AIR DISPERSION MODELLING ASSESSMENT OF CUMULATIVE RELEASES FROM THE PROPOSED ENERGY RECOVERY FACILITY AT TEES VALLEY INCOMBINATION WITH REDCAR ENERGY CENTRE & CIRCULAR FUELS ARBORETUM

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ACRONYMS / TERMS USED IN THIS REPORT

AAD	Ambient Air Directive
ADMS	Atmospheric Dispersion Modelling System
APIS	Air Pollution Information System
AQAL	Air Quality Assessment Level
AQDD	Air Quality Daughter Directive
AQMA	Air Quality Management Area
AQMAU	Air Quality Modelling Assessment Unit
AQO	Air Quality Objective
AQS	Air Quality Standard
As	Arsenic
ASR	Annual Status Report
B[a]P	Benzo[a]Pyrene
BAT	Best Available Techniques
BAT-AEL	Best Available Techniques–Associated Emission Level
Bref	Best Available Techniques Reference Document
BSG	BSG Ecology
Cd	Cadmium
CERC	Cambridge Environmental Research Consultants
CFA	Circular Fuels Arboretum
CO	Carbon monoxide
Co	Cobalt
CrIII	Chromium III
CrVI	Chromium VI
cSAC	Candidate Special Areas of Conservation
Cu	Copper
DAS	Discretionary Advice Service
DEFRA	Department for Environment, Food and Rural Affairs
DT	Diffusion Tube
EA	Environment Agency
ECL	Environmental Compliance Ltd
ELV	Emission Limit Value
EP	Environmental Permit
EPAQS	Expert Panel on Air Quality Standards
EPR	Environmental Permitting Regulations
EPUK	Environmental Protection UK
ERF	Energy Recovery Facility
FCC	FCC Waste Services (UK) Limited
GLC	Ground Level Concentration
HCl	Hydrogen Chloride
HF	Hydrogen Fluoride
Hg	Mercury
HZI	Hitachi Zosen Inova
IAQM	Institute of Air Quality Management
IED	Industrial Emissions Directive
LNR	Local Nature Reserve
Met Data	Meteorological Data
Met Office	Meteorological Office

ACRONYMS / TERMS USED IN THIS REPORT (cont.)

Met Station	Meteorological Station
Met Year	Meteorological Year
Mn	Manganese
N	Nitrogen
NE	Natural England
NH_3	Ammonia
Ni	Nickel
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NRW	Natural Resources Wales
NWP	Numerical Weather Prediction
PAH	Polyaromatic Hydrocarbons
Pb	Lead
PC	Process Contribution
PCB	Polychlorinated Biphenyls
PEC	Predicted Environmental Concentration
PM_{10}	Particulate Matter (with a diameter of 10 µm or less)
$PM_{2.5}$	Particulate Matter (with a diameter of 2.5 µm or less)
Ramsar	Ramsar Convention on Wetlands of International Importance
RCBC	Redcar and Cleveland Borough Council
REC	Redcar Energy Centre
S	Sulphur
SAC	Special Areas of Conservation
Sb	Antimony
SEPA	Scottish Environment Protection Agency
sHRA	Shadow Habitats Regulation Assessment
SO_2	Sulphur Dioxide
SPA	Special Protection Areas
SSSI	Site of Special Scientific Interest
Tl	Thallium
The Installation	Tees Valley Energy Recovery Centre
V	Vanadium
VOC	Volatile Organic Compounds
WHO	World Health Organisation

1. INTRODUCTION

1.1. Cumulative Impacts

1.1.1. In addition to the effect of the proposed Installation, there are several other developments in the surrounding area which may have an effect on both human and ecological health when considered in combination. Existing emissions within the area are considered to already be accounted for in background air quality data.

1.1.2. ECL have recently (February 2023) been made aware of a further development, namely the Circular Fuels Arboretum ("CFA") – Dorman Point. This is for a proposed di-methyl ether ("DME") production plant. The proposed plant will process up to 300,000 tonnes per annum of waste derived fuel, to undergo gasification, and the subsequent syn-gas, following gas scrubbing will be used to produce DME. As this plant is adjacent to the proposed Installation it will be included in the cumulative assessment. Consequently, this report serves to consider the additional impact that the CFA will have on air quality in the area. This will be carried out making use of the emissions data disclosed in the air quality chapter submitted as part of the planning application documentation for the CFA[1] and information kindly provided by Circular Fuels Limited via their air quality consultants.

1.1.3. It should be noted that ECL's dispersion modelling report ECL.007.04.01/ADM previously considered the following development:

- Redcar Energy Centre ("REC"). The REC will be situated at land formerly occupied by Redcar Bulk Terminal (approximately 4.8km to the north of the Installation) and is due to be commissioned circa 2024 to 2025. Consequently, the emissions arising from the two stacks associated with its two process lines will be incorporated into the cumulative impact assessment undertaken as part of this study. This will be carried out making use of the emissions data disclosed in the air quality chapter submitted as part of the planning application documentation for REC[2];

1.1.4. For ease of reference, the developments that ECL were aware of (February 2022), but have been excluded from both the February 2022 modelling study and this assessment are as follows:

- Potential new Energy from Waste ("EfW") site opening in 2026 at the former SSI steelworks site – situated approximately 1.6 km east-northeast from the proposed FCC Installation – this information was obtained from pre-release statements only, no further data is available, consequently this development will not be considered;
- Dockside Road (1) and Dockside Road (2) – Teeside Renewable Energy Centre, operated by PD Ports, is expected to be operational within the next few years. Situated approximately 1.7 km to the west of the proposed Installation, again this information was obtained from pre-release statements only, no further data is available, consequently this development will not be considered.
- Wilton 11 EfW, operated by Suez / Sembcorp. Situated approximately 2.1 km east from the proposed Installation. Despite being operational since around 2018, no

[1] Planning Application Reference Number: R/2020/0411/FFM. Available online via: https://planning.redcar-cleveland.gov.uk/Planning/Display?applicationNumber=R%2F2023%2F0080%2FESM
[2] Planning Application Reference Number: R/2020/0411/FFM. Available online via: https://planning.redcar-cleveland.gov.uk/Planning/Display?applicationNumber=R%2F2020%2F0411%2FFFM

data is publicly available in relation to the input data required to model the site within either the HHRA or the ADM. An information request has been sent to the EA however, at time of writing no suitable data is available;

- Haverton Hill household waste recycling centre and North East Energy Recovery Centre, both operated by Suez. Both sites are located approximately 6.5 km to the west from the proposed Installation. It is considered, given their considerable distance from the proposed Installation it will not be necessary to include them in the cumulative assessment; and
- Tees Eco Energy – currently proposed (planning and permitting granted). Situated approximately 6.7 km to the west from the proposed Installation. It is considered, given the considerable distance of Tees Eco Energy from the proposed Installation, it will not be necessary to be included in the cumulative assessment.

1.2. Model Setup

1.2.1. This assessment considered the effect of any cumulative emissions arising from the proposed Installation, the REC and CFA at the maximum point of impact and at potentially sensitive human receptor and ecological locations. Modelling was undertaken with the following settings:

- To allow for a conservative assessment, ADMS 6 has been used to re-run the cumulative assessment as it has been noted that ADMS 6 is providing slightly higher results than ADMS 5;
- buildings effects were included for the REC, FCC and the CFA. Due to the number of buildings, only those over 20m high were included in the assessment. Buildings data for the CFA was obtained from the planning application documentation for the CFA. For the REC, the buildings included within the model were those detailed in Table 11.8 of the RPS report: *Chapter 11 Air Quality* – which was submitted as part of the planning application for the REC;
- the modelled grid was as specified in ECL's dispersion modelling report ECL.007.04.01/ADM;
- complex terrain was included (refer to Terrain File Three of Section 2.17 of ECL's dispersion modelling report ECL.007.04.01/ADM for further details);
- emission rates for pollutants were as outlined in Table 10a of Section 2.11. of ECL's dispersion modelling report ECL.007.04.01/ADM for the Installation and as calculated from the stack and emission characteristics detailed in the RPS report for the REC (i.e., Tables 11.9 and 11.10 of the *Chapter 11 Air Quality* report submitted as part of the planning application for the REC). Emission rates for the CFA were obtained from the Addendum to Environmental Statement rDME Production Facility (submitted as part of the planning application for the CFA);
- stack heights of 90m were considered for the Installation, with stack heights of 80m for REC's two emission points. The three emission points as detailed in the planning application for the CFA were used, however only pollutants common the FCC Installation were considered;
- a surface roughness of 0.5m was used for the dispersion site and 0.3m for the met measurement site; and
- 5 years of hourly sequential observed met data from Loftus Met Station, together with 1 year of hourly sequential NWP data for the stack coordinates of the FCC installation for the year 2020 were used for the assessment.

