Detailed Air Dispersion Modelling of Emissions to Atmosphere from Hard Anodising Surface Treatments Ltd, Kidderminster

Prepared for:

Hard Anodising Surface Treatments Ltd

By:

ENVIROSOLUTION LTD

Suite 53

3a Bridgewater Street

Liverpool

L1 0AB

Date: March 2026

EnviroSolution Ltd
Document Verification

Site Address	Hard Anodising Surface Treatments Limited, Firs Estate Stourport Road, Kidderminster, DY11 7QN		
Report Title	Detailed Air Dispersion Modelling Report		
Job Number	CL101	**Document Ref.**	CL1005
Date Issued	March 2026	**Report Version**	V1
Prepared by	David Harvey	**Signature**	D. Harvey
Checked by	Gemma Lucas	**Signature**	Gemma Lucas

Disclaimer

1 INTRODUCTION

EnviroSolution Ltd was commissioned to undertake an air quality assessment of emissions to the atmosphere from the Hard Anodising Surface Treatment Ltd Installation at Stourport Road, Kidderminster, DY11 7QN.

The outcome of an H1 assessment undertaken in 2025 and updated in 2026, required to support the application for an Environmental Permit (EP), was that detailed modelling and assessment is required for emissions of particulate matter (PM_{10}) and hexavalent chromium Cr (VI) [(1)].

The pollutants considered in this detailed modelling and assessment are:

- Particulate matter (PM_{10}/$PM_{2.5}$); and
- Hexavalent chromium Cr (VI)

Particulate matter (PM_{10}/$PM_{2.5}$) is emitted to the atmosphere from eight stacks, and hexavalent chromium Cr (VI) from three stacks.

Figure 1.1 shows the location of Hard Anodising Surface Treatment installation.

Figure 1.1 Location of Hard Anodising Surface Treatment, Kidderminster

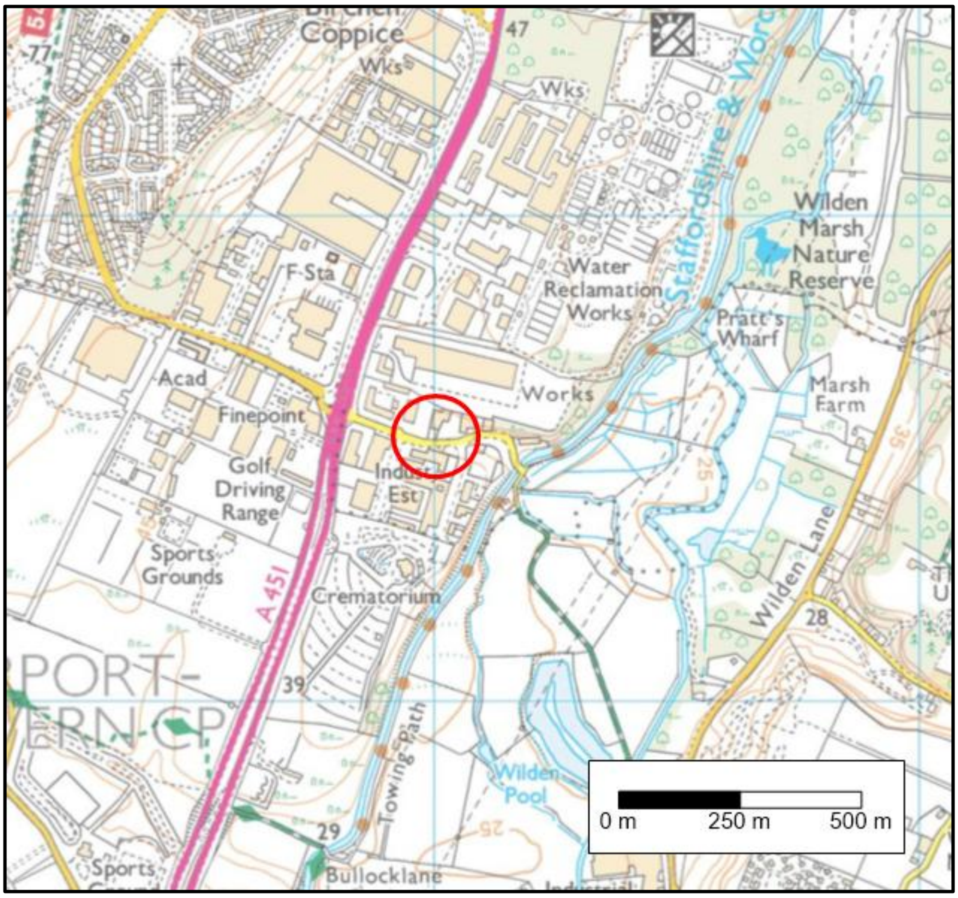
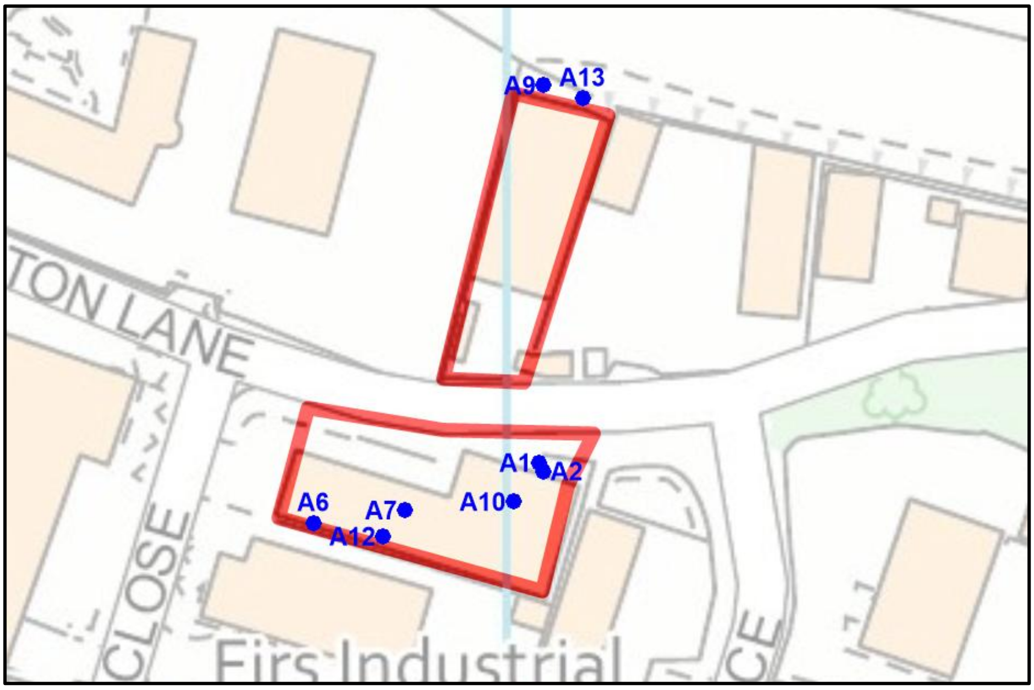


Figure 1.2 shows the installation boundaries and the location of the eight emission

(1)Hard Anodising Surface Treatment H1 v2 (CL1003) points.

Figure 1.2 Location of Emission Points and Installation Boundaries



The ADMS 6.0 dispersion model has been used to predict ground-level concentrations of the following pollutants released into the atmosphere from the installation.

- Particulate matter (PM_{10}/$PM_{2.5}$); and
- Hexavalent chromium Cr (VI)

The remainder of this report is structured as follows:

- Section 2: Describes the assessment criteria
- Section 3: Presents and assesses the existing air quality
- Section 4: Describes the modelling methodology
- Section 5: Assessment of Impacts
- Section 6: Sensitivity analysis
- Section 7: Provides a summary and conclusions

About the Author

This air quality assessment and report was prepared by David Harvey, MBA BSc FIAQM, who has 30 years of experience in air quality.

2 ASSESSMENT AND SIGNIFICANCE CRITERIA

2.1 INTRODUCTION

This section presents the relevant air quality legislation and guidance, together with significance levels. It also describes the pollutants assessed.

2.2 LEGISLATION

2.2.1 European Legislation

The Air Quality (England) Regulations 2000 (SI 2000 No. 928) and Air Quality (England) (Amendment) Regulations 2002 (SI 2002 No. 3043) include national air quality objectives, which, in most cases, are numerically synonymous with the European limit values. However, they may have different compliance target dates and apply to different locations. The air quality objectives are for specific use by local authorities when undertaking their Local Air Quality Management (LAQM) duties in pursuit of Part IV of the Environment Act 1995.

