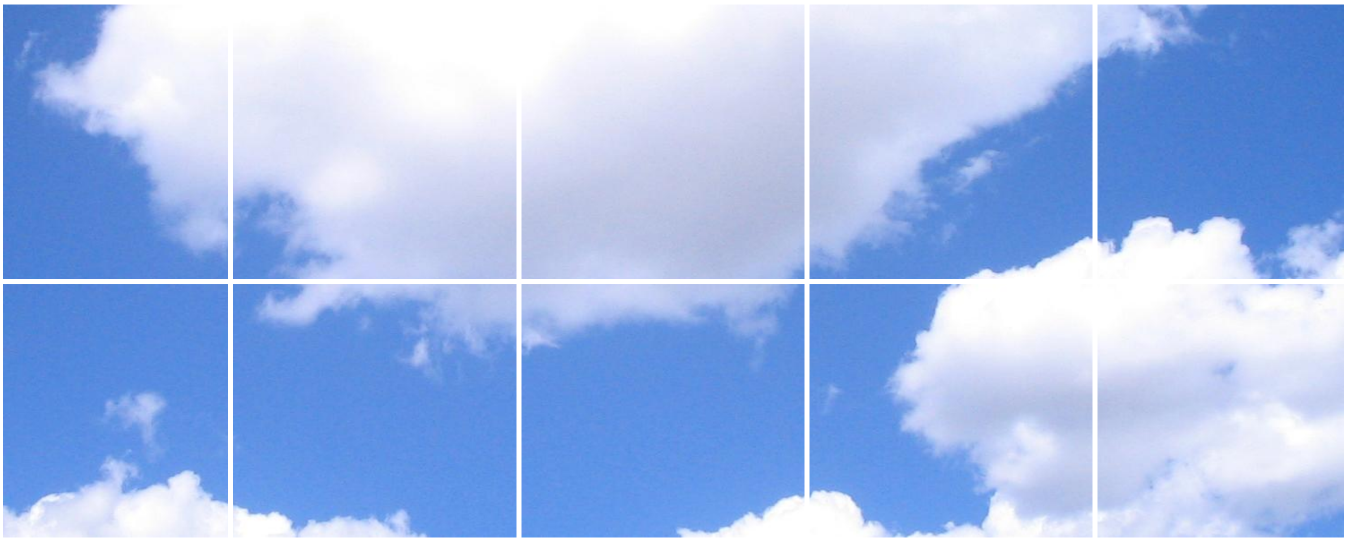

Peaslake Biomass Boiler Air Quality Assessment

Report to Guildford Borough Council

Unrestricted

AEAT/ENV/R/2930 Issue 1

December 2009

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Executive Summary

AEA have been commissioned by Guildford Borough Council to investigate the air quality impact of an existing biomass boiler installation adjacent to Peaslake School at Peaslake, Guildford.

The main pollutants assessed were particulate material with aerodynamic diameter of 10 microns or less (PM_{10}) and nitrogen dioxide (NO_2).

The results indicate that the boiler emissions will not result in any exceedences of the AQS objectives for NO_2 and PM_{10}, indeed the process contributions are typically a small percentage of the overall AQS objectives.

For example, the worst case result modelled during this exercise was modelled at the 1st floor of Peaslake School for annual mean objectives for NO_2 (5.5 $\mu g.m^{-3}$) and PM_{10}.(0.7 $\mu g.m^{-3}$). These modelled concentrations represent 13.8 % and 1.8% of the annual mean objective (40 $\mu g/m^3$) for PM_{10} and NO_2 respectively. Modelled results for discrete receptors are shown in Table 4.1, Section 4.1.

It should also be noted that the results shown in this table are extremely conservative as it assumed that NOx converts entirely to NO_2. Additionally, it is assumed that the biomass boiler is running 24 hours per day, 365 days per year.

The assessment has been carried out based on a boiler stack height of 4.6 m above ground level. Air quality impacts were calculated using Atmospheric Dispersion Modelling System (ADMS 4.1) – a dispersion model developed by the UK consultancy CERC. The most recent version of the model was used in conjunction with one year of hourly sequential meteorological data. For the purposes of this study we have considered a number of receptors located in the vicinity of the existing biomass boiler stack.

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1 Introduction

1.1 Purpose of the study

The objective of this study is to describe and assess the impacts on air quality of emissions from the existing 50kW biomass-fuelled boiler at Peaslake School, Guildford. The study seeks to provide Guildford Borough Council with a quantitative estimate of the air quality impact of the existing biomass boiler in the context of current UK air quality standards.

1.2 General approach taken

The approach taken in this study was to:

- Collect and interpret boiler specification data for input to the dispersion model;
- Obtain one year of meteorological data, and terrain data for the study area;
- Obtain local background concentrations from national mapping;
- Model the concentrations of oxides of nitrogen (NO_x) and fine particulates (PM_{10}) around the study area, concentrating on the locations (receptors) where people might be exposed over the relevant averaging times of the air quality objectives; and
- Present the concentrations as contour plots of concentrations and assess the uncertainty in the predicted concentrations.

1.3 Numbering of figures and tables

The numbering scheme is not sequential, and the figures and tables are numbered according to the chapter and section that they relate to.

1.4 Units of concentration

The units throughout this report are presented in $\mu g.m^{-3}$ (which is consistent with the presentation of Air Quality Strategy (AQS) objectives), unless otherwise noted.

1.5 Structure of the report

This document is an air quality impact assessment for the area surrounding Peaslake School in Guildford. This chapter, Chapter 1 has summarised the need for the work and the approach to completing the study.

