Intended for
AB InBev UK Limited

Date
March 2020

Project Number
1700003382_ERA

AB INBEV UK LIMITED ENVIRONMENTAL RISK ASSESSMENT

RAMBOLL

AB INBEV UK LIMITED
ENVIRONMENTAL RISK ASSESSMENT

Project No.	**1700002282**
Issue No.	**02**
Date	**31/03/2020**
Made by	**Lucy Cleverley/ Karen Hardy**
Checked by	**Lucy Cleverley**
Approved by	**Greg Roberts**

Made by:

Checked/Approved by:

Version Control Log

Revision	Date	Made by	Checked by	Approved by	Description
1	30/09/2019	LC/ KH	LC	GR	First issue to client
2	31/03/2020	KH	RW	RW	Updated with new Air Quality Modelling Report

Ramboll
8 Village Way
Tongwynlais
Cardiff
CF15 7NE
United Kingdom
T +44 2920 543 550
www.ramboll.co.uk

CONTENTS

APPENDICES

INTRODUCTION

Ramboll Environment and Health UK Limited (Ramboll) was commissioned by AB InBev UK Limited ('AB InBev' or the 'Client') to prepare a Site Condition Report (SCR) for its manufacturing facility located at The Brewery, Wilcrick, Magor, Caldicot, Monmouthshire, NP26 3RA (the 'Facility' or the 'site'). The SCR shall support AB InBev's application for a variation to their existing Environmental Permit (EP) (BX7282IS).

The SCR (and application for a variation to the EP) requires an Environmental Risk Assessment (ERA) to be carried out based on Natural Resources Wales' EPR H1 Guidance. The objective of the ERA is to identify the substances used and produced that could pollute the soil or groundwater if there was an accident, or if measures to protect land fail.

In accordance with the aforementioned guidance, this ERA is structured as follows:

1. Identification and consideration of risks for the Facility and sources of the risks.
2. Identification of receptors (people, animals, property and anything else that could be affected by the hazard) at risk from the Facility.
3. Identification of possible pathways from the sources of the risks to receptors.
4. Assessment of the risks relevant to the specific activities carried out at the site and consideration of which risks can be screened out as negligible.
5. Description of measures to control identified risks.

1. IDENTIFICATION OF ENVIRONMENTAL RISKS

1.1 Source-Pathway-Receptor Concept

In order for pollution to have an impact on the environment, a pollution linkage must be present which relies on the Source-Pathway-Receptor concept, where all three factors must be present and linked for a potential risk to exist.

A "pollution linkage" requires the following:

i) A "source" is a substance which is in, on or under the land and which has the potential to cause significant harm to a relevant receptor, or to cause significant pollution of controlled waters;

ii) A "receptor" is something that could be adversely affected by a contaminant, for example a person, an organism, an ecosystem, property, or controlled waters; and

iii) A "pathway" is a route by which a receptor is or might be affected by a contaminant.

Identification of the source, pathway and receptor enables management interventions to be made to manage the environmental risks and avoid pollution reaching the receptor.

In this section the potential sources (environmental risks) of pollution at the Facility are identified and screened for their significance, and the potential pathways and receptors are identified.

1.2 Environmental Risks

The Operator is required to identify the environmental risks (sources of potential contamination) which could occur during the operation of the Facility, including any risks which may arise from accidents. The EA online guidance[1] stipulates that the Operator must consider the following potential risks:

- any discharge (e.g. sewage or trade effluent to surface water or groundwater);
- accidents;
- odour;
- noise and vibration;
- uncontrolled and unintended ('fugitive') emissions (for which risks include dust, litter, pests; and pollutants that shouldn't be in the discharge); and
- visible emissions (e.g. smoke or visible plumes).

In considering the risk, the Operator can determine that a potential risk is not considered to be significant in terms of its potential impact on the environment; however, a justification must be provided for any risk which is 'screened out'.

Based on the guidance summarised above the potential environmental risks at the Facility have been identified and have been determined either applicable or not applicable based on the potential environmental impact arising from the risk. A summary of these risks is presented in the table below which also provides justifications where risks are considered to be insignificant. The risks which have been identified as significant have been included in the risk assessment in Section 5 of this report.

[1] https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit#risks-from-your-site

Table 1.1: Screening of Environmental Risks

Environmental Risk	Applicability	Justification
Controlled discharges to surface waters	Applicable	Under its Environmental Permit (BX7282IS), the Facility has three permitted discharges to surface water: discharge of treated effluent from the ETP into the Severn Estuary; disposal of surface water at the main brewery site to the Waundeilad Reen; and disposal of surface water at the effluent treatment plant site to the Mill Reen.
Controlled discharges to Groundwater	Not Applicable	There are no controlled discharges to groundwater from the Facility. This risk has not been considered for further assessment.
Accidents	Applicable	Plant or Equipment Failure: Large quantities of equipment are in-use across the Facility. The failure of plant or equipment may result in an incident occurring which could potentially impact on the environment. Materials Handling: Raw materials and wastes are stored on both the main site and the ETP site in bulk and are transported across the Facility via pipework and in IBCs on fork lift trucks. There is the potential for accidents (e.g. spills, leaks etc.) to occur during the filling of bulk storage vessels and the movement of materials, which may result in contaminated run-off. Vandalism: The Facility is located in a relatively remote rural area and may be a target for vandalism and theft. Operator Error: Whilst the majority of the processing plant is automated, the potential for operator error cannot be ruled out.
Odour	Applicable	Emissions from the Installation have the potential to be odorous, particularly the brewing process and operations at the off-site effluent treatment plant. In addition, odours may be produced at the on-site waste water treatment plant and from the storage of waste at the recycling area of the main brewery site.
Noise & Vibration	Applicable	Operations at the Installation have the potential to produce noise, in particularly the movement of Heavy Goods Vehicles making deliveries to and collections from the site. In addition, the use of machinery on-site, the movement of barrels and the boilers have the potential to cause emissions of noise from the site.
Visual Impact	Not Applicable	The Facility is positioned adjacent to the M4 within a predominantly agricultural area with some commercial land uses and sparse residential properties. Visible emissions from the Facility are limited to steam/ water vapour from the evaporative condensers and cooling towers and permitted releases from the boiler stacks. These emissions are not considered to be significant in terms of visual impact. There are no records of complaints regarding the visual impact of emissions at the Facility. Based on this, visual impact has not been considered to be

Environmental Risk	Applicability	Justification
		significant and has not been included for further assessment.
Fugitive Emissions to air and water	Applicable	Surface Water: potential for blocked/ damaged drains or misconnections in the drainage system to result in an uncontrolled release of process wastewater to ground or surface water. Storm water discharges: storm water run-off from the site roofs and yard areas is directed via an integrated wastewater and storm water drainage system to the on-site wastewater treatment plant and then pumped to the off-site ETP. In the event of a flood, process water, diluted by flood water is pumped into the Waundeilad Reen. Although the pH is tested prior to release, there remains the potential for polluted discharges to enter surface water due to failure of the penstock valve or failure of monitoring systems. Dust: The delivery and collection of dry raw materials and wastes give rise to the potential of generation of dust emissions. Whilst dry materials are delivered in internal areas, dry waste materials are currently collected in bulk in a dedicated external area of the site. There is a therefore potential for dust generation in external areas. Litter: Wastes are produced at the Facility which are stored in secure containers at a dedicated, central location of the site, limiting the potential for litter to be windblown. At the off-site ETP, wastes are stored in secure waste skips and are collected by a waste contractor at appropriate intervals.
Controlled releases to air	Applicable	Air emissions comprise combustion products from the Facility's natural gas fired HTHW and steam boilers at the main brewery site and from the CHP plant and flare stack from the anaerobic digestion plant at the effluent treatment plant. In addition, water vapour/ steam from cooling towers and evaporative condensers from brewing vessels, and at various locations around the site.
Global Warming Potential	Applicable	Both direct and indirect greenhouse gas emissions arise from the operation of the Facility. Direct emissions arise from the burning of gas / oil in the on-site boilers and off-site CHP, and operation of the chiller and cooling systems (which use regulated greenhouse gases). Indirect emissions arise from the use of electricity, and water. There are also other indirect impacts from both in the production and supply process.
Facility Waste	Applicable	Hazardous and non-hazardous wastes are produced at the Facility as a result of the production processes, maintenance and administrative functions.

2. IDENTIFICATION OF RECEPTORS

A receptor is defined as something that could be adversely affected by a pollutant. Based on visual observations of the Facility and the information relating to its environmental setting (provided in the SCR) Ramboll has identified the receptors within the vicinity of the site. The receptors are depicted on Figure 8 of Appendix 1 of the SCR which shows the Facility boundary and the location of each receptor; a summary of the identified receptors is provided in Table 2.1 below.

Table 2.1: Summary of Identified Receptors

Receptor	Location
Groundwater: The Brewery site is situated on a Secondary A Aquifer; however, it is not in a Groundwater Source Protection Zone. The Tidal Mud Flats underlying the ETP are classified as Unproductive Strata. There no records of groundwater abstraction wells within 1km of the Brewery or ETP sites.	Across the entirety of the Facility and in the immediate vicinity of the Facility
Surface Water: Brewery Site A pond is located on-site, outside the restaurant area and includes several ornamental carp. A surface water pond feature is present outside of the installation boundary, adjacent to the west of the pumping station. Other nearby water features include drainage channels adjacent to a roadway approximately 100m to the south of the site, connecting to a series of drainage reens across Caldicot Level. ETP The ETP is surrounded by interconnected reens, all of which drain to the Severn Estuary via the Magor Pill. The Facility is permitted to discharge treated process effluent from the ETP to the Severn Estuary, and to discharge uncontaminated surface water from the main brewery site to the Waundeilad Reen and from the ETP site to the Mill Reen. There are no records of surface water abstraction licences recorded within 1km of the Brewery or ETP sites.	On-site and in the immediate vicinity of the Facility.
Ground: Brewery Site The site is underlain by Made Ground across the majority of the site to a maximum depth of 1.7m bgl; underlain by gravelly silty sandy clay to a maximum depth of 4.5m bgl; underlain by Sandstone bedrock; or in the far west of the site, Made Ground was found to be underlain by Mercia Mudstone. ETP The ETP site is underlain by Made Ground to a maximum depth of 1.8m bgl comprising sandy gravelly clay; underlain by clay and gravelly clay to 5m bgl; underlain by Mercia Mudstone.	Across the entirety of the Facility and in the immediate vicinity of the Facility
Atmosphere: Brewery Site Air emissions comprise combustion products from the Facility's natural gas fired HTHW and steam boilers. In addition, water vapour/ steam from operations on-site. In addition, water vapour/ steam from cooling towers and evaporative condensers from brewing vessels, and at various locations around the site.	Across the entirety of the Facility and in the immediate vicinity of the Facility

Receptor	**Location**
ETP Air emissions at the ETP site comprise combustion products from the CHP plant and from the flare stack from the anaerobic digestion plant.	
Designated Ecological Sites: Brewery Site The Gwent Levels Site of Special Scientific Interest (SSSI) is located 358m south of the site, designated due to rich assemblages of invertebrate species. The area also contains a number of nationally rare plant species. ETP The ETP is located within the Gwent Levels SSSI. The Severn Estuary is located 42m south-east of the site at its closest point and is designated as a SSSI, Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar site.	358 m south of the brewery site and 42 m south- east of the ETP.
Human Occupation: Facility workers and visitors are present across the internal and external areas of the brewery site, and at operational areas of the ETP site. Brewery Site There are public footpaths within 36 m south, 136 m south-west and 166 m west of the site. In addition, a hotel is located approximately 161 m north-east, and the M4 approximately 223 m north-east from the site, a police station is present 141 m north-east of the north- eastern site boundary, and the residential area of Magor is situated from 305 m east. A railway line is located approximately 314 m south. ETP Public footpaths run adjacent to the south-eastern site boundary and within 154 m south-west and 175 m north of the ETP site. The nearest residential properties are situated approximately 530 m north- west. Human receptors are present intermittently at these locations.	On-site and directly adjacent

3. POTENTIAL POLLUTION PATHWAYS

3.1 Identification of Possible Pathways from the Sources of the Risks to Receptors

The potential pollution pathways between the sources identified in Section 1 (excluding those which have been screened out) and the receptors identified in Section 2 are summarised in the table below.

Table 3.1: Potential Pollution Pathways

Source	Potential Pathway	Receptor
Controlled discharges to surface waters.	Surface water pumped from the brewery site to the Waundeilad Reen. Surface water runoff from the lorry park area to highways surface water drainage. Below ground pipe from the ETP to the Severn Estuary. Surface water at the effluent treatment plant site, discharged to the Mill Reen.	Waundeilad Reen Mill Reen.
Odour: arising from the brewing process; waste materials; effluent at the on-site waste water treatment plant; and operations at the off-site ETP.	Through the air.	*Humans including:* Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the Facility.
Visual emissions: arising from combustion activities; cooling towers and evaporative condensers.	Through the air.	*Humans including:* Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the Facility.
Noise and Vibration: arising from vehicle movements; site operations; process machinery; and ETP.	Transmitted through the air and through ground vibration.	*Humans including:* Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the Facility.
Accidents: including plant or equipment failure; materials handling; vandalism; operator error; fire; and, flooding.	Over site surfaces; through site drainage systems; and through the air.	*Surface water; Groundwater; Ground; Atmosphere, and Humans including:* Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes /

Source	Potential Pathway	Receptor
		roadways surrounding the Facility.
Fugitive Emissions: including dust; litter; and surface water run-off.	Through the air; windblown; over Facility surfaces; through Facility drainage systems.	*Surface water; groundwater; ground; atmosphere, and humans including:* facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the brewery.
Controlled release to air: from point sources.	Through the air; windblown.	*Atmosphere, and humans including:* Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the brewery.
Global Warming Potential: from direct and indirect use of fossil fuels.	Through the air.	*Atmosphere.*
Installation Waste: hazardous and non-hazardous wastes arising as a result of production processes; maintenance; and administrative functions undertaken at the Facility.	Windblown over ground; surface water run-off.	*Groundwater; surface water; ground; and atmosphere.*

4. RISK ASSESSMENT METHODOLOGY

The risk assessment provides a simple representation of the hypothesised relationships between contaminants, pathways and receptors. This allows the identification of potential contamination linkages and, therefore, an interpretation of the potential for pollution to occur at the Facility or within the vicinity of the site as a result of the activities at the Facility.

The potential for pollution to occur at the site is determined by assessing the likelihood of an identified receptor being exposed to pollution emanating from a source at the Facility and the resultant consequences of any such exposure. In determining the likelihood and the consequence of a pollution exposure the risk management techniques which are used at the Facility, and the effect on any such exposure are considered. Where the risk management techniques are considered to have a mitigating impact, the resultant overall likelihood of the pollution exposure occurring and its consequences on a receptor are lowered.

4.1 Assessing Likelihood and Consequence

Within the risk assessment, each hypothesised relationship between contaminants, pathways and receptors is assessed to determine the likelihood of the receptor being exposed to pollution and the consequences of exposure using the rankings listed in the tables below.

Table 4.1: Likelihood Rankings

Very Low	Low	Medium	High
Exposure to pollution is considered to be *highly unlikely*.	Exposure is considered to be *unlikely*.	Exposure is considered to be *likely*.	Exposure is considered to be *highly likely* to occur.

Table 4.2: Consequence Rankings

Very Low	Low	Medium	High
No impact or imperceptible impact on the receptor.	Low level impact easily and quickly mitigated or may not require any intervention to rectify any impact.	Moderate impact which will not be rectified without some mitigation / intervention.	High impact requiring significant intervention / mitigation and may have caused irreparable damage to the receptor.

4.2 Assessment of Risk

Following the determination of the likelihood and consequence rankings for the hypothesised relationships developed using the source-pathway-receptor concept, the matrix in the table below is used to determine the overall risk of the pollution exposure occurring.

Table 4.3 Risk Matrix

		Likelihood			
		Very Low	**Low**	**Medium**	**High**
Consequence	**High**	Low	Medium	High	High
	Medium	Low	Medium	Medium	High
	Low	Low	Low	Medium	Medium
	Very Low	Very Low	Low	Low	Low

5. RISK ASSESSMENT

5.1 Controlled Discharge to Surface Water

The Operator is permitted to discharge to surface water at three locations; two at the ETP (uncontaminated surface water to the Mill Reen and treated effluent discharge from the ETP to the Severn Estuary) and one at the main brewery site (uncontaminated surface water to the Waundeilad Reen). The Permit stipulates that, for the discharge from the ETP to the Severn Estuary, continuous flow monitoring is required, and that the volume of discharge is not to exceed 10,000m^3 per day or 126 l/s. Continuous monitoring is also required for pH, which is required to be >5 and <9 and temperature, which has a maximum limit of 30^{o}C. In addition, the permit stipulates that current discharge limits are: 200 mg/l biochemical oxygen demand (BOD); 150 mg/l suspended solids; 0.01 mg/l Total copper; 0.005 mg/l Total cadmium; 0.015 mg/l Total chromium; 0.0005 Total mercury, 0.03 mg/l Total nickel; 0.07 mg/l Total zinc; and 0.025 mg/l Total arsenic.

The 2019 application to vary the EP includes the addition of a discharge of surface water runoff from the new lorry park at the south of the site, to highways drainage (discharge point W5).

Management of the off-site ETP and the discharge to the estuary is contracted to Suez, who are responsible for all monitoring of the discharge, and for investigating and reporting any exceedances to the main brewery site. Suez reported one incident during 2017 of an exceedance of the permitted temperature limit of 30^{o}C, by a discharge measured at 31.8^{o}C. The exceedance was measured during a period of weather with extreme temperatures, and was reported to be caused by natural heating of the water. The exceedance was reported to NRW who did not consider the exceedance to be a breach. In addition, a pollution incident occurred during September 2017 when a pump at the off-site ETP failed, allowing an uncontrolled discharge to surface water. Further information on the incident and corrective action is provided in section 6 of the SCR.

Ramboll anticipates that tighter discharge limits may be stipulated following the publishing of the reviewed Food & Drink BREF. The Operator is in discussion with NRW regarding how this will affect current operations.

