Air Quality Assessment

The Royal Mint Limited

21st January 2025

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Air Quality Assessment

The Royal Mint Limited

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EXECUTIVE SUMMARY

Sol Environment Ltd has been commissioned by The Royal Mint to undertake an assessment of the local air quality impacts arising from a re-evaluation of emission sources at the Llantrisant facility, Pontyclun, South Wales. This has resulted in the removal from the assessment of some emission sources that no longer operate, and the identification of some smaller emissions not previously considered. A review of other factors that will affect the dispersion of emissions from the Site is also provided (e.g. stack height, stack location, building dimensions, operational hours). Following this review, a dispersion modelling assessment of the subsequent emission sources is provided. The assessment has been undertaken to determine the impact of the facility at nearby sensitive human and ecological receptors and is provided to support an application to vary the Environmental Permit for the Site.

Predicted pollutant concentrations at sensitive receptor locations are compared with the air quality standards and objectives set for the protection of human health. It is concluded that predicted impacts are not significant or that it is unlikely that the air quality objectives would be exceeded. Therefore, the maximum impact of the identified pollutant emissions from the Site is considered not significant on the basis of the Environment Agency's Risk Assessment Guidance.

The impact of the identified pollutant emissions on local habitat sites was also assessed and found to be not significant compared with relevant critical levels and critical loads.

Based on the above information, it is considered that the future operations at the Site would not have an adverse impact on local air quality.

1. INTRODUCTION

1.1 Purpose of the Assessment

Sol Environment Ltd has been commissioned by The Royal Mint to undertake an assessment of the local air quality impacts arising from a re-evaluation of emission sources at the Llantrisant facility, Pontyclun, South Wales. This has resulted in the removal from the assessment of some emission sources that no longer operate, and the identification of some smaller emissions not previously considered.

A review of other factors that will affect the dispersion of emissions from the Site is also provided (e.g. stack height, stack location, building dimensions, operational hours). Following this review, a dispersion modelling assessment of the subsequent emission sources is provided. The assessment has been undertaken to determine the impact of the facility at nearby sensitive human and ecological receptors and is provided to support an application to vary the Environmental Permit for the Site.

1.2 Scope of the Assessment

The location of The Royal Mint facility is presented in Figure 1.1. The facility is located in a semi-rural area. To the north of the Site is agricultural land with outlying residential properties and farms. The Llantrisant Business Park lies immediately to the east, south and west and The Royal Glamorgan Hospital is approximately 450 m south-southwest of the Site.

A number of emission points from site have been removed. A review of emissions has identified the following that will continue to operate either continuously or for specified periods:

- A16 (nickel plating – Armour 2) will operate for around three months of the year.
- A21 (SAFED 6 Annealing Ovens) will operate for around three months of the year.
- A23 (Seco Warick Oven) will operate for around three months of the year.
- A29 (Toolroom Vacuum Furnace) will operate as and when required but has been excluded from the assessment as the only emission is likely to comprise mineral oil.
- A30 and A31 (Trial Plating Line Emissions 1 and 2) will operate for three months of the year.
- A32 (Depop Stack) will operate continuously except during maintenance.
- A33 (Spalek Wet Chemistry Scrubber) will operate for around 33% of the time.
- A34 (Dust Extraction) will operate continuously except during maintenance.
- EP1 (Burn-off Oven) will operate for around 31% of the time.
- ERV (Emergency Relief Valve associated with A33) has been excluded from the assessment as emissions from this would be infrequent and only occur for very short periods.

EP1 and ERV are new emission points that were not previously permitted on site.

Taking into account of the above emission sources, the assessment has considered the impact of the identified activities on the emissions of the oxides of nitrogen (NO_x), ammonia (NH_3), copper (Cu), zinc (Zn), lead (Pb), hydrogen bromide (HBr), sulphuric acid (H_2SO_4), hydrogen chloride (HCl), acetic acid, chlorine (Cl_2), chlorine dioxide (ClO_2) and fine particles (PM_{10} and $PM_{2.5}$).

Emissions of NO_x, NH_3 and HCl can contribute to impacts at habitat sites including nutrient nitrogen deposition and acidification.

This report presents the findings of a dispersion modelling assessment to determine the impact of the identified activities on air quality at sensitive human and habitat receptors in the surrounding area. The emissions parameters used in the assessment for the recently commissioned activities are based on estimated emissions and are considered to be worst-case. For the existing sources, historical monitoring data have been used.

A glossary of common air quality terminology is provided in Appendix A.

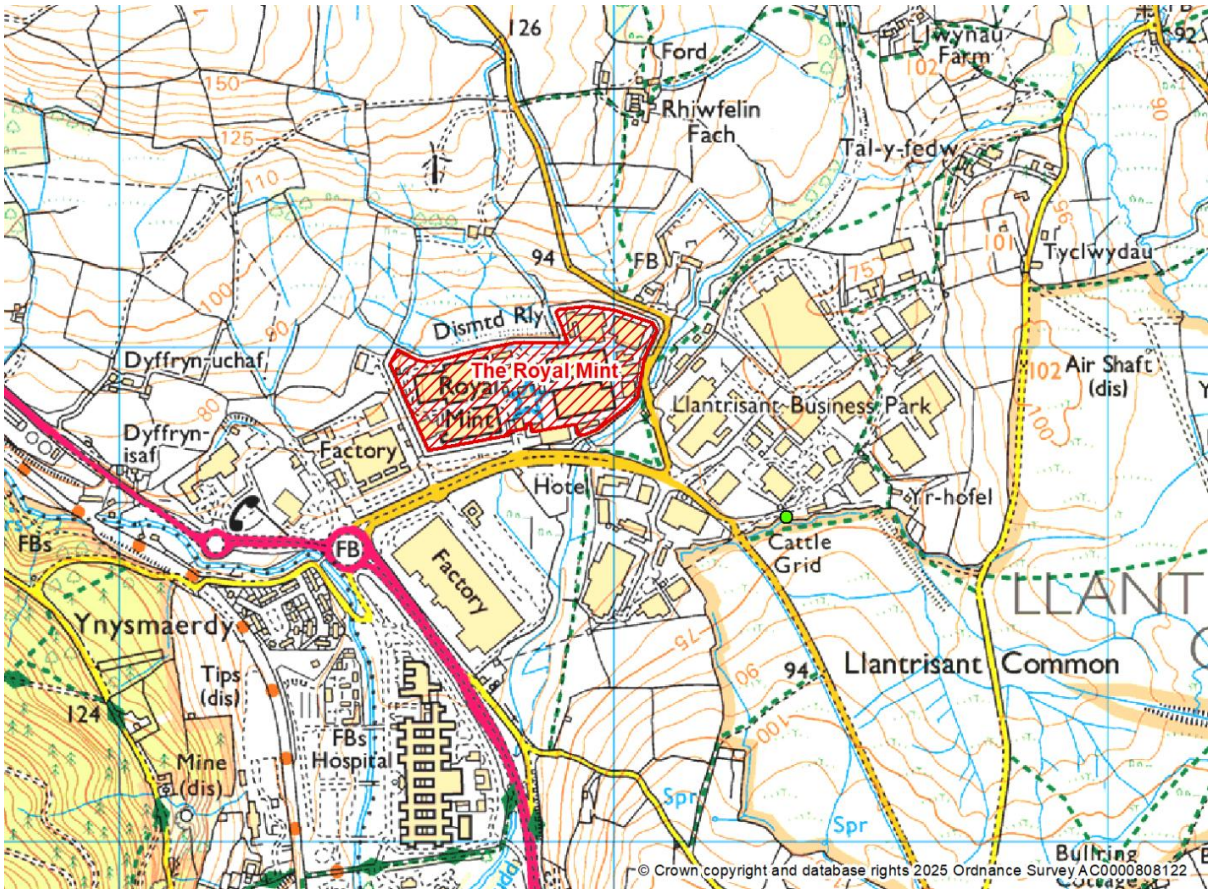


Figure 1.1 Site Location Plan

2. LEGISLATION AND POLICY

2.1 The European Directive on Ambient Air and Cleaner Air for Europe

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, ozone (O_3), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni) and mercury (Hg).

2.2 Air Quality Standards Regulations

The Air Quality Standards Regulations 2010 have adopted into UK law the limit values required by EU Directive 2008/50/EC and came into force on the 10th June 2010. These regulations prescribe the 'relevant period' (referred to in Part I2V of the Environment Act 1995) that local authorities must consider in their review of the future quality of air within their area. The regulations also set out the air quality objectives to be achieved by the end of the 'relevant period'.

Ozone is not included in the Regulations as, due to its trans-boundary nature, mitigation measures must be implemented at a national level rather than at a local authority level.

The Environmental Assessment Levels (EALs), air quality standards and objectives for the pollutants considered in the assessment are presented in Appendix B.

2.3 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 the 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[1]. This guidance, referred to in this chapter as LAQM.TG(22) is applicable to the Devolved Administrations and has been used where appropriate in the assessment.

[1] Department for Environment, Food and Rural Affairs (Defra), (2022): Part IV The Environment Act 1995 Local Air Quality Management Review and assessment Technical Guidance LAQM.TG(22) (August 2022)

2.4 Rhondda-Cynon-Taf County Borough Council Review and Assessment of Air Quality

Rhondda-Cynon-Taf County Borough Council (RCTCBC) carries out frequent review and assessments of air quality within the area and produce Progress Reports in accordance with the requirements of the Regulations. The most recent LAQM report is the 2023 Progress Report[2].

On average, the county enjoys relatively good air quality, with background pollutant concentrations in rural areas well within the air quality standards. However, in a number of urban areas there are measured exceedances of the annual mean air quality objective for NO_2 due to road traffic congestion, which are accentuated by topographical and urban features (e.g. street canyons) which impede dispersion.

To date, the council has declared sixteen AQMAs for NO2. The facility is not within a designated AQMA. The nearest AQMA is approximately 4 km southwest of the Site adjacent to the A473 in Llanharan. At this distance it is considered unlikely to be adversely impacted by emissions from the Site.

[2] Rhondda Cynon Taf County Borough Council 2023 Air Quality Progress Report (September 2023)

3. METHODOLOGY

3.1 Scope of the Assessment

The scope of the assessment 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);
- Desk study to confirm the location of nearby areas that may be sensitive to changes in local air quality; and
- Review and modelling of emissions data which have been used as an input to the Breeze AERMOD dispersion modelling assessment.

Predicted ground level concentrations are compared with relevant air quality standards for the protection of health and critical levels / loads for the protection of sensitive ecosystems and vegetation.

3.2 Dispersion Model Parameters

Introduction

The predicted impact of the proposed installation on local air quality has been undertaken using the Breeze AERMOD 12 dispersion model (US EPA Version 23132).

The emission points that have been included in the assessment are presented in Table 3.1. Only those emission sources that emit NO_x, NH_3, Cu, Zn, Pb, HBr, HCl, H_2SO_4, acetic acid, Cl_2, ClO_2, PM_{10}, and $PM_{2.5}$ are included in the assessment. The location of each emission is provided in Figure 3.1.

