Hindlow Works

Proposed Combined Heat and Power Plant

Appendix A - Air Quality Impact Assessment

SLR Ref: 403.04047.00003
Rev: Issue 1
October 2016

CONTENTS

TABLES

FIGURES

1.0 INTRODUCTION

SLR Consulting has been commissioned by Lhoist UK Limited to undertake a detailed air quality impact assessment (AQIA) to support the planning application for a combined heat and power (CHP) plant at the Hindlow Works, Buxton, Derbyshire. This assessment forms a technical appendix to the Planning Statement that supports a planning application for the proposed CHP plant.

1.1 Proposed Development

The proposal would involve the installation and operation of a CHP plant for on-site electricity generation via a gas fired engine. The plant would be located in the eastern part of the works site behind the Sorbacal Plant. Full details of the planning application are contained within the 'Planning Statement' which supports the planning application; the following details are of direct relevance to the AQIA:

- the CHP plant would be fired on natural gas with a 2004kW_{el} output;
- combustion emissions would be discharged via a 10m exhaust stack; and
- the proposed gas engine is supplied with a maximum nitrogen oxide (NO_x) exhaust emission of <500mg/Nm³.

1.2 Scope of Assessment

The scope of the assessment is to investigate combustion emissions from the CHP plant and the potential impact on air quality by comparison to environmental quality standards for the protection of human health and ecological conservation sites contained within legislation and regulatory guidance.

Following guidance contained within Environmental Protection UK's '*Combined Heat and Power: Air Quality Guidance for Local Authorities*' the combustion pollutants of concern for CHPs fired on natural gas are emissions of oxides of nitrogen (nitrogen oxide and nitrogen dioxide). The scope of the assessment therefore specifically addresses these potential impacts.

1.3 Structure of Report

The remainder of this report is structured as follows:

- Section 2 provides a summary of the relevant legislation and guidelines;
- Section 3 details the methodology applied in undertaking the assessment;
- Section 4 provides a description of the surrounding environment, including potentially sensitive receptors and a description of local air quality conditions;
- Section 5 reports the predicted impacts, and
- Section 6 concludes the report.

2.0 LEGISLATION, POLICY AND GUIDANCE

2.1 National Air Quality Legislation and Guidance

2.1.1 Air Quality Standards Regulations

The Air Quality Standards Regulations 2010 (the regulations) provide the transposition of the Air Quality Framework Directive, and transpose the Fourth Daughter Directive within the UK. The regulations include Limit Values, Target Values, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment (collectively termed Air Quality Assessment Levels (AQAL) throughout this report). Those relevant to this Air Quality Assessment are presented within Table 2-1 and Table 2-2.

Table 2-1
Relevant Air Quality Limit Value for Protection of Human Health

Pollutant	Limit Value	Measured as:	
Nitrogen dioxide (NO_2)	40µg/m^3	Annual mean	-
	200µg/m^3	1 hour mean	Not to be exceeded more than 18 times a calendar year

Table 2-2
Relevant Critical Level for the Protection of Vegetation and Ecosystems

Pollutant	Concentration (μg/m^3)	Measured as
Oxides of Nitrogen (NOx)	30	Annual mean

2.1.2 Air Quality Strategy

The United Kingdom Air Quality Strategy (UK AQS) for England, Scotland, Wales and Northern Ireland[1], last updated in 2007, sets out the Government's policies aimed at delivering cleaner air in the United Kingdom (UK). It sets out a comprehensive strategic framework within which air quality policy will be taken forward in the short to medium term, and the roles that Government, industry, the Environment Agency (EA), local government, business, individuals and transport have in protecting and improving air quality.

2.1.3 Local Air Quality Management (LAQM)

Section 82 of the Environment Act 1995 (Part IV) requires local authorities to periodically review and assess the quality of air within their administrative area. The reviews consider the present and future air quality and whether AQALs prescribed in regulations are being achieved or are likely to be achieved in the future.

Where any of the prescribed AQALs are not likely to be achieved the authority concerned must designate an Air Quality Management Area (AQMA). For each AQMA the local authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the AQAL. As such, Local Authorities (LAs) have formal powers to control air quality through a combination of LAQM and by use of their wider planning policies.

[1] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA. July 2007.

Defra has published technical guidance for use by local authorities in their review and assessment work[2]. Guidance within the document is also relevant to air quality assessments undertaken to support planning applications. The document provides guidance on assessing air quality against the regulations stating that the AQALs should be assessed at locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the standard. A summary of relevant exposure for the standards presented in Table 2-1 are shown below in Table 2-3.

Table 2-3
Relevant Public Exposure

Averaging Period	Relevant Locations	Objectives should apply at:	Objectives should not apply at:
Annual mean	Where individuals are exposed for a cumulative period of 6 months in a year	Building facades of residential properties, schools, hospitals etc.	Facades of offices Hotels Gardens of residences Kerbside sites
1-hour mean	Where individuals might reasonably expected to spend one hour or longer	As above together with kerbside sites of regular access, car parks, bus stations etc.	Kerbside sites where public would not be expected to have regular access

2.2 Standards for Protection of Ecological Receptors

Designated habitats may contain species, habitats or other receptors which are potentially sensitive to atmospheric pollution for which indicative exposure thresholds for their protection have been defined. These thresholds are known as Critical Levels (C_{Le} - for airborne concentrations) and Critical Loads (C_{Lo} - for deposition rates).

2.2.1 Critical Levels

C_{Le}'s are a quantitative estimate of exposure to one or more airborne pollutants in gaseous form, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. The NOx C_{Le} for the protection of vegetation and ecosystems is defined within the Air Quality Standards Regulations (see Table 2-2).

2.2.2 Critical Loads

C_{Lo}'s are a quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge.

Empirical critical loads are set out in the UK Air Pollution Information System (APIS) website (www.apis.ac.uk/). The APIS is a support tool for assessment of potential effects of air pollutants on habitats and species developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology. The relevant C_{Lo}'s from APIS are provided in Section 4.2.3.

[2] Department for Environment, Food and Rural Affairs (Defra): Local Air Quality Management Technical Guidance LAQM.TG(16), 2016.

