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ENERGY AND CLIMATE CHANGE
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MINING, QUARRYING AND MINERAL ESTATES
WASTE RESOURCE MANAGEMENT

CHINA TOWN DEVELOPMENT COMPANY LIMITED

NEW CHINATOWN, LIVERPOOL

AIR QUALITY ASSESSMENT

August 2015

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CHINA TOWN DEVELOPMENT COMPANY LIMITED

NEW CHINA TOWN, LIVERPOOL

AIR QUALITY ASSESSMENT

August 2015

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DRAWINGS

1 INTRODUCTION

1.1.1 Wardell Armstrong LLP was instructed by China Town Development Company Limited to undertake an Air Quality Assessment for a 1.84 hectare area of land on the west side of Great George Street, Liverpool (centred on NGR SJ 3514 8940).

1.1.2 The proposals entail the submission of a hybrid planning application of three phases:

- Phase 1 is subject to a detailed application and promotes the erection of a 6 storey mixed use building comprising 6 townhouses (Class C3), 117 apartments (Class C3), private gardens/terraces, Class D2 public 'event lab' (157 sqm GEA), 259 sqm of mixed commercial space in 7 units within any combination of Use Class A1, A2, A3, A4, A5, B1, D1 or D2, 72 car parking spaces at lower ground level accessed via Hardy Street, cycle parking, plant and bin stores, means of enclosure, and hard and soft landscaping.

- Phases 2 and 3 are subject to an outline application, with all matters reserved with the exceptions of landscaping and access. These two phases promote the erection of 9 buildings (siting, massing and height fixed) comprising 675 apartments, and 10,361 sqm (111,528 sqft) of mixed commercial space within any combination of Use Class A1, A2, A3, A4, A5, B1, C1 (132 bedroom hotel with ancillary restaurant and gymnasium), D1 or D2, alterations to railway ventilation shaft (involving reduction in walls and re-capping), private open space/public realm/gardens/terraces, 891 subterranean car parking spaces accessed via both St. James Street and Upper Pitt Street, cycle parking, plant and bin stores, means of enclosure, and hard and soft landscaping.

1.1.3 The site currently comprises open brownfield land. To the north, the site is bordered by Hardy Street, with existing residential dwellings beyond. To the east, the site is bordered by the A5038 Great George Street with existing residential dwellings and Liverpool Anglican Cathedral beyond. To the south the site is bordered by Upper Frederick Street with existing residential dwellings beyond. To the west the site is bordered by residential dwellings on a number of roads. The location of the site is shown on drawing number ST14813-004.

1.1.4 This report details the results of the air quality assessment undertaken in support of a hybrid planning application for the proposed development. The report discusses the potential air quality impacts of the additional road traffic generated by the proposed development. Air pollutant concentrations are considered at existing sensitive

receptor locations in the vicinity of the proposed development, and also at proposed receptor locations within the site.

2 PLANNING POLICY CONTEXT

2.1 Air Quality Legislation

2.1.1 The UK National Air Quality Strategy (NAQS) was published in March 1997 fulfilling the requirement under the Environment Act 1995 for a national air quality strategy setting out policies for the management of ambient air quality. The Strategy sets objectives for eight pollutants, which may potentially occur in the UK at levels that give cause for concern. These pollutants are: nitrogen dioxide (NO_2), sulphur dioxide, carbon monoxide, lead, fine particulates (PM_{10}), benzene, 1, 3–butadiene and ozone.

2.1.2 The Strategy was reviewed and a Review Report[1] and Consultation Document[2] were published by the Department of the Environment, Transport and the Regions in 1999. A revised version (The Air Quality Strategy (AQS) 2000), which supersedes the 1997 Strategy, was published in January 2000. The AQS 2000 strengthens the objectives for a number of pollutants with the exception of that for particulates, which was replaced with the less stringent EU limit value.

2.1.3 The objectives for the eight pollutants in the Strategy provide the basis of the implementation of Part IV of the Environment Act 1995. The Air Quality Strategy objectives for each pollutant, except ozone, were given statutory status in the Air Quality (England and Wales) Regulations, 2000[3] and Air Quality (England) (Amendment) Regulations 2002[4] ('the Regulations').

2.1.4 In 2007 the Air Quality Strategy was revised. This latest strategy[5] does not remove any of the objectives set out in the previous strategy or its addendum, apart from replacing the provisional 2010 objective for PM_{10} in England, Wales and Northern Ireland with the exposure reduction approach for $PM_{2.5}$. The UK Government and the Devolved Administrations have now therefore set new national air quality objectives for particulate matter smaller than 2.5µm diameter ($PM_{2.5}$).

[1] Department of the Environment, Transport and the Regions, January 1999. Report on the Review of the National Air Quality Strategy, Proposals to amend the Strategy.
[2] Department of the Environment, Transport and the Regions 1999, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. A consultation document.
[3] The Air Quality (England) Regulations 2000. SI No 928.
[4] The Air Quality (Amendment) Regulations 2002.
[5] Department of Environment, Food and Rural Affairs, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007.

2.1.5 EU Directive 2008/50/EC[6] came into force in June 2008 and was transposed into legislation in England on 11th June 2010 as 'The Air Quality Standards Regulations 2010'[7]. This EU Directive consolidates existing air quality legislation and provides a new regulatory framework for $PM_{2.5}$.

2.1.6 The current Air Quality Standards and Objectives, as set out in the Air Quality Standards Regulations 2010, are detailed in Table 1.

Table 1: Air Quality (England and Wales) Regulations 2010. Summary of Current Air Quality Standards and Objectives

Pollutant	**Averaging Period**	**Limit Value**
Sulphur Dioxide	1 hour	350µg/m^3 not to be exceeded more than 24 times a calendar year
	24 hour mean	125µg/m^3 not to be exceeded more than 3 times a calendar year
Nitrogen Dioxide	1 hour	200µg/m^3 not to be exceeded more than 18 times a calendar year
	Calendar year	40µg/m^3
Benzene	Calendar year	5µg/m^3
Lead	Calendar year	0.5µg/m^3
PM_{10}	24 hour mean	50µg/m^3 not to be exceeded more than 35 times a calendar year
	Calendar year	40µg/m^3
$PM_{2.5}$	Calendar year	25µg/m^3 to be met by 1st January 2015
Carbon Monoxide	Maximum 8 hour daily mean	10mg/m^3
Pollutant	**Target Value for the total content in the PM_{10} fraction averaged over a calendar year**	**Date by which target value should be met**
Arsenic	6ng/m^3	31st December 2012
Cadmium	5ng/m^3	31st December 2012
Nickel	20ng/m^3	31st December 2012
Benzo(a)pyrene	1ng/m^3	31st December 2012

[6] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on Ambient Air Quality and Cleaner Air for Europe.
[7] Statutory Instruments 2010 No. 1001 The Air Quality Standards Regulations 2010.

2.1.7 Examples of where the Air Quality Objectives should/should not apply are included in Table 2. This table is taken from Local Air Quality Management Technical Guidance document LAQM.TG (09)[8].

Table 2: Examples of Where the Air Quality Objectives Should/Should Not Apply

Averaging Period	Objectives Should Apply at:	Objectives Should Generally Not Apply at:
Annual Mean	All background locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries, etc.	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites or any other location where public exposure is expected to be short term.
24 hour (daily) mean 8 hour mean	All locations where the annual mean objectives would apply together with Hotels. Gardens of residential properties[1]	Kerbside sites, or any other location where public exposure is expected to be short term.
1 hour mean	All locations where the annual mean and 24 and 8-hour objectives apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks and railway stations etc. which are not fully enclosed where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations to which the public might reasonably be expected to spend one hour or longer.	Kerbside sites where public would not be expected to have regular access.
15 min mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.	

[1]: Such locations should represent parts of the garden where relevant public exposure is likely, for example where there is seating or play areas. It is unlikely that relevant public exposure would occur at the extremities of the garden boundary, or in front gardens although local judgement should always be applied.

2.2 Local Air Quality Management Guidance

2.2.1 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, July 2007, establishes the framework for air quality improvements based on measures agreed at a national and international level.

[8] Part IV of the Environment Act 1995: Local Air Quality Management Technical Guidance 2009.

2.2.2 However, despite these measures, it is recognised that areas of poor air quality will remain and these should be dealt with through the Local Air Quality Management (LAQM) process using locally implemented measures.

2.2.3 LAQM legislation in the Environment Act 1995 requires local authorities to conduct periodic review and assessments of air quality. These aim to identify all those areas where the air quality objectives are being, or are likely to be, exceeded.

2.2.4 All authorities were required to undertake the first stage of review and assessment which concluded in September 2001. In those areas identified as having the potential to experience elevated levels of pollutants the authority was required to undertake a more detailed second stage review comprising two steps; Updating and Screening Assessments (USA) and Detailed Assessments. Where it was predicted that one or more of the air quality objectives would be unlikely to be met by the end of 2005, local authorities were required to proceed to a third stage and, if necessary, declare Air Quality Management Areas (AQMAs) and make action plans for improvements in air quality, in pursuit of the national air quality objectives.

2.2.5 In 2007 an Evaluation Report was commissioned by the UK Government and Devolved Administrations. Following this review revised LAQM Technical Guidance was published in February 2009 comprising LAQM.TG(09). This revised guidance draws together previous guidance and the recommendations of the 2007 Evaluation Report. LAQM.TG(09) maintains the phased approach to review and assessment established in previous technical guidance. The intention is that local authorities should only undertake a level of assessment that is commensurate with the risk of an air quality objective being exceeded.

2.2.6 Where a Detailed Assessment indicates that any of the air quality objectives are likely to be exceeded, an AQMA must be designated, or the geographical boundaries of an existing AQMA must be modified. An AQMA should only be declared if a Detailed Assessment has been undertaken.

2.2.7 Once an AQMA has been declared the local authority is required to undertake a Further Assessment within 12 months of the declaration.

2.2.8 A rolling programme of Updating and Screening Assessment and Detailed Assessment based on a three-year cycle has been laid down by Defra in its LAQM.TG(09) policy guidance. This is supplemented by Progress Reports which are intended to maintain continuity in the LAQM process between the three-yearly cycle of Review and Assessment. Progress Reports are required in the years when the authority is not completing an Updating and Screening Assessment.

2.3 National Planning Policy

2.3.1 The National Planning Policy Framework[9], introduced in March 2012, requires that planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of AQMAs and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in AQMAs is consistent with the local air quality action plan.

2.3.2 The Planning Practice Guidance[10], updated in March 2014, states that whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impacts in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife).

2.3.3 Where a proposed development is anticipated to give rise to concerns about air quality an appropriate assessment needs to be carried out. Where the assessment concludes that the proposed development (including mitigation) will not lead to an unacceptable risk from air pollution, prevent sustained compliance with national objectives or fail to comply with the requirements of the Habitats Regulations, then the local authority should proceed to decision with appropriate planning conditions and/or obligations.

[9] Department for Communities and Local Government. National Planning Policy Framework, March 2012

[10] Department for Communities and Local Government. Planning Practice Guidance: Air Quality, March 2014

2.4 Liverpool City Council – Local Air Quality Management Review and Assessment

2.4.1 Liverpool City Council (LCC) declared two AQMAs following the first round of review and assessment: in Liverpool city centre and at the Rocket junction at the end of the M62. Following extensive monitoring at a number of locations, which indicated exceedances of the annual mean NO_2 objective, the entire city area was declared as an AQMA in May 2008.

2.4.2 The 2014 progress report, the most recent air quality report available from LCC, considers monitoring data collected since the previous year's progress report. The progress report concluded that, in 2013, the annual mean NO_2 objective was exceeded at 90% of the monitoring locations within the city.

2.4.3 LCC is responsible for undertaking air quality monitoring within the city area. There are currently four automatic monitoring locations in operation, including an urban background continuous analyser at Speke. In addition, there are approximately 70 diffusion tubes in operation, including those which have been co-located.

2.4.4 The proposed development is located within the existing city wide AQMA. There are no representative background monitoring locations in the vicinity of the proposed development site. There is however an NO_2 urban roadside diffusion tube monitoring location within the study area and therefore, verification of the air quality assessment can be undertaken.

