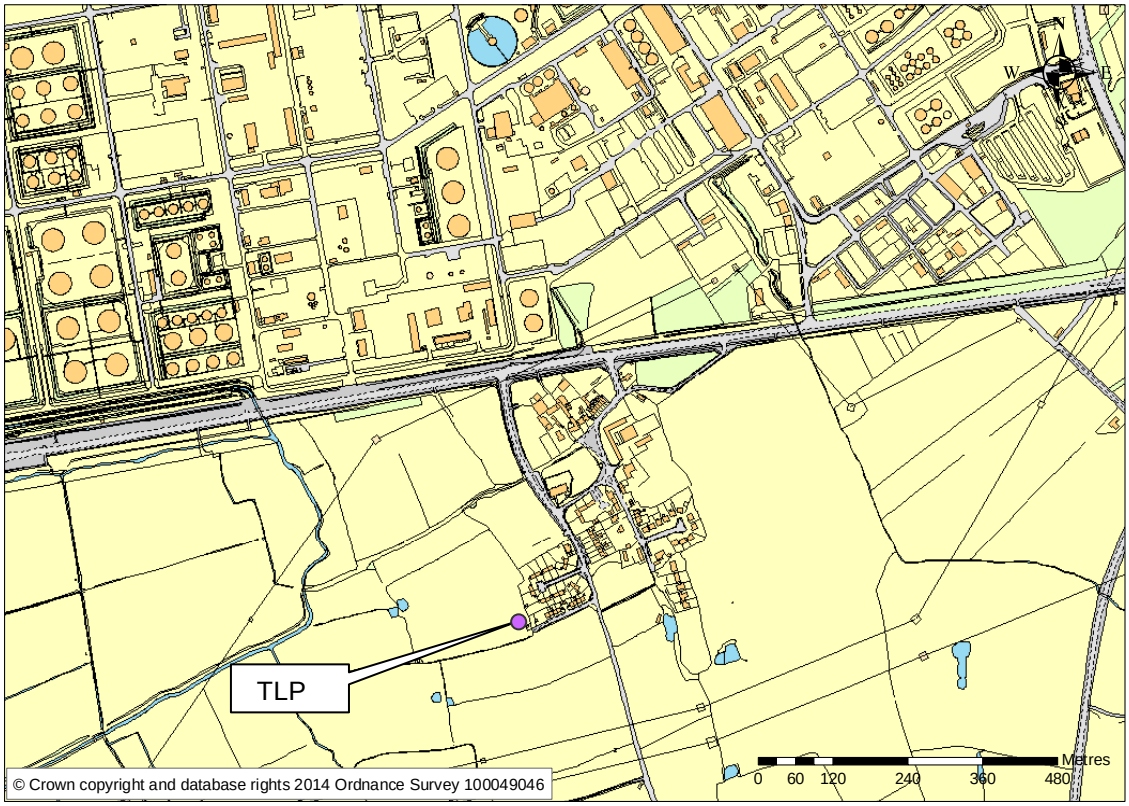


Figure 4 Location of automatic monitoring station in Ellesmere Port

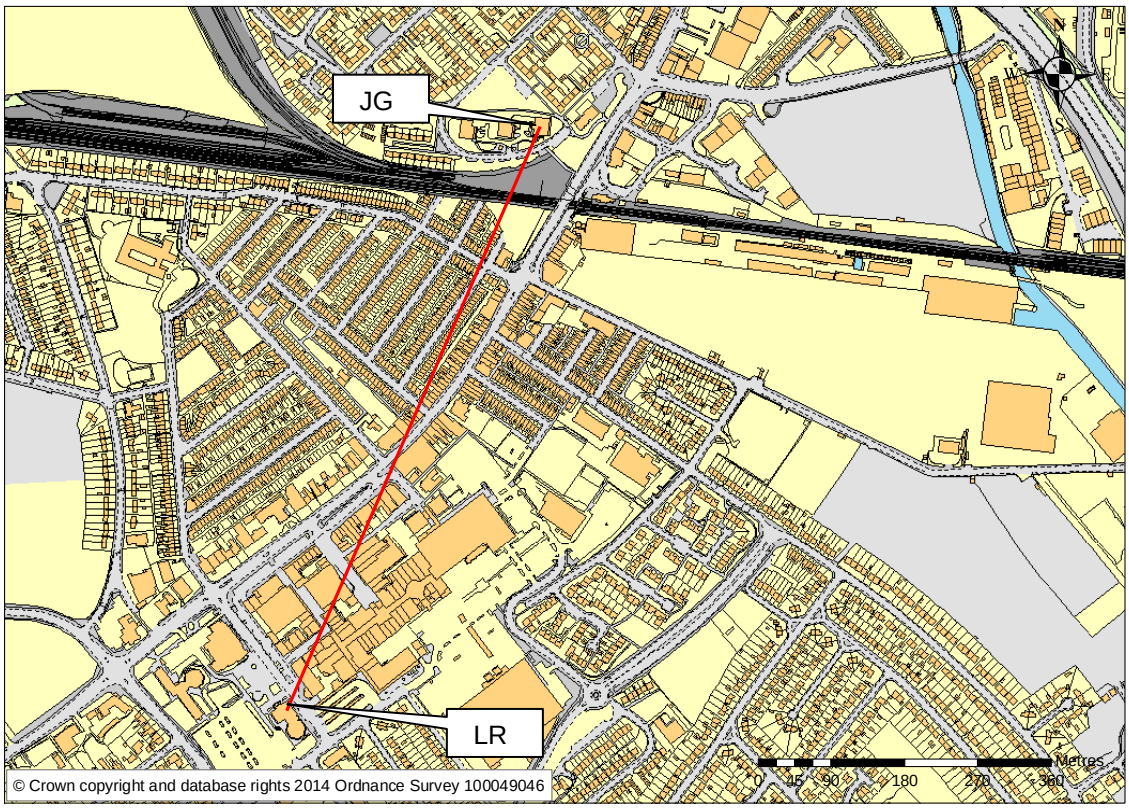


Figure 5 Location of automatic monitoring station in Frodsham

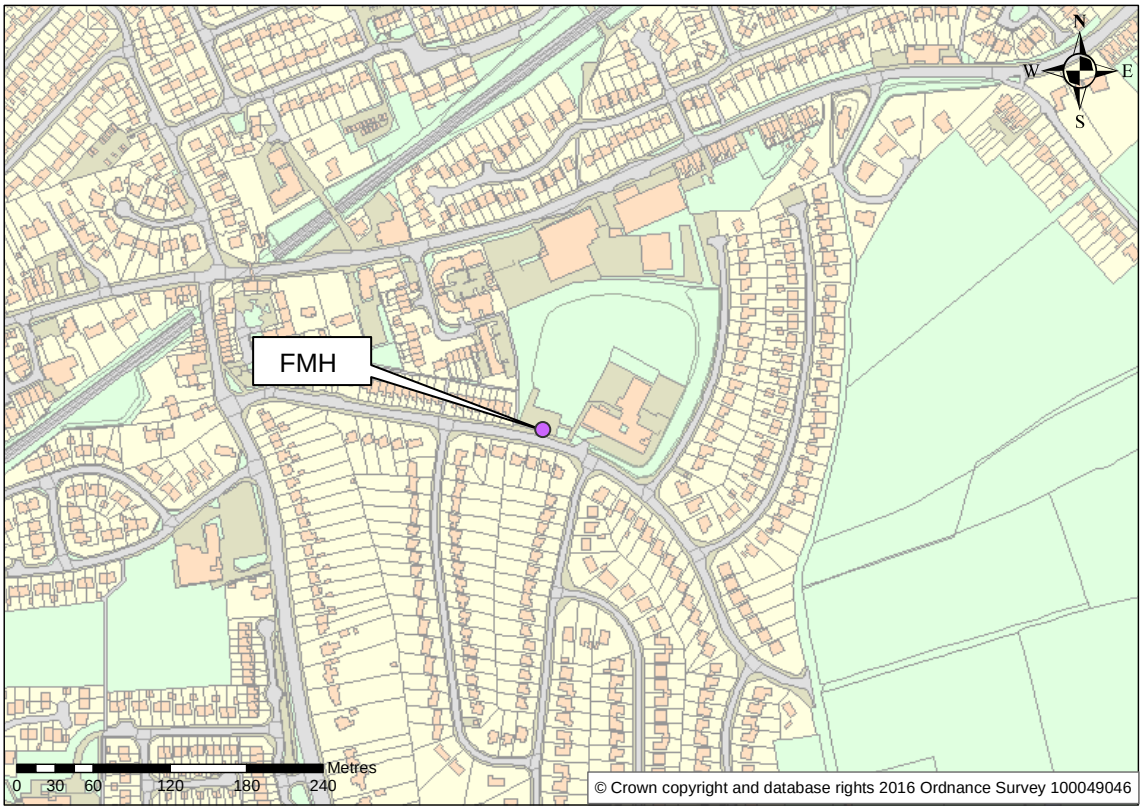


Figure 6 Location of automatic monitoring station in Elton

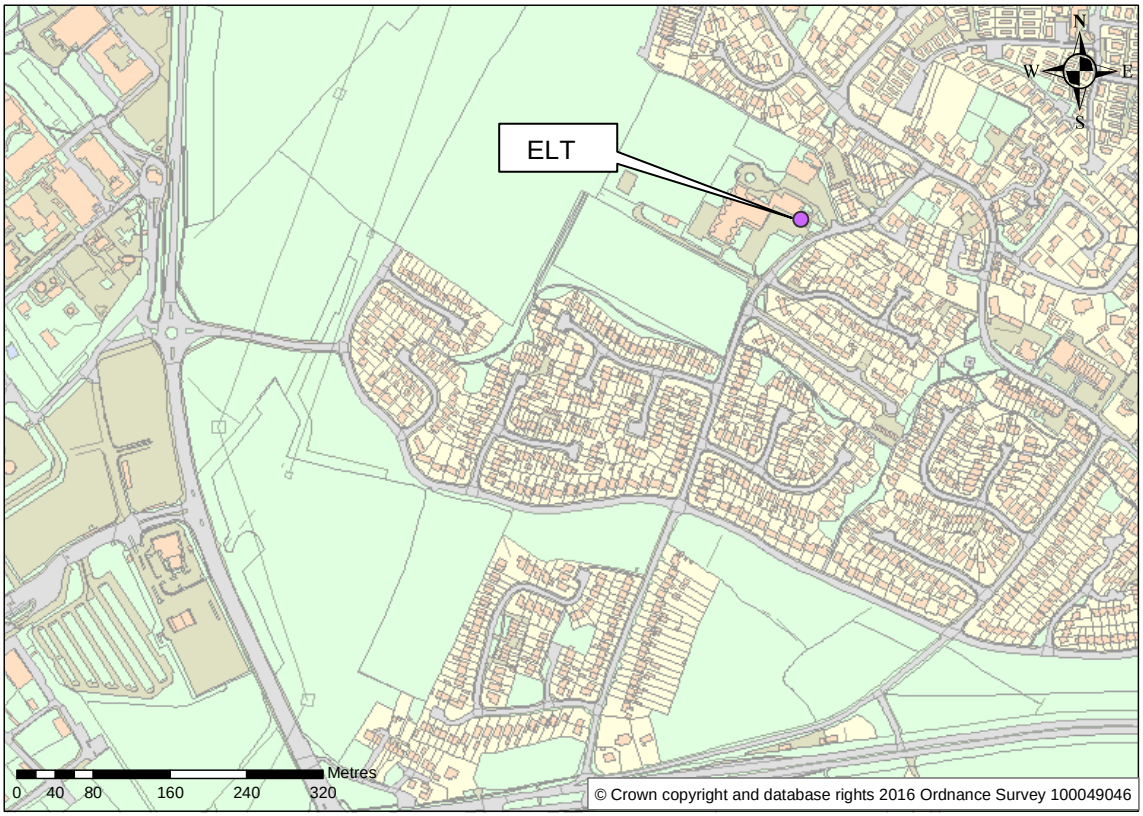


