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York Potash Project Harbour Facilities Environmental Statement: Section 13 Air Quality Appendix 13.1

Environmental Statement

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1 Construction Phase Fugitive Dust and Fine Particulate Matter Methodology and Assessment

1.1.1 The following section outlines criteria developed by the Institute of Air Quality Management (IAQM) (IAQM 2014) for the assessment of air quality impacts arising from construction activities. The approach to the construction phase assessment is also consistent with the approach detailed in the Environment Agency's Horizontal Guidance Document H1 Annex A (Environment Agency 2011a); however, the assessment is presented in the IAQM format, as the approach to assessment is more detailed. The assessment procedure is divided into five steps and is summarised below:

1.2 Step 1: Screening the Need for a Detailed Assessment

1.2.1 The IAQM guidance (IAQM, 2014) states that an assessment will normally be required where there are human receptors within 350m of the site boundary and/or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s). Ecological receptors within 50m of the site boundary or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s), are also identified at this stage and any ecological assessment should consider the sensitivity of present habitats and plant communities to potential dust deposition.

1.2.2 An ecological receptor refers to any sensitive habitat that is affected by dust soiling. For locations with a statutory designation, such as a Site of Specific Scientific Interest (SSSI), Special Area of Conservation (SACs) and Special Protection Areas (SPAs), consideration should be given as to whether the particular site is sensitive to dust. Some non-statutory sites may also be considered if appropriate.

1.2.3 Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is 'negligible'.

1.2.4 Human receptors within 350m of the site boundary include existing industrial operations and places of work, and public footpaths; a Detailed Assessment was therefore required.

1.2.5 The closest designated ecological site is South Gare and Coatham Sand SSSI which is located approximately 600m north of the Harbour Facilities site boundary. Guidance from the project ecologist was sought to determine the presence of the habitats sensitive to dust within the assessment study area. Confirmation was received that there are no such habitats or species present within the site or 50m of the site boundary. Ecological effects are therefore not considered further within the construction phase dust assessment.

1.3 Step 2: Assess the Risk of Dust Impacts

1.3.1 A site is allocated to a risk category on the basis of the scale and nature of the works (Step 2A) and the sensitivity of the area to dust impacts (Step 2B). These two factors are combined in Step 2C to determine the risk of dust impacts before the implementation of mitigation measures. The assigned risk categories may be different for each of the construction activities (demolition, construction, earthworks and trackout).

1.4 Step 2A: Define the Potential Dust Emission Magnitude

1.4.1 The dust emission magnitude was determined for demolition, earthworks, construction and trackout and is based on the scale of the anticipated works. **Table A13.1.1** describes the potential dust emission class criteria for each outlined construction activity.

Table A13.1.1 Criteria Used in the Determination of Dust Emission Class

Activity	Criteria used to Determine Dust Emission Class		
	Small	Medium	Large
Demolition	• Total building volume <20,000m^2 • Material with low potential for dust release	• Total building volume 20,000 – 50,000m^2 • Potentially dusty material	• Total building volume >50,000m^2 • Potentially dusty material
Earthworks	• Total site area <2,500m^2 • <5 heavy moving earth vehicles active at any one time • Total material moved <20,000 tonnes	• Total site area 2,500 – 10,000m^2 • 5-10 heavy moving earth moving vehicles active at any one time • Total material moved 20,000 – 100,000 tonnes	• Total site area >10,000m^2 • >10 heavy earth moving vehicles active at any one time • Total material moved >100,000 tonnes
Construction	• Total building volume <25,000m^3 • Construction material with low potential for dust release	• Total building volume 25,000 – 100,000m^3 • Potentially dusty construction material (e.g. concrete) • On-site concrete batching	• Total building volume >100,000m^3 • On-site concrete batching • Sandblasting
Trackout	• <10 outward HDV trips in any one day • Unpaved road length <50m	• 10 - 50 outward HDV trips in any one day • Unpaved road length 50-100m	• >50 outward HDV trips in any one day • Unpaved road length >100m

1.4.2 Two options are being considered for the quay construction within an overall envelope – an open quay structure and a solid quay structure. In addition three quay alignments are being considered. The development of the port terminal would be undertaken in two phases to provide the necessary export facilities that mirror the predicted increase in production from an initial 6.5mtpa to 13mtpa of product.

Details of the construction phasing and programme are provided in the Environmental Statement Section 3: Description of the proposed harbour facilities.

1.4.3 Construction activities proposed include site mobilisation, demolition and site preparation, dredging, installation of the piles and foundations, construction of a concrete deck, reclamation works, revetment of the river embankment, works to raise and improve ground, installation of materials handling plant on the quay, construction of the proposed facilities and erection of the conveyor and transfer towers and associated infrastructure, installation of mechanical and electrical services, commissioning and demobilisation.

1.4.4 The current programme of works proposes that site mobilisation will begin in January 2017 for a period of two months. The minimum construction period for Phase 1 works is 17 months for both forms of quay structure. The minimum construction period for Phase 2 works is also 17 months for both forms of quay structure. Phase 2 works are programmed to commence within 6 years of completion of Phase 1.

1.4.5 The potential dust emission magnitudes for the proposed development were determined using the criteria detailed in **Table A13.1.1**:

- Demolition:
  - Demolition of the existing NWL jetty and dolphins is envisaged.
  - It is estimated that the total volume of demolition required will be 20,000 - 50,000m^3. This is considered to be a conservative assumption.
  - Potentially dust construction material e.g. concrete will be used.
  - The dust emission magnitude was therefore defined as **medium**.
- Earthworks:
  - The total site area is greater than 10,000m^2.
  - More than 10 heavy earth moving vehicles are assumed to be in operation at any one time.
  - More than 100,000 tonnes of material could be moved.
  - The dust emission magnitude for earthworks was therefore defined as **large**.
- Construction:
  - The total building volume, including harbour facilities and conveyor, will be greater than 100,000m^3.
  - Piling will be required as part of the construction activities.
  - There is the potential for on-site concrete batching to be required.
  - Potentially dusty construction material e.g. concrete will be used.
  - The dust emission magnitude for construction was therefore defined as **large**.