2.3 Planning Policy

2.3.1 National Policy

The National Planning Policy Framework (NPPF) describes the policy context in relation to pollutants including air pollutants:

> *'The Government's objective is that planning should help to deliver a healthy natural environment for the benefit of everyone and safe places which promote wellbeing.*
> *To achieve this objective, the planning system should contribute and enhance the natural and local environment by:*
> *[...] preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of land, air, water or noise pollution or land instability.'*

Specifically in terms of development with regard to air quality:

> *'Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan.*

The NPPF is accompanied by supporting Planning Practice Guidance (PPG) which includes guiding principles on how planning can take account of the impacts of new development on air quality. In regards to air quality, the PPG states

> *"Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values […] It is important that the potential impact of new development on air quality is taken into account […] where the national assessment indicates that relevant limits have been exceeded or are near the limit."*
>
> *"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 impact 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).*
>
> *The PPG sets out the information that may be required within the context of a supporting air quality assessment, stating that "assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality […] Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact".*

The policy contained within the NPPF and PPG relating to air quality is addressed within this assessment.

2.3.2 Minerals Policy

The Derbyshire Minerals and Waste Development Framework (DMWDF) is a collection of documents setting out the planning policies that will apply to proposals for minerals and waste development. This includes the saved policies contained within the Derby and

Derbyshire Minerals Local Plan (adopted 2000 and amended in 2002). Policy MP1 on 'The Environmental Impact of Mineral Development' is relevant to air quality stating:

> *"Proposals for mineral development will be permitted provided that their impact on the environment is acceptable having regard to:*
>
> *1) the effect on local communities and neighbouring land uses by reason of … pollution or disturbance*
>
> *[…]*
>
> *5) the effect on sites and features of wildlife or geological/ geomorphological importance"*

2.3.3 Local Policy

The High Peak Local Plan was adopted on 14 April 2016. Policy EQ 10 is relevant to air quality it states:

> *"The Council will protect people and the environment from unsafe, unhealthy and polluted environments. This will be achieved by:*
>
> *Ensuring developments avoid potential adverse effects and only permitting developments that are deemed (individually or cumulatively) to result in the following types of pollution if any remaining potential adverse effects are mitigated to an acceptable level by other environmental controls or measures included in the proposals . This may be achieved by the imposition of planning conditions or through a planning obligation. The Council will not permit any proposal that has an adverse effect on a European site:*
>
> - *Air pollution […]."*

2.4 Assessment Guidance

2.4.1 Local Air Quality Management Technical Guidance LAQM.TG(16)

Defra has published technical guidance for use of local authorities in their LAQM work (referred to as LAQM.TG(16)). The guidance includes approaches and methods for handling background air quality data and undertaking assessments. The guidance has been applied as appropriate in this assessment; further detail on the methodology is provided in Section 3.0).

2.4.2 Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) Guidance

Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) have together published guidance[3] to help ensure that air quality is properly accounted for in the development control process. It clarifies when an air quality assessment should be undertaken, what it should contain, and how impacts should be described and assessed. Importantly, it sets out a recommended approach to assess the significance of effects.

[3] Environmental Protection UK and Institute of Air Quality Management, 'Land-Use Planning and Development Control: Planning for Air Quality', 2015.

2.4.3 EPUK CHP Guidance

EPUK has published guidance[4] on CHP plant for local authorities. The guidance addresses the assessment and management of the effects of CHP plant on air quality and identifies which pollutants should be considered for the various fuel types.

[4] Environmental Protection UK, 'Combined Heat and Power: Air Quality Guidance for Local Authorities' (February 2012)

3.0 ASSESSMENT METHODOLOGY

3.1 Approach

The assessment has been undertaken as a 'detailed assessment' using dispersion modelling. The assessment incorporates:

- identification of sensitive receptors and compilation of the existing air quality baseline;
- quantification of emissions from the plant;
- atmospheric dispersion modelling to determine process contribution to ambient concentrations; and
- assessment of impacts by comparison to AQALs and Critical Loads.

3.2 Baseline Air Quality

Baseline air quality is presented within Section 4.0 and has been evaluated using the following sources of information:

- High Peak Borough Council LAQM reports and monitoring data;
- Defra monitoring and background air quality maps; and
- APIS.

3.3 Quantification of Emissions

The emission parameters applied in the modelling are provided in Table 3-1 below. The CHP emission parameters have been input on the basis of manufacturer's design and specifications[5]. Kiln emissions for the assessment of potential cumulative impacts have been input on the basis of monitoring data provided by Lhoist.

Table 3-1
Emission Parameters

Parameter / Source	CHP Plant	Kiln 1	Kiln 2
Stack Height (m)	10	44	44
Emission temperature (K)	453	52	120
Stack diameter (m)	0.5	1.26	1.26
Velocity (m/s)	24.1	12.2	13.5
NOx Concentration (mg/Nm^3)	500	25	51
Flow (Nm^3/s)	2.13[(a)]	10.2[(b)]	9.3[(b)]
NOx emission g/s	1.06	0.32	0.60

Table Note:
a) Normalised to 273K, dry, 101.3kPa, 5%O_2
b) Normalised to 273K, wet, actual %O_2

3.4 Dispersion Modelling

The dispersion model used is the US American Meteorological Society and Environmental Protection Agency Regulatory Model, AERMOD v9. This model is commonly used for

[5] Lhoist – Hindlow, Containerised Combined Heat & Power Plant C3447LC04, Clarke Energy Limited, (5th July 2016)

assessments of this kind and has been accepted as suitable for use by the LAQM authorities and Environment Agency on similar projects.

Details of model inputs including model domain and receptor grids, topography, building downwash and meteorological data are provided in Appendix A.

3.5 Model Output and Significance of Impacts

The assessment of impacts against the AQALs as defined in Section 2.0 was undertaken using model output as described in Table 3-2 below.

Model output is for total NOx. Following Environment Agency Air Quality Modelling and Assessment Unit guidance[6] on conversion ratio for NOx and NO_2, a worst case scenario has been applied in that 70% of NO_x is present as NO_2 in relation to long term impacts and 35% of NO_x is present as NO_2 in relation to short-term impacts.

The adjusted NO_2 output (Process Contribution (PC)) has been added to the baseline concentration to derive the predicted environmental concentration (PEC: PC + background).

