# GAS-FIRED STANDBY ELECTRICITY GENERATION FACILITY

# LAND AT SEVERN ROAD, HALLEN

# AIR QUALITY ASSESSMENT

March 2023

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**CONTENTS**

# 1.0 INTRODUCTION

## 1.1 Background

This air quality assessment has been undertaken by Isopleth Ltd further to instruction by Forsa Energy Gas Holdings Ltd (hereafter referred to as 'Forsa').

The assessment considers air quality impacts associated with the proposed development of a small scale standby electricity generation plant (SSSEGP) peaking power plant at their site on Land At Severn Road, Hallen, Bristol, South Gloucestershire BS10 7RZ (Drawing AQ1). The site lies within the administrative area of South Gloucestershire Council (SGC).

The proposed development will be for 11 No. Jenbacher J624, K12 4.5$MW_e$ engines, fuelled by natural gas, for electricity generation that together will generate a total of 49.5$MW_e$ with a stack height of 12m.

The impact of the proposed electricity generation facility on local air quality has been assessed. The type, source and significance of potential impacts are identified and the measures employed to minimise these impacts are described.

The key pollutant associated with operation of the spark ignition engines considered in this assessment are oxides of nitrogen ($NO_x$ as $NO_2$), the primary pollutants arising from the combustion of natural gas, for which there is a quantitative limit. Other pollutants, such as sulphur dioxide ($SO_2$), sometimes associated with the operation of spark ignition engines (when run on biogas) are generated in negligible levels when using this fuel type. The Environment Agency has requested assessment of formaldehyde ($CH_2O$) at other sites and for this reason this pollutant has also been assessed. Predicted ground level concentrations of $NO_2$ are compared with relevant air quality standards and guidelines for the protection of human health and sensitive habitats.

## 1.2 Planning History

Full planning permission (Ref: P19/17024/F) was granted on 15th January 2020 for the following at the same location:

> *'Installation of a gas powered peaking plant with associated infrastructure and landscaping works.'*

The scheme proposed for application P19/17024/F consisted of 25 mains gas electrical generators, each rated at 1.950 MWe output. The total electrical export was 49 MWe. Each engine sat within its own container and discharged to atmosphere via its own individual 7 m stack.

The application for the approved scheme was supported by an air quality assessment completed by Wood Ltd. The South Gloucestershire Council Environmental Protection Unit had no objection in principle to the proposed development subject to further points of clarification at that time. The facility was assumed to operate for a maximum of 4000 hours per year in the Wood AQ assessment.

## 1.3 Scope

This detailed assessment report relates to the impact of air pollutants from the operation of the proposed electricity generation facility. Results of the dispersion modelling for engine exhaust emissions are presented in terms of concentrations, with a description of magnitude and also determination of significance where relevant.

# 2.0 SITE DESCRIPTION

## 2.1 Location

The site is located within part of a field off Severn Road, Hallen, immediately to the east of Hallen Industrial Estate. The area the subject of this application is located within the Severnside Enterprise area.

The approximate National Grid Reference for the site is 354335, 181240. A location plan of the site is presented as Drawing AQ1.

## 2.2 Development Description

The site will operate on a largely unmanned basis and will be remotely operated by Forsa. The standby, natural gas fuelled spark ignition engines provide balance to the National Grid during unexpected periods of high demand for electricity or where there are constraints on electricity available in England and Wales.

The proposed facility will comprise 11 No. 4.499 $MW_e$ Jenbacher J624, K12 spark ignition engines, fuelled by natural gas, for electricity generation that together will generate a total of 49.5 MWe. Emissions to air will be via 11 No. engine exhausts of 12m in height, each serving a single engine.

The NOx emission concentration of the engines is **250 mg/Nm$^3$ at 5% $O_2$**, 0 degC, 1atm, dry. This may be converted to differing oxygen concentrations using the equation in MCERTS monitoring Guidance M2 Box 3.5. In this case, the concentration may also be expressed as **95 mg/Nm$^3$ at 15% $O_2$**, 0 degC, 1atm, dry.

This air quality assessment assumes that each of the engines within the power plant will operate for a maximum of 2250 hours per year.

# 3.0 REGULATORY STANDARDS AND GUIDELINES

## 3.1 International Legislation and Policy

European Directive 2008/50/EC of the European Parliament and of the Council of 21st May 2008, sets legally-binding Europe-wide limit values for the protection of public health and sensitive habitats. The Directive streamlines the European Union's air quality legislation by replacing four of the five existing Air Quality Directives within a single, integrated instrument.

The pollutants included are sulphur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), particulate matter of less than 10 micrometres (µm) in aerodynamic diameter ($PM_{10}$), particulate matter of less than 2.5 µm in aerodynamic diameter lead ($PM_{2.5}$), lead (Pb), carbon monoxide (CO), benzene ($C_6H_6$), ozone ($O_3$), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni) and mercury (Hg).

Directive 2008/50/EC makes it clear that the ambient air quality standards shall not be enforced where there is no regular public access and fixed habitation:

> *'2. Compliance with the limit values directed at the protection of human health shall not be assessed at the following locations:*
>
> *(a) any locations situated within areas where members of the public do not have access and there is no fixed habitation;*
>
> *(b) in accordance with Article 2(1), on factory premises or at industrial installations to which all relevant provisions concerning health and safety at work apply;*
>
> *(c) on the carriageway of roads; and on the central reservations of roads except where there is normally pedestrian access to the central reservation.'*

The Environmental Permitting (England and Wales) (Amendment) (EU Exit) Regulations 2019 (SI 2019/39) were made on 8 January 2019 and come into force on exit day. The Regulations ensure that the Environmental Permitting (EP) regime in England and Wales can continue to function after Brexit.

## 3.2 Air Quality Strategy for England, Scotland, Wales & Northern Ireland

The Government's policy on air quality within the UK is set out in the Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland (AQS) published in July 2007, pursuant to the requirements of Part IV of the Environment Act 1995. The AQS sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met in the UK. The AQS is designed to be an evolving process that is monitored and regularly reviewed.

The AQS sets standards and objectives for ten main air pollutants to protect health, vegetation and ecosystems.

The air quality standards are long-term benchmarks for ambient pollutant concentrations which represent negligible or zero risk to health, based on medical and scientific evidence

reviewed by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO). These are general concentration limits, above which sensitive members of the public (e.g. children, the elderly and the unwell) might experience adverse health effects.

The air quality objectives are medium-term policy based targets set by the Government which take into account economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance, i.e. a limited number of permitted exceedences of the standard over a given period.

For some pollutants there is both a long-term (annual mean) standard and a short-term standard. In the case of $NO_2$, the short-term standard is for a 1-hour averaging period, whereas for CO it is the 8-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants.

**Table 3-1**
**Air Quality Strategy Objectives**

| Pollutant | Concentrations | Measured As |
|---|---|---|
| Nitrogen Dioxide ($NO_2$) | 200 µg/m$^3$ not to be exceeded more than 18 times per year | 1 hour mean |
| | 40 µg/m$^3$ | Annual mean |

The health studies which provide the basis for the air quality standards are based on data for individuals within a population, and therefore the exposure should relate to that of an individual.

For the purposes of LAQM, regulations state that exceedances of the objectives should be assessed in relation to 'the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present'.

Examples of where the objectives should, and should not apply, are summarised in Table 3-2 below, as taken from DEFRA Guidance LAQM TG(22). This table should be considered in the context of the conclusions of various review documents such as The AQC report[1] *Relationship between the UK Air Quality Objectives and Occupational Air Quality Standards* (November 2016). In particular it is important that, when setting the objective, DEFRA took account of EPAQs's recommendations. It was also influenced by the limit value set in European Commission's First Air Quality Daughter Directive which made it clear that it only applied to *'outdoor air in the troposphere, excluding work places'*. The Ambient air quality Directive is consistent with this, stating that *'Compliance with the limit values directed at the protection of human health shall not be assessed… on factory premises or at industrial installations to which all relevant provisions concerning health and safety at work apply'*.

[1] http://www.aqconsultants.co.uk/AQC/media/Reports/Relationship-between-the-UK-Air-Quality-Objectives-and-Occupational-Air-Quality-Standards.pdf

As such, commercial / industrial occupiers of industrial units would therefore be outside the requirements of the air quality objectives. Occupiers of industrial units where members of the public would 'regularly be present' are however within the requirements, such as some of those mentioned in section 2.1 above.

**Table 3-2**
**Air Quality Strategy Objectives**

| Averaging Period | Objectives should apply at: | Objectives should generally not apply at: |
|---|---|---|
| Annual mean | All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc. | Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term. |
| 24-hour mean and 8-hour mean | All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties | Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term. |
| 1-hour mean | All locations where the annual mean, 24 and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably expected to spend one hour or longer. | Kerbside sites where the public would not be expected to have regular access. |

### 3.3 Environmental Assessment Levels

The Environmental Assessment Level (EAL) for formaldehyde is currently based on the 30-min WHO limit in addition to an annual average limit derived from the EH40 occupational exposure limits for the pollutant.

**Table 3-3**
**EALs**

| Pollutant | Concentration | Measured As |
|---|---|---|
| Formaldehyde ($CH_2O$) | 100 µg/m$^3$ | 30-min mean |
| | 5 µg/m$^3$ | Annual mean |

For purposes of averaging time conversion, a factor of 1.3 has been used to convert the hourly average to a 30 minute average, in accordance with Environment Agency guidance.

### 3.4 Local Air Quality Management (LAQM)

Part IV of the Environment Act 1995 also requires local authorities to periodically Review and Assess the quality of air within their administrative area. The Reviews have to consider the present and future air quality and whether any air quality objectives prescribed in Regulations are being achieved or are likely to be achieved in the future.

Where any of the prescribed air quality objectives are not likely to be achieved the authority concerned must designate that part an Air Quality Management Area (AQMA).

For each AQMA, the local authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the air quality objectives. Local authorities are not statutorily obliged to meet the objectives, but they must show that they are working towards them.

The Department of Environment, Food and Rural Affairs (DEFRA) has published technical guidance for use by local authorities in their Review and Assessment work. This guidance is commonly referred to as LAQM.TG(22). Full details are available on the DEFRA website.

### 3.5 The Habitats Directive

The 'Habitats Directive' relates to Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. The Directive establishes the EU wide Natura 2000 ecological network of protected areas, safeguarded against potentially damaging developments. Natura 2000 sites in the UK include Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). One or more nationally protected sites such as SSSI may be found within Natura 2000 sites, or outside these but do not themselves fall within the Natura 2000 network and are not therefore covered by the Habitats Directive unless they also fall within an SPA or SAC.