Table 3.1 Emissions to Air Considered for the Assessment

Ref.	Source	Operational Hours (h/a)	Pollutant Emission
A16	Nickel Plating – Armour 2	2,160	NO_x, Cu, Zn and Pb
A21	SAFED 6 Annealing Oven	2,160	NO_x, NH_3 and H_2SO_4
A23	Seco Warick Oven	2,160	NO_x, NH_3 and H_2SO_4
A30	Trial Plating Line Emission 1	2,160	NO_x, HCl and H_2SO_4
A31	Trial Plating Line Emission 2	2,160	NO_x, HCl and H_2SO_4
A32	De-soldering scrubbing plant	8,232	NO_x, Cu, Zn, Pb and HBr
A33	Surface gold reactor scrubbing plant	2,940	NO_x, Cu, Zn,Pb, HCl, acetic acid, Cl_2 and ClO_2
A34	Dust extraction plant	8,232	PM_{10} and $PM_{2.5}$
EP1	Burn-off Oven	2,744	HBr

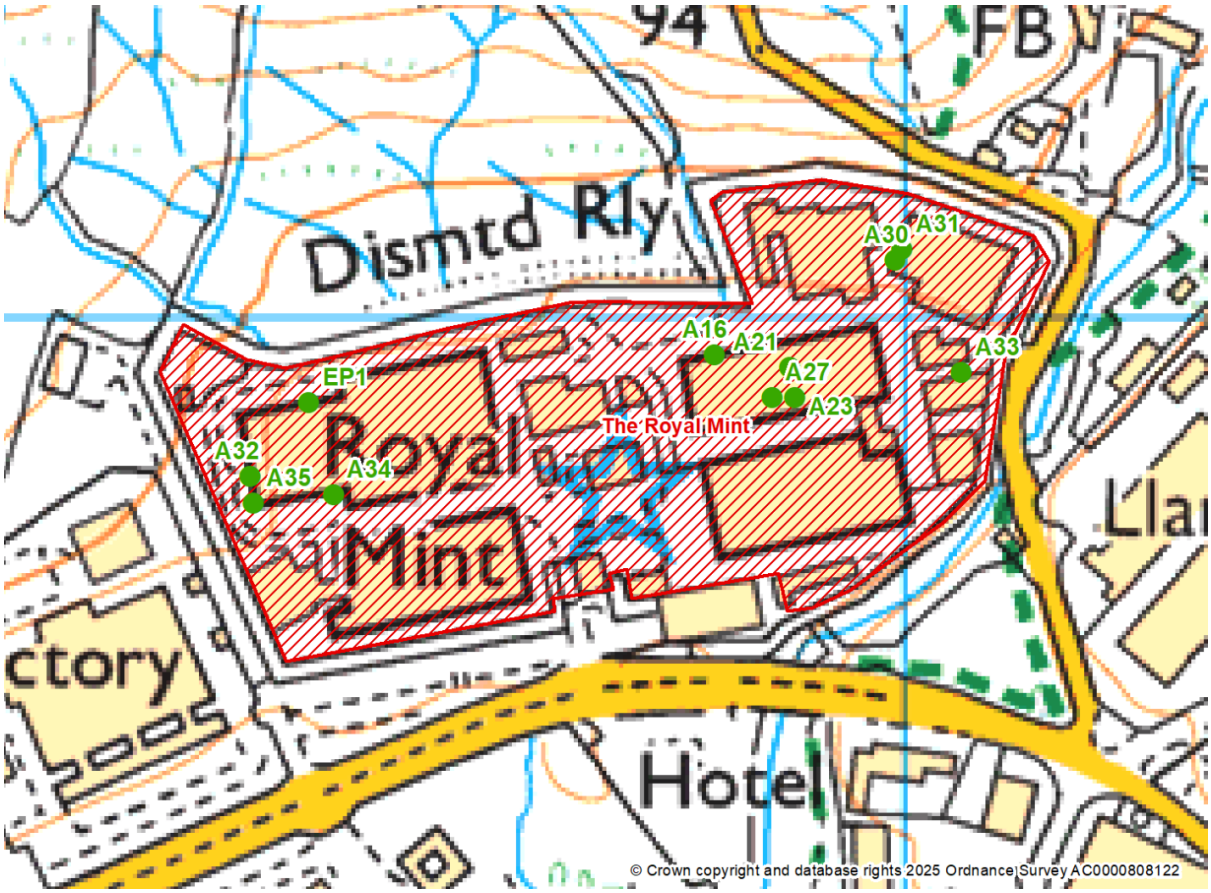


Figure 3.1 Location of Retained Emission Sources

For assessing short-term impacts, all emission sources are assumed to be operating at full load, continually throughout the year. For long-term impacts, the emissions are pro-rated by the operational hours (refer to Appendix C).

Stack monitoring was originally undertaken in 2013 for emission points A16, A23, A30 and A31 to assess the representative pollutant concentrations being released by these process stacks. All of these processes are consistent and continuous and have not been subject to any material change since the original testing in 2013 and are therefore considered relevant for this assessment.

A summary of the input parameters used in the assessment are provided in Appendix C.

Meteorological Data

Dispersion modelling has been undertaken using five years (2015-2019) of hourly sequential meteorological data in order to take account of inter-annual variability and reduce the effect of any atypical conditions. Data from a meteorological station at Rhoose – Cardiff Airport (approximately 18 km south of the Site) has been used for the assessment, which is the most representative data currently available for the area.

Wind roses for each year of meteorological data are presented in Appendix D.

Building Downwash / Entrainment

The presence of buildings close to emission sources can significantly affect the dispersion of pollutants by leading to a phenomenon called 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 results in higher ground level concentrations closer to the stack.

Downwash effects are only significant where building heights are greater than 30 to 40% of the emission release height. The downwash structures also need to be sufficiently close for their influence to be significant. All potential downwash structures have been included in the model. Details of these are provided in Table 3.2. These include on-site and off-site buildings at the adjacent Llantrisant Business Park (LBP).

Table 3.2 Building Downwash Structures Included in the Dispersion Model

Building	Easting	Northing	Height (m)	Length (m)	Width (m)	Angle
Silo 1	304037	184936	7	Diameter = 2.4 m		
Silo 2	304031	184934	7	Diameter = 2.4 m		
Silo3	304025	184933	7	Diameter = 2.4 m		
Silo4	304020	184932	7	Diameter = 2.4 m		
Silo5	304036	184941	7	Diameter = 2.4 m		
Silo6	304030	184939	7	Diameter = 2.4 m		
Silo7	304023	184938	7	Diameter = 2.4 m		
Silo8	304041	184942	7	Diameter = 2.4 m		
Silo9	304043	184937	7	Diameter = 2.4 m		
Building B4	303821	184964	5.5	Polygon		
Building 10	304058	184965	6.5	Polygon		
Building 17b	304039	184984	5.1	Polygon		
Building 1	303745	184981	12.4	Polygon		
LBP SE 1	304182	184942	8	Polygon		
LBP SE 2	304192	184871	8	Polygon		
Building 3	303807	184919	11.8	23.9	36.5	79
Building 9a	303862	184976	13	49	125	79
Building 9b	303877	184913	13	60.1	121.5	79
Building 2	303654	184866	6.6	52.7	112.4	79
LBP East	304258	185073	8	168.5	134.1	54.3
Chem Store	303913	185017	6	14.2	55.4	-9
RME	303917	184844	6	65	28.1	171
Building B10b	304041	184932	8	24	19.7	171
Building 27a	303978	185041	5.5	47.7	26.9	171

Building 27c	303987	185072	8.8	62	28.5	171
Building 11	304004	185063	9.1	35	69.7	109
Building 12	304007	185025	10.8	18.5	54.5	109

3.3 Significance Criteria

Impacts on Human Health

The Environment Agency has developed criteria for assessing the significance of an impact compared with relevant air quality standards and background air quality[3]. A process contribution (PC) is considered potentially significant if:

- The long term PC > 1% of the long-term air quality standard.
- The short term PC > 10% of the short-term air quality standard.

At 1% of the long term air quality standard, the impact of a development is unlikely to be significant compared with background air quality. Both the short and long term criteria are also designed to ensure that there is a substantial safety margin to protect public health and the environment.

If the screening criteria are not met, the process contribution should be considered in combination with relevant ambient background pollutant concentrations. The air quality standards are likely to be met if:

- The long term PC + background concentration < 70% of the air quality standard.
- The short term PC < 20% (air quality standard – short term background concentration), where the short term background concentration is assumed to be twice the long term background concentration.

Impacts on Habitat Sites

The Environment Agency has developed criteria for assessing at SPAs, SACs, Ramsar sites and SSSIs, compared with the relevant critical level/load and background conditions. The criteria are designed to ensure that there is a substantial safety margin to protect the environment.

Stage 1

A process contribution (PC) is considered insignificant if:

- The long term PC < 1% of the long-term critical level/load
- The short term PC < 10% of the short-term critical level/load

Stage 2

If the Stage 1 screening criteria are not met, the PC should be considered in combination with relevant ambient background pollutant concentrations and deposition rates. The critical levels/loads are likely to be met if:

- The long term PC + background < 70% of the critical level/load

[3] Environment Agency Risk Assessment Guidance (https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit)

- The short term PC < 20% of the (critical level/load – the short term background)

For local nature sites (SINCs, SLINCs, NNRs, LNRs and ancient woodland), a process contribution (PC) is considered not significant if:

- The long term PC < 100% of the long-term critical level/load
- The short term PC < 100% of the short-term critical level/load

3.4 Sensitive Receptors

Specific receptors have been identified where people are likely to be regularly exposed for prolonged periods of time (e.g. residential areas). The location of each of the discrete sensitive receptors is presented in Table 3.3 and Figure 3.2.

Table 3.3 Human Health Receptors

Ref.	Receptor	Type	Easting	Northing
D1	Rhiwfelin Fawr	Residential	303163	185915
D2	Rhiwfelin Nursing Home	Nursing Home	303276	186124
D3	Rhiwfelin Fach	Residential	304036	185512
D4	Glanmychydd-Fach	Residential	304071	185111
D5	Llantrisant Dialysis Centre	Medical Facility	304500	185110
D6	Tal-y-fedw	Residential	304693	185336
D7	Tyclwydau	Residential	304847	184161
D8	Llwyncrwn Isaf	Residential	305459	184617
D9	Ty'n-y-coed	Residential	305649	184240
D10	Coed-yr-Escob Primary School	School	304482	183941
D11	Graig-y-Ilan	Residential	303946	184107
D12	Royal Glamorgan Hospital	Hospital	303610	184366
D13	Glan-yr-ely	Residential	303378	184553
D14	Signalmans Cottage	Residential	303047	184627
D15	Dyffryn-isaf	Residential	303012	184754
D16	Dyffryn-uchaf	Residential	303063	184907
D17	Bedw	Residential	302567	185478
D18	Royal Mint Experience	Leisure	303887	184825

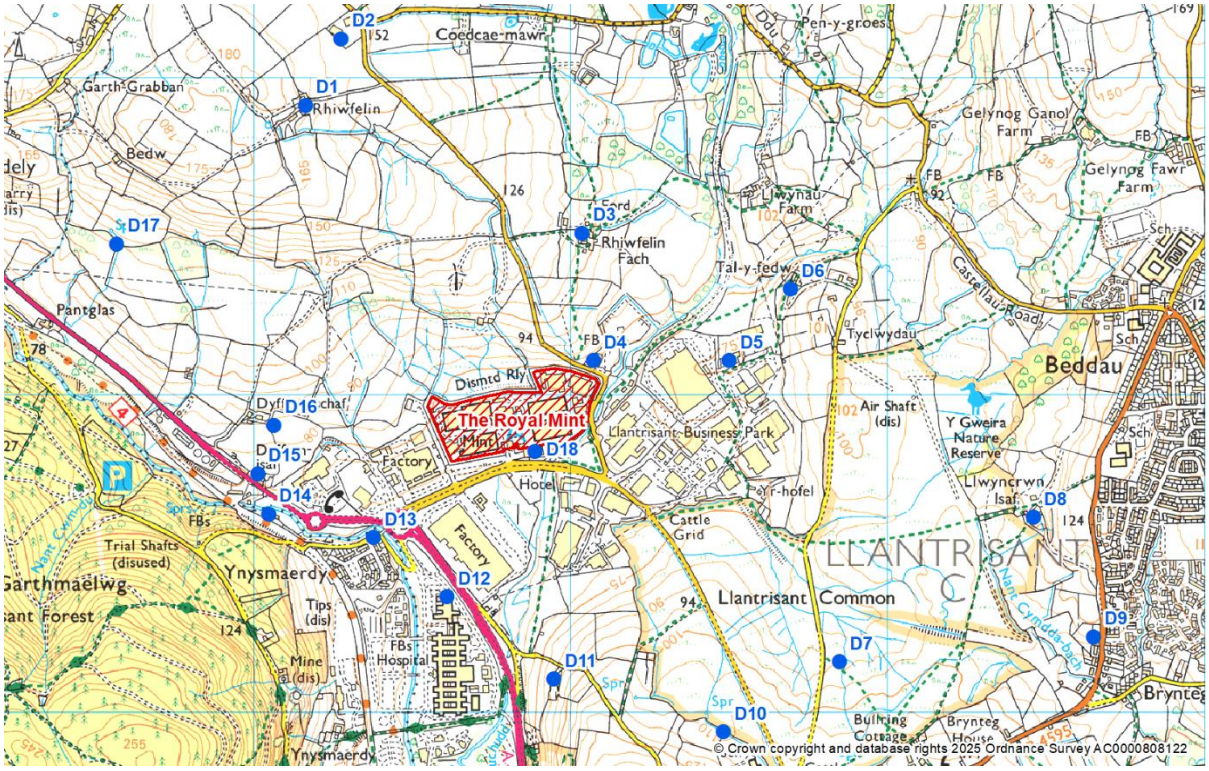


Figure 3.2 Sensitive Human Health Receptor Locations

Pollutant concentrations have been predicted at both discrete receptor locations and over a 4 km by 4 km Cartesian grid of 25m resolution.

