Cambridge Regional College and Cambridgeshire County Council

Cambridge Regional College

Air Quality Assessment

May 2010

Halcrow Group Limited

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Contents

1 Introduction

1.1 *Background*

1.1.1 This report presents an assessment of air quality issues that may result from the construction and operation of the proposed educational centre at Cambridge Regional College, King Hedges Road, Cambridge (known as Application Site from herein).

1.1.2 During construction, temporary impacts could arise from the emission of air pollutants and dust. Construction dust normally comprises inert particles up to 75 microns (μm) in diameter[1]. Most construction dust consists of large particles (diameter > 30 μm) that have a very short lifetime in the atmosphere and tend to be deposited within 100 m of the source. Particles of this size are too large to penetrate into the lungs, but can cause eye, nose and throat irritation. Furthermore, their deposition on property and cars causes soiling and discolouration and may result in complaints of nuisance through amenity loss or perceived damage.

1.1.3 Local air quality is primarily of concern to ecosystems and human health. Air pollution is known to have detrimental cardiopulmonary (heart and lung) effects on the human body, and can trigger increased hospital admissions and contribute to premature mortality. In addition, air pollution can have a negative impact on the environment by directly affecting vegetation, and by modifying the nutrient and acid status of soils and waters.

1.1.4 Due to the size of the proposed development and the proposed number of car parking spaces, there will be negligible impacts on road traffic and vehicular emissions. There is however concern that the Application Site will introduce receptors into an area of poor air quality. Air quality at the Application Site is considered in this report. The main air pollutants of concern at the Application Site are vehicular pollutants associated with the A14 and King Hedges Road, specifically nitrogen dioxide (NO_2) and particulate matter smaller than 10 micrometers diameter (PM).

1.2 *Relevant Legislation and Policy Guidance*

European Legislation

[1] BS6069. Method for the manual gravimetric determination of concentration and mass flow rate of particulate matter in gas carrying ducts

1.2.1 The principal driver of domestic air quality legislation derives from European Union (EU) Directives. EU Framework Directive 96/62/EC was the first overarching strategy-level document produced within the EU, and came into force in 1996. The Directive is based on ambient air quality assessment and management, and outlines the basic principles by which air quality should be assessed and managed throughout Member States. Specifically, it aims to:

- establish air quality limit (target) values to protect ecosystems and human health;
- outline the European Commission's reporting requirements; and
- establish common assessment methods (monitoring and modelling) throughout the territory of Member States.

1.2.2 Limit values for twelve air pollutants are specified in four Daughter Directives:

- Directive 1999/30/EC relating to limit values for sulphur dioxide (SO_2), nitrogen dioxide (NO_2) oxides of nitrogen (NO_x), particulate matter (PM) and lead in ambient air;
- Directive 2000/69/EC relating to limit values for benzene and carbon monoxide (CO) in ambient air;
- Directive 2002/3/EC relating to ozone (O_3) in ambient air; and
- Directive 2004/107/EC relating to a target value for arsenic, cadmium, nickel and benzo(a)pyrene in ambient air.

1.2.3 The European Commission worked together with Clean Air For Europe (CAFE) to produce and publish a new European Directive in 2008 (Directive 2008/50/EC). Key changes include:

- The merging of existing legislation into a single directive, with the exception of the fourth Daughter Directive which will be implemented in the new directive at a later date;
- a new air quality objective for particulate matter smaller than 2.5 µm in aerodynamic diameter ($PM_{2.5}$). The objective includes a limit value and exposure reduction target; and
- provision for extended compliance deadlines for NO_2 and particulate matter smaller than 10 µm in aerodynamic diameter (PM_{10}).

Member states have until June 2010 to transpose the new directive.

National Objectives

1.2.4 The Environment Act, 1995 required the Government to prepare an Air Quality Strategy for the UK which would set out standards and objectives for air pollutants and outline measures that local authorities should undertake to improve air quality.

