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Consulting Engineers Limited

Ford Energy Recovery Facility and Waste Sorting and Transfer Facility, Ford Circular Technology Park

Viridor, Grundon Waste Management and Ford Energy from Waste Ltd

Appendix C3: Emissions Modelling

ENGINEERING CONSULTING

Document approval

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Contents

1 Introduction

This Appendix sets out the approach taken to modelling emissions from the proposed Energy Recovery Facility ("the ERF") which is to constitute part of the Proposed Ford Circular Technology Park – Ford ERF and WSTF (the "Proposed Development"). This includes all model inputs and justifications where appropriate. Finally, this Appendix presents the results of the modelling.

2 Air Quality Standards, Objectives and Guidelines

In the UK, Ambient Air Directive (AAD) Limit Values, Targets, and air quality standards and objectives for major pollutants are described in The Air Quality Strategy (AQS). In addition, the Environment Agency include Environmental Assessment Levels (EALs) for other pollutants in the environmental management guidance 'Air Emissions Risk Assessment for your Environmental Permit'[1] ("Air Emissions Guidance"), which are also considered. The long-term and short-term EALs from these documents have been used when the AQS does not contain relevant objectives. Standards and objectives for the protection of sensitive ecosystems and habitats are also contained within the Air Emissions Guidance and the Air Pollution Information System (APIS).

2.1 Pollutants

2.1.1 Nitrogen dioxide

All combustion processes produce nitric oxide and nitrogen dioxide, known by the general term of nitrogen oxides. In general, the majority of the nitrogen oxides released is in the form of NO, which then reacts with ozone in the atmosphere to form nitrogen dioxide. Of the two compounds, nitrogen dioxide is associated with adverse effects on human health, principally relating to respiratory illness. The World Health Organisation has stated that "many chemical species of nitrogen oxides exist, but the air pollutant species of most interest from the point of view of human health is nitrogen dioxide".

The single greatest source of nitrogen oxides in England is road transport. According to the most recent annual report from the National Atmospheric Emissions Inventory (NAIE)[2], in 2017 road transport accounted for 51% of UK emissions. Power stations (16%) and industrial, commercial and residential combustion (18%) are also significant contributors. High levels of nitrogen oxides in urban areas are almost always associated with high traffic densities.

The AQS includes two objectives, which are also included in the Air Quality Directive.

- A limit for the one-hour mean of 200 µg/m³, not to be exceeded more than 18 times a year (equivalent to the 99.79th percentile).
- A limit for the annual mean of 40 µg/m³.

The Air Quality Directive includes objectives for the protection of sensitive vegetation and ecosystems of 30 µg/m³ for the annual mean nitrogen oxides. This is also transposed within the AQS. The APIS also defines the daily mean Critical Level as 75 µg/m³ for nitrogen oxides.

2.1.2 Sulphur dioxide

Sulphur dioxide is predominantly released by the combustion of fuels containing sulphur. Emissions of sulphur dioxide have reduced by 96% since 1990, due to a reduction in the number of coal-fired combustion plants, the installation of flue gas desulphurisation plants on a number of large coal-

[1] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#environmental-standards-for-air-emissions

[2] NAIE Air Pollution Inventories for England, Scotland, Wales and Northern Ireland: 1990-2017, DEFRA.

fired power stations and the reduction in sulphur content of liquid fuels. The AQS contains three objectives for the control of sulphur dioxide:

- A limit for the 15-minute mean of 266 µg/m³, not to be exceeded more than 35 times a year (the 99.9th percentile).
- A limit for the one hour mean of 350 µg/m³, not to be exceeded more than 24 times a year (the 99.73rd percentile).
- A limit for the daily mean of 125 µg/m³, not to be exceeded more than 3 times a year (the 99.2nd percentile).

The hourly and daily objectives are included in the Air Quality Directive.

The Air Quality Directive includes a Critical Level for the protection of vegetation and ecosystems of 20 µg/m³ as an annual mean and as a winter average. This is also transposed into the AQS. In addition, APIS defines the long-term Critical Level as 10 µg/m³ where lichens or bryophytes are present.

2.1.3 Particulate matter

Concerns over the health impact of solid matter suspended in the atmosphere tend to focus on particles with a diameter of less than 10 µm, known as PM_{10}. These particles have the ability to enter and remain in the lungs. Various epidemiological studies have shown increases in mortality associated with high levels of PM_{10}, although the underlying mechanism for this effect is not yet understood. According to the NAIE, significant sources of PM_{10} include industrial processes (13%), industrial processes (30%) residential, commercial and public sector combustion (27%), and transport (14%).

The AQS includes two objectives for PM_{10}, both of which are included in the Air Quality Directive.

- A limit for the annual mean of 40 µg/m³.
- A daily limit of 50 µg/m³, not to be exceeded more than 35 times a year (the 90.41st percentile).

The previous AQS included some provisional objectives for particulate matter with a diameter less than 2.5 µm ($PM_{2.5}$). These have been replaced by an exposure reduction objective for $PM_{2.5}$ in urban areas and a target value for $PM_{2.5}$ of 25 µg/m³ as an annual mean. This target value is included in the Air Quality Directive. The single greatest source of $PM_{2.5}$ is residential, commercial and public sector combustion (43%).

2.1.4 Carbon monoxide

Carbon monoxide is produced by the incomplete combustion of fuels containing carbon. By far the most significant sources are residential, commercial public sector combustion (36%), industrial combustion (30%) and transport (24%). Carbon monoxide can interfere with the processes that transport oxygen around the body, which can prove fatal at very high levels.

Concentrations in the UK are well below levels at which health effects can occur. The AQS includes the following objective for the control of carbon monoxide, which is also included in the Air Quality Directive:

- A limit for the 8-hour running mean of 10 mg/m³.

The Environment Agency's Air Emissions Guidance also defines the hourly EAL as 30 mg/m³.

2.1.5 Hydrogen chloride

There are no objectives for hydrogen chloride contained within the AQS. The Air Emissions Guidance defines the short-term EAL as 750 µg/m³, but provides no long-term EAL.

2.1.6 Hydrogen fluoride

There are no objectives for hydrogen fluoride contained within the AQS. The Air Emissions Guidance defines the short-term EAL as 160 µg/m³ and the long-term EAL as 16 µg/m³. In addition, Critical Levels for the protection of vegetation and ecosystems of 5 µg/m³ as a daily mean and 0.5 µg/m³ as a weekly mean concentration are set for hydrogen fluoride.

2.1.7 Ammonia

There are no objectives for ammonia contained within the AQS. However, the Air Emissions Guidance defines the short term EAL as 2,500 µg/m³ and the long term EAL as 180 µg/m³.

APIS also provides Critical Levels for the protection of vegetation and ecosystems. This level is 3 µg/m³ as an annual mean, reduced to 1 µg/m³ where lichens or bryophytes are present.

2.1.8 Volatile Organic Compounds (VOCs)

A variety of VOCs could be released from the stacks, of which benzene and 1,3-butadiene are included in the AQS and monitored at various stations around the UK. The AQS includes the following objectives for the running annual mean:

- Benzene – 5 µg/m³; and
- 1,3-butadiene – 2.25 µg/m³.

The Environment Agency's Air Emissions Guidance includes a short-term EAL for benzene, calculated from occupational exposure. This is a limit of 195 µg/m³ for an hourly mean. There are no short-term EALs for 1,3-butadiene.

2.1.9 Metals

Lead is the only metal included in the AQS. Emissions of lead in the UK have declined by 98% since 1970, due principally to the virtual elimination of leaded petrol.

The AQS includes objectives to limit the annual mean to 0.5 µg/m³ by the end of 2004 and to 0.25 µg/m³ by the end of 2008. Only the first objective is included in the Air Quality Directive.

The fourth Daughter Directive on air quality (Commission Decision 2004/107/EC) includes target values for arsenic, cadmium and nickel. However, the preamble to the Directive makes it clear that the use of these target values is relatively limited. Paragraph (5) states:

"The target values would not require any measures entailing disproportionate costs. Regarding industrial installations, they would not involve measures beyond the application of best available techniques (BAT) as required by Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control (5) and in particular would not lead to the closure of installations. However, they would require Member States to take all cost-effective abatement measures in the relevant sectors."

And paragraph (6) states:

"In particular, the target values of this Directive are not to be considered as environmental quality standards as defined in Article 2(7) of Directive 96/61/EC and which, according to Article 10 of that Directive, require stricter conditions than those achievable by the use of BAT."

Although these target values have been included in the assessment, it is important to note that the application of the target values would not have an effect on the design or operation of the ERF. The ERF will be designed in accordance with BAT and will include cost effective methods for the abatement of arsenic, cadmium and nickel, including the injection of activated carbon and a fabric filter.

Emissions limits have been set in permits for similar facilities for a number of heavy metals which do not have air quality standards associated with them. The EALs for these metals, and lead, are summarised in Table 1. Some metals included in this assessment do not have EALs.

Table 1: Environmental Assessment Levels (EALs) for Metals

Metal	AAD Limit / Target (ng/m³)	EALs (ng/m³)	
		Long-term	Short-term
Arsenic	6	3	-
Antimony	-	5,000	150,000
Cadmium	5	5	-
Chromium (II & III)	-	5,000	150
Chromium (VI)	-	0.2	-
Cobalt	-	-	-
Copper	-	10,000	200
Lead	500 (250 AQS Target)	250	-
Manganese	-	150	1500
Mercury	-	250	7,500
Nickel (total nickel compounds in the PM_{10} fraction)	20	20	-
Thallium	-	-	-
Vanadium	-	5	1

2.1.10 Dioxins and furans

Dioxins and furans are a group of organic compounds with similar structures, which are formed as a result of combustion in the presence of chlorine. Principal sources include steel production, power generation, coal combustion and uncontrolled combustion, such as bonfires. The Municipal Waste Incineration Directive and UK legislation imposed strict limits on dioxin emissions in 1995, with the result that current emissions from incineration of municipal solid waste in the UK in 1999 were less than 1% of the emissions from waste incinerators in 1995. The Waste Incineration Directive, now included in the IED, imposed even lower limits, reducing the limit to one tenth of the previously permitted level.

One dioxin, 2,3,7,8-TCDD, is a definite carcinogen and a number of other dioxins and furans and dioxin-like PCBs are considered to be possible carcinogens. A tolerable daily intake for dioxins, furans and dioxin-like PCBs of 2 pg I-TEQ per kg bodyweight per day has been recommended by the Committee on the Toxicity of Chemicals in Food, Consumer Products and the Environment. This is expressed as the total intake from inhalation and ingestion. The Human Health Risk Assessment (Appendix E of the Environmental Statement) considers the intake from inhalation and ingestions and compares this to the tolerable daily intake.

2.1.11 Polychlorinated biphenyl (PCBs)

PCBs have high thermal, chemical and electrical stability and were manufactured in large quantities in the UK between the 1950s and mid 1970s. Commercial PCB mixtures, which contained a range of dioxin-like and non-dioxin like congeners, were sold under a variety of trade names, the most common in the UK being the Aroclor mixtures. UK legislative restrictions on the use of PCBs were first introduced in the early 1970s.

Although now banned from production current atmospheric levels of PCBs are due to the ongoing primary anthropogenic emissions (e.g. accidental release of products or materials containing PCBs), volatilisation from environmental reservoirs which have previously received PCBs (e.g. sea and soil) or incidental formation of some congeners during the combustion process.

There are no objectives for PCBs contained within the AQS. However, the Air Emissions Guidance defines the short-term EAL as 6 µg/m³ and the long-term EAL as 0.2 µg/m³.

A number of PCBs are considered to possess dioxin like toxicity and are known as dioxin-like PCBs. The effect of emissions of dioxins, furans and dioxin-like PCBs has been assessed within Appendix 8.3 [Human Health Risk Assessment].

2.1.12 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are members of a large group of organic compounds widely distributed in the atmosphere. The best known PAH is benzo[a]pyrene (B[a]P). The AQS included an objective to limit the annual mean of B[a]P to 0.25 ng/m³. This goes beyond the requirements of European Directives, since the fourth Daughter Directive on air quality (Commission Decision 2004/107/EC) includes a target value for B[a]P of 1 ng/m³ as an annual mean.

2.1.13 Summary

AAD Target and Limit Values, AQS Objectives, and EALs are set at levels well below those at which significant adverse health effects have been observed in the general population and in particularly sensitive groups. For the remainder of the works these are collectively referred to as AQALs. Table 2 to Table 4 summarise the air quality objectives and guidelines used in this assessment. The sources for each of the values can be found in the preceding sections.

Table 2: Air Quality Assessment Levels (AQALs)

Pollutant	AQAL (µg/m³)	Averaging Period	Frequency of Exceedances	Source
Nitrogen dioxide	200	1 hour	18 times per year (99.79th percentile)	AAD Limit Value
	40	Annual	-	AAD Limit Value
Sulphur dioxide	266	15 minutes	35 times per year (99.9th percentile)	AQS Objective

Pollutant	AQAL ($\mu g/m^3$)	Averaging Period	Frequency of Exceedances	Source
	350	1 hour	24 times per year (99.73rd percentile)	AAD Limit Value
	125	24 hours	3 times per year (99.18th percentile)	AAD Limit Value
Particulate matter (PM_{10})	50	24 hours	35 times per year (90.41st percentile)	AQS Objective
	40	Annual	-	AQS Objective
Particulate matter ($PM_{2.5}$)	25	Annual	-	AQS Target
Carbon monoxide	10,000	8 hours, running	-	AAD Limit Value
	30,000	1 hour	-	Air Emissions Guidance
Hydrogen chloride	750	1 hour		Air Emissions Guidance
Hydrogen fluoride	160	1 hour	-	Air Emissions Guidance
	16	Annual	-	Air Emissions Guidance
Ammonia	2,500	1 hour	-	Air Emissions Guidance
	180	Annual	-	Air Emissions Guidance
Benzene	5	Annual	-	Air Emissions Guidance
	195	1 hour	-	Air Emissions Guidance
1,3-butadiene	2.25	Annual, running	-	AQS Objective
PCBs	6	1-hour	-	Air Emissions Guidance
	0.2	Annual	-	Air Emissions Guidance
PAHs	0.00025	Annual	-	AQS Objective

Table 3: Air Quality Assessment Levels for Metals

Pollutant	AQAL (ng/m^3)	Averaging Period	Source
Cadmium	-	1 hour	-
	5	Annual	AAD Target Value
Mercury	7,500	1 hour	Air Emissions Guidance
	250	Annual	Air Emissions Guidance
Antimony	150,000	1 hour	Air Emissions Guidance
	5,000	Annual	Air Emissions Guidance
Arsenic	-	1 hour	-
	3	Annual	Air Emissions Guidance

Pollutant	AQAL (ng/m³)	Averaging Period	Source
Chromium (II & III)	150,000	1 hour	Air Emissions Guidance
	5,000	Annual	Air Emissions Guidance
Chromium (VI)	-	1 hour	-
	0.2	Annual	Air Emissions Guidance
Copper	200,000	1 hour	Air Emissions Guidance
	10,000	Annual	Air Emissions Guidance
Lead	-	1 hour	-
	250	Annual	AQS Target
Manganese	1,500,000	1 hour	Air Emissions Guidance
	150	Annual	Air Emissions Guidance
Nickel	-	1 hour	-
	20	Annual	AAD Limit
Vanadium	1,000	1 hour	Air Emissions Guidance
	5,000	Annual	Air Emissions Guidance

Table 4: Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Concentration (µg/m³)	Measured as	Source
Nitrogen oxides (as nitrogen dioxide)	75	Daily mean	APIS
	30	Annual mean	AAD Critical Level
Sulphur dioxide	10	Annual mean for sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystems integrity	Air Emissions Guidance / APIS
	20	Annual mean for all higher plants	AAD Critical Level
Hydrogen fluoride	5	Daily mean	Air Emissions Guidance / APIS
	0.5	Weekly mean	Air Emissions Guidance / APIS
Ammonia	1	Annual mean for sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystems integrity	APIS
	3	Annual mean for all higher plants	APIS

2.2 Areas of relevant exposure

The AQALs apply only at areas of exposure relevant to the assessment level. The following table extracted from Local Authority Air Quality Technical Guidance (2016) (LAQM.TG(16))[3] explains where the AQALs apply.

Table 5: Guidance on Where AQALs Apply

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

[3] Department for Environment, Food and Rural Affairs, Local Air Quality Management Technical Guidance (TG16), February 2018, available at: https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf

3 Sensitive Receptors

As part of this assessment, the predicted process contribution (PC) from the ERF at the point of maximum impact and a number of sensitive receptors has been evaluated.

3.1 Human sensitive receptors

The human sensitive receptors identified for assessment are displayed in Figure 1 of Annex A and listed in Table 6. These have been identified as the closest residential properties in each wind direction, along with any schools and hospitals identified within 3 km of the Site. There is potential for the Proposed Development to impact upon other projects in the vicinity of Proposed Development. Therefore, a number of additional human sensitive receptors have been included to represent the proposed residential developments identified during the scoping process.

