Kintore Hydrogen Plant

Appendix 11.1: Operational Air Quality Assessment

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Quality management			
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1 Introduction

1.1 Overview

1.1.1 This operational Air Quality Assessment (AQA) has been prepared by the Savills Environment and Infrastructure team for the proposed Kintore Hydrogen Plant (hereafter referred to as the proposed development). Specifically, the AQA has focused on emissions of nitrogen dioxide (NO_2) arising from the operation of a hydrogen flare at the proposed development.

1.1.2 This AQA is an appendix to Chapter 11: Air Quality of the Kintore Hydrogen Plant Environmental Impact Assessment Report (EIAR). The purpose of this appendix is to provide an air quality assessment of the potential effects of the hydrogen flare on local air quality. Details of the model set up, the baseline conditions, the different model scenarios, and the results provided by each model scenario are presented in this technical appendix. The EIAR chapter concludes as to the significance of potential effects on receptors.

1.2 Project description

1.2.1 The proposed development would be a facility for production of hydrogen from water by electrolysis using renewable electricity. Full details are given in Chapter 2: Project Description and Site Setting of the EIAR. In overview, the land within the proposed development boundary can be divided into four parts:

- the main electrolysis plant site including temporary construction access and permanent access road;
- the electrical connection from Kintore Substation to the electrolysis plant;
- the underground hydrogen pipeline to a connection and blending point for export into National Grid Gas's existing National Transmission System (NTS);
- the water abstraction and discharge point, pumping and treatment station, and underground water pipelines to and from the River Don; and
- the riparian and other habitat creation and enhancement area on the east bank of the River Don.

1.2.2 The hydrogen flare would be located at the electrolysis plant site, which is referred to as the development site in this appendix. Other areas within the planning application boundary, such as the water pipeline route, have no source of operational air pollutant emissions.

1.2.3 An enclosed ground flare is the preferred solution to safely manage hydrogen should the high-pressure elements of the system need to be de-pressurised and the hydrogen inventory removed during an abnormal operational event. Use of the flare in this way would be for abnormal events, and hence very rare. Much smaller quantities of low-pressure hydrogen also need to be managed routinely during start-up, shut-down and maintenance events for the electrolysis modules, e.g. where lines within the plant need to be purged. The enclosed ground flare would be used routinely for this purpose, having internally a series of hydrogen burners which allow it to be flexible to the much varying quantities of hydrogen requiring routine flaring or potentially abnormal event flaring.

1.2.4 The proposed electrolysis plant site is located on land to the west of the existing Kintore Substation and is currently agricultural land. The site is not located in an Air Quality Management Area (AQMA) and there are no internationally-, nationally-, or locally-designated nature conservation sites within a 5 km radius of the electrolysis plant site, although the Loch of Skene SPA is located just over 5 km from the application boundary.

2 Legislation and Policy

The European Directive on ambient air and cleaner air for Europe

2.1.1 European Directive 2008/50/EC of the European Parliament and the Council of 21 May 2008 sets legally binding concentration-based limit values, as well as target values, for the protection of public health and sensitive habitats [1]. The Directive was transposed into domestic law by the Air Quality Standards Regulations in England, Scotland, Wales and Northern Ireland in June 2010 [2].

2.1.2 The pollutants included are sulphur dioxide (SO_2), nitrogen dioxide (NO_2), oxides of nitrogen (NO_x) particulate matter of less than 10 micrometres (µm) in aerodynamic diameter (PM_{10}), particulate matter of less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$), lead (Pb), carbon monoxide (CO), benzene, ozone (O_3), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni) and mercury (Hg).

2.1.3 Of these pollutants, the relevant pollutant emitted by combustion of hydrogen is NO_x.

UK Air Quality Strategy

2.1.4 The Environment Act 1995 established the requirement for the government and devolved administrations to produce a National Air Quality Strategy (AQS) for improving ambient air quality. The AQS for England, Scotland, Wales and Northern Ireland was published in July 2007 and sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met in the UK [3]. In July 2021, the Scottish Government published an updated AQS, the Cleaner Air for Scotland 2 – Towards a Better Place for Everyone [4]. The new AQS sets out how the Scottish Government will continue to deliver air quality improvements to achieve the objective levels, with actions shaped around 10 general themes that largely reflect the high level recommendations arising from a review of the first Cleaner Air for Scotland strategy.

2.1.5 The UK AQS sets standards and objectives for 10 main air pollutants in order to protect health, vegetation and ecosystems. These are benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, particulate matter (PM_{10} and $PM_{2.5}$), sulphur dioxide, ozone and polycyclic aromatic hydrocarbons.

2.1.6 The air quality standards are long-term benchmarks for ambient pollutant concentrations which represent negligible or zero risk to health, based on scientific and medical evidence. Objectives are policy targets expressed as a concentration that should be achieved, all the time or for a percentage of time, by a certain date. These are general concentration limits, above which sensitive members of the public (e.g. children, the elderly and the unwell) might experience adverse health effects.

2.1.7 The limit values and objectives relevant to this assessment are summarised in Table 2.1.

Table 2.1: Summary of relevant objectives of the National Air Quality Strategy [5]

Pollutant	Objectives	Concentration measured as	Date to be achieved by (and maintained thereafter)
Nitrogen dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	1 hour mean	31 December 2005
	40 µg/m^3	Annual mean	31 December 2005

Local Air Quality Management (LAQM)

2.1.8 The 1995 Environment Act also established the UK system of Local Air Quality Management (LAQM), that requires local authorities to go through a process of review and assessment of air quality in their areas, identifying places where objectives are not likely to be met, then declaring Air Quality Management Areas (AQMAs) and putting in place Air Quality Action Plans to improve air quality.

2.1.9 Information about baseline air quality, discussed in Section 5, has been drawn from sources including published monitoring data under the LAQM regime.

Aberdeenshire Local Development Plan

2.1.10 The policies and land allocations in the Aberdeenshire Local Development Plan will direct decision-making on all land-use planning issues and planning applications in Aberdeenshire [6].

2.1.11 Policy P4: Hazardous and Potentially Polluting Developments and Contaminated Land states that the Council will refuse development if there is a "*risk that could cause significant pollution, create a significant nuisance (for example through impacts on air quality or noise), or present an unacceptable danger to the public or the environment*". As part of this policy, appropriate mitigation measures must be provided for any potential significant detrimental impacts on air quality from the proposed development.

2.1.12 Policy PR1: Protecting Important Resources states that new developments should not have a significant adverse impact on air quality. Additionally, air quality assessments may be required to demonstrate that appropriate mitigation to minimise any adverse effects can be provided and implemented.

Pollution Prevention and Control Regulations

2.1.13 The Pollution Prevention and Control (Scotland) Regulations 2012 implement the requirements of the European Industrial Emissions Directive (IED) in Scotland. Operation of the proposed development, including the flare, will be subject to a PPC permit regulated by SEPA. This will define the maximum allowable emission concentration from the flare, monitoring and reporting to SEPA.

2.2 Guidance

LAQM Technical Guidance

2.2.1 The Department for Environment, Food and Rural Affairs (Defra) has published technical guidance for use by local authorities in their review and assessment work in their Local Air Quality Management Technical Guidance (LAQM.TG(22)) [7]. This guidance provides methods and assessment criteria that are applicable to planning developments. This guidance has been used where appropriate in this assessment.

EPUK and IAQM Land Use Planning and Development Control

2.2.2 Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) published the Land-Use Planning and Development Control: Planning for Air Quality guidance in January 2017 [8]. This guidance sets out criteria for identifying when a more detailed assessment of operational impacts is required, guidance on undertaking detailed assessments and criteria for assigning the significance of any identified impacts. This guidance has been used where appropriate in this assessment.

Hydrogen Production Guidance on Emerging Techniques

2.2.3 SEPA together with the UK's other three environmental regulators has published guidance on emerging techniques (GET) on how to prevent or minimise the environmental impacts of hydrogen production by electrolysis of water [9]. This is part of the suite of guidance on emerging techniques and Best Available Techniques (BAT) associated with the Environmental Permitting and PPC permitting regimes. The design of the proposed development and assessment of emissions from hydrogen flaring have had regard to this guidance.

3 Methodology

3.1.1 The assessment relies on the planning guidance by EPUK and IAQM [8]. As part of the assessment, the following factors are to be taken into account as per the guidance:

- the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives; and
- the presence and location of AQMA as an indicator of local hotspots where the air quality objectives may be exceeded.

3.1.2 Other factors referred to in the guidance relate to the suitability of a development site for residential occupiers, which is not applicable for the proposed development.

3.1.3 Significance of impacts has been determined by standards set out below in Table 3.1. Impacts classified as 'moderate' or higher are considered to be significant for receptors of 'high' sensitivity.

Table 3.1: Impact descriptors matrix for individual receptors [10]

Long term average concentration at receptor in assessment year	% 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

AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level' (EAL).

The table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. The user is encouraged to treat the numbers with recognition of their likely accuracy and not assume a false level of precision. Changes of 0%, i.e. less than 0.5% will be described as negligible.

The table is only designed to be used with annual mean concentrations.

Descriptors are for individual receptors only; the overall significance is determined using professional judgement. For example, a 'moderate' adverse impact at one receptor may not mean that the overall impact has a significant effect. Other factors need to be considered.

When defining the concentration as a percentage of the AQAL, use the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme' concentration for an increase.

The total concentration categories reflect the degree of potential harm by reference to the AQAL value. At exposures less than 75% of this value, i.e. well below, the degree of harm is likely to be small. As the exposure approached and exceeds the AQAL, the degree of harm increases. This change naturally becomes more important when the result is an exposure that is approximately equal to, or greater than the AQAL.

It is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the AQAL. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the AQAL, rather than being exactly equal to it.

3.1.4 The above criteria and matrix are for assessing long-term impacts. In relation to short-term impacts, paragraph 6.39 of the EPUK & IAQM (2017) guidance states:

3.1.5 "*Where such peak short term concentrations from an elevated source are in the range 11-20% of the relevant AQAL, then their magnitude can be described as small, those in the range 21-50% medium and those above 51% as large. These are the maximum concentrations experienced in any year and the severity of this impact can be described as* *slight, moderate and substantial respectively, without the need to reference background or baseline concentrations. That is not to say that background concentrations are unimportant, but they will, on an annual average basis, be a much smaller quantity than the peak concentration caused by a substantial plume and it is the contribution that is used as a measure of the impact, not the overall concentration at a Receptor. This approach is intended to be a streamlined and pragmatic assessment procedure that avoids undue complexity*."

3.1.6 Therefore, the following descriptors for assessing the impact magnitude resulting from short term impacts are applied in this assessment:

- 10% or less – negligible;
- 11-20% – slight;
- 21-50% – moderate; and
- 51% or greater – substantial.

3.1.7 Impacts classified as 'moderate' or higher are considered to be significant for 'high' sensitivity receptors. However, the assessment of significance is principally left to professional judgement and guidance is provided on the factors that need to be considered, namely:

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

3.1.8 A quantitative assessment of air quality impacts arising from the hydrogen flare have been modelled using the Atmospheric Dispersion Modelling System (ADMS), developed by Cambridge Environmental Research Consultants (CERC). Further details of model parameters and setup are provided in Section 4.

