RISK & HAZARD MANAGEMENT

# Environmental Permit Variation

# Detailed Dispersion Modelling

## Unifrax, Widnes

Safety Risk Business Risk Environment Risk

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# 1 Introduction

## 1.1 Purpose of the Study

The purpose of this study is to provide an air quality assessment of releases to atmosphere from the Unifrax site in Widnes and the impacts of the introduction of a fourth production line for Saffil Alumina Fibre, known as Line 4. The purpose of the assessment is to support the permit variation application for the project.

Prior to ADMS modelling, an H1 assessment was undertaken, and some substances screened out. This detailed modelling focuses on NOx, PM10 which were not screened out, and dioxins for which the use of the H1 tool is not suitable. The H1 risk assessment, is provided in an additional appendix to Document 005, of which this document is also an appendix.

## 1.2 Site Background

Current production from Widnes serves a wide range of customers in industrial and automotive applications. Most customers are overseas.

Typical industrial applications include furnace linings and modules, specialist refractory boards and shapes and filtration applications.

Automotive applications form a larger part of the overall volume with the main application being gaskets in catalytic converters (autowraps). Fibre from Widnes is exported to sister factories in North Wales and South Africa for conversion into autowraps using a wet laid process. It is also supplied to other customers who operate similar processes. Other automotive applications include heat protection, battery separators, metal matrix reinforcement and diesel particulate filters.

Line 4 is being built to service demand for SiFAB™, a new silicon fibre product developed by Unifrax for use as an anode material in Lithium-ion rechargeable batteries. SiFAB™ offers significant advantages in charge density and physical battery size due to its chemistry and is a very significant opportunity to improve for example portable battery life, electric vehicle range and reduce weight in hand-held devices. SiFAB™ is a pure silicon fibre made by converting the silica (silicon dioxide) fibre made at Widnes into the required silicon fibre by reduction. The first commercial production line for SiFAB™ is currently planned for installation in Indiana, USA. Silica fibre from Widnes will be exported to this facility and future capacity for conversion into SiFAB™. Line 4 will also have capability to make other Saffil and M-Fil fibres in order to fill capacity and maintain sales revenue as the market for SiFAB™ develops. Line 1 is being removed from the permit as it is no longer in use.

There will be five new emission points to air, which largely replicate the emission points for Line 3 (A11 Line 4 heat treatment ovens, A12a and A12b dust collection units, A13 boiler and A14 indirect gas firing – heat treatment). Emission points A1 (Line 1) and A8 (standby oil fired boiler) will be removed from service so are no longer included within the assessment. Emission point A2 will remain in service to support fibre reprocessing and repacking operations, unconnected with the operation of Line 1 – which will be permanently removed from service.

A layout and location map of the site can be found in supporting document 003 – site plans and drawings.

## 1.3 Modelled Scenarios

For the purpose of this assessment, releases to air are from a number of different point sources, specified in the table below. Note, within the modelling, concentrations at both monitored emissions and emissions at the current/proposed ELV within the permit are modelled. The table also provides details of the ELVs considered.

**Table 1 Point sources**

| Emission point | Grid Reference | Source | Emissions modelled | ELV modelled ($mg/m^3$) |
|---|---|---|---|---|
| A2 | 352922 385322 | Line 1 dust collection | Particulates | 5 $mg/m^3$ |
| A3 | 352868 385336 | Line 2 ovens | Dioxin | 0.3 $ng/m^3$ |
| A4 | 352917 385346 | Line 2 dust collection | Particulates | 5 $mg/m^3$ |
| A5 | 352923 385285 | Line 3 ovens | Dioxin | 0.3 $ng/m^3$ |
| A6 | 352978 385299 | Line 3 dust collection | Particulates | 5 $mg/m^3$ |
| A7 | 352942 385328 | Boiler | NOx | 140 $mg/m^3$ |
| A9 | 352942 385328 | Boiler | NOx | 100 $mg/m^3$ |
| A11 | 352951 385254 | Line 4 ovens | Dioxin | 0.3 $ng/m^3$ |
| A12a | 353043 385288 | Line 4 dust collection part a (general process dust extraction) | Particulates | 5 $mg/m^3$ |
| A12b | 353021 385278 | Line 4 dust collection part b (fibre picking, shredding and milling) | Particulates | 5 $mg/m^3$ |
| A13 | 352942 385328 | Boiler | NOx | 100 $mg/m^3$ |
| A14 | 352933 385247 | Indirect gas firing – heat treatment | NOx | 100 $mg/m^3$ |

# 2 Emissions and Air Quality Standards

The pollutants considered in the assessment include the oxides of nitrogen (NOx), particulates (PM10) and dioxins. There is currently no formal guidance in the UK on the assessment of health risks associated with exposure to emissions from facilities that may emit dioxins, and in England and Wales the Environment Agency's Air Quality Management and Assessment Unit (AQMAU) have accepted the use of the US EPA methodology as appropriate. However, where the USEPA methodology appears to make assumptions that are unlikely to be valid for the UK (Widnes) situation, alternative calculations are submitted.

## 2.1 Oxides of Nitrogen

The oxides of nitrogen comprise principally of nitric oxide (NO) and nitrogen dioxide ($NO_2$). The oxides of nitrogen (NOx) in combustion processes may be formed from the oxidation of nitrogen in the fuel or from the reaction of nitrogen and oxygen at high temperatures. The majority of NOx is emitted from combustion processes as NO (typically over 90%), a relatively innocuous substance that rapidly oxidises to $NO_2$ in ambient air. Health based standards for NOx generally relate to $NO_2$.

There are two types of air quality standards for nitrogen dioxide applicable in the UK including:

- Air Quality Strategy objectives
- European Union Daughter Directive air quality standards

Air quality limits and objectives (from the Air Quality Strategy/Daughter Directive) for the oxides of nitrogen in the UK are summarised in Table 2 below.

**Table 2 Oxides of Nitrogen limits**

| Averaging period | Air Quality Standard (µg/m$^3$) |
|---|---|
| 1-hour mean not to be exceeded more than 18 times per calendar year (99.79 Percentile) | 200 |
| Annual mean | 40 |

For protected conservation areas, the limits are provided in the table below:

**Table 3 Oxides of Nitrogen as $NO_2$ limits**

| Averaging period | Target (µg/m$^3$) |
|---|---|
| Daily mean | 75 |
| Annual mean | 30 |

## 2.2 Particulates

The UK Air Quality Standards for particulates are summarised in Table 4 below.

**Table 4 Particulate limits**

| Averaging period | Air Quality Standard ($\mu g/m^3$) |
|---|---|
| 24 hr short-term mean (90.41 Percentile) | 50 |
| Annual mean | 40 |

# 3 Ambient and Background Levels

The purpose of this section is to provide an assessment of the background air quality for the general location.

The most recent available background concentration data for Particulates and $NO_2$ were obtained using the UK Air Quality Archive website. Predicted 2019 levels for the Unifrax Widnes area are shown in the table below. 2019 has been selected as a worst-case pre-pandemic background concentration.

**Table 5 $NO_2$ long term background levels**

| Feature | Grid Reference | Background level grid reference used | Level ($\mu g/m^3$) |
|---|---|---|---|
| Offsite | 352870, 385420 | 352500, 385500 | 16.06 |
| **Sensitive receptor** | | | |
| St Helens canal/Widnes Warth | 352980, 385170 | 352500, 385500 | 16.06 |
| Randle Reed Bed | 353880, 384450 | 353500, 383500 | 15.37 |
| Houses off French Street | 352610, 385970 | 352500, 385500 | 16.06 |
| New Housing estate to the west of the site | 352625, 385211 | 352500, 385500 | 16.06 |
| Caravans at the Warrington Road Site | 352320, 385680 | 352500, 385500 | 16.06 |
| AQMA 1 | 351920, 385600 | 351500, 386500 | 14.67 |
| AQMA 2 | 351890, 386040 | 351500, 386500 | 14.67 |
| Wigg Island | 353330, 383550 | 352500, 383500 | 13.71 |
| Mersey Estuary | 350990, 383730 | 350500, 383500 | 14.88 |

Table 6 PM10 Long term background levels

| Feature | Grid Reference | Background level grid reference used | Level (µg/m$^3$) |
|---|---|---|---|
| Offsite | 352870, 385420 | 352500, 385500 | 12.78 |
| **Sensitive receptor** | | | |
| St Helens canal/Widnes Warth | 352980, 385170 | 352500, 385500 | 12.78 |
| Reed Bed | 353880, 384450 | 353500, 383500 | 11.56 |
| Houses off French Street | 352610, 385970 | 352500, 385500 | 12.78 |
| New Housing estate to the west of the site | 352625, 385211 | 352500, 385500 | 12.78 |
| Caravans at the Warrington Road Site | 352320, 385680 | 352500, 385500 | 12.78 |
| AQMA 1 | 351920, 385600 | 351500, 385500 | 13.56 |
| AQMA 2 | 351890, 386040 | 351500, 386500 | 13.02 |
| Wigg Island | 353330, 383550 | 352500, 383500 | 11.34 |
| Mersey Estuary | 350990, 383730 | 350500, 383500 | 12.96 |

It should be noted that existing site emissions will have contributed to the predictions of background concentrations.

The above values are used for modelling of Long Term emissions; modelling of Short Term emissions uses a value of double the Long Term average background value.

Background concentration of dioxins is based on the most recently available TOMPs network data (2010) for Manchester and is assessed as 5.00E-05 ngTEQ/m$^3$ for the Widnes area.

# 4 ADMS Model

The dispersion modelling software used for the assessment was Cambridge Environmental Research Consultant's Atmospheric Dispersion Modelling Software (ADMS). The version used is ADMS 5.2.2. ADMS is a new generation Gaussian plume air dispersion model which means that the atmospheric boundary layer properties are characterised by two parameters, rather than in terms of the single parameter Pasquill-Gifford class:

- the boundary layer depth, and
- the Monin-Obukhov length.

Dispersion under convective meteorological conditions uses a skewed Gaussian concentration distribution (shown by validation studies to be a better representation than a symmetrical Gaussian expression).

## 4.1 ADMS Validation

CERC models are continually validated against available measured data obtained from real world situations, field campaigns and wind tunnel experiments.

Validation of the ADMS dispersion models has been performed using many experimental datasets that test different aspects of the models, for instance: ground/high level sources, passive and buoyant releases, buildings, complex terrain, chemistry, deposition and plume visibility. These studies are both short-term as well as annual and involve tracer gases or specific pollutants of interest.

ADMS has been formally validated and is widely used in the UK and internationally for regulatory purposes. It has been used in a wide number of Air Quality studies, dating from the present, back to 2006, all of which can be found on the CERC website.

# 5 Input and Emission Parameters

The following table presents the parameters used within the ADMS modelling and have been approved by the client. The location of the stacks included in the model is shown in the map in the Appendix. The raw data used to calculate the emissions rates is provided alongside this report with the ADMS input files.

**Table 7 Model Parameters**

| Parameter | A2 | A3 | A4 | A5 | A6 | A7 | A9 | A11 | A12a | A12b | A13 | A14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Source | Line 1 dust collection | Line 2 heat treatment | Line 2 dust collection | Line 3 heat treatment | Line 3 dust collection | Boilers | Boilers | Line 4 heat treatment | Line 4 dust collection (general process dust extraction) | Line 4 dust collection (fibre picking, shredding and milling) | Boilers | Indirect gas firing – heat treatment |
| Emissions | PM10 | Dioxins | PM10 | Dioxins | PM10 | NOx | NOx | Dioxins | PM10 | PM10 | NOx | NOx |
| Total Flow ($m^3$/hr) | 35,604 | 43,708 | 29,886 | 49,431 | 47,338 | 2,893 | 7,890 | 55,610 | 47,338 | 47,338 | 7,890 | 6,405 |
| Exit Temp ($^0$C) | 23 | 49 | 32 | 45 | 40 | 140 | 150 | 45 | 40 | 40 | 150 | 125 |
| Height (m) | 14.5 | 40 | 8.15 | 40 | 20 | 30 | 30 | 40 | 20 | 20 | 30 | 30 |
| Diameter (m) | 0.98 | 1.5 | 0.93 | 1.5 | 0.93 | 0.6 | 0.6 | 1.5 | 0.93 | 0.93 | 0.6 | 0.47 |
| OS Grid Reference | 352922 385322 | 352868 385336 | 352917 385346 | 352923 385285 | 352978 385299 | 352942 385328 | 352942 385328 | 352951 385254 | 353043 385288 | 353021 385278 | 352942 385328 | 352933 385247 |
| Pollutant emission rates (g/s) | 1.04E-02 | 2.44E-09 | 7.56E-03 | 1.21E-09 | 1.40E-02 | 9.58E-02 | 2.03E-01 | 1.36E-09 | 1.40E-02 | 1.40E-02 | 2.03E-01 | 8.90E-02 |
| Pollutant emission rates (g/s) at ELV | 4.94E-02 | 3.64E-09 | 4.15E-02 | 4.12E-09 | 6.57E-02 | 1.13E-01 | 2.19E-01 | 4.63E-09 | 6.57E-02 | 6.57E-02 | 2.19E-01 | 1.78E-01 |
| Volumetric flow rate ($m^3$/s) | 9.89 | 12.14 | 8.30 | 13.73 | 13.15 | - | - | 15.45 | 13.15 | 13.15 | - | - |
| Mass flux (kg/s) | - | - | - | - | - | 1.0009 | 2.73 | - | - | - | 2.73 | 2.22 |

Note: only one of volumetric flow rate or mass flux need to be input into ADMS.

# 6 Receptors

This section sets out the details of discrete receptors and the x and y co-ordinates used within ADMS to assess the impact at these locations.

## 6.1 Ecological Receptors

The Environment Agency's Air Emissions Risk (AER) Guidance provides the following detail regarding consideration of ecological receptors:

*Check if there are any of the following within 10 km of your site:*

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

*Check if there are any of the following within 2 km of your site:*

- *Sites of Special Scientific Interest (SSSIs)*
- *Local Nature Sites (ancient woods, local wildlife sites, Sites of Nature Conservation)*
- *Importance (SNCIs) and national and local nature reserves)*

Therefore, the table below provides details of the receptors considered within the assessment. These have been identified using Magic Maps and buffering the 10 km and 2 km distances from the site.

**Table 8 Ecological Receptors**

| Receptors | Distance from site (m) | Designation | Easting, x (m) | Northing, y (m) | Height above ground, z (m) |
|---|---|---|---|---|---|
| St Helens canal/Widnes Warth | ~ 90 | Local wildlife site | 352980 | 385170 | 0 |
| Randle Reed Bed | ~ 1,100 | Biodiversity Action Plan Priority Habitat | 353880 | 384450 | 0 |
| Wigg Island | ~ 1,300 | LNR | 353330 | 383550 | 0 |
| Mersey Estuary | ~ 2,600 | Ramsar, SPA, SSSI | 350990 | 383730 | 0 |

## 6.2 Human Receptors

The nearest human receptors are people working in the commercial premises adjacent to the Unifrax Widnes site. These people will only be exposed during their working day and not for all hours of the year.

The table below provides details of the human receptors considered within the assessment, which are the nearest commercial and residential areas to the site.

**Table 9 Human Receptors**

| Receptors | Easting, x (m) | Northing, y (m) | Height above ground, z (m) |
|---|---|---|---|
| Houses off French Street | 352610 | 385970 | 1.8 |
| New Housing estate to the west of the site | 352625 | 385211 | 1.8 |
| Caravans at the Warrington Road Site | 352320 | 385680 | 1.8 |
| Nearest commercial premises | 352870 | 385420 | 1.8 |

Halton Borough Council have declared two Air Quality Management Areas (AQMAs) where road traffic emissions may cause exceedance of the air quality standard for NOx.[1]

These have been included within the assessment also.

These receptors in relation to the site are all presented on a map in the Appendix.

[1] AQMAs Declared by Halton Borough Council, https://uk-air.defra.gov.uk/aqma/local-authorities?la_id=116 (accessed October 2021).

# 7 Weather Data

For meteorological data to be suitable for dispersion modelling purposes several meteorological parameters need to be measured, on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature. There is only a limited number of sites where the required meteorological measurements are made. In the UK, all these sites are quality controlled by the Met Office.

The most important climatological parameters governing the atmospheric dispersion of pollutants are as follows.

- Wind direction determines the broad transport of the release and the sector of the compass into which the release is dispersed.
- Wind speed will affect low-level releases by increasing the initial dilution of pollutants in the release.
- Atmospheric stability is a measure of the turbulence, particularly of the vertical motions present.

## 7.1 Local Meteorological Data

The nearest station to the site with full data suitable for dispersion modelling as informed by the Met Office is located at Rostherne, 20 km to the east of the site. This is considered the most representative of conditions in the vicinity of the site and three years of annual hourly-sequential meteorological data for this observing station have been obtained from the Met Office, who specifically provide weather data sets for use in ADMS modelling. Within the previous dispersion modelling carried out for the site and approved by the EA, weather data from Manchester Ringway was obtained and used. The Met Office were asked for data from the same station for this assessment for consistency but that station is no longer available and Rostherne was provided as the best alternative. Wind roses from the previous assessment and the wind roses for the Rostherne data have been compared and generally show the same dominant wind direction.

Data for the years 2017 to 2019 have been obtained, and the following parameters included for each hour:

- Wind speed (at 10 m)
- Wind direction (degrees)
- Cloud cover (oktas)
- Temperature (degrees Celsius)
- Sensible heat flux ($W/m^2$)
- Boundary layer depth (m)
- Precipitation rate (mm/h)
- Relative humidity (percentage)

Wind roses for each year between 2017 and 2019 are shown below.

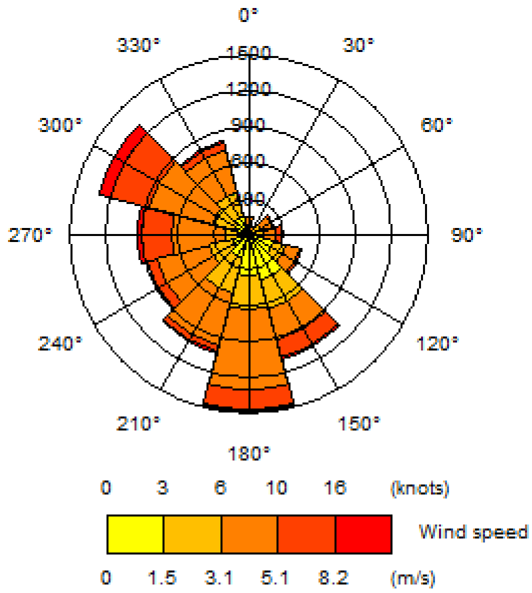



**Figure 1 2017 Wind Rose**

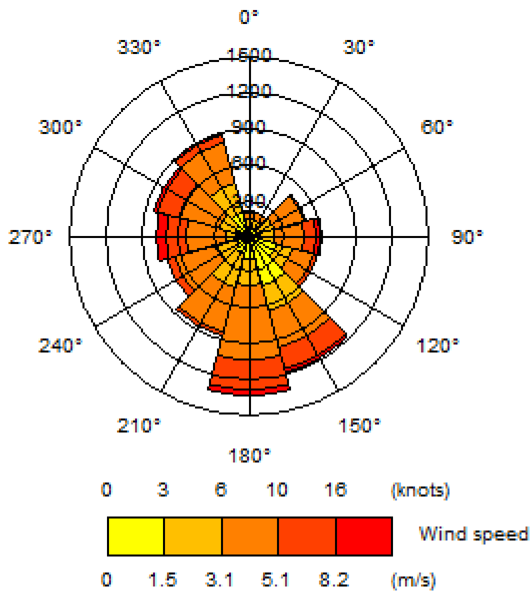



**Figure 2 2018 Wind Rose**

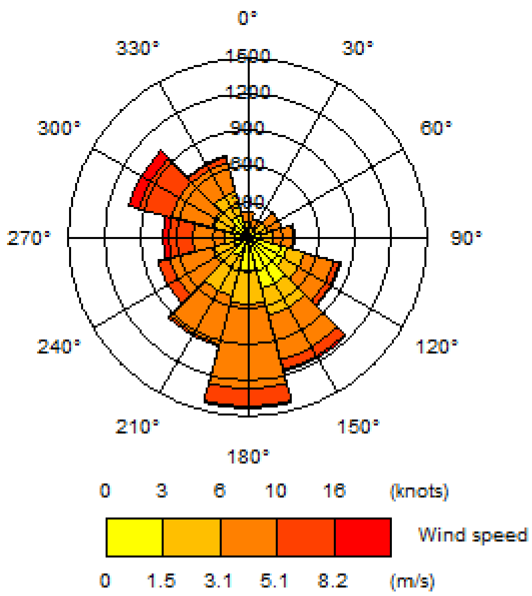



**Figure 3 2019 Wind Rose**

The ADMS model was run independently for each year of meteorological data in order to obtain results from each year for comparison to the emission limits to ensure the results are representative of more long-term weather conditions and any peaks which may be missed by only using one year of data are captured.

# 8 Terrain/Buildings

## 8.1 Terrain

There are no significant terrain features in the area surrounding the site, therefore stack dispersion is unlikely to be influenced by the effects of elevated terrain and the digital terrain model within ADMS has not been used.

## 8.2 Buildings

Emissions from stacks may be influenced by significantly sized buildings in the vicinity of the dispersion. The locations and dimensions of the buildings considered, including parameters such as size, shape and position relative to the stacks are presented in the table below. within the model are presented in the table below and shown on a map in the Appendix. The effect of buildings on dispersion was modelled using the ADMS advanced ‘Buildings’ option.

**Table 10 Building Data**

| Building | Shape | Location of building centre | | Height (m) | Length/ Diameter (m) | Width (m) | Angle (°) |
|---|---|---|---|---|---|---|---|
| | | Easting x (m) | Northing y (m) | | | | |
| Line 2 | Rectangular | 352857 | 385309 | 10 | 115 | 25 | 73.0 |
| Line 3/4 including extension | Rectangular | 352964 | 385283 | 12 | 152 | 26 | 73.0 |
| Preparation | Rectangular | 352843 | 385282 | 24 | 15 | 15 | 163.0 |
| Warehouse | Rectangular | 352939 | 385361 | 12 | 25 | 25 | 73.0 |
| Line 2 extension | Rectangular | 352933 | 385337 | 10 | 48 | 16 | 73.0 |

The boiler house, bag house and new solutions building are considered too small to have any significant effect on dispersion, especially given the height of the majority of the stacks onsite and their locations.

# 9 Impact Assessment

This section sets out the assessment of impact from the site on both environmental receptors and human receptors from each of the substances not screened out within the H1 Risk Assessment, particulates (PM10), NOx and dioxins in turn.

## 9.1 Particulates

Detailed Air Dispersion Modelling was carried out using the ADMS 5.2 model to assess the short term and long-term concentrations of particulates (PM10). Meteorological data from 2017 to 2019 was used and results are presented for all years of meteorological data.

The Process Contribution (PC) from modelling has been added to the background levels for each sensitive location and then compared with the relevant air quality standard.

