Chapter 14 Air Quality

14. Air Quality

Introduction and Methodology

Scope and Planning Context

14.1 This chapter assesses the potential for a local air quality impact from the proposed development, primarily due to emissions from the operational aspects of the proposed facilities.

14.2 The assessment aims to evaluate the likelihood and possible magnitude of an adverse impact in relation to national and local air quality objectives and strategies, and if found necessary, to detail mitigation that will ensure the proposed development will comply with the requirements of PPS11 Planning and Waste Management and in particular Policy WM1 'Environmental Impact of a Waste Management Facility'.

Proposed Development (Key Facts for Air Quality Assessment)

14.3 The MBT facility will include front-end mechanical sorting of waste to recover quality recyclates followed by biological treatment of the remaining organic rich fraction in a series of bio-drying tunnels. The MBT facility comprises the following main elements:

- Delivery and reception;
- Waste pre-treatment, shredding and automatic sorting, with a design capacity to receive and treat approximately 300,000 tonnes of municipal waste per annum;
- Biological treatment; and
- Exhaust air treatment.

14.4 The exhaust air treatment from the biological treatment process consists of a two stage treatment process. For the first stage of treatment exhaust air is passed through an acid scrubber for the removal of ammonia, which is followed by the passing of the air through a biofilter for the removal of odours. The acid scrubbing stage is required to protect micro-organisms in the biofilter from ammonia, and comprises two vertical packed tower columns into which a sulphuric acid solution, or similar, is pumped. The control of the acid solution is based on its pH, and there is also monitoring of pressure and temperature at different stages within the system, the exhaust air temperature being kept below 38°C.

14.5 The exhaust air is then passed to the biofilter which will have four separate areas which can be taken off line independently for maintenance. The base of the biofilter is an aeration floor to distribute the exhaust air up into the two layers of biofilter material, the first layer being approximately 0.6m of 40-80mm wood chippings, the second layer being approximately 1.2m of 20-40mm mixed bark, pine wood chips and possibly coconut fibre, though the composition of those fillings may be varied. The exhaust air is then drawn by fans to be emitted via a single stack adjacent the central building housing the acid scrubber system.

14.6 The key features of the EfW facility will include:

- Single line grate stoker with 68MWTH thermal input;
- Expected to receive and treat up to 245,000 (approximately) tonnes per annum of process waste output from the MBT,211,000 tonnes at design load point LPB (of the Capacity Diagram for the EfW) for the year 2019/20;
- Condensing turbo generator with air cooler condenser;
- Export approximately 14MW of electricity to the grid;
- Efficiency criteria R1 of 0.734 (in excess of 0.65 threshold) corresponding to design load point LPB operation with maximal heat export to MBT and maximal EfW internal heating. The Waste Framework Directive 2008/98/EC specifies the formula to calculate the efficiency criteria and so long as the value is above the 0.65 threshold the EfW plant can be classed under that Directive as a recovery operation (R1) rather than a disposal operation (D10);
- Electrical Efficiency at design load point LPB without heat extraction – generator output: 27%;
- DeNOX by Selective Non-Catalytic Reduction (SCNR) Flue Gas Treatment using Ammonia solution;
- Semi-dry flue gas cleaning using hydrated lime sorption and bag filters for the removal of acidic gas components hydrogen chloride HCl, HF and sulphur dioxide SO_2/SO_3 (SO_2);
- Reactions for absorption of heavy metals, mercury and dioxins/furans take place in the dry sorption reactor by adding activated carbon; and
- Overall expected annual waste throughput availability of approximately 8,000 hours.

14.7 The EfW plant consists primarily of the following elements:

- Waste tipping hall and waste storage bunker;
- Combustion and steam generation facility;
- Electricity generating turbo generator and transmission infrastructure;
- Flue gas treatment system;
- Water/steam circulation system;
- Auxiliary Fuel Supply systems; and
- Automation and Control System.

14.8 The flue gas cleaning unit will be designed as a dry or semi-dry flue gas system to comply with the emission limits required by the Industrial Emissions Directive (2010/75/EC). The Industrial Emissions Directive (IED) revises and replaces seven existing directives into one, including the WID, and implementation of the IED applies from 6 January 2013 in respect of new installations after that date.

14.9 To comply with the permitted target emission levels, the flue gas is first cooled by water injection to achieve the optimum temperature and moisture for absorption, then treated in a dry reactor by hydrated lime ($Ca\ (OH)_2$) to separate the acid components (SO_2 and HCl) and activated carbon to eliminate organic compounds (dioxins) and heavy metals (mercury). To meet the limiting value for NO_x an SNCR-system is proposed comprising an ammonia injection system.

14.10 The EfW incinerator bottom ash (IBA) is to be treated on site in a separate facility, to separate ferrous and non-ferrous metals and to produce marketable aggregates.

14.11 As IBA is a heterogeneous mixture of minerals, metals, unburned waste and water the treatment focuses mainly on the mechanical separation of those components and to allow completion of the chemical reactions (hydration and carbonation) which commence during the quenching of the incinerator ash.

14.12 For this reason the bottom ash is initially stored in the nearby IBA Treatment Facility for approximately 4-6 weeks to mature, and during that period of time water will be applied to the bottom ash using a roof installed sprinkler / hydrant system to aid the maturation process and also to provide dust suppression.

14.13 That maturation process will take place in the proposed IBA treatment facility where the IBA will be stored. The raw IBA is introduced into the building by trucks from the EfW facility.

14.14 As a result of the quenching within the EfW bunker the bottom ash has a high initial moisture content up to 25%, and therefore there is not a risk of fugitive emissions to air from the IBA.

14.15 Other sources of emissions to air at the EfW are an emergency power generator which uses diesel, an emergency gasoil heating boiler, and pressure release safety valves atop the ammonia storage tanks. Those emissions have not been appraised because they relate to short periods of maintenance or safety situations. The emergency power generator is to provide emergency power operation and to facilitate the safe shut down of the EfW for maintenance or fault of the grid connection, with annual operation of the generator estimated at 60 hours (monthly testing excluded). The emergency boiler will be used if for the production of heat and hot water when the EfW plant has to be shut down. The ammonia tank safety valves open only by pressure greater than 200mbar in the tanks, but in normal operation those safety valves do not open because when filling from tanker the gases in the tanks return to that tanker.

Anticipated Vehicle Movements

14.16 It is proposed that the eleven Councils within the arc21 area will deliver their municipal waste to the proposed development for treatment.

14.17 The operational site is accessed from the Boghill Road off Hydepark Road and has a history of HGV movements associated with the quarrying activities, as explained in Chapter 12 of the ES and Appendix 12.1.

14.18 Boghill Road leads onto Flush Road, although it is noted that this road has a 7.5 tonne weight limit and is therefore unable to accommodate tipper traffic. Key routes in the vicinity of the application site are therefore:

- Hydepark Road;
- Hightown Road;
- Mallusk Road; and
- Scullions Road which provides access to Sandyknowes Roundabout and the motorway network.

Assessment Methodology

14.19 The assessment in this chapter is based upon comparison of the baseline local air quality (current and projected without the development proposals) at the application site to the air quality impacts predicted to result from the development proposal.

14.20 Operation of the proposed development will require an environmental permit, so for emissions to air from the MBT and EfW the assessment methodology outlined by the Environment Agency's environmental permitting guidance, in particular its Horizontal Guidance H1 Environmental Risk Assessment and associated H1 Annex A – Amenity and accident risk from installations and waste activities, and Annex F – Air Emissions, has been applied. For possible impact from increased traffic the methodology outlined by the UK Design Manual for Roads and Bridges (DMRB) has been applied.

14.21 Both methodologies adopt a staged approach, commencing with screening of the potential impacts to determine whether the potential air quality impact may be significant and therefore require more detailed assessment, or insignificant such that they will have negligible impact and no further assessment is required.

14.22 A bioaerosol risk assessment has also been carried out even though there is not an existing workplace or existing dwelling within 250 metres of the stack for release of emissions from the MBT, as it is within that facility where biological treatment will be carried out. That is considered to be a conservative approach. The Environment Agency's Position Statement 031 Version 1, 1st November 2010, 'Composting and potential health effects from bioaerosols: our interim guidance for permit applicants', which applies across England and Wales, stipulates that when authorising new waste composting facilities, applicants will have to provide the Environment Agency with a site specific bioaerosol risk assessment if there is a sensitive receptor, i.e. a dwelling or workplace where workers are frequently present, within 250 metres of the composting site boundary. Workplace does not apply to the facility being assessed because the health of staff working at the facility is covered by Health and Safety Legislation.

Relevant Legislation and Guidance

National Air Quality Objectives

14.23 The objectives adopted in the UK are defined in the latest Air Quality Strategy for England, Scotland, Wales and Northern Ireland, published on 17th July 2007.

14.24 Those which are limit values required by EU Daughter Directives on Air Quality have been transposed into law through the Air Quality Standards Regulations (Northern Ireland) 2007 which came into force on 28th May 2007, and also the Air Quality Standards Regulations (Northern Ireland) 2010 which came into force on 11th June 2010.

14.25 The Air Quality (Northern Ireland) Regulations 2003 provide the statutory basis for air quality objectives which are required to be achieved under local air quality management. The air quality objectives are summarised in the following table.

Table 14.1 Summary of Statutory Air Quality Limit Values, Target Values and Objectives

Pollutant	Limit, Target or Objective	Measured as	To be achieved by
Benzene (2003 regulations) Benzene (2007 regulations)	16.25 µg/m^3 5 µg/m^3	Running Annual Annual Mean	31 December 2003 1 January 2010
1,3-Butadiene (2003 regulations)	2.25 µg/m^3	Running Annual Mean	31 December 2003
Carbon monoxide	10.0 mg/m^3	Maximum daily running 8 Hour Mean	1 January 2005
Lead	0.5 µg/m^3	Annual Mean	31 December 2004
	0.25 µg/m^3	Annual Mean	31 December 2008
Nitrogen dioxide and oxides of nitrogen	200 µg/m^3 not to be exceeded more than 18 times per year	1 Hour Mean	1 January 2010
	40 µg/m^3	Annual Mean	1 January 2010
	30 µg/m^3 for protection of vegetation and ecosystems	Annual Mean	In force since 19th July 2001
Ozone (objective)	100 µg/m^3 not to be exceeded on more than 10 times a year.	8 hr mean	31 December 2010
Ozone (2010	120 µg/m^3 not to be	Daily maximum of	Not defined

Pollutant	Limit, Target or Objective	Measured as	To be achieved by
regulations)	exceeded on more than 25 days per year over three years. Long term objective is 120 µg/m^3.	running 8 hr mean	
	(V) AOT 40 (calculated from 1 hr values) 18,000 µg/m^3.h averaged over five years. Long term objective is AORT 40 (calculated from 1 hr values) 6000 µg/m^3.h	May to July	Not defined
Particles (PM10 i.e. particulate matter <10µm) (gravimetric)	50 µg/m^3 not to be exceeded more than 35 times per year	24 Hour Mean	31 December 2004
	40 µg/m^3	Annual Mean	31 December 2004
In PM10 Arsenic Cadmium Nickel	 6 ng/m^3 5 ng/m^3 20 ng/m^3	 Annual Mean " "	 31 December 2012 31 December 2010 "
Particles* (PM2.5 i.e. particulate matter <2.5µm) (gravimetric)	25 µg/m^3	Annual Mean	2010
	20 µg/m^3	Annual Mean	1 January 2020
Sulphur dioxide	266 µg/m^3 Not to be exceeded more than 35 times per year	15 Minute Mean	31 December 2005
	350 µg/m^3 Not to be exceeded more than 24 times per year	1 Hour Mean	31 December 2004
	125 µg/m^3 Not to be exceeded more than 3 times per year	24 Hour Mean	31 December 2004
	20 µg/m^3 for the protection of vegetation and ecosystems	Annual Mean and Winter Mean (October - March)	In force since 19th July 2001
Notes: mg/m^3 - milligrams per cubic metre, µg/m^3 - micrograms per cubic metre, ng/m^3 – nanograms per cubic metre.			

14.26 The EU Directive on Ambient Air Quality and Cleaner Air for Europe (Directive 2008/50/EC) May 2008, which was transposed to national law in June 2010, introduced new objectives for fine particles PM2.5 but did not change the existing air quality standards. It did, however, give Member States greater flexibility in meeting some of the standards in areas where they have difficulty complying.

Emission Standards

Industrial Emissions Directive

14.27 The design and operation of incinerators is now governed by the European Communities' Industrial Emissions Directive (IED) 2010/75/EC, which requires adherence to emission limits for a range of substances as detailed in Table 14.2.

14.28 This air quality assessment therefore focuses on those substances and the IED emission limit values (ELV) have been used to calculate the maximum allowable emission concentrations for each substance, based on the design flow characteristics of the proposed new incinerator.

Table 14.2 Air Emission Limit Values specified in Annex VI of the IED (2010/75/EC)

Substance	**Daily Average Values**	**Half Hourly Average Values**	
		100%iles	**97%iles**
Total dust	10	30	10
Gaseous and vaporous organic substances, expressed as total organic carbon (TOC)	10	20	10
Hydrogen chloride (HCl)	10	60	10
Hydrogen fluoride (HF)	1	4	2
Sulphur dioxide (SO_2)	50	200	50
Nitrogen monoxide and nitrogen dioxide (NO_2) expressed as NO_2 (for new waste incinerator plants)	200	400	200
Carbon Monoxide (CO)	50	100, and 150 as 10 minute average	N/A
	Average values for minimum 30 minutes to maximum 8 hours		
Cadmium and its compounds, expressed as Cd, and Thallium and its compounds expressed as Tl (hereafter maybe referred to as Group 1)	Total 0.05		

Substance	Daily Average Values	Half Hourly Average Values	
		100%iles	97%iles
Mercury and its compounds, expressed as Hg (hereafter maybe referred to as Group 2)	Total 0.05		
Antimony and its compounds, expressed as Sb, Arsenic and its compounds expressed as As, Lead and its compounds expressed as Pb, Chromium and its compounds expressed as Cr, Cobalt and its compounds expressed as Co, Copper and its compounds expressed as Cu, Manganese and its compounds expressed as Mn, Nickel and its compounds expressed as Ni, Vanadium and its compounds expressed as V (hereafter maybe referred to as Group 3)	Total 0.5		
Dioxins and furans	0.0000001 as a 6 to 8 hour average of total concentration calculated using the concept of toxic equivalence in accordance with the IED Annex VI Part 2.		
Notes: 1. All values mg/m3 at applicable at: temperature 273K, pressure 101.3kPa, 11% oxygen, dry gas.			

Non Statutory Air Quality Objectives

For the Protection of Human Health

14.29 Where no formal air quality objectives exist, reference can be made to guidance published by the World Health Organisation (Air Quality Guidelines 2nd Edition), the DEFRA Expert Panel on Air Quality Standards (EPAQS), or environmental assessment levels (EALs) for air (for the protection of human health) derived by the Environment Agency and published in its environmental permitting Horizontal Guidance Note H1 – Annex F Air Emissions.

14.30 The H1 EALs may be revised over time, but are listed in the following table for the substances which may be emitted by the development, with values from other guidance if different. For more detailed evaluation quantitative risk assessment may be appropriate.

Table 14.3 Environmental Action Levels (for the Protection of Human Health)

Substance	Long term EAL (i.e. annual mean) µg/m^3	Short term EAL (i.e. hourly mean) µg/m^3	Maximum Deposition Rate in EPR H1 Annex F Table B8 mg/m2/day
Ammonia	180	2500	
Antimony	5	150	
Arsenic	0.003 (NB lower than air quality target for end 2012)		0.02
Benzene (surrogate for TOC)		195*	
Carbon monoxide		30,000	
Cadmium	0.005	1.5 *	0.009
Chromium (II and III)	5	150	1.5
Cobalt	0.2 *	6 *	
Copper	10	200	0.25
Dioxins and furans	None	None	
Hydrogen chloride (HCl)	20 **	750	
Hydrogen fluoride (HF)	16	160	Fluoride 2.1
Hydrogen sulphide	140	150	
Lead		N/A	1.1
Manganese	0.15	1500	
Mercury	0.25	7.5	0.004
Nickel		30	0.11
Sulphur Dioxide	50		
Thallium	1 *	30 *	
Vanadium	5	1 24hr	

Substance	Long term EAL (i.e. annual mean) µg/m³	Short term EAL (i.e. hourly mean) µg/m³	Maximum Deposition Rate in EPR H1 Annex F Table B8 mg/m2/day
Notes: * Denotes derived by Atkins from EH40/2001 as per Environment Agency methodology in H1 Annex F. ** From the Environment Agency's earlier Horizontal Guidance Note IPPC H1 v6 July 2003, though the Expert Panel on Air Quality Standard publication Guidelines for Halogens and Hydrogen Halides in Ambient Air for Protecting Human Health against Acute Irritancy Effects, 2006, states that for its recommended limit of 0.75mg/m³ over a 1 hour averaging period *"long term effects at these low concentrations are considered unlikely"*.			

For the Protection of Ecosystems and Vegetation

14.31 In addition to the levels defined in the AQS for NO_x and SO_2, the following EALs for the protection of ecosystems and vegetation are also defined in H1 as guideline levels which apply at nature conservation sites, with the most conservative value being used for screening purposes.

Table 14.4 Additional EALs for Ecosystems

Substance	EAL µg/m³	Measured as:
Ammonia	1	Annual mean. For sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's integrity.
	3	Annual mean. For all higher plants (all other ecosystems).
Sulphur dioxide	10	Annual mean. For sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's integrity.
	20	Annual mean. For all higher plants (all other ecosystems).
Nitrogen oxides (as NO_2)	30	Annual mean.
	75	Daily mean.
Hydrogen fluoride	<5	Daily mean.
	<0.5	Weekly mean.

Deposited Dust

14.32 In relation to air quality criteria for assessing dust there are two aspects, namely health effects and annoyance effects.

14.33 For health from inhalable dust the focus is on small particles less than 10 micro-metres in diameter, i.e. PM10, whereas for annoyance effects all sizes of particulate are considered.

14.34 Annoyance due to dust occurs as deposition levels and airborne dust concentrations increase, with dust deposition on windows, on the outside of houses and on cars being the most frequent causes.