2.4.5 There are two diffusion tubes located within the study area. One on Berry Street (LCC Ref: B42) outside St Lukes Church pedestrian crossing and another on the corner of Renshaw Street/Bold Street (LCC Ref: B43). In 2013, the bias adjusted annual average NO_2 concentration was 53µg/m^3 and 67µg/m^3 respectively.

3 ASSESSMENT METHODOLOGY

3.1 Consultation and Scope of Assessment

3.1.1 A proposed methodology was presented to Mr Paul Farrell, Principal Officer at LCC on the 3rd July 2015. The following points were put forward, and were agreed by Mr Farrell on the 9th July 2015:

- A construction phase dust assessment will be undertaken in accordance with Institute of Air Quality Management (IAQM) guidance;
- A detailed air quality assessment will also be undertaken, using the air dispersion model ADMS-Roads, to consider the potential air quality impacts during the operational phase of the proposed development;
- 2013 meteorological data will be obtained from the Liverpool Airport meteorological recording station, which is the closest station and is considered to be the most representative of conditions at the proposed development;
- There are no representative NO_2 or PM_{10} background monitoring locations in the vicinity of the proposed development and therefore background concentrations will be obtained for the appropriate grid square(s) from the 2011-based Defra default concentration maps; and
- The roadside NO_2 diffusion tube located on the Renshaw Street/Bold Street Corner (LCC Ref: B43) will be used for verification of the ADMS model.

3.2 Construction Phase Assessment – Dust Emissions

3.2.1 To assess the impacts associated with dust and PM_{10} releases, during the construction phase of the development, an assessment has been undertaken in accordance with IAQM guidance[11].

[11] Guidance on the Assessment of Dust from Demolition and Construction', February 2014

Step 1

3.2.2 Step 1 of the assessment is to screen the requirement for a more detailed assessment. The guidance states that an assessment will normally be required where there are existing human sensitive receptors within 350m of the site boundary and/or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

3.2.3 With regards to ecological receptors, the guidance states that an assessment will normally be required where there are existing ecological receptors within 50m of the site boundary and/or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

3.2.4 Where there are existing sensitive receptors locations within 350m of the site boundary, it is necessary to proceed to Step 2 of the assessment.

Step 2

3.2.5 Step 2 of the assessment determines the potential risk of dust and PM_{10} arising in sufficient quantities to cause annoyance and/or health and/or ecological impacts. The risk is related to:

- The activities being undertaken (demolition, number of vehicles and plant etc);
- The duration of these activities;
- The size of the site;
- The meteorological conditions (wind speed, direction and rainfall);
- The proximity of receptors to the activity;
- The adequacy of the mitigation measures applied to reduce or eliminate dust; and
- The sensitivity of receptors to dust.

3.2.6 The risk of dust and PM_{10} effects is determined using four risk categories: negligible, low, medium and high risk. A site is allocated to a risk category based upon two factors:

- **Step 2A** – the scale and nature of the works which determines the potential dust emission magnitude as small, medium or large; and
- **Step 2B** – the sensitivity of the area to dust impacts which is defined as low, medium or high sensitivity.

3.2.7 These two factors are combined in **Step 2C** to determine the risk of dust impacts with no mitigation applied.

3.2.8 The risk of dust effects is determined for four types of construction phase activities, with each activity being considered separately. If a construction phase activity is not taking place on the site, then it does not need to be assessed. The four types of activities to be considered are:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

Step 3

3.2.9 Step 3 of the assessment determines the site-specific mitigation required for each of the activities, based on the risk determined in Step 2. Mitigation measures are detailed in guidance published by the Greater London Authority[12], recommended for use outside the capital by LAQM guidance and the IAQM guidance document itself. If the risk is classed as negligible, no mitigation measures beyond those required by legislation will be necessary.

Step 4

3.2.10 Step 4 assesses the residual effect, with mitigation measures in place, to determine whether or not these are significant.

Existing Sensitive Receptors – Human Receptors

3.2.11 The closest sensitive receptor locations to the proposed development are residential in nature, and are detailed in Table 3.

Table 3: Existing Dust Sensitive Receptors – Human Receptors

Receptor	Direction from the Site	Approximate Distance from the Site Boundary
Existing residential properties on Hardy Street	North	17.5m at the closest point (i.e. 12 Hardy Street)
Existing residential properties on Greenville Street South	West	19.8m at the closest point (i.e. 30 Greenville Street South)
Existing residential properties on Duncan Street	South West	13m at the closest point (i.e. Frank Carrol Court, Duncan Street)

[12] Greater London Authority (2006) The Control of Dust and Emissions from Construction and Demolition: Best Practice Guidance

Table 3: Existing Dust Sensitive Receptors – Human Receptors		
Receptor	**Direction from the Site**	**Approximate Distance from the Site Boundary**
Existing residential properties on Alfred Mews	East	35.5m at the closest point (i.e. 21 Alfred Mews)

Existing Sensitive Receptors – Ecological Receptors

3.2.12 There are no designated statutory or non-statutory ecological receptors located within 50m of the site boundary and/or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s). Therefore it is not necessary to consider them in this assessment.

3.3 Operational Phase Assessment – Road Traffic Emissions

Modelling of Road Traffic Emissions

3.3.1 The air dispersion model ADMS-Roads (CERC, Version 3.4) has been used to assess the potential impact of development generated traffic on air quality at existing receptor locations. The air dispersion model has been used to predict nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) concentrations, as these are the pollutants considered most likely to exceed the air quality objectives.

3.3.2 Air dispersion modelling has been carried out to estimate pollutant concentrations, due to road traffic emissions, for two assessment years as follows:

- The verification and base year (2013): This is the most recent year for which traffic flow information, local monitored pollution data and meteorological data are available; and
- An opening/future year of the development (2020): This is the year in which the development will be completed and is considered both without the development and with the development in place.

Road Traffic Data

3.3.3 The ADMS-Roads model requires the input of detailed road traffic flow information for those routes which will be affected by the proposed development. The traffic flow information used in the assessment is included in Appendix A.

3.3.4 Detailed traffic flow information, for use in the ADMS-Roads air dispersion model, has been provided by DTPC UK LLP, the appointed transport consultant for the project.

3.3.5 Traffic flow information has been provided by the transport consultant as 24 hour Annual Average Daily Traffic (AADT) flows, with HGV percentages, for the following links:

- St James Place;
- Upper Parliament Street;
- Parliament Street;
- Great George Place;
- Great George Street;
- St James Street;
- Duke Street;
- Upper Duke Street;
- Leece Street; and
- Renshaw Street.

3.3.6 Air quality modelling has been carried out to predict pollutant concentrations, due to road traffic emissions, for a total of three scenarios:

- Scenario 1: 2013 Verification and Base Year;
- Scenario 2: 2020 Opening/Future Year (Without Development); and
- Scenario 3: 2020 Opening/Future Year (With Development).

Meteorological Data

3.3.7 The meteorological data used in the air quality modelling has been obtained from ADM Limited. Meteorological data has been obtained for 2013 from the Liverpool Airport recording station. This is located approximately 9.8km from the proposed development and is considered to be the most representative of the conditions at the proposed development, due to its relative location and similar altitude.

3.3.8 The meteorological data provides hourly wind speed and direction information. The 2013 wind rose for the Liverpool Airport meteorological recording station is included in Appendix B.

Existing Sensitive Receptor Locations

3.3.9 Fourteen representative existing sensitive receptor locations (identified as ESR 1 to ESR 14) have been considered in the air quality assessment. These are residential in nature and have been selected as they are locations at which the annual mean air quality objectives apply.

3.3.10 Details of these are given in Table 4, and their locations are shown on drawing ST14813-004.

Table 4: Existing Sensitive Receptor Locations

Receptor	Address	Grid Reference		Receptor Type
		Easting	Northing	
ESR 1	80 Parliament Street	335150	389063	Residential
ESR 2	18 Pine Mews	335225	389133	Residential
ESR 3	4 Prince Albert	335054	389268	Residential
ESR 4	23 Alfred Mews	335210	389296	Residential
ESR 5	5 Arch View Crescent	335199	389606	Residential
ESR 6	26 Arch View Crescent	335221	389650	Residential
ESR 7	1a Kingham House	335189	389690	1st Floor Residential
ESR 8	2 Leece Street	335250	389930	1st Floor Residential
ESR 9	8 Berry Street	335206	389852	1st Floor Residential
ESR 10	60 Berry Street	335168	389703	1st Floor Residential
ESR 11	16 Dean, Cathedral Gate	335203	389364	Residential
ESR 12	20 Chung Hok House	335210	389207	Residential
ESR 13	4f Anglican Court	335310	389091	Residential
ESR 14	1 Blair Street	335378	389111	Residential

Proposed Sensitive Receptor Locations

3.3.11 Three proposed sensitive receptor locations have been selected along the site boundary to represent the proposed residential areas closest to Great George Street.

3.3.12 Pollutant concentrations at the proposed receptor locations have been predicted for scenario 3 (as detailed in paragraph 3.4.7). It is only necessary to consider the 'with development' scenario for the proposed receptor locations as they will not experience any 'without development' conditions. It is not therefore necessary to consider the changes in pollutant concentrations at the proposed receptor location.

3.3.13 Details of the proposed sensitive receptor locations are provided in Table 5, and the locations are shown on drawing ST14813-004.

Table 5: Proposed Sensitive Receptor Locations

Receptor Point	Location	Grid Reference	
		Easting	Northing
PR 1	Proposed residential receptor to the south of the site.	335171	389241
PR 2	Proposed residential receptor in the centre of the site.	335170	389393
PR 3	Proposed residential receptor to the north of the site.	335171	389532

Model Verification

3.3.14 Defra Local Air Quality Management Technical Guidance, 2009, (LAQM.TG(09)) recognises that model validation generally refers to detailed studies that have been carried out by the model supplier or a regulatory agency. The ADMS-Roads model has been validated by the supplier CERC.

3.3.15 Model verification is used to check the performance of the model at a local level. The verification of the ADMS-Roads model is achieved by modelling concentrations at existing monitoring locations in the vicinity of the proposed development and comparing the modelled concentrations with the measured concentrations.

3.3.1 As there is currently no roadside continuous analyser in operation along the roads for which traffic flow information is available, bias-adjusted monitoring data from two urban roadside diffusion tube locations on Renshaw Street/Bold Street corner and Berry Street outside St Luke's Church pedestrian crossing have been used.

3.3.2 There are no PM_{10} monitoring locations along roads for which traffic data is available and therefore adjustment of modelled PM_{10} concentrations has not been possible.

3.3.3 NO_2 measurement data, from 2013, has been used for the purposes of verification, as this is the most recent year for which bias-adjusted data is available. The monitoring data that has been used in the model verification procedure is detailed in Table 6.

Table 6: NO_2 Diffusion Tube Data for 2013 Used for Model Verification

LCC Reference	Location	Grid Reference		2013 Bias Adjusted NO_2 Annual Average Concentration* ($\mu g/m^3$)
		Easting	Northing	
B42	Berry Street outside St Luke's Church pedestrian crossing	335221	389886	53
B43	Renshaw Street/Bold Street Corner	335222	389937	67
**Obtained from the Environmental Protection Unit at LCC*				

3.3.4 Further details of the model verification are included in Appendix C.

3.4 Information Sources

3.4.1 The following sources of information have been used in the preparation of this report:

- Part IV Environment Act, Chapter 25, Air Quality, 1995;
- DEFRA, The UK National Air Quality Strategy, March 1997;
- The Air Quality Standards Regulations 2010;
- Department for Communities and Local Government, National Planning Policy Framework (NPPF), March 2012;
- Department for Communities and Local Government, Planning Practice Guidance, March 2014;
- Department for the Environment, Food and Rural Affairs, Local Air Quality Management Technical Guidance LAQM.TG(09), published February 2009;
- Environmental Protection UK and the Institute of Air Quality Management, Land-Use Planning and Development Control: Planning for Air Quality, May 2015;
- Institute of Air Quality Management (IAQM) guidance: 'Guidance on the Assessment of Dust from Demolition and Construction' (February 2014);
- Liverpool City Council, 2014 Progress Report;
- 2013 bias-adjusted diffusion tube data, obtained from Liverpool City Council;

- Meteorological data for 2013 from the Liverpool Airport recording station, obtained from ADM Limited; and
- Traffic flow information, provided by DTPC UK LLP (detailed in Appendix A).