3.5 Habitat Assessment

The Environment Agency's risk assessment guidance states that the impact of emissions to air on vegetation and ecosystems should be assessed for the following habitat sites within 10 km of the source:

- Special Areas of Conservation (SACs) and candidate SACs (cSACs) designated under the EC Habitats Directive4;
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive5; and
- Ramsar Sites designated under the Convention on Wetlands of International Importance6.

Within 2 km of the source:

- Sites of Special Scientific Interest (SSSI) established by the 1981 Wildlife and Countryside Act;
- National Nature Reserves (NNR);
- Local Nature Reserves (LNR);

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

5 Council Directive 79/409/EEC on the conservation of wild birds

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

- local wildlife sites (Sites of Interest for Nature Conservation, SINC and Sites of Local Interest for Nature Conservation, SLINC); and
- Ancient woodland.

Habitat receptor designations and locations relevant to the assessment are presented in Table 3.4.

Table 3.4 Sensitive Habitat Receptors

Receptor	Primary Habitat	Approx. Location (Relative to Site)
Llantrisant Common and Pastures SSSI	Acid grassland and bogs	300 m south and southwest
Rhos Tonyrefail SSSI	Blanket bog	100 m northwest
Cardiff Beech Woods SAC	Beech Woodland	7.5 km east-southeast

Due to the close proximity of the two SSSIs to the Site, the designated areas have been modelled using a Cartesian grid of 50 m resolution to enable the maximum impact to be determined. Cardiff Beech Woods SAC, which is 7.5 km from the facility, has been represented in the model by a discrete receptor at the nearest boundary of the designated area.

Emissions of NO_x and NH_3 will contribute to nutrient nitrogen deposition and acidification. Other emissions (e.g. HBr, HCl, H_2SO_4 and acetic acid) may also contribute to acidification. The modelled ground level pollutant concentrations are used to predict deposition rates, using typical deposition velocities. A summary of NO_x, NH_3, H_2SO_4 and HCl dry deposition velocities is presented in Table 3.5. However, there is no information available on appropriate deposition velocities for HBr and acetic acid. HBr is less reactive than HCl and it is assumed that this would have a lower deposition velocity compared to HCl. It is also concluded that acetic acid is relatively stable as it has a boiling point of 119ºC. Therefore, it is assumed that HBr and acetic acid have deposition velocities comparable to sulphur dioxide (SO_2).

Table 3.5 Assumed Dry Deposition Velocities (m/s)

Pollutant	Grassland	Woodland
Oxides of nitrogen	0.0015	0.003
Ammonia	0.02	0.03
HCl	0.025	0.060
H_2SO_4	0.01	0.01
HBr (assumed)	0.012	0.024
Acetic acid (assumed)	0.012	0.024

Predicted nutrient nitrogen deposition and acidification rates are compared with relevant critical loads for the protection of sensitive ecosystems and vegetation (see Appendix E).

3.6 Baseline Conditions

This section provides an assessment of baseline conditions for the Site. The assessment of impacts requires a comparison of the pollutant concentrations with the relevant air quality standard taking into account background concentrations of the pollutant. Background monitoring data is not always available locally, particularly in areas that have good air quality. However, it is normal practice to obtain data from a comparable location to describe the air quality at the development site. Therefore, air quality at the Site has been characterised based on monitoring data and modelled data obtained from national and local sources, where this is available.

3.6.1 Nitrogen Dioxide (NO_2)

Rhondda Cynon Taf County Borough Council undertake automatic ambient air quality monitoring at four locations and non-automatic monitoring of nitrogen dioxide (NO_2) at 54 sites in 2022. However, all of these monitoring sites are located within more urban areas, particular within areas that are designated as AQMA. Therefore, measured concentrations at these locations would not be representative of air quality at the Site.

In the absence of measured concentrations, annual mean NO_2 background concentrations for 2024 have been obtained from the Defra UK Background Air Pollution Maps. The latest background maps were issued in November 2024 and are based on 2021 monitoring data. The 2024 mapped annual mean NO_2 background concentration for the Site and surrounding area is 9.1 µg/m^3, 23% of the air quality objective. This is the maximum for the sixteen 1 km^2 grid squares surrounding the Site.

3.6.2 Particulate Matter (PM_{10} and $PM_{2.5}$)

The maximum Defra background mapped concentration for 2024 is 11.0 µg/m^3 for PM_{10} and 6.8 µg/m^3 for $PM_{2.5}$ for the sixteen 1 km^2 grids located around the Site. These are assumed to be representative of air quality at the Site.

3.6.3 Hydrogen Chloride (HCl)

Ambient monitoring of hydrogen chloride has been carried out as part of the Defra Acid Gases & Aerosol Network at a number of locations around the UK. The closest monitoring site is at Rosemaund (rural background), which is 80 km southwest of the Site. This is some distance from the Site but in a similar rural location and likely to be comparable to concentrations at the Site.

There are no data beyond 2015 but monthly measured concentrations in 2015 varied between 0.14 and 0.40 µg/m^3. Therefore, the highest monthly mean concentration (0.40 µg/m^3) is assumed to be representative of annual mean concentrations at the Site.

3.6.4 Trace Metals

Defra has undertaken monitoring of trace elements at a number of locations in the UK since 1976 as part of the UK Urban and Rural Heavy Metals Monitoring Network. The nearest most relevant (not urban industrial) monitoring site is located at Pontardawe Brecon Road. The monitoring site is a suburban industrial site and measured concentrations are likely to be higher than at the Site. The monitoring site is located around 37 km to the northwest of the Site. There are nearer monitoring sites but these are located within industrial and urban areas of Swansea and would not be characteristic of measured concentrations at the Site.

Concentrations measured at the Pontardawe Brecon Road site between 2021 and 2023 are summarised in Table 3.6.

Table 3.6 Average Annual Mean Trace Metal Concentrations at Swansea Coedgwilym (ng/m^3)

Pollutant	2021	2022	2023
Copper (Cu)	4.8	4.2	3.0
Lead (Pb)	5.6	5.8	4.6
Zinc (Zn)	13.8	11.9	10.7

For the purposes of the assessment the maximum annual mean for each metal has been used to characterise air quality at the Site and is considered to be representative of the worst-case.

3.6.5 Ammonia

The Air Pollution Information System (APIS) provides mapped background ammonia concentrations principally for the assessment of airborne impacts of ammonia on habitat sites. This indicates that background ammonia concentrations in the vicinity of the proposed facility and surroundings are around 0.90 µg/m^3.

3.6.6 Other Pollutants

Monitoring of other emissions (H_2SO_4, HBr, acetic acid, Cl_2 and ClO_2) are not currently carried out in the UK. However, background sources are likely to be low. Therefore, the assessment has focussed on the process contribution only in comparison with the environmental assessment level (EAL) for these emissions.

3.6.7 Summary of Background Concentrations

A summary of the annual mean and short-term background concentrations assumed for the assessment is presented in Table 3.7. The current background concentrations are assumed to be representative of future year concentrations. Since pollutant concentrations are expected to decline in the future, this methodology ensures that the worst-case impacts are determined (i.e. future impacts combined with existing air quality).

Table 3.7 Summary of Background Concentrations

Pollutant	Annual Mean	Short-Term
Nitrogen Dioxide (NO_2)	9.1 µg/m^3	18.2 µg/m^3 (a)(b)
Particles (PM_{10})	11.0 µg/m3	22.0 µg/m3 (a)(c)
Particles ($PM_{2.5}$)	6.8 µg/m^3	n/a
Hydrogen chloride	0.40 µg/m^3	0.80 µg/m^3 (a)(b)
Ammonia (NH_3)	0.90 µg/m^3	1.8 µg/m^3 (a)(b)
Copper (Cu)	4.8 ng/m^3	9.6 µg/m^3 (a)(c)
Zinc (Zn)	13.8 ng/m^3	27.6 ng/m^3 (a)(b)
Lead (Pb)	5.8 ng/m^3	n/a

Background concentration estimated by multiplying the annual mean by a factor of 2 in accordance with the EA Guidance
Hourly mean concentration
24-hour mean concentration

4. ASSESSMENT OF IMPACTS

4.1 Human Health Impact

Predicted pollutant concentrations (PC) for the five years of meteorological data are presented as the maximum concentration for each of the discrete receptors identified in Section 3.4. The significance of the impacts has been assessed in accordance with the Environment Agency's risk assessment guidance.

The maximum PC is added to the estimated background concentration for the area (see Section 3.6) to give the total predicted environmental concentration (PEC) for comparison with the relevant air quality standards and objectives. The significance of the impacts has been assessed in accordance with the significance criteria specified by the Environment Agency's risk assessment guidance (refer Section 3.3).

4.1.1 Nitrogen Dioxide (NO2)

The maximum predicted annual mean and 99.8th percentile of 1-hour mean ground level NO_2 concentrations for the retained emission sources are presented in Table 4.1. Emissions of NOx are considered for A16, A21, A23, A30, A31, A32 and A33. Predicted concentrations are compared to the annual mean and hourly mean air quality objectives (AQO) for NO_2.

Table 4.1 Predicted NO_2 Concentrations

Receptor	Annual Mean		99.8th Percentile of 1-Hour Means	
	PC (µg/m^3)	PC (% of AQO)	PC (µg/m^3)	PC (% of AQO)
Maximum predicted	0.46	1.1%	2.2	1.1%
Rhiwfelin Fawr	0.001	0.0%	0.03	0.0%
Rhiwfelin Nursing Home	0.001	0.0%	0.03	0.0%
Rhiwfelin Fach	0.007	0.0%	0.19	0.1%
Glanmychydd-Fach	0.049	0.1%	0.49	0.2%
Llantrisant Dialysis Centre	0.019	0.0%	0.21	0.1%
Tal-y-fedw	0.008	0.0%	0.14	0.1%
Tyclwydau	0.005	0.0%	0.13	0.1%
Llwyncrwn Isaf	0.004	0.0%	0.06	0.0%
Ty'n-y-coed	0.003	0.0%	0.07	0.0%
Coed-yr-Escob Primary School	0.003	0.0%	0.09	0.0%
Graig-y-llan	0.006	0.0%	0.21	0.1%
Royal Glamorgan Hospital	0.008	0.0%	0.26	0.1%
Glan-yr-ely	0.011	0.0%	0.18	0.1%
Signalmans Cottage	0.007	0.0%	0.15	0.1%
Dyffryn-isaf	0.006	0.0%	0.12	0.1%
Dyffryn-uchaf	0.006	0.0%	0.15	0.1%
Bedw	0.001	0.0%	0.04	0.0%

Royal Mint Experience	0.055	0.1%	0.82	0.4%
AQO (µg/m³)	40		200	
Background (µg/m³)	9.1		18.2	
Maximum PC as %age AQO	9.6		20.4	
Maximum PEC as %age AQO	23.9%		10.2%	

At sensitive receptors, the maximum predicted annual mean NO_2 concentration is 0.055 µg/m³ (0.1% of the AQO) and would be assessed as not significant in accordance with the Environment Agency's risk assessment guidance. For the maximum predicted concentration anywhere within the model domain the impact would be assessed as potentially significant as the PC is 1.1% of the AQO but the PEC is less than 70% of the AQO and it is unlikely that the AQO would be exceeded. The location of the predicted maximum occurs within the industrial estate (refer Figure 4.1) where there would be no relevant long-term public exposure (e.g. residential receptors). Therefore, it is concluded that the long-term impact of the emissions of NOx from the Site activities would be not significant.