- Trackout:
  - There are expected to be more than 50 outward HGV movements in any one day.
  - The unpaved road length on site is predicted to be greater than 100m.
  - The dust emission magnitude for trackout was therefore defined as **large**.

The dust magnitudes for earthworks, construction and trackout are summarised in **Table A13.1.2.**

Table A13.1.2 Dust Emission Magnitude for the Site.

Activity	Dust Emission Magnitude
Demolition	Medium
Earthworks	Large
Construction	Large
Trackout	Large

1.5 Step 2B: Define the Sensitivity of the Area

1.5.1 The sensitivity of the area takes into account the following factors:

- the specific sensitivities of receptors in the area;
- the proximity and number of receptors;
- the local background PM_{10} concentration; and
- site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of windblown dust.

1.5.2 The criteria for determining the sensitivity of receptors is detailed in **Table A13.1.3** for dust soiling effects and health effects of PM_{10}.

Table A13.1.3 Criteria for Determining Sensitivity of Receptors

Sensitivity of Receptor	Criteria for Determining Sensitivity	
	Dust Soiling Effects	Health Effects of PM_{10}
High	Dwellings, museums and other culturally important collections, medium and long-term car parks and car showrooms	Residential properties, hospitals, schools and residential care homes
Medium	Parks, places of work	Office and shop workers not occupationally exposed to PM_{10}

Sensitivity of Receptor	Criteria for Determining Sensitivity	
	Dust Soiling Effects	**Health Effects of PM_{10}**
Low	Playing fields, farmland, footpaths, short-term car parks and roads	Public footpaths, playing fields, parks and shopping streets

1.5.3 The criteria detailed in **Table A13.1.4** and **Table A13.1.5** were used to determine the sensitivity of the area to dust soiling effects and human health impacts. **Figure 13.1** details the distance bands, as detailed in **Table A13.1.4** and **Table A13.1.5**, from the site boundary for use in the construction phase assessment.

Table A13.1.4 Sensitivity of the Area to Dust Soiling Effects on People and Property.

Receptor Sensitivity	Number of Receptors	Distance from Source (m)			
		<20	<50	<100	<350
High	**>100**	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	**>1**	Medium	Low	Low	Low
Low	**>1**	Low	Low	Low	Low

Table A13.1.5 Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Concentrations	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32µg.m^{3}	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	>28-32µg.m^{3}	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low

Receptor Sensitivity	Annual Mean PM_{10} Concentrations	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
		1-10	High	Medium	Low	Low	Low
	>24-28µg.m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24µg.m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Sensitivity of People to Dust Soiling

- Demolition, construction and earthworks: there are more than 100 residential properties within 350m of the site boundary, and industrial places of work less than 20m from the site boundary. The public footpaths that are located within or in close proximity to the site boundary will be redirected as appropriate during the construction and operational phases; however they could still be located within 20m of the site boundary and construction works. The sensitivity of the area is therefore **high**; and
- Trackout: there are no residential properties or places of work within 50m of site access routes up to 500m from the boundary. A public footpath is located within 50m of the site access routes. The sensitivity of the area is therefore **low**.

Sensitivity of People to Health Effects of PM_{10}

- Demolition, construction and earthworks: there are more than ten places of work within 20m of the site boundary. The sensitivity is therefore **high**.

- Trackout: there are no residential properties or places of work within 50m of site access routes up to 500m from the boundary. A public footpath is located within 50m of the site access routes. The sensitivity of the area is therefore **low**.

1.5.4 The sensitivity of the area to dust soiling and human health impacts for each activity is summarised in **Table A13.1.6**.

Table A13.1.6 Outcome of Defining the Sensitivity of the Area

Potential Impact	Sensitivity of the Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	High	High	High	Low
Human Health	High	High	High	Low

1.6 Step 2C: Define the Risk of Impacts

1.6.1 The dust emission magnitude and sensitivity of the area are combined and the risk of impacts from each activity (demolition, earthworks, construction and trackout), before mitigation is applied, was determined. The risks of dust soiling and human health before mitigation are summarised in **Tables A13.1.7.**

Table A13.1.7 Summary Dust Risk Table to Define Site-specific Mitigation

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium Risk	High Risk	High Risk	Low Risk
Human Health	Medium Risk	High Risk	High Risk	Low Risk

1.7 Step 3: Site-Specific Mitigation

1.7.1 The specific mitigation measures to be embedded within the scheme were defined with reference to the identification of the site as a low, medium or high risk site. The embedded mitigation measures for the proposed scheme are detailed in **Section 13.5 of Chapter 13**.

1.8 Step 4: Determine Significant Effects

1.8.1 Experience in the UK is that good site practice is capable of mitigating the impact of fugitive emissions of particulate matter effectively, so that in all but the most exceptional circumstances, effects at receptors can be controlled to ensure impacts are of negligible or of slight adverse significance at worst. The impact descriptions used to determine the significance of the scheme with mitigation in place are provided in **Table A13.1.8**.

Table A13.1.8 Impact Descriptors for Each Activity with Mitigation, at Individual Receptors

Sensitivity of Surrounding Area	Risk of Site Giving Rise to Dust Effects		
	High	Medium	Low
High	Slight Adverse	Slight Adverse	Negligible
Medium	Slight Adverse	Negligible	Negligible
Low	Negligible	Negligible	Negligible

1.8.2 The risks identified were used to determine the specifics of the embedded mitigation required as part of the scheme. The significance of the impacts arising from the risks identified are summarised in **Table A13.1.9**.