1.2.5 The latest version of the National Air Quality Strategy was published in 2007. There were no changes to the objectives set out in the 2000 strategy or its addendum, apart from the replacing of the provisional 2010 PM_{10} objective in England, Wales and Northern Ireland with an exposure reduction approach. The objective is based on the fact there is no recognisable safe health threshold for particulate matter. The strategy introduced two new objectives for $PM_{2.5}$: a 'cap' of 25 $\mu g\ m^{-3}$ to be achieved by 2020, and an exposure reduction target of 15% in average urban background concentrations to be achieved between 2010 and 2020.

1.2.6 Air quality objectives are in most cases, numerically synonymous with European limit values although some have earlier compliance dates. Of key concern to this assessment are NO_2 and PM_{10}. The national air quality objectives for these pollutants are summarised in Table 1.

Table 1: Relevant Air Quality Objectives and EU Limit Values for NO_x, NO_2 and PM_{10}

Air Quality Objectives and European Directives for the protection of human health					
Air Quality Objectives				EU Limit Values	
Pollutant	**Concentration**	**Averaging Period**	**Compliance Date**	**Concentration**	**Compliance Date**
Nitrogen dioxide (NO_2)	200 µg m^{-3}	1-hour mean (not to be exceeded more than 18 times per	31 December 2005	200 µg m^{-3} (18 exceedances)	1 January 2010
	40 µg m^{-3}	annual mean	31 December 2005	40 µg m^{-3}	1 January 2010
Particulates (PM_{10})	50 µg m^{-3}	24-hour mean (not to be exceeded more than 35 times per year)	31 December 2010	50 µg m^{-3} (35 exceedances)	1 January 2005
	40 µg m^{-3}	annual mean	31 December 2010	40 µg m^{-3}	1 January 2005

1.2.7 It should be noted that because the Strategy is not implemented under legislation, Local Authorities have no legal requirement to achieve compliance with national air quality objectives. Primary legislation flows from the EU. Local Authorities are however required to demonstrate best efforts to work towards achieving national air quality objectives in order to meet statutory EU limit values.

1.2.8 Part IV of the Environment Act 1995 sets out a system of Local Air Quality Management (LAQM); it is a component of the UK's approach to managing air quality. Under LAQM Local Authorities have a duty to make periodic reviews of local air quality against national air quality objectives. Where a Local Authority's Review and Assessment of local air quality indicates that air quality objectives are not expected to be achieved, Local Authorities are required to designate Air Quality Management Areas (AQMAs). An Air Quality Action

Plan (AQAP) must then be formulated, detailing how the Local Authority aims to improve air quality within the AQMA.

1.2.9 Construction dust is not covered by national Air Quality Regulations. Generally dust is only a cause of annoyance and when of sufficient scale and frequency may become a Statutory Nuisance; it is unlikely to be prejudicial to health. Relevant legislation dealing with Statutory Nuisance is given in Part III of the Environmental Protection Act 1990.

Policies and Plans

1.2.10 Planning Policy Statement 23: Planning and Pollution Control (2004) contains advice on when air quality should be a material consideration in development control decisions. Existing and future air quality should be taken into account, as well as the presence of any AQMAs. It notes that the findings of local authority Review and Assessments of air quality will be important, as they will identify local air pollution problems, which may in turn influence the siting of certain types of development.

1.2.11 The need for compliance with any statutory environmental quality standards or objectives, including the air quality objectives prescribed by the Air Quality Regulations 2000 (as amended), will also be a factor in determining whether air quality is a material consideration. It goes on to state that not all planning applications for developments inside or adjacent to AQMAs should be refused, even if the development would result in a deterioration of local air quality as such an approach would 'sterilise' development. Whilst air quality is a material consideration in the determination of planning applications, locations designated as AQMAs are not intended to cause the refusal of the development outright. Local planning authorities, transport authorities and pollution control authorities are required to explore the possibility of securing mitigation measures that would allow the proposal to proceed.

2 Assessment Methodology

2.1 *Overview*

2.1.1 The air quality assessment has involved the following key elements:

- assessment of existing air quality in the vicinity of the Application Site following a review of South Cambridgeshire District Council's (SCDC) Air Quality Review and Assessment documents and air quality data for the area;
- assessment of air quality at the Application Site using data from a three month air quality monitoring campaign that was undertaken in 2007 for a proposed open air multiuse games area (MUGA) in the north-east corner of the college site;
- semi-quantitative assessment of the effect of the construction phase in terms of the potential for dust complaints; and
- assessment of local air quality at the Application Site using the DMRB Air Quality Screening Model based on traffic data for the A14 and King Hedges Road.