## Short Term

**Table 11 Short Term PM10 (2017)**

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 0.19 | 25.56 | 25.76 | 50 | 0.39% | 52% |
| Randle Reed Bed | 0.07 | 23.11 | 23.18 | 50 | 0.14% | 46% |
| Mersey Estuary | 0.001 | 25.92 | 25.92 | 50 | 0.002% | 52% |
| Wigg Island LNR | 0.01 | 22.69 | 22.70 | 50 | 0.02% | 45% |
| Nearest working population (offsite) | 0.48 | 25.56 | 26.04 | 50 | 0.96% | 52% |
| New Housing estate to the west of the site | 0.01 | 25.56 | 25.57 | 50 | 0.02% | 51% |
| Houses off French St | 0.10 | 25.56 | 25.66 | 50 | 0.22% | 51% |
| Caravans at the Warrington Road site | 0.04 | 25.56 | 25.60 | 50 | 0.08% | 51% |
| AQMA 1 | 0.01 | 27.12 | 27.13 | 50 | 0.02% | 54% |
| AQMA 2 | 0.03 | 26.05 | 26.07 | 50 | 0.06% | 52% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 0.97 | 25.56 | 26.53 | 50 | 1.9% | 53% |
| Randle Reed Bed | 0.33 | 23.11 | 23.44 | 50 | 0.7% | 47% |
| Mersey Estuary | 0.01 | 25.92 | 25.93 | 50 | 0.01% | 52% |
| Wigg Island LNR | 0.05 | 22.69 | 22.74 | 50 | 0.1% | 45% |
| Nearest working population (offsite) | 2.56 | 25.56 | 28.12 | 50 | 5.1% | 56% |
| New Housing estate to the west of the site | 0.04 | 25.56 | 25.60 | 50 | 0.1% | 51% |
| Houses off French St | 0.51 | 25.56 | 26.07 | 50 | 1.0% | 52% |
| Caravans at the Warrington Road site | 0.20 | 25.56 | 25.76 | 50 | 0.4% | 52% |
| AQMA 1 | 0.04 | 27.12 | 27.16 | 50 | 0.1% | 54% |
| AQMA 2 | 0.14 | 26.05 | 26.19 | 50 | 0.3% | 52% |

Table 12 Short Term PM10 (2018)

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 0.23 | 25.56 | 25.79 | 50 | 0.5% | 52% |
| Randle Reed Bed | 0.07 | 23.11 | 23.18 | 50 | 0.1% | 46% |
| Mersey Estuary | 0.01 | 25.92 | 25.93 | 50 | 0.02% | 52% |
| Wigg Island LNR | 0.01 | 22.69 | 22.70 | 50 | 0.02% | 45% |
| Nearest working population (offsite) | 0.54 | 25.56 | 26.10 | 50 | 1.1% | 52% |
| New Housing estate to the west of the site | 0.24 | 25.56 | 25.80 | 50 | 0.5% | 52% |
| Houses off French St | 0.12 | 25.56 | 25.68 | 50 | 0.2% | 51% |
| Caravans at the Warrington Road site | 0.05 | 25.56 | 25.61 | 50 | 0.1% | 51% |
| AQMA 1 | 0.03 | 27.12 | 27.15 | 50 | 0.1% | 54% |
| AQMA 2 | 0.03 | 26.05 | 26.08 | 50 | 0.1% | 52% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 1.17 | 25.56 | 26.73 | 50 | 2.3% | 54% |
| Randle Reed Bed | 0.34 | 23.11 | 23.46 | 50 | 0.7% | 47% |
| Mersey Estuary | 0.06 | 25.92 | 25.98 | 50 | 0.1% | 52% |
| Wigg Island LNR | 0.06 | 22.69 | 22.75 | 50 | 0.1% | 45% |
| Nearest working population (offsite) | 2.83 | 25.56 | 28.39 | 50 | 5.7% | 57% |
| New Housing estate to the west of the site | 1.18 | 25.56 | 26.74 | 50 | 2.4% | 54% |
| Houses off French St | 0.56 | 25.56 | 26.12 | 50 | 1.1% | 52% |
| Caravans at the Warrington Road site | 0.27 | 25.56 | 25.83 | 50 | 0.5% | 52% |
| AQMA 1 | 0.16 | 27.12 | 27.27 | 50 | 0.3% | 55% |
| AQMA 2 | 0.15 | 26.05 | 26.20 | 50 | 0.3% | 52% |

**Table 13 Short Term PM10 (2019)**

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 0.18 | 25.56 | 25.74 | 50 | 0.4% | 51% |
| Randle Reed Bed | 0.07 | 23.11 | 23.18 | 50 | 0.1% | 46% |
| Mersey Estuary | 0.01 | 25.92 | 25.93 | 50 | 0.01% | 52% |
| Wigg Island LNR | 0.01 | 22.69 | 22.70 | 50 | 0.02% | 45% |
| Nearest working population (offsite) | 0.61 | 25.56 | 26.17 | 50 | 1.2% | 52% |
| New Housing estate to the west of the site | 0.07 | 25.56 | 25.63 | 50 | 0.1% | 51% |
| Houses off French St | 0.11 | 25.56 | 25.67 | 50 | 0.2% | 51% |
| Caravans at the Warrington Road site | 0.07 | 25.56 | 25.63 | 50 | 0.1% | 51% |
| AQMA 1 | 0.04 | 27.12 | 27.16 | 50 | 0.1% | 54% |
| AQMA 2 | 0.04 | 26.05 | 26.09 | 50 | 0.1% | 52% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 0.87 | 25.56 | 26.43 | 50 | 1.7% | 53% |
| Randle Reed Bed | 0.34 | 23.11 | 23.46 | 50 | 0.7% | 47% |
| Mersey Estuary | 0.04 | 25.92 | 25.96 | 50 | 0.1% | 52% |
| Wigg Island LNR | 0.05 | 22.69 | 22.74 | 50 | 0.1% | 45% |
| Nearest working population (offsite) | 3.16 | 25.56 | 28.72 | 50 | 6.3% | 57% |
| New Housing estate to the west of the site | 0.32 | 25.56 | 25.88 | 50 | 0.6% | 52% |
| Houses off French St | 0.55 | 25.56 | 26.11 | 50 | 1.1% | 52% |
| Caravans at the Warrington Road site | 0.36 | 25.56 | 25.92 | 50 | 0.7% | 52% |
| AQMA 1 | 0.21 | 27.12 | 27.32 | 50 | 0.4% | 55% |
| AQMA 2 | 0.21 | 26.05 | 26.26 | 50 | 0.4% | 53% |

Modelling shows that predicted short term PECs are likely to be well below the EAL, with a maximum of 54% at AQMA 1 for predicted emissions for all years of meteorological data, and a maximum of 58% at the nearest offsite working population at ELV using 2019 meteorological data. It should be noted that the background concentrations at all locations are the significant contributor to the total concentration, with the site contribution being significantly less than any background level.

The following figures provide an indication, respectively, of the short term PM10 distribution using each year of meteorological data at:

- Average monitored/predicted emissions and
- Current/proposed ELV.

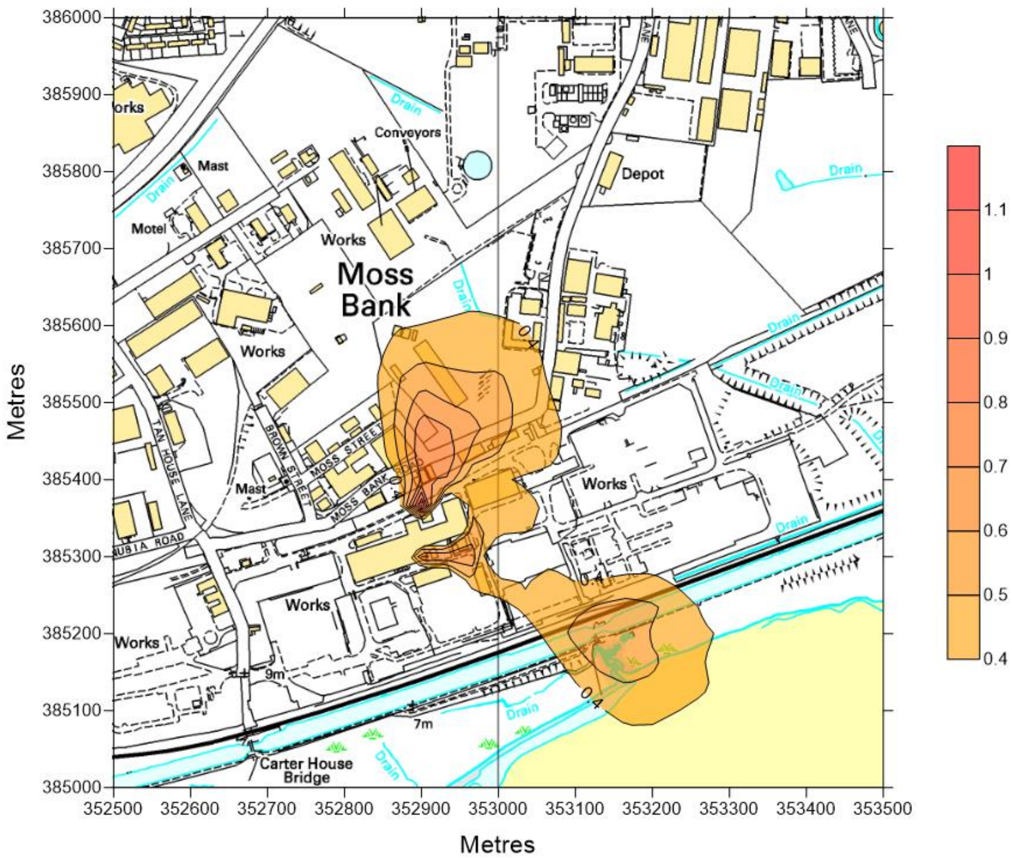



**Figure 4 Short term PM10 (µg/m³) at average monitored/predicted emissions (2017)**


**Figure 5 Short term PM10 (µg/m³) at average monitored/predicted emissions (2018)**

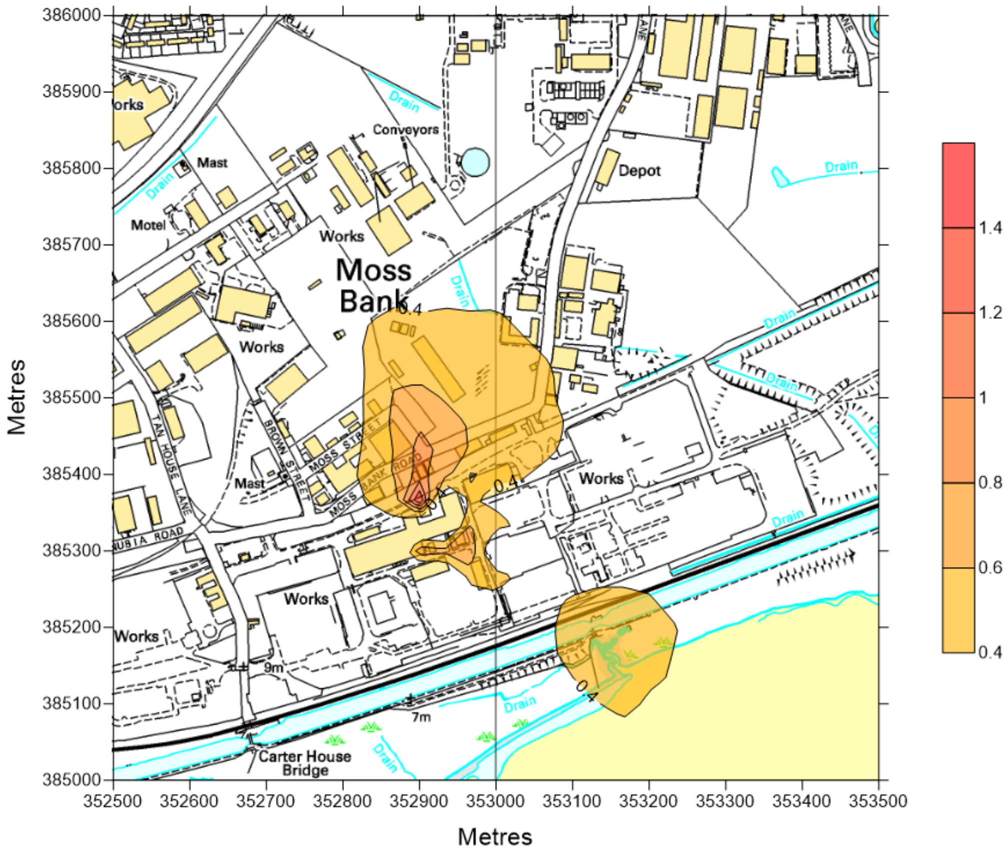



**Figure 6 Short term PM10 (µg/m³) at average monitored/predicted emissions (2019)**

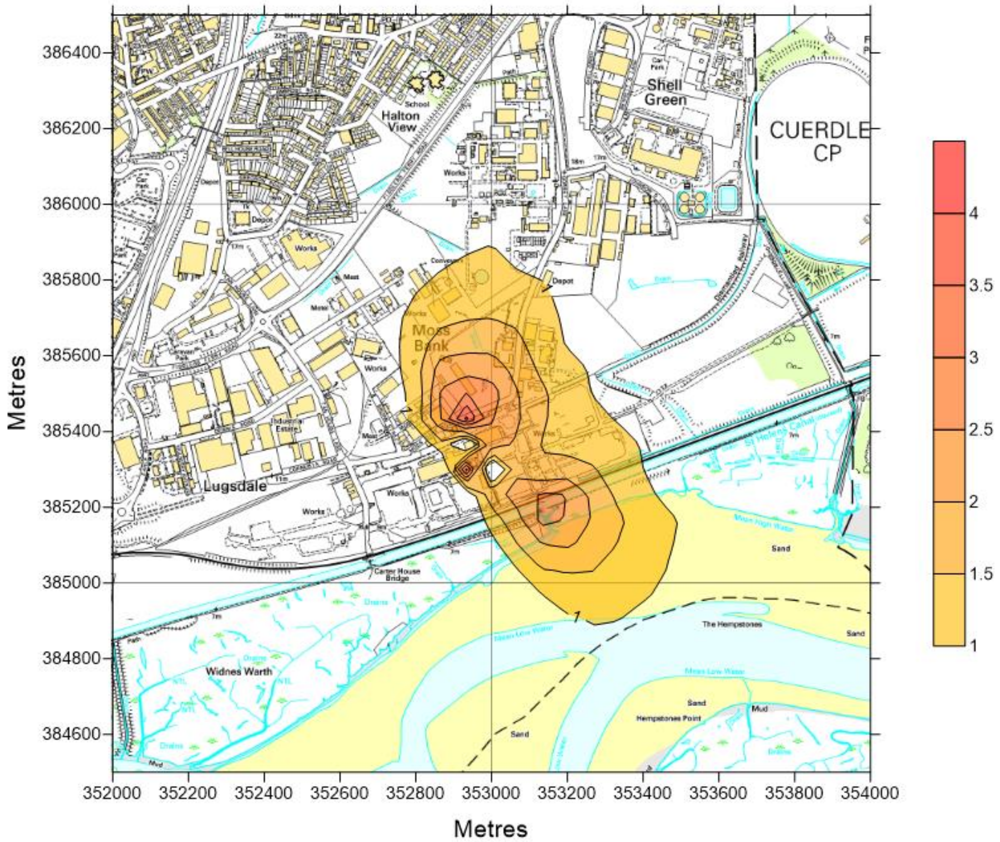



**Figure 7 Short Term PM10 (µg/m³) at current/proposed ELV (2017)**

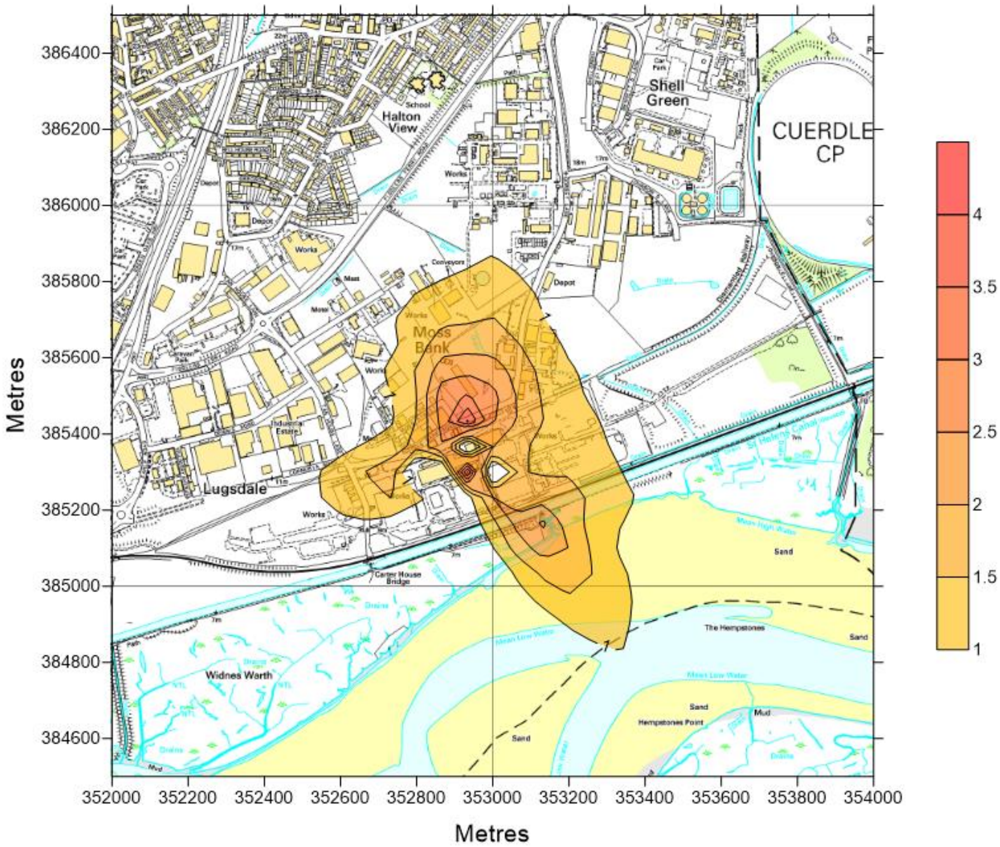



**Figure 8 Short Term PM10 (µg/m³) at current/proposed ELV (2018)**

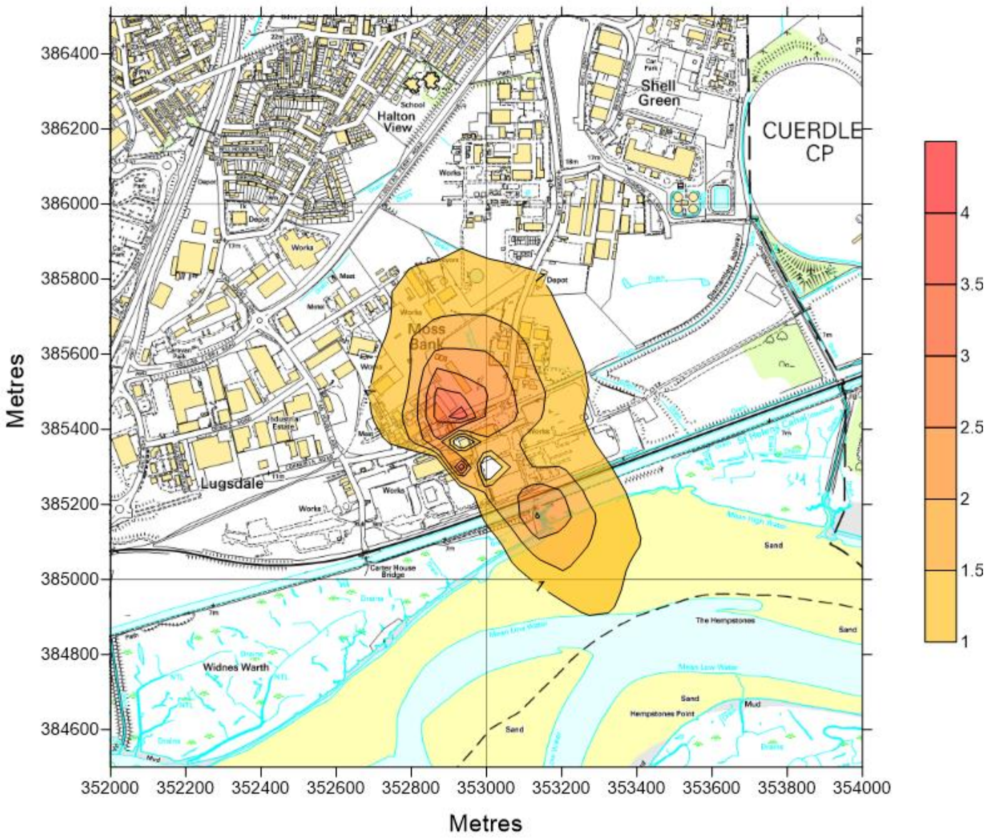



**Figure 9 Short Term PM10 (μg/m³) at current/proposed ELV (2019)**

The table provides a summary of the onsite and offsite results.

**Table 14 Short Term Particulate Modelling Results**

| Year | Onsite PC from ADMS Modelling (μg/m³) | Offsite PC from ADMS Modelling (μg/m³) | Background Conc. (μg/m³) | Onsite Total Conc. (μg/m³) | Offsite Total Conc. (μg/m³) | EAL (μg/m³) | Onsite % PEC of EAL | Offsite % PEC of EAL |
|---|---|---|---|---|---|---|---|---|
| **At Monitored levels** | | | | | | | | |
| 2017 | 1.1 | 1 | 25.56 | 26.66 | 26.56 | 50 | 53% | 53% |
| 2018 | 1.2 | 1 | 25.56 | 26.76 | 26.56 | 50 | 54% | 53% |
| 2019 | 1.4 | 1.4 | 25.56 | 26.96 | 26.96 | 50 | 54% | 54% |
| **At Current/proposed limits** | | | | | | | | |
| 2017 | 4 | 4 | 25.56 | 29.56 | 29.56 | 50 | 59% | 59% |
| 2018 | 4 | 4 | 25.56 | 29.56 | 29.56 | 50 | 59% | 59% |
| 2019 | 4 | 4 | 25.56 | 29.56 | 29.56 | 50 | 59% | 59% |

## Long Term

**Table 15 Long Term PM10 (2017)**

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 0.05 | 12.78 | 12.83 | 40 | 0.12% | 32% |
| Randle Reed Bed | 0.02 | 11.56 | 11.58 | 40 | 0.05% | 29% |
| Mersey Estuary | 0.001 | 12.96 | 12.96 | 40 | 0.003% | 32% |
| Wigg Island LNR | 0.003 | 11.34 | 11.35 | 40 | 0.01% | 28% |
| Nearest working population (offsite) | 0.14 | 12.78 | 12.92 | 40.00 | 0.35% | 32% |
| New Housing estate to the west of the site | 0.02 | 12.78 | 12.80 | 40 | 0.05% | 32% |
| Houses off French St | 0.03 | 12.78 | 12.81 | 40 | 0.08% | 32% |
| Caravans at the Warrington Road site | 0.01 | 12.78 | 12.79 | 40 | 0.03% | 32% |
| AQMA 1 | 0.01 | 13.56 | 13.56 | 40 | 0.01% | 34% |
| AQMA 2 | 0.01 | 13.02 | 13.03 | 40 | 0.02% | 33% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 0.24 | 12.78 | 13.02 | 40 | 0.61% | 33% |
| Randle Reed Bed | 0.10 | 11.56 | 11.66 | 40 | 0.25% | 29% |
| Mersey Estuary | 0.01 | 12.96 | 12.97 | 40 | 0.02% | 32% |
| Wigg Island LNR | 0.01 | 11.34 | 11.36 | 40 | 0.03% | 28% |
| Nearest working population (offsite) | 0.73 | 12.78 | 13.51 | 40.00 | 1.83% | 34% |
| New Housing estate to the west of the site | 0.10 | 12.78 | 12.88 | 40.00 | 0.24% | 32% |
| Houses off French St | 0.15 | 12.78 | 12.93 | 40.00 | 0.38% | 32% |
| Caravans at the Warrington Road site | 0.06 | 12.78 | 12.84 | 40 | 0.15% | 32% |
| AQMA 1 | 0.03 | 13.56 | 13.59 | 40 | 0.07% | 34% |
| AQMA 2 | 0.04 | 13.02 | 13.06 | 40 | 0.09% | 33% |

Table 16 Long Term PM10 (2018)

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 0.06 | 12.78 | 12.84 | 40 | 0.14% | 32% |
| Randle Reed Bed | 0.02 | 11.56 | 11.58 | 40 | 0.05% | 29% |
| Mersey Estuary | 0.003 | 12.96 | 12.96 | 40 | 0.01% | 32% |
| Wigg Island LNR | 0.003 | 11.34 | 11.35 | 40 | 0.01% | 28% |
| Nearest working population (offsite) | 0.17 | 12.78 | 12.95 | 40 | 0.43% | 32% |
| New Housing estate to the west of the site | 0.05 | 12.78 | 12.83 | 40 | 0.13% | 32% |
| Houses off French St | 0.03 | 12.78 | 12.81 | 40 | 0.08% | 32% |
| Caravans at the Warrington Road site | 0.02 | 12.78 | 12.80 | 40 | 0.04% | 32% |
| AQMA 1 | 0.01 | 13.56 | 13.57 | 40 | 0.02% | 34% |
| AQMA 2 | 0.01 | 13.02 | 13.03 | 40 | 0.02% | 33% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 0.28 | 12.78 | 13.06 | 40.00 | 0.70% | 33% |
| Randle Reed Bed | 0.09 | 11.56 | 11.65 | 40.00 | 0.23% | 29% |
| Mersey Estuary | 0.02 | 12.96 | 12.98 | 40.00 | 0.04% | 32% |
| Wigg Island LNR | 0.02 | 11.34 | 11.36 | 40.00 | 0.04% | 28% |
| Nearest working population (offsite) | 0.86 | 12.78 | 13.64 | 40.00 | 2.15% | 34% |
| New Housing estate to the west of the site | 0.26 | 12.78 | 13.04 | 40.00 | 0.66% | 33% |
| Houses off French St | 0.16 | 12.78 | 12.94 | 40.00 | 0.40% | 32% |
| Caravans at the Warrington Road site | 0.08 | 12.78 | 12.86 | 40.00 | 0.21% | 32% |
| AQMA 1 | 0.04 | 13.56 | 13.60 | 40.00 | 0.11% | 34% |
| AQMA 2 | 0.05 | 13.02 | 13.07 | 40.00 | 0.12% | 33% |

Table 17 Long Term PM10 (2019)

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 0.04 | 12.78 | 12.82 | 40 | 0.10% | 32% |
| Randle Reed Bed | 0.02 | 11.56 | 11.58 | 40 | 0.05% | 29% |
| Mersey Estuary | 0.002 | 12.96 | 12.96 | 40 | 0.005% | 32% |
| Wigg Island LNR | 0.003 | 11.34 | 11.35 | 40 | 0.01% | 28% |
| Nearest working population (offsite) | 0.17 | 12.78 | 12.95 | 40.00 | 0.43% | 32% |
| New Housing estate to the west of the site | 0.03 | 12.78 | 12.81 | 40 | 0.06% | 32% |
| Houses off French St | 0.03 | 12.78 | 12.81 | 40 | 0.08% | 32% |
| Caravans at the Warrington Road site | 0.02 | 12.78 | 12.80 | 40 | 0.05% | 32% |
| AQMA 1 | 0.01 | 13.56 | 13.57 | 40 | 0.03% | 34% |
| AQMA 2 | 0.01 | 13.02 | 13.03 | 40 | 0.03% | 33% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 0.20 | 12.78 | 12.98 | 40.00 | 0.51% | 32% |
| Randle Reed Bed | 0.09 | 11.56 | 11.65 | 40.00 | 0.22% | 29% |
| Mersey Estuary | 0.01 | 12.96 | 12.97 | 40.00 | 0.02% | 32% |
| Wigg Island LNR | 0.01 | 11.34 | 11.36 | 40.00 | 0.04% | 28% |
| Nearest working population (offsite) | 0.90 | 12.78 | 13.68 | 40.00 | 2.26% | 34% |
| New Housing estate to the west of the site | 0.13 | 12.78 | 12.91 | 40.00 | 0.32% | 32% |
| Houses off French St | 0.16 | 12.78 | 12.94 | 40.00 | 0.40% | 32% |
| Caravans at the Warrington Road site | 0.10 | 12.78 | 12.88 | 40.00 | 0.26% | 32% |
| AQMA 1 | 0.05 | 13.56 | 13.61 | 40.00 | 0.12% | 34% |
| AQMA 2 | 0.06 | 13.02 | 13.08 | 40.00 | 0.14% | 33% |

Modelling shows that predicted long term PECs are likely to be well below the EAL, with a maximum of 34% at AQMA 1 for predicted emissions for all years of meteorological data, and a maximum of 34% at the nearest offsite working population at ELV for all years of meteorological data. It should be noted that the background concentrations at all locations are the significant contributor to the total concentration, with the site contribution being significantly less than any background level.

