AQMA Technical Note

Tonbridge and Malling Borough Council AQMA Review

November 2019

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Executive Summary

Bureau Veritas have been commissioned by Tonbridge and Malling Borough Council to complete a review of the Council's existing Air Quality Management Areas (AQMAs) to help inform a new Air Quality Action Plan (AQAP). The Council currently have seven AQMAs, all of which have been declared in relation to traffic emissions; six of the AQMAs have been designated for exceedances of the NO_2 annual mean Air Quality Strategy objective, whereas the M20 AQMA has been declared due to exceedances of both the NO_2 annual mean and the PM_{10} 24-hour mean AQS objectives.

A dispersion modelling assessment has been completed whereby NO_2 and PM_{10} concentrations have been predicted across all relevant areas within the borough at both specific receptor locations, and across a number of gridded areas to allow the production of concentration isopleths. This has been used to supplement local monitoring data to provide a clear picture of the pollutant conditions within the borough.

Following the completion of the analysis of both monitoring data and modelled concentrations across all of the assessed area a number of recommendations have been made in terms of the AQMAs within Tonbridge and Malling:

- M20 AQMA (1) – A revocation of the AQMA in terms of the 24-hour PM_{10} objective, and for the annual mean NO_2 designation to remain in force;
- Ditton AQMA (2) – A revocation of the AQMA;
- Tonbridge High Street AQMA (3) – The AQMA to remain in place based upon current monitoring results, with the designation to be reviewed based upon future monitoring data;
- Wateringbury AQMA (4) – The AQMA to remain in place based upon monitoring and modelled results;
- Aylesford AQMA (5) – A revision of the AQMA boundary based upon both monitored and modelled concentrations;
- Larkfield AQMA (6) – A revision of the AQMA boundary based upon both monitored and modelled concentrations; and
- Borough Green AQMA (7) – A revision of the AQMA boundary based upon both monitored and modelled concentrations.

The next steps upon completion of this Technical Note are to develop, through consideration of merit, a defined set of achievable measures to be drawn forward into the revised action plan document.

1 Introduction

Bureau Veritas have been commissioned by Tonbridge and Malling Borough Council ("the Council") to complete a review of the Council's existing Air Quality Management Areas (AQMAs) to help inform a new Air Quality Action Plan (AQAP). The Council's current draft AQAP was published in 2011, and the details presented within this Technical Note are to be used to develop an updated AQAP.

The Council currently have seven AQMAs. All of which are related to traffic emissions; six of the AQMAs have been designated for exceedances of the NO_2 annual mean Air Quality Strategy (AQS) objective, whereas the M20 AQMA has been declared due to exceedances of both the NO_2 annual mean and the PM_{10} 24-hour mean AQS objectives. Details of the AQMAs are as follows:

- M20 AQMA (1) – An area extending 39m from the centreline along the M20 motorway between the points where it passes below New Hythe Lane, Larkfield to the west and where it crosses Hall Road, Aylesford to the east;
- Ditton AQMA (2) – An area incorporating the Station Road/London Road A20 crossroads in the Parish of Ditton;
- Tonbridge High Street AQMA (3) – An area incorporating the High Street between Botany and the High Street/Vale Road roundabout, Tonbridge;
- Wateringbury AQMA (4) – An area incorporating the Red Hill/Tonbridge Road A26 crossroads in the Parish of Wateringbury;
- Aylesford AQMA (5) – An area encompassing the A20 London Road in Aylesford, including the junction with Hall Road and Mills Road;
- Larkfield AQMA (6) – An area encompassing the A20 London Road in East Malling, Larkfield and Ditton, including the junction with New Hythe Lane; and
- Borough Green AQMA (7) – Parts of Sevenoaks Road A25, Western Road and the High Street in Borough Green.

1.1 Scope of Report

This Technical Note seeks, with reasonably certainty, to predict the magnitude and geographical extent of any exceedances of the AQS objectives, providing the Council with updated modelling data that can be utilised for the development and/or updates to AQAP measures.

The areas considered as part of this study are illustrated in the figures shown under each AQMA heading within this report. The following are the main objectives of this report:

- To assess the air quality at selected locations ("receptors") at the façades of existing residential units, representative of worst-case exposure within, and close to the existing AQMA boundaries, based on modelling of emissions from road traffic on the local road network;
- To determine the geographical extent of any potential exceedance of the annual mean AQS objective for NO_2, and in regards to the M20 AQMA the 24-hour AQS objective for PM_{10};
- To determine the relative contributions of various source types to the overall pollutant concentrations through the completion of a source apportionment study; and

- To put forward recommendations as to the extent of any changes to the current AQMA boundary, and any changes to the declaration of the specific AQMAs.

The approach adopted in this assessment to assess the impact of road traffic emissions on air quality utilised the atmospheric dispersion model ADMS-Roads version 4.1.1, focusing on emissions of oxides of nitrogen (NO_x), which comprise of nitric oxide (NO) and NO_2, and also on PM_{10}.

In order to provide consistency with the Council's own work on air quality, the guiding principles for air quality assessments as set out in the latest guidance and tools provided by Defra for air quality assessment (LAQM.TG(16)[1]) have been used.

All figures presented within this Technical Note are not to scale and contain Ordnance Survey Data © Crown Copyright and database right 2019. Ordnance Survey 100049046.

[1] Local Air Quality Management Technical Guidance LAQM.TG(16). April 2016. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

2 Assessment Methodology

To predict pollutant concentrations of road traffic emissions the atmospheric model ADMS Roads version 4.1.1 was utilised, with the approach used based upon the following:

- Prediction of NO_2 and PM_{10} (where relevant) concentrations to which existing receptors may be exposed and comparison with the relevant AQS objectives;
- Quantification of relative NO_2 contribution of sources to overall NO_2 pollutant concentration; and
- Determination of the geographical extent of any potential exceedances in regards to the existing AQMA boundaries and proposed boundary changes stated in the previous assessment.

Pollutant concentrations have been predicted within a baseyear of 2018, with model inputs relevant to the assessment based upon the same year.

2.1 Traffic Inputs

Traffic flows for the road links included within the model have been taken from two sources; Kent County Council data presented within the Councils Local Plan Transport Assessment[2], and the remaining links from the DfT traffic count online resource[3]. Where relevant traffic flows for years preceding 2018 have been used, the data has been factored up to 2018 a factor derived from TEMPro Version 7.2.

Traffic speeds were modelled at the relevant speed limit for each road. However, in accordance with LAQM.TG(16)[1], where appropriate, traffic speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues or slower traffic are known to occur.

The Emissions Factors Toolkit (EFT) version 9.0[4] developed by Bureau Veritas on behalf of Defra has been used to determine vehicle emission factors for input into the ADMS-Roads model. The emission factors are based upon the traffic data inputs used within the assessment.

2.2 General Model Inputs

A site surface roughness value of 0.5m was entered into the ADMS-roads model, consistent with the suburban nature of the modelled domain.

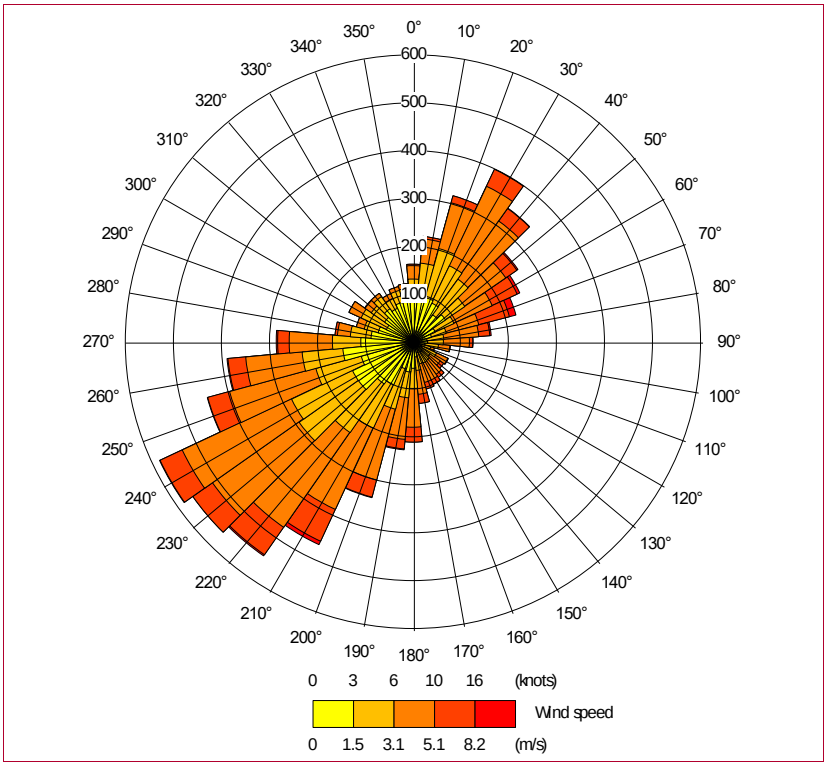
One year of hourly sequential meteorological data from a representative synoptic station is required by the dispersion model. 2018 meteorological data from Charlwood weather station, has been used in this assessment. A wind rose for this site for the year 2018 is presented in Figure 2.1.

[2] Mott MacDonald, Tonbridge and Malling Local Plan, Transport Assessment (2018

[3] Department for Transport, Traffic distribution by time of day on all roads in Great Britain (2019), available at https://www.gov.uk/government/collections/road-traffic-statistics

[4] Defra, Emissions Factors Toolkit (2019). http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

Figure 2.1 – Wind Rose for Charlwood 2018 Meteorological Data 2018



2.3 Sensitive Receptors

180 specific receptors were included within the assessment to represent locations of relevant exposure, the locations were identified through the completion of a desktop study and through consultation with the Council. In addition concentrations were also modelled across regular gridded area's set across the individual AQMAs within the model domain at a receptor height of 1.5m (plus at 3m for AQMA 3). These were supplemented with additional receptor points added close to the modelled road links, using the intelligent gridding tool in ADMS-Roads.

The majority of the receptors (162) were included at a height of 1.5m to represent ground level exposure, whereas 18 receptors were included at increased heights of 3m or 5m at various locations to represent exposure at buildings with residential use at a first storey level. The receptors at a height of greater than 1.5m are all located within AQMA 3 where there is residential exposure located above ground floor commercial usage along Tonbridge High Street.

2.4 Model Outputs

Background pollutant values derived from the Defra background maps database[5] have been used in conjunction with the concentrations predicted by the ADMS-Roads model to calculate predicted total annual mean concentrations of NO_x.

For the prediction of annual mean NO_2 concentrations for the modelled scenarios, the output of the ADMS-Roads model for road NOx contributions has been converted to total NO2 following the methodology in LAQM.TG(16)1, using the NO_x to NO_2 conversion tool developed on behalf of Defra. This tool also utilises the total background NO_x and NO_2 concentrations. This assessment has utilised version 7.1 of the NO_x to NO_2 conversion tool[6]. The road contribution is then added to the appropriate NO_2 background concentration value to obtain an overall total NO_2 concentration.

[5] Defra Background Maps (2019), http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

[6] Defra NO_x to NO_2 Calculator (2019), available at https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

In addition to the calculation of total NO_2 annual mean concentrations, source apportionment was also carried out split between the following vehicle classes, for both NO_x and NO_2:

- Cars;
- Light-Goods Vehicles (LGVs);
- Heavy-Goods Vehicles (HGVs);
- Bus and Coaches; and
- Motorcycles.

Verification of the ADMS-Roads assessment has been undertaken using a number of local authority diffusion tube monitoring locations in accordance with the methodology detailed within LAQM.TG(16)[1]. Due to the spatial variance of the AQMA's across Tonbridge and Malling, separate verification has been completed for a number of different areas to take into account local monitoring results and specific local conditions. All NO_2 results presented in the assessment are those calculated following the process of model verification, using the following NO_x verification factors:

- AQMAs 1, 2, 5 and 6 – 1.827;
- AQMA 3 – 2.461;
- AQMA 4 – 5.684; and
- AQMA 7 – 2.334.

For the prediction of short term PM_{10} within the assessment of AQMA 1, LAQM.TG(16)[1] provides an empirical relationship between the annual mean and the number of exceedances of the 24-hour mean AQS objective for PM_{10} that can be calculated as follows:

$$Number\ of\ 24\ hour\ Mean\ Exceedences = -18.5 + 0.00145 * annual\ mean^3 + \frac{206}{annual\ mean}$$

This relationship has thus been adopted to determine whether exceedances of the short-term PM_{10} AQS objective are likely in this assessment, with annual mean PM_{10} results derived by combining the modelled road contributions with the relevant background annual mean PM_{10} concentrations. As with the modelled road NO_x emissions, the modelled PM_{10} road emissions have had a verification factor applied to them. There are no PM_{10} monitoring sites within Tonbridge and Malling, therefore as per LAQM.TG(16)[1] guidance the relevant NO_x verification factor has been used (1.827).

3 Modelling Results

The following section provides a detailed assessment for each AQMA, comparing monitoring completed within the AQMA over a five year period with the modelled concentrations of annual mean NO_2, and in reference to AQMA 1, 24-hour PM_{10} concentrations. Details of each monitoring location, and monitoring results have been taken from the 2019 Annual Status Report[7] completed by the Council. For each AQMA, recommendations have been put forward in terms of the current determination of the specific AQMA, in relation to potential changes to the designation or boundary.

Within the tabulated presentation of results for each AQMA any exceedances of the annual mean AQS objective of 40µg/m^3 have been highlighted in red, and where the predicted annual mean is within 10% of the annual mean objective (36µg/m^3) this has been highlighted in orange. Annual mean concentrations that are within 10% of the objective have been highlighted as a precautionary procedure, this is to ensure that for any recommendations made in terms of AQMA designation and revocation an element of uncertainty has been taken into account in regards to the predicted modelling concentrations.

3.1 AQMA 1 – M20

3.1.1 Council Monitoring Data

AQMA 1 is currently designated for both concentrations of annual mean NO_2 and 24-hour PM_{10}, and the current boundary incorporates a large section of the M20 between Larkfield and Aylesford. Currently there are nine diffusion tubes monitoring annual mean NO_2 located within the AQMA's modelled area, but there is not any PM_{10} monitoring located within the AQMA. The current monitoring diffusion tube sites both within, and located close to the AQMA are presented in Figure 3.1, and results for the previous five years are detailed in Table 3.1.