4 Model Inputs and Outputs

4.1 Dispersion model selection

4.1.1 A number of commercially available dispersion models are able to predict ground level concentrations arising from emissions to atmosphere from elevated point sources. Modelling for this study has been undertaken using version 5.0.1.3 of the Atmospheric Dispersion Modelling System (ADMS) developed by Cambridge Environmental Research Consultants (CERC). The model calculates the mean concentration over flat terrain, but also allows for the effect of complex terrain, buildings and deposition to be modelled. Dispersion models predict atmospheric concentrations with a set level of confidence and there can be variations in results between models under certain conditions.

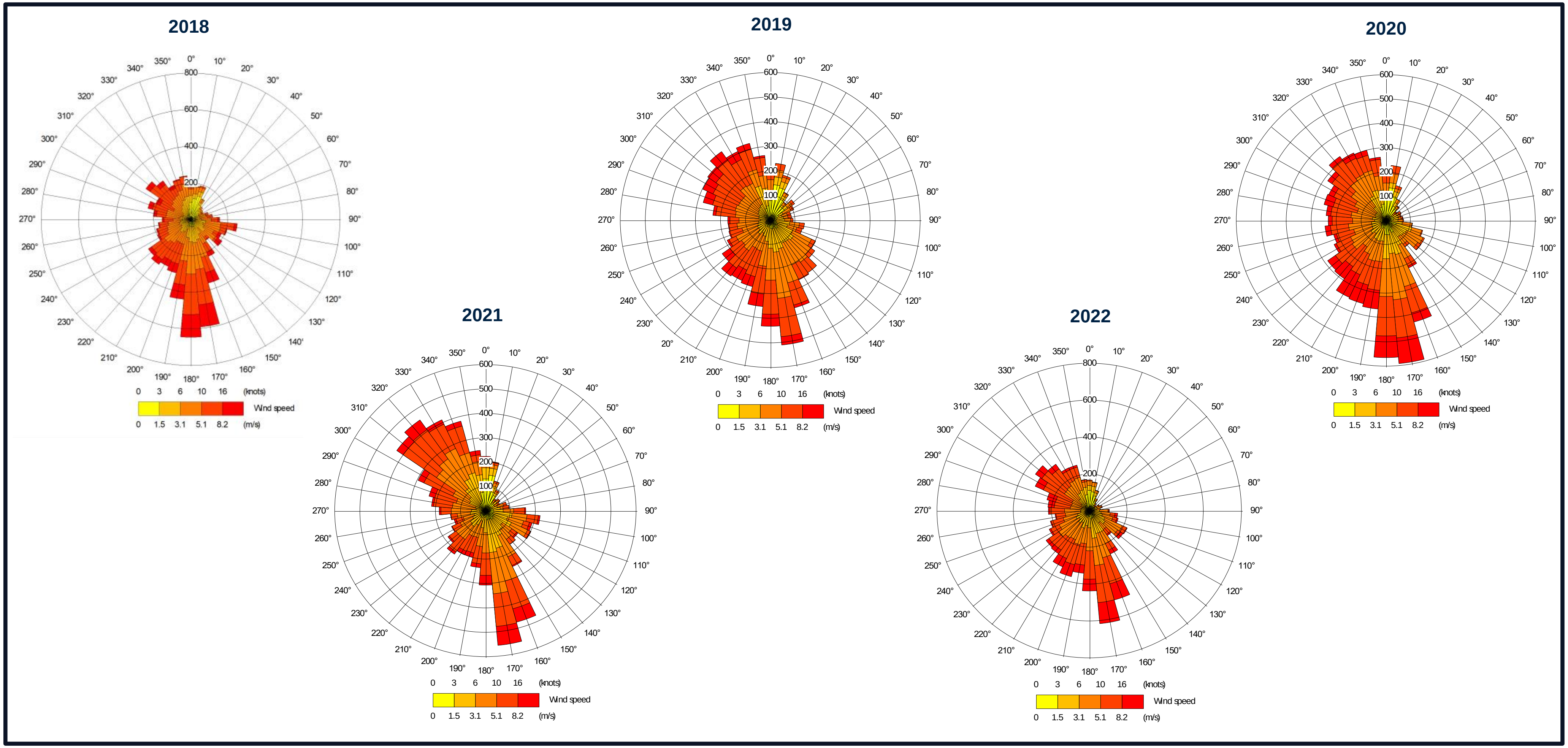
4.2 Meteorological data

4.2.1 The most important meteorological parameters governing the atmospheric dispersion of pollutants are wind direction, wind speed and atmospheric stability:

- Wind direction determines the direction into which the plume is dispersed;
- Wind speed affects the distance that the plume travels over time and can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise; and
- Atmospheric stability is a measure of turbulence of the air, and particularly of its vertical motion. It therefore affects the spread of the plume as it travels away from the source. ADMS uses a parameter known as the Monin-Obukhov length that, together with the wind speed, describes the stability of the atmosphere.

4.2.2 For meteorological data to be suitable for dispersion modelling purposes, wind speed, wind direction, cloud cover and temperature need to be measured on an hourly basis. There are only a limited number of sites where such measurements are made. The most appropriate Met Office observing station, with full data suitable for dispersion modelling, is located at Dyce (Aberdeen Airport), approximately 11 km to the east of the proposed development. Five years of meteorological data have been obtained (2018 to 2022, latest available) and a wind rose for each year is presented in Figure 4.1.

Figure 4.1: Wind Roses – Dyce 2018-2022



4.3 Building wake effects

4.3.1 The movement of air over and around buildings generates areas of flow circulation, which can lead to increased ground level concentrations in the building wakes. Indicative layout scenarios of the buildings have been used to develop a set of worst-case and reasonable-case input assumptions for modelling purposes. These have been based on the maximum design envelope parameters for the main electrolysis plant buildings specified in Chapter 2 of the EIAR. Reconfiguration or reducing the size of buildings within that envelope in subsequent stages of detailed design will not increase the effects on air quality but may reduce these.

4.3.2 For the purposes of the assessment, individual buildings or structures of the similar parameter height have been grouped together in blocks and treated as one large building to enable these to be represented in the model. The maximum building dimensions as input to the model to represent the proposed development are provided in Table 4.1.

4.3.3 Representative building envelope shapes have been placed in the appropriate zones as per the Planning Parameters Plan shown in Volume 2, Chapter 2 of the EIAR). These are representative of the illustrative masterplan layouts for the proposed development, simplified to enable modelling. Blocks of buildings were modelled in three locations. The first of these was to the north of the blue zone, as close to the flaring infrastructure area as possible to represent a maximum-case scenario for proximity and building wake effects. Other buildings are located within the corresponding development zones on the site. The layout of buildings as represented in the model can be seen in Figure 4.2.

Table 4.1: Maximum building parameters

Building Name	X	Y	Height (m)	Length (m)	Width (m)	Angle (°)
Northern blue zone						
Compressor Buildings	376329	814127	20	60	60	72
Electrolyser Buildings	376149	813999	16	360	168	72
33/400 kV AIS/GIS	375942	813938	12	160	70	162
Cooling Tower Units	376345	814035	15	120	35	162
Southern blue zone						
Compressor Buildings	376414	813958	20	60	60	55
Electrolyser Buildings	376274	813941	16	360	168	55
33/400 kV AIS/GIS	376096	813671	12	160	70	145
Cooling Tower Units	376458	813878	15	120	35	145
Yellow zone						
Compressor Buildings	376487	813578	20	60	60	72
Electrolyser Buildings	376314	813436	16	360	168	72
33/400 kV AIS/GIS	376110	813367	12	160	70	162
Cooling Tower Units	376505	813489	15	120	35	162

Figure 4.2: Location of buildings in the model

4.4 Terrain

4.4.1 The presence of elevated terrain can affect the dispersion of pollutants by reducing 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 an elevated source and reducing concentrations further away.

4.4.2 A topography file using OS Terrain 50 data was initially used in modelling to represent terrain within the study area. However, when using a terrain file, the model encountered interactions between building wake effects and terrain effects that could not be modelled. This occurs where a region of reverse flow over changing terrain height is represented in the model as being well-mixed, and so a constant concentration is necessarily assumed: this conflicts with modelling building wake effects in proximity to such terrain, which cannot be represented as impacting the assumed well-mixed concentration, and so the model would need to exclude building wake effects in some locations.

4.4.3 To test the impact of this limitation and identify the 'worst-case' modelling parameters for this assessment, a series of sensitivity tests were run:

- buildings wake effects included, terrain included – this causes the limitation to some results as described above;
- building wake effects included, terrain excluded; and
- building wake effects excluded, terrain included.

4.4.4 The maximum grid concentration and maximum concentration at sensitive receptors was examined in each case. It was found that while terrain does impact concentration and dispersion, it has a far lesser impact on the maximum concentrations compared to the inclusion of building wake effects in this case. As previously stated, if a building is in a region of reverse flow due to terrain, the model would need to assume there are no buildings. However, this is unrealistic as buildings could have an important effect on dispersion for the proposed development due to the potentially relatively close proximity of flare stack and buildings, fact that the flare stack height may be no greater than the nearest building height, and the relatively close proximity of the nearest sensitive residential receptors to both flare stack and buildings.

4.4.5 Therefore, as the buildings were found to have a greater influence on the concentration and dispersion (and therefore produced results that are conservative and representative of a maximum-case scenario), the ADMS complex terrain module was not used for the model runs.

4.5 Surface roughness

4.5.1 The roughness of the terrain over which a plume passes can have a significant effect on dispersion by altering the velocity profile with height, and the degree of atmospheric turbulence. This is accounted for by a parameter called the surface roughness length.

4.5.2 A surface roughness length of 0.5 m has been used within the model to represent the average surface characteristics across the study area.

4.6 Stack parameters and emissions rates used in model

4.6.1 Stack and emission characteristics modelled are provided in Table 4.2. As no emission concentration limit is currently expressed in BAT or GET guidance for PPC permitting, the stack and emission characteristics are expressed as actual conditions based on conservative data sourced from manufacturers, rather than normalised conditions at an emission limit.

4.6.2 Four different scenarios have been modelled, showing two different stack sizes (representing a stack design envelope) and two different stack locations (representing different areas of the locational envelope defined in the Planning Parameters Plan). Scenarios 1 and 2 model the smaller of the two stack options at the two locations, with scenarios 3 and 3 showing the larger stack option.

4.6.3 The stack locations are (a) a worst-case location, being to the east of the flaring infrastructure area, adjacent to a modelled location of the tallest development buildings, closest to the eastern site boundary and hence the closest sensitive residential receptors), and (b) what is potentially a more likely location, based on the illustrative masterplan options at this stage, being to the north of the flaring infrastructure area and further from both buildings and receptors. Scenario 1 and scenario 3 model the stack at the worst-case location, whilst scenario 2 and scenario 4 model the more likely location.

