Emission reduction assessment for the proposed development at Jack Straw's Lane, Oxford

Report to Cantay Estates Ltd

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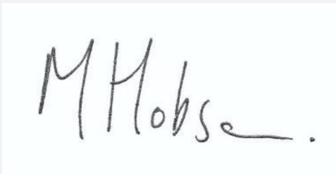
Signature	
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1 Introduction

Aether has been commissioned by Cantay Estates Ltd to undertake an emission reduction assessment to support a planning application for the proposed development at Jack Straw's Lane, Oxford. The current site consists of nine empty one storey buildings with 30 parking spaces which had previous use as a carpentry and joinery factory.

The proposed zero-emission development will consist of the demolition of the current buildings and the construction of eight dwellings. The development will be heated by Air Source Heat Pumps (ASHP) and will include eight car parking spaces exclusively for zero-exhaust emission vehicles. To identify potential emissions savings provided by the development, those associated with an alternative regeneration of the current buildings and parking spaces for motor and bodywork repair has been calculated.

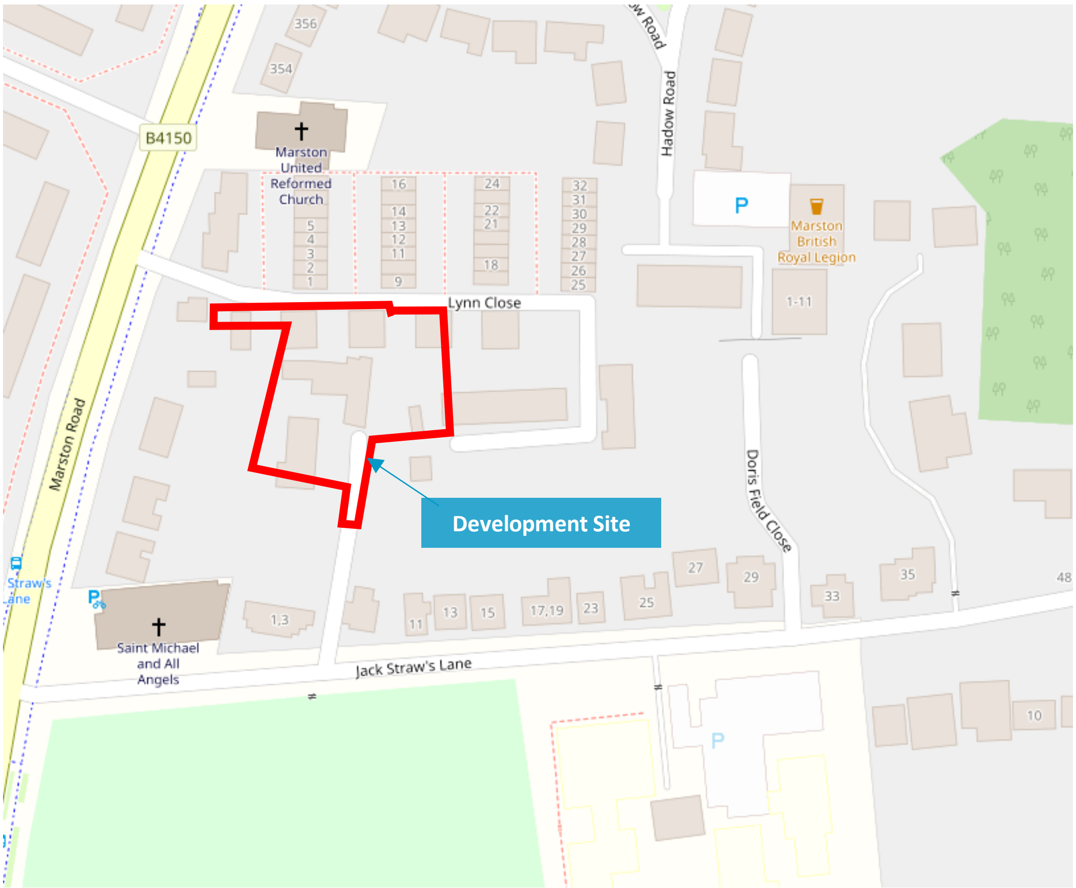
An emission reduction assessment is an alternative to a traditional air quality assessment, and it requires the changes in air pollutant and greenhouse gas emissions under different scenarios to be calculated.

The development falls within the City of Oxford and a summary of their local action plans and strategies is provided below.

1.1 The Location of the Development

The proposed development is located at Jack Straw's Lane, Oxford (**Figure 1**).

Figure 1: Location of the development site



Source: © OpenStreetMap contributors

1.2 Local Air Quality Management

This section provides some background to the LAQM process.