2.2 *Consultation*

2.2.1 Consultation was undertaken between Stephen Pyatt (Senior Air Quality Consultant, Halcrow) and Jo Dicks (Cambridge City Council), with regards to the methodology to be adopted for the assessment. Air Quality monitoring data for 2009 was obtained from SCDC, following consultation between Paul Manktelow (Air Quality Consultant, Halcrow) and Adam Finch, (Air Quality Officer, SCDC) on 5 May 2010.

2.3 *Air Quality Impacts during Construction*

Potential Impacts

2.3.1 The construction phase of the proposed development is likely to affect local air quality through the generation and subsequent deposition of construction dust. Dust deposition on windows, properties, and cars can result in complaints through surface soiling.

2.3.2 The amount of dust generated from construction activities depends on:

- the type of materials handled;
- the length and scale of operation;
- the type of activities performed on site;

- the weather conditions; and
- the effectiveness of dust suppression measures.

Furthermore, the perception of dust from surface soiling is determined by factors such as[2]:

- the colour contrast between the dust and the surface on which it settles;
- the nature of the illumination of the surface;
- the presence of a nearby clean 'reference' surface against which comparisons can be made;
- the personal experience and expectation of the observer; and
- adverse publicity influencing the expectation of the observer.

2.3.3 The factors above mean that it is not possible to reliably predict the number of dust complaints that will occur during the construction phase of the development. It is however possible to estimate the distance from dust generating activities over which dust complaints may occur. Studies of dust impacts from quarrying, waste disposal and construction operations indicate rapid fall-off in downwind dust concentrations with increasing distance from the source due to particle dispersion and deposition. Large and heavy particles fall out closer to the source than finer and lighter particles. Particles greater than 30 μm in size tend to comprise the greatest portion of dust emitted by dust generating activities, and these particles are the most visible and therefore most likely to generate complaints. Particles of this size deposit largely within 100 m of sources, and as such, potential dust impacts on local air quality have been considered at all sensitive receptors within 100 m of proposed construction activities.

Sensitive Receptors

2.3.4 For construction dust, potentially sensitive receptors are defined as:

One or more locations where the effect of dust emissions associated with construction activities may result in complaints.

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[2] Office of the Deputy Prime Minister, 2005. Mineral Policy Statement 2: Controlling and Mitigating the Environmental Effects of Mineral Extraction in England, Annex 1: Dust.

2.4 *Air Quality Impacts during Operation*

<u>Potential Impacts</u>

2.4.1 The Application Site will introduce new receptors into an area that is considered to have poor air quality, due largely to vehicular emissions from the A14.

2.4.2 The main vehicular pollutants of concern with regards to national air quality objectives/EU limit values are NO_2 and PM_{10}. This assessment has therefore only considered these pollutants.

2.4.3 The assessment has been undertaken based on the year 2009, which can be considered worst-case in terms of air quality, as emissions and pollutant concentrations are expected to decline into future years in response to cleaner emission technologies and air quality legislation. Year 2009 predictions have been verified against monitoring data, improving the reliability of the air quality predictions. The opening year of the development is due to be 2011.

2.4.4 Total concentrations of NO_2 and PM_{10} comprise a background and local component. The background concentration is determined by regional, national and international emissions, and often represents a significant proportion of the total pollutant concentration. The local component is determined by local pollutant sources (such as roads, chimney stacks, etc…).

2.4.5 Background pollutant concentrations are spatially and temporally variable throughout the UK. Background NO_x, NO_2 and PM_{10} concentrations representative of conditions in the study area have been derived from the urban background continuous monitor at Orchard Park Primary School. The monitor is located approximately 800 m south west of the Application Site (refer to Section 3.2 for further details).