2.2.2 National Legislation And Guidance

The Government's policy on air quality within the UK is set out in the Air Quality Strategy for England, Scotland, Wales & Northern Ireland Strategy (AQS), published in July 2007, following the requirements of Part IV of the Environment Act 1995. The Air Quality Strategy (AQS) sets out a framework to reduce adverse health effects from air pollution and ensures that international commitments are met. The AQS sets pollution standards and objectives to protect human health, vegetation and ecosystems.

Many of the objectives in the Air Quality Strategy (AQS) were made statutory in England with the Air Quality (England) (Amendment) Regulations 2002 for Local Air Quality Management (LAQM).

2.2.3 Review And Assessment

Under Part IV of the Environment Act 1995, local planning authorities must review and assess the air quality within their area through staged appraisals to meet the objectives by target dates defined in the Air Quality (England) (Amendment) Regulations. Where the air quality objectives have not been achieved, the local planning authority must designate an AQMA and draw up an air quality action plan (AQAP) to achieve future air quality objectives.

2.3 INDUSTRIAL POLLUTION REGULATION

Atmospheric emissions from industrial processes are controlled in the UK through the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments. These regulations implement the European Union's Industrial Emissions Directive (2010/75/EU) in England and Wales.

2.4 DESCRIPTION OF POLLUTANTS

This section describes the two pollutants considered in this assessment, which are:

- Particulate matter (PM_{10}/$PM_{2.5}$); and
- Chromium (VI)

2.3.2 PARTICULATE MATTER (PM)

Particulate matter (PM) is a term used to describe all suspended matter, sometimes called total suspended particulate matter (TSP). Sources of particulate matter in the air include road transport. Chemical processes in the air can also lead to the formation of particles. Both $PM_{2.5}$ (<2.5 µm) and PM_{10} (<10 µm) are of health concern because of their ability to penetrate and remain deep within the lungs due to their small size.

The combustion of biomass will cause the formation of PM_{10} and $PM_{2.5}$ through a number of mechanisms, including incomplete combustion, condensation of VOCs, and secondary formation via chemical reactions.

This assessment conservatively assumes that all the particulate matter is $PM_{2.5}$.

2.4.1 Chromium and Chromium (VI)

Chromium (Cr) is a metallic element that exists in different oxidation states, including chromium (III) and chromium (VI). While chromium (III) is an essential nutrient for the human body in small amounts, chromium (VI) and its compounds are highly toxic and can have detrimental health effects.

Breathing in chromium (VI), especially in fine particles, can lead to respiratory problems such as nose, throat, and lung irritation. Prolonged exposure to high levels may cause lung cancer.

Chromium (VI) can be released into the air and water through various industrial activities, such as metal plating, leather tanning, stainless steel production, and chemical manufacturing. Chromium can also occur naturally in soil and rocks, but human activities tend to be the primary sources of elevated chromium levels.

2.5 ASSESSMENT CRITERIA

Tables 2.1 and **2.2** show the assessment criteria used to assess the impacts on human health**.**

The Environmental Assessment Levels (EALs) used in this assessment are set by the Environment Agency (EA). It should be noted that there is no short-term assessment criterion for chromium (VI).

There are no assessment criteria for PM_{10}/$PM_{2.5}$ or Cr (VI) set for the protection of conservation areas.

Table 2.1 Environmental Assessment Levels (EALs) for the Protection of Human Health

Substance	Averaging time	Assessment Criteria $\mu g\ m^{-3}$
Particulate matter (PM_{10})	Annual mean	40
	90.4th %ile of 24-hour means	50
Particulate matter ($PM_{2.5}$)	Annual mean	20
	Annual mean (by 2028)	12
	Annual mean (by 2040)	10
Chromium (Cr VI)	Annual mean	0.00025 (0.25 ng m^{-3})

2.6 SIGNIFICANCE CRITERIA

The impact refers to the predicted change to the prevailing environment due to emissions to the atmosphere.

The significance of an impact is generally determined by the combination of the sensitivity and 'value' of the affected environmental receptor and the predicted 'extent' and 'magnitude' of the impact or change.

The Environment Agency's (EA) risk assessment guidance includes a test for the insignificance of impacts, which is used in this assessment [(1)].

For human health impacts, the Environment Agency's (EA) risk assessment guidance includes a two-stage test for insignificance of impacts [(2)].

Stage 1:

The Environment Agency (EA) guidance states that the process contribution (PC) can be considered as insignificant if both of the following are achieved:

- *The long-term PC is <1% of the long-term Environmental Assessment Level (EAL)*
- *The short-term PC is < 10% of the short-term Environmental Assessment Level (EAL)*

The Environment Agency (EA) guidance states:

If you meet both of these criteria you don't need to do any further assessment of the substance. If you don't meet them you need to carry out a second stage of screening to determine the impact of the PEC.

(1) https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit .
(2) https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit .

Stage 2:

The Environment Agency (EA) guidance states that detailed modelling of emissions is needed for emissions that do not meet both of the following requirements:

- *The long-term PEC is less than 70% of the long-term EAL*
- *The short-term PC is less than 20% of the short-term EAL minus twice the long-term background concentration*

This does not mean that if these thresholds are exceeded, the process contribution (PC) is significant; it just means that it cannot be ruled out as insignificant.

3 AMBIENT AIR QUALITY DATA

3.1 INTRODUCTION

This section describes the ambient air quality for the location of Hard Anodising Surface Treatment, Kidderminster works.

The criteria used throughout this assessment are compared to the contribution to ambient pollutant concentrations resulting from emissions to the atmosphere from the stacks. Therefore, an accurate determination of the prevailing concentration is not necessary. However, estimates of the overall background concentrations are presented for completeness.

3.2 SOURCES OF POLLUTION

The prevailing air quality will result from emissions from local and distant sources of pollution. Away from the impact of local sources of pollution, such as roads and industry, pollutant levels will reflect the prevailing background concentrations.

These sources of pollution will include:

- **Road Traffic:** Vehicle emissions, particularly from diesel-powered vehicles, release pollutants such as nitrogen oxides (NO_x), particulate matter (PM_{10}), and volatile organic compounds (VOCs).

- **Industrial Activities:** Industrial facilities near the Hard Anodising Surface Treatment, Kidderminster, may contribute to pollution.

- **Residential Heating and Energy Consumption:** Residential areas near Hard Anodising Surface Treatment, Kidderminster, may contribute to air pollution by burning fossil fuels for heating and energy consumption.

It is important to note that the specific contribution and impact of these pollution sources near Hard Anodising Surface Treatment, Kidderminster, will vary depending on weather conditions, traffic patterns, and the proximity of sensitive receptors like residential areas, schools, and healthcare facilities.

3.3 MEASURED CONCENTRATIONS

Local Authorities do not monitor heavy metals, as it is not part of Local Air Quality Management (LAQM).

The Environment Agency (EA) manage the UK's national monitoring sites on behalf of Defra and the Devolved Administrations.

The heavy metals network of monitors was expanded to 24 sites in 2008. Each site monitors Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Mercury (Hg), Manganese (Mn), Nickel (Ni), Lead (Pb), Platinum (Pt), Vanadium (V) and Zinc (Zn). There is no routine monitoring of Chromium (VI).

The closest heavy metal monitoring site to Hard Anodising Surface Treatment, Kidderminster, is Walsall Pleck Park.

Table 3.1 shows the details of the Walsall Pleck Park heavy metal monitoring site, which is an urban background site, 30 km from the installation site.

Table 3.1 **Details of Walsall Pleck Park Heavy Metal Monitoring Site**

Monitoring Site	Environment Type	OS Grid Reference	Distance (km)
Walsall Pleck	Urban Background	399832,296868	30

Table 3.2 shows the measured annual average concentrations of total chromium from 2021 to 2024.

Table 3.2 **Measured Annual Average Concentration Chromium (Cr), (ng m^{-3}): Walsall Pleck Park**

Year	Total Chromium (Cr)
2021	2.3
2022	2.3
2023	2.3
2024	3.1
Average: 2021 to 2024	**2.5**
Environmental Assessment Level (EAL)	**No Long-Term Assessment Level**

Table 3.2 shows that the 2021 to 2024 average measured concentration of cadmium (Cd) at the closest monitoring site is 2.5 ng m^{-3}.

Ambient concentrations of chromium (VI) are not available for any UK monitoring site.

Text Box 3.1 provides background on the likely percentage of chromium (VI) in total chromium (Cr).