14.35 Smaller dust particles remain airborne for longer, dispersing widely and depositing more slowly over a wider area. However there are no definitive British standards or limits for ambient dust for assessing annoyance, though various publications include suggested guidelines. These include the Environment Agency's Technical Guidance Document (Monitoring) M17 Monitoring of particulate matter in ambient air around waste facilities, March 2004 which refers to a 'custom and practice' limit in England and Wales of 200 mg/m^2/day being used for measurements with dust deposition gauges. There will be less risk with a lower rate and less likelihood of annoyance.

14.36 For the possible deposition to ground of substances within dust, the Environment Agency's environmental permitting guidance, H1 Annex F Air Emissions, also provides for indicative substances maximum deposition rates which can be used for initial assessment purposes.

Odour, Bio-aerosols and Plume Visibility

14.37 There is currently no legislation in the UK defining acceptable odour or bio-aerosol concentrations in terms of the concentrations, but "nuisance" must not occur. That is a subjective rather than objective measure and evaluation may vary from place to place for the same concentration of a given substance. A visible plume due to condensing water vapour may be a hazard if it could affect air traffic or safety near ground level, e.g. due to fog or ice on roadways, and may also have a visual amenity impact.

14.38 Planning Policy Statement 11 (PPS 11) Planning and Waste Management refers to waste management facilities, noting that good practice requirements are normally incorporated into the terms of waste licences. In general PPS11 provides a precautionary approach to ensuring that developments will not give rise to adverse impacts.

14.39 It notes that *"due to the potential for the generation of odour, dust, noise and bio-aerosols (including bacterial and fungal spores) the operation of commercial composting facilities can present problems in the vicinity of residential areas and workplaces".*

14.40 It adds *"While noise and dust can be adequately controlled thorough operational measures, both odour and bio-aerosols have the potential to impact on the public at some distance from the operations".*

14.41 DoE Planning's Development Control Circular addresses issues which may give rise to nuisance. This has been deemed to include odour and noise. Also potentially relevant is the Development Control Advice Note 10 (Revised 2012), Environmental Impact Assessment

(EIA), though that does not have statutory force and mainly gives general guidance on the operation of the Planning (EIA) Regulations (Northern Ireland) 2012.

14.42 Bio-aerosols are complex mixture of airborne micro-organisms and their products, which are ubiquitous, particularly in rural environments. The Environment Agency Position Statement 031 'Composting and potential health effects from bioaerosols: our interim guidance for permit applicants', refers to acceptable concentrations of bio-aerosols as predicted or from direct measurements at sensitive receptors which are attributable to composting operations open or enclosed as being 300, 1000 and 500 colony forming units (cfu) per m^3 for Gram negative bacteria, total bacteria and Aspergillus fumigatus respectively.

14.43 Gram negative bacteria are bacteria that do not retain crystal violet dye in the Gram staining protocol. In a Gram stain test, a counterstain is added after the crystal violet dye, colouring all Gram-negative bacteria with a red or pink colour. The test itself is useful in classifying two distinct types of bacteria based on the structural differences of their cell walls. Due to their structure containing endotoxin, Gram negative bacteria generally pose a greater health risk than other bacteria, though endotoxins are also present in some Gram positive bacteria, and serious health problems can arise from Aspergillus fumigatus, though there is a wide variability in individual susceptibility to bioaerosol exposure.

Explanation of Baseline Conditions

Application Site Details and Topography

14.44 Hightown Quarry is located in the Divis Summits Landscape Character Area on the north eastern slopes of the Belfast Hills, approximately 1km southwest of Hightown and 2.5km southwest of Glengormley. The overall quarry site covers some 62 hectares in total although the proposed application site extends to 52.4 hectares.

14.45 The application site is an active quarry and the floor of the quarry is stepped between two main terraces at +245m AOD and +260m AOD. Along the south of the application site the quarry faces rise to a maximum of +290m AOD (original ground level) with the north side of the quarry open to some remote views. There will be rock excavation required to level off these terraces to receive the proposed structures and for construction of internal access roads.

Meteorological Conditions

14.46 The most important meteorological parameters governing the atmospheric dispersion of pollutants are:

- wind direction;
- wind speed; and
- atmospheric stability, i.e. the amount of turbulence, particularly of the vertical motions.

14.47 For this study, hourly sequential meteorological data for 2004–2012 acquired for Belfast International Airport, has been used. That is because it is the nearest meteorological station with the necessary meteorological parameters for the dispersion model. Wind roses for each of those years are provided in Appendix 14.1, and show the prevailing wind to be south to south westerly, with an average wind speed of 4.22m/s and calm winds for 1.14% of the time.

Potential Receptors: Human

14.48 The following table provides details of the nearest potential receptors which are mainly dwellings and areas utilised by humans, around Hightown Quarry, and which may be sensitive to emissions associated with the proposed MBT and EfW plants.

Table 14.5 Indicative Receptors

No.	Potential Receptor & Grid Reference	Receptor Type e.g. Farm or Residence only	Details Relative to EfW Stack		
			Distance (m)	Elevation (mOD)	Direction
1	35 Boghill Rd. (329050, 381470)	Farm	1294	161.33	N
2	34 Boghill Rd. (329190, 391220)	Residence	1045	169.33	N
3	32 Boghill Rd. (329140, 380990)	Farm	812	184.11	N
4	26 Boghill Rd. (329370, 381110)	Residence	967	173.67	NNE
5	102 Upper Hightown Rd. (339330, 391140) proxy for Newtownabbey	Residence	1551	193.00	NW
6	100 Upper Hightown Rd. (330350, 381130) proxy for Newtownabbey	Farm	1561	193.67	NW
7	62 Upper Hightown Rd. (330120, 380370)	Farm	1025	210.00	E
8	43 Flush Rd. (330130, 379600)	Farm	1170	284.00	SE
9	53 Flush Rd. (329540, 379360)	Farm	923	280.67	SSE
10	65 Flush Rd. (329300, 379520)	Farm	684	262.00	S

No.	Potential Receptor & Grid Reference	Receptor Type e.g. Farm or Residence only	Details Relative to EfW Stack		
			Distance (m)	Elevation (mOD)	Direction
11	55 Flush Rd. (329160, 379100)	Residence plus possible industry	1079	279.00	S
12	69 Flush Rd. (329080, 379260)	Farm	919	276.00	S
13	120 Flush Rd. (328620, 380230)	Residence plus possible industry	496	244.67	W
14	133 Flush Rd. (328450, 380510)	Farm	742	223.00	WNW
15	148 Flush Rd. (328250, 380820)	Farm	1076	217.67	NW
16	149 Flush Rd. (328260, 380850)	Residence	1086	218.00	NW
17	151 Flush Rd. (328240, 380900)	Residence	1133	220.00	NW
18	55 Boghill Rd. (328390, 381200)	Residence	1252	206.89	NNW
19	45 Boghill Rd. (328730, 381390)	Residence plus business premises	1271	187.67	NNW
20	40 Boghill Rd. (328860, 381190)	Residence	1043	181.67	NNW
21	Belfast Centre AURN Site 103 (333900,374400)	Belfast monitoring station	7503	5	SSE

Notes: Distance is approximate from centre of EfW stack. Elevation is as interpolated from the terrain data by the dispersion model software (Aermap).

Potential Receptors: Ecological

14.49 The Environment Agency’s Horizontal Guidance Note H1 Environmental risk assessment for permits, Annex F – Air Emissions, requires that nature conservation sites are screened against relevant standards if the conservation sites occur within the following specified distance criteria:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 10km of the installation (or 15km coal or oil fired power station); or
- Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), Local Nature Reserves (LNRs), local wildlife sites and ancient woodland within 2km of the location of the installation.

14.50 The Environment Agency has developed the following four stage process for assessing the impact of regulated processes on conservation sites in relation to the requirements of the European Council (EC) Directive on the conservation of natural habitats and of wild fauna and flora (the “Habitats Directive”) which was implemented by The Conservation (Natural Habitats, etc) Regulations (Northern Ireland) 1995 (the “Habitats Regulations”):

- Stage 1: Identification of relevant permissions. The objective is to identify those designated European sites in the vicinity of a particular installation where an impact may conceivably occur.
- Stage 2: Assessment of likely significant effect. A screening stage to identify only those installations which are likely to cause a significant effect on the European site(s).
- Stage 3: Appropriate assessment. This is a detailed assessment to determine whether the installation ‘will not adversely affect the integrity of the European Site’.
- Stage 4: Determination of application. This is the stage at which the Environment Agency determines whether or not the activity for which authorisation is being sought is unlikely to lead to an adverse effect on the integrity of the habitat site(s).

14.51 For Stage 1, based on digital datasets held by the Northern Ireland Environment Agency and downloaded from its website, the following table lists designated sites within 10km of the site.

Table 14.6 Designated Sites within 10km of the Proposed Development

Designation	Name	Reference	Approximate Distance from the Development km		
			<2	2-5	5-10
SPA	Belfast Lough SPA	UK9020101		4.3km	
SPA	Belfast Lough Open Water SPA	UK9020290			✓
SAC	None within 10km	-			
RAMSAR	Belfast Lough Ramsar Site	UK12002		4.3km	
ASSI	Inner Belfast Lough	ASSI029			✓
ASSI	Outer Belfast Lough	ASSI104			✓
ASSI	Ballypalady	ASSI243			✓

Designation	Name	Reference	Approximate Distance from the Development km		
ASSI	Slievenacloy	ASSI063			
NNRs	None within 2km	-			
SLNCI	Belfast Hills – Squires Hill	B30	0.5km S		
SLNCI	Boghill	N7	1.1km NW		
SLNCI	Hyde Park Dam	N6	0.7km N		
SLNCI	Cave Hill-Collinward	B32	0.8km E		
Area of Scientific Interest (ASI)	Hazelwood			3.5km E	
Notes: 1. SLNCI and ASI designations as in Belfast Metropolitan Area Plan 2015 Draft Plan Technical Supplement 11 Volume 2 Countryside Assessment.					

14.52 The ASSI's and ASI are beyond 2km from the application site and hence do not need to be assessed (Ballypalady ASSI is in any case designated solely on geological interest), though the ASSI's for the Inner and Outer Belfast Lough lie within the Belfast Lough SPA and RAMSAR.

Local Air Quality Management

14.53 A local air quality management (LAQM) system was introduced by Part III of the Environment (Northern Ireland) Order 2002 (the Order) for which District Councils are required to review the present quality of air and the likely future quality of air and assess whether the nationally prescribed objectives are likely to be achieved.

14.54 If a local authority finds places where the objectives are not likely to be achieved, it must declare an Air Quality Management Area (AQMA). The proposed MBT facility is located on the edge of the Antrim Borough Council area and within close proximity to the administrative boundaries of both Belfast City Council and Newtownabbey Borough Council. Accordingly the existing air quality has been considered with reference to each of the three Council areas.

14.55 Antrim Borough Council declared an AQMA in October 2004, due to the emissions of sulphur dioxide from domestic solid fuel burning at two housing estates in Antrim Town. Its Air Quality Action Plan, launched in July 2007, considers a range of options to reduce emissions of sulphur dioxide within the AQMA. The Council has been assessing the levels of the pollutants identified by the government since 2003 and its most recent progress report found that outside the AQMA the air quality objectives for all the prescribed pollutants were being met throughout the Borough.

14.56 Belfast City Council declared four AQMAs in August 2004, related to emissions of nitrogen dioxide and particulate matter, predominately from road transport. Air quality criteria were also reported as being exceeded in the 2006 Updating and Screening Assessment. The four AQMAs are located in Belfast city.

14.57 Newtownabbey Borough Council declared three AQMAs in January 2008, located in Ballyclare, Elmfield and Sandyknowes within Newtownabbey for NO_2 from road traffic.

14.58 The closest AQMAs to the proposed MBT and EfW plant are 3km away at Elmfield and Sandyknowes in Newtownabbey. The closest Belfast AQMA, along the M1 / Westlink corridor, is 7 km from the application site and Antrim's only AQMA is over 10km from the application site.

Existing Local Sources of Emissions

14.59 Air quality information obtained from the UK National Atmospheric Emissions Inventory (NAEI) (www.naei.org.uk) includes the contribution of key sectors to annual average total emissions within the UK. Data for 2009 for the 1km grid square containing the proposed development and surrounding 1km squares is presented in the Table 14.8 which provides a comparative reference for potential emissions from the development to those from existing transport and industrial sources.

Table 14.7 Local Emissions in 2009

Category	NO_x t/yr	PM10 t/yr	SO_2 t/yr	VOC t/yr
Energy Production and Transformation	0	0.1671	0	0.1299
Commercial, Institutional and Residential Combustion	0.4257	0	0	0
Industrial Combustion	0	0.007661	0	3.3601
Industrial Processes	0	0	0	1.2009
Production and Distribution of Fossil Fuels	0	0.00591	0.018911	0.3618
Solvent Use	0	0.47281	0.08502	0.077956
Road Transport	5.5901	0.1401	0.0005353	0
Other Transport	1.4501	0.076056	0	0.073401
Waste Treatment and Disposal	0.007696	0.40132	0	0
Agriculture	0	0.04451	0	0
Nature	0.006742	0	0	0
Notes: Annual average total emissions of 9 kilometre grid squares, centred at GB OS Grid Coordinates 142500, 535500.				

Existing Air Quality

14.60 Estimated background air quality data for the area is available from the UK Air Quality Archive (www.airquality.co.uk) which provides a range of data sets for various substances monitored in the UK, including a Northern Ireland data set with receptors centred on the NI OS grid.

14.61 Nitrogen dioxide and particulate matter background maps are available calculated from a base year of 2008, and projections for all years up to and including 2020 on a kilometre square basis, whereas for other substances there is less comprehensive or more widespread data set.

14.62 Hourly pollutant data is also available from the UK National Air Quality Archive from the Automatic Urban Monitoring Network (AURN). The closest monitoring station to the application site is Belfast Centre (AURN Site No. 103), located at grid reference 333900, 374400, approximately 7.5km south south-east of Hightown Quarry. For comparative reference to background air quality data for the rural Hightown Quarry location, the following table lists the average concentrations recorded at the Belfast Centre monitoring site.

Table 14.8 Belfast Centre AURN Site 103 Average Values

Pollutant	Average Concentration, µg/m^3			
	2009	2010	2011	2012
Carbon monoxide	187	245	185	241
PM10 particulate matter (Hourly measured)	20.1	21.7	20.6	14.7
Nitric oxide	15.9	21.6	13.6	13.7
Nitrogen dioxide	32.8	34.8	28.1	29.3
Nitrogen oxides as nitrogen dioxide	57.0	67.6	48.7	50.4
Non-volatile PM10 (Hourly measured)	16.6	18.6	16.9	11.9
Non-volatile PM2.5 (Hourly measured)	9.4	10.6	10.5	7.9
Ozone	37.8	37.7	42.9	41.8
PM2.5 particulate matter (Hourly measured)	12.3	13.5	14.0	10.4
Sulphur dioxide	3.3	3.7	2.3	2.4
Volatile PM10 (Hourly measured)	3.5	3.1	3.9	2.8
Volatile PM2.5 (Hourly measured)	2.9	2.9	3.5	2.4
Source: UK National Air Quality Archive Automatic Urban Monitoring Network (AURN) for Site No. 103.				

14.63 The Belfast Centre AURN (Site No.103) is part of the UK Heavy Metals Monitoring Network, with the most recent report detailing that data being NPL Report AS 69 – Report to the Department of Environment, Food and Rural Affairs, the Welsh Government, the Department of the Environment in Northern Ireland and the Scottish Government, by the National Physical Laboratory: Annual Report for 2011 on the UK Heavy Metals Monitoring Network, June 2012.

Monthly data for the monitoring site is available for each year, for which the most recent data is provided in the following table as annual averages.

Table 14.9 Belfast Centre AURN: Heavy Metal Concentrations

Site 103: Belfast Centre AURN: Average Mass Concentrations, ng/m3													
	As	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg(p)**	**Hg(v)**
2011	0.285	0.098	2.23	6.38	199.8	3.08	0.639	3.98	0.007	0.984	11.2	0.011	2.41
2012	0.310	0.084	2.44	6.93	211.3	3.09	0.795	4.11	0.010	1.34	11.9	0.009	1.58
Source: UK National Air Quality Archive Automatic Urban Monitoring Network (AURN) for Site No. 103. Note: Hg(p) and Hg(v) refer to particulate phase mercury and vapour phase mercury, respectively.													

14.64 As the proposed development site is in a rural area with mainly agricultural use nearby, background bio-aerosol concentrations at the site and adjacent areas may be elevated compared to more urbanised areas, and there is also likely to be seasonal variation in the background bioaerosol levels. However no data is available on the actual background bio-aerosol concentrations.

Air Quality Monitoring Data

14.65 Air quality monitoring has been ongoing at selected locations near to the Hightown Quarry site since June 2013. The monitoring is being carried out using Gradko diffusion tubes left exposed for a month and with analysis by Gradko Environmental a division of Gradko International Ltd. Initial results as provided by the laboratory are summarised in the following table.

Table 14.10 Local Air Quality Monitoring Data

Sample Location	Coordinates	No. of Sampling Periods	Nitrogen Dioxide µg/m^3	Sulphur Dioxide µg/m^3
Squires Hill	330219, 378981	4	7.26, 7.02, 5.48, 9.39	3.58, 2.84, 1.29, 3.80
Flush Road (bridge)	329099, 379206	4	5.67, 6.48, 4.43, 10.51	1.42, 1.63, <1.11, 162
Flush Road (field)	328390, 380520	4	5.38, 5.45, 3.76, 7.36	1.55, 1.39, <1.11, 1.36
Boghill Road	328976, 381234	4	5.98, 5.90, 4.29, 7.27	1.39, <1.39, <1.11, <1.36
62 Upper Hightown Road	330157, 380093	4	5.57, 6.00, 4.25, 8.43	1.30, 2.06, 13.44, 1.37
Hightown Road	330387, 381091	4	10.22, 11.02, 6.40, 14.75	2.15, 1.95, 1.11, 3.64

14.66 Diffusions tubes for ambient monitoring of nitrogen dioxide are affected by several sources of interference which can cause under or overestimation often referred to as "bias" compared to a chemiluminescent analyser which is defined within Europe as the reference method. The 2012 Air Quality Updating and Screening Assessment for Belfast City Council, derived and utilised a bias adjustment factor of 0.81 for 2011 data, and the 2012 Air Quality Updating and Screening Assessment for Newtownabbey Borough Council, derived and utilised a bias adjustment factor of 0.92 for 2011 data. Those bias adjustment factors suggest the actual nitrogen dioxide concentrations could be slightly lower than those presented in the table. The initial monitoring results although slightly higher than indicated for the Hightown Quarry vicinity from review of the available sources of data, are still well below applicable air quality standards.