The two air quality pollutants of most concern are nitrogen dioxide (NO_2) and particulate matter.

The oxides of nitrogen (NO_X) comprise principally of nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is a reddish brown gas (at sufficiently high concentrations) and occurs as a result of the oxidation of NO, which in turn originates from the combination of atmospheric nitrogen and oxygen during combustion processes. NO_2 can also form in the atmosphere due to a chemical reaction between NO and ozone (O_3). Health based standards for NO_X generally relate to NO_2, where acute and long-term exposure may adversely affect the respiratory system.

Particulate matter is a term used to describe all suspended solid matter, sometimes referred to as Total Suspended Particulate matter (TSP). Sources of particles in the air include road transport, power stations, quarrying, mining and agriculture. Chemical processes in the atmosphere can also lead to the formation of particles. Particulate matter with an aerodynamic diameter of less than 10 µm is the subject of health concerns because of its ability to penetrate deep within the lungs and is known in its abbreviated form as PM_{10}.

A growing body of research has also pointed towards the smaller particles as a metric more closely associated with adverse health impacts. In particular, particulate matter with an aerodynamic diameter of less than 2.5 µm, known as $PM_{2.5}$. Local Authorities in England have a flexible role[1] in working towards reducing emissions and concentrations of $PM_{2.5}$ as there is no specific objective for them. However, there is a UK objective of an annual mean limit of 25 $\mu g/m^3$.

Local authorities are required to periodically review and assess the current and future quality of air in their areas. Where it is determined that an air quality objective is not likely to be met, the authority must designate an Air Quality Management Area (AQMA) and produce an Air Quality Action Plan (AQAP).

The site lies within the administrative boundaries of Oxford City Council, which declared an AQMA in 2010, covering the entire extent of the city for exceedances of the annual mean NO_2 objective[2]. The proposed development site falls within this AQMA. An AQAP was produced in 2013; this outlines the measures that the Council is taking to improve air quality. The 2013 AQAP replaces the original action plan created in 2006 and prioritises measures to deliver sustainable road transport. The AQAP identifies six key themes[3]:

- Support for development of sustainable transport measures
- Support for the uptake of low and zero emission vehicles
- Reducing freight emissions
- Planning for sustainable transport
- Managing the Council's transport emissions

1 LAQM TG16 – paragraph 1.09
2https://www.oxford.gov.uk/info/20216/air_quality_management/206/air_quality_management_in_oxford/3
3https://www.oxford.gov.uk/info/20216/air_quality_management/206/air_quality_management_in_oxford/2

- Developing partnerships and public education

In addition, Oxford City Council recently announced plans to develop a 'zero emission zone' (ZEZ) building upon the current low emission zone in place[4]. The ZEZ will eventually ban all diesel and petrol vehicles from central Oxford. Although this mainly pertains to transport, the plans demonstrate the motivations of Oxford City Council, and such an emphasis on air quality may result in further scrutiny of developments within the Oxford area in regard to their potential impact.

1.3 Local Climate Change Action

There is currently no legal duty for Local Authorities to take action on climate change, but councils have a crucial role in helping the UK meet its carbon targets. In January 2019, Oxford City Council members unanimously declared a climate emergency and agreed to create a citizens' assembly in Oxford to help consider new carbon targets and additional measures to reduce emissions[5]. In April of that year, members set a vision to reduce the City Council's own emissions to net zero by 2030 at the latest. Oxford's latest Sustainability Strategy is expected to be published soon.