Table A13.1.9 Summary Significance Table, With Mitigation

Potential Impact	Activity			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Slight Adverse	Slight Adverse	Slight Adverse	Negligible
Human Health	Negligible	Negligible	Negligible	Negligible

1.8.3 The background PM_{10} concentrations at the identified receptor locations are 'well below' the respective annual mean air quality objective (40µg.m^{-3}). Mitigation is proposed as part of the design of the scheme, and with the effective implementation of the mitigation and the existing low background concentrations, it is unlikely that the proposed construction phase activities will cause an exceedence of the relevant short term or long term air quality objectives at receptor locations. The impact of the construction phase activities on PM_{10} concentrations, with respect to human health, is therefore considered to be **negligible**.

2 Construction and Operational Phase Road Traffic Emissions Assessment Methodology

2.1.1 The Atmospheric Dispersion Modelling System for Roads (ADMS-Roads) v3.2.4 was used to assess the local air quality impact of construction and development-generated vehicle exhaust emissions on concentrations of NO_2 and PM_{10}, at existing receptors located adjacent to the considered road network.

2.2 Traffic Data

2.2.1 Traffic flow data comprising Annual Average Daily Traffic (AADT) flows, traffic composition (Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV) split) and link speeds (kph) to account for the presence of traffic signals, junctions and roundabouts were used in the ADMS-Roads model.

2.2.2 Vehicle movements generated during the construction phase of the harbour facility were provided for 2017 as this is anticipated to be the peak year of traffic generation for the duration of the harbour facility construction works.

2.2.3 The traffic generation from each element of the YPP (Mine, MTS, MHF and Harbour facilities) was derived from the 'master' construction schedule. The highest traffic demand across the construction period was assigned to the network to give a worst case traffic demand per road link.

2.2.4 To provide a conservative assessment for in-combination effects, 2015 was utilised as this represents the first period of peak traffic generation. 2015 represents potential for greater impacts when compared to a later start date, as background traffic demand would be lower and therefore increases in traffic flows in 2015 will be more significant.

2.2.5 The baseline traffic flows for the identified road links that are anticipated to experience increases in construction traffic, and the traffic generated during the construction phase of the harbour facility, are detailed in **Table A13.2.1**.

Table A13.2.1 Traffic Generated during the Construction Phase of the Harbour Facility in 2017

Link	2017 Peak Construction Traffic Flows		2017 AADT Baseline Flows Without Construction	Percentage Increase (%)
	Total Vehicles	HGVs		
1	63	0	95,222	0.07
2	141	67	27,488	0.51
3	66	0	12,942	0.51
4	26	0	33,196	0.08
5	27	0	26,452	0.10
6	7	0	15,374	0.04
7	0	0	20,466	0.00

Link	2017 Peak Construction Traffic Flows		2017 AADT Baseline Flows Without Construction	Percentage Increase (%)
	Total Vehicles	HGVs		
8	1	0	11,599	0.01
9	4	0	13,520	0.03
10	3	0	20,794	0.01
11	0	0	5,621	0.00
12	3	0	10,101	0.03
14	1	0	12,178	0.01
15	1	0	11,099	0.01
44	207	67	18,085	1.14

2.2.6 There are anticipated to be a maximum of 26 operational staff working at the harbour facility each day during Phase 1. During Phase 2, there are anticipated to be a maximum of 34 operational staff working at the facility each day.

2.2.7 A cumulative assessment was undertaken to consider traffic flows generated by the construction and operation of all four aspects of the York Potash Project: Mine, Mineral Transfer System, Materials Handling Facility and harbour facility.

2.2.8 Traffic data for the 2015, 2020 and 2030 scenarios included traffic flows from the Harbour Facilities development in addition to the mine, MTS and MHF aspects of the YPP. Cumulative road traffic impacts were therefore considered in this assessment.

2.2.9 The spatial scope of the assessment focussed on the routes likely to be affected by increases in road traffic as a result of the construction and operational phases of the harbour facility and the MHF. Separate study areas were identified for the mine and MTS elements of the YPP as the nearest part of the mine and MTS scheme is located approximately 7km from the harbour facilities site boundary. The road links considered in the assessment are detailed below:

- A19;
- A66;
- A1053;
- A1085;
- A174;
- A173;
- A171;
- A1043; and
- A172.

2.2.10 Traffic flow data were provided by Royal HaskoningDHV, the Transport Consultants for the project. The traffic data used in the assessment are detailed in **Table A13.2.2** and **Table A13.2.3**. Vehicles were assumed to travel at the road speed limit, apart from the approach to junctions and roundabouts where queueing traffic sections were included in the model at 20kph where appropriate, in accordance with Defra guidance (Defra 2009).

Table A13.2.2 Traffic Data used in the Road Traffic Emissions Assessment – 2013 and 2015 Scenarios

Link	2013 Verification		2015 Without Construction Traffic		2015 With Construction Traffic		Speed (kph)
	AADT Flow	HGV %	AADT Flow	HGV %	AADT Flow	HGV %	
1	92,236	6.96	93,116	6.86	95,285	6.85	112
2	26,244	8.43	26,792	8.23	27,628	8.43	80
3	12,129	8.70	12,563	8.46	13,008	8.42	112
4	30,724	4.18	31,488	3.93	33,222	3.93	80/112
5	25,627	5.92	26,104	5.91	26,479	5.90	112
6	14,900	2.65	15,043	2.61	15,380	2.61	48
7	19,816	3.64	20,236	3.69	20,466	3.69	48/64
9	13,099	4.23	13,394	4.22	13,524	4.22	96
10	20,100	3.95	20,568	3.99	20,798	3.99	80/96/112
11	5,367	5.53	5,441	5.36	5,621	5.36	48/96
14	11,651	3.38	11,803	3.29	12,179	3.29	96
44	17,332	4.83	17,555	4.71	18,292	5.02	112