2.4.6 The local pollutant component associated with road traffic on the A14 and King Hedges Road has been predicted using the Design Manual for Roads and Bridges (DMRB) Screening Tool v1.03c (see Appendix for details of traffic data). The tool allows roadside pollutant concentrations to be calculated from the flow, speed and composition of traffic. The local component has been added to the background concentration in order to calculate total concentrations across the Application Site.

2.4.7 Nitric oxide (NO) accounts for the majority of NO_x emitted from vehicles. NO is not considered to be harmful to health but once released to the atmosphere can be rapidly oxidised to the much more harmful NO_2. NO_x associated with road traffic (estimated from DMRB Screening Tool) has been converted to an NO_2 concentration using version 2.1 of the NO_x to NO_2 calculator developed for Local Air Quality Management Technical Guidance 2009 (LAQM.TG(09)). The calculator takes into account the difference between vehicular emissions of NO_x and background NO_x, the concentration of O_3 (to oxidise NO to NO_2), and the different proportions of primary (directly emitted) NO_2 in different years.

Sensitive Receptors

2.4.8 The air quality objectives/EU limit values most relevant to this assessment are for annual mean NO_2 and annual and daily mean PM_{10}. Concentrations have been predicted along a transect on the Application Site in order to capture the maximum cumulative impact of the A14 and King Hedges Road which are located north and south of the Application site, respectively. Predicted concentrations have been compared against the relevant objectives/EU limit values.

3 Baseline Conditions

3.1 *Air Quality Review and Assessment*

3.1.1 Previous rounds of Review and Assessment undertaken by SCDC have led to the declaration of an AQMA along the area of the A14 between Bar Hill (to the west of Cambridge) and Milton (to the north east of Cambridge). The AQMA has been declared for exceedances of the annual mean objective for NO_2 and the daily objective for PM_{10}. The Application Site is located within the boundaries of the AQMA.

3.2 *Air Quality Monitoring*

3.2.1 There are two principle methods used for measuring air quality, either using passive sampling techniques such as diffusion tubes or through the use of sophisticated continuous monitoring equipment. The advantages and disadvantages of each monitoring technique are outlined in Table 2.

Table 2: Advantages and Disadvantage of Air Quality Monitoring Techniques

Method	Advantages	Disadvantages
Diffusion Tube	Inexpensive and so allow good spatial coverage Can be easily placed at building façades	Only provide long term average concentrations Inferior precision and accuracy relative to continuous methods Require laboratory analysis

Method	Advantages	Disadvantages
Continuous Monitor	Provide high resolution data Superior precision and accuracy relative to diffusion tube methods	Relatively expensive Regular calibration required Trained operator required

3.2.2 SCDC currently operate three continuous air quality monitoring stations within their district. Impington monitoring station (OS – 543739, 261625) measures NO_x, NO_2 and PM_{10}, and is situated approximately 2 km west of the Application Site. The monitor is located approximately 10 m from the A14, and is representative of roadside air quality. Annual mean NO_2 and PM_{10} concentrations measured from the station are presented in Table 3 for the years 2007, 2008 and 2009. The number of exceedances of the hourly mean threshold for NO_2 (200 μg m^{-3}) and the daily mean threshold for PM_{10} (50 μg m^{-3}) are presented in parenthesis.

Table 3. Annual Mean NO_2 and PM_{10} Concentration (μg m^{-3}) at Impington Monitoring Station

Pollutant	2007	2008	2009
NO_2	**41** (0)	35 (0)	33 (0)
PM_{10}	34 (34)	33 **(43)**	**41 (55)**

Number of exeedances of short term threshold given in parenthesis. Exceedance of air quality objective/EU limit value highlighted in bold.

3.2.3 Table 3 shows that the annual mean NO_2 concentration observed at Impington monitoring station exceeded the annual mean objective/EU limit value for NO_2 (40 μg m^{-3}) in 2007, but was below the annual mean objective/EU limit value in both 2008 and 2009. No exceedances of the 1 hour mean threshold for NO_2 (200 μg m^{-3}, only to be exceeded 18 times per annum) were observed in 2007, 2008 and 2009. Annual mean PM_{10} concentrations at the station were below the annual mean objective/EU limit value for PM_{10} in 2007 and 2008, but an exceedance of the annual mean objective/EU limit value was observed in 2009. The daily objective for PM_{10} (50 μg m^{-3} only to be exceeded 35 times per year) was exceeded at the monitor in 2008 and 2009.