Table 5.1: Controlled Discharge to Surface Water

Source-Pathway-Receptor Hypothetical Model			**Risk Management Techniques**	**Assessing the Risk**		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
Controlled Discharge to Surface Water: out of specification effluent	Severn Estuary (SSSI, SAC, SPA, Ramsar)	Below ground pipe	• Trade effluent is managed by Suez, who monitor effluent at all stages of the process to identify the potential for, and prevent the occurrence of, any exceedances of the parameters stipulated in the Environmental Permit. The actions to be taken, and personnel responsible, should there be an increased risk of an exceedance are documented in Suez's work instruction 'ONRAMS-OP-MAG-ABI-ETP-0069(1)- Action to be Taken in the Event of an Environmental Incident'. • Suez use a SCADA system to automatically monitor effluent at certain points, from when it leaves the on-site wastewater treatment plant, throughout the process, to final discharge to surface water. Suez have set thresholds which, if exceeded, SCADA sends an automatic alarm to connected mobile phones. If any threshold is exceeded, then effluent can be transferred to the calamity tank and gradually released back into the wastewater treatment process. • Samples of final effluent are taken and analysed daily by Suez at the off-site ETP laboratory. Composite samples are sent to an external certified laboratory every 7 to 8 days for verification of Suez's data. • Pumps and tanks are subject to a Planned Preventative Maintenance schedule to reduce the risk of out of specification effluent arising due to failure of equipment.	Low	Medium	**Low**
	Mill Reen	Below ground pipe	• Surface water from the off-site ETP is passed through an interceptor prior to discharge to the Mill Reen. The interceptor is maintained on a 6-monthly basis.	Medium	Medium	**Medium**
	Waundeilad Reen	Below ground pipe	• All surface water from the main brewery site is directed via the drainage system to the on-site waste water treatment plant, where it is combined with process effluent and pumped to the off-site ETP for treatment and discharge to the Severn Estuary. • In the event of a flood, the dilution factor provided by the additional surface water is considered, and agreed by NRW, to be sufficient in diluting the process effluent to an acceptable level to discharge to the Waundeilad Reen. The pH of the discharge is monitored prior to discharge.	Low	Low	**Low**

Source-Pathway-Receptor Hypothetical Model			Risk Management Techniques	Assessing the Risk		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
Controlled Discharge to Surface Water: pump failure	Mill Reen	Surface water drainage	• With the exception of Pump Pit Zero and the Inlet Sump Pump, all pumps at the off-site ETP have a back-up pump. If a pump fails, the potential for the sump to overflow would arise, resulting in a potential release of untreated effluent to surface water. In the event of a pump failure or sump overflow, the SCADA system would send an automatic alarm to Suez. Out of manned ours, a member of Suez personnel is on call, who has remote access to the SCADA via laptop. • In the event of failure, untreated effluent could be diverted to the Calamity Tank, which has the capacity to hold sixteen hours' worth of effluent. Effluent can then be re-circulated if required. • In the event that the capacity of the Calamity Tank and other tanks is reached, the brewery would cease operations until the ETP was back in full operation.	Medium	Medium	**Medium**
	Severn Estuary (SSSI, SAC, SPA, Ramsar)	Discharge pipeline	• In the event of failure of equipment at the off-site ETP, there is potential for effluent to be discharged to the estuary. Effluent is monitored by Suez during all stages of treatment, from the point it leaves the brewery, throughout the process, to final discharge.	Low	Medium	**Medium**
	Waundeilad Reen	Surface water drainage	• Surface water at the main brewery site is retained on site, at the wastewater treatment plant by a penstock valve, before being pumped to the off-site ETP. In the event that the pump to the ETP fails, operations at the brewery would cease until the failure was corrected. Any effluent already in the drainage system would be collected by a tanker for disposal off-site.	Low	Medium	**Low**
Controlled Discharge to Surface Water: breach of the drainage system	Gwent Levels SSSI Secondary A Aquifer	Directly from cracks in the drains to ground/ groundwater	• AB InBev is committed to undertaking a drainage condition survey of the entire site including the ETP and the effluent pipeline. It is anticipated that some drainage maintenance work will be required to maintain integrity.	Medium	Medium	**Medium**
Controlled Discharge to Surface Water: contamination of surface water	Mill Reen Waundeilad Reen Gwent Levels SSSI Severn Estuary (SSSI, SAC, SPA, Ramsar)	Overland Via pump/ pipe	• Surface water at the brewery site combines with process effluent on-site, before being pumped to the ETP for treatment. Therefore, any small-scale contamination would be pH balanced and treated at the ETP prior to discharge. • In the event of a flood, process water, diluted by surface water, is pumped to the Waundeilad Reen. It has been agreed with NRW that the dilution of process water by uncontaminated flood water would be sufficient to consider the discharge 'uncontaminated'. The pH of this effluent is monitored prior to discharge. • In the event of potential contamination of surface water at the lorry park area, the spillage procedure is followed to prevent contaminated runoff from entering the drainage system.	Low	Low	**Low**

5.2 Odour

The potential sources of odour at the Facility have been identified and used to develop the risk assessment for odour (see Table 5.2 below). There are no records of complaints relating to odour at the main brewery site; however historically there have been odour complaints at the ETP, from a local landowner. There have been no complaints relating to odour at either site in recent years.

Table 5.2: Odour

Source-Pathway-Receptor Hypothetical Model			**Risk Management Techniques**	**Assessing the Risk**		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
Odour: brewing process	*Humans including:* Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the Facility.	Fugitive emissions to air from building openings / air handling units	• Fugitive emissions from buildings are minimised by fast-acting doors, keeping them closed whenever they are not needed for access.	Medium	Low	**Low**
Odour: waste materials		Fugitive emissions to outdoor air	• Wastes produced at the site include general, card and plastics, waste cans and small amounts of hazardous wastes. These wastes are stored in designated covered containers and skips, and are considered to be at low risk of becoming malodourous. • The wastes are stored at the 'Recycling Area', which is situated at a central location of the site, reducing the risk of odour from any waste reaching the site boundary. • Frequent collections of wastes are scheduled.	Low	Low	**Low**
Odour: effluent at the on-site waste water treatment plant		Fugitive emissions to outdoor air	• The on-site waste water treatment plant is located towards the south of the brewery site, away from the majority of human receptors on-site. The area is approximately 200 m from the nearest residential building; however, the warehouse buildings lie in between and would prevent any potential odour at the site boundary. • Minimal treatment of the effluent is carried out on-site, and therefore the potential for offensive odours to be produced is low.	Low	Low	**Low**
Odour: operations at the off-site ETP		Fugitive emissions to outdoor air	• The off-site ETP is situated on the coastline, in a remote location approximately 450 m from the nearest receptor. • The performance and operation of the ETP is managed and monitored daily by Suez. • Sludge is removed by a tanker daily. Although some odour is generated during sludge removal, the distance between the ETP and local receptors makes it unlikely that odour would cause a nuisance. • High concentrations of hydrogen sulphide (H_2S) had been observed at the ETP. Ramboll carried out an investigation into the causes of the elevated concentrations and recommended actions to reduce these levels (Report Ref: 1700003278-Magor Brewery Hydrogen Sulphide Investigation). The facility is currently implementing actions and planning to address the issue.	Medium	Low	**Medium**

5.3 Noise

The potential sources of noise at the Facility have been identified and used to develop the risk assessment for noise (see Table 5.3 below). There is the potential for noise to arise through the transport and receipt of raw materials and through the collection and distribution of finished products and wastes by heavy goods vehicles. Forklift trucks are also used to transport goods on-site. Production processes including the boilers and steam are also potential sources of noise on the site. The risk assessment for individual noise sources is provided in the table below.

Table 5.3: Noise

Source-Pathway-Receptor Hypothetical Model			**Risk Management Techniques**	**Assessing the Risk**		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
Noise: arising from the movement of heavy goods vehicles (HGVs) & forklift trucks across the Facility, and engine noise / alarms from other vehicles working on, and visiting the site.	*Humans including:* Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the factory	Through the air and ground vibration	• A site speed limit of 10 miles per hour is in operation across the Facility to minimise engine noise. • The site is located close to Junction 23A of the M4 motorway, meaning disruption from transport vehicles off-site is minimised. • The car park for operatives and visitors is located next to the site entrance minimising the movements of traffic on the site. • Noise embankments have been built around the site perimeter to minimise the risk of noises on site travelling off-site.	Low	Low	**Low**
Noise and vibration: arising from the operation of ancillary plant (comprising boiler, air compressors, chillers).			• The boilers and other process equipment is contained within buildings with fast-acting doors, minimising noise to the external environment. • All plant at the site is maintained in accordance with manufacturers' specifications and managed through a Planned Preventative Maintenance schedule to minimise excessive noise from poor performance. • Noise embankments have been built around the site perimeter to minimise the risk of noises on site travelling off-site.	Low	Low	**Low**
Noise and Vibration: arising from the internal handling of raw materials and production equipment.			• All production processes are undertaken within buildings. • Fast-acting building doors are kept closed whenever they are not needed for access. • All plant is maintained periodically in accordance with manufacturers' specifications to minimise excessive noise from poor performance.	Low	Low	**Low**
Noise and Vibration: arising from vehicles and operations at the off-site ETP.			• The remote location of the off-site ETP restricts noise disturbance from its operations. • Waste collections from the off-site ETP are restricted to between the hours of 7:30 and 16:30.	Low	Low	**Low**

5.4 Accidents

The risk assessment for accidents at the site is included in the table below.

Table 5.4: Accidents

Source-Pathway-Receptor Hypothetical Model			Risk Management Techniques	Assessing the Risk		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
Accident: Failure in containment of diesel oil storage tank (or other bulk storage) and associated equipment (valves, pipes etc.). Overfilling of oil tank or other spillage / operator error during filling or decanting from tank.	*Ground*	Over Installation surfaces; and, through Installation drainage systems.	• The Facility maintains a register of bulk storage tanks/ containers and their contents. All bulk storage is provided with secondary bunding. An assessment of bunding was carried out by Ramboll in December 2018/ January 2019 and maintenance is ongoing. • The Facility has a spillage emergency response procedure in place which is detailed in the EMS and the Accident Management Plan (dated November 2018). • In the event that primary and secondary containment of a substance failed, the substance may enter the site drainage system. The substance could either be retained on-site and collected by tanker; or personnel at the main brewery site would alert personnel at the off-site WWTP to allow time for preparation for appropriate treatment. From the off-site WWTP, the substance could be diverted to the Calamity Tank and drip-fed through the process, to add a dilution factor; or could be collected from the off-site by tanker. • The Facility is committed to commissioning a CCTV drainage survey to inspect the integrity of site drainage, i.e. in order to ensure there are no pathways to groundwater or surface water.	Medium	Medium	**Medium**
	Groundwater					
	Surface Water					
Accident: Failure in containment of effluent storage: various tanks, sumps and associated equipment (valves, pipes etc.).	*Ground*	Over surfaces & through drainage systems Directly into the Severn Estuary, Waundeilad Reen or Mill Reen.	• In the event of containment failure at the off-site ETP, untreated effluent could be diverted to the Calamity Tank, which has the capacity to hold sixteen hours' worth of effluent. • In the event that the capacity of the Calamity Tank and other tanks is reached, the brewery would cease operations until the ETP was back in full operation. • In the event of pump failure, most pumps have a back-up that would be automatically engaged. • The Axel-Maint maintenance system used by Suez produces daily tasks, based on daily, monthly or weekly schedules. All assets at the off-site ETP are included on the Axel-Maint platform, including containment and bunding. • In the event of a spillage at the off-site ETP, Suez follow the work instruction 'ONRAMS-OP-MAG-ABI-ETP-0070(1)- Response to a Chemical Spill at the BTS'.	Medium	Low	**Medium**
	Groundwater			Medium	Medium	**Medium**
	Surface Water			Medium	Medium	**Medium**
	Atmosphere	Odours directly to outdoor air	• The off-site ETP is situated on the coastline, in a remote location approximately 450 m from the nearest receptor. • The performance and operation of the ETP is managed and monitored daily by Suez. • Sludge is removed by a tanker daily. Although some odour is generated during sludge removal, the distance between the ETP and local receptors makes it unlikely that odour would cause a nuisance.	Medium	Low	**Medium**
Accident: release from ammonia tank	Atmosphere	Odour directly to outdoor air & potentially indoor air	• Ammonia is used in refrigeration plant at the facility, which is maintained as required, and at a minimum of 6-monthly intervals under a service contract with Integral. The plant is included in the facility's "SAP" (planned preventative maintenance schedule), which records required maintenance frequencies for infrastructure and equipment at the facility and send alerts when routine maintenance is due. Integral are on call 24/7 in case of an ammonia leak.	Low	High	**Medium**

Source-Pathway-Receptor Hypothetical Model			Risk Management Techniques	Assessing the Risk		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
			• Areas where ammonia are in use are fitted with automatic leak detection and alarms. In the event of a leak, the facility has implemented a response and evacuation procedure: Ammonia Emergency Evacuation Procedure.			
	Surface water	Drainage system	• In the event of a leak of ammonia entering the drainage system, the facility has the potential to hold water at the on-site wastewater treatment plant. If effluent contaminated with ammonia had been pumped to the off-site ETP, Suez would be informed to allow them to prepare to treat the effluent appropriately.	Low	High	**Medium**
Accident: Spillage / Release of raw materials during internal handling and storage	*Ground*	Through Facility drainage systems (it is noted that the pathway would only occur if a failure in the Facility drainage associated with the process effluent occurred).	• All internal areas of the Facility feature impermeable surfaces. • Interceptors are present across the site and are inspected regularly, in line with the PPM schedule recorded via the Facility's 'SAP' system. • All effluent from the production areas drains to the waste water treatment plant on-site prior to pumping to the off-site ETP. • Spill kits are available in key risk areas. • The spill response procedure is defined in sites Accident Management Plan, revised November 2018. • In the event of a spillage at the off-site ETP, Suez follow the work instruction 'ONRAMS-OP-MAG-ABI-ETP-0070(1)- Response to a Chemical Spill at the BTS'.	Low	Low	**Low**
	Groundwater			Low	Low	**Low**
	Surface Water			Low	Low	**Low**
Accidents (Vandalism): Damage / theft of externally located equipment / tanks	*Ground*	Over Facility surfaces; and, through drainage systems.	• CCTV covers the site, which is secured by fencing and with authorised access only. All visitors and contractors enter via the gatehouse, which is manned 24/7 by site security. • The Facility is operational 24/7, 365 days a year, so is manned at all times. • The off-site ETP is covered by CCTV, which is monitored remotely out of hours. The off-site is manned 7:30-16:30, 7 days a week and the gates are padlocked out of hours. Suez are on call at all times when personnel are not present at the ETP.	Low	Low	**Low**
	Groundwater			Low	Low	**Low**
	Surface Water			Low	Low	**Low**
Accidents (Fire): Fire and arson attacks	*Ground*	Over Facility surfaces; through the air; and, through Installation drainage systems.	• A Site Emergency Evacuation Plan is in place along with departmental fire plans and fire risk assessments. • Fire alarm systems are subject to monthly maintenance. • Trained Fire Marshals are in place to respond to alarms. • Firefighting equipment is available on site for handling small fires. • Fire water would be discharged to the off-site ETP for treatment, or may be discharged to the Waundeilad Reen if it meets set criteria (e.g. pH). • In the event of a fire at the off-site ETP, operations at the brewery would cease until the ETP was fully operational and able to effectively treat brewery effluent.	Low	Low	**Low**
	Groundwater			Low	Low	**Low**
	Surface Water			Low	Low	**Low**
	Atmosphere			Low	Low	**Low**
Accidents: Explosion	*Ground*	Over Facility surfaces; through the air;	• In the Accident Management Plan (dated November 2018), areas at risk of explosion have been identified as: the boiler house (natural gas), brew house (cereal dust), refrigeration plant (ammonia), fork lift refuelling area, and the use of biogas for the CHP at the off-site ETP.	Low	Low	**Low**

Source-Pathway-Receptor Hypothetical Model			Risk Management Techniques	Assessing the Risk		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
	Groundwater	and, through Installation drainage systems.	• A DSEAR Assessment was undertaken during December 2018 and actions arising from the assessment are ongoing.	Low	Low	**Low**
	Surface Water			Low	Low	**Low**
	Atmosphere			Low	Low	**Low**

5.5 Fugitive Emissions

The risk assessment for fugitive emissions is presented in the table below.

Table 5.5: Fugitive Emissions

Source-Pathway-Receptor Hypothetical Model			Risk Management Techniques	Assessing the Risk		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
Fugitive Emissions: dust and particulates from production areas	*Humans including:* Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the factory.	Through the air	• Grains, yeast and rice are delivered to an internal area which is a designated ATEX area. In addition, the potential for fugitive emissions of dust arises from the grinding of grains in the Mill House. Emissions of dust from these internal areas to the environment is reduced by fast-acting doors, and by abatement equipment. • The potential for emissions of dust in external areas arises from the collection of spent yeast and wood chip by lorry. Emissions of dust are minimised, however, due to the production process producing damp waste yeast rather than dry.	Medium	Medium	**Medium**
	A*tmosphere*			Low	Low	**Low**
Fugitive Emissions: litter and debris from Facility activities	*Humans including: Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the factory.*	Through the air	• All wastes produced at the Facility are segregated and provided with suitable containment. • All wastes are stored within a dedicated recycling and waste area close to the centre of the site, protecting the area from wind, and reducing the risk of litter being windblown. • Wastes are stored either in a container skip or are baled ready for collection. • Wastes at the Off-Site ETP are stored in wheelie bins and collected by Biffa as required.	Low	Low	**Low**
Fugitive Emissions: surface water run-off from external areas at the brewery site	*Surface Water*	Through drainage systems	• Surface water run-off from site roofs and yard areas is directed via the surface water drainage system to the on-site waste water treatment plant, where it is combined with process effluent, pH-balanced, and then pumped to the Off-site ETP. • In the event of a spill on site resulting in contamination of the surface water system, personnel at the Off-site ETP are alerted and the run-off is treated appropriately prior to discharge to the Severn Estuary. • Although the Facility is permitted to discharge uncontaminated surface water to the Waundeilad Reen, this discharge point is only utilised in the event of a flood when the Off-site ETP would not cope with the volume of flood water. The flood water is tested for pH prior to release to the reen. *The Facility is committed to undertaking a CCTV survey of the drainage system to establish whether there are any pathways from surface water to ground water.*	Medium	Medium	**Medium**
	Ground water					
Fugitive Emissions: surface water run-off from the Off-site ETP	*Surface Water*	Through drainage systems	• Surface water from the Off-site ETP flows through an interceptor prior to discharge to the Mill Reen. The interceptor is subject to 6-monthly emptying and maintenance. • In the event of a spill at the Off-site ETP, surface water drainage channels are protected using the spill kit available.	Medium	Medium	**Medium**
Fugitive Emissions: surface water run-off from the lorry park	*Surface Water*	Through drainage systems	• Surface water run-off from the lorry park area is to enter the municipal highways stormwater drainage system at discharge point W5. • In the event of a spill at the lorry park, the emergency spillage response procedure is to be followed (as detailed in the EMS and the Accident Management Plan (dated November 2018)). Spill kits will be available at the location. • All surface water runoff from the new lorry park area flows to aco drainage channels, from where it is to be directed through a Kings Bypass Separator (or similar approved interceptor) to remove any	Low	Low	**Low**

Source-Pathway-Receptor Hypothetical Model			Risk Management Techniques	Assessing the Risk		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
			oil-type substances, before passing through a cellular storage tank to control flow to the municipal stormwater drainage system. Drainage plans have been provided in Appendix 1.			

5.6 Controlled Releases to Air

The risk assessment for controlled releases to air is presented in the table below.