Text Box 3.1 Percentage of Chromium VI in Total Chromium (Cr (III) and Compounds)

> Estimates of the comparative concentrations in air of Cr(III) and Cr(VI) are uncertain, in part because the ratio is variable and dependent on the source of chromium. In the UK it is likely that less than 20% of emissions are of Cr(VI), those with the higher proportions from chromium-using industries (Passant, 2006). The proportion of Cr(VI) in ambient air may be lower than that measured in emissions. Data from Canada, quoted by Rowbotham ***et al.*** (2000), suggest that Cr(VI) constitutes between 3 and 8% of total airborne chromium in that country. Keiber ***et al.*** (2002) found that about half of the chromium in rainwater in the USA was in water soluble form and of this there were approximately equal concentrations of Cr(VI) and Cr(III). As most of the insoluble chromium is likely to be present as Cr(III), this implies that the Cr(III)/Cr(VI) ratio in air was about 3:1.

Source: Consultation on guidelines for metal and metalloids in ambient air for the protection of human health.

The Environment Agency (EA) suggests that chromium (VI) should be assumed to be 20% of the total background chromium (Cr) for screening purposes [(1)].

Assuming that chromium (VI) is 20% of the total chromium in ambient air, this would suggest an ambient chromium (VI) concentration of 0.50 ng m^{-3} compared to the Air Quality Assessment Level (AQAL) of 0.25 ng m^{-3}. Without directly measured concentrations of chromium (VI), it is not possible to know how representative the estimated concentration of 0.50 ng m^{-3} is, and therefore, it needs to be treated with caution.

There are no PM_{10} monitoring stations that are relevant to this assessment.

3.4 ESTIMATED BACKGROUND CONCENTRATIONS

The Department for Environment, Food and Rural Affairs (Defra) provides estimates of the background concentrations for several pollutants for many years on a 1 km grid resolution for the whole of the UK. The closest grid square to the installation site is centred on 381500, 273500

Table 2.2 2026 Estimated Annual Average Background Pollutant Concentrations for OS Grid Reference 381500, 273500

Pollutant	Background Concentration	Unit	Data Source
PM_{10}	10.7	$\mu g\ m^{-3}$	Defra Background
$PM_{2.5}$	6.3	$\mu g\ m^{-3}$	Defra Background

(1) Environment Agency (EA, September 2012) Guidance for applicants on the Impacts Assessment for Group 3 Metals Version 3.

4 METHODOLOGY

4.1 INTRODUCTION

This section describes the methodology and assumptions made for the air quality assessment.

4.2 EMISSIONS DATA

The eight stacks modelled in this assessment are:

- Particulate matter ($PM_{10}/PM_{2.5}$); and
- Hexavalent chromium Cr (VI)

Particulate Matter ($PM_{10}/PM_{2.5}$) is emitted to the atmosphere from eight stacks, and hexavalent chromium Cr (VI) from three stacks.

Table 4.1 shows the parameters which describe the physical properties of emissions from the eight sources.

Table 4.1 Emissions and Physical Properties

Stack ID	**A1**	**A2**	**A6**	**A7**	**A9**	**A10**	**A12**	**A13**
Description	**Nitric Acid**	**Chromic Acid Anodising**	**Fume Cabinet-Lab**	**Vat 2 Anodising**	**Vats 9 & 12 Anodis.**	**Enp Vat**	**Dichromate Seal Shop 1**	**Dichromate Seal Factory 2**
Number of flues in each stack	1	1	1	1	1	1	1	1
OS Grid Reference (m)	382008 273520	382009 273518	381956 273506	381977 273509	382009 273607	382002 273511	381972 273503	382018 273604
Release height level (m)	6	9	5	8	9	8	7	8
Actual diameter (m)	0.15	0.32	0.30	0.32	0.85	0.30	0.32	0.2
Emission temp (deg C)	13.3	16.3	20.8	13.8	14.3	20.4	27.4	20.1
Hours per year	8,760	2,500	50	2,500	2,500	1,920	2,500	250
Percentage operation (%)	100%	29%	1%	29%	29%	22%	29%	3%
Actual vol. flow rate ($Am^3\ hr^{-1}$)	428	1,788	430	1,332	7,997	4,344	2,161	2,152
Actual vol. flow rate ($Am^3\ s^{-1}$)	0.12	0.50	0.12	0.37	2.22	1.21	0.60	0.60
Actual exit velocity ($m\ s^{-1}$)	6.7	6.2	1.7	4.6	3.9	17.1	7.5	19.0
Normalised flow ($Nm^3\ hr^{-1}$) (a)	409	1,691	400	1,271	7,631	4,053	1,972	2,013
Normalised flow ($Nm^3\ s^{-1}$) (a)	0.11	0.47	0.11	0.35	2.12	1.13	0.55	0.56
Emission Conc. (mg Nm^{-3}) (a)								
Chromium (Cr)	-	0.029	-	-	-	-	0.030	0.0041
$PM_{10}/PM_{2.5}$	0.99	0.94	0.82	1.00	1.8	11.2	9.7	0.60
Emission Rate (mg s^{-1}): Short Term								
Chromium (Cr)	-	0.014	-	-	-	-	0.016	0.0023
$PM_{10}/PM_{2.5}$	0.11	0.44	0.091	0.35	3.82	12.6	5.31	0.34
Emission Rate (mg s^{-1}): Long Term								
Chromium (Cr)	-	0.0039	-	-	-	-	0.0047	0.000065
$PM_{10}/PM_{2.5}$	0.11	0.13	0.00052	0.10	1.09	2.76	1.52	0.0096
(a) Normalised to 273K, 101.3kPa, without correction for water vapour content.								

Predictions of short-term impacts (24-hour averages) are made using the short-term emission rates, and predictions of long-term impacts (annual averages) are made using the long-term emission rates.

4.3 RECEPTORS

Predictions of ground-level concentrations are made using a grid of receptors. The receptor grid is 1,000 m by 1,000 m, with a grid spacing of 5 m. Predictions using a grid of receptors allow the maximum impact to be determined, and the predicted ground-level concentrations can be presented as contour plots.

Table 4.2 presents details of the specific receptors included in the modelling selected because of their potential for '*relevant exposure*'.

Table 4.2 Receptor Locations for Impacts on Human Health

No.	Description	Distance from Installation Centre (km)	OS Grid Reference (m)
R1	Residential	0.9	382868 273534
R2	Residential	1.0	382995 273730
R3	Residential	0.9	381990 274463
R4	Residential	0.8	381566 274212
R5	Residential	0.7	381356 273871
R6	Sports Club	0.6	381431 273402
R7	Sports Club	0.4	381594 273344
R8	Commercial	<0.1	382017 273511
R9	Commercial	<0.1	382014 273499
R10	Commercial	<0.1	381982 273493
R11	Commercial	<0.1	381941 273505
R12	Commercial	<0.1	382024 273582
R13	Commercial	<0.1	382053 273558
R14	Commercial	<0.1	382049 273675
R15	Commercial	<0.1	381914 273539
R16	Commercial	<0.1	381968 273611

Figure 4.1 shows the locations of the receptors R1 to R7 (residential and sports).

Figure 4.1 Location of Receptors R1 to R7 (Residential and Sports)

