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DISPERSION MODELLING ASSESSMENT OF EMISSIONS FROM PROPOSED CHANGES TO ORMONDE ORGANICS BIOLOGICAL TREATMENT FACILITY LOCATED IN ORMONDE ORGANICS, FIDDOWN, PORTLAW, CO. WATERFORD.

PERFORMED BY ODOUR MONITORING IRELAND ON THE BEHALF OF ORMONDE ORGANICS LTD.

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EXECUTIVE SUMMARY

Odour Monitoring Ireland Ltd was commissioned by Ormonde Organics Ltd to perform a dispersion modelling assessment of exhaust gas emissions from their proposed upgraded operations of their biological treatment facility located in Ormonde Organics Ltd, Fiddown, Portlaw, Co. Waterford. Dispersion modelling was performed for the proposed facility operations for Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Total non-methane VOC's as Benzene and Odour. Specific mass emission rates of compounds were collated for emission points AEP1 to AEP8. These were inputted into the dispersion modelling to allow for the assessment of air quality in the vicinity of the proposed facility emissions points when in operation.

Dispersion modelling assessment was performed utilising AERMOD Prime (21112) dispersion model. Five years of hourly sequential meteorological data from Oak Park (2016 to 2020 inclusive) was used within the dispersion model. The dispersion modelling assessment was performed in accordance with requirements contained in EPA Guidance AG4 (2020). The mass limit emission rate of each pollutant was inputted with the source characteristics into the dispersion model in order to assess the maximum predicted ground level concentrations of each pollutant at nearby sensitive receptor. This was then compared with statutory and regulatory guideline ground level concentration limit values for such pollutants.

The following conclusions are drawn from the study:

1. The assessment was carried out to provide information in line with standard information to be provided regulatory bodies for such projects.

2. Specific dispersion modelling was performed for Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Total non-methane VOC's as Benzene and Odours for the proposed facility operations.

3. With regards to Carbon monoxide impact assessment, the maximum GLC+Baseline for CO from the operation of the facility is 694 $\mu g/m^3$ for the maximum 8-hour mean concentration at the 100^{th} percentile. When combined predicted and baseline conditions are compared to the Irish guideline/limit values and EU Limit values set out in SI 180 of 2011 and Directive 2008/50/EC, this is 6.90% of the impact criterion.

4. With regards to Oxides of nitrogen impact assessment, the maximum GLC+Baseline for NO_2 from the operation of the facility is 92.52 $\mu g/m^3$ for the maximum 1-hour mean concentration at the 99.79^{th} percentile. When combined predicted and baseline conditions are compared to SI 180 of 2011 and Directive 2008/50/EC, this is 46.30% of the impact criterion. An annual average was also generated to allow comparison with values contained in SI 180 of 2011 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration at the worst case sensitive receptor in the vicinity of the facility was 9.35 $\mu g/m^3$. When compared the annual average NO_2 air quality impact criterion is 23.40% of the impact criterion.

5. With regards to Sulphur dioxide impact assessment, the maximum GLC+Baseline for SO_2 from the operation of the facility is 35.34 and 9.58 $\mu g/m^3$ for the maximum 1-hour and 24 hr mean concentration at the 99.73^{th} and 99.18^{th} percentile, respectively. When combined predicted and baseline conditions are compared to SI 180 of 2011 and Directive 2008/50/EC, this is 10.10% and 7.70% of the set target limits established for the 1 hour and 24 hour assessment criteria. An annual average was also generated to allow comparison with SI 180 of 2011 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 4.78 $\mu g/m^3$. When compared the annual average SO_2 air quality impact criterion is 23.90% of the impact criterion.

6. With regards to Total non-methane VOCs as Benzene impact assessment, the maximum GLC+Baseline for TNMVOC as Benzene from the operation of the facility is 0.94 $\mu g/m^3$ for the maximum Annual average ground level concentration. TNMVOC as Benzene modelling results indicate that the ambient ground level annual average concentrations could be up to 18.70% of the impact criterion (assuming all TNMVOC is Benzene, which will not be the case in this instance).

7. With regards to Odour impact assessment, the results indicate that the ambient ground level concentrations at receptor locations are below the relevant guideline odour air quality guideline value for the proposed facility operation. It is predicted that the odour plume spread is in a north westerly to south easterly direction of approximately 200 metres from the emission points with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98th percentile of hourly averages for worst case meteorological year Oak Park 2020. A number of high level key mitigation measures will need to be implemented into the design of the odour management system to include:

   a. All new buildings should be fitted with a high integrity building fabric with a leakage rate of no greater than 3 $m^3/m^2/hr$ at 50 Pa.
   b. The facility buildings should be capable of attaining a negative pressure value in the region of –ive 5 to –ive 15 Pa when ventilation is applied to the facility buildings.
   c. All sumps, tanks etc. should be sealed with tight fitting high containment efficiency covers so as to prevent the release of odours from such processes.
   d. All mechanical processes within the pre-treatment building should be placed under appropriate negative pressure so as to ensure no significant odour release to the headspace of the building.
   e. All building should be fitted with appropriate roller doors / access points of sealed nature (max leakage rate of 10 $m^3/m^2/hr$ at 20 Pa).
   f. All buildings / processes holding or processing material with the potential to generate odours shall be placed under negative ventilation with all odourous air ducted to an appropriate odour control system for treatment. The odour control system shall be capable of providing treatment of odourous air to a level of less than 1,000 Ou_E/m^3 in the treated exhaust air stream.
   g. With regards to the existing and proposed biofiltration odour control systems, these shall be covered and fitted with an exhaust stack to aid dispersion. The exhaust stack height shall be a minimum of 15 m.
   h. An odour management plan shall be developed for the operating facility so as to ensure adequate operation of all odour management systems on a day to day basis.

8. The overall modelling indicates that the facility will not result in any significant impact on air quality in the surrounding area with all ground level concentrations of pollutants well within their respective ground level concentration limit values.

1. Introduction and scope

1.1 Introduction

Odour Monitoring Ireland Ltd was commissioned by Ormonde Organics Ltd to perform a dispersion modelling assessment of the proposed upgraded facility operations for a range of pollutants which could potentially be emitted from the proposed upgraded biological treatment facility located in Ormonde Organics Ltd, Fiddown, Portlaw, Co. Waterford.

The assessment allowed for the examination of both short and long term ground level concentrations (GLC's) of compounds as a result of the operation of the proposed emission points:

- Existing Gas utilisation engine 1 (AEP1),
- Existing Gas utilisation engine 2 (AEP2),
- Existing Gas utilisation engine 3 (AEP3),
- Existing Flare (AEP4),
- Existing Odour control unit 1 – Biofilter (AEP5),
- Existing Odour control 2 - Biofilter (AEP7),
- Existing Odour control unit 3 – Biofilter (AEP8) and
- Proposed Odour control unit 4 - Biofilter (AEP9).

The main compounds assessed included Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Total non-methane volatile organic compounds (as Benzene) and Odours.

Predicted dispersion modelling GLC's were compared to regulatory / guideline ground level limit values for each pollutant.

The materials and methods, results, discussion of results and conclusions are presented within this document.

1.2 Scope of the work

The main aims of the study included:

- Calculation of mass emission rates of specified pollutants utilising published emission limit value contained within the Medium Combustion Directive and EPA licence WO211-02.
- Air dispersion modelling assessment of the proposed upgraded Ormonde Organics Ltd Biological treatment facility in accordance with EPA Guidance AG4 guidance.
- Assessment whether the predicted ground level concentrations of pollutants are in compliance with ground level concentration limit values as taken from SI 180 of 2011 – Air Quality Regulations, CAFÉ Directive 2008/50/EC and EPA Guidance AG4.

1.3 Model assumptions

The approach adopted in this assessment is considered a worst-case investigation in respect of emissions to the atmosphere from proposed upgraded facility for emission points AEP1, AEP2, AEP3, AEP4, AEP5, AEP7, AEP8 and AEP9. These predictions are therefore most likely to overestimate the GLC's that may actually occur for each modelled scenario. These assumptions are summarised and include:

- Emissions to the atmosphere from the specified emission points operation were assumed to occur 24 hours each day / 7 days per week over a standard year at 100% output, including AEP4 (i.e. so as to remain conservative). AEP4 is a flare and will only operate for a period of between 1% to 3% of the operational year and only when gas the utilisation engines are not operational due to servicing,
- Five years of hourly sequential meteorological data from Oak Park 2016 to 2020 inclusive was screened to assess worst case dispersion year which will provide statistical significant results in terms of the short and long term assessment. This is in keeping with current national and international recommendations. The worst case year Oak Park 2020 was used for data presentation,
- Maximum GLC's at receptors + Background were compared with relevant air quality objectives and limit values,
- All emissions were assumed to occur at maximum potential emission concentration and mass emission rates for each scenario which will not be the case in reality,
- AERMOD Prime (21112) dispersion modelling was utilised throughout the assessment in order to provide the most conservative dispersion estimates.
- Five years of hourly sequential meteorological data from Oak Park 2016 to 2020 inclusive was used in the modelling screen which will provide statistical significant results in terms of the short and long term assessment. The worst case year for Oak Park met station was 2020 and was used for contour plot presentation. This is in keeping with current national and international recommendations (EPA Guidance AG4 and EA Guidance H4). In addition, AERMOD incorporates a meteorological pre-processor AERMET PRO. The AERMET PRO meteorological preprocessor requires the input of surface characteristics, including surface roughness (z0), Bowen Ratio and Albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of Albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc.) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the meteorological station for Bowen Ratio and Albedo and to a distance of 1km for surface roughness in line with USEPA recommendations.
- All building wake effects on all applicable emission points were assessed within the dispersion model using the building prime algorithm (e.g. all buildings / structures / tanks were included).
- Receptor heights were assumed to be 1.8 m above ground level.

2. Materials and methods

This section describes the materials and methods used throughout the dispersion modelling assessment.

2.1 Dispersion modelling assessment

2.1.1 Atmospheric dispersion modelling of air quality: What is dispersion modelling?

Any material discharged into the atmosphere is carried along by the wind and diluted by wind turbulence, which is always present in the atmosphere. This process has the effect of producing a plume of air that is roughly cone shaped with the apex towards the source and can be mathematically described by the Gaussian equation. Atmospheric dispersion modelling has been applied to the assessment and control of emissions for many years, originally using Gaussian form ISCST 3. Once the compound emission rate from the source is known, (g s^{-1}), the impact on the vicinity can be estimated. These models can effectively be used in three different ways:

- Firstly, to assess the dispersion of compounds;
- Secondly, in a "reverse" mode, to estimate the maximum compound emissions which can be permitted from a site in order to prevent air quality impact occurring;
- And thirdly, to determine which process is contributing greatest to the compound impact and estimate the amount of required abatement to reduce this impact within acceptable levels (McIntyre et al. 2000).

In this latter mode, models have been employed for imposing emission limits on industrial processes, control systems and proposed facilities and processes (Sheridan et al., 2002).