The hourly-mean predicted concentrations are less than 10% of the AQO at all locations including the maximum predicted and the impact would be assessed as not significant according to the Environment Agency's risk assessment guidance.

Predicted annual mean and 99.8th percentile of hourly mean NO_2 concentrations for the most recent meteorological year (2019), are presented as contour plots in Figures 4.1 and 4.2, respectively.

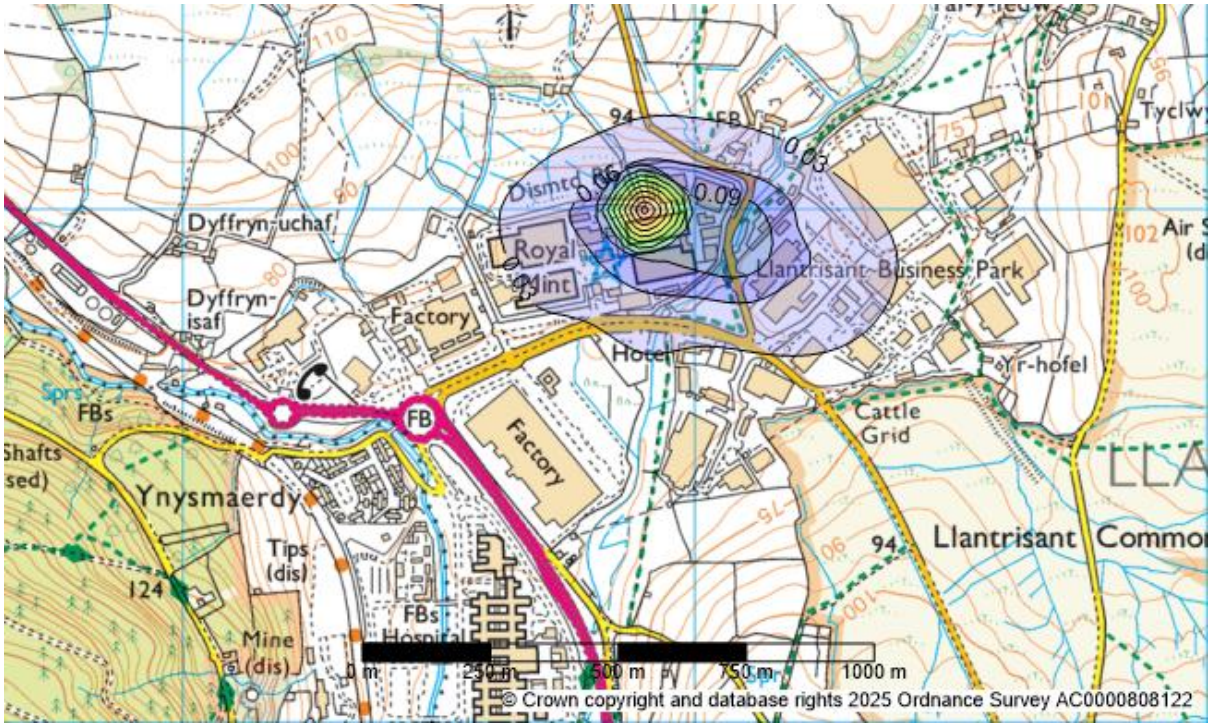


Figure 4.1 Predicted Annual Mean NO_2 Concentrations (µg/m³)

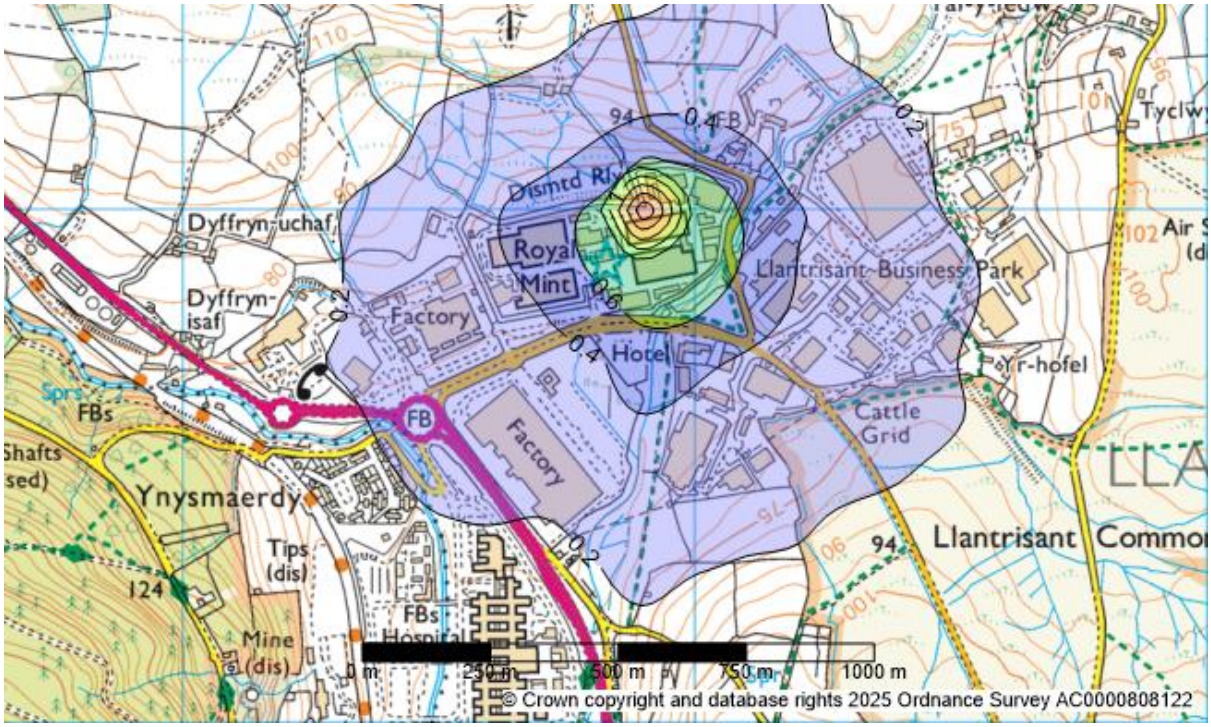


Figure 4.2 Predicted 99.8th Percentile of 1-Hour Mean NO_2 Concentrations (µg/m³)

4.1.2 Particulate Matter (as PM10)

Predicted annual mean and 90.4th percentile of 24-hour mean PM_{10} concentrations arising from emissions from A34 at the selected receptor locations are presented in Table 4.2. The predictions assume that 100% of the particulate matter emitted from the relevant sources is PM_{10}. A contour plot of the 90.4th percentile of 24-hour means is also presented in Figure 4.3.

Table 4.2 Predicted PM_{10} Concentrations

Receptor	Annual Means		90.4th %ile of 24-hour Means	
	PC (µg/m³)	PC (% of AQO)	PC (µg/m³)	PC (% of AQO)
Maximum predicted	1.3	3.3%	4.2	8.3%
Rhiwfelin Fawr	0.006	0.0%	0.02	0.0%
Rhiwfelin Nursing Home	0.006	0.0%	0.02	0.0%
Rhiwfelin Fach	0.029	0.1%	0.10	0.2%
Glanmychydd-Fach	0.102	0.3%	0.30	0.6%
Llantrisant Dialysis Centre	0.048	0.1%	0.14	0.3%
Tal-y-fedw	0.022	0.1%	0.07	0.1%
Tyclwydau	0.031	0.1%	0.09	0.2%
Llwyncrwn Isaf	0.018	0.0%	0.05	0.1%
Ty'n-y-coed	0.017	0.0%	0.05	0.1%
Coed-yr-Escob Primary School	0.020	0.0%	0.07	0.1%

Graig-y-Ilan	0.035	0.1%	0.13	0.3%
Royal Glamorgan Hospital	0.069	0.2%	0.24	0.5%
Glan-yr-ely	0.102	0.3%	0.33	0.7%
Signalmans Cottage	0.081	0.2%	0.27	0.5%
Dyffryn-isaf	0.076	0.2%	0.26	0.5%
Dyffryn-uchaf	0.060	0.1%	0.20	0.4%
Bedw	0.013	0.0%	0.04	0.1%
Royal Mint Experience	0.457	1.1%	1.1	2.3%
AQO (µg/m^3)	40		50	
Background (µg/m^3)	11.0		22.0	
Maximum PC as %age AQO	3.3%		8.3%	
Maximum PEC as %age AQO	30.8%		52.3%	

At sensitive receptor locations where there is relevant public exposure (e.g. residential properties), the maximum predicted PM_{10} concentrations are less than 1% and 10% of the relevant long and short-term AQOs, respectively. Therefore, the impacts would be assessed as not significant in accordance with the Environment Agency's risk assessment guidance. As the maximum predicted and at the Royal Mint Experience, annual mean predicted concentrations are potentially significant at greater than 1% of the AQO. However, the PEC is well below 70% of the AQO and it is unlikely that the AQO would be exceeded.

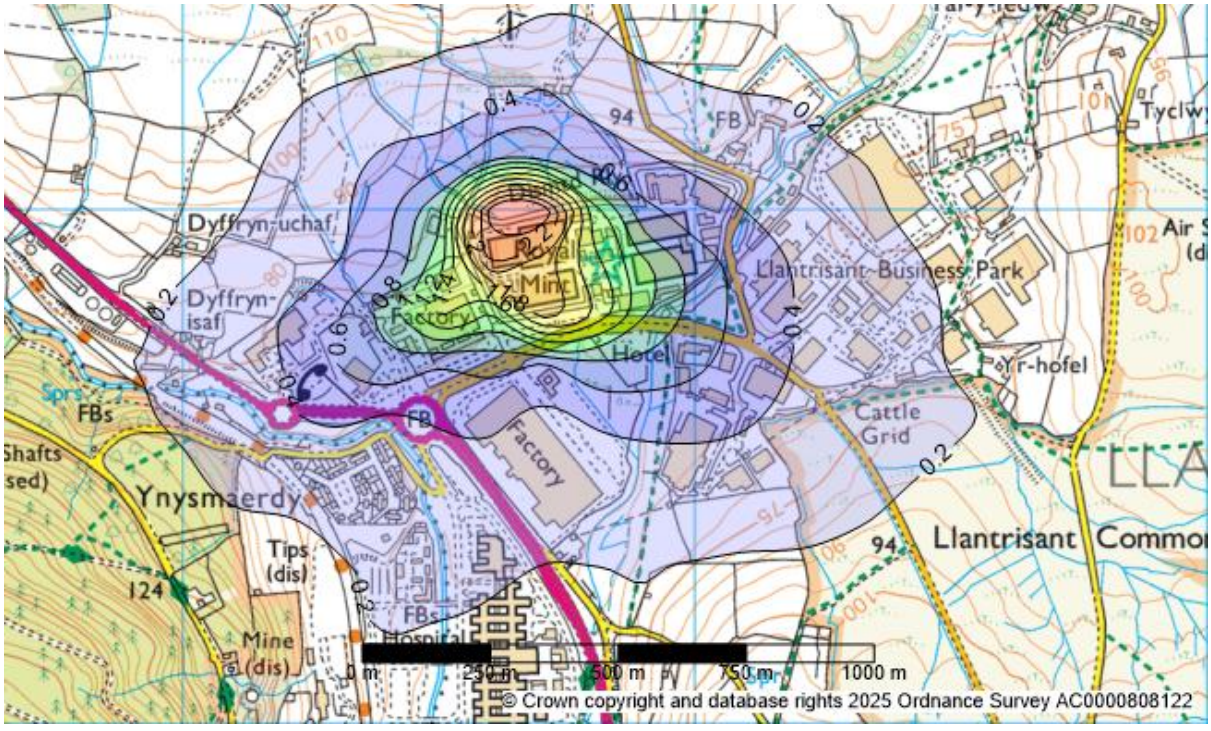


Figure 4.3 Predicted 90.4th Percentile of 24-Hour Mean PM_{10} Concentrations (µg/m3)

4.1.3 Particulate Matter (as $PM_{2.5}$)

Predicted annual mean $PM_{2.5}$ concentrations arising from emissions from A34 at the selected receptor locations are presented in Table 4.3. The predictions assume that 100% of the particulate matter emitted from the relevant sources is $PM_{2.5}$. A contour plot of annual mean $PM_{2.5}$ (and PM_{10}) is presented in Figure 4.4.