Table 3-2
Model Outputs

NO_2 AQAL Averaging Period	Model Output (PC)	Predicted Environmental Concentration (PEC)
1 hour mean. Not to be exceeded more than 18 times a calendar year	99.79%ile of 1-hour means	PC + 2 x annual mean background
Calendar year	Annual Mean	PC+ annual mean background

Descriptors for change and predicted impact applied in this assessment are taken from the EPUK/IAQM Guidance in which the impact severity for a proposed development is judged on the basis of the long term impacts using the matrix in Table 3-3.

Table 3-3
Impact Significance Matrix

Concentration with development	Percentage Change in Air Quality Relative to annual AQAL (%)			
	1 (note a)	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

Table Note: a) Changes of less than 1% will be described as Negligible

3.6 Assessment of Air Quality Impacts on Habitats

Deposition was modelled using AERMOD following the modelling procedures defined in the SCAIL model guidance for assessing the impact of combustion installations[7]. The deposition parameters were input as shown in Table 3-4.

[6] Environment Agency, Air Quality Modelling and Assessment Unit, '*Conversion Ratios for NO_x and NO_2* ' (no date).http://webarchive.nationalarchives.gov.uk/20140328084622/http:/www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf

[7] EA, SEPA, NIEA, SNIFFER, '*Final Report for SCAIL Combustion*' (May 2010).

Table 3-4
Deposition Parameters

Parameter	NO_2
Diffusivity in air (cm^2/s)	0.1361
Diffusivity in water (cm^2/s)	1.90E-05
Cuticular resistance (s/m)	9999
Henry's Law (Pa m^3/mol)	10132.5
Reactivity	0.5

The predicted deposition rates were converted from NO_2 µg/m^2/s to units of N kg/ha/year by multiplying the dry deposition flux by the standard conversion factor of 96. The predicted N deposition rates are converted to units of equivalents (k_{eq}/ha/year), which is a measure of how acidifying the chemical species can be, by multiplying the dry deposition flux (kg/ha/year) by a factor of 0.07.

The calculation of the process contribution to the critical load function has been carried out according to the guidance on APIS, which is as follows:

> *'The potential impacts of additional sulphur and/or nitrogen deposition from a source are partly determined by PEC, because only if PEC of nitrogen deposition is greater than CLminN will the additional nitrogen deposition from the source contribute to acidity. Consequently, if PEC is less that CLminN only the acidifying effects of sulphur from the process need to be considered:*
>
> *Where PEC N Deposition < CLminN*
>
> *PC as % CL function = (PC S deposition/CLmaxS)*100*
>
> *Where PEC is greater than CLminN (the majority of cases), the combined inputs of sulphur and nitrogen need to be considered. In such cases, the total acidity input should be calculated as a proportion of the CLmaxN.*
>
> *Where PEC N Deposition > CLminN*
>
> *PC as %CL function = ((PC of S+N deposition)/CLmaxN)*100'*

3.6.1 Assessment of Impact Significance at Conservation Sites

The assessment of the significance of impacts at protected conservation sites has been undertaken following the approach detailed in Environment Agency guidance[8],[9]. This guidance provides risk based screening criteria to determine whether emissions are likely to result in 'significant pollution':

- if the PC at an SPA, SAC or SSSI is less than 1% of the relevant long-term benchmark (EAL, critical level or critical load), the emission is '*not likely to have a significant effect alone or in combination irrespective of the background levels';*

[8] EA's Operational Instruction 66_12 'Simple assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation'

[9] EA's Operational Instruction 67_12 'Detailed assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation'

- if the PC at an SPA, SAC or SSSI is more than 1% of the relevant long-term benchmark then the background is considered to derive the PEC. If the PEC is less than 100% it can be concluded there will be '*no adverse effect*'; and
- for NNR, LNR, LWS and AW if the process contribution is less than 100% of the relevant critical level or load then it can be concluded there is '*no significant pollution*'.

4.0 BASELINE ENVIRONMENT

4.1 Site Location and Sensitive Receptors

The CHP is to be situated in the eastern part of the Hindlow Works site behind the Sorbacal Plant. The surrounding area is predominantly agricultural land with isolated residential properties. To the east, southeast and northwest of the Works lie mineral workings. The site setting and assessed receptor location (as described in the following sections) are shown in Figure 4-1