Table 6: Human Sensitive Receptors

ID	Name	Location		Distance from the stacks (m)
		x	y	
R1	Ford Lane 1	499101	103893	727
R2	Ford Lane 2	499246	103908	669
R3	Ford Lane 3	499674	103662	399
R4	Rodney Crescent	499962	103515	498
R5	Ford Road	500100	103236	588
R6	Ford Open Prison 1	500137	102865	757
R7	Horsemere Green Lane 1	500109	102385	1,088
R8	Horsemere Green Lane 2	499847	102322	1,029
R9	Beagle Drive	499015	102981	591
R10	Yapton Primary School	497788	103647	1,762
R11	Proposed Ford Airfield Residential 1	499218	103340	300
R12	Proposed Ford Airfield Residential 2	499319	102906	436
R13	Proposed Ford Airfield Residential 3	499249	103576	386
R14	Proposed Ford Airfield Residential 4	498952	103288	563
R15	Proposed Ford Airfield Residential 5	499156	103056	432
R16	Proposed Landings Residential Development 1	499593	103313	80
R17	Proposed Landings Residential Development 2	499744	103175	259
R18	Proposed Landings Residential Development 3	499660	103040	294
R19	Proposed Landings Residential Development 4	499470	103463	173
R20	Proposed Allocation of Arun DC Secondary School	498749	103383	771
R21	Proposed Residential Development Climping	499851	102072	981
R22	Proposed Residential Development Bilsham Road	497709	102995	1,831
R23	Proposed Residential Development Drove Lane	497575	103238	1,941

ID	Name	Location		Distance from the stacks (m)
		x	y	
R24	Proposed Residential Development Walberton	497446	106017	3,418
R25	Proposed Residential Development Littlehampton	502954	103875	3,487

3.2 Ecological sensitive receptors

A study was undertaken to identify the following sites of ecological importance in accordance with the following screening distances laid out in the Air Emissions Guidance:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs), or Ramsar sites within 10 km of the Site;
- Sites of Special Scientific Interest (SSSIs) within 2 km of the Site; and
- National Nature Reserves (NNR), Local Nature Reserves (LNRs), local wildlife sites and ancient woodlands within 2 km of the Site.

The sensitive ecological receptors identified as a result of the study are displayed in Figure 2 of Annex A and are listed in Table 7. A review of the citation and APIS website for each site has been undertaken to determine if lichens or bryophytes are an important part of the ecosystem's integrity. If lichens or bryophytes are present, the more stringent Critical Level has been applied as part of the assessment.

Table 7: Ecological Sensitive Receptors

ID	Site	Designation	Closest point to Site		Distance from stacks at closest point (km)	Lichens/ bryophytes present
			X	Y		
European and UK Designated Sites						
E1	Duncton to Bignor Escarpment	SAC(1) & SSSI(2)	497390	112940	9.9	YES
Locally Designated Sites						
E2	Ford Ancient Woodland	AW(3)	499896	104569	1.3	YES
Notes: *(1) SAC = Special Area of Conservation.* *(2) SSSI = Site of Special Scientific Interest.* (3) *AW = Ancient woodland.*						

4 Process Emissions Dispersion Modelling Methodology

4.1 Selection of model

Detailed dispersion modelling has been undertaken using the model ADMS 5.2, developed and supplied by Cambridge Environmental Research Consultants (CERC) This is a new generation dispersion model, which characterises the atmospheric boundary layer in terms of the atmospheric stability and the boundary layer height. In addition, the model uses a skewed Gaussian distribution for dispersion under convective conditions, to take into account the skewed nature of turbulence. The model also includes modules to take account of the effect of buildings and complex terrain.

ADMS is routinely used for modelling of emissions for planning and Environmental Permitting purposes to the satisfaction of the Environment Agency and local authorities. The maximum predicted concentration for each pollutant and averaging period has been used to determine the significance of any potential impacts.

4.2 Emission limits

The IED (Directive 2010/75/EU), adopted on 7th January 2013, is the key European Directive which covers almost all regulation of industrial processes in the EU. Within the IED, the requirements of the relevant sector Best Available Techniques (BAT) Reference Documents (BREFs) become binding as BAT guidance, as follows.

- Article 15, paragraph 2, of the IED requires that Emission Limit Values (ELVs) are based on best available techniques, referred to as BAT.
- Article 13 of the IED, requires that 'the Commission' develops BAT guidance documents (referred to as BREFs).
- Article 21, paragraph 3, of the IED, requires that when updated BAT conclusions are published, the Competent Authority (in England this is the Environment Agency) has up to four years to revise permits for facilities covered by that activity to comply with the requirements of the sector specific BREF.

The Waste Incineration BREF was published by the European Integrated Pollution Prevention and Control (IPPC) Bureau in December 2019. The BREF has introduced BAT-AELs (BAT Associated Emission Levels) which are more stringent than those currently set out in the IED for some pollutants. The ERF will be designed to meet the requirements of the BREF for a new plant. Therefore, it has been assumed that the emissions from the ERF will comply with the BAT-AELs set out in the BREF for new plants. For the remainder of this assessment the anticipated emission limits, which are a combination of BAT-AELs and emission limits from the IED, are referred to as Emission Limit Values (ELVs).

4.3 Source and emissions data

The principal inputs to the model with respect to the emissions to air from the ERF are presented in Table 8 and Table 9. This data is based on the combustion of 32.5 tonnes per hour of residual waste with a net calorific value of 10.5 MJ/kg.

Table 8: Stack Source Data

Item	Unit	Value
Stack Data		
Height	m	See Stack Height Analysis (Section 5.1)
Internal diameter	m	2.40
Location	m, m	499515, 103296
Flue Gas Conditions		
Temperature	°C	130
Exit moisture content	% v/v	17.56%
	kg/kg	0.128
Exit oxygen content	% v/v dry	6.40%
Reference oxygen content	% v/v dry	11%
Volume at reference conditions (dry, ref O_2)	Nm^3/s	53.80
Volume at actual conditions	Am^3/s	67.85
Flue gas exit velocity	m/s	15

Table 9: Stack Emissions Data

Pollutant	Daily or Periodic	Half-hourly	Daily or Periodic	Half-hourly
	Conc. (mg/Nm^3)		Release Rate (g/s)	
Oxides of nitrogen (as NO_2)	120	400	6.456	21.520
Sulphur dioxide	30	200	1.614	10.760
Carbon monoxide	50	150(1)	2.690	8.070
Fine Particulate Matter (PM)(2)	5	30	0.269	1.614
Hydrogen chloride	6	60	0.323	3.228
Volatile organic compounds (as TOC)	10	20	0.538	1.070
Hydrogen fluoride	1	4	0.054	0.215
Ammonia	10	-	0.538	-
Cadmium and thallium	0.02	-	1.076 mg/s	-
Mercury	0.02	0.035	1.076 mg/s	1.883 mg/s
Other metals(3)	0.3	-	16.140 mg/s	-
Benzo(a)pyrene (PaHs)(4)	0.105 µg/Nm^3	-	5.649 µg/s	-
Dioxins and furans	0.06 ng/Nm^3	-	3.228 ng/s	-
PCBs(5)	5.0 µg/Nm^3	-	0.269 mg/s	-

Notes:

All emissions are expressed at reference conditions of dry gas, 11% oxygen, 273.15K.

(1) Averaging period for carbon monoxide is 95% of all 10-minute averages in any 24-hour period.

(2) As a worst-case it has been assumed that the entire PM emissions consist of either PM_{10} or $PM_{2.5}$ for comparison with the relevant AQALs.

(3) Other metals consist of antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V).

(4) The highest recorded emission concentration of B[a]P from the Environment Agency's public register was 0.105 ug/m³, or 0.000105 mg/m³ (dry, 11% oxygen, 273K). This is assumed to be the emission concentration for the ERF.

(5) The Waste Incineration BREF provides a range of values for PCB emissions to air from European municipal waste incineration plants. This states that the annual average total PCBs is less than 0.005 mg/Nm³ (dry, 11% oxygen, 273K). In lieu of other available data, this has been assumed to be the emission concentration for the ERF.

The ERF is designed to operate at full capacity and is not anticipated to have significant changes in loading. Therefore, it is appropriate to base the assessment on the design point of the system.

If the ERF continually operated at the half-hourly limits, the daily limits would be exceeded. The ERF is designed to achieve the daily limits and as such will only operate at the short-term limits for short periods on rare occasions.

4.4 Other Inputs

4.4.1 Modelling domain

Modelling has been undertaken over an 8.5 km x 8.5 km grid with a spatial resolution of 85 m. The grid spacing in each direction is less than 1.5 times the minimum stack height considered in accordance with the Environment Agency's modelling guidance. Reference should be made to Figure 3 of Annex A for a graphical representation of the modelling domain used. The extent of the modelling domain is detailed in Table 10.

Table 10: Modelling Domain

Grid Quantity	Value
Grid spacing (m)	85
Grid points	101
Grid Start X (m)	495250
Grid Finish X (m)	503750
Grid Start Y (m)	99050
Grid Finish Y (m)	107550

4.4.2 Meteorological data and surface characteristics

The impact of meteorological data was taken into account by using weather data from the Shoreham meteorological recording station for the years 2014 – 2018. Shoreham is approximately 21 km to the west of the ERF and is the closest and most representative meteorological station available. The Environment Agency recommends that 5 years of data are used to take into account inter-annual fluctuations in weather conditions. The years 2014 to 2018 were used as this was the data that was available at the start of this project. Although 2019 data is now available, the use of 2019 data is not likely to change the results of the assessment. Wind roses for each year are presented in Figure 4 of Annex A.

The minimum Monin-Obukhov length can be selected in ADMS for both the dispersion site and the meteorological site. This is a measure of the minimum stability of the atmosphere and can be adjusted to account for urban heat island effects which prevent the atmosphere in urban areas from ever becoming completely stable. The minimum Monin-Obukhov length has been set to 1 m (the model default) for the dispersion and meteorological sites. The value of 1 m is appropriate for rural areas and is considered appropriate for the surroundings of the dispersion and meteorological sites.

The surface roughness length can be selected in ADMS for both the dispersion site and the meteorological site. The surface roughness has been set to 0.3 m for the meteorological site, which is appropriate for the open fields of the meteorological site. The surface roughness has also been set to 0.3 m for the dispersion site. This value is considered appropriate for the mix of widely spaced industrial units and open fields surrounding the ERF. The sensitivity of the modelling to the choice of surface roughness has been considered in Section 5.2.

4.4.3 Buildings

The presence of adjacent buildings can significantly affect the dispersion of the atmospheric emissions in various ways:

- Wind blowing around a building distorts the flow and creates zones of turbulence. The increased turbulence can cause greater plume mixing.
- The rise and trajectory of the plume may be depressed slightly by the flow distortion. This downwash leads to higher ground level concentrations closer to the stack than those which would be present without the building.

The Environment Agency recommends that buildings should be included in the modelling if they are both:

- Within 5L of the stack (where L is the smaller of the building height and maximum projected width of the building); and
- Taller than 40% of the stack.

The ADMS 5.2 user guide also states that buildings less than one third of the stack height will not have any effect on dispersion and are ignored by the model.

The ADMS dispersion model approximates an "effective building" based on the buildings inputted into the model. This effective building is a single building with a cross wind width and length for each wind direction. The size (footprint and height) of this effective building depends upon the height of each building inputted into the model, and the location of the centre of this building in relation to the stack. A sensitivity analysis has been undertaken in order to determine a suitable building layout configuration for the assessment. Details of the results of the building sensitivity analysis can be found in Section 5.3.

The details of the building included within the dispersion model used for the purpose of the assessment is presented in Table 11 and a site plan showing the location is presented in Figure 7 of Annex A.

Table 11: Building Details

Buildings	Centre Point		Height (m)	Width (m)	Length (m)	Angle (°)
	X (m)	Y (m)				
Boiler Hall	499488.9	103362.6	40.4	61.0	163.0	344.0

4.4.4 Terrain

It is recommended that, where gradients within 500 m of the modelling domain are greater than 1 in 10, the complex terrain module within ADMS (FLOWSTAR) should be used. A review of the local area has deemed that it is not necessary to take into account the effects of terrain in the modelling.

4.5 Chemistry

The Facility will release nitric oxide (NO) and nitrogen dioxide (NO_2) which are collectively referred to as NOx. In the atmosphere, nitric oxide will be converted to nitrogen dioxide in a reaction with ozone which is influenced by solar radiation. Since the air quality objectives are expressed in terms of nitrogen dioxide, it is important to be able to assess the conversion rate of nitric oxide to nitrogen dioxide.

Ground level NOx concentrations have been predicted through dispersion modelling. Nitrogen dioxide concentrations reported in the results section assume 70% conversion from NOx to nitrogen dioxide for annual means and a 35% conversion for short term (hourly) concentrations, based upon the worst-case scenario in the Environment Agency methodology. Given the short travel time to the areas of maximum concentrations, this approach is considered conservative.

4.6 Baseline concentrations

Background concentrations for the assessment have been derived from monitoring and national mapping as presented in Appendix C1 [Baseline Analysis]. For short term averaging periods, the background concentration has been assumed to be twice the long-term ambient concentration following the Air Emissions Guidance methodology.

5 Sensitivity Analysis

5.1 Stack height assessment

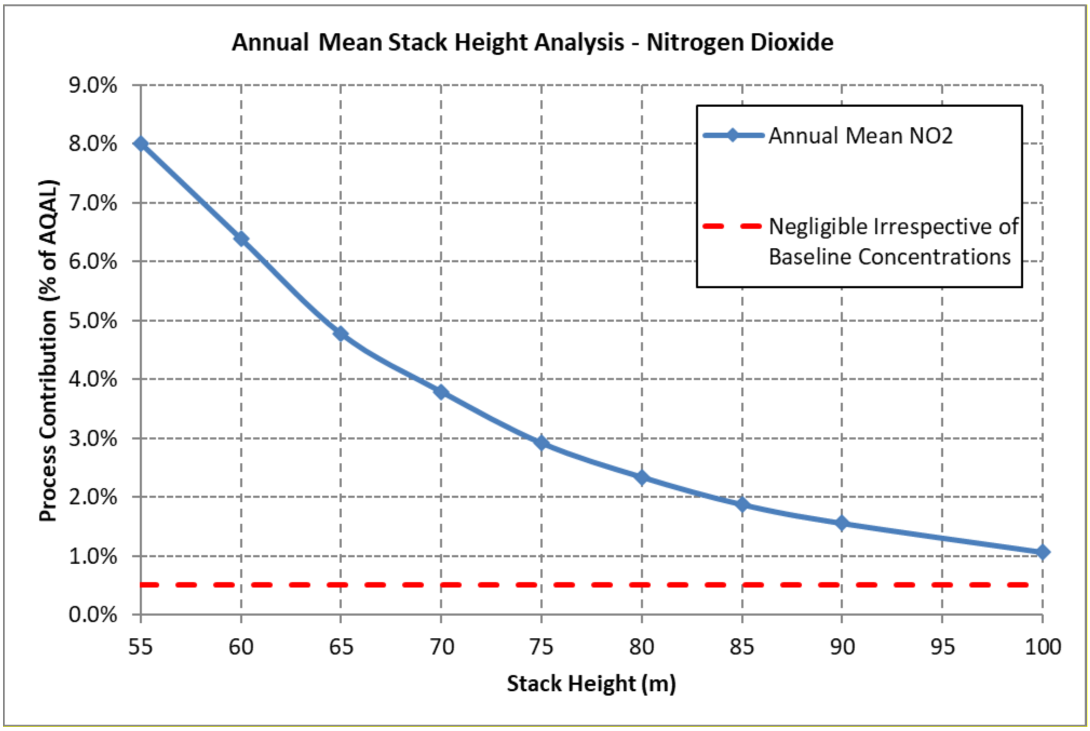
When determining a suitable stack height, it is best practice to identify the stack height where the rate of reduction in maximum ground level concentration with increased height slows down. This can be identified on a graph as a step change in the slope. This assessment considers a range of stack heights from 55 m to 100 m.

The following parameters were kept constant:

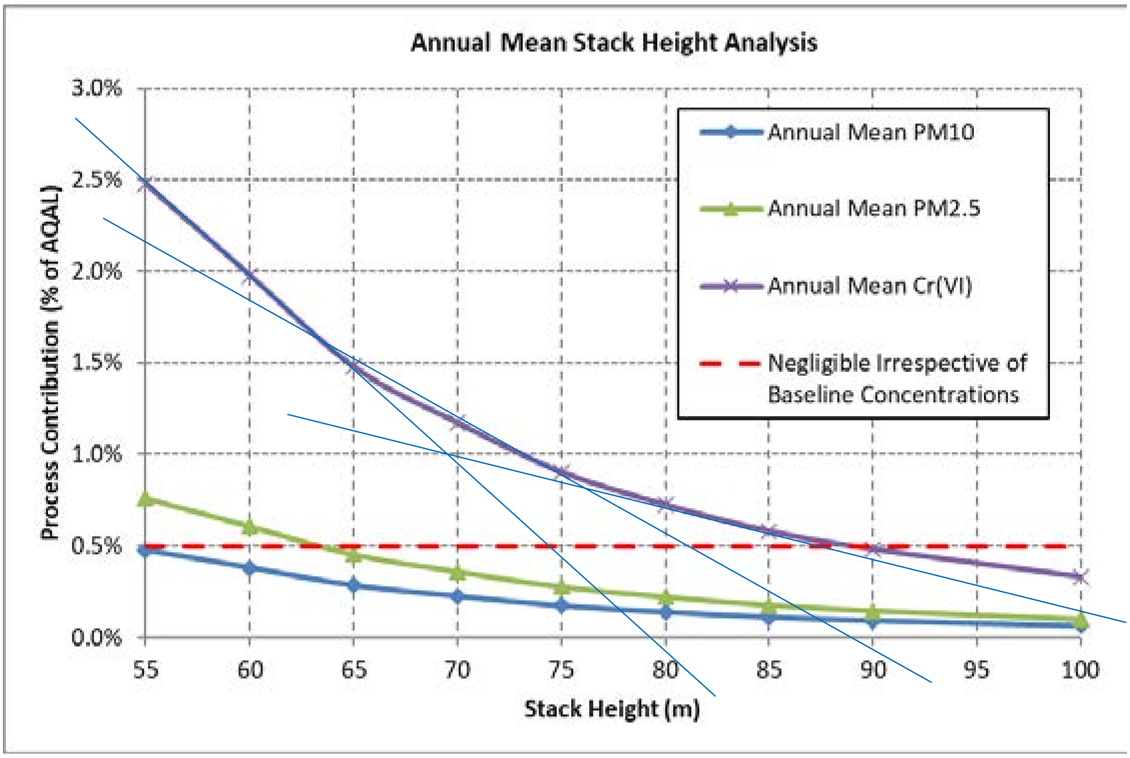
- Buildings – included;
- Terrain file – excluded;
- Dispersion site surface roughness value – 0.3 m;
- Meteorological site surface roughness – 0.3 m;
- Dispersion site Monin-Obukhov length – model default;
- Meteorological site Monin-Obukhov length – 10 m; and
- Meteorological data used – Shoreham 2014 to 2018.