Table 4.2: Stack and emissions characteristics

Model input	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Stack location (x,y)	376410, 814125	376047, 814129	376410, 814125	376047, 814129

Model input	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Height (m)	20	20	28	28
Internal diameter (m)	10	10	17	17
Emission velocity (m/s)	69	69	24	24
Emission flow rate (m^3/s)	5,420	5,420	5,420	5,420
Emission temperature (°C)	1,300	1,300	1,300	1,300
Emission of NO_x rate (g/s)	91	91	91	91

4.7 NO_x to NO_2 assumptions

4.7.1 Total conversion (i.e. 100% of NO_x to NO_2) is used for the estimation of the absolute upper limit of the annual mean NO_2. This is based on the assumption that all NO emitted is converted to NO_2 before it reaches ground level. However, in reality the conversion is an equilibrium reaction and even at ambient concentrations a proportion of NO_x remains in the form of NO. The application of total conversion of NO_x to NO_2 is therefore a conservative assumption and represents a worst case approach.

4.7.2 Guidance issued by the Environment Agency indicate that for short term concentrations, it should be assumed that only 50% of NO_x converts to NO_2 in the environment [11].

4.8 Modelling of long-term and short-term emissions

4.8.1 Long-term (annual-mean) NO_2 concentration has been modelled for comparison with the relevant annual mean objectives on the assumption of continuous and full capacity flare operation. This is an extremely conservative assessment, given that the flare would only be used at the full modelled capacity in an abnormal event, so in reality it would not be expected to occur for more than a few hours per year. It provides the simplest way to consider the maximum possible case of variable flare operation, in terms of the duration of use and the amount of hydrogen that is flared.

4.8.2 For short-term NO_2 concentrations, the objective is for the hourly-mean concentration not to exceed 200 µg/m^3 more than 18 times per calendar year. As there are 8,760 hours in a non-leap year, the hourly-mean concentration would need to be below 200 µg/m^3 in 8,742 hours, i.e. 99.79% of the time. Therefore, the 99.79th percentile of hourly NO_2 has been modelled. Again, this is a very conservative scenario as the flare would not be expected to be used at full capacity 18 times per year, and times of operation at full capacity would be unlikely to coincide with the hours of meteorological conditions which lead to the highest ground-level concentrations.

5 Baseline Conditions

5.1.1 This following section sets out the baseline air quality conditions in the area of the proposed development. For this assessment, baseline data was obtained from the most recent Air Quality Annual Progress Report (APR) for Aberdeenshire Council [12] and the background mapping data for local authorities from Defra [13].

5.2 Existing baseline conditions

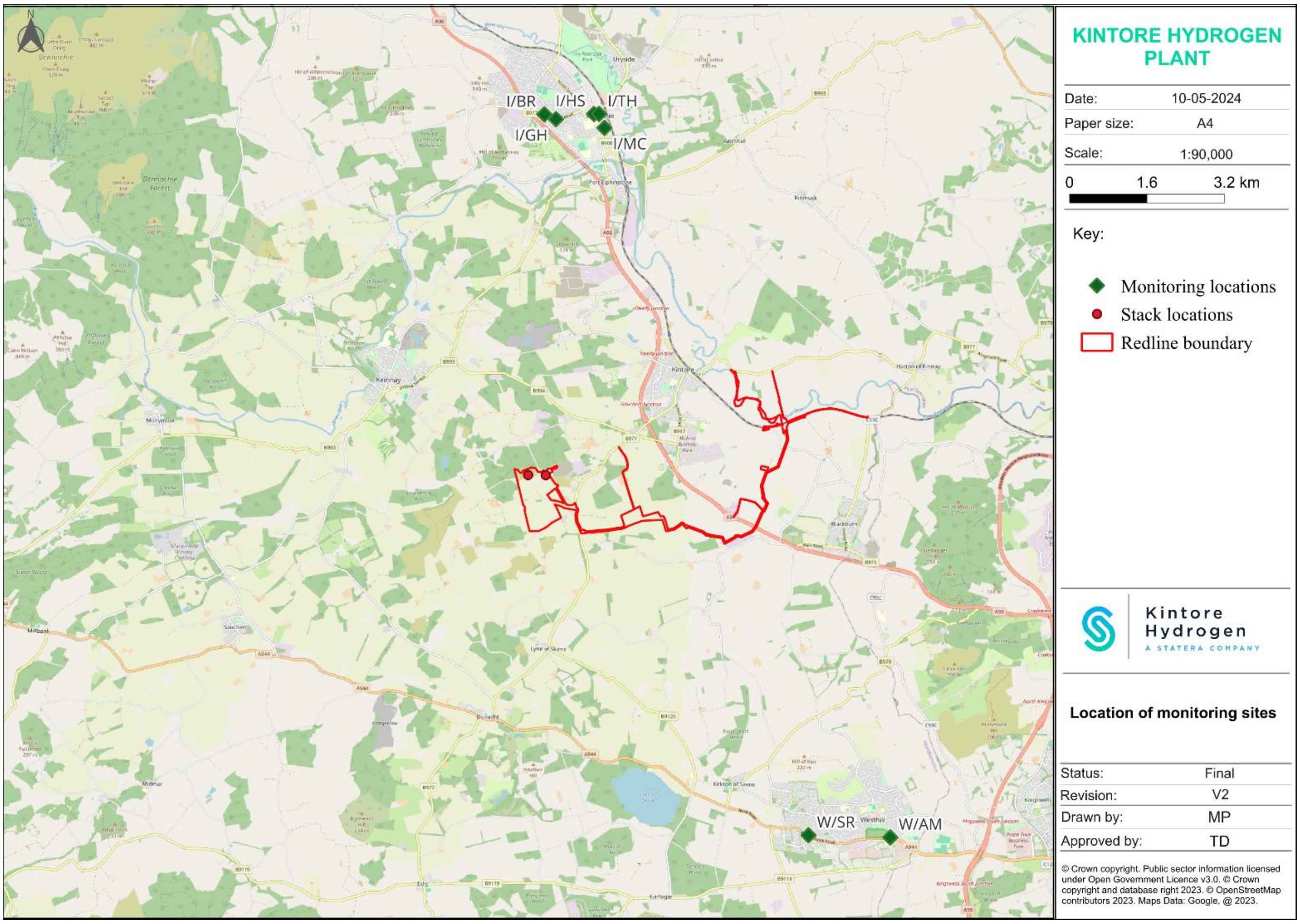
5.2.1 Aberdeenshire Council has not declared any AQMAs and the available evidence suggests that Aberdeenshire benefits from generally good air quality in terms of those pollutants considered under the Local Air Quality Management regime.

5.2.2 Aberdeenshire Council does not undertake any automatic (continuous) monitoring within the authority's area, but do undertake non-automatic (passive) monitoring of NO_2 at 11 sites. The closest monitoring locations to the proposed development are in the towns of Westhill and Inverurie, shown in Figure 5.1. Table 5.1 details the monitored NO_2 concentrations for the years 2020-22 for the seven sites nearest the proposed development. However, only one of these locations is representative of ambient background concentrations; the others are roadside sites, selected by the council for monitoring due to higher background concentrations from road traffic emissions.

Table 5.1: Monitored annual mean NO_2 concentrations

Site ID	Site Name	Site Type	X	Y	Distance from flare (m)	Annual mean NO_2 concentration (bias adjusted) (µg/m^3)		
						2020	2021	2022
I/HS	Inverurie 1	Roadside	377408	821583	7,500	14	15	19
I/GH	Inverurie 2	Background	376622	821476	7,325	4	4	5
I/MC	Inverurie MC	Roadside	377624	821295	7,250	14	17	15
I/BR	Inverurie BR	Roadside	376382	821574	7,500	12	12	12
I/TH	Inverurie TH	Roadside	377512	821584	7,500	11	13	14
W/AM	Westhill AM	Roadside	383526	806645	10,250	11	14	14
W/SR	Westhill 2	Roadside	381837	806691	9,150	9	11	9

Figure 5.1: Aberdeenshire non-automatic monitoring site locations



5.2.3 Based on the data presented in Table 5.1, the NO_2 annual mean concentrations in all years are well below the annual mean objective of 40 µg/m^3.

5.2.4 Defra provides background concentration maps to assist local authorities in undertaking their air quality review and assessments. The most recent 2018 reference year background maps are based on the monitoring and meteorological data for 2018 and present projected concentrations for years 2018 to 2030 [13].

5.2.5 Defra notes that the projections for the 2018-based background maps are based on assumptions before the COVID-19 pandemic; they do not reflect short- or long-term impacts on emissions in 2020 due to the lockdown during the pandemic. For the projected year 2024, the NO_2 background concentration for the grid square within which the proposed development is located (376500, 814500) is 3.23 µg/m^3. 2024 as the baseline year has been selected as a conservative approach and assumes there will be no reduction in background conditions for future years when the proposed development would be operational. However, this concentration estimate is significantly below the range of monitoring results, and so the use of these data would not be conservative.

5.2.6 The average measured concentration in 2022 for the roadside locations is 13.8 µg/m^3, whereas only a single urban background monitoring location is available and indicates a lower concentration of 4–5 µg/m^3, similar to the Defra mapped concentration of 3 µg/m^3. For the purpose of this assessment, a concentration of 13.8 µg/m^3 has been adopted as the baseline in order to take a conservative approach and avoid any potential underestimation of the contribution from other local emission sources in the baseline, including traffic for receptors at roadside locations.