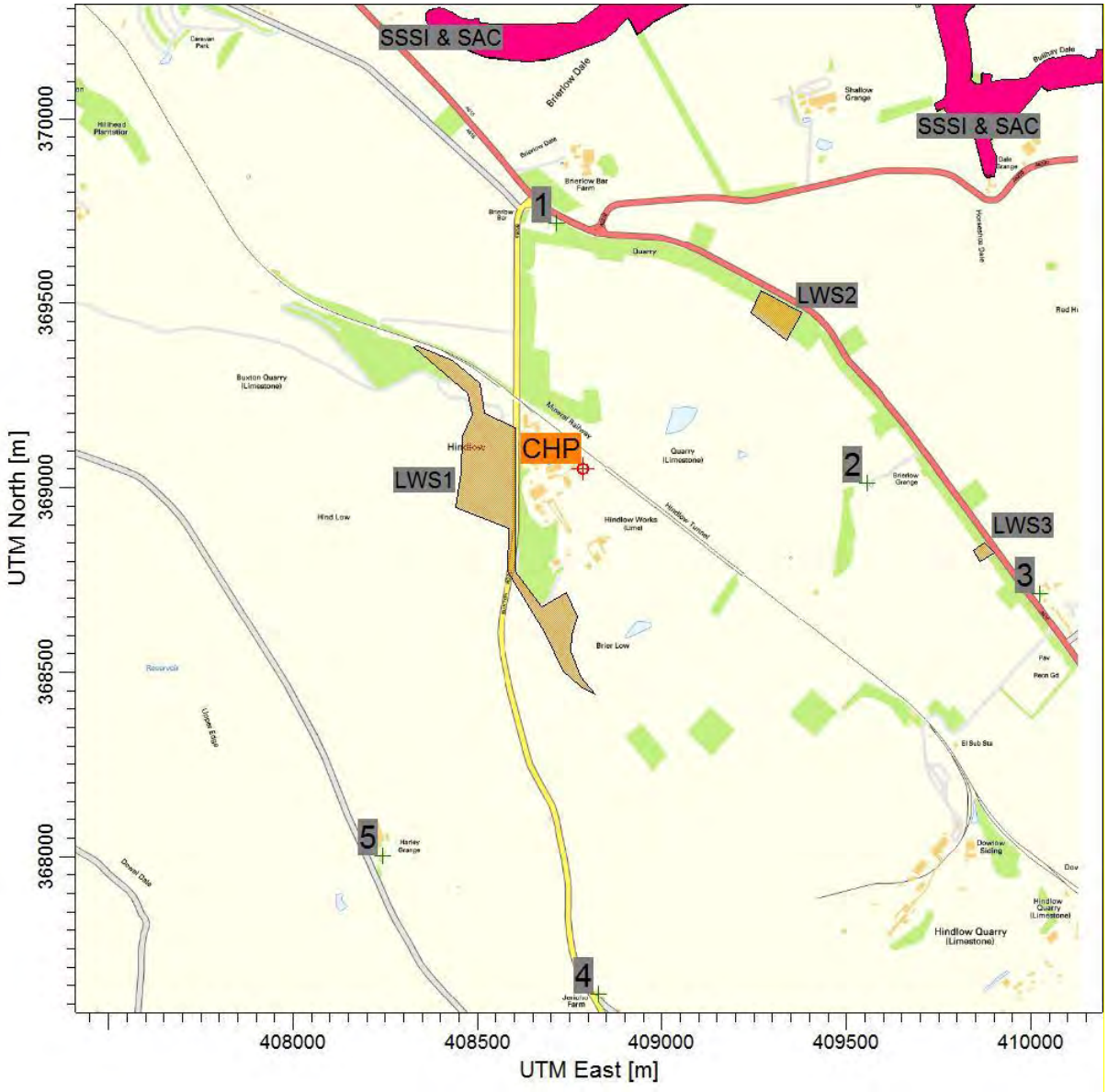

Figure 4-1
Site Setting

4.1.1 Human Receptors

The dispersion modelling has been completed using a receptor grid, as such the impact has been assessed at all locations surrounding the site. A number of discrete sensitive receptors have been selected to facilitate presentation and discussion of the air quality impact in the

surrounding area (listed in Table 4-1 and shown in Figure 4-1). These include the nearest receptor locations to the site where impacts are likely to be greatest.

Table 4-1
Assessed Discrete Human Receptor Locations

Reference	Receptor
R1	Brierlow Bar
R2	Brierlow Grange
R3	Sterndale
R4	Jericho Farm
R5	Harley Grange

4.1.2 Habitat Conservation Sites

Searches for Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNR), Local Nature Reserves (LNR), and ancient woodland (AW) and Local Wildlife Sites (LWS) within 2km of the installation have been undertaken using the Defra 'Multi-Agency Geographic Information for the Countryside (MAGIC)' web resource for protected sites and High Peak Local Plan Polices maps for LWS's.

On the basis of the searches undertaken units of the Topley Pike and Deep Dale SSSI that also form part of the Peak District Dales SAC require assessment and three Derbyshire Local Wildlife Sites.

4.2 Baseline Air Quality

4.2.1 Local Air Quality Management

The Application Site lies within the administrative area of HPBC. As required under Section 82 of the Environment Act (1995) (Part IV), HPBC has conducted an ongoing exercise to review and assess air quality within their area of jurisdiction.

Air quality within HPBC is generally good as would be expected given its rural characteristics. The latest published LAQM report[10] indicates that all AQS pollutants meet their objectives, with the exception of NO_2 at Tintwistle which is the subject of monitoring to inform a Detailed Assessment on the need to declare an Air Quality Management Area. Tintwistle is approximately 25km north of the site and as such the proposed CHP will not influence the potential designation of the AQMA in this area. In the local area to the Application Site the LAQM reports do not raise any issues of concern.

4.2.2 Background Air Quality

The closest air quality monitoring sites for NO_2 are situated in Buxton approximately 5km north west of the Application Site. Given the urban setting of the monitoring sites they are not considered representative of baseline conditions in the more rural surroundings of the Application Site.

Defra provide modelled background pollutant concentration data on a 1km x 1km spatial resolution across the UK that is routinely used to support LAQM and Air Quality

[10] High Peak Borough Council, 2013 Air Quality Progress Report for High Peak Borough Council (January 2014). http://www.highpeak.gov.uk/hp/council-services/pollution-and-noise-control/air-quality accessed 30/09/2016

Assessments[11]. The projected 2016 backgrounds for the study area are presented in Table 4-2.

Table 4-2
Background NO_2

Grid Square	NO_2 Concentration
408500, 369500	11.9
409500, 369500	10.7
410500, 368500	10.4
408500, 367500	10.2
408500, 368500	10.3

4.2.3 Baseline Conditions at Ecological Sites

APIS has been used to provide information on:

- identification of whether the habitats present are sensitive to effects caused by emissions;
- current baseline NOx concentrations (Table 4-3); and
- Critical Loads and current deposition rates (Table 4-3 and Table 4-4).

The APIS data indicates that the C_{Le} for NO_x are not exceeded at any of the ecological receptors. The nitrogen C_{Lo} is exceeded at all sites but the acid C_{Lo} is not.

Table 4-3
Nitrogen oxide Concentration, N C_{Lo} and Deposition

Name / Type	Habitat Class (most sensitive feature)	Critical Load Range (kg N/ha/yr)	Deposition (kg N/ha/yr)	APIS NOx Background (µg/m³)
Topley Pike and Deep Dale SSSI	Alpine and subalpine calcareous grasslands (Inland rock (Asplenium viride - Cystopteris fragilis community))	5-10	31.2	17.92
Peak District Dales SAC	Alpine and subalpine grasslands (Calcareous rocky slopes with chasmophytic vegetation)	5-10	31.2	17.92
LWS 1	Lowland calcareous grassland	15-25	31.1	14.86
LWS 2	Deciduous woodland	10-20	49.4	14.86
LWS 3	Deciduous woodland	10-20	49.4	14.86

Table 4-4
Acid Critical Load Functions and Current Loads (kg_{eq}/ha/yr)