Source-Pathway-Receptor Hypothetical Model			**Risk Management Techniques**	**Assessing the Risk**		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
Controlled Releases to Air: Boiler Stack Emissions	*Atmosphere* *Humans including:* Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the factory	Through the air	• The Facility operates four boilers at the main brewery site with a combined thermal input below 50 MW. The boilers are maintained under a Planned Preventative Maintenance schedule, and are operated and monitored in compliance with the Facility's Environmental Permit (BX7282IS) and Greenhouse Gas Emissions Permit (UK-W-IN-11421). • A Flue-Ace heat recovery system has recently been installed and modelling has been carried out to estimate the effect on air emissions from the boiler (Appendix 2). • Two redundant CHP plant are present at the Facility which were taken out of operation approximately six years ago. The Facility has no plans to reinstate the units in the future.	High	Medium	**Medium**
Controlled Releases to Air: CHP and biogas flare	*Atmosphere* *Humans including: Facility workers/ visitors;* intermittent presence on pedestrian routes / roadways surrounding the factory	Through the air	• Process biogas produced at the Off-site ETP is burned to power a CHP plant, which is used to power the off-site ETP. Approximately 50% of the gas produced is used by the CHP, with the remaining gas being flared off. Emissions from the CHP and the biogas flare are permitted and are monitored as required by the permit. • The CHP is maintained under contract by Veolia.	High	Medium	**Medium**
Controlled Releases to Air: water vapour from cooling towers and evaporative condensers	*Atmosphere* *Humans including:* Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the factory	Through the air	• The emissions from these point sources comprises water vapour only.	Low	Low	**Low**

5.7 Global Warming Potential

Table 5.7: Global Warming Potential

Source-Pathway-Receptor Hypothetical Model			Risk Management Techniques	Assessing the Risk		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
Global Warming Potential: Combustion of natural gas within boiler to support production processes resulting in direct emissions of greenhouse gasses	*Atmosphere*	Through the air	• The Facility operates four boilers at the main brewery site with a combined thermal input of greater than 50 MW. A Flue-Ace heat recovery system has recently been installed to recover heat to pre-heat the water for the boilers. • The boilers are operated in accordance with the Facility's Environmental and Greenhouse Gas Emissions permits.	High	Medium	**Medium**
Global Warming Potential: Combustion of biogas at the Off-site ETP resulting in direct emissions of greenhouse gasses	*Atmosphere*	Through the air	• Biogas produced at the off-site ETP is burned by a CHP plant, which is used to power the off-site. Approximately 50% of the gas produced is used by the CHP, with the remaining gas being flared off. Emissions from the CHP and the biogas flare are permitted and are monitored as required by the permit.	Medium	Low	**Low**
Global Warming Potential: Use of grid-sourced electricity to support production processes resulting in in-direct emissions of greenhouse gasses.	*Atmosphere*	Through the air	• Energy consumption is monitored, recorded, and reported on a monthly basis to the corporate function in Europe. • The Facility is investigating renewable energy sources for the future, including the potential to use solar power. • The off-site ETP is powered by biogas produced during the effluent treatment process, reducing the amount of electricity used from the grid. If more electricity is produced than is needed, some electricity is fed back to the grid.	High	Very Low	**Low**
Global Warming Potential: Use of refrigerant gases in the chiller systems in the Cold Store Warehouse & refrigerated trailers	*Atmosphere*	Through the air	• The comfort cooling systems at the Facility contain refrigerants including R410A, which is a hydrofluorocarbon (HFC), and a regulated greenhouse gas. The systems are maintained and leak checked by qualified personnel, under contract by Apleona.	Medium	Medium	**Medium**

5.8 Installation Waste

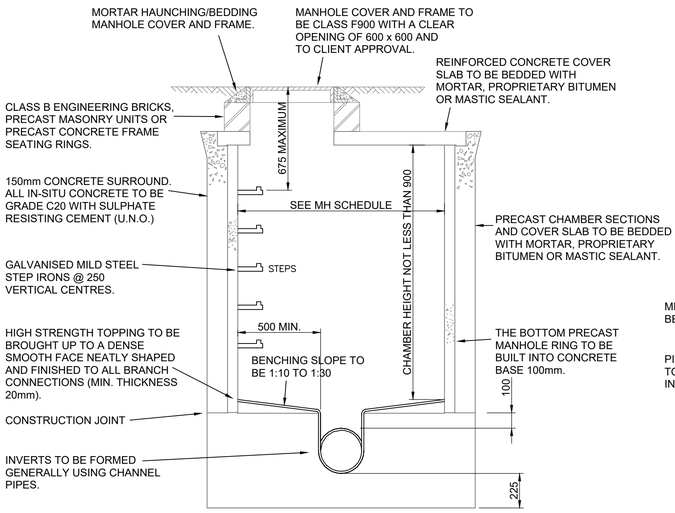
Table 5.8: Installation Waste

Source-Pathway-Receptor Hypothetical Model			Risk Management Techniques	Assessing the Risk		
Source of Pollution	**Receptor**	**Pathway**		**Likelihood of Exposure**	**Consequence of Exposure**	**Overall Risk**
Facility Waste: Wastes which arise from production and administrative activities at the site comprising: card; plastic; general waste; food waste; metals; wood; Waste Electronic and Electrical Equipment (WEEE); batteries; waste oils; fluorescent tubes; and used spill kits.	*Humans including:* Facility workers/visitors; workers on adjacent premises; local residents; intermittent presence on pedestrian routes / roadways surrounding the factory	Through the air	• All wastes produced at the Facility are segregated and provided with suitable containment. • All wastes are stored within a dedicated recycling and waste area close to the centre of the site, protecting the area from wind, and reducing the risk of litter being windblown. • Wastes are stored either in a container skip or are baled ready for collection. • Wastes at the off-site ETP are stored in wheelie bins and collected by Biffa as required. • Wastes produced at the Facility are unlikely to produce significant quantities of leachate. • The management of waste is contracted to Biffa, who manage storage and arrange collections on behalf of the Facility. • All wastes removed from the Facility are recovered / disposed of at permitted facilities.	Low	Low	**Low**
	Surface Water	Over Facility surfaces; and through drainage systems		Low	Low	**Low**
	Groundwater			Low	Low	**Low**
	Ground			Low	Low	**Low**
Facility Waste: Process effluent storage tank and sump and associated equipment (valves, pipes etc.); and ETP sludge	*Ground*	Over Facility surfaces; and through drainage systems.	• All assets at the ETP are included in the Axel-Maint maintenance system, managed by Suez on behalf of the Facility. The system provides for daily, weekly, monthly and annual checks and maintenance of all equipment as necessary, and includes all equipment and infrastructure including tanks and bunds and pipework. • In the event of equipment failure in the ETP, backup pumps are in place, and systems are in place to divert effluent to the Calamity Tank for holding if required. • A SCADA system is used to monitor effluent, which sends automatic alarms and notifications in the event of an incident. • Duty of care checks are completed for all waste contractors to ensure they are appropriately licensed for the carriage of waste. • All wastes removed from the site is recovered / disposed of at permitted facilities.	Medium	Low	**Medium**

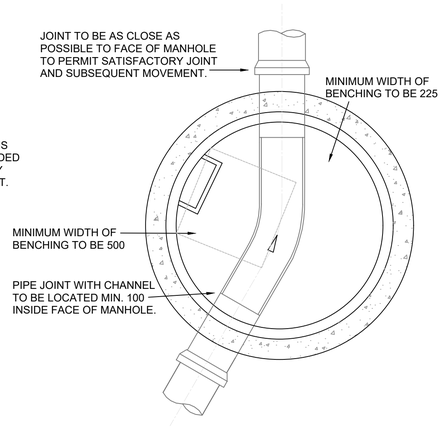
6. ERA CONCLUSION

Ramboll has identified potential environmental risks at the Facility and determined the potential environmental impact arising from each risk. The assessment has demonstrated that with the appropriate management controls in place, risks identified are acceptable, i.e. low to medium.

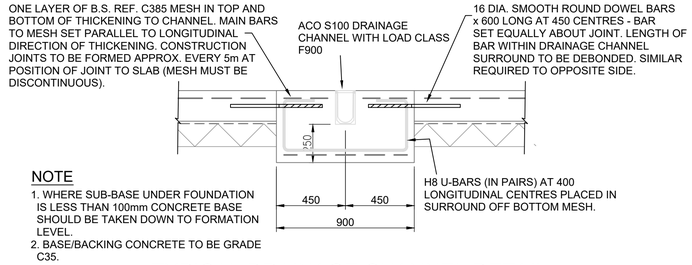
APPENDIX 1
LORRY PARK DRAINAGE PLAN



TYPICAL MANHOLE DETAILS (GROUND LEVEL TO SOFFIT OF PIPE < 3m)

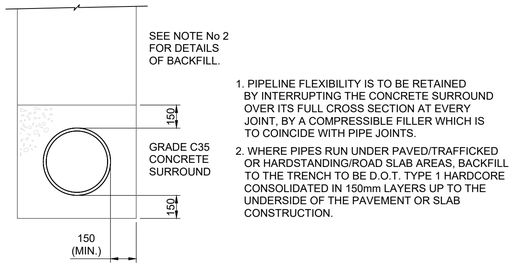


SECTIONAL PLAN ON MANHOLE



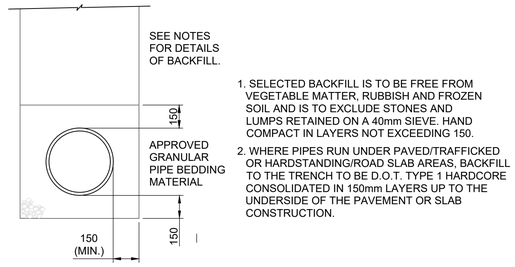
NOTE
1. WHERE SUB-BASE UNDER FOUNDATION IS LESS THAN 100mm CONCRETE BASE SHOULD BE TAKEN DOWN TO FORMATION LEVEL.
2. BASE/BACKING CONCRETE TO BE GRADE C35.

TYPICAL DRAINAGE CHANNEL DETAIL (ALL DETAILS AS FOR TYPICAL HARDSTANDING U.N.O.)



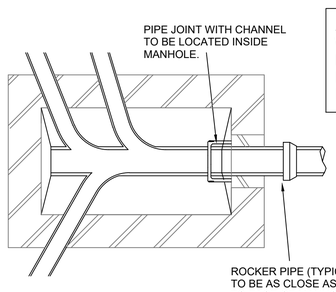
1. PIPELINE FLEXIBILITY IS TO BE RETAINED BY INTERRUPTING THE CONCRETE SURROUND OVER ITS FULL CROSS SECTION AT EVERY JOINT, BY A COMPRESSIBLE FILLER WHICH IS TO COINCIDE WITH PIPE JOINTS.
2. WHERE PIPES RUN UNDER PAVED/TRAFFICKED OR HARDSTANDING/ROAD SLAB AREAS, BACKFILL TO THE TRENCH TO BE D.O.T. TYPE 1 HARDCORE CONSOLIDATED IN 150mm LAYERS UP TO THE UNDERSIDE OF THE PAVEMENT OR SLAB CONSTRUCTION.

TYPICAL PIPE BEDDING DETAIL WHERE COVER FROM GROUND TO PIPE SOFFIT LESS THAN 1200mm



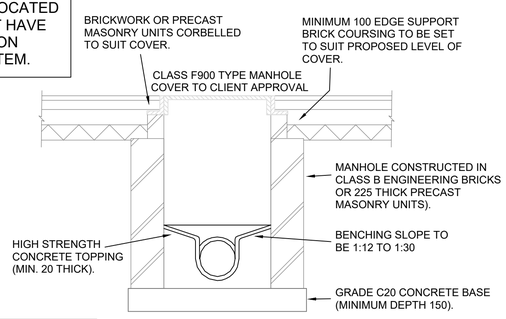
1. SELECTED BACKFILL IS TO BE FREE FROM VEGETABLE MATTER, RUBBISH AND FROZEN SOIL AND IS TO EXCLUDE STONES AND LUMPS RETAINED ON A 40mm SIEVE. HAND COMPACT IN LAYERS NOT EXCEEDING 150.
2. WHERE PIPES RUN UNDER PAVED/TRAFFICKED OR HARDSTANDING/ROAD SLAB AREAS, BACKFILL TO THE TRENCH TO BE D.O.T. TYPE 1 HARDCORE CONSOLIDATED IN 150mm LAYERS UP TO THE UNDERSIDE OF THE PAVEMENT OR SLAB CONSTRUCTION.

TYPICAL PIPE BEDDING DETAIL WHERE COVER FROM GROUND TO PIPE SOFFIT GREATER THAN 1200mm



TYPICAL PLAN

NOTE
WHERE MANHOLES ARE LOCATED INTERNALLY COVER MUST HAVE FACTORY FITTED VIBRATION RESISTANT LOCKING SYSTEM.

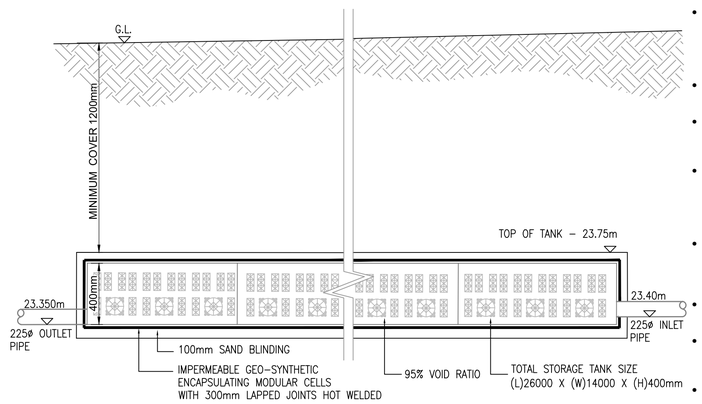


TYPICAL SECTION

INTERNAL DIMENSIONS OF MANHOLE NOMINALLY 1200mm x 600mm BUT MANHOLE WIDTH SHOULD BE INCREASED FOR PIPES LARGER THAN 225 DIA. TO GIVE 225mm BENCHING EACH SIDE AND THE BRICKWORK/MASONRY UNITS CORBELLED DOWN TO SUIT COVER

NOTE
INVERTS TO BE FORMED USING CHANNEL PIECES

TYPICAL MANHOLE DETAILS WHERE GROUND LEVEL TO PIPE SOFFIT LESS THAN 1.5m



TYPICAL CELLULAR STORAGE TANK SECTION DETAIL

- EXCAVATE THE TRENCH TO THE REQUIRED DEPTH ENSURING THAT THE PLAN AREA IS SLIGHTLY GREATER THAN THAT OF THE STORAGE CELL UNITS.
- LAY 100mm BED COURSE SAND, LEVEL AND COMPACT.
- LAY THE GEO-SYNTHETIC OVER THE BASE AND UP THE SIDE OF THE TRENCH.
- LAY THE STORAGE CELL UNITS PARALLEL WITH EACH OTHER OR IN A BRICK BONDED FORMATION. FOR MULTI LAYERS USE THE CLIPS AND THE SHEAR CONNECTERS.
- LAP AND SEAL THE GEO-TEXTILE AROUND THE UNITS, IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS.
- DRAINAGE CONNECTIONS TO BE MADE USING PROPRIETRY ADAPTORS.
- LAY 100mm OF COURSE SAND BETWEEN THE TRENCH WALLS AND THE STORAGE UNITS AND COMPACT.
- LAY 100mm BED OF COARSE SAND OVER THE GEO-TEXTILE AND COMPACT. BACKFILL WITH SELECTED AS DUG MATERIAL LAID AND COMPACTED IN LAYERS

GENERAL NOTES
1.1. THIS DRAWING IS COPYRIGHT AND SHOULD NOT BE REPRODUCED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF PATRICK PARSONS LTD.
1.2 DO NOT SCALE FROM THIS DRAWING.
1.3. LOCATIONS OF ALL EXISTING SERVICES ON-SITE TO BE CONFIRMED & PROVIDED TO THE ENGINEER PRIOR TO COMMENCEMENT OF WORKS.
1.4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT PATRICK PARSONS LTD DRAWINGS & SPECIFICATIONS.
1.5. ALL DETAILS TO BE CHECKED ON SITE BY CONTRACTOR AND ANY DISCREPANCIES REPORTED BACK TO THE ENGINEER PRIOR TO CONSTRUCTION

Rev.	Amendments	Date	By
P1	INITIAL ISSUE.	08.02.19	TE

Revisions

PATRICKPARSONS
5 Waverley Road
Huddersfield
West Yorkshire
HD1 5NA
United Kingdom
T. +44 (0)1484 516 977
E. info@patrickparsons.co.uk
W. www.patrickparsons.co.uk

Client
AB InBev UK Ltd

Project
HGV HOLDING AREA
MAGOR

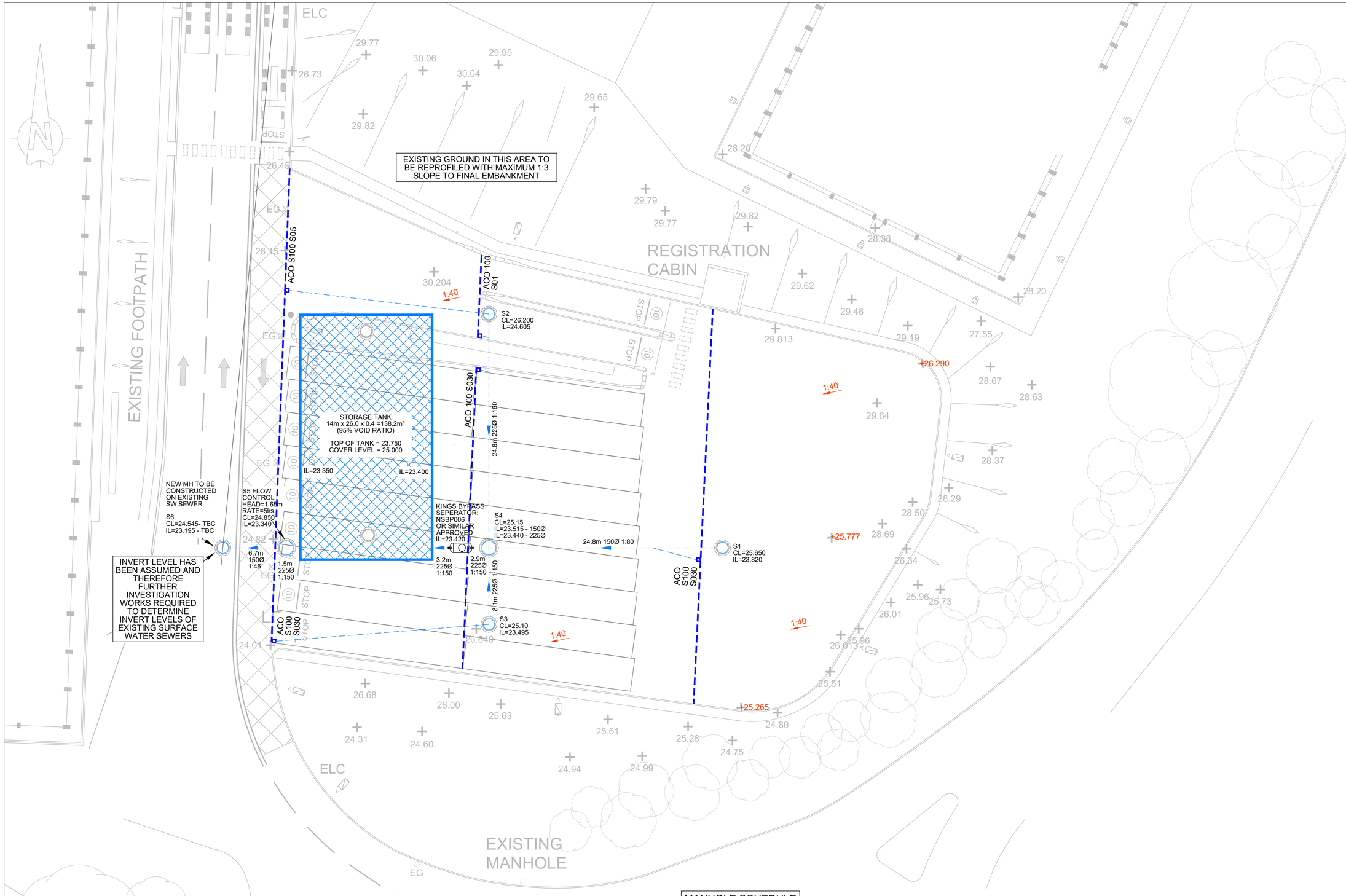
Drawing
DRAINAGE DETAILS

Scales 1:200 At original size A1

Drawn TE Checked MJM
Date FEB 2019

Status PRELIMINARY

Drawing No. H18143-201 Rev. P1



GENERAL NOTES

1.1. THIS DRAWING IS COPYRIGHT AND SHOULD NOT BE REPRODUCED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF PATRICK PARSONS LTD.
1.2 DO NOT SCALE FROM THIS DRAWING.
1.3. LOCATIONS OF ALL EXISTING SERVICES ON-SITE TO BE CONFIRMED & PROVIDED TO THE ENGINEER PRIOR TO COMMENCEMENT OF WORKS.
1.4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT PATRICK PARSONS LTD DRAWINGS & SPECIFICATIONS.
1.5. ALL LEVELS TO BE CHECKED ON SITE BY CONTRACTOR AND ANY DISCREPANCIES REPORTED BACK TO THE ENGINEER PRIOR TO CONSTRUCTION

DRAINAGE STRATEGY
SURFACE WATER TO BE DISCHARGED TO EXISTING SEWER IN ACCESS ROAD AT A RESTRICTED RATE OF 5l/s.