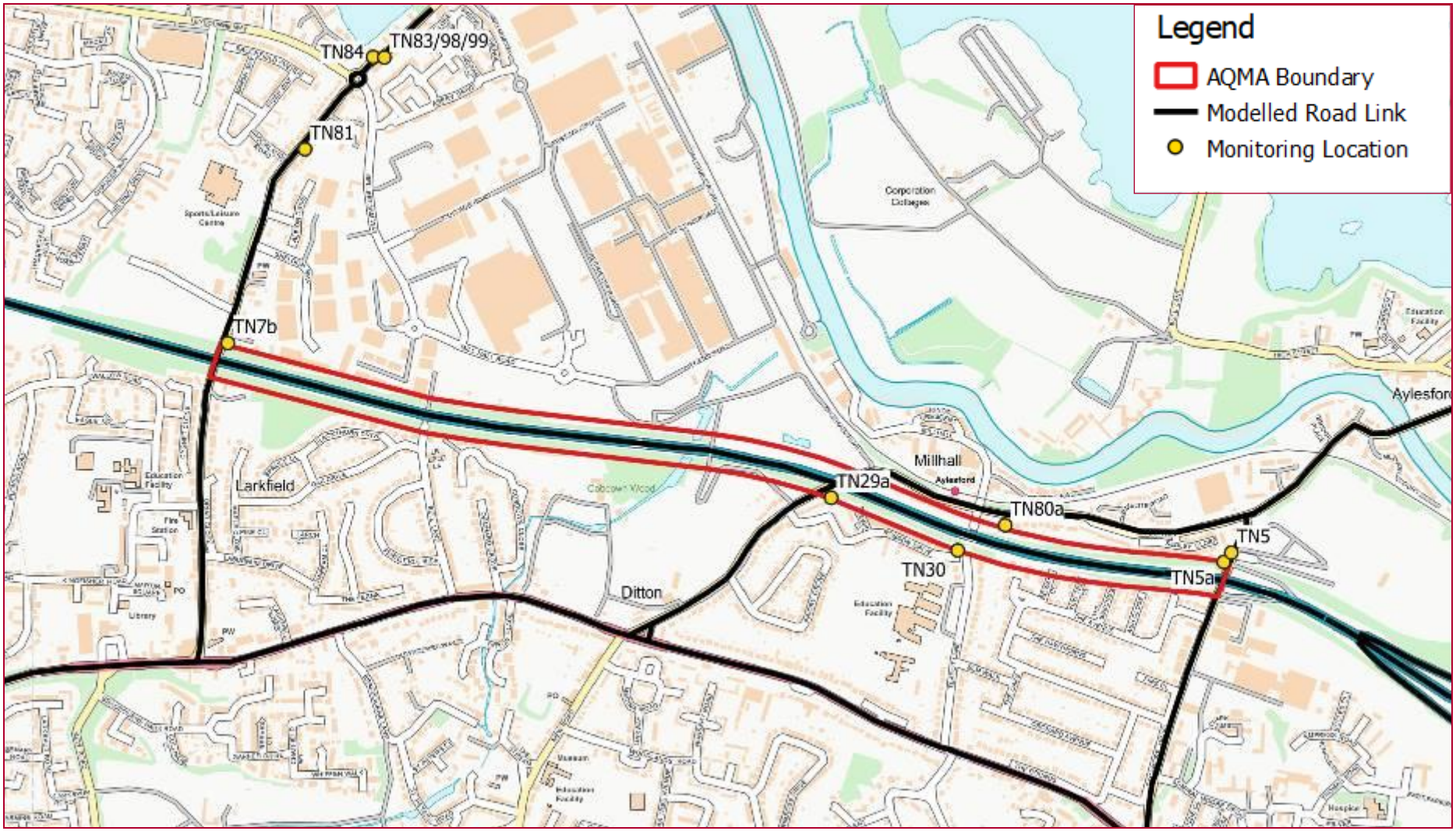
It can be seen that there have not been any exceedances of the annual mean NO_2 AQS objective within, or close to the AQMA for the past five years. The highest concentration recorded in 2018 was 34.9µg/m^3 at TN5, which since its inception in 2016 has recorded the highest annual mean concentration for the past three years.

Table 3.1 – Passive NO_2 Monitoring Within, and Close to AQMA 1

Site	Site Type	OS Grid Ref X	OS Grid Ref Y	Distance to Road (m)	Located In AQMA	Annual Mean NO_2 Concentration (µg/m^3)[1]				
						2014	2015	2016	2017	2018
TN5	R	572628	158566	4.85	YES	-	-	38.1	38.8	34.9
TN7b	R	570391	159032	33.3	YES	-	-	38.0	36.7	31.5
TN80a	R	572124	158627	35.8	YES	38.8	35.1	34.4	35.4	30.2
TN5a	R	572611	158545	26.7	YES	37.1	35.5	34.5	34.1	30.1
TN30	R	572018	158571	22	YES	28.3	29.3	29.7	26.7	25.5
TN29a	R	571736	158688	22.4	YES	24.9	25.4	28.0	25.2	24.1
TN83, 98, 99	R	570740	159667	4.1	NO	38.2	34.3	35.8	35.9	33.1
TN84	R	570715	159668	7.4	NO	31.1	30.0	29.9	29.6	26.7
TN81	R	570563	159463	5.4	NO	33.7	29.7	31.2	28.8	28.4
In **bold**, exceedance of the annual mean NO_2 AQS objective of 40µg/m^3 R= Roadside Details of diffusion tubes and results taken from the 2019 Tonbridge and Malling ASR										

[7] Tonbridge and Malling District Council, 2019 Annual Status Report (2019).

Figure 3.1 – AQMA 1, Modelled Roads and Monitoring Locations



3.1.2 Annual Mean NO_2

Table 3.2 provides the modelled annual mean NO_2 concentrations predicted at existing residential receptor locations for 2018. Of the 39 modelled receptor locations, exceedances of the annual mean NO_2 objective have been predicted at nine receptors, and one further receptor had an annual mean predicted to be within 10% of the AQS objective. From the annual mean NO_2 concentration isopleths presented in Figure 3.3-3.5, it can be seen that the extent of the predicted exceedances of the annual mean objective are similar to the existing AQMA boundary.

Table 3.2 – AQMA 1, Summary of Modelled Receptor Results (NO_2)

Receptor ID	OS Grid X	OS Grid Y	Height (m)	AQS objective (µg/m³)	2018 Annual Mean NO_2 (µg/m³)	% of AQS objective
1|1	572517	158317	1.5	40	24.0	60.0%
1|2	572556	158400	1.5	40	27.7	69.2%
1|3	572130	158620	1.5	40	**44.8**	112.0%
1|4	571855	158712	1.5	40	**50.4**	126.1%
1|5	571742	158690	1.5	40	**42.9**	107.1%
1|6	571578	158632	1.5	40	24.6	61.4%
1|7	570320	158789	1.5	40	24.5	61.2%
1|8	570500	159382	1.5	40	30.7	76.8%
1|9	570640	159555	1.5	40	29.3	73.2%
1|10	570712	159684	1.5	40	24.2	60.6%
1|11	569534	159194	1.5	40	34.4	86.1%
1|12	569736	159233	1.5	40	38.3	95.8%
1|13	570016	159139	1.5	40	**41.3**	103.2%
1|14	572930	158854	1.5	40	23.3	58.4%
1|15	572854	158803	1.5	40	28.3	70.8%
1|16	572720	158703	1.5	40	24.3	60.6%
1|17	572519	158603	1.5	40	30.5	76.3%
1|18	572314	158653	1.5	40	30.9	77.2%
1|19	572176	158538	1.5	40	**44.7**	111.7%
1|20	571942	158596	1.5	40	35.5	88.7%
1|21	571816	158660	1.5	40	**41.6**	104.1%
1|22	571999	158652	1.5	40	**51.6**	129.1%
1|23	571667	158664	1.5	40	28.3	70.8%
1|24	571564	158572	1.5	40	23.7	59.3%
1|25	573236	158002	1.5	40	31.5	78.7%
1|26	573333	158280	1.5	40	**59.0**	147.6%
1|27	572620	158564	1.5	40	32.2	80.6%
1|28	570343	158746	1.5	40	26.1	65.1%
1|29	570346	158845	1.5	40	29.6	73.9%
1|30	570321	158896	1.5	40	25.6	64.0%
1|31	570332	158943	1.5	40	31.4	78.6%
1|32	570374	158940	1.5	40	34.2	85.5%
1|33	570392	159034	1.5	40	**44.4**	111.0%
1|34	570424	159099	1.5	40	32.5	81.4%
1|35	570479	159274	1.5	40	27.7	69.1%
1|36	570407	159407	1.5	40	21.5	53.7%
1|37	570562	159495	1.5	40	26.9	67.2%
1|38	570647	159609	1.5	40	25.9	64.7%
1|39	570772	159690	1.5	40	32.8	82.0%

Figure 3.2 – AQMA 1, Modelled Receptor NO_2 Concentrations

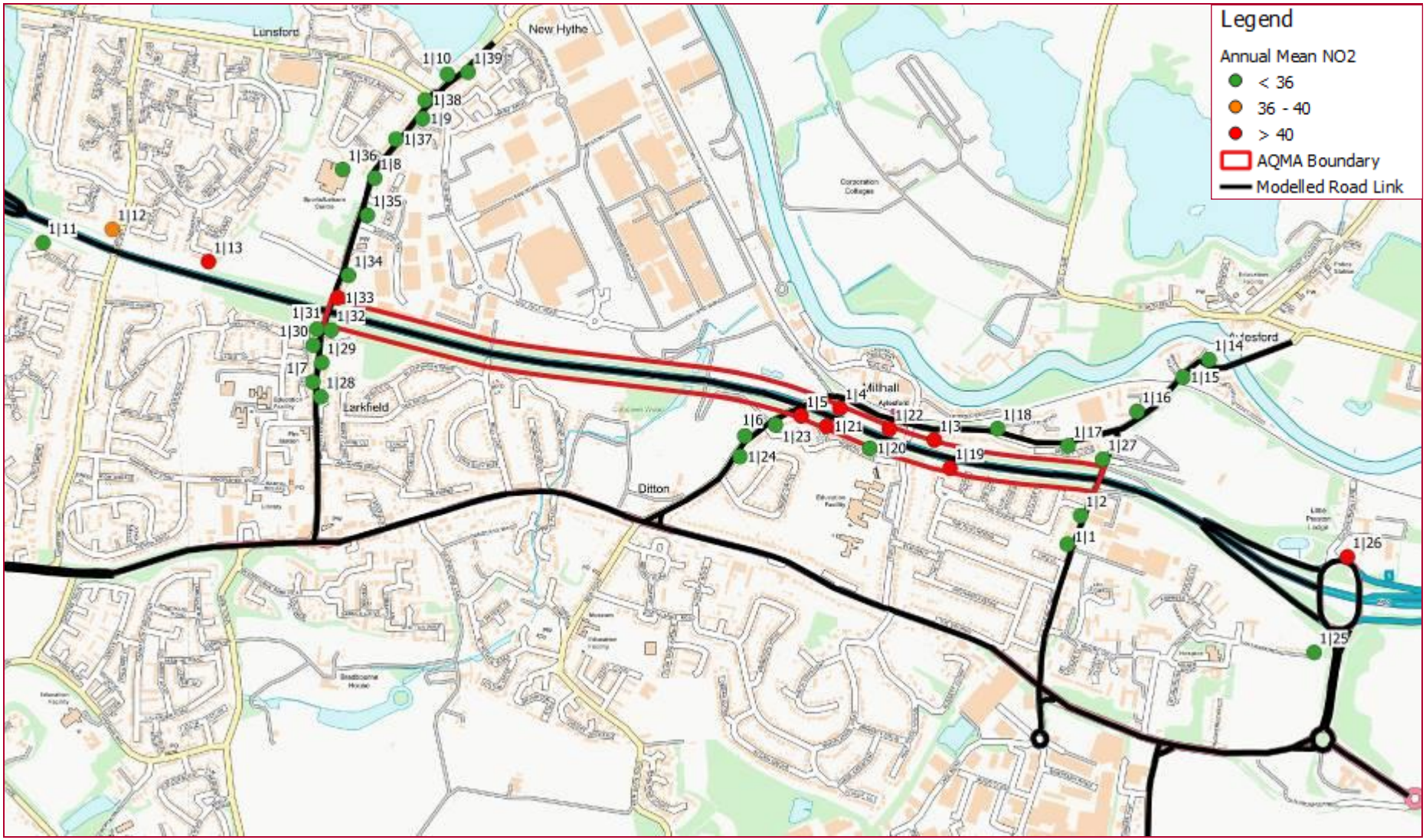


Figure 3.3 – AQMA 1, Modelled NO_2 Concentration Ispoleths, Western Section

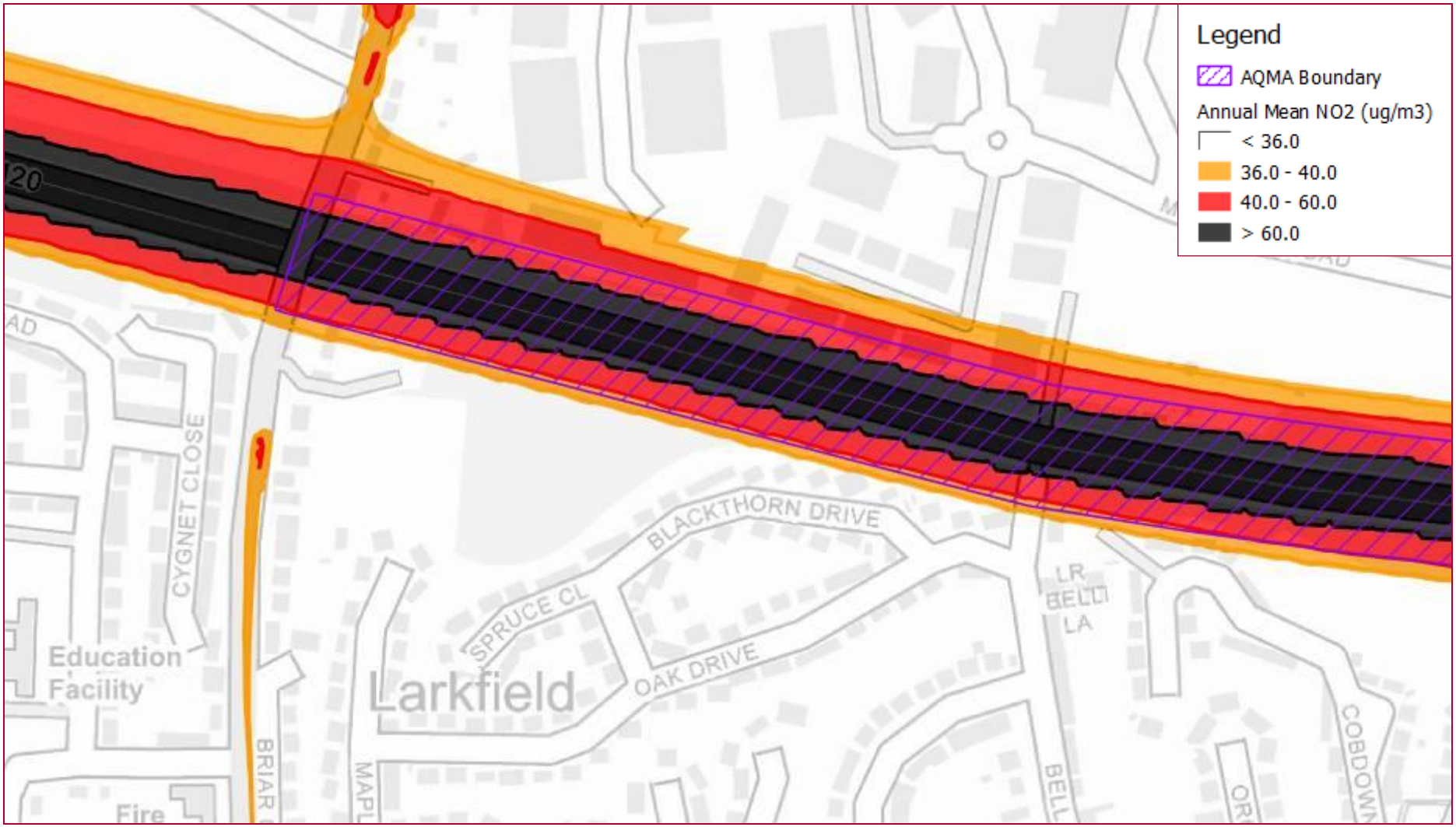


Figure 3.4 – AQMA 1, Modelled NO_2 Concentration Ispoleths, Central Section

Figure 3.5 – AQMA 1, Modelled NO_2 Concentration Ispoleths, Eastern Section

3.1.3 Daily PM_{10}

Table 3.3 provides the modelled mean 24-hour PM_{10} concentrations that are in exceedance of 50µg/m^3, the AQS objective in terms of 24-hour concentrations is that the concentration of 50µg/m^3 should not be exceeded more than 35 times within a calendar year. The AQS objective was not exceeded at any of the modelled receptor locations, the maximum number of 24-hour mean concentrations greater than 50µg/m^3 was 17 predicted at receptor 26.