Two key sections relevant to air quality in the Directive are those found in Article 6:

> *'2. Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive .*
>
> *3. Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in*

*combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives*. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.'* [*my emphasis]

Therefore, according to the Directive, a scheme must only proceed where it does not adversely affect the integrity of one or more SAC or SPAs in view of the site's conservation objectives. This should include the potential for in-combination impacts which prevents the possibility of multiple schemes with a very small (but not negligible) impact together adversely affecting the integrity of one or more SAC or SPAs in view of the site's conservation objectives.

### 3.6 National Planning Policy

The latest revision of the National Planning Policy Framework (NPPF) was published in July 2021 and sets out the Government's planning policies for England and how these are expected to be applied.

The purpose of the planning system is to contribute to the achievement of sustainable development. In order to ensure this, this NPPF recognises three overarching objectives, including the following of relevance to air quality:

*"c) An environment objective - to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigation and adapting to climate change, including moving to a low carbon economy."*

Chapter 15 (paragraph 174) of the NPPF details objectives in relation to conserving and enhancing the natural environment. It states that:

*"Planning policies and decisions should contribute to and enhance the natural and local environment by:*

*[…]*

*e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality […]"*

The NPPF (paragraph 186) specifically recognises air quality as part of delivering sustainable development and states that:

*"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the*

*presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."*

The implications of the NPPF have been considered throughout this assessment.

### 3.7 South Gloucestershire Council Policies

South Gloucestershire Local Plan Policies, Sites and Places Plan (Adopted) November 2017 includes Policy **PSP21** 'Environmental Pollution and Impacts':

*'Development proposals will be acceptable where they clearly demonstrate that development is sited and designed to prevent unacceptable risks and avoid unacceptable levels of pollution adversely impacting, by way of; fumes, dust, noise, vibration, odour, light or other forms of air, land, water pollution, exposure to contaminated land or land instability, directly or cumulatively, on:*

- *environmental amenity; and*
- *the health, safety and amenity of users of the site or the surrounding area.*

*Account will be taken of:*

- *The impact of existing sources of noise or other pollution on the new development; and*
- *The impact of the new development on existing uses by reason of its sensitivity to noise or other pollution.*

*A. Potentially Polluting Development*

*Development proposals which have the potential for adverse impact(s), but is justified for reasons of economic or wider social need, will be expected to provide an appropriate scheme of mitigation.*

*Account will be taken of:*

- *the location, design and layout of the proposed development;*
- *measures to bring levels of emissions to an acceptable level;*
- *measures to control run-off and other diffuse pollution;*
- *measures to avoid pollution of the ground, groundwater and atmosphere;*
- *hours of operation; and*

- *measures that reduce existing levels of pollution.*

*In all cases, development proposals will be expected to provide mitigation to an appropriate standard, with an acceptable design, particularly in proximity to existing, sensitive uses or sites.*

*B. Development Sensitive to Pollution*

*New development proposals sensitive to existing pollution sources, including fumes, dust, noise, vibration, odour, light or other forms of air, land or water pollution, will be acceptable where the pollution can be satisfactorily mitigated.*

*Development proposals sensitive to pollution will be acceptable where they would not threaten through the imposition of undue operational constraints, existing uses considered desirable for reasons of safeguarding, economic or wider social needs.*

*C. Noise, Air Quality and Contaminated Land*

*……*

*Air Quality*

*Development that, on its own or cumulatively, has the potential for significant emissions to the detriment of air quality, particularly in or adjacent to air quality management areas, will be acceptable where potential adverse effects are mitigated to an acceptable level, by an appropriate scheme of mitigation.*

*Development that would introduce new receptors into designated air quality management areas and other potential areas of poor air quality, should take account of existing air pollution and include measures to mitigate the impact on future receptors to an acceptable level. Development outside Air Quality Management Areas (AQMAs) should not cause new AQMAs to be designated.'*

A detailed review of planning policy is outside the scope of this report.

# 4.0 ASSESSMENT METHODOLOGY

The scope of the impact assessment for stack emissions from the proposed plant has been determined in the following way:

- review of air quality data for the area surrounding the Site, including data from the Defra Air Quality Information Resource (UK-AIR) and the Air Pollution Information System (APIS);
- desk study to confirm the location of nearby areas that may be sensitive to changes in local air quality; and
- review of emission parameters for the power plant and dispersion modelling using the Breeze AERMOD 11 dispersion model to predict ground-level concentrations of pollutants at sensitive human and habitat receptor locations.

Manufacturer emission limits have been assumed for the purposes of the modelling assessment and each engine is assumed to be operating at full load for 2250 hours in the year.

The input parameters used in the assessment are identified in Appendix A.

## 4.1 Local Meteorological Data

The dispersion modelling has been carried out using five years (2014-2018) of hourly sequential meteorological data in order to take account of inter-annual variability and reduce the effect of any atypical conditions. Data from the Filton meteorological station, which closed in 2019, has been used for the assessment. This site is the most representative data currently available for the area which provides the level of completeness required for dispersion modelling (i.e. minimal missing data).

The meteorological data has been prepared based on a surface roughness of 0.1m with the Albedo / Bowen is characterised as water (30%), urban (40%) and grassland (30%).

A windrose for all years of meteorological data are presented in Appendix B.

## 4.2 Topography

The presence of elevated terrain can significantly affect the dispersion of pollutants and the resulting ground level concentration in a number of ways. Elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to a source and reducing concentrations further away.

The power plant containers are sites on concrete plinths and lie at a basal elevation of around 5m AoD. Topography has been incorporated within the dispersion model.

AERMOD utilises digital elevation data to determine the impact of topography on dispersion from a source. Topographical data for the site has been obtained in OS digital (.ntf) format.

Data was processed by the AERMAP function within AERMOD to calculate terrain heights, and interpolate data to calculate terrain heights for sources, buildings etc.

### 4.3 Building Downwash / Entrainment

The presence of buildings close to emission sources can significantly affect the dispersion of pollutants by leading to downwash. This occurs when a building distorts the wind flow, creating zones of increased turbulence. Increased turbulence causes the plume to come to ground earlier than otherwise would be the case and result in higher ground level concentrations closer to the stack.

Downwash effects are only significant where building heights are greater than 40% of the emission release height. The downwash structures also need to be sufficiently close for their influence to be significant.

The engine containers are a maximum of 4.5m in height and have been included in the dispersion model to account for potential downwash effects and allow for stack height determination. All other buildings / structures within 5 stack heights are lower than 40% of the stack and are therefore not relevant to the model.

### 4.4 Nitrogen Oxides to $NO_2$ Conversion

Oxides of nitrogen (NOx) emitted to atmosphere as a result of combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, NO is oxidised to $NO_2$. The proportion of NO converted to $NO_2$ depends on a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone ($O_3$).

A conversion ratio of 70% NOx:$NO_2$ has been assumed for comparison of predicted concentrations with the long-term objectives for $NO_2$. A conversion ratio of 35% has been utilised for the assessment of short-term impacts, as recommended by Environment Agency guidance[2].

### 4.5 Sensitive Human Health Receptors

The term 'sensitive receptors' includes any persons, locations or systems that may be susceptible to changes as a consequence of the proposed power plant. As described in section 3.2 of this report, annual objectives only apply at residences.

A selection of the closest receptors to the development which have been used for modelling purposes are shown in Tables 4.1 – 4.2 and are also shown on Drawings AQ1 and ECO1. It is recognised that this list is not exhaustive, however these receptors have been selected in order to provide an indication of impacts in all directions from the proposed plant.

[2] AQMAU, Conversion Rates for NOx and $NO_2$.

Table 4-1 shows the locations of the modelled receptors which have been classed as potential residences:

**Table 4-1**
**Modelled Receptors: Residential**

| Reference | Description | OS GR Xm | OS GR Ym |
|---|---|---|---|
| HR1 | Barnacre | 354758.3 | 180657.2 |
| HR2 | Sampson Farm | 355609.2 | 180748.0 |
| HR3 | Berwick Court | 354965.3 | 180287.2 |
| HR4 | Hallen Farm | 354634.3 | 180404.0 |
| HR5 | Elmington Manor Farm | 355664.0 | 181529.3 |

For impacts at this site, a receptor grid at 35m resolution across the model domain has also been used (approximately 3 stack heights). These results have been presented as impact isopleths and this allows the concentration at all locations to be seen. These predicted ground level concentrations may then be compared with relevant long term and short term air quality standards and guidelines for the protection of health.

### 4.6 Sensitive Habitats and Ecosystems

The presence of the following habitat sites have been assessed:

- Special Areas of Conservation (SACs) and candidate SACs (cSACs) designated under the EC Habitats Directive[3];
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive[4];
- Ramsar Sites designated under the Convention on Wetlands of International Importance[5].
- Sites of Special Scientific Interest (SSSI);
- Ancient Woodland;
- Local Nature Reserves (LNR).

Where sensitive ecological receptors are present, maximum predicted ground level concentrations of NOx are compared with relevant critical levels, thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive plants and animals. The development is not a significant source of $SO_2$ or HCL / HF.

Environment Agency guidance states that *"the critical levels should be applied at all locations as a matter of policy, as they represent a standard against which to judge ecological harm*".

[3] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

[4] Council Directive 79/409/EEC on the conservation of wild birds.

[5] Ramsar (1971), The Convention of Wetlands of International Importance especially as Waterfowl Habitat.

Critical loads refer to the threshold beyond which deposition of pollutants to water or land results in measurable damage to vegetation and habitats. The maximum predicted deposition rates are compared with site specific critical loads obtained from APIS.

MAGIC searches for areas 10km (European sites and SSSI) and 2km from the site (AW) are included in Appendix E. These distances are consistent with Environment Agency Guidance for standby generation. The receptors modelled are shown in table 4-2 below and shown on Drawing ECO1.