The graphs below show the ground level concentration at the point of maximum impact as a percentage of the relevant AQAL for a range of stack heights for the ERF.

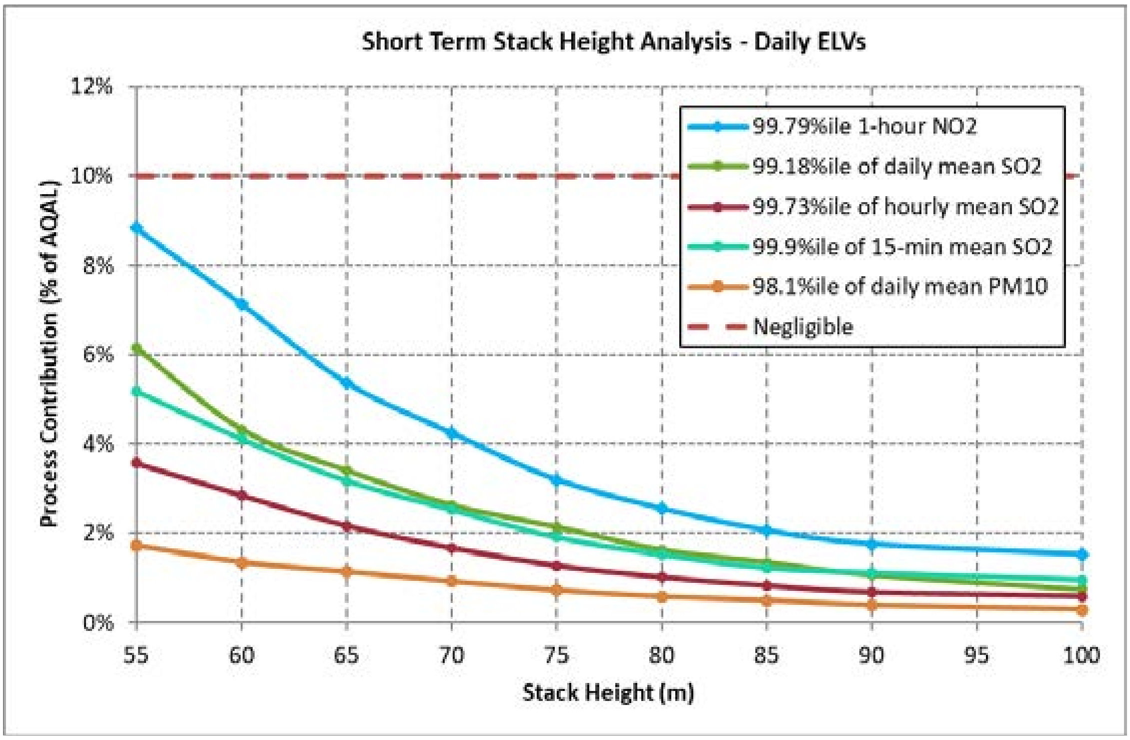
Graph 1 – Annual Mean Nitrogen Dioxide



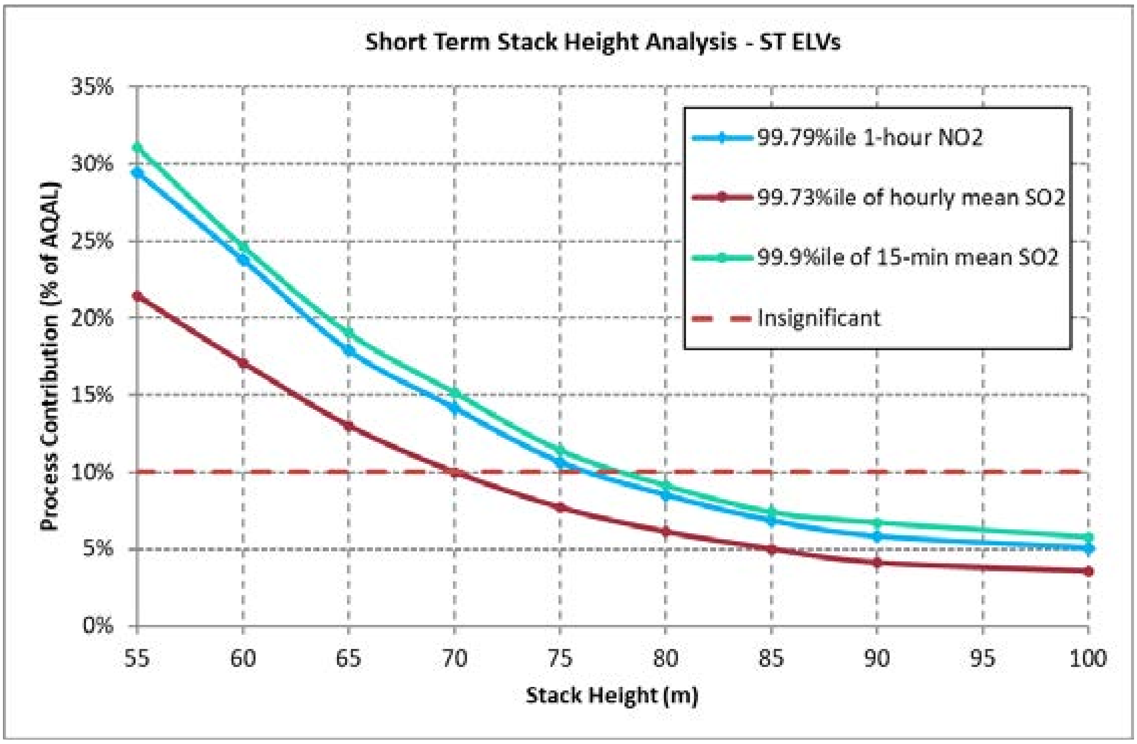
Graph 2 – Annual Mean Particulate Matter and Chromium (VI)



Graph 3 – Short Term Impact – Daily ELVs



Graph 4 – Short Term Impact – Short Term (half hourly) ELVs



Analysis of the graphs shows that for annual mean nitrogen dioxide concentrations, there is a clear change in the slope at a stack height of 65 m, with smaller changes in the slope at stack heights of 75 m and 78 m. For annual mean particulate matter and chromium VI there is a small change in the slope at a stack a stack height of 60 m and no significant changes in the slope at stack heights greater than 60 m.

For short-term concentrations there is no clear step change in the angle of the slope, but rather a general flattening of the slope observed as the stack height is increased. However, with an 85 m high stack, at the point of maximum impact:

- all annual mean impacts can be described as 'negligible' when the PEC is considered; and
- all short-term impacts can be described as 'negligible' irrespective of baseline concentrations if it is assumed that the plant operates at the half-hourly BAT-AELs.

Based on the stack height analysis the recommended height of the stack is 85 m. This provides adequate dispersion of pollutants from the ERF.

5.2 Surface roughness

The sensitivity of the results to using spatially varying surface roughness length has been considered by running the model with a variety of surface roughness lengths for the dispersion site. For all sensitivity analyses the impact of changing model parameters on the maximum annual mean and short-term concentrations of oxides of nitrogen have been considered.

The following parameters were kept constant:

- Stack height – 85 m
- Buildings – included;
- Terrain file – excluded;

- Meteorological site surface roughness – 0.3 m;
- Dispersion site Monin-Obukhov length – model default;
- Meteorological site Monin-Obukhov length – model default; and
- Meteorological data used – Shoreham 2018.

The contribution of the ERF to the ground level concentration of the emissions of oxides of nitrogen at the point of maximum predicted concentration is presented in Table 12.

Table 12: Surface Roughness Sensitivity Analysis

Surface roughness (m)	Oxides of Nitrogen PC (µg/m³)			
	Point of Maximum Impact		Maximum Impacted Receptor	
	Annual Mean	Max 1-hour mean	Annual Mean	Max 1-hour mean
0.1	0.67	17.62	0.25	16.54
0.3	**0.79**	**19.40**	**0.32**	**16.72**
0.5	0.85	20.33	0.36	16.67
0.7	0.90	20.92	0.39	16.59
1	0.96	21.58	0.48	16.47

As shown, increasing the surface roughness value leads to greater annual mean concentrations at the point of maximum impact and at the maximum impacted receptor. Increasing the surface roughness length leads to greater short-term concentrations at the point of maximum impact, but at the maximum impacted receptor the peak impact is fairly similar. A surface roughness value of 0.3 m was selected for the model as this was deemed the most appropriate for the surrounding landscape which mainly comprises open fields, copses and isolated industrial buildings.

5.3 Building parameters

The ERF will consist of process buildings enclosed between a number of sloped parapets positioned on the east and west side of the buildings. The waste reception and tipping hall will be enclosed between two sloped parapets each with a maximum tip height of 41.7 m. The boiler hall and flue gas treatment buildings will be enclosed between two sloped parapets each with a maximum tip height of 51.22 m. It is not possible to explicitly model a sloped roof in ADMS and as set out in Section 4.4.3 the ADMS model calculates and effective building based on the building detailed inputted into the model. Therefore, the following three building configurations have been considered in a sensitivity analysis:

- Scenario 1 – a single building envelope at a height of 51.2 m.
- Scenario 2 - a single building envelope at a height of 40.41 m. This is the average height of the lowest and highest point of the parapets; and
- Scenario 3 – two blocked buildings at the top height of each parapet (41.7 m and 51.2 m).

A visual representation of the building configurations associated with the above scenarios is presented in Figure 5 of Annex A and the details of the buildings within the models are presented in Table 13.

Table 13: Building Details

Scenario	Buildings	Centre Point		Height (m)	Width (m)	Length (m)	Angle (°)
		X (m)	Y (m)				
Scenario 1	Boiler Hall	499488.9	103362.6	51.2	61.0	163.0	344.0
Scenario 2	Boiler Hall	499488.9	103362.6	40.4	61.0	163.0	344.0
Scenario 3	Boiler Hall	499501.5	103334.6	51.2	27	103	342.0
	Tipping Hall	499476	103406.2	41.5	61	73	342.0

As set out in Section 4.4.3, the ADMS model calculates an effective building for each wind direction based on the cross-wind dimensions of the buildings input into the model. In general, the larger the building the greater the building downwash effect. The footprint of the effective buildings for Scenario 1 and 2 are the same but the height varies: scenario 1 assumes an effective building height of 51.2 m whereas scenario 2 assumes an effective building height of 40.4 m. The effective building height for Scenario 3 is 51.2 m. However, due to the stepped building configuration and the cross-wind dimensions of the buildings the effective building footprint calculated by the model is not the same as that for scenario 1 and 2.

Table 14 presents the ground level concentration of oxides of nitrogen at the point of maximum predicted concentration for each building scenario. The following parameters were kept constant:

- Stack height – 85 m;
- Terrain file – excluded;
- Dispersion site surface roughness value – 0.3 m;
- Meteorological site surface roughness – 0.3 m;
- Dispersion site Monin-Obukhov length – model default;
- Meteorological site Monin-Obukhov length – model default; and
- Meteorological data used – Shoreham 2018.

Table 14: Effect of Buildings

Scenario used in model	Oxides of Nitrogen PC (µg/m³)			
	Point of Maximum Impact		Maximum Impacted Receptor	
	Annual Mean	Max 1-hour mean	Annual Mean	Max 1-hour mean
Scenario 1 - a single building envelope at a height of 51.2 m	1.77	42.05	1.23	22.55
Scenario 2 - a single building envelope at a height of 40.41 m	**1.07**	**28.30**	**0.51**	**20.74**
Scenario 3 - two blocked buildings at the top height of each parapet	1.67	34.25	1.19	20.85

As shown in Table 14, Scenario 1 and 3 result in higher annual mean ground level concentrations due a greater building downwash effect. As shown on Figure 5, the parapets are on the long axis of the building. The height of the tallest process building enclosed between the parapets is only 40 m. The stack is located to the south of the building where the parapet height is 32 m Therefore, assuming an effective building height of 51.2 m significantly overestimates the building downwash effects.

Scenario 2 assumes the building to be the average height of the parapets or 40.4 m, this results in lower annual mean and short-term concentrations at the point of maximum impact and at the maximum impacted receptor. However, the effective building height for Scenario 2 is more representative of the height of the process buildings enclosed between the parapets and is considered to be most representative of the likely building downwash effects. Therefore, the remainder of this assessment has been undertaken assuming the building dimensions from Scenario 2.

5.4 Sensitivity analysis – operating below the design point

Dispersion modelling has been undertaken based on the emission parameters based on the design point for the ERF. The ERF will be operated as a commercial plant, so it is beneficial to operate at full capacity. If loading does fall below the design point the volumetric flow rate and the exit velocity of the exhaust gases would reduce. The effect on this would decrease the quantity of pollutants emitted but also to reduce the buoyancy of the plume due to momentum. The reduction in buoyancy, which would lead to reduced dispersion, would be more than offset by the decrease in the amount of pollutants being emitted, so that the impact of the plant when running below the design point would be reduced.

6 Impact on Human Health

6.1 At the point of maximum impact

Table 15 and Table 16 present the results of the dispersion modelling of process emissions from the ERF at the point of maximum impact. This is the maximum predicted concentration based on the following:

- Modelling domain size – 8.5 km x 8.5 km at 85 m resolution;
- Stack height – 85 m;
- 5 years of weather data 2014 to 2018 from Shoreham meteorological recording station;
- Operation at the long term ELVs for 100% of the year;
- Operation at the short term ELVs during the worst-case conditions for dispersion of emissions (Table 16 only);
- Environment Agency's worst-case conversion of NOx to nitrogen dioxide;
- The entire VOC emissions are assumed to consist of either benzene or 1,3-butadiene; and
- Cadmium is released at the combined emission limit for cadmium and thallium.

The baseline concentration is taken from the review of baseline monitoring contained in Appendix C1 [Baseline Review].

Impacts that cannot be described as 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria are highlighted. Where the impact cannot be screened out as 'negligible' irrespective of the total concentration, further analysis has been undertaken. The discussion of the results is contained within ES Chapter 6 [Air Quality, Odour and Dust].

Table 15: Dispersion Modelling Results – Point of Maximum Impact - Daily ELVs

Pollutant	Quantity	Units	AQAL	Bg Conc.	PC at Point of Maximum Impact						Max as % of AQAL	PEC (PC +Bg)	PEC as % of AQAL
					2014	2015	2016	2017	2018	Max			
Nitrogen dioxide	Annual mean	µg/m³	40	20.71	0.59	0.75	0.65	0.62	0.55	0.75	1.88%	21.46	53.65%
	99.79th%ile of hourly means	µg/m³	200	41.42	3.91	4.06	4.11	4.04	3.78	4.11	2.06%	45.53	22.77%
Sulphur dioxide	99.18th%ile of daily means	µg/m³	125	13.78	1.44	1.70	1.56	1.47	1.36	1.70	1.36%	15.48	12.38%
	99.73rd%ile of hourly means	µg/m³	350	13.78	2.73	2.87	2.91	2.82	2.67	2.91	0.83%	16.69	4.77%
	99.9th%ile of 15 min. means	µg/m³	266	13.78	3.10	3.27	3.20	3.21	3.20	3.27	1.23%	17.05	6.41%
PM_{10}	Annual mean	µg/m³	40	16.11	0.04	0.04	0.04	0.04	0.03	0.04	0.11%	16.15	40.39%
	90.4th%ile of daily means	µg/m³	50	32.22	0.11	0.13	0.13	0.12	0.12	0.13	0.27%	32.35	64.71%
$PM_{2.5}$	Annual mean	µg/m³	25	10.89	0.04	0.04	0.04	0.04	0.03	0.04	0.18%	10.93	43.74%
Carbon monoxide	8 hour running mean	µg/m³	10,000	530	4.22	4.63	4.44	4.36	4.16	4.63	0.05%	534.63	5.35%
	Hourly mean	µg/m³	30,000	530	10.37	9.44	7.22	11.79	8.08	11.79	0.04%	541.79	1.81%
Hydrogen chloride	Hourly mean	µg/m³	750	1.42	1.24	1.13	0.87	1.42	0.97	1.42	0.19%	2.84	0.38%
Hydrogen fluoride	Annual mean	µg/m³	16	2.35	0.01	0.01	0.01	0.01	0.01	0.01	0.06%	2.36	14.74%
	Hourly mean	µg/m³	160	4.70	0.21	0.19	0.14	0.24	0.16	0.24	0.15%	4.94	3.08%
Ammonia	Annual mean	µg/m³	180	1.93	0.07	0.09	0.08	0.07	0.07	0.09	0.05%	2.02	1.12%
	Hourly mean	µg/m³	2,500	3.86	2.07	1.89	1.44	2.36	1.62	2.36	0.09%	6.22	0.25%

Pollutant	Quantity	Units	AQAL	Bg Conc.	PC at Point of Maximum Impact						Max as % of AQAL	PEC (PC +Bg)	PEC as % of AQAL
					2014	2015	2016	2017	2018	Max			
VOCs (as benzene)	Annual mean	µg/m³	5	0.36	0.07	0.09	0.08	0.07	0.07	0.09	1.79%	0.45	8.99%
	Hourly mean	µg/m³	195	0.72	2.07	1.89	1.44	2.36	1.62	2.36	1.21%	3.08	1.58%
VOCs (as 1,3-butadiene)	Annual mean	µg/m³	2.25	0.15	0.07	0.09	0.08	0.07	0.07	0.09	3.97%	0.24	10.64%
Mercury	Annual mean	ng/m³	250	3.69	0.14	0.18	0.16	0.15	0.13	0.18	0.07%	3.87	1.55%
	Hourly mean	ng/m³	7500	7.38	4.15	3.78	2.89	4.72	3.23	4.72	0.06%	12.10	0.16%
Cadmium	Annual mean	ng/m³	5	0.26	0.14	0.18	0.16	0.15	0.13	0.18	3.57%	0.44	8.77%
	Hourly mean	ng/m³	-	0.52	4.15	3.78	2.89	4.72	3.23	4.72	-	5.24	-
PAHs	Annual mean	pg/m³	200	330	0.74	0.94	0.81	0.78	0.69	0.94	0.38%	330.94	132.38%
Dioxins	Annual mean	fg/m³	-	33	0.42	0.54	0.47	0.44	0.39	0.54	-	33.54	-
PCBs	Annual mean	ng/m³	250	127.46	0.04	0.04	0.04	0.04	0.03	0.04	0.02%	127.50	63.75%
	Hourly mean	ng/m³	6000	254.92	1.04	0.94	0.72	1.18	0.81	1.18	0.02%	256.10	4.27%
Other metals	Annual mean	ng/m³	-	-	-	-	-	-	-	2.68	See metals assessment – Section 6.2.4		
	Hourly mean	ng/m³	-	-	-	-	-	-	-	70.75			

Note:
All assessment is based on the maximum PC using all 5 years of weather data.