2. ASSESSMENT AT THE POINT OF MAXIMUM IMPACT

2.1. Comparison of Maximum Predicted Pollutant Ground Level Concentrations with Air Quality Standards

2.1.1. The predicted PCs for each of the pollutants considered in the assessment at the maximum point of impact have been extracted and are presented in Table 1. It should be noted that the location of the maximum impact may not be in an area where there is a relevant public exposure. Table 1 looks at the cumulative impact of the FCC, REC and CFA in combination.

2.1.2. Maximum concentrations are considered potentially significant if the long-term prediction is greater than 1% of the long-term AQS. For short-term predictions, a potentially significant concentration would be greater than 10% of the short-term AQS. In Table 1, any PCs that are above these significance criteria are indicated in bold type.

Table 1: Comparison of Predicted Maximum GLCs with AQSs - Cumulative

Pollutant	Max PC FCC + REC + CFA (µg/m³)	WCMY (FCC + REC + CFA)	AQS (µg/m³)	PC as a % of AQS FCC + REC + CFA
NO_2 (annual mean)	**5.42**	2020	40	**13.6%**
NO_2 (1 hour, 99.79th percentile)	20.0	2017	200	9.98%
SO_2 (24 hour, 99.18th percentile)	7.67	2017	125	6.13%
SO_2 (1 hour (99.73rd percentile))	14.1	2017	350	4.02%
SO_2 (15min, 99.9th Percentile)	15.2	2017	266	5.71%
PM_{10} (annual)	**2.25**	2017	40	**5.63%**
PM_{10} (90.41st Percentile 24hour)	4.25	NWP 2020	50	8.50%
$PM_{2.5}$ (annual)	**2.25**	2017	20	**11.3%**
CO (8 hour, 100th %ile)	23.1	2016	10000	0.23%
VOC (annual)	**6.85**	2017	5	**137%**
Ammonia (annual)	0.693	2020	180	0.38%
Ammonia (1-hour)	5.85	NWP 2020	2500	0.23%
Hydrogen Chloride (1-hour)	3.33	NWP 2020	750	0.44%
Hydrogen Fluoride (annual)	0.0653	2020	16	0.41%
Hydrogen Fluoride (1-hour)	0.571	NWP 2020	160	0.36%
Antimony (annual)	0.0194	2020	5	0.39%
Antimony (1-hour)	0.170	NWP 2020	150	0.11%
Arsenic (annual)	**0.0194**	2020	0.003	**646%**
Cadmium (annual)	**0.00128**	2020	0.005	**26%**
Chromium (annual)	0.0194	2020	5	0.39%
Chromium (1-hour)	0.170	NWP 2020	150	0.11%
Chromium VI (annual)	**0.0194**	2020	0.0002	**9683%**
Cobalt (annual)	**0.0194**	2020	0.2	**9.68%**

Table 1: Comparison of Predicted Maximum GLCs with AQSs – Cumulative (cont)

Pollutant	Max PC FCC + REC + CFA (µg/m^3)	WCMY (FCC + REC + CFA)	AQS (µg/m^3)	PC as a % of AQS FCC + REC + CFA
Cobalt (1-hour)	0.170	NWP 2020	6	2.83%
Copper (annual)	0.0194	2020	10	0.19%
Copper (1-hour)	0.170	NWP 2020	200	0.08%
Lead(annual)	**0.0194**	2020	0.25	**7.75%**
Manganese (annual)	**0.0194**	2020	1	**1.94%**
Manganese (1-hour)	0.170	NWP 2020	1500	0.011%
Mercury (annual)	0.00128	2020	0.25	0.51%
Mercury (1-hour)	0.0113	NWP 2020	7.5	0.15%
Nickel (annual)	**0.0194**	2020	0.02	**97%**
Thallium (annual)	0.00128	2020	1	0.13%
Thallium (1-hour)	0.0113	NWP 2020	30	0.038%
Vanadium (annual)	0.0194	2020	5	0.39%
Vanadium (24-hour)	0.0907	2017	1	9.07%
Benzo[a]pyrene (annual) (as PAHs)	**0.0000841**	NWP 2020	0.00025	**34%**
PCBs (annual)	0.00000000181	NWP 2020	0.2	0.0000009%
PCBs (1-hour)	0.0000000315	2018	6	0.00000053%
Dioxins (annual)	0.00000000375	2020	No Standard Applies	

2.1.3. It can be seen from the data in Table 1, that the cumulative impact varies depending on the pollutant considered. The potentially significant impacts are for long-term (annual):

- NO_2;
- PM_{10};
- $PM_{2.5}$;
- VOC (as benzene);
- As;
- Cd;
- Cr(VI);
- Co;
- Pb;
- Mn;
- Ni, and
- PAH (as B[a]P)

2.1.4. It is important to note that the metals, at this step of the assessment, have each been modelled at their respective ELVs. See Table 10a of Section 2.11. of ECL's dispersion modelling report ECL.007.04.01/ADM, for the FCC Installation, Table 11.10. of the RPS report for REC[3] and the Addendum to Environmental Statement rDME Production Facility submitted as part of the planning application for the CFA.

2.1.5. However, it would not be reasonable to assume that each Group 3 metal emits at the maximum ELV for the group. In this regard, the EA has provided guidance on the steps required for assessing the impact of metals emissions (see Section 2.23., of ECL's dispersion modelling report ECL.007.04.01/ADM). If any of the Group 3 metals exceed 1% of a long-term standard, then the PEC should be compared against the AQS. If the PEC is greater than 100% of the AQS then case specific screening is required. Consequently, background concentrations for As, Cr(VI), Co, Pb, Mn and Ni are required. Cd will also be considered with the Group 3 metals.

2.2. Step 1 and 2 Screening of Group 2 and 3 Metals

2.2.1. Using the background concentrations detailed in Table 14 of Section 3.4 of ECL's dispersion modelling report ECL.007.04.01/ADM, and a background concentration of 0.000647 µg/m^3 for Cd (as also acquired from Scunthorpe Low Santon urban industrial monitoring site (2019 data)), PECs for the potentially significant Group 2 and 3 metals are provided in Table 2. Any PECs greater than 100% of the AQS are highlighted in bold.

Table 2: PECs of Group 3 Metals – Step 1 Screening - Cumulative

Pollutant	Max PC (FCC + REC + CFA) (µg/m^3)	Background Concentration (µg/m^3)	Max PEC (FCC + REC + CFA) (µg/m^3)	AQS (µg/m^3)	PEC as a % of AQS (FCC + REC + CFA)
Arsenic (annual)	0.0194	0.00079	**0.0202**	0.003	**672%**
Cadmium (annual)	0.00128	0.000647	0.00193	0.005	39%
Chromium VI (annual)	0.0194	0.000749	**0.0201**	0.0002	**10,057%**
Cobalt (annual)	0.0194	0.000177	0.0195	0.2	9.8%
Lead (annual)	0.0194	0.0154	0.0347	0.25	13.9%
Manganese (annual)	0.0194	0.073	0.0929	1	9.3%
Nickel (annual)	0.0194	0.00124	**0.0206**	0.02	**103%**

Note: For Table 2 the WCMY was 2020 for all.

2.2.2. The data in Table 2 indicates that, although for the majority of pollutants the PECs can be screened out, further screening is required for long-term As, Cr(VI) and Ni.

[3] Refer to Chapter 11, Air Quality of Planning Application Reference Number: R/2020/0411/FFM. Available online via: https://planning.redcar-cleveland.gov.uk/Planning/Display?applicationNumber=R%2F2020%2F0411%2FFFM

2.2.3. Step 2 screening indicates that where the PC exceeds 1% of the long standard, the maximum emissions data in Appendix A of the EA's Group 3 metals assessment guidance can be used to revise the predictions, and the PEC then compared against the AQS. The guidance states that As comprises 5% of the Group 3 metals, Cr(VI) 0.03% and Ni 44%. Consequently, the emission rates for each have been recalculated based on these percent ages. The results of the assessment may be found in Table 3.