Table 3.3 – AQMA 1, Summary of Modelled Receptor Results (PM_{10})

Receptor ID	OS Grid X	OS Grid Y	Height (m)	AQS Objective (Daily Means > 50µg/m^3)	2018 Daily Means > 50µg/m^3	% of AQS objective
1|1	572517	158317	1.5	35	3	8.6%
1|2	572556	158400	1.5	35	4	11.4%
1|3	572130	158620	1.5	35	7	20.0%
1|4	571855	158712	1.5	35	9	25.7%
1|5	571742	158690	1.5	35	7	20.0%
1|6	571578	158632	1.5	35	3	8.6%
1|7	570320	158789	1.5	35	4	11.4%
1|8	570500	159382	1.5	35	4	11.4%
1|9	570640	159555	1.5	35	3	8.6%
1|10	570712	159684	1.5	35	2	5.7%
1|11	569534	159194	1.5	35	4	11.4%
1|12	569736	159233	1.5	35	5	14.3%
1|13	570016	159139	1.5	35	5	14.3%
1|14	572930	158854	1.5	35	3	8.6%
1|15	572854	158803	1.5	35	4	11.4%
1|16	572720	158703	1.5	35	3	8.6%
1|17	572519	158603	1.5	35	4	11.4%
1|18	572314	158653	1.5	35	4	11.4%
1|19	572176	158538	1.5	35	7	20.0%
1|20	571942	158596	1.5	35	5	14.3%
1|21	571816	158660	1.5	35	6	17.1%
1|22	571999	158652	1.5	35	9	25.7%
1|23	571667	158664	1.5	35	4	11.4%
1|24	571564	158572	1.5	35	3	8.6%
1|25	573236	158002	1.5	35	5	14.3%
1|26	573333	158280	1.5	35	17	48.6%
1|27	572620	158564	1.5	35	5	14.3%
1|28	570343	158746	1.5	35	4	11.4%
1|29	570346	158845	1.5	35	5	14.3%
1|30	570321	158896	1.5	35	4	11.4%
1|31	570332	158943	1.5	35	4	11.4%
1|32	570374	158940	1.5	35	5	14.3%
1|33	570392	159034	1.5	35	6	17.1%
1|34	570424	159099	1.5	35	3	8.6%
1|35	570479	159274	1.5	35	3	8.6%
1|36	570407	159407	1.5	35	2	5.7%
1|37	570562	159495	1.5	35	3	8.6%
1|38	570647	159609	1.5	35	2	5.7%
1|39	570772	159690	1.5	35	4	11.4%

3.2 AQMA 2 – Ditton

3.2.1 Council Monitoring Data

AQMA 2 incorporates an area in Ditton covering the Station Road/London Road A20 crossroads, and there are currently three diffusion tube monitoring sites located within the AQMA. Figure 3.6 illustrates the locations of the diffusion tube monitoring sites in the modelled area and monitoring results for the previous five years are detailed in Table 3.4. It can be seen that there have not been any exceedances of the annual mean NO_2 AQS objective within, the AQMA for the past five years. The monitoring site DF4, 5, 6 has recorded the highest annual mean concentration within the AQMA since 2015 when monitoring began at this location.

Table 3.4 – Passive NO_2 Monitoring Within, and Close to AQMA 2

Site	Site Type	OS Grid Ref X	OS Grid Ref Y	Distance to Road (m)	Located In AQMA	Annual Mean NO_2 Concentration ($\mu g/m^3$)[1]				
						2014	2015	2016	2017	2018
TN47	UB	571399	158375	23	YES	19.1	18.8	19.6	19.6	18.0
TN105	R	571305	158412	11.8	YES	-	-	25.8	24.1	21.2
DF4, 5, 6	R	571139	158427	1.9	YES	-	33.1	33.1	31.9	32.0
In **bold**, exceedance of the annual mean NO_2 AQS objective of 40µg/m^3 Bias Adjustment Factors listed with relevant year R= Roadside; UB = Urban Background										

3.2.2 Annual Mean NO_2

Table 3.15 provides the annual mean NO_2 concentrations predicted at existing residential receptor locations for 2018. There were no exceedances of the annual mean NO_2 objective at any of the 13 modelled receptor locations. The maximum annual mean concentration was 29.6µg/m^3 predicted at receptor 2, this equates to 75% of the annual mean objective. In addition, Figure 3.8 presents that all predicted concentrations above 36µg/m^3 are predicted to be within the road link and not at any locations of relevant exposure.

Table 3.5 – AQMA 2, Summary of Modelled Receptor Results

Receptor ID	OS Grid X	OS Grid Y	Height (m)	AQS objective ($\mu g/m^3$)	2018 Annual Mean NO_2 ($\mu g/m^3$)	% of AQS objective
2|1	571306	158412	1.5	40	24.8	61.9%
2|2	571356	158377	1.5	40	29.6	74.0%
2|3	571183	158402	1.5	40	25.8	64.5%
2|4	571502	158488	1.5	40	22.0	55.0%
2|5	571399	158428	1.5	40	23.5	58.7%
2|6	571228	158383	1.5	40	25.5	63.8%
2|7	571283	158353	1.5	40	22.8	57.0%
2|8	571353	158342	1.5	40	24.7	61.7%
2|9	571401	158375	1.5	40	25.0	62.4%
2|10	571574	158329	1.5	40	24.5	61.3%
2|11	571624	158254	1.5	40	20.6	51.5%
2|12	571773	158210	1.5	40	24.1	60.3%
2|13	571919	158172	1.5	40	27.7	69.3%

Figure 3.6 – AQMA 2, Modelled Roads and Monitoring Locations

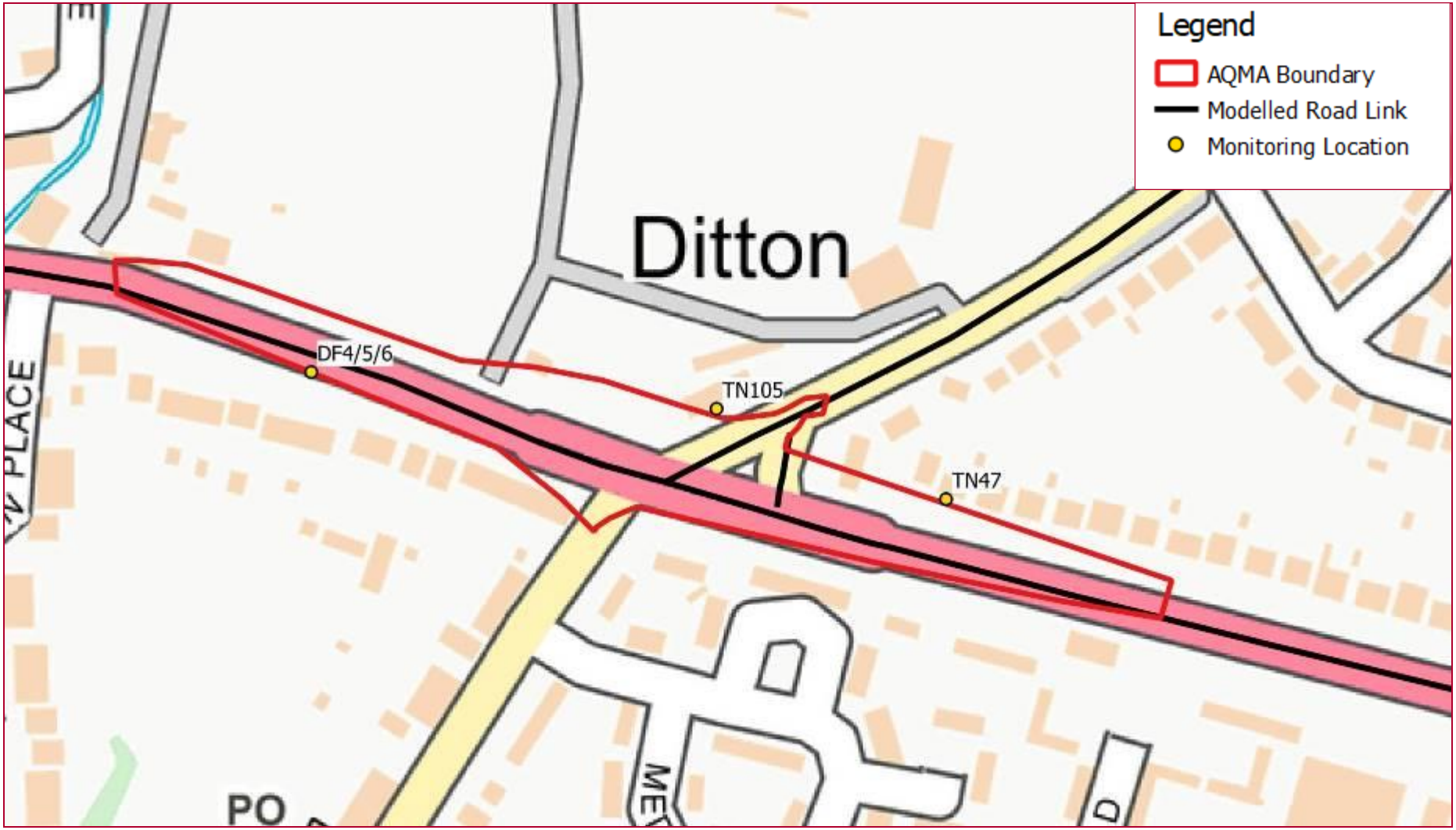


Figure 3.7 – AQMA 2, Modelled Receptor NO_2 Concentrations

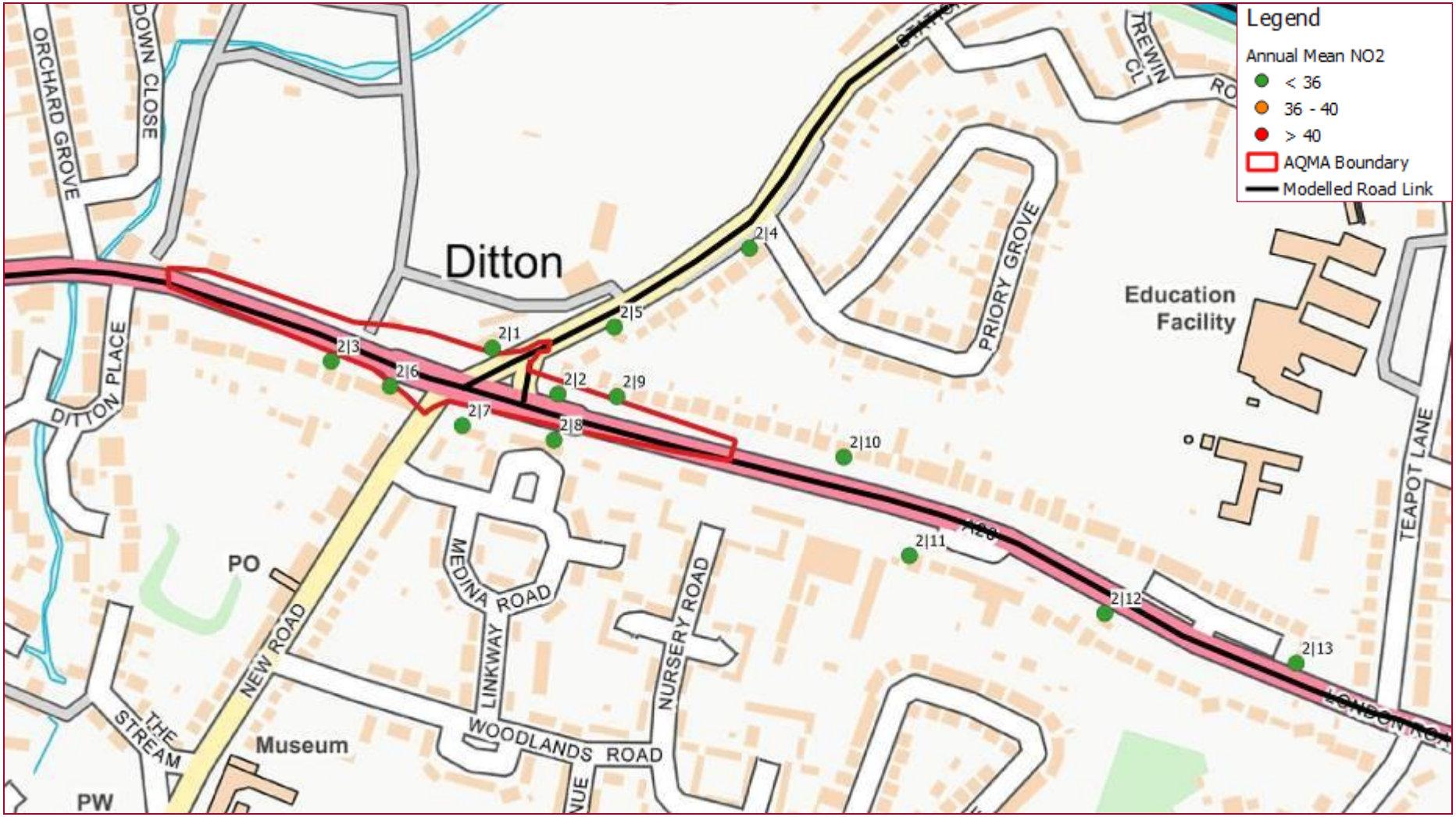


Figure 3.8 – AQMA 2, Modelled NO_2 Concentration Isopleths

3.3 AQMA 3 – Tonbridge High Street

3.3.1 Council Monitoring Data

AQMA 3 incorporates Tonbridge High Street, between New Wharf Road and the High Street/Vale Road roundabout in Tonbridge. There are currently seven diffusion tube monitoring sites located within, or close to the AQMA's area. In addition, historically the automatic site ZT5 has been located within the AQMA, this monitor was relocated to Wateringbury (AQMA 4) part way through 2018[8]. Figure 3.9 illustrates the locations of the monitoring sites within and close to the modelled area and monitoring results for the previous five years are detailed in Table 3.6.

2018 has been the first year over the previous five where there have not been any exceedances of the annual mean objective, it should be noted that the concentration at ZT5 has been annualised due to the monitor being moved to Wateringbury part way through the year. The number of monitoring sites that has exceeded the annual mean objective has reduced from four in 2014, to three in 2015, to two in 2017 and as stated above there were no exceedances in 2018.