Figure 7 Location of NO_2 diffusion tubes in Chester

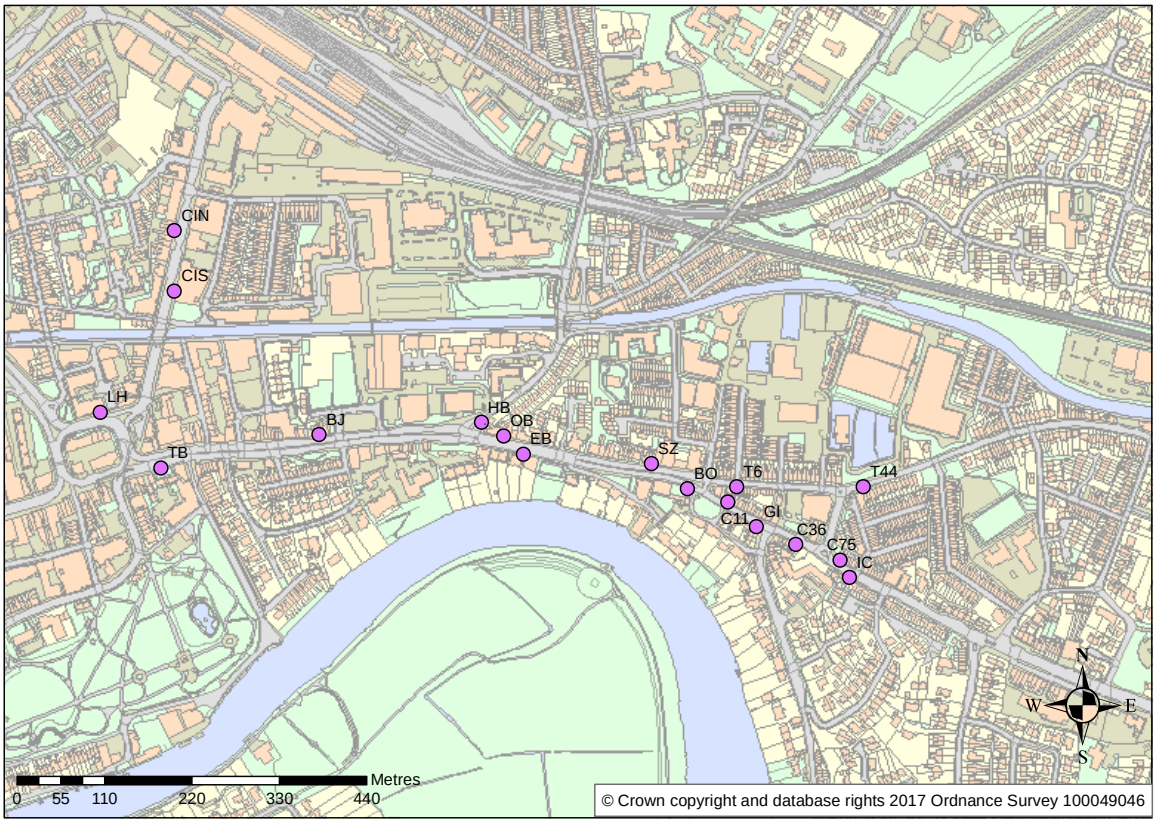


Figure 8 Location of NO_2 diffusion tubes in Chester

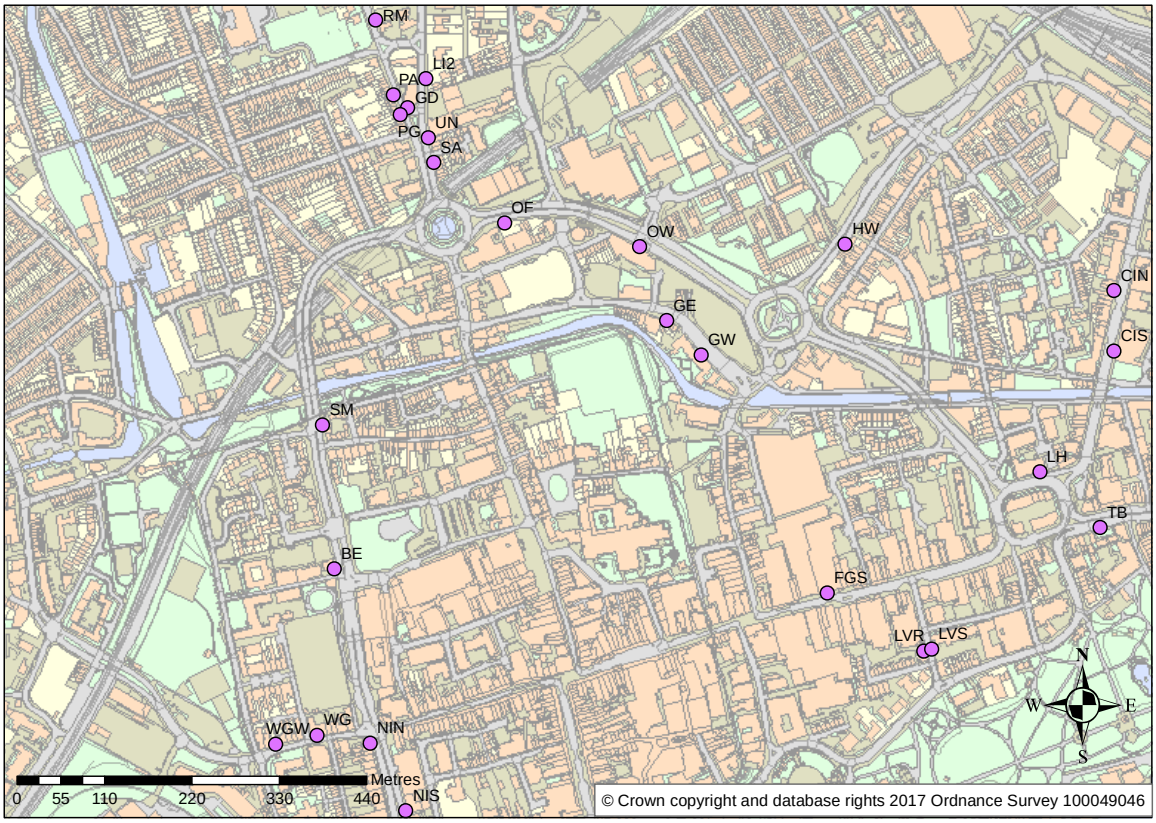


Figure 9 Location of NO_2 diffusion tubes in Chester

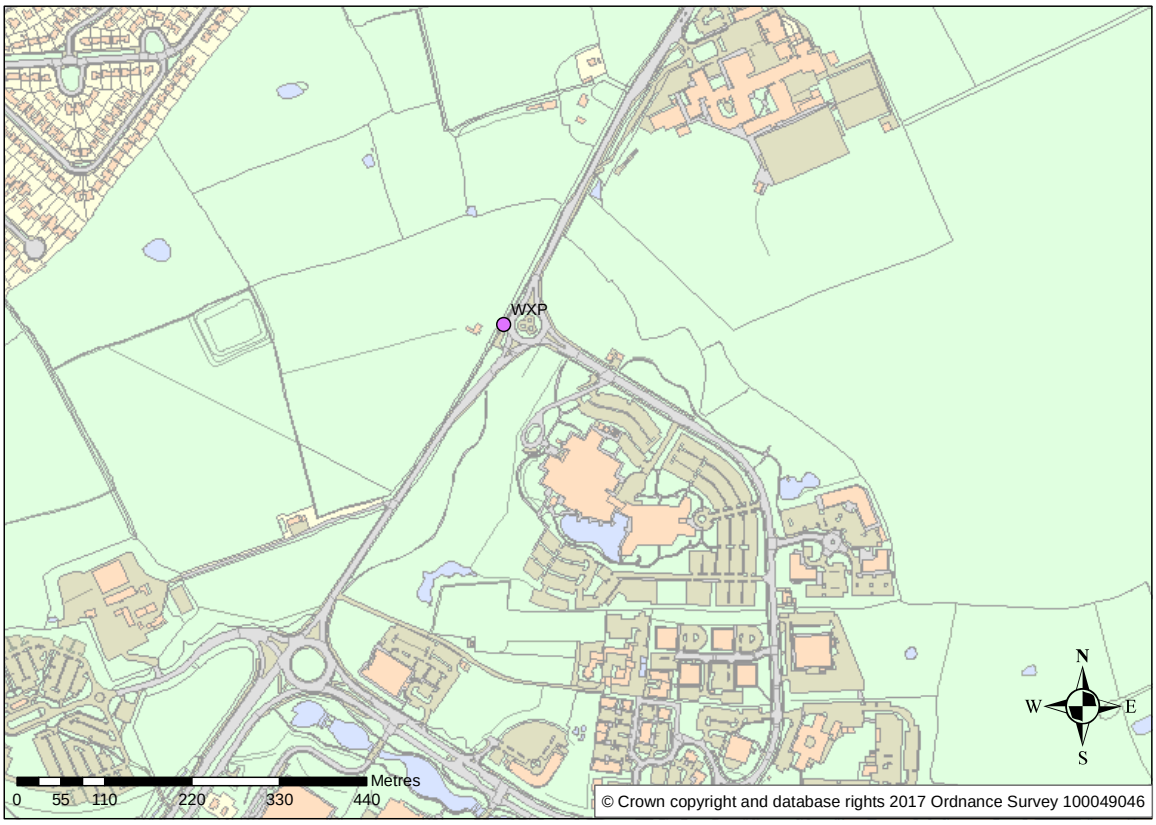


Figure 10 Location of NO_2 diffusion tubes in Ellesmere Port

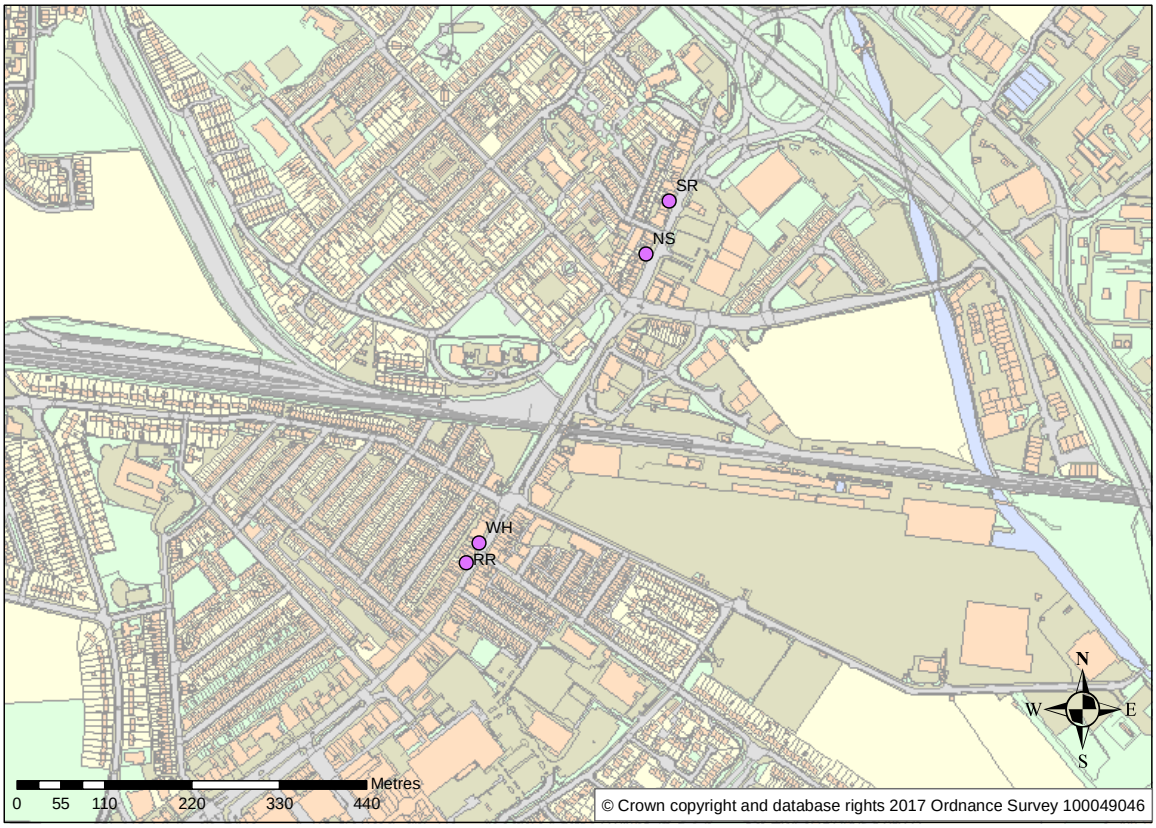