Table 3: PECs of Group 3 Metals – Step 2 Screening - Cumulative

Pollutant	Maximum PC (FCC + REC + CFA) (μg/m³)	AQS (μg/m³)	PC as a % of AQS (FCC + REC + CFA)	Background Concentration (μg/m³)	Max PEC (FCC + REC + CFA) (μg/m³)	PEC as a % of AQS (FCC + REC + CFA)
As (annual mean)	0.000968	0.003	32%	0.000788	0.00176	59%
Cr(VI) (annual mean)	0.00000581	0.0002	2.9%	0.000749	0.00075	**377%**
Nickel (annual)	0.008521	0.02	42.6%	0.00124	0.00976	49%

Note: For Table 3 the WCMY was 2020 for FCC, REC and CFA in combination.

2.2.4. The data in Table 3 indicates that, following further screening, the PECs for As and Ni can now be screened out.

2.2.5. The PCs for Cr(VI) shown in Table 3, whilst significantly lower than the results presented in Table 2 for the Step 1 screening, are still potentially significant, at 2.9% of the AQS. The cumulative concentrations observed with all three facilities operating are significantly higher than when just the FCC and REC are operating. Consequently Table 4 provides a breakdown of the impact from each installation.

Table 4: PCs for Cr(VI) from each Installation

Pollutant Chromium VI (annual)	PC following Group 3 Guidance (μg/m³)	AQS	PC as a % of AQS
FCC	0.000000864	0.0002	0.43%
REC	**0.00000213**		**1.06%**
CFA	**0.00000569**		**2.84%**
FCC + REC	**0.00000222**		**1.11%**
FCC + REC + CFA	**0.00000581**		**2.90%**

2.2.6. Table 4 shows that the PC from the FCC installation can be considered not significant, and when the FCC and the REC are considered together the impact only just exceeds the significance criteria. However, when all three installations are considered, the PC is 2.90%

of the AQS. From the data in Table 4, it is clear that the majority of this impact is attributable to the CFA, its PC being 2.84% alone.

2.2.7. When the FCC Installation in-combination with the REC are modelled, the maximum predicted annual GLC for Cr(VI), occurs in an area approximately 400m north of REC (456145 (X), 526349 (Y)) and is therefore, in the context of this modelling study, more likely to be associated with the predicted PCs for REC's two emission points.

2.2.8. When all three installations are considered, the maximum predicted annual GLC for Cr(VI) occurs in an area approximately 22m north of the CFA's oxidiser stack location at 454745, (X), 521509(Y)). The locations of the maximum GLCs for each installation are provided in Table 5.

Table 5: Comparision of Max PC Location from Each Installation – Cr(VI)

Installation	Grid Coordinates (X)	Grid Coordinates (Y)	Distance and Direction from FCC A1/A2 Stack
FCC	454425	521989	581m North (5°)
REC	456145	526349	5,245m North-northeast (20˚)
CFA	454745	521509	379m East-northeast (75°)
FCC + REC	456145	526349	5,245m North-northeast (20°)
All	454745	521509	379m East-northeast (75°)

2.2.9. From both Tables 4 and 5, it is clear that when the FCC Installation is operated in combination with the REC then the emissions are more heavily influenced by the REC due to the location of the Max GLC. However, when the CFA is also added, this installation has the greatest impact on the emissions, and consequently, the maximum GLC for all emissions points is the same location as that from the CFA in isolation.

2.2.10. It should also be noted that the FCC installation has outline permission for an energy from waste plant and the emissions from which have already been considered in the outline planning application. The application for the CFA has not considered any cumulative impacts.

2.2.11. As the PC from all three installations operating in combination is still potentially significant further assessment must be undertaken. The location of the maximum point of ground level is located 22m north of the CFA's oxidiser stack, and therefore within the site boundary. It is therefore important to consider potentially sensitive human receptor ("HSR") locations. These are provided in Table 6 for Cr(VI). The HSR locations are those as specified in ECL's dispersion modelling report ECL.007.04.01/ADM.

Table 6: PCs for Cr(VI) at Sensitive Human Recptor Locations

Pollutant	HSR	Maximum PC (μg/m^3)	Worst Case Met Year	AQS (μg/m^3)	PC as a % of AQS
Chromium VI (annual)	HSR1	0.000000444	NWP 2020	0.0002	0.22%
	HSR2	0.000001022	2016		0.51%
	HSR3	0.000000735	NWP 2020		0.37%
	HSR4	0.000000911	2016		0.46%
	HSR5	0.000000665	2016		0.33%
	HSR6	0.000000546	NWP 2020		0.27%
	HSR7	0.000000480	NWP 2020		0.24%
	HSR8	0.000000521	NWP 2020		0.26%
	HSR9	0.000000457	2018		0.23%
	HSR10	0.000000638	2016		0.32%
	HSR11	0.000001441	NWP 2020		0.72%
	HSR12	0.000000456	NWP 2020		0.23%
	HSR13	0.000000448	NWP 2020		0.22%
	HSR14	0.000000542	2020		0.27%
	HSR15	0.000000871	2017		0.44%
	HSR16	0.000000344	NWP 2020		0.17%

Note to Table: Emission concentrations have been adjusted in accordance with the EA's Group 3 metals assessment guidance

2.2.12. The data in Table 6 shows that where there is exposure to potentially sensitive receptors, the maximum GLCs are less that 1% of the AQS and therefore can be considered not significant.

2.2.13. It should also be noted that this cumulative assessment is ultra conservative. It assumes that all three installations are operating at the maximum permitted emission limit, 24 hours a day, 7 days a week. This is unlikely to be the case.

2.3. Step 2 Screening of Remaining Pollutants

2.3.1. The long-term impacts of NO_2, PM_{10}, $PM_{2.5}$, VOC and PAH (see Table 1), also require further assessment. The next stage of the Step 2 impact significance screening process is to compare the long-term pollutant PECs with the criteria outlined in Section 2.21. of ECL's dispersion modelling report ECL.007.04.01/ADM.

2.3.2. Using the relevant background data, the PEC assessment for annual NO_2, PM_{10}, $PM_{2.5}$, VOC and PAH is shown in Table 7 for the FCC Installation in combination with the REC and CFA. Any potentially significant PCs are indicated in bold.

Table 7: Long-term impacts of NO_2, $PM_{2.5}$, VOC and PAH – Step 2 Screening - FCC + REC + CFA

Pollutant	Worst Case Met Year	Maximum PC (µg/m³)	AQS (µg/m³)	PC as a % of AQS	Background Concentration (µg/m³)	Maximum PEC (µg/m³)	PEC as a % of AQS	Impact Descriptor
NO_2 (annual mean)	2020	5.42	40	13.6%	24.8	30.2	75.6%	Moderate
PM_{10} (annual)	2017	2.25	40	5.63%	12.24	14.5	36.2%	Slight
$PM_{2.5}$ (annual)	2017	2.25	20	11.3%	7.85	10.1	50.5%	Moderate
VOC (annual mean)	2017	6.85	5	137%	0.362	7.21	144%	Substantial
PAH (as B[a]P) (annual mean)	NWP 2020	0.0000841	0.00025	33.6%	0.000206	0.000290	116%	Substantial

2.3.3. The data in Table 7 indicates that for PM_{10} the impact on the environment can be classed as 'slight', in accordance with the IAQM guidance, and 'moderate' for $PM_{2.5}$ and NO_2. When using the EA online guidance for screening assessments for emissions to air, further detailed modelling is not required if PECs are less than 70% of the long-term AQS. Although not directly applicable to the detailed modelling stage, the PECs of annual PM_{10} and $PM_{2.5}$ would be considered not significant based on the screening criteria.

2.3.4. Impacts for NO_2 are considered to be moderate, however as there is no breach of the AQS it can be concluded that the impact on air quality would be not significant.

2.3.5. For VOC and PAH (as B[a]P) the impact on the environment can be classed as 'substantial', in accordance with the IAQM guidance.

VOC as Benzene

2.3.6. Table 8 provides a breakdown of the impact from each installation.

Table 8: PCs and PECs for VOC from Each Installation

Pollutant VOC as Benzene (annual)	Max PC (µg/m³)	AQS	PC as a % of AQS	Back-ground (µg/m³)	PEC as a % of AQS	Impact Descriptor
FCC	0.0700	5	1.40%	0.362	8.64%	Negligible
REC	0.174		3.47%		10.7%	Negligible
CFA	6.84		137%		144%	Substantial
FCC + REC	0.184		3.69%		10.9%	Negligible
FCC + REC + CFA	6.84		137%		144%	Substantial

2.3.7. Table 8 shows that the PEC from the FCC installation, and REC in isolation can be considered negligible, and when the FCC and the REC are considered together the impact again can be described as negligible. However, the impact from the CFA in isolation can be considered substantial, and therefore dominates the cumulative impact.