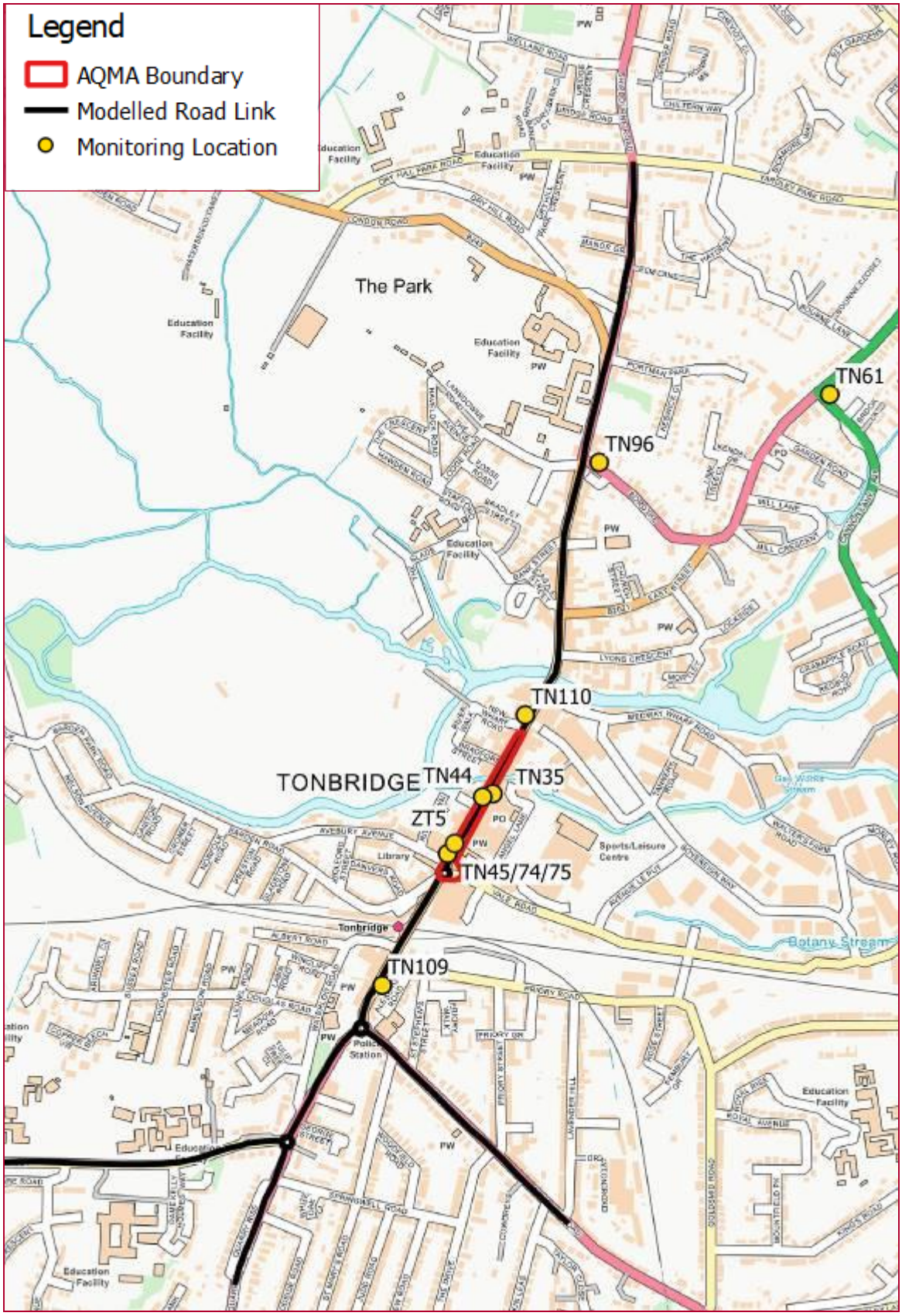
Table 3.6 – Passive and Automatic NO_2 Monitoring Within, and Close to AQMA 3

Site	Site Type	OS Grid Ref X	OS Grid Ref Y	Distance to Road (m)	Located In AQMA	Annual Mean NO_2 Concentration ($\mu g/m^3$)[1]				
						2014	2015	2016	2017	2018
TN35	UC	558948	146277	3.8	YES	**43.2**	36.7	34.6	37.5	36.4
TN44	UC	558929	146271	3.3	YES	**42.0**	**40.1**	**40.5**	38.4	35.2
ZT5*	UC	558877	146185	2.2	YES	**46.6**	**45.8**	**46.8**	**49.6**	34.9
TN45, 74, 75	UC	558864	146166	2.3	YES	**42.7**	**41.6**	**40.5**	**42.3**	39.0
TN61	R	559572	147017	6	NO	23.3	23.4	23.4	22.5	21.6
TN96	R	559145	146891	3.5	NO	34.9	33.3	34.0	30.5	30.1
TN110	R	559008	146423	4.6	YES	-	-	30.1	32.8	28.4
TN109	R	558743	145922	4	NO	-	-	36.0	34.3	33.9

In **bold**, exceedance of the annual mean NO_2 AQS objective of $40\mu g/m^3$
Bias Adjustment Factors listed with relevant year
R= Roadside; UC = Urban Centre
* The ZT5 automatic monitor was relocated from Tonbridge High Street to Wateringbury in June 2018

[8] ZT5 required annualisation in line with the LAQM TG.16 guidance for 2018 data.

Figure 3.9 – AQMA 3, Modelled Roads and Monitoring Locations



3.3.2 Annual Mean NO_2

Table 3.7 provides the annual mean NO_2 concentrations predicted at existing residential receptor locations for 2018. Of the 28 modelled receptor locations, an exceedances of the annual mean NO_2 objective has only been predicted at one location that is outside of the existing AQMA, and one further receptor, also outside of the existing AQMA, had an annual mean predicted to be within 10% of the AQS objective. There were no predicted exceedances of the annual mean objective within the AQMA.

It should be noted that receptors have been modelled at relevant heights in terms of relevant exposure derived from Box 1.1 of LAQM.TG(16)[1]. The majority of relevant exposure located on Tonbridge High Street is located at first floor height due to commercial premises at ground floor level. The changes in annual mean concentration in terms of height (1.5m and 3m) are presented within Figure 3.11 and Figure 3.12. At a receptor height of 1,5m exceedances of the annual mean objective run adjacent with Tonbridge High Street throughout the AQMA. When the receptor height is increased to 3m all exceedances are contained within the boundary of the road link.

Table 3.7 – AQMA 3, Summary of Modelled Receptor Results

Receptor ID	OS Grid X	OS Grid Y	Height (m)	AQS objective ($\mu g/m^3$)	2018 Annual Mean NO_2 ($\mu g/m^3$)	% of AQS objective
3|1	557480	145156	1.5	40	13.3	33.3%
3|2	557578	145378	1.5	40	14.4	35.9%
3|3	557923	145602	1.5	40	14.4	36.0%
3|4	558548	145653	1.5	40	21.1	52.8%
3|5	558659	145782	3	40	30.5	76.4%
3|6	558661	145787	1.5	40	36.4	91.0%
3|7	558666	145791	5	40	24.5	61.3%
3|8	558706	145900	3	40	26.5	66.4%
3|9	558737	145952	3	40	25.2	63.0%
3|10	558834	146135	3	40	23.4	58.6%
3|11	558903	146241	3	40	25.2	62.9%
3|12	558953	146290	3	40	33.4	83.6%
3|13	559005	146384	3	40	35.5	88.9%
3|14	559012	146428	3	40	29.3	73.3%
3|15	559080	146639	3	40	34.5	86.1%
3|16	559072	146759	3	40	25.8	64.6%
3|17	559124	146914	3	40	35.9	89.7%
3|18	559113	146931	1.5	40	29.9	74.8%
3|19	559194	147194	3	40	31.1	77.8%
3|20	559197	147202	1.5	40	35.5	88.8%
3|21	559195	147335	1.5	40	25.8	64.4%
3|22	559214	147367	1.5	40	**40.5**	101.1%
3|23	558503	145431	1.5	40	29.0	72.6%
3|24	558776	145792	1.5	40	32.8	82.1%
3|25	558799	145745	1.5	40	22.2	55.6%
3|26	558859	145689	1.5	40	22.6	56.5%
3|27	558941	145634	1.5	40	29.3	73.3%
3|28	559016	145535	1.5	40	20.7	51.8%

Figure 3.10 – AQMA 3, Modelled Receptor NO_2 Locations

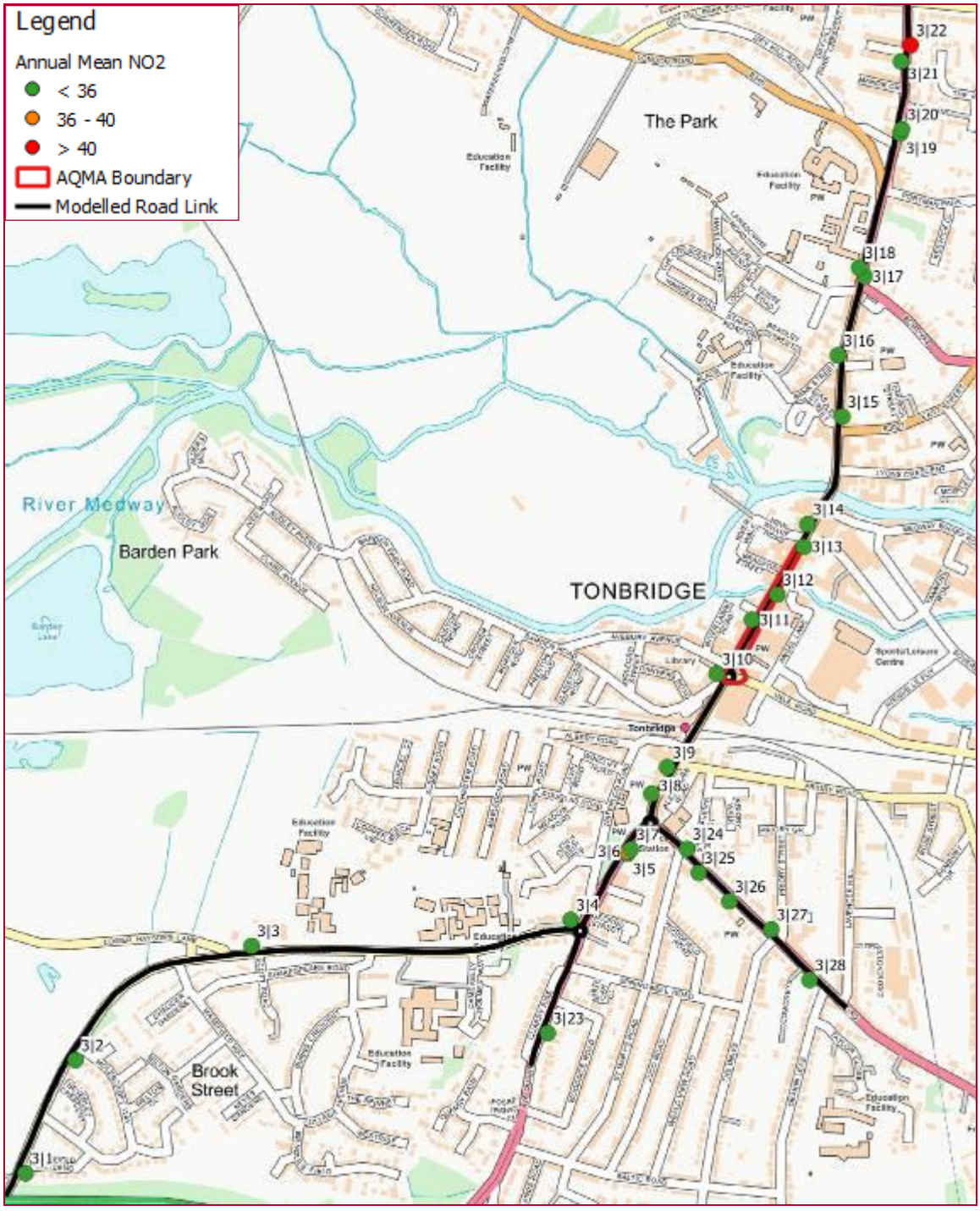


Figure 3.11 – AQMA 3, Modelled NO_2 Concentration Ispoleths (1.5m Height)

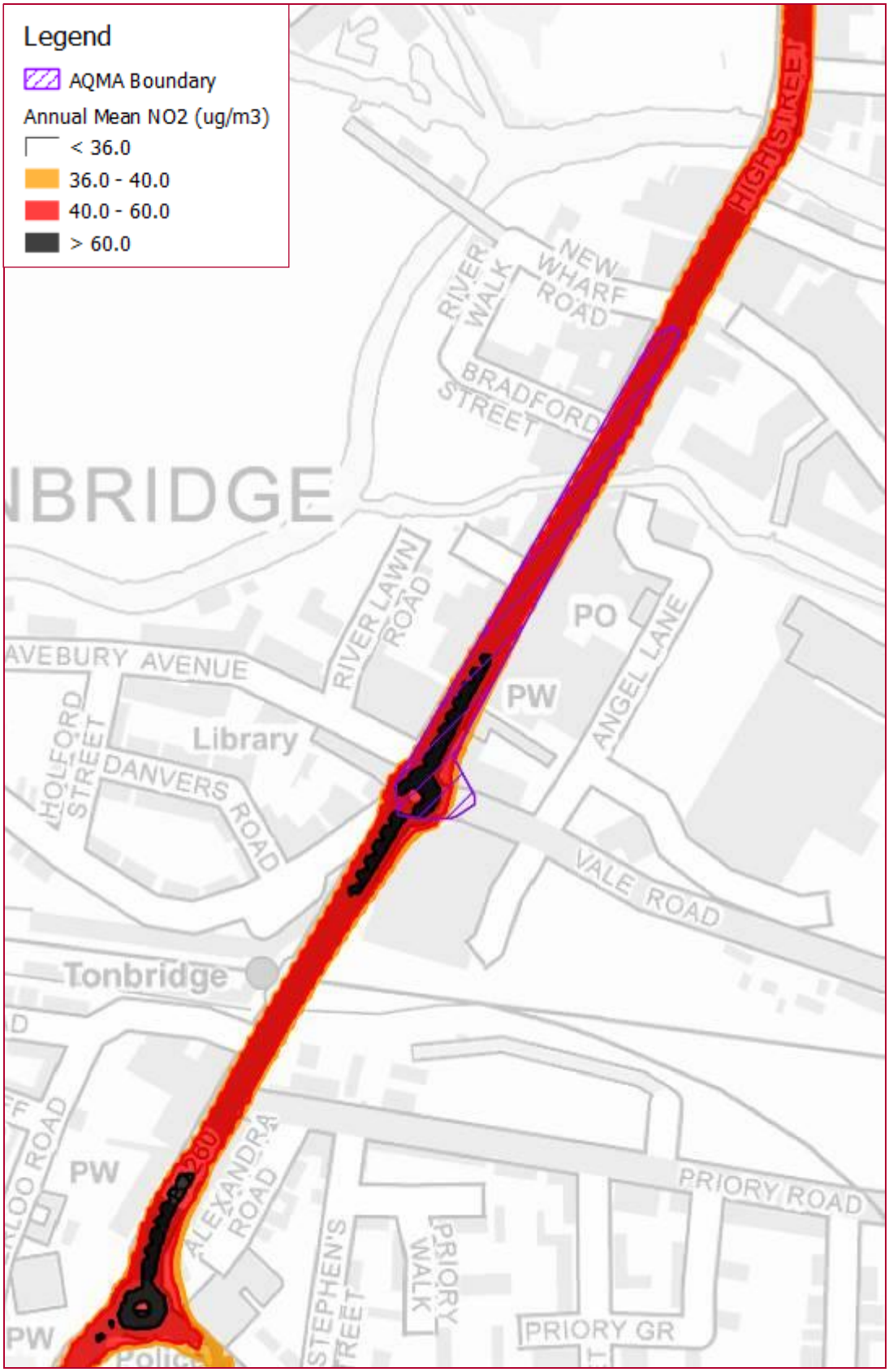
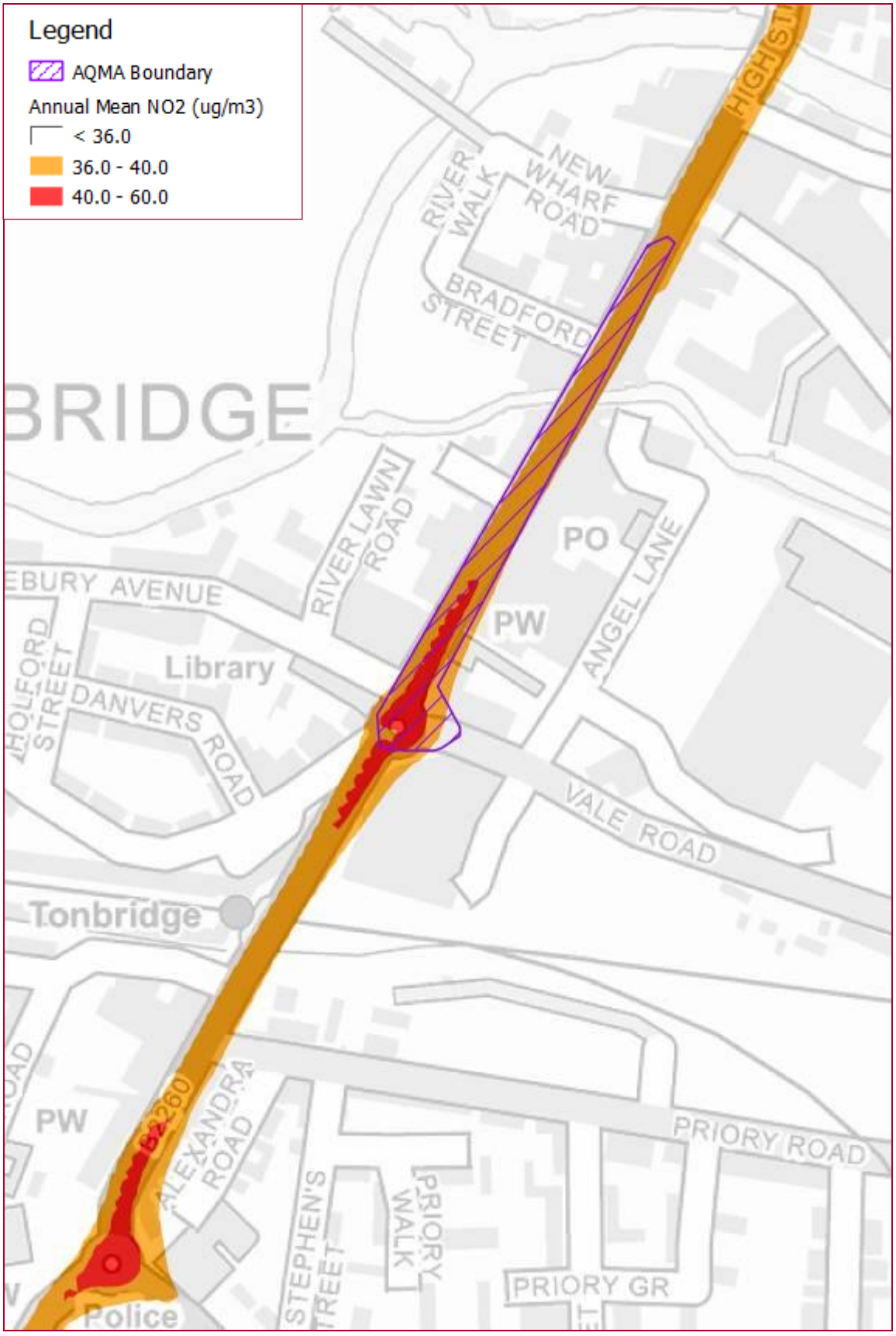