3.2.4 Orchard Park Primary School monitoring station (OS - 544558, 261579) is located approximately 1 km south-west of the Application Site, and was commissioned in April 2009. The monitor is representative of urban background air quality and measures NO_x, NO_2 and PM_{10}. The mean NO_x, NO_2 and PM_{10} concentration measured from the station in 2009 is presented in Table 4. The number of exceedances of the hourly mean threshold for NO_2 (200 µg m^{-3}) and the daily mean threshold for PM_{10} (50 µg m^{-3}) are presented in parenthesis.

Table 4. Annual Mean NO_x, NO_2 and PM_{10} Concentration (µg m^{-3}) at Orchard Park Monitoring Station

Pollutant	2009
NO_x	33
NO_2	20 (0)
PM_{10}	16 (0)

Number of exceedances of short term threshold given in parenthesis. Exceedance of air quality objective/EU limit value highlighted in bold.

3.2.5 Table 4 shows that mean NO_2 and PM_{10} concentrations observed at Orchard Park Primary School monitoring station were below annual mean objective/EU limit values in 2009. Furthermore, no exceedances of the short term objective were observed for either pollutant.

3.2.6 SCDC also operate a continuous monitoring station at Bar Hill, but the site is located over 7 km northwest of the Application Site, and is unlikely to be representative of air quality at Application Site receptors.

3.2.7 In addition to continuous monitoring, SCDC measure NO_2 across the district from a network of twenty five passive diffusion tubes. Three diffusion tube monitoring sites are likely to be broadly representative of air quality at the Application Site. Triplicate tubes are co-located with the urban background continuous monitor at Orchard Park Primary School. NO_2 is also monitored from two sites in Arbury Park, approximately 1 km west of the Application Site, and approximately 90 m from the A14. Both tubes are located between the same junctions of the A14 as the Application Site and should therefore be influenced by the same traffic flows and road traffic emissions. NO_2 monitoring commenced at Orchard Park and Arbury Park diffusion tube sites at the end of July, 2008.

Average 2008 (July to December) and 2009 annual mean NO_2 concentrations measured by the tubes are presented in Table 5. NO_2 concentrations have been bias adjusted by SCDC using a bias adjustment factor of 0.8 in both years[3].

Table 5. Bias Adjusted Annual Mean NO_2 Concentrations ($\mu g\ m^{-3}$) Observed from Diffusion Tube Monitoring.

Location	OS Grid Ref	2008	2009
Chieftain Way, Arbury Park	544828, 261738	30.3	24.6
Topper Street, Arbury Park	545056, 261784	28.9	26.0
Orchard Park School	544557, 261571	23.4	22.9
Orchard Park School	544557, 261571	24.5	22.5
Orchard Park School	544557, 261571	25.0	23.6

Exceedances of air quality objectives highlighted in bold. Year 2008 mean concentration based on period August – December only.

3.2.8 Table 5 shows that year 2009 annual mean NO_2 concentrations were below the annual mean objective/EU limit value for NO_2 at diffusion tube monitoring sites within the vicinity of the Application Site. Period mean NO_2 concentrations were also below the annual mean objective/EU limit value for NO_2 in 2008, and are likely to have been below the objective if monitoring had been undertaken for the full year.

3.2.9 Halcrow Group Ltd undertook diffusion tube monitoring from the Cambridge Regional College site over a three month period (24 May to 16 August) in 2007[4]. The monitoring study was undertaken as part of a proposal for an open air multiple use games area (MUGA) on the college site. Four diffusion tubes were placed around the MUGA site (14 to 47 m from A14) and three were co-located with the continuous monitor at Impington in-order to derive a bias adjustment factor. Year 2007 annual average concentrations were estimated from the three month bias adjusted period mean, by applying the average ratio of

[3] 2008 adjustment based on average national factor, 2009 based on collocation study undertaken by SCDC.