2.3.8. When the FCC Installation in-combination with the REC are modelled, the maximum predicted annual GLC for VOC, occurs in an area approximately 400m north of REC (456105 (X), 526389 (Y)) and is therefore, in the context of this modelling study, more likely to be associated with the predicted PCs for REC's two emission points.

2.3.9. When all three installations are considered, the maximum predicted annual GLC for VOC occurs in an area approximately 100m northwest of the CFA's oxidiser stack location at 454665 (X), 521549(Y)). The locations of the maximum GLCs for each installation are provided in Table 9.

Table 9: Comparision of Max PC Location from Each Installation - VOC

Installation	Grid Coordinates (X)	Grid Coordinates (Y)	Distance and Direction from FCC A1/A2 Stack
FCC	454425	522029	621m North (4°)
REC	456105	526429	5,307m North-northeast (19˚)
CFA	454665	521549	318m East-northeast (64°)
FCC + REC	456105	526389	5,270m North-northeast (19°)
All	454665	521549	318m East-northeast (64°)

2.3.10. From both Tables 8 and 9, it is clear that when the FCC Installation is operated in combination with the REC then the emissions are more heavily influenced by the REC due to the location of the Max GLC. However, when the CFA is also added, this installation has the greatest impact on the emissions, and consequently, the maximum GLC for all emissions points is the same location as that from the CFA in isolation.

2.3.11. Again, it should also be noted that the FCC installation has outline permission for an energy from waste plant and the emissions from which have already been considered in the outline planning application. The application for the CFA has not considered any cumulative impacts.

2.3.12. As the PC from all three installations operating in combination is still potentially significant further assessment much be undertaken. The location of the maximum point of ground level is located 100m northwest of the CFA's oxidiser stack, and therefore within the site boundary. It is therefore important to consider potentially sensitive human receptor ("HSR") locations and the PEC. These are provided in Table 10 for VOC. The HSR locations are those as specified in ECL's dispersion modelling report ECL.007.04.01/ADM.

Table 10: PECs for VOC at Sensitive Human Recptor Locations

HSR	Maximum PC (µg/m^3)	Worst Case Met Year	AQS (µg/m^3)	PC as a % of AQS	Background	PEC as a % of AQS	Impact Descriptor
HSR1	0.4030	NWP 2020	5	8.06%	0.358	15.2%	Slight
HSR2	0.5348	2016		10.70%		17.9%	Moderate
HSR3	0.4422	NWP 2020		8.84%		16.0%	Slight
HSR4	0.4871	2016		9.74%		16.9%	Slight
HSR5	0.2926	NWP 2020		5.85%		13.0%	Slight
HSR6	0.2814	NWP 2020		5.63%		12.8%	Slight
HSR7	0.2406	NWP 2020		4.81%		12.0%	Negligible
HSR8	0.2445	NWP 2020		4.89%		12.1%	Negligible
HSR9	0.5764	2019		11.53%		18.7%	Moderate
HSR10	0.2878	2016		5.76%		12.9%	Slight
HSR11	1.0876	NWP 2020		21.75%		28.9%	Moderate
HSR12	0.2277	2019		4.55%		11.7%	Negligible
HSR13	0.3847	2019		7.69%		14.9%	Slight
HSR14	0.2195	2018		4.39%		11.6%	Negligible
HSR15	0.5349	2017		10.70%		17.9%	Moderate
HSR16	0.1556	NWP 2020		3.11%		10.3%	Negligible

2.3.13. The data in Table 7 indicates that for VOC, at the various HSRs, the impact on the environment can be classed as 'negligible' to 'moderate' in accordance with the IAQM guidance. When using the EA online guidance for screening assessments for emissions to air, further detailed modelling is not required if PECs are less than 70% of the long-term AQS. Although not directly applicable to the detailed modelling stage, the PECs would be considered not significant at all locations based on the screening criteria. As there are no breaches of the AQS it can be concluded that the impact on air quality would be not significant at the HSRs.

2.3.14. It should also be noted that this cumulative assessment is ultra conservative. It assumes that all three installations are operating at the maximum permitted emission limit, 24 hours a day, 7 days a week. This is unlikely to be the case.

PAH (as B[a]P)

2.3.15. For PAH (as B[a]P), the cumulative concentrations observed with all three facilities operating are only slightly higher than when just the FCC and REC are operating. Table 11 provides a breakdown of the impact from each installation.

Table 11: PCs and PECs for PAH (as B[a]P) from Each Installation

Pollutant VOC as Benzene (annual)	PC following Group 3 Guidance (µg/m³)	AQS	PC as a % of AQS	Back-ground (µg/m³)	PEC as a % of AQS	Impact Descriptor
FCC	0.0000083	0.00025	3.32%	0.000206	86%	Negligible
REC	0.0000821		32.8%		115%	Substantial
CFA	0.0000042		1.67%		84%	Negligible
FCC + REC	0.0000840		33.6%		116%	Substantial
FCC + REC + CFA	0.0000841		33.6%		116%	Substantial

2.3.16. In the case of PAH (as B[a]P), it is the emissions from the REC that dominate the cumulative impact with emissions from the REC, REC + FCC and all three installations in combination being classed as substantial. Impacts from both FCC and the CFA in isolation can be considered negligible.

2.3.17. When the FCC Installation in-combination with the REC are modelled, the maximum predicted annual GLC for PAH, occurs in an area approximately 495m northeast of the REC (456185 (X), 526429 (Y)) and is therefore, in the context of this modelling study, more likely to be associated with the predicted PCs for REC's two emission points.

2.3.18. When all three installations are considered, the maximum predicted annual GLC for PAH occurs at the same location – 495m northeast of the REC. The locations of the maximum GLCs for each installation are provided in Table 12.

Table 12: Comparision of Max PC Location from Each Installation - PAH (as B[a]P)

Installation	Grid Coordinates (X)	Grid Coordinates (Y)	Distance and Direction from FCC A1/A2 Stack
FCC	454705	522229	881m North-northeast (22°)
REC	456185	526429	5,334m North-northeast (20˚)
CFA	454745	521509	379m East-northeast (75°)
FCC + REC	456185	526429	5,334m North-northeast (20°)
All	456185	526429	5,334m East-northeast (20°)

2.3.19. From both Tables 11 and 12, it is clear that when the FCC Installation is operated in combination with the REC and CFA the emissions are most heavily influenced by the REC due to the location of the Max GLC. The maximum GLC for all emissions points is the same location as that from the REC in isolation.

2.3.20. It should also be noted that the predicted location of the maximum GLC is not necessarily representative of permanent human exposure as the location is that of grassland and sand dune and lies just outside the boundary of the Teesmouth and Cleveland Coast habitat site.

2.3.21. However, as the PC from all three installations operating in combination is still potentially significant further assessment much be undertaken. It is therefore important to consider potentially sensitive human receptor ("HSR") locations and the PEC. These are provided in Table 13 for PAH (as B[a]P). The HSR locations are those as specified in ECL's dispersion modelling report ECL.007.04.01/ADM.

Table 13: PECs for PAH (asB[a]P) at Sensitive Human Recptor Locations

HSR	Maximum PC (µg/m^3)	Worst Case Met Year	AQS (µg/m^3)	PC as a % of AQS	Background	PEC as a % of AQS	Impact Descriptor
HSR1	0.00000446	NWP 2020	0.00025	1.79%	0.000206	84%	Slight
HSR2	0.00000811	2016		3.25%		86%	Slight
HSR3	0.00000657	NWP 2020		2.63%		85%	Slight
HSR4	0.00000724	2016		2.90%		85%	Slight
HSR5	0.00000655	2016		2.62%		85%	Slight
HSR6	0.00000593	NWP 2020		2.37%		85%	Slight
HSR7	0.00000548	NWP 2020		2.19%		85%	Slight
HSR8	0.00000580	NWP 2020		2.32%		85%	Slight
HSR9	0.00000533	2018		2.13%		85%	Slight
HSR10	0.00000600	2016		2.40%		85%	Slight
HSR11	0.0000122	NWP 2020		4.86%		87%	Slight
HSR12	0.00000526	NWP 2020		2.11%		85%	Slight
HSR13	0.00000511	NWP 2020		2.04%		84%	Slight
HSR14	0.00000806	NWP 2020		3.22%		86%	Slight
HSR15	0.00000673	2017		2.69%		85%	Slight
HSR16	0.00000432	NWP 2020		1.73%		84%	Slight

2.3.22. The data in Table 13 indicates that for PAH (as B[a]P), at the various HSRs, the impact on the environment can be classed as 'slight' in accordance with the IAQM guidance. It should be noted that the impact at all locations is heavily influenced by the background concentration which is already 82% of the AQS. As there are no breaches of the AQS it can be concluded that the impact on air quality would be not significant at the HSRs.