Figure 3.12 – AQMA 3, Modelled NO_2 Concentration Ispoleths (3m Height)



3.4 AQMA 4 – Wateringbury

3.4.1 Council Monitoring Data

AQMA 4 incorporates the Red Hill/Tonbridge Road A26 crossroads in Wateringbury. There are currently five diffusion tube sites located within, or close to the AQMA's area. In addition the automatic site ZT7, was established part way through 2018[9] after being relocated from Tonbridge High Street (ZT5). Figure 3.13 illustrates the locations of the monitoring sites within and close to the modelled area and monitoring results for the previous five years are detailed in Table 3.8.

Within AQMA 4 two monitoring sites have exceeded the annual mean objective for the past five years, with concentrations in excess of 60µg/m^3 experienced between 2014 and 2017 at site TN42, 76, 77. Between 2014 and 2018 there has been a reduction in annual mean concentration at site TN42, 76, 77 but it remained close to 60µg/m^3 in 2018 (58.1µg/m^3).

Table 3.8 – Passive and Automatic NO_2 Monitoring Within, and Close to AQMA 4

Site	Site Type	OS Grid Ref X	OS Grid Ref Y	Distance to Road (m)	Located In AQMA	Annual Mean NO_2 Concentration (µg/m^3)[1]				
						2014	2015	2016	2017	2018
TN33	R	569201	153486	1.25	YES	**52.7**	**51.9**	**56.4**	**53.6**	**51.9**
TN43	R	569187	153498	2.6	YES	38.2	38.2	39.1	38.7	35.7
TN42, 76, 77	R	569226	153475	1.3	YES	**64.8**	**63.5**	**64.8**	**61.3**	**58.1**
TN108	R	569056	153537	4	NO	-	-	23.0	23.7	20.9
TN115, TN116, TN117	R	569165	153493	1	YES	-	-	-	-	19.9
ZT7*	R	569165	153493	0.2	YES	-	-	-	-	23.6

In **bold**, exceedance of the annual mean NO_2 AQS objective of 40µg/m^3
Bias Adjustment Factors listed with relevant year
R= Roadside
* The ZT5 automatic monitor was relocated from Tonbridge High Street to Wateringbury in June 2018

[9] ZT7 required annualisation in line with the LAQM TG.16 guidance for 2018 data.

Figure 3.13 – AQMA 4, Modelled Roads and Monitoring Locations

3.4.2 Annual Mean NO_2

Table 3.15 provides the modelled annual mean NO_2 concentrations predicted at existing residential receptor locations for 2018. Of the 23 modelled receptor locations, an exceedance of the annual mean NO_2 objective has been predicted at one receptor within the existing AQMA, and a further receptor located close to the boundary of the AQMA had annual mean concentration predicted to be within 10% of the AQS objective. There were no predicted exceedances of the annual mean objective outside of the AQMA.

Employing the same methodology as for AQMA 3, receptors have been modelled at relevant heights in terms of relevant exposure derived from Box 1.1 of LAQM.TG(16)[1]. Receptors 4, 6 and 9 have been modelled at a first floor height due to commercial premises at ground floor level.

From the annual mean NO_2 concentration isopleths presented in Figure 3.15, it can be seen that predicted exceedances of the annual mean objective are of a similar extent to the existing AQMA boundary.

Table 3.9 – AQMA 4, Summary of Modelled Receptor Results

Receptor ID	OS Grid X	OS Grid Y	Height (m)	AQS objective (µg/m^3)	2018 Annual Mean NO_2 (µg/m^3)	% of AQS objective
4|1	569150	153418	1.5	40	23.2	58.1%
4|2	569136	153441	1.5	40	20.4	51.0%
4|3	569180	153466	1.5	40	34.2	85.4%
4|4	569167	153446	3	40	24.6	61.6%
4|5	569153	153495	1.5	40	23.4	58.5%
4|6	569180	153501	3	40	39.5	98.8%
4|7	569171	153508	1.5	40	25.3	63.2%
4|8	569156	153517	1.5	40	25.0	62.5%
4|9	569147	153523	3	40	20.9	52.2%
4|10	569014	153550	1.5	40	17.2	43.0%
4|11	568870	153602	1.5	40	17.6	43.9%
4|12	568598	153611	1.5	40	13.2	33.0%
4|13	567601	153502	1.5	40	14.4	36.0%
4|14	569189	153507	1.5	40	30.6	76.5%
4|15	569209	153529	1.5	40	21.0	52.4%
4|16	569251	153539	1.5	40	20.1	50.2%
4|17	569385	153631	1.5	40	14.7	36.6%
4|18	569209	153487	1.5	40	50.8	126.9%
4|19	569247	153470	1.5	40	32.7	81.7%
4|20	569288	153464	1.5	40	22.8	56.9%
4|21	569499	153409	1.5	40	20.1	50.1%
4|22	569814	153372	1.5	40	18.8	47.1%
4|23	570413	153375	1.5	40	21.4	53.4%

Figure 3.14 – AQMA 4, Modelled Receptor NO_2 Concentrations

Figure 3.15 – AQMA 4, Modelled NO_2 Concentration Ispoleths

3.5 AQMA 5 – Aylesford

3.5.1 Council Monitoring Data

AQMA 5 incorporates the A20 London Road in Aylesford, including the Hall Road and Mills Road Junction. There are currently seven diffusion tube monitoring sites located within, or close to the AQMA's area. Figure 3.16 illustrates the locations of the diffusion tube monitoring sites in the modelled area. Recent results for the monitoring sites are shown in Table 3.10.

Within AQMA 5 two monitoring sites have exceeded the annual mean objective for the past five years (TN60, 62, 63 and DF1, 2, 3), with all other monitoring sites recording compliance with the objective. Both TN60, 62, 63 and DF1, 2, 3 are located close to the Hall Road/Mills Road junction.

Table 3.10 – Passive NO_2 Monitoring Within, and Close to AQMA 5

Site	Site Type	OS Grid Ref X	OS Grid Ref Y	Distance to Road (m)	Located In AQMA	Annual Mean NO_2 Concentration ($\mu g/m^3$)[1]				
						2014	2015	2016	2017	2018
TN68	R	572430	157975	6.6	YES	31.9	30.8	30.8	31.4	28.3
TN104	R	572976	157726	8.2	YES	-	-	37.3	32.8	35.5
TN60, 62, 63	R	572423	157932	6.5	YES	**45.3**	**44.1**	**44.8**	**44.8**	**41.7**
DF1, 2, 3	R	572459	157904	2.5	YES	**-**	**42.6**	**44.3**	**44.1**	**40.1**
TN100	R	572998	156292	6.2	NO	21.5	21.8	22.9	24.4	21.4
TN102	R	572768	157186	14.5	NO	19.4	19.3	20.0	23.0	19.0
TN103	R	572739	157532	9.5	NO	20.6	20.9	23.9	21.5	21.7

In **bold**, exceedance of the annual mean NO_2 AQS objective of $40\mu g/m^3$
Bias Adjustment Factors listed with relevant year
R= Roadside

3.5.2 Annual Mean NO_2

Table 3.15 provides the modelled annual mean NO_2 concentrations predicted at existing residential receptor locations for 2018. Of the 16 modelled receptor locations, there was one predicted exceedance of the annual mean NO_2 objective (receptor 6), and one additional receptor had an annual mean concentration predicted to be within 10% of the AQS objective. Receptor 6 is located at a residential property close to the Hall Road/Mills Road junction.

From the annual mean NO_2 concentration isopleths presented in Figure 3.18, it can be seen that predicted exceedances of the annual mean objective are limited to the Hall Road/Mills Road junction. The only relevant receptor within the predicted exceedance area is the residential property at which receptor 6 has been located.

Table 3.11 – AQMA 5, Summary of Modelled Receptor Results

Receptor ID	OS Grid X	OS Grid Y	Height (m)	AQS objective ($\mu g/m^3$)	2018 Annual Mean NO_2 ($\mu g/m^3$)	% of AQS objective
5|1	572996	156318	1.5	40	25.2	63.1%
5|2	572801	157090	1.5	40	22.5	56.2%
5|3	572741	157529	1.5	40	23.9	59.7%
5|4	572980	157726	1.5	40	34.0	84.9%
5|5	572782	157764	1.5	40	30.8	76.9%
5|6	572431	157922	1.5	40	**46.5**	116.2%
5|7	572431	157974	1.5	40	27.8	69.5%
5|8	572463	158052	1.5	40	28.3	70.6%
5|9	572526	158323	1.5	40	25.5	63.7%
5|10	572556	158400	1.5	40	27.7	69.2%

Receptor ID	OS Grid X	OS Grid Y	Height (m)	AQS objective (µg/m^3)	2018 Annual Mean NO_2 (µg/m^3)	% of AQS objective
5|11	572421	157839	1.5	40	29.6	74.0%
5|12	572453	157797	1.5	40	38.9	97.1%
5|13	572497	157923	1.5	40	27.2	67.9%
5|14	572616	157879	1.5	40	23.2	58.1%
5|15	572452	157954	1.5	40	30.6	76.4%
5|16	573339	157664	1.5	40	24.2	60.6%