Chapter 2 introduces the latest English legislative standards and objectives for NO_2 and PM_{10} and discusses background air quality in the study area.

Chapter 3 contains details of the information and methodology used to conduct the air quality assessment and outlines the study area.

Chapter 4 describes the results of the modelling assessment and discusses whether the UK objectives and EU limit values for NO_2 or PM_{10} are considered likely to be exceeded in the study area as a result of emissions from the boiler installation. The contribution of boiler emissions to concentrations of these pollutants at key receptors will be presented and discussed. The results of the analysis are discussed and shown in tabular form and as contour plots.

Chapter 5 outlines the conclusions and recommendations for both NO_2 and PM_{10} from the assessment.

1.6 Explanation of the modelling output

The contour maps generated in the modelling for this report are an indication of the predicted pollutant concentrations around the area modelled. They are not lines of absolute values and should not be considered as such. Care should also be taken, in cases where contours join up as enclosed loops. No assumptions of pollutant concentrations can be made on locations outside of the area being modelled.

2 Air quality standards and guidelines

2.1 Air Quality Strategy and objectives

Biomass burners emit PM_{10} and oxides of nitrogen NO_x Local Authorities are required under the Environment Act 1995 to assess air quality in their areas from time to time against air quality objectives set out in regulation; both of these pollutants are normally included in such assessments.

Local Authorities are required to declare an Air Quality Management Area (AQMA) where it is likely that these objectives will not be achieved and to prepare an Action Plan to set out proposed measures to be taken to achieve the air quality objectives. There are no AQMAs throughout Guildford Borough.

The latest Air Quality Strategy for England, Wales and Northern Ireland was published on 17th July 2007. The objectives, that mirror limit values required by EU Framework and Daughter Directives on Air Quality, have been transposed into UK law through the Air Quality Standards Regulations 2007 which came into force on 15th February 2007. A new EU Directive has recently been published which consolidates the Framework and first three Daughter Directives, but this has yet to be transposed into UK Regulations. Table 2.1 shows an outline of the current UK Air Quality Objectives. NO_2 andPM_{10} are considered in this report in relation to the annual average and short-term objectives for each pollutant.

Experience from monitoring shows that if the 40 $\mu g.m^{-3}$ annual mean value is achieved, for NO_2, there is normally no risk of the hourly mean objective being breached. The relationship between annual and daily mean for PM_{10} is less predictable, and exceedences of the short term objective can still be observed even where the annual mean complies with the objective.

The other Air Quality Strategy pollutants do not need to be considered in this assessment.

The Air Quality Strategy's standards and objectives are shown in Table 2.1. The table shows the standards in $\mu g.m^{-3}$ ($mg.m^{-3}$ for CO) with the number of exceedences that are permitted (where applicable).

Table 2.1 Objectives included in the Air Quality Regulations and subsequent Amendments, for the purpose of Local Air Quality Management

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene All authorities	16.25 $\mu g.m^{-3}$	running annual mean	31.12.2003
Authorities in England and Wales only	5.00 $\mu g.m^{-3}$	annual mean	31.12.2010
Authorities in Scotland and Northern Ireland only	3.25 $\mu g.m^{-}$	running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu g.m^{-3}$	running annual mean	31.12.2003
Carbon monoxide Authorities in England, Wales and Northern Ireland only	10.0 $mg.m^{-3}$	maximum daily running 8-hour mean	31.12.2003
Authorities in Scotland only	10.0 $mg.m^{-3}$	running 8-hour mean	31.12.2003
Lead	0.5 $\mu g.m^{-3}$ 0.25 $\mu g.m^{-3}$	annual mean annual mean	31.12.2004 31.12.2008
Nitrogen dioxide	200 $\mu g.m^{-3}$ not to be exceeded more than 18 times a year 40 $\mu g.m^{-3}$	1 hour mean annual mean	31.12.2005 31.12.2005
Particles (PM_{10}) (gravimetric)[a] All authorities	50 $\mu g.m^{-3}$ not to be exceeded more than 35 times a year 40 $\mu g.m^{-3}$	24 hour mean annual mean	31.12.2004 31.12.2004
Authorities in Scotland only[b]	50 $\mu g.m^{-3}$ not to be exceeded more than 7 times a year 18 $\mu g.m^{-3}$	24 hour mean annual mean	31.12.2010 31.12.2010
Sulphur dioxide	350 $\mu g.m^{-3}$ not to be exceeded more than 24 times a year 125 $\mu g.m^{-3}$ not to be exceeded more than 3 times a year 266 $\mu g.m^{-3}$ not to be exceeded more than 35 times a year	1 hour mean 24 hour mean 15 minute mean	31.12.2004 31.12.2004 31.12.2005

a. Measured using the European gravimetric transfer sampler or equivalent.
b. These 2010 Air Quality Objectives for PM_{10} apply in Scotland, as set out in the Air Quality (Scotland) Amendment Regulations 2002.

2.2 Sensitive locations

The locations where objectives apply are defined in the AQS as locations outside buildings or other natural or man-made structures above or below ground where members of the public are regularly present and might reasonably be expected to be exposed over the relevant averaging period of the objectives. Typically, these include residential properties, hospitals and schools for the longer averaging periods (i.e. annual mean) pollutant objectives and residential dwellings for short-term (i.e. 1-hour and 24 hour) pollutant objectives.