Figure 11 Location of NO_2 diffusion tubes in Frodsham

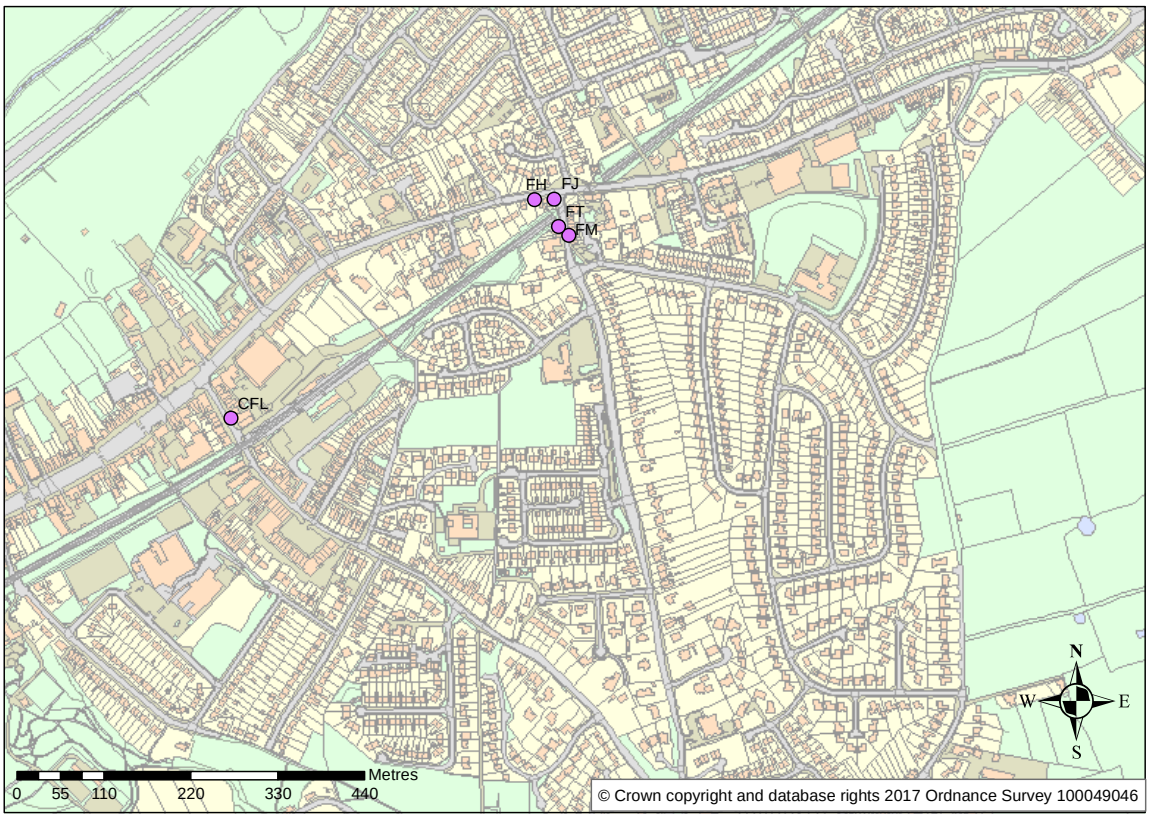


Figure 12 Location of NO_2 diffusion tube, Christleton

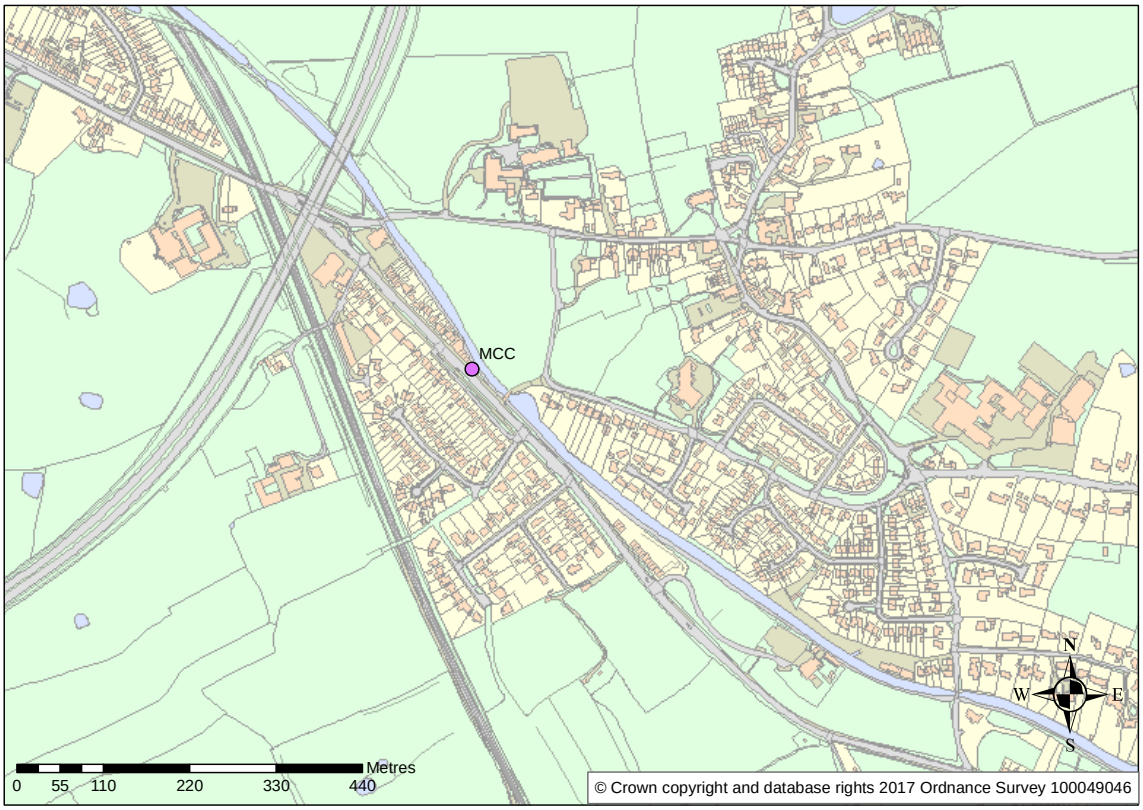


Figure 13 Location of NO_2 diffusion tube, Rudheath

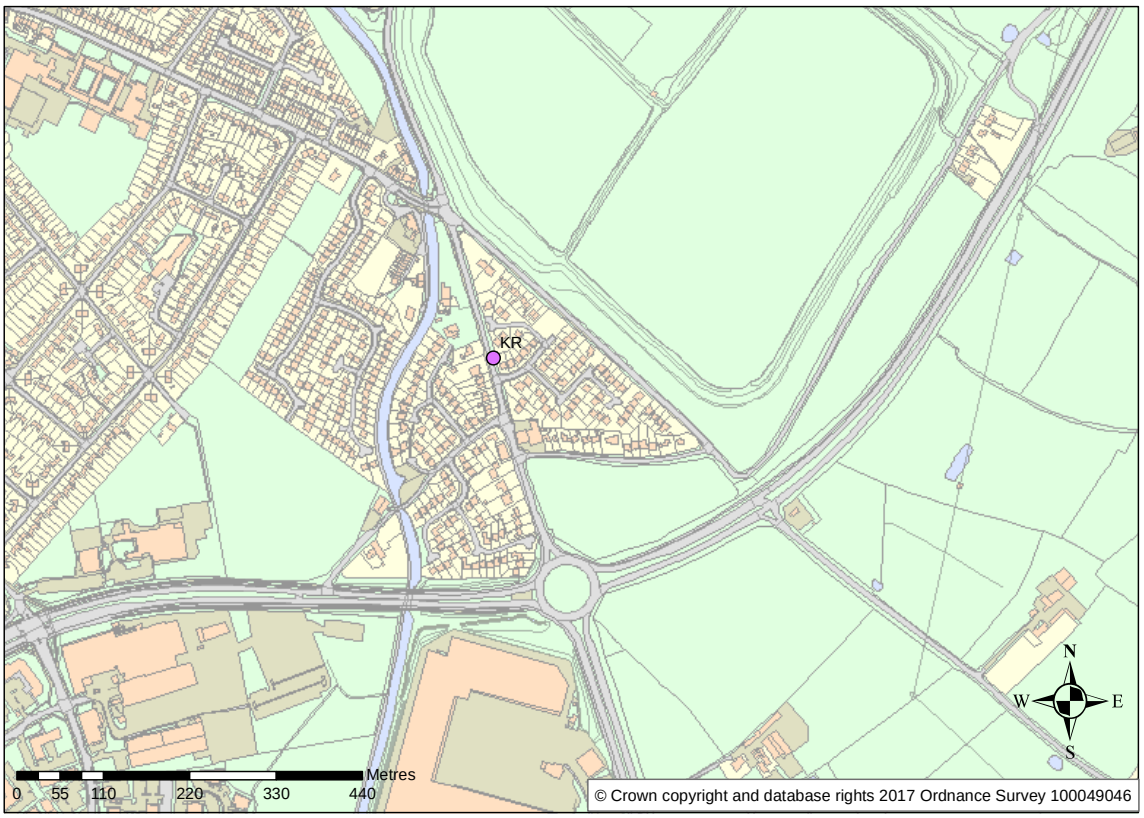
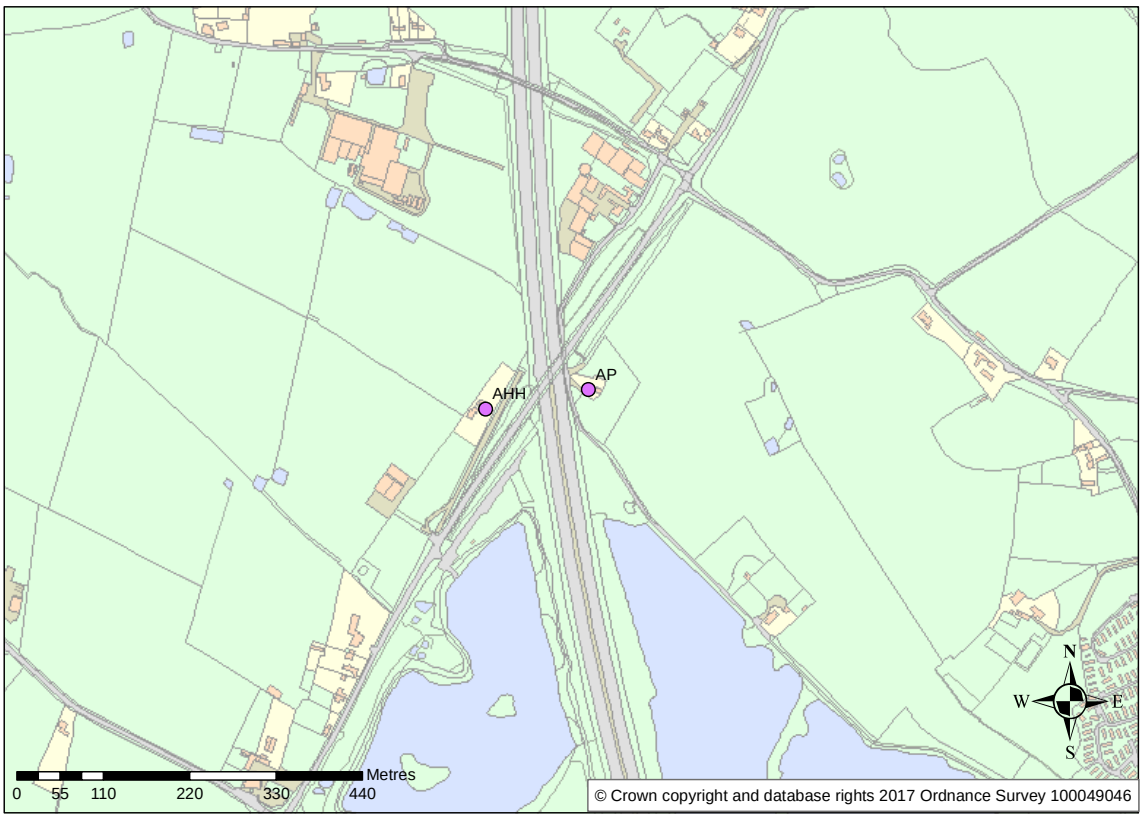


Figure 14 Location of NO2 diffusion tube, Allostock



Appendix E: Summary of air quality objectives in England

Table 18 Air quality objectives in England

Pollutant	Air quality objective[5]	
	Concentration	**Measured as**
Nitrogen dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	one-hour 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	one-hour 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