2.3.23. It should also be noted that this cumulative assessment is ultra conservative. It assumes that all three installations are operating at the maximum permitted emission limit, 24 hours a day, 7 days a week. This is unlikely to be the case.

3. ASSESSMENT AT POTENTIALLY SENSITIVE HUMAN RECEPTORS

3.1. Summary

3.1.1. Cumulative impacts of all three installations at potentially sensitive receptors have not been individually modelled (with the exception of Cr(VI), PAH and VOC). As the maximum point of impact of all pollutants can be considered not significant then by default all other points modelled can also be considered not significant.

3.1.2. For those pollutants which did not screen out - Cr(VI), PAH and VOC – further assessment at the potentially sensitive receptor locations has been undertaken, and is fully assessed in Section 2 of this report.

4. ASSESSMENT AT HABITAT SITES – CRITICAL LEVELS

4.1. Introduction

4.1.1. This assessment considered the effect of cumulative emissions from the FCC Installation, REC and CFA on critical levels for the habitat sites identified in Table 2 of ECL's dispersion modelling report ECL.007.04.01/ADM.

4.2. Comparison of Maximum Predicted Pollutant Ground Level Concentrations with Critical Levels for the Protection of Vegetation and Ecosystems - Oxides of Nitrogen

4.2.1. A summary of maximum predicted GLCs of oxides of nitrogen at the identified sensitive habitat sites is presented in Table 14. In accordance with the EA guidance, the significance of the impacts has been determined using the 1% and 10% criteria for long and short-term predictions, respectively, for SPAs, SACs, Ramsars and SSSIs (see Section 2.22. of ECL's dispersion modelling report ECL.007.04.01/ADM). Any significant impacts are highlighted in bold.

Table 14: Comparison of Maximum Predicted Oxides of Nitrogen Ground Level Concentrations (PCs) with Critical Levels at Sensitive Habitat Sites

Pollutant		NO_X (annual mean)	NO_X (24-hour mean)
Critical Level (µg/m³)		30	75
Maximum PC (µg/m³)		**0.942**	6.24
Max PC as % of Critical Level		**3.14%**	8.32%
NYM1	North York Moors - SAC / SPA	0.0773	0.784
TCC1	Teesmouth and Cleveland Coast - SPA / SSSI	**0.411**	5.76
TCC2	Teesmouth and Cleveland Coast - SPA / SSSI	**0.854**	5.20
TCC3	Teesmouth and Cleveland Coast - SPA / SSSI	**0.515**	4.07
TCC4	Teesmouth and Cleveland Coast - SPA / SSSI	0.232	3.30
TCC5	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.390**	5.22
TCC6	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.357**	4.04
TCC7	Teesmouth and Cleveland Coast - SPA / Ramsar	0.218	2.90
TCC8	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.473**	3.38
TCC9	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.916**	6.24
TCC10	Teesmouth and Cleveland Coast - SPA / Ramsar	0.205	2.13
TCC11	Teesmouth and Cleveland Coast - SPA / Ramsar	0.300	4.35
TCC12	Teesmouth and Cleveland Coast - SPA / Ramsar	0.177	2.03
TCC13	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.942**	5.48
TCC14	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.374**	3.71

4.2.2. It can be seen from the data in Table 14 that the daily mean oxides of nitrogen PCs are all less than 10% of the respective critical level and therefore, are not significant at all SACs, SPAs, SSSIs and Ramsar sites considered.

4.2.3. For the annual mean oxides of nitrogen PCs, the impact is potentially significant (i.e., greater than 1% of the long-term critical level) at TCC1-3, TCC5-6, TCC8-9 and TCC13-14 inclusive. Consequently, PECs will need to be calculated for these receptors.

4.2.4. Using the background NO_X concentrations, provided in Table 6 of Section 2.8. of ECL's dispersion modelling report ECL.007.04.01/ADM, the PEC assessment is provided in Table 15

Table 15: Comparison of Maximum Predicted Oxides of Nitrogen PECs with Critical Levels at Sensitive Habitat Sites

ADMS Ref. [(a)]	Annual NO_X PC ($\mu g/m^3$)	CL ($\mu g/m^3$)	Background ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PEC as %age of CL
TCC1	**0.411**	30	**30.27**	**30.68**	**102%**
TCC2	**0.854**		**35.78**	**36.63**	**122%**
TCC3	**0.515**		**35.78**	**36.30**	**121%**
TCC5	**0.390**		25.65	26.04	87%
TCC6	**0.357**		28.89	29.25	97%
TCC8	**0.473**		**49.10**	**49.57**	**165%**
TCC9	**0.916**		27.93	28.85	96%
TCC13	**0.942**		21.52	22.46	75%
TCC14	**0.374**		24.14	24.51	82%

Notes to Table
(a) Refer to Section 2.4 of ECL Report ECL.007.04.01/ADM, for further details regarding the receptor name and designation.
CL = Critical Level.

4.2.5. It can be seen from the results in Table 15, that whilst it can be assumed for TCC5, TCC6, TCC9, TCC13 and TCC14 that there will be no adverse effect (i.e., the PECs are less than 100% of the critical level), the PECs for TCC1, TCC2, TCC3 and TCC8 are potentially significant.

4.2.6. The data shows that the ambient background levels at TCC1, TCC2, TCC3 and TCC8 already exceed the long-term critical level in the absence of the development (i.e., a concentration that is 103% of the critical level at TCC1, 119% at TCC2 and TCC3 and 164% at TCC8).

4.2.7. As discussed in Section 5.2 of ECL's dispersion modelling report ECL.007.04.01/ADM., BSG have provided the following assessment, (see BSG's reports in Appendix 2 of ECL's dispersion modelling report ECL.007.04.01/ADM):

The habitats at the various modelling points are either intertidal mudflat or are permanently inundated with sea water. Mudflat is not considered to be sensitive to elevated NO_X levels of the magnitude predicted for the proposed development due to the effects of inundation, dilution, tidal mixing and dispersal.

It is also understood that parts of the estuary are subject to dredging in order to maintain a navigable channel. The removal of sediment will by default result in the removal of nutrients contained within those sediments.

Examination of the evidence base for the Teesmouth and Cleveland Coast SPA / Ramsar extension indicates that, whilst some tern species may feed within the estuary (and potentially in the vicinity of the areas where small-scale exceedance of NO_X are predicted), most of the qualifying species are associated with more distant areas. Terns are mainly piscivorous and it is concluded that the predicted air quality changes are not likely to affect prey availability and hence the conservation status of these species.

4.2.8. Consequently, based on the above and the fact that the PCs are only add a small amount to the background, it can be assumed there will be no adverse effect at all locations considered.

4.3. Comparison of Maximum Predicted Pollutant Ground Level Concentrations with Critical Levels for the Protection of Vegetation and Ecosystems - Sulphur Dioxide

4.3.1. A summary of maximum predicted GLCs of sulphur dioxide at the identified sensitive habitat sites are presented in Table 16. In accordance with the EA Online Guidance, the significance of the impacts has been determined using the 1% criteria for long-term predictions, for SPAs, SACs, Ramsars and SSSIs (see Section 2.22. of ECL's dispersion modelling report ECL.007.04.01/ADM). Any significant impacts are highlighted in bold.

Table 16: Comparison of Maximum Predicted Sulphur Dioxide Ground Level Concentrations (PCs) with Critical Levels at Sensitive Habitat Sites

	Pollutant	SO_2 (annual mean)
	Critical Level (µg/m^3)	20 [(a)]
	Maximum PC (µg/m^3)	**0.247**
	Max PC as % of Critical Level	**1.23%**
NYM1	North York Moors - SAC / SPA	0.0212
TCC1	Teesmouth and Cleveland Coast - SPA / SSSI	0.1132
TCC2		**0.235**
TCC3		0.141
TCC4		0.0640
TCC5	Teesmouth and Cleveland Coast - SPA / Ramsar	0.1075
TCC6		0.0995
TCC7		0.0602
TCC8		0.1271
TCC9		**0.247**
TCC10		0.0569
TCC11		0.0797
TCC12		0.0476
TCC13		**0.242**
TCC14	Teesmouth and Cleveland Coast – SSSI	0.098

Notes to Table

(a) From a review of the citations for each particular ecological designation, of the range of features noted, lichens and bryophytes are not included. It has therefore been considered that lichens and bryophytes are not important components of the ecological habitat sites modelled, with the critical level of 20 µg/m^3 therefore used.