Figure 3.16 – AQMA 5, Modelled Roads and Monitoring Locations

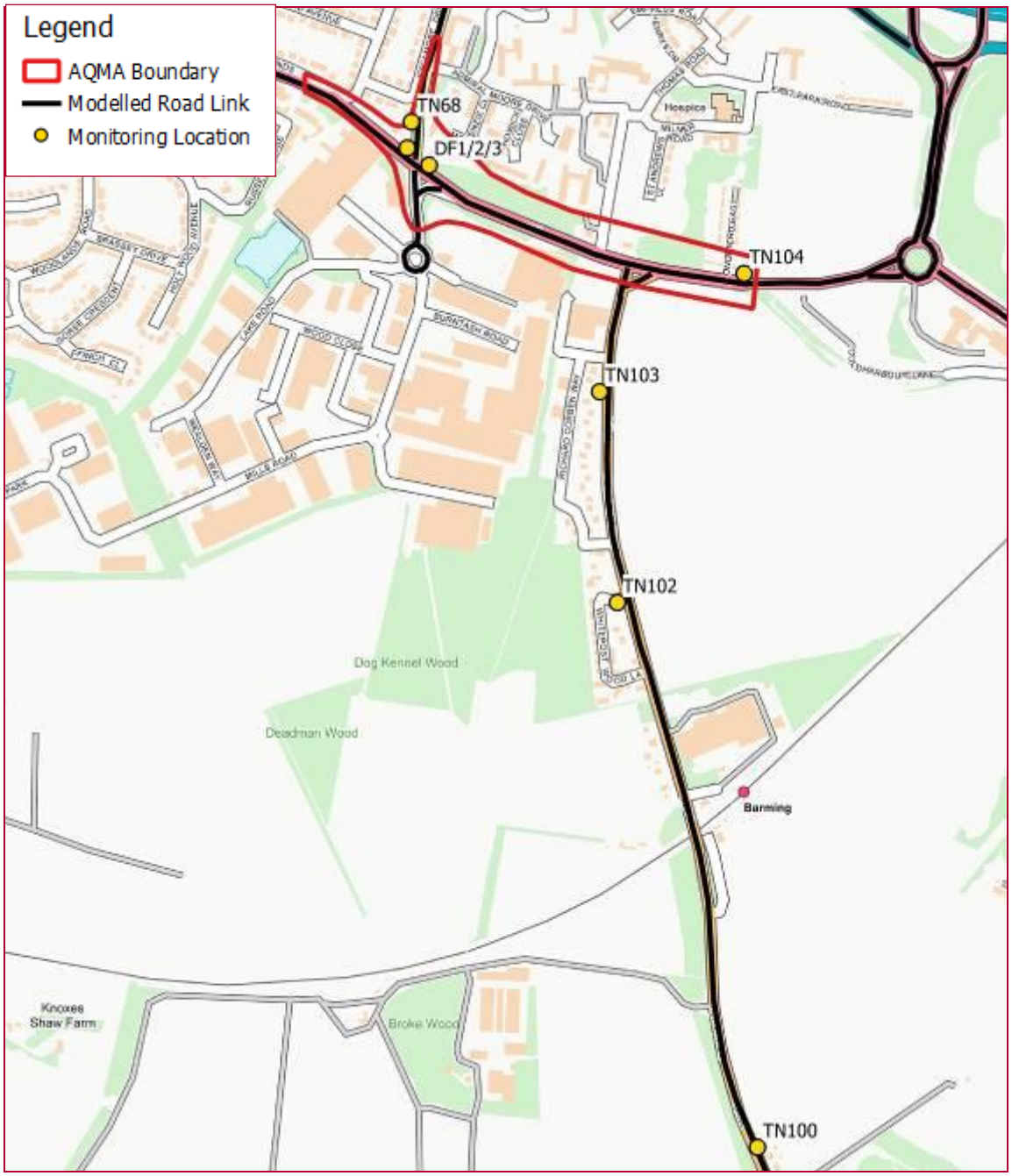


Figure 3.17 – AQMA 5, Modelled Receptor NO_2 Concentrations

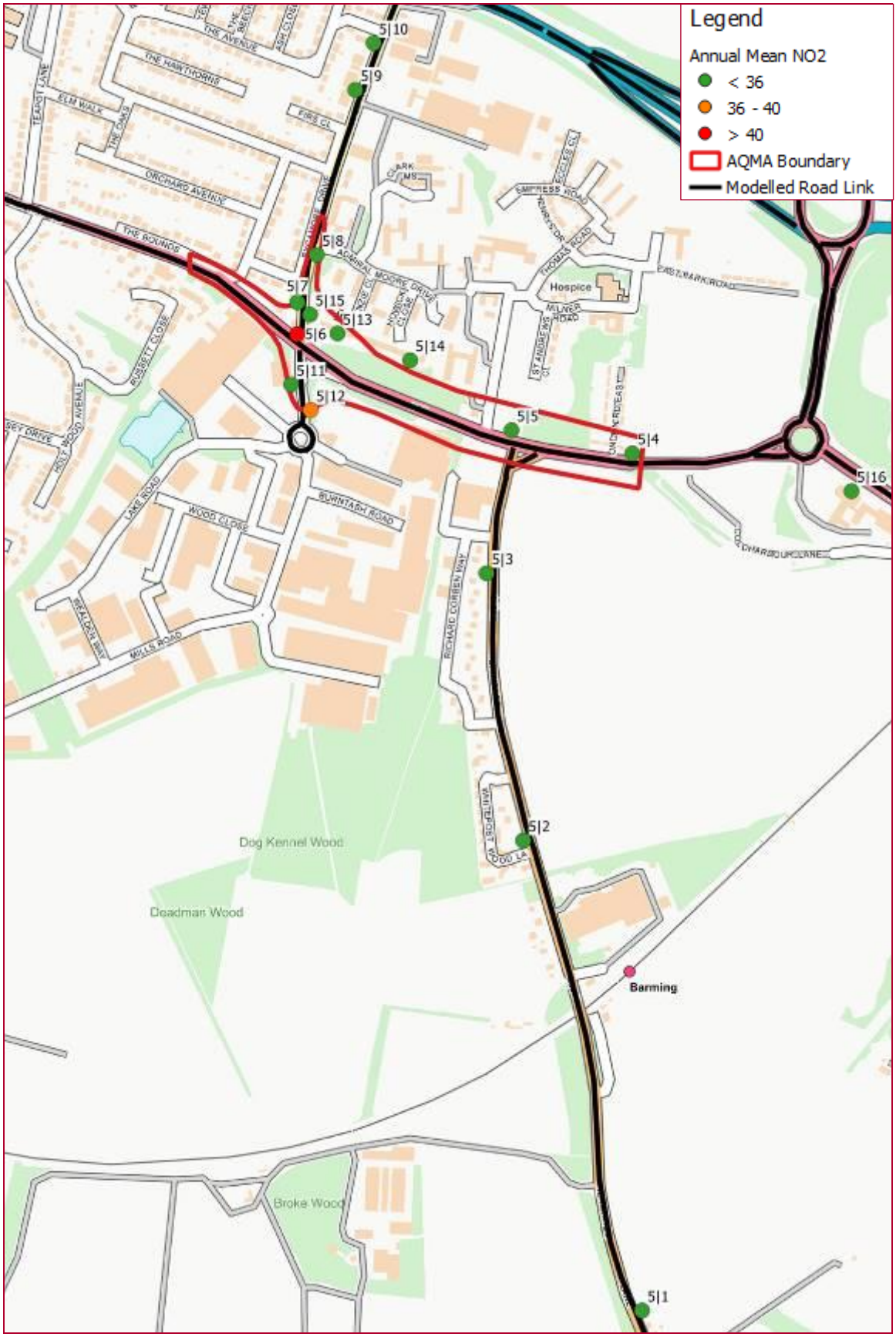


Figure 3.18 – AQMA 5, Modelled NO_2 Concentration Ispoleths

3.6 AQMA 6 – Larkfield

3.6.1 Council Monitoring Data

AQMA 6 encompasses the A20 London Road in East Malling, Larkfield and Ditton, including the New Hythe Lane junction. There are currently four diffusion tube sites located within the AQMA's modelled area. Figure 3.19 illustrates the locations of the diffusion tube monitoring sites in the modelled area. Recent results for the monitoring sites are shown in Table 3.12.

Within AQMA 6 monitoring site TN106 has exceeded the annual mean objective for the past three years, with all other monitoring sites recording compliance with the objective from 2017. TN106 is located on a residential façade therefore is sited at a location of relevant explore in relation to NO_2 annual mean concentrations

Table 3.12 – Passive NO_2 Monitoring Within, and Close to AQMA 6

Site	Site Type	OS Grid Ref X	OS Grid Ref Y	Distance to Road (m)	Located In AQMA	Annual Mean NO_2 Concentration ($\mu g/m^3$)[1]				
						2014	2015	2016	2017	2018
TN64	R	570948	158482	5	YES	30.6	29.0	31.0	29.4	29.0
TN57, 58, 59	R	570467	158328	4.82	YES	36.5	34.0	33.7	31.4	32.2
DF7, 8, 9	R	570386	158311	1.4	YES	-	35.2	**41.8**	35.0	32.8
TN106	R	570189	158326	2.25	YES	-	-	**43.9**	**43.2**	**42.0**
In **bold**, exceedance of the annual mean NO_2 AQS objective of $40\mu g/m^3$ Bias Adjustment Factors listed with relevant year R= Roadside										

3.6.2 Annual Mean NO_2

Table 3.15 provides the annual mean NO_2 concentrations predicted at existing residential receptor locations for 2018. There were no exceedances of the annual mean NO_2 objective at any of the nine modelled receptor locations. As stated above the monitoring site TN106 has exceeded the annual mean objective for the past three years, because of a poor correlation within the verification procedure when compared to all other verification monitoring locations, TN106 was removed from the verification calculations. Due to the monitored exceedance at TN106 it has been proposed within Section 5 that the AQMA boundary to the west of New Hythe Lane remain in its current designation.

The maximum annual mean concentration was $34.1\mu g/m^3$ predicted at receptor 1, this equates to 85.3% of the annual mean objective. In addition Figure 3.21 presents that all predicted concentrations above $36\mu g/m^3$ are predicted to be within the road link and not at any locations of relevant exposure.

Table 3.13 – AQMA 6, Summary of Modelled Receptor Results

Receptor ID	OS Grid X	OS Grid Y	Height (m)	AQS objective ($\mu g/m^3$)	2018 Annual Mean NO_2 ($\mu g/m^3$)	% of AQS objective
6|1	570816	158457	1.5	40	34.1	85.3%
6|2	570343	158413	1.5	40	32.3	80.7%
6|3	570323	158486	1.5	40	22.8	56.9%
6|4	569884	158302	1.5	40	21.1	52.8%
6|5	569487	158266	1.5	40	27.9	69.8%
6|6	568907	158220	1.5	40	22.6	56.5%
6|7	568702	158298	1.5	40	19.9	49.8%
6|8	569028	158233	1.5	40	20.5	51.3%
6|9	569339	158269	1.5	40	21.5	53.7%

Figure 3.19 – AQMA 6, Modelled Roads and Monitoring Locations

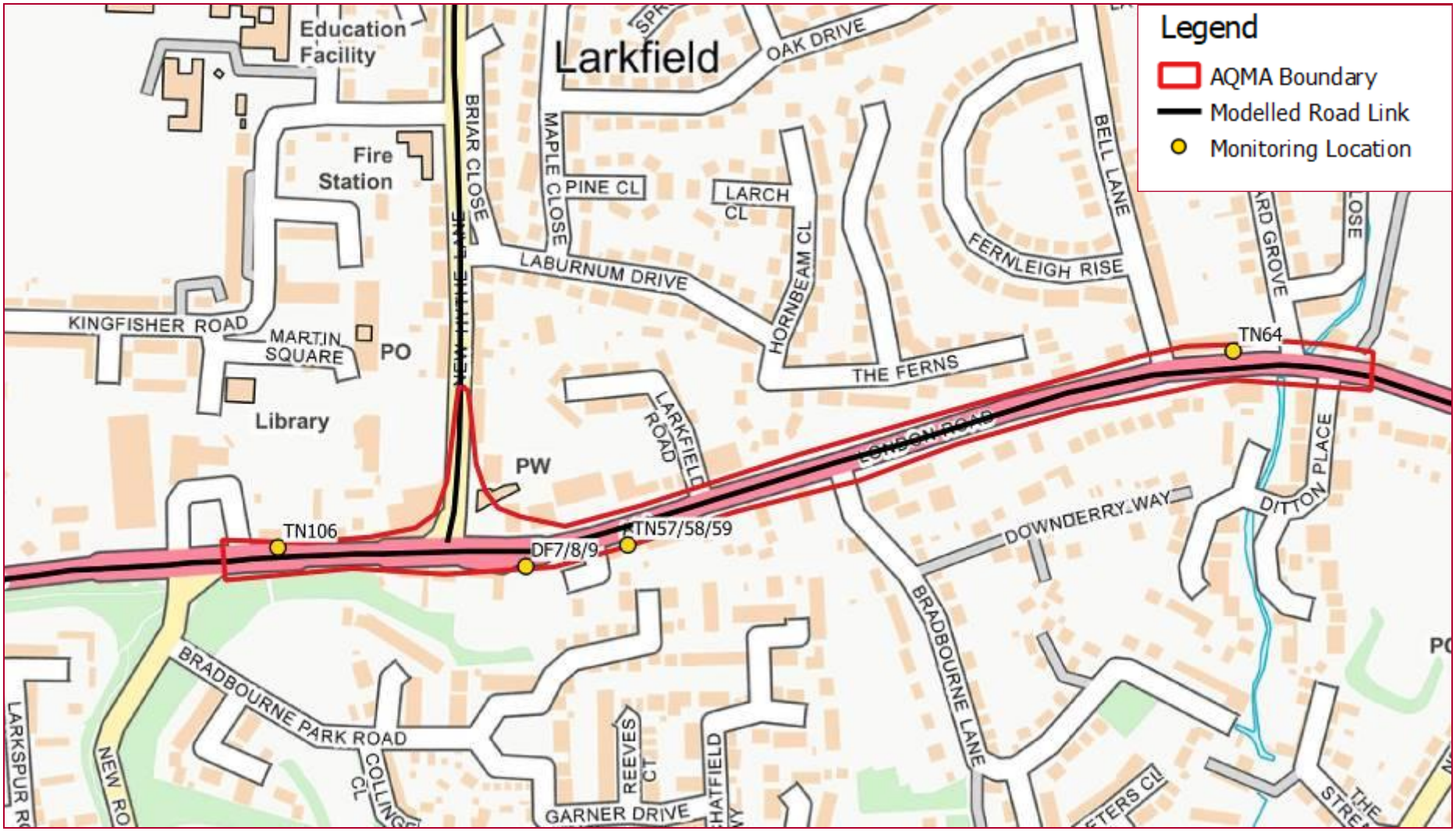


Figure 3.20 – AQMA 6, Modelled Receptor NO_2 Locations

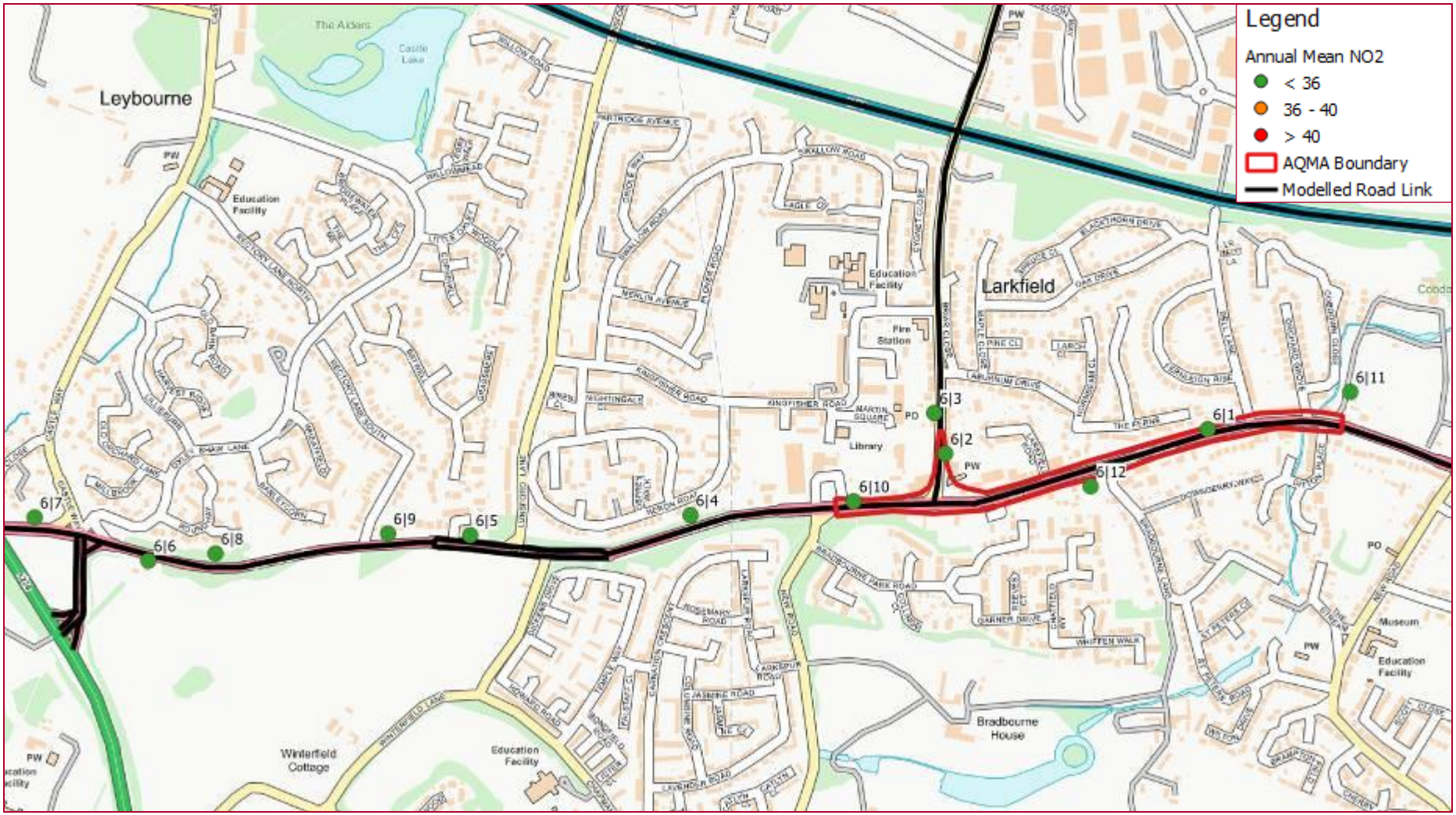


Figure 3.21 – AQMA 6, Modelled NO_2 Concentration Ispoleths

3.7 AQMA 7 – Borough Green

3.7.1 Council Monitoring Data

AQMA 7 includes a number of sections of Sevenoaks Road (A25), Western Road and Borough Green High Street. There are currently 12 diffusion tubes monitoring sites located within or close to the AQMA's modelled area. Figure 3.22 illustrates the locations of the diffusion tube monitoring sites in the modelled area. Recent results for the monitoring sites are shown in Table 3.14.