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

Appendix F: Long-term trends

Figure 15 Five-year trends of NO_2 at real-time sites

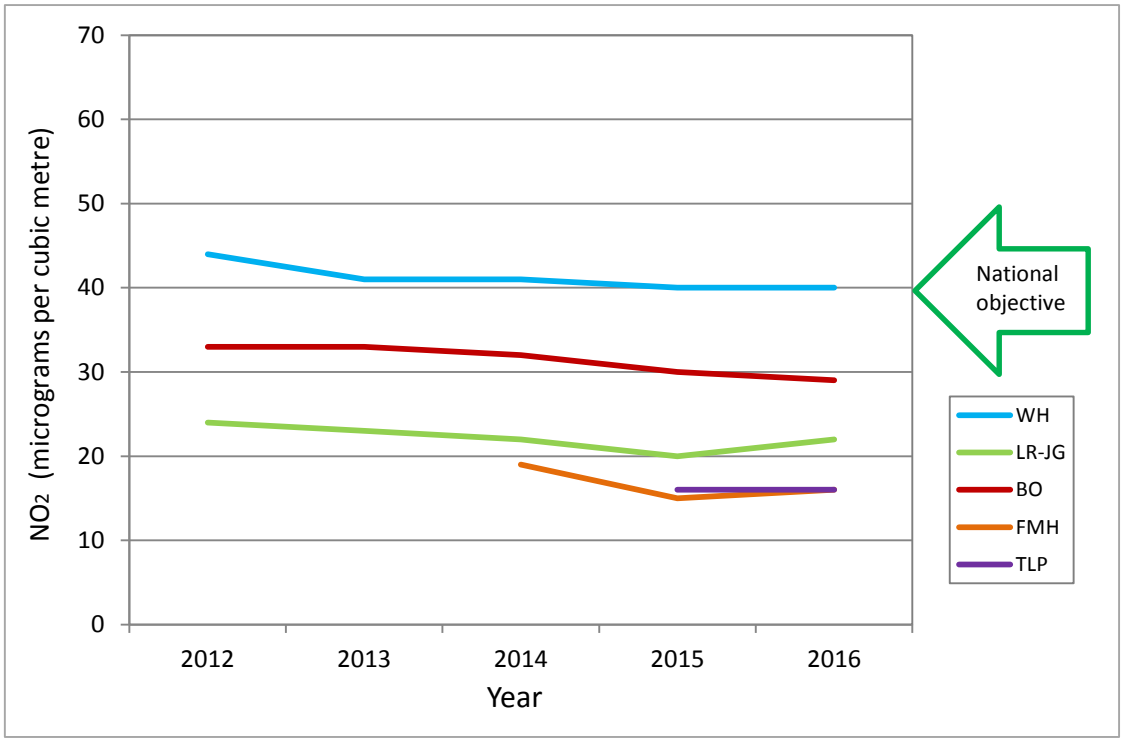


Figure 16 Five-year trends of NO_2 at Chester diffusion tubes

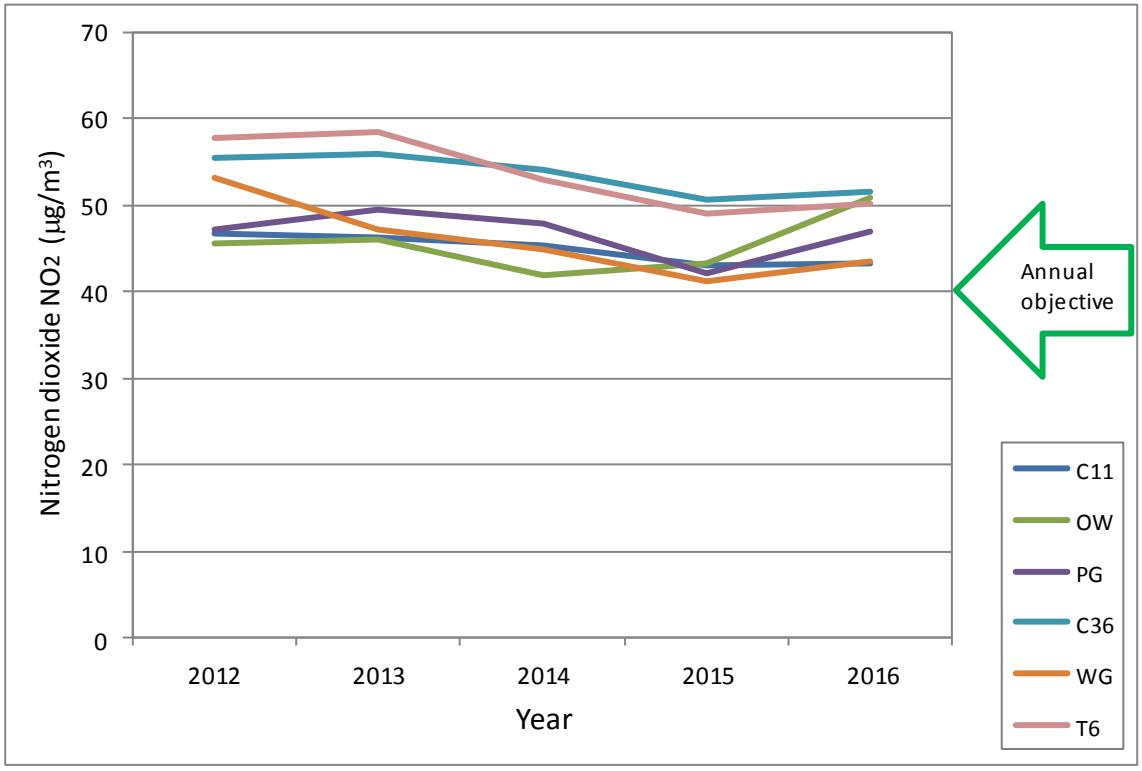