Any dispersion modelling approach will exhibit variability between the predicted values and the measured or observed values due to the natural randomness of atmospheric environment. A model prediction can, at best, represent only the most likely outcome given the apparent environmental conditions at the time. Uncertainty depends on the completeness of the information used as input to the model as well as the knowledge of the atmospheric environment and the ability to represent that process mathematically. Good input information (emission rates, source parameters, meteorological data and land use characteristics) entered into a dispersion model that treats the atmospheric environment simplistically will produce equally uncertain results as poor information entered into a dispersion model that seeks to simulate the atmospheric environment in a robust manner. It is assumed in this discussion that pollutant emission rates are representative of maximum emission events, source parameters accurately define the point of release and surrounding structures, meteorological conditions define the local atmospheric environment and land use characteristics describe the surrounding natural environment. These conditions are employed within the dispersion modelling assessment therefore providing good confidence in the generated predicted exposure concentration values.

2.1.2 Atmospheric dispersion modelling of air quality: dispersion model selection

The AERMOD model was developed through a formal collaboration between the American Meteorological Society (AMS) and U.S. Environmental Protection Agency (U.S. EPA). AERMOD is a Gaussian plume model and replaced the ISC3 model in demonstrating compliance with the National Ambient Air Quality Standards (Porter et al., 2003) AERMIC (USEPA and AMS working group) is emphasizing development of a platform that includes air turbulence structure, scaling, and concepts; treatment of both surface and elevated sources; and simple and complex terrain. The modelling platform system has three main components: AERMOD, which is the air dispersion model; AERMET, a meteorological data pre-processor; and AERMAP, a terrain data pre-processor (Cora and Hung, 2003).

AERMOD is a Gaussian steady-state model which was developed with the main intention of superseding ISCST3 (NZME, 2002). The AERMOD modeling system is a significant departure from ISCST3 in that it is based on a theoretical understanding of the atmosphere rather than depend on empirical derived values. The dispersion environment is characterized by turbulence theory that defines convective (daytime) and stable (nocturnal) boundary layers instead of the stability categories in ISCST3. Dispersion coefficients derived from turbulence theories are not based on sampling data or a specific averaging period. AERMOD was especially designed to support the U.S. EPA's regulatory modeling programs (Porter at al., 2003)

Special features of AERMOD include its ability to treat the vertical in-homogeneity of the planetary boundary layer, special treatment of surface releases, irregularly-shaped area sources, a three plume model for the convective boundary layer, limitation of vertical mixing in the stable boundary layer, and fixing the reflecting surface at the stack base (Curran et al., 2006). A treatment of dispersion in the presence of intermediate and complex terrain is used that improves on that currently in use in ISCST3 and other models, yet without the complexity of the Complex Terrain Dispersion Model-Plus (CTDMPLUS) (Diosey et al., 2002).

Input data from stack emissions, and source characteristics will be used to construct the basis of the modelling scenarios. These can be found in *Table 3.1*.

2.2 Air quality impact assessment criteria

The predicted air quality impact from the operation of the upgraded facility emission points AEP1, AEP2, AEP3, AEP4, AEP5, AEP7, AEP8 and AEP9 for each scenario is compared to relevant air quality objectives and limits. Air quality standards and guidelines referenced in this report include:

- SI 180 of 2011 – Air Quality Standards Regulations 2011.
- EU limit values set out in the Directives on Air Quality 2008/50/EC.
- AG4 (2020) guidance document on dispersion modelling, Environmental Protection Agency.

Air quality is judged relative to the relevant Air Quality Standards, which are concentrations of pollutants in the atmosphere, which achieve a certain standard of environmental quality. Air quality Standards are formulated on the basis of an assessment of the effects of the pollutant on public health and ecosystems.

In general terms, air quality standards have been framed in two categories, limit values and guideline values. Limit values are concentrations that cannot be exceeded and are based on WHO guidelines for the protection of human health. Guideline values have been established for long-term precautionary measures for the protection of human health and the environment. European legislation has also considered standard for the protection of vegetation and ecosystems.

The relevant air quality standards for proposed emission sources AEP1, AEP2, AEP3, AEP4, AEP5, AEP7, AEP8 and AEP9 are presented in *Table 2.1*.

2.2.1 Air Quality Guidelines value for air pollutants

Table 2.1 illustrates the guideline and limit values for air quality pollutants in Ireland.

Table 2.1. EU and Irish Limit values set out in the SI 180 of 2011, CAFÉ directive 2008/50/EC and AG4 guidance document.

POLLUTANT	Objective			
	Concentration	**Maximum No. Of exceedence allowed**	**Exceedence expressed as percentile**	**Measured as**
Nitrogen dioxide and oxides of nitrogen	300 µg m^{-3} NO_2 200 µg m^{-3} NO_2 40 µg m^{-3} NO_2 30 µg m^{-3} NO_2	18 times in a year 18 times in a year -- --	99.79^{th} percentile 99.79^{th} percentile -- --	1 hour mean 1 hour mean Annual mean Annual mean-vegetation
Carbon monoxide (CO)	10 mg m^{-3}	None	100^{th} percentile	Running 8 hour mean
Sulphur dioxide (SO_2)	350 µg m^{-3} 125 µg m^{-3} 20 µg m^{-3}	24 times in a year 3 times in a year --	99.73th percentile 99.18^{th} percentile --	1 hour mean 24 hour mean Annual mean and winter mean (1^{st} Oct to 31^{st} March
Total non-methane VOC's as Benzene	5 µg m^{-3}	None	--	Annual mean
Odour	<1.50 Ou_E/m^3	175 times in a year	98^{th} percentile	1 hour mean

2.3 Existing Baseline Air Quality

The EPA has been monitoring national Air quality from a number of sites around the country. This information is available from the EPA's website. The values presented for SO_2, NO_2, and CO give an indication of expected rural imissions of the compounds listed in *Table 2.1*. *Table 2.2* illustrates the baseline data expected to be obtained from rural areas for classical air pollutants. Since the facility is located in a rural area, it would be considered located in a Zone D area according to the EPA's classification of zones for air quality. Traffic and industrial related emissions would be medium.

Table 2.2. Baseline air quality data used to assess air quality impact criterion in a number of Zone D regions (Zone A & C for Carbon monoxide and Benzene).

Parameter - Zone C unless otherwise stated for CO, NO_2, SO_2	**Annual average Year 2018 (µg/m^3)**	**Annual average 2019 (µg/m^3)**	**Annual average Year 2020 (µg/m^3)**	**Notes**
Oxides of nitrogen (NO_2) - Zone D[1]	4.67	5.67	7.6	EPA Baseline reports - Air quality in Ireland 2018, 2019, 2020
Sulphur dioxide (SO_2) - Zone D[1]	2.6	3.1	4.15	EPA Baseline reports - Air quality in Ireland 2018, 2019, 2020
Carbon monoxide (CO) - Zone A/C[1]	0.35	0.10	0.40	EPA Baseline reports - Air quality in Ireland 2018, 2019, 2020
Benzene – Zone A/C[1]	0.23	0.197	0.28	EPA Baseline reports - Air quality in Ireland 2018, 2019, 2020

Notes: [1] denotes taken from Air quality in Ireland 2018, 2019 and 2020 – Key indicators of ambient air quality, www.epa.ie.

2.4 Meteorological data

Five years of hourly sequential meteorological data was chosen for the modelling exercise (i.e. Oak Park 2016 to 2020 inclusive). A schematic wind rose and tabular cumulative wind speed and directions of all five years are presented in *Section 7*. All five years of met data was screened to provide more statistical significant result output from the dispersion model. This is in keeping with national and international recommendations on quality assurance in operating dispersion models and will provide a worst case assessment of predicted ground level concentrations based on the input emission rate data. Surface roughness, Albedo and Bowen ratio were assessed and characterised around each met station for AERMET Pro processing.

2.5 Terrain data

Topography effects were accounted for within the dispersion modelling assessment Individual sensitive receptors were inputted into the model at their specific height in order to take account of any effects of elevation on GLC's at their specific locations. Topographical data was inputted into the model utilising the AERMAP algorithm. Each receptor was established at a normal breathing height of 1.80 m.

2.6 Building wake effects

Building wake effects are accounted for in modelling scenarios through the use of the Prime algorithm (i.e. all building features located within the facility) as this can have a significant effect on the compound plume dispersion at short distances from the source and can significantly increase GLC's in close proximity to the facility.

3. Results

This section describes the results obtained for the dispersion modelling exercise. All input data and source characteristics were developed in conjunction with information and engineering drawings provided by Ormonde Organics Ltd.

3.1. Dispersion model input data – Source characteristics and mass emission rate

Table 3.1 illustrates the source characteristics and mass emission rates for each emission point utilised within the dispersion model. Grid reference location, stack height (A.G.L), referenced and actual maximum volume flow, efflux velocity and temperature of the emission point are presented within this table for reference purposes.

Table 3.1. Source characteristics for proposed emission points AEP1, AEP2, AEP3, AEP4, AEP5, AEP7, AEP8 and AEP9**.**

Source characteristics	**AEP-1 CHP Gas Engine**	**AEP-2 CHP Gas Engine**	**AEP-3 CHP Gas Engine**	**AEP-4 Gas Flare**	**AEP-5 Biofilter**	**AEP-7 Biofilter**	**AEP-8 Biofilter**	**AEP-9 Proposed Biofilter**
X coordinate (m) (ITM)	647298	647300.2	647302.7	647325.8	647171.7	647183.2	647288.8	647305.6
Y coordinate (m) (ITM)	618023.2	618027	618030.3	618009.7	617901	617892.4	617941.9	617955.4
Finish floor level (FFL) (m)	7.4	7.4	7.4	11.39	11.39	11.39	8.25	8.25
Emission point height (m) (A.G.L)	16	16	16	8.2	15	15	15	15
Emission point diameter (m)	0.35	0.35	0.35	2.20	1.0	1.0	0.50	0.50
Temperature (K)	523.15	523.15	523.15	1273.15	293.15	293.15	293.15	293.15
Volume flow rate (Nm^3/hr)	8,500[1]	8,500[1]	8,500[1]	5,000[6]	40,000[2]	40,000[2]	10,000[2]	10,000[2]
Expected O2 content (%)	8	8	8	10	20.95	20.95	20.95	20.95
Expected Moisture content (%)	8	8	8	8	3.5	3.5	3.5	3.5
Actual Flow rate (Am^3/hr)	8,091	8,091	8,091	41,595	42,923[3]	42,923[3]	10,728[3]	10,728[3]
Efflux velocity (m/s)	23.36	23.36	23.36	3.04	15.18	15.18	15.18	15.18
Receptor height (m)	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Operation hours	24/7/365	24/7/365	24/7/365	less than 3% in a year but modelled as 24/7/365	24/7/365	24/7/365	24/7/365	24/7/365
Carbon monoxide (mg/Nm^3 273.15K, 101.3KPa, 15%O_2, dry gas)	1,400[4]	1,400[4]	1,400[4]	50	-	-	-	-
Oxides of nitrogen (mg/Nm^3 273.15K, 101.3KPa, 15%O_2, dry gas)	190[5]	190[5]	190[5]	150	-	-	-	-
Sulphur dioxide (mg/Nm^3 273.15K, 101.3KPa, 15%O_2, dry gas)	60[5]	60[5]	60[5]	150	-	-	-	-
TOC as C (mg/Nm^3 273.15K, 101.3KPa, 15%O_2, dry gas)	1,000[4]	1,000[4]	1,000[4]	-	-	-	-	-
TNMVOC (mg/Nm^3 273.15K, 101.3KPa, 15%O_2, dry gas)	75[4]	75[4]	75[4]	10	-	-	-	-
Odours (Ou_E/m^3, 293.15K, 101.3KPa, wet gas)	-	-	-	-	1,000	1,000	1,000	1,000
Carbon monoxide (g/s)	3.31	3.31	3.31	0.07	-	-	-	-
Oxides of nitrogen (g/s)	0.45	0.45	0.45	0.21	-	-	-	-
Sulphur dioxide (g/s)	0.14	0.14	0.14	0.21	-	-	-	-
TOC as C (g/s)	2.36	2.36	2.36	-	-	-	-	-
TNMVOC (g/s)	0.18	0.18	0.18	0.01	-	-	-	-
Odours (OuE/s)	-	-	-	-	11,111	11,111	2,778	2,778

