

New monitoring data

The Borough Council currently undertake ambient monitoring of the following pollutants covered by the AQS in King's Lynn and West Norfolk:

- NO₂ (automatic analyser and diffusion tubes)
- Particulate matter, PM₁₀ (TEOM and Osiris)
- SO₂ (DELTA denuder)

Since the previous Updating and Screening Assessment, monitoring of benzene has commenced in the Borough. Pace Petroleum undertakes this at their storage depot, Estuary Road, King's Lynn.

In addition, although not part of the AQS, PM_{2.5} and PM₁ are also measured by the Osiris monitor at Stoke Ferry.

Automatic monitoring sites

The automatic monitoring site at King's Lynn Railway Road comprises a chemiluminescence NO_x/NO₂ analyser and TEOM PM₁₀ analyser – both analysers were operational in 2006. The King's Lynn Railway Road site is not affiliated to Defra's Automatic Urban and Rural Monitoring Network (AURN), but is part of the National Automatic Monitoring Calibration Club where data are managed to the same QA procedures and standards as AURN sites. Site details are shown in Appendix 1.

The South Quay TEOM PM₁₀ monitor was removed in March 2006 in line with the revocation of the South Quay AQMA. The TEOM has been relocated to Edward Benefer Way to monitor King's Lynn Docks activity, although it is not yet in operation.

An Osiris particulate screening monitor is located at Furlong Road, Stoke Ferry, close to a feed mill operated by Grampian Country Feeds Ltd.

Sulphur dioxide

Background concentrations of sulphur dioxide have been measured at Stoke Ferry Water Treatment Works since 1986, as part of the UK Acid Deposition Monitoring Network – a Defra-funded monitoring network. The hydrogen peroxide bubbler method was employed until 2001, when it was superseded with the more sensitive filter-pack sampler. At the end of 2006, filter-pack sampling was also terminated, although SO₂ concentrations continue to be monitored under the UK Nitric Acid Monitoring Network, a 'daughter' network of the UK Acid Deposition Monitoring Network.

The current sampler is a DELTA sampler (Denuder for Long-Term Atmospheric sampling) – a diffusion denuder system incorporating a small pump that draws air through two coated glass tubes that adsorb acid gases, including SO₂. A particulate filter at the end of the denuder collects airborne aerosols. Council personnel operate the site and change the denuders on a monthly basis. The Centre for Ecology and Hydrology (CEH), Edinburgh, are responsible for data QA/QC.

Diffusion tube monitoring sites

In 2006, the King's Lynn & West Norfolk NO₂ diffusion tube monitoring network grew to 71 sites. Of these, 27 were located within the newly extended Railway Road AQMA. 25 new monitoring sites commenced in 2006 (including a blank) and 11 sites closed. Monitoring locations are described in more detail in Appendix 1.

Recent monitoring results and comparison with AQS objectives

QA/QC

The NO₂ diffusion tubes are prepared and analysed by Gradko Laboratories, using 20% v/v TEA in water. Triplicate diffusion tubes are co-located with the King's Lynn Railway Road automatic NO_x/NO₂ analyser. Two NO₂ background sites also have diffusion tubes running in triplicate. A 'blank' tube is also run.

The Borough Council of King's Lynn & West Norfolk is part of the National Automatic Monitoring Calibration Club, and automatic monitoring data are managed and ratified to the same procedures and standards as AURN sites. The Borough Council ratifies all diffusion tube data. All data presented in this progress report are fully ratified.

NO₂ diffusion tube bias

Diffusion tubes frequently exhibit bias (over-or under-read) relative to chemiluminescence analysers, the reference technique for NO₂. The Guidance states that it is necessary to correct for any such bias when using diffusion tube results for review and assessment purposes.

National bias adjustment factors are available from Local Authority co-location studies, prepared by Air Quality Consultants. This is a summary spreadsheet and is available via the Air Quality Review and Assessment website (<http://www.uwe.ac.uk/aqm/review>). This study provides a combined bias adjustment factor based on the co-location studies for each type of diffusion tube.