Figure 17 Five-year trends of NO_2 at Ellesmere Port diffusion tubes

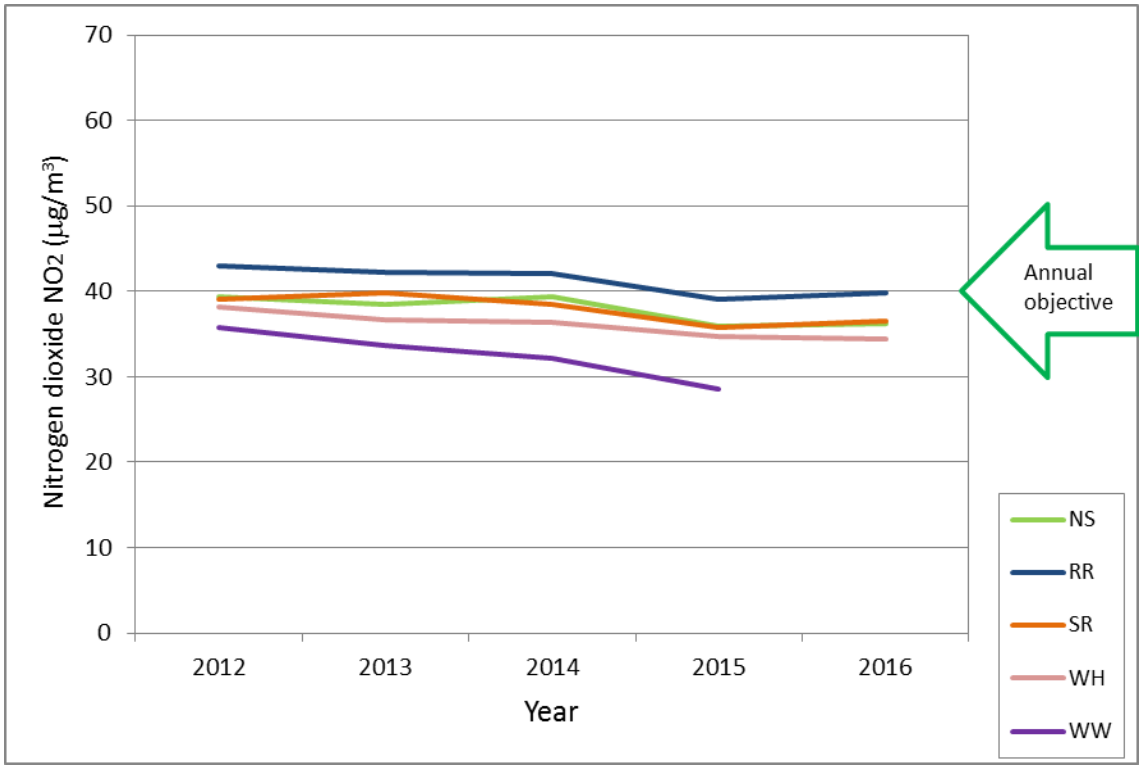


Figure 18 Five-year trends of NO_2 at Frodsham diffusion tubes

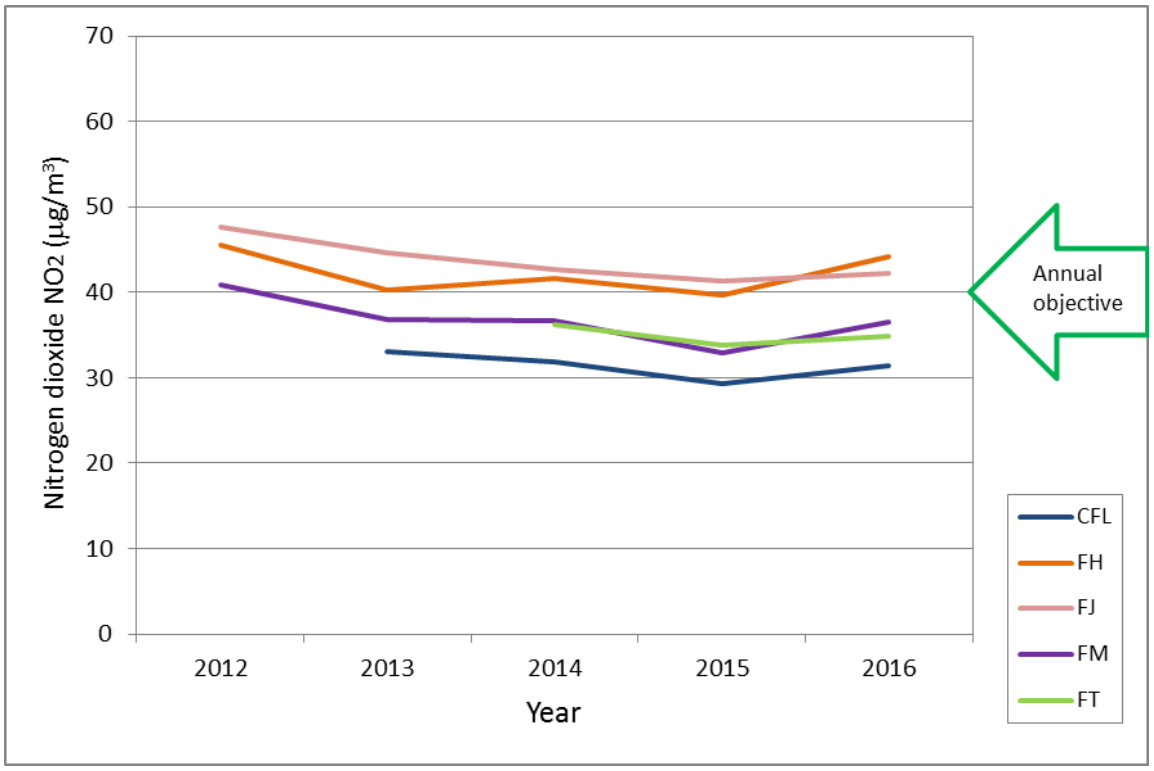


Figure 19 Five-year trends of PM_{10} in Cheshire West

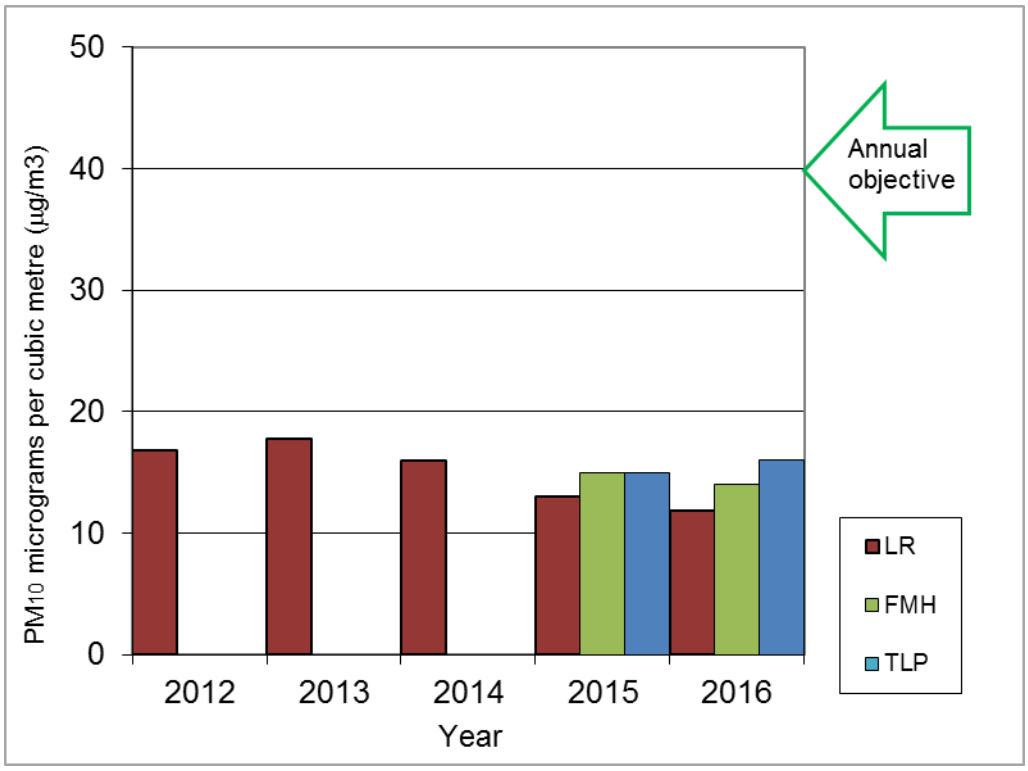