[4] Halcrow Group Ltd, 2007. Cambridge Regional College, College Consolidation, Science Park Campus, Air Quality Addendum.

the period to annual mean concentration derived from continuous monitoring stations at Impington and Bar Hill. Bias adjusted period mean and estimated annual mean NO_2 concentrations measured from the diffusion tubes at the Cambridge Regional College site are presented in Table 6.

Table 6. Bias Adjusted Period Mean and Estimated Annual Mean NO_2 Concentrations ($\mu g.m^{-3}$) Observed from Diffusion Tube Monitoring on Cambridge Regional College Site in 2007

Monitoring Site	Approx Distance from A14 (m)	2007 Period Mean	2007 Annual Mean
CRC 1	14	32.7	32.0
CRC 2	29	31.8	31.1
CRC 3	42	27.3	26.7
CRC 4	47	27.4	26.8

Period Mean is average from 3 months of monitoring (24 May to 16 August 2007)

3.2.10 Table 6 shows that year 2007 period and estimated annual mean NO_2 concentrations were below the annual mean objective/EU limit value for NO_2 at diffusion tube monitoring sites across the MUGA site.

4 Impacts during Construction

4.1.1 The construction phase of the development has the potential to generate dust, which may deposit on property and cars causing soiling and discolouration and can result in complaints through amenity loss or perceived damage.

4.1.2 It is not possible to predict the amount of dust generated during construction (Section 2.3), and so the impact magnitude and significance of construction activities cannot be quantified. It should be noted however; that the construction phase of the development has the potential to result in complaints at all receptors located within 100 m of construction activities. Adverse air quality impacts during construction are however likely to be short-term and with the application of dust mitigation measures to ensure that Best Practical Means are being employed (Section 6.1), the significance of the impacts are predicted to be ***slight adverse***.

5 Impacts during Operation

5.1 *Model Verification*

5.1.1 Before undertaking a rigorous air quality assessment at the Application Site, it is important to verify modelled concentrations against air quality monitoring data. This process involves a comparison between predicted and measured road traffic contributions to pollutant concentrations.

5.1.2 Predicted road-traffic NO_x concentrations have been verified against year 2009 annual mean observations from the two diffusion tubes located in Arbury Park (~1 km west of Application Site, and ~90 m from A14). Both of these tubes are located between the same junctions of the A14 as the Application Site, and are therefore influenced by the same flow of traffic. Because diffusion tubes only measure total NO_2, the road-traffic NO_x concentration measured by each tube was estimated following the methodology outlined in Box A3.6 of LAQM.TG09. The year 2009 annual mean background NO_2 concentration measured from the continuous monitor at Orchard Park was subtracted from the total NO_2 concentration measured, and the road-traffic NO_2 component was converted to NO_x using version 2.1 of the NO_x to NO_2 calculator developed for LAQM.TG(09).

5.1.3 Table 7 shows the predicted and measured road-traffic NO_x concentration at each diffusion tube monitoring site. Road-traffic NO_x concentrations are under-predicted at each site, and an average adjustment factor of 1.54 was calculated from the results (i.e. observed NO_x is on average 54% higher than modelled NO_x). Modelled road NO_x and PM_{10} values have subsequently been increased by 54%.

Table 7. Year 2009 Observed and Modelled Annual Mean Road Traffic NO_x ($\mu g\ m^{-3}$) at Diffusion Tube Sites

Diffusion Tube Site	Observed Road NO_x	Modelled Road NO_x	Observed/ Modelled
Chieftain Way, Arbury Park	10.2	7.0	1.45
Topper Street, Arbury Park	13.5	8.3	1.62
		Average Bias	1.54

5.2 *Local Air Quality at Application Site*

5.2.1 Air quality at the Application Site will be influenced by vehicular emissions associated with road traffic on the A14 and King Hedges Road, which are located approximately 117 m north and 7 m south of the Application Site, respectively.