Ten nationwide co-location studies were carried out in 2006 using 20% v/v TEA in water diffusion tubes from Gradko Laboratories. The National average bias adjustment factor is 0.98, compared to the locally derived factor of 0.94. All conclusions in this Progress Report are based on concentrations adjusted using the National bias adjustment factor, although concentrations using the locally derived factor are also shown for comparison.

Automatic NO₂ results

2006 NO₂ statistics and data capture percentages from the Railway Road automatic analyser are presented below in Table 3. All statistics have been ratified according to the QA/QC procedures in section 2.4.1.

Table 3 Automatic NO₂ monitoring data for 2006

Automatic NO ₂ monitoring data: 2006				
Site name	Data capture	NO ₂ annual mean (µgm ⁻³)	Max hourly mean (µgm ⁻³)	99.8 th Percentile of hourly means (µgm ⁻³)
King's Lynn, Railway Road	86.6 %	32	103	84

Data capture at the Railway Road automatic monitoring site was less than 90 % in 2006. As a result, the assessment with respect to the short-term AQS objective (200 µgm⁻³) must be performed on the 99.8th percentile of hourly means⁶.

The 99.8th percentile of hourly means at Railway Road is less than the objective value of 200 µgm⁻³.

No breaches of the short-term AQS objective for nitrogen dioxide are therefore predicted at this location.

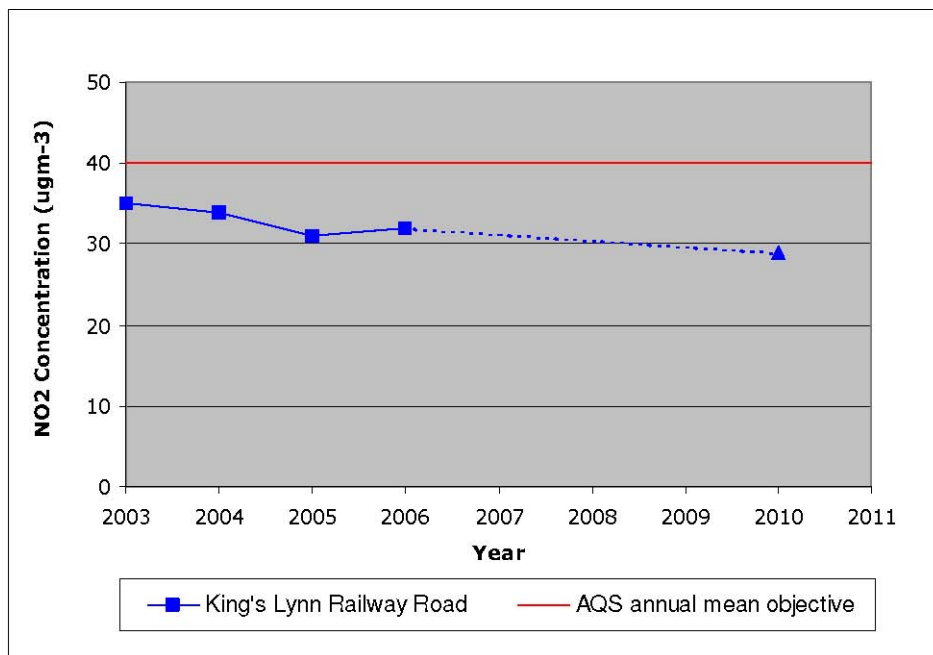
The King's Lynn Railway Road automatic analyser started in September 2002. An historic time series of annual mean nitrogen dioxide concentrations over the last four years (and a projected concentration for 2010) is shown in Table 4 and Figure 1.

Table 4 Historic automatic NO₂ annual mean concentrations, with projected concentrations for 2010 (µgm⁻³)

Automatic NO ₂ annual mean concentrations (µgm ⁻³)					
Site name	2003	2004	2005	2006	2010 ⁷
King's Lynn Railway Road	35	34	31 +	32 +	29

+ Data capture below 90%

Figure 1 Chart showing historic NO₂ annual mean concentrations, with projection for 2010



The annual mean nitrogen dioxide concentrations at Kings' Lynn Railway Road were again less than 40 µgm⁻³ indicating that concentrations in the town centre remain within the AQS annual mean objective limits. This site is within 1 m of the Railway Road AQMA.