Name / Type	Habitat Class (most sensitive feature)	Critical Load Function	N Dep	S Dep	C_{Lo} exceeded?
Topley Pike and Deep Dale SSSI	Acid grassland (Neutral grassland (Damp tall-herb grassland, damp grassland/ scrub transitions))	CLminN: 0.223 CLmaxN: 4.783 CLmaxS: 4.560	2.25	0.63	No
Peak District Dales SAC	Montane (Calcareous and calcshist screes of the montane to alpine levels (Thlaspietea rotundifolii) - Base-rich scree)	CLminN: 0.393 CLmaxN: 4.768 CLmaxS: 4.590	2.25	0.63	No

11 Defra, UK Air Information Resource (UK-AIR) website, http://uk-air.defra.gov.uk/ , accessed September 2016

Name / Type	Habitat Class (most sensitive feature)	Critical Load Function	N Dep	S Dep	C_{Lo} exceeded?
LWS 1	Lowland calcareous grassland	CLmaxS: 4.2 CLminN: 0.85 CLmaxN: 5.06	2.22	0.53	No
LWS 2	Deciduous woodland	CLmaxS: 12.59 CLminN: 0.14 CLmaxN: 12.73	3.53	0.69	No
LWS 3	Deciduous woodland	CLmaxS: 7.53 CLminN: 0.14 CLmaxN: 7.67	3.53	0.69	No

4.3 Meteorological Conditions

The most important meteorological parameters governing the atmospheric dispersion of pollutants are as follows:

- wind direction determines the broad transport of the emission and the sector of the compass into which the emission is dispersed;
- wind speed will affect ground level concentrations of emissions by increasing the initial dilution of pollutants in the emission; and
- atmospheric stability; a measure of the turbulence, particularly of the vertical motions present.

A windrose for the site (2011 to 2015), providing the frequency of wind speed and direction, is presented in Figure 4-2 below. The windrose shows winds from the south west are most frequent with winds from the north east least frequent.

4.4 Topography and Buildings

The presence of elevated terrain and buildings can affect the dispersion of pollutants and the resulting ground level concentration in a number of ways. Elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to a source and reducing concentrations further away. The presence can cause building downwash. Building downwash occurs when turbulence, induced by nearby structures, causes pollutants emitted from an elevated source to be displaced and dispersed rapidly towards the ground, resulting in elevated ground level concentrations.

The topography of the surrounding area is hilly. The works itself lies at approximately 366m Above Ordnance Datum (AOD) on a north west facing slope. The land rises to the south east, south and the west and falls slowly to the north. The SAC and SSSI lie on land at approximately 310m AOD approximately 1km to the north. Terrain has been incorporated into the modelling (see Appendix A).

Existing buildings on site have the potential to have an effect on dispersion, in particular a number of buildings which are more elevated than the discharge point of the CHP. The existing buildings and the proposed CHP container have been incorporated into the modelling (see Appendix A).

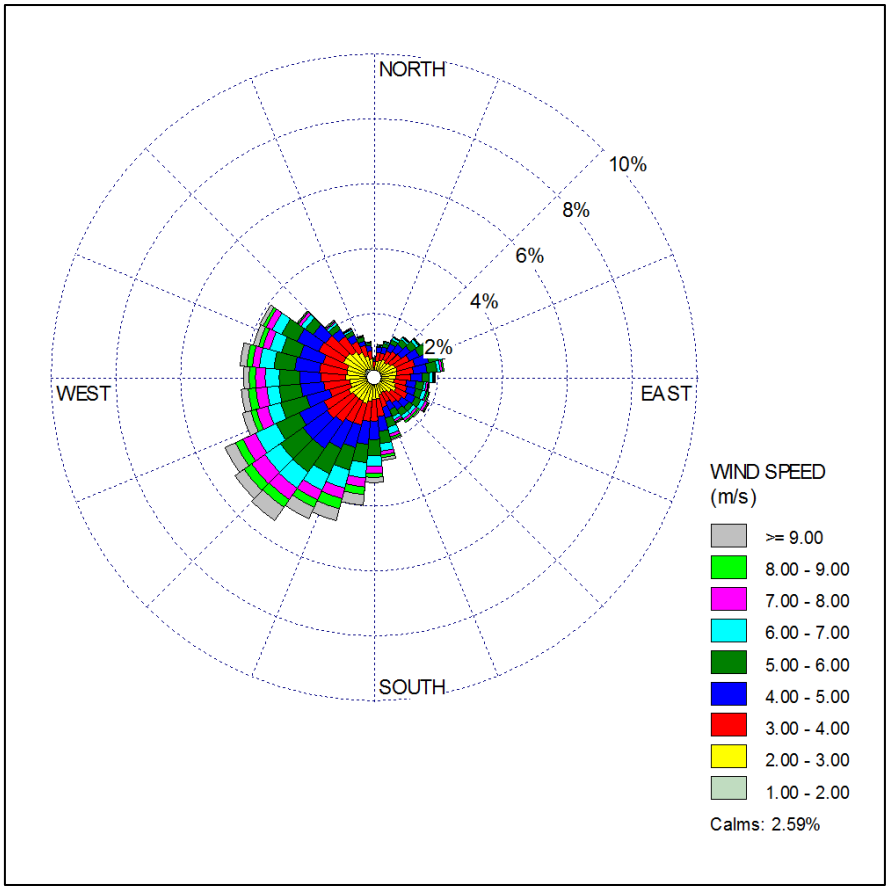

Figure 4-2
Windrose (2011-2015)

5.0 PREDICTED IMPACTS

5.1 Impacts on Annual Mean AQAL

The process contribution (PC) and predicted environmental concentration (PEC: PC + existing Kiln emissions + background) at receptor locations for the annual mean averaging period are presented in Table 5-1. The ground level annual mean process contribution is presented graphically in Figure 5-2.

The impact on annual mean AQAL at receptor locations has been classified according to the EPUK-IAQM criteria. The PC at the receptors is less than 5% of the AQAL and the PEC is less than 75% of the AQAL. The impact is therefore classified as 'negligible'.