Table A13.2.3 Traffic Data used in the Road Traffic Emissions Assessment – 2020 and 2030 Scenarios

Link	2020 Without Development		2020 With Development		2030 Without Development		2030 With Development		Speed (kph)
	AADT Flow	HGV %	AADT Flow	HGV %	AADT Flow	HGV %	AADT Flow	HGV %	
1	98,524	6.75	98,644	6.78	111,070	6.35	111,190	6.38	112
2	28,963	7.99	29,262	8.02	34,465	7.05	34,764	7.08	80
3	13,961	7.99	14,166	8.06	17,650	6.57	17,855	6.64	112
4	35,731	3.72	35,864	3.71	48,094	2.93	48,228	2.92	80/112
5	27,644	5.76	27,892	5.80	30,802	5.41	31,050	5.45	112

Link	2020 Without Development		2020 With Development		2030 Without Development		2030 With Development		Speed (kph)
	AADT Flow	HGV %	AADT Flow	HGV %	AADT Flow	HGV %	AADT Flow	HGV %	
6	15,918	2.57	16,198	2.53	17,891	2.42	18,171	2.39	48
7	21,443	3.58	21,478	3.62	23,878	3.31	23,913	3.34	48/64
9	14,254	4.08	14,345	4.11	15,885	3.83	15,976	3.86	96
10	21,913	3.86	22,300	3.83	24,583	3.55	24,970	3.53	80/96/112
11	5,886	5.22	6,011	5.11	7,064	4.61	7,188	4.53	48/96
14	12,727	3.21	12,860	3.17	15,138	2.86	15,271	2.83	96
44	18,891	4.59	19,225	4.72	22,316	4.12	22,650	4.24	112

2.3 Assessment Scenarios

2.3.1 A verification year of 2013 was considered as this was the most recent year for which traffic data, meteorological data and air quality monitoring data were available.

2.3.2 The assessment considered the following scenarios:

- Scenario 1: 2013 Verification Year;
- Scenario 2: 2015 baseline without construction traffic;
- Scenario 3: 2015 with construction traffic;
- Scenario 4: 2020 baseline without development traffic;
- Scenario 5: 2020 with development traffic;
- Scenario 6: 2030 baseline without development traffic; and
- Scenario 6: 2030 baseline with development traffic.

2.4 Meteorological Data

2.4.1 2013 meteorological data from the Teesside recording station was used in the ADMS-Roads model. This is the closest, most representative recording station to the development site and the use of 2013 meteorological data from this station was agreed with Redcar and Cleveland Borough Council (RCBC) during the consultation period.

2.5 Background Pollutant Concentrations

2.5.1 The air quality assessment requires the derivation of background pollutant concentration data that are factored to the year of assessment, to which contributions from the assessed roads are added.

2.5.2 Background pollutant concentrations used in this assessment were sourced from background pollutant maps (Defra, 2014) provided by Defra for a 1km x 1km resolution of the UK. The relevant background pollutant concentrations were obtained for the grid squares covering the study area.

2.5.3 Due to current uncertainties regarding the rate at which background pollutant concentrations are decreasing, the assessment utilised 2011 background pollutant concentrations for the 2013 and 2015 assessment scenarios. Background pollutant concentrations are still expected to decrease in the future. For the 2020 and 2030 scenarios this approach was considered to be overly conservative as it is anticipated that by these dates background concentrations will have reduced from 2011 values. As such 2020 and 2030 scenarios assume projected background concentrations for these years, as provided by Defra.

2.5.4 The background pollutant concentrations at each receptor location considered in the road traffic emissions assessment are detailed in **Table A13.2.4**.

Table A13.2.4 Annual Mean Background Pollutant Concentrations at Receptor Locations for Each Assessment Year – Road Traffic Emissions Assessment

Receptor	NO_2			PM_{10}			$PM_{2.5}$		
	2015 ($\mu g.m^{-3}$)	2020 ($\mu g.m^{-3}$)	2030 ($\mu g.m^{-3}$)	2015 ($\mu g.m^{-3}$)	2020 ($\mu g.m^{-3}$)	2030 ($\mu g.m^{-3}$)	2015 ($\mu g.m^{-3}$)	2020 ($\mu g.m^{-3}$)	2030 ($\mu g.m^{-3}$)
R1	15.25	10.37	9.53	14.18	13.11	13.03	9.50	8.55	8.44
R2	19.28	13.50	12.28	14.51	13.42	13.37	9.96	8.99	8.90
R3	17.52	12.28	11.41	14.84	13.82	13.76	9.68	8.75	8.64
R4	16.23	11.70	11.07	17.07	15.97	16.07	10.55	9.63	9.58
R5	10.46	7.61	7.07	14.27	13.29	13.19	9.07	8.21	8.09
R6	10.46	7.61	7.07	14.27	13.29	13.19	9.07	8.21	8.09
R7	9.91	7.28	6.77	14.48	13.53	13.41	9.04	8.20	8.07
R8	11.15	8.40	8.11	14.41	13.39	13.29	9.33	8.42	8.30
R9	11.10	7.94	7.23	14.54	13.55	13.45	9.22	8.34	8.23
R10	13.43	9.73	8.71	14.92	13.86	13.78	9.56	8.60	8.49
R11	14.25	10.57	9.32	14.63	13.54	13.47	9.62	8.63	8.51
R12	14.25	10.57	9.32	14.63	13.54	13.47	9.62	8.63	8.51
R13	18.63	13.74	11.74	15.31	14.10	14.08	10.41	9.25	9.16
R14	14.95	10.87	9.91	14.38	13.31	13.23	9.62	8.66	8.55
R15	15.57	11.34	10.20	13.97	12.85	12.78	9.60	8.57	8.46
R16	17.97	12.98	11.03	14.86	13.66	13.63	10.12	8.98	8.88
R17	18.63	13.74	11.74	15.31	14.10	14.08	10.41	9.25	9.16
R18	16.74	11.34	10.43	15.66	14.44	14.39	10.18	9.08	8.98