THIS REQUIRES THE FOLLOWING STORAGE:
1 IN 30-YEAR = 74m³
1 IN 100-YEAR + 20%CC = 138m³

LEGEND

- EXISTING SURFACE WATER SEWER
- PROPOSED SURFACE WATER SEWER
- PROPOSED SURFACE WATER CHAMBER
- ACO CHANNEL DRAIN OR SIMILAR APPROVED
- +61.32 EXISTING LEVEL
- +61.32 PROPOSED LEVEL
- 1:100 GRADIENT
- DIRECTION OF FALL
- ACCESS CHAMBER

MANHOLE SCHEDULE

Manhole Reference	Cover Level (m.A.O.D)	Invert Level (m.A.O.D)	Depth To Invert (m)	Depth To Soffit (m)	Pipe Size Dia (mm)	Manhole Dia (mm)	Manhole Type	Grade Of Cover	Adopting Authority
S1	25.650	23.820	1.830	1.680	150	1200	TYPE B	E600	(PRIVATE)
S2	26.200	24.605	1.595	1.370	225	1200	TYPE B1/E	E600	(PRIVATE)
S3	25.100	23.495	1.605	1.380	225	1200	TYPE B1/E	E600	(PRIVATE)
S4	25.150	23.440	1.710	1.485	225	1500	TYPE B1/E	E600	(PRIVATE)
S5	24.850	23.340	1.510	1.360	150	1500	FLOW CONTROL MH	E600	(PRIVATE)
S6	24.545	23.195	1.350	#VALUE!	EX.	1200	TYPE B1/E	E600	(PRIVATE)

Cover levels may vary to suit on site working conditions

Rev.	Amendments	Date	By
P1	INITIAL ISSUE.	08.02.19	TE

Revisions

PATRICK PARSONS
5 Waverley Road
Huddersfield
West Yorkshire
HD1 5NA
United Kingdom
T. +44 (0)1484 516 977
E. info@patrickparsons.co.uk
W. www.patrickparsons.co.uk

Client: AB INBEV UK LTD

Project: HGV HOLDING AREA MAGOR

Drawing: DRAINAGE LAYOUT

Scales 1:200 At original size A1

Drawn TE Checked MJM
Date FEB 2019

Status PRELIMINARY

Drawing No. H18143-200 Rev. P1

APPENDIX 2
AIR QUALITY MODELLING REPORT

On behalf of
AB In-bev UK Limited.

Intended for
AB In-bev UK Limited.

Date
March 2020

Project Number
1620009178

AB IN-BEV LTD, MAGOR
AIR QUALITY MODELLING REPORT

RAMBOLL

AB IN-BEV LTD, MAGOR
AIR QUALITY MODELLING REPORT

Project No.	**1620009178**
Issue No.	**P01**
Date	**31/03/2020**
Made by	**Ana Gomes**
Checked by	**Graham Harker**
Approved by	**Graham Harker**

Made by:	
Checked/Approved by:	

Version Control Log

Revision	Date	Made by	Checked by	Approved by	Description
01	31/03/2020	AG	GH	GH	First Draft Modelling Report

Ramboll
Cornerblock
Two Cornwall Street
Birmingham
West Midlands B3 2DX
United Kingdom

T +44 121 230 1650
https://uk.ramboll.com

CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

EXECUTIVE SUMMARY

Ramboll UK Ltd (Ramboll) has been commissioned by AB In-Bev UK Ltd to undertake air dispersion modelling in support of an Environmental Permit variation application incorporating the operation of a Flue Ace heat recovery system.

This report sets out the method and results of the dispersion modelling; broadly the scope of the air quality assessment includes:

- Review of local air quality data surrounding the Site;
- Desk study of the building arrangements and locations of human and ecological receptors sensitive to a change in local air quality resulting from the boiler emissions; and
- ADMS dispersion modelling of the operational plant emissions to predict process contributions (PCs) and Predicted Environmental Concentrations (PECs) at identified sensitive receptors for comparison against relevant ambient assessment levels.

The modelling has updated modelling undertaken by Exova which was originally submitted in support of the permit variation application. Following submission of the permit variation application, Natural Resources Wales requested further information on the impact of the plant on ecological sites in the vicinity as well as information on the impacts of CO and SO_2 emissions.

The modelling assessment has been undertaken for two scenarios; with and without the Flue Ace heat recovery system operational and on a conservative basis of all of the equipment operating all year round. The maximum predicted impacts for any of the five years' worth of meteorological data modelled have been reported. Overall, the predicted impacts are considered to be conservative and worst case. As the equipment is gas fired, only emissions of NO_x and CO have been modelled as natural gas contains insignificant amounts of sulphur.

Impacts have been predicted at a number of human health and ecological receptor locations in the vicinity of the site.

Without the Flue Ace operational, all of the PCs are either insignificant or the PECs are significantly lower than the relevant critical level or load.

With the Flue Ace operational, all of the PCs are either insignificant or the PECs are significantly lower than the relevant critical level or load for the human health receptors and non-designated ecological sites. At three of the designated ecological sites (Magor Marsh SSSI, Gwent Levels – Magor & Undy SSSI and Penhow Woodlands SSSI) the maximum nitrogen deposition rates are marginally above 1% of the site relevant critical loads and the PECs exceed the critical loads. The PCs are very small in comparison to the existing baseline deposition rates and the extent of the exceedance of the 1% threshold within the habitats is small. Given the conservative nature of the modelling, the existing baseline deposition rates and the limited extent of the impact above 1% within the habitat, it is not considered that the deposition would have significant effects on the integrity of the SSSIs.

1. INTRODUCTION

Ramboll UK Ltd (Ramboll) has been commissioned by AB In-Bev Ltd ('the client'), to undertake air dispersion modelling in support of an Environmental Permit variation application at their site in Mangor. The modelling has updated modelling undertaken by Exova[1] which was originally submitted in support of the permit variation application. Following submission of the permit variation application, Natural Resources Wales requested further information[2] on the impact of the plant on ecological sites as well as information on the impacts of CO and SO_2 emissions.

This report sets out the method and results of the dispersion modelling used to assess the air quality impacts of the plant.

1.1 Site Description

The site lies to the west of Magor, to the south west of Junction 23A of the M4 motorway. The site location is shown in **Error! Reference source not found.**, taken from the Exova report.

Figure 1.1: Site Location

The site is not located within an Air Quality Management Area (AQMA).

[1] Inbev Mangor Air Quality Assessment NOx Emissions Flue Ace system, File reference number: CNE9N February 2018 Exova
[2] Natural Resources Wales, PAN-008056, letter dated 30th January 2020

1.2 Scope

The permit variation concerns the installation of a Flue Ace system, which recovers heat from the exhaust of the high temperature hot water boilers (A1 and A2). There are two smaller steam boilers on site, A3 and A4. The maximum future heat demand from the site is equivalent to the two high temperature hot water boilers and one of the steam boilers operating.

Two scenarios have been modelled:

- Scenario 1. Operation of all of the boilers on site (A1, A2, A3 and A4) with the flue gases exiting from the existing stack and without the Flue Ace operating.
- Scenario 2. Operation of two of the existing boilers on site (A3 and A4) with the flue gases exiting from the existing stack, and operation of boilers A1 and A2 through the Flue Ace stack.

The modelled scenarios are conservative as all of the boilers are assumed to be operating all year round.

As the boiler plant is natural gas fired, the pollutants of concern are oxides of nitrogen (NO_x) and carbon monoxide (CO). Natural gas has negligible sulphur content and therefore emissions of sulphur dioxide are considered to be negligible and are not incorporated into the model.

The Exova modelling report considered a mixture of human health and ecological receptor locations. These receptor locations have been retained in this report, but additional explanation is provided on the nature of the receptors that were considered and which air quality assessment levels apply.

In addition, Natural Resources Wales requested information be provided on the impacts at specific ecological receptor sites as set out in their Screening Report[3]. The specific ecological receptor locations in the Screening Report are:

- Severn Estuary Special Area of Conservation (SAC) (UK0013030), Special Protection Area (SPA) (UK9015022) and Ramsar (UK11081)
- River Usk/Afon Wysg SAC (UK0013007)
- Wye Valley and Forest of Dean Bat Sites SAC (UK0014794)
- Magor Marsh Site of Special Scientific Interest (SSSI) (33WHB)
- Penhow Woodlands SSSI (33WGW)
- Gwent Levels – Magor and Undy SSSI (33WEC)
- Gwent Levels – Redwick and Llandevenny SSSI (33WDN)
- 18 x Ancient Woodland Sites
- Upper Cottage Pond Local Wildlife Site (LWS)
- Wood West of Common-y-Coed LWS
- Grange Wood & The Larches LWS
- Grange Road LWS
- Breezy Bank to Rockfield Farm LWS
- Cae Wall Wood LWS
- Greenmoor Pool LWS
- Wilcrick Fort West LWS

[3] Natural Resources Wales, Nature and Heritage Conservation, Screening Report PAN-008056, 30/01/2020

- Ridings Wood LWS
- Land at Barecroft Common LWS
- Upper Grange Farm Field LWS
- Bowkett Field, Barecroft LWS
- Blackwall Lane Field LWS
- Bridewell Common Field LWS
- Barecroft Fields LWS
- Bluehouse Farm LWS

The locations of the sites were provided indicatively on a number of maps within the NRW Screening Report and there are overlaps between the Local Wildlife Sites and the Ancient Woodlands.

Section 3.2.3 of this report contains maps showing the modelled receptor locations representative of the sites within the Screening Report.

2. METHODOLOGY

2.1 Introduction

The scope of the assessment has been determined by consideration of the following:

- Review of local air quality data for the including Defra background maps and information on the Air Pollution Information System (APIS) website;
- Desk study of the building arrangements and locations of human and ecological receptors sensitive to a change in local air quality resulting from the boiler emissions;
- ADMS dispersion models with operational energy centre emissions to predict process contributions (PCs) and Predicted Environmental Concentrations (PECs) at identified sensitive receptors for comparison against relevant assessment levels and loads.

2.2 Air Quality Strategy Objectives

The long-term and short-term National Air Quality Objectives (NAQOs) that are applicable to this assessment are detailed below in Table 2.1.

Table 2.1: National Air Quality Objectives

Pollutant	Concentration ($\mu g/m^3$)	Averaging Period	NAQO Exceedances Allowed	Percentiles
Human Health Impacts				
Nitrogen dioxide (NO_2)	200	One hour mean	18	99.79
Nitrogen dioxide (NO_2)	40	Annual mean	-	-
Ecological receptors				
Oxides of nitrogen (NO_x)	30	Annual mean	-	-

Recent guidance produced by the Institute of Air Quality Management (IAQM)[4] provides an explanation of the reasoning behind setting of the annual mean NO_x objective for the protection of ecosystems (paragraphs D.4.8 to D.4.10):

> *'The critical level does not differentiate between the role of nitrogen deposition and NO_x in the air. It is a precautionary general threshold, not specific to a particular habitat, plant species or impact pathway, below which there is currently a high degree of confidence that no adverse effects on vegetation will arise. Long-term NO_x concentrations below the critical level are therefore desirable. Some species or habitats may not show adverse effects until higher concentrations are present.*
>
> *The long-term (annual mean) concentration of NO_x is most relevant for its impacts on vegetation, as the effects, particularly through the nitrogen deposition pathway, are additive over months and years. This is reflected in the adoption of the long-term guideline in the EU Air Quality Directive as a limit value for vegetation. However, atmospheric exposure to very high concentrations of NO_x for short periods (hours/days) may also have an adverse effect under certain conditions even if the long-term concentrations are below the limit value. The WHO guidelines include a short term (24-hour average) NO_x critical level of 75µg/m^3. Originally set at 200µg/m^3 as a four-hour*

[4] A guide to the assessment of air quality impacts on designated nature conservation sites, D.4.9, v1.0 June 2019

mean, the more detailed CD-ROM version of the 2000 WHO guidelines comments: "Experimental evidence exists that the CLE decreases from around 200µg/m^3 to 75µg/m^3 when in-combination with O_3 or SO_2 at or above their critical levels. In the knowledge that short-term episodes of elevated NO_x concentrations are generally combined with elevated concentrations of O_3 or SO_2, 75µg/m^3 is proposed for the 24 h mean." Ozone and SO_2 concentrations are typically low in the UK compared to many other countries. If a regulator does require the use of the short term NO_x critical level, given the low UK SO_2 concentrations IAQM consider it is most appropriate to use 200µg/m^3 as the short term critical load.

The relative importance of the long-term mean compared to the short term mean is reflected in several studies which state that the 'UNECE Working Group on Effects strongly recommended the use of the annual mean value, as the long-term effects of NOx are thought to be more significant than the short term effects'. This IAQM guidance, therefore, recommends that only the annual mean NO_x concentration is used in assessments unless specifically required by a regulator; for instance, as part of an industrial permit application where high, short term peaks in emissions, and consequent ambient concentrations, may occur.'

In terms of the assessment of the impacts of NO_x emissions for an Environmental Permit, the assessment is required to consider both the annual mean and daily mean concentrations. As the extract from the IAQM guidance makes clear however, compliance with the annual mean critical level is the more significant of the two parameters and is likely to be highly protective of vegetation in general.

In terms of the daily mean critical level, the published Environmental Assessment Level in EA guidance[5] is 75µg/m^3 and this is likely to be highly conservative in the context of UK O_3 and SO_2 concentrations, and a critical level of 200µg/m^3 is likely to be more appropriate. However, in order to be conservative, the results of the dispersion modelling are compared against the lower critical level of 75µg/m^3 in this assessment.

2.3 Critical Loads

2.3.1 Introduction

For the deposition of air pollutants critical loads have been set for different habitats. The Air Pollution Information System (APIS)[6] provides critical loads for nitrogen deposition (leading to eutrophication) and nitrogen acid deposition (leading to acidification) for different habitat types and specific site relevant critical loads for designated sites.

2.3.2 Site Relevant Critical Loads for Designated Sites

For this study, the lowest site relevant critical loads quoted on APIS for the designated sites have been used, as shown in Table 2.2. However, an ecological investigation has not been undertaken to confirm that the selected habitats are present at the particular receptor location chosen for the assessment. Depending on the outcome of the modelling, this can be undertaken at a future date if necessary.

[5] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

[6] http://www.apis.ac.uk accessed March 2020

Table 2.2: Site Relevant Critical Loads

Site	Habitat	N critical load (kgN/ha/yr)	Acid critical load (keq/ha/yr)		
			MinCLMinN	MinCLMaxN	MinCLMaxS
Severn Estuary SAC, SPA & Ramsar	Pioneer, low-mid, mid-upper saltmarshes/acid grassland	20	0.40	4.50	4.10
River Usk SAC	Water courses of plain to montane levels	3*	-	-	-
Wye Valley/Forest of Dean Bat sites SAC	Greater/lesser horseshoe bat	10	0.1	1.8	1.7
Gwent Levels - Redwick & Llandevenny SSSI	Neutral grassland/acid grassland	10	0.438	2.038	1.60
Magor Marsh SSSI	Fen, marsh and swamp/acid grassland	10	0.438	2.038	1.60
Gwent Levels - Magor & Undy SSSI	Surface standing waters	10	0.438	2.038	1.60
Penhow Woodlands SSSI	Coniferous woodland/unmanaged broadleaved and coniferous	5	0.142	6.072	5.93

For the River Usk SAC, APIS states that there are *'No comparable habitat with established critical load estimate available'* and therefore the lowest critical load available in APIS has been used. APIS recommends that the selected critical load of 3kgN/ha/year should only be applied to oligotrophic waters with low alkalinity with no significant agricultural or other human inputs. It is therefore likely that this critical load is conservative for the River Usk SAC as the habitat is likely to be subject to agricultural and human inputs.

2.3.3 Critical Loads for LWS and Ancient Woodlands

For non-designated sites such as LWS and ancient woodlands the critical loads for the assessment could be based on an evaluation of the particular habitat present within the site. However, when deposition is calculated from the predicted NO_2 concentration, there are two broad deposition velocities used; 1.5mm/s for grassland type habitats and 3.0mm/s for woodland type habitats.

As explained in Section 2.4.2 below, the significance criteria for non-designated sites is based on not exceeding 100% of the relevant assessment level. It is therefore possible to calculate a NO_x process contribution that would be equivalent to the lowest APIS critical load for either grassland or woodland habitats and use this as a screening criteria as to whether the nitrogen deposition critical load would be exceeded for any LWS or ancient woodlands in the vicinity of the site.

Section 5.5.4.4 of the IAQM guidance notes that where the change in NO_x concentrations is less than 0.4µg/m^3 it is unlikely that nitrogen deposition would exceed 1% of the most stringent critical loads for nitrogen and acid deposition. This is on the basis that the most stringent critical load for a grassland type habitat is 5kgN/ha/year. The calculation is based on a conversion factor for NO_x to NO_2 of 0.7 and a deposition velocity of 1.5mm/s for grassland habitats, i.e. a NO_x concentration of 0.4µg/m^3 is equivalent to 0.04kgN/ha/year, or less than 1% of 5kgN/ha/year. For grassland habitats therefore, for the nitrogen deposition not exceed 100% of the most stringent critical load, the annual mean NO_x contribution from the facility would need to be less than 40µg/m^3. As this is above the annual mean critical level screening criteria of

30µg/m^3, if the critical level screens out as being insignificant for grassland habitats, then the critical load will also screen out as insignificant.

For woodland habitats, the APIS website quotes the lowest critical load for woodland type habitats as 5kgN/ha/year. With a deposition velocity of 3mm/s, a NO_x concentration of 20µg/m^3 would be equivalent to 100% of this critical load. In order to be conservative, a NO_x screening criterion of 20µg/m^3 has been used to confirm when critical loads are insignificant for non-designated sites.

2.4 Significance Criteria

2.4.1 Human Health Receptors

For Environmental Permitting, Natural Resources Wales currently follow guidance issued by the Environment Agency for assessing the risks of air pollution. For Environmental Permitting, the process contribution (PC) is compared against the relevant environmental standard. PCs that meet both the following criteria can be screened out from further assessment:

- the short-term PC is less than 10% of the short-term environmental standard,
- the long-term PC is less than 1% of the long-term environmental standard.

Whilst intended to apply to screening assessments and the need to undertake dispersion modelling of emissions, the above criteria are commonly applied to the consideration of the impacts from dispersion modelling. Where the PCs do not screen out, the Predicted Environmental Concentration (PEC) must also be calculated. The PEC includes the background concentration and assesses the cumulative impact in relation to the environmental standard.

The following screening criteria are then applied to the PECs:

- the short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration,
- the long-term PEC is less than 70% of the long-term environmental standards.

Again, whilst these are screening criteria, they are commonly applied to the consideration of the results of modelling assessments.

2.4.2 Ecological Receptors

For ecological assessments for designated sites similar criteria apply:

- the short-term PC is less than 10% of the short-term environmental standard for protected conservation areas,
- the long-term PC is less than 1% of the long-term environmental standard for protected conservation areas.

Where the above assessment criteria are not met, the long-term PEC is assessed:

- If the long-term PEC is less than 70% of the long-term environmental standard, the emissions are insignificant and dispersion modelling is not required.

If the PEC is greater than 70% of the long-term environmental standard, detailed modelling is required, but thereafter, the assessment of significance is whether or not the PEC exceeds the environmental standard.

For non-designated sites such as ancient woodlands and LWS, then consideration is only given to the PC. If concentrations meet both of the following criteria, then the impacts are considered insignificant and no further assessment is necessary:

- the short-term PC is less than 100% of the short-term environmental standard.
- the long-term PC is less than 100% of the long-term environmental standard.

The guidance simply states that if the PC exceeds the screening criteria then detailed modelling must be undertaken.

3. DISPERSION MODELLING

3.1 Introduction

Air quality impacts were modelled using the ADMS5[7] air quality dispersion model. This uses representative meteorological data for the local area and plant emissions data to predict ambient concentrations of pollutants in the vicinity of the stack. Details of the ADMS 5 model set up are provided in Appendix 1 with an overview in the following sections.

3.2 Model Set Up

3.2.1 Emission Rates and Operating Hours

There are two high temperature hot water (HTHW) boilers that provide heat to the installation and two steam boilers. Current operational load is equivalent to one HTHW boiler operating and one steam boiler operating. Future operational loads could mean that two HTHW boilers will be required to operate.

For dispersion modelling purposes it is assumed that all of the boilers will be operational all year round; this will over-estimate both the long-term and short-term concentrations as simultaneous operation of all of the boilers is unlikely to occur.

As noted in Section 1.2, two scenarios have been modelled:

- Scenario 1. Operation of all of the boilers on site (A1, A2, A3 and A4) with the flue gases exiting from the existing stack and the Flue Ace not operating.
- Scenario 2. Operation of two of the existing boilers on site (A3 and A4) with the flue gases exiting from the existing stack, and operation of boilers A1 and A2 through the Flue Ace stack.

Emission rates and volumetric flowrates have been based on data within the Exova report and the permit emission limit values (ELVs) for NO_x. As there are no ELVs for CO for the boilers, a conservative ELV has been chosen for modelling purposes.