The following figures provide an indication, respectively, of the long term PM10 distribution using each year of meteorological data at:

- Average monitored/predicted emissions and
- At current/proposed ELV.

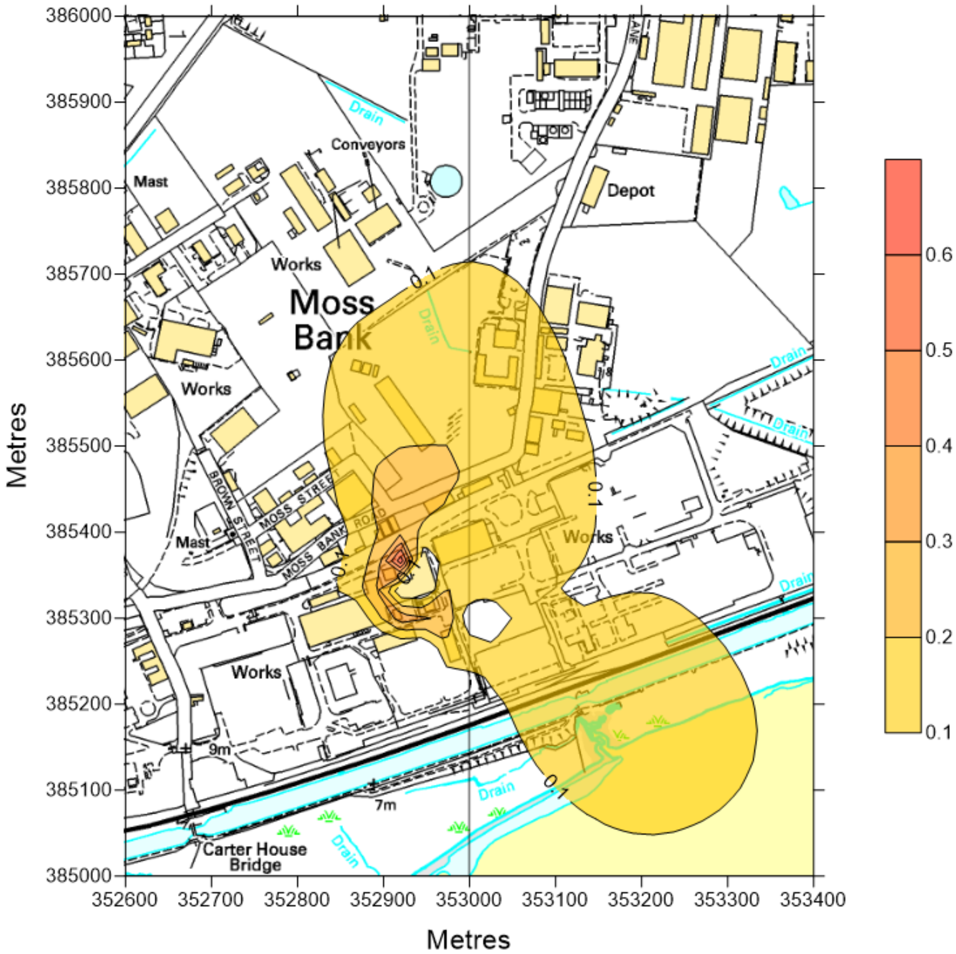



**Figure 10 Long term PM10 (μg/m³) at average monitored/predicted emissions (2017)**

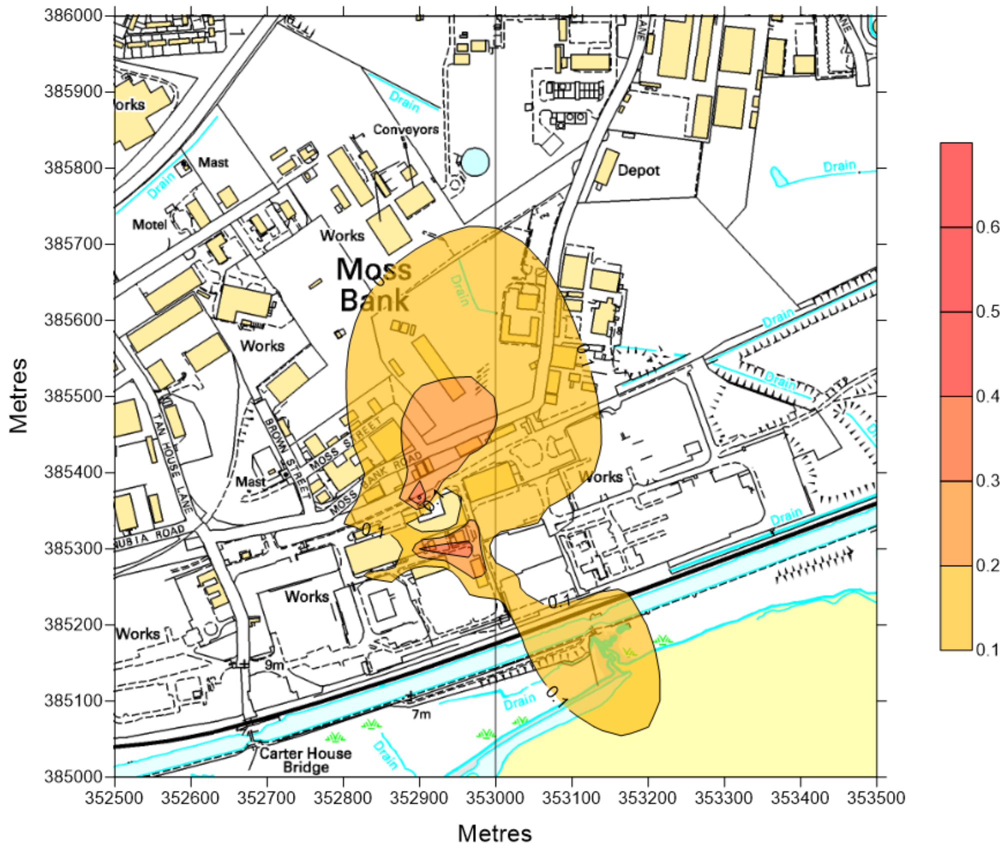



**Figure 11 Long term PM10 (µg/m³) at average monitored/predicted emissions (2018)**

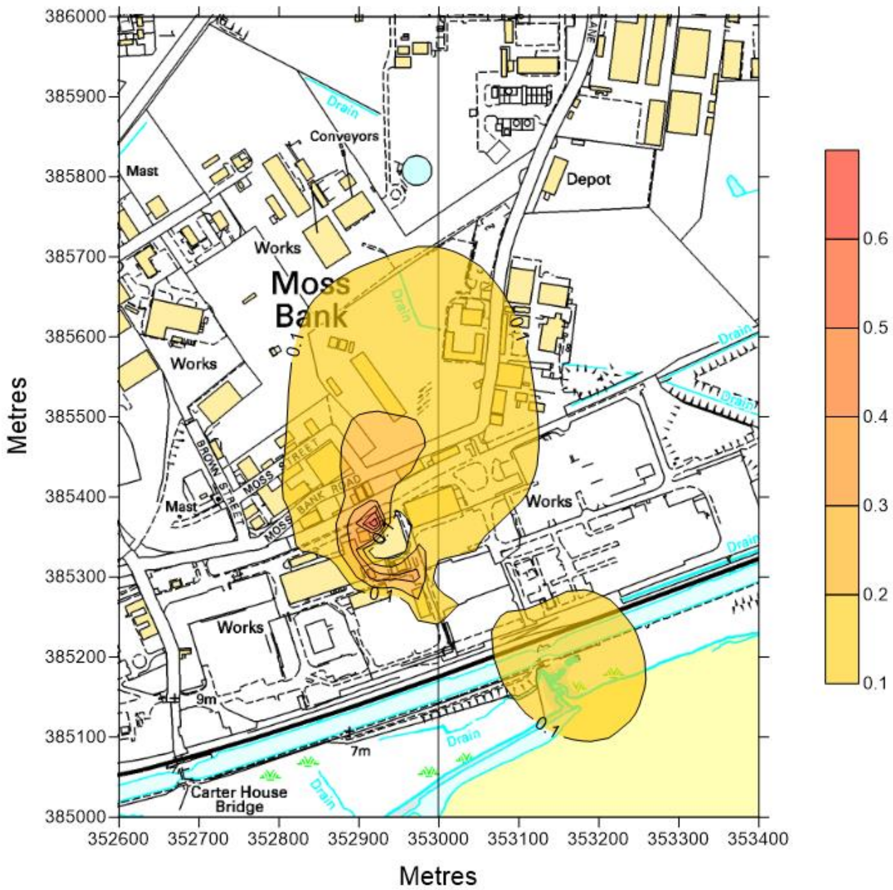



**Figure 12 Long term PM10 (µg/m³) at average monitored/predicted emissions (2019)**

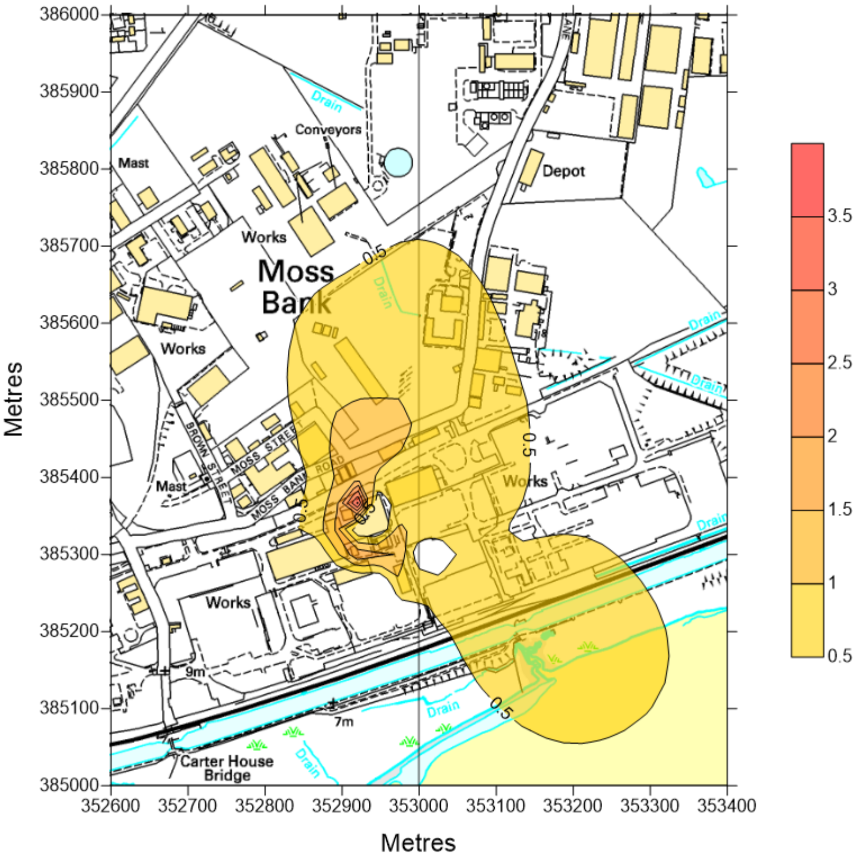



**Figure 13 Long Term PM10 (µg/m³) at current/proposed ELV (2017)**

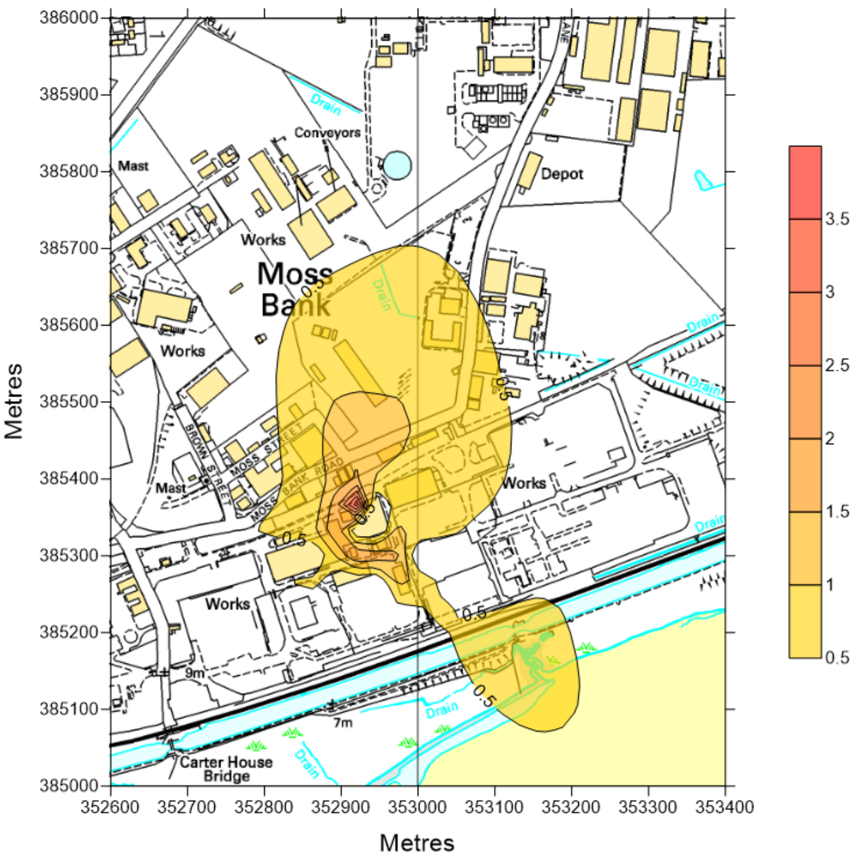



**Figure 14 Long Term PM10 (µg/m³) at current/proposed ELV (2018)**

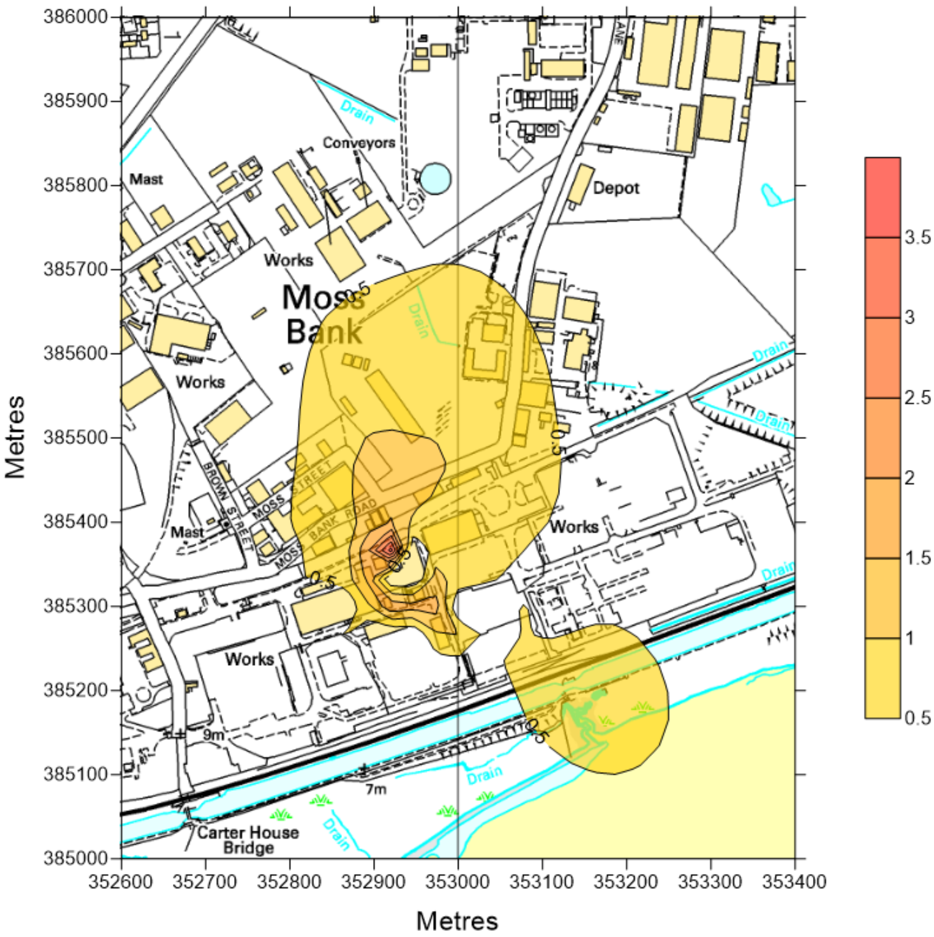



**Figure 15 Long Term PM10 (µg/m³) at current/proposed ELV (2019)**

The table provides a summary of the onsite and offsite results.

**Table 18 Long Term Particulate Modelling Results**

| Year | Onsite PC from ADMS Modelling (µg/m³) | Offsite PC from ADMS Modelling (µg/m³) | Background Conc. (µg/m³) | Onsite PEC (µg/m³) | Offsite PEC (µg/m³) | EAL (µg/m³) | Onsite % PEC of EAL | Offsite % PEC of EAL |
|---|---|---|---|---|---|---|---|---|
| **At Monitored levels** | | | | | | | | |
| 2017 | 0.6 | 0.4 | 12.78 | 13.38 | 13.18 | 40 | 33% | 33% |
| 2018 | 0.6 | 0.4 | 12.78 | 13.38 | 13.18 | 40 | 33% | 33% |
| 2019 | 0.6 | 0.4 | 12.78 | 13.38 | 13.18 | 40 | 33% | 33% |
| **At Current/proposed limits** | | | | | | | | |
| 2017 | 3.5 | 2.0 | 12.78 | 16.28 | 14.78 | 40 | 41% | 37% |
| 2018 | 3.5 | 2.0 | 12.78 | 16.28 | 14.78 | 40 | 41% | 37% |
| 2019 | 3.5 | 2.0 | 12.78 | 16.28 | 14.78 | 40 | 41% | 37% |

### 9.1.2 Nitrogen Oxides

Detailed Air Dispersion Modelling was carried out using the ADMS 5.2 model to assess the concentrations of $NO_2$. Meteorological data from 2017 to 2019 was used and results are presented for all years of meteorological data.

The Process Contribution (PC) from modelling has been added to the background levels for each sensitive location, and then compared with the relevant air quality standard (EAL), as shown in results table below.

Sensitive site specific EALs have been chosen as a critical level for the protection of vegetation and ecosystems, as shown below.

Boiler emissions of nitrogen oxides are treated as if they are all as $NO_2$. In practice, the actual emission is expected to be about 10% $NO_2$ and 90% NO. At the NO concentration in these emissions, the half-life for conversion of NO to $NO_2$ in the atmosphere is reported to be about half an hour. For receptors close to the source, only a fraction of the NO will have reacted in the atmosphere to $NO_2$ so the modelling will over-predict $NO_2$ concentrations in the immediate area around the site.

Note: there is expected to be a small amount of NOx released from emission point A11 due to gas burning in the high temperature kiln used in this operation, but this is expected to be insignificant versus the overall emissions from the boilers.

## Short Term

**Table 19 Short Term $NO_2$ (2017)**

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 3.32 | 32.12 | 35.44 | 75 | 4.43% | 47% |
| Randle Reed Bed | 1.06 | 30.74 | 31.80 | 75 | 1.41% | 42% |
| Mersey Estuary | 0.33 | 29.76 | 30.09 | 75 | 0.44% | 40% |
| Wigg Island LNR | 0.39 | 27.42 | 27.82 | 75 | 0.53% | 37% |
| Nearest working population (offsite) | 11.71 | 32.12 | 43.83 | 200 | 5.86% | 22% |
| New Housing estate to the west of the site | 6.04 | 32.12 | 38.16 | 200 | 3.02% | 19% |
| Houses off French St | 3.65 | 32.12 | 35.77 | 200 | 1.83% | 18% |
| Caravans at the Warrington Road site | 3.43 | 32.12 | 35.55 | 200 | 1.72% | 18% |
| AQMA 1 | 2.26 | 29.34 | 31.60 | 75 | 3.01% | 42% |
| AQMA 2 | 2.05 | 29.34 | 31.39 | 75 | 2.73% | 42% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 3.67 | 32.12 | 35.79 | 75 | 4.89% | 48% |
| Randle Reed Bed | 1.17 | 30.74 | 31.91 | 75 | 1.56% | 43% |
| Mersey Estuary | 0.36 | 29.76 | 30.12 | 75 | 0.48% | 40% |
| Wigg Island LNR | 0.43 | 27.42 | 27.86 | 75 | 0.58% | 37% |
| Nearest working population (offsite) | 13.06 | 32.12 | 45.18 | 200 | 6.53% | 23% |
| New Housing estate to the west of the site | 6.66 | 32.12 | 38.78 | 200 | 3.33% | 19% |
| Houses off French St | 4.03 | 32.12 | 36.15 | 200 | 2.02% | 18% |
| Caravans at the Warrington Road site | 3.77 | 32.12 | 35.89 | 200 | 1.89% | 18% |
| AQMA 1 | 2.49 | 29.34 | 31.83 | 75 | 3.32% | 42% |
| AQMA 2 | 2.26 | 29.34 | 31.60 | 75 | 3.01% | 42% |

Table 20 Short Term $NO_2$ (2018)

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 3.48 | 32.12 | 35.60 | 75 | 4.64% | 47% |
| Randle Reed Bed | 0.80 | 30.74 | 31.54 | 75 | 1.07% | 42% |
| Mersey Estuary | 0.39 | 29.76 | 30.15 | 75 | 0.52% | 40% |
| Wigg Island LNR | 0.41 | 27.42 | 27.83 | 75 | 0.55% | 37% |
| Nearest working population (offsite) | 16.96 | 32.12 | 49.08 | 200 | 8.48% | 25% |
| New Housing estate to the west of the site | 7.67 | 32.12 | 39.79 | 200 | 3.84% | 20% |
| Houses off French St | 3.70 | 32.12 | 35.82 | 200 | 1.85% | 18% |
| Caravans at the Warrington Road site | 3.47 | 32.12 | 35.59 | 200 | 1.74% | 18% |
| AQMA 1 | 2.58 | 29.34 | 31.92 | 75 | 3.44% | 43% |
| AQMA 2 | 2.24 | 29.34 | 31.58 | 75 | 2.99% | 42% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 3.73 | 32.12 | 35.85 | 75 | 4.97% | 48% |
| Randle Reed Bed | 0.92 | 30.74 | 31.66 | 75 | 1.23% | 42% |
| Mersey Estuary | 0.42 | 29.76 | 30.18 | 75 | 0.56% | 40% |
| Wigg Island LNR | 0.46 | 27.42 | 27.88 | 75 | 0.61% | 37% |
| Nearest working population (offsite) | 18.77 | 32.12 | 50.89 | 200 | 9.39% | 25% |
| New Housing estate to the west of the site | 8.44 | 32.12 | 40.56 | 200 | 4.22% | 20% |
| Houses off French St | 4.08 | 32.12 | 36.20 | 200 | 2.04% | 18% |
| Caravans at the Warrington Road site | 3.82 | 32.12 | 35.94 | 200 | 1.91% | 18% |
| AQMA 1 | 2.84 | 29.34 | 32.18 | 75 | 3.79% | 43% |
| AQMA 2 | 2.46 | 29.34 | 31.80 | 75 | 3.28% | 42% |

**Table 21 Short Term $NO_2$ (2019)**

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 2.56 | 32.12 | 34.68 | 75 | 3.4% | 46% |
| Randle Reed Bed | 0.85 | 30.74 | 31.59 | 75 | 1.1% | 42% |
| Mersey Estuary | 0.35 | 29.76 | 30.11 | 75 | 0.5% | 40% |
| Wigg Island LNR | 0.33 | 27.42 | 27.75 | 75 | 0.4% | 37% |
| Nearest working population (offsite) | 12.12 | 32.12 | 44.24 | 200 | 6.1% | 22% |
| New Housing estate to the west of the site | 6.99 | 32.12 | 39.11 | 200 | 3.5% | 20% |
| Houses off French St | 3.72 | 32.12 | 35.84 | 200 | 1.9% | 18% |
| Caravans at the Warrington Road site | 3.56 | 32.12 | 35.68 | 200 | 1.8% | 18% |
| AQMA 1 | 2.47 | 29.34 | 31.81 | 75 | 3.3% | 42% |
| AQMA 2 | 2.08 | 29.34 | 31.42 | 75 | 2.8% | 42% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 2.82 | 32.12 | 34.94 | 75 | 3.76% | 47% |
| Randle Reed Bed | 0.93 | 30.74 | 31.67 | 75 | 1.24% | 42% |
| Mersey Estuary | 0.39 | 29.76 | 30.15 | 75 | 0.52% | 40% |
| Wigg Island LNR | 0.37 | 27.42 | 27.79 | 75 | 0.49% | 37% |
| Nearest working population (offsite) | 13.47 | 32.12 | 45.59 | 200 | 6.74% | 23% |
| New Housing estate to the west of the site | 7.69 | 32.12 | 39.81 | 200 | 3.85% | 20% |
| Houses off French St | 4.09 | 32.12 | 36.21 | 200 | 2.05% | 18% |
| Caravans at the Warrington Road site | 3.91 | 32.12 | 36.03 | 200 | 1.96% | 18% |
| AQMA 1 | 2.71 | 29.34 | 32.05 | 75 | 3.61% | 43% |
| AQMA 2 | 2.29 | 29.34 | 31.63 | 75 | 3.05% | 42% |

Modelling shows that predicted short term PECs are likely to be below the EAL, with a maximum of 47% at St Helens canal/Widnes Warth for predicted emissions, and a maximum of 48% at St Helens canal/Widnes Warth at ELV, both using 2017 and 2018 meteorological data. It should be noted that the background concentrations at the majority of locations are the significant contributor to the total concentration, with the site contribution being significantly less than any background level. In other cases, the background and site contributions are roughly equal, with the highest totals still being well below the EAL. It is also worth noting that the background levels will include a contribution from the existing processes at the site.