4.3.2. It can be seen from the data in Table 16 that, with the exception of TCC2, TCC9 and TCC13 the annual mean sulphur dioxide PCs are all less than 1% of the critical levels and therefore are not significant at all SACs, SPAs, SSSIs and Ramsar sites considered.

4.3.3. It should be noted that the background SO_2 concentration at TCC13, as reported by APIS is 0 µg/m^3. However, it is suspected this value is erroneous and in the interest of being conservative the SO_2 value from TCC11 (i.e., the receptor closest in distance to TCC13) of 2.38 µg/m^3 will be used for calculating the SO_2 PECs for TCC13. PECs are provided in Table 17.

Table 17: Comparison of Maximum Predicted Environemntal Concentrations of Sulphur Dioxide with Critical Levels at Sensitive Habitat Sites

ECL Receptor Ref	Receptor Name	Long Term PC (µg/m³)	Long Term Critical Level (CL) (µg/m³)	Long Term PC as a % of the CL (µg/m³)	Background (µg/m³)	PEC (µg/m³)	PEC as %age of CL
TCC2	Teesmouth and Cleveland Coast - SPA (+ SSSI)	**0.235**	20	**1.18%**	3.05	3.29	16.4%
TCC9	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.247**		**1.23%**	3.89	4.14	20.7%
TCC13		**0.242**		**1.21%**	2.38	2.62	13.1%

4.3.4. Consequently, as all PECs are less than 100% of the critical level, it can be assumed there will be no adverse effect at all locations.

4.4. Comparison of Maximum Predicted Pollutant Ground Level Concentrations with Critical Levels for the Protection of Vegetation and Ecosystems - Ammonia

4.4.1. A summary of maximum predicted GLCs of ammonia at the identified sensitive habitat sites are presented in Table in Table 18. In accordance with the EA Online guidance, the significance of the impacts has been determined using the 1% criteria for long-term predictions, for SPAs, SACs, Ramsars and SSSIs. Any significant impacts are highlighted in bold.

Table 18: Comparison of Maximum Predicted Ammonia Ground Level Concentrations (PCs) with Critical Levels at Sensitive Habitat Sites

	Pollutant	NH_3 (annual mean) - Other Vegetation
	Critical Level (µg/m^3)	3 [(a)]
	Maximum PC (µg/m^3)	**0.850**
	Max PC as % of Critical Level	**2.83%**
NYM1	North York Moors – SAC / SPA	0.00716
TCC1	Teesmouth and Cleveland Coast – SPA / SSSI	**0.0392**
TCC2	Teesmouth and Cleveland Coast – SPA / SSSI	**0.0810**
TCC3	Teesmouth and Cleveland Coast – SPA / SSSI	**0.0485**
TCC4	Teesmouth and Cleveland Coast – SPA / SSSI	0.0220
TCC5	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.0372**
TCC6	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.0343**
TCC7	Teesmouth and Cleveland Coast - SPA / Ramsar	0.0207
TCC8	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.0432**
TCC9	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.0850**
TCC10	Teesmouth and Cleveland Coast - SPA / Ramsar	0.0195
TCC11	Teesmouth and Cleveland Coast - SPA / Ramsar	0.0271
TCC12	Teesmouth and Cleveland Coast - SPA / Ramsar	0.0162
TCC13	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.0814**
TCC14	Teesmouth and Cleveland Coast – SSSI	**0.0331**

Note to Table

(a) From a review of the citations for each particular ecological designation, of the range of features noted, lichens and bryophytes are not included. It has therefore been considered that lichens and bryophytes are not important components of the ecological habitat sites modelled, with the critical level of 3 µg/m^3 therefore used.

4.4.2. It can be seen from the data in Table 18 that the annual mean ammonia PCs are all less than 1% of the critical level at some of the ecological sites. The impact is potentially significant (i.e., greater than 1% of the long-term critical level) at TCC1, TCC2, TCC3, TCC5, TCC6, TCC8, TCC9, TCC13 and TCC14. Consequently, PECs will need to be calculated for these receptors.

4.4.3. Using the relevant background NH_3 concentrations, provided in Table 6 of Section 2.8 of ECL's dispersion modelling report ECL.007.04.01/ADM, the PEC assessment for the potentially significant receptors is provided in Table 19.

Table 19: Comparison of Maximum Predicted NH_3 PECs with Critical Levels at Sensitive Habitat Sites

ADMS Ref. [(a)]	Annual NH_3 PC ($\mu g/m^3$)	CL ($\mu g/m^3$)	Annual NH_3 PC as %age of CL	Background ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PEC as %age of CL
TCC1	**0.0392**	3	**1.31%**	1.60	1.639	54.6%
TCC2	**0.0810**		**2.70%**		1.68	56.0%
TCC3	**0.0485**		**1.62%**		1.649	55.0%
TCC5	**0.0372**		**1.24%**		1.637	54.6%
TCC6	**0.0343**		**1.14%**		1.634	54.5%
TCC8	**0.0432**		**1.44%**		1.643	54.8%
TCC9	**0.0850**		**2.83%**	1.42	1.505	50.2%
TCC13	**0.0814**		**2.71%**	0.89	0.971	32.4%
TCC14	**0.0331**		**1.10%**	1.71	1.743	58.1%

Notes to Table
CL = Critical Level.

4.4.4. As displayed by the results in Table 19, it can be assumed that there will be no adverse effect on the ecological sites assessed (i.e., the PECs are all less than 100% of the critical level).

4.5. Comparison of Maximum Predicted Pollutant Ground Level Concentrations with Critical Levels for the Protection of Vegetation and Ecosystems - Hydrogen Fluoride

4.5.1. A summary of maximum predicted GLCs of hydrogen fluoride at the identified sensitive habitat sites are presented in Table 20. In accordance with the EA Online guidance, the significance of the impacts has been determined using the 1% and 10% criteria for long and short-term predictions, respectively, for SPAs, SACs, Ramsars and SSSIs. Any significant impacts are highlighted in bold.

Table 20: Comparison of Maximum Predicted Hydrogen Fluoride Ground Level Concentrations (PCs) with Critical Levels at Sensitive Habitat Sites

	Pollutant	HF (weekly mean)	HF (daily mean)
	Critical Level (µg/m³)	0.5	5
	Maximum PC (µg/m³)	**0.0271**	0.0548
	Max PC as % of Critical Level	**5.42%**	1.10%
NYM1	North York Moors - SAC / SPA	0.00483	0.00744
TCC1	Teesmouth and Cleveland Coast - SPA / SSSI	**0.0222**	0.0548
TCC2		**0.0271**	0.0482
TCC3		**0.0165**	0.0385
TCC4		**0.0177**	0.0315
TCC5	Teesmouth and Cleveland Coast - SPA / Ramsar	**0.0203**	0.0498
TCC6		**0.0205**	0.0386
TCC7		**0.0156**	0.0276
TCC8		**0.0137**	0.0306
TCC9		**0.0220**	0.0516
TCC10		**0.01026**	0.0199
TCC11		**0.0139**	0.0360
TCC12		**0.00769**	0.0168
TCC13		**0.0187**	0.0454
TCC14	Teesmouth and Cleveland Coast – SSSI	**0.0190**	0.0307

4.5.2. It can be seen from the data in Table 20 that the daily mean HF PCs are all less than 10% of the critical levels and therefore are not significant at all SACs, SPAs, SSSIs and Ramsar sites considered.

4.5.3. For the weekly mean HF PCs, a conservative approach has been taken and the significance of impacts have been assessed against the 1% criterion for long-term predictions. Consequently, the weekly average HF PCs are greater than 1% of the critical level for TCC1- TCC14, inclusive, and are therefore potentially significant. For NYM1 the long-term significance criteria has not been exceeded (being less than 1% of the critical level).

4.5.4. For the ecological receptors with PCs that are potentially significant PECs will need to be calculated. Monitoring of ambient levels of HF is not currently carried out in the UK. A modelling study has suggested a natural background concentration of 0.0005 µg/m^3 with an elevated background of 0.003 µg/m^3 where there are local anthropogenic emission sources [(4)]. In the interest of being conservative, the higher background concentration (i.e., 0.003 µg/m^3) will be used for the purposes of calculating the PECs.