2.3 Combustion plant emissions

The utilisation of biomass for energy can affect air quality in a variety of ways. A large proportion of the total air pollutants of a bioenergy production chain are released during combustion of biomass or biomass-derived fuels. Emission levels of some of these pollutants, such as NO_x and oxides of sulphur (SO_x) depend heavily on the chemical composition of individual fuels while emission levels of other pollutants such as particulates (PM), PAHs and carbon monoxide depend on the completeness of the combustion process. The sulphur and nitrogen content of wood biomass is low but higher than for gas and hence displacement of gas may lead to a modest increase in SO_2 and NO_x emission.

The emissions to atmosphere from combustion can cause impact on the environment at a local, national and transboundary scale. However, the pollutants associated with biomass combustion are also associated with other combustion processes (including transport) and the use of biomass can lead to an increase or decrease in emission. The relative contribution will depend on the type of fuel and combustion technology displaced. Some of these pollutants (e.g. PM, SO_2 and NO_x) are regulated by British and European legislation on air quality.

The subject of this assessment is the dispersion of PM_{10} and NO_x resulting from the current Peaslake biomass boiler. The relevant pollutants are described below.

Particulates (PM_{10})

Particle pollution is one of the most difficult measurements but most widely understood by the public as it is visible through its effects on soiling and nasal passages. The quantification of particulate material (PM) is defined by its effective aerodynamic diameter i.e. PM_{10} is all material up to aerodynamic diameter of 10 μm. This size fraction represents the depth particles travel into the respiratory system. Particles arise from both combustion processes such as coal, biomass or traffic and from abrasive processes such as construction, vehicle movement, grinding and cutting operations. These are both regarded a primary particles. Secondary PM results from atmospheric reactions between other pollutants emitted such as sulphur, nitrogen oxides and ammonia, and consists of a mix of compounds but to a large degree is composed of ammonium nitrate, chloride and sulphate. Exposure to fine particles is associated with respiratory and cardiovascular illnesses, as these particle sizes are likely to be inhaled into the thoracic region of the respiratory tract.

Oxides of nitrogen (NO_x)

As part of combustion using air as the source of oxygen, oxides of nitrogen are produced as a result of the reaction between the nitrogen present in the air. Oxides of nitrogen include nitric oxide (NO) and NO_2. In addition to these species, nitrous oxide (N_2O) can be produced under certain conditions and within certain processes e.g. fluidised bed combustion. Road transport is the main source of NO_X associated with the air quality issues but power and industrial sectors using combustion make appreciable contributions. High levels of NO_x are associated with damage to lung function and enhancement of the response to allergens in sensitive individuals. In addition, NO_X contributes to acidification and/or eutrophication of habitats. This affect does not necessarily impact on the local environment but can impact great distances from the source. N_2O has a contribution to global warming and hence climate change as it acts as a greenhouse gas and is 290 times more effective as a greenhouse gas than methane. NO_X also contributes to ground level ozone via reactions with volatile organic compounds and sunlight.

2.4 Background air quality in Guildford

The background data available at the air quality archive (www.airquality.co.uk) were used to assess current levels of NO_2 and PM_{10} in the study area. This data estimated concentrations of key pollutants at a resolution of 1x1km for the whole of England in 2008.

Background concentrations of NOx, NO_2 and PM_{10} for 2008 are provided in Table 2.2

Table 2.2 2008 Background Concentrations of PM_{10} and NO_2

Pollutant	2008 Mapped Concentration
PM_{10}	16.5
NO_2	11.6
NOx	

3 Modelling methodology

The air quality impact in the area surrounding the biomass boiler emissions was calculated using Atmospheric Dispersion Modelling System (ADMS). ADMS is a dispersion model developed by the UK consultancy CERC. The most up-to-date version of the model, ADMS 4.1, was used for this assessment.

Dispersion models, which are used to predict ground level pollutant concentrations, are commonly based on Gaussian Dispersion Theory. The simplest realisation of this is to imagine a puff of pollution being released by a point source. As the puff moves downwind away from the source it expands in volume, incorporating dilution air from around it, thereby reducing its concentration. A Gaussian distribution has the appearance of a bell-shaped curve with maximum concentration occurring along the plume centreline. The latest dispersion models replace the concept of discrete atmospheric stability classes with an infinitely variable measure of the surface heat flux. This influences the turbulent structure of the atmosphere and hence the dispersion of the plume.

A study by AEA[1] has provided a toolkit for local authorities in Greater London to assess the potential air quality impact of new biomass boiler installations. A set of nomographs is provided to estimate the required stack height to limit ground level pollution to an acceptable level, and where necessary, a correction calculation based on the 3rd Memorandum on Chimney Heights is provided. A similar set of nomographs was developed for inclusion in the latest air quality guidance documents for Local Authorities- LAQM.TG(09).

3.1 Mapping

Guildford Borough Council provided a CAD DXF file of the study area. This enabled accurate OS x,y grid references to be obtained for the study area as a whole, and specific features such as stack location, office buildings, and local receptors to be accurately identified.