Table 16: Dispersion Modelling Results – Point of Maximum Impact - Short-Term ELVs

Pollutant	Quantity	Units	AQAL	Bg Conc.	PC (PC) at Point of Maximum Impact						Max as % of AQAL	PEC (PC +Bg)	PEC as % of AQAL
					2014	2015	2016	2017	2018	Max			
Nitrogen dioxide	99.79th%ile of hourly means	µg/m³	200	41.42	13.02	13.55	13.71	13.46	12.60	13.71	6.86%	55.13	27.57%
Sulphur dioxide	99.73rd%ile of hourly means	µg/m³	350	13.78	18.20	19.16	19.41	18.80	17.80	19.41	5.55%	33.19	9.48%
	99.9th%ile of 15 min. means	µg/m³	266	13.78	20.66	21.83	21.35	21.40	21.30	21.83	8.21%	35.61	13.39%
Carbon monoxide	8 hour running mean	µg/m³	10,000	530	12.65	13.90	13.33	13.08	12.47	13.90	0.14%	543.90	5.44%
	Hourly mean	µg/m³	30,000	530	31.10	28.31	21.65	35.37	24.25	35.37	0.12%	565.37	1.88%
Hydrogen chloride	Hourly mean	µg/m³	750	1.42	12.45	11.33	8.66	14.16	9.71	14.16	1.89%	15.58	2.08%
Hydrogen fluoride	Hourly mean	µg/m³	160	4.70	0.83	0.76	0.58	0.94	0.65	0.94	0.59%	5.64	3.53%
VOCs (as benzene)	Hourly mean	µg/m³	195	0.72	2.49	2.27	1.73	2.83	1.94	2.83	1.45%	3.59	1.84%
Mercury	Hourly mean	ng/m³	7500	7.38	4.15	3.78	2.89	4.72	3.23	4.72	0.06%	11.50	0.15%

Note:
All assessment is based on the maximum PC using all 5 years of weather data and operation at the short-term ELVs.

As shown, at the point of maximum impact all of the PCs are less than 10% of the short-term AQAL and less than 0.5% of the annual mean AQAL and can be screened out as 'negligible' irrespective of the baseline concentration in accordance with the IAQM 2017 guidance, with the exception of the annual mean impacts of the following pollutants:

- nitrogen dioxide;
- VOCs; and
- cadmium;

Further analysis of the likely future baseline concentrations has been undertaken to define the magnitude of change for annual mean impacts. The discussion of this analysis is contained within Chapter 6 of the ES [Air Quality].

6.2 Further assessment

6.2.1 Annual mean nitrogen dioxide

The annual mean nitrogen dioxide PC from the ERF is predicted to be 1.88% of the AQAL at the point of maximum impact. Table 17 details the impact of annual mean nitrogen dioxide contributions from process emissions at the identified sensitive human receptor locations. PCs greater than 0.5% of the AQAL are highlighted. Figure 7 of Annex A shows the spatial distribution of emissions.

Table 17: Annual Mean Nitrogen Dioxide Impact at Identified Sensitive Receptors

Receptor	PC		Predicted Environmental Concentration	
	µg/m³	as % of AQAL	µg/m³	as % of AQAL
R1	0.20	0.49%	20.91	52.26%
R2	0.22	0.56%	15.20	38.01%
R3	0.13	0.32%	20.84	52.10%
R4	0.36	0.90%	12.70	31.75%
R5	0.16	0.40%	20.87	52.18%
R6	0.15	0.36%	20.86	52.14%
R7	0.12	0.30%	20.83	52.07%
R8	0.22	0.54%	12.95	32.37%
R9	0.11	0.27%	20.82	52.05%
R10	0.07	0.17%	20.78	51.94%
R11	0.01	0.02%	20.72	51.80%
R12	0.12	0.29%	20.83	52.07%
R13	0.08	0.19%	20.79	51.97%
R14	0.04	0.09%	20.75	51.87%
R15	0.05	0.12%	20.76	51.90%
R16	<0.01	<0.01%	20.71	51.78%
R17	0.01	0.02%	20.72	51.80%
R18	0.03	0.07%	20.74	51.84%

Receptor	PC		Predicted Environmental Concentration	
	µg/m³	as % of AQAL	µg/m³	as % of AQAL
R19	0.04	0.10%	20.75	51.88%
R20	0.08	0.21%	20.79	51.98%
R21	0.24	0.61%	12.95	32.38%
R22	0.03	0.08%	20.74	51.86%
R23	0.03	0.07%	20.74	51.85%
R24	0.04	0.10%	20.75	51.88%
R25	0.09	0.24%	20.80	52.01%

6.2.2 Annual mean VOCs

There are two VOCs for which an AQAL has been set: benzene and 1,3-butadiene. For the purpose of this analysis it has been assumed that the entire VOC emissions consist of only benzene or 1,3-butadiene. This is a highly conservative assumption as it does not take into account the speciation of VOCs in the emissions and the modelling does not take into account the volatile nature of the compounds.

The PC from the ERF is predicted to be 1.79% of the AQAL for benzene and 3.97% of the AQAL for 1,3-butadiene at the point of maximum impact. Table 18 and Table 19 detail the impact of annual mean benzene and 1,3-butadiene contributions from process emissions at the identified sensitive human receptor locations. PCs greater than 0.5% of the AQAL are highlighted. Figure 8 and Figure 9 of Annex A show the spatial distribution of emissions.

Table 18: Annual Mean VOCs (as Benzene) Impact at Identified Sensitive Receptors

Receptor	PC		Predicted Environmental Concentration	
	µg/m³	as % of AQAL	µg/m³	as % of AQAL
R1	0.02	0.47%	0.38	7.67%
R2	0.03	0.53%	0.39	7.73%
R3	0.02	0.31%	0.38	7.51%
R4	0.04	0.86%	0.40	8.06%
R5	0.02	0.39%	0.38	7.59%
R6	0.02	0.35%	0.38	7.55%
R7	0.01	0.28%	0.37	7.48%
R8	0.03	0.51%	0.39	7.71%
R9	0.01	0.26%	0.37	7.46%
R10	0.01	0.16%	0.37	7.36%
R11	<0.01	0.02%	0.36	7.22%
R12	0.01	0.28%	0.37	7.48%
R13	0.01	0.18%	0.37	7.38%
R14	<0.01	0.09%	0.36	7.29%
R15	0.01	0.11%	0.37	7.31%
R16	<0.01	<0.01%	0.36	7.20%

Receptor	PC		Predicted Environmental Concentration	
	µg/m³	as % of AQAL	µg/m³	as % of AQAL
R17	<0.01	0.02%	0.36	7.22%
R18	<0.01	0.06%	0.36	7.26%
R19	<0.01	0.10%	0.36	7.30%
R20	0.01	0.20%	0.37	7.40%
R21	0.03	0.58%	0.39	7.73%
R22	<0.01	0.08%	0.36	7.28%
R23	<0.01	0.07%	0.36	7.27%
R24	<0.01	0.10%	0.36	7.30%
R25	0.01	0.23%	0.37	7.43%

Table 19: Annual Mean VOCs (as 1,3-Butadiene) Impact at Identified Sensitive Receptors

Receptor	PC		Predicted Environmental Concentration	
	µg/m³	as % of AQAL	µg/m³	as % of AQAL
R1	0.02	1.03%	0.17	7.70%
R2	0.03	1.18%	0.18	7.84%
R3	0.02	0.68%	0.17	7.35%
R4	0.04	1.90%	0.19	8.57%
R5	0.02	0.86%	0.17	7.52%
R6	0.02	0.77%	0.17	7.43%
R7	0.01	0.63%	0.16	7.29%
R8	0.03	1.14%	0.18	7.81%
R9	0.01	0.58%	0.16	7.25%
R10	0.01	0.35%	0.16	7.02%
R11	<0.01	0.05%	0.15	6.72%
R12	0.01	0.62%	0.16	7.28%
R13	0.01	0.41%	0.16	7.08%
R14	<0.01	0.19%	0.15	6.86%
R15	0.01	0.26%	0.16	6.92%
R16	<0.01	<0.01%	0.15	6.67%
R17	<0.01	0.05%	0.15	6.72%
R18	<0.01	0.14%	0.15	6.81%
R19	<0.01	0.21%	0.15	6.88%
R20	0.01	0.44%	0.16	7.10%
R21	0.03	1.29%	0.18	7.85%
R22	<0.01	0.18%	0.15	6.84%
R23	<0.01	0.15%	0.15	6.81%

Receptor	PC		Predicted Environmental Concentration	
	µg/m³	as % of AQAL	µg/m³	as % of AQAL
R24	<0.01	0.22%	0.15	6.89%
R25	0.01	0.50%	0.16	7.17%

6.2.3 Annual mean cadmium

The annual mean cadmium PC from the ERF is predicted to be 3.57% of the AQAL. However, this assumes that the entire cadmium and thallium emissions consist of only cadmium. The Waste Incineration BREF shows that the average concentration recorded from UK plants equipped with bag filters was 1.6 µg/Nm^3 (or 8% of the ELV of 0.02 mg/Nm^3), the highest recorded concentration of cadmium and thallium was 14 µg/Nm^3 (or 70% of the ELV of 0.02 mg/Nm^3) and only three lines recorded concentrations higher than 10 µg/Nm^3 (or 50% of the ELV of 0.02mg/Nm^3).

Table 20 shows the annual mean cadmium PC at the identified sensitive human receptor locations, for cadmium emitted at 100%, 50% and 8% of the ELV, referred to as the 'screening', 'worst case' and 'typical' scenarios. PCs greater than 0.5% of the AQAL are highlighted. Figure 10 of Annex A shows the spatial distribution of emissions assuming cadmium is emitted at 8% of the combined cadmium and thallium emission limit.

Table 20: Annual Mean Cadmium Impact at Identified Sensitive Receptors

Receptor	PC (as % of AQAL)					
	Screening		Worst-case		Typical	
	ng/m³	% AQAL	ng/m³	% AQAL	ng/m³	% AQAL
Point of maximum impact	0.18	3.57%	0.08	1.78%	0.01	0.28%
R1	0.05	0.93%	0.02	0.47%	<0.01	0.07%
R2	0.05	1.06%	0.03	0.53%	<0.01	0.08%
R3	0.03	0.61%	0.02	0.31%	<0.01	0.05%
R4	0.09	1.71%	0.04	0.86%	0.01	0.14%
R5	0.04	0.77%	0.02	0.39%	<0.01	0.06%
R6	0.03	0.69%	0.02	0.35%	<0.01	0.06%
R7	0.03	0.57%	0.01	0.28%	<0.01	0.05%
R8	0.05	1.03%	0.03	0.51%	<0.01	0.08%
R9	0.03	0.52%	0.01	0.26%	<0.01	0.04%
R10	0.02	0.32%	0.01	0.16%	<0.01	0.03%
R11	<0.01	0.05%	<0.01	0.02%	<0.01	<0.01%
R12	0.03	0.56%	0.01	0.28%	<0.01	0.04%
R13	0.02	0.37%	0.01	0.18%	<0.01	0.03%
R14	0.01	0.17%	<0.01	0.09%	<0.01	0.01%
R15	0.01	0.23%	0.01	0.11%	<0.01	0.02%
R16	<0.01	<0.01%	<0.01	<0.01%	<0.01	<0.01%

Receptor	PC (as % of AQAL)					
	Screening		Worst-case		Typical	
	ng/m³	% AQAL	ng/m³	% AQAL	ng/m³	% AQAL
R17	<0.01	0.05%	<0.01	0.02%	<0.01	<0.01%
R18	0.01	0.13%	<0.01	0.06%	<0.01	0.01%
R19	0.01	0.19%	<0.01	0.10%	<0.01	0.02%
R20	0.02	0.39%	0.01	0.20%	<0.01	0.03%
R21	0.06	1.16%	0.03	0.58%	<0.01	0.09%
R22	0.01	0.16%	<0.01	0.08%	<0.01	0.01%
R23	0.01	0.13%	<0.01	0.07%	<0.01	0.01%
R24	0.01	0.20%	<0.01	0.10%	<0.01	0.02%
R25	0.02	0.45%	0.01	0.23%	<0.01	0.04%

6.2.4 Heavy metals – at the point of maximum impact

Table 21 and Table 22 detail the PC and PEC assuming that each metal is released at the combined long and short term metal ELVs set out in the Waste Incineration BREF respectively. If the PC is greater than 1% of the AQAL when it is assumed that each metal is emitted at the total metal ELV, further analysis has been undertaken assuming the release is no greater than the maximum monitored at an existing waste facility. The Environment Agency metals guidance details the maximum monitored concentrations of group 3 metals emitted by Municipal Waste Incinerators and Waste Wood Co-Incinerators as a percentage of the IED group 3 ELV. We have used the maximum monitored emission presented in the Environment Agency's analysis as a conservative assumption.

Table 21: Long-Term Metals Results – Point of Maximum Impact

Metal	AQAL	Background conc.	Metals emitted at combined metal limit				Metal as % of ELV (1)	Metals emitted no worse than a currently permitted facility			
			PC		PEC			PC		PEC	
	ng/m³	ng/m³	ng/m³	as % AQAL	ng/m³	as % AQAL		ng/m³	as % AQAL	ng/m³	as % AQAL
Arsenic	3	0.81	2.68	89.37%	3.49	116.37%	8.33%	0.22	7.45%	1.03	34.45%
Antimony	5,000	0.38	2.68	0.05%	3.06	0.06%	3.83%	0.10	<0.01%	0.48	0.01%
Chromium	5,000	13.16	2.68	0.05%	15.84	0.32%	30.67%	0.82	0.02%	13.98	0.28%
Chromium (VI)	0.2	2.63	2.68	1340.53%	5.31	2656.53%	0.04%	<0.01	0.58%	2.63	1316.58%
Cobalt	-	0.32	2.68	-	3.00	-	1.87%	0.05	-	0.37	-
Copper	10,000	11.10	2.68	0.03%	13.78	0.14%	9.67%	0.26	<0.01%	11.36	0.11%
Lead	250	11.06	2.68	1.07%	13.74	5.50%	16.77%	0.45	0.18%	11.51	4.60%
Manganese	150	10.90	2.68	1.79%	13.58	9.05%	20.00%	0.54	0.36%	11.44	7.62%
Nickel	20	6.61	2.68	13.41%	9.29	46.46%	73.33%	1.97	9.83%	8.58	42.88%
Vanadium	5,000	1.55	2.68	0.05%	4.23	0.08%	2.00%	0.05	<0.01%	1.60	0.03%

Notes:
(1) Metal as maximum percentage of the group 3 BAT-AEL, re-calculated from the Environment Agency metals guidance document (V.4) Table A1.

Table 22: Short-Term Metals Results – Point of Maximum Impact

Metal	AQAL	Background conc.	Metals emitted at combined metal limit				Metal as % of ELV (1)	Metals emitted no worse than a currently permitted facility			
			PC		PEC			PC		PEC	
	ng/m³	ng/m³	ng/m³	as % AQAL	ng/m³	as % AQAL		ng/m³	as % AQAL	ng/m³	as % AQAL
Arsenic	-	0.81	70.75	-	72.37	-	8.33%	5.90	-	7.52	-
Antimony	150,000	0.38	70.75	0.05%	71.51	0.05%	3.83%	2.71	<0.01%	3.47	<0.01%
Chromium	150,000	13.16	70.75	0.05%	97.07	0.06%	30.67%	21.70	0.01%	48.02	0.03%
Chromium (VI)	-	2.63	70.75	-	76.01	-	0.04%	0.03	-	5.29	-
Cobalt	-	0.32	70.75	-	71.39	-	1.87%	1.32	-	1.96	-
Copper	200,000	11.10	70.75	0.04%	92.95	0.05%	9.67%	6.84	<0.01%	29.04	0.01%
Lead	-	11.06	70.75	-	92.87	-	16.77%	11.86	-	33.98	-
Manganese	1,500,000	10.90	70.75	<0.01%	92.55	0.01%	20.00%	14.15	<0.01%	35.95	<0.01%
Nickel	-	6.61	70.75	-	83.97	-	73.33%	51.88	-	65.10	-
Vanadium	1,000	1.55	70.75	7.07%	73.85	7.38%	2.00%	1.41	0.14%	4.51	0.45%

Notes:
(1) Metal as maximum percentage of the group 3 BAT-AEL, re-calculated from the Environment Agency metals guidance document (V.4) Table A1.

As shown in Table 21 and Table 22, if it is assumed that the entire emissions of metals consist of only one metal, the impact is generally less than 1% of the long term and less than 10% of the short term AQAL, with the exception of annual mean impacts of arsenic, chromium (VI), lead, manganese and nickel. The PEC is only predicted to exceed the long term AQAL for arsenic and chromium (VI) using this worst-case screening assumption. If it is assumed that the ERF would perform no worse than a currently operating facility, the PC is below 1% of the long term and 10% of the short term AQAL for all pollutants with the exception of annual mean arsenic and nickel.

7. Impact at Ecological Receptors

This section provides an assessment of the impact of emissions at the ecological receptors identified in Section 3.2.

7.1 Methodology

7.1.1 Atmospheric emissions - Critical Levels

The impact of emissions from the ERF has been compared to the Critical Levels listed in Table 4 and the results are presented in Section 7.2.