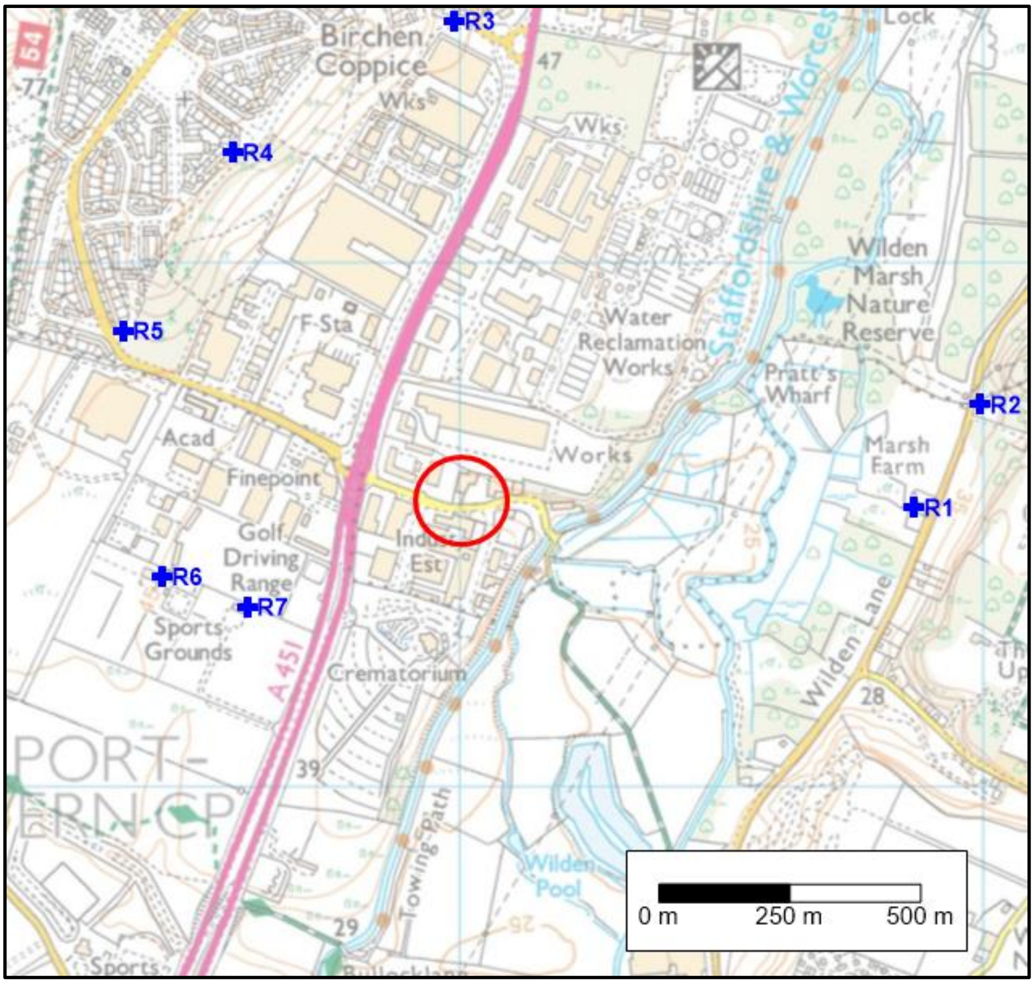
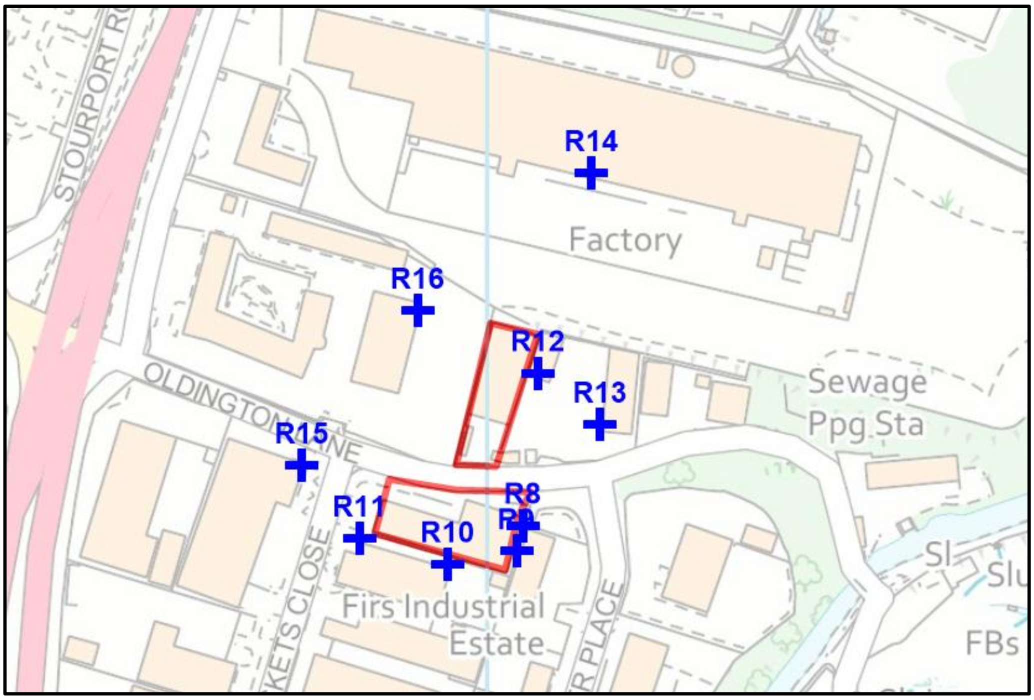


Figure 4.2 shows the locations of the receptors R8 to R16, which are the commercial specific receptors.

Figure 4.2 Location of Receptors R8 to R16 (Commercial)



The selected receptors are representative of locations where there is relevant exposure, such as residential properties. For Local Air Quality Management (LAQM), the Air Quality Strategy Objectives (AQS) only apply where there is '*relevant exposure*'. This is defined as being where members of the public are regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective. For the annual average objective, locations of relevant exposure include residential properties, schools and hospitals.

For ecological sites, the Environment Agency (EA) requires consideration of the following ecological sites within 10 km:

- Special Protection Areas (SPAs)
- Special Areas of Conservation (SACs)
- Ramsar sites (protected wetlands)

and within 2 km:

- Sites of Special Scientific Interest (SSSIs)
- local nature sites (ancient woods, local wildlife sites and national and local nature reserves)

However, the assessment of impacts at ecological sites is not required in this assessment because there are no ecological impacts associated with emissions of either particulate matter (PM_{10}/$PM_{2.5}$) or hexavalent chromium Cr (VI).

4.4 FACTORS AFFECTING DISPERSION

Several factors will affect how emissions disperse once released into the atmosphere. The four factors having the most significant effect on dispersion are:

- Physical characteristics of the emissions
- Climate
- Terrain
- Building downwash

4.4.1 Physical Characteristics of the Emissions

Provided that the exhaust gases have sufficient velocity to overcome the effects of stack tip downwash, which is almost certainly the case for velocities of 15 $m\ s^{-1}$ or more, the physical characteristics of the flue gases will determine the amount of plume rise and hence the effect on ground-level pollutant concentrations. The degree of plume rise depends on the greater thermal buoyancy or momentum effects and is not necessarily a combination of the two effects.

4.4.2 Climate

Wind speed, wind direction, and atmospheric stability are the most important meteorological parameters governing the atmospheric dispersion of pollutants.

- **Wind direction** determines the broad transport of the plume and the sector of the compass into which the plume is dispersed.

- **Wind speed** can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise.

- **Atmospheric stability** is a measure of the turbulence of the air, particularly of the vertical motions present. For dispersion modelling purposes, one method of classifying stability is by using Pasquill Stability categories, A to F. Dispersion models, such as ADMS and AERMOD, do not allocate the degree of atmospheric turbulence into six discrete categories (A-F). These models use a parameter known as the Monin-Obukhov length, which, together with the wind speed, describes the atmosphere's stability.

4.4.3 Building Downwash

The presence of buildings can significantly affect the dispersion of atmospheric emissions. Wind blowing around a building distorts the flow and creates greater turbulence zones than if the building were absent. Increased turbulence causes greater plume mixing; the rise and trajectory of the plume may be depressed generally by the flow distortion. For elevated releases such as from stacks, building downwash leads to higher ground-level concentrations closer to the stack than those present if a building were not there. The effects of building downwash are usually only significant where the buildings are more than 40% of the stack height.

Table 4.4 shows the dimensions of the buildings included in the modelling.

Table 4.4 **Dimensions of Buildings Included in the Modelling**

Building	Centre (m)		Height (m) (a)	Length (m)	Width (m)	Angle (deg) (b)
1	381980	273507	6.0	64	14	106
2	382001	373516	6.0	29	14	106
3	382007	273583	6.0	23	44	104
4	381960	273488	11.0	42	21	106
5	382020	273491	7.0	14	36	106

(a) Height above ground level (at the location of the stack).
(b) Angle building length makes to the north.

Section 6 includes a sensitivity analysis of the model-predicted concentration to building downwash effects.

4.4.4 Nature of The Surface

Terrain

The effects of elevated terrain can affect dispersion and have been included in the modelling.

Roughness

The surface's nature can significantly influence dispersion by affecting the vertical velocity profile (ie the rate of increase in wind speed for increasing heights above ground level). The amount of atmospheric turbulence also affects dispersion.

The site is in a commercial area with industrial buildings, which will affect dispersion by increasing turbulence and reducing the wind speed close to the ground.

Considering the site's surrounding nature, a surface roughness length of 0.5 m has been assumed for the dispersion modelling and represents a reasonable balance.

Section 6 includes a sensitivity analysis of the model-predicted concentration to surface roughness.

4.5 SELECTION OF SUITABLE DISPERSION MODEL

The dispersion models widely used to predict ground-level pollutant concentrations are based on the concept of the time-averaged lateral and vertical concentration of pollutants in a plume being characterised by a Gaussian distribution. Models such as ADMS and AERMOD have been developed, which replace the description of the atmospheric boundary layer as being composed of discrete stability classes with an infinitely variable measure of the surface heat flux, which in turn influences the turbulent structure of the atmosphere and hence the dispersion of a plume.