Receptor	NO_2			PM_{10}			$PM_{2.5}$		
	2015 ($\mu g.m^{-3}$)	2020 ($\mu g.m^{-3}$)	2030 ($\mu g.m^{-3}$)	2015 ($\mu g.m^{-3}$)	2020 ($\mu g.m^{-3}$)	2030 ($\mu g.m^{-3}$)	2015 ($\mu g.m^{-3}$)	2020 ($\mu g.m^{-3}$)	2030 ($\mu g.m^{-3}$)
R19	21.84	15.95	13.68	16.83	15.50	15.51	11.13	9.85	9.77
R20	26.61	19.51	16.83	17.27	15.78	15.83	11.73	10.28	10.21
R21	23.28	17.16	15.81	15.40	14.10	14.11	10.65	9.54	9.47
R22	21.50	15.50	13.45	16.77	15.47	15.50	11.09	9.86	9.79
R23	18.29	12.52	11.12	15.09	13.82	13.78	10.24	9.06	8.96
R24	13.43	9.73	8.71	14.92	13.86	13.78	9.56	8.60	8.49
R25	15.54	11.35	10.01	14.56	13.45	13.38	9.76	8.73	8.62
R26	15.54	11.35	10.01	14.56	13.45	13.38	9.76	8.73	8.62
R27	15.54	11.35	10.01	14.56	13.45	13.38	9.76	8.73	8.62
R28	16.12	12.03	10.55	14.46	13.33	13.27	9.79	8.74	8.63
R29	26.61	19.51	16.83	17.27	15.78	15.83	11.73	10.28	10.21
R30	21.12	15.30	13.34	16.25	14.97	14.98	10.81	9.61	9.53
R31	18.08	12.15	10.76	15.10	13.84	13.80	10.23	9.06	8.96
R32	19.97	14.37	13.14	14.76	13.61	13.57	10.13	9.12	9.03
R33	14.57	10.39	9.49	14.95	13.87	13.78	9.69	8.72	8.60
R34	10.50	7.65	7.22	14.70	13.71	13.61	9.26	8.40	8.28

2.6 NOx to NO_2 Conversion

2.6.1 Oxides of nitrogen (NOx) concentrations were predicted using the ADMS-Roads model. The modelled road contribution of NOx at the identified receptor locations was then converted to NO_2 using the NOx to NO_2 calculator (v4.1, 2014) (Defra 2014), in accordance with Defra guidance.

2.7 Emission Factors

2.7.1 Emission factors from the Emissions Factor Toolkit (version 6.0.2) (Defra 2014), released in November 2014, were utilised in the assessment. There is uncertainty regarding the rate of reduction in emissions from road vehicles in the future. In order to provide a conservative assessment, emission factors for the assessment year 2011 were utilised in the 2013 and 2015 scenarios. For the 2020 and 2030 scenarios, this approach was considered to be overly conservative as it is anticipated that by these dates emission rates will have reduced from 2011 values. Emission factors from the corresponding years were therefore used in the 2020 and 2030 scenarios.

2.8 Surface Roughness

2.8.1 A surface roughness of 0.5m was included within the ADMS-Roads dispersion model. This value corresponds to 'parkland, open suburbia', which was considered to be representative of the study area and identified receptor locations at which potential impacts were assessed.

2.9 Model Adjustment

2.9.1 The verification of the ADMS-Roads model output was achieved by modelling concentrations at existing monitoring locations in the vicinity of the proposed development and comparing the modelled concentration with the measured concentration.

2.9.2 Three diffusion tube monitoring surveys were undertaken in 2013 and 2014 across the YPP study area to measure annual mean NO_2 concentrations. The monitoring data were annualised to 2013 concentrations in accordance with Defra guidance (Defra 2009).

2.9.3 25 diffusion tube monitoring locations were reviewed and diffusion tubes DT1 and DT25 were considered to be suitable roadside sites within the harbour facilities study area for use in the model verification. Diffusion tubes DT1 and DT25 are located adjacent to the A174, approximately 3.1km and 3.4km south of the harbour facilities boundary respectively. The full verification procedure is detailed in **Table A13.2.5**.

Table A13.2.5 Model Verification Process

Model Verification Procedure	NO_2 Diffusion Tube Monitoring Locations	
	DT1	DT25
2013 Background NO_2 (µg.m^{-3})	15.25	15.25
Monitored Road Contribution NOx (µg.m^{-3})	19.46	27.61
Modelled Road Contribution NOx (µg.m^{-3})	15.65	15.77
Ratio of Monitored Road Contribution NOx/Modelled Road Contribution NOx	1.24	1.75
Adjustment Factor for Modelled Road Contribution	**1.4991**	
Adjusted Modelled Road Contribution NOx (µg.m^{-3})	23.46	23.64
Modelled Total NO_2 (based on empirical NOx/NO_2 relationship) (µg.m^{-3})	26.65	26.70
Monitored Total NO_2	24.80	28.50
Ratio of Modelled Total NO_2 to Monitored Total NO_2	6.94	-6.74

2.10 Predicting Exceedence of the Short-Term Objectives

2.10.1 The guidance document LAQM TG(09) sets out the method by which the number of days in which the PM_{10} 24 hour objective is exceeded can be obtained based on a relationship with the predicted PM_{10}

annual mean concentration. The calculation utilised in the prediction of short-term PM_{10} concentrations is detailed below:

No. 24-hour mean exceedences = -18.5 + 0.00145 x annual mean^3 + (206/annual mean)

2.10.2 Research projects completed on behalf of Defra and the Devolved Administrations (AEAT, 2008) (Laxen and Marner, 2003) concluded that the hourly mean nitrogen dioxide objective is unlikely to be exceeded if annual mean concentrations are predicted to be less than 60µg.m^{-3}. This value was therefore used as an annual mean equivalent threshold to evaluate likely exceedence of the hourly mean NO_2 objective.