As the Flue Ace system is a heat recovery system with the emissions deriving from boilers A1 and A2, the emission rate is the sum of the emission rates from A1 and A2. The Flue Ace is assumed to be operating at 100% capacity. The emissions data are summarised in Table 3.1.

Table 3.1: Emission Data used in the Modelling

Equipment	Flowrate (Am^3/s)	Temperature (°C)	Velocity (m/s)	Normalised Flowrate* (Nm^3/s)	NO_x		CO	
					mg/Nm^3	g/s	mg/Nm^3	g/s
A1 HTHW boiler, 18MW	9.67	186	7.4	5.08	220	1.12	100	0.51
A2 HTHW boiler, 18MW	9.67	186	7.4	5.08	220	1.12	100	0.51
A3 steam boiler, 4.1MW	2.18	186	7.4	1.15	140	0.16	100	0.11
A4 steam boiler, 7.1MW	3.81	186	7.4	2.00	140	0.28	100	0.20
A9 Flue Ace	5.70	110	11.34	-	-	2.24	-	1.02

*Emissions have been normalised to 273K, dry gas and 3% oxygen.

In comparison to the data used in the modelling, the latest monitoring data results from Exova emissions testing of the boilers are shown in Table 3.2.

Table 3.2: Emissions Monitoring Data

Boiler	Exova Monitoring Date	NO_x (mg/Nm^3)	CO (mg/Nm^3)
A1 HTHW boiler, 18MW	4th November 2019	214	0.28
A2 HTHW boiler, 18MW	8th October 2019	193	1.7
A3 steam boiler, 4.1MW	8th October 2019	97.8	2.1
A4 steam boiler, 7.1MW	8th October 2019	92.5	10.2

The monitoring data confirms that the boilers operate below their ELVs for NO_x. For CO, the assumed modelling concentration of $100mg/Nm^3$ will be very conservative compared to the actual operating regime of the boilers.

3.2.2 Meteorological Data

The modelling has used 5 years' worth of meteorological data for 2015-2019 from the Cardiff Airport meteorological station which is located approximately 40km to the west of the site. The results from the year that gave the highest predicted concentrations have been reported in the assessment.

3.2.3 Receptor Locations

Annual mean and the 99.79th percentile of one hour mean NO_2 concentrations have been predicted at human health receptor locations in the vicinity of the development. The same receptor locations were used as in the original Exova modelling report. In addition, specific receptor locations were chosen within each ecological habitat to represent the closest points to the site. All concentrations were predicted at ground level with a terrain data file used to take account of varying terrain in the vicinity of the site. The receptor locations are specified in Table 3.3 overleaf and are shown in Figures 3.1 and 3.2.

In addition to predicting concentrations at individual receptor locations, a grid of receptors was used to provide a visual interpretation of the dispersion of emissions. The receptor grid was 6,000 metres west to east and north to south approximately centred on the site, with a grid spacing of 60 metres.

Table 3.3: Receptor Locations

No	Name	Type	Relevant Averaging Period		Grid Reference	
			Long-term	Short Term	x	y
1	Gwent Police Station	Commercial/Office	X	√	341887.65	187683.25
2	Magor Court	Residential	√	√	342035.68	187640.27
3	Council depot	Commercial/Office	X	√	341875.71	187575.80
4	Residential property	Residential	√	√	341359.98	187134.09
5	Upper Cottage	Residential	√	√	341185.69	187129.32
6	Residential property	Residential	√	√	342140.74	187618.78
7	Llanberis property	Residential	√	√	342095.37	187542.38
8	Queens Gardens	Residential	√	√	342054.78	187449.26
9	Blenheim Gardens	Residential	√	√	342018.97	187365.69
10	Residential property	Residential	√	√	341016.17	188029.45
11	Upper Grange Farm	Residential	√	√	342682.73	188423.41
12	Magor Church in Wales School	School	√	√	342654.08	187134.09
13	Magor Church	Church	x	√	342558.57	186976.51
14	Beeches Farm Caravan Park	Residential	√	√	342852.25	187914.85
15	Agricultural building	Farm	x	√	342014.79	188745.75
16	Scubor Fach farm	Residential	√	√	341330.74	188652.63
17	West End property	Residential	√	√	342022.29	186987.48
18	Whitewall Common	Non-designated site	√	√	342771.22	186492.89
19	Severn Estuary SAC, SPA, Ramsar	Designated site	√	√	343850.93	184869.88
20	Magor Services	Commercial/Office	x	√	342047.54	187968.39
21	Magor Services hotel	Commercial/Office	x	√	342154.91	188034.85
22	Council offices	Commercial/Office	x	√	341801.26	187816.99
23	Brewery building	Commercial/Office	x	x	341292.80	187440.59

No	Name	Type	Relevant Averaging Period		Grid Reference	
			Long-term	Short Term	x	y
24	River Usk SAC, At Liswerry Pill Bridge	Designated site	√	√	332967.00	187027.00
25	Wye Valley/Forest of Dean Bat sites SAC	Designated site	√	√	348390.00	194268.00
26	Gwent Levels - Redwick & Llandevenny SSSI	Designated site	√	√	341219.00	186980.00
27	Magor Marsh SSSI	Designated site	√	√	342320.00	186862.00
28	Gwent Levels - Magor & Undy SSSI	Designated site	√	√	342767.00	186850.00
29	Penhow SSSI	Designated site	√	√	342642.00	189419.00
32	Gwent Levels - Redwick & Llandevenny SSSI	Designated site	√	√	340562.64	187320.13
30	Penhow SSSI	Designated site	√	√	342020.64	189482.00
31	Penhow SSSI	Designated site	√	√	341579.89	189660.59
33	Gwent Levels - Redwick & Llandevenny SSSI	Designated site	√	√	340445.04	187782.33
34	Ancient Woodlands	Non-designated site	√	√	340708.50	187820.86
35	Ancient Woodlands	Non-designated site	√	√	342609.25	188544.15
36	Ancient Woodlands	Non-designated site	√	√	343465.81	188230.49
37	Ancient Woodlands	Non-designated site	√	√	340337.44	188921.95
38	Ancient Woodlands	Non-designated site	√	√	339974.95	188124.82
39	Ancient Woodlands	Non-designated site	√	√	339795.20	188578.91
40	Ancient Woodlands	Non-designated site	√	√	339798.64	187894.40
41	Local Wildlife Site	Non-designated site	√	√	339762.00	186814.05
42	Local Wildlife Site	Non-designated site	√	√	341858.50	186887.80
43	Local Wildlife Site	Non-designated site	√	√	341507.44	186730.99
44	Local Wildlife Site	Non-designated site	√	√	342927.43	186851.78
45	Local Wildlife Site	Non-designated site	√	√	343383.34	187683.49
46	Local Wildlife Site	Non-designated site	√	√	342375.27	187731.12
47	Local Wildlife Site	Non-designated site	√	√	342228.43	186126.42
48	Local Wildlife Site	Non-designated site	√	√	342958.68	188653.19

Figure 3.1: Receptor Locations – 10km

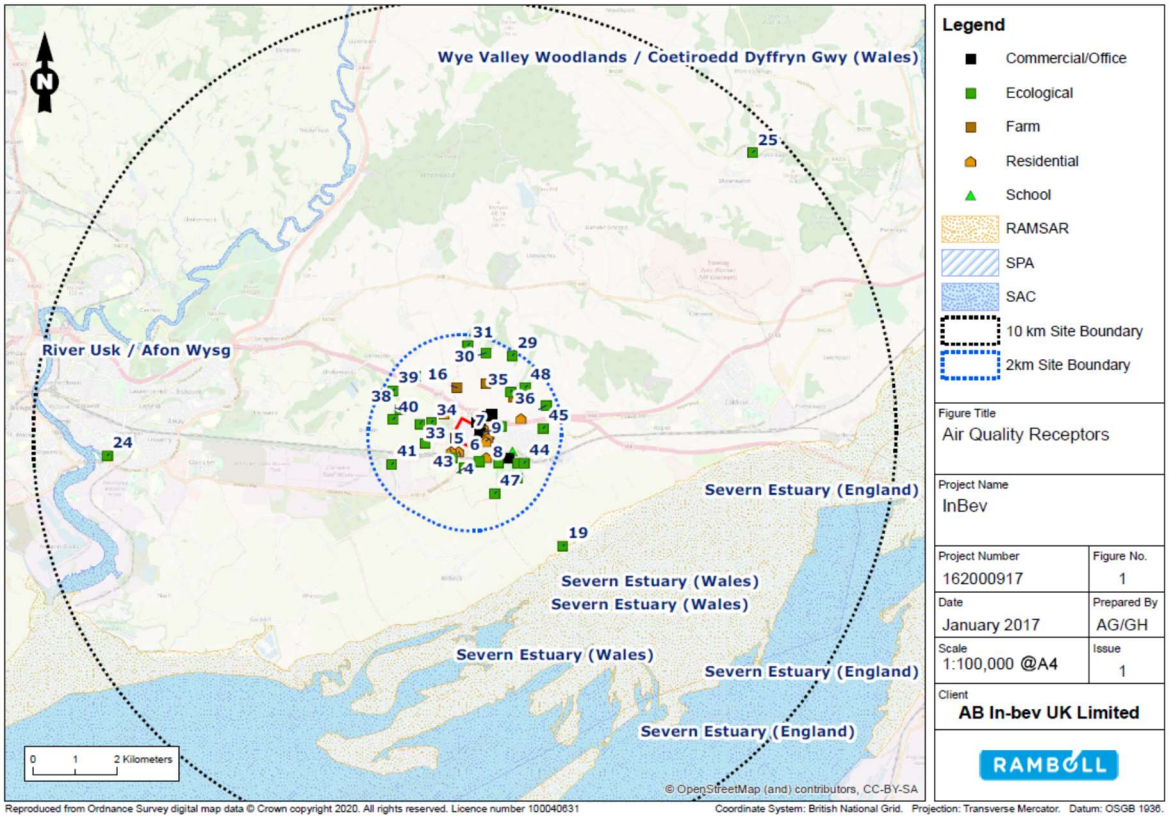
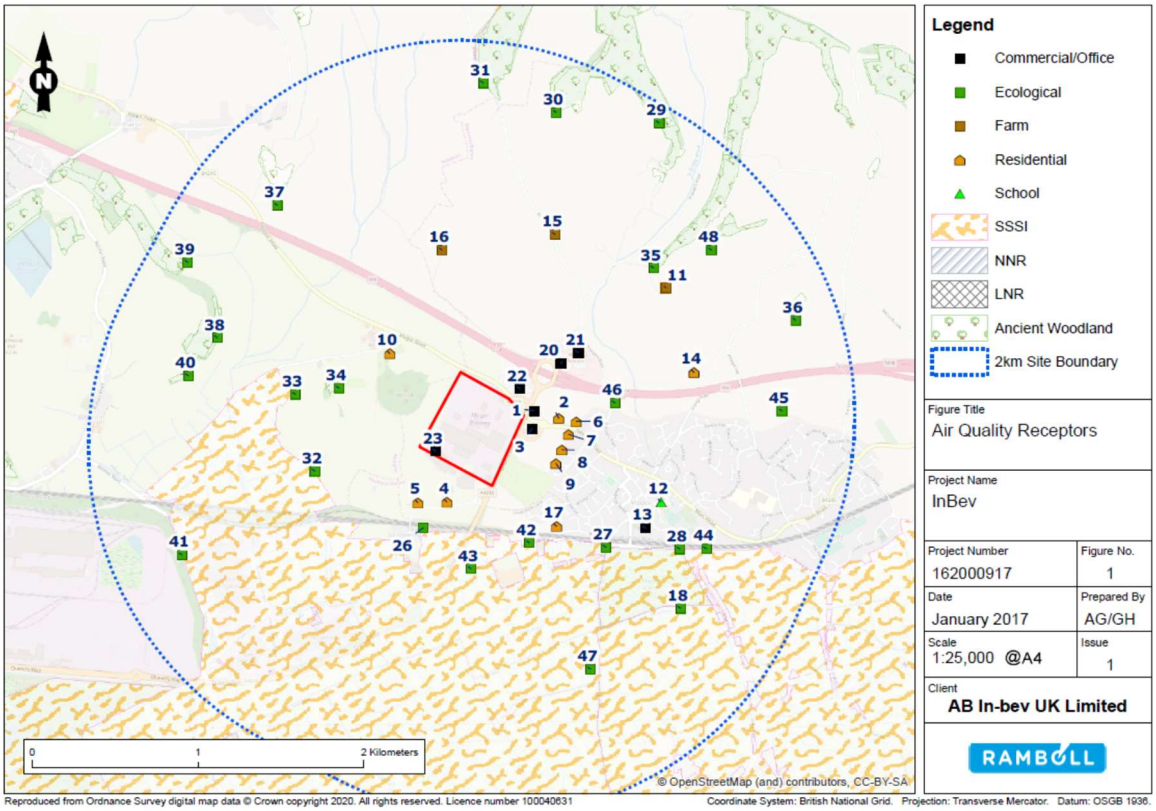


Figure 3.2: Receptor Locations – 2km



Nitrogen deposition has been calculated from the predicted annual mean NO_x concentrations by using a conversion factor of 0.7 to convert NO_x to NO_2. A deposition velocity of 1.5mm/s was used to convert NO_2 concentrations into a deposition flux for grassland habitats and 3.0mm/s for woodland habitats; and the results converted into kgN/ha/year in accordance with the AQTAG06 guidance[8].

[8] AQTAG06 Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. 20/4/10, v10

4. BASELINE

4.1 Local Monitoring Data

A review of the Monmouthshire County Council monitoring data confirms that there are no nitrogen dioxide monitoring locations in the vicinity of the site.

4.2 Defra Background Map Data

The 2020 Defra predicted background concentrations for the grid squares covering the site and the receptor locations are shown in Table 4.1 below. As anticipated, these show very low NO_x and NO_2 concentrations reflecting the rural nature of the area surrounding the site. As all of the PCs for CO are insignificant (see Section 5.2) then the background CO concentrations have not been included here-in.

Table 4.1: 2020 Background Concentrations (µg/m^3)

No	Name	NO_x	NO_2	Grid Reference	
				x	y
1	Gwent Police Station	19.2	13.9	341500	187500
2	Magor Court	12.7	9.5	342500	187500
3	Council depot	18.1	13.3	341500	187500
4	Residential property	11.2	8.5	341500	187500
5	Upper Cottage	11.2	8.5	341500	187500
6	Residential property	7.7	5.9	342500	187500
7	Llanberis property	19.2	13.9	342500	187500
8	Queens Gardens	12.7	9.5	342500	187500
9	Blenheim Gardens	16.8	12.2	342500	187500
10	Residential property	16.8	12.2	341500	188500
11	Upper Grange Farm	20.6	14.7	342500	188500
12	Magor Church in Wales School	7.2	5.6	342500	187500
13	Magor Church	11.1	8.4	342500	186500
14	Beeches Farm Caravan Park	11.2	8.5	342500	187500
15	Agricultural building	11.2	8.5	342500	188500
16	Scubor Fach farm	10.9	8.3	341500	188500
17	West End property	12.2	9.1	342500	186500
18	Whitewall Common	10.9	8.3	342500	186500
19	Severn Estuary SAC, SPA, Ramsar	11.7	8.8	343500	184500
20	Magor Services	12.2	9.1	342500	187500
21	Magor Services hotel	12.2	9.1	342500	188500

No	Name	NO_x	NO_2	Grid Reference	
				x	y
22	Council offices	12.7	9.5	341500	187500
23	Brewery building	11.9	9.0	341500	187500
24	River Usk SAC, At Liswerry Pill Bridge	18.8	13.7	332500	187500
25	Wye Valley/Forest of Dean Bat sites SAC	13.8	10.3	348500	194500
26	Gwent Levels - Redwick & Llandevenny SSSI	13.8	10.3	341500	186500
27	Magor Marsh SSSI	12.1	9.1	342500	186500
28	Gwent Levels - Magor & Undy SSSI	9.9	7.6	342500	186500
29	Penhow SSSI	11.1	8.4	342500	189500
32	Gwent Levels - Redwick & Llandevenny SSSI	11.1	8.4	340500	187500
30	Penhow SSSI	11.2	8.5	342500	189500
31	Penhow SSSI	19.2	13.9	341500	189500
33	Gwent Levels - Redwick & Llandevenny SSSI	19.2	13.9	340500	187500
34	Ancient Woodlands	11.2	8.5	340500	187500
35	Ancient Woodlands	12.7	9.5	342500	188500
36	Ancient Woodlands	19.2	13.9	343500	188500
37	Ancient Woodlands	12.7	9.5	340500	188500
38	Ancient Woodlands	18.1	13.3	339500	188500
39	Ancient Woodlands	11.2	8.5	339500	188500
40	Ancient Woodlands	11.2	8.5	339500	187500
41	Local Wildlife Site	7.7	5.9	339500	186500
42	Local Wildlife Site	19.2	13.9	341500	186500
43	Local Wildlife Site	12.7	9.5	341500	186500
44	Local Wildlife Site	16.8	12.2	342500	186500
45	Local Wildlife Site	16.8	12.2	343500	187500
46	Local Wildlife Site	20.6	14.7	342500	187500
47	Local Wildlife Site	7.2	5.6	342500	186500
48	Local Wildlife Site	11.1	8.4	342500	188500

The Defra background concentrations represent modelled pollutant concentrations averaged across the relevant 1km grid square. There will be locally higher concentrations where receptors are located in close proximity to locally busy roads, but consideration can be given to specific receptor locations when considering the results of the modelling, i.e. where predicted concentrations as a result of the modelling are not insignificant in their own right. As the ecological sites are not located adjacent to busy roads the Defra background concentrations are likely to be representative of the baseline concentrations at the receptor locations.

In terms of the assessment, the Defra background concentrations will therefore be used as the baseline concentrations which are likely to be only slightly under-predicted. To assess the short-term PEC against the short-term air quality objectives, a baseline concentration of double the annual mean has been used.

4.3 APIS Background Data

The APIS website provides estimates of background pollutant concentrations and deposition for ecological sites averaged over 5km grid squares. The background deposition data are currently 3-year averages for 2016-2018 and are shown in Table 4.2 for the designated sites. It should be noted that the background data are not projected forward and background deposition rates are anticipated to reduce in the future due to reductions in NO_x emissions from combustion.

Table 4.2: Background Nitrogen Deposition (kgN/ha/year)

Site	Habitat	Baseline Deposition		
		Nitrogen (kgN/ha/yr)	Nitrogen acid (keqN/ha/yr)	Sulphur acid (keqS/ha/yr)
Severn Estuary SAC, SPA & Ramsar	Pioneer, low-mid, mid-upper saltmarshes/acid grassland	9.66	0.7	0.2
River Usk SAC	Water courses of plain to montane levels	16.94	1.2	0.3
Wye Valley/Forest of Dean Bat sites SAC	Greater/lesser horseshoe bat	24.64	1.8	0.2
Gwent Levels - Redwick & Llandevenny SSSI	Neutral grassland/acid grassland	14.40	1.03	0.17
Magor Marsh SSSI	Fen, marsh and swamp/acid grassland	14.40	1.03	0.17
Gwent Levels - Magor & Undy SSSI	Surface standing waters	14.40	1.03	0.17
Penhow Woodlands SSSI	Coniferous woodland/unmanaged broadleaved and coniferous	24.50	1.75	0.2

5. RESULTS

5.1 Introduction

The modelling results in this section are the highest predicted concentrations and deposition from any of the five years' worth of meteorological data modelled. They represent all equipment operating at their ELVs all year round and are therefore conservative. The results are presented for Scenario 1 (without the Flue Ace operating) and for Scenario 2 (with the Flue Ace operating). The results are presented for the relevant averaging period appropriate for the receptor, i.e. the annual mean concentrations are only presented at residential receptor locations.

The results are presented for the human health and ecological receptors separately. In addition, in the case of the ecological receptors, the results are separated between designated and non-designated sites. For the designated sites where there are more than one receptor location in the site, the results are presented for the receptor location that gave the highest results.