SO₂ – DELTA denuder results

Background SO₂ concentrations continue to be made on a monthly basis at Stoke Ferry, as part of the UK Acid Deposition Monitoring Network. Measurements are made by the DELTA denuder, outlined in section 2.2.

The annual mean SO₂ background concentration at Stoke Ferry was 1.6 µgm⁻³ in 2006. This is comparable to the 2005 annual mean of 1.4 µgm⁻³. While the annual mean cannot easily be translated into the temporal resolutions required for comparison against the Air Quality Objectives, the maximum monthly concentration of 2.4 µgm⁻³ is a good indication that the short-term means will have been met.

NO₂ diffusion tube results

NO₂ diffusion tube concentrations, bias adjusted using both national and locally derived factors, are shown in Table 5. Those tubes located within the Railway Road AQMA are denoted with a star *. Conclusions are drawn from national rather than locally derived bias adjustment factors.

Table 5 NO₂ annual mean concentrations from diffusion tube sites for 2006 – shown using both Locally derived and National bias adjustment factors ($\mu\text{g}\text{m}^{-3}$)

NO₂ diffusion tube annual mean concentrations ($\mu\text{g}\text{m}^{-3}$)					
ID	Site name	Within AQMA?	Site type	Annual mean Local bias adjusted)	Annual mean National bias adjusted
1	Railway Road 1	*	K	43	44
2	Railway Road 4	*	R	54	56
3	Railway Road 5	*	R	49	51
4	Railway Road 6		K	38	39
5	Bus Station 1 – Bay 5		Bus station	41	43
6	Bus Station 2 – Travel office		Bus station	34	36
7 8 9	Railway Rd Monitoring Station	*	Co-located	31	33
10	Mill Fleet 1		R	25	26
11	Mill Fleet 2		R	25	26
12	London Road 1	*	R	41	43
13	London Road 2	*	R	35	36
14	London Road 3	*	R	37	39
15	London Road 4	*	R	38	40
16	London Road 5	*	R	39	41
17	Southgates	*	K	41	43
18	Wisbech Rd KL		R	26	27
19	NORA 1		R	22	23
20	Hardwick Road		R	30	31
21	Vancouver Avenue 1		R	29	30
22	London Road 10	*	K	33	35
23	London Road 11	*	R	40	41
24	London Road 6	*	R	39	40
25	London Road 7	*	R	36	38
26	London Road 8	*	R	36	37
27 28 29	The Walks		R	21	22
30	Railway Road 7	*	R	41	43
31	St John's Terrace	*	R	34	35
32	St John's Terrace / Blackfriars	*	R	32	33

33	Waterloo Street		K	26	27
34	Portland Street		K	26	27
35	Railway Road 2	*	K	37	39
36	Railway Road 3	*	R	36	38
37	Wellesley Street		K	35	36
38	Blackfriars 2	*	R	36	38
39	Blackfriars 1	*	R	36	37
40	Norfolk Street	*	R	36	37
41	Blackfriars 3	*	R	46	48
42	Littleport Street	*	R	35	36
43	Gaywood Road 2		R	30	31

NO ₂ diffusion tube annual mean concentrations (µgm ³)					
ID	Site name	Within AQMA?	Site type	Annual mean Local bias adjusted)	Annual mean National bias adjusted
44	The Swan Gayton Road		R	35	36
45	Wootton Road 2		R	41	42
46	Wootton Road 1		R	34	35
47	Lynn Road 1		R	32	33
48	Lynn Road 2		R	36	38
49	Gaywood Road 3		R	31	32
50	Gaywood Road 1		R	28	29
51	Austin Street 1	*	R	40	41
52	Austin Street 2	*	R	35	36
53	Edward Benefer Way		R	24	25
54 55 56	Kilham's Way		R	15	16
57	Low Road South Wootton		R	24	26
58	Castle Rising Rd South Wootton		R	22	23
59	Tennyson Avenue 1		R	21	22