2.11 Identification of Receptor Locations

2.11.1 Sensitive receptor locations were identified within the study area for consideration in the road traffic emissions assessment. Predicted changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations, as a result of development-generated traffic during the construction and operational phases, were calculated at these locations.

2.11.2 The sensitive receptor locations were selected based on their proximity to road links affected by the proposed development, where the potential effect of development-related traffic emissions on local air pollution would be most significant. The existing sensitive receptor locations are detailed in **Table A13.2.6** and in **Figure 9.4**.

Table A13.2.6 Road Traffic Emission Assessment Sensitive Receptor Locations

Receptor ID	Grid Reference		Receptor Type
	X	Y	
R1	457310	519648	19 Chestnut Close, Middlesbrough
R2	455137	520799	97 Bolckow Road, Grangetown
R3	460167	522249	1 Plantation Road, Redcar
R4	461263	522300	14 Acacia Court, Redcar
R5	465004	519681	Mill Farm, Markse Lane, Skelton-in-Cleveland
R6	465538	519011	4 Markse Lane, Skelton-in-Cleveland
R7	465262	518881	1 Bridge Houses, Skelton-in-Cleveland
R8	461223	516747	12 Minskip Close, Guisboroguh
R9	456003	515696	9 Upsall Cottages, Guisborough
R10	454345	515428	Nunthorpe Secondary School, Nunthorpe

Receptor ID	Grid Reference		Receptor Type
R11	452993	514411	Adel, Dixons Bank, Marton-in-Cleveland
R12	452813	514529	80 St. Cuthbert Avenue, Marton-in-Cleveland
R13	451884	515428	Captain Cook Primary School, Marton-in-Cleveland
R14	456161	518583	2 Keepersgate, Eston
R15	454484	517105	95 Bexley Drive, Normanby
R16	449081	515280	49 Finchlay Court, Middlesbrough
R17	451112	515468	21 Hammond Close, Marton-in-Cleveland
R18	446733	514176	Plum Tree Farm, Thornaby, Stockton-on-Tees
R19	447198	517676	73 Ashford Avenue, Middlesborough
R20	448068	519276	5 Bede Court, Middlesbrough
R21	453790	520844	12 Elgin Avenue, Grangetown
R22	445474	521161	Cherry Tree Care Centre, South Road
R23	444097	524536	18 Lenham Close, Billingham
R24	454306	515669	Upsall Lodge, Guisborough Road, Nunthorpe
R25	453341	516662	13 Church Lane, Ormesby
R26	453610	516521	24 Ormesby Bank, Ormesby
R27	453660	516398	71 Ormesby Bank, Ormesby
R28	452191	515055	34 Dixons Bank, Marton-in-Cleveland
R29	448051	519108	104 West Lane, Middlesbrough
R30	445101	522120	24 Costain Grove, Stockton-On-Tees
R31	444699	523002	47 Rook Lane, Stockton-On-Tees
R32	454502	520549	12 Elgin Avenue, Grangetown
R33	455143	517478	19a Woodlands Drive, Normanby
R34	460226	516130	17 Priors Wood, Guisborough

3 Construction and Operational Phase Road Traffic Emissions Assessment Results

3.1.1 Predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations for the 2015, 2020 and 2030 'with development' scenarios are detailed in **Table A13.3.1** to **Table A13.3.12**. Predicted concentrations for the 'without development' scenarios and the predicted change in NO_2, PM_{10} and $PM_{2.5}$ concentrations, as a result of the construction and operational phases of the development, are also shown for comparison purposes. Exceedences of the annual mean objectives are shown in bold text.

3.2 Nitrogen Dioxide Results and Predicted Changes

Table A13.3.1 Predicted NO_2 Annual Mean Concentrations ($\mu g.m^{-3}$), Magnitude of Change and Impact Descriptors at Receptor Locations in 2015 Without and With Construction Traffic

Receptor ID	Annual Mean NO_2 Concentration ($\mu g.m^{-3}$)		Change	Magnitude of Change	Impact
	2015 Without Construction Traffic	2015 With Construction Traffic			
R1	26.18	26.28	0.10	Imperceptible	Negligible
R2	24.10	24.52	0.42	Small	Negligible
R3	23.98	24.03	0.05	Imperceptible	Negligible
R4	25.85	25.91	0.06	Imperceptible	Negligible
R5	17.73	17.77	0.04	Imperceptible	Negligible
R6	18.42	18.49	0.07	Imperceptible	Negligible
R7	13.98	14.27	0.29	Imperceptible	Negligible
R8	15.85	16.36	0.51	Small	Negligible
R9	20.96	21.93	0.97	Small	Negligible
R10	20.54	21.42	0.88	Small	Negligible
R11	26.85	28.47	1.62	Small	Negligible
R12	25.32	26.72	1.40	Small	Negligible
R13	26.88	27.77	0.89	Small	Negligible
R14	24.56	25.15	0.59	Small	Negligible
R15	25.35	25.95	0.60	Small	Negligible
R16	26.46	26.95	0.49	Small	Negligible