Notes:

[1] denotes: ref conditions are 273.15K, 101.3KPa, 15%O_2, dry gas - as per Medium Combustion Directive

[2] denotes: ref conditions are 273.15K, 101.3KPa, wet gas

[3] denotes: ref conditions are 293.15K, 101.3KPa, wet gas

[4] denotes: as per Eras Eco IPPC Licence WO211-02, no limit in Medium Combustion Directive

[5] denotes: as per Medium combustion directive

[6] denotes: ref conditions are 275.15K, 101.3KPa, 3%O_2, dry gas

3.2 Dispersion modelling assessment

AERMOD Prime (21112) was used to determine the overall ground level impact of emission points AEP1, AEP2, AEP3, AEP4, AEP5, AEP7, AEP8 and AEP9 located in the biological treatment facility Ormonde Organics Ltd site, Fiddown, Portlaw, Co. Waterford. These computations give the relevant GLC's at each 20 and 200-meter X Y Cartesian grid receptor location that is predicted to be exceeded for the specific air quality impact criteria. Individual receptor elevations were established at their specific height above ground and also included a 1.80 m normal breathing zone. A total Cartesian + individual receptors of 2,963 points was established giving a total grid coverage area of 25.0 square kilometres around the emission points.

Five years of hourly sequential meteorological data from Oak Park (Oak Park 2016 to 2020 inclusive) and source characteristics (*see Table 3.1*), including emission date contained in *Table 3.1* were inputted into the dispersion model.

In order to obtain the predicted environmental concentration (PEC), background data was added to the process emissions. In relation to the annual averages, the ambient background concentration was added directly to the process concentration. However, in relation to the short-term peak concentrations, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK Environment Agency advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum short-term concentration due to emissions from the source to twice the annual mean background concentration.

3.3 Dispersion model Scenarios

AERMOD Prime (USEPA ver. 21112) was used to determine the overall air quality impact of AEP1, AEP2, AEP3, AEP4, AEP5, AEP7, AEP8 and AEP9 combined emission points while in operation at 100% capacity for named air pollutants.

Impacts from the emission points were assessed in accordance with the impact criterion contained in Directive 2008/50/EC, SI 180 of 2011 and EPA Guidance AG4 (2020).

Eight scenarios were assessed within the dispersion model examination for each of the classical air pollutants and odours.

The dispersion modelling is carried out in line with the requirements of EPA guidance document AG4 (2020).

The output data was analysed to calculate the following:

Ref Scenario 1: Predicted cumulative ground level concentration of Carbon monoxide emission contribution of cumulative emissions for the 100^{th} percentile of 8 hour averages for Oak Park meteorological station year 2020 for a Carbon monoxide concentration of less than or equal to 400 µg/m^3 assuming 24 hr operation (*see Figure 6.3*).

Ref Scenario 2: Predicted cumulative ground level concentration of Oxides of nitrogen emission contribution of cumulative emissions for the 99.79^{th} percentile of 1 hour averages for Oak Park meteorological station year 2020 for an Oxides of nitrogen concentration of less than or equal to 100 µg/m^3 assuming 24 hr operation (*see Figure 6.4*).

Ref Scenario 3: Predicted cumulative ground level concentration of Oxides of nitrogen emission contribution of cumulative emissions for the Annual average for Oak Park meteorological station year 2020 for an Oxides of nitrogen concentration of less than or equal to 5.0 µg/m^3 assuming 24 hr operation (*see Figure 6.5*).

Ref Scenario 4: Predicted cumulative ground level concentration of Sulphur dioxide emission contribution of cumulative emissions for the 99.73th percentile of 1 hour averages for Oak Park meteorological station year 2020 for an Sulphur dioxide concentration of less than or equal to 30 µg/m^3 assuming 24 hr operation (*see Figure 6.6*).

Ref Scenario 5: Predicted cumulative ground level concentration of Sulphur dioxide emission contribution of cumulative emissions for the 99.18th percentile of 24 hour averages for Oak Park meteorological station year 2020 for an Sulphur dioxide concentration of less than or equal to 15 µg/m^3 assuming 24 hr operation (*see Figure 6.7*).

Ref Scenario 6: Predicted cumulative ground level concentration of Sulphur dioxide emission contribution of cumulative emissions for the Annual average for Oak Park meteorological station year 2020 for an Sulphur dioxide concentration of less than or equal to 1.50 µg/m^3 assuming 24 hr operation (*see Figure 6.8*).

Ref Scenario 7: Predicted cumulative ground level concentration of TNMVOC as Benzene emission contribution of cumulative emissions for the Annual average for Oak Park meteorological station year 2020 for an TNMVOC as Benzene concentration of less than or equal to 1.50 µg/m^3 assuming 24 hr operation (*see Figure 6.9*).

Ref Scenario 8: Predicted cumulative ground level concentration of Odour emission contribution of cumulative emissions for the 98th percentile of hourly averages for Oak Park meteorological station year 2020 for an Odour concentration of less than or equal to 1.50 Ou_E/m^3 assuming 24 hr operation (*see Figure 6.10*).

4. Discussion of results

This section will present the results of the dispersion modelling.

AERMOD GIS Pro Prime (Ver. 21112) was used to determine the overall named air pollutant air quality impact of the existing and proposed emission points AEP1, AEP2, AEP3, AEP4, AEP5, AEP7, AEP8 and AEP9 during operation.

Various averaging intervals were chosen to allow direct comparison of predicted GLC's with the relevant air quality assessment criteria as outline in *Section 2.2.1*. In particular, 1-hour, 24 hour, percentile and annual average GLC's of the specified pollutants were calculated at 20 and 200 metres distances from the site over a fine and coarse grid extent of 25.0 kilometres squared. Relevant percentiles of these GLC's were also computed for comparison with the relevant pollutant Air Quality Standards to include SI 180 of 2011, Directive 2008/50/EC and EPA Guidance AG4 (2020).

In modelling air dispersion of NOx from combustion sources, the source term should be expressed as NO_2, e.g., NOx mass (expressed as NO_2). Some of the exhaust air is made up of NO while some is made up of NO_2. NO will be converted in the atmosphere to NO_2 but this will depend on a number of factors to include Ozone and VOC concentrations. In order to take account of this conversion the following screening can be performed.

Worst case scenario treatment

35% for short-term and 70% for long-term average concentration should be considered to assess compliance with the relevant air quality objective.

This is in accordance with recommendations from the Environmental Agency UK for the dispersion modelling of NO_2 emissions from combustion processes, www.environmentagency.gov.uk

Within AG4, it states that 50% for short-term and 100% for long term average concentration should be considered to assess compliance with the relevant air quality objective. As this is a more conservative approach, this was the adapted approach in this report (EPA, 2020, AG4)

Maximum predicted GLC's are presented within this table to allow for comparison with Directive 2008/50/EC and SI 180 of 2011. In addition, the predicted ground level concentrations at the selected residential receptors are presented in the Discussion of Results section of the document for all pollutants. A total of 18 individual sensitive receptors were included within the dispersion model and the location of same is presented in *Figure 6.1*. Illustrative contour plots for information purposes only are presented in *Section 6* of this report for each modelled scenario for illustrative purposes only.

Predictive air dispersion modelling was used to ascertain the maximum ground level concentrations at the identified sensitive receptors and beyond the boundary of the facility of selected worst case pollutant concentration to allow for comparison with the ground level limit values contained in *Table 2.1*. *Table 4.1* illustrates the results of the dispersion modelling assessment for each pollutant and comparison with the air quality guideline and limit values contained in *Table 2.1*.

4.1 Assessment of air quality impacts for pollutants from identified facility emission points AEP1, AEP2, AEP3, AEP4, AEP5, AEP7, AEP8 and AEP9

Predictive air dispersion modelling was used to ascertain the maximum ground level concentrations at the identified sensitive receptors and beyond the boundary of the facility of selected worst case pollutant concentration to allow for comparison with the ground level limit values contained in *Table 2.1*. *Table 4.1* illustrates the results of the dispersion modelling assessment for each pollutant and comparison with the air quality guideline and limit values contained in *Table 2.1*.

Table 4.1. Predicted ground level concentrations for identified pollutants at sensitive and worst case boundary receptor for various averaging periods for facility emission points AEP1, AEP2, AEP3, AEP4, AEP5, AEP7, AEP8 and AEP9.