3.2 Meteorology

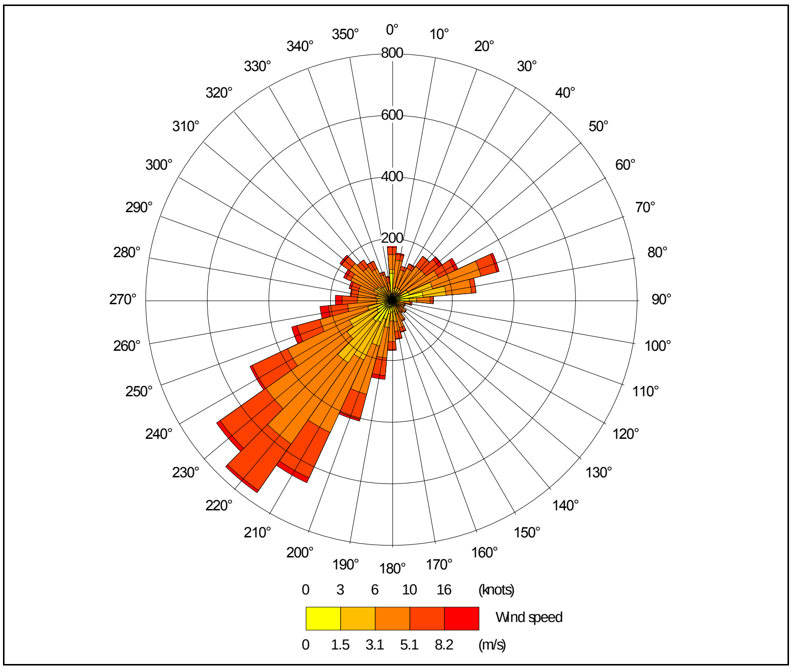
Hourly sequential meteorological data for the nearest suitable meteorological station with adequate data capture, Gatwick Airport, was obtained for the calendar year 2008. The meteorological data provided information on wind speed, direction and the extent of cloud cover for each hour of the period.

Prevailing winds are mostly south-westerly with strongest winds being observed between 200^o and 240^o. The wind rose for 2008 is shown in Figure 3.1.

A minimum Monin – Obukhov length of 30m was used as CERC recommend this value for use with mixed urban areas.

1 Review of Potential Impact on Air Quality from Increased Wood Fuelled Biomass Use in London, AEA Energy and Environment, 2007

Figure 3.1 Gatwick Wind Roses for 2008



3.3 Building parameters

Nearby buildings and complex topography can have a significant effect on the dispersion characteristics of a stack plume. The main effect can be to increase concentrations in the immediate vicinity of the building, while reducing concentrations further away. The estimated dimensions of the idealised buildings (Peaslake School, local out buildings etc) were input to the model to assess the effect of on-site buildings on dispersion. ADMS contains algorithms that account for these effects and these have been included in this exercise. Building locations and dimensions were added using the ADMS Mapper utility using a DXF base map to ensure correct location and orientation. The utility calculates the width, length and rotation of the buildings from the graphical input of the user. ADMS Mapper cannot model complex building shapes so the idealised buildings are rectangular. The building input data used in the assessment is provided in Table 3.1 below.

Table 3.1 Building Parameters as defined in ADMS

Building	Grid Reference at Centre X	Grid Reference at Centre Y	Height (m)	Length (m)	Width (m)
Biomass Unit Housing	509020.1	145158.9	3.95	4.28	11.17
Peaslake School	509012.7	145141.8	8.50	13.24	28.88
Overlea Section 1	508970.8	145159.4	6.00	6.71	12.89
Overlea Section 2	508962.0	145157.5	6.00	10.77	4.25
Windy	508996.9	145121.8	6.00	9.97	15.89
Outbuilding Section 1	509064.3	145111.0	2.50	5.35	15.76
Out Building Section 2	509073.6	145104.0	2.50	6.96	16.31
Hurst/ Autumn Section 1	509082.4	145135.2	10.00	6.61	4.64
Hurst/ Autumn Section 2	509088.3	145132.9	10.00	23.34	7.48

3.4 Terrain and land use

The site is located in a flat area of Guildford and has a typical elevation of around 140 m above sea level. The boiler house is partially bounded by residential and commercial buildings to the north and west, and mainly open to the south and east.

A surface roughness value of 0.5m was used as CERC suggest this is appropriate for open suburbia and parkland. Model default values were used for surface albedo (0.23) and the Priestley Taylor parameter (1).

3.5 Addition of background concentrations to modelled contribution

In order to assess the impact of emissions on local air quality using dispersion models it is necessary to add the modelled concentrations to background concentrations. If the impact on air quality is assessed in terms of pollutant concentrations averaged over a year, then the total concentration is the sum of the source and background averaged concentrations. However, serious effects of many air pollutants on human health arise from short-term peak concentrations rather than longer term averages. This is reflected in the AQS objectives, which, in terms of NO_2, are set in terms of the highest percentiles of hourly concentrations experienced in a year. For impacts assessed in this way, it is not appropriate to add the maximum-modelled source concentrations to the maximum background concentrations because they are unlikely to occur simultaneously.

Research carried out by the Environment Agency provided a method for addition of these components[2]. It was found that simple addition can overestimate the source contribution by a factor of up to two and that in general the overestimate is more severe for higher percentiles. Two additional methods were proposed- with the one used in this assessment being the twice-annual mean method. This takes the form:

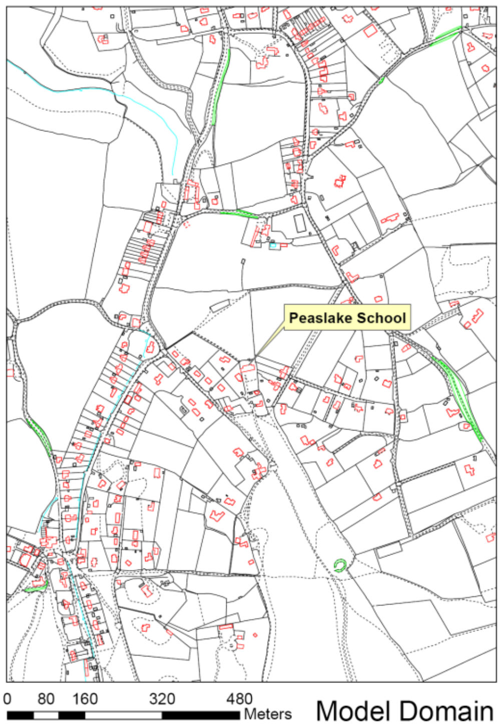
$$T_q = S_q + 2A_m$$

S is the source concentration, *A* is the background concentration, *T* is the sum of the two, *q* is the required percentile, and *m* is the annual mean.