4 ASSESSMENT OF SIGNIFICANCE

4.1 Construction Phase Assessment – Dust Emissions

4.1.1 The IAQM) document guidance details criteria for assessing the sensitivity of an area to dust soiling and health effects of PM_{10}, as summarised in Tables 7 to 9 below.

4.1.2 The guidance then goes on to provide significance criteria for the classification of dust soiling and human health effects from demolition, earthworks, construction activities and trackout, as summarised in Tables 10 to 12 below.

Sensitivity of the Area – Human Receptors

4.1.3 The sensitivity categories for different types of receptors, to both dust soiling effects and the health effects of PM_{10}, are described in Table 7.

Table 7: Sensitivity Categories for Human Receptors

Sensitivity Category	Dust Soiling Effects	Health effects of PM_{10}
High	Users can reasonably expect to enjoy a high level of amenity; Appearance, aesthetics or value of a property would be diminished; Examples include dwellings, museums and other culturally important collections, medium and long term car parks and car show rooms.	Locations where members of the public are exposed over a period of time relevant to the air quality objective for PM_{10}; Examples include residential properties, hospitals, schools, and residential care homes.
Medium	Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; The appearance, aesthetics or value of their property could be diminished; People or property wouldn't reasonably be expected to be continuously present or regularly for extended periods of time; Examples include parks and places of work.	Locations where people are exposed as workers and exposure is over a period of time relevant to the air quality objective for PM_{10}; Examples include office and shop workers but will generally not include workers occupationally exposed to PM_{10}.
Low	Enjoyment of amenity would not reasonably be expected; Property would not be diminished in appearance, aesthetics or value; People or property would expected to be present only for limited periods of time; Examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.	Locations where human exposure is transient; Examples include public footpaths, playing fields, parks and shopping streets.

4.1.4 Based upon the category of receptor sensitivity, the sensitivity of the area to dust soiling effects is determined using the criteria detailed in Table 8.

Table 8: Sensitivity of the Area to Dust Soiling Effects on People and Property					
Receptor Sensitivity	**Number of Receptors**	**Distance from Source (m)**			
		<20m	**<50m**	**<100m**	**<350m**
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

4.1.5 Based upon the category of receptor sensitivity, the sensitivity of the area to the health effects of PM_{10} is determined using the criteria detailed in Table 9.

Table 9: Sensitivity of the Area to Human Health Impacts							
Receptor Sensitivity	**Annual Mean PM_{10} Concentration**	**Number of Receptors**	**Distance from Source (m)**				
			<20m	**<50m**	**<100m**	**<200m**	**<350m**
High	>32µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Risk of Dust Impacts

4.1.6 The risk of dust being generated by demolition activities at the site is determined using the criteria in Table 10.

Table 10: Risk of Dust Impacts - Demolition			
Sensitivity of Area	**Dust Emission Magnitude**		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

4.1.7 The risk of dust being generated by earthworks and construction activities at the site is determined using the criteria in Table 11.

Table 11: Risk of Dust Impacts – Earthworks and Construction			
Sensitivity of Area	**Dust Emission Magnitude**		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

4.1.8 The risk of dust being generated by trackout from the site is determined using the criteria in Table 12.

Table 12: Risk of Dust Impacts – Trackout			
Sensitivity of Area	**Dust Emission Magnitude**		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

4.2 Operational Phase Assessment – Road Traffic Emissions

Assessing the Impact of a Proposed Development

4.2.1 Guidance has been prepared by Environmental Protection UK (EPUK) and the IAQM with relation to the assessment of the air quality impacts of proposed developments and their significance[13].

4.2.2 The impact of a development is usually assessed at specific receptors, and takes into account both the long term background concentrations, in relation to the relevant Air Quality Assessment Level (AQAL) at these receptors, and the change with the development in place.

4.2.3 The impact descriptors for individual receptors are detailed in Table 13.

Table 13: Impact Descriptors for Individual Receptors (NO_2 and PM_{10})

Long Term Average Concentration at Receptor in Assessment Year*	Percentage Change in Concentration Relative to Air Quality Assessment Level (AQAL)*			
	1%	2-5%	6-10%	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

**Percentage pollutant concentrations have been rounded to whole numbers, to make it easier to assess the impact. Changes of 0% (i.e. less than 0.5%) should be described as Negligible*

Determining the Significance of Effects

4.2.4 Impacts on air quality, whether adverse or beneficial, will have an effect on human health that can be judged as either 'significant' or 'not significant'.

4.2.5 Once the impact of the proposed development has been assessed for the individual impacts, the overall significance is determined using professional judgement. This takes into account a number of factors such as:

[13] Environmental Protection UK and the Institute of Air Quality Management, Land-Use Planning and Development Control: Planning for Air Quality, May 2015

- The existing and future air quality in the absence of the development;
- The extent of the current and future population exposure to the impacts; and
- The influence and validity of any assumptions adopted when undertaking the prediction of impacts.

4.2.6 A discussion of the impacts of the proposed development, and their significance, is included in section 6.2 and 8 of this report, respectively.

5 BASELINE SITUATION

5.1 Operational Phase Assessment – Road Traffic Emissions

Background Air Pollutant Concentrations

5.1.1 The ADMS assessment needs to take into account background concentrations upon which the local, traffic derived pollution is superimposed. The data may be derived through long term ambient measurements at background sites, remote from immediate sources of air pollution, or alternatively from the default concentration maps which have been provided for use by Defra with the revised LAQM.TG(09) guidance.

5.1.2 In the absence of representative background NO_x, NO_2 PM_{10} and $PM_{2.5}$ monitoring data being available for the local area, background concentrations have been obtained from the 2011-based Defra default concentration maps for the appropriate 1km x 1km grid squares. These are available on the Defra website[14]. As the receptors are located in more than one grid square, the highest NO_x, NO_2, PM_{10} and $PM_{2.5}$ concentrations have been used to provide a robust assessment.

5.1.3 A sensitivity analysis has also been undertaken to address current evidence, which suggests that background NO_2 concentrations are not decreasing in accordance with expected reductions. 2013 background concentrations and emission factors have therefore been applied to the 2020 opening year scenarios. This is considered to be a conservative approach, as it is likely that there will be some improvement in background air quality, and emission factors, before 2020.

5.1.4 The background pollutant concentrations used in the assessment are detailed in Table 14.

[14] http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

Table 14: 2013 Background Pollutant Concentrations. NO_x, NO_2 and PM_{10} Concentrations Obtained from the 2011-Based Defra Default Concentration Maps (Grid Square: 335500, 389500)		
Pollutant	**Pollutant Concentrations (µg/m³)**	
	2013	**2020**
Oxides of Nitrogen (NO_x)	34.59	26.75
Nitrogen Dioxide (NO_2)	23.59	18.92
Particulates (PM_{10})	15.63	14.47
Particulates ($PM_{2.5}$)	10.71	9.62

Modelled Baseline Concentrations

5.1.5 The baseline assessment (i.e. scenarios 1 and 2) has been carried out for the fourteen existing sensitive receptors considered (i.e. ESR 1 to ESR 14). The corrected NO_2 and uncorrected PM_{10} and $PM_{2.5}$ concentrations are detailed in Table 15 and are also included in Appendix D.

Table 15: Predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at Existing Sensitive Receptor Locations for 2013 and 2020 'Without Development' Scenarios						
Receptor	**Calculated Annual Mean Concentrations (µg/m³)**					
	NO_2 * (Corrected)		**PM_{10} (Uncorrected)**		**$PM_{2.5}$ (Uncorrected)**	
	Scenario 1: 2013	**Scenario 2: 2020**	**Scenario 1: 2013**	**Scenario 2: 2020**	**Scenario 1: 2013**	**Scenario 2: 2020**
ESR 1	53.33	40.08	16.43	15.17	11.22	10.02
ESR 2	44.32	33.53	16.14	14.92	11.03	9.87
ESR 3	34.77	25.88	15.92	14.73	10.89	9.77
ESR 4	35.12	26.49	15.92	14.72	10.89	9.76
ESR 5	37.67	28.11	16.01	14.81	10.94	9.81
ESR 6	39.85	29.95	16.05	14.84	10.97	9.83
ESR 7	52.47	39.04	16.32	15.07	11.15	9.96
ESR 8	51.51	34.51	16.12	14.86	11.03	9.84
ESR 9	40.42	29.79	16.03	14.82	10.96	9.82
ERS 10	49.80	36.87	16.24	14.99	11.10	9.92
ESR 11	39.19	29.30	15.98	14.77	10.93	9.79

Table 15: Predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at Existing Sensitive Receptor Locations for 2013 and 2020 'Without Development' Scenarios

Receptor	Calculated Annual Mean Concentrations (µg/m³)					
	NO_2 * (Corrected)		PM_{10} (Uncorrected)		$PM_{2.5}$ (Uncorrected)	
	Scenario 1: 2013	Scenario 2: 2020	Scenario 1: 2013	Scenario 2: 2020	Scenario 1: 2013	Scenario 2: 2020
ESR 12	37.50	28.22	15.96	14.76	10.92	9.78
ESR 13	42.76	32.63	16.18	14.97	11.05	9.90
ESR 14	44.32	33.81	16.30	15.08	11.12	9.96

** NO_2 concentrations obtained by inputting predicted NO_x concentrations into the NO_x to NO_2 calculator[15] in accordance with LAQM.TG(09)*

Scenario 1: 2013 Verification and Base Year

5.1.6 The 2013 baseline annual mean NO_2 concentrations (corrected) are predicted to range from 34.77 to 53.33µg/m³ for the fourteen existing sensitive receptor locations considered. Exceedance of the annual mean objective concentration for NO_2 (40µg/m³) is predicted to occur at eight of the fourteen receptors.

5.1.7 The whole of Liverpool City Council's administrative area is declared an AQMA due to exceedances of NO_2. Given that the roadside diffusion tubes within the study area are currently measuring concentrations which significantly exceed the annual mean objective concentration for NO_2, elevated concentrations would therefore be expected at nearby existing sensitive receptors.

5.1.8 The 2013 baseline annual mean PM_{10} concentrations (uncorrected) are predicted to range from 15.92 to 16.43µg/m³ for the fourteen existing sensitive receptor locations considered. Exceedance of the annual mean objective concentration for PM_{10} (40µg/m³) is not predicted to occur.

5.1.9 The 2013 baseline annual mean $PM_{2.5}$ concentrations (uncorrected) are predicted to range from 10.89 to 11.22µg/m³ for the fourteen existing sensitive receptor locations considered. Exceedance of the annual mean objective concentration for $PM_{2.5}$ (25µg/m³) is not predicted to occur.

[15] NO_x to NO_2 Calculator, Defra Local Air Quality Management web pages (http://laqm.defra.gov.uk/tools-monitoring-data/no-calculator.html)

Scenario 2: 2020 Opening/Future Year, Without Development

5.1.10 The 2020 'without development' annual mean NO_2 concentrations (corrected) are predicted to range from 25.88 to 40.08µg/m^3 for the fourteen existing sensitive receptor locations considered. Exceedance of the annual mean objective concentration for NO_2 (40µg/m^3) is predicted to occur at one of the fourteen receptors. ESR 1 is located close to the junction of two busy roads, therefore, higher concentrations of NO_2 would be expected at this location.

5.1.11 The 2020 'without development' annual mean PM_{10} concentrations (uncorrected) are predicted to range from 14.72 to 15.17µg/m^3 for the fourteen existing sensitive receptor locations considered. Exceedance of the annual mean objective concentration for PM_{10} (40µg/m^3) is not predicted to occur.

5.1.12 The 2020 'without development' annual mean $PM_{2.5}$ concentrations (uncorrected) are predicted to range from 9.76 to 10.02µg/m^3 for the fourteen existing sensitive receptor locations considered. Exceedance of the annual mean objective concentration for $PM_{2.5}$ (25µg/m^3) is not predicted to occur.