Receptor ID	X coordinate (m)	Y coordinate (m)	Scenario 1 - 8 hr Carbon monoxide GLC (µg/m^3)	Scenario 2 - 99.79%ile 1 hr NO_2 GLC (µg/m^3)	Scenario 3 - Annual average NO_2 GLC (µg/m^3)	Scenario 4 - 99.73%ile 1 hr SO_2 GLC (µg/m^3)	Scenario 5 - 99.18th %ile 24 hrs SO_2 GLC (µg/m^3)	Scenario 6 - Annual average SO_2 GLC (µg/m^3)	Scenario 7 - Annual average TNMVOC as Benzene GLC (µg/m^3)	Scenario 8 - 98th %ile 1 hr Odour GLC (Ou$_E$/m^3)
R1	646788	617252	68.70	17.42	0.21	5.39	1.26	0.07	0.08	0.10
R2	646608	617488	83.77	21.74	0.20	6.62	0.96	0.07	0.08	0.03
R3	646814	618377	194.06	56.37	1.31	20.83	3.86	0.47	0.49	0.73
R4	646436	617884	218.19	77.32	0.48	24.36	2.21	0.16	0.19	0.06
R5	646212	618295	148.86	35.64	0.33	13.26	1.74	0.13	0.12	0.05
R6	646126	618430	68.45	19.32	0.21	9.99	1.14	0.09	0.07	0.05
R7	646457	618649	233.21	55.27	0.83	21.93	2.49	0.32	0.30	0.20
R8	647923	618176	99.71	25.55	1.01	9.70	2.96	0.40	0.36	0.27
R9	647796	618623	91.91	20.30	0.58	6.86	1.96	0.21	0.22	0.17
R10	646904	618284	293.83	67.79	1.75	26.15	5.43	0.63	0.66	0.99
R11	646687	618202	156.06	35.71	0.45	11.86	2.23	0.16	0.17	0.31
R12	646940	618193	241.97	75.14	1.44	27.04	4.74	0.52	0.54	1.08
R13	646735	618123	187.14	34.91	0.43	12.04	2.19	0.16	0.16	0.25
R14	646796	617960	126.12	29.96	0.32	9.72	1.58	0.12	0.12	0.15
R15	646703	617996	78.45	22.92	0.25	7.95	1.50	0.09	0.09	0.12
R16	647233	617413	220.00	42.50	1.20	25.00	3.80	0.40	0.50	0.40
Worst case boundary GLC (µg/m^3)	-	-	600.00	65.00	8.00	45.00	20.00	3.00	2.50	3.00
Max predicted conc. value at human receptor beyond the facility boundary (µg/m^3)	-	-	293.83	77.32	1.75	27.04	5.43	0.63	0.66	1.08
Max predicted conc. value at the facility boundary (µg/m^3)	-	-	600	65.00	8.00	45	20	3.0	2.50	3.00
Average Baseline conc. (µg/m^3)	-	-	400	15.20	7.60	8.30	4.15	4.15	0.28	
Combined baseline and worst case receptor conc. (µg/m^3)	-	-	694	92.52	9.35	35.34	9.58	4.78	0.94	1.08
Combined baseline and worst case conc. at boundary (µg/m^3)	-	-	1,000	80.20	15.60	53.30	24.15	7.15	2.78	3.00
Environmental Assessment Level Human health (µg/m^3)	-	-	10,000	200	40	350	125	20	5	1.5
% of impact criterion (human impact)	-	-	**6.9**	**46.3**	**23.4**	**10.1**	**7.7**	**23.9**	**18.7**	**71.7**

4.1.1 Carbon monoxide – Ref Scenario 1

The results for the potential air quality impact for dispersion modelling of Carbon monoxide (CO) based on process guaranteed emission rates in *Table 3.1* are presented in *Table 4.1.* Results are presented for the maximum predicted percentile emission regime. As can be observed in *Table 4.1,* the maximum GLC+Baseline for CO from the operation of the facility is 694 $\mu g/m^3$ for the maximum 8-hour mean concentration at the 100^{th} percentile. When combined predicted and baseline conditions are compared to the Irish guideline/limit values and EU Limit values set out in SI 180 of 2011 and Directive 2008/50/EC, this is 6.90% of the impact criterion.

4.1.2 Oxides of nitrogen – Ref Scenarios 2 and 3

The results for the potential air quality impact for dispersion modelling of Oxides of nitrogen (NO_X as NO_2) based on process guaranteed emission rates in *Table 3.1* are presented in *Table 4.1.* Results are presented for the maximum predicted percentile emission regime. As can be observed in *Table 4.1,* the maximum GLC+Baseline for NO_2 from the operation of the facility is 92.52 $\mu g/m^3$ for the maximum 1-hour mean concentration at the 99.79^{th} percentile. When combined predicted and baseline conditions are compared to SI 180 of 2011 and Directive 2008/50/EC, this is 46.30% of the impact criterion.

An annual average was also generated to allow comparison with values contained in SI 180 of 2011 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration at the worst case sensitive receptor in the vicinity of the facility was 9.35 $\mu g/m^3$. When compared the annual average NO_2 air quality impact criterion is 23.40% of the impact criterion.

4.1.3 Sulphur dioxide – Ref Scenarios 4, 5 and 6

The results for the potential air quality impact for dispersion modelling of Sulphur dioxide (SO_2) based on process guaranteed emission rates in *Table 3.1* are presented in *Table 4.1.* Results are presented for the maximum predicted percentile emission regime. As can be observed in *Table 4.1,* the maximum GLC+Baseline for SO_2 from the operation of the facility is 35.34 and 9.58 $\mu g/m^3$ for the maximum 1-hour and 24 hr mean concentration at the 99.73^{th} and 99.18^{th} percentile, respectively. When combined predicted and baseline conditions are compared to SI 180 of 2011 and Directive 2008/50/EC, this is 10.10% and 7.70% of the set target limits established for the 1 hour and 24 hour assessment criteria.

An annual average was also generated to allow comparison with SI 180 of 2011 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 4.78 $\mu g/m^3$. When compared the annual average SO_2 air quality impact criterion is 23.90% of the impact criterion.

4.1.4 TNMVOC as Benzene – Ref Scenario 7

The results for the potential air quality impact for dispersion modelling of TNMVOC as Benzene based on process guaranteed emission rates in *Table 3.1* are presented in *Table 4.1*. TNMVOC as Benzene modelling results indicate that the ambient ground level annual average concentrations could be up to 18.70% of the impact criterion (assuming all TNMVOC is Benzene, which will not be the case in this instance).

4.1.5 Odour – Ref Scenario 8

The results for the potential air quality impact for dispersion modelling of Odour based on the process guaranteed emission rates in *Table 3.1* are presented in *Table 4.1*. Odour modelling results indicate that the ambient ground level concentrations at receptor locations are below the relevant guideline odour air quality guideline value for the proposed facility operation.

With regards to the proposed facility operations, as can be observed in *Figure 6.10*, it is predicted that odour plume spread is in a north westerly to south easterly direction of approximately 200 metres from the emission points with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98^{th} percentile of hourly averages for worst case meteorological year Oak Park 2020. In accordance with odour impact criterion presented in *Table 2.1*, and in keeping with currently recommended odour impact criterion in this country, no long-term odour impacts will be experienced by receptors in the vicinity of the proposed facility operations.

A number of key mitigation measures will need to be implemented into the design of the odour management system to include:

2. All new buildings should be fitted with a high integrity building fabric with a leakage rate of no greater than 3 $m^3/m^2/hr$ at 50Pa.
3. The facility buildings should be capable of attaining a negative pressure value in the region of –ive 5 to –ive 15 Pa when ventilation is applied to the facility buildings.
4. All sumps, tanks etc. should be sealed with tight fitting high containment efficiency covers so as to prevent the release of odours from such processes.
5. All mechanical processes within the pre-treatment building should be placed under appropriate negative pressure so as to ensure no significant odour release to the headspace of the building.
6. All building should be fitted with appropriate roller doors / access points of sealed nature (max leakage rate of 10 $m^3/m^2/hr$ at 20Pa).
7. All buildings / processes holding or processing material with the potential to generate odours shall be placed under negative ventilation with all odourous air ducted to an appropriate odour control system for treatment. The odour control system shall be capable of providing treatment of odourous air to a level of less than 1,000 Ou_E/m^3 in the treated exhaust air stream.
8. With regards to the existing and proposed biofiltration odour control systems, these shall be covered and fitted with an exhaust stack to aid dispersion. The exhaust stack height shall be a minimum of 15 m.
9. An odour management plan shall be developed for the operating facility so as to ensure adequate operation of all odour management systems on a day to day basis.

5. Conclusions

Odour Monitoring Ireland Ltd was commissioned by Ormonde Organics Ltd to perform a dispersion modelling study of the proposed upgraded biological treatment facility located in Fiddown, Portlaw, Co. Waterford. Following a detailed impact and dispersion modelling assessment, it was demonstrated that no significant environmental impact will occur if the source characteristics and emission limit value in the exhaust gas stream are achieved.

The following conclusions are drawn from the study:

1. The assessment was carried out to provide information in line with standard information to be provided regulatory bodies for such projects.

2. Specific dispersion modelling was performed for Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Total non-methane VOC's as Benzene and Odours for the proposed facility operations.

3. With regards to Carbon monoxide impact assessment, the maximum GLC+Baseline for CO from the operation of the facility is 694 $\mu g/m^3$ for the maximum 8-hour mean concentration at the 100^{th} percentile. When combined predicted and baseline conditions are compared to the Irish guideline/limit values and EU Limit values set out in SI 180 of 2011 and Directive 2008/50/EC, this is 6.90% of the impact criterion.

4. With regards to Oxides of nitrogen impact assessment, the maximum GLC+Baseline for NO_2 from the operation of the facility is 92.52 $\mu g/m^3$ for the maximum 1-hour mean concentration at the 99.79^{th} percentile. When combined predicted and baseline conditions are compared to SI 180 of 2011 and Directive 2008/50/EC, this is 46.30% of the impact criterion. An annual average was also generated to allow comparison with values contained in SI 180 of 2011 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration at the worst case sensitive receptor in the vicinity of the facility was 9.35 $\mu g/m^3$. When compared the annual average NO_2 air quality impact criterion is 23.40% of the impact criterion.

5. With regards to Sulphur dioxide impact assessment, the maximum GLC+Baseline for SO_2 from the operation of the facility is 35.34 and 9.58 $\mu g/m^3$ for the maximum 1-hour and 24 hr mean concentration at the 99.73^{th} and 99.18^{th} percentile, respectively. When combined predicted and baseline conditions are compared to SI 180 of 2011 and Directive 2008/50/EC, this is 10.10% and 7.70% of the set target limits established for the 1 hour and 24 hour assessment criteria. An annual average was also generated to allow comparison with SI 180 of 2011 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 4.78 $\mu g/m^3$. When compared the annual average SO_2 air quality impact criterion is 23.90% of the impact criterion.

6. With regards to Total non-methane VOCs as Benzene impact assessment, the maximum GLC+Baseline for TNMVOC as Benzene from the operation of the facility is 0.94 $\mu g/m^3$ for the maximum Annual average ground level concentration. TNMVOC as Benzene modelling results indicate that the ambient ground level annual average concentrations could be up to 18.70% of the impact criterion (assuming all TNMVOC is Benzene, which will not be the case in this instance).