Receptor ID	Annual Mean NO_2 Concentration ($\mu g.m^{-3}$)		Change	Magnitude of Change	Impact
R17	24.61	24.98	0.37	Imperceptible	Negligible
R18	**44.83**	**44.94**	0.11	Imperceptible	Negligible
R19	**45.46**	**45.57**	0.11	Imperceptible	Negligible
R20	37.07	37.75	0.68	Small	Slight Adverse
R21	30.13	30.69	0.56	Small	Negligible
R22	**42.35**	**42.44**	0.09	Imperceptible	Negligible
R23	37.80	37.88	0.08	Imperceptible	Negligible
R24	28.94	30.46	1.52	Small	Negligible
R25	25.35	25.93	0.58	Small	Negligible
R26	23.99	24.28	0.29	Imperceptible	Negligible
R27	21.38	21.59	0.21	Imperceptible	Negligible
R28	24.10	24.99	0.89	Small	Negligible
R29	36.61	37.25	0.64	Small	Slight Adverse
R30	31.39	31.44	0.05	Imperceptible	Negligible
R31	27.30	27.34	0.04	Imperceptible	Negligible
R32	26.54	27.08	0.54	Small	Negligible
R33	24.23	24.82	0.59	Small	Negligible
R34	15.48	16.02	0.54	Small	Negligible

Table A13.3.2 Predicted NO_2 Annual Mean Concentrations ($\mu g.m^{-3}$), Magnitude of Change and Impact Descriptors at Receptor Locations in 2020 Without and With Operational Traffic

Receptor ID	Annual Mean NO_2 Concentration ($\mu g.m^{-3}$)		Change	Magnitude of Change	Impact
	2020 Without Operational Traffic	2020 With Operational Traffic			
R1	16.83	16.86	0.03	Imperceptible	Negligible
R2	15.89	15.91	0.02	Imperceptible	Negligible

Receptor ID	Annual Mean NO_2 Concentration (µg.m^{-3})		Change	Magnitude of Change	Impact
R3	16.51	16.53	0.02	Imperceptible	Negligible
R4	17.74	17.76	0.02	Imperceptible	Negligible
R5	12.03	12.07	0.04	Imperceptible	Negligible
R6	12.42	12.47	0.05	Imperceptible	Negligible
R7	9.49	9.53	0.04	Imperceptible	Negligible
R8	11.12	11.17	0.05	Imperceptible	Negligible
R9	14.06	14.16	0.10	Imperceptible	Negligible
R10	13.89	13.92	0.03	Imperceptible	Negligible
R11	18.41	18.44	0.03	Imperceptible	Negligible
R12	17.50	17.52	0.02	Imperceptible	Negligible
R13	18.53	18.54	0.01	Imperceptible	Negligible
R14	16.45	16.49	0.04	Imperceptible	Negligible
R15	17.05	17.10	0.05	Imperceptible	Negligible
R16	17.91	17.95	0.04	Imperceptible	Negligible
R17	17.19	17.22	0.03	Imperceptible	Negligible
R18	28.60	28.62	0.02	Imperceptible	Negligible
R19	30.23	30.25	0.02	Imperceptible	Negligible
R20	24.79	24.84	0.05	Imperceptible	Negligible
R21	20.50	20.53	0.03	Imperceptible	Negligible
R22	28.12	28.14	0.02	Imperceptible	Negligible
R23	24.14	24.16	0.02	Imperceptible	Negligible
R24	19.28	19.40	0.12	Imperceptible	Negligible
R25	17.10	17.15	0.05	Imperceptible	Negligible
R26	16.42	16.49	0.07	Imperceptible	Negligible
R27	14.85	14.89	0.04	Imperceptible	Negligible
R28	16.63	16.65	0.02	Imperceptible	Negligible

Receptor ID	Annual Mean NO_2 Concentration (μg.m^{-3})		Change	Magnitude of Change	Impact
R29	24.62	24.65	0.03	Imperceptible	Negligible
R30	21.19	21.20	0.01	Imperceptible	Negligible
R31	17.43	17.43	0.00	Imperceptible	Negligible
R32	17.56	17.60	0.04	Imperceptible	Negligible
R33	15.99	16.05	0.06	Imperceptible	Negligible
R34	10.54	10.59	0.05	Imperceptible	Negligible

Table A13.3.3 Predicted NO_2 Annual Mean Concentrations (μg.m^{-3}), Magnitude of Change and Impact Descriptors at Receptor Locations in 2030 Without and With Operational Traffic

Receptor ID	Annual Mean NO_2 Concentration (μg.m^{-3})		Change	Magnitude of Change	Impact
	2030 Without Operational Traffic	2030 With Operational Traffic			
R1	14.30	14.31	0.01	Imperceptible	Negligible
R2	13.75	13.76	0.01	Imperceptible	Negligible
R3	14.58	14.59	0.01	Imperceptible	Negligible
R4	15.61	15.62	0.01	Imperceptible	Negligible
R5	10.05	10.07	0.02	Imperceptible	Negligible
R6	10.30	10.33	0.03	Imperceptible	Negligible
R7	8.20	8.22	0.02	Imperceptible	Negligible
R8	9.83	9.85	0.02	Imperceptible	Negligible
R9	11.11	11.17	0.06	Imperceptible	Negligible
R10	11.32	11.34	0.02	Imperceptible	Negligible
R11	14.15	14.16	0.01	Imperceptible	Negligible
R12	13.61	13.62	0.01	Imperceptible	Negligible
R13	14.67	14.68	0.01	Imperceptible	Negligible
R14	13.35	13.38	0.03	Imperceptible	Negligible