**Table 4-2**
**Modelled Receptors: Ecological**

| Reference | Description | OS GR Xm | OS GR Ym |
|---|---|---|---|
| ER1 | Berwick Wood AW 1 | 356004.0 | 181276.0 |
| ER2 | Berwick Wood AW 2 | 355411.0 | 180283.0 |
| ER3 | Hakes Hill Wood AW | 356224.0 | 181207.0 |
| ER4 | Haw Wood AW | 355630.0 | 180017.0 |
| ER5 | Lawrence Weston Moor LNR | 354748.0 | 179412.0 |
| ER6 | Severn Estuary Ramsar/SSSI/SAC/SPA 1 | 352541.0 | 181256.0 |
| ER7 | Severn Estuary Ramsar/SSSI/SAC/SPA 2 | 353002.0 | 182074.0 |
| ER8 | Severn Estuary Ramsar/SSSI/SAC/SPA 3 | 353352.0 | 182744.0 |
| ER9 | Avon Gorge | 354780.0 | 175614.0 |

It can be seen that the proposed development site is located within 2km of the Severn Estuary SSSI / SPA / Ramsar site. The Severn Estuary SPA covers 17600 hectares, clearly all of which is not relevant to the potential impacts from the proposed site. The closest SSSI interest units are:

- Severn Estuary SSSI - Chittening Warth (027). Unit area (ha):37.956. Littoral Sediment. Middle and upper saltmarsh dominated by mainly homogenous stands of sea couch with some dense areas of reed at the southern extent of the unit;
- Severn Estuary SSSI - New Pill (028). Unit area (ha): 16.1317. Littoral Sediment;
- Severn Estuary SSSI - Gravel Banks (029). Unit area (ha): 340.9013. Intertidal mud and sand.

The relevant nutrient nitrogen Critical Load Class for Littoral sediment at the Severn Estuary SSSI is pioneer, low-mid, mid-upper saltmarshes, with an empirical Critical Load of 20 – 30 kg N/ha/yr. There is no acidity critical load for this habitat type or location.

The isopleths included in the appendices to this report allow the impact to be seen in relation to any ecological sites of local interest which have not been specifically mentioned in this report.

A summary of critical levels for the protection of sensitive ecosystems and vegetation is presented in Appendix C.

## 4.7 Significance of Impact

The significance of impact from the generation plant at the Avonmouth facility has been considered against criteria for both planning and also permitting criteria issued by the Environment Agency.

### *4.7.1 Planning*

The EPUK Guidance describes that:

> *'Impacts on air quality, whether adverse or beneficial, will have an effect on human health that can be judged as 'significant' or 'not significant'. This is the primary requirement of the EIA regulations, but is also relevant to other air quality assessments.*
>
> *It is important to distinguish between the meaning of 'impact' and 'effect' in this context. An impact is the change in the concentration of an air pollutant, as experienced by a receptor.*
>
> *This may have an effect on the health of a human receptor, depending on the severity of the impact and other factors that may need to be taken into account. Judging the severity of an impact is generally easier than judging the significance of an effect.'*

In determining impact significance from the pollutants discharged to air, specific reference has been made to Table 6.3 of "Development Control: Planning for Air Quality", which presents descriptors for impact magnitude and impact significance. These descriptors are reproduced below and relate to annual average impacts.

**4-1: EPUK Impact descriptors for individual receptors**

| Long term average Concentration at receptor in assessment year | % Change in concentration relative to Air Quality Assessment Level (AQAL) | | | |
|---|---|---|---|---|
| | 1 | 2-5 | 6-10 | >10 |
| 75% or less of AQAL | Negligible | Negligible | Slight | Moderate |
| 76-94% of AQAL | Negligible | Slight | Moderate | Moderate |
| 95-102% of AQAL | Slight | Moderate | Moderate | Substantial |
| 103-109% of AQAL | Moderate | Moderate | Substantial | Substantial |
| 110% or more of AQAL | Moderate | Substantial | Substantial | Substantial |

The following standard terminology has been applied:

- Substantial beneficial;
- Moderate beneficial;
- Minor beneficial;
- Neutral/negligible;
- Minor adverse;
- Moderate adverse; and

- Substantial adverse.

In relation to short-term impacts, the EPUK guidance states:

> *'6.38 Where such peak short term concentrations from an elevated source are in the range 10-20% of the relevant AQAL, then their magnitude can be described as small, those in the range 20-50% medium and those above 50% as large. These are the maximum concentrations experienced in any year and the severity of this impact can be described as slight, moderate and substantial respectively, without the need to reference background or baseline concentrations. That is not to say that background concentrations are unimportant, but they will, on an annual average basis, be a much smaller quantity than the peak concentration caused by a substantial plume and it is the contribution that is used as a measure of the impact, not the overall concentration at a receptor. This approach is intended to be a streamlined and pragmatic assessment procedure that avoids undue complexity.'*

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

- <10%: Negligible;
- 10-20%: Small;
- 20-50%: Medium; and
- >50 Large.

The EPUK guidance also states that:

> *'judgement of the significance should be made by a competent professional who is suitably qualified. The reasons for reaching the conclusions should be transparent and set out logically.'*

An impact which results in an exceedance of an air quality objective will normally be regarded as 'significant'.

### *4.7.2 Permitting*

The EA impact, effect and significance criteria are as detailed below.

Stage 1

The EA Guidance describes that, to screen out a PC for any substance so that no further assessment is needed for that pollutant, the PC must meet both of the following criteria:

- 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

If both of these criteria are met no further assessment of the substance is required. There will be a need to carry out a second stage of screening to determine the impact of the PEC if the criteria are not met.

Stage 2

The EA Guidance describes that, in the second stage of screening if both of the following requirements are met there is no requirement for any further assessment of that substance. Detailed modelling will be required for emissions that don't meet both of the following requirements:

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

The guidance then states that no further action is needed if the assessment has shown that both of the following apply:

- emissions comply with BAT associated emission levels (AELs) or the equivalent requirements where there is no BAT AEL; and
- the resulting PECs are not predicted to exceed environmental standards

A cost benefit analysis is required if any of the following apply:

- PCs could cause a PEC to exceed an environmental standard (unless the PC is very small compared to other contributors);
- the PEC is already exceeding an environmental standard;
- the activity or part of it isn't covered by a 'BAT reference document' (BREF);
- the emissions from the facility don't comply with BAT AELs; or
- a BAT assessment has been requested.

If the emissions from the facility that affect ecological sites meet both of the following criteria, they are insignificant:

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

If these requirements are not met there is a need to calculate the PEC and check the PEC against the standard for protected conservation areas.

- If your long-term PC is greater than 1% and the PEC is less than 70% of the long-term environmental standard, the emissions are insignificant and there is no requirement to assess them any further; however
- If the PEC is greater than 70% of the long-term environmental standard, detailed modelling is required.

# 5.0 BASELINE CONDITIONS

## 5.1 Council Review and Assessment of Air Quality

The 2021 / 22 Annual Status Review states that:

> *'The main air pollutant of concern locally is nitrogen dioxide ($NO_2$), which mostly arises from road traffic (34%, rising to 80% near roadsides). Particulate matter is also a pollutant of concern. Sources of particulate matter ($PM_{10}$ and $PM_{2.5}$ which are described by the particle size) include domestic wood and coal burning (38%), industrial combustion (16%) and road transport (12%).'*
>
> *'There are two AQMAs currently declared in South Gloucestershire in relation to exceedances, or likely exceedances, of the annual mean objective for nitrogen dioxide (40 µg/m$^3$):*
>
> 1) *Staple Hill – in the centre around the Broad Street/ High Street/ Soundwell Road/ Victoria Street crossroads and the High Street/ Acacia Road/ Pendennis Road crossroads.*
> 2) *Kingswood – Warmley – from the Bristol/ South Gloucestershire boundary in Kingswood along the A420 to the junction with Goldney Avenue in Warmley.'*

The proposed development site is therefore not located within an AQMA.

## 5.2 Local Monitoring Data

There is a network of $NO_2$ diffusion tubes located within the South Gloucestershire Council area. The closest of these is Diffusion Tube 38: Severn Beach - Ableton Lane Severn Beach Primary School façade (354282,184653). As such there is no recent Council data which is directly relevant to the site location.

## 5.3 DEFRA Background Maps

Information on background concentrations in the vicinity of the site has been obtained from the DEFRA background pollutant maps. Background concentrations from the grid square which represents the site for the current year of 2023 are shown in Table 5-1 below.

- $NO_x$: 18.1µg/m$^3$;
- $NO_2$: 13.4µg/m$^3$.

Estimated DEFRA background concentrations are therefore 'well below' the relevant objectives. For purposes of this assessment the highest values have been used to represent the background (OS GR 354500, 181500).

## 5.4 Backgrounds: Ecological Receptors

The average 2019 NOx background given by APIS for the Severn Estuary SSSI is (as would be expected for the location in the Estuary) is similar to the DEFRA background for this grid square, at 18.0 µg/m$^3$.

In terms of nutrient Nitrogen critical load, the average background at the Severn Estuary is 15.8kg N/ha/yr against the critical load range of 20-30 for pioneer, low-mid, mid-upper saltmarshes. This interest feature is not sensitive to acid deposition.

# 6.0 PREDICTED IMPACTS

The assessment results are presented in the tables below.

## 6.1 All Locations

The predicted process contribution (PC) at the maximum point of impact (offsite) is presented in Table 6.1 for short term limits. The annual objective does not apply at the point of maximum ground level concentration except where a residence is present.

**Table 6-1**
**Maximum Predicted Ground Level Concentrations**

| Pollutant | Averaging Period | EAL (µg/m$^3$) | PC (µg/m$^3$) | PC (%age of EAL) |
|---|---|---|---|---|
| $NO_2$ | 1-hour | 200 | 78.0 | 39% |
| $CH_2O$ | 30-min | 100 | 66.3 | 66% |

[*18th Highest value of operational period, equating to 99.79$^{th}$ percentile of entire year.]

The results show that:

- the process contribution for short term $NO_2$ is below the relevant objective at this point of maximum impact; and
- the process contribution for short term $CH_2O$ is also below the relevant EAL at this point of maximum impact.

As can be seen in the impact drawings, these maximum levels do not occur at a location where members of the public would regularly be present.

The potentially significant long-term and short-term impacts are compared with the baseline concentrations (i.e. PC + Baseline, or Predicted Environmental Concentration, 'PEC') for the power generation plant in Table 6.2. There is no background data for formaldehyde.

**Table 6-2**
**Comparison of Predictions with Baseline Concentrations**

| Pollutant | EAL | Baseline | PEC | PEC (as a %age of EAL) |
|---|---|---|---|---|
| $NO_2$ | 200 | 26.9 | 104.9 | 52% |
| $CH_2O$ | 100 | 0.0 | 66.3 | 66% |

In terms of impact at the point of maximum Ground Level Concentration (GLC) the magnitude of change in 1-hour $NO_2$ impact is 'large'. However, this location is not a location '*where members of the public have regular access*', i.e. it is not likely that a member of the public would be at this location for 18 hours or more per year as this to the north east the site, north of the Hallen Industrial Estate.