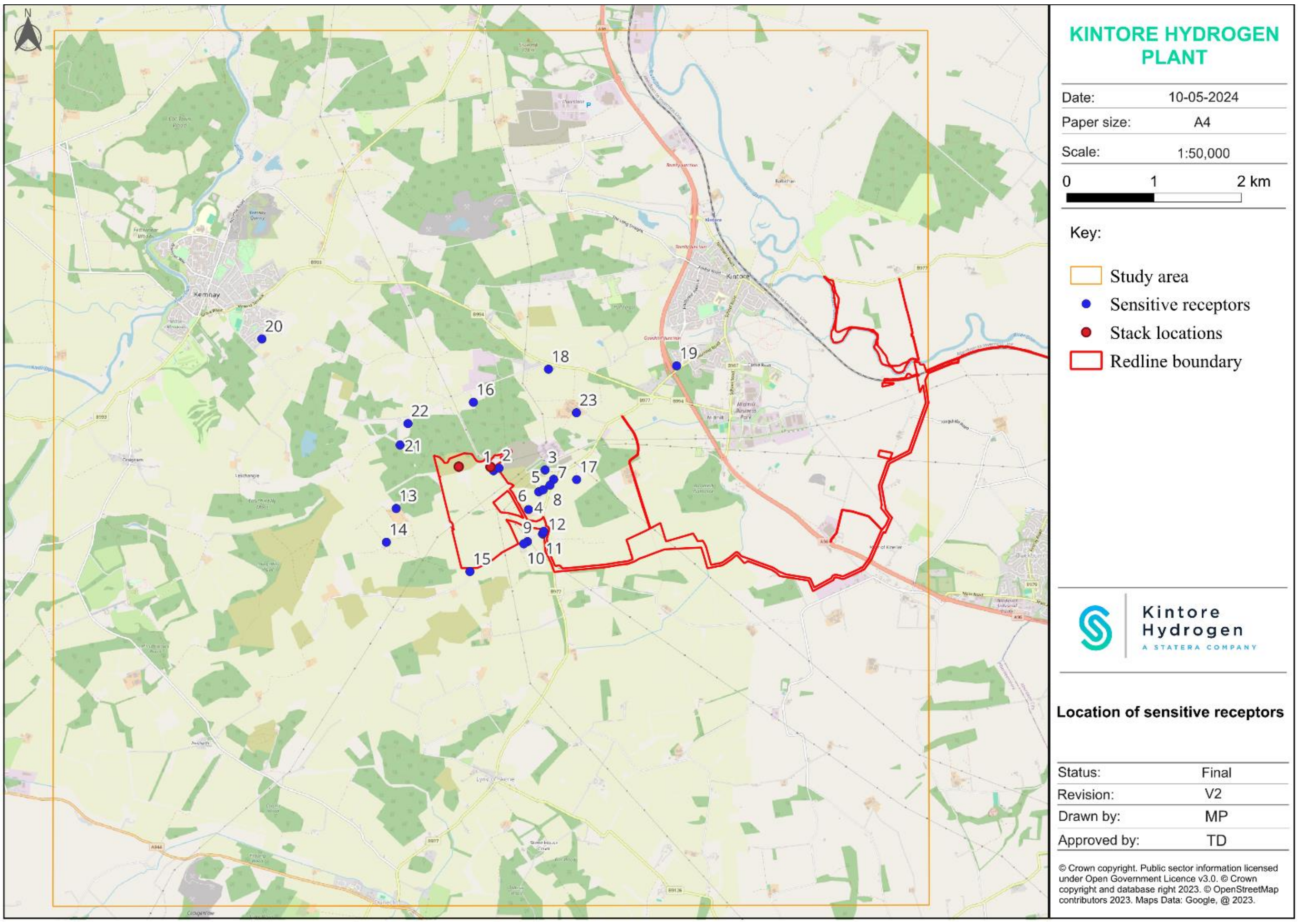
6 Study Area and Sensitive Receptors

6.1.1 A 10 km by 10 km Cartesian grid (i.e. 5 km north, south, east and west from the flare) with a resolution of 50 m was created to map the NO_2 output from the hydrogen flare. This study area encompasses the nearest settlements of Kintore and Kemnay together with other smaller groups of residences around the site.

6.1.2 In addition to the NO_2 concentrations across the modelled grid domain, 23 individual sensitive receptors have been identified to model. Representative sensitive receptors for this assessment have been selected at the nearest residential properties to the flare. Additionally, receptor points on the outskirts of Kintore and Kemnay have been added to quantify the maximum air quality impact of the flare in these more densely populated areas. The extent of the Cartesian grid and the location of representative sensitive receptors are shown in Figure 6.1

6.1.3 There are no nationally- or internationally-designated ecological sites within 5 km of the site.

Figure 6.1: Location of sensitive receptors and extent of modelled grid



7 Model Results

7.1.1 For each scenario, the result presented is the maximum year among the five years of meteorological data used. Results are presented for each sensitive receptor, as well as the maximum concentration within the modelled grid area outside the electrolysis plant site boundary. Areas within the site boundary are not considered within this assessment on the basis that these areas would not be publicly accessible; workforce health and safety would be managed under the applicable legislation and PPC permit.

7.1.2 Results are presented as the process contribution (PC) and the predicted environmental concentration (PEC). The PC is the contribution of the proposed development (hydrogen flare) emissions to local air quality at each of the receptors. The PEC is the PC plus the background pollutant concentration. Results are compared to the relevant AQAL, and the impact assessed in accordance with the IAQM planning guidance.

7.2 Scenario 1

7.2.1 The predicted annual mean concentrations of the PC and PEC values at the selected sensitive receptors, as well as the maximum concentration at any grid point outside the site boundary, are presented in Table 7.1. A contour plot of annual mean PC is shown in Figure 7.1.

7.2.2 As shown, when the magnitude of change is considered in the context of the AQAL, the impact descriptor ranges from 'negligible' to 'slight' at all sensitive receptors, which is not significant.

7.2.3 The maximum concentration at a grid point outside the site boundary has an initial impact indicator of 'moderate adverse' based on the percentage contribution of the PC to the AQAL, which is classed as potentially significant. However, guidance from Defra on air quality management (published by the Environment Agency) states that:

"*You don't need to take further action if your assessment has shown that both of the following apply:*

- *Your proposed emissions comply with BAT associated emission levels (AELs) or the equivalent requirements where there is not BAT EAL*
- *The resulting PECs won't exceed environmental standards".* [11]

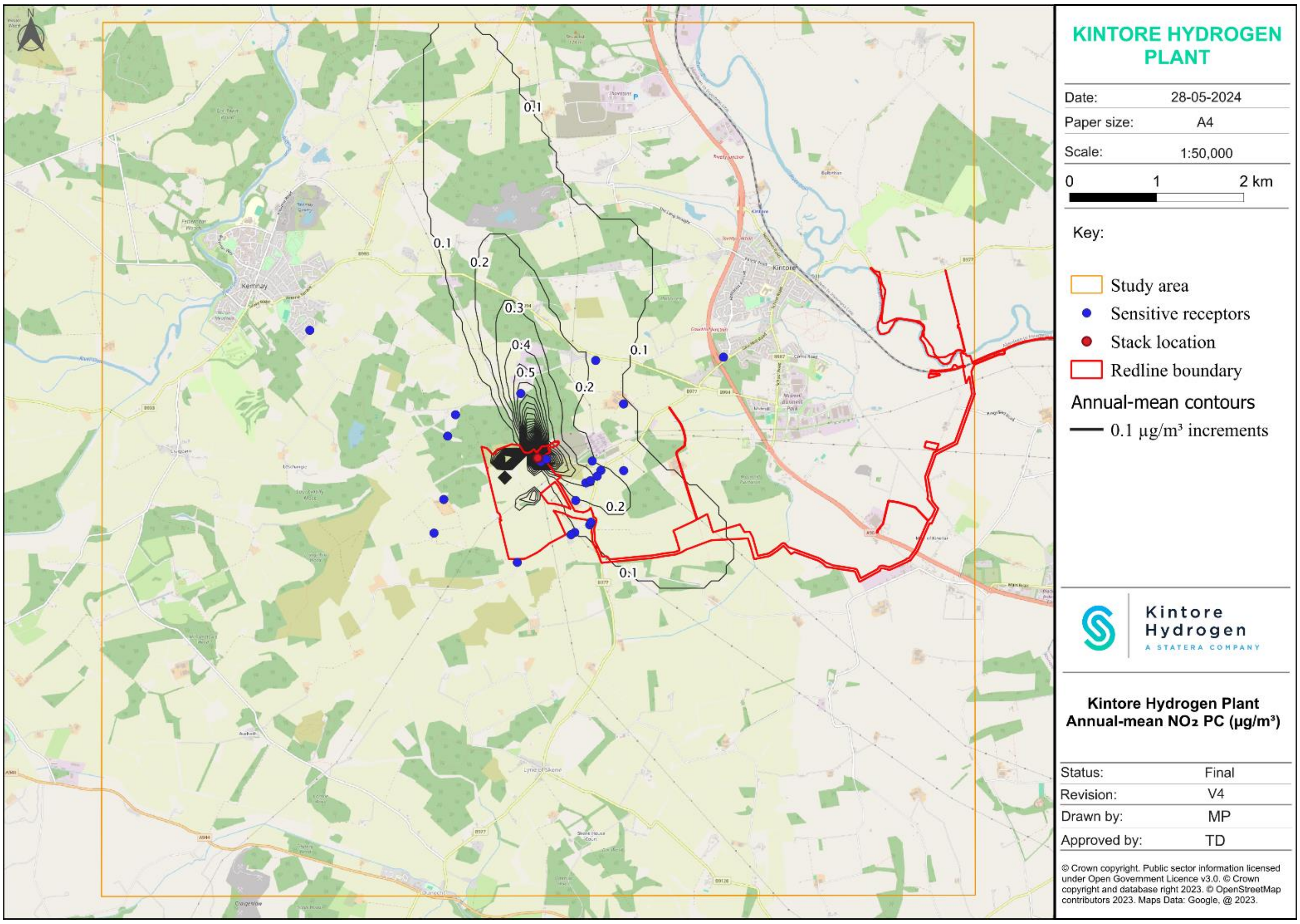
7.2.4 The PEC for the maximum concentration of NO_2 outside the site boundary is below the AQAL of 40 µg/m^3 and so does not need to be considered further. Therefore, the impact is not considered to be significant. It should also be noted that this is a maximum grid point, and not located at any existing sensitive receptor.

Table 7.1: Long-term (annual) predicted NO_2 concentrations (µg/m^3) at sensitive receptors

Receptor ID	PC	PC as % of AQAL	PEC	PEC as % of AQAL	Impact descriptor
Maximum concentration outside site boundary	7.71	19%	21.54	54%	Moderate
1	3.28	8%	17.12	43%	Slight
2	2.48	6%	16.31	41%	Slight
3	0.22	1%	14.05	35%	Negligible
4	0.35	1%	14.18	35%	Negligible
5	0.33	1%	14.17	35%	Negligible
6	0.19	0%	14.02	35%	Negligible

Receptor ID	PC	PC as % of AQAL	PEC	PEC as % of AQAL	Impact descriptor
7	0.23	1%	14.06	35%	Negligible
8	0.28	1%	14.12	35%	Negligible
9	0.09	0%	13.92	35%	Negligible
10	0.08	0%	13.91	35%	Negligible
11	0.14	0%	13.97	35%	Negligible
12	0.15	0%	13.98	35%	Negligible
13	0.00	0%	13.84	35%	Negligible
14	0.00	0%	13.84	35%	Negligible
15	0.00	0%	13.84	35%	Negligible
16	0.64	2%	14.47	36%	Negligible
17	0.16	0%	13.99	35%	Negligible
18	0.18	0%	14.02	35%	Negligible
19	0.05	0%	13.88	35%	Negligible
20	0.01	0%	13.85	35%	Negligible
21	0.04	0%	13.87	35%	Negligible
22	0.03	0%	13.87	35%	Negligible
23	0.10	0%	13.93	35%	Negligible

Figure 7.1: Annual-mean NO_2 process contributions (µg/m³)



7.2.5 Table 7.2 lists the short-term PC values at sensitive receptors and the maximum concentration at any grid point outside the site boundary. Figure 7.2 shows a contour plot of hourly-mean PC.

7.2.6 Of the individual sensitive receptors, the results show that the highest PC as a percentage of the AQAL is 99% (at receptor 1) and has an initial impact descriptor of 'substantial' based on percentage contribution. Receptor 2 also has an initial impact descriptor of 'substantial', with a PC as a percentage of the AQAL of 55%. As such, the impact at these locations are considered to be potentially significant.

7.2.7 With reference to these locations, the Environment Agency's guidance states that where the PCs exceed 10% of the AQAL, the impacts are not considered significant if the PEC remains below the AQAL [11]. The guidance continues by stating that:

"*when you calculate background concentration, you can assume that the short-term background concentration of a substance is twice its long-term concentration*".

7.2.8 Assuming a background NO_2 concentration of 27.6 µg/m³, the PEC for receptor 2 is 137.75 µg/m³ and 69% of the AQAL (which is 200 µg/m³). On the basis that the PEC remains below the AQAL for receptor 2, this is not considered to be significant.