The following figures provide an indication, respectively, of the short term $NO_2$ distribution using each year of meteorological data at:

- Average monitored/predicted emissions and
- Current/proposed ELV

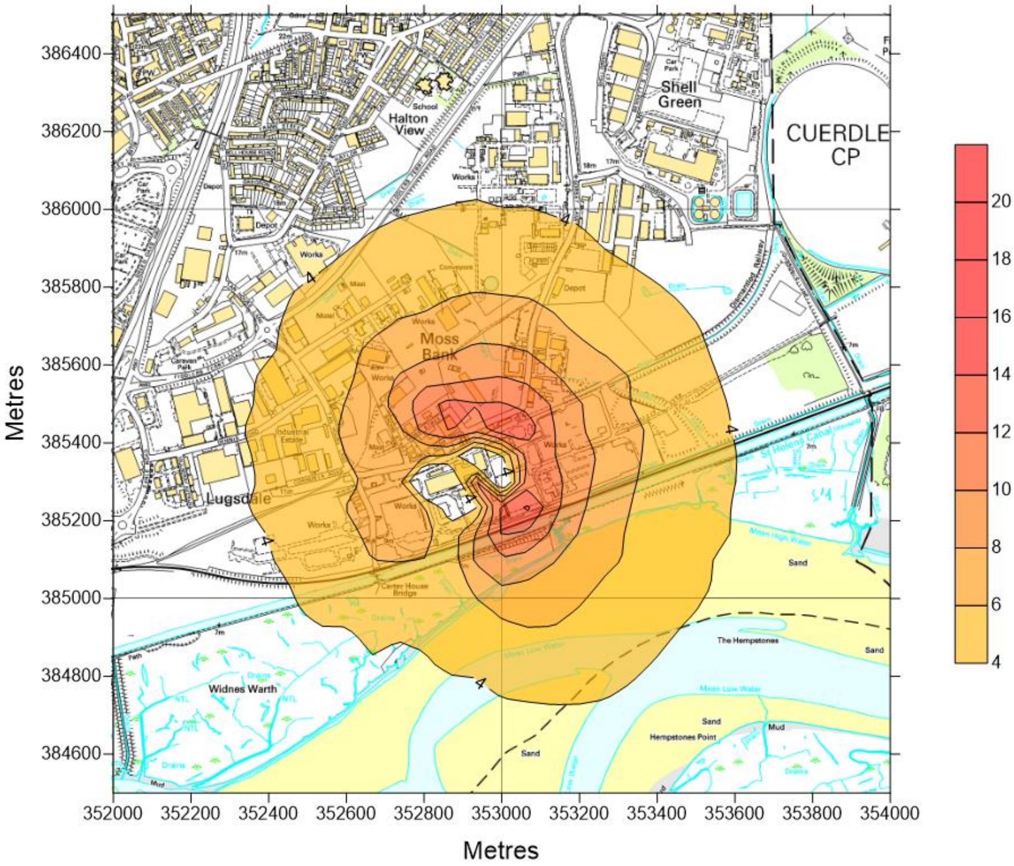



**Figure 16 Short term $NO_2$ ($\mu g/m^3$) at average monitored/predicted emissions (2017)**

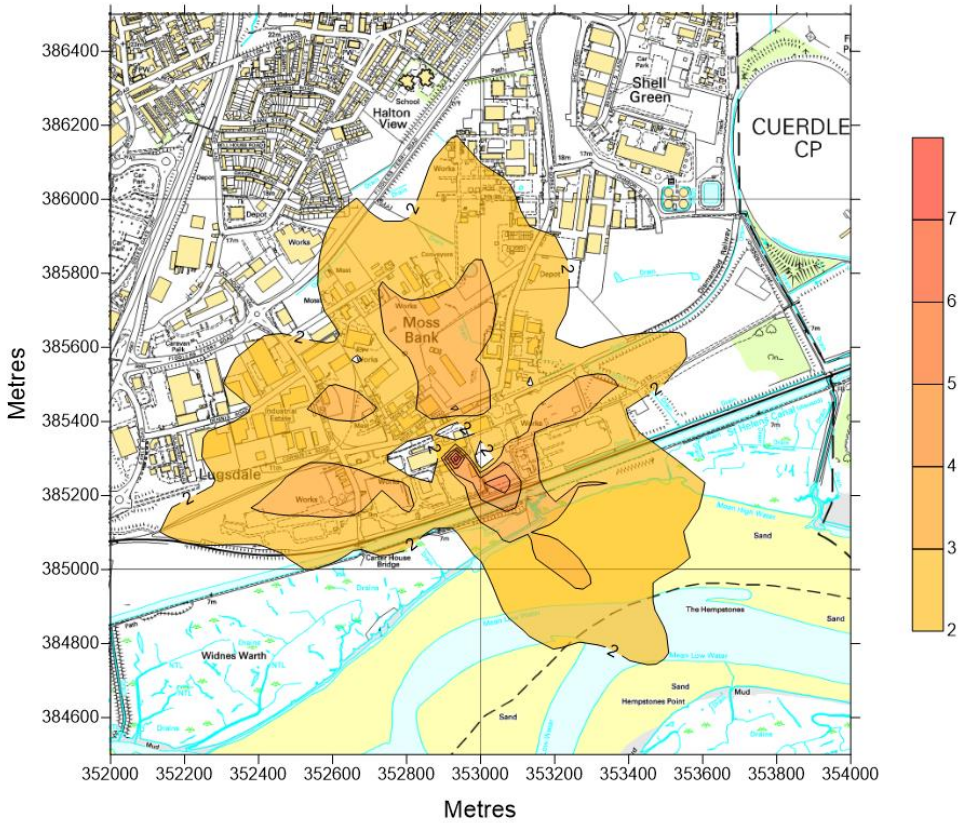



**Figure 17 Short term (daily) $NO_2$ ($\mu g/m^3$) at average monitored/predicted emissions (2017)**

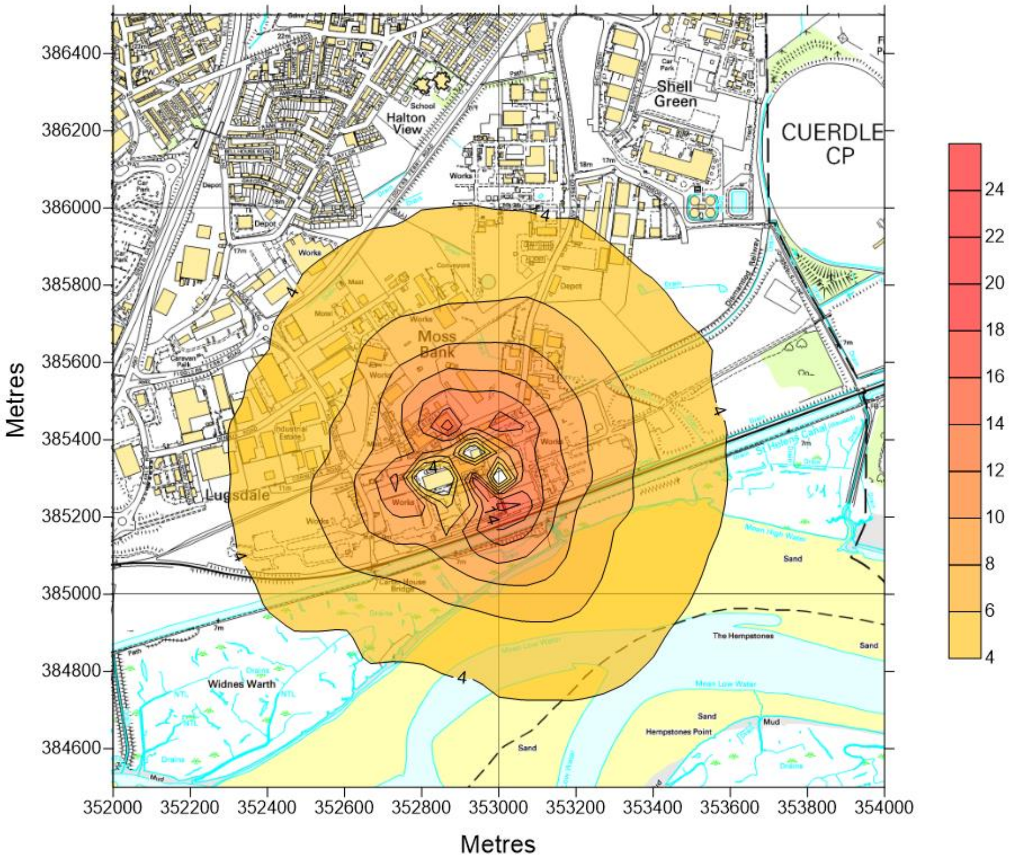



**Figure 18 Short term $NO_2$ (µg/m$^3$) at average monitored/predicted emissions (2018)**

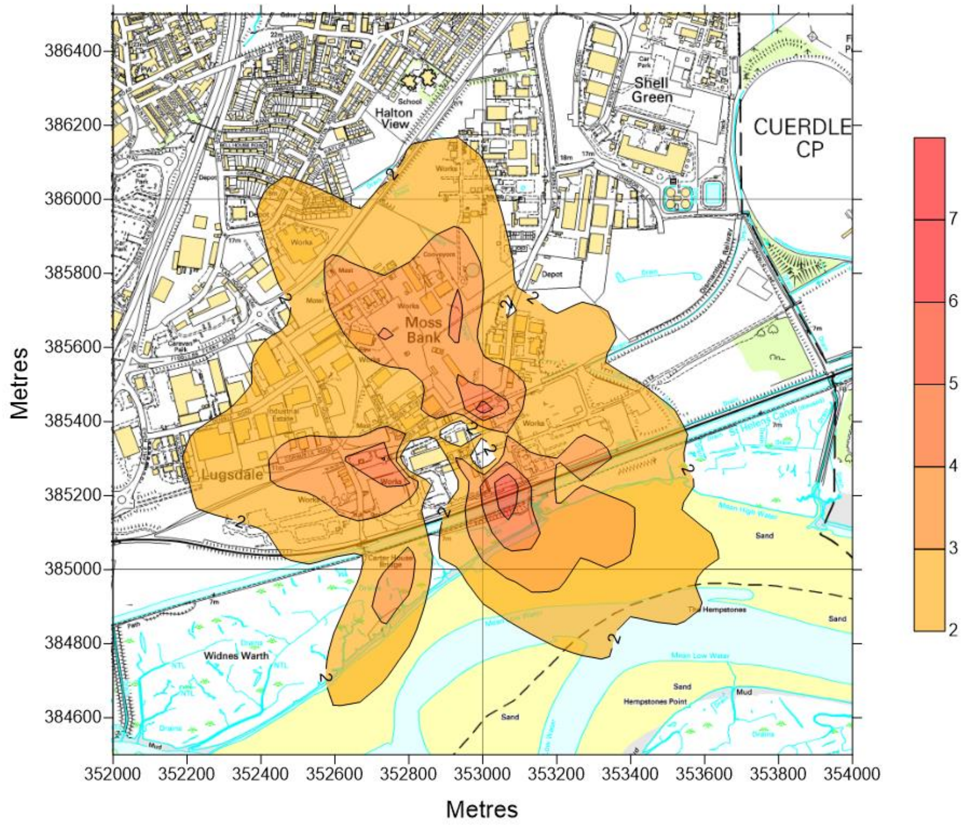



**Figure 19 Short term (daily) $NO_2$ (µg/m$^3$) at average monitored/predicted emissions (2018)**

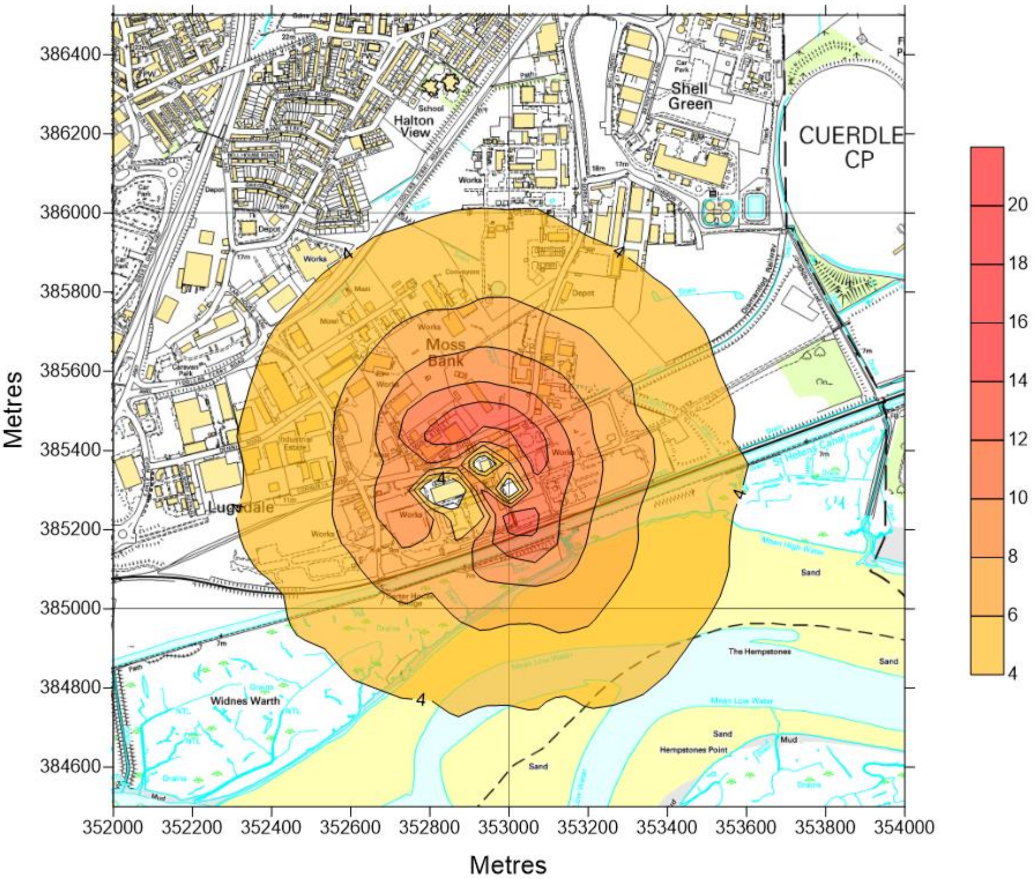



**Figure 20 Short term $NO_2$ (µg/m³) at average monitored/predicted emissions (2019)**

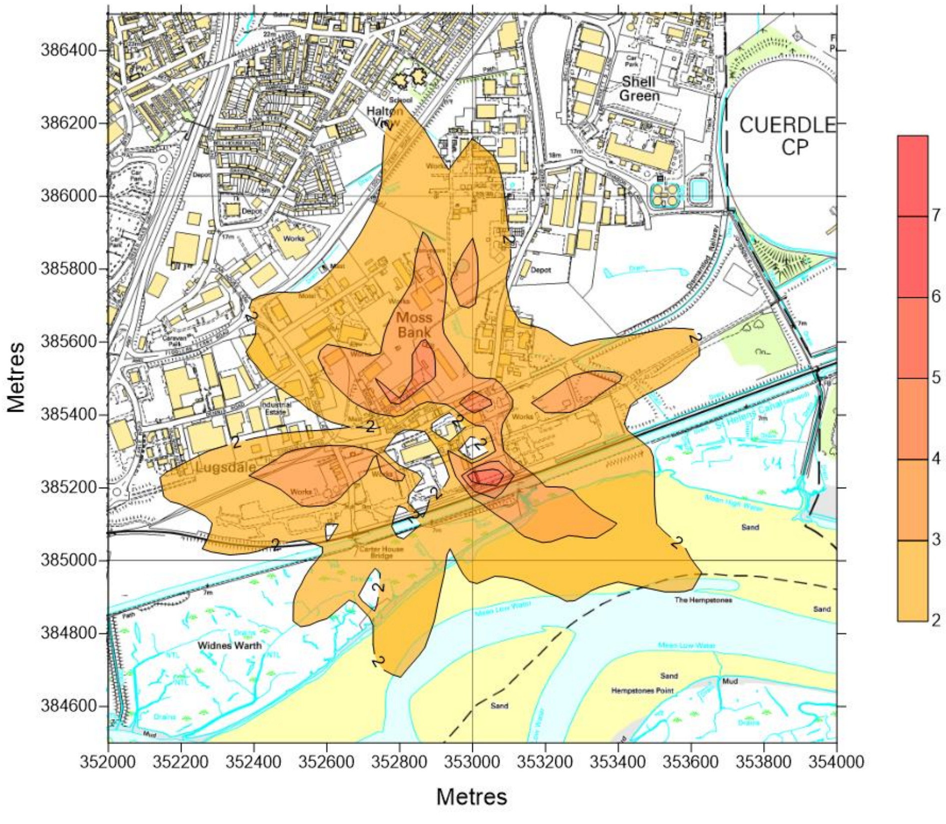



**Figure 21 Short term $NO_2$ (µg/m³) (daily env) at average monitored/predicted emissions (2019)**

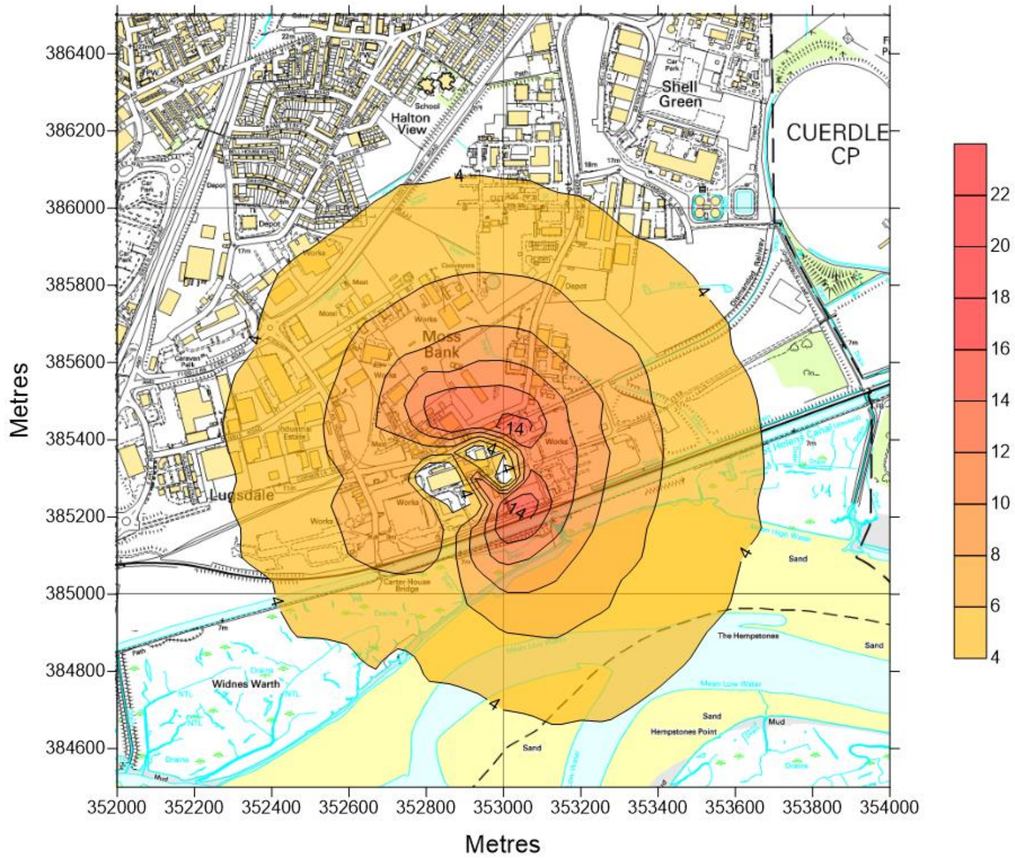



**Figure 22 Short Term $NO_2$ (µg/m³) at current/proposed ELV (2017)**

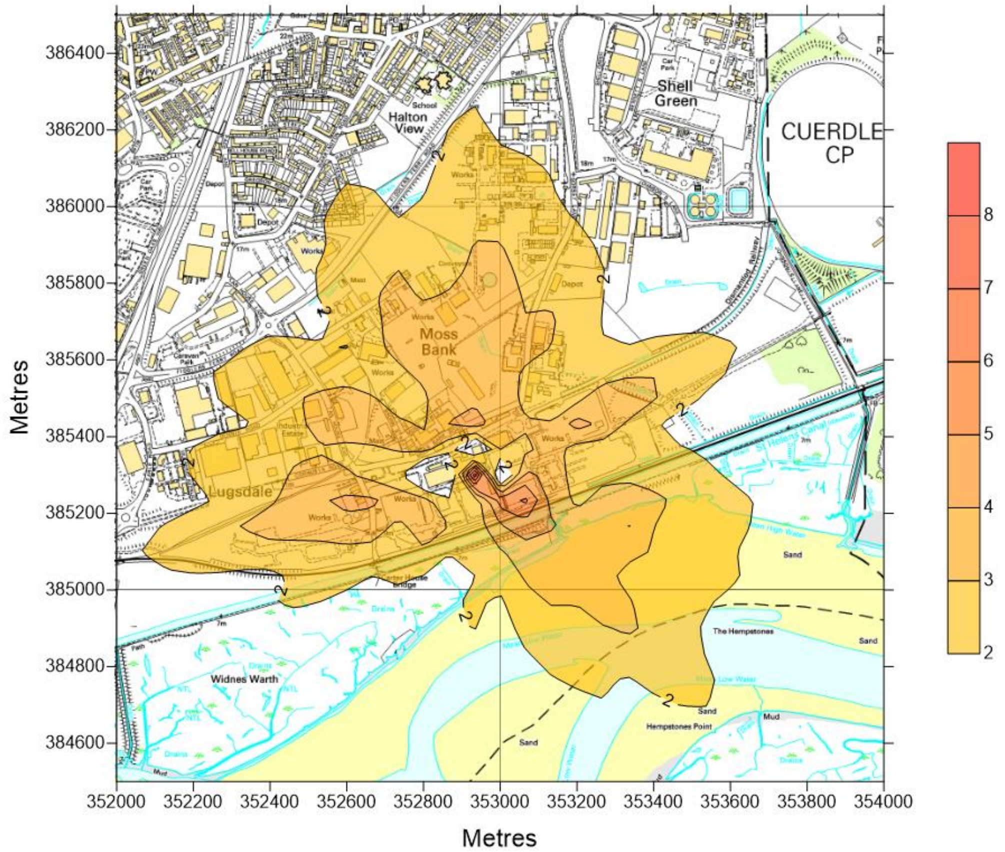



**Figure 23 Short Term (daily) $NO_2$ (µg/m³) at current/proposed ELV (2017)**

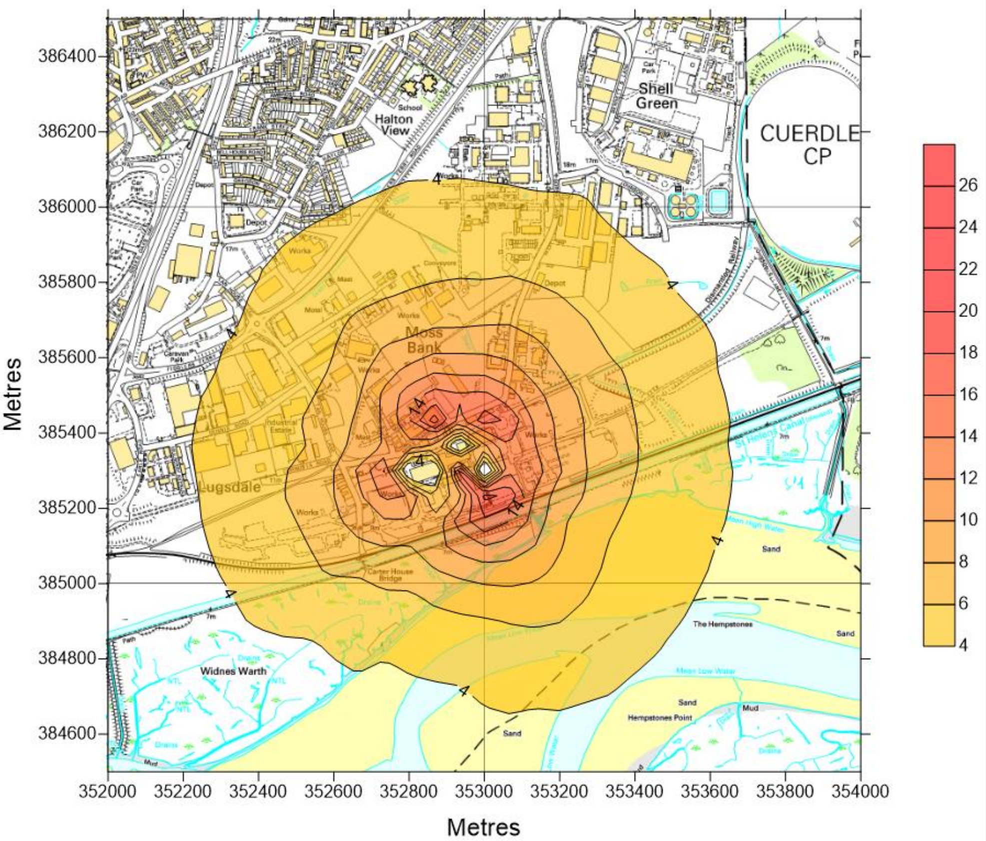



**Figure 24 Short Term $NO_2$ ($\mu g/m^3$) at current/proposed ELV (2018)**

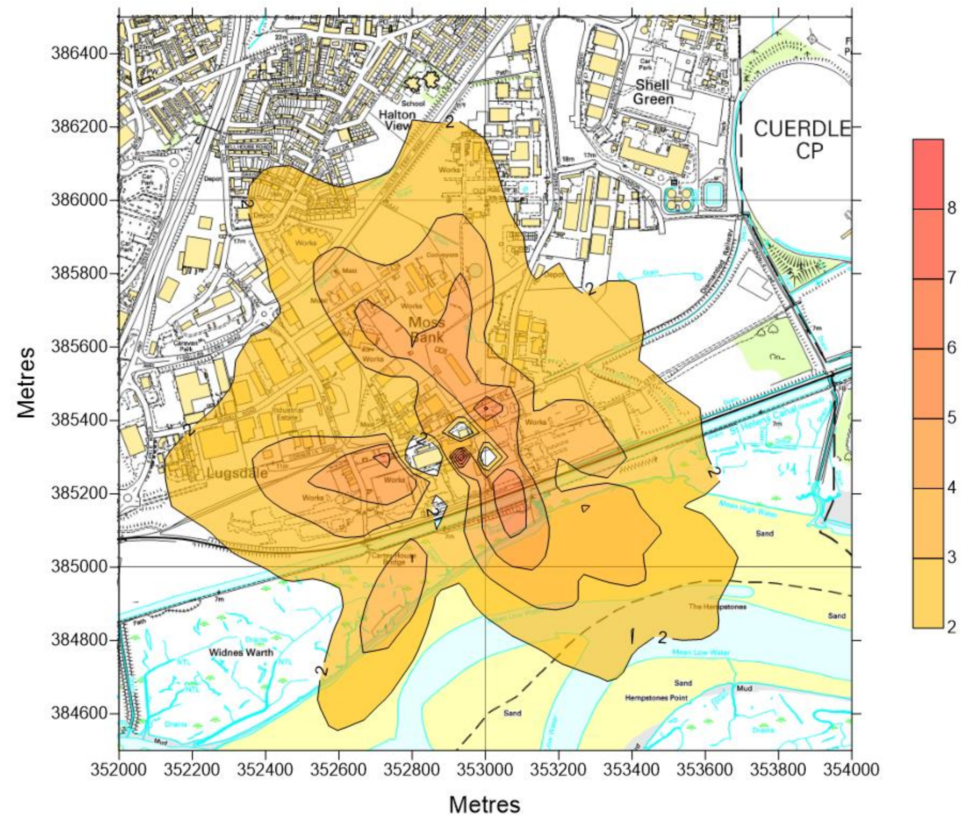



**Figure 25 Short Term (daily) $NO_2$ ($\mu g/m^3$) at current/proposed ELV (2018)**

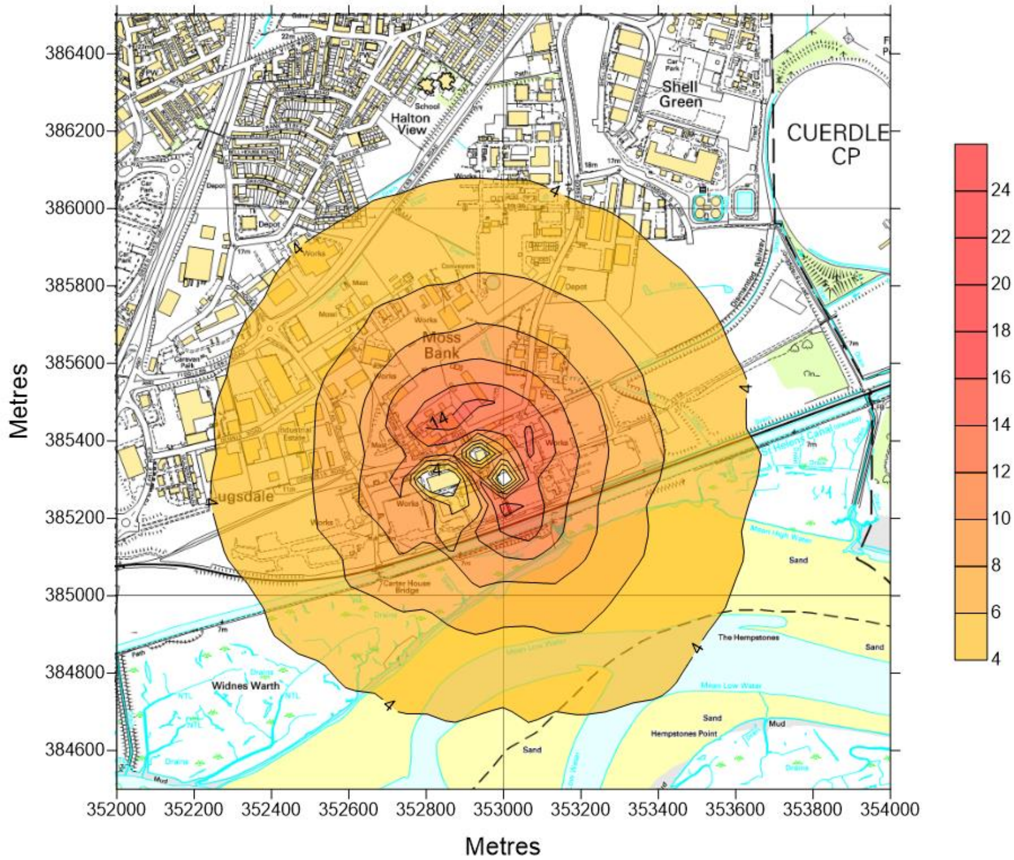



**Figure 26 Short Term $NO_2$ (µg/m$^3$) at current/proposed ELV (2019)**

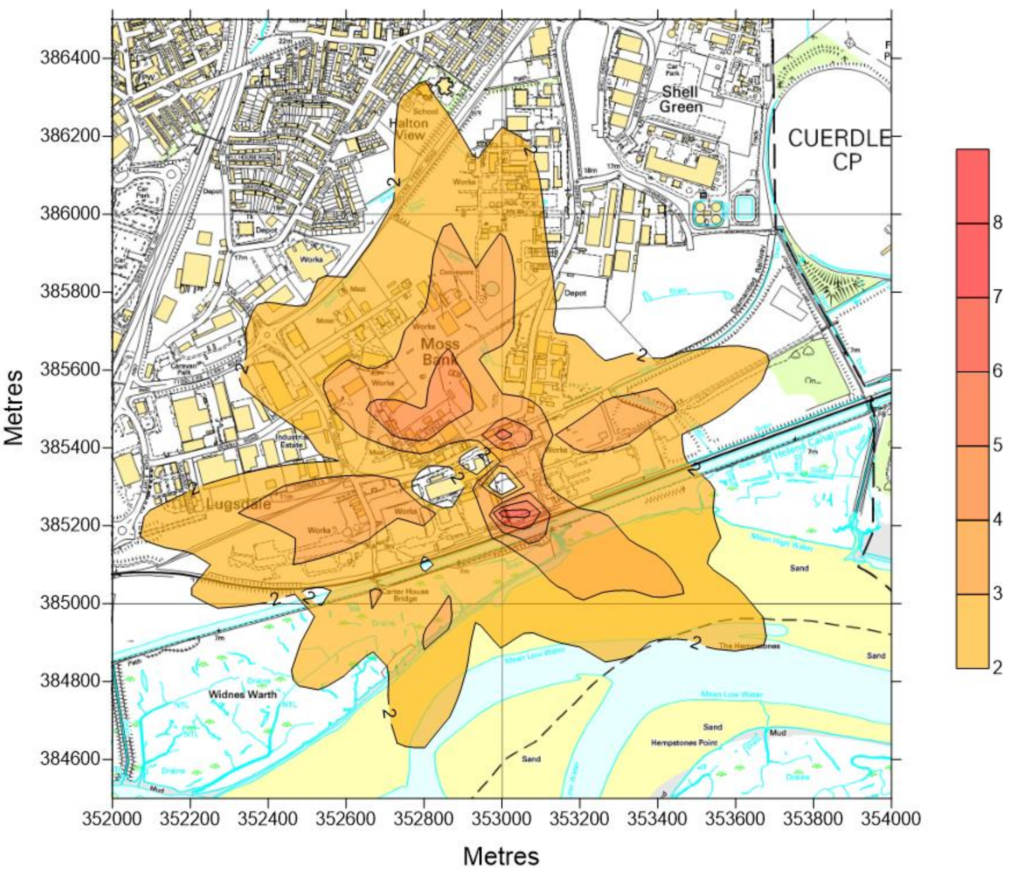



**Figure 27 Short Term (Daily) $NO_2$ (µg/m$^3$) at current/proposed ELV (2019)**

The table provides a summary of the onsite and offsite results.

**Table 22 Short Term $NO_2$ Modelling Results**

| Year | Onsite PC from ADMS Modelling (µg/m³) | Offsite PC from ADMS Modelling (µg/m³) | Background Conc (µg/m³) | Onsite PEC (µg/m³) | Offsite PEC (µg/m³) | EAL (µg/m³) | Onsite % PEC/EAL | Offsite % PEC/EAL |
|---|---|---|---|---|---|---|---|---|
| **At Monitored levels** | | | | | | | | |
| 2017 | 20 | 14 | 32.12 | 52.12 | 46.12 | 200 | 26% | 23% |
| 2018 | 24 | 18 | 32.12 | 56.12 | 50.12 | 200 | 28% | 25% |
| 2019 | 20 | 14 | 32.12 | 52.12 | 46.12 | 200 | 26% | 23% |
| **At Current/proposed limits** | | | | | | | | |
| 2017 | 22 | 14 | 32.12 | 54.12 | 46.12 | 200 | 27% | 23% |
| 2018 | 26 | 19 | 32.12 | 58.12 | 51.12 | 200 | 29% | 26% |
| 2019 | 24 | 14 | 32.12 | 56.12 | 46.12 | 200 | 28% | 23% |

## Long Term

Table 23 Long Term $NO_2$ (2017)

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 0.09 | 16.06 | 16.15 | 30 | 0.30% | 54% |
| Randle Reed Bed | 0.11 | 15.37 | 15.48 | 30 | 0.36% | 52% |
| Mersey Estuary | 0.01 | 14.88 | 14.89 | 30 | 0.02% | 50% |
| Wigg Island LNR | 0.01 | 13.71 | 13.72 | 30 | 0.03% | 46% |
| Nearest working population (offsite) | 0.07 | 16.06 | 16.13 | 40 | 0.18% | 40% |
| New Housing estate to the west of the site | 0.07 | 16.06 | 16.13 | 40 | 0.18% | 40% |
| Houses off French St | 0.14 | 16.06 | 16.20 | 40 | 0.36% | 41% |
| Caravans at the Warrington Road site | 0.05 | 16.06 | 16.11 | 40 | 0.13% | 40% |
| AQMA 1 | 0.03 | 14.67 | 14.70 | 30 | 0.10% | 49% |
| AQMA 2 | 0.03 | 14.67 | 14.70 | 30 | 0.10% | 49% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 0.10 | 16.06 | 16.16 | 30 | 0.33% | 54% |
| Randle Reed Bed | 0.12 | 16.06 | 16.18 | 30 | 0.39% | 54% |
| Mersey Estuary | 0.01 | 15.37 | 15.38 | 30 | 0.03% | 51% |
| Wigg Island LNR | 0.02 | 14.88 | 14.90 | 30 | 0.06% | 50% |
| Nearest working population (offsite) | 0.08 | 13.71 | 13.79 | 40 | 0.20% | 34% |
| New Housing estate to the west of the site | 0.08 | 16.06 | 16.14 | 40 | 0.20% | 40% |
| Houses off French St | 0.16 | 16.06 | 16.22 | 40 | 0.39% | 41% |