For the purpose of the ecological assessment, the mapped background dataset from APIS has been used. If the PC is greater than 1% of the long-term or 10% of the short-term Critical Level further consideration will be made to the baseline concentrations.

7.1.2 Deposition of emissions - Critical Loads

In addition to the Critical Levels for the protection of ecosystems, habitat specific Critical Loads for nature conservation sites at risk from acidification and nitrogen deposition (eutrophication) are outlined in APIS.

An assessment has been made for each habitat feature identified in APIS for the specific site. The site-specific features tool has been used to identify the feature habitats. The lowest Critical Loads for each designated site have been used to ensure a robust assessment.

APIS does not include site specific Critical Loads for locally designated sites. In lieu of this, the search by location function of APIS has been used to obtain Critical Loads based on the broad habitat type and location. The relevant Critical Loads are presented in Annex B [APIS Critical Loads].

If the impact of process emissions from the ERF upon nitrogen or acid deposition is greater than 1% of the Critical Load, further assessment has been undertaken.

7.1.3 Nitrogen deposition – eutrophication

Annex C summarises the Critical Loads for nitrogen deposition and background deposition rates as detailed in APIS for each identified receptor. The impact has been assessed against these Critical Loads for nitrogen deposition.

7.1.4 Acidification

The APIS Database contains a maximum critical load for sulphur (CLmaxS), a minimum Critical Load for nitrogen (CLminN) and a maximum Critical Load for nitrogen (CLmaxN). These components define the Critical Load function. Where the acid deposition flux falls within the area under the Critical Load function, no exceedances are predicted.

A search has been undertaken for each of the ecological receptors identified. Each site contains a number of habitat types, each with different Critical Loads. Annex A summaries the Critical Loads for acidification and background deposition rates as detailed in APIS for each identified habitat. The lowest Critical Loads for each designated site have been used to ensure a robust assessment, except where stated. The impact has been assessed against these Critical Load functions. Where a Critical

Load function for acid deposition is not available, the total nitrogen and sulphur deposition has been presented and compared with the background concentration.

7.1.5 Calculation methodology – nitrogen deposition

The impact of deposition has been assessed using the methodology detailed within the Habitats Directive AQTAG 6 (March 2014). The steps to this method are as follows.

1. Determine the annual mean ground level concentrations of nitrogen dioxide and ammonia at each site.
2. Calculate the dry deposition flux (µg/m^2/s) at each site by multiplying the annual mean ground level concentration by the relevant deposition velocity presented in Table 23.
3. Convert the dry deposition flux into units of kgN/ha/yr using the conversion factors presented in Table 23.
4. Compare this result to the nitrogen deposition Critical Load.

Table 23: Deposition Factors

Pollutant	Deposition Velocity (m/s)		Conversion Factor (µg/m^2/s to kg/ha/year)
	Grassland	Woodland	
Nitrogen dioxide	0.0015	0.003	96.0
Sulphur dioxide	0.0120	0.024	157.7
Ammonia	0.0200	0.030	259.7
Hydrogen chloride	0.0250	0.060	306.7

7.1.5.1 Acidification

Deposition of nitrogen, sulphur, hydrogen chloride and ammonia can cause acidification and should be taken into consideration when assessing the impact of the ERF.

The steps to determine the acid deposition flux are as follows.

1. Determine the dry deposition rate in kg/ha/yr of nitrogen, sulphur, hydrogen chloride and ammonia using the methodology outlined in Section 7.1.5.
2. Apply the conversion factor for N outlined in Table 23 to the nitrogen and ammonia deposition rate in kg/ha/year to determine the total keq N/ha/year.
3. Apply the conversion factor for S to the sulphur deposition rate in kg/ha/year to determine the total keq S/ha/year.
4. Apply the conversion factor for HCl to the hydrogen chloride deposition rate in kg/ha/year to determine the dry keq Cl/ha/year.
5. Determine the wet deposition rate of HCl in kg/ha/yr by multiplying the model output by the factors presented in Table 24.
6. Apply the conversion factor for HCl to the hydrogen chloride deposition rate in kg/ha/year to determine the wet keq Cl/ha/year.
7. Add the contribution from S to HCl dry and wet and treat this sum as the total contribution from S.
8. Plot the results against the Critical Load functions.

Table 24: Conversion Factors

Pollutant	Conversion Factor (kg/ha/year to keq/ha/year)
Nitrogen	Divide by 14
Sulphur	Divide by 16
Hydrogen chloride	Divide by 35.5

The March 2014 version of the AQTAG 6 document states that, for installations with an HCl emission, the PC of HCl, in addition to S and N, should be considered in the acidity Critical Load assessment. The H+ from HCl should be added to the S contribution (and treated as S in APIS tool). This should include the contribution of HCl from wet deposition.

Consultation with AQMAU confirmed that the maximum of the wet or dry deposition rate for HCl should be included in the calculation. For the purpose of this analysis it has been assumed that wet deposition of HCl is double dry deposition.

The contribution from the ERF has been calculated using APIS formula:

Where PEC N Deposition < CLminN:

PC as % of CL function = PC S deposition / CLmaxS

Where PEC N Deposition > CLminN:

PC as % of CL function = (PC S + N deposition) / CLmaxN

7.2 Results – atmospheric emissions - Critical Levels

The impact of emissions from the operation of the ERF has been compared to the Critical Levels. For the purpose of the ecological assessment, the mapped background dataset from APIS has been used. If the emissions of a particular pollutant are greater than 1% of the long-term or 10% of the short-term Critical Level, further assessment would be undertaken. The PC has been calculated based on the maximum predicted using all five years of weather data.

Table 25: Process Contribution at Designated Ecological Sites – µg/m³

Site	NOx		SO_2	HF		NH_3
	Annual Mean	Daily Mean	Annual Mean	Weekly Mean	Daily Mean	Annual Mean
European designated sites (within 10km) and UK designated sites (within 2km)						
Duncton to Bignor Escarpment	0.02	0.36	<0.01	<0.01	<0.01	<0.01
Locally designated sites (within 2km)						
Ford Ancient Woodland	0.38	3.70	0.10	0.01	0.03	0.03

Table 26: Process Contribution at Designated Ecological Sites – as % of Critical Level

Site	NOx		SO_2	HF		NH_3
	Annual Mean	Daily Mean	Annual Mean	Weekly Mean	Daily Mean	Annual Mean
European designated sites (within 10km) and UK designated sites (within 2km)						
Duncton to Bignor Escarpment	0.06%	0.48%	0.02%	0.11%	0.06%	0.05%
Locally designated sites (within 2km)						
Ford Ancient Woodland	1.27%	4.93%	0.95%	2.62%	0.62%	3.18%

As shown in Table 26, at all designated sites the PC is less than 1% of the Critical Level and can be screened out as 'insignificant' for all pollutants considered, with the exception of annual mean oxides of nitrogen and ammonia at the Ford Ancient Woodland.

Further assessment of these impacts is presented in ES Chapter 6 [Air Quality, Odour and Dust].

7.3 Results - deposition of emissions - Critical Loads

Annex C [Deposition Analysis at Ecological Sites] presents the results at each of the identified ecological receptors. The contribution from the ERF has been assessed against the most sensitive feature in each statutory designated site.

7.3.1 Results - Designated Ecological Sites

As shown in Annex C, at all sites the PC is less than 1% of the Critical Load and can be screened out as 'insignificant' for all pollutants considered, with the exception of nitrogen deposition on broadleaved deciduous woodland habitats at the Ford Ancient Woodland.

8 Roads Modelling

8.1 Methodology

8.1.1 Selection of model

Detailed dispersion modelling was undertaking using the model ADMS-Roads 5.0, developed and supplied by Cambridge Environmental Research Consultants (CERC). This model is routinely used for modelling of emissions for environmental assessment purposes to the satisfaction of local authorities.

8.1.2 Input data

The model requires input data that details the following parameters:

- Traffic flow data;
- Vehicle emission factors;
- Spatial co-ordinates of emissions;
- Discrete receptor points;
- Meteorological data;
- Roughness length; and,
- Monin-Obukhov length.

8.1.2.1 Traffic flow data

24-hour AADT flows and HDV numbers have been provided by Ramboll, the transport consultant for the project, for the following scenarios:

- 2024 do-minimum; and
- 2024 do-something.

The do-minimum scenarios include a Tempro growth factor to represent general traffic growth due to Local Plan allocations and a number of additional committed developments including the current operations on site. The do-something scenarios are the do minimum plus the additional traffic from the Proposed Development minus those which would be displaced as discussed in the Transport Assessment.

The traffic data used in the assessment is presented in the following table.

Table 27: Traffic data used in assessment

Link	24- hour AADT Do minimum 2026		24- hour AADT Do something 2026	
	Cars	HGVs	Cars	HGVs
Station road	14,488	345	14,401	343
Ford road north of Viridor access	14,488	345	14,401	343

Link	24- hour AADT Do minimum 2026		24- hour AADT Do something 2026	
	Cars	HGVs	Cars	HGVs
Viridor Access	774	61	896	185
Ford Road south of Viridor access	14,981	529	14,989	650
A259 Croockthorn Lane	31,956	1,201	31,788	1,254

LDVs have been modelled at the speed limit and HDVs have been modelled at 5 kph below the speed limit, with the exception of junction approaches. In accordance with the guidance outlined in LAQM.TG(16), road junctions have been modelled with the assumption of approximately a 50 m slow-down phase, prior to the junction line. These slow-down phases have been modelled at a speed of 20 km/h. Reference should be made to Figure 11 which shows the links modelled and speeds used.

8.1.2.2 Vehicle emission factors

Emission factors for NO_X, PM_{10} and $PM_{2.5}$ have been determined for each scenario using the traffic data and the Emissions Factors Toolkit (EFT) v 9.0 (2VC) database of road traffic emission factors within ADMS Roads. All roads were classified as “England (Rural)”.

The EFT predicts that emissions from road vehicles will reduce in future years as newer cleaner vehicles enter the fleet. However, recent evidence has shown that the rate of this reduction may not be occurring in the real world. As such the assessment has considered the following scenarios:

- A worst-case which assumes there is no change to the fleet composition on the local road network from 2017 and the assessment year; and
- A best-case scenario in which the fleet composition changes in line with current projections which results in lower emissions along the road.

In line with the process emissions modelling as conservative measure, 2017 background concentrations have been applied to the future year scenarios.

This approach is in line with the interim position statement released by the IAQM in October 2016[4] relating to detailing with uncertainty in vehicle NOx emission factors. When presenting the results at receptor locations the best case and worst case results for nitrogen dioxide have been presented.

8.1.2.3 Spatial co-ordinates of vehicle emissions

Street locations and widths were estimated from a desk-top mapping study and referenced to UK National Grid Reference (NGR) co-ordinates.

It is not possible to enter building dimension data into the ADMS-Roads dispersion modelling software to calculate building downwash. However, it is possible to define some roads as ‘street canyons’. A desk-stop study has been carried out through a review of aerial photos. No roads have been identified as street canyons within the study area.

[4] IAQM, Dealing with Uncertainty in Vehicle NOx Emissions Within Air Quality Assessments, October 2016

8.1.2.4 Discrete receptor points

The dispersion modelling study was undertaken for 22 receptor points representing residential properties along the roads affected by traffic generated by the Proposed Development. These receptor locations are presented in Figure 11.

8.1.2.5 Meteorological data

To calculate pollutant concentrations at identified receptor locations, the model uses sequential hourly meteorological data, including wind direction, wind speed, temperature, cloud cover and stability, which exert significant influence over atmospheric dispersion. The same meteorological data as surface characteristics as used for the process emissions modelling has been used as detailed in Section 4.4.2.

8.1.3 Post modelling - conversion from NOx to nitrogen dioxide

The modelled road-NOx and the mapped background concentrations have been used as inputs in DEFRA's NOx to NO_2 calculator (V7.1) to convert modelled NOx to NO_2 in accordance with the methodology outlined in LAQM.(TG16).

When converting from NOx to nitrogen dioxide the following inputs have been used:

- The year has been taken as the same as the emissions data;
- The local authority has been selected as "Arundel"; and
- The traffic mix has been selected as "All other urban UK traffic".

8.2 Results

The following table presents the results of the road traffic modelling at each of the identified sensitive receptors for the worst-case scenario than emissions do not reduce in line with projections from the 2017 levels used to produce the EFT.

The peak impact occurs at R12, which is the closest building to the road. On reviewing the local area this is a prison building and not a building used for residential use. Therefore, the annual mean AQAL does not necessarily apply. However, the maximum annual mean nitrogen dioxide impact at this point is 0.7% and the PEC is predicted to be well below 75% of the AQAL. Therefore, the magnitude of change is described as negligible. If it is assumed that emissions from vehicles reduce in line with projections the impact is well below 0.5% of the AQAL and can be described as negligible irrespective of baseline levels. The maximum impact of PM emissions even if it is assumed that emissions do not reduce in line with projections is well below 0.5% of the AQAL and can be described as negligible irrespective of baseline levels. This assumes uses the calculated PM_{10} concentration and compares it to the AQAL for $PM_{2.5}$ as recommended by the IAQM.

The review of the process emissions dispersion modelling has shown that the area where peak impacts from process emissions does not occur in the same place as traffic due to the routing of the vehicles along Ford Road to the south. Therefore, there is little risk of significant in combination impacts from process and traffic emissions.

Table 28: Annual mean nitrogen dioxide impact – worst case

Receptor	2026 Do-minimum	2026 Do-something	Impact	
	µg/m³	µg/m³	µg/m³	% of AQAL
R1	12.19	12.19	<0.01	<0.1%
R2	12.76	12.77	0.01	<0.1%
R3	11.20	11.24	0.04	0.1%
R4	14.77	14.97	0.20	0.5%
R5	15.03	15.23	0.20	0.5%
R6	14.83	15.03	0.20	0.5%
R7	14.67	14.85	0.18	0.4%
R8	14.60	14.78	0.18	0.4%
R9	14.78	14.97	0.19	0.5%
R10	14.58	14.76	0.18	0.4%
R11	15.63	15.85	0.22	0.6%
R12	18.48	18.78	0.30	0.8%
R13	11.83	11.93	0.10	0.2%
R14	15.52	15.73	0.21	0.5%
R15	15.03	15.25	0.22	0.5%
R16	16.14	16.39	0.25	0.6%
R17	16.07	16.27	0.20	0.5%
R18	15.19	15.31	0.12	0.3%
R19	18.02	18.03	0.01	<0.1%
R20	20.14	20.14	<0.01	<0.1%
R21	16.62	16.62	<0.01	<0.1%
R22 - School	12.98	13.01	0.03	0.1%

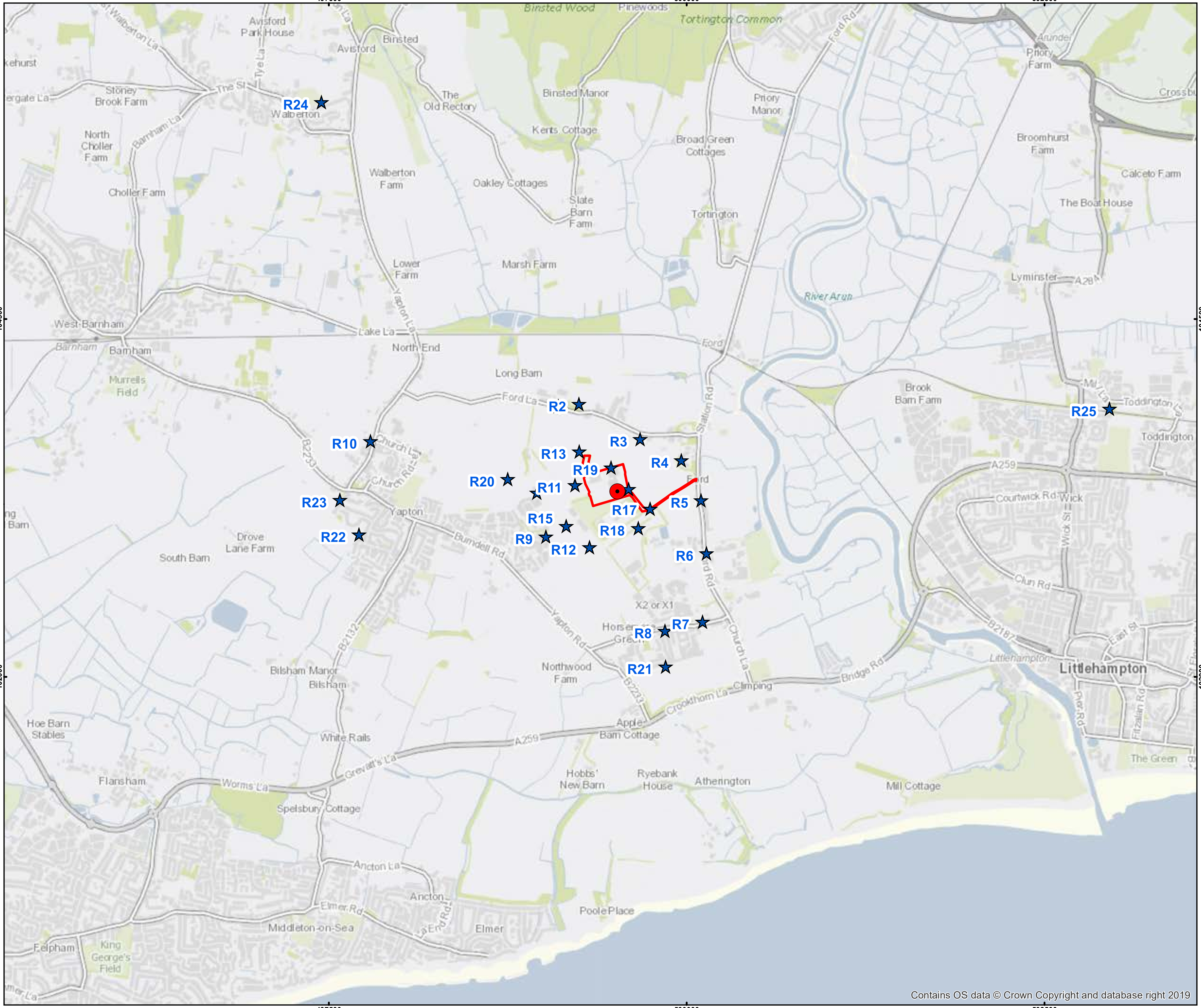
Table 29: Annual mean PM2.5 impact

Receptor	2026 Do-minimum	2026 Do-something	Impact	
	µg/m³	µg/m³	µg/m³	% of AQAL
R1	9.82	9.82	<0.01	<0.1%
R2	9.89	9.89	<0.01	<0.1%
R3	9.69	9.69	<0.01	<0.1%
R4	10.12	10.14	0.02	0.1%
R5	10.16	10.18	0.02	0.1%
R6	10.14	10.16	0.02	0.1%