7.2.9 The PEC for receptor 1, however, would exceed the AQAL in the modelled scenario. It should noted here that the appraisal is initially on a highly conservative basis, considering flare operation at maximum capacity during every hour of the year. This is not the proposed mode of operation: in practice it is extremely unlikely that flare operation at this capacity, which is a capability provided for abnormal events, would occur as frequently as 18 times, for an hour each time, per annum (which is the basis of the short-term AQAL). It is therefore extremely unlikely that the short-term AQAL, by definition, could be exceeded in practice.

7.2.10 Furthermore, there is a steep gradient in the change in concentration with distance around this location, looking at both the gridded model output and individual receptor results: receptor 1 and 2 are 70 m apart and have a difference of 87.27 $\mu g/m^3$, and the grid cell that receptor 1 is located in has a NO_2 concentration of 140.63 $\mu g/m^3$, which is a difference of 56.72 $\mu g/m^3$ when compared to receptor 1. This large variance is reflective of the close proximity to the flare, it having been modelled at a worst-case distance of approximately 50 m from receptor 1. Were receptor 1 to remain occupied during operation, mitigation of short-term NO_2 concentrations could be achieved by locating the flare further away, as shown by Scenario 2.

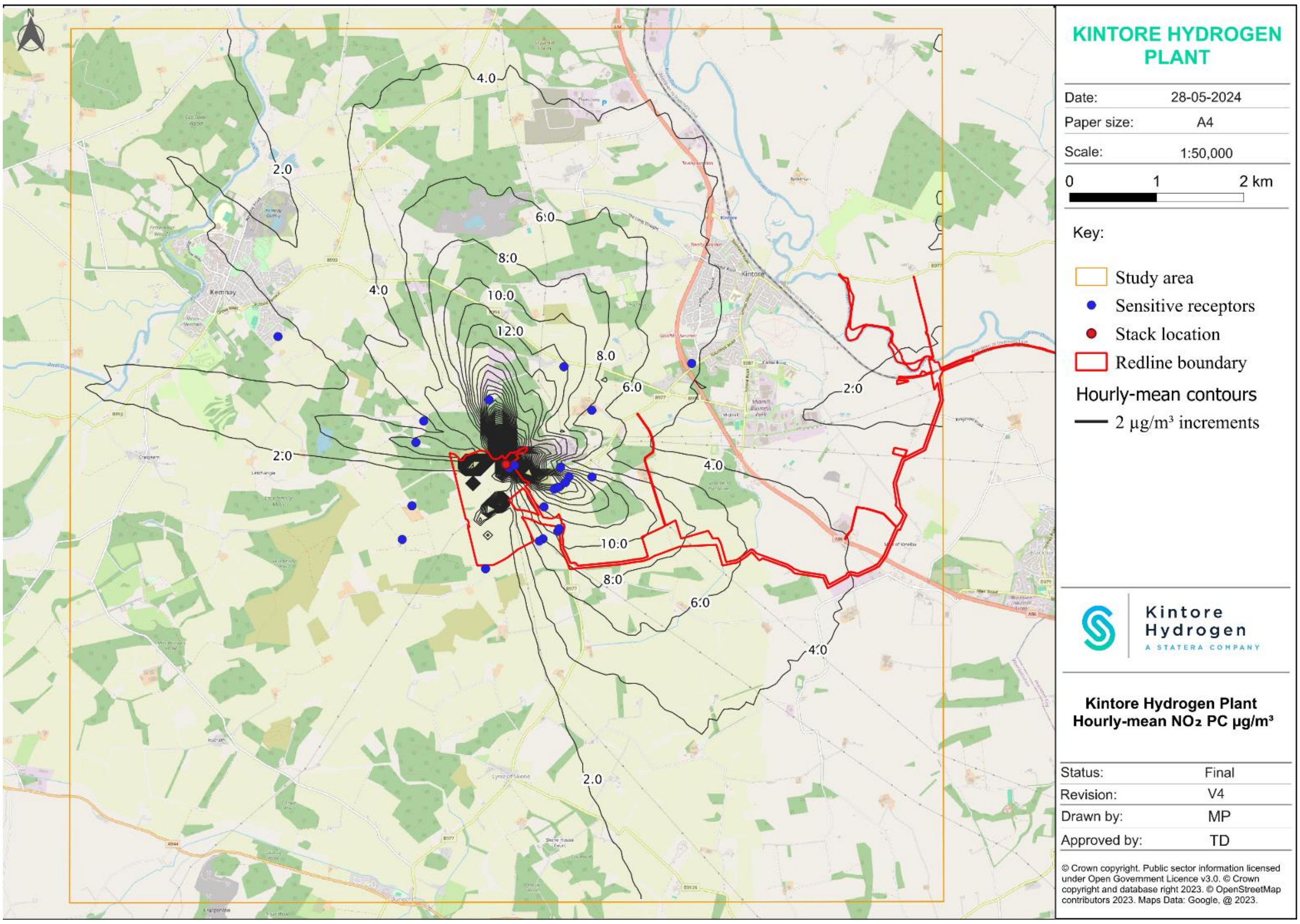
7.2.11 The maximum concentration at any grid point outside the site boundary also has an initial impact descriptor of ‘substantial’. The PC and the PEC would exceed the AQAL of 200 $\mu g/m^3$. As noted above, this could only be the case if the flare were to be operated at maximum capacity for more than 18 hours per year (which is not expected). The maximum concentration in the modelled grid area is not at the location of a sensitive receptor.

Table 7.2: Short-term (hourly) predicted NO_2 concentrations ($\mu g/m^3$) at sensitive receptors

Receptor ID	PC	PC as % of AQAL	Impact descriptor
Maximum concentration outside site boundary	288.16	144%	Substantial
1	197.35	99%	Substantial
2	110.08	55%	Substantial
3	5.27	3%	Negligible
4	13.31	7%	Negligible
5	14.38	7%	Negligible
6	6.50	3%	Negligible
7	8.99	4%	Negligible
8	12.02	6%	Negligible
9	3.83	2%	Negligible
10	3.31	2%	Negligible
11	5.57	3%	Negligible
12	5.50	3%	Negligible
13	0.19	0%	Negligible
14	0.19	0%	Negligible
15	0.13	0%	Negligible
16	14.85	7%	Negligible
17	5.63	3%	Negligible
18	6.41	3%	Negligible
19	1.97	1%	Negligible
20	0.65	0%	Negligible
21	3.16	2%	Negligible

Receptor ID	PC	PC as % of AQAL	Impact descriptor
22	1.68	1%	Negligible
23	3.77	2%	Negligible

Figure 7.2: Hourly-mean NO_2 process contributions (µg/m^3)



7.3 Scenario 2

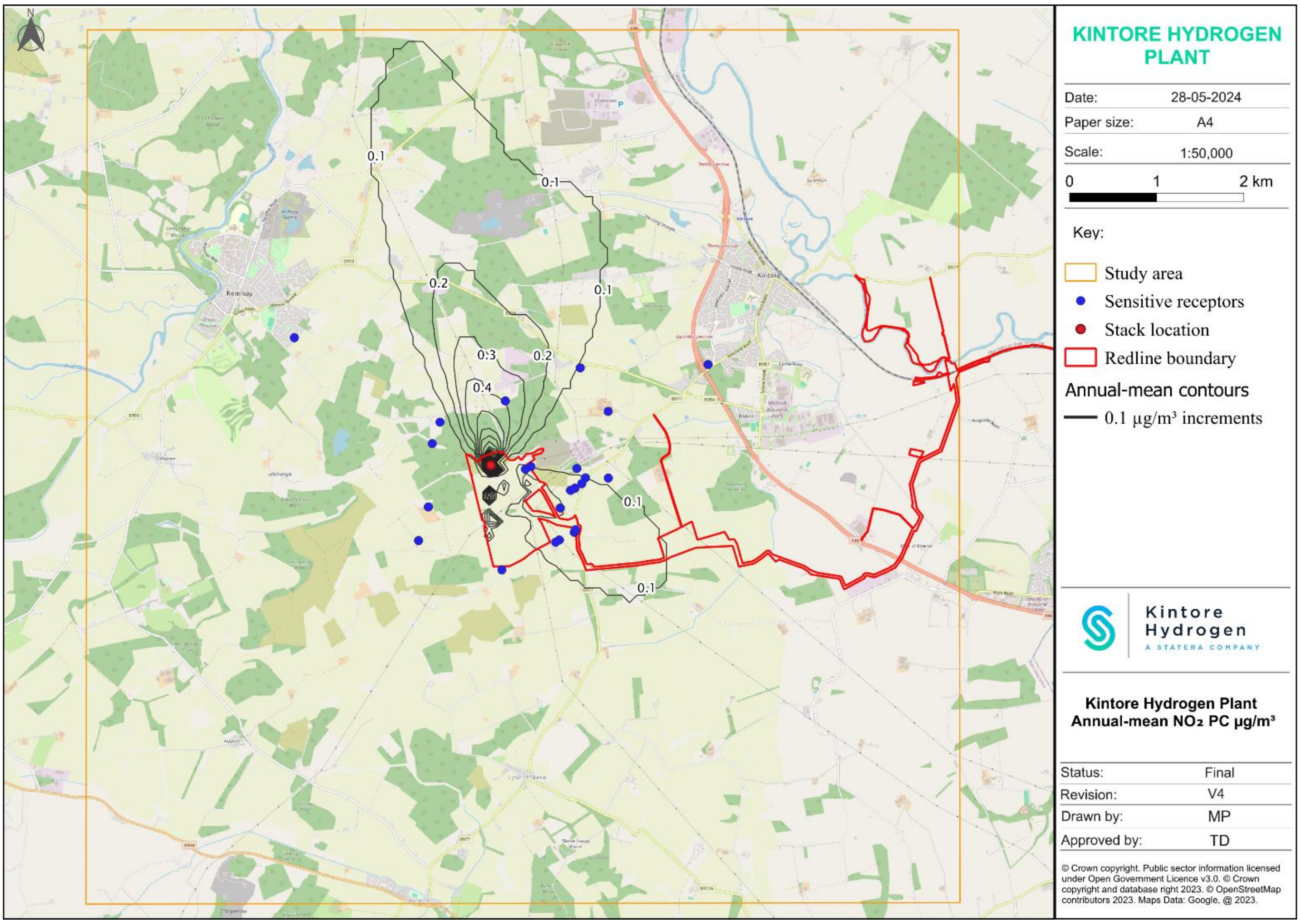
7.3.1 The predicted annual mean concentrations of the PC and PEC values at the selected sensitive receptors, as well as the maximum concentration at any grid point outside the site boundary, are presented in Table 7.3. A contour plot of annual mean PC is shown in Figure 7.3.

7.3.2 As shown, the impact descriptor for all sensitive receptors and for the maximum concentration of NO_2 at any grid point outside the site boundary has an impact indicator of ‘negligible’ based on the percentage contribution of the PC to the AQAL, which is not significant.