Contour plots for the pollutants with potentially significant impacts are contained in Appendix 2. The contour plots represent the maximum predicted concentration at each of the receptor grid points for any of the five years of meteorological data modelled.

5.2 Human Health Impacts

5.2.1 Without Flue Ace Operating

The maximum predicted PCs and PECs for the five years' worth of meteorological data modelled for Scenario 1 are shown in Tables 5.1 to 5.3.

Table 5.1: Predicted Annual Mean NO_2 Concentrations

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
2	40	13.9	1.2	3.0	15.1	37.7
4	40	12.2	0.1	0.2	12.3	30.9
5	40	12.2	0.2	0.5	12.4	31.1
6	40	13.9	1.2	2.9	15.1	37.6
7	40	13.9	1.0	2.6	14.9	37.3
8	40	13.9	0.7	1.7	14.6	36.5
9	40	13.9	0.4	0.9	14.3	35.6
10	40	13.3	0.3	0.7	13.6	33.9
11	40	9.5	0.2	0.5	9.7	24.4
12	40	13.9	0.4	0.9	14.3	35.6
13	40	8.5	0.3	0.6	8.7	21.8
14	40	13.9	0.4	1.0	14.3	35.8
16	40	13.3	0.1	0.3	13.4	33.5
17	40	8.5	0.1	0.2	8.5	21.3

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
20	40	13.9	0.4	1.1	14.3	35.8
21	40	9.5	0.4	1.0	9.9	24.9
22	40	12.2	0.1	0.3	12.4	31.0

None of the PECs exceeds the air quality assessment level, with the maximum PEC only 37.6%.

Table 5.2: Predicted Hourly Mean 99.79th%ile NO_2 Concentrations

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
1	200	24.5	4.2	2.1	-	-
2	200	27.8	4.8	2.4	-	-
3	200	24.5	3.7	1.8	-	-
4	200	24.5	3.2	1.6	-	-
5	200	24.5	3.0	1.5	-	-
6	200	27.8	4.3	2.1	-	-
7	200	27.8	4.7	2.3	-	-
8	200	27.8	4.6	2.3	-	-
9	200	27.8	4.1	2.0	-	-
10	200	26.5	3.0	1.5	-	-
11	200	19.1	1.9	0.9	-	-
12	200	27.8	2.1	1.1	-	-
13	200	16.9	1.9	1.0	-	-
14	200	27.8	1.9	0.9	-	-
15	200	19.1	1.9	1.0	-	-
16	200	26.5	2.2	1.1	-	-
17	200	16.9	2.7	1.3	-	-
20	200	27.8	4.3	2.2	-	-
21	200	19.1	3.5	1.7	-	-
22	200	24.5	5.0	2.5	-	-

All of the hourly mean PCs are less than 10% of the assessment level and therefore insignificant, and therefore no consideration is given of the PECs.

Table 5.3: Predicted 8 Hour Running Mean CO Concentrations

Receptor	AQAL µg/m³	PC µg/m³	PC as % of the AQAL
1	10,000	4.6	0.05
2	10,000	6.2	0.06
3	10,000	5.4	0.05
4	10,000	3.8	0.04
5	10,000	3.9	0.04
6	10,000	5.6	0.06
7	10,000	6.1	0.06
8	10,000	5.7	0.06
9	10,000	5.1	0.05
10	10,000	4.1	0.04
11	10,000	2.4	0.02
12	10,000	2.4	0.02
13	10,000	2.5	0.02
14	10,000	2.4	0.02
15	10,000	2.6	0.03
16	10,000	2.7	0.03
17	10,000	3.3	0.03
20	10,000	5.3	0.05
21	10,000	4.3	0.04
22	10,000	6.8	0.07

All of the predicted CO PCs are insignificant and below 0.1% of the assessment level.

5.2.2 With Flue Ace Operating

The maximum predicted PCs and PECs for the five years' worth of meteorological data modelled for Scenario 2 are shown in Tables 5.4 to 5.6.

Table 5.4: Predicted Annual Mean NO_2 Concentrations

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
2	40	13.9	5.5	13.9	19.4	48.6
4	40	12.2	0.6	1.6	12.9	32.2
5	40	12.2	0.9	2.2	13.1	32.8

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
6	40	13.9	3.9	9.6	17.7	44.3
7	40	13.9	4.3	10.7	18.2	45.4
8	40	13.9	4.1	10.2	18.0	44.9
9	40	13.9	3.2	8.1	17.1	42.8
10	40	13.3	0.9	2.1	14.1	35.3
11	40	9.5	0.4	1.1	10.0	24.9
12	40	13.9	1.2	3.0	15.1	37.7
13	40	8.5	1.1	2.9	9.6	24.0
14	40	13.9	0.7	1.7	14.6	36.5
16	40	13.3	0.4	1.0	13.6	34.1
17	40	8.5	0.6	1.6	9.1	22.7
20	40	13.9	1.8	4.6	15.7	39.3
21	40	9.5	1.4	3.4	10.9	27.2
22	40	12.2	5.9	14.7	18.1	45.3

None of the PECs exceeds the air quality assessment level, with the maximum PEC only 48.6%.

Table 5.5: Predicted Hourly Mean 99.79th%ile NO_2 Concentrations

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
1	200	24.5	40.0	20.0	95.8	47.9
2	200	27.8	23.3	11.7	51.0	25.5
3	200	24.5	48.0	24.0	101.1	50.6
4	200	24.5	18.0	9.0	21.2	10.6
5	200	24.5	19.4	9.7	23.9	11.9
6	200	27.8	18.8	9.4	38.1	19.0
7	200	27.8	29.0	14.5	50.4	25.2
8	200	27.8	31.8	15.9	52.2	26.1
9	200	27.8	26.6	13.3	42.8	21.4
10	200	26.5	13.4	6.7	17.7	8.8
11	200	19.1	6.9	3.5	9.0	4.5

Receptor	AQAL µg/m³	Background Concentration µg/m³	PC µg/m³	PC as % of the AQAL	PEC µg/m³	PEC as a % of the AQAL
12	200	27.8	14.5	7.2	20.4	10.2
13	200	16.9	15.3	7.6	21.0	10.5
14	200	27.8	8.0	4.0	11.5	5.7
15	200	19.1	10.6	5.3	12.8	6.4
16	200	26.5	11.4	5.7	13.4	6.7
17	200	16.9	16.1	8.1	19.2	9.6
20	200	27.8	17.7	8.9	26.9	13.5
21	200	19.1	14.3	7.2	21.1	10.5
22	200	24.5	48.5	24.2	77.8	38.9

None of the PECs exceeds the air quality assessment level, with the maximum PEC only 50.6%.

Table 5.6: Predicted 8 Hour Running Mean CO Concentrations

Receptor	AQAL µg/m³	PC µg/m³	PC as % of the AQAL
1	10,000	42.4	0.42
2	10,000	21.1	0.21
3	10,000	46.7	0.47
4	10,000	15.6	0.16
5	10,000	20.3	0.20
6	10,000	19.4	0.19
7	10,000	42.8	0.43
8	10,000	28.3	0.28
9	10,000	24.1	0.24
10	10,000	12.4	0.12
11	10,000	6.1	0.06
12	10,000	12.1	0.12
13	10,000	11.3	0.11
14	10,000	5.5	0.05
15	10,000	6.2	0.06
16	10,000	7.8	0.08
17	10,000	10.9	0.11
20	10,000	20.3	0.20

Receptor	AQAL µg/m³	PC µg/m³	PC as % of the AQAL
21	10,000	15.3	0.15
22	10,000	60.6	0.61

All of the predicted CO PCs are insignificant and below 0.5% of the assessment level.

5.3 Ecological Impacts

5.3.1 Without Flue Ace Operating

Designated Sites

The maximum predicted NO_x concentrations within the habitats are shown in Tables 5.7 and 5.8.

Table 5.7: Maximum Annual Mean NO_x concentrations

Site	Critical Level (µg/m³)	PC (µg/m³)	% PC of Critical Level	2020 NO_x Background (µg/m³)	PEC (µg/m³)	% PEC Critical Level
Severn Estuary SAC, SPA & Ramsar	30	0.05	0.2	-	-	-
River Usk SAC	30	0.02	0.1	-	-	-
Wye Valley/Forest of Dean Bat sites SAC	30	0.02	0.1	-	-	-
Gwent Levels - Redwick & Llandevenny SSSI	30	0.37	1.2	12.2	12.6	41.9
Magor Marsh SSSI	30	0.16	0.5	-	-	-
Gwent Levels - Magor & Undy SSSI	30	0.32	1.1	11.2	11.5	38.4
Penhow Woodlands SSSI	30	0.10	0.3	-	-	-

Table 5.8: Maximum Daily Mean NO_x concentrations

Site	Critical Level (µg/m³)	PC (µg/m³)	% PC of Critical Level	2020 NO_x Background (µg/m³)	PEC (µg/m³)	% PEC Critical Level
Severn Estuary SAC, SPA & Ramsar	75	0.6	0.8	-	-	-
River Usk SAC	75	0.6	0.8	-	-	-
Wye Valley/Forest of Dean Bat sites SAC	75	0.3	0.4	-	-	-
Gwent Levels - Redwick & Llandevenny SSSI	75	4.5	6.0	-	-	-
Magor Marsh SSSI	75	3.2	4.2	-	-	-
Gwent Levels - Magor & Undy SSSI	75	2.6	3.5	-	-	-
Penhow Woodlands SSSI	75	2.5	3.3	-	-	-

The maximum predicted annual mean NO_x concentrations are well below 1% of the long-term critical level apart from at Gwent Levels. For these receptors, the maximum predicted PECs are well below the assessment levels. The maximum predicted daily mean NO_x concentrations are well below 10% of the short-term critical level, even assuming that all of the equipment in the energy centre operates continuously all year round.

The maximum predicted nitrogen and acid deposition within the habitats are shown in Tables 5.9 and 5.10.

Table 5.9: Maximum Nitrogen Deposition

Site	Critical Load (kg/ha/yr)	PC (kg/ha/yr)	% PC of Critical Load	Background (kg/ha/yr)	PEC (kg/ha/yr)	% PEC Critical Level
Severn Estuary SAC, SPA & Ramsar	20	0.005	0.03	-	-	-
River Usk SAC	3	0.002	0.07	-	-	-
Wye Valley/Forest of Dean Bat sites SAC	10	0.004	0.04	-	-	-
Gwent Levels - Redwick & Llandevenny SSSI	10	0.037	0.37	-	-	-
Magor Marsh SSSI	10	0.016	0.16	-	-	-
Gwent Levels - Magor & Undy SSSI	10	0.032	0.32	-	-	-
Penhow Woodlands SSSI	5	0.020	0.40	-	-	-

Table 5.10: Maximum Nitrogen Acid Deposition

Site	Critical Load (keq/ha/yr)	PC (keq/ha/yr)	% PC of Critical Load	Background (keq/ha/yr)	PEC (keq/ha/yr)	% PEC Critical Level
Severn Estuary SAC, SPA & Ramsar	4.500	0.0004	0.01	-	-	-
River Usk SAC	-	0.0001	-	-	-	-
Wye Valley/Forest of Dean Bat sites SAC	1.800	0.0003	0.02	-	-	-
Gwent Levels - Redwick & Llandevenny SSSI	2.038	0.0027	0.13	-	-	-
Magor Marsh SSSI	2.038	0.0012	0.06	-	-	-
Gwent Levels - Magor & Undy SSSI	2.038	0.0023	0.11	-	-	-
Penhow Woodlands SSSI	6.070	0.0014	0.02			

The maximum predicted nitrogen and nitrogen acid depositions at each of the receptors is well below 1% of the relevant critical load. Nitrogen and nitrogen acid deposition are therefore not significant, and no consideration of the PECs is necessary.

Non-designated Sites

The maximum predicted NO_x concentrations within the habitats are shown in Tables 5.11 and 5.12.

Table 5.11: Maximum Annual Mean NO_x concentrations

Site	Critical Level (µg/m³)	PC (µg/m³)	% PC of Critical Level	2020 NO_x Background (µg/m³)	PEC (µg/m³)	% PEC Critical Level
18	30	0.15	0.5	-	-	-
34	30	0.28	0.9	-	-	-
35	30	0.24	0.8	-	-	-
36	30	0.27	0.9	-	-	-
37	30	0.10	0.3	-	-	-
38	30	0.15	0.5	-	-	-
39	30	0.13	0.4	-	-	-
40	30	0.12	0.4	-	-	-
41	30	0.17	0.6	-	-	-
42	30	0.07	0.2	-	-	-
43	30	0.04	0.1	-	-	-
44	30	0.34	1.1	-	-	-
45	30	0.42	1.4	-	-	-
46	30	1.18	3.9	-	-	-
47	30	0.05	0.2	-	-	-
48	30	0.20	0.7	-	-	-

Table 5.12: Maximum Daily Mean NO_x concentrations

Site	Critical Level (µg/m³)	PC (µg/m³)	% PC of Critical Level	2020 NO_x Background (µg/m³)	PEC (µg/m³)	% PEC Critical Level
18	75	2.1	2.8	-	-	-
34	75	5.9	7.8	-	-	-
35	75	2.8	3.7	-	-	-
36	75	2.2	2.9	-	-	-
37	75	2.6	3.5	-	-	-
38	75	3.2	4.3	-	-	-
39	75	2.1	2.8	-	-	-
40	75	2.7	3.7	-	-	-
41	75	1.7	2.3	-	-	-
42	75	3.2	4.2	-	-	-
43	75	2.5	3.3	-	-	-
44	75	2.7	3.6	-	-	-
45	75	2.6	3.5	-	-	-
46	75	6.5	8.7	-	-	-
47	75	1.8	2.4	-	-	-

Site	Critical Level (µg/m³)	PC (µg/m³)	% PC of Critical Level	2020 NO_x Background (µg/m³)	PEC (µg/m³)	% PEC Critical Level
48	75	2.1	2.8	-	-	-

All of the annual mean and daily mean NO_x concentrations are less than 100% of the respective critical levels at the non-designated sites and are therefore not significant.

All of the annual mean NO_x concentrations are significantly less than 20µg/m^3 and therefore the nitrogen deposition will be below 100% of the most stringent critical load for any of the non-designated sites.

5.3.2 With Flue Ace Operating

Designated Sites

The maximum predicted NO_x concentrations within the habitats are shown in Tables 5.13 and 5.14.

Table 5.13: Maximum Annual Mean NO_x concentrations

Site	Critical Level (µg/m³)	PC (µg/m³)	% PC of Critical Level	2020 NO_x Background (µg/m³)	PEC (µg/m³)	% PEC Critical Level
Severn Estuary SAC, SPA & Ramsar	30	0.20	0.7	-	-	-
River Usk SAC	30	0.06	0.2	-	-	-
Wye Valley/Forest of Dean Bat sites SAC	30	0.03	0.1	-	-	-
Gwent Levels - Redwick & Llandevenny SSSI	30	0.99	3.3	12.2	13.2	44.0
Magor Marsh SSSI	30	1.09	3.6	11.2	12.3	41.0
Gwent Levels - Magor & Undy SSSI	30	1.30	4.3	11.2	12.5	41.7
Penhow Woodlands SSSI	30	0.35	1.2	10.9	11.3	37.6

Table 5.14: Maximum Daily Mean NO_x concentrations

Site	Critical Level (µg/m³)	PC (µg/m³)	% PC of Critical Level	2020 NO_x Background (µg/m³)	PEC (µg/m³)	% PEC Critical Level
Severn Estuary SAC, SPA & Ramsar	75	2.55	3.4	-	-	-
River Usk SAC	75	1.05	1.4	-	-	-
Wye Valley/Forest of Dean Bat sites SAC	75	0.58	0.8	-	-	-
Gwent Levels - Redwick & Llandevenny SSSI	75	20.79	27.7	24.4	45.2	60.2
Magor Marsh SSSI	75	9.55	12.7	22.4	32.0	42.6
Gwent Levels - Magor & Undy SSSI	75	9.99	13.3	22.4	32.4	43.2
Penhow Woodlands SSSI	75	5.22	7.0	-	-	-

The maximum predicted annual mean NO_x concentrations are well below 1% of the long-term critical level apart from at Gwent Levels, Magor Marsh and Penhow Woodlands. For these receptors, the maximum predicted PECs are well below the assessment levels. The maximum predicted daily mean NO_x concentrations are below 10% of the critical level apart from at Gwent Levels and Magor Marsh, but the PECs are well below the critical level at these receptors.

The maximum predicted nitrogen and acid deposition within the habitats are shown in Tables 5.15 and 5.16.

Table 5.15: Maximum Nitrogen Deposition

Site	Critical Load (kg/ha/yr)	PC (kg/ha/yr)	% PC of Critical Load	Background (kg/ha/yr)	PEC (kg/ha/yr)	% PEC Critical Level
Severn Estuary SAC, SPA & Ramsar	20	0.020	0.10	-	-	-
River Usk SAC	3	0.006	0.20	-	-	-
Wye Valley/Forest of Dean Bat sites SAC	10	0.006	0.06	-	-	-
Gwent Levels - Redwick & Llandevenny SSSI	10	0.100	1.00	-	-	-
Magor Marsh SSSI	10	0.110	1.10	14.4	14.51	**145.1**
Gwent Levels - Magor & Undy SSSI	10	0.131	1.31	14.4	14.53	**145.3**
Penhow Woodlands SSSI	5	0.070	1.41	24.5	24.57	**491.4**

Table 5.16: Maximum Nitrogen Acid Deposition

Site	Critical Load (keq/ha/yr)	PC (keq/ha/yr)	% PC of Critical Load	Background (keq/ha/yr)	PEC (keq/ha/yr)	% PEC Critical Level
Severn Estuary SAC, SPA & Ramsar	4.500	0.0014	0.03	-	-	-
River Usk SAC	-	0.0004	-	-	-	-
Wye Valley/Forest of Dean Bat sites SAC	1.800	0.0004	0.02	-	-	-
Gwent Levels - Redwick & Llandevenny SSSI	2.038	0.0071	0.35	-	-	-
Magor Marsh SSSI	2.038	0.0078	0.38	-	-	-
Gwent Levels - Magor & Undy SSSI	2.038	0.0094	0.46	-	-	-
Penhow Woodlands SSSI	6.070	0.0050	0.08	-	-	-

The maximum predicted nitrogen deposition is below 1% of the critical load at the Severn Estuary, River Usk and Wye Valley sites. At Magor Marsh, Gwent Levels – Magor & Undy and

Penhow Woodlands SSSIs the maximum nitrogen deposition is above 1% of the critical load but less than 1.5% of the critical load at the point of maximum deposition. The deposition is dominated by existing baseline deposition rates.

Figure 5.7 shows the predicted nitrogen deposition for grassland habitats (Magor Marsh SSSI and Gwent Levels – Magor & Undy SSSI). The predicted 0.1kgN/ha/year contour is equal to 1% of the critical load and it only extends a short distance into the habitats.

Figure 5.8 shows the predicted nitrogen deposition for woodland habitats (Penhow Woodlands SSSI). The predicted 0.05kgN/ha/year contour is equal to 1% of the critical load and it only extends a short distance into the habitat.

The maximum predicted nitrogen acid deposition at each of the receptors is well below 1% of the relevant critical load. Nitrogen acid deposition is therefore not significant, and no consideration of the PECs is necessary.

Non-designated Sites

The maximum predicted NO_x concentrations within the habitats are shown in Tables 5.17 and 5.18.