| Caravans at the Warrington Road site | 0.06 | 16.06 | 16.12 | 40 | 0.14% | 40% |
| AQMA 1 | 0.03 | 16.06 | 16.09 | 30 | 0.11% | 54% |
| AQMA 2 | 0.03 | 14.67 | 14.70 | 30 | 0.12% | 49% |

Table 24 Long Term $NO_2$ (2018)

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 0.14 | 16.06 | 16.20 | 30 | 0.47% | 54% |
| Randle Reed Bed | 0.09 | 15.37 | 15.46 | 30 | 0.30% | 52% |
| Mersey Estuary | 0.02 | 14.88 | 14.90 | 30 | 0.05% | 50% |
| Wigg Island LNR | 0.02 | 13.71 | 13.73 | 30 | 0.06% | 46% |
| Nearest working population (offsite) | 0.11 | 16.06 | 16.17 | 40 | 0.28% | 40% |
| New Housing estate to the west of the site | 0.22 | 16.06 | 16.28 | 40 | 0.55% | 41% |
| Houses off French St | 0.17 | 16.06 | 16.23 | 40 | 0.43% | 41% |
| Caravans at the Warrington Road site | 0.07 | 16.06 | 16.13 | 40 | 0.18% | 40% |
| AQMA 1 | 0.05 | 14.67 | 14.72 | 30 | 0.18% | 49% |
| AQMA 2 | 0.05 | 14.67 | 14.72 | 30 | 0.15% | 49% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 0.15 | 16.06 | 16.21 | 30 | 0.49% | 54% |
| Randle Reed Bed | 0.10 | 15.37 | 15.47 | 30 | 0.33% | 52% |
| Mersey Estuary | 0.02 | 14.88 | 14.90 | 30 | 0.06% | 50% |
| Wigg Island LNR | 0.02 | 13.71 | 13.73 | 30 | 0.07% | 46% |
| Nearest working population (offsite) | 0.12 | 16.06 | 16.18 | 40 | 0.30% | 40% |
| New Housing estate to the west of the site | 0.24 | 16.06 | 16.30 | 40 | 0.60% | 41% |
| Houses off French St | 0.18 | 16.06 | 16.24 | 40 | 0.45% | 41% |
| Caravans at the Warrington Road site | 0.08 | 16.06 | 16.14 | 40 | 0.20% | 40% |
| AQMA 1 | 0.06 | 14.67 | 14.73 | 30 | 0.19% | 49% |
| AQMA 2 | 0.05 | 14.67 | 14.72 | 30 | 0.17% | 49% |

Table 25 Long Term $NO_2$ (2019)

| | PC from ADMS modelling (µg/m³) | Background (µg/m³) | Total Concentration (PEC) (µg/m³) | EAL (µg/m³) | % PC of EAL | % PEC of EAL |
|---|---|---|---|---|---|---|
| **At average monitored/predicted emissions** | | | | | | |
| St Helens canal/Widnes Warth | 0.08 | 16.06 | 16.14 | 30 | 0.25% | 54% |
| Randle Reed Bed | 0.09 | 15.37 | 15.46 | 30 | 0.30% | 52% |
| Mersey Estuary | 0.01 | 14.88 | 14.89 | 30 | 0.04% | 50% |
| Wigg Island LNR | 0.02 | 13.71 | 13.73 | 30 | 0.05% | 46% |
| Nearest working population (offsite) | 0.10 | 16.06 | 16.16 | 40 | 0.25% | 40% |
| New Housing estate to the west of the site | 0.09 | 16.06 | 16.15 | 40 | 0.23% | 40% |
| Houses off French St | 0.16 | 16.06 | 16.22 | 40 | 0.40% | 41% |
| Caravans at the Warrington Road site | 0.09 | 16.06 | 16.15 | 40 | 0.24% | 40% |
| AQMA 1 | 0.05 | 14.67 | 14.72 | 30 | 0.18% | 49% |
| AQMA 2 | 0.05 | 14.67 | 14.72 | 30 | 0.17% | 49% |
| **At current/proposed ELV** | | | | | | |
| St Helens canal/Widnes Warth | 0.09 | 16.06 | 16.15 | 30 | 0.30% | 54% |
| Randle Reed Bed | 0.10 | 15.37 | 15.47 | 30 | 0.33% | 52% |
| Mersey Estuary | 0.01 | 14.88 | 14.89 | 30 | 0.04% | 50% |
| Wigg Island LNR | 0.02 | 13.71 | 13.73 | 30 | 0.06% | 46% |
| Nearest working population (offsite) | 0.11 | 16.06 | 16.17 | 40 | 0.28% | 40% |
| New Housing estate to the west of the site | 0.10 | 16.06 | 16.16 | 40 | 0.25% | 40% |
| Houses off French St | 0.18 | 16.06 | 16.24 | 40 | 0.44% | 41% |
| Caravans at the Warrington Road site | 0.10 | 16.06 | 16.16 | 40 | 0.26% | 40% |
| AQMA 1 | 0.06 | 14.67 | 14.73 | 30 | 0.20% | 49% |
| AQMA 2 | 0.06 | 14.67 | 14.73 | 30 | 0.19% | 49% |

Modelling shows that predicted long term PECs are likely to be below the EAL, with a maximum of 54% at St Helens canal/Widnes Warth for predicted emissions, and at ELV, using all years of meteorological data. It should be noted that the background concentrations at the majority of locations are the significant contributor to the total concentration, with the site contribution being significantly less than any background level.

The following figures provide an indication, respectively, of the long term $NO_2$ distribution using each year of meteorological data at:

- Average monitored/predicted emissions and
- Current/proposed ELV.