7. With regards to Odour impact assessment, the results indicate that the ambient ground level concentrations at receptor locations are below the relevant guideline odour air quality guideline value for the proposed facility operation. It is predicted that the odour plume spread is in a north westerly to south easterly direction of approximately 200 metres from the emission points with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98^{th} percentile of hourly averages for worst case meteorological year Oak Park 2020. A

number of high level key mitigation measures will need to be implemented into the design of the odour management system to include:

a. All new buildings should be fitted with a high integrity building fabric with a leakage rate of no greater than 3 $m^3/m^2/hr$ at 50 Pa.
b. The facility buildings should be capable of attaining a negative pressure value in the region of –ive 5 to –ive 15 Pa when ventilation is applied to the facility buildings.
c. All sumps, tanks etc. should be sealed with tight fitting high containment efficiency covers so as to prevent the release of odours from such processes.
d. All mechanical processes within the pre-treatment building should be placed under appropriate negative pressure so as to ensure no significant odour release to the headspace of the building.
e. All building should be fitted with appropriate roller doors / access points of sealed nature (max leakage rate of 10 $m^3/m^2/hr$ at 20 Pa).
f. All buildings / processes holding or processing material with the potential to generate odours shall be placed under negative ventilation with all odourous air ducted to an appropriate odour control system for treatment. The odour control system shall be capable of providing treatment of odourous air to a level of less than 1,000 Ou_E/m^3 in the treated exhaust air stream.
g. With regards to the existing and proposed biofiltration odour control systems, these shall be covered and fitted with an exhaust stack to aid dispersion. The exhaust stack height shall be a minimum of 15 m.
h. An odour management plan shall be developed for the operating facility so as to ensure adequate operation of all odour management systems on a day to day basis.

8. The overall modelling indicates that the facility will not result in any significant impact on air quality in the surrounding area with all ground level concentrations of pollutants well within their respective ground level concentration limit values.

6. *Appendix I* - Air dispersion modelling contour plots (Process contributions and illustrative purposes only).

6.1 Site layout drawing and location of nearby receptors

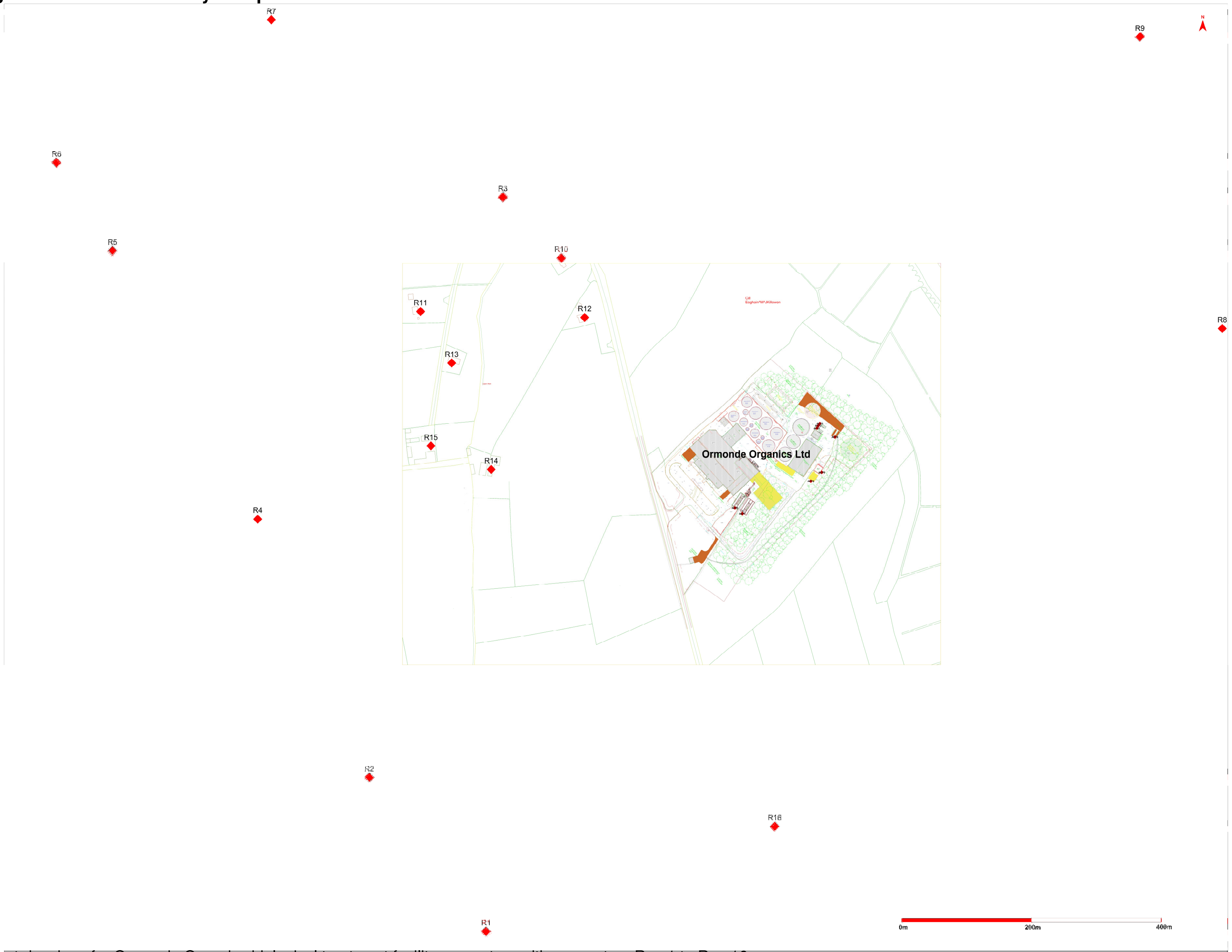

Figure 6.1. Plan view facility layout drawings for Ormonde Organics biological treatment facility nearest sensitive receptors Rec 1 to Rec 16.

Figure 6.2. Plan view facility layout drawings for Ormonde Organics biological treatment facility including specific location of existing and proposed emission points AEP1 to AEP8.

6.2. Dispersion modelling contour plots for Scenarios 1 to 8 – Worst case meteorological year Oak Park 2020

6.2.1 Scenario 1 - Carbon monoxide

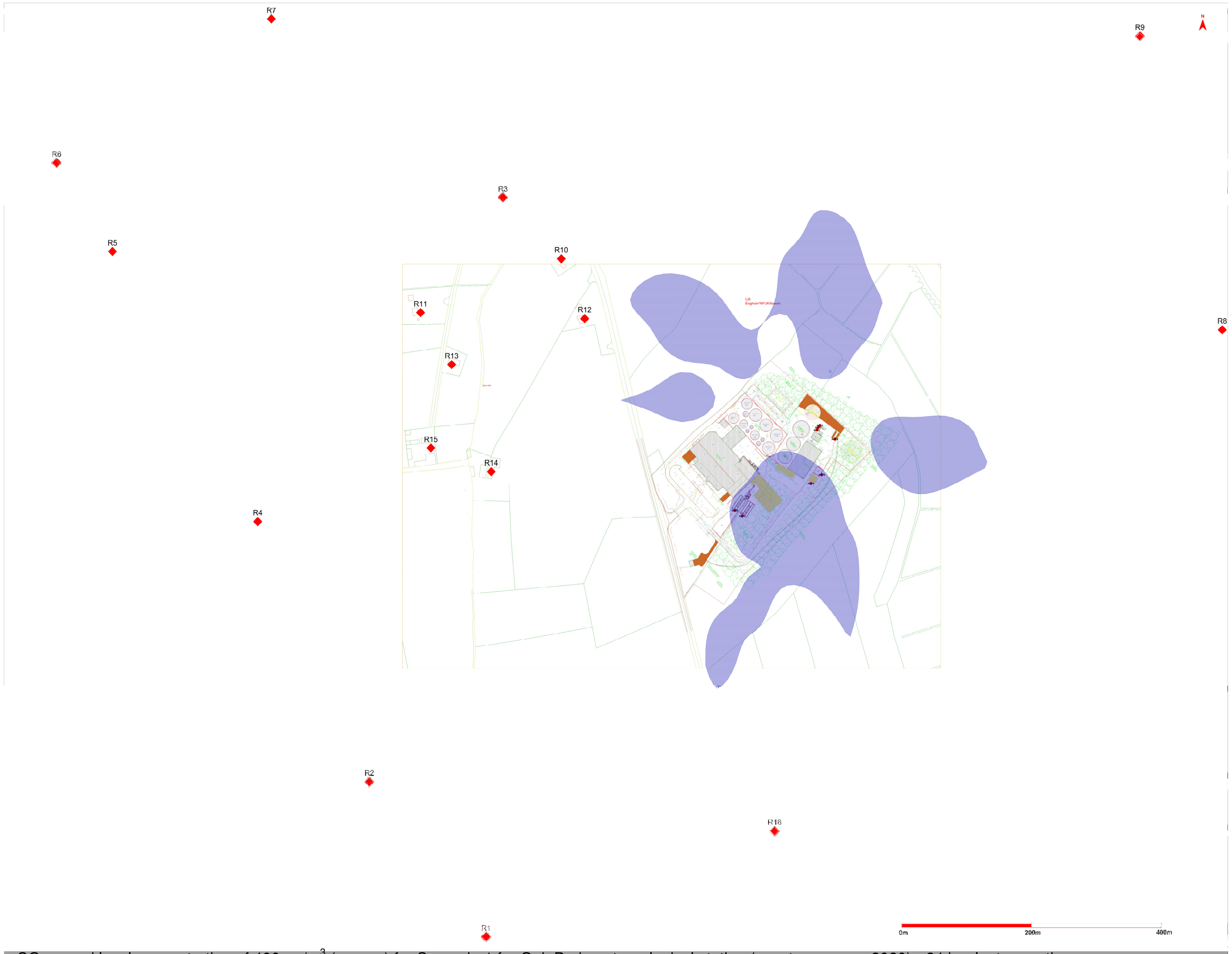

Figure 6.3. Predicted 8 hr average CO ground level concentration of 400 µg/m^3 ( ) for Scenario 1 for Oak Park meteorological station (worst case year 2020) - 24 hr plant operation.