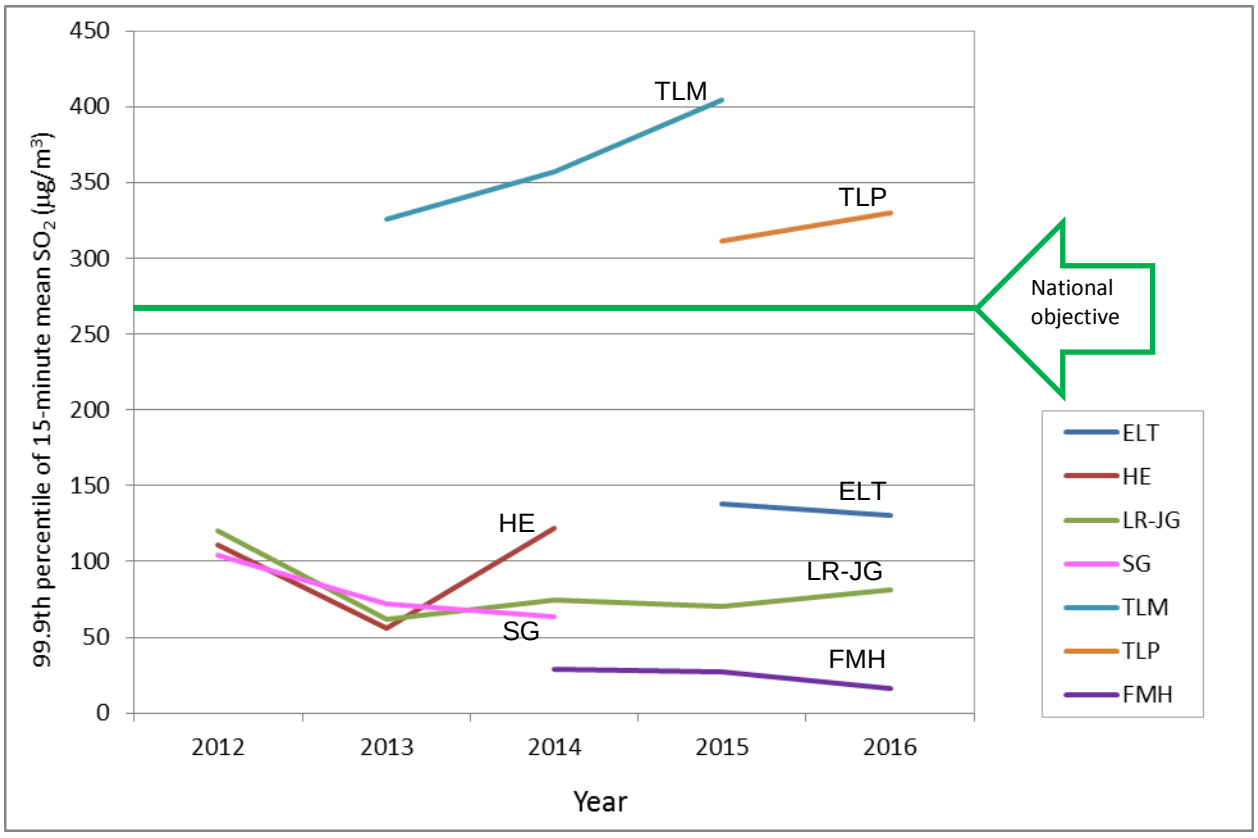


Figure 20 Five-year trends of SO_2 in Cheshire West



Appendix G:Inter-site comparisons

Figure 21 Inter-site hourly NO_2 comparisons 2016 (AQDM Ltd.)

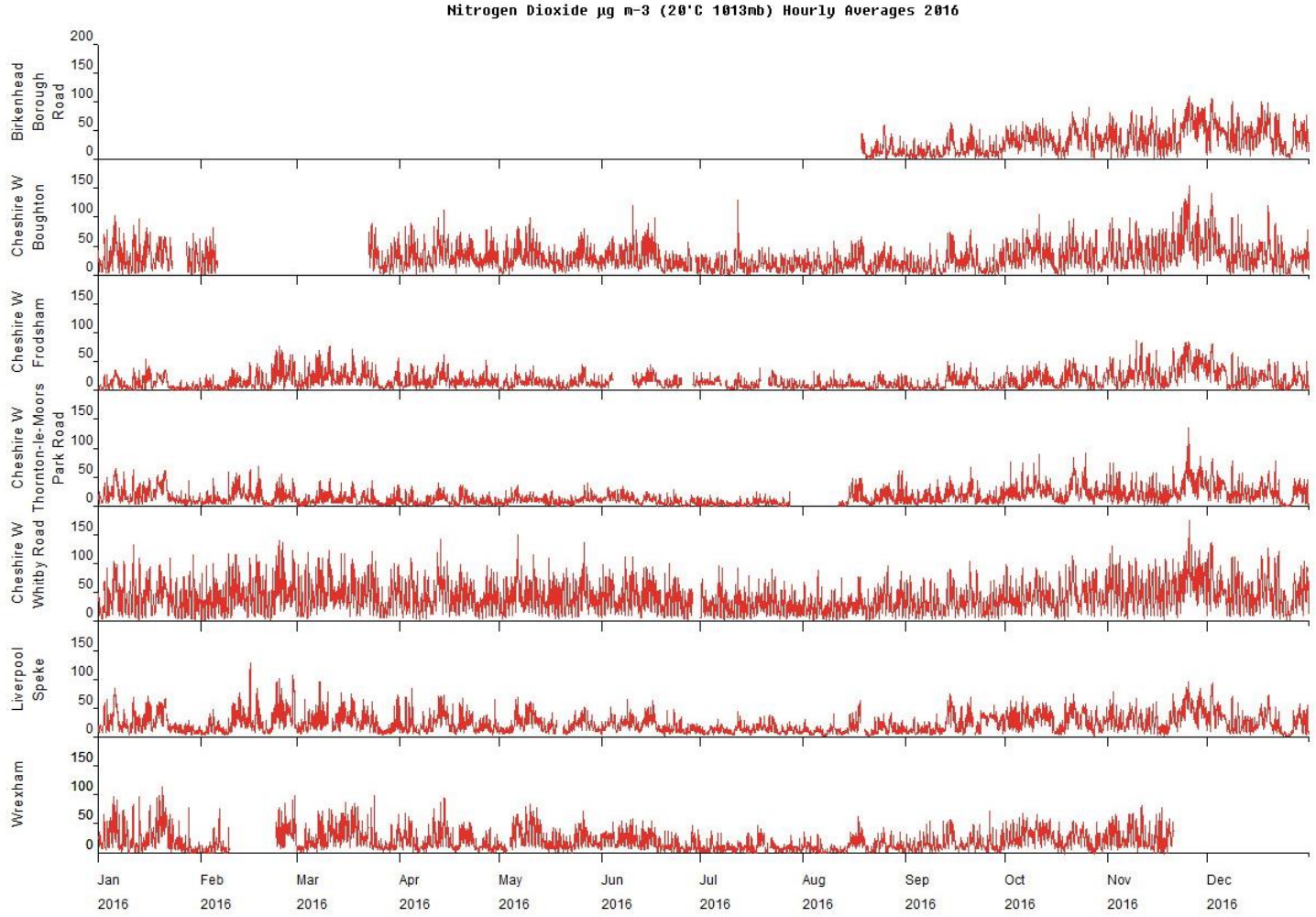


Figure 22 Inter-site hourly PM_{10} comparisons 2016 (AQDM Ltd.)