Table 5.17: Maximum Annual Mean NO_x concentrations

Site	Critical Level (µg/m³)	PC (µg/m³)	% PC of Critical Level	2020 NO_x Background (µg/m³)	PEC (µg/m³)	% PEC Critical Level
18	30	0.75	2.5	-	-	-
34	30	1.07	3.6	-	-	-
35	30	0.56	1.9	-	-	-
36	30	0.45	1.5	-	-	-
37	30	0.26	0.9	-	-	-
38	30	0.44	1.5	-	-	-
39	30	0.30	1.0	-	-	-
40	30	0.45	1.5	-	-	-
41	30	0.41	1.4	-	-	-
42	30	0.49	1.6	-	-	-
43	30	0.40	1.3	-	-	-
44	30	1.17	3.9	-	-	-
45	30	0.75	2.5	-	-	-
46	30	2.73	9.1	-	-	-
47	30	0.28	0.9	-	-	-
48	30	0.40	1.3	-	-	-

Table 5.18: Maximum Daily Mean NO_x concentrations

Site	Critical Level ($\mu g/m^3$)	PC ($\mu g/m^3$)	% PC of Critical Level	2020 NO_x Background ($\mu g/m^3$)	PEC ($\mu g/m^3$)	% PEC Critical Level
18	75	7.07	9.4	-	-	-
34	75	16.33	21.8	-	-	-
35	75	6.45	8.6	-	-	-
36	75	4.45	5.9	-	-	-
37	75	5.61	7.5	-	-	-
38	75	6.14	8.2	-	-	-
39	75	5.88	7.8	-	-	-
40	75	6.55	8.7	-	-	-
41	75	10.86	14.5	-	-	-
42	75	7.87	10.5	-	-	-
43	75	8.80	11.7	-	-	-
44	75	8.93	11.9	-	-	-
45	75	5.00	6.7	-	-	-
46	75	14.95	19.9	-	-	-
47	75	4.58	6.1	-	-	-
48	75	4.00	5.3	-	-	-

All of the annual mean and daily mean NO_x concentrations are less than 100% of the respective critical levels at the non-designated sites and are therefore not significant.

All of the annual mean NO_x concentrations are significantly less than 20$\mu g/m^3$ and therefore the nitrogen deposition will be below 100% of the most stringent critical load for any of the non-designated sites.

6. CONCLUSIONS

An assessment of the impacts of emissions from the boilers at the In-Bev UK site at Magor has been carried out. The assessment has been undertaken for two scenarios; with and without the Flue Ace heat recovery system operational and on a conservative basis of all of the equipment operating all year round. The maximum predicted impacts for any of the five years' worth of meteorological data modelled have been reported. Overall, the predicted impacts are considered to be conservative and worst case.

Impacts have been predicted at a number of human health receptor locations in the vicinity of the site, both residential and commercial/industrial receptor locations. For the residential receptors, long-term and short-term impacts have been considered where-as for commercial/industrial receptors only short-term impacts have been considered.

Impacts have also been predicted at ecological receptor locations in the vicinity of the site as requested by NRW; both designated and non-designated sites have been considered.

Without the Flue Ace operational, all of the PCs are either insignificant or the PECs are significantly lower than the relevant critical level or load.

With the Flue Ace operational, all of the PCs are either insignificant or the PECs are significantly lower than the relevant critical level or load for the human health receptors and non-designated ecological sites. At three of the designated sites (Magor Marsh SSSI, Gwent Levels – Magor & Undy SSSI and Penhow Woodlands SSSI) the maximum nitrogen deposition rates are marginally above 1% of the site relevant critical loads and the PECs exceed the critical loads. The PCs are very small in comparison to the existing baseline deposition rates and the extent of the exceedance of the 1% threshold within the habitats is small. Given the conservative nature of the modelling, the existing baseline deposition rates and the limited extent of the impact above 1% within the habitat, it is not considered that the deposition would have significant effects on the integrity of the SSSIs.

APPENDIX 1
MODELLING SET UP

Stack Emissions Modelling Input Parameters – Existing Site

Parameter	A1	A2	A3	A4	A9
Modelled Stack Location	341661.0 187671.5	341661.0 187671.0	341660.5 187671.0	341660.5 187671.5	341653 187674
Flue height (m)	38	38	38	38	9
Flue diameter (m)	1.29	1.29	0.61	0.81	0.8
Exit velocity (m/s)	7.4	7.4	7.4	7.4	11.4
Flue exit Temperature (°C)	186	186	186	186	110
Actual flue volumetric flow (m^3/s)	9.67	9.67	2.18	3.81	5.70
Normalised flue volumetric flow (Nm^3/s)	5.08	5.08	1.15	2.00	-
NO_x emission concentration (mg/Nm^3)	220	220	140	140	-
NO_x emission, each (g/s)	1.12	1.12	0.16	0.28	2.24
CO emission concentration (mg/Nm^3)	100	100	100	100	-
CO emission, each (g/s)	0.51	0.51	0.11	0.20	1.02

Operational Hours

For modelling purposes, the equipment is assumed to be operating continuously, 24 hours every day.

Special Treatments

Conversion ratios of 70% and 35% have been applied for the conversion of NO_X to NO_2 for annual and hourly mean concentrations in accordance with the *EA Conversion Ratios for NO_x and NO_2*[9].

Buildings Effects

Tall buildings can have a substantial impact on the dispersion of pollutants from stacks, as a result of building downwash i.e. pollutants being drawn down in the wake of a building, giving rise to high concentrations close to the base of the buildings. ADMS5 is able to take account of this potential impact by the inclusion of buildings in the model. The buildings included within the modelling are provided in the table below.

Buildings

New Delete

Main	Name	Shape	X (m)	Y (m)	Height (m)	Length / Diameter (m)	Width (m)	Angle (°)
✓	Boiler house	Rectangular	341673	187660	10	60	20	23.7
	Tank 1	Circular	341647	187685	9	7	7	0
	Tank 2	Circular	341643	187676	9	7	7	0
	Tank 3	Circular	341639	187668	9	7	7	0
	Boiler annex	Rectangular	341658	187661	8	10	8.4	23.7
	Engine house	Rectangular	341663	187687	12	20	13.7	23.7
	Brew house	Rectangular	341580	187705	17	50	50	23.7
	Offices	Rectangular	341602	187599	6	20	30	23.7
	Building	Rectangular	341540	187613	17	45	50	23.7
	Kegging	Rectangular	341663	187474	14	106	106	23.7

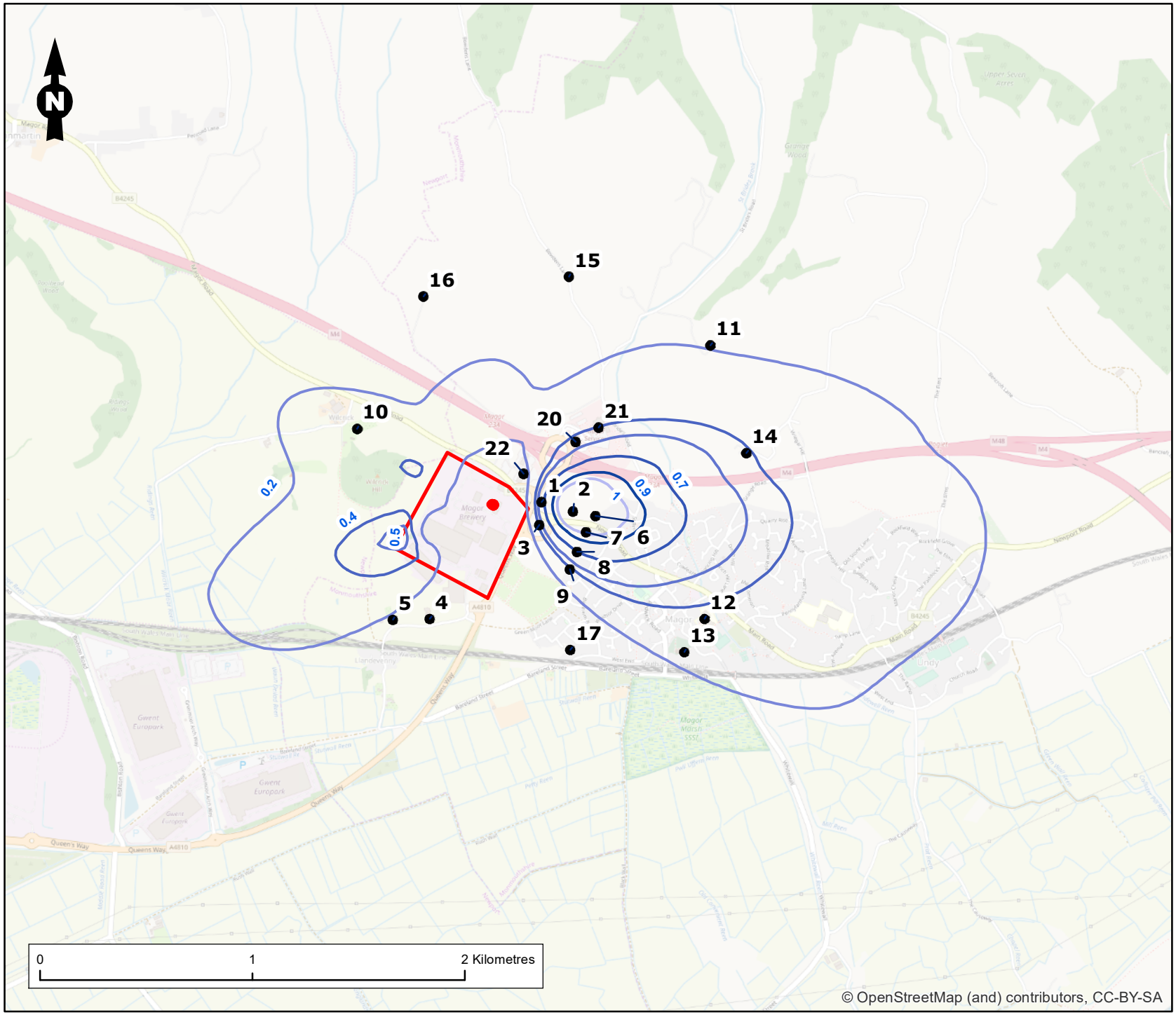
Terrain and Surface Roughness

Terrain was included in the model as the area in the immediate vicinity of the south and to the north is relatively undulating. To the south of the site, towards the Severn Estuary, the land is relatively flat.

The modelling adopts the maximum surface roughness value of 0.2m for the Site. The meteorological measurement site's surface roughness was set to the same value of the site.

[9] Air Quality Modelling and Assessment Unit, available at file:///Z:/Modelling%20Data/Guidance/noxno2conv2005_1233043.pdf

APPENDIX 2
CONTOUR PLOTS



Legend

- Indicative Site Boundary
- Flue
- Receptors

Annual Mean NO_2 ($\mu g/m^3$)

- 0.2
- 0.4
- 0.5
- 0.7
- 0.9
- 1

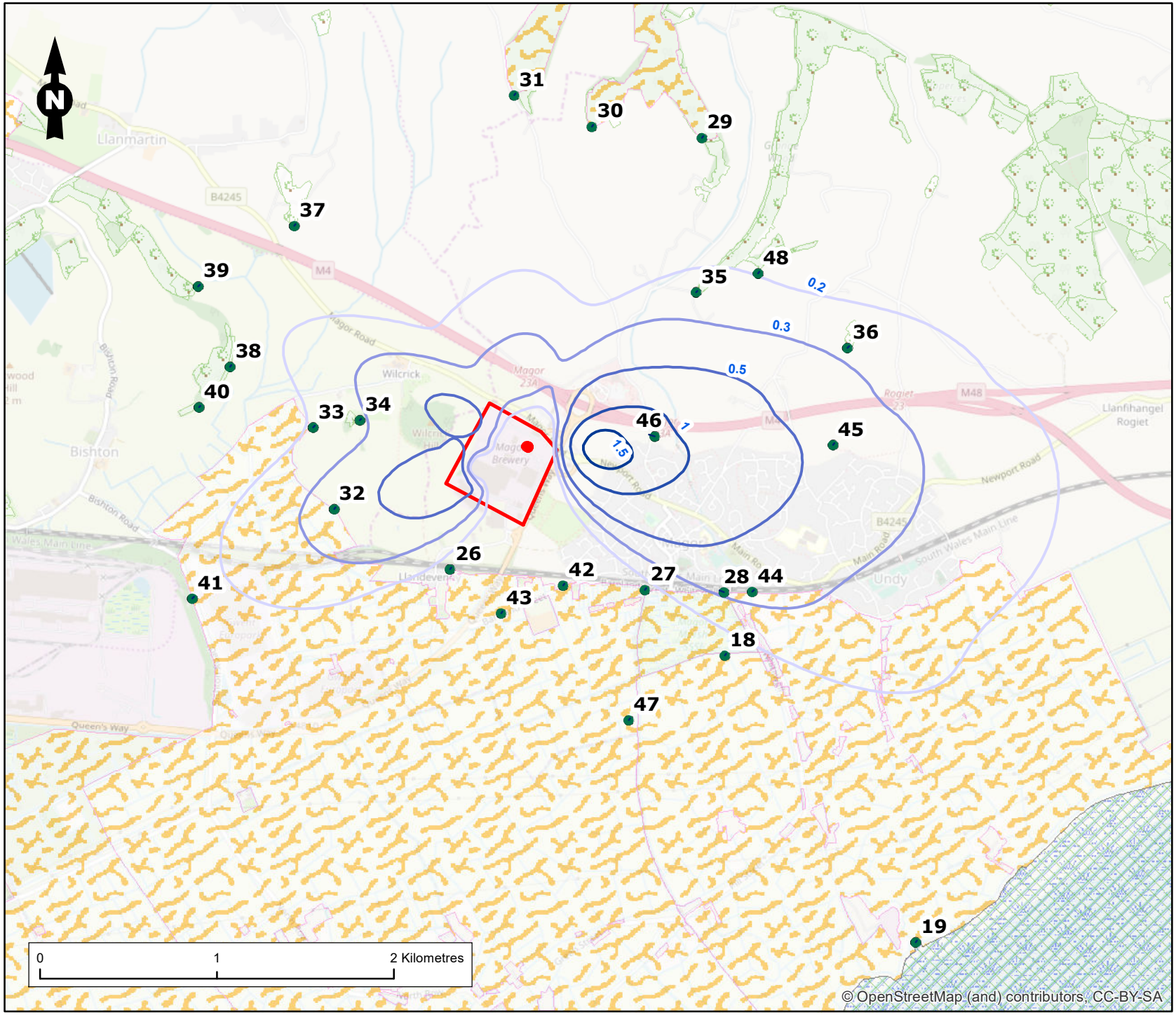
Predicted Annual Mean NO_2 Concentrations without Flue Ace ($\mu g/m^3$)

Project Number	Figure No.
1620009178	5.1
Date	**Prepared By**
January 2017	AG/GH
Scale	**Issue**
1:25,000 @A4	1

Client
AB In-bev UK Limited

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Legend

- Indicative Site Boundary
- Flue
- Ecological Receptors
- RAMSAR
- SPA
- SAC
- SSSI
- Ancient Woodland

Annual Mean NOx (µg/m^3)

- 0.2
- 0.3
- 0.5
- 1
- 1.5

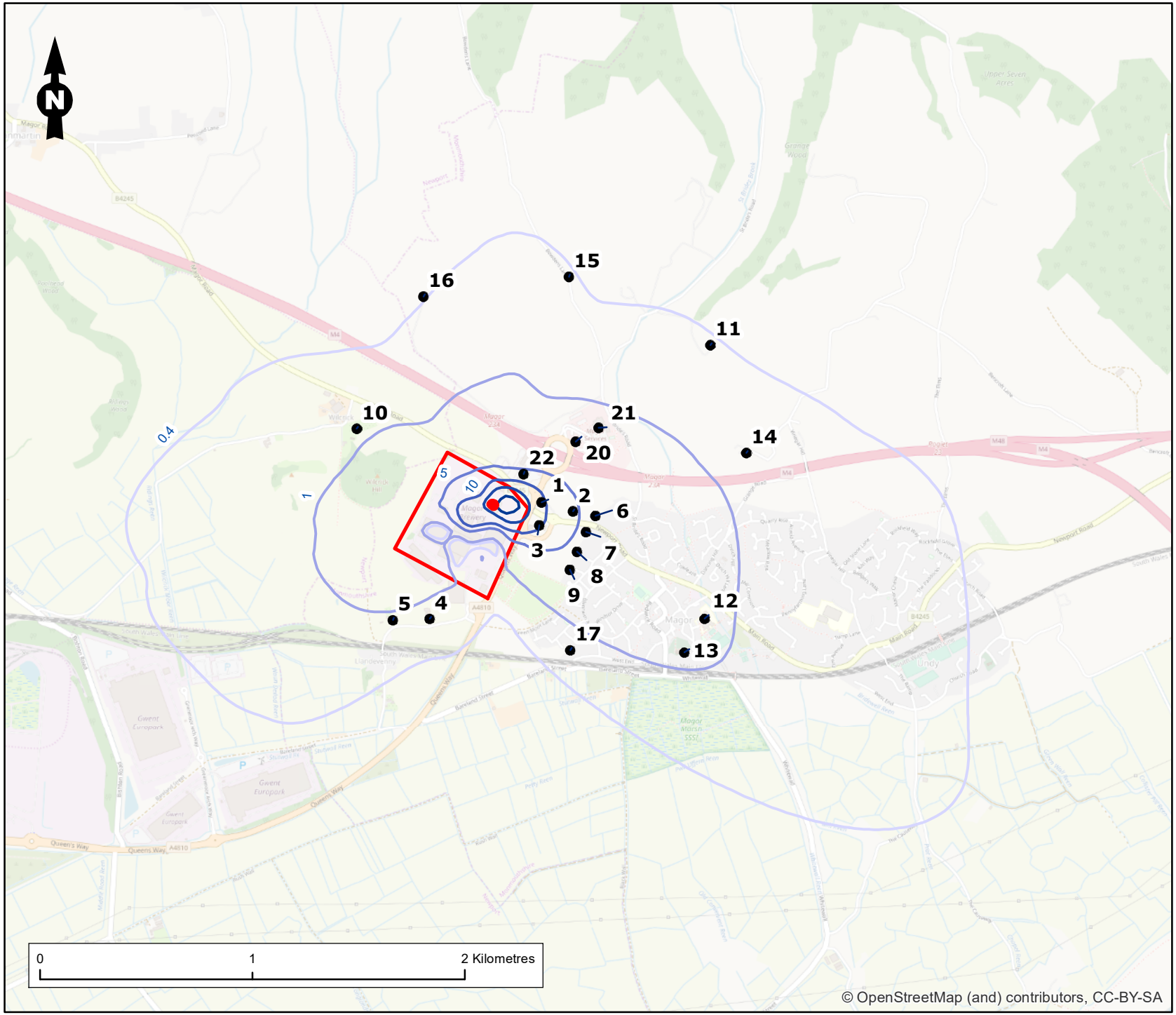
Predicted Annual Mean NOx Concentrations without Flue Ace (µg/m^3)

Project Number	Figure No.
1620009178	5.2
Date	**Prepared By**
March 2020	AG/GH
Scale	**Issue**
1:30,000 @A4	1

Client
AB In-bev UK Limited

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Legend

- Indicative Site Boundary
- Flue
- Receptors

Annual Mean NO_2 (µg/m^3)