Table 7.3: Long-term (annual) predicted NO_2 concentrations (µg/m^3) at sensitive receptors

Receptor ID	PC	PC as % of AQAL	PEC	PEC as % of AQAL	Impact descriptor
Maximum concentration outside site boundary	1.59	4%	15.42	39%	Negligible
1	0.20	0%	14.03	35%	Negligible
2	0.12	0%	13.95	35%	Negligible
3	0.09	0%	13.92	35%	Negligible
4	0.16	0%	14.00	35%	Negligible
5	0.15	0%	13.98	35%	Negligible
6	0.21	1%	14.04	35%	Negligible
7	0.11	0%	13.94	35%	Negligible
8	0.13	0%	13.96	35%	Negligible
9	0.15	0%	13.98	35%	Negligible
10	0.14	0%	13.97	35%	Negligible
11	0.17	0%	14.00	35%	Negligible
12	0.17	0%	14.00	35%	Negligible
13	0.00	0%	13.84	35%	Negligible
14	0.00	0%	13.84	35%	Negligible
15	0.02	0%	13.85	35%	Negligible
16	0.40	1%	14.23	36%	Negligible
17	0.09	0%	13.92	35%	Negligible
18	0.10	0%	13.93	35%	Negligible
19	0.03	0%	13.86	35%	Negligible
20	0.02	0%	13.85	35%	Negligible
21	0.05	0%	13.88	35%	Negligible
22	0.06	0%	13.89	35%	Negligible
23	0.05	0%	13.88	35%	Negligible

Figure 7.3: Annual-mean NO_2 process contributions (µg/m³)



7.3.3 Table 7.4 lists the short-term PC values at sensitive receptors and the maximum concentration at any grid point outside the site boundary. Figure 7.4 shows a contour plot of hourly-mean PC.

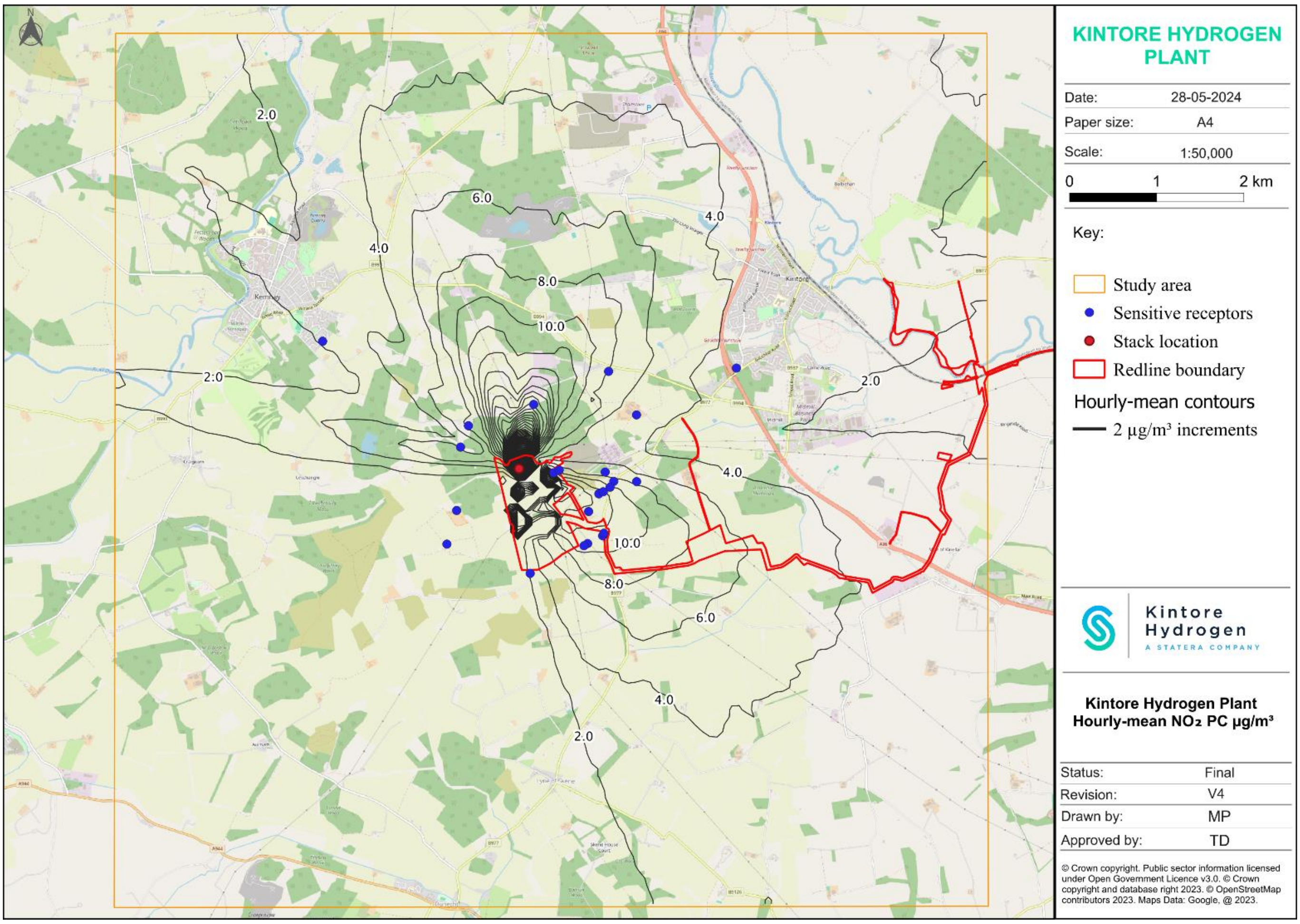
7.3.4 As shown, the impact descriptors at all sensitive receptors are classed as ‘negligible’ based on percentage contribution. The maximum concentration at any grid point outside the site boundary has an initial impact indicator of ‘moderate’. Assuming a NO_2 background concentration of 27.6 µg/m³, this gives a PEC of 106.60 µg/m³, which is 53% of the AQAL. On this basis, this is not considered to be significant.

Table 7.4: Short-term (hourly) predicted NO_2 concentrations (µg/m³) at sensitive receptors

Receptor ID	PC	PC as % of AQAL	Impact descriptor
Maximum concentration outside site boundary	78.93	39%	Moderate
1	6.24	3%	Negligible
2	3.96	2%	Negligible
3	3.61	2%	Negligible

Receptor ID	PC	PC as % of AQAL	Impact descriptor
4	5.85	3%	Negligible
5	5.36	3%	Negligible
6	6.94	3%	Negligible
7	4.25	2%	Negligible
8	5.23	3%	Negligible
9	5.32	3%	Negligible
10	5.09	3%	Negligible
11	5.82	3%	Negligible
12	5.85	3%	Negligible
13	0.22	0%	Negligible
14	0.19	0%	Negligible
15	1.02	1%	Negligible
16	11.99	6%	Negligible
17	3.64	2%	Negligible
18	4.02	2%	Negligible
19	1.77	1%	Negligible
20	1.12	1%	Negligible
21	2.66	1%	Negligible
22	4.23	2%	Negligible
23	2.53	1%	Negligible

Figure 7.4: Hourly-mean NO_2 process contributions (µg/m³)



7.4 Scenario 3

7.4.1 The predicted annual mean concentrations of the PC and PEC values at the selected sensitive receptors, as well as the maximum concentration at any grid point outside the site boundary, are presented in Table 7.5. A contour plot of annual mean PC is shown in Figure 7.5.

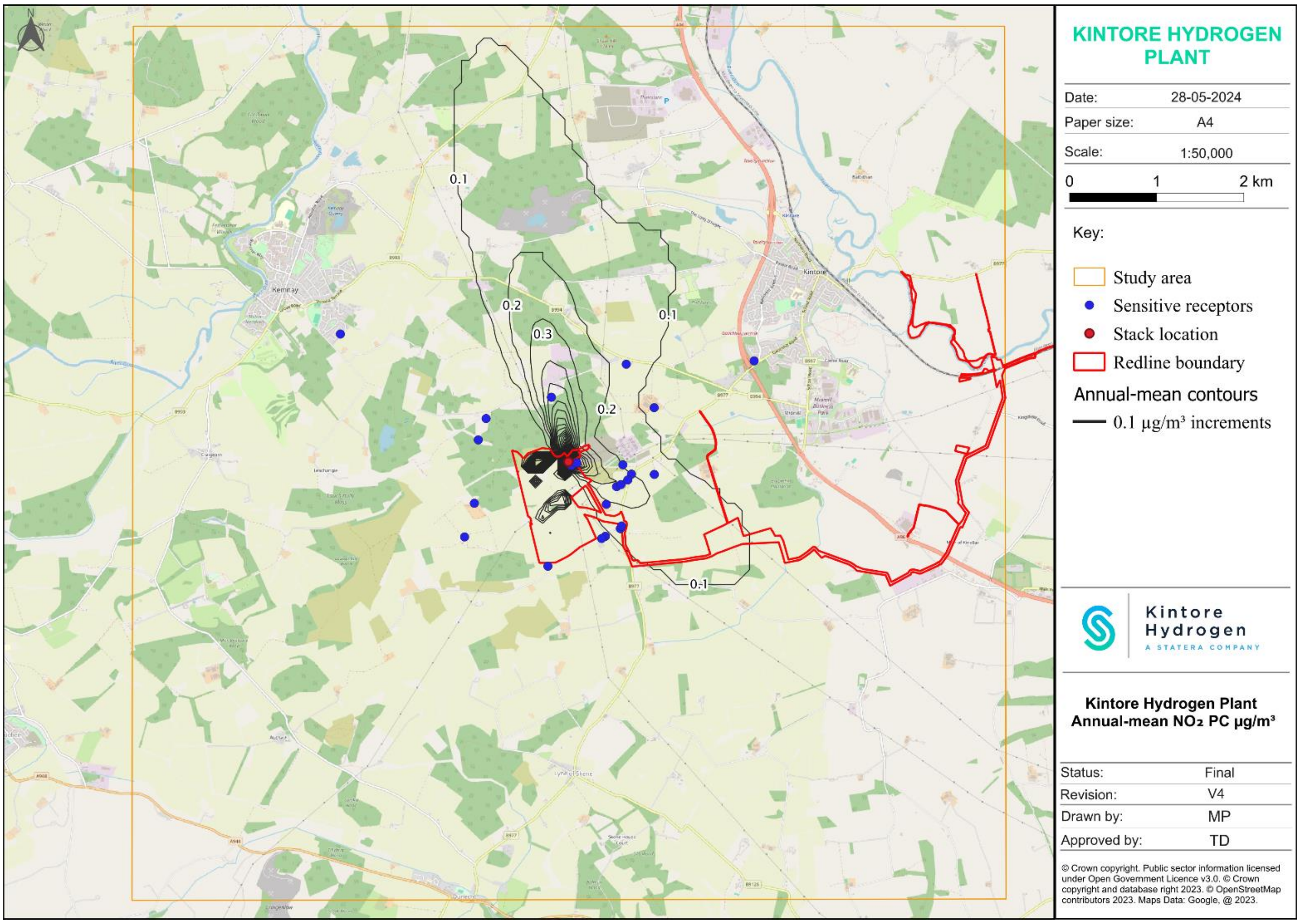
7.4.2 As shown, the impact descriptor for all sensitive receptors is 'negligible' based on the percentage contribution of the PC to the AQAL, which is not significant. The maximum concentration at any grid point outside the site boundary has an initial impact descriptor of 'moderate', which is potentially significant. However, the PEC is below the AQAL of 40 µg/m³ and so does not need to be considered further. Therefore, the impact is not considered to be significant. It should also be noted that this is a maximum grid point, and not located at any existing sensitive receptor.