Background Data Values Used for this Assessment

14.67 Indicative background concentrations utilised in this assessment are listed in Table 14.11. The EfW and MBT plant are anticipated to both be operational by 2018 and predicted background concentrations have been utilised for that year, where possible, as that should be a worst case scenario for ambient background concentrations of air pollutants given they are generally predicted to improve each year due to technological advances leading to improved controls and lower emissions.

14.68 Revised total background maps for NO_x, NO_2, PM10 and PM2.5 are now available for each Local Authority Area for 2010. Estimated background concentrations for the years 2008 to 2020 are currently still projected from the 2008 background maps.

Table 14.11 Indicative Background Air Quality Data

Substance	Value	Source
PM10	2018 10.8 µg/m^3	www.airquality.co.uk projection for 2018 for kilometre square centre grid reference 329500, 380500, the Hightown Quarry application site being located in the south west of that grid square. The average value for the 3x3 kilometre grid squares centred on 329500, 380500 is 10.8 µg/m^3.
PM2.5	2018 6.0 µg/m^3	www.airquality.co.uk projection for 2018 for centre grid reference 329500, 380500. The average value for the 3x3 kilometre grid squares centred on 329500, 380500 is 6.1 µg/m^3.
VOC e.g. benzene	2011 0.562 µg/m^3	www.airquality.co.uk. Belfast Centre, benzene pumped tube data. 1,3-Butadiene was 0.03 µg/m^3 in 2006 by diffusion tube.

Substance	Value	Source
Hydrogen chloride	2011 0.28 μg/m^3	http://www.uk-pollutantdeposition.ceh.ac.uk AGANET network at Hillsborough (grid ref. 324317,357731 approximately 23km south west of the Hightown Quarry application site).
Hydrogen fluoride	≤ 2.35 μg/m^3	From Expert Panel on Air Quality Standards – Guidelines for halogens and hydrogen halides in ambient air for protecting human health against acute irritancy effects, February 2006.
Sulphur dioxide	2011 0.34 μg/m^3	http://www.uk-pollutantdeposition.ceh.ac.uk/, Acid Gases and Aerosols Network (AGANET) network at Hillsborough (grid ref. 324317,357731).
Nitrogen dioxide	4.4 μg/m^3	www.airquality.co.uk projection for 2018 for centre grid reference 329500, 380500. The average value for the 3x3 kilometre grid squares centred on 329500, 380500 is 4.7 μg/m^3.
Carbon monoxide	2011 184 μg/m^3	www.airquality.co.uk, Automatic Urban Monitoring Network, Belfast Centre Site No.103.
Cadmium	2008 <0.08 ng/m^3 2008 0.1-0.2 g/ha/yr	Interpolated from www.uk-pollutantdeposition.ceh.ac.uk UK pollutant maps for heavy metals air concentration and total deposition.
Thallium	N/A	Not available.
Mercury	2008 <1.6 ng/m3 60-80 mg/ha/yr	Interpolated from www.uk-pollutantdeposition.ceh.ac.uk UK pollutant maps for heavy metals air concentration and total deposition.
Antimony	N/A	Not available.
Arsenic	2008 <0.40 ng/m^3 2008 2-3 g/ha/yr	Interpolated from www.uk-pollutantdeposition.ceh.ac.uk UK pollutant maps for heavy metals air concentration and total deposition.
Lead	2008 <4.0 ng/m^3 2008 5-10 g/ha/yr	Interpolated from www.uk-pollutantdeposition.ceh.ac.uk UK pollutant maps for heavy metals air concentration and total deposition.
Chromium	2008 >0.60 ng/m3 2008 1-2 g/ha/yr	Interpolated from www.uk-pollutantdeposition.ceh.ac.uk UK pollutant maps for heavy metals air concentration and total deposition.
Cobalt	N/A	Not available.

Substance	Value	Source
Copper	2008 <1.5 ng/m^3 2008 5-10 g/ha/yr	Interpolated from www.uk-pollutantdeposition.ceh.ac.uk UK pollutant maps for heavy metals air concentration and total deposition.
Manganese	2011 & 2012 3.1 ng/m^3	www.airquality.co.uk, UK heavy metals monitoring network -Belfast Centre.
Nickel	2008 0.5-0.75 ng/m^3 2008 1-2.5 g/ha/yr	Interpolated from www.uk-pollutantdeposition.ceh.ac.uk UK pollutant maps for heavy metals air concentration and total deposition.
Vanadium	2006 <1.0 ng/m^3	UK Heavy Metal Monitoring Network, Project EPG 1/3/204, Heavy Metals Report dated May 2006.
Dioxins and furans	N/A	Not available.
Ammonia	2011 4.95 µg/m^3	http://www.uk-pollutantdeposition.ceh.ac.uk/, Ammonia network at Hillsborough (grid ref. 324317,357731).

Acidification & Nutrient Enrichment

14.69 Acidification and nutrient enrichment may occur due to emissions to air from the EfW. Acidification is a decrease in pH of surface waters and soils, due to atmospheric input to ecosystems of substances which may acidify soils and freshwaters.

14.70 The Air Pollution Information System (APIS) states that acidification generally refers to deposition of sulphur and nitrogen species, including SO_2, NO_x and NH_3, as well as other minor pollutants e.g. HCl and HF.

14.71 Acid deposition refers to both wet deposition and dry deposition, though wet deposition of SO_2, NO_2 and NH_3 is not significant within a short range. Nutrient enrichment occurs due to nitrogen deposition which can result in a highly productive ecosystem, and terrestrial nutrient enriched ecosystems are often of reduced conservation value.

14.72 For acid deposition and nitrogen deposition APIS provides critical load and critical levels for specific sites, a location and habitat, the critical load relating to the quantity of pollutant deposited from air to the ground, whereas the critical level being the gaseous concentration of a pollutant in the air. The site deposition data is now based on the Concentration Based Estimated Deposition model bringing it in line with the data for substance.

14.73 The critical loads and critical levels are the threshold level for the deposition or atmospheric concentration of a pollutant above which harmful indirect effects can be shown on a habitat or species, according to current knowledge. The APIS website indicates that to derive the critical loads and critical levels for terrestrial ecosystems typical biological criteria based on no adverse effect on growth, soil stability, and groundwater quality were used, whilst for surface waters, stream and lake fauna were used. The APIS website states there are currently no critical loads or levels for halogens, heavy metals, persistent organic pollutants, volatile organic compounds or dusts.

14.74 Details of relevant critical loads taken from the Air Pollution Information System (APIS) website are provided in the following table.

Table 14.12 Existing Levels of Deposition at Ecological Receptors

No.	Protected Area	Feature	Acid Deposition (keq/ha/yr)		Nitrogen Deposition (kgN/ha/year)		Source of Deposition Data
			Critical Load	Current Load	Critical Load	Current Load	
22	Belfast Lough SPA (based on average set of critical loads & deposition values)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	Not acid sensitive	1.55 [N:1.35 S:0.2]	20-30	21.96 (mean)	Site Relevant for Belfast Lough SPA – 2009-2011
23	Belfast Lough SPA (335300, 378300)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	Not acid sensitive	1.74 [N:1.63 S:0.18]	20-30	22.82	2009-2011 (3 year average)
24	Belfast Lough SPA & Inner Belfast Lough ASSI (334881, 380373, a western point)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	Not acid sensitive	1.74 [N:1.63 S:0.18]	20-30	22.82	2009-2011 (3 year average)

No.	Protected Area	Feature	Acid Deposition (keq/ha/yr)		Nitrogen Deposition (kgN/ha/year)		Source of Deposition Data
			Critical Load	**Current Load**	**Critical Load**	**Current Load**	
25	Belfast Lough Open Water SPA (343000, 385000, a central point)	Marine area. Sea inlet. *Podiceps cristatus* (A005) (coastal saltmarsh)	No compar-able acid critical load class.	1.35 [N:1.26 S:0.15]	20-30	17.64	2009-2011 (3 year average)
26	Outer Belfast Lough ASSI (335635, 381087 a western point)	Coastal sand dunes / Coastal vegetated shingle	CLminN: 0.438 CLmaxN: 2.028 CLmaxS: 1.59	1.63 (mean) [N:1.30 S:0.20]	8-15	21.43 (mean)	Site Relevant for Outer Belfast Lough ASSI - Predicted for year 2020
27	Belfast Hills – Squires Hill SLNCI (330200, 378800, a central point)	Heath, grassland , scrub. (dwarf shrub heath)	CLminN: 0.57 CLmaxN: 1.45 CLmaxS: 0.87	2.09 [N:1.99 S:0.17]	10-20 northern wet heath (Calluna)	27.86	2009-2011 (3 year average)
28	Belfast Hills – Squires Hill SLNCI (328916, 378962, a western point)	Heath, grassland , scrub. (dwarf shrub heath)	CLminN: 0.71 CLmaxN: 2.33 CLmaxS: 1.62	2.09 [N:1.99 S:0.17]	10-20 northern wet heath (Calluna)	27.86	2009-2011 (3 year average)

No.	Protected Area	Feature	Acid Deposition (keq/ha/yr)		Nitrogen Deposition (kgN/ha/year)		Source of Deposition Data
			Critical Load	Current Load	Critical Load	Current Load	
29	Cave Hill – Collinward SLNCI (332378, 379708)	Heath, grassland, scrub. (dwarf shrub heath)	CLminN: 0.87 CLmaxN: 1.35 CLmaxS: 0.48	1.74 [N:1.63 S:0.18]	10-20 northern wet heath (Calluna)	22.82	2009-2011 (3 year average)
30	Cave Hill – Collinward SLNCI (330700, 380600)	Heath, grassland, scrub. (dwarf shrub heath)	CLminN: 0.71 CLmaxN: 2.35 CLmaxS: 1.63	2.09 [N:1.99 S:0.17]	10-20 northern wet heath (Calluna)	27.86	2009-2011 (3 year average)
31	Boghill SLNCI (328000, 381500)	Lake & wet grassland. (coastal & floodplain grazing marsh)	No compare-able acid critical load class.	2.09 [N:1.99 S:0.17]	20-30 Low & medium altitude hay meadows	27.86	2009-2011 (3 year average)
32	Boghill SLNCI (327537, 381136)	Lake & wet grassland. (coastal & floodplain grazing marsh)	No compare-able acid critical load class.	2.09 [N:1.99 S:0.17]	20-30 Low & medium altitude hay meadows	27.86	2009-2011 (3 year average)

No.	Protected Area	Feature	Acid Deposition (keq/ha/yr)		Nitrogen Deposition (kgN/ha/year)		Source of Deposition Data
			Critical Load	Current Load	Critical Load	Current Load	
33	Hyde Park Dam SLNCI (329030, 381635)	Reservoir surrounded by varied swamps. Autumnal water-starwort. (fen, marsh & swamp)	Not sensitive to acidity	2.09 [N:1.99 S:0.17]	10-15 Valley mires, poor fens and transition mires	27.86	2009-2011 (3 year average)
34	Hazelwood ASI (332496, 380422)	Hazel woodland and scrub. (broadleaved, mixed & yew woodland)	CLminN: 0.14 CLmaxN: 1.64 CLmaxS: 1.49	2.75 [N:2.65, S:0.2]	10-20 Broad leaved deciduous trees	37.1	2009-2011 (3 year average)

Source: Air Pollution Information System (APIS) website.

Notes: CL=Critical Load, N=Nitrogen, S=Sulphur

1. For Belfast Lough Ramsar Site refer to Belfast Lough SPA and ASSIs.
2. Where habitat designation for the protected area is not detailed on the APIS resource, a suitable APIS designation has been applied, shown in brackets.

Belfast Lough SPA

14.75 The Belfast Lough SPA regularly supports internationally important numbers of Redshank in winter (draft Belfast Metropolitan Area Plan 2015). Redshank and its broad habitat (i.e. littoral sediment) are not sensitive to acidity, hence no critical load function exists for the Belfast Lough SPA. The species itself has no critical load function for nitrogen deposition i.e. eutrophication, and is therefore assessed through the empirical eutrophication critical load for the broad habitat of 20-30 kgN/ha/yr.

Predicted Environmental Effects and their Significance

Air Quality Impact due to Substance Emissions

14.76 The methodology that has been followed is consistent with that detailed in the Environment Agency's permitting guidance H1 Environmental Risks Assessment - Annex F Air Emissions. It includes a number of sequential steps for risk assessment of point source emissions which have been carried out for this assessment:

- Describe the emissions and receptors;
- Calculate the process contributions (the concentration of emitted substances after dispersion into air);
- Screen out insignificant emissions that do not warrant further investigation;
- Decide if detailed air modelling is needed;
- Assess the emissions against local standards; and
- Summarise the effects of the emissions.

14.77 The Environment Agency's permitting guidance H1 – Annex F Air Emissions outlines a methodology to estimate the process contribution of the emissions based on a conservative estimate of their dispersion as maximum annual averages or maximum hourly averages based on the effective height of release, and for the assessment of the long and short term emissions based on the process contribution.

14.78 The assessment process utilises dispersion factors for long- and short-term releases which assume "worst case" conditions, hence it screens out insignificant emissions and determines whether detailed air dispersion modelling or greater control measures may be required.

14.79 For this study to ensure a robust assessment, dispersion modelling has been utilised to derive process contribution values.

14.80 The H1 – Annex F guidance states that '*process contributions can be considered insignificant if:*

- *the long term process contribution is <1% of the long term environmental standard; and*
- *the short term process contribution is <10% of the short term environmental standard.*

14.81 *The long term process contribution 1% threshold is based on the judgements that:*

- *it is unlikely that an emission at this level will make a significant contribution to air quality since process contributions will be small in comparison to background levels, even if a standard is exceeded; and*

- *the proposed 1% threshold is also two orders of magnitude below the standard and provides a substantial safety margin to protect health and the environment.*

14.82 *The short term 10% process contribution threshold is based on the judgements that:*

- *spatial and temporal conditions mean that process contributions are more likely to dominate ambient environmental concentrations;*
- *short term background concentrations can be assumed to be twice long-term concentrations; and*
- *the proposed 10% threshold is an order of magnitude below the standard and provides a substantial safety margin to protect health and the environment.'*

14.83 Where potentially significant emissions are identified, it is necessary to decide whether more detailed air modelling is needed, and the H1 – Annex F guidance states that *'as a guide, detailed modelling of long term emissions may be useful where:*

- *local receptors may be sensitive to long term emissions;*
- *released substances fall under an Air Quality Management Plan; and*
- *the sum of the background concentration and process contribution exceed 70% of the appropriate long term standard:*

$$PC_{long\ term} + \text{background concentration} > 70\% \text{ standard.}$$

14.84 *This 70% suggested guideline is based on the judgements that:*

- *background concentrations will usually dominate process contributions for long-term releases;*
- *process contributions may lead to a breach of standards where background levels of a substance are already high; and*
- *there is a likely possible error margin of ±50% in monitoring data of background levels.'*

14.85 The H1 – Annex F guidance also indicates that *'as a guide, detailed modelling of short term emissions may be useful where:*

- *local receptors may be sensitive to short-term emissions; and*
- *the short term process contribution is more than 20% of the relevant short term environmental standard minus twice the long term background concentration:*

$$PC_{short\ term} > 20\% \ (\text{standard}_{short\ term} - 2 \times \text{background}_{long\ term})$$

Note that this assumes the short-term ambient background concentration to be twice the long-term ambient concentration.'

14.86 For potential impact to vegetation and ecosystems, the assessment methodology outlined in the Environment Agency's Habitats Directive Handbook, and in particular its Appendix 7 Stage 1 and Stage 2 Assessment of new PIR permissions under the Habitats Regulations and Stage 3 and 4 Assessment of new PIR permissions under the Habitats Regulations, is similar to that of the H1 – Annex F guidance, the assessment criterion being those relevant to each specific habitat site.

Emissions

14.87 The anticipated parameters for normal operating conditions for the proposed new EfW at the design load point LPB and the MBT are provided in Appendix 14.2. Those operating parameters have been utilised to derive the emission rates detailed in Tables 14.13 and 14.14. For the EfW, these relate to the maximum allowed by the IED emission limit values (ELVs). For the MBT, these relate to the exhaust air expected target emission concentrations.

14.88 The emission rates derived for the EfW utilise the IED emission limit values, and assume continuous operation of the EfW and MBT at normal working load and ignore non-operating time for maintenance.

14.89 For the EfW, emissions at the IED limits are unlikely to be the case in reality because operation at those levels would, simply by the virtue of normal process fluctuations such as temporary heat overload, be likely to breach the ELVs. The substance emission rate values are detailed in Table 14.13.

Table 14.13 Emission Rates from EfW

Substance	Daily Average Values used for assessment of long term impact		Half Hourly Average Values used for assessment of short term impact when assessment criterion averaging period is <24hr	
	mg/Nm^3	g/s	mg/Nm^3	g/s
Total dust	10	0.3889	N/A	N/A
Gaseous and vaporous organic substances, expressed as total organic carbon	10	0.3889	20	0.7778
Hydrogen chloride (HCl)	10	0.3889	60	2.3333
Hydrogen fluoride (HF)	1	0.0389	4	0.1556
Sulphur dioxide (SO_2)	50	1.9444	200	7.7778
Nitrogen monoxide and nitrogen dioxide (NO_2) expressed as NO_2	200, e.g. 100% as NO_2	7.7778	400, e.g. 50% as NO_2 i.e. 200	7.7778
Carbon Monoxide	50	1.9444	100	3.8889

Substance	Daily Average Values used for assessment of long term impact		Half Hourly Average Values used for assessment of short term impact when assessment criterion averaging period is <24hr	
	mg/Nm^3	**g/s**	**mg/Nm^3**	**g/s**
	Average values for minimum 30 minutes to maximum 8 hours used for assessment of long and short term impact			
	mg/m^3		g/s	
Group 1: Cadmium and Thallium	0.05		0.0019	
Group 2: Mercury	0.05		0.0019	
Group 3: Antimony, Arsenic, Lead, Chromium, Cobalt, Copper, Manganese, Nickel, Vanadium	0.5		0.0194	
Dioxins and furans	0.0000001 TE (toxic equivalent) as a 6 to 8 hour average of total concentration		3.889E-9 TE	

Notes:

1. All values mg/m^3 at applicable at: temperature 273K, pressure 101.3kPa, 11% oxygen, dry gas.
2. For nitrogen oxides for a worst case scenario it has been assumed that 35% of the NO_x is present as NO_2 for short term impact and 70% conversion to NO_2 for long term impact.
3. For metals a precautionary approach has been used by applying the whole of the IED limit for each metal.
4. For dioxins and furans the emission limit value refers to the total concentration determined by multiplying the mass concentrations of specific dibenzo-p-dioxins and dibenzofurans by toxicity equivalence factors before summing, as prescribed in the IED.
5. In order to provide an assessment for potential ammonia that substance has been assumed to be emitted from the EfW at 10mg/Nm^3.