6 IMPACT ASSESSMENT

6.1 Construction Phase Assessment – Dust Emissions

6.1.1 The main activities involved with the construction phase of works are as follows:

- **Earthworks** which may be required prior to the construction phase of works. Sources of dust can include:
  - Cleaning the site;
  - Stripping and stockpiling of topsoil and subsoil;
  - Ground excavation;
  - Bringing in, tipping and spreading materials on site;
  - Stockpiling materials;
  - Levelling ground;
  - Trenching;
  - Road construction;
  - Vehicle movements on site roads; and
  - Windblown materials from site.
- **Construction** which will involve the construction of individual building access roads, the car parking areas and the buildings themselves; and
- **Trackout** which is the transport of dust and dirt by vehicles travelling from a construction site on to the public road network. This may occur through the spillage of dusty materials onto road surfaces or through the transportation of dirt by vehicles that have travelled over muddy ground on the site. This dust and dirt can then be deposited and re-suspended by other vehicles.

6.1.2 There are no proposed demolition activities associated within the development site. Demolition activities are not therefore considered within this assessment.

Step 2A

6.1.3 Step 2A of the construction phase dust assessment has defined the potential dust emission magnitude from earthworks, construction and trackout in the absence of site specific mitigation. Examples of the criteria for the dust emission classes are detailed in the IAQM guidance.

Step 2B

6.1.4 Step 2B of the construction phase dust assessment has defined the sensitivity of the area, taking into account the significance criteria detailed in Tables 7 to 9, for earthworks, construction and trackout. The sensitivity of the area to each activity is assessed for potential dust soiling and human health effects.

6.1.5 For earthworks and construction, there are between 10 and 100 residential receptor locations within 50 m of where these activities may take place.

6.1.6 For trackout, there are between 10 and 100 residential receptor locations within 20m of where trackout may occur, for a distance of up to 500m from the site access.

Step 2C

6.1.7 Step 2C of the construction phase dust assessment has defined the risk of impacts from each activity. The dust emission magnitude is combined with the sensitivity of the surrounding area. The risk of dust impacts from each activity, with no mitigation in place, has been assessed in accordance with the criteria detailed in Tables 10 to 12.

Summary

6.1.8 Table 16 details the results of Step 2 of the construction phase assessment for human receptors.

Table 16: Construction Phase Dust Assessment (Step 2) – Human Receptors

	Activity			
	Demolition	**Earthworks**	**Construction**	**Trackout**
Step 2A				
Dust Emission Magnitude	N/A	Large[a]	Large[b]	Medium[c]
Step 2B				
Sensitivity of Closest Receptors	N/A	High	High	High
Sensitivity of Area to Dust Soiling Effects	N/A	High	High	High
Sensitivity of Area to Human Health Effects	N/A	Low[d]	Low[d]	Low[d]
Step 2C				
Dust Risk: Dust Soiling	N/A	High	High	Medium
Dust Risk: Human Health	N/A	Low	Low	Low

Table 16: Construction Phase Dust Assessment (Step 2) – Human Receptors				
	Activity			
	Demolition	**Earthworks**	**Construction**	**Trackout**
a. Total site area estimated to be >10,000m² *b. Total building volume estimated to be >100,000m³* *c. Estimation of HGV movements to be between 10 and 50 per day* *d. Background annual mean PM_{10} concentration is considered to be less than 24µg/m³ (based on data obtained from the LAQM Defra default concentration maps, for the appropriate grid squares, as detailed in Table 14)*				

6.2 Operational Phase Assessment – Road Traffic Emissions

Existing Sensitive Receptor Locations

6.2.1 The impact assessment has been carried out for the fourteen representative existing sensitive receptor locations (i.e. ESR 1 to ESR 14). Table 17 shows the changes in pollutant concentrations for the 2020 opening year, for both the 'Without Development' and 'With Development' scenarios. The corrected NO_2 and uncorrected PM_{10} and $PM_{2.5}$ concentrations are included in Appendix D.

Table 17: Predicted NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Existing Sensitive Receptor Locations for 2020 'Without Development' and 'With Development' Scenarios

Receptor	**Level of Development**	**Calculated Annual Mean Concentrations (µg/m³)**		
		NO_2 (Corrected)	**PM_{10} (Uncorrected)**	**$PM_{2.5}$ (Uncorrected)**
ESR 1	Without development	40.08	15.17	10.02
	With development	41.50	15.23	10.05
	Percentage Change in relation to AQAL	*3.55%*	*0.14%*	*0.13%*
ESR 2	Without development	33.53	14.92	9.87
	With development	35.41	14.98	9.91
	Percentage Change in relation to AQAL	*4.70%*	*0.16%*	*0.14%*
ESR 3	Without development	25.88	14.73	9.77
	With development	29.54	14.89	9.85
	Percentage Change in relation to AQAL	*9.15%*	*0.39%*	*0.34%*
ESR 4	Without development	26.49	14.72	9.76
	With development	27.92	14.77	9.79
	Percentage Change in relation to AQAL	*3.58%*	*0.13%*	*0.11%*

Table 17: Predicted NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Existing Sensitive Receptor Locations for 2020 'Without Development' and 'With Development' Scenarios				
Receptor	**Level of Development**	**Calculated Annual Mean Concentrations (µg/m³)**		
		NO_2 (Corrected)	**PM_{10} (Uncorrected)**	**$PM_{2.5}$ (Uncorrected)**
ESR 5	Without development	28.11	14.81	9.81
	With development	28.99	14.85	9.83
	Percentage Change in relation to AQAL	*2.20%*	*0.09%*	*0.08%*
ESR 6	Without development	29.95	14.84	9.83
	With development	30.70	14.87	9.84
	Percentage Change in relation to AQAL	*1.88%*	*0.07%*	*0.06%*
ESR 7	Without development	39.04	15.07	9.96
	With development	40.31	15.11	9.98
	Percentage Change in relation to AQAL	*3.18%*	*0.12%*	*0.10%*
ESR 8	Without development	34.51	14.86	9.84
	With development	36.02	14.90	9.87
	Percentage Change in relation to AQAL	*3.78%*	*0.11%*	*0.10%*
ESR 9	Without development	29.79	14.82	9.82
	With development	30.59	14.85	9.83
	Percentage Change in relation to AQAL	*2.00%*	*0.07%*	*0.06%*
ESR 10	Without development	36.87	14.99	9.92
	With development	38.05	15.04	9.94
	Percentage Change in relation to AQAL	*2.95%*	*0.10%*	*0.09%*
ESR 11	Without development	29.30	14.77	9.79
	With development	30.77	14.82	9.82
	Percentage Change in relation to AQAL	*3.68%*	*0.12%*	*0.10%*
ESR 12	Without development	28.22	14.76	9.78
	With development	30.03	14.82	9.82
	Percentage Change in relation to AQAL	*4.53%*	*0.15%*	*0.13%*
ESR 13	Without development	32.63	14.97	9.90
	With development	34.02	15.02	9.93

Table 17: Predicted NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Existing Sensitive Receptor Locations for 2020 'Without Development' and 'With Development' Scenarios				
Receptor	**Level of Development**	**Calculated Annual Mean Concentrations (µg/m³)**		
		NO_2 (Corrected)	**PM_{10} (Uncorrected)**	**$PM_{2.5}$ (Uncorrected)**
	Percentage Change in relation to AQAL	*3.48%*	*0.14%*	*0.12%*
ESR 14	Without development	33.81	15.08	9.96
	With development	35.26	15.15	10.00
	Percentage Change in relation to AQAL	*3.62%*	*0.17%*	*0.15%*

Scenario 3: 2020 Opening/Future Year, With Development

6.2.2 The 2020 'with development' annual mean NO_2 concentrations (corrected) are predicted to range from 27.92 to 41.50µg/m³ for the fourteen existing sensitive receptor locations considered. Exceedance of the annual mean objective concentration for NO_2 (40µg/m³) is predicted to occur at two of the fourteen existing sensitive receptors (ESR 1 and ESR 7). The proposed development is predicted to lead to an exceedance at ESR 7.

6.2.3 The 2020 'with development' annual mean PM_{10} concentrations (uncorrected) are predicted to range from 14.77 to 15.23µg/m³ for the fourteen existing sensitive receptor locations considered. Exceedance of the annual mean objective concentration for PM_{10} (40µg/m³) is not predicted to occur.

The 2020 'with development' annual mean $PM_{2.5}$ concentrations (uncorrected) are predicted to range from 9.79 to 10.05µg/m³ for the fourteen existing sensitive receptor locations considered. Exceedance of the annual mean objective concentration for $PM_{2.5}$ (25µg/m³) is not predicted to occur.

Assessment of Impact

6.2.4 Using the descriptors detailed in Table 13, the impact of the proposed development can be assessed at each of the fourteen existing sensitive receptors considered.

6.2.5 The impact on NO_2 concentrations in 2020 is detailed in Table 18.

Table 18: Impact on NO_2 Concentrations in 2020			
Proposed Receptor Location	**Percentage Change in Relation to AQAL**	**Annual Mean Concentration in Relation to AQAL**	**Impact**
ESR 1	2 – 5%	103 – 109%	Moderate

Table 18: Impact on NO_2 Concentrations in 2020			
Proposed Receptor Location	**Percentage Change in Relation to AQAL**	**Annual Mean Concentration in Relation to AQAL**	**Impact**
ESR 2	2 – 5%	76 – 94%	Slight
ESR 3	6 – 10%	<75%	Slight
ESR 4	2 – 5%	<75%	Negligible
ESR 5	2 – 5%	<75%	Negligible
ESR 6	2 – 5%	76 – 94%	Slight
ESR 7	2 – 5%	95 - 102%	Moderate
ESR 8	2 – 5%	76 – 94%	Slight
ESR 9	2 – 5%	76 – 94%	Slight
ESR 10	2 – 5%	95 – 102%	Moderate
ESR 11	2 – 5%	76 – 94%	Slight
ESR 12	2 – 5%	<75%	Negligible
ESR 13	2 – 5%	76 – 94%	Slight
ESR 14	2 – 5%	76 – 94%	Slight

6.2.6 The impact on PM_{10} concentrations in 2020 is detailed in Table 19.

Table 19: Impact on PM_{10} Concentrations in 2020			
Proposed Receptor Location	**Percentage Change in Relation to AQAL**	**Annual Mean Concentration in Relation to AQAL**	**Impact**
ESR 1	<0.5%*	<75%	Negligible
ESR 2	<0.5%*	<75%	Negligible
ESR 3	<0.5%*	<75%	Negligible
ESR 4	<0.5%*	<75%	Negligible
ESR 5	<0.5%*	<75%	Negligible
ESR 6	<0.5%*	<75%	Negligible
ESR 7	<0.5%*	<75%	Negligible
ESR 8	<0.5%*	<75%	Negligible
ESR 9	<0.5%*	<75%	Negligible
ESR 10	<0.5%*	<75%	Negligible

Table 19: Impact on PM_{10} Concentrations in 2020			
Proposed Receptor Location	**Percentage Change in Relation to AQAL**	**Annual Mean Concentration in Relation to AQAL**	**Impact**
ESR 11	<0.5%*	<75%	Negligible
ESR 12	<0.5%*	<75%	Negligible
ESR 13	<0.5%*	<75%	Negligible
ESR 14	<0.5%*	<75%	Negligible
* Changes of less than 0.5% should be described as negligible			

6.2.7 The impact on $PM_{2.5}$ concentrations in 2020 is detailed in Table 20.

Table 20: Impact on $PM_{2.5}$ Concentrations in 2020			
Proposed Receptor Location	**Percentage Change**	**Annual Mean Concentration in Relation to AQAL**	**Impact**
ESR 1	<0.5%*	<75%	Negligible
ESR 2	<0.5%*	<75%	Negligible
ESR 3	<0.5%*	<75%	Negligible
ESR 4	<0.5%*	<75%	Negligible
ESR 5	<0.5%*	<75%	Negligible
ESR 6	<0.5%*	<75%	Negligible
ESR 7	<0.5%*	<75%	Negligible
ESR 8	<0.5%*	<75%	Negligible
ESR 9	<0.5%*	<75%	Negligible
ESR 10	<0.5%*	<75%	Negligible
ESR 11	<0.5%*	<75%	Negligible
ESR 12	<0.5%*	<75%	Negligible
ESR 13	<0.5%*	<75%	Negligible
ESR 14	<0.5%*	<75%	Negligible
* Changes of less than 0.5% should be described as negligible			

Proposed Sensitive Receptor Locations

6.2.8 Air pollutant concentrations have also been modelled for three proposed receptor locations, for the 2020 'with development' scenario, as detailed in Table 21. The corrected NO_2 and uncorrected PM_{10} and $PM_{2.5}$ concentrations are included in Appendix D.