Receptor	2026 Do-minimum	2026 Do-something	Impact	
	µg/m³	µg/m³	µg/m³	% of AQAL
R7	10.12	10.14	0.02	0.1%
R8	10.11	10.14	0.02	0.1%
R9	10.14	10.16	0.02	0.1%
R10	10.15	10.17	0.02	0.1%
R11	10.28	10.31	0.02	0.1%
R12	10.65	10.68	0.04	0.1%
R13	9.81	9.82	0.01	<0.1%
R14	10.27	10.29	0.02	0.1%
R15	10.11	10.13	0.02	0.1%
R16	10.23	10.25	0.02	0.1%
R17	10.27	10.29	0.02	0.1%
R18	10.22	10.23	0.01	0.1%
R19	10.66	10.66	<0.01	<0.1%
R20	10.96	10.96	<0.01	<0.1%
R21	10.47	10.47	<0.01	<0.1%
R22 - School	9.78	9.78	<0.01	<0.1%

Annexes

A Figures



Legend

- Stack Location
- Site Boundary
- Human Sensitive Receptors

Client:	Viridor, Grundon and Ford EfW
Site:	Ford
Project:	Ford Circular Technology Park
Title:	Figure 1 - Human Sensitive Receptors
Drawn by: Rhys Weir	Date: 29/05/2020

0 0.25 0.5 1 km

Scale: 1:25,000

N

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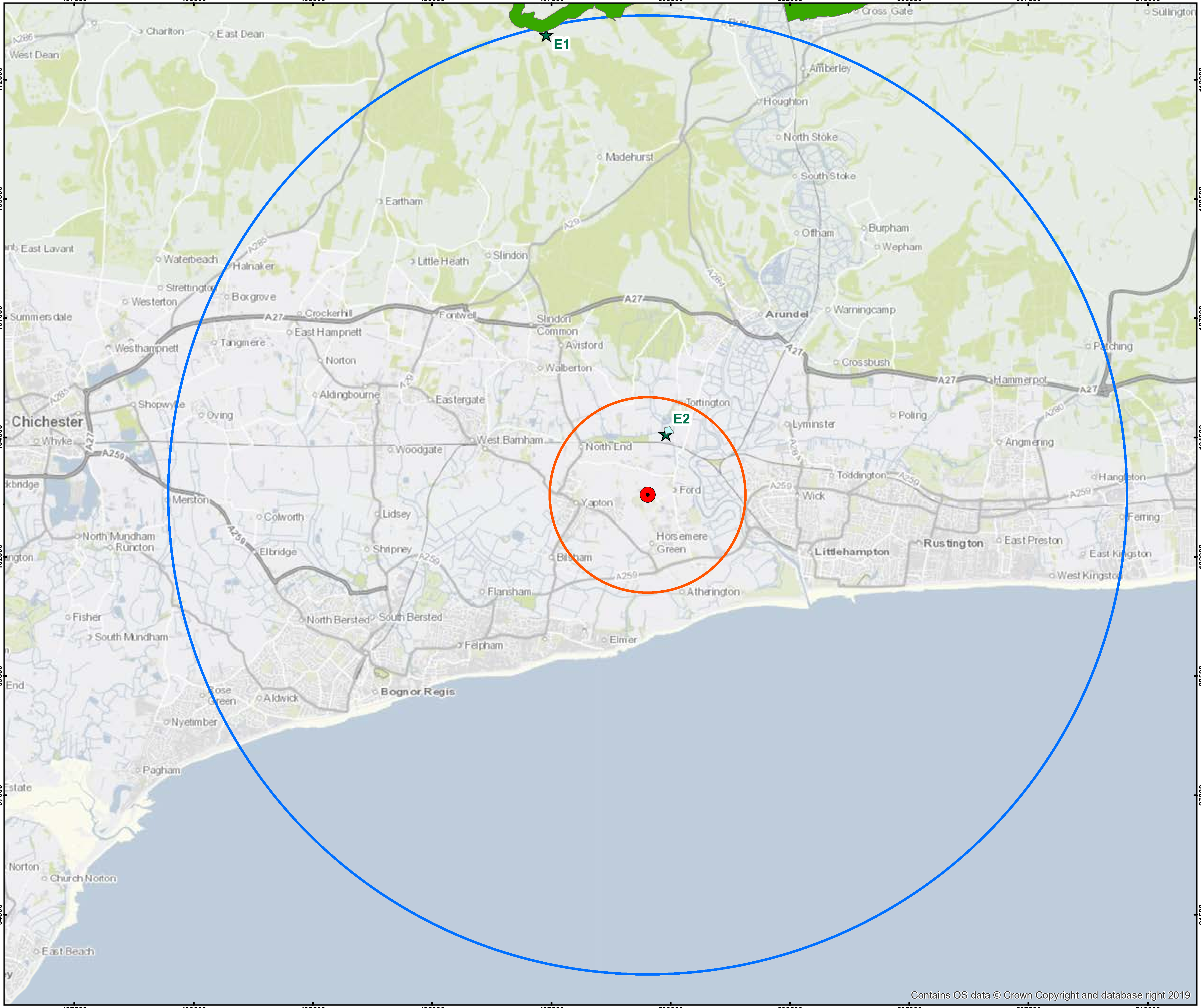
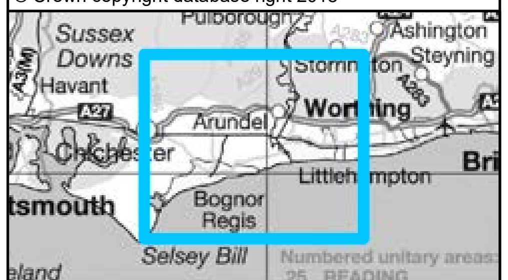


Legend

- Stack Location
- Ecological Receptor Points
- 2 km Buffer
- 10 km Buffer
- Duncton & Bignor Escarpment Extent
- Ford Ancient Woodland Extent

Client:	Viridor, Grundon and Ford EfW
Site:	Ford
Project:	Ford Circular Technology Park
Title:	Figure 2 - Ecological Sensitive Receptors
Drawn by: Rhys Weir	Date: 26/05/2020



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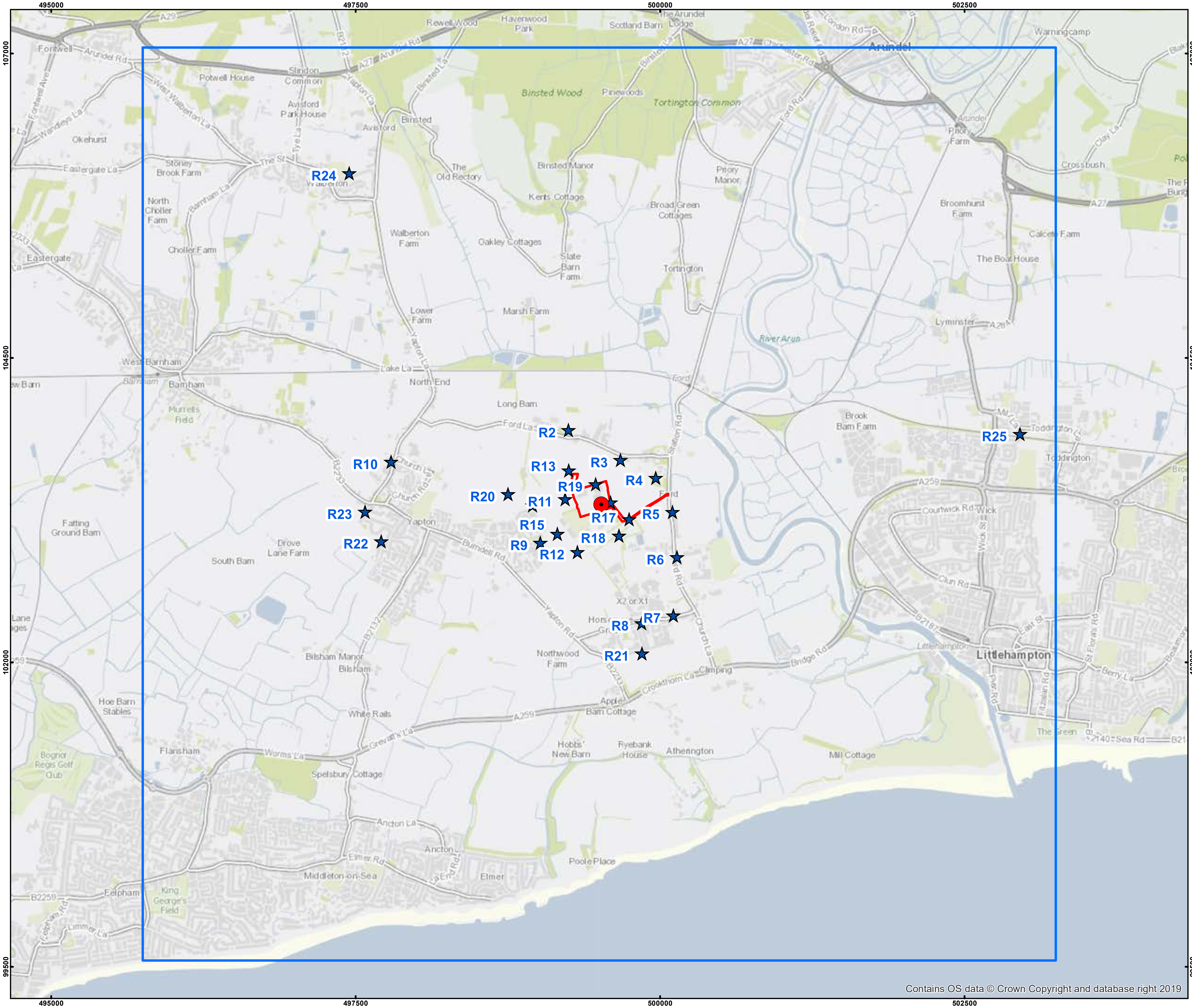
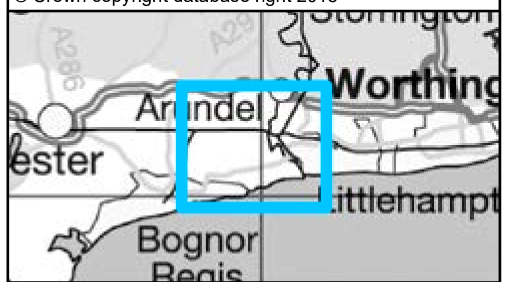


Legend

- Stack Location
- Human Sensitive Receptors
- Modelling Domain
- Site Boundary

Client:	Viridor, Grundon and Ford EfW
Site:	Ford
Project:	Ford Circular Technology Park
Title:	Figure 3 - Dispersion Model Inputs
Drawn by: Rhys Weir	Date: 29/05/2020



0 0.3 0.6 1.2 km

Scale: 1:29,000

N

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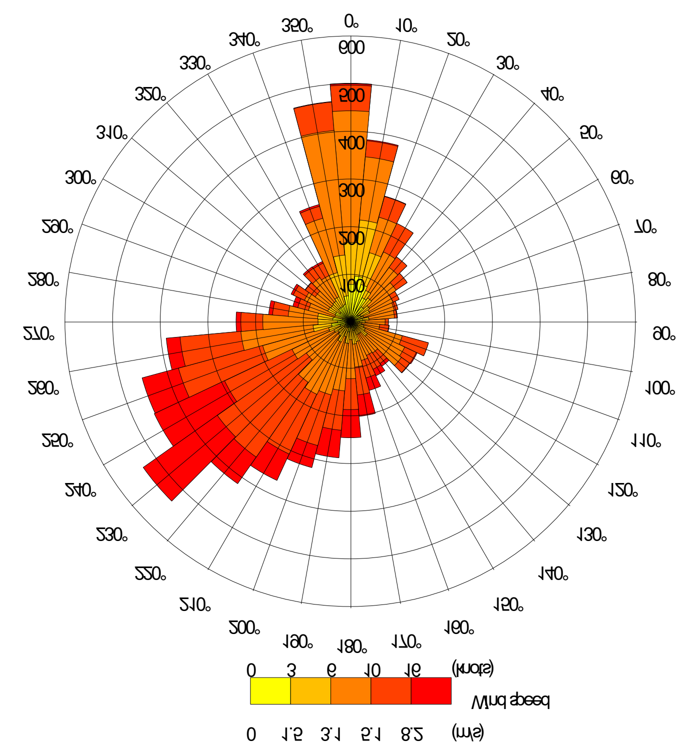
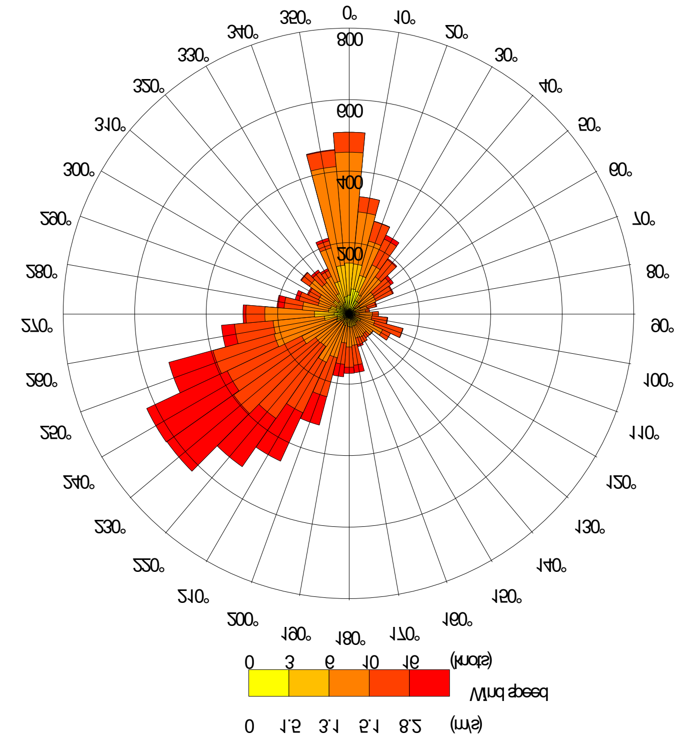
500000

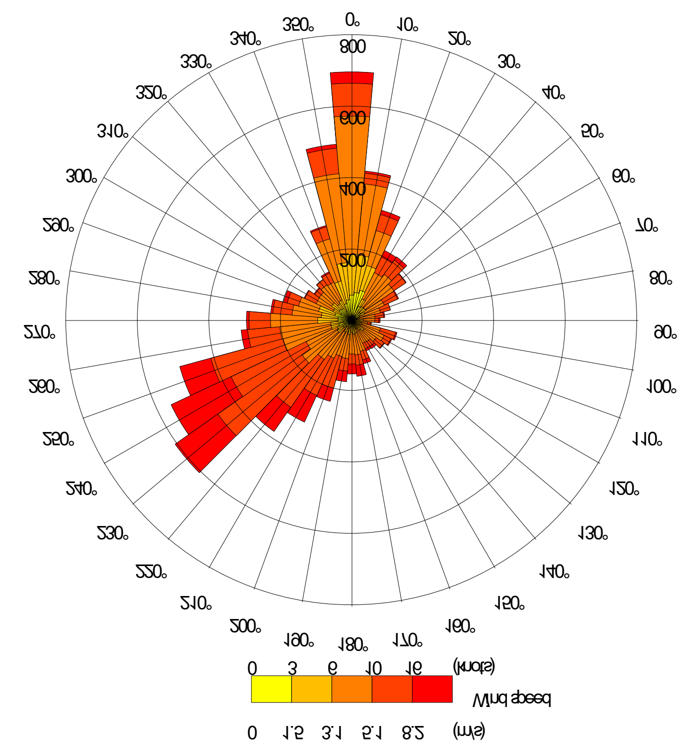
2014



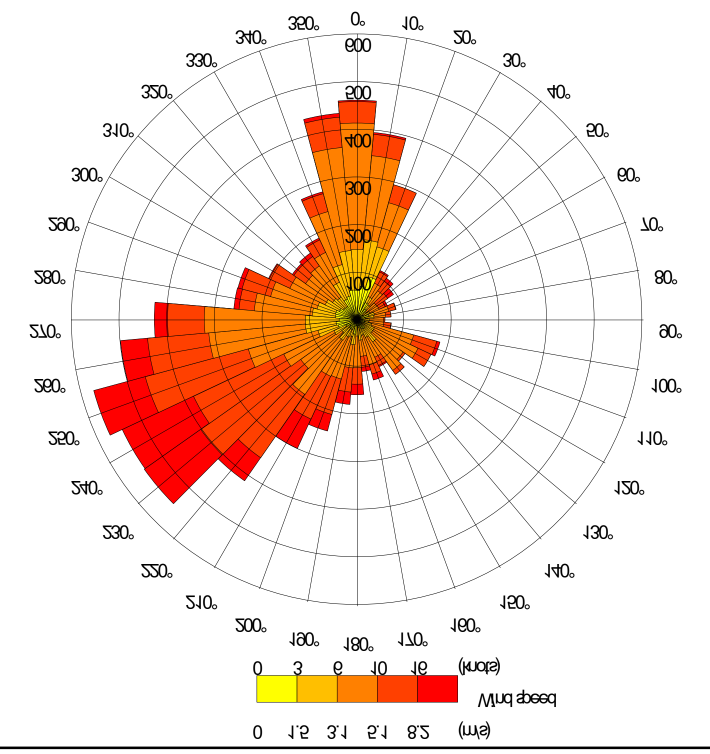
2015



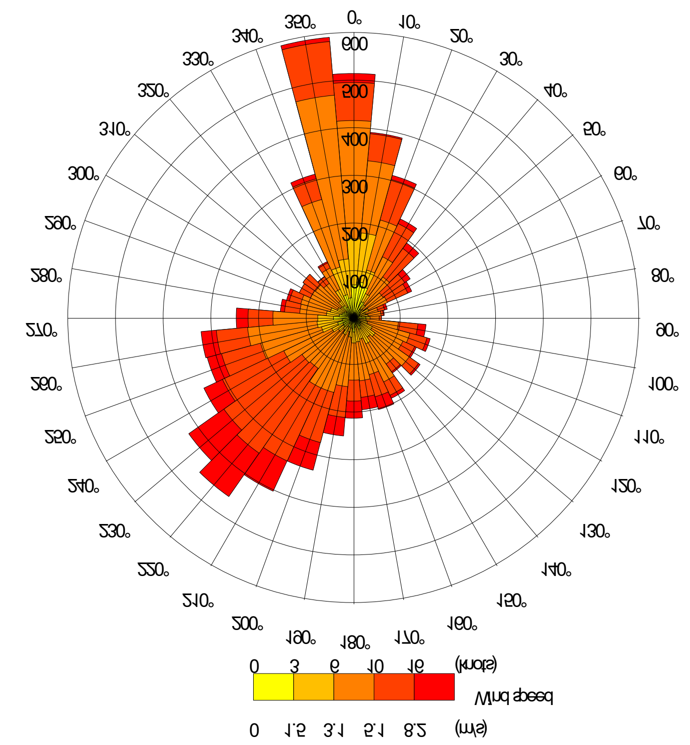
2016



2017



2018



500000

Client:	Viridor, Grundon and Ford EfW
Site:	Ford
Project:	Ford Circular Technology Park