14.90 For the MBT the final emissions are after scrubbing and biofiltration, will be from the biofilter released via stack. The emission rates are anticipated to be as detailed in Table 14.14.

Table 14.14 Anticipated Emission Rates from MBT

Substance	Anticipated Concentration	Anticipated Emission Rate
Particulate	< 1 mg/m^3	0.0375 g/s
Ammonia	< 1 mg/m^3 (transient peaks to 10 mg/m^3)	0.0375 g/s
Odour	500 ou/m^3	18750 ou/s
Notes: Emission rates are for air flow of 135,000m^3/hour. The biofilter is intended to achieve a nominal odour concentration of 500 ou/m^3 at the biofilter stack exit at an airflow of 135,000 m3/hr. Allowing for the uncertainties of olfactometric measurement, the nominal result of a single measurement for a given limit of 500 ou/m^3 may give rise to a maximum value of 990 ou/m^3 (reference: VDI 3477, Annex B).		

14.91 Other substances such as hydrogen sulphide (H_2S), sulphur dioxide (SO^2), and volatile organic compounds (VOC) including methane have been considered as they may occasionally be present in the air extracted from the MBT. However, the largest component of the air flow to the MBT air treatment system is from the closely controlled bio-drying process which is highly aerobic, minimising the potential for anaerobic conditions which typically lead to production of those substances. Combined with treatment of exhaust air in the wet scrubber and biofilter system, the predominance of the air component from the highly aerobic bio-drying tunnels minimises the potential for emissions of H_2S, SO_2 and VOC in the exhaust air to be released via the stack and they are unlikely to be present beyond trace concentrations.

14.92 This assessment has been carried out based on the substance emissions from the MBT and EfW separately and in combination.

Dispersion Model

14.93 For this air quality assessment the predictive dispersion modelling has been carried out using two separate models, AERMOD and ADMS. AERMOD is one of the US EPA's air quality models available via its website, along with the model code, documentation, supporting technical documents and evaluation databases. It is a steady-state Gaussian plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. ADMS is a comparable Gaussian plume air dispersion model produced by the Cambridge Environmental Research Consultants, and includes a plume visibility module which is not available within AERMOD. Pre-application engagement with NIEA IPRI endorsed this approach.

14.94 The AERMOD dispersion model set up details are provided in Appendix 14.2 and the dispersion model was run with meteorological data for each individual year 2004 to 2012 to determine the annual maximum and variation.

14.95 For the EfW, a stack height calculation was made following the methodology within the HMIP Technical Guidance Note (Dispersion) D1, Guidelines on Discharge Stack Heights for Polluting Emissions, 1993, which indicated a stack height of 63m could suffice, assuming a single large EfW building. However initial dispersion modelling carried out within the draft ES that was submitted into the PAD process for consultee feedback indicated that a height of at least 80m, i.e. an emission height of 325mAOD derived from a modelled ground level of 245mAOD plus 80m, would be required to provide sufficient dispersion.

14.96 During the Pre Application Discussion period in consultation with the Industrial Pollution and Radiochemical Inspectorate of the Northern Ireland Environment Agency, further dispersion modelling was carried out. That additional modelling was to further investigate the environmental improvement which may be gained by increasing the EfW stack height and to reduce uncertainty relating to potential terrain effects at the quarry and due to nearby hills, and also to provide an appraisal of plume visibility from the EfW. The additional modelling was also for emissions from the MBT because it was considered that releasing those emissions via a stack as opposed to an open biofilter would be a more precautionary approach than via an area source.

14.97 The additional dispersion modelling was carried out in AERMOD and ADMS. For complex terrain ADMS can carry out calculation of the flow field and turbulence field by its linear wind flow model FLOWSTAR, whereas AERMOD makes a complex empirical correction for the effects of terrain by a weighted combination of the concentration from a horizontal plume state, in which the plume can impact on the terrain, and a terrain following plume state, where the plume can impact on the terrain. Thus the two dispersion models can produce different results in some complex terrain and the use of results from the two models reinforces the confidence in conclusions drawn from the dispersion modelling.

14.98 Details regarding the sensitivity of the AERMOD dispersion model output to the various inputs are provided in Appendix 14.3, and details and results from the ADMS dispersion modelling carried out are provided in Appendix 14.8. The use of AERMOD combined with the appraisal of the dispersion model sensitivity and the use of ADMS provides a robust approach.

14.99 In general terms it was found that in comparison to the AERMOD model the ADMS model gave similar or slightly higher annual average values, and mainly similar or lower values for shorter averaging periods, but showed less variance due to nearby terrain such as at Squires Hill. It was evaluated that environmental improvement in terms of reducing maximum process contributions would be optimised by increasing the stack height, and that would further align the design requirement of the EfW to apply best available techniques (BAT) to prevent pollution.

14.100 Through discussion with NIEA IPRI design adjustments were made to proceed with an EfW stack height of 95m i.e. an emission height of 340m derived from a modelled ground level of 245m, as at that height the dispersion model results attain or are very close to the screening criteria detailed earlier. While it is not normally considered necessary to achieve those screening criteria for every substance to ensure no significant pollution, harm or environmental impact, it is considered that the adjustment to 95m provides a more conservative and precautionary approach, responding to the context of the local topography and nature of the surrounding area, and optimising the BAT appraisal for the EfW.

14.101 In addition a further design adjustment following submission of the draft ES has introduced a 20 metre stack to the exhaust air treatment system at the MBT to provide greater potential for dispersion of emissions.

AERMOD Dispersion Model Predictions – Normal Operations of EfW

14.102 Normal operations of the EfW correspond to design point with 100% heat release for the waste throughput. There is also a short-term overload condition and a minimum load condition. For each load condition the EfW will have to comply with the requirements of the Industrial Emissions Directive and in particular its emission limits, the control of emissions and monitoring.

14.103 Contour plots of the dispersion model predictions for nitrogen dioxide, sulphur dioxide and particulates such as PM10 at their respective daily emission rates are provided in Appendix 14.4. Long term airborne concentrations for other substances can be estimated from those contour plots based on the relative ratio of those airborne concentrations and emission rates. For the AERMOD dispersion model the maximum process contributions (PC) generally occur to the south east or south, for example localised at Squires Hill or the Divis Mountain summit, rather than downwind of the prevailing west south west to south wind direction.

Long Term Emission Rates

14.104 The long term process contributions (PC) taken as the maximum interpolated by the AERMOD dispersion model at the modelled receptors using meteorological data for 2004 to 2012, are provided in Table 14.15.

14.105 The model predictions also assume the plant will operate continuously with emissions at the maximum allowable under the Industrial Emissions Directive. In actuality the emissions on average will be lower because the waste throughput will not be with the EfW working at maximum capacity continuously, and there will be non-operational periods to facilitate servicing and maintenance.

14.106 Long term process contribution at less than 1% of the assessment criterion are assessed as insignificant, whereas for those greater than 1% of the assessment criterion the process environmental contribution (PEC) has been calculated taking account of the estimated background concentration.

Table 14.15 AERMOD Dispersion Model Predictions for Long Term Impact by Direct Inhalation

Substance	Emission Concentration mg/Nm^3	Assessment Criterion µg/m^3	Criterion Averaging Period	PC µg/m^3	PC as % of assessment criterion	Background µg/m^3	PEC µg/m^3	PEC as % of assessment criterion
PM10	10 (daily average)	40	Annual	0.026	0.07			
PM2.5	10 (daily average)	20	Annual	0.026	0.13			
TOC	10 (daily average)	5	Annual	0.026	0.52			
HCl	10 (daily average)	20	Annual	0.026	0.13			
HF	1 (daily average)	16	Annual	0.0026	0.02			
SO_2	50 (daily average)	50	Annual	0.13	0.26			
NO, 70% as NO_2	200 (daily average)	40	Annual	0.37	0.91			
CO	50 (daily average)	350	Annual	0.13	0.04			
Cd	0.05 (0.5-8hr average)	0.005	Annual	0.00013	2.6	0.00008	0.00021	4.2
Tl		1	Annual	0.00013	0.01			
Hg	0.05 (0.5-8hr average)	0.25	Annual	0.00013	0.05			
Sb	0.5 (0.5-8hr average)	5	Annual	0.0013	0.03			
As		0.006	Annual	0.0013	21.8	0.0004	0.0017	28.5
Pb		0.25	Annual	0.0013	0.52			
Cr		5	Annual	0.0013	0.03			
Co		0.2	Annual	0.0013	0.66			
Cu		10	Annual	0.0013	0.01			

Substance	Emission Concentration mg/Nm^3	Assessment Criterion µg/m^3	Criterion Averaging Period	PC µg/m^3	PC as % of assessment criterion	Background µg/m^3	PEC µg/m^3	PEC as % of assessment criterion
Mn		0.15	Annual	0.0013	0.87			
Ni		0.02	Annual	0.0013	6.6	0.00075	0.0021	10.3
V		5	Annual	0.0013	0.03			
NH_3	10 (daily average)	8	Annual	0.026	0.33			

Notes:

1. The maximum long term process contribution occurs using meteorological data for 2005.

2. For assessment of possible emission of PM2.5, a concentration has been assumed the same as that for PM10 (whereas in reality PM2.5 would be a proportion of PM10).

3. For assessment of emission of nitrous oxide, 70% has been assumed to be converted to NO_2 in the long term, as that is the Environment Agency's worst case scenario in its guidance 'Conversion ratios for NO_x and NO_2'.

4. For this assessment it has initially been assumed that emission of each individual metal occurs at the IED aggregate limit.

5. In order to provide an initial assessment for potential ammonia that substance has been assumed to be emitted from the EfW at 10mg/Nm^3.

14.107 The process contribution of most substances is less than 1% of the assessment criterion and hence can be screened out as insignificant.

14.108 The exceptions are arsenic, cadmium, and nickel. However for those substances the PEC was found to be well below 70% of their respective long-term assessment criterion and it's unlikely those substances would be emitted at the maximum respective IED emission rates as appraised. Indeed the Environment Agency paper 'Releases from municipal incinerators September 2012 version 3 Guidance to applicants on impact assessment for group 3 metals stack' indicates it is reasonable to assume that each Group 3 metal comprises no more than a ninth (11%) of the IED emission concentration for Group 3 metals. Hence process contributions are likely to be lower than appraised and further assessment of those substances is not necessary.

14.109 The Environment Agency paper 'Releases from municipal incinerators September 2012 version 3 Guidance to applicants on impact assessment for group 3 metals stack' also provides relevant guidance regarding the potential for chromium (VI) to form a proportion of the total chromium emitted, including a summary of measurements which indicate that total chromium typically represents on average 2.2% of the Group 3 metals emission limit value, with a range from 0.08% to 10.4%. It indicates that on average chromium (VI) emission is likely to be less than 1% of total chromium. In the absence of actual data for the proposed EfW, an appraisal for chromium (VI) has been carried out based on emissions of total chromium at one ninth of the IED aggregate emission limit for the Group 3 metals, and an emission proposed of 1% of chromium (VI) to total chromium. That equates to an emission rate four times more than the maximum indicated in the Environment Agency September 2012 guidance for Group 3 metals.

14.110 Based on the maximum process contribution of 0.0013µg/m^3 for a Group 3 metal at the IED aggregate limit of 0.5mg/m^3, the potential process contribution for chromium (VI) would be 1.44E-6 µg/m^3, representing 0.7% of the EAL for chromium (VI) and hence the potential emissions of chromium (VI) are assessed as insignificant.

Short Term Emission Rates

14.111 The maximum short term process contributions (PC) taken as indicated by AERMOD dispersion model results utilising meteorological data for 2004 to 2012, are provided in Table 14.16.

14.112 The model predictions assume the plant will operate continuously with emissions at the maximum allowable under the Industrial Emissions Directive, whereas the emissions on average will be lower because there will be non-operational periods for servicing and maintenance and there is emission abatement.

14.113 In addition, for total dust, gaseous and vaporous organic substances expressed as total organic carbon, hydrogen chloride, hydrogen fluoride, sulphur dioxide, and nitrogen monoxide and nitrogen dioxide, the half hourly emission limits apply as 100 and 97 percentile, so the maximum emission rate is only allowable for 3% of the time, i.e. 43.2 minutes per day. The half hourly average 97 percentile emission limits are the same as the daily average limits, or for hydrogen fluoride twice its daily average emission limit, so if emission of those substances occurred at their respective maximum half hourly emission limits for 3% of the time, thereafter the substance emissions would have to be lower than the 97 percentile half hourly average limits in order to comply with the respective daily average emission limits.

14.114 Process contributions at less than 10% of the assessment criterion are assessed as insignificant, whereas for those greater than 10% of the assessment criterion the process environmental contribution (PEC) has been calculated taking account of the estimated background concentration.

Table 14.16 AERMOD Dispersion Model Predictions for Short Term Impact by Direct Inhalation

Substance	Emission Concentration mg/m³	Assessment Criterion µg/m³	Criterion Averaging Period	PC µg/m³	PC as % of assessment criterion	Background µg/m³	PEC µg/m³	PEC as % of assessment criterion
PM10	10 (daily average)	50	24 hr (90.41 %ile)	0.085	0.17			
TOC	20 (1/2 hr 100%ile)	195	1hr	10.4	5.3			
HCl	60 (1/2hr 100%ile)	750	1hr	31.2	4.2			
HF	4 (1/2 hr 100%ile)	160	1hr	2.1	1.3			
SO_2	50 (daily average)	125	24hr (99.18 %ile)	1.5	1.2			
SO_2	200 (1/2hr 100%ile)	350	1hr (99.73 %ile)	53.3	15.2	0.34	54.0	15.4
SO_2	50 (1/2hr 97%ile and daily average)	350	1hr (99.73 %ile)	13.3	3.8	0.34	14.0	4.0
SO_2	200 (1/2hr 100%ile)	266	15min (99.90 %ile)	91.4	34.4	0.34	92.11	34.6
SO_2	50 (1/2hr 97%ile and daily average)	266	15min (99.90 %ile)	22.9	8.6	0.34	23.5	8.8
NO, 35% as NO_2	400 (1/2hr 100%ile)	200	1hr (99.79 %ile)	40.7	20.3	4.4	49.5	24.7
NO, 35% as NO_2	200 (1/2hr 97%ile)	200	1hr (99.79 %ile)	20.3	10.2	4.4	29.1	14.6
CO	100 (1/2hr average)	10000	8hr	8.3	0.08			
Cd	0.05 (0.5-8hr average)	1.5	1hr	0.037	2.5			

Substance	Emission Concentration mg/m^3	Assessment Criterion µg/m^3	Criterion Averaging Period	PC µg/m^3	PC as % of assessment criterion	Background µg/m^3	PEC µg/m^3	PEC as % of assessment criterion
Tl		30	1hr	0.037	0.12			
Hg	0.05 (0.5-8hr average)	7.5	1hr	0.037	0.49			
Sb	0.5 (0.5-8hr average)	150	1hr	0.37	0.27			
As		15	1hr	0.37	2.4			
Pb		N/A	1hr	0.37	N/A			
Cr		150	1hr	0.37	0.24			
Co		6	1hr	0.37	6.1			
Cu		200	1hr	0.37	0.18			
Mn		1500	1hr	0.37	0.02			
Ni		30	1hr	0.37	1.2			
V		1	24hr	0.042	4.2			
NH_3	10 (daily average)	2500	1hr	5.2	0.21			

Notes:

1. Maximum short term process contributions (STPC) occur with the following averaging periods and meteorological combinations: 24hr 90.41%ile using 2004 data, for the remaining averaging periods the maximum STPC occur using 2010 data.

2. For assessment of emission of PM2.5, a concentration has been assumed the same as that for PM10 (whereas in reality PM2.5 would be a proportion of PM10).

3. For SO_2, the 15 minute 99.9%ile has been derived by multiplying its 1 hour 99.9%ile by 1.34 (a conversion factor given in the H1 Annex F publication.

4. For assessment of emission of nitrous oxide, 35% has been assumed to be converted to NO_2 in the short term, as that is the Environment Agency's worst case short term scenario in its guidance 'Conversion ratios for NO_x and NO_2'

5. For this assessment it has been assumed that emissions of each individual metal occur at the relevant IED metal group aggregate limit.

6. In order to provide an assessment for potential ammonia that substance has been assumed to be emitted from the EfW at 10mg/Nm^3.

14.115 The process contribution of most substances is less than 10% of the assessment criterion. Consequently, the short term emissions of those substances will have an insignificant effect.

14.116 The potential exceptions are the 1hr 99.73 percentile and 15 minute 99.9 percentile for SO_2 and 1hr 99.79 percentile for NO_2, though that only applies if there were continuous emissions at the 100 percentile half hourly emission limit. That will not occur in practice because there also needs to be compliance with the 97 percentile half hour emission limits which are lower, and at the 97 percentile half hour emission limits those substances are close to or less than 10% of the assessment criterion.

14.117 Nevertheless process environmental contributions (PEC) have been calculated for those substances as the process contribution plus twice the background concentration. This assumes the short term ambient background concentration to be twice the long term ambient concentration, but the maximum process contribution and maximum background concentration may be separated both temporally and spatially so that the addition of the two “worst case” short-term concentrations together is unlikely.

14.118 The PECs were also found to be below the respective short term assessment criterions, which are the limits set for the protection of human health and so further assessment of the potential for short term impact by SO_2 or NO_2 is not necessary.

Assessment of Emissions of Dioxins and Furans

14.119 Air concentrations of dioxins and furans are recognised as an insignificant route of exposure via the respiratory route for humans to these substances and no standards for dioxins and furans in air have been set.

14.120 Dioxins and furans have been assessed (together with toxic metals), in terms of overall intake, including both inhalation and the potential for the more significant exposure route of ingestion, via a human health risk assessment which is provided as Appendix 14.9.