Table 7.5: Long-term (annual) predicted NO_2 concentrations (µg/m³) at sensitive receptors

Receptor ID	PC	PC as % of AQAL	PEC	PEC as % of AQAL	Impact descriptor
Maximum concentration outside site boundary	4.71	12%	18.54	46%	Moderate
1	1.65	4%	15.48	39%	Negligible

Receptor ID	PC	PC as % of AQAL	PEC	PEC as % of AQAL	Impact descriptor
2	1.58	4%	15.42	39%	Negligible
3	0.19	0%	14.02	35%	Negligible
4	0.29	1%	14.13	35%	Negligible
5	0.28	1%	14.11	35%	Negligible
6	0.18	0%	14.01	35%	Negligible
7	0.20	1%	14.03	35%	Negligible
8	0.24	1%	14.07	35%	Negligible
9	0.08	0%	13.92	35%	Negligible
10	0.07	0%	13.90	35%	Negligible
11	0.13	0%	13.97	35%	Negligible
12	0.14	0%	13.98	35%	Negligible
13	0.00	0%	13.84	35%	Negligible
14	0.00	0%	13.84	35%	Negligible
15	0.00	0%	13.84	35%	Negligible
16	0.53	1%	14.37	36%	Negligible
17	0.15	0%	13.98	35%	Negligible
18	0.17	0%	14.00	35%	Negligible
19	0.04	0%	13.88	35%	Negligible
20	0.01	0%	13.85	35%	Negligible
21	0.04	0%	13.87	35%	Negligible
22	0.03	0%	13.87	35%	Negligible
23	0.09	0%	13.92	35%	Negligible

Figure 7.5: Annual-mean NO_2 process contributions (µg/m³)



7.4.3 Table 7.6 lists the short-term PC values at sensitive receptors and the maximum concentration at any grid point outside the site boundary. Figure 7.6 shows a contour plot of hourly-mean PC.

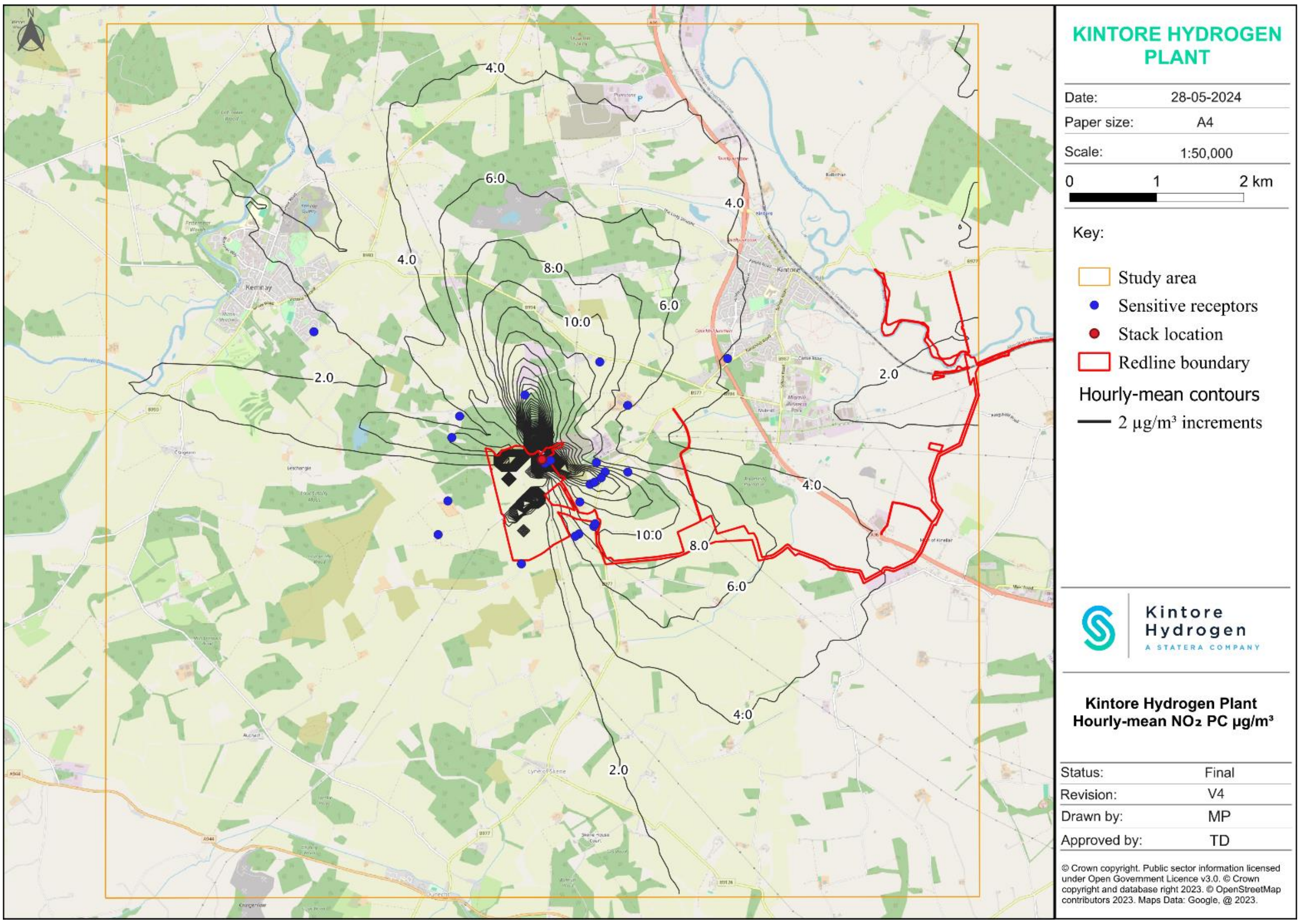
7.4.4 As shown, the initial impact descriptors at sensitive receptors range from 'negligible' to 'moderate' and the initial impact descriptor for the maximum concentration at any grid point outside the site boundary is 'substantial'. When adding the background concentration to this, the PEC for the receptor 1 is 90.23 µg/m³ and 45% of the AQAL, for receptor 2 is 78.07 µg/m³ and 39% of the AQAL, and the PEC for the maximum concentration at any grid point outside the site boundary is 163.99 µg/m³ and 82% of the AQAL. On the basis that the PEC remains below the AQAL of 200 µg/m³, this is not considered to be significant.

Table 7.6: Short-term (hourly) predicted NO_2 concentrations (µg/m³) at sensitive receptors

Receptor ID	PC	PC as % of AQAL	Impact descriptor
Maximum concentration outside site boundary	136.32	68%	Substantial
1	62.56	31%	Moderate

Receptor ID	PC	PC as % of AQAL	Impact descriptor
2	50.40	25%	Moderate
3	4.32	2%	Negligible
4	10.33	5%	Negligible
5	10.20	5%	Negligible
6	5.88	3%	Negligible
7	6.92	3%	Negligible
8	9.21	5%	Negligible
9	3.58	2%	Negligible
10	3.09	2%	Negligible
11	5.17	3%	Negligible
12	5.05	3%	Negligible
13	0.18	0%	Negligible
14	0.17	0%	Negligible
15	0.13	0%	Negligible
16	12.76	6%	Negligible
17	4.96	2%	Negligible
18	5.66	3%	Negligible
19	1.89	1%	Negligible
20	0.62	0%	Negligible
21	2.92	1%	Negligible
22	1.53	1%	Negligible
23	3.50	2%	Negligible

Figure 7.6: Hourly-mean NO_2 process contributions (µg/m³)



7.5 Scenario 4

7.5.1 The predicted annual mean concentrations of the PC and PEC values at the selected sensitive receptors, as well as the maximum concentration at any grid point outside the site boundary, are presented in Table 7.7. A contour plot of annual mean PC is shown in Figure 7.7.

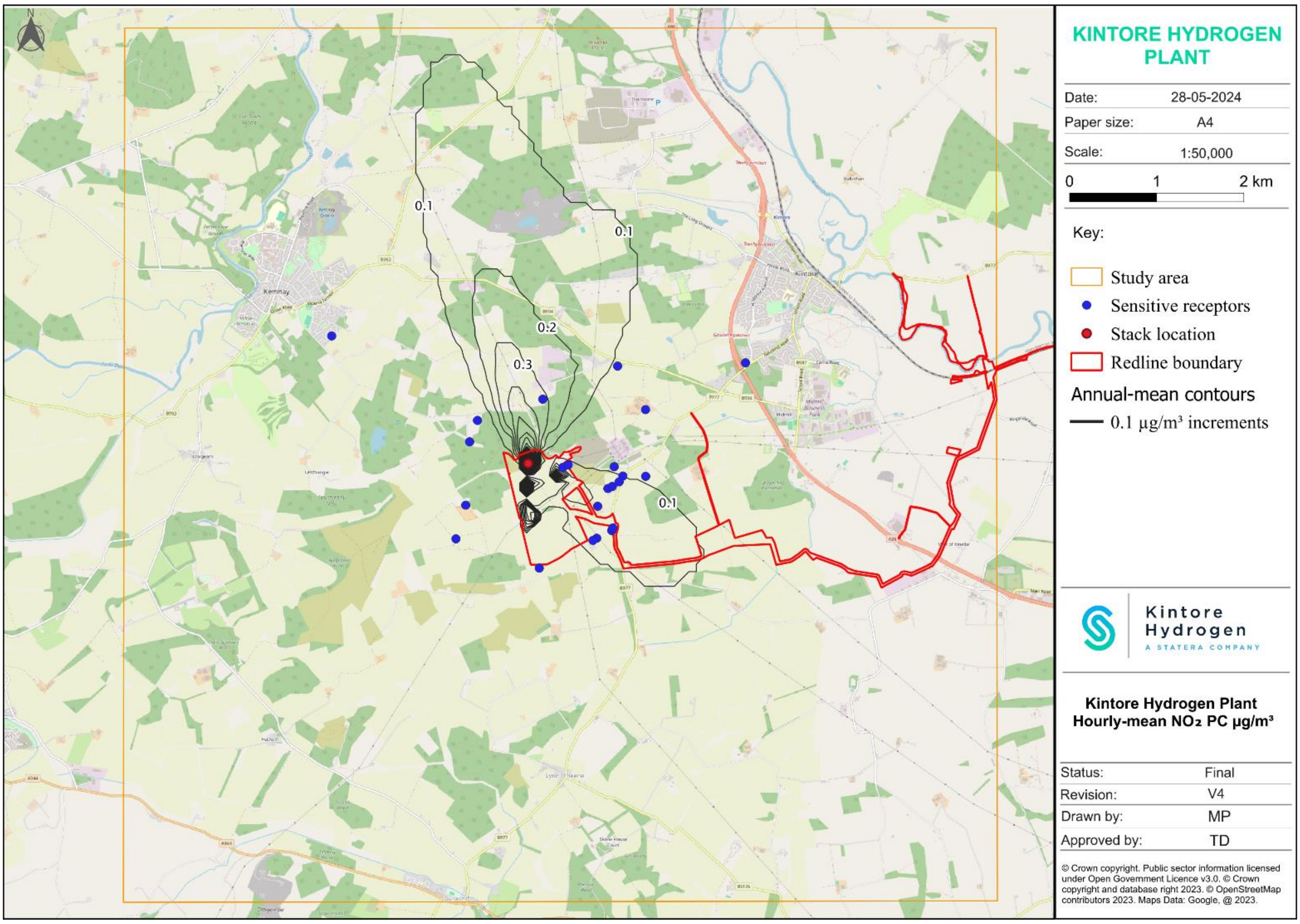
7.5.2 As shown, the impact descriptor for all sensitive receptors as well as the maximum concentration at any grid point outside the site boundary is 'negligible', which is not significant.