60	Tennyson Avenue 2		R	23	24
61	Wisbech Road 1		R	21	22
62	Wisbech Road Elm 1		R	23	24
63	Wisbech Road Elm 3		R	21	21
64	Wisbech Road Elm 4		R	24	25
65	Wisbech Road Elm 5		R	21	22
66	Wisbech Road Elm 6		R	24	25
67	Wisbech Road Elm 2		R	28	30
68	London Road Downham Market		R	23	24
69	Railway Road Downham Market		R	22	23
70	Bridge Street Downham Market		R	26	27
71	Lynn Road Downham Market		R	31	32
72	Bexwell Road Downham Market		R	31	32
73	Buckenham Drive Stoke Ferry		R	15	16
74	High Street Stoke Ferry		R	17	18
75	Furlong Road Stoke Ferry		R	17	18
76	West Winch 1		R	24	25
77	West Winch 2		R	28	29

Bold red Exceedences of the AQS annual mean objective

***** Within extended Railway Road AQMA

R Roadside location

K Kerbside location

Exceedences of the annual mean objective are seen at the majority of monitoring sites within the Railway Road AQMA, justifying its extension in February 2007.

Exceedences outside the AQMA

Exceedences of the annual mean objective are seen at two locations outside the AQMA in 2006: Bus Station – Bay 5 and Wootton Road 2.

The annual mean NO₂ concentration at **Bus Station – Bay 5** was 43 µg m⁻³. While there is no exposure with regards the annual mean objective, there is relevant short-term (1-hour) public exposure at this location. A study conducted by Air Quality Consultants (AQC, 2003) concludes that it would be appropriate to base the decision of a likely exceedence of the 1-hour NO₂ objective on an exceedence of 60 µg m⁻³ as an annual mean. In light of this, no action needs to be taken at this time, although continued monitoring at this location is recommended.

A marginal exceedence was also seen at **Wootton Road 2**, Gaywood, where the annual mean concentration was 42 µg m⁻³. The diffusion tube is at a roadside location (1-5 m from kerb) and 39 cm from the nearest residential property. The diffusion tube thus represents a potential exceedence of the annual mean NO₂ objective, with relevant public exposure.

It is therefore recommended that the Borough Council of King's Lynn & West Norfolk proceed to a **Detailed Assessment for NO₂**, focussing on the Gaywood area of King's Lynn around the Wootton Road 2 diffusion tube. The Council should consider deploying an automatic NO_x analyser in Gaywood to confirm these concentrations, which should be co-located with diffusion tube monitoring (ideally in triplicate) to verify concentrations from Wootton Road 2 and other diffusion tubes in the vicinity.

Elm High Road, Wisbech

The 2006 Updating and Screening Assessment highlighted a potential exceedence of the NO₂ annual mean objective

along Elm High Road, Wisbech, on the boundary of the Fenland District local authority. Since then, both local authorities have deployed additional NO₂ diffusion tubes along the length of Elm High Road, including the roundabout with the A47 and at all relevant receptors in the vicinity. All diffusion tubes in the Borough of King's Lynn & West Norfolk area are showing satisfactory NO₂ concentrations for 2006, and the Council is confident that a Detailed Assessment for NO₂ is not required. Concentrations will continue to be monitored.

Automatic PM₁₀ results

Annual particulate matter statistics and data capture percentages from the King's Lynn Railway Road TEOM in 2006 are presented in Table 6. All statistics have been ratified according to the QA/QC procedures in section 2.4.1 and have been converted to gravimetric equivalent using a factor of 1.3.

The annual mean objective for PM₁₀ is 40 µg m⁻³. The short-term objective for PM₁₀ is 50 µg m⁻³, not to be exceeded more than 35 times a year. The number of exceedences can only be counted where data capture is greater than 90%. If the data capture is less than 90%, the 90th percentile of 24-hour means must be calculated; this should not exceed 50 µg m⁻³.

Table 6 below shows the data obtained from the Railway Road TEOM in 2006. Data capture is good, so the number of measured 24-hour exceedences can be used. It can be seen that both the short-term and annual mean 2004 objectives for PM₁₀ continue to be met at Railway Road in 2006.