Table 4.3 Predicted $PM_{2.5}$ Concentrations

Receptor	Annual Means	
	PC (µg/m³)	PC (% of Limit Value)
Maximum predicted	1.3	6.7%
Rhiwfelin Fawr	0.006	0.0%
Rhiwfelin Nursing Home	0.006	0.0%
Rhiwfelin Fach	0.029	0.1%
Glanmychydd-Fach	0.102	0.5%
Llantrisant Dialysis Centre	0.048	0.2%
Tal-y-fedw	0.022	0.1%
Tyclwydau	0.031	0.2%
Llwyncrwn Isaf	0.018	0.1%
Ty'n-y-coed	0.017	0.1%
Coed-yr-Escob Primary School	0.020	0.1%
Graig-y-llan	0.035	0.2%
Royal Glamorgan Hospital	0.069	0.3%
Glan-yr-ely	0.102	0.5%
Signalmans Cottage	0.081	0.4%
Dyffryn-isaf	0.076	0.4%
Dyffryn-uchaf	0.060	0.3%
Bedw	0.013	0.1%
Royal Mint Experience	0.457	2.3%
Limit Value (µg/m³)	20	
Background (µg/m³)	6.8	
Maximum PC as %age Limit Value	6.7%	
Maximum PEC as %age Limit Value	40.7%	

At sensitive receptor locations where there is relevant public exposure (e.g. residential properties), the maximum predicted $PM_{2.5}$ concentrations are less than 1% of the EU limit values of 20 µg/m³. Therefore, the impacts would be assessed as not significant in accordance with the Environment Agency's risk

assessment guidance. As the maximum predicted and at the Royal Mint Experience, annual mean predicted concentrations are potentially significant at greater than 1% of the EU limit values. However, the PEC is well below 70% of the limit value and it is unlikely that the AQO would be exceeded.

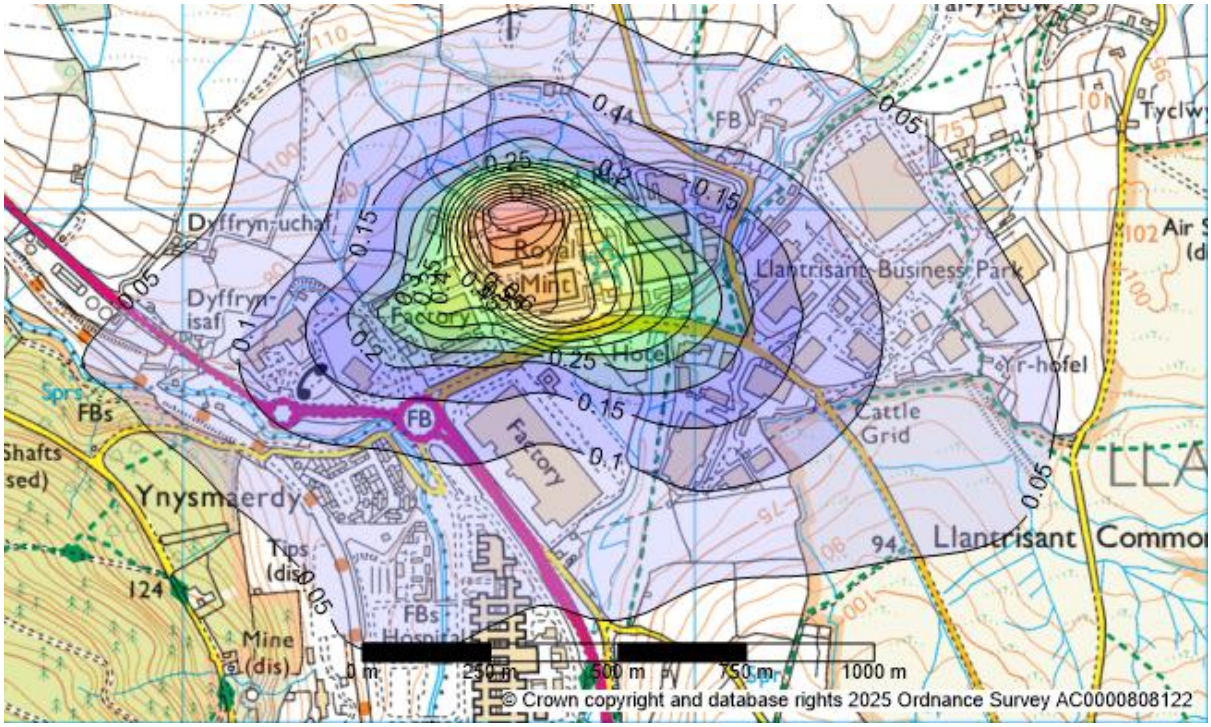


Figure 4.4 Predicted Annual Mean $PM_{2.5}$ and PM_{10} Concentrations (µg/m³)

4.1.4 Copper (Cu)

The maximum predicted 24 hour mean ground level Cu concentrations are presented in Table 4.4. These result from emissions from A16, A32 and A33.

Table 4.4 Predicted Cu Concentrations

Receptor	Maximum 24-Hour Mean	
	PC (ng/m³)	PC (% of EAL)
Maximum predicted	32.7	65.4%
Rhiwfelin Fawr	0.56	1.1%
Rhiwfelin Nursing Home	0.29	0.6%
Rhiwfelin Fach	2.2	4.4%
Glanmychydd-Fach	9.8	19.6%
Llantrisant Dialysis Centre	3.4	6.7%
Tal-y-fedw	1.6	3.2%
Tyclwydau	1.1	2.2%
Llwyncrwn Isaf	1.0	2.0%
Ty'n-y-coed	0.9	1.7%

Coed-yr-Escob Primary School	1.1	2.2%
Graig-y-Ilan	1.6	3.1%
Royal Glamorgan Hospital	3.5	7.0%
Glan-yr-ely	3.2	6.4%
Signalmans Cottage	1.9	3.8%
Dyffryn-isaf	1.9	3.7%
Dyffryn-uchaf	2.4	4.7%
Bedw	1.1	2.2%
Royal Mint Experience	16.9	33.7%
EAL (ng/m^3)	50	
Background (ng/m^3)	9.6	
Maximum PC as %age EAL	65.4%	
Maximum PEC as %age EAL	84.6%	

At sensitive receptor locations where there is relevant public exposure (e.g. residential properties), maximum predicted 24-hour mean Cu concentrations are greater than 1% of the long-term 24-hour mean EAL. Highest public exposure is predicted at Glanmychydd-Fach and represents 19.6% of the EAL of 50 ng/m^3. However, the PEC at this receptor is 38.8% of the EAL and well below 70%. Therefore, it is unlikely that the PEC would be exceeded.

4.1.5 Zinc (Zn)

The maximum predicted annual and 1 hour mean ground level Zn concentrations are presented in Table 4.5. These result from emissions from A16, A32 and A33.

Table 4.5 Predicted Zn (as Zinc Oxide) Concentrations

Receptor	Annual Mean		Maximum 1-Hour Mean	
	PC (ng/m^3)	PC (% of EAL)	PC (ng/m^3)	PC (% of EAL)
Maximum predicted	4.7	<0.1%	320	<0.1%
Rhiwfelin Fawr	0.03	<0.1%	10.4	<0.1%
Rhiwfelin Nursing Home	0.02	<0.1%	6.7	<0.1%
Rhiwfelin Fach	0.19	<0.1%	78.8	<0.1%
Glanmychydd-Fach	0.84	<0.1%	190	<0.1%
Llantrisant Dialysis Centre	0.33	<0.1%	83.4	<0.1%
Tal-y-fedw	0.13	<0.1%	84.6	<0.1%
Tyclwydau	0.12	<0.1%	57.7	<0.1%
Llwyncrwn Isaf	0.09	<0.1%	42.3	<0.1%

Ty'n-y-coed	0.07	<0.1%	27.5	<0.1%
Coed-yr-Escob Primary School	0.07	<0.1%	48.8	<0.1%
Graig-y-llan	0.10	<0.1%	48.7	<0.1%
Royal Glamorgan Hospital	0.19	<0.1%	71.0	<0.1%
Glan-yr-ely	0.26	<0.1%	71.8	<0.1%
Signalmans Cottage	0.17	<0.1%	43.3	<0.1%
Dyffryn-isaf	0.16	<0.1%	28.9	<0.1%
Dyffryn-uchaf	0.15	<0.1%	42.3	<0.1%
Bedw	0.04	<0.1%	38.7	<0.1%
Royal Mint Experience	1.1	<0.1%	299	<0.1%
EAL (ng/m^3)	50,000		1,000,000	
Background (ng/m^3)	13.8		27.6	
Maximum PC as %age EAL	<0.1%		<0.1%	
Maximum PEC as %age EAL	<0.1%		<0.1%	

Maximum predicted annual mean Zn concentrations are assessed as not significant (<1% of the EAL) at all of the identified receptors and as the maximum predicted.

The hourly-mean predictions are less than 10% of the EAL at all locations and therefore the short-term impacts are not significant in accordance with the Environment Agency's risk assessment guidance.

4.1.6 Lead (Pb)

The maximum predicted annual mean ground level lead concentrations are presented in Table 4.6. These result from emissions from A16, A32 and A33.

Table 4.6 Predicted Lead Concentrations

Receptor	Annual Means	
	PC (ng/m^3)	PC (% of Limit Value)
Maximum predicted	1.0	0.4%
Rhiwfelin Fawr	0.006	<0.1%
Rhiwfelin Nursing Home	0.005	<0.1%
Rhiwfelin Fach	0.043	<0.1%
Glanmychydd-Fach	0.194	0.1%
Llantrisant Dialysis Centre	0.078	<0.1%
Tal-y-fedw	0.029	<0.1%
Tyclwydau	0.029	<0.1%
Llwyncrwn Isaf	0.021	<0.1%

Ty'n-y-coed	0.017	<0.1%
Coed-yr-Escob Primary School	0.016	<0.1%
Graig-y-Ilan	0.025	<0.1%
Royal Glamorgan Hospital	0.047	<0.1%
Glan-yr-ely	0.063	<0.1%
Signalmans Cottage	0.043	<0.1%
Dyffryn-isaf	0.040	<0.1%
Dyffryn-uchaf	0.037	<0.1%
Bedw	0.010	<0.1%
Royal Mint Experience	0.28	0.1%
Limit Value (ng/m^3)	250	
Background (ng/m^3)	5.8	
Maximum PC as %age Limit Value	0.4%	
Maximum PEC as %age Limit Value	2.7%	

Maximum predicted annual mean Pb concentrations are assessed as not significant (<1% of the EAL) at all of the identified receptors and as the maximum predicted.

4.1.7 Hydrogen Bromide (HBr)

Predicted maximum hourly mean concentrations of HBr arising from emissions from A32 and EP1 are presented in Table 4.7.

Table 4.7 Predicted HBr Concentrations

Receptor	Maximum Hourly Means	
	PC (µg/m^3)	PC (% of Limit Value)
Maximum predicted	8.5	1.2%
Rhiwfelin Fawr	0.14	<0.1%
Rhiwfelin Nursing Home	0.10	<0.1%
Rhiwfelin Fach	0.77	0.1%
Glanmychydd-Fach	2.17	0.3%
Llantrisant Dialysis Centre	0.88	0.1%
Tal-y-fedw	0.62	0.1%
Tyclwydau	0.52	0.1%
Llwyncrwn Isaf	0.40	0.1%
Ty'n-y-coed	0.34	<0.1%
Coed-yr-Escob Primary School	0.78	0.1%

Graig-y-Ilan	0.89	0.1%
Royal Glamorgan Hospital	1.62	0.2%
Glan-yr-ely	1.84	0.3%
Signalmans Cottage	1.09	0.2%
Dyffryn-isaf	1.10	0.2%
Dyffryn-uchaf	1.48	0.2%
Bedw	0.89	0.1%
Royal Mint Experience	2.85	0.4%
EAL (µg/m³)	700	
Maximum PC as %age EAL	1.2%	

Predicted concentrations of HBr are less than 10% of the EAL and in accordance with the Environment Agency's risk assessment guidance the impact at all receptor locations would be described as not significant.