Table 7.7: Long-term (annual) predicted NO_2 concentrations (µg/m³) at sensitive receptors

Receptor ID	PC	PC as % of AQAL	PEC	PEC as % of AQAL	Impact descriptor
Maximum concentration outside site boundary	1.22	3%	15.05	38%	Negligible
1	0.18	0%	14.01	35%	Negligible
2	0.10	0%	13.94	35%	Negligible
3	0.08	0%	13.91	35%	Negligible
4	0.15	0%	13.99	35%	Negligible

Receptor ID	PC	PC as % of AQAL	PEC	PEC as % of AQAL	Impact descriptor
5	0.14	0%	13.97	35%	Negligible
6	0.19	0%	14.03	35%	Negligible
7	0.10	0%	13.93	35%	Negligible
8	0.12	0%	13.95	35%	Negligible
9	0.14	0%	13.97	35%	Negligible
10	0.13	0%	13.96	35%	Negligible
11	0.16	0%	13.99	35%	Negligible
12	0.16	0%	13.99	35%	Negligible
13	0.00	0%	13.84	35%	Negligible
14	0.00	0%	13.84	35%	Negligible
15	0.02	0%	13.85	35%	Negligible
16	0.32	1%	14.15	35%	Negligible
17	0.08	0%	13.92	35%	Negligible
18	0.09	0%	13.92	35%	Negligible
19	0.03	0%	13.86	35%	Negligible
20	0.02	0%	13.85	35%	Negligible
21	0.05	0%	13.88	35%	Negligible
22	0.05	0%	13.89	35%	Negligible
23	0.04	0%	13.88	35%	Negligible

Figure 7.7: Annual-mean NO_2 process contributions (µg/m³)



7.5.3 Table 7.8 lists the short-term PC values at sensitive receptors and the maximum concentration at any grid point outside the site boundary. Figure 7.8 shows a contour plot of hourly-mean PC.

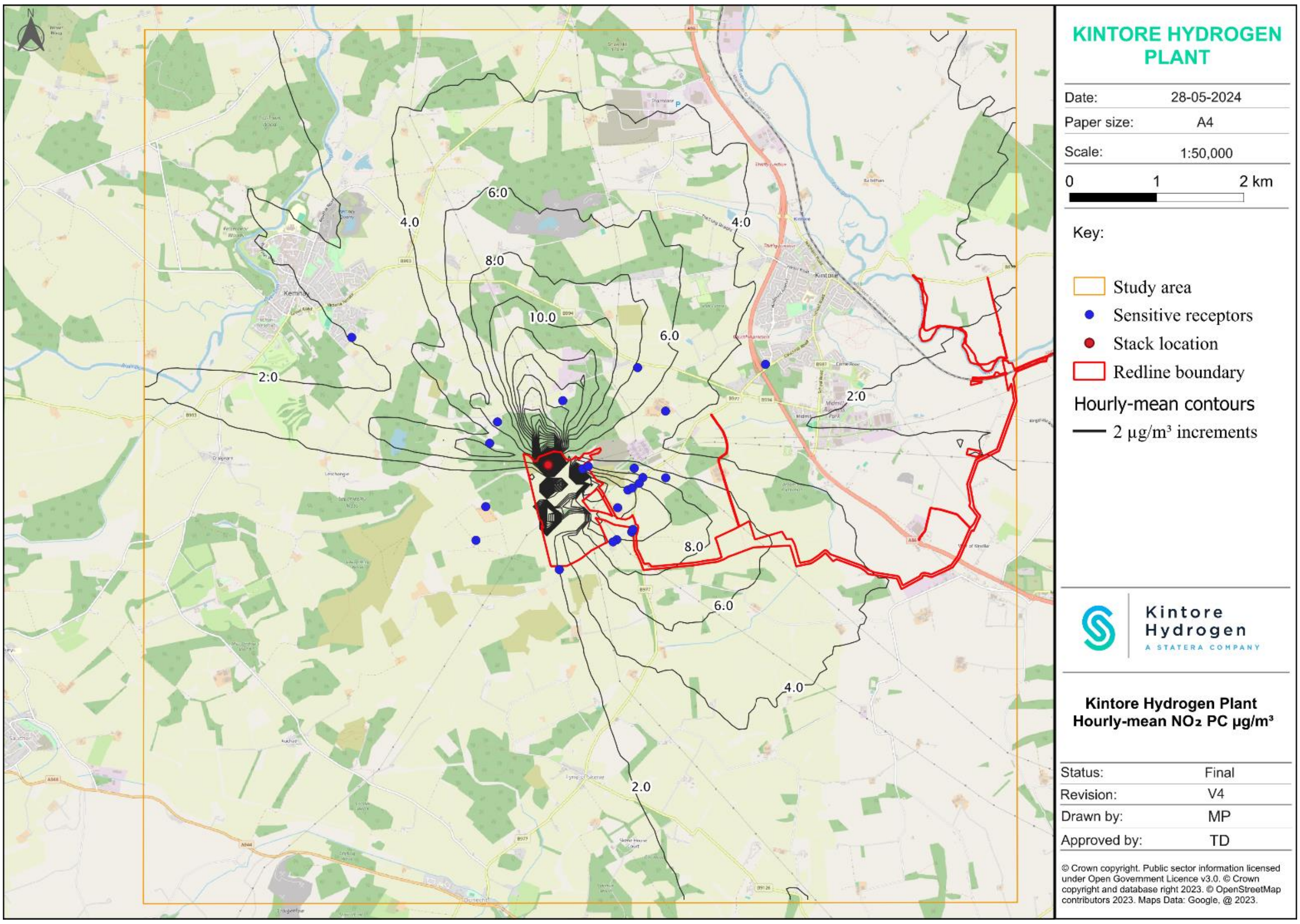
7.5.4 As shown, the impact descriptors at sensitive receptors are all ‘negligible’ and the impact descriptor for the maximum concentration at any grid point outside the site boundary is ‘slight’. On this basis, the impact of scenario 4 is deemed to not be significant.

Table 7.8: Short-term (hourly) predicted NO_2 concentrations (µg/m³) at sensitive receptors

Receptor ID	PC	PC as % of AQAL	Impact descriptor
Maximum concentration outside site boundary	34.15	17%	Slight
1	6.01	3%	Negligible
2	3.50	2%	Negligible
3	3.34	2%	Negligible
4	5.46	3%	Negligible
5	5.18	3%	Negligible
6	6.48	3%	Negligible

Receptor ID	PC	PC as % of AQAL	Impact descriptor
7	3.97	2%	Negligible
8	4.86	2%	Negligible
9	4.98	2%	Negligible
10	4.77	2%	Negligible
11	5.50	3%	Negligible
12	5.50	3%	Negligible
13	0.20	0%	Negligible
14	0.19	0%	Negligible
15	0.97	0%	Negligible
16	7.43	4%	Negligible
17	3.44	2%	Negligible
18	3.86	2%	Negligible
19	1.69	1%	Negligible
20	1.07	1%	Negligible
21	2.40	1%	Negligible
22	3.62	2%	Negligible
23	2.41	1%	Negligible

Figure 7.8: Hourly-mean NO_2 process contributions (µg/m^3)



8 Conclusion

8.1.1 A quantitative assessment of air quality impacts arising from hydrogen flare operation have been modelled. Four scenarios representing the design envelope have been modelled, being the combination of two stack designs and two stack locations.

8.1.2 In scenarios 2, 3 and 4, no exceedances of the applicable air quality objectives are predicted at any existing sensitive receptor location. The maximum modelled concentration at any grid point outside the site boundary would also fall below the relevant air quality objectives.

8.1.3 Scenario 1 is the only option that indicates the potential for significant air quality effects, where the maximum short-term (hourly) NO_2 concentration at receptor 1 and at any modelled grid point outside the site boundary could exceed the one-hour AQAL of 200 µg/m^3 on more than 18 occasions per year. This maximum case results from having been modelled on an extremely conservative approach of assuming continuous, maximum capacity flare operation throughout a year. The flare is designed to provide for safe disposal of hydrogen during an abnormal event. It would not be operated routinely in this way, and it is extremely unlikely that it would be used for an hour on 18 or more occasions in a year. It is therefore extremely unlikely that the short-term AQAL, by definition, could be exceeded in practice. As shown by scenarios 2, 3 and 4, this could also be mitigated (should the sensitive receptor properties at Receptor 1 remain occupied in operation of the proposed development, via the location and design of the stack.

References

[1] EU, “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,” 2008. [Online]. Available: https://eur-lex.europa.eu/eli/dir/2008/50/oj.

[2] Scottish Government, “The Air Quality Standards (Scotland) Regulations 2010,” 2010. [Online]. Available: https://www.legislation.gov.uk/ssi/2010/204/contents.

[3] Defra, “The Air Quality Strategy for England, Scotland, Wales and Northern Ireland,” 2007. [Online]. Available: https://assets.publishing.service.gov.uk/media/5a758459ed915d731495a940/pb12654-air-quality-strategy-vol1-070712.pdf.

[4] Scottish Government, “Cleaner Air for Scotland 2 - Towards a Better Place for Everyone,” July 2021. [Online]. Available: https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2021/07/cleaner-air-scotland-2-towards-better-place-everyone/documents/cleaner-air-scotland-2-towards-better-place-everyone/cleaner-air-scotland-2-towards-better-place-ever.

[5] Scottish Air Quality, “Air Quality in Scotland,” 2021. [Online]. Available: https://www.scottishairquality.scot/air-quality/standards.

[6] Aberdeenshire Council, “Aberdeenshire Local Development Plan 2023,” 2023. [Online]. Available: https://online.aberdeenshire.gov.uk/ldpmedia/LDP2021/AberdeenshireLocalDevelopmentPlan2023IntroductionAndPolicies.pdf.

[7] Defra, “Local Air Quality Management Technical Guidance (TG22),” 2022. [Online]. Available: https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf.

[8] EPUK & IAQM, “Land-Use Planning & Development Control: Planning for Air Quality,” 2017. [Online]. Available: https://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf.

[9] EA, SEPA, NRW and NIEA, “Hydrogen production by electrolysis of water: emerging techniques,” March 2024. [Online]. Available: https://www.gov.uk/guidance/hydrogen-production-by-electrolysis-of-water-emerging-techniques.

[10] EPUK and IAQM, “Land-Use Planning & Development Control: Planning For Air Quality,” EPUK and IAQM, 2017.

[11] EA and Defra, “Air emissions risk assessment for your environmental permit,” 2023. [Online]. Available: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#risk-assessment-tool. [Accessed 05 May 2024].

[12] Aberdeenshire Council, “2023 Air Quality Annual Progress Report (APR) for Aberdeenshire Council,” 2023. [Online]. Available: https://www.scottishairquality.scot/sites/default/files/publications/2023-09/APR__Scotland_2023_v1.0.pdf.

[13] Defra, “Background Mapping data for local authorities - 2018,” [Online]. Available: https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018.