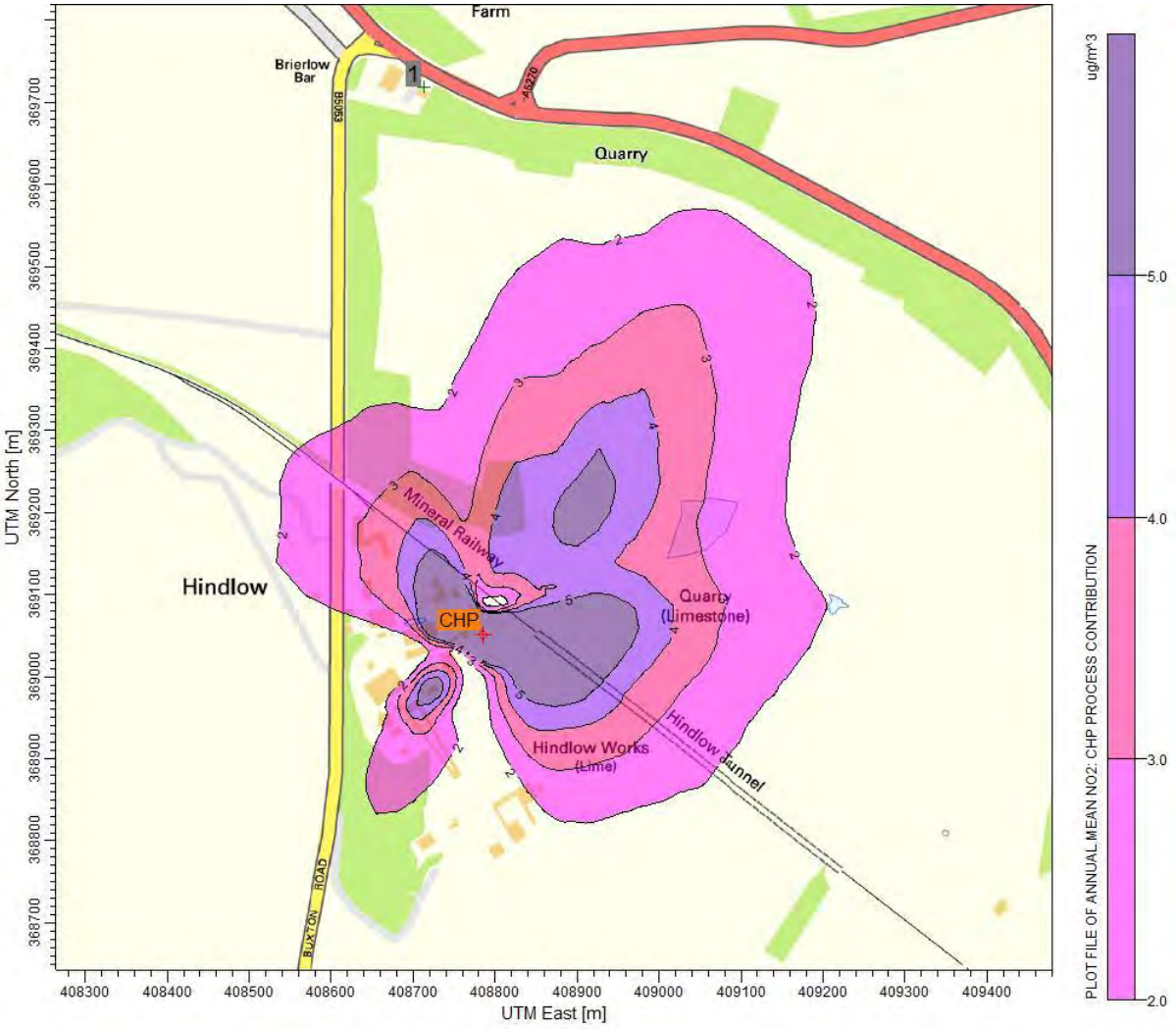

Figure 5-1
Annual Mean NO_2 Process Contribution

Table 5-1
Annual Mean Concentrations at Receptor Locations

Ref.	CHP PC (µg/m^3)	PC % EAL	PEC (µg/m^3)	PEC% EAL	Impact Significance
R1	0.6	1.5%	12.7	32%	Negligible
R2	0.8	2.1%	11.6	29%	Negligible
R3	0.4	1.0%	10.9	27%	Negligible
R4	0.1	0.2%	10.3	26%	Negligible
R5	0.2	0.5%	10.5	26%	Negligible

5.2 Impacts on 1-hour Mean AQAL

The PC and PEC at receptor locations for the 1-hour mean averaging period (as a 99.79%ile) are presented in Table 5-2. There is considered to be a negligible to small change as a result of the process contribution from the CHP. The impact is presented graphically in Figure 5-2.

On the basis that the PEC is considerably below the AQAL, i.e. less than 30% of the AQAL, the significance of impact is considered 'negligible'.