## 6.2 Discrete Receptors: Residential

The predicted process contribution (PC) and predicted environmental concentration (PEC) at the assessed receptor locations, where members of the public would reasonably be expected to spend time, is presented in Table 6.3.

**Table 6-3**
**Residential Receptor Impact Concentrations (µg/m$^3$)**

| Receptor | PC Annual $NO_2$ | PEC Annual $NO_2$ | PC 1-hr $NO_2$ | PEC 1-hr $NO_2$ | PC Annual $CH_2O$ | PC 30-min $CH_2O$ |
|---|---|---|---|---|---|---|
| HR1 | 0.09 | 13.5 | 8.4 | 35.2 | 0.03 | 14.5 |
| HR2 | 0.07 | 13.5 | 6.2 | 33.1 | 0.02 | 6.9 |
| HR3 | 0.05 | 13.5 | 4.6 | 31.4 | 0.01 | 8.6 |
| HR4 | 0.08 | 13.5 | 6.9 | 33.8 | 0.02 | 11.2 |
| HR5 | 0.47 | 13.9 | 12.3 | 39.1 | 0.13 | 7.4 |

Maximum predicted impacts can be seen in Appendix D. The highest long term $NO_2$ impact at an assessed residential receptor is predicted to fall at HR5 (Elmington Manor Farm) which represents 1.2% of the annual objective and is therefore negligible, the overall PEC being less than 35% of the objective . The highest hourly $NO_2$ impact at an assessed residential receptor is predicted to also fall at receptor HR5 which is 5.8% of the short term objective.

## 6.3 Discrete Receptors: Ecological

### *6.3.1 Critical Levels PC*

The NOx critical level PC impacts at all locations (annual and 24-hour) can be seen below.

**Table 6-4**
**Ecological Receptors: Critical Levels (µg/m$^3$)**

| Receptor | PC Annual $NO_X$ | Annual $NO_X$ % of limit | PC 24-hr NOx | 24-hr NOx % of limit |
|---|---|---|---|---|
| ER1 | 0.383 | 1.3% | 4.2 | 5.5% |
| ER2 | 0.060 | 0.2% | 1.7 | 2.3% |
| ER3 | 0.463 | 1.5% | 4.5 | 6.0% |
| ER4 | 0.099 | 0.3% | 2.0 | 2.7% |
| ER5 | 0.058 | 0.2% | 2.1 | 2.8% |
| ER6 (Severn SAC / SPA) | 0.077 | 0.3% | 2.9 | 3.9% |
| ER7 (Severn SAC / SPA) | 0.087 | 0.3% | 3.0 | 4.0% |
| ER8 (Severn SAC / SPA) | 0.106 | 0.4% | 2.2 | 3.0% |
| ER9 | 0.029 | 0.1% | 1.1 | 1.4% |

The highest annual average NOx impact within the Severn Estuary European designation is 0.1 µg/m$^3$ which represents 0.4% of the annual average NOx critical level. The highest 24-hour average NOx impact within the Severn Estuary European designation is 3.0µg/m$^3$ which represents 4.0% of the 24-hour average NOx critical level and at less than 10% of the EAL is

therefore insignificant. The PEC is below 100% at all local sites and AW and therefore acceptable according to EA Guidance.

### *6.3.2 Critical Levels PEC*

The NOx critical level Predicted Environmental Concentration can be seen in Table 6-5, below.

**Table 6-5**
**Ecological Receptors: Critical Level PEC (µg/m³)**

| Receptor | PC Annual $NO_X$ | PEC Annual $NO_X$ | PEC Annual $NO_X$ % of limit |
|---|---|---|---|
| ER1 | 0.383 | 18.5 | 61.5% |
| ER2 | 0.060 | 18.1 | 60.4% |
| ER3 | 0.463 | 18.5 | 61.8% |
| ER4 | 0.099 | 18.2 | 60.6% |
| ER5 | 0.058 | 18.1 | 60.4% |
| ER6 (Severn SAC / SPA) | 0.077 | 18.1 | 60.5% |
| ER7 (Severn SAC / SPA) | 0.087 | 18.2 | 60.5% |
| ER8 (Severn SAC / SPA) | 0.106 | 18.2 | 60.6% |
| ER9 | 0.029 | 18.1 | 60.3% |

The process contribution is below 1% of the NOx annual critical load at the Severn Estuary European designation and the PEC is less than 100% of the limit indicating that the NOx critical level will not be exceeded at this location and the PC is negligible. The PEC is below 100% at all local sites and AW and therefore acceptable according to EA Guidance.

### *6.3.3 Critical Loads*

In relation to critical loads, the Nutrient N impacts at all locations can be seen in Table 6-6, below.

**Table 6-6**
**Ecological Receptors: Critical Loads**

| Receptor | PC | lower critical load Kg N/ha/yr | PC (% of lower critical load) |
|---|---|---|---|
| ER1 | 0.110 | 10.00 | 1.10% |
| ER2 | 0.017 | 10.00 | 0.17% |
| ER3 | 0.133 | 10.00 | 1.33% |
| ER4 | 0.028 | 10.00 | 0.28% |
| ER5 | 0.008 | 10.00 | 0.08% |
| ER6 (Severn SAC / SPA) | 0.011 | 20.00 | 0.06% |
| ER7 (Severn SAC / SPA) | 0.013 | 20.00 | 0.06% |
| ER8 (Severn SAC / SPA) | 0.015 | 20.00 | 0.08% |
| ER9 | 0.008 | 10.00 | 0.08% |

As the process contributions are less than 1% of the nutrient N critical load at the Severn Estuary, therefore nutrient N impacts are insignificant at all of the assessed locations

according to Environment Agency guidance. The impact of the proposed facility at any location within the SSSI / SAC / SPA is therefore predicted to be greatest is therefore negligible. The PEC is below 100% at all local sites and AW and therefore acceptable according to EA Guidance.

### 6.4 Comparison with Previous Applications

The Wood air quality assessment submitted with application reference P19/17024/F assumed that the gas engines would operate for a maximum of 4000 hours per year and that the engines would exhaust through 7m stacks. As described in this assessment the current scheme assumes that the gas engines would operate for a maximum of 2250 hours per year and that the engines would exhaust through 12m stacks.

Comparison of the results from the Wood Ltd assessment and the results for the current scheme are that, as would be expected given the assumptions and scheme design for the two schemes, results are predicted to be significantly lower than for the approved scheme.

### 6.5 Summary

In relation to the impact screening:

- Short term predictions at the point of maximum GLC cannot be considered 'insignificant';
- Long term prediction also cannot be considered 'insignificant'.

However, at locations where the hourly and / or annual objectives must be applied, levels are well below the relevant $NO_2$ objectives.

No further mitigation is required, beyond that already in place (i.e. stack height and use of lean burn engines) and in relation to AQ there is no reason why planning consent should not be granted. Furthermore, predicted impacts have been demonstrated to be significantly lower than those for the scheme previously approved for this site, as would be expected.

### 6.6 Suitability for Permitting

EA Guidance 'Environmental permitting: air dispersion modelling reports' (24th May 2019) states that:

> *'You must include a discussion of results (what they mean and their significance) before you make your final conclusions.'*

However:

> *'At the detailed modelling stage there are no criteria to determine whether:*
>
> - *PCs are significant*
> - *PECs are insignificant or significant'*

In addition, Environment Agency Guidance 'Air emissions risk assessment for your environmental permit' states the following in relation to the requirements for further action, based on the results of the detailed modelling.

When you don't need to take further action

> *'You don't need to take further action if your assessment has shown that both of the following apply:*
>
> - *your proposed emissions comply with BAT associated emission levels (AELs) or the equivalent requirements where there is no BAT AEL*
> - *the resulting PECs won't exceed environmental standards'*

However:

> *When you need to take further action. You'll need to do a cost benefit analysis if any of the following apply:*
>
> - *your PCs could cause a PEC to exceed an environmental standard (unless the PC is very small compared to other contributors – if you think this is the case contact the Environment Agency)*
> - *the PEC is already exceeding an environmental standard*
> - *your activity or part of it isn't covered by a 'BAT reference document' (BREF)*
> - *your proposals don't comply with BAT AELs - in this case you'll need to make a request for an exception ('derogation') that includes a cost benefit analysis of your proposals*
> - *you've been asked to do a BAT assessment*

At locations where the hourly and / or annual objectives must be applied, levels are below the relevant $NO_2$ objectives. Therefore:

1. Emissions from the generators comply with BAT associated emission levels (AELs); and
2. the PCs will not cause a PEC to exceed an environmental standard at locations where the hourly and / or annual objectives must be applied; and
3. the PEC is not already exceeding an environmental standard at locations where the hourly and / or annual objectives must be applied.

For these reasons, it is acceptable for the EA to issue a Permit for this site when comparing the impacts against their assessment criteria.

# 7.0 IN-COMBINATION CONSIDERATIONS

## 7.1 The Habitats Directive

The 'Habitats Directive' relates to Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. The Directive establishes the EU wide Natura 2000 ecological network of protected areas, safeguarded against potentially damaging developments. Natura 2000 sites in the UK include Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). One or more nationally protected sites such as SSSI may be found within Natura 2000 sites, or outside these but do not themselves fall within the Natura 2000 network and are not therefore covered by the Habitats Directive unless they also fall within an SPA or SAC.

Two key sections relevant to air quality in the Directive are those found in Article 6:

> *'2. Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive .*
>
> *3. Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives*. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.'* [*my emphasis]

Therefore, according to the Directive, a scheme must only proceed where it does not adversely affect the integrity of one or more SAC or SPAs in view of the site's conservation objectives. This should include the potential for in-combination impacts which prevents the possibility of multiple schemes with a very small (but not negligible) impact together adversely affecting the integrity of one or more SAC or SPAs in view of the site's conservation objectives.

## 7.2 In-Combination Screening

In order to determine the total sum of potential impacts at a particular location, the following must be determined where an impact may not be 'screened out' as negligible either alone or in combination with other schemes. This '*de minimis*' threshold is typically taken to be 1% of the limit.

- The process contribution;
- The background; and
- Any other relevant scheme which is not already incorporated in the background.