14.121 For each of the receptor exposure scenarios, the assessment predicts a lifetime cancer risk of less than 1 in 100,000 and a hazard index of less than one, indicating minimal risk of carcinogenicity and minimal risk of a non-cancer health impact. The potential intake of dioxins and furans is predicted to be well below tolerable daily intake values. Furthermore due to the precautionary approach applied to the input parameters, it is considered unlikely the emissions and receptor exposure scenarios as evaluated will occur, and less exposure and notably less substance intake is more probable for the site situation.

AERMOD Dispersion Model Predictions – Vegetation and Ecosystems

14.122 For ecosystems the Environment Agency’s Habitats Directive Handbook, and particular its Appendix 7 Stage 3 and 4 Assessment of new PIR permissions under the Habitats Regulations, and also AQTAG06 Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air, provide guidance on determining whether there is the potential for impact from an installation and whether it will be significant.

14.123 The IED specifies the requirement for monitoring for a wide range of substances. Those are substances likely to be present in the waste or which could be produced by its thermal treatment and which could potentially have a significant effect. Waste that may contain significant levels of other hazardous substances will be rejected from the plant.

14.124 Accordingly, assessment for potential impact to vegetation and ecosystems has been restricted to the substances covered by the IED emission limits.

Direct Effect of Substances in the Air

14.125 The maximum process contribution from the EfW are indicated in the following table for the various substances with vegetation and ecosystem specific standards, as those substances may have a direct effect on vegetation though the assessment criterion apply at nature conservation sites. The maximum process contributions are predicted at Divis Mountain summit which is not a designated nature conservation site. Slightly lower concentrations are predicted at Squires Hill SLNCI.

14.126 Long term (annual) process contribution at less than 1% of the long term assessment criterion or and short term (24 hour or shorter duration) assessment at less than 10% of the short term assessment criterion are assessed as insignificant, whereas for those greater than 1% or 10% of the relevant assessment criterion the process environmental contribution (PEC) has been calculated taking account of the estimated background concentration.

Table 14.17 Screening of Impact from Emissions to Air

Substance	Emission Concentrat-ion mg/m^3	Assessment Criterion µg/m^3	Averaging Period	Max PC µg/m^3	Max PC as % of assessment criterion	Background µg/m^3	PEC µg/m^3	PEC as % of assessment criterion
HF	1	5	24hr	0.085	1.7			
SO_2	50	20	Annual	0.13	0.65			
NO as NO_2	200	30	Annual	0.52	1.70	4.4	4.9	16.4
NO as NO_2	200	75	24hr	16.9	22.6	4.4	25.7	34.3
NH_3	10	3	Annual	0.026	0.87			

Notes:

1. Maximum long term process contributions occur using the 2005 meteorological data, whereas maximum short term (24 hour) process contributions occur using the 2006 meteorological data.

2. For assessment emission of nitrous oxide to vegetation, 100% has been assumed to be converted to NO_2, though the Environment Agency's guidance is that a worst case scenario would be 100% to 70% conversion to NO_2 in the long term.

3. In order to provide an assessment for potential ammonia that substance has been assumed to be emitted at 10mg/m^3.

4. The available information for the nearby designated sites does not indicate a site where lichens and bryophytes are an important part of the ecosystems' integrity, therefore for SO_2 and NH_3 the assessment criterion applicable to "all higher plants (all other ecosystems)" have been utilised.

14.127 The maximum long term process contributions for sulphur dioxide and ammonia are below 1% of the long term assessment criterion and as such general emissions to air of those substances are screened out as insignificant. The maximum short term process contributions for hydrogen fluoride are below 10% of the short term assessment criterion and as such general emissions to air of those substances are screened out as insignificant.

14.128 The maximum process contribution of nitrogen dioxide as an annual average is more than the 1% of the long term criteria and as a twenty four hour average is above the 10% of the short term criteria. That is based on maximum process contributions at maximum emission rates for continuous operation of the EfW. As the maximum process environmental contribution is less than 70% of the criteria and the process contributions elsewhere will be much lower, further assessment is not necessary.

Acidification

14.129 Process contributions to acid deposition have been derived from the AERMOD dispersion modelling with deposition rates and conversions carried out in accordance with the Environment Agency's AQTAG06 Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air.

14.130 That guidance indicates wet deposition of NO_2, NH_3 and SO_2 is not significant within a short range (and therefore wet deposition has not been addressed in this assessment), and its approach is to calculate the dry deposition flux for the various relevant substances and convert to units which provide a measure of how acidifying the substances can be, as follows:

Dry deposition flux = process contribution at ground level (µg/m3) x deposition velocity (m/s)

14.131 For this assessment the following dry deposition velocities have been utilised, applicable to land cover with grassland, as per the guidance given in AQTAG06:

- 0.0015 m/s for NO_2;
- 0.02 m/s for NH_3; and
- 0.012 m/s for SO_2.

14.132 The dry deposition flux has then been converted from units of µg/m2/s to units of kg/ha/year by multiplying the dry deposition flux by standard conversion factors based on the molecular weight proportion of N or S in the substance, which are:

- 96 for NO_2;
- 259.7 for NH_3; and
- 157.7 for SO_2.

14.133 Those are then converted into units of equivalents i.e. 'moles of charge' (keq kg / ha / year) which is a measure of how acidifying the chemical species can be, by multiplying the dry deposition flux (kg / ha / year) by the following standard conversion factors:

- 0.071428 for N; and
- 0.0625 for S.

14.134 The following table compares the predicted process contributions of nitrogen and sulphur to acid deposition compared to the relevant critical load for the habitat types associated with each designated site as derived from the UK Air Pollution Information System (APIS) website.

Table 14.18 Acidification due to Nitrogen

No.	Protected Area	Feature	Acid Deposition (keq/ha/yr)		Process Contribution (PC) as N keq/ha/year	PC as % of CLmax N
			Critical Load	Current Load		
22	Belfast Lough SPA (based on average set of critical loads & deposition values)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	Not acid sensitive	1.55 [N:1.35 S:0.2]	0.0008	N/A
23	Belfast Lough SPA (335300, 378300)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	Not acid sensitive	1.74 [N:1.63 S:0.18]	0.0009	N/A
24	Belfast Lough SPA & Inner Belfast Lough ASSI (334881, 380373, a western point)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	Not acid sensitive	1.74 [N:1.63 S:0.18]	0.0011	N/A
25	Belfast Lough Open Water SPA (343000, 385000, a central point)	Marine area. Sea inlet. *Podiceps cristatus* (A005) (saltmarsh)	No comparabl e acid critical load class.	1.35 [N:1.26 S:0.15]	0.0008	N/A

No.	Protected Area	Feature	Acid Deposition (keq/ha/yr)		Process Contribution (PC) as N keq/ha/year	PC as % of CLmax N
			Critical Load	Current Load		
26	Outer Belfast Lough ASSI (335635, 381087 a western point)	Coastal sand dunes / Coastal vegetated shingle	CLminN: 0.438 CLmaxN: 2.028 CLmaxS: 1.59	1.63 [N:1.63 S:0.20]	0.0011	0.10
27	Belfast Hills – Squires Hill SLNCI (330200, 378800, a central point)	Heath, grassland, scrub. (dwarf shrub heath)	CLminN: 0.57 CLmaxN: 1.45 CLmaxS: 0.87	2.09 [N:1.99 S:0.17]	0.0066	0.46
28	Belfast Hills – Squires Hill SLNCI (328916, 378962, a western point)	Heath, grassland, scrub. (dwarf shrub heath)	CLminN: 0.71 CLmaxN: 2.33 CLmaxS: 1.62	2.09 [N:1.99 S:0.17]	0.0021	0.09
29	Cave Hill – Collinward SLNCI (332378, 379708)	Heath, grassland, scrub. (dwarf shrub heath)	CLminN: 0.87 CLmaxN: 1.35 CLmaxS: 0.48	1.74 [N:1.63 S:0.18]	0.0043	0.32
30	Cave Hill – Collinward SLNCI (330700, 380600)	Heath, grassland, scrub. (dwarf shrub heath)	CLminN: 0.71 CLmaxN: 2.35 CLmaxS: 1.63	2.09 [N:1.99 S:0.17]	0.0046	0.20
31	Boghill SLNCI (328000, 381500)	Lake & wet grassland. (coastal & floodplain grazing marsh)	No comparable acid critical load class.	2.09 [N:1.99 S:0.17]	0.0021	N/A
32	Boghill SLNCI	Lake & wet	No	2.09	0.0015	N/A

No.	Protected Area	Feature	Acid Deposition (keq/ha/yr)		Process Contribution (PC) as N keq/ha/year	PC as % of CLmax N
			Critical Load	Current Load		
	(327537, 381136)	grassland. (coastal & floodplain grazing marsh)	comparabl e acid critical load class.	[N:1.99 S:0.17]		
33	Hyde Park Dam SLNCI (329030, 381635)	Reservoir surrounded by varied swamps. Autumnal water-starwort. (fen, marsh & swamp)	Not sensitive to acidity	2.09 [N:1.99 S:0.17]	0.0042	N/A
34	Hazelwood ASI (332496,380422)	Hazel woodland and scrub. (broadleaved, mixed & yew woodland)	CLminN: 0.14 CLmaxN: 1.64 CLmaxS: 1.49	2.75 [N:2.65, S:0.20]	0.0035	0.21

Notes:

1. CL=Critical Load, N=Nitrogen, calculations assume 100% of NO_x emitted may contribute to nitrogen deposition and predicted process contribution based on meteorological data for 2005.

2. In order for the assessment to include nitrogen from ammonia, potential ammonia has been assumed to be emitted from the EfW at $10mg/Nm^3$.

3. Where habitat designation for the protected area is not detailed on the APIS resource, a suitable APIS designation has been applied, shown in brackets.

Table 14.19 Acidification due to Sulphur

No.	Protected Area	Feature	Acid Deposition (keq/ha/yr)		Process Contribution (PC) as S keq/ha/year	PC as % of CLmax S
			Critical Load	Current Load		
22	Belfast Lough SPA (based on average set of critical loads & deposition values)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	Not acid sensitive	1.55 [N:1.35 S:0.20]	0.0008	N/A
23	Belfast Lough SPA (335300, 378300)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	Not acid sensitive	1.74 [N:1.163 S:0.18]	0.0009	N/A
24	Belfast Lough SPA & Inner Belfast Lough ASSI (334881, 380373, a western point)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	Not acid sensitive	1.74 [N:1.63 S:0.18]	0.0011	N/A
25	Belfast Lough Open Water SPA (343000, 385000, a central point)	Marine area. Sea inlet. *Podiceps cristatus* (A005) (saltmarsh)	No comparabl e acid critical load class.	1.35 [N:1.26 S:0.15]	0.0008	N/A
26	Outer Belfast Lough ASSI (335635, 381087 a western point)	Coastal sand dunes / Coastal vegetated shingle	CLminN: 0.438 CLmaxN: 2.028 CLmaxS: 1.59	1.63 [N:1.30 S:0.20]	0.0011	0.07
27	Belfast Hills – Squires Hill SLNCI (330200, 378800, a central point)	Heath, grassland, scrub. (dwarf shrub heath)	CLminN: 0.57 CLmaxN: 1.45 CLmaxS: 0.87	2.09 [N:1.99 S:0.17]	0.0068	0.78

No.	Protected Area	Feature	Acid Deposition (keq/ha/yr)		Process Contribution (PC) as S keq/ha/year	PC as % of CLmax S
			Critical Load	Current Load		
28	Belfast Hills – Squires Hill SLNCI (328916, 378962, a western point)	Heath, grassland, scrub. (dwarf shrub heath)	CLminN: 0.71 CLmaxN: 2.33 CLmaxS: 1.62	2.09 [N:1.99 S:0.17]	0.0022	0.13
29	Cave Hill – Collinward SLNCI (332378, 379708)	Heath, grassland, scrub. (dwarf shrub heath)	CLminN: 0.87 CLmaxN: 1.35 CLmaxS: 0.48	1.74 [N:1.63 S:0.18]	0.0044	0.92
30	Cave Hill – Collinward SLNCI (330700, 380600)	Heath, grassland, scrub. (dwarf shrub heath)	CLminN: 0.71 CLmaxN: 2.35 CLmaxS: 1.63	2.09 [N:1.99 S:0.17]	0.0047	0.29
31	Boghill SLNCI (328000, 381500)	Lake & wet grassland. (coastal & floodplain grazing marsh)	No comparable acid critical load class.	2.09 [N:1.99 S:0.17]	0.0021	N/A
32	Boghill SLNCI (327537, 381136)	Lake & wet grassland. (coastal & floodplain grazing marsh)	No comparable acid critical load class.	2.09 [N:1.99 S:0.17]	0.0016	N/A
33	Hyde Park Dam SLNCI (329030, 381635)	Reservoir surrounded by varied swamps. Autumnal water-starwort. (fen, marsh & swamp)	Not sensitive to acidity	2.09 [N:1.99 S:0.17]	0.0043	N/A

No.	Protected Area	Feature	Acid Deposition (keq/ha/yr)		Process Contribution (PC) as S keq/ha/year	PC as % of CLmax S
			Critical Load	Current Load		
34	Hazelwood ASI (332496,380422)	Hazel woodland and scrub. (broadleaved, mixed & yew woodland)	CLminN: 0.14 CLmaxN: 1.64 CLmaxS: 1.49	2.75 [N:2.65, S:0.2]	0.0043	0.29

Notes:

1. CL=Critical Load, S=Sulphur, predicted process contribution based on meteorological data for 2004.

3. Where habitat designation for the protected area is not detailed on the APIS resource, a suitable APIS designation has been applied, shown in brackets.

14.135 As the predicted process contribution towards acid deposition is less than 1% of the critical load at each site, the potential for acid deposition can be screened out as insignificant.

Nutrient Enrichment

14.136 Utilising the predicted process contributions of nitrogen deposition in kg / ha / year due to NO_x and NH_3, calculated as outlined for acidification, the following table compares the predicted process contributions of nitrogen deposition to the relevant critical load for the habitat types associated with each designated site as derived from the UK Air Pollution Information System (APIS) website.

Table 14.20 Deposition at Ecological Receptors

No.	Protected Area	Feature	Nitrogen Deposition (kgN/ha/year)		Process Contribution (PC) as N kgN/ha/year	PC as % of Critical Load (minimum CL)
			Critical Load	Current Load		
22	Belfast Lough SPA (based on average set of critical loads & deposition values)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	20-30	21.96	0.011	0.05

No.	Protected Area	Feature	Nitrogen Deposition (kgN/ha/year)		Process Contribution (PC) as N kgN/ha/year	PC as % of Critical Load (minimum CL)
			Critical Load	Current Load		
23	Belfast Lough SPA (335300, 378300)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	20-30	22.82	0.013	0.06
24	Belfast Lough SPA & Inner Belfast Lough ASSI (334881, 380373, a western point)	Common redshank *Tringa tetanus* (Eastern Atlantic – wintering) (A162)	20-30	22.82	0.016	0.08
25	Belfast Lough Open Water SPA (343000, 385000, a central point)	Marine area. Sea inlet. *Podiceps cristatus* (A005) (saltmarsh)	20-30	17.64	0.012	0.06
26	Outer Belfast Lough ASSI (335635, 381087 a western point)	Coastal sand dunes / Coastal vegetated shingle	8-15	21.43	0.015	0.30
27	Belfast Hills – Squires Hill SLNCI (330200, 378800, a central point)	Heath, grassland, scrub. (dwarf shrub heath)	10-20 northern wet heath (Calluna)	27.86	0.093	0.93
28	Belfast Hills – Squires Hill SLNCI (328916, 378962, a western point)	Heath, grassland, scrub. (dwarf shrub heath)	10-20 northern wet heath (Calluna)	27.86	0.030	0.30
29	Cave Hill – Collinward SLNCI (332378, 379708)	Heath, grassland, scrub. (dwarf shrub heath)	10-20 northern wet heath (Calluna)	22.82	0.060	0.60

No.	Protected Area	Feature	Nitrogen Deposition (kgN/ha/year)		Process Contribution (PC) as N kgN/ha/year	PC as % of Critical Load (minimum CL)
			Critical Load	Current Load		
30	Cave Hill – Collinward SLNCI (330700, 380600)	Heath, grassland, scrub. (dwarf shrub heath)	10-20 northern wet heath (Calluna)	27.86	0.065	0.65
31	Boghill SLNCI (328000, 381500)	Lake & wet grassland. (coastal & floodplain grazing marsh)	20-30 Low & medium altitude hay meadows	27.86	0.029	0.15
32	Boghill SLNCI (327537, 381136)	Lake & wet grassland. (coastal & floodplain grazing marsh)	20-30 Low & medium altitude hay meadows	27.86	0.021	0.11
33	Hyde Park Dam SLNCI (329030, 381635)	Reservoir surrounded by varied swamps. Autumnal water-starwort. (fen, marsh & swamp)	10-15 Valley mires, poor fens and transition mires	27.86	0.059	0.59
34	Hazelwood ASI (332496,380422)	Hazel woodland and scrub. (broadleaved, mixed & yew woodland)	10-15 Broad leaved deciduous trees	37.1	0.049	0.49

Notes

1. CL=Critical Load, N=Nitrogen, calculations assume 100% of NO_x emitted may contribute to nitrogen deposition and predicted process contribution based on meteorological data for 2004.

2. In order for the assessment to include nitrogen from ammonia, potential ammonia has been assumed to be emitted from the EfW at 10mg/Nm^3.

3. Where habitat designation for the protected area is not detailed on the APIS resource, a suitable APIS designation has been applied, shown in brackets.

14.137 As the predicted process contribution towards nutrient enrichment by nitrogen deposition is less than 1% of the critical load at each site, the potential for nutrient enrichment by nitrogen deposition can be screened out as insignificant.

Smothering by Deposited Dust

14.138 An estimated process contribution deposition rate for screening of the deposition of particulates can be calculated in accordance with the H1 – Annex F guidance as:

PCground = (PCair x deposition velocity x 3 x 86400) / 1000

14.139 PCground is the process contribution as a daily deposition rate (mg/m2/day), with deposition velocity taken to be 0.01m/s, and PCair = process contribution to air as µg/m3, based on the maximum annual average ground level concentration. The value of 3 is a nominal factor to convert dry deposition to total deposition and the value 86,400 is a correction factor from per second to per day.

14.140 The predicted PM10 maximum long term process contribution to air of 0.026µg/m^3 gives a calculated maximum deposition rate of 0.068mg/m^2/day, which is much less than 1% of the 'custom and practice' limit in England and Wales of 200 mg/m^2/day referred to in the Environment Agency's Technical Guidance Document (Monitoring) M17 Monitoring of particulate matter in ambient air around waste facilities, March 2004.