4.1.8 Hydrogen Chloride (HCl)

Predicted maximum hourly mean concentrations of HCl arising from emissions from A16, A30, A31 and A33 are presented in Table 4.8.

Table 4.8 Predicted HCl Concentrations

Receptor	Maximum Hourly Means	
	PC (µg/m³)	PC (% of Limit Value)
Maximum predicted	3.7	0.5%
Rhiwfelin Fawr	0.09	<0.1%
Rhiwfelin Nursing Home	0.09	<0.1%
Rhiwfelin Fach	0.58	0.1%
Glanmychydd-Fach	3.2	0.4%
Llantrisant Dialysis Centre	1.5	0.2%
Tal-y-fedw	1.1	0.1%
Tyclwydau	0.81	0.1%
Llwyncrwn Isaf	0.44	0.1%
Ty'n-y-coed	0.51	0.1%
Coed-yr-Escob Primary School	0.26	<0.1%
Graig-y-Ilan	1.0	0.1%
Royal Glamorgan Hospital	0.94	0.1%
Glan-yr-ely	0.93	0.1%
Signalmans Cottage	0.81	0.1%
Dyffryn-isaf	0.68	0.1%

Dyffryn-uchaf	0.96	0.1%
Bedw	0.18	<0.1%
Royal Mint Experience	2.5	0.3%
EAL (µg/m^3)	750	
Background (µg/m^3)	0.40	
Maximum PC as %age EAL	0.5%	
Maximum PEC as %age EAL	0.5%	

Predicted concentrations of HCl are less than 10% of the EAL and in accordance with the Environment Agency's risk assessment guidance, the impact at all receptor locations would be described as not significant.

4.1.9 Sulphuric Acid (H_2SO_4)

The maximum predicted annual mean and 1 hour mean ground level H_2SO_4 concentrations are presented in Table 4.9 for emissions arising from A16, A21, A23, A30 and A31.

Table 4.9 Predicted Sulphuric Acid Concentrations

Receptor	Annual Mean		Maximum 1-Hour Mean	
	PC (µg/m^3)	PC (% of EAL)	PC (µg/m^3)	PC (% of EAL)
Maximum predicted	0.028	0.3%	1.6	0.5%
Rhiwfelin Fawr	0.0001	<0.1%	0.05	<0.1%
Rhiwfelin Nursing Home	0.0001	<0.1%	0.03	<0.1%
Rhiwfelin Fach	0.0010	<0.1%	0.38	0.1%
Glanmychydd-Fach	0.0048	<0.1%	1.2	0.4%
Llantrisant Dialysis Centre	0.0017	<0.1%	0.48	0.2%
Tal-y-fedw	0.0006	<0.1%	0.45	0.2%
Tyclwydau	0.0006	<0.1%	0.29	0.1%
Llwyncrwn Isaf	0.0005	<0.1%	0.21	0.1%
Ty'n-y-coed	0.0004	<0.1%	0.14	<0.1%
Coed-yr-Escob Primary School	0.0003	<0.1%	0.23	0.1%
Graig-y-llan	0.0005	<0.1%	0.27	0.1%
Royal Glamorgan Hospital	0.0010	<0.1%	0.35	0.1%
Glan-yr-ely	0.0013	<0.1%	0.37	0.1%
Signalmans Cottage	0.0009	<0.1%	0.24	0.1%
Dyffryn-isaf	0.0008	<0.1%	0.16	0.1%
Dyffryn-uchaf	0.0008	<0.1%	0.25	0.1%
Bedw	0.0002	<0.1%	0.18	0.1%

Royal Mint Experience	0.0061	0.1%	1.4	0.5%
EAL (µg/m³)	10		300	
Maximum PC as %age EAL	0.3%		0.5%	

Maximum predicted annual mean H_2SO_4 concentrations are assessed as not significant (<1% of the EAL) at all of the identified receptors and as the maximum predicted.

The hourly-mean predictions are less than 10% of the EAL at all locations and therefore the short-term impacts are not significant in accordance with the Environment Agency's risk assessment guidance.

4.1.10 Ammonia (NH_3)

The maximum predicted annual mean and 1 hour mean ground level NH_3 concentrations are presented in Table 4.10 for emissions arising from A21 and A23.

Table 4.10 Predicted Ammonia Concentrations

Receptor	Annual Mean		Maximum 1-Hour Mean	
	PC (µg/m³)	PC (% of EAL)	PC (µg/m³)	PC (% of EAL)
Maximum predicted	0.016	<0.1%	1.2	<0.1%
Rhiwfelin Fawr	0.00003	<0.1%	0.017	<0.1%
Rhiwfelin Nursing Home	0.00002	<0.1%	0.012	<0.1%
Rhiwfelin Fach	0.00024	<0.1%	0.116	<0.1%
Glanmychydd-Fach	0.0012	<0.1%	0.366	<0.1%
Llantrisant Dialysis Centre	0.00043	<0.1%	0.129	<0.1%
Tal-y-fedw	0.00015	<0.1%	0.112	<0.1%
Tyclwydau	0.00016	<0.1%	0.072	<0.1%
Llwyncrwn Isaf	0.00011	<0.1%	0.050	<0.1%
Ty'n-y-coed	0.00009	<0.1%	0.036	<0.1%
Coed-yr-Escob Primary School	0.00008	<0.1%	0.049	<0.1%
Graig-y-llan	0.00014	<0.1%	0.100	<0.1%
Royal Glamorgan Hospital	0.00027	<0.1%	0.139	<0.1%
Glan-yr-ely	0.00035	<0.1%	0.108	<0.1%
Signalmans Cottage	0.00020	<0.1%	0.075	<0.1%
Dyffryn-isaf	0.00019	<0.1%	0.057	<0.1%
Dyffryn-uchaf	0.00017	<0.1%	0.087	<0.1%
Bedw	0.00005	<0.1%	0.027	<0.1%
Royal Mint Experience	0.0020	<0.1%	0.484	<0.1%
EAL (µg/m³)	180		2500	

Background (µg/m^3)	0.9	1.8
Maximum PC as %age EAL	<0.1%	<0.1%
Maximum PEC as %age EAL	0.5%	0.1%

Maximum predicted annual mean NH_3 concentrations are assessed as not significant (<1% of the EAL) at all of the identified receptors and as the maximum predicted.

The hourly-mean predictions are less than 10% of the EAL at all locations and therefore the short-term impacts are not significant in accordance with the Environment Agency's risk assessment guidance.

4.1.11 Other Emissions from A33

There are other pollutant emissions from A33 including acetic acid, chlorine (Cl_2) and chlorine dioxide (ClO_2). Acetic acid and ClO_2 have annual mean EALs and predicted annual mean concentrations for these are presented in Table 4.11.

Table 4.11 Predicted Annual Mean Acetic Acid and Chlorine Dioxide Concentrations

Receptor	Annual Mean Acetic Acid		Annual Mean Chlorine Dioxide	
	PC (µg/m^3)	PC (% of EAL)	PC (µg/m^3)	PC (% of EAL)
Maximum predicted	0.037	<0.1%	0.0037	0.1%
Rhiwfelin Fawr	0.0003	<0.1%	0.00003	<0.1%
Rhiwfelin Nursing Home	0.0002	<0.1%	0.00002	<0.1%
Rhiwfelin Fach	0.0021	<0.1%	0.00021	<0.1%
Glanmychydd-Fach	0.0155	<0.1%	0.00155	0.1%
Llantrisant Dialysis Centre	0.0061	<0.1%	0.00061	<0.1%
Tal-y-fedw	0.0018	<0.1%	0.00018	<0.1%
Tyclwydau	0.0017	<0.1%	0.00017	<0.1%
Llwyncrwn Isaf	0.0013	<0.1%	0.00013	<0.1%
Ty'n-y-coed	0.0011	<0.1%	0.00011	<0.1%
Coed-yr-Escob Primary School	0.0008	<0.1%	0.00008	<0.1%
Graig-y-llan	0.0017	<0.1%	0.00017	<0.1%
Royal Glamorgan Hospital	0.0028	<0.1%	0.00028	<0.1%
Glan-yr-ely	0.0031	<0.1%	0.00031	<0.1%
Signalmans Cottage	0.0019	<0.1%	0.00019	<0.1%
Dyffryn-isaf	0.0018	<0.1%	0.00018	<0.1%
Dyffryn-uchaf	0.0016	<0.1%	0.00016	<0.1%
Bedw	0.0004	<0.1%	0.00004	<0.1%
Royal Mint Experience	0.017	<0.1%	0.0017	0.1%

EAL (µg/m³)	250	2.8
Maximum PC as %age EAL	<0.1%	0.1%

Predicted annual mean concentrations are less than 1% of the respective EALs and the impact at all receptors would be assessed as not significant according to the Environment Agency's risk assessment guidance.

Acetic acid, chlorine and chlorine dioxide also have short term EALs based on an hourly average. The predicted concentrations for these are provided in Table 4.12.

Table 4.12 Predicted Maximum Hourly Mean Acetic Acid, Chlorine and Chlorine Dioxide Concentrations

Receptor	Maximum Acetic Acid		Maximum Chlorine and Chlorine Dioxide		
	PC (µg/m³)	PC (% of EAL)	PC (µg/m³)	Chlorine PC (% of EAL)	Chlorine Dioxide PC (% of EAL)
Maximum predicted	3.7	0.1%	0.37	0.1%	0.4%
Rhiwfelin Fawr	0.080	<0.1%	0.008	<0.1%	<0.1%
Rhiwfelin Nursing Home	0.091	<0.1%	0.009	<0.1%	<0.1%
Rhiwfelin Fach	0.57	<0.1%	0.057	<0.1%	0.1%
Glanmychydd-Fach	3.2	0.1%	0.32	0.1%	0.4%
Llantrisant Dialysis Centre	1.4	<0.1%	0.14	<0.1%	0.2%
Tal-y-fedw	0.95	<0.1%	0.095	<0.1%	0.1%
Tyclwydau	0.74	<0.1%	0.074	<0.1%	0.1%
Llwyncrwn Isaf	0.37	<0.1%	0.037	<0.1%	<0.1%
Ty'n-y-coed	0.48	<0.1%	0.048	<0.1%	0.1%
Coed-yr-Escob Primary School	0.24	<0.1%	0.024	<0.1%	<0.1%
Graig-y-llan	0.96	<0.1%	0.096	<0.1%	0.1%
Royal Glamorgan Hospital	0.93	<0.1%	0.093	<0.1%	0.1%
Glan-yr-ely	0.91	<0.1%	0.091	0.1%	0.1%
Signalmans Cottage	0.77	<0.1%	0.077	<0.1%	0.1%
Dyffryn-isaf	0.66	<0.1%	0.066	<0.1%	0.1%
Dyffryn-uchaf	0.91	<0.1%	0.091	<0.1%	0.1%
Bedw	0.15	<0.1%	0.015	<0.1%	<0.1%
Royal Mint Experience	2.5	0.1%	0.25	0.1%	0.3%
EAL (µg/m³)	3700		-	290	84
Maximum PC as %age EAL	0.1%		-	0.1%	0.4%

Predicted maximum hourly mean concentrations of acetic acid, chlorine and chlorine dioxide are all less than 10% of the respective short-term EALs and the impact would be described as not significant in accordance with the Environment Agency's risk assessment guidance.

4.2 Habitat Impact

The impact of emissions on airborne NO_x, NH_3, nutrient nitrogen deposition and acidification is presented. Information on the site-specific critical levels and critical loads that have been adopted for the assessment are provided in Appendix E.

4.2.1 Oxides of Nitrogen

Predicted annual mean concentrations of NO_x arising from the retained emissions from the Site are compared with the critical level for NO_x of 30 µg/m^3 in Table 4.13 for the three habitat sites. Maximum predicted 24 hour mean concentrations of NO_x at the three sites are compared with the short-term critical level in Table 4.14.