5.2.2 Total annual mean NO_2 and PM_{10} concentrations have been predicted along two transects, the first from the closest point of the site to the A14 (117 m), extending towards King Hedges Road, and the second, from the closest point of the site to King Hedges Road (7 m), extending towards the A14. Both transects should capture the maximum cumulative impact of traffic pollutants emanating from both roads. Table 8 shows the annual mean concentrations predicted along each transect. The results are based on the year 2009, which can be considered worst-case in terms of air pollutant concentrations at the Application Site, since concentrations are expected to decline into future years in response to cleaner emission technologies and air quality legislation.

Table 8. Total Annual Mean NO_2 and PM_{10} concentrations ($\mu g\ m^{-3}$) Predicted across the Application Site

Transect 1 (from A14 towards King Hedges Road)			
Distance A14 (m)	**Distance KHR (m)**	**NO_2**	**PM_{10}**
117	100	23.9	17.0
122	95	23.6	16.9
127	90	23.4	16.8
Transect 2 (from King Hedges Road towards A14)			
Distance A14 (m)	**Distance KHR (m)**	**NO_2**	**PM_{10}**
210	7	24.9	18.0

205	13	24.3	17.8
200	18	23.9	17.6

Distances are from road centreline

5.2.3 Maximum pollutant concentrations along Transect 1 are predicted at the closest point to the A14, and are 23.9 and 17.0 µg m^{-3} for NO_2 and PM_{10}, respectively. Concentrations decrease with increasing distance from the A14 (decreasing distance from King Hedges Road), suggesting that across the northern extent of the Application Site, the influence of the A14 is greater than the influence of King Hedges Road. This also suggests that the worst case cumulative impact of both roads has been captured across the northern extent of the site.

5.2.4 Maximum pollutant concentrations along Transect 2 are predicted at the closest point to King Hedges Road and are 24.9 and 18.0 µg m^{-3} for NO_2 and PM_{10}, respectively. Concentrations decrease with increasing distance from Kings Hedges Road (decreasing distance from the A14), suggesting that across the southern extent of the Application Site, the influence of King Hedges Road is greater than the influence of the A14. This also suggests that the worst case cumulative impact of both roads has been captured across the southern extent of the site.

5.2.5 Taking the results predicted along both transects into account, it can be concluded that annual mean NO_2 and PM_{10} concentrations are currently well below annual mean objective/EU limit values across the entire Application Site.

5.2.6 A maximum of one exceedance of the daily PM_{10} threshold is predicted along both transects (not shown), which well below the 35 exceedances permitted throughout the year. Furthermore, an analysis of the relationship between 1-hour and annual mean NO_2 concentrations at roadside sites concluded that there is unlikely to be an exceedance of the 1-hour NO_2 objective when the annual mean is less than 60 µg m^{-3} (LAQM.TG09). Based on this analysis it is unlikely that the 1-hour NO_2 objective (200 µg m^{-3}) is being exceeded across the Application Site.

5.2.7 Monitoring data also suggests that annual mean NO_2 concentrations are likely to be well below annual mean air quality objective/EU limit values across the Application Site. The two diffusion tubes at Arbury Park (Section 3.2) are located between the same junctions of the A14 as the Application Site and should therefore be influenced by the same vehicular emissions. Both tubes are located approximately 100 m from the centreline of the A14, and are therefore around 20m closer to carriageway than the Application Site. Table 5 shows that the annual mean NO_2 concentration observed from these tubes in 2009 was 24.6 and

26 μg m^{-3} at Chieftain Way and Topper Street, respectively. The concentrations observed were therefore well below annual mean air quality objective/EU limit values.

5.2.8 Diffusion tubes used to monitor NO_2 across the Cambridge Regional College Site in 2007 (Section 3.2) measured a maximum average three month concentration of 32.7 μg m^{-3} (annual mean NO_2 concentration of 32 μg m^{-3} estimated from the max period mean) at a distance of only 14 m from the A14. These results are further evidence that annual mean NO_2 concentrations are likely to be well below air quality objective/EU limit values at the Application Site.