Receptor ID	Annual Mean NO_2 Concentration (µg.m^{-3})		Change	Magnitude of Change	Impact
R15	13.73	13.75	0.02	Imperceptible	Negligible
R16	14.07	14.09	0.02	Imperceptible	Negligible
R17	13.87	13.89	0.02	Imperceptible	Negligible
R18	21.38	21.39	0.01	Imperceptible	Negligible
R19	22.72	22.73	0.01	Imperceptible	Negligible
R20	20.10	20.12	0.02	Imperceptible	Negligible
R21	17.87	17.88	0.01	Imperceptible	Negligible
R22	21.44	21.45	0.01	Imperceptible	Negligible
R23	18.43	18.43	0.00	Imperceptible	Negligible
R24	14.64	14.71	0.07	Imperceptible	Negligible
R25	13.58	13.60	0.02	Imperceptible	Negligible
R26	13.18	13.23	0.05	Imperceptible	Negligible
R27	12.20	12.23	0.03	Imperceptible	Negligible
R28	13.37	13.38	0.01	Imperceptible	Negligible
R29	20.01	20.03	0.02	Imperceptible	Negligible
R30	17.00	17.00	0.00	Imperceptible	Negligible
R31	14.04	14.04	0.00	Imperceptible	Negligible
R32	15.11	15.13	0.02	Imperceptible	Negligible
R33	12.94	12.97	0.03	Imperceptible	Negligible
R34	9.05	9.07	0.02	Imperceptible	Negligible

3.3 Particulate Matter (PM_{10}) Results and Predicted Changes

Table A13.3.4 Predicted PM_{10} Annual Mean Concentrations ($\mu g.m^{-3}$), Magnitude of Change and Impact Descriptors at Receptor Locations in 2015 Without and With Construction Traffic

Receptor ID	Annual Mean PM_{10} Concentration ($\mu g.m^{-3}$)		Change	Magnitude of Change	Impact
	2015 Without Construction Traffic	2015 With Construction Traffic			
R1	15.54	15.55	0.01	Imperceptible	Negligible
R2	15.01	15.04	0.03	Imperceptible	Negligible
R3	15.57	15.57	0.00	Imperceptible	Negligible
R4	18.24	18.24	0.00	Imperceptible	Negligible
R5	15.14	15.15	0.01	Imperceptible	Negligible
R6	15.21	15.22	0.01	Imperceptible	Negligible
R7	14.90	14.92	0.02	Imperceptible	Negligible
R8	14.95	15.00	0.05	Imperceptible	Negligible
R9	15.64	15.73	0.09	Imperceptible	Negligible
R10	15.74	15.81	0.07	Imperceptible	Negligible
R11	15.72	15.79	0.07	Imperceptible	Negligible
R12	15.58	15.64	0.06	Imperceptible	Negligible
R13	16.25	16.31	0.06	Imperceptible	Negligible
R14	15.43	15.48	0.05	Imperceptible	Negligible
R15	15.05	15.10	0.05	Imperceptible	Negligible
R16	15.80	15.84	0.04	Imperceptible	Negligible
R17	15.96	15.99	0.03	Imperceptible	Negligible
R18	19.11	19.13	0.02	Imperceptible	Negligible
R19	19.73	19.75	0.02	Imperceptible	Negligible
R20	18.50	18.56	0.06	Imperceptible	Negligible
R21	16.17	16.21	0.04	Imperceptible	Negligible

Receptor ID	Annual Mean PM_{10} Concentration ($\mu g.m^{-3}$)		Change	Magnitude of Change	Impact
R22	19.28	19.29	0.01	Imperceptible	Negligible
R23	17.37	17.38	0.01	Imperceptible	Negligible
R24	16.52	16.63	0.11	Imperceptible	Negligible
R25	15.64	15.69	0.05	Imperceptible	Negligible
R26	15.55	15.58	0.03	Imperceptible	Negligible
R27	15.23	15.25	0.02	Imperceptible	Negligible
R28	15.35	15.41	0.06	Imperceptible	Negligible
R29	18.44	18.50	0.06	Imperceptible	Negligible
R30	17.40	17.40	0.00	Imperceptible	Negligible
R31	16.11	16.11	0.00	Imperceptible	Negligible
R32	15.48	15.52	0.04	Imperceptible	Negligible
R33	16.01	16.06	0.05	Imperceptible	Negligible
R34	15.27	15.32	0.05	Imperceptible	Negligible

Table A13.3.5 Predicted PM_{10} Annual Mean Concentrations ($\mu g.m^{-3}$), Magnitude of Change and Impact Descriptors at Receptor Locations in 2020 Without and With Operational Traffic

Receptor ID	Annual Mean PM_{10} Concentration ($\mu g.m^{-3}$)		Change	Magnitude of Change	Impact
	2020 Without Operational Traffic	2020 With Operational Traffic			
R1	14.29	14.29	0.00	Imperceptible	Negligible
R2	13.82	13.83	0.01	Imperceptible	Negligible
R3	14.39	14.39	0.00	Imperceptible	Negligible
R4	16.95	16.95	0.00	Imperceptible	Negligible
R5	13.99	13.99	0.00	Imperceptible	Negligible
R6	14.04	14.05	0.01	Imperceptible	Negligible
R7	13.88	13.88	0.00	Imperceptible	Negligible
R8	13.82	13.83	0.01	Imperceptible	Negligible

Receptor ID	Annual Mean PM_{10} Concentration ($\mu g.m^{-3}$)		Change	Magnitude of Change	Impact
R9	14.37	14.38	0.01	Imperceptible	Negligible
R10	14.51	14.52	0.01	Imperceptible	Negligible
R11	14.37	14.38	0.01	Imperceptible	Negligible
R12	14.28	14.28	0.00	Imperceptible	Negligible
R13	14.87	14.88	0.01	Imperceptible	Negligible
R14	14.08	14.09	0.01	Imperceptible	Negligible
R15	13.64	13.65	0.01	Imperceptible	Negligible
R16	14.35	14.35	0.00	Imperceptible	Negligible
R17	14.58	14.59	0.01	Imperceptible	Negligible
R18	17.03	17.03	0.00	Imperceptible	Negligible
R19	17.67	17.67	0.00	Imperceptible	Negligible
R20	16.76	16.77	0.01	