1.4 Local Pollutant Concentrations

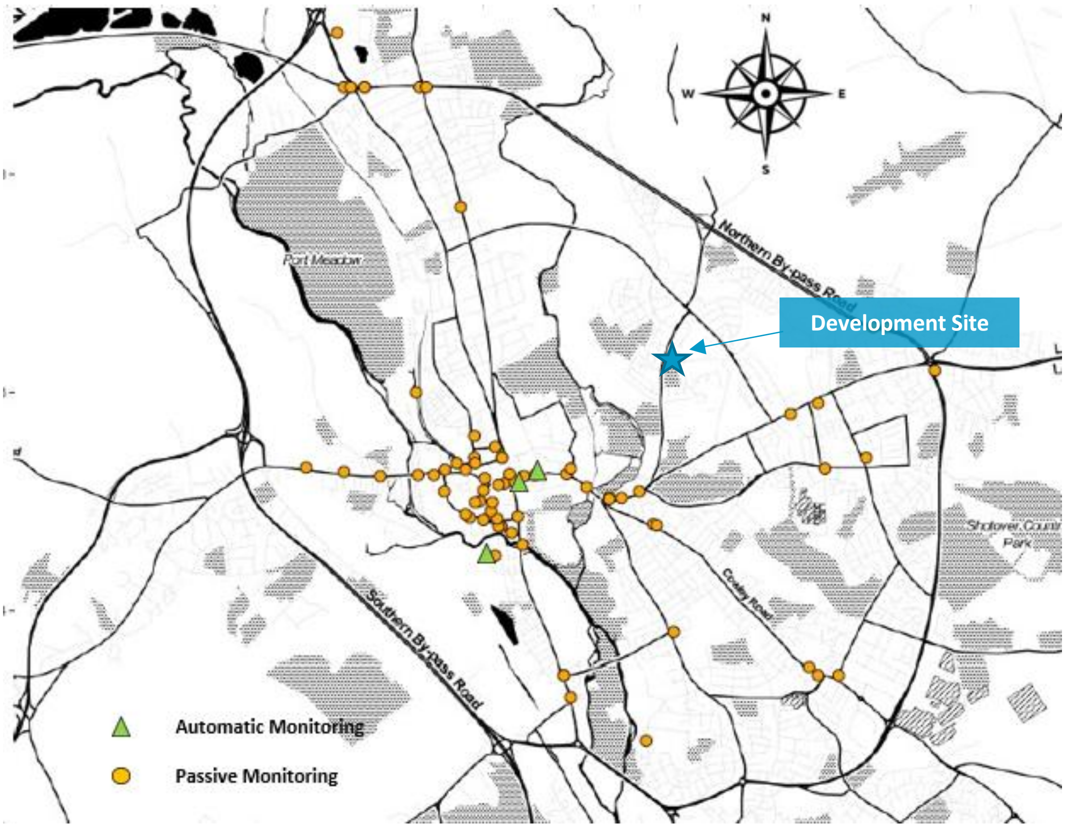
This section provides an overview of the local data available to give an indication of current air pollution concentrations in proximity of the development site.

1.4.1 Local monitoring data

Oxford has three automatic monitoring sites which measure nitrogen dioxide (NO_2); two of these sites also monitor particulate matter of less than 10 µm (PM_{10}) and of these, one also monitors particulate matter of less than 2.5 µm ($PM_{2.5}$). However, all three of these sites lie more than 1.5km from the development site and are therefore unlikely to be representative. NO_2 concentrations are also measured passively at diffusion tube sites across the City. Unfortunately, no diffusion tube site is particularly close to the development, as seen in **Figure 2**.

4 https://www.oxford.gov.uk/zez
5 https://www.oxford.gov.uk/citizensassembly

Figure 2: The location of the automatic and passive (diffusion tube) sites in Oxford[6]



The closest three diffusion tube sites are located between 1.2km to 1.5km of the development site. Details of these monitoring sites are given in **Table 2**.

Monitoring results have been taken from the Council's latest Annual Status Report (ASR)[6].

Table 1: The three closest monitoring sites to the Jack Straw's Lane, Oxford development

Site Name	Site Type	Pollutant	Grid Reference	Distance to Kerb (m)	Approx. Distance to development site (m)
Headley Way/London Road	R	NO_2	453982, 206817	2	1230
49 London Road	R	NO_2	454138, 206903	2	1320
St Clements 3	R	NO_2	452625, 206068	1	1440

Note: R = roadside

The diffusion tubes were analysed by South Yorkshire Air Quality Samplers, who participate in the Proficiency scheme[7]. Whilst diffusion tubes provide an indicative estimate of pollutant concentrations, they tend to under or over read. The data is therefore corrected using a bias adjustment factor. There are two types of bias

[6] https://www.oxford.gov.uk/downloads/file/6429/air_quality_annual_status_report_2018

[7] This is a national QA/QC scheme.

adjustment factor – local and national. The local factor is derived from co-locating diffusion tubes (usually in triplicate) with automatic monitors, whereas the national factor is obtained from the average bias from all local authorities using the same laboratory. The City of Oxford has applied a local bias adjustment factor of 0.94 for roadside sites and 1.05 for urban background sites to their 2019 diffusion tube results.

Monitoring results are presented in **Table 3**. The data shows that the annual mean NO_2 objective was not exceeded at any of the monitoring sites between 2017 and 2019. Diffusion tubes do not provide information on hourly exceedances, but research[8] identified a relationship between the annual and 1 hour mean objective, such that exceedances of the latter were considered unlikely where the annual mean was below 60 µg/m^3. Therefore, no exceedances of the hourly mean objective are expected at the diffusion tube monitoring sites.