Table 4.13 Predicted Maximum Annual Mean NO_x Concentrations

Habitat Site	NO_x Annual Mean PC (µg/m^3)	NO_x Annual Mean %age of Critical Level
Llantrisant Common and Pastures SSSI	0.0077	<0.1%
Rhos Tonyrefail SSSI	0.0048	<0.1%
Cardiff Beech Woods SAC	0.00010	<0.1%
Critical level (µg/m^3)	30	

Predicted annual mean concentrations are 1% or less of the critical level of 30 µg/m^3 at all habitat sites and the impact would be assessed as not significant.

Table 4.14 Predicted Maximum 24-hour Mean NOx Concentrations

Habitat Site	NO_x Maximum 24-hour Mean PC (µg/m^3)	NO_x Maximum 24-hour Mean %age of Critical Level
Llantrisant Common and Pastures SSSI	0.21	0.3%
Rhos Tonyrefail SSSI	0.26	0.3%
Cardiff Beech Woods SAC	0.0043	<0.1%
Critical level (µg/m^3)	75	

Predicted maximum 24-hour mean concentrations are 10% or less of the critical load of 75 µg/m^3 at all habitat sites and the impact would be assessed as not significant.

4.2.2 Ammonia (NH_3)

Predicted annual mean concentrations of NH_3 arising from emissions from retained emissions at the Site are compared with the most stringent critical level for NH_3 of 1 µg/m^3 in Table 4.15 for the three habitat sites.

Table 4.15 Predicted Maximum Annual Mean NH3 Concentrations

Habitat Site	NH_3 Annual Mean PC (µg/m^3)	NH_3 Annual Mean %age of Critical Level
Llantrisant Common and Pastures SSSI	0.00078	0.1%
Rhos Tonyrefail SSSI	0.00046	<0.1%
Cardiff Beech Woods SAC	0.000009	<0.1%
Critical level (µg/m^3)	1	

Predicted annual mean concentrations are 1% or less of the critical level of 1 µg/m^3 at all habitat sites and the impact would be assessed as not significant.

4.2.3 Nutrient Nitrogen

Emissions of NO_x and NH_3 will also contribute to nutrient nitrogen deposition. A comparison of predicted deposition rates with the most stringent critical load (CL) for each habitat is presented in Table 4.16.

Table 4.16 Predicted Nutrient Nitrogen at Habitat Sites

Habitat Site	Nutrient Nitrogen PC (kgN/ha/a)	Nutrient Nitrogen PC (%age CL)	Nutrient Nitrogen PEC (kgN/ha/a)	Nutrient Nitrogen PEC (%age CL)
Llantrisant Common and Pastures SSSI	0.0052	0.1%	13.00	260%
Rhos Tonyrefail SSSI	0.0031	0.1%	13.27	265%
Cardiff Beech Woods SAC	0.00010	<0.1%	22.29	223%

For all habitat sites, the PC is less than 1% of the most stringent critical load and the impact of nutrient nitrogen deposition is assessed as not significant.

4.2.4 Acidification

Emissions of NO_x, NH_3, HCl, HBr, H_2SO_4 and acetic acid will contribute to acidification impacts. A summary of the predicted annual mean airborne concentration of each at the three habitat sites is presented in Table 4.17. Predicted concentrations for NO_x and NH_3 are presented in Table 4.13 and 4.15, respectively.

Table 4.17 Predicted Maximum HCl, HBr, H_2SO_4 and Acetic Acid Concentrations

Habitat Site	HCl Annual Mean	HBr Annual Mean	H_2SO_4 Annual Mean	Acetic Acid Annual Mean
	PC (µg/m³)	PC (µg/m³)	PC (µg/m³)	PC (µg/m³)
Llantrisant Common and Pastures SSSI	0.0075	0.016	0.0029	0.0082
Rhos Tonyrefail SSSI	0.012	0.029	0.0019	0.0033
Cardiff Beech Woods SAC	0.00010	0.00023	0.000041	0.00010

The maximum predicted concentrations at the identified habitat sites have been used to determine the contribution to acidification. A summary of the acidification impacts is provided in Table 4.18. The predicted concentrations are compared to the most stringent critical load (CLmaxN) for acidification for each habitat site.

Table 4.18 Predicted Acidification at Habitat Sites

Habitat Site	Total Acidification PC	Total Acidification PC	Total Acidification PEC	Total Acidification PEC
	(keq/ha/a)	(%age CL)	(keq/ha/a)	(%age CL)
Llantrisant Common and Pastures SSSI	0.0016	0.2%	1.071	136%
Rhos Tonyrefail SSSI	0.0018	0.2%	1.092	134%
Cardiff Beech Woods SAC	0.000041	<0.1%	1.790	125%

Highest acidification impacts relative to the respective critical loads occur at the Llantrisant Common and Pastures SSSI and Rhos Tonyrefail SSSI due to the proximity of these to the Site. Total emissions contribute 0.2% of the critical load and would be assessed as not significant.

5. CONCLUSIONS

Detailed air quality modelling using the AERMOD 12 dispersion model has been carried out to determine the local air quality impacts associated with the Royal Mint site. A number of permitted emission points have been removed along with the identification of some smaller emissions not previously consented. This report provides an updated assessment for the site.

Predicted pollutant concentrations at sensitive receptor locations are compared with the air quality standards and objectives set for the protection of human health. It is concluded that predicted impacts are not significant or that it is unlikely that the air quality objectives would be exceeded.

At the identified habitat sites, the predicted process contributions are not significant compared with the critical levels for NO_x and NH_3 and site-specific critical loads for nutrient nitrogen deposition and acidification.

Based on the above information, it is considered that the proposed operations at the Site do not have an adverse impact on local air quality.

APPENDIX A AIR QUALITY TERMINOLOGY

Term	Definition
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedences within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between 2 years, which is useful for pollutants that have higher concentrations during the winter months.
AQMA	Air Quality Management Area.
Defra	Department for Environment, Food and Rural Affairs.
Exceedance	A period of time where the concentration of a pollutant is greater than, or equal to, the appropriate air quality standard.
Fugitive emissions	Emissions arising from the passage of vehicles that do not arise from the exhaust system.
LAQM	Local Air Quality Management.
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO_2	Nitrogen dioxide.
NO_x	Nitrogen oxides.
O_3	Ozone.
Percentile	The percentage of results below a given value.
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
ppb parts per billion	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppb means that for every billion (10^9) units of air, there is one unit of pollutant present.
ppm parts per million	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppm means that for every billion (10^6) units of air, there is one unit of pollutant present.
Ratification (Monitoring)	Involves a critical review of all information relating to a data set, in order to amend or reject the data. When the data have been ratified they represent the final data to be used (see also validation).
µg/m³ micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 1ug/m3 means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
UKAS	United Kingdom Accreditation Service.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
USA	Updating and Screening Assessment.
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.

Term	Definition
Validation (monitoring)	Screening monitoring data by visual examination to check for spurious and unusual measurements (see also ratification).
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.

APPENDIX B AIR QUALITY STANDARDS AND OBJECTIVES

Pollutant	Averaging Period	EAL / AQS (µg/m^3)	Comments
Nitrogen dioxide (NO_2)	annual	40	UK AQO and EU Limit Value
	1-hour	200	UK AQO and EU Limit Value, not to be exceeded more than 18 times per annum, equivalent to the 99.8th percentile of 1-hour means
Particulate matter (as PM_{10})	annual	40	UK AQO and EU Limit Value
	24-hour	50	UK AQO and EU Limit Value, not to be exceeded more than 35 times per annum, equivalent to the 90.4th percentile of 24 hour means
Particulate matter (as $PM_{2.5}$)	annual	20	EU Target Value
Hydrogen chloride (HCl)	1-hour	750	EPAQS
Hydrogen bromide (HBr)	1-hour	700	EPAQS
Ammonia (NH_3)	annual	180	EAL
	1-hour	2500	EAL
Sulphuric acid (H_2SO_4)	annual	10	EAL
	1-hour	300	EAL
Copper (Cu)	24-hour	0.050	EAL
Lead (Pb)	annual	0.25	UK AQO
Zinc (Zn as ZnO)	annual	50	EAL
	1-hour	1,000	EAL
Acetic acid	annual	250	EAL
	1-hour	3700	EAL
Chlorine	1-hour	290	EAL
Chlorine dioxide	annual	2.8	Derived from OELs
	1-hour	84	Derived from OELs

APPENDIX C DISPERSION MODEL INPUT PARAMETERS

Table C1: Emission Parameters –Emissions A16, A21, A23, A30 and A31					
Parameter / Sources	A16	A21	A23	A30	A31
Stack height (m)	16	15.1	15.1	10	10
Stack exit diameter (m)	0.90	0.25	0.30	0.20	0.20
Temperature of release (K)	293	335	352	294	294
Actual flow rate (Am3/s)	10.1	0.84	1.0	0.48	0.42
Normalised flow rate (Nm^3/s) (a)	9.3	0.68	0.80	0.44	0.39
Emission velocity at stack exit (m/s)	15.9	17.1	14.7	15.3	13.3
Operational hours (h/a)	2160	2160	2160	2160	2160
Emission Concentrations (mg/Nm^3)					
NO_x	0.3	14.2	0.2	0.42	0.42
Cu	0.067	-	-	-	-
Zn	0.12	-	-	-	-
Pb	0.025	-	-	-	-
NH_3	-	0.77	0.91	-	-
HCl	0.17	-	-	0.066	0.066
Short-term Emission Rate (g/s)					
NO_x	0.0028	0.0097	0.00016	0.00019	0.00016
Cu	0.00041 (b)	-	-	-	-
Zn	0.0011	-	-	-	-
Pb	0.00023	-	-	-	-
NH_3	-	0.00053	0.00073	-	-
HCl	0.0016	-	-	0.000029	0.000026
Long-term Emission Rate (g/s) (c)					
NO_x	0.00068	0.0024	0.000040	0.000046	0.000040
Cu	-	-	-	-	-
Zn	0.00027	-	-	-	-
Pb	0.000057	-	-	-	-
NH_3	-	0.00013	0.00018	-	-
HCl	0.00039	-	-	0.0000072	0.0000063

(a) Corrected for temperature only
(b) Assumes only two of the three pods operates
(c) Emissions pro-rated according to the annual operating hours

Table C2: Emission Parameters – A32, A33, A34 and EP1				
Parameter / Sources	A32	A33	A34	EP1
Stack height (m)	16	14.9	13.2	16
Stack exit diameter (m)	0.254	0.250	1.12	0.3
Temperature of release (K)	293	Ambient	Ambient	903
Actual flow rate (Am3/s)	0.51	0.97	13.9	0.68
Normalised flow rate (Nm^3/s) (a)	0.48	0.92	13.2	0.20
Emission velocity at stack exit (m/s)	10.1	19.7	14.1	9.6
Operating hours per annum	8232	2940	8232	2744
Operating hours per day	24	12	24	8
Emission Concentrations (mg/Nm^3)				
NO_x	0.01	0.01	-	-
Zn, Cu, Pb	0.01	0.01	-	-
HBr	10	-	-	50
HCl	-	10	-	-
Acetic acid	-	10	-	-
Chlorine	-	1	-	-
Chlorine dioxide	-	1	-	-
Total suspended particles	-	-	5	-
Short-term Emission Rate (g/s)				
NO_x	0.0000048	0.0000092	-	-
Cu	0.0000048	0.0000061 (b)	-	-
Zn	0.0000048	0.0000092		
Pb	0.0000048	0.0000092		
HBr	0.0048	-	-	0.010
HCl and acetic acid	-	0.0092	-	-
Chlorine and chlorine dioxide	-	0.00092	-	-
Total suspended particles	-	-	0.066	-
Long-term Emission Rate (g/s)				
NOx	0.0000045	0.0000031	-	-
Zn, Pb	0.0000045	0.0000031		
HBr	0.0045	-	-	0.0032
HCl and acetic acid	-	0.0031	-	-
Chlorine and chlorine dioxide	-	0.00031	-	-
Total suspended particles	-	-	0.062	-

(a) Corrected for temperature only
(b) Assumes it operates for only two of the three shifts
(c) Emissions pro-rated according to the annual operating hours