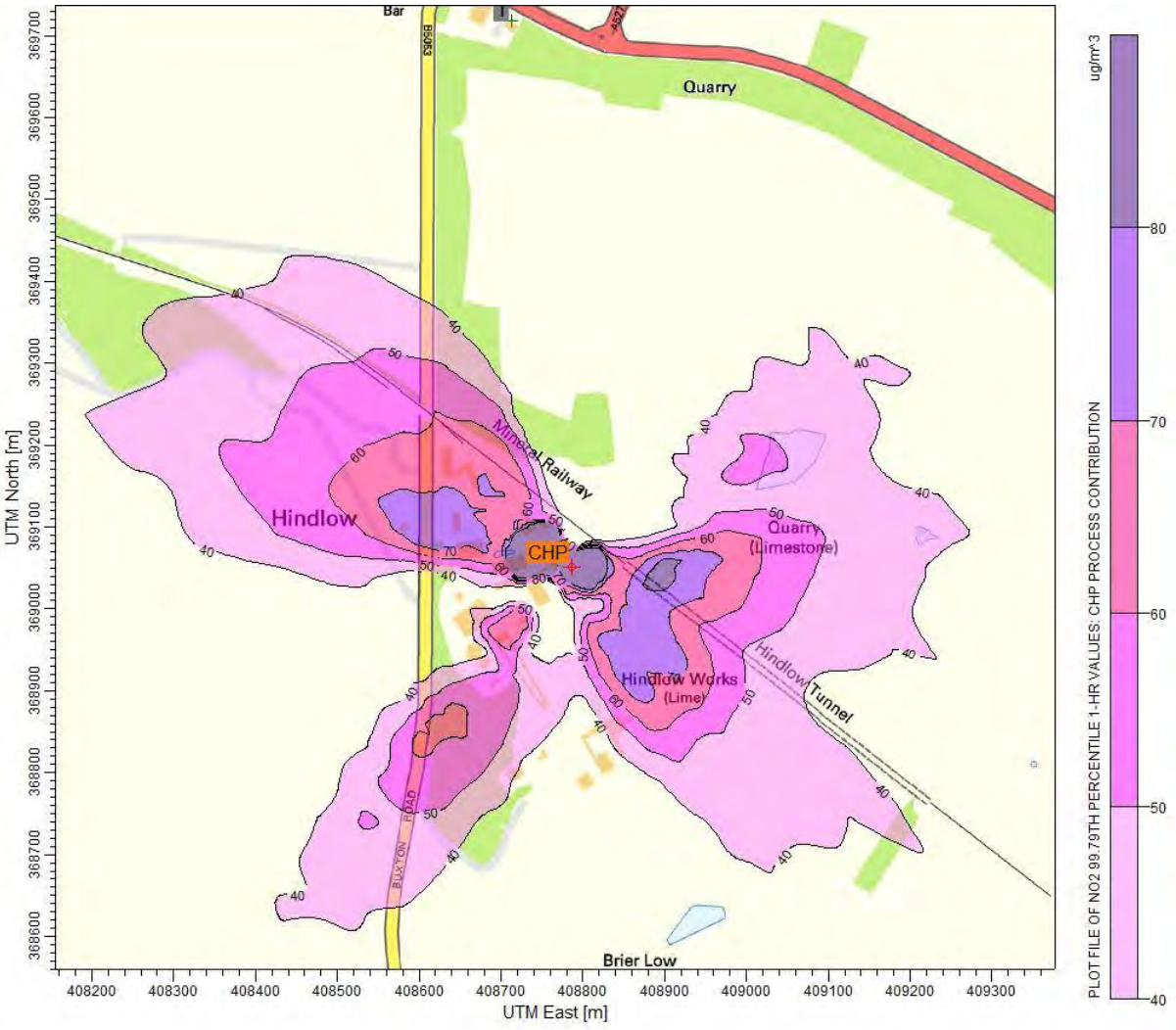

Figure 5-2
1-hour Mean 99.8%ile NO_2 Process Contribution

Table 5-2
1-hr Mean (99.79%ile) Concentrations at Receptor Locations

Ref.	PC ($\mu g/m^3$)	PC % EAL	PEC ($\mu g/m^3$)	PEC% EAL	Impact Significance
R1	12.7	6.3%	37.7	19%	Negligible
R2	26.3	13.1%	48.2	24%	Negligible
R3	14.5	7.2%	35.9	18%	Negligible
R4	2.4	1.2%	23.2	12%	Negligible
R5	11.4	5.7%	32.6	16%	Negligible

5.3 Impacts on Habitat Conservation Sites

5.3.1 Critical Levels

The maximum predicted ground level process contribution of NO_x at the SSSI and SAC is presented in Table 5-3. The PC due to the CHP is >1% of the C_{Le} therefore the cumulative impacts including the Kilns and background NOx has been assessed. The cumulative impact is below the C_{Le}, as such it can be concluded there will be '*no adverse effect'* on the SSSI or SAC. Impacts at the LWSs are less than 100% of the C_{Le} and therefore there is predicted to be '*no significant pollution*'.

Table 5-3
Predicted Nitrogen oxide Concentration at Ecological Receptors ($\mu g/m^3$)

ID	CHP PC	% of C_{Le}	Cumulative PC	% of C_{Le}	PEC	% of C_{Le}
			Comparison against Annual mean C_{Le}			
Topley Pike and Deep Dale SSSI	0.5	1.7%	0.6	2.0%	18.5	61.7%
Peak District Dales SAC	0.5	1.7%	0.6	2.0%	18.5	61.7%
LWS 1	4.3	14.5%	4.4	14.6%	19.2	64.1%
LWS 2	0.7	2.5%	0.8	2.8%	15.7	52.3%
LWS 3	2.2	7.4%	2.4	8.0%	17.3	57.5%

5.3.2 Critical Loads

The predicted deposition rates at the ecological receptors compared to the C_{Lo}'s are presented in Table 5-4 and Table 5-5 below, for contribution to N and acid deposition respectively. The PC from the CHP is less than 1% of the C_{Lo}'s at the SAC and SSSI, the emission therefore is '*not likely to have a significant effect alone or in combination irrespective of the background levels'.* The PC from the CHP is less than 100% of the C_{Lo}'s at the LWS, therefore there is predicted to be '*no significant pollution*'.

Table 5-4
Predicted N Deposition at Ecological Receptors

ID	CHP PC N (kg/ha/yr)	PC as % of Lower C_{Lo}
Topley Pike and Deep Dale SSSI	0.042	0.8%
Peak District Dales SAC	0.042	0.8%
LWS 1	0.498	3.3%
LWS 2	0.062	0.6%
LWS 3	0.207	2.1%

Table 5-5
Predicted Acid Deposition at Ecological Receptors

ID	CHP PC N (k_{eq}/ha/yr)	PC as % C_{Lo}
Topley Pike and Deep Dale SSSI	0.003	0.1%
Peak District Dales SAC	0.003	0.1%
LWS 1	0.036	0.7%
LWS 2	0.004	<0.1%
LWS 3	0.015	0.2%

6.0 CONCLUSION

The assessment of emissions from the proposed CHP, undertaken using detailed dispersion modelling techniques, leads to the following conclusions:

- the impact at relevant human exposure locations for the NO_2 annual mean and 1-hour mean AQALs is of negligible significance according to IAQM significance criteria;
- the impact on NOx Critical Levels at Topley Pike and Deep Dale SSSI Peak District Dales SAC is concluded to result in '*no adverse effect*' and impacts on Critical Loads are '*not likely to have a significant effect alone or in combination irrespective of the background levels'* according to the impact framework detailed in Environment Agency guidance; and
- the impact on LWSs is predicted to result in '*no significant pollution'* according to the impact framework detailed in Environment Agency guidance

On this basis effects on air quality as a result of emissions from the proposed CHP are not considered significant.