Title:

Figure 4 - Wind Roses Shoreham 2014 - 2018

Drawn by: Rhys Weir | Date: 26/05/2020

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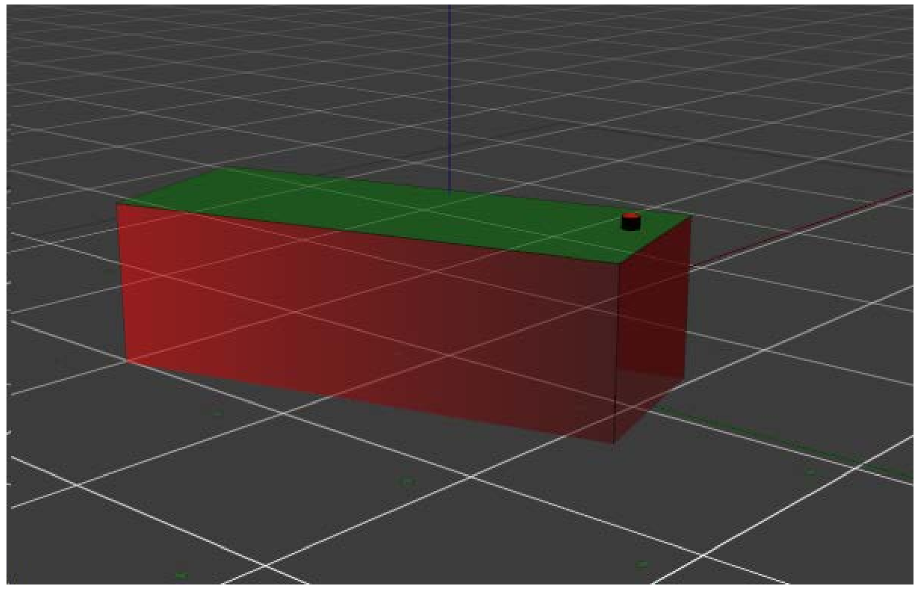
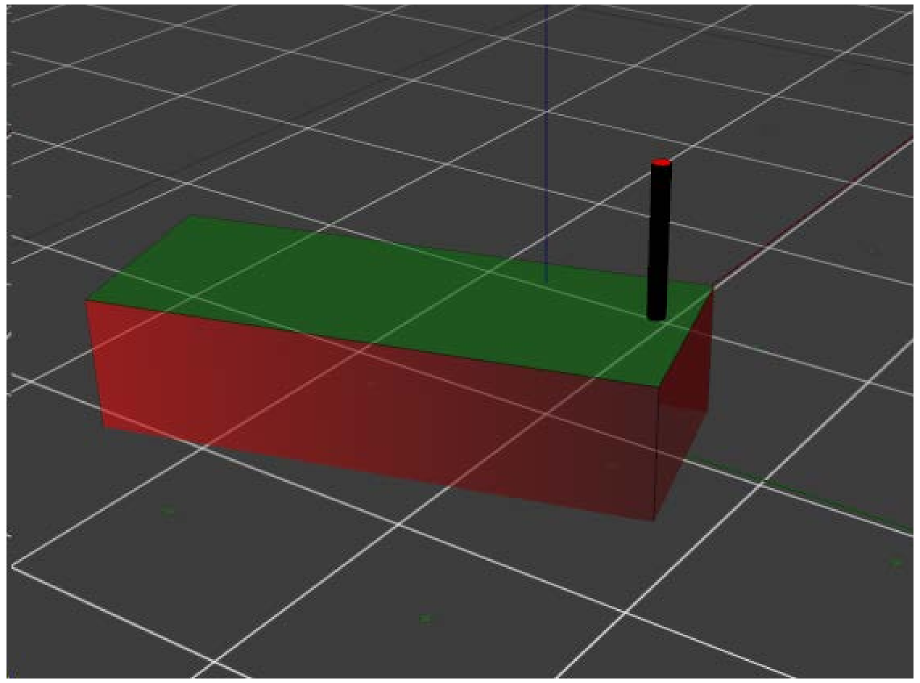
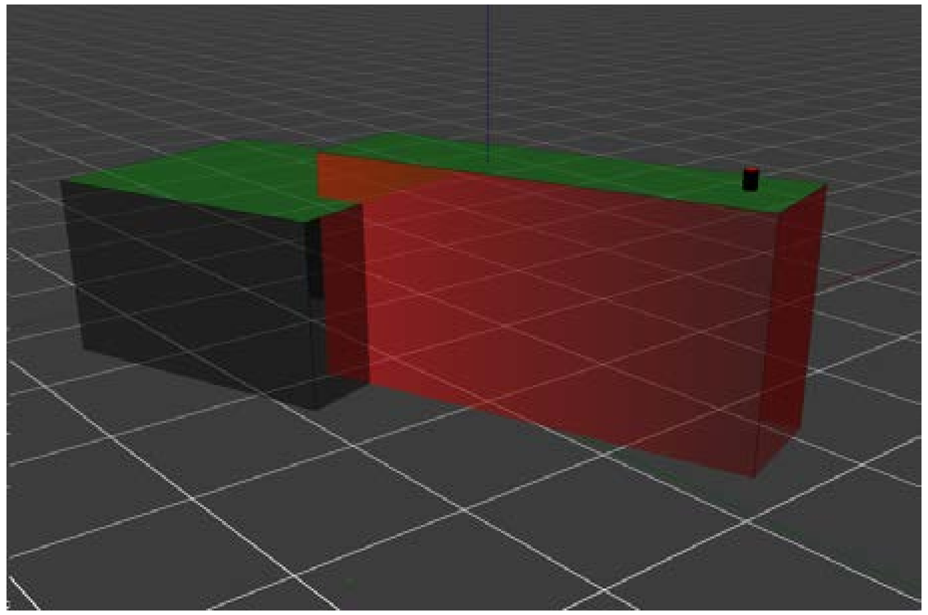


Scenario 1



Scenario 2



Scenario 3

	Viridor, Grundon and Ford EfW
	Ford
	Ford Circular Technology Park

Figure 5 - Building Layout Sensitivity

Date: 26/05/2020

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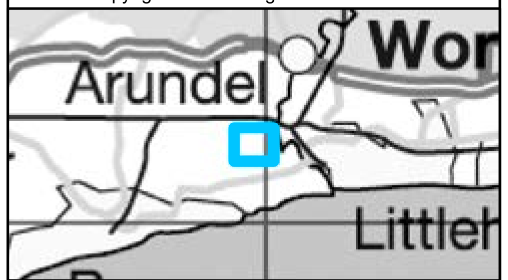
Legend

- Stack Location
- Building Modelled
- Site Boundary

Client:	Viridor, Grundon and Ford EfW
Site:	Ford
Project:	Ford Circular Technology Park
Title:	Figure 6 - Site Layout

Drawn by: Rhys Weir | Date: 29/05/2020



0 0.05 0.1 0.2 km

Scale: 1:5,000

N

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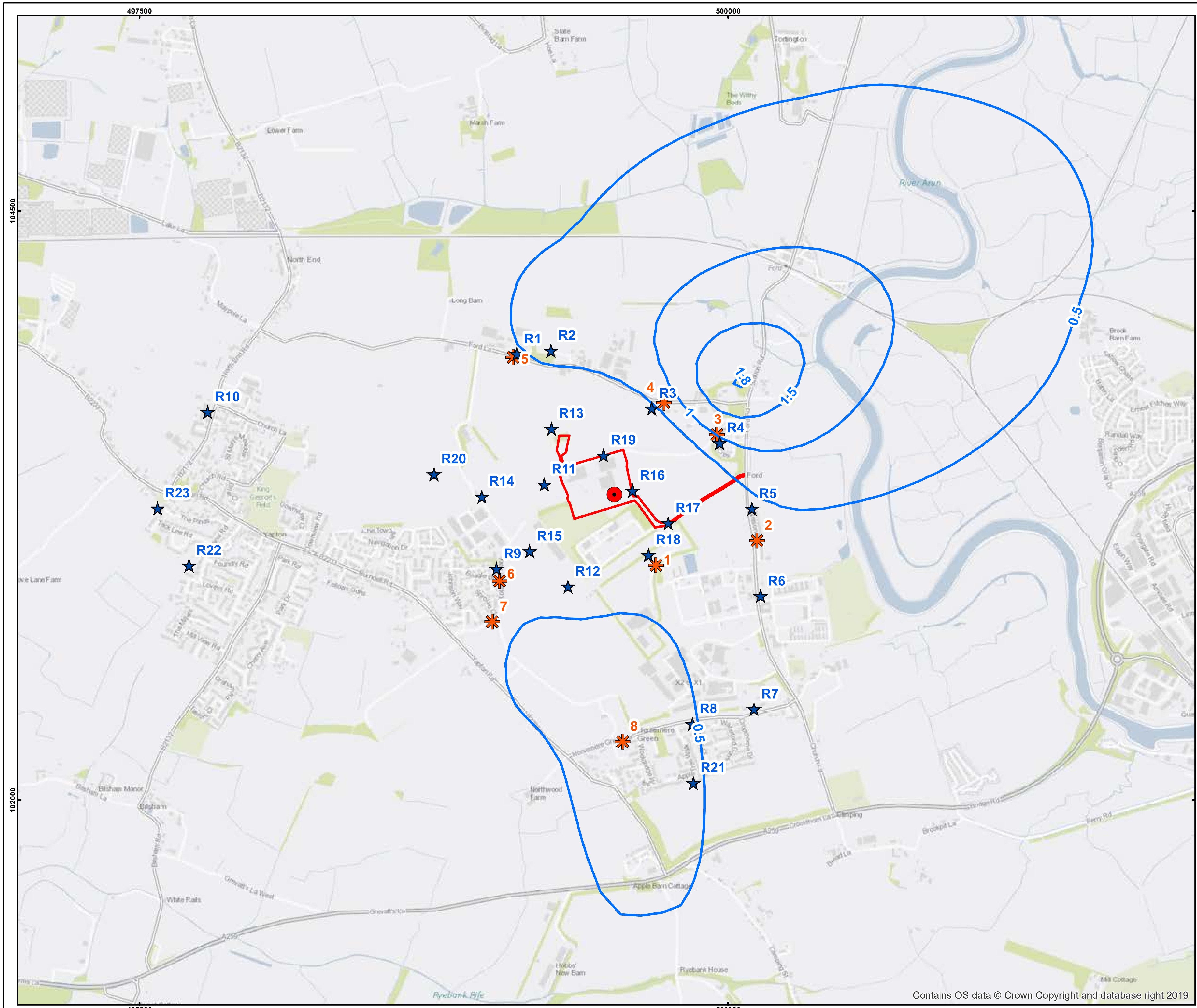
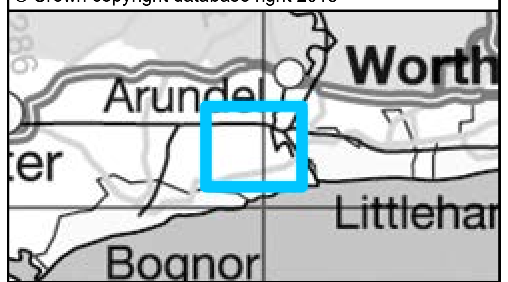


Legend

- Stack Location
- Site Boundary
- Human Sensitive Receptors
- Annual Mean Nitrogen Dioxide as % of AQAL
- TRL Diffusion Tube locations

Client:	Viridor, Grundon and Ford EfW
Site:	Ford
Project:	Ford Circular Technology Park
Title:	Figure 7 - Annual Mean Nitrogen Dioxide Analysis

Drawn by: Rhys Weir | Date: 29/05/2020



0 0.15 0.3 0.6 km

Scale: 1:15,000

N

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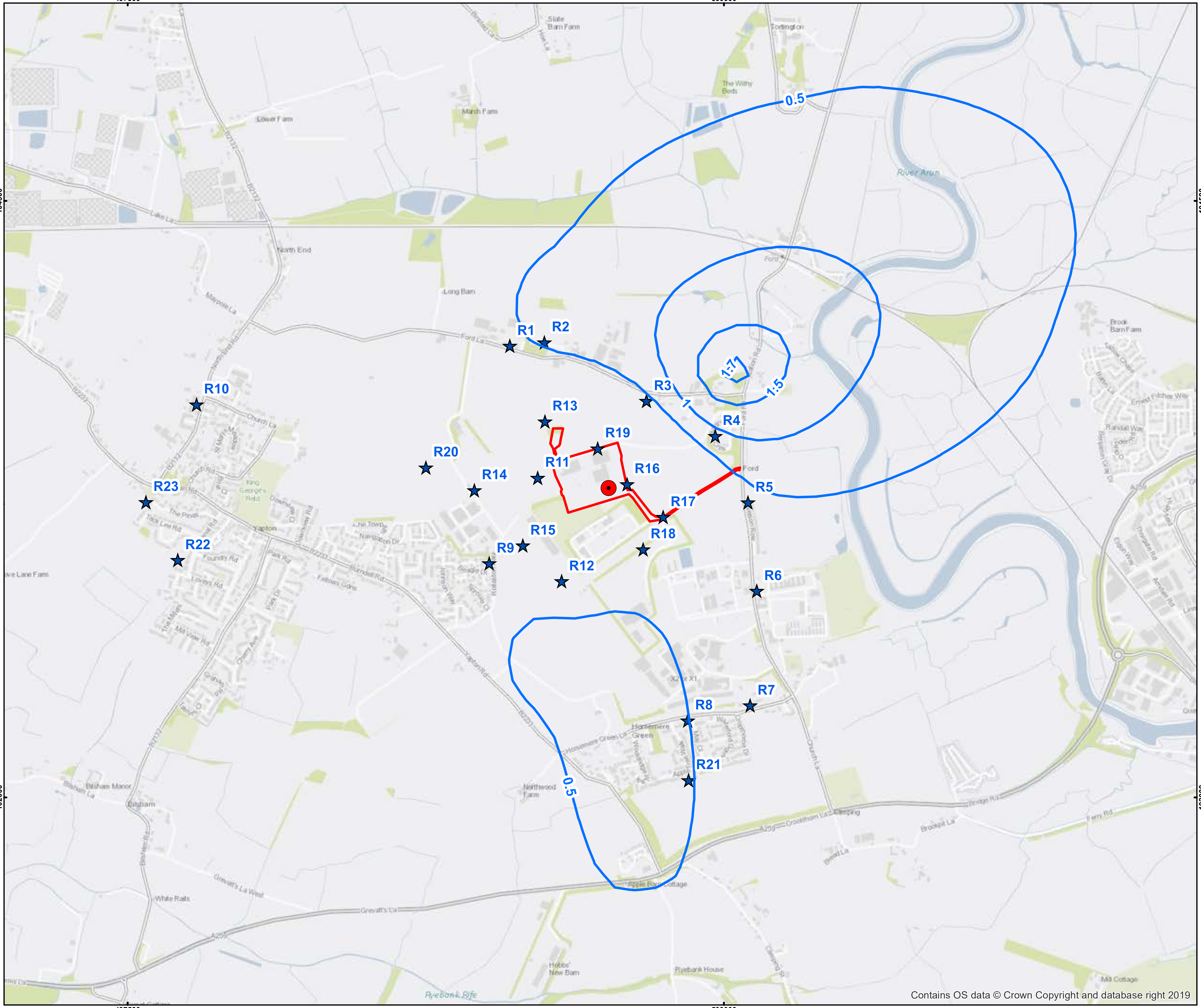


Legend

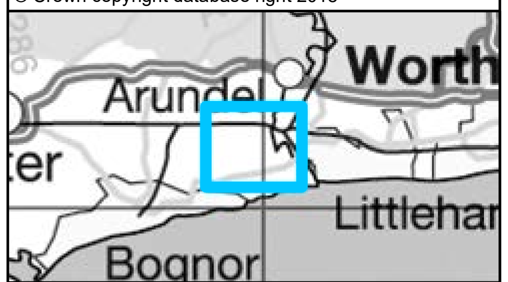
- Stack Location
- Site Boundary
- Human Sensitive Receptors
- Annual Mean Benzene as % of AQAL

Client:	Viridor, Grundon and Ford EfW
Site:	Ford
Project:	Ford Circular Technology Park