Two commercially available dispersion models which have been described by the Environment Agency (EA) as being 'new generation' are:

- AERMOD: The US **A**merican Meteorological Society and **E**nvironmental Protection Agency **R**egulatory Model Improvement Committee developed the dispersion **MOD**del called AERMOD, which incorporates the latest understanding of the atmospheric boundary layer.

- Atmospheric Dispersion Modelling System (ADMS): This dispersion model was developed by the UK consultancy CERC. The model allows for the skewed nature of turbulence within the atmospheric boundary layer.

In many respects, the models are quite similar and generate comparable predictions of ground-level concentrations in many situations.

The ADMS 6.0 dispersion model was selected for use in this assessment because it has been extensively validated and widely used for assessment work of this nature.

4.6 METEOROLOGICAL DATA

An essential input to the dispersion model is the meteorological data.

The closest observing stations are:

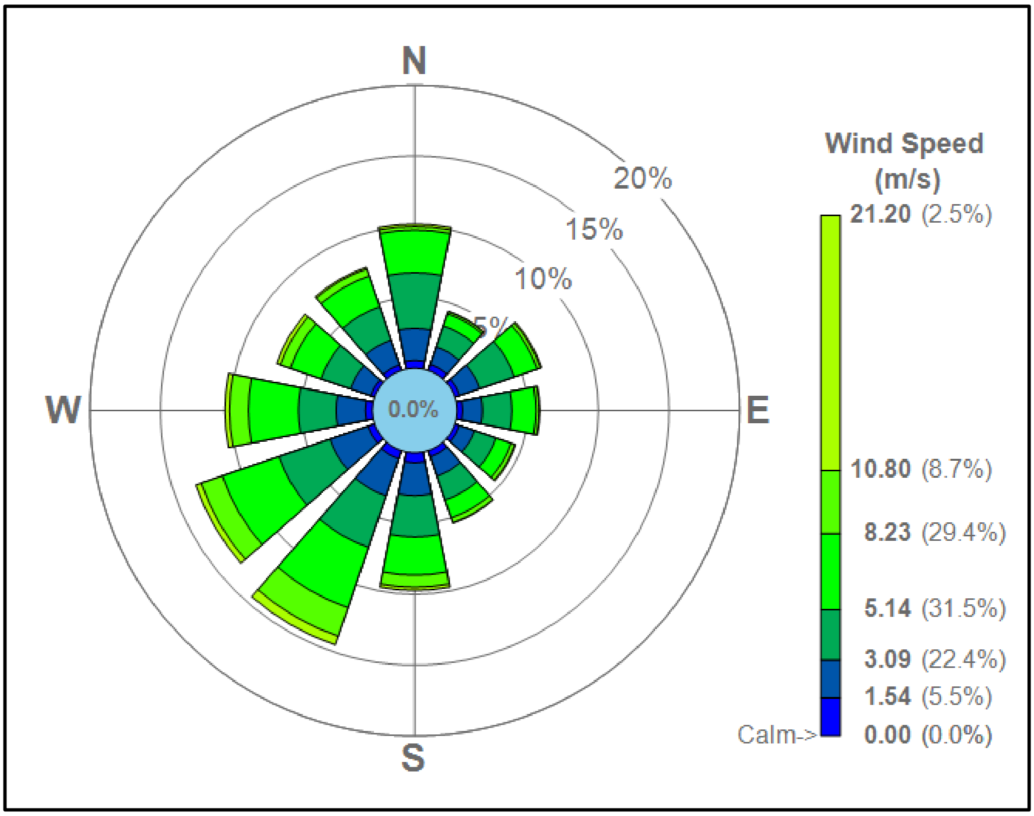
- Pershore (28 km)
- Cosford (31 km)
- Birmingham (34 km)

Given distances to the nearest observing stations, this assessment uses 2021 to 2025 Numerical Weather Prediction (NWP) data for the location of the installation. NWP data are increasingly being used where there is concern over how representative observed data are.

Figure 4.3 shows the wind rose for 2021-2025 NWP data, used in this assessment, which shows that the prevailing wind is from the south-west, which will transport emissions to the north-east.

The sensitivity analysis presented in **Section 6** of this report details the model's sensitivity to the choice of meteorological data.

Figure 4.3 **Wind Rose from NWP Windrose for Kidderminster (2021-2025)**



5 PREDICTIONS AND ASSESSMENT OF IMPACTS

5.1 INTRODUCTION

This section presents the contribution to ground-level concentrations predicted to occur due to atmospheric emissions from Hard Anodising Surface Treatment, Kidderminster. Predictions of routine emissions to the atmosphere of chromium (VI) and particulate matter (PM_{10}/$PM_{2.5}$) are modelled and assessed.

The sensitivity of model-predicted concentration to year-to-year variation in meteorological data is presented in **Section 6**.

5.2 MODELLING AND ASSESSMENT OF EMISSIONS

5.2.1 Hexavalent Chromium Cr (VI)

It is conservatively assumed that 100% of the emissions for chromium (Cr) is hexavalent chromium Cr (VI).

Table 5.1 shows the predicted annual average ground-level process contribution (PC) of chromium (VI) at the specific receptors and grid maximum. Predictions are for each of the five years of meteorological data. Predictions are made using the long-term emission rates shown in **Table 4.1**.

Table 5.1 ADMS 6.0 Predicted, Process Contribution (PC) of Chromium (VI) (ng m^{-3}); Five Years of Meteorological Data (2021 to 2025)

Location	2021	2022	2023	2024	2025	Max.	Maximum as Percentage of EAL (%) [(a)]
R1	0.0065	0.0061	0.0065	0.0067	0.0050	**0.0067**	2.7%
R2	0.0054	0.0052	0.0054	0.0057	0.0043	**0.0057**	2.3%
R3	0.0058	0.0063	0.0070	0.0064	0.0054	**0.0070**	2.8%
R4	0.0024	0.0046	0.0030	0.0032	0.0034	**0.0046**	1.8%
R5	0.0049	0.0048	0.0030	0.0038	0.0046	**0.0049**	2.0%
R6	0.0091	0.0076	0.0087	0.0066	0.0125	**0.0125**	5.0%
R7	0.0155	0.0121	0.0148	0.0130	0.0211	**0.0211**	8.5%
R8	0.82	0.84	0.85	0.84	0.82	**0.85**	340%
R9	0.70	0.67	0.68	0.66	0.67	**0.70**	279%
R10	0.84	0.82	0.77	0.82	0.81	**0.84**	338%
R11	0.43	0.40	0.43	0.34	0.49	**0.49**	197%
R12	0.39	0.38	0.40	0.38	0.39	**0.40**	161%
R13	0.30	0.32	0.37	0.35	0.31	**0.37**	150%
R14	0.11	0.11	0.11	0.11	0.11	**0.11**	44%
R15	0.16	0.14	0.13	0.13	0.18	**0.18**	72%
R16	0.15	0.17	0.17	0.16	0.17	**0.17**	69%
Receptor Max	**0.84**	**0.84**	**0.85**	**0.84**	**0.82**	**0.85**	**340%**
Grid Maximum	**2.09**	**2.04**	**2.07**	**2.01**	**2.15**	**2.15**	**861%**

(a) Environmental Assessment Level (EAL): 0.25 ng m^{-3}.

Table 5.1 shows that the maximum predicted Process Contribution (PC) at any specific receptor is 0.85 ng $m^{-3,}$ which is 340% of the Environmental Assessment Level (EAL) of 0.25 ng m^{-3}.

The maximum predicted annual average at any specific receptor where there is relevant exposure (ie annual average impacts at residential properties, R1-R5) is 0.0070 ng $m^{-3,}$ which is 2.8% of the Environmental Assessment Level (EAL) of 0.25 ng m^{-3}. It is reasonable to exclude all locations where there is no potential long-term exposure, given that for chromium (VI) it is only long-term impacts that are of concern to human health.

The emissions cannot be screened out as insignificant using the Environment Agency (EA) Stage 1 test, as the Process Contribution (PC) is not less than 1% of the Environmental Assessment Levels (EAL).

Given a background concentration of 0.50 ng m^{-3} (see **Section 3.3**), the Predicted Environmental Concentration (PEC) exceeds the Stage 2 test for insignificance (70%) and, therefore, cannot be screened out as insignificant using the EA's two-stage test for insignificance.

However, there is considerable uncertainty over the actual background concentration of chromium (VI) as no measured data are available. If it were to
It is assumed that the background concentration was 0.16 ng m^{-3} or less. The PEC for the emissions as a percentage of the EAL would be less than 70% of the Environmental Assessment Levels (EAL), and the impacts could be screened as insignificant.