The APIS backgrounds for ecological sites are calculated to the end of 2020, meaning only those schemes which are operation (or due to be operational) after 1st January 2021 would be regarded as having the potential to further increase this background. Of course there are likely to be other sites which cease to contribute, however there is no method available to allow these contributions to be subtracted from the APIS background.

### 7.3 Screening

As described in Section 6.3 of this report, the impacts at the Severn Estuary are below 1% and therefore insignificant, either alone or in combination with other schemes.

# 8.0 CONCLUSIONS

An assessment has been carried out to determine the local air quality impacts associated with the operation of a proposed standby power plant on Land At Severn Road, Hallen, Bristol, South Gloucestershire BS10 7RZ.

Detailed air quality modelling using the AERMOD 11 dispersion model has been undertaken to predict the impacts associated with stack emissions from the gas engines at the Site. As a worst-case, emissions from each of the stacks have been assumed to occur for 2250 hours per year when comparing against long term air quality limits and the entire year when comparing against short term limits. Actual operational hours are likely to be significantly lower.

All impacts, human and ecological, are predicted to be below limit values at locations where the Air Quality Directive states that they must be applied. When applying the theoretical worst case assumptions above (i.e. that each of the engines is operating for 2250 hours per year) it can be seen that there is no realistic potential for a breach of the air quality objectives at any location.

Similarly, the operation of the facility will have no significant impact on the Severn Estuary SPA / RAMSAR either alone, or in combination with other sources of air pollution. The annual average critical level or nutrient nitrogen critical loads are not at risk as a result of the operation of the Forsa Avonmouth SSSEGP, either alone or in combination with other sources.

In summary, it can be concluded that the predicted short term and long term PECs at the sensitive human and ecological receptors are within acceptable limits. The site is therefore unlikely to cause an exceedance of an EAL (or upper critical load / level). For these reasons, it is acceptable for the EA to issue a Permit for this site when comparing the impacts against their assessment criteria and in relation to air quality there is no reason why planning consent should not be granted.

***Notice:***

*This report was produced by Isopleth Ltd to present the results of an air quality constraints assessment for a proposed power plant at a site on Land at Severn Road, Hallen, Bristol, South Gloucestershire BS10 7RZ.*

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# DRAWINGS AQ1 AND ECO1

HR1
HR2
HR3
HR4
HR5

NOTES

LEGEND

SITE LOCATION

HUMAN RECEPTOR LOCATION

N
W
E
S

FORSA ENERGY

SITE
**Avonmouth**

PROJECT
**Air Quality Assessment**

DRAWING TITLE
**Human Receptor Location**

| DRAWING NUMBER | REVISION |
|---|---|
| **AQ1** | 0 |
| SCALE | DATE |
| 1:12500 @ A3 | 13.02.2023 |

ISOPLETH

ER8
ER7
ER6
ER1
ER3
ER2
ER4
ER5

NOTES

LEGEND

SITE LOCATION

ECOLOGICAL RECEPTOR LOCATION

N
W
E
S

FORSA ENERGY

SITE
**Avonmouth**

PROJECT
**Air Quality Assessment**

DRAWING TITLE
**Ecological Receptor Location**

| DRAWING NUMBER | REVISION |
|---|---|
| **ECO1** | 0 |
| SCALE | DATE |
| 1:12500 @ A3 | 13.02.2023 |

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# APPENDIX A: INPUT DATA

The data for the FORSA Engines has been provided by the engine supplier.

**Table A-1**
**Modelling Inputs**

| Parameter | Value |
|---|---|
| Engine Make | Jenbacher |
| Engine Model | J624, K12 |
| No. of engines | 11 |
| Max hours per year | 2250 |
| Engine rating ($kW_e$) | 4499 |
| NOx concentration ($mg/Nm^3$)* | 95 |
| CH2O concentration ($mg/Nm^3$)* | 18.75 |
| Exhaust Temp (K) | 624 |
| Actual Flow ($Am^3/s$ per engine) | 11.96 |
| H2O (%) | 10.1% |
| Oxygen (wet %) | 9.4% |
| Oxygen (dry %) | 10.5% |
| Normalised Flow ($Nm^3/s$ per engine) | 8.30 |
| NOx mass emission (g/s) per engine | 0.79 |
| $CH_2O$ mass emission (g/s) per engine | 0.16 |
| Stack Diameter (m) | 0.80 |
| Velocity of release (m/s) | 23.79 |
| Height of Stack (m) | 12.0 |

[at 15% $O_2$, 0 degC, 1atm, dry]

Modelled mass emissions differ from those in the table above for the reasons given in this report, in that they have been adjusted for $NO_X$:$NO_2$ proportion in accordance with EA guidance and also hours of operation in the case of long term emissions. For example in relation to NOx from the FORSA Engines:

- NOx mass emission per engine = 0.79 g/s;
- Multiplied by 0.7 for NOx:NO2 = 0.552 g/s;
- Multiplied by (3000 / 8760) hours = 0.142 g/s (modelling input).

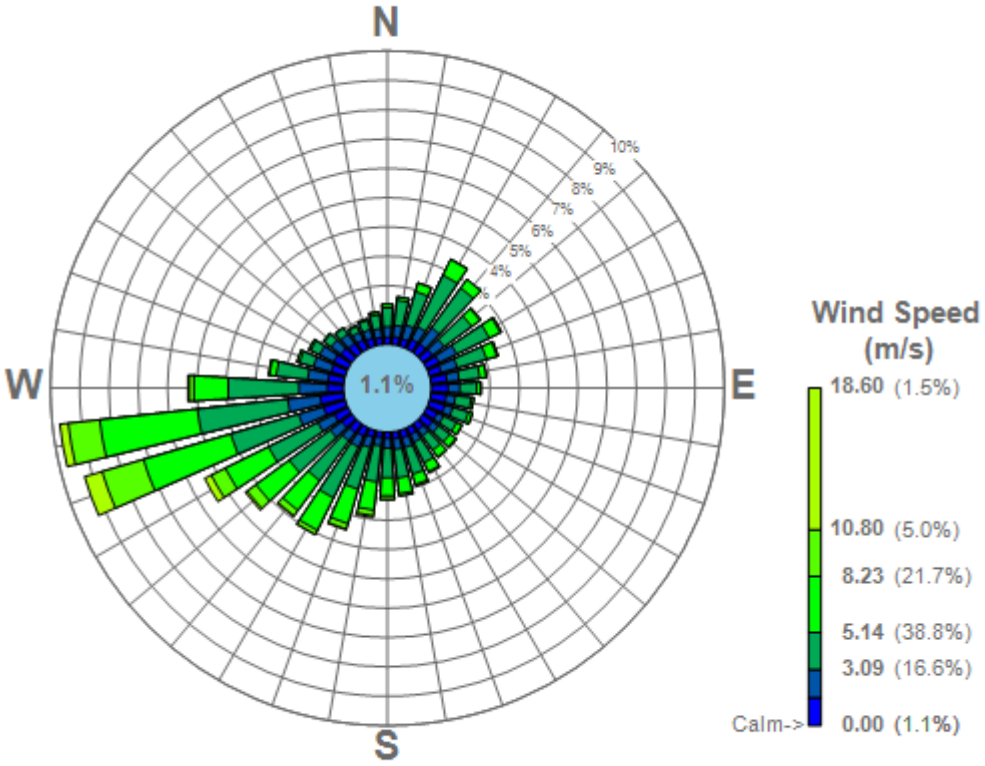
The $CH_2O$ concentration and mass emission rate is taken from testing data for other FORSA sites.

The locations of the stacks for the modelled units are shown in the tables below.

**Table A-2**
**Stack Locations**

| Stack | OS Xm | OS Ym |
|---|---|---|
| NEW Forsa Stack 1 | 354315.5 | 181259.5 |
| NEW Forsa Stack 2 | 354319.6 | 181256.0 |
| NEW Forsa Stack 3 | 354323.2 | 181252.7 |
| NEW Forsa Stack 4 | 354327.0 | 181249.3 |
| NEW Forsa Stack 5 | 354330.8 | 181245.9 |
| NEW Forsa Stack 6 | 354334.6 | 181242.4 |
| NEW Forsa Stack 7 | 354342.2 | 181235.7 |
| NEW Forsa Stack 8 | 354345.9 | 181232.3 |
| NEW Forsa Stack 9 | 354349.7 | 181228.9 |
| NEW Forsa Stack 10 | 354353.5 | 181225.6 |
| NEW Forsa Stack 11 | 354357.3 | 181222.0 |

# APPENDIX B: WIND DATA



# APPENDIX C: AIR QUALITY LIMITS

**Table C-1**
**Air Quality Strategy Objectives**

| Pollutant | Concentrations | Measured As |
|---|---|---|
| Nitrogen Dioxide ($NO_2$) | 200 µg/m$^3$ not to be exceeded more than 18 times per year | 1 hour mean |
| | 40 µg/m$^3$ | Annual mean |
| Nitrogen Dioxide ($NO_x$) | 30 µg/m$^3$ | Annual mean : Protection of Vegetation |
| | 75 µg/m$^3$ | 24h: Protection of Vegetation |
| Formaldehyde ($CH_2O$) | 5 µg/m$^3$ | Annual mean |
| | 100 µg/m$^3$ | 30 min average |