(4) EPAQS (February 2006), Guidelines for Halogen and Hydrogen Halides in Ambient Air for Protecting Human Health Against Acute Irritancy Effects

4.5.5. For all three installations in combination, the maximum weekly HF PC occurs at TCC2 and the worst-case PEC at TCC2 would be 0.0301 (or 6.02% of the weekly critical level). Consequently, it can be assumed that there will be no adverse effect.

5. ASSESSMENT IMPACTS ON HABITAT SITES – DEPOSITION

5.1. Introduction

5.1.1. Sections 9.15. and 9.16. of ECL's dispersion modelling report ECL.007.04.01/ADM, considered the effect of cumulative emissions from the Installation and REC on critical loads for the habitat sites identified in Table 2 of the same report. The deposition velocities for grassland (as outlined in Table 8 of Section 2.9. of ECL's dispersion modelling report ECL.007.04.01/ADM,) were utilised for all ecological sites assessed. This section compares the cumulative impact of all three installations.

5.2. Comparison of Maximum Predicted Nutrient Nitrogen Deposition Rates with Critical Loads – European Sites and SSSIs

5.2.1. A summary of maximum predicted nutrient nitrogen deposition rates at the identified European Sites and SSSIs are presented in Table 21.

5.2.2. It should be noted that, as APIS does not provide data for Ramsar sites, as the Ramsar site (i.e., TCC5 – TCC13) is noted for the same bird species as the SPA, it is reasonable to assume that the site should be treated in the same way. Consequently, the habitat interest and feature selected for the SPA has also been selected for the Ramsar site considered.

5.2.3. In Table 21, any PCs greater than 1% of the critical load and PECs greater than 100% (i.e., the level beyond which it cannot be assumed that there will be no adverse effect on European Sites and SSSI's) of the critical load are highlighted in bold.

Table 21: Comparison of Maximum Predicted Nutrient Nitrogen Deposition Rates with Critical Loads at Sensitive Habitat Sites – European Sites and SSSIs

ADMS Ref.	Site Details	Lower Critical Load (kgN/ha/yr)	Upper Critical Load (kgN/ha/yr)	Nutrient Nitrogen Deposition Rate [(a)] (kgN/ha/yr)	PC as a % of Lower Critical Load	PC as a % of Upper Critical Load	Background Conc. (kgN/ha/yr)	PEC (kgN/ha/yr)	PEC as % of Lower Critical Load	PEC as a% of Upper Critical Load
NYM1	North York Moors – SAC (Blanket Bogs – Raised and blanket bogs)	5	10	0.0327	0.65%	0.33%	n/a	n/a	n/a	n/a
	North York Moors – SPA (European Golden Plover – Reproducing – Montane habitats)	5	10	0.0327	0.65%	0.33%	n/a	n/a	n/a	n/a
TCC1	Sandwich Tern / Little Tern - Supralittoral sediment - Coastal stable dune grasslands (calcareous type)	10	15	**0.210**	**2.10%**	**1.40%**	8.96	9.17	92%	61%
TCC2				**0.399**	**3.99%**	**2.66%**		9.36	94%	62%
TCC3				**0.261**	**2.61%**	**1.74%**		9.22	92%	61%
TCC4				**0.1180**	**1.18%**	0.79%		9.08	91%	n/a
TCC5				**0.197**	**1.97%**	**1.31%**		9.16	92%	61%
TCC6				**0.184**	**1.84%**	**1.23%**		9.14	91%	61%
TCC7				**0.1098**	**1.10%**	0.73%		n/a	n/a	n/a
TCC8				**0.227**	**2.27%**	**1.52%**		9.19	92%	61%
TCC9				**0.439**	**4.39%**	**2.93%**	8.4	8.84	88%	59%
TCC10				0.0955	0.95%	0.64%	8.96	n/a	n/a	n/a
TCC11				**0.144**	**1.44%**	0.96%	10.78	**10.92**	**109%**	73%
TCC12				0.0798	0.80%	0.53%		n/a	n/a	n/a
TCC13				**0.462**	**4.62%**	**3.08%**	9.1	9.56	96%	64%
TCC14				**0.179**	**1.79%**	**1.19%**	10.78	**10.96**	**110%**	73%

Notes to Table
(a) Total PC to nutrient nitrogen deposition is derived from the sum of the contribution from Nitrogen and Ammonia (dry deposition only).

5.2.4. It can be seen from the data in Table 16 that, following the calculations of the PECs, there are predicted exceedances for nitrogen deposition at modelling points TCC11 and TCC14, with the remaining sites screening out as insignificant.

5.2.5. Background levels are already elevated, this heavily dominates the PCs from the three installations.

5.2.6. At both TCC11 and TCC14 the background levels already exceed the lower critical load in the absence of the predicted process contributions from the installations. Extensive discussions have been held with NE and their concluding response is that:

Given that the predicted exceedance is small and should be taken in the context with the elevated background concentrations, Natural England does not require further information at this stage.

5.2.7. The full Natural England response may be found in ECL's dispersion modelling report ECL.007.04.01/ADM).

5.3. Comparison of Maximum Predicted Acid Deposition Rates with Critical Loads – European Sites and SSSIs

5.3.1. A summary of maximum predicted acid deposition rates at the identified European Sites and SSSIs are presented in Table 22. Habitat Interests considered are as specified in Table 5 of Section 2.7. of ECL's dispersion modelling report ECL.007.04.01/ADM, with the deposition velocities for grassland used for all ecological sites assessed.

5.3.2. In Table 22, any PCs greater than 1% of the critical load, and PECs greater than 100% (i.e., the level beyond which it cannot be assumed that there will be no adverse effect on European Sites and SSSI's) of the critical load are highlighted in bold.

Table 22: Comparison of Maximum Predicted Acid Deposition Rates with Critical Loads at Sensitive Habitat Sites – European Sites and SSSIs

ADMS Ref.	Site Details	PC N (keq/Ha/yr)	BG N (keq/ha/yr)	PC S (keq/Ha/yr)	BG S (keq/ha/yr)	CL MinN (keq/ha/yr)	CL MaxN (keq/ha/yr)	CL MaxS (keq/ha/yr)	PEC N (keq/ha/yr)	PEC S (keq/ha/yr)	PC as % of CL	Total PEC (keq/ha/yr)	PEC as % of CL
NYM1	North York Moors – SAC (Blanket Bogs – Raised and blanket bogs)	0.00233	1.36	0.00247	0.18	0.321	0.504	0.183	1.36	0.182	1.0%	n/a	n/a
	North York Moors – SPA (European Golden Plover – Reproducing – Montane habitats)	0.00233	1.36	0.00247	0.18	0.178	0.47	0.150	1.36	0.182	1.0%	n/a	n/a
TCC1	Teesmouth and Cleveland Coast – SPA Sandwich Tern / Little Tern - Supralittoral sediment - Coastal stable dune grasslands (calcareous type)	0.01498	1.03	0.01578	0.20	0.856	4.856	4.00	1.04	0.216	0.63%	n/a	n/a
TCC2		0.0309	1.03	0.0327	0.20	0.856	4.856	4.00	1.06	0.233	**1.3%**	1.29	27%
TCC3		0.01858	1.03	0.0196	0.20	0.856	4.856	4.00	1.05	0.220	0.79%	n/a	n/a
TCC4		0.00840	1.03	0.00888	0.20	0.856	4.856	4.00	1.04	0.209	0.36%	n/a	n/a

Table 22: Comparison of Maximum Predicted Acid Deposition Rates with Critical Loads at Sensitive Habitat Sites – European Sites and SSSIs (cont.)