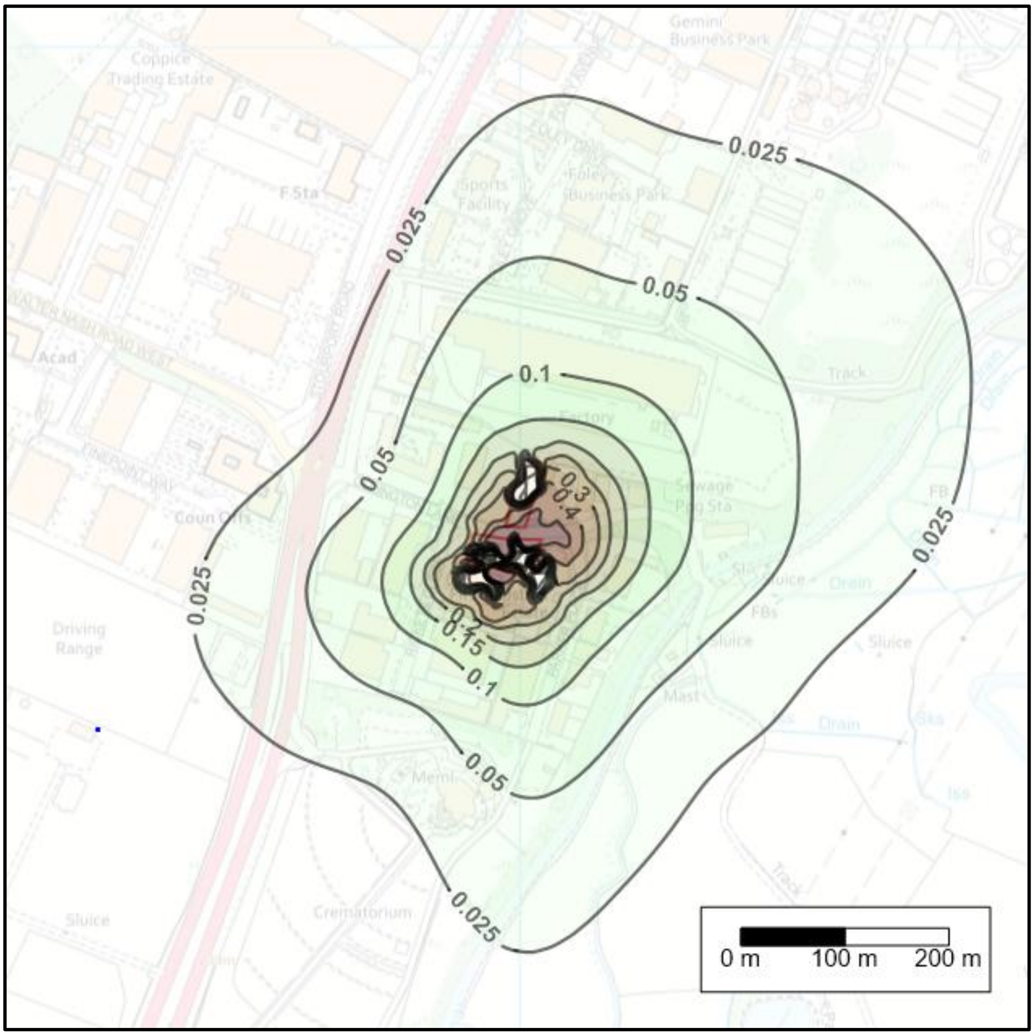
It should also be noted that the assessment assumes 100% of chromium (Cr) emissions are hexavalent chromium Cr (VI). If it were to be assumed that 20% of the emissions of chromium (Cr) are hexavalent chromium Cr (VI) then at the receptors where there is relevant exposure (R1-R5), the maximum process contribution (PC) would be 0.0014 ng $m^{-3,}$ which is 0.6% of the Environmental Assessment Level (EAL) of 0.25 ng m^{-3} and therefore insignificant.

Given that the maximum predicted Process Contribution (PC) at any receptor with long-term exposure (i.e., residential receptors) is 2.8% of the Environmental Assessment Levels (EAL), it is considered that the predicted impacts at the residential receptors are not of concern to human health.

Figure 5.1 shows the predicted annual average Chromium (VI) for the measured emissions using 2023 meteorological data, as this gives rise to the highest predicted impact.

The figures show that peak predicted ground-level concentrations (Process Contribution, PC) occur within about 50 m of the installation.

Figure 5.1 **ADMS 6.0 Predicted Annual Average Ground-Level Concentration (Process Contribution, PC) Chromium (VI); 2023 Meteorological Data (ng m^{-3})**



Environmental Assessment Level (EAL): 0.25 ng m^{-3}

5.2.2 Particulate Matter (PM_{10}/$PM_{2.5}$)

Table 5.2 shows the predicted annual average ground-level process contribution (PC) particulate matter (PM_{10}/$PM_{2.5}$) at the specific receptors and at the point of maximum impact. The predicted annual averages are modelled using the long-term emissions rate.

Table 5.2 ADMS 6.0 Predicted Annual Average Ground Level Concentrations, Process Contribution (PC) Particulate Matter, PM_{10}/$PM_{2.5}$ $\mu g\ m^{-3}$)

Location	2021	2022	2023	2024	2025	Max.	Maximum as a Percentage of EAL (%)	
							PM_{10} (a)	$PM_{2.5}$ (b)
R1	0.004	0.004	0.004	0.004	0.003	**0.004**	0.0%	0.0%
R2	0.003	0.003	0.003	0.004	0.003	**0.004**	0.0%	0.0%
R3	0.004	0.004	0.004	0.004	0.003	**0.004**	0.0%	0.0%
R4	0.002	0.003	0.002	0.002	0.002	**0.003**	0.0%	0.0%
R5	0.003	0.003	0.002	0.002	0.003	**0.003**	0.0%	0.0%
R6	0.005	0.005	0.005	0.004	0.008	**0.008**	0.0%	0.0%
R7	0.009	0.007	0.008	0.008	0.012	**0.012**	0.0%	0.1%
R8	0.39	0.40	0.43	0.41	0.39	**0.43**	1.1%	2.2%
R9	0.35	0.34	0.34	0.35	0.34	**0.35**	0.9%	1.8%
R10	0.44	0.43	0.43	0.44	0.42	**0.44**	1.1%	2.2%
R11	0.22	0.21	0.22	0.18	0.25	**0.25**	0.6%	1.3%
R12	0.24	0.24	0.23	0.24	0.23	**0.24**	0.6%	1.2%
R13	0.18	0.19	0.20	0.20	0.17	**0.20**	0.5%	1.0%
R14	0.09	0.09	0.09	0.09	0.09	**0.09**	0.2%	0.4%
R15	0.08	0.07	0.07	0.07	0.09	**0.09**	0.2%	0.5%
R16	0.09	0.10	0.10	0.09	0.10	**0.10**	0.3%	0.5%
Receptor Max	**0.44**	**0.43**	**0.43**	**0.44**	**0.42**	**0.44**	**1.1%**	**2.2%**
Grid Maximum	**0.85**	**0.85**	**0.89**	**0.86**	**0.88**	**0.89**	**2.2%**	**4.5%**

(a) Environmental Assessment Level (EAL) for PM_{10}: 40.0 $\mu g\ m^{-3}$.
(b) Environmental Assessment Level (EAL) for $PM_{2.5}$: 20.0 $\mu g\ m^{-3}$.