Table 21: Predicted NO_2 and PM_{10} Concentrations at Proposed Sensitive Receptor Location for 2020 'With Development' Scenario

Proposed Receptor Location	Calculated Annual Mean Concentrations (µg/m³)		
	NO_2 (Corrected)	PM_{10} (Uncorrected)	$PM_{2.5}$ (Uncorrected)
PR 1	31.11	14.90	9.86
PR 2	26.05	14.77	9.78
PR 3	26.65	14.77	9.78

Scenario 3: 2020 Opening/Future Year, With Development

6.2.9 The 2020 'with development' annual mean NO_2 concentrations (corrected) are predicted to range from 26.05 to 33.67µg/m³, at the three proposed sensitive receptor locations considered. Exceedance of the annual mean objective concentration for NO_2 (40µg/m³) is not predicted to occur.

6.2.10 The 2020 'with development' annual mean PM_{10} concentrations (uncorrected) are predicted to range from 14.77 to 14.90µg/m³, at the three proposed sensitive receptor locations considered. Exceedance of the annual mean objective concentration for PM_{10} (40µg/m³) is not predicted to occur.

6.2.11 The 2020 'with development' annual mean $PM_{2.5}$ concentrations (uncorrected) are predicted to range from 9.78 to 9.86µg/m³, at the three proposed sensitive receptor locations considered. Exceedance of the annual mean objective concentration for $PM_{2.5}$ (25µg/m³) is not predicted to occur.

7 SENSITIVITY ANALYSIS

7.1 Existing Sensitive Receptor Locations

7.1.1 Current evidence suggests that NO_2 background concentrations are not decreasing in accordance with expected reductions. At present, there is uncertainty about how background NO_2 concentrations will change in future years.

7.1.2 To provide a robust assessment, a sensitivity analysis has been undertaken for the 2020 opening/future year scenario. This analysis assumes that there will be no improvement in background air quality between 2013 and 2020. 2013 background pollutant concentrations and 2013 emission factors have therefore been applied to the 2020 opening/future year scenario.

7.1.3 The results of the sensitivity analysis, undertaken for the fourteen existing sensitive receptor locations, are detailed in Table 22 and detailed in Appendix E.

Table 22: Predicted NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Existing Sensitive Receptor Locations for 2020 'Without Development' and 'With Development' Scenarios Assuming No Improvement in Air Quality

Receptor	Level of Development	Calculated Annual Mean Concentrations (µg/m³)		
		NO_2 (Corrected)	PM_{10} (Uncorrected)	$PM_{2.5}$ (Uncorrected)
ESR 1	Without development	55.30	16.50	11.26
	With development	58.21	16.57	11.30
	Percentage Change in relation to AQAL	*7.07%*	*0.18%*	*0.18%*
ESR 2	Without development	45.87	16.18	11.06
	With development	49.16	16.26	11.11
	Percentage Change in relation to AQAL	*8.23%*	*0.20%*	*0.21%*
ESR 3	Without development	35.78	15.95	10.91
	With development	42.34	16.14	11.02
	Percentage Change in relation to AQAL	*16.40%*	*0.46%*	*0.46%*
ESR 4	Without development	36.02	15.94	10.90
	With development	38.56	15.00	10.94
	Percentage Change in relation to AQAL	*6.35%*	*0.15%*	*0.16%*
ESR 5	Without development	38.73	16.04	10.96
	With development	40.45	16.09	10.99

Table 22: Predicted NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Existing Sensitive Receptor Locations for 2020 'Without Development' and 'With Development' Scenarios Assuming No Improvement in Air Quality

Receptor	Level of Development	Calculated Annual Mean Concentrations (µg/m³)		
		NO_2 (Corrected)	PM_{10} (Uncorrected)	$PM_{2.5}$ (Uncorrected)
	Percentage Change in relation to AQAL	*4.30%*	*0.11%*	*0.11%*
ESR 6	Without development	41.15	16.08	10.99
	With development	42.60	16.12	11.01
	Percentage Change in relation to AQAL	*3.63%*	*0.08%*	*0.09%*
ESR 7	Without development	54.48	16.38	11.19
	With development	57.01	16.44	11.23
	Percentage Change in relation to AQAL	*6.33%*	*0.15%*	*0.15%*
ESR 8	Without development	53.31	16.15	11.05
	With development	56.69	16.21	11.09
	Percentage Change in relation to AQAL	*8.45%*	*0.14%*	*0.15%*
ESR 9	Without development	41.61	16.06	10.98
	With development	43.22	16.10	11.00
	Percentage Change in relation to AQAL	*4.03%*	*0.09%*	*0.09%*
ESR 10	Without development	51.60	16.29	11.13
	With development	53.96	16.34	11.17
	Percentage Change in relation to AQAL	*5.90%*	*0.13%*	*0.13%*
ESR 11	Without development	40.34	16.01	10.95
	With development	42.99	16.07	10.99
	Percentage Change in relation to AQAL	*6.63%*	*0.15%*	*0.15%*
ESR 12	Without development	38.58	15.99	10.94
	With development	41.77	16.06	10.98
	Percentage Change in relation to AQAL	*7.98%*	*0.19%*	*0.19%*
ESR 13	Without development	44.22	16.23	11.08
	With development	46.65	16.29	11.12
	Percentage Change in relation to AQAL	*6.08%*	*0.17%*	*0.17%*

Table 22: Predicted NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Existing Sensitive Receptor Locations for 2020 'Without Development' and 'With Development' Scenarios Assuming No Improvement in Air Quality				
Receptor	**Level of Development**	**Calculated Annual Mean Concentrations (µg/m³)**		
		NO_2 (Corrected)	**PM_{10} (Uncorrected)**	**$PM_{2.5}$ (Uncorrected)**
ESR 14	Without development	45.87	16.35	11.15
	With development	48.41	16.43	11.20
	Percentage Change in relation to AQAL	*6.35%*	*0.20%*	*0.20%*

Assessment of Impact

7.1.4 Using the descriptors detailed in Table 13, the impact of the proposed development can be assessed at each of the fourteen existing sensitive receptors considered.

7.1.5 The impact on NO_2 concentrations in 2020 is detailed in Table 23.

Table 23 Impact on NO_2 Concentrations in 2020			
Proposed Receptor Location	**Percentage Change in relation to AQAL**	**Annual Mean Concentration in Relation to AQAL**	**Impact**
ESR 1	6 – 10%	>110%	Substantial
ESR 2	6 – 10%	>110%	Substantial
ESR 3	>10%	103 – 109%	Substantial
ESR 4	6 – 10%	95 – 102%	Moderate
ESR 5	2 – 5%	95 – 102%	Moderate
ESR 6	2 – 5%	103 – 109%	Moderate
ESR 7	6 – 10%	>110%	Substantial
ESR 8	6 – 10%	>110%	Substantial
ESR 9	2 – 5%	103 – 109%	Moderate
ESR 10	2 – 5%	>110%	Substantial
ESR 11	6 – 10%	103 – 109%	Substantial
ESR 12	6 – 10%	103 – 109%	Substantial
ESR 13	6 – 10%	>110%	Substantial
ESR 14	6 – 10%	>110%	Substantial

7.1.6 The impact on PM_{10} concentrations in 2020 is detailed in Table 24.

Table 24: Impact on PM_{10} Concentrations in 2020

Proposed Receptor Location	Percentage Change in Relation to AQAL	Annual Mean Concentration in Relation to AQAL	Impact
ESR 1	<0.5%*	<75%	Negligible
ESR 2	<0.5%*	<75%	Negligible
ESR 3	<0.5%*	<75%	Negligible
ESR 4	<0.5%*	<75%	Negligible
ESR 5	<0.5%*	<75%	Negligible
ESR 6	<0.5%*	<75%	Negligible
ESR 7	<0.5%*	<75%	Negligible
ESR 8	<0.5%*	<75%	Negligible
ESR 9	<0.5%*	<75%	Negligible
ESR 10	<0.5%*	<75%	Negligible
ESR 11	<0.5%*	<75%	Negligible
ESR 12	<0.5%*	<75%	Negligible
ESR 13	<0.5%*	<75%	Negligible
ESR 14	<0.5%*	<75%	Negligible
* Changes of less than 0.5% should be described as negligible			

7.1.7 The impact on $PM_{2.5}$ concentrations in 2020 is detailed in Table 25.

Table 25: Impact on $PM_{2.5}$ Concentrations in 2020

Proposed Receptor Location	Percentage Change in Relation to AQAL	Annual Mean Concentration in Relation to AQAL	Impact
ESR 1	<0.5%*	<75%	Negligible
ESR 2	<0.5%*	<75%	Negligible
ESR 3	<0.5%*	<75%	Negligible
ESR 4	<0.5%*	<75%	Negligible
ESR 5	<0.5%*	<75%	Negligible
ESR 6	<0.5%*	<75%	Negligible
ESR 7	<0.5%*	<75%	Negligible

Table 25: Impact on $PM_{2.5}$ Concentrations in 2020			
Proposed Receptor Location	**Percentage Change in Relation to AQAL**	**Annual Mean Concentration in Relation to AQAL**	**Impact**
ESR 8	<0.5%*	<75%	Negligible
ESR 9	<0.5%*	<75%	Negligible
ESR 10	<0.5%*	<75%	Negligible
ESR 11	<0.5%*	<75%	Negligible
ESR 12	<0.5%*	<75%	Negligible
ESR 13	<0.5%*	<75%	Negligible
ESR 14	<0.5%*	<75%	Negligible
* Changes of less than 0.5% should be described as negligible			

7.2 Proposed Sensitive Receptor Locations

7.2.1 The results of the sensitivity analysis, undertaken for the three proposed sensitive receptor locations, are detailed in Table 26 and included in Appendix E.

Table 26: Predicted NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Proposed Sensitive Receptor Location for 2020 'With Development' Scenario Assuming No Improvement in Air Quality			
Proposed Receptor Location	**Calculated Annual Mean Concentrations (µg/m^3)**		
	NO_2 (Corrected)	**PM_{10} (Uncorrected)**	**$PM_{2.5}$ (Uncorrected)**
PR 1	43.72	16.16	11.04
PR 2	40.34	15.98	10.11
PR 3	36.73	15.21	9.62

Scenario 3: 2020 Opening/Future Year, With Development

7.2.2 The 2020 'with development' annual mean NO_2 concentrations (corrected) are predicted to range from 36.73 to 43.72µg/m^3, at the three proposed sensitive receptor locations considered. Exceedance of the annual mean objective concentration for NO_2 (40µg/m^3) is predicted to occur at PR1 in the south eastern part of the site and PR2, in the eastern part of the site.

7.2.3 PR1 was selected to represent the closest part of the proposed development to the Great George Street and Parliament Street Junction with modelling undertaken at ground floor height to represent a worst case scenario. Although an exceedance has been predicted at this location within the sensitivity analysis, it should be noted that this presents a conservative approach in that it assumes no improvement in air quality by 2020. In reality, some improvement would be expected before 2020 and therefore exceedances are considered to be less likely.

7.2.4 The 2020 'with development' annual mean PM_{10} concentrations (uncorrected) are predicted to range from 15.21 to 16.16µg/m^3, at the three proposed sensitive receptor locations considered. Exceedance of the annual mean objective concentration for PM_{10} (40µg/m^3) is not predicted to occur.

7.2.5 The 2020 'with development' annual mean $PM_{2.5}$ concentrations (uncorrected) are predicted to range from 9.62 to 11.04µg/m^3, at the three proposed sensitive receptor locations considered. Exceedance of the annual mean objective concentration for $PM_{2.5}$ (25µg/m^3) is not predicted to occur.