Title:

Figure 8 - Annual Mean Benzene Analysis

Drawn by: Rhys Weir | Date: 29/05/2020



0 0.15 0.3 0.6 km

Scale: 1:15,000

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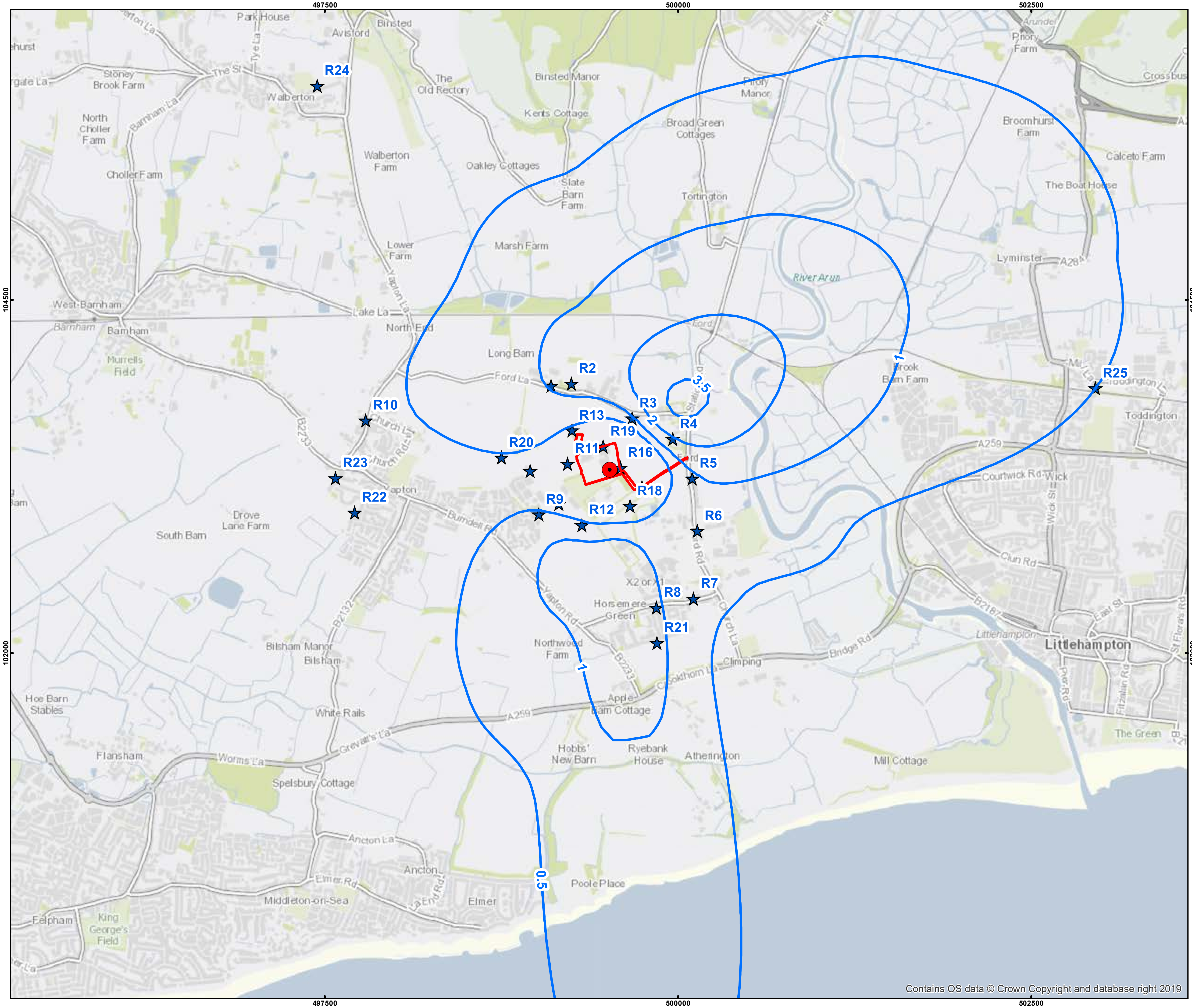

Legend

- Stack Location
- Site Boundary
- Human Sensitive Receptors
- Annual Mean 1,3-butadiene as % of AQAL

Client:	Viridor, Grundon and Ford EfW
Site:	Ford
Project:	Ford Circular Technology Park
Title:	Figure 9 - Annual Mean 1,3-Butadiene Analysis
Drawn by: Rhys Weir	Date: 29/05/2020

0 0.25 0.5 1 km

Scale: 1:25,000

N

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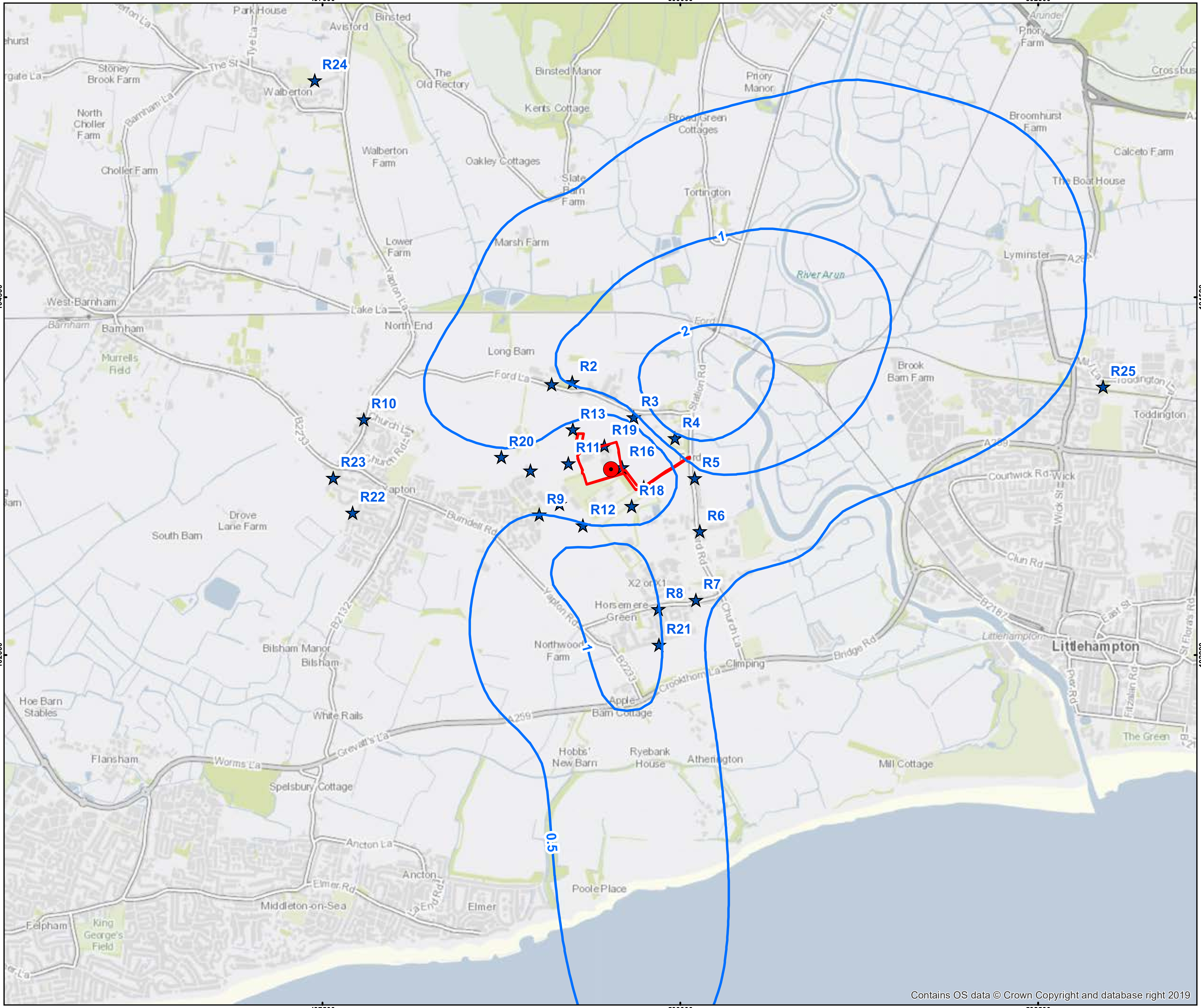

Legend

- Stack Location
- Site Boundary
- Human Sensitive Receptors
- Annual Mean Cadmium as % of AQAL (screening)

Client:	Viridor, Grundon and Ford EfW
Site:	Ford
Project:	Ford Circular Technology Park
Title:	Figure 10 - Annual Mean Cadmium Analysis

Drawn by: Rhys Weir | Date: 29/05/2020

0 0.25 0.5 1 km

Scale: 1:25,000

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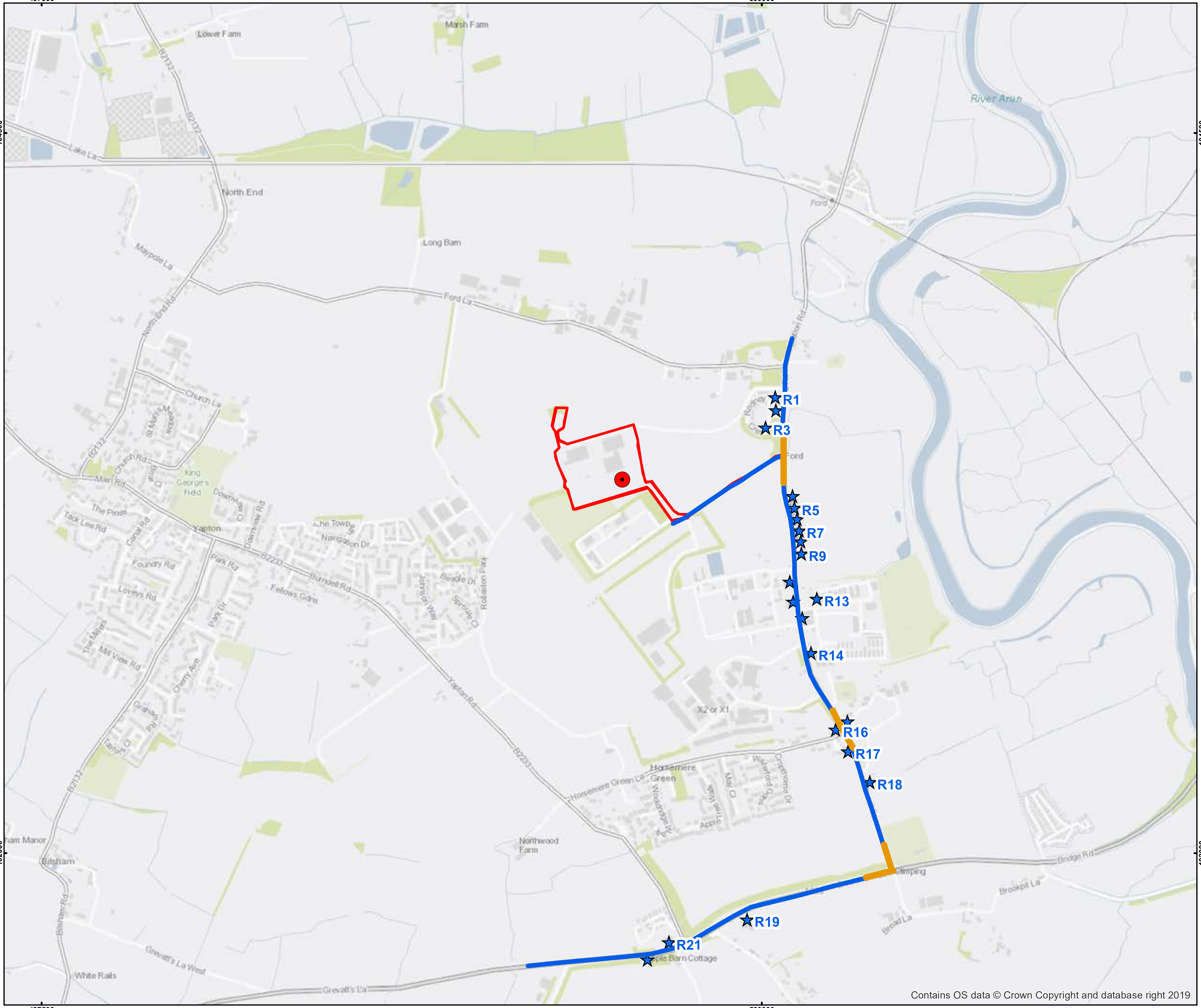
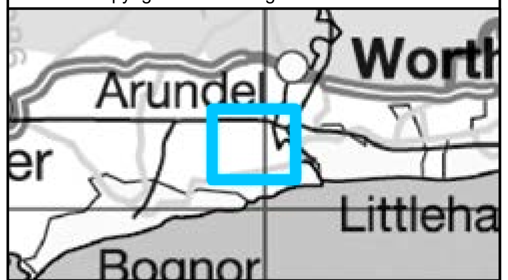


Legend

- Stack Location
- Site Boundary
- Receptor Locations
- Slow Down Junction
- Free Flowing Roads

Client:	Viridor, Grundon and Ford EfW
Site:	Ford
Project:	Ford Circular Technology Park
Title:	Figure 11 - ADMS Roads Model Inputs

Drawn by: Rhys Weir | Date: 29/05/2020



0 0.125 0.25 0.5 km

N

Scale: 1:12,421

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B APIS Critical Loads

Table 30: Nitrogen Deposition Critical Loads

Site	Species/Habitat Type	NCL Class	Lower Critical Load (kgN/ha/yr)	Upper Critical Load (kgN/ha/yr)	Maximum Background (kgN/ha/yr)
European and UK Statutory Designated Sites					
Duncton & Bignor Escarpment	Asperulo-Fagetum beech forests	Fagus Woodland	10	20	23.2
	Calcareous grassland	Sub-atlantic semi-dry calcareous grassland	15	25	14.6
Locally Designated Sites					
Ford Ancient Woodland	Broadleaved, mixed and yew woodland	Broadleaved deciduous woodland	10	20	21.28

Table 31: Acid Deposition Critical Loads

Site	Species/Habitat Type	Acidity Class	Critical Load Function (keq/ha/yr)			Maximum Background (keq/ha/yr)	
			CLminN	CLmaxN	CLmaxS	N	S
European and UK Statutory Designated Sites							
Duncton & Bignor Escarpment	Asperulo-Fagetum beech forests	Unmanaged Broadleafed/Coniferous Woodland	0.142	2.112	1.97	1.7	0.2
	Calcareous grassland	Calcareous grassland (using base cation)	0.856	4.856	4	1.0	0.2
Locally Designated Sites							
Ford Ancient Woodland	Broadleaved, mixed and yew woodland	Broadleaved deciduous woodland	0.357	11.301	10.944	1.48	0.17

C Deposition Analysis at Ecological Sites

Table 32: Annual Mean PC used for Deposition Analysis

Site	Annual Mean PC (ng/m³)			
	Nitrogen Dioxide	Sulphur Dioxide	Hydrogen Chloride	Ammonia
European and UK Statutory Designated Sites				
Duncton & Bignor Escarpment	11.74	4.19	0.84	1.40
Locally Designated Sites				
Ford Ancient Woodland	267.37	95.49	19.11	31.85

Table 33: Deposition Calculation - Grassland

Site	Deposition Velocity	Deposition (g/ha/yr)				N Deposition (gN/ha/yr)	Acid Deposition geq/ha/yr	
		NO_2	SO_2	HCl	NH_3		N	S
European and UK Statutory Designated Sites								
Duncton & Bignor Escarpment	Grassland	0.002	0.008	0.006	0.007	0.009	0.001	0.001
Locally Designated Sites								
Ford Ancient Woodland	Woodland	0.039	0.181	0.147	0.165	0.204	0.015	0.020

Table 34: Deposition Calculation - Woodland

Site	Deposition Velocity	Deposition (g/ha/yr)				N Deposition (gN/ha/yr)	Acid Deposition geq/ha/yr	
		NO_2	SO_2	HCl	NH_3		N	S
European and UK Statutory Designated Sites								
Duncton & Bignor Escarpment	Grassland	0.003	0.016	0.015	0.011	0.014	0.001	0.002
Locally Designated Sites								

Site	Deposition Velocity	Deposition (g/ha/yr)				N Deposition (gN/ha/yr)	Acid Deposition geq/ha/yr	
		NO_2	SO_2	HCl	NH_3		N	S
Ford Ancient Woodland	Woodland	0.077	0.361	0.352	0.248	0.325	0.023	0.042

Table 35: Detailed Results – Nitrogen Deposition

Site	NCL Class	Deposition Velocity	PC			Predicted Environmental Concentration		
			PC N dep (gN/ha/yr)	% of Lower CL	% of Upper CL	PEC N dep (kgN/ha/yr)	% of Lower CL	% of Upper CL
European and UK Statutory Designated Sites								
Duncton & Bignor Escarpment	Fagus Woodland	Woodland	0.014	0.14%	0.07%	23.214	232.14%	116.07%
	Sub-atlantic semi-dry calcareous grassland	Grassland	0.009	0.06%	0.04%	14.609	97.39%	58.44%
Locally Designated Sites								
Ford Ancient Woodland	Broadleaved deciduous woodland	Woodland	0.325	3.25%	1.63%	21.045	210.45%	105.23%

Table 36: Detailed Results – Acid Deposition

Site	Acidity Class	Deposition Velocity	PC			Predicted Environmental Concentration		
			N (geq/ ha/yr)	S (geq/ ha/yr)	% of CL Function	N (keq/ ha/yr)	S (keq/ ha/yr)	% of CL Function
European and UK Statutory Designated Sites								
Duncton & Bignor Escarpment	Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.001	0.002	0.14%	1.701	0.202	90.10%
	Calcareous grassland (using base cation)	Grassland	0.001	0.001	0.03%	1.001	0.201	24.74%
Locally Designated Sites								
Ford Ancient Woodland	Broadleaved deciduous woodland	Woodland	0.023	0.042	0.58%	1.503	0.212	15.18%

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