3.6 Model domain

The domain comprises a 1km square, centred on the existing biomass boiler stack (grid ref. 509018, 145157). The extent of the study area is shown in Figure 3.2 below.

Figure 3.2: Extent of Model Domain



[2] Environment Agency Research and Development Technical Report: P361 Addition of Background Concentrations to Modelled Concentrations from Discharge Stacks

A grid resolution of 20m was used resulting in 50 points in both x and y directions. This resulted in a model output with 2500 separate concentration estimates for each iteration. In addition to the 20m grid, and within the area immediately surrounding the school, relevant receptors were selected by Guildford Borough Council. These are listed in Table 3.2 below.

Table 3.2 Modelled residential receptors

Receptor location	Height above Ground Level (m)	OS x,y
Peaslake School – Ground Floor	1.5	509027,145154
Peaslake School – First Floor	4.5	509027,145154
Overlea	1.5	508978,145158
Windy	1.5	508996,145134
Outbuilding	1.5	509058,145118
Hurst/ Autumn – Ground Floor	1.5	509079,145133
Hurst/ Autumn – First Floor	5	509079,145133

The grid reference of each receptor was input to the model to obtain predicted concentrations of the pollutants of interest at these properties. This approach ensures information can be provided for the properties most likely to see concentration increases. The high resolution of the automatically generated 20m grid is sufficiently detailed to estimate concentrations at the majority of surrounding properties which lie further away from the biomass boiler stack and that were not explicitly input to the model.

Each building comprised of various levels. As such, realistic heights were modelled for each receptor, to simulate concentrations that could be encountered both at ground level, and at the first storey of relevant buildings.

3.7 Boiler specifications

The proposed boiler is a Woodpecker 50kW wood pellet boiler, for which specifications were provided by Guildford Borough Council. All pollutant emission rates used in the model have been provided from a boiler test report provided to Guildford Borough Council from Woodpecker Energy. Key boiler specifications used in the modelling exercise are presented in Table 3.4. It should also be noted that the model represents a conservative estimate of boiler emissions as the boiler will not run 24 hours a day, 365 days per year. Additionally, velocity has been calculated based on available information such as heat output and flue exhaust diameter.

Table 3.4 Biomass boiler specifications

Boiler specification	
Heat output	50kW
Flue gas velocity	3.65 m/s
Flue diameter	130mm
Flue gas temperature	162^{o}C

3.8 Stack parameters

Emissions of NO_x and PM_{10} from the proposed biomass boiler will originate from one stack. For the purposes of this assessment, the stack has been modelled at 4.6m. Pollutant emission rates are provided in Table 3.5, and are expressed in g/s. Stack height was modelled using the same emissions data.

Table 3.5 Stack emission rates

Pollutant	Emission rate (g/s)
NO_x	0.00686
PM_{10}	0.00102

The stack location is a fixed parameter and does not change in the modelled scenario, and is at OS Grid X (m) 509018, Y (m) 145157. The dispersion modelling assessment is based on parameters of the existing biomass boiler and stack.

All PM_{10} emissions and modelled concentrations were compared with the relevant PM_{10} objectives. Additionally, a conservative approach to assessing NO_2 has also been used; all NO_x emissions are assumed to completely convert to NO_2 on leaving the stack so modelled results will be compared with the relevant NO_2 objectives. This represents a conservative approach to predicting NO_2 as it is likely a portion of the emitted NO_x will not convert fully within the model domain. In addition, it is very unlikely the boiler will operate 24 hours a day which lends additional conservatism to the assessment.

4 Dispersion Modelling Results

The dispersion model has been used to predict ground level concentrations across the domain providing concentration estimates for 2500 points. In addition to their ground level concentrations being modelled explicitly, nearby residential receptors were also assigned a height relative to the number of storeys for each building to assess the concentrations that could be encountered on the (where relevant) first floor of these properties.

Results are presented for the highest predicted concentrations across the domain and at designated receptors for the modelled stack height of 4.6m. See table 4.1 for details.

Additionally, contour maps showing the contribution of the boiler to local concentrations of PM_{10} and NO_2 are provided in Figures 4.1-4.4.

4.1 Results

PM_{10} Annual Mean

For the PM_{10} annual mean, the maximum stack contribution predicted at any ground level location within the grid of receptor points (1,000,000m^3) is **0.8 μg.m^{-3}** located at an area immediately to the east of the Biomass Boiler House. This equates to 2.0% of the PM_{10} objective. When background for PM_{10} (16.5 μg.m^{-3}) is added to the stack contribution, a value of **17.3 μg.m^{-3}** is derived. This equates to 43.3% of the annual mean objective for PM_{10}. This is not an area where continuous exposure is expected.