# APPENDIX D: IMPACT PLOTS

**Figure D1: Annual Average $NO_2$ impact**

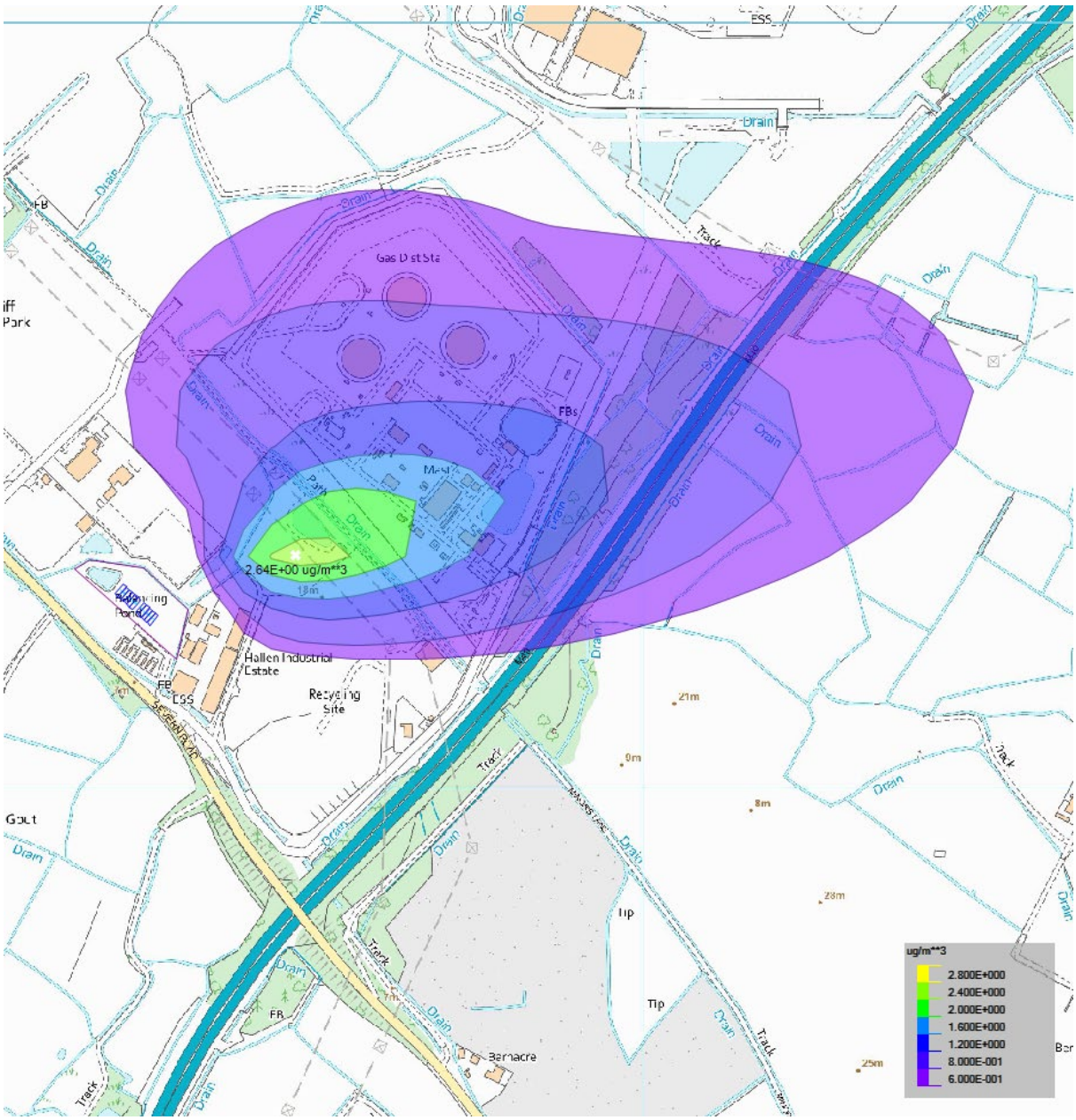


**Figure D2: 1hr (99.79th percentile) $NO_2$ impact**

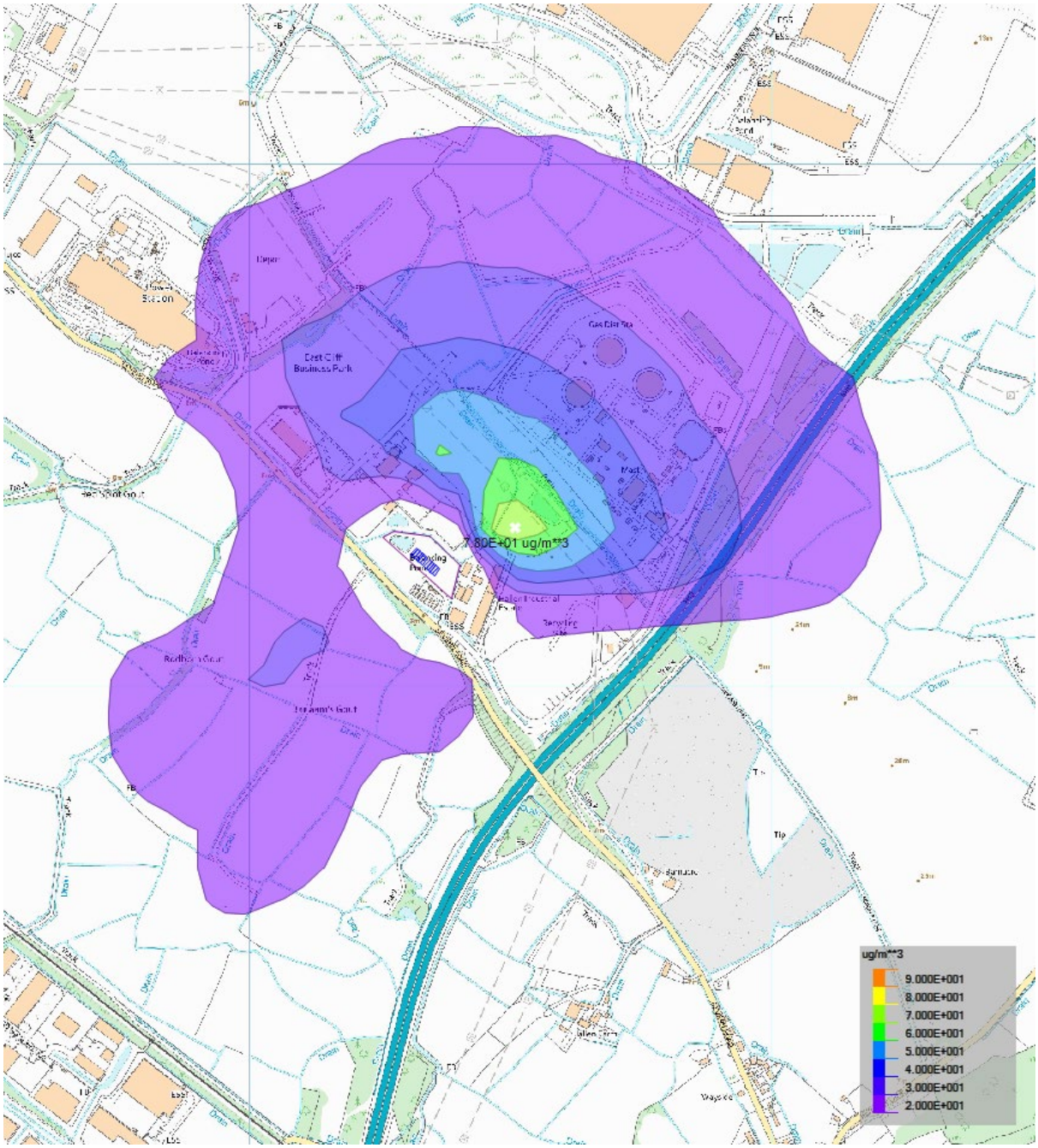


**Figure D3: Annual Average $NO_x$ impact (Ecology)**

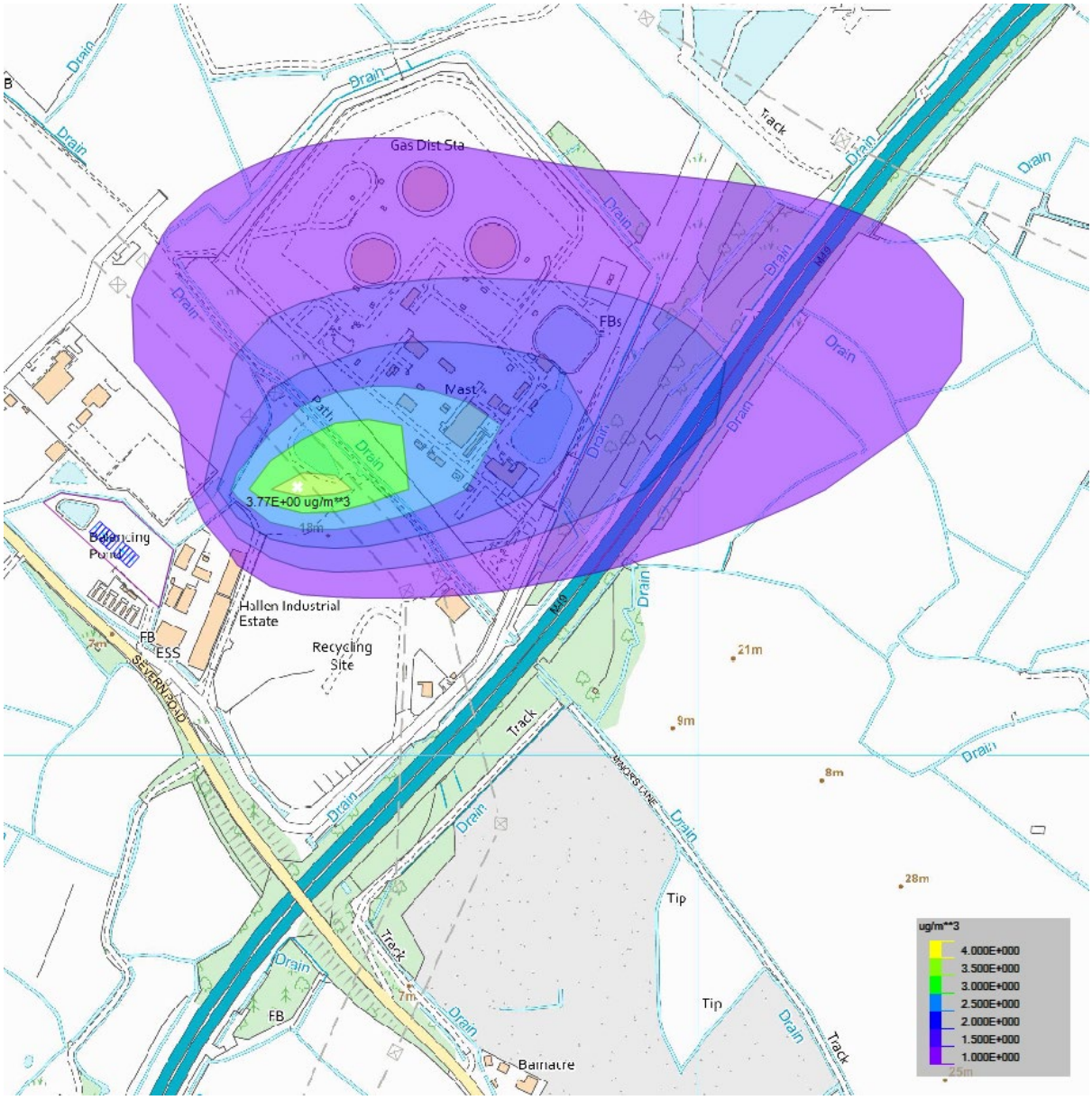


**Figure D4: 24 hour Average $NO_x$ impact (Ecology)**

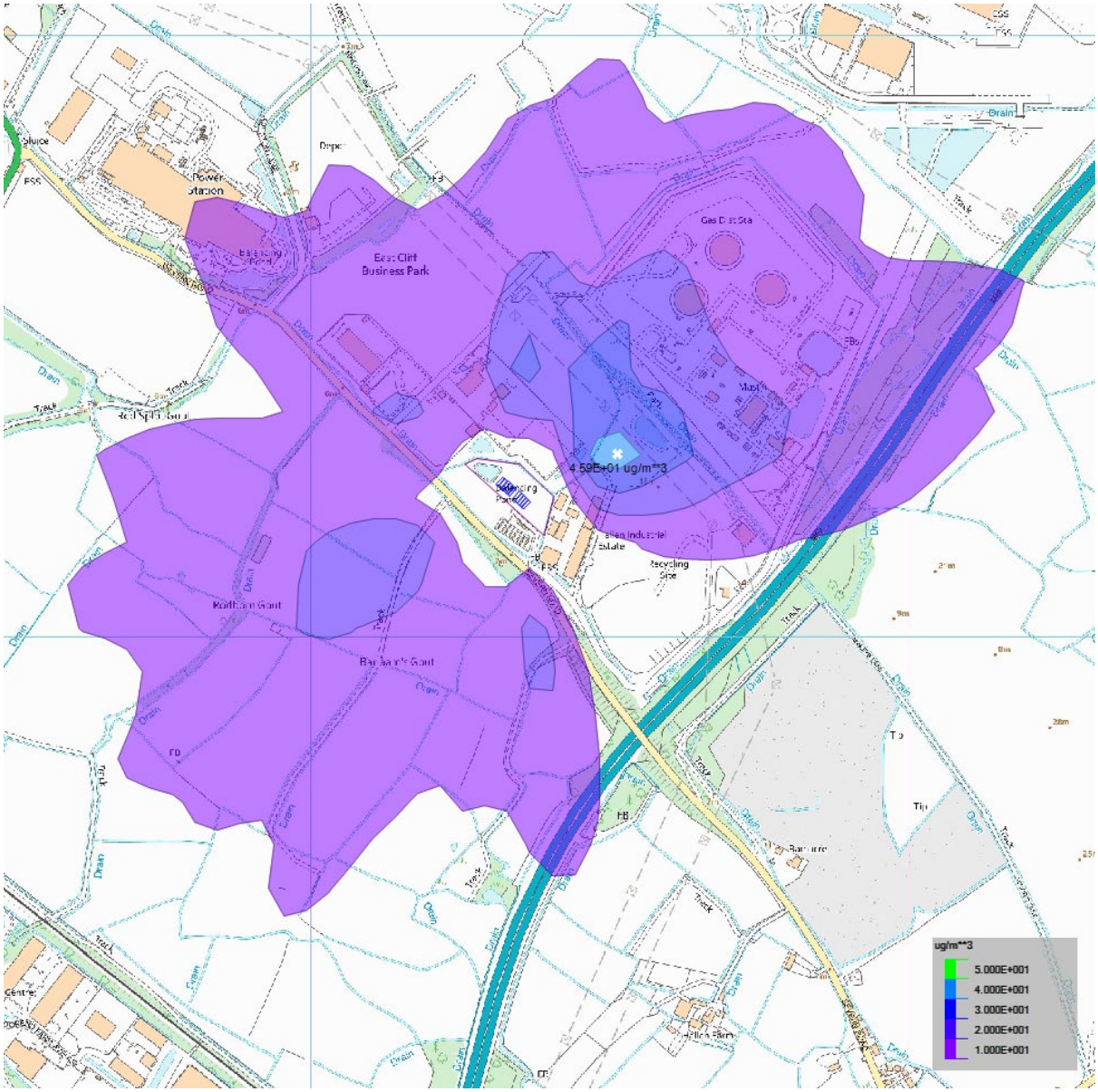


**Figure D5: Annual Average $CH_2O$ impact**

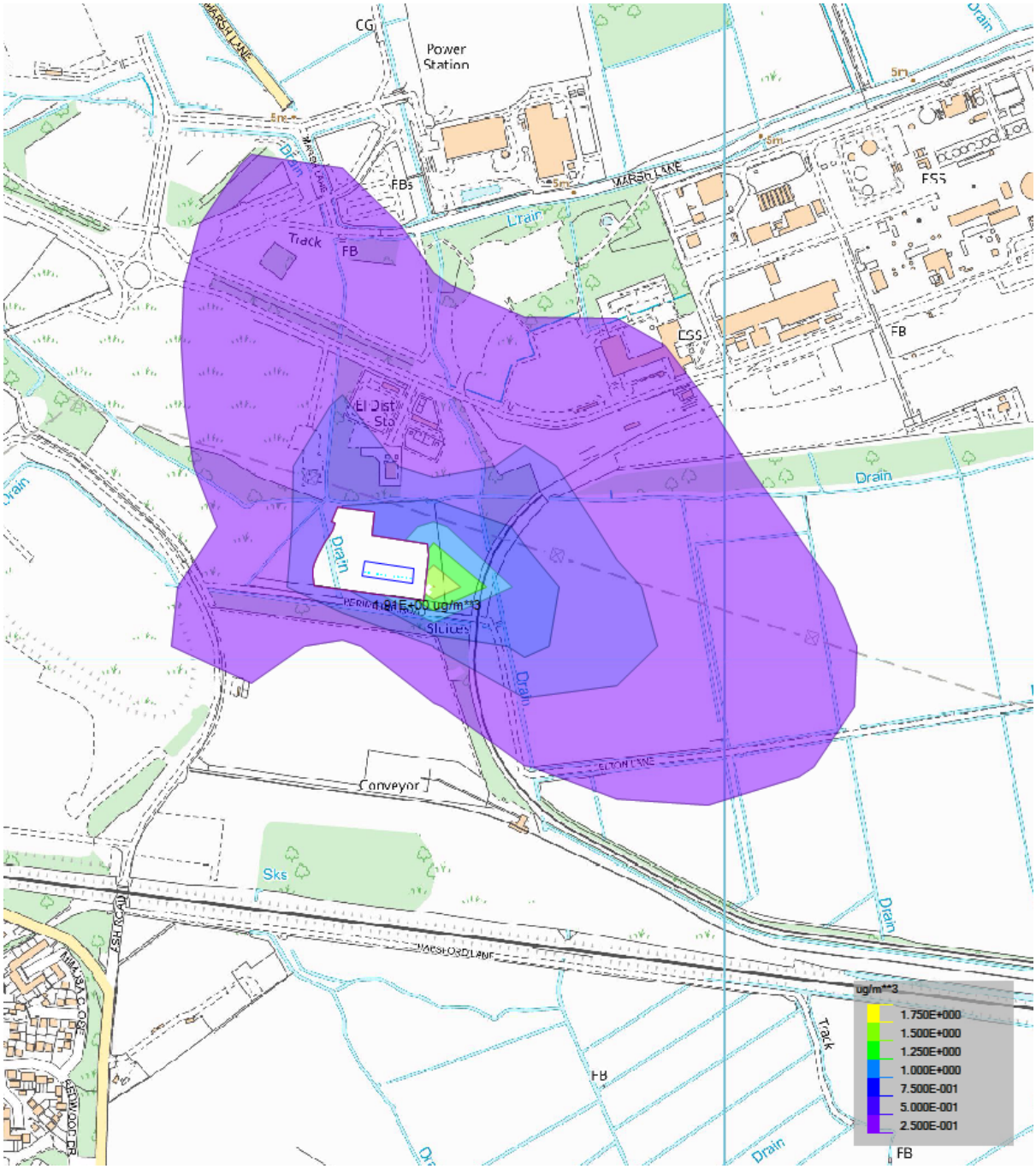
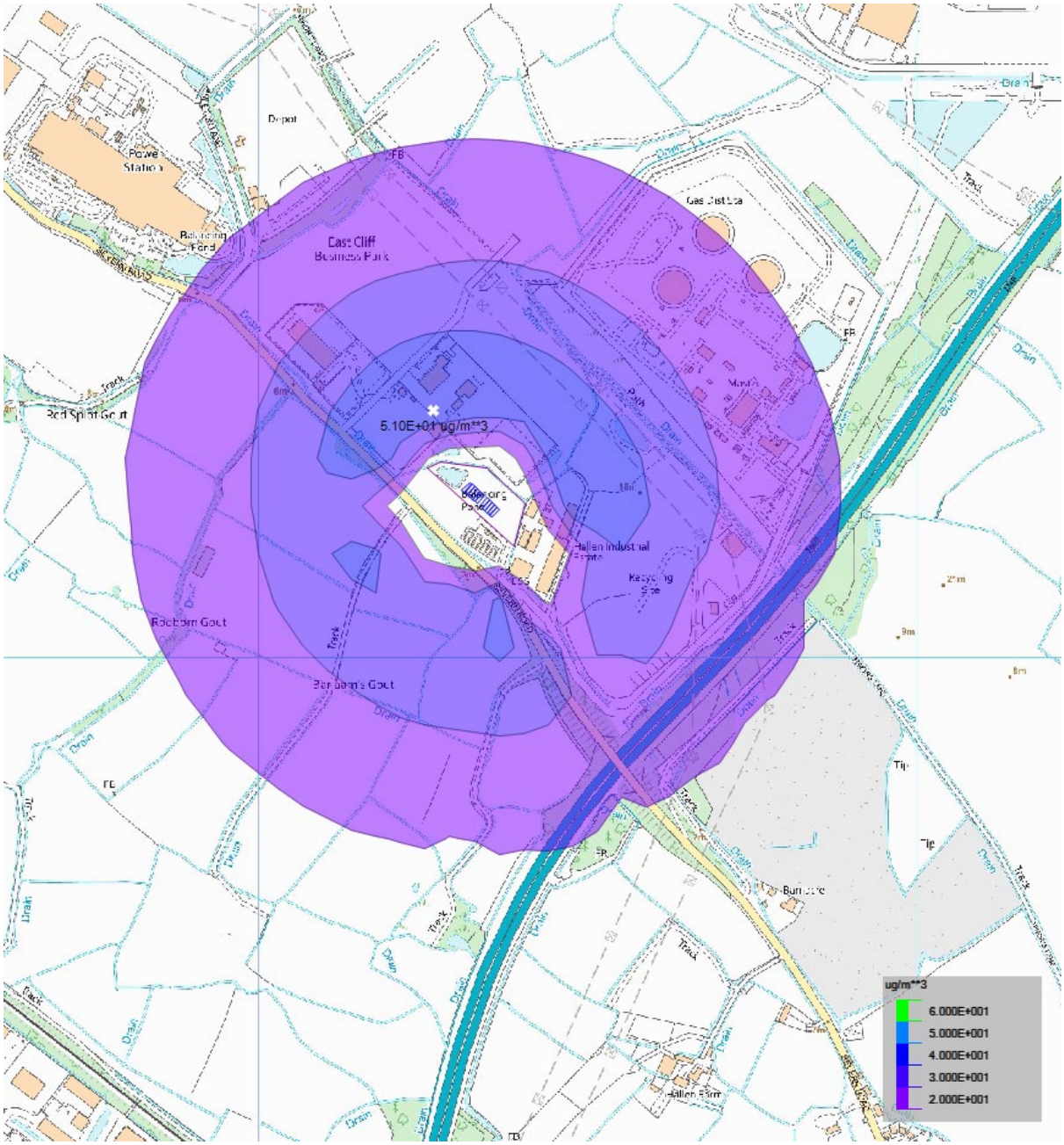