6 Mitigation Measures

6.1 *During Construction*

6.1.1 In order to mitigate against the potential for construction dust emissions to atmosphere, Best Practicable Means (BPM) should be adopted. These measures are likely to include techniques such as:

- all plant and equipment to be maintained in accordance with appropriate legislation or manufacturers recommendations to ensure emissions to atmosphere are minimised;
- engines of plant and machinery and lorries to be turned off at all times when not in use;
- no burning of material to take place on site;
- ensure adequate water supply on site;
- ensure run-off water from dust suppression activities is disposed of in accordance with appropriate legal requirement;
- wheel washing at the exits from construction areas where there is a potential for dust and mud to be carried on to the highway;
- regular visual monitoring of construction activities to identify any significant dust sources;
- location of potentially significant dust sources away from construction site boundaries wherever possible;
- water suppression in dry conditions to reduce dust emissions (use mobile bowsers or fixed sprayers as appropriate);

- a speed limit applied to all construction vehicles working on the construction site;
- minimising heights for any stockpiles and tipping operations;
- avoid double handling of excavated material wherever practicable;
- seal or re-vegetate completed earthworks as soon as reasonably practicable after completion;
- use of solid hoardings around the site boundary and dust generating activities;
- sheeting of loads during transport of dusty/friable material; and
- ensure deliveries of bulk cement and other similar powder materials are in enclosed tankers and stored in suitable silos with emission control systems to prevent escape of material and overfilling during delivery.

6.1.2 Where construction activities are close to potentially sensitive receptors, additional dust control procedures should be adopted as appropriate. These may include:

- avoiding earthworks during dry weather or provision of additional suppression equipment to control dust;
- ensure mixing of cement, grout and other similar materials takes place in locations remote from sensitive receptors or is totally enclosed; and
- use increased hording heights around sensitive receptors.

6.1.3 With the adoption of BPM as specified above, the impacts of dust from the construction phase are predicted to be ***temporary***, of ***slight adverse*** significance with ***no long term adverse impacts***.

6.2 *During Operation*

6.2.1 NO_2 and PM_{10} concentrations are predicted to be well below air quality objective/EU limit values at the Application Site, and therefore no mitigation measures are recommended for local air quality.

7 Summary

7.1.1 Certain activities in the site clearance and construction period are likely to result in dust which has the potential to cause complaints at nearby properties if unmitigated. However, with the adoption of Best Practical Means (BPM) complaints should be avoidable; the impacts of dust from the construction phase are predicted to be temporary, of ***slight adverse*** significance with no residual adverse impacts.

7.1.2 Air quality at the Application Site is influenced by vehicular emissions from road traffic on the A14 and King Hedges Road. Concentrations of nitrogen dioxide (NO_2) and particulate matter smaller than 10 microns in diameter (PM_{10}) have been predicted across the Application Site using the Design Manual for Roads and Bridges Screening Tool (v1.03c), taking into account vehicular emissions associated with both roads. Total NO_2 and PM_{10} concentrations are predicted to be well below air quality objective/EU limit values across the Application Site. Annual mean NO_2 concentrations measured from diffusion tubes within 100 m of the A14 are also well below annual mean objective/EU limit values, supporting the conclusions of the modelling study.

8 Appendix

8.1 *Traffic Data*

8.1.1 Traffic data for the A14 has been derived from the Department for Transport (www.dft.gov.uk/matrix). Traffic counter observations of the Annual Average Daily Traffic (AADT) flow and proportion of Heavy Goods Vehicles (HGVs) on the A14 are available for 2008. A traffic growth factor of 1% has been used to grow year 2008 flows to year 2009 based on Trip End Model Presentation Program (TEMPRO) data[5]. Year 2009 peak hourly flows were used to derive AADT flows on King Hedges Road[5]. Traffic speeds were not available for either road. Traffic speeds were assumed to be equal to the national speed limit. The traffic data used for the air quality modelling predictions at the Application Site is shown in Table A.1.

Table A.1. Year 2009 Traffic Data for A14 and King Hedges Road

Road	AADT	% HGV	Speed (kph)
A14	61947	13	113
King Hedges Road	13770	1.6	48

[5] Provided by Alex Silver (Transport Consultant, Mayer Brown Limited) following email correspondence with Stephen Pyatt (Senior Air Quality Consultant, Halcrow) on 11.05.2010.