The maximum stack contribution predicted at any of the receptors was observed at the 4.5m level (1st Floor) of Peaslake School, and is around **0.7 μg.m^{-3}**. This equates to 1.8% of the PM_{10} objective. When combined with the 2008 annual background, a value of **17.7 μg.m^{-3}** is derived, which equates to 44.3% of the PM_{10} objective.

Details of concentrations at other receptors are shown in Table 4.1. Annual mean PM_{10} predictions for this stack height are presented spatially in the contour plot in Figure 4.1.

PM_{10} Short Term 24hr Mean

For the particulate 24 hr mean, the maximum 90th %ile stack contribution predicted at any ground level location within the grid of receptor points (1,000,000m^3) is **2.0 μg.m^{-3}** located at an area immediately to the east of the Biomass Boiler House. This is equivalent to 4.0% of the 24 hour mean objective. When this is added to twice the annual background for 2008 (33.0 μg.m^{-3}) a value of **35.0 μg.m^{-3}** is derived which is equivalent to 70.0% of the objective.

The maximum stack contribution predicted at any of the additional receptors was observed at the 4.5m level of Peaslake School, and is around **2.5 μg.m^{-3}**. This is equivalent to 5.0% of the 24 hr mean objective. When this is added to twice the annual background for 2008 (33.0 μg.m^{-3}) a value of **35.5 μg.m^{-3}** is derived which is equivalent to 71.0% of the objective.

Details of concentrations at other receptors are shown in Table 4.1. 24 hour mean PM_{10} predictions for this stack height are presented spatially in the contour plot in Figure 4.2.

NO_2 Annual Mean

For the NO_2 annual mean, the maximum stack contribution predicted at any ground level location within the grid of receptor points (1,000,000m^3) is **5.7 μg.m^{-3}** located at an area immediately to the east of the Biomass Boiler House. This equates to 14.3% of the NO_2 objective. When the 2008 background concentration (11.6 μg.m^{-3}) is added to the stack contribution, a value of **17.3 μg/m^3** is derived. This equates to 43.3% of the annual mean objective for NO_2. This is not an area where continuous exposure is expected.

The maximum stack contribution predicted at any of the receptors was observed at the 4.5m level of Peaslake School, and is around **5.5 μg.m^{-3}**. This equates to 13.8% of the NO_2 objective. When combined with the 2008 annual background, a value of **17.1 μg.m^{-3}** is derived, this equates to 42.3% of the NO_2 objective.

Details of concentrations at other receptor are shown in Table 4.1. Annual mean NO_2 predictions for this stack height are presented spatially in the contour plot in Figure 4.3.

NO_2 Short Term 1hr Mean

For the NO_2 1 hour mean, the maximum 99th %ile stack contribution predicted at any ground level location within the grid of receptor points (1,000,000m^3) is **24.4 μg.m^{-3}** located west of the Biomass Boiler House. This is equivalent to 12.2% of the 1 hour mean objective. When this is added to twice the annual background for 2008 (23.2 μg.m^{-3}) a value of **47.5 μg.m^{-3}** is derived which is equivalent to 23.8% of the objective.

The maximum stack contribution predicted at any of the additional receptors was observed at the 4.5m level of Peaslake School, and is around **84.1 μg.m^{-3}**. This is equivalent to 42.1% of the 1 hour mean objective. When this is added to twice the annual background for 2008 a value of **107.3 μg.m^{-3}** is derived which is equivalent to 53.7% of the objective. It should be noted that a very conservative assessment technique has been used so it is likely that the NO_2 concentrations described will be overestimates as some proportion of the released NOx will not convert to NO_2 in the domain.

Details of concentrations at other receptor are shown in Table 4.1. 1 hour mean NO_2 predictions for this stack height are presented spatially in the contour plot in Figure 4.4.

Table 4.1: Details and Concentrations at various specified receptors based on 4.6m-stack height

Receptor Name	Approx height above ground (m)	Background NO_2 (μg.m-^{3})	Background PM10 (μg.m-^{3})	Process contribution NO_2 Annual Mean (μg.m-^{3})	Process contribution NO_2 99th %ile (μg.m-^{3})	Process contribution PM10 Annual Mean (μg.m-^{3})	Process contribution PM10 90th %ile (μg.m-^{3})
Peaslake School Gnd Floor	1.5	11.60	16.50	4.60	25.29	0.64	1.35
Peaslake School First Floor	4.5	11.60	16.50	5.55	84.13	0.71	2.45
Overlea	1.5	11.60	16.50	0.56	11.33	0.09	0.31
Windy	1.5	11.60	16.50	3.25	21.91	0.48	1.08
Outbuilding	1.5	11.60	16.50	0.35	8.25	0.05	0.20
Hurst/ Autumn Gnd Floor	1.5	11.60	16.50	0.31	7.80	0.04	0.15
Hurst/ Autumn First Floor	5	11.60	16.50	0.29	9.71	0.04	0.14

Results are presented in terms of the emissions contribution to the annual, 1-hour and 24-hour Air Quality Standards for both NO_2 and PM_{10}. Currently, the annual and 1-hour mean objectives for NO_2 are set at 40 μg.m^{-3} and 200 μg.m^{-3}, respectively. For PM_{10} the annual and 24-hour mean objectives are 40 μg.m^{-3} and 50 μg.m^{-3}.

The annual mean standard (the average of all hourly concentrations in the year) is an absolute value which should not be exceeded at locations with relevant exposure, whereas the NO_2 1-hour standard represents a value which can be exceeded no more than 18 times in a calendar year and the PM_{10} 24-hour standard can be exceeded no more than 35 times per calendar year.