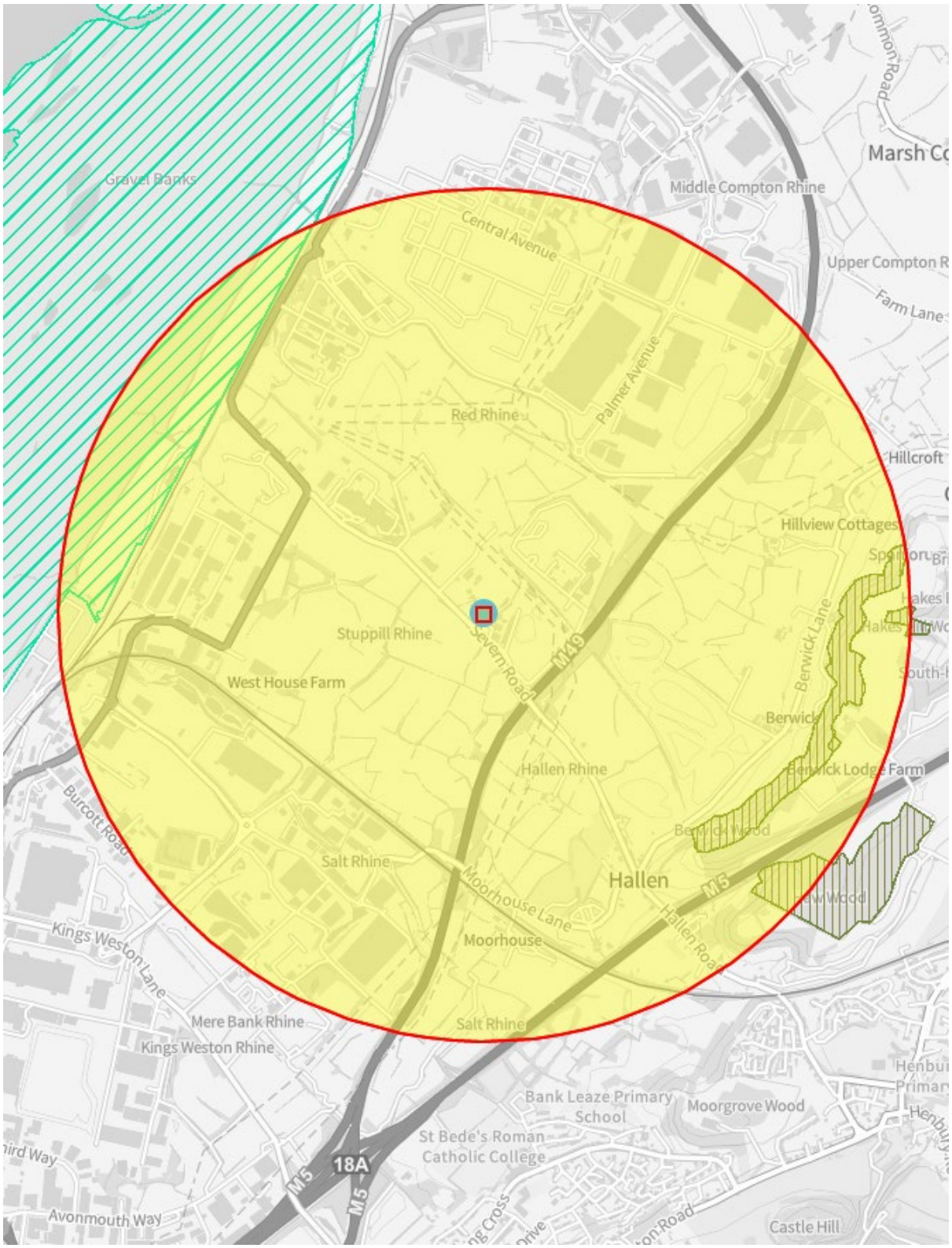
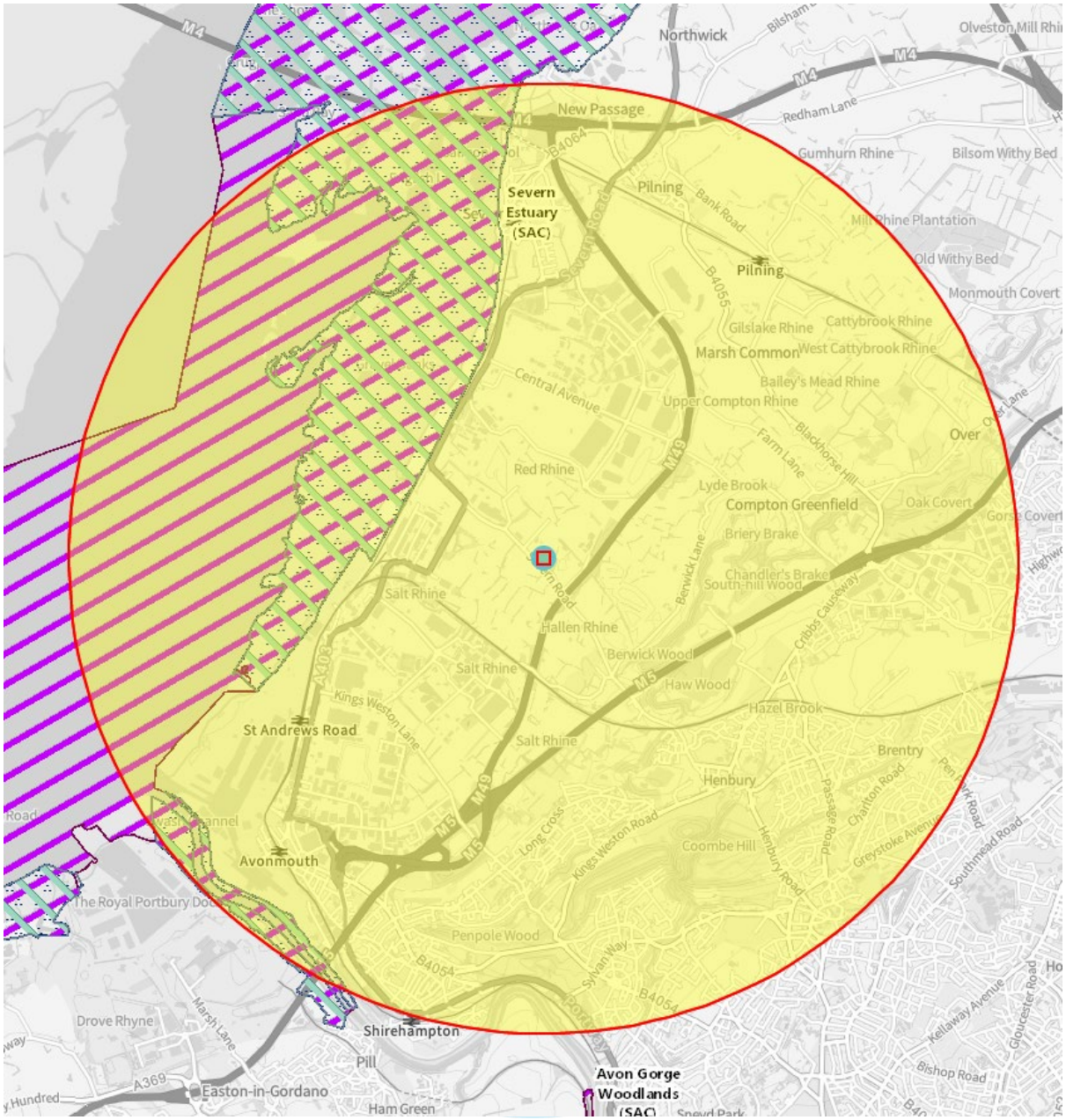


**Figure D6: Hourly Average $CH_2O$ impact**



# APPENDIX E: ECOLOGICAL SEARCHES




Northwick
New Passage
Severn Estuary (SAC)
Pilning
Gumhurn Rhine
Bilsom Withy Bed
Old Withy Bed
Monmouth Covert
Gilslake Rhine
Cattybrook Rhine
West Cattybrook Rhine
Marsh Common
Bailey's Mead Rhine
Upper Compton Rhine
Over
Red Rhine
Lyde Brook
Compton Greenfield
Oak Covert
Briery Brake
Chandler's Brake
South-hill Wood
Salt Rhine
Hallen Rhine
Berwick Wood
Haw Wood
Hazel Brook
St Andrews Road
Brentry
Henbury
Avonmouth
Coombe Hill
Penpole Wood
Drove Rhyne
Shirehampton
Pill
Easton-in-Gordano
Ham Green
Avon Gorge Woodlands (SAC)
Bishop Road
Kellaway Avenue
Southmead Road
Redham Lane
Bank Road
Central Avenue
Farm Lane
Blackhorse Hill
Berwick Lane
Cribbs Causeway
Kings Weston Lane
Kings Weston Road
Long Cross
Passage Road
Charlton Road
Greystoke Avenue
Henbury Road
Sylvan Way
Marsh Lane
M4
M5
M49
A369
B4064
B4055
B4054

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