6.2.2 Scenario 2 and 3 - Oxides of nitrogen

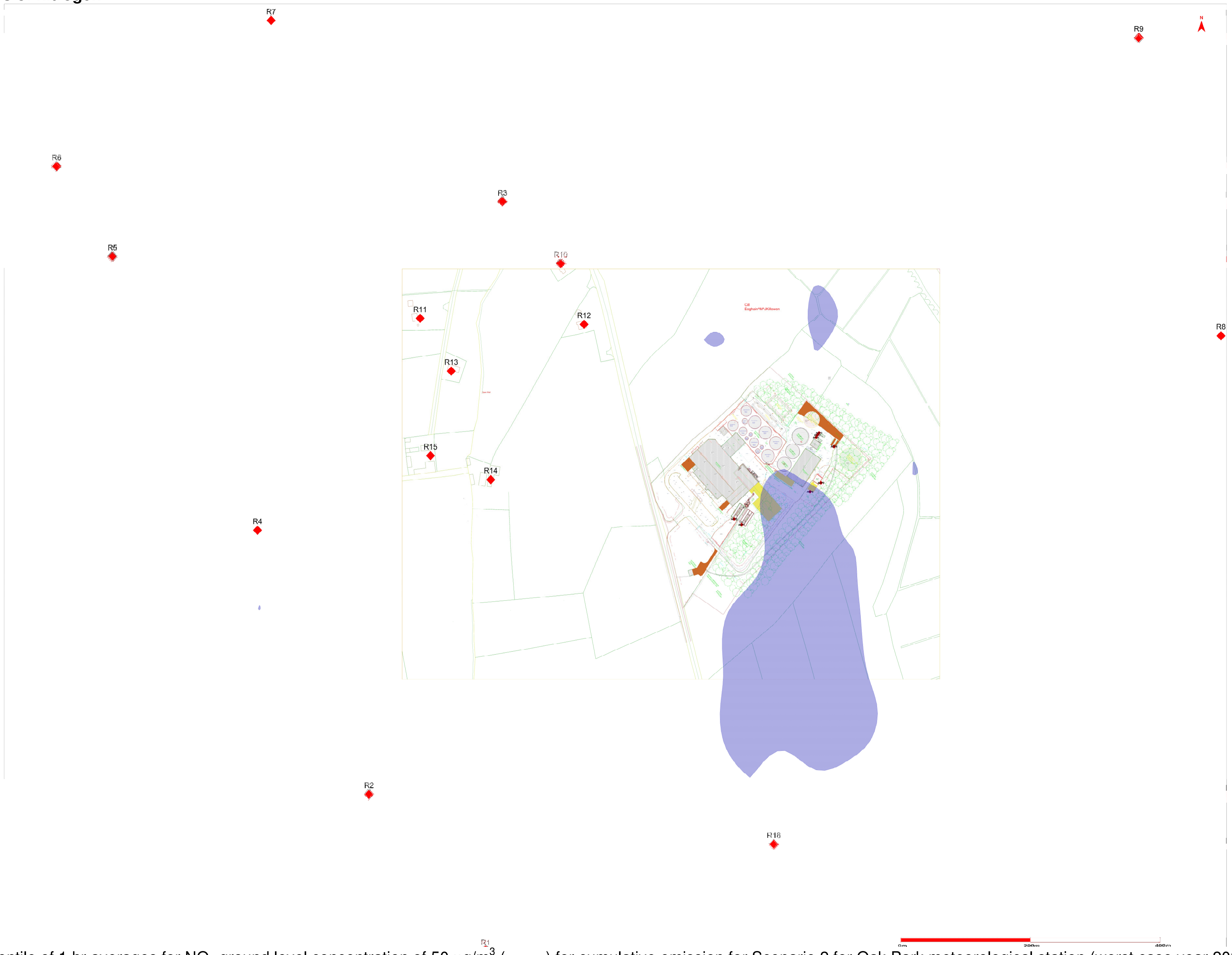

Figure 6.4. Predicted 99.79th percentile of 1 hr averages for NO_2 ground level concentration of 50 µg/m^3 (▬) for cumulative emission for Scenario 2 for Oak Park meteorological station (worst case year 2020) - 24 hr plant operation.

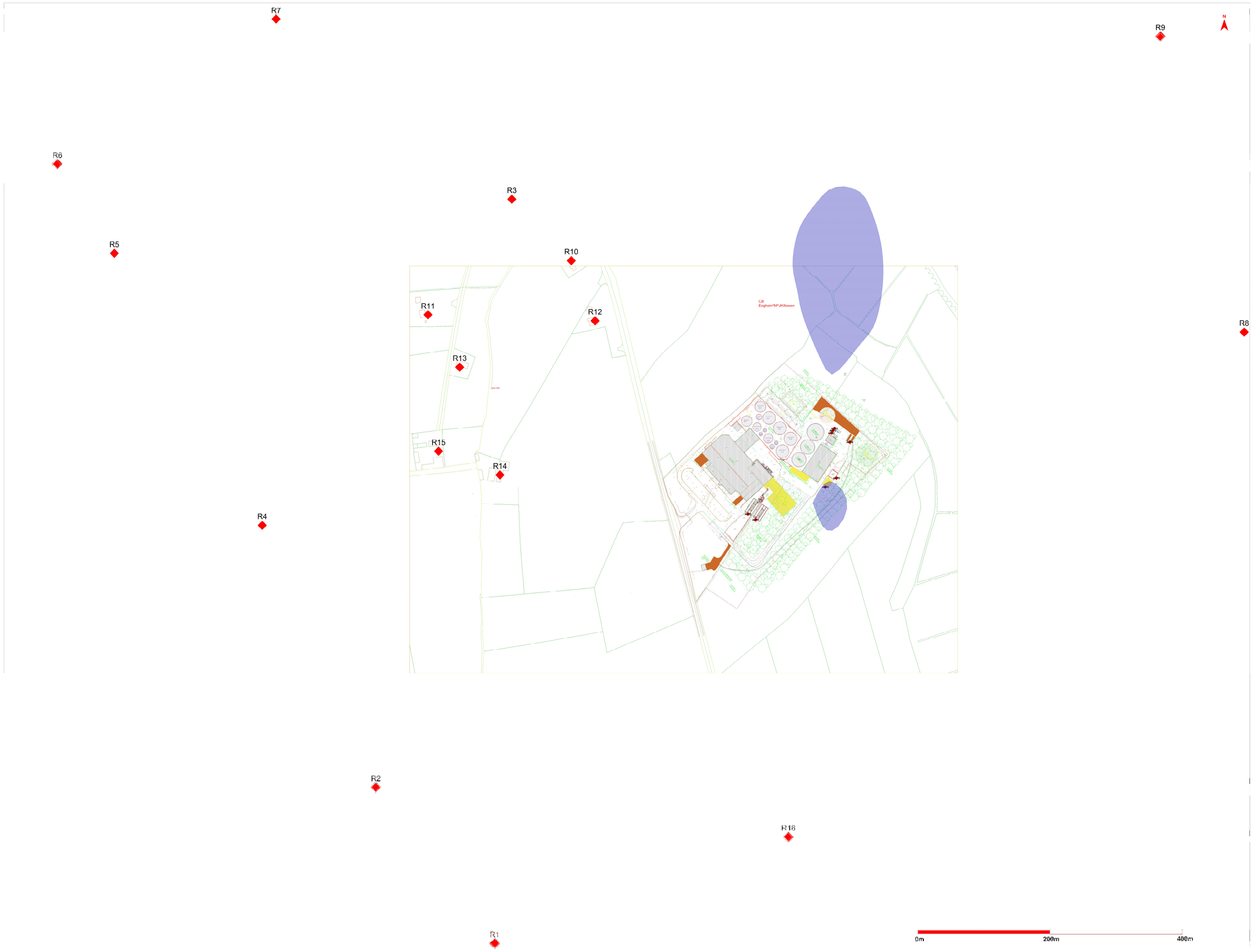

Figure 6.5. Predicted annual average NO_2 ground level concentration of 5.0 µg/m^3 (▬) for cumulative emissions for Scenario 3 for Oak Park meteorological station (worst case year 2020) - 24 hr plant operation.

6.2.3 Scenario 4, 5 and 6 - Sulphur dioxide

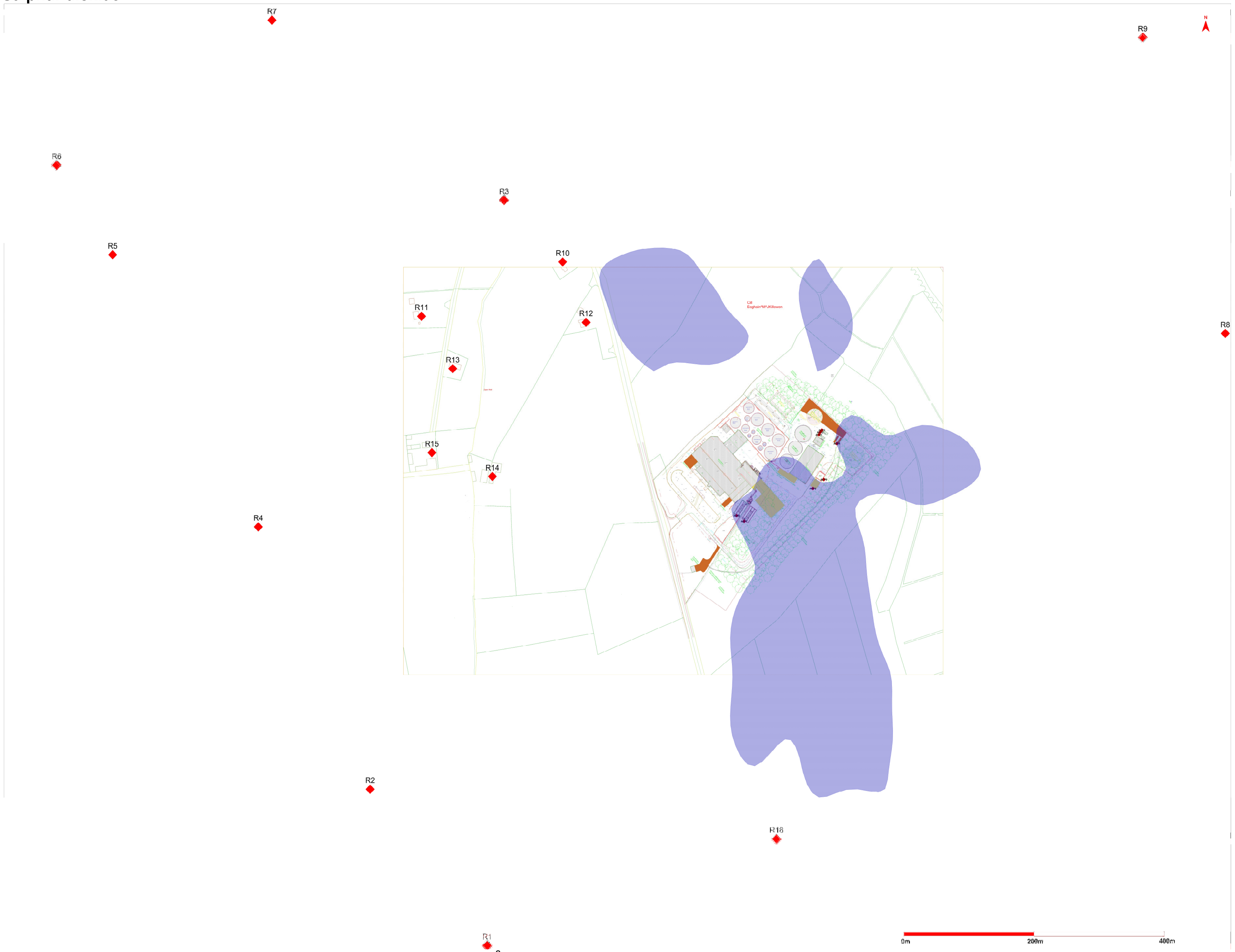

Figure 6.6. Predicted 99.73th percentile of 1 hr averages for SO_2 ground level concentration of 30 µg/m^3 ( ) for Scenario 4 for Oak Park meteorological station (worst case year 2020) - 24 hr plant operation.