14.141 The Air Pollution Information System states there is no threshold against which to assess the impact of particulate deposition. Notwithstanding that, the predicted maximum dust deposition rate is less than a thousandth of 200mg/m^2/day. It follows that the potential level of deposition can be considered to be trivial in terms of smothering and insignificant.

Deposition of Persistent Substances

14.142 Emissions to air from the EfW may result in deposition onto the surrounding land. The assessment of long term impact to humans by direct inhalation and the appraisal of deposition to vegetation ecosystems demonstrates that the long term process contributions will not be significant. The H1 Annex F guidance also indicates maximum deposition rates for certain substances for which further evaluation can be carried out. An estimated process contribution deposition rate for screening of the deposition of those substances has been calculated in accordance with the H1 – Annex F guidance as:

PCground = (PCair x deposition velocity x 3 x 86400) / 1000

14.143 PCground is the process contribution as a daily deposition rate (mg/m^2/day), with deposition velocity taken to be 0.01m/s, and PCair equals the process contribution to air as µg/m^3, based on the maximum annual average ground level concentration. The value of 3 is a nominal factor to convert dry deposition to total deposition and the value 86,400 is a correction factor from days to seconds.

14.144 Table 14.21 compares the predicted process contributions as deposition rates to the relevant maximum deposition rate given in the H1 Annex F guidance.

14.145 Where the predicted process contribution as a maximum deposition rate represents more than 1% of the maximum allowed deposition rate, the process environmental contribution has been calculated as the maximum deposition rate plus the background deposition rate.

Table 14.21 Assessment against Maximum Deposition Rates

Substance	Max. allowed deposition rate (MADR) $mg/m^2/day$	Process contribution as max deposition rate MDR (see note 1) $mg/m^2/day$	PC as % of MADR	Background deposition $mg/m^2/day$ (see note 2)	PEC $mg/m^2/day$	PEC as % of MADR
Cd deposit	0.009	0.0003	3.8	0.000055	0.0004	4.4
Hg deposit	0.004	0.0003	8.5	0.000022	0.0004	9.0
As deposit	0.02	0.0034	16.9	0.000822	0.0042	21.0
Cr deposit	1.5	0.0034	0.23			
Cu deposit	0.25	0.0034	1.4	0.002740	0.0061	2.4
Pb deposit	1.1	0.0034	0.31			
Ni deposit	0.11	0.0034	3.1	0.000685	0.0041	3.7

Notes:

1. For this assessment it has been assumed that emissions of each individual metal occur at the relevant IED metal group aggregate limit.

2. Background deposition rates have been taken as the highest of the range interpolated from www.uk-pollutantdeposition.ceh.ac.uk UK pollutant maps for heavy metals total deposition.

14.146 The process contribution as a maximum deposition rate for chromium and lead is less than 1% of the maximum allowed deposition rate and is screened out as insignificant. For other substances the process environmental contribution is less than 70% of the maximum allowed deposition rate, and emissions are likely to be much lower than that appraised, further assessment is not necessary.

Dispersion Model Predictions – Abnormal Operations

14.147 The IED Article 46 Control of emissions provides some operational flexibility to resolve problems on the plant without initiating a complete shutdown, 14.148 Abnormal operations typically include incidents such as technically unavoidable stoppages, disturbances or failures of the pollution control equipment or monitoring equipment, though the IED Article 47 requires "in the case of a breakdown, the operator shall reduce or close down operations as soon as practicable until normal operations can be restored".

14.149 The IED requires that waste incineration plant must not continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limit values are exceeded, and that the cumulative duration of operation in such conditions over 1 year must not exceed 60 hours in a year, applying to those furnaces which are linked to one single waste gas cleaning device.

14.150 During abnormal operations the IED emission limits may be transiently exceeded, though the IED Annex VI stipulates that the total dust content of the emissions into the air of a waste incineration plant shall under no circumstances exceed 150 mg/m^3 expressed as a half-hourly average and the air emission limit values for CO and TOC as daily or half hourly average values shall not be exceeded.

14.151 Consequently the potential effect of abnormal operation for both short term and long term impact has been assessed, though given that restrictions apply to the duration of abnormal operating conditions, a significant long term environmental impact will not occur.

Failure of Monitoring Equipment

14.152 Abnormal operation resulting from failure of a monitoring device does not in itself affect emissions, so a period of abnormal emissions due to failure of a monitoring device is unlikely. If a monitoring device failed it is also unlikely that the short period during which monitoring did not take place would coincide with an emission above an IED limit.

Failure of Pollution Control Equipment

14.153 Emissions from the EfW will be controlled by the following pollution control equipment:

- SNCR using ammonia (main combustion chamber);
- Semi-dry process with evaporative cooler and hydrated lime injection;
- Dry lime and activated carbon injection (with reaction / sorption tower); and
- Bag filters with solids recycle to sorption tower to minimise reactant usage.

14.154 Failure of one or more items of the above control equipment has the potential to cause increased emissions for a period of up to 4 hours after which waste must cease to be charged and the plant shut down. Therefore failure of the following items of abatement equipment has been considered and assessed:

- SNCR equipment, leading to increased emissions of nitrogen oxides;

- Acid gas abatement system, leading to increased emissions of sulphur dioxide, hydrogen chloride and hydrogen fluoride;
- Activated carbon system leading to increased emissions of gaseous heavy metals and dioxins/furans; and
- Bag filters, leading to increased emissions of particulate matter, metals and dioxins/furans.

14.155 Breakdowns of the above abatement equipment and their likely long term and short term impact on air quality has been estimated by scaling the predicted ground level concentrations produced during normal operation by the ratio of the normal to the estimated abnormal emission concentrations.

14.156 The effect of the EfW using the abnormal operation allowances has been estimated through its effect on short term (usually one hour) and long term (annual average) ground level concentrations. For long term concentrations, it is assumed that the unabated emission persists for 60 hours in the year, and assuming 8000 hours of operation per year, the remaining 7940 hours in the year the emission is at the normal emission limit value. For assessment of potential abnormal emissions assuming 8000 hours of operation, i.e. non-operational time of about 32 days per year, is a more conservative approach than assuming continuous operation, i.e. 8760 hours per year.

Failure of the SNCR System

14.157 For failure of the SNCR system, this technique typically abates between 40% to 60% of the NO_x formed. Taking the IED limit for normal operation of 200 mg/Nm^3 and assuming 40% abatement during normal operation, the unabated emission should not exceed 500 mg/Nm^3, i.e. the emissions increase 2.5:1 over the IED emission limit.

Short Term Impact

14.158 Based on the maximum half hourly average emission limits the maximum short term process contribution (PC) for NO_2 under normal operating conditions is predicted to be 40.7µg/m^3 as a 99.79 %ile of the 1 hour average. Under abnormal operating conditions it could be 40.7 x 2.5 = 101.7µg/m^3, which is 50.8% of the short term assessment criterion of 200µg/m^3. With a local background of around 4.4µg/m^3, the short term PEC (process contribution plus twice the background) would be 110.5µg/m^3 which is 55% of the short term assessment criterion.

14.159 That PEC is greater than 20% of the assessment criterion and so is potentially a concern, but the PEC is well below the assessment criterion and the assessment represents a worst case scenario because the maximum process contribution is predicted based on continuous emissions at the half hourly average 100 percentile limit (as opposed to the much lower half hourly average 97 percentile limit), coinciding with the worst case meteorological conditions. That is a pessimistic scenario and it is unlikely such a high process contribution for short term

NO_2 will occur, and indeed the maximum process concentration is highly localised. Assessment based on the IED half hourly average 97 percentile limit, which is the same as the daily average limit, would be half that process contribution and short term PEC would be 40.7% of the short term assessment criterion.

Long Term Impact

14.160 The maximum long term PC for NO_2 under normal operating conditions is 0.37µg/m^3. Due to abnormal operating conditions the PC could be [(0.37 x 2.5 x 60) + (0.37 x 7940)] / 8000 = 0.53µg/m^3, which is 1.3% of the long term assessment criterion of 40µg/m^3. A more unlikely scenario would be if higher emissions occurred during abnormal operating conditions, e.g. equivalent to the 99.79% of the 1 hour average from continuous emission at the half hourly average 100 percentile limit i.e. 94.2µg/m^3.

14.161 It is unlikely that each failure of the SNCR would occur with the highest emissions, but if that emission occurred during each occasion of abnormal operating conditions, the abnormal PC could be [(40.7 x 2.5 x 60) + (0.37 x 7940)] / 8000 = 1.1µg/m^3, which is 2.8% of the long term assessment criterion of 40µg/m^3. However with a local background of around 4.4µg/m^3, the long term PEC (process contribution plus the background) would be 5.5µg/m^3 which is 13.8% of the long term assessment criterion. As the long term assessment criterion is an air quality objective and the PEC is less than 70% of that objective, the long term abnormal emissions are not likely to cause exceedance of that objective.

Conclusion

14.162 Taking that into account and the conservative nature of the assessment it is concluded that abnormal operation due to failure of the SNCR to the maximum extent allowed by the IED is not likely to lead to a breach of an air quality objective, and consequently there would be no adverse impact. Based on that screening there would also be negligible change to the nitrogen levels and loads at habitat sites.

Failure of the Acid Gas Abatement System

14.163 For the acidic gas components HCl, HF and SO_2, the flue gas treatment system is based on absorption using the additive calcium hydroxide. The flue gas enters the treatment at 170°C and the evaporative cooler eliminates peaks of SO_2 and HCI and other acidic components, and quenches the flue gas down to an optimal reaction temperature of approximately 135°C for the dry absorption stage, which consists of the dry sorption reactor and bag filter. The absorption agent dosing is dependent on the HCL and SO_2 content in the raw gas measured behind the boiler flue gas exit.

14.164 The design of the EfW plant is such that under normal load conditions the daily average concentrations at the boiler outlet are anticipated to be for HCL 2,000mg/m^3, for HF 100mg/m^3, and for SO_2 600mg/m^3..

14.165 Emission of HCL at that concentration would be more than thirty times the HCL short term emission limit, which for the predicted maximum process contribution would lead to an exceedance of the HCl short term assessment criterion.

14.166 Entire failure of both stages of the absorption process is considered as not likely to occur. For failure of the acid gas abatement system, an acid pollutant release of 600mg/m3 has been used for HCl and SO_2, and 30mg/m^3 for HF, an order of magnitude increase for HCl and maintaining the 20:1 HCl to HF ratio indicated by the combustion calculations. The SO_2 abnormal emission concentration would increase the predicted process contribution by three times its IED half hourly average 100 percentile emission limit of 200mg/m^3.

Short Term Impact

14.167 The short term impact results due to the failure of the acid gas abatement system are shown in the following Table 14.22.

Table 14.22 Assessment of Short Term Impact Due to Failure of the Acid Gas Abatement System

Substance at ½ hr 100%ile unless stated otherwise	**Average Period**	**Assess-ment Criterion µg/m^3**	**Max. PC (for emission at ½ hr 100%ile µg/m^3**	**PC abnormal µg/m^3**	**PC as % of assess-ment criterion**	**PEC abnormal µg/m^3**	**PEC as % of assess -ment criterio n**
HCl	1 hr	750	31.2	312.0	41.6	312.0	41.6
HF	1 hr	160	2.1	15.6	9.8	15.6	9.8
SO_2	1 hr 99.73%il e	350	53.3	159.9	45.7	160.6	45.9
SO_2	15 min 99.9%ile	266	91.4	274.3	103.1	275.0	103.4
SO_2 at ½ hr 97%ile	15 min 99.9%ile	266	22.9	68.6	25.8	69.3	26.0

14.168 The abnormal PC and PEC for SO_2 are greater than its short term assessment criterion as a 15min 99.9 percentile. That exceedance is potentially a concern, but the assessment assumes a worst case scenario because the maximum process contribution is predicted based on continuous emission at the half hourly average 100 percentile limit (as opposed to the much lower half hourly average 97 percentile limit) coinciding with the worst case meteorological conditions.

14.169 That is very pessimistic and it is unlikely such a high process contribution for short term SO_2 will occur, and indeed the maximum concentration is highly localised. Assessment based on the IED half hourly average 97 percentile limit, which is the same as the daily average limits, gives an abnormal PC and PEC of about 26% of the assessment criterion. Based on the conservative nature of the assessment, the potential for a short term impact due to failure of the acid gas abatement system is assessed as unlikely.

Long Term impact

14.170 Assessment of the potential long term impact due to the failure of the acid gas abatement system is shown in Table 14.23, with PC abnormal calculated as an average for the year assuming sixty hours of abnormal emissions at ten, twenty and three times the respective long term emission rates for HCl, HF and SO_2, and 7940 hours at the normal long term emission rate.

Table 14.23 Assessment of Long Term Impact Due to Failure of the Acid Gas Abatement System

Substance	**Average Period**	**Assess-ment Criterion µg/m³**	**PC normal µg/m³**	**PC abnormal µg/m³ (see note 1)**	**PC as % of assess-ment criterion**	**PEC abnormal µg/m³**	**PEC as % of assess-ment criter-ion**
HCl	Annual	20	0.026	0.085	0.42		
HF	Annual	16	0.0026	0.032	0.20		
SO_2	Annual	50	0.131	0.177	0.35		

Notes:

1. The PC abnormal has been calculated as an average for the year assuming sixty hours of abnormal emissions at sixty, thirty and twelve times the respective long term emission rates for HCl, HF and SO_2, and 7940 hours at the normal long term emission rate.

14.171 If in the unlikely scenario that on each occasion of abnormal operating conditions emissions occurred with emission rates of 600mg/m3 for HCl and SO_2, and 30mg/m^3 for HF, the abnormal PC would not exceed 1% of the assessment criterion and the PEC would not exceed 70% of that criterion.

14.172 Based on the long term PEC due to the abnormal emissions being less than 1% of the assessment criterion, the long term abnormal emissions of HCL, HF and SO_2 are screened out as insignificant in the event of a failure of the acid gas abatement system.

Conclusion

14.173 There will be no adverse impact from abnormal operation due to failure of the acid gas abatement system to the maximum duration allowed by the IED.

Failure of the Activated Carbon Injection System

14.174 For gaseous heavy metal and dioxin/furans the flue gas treatment system is based on adsorption using activated carbon as the reactive compound. Under normal load conditions the average concentrations at the boiler outlet are predicted to be 2,500mg/m^3 for dust, 0.5mg/m^3 for mercury, 10mg/m^3 for cadmium plus thallium, and for Sb, As, Cr, Co, Cu, Pb, Mn, Ni and V a total of 500mg/m^3, dioxins/furans in total 5.0ng/m^3, reducing to the less than their respective IED limits by the flue gas treatment system.

14.175 At those concentrations the flue gas treatment system provides abatement in the short term of 98.8% to the IED half hourly average 100 percentile limit of 30mg/m^3 for PM10, 90% for mercury to its IED limit of 0.05mg/m^3, 99.5% for cadmium plus thallium to their limit of 0.05mg/m^3, and 99.9% for total residues of Sb, As, Cr, Co, Cu, Pb, Mn, Ni and V to their IED limit of 0.5mg/m^3. However the main reduction will occur through the removal of particulate matter from the flue gas during its treatment process as the majority of those substances will be as particulate matter or particle bound, exceptions being mercury and some dioxins/furans.

14.176 Consequently for failure of the activated carbon system, there is no good figure available for the likely unabated concentrations entering that system, and abatement of 95% has been initially assumed for that system. With that assumption the IED emission limits represent 5% of the unabated values, so unabated emissions as a consequence of failure of the activated carbon system would be twenty times higher than the IED emission limits.

Short Term Impact

14.177 For metals, assessment of the potential short term impact due to the failure of the activated carbon injection system is shown in the following table.

Table 14.24 Assessment of Short Term Impact Due to Failure of Activated Carbon Injection System

Metal	Average Period	Assess-ment Criterion μg/m^3	PC normal μg/m^3 (see note 1)	PC abnormal μg/m^3	PC as % of assess-ment criterion	PEC abnormal μg/m^3	PEC abnormal as % of assess-ment criterion
Cd	1hr	1.5	0.037	0.738	49.2	0.738	49.2

Metal	Average Period	Assess-ment Criterion µg/m³	PC normal µg/m³ (see note 1)	PC abnormal µg/m³	PC as % of assess-ment criterion	PEC abnormal µg/m³	PEC abnormal as % of assess-ment criterion
Tl	1hr	30	0.037	0.738	2.5		
Hg	1hr	7.5	0.037	0.738	9.8		
Sb	1hr	150	0.366	7.3	4.9		
As	1hr	15	0.366	7.313	48.75	7.314	48.76
Pb	1hr	N/A	0.366	7.3	N/A		
Cr	1hr	150	0.366	7.3	4.8		
Co	1hr	6	0.366	7.3	121.9	N/A	≥121.9
Cu	1hr	200	0.366	7.3	3.7		
Mn	1hr	1500	0.366	7.3	0.49		
Ni	1hr	30	0.366	7.313	24.38	7.315	24.38
V (see note 2)	24hr	1	0.424	0.1765	17.65	0.1767	17.67

Notes:

N/A = No Short term assessment criterion available.

1. For the purposes of initial screening it has been assumed that emissions of each individual metal occur at the relevant IED metal group aggregate limit.

2. For vanadium, the PC abnormal has been calculated as an average within a 24 hour period assuming four hours of abnormal emissions (equates to 20 x maximum process contribution as 1hr average) and twenty hours at the normal short term emission rate (equates to normal process contribution as 24hr average).

14.178 For the majority of metals the short term PC is below 10% of the assessment criterion or the PEC due to short term abnormal emissions is below 20% of the short term assessment criterion.

14.179 The exceptions are arsenic, cobalt, nickel and vanadium, for which the long term PEC due to the estimated abnormal emission is greater than 20% of the short term assessment criterion. However that assumes continuous emission of each of those substances, whereas the plant would have to be shut down after four hours, and also emission at the IED aggregate limit for the nine Group 3 metals, which is also unlikely. The PEC is well below the short term assessment criterion except for cobalt, but if the actual emissions of those substances were only a ninth of the IED aggregate limit, the estimated abnormal PC and for those metals would be less than 10% of the assessment criterion or the PEC less than 20% of that criterion.