8 ASSESSMENT OF SIGNIFICANCE

8.1 Operational Phase Assessment – Road Traffic Emissions

8.1.1 The significance of the overall effects of the proposed development has been assessed. This assessment is based on professional judgement and takes into account a number of factors, including:

- Baseline NO_2 concentrations in the 2013 Verification and Base Year are elevated, with exceedance of the annual mean objective predicted at eight of the fourteen receptor locations considered, all of which are located within the existing Liverpool AQMA;
- With regard to the future baseline (i.e. the 2020 Opening/Future Year 'without development' scenario), the results of the air quality assessment predict that, for NO_2, thirteen of the fourteen existing receptors considered will be below 40µg/m^3. However, this is considered to be a 'best case' scenario. The sensitivity analysis, which is a 'worst case' scenario, predicts NO_2 concentrations will exceed the annual mean objective at 10 of the 14 receptor locations considered. The true future baseline is considered to lie somewhere between these two sets of results. Therefore, elevated NO_2 concentrations are considered likely in 2020, without the development in place;
- Baseline and future PM_{10} concentrations are below 30 µg/m^3 at all fourteen existing sensitive receptors, in both the air quality assessment and sensitivity analysis;
- Baseline and future $PM_{2.5}$ concentrations are below 20µg/m^3 at all fourteen existing sensitive receptors, in both the air quality assessment and sensitivity analysis;
- The air quality assessment predicts a negligible impact on NO_2 at three of the fourteen receptors. A slight impact is predicted at eight and a moderate impact is predicted at three. However, the sensitivity analysis predicts a moderate impact at four of the receptors and a substantial impact at ten. It is considered that the true impact lies somewhere between these two sets of results;
- The air quality assessment predicts a negligible impact on PM_{10} and $PM_{2.5}$ concentrations at all fourteen existing sensitive receptor locations.

8.1.2 Based on these factors, the effect of the proposed development on human health is considered to be 'significant'. As a result, mitigation measures will need to be recommended to minimise these effects.

9 MITIGATION MEASURES

9.1 Construction Phase Assessment – Dust Emissions

Step 3

9.1.1 During the construction phase the implementation of effective mitigation measures will substantially reduce the potential for nuisance dust and particulate matter to be generated.

9.1.2 Step 2C of the construction phase assessment identified that:

- The risk of dust soiling effects is classed as high for earthworks and construction, and medium for trackout; and
- The risk of human health effects is classed as low for earthworks, construction and trackout.

9.1.3 This assumes that no mitigation measures are applied, except those required by legislation. Site specific mitigation measures do not need to be recommended if the risk category is negligible.

9.1.4 As the risk categories for these activities are not negligible, site specific mitigation measures will need to be implemented to ensure that dust effects will not be significant.

9.1.5 A best practice dust mitigation plan will be written and implemented for the site. This will set out the practical measures that could be incorporated as part of a best working practice scheme. This will take into account the recommendations included within the IAQM guidance, which may include:

- Re-vegetate earthworks and exposed areas/ soil stockpiles to stabilise surfaces as soon as practicable;
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place;
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery;
- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use; and

- Ensure vehicles entering and leaving the sites are covered to prevent escape of materials during transport.

9.1.6 It is recognised that the final design solutions will be developed with the input of the Contractor to maximise construction efficiencies, to use modern construction techniques and sustainable materials, and to incorporate the particular skills and experience offered by the successful contractor.

Step 4

9.1.7 Step 4 of the construction phase dust assessment has been undertaken to determine the significance of the dust effects arising from earthworks, construction and trackout associated with the proposed development.

9.1.8 The implementation of effective mitigation measures during the construction phase, such as those detailed in Step 3, will substantially reduce the potential for nuisance dust and particulate matter to be generated and any residual impact should not be significant.

9.2 Operational Phase Assessment – Road Traffic Emissions

Existing Sensitive Receptor Locations

9.2.1 An air quality assessment has been undertaken to consider the potential impact of development-generated vehicles on air quality at fourteen existing sensitive receptor locations.

9.2.2 The air quality assessment predicts that there will be a slight impact on concentrations of NO_2 at eight of the fourteen existing sensitive receptors considered, in 2020 with the development in place. Three of the existing sensitive receptors are predicted to have a moderate impact and three negligible.

9.2.3 The sensitivity analysis predicts that there will be a substantial adverse impact on ten of the fourteen existing sensitive receptors considered, in 2020 with the development in place. Four of the existing receptors are predicted to have a moderate adverse impact

9.2.4 The air quality assessment and sensitivity analysis predicts that there will be a negligible impact on concentrations of PM_{10} and $PM_{2.5}$, at all fourteen existing sensitive receptors considered, in 2020 with the development in place.

Proposed Sensitive Receptor Locations

9.2.5 The air quality assessment has also predicted pollutant concentrations at three proposed receptor locations within the proposed development. These are considered to be representative of the closest parts of the site to Great George Street.

9.2.6 Predicted NO_2 concentrations are below the annual mean air quality objectives, for 2020, at all three proposed receptors. The sensitivity analysis predicts an exceedance at PR 2, which is close to the site access. However, given that this presents a conservative approach, by assuming no improvement in air quality before 2020, it is considered unlikely that there will be an exceedance at this location.

9.2.7 Predicted PM_{10} and $PM_{2.5}$ concentrations are below the annual mean air quality objectives, for 2020, at all three proposed sensitive receptor locations considered in both the air quality assessment and sensitivity analysis. Given that the sensitivity analysis presents a conservative approach, it is considered unlikely that there would be an exceedance for these pollutants at these locations.

Recommendations for Mitigation

9.2.8 Based on professional judgement, and a number of factors, the effect of the proposed development on human health is considered to be 'significant'. Mitigation measures will therefore need to be recommended for the site, in order to minimise this effect and an air pollution damage cost calculation has been carried out.

Air Pollution Damage Cost Assessment

9.2.9 The air pollution damage cost assessment utilises the current DEFRA Emission Factor Toolkit (version 6), available on the Defra website[16], to estimate the annual link emissions associated with the additional development generated vehicles over a 5 year period. The calculation attributes a monetary value to those emissions using the Interdepartmental Group on Costs and Benefits[17] (IGCB) Damage Cost Guidelines.

9.2.10 The total number of trips in a 24-hour period, generated by the proposed development, was included within the damage cost assessment to determine the transport related emissions. The total trip generation in a 24 hour period is 3,793 vehicles. The average trip length is assumed to be 10km and the average speed to be

[16] Defra Local Air Quality Management website (http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html)

[17] Defra, Interdepartmental Group on Costs and Benefits (https://www.gov.uk/air-quality-economic-analysis#damage-costs-approach)

50kph. The calculation was undertaken for NO_x emissions, which the IGCB gives a central estimated cost (2010) of £955/tonne.

9.2.11 The results of the calculation are detailed in Table 27. It is considered that the damage cost assessment provides a possible basis for defining the financial commitment required for offsetting potential development-generated emissions. Mitigation measures which could be implemented include:

- Support for and promotion of car clubs;
- Contributions to low emission vehicle refuelling infrastructure;
- Provision of incentives for the uptake of low emission vehicles;
- Financial support to low emission public transport options; and
- Improvements to cycling and walking infrastructure.

Table 27 Damage Cost Calculation Undertaken Using EFT and by Taking Into Account the IGCB Damage Cost Figures

Step	**NO_x**
Emission calculation using EFT spreadsheet	3618.49kg/yr
Conversion into tonnes per annum	3.6184 tonnes/yr
IGCB air quality damage costs per tonne	NO_x (Central Estimate): £955
Calculation of air quality damage per year	£3455.66
Calculation of air quality damage over 5 year period	£17,278.31

9.2.12 The total damage cost of NO_x for the proposed development over a five year period is £17,278.31.

10 CONCLUSIONS

10.1 Construction Phase Assessment – Dust Emissions

10.1.1 The construction phase assessment has been undertaken to determine the risk and significance of dust effects from earthworks, construction and trackout from the proposed development. The assessment has been undertaken in accordance with the guidance on assessing the impacts of construction phase dust published by IAQM.

10.1.2 The risk of dust soiling effects is considered to be high for earthworks and construction, and medium for trackout. The risk of human health effects is classed as low for earthworks, construction and trackout. Site specific mitigation measures will therefore need to be implemented at the site.

10.1.3 With site specific mitigation measures in place, as detailed in Section 7 of this report, the significance of dust effects for earthworks, construction and trackout are considered to be not significant.

10.2 Operational Phase Assessment – Road Traffic Emissions

Existing Sensitive Receptor Locations

10.2.1 The air quality assessment and sensitivity analysis have considered air quality at fourteen representative existing sensitive receptor locations.

10.2.2 The air quality assessment and sensitivity analysis predicts that there will be a moderate impact at three of the existing sensitive receptors. It also predicts a slight impact at eight and a negligible impact at three.

10.2.3 The sensitivity analysis predicts that there will be a substantial impact at ten of the existing sensitive receptors. It also predicts a moderate impact at four.

10.2.4 The air quality assessment predicts that there will be a negligible impact on concentrations of PM_{10} and $PM_{2.5}$, at all fourteen existing sensitive receptors considered, in 2020 with the development in place.

10.2.5 To summarise, the air quality assessment indicates that the proposed development generated traffic will have a moderate impact at existing sensitive receptor locations in 2020. Air quality effects are therefore considered to be 'significant'. As a result, mitigation measures will need to be considered.

Proposed Sensitive Receptor Location

10.2.6 The air quality assessment predicts that NO_2 concentrations will be below the respective annual mean air quality objectives, for 2020, at the three proposed sensitive receptor locations considered.

10.2.7 The sensitivity analysis predicts that there will be an exceedance of the NO_2 objective at PR 2, which is close to the site access.

10.2.8 The air quality assessment and sensitivity analysis predicts that PM_{10} and $PM_{2.5}$ concentrations will be below the respective annual mean air quality objectives, for 2020, at the three proposed sensitive receptor locations considered.

Recommendations for Mitigation

10.2.1 Based on professional judgement, and a number of factors, the effect of the proposed development on human health is considered to be 'significant', when a worst case approach is adopted which assumes no improvement in backgrounds or emission factors. Therefore, mitigation measures are required, as outlined in Section 7.