Table 6 Automatic PM₁₀ monitoring data for 2006

Automatic PM ₁₀ data 2006 (gravimetric equivalent)				
Site name	Data capture	PM ₁₀ annual mean (µg m ⁻³)	Max 24-hr mean (µg m ⁻³)	Number of exceedences
King's Lynn Railway Road	91.8 %	26	73	9

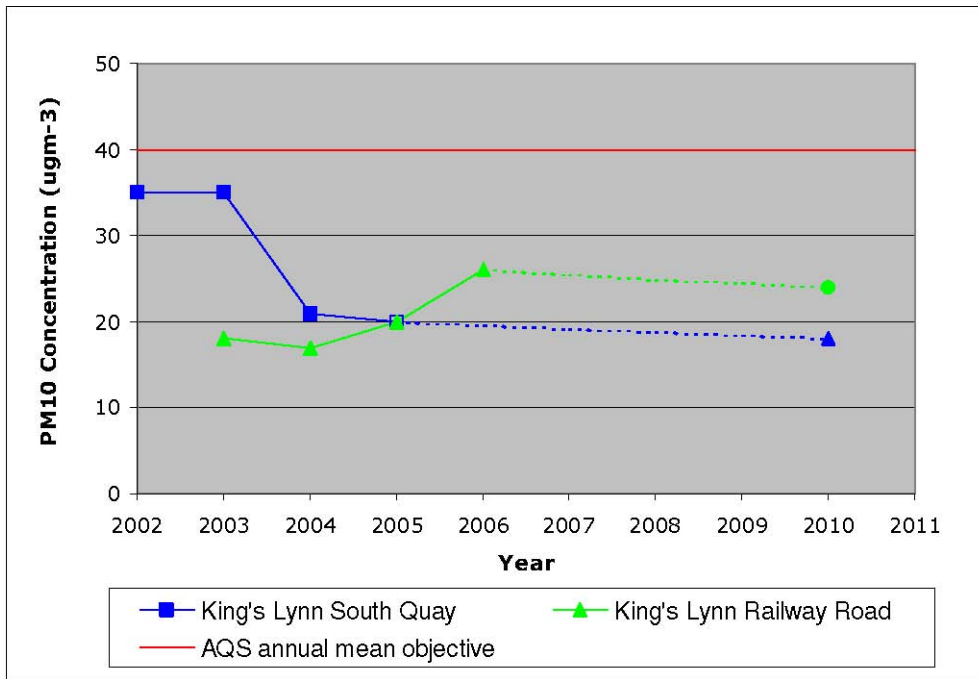
Table 7 and Figure 2 show a time-series of PM₁₀ concentrations at the King's Lynn monitoring sites over the past five years, with estimated projections of 2010 concentrations. Projections are based on 2005 concentrations from South Quay and 2006 concentrations from Railway Road.

Table 7 Historic automatic PM₁₀ annual mean concentrations, with projected concentrations for 2010 (µg m⁻³)

Automatic PM ₁₀ annual mean concentrations (gravimetric equivalent) (µg m ⁻³)						
Site name	2002	2003	2004	2005	2006	2010 ^a
King's Lynn South Quay	35 +	35 +	21	20	Site Closed	18
King's Lynn Railway Road		18	17	20	26	24

+ Data capture below 90% Figure 2 below shows an encouraging decreasing trend in PM₁₀ concentrations at South Quay, although concentrations at Railway Road appear to be increasing. While both sites remain well below the 2004 annual mean objective of 40 µg m⁻³, the trend at Railway Road should be closely monitored.

Figure 2 Chart showing historic PM₁₀ annual mean concentrations, with projections for 2010



The 2010 Objectives for Particulate Matter

The previous Updating and Screening Assessment commented that it was likely that the provisional 2010 PM₁₀ objectives (24-hour mean and annual mean) would be exceeded in many areas of King's Lynn. However, it should be taken into consideration that there is current uncertainty surrounding future particulate matter objectives; there is the possibility that the PM₁₀ objectives will be lowered making the objectives harder to meet, or alternatively changing to a PM_{2.5} objective. Additionally, the emphasis may change from 'hot spot' identification to gap closure in terms of the number of people exposed to a certain level of pollution. Until these objectives are set, the Borough Council of King's Lynn & West Norfolk is not required to carry out a detailed assessment for PM₁₀.

Benzene diffusion tube results

Benzene diffusion tubes have been exposed, as per the PPC permit, at the PACE Petroleum storage depot on Estuary Road, King's Lynn. However, the data quality is not yet good enough to give a firm indication of concentrations in the vicinity. Monitoring will continue and