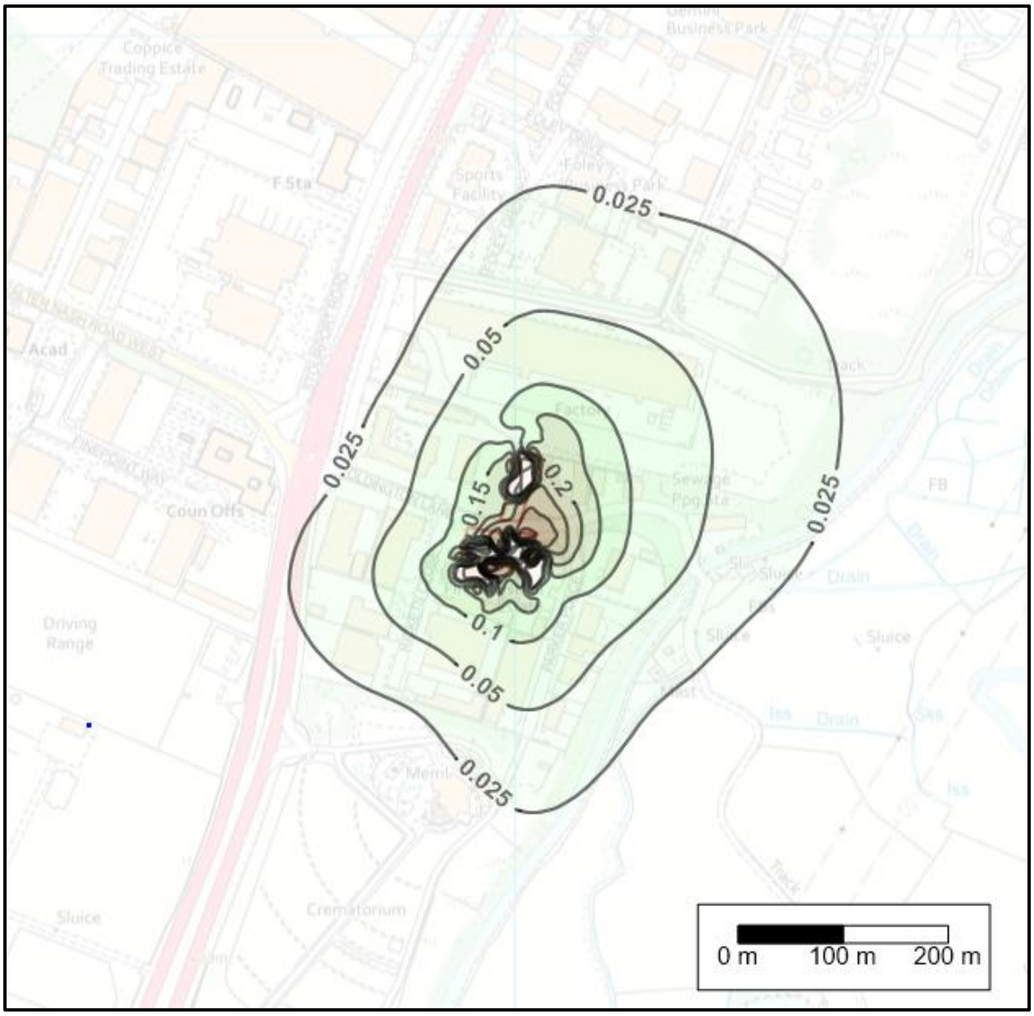
Table 5.2 shows the maximum predicted annual average at any specific receptor where there is relevant exposure (ie annual average impacts at residential properties, R1-R5) is 0.004 $\mu g\ m^{-3,}$ which is 0.0% of the Environmental Assessment Level (EAL) of 40.0 $\mu g\ m^{-3}$ for PM_{10} and 20 $\mu g\ m^{-3}$ for $PM_{2.5}$. It is reasonable to exclude all locations where there is no potential long-term exposure, given that it is only long-term impacts that are of concern to human health.

Table 5.2 shows that the long-term emissions of both PM_{10} and $PM_{2.5}$ can be screened out as insignificant using the Environment Agency (EA) Stage 1 test, as the Process Contribution (PC) is not less than 1% of the Environmental Assessment Levels (EAL).

Figure 5.2 shows the predicted annual average concentration of particulate matter (PM_{10}/$PM_{2.5}$) using 2023 meteorological data, as this rise to highest predicted impact.

The figures show that peak predicted ground-level concentrations (Process Contribution, PC) occur within about 50 m of the installation.

Figure 5.2 **ADMS 6.0 Predicted Annual Average Ground-Level Concentration (Process Contribution, PC) Particulate Matter (PM_{10}/$PM_{2.5}$); 2023 Meteorological Data ($\mu g\ m^{-3}$)**



PM_{10}: Environmental Assessment Level (EAL): 40.0 $\mu g\ m^{-3}$
$PM_{2.5}$: Environmental Assessment Level (EAL): 20.0 $\mu g\ m^{-3}$

Table 5.3 shows the predicted maximum 90.4th percentile of the 24-hour average process contribution (PC) of PM_{10} at the specific receptors and at the point of maximum impact. The predicted 24-hour average uses the short-term emission rates.

Table 5.3 **ADMS 6.0 Predicted Maximum 90.4th Percentile of 24-Hour Average Ground Level Concentration, Process Contribution (PC) PM_{10} ($\mu g\ m^{-3}$)**

Location	2021	2022	2023	2024	2025	Max.	Maximum as Percentage of EAL (%) [(a)]
R1	0.05	0.04	0.05	0.05	0.04	**0.05**	0.1%
R2	0.04	0.04	0.04	0.04	0.03	**0.04**	0.1%
R3	0.05	0.05	0.05	0.05	0.04	**0.05**	0.1%
R4	0.03	0.04	0.03	0.03	0.03	**0.04**	0.1%
R5	0.04	0.04	0.03	0.03	0.05	**0.05**	0.1%
R6	0.10	0.08	0.09	0.06	0.12	**0.12**	0.2%
R7	0.15	0.14	0.15	0.12	0.21	**0.21**	0.4%
R8	3.47	3.77	3.93	3.63	3.57	**3.93**	7.9%
R9	3.07	2.82	2.96	2.96	2.90	**3.07**	6.1%
R10	2.71	2.61	2.64	2.69	2.60	**2.71**	5.4%
R11	2.67	2.95	2.58	2.14	3.19	**3.19**	6.4%
R12	2.18	2.02	1.99	1.88	1.97	**2.18**	4.4%
R13	1.90	1.83	2.05	1.99	1.82	**2.05**	4.1%
R14	1.09	1.01	1.00	1.04	0.96	**1.09**	2.2%
R15	1.21	1.16	1.12	0.87	1.48	**1.48**	3.0%
R16	1.02	1.13	1.10	1.04	1.15	**1.15**	2.3%
Receptor Max	**3.47**	**3.77**	**3.93**	**3.63**	**3.57**	**3.93**	**7.9%**
Grid Maximum	**4.75**	**4.89**	**5.26**	**4.91**	**5.07**	**5.26**	**10.5%**

(a) Environmental Assessment Level (EAL): 50.0 $\mu g\ m^{-3}$.

Table 5.3 shows that the maximum predicted Process Contribution (PC) at any specific receptor is 3.9 $\mu g\ m^{-3,}$ which is 7.9% of the Environmental Assessment Level (EAL) of 50 $\mu g\ m^{-3}$.

It is not possible to use the first state of the EA's two-stage test for insignificance to screen the predicted impacts as insignificant, given that the grid maximum is 10.5% of the EAL.

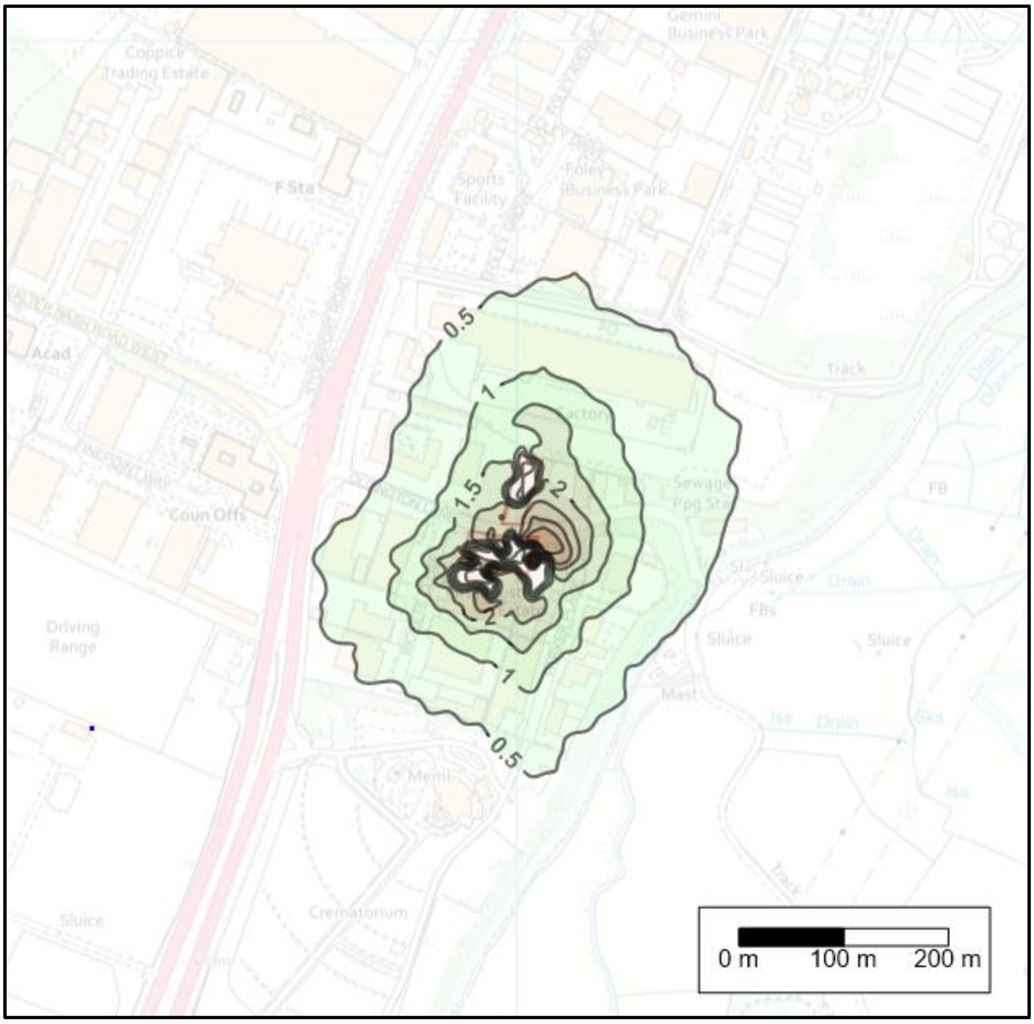
The grid maximum of 5.26 $\mu g\ m^{-3}$ is 20% of the short-term EAL minus twice the annual average background of 10.7 $\mu g\ m^{-3}$ and therefore can be screened as insignificant.