- 0.4
- 1
- 5
- 10
- 20
- 30

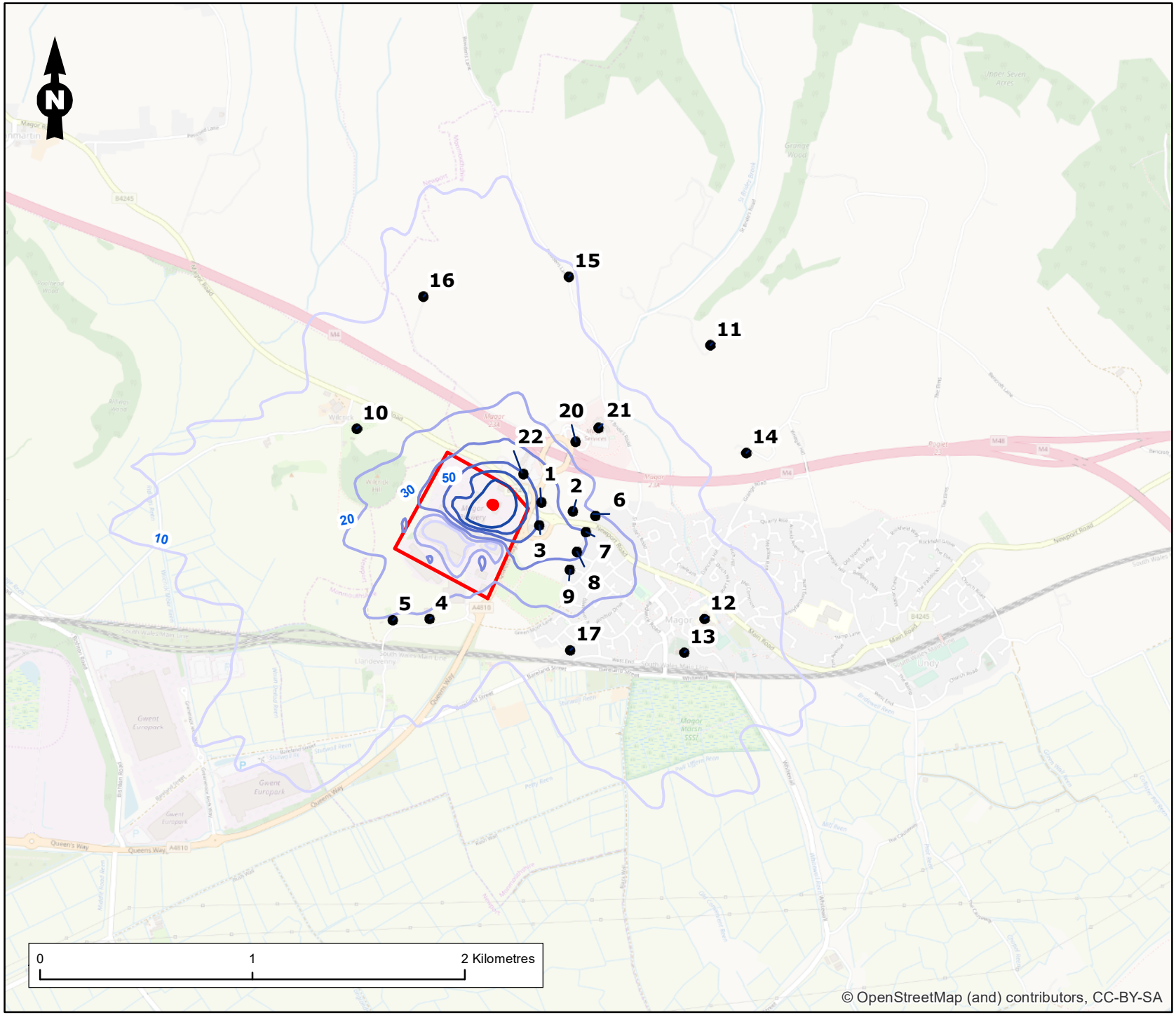
Predicted Annual Mean NO_2 Concentrations with Flue Ace (µg/m^3)

Project Number	Figure No.
1620009178	5.3
Date	**Prepared By**
March 2020	AG/GH
Scale	**Issue**
1:25,000 @A4	1

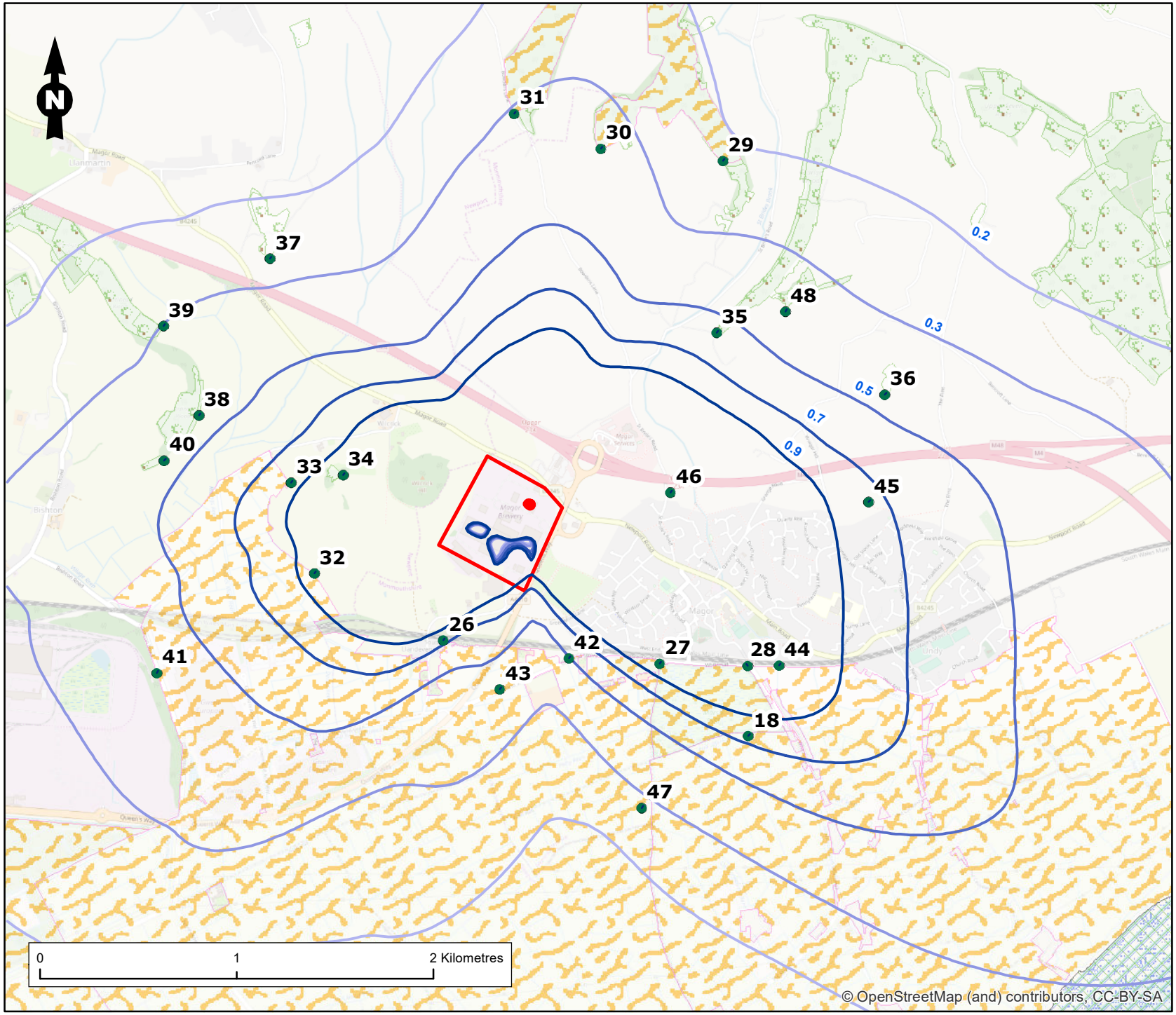
Client
AB In-bev UK Limited

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Legend

- Indicative Site Boundary
- Flue
- Ecological Receptors
- RAMSAR
- SPA
- SAC
- SSSI
- Ancient Woodland

Annual Mean NOx (µg/m^3)

- 0.2
- 0.3
- 0.5
- 0.7
- 0.9

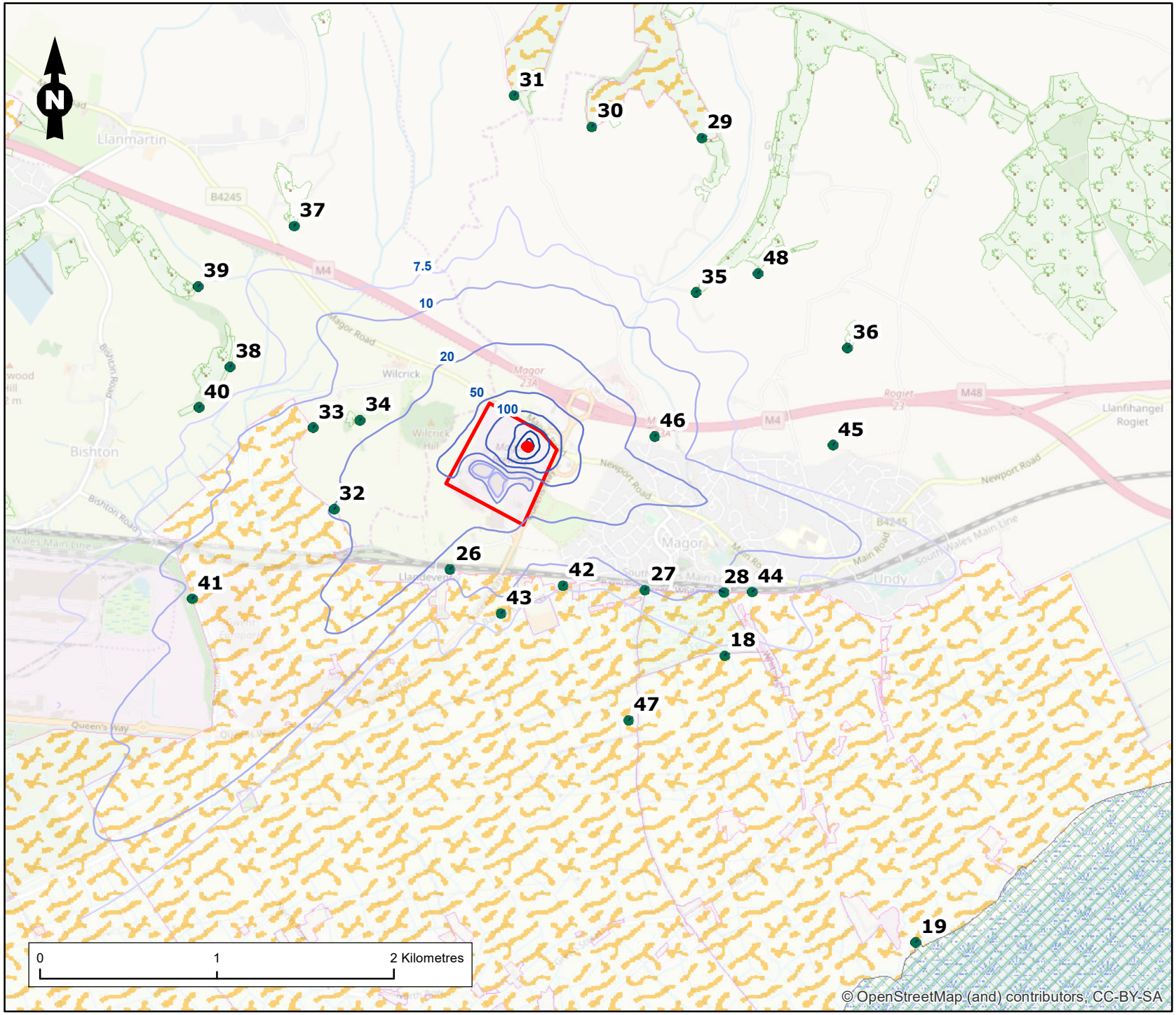
Predicted Annual Mean NOx Concentrations with Flue Ace (µg/m^3)

Project Number: 1620009178	Figure No.: 5.5
Date: March 2020	Prepared By: AG/GH
Scale: 1:27,000 @A4	Issue: 1

Client: **AB In-bev UK Limited**

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Legend

- Indicative Site Boundary
- Flue
- Ecological Receptors
- RAMSAR
- SPA
- SAC
- SSSI
- Ancient Woodland

Daily Mean NOx (µg/m³)

- 7.5
- 10
- 20
- 50
- 100
- 200
- 300
- 400

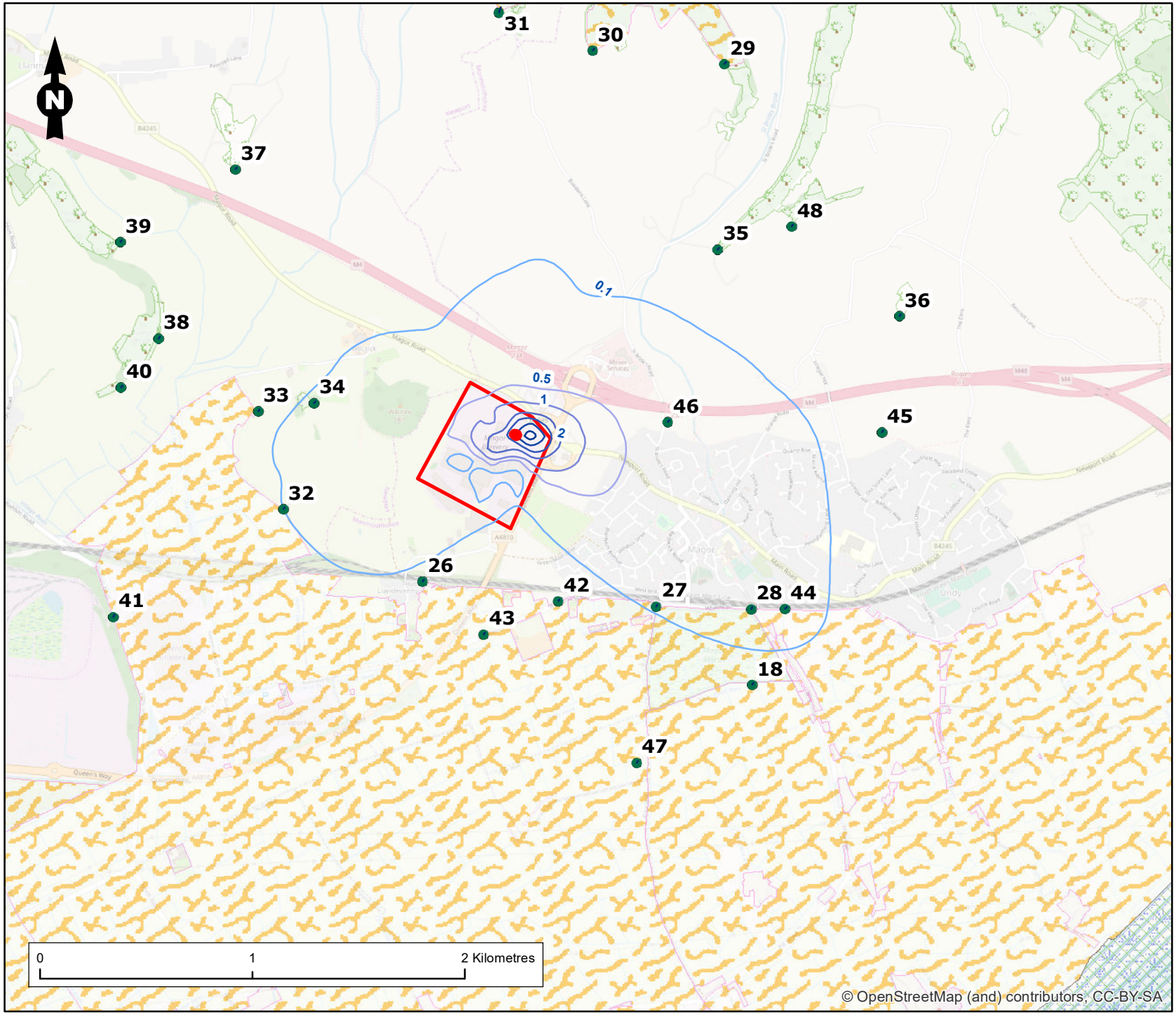
Predicted Daily Mean NOx Concentrations with Flue Ace (µg/m³)

Project Number	Figure No.
1620009178	5.6
Date	**Prepared By**
March 2020	AG/GH
Scale	**Issue**
1:30,000 @A4	1

Client
AB In-bev UK Limited

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Legend

- Indicative Site Boundary
- Flue
- Ecological Receptors
- RAMSAR
- SPA
- SAC
- SSSI
- Ancient Woodland

Nitrogen Deposition (kg N/ha/yr)

- 0.1
- 0.5
- 1
- 2
- 3
- 4
- 5

Predicted Grassland Nitrogen Deposition with Flue Ace (kg N/ha/yr)

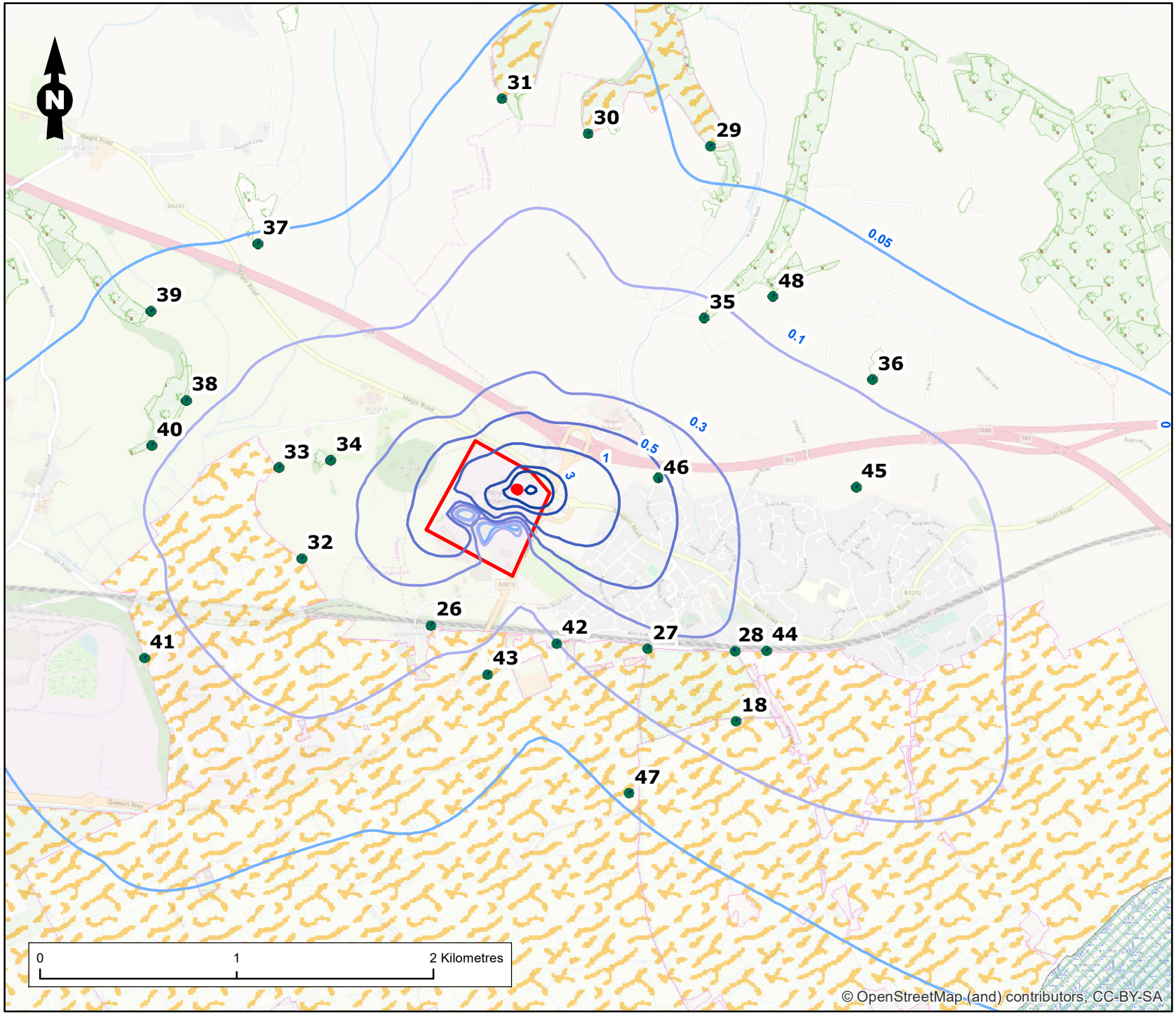
Project Number	Figure No.
1620009178	5.7
Date	**Prepared By**
March 2020	AG/GH
Scale	**Issue**
1:25,000 @A4	1

Client

AB In-bev UK Limited

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Legend

- Indicative Site Boundary
- Flue
- Ecological Receptors
- RAMSAR
- SPA
- SAC
- SSSI
- Ancient Woodland

Nitrogen Deposition (kg N/ha/yr)

- 0.05
- 0.1
- 0.3
- 0.5
- 1
- 3
- 5
- 10

Predicted Woodland Nitrogen Deposition with Flue Ace (kg N/ha/yr)

Project Number	Figure No.
1620009178	5.8
Date	**Prepared By**
March 2020	AG/GH
Scale	**Issue**
1:27,000 @A4	1

Client

AB In-bev UK Limited

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.