7.0 CLOSURE

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Lhoist; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

APPENDIX A – MODEL INPUTS

Model Domain / Receptors

The modelling has been undertaken using a receptor grid across an Ordnance Survey map of the study area. Pollutant exposure isopleths are generated by interpolation between receptor points and superimposed onto the map. This method allows the maximum concentration in the surrounding area to be assessed. A receptor grid was applied at the following resolutions:

- 10m grid resolution to 100m;
- 20m grid resolution to 200m;
- 50m grid resolution to 500m;
- 100m grid resolution to 1000m; and
- 200m grid resolution to 2000m from source.

In addition the modelling of discrete sensitive receptor locations as described in Section 4.1.1 was undertaken.

Topography

AERMOD utilises digital elevation data to determine the impact of topography on dispersion from a source. Topographical data for the site has been obtained in OS digital (.ntf) format. The model was run with OS 1:50,000 scale digital height contour data. Data was processed by the AERMAP function within AERMOD to calculate terrain heights. The ground level elevations for buildings within the application site have been entered on the basis of site data.

Meteorological Data and Pre-processing

The meteorological data used in this study is obtained from assimilation and short term forecast fields of the Numerical Weather Prediction (NWP) system known as the Global Forecast System (GFS). The GFS resolution data has been processed using the flow field module of ADMS (FLOWSTAR) to account for local topological features. A 5 year data set, covering the period 2011 – 2015 has been used for this assessment. This accounts for inter-year variability in meteorological conditions. A windrose is presented in Figure 4-2.

The meteorological data was obtained in .met format from the data supplier and converted to the required surface and profile formats for use in AERMOD using AERMET View meteorological pre-processor. Based on the surrounding characteristics surface roughness, bowen ratio and albedo were entered as in Table A-1.

Table A-1
Assessed Discrete Human Receptor Locations

Sector	Albedo	Bowen ratio	Surface Roughness
10 - 350	0.2800	0.750	0.085
350 -10	0.1775	0.825	0.900

Building Downwash

The integrated Building Profile Input Programme (BPIP) module within AERMOD was used to assess the potential impact of building downwash upon predicted dispersion characteristics. Buildings input to the model are presented in Figure A-1.

Figure A-1
Modelled Buildings

ABERDEEN
214 Union Street,
Aberdeen AB10 1TL, UK
T: +44 (0)1224 517405

AYLESBURY
7 Wornal Park, Menmarsh Road,
Worminghall, Aylesbury,
Buckinghamshire HP18 9PH, UK
T: +44 (0)1844 337380

BELFAST
Suite 1 Potters Quay, 5 Ravenhill Road,
Belfast BT6 8DN, UK, Northern Ireland
T: +44 (0)28 9073 2493

BRADFORD-ON-AVON
Treenwood House, Rowden Lane,
Bradford-on-Avon, Wiltshire BA15 2AU,
UK
T: +44 (0)1225 309400

BRISTOL
Langford Lodge, 109 Pembroke Road,
Clifton, Bristol BS8 3EU, UK
T: +44 (0)117 9064280

CAMBRIDGE
8 Stow Court, Stow-cum-Quy,
Cambridge CB25 9AS, UK
T: + 44 (0)1223 813805

CARDIFF
Fulmar House, Beignon Close, Ocean
Way, Cardiff CF24 5PB, UK
T: +44 (0)29 20491010

CHELMSFORD
Unit 77, Waterhouse Business Centre,
2 Cromar Way, Chelmsford, Essex
CM1 2QE, UK
T: +44 (0)1245 392170

DUBLIN
7 Dundrum Business Park, Windy
Arbour, Dundrum, Dublin 14 Ireland
T: + 353 (0)1 2964667

EDINBURGH
4/5 Lochside View, Edinburgh Park,
Edinburgh EH12 9DH, UK
T: +44 (0)131 3356830

EXETER
69 Polsloe Road, Exeter EX1 2NF, UK
T: + 44 (0)1392 490152

GLASGOW
4 Woodside Place, Charing Cross,
Glasgow G3 7QF, UK
T: +44 (0)141 3535037

GRENOBLE
BuroClub, 157/155 Cours Berriat,
38028 Grenoble Cedex 1, France
T: +33 (0)4 76 70 93 41

GUILDFORD
65 Woodbridge Road, Guildford
Surrey GU1 4RD, UK
T: +44 (0)1483 889 800

LEEDS
Suite 1, Jason House, Kerry Hill,
Horsforth, Leeds LS18 4JR, UK
T: +44 (0)113 2580650

LONDON
83 Victoria Street,
London, SW1H 0HW, UK
T: +44 (0)203 691 5810

MAIDSTONE
19 Hollingworth Court, Turkey Mill,
Maidstone, Kent ME14 5PP, UK
T: +44 (0)1622 609242

MANCHESTER
8th Floor, Quay West, MediaCityUK,
Trafford Wharf Road,
Manchester M17 1HH, UK
T: +44 (0)161 872 7564

NEWCASTLE UPON TYNE
Sailors Bethel, Horatio Street,
Newcastle-upon-Tyne NE1 2PE, UK
T: +44 (0)191 2611966

NOTTINGHAM
Aspect House, Aspect Business Park,
Bennerley Road, Nottingham NG6 8WR,
UK
T: +44 (0)115 9647280

SHEFFIELD
Unit 2 Newton Business Centre,
Thorncliffe Park Estate, Newton
Chambers Road, Chapeltown,
Sheffield S35 2PW, UK
T: +44 (0)114 2455153

SHREWSBURY
2nd Floor, Hermes House, Oxon
Business Park, Shrewsbury SY3 5HJ,
UK
T: +44 (0)1743 239250

STAFFORD
8 Parker Court, Staffordshire Technology
Park, Beaconside, Stafford ST18 0WP,
UK
T: +44 (0)1785 241755

STIRLING
No. 68 Stirling Business Centre,
Wellgreen, Stirling FK8 2DZ, UK
T: +44 (0)1786 239900

WORCESTER
Suite 5, Brindley Court, Gresley Road,
Shire Business Park, Worcester WR4
9FD, UK
T: +44 (0)1905 751310

www.slrconsulting.com