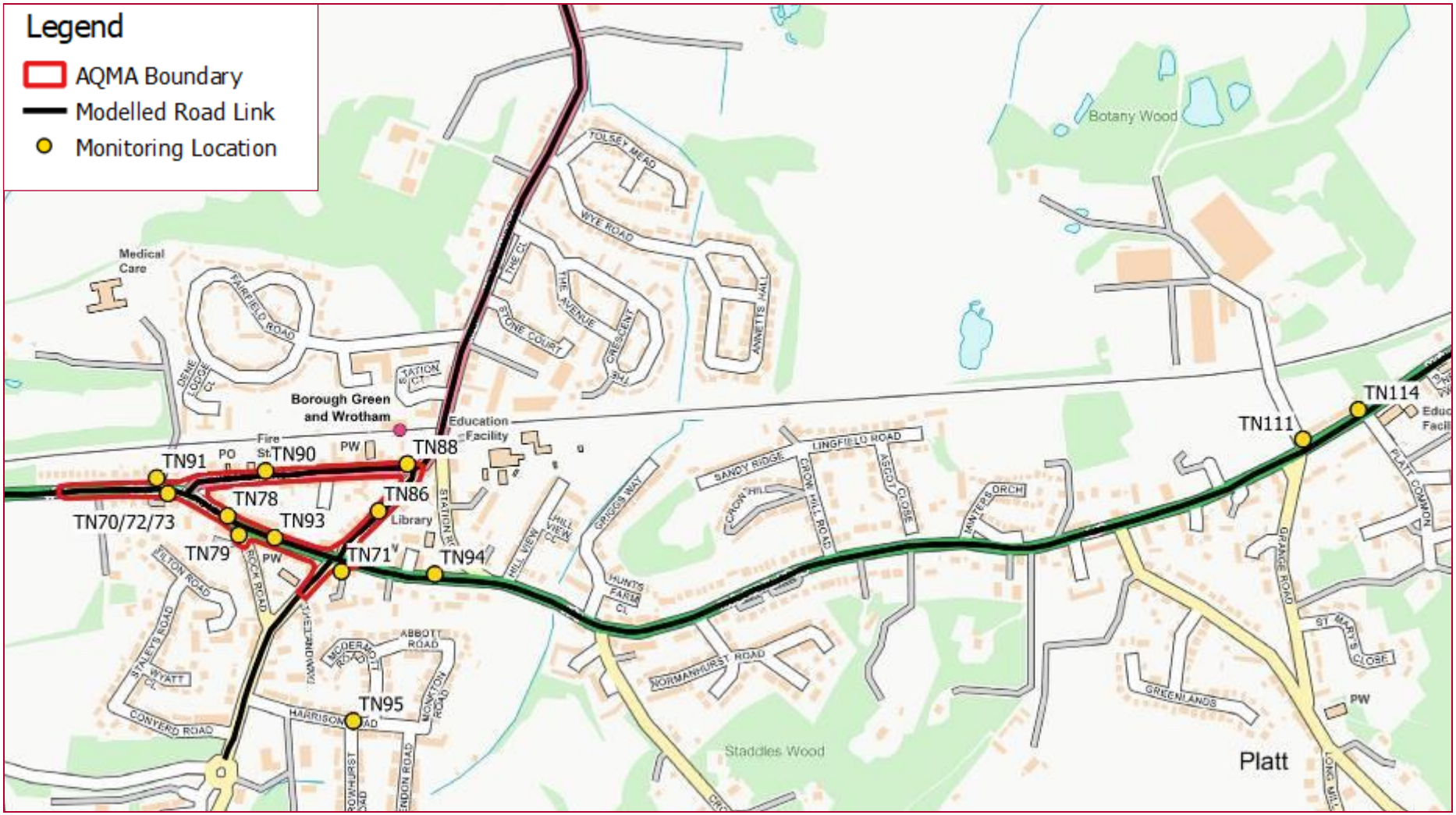
2018 has been the first year over the previous five years where there have not been any exceedances of the annual mean objective, monitoring site TN70, 72, 73 remained within 10% of the objective with 2018. Aside from sites TN70, 72, 73 and TN93, there have not been any annual mean concentrations above 30µg/m^3 since 2016.

Table 3.14 – Passive NO_2 Monitoring Within, and Close to AQMA 7

Site	Site Type	OS Grid Ref X	OS Grid Ref Y	Distance to Road (m)	Located In AQMA	Annual Mean NO_2 Concentration (µg/m^3)[1]				
						2014	2015	2016	2017	2018
TN78	R	560654	157296	3.1	YES	-	-	33.6	28.7	27.8
TN79	R	560670	157269	7.2	YES	29.3	29.0	31.2	27.6	25.7
TN86	UC	560869	157303	2.46	YES	24.6	22.6	25.0	24.5	22.0
TN88	R	560910	157370	4.3	YES	24.9	23.8	26.8	23.5	22.2
TN90	R	560708	157360	4.5	YES	24.2	22.2	25.7	25.6	22.7
TN93	R	560721	157265	1.5	YES	34.8	34.0	39.8	35.8	34.6
TN94	R	560949	157213	4.3	NO	29.1	28.1	28.5	27.3	24.3
TN114	R	562264	157447	6.5	NO	-	-	26.1	22.3	20.1
TN70, 72, 73	R	560569	157328	2.06	YES	**42.2**	**42.1**	**45.6**	**43.0**	39.6
TN111	R	562185	157405	2.2	NO	-	-	-	-	16.9
TN95	UB	560833	157004	1.7	NO	15.3	14.8	16.1	14.6	13.6
TN91	R	560553	157350	14.2	YES	18.4	16.5	18.6	18.2	16.3

In **bold**, exceedance of the annual mean NO_2 AQS objective of 40µg/m^3
Bias Adjustment Factors listed with relevant year
R= Roadside; UC = Urban Centre; UB = Urban Background

Figure 3.22 – AQMA 7, Modelled Roads and Monitoring Locations



3.7.2 Annual Mean NO_2

Table 3.15 provides the annual mean NO_2 concentrations predicted at existing residential receptor locations for 2018. Of the 49 modelled receptor locations, all receptor locations were predicted to be in compliance with the annual mean NO_2 objective, and there was one receptor predicted to have an annual mean to be within 10% of the AQS objective.

The concentration isopleths presented in Figure 3.25 show that the concentrations in exceedance of the annual mean objective are mostly predicted to be within the road links, with relevant exposure only within the exceedance isopleths on Sevenoaks Road to the west of the AQMA close to receptor 3 and diffusion tube TN70, 72, 73.

Table 3.15 – AQMA 7, Summary of Modelled Receptor Results

Receptor ID	OS Grid X	OS Grid Y	Height (m)	AQS objective (µg/m^3)	2018 Annual Mean NO_2 (µg/m^3)	% of AQS objective
7|1	560399	157344	1.5	40	28.4	71.0%
7|2	560504	157320	1.5	40	28.3	70.7%
7|3	560562	157327	1.5	40	37.7	94.3%
7|4	560581	157322	1.5	40	33.6	83.9%
7|5	560604	157350	1.5	40	27.8	69.4%
7|6	560624	157355	3	40	25.3	63.2%
7|7	560671	157342	1.5	40	24.5	61.2%
7|8	560881	157371	1.5	40	25.5	63.8%
7|9	560912	157358	1.5	40	34.5	86.3%
7|10	560904	157344	3	40	28.7	71.8%
7|11	560918	157331	1.5	40	28.3	70.8%
7|12	560822	157268	1.5	40	30.0	75.0%
7|13	560746	157248	1.5	40	25.3	63.3%
7|14	560782	157252	1.5	40	29.6	73.9%
7|15	560651	157299	1.5	40	33.6	83.9%
7|16	560600	157317	1.5	40	34.6	86.5%
7|17	561036	157620	1.5	40	27.3	68.2%
7|18	561075	157770	1.5	40	22.8	57.0%
7|19	561063	158228	1.5	40	20.6	51.5%
7|20	561196	157143	1.5	40	27.4	68.5%
7|21	561349	157152	1.5	40	22.1	55.4%
7|22	561489	157243	1.5	40	20.4	51.0%
7|23	561781	157238	1.5	40	21.0	52.5%
7|24	561867	157275	1.5	40	27.5	68.8%
7|25	562075	157324	1.5	40	25.4	63.5%
7|26	562209	157420	1.5	40	20.3	50.6%
7|27	562391	157512	1.5	40	25.4	63.5%
7|28	562770	157841	1.5	40	22.9	57.3%
7|29	562949	157947	1.5	40	22.0	55.0%
7|30	560786	157225	1.5	40	35.4	88.4%
7|31	560746	157163	1.5	40	24.2	60.5%
7|32	560695	157054	1.5	40	19.5	48.8%
7|33	560663	157003	1.5	40	19.7	49.2%
7|34	560053	157255	1.5	40	21.3	53.2%
7|35	560478	157345	1.5	40	31.4	78.4%
7|36	560692	157282	1.5	40	28.2	70.6%
7|37	560771	157368	1.5	40	22.0	55.0%
7|38	560898	157194	1.5	40	20.0	50.1%
7|39	561025	157185	1.5	40	19.8	49.6%
7|40	561020	157380	1.5	40	16.7	41.8%
7|41	560969	157499	1.5	40	22.9	57.3%
7|42	561021	157679	1.5	40	18.0	44.9%
7|43	561082	157726	1.5	40	24.0	60.0%
7|44	561120	157866	1.5	40	20.3	50.7%

Receptor ID	OS Grid X	OS Grid Y	Height (m)	AQS objective (µg/m^3)	2018 Annual Mean NO_2 (µg/m^3)	% of AQS objective
7|45	561132	157842	1.5	40	34.3	85.7%
7|46	561082	158262	1.5	40	25.1	62.8%
7|47	561072	158159	1.5	40	18.5	46.2%
7|48	561149	158377	1.5	40	30.5	76.3%
7|49	561106	158626	1.5	40	20.5	51.3%

Figure 3.23 – AQMA 7, Modelled Receptor NO_2 Locations (Wide view)

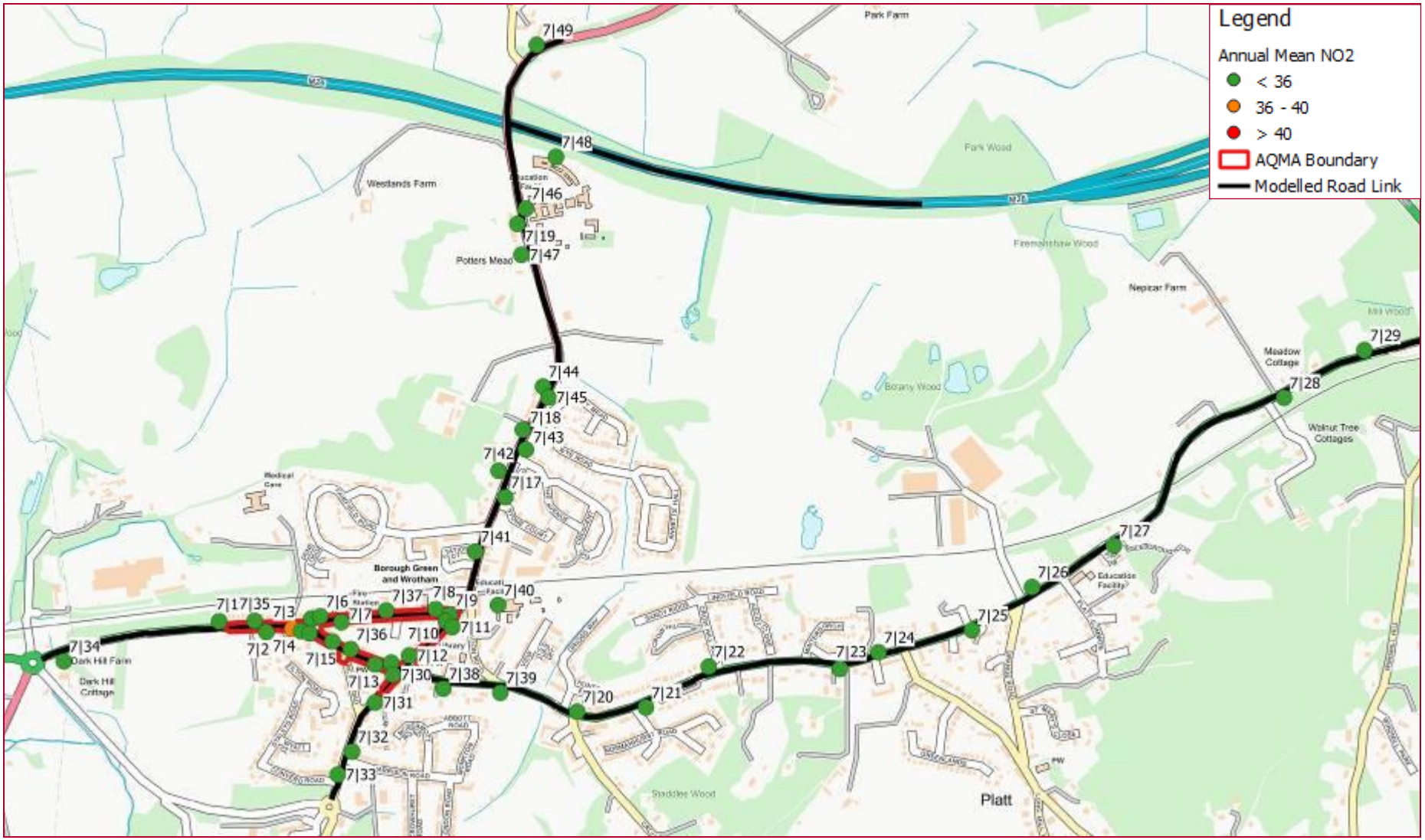


Figure 3.24 – AQMA 7, Modelled Receptor NO_2 Locations (Close up to AQMA)

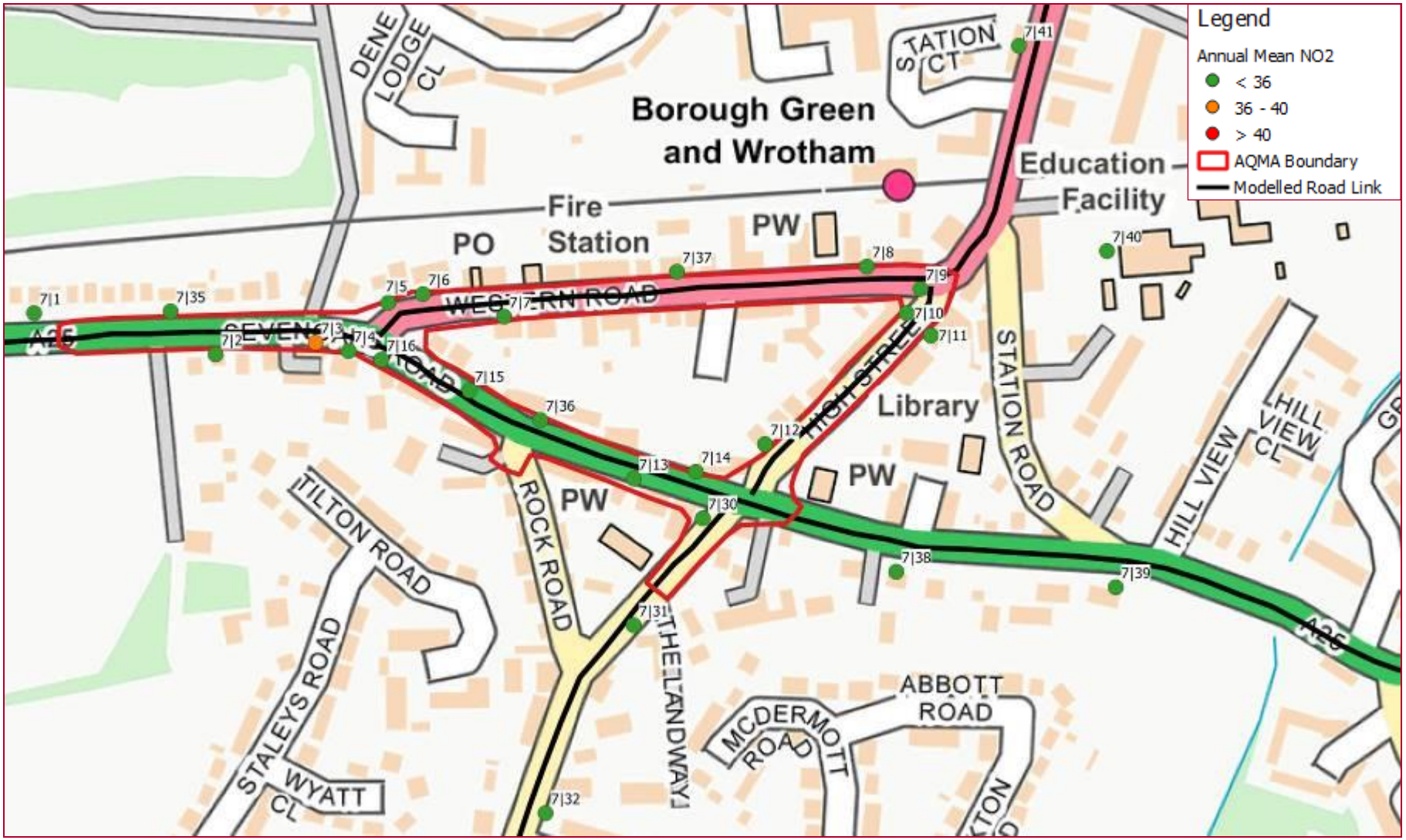


Figure 3.25 – AQMA 7, Modelled NO_2 Concentration Ispoleths

4 Source Apportionment

To help inform the development of measures as part of the action plan stage of the project, NO_x source apportionment exercise was undertaken for the following vehicle classes:

- Cars;
- Light-Goods Vehicles (LGVs);
- Heavy-Goods Vehicles (HGVs);
- Bus and Coaches; and
- Motorcycles.