4.2 Dispersion Contour Plots

The results of the modelling exercise for PM_{10} and NO_x (NOx has been conservatively assumed to completely convert to NO_2) are presented spatially for the base case stack height of 10m (from ground level) in Figures 4.1-4.4. Results are presented as process contribution in $\mu g.m^{-3}$.

Figure 4.1: PM_{10} annual mean spacial distribution modelled for 4.6m stack

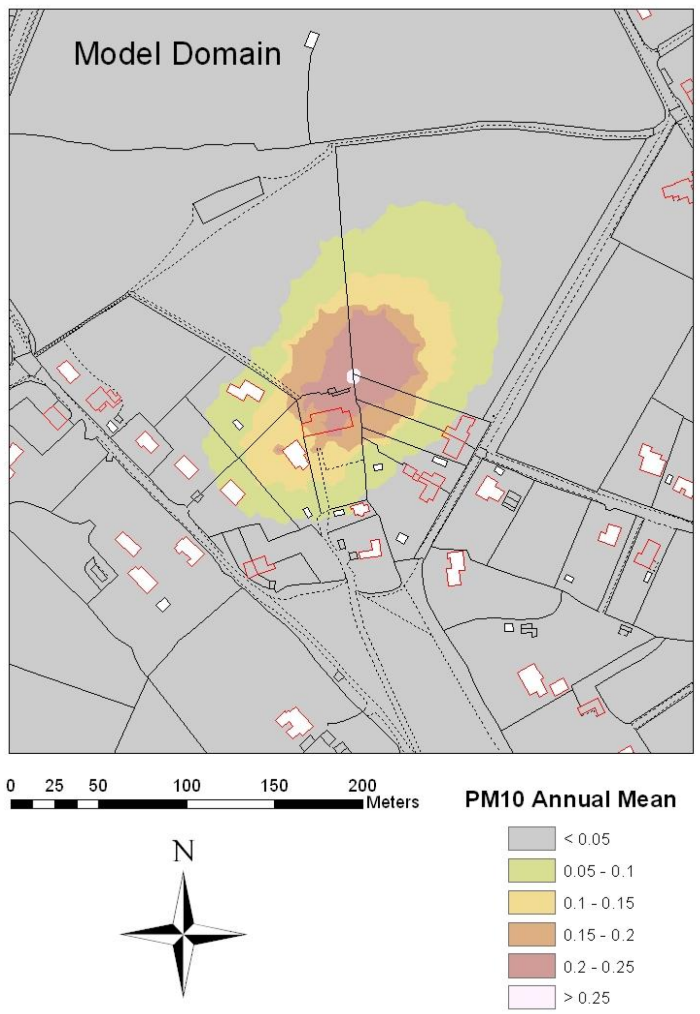


Figure 4.2: PM_{10} 24 hour mean spacial distribution modelled for 4.6m stack

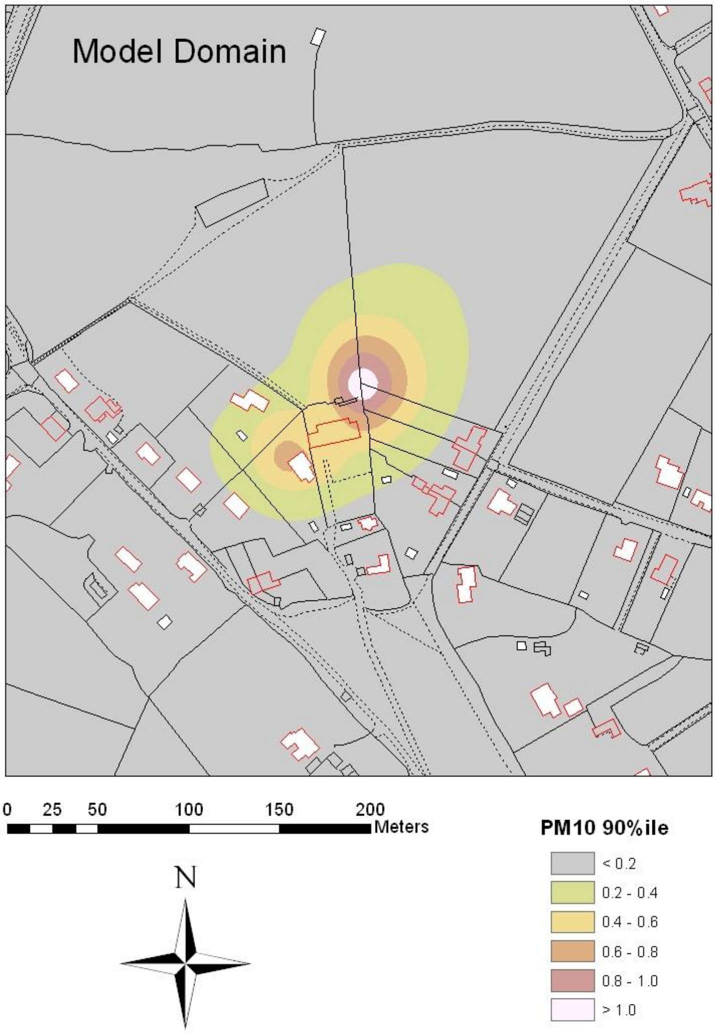


Figure 4.3: NO_2 annual mean spacial distribution modelled for 4.6m stack

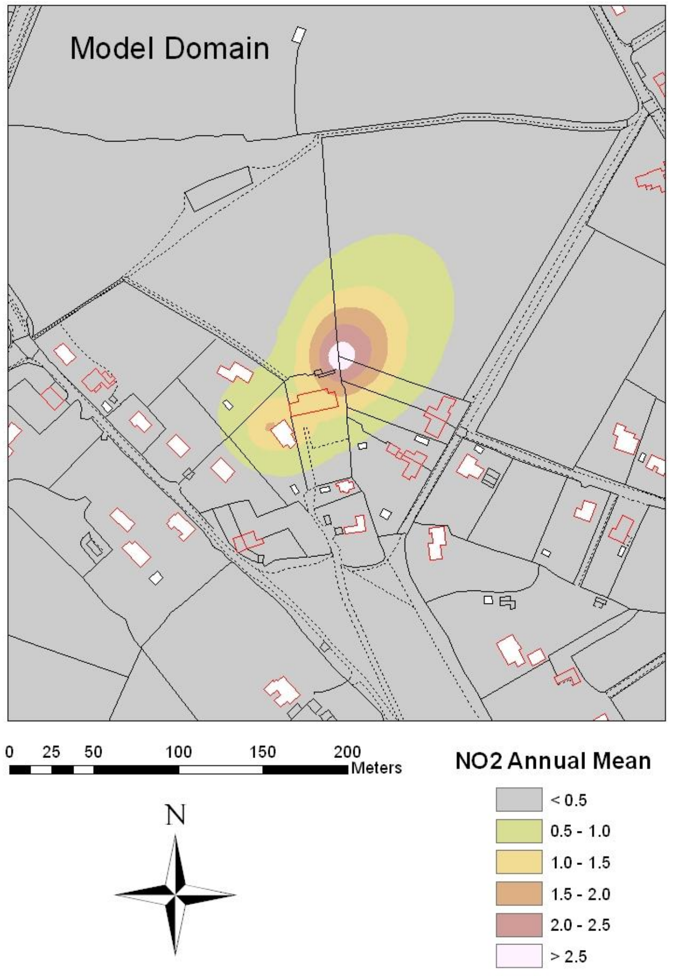
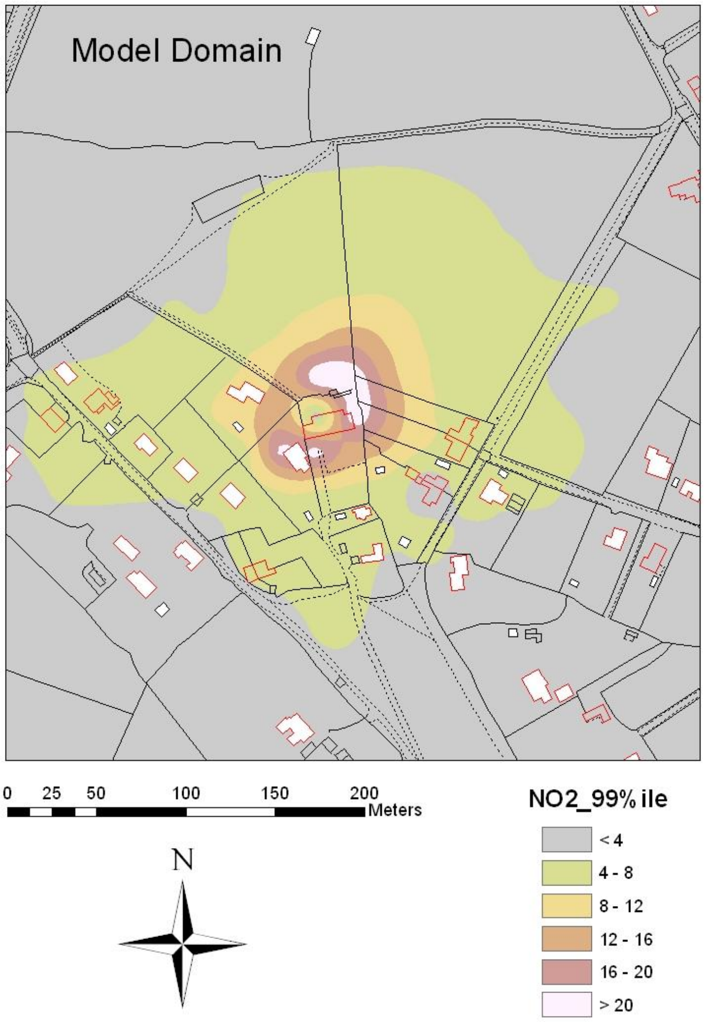


Figure 4.4: NO_2 1 hour mean spacial distribution modelled for 4.6m stack



5 Conclusions

Atmospheric Dispersion Modelling System (ADMS) Version 4.1 was used to predict the air quality impact of the existing Woodpecker 50kW biomass burning boiler on the locality surrounding Peaslake Infant School, in Guildford. A constant emission scenario has been assumed to produce a conservative assessment of air quality impact. Concentrations of NO_2 and PM_{10} have been predicted for an existing stack height of 4.6 m above ground level.

The results indicate that the boiler emissions will not result in any exceedences of the AQS objectives for NO_2 and PM_{10}, indeed the process contributions are typically a small percentage of the overall AQS objectives.

The worst case result modelled during this exercise was modelled at the 1st floor of Peaslake School for annual mean objectives for NO_2 (5.5 $\mu g.m^{-3}$) and PM_{10}.(0.7 $\mu g.m^{-3}$). These modelled concentrations represent 13.8 % and 1.8% of the annual mean objective (40 $\mu g/m^3$) for PM_{10} and NO_2 respectively.

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