When considering the significance of the predicted impacts, it is important to remember that the modelling assumes emissions are at their maximum for the entire 35 24-hour time period in one year (90.4th percentile), which results in the worst dispersion.

Figure 5.3 shows the predicted maximum 90.4th Percentile of 24-hour average concentration of particulate matter (PM_{10}) using 2023 meteorological data, as this rise to highest predicted impact.

The figures show that peak predicted ground-level concentrations (Process Contribution, PC) occur within about 50 m of the installation.

Figure 5.2 **ADMS 6.0 Predicted 90.4th Percentile of 24-Hour Average Ground-Level Concentration (Process Contribution, PC) PM_{10}: 2023 Meteorological Data ($\mu g\ m^{-3}$)**



Environmental Assessment Level (EAL): 50 $\mu g\ m^{-3}$

6 SENSITIVITY ANALYSIS

6.1 INTRODUCTION

This section considers the sensitivity of model-predicted concentrations to the following:

- Meteorological data
- Roughness length
- Terrain
- Buildings
- Stack height
- Grid Spacing

Predictions are for the grid maximum predicted process contribution (PC) of chromium (VI).

6.2 METEOROLOGICAL DATA

The assessment presented in this report is based on predictions made using five years (2021-2025) of NWP meteorological data for Kidderminster.

To illustrate the year-to-year variation in meteorological data and sensitivity to meteorological data selection, **Table 6.1** shows the maximum predicted concentration of chromium (VI) for each of the five years of meteorological data using the NWP data from 2021 to 2025 and using the 2024 data from both Pershore (28 km) and Birmingham (34 km).

Table 6.1 Meteorological Data: ADMS 6.0 Maximum Predicted Annual Average Concentration of Chromium (VI): Receptor Maximum (ng m^{-3})

Source	Year	Annual Average
NWP	2021	2.09
NWP	2022	2.04
NWP	2023	2.07
NWP	**2024**	**2.01**
NWP	2025	2.15
Pershore	2024	2.09
Birmingham	2024	2.12
Environmental Assessment Level (EAL)		**0.25**

Table 6.1 shows some year-to-year variation in the predicted concentration for NWP data for 2021 to 2025, although the variation is insignificant. For 2024 meteorological data, predictions from Pershore and Birmingham are very close to the predicted concentration using NWP data.

6.3 ROUGHNESS LENGTH

The roughness length of 0.5 m used in this assessment was selected using professional judgement. Roughness length cannot be directly measured. In practice, there is no one unique roughness that fits a given wind speed profile. Roughness length will also vary depending on wind direction and other factors, such as the season of the year.

Therefore, it is of interest to see how sensitive the model predictions are to roughness length.

Table 6.2 shows the maximum predicted concentration of chromium (VI) for roughness lengths in the range of 0.25 m to 1.0 m using 2023 meteorological data.

Table 6.2 Roughness Length: ADMS 6.0 Maximum Predicted Annual Average Concentration of Chromium (VI): (ng m^{-3})

Roughness Length (m)	Annual Average
0.25	2.02
0.5	**2.07**
1.0	2.00
Environmental Assessment Level (EAL)	**0.25**

Table 6.2 shows that the maximum predicted annual average increases with is not sensitive to the selected roughness length.

6.4 TERRAIN AND BUILDINGS

The modelling presented in this assessment included the effects of buildings and terrain. **Table 6.3** shows the maximum predicted chromium (VI), both with and without the effects of terrain and buildings, using 2023 meteorological data.

Table 6.3 Terrain and Buildings: ADMS 6.0 Predicted Annual Average Concentration of Chromium (VI): Grid Maximum (ng m^{-3})

Terrain Effects	Building Effects	Annual Average
Yes	**Yes**	**2.07**
Yes	No	0.29
No	Yes	2.15
No	No	0.30
Environmental Assessment Level (EAL)		**0.25**

Table 6.3 shows that the effects of building downwash are significant and the effects of terrain are not significant.

6.5 STACK HEIGHT

Table 6.4 shows the predicted concentration for a stack height in the range of -2.0 m to + 2 m compared to their actual heights. Predictions are made for 2023 meteorological data.

Table 6.4 **Stack Height: ADMS 6.0 Predicted Annual Average Concentration of Chromium (VI): Grid Maximum (ng m^{-3})**

Stack Height (m)			Annual Average
A2	**A12**	**A13**	
7	6	6	2.76
8	6	7	2.54
9 (Actual)	**7 (Actual)**	**8 (Actual)**	**2.07**
10	8	9	1.64
11	9	10	1.27
Assessment Level			**0.25**

Table 6.4 shows that an increase in the stack height reduces the maximum predicted concentration.

6.6 GRID SPACING

This assessment used a grid spacing of 5 m. **Table 6.4** shows the maximum predicted concentration of chromium (VI) grid spacing in the range 2.5 m to 10 m. Predictions are made for 2023 meteorological.

Table 6.5 **Grid Spacing: ADMS 6.0 Predicted Annual Average Concentration of Chromium (VI, ng m^{-3})**

Grid Spacing (m)	Annual Average
2.5	2.07
5.0	**2.07**
10.0	2.06
Assessment Level	**0.25**

Table 6.5 shows that the use of a 2.5 m receptor spacing gives rise to a maximum predicted concentration that is the same as that for a 5 m grid. This demonstrates that the receptor spacing of 5 m used in this assessment is sufficient to capture the maximum concentration.

7 SUMMARY AND CONCLUSIONS

EnviroSolution Ltd was commissioned to undertake an air quality assessment of emissions to the atmosphere from Hard Anodising Surface Treatment Ltd Installation at Stourport Road, Kidderminster, DY11 7QN.

The outcome of the H1 assessment undertaken in 2025 and updated in 2026, required to support the application for an Environmental Permit (EP), was that detailed modelling and assessment is required for emissions of particulate matter (PM_{10}) and hexavalent chromium Cr (VI). (1)

The pollutants considered in this detailed modelling and assessment are:

- Particulate matter (PM_{10}/$PM_{2.5}$); and
- Hexavalent chromium Cr (VI)

Particulate Matter (PM_{10}/$PM_{2.5}$) is emitted to the atmosphere from eight stacks, and hexavalent chromium Cr (VI) from three stacks.

Predictions are made using the ADMS 6.0 dispersion model for each of five years of meteorological data. The predicted impacts have been compared against Environmental Assessment Levels (EALs) set by the Environment Agency (EA) to determine their significance.

A detailed analysis of the sensitivity of the model-predicted concentration to assumptions made has been included in this report.

The principal conclusions of this assessment are:

- The maximum predicted Process Contribution (PC) of hexavalent chromium Cr (VI) at any receptor where there is long-term exposure (ie residential receptors) is 2.8% of the Environmental Assessment Levels (EAL).

- Given that the assessment conservatively assumes 100% of chromium (Cr) emissions are hexavalent chromium (Cr VI), it is considered that predicted impacts of hexavalent chromium (Cr VI) at the residential receptors are not of concern to human health.

- The assessment shows that the predicted impacts of PM_{10} and $PM_{2.5}$ are insignificant.

(1) Hard Anodising Surface Treatment H1 v2 (CL1003).