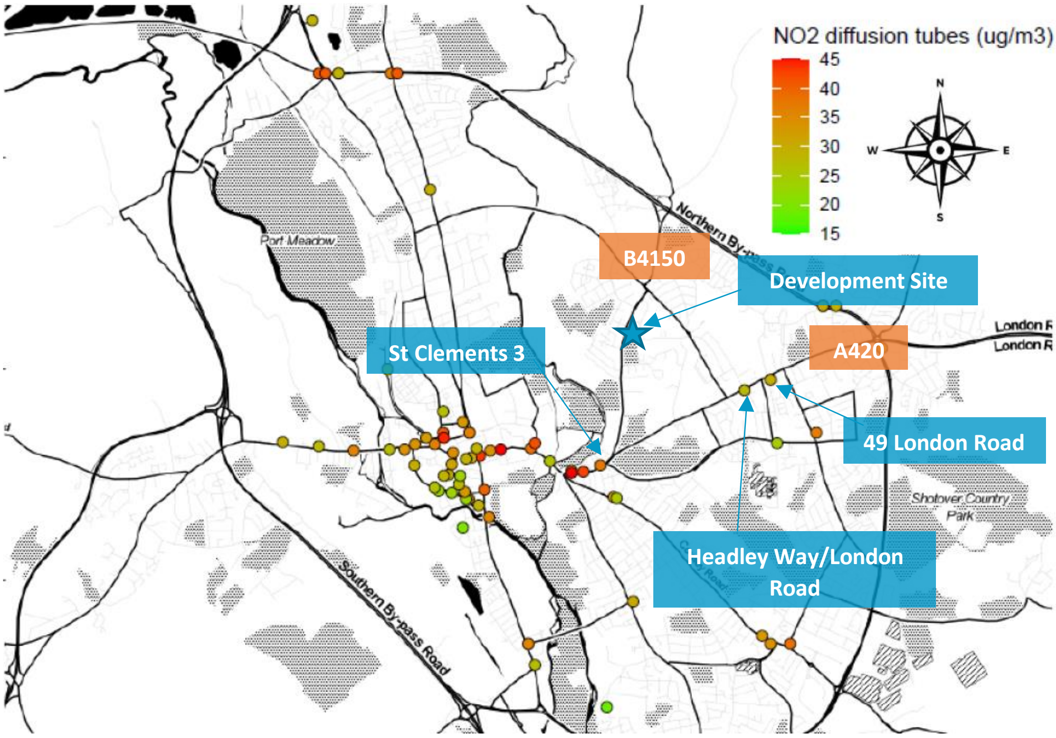
Table 2: Monitoring results for sites close to the proposed development site, 2017-2019

Objective	Site Name	2017	2018	2019
Annual mean NO_2 (µg/m^3)	Headley Way/London Road	27	25	27
	49 London Road	24	25	25
	St Clements 3	-	-	36

Figure 3 below shows the levels of NO_2 in Oxford in 2019 are highest around the city centre and at busy junctions. The elevated levels of NO_2 measured at the St Clements 3 site are likely due to its position at the junction of the B4150 and the A420. This is not representative of the development site, which is situated adjacent to the B4150. The Headley Way/London Road and 49 London Road sites along the A420 may be more representative of the development site.

[8] As described in Box 5.2 of LAQM Technical Guidance (TG16).

Figure 3: NO₂ results from diffusion tube sites in Oxford, 2019[6]



2 Emission Reduction Assessment

2.1 Background to emission reduction assessments

An emission reduction assessment provides an integrated based approach to both buildings and road transport emission reductions via the simultaneous assessment of both air quality pollutants and greenhouse gases (in terms of CO_2 equivalent[9]) both pre- and post-development.

The assessment builds on guidance and toolkit provided on low emission strategies by the Low Emission Strategy Partnership (LESP) in 2010[10] and the Supplementary Planning Documents for Low Emission Strategies 2011 [11]. However, more up to date data such as that outlined in the Sustainable Design and Construction Supplementary Planning Guidance (SPG) April 2014[12] and more up to date road transport emission factors from the UK's National Atmospheric Emissions Inventory (NAEI) has been used.

2.2 Building operational emissions

Building emissions have been developed for the proposed motor and bodywork repair use based upon:

[9] CO_2e is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same GWP.
[10] https://laqm.defra.gov.uk/action-planning/aqap-supporting-guidance.html#LESguide
[11] http://www.lowemissionstrategies.org/downloads/LES%20SPD%20Guidance%20-%20Jan%2011.pdf
[12]https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/Sustainable%20Design%20%26%20Construction%20SPG.pdf

- On-site emissions of NO_X, PM_{10} and CO_2e associated with building use (kg/annum) calculated from default energy use values (kWh/annum) and a default emission factor (kg/kWh)

It is worth noting that only direct emissions occurring at the proposed site from gas use are accounted for and the impact of electricity generation has not been calculated.