10.2.2 A damage cost calculation has been carried out in order to provide a possible basis for defining the financial commitment required for offsetting potential development-generated emissions. The total damage cost of NO_x for the proposed development, over a five year period, is £17,278.31

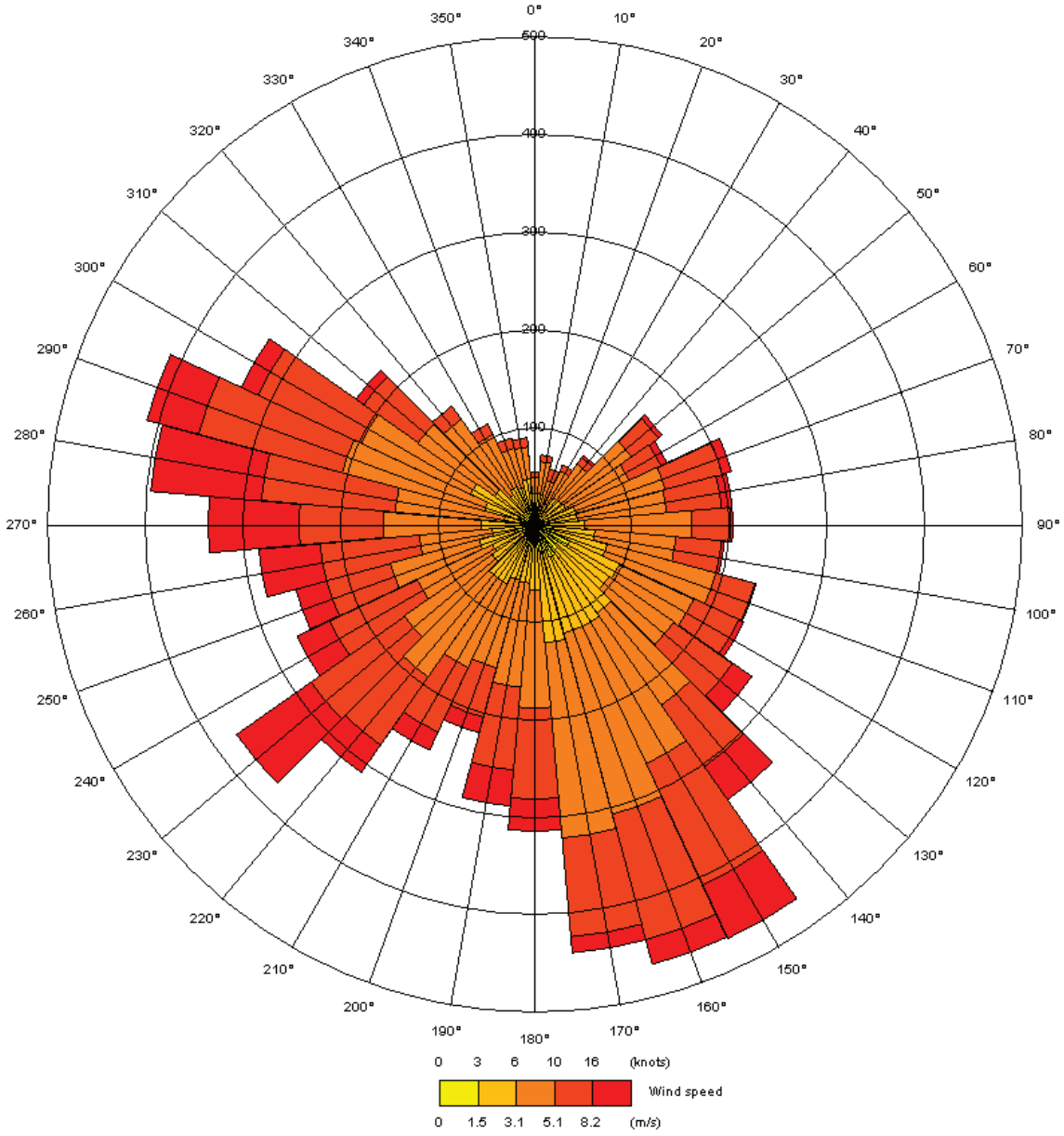
10.2.3 It is considered that the implementation of the mitigation measures, in accordance with the possible measures outlined in section 7, will assist with reducing any potential impacts of the proposed development. The extent of the mitigation measures included with the proposed development should equal the cost determined by the damage cost assessment.

Appendix A:
Traffic Flow Information
Used in the Air Quality Assessment

24 Hour Annual Average Daily Traffic (AADT) Flows, Provided by DTPC UK on 05th August 2015

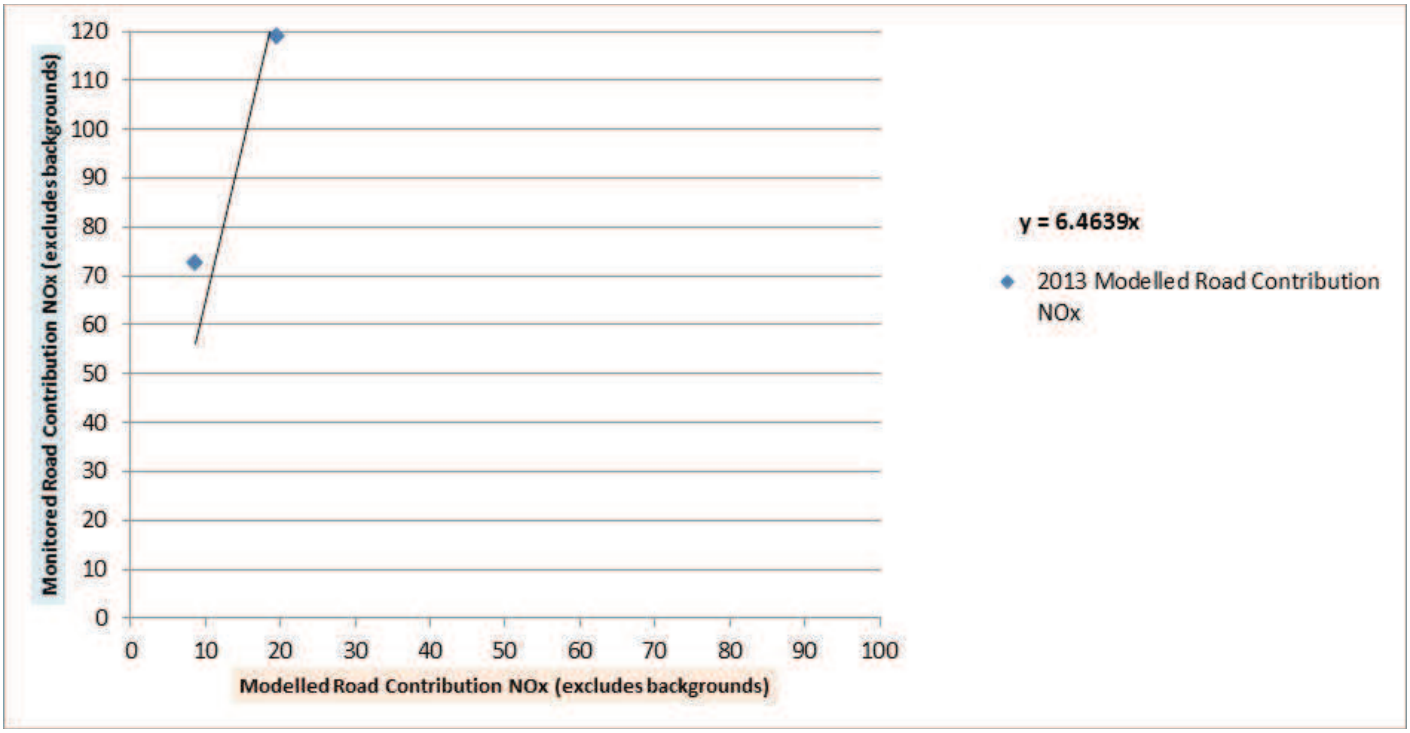
Link	Link Name	Speed Info (kph)	Scenario 1: 2013 Verification and Base Year		Scenario 2: 2020 Opening/Future Year Without Development		Scenario 3: 2020 Opening/Future Year With Development	
			LGV	HGV	LGV	HGV	LGV	HGV
1	Renshaw Street	48	11012	1646	11950	1786	12840	1919
2	Leece Street	48	4184	857	4541	930	5390	1104
3	Berry Street	48	11323	350	12287	380	13279	411
4	Upper Duke Street	48	8562	175	9290	190	9873	201
5	Great George Street North of Site access	48	10834	335	11756	364	12971	401
6	Great George Street South of Site access	48	10834	335	11756	364	14221	440
7	Duke Street	48	9339	289	10134	313	10798	334
8	A562 East Upper Parliament Street	48	23815	241	25844	261	28630	289
9	A561 St James Place	48	22834	706	24778	766	26619	823
10	A562 West Parliament Street	48	28273	577	30680	626	32530	664
11	A561 St James Street	48	6990	368	7585	399	13560	714
**Slow down sections modelled at 20kph*								

Appendix B:
2013 Wind Rose for Liverpool Airport Meteorological Recording Station

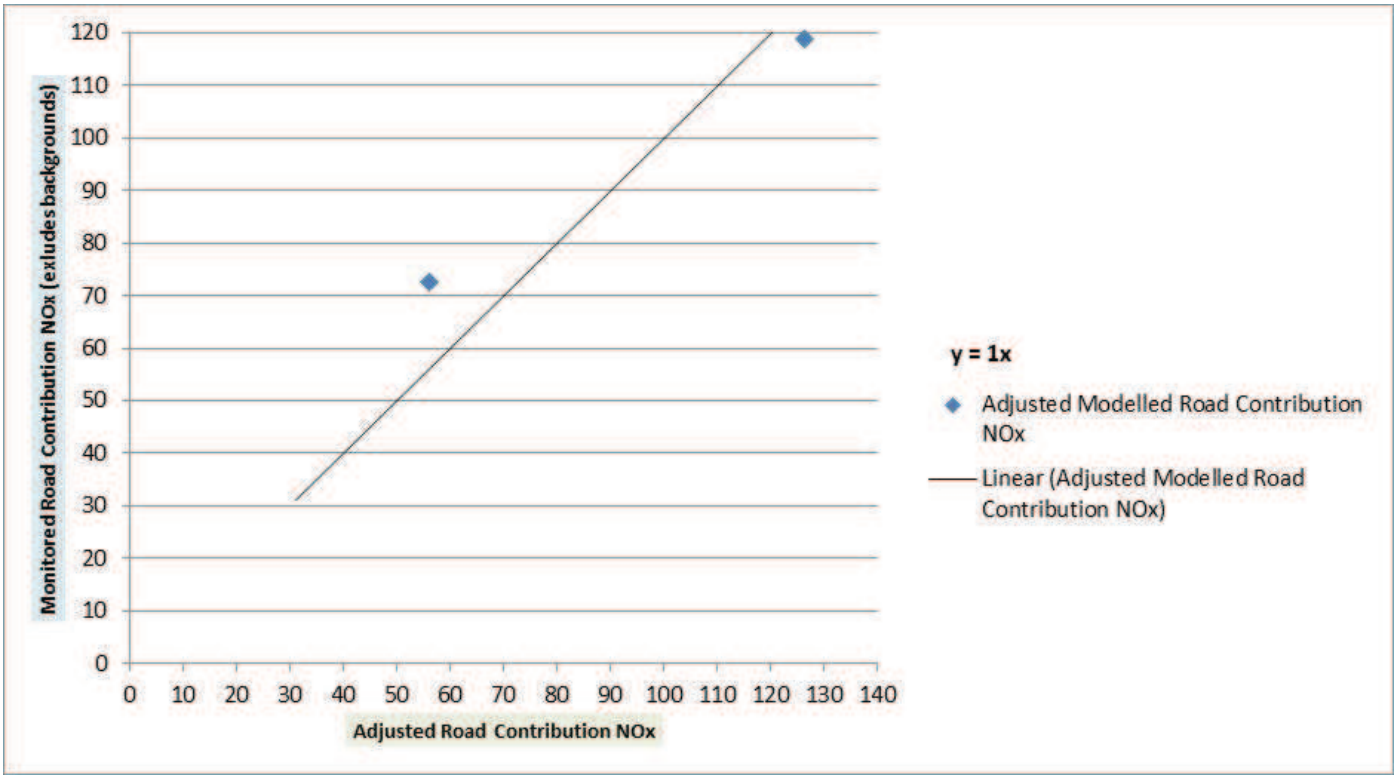

0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°
190°
200°
210°
220°
230°
240°
250°
260°
270°
280°
290°
300°
310°
320°
330°
340°
350°
500
400
300
200
100
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)