ADMS Ref.	Site Details	PC N (keq/Ha/yr)	BG N (keq/ha/yr)	PC S (keq/Ha/yr)	BG S (keq/ha/yr)	CL MinN (keq/ha/yr)	CL MaxN (keq/ha/yr)	CL MaxS (keq/ha/yr)	PEC N (keq/ha/yr)	PEC S (keq/ha/yr)	PC as % of CL	Total PEC (keq/ha/yr)	PEC as % of CL
TCC1 – TCC4 & TCC14	Teesmouth and Cleveland Coast - SSSI	No information currently held / accessible via APIS' portal											
TCC5	Teesmouth and Cleveland Coast – SPA / Ramsar Sandwich Tern / Little Tern - Supralittoral sediment - Coastal stable dune grasslands (calcareous type)	0.01404	1.03	0.01481	0.20	0.856	4.856	4.00	1.04	0.215	0.59%	n/a	n/a
TCC6		0.01308	1.03	0.01386	0.20	0.856	4.856	4.00	1.04	0.214	0.55%	n/a	n/a
TCC7		0.00782	1.03	0.00827	0.20	0.856	4.856	4.00	1.04	0.208	0.33%	n/a	n/a
TCC8		0.0162	1.03	0.01721	0.20	0.856	4.856	4.00	1.05	0.217	0.69%	n/a	n/a
TCC9		0.0313	1.01	0.0329	0.23	0.856	4.856	4.00	1.04	0.263	**1.3%**	1.30	27%
TCC10		0.00680	1.03	0.00721	0.20	0.856	4.856	4.00	1.04	0.207	0.29%	n/a	n/a
TCC11		0.01026	1.07	0.01086	0.28	0.856	4.856	4.00	1.08	0.291	0.43%	n/a	n/a
TCC12		0.00568	1.07	0.00600	0.28	0.856	4.856	4.00	1.08	0.286	0.24%	n/a	n/a
TCC13		0.0329	0.75	0.03483	0.25	0.856	4.856	4.00	0.783	0.285	0.87%	n/a	n/a

Notes to Table
PC N = Process contribution from Nitrogen and Ammonia (dry deposition only)
PC S = Process contribution from Sulphur (dry deposition) and Hydrogen Chloride (wet and dry deposition)
PEC = Predicted environmental concentration
BG = Background concentration
CL = Critical Load

5.3.1. It can be seen from the data in Table 22 that the maximum acid deposition rates due to process contributions do not exceed 1% of the critical load at all the modelled points, with the exception of TCC2 and TCC9. However, as the PECs at these locations are less than 100% of the critical load, no further assessment is required.

6. CONCLUSION

6.1. Purpose of Assessment

6.1.1. Cumulative impacts form the FCC Installation in combination with the REC were initially considered as part of ECL's dispersion modelling report ECL.007.04.01/ADM. Subsequently, it was discovered that a further development was planned for the site adjacent to the FCC Installation – the CFA – and consequently a further cumulative assessment was undertaken.

6.2. Impact at Maximum point of GLC

6.2.1. For the majority of pollutants, the maximum GLCs were higher with all three installations, as would be expected when adding another emission point. However, with the FCC and REC Installations operating together the location of the maximum GLC is closer to the REC than the FCC Installation, thus indicating that it is the REC emissions that are dominant.

6.2.2. When all three installations are considered, the location of the maximum GLC is now located closer to the CFA, thus indicating that the CFA emissions are dominant.

6.2.3. All emissions from the three installations do screen out with the exception of Cr(VI), PAH (as B[a]P) and VOC).

6.2.4. For Cr(VI) PCs from the FCC installation in isolation can be considered not significant, and when the FCC and the REC are considered together the impact only just exceeds the significance criteria. However, when all three installations are considered, the PC is 2.90% of the AQS, the majority of this impact is attributable to the CFA, its PC being 2.84% alone.

6.2.5. When the FCC Installation in-combination with the REC are modelled, the maximum predicted annual GLC for Cr(VI), occurs in an area approximately 400m north of REC (456145 (X), 526349 (Y)) and is therefore, in the context of this modelling study, more likely to be associated with the predicted PCs for REC's two emission points. However, when all three installations are considered, the maximum predicted annual GLC for Cr(VI) occurs in an area approximately 22m north of the CFA's oxidiser stack location at 454745, (X), 521509(Y)). A further indicator that the majority of the impact associated with Cr(VI) is attributable to the CFA.

6.2.6. As the PC for Cr(VI) from all three installations operating in combination was still considered to be potentially significant, further assessment was undertaken at the potentially sensitive human receptor locations. All PCs at these locations were less than 1% of the AQS and therefore the impact was considered not significant.

6.2.7. For VOC as benzene the cumulative concentrations observed with all three facilities operating are significantly higher than when just the FCC and REC are operating. Again, it is the emissions from the CFA that dominate, and are 137% of the AQS. The FCC and REC installations having PCs of 1.4% and 3.47% respectively. The location of the maximum is also located approximately 100m northwest of the CFA's oxidiser stack.

6.2.8. As the PC for VOC from all three installations operating in combination was still considered to be potentially significant further assessment was undertaken at the potentially sensitive human receptor locations. PCs at the sensitive receptor locations varied from 3.1% to 22%, and when PECs were calculated they could be classed as 'negligible' to 'moderate'. However, as the maximum PEC did not exceed 30% of the AQS it can be concluded that the impact on air quality from VOCs would be not significant at the HSRs.

6.2.9. For PAH (as B[a]P), the cumulative concentrations observed with all three facilities operating are only slightly higher than when just the FCC and REC are operating. For this pollutant, it is the emissions from the REC that dominate the cumulative impact with emissions from the REC, REC + FCC and all three installations in combination being classed as substantial. Impacts from both FCC and the CFA in isolation can be considered negligible.

6.2.10. When the FCC Installation in-combination with the REC are modelled, the maximum predicted annual GLC for PAH occurs in an area approximately 495m northeast of the REC (456185 (X), 526429 (Y)) and is therefore, in the context of this modelling study, more likely to be associated with the predicted PCs for REC's two emission points. Further assessment of the impact was therefore undertaken at the location of the potentially sensitive human receptors. PCs ranged from 1% to 5% however all PECs could be classed as 'slight'. It should be noted that the impact at all locations is heavily influenced by the background concentration which is already 82% of the AQS. As there are no breaches of the AQS it can be concluded that the impact on air quality would be not significant at the HSRs.

6.3. Impact at Potentially Sensitive Receptors

6.3.1. Cumulative impacts of all three installations at potentially sensitive receptors have not been individually modelled (with the exception of Cr(VI), PAH and VOC). As the maximum point of impact of all pollutants can be considered not significant then by default all other points modelled can also be considered not significant.

6.3.2. For those pollutants which did not screen out - Cr(VI), PAH and VOC – further assessment at the potentially sensitive receptor locations has been undertaken, and concluded that there are no breaches of AQSs, consequently there would be no adverse impact on local air quality.

6.4. Impact on Habitat Sites – Critical Levels

6.4.1. The daily mean oxides of nitrogen PCs are all less than 10% of the respective critical level and therefore, are not significant at all SACs, SPAs, SSSIs and Ramsar sites considered. For the annual mean oxides of nitrogen PCs, the impact is potentially significant at TCC1-3, TCC5-6, TCC8-9 and TCC13-14 inclusive. Following assessment of the PECs, only concentrations at TCC1-3 and TCC8 remained potentially significant. This is mainly due to the ambient background levels at these locations already exceeding the long-term critical level in the absence of the development. However, further to discussion with ecologists, the predicted air quality changes are not likely to affect species in the area. Consequently, based on the above and the fact that the PCs only add a small amount to the background, it can be assumed there will be no adverse effect at all locations considered

6.4.2. For SO_2, NH_3 and HF, all of the PECs are less than 100% of the critical level, therefore it can be assumed there will be no adverse effect at all locations.

6.5. Impact on Habitat Sites – Deposition

6.5.1. Following the calculations of the PECs for nutrient nitrogen, there are predicted exceedances for nitrogen deposition at modelling points TCC11 and TCC14, with the remaining sites screening out as insignificant.

6.5.2. Extensive discussions have been held with NE and their response is that:

Given that the predicted exceedance is small and should be taken in the context with the elevated background concentrations, Natural England does not require further information at this stage.

6.5.3. For acid deposition, the maximum acid deposition rates due to process contributions are less than 1% of the critical load at all the modelled points, with the exception of TCC2 and TCC9. However, as the PECs at these locations are less than 100% of the critical load, no further assessment is required.

6.6. Summary

6.6.1. Emissions from all three installation in combination are higher than just the FCC Installation and the REC in combination (as would be expected), however, the maximum point of ground level concentration for the majority of pollutants now occurs in closer proximity to the CFA. This indicates that the CFA does have an impact on the local air quality when considered in combination with the FCC Installation and the REC – particularly in the case of some pollutants e.g. VOC. It is considered that this could be due to the shorter stack height of the CFA oxidiser at 37m (compared to the FCC and REC installations 90m and 80m respectively), hence plume grounding occurs closer to the stack location.

6.6.2. While it is clear there is an additional impact on local air quality from the three installations in combination, and that the majority of the impact for certain pollutants is attributable to the CFA, further assessment has demonstrated that the impacts on potentially sensitive human receptors and ecological sites can be considered not significant.