Table 3 presents the data used for the calculation along with the resulting annual building NO_X and CO_2e emissions estimation if the site is used as a garage. Gas consumption will result in negligible particulate matter emissions and therefore emissions of this pollutant are not included in the building assessment. Annual energy use has been estimated based upon CIBSE TM46:2008 energy benchmarks[13].

Table 3: Building Emissions Data

Input data					Results: (kg/annum)	
Land use class	**Boiler fuel**	**Energy Use (kWh/annum)**	**NO_X EF (g/kWh**	**CO_2e EF (g/kWh)**	**NO_X**	**CO_2e**
B2-B7 (General industrial)	Gas	125,550	0.04	183.9	5.0	23,085

This assessment assumes that a CSH/BREEAM Ultra-Low NO_X gas boiler(s) (< 40 mg/Kwh) would be installed.

The results show that if ASHP are used for the proposed residential development that NO_X emissions from on-site building operations would reduce by 5kg per year and CO_2e emissions by 23,085kg per year.

2.3 Transport operational emissions

Direct transport emissions have been developed for the proposed motor and bodywork repair centre and the alternative residential use based upon:

- Annual trip rate, based on the number of daily trips being equal to number of parking spaces (30)
- Average vehicle trip length (km) in the South East [14]
- Default NO_X, PM_{10} and CO_2e passenger car exhaust emission factors
  - NO_X and PM_{10} (exhaust, brake & tyre wear and road abrasion) emission factors based on values for all urban cars[15]
  - CO_2e emission factor derived using DEFRA GHG conversion factors[16], weighted by the proportion of petrol and diesel cars registered in the UK in 2019[17]

[13] CIBSE TM46:2008 Table 1 Benchmark categories and values – values for "workshop" applied.
[14] https://www.nimblefins.co.uk/average-car-journey-uk#:~:text=Average%20Car%20Journey%20Distance%20UK,travelling%20alone%20(7.8%20miles). Value for South East applied
[15] National Atmospheric Emissions Inventory
[16] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020
[17] https://www.gov.uk/government/statistical-data-sets/veh02-licensed-cars

It is worth noting that only direct emissions occurring from road vehicles are accounted for and the impact of electricity generation to power the road vehicles has not been calculated.

Table 4 presents the data used for the calculation along with the resulting annual transport NO_X,PM_{10} and CO_2e emissions estimations if the site is used for a garage.

Table 4: Direct transport Emissions Data if the site is used as a garage

Input data					Results: (kg/annum)		
Trip rate (trips /annum)	Av. Trip (km)	NO_X EF (g/km)	PM_{10} EF (g/km)	CO_2e EF (g/km)	NO_X	PM_{10}	CO_2e
10,950	14.6	0.356	0.030	172	57.0	4.8	27,575

Table 6 presents the data used for the calculation and the resulting emissions if the site is used for residential purposes. As the vehicles in this scenario will all be zero exhaust emissions at the point of use, only PM10 emissions from brake and tyre wear and road abrasion are applicable.

Table 6: Direct transport Emissions Data if the site is used for residential purposes

Input data					Results: (kg/annum)		
Trip rate (trips /annum)	Av. Trip (km)	NO_X EF (g/km)	PM_{10} EF (g/km)	CO_2e EF (g/km)	NO_X	PM_{10}	CO_2e
10,950	14.6	0	0.022	0	0	0.93	0

The results show that direct NO_X, PM_{10} and CO_2e vehicle emissions would decrease by 57kg, 3.9kg and 27,575kg respectively if the residential site was a zero emission residential development.

3 Summary and Conclusions

An emission reduction assessment has been undertaken for a proposed residential development at Jack Straw's Lane, Oxford. The City of Oxford council has declared an Air Quality Management Area (AQMA) covering the entire extent of the city due to the exceedance of the annual mean nitrogen dioxide (NO_2) objective. The proposed development lies within this AQMA. In addition, the Council have declared a Climate Emergency and are therefore keen to reduce GHG emissions in the borough.

The emission reduction assessment has compared the proposed zero-emission residential development with the emissions associated with an alternative use of the current buildings and parking spaces for motor and bodywork repair. The results of the assessment estimate that a total of **62kg** of nitrogen oxides (NO_X), **3.9kg** of particulate matter (PM_{10}) and **50,660kg** of carbon dioxide equivalent (CO_2e) will be saved per annum from direct emissions if the zero-emission residential development is implemented, compared with the motor and bodywork repair use.

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