APPENDIX D RHOOSE WIND ROSES

Figure D1: 2015

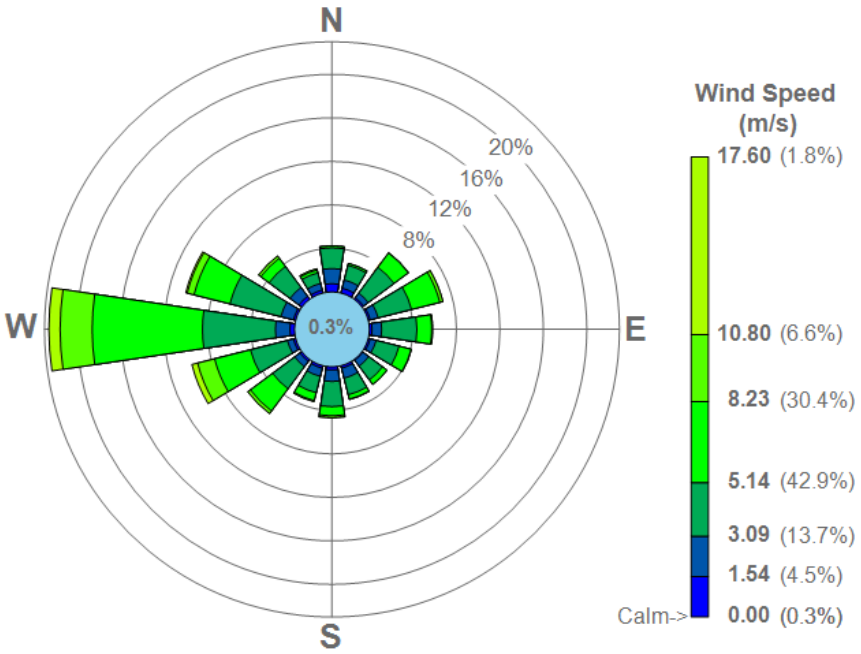


Figure D2: 2016

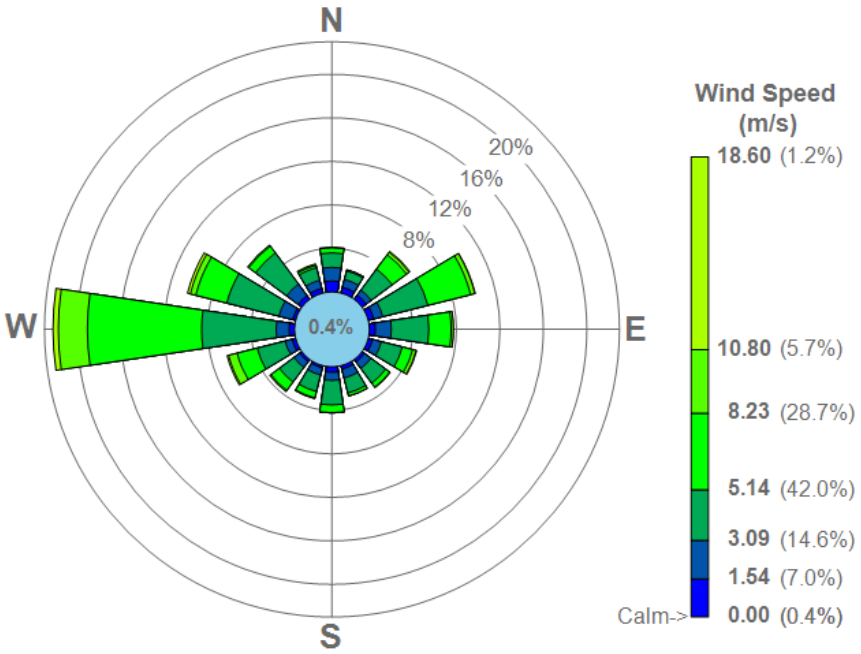


Figure D3: 2017

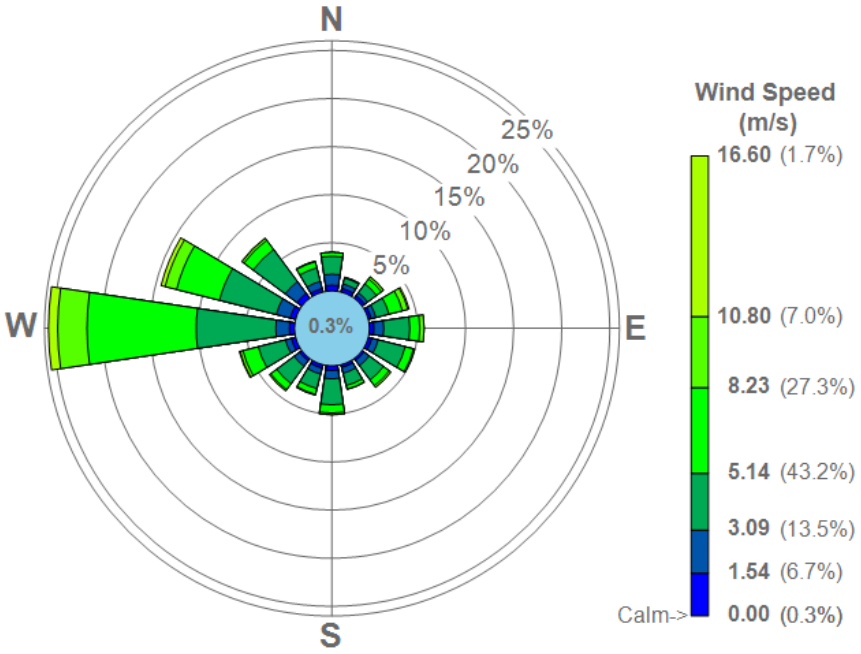


Figure D4: 2018

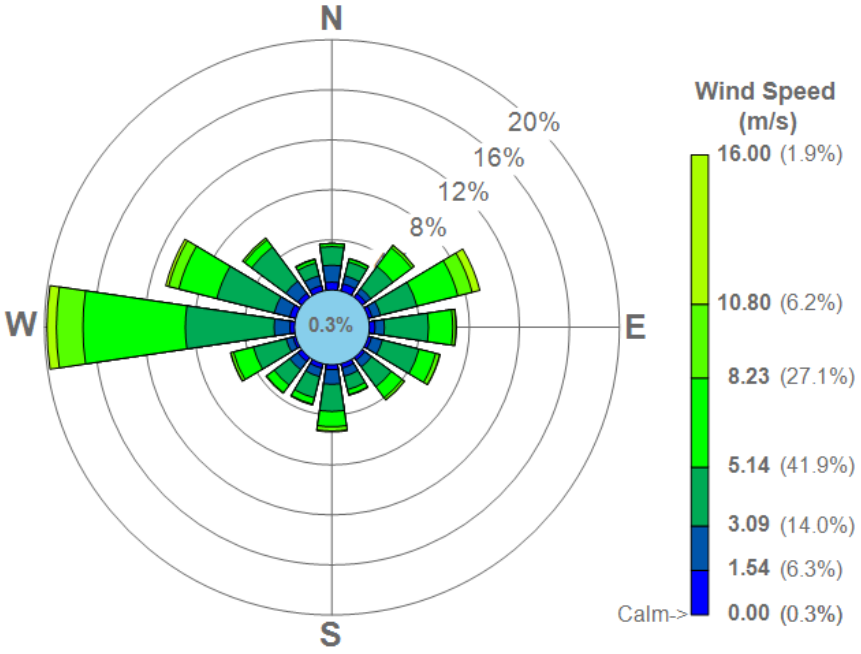
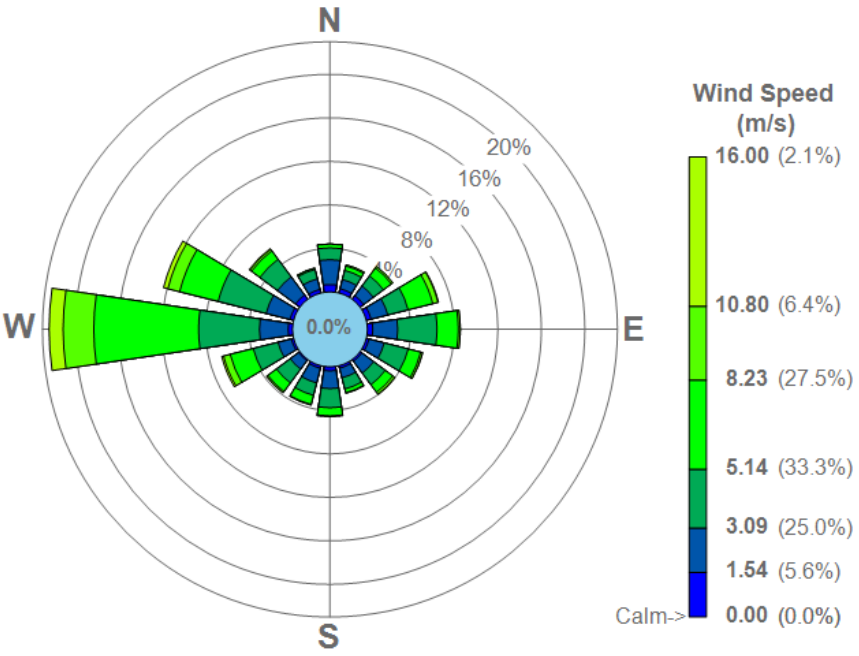


Figure D5: 2019



APPENDIX E ENVIRONMENTAL ASSESSMENT LEVELS FOR THE PROTECTIONS OF VEGETATION AND ECOSYSTEMS

Critical Levels

Critical levels are thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive plants and animals.

The critical levels for the protection of vegetation and ecosystems (as defined by the EU Directive 2008/50/EC and the 2010 UK Air Quality Standards Regulations) that are relevant to the assessment are summarised in Table E1.

Table E1: Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Averaging Period	Concentration (μg/m^3)
Oxides of Nitrogen (NOx)	Annual Mean	30
	24-Hour Mean	75
Ammonia	Annual Mean	1 - 3

Nutrient Nitrogen Critical Loads

Critical loads refer to the threshold beyond which deposition of pollutants to water or land results in measurable damage to vegetation and habitats. This takes the form of either gravitational settling of particulate matter (dry deposition) or wet deposition, where atmospheric pollutants dissolve in water vapour and then precipitate to the ground (e.g. as rain, snow, fog etc.).

Critical loads for eutrophication (nutrient nitrogen deposition) and background nutrient nitrogen deposition rates have been obtained from APIS and are summarised in Table E2 for the identified habitats present. Background concentrations are for the 2021 mid year.

Table E2: Critical Loads for Eutrophication

Habitat Site	Critical Load Class	Critical Load (kg N/ha/a)	Background N Deposition (kg N/ha/a)
Llantrisant Common and Pastures SSSI	Acid grassland	5 - 15	12.99
Rhos Tonyrefail SSSI	Blanket bog	5 - 10	13.27
Cardiff Beech Woods SAC	Beech woodland	10 - 15	22.29

Acidification Critical Loads

Critical loads for acidification and background acid deposition rates have been obtained from APIS and are summarised in Table E3 for the identified habitats present.

For acid deposition, the critical load of a habitat site is largely determined by the underlying geology and soils. The critical load of acidification is defined by a critical load function (CLF) which describes the relationship between the relative contributions of sulphur (S) and nitrogen (N) to the total acidification.

The critical load function is defined by the following parameters:

- CLmaxS, the maximum critical load of acidity for S, assuming there is no N deposition;
- CLminN, is the critical load of acidity due to nitrogen removal processes in the soil only (i.e. independent of deposition); and
- CLmaxN, is the maximum critical load of acidity for N, assuming there is no S deposition.

There are no significant emissions of sulphur from the new emission sources and values for CLmaxN are provided only for comparison with the total deposition of NO_x, HCl, H_2SO_4, HBr and acetic acid.

Table E3: Critical Loads for Acidification

Habitat Site	Primary Sensitive Habitat	CLmaxN (keq/ha/a)	Background (keq/ha/a)
Llantrisant Common and Pastures SSSI	Bogs	0.79	1.07
Rhos Tonyrefail SSSI	Blanket bogs	0.814	1.09
Cardiff Beech Woods SAC	Unmanaged woodland	1.428	1.79