14.180 Similarly if abatement due to the carbon injection system was actually greater than 95%, then this analysis which assumes emission at the IED substance limits or aggregate limits, would indicate the potential for higher abnormal PC and hence potentially higher PECs. In reality the majority of the heavy metals are not likely to be in gaseous form (an exception is mercury but that could be 100 times its emission limit and its PEC not exceed the short term assessment criterion), and the activated carbon system in combination with the bag filters is likely to achieve high abatement to emission concentrations much lower than the IED substance or aggregate limits

14.181 Based on that appraisal an adverse short term impact due to failure of the activated carbon injection system is assessed as unlikely.

Long Term Impact

14.182 For metals, assessment of the potential long term impact due to the failure of the activated carbon injection system is shown in the following table.

Table 14.25 Assessment of Long Term Impact Due to Failure of Activated Carbon Injection System

Metal	Average Period	Assess-ment Criterion $\mu g/m^3$	PC normal $\mu g/m^3$ (see note 1)	PC abnormal $\mu g/m^3$ (see note 2)	PC as % of assess-ment criterion	PEC abnormal $\mu g/m^3$	PEC abnormal as % of assess-ment criterion
Cd	Annual	1.5	0.00013	0.00015	3.0	0.00031	6.2
Tl	Annual	30	0.00013	0.00015	0.01		
Hg	Annual	7.5	0.00013	0.00015	0.06		
Sb	Annual	150	0.0013	0.0015	0.03		
As	Annual	15	0.0013	0.0015	24.9	0.0023	38.3
Pb	Annual	N/A	0.0013	0.0015	0.6		
Cr	Annual	150	0.0013	0.0015	0.03		
Co	Annual	6	0.0013	0.0015	0.75		
Cu	Annual	200	0.0013	0.0015	0.01		

Metal	Average Period	Assess-ment Criterion $\mu g/m^3$	PC normal $\mu g/m^3$ (see note 1)	PC abnormal $\mu g/m^3$ (see note 2)	PC as % of assess-ment criterion	PEC abnormal $\mu g/m^3$	PEC abnormal as % of assess-ment criterion
Mn	Annual	1500	0.0013	0.0015	1.0		
Ni	Annual	30	0.0013	0.0015	7.5	0.0030	15.0
V	Annual	1	0.0013	0.0015	0.03		

Notes:

1. For this assessment it has been assumed that emissions of each individual metal occur at the relevant IED metal group aggregate limit.

2. The PC abnormal has been calculated as [(PC normal long term x 20 x 60) + (PCnormal long term x 7940)] / 8000.

14.183 The long term abnormal PC for most substances is less than 1% of the assessment criterion and so screened out as insignificant. For arsenic and nickel the long term abnormal PEC is less than 70% of the assessment criterion, and so abnormal emissions of those metals is not likely to cause exceedance of an air quality objective in the event of a failure of the activated carbon injection system.

Increase in Dioxin Emissions

14.184 Dioxins and furans have been assessed in terms of overall intake, including both inhalation and the more significant exposure route of ingestion, within the human health risk assessment provided in Appendix 14.9, which has also considered the impact of abnormal emissions of dioxins and furans. For the abnormal emissions scenario appraised the estimated increased average daily intake for the maximum predicted concentrations due to emission from the EfW, and for the receptor type with the most exposure, would not pose a risk to human health.

Conclusion

14.185 There will be no adverse impact from abnormal operation due to failure of the activated carbon injection system to the maximum duration allowed by the IED.

Failure of the Bag Filters

14.186 For failure of the bag filter, emission at the maximum 150mg/m^3 limit specified for particulate matter in the IED under abnormal operations will cause an increase in the maximum short term ground level concentration in the ratio 5:1 as the half hour average is 30mg/m^3.

14.187 The worst case emissions of heavy metals and dioxins would be that they would increase in the same ratio as the particulate, namely a 5:1 increase over the short term emission value. Failure of the entire bag filter system is unlikely because the different fabric filter chambers are controlled separately for their dust content. Each chamber can be individually isolated for maintenance or in the event of a failure allowing the process to continue at an adequate performance level and remain compliant with the emission limits.

Short Term Impact

14.188 Assessment of the potential short term impact due to the failure of the bag filters is shown in the Table 14.26 overleaf.

Table 14.26 Assessment of Short Term Impact Due to Failure of Bag Filters

Substance	Average Period	Assessment Criterion μg/m^3	PC normal μg/m^3 (see note 1)	PC abnormal μg/m^3	PC as % of assessment criterion	PEC abnormal μg/m^3	PEC abnormal as % of assessment criterion
PM10 (see note 2)	24hr 90.41%ile	50	0.085	0.14	0.28		
Cd	1hr	1.5	0.037	0.18	12.3	0.18	12.3
Tl	1hr	30	0.037	0.18	0.61		
Hg	1hr	7.5	0.037	0.18	2.5		
Sb	1hr	150	0.366	1.8	1.2		
As	1hr	15	0.366	1.8	12.2	1.8	12.2
Pb	1hr	N/A	0.366	1.8	N/A		
Cr	1hr	150	0.366	1.8	1.2		
Co	1hr	6	0.366	1.8	30.5	N/A	Likely to be less than 70% unless back-ground ≥ 1.2μg/m3
Cu	1hr	200	0.366	1.8	0.9		
Mn	1hr	1500	0.366	1.8	0.12		
Ni	1hr	30	0.366	1.8	6.1		
V (see note 3)	24hr	1	0.042	0.071	7.1		

Notes:
N/A = No Short term assessment criterion available.
1. For this assessment it has been assumed that emissions of each individual metal occur at the relevant IED metal group aggregate limit.
2. For PM10, the PC abnormal has been calculated as an average within a 24 hour period assuming four hours of abnormal emissions (equates to 5 x process contribution as 90.41%ile of 24hr average) and twenty hours at the normal short term emission rate (equates to normal process contribution as 90.41%ile of 24hr average).
3. For vanadium, the PC abnormal has been calculated as an average within a 24 hour period assuming four hours of abnormal emissions (equates to 5 x maximum process contribution as 1hr average) and twenty hours at the normal short term emission rate (equates to normal process contribution as 24hr average).

14.189 The short term process contributions for cadmium, arsenic and cobalt exceed 10% of the short term assessment criterion, but the PECs for cadmium and arsenic are less than 20% of that criterion. Although the short term process contribution for cobalt exceeds 10% of its short term assessment criterion, it is assessed as unlikely the PEC would exceed 20% of that criterion because there would have to be a relatively high background concentration of cobalt in comparison to other metals.

14.190 For most substances the abnormal PC is less than 10% and is screened out as insignificant. For cadmium, arsenic and cobalt the abnormal PEC being less than 20% of the short term assessment criterion and so an exceedance of an air quality object is not likely in the event of a failure of the bag filters.

Long Term Impact

14.191 Assessment of the potential long term impact due to the failure of the bag filters is shown in the following table. Metals are appraised under ‘failure of the activated carbon injection system’ as that provides a more conservative scenario.

Table 14.27 Assessment of Long Term Impact Due to Failure of Bag Filters

Substance	**Average Period**	**Assess-ment Criterion µg/m^3**	**PC normal µg/m^3**	**PC abnormal µg/m^3 (see note 1)**	**PC as % of assessment criterion**	**PEC abnormal µg/m^3**	**PEC abnormal as % of assess-ment criterion**
PM10	Annual	40	0.026	0.029	0.07		
Notes: 1. For PM10, the PC abnormal has been calculated as [(0.026 x 15 x 60) + (0.026 x 7940)] / 8000.							

14.192 In the unlikely scenario that on each occasion of abnormal operating conditions emissions occurred at the maximum hourly average rate, the abnormal PC would not exceed 1% of the assessment criterion and hence can be screened out as insignificant in the event of a failure of the bag filters.

Conclusion

14.193 There will be no adverse impact from abnormal operation due to failure of the bag filters to the maximum duration allowed by the IED.

AERMOD Dispersion Model Predictions – MBT

14.194 It is envisaged that the MBT will commence operation in advance of the EfW so potential emissions from the exhaust air treatment system of the MBT have been modelled separately to those from the EfW. The anticipated maximum substance emission concentrations from the exhaust air treatment system for normal operations were modelled, and for initial screening the process contribution (PC) from the MBT has been taken as the maximum predicted at the modelled receptors. The maximum dispersion model predictions for the MBT from meteorological data for 2004 to 2012 are provided in the following table. Contour plots of the dispersion model predictions for particulates as PM10 (long and short term) and ammonia (short term) are provided in Appendix 14.5.

14.195 Airborne concentrations for other substances can be estimated from those contour plots based on the relative ratio of the substance emission concentrations.

14.196 Process contribution at less than 1% or 10% of the long or short term assessment criterion respectively are assessed as insignificant, whereas for those greater than 1% or 10% of the long or short term assessment criterion respectively, the process environmental contribution (PEC) has been calculated taking account of the estimated background concentration.

Table 14.28 AERMOD Dispersion Model Predictions for Impact from the MBT

Substance	**Emission Rate mg/m^3**	**Assessment Criterion µg/m^3**	**Average Period**	**PC µg/m^3**	**PC as % of assessment criterion**	**Background µg/m^3**	**PEC µg/m^3**	**PEC as % of assessment criterion**
Long Term Impact by Direct Inhalation								
PM10	1	40	Annual	1.70	4.3	10.8	12.5	31.3
NH_3	1	8	Annual	1.70	21.3	4.95	6.65	83.1
Short Term Impact by Direct Inhalation								
PM10	1	50	24hr 90.41%ile	5.2	10.4	10.8	26.8	53.6
NH_3	1	2500	1hr	219.2	8.8			

14.197 For long term impact by inhalation the maximum process contributions for PM10 is more than 1% of the assessment criterion, though the PEC is less than 70% of its assessment criterion and occurs localised within the site, so further assessment of that substance is not required. For long term impact by inhalation the maximum process contribution for ammonia is more than 1% of the assessment criterion and the PEC is more than 70% of the assessment criterion. But the maximum occurs localised within the site and the PEC beyond the site boundary is less than 70% of the assessment criterion, so further assessment is not necessary.

14.198 For short term impact by inhalation the maximum process contribution for PM10 is more than 10% of the assessment criterion and the PEC more than 20% of the assessment criterion, though as the maximum occurs localised within the site and the process contribution beyond the site boundary is less than 10% of the assessment criterion, further assessment is not necessary.

14.199 Potential nitrogen deposition at the site due to the ammonia process contribution has been assessed in Chapter 9 – Ecology.

In Combination Emissions from MBT with EfW

14.200 Maximum process contributions for the MBT are higher than for the EfW but occur locally near to the MBT plant, and therefore it is not appropriate to carry out appraisal based on maximum process contributions from the combined emissions. Of relevance for the combined emissions are the process contributions at nearby receptors such as dwellings or habitat sites. Those will not be higher than the maximum process contributions that have been previously assessed so no further consideration is required.

Air Quality Impact due to Odour Emissions

14.201 Section 63 of the Clean Neighbourhoods and Environment Act 2011 includes as a statutory nuisance “any dust, steam, smell or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance”. The determination of whether or not an odour constitutes a nuisance is usually carried out by the Local Authority, but there is currently no legislation in the UK defining acceptable odour concentrations, although a number of guidelines do exist.

14.202 Relevant guidance is the DEFRA publication ‘Odour Guidance for Local Authorities’, March 2010, and the Environment Agency’s Horizontal Guidance which is of relevance to environmental permit applications, with particular relevance being the Agency’s Technical Guidance Note H4 Odour Management – How to comply with your environmental permit, April 2011.

14.203 An assessment of potential for odour from the proposed development broadly follows the guidance in those documents.

14.204 The risk of unacceptable odour events occurring and affecting nearby properties depends on the characteristics of the odour that may occur, the duration of the odour generating activities and the distance between the odour generating activities and potential receptors, together with the frequency with which the wind blows from the source to the receiver. The risk will be modified by odour management or abatement systems that are in use and the degree of containment of operations within a building. Each of those factors is considered in turn to derive an overall appraisal of the risk and need for mitigation measures, if any.

Odour Criteria

14.205 In order to overcome the practical difficulties of trying to analyse a large number of odorous substances at very low concentrations the concept of odour concentration has been developed.

14.206 In simple terms this measures the number of times a sample of odorous air has to be diluted before 50% of a panel of "sniffers" cannot distinguish it from clean air.

14.207 The odour concentration of an undiluted sample that is at that threshold level is defined as 1 ou/m^3, the odour recognition threshold being generally about three to five times the odour detection threshold concentration. Approximately 2% of population have a very poor sense of smell and approximately 2% are hypersensitive, and that has to be taken into account when assessing complaints.

14.208 McGovern of Northumberland Water Ltd. (1994) reported that in 1990, surveys surrounding 200 industrial odour sources in the Netherlands showed that there were justifiable complaints when 98th percentile compliance with an odour exposure standard of 5ou/m^3 was achieved. As a consequence Northumberland Water adopted a standard of 5ou/m^3 for a maximum of 2% of all hours as the "normal'' nuisance level. For comparison the Environment Agency's H4 Odour Management Consultation Draft in Appendix 3 – Important Odour Information, indicates the following as a very approximate guide:

- 1ou/m^3 is the point of detection, although individuals may develop a tolerance to a medley of normal background odours, such as traffic, grass cutting, plants, etc. This background can be anything from 5 to 40 ou/m^3;
- 1-5ou/m^3 the odour is recognisable. A rapidly fluctuating odour is often more noticeable than a steady background odour at a low concentration. People can detect and respond to odour exposure that lasts as little as one or two seconds;
- 5ou/m^3 is a faint odour; and
- 0ou/m^3 is a distinct odour.

14.209 The H4 Odour Management, March 2011, Appendix 3 – Modelling Odour Exposure, indicates the following benchmarks 98th percentiles of hourly average concentrations of odour modelled over a year at a site or installation boundary:

- 1.5ou/m^3 for most offensive odours;
- 3.0ou/m^3 for moderately offensive odours; and
- 6.0ou/m^3 for less offensive odours.

14.210 Those were based on a Dutch livestock dose response study, which associates these levels with 10% of the general public, nearby receptors or workers in agriculture reporting annoyance due to pig odours.

14.211 The H4 Odour Management guidance is that modelled results which project exposures above those benchmark levels, after taking uncertainty into account, indicates the likelihood of unacceptable odour pollution, however the criteria have not undergone robust validation in terms of their applicability to the sewage treatment sector in the UK.

14.212 For comparison the UKWIR publication Odour Control in Wastewater Treatment, 2001, presented data which indicate that at exposures below 5ou/m^3 as a 98th percentile of one hour average odour concentration, complaints were relatively rare at 3% of the total number of registered complaints. In the intermediate zone, 5 to 10ou/m^3 as a 98th percentile of one hour average odour concentration, a significant fraction of total registered complaints occur with 38% of the total, whereas the majority of complaints, 59%, occur in the area exposed to concentrations at or greater than 10ou/m^3 as the 98th percentile of one hour average odour concentration.

14.213 The H4 Odour Management, Appendix 3, also provides the following examples of the three benchmark odour categories:

- Highly offensive processes - decaying animal or fish remains, processes involving septic effluent or sludge, biological landfill odour;
- Moderately offensive - intensive livestock rearing fat frying (food processing) sugar beet processing, well aerated green waste composting; and
- Less offensive – brewery, confectionery, coffee roasting, bakery.

14.214 Consequently odours in the exhaust air after treatment of the process air from the MBT are likely to be classified as highly or moderately offensive, whereas odours will not be emitted from the EfW stack because they will be destroyed by the high combustion temperatures.

14.215 However the exhaust air from the MBT will firstly pass two parallel lines of wet scrubbers, which are to be controlled to remove potentially odorous substances such as ammonia, prior to entering the biofilter which will also reduce the odour level.

14.216 Those will ensure that there is less likelihood of offensive odour being released i.e. in comparison to odour from untreated waste or the biological treatment process, hence the benchmark level for moderately offensive odour is appropriate.

14.217 The Horizontal Guidance H1 Environmental risk assessment for permits, and in particular its Annex A Amenity and accident risks from installations and waste operations, broadly outline an approach for a qualitative appraisal of potential odour risk and its management which can be presented via a tabulated format.

14.218 Generally operators should then aim to mitigate the potential for odour by applying an odour management plan and using BAT (Best Available Techniques), and the H4 Odour Management identifies what the Environment Agency is looking for in an odour management plan.

Potential Odour Sources

14.219 The waste expected at the MBT arises from municipal and third party sources, and the products from its processing may be odorous. This will be transported to and from the site in containers or covered vehicles.

14.220 Unloading of the incoming waste will be carried out within the enclosed confines of the MBT reception building after the automated roller shutter doors have been closed following entry to the building by a refuse vehicle. This will provide containment of possible odour emissions from that unloading operation, as will the other MBT buildings for the various waste processing and treatment operations.

14.221 The design and planned operation of the new MBT plant is intended to ensure that odour emissions from the waste processing within the enclosed building are minimised.

14.222 To do so air will be drawn into the various MBT waste processing areas so they are kept under a slight negative pressure, with emissions then circulated through the exhaust system to the wet scrubbers and biofilter. That system should effectively negate the possibility of odorous emissions escaping outside the buildings. Biofilters are widely considered as a suitable choice for the reduction of odour emissions from enclosed waste processing operations, such as bio-drying, and are able to mitigate emissions of a wide number of different compounds.

14.223 The EfW buildings where waste handling occurs will also be under a negative pressure due to combustion air suction and thus generated flue gas glow through to the EfW stack and odours will not be emitted from the EfW stack because they will be destroyed by the high combustion temperatures.

14.224 Background odours are likely to be typical for a semi-rural area and may include odours due to livestock, crops, and agricultural activities such as slurry spreading and general farm management. There may also be transient odours from natural vegetation and roads, and background odours may vary from season to season, however they cannot be relied upon to mask a particular smell because the human nose is very efficient at picking out a particular odour within a mixture of odours.

Assessment

14.225 For an odour to become unacceptable it needs to be recognisable, have unpleasant characteristics and be present for a high percentage of the time. But in addition to proximity between the source and receptor the assessment of odour and application of the odour management controls can also take account of wind direction frequency. Wind data specific to the site is not available, so reference has been made to Met Office data for Belfast International Airport, for which wind roses are provided in Appendix 14.1.

14.226 Those indicate that calm conditions may occur for around 1% of the time, which is when odour can build up locally around open sources, as there is little air movement to disperse the odour.