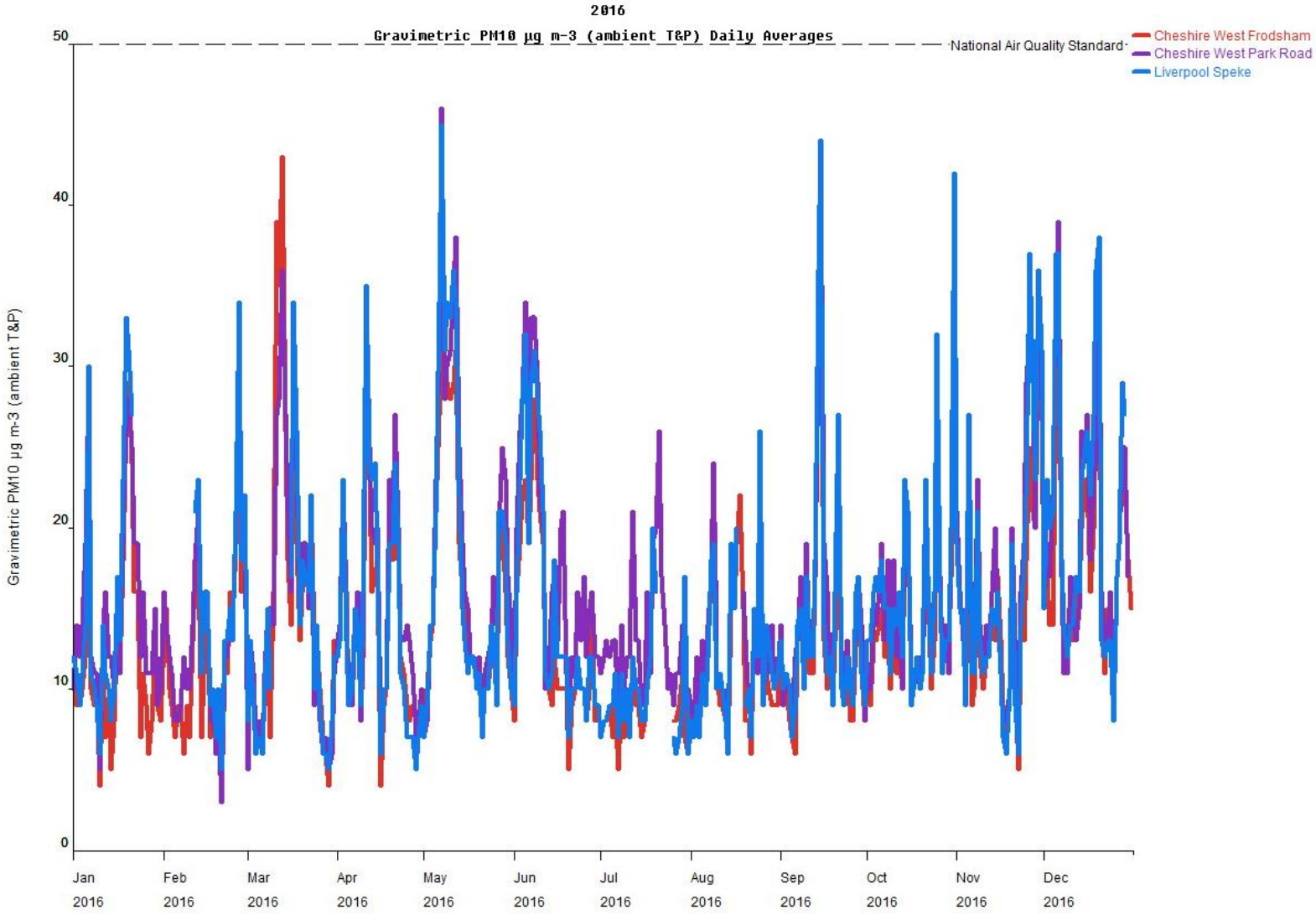
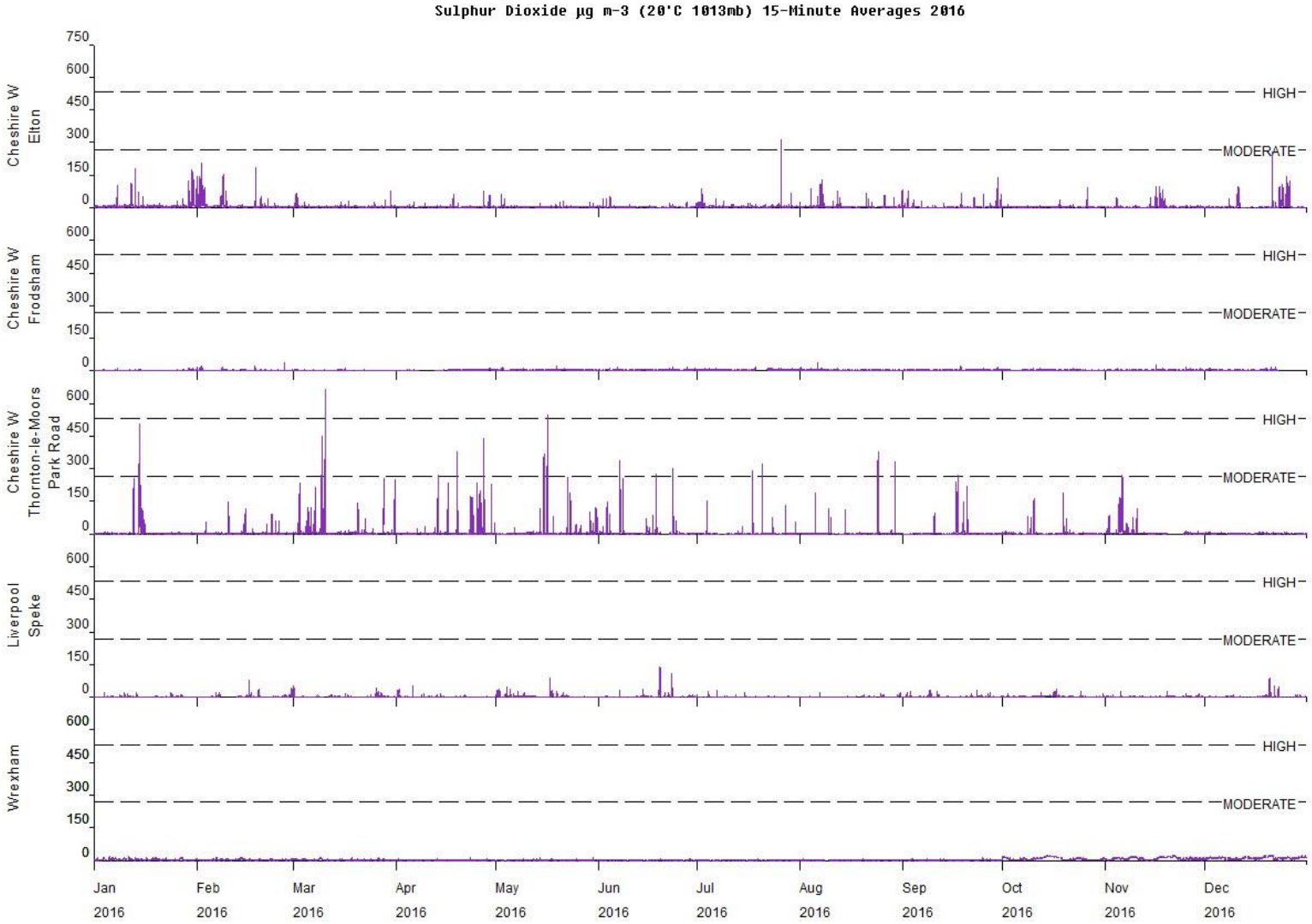


Figure 23 Inter-site hourly SO_2 comparisons 2016 (AQDM Ltd.)



Glossary of terms

Abbreviation	Description
AQAP	Air quality action plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the LA 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
EU	European Union
EV	Electric vehicle
LAQM	Local air quality management
NICE	National Institute for Health and Care Excellence
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
PM_{10}	Airborne particulate matter with a diameter of 10µm (micrometres/microns) or less
$PM_{2.5}$	Airborne particulate matter with a 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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