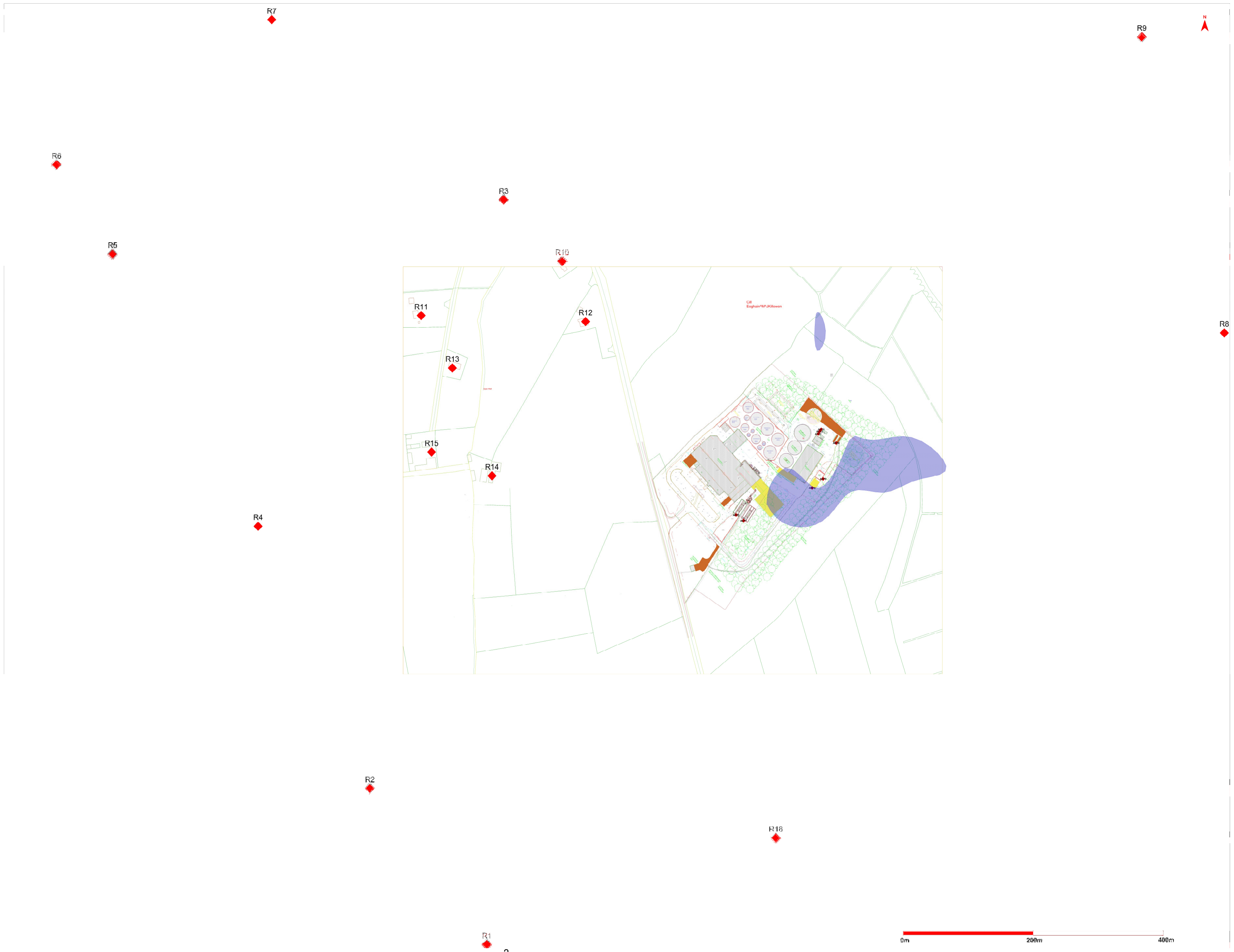

Figure 6.7. Predicted 99.18th percentile of 24 hr averages for SO_2 ground level concentration of 15 µg/m^3 (▬▬) for Scenario 5 for Oak Park meteorological station (worst case year 2020) - 24 hr plant operation.

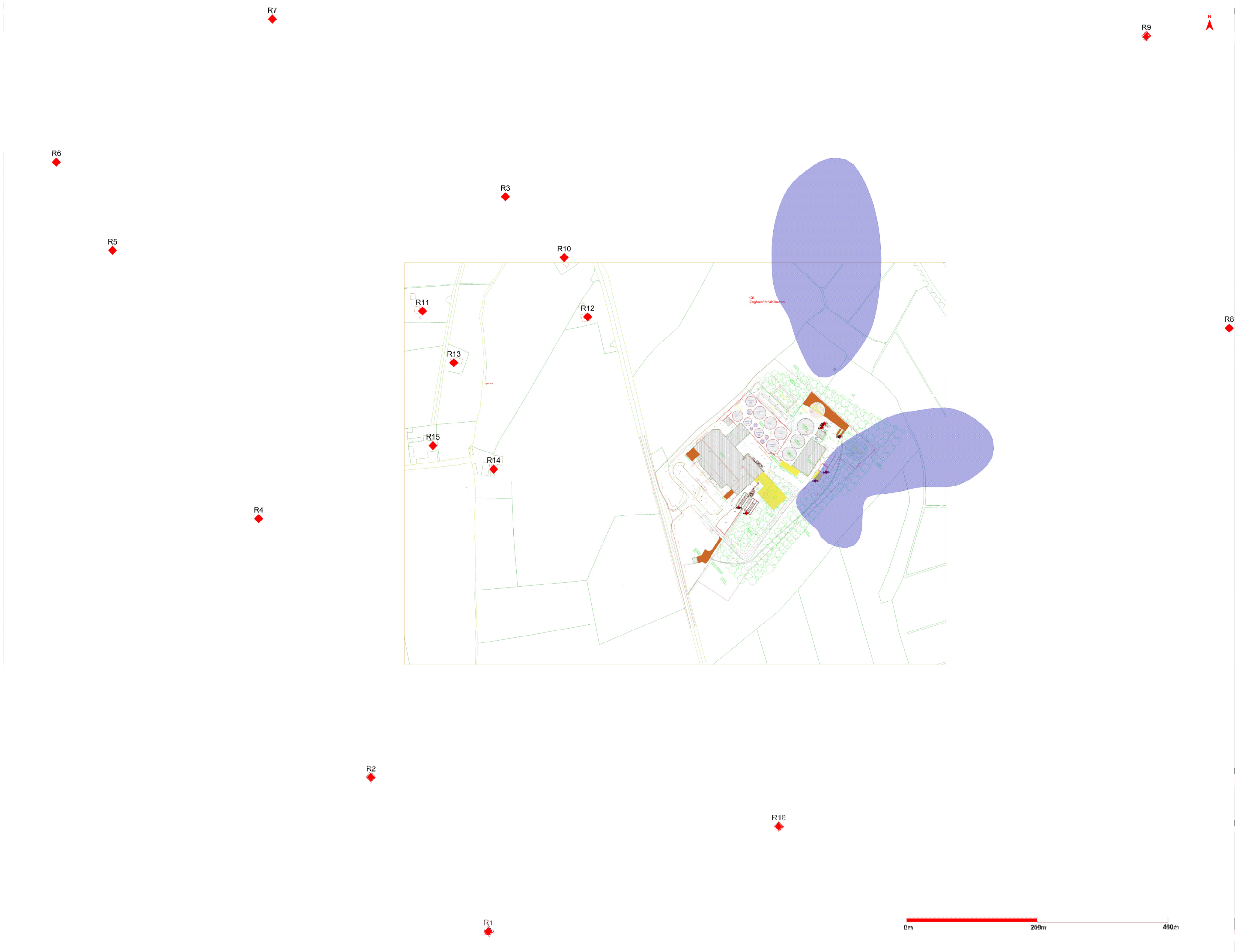

Figure 6.8. Predicted annual average SO_2 ground level concentration of 1.50 µg/m^3 (▬▬) for Scenario 6 for Oak Park meteorological station (worst case year 2020) - 24 hr plant operation.

6.2.4 Scenario 7 – TNMVOC as Benzene

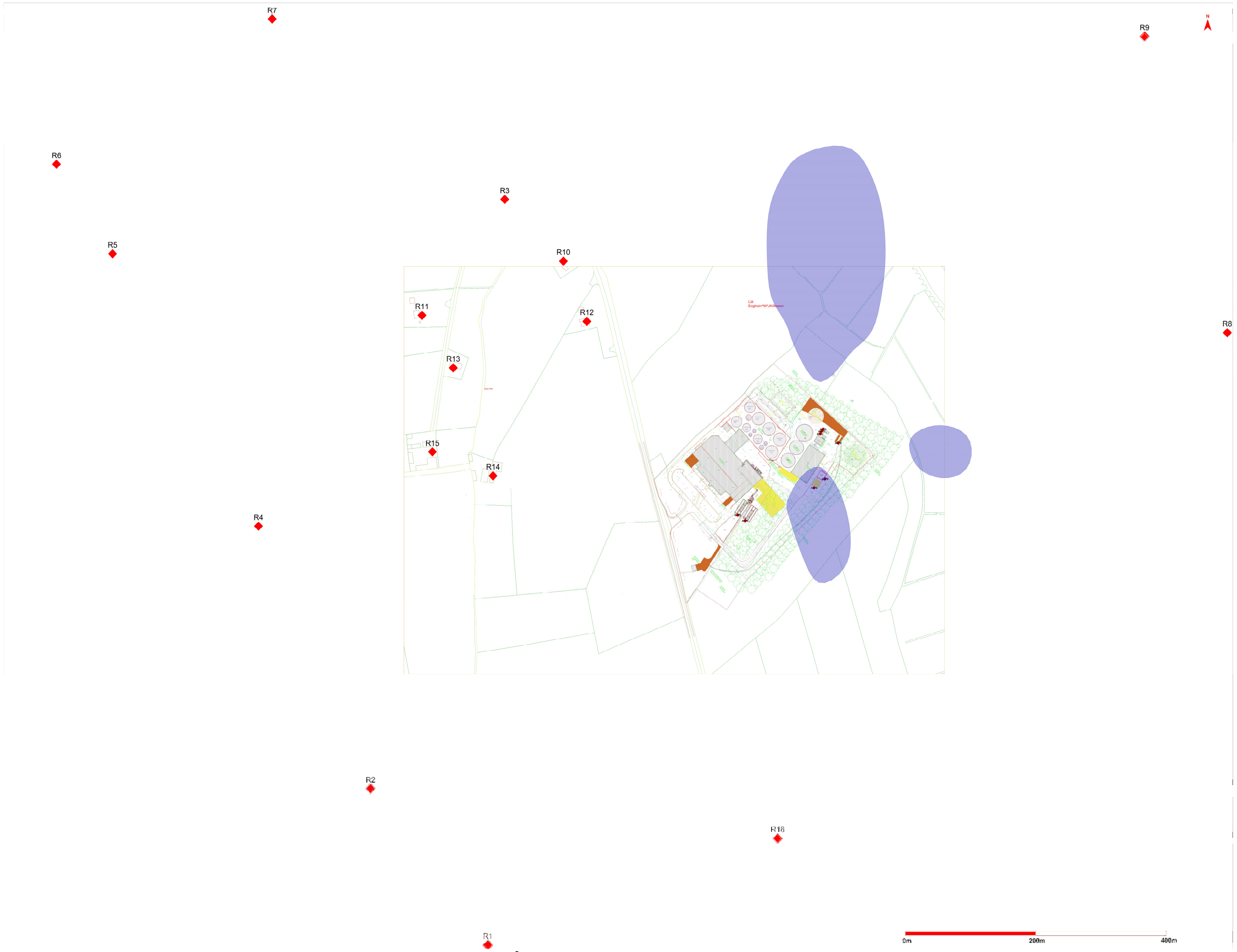

Figure 6.9. Predicted annual averages for TNMVOC as Benzene ground level concentration of 1.50 µg/m^3 (▬) for Scenario 7 for Oak Park meteorological station (worst case year 2020) - 24 hr plant operation.