14.227 The negative air pressure system for the waste processing buildings should effectively retain odours during calm conditions. Based on the data for Belfast (Aldergrove) International Airfield for 2004 to 2012, i.e. a potential 78,912 hourly wind direction measurements (though 150 readings were missing), south westerly winds prevail.

14.228 Hence potential receptors to the north-east are most likely to be downwind, with their aggregated time downwind being 12% which equates to 44 days.

14.229 The only other direction where receptors may be downwind of the proposed development for more than 10% of the time is to the north north-east, whereas receptors to the south to west north-west are likely to be downwind for less than 5% of the time on aggregate, which equates to less than 18 days.

14.230 Overall the wind data indicates the period of time receptors at nearby properties are downwind of the proposed development and hence may experience an odour, could vary from 2-12%, but complaints would only be likely to arise if the odour was unpleasant or persistent.

14.231 However that scenario is not envisaged given the anticipated MBT operating procedures and exhaust air treatment, which will ensure the odour emitted is not as malodorous as the waste when received. The waste material will be transported to the proposed development in containers or covered vehicles, thereby mitigating the potential for a malodorous emission during waste transportation.

14.232 To further evaluate the potential for an odour annoyance complaint due to possible emissions of odour from the MBT biofilter exhaust air treatment system, odour emissions of 1,000ou/m^3 have been modelled to allow for possible uncertainty in the measurement of odour as that is twice the biofilter manufacturer's anticipated emission of 500ou/m^3.

14.233 For the exhaust air extraction rate of 135,000m^3/hr, an odour concentration of 1000ou/m^3 equates to a total odour release rate of 37,500ou/s. The dispersion model parameters were as per Appendix 14.2 and the model was run with meteorological data for the individual years 2004 to 2012. The meteorological data for 2008 and 2009 were found to predict the lowest concentrations, whereas the data for 2004-7 and 2011-12 predicted similar dispersion patterns with 2010 predicting the highest 98^{th} percentile of the hourly values.

14.234 The dispersion model predictions for the 2010 meteorological data are provided in Appendix 14.6. The predictions indicate that for an odour emission concentration of 1000ou/m^3 emitted continuously, nearby receptors would not experience concentrations above 1.5ou/m^3 as a 98^{th} percentile of the hourly values, and concentrations above 1.5ou/m^3 as a 98^{th} occur within the site and locally along at the site boundary to the south east for up to 50m beyond the site boundary. If the odour emission concentration was continuously 500ou/m3, odour concentrations above 1.5ou/m^3 as a 98^{th} percentile of the hourly values are not likely to occur beyond the site boundary.

14.235 Hence the dispersion model predictions indicate that potential odour emissions from the MBT with the proposed exhaust air treatment system are unlikely to cause annoyance complaints from the nearby residents. For the design odour emission target, the predictions indicate that in adverse meteorological conditions there could on occasions be a faint and potentially recognisable odour within the application site and locally at the application site boundary to the south east of the MBT.

Air Quality Impact due to Bioaerosols

Potential Bio-aerosol Sources

14.236 Handling of waste expected at the MBT, e.g. municipal waste, such as its unloading and processing can be expected to give rise to bioaerosols, though there are expected to be no potential for fugitive emissions from transportation of materials to and from the site because the materials will be in containers or covered vehicles. Unloading of the incoming waste will be carried out within the MBT reception building which will provide containment of bio-aerosol emissions from that unloading operation, as will the other areas within the MBT provide containment of bio-aerosol emissions for the various waste processing and treatment operations.

14.237 Furthermore the design and planned operation of the new MBT plant is intended to ensure that fugitive emissions are minimised. Essentially air will be drawn into the MBT so that internally it is kept under a slight negative pressure, with emissions then circulated through the exhaust system to a wet scrubber treatment system and then to a biofilter. That system will effectively negate the possibility of fugitive bio-aerosol emissions escaping to outside the buildings. Within the buildings and process areas where the mechanical and biological treatment of the waste will have the potential to generate bio-aerosol emissions and indication of the bioaerosol concentrations which may occur is provided by the 'red zone' defined by the HSE research report RR786. The red zone applies next to a composting activity where:

- There is a 64% chance of being exposed to more than 100,000cfu/m^3 bacteria and a 28% chance of being exposed to more than 1 million cfu/m^3 bacteria.
- There is a 24% chance of being exposed to more than 100,000cfu/m^3 Aspergillus fumigatus fungus spores and a 4% chance of being exposed to more than 1 million cfu/m^3 Aspergillus fumigatus spores.

14.238 Further away from compost handling machinery, and up to 50 metres from composting, which the report defines as the 'amber zone':

- There is only a 6% chance that exposure to airborne bacteria will be greater than 5,000cfu/m^3 and 36% chance of it being greater than 1,000cfu/m^3.
- There is only a 6% chance that exposure to airborne Aspergillus fumigatus spores will be more than 5,000cfu/m^3 and 21% chance that exposure to airborne Aspergillus fumigatus spores will be more than 1,000cfu/m^3.

14.239 Although that data relates to open air composting rather a bio-drying operation which is to be carried out at the MBT, it provides an indication of the levels of bio-aerosols which may enter the MBT exhaust air treatment system

Assessment

14.240 For distances of 100 to 250m from an open air composting site, the HSE research report RR786 defines a 'green zone' where:

- There is only a 7% chance that exposure to airborne bacteria will be greater than 5,000 cfu/m3 and 18% chance of it being greater than 1,000cfu/m^3.
- There is only a 2% chance that exposure to airborne Aspergillus fumigatus spores will be more than 5,000 cfu/m3 and 17% chance that exposure to airborne Aspergillus fumigatus spores will be more than 1,000cfu/m^3.

14.241 There are no existing workplaces or dwellings located within 250m of the MBT and its biofilter emission point, and the HSE RR786 'green zone' definition indicates that even without the containment provided by the MBT building and its exhaust air treatment, potential receptors further than 250m would be unlikely to experience airborne bacteria greater than 1,000cfu/m^3 due to an open composting operation.

14.242 Hence as the MBT exhaust air treatment system will minimise the possibility of bio-aerosol emissions escaping freely to outside the MBT, and as the exhaust air will firstly pass a wet scrubber, that treatment will reduce potential particulate and bio-aerosol concentrations to less than may occur from an open composting operation, particularly so for organisms which have clumped together to form larger particles. The wet scrubber treatment system is likely to reduce the viability of organisms, and it also envisaged that the biofilter media will further reduce the emissions of particulates and bio-aerosols.

14.243 There is no data available on actual bioaerosol concentrations emitted after the proposed exhaust air treatment system or for the bioaerosol background concentrations at the site. However the study ‘Biofiltration at Composting Facilities: Effectiveness for Bioaerosol Control, M. Sanchez-Monedro et al, Environmental Science and Technology, 2003, 37, 4299-4303, evaluated seven biofilters originally designed for odour control. That study found that “biofiltration achieved an average reduction greater than 90% and 39% in the concentrations of A. fumigatus and mesophilic bacteria, respectively. In all the plants, the airborne A. fumigatus concentration after the biofilter was lower than 1.2 x 10^3 cfu/m^3, independent of the inlet concentration, whereas the mesophilic bacteria concentration was dependent on the inlet concentration. The different behaviours of the two microorganism groups were thought to be due to the different aerodynamic characteristics of the particles that affected the capture by impact in the biofilter bed”. (Mesophilic bacteria are organisms which grow best in moderate temperatures, typically between 20 and 45 °C).

14.244 That Aspergillus fumigatus concentration is lower than the HSE research report RR786 finding that up to 50 metres from open composting and associated machinery there is only a 6% chance that exposure to airborne bacteria or Aspergillus fumigatus spores will be greater than 5,000cfu/m^3.

14.245 To further evaluate the potential for dispersion of bioaerosol emissions, AERMOD dispersion modelling has been carried out. However due to uncertainties in modelling bioaerosols, the dispersion modelling has primarily been used to explore the risk in relation to possible bioaerosol emission levels and dispersion, and thereby provide a reference point to aide future risk management and operational monitoring. Uncertainty in dispersion modelling of bioaerosols arises because:

- The type and size of bioaerosols will vary and their release is likely to be episodic.
- Clumping of organisms is likely to occur, thereby forming larger particles and thus leading to settling of the particles i.e. non-gaseous behaviour.
- There will be a loss of viability of organisms with time.

14.246 The modelling has been carried with the bioaerosols as an ideal gas, thereby assuming very small particle size and very low settling velocity, because that provides a precautionary indication of the potential for dispersion, whereas modelling bioaerosols as particles with plume depletion by dry and wet deposition will result in lower and hence less precautionary ground level concentrations, though it may more closely reflect natural processes.

14.247 An emission rate of 5,000cfu/m^3 have been modelled, as that would be a low level of control for an enclosed system provided by the exhaust air treatment system (i.e. poor performance or failure) because that concentration is the same as the levels indicated by the HSE research report RR786 at 50 to 100m from an open air composting site, that distance being within the scale of the proposed development site. For the exhaust air extraction rate of 135,000m3/hr, an emission concentration of 5,000cfu/m^3 equates to a total release rate of 187,500cfu/s. The dispersion model parameters were as per Appendix 14.2 and the model was run with meteorological data for individual years 2004-2012.

14.248 For each meteorological data year the maximum predicted values are south east of the biofilter, with 2010 predicting furthest dispersion. For 2010 the dispersion model predictions as the highest values for an 8hr averaging period are provided in Appendix 14.7. The predictions show maximum concentrations below 300cfu/m^3 for an 8hr averaging period, with the occurrence of concentrations 100-235cfu/m^3 likely to be highly localised and within the site boundary. Predictions for a 24hr averaging period will be lower. As such it is not anticipated that the MBT will give rise to bio-aerosol emissions at concentrations which could affect nearby sensitive receptors.

ADMS Dispersion Model Predictions – EfW Plume Visibility

Potential for a Visible Plume

14.249 ADMS is a Gaussian plume air dispersion model produced by the Cambridge Environmental Research Consultants which includes a plume visibility module from which results for the EfW and MBT are provided in Appendix 14.8. The ADMS 4.2 plume visibility module has been used to provide a prediction of the frequency that a visible plume may occur, along with its length and whether a visible plume may reach ground level. The predictions are provided because in certain atmospheric conditions when the combined moisture in the ambient air and emitted hot air from the EfW or MBT reaches saturation, water vapour will condense and can form a visible plume.

14.250 For the EfW it is predicted a visible plume may occur for approximately 20% of the time and for most of the time will be wholly above the operational site, the average length of the visible plume being 55-75m. A grounding of a visible plume from the EfW stack is not predicted.

14.251 For the MBT it is predicted a visible plume may occur for approximately 10-15% of the time and the average length of the visible plume being 17-22m. A grounding of a visible plume from the MBT stack is not predicted.

Assessment

14.252 Based on the available predictions, if a visible plume occurs from the EfW or MBT stacks they are not likely to represent a hazard to air traffic and a potential hazard due a visible plume near ground is not predicted.

14.253 An appraisal of potential visible plumes in relation to the visual amenity is provided in the chapter on Landscape and Visual Impact.

Air Quality Impact due to Operational Traffic

14.254 To assess the possible air quality impact from traffic changes, reference has been made to the methodology within the Highways Agency Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment Section 3 Environmental Assessment Techniques Part 1 HA 207/07 Air Quality to assess the possible pollutant concentrations (e.g. annual mean concentrations of NO_2 and PM10) from traffic changes associated with the proposed development.

14.255 The overall objective of that methodology is to define the depth of assessment necessary to enable informed decision-making at as early a stage of a project as possible, utilising a 'fit-for-purpose' assessment method and relying on four 'Assessment Levels':

- Scoping;
- Simple;
- Detailed; and
- Mitigation / enhancement and monitoring.

14.256 Assessment is carried out using traffic data without the development and with the development, but firstly provides a test that is designed to establish whether a scheme ought to be subject to more detailed air quality assessment. With regard to local air quality, affected roads are those which meet the following criteria and for which at least a simple assessment should be carried out to determine the possible impact to properties or Designated Sites within 200m of the roads:

- Road alignment will change by 5m or more;
- Daily traffic flows will change by 1,000 AADT (annual average daily traffic) or more;
- Heavy duty vehicle (HDV) flows will change by 200 AADT or more;
- Daily average speed will change by 10 km/hr or more; or
- Peak hour speed will change by 20 km/hr or more.

14.257 If no roads meet these criteria, then it is not necessary to undertake any calculations to assess the potential effect on local air quality. However, a qualitative assessment should be made as to whether the project is likely to have a marginal improvement or marginal deterioration in emissions based on the change in distance travelled with the scheme.

Assessment

14.258 The predicted change in traffic flows based on the Transport Assessment (Appendix 12.1) and provided in Appendix 14.9 do not exceed the criteria of daily traffic flows changing by 1,000 AADT or more or HDV flows changing by 200 AADT or more. On the affected roads the daily average speed is not anticipated to change by 10km/hr or more and the peak hour speed is not anticipated to change by 20km/hr or more. The Boghill Road to Hydepark Road junction is to be upgraded but the road alignments are not anticipated to change by 5m or more.

14.259 Therefore it is not necessary to undertake calculations to assess the potential effect on local air quality. However in qualitative terms and although there have been previous vehicle movements to and from the quarry, a marginal deterioration in the existing local air quality can be expected due to the traffic travelling to and from the proposed development.

Predicted Environmental effects and their Significance (Construction)

Method of Assessment

14.260 A qualitative appraisal has been carried out to assess the potential for an impact to local air quality due to construction and that approach is considered appropriate for the proposed development because:

- It is on land previously used for commercial activities;
- The development is relatively isolated and is not within an urban area of dwellings; and
- Potential impacts due to construction related activities can normally be mitigated by the application of good construction practice and standard control techniques.

Construction Activities

14.261 During construction there could be air quality issues arising from construction vehicles and activities due to exhaust fumes and dust from the construction activities and movement of vehicles and equipment associated with the development (HGVs and construction vehicles and equipment such as generators and pumps). Vehicle movements will occur on site associated with the following activities:

- Clearance and excavations for foundations and drainage e.g. vegetation removal, cut and fill, ground preparation and landscaping Deliveries of construction materials.
- Limited landscaping activities.

Assessment

14.262 Construction related emissions to air will only occur during the construction phase working hours, and hence will only have a temporary occurrence with a potential for short term increases in pollutants from vehicle emissions or fugitive dust emissions i.e. PM10 or deposited.

14.263 The main potential concern relates to dust from excavation activities, though those activities will only occur during the relatively limited groundworks phase early in the construction programme.

14.264 The effects of fugitive dust emissions are invariably transient and can normally be mitigated by good construction practice. As a consequence the potential impacts have not been assessed in greater detail, though in dry conditions shallow soils if present could have a propensity to generate dust, and appropriate dust mitigation measures will be planned for the construction works.

Description of Proposed Mitigation Measures (Operational)

Operational Emissions

14.265 The proposed EfW has been designed and will be operated to comply with the IED. The assessment of emissions from the EfW has been carried out assuming worst case scenarios based on maximum emission rates that could be allowed under that Directive, and assuming the EfW operates continuously. It is therefore considered to be robust.

14.266 The EfW has been designed to ensure that emissions are below the IED emission limit values, and there will also be periods of non-operational time for maintenance. Actual emissions will be confirmed during the EfW's commissioning validation required to obtain an environmental permit prior to its commercial operation. There may be a slight localised increase in concentrations of the substances emitted.

Operational Odour

14.267 Primary odour control measures include waste and materials being transported in containers or covered trucks, with all unloading and processing of the waste occurring within the MBT buildings, which will be under negative air pressure with the exhaust air treated by wet scrubbing and biofiltration, and emission release via a 20m high stack.

14.268 As such it is not anticipated that the new MBT will give rise to odour that may cause annoyance complaints from the nearest residents to the facilities.

14.269 Similarly, waste handling within the EfW reception area will always be contained within an enclosed building and also be under a negative pressure due to combustion air suction and thus generated flue gas flow through to the EfW stack. Odours will not be emitted from the EfW stack because they will be destroyed by the high combustion temperatures.

14.270 The odour control measures, their application, management and monitoring will be detailed in an odour management plan (OMP), and the need for further control can be kept under review dependent on the actual wastes handled.

14.271 There will remain a potential for transient occurrences of slight odour due to operation of the new MBT, but that is not predicted to give rise to annoyance complaints from nearby residents.

Operational Traffic

14.272 Mitigation is not required because there is likely to be only a slight deterioration in the existing local air quality due to the traffic travelling to and from the proposed development.

Description of Proposed Mitigation Measures (Construction)

14.273 The construction environmental management planning will take account of the envisaged vehicle movements and potential fugitive emissions such as dust.

14.274 Dust emissions will be minimised by the adoption of good construction industry practices for dust control, including employing dust control measures and regular dust monitoring by daily visual checks. During construction those control measures may include avoidance of earth moving in very dry or windy conditions, water spraying of dusty areas during dry weather, and sheeting of dusty materials being delivered to the application site or transported off site.

14.275 Those measures are proven to be effective in reducing particulate emissions to the extent that impact on nearby properties is avoided. Further measures that could be applied include the covering of dusty stockpiled materials and temporary wheel wash facilities to prevent dust being carried onto local roads. For construction vehicle emissions mitigation will largely be reliant on meeting vehicle emission standards and construction traffic planning.

14.276 There will be no significant residual effects to air quality from construction related activities.

Description of Residual Effects and their Significance Taking Mitigation into Account

14.277 There is a potential for a slight deterioration in local air quality due to emissions from the proposed new EfW, though its emissions will be constrained to comply with the Industrial Emissions Directive and there will be no breach of an air quality standard or an impact to human health or the environment.

14.278 There is a potential for a slight deterioration in local air quality due to emissions from the proposed new MBT, and a potential risk of odour at the site boundary to the south east of the MBT. That odour risk is assessed to be very small with odour emissions, if they occurred, infrequent and transient, the risk being mitigated by appropriate waste management procedures and associated odour management planning.

14.279 A visible plume from the EfW or MBT stacks is likely to occur for around 20% of the time, but will invariably be within the site boundary and a potential hazard due a visible plume near ground is not predicted. Chapter 10 of this ES assesses the significance of the plume visibility from a landscape and visual perspective.

14.280 There is a potential for a slight deterioration in the existing local air quality due to emissions from vehicles associated with the proposed new facility. However local air quality will remain good and well within national air quality standards.

14.281 There is potential for transient adverse effects to air quality due to dust during construction of the proposed development though those affects will be constrained to the construction period and are likely to be localised to within or very close to the application site.