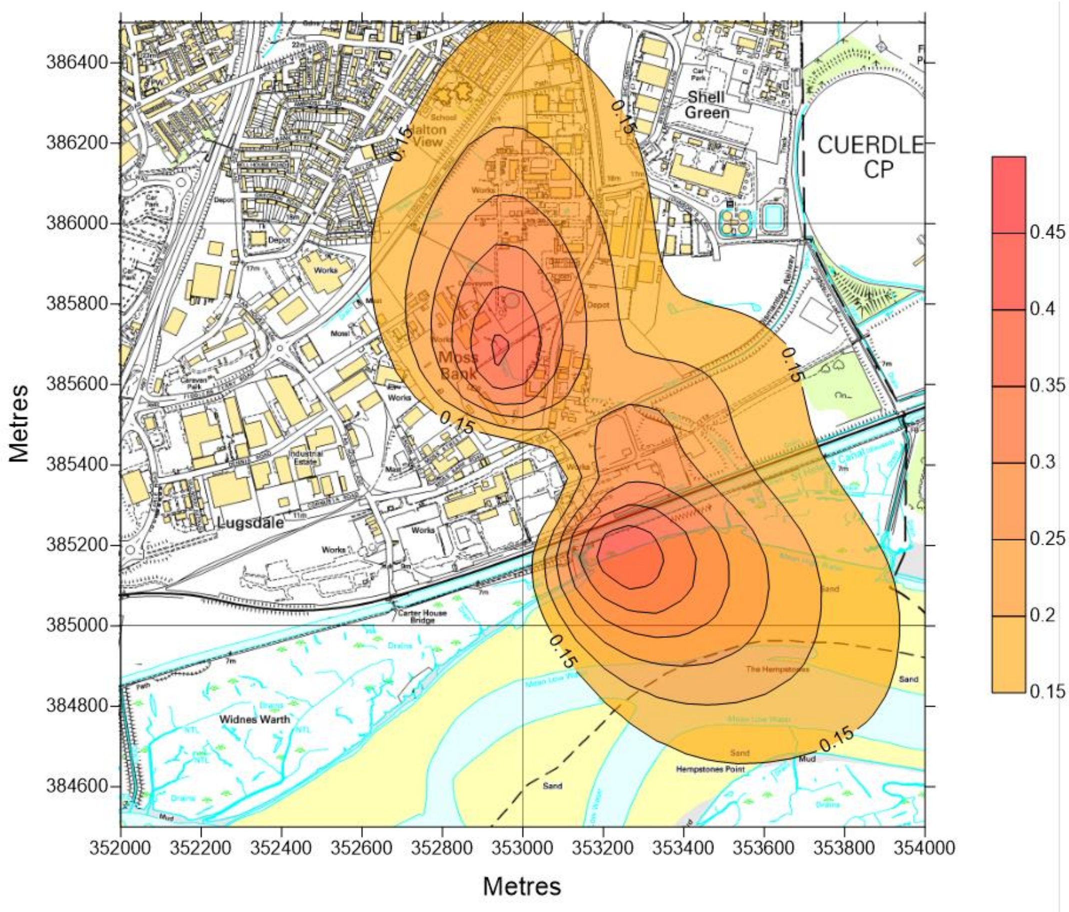



**Figure 28 Long term $NO_2$ (µg/m$^3$) at average monitored/predicted emissions (2017)**

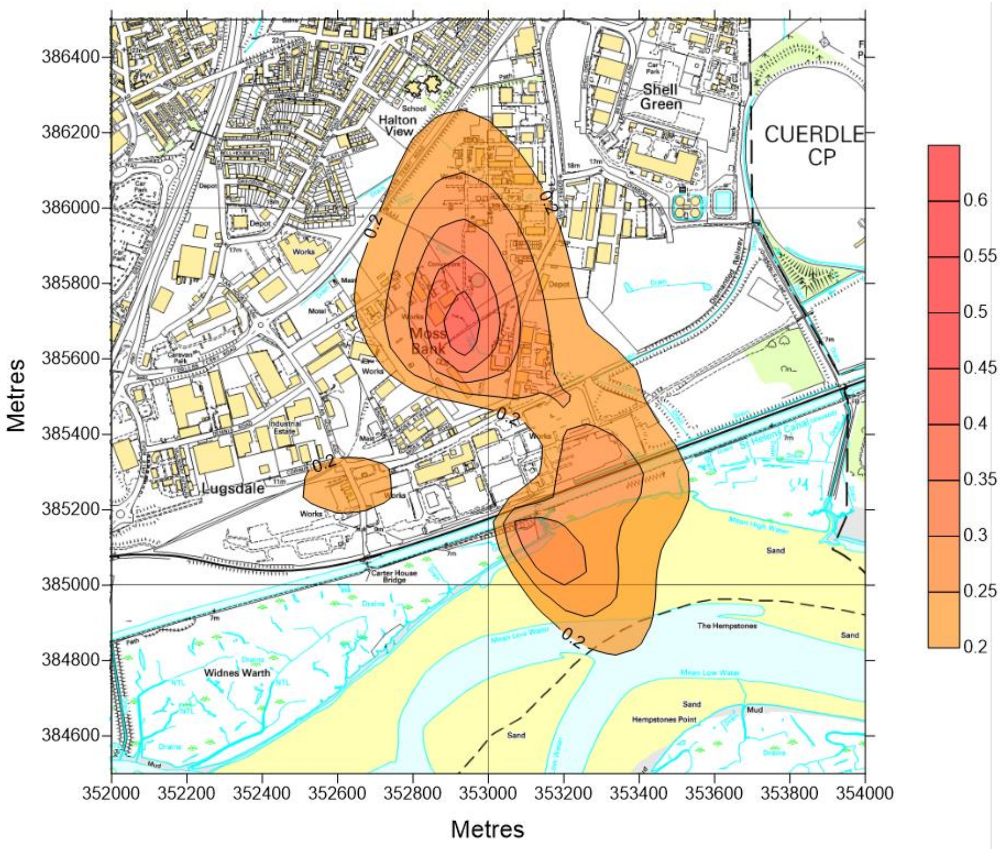



**Figure 29 Long term $NO_2$ ($\mu g/m^3$) at average monitored/predicted emissions (2018)**

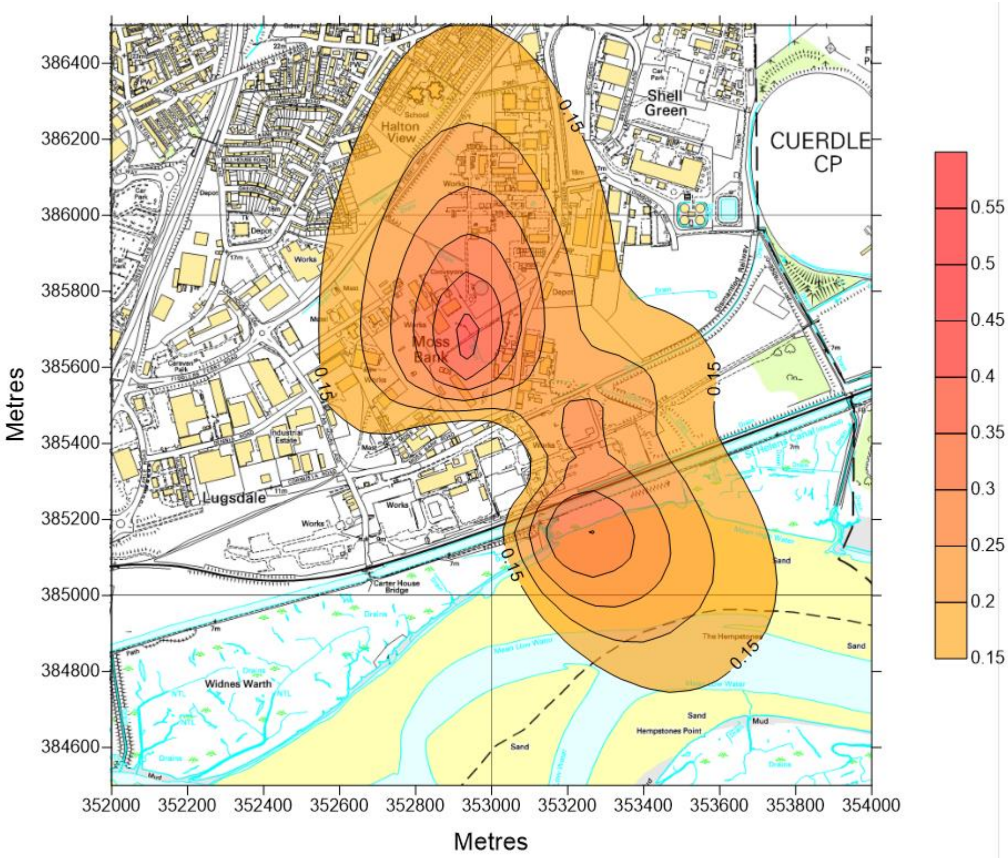



**Figure 30 Long term $NO_2$ ($\mu g/m^3$) at average monitored/predicted emissions (2019)**

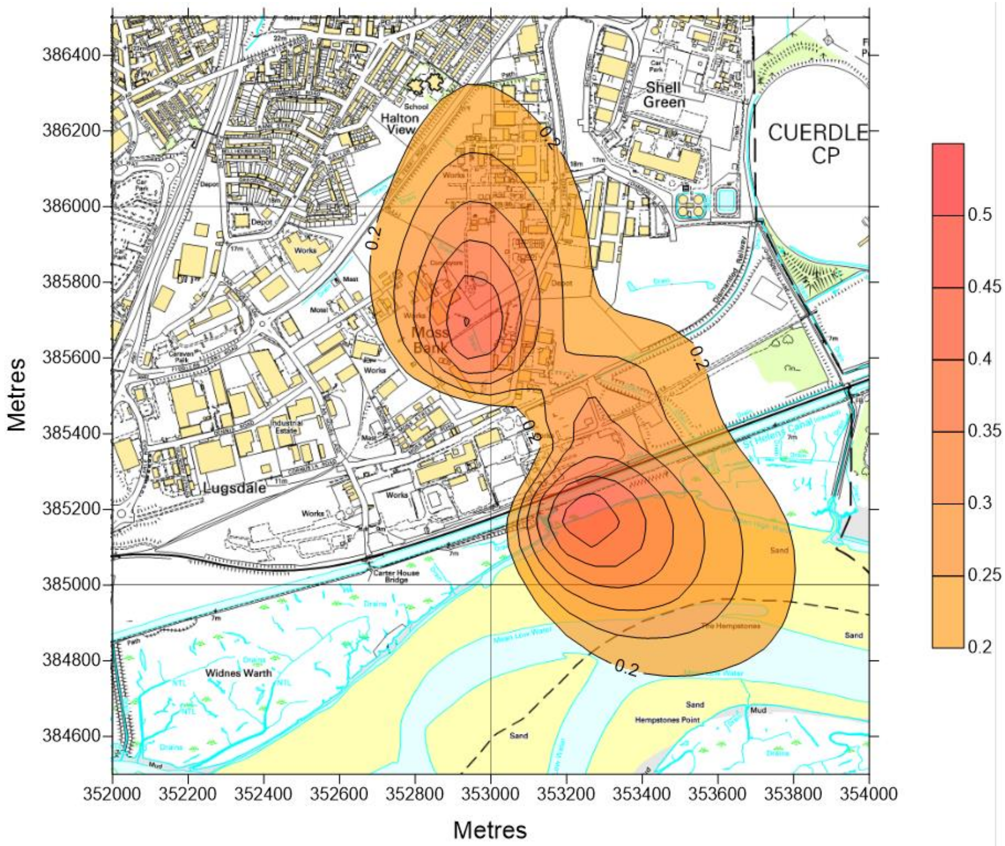



**Figure 31 Long Term $NO_2$ (µg/m$^3$) at current/proposed ELV (2017)**

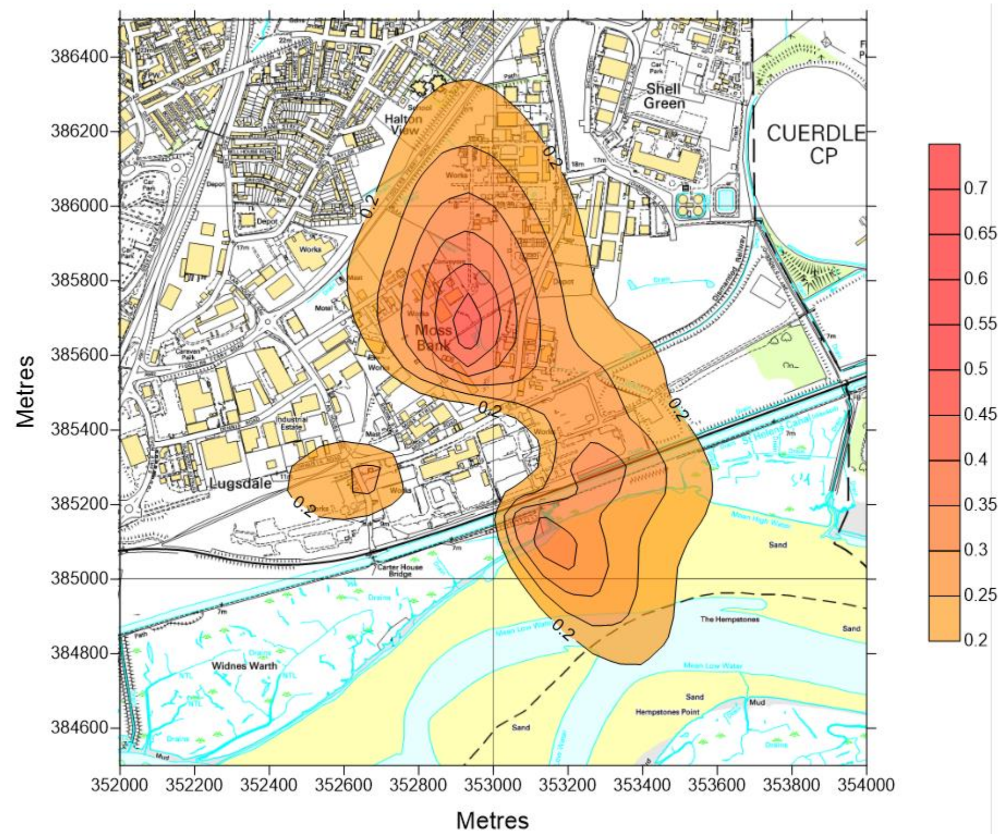



**Figure 32 Long Term $NO_2$ (µg/m$^3$) at current/proposed ELV (2018)**

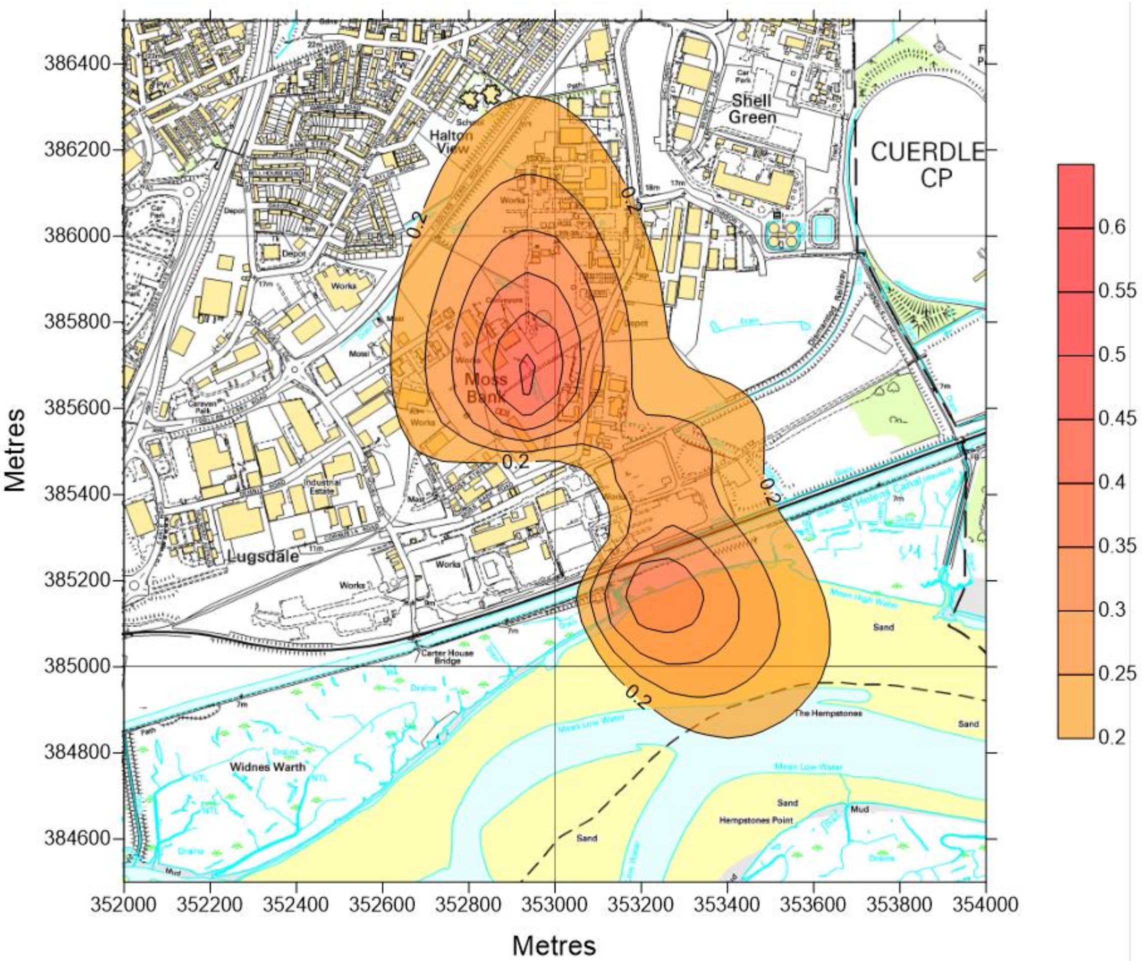



**Figure 33 Long Term $NO_2$ (µg/m³) at current/proposed ELV (2019)**

The table provides a summary of the onsite and offsite results.

**Table 26 Long Term $NO_2$ Modelling Results**

| Year | Onsite PC from ADMS Modelling (µg/m³) | Offsite PC from ADMS Modelling (µg/m³) | Background Conc (µg/m³) | Onsite PEC (µg/m³) | Offsite PEC (µg/m³) | EAL (µg/m³) | Onsite % PEC/EAL | Offsite % PEC/EAL |
|---|---|---|---|---|---|---|---|---|
| **At Monitored levels** | | | | | | | | |
| 2017 | 0.45 | 0.4 | 16.06 | 16.51 | 16.46 | 40 | 41% | 41% |
| 2018 | 0.6 | 0.4 | 16.06 | 16.66 | 16.46 | 40 | 42% | 41% |
| 2019 | 0.55 | 0.4 | 16.06 | 16.61 | 16.46 | 40 | 42% | 41% |
| **At Current/proposed limits** | | | | | | | | |
| 2017 | 0.5 | 0.45 | 16.06 | 16.56 | 16.51 | 40 | 41% | 41% |
| 2018 | 0.7 | 0.4 | 16.06 | 16.76 | 16.46 | 40 | 42% | 41% |
| 2019 | 0.6 | 0.4 | 16.06 | 16.66 | 16.46 | 40 | 42% | 41% |

## Nitrogen Nutrient Deposition

The critical loads given in APIS cover nutrient nitrogen deposition where the gas phase contains NO and $NO_2$. The low deposition velocity of NO and $NO_2$, 0.00015 and 0.0015m/s means that 1 $\mu g/m^3$ of $NO_2$ will only give rise to 0.14 kg/ha/y nutrient nitrogen input.

The Critical Loads for any of the sensitive ecological sites affected by deposition from Unifrax Widnes are given on the APIS web site as 20-30 kg N $ha^{-1}$ $yr^{-1}$. $NO_2$ concentration meeting the atmospheric concentration standard will not be critical for nutrient nitrogen input.

Critical loads have been taken from the APIS website[2].

| Habitat type | Critical load $NO_2$ kg/ha/y | Potential impact |
|---|---|---|
| Mid-upper saltmarshes | 20-30 | Increase in dominance of graminoids |
| Pioneer and low-mid saltmarshes | 20-30 | Increase in late-successional species, increase in productivity |
| Rich fens [including reed-beds] | 15-30 | Increase in tall graminoids, decrease in bryophytes |

2 Air Pollution Information System, *Indicative values within nutrient nitrogen critical load ranges for use in air pollution impact assessments*, http://www.apis.ac.uk/indicative-critical-load-values (accessed October 2021).

### 9.1.3 Dioxin Health Risk Assessment

#### Introduction

The basis for the dioxin health risk assessment is predictive modelling using the ADMS Version 5.2 atmospheric dispersion model to estimate concentrations and deposition rates for dioxins as a result of stack emissions from the site as a whole. It does not take account of any existing dioxin contamination at the locations of the specific receptors. Meteorological data from 2017 to 2019 was used and results using all three meteorological years are presented.

The health risk assessment takes into account the US EPA methodology outlined in the "Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities, EPA530-R-05-006, September 2005". There is currently no formal guidance in the UK on the assessment of health risks associated with exposure to emissions from facilities that may emit dioxins, and in England and Wales the Environment Agency's Air Quality Management and Assessment Unit (AQMAU) have accepted the use of the US EPA methodology as appropriate. However, where the USEPA methodology appears to make assumptions that are unlikely to be valid for the UK (Widnes) situation, alternative calculations are submitted.

Background concentration of dioxins is based on the most recently available TOMPs network data (2010) for Manchester and is assessed as 5.00E-05 ngTEQ/$m^3$ for the Widnes area.

#### Source of dioxins

Lines 2, 3 and 4 are recognised as a potential source of dioxins. 85% of gases potentially containing dioxins are collected and treated in a regenerative thermal oxidiser.

#### Potential Pathways for Exposure to Dioxins

The following pathways were considered as part of the health risk assessment:

- Inhalation
- Ingestion of soil
- Consumption of fruit and vegetables
- Consumption of dairy produce
- Consumption of poultry and eggs
- Consumption of lamb, beef and pork
- Consumption of fish
- Breast milk
- Drinking water

Members of the local population are only likely to be exposed to significant effects associated with emissions of dioxins from the site if:

- They spend periods of time at locations where and when emissions from the site increase the concentration of dioxins significantly above the existing background

- They consume food grown at locations where emissions increase the concentration of dioxins above the concentration normally present in food from those locations
- They undertake activities likely to lead to ingestion of soil at locations where emissions have increased the concentration of dioxins in the soil above those normally present and
- They drink water from sources exposed to increased concentrations of dioxins above the levels normally present.

The extent of exposure that any person may experience will depend directly on the degree to which they engage in any or all of the above activities, and by how much existing background concentrations of dioxins increase as a result of the operation of the site.

## Pathways Relevant to emissions from Unifrax Widnes

### *Inhalation*

People living in the vicinity of the site may be exposed to marginally higher levels of dioxins as a result of the operation of Unifrax Widnes for the proportion of the time that they spend there. Accordingly, this pathway is considered relevant to the current assessment.

### *Ingestion of Soil*

People working on the land within close proximity to the site may be exposed to marginally higher levels of dioxins as a result of the operation of the site for the proportion of the time that they work there. The potential for exposure by soil ingestion is likely to affect only a few local residents who may tend plots in their home gardens, and then for only limited periods of the year. Children playing in local gardens may also ingest some soil. Increased dioxin intake due to contribution from Saffil via the ingestion of soil is included in the assessment.

### *Food intake*

The majority of the general population purchase their food from large commercial outlets, which source their produce from across the UK and outside the country.  There are only a small number of convenience stores in Widnes that might market local produce. There are no local producers of food direct to market within 1.5 km of the site. The overwhelming majority of the local population’s exposure to dioxins due to consumption of food will not be affected significantly by the operation of Unifrax Widnes.

### *Consumption of Fruit and Vegetables*

People who consume fruit and vegetables grown near the site may be exposed to marginally higher levels of dioxins as a result of the operation of the process, although any increase is likely to be small compared with existing exposures.  The likelihood of individuals obtaining almost all of their fruit and vegetable consumption from gardens is likely to be low. No allotments have been identified within 1 km. Nevertheless, dioxin intake via the consumption of fruit and vegetables is included in the assessment.

### *Consumption of Local Dairy Produce*

Unifrax Widnes is located in an urban environment. There is no pasture land within 1.5 km of Unifrax Widnes.  Accordingly, there is no potential for grazing animals to forage on pasture land that could be significantly contaminated by deposition of dioxins emitted from Unifrax Widnes.

This scenario could only apply to those people whose milk supply is produced by dairy herds grazing on pasture land that could potentially become contaminated in the vicinity of the site. However, no dairy farms have been identified within 10 km of the site.

Milk in the UK is blended in bulk, and much is semi-skimmed before distribution so dioxin in milk and milk products consumed by people in the houses near to the site will be at the national average.

Therefore, consumption of local dairy produce is not considered for this assessment.

### *Consumption of Poultry and Eggs*

Privately reared poultry may be exposed to dioxins through soil ingested with food picked up from the ground. It is known that rearing poultry does not occur to a significant scale in the vicinity of the proposed development site. Both caged and commercial free-range birds derive their food from controlled feed. There is little scope for land being available for conversion to free-range egg production. Nevertheless, dioxin intake via the consumption of poultry and eggs is included in the assessment as there is scope for domestic poultry within 1 km of the site.

### *Consumption of Lamb, Beef and Pork*

The nearest farmland that might be used for grazing or making silage is 1.5 km from the site. Dioxin deposition at this distance is below 1% of background deposition.

A search on the internet identified no direct farm sales of meat products in the vicinity of the site. From that, it is deduced that meat consumed in the Widnes area is from commercial suppliers. Dioxin emissions from the site therefore have no effect on exposure due to consumption of lamb, beef and pork.

Therefore, consumption of lamb, beef and pork is not considered further as a potential pathway in this assessment

### *Consumption of Fish*

Oily fish can be a source of dioxins to human consumers.

The majority of fish consumed in the UK is from marine caught fish or from fish farmed remote from Widnes. There is however one small fish farm 5.5 km north of the site. It is devoted to production of Koi Carp rather than fish for human consumption. Fishing in the Spike Island stretch of the St Helens canal is for coarse fish not for consumption

It is considered that emissions from the site will not influence dioxin content of fish for human consumption. Therefore, consumption of fish is not considered for this assessment.

### Breast Milk

The consumption of breast milk by infants may be a potentially significant pathway for the dietary intake of dioxins due to absorption by the mother's lactic system.

### Drinking Water

The likelihood of contamination of groundwater aquifers occurring due to the deposition of dioxins associated with emissions from the site is considered highly unlikely given their very low solubility and the depth of the aquifer. The likelihood of local residents collecting rainwater for drinking purposes is thought to be low and has been discounted. Accordingly, no further consideration has been given to drinking water as a potential pathway.

## Receptor Scenarios

Of the sensitive receptors identified in Section 6, few are susceptible to dioxins. The table below shows the dioxin sensitive receptors including potentially relevant pathways.

**Table 27 Dioxin sensitive sites specific pathways**

| Exposure Pathways | Houses off French Street | Caravans at the Warrington Road Site | Farmland Adjacent to Fiddlers Ferry Power Station | New Housing estate to the west of the site |
|---|---|---|---|---|
| Inhalation | Y | Y | Y | Y |
| Ingestion of Soil | Y | Y | Y | Y |
| Consumption of Fruit and Vegetables | Y | N | Y | Y |
| Consumption of Local Dairy Produce | N | N | N | N |
| Consumption of Poultry and Eggs | Y | N | Y | Y |
| Consumption of Beef and Pork | N | N | N | N |
| Consumption of Fish | N | N | N | N |
| Breast Milk | Y | Y | N | Y |
| Drinking Water | N | N | N | N |

**Table 28 Dioxin dispersion modelling results**

| | PC from ADMS modelling (ng/m³) | | |
|---|---|---|---|
| | **2017** | **2018** | **2019** |
| **At monitored/predicted emissions** | | | |
| Houses off French Street | 9.96E-07 | 1.13E-06 | 1.12E-06 |
| Caravans at the Warrington Road Site | 3.51E-07 | 4.59E-07 | 6.67E-07 |
| Farmland Adjacent to Fiddlers Ferry Power Station | 4.00E-07 | 4.00E-07 | 4.00E-07 |
| New Housing estate to the west of the site | 3.30E-07 | 1.14E-06 | 4.12E-07 |
| **At ELV** | | | |
| Houses off French Street | 2.36E-06 | 2.68E-06 | 2.65E-06 |
| Caravans at the Warrington Road Site | 8.48E-07 | 1.11E-06 | 1.61E-06 |
| Farmland Adjacent to Fiddlers Ferry Power Station | 1.00E-06 | 1.00E-06 | 1.00E-06 |
| New Housing estate to the west of the site | 8.58E-07 | 2.94E-06 | 1.07E-06 |

The following figures provide an indication, respectively, of the long-term dioxin distribution using each year of meteorological data at:

- Average monitored/predicted emissions and
- ELV

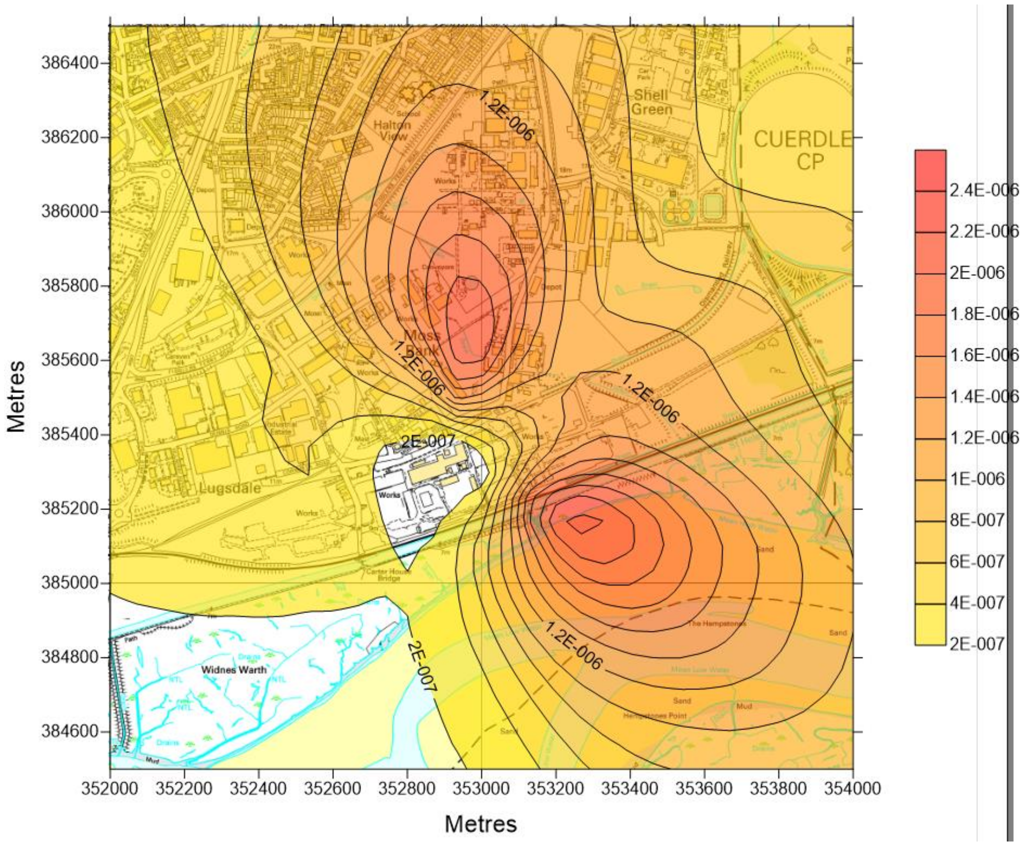



**Figure 34 Long term dioxin (ng/m³) at average monitored/predicted emissions (2017)**

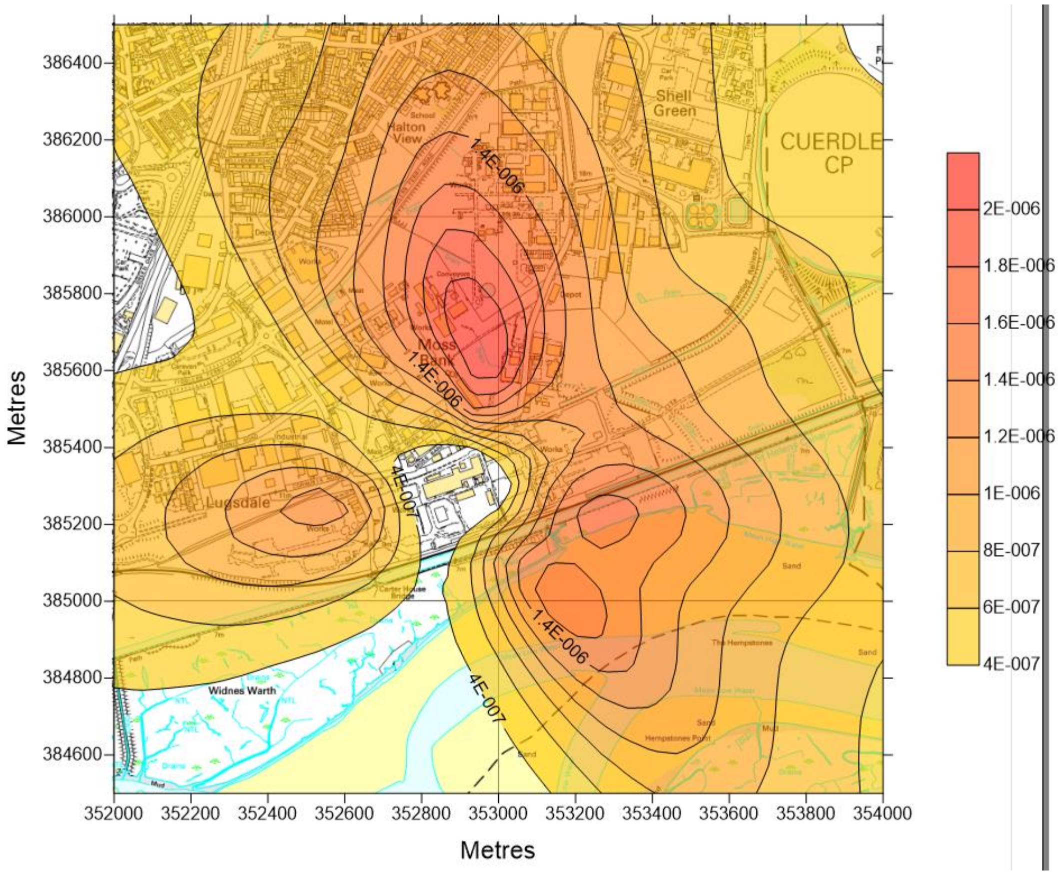



**Figure 35 Long term dioxin (ng/m³) at average monitored/predicted emissions (2018)**

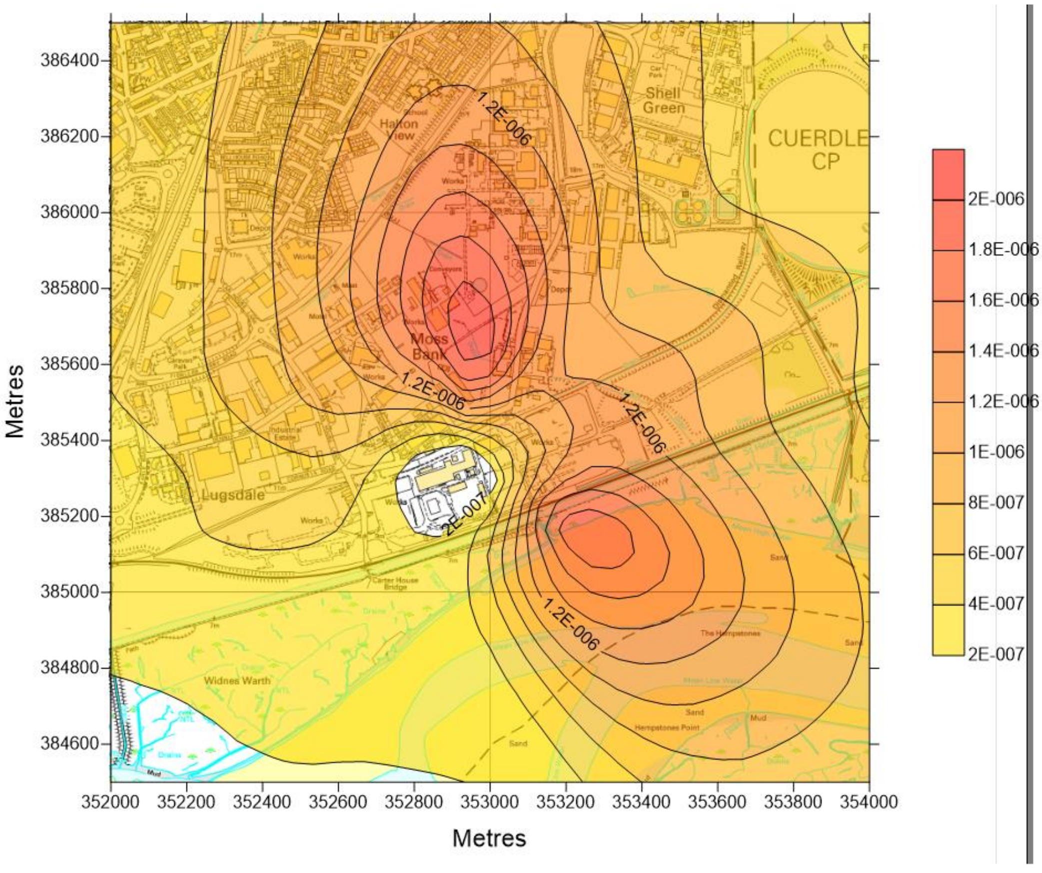



**Figure 36 Long term dioxin (ng/m³) at average monitored/predicted emissions (2019)**

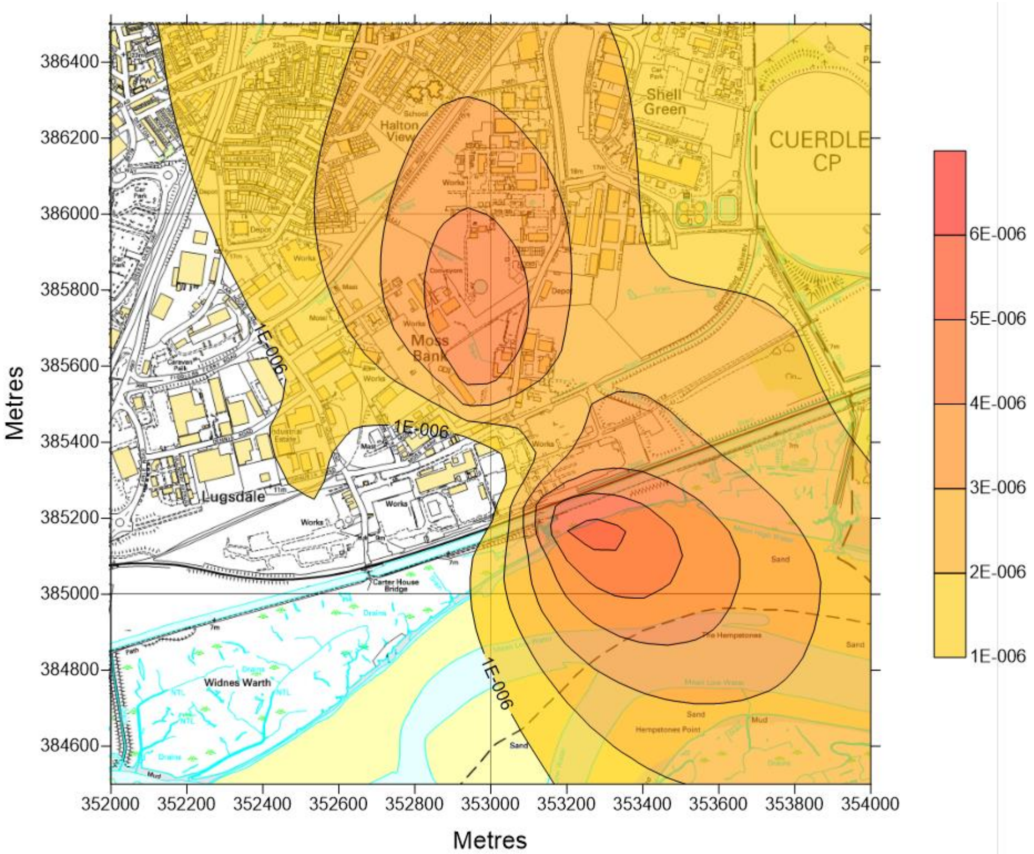



**Figure 37 Long Term dioxin (ng/m$^3$) at current/proposed ELV (2017)**

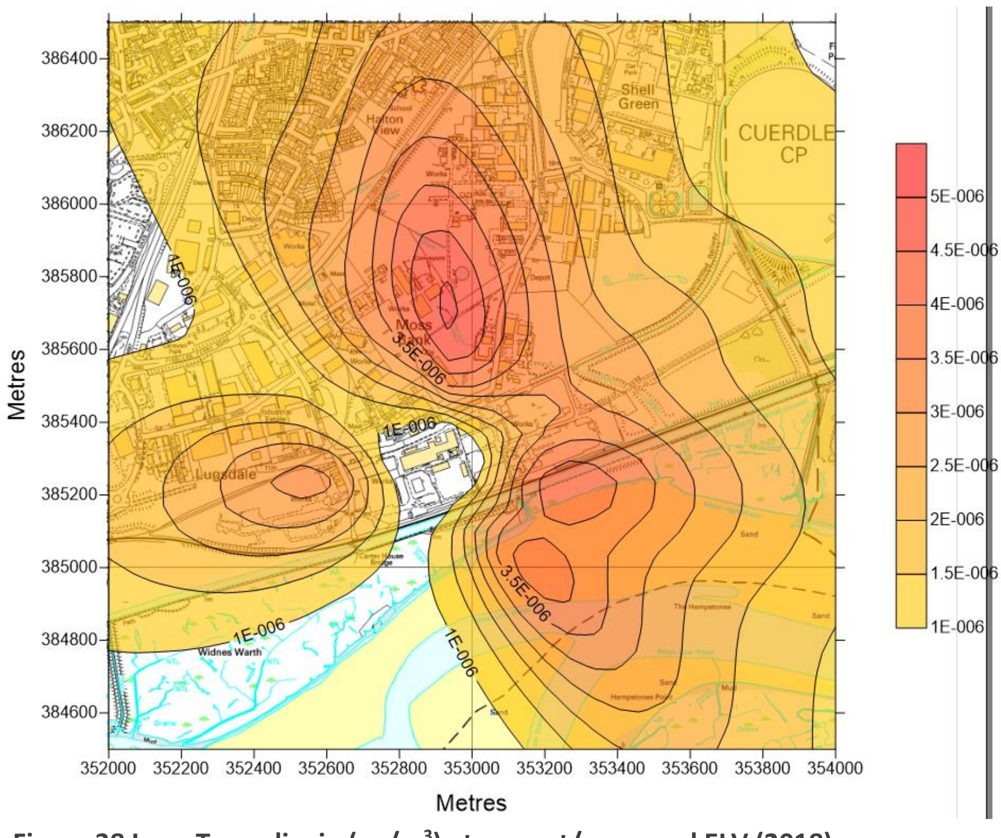



**Figure 38 Long Term dioxin (ng/m$^3$) at current/proposed ELV (2018)**

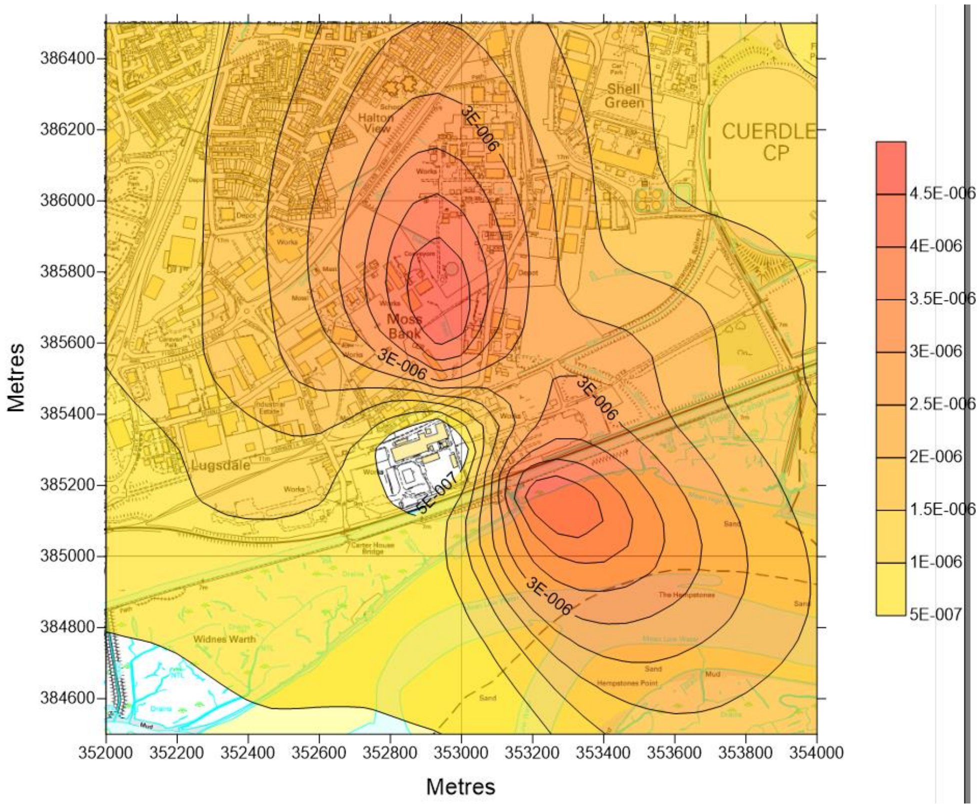



**Figure 39 Long Term dioxin (ng/m$^3$) at current/proposed ELV (2019)**

The following receptor scenarios have been considered as relevant to the exposure sites selected:

## ***Inhalation Dose***

The area in the immediate vicinity of the site is predominantly urban. Unifrax Widnes is bordered to the north by commercial premises. The nearest permanent housing will be the new housing to the west of the site. This is built on what was brownfield land. There is also a caravan site 700 m at 300 degrees east of north from the site. People living and working in the vicinity of the site may be exposed to dioxins via the inhalation route. The additional concentration of dioxins likely to occur at the nearest housing due to Unifrax Widnes has been modelled using ADMS 5.2. The emissions modelled are for normal operation and for operation at the ELV using weather data from Rostherne for 2017, 2018 and 2019.

Table 29 Dioxin Inhalation Dose (2017)

| Location | PC (ng/m³) | 70 kg adult breath (m³/day) | 15 kg child breath (m³/ day) | Adult Intake (ng/day) | Adult Intake (pg/day) | Child intake (ng/day) | Child Intake (pg/day) | Adult (70kg) TDI (pg/day)* | Child (15kg) TDI (pg/day)* | Atmospheric inhalation % of adult TDI* | Atmospheric inhalation % of child TDI* | Site % contribution of total adult or child inhalation** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Background | 5.00E-05 | 20 | 7.8 | 1.00E-03 | 1.00 | 3.90E-04 | 0.39 | 140 | 30 | 0.71% | 1.30% | N/A (background) |
| **At Monitored/Predicted** | | | | | | | | | | | | |
| Houses off French Street | 9.96E-07 | 20 | 7.8 | 1.99E-05 | 0.02 | 7.77E-06 | 0.01 | 140 | 30 | 0.01% | 0.03% | 2.0% |
| Caravans at the Warrington Road Site | 3.51E-07 | 20 | 7.8 | 7.02E-06 | 0.01 | 2.74E-06 | 0.003 | 140 | 30 | 0.01% | 0.01% | 0.7% |
| Farmland Adjacent to Fiddlers Ferry Power Station | 4.00E-07 | 20 | 7.8 | 8.00E-06 | 0.01 | 3.12E-06 | 0.003 | 140 | 30 | 0.01% | 0.01% | 0.8% |
| New Housing estate to the west of the site | 3.30E-07 | 20 | 7.8 | 6.60E-06 | 0.01 | 2.57E-06 | 0.003 | 140 | 30 | 0.005% | 0.01% | 0.7% |
| **At ELV** | | | | | | | | | | | | |
| Houses off French Street | 2.36E-06 | 20 | 7.8 | 4.73E-05 | 0.05 | 1.84E-05 | 0.02 | 140 | 30 | 0.03% | 0.06% | 4.5% |
| Caravans at the Warrington Road Site | 8.48E-07 | 20 | 7.8 | 1.70E-05 | 0.02 | 6.61E-06 | 0.01 | 140 | 30 | 0.01% | 0.02% | 1.7% |
| Farmland Adjacent to Fiddlers Ferry Power Station | 1.00E-06 | 20 | 7.8 | 2.00E-05 | 0.02 | 7.80E-06 | 0.01 | 140 | 30 | 0.01% | 0.03% | 2.0% |
| New Housing estate to the west of the site | 8.58E-07 | 20 | 7.8 | 1.72E-05 | 0.02 | 6.69E-06 | 0.01 | 140 | 30 | 0.01% | 0.02% | 1.7% |

* Tolerable Daily Intake. For dioxins, this is 2pg I-TEQ/kg bodyweight per day, e.g., for a 70 kg adult, the TDI is 70 kg x 2 pg/kg/day = 140 pg/day. The Tolerable inhalation Daily Intake (TiDI) is defined as 20% of the TDI.

**Total inhalation is background concentration added to concentration at sensitive receptor from Unifrax Widnes as calculated from ADMS.

Table 30 Dioxin Inhalation Dose (2018)

| Location | PC (ng/m³) | 70 kg adult breath (m³/day) | 15 kg child breath (m³/ day) | Adult Intake (ng/day) | Adult Intake (pg/day) | Child intake (ng/day) | Child Intake (pg/day) | Adult (70kg) TDI (pg/day)* | Child (15kg) TDI (pg/day)* | Atmospheric inhalation % of adult TDI* | Atmospheric inhalation % of child TDI* | Site % contribution of total adult or child inhalation** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Background | 5.00E-05 | 20 | 7.8 | 1.00E-03 | 1.00 | 3.90E-04 | 0.39 | 140 | 30 | 0.71% | 1.30% | N/A (background) |
| **At Monitored/Predicted** | | | | | | | | | | | | |
| Houses off French Street | 1.13E-06 | 20 | 7.8 | 2.25E-05 | 0.02 | 8.78E-06 | 0.01 | 140 | 30 | 0.02% | 0.03% | 2.2% |
| Caravans at the Warrington Road Site | 4.59E-07 | 20 | 7.8 | 9.19E-06 | 0.01 | 3.58E-06 | 0.004 | 140 | 30 | 0.01% | 0.01% | 0.9% |
| Farmland Adjacent to Fiddlers Ferry Power Station | 4.00E-07 | 20 | 7.8 | 8.00E-06 | 0.01 | 3.12E-06 | 0.003 | 140 | 30 | 0.01% | 0.01% | 0.8% |
| New Housing estate to the west of the site | 1.14E-06 | 20 | 7.8 | 2.28E-05 | 0.02 | 8.91E-06 | 0.009 | 140 | 30 | 0.02% | 0.03% | 2.2% |
| **At ELV** | | | | | | | | | | | | |
| Houses off French Street | 2.68E-06 | 20 | 7.8 | 5.36E-05 | 0.05 | 2.09E-05 | 0.02 | 140 | 30 | 0.04% | 0.07% | 5.1% |
| Caravans at the Warrington Road Site | 1.11E-06 | 20 | 7.8 | 2.22E-05 | 0.02 | 8.66E-06 | 0.01 | 140 | 30 | 0.02% | 0.03% | 2.2% |
| Farmland Adjacent to Fiddlers Ferry Power Station | 1.00E-06 | 20 | 7.8 | 2.00E-05 | 0.02 | 7.80E-06 | 0.01 | 140 | 30 | 0.01% | 0.03% | 2.0% |
| New Housing estate to the west of the site | 2.94E-06 | 20 | 7.8 | 5.87E-05 | 0.06 | 2.29E-05 | 0.02 | 140 | 30 | 0.04% | 0.08% | 5.5% |

* Tolerable Daily Intake. For dioxins, this is 2pg I-TEQ/kg bodyweight per day, e.g., for a 70 kg adult, the TDI is 70 kg x 2 pg/kg/day = 140 pg/day. The Tolerable inhalation Daily Intake (TiDI) is defined as 20% of the TDI.

**Total inhalation is background concentration added to concentration at sensitive receptor from Unifrax Widnes as calculated from ADMS.

Table 31 Dioxin Inhalation Dose (2019)

| Location | PC (ng/m³) | 70 kg adult breath (m³/day) | 15 kg child breath (m³/ day) | Adult Intake (ng/day) | Adult Intake (pg/day) | Child intake (ng/day) | Child Intake (pg/day) | Adult (70kg) TDI (pg/day)* | Child (15kg) TDI (pg/day)* | Atmospheric inhalation % of adult TDI* | Atmospheric inhalation % of child TDI* | Site % contribution of total adult or child inhalation** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Background | 5.00E-05 | 20 | 7.8 | 1.00E-03 | 1.00 | 3.90E-04 | 0.39 | 140 | 30 | 0.71% | 1.30% | N/A (background) |
| **At Monitored/Predicted** | | | | | | | | | | | | |
| Houses off French Street | 1.12E-06 | 20 | 7.8 | 2.24E-05 | 0.02 | 8.72E-06 | 0.01 | 140 | 30 | 0.02% | 0.03% | 2.2% |
| Caravans at the Warrington Road Site | 6.67E-07 | 20 | 7.8 | 1.33E-05 | 0.01 | 5.21E-06 | 0.01 | 140 | 30 | 0.01% | 0.02% | 1.3% |
| Farmland Adjacent to Fiddlers Ferry Power Station | 4.00E-07 | 20 | 7.8 | 8.00E-06 | 0.01 | 3.12E-06 | 0.003 | 140 | 30 | 0.01% | 0.01% | 0.8% |
| New Housing estate to the west of the site | 4.12E-07 | 20 | 7.8 | 8.24E-06 | 0.01 | 3.21E-06 | 0.003 | 140 | 30 | 0.01% | 0.01% | 0.8% |
| **At ELV** | | | | | | | | | | | | |
| Houses off French Street | 2.65E-06 | 20 | 7.8 | 5.31E-05 | 0.05 | 2.07E-05 | 0.02 | 140 | 30 | 0.04% | 0.07% | 5.0% |
| Caravans at the Warrington Road Site | 1.61E-06 | 20 | 7.8 | 3.21E-05 | 0.03 | 1.25E-05 | 0.01 | 140 | 30 | 0.02% | 0.04% | 3.1% |
| Farmland Adjacent to Fiddlers Ferry Power Station | 1.00E-06 | 20 | 7.8 | 2.00E-05 | 0.02 | 7.80E-06 | 0.01 | 140 | 30 | 0.01% | 0.03% | 2.0% |
| New Housing estate to the west of the site | 1.07E-06 | 20 | 7.8 | 2.13E-05 | 0.02 | 8.31E-06 | 0.01 | 140 | 30 | 0.02% | 0.03% | 2.1% |

* Tolerable Daily Intake. For dioxins, this is 2pg I-TEQ/kg bodyweight per day, e.g., for a 70 kg adult, the TDI is 70 kg x 2 pg/kg/day = 140 pg/day. The Tolerable inhalation Daily Intake (TiDI) is defined as 20% of the TDI.

**Total inhalation is background concentration added to concentration at sensitive receptor from Unifrax Widnes as calculated from ADMS.

The table above shows that the background atmospheric concentration of dioxins is substantially larger than the concentration attributable to Unifrax Widnes emissions. From these results it is concluded that the additional contribution from site emissions will only marginally increase the exposure of people at the nearest housing through the inhalation route.

## *Ingestion of Soil*

The additional exposure to dioxins by ingestion of soil in the nearest garden has been assessed. The dry deposition velocity of dioxins is assumed to be 0.002 m/s based on Koestler et al[3]. This figure is increased to 0.006 m/s to account for additional wet deposition.

The results for atmospheric dioxin concentration (see Table 28) have been compared both for the houses off French Street and for the new housing estate to the west of the site, considering all three years' meteorological data. Although the new houses to the west are closer in proximity to the site than the houses off French Street, the ADMS modelling predicts a lower concentration here in 2017 and 2019, most likely due to prevailing conditions such as wind direction. The overall worst-case concentration result is of 1.14E-06 ng TEQ/$m^3$ at the new housing estate to the west of the site for 2018 meteorological data, therefore this value is carried through into the assessment below.

Deposition over 25 years would give a total of 5.40 ng/$m^2$, which if mixed with soil, dry density 1.5 kg/l, to a depth of 0.1 m would give an additional soil concentration of 0.04 ng/kg DW. This is compared with the urban guideline value of 8,000 ng/kg.

Using the exposure factor from SC050021/dioxins SGV of 0.0104 pg/kg body weight/day/ng/kgDW, this gives a soil average daily exposure of 0.00037 pg WHO-TEQ/kg body weight/day. This is an order of magnitude less than the inhalation dose.

The tables below present the constants and calculations used to inform these conclusions.

**Table 32 Dioxin Soil Ingestion Calculation Constants**

| Constant | Value |
|---|---|
| **Dry deposition velocity (m/s)[(3)]** | 0.002 |
| **Wet and dry deposition velocity in nearest garden (m/s)** | 0.006 |
| **Dry soil density kg/L** | 1.5 |
| **Exposure factor (pg/kg body weight/day/ng/kgDW) from SC050021/dioxinsSGV** | 0.0104 |
| **TEF (Toxicity Equivalence Factor)** | 1 |
| **TDSI pg WHO-TEQ/kgBW/day** | 1 |

[3] (1) Koester, C.J. and R.A. Hites. 1992. Wet and dry deposition of chlorinated dioxins and furans.

**Table 33 Dioxin Soil Ingestion (2017)**

| | PC (ng/m³) | Deposition (ng/m²/s) | Deposition (ng/m²/yr) | Dioxin conc after 25 years operation (ng/kg)* | Soil average daily exposure (pg WHO-TEQ/kg BW/day) | Adult (70 kg) | Child (15 kg) | Hazard index | % increase due to site contribution |
|---|---|---|---|---|---|---|---|---|---|
| Background | 5.00E-05 | 3.00E-07 | 9.46 | 1.5768 | 0.01640 | 2.29582 | 0.49196 | 0.0164 | N/A (background) |
| **At monitored/predicted emissions** | | | | | | | | | |
| Houses off French Street | 9.96E-07 | 5.98E-09 | 0.19 | 0.0314 | 0.00033 | 0.04574 | 0.00980 | 0.0003 | 2.0% |
| Caravan site | 3.51E-07 | 2.11E-09 | 0.07 | 0.0111 | 0.00012 | 0.01612 | 0.00345 | 0.0001 | 0.7% |
| Farmland | 4.00E-07 | 2.40E-09 | 0.08 | 0.0126 | 0.00013 | 0.01837 | 0.00394 | 0.0001 | 0.8% |
| New Housing estate to the west of the site | 3.30E-07 | 1.98E-09 | 0.06 | 0.0104 | 0.00011 | 0.01515 | 0.00325 | 0.0001 | 0.7% |
| **At ELV** | | | | | | | | | |
| Houses off French Street | 2.36E-06 | 1.42E-08 | 0.45 | 0.0745 | 0.00078 | 0.10851 | 0.02325 | 0.0008 | 4.7% |
| Caravan site | 8.48E-07 | 5.09E-09 | 0.16 | 0.0267 | 0.00028 | 0.03894 | 0.00834 | 0.0003 | 1.7% |
| Farmland | 1.00E-06 | 6.00E-09 | 0.19 | 0.0315 | 0.00033 | 0.04592 | 0.00984 | 0.0003 | 2.0% |
| New Housing estate to the west of the site | 8.58E-07 | 5.15E-09 | 0.16 | 0.0270 | 0.00028 | 0.03938 | 0.00844 | 0.0003 | 1.7% |

*Assuming no degradation or re-evaporation, mixing depth 0.1m.