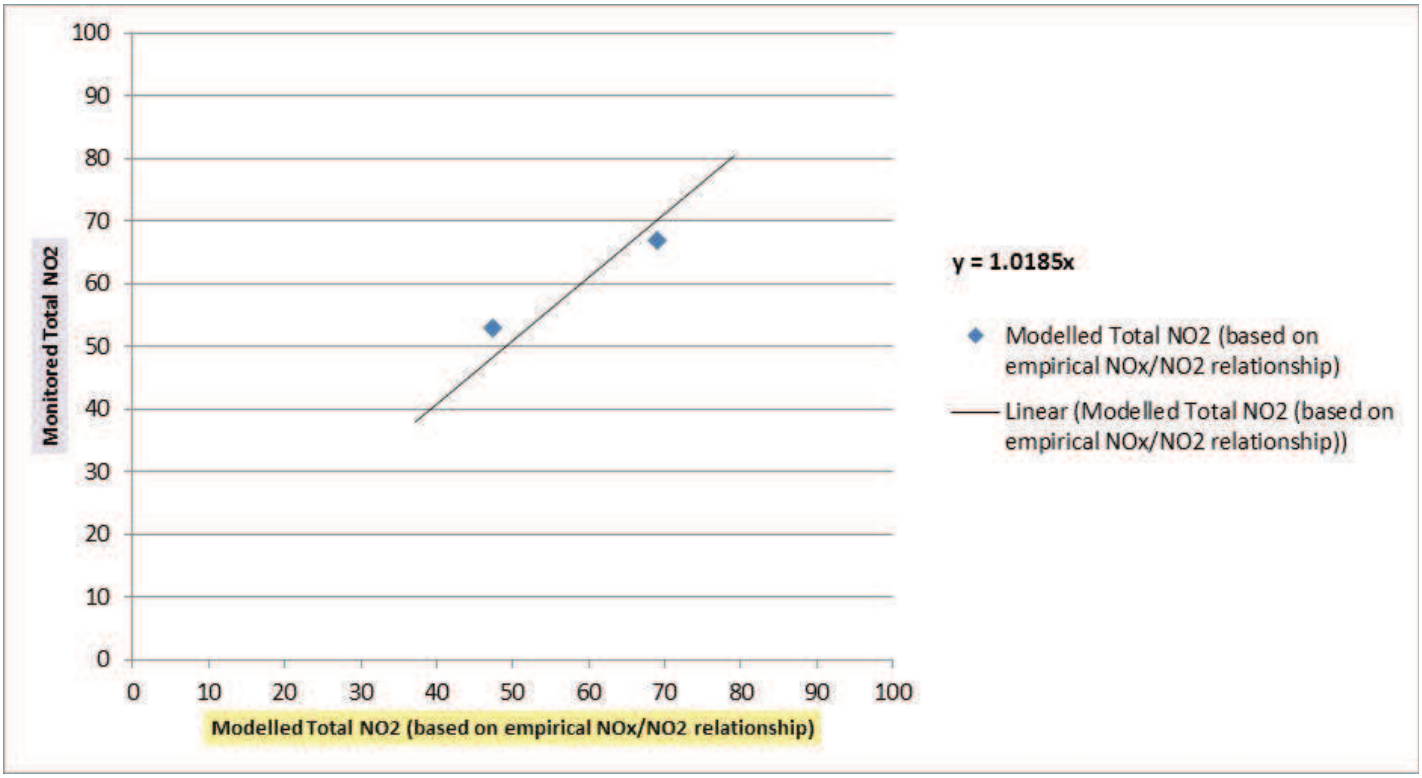
Appendix C:
Model Verification Procedure

	1	2	3	4	5	6	7
Address	2013 Monitored Total NO2	2013 Monitored Total NOx	2013 Background NO2	2013 Background NOx	Monitored Road Contribution NO2 (total - background)	Monitored Road Contribution NOx (excludes background)	Modelled Road Contribution NOx (excludes background)
V 1	53.00	107.31	23.59	34.60	29.41	72.71	8.68
V 2	67.00	153.58	23.59	34.60	43.41	118.98	19.55



	8	9	10	11	12	13	14
Address	Ratio of Monitored Road Contribution NOx / Modelled Road Contribution NOx	Adjustment Factor for Modelled Road Contribution	Adjusted Modelled Road Contribution NOx	Adjusted Modelled Total NOx (including background NOx)	Modelled Total NO2 (based on empirical NOx / NO2 relationship)	Monitored Total NO2	% Difference [(modelled - monitored) / monitored] x 100
V 1	8.38		56.11	90.71	47.28	53.00	-10.79
V 2	6.09		126.35	160.95	69.04	67.00	3.04
		6.4639					


Monitored Road Contribution NOx (exludes backgrounds)
120
110
100
90
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
Adjusted Road Contribution NOx
y = 1x
Adjusted Modelled Road Contribution NOx
Linear (Adjusted Modelled Road Contribution NOx)


Monitored Total NO2
100
90
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100
Modelled Total NO2 (based on empirical NOx/NO2 relationship)
y = 1.0185x
Modelled Total NO2 (based on empirical NOx/NO2 relationship)
Linear (Modelled Total NO2 (based on empirical NOx/NO2 relationship))

Appendix D:
Air Quality Assessment Results

Annual Mean NO_2 Concentrations (Corrected) and PM_{10} and $PM_{2.5}$ Concentrations (Uncorrected) in µg/m³

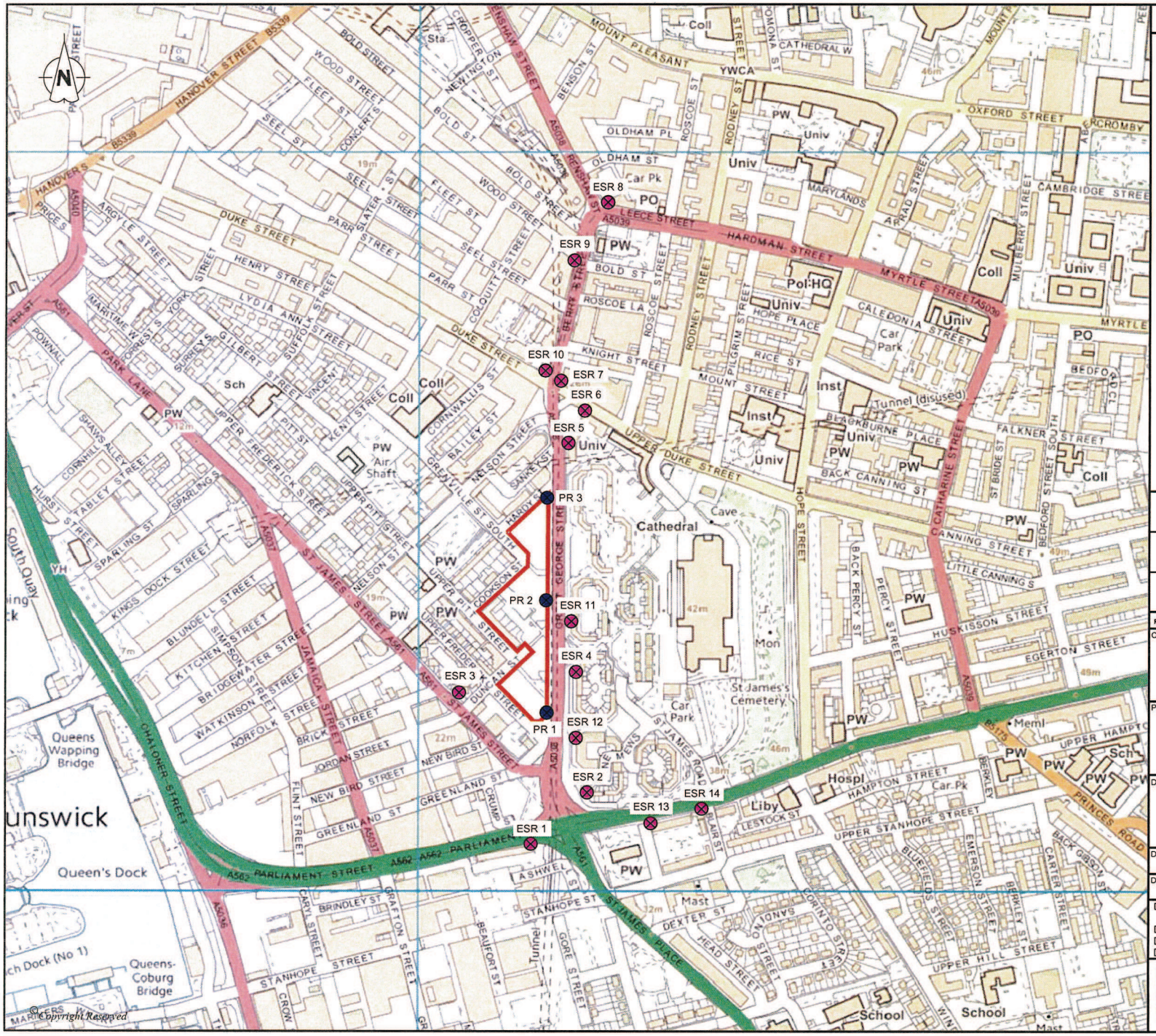
Receptor	Scenario 1: 2013 Verification and Base Year			Scenario 2: 2020 Opening/Future Year Without Development			Scenario 3: 2020 Opening/Future Year With Development		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
ESR 1	53.33	16.43	11.22	40.08	15.17	10.02	41.50	15.23	10.05
ESR 2	44.32	16.14	11.03	33.53	14.92	9.87	35.41	14.98	9.91
ESR 3	34.77	15.92	10.89	25.88	14.73	9.77	29.54	14.89	9.85
ESR 4	35.12	15.92	10.89	26.49	14.72	9.76	27.92	14.77	9.79
ESR 5	37.67	16.01	10.94	28.11	14.81	9.81	28.99	14.85	9.83
ESR 6	39.85	16.05	10.97	29.95	14.84	9.83	30.70	14.87	9.84
ESR 7	52.47	16.32	11.15	39.04	15.07	9.96	40.31	15.11	9.98
ESR 8	51.51	16.12	11.03	34.51	14.86	9.84	36.02	14.90	9.87
ESR 9	40.42	16.03	10.96	29.79	14.82	9.82	30.59	14.85	9.83
ESR 10	49.80	16.24	11.10	36.87	14.99	9.92	38.05	15.04	9.94
ESR 11	39.19	15.98	10.93	29.30	14.77	9.79	30.77	14.82	9.82
ESR 12	37.50	15.96	10.92	28.22	14.76	9.78	30.03	14.82	9.82
ESR 13	42.76	16.18	11.05	32.63	14.97	9.90	34.02	15.02	9.93
ESR14	44.32	16.30	11.12	33.81	15.08	9.96	35.26	15.15	10.00
PR 1							31.11	14.90	9.86
PR 2							29.05	14.77	9.78
PR 3							26.65	14.77	9.78

Appendix E:
Sensitivity Analysis Results

Annual Mean NO_2 Concentrations (Corrected) and PM_{10} and $PM_{2.5}$ Concentrations (Uncorrected) in µg/m^3

Receptor	Scenario 2: 2020 Opening/Future Year Without Development			Scenario 3: 2020 Opening/Future Year With Development		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
ESR 1	55.38	16.50	11.26	58.21	16.57	11.30
ESR 2	45.87	16.18	11.06	49.16	16.26	11.11
ESR 3	35.78	15.95	10.91	42.34	16.14	11.02
ESR 4	36.02	15.94	10.90	38.56	16.00	10.94
ESR 5	38.73	16.04	10.96	40.45	16.09	10.99
ESR 6	41.15	16.08	10.99	42.60	16.12	11.01
ESR 7	54.48	16.38	11.19	57.01	16.44	11.23
ESR 8	53.31	16.15	11.05	56.69	16.21	11.09
ESR 9	41.61	16.06	10.98	43.22	16.10	11.00
ESR 10	51.60	16.29	11.13	53.96	16.34	11.17
ESR 11	40.34	16.01	10.95	42.99	16.07	10.99
ESR 12	38.58	15.99	10.94	41.77	16.06	10.98
ESR 13	44.22	16.23	11.08	46.65	16.29	11.12
ESR14	45.87	16.35	11.15	48.41	16.43	11.20
PR 1				43.72	16.16	11.04
PR 2				40.34	16.00	10.95
PR 3				36.73	15.99	10.93

Drawing



DO NOT SCALE FROM THIS DRAWING | A3

REFERENCE

- SITE BOUNDARY
- EXISTING SENSITIVE RECEPTOR LOCATION
- PROPOSED SENSITIVE RECEPTOR LOCATION

REVISION	DETAILS	DATE	DRAWN	CHK'D	APP'D
A	First Issue	12/08/15	PG	MP	MTW

CLIENT

China Town
Development Company Limited

PROJECT

Environmental Services:
Tribeca, Liverpool

DRAWING TITLE

Existing and Proposed
Sensitive Receptors Locations

DRG No.	SCALE	DATE
ST14813-004	1:5000 @ A3	30/07/15

DRAWN BY	CHECKED BY	APPROVED BY
PG	MP	MTW

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		■ LEIGH	TEL 01942 260101
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☐ WEST BROMWICH	TEL 0121 580 0909	☐ EDINBURGH	TEL 0131 555 3311
☐ LONDON	TEL 020 7287 2672	☐ TAUNTON	TEL 01823 703100

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