This provides vehicle contributions of NO_x as a proportion of the total NO_x concentration, which will allow the Council to develop specific AQAP measures targeting a reduction in emissions from specific vehicle types.

It should be noted that emission sources of NO_2 are dominated by a combination of direct NO_2 (f-NO_2) and oxides of nitrogen (NO_x), the latter of which is chemically unstable and rapidly oxidised upon release to form NO_2. Reducing levels of NO_x emissions therefore reduces concentrations of NO_2. As a consequence, the source apportionment study has firstly considered the emissions of NO_x, which are assumed to be representative of the main sources of NO_2, and secondly emissions of NO_2.

With regards to the discrete receptor locations, consideration has been given to the following groups of receptors:

- The average NO_x and NO_2 contributions across all modelled locations. This provides useful information when considering possible action measures to test and adopt. It will however understate road NO_x concentrations in problem areas;
- The average NO_x and NO_2 contributions across all locations with modelled NO_2 concentration greater than 40µg/m^3. This provides an indication of source apportionment in problematic areas (i.e. only where the AQS objective is exceeded). As such, this information should be considered with more scrutiny when testing and adopting action measures;

Table 4.1 details the source apportionment results for NO_x concentrations, whilst Figure 4.1 presents pie charts illustrate the results.

When considering the average NO_x concentration across all modelled receptors, road traffic accounts for 39.4µg/m^3 (61.9%) of total NO_x concentration. Of this 39.4µg/m^3, Cars account for the most (28.8%) of any of the vehicle types, followed by LGVs (17.8%). HGVs and Buses/Coaches account for a similar total road-NO_x, with HGVs at 9.0% (4.3µg/m^3) and Buses/Coaches at 6.1% (2.9µg/m^3), whilst Motorcycles are found to contribute <1%.

When considering the average NO_x concentration at receptors with NO_2 concentration greater than 40µg/m^3, road traffic accounts for 71.5µg/m^3 (78.0%) of 91.6µg/m^3. Of this 71.5µg/m^3, Cars account for the most (32.4%) of any of the vehicle types, followed by LGVs (20.5%), HGVs (13.2%), Buses/Coaches (5.2%), and Motorcycles contributing <1%.

Table 4.1 – NO_x Source Apportionment Results

Results	All Vehicles	Car	LGV	HGV	Bus	Motorcycle	Background
Average across all modelled receptors							
NO_x Concentration (µg/m³)	29.4	13.7	8.5	4.3	2.9	0.1	18.1
Percentage	61.9%	28.8%	17.8%	9.0%	6.1%	0.2%	38.1%
Percentage Road Contribution	100.0%	46.6%	28.8%	14.5%	9.9%	0.3%	-
Average Across All Receptors With NO_2 Concentration Greater Than 40µg/m³							
NO_x Concentration (µg/m³)	71.5	32.4	20.5	13.2	5.2	0.2	20.1
Percentage	78.0%	35.4%	22.4%	14.4%	5.6%	0.2%	22.0%
Percentage Road Contribution	100.0%	45.3%	28.7%	18.5%	7.2%	0.2%	-

Figure 4.1 – Pie Charts showing NO_x Source Apportionment Results

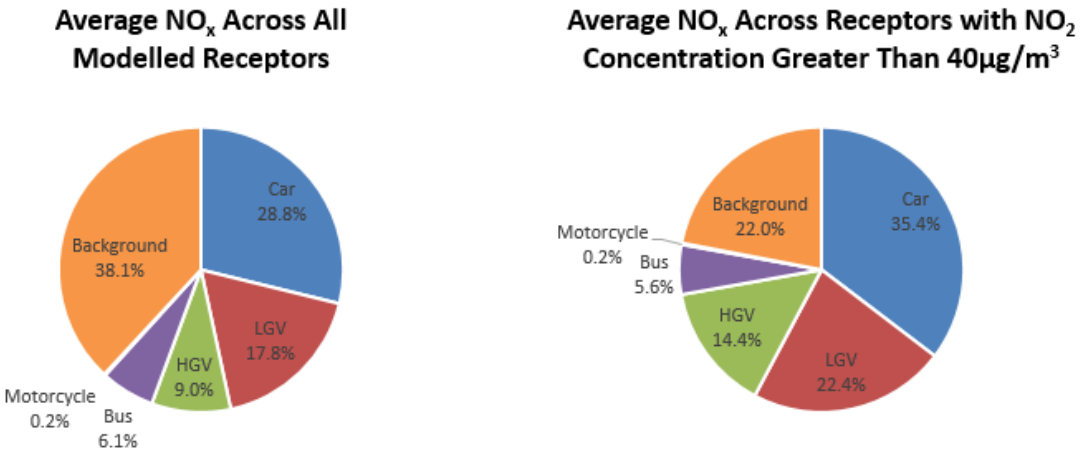


Table 4.2 details the source apportionment results for NO_2 concentrations, whilst Figure 4.2 presents pie charts illustrate the results.

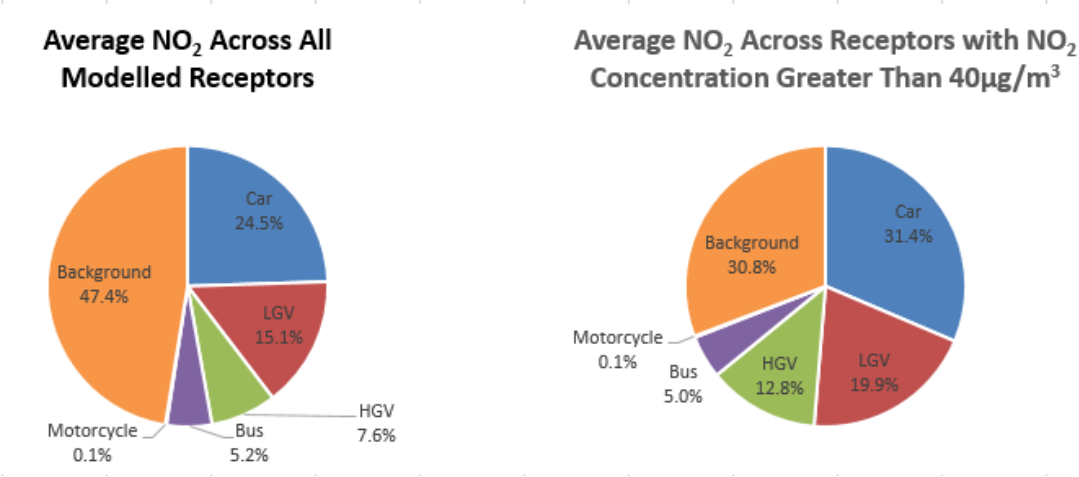
When considering the average NO_2 concentration across all modelled receptors, road traffic accounts for 14.4µg/m³ (52.6%) of total µg/m³. Of this 14.4µg/m³, Cars account for the most (24.5%) of any of the vehicle types, followed by LGVs (15.1%). HGVs and Buses/Coaches account for a similar total road-NO_2, with HGVs at 7.6% (2.1µg/m³) and Buses/Coaches at 5.2% (1.4µg/m³), whilst Motorcycles are found to contribute <1%.

When considering the average NO_2 concentration at receptors with NO_2 concentration greater than 40µg/m³, road traffic accounts for 32.2µg/m³ (69.2%) of 46.5µg/m³. Of this µg/m³, Cars account for the most (31.4%) of any of the vehicle types, followed by LGVs (19.9%), HGVs (12.8%), Buses/Coaches (5.0%), and Motorcycles contributing <1%.

Table 4.2 – NO_2 source Apportionment Results

Results	All Vehicles	Car	LGV	HGV	Bus	Motorcycle	Background
Average across all modelled receptors							
NO_2 Concentration ($\mu g/m^3$)	14.4	6.7	4.1	2.1	1.4	0.0	13.0
Percentage	52.6%	24.5%	15.1%	7.6%	5.2%	0.1%	47.4%
Percentage Road Contribution	100.0%	46.6%	28.8%	14.4%	9.9%	0.3%	-
Average Across All Receptors With NO_2 Concentration Greater Than 40$\mu g/m^3$							
NO_2 Concentration ($\mu g/m^3$)	32.2	14.6	9.3	6.0	2.3	0.1	14.3
Percentage	69.2%	31.4%	19.9%	12.8%	5.0%	0.1%	30.8%
Percentage Road Contribution	100.0%	45.4%	28.8%	18.5%	7.2%	0.2%	-

Figure 4.2 – Pie Charts showing NO_2 Source Apportionment Results



5 Conclusions and Recommendations

Following the completion of the analysis of both monitoring data and modelled concentrations across all of the assessed area a number of recommendations have been made in terms of the AQMAs within Tonbridge and Malling.

5.1 AQMA 1 – M20

AQMA 1 is currently designated for both concentrations of annual mean NO_2 and 24-hour PM_{10}, monitoring is completed within, and close to the AQMA using NO_2 diffusion tubes. There has been no PM_{10} monitoring completed since the designation of the AQMA. There have not been any monitored exceedances of the NO_2 annual mean objective within the past five years but the modelling has predicted concentrations of 40µg/m^3 to have a similar extent to the existing AQMA boundary.

Based upon the analysis of results it is recommended for the AQMA to remain in force with its current boundary in relation to the annual mean NO_2 objective and be revoked in terms of 24-hour PM_{10} objective. The M20 is a Highways England controlled road and therefore the measures to be developed would have to be a collaboration between the Council and Highways England. Works are currently being undertaken to install a Smart Motorway between Junction 3 (West Malling) and Junction 5 (Aylesford), with the aim to improve traffic flow and therefore this may have beneficial impacts for air quality in the area.

In addition to possible collaborative measures, further borough-wide initiatives should be developed that may not have a large direct impact upon AQMA 1 but would bring about improvements across the borough.

5.2 AQMA 2 – Ditton

There have not been any monitored exceedances of the NO_2 annual mean objective within the AQMA over the past five years. In addition the modelling results predicted a maximum annual mean of 29µg/m^3 at a location of relevant exposure and all concentrations in excess of 40µg/m^3 are restricted to within the boundary of the road link.

Due to the ongoing compliance presented within the monitoring completed, and the concentrations predicted through the dispersion modelling, it is recommended that AQMA 2 is revoked.

5.3 AQMA 3 – Tonbridge High Street

There were no monitored exceedances recorded during 2018. This is the first year that no exceedances have occurred in the past five years. A downward trend in annual mean concentrations within the AQMA is visible between 2014 and 2018. In addition, there were no modelled exceedances predicted within the AQMA at relevant locations of exposure. This would suggest that concentrations of NO_2 are improving within the area without the application of specific measures for the AQMA. Due to the High Street environment of commercial usage at ground floor level and residential at first floor level, NO_2 concentration predictions were completed at varying heights to present the change in concentrations in relation to changing heights.

Due to the general downward trend that is apparent within the AQMA it is recommended that a mixture of area specific and borough wide initiatives be implemented regarding Tonbridge High Street. Although the concentrations are not yet at a level whereby the AQMA should be revoked, if they continue to remain below the annual mean objective this should be considered in the future.

5.4 AQMA 4 – Wateringbury

Diffusion tube monitoring sites within AQMA 4 have consistently recorded exceedances of the annual mean objective over the past five years, with concentrations of over 60µg/m^3 recorded at

one location between 2014 and 2017. Monitored concentrations are consistently higher on the eastern approach to the central junction within Wateringbury compared to the western approach. The automatic monitor ZT7 was re-located to the western approach to the central junction in June 2018, with the annualised 2018 annual mean recorded as 23.6µg/m^3.

The completed modelling within Wateringbury broadly agrees with the monitored data, with the highest annual mean concentrations predicted at properties on the northern side of Tonbridge Road.

Due to the monitored and modelled concentrations within the Wateringbury AQMA being the highest within the borough it is recommended that in addition to borough-wide measures being implemented, measures specific to Wateringbury are also developed and implemented. These should specifically target the central junction where concentrations are at their highest.

5.5 AQMA 5 – Aylesford

There are two diffusion tube monitoring locations within the Aylesford AQMA that consistently exceed the annual mean NO_2 objective, these are located close to the junction of the A20, Hall Road and Mills Road. In addition this is the only location where a modelled exceedance of the annual mean objective was predicted. In terms of relevant exposure only a small number of properties fronting the A20 are within areas predicted to be in exceedance of the annual mean objective.

Due to the spatial extent of the monitored and predicted exceedances it is recommended to revise the AQMA boundary from its existing form to that which encompasses the small area of exceedance on the north western corner of the main junction. Concentrations are not yet at a level within the AQMA to revoke therefore a mixture of area specific and borough wide initiatives should be implemented.

5.6 AQMA 6 – Larkfield

There was one diffusion tube monitoring location that exceeded the annual mean objective in 2018. This tube has experienced an exceedance each year since monitoring commenced at the location in 2016. The diffusion tube is sited on a residential façade and therefore is located at a location of relevant exposure. From the modelling completed there were no exceedances of the annual mean NO_2 objective at any of the modelled receptor locations, and the concentration isopleths display that all concentrations in excess of 40µg/m^3 are contained with the modelled road links.

Due to the location of the monitored exceedance it is recommended to revise the AQMA boundary, retracting the eastern boundary of the AQAM to the junction if London Road and New Hythe Lane. This would incorporate the monitoring location that is currently showing an exceedance, and the junction whereby predicted concentrations are at their highest. Due amendment rather than revocation being recommended, a mixture of AQMA specific and borough wide initiatives should be implemented.

5.7 AQMA 7 – Borough Green

There were no monitored exceedances recorded during 2018, which is the first time this has occurred over the past five years. One monitoring location (TN70, 72, 73) has consistently been in exceedance of the annual mean objective, within 2018 this was below, but within 10% of the objective (39.6µg/m^3). Across the majority of the monitoring sites within the AQMA a downward trend in annual mean concentrations within the AQMA is visible between 2014 and 2018. In addition there were no modelled exceedances predicted within the AQMA at relevant locations of exposure, but there was one receptor concentration predicted to be within 10% of the objective at a location close to TN70, 72, 73. The concentration isopleths display that exceedances of the annual mean objective are mostly predicted to be within the boundaries of the road links, with this encroaching to relevant receptors only in the locality of TN70, 72, 73.

Due to the location of the monitoring site, and modelled receptors that are within 10% of the annual mean objective it is recommended to revise the current AQMA boundary. As all other monitoring sites and modelled receptors show compliance with the objective the boundary should remain around the junction of Sevenoaks Road and Western Road to the west of the current AQMA. Due amendment rather than revocation being recommended, a mixture of AQMA specific and borough wide initiatives should be implemented.