6.2.5 Scenario 8 – Odour

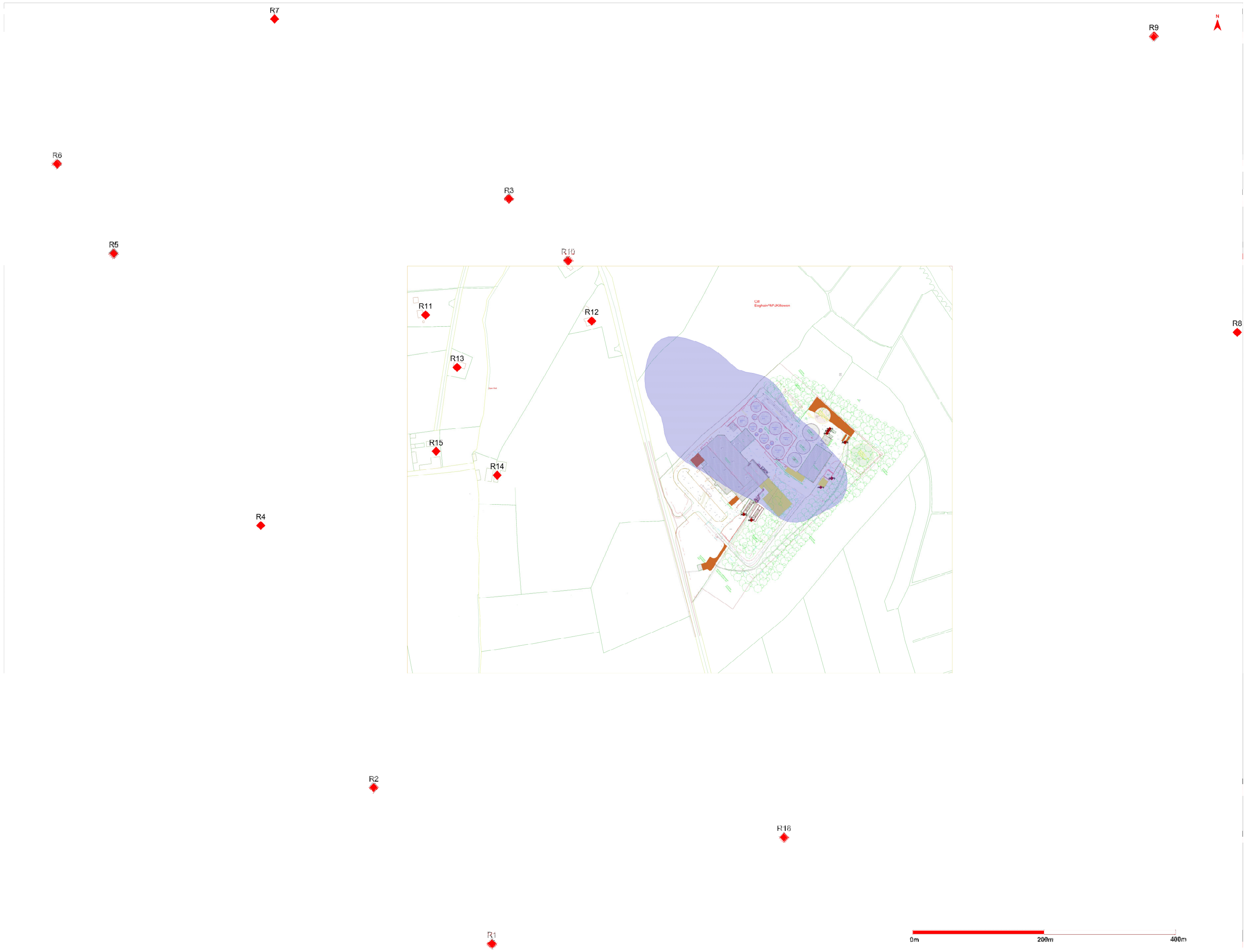

Figure 6.10. Predicted 98th percentile of 1 hr averages for Odour ground level concentration of less than or equal to 1.50 Ou_E/m^3 ( ) for cumulative emission for Scenario 8 for Oak Park meteorological station (worst case year 2020) - 24 hr plant operation.

7. *Appendix II* - Meteorological data used within the Dispersion modelling study.

Meteorological file Oak Park 2016 to 2020 inclusive

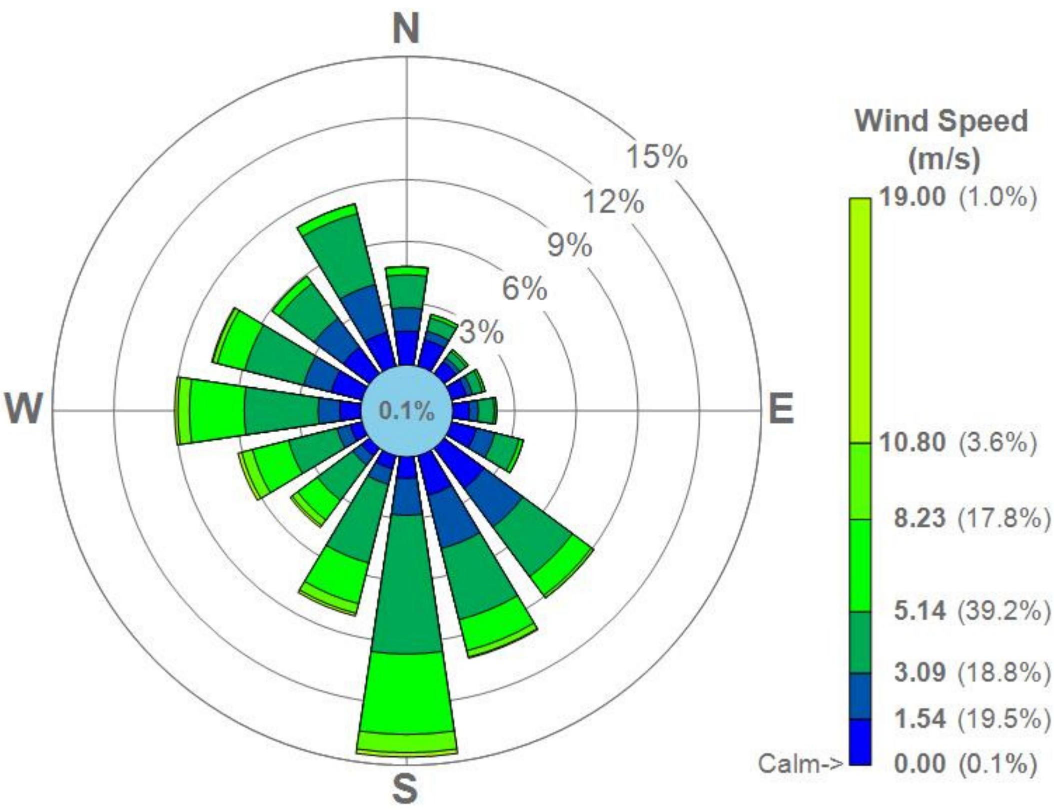

Figure 7.1. Schematic illustrating windrose for meteorological data used for atmospheric dispersion modelling, Oak Park 2016 to 2020 inclusive.

Table 7.1. Cumulative wind speed and direction for meteorological data used for atmospheric dispersion modelling Oak Park 2016 to 2020 inclusive.

Cumulative Wind Speed Categories							
Relative Direction	**> 1.54**	**>3.09**	**>5.14**	**>8.23**	**> 10.80**	**< 10.80**	**Total**
0	1.64	1.12	1.61	0.39	0.02	0.00	4.78
22.5	1.32	0.43	0.67	0.18	0.00	0.00	2.60
45	0.73	0.24	0.37	0.12	0.00	0.00	1.47
67.5	0.74	0.31	0.50	0.13	0.00	0.00	1.68
90	0.79	0.44	0.78	0.11	0.01	0.00	2.12
112.5	1.25	0.93	1.21	0.21	0.01	0.00	3.60
135	2.44	2.34	3.01	1.14	0.14	0.02	9.09
157.5	1.99	2.66	3.58	1.56	0.32	0.06	10.16
180	1.04	1.79	6.76	3.92	0.89	0.22	14.60
202.5	0.66	0.78	3.94	2.05	0.49	0.14	8.05
225	0.48	0.55	2.14	1.18	0.34	0.12	4.82
247.5	0.59	0.67	2.42	1.82	0.54	0.19	6.23
270	1.02	1.05	3.59	2.67	0.56	0.16	9.05
292.5	1.54	1.38	2.95	1.38	0.23	0.05	7.55
315	1.61	1.76	2.12	0.42	0.01	0.00	5.92
337.5	1.69	2.39	3.56	0.49	0.01	0.00	8.14
Total	**19.54**	**18.84**	**39.20**	**17.77**	**3.56**	**0.96**	**99.87**
Calms	**-**	**-**	**-**	**-**	**-**	**-**	**0.13**
Missing	**-**	**-**	**-**	**-**	**-**	**-**	**0.00**
Total	**-**	**-**	**-**	**-**	**-**	**-**	**100.00**

8. *Appendix III* - Checklist for EPA requirements for air dispersion modelling reporting

Table 8.1. EPA checklist as taken from their air dispersion modelling requirements report.

Item	Yes/No	Reason for omission/Notes
Location map	Section 6	-
Site plan	Section 6	-
List of pollutants modelled and relevant air quality guidelines	Yes	-
Details of modelled scenarios	Yes	-
Model description and justification	Yes	-
Special model treatments used	Yes	-
Table of emission parameters used	Yes	-
Details of modelled domain and receptors	Yes	-
Details of meteorological data used (including origin) and justification	Yes	-
Details of terrain treatment	Yes	-
Details of building treatment	Yes	-
Details of modelled wet/dry deposition	N/A	-
Sensitivity analysis	Yes	Five years of hourly sequential data screened from nearest only valid met station – Oak Park 2016 to 2020 screened. Worst case year Oak Park 2020.
Assessment of impacts	Yes	Pollutant emissions assessment from process identified.
Model input files	No	DVD will be sent upon request. Files are a total of 5.1 GB in size.