**Table 34 Dioxin Soil Ingestion (2018)**

| | PC (ng/m³) | Deposition (ng/m²/s) | Deposition (ng/m²/yr) | Dioxin conc after 25 years operation (ng/kg)* | Soil average daily exposure (pg WHO-TEQ/kg BW/day) | Adult (70 kg) | Child (15 kg) | Hazard index | % increase due to site contribution |
|---|---|---|---|---|---|---|---|---|---|
| Background | 5.00E-05 | 3.00E-07 | 9.46 | 1.5768 | 0.01640 | 2.29582 | 0.49196 | 0.0164 | N/A (background) |
| **At monitored/predicted emissions** | | | | | | | | | |
| Houses off French Street | 1.13E-06 | 6.75E-09 | 0.21 | 0.0355 | 0.00037 | 0.05168 | 0.01107 | 0.0004 | 2.3% |
| Caravan site | 4.59E-07 | 2.76E-09 | 0.09 | 0.0145 | 0.00015 | 0.02109 | 0.00452 | 0.0002 | 0.9% |
| Farmland | 4.00E-07 | 2.40E-09 | 0.08 | 0.0126 | 0.00013 | 0.01837 | 0.00394 | 0.0001 | 0.8% |
| New Housing estate to the west of the site | 1.14E-06 | 6.85E-09 | 0.22 | 0.0360 | 0.00037 | 0.05244 | 0.01124 | 0.0004 | 2.3% |
| **At ELV** | | | | | | | | | |
| Houses off French Street | 2.68E-06 | 1.61E-08 | 0.51 | 0.0845 | 0.00088 | 0.12310 | 0.02638 | 0.0009 | 5.4% |
| Caravan site | 1.11E-06 | 6.66E-09 | 0.21 | 0.0350 | 0.00036 | 0.05096 | 0.01092 | 0.0004 | 2.2% |
| Farmland | 1.00E-06 | 6.00E-09 | 0.19 | 0.0315 | 0.00033 | 0.04592 | 0.00984 | 0.0003 | 2.0% |
| New Housing estate to the west of the site | 2.94E-06 | 1.76E-08 | 0.56 | 0.0926 | 0.00096 | 0.13488 | 0.02890 | 0.0010 | 5.9% |

*Assuming no degradation or re-evaporation, mixing depth 0.1m.

Table 35 Dioxin Soil Ingestion (2019)

| | PC ($ng/m^3$) | Deposition ($ng/m^2/s$) | Deposition ($ng/m^2/yr$) | Dioxin conc after 25 years operation (ng/kg)* | Soil average daily exposure (pg WHO-TEQ/kg BW/day) | Adult (70 kg) | Child (15 kg) | Hazard index | % increase due to site contribution |
|---|---|---|---|---|---|---|---|---|---|
| Background | 5.00E-05 | 3.00E-07 | 9.46 | 1.5768 | 0.01640 | 2.29582 | 0.49196 | 0.0164 | N/A (background) |
| **At monitored/predicted emissions** | | | | | | | | | |
| Houses off French Street | 1.12E-06 | 6.71E-09 | 0.21 | 0.0352 | 0.00037 | 0.05132 | 0.01100 | 0.0004 | 2.2% |
| Caravan site | 6.67E-07 | 4.00E-09 | 0.13 | 0.0210 | 0.00022 | 0.03064 | 0.00657 | 0.0002 | 1.3% |
| Farmland | 4.00E-07 | 2.40E-09 | 0.08 | 0.0126 | 0.00013 | 0.01837 | 0.00394 | 0.0001 | 0.8% |
| New Housing estate to the west of the site | 4.12E-07 | 2.47E-09 | 0.08 | 0.0130 | 0.00014 | 0.01891 | 0.00405 | 0.0001 | 0.8% |
| **At ELV** | | | | | | | | | |
| Houses off French Street | 2.65E-06 | 1.59E-08 | 0.50 | 0.0837 | 0.00087 | 0.12189 | 0.02612 | 0.0009 | 5.3% |
| Caravan site | 1.61E-06 | 9.64E-09 | 0.30 | 0.0507 | 0.00053 | 0.07377 | 0.01581 | 0.0005 | 3.2% |
| Farmland | 1.00E-06 | 6.00E-09 | 0.19 | 0.0315 | 0.00033 | 0.04592 | 0.00984 | 0.0003 | 2.0% |
| New Housing estate to the west of the site | 1.07E-06 | 6.39E-09 | 0.20 | 0.0336 | 0.00035 | 0.04893 | 0.01048 | 0.0003 | 2.1% |

*Assuming no degradation or re-evaporation, mixing depth 0.1m.

Data in the tables above show that ingestion of soil contaminated with dioxins from the site will not be a significant route compared with inhalation of dioxins from the site, which has been demonstrated as less than background inhalation.

There are no appropriate air standards available for dioxin emissions, therefore a human health risk assessment approach is used to determine the long-term impact of dioxin. This has been used in previous assessment of dioxin emissions from Unifrax Widnes and is an approach that has been accepted by the EA.

Dispersion modelling results are added to background levels (0.05 pg/m$^3$) to determine the concentration on and off site. The highest concentrations have been used as a worst case.

The recommended WHO Tolerable Daily Intake (TDI) for dioxins is 2 pg I-TEQ/kg bodyweight per day. A weight of 70 kg has been used for average adult weight and 15 kg for a child. The Tolerable inhalation Daily Intake (TiDI) is defined as 20% of the TDI.

It is assumed that the average adult inhalation rate is 20m$^3$ of air per day and for children 7.8 m$^3$ of air per day. These figures have been used to multiply the predicted concentrations in order to give a daily intake.

The calculated amounts for both adults and children are shown in the tables below.

**Table 36 Adult Dioxin Health Risk Assessment (TiDI) (2017)**

| | PC from ADMS Modelling (pg/m$^3$) | Background Conc (pg/m$^3$) | PEC (pg/m$^3$) | Maximum levels of exposure (pg) | TDI (pg) per kg BW | TiDI (pg) per kg BW | TiDI x BW (pg) | % of Recommended TiDI |
|---|---|---|---|---|---|---|---|---|
| **At monitored levels** | | | | | | | | |
| Onsite | 2.00E-04 | 0.05 | 5.02E-02 | 1.0 | 2 | 0.4 | 28 | 3.6% |
| Offsite | 2.40E-03 | 0.05 | 5.24E-02 | 1.0 | 2 | 0.4 | 28 | 3.7% |
| **At current and proposed limits** | | | | | | | | |
| Onsite | 5.00E-04 | 0.05 | 5.05E-02 | 1.0 | 2 | 0.4 | 28 | 3.6% |
| Offsite | 6.00E-03 | 0.05 | 5.60E-02 | 1.1 | 2 | 0.4 | 28 | 4.0% |

Table 37 Child Dioxin Health Risk Assessment (TiDI) (2017)

| | PC from ADMS Modelling ($pg/m^3$) | Background Conc ($pg/m^3$) | PEC ($pg/m^3$) | Maximum levels of exposure (pg) | TDI (pg) per kg BW | TiDI (pg) per kg BW | TiDI x BW (pg) | % of Recommended TiDI |
|---|---|---|---|---|---|---|---|---|
| **At monitored levels** | | | | | | | | |
| Onsite | 2.00E-04 | 0.05 | 5.02E-02 | 1.0 | 2 | 0.4 | 6 | 16.7% |
| Offsite | 2.40E-03 | 0.05 | 5.24E-02 | 1.0 | 2 | 0.4 | 6 | 17.5% |
| **At current and proposed limits** | | | | | | | | |
| Onsite | 5.00E-04 | 0.05 | 5.05E-02 | 1.0 | 2 | 0.4 | 6 | 16.8% |
| Offsite | 6.00E-03 | 0.05 | 5.60E-02 | 1.1 | 2 | 0.4 | 6 | 18.7% |

Table 38 Adult Dioxin Health Risk Assessment (TiDI) (2018)

| | PC from ADMS Modelling ($pg/m^3$) | Background Conc ($pg/m^3$) | PEC ($pg/m^3$) | Maximum levels of exposure (pg) | TDI (pg) per kg BW | TiDI (pg) per kg BW | TiDI x BW (pg) | % of Recommended TiDI |
|---|---|---|---|---|---|---|---|---|
| **At monitored levels** | | | | | | | | |
| Onsite | 2.00E-04 | 0.05 | 5.02E-02 | 1.0 | 2 | 0.4 | 28 | 3.6% |
| Offsite | 2.00E-03 | 0.05 | 5.20E-02 | 1.0 | 2 | 0.4 | 28 | 3.7% |
| **At current and proposed limits** | | | | | | | | |
| Onsite | 5.00E-04 | 0.05 | 5.05E-02 | 1.0 | 2 | 0.4 | 28 | 3.6% |
| Offsite | 5.00E-03 | 0.05 | 5.50E-02 | 1.1 | 2 | 0.4 | 28 | 3.9% |

Table 39 Child Dioxin Health Risk Assessment (TiDI) (2018)

| | PC from ADMS Modelling ($pg/m^3$) | Background Conc ($pg/m^3$) | PEC ($pg/m^3$) | Maximum levels of exposure (pg) | TDI (pg) per kg BW | TiDI (pg) per kg BW | TiDI x BW (pg) | % of Recommended TiDI |
|---|---|---|---|---|---|---|---|---|
| **At monitored levels** | | | | | | | | |
| Onsite | 2.00E-04 | 0.05 | 5.02E-02 | 1.0 | 2 | 0.4 | 6 | 16.7% |
| Offsite | 2.00E-03 | 0.05 | 5.20E-02 | 1.0 | 2 | 0.4 | 6 | 17.3% |
| **At current and proposed limits** | | | | | | | | |
| Onsite | 5.00E-04 | 0.05 | 5.05E-02 | 1.0 | 2 | 0.4 | 6 | 16.8% |
| Offsite | 5.00E-03 | 0.05 | 5.50E-02 | 1.1 | 2 | 0.4 | 6 | 18.3% |

Table 40 Adult Dioxin Health Risk Assessment (TiDI) (2019)

| | PC from ADMS Modelling (pg/m³) | Background Conc (pg/m³) | PEC (pg/m³) | Maximum levels of exposure (pg) | TDI (pg) per kg BW | TiDI (pg) per kg BW | TiDI x BW (pg) | % of Recommended TiDI |
|---|---|---|---|---|---|---|---|---|
| **At monitored levels** | | | | | | | | |
| Onsite | 2.00E-04 | 0.05 | 5.02E-02 | 1.0 | 2 | 0.4 | 28 | 3.6% |
| Offsite | 2.00E-03 | 0.05 | 5.20E-02 | 1.0 | 2 | 0.4 | 28 | 3.7% |
| **At current and proposed limits** | | | | | | | | |
| Onsite | 5.00E-04 | 0.05 | 5.05E-02 | 1.0 | 2 | 0.4 | 28 | 3.6% |
| Offsite | 4.50E-03 | 0.05 | 5.45E-02 | 1.1 | 2 | 0.4 | 28 | 3.9% |

Table 41 Child Dioxin Health Risk Assessment (TiDI) (2019)

| | PC from ADMS Modelling (pg/m³) | Background Conc (pg/m³) | PEC (pg/m³) | Maximum levels of exposure (pg) | TDI (pg) per kg BW | TiDI (pg) per kg BW | TiDI x BW (pg) | % of Recommended TiDI |
|---|---|---|---|---|---|---|---|---|
| **At monitored levels** | | | | | | | | |
| Onsite | 2.00E-04 | 0.05 | 5.02E-02 | 1.0 | 2 | 0.4 | 6 | 16.7% |
| Offsite | 2.00E-03 | 0.05 | 5.20E-02 | 1.0 | 2 | 0.4 | 6 | 17.3% |
| **At current and proposed limits** | | | | | | | | |
| Onsite | 5.00E-04 | 0.05 | 5.05E-02 | 1.0 | 2 | 0.4 | 6 | 16.8% |
| Offsite | 4.50E-03 | 0.05 | 5.45E-02 | 1.1 | 2 | 0.4 | 6 | 18.2% |

Modelling typical emissions based on monitored levels shows that predicted levels both onsite and offsite are likely to be significantly below the TiDI for adults and children.

The results also show that when current and proposed limits are modelled that predicted levels both onsite and offsite are still likely to be significantly below the TiDI for adults and children.

## Food intake

### *Exposure via the Consumption of Fruit and Vegetables*

This scenario is only likely to apply to a small proportion of the local population who grow fruit and vegetables for their own consumption in their gardens in the vicinity of the site. The nearest allotment to the site is 1.2 km from the site and is represented by gardens at French Street.

Dioxin in soil is not generally biologically transferred to fruit or vegetables via the roots and stems. Dioxin contamination of fruit and vegetables from soil is largely by direct surface contamination.

Atmospheric deposition can contaminate both fruit and vegetables. How much of the surface contamination remains in prepared food is variable, e.g., outer surfaces are peeled or otherwise rejected before consumption.

Data is not available to make a realistic prediction; however, worst case could be where open leaves are consumed on a regular basis for example vegetable foliage. Vegetable leaves are unlikely to be available except during the summer.

Taking a surface area of exposed leaves of 1 $m^2$ and an age of usable leaves of 1 month, this gives a burden of 16 pg for a large sample of vegetable foliage at French Street if all three lines are operating as predicted, for both 2019 and 2018 meteorological data, with 15 pg for 2017 meteorological data. Assuming that a person is unlikely to consume as much as 1 $m^2$ of vegetable foliage per day, a dietary input could be estimated.

This estimates a summer dietary input of 1.6 pg per day for an adult and 0.8 pg for a child from garden vegetables for 2019 and 2018 meteorological data, with 1.6 pg per day for an adult and 0.8 pg per day for a child for 2017 meteorological data. This could amount to less than 1% of the TDI during part of the year.

### *Exposure by the Consumption of Poultry and Eggs*

This scenario could apply to those individuals who derive their total consumption of eggs and poultry meat produced within the potential zone of exposure of the emissions from the site.

No registered flocks of chickens kept near Widnes have been identified. Nevertheless, the consumption of domestically managed chickens and eggs could be a potential exposure pathway. This is a foreseeable scenario since there is no requirement for a householder to seek permission to keep chickens provided the flock is less than 50 birds nor is it necessary to notify the owners of a nearby industrial process if they did. This could be a pathway for dioxin exposure and as such it is appropriate that it should be investigated.

Accordingly, an assessment for exposure to dioxins has been undertaken for the intake of dioxins via the consumption of eggs and chicken in order to represent a possible future scenario where the rearing of free-range eggs and poultry became significant.

The US EPA Human Health Risk Assessment Protocol (HHRAP) methodology was taken into account to assess the potential exposure to dioxins arising from emissions from the site.

The following approach was used to estimate the potential dioxin concentration in eggs due to ingestion of soil and grain by free-range chickens reared at the nearest housing.

Concentration of dioxin in eggs was estimated by summing dioxin in diet from grain and dioxin ingested from soil and assuming a biotransfer factor of 1 from hens to eggs. Taking into account:

- Quantity of grain ingested by chickens – assumed to be 0.2 kg/d (US EPA HHRAP)
- Concentration of dioxin in grain is based on data published by the EC Scientific Committee on Animal Nutrition.

This Committee conclude that:

"All other feed materials of plant (roughages, cereals, legume seeds) and animal (milk by-products, meat and bone meal) origin contain mean concentrations of dioxins around or below 0.2 ng WHO-TEQ/kg DM."

The fraction of grain grown on soil contaminated by dioxin from the site and ingested by chickens is assumed to be very low as feed grain for hens in local gardens would have been bought from national suppliers that would only very marginally be affected by emissions from the site. The same is also typical at the nearest free-range hen farms in the Widnes area, which is over 4 km from the site.

- Quantity of soil ingested by chicken – assumed to be 0.022 kg day-1 (US EPA HHRAP)
- Maximum annual average incremental increase in dioxin concentration in soil – estimated by modelling to be of the order of 0.0014 ng/kg based on a dioxin deposition velocity of 0.006 m/s and an annual mean concentration of 1.13E-06 ng/m$^3$
- Soil bioavailability factor – assumed to be 1.0 (US EPA HHRAP)
- Biotransfer factor for chicken eggs – assumed to be 1.09984 (US EPA HHRAP Database)

As the chickens eat about 0.2 kg of grain with somewhat below 0.2 ng WHO-TEQ/kg DM and ingest 0.022 kg of soil where the incremental increase in dioxin is of the order of 0.0014 ng WHO-TEWQ/kg DW, the influence of dioxin from the site on dioxin in eggs from hens at nearby housing is minimal. The same argument would apply to chicken meat.

### *Breast Milk*

The dioxin content of breast milk will depend on the total intake of the mother from all sources. At the nearest housing, the calculations above suggest that Unifrax Widnes emissions will increase the total intake of dioxins from all routes by less than 1% of the TDI.

## Dioxin Conclusion

The methods for estimating inhalation dose and dose from soil are relatively well established. The combined inhalation and soil ingestion dose has been shown to be very much less than the tolerable daily intake (TDI).

The UK Soil Guideline value for residential areas of 8,000 ng/kg dry weight is compared with the additional dioxin input from the site (lines 2, 3 and 4) over 25 years of 0.036 ng/kg. This is the highest predicted concentration based on the ADMS modelling for the new housing estate to the west of the site (using 2018 meteorological data).

The methodology for estimating human intake from home grown vegetables and home raised poultry and eggs due to atmospheric deposition is much less well established for an urban area such as Widnes.

The UK guideline value for garden soil takes into account soil contamination of home grown produce that is taken to include vegetables and eggs.

Detailed modelling of dioxin emissions combined with an assessment of potential routes by which dioxins could reach human receptors shows that emissions from the site have the potential to marginally increase the dioxin burden to the nearest human receptors, but is minimal and not of concern.

# 10 Conclusion

Detailed dispersion modelling has been carried out using ADMS 5.2.2 to assess the impacts of the site on both nearby environmental receptors and human receptors.

The results from the detailed dispersion modelling assessment have shown overall that the site will not have any significant impacts on the nearby environmental and human receptors and the concentrations are below all the relevant air quality and environmental standards, both with predicted emission concentrations and also if the site were operating at the top end of the permitted range (at the emission limit values).

# 11 Appendices

The following appendices are provided in this document:

- Appendix 1 – Receptor map
- Appendix 2 – Building/stack location map

## 11.1 Appendix 1 – Receptor map

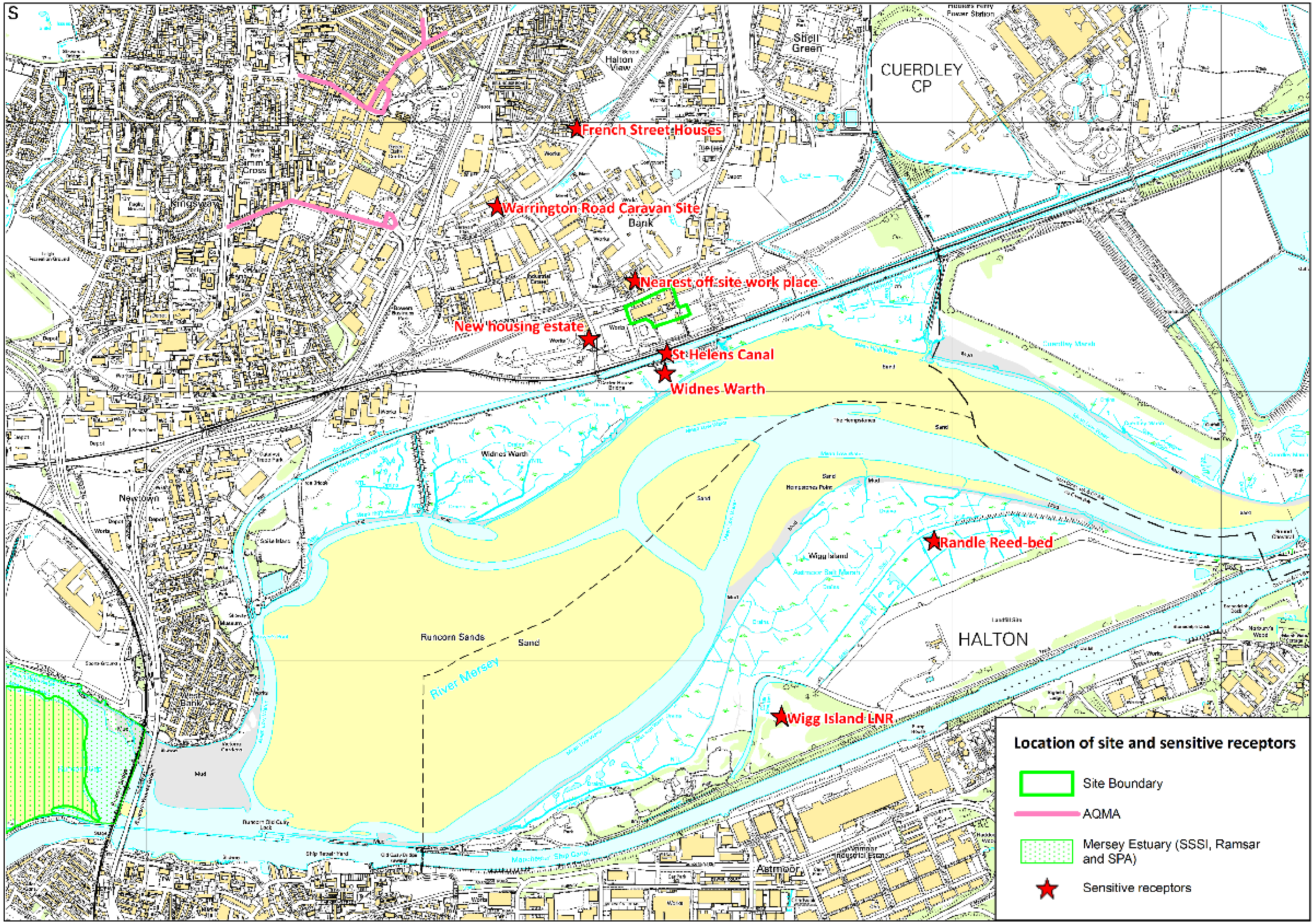
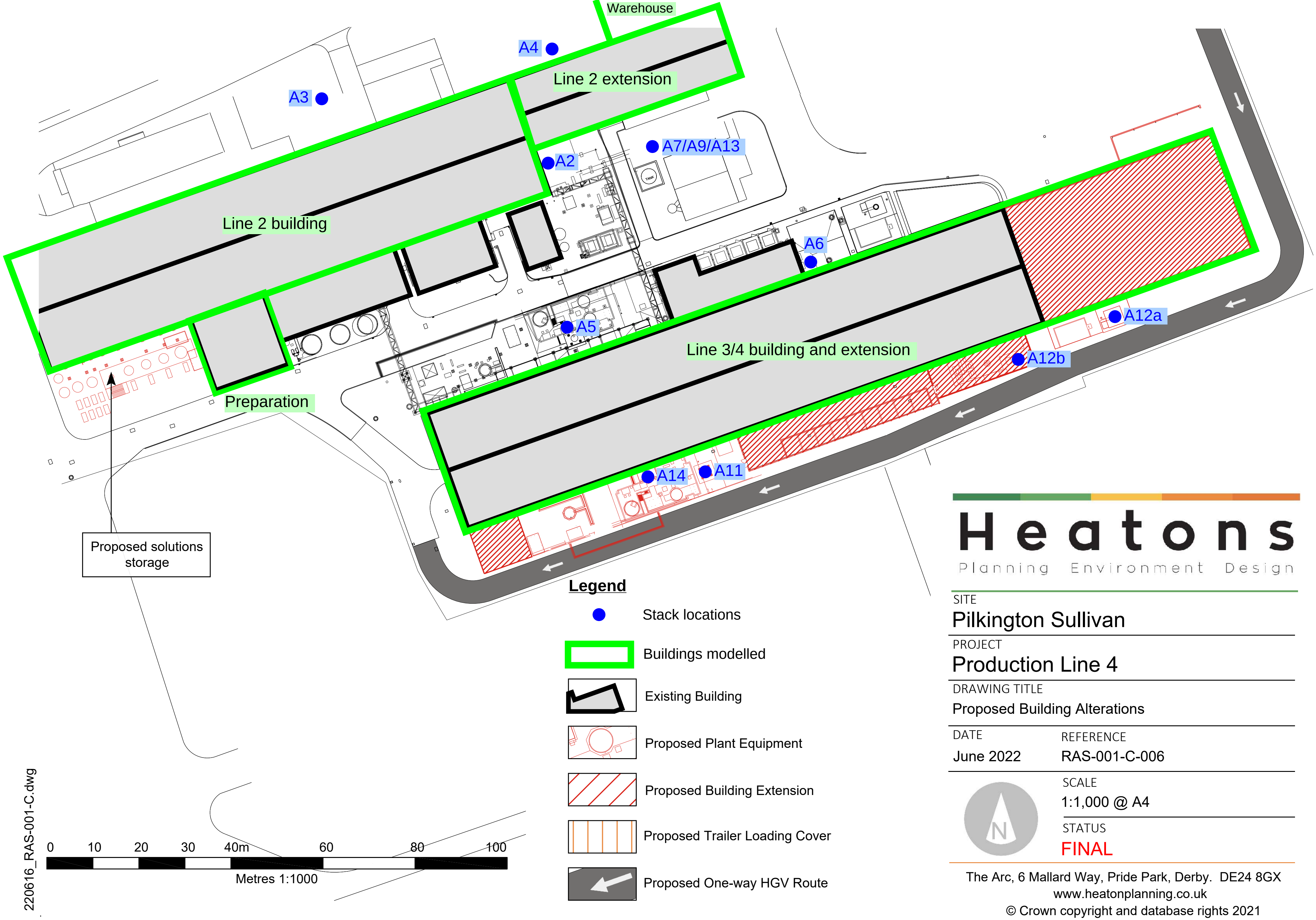



**Figure 40 Site location and nearby receptors**

## 11.2 Appendix 2 – Building/stack location map




# Heatons

Planning Environment Design

SITE
Pilkington Sullivan

PROJECT
Production Line 4

DRAWING TITLE
Proposed Building Alterations

DATE
June 2022

REFERENCE
RAS-001-C-006

SCALE
1:1,000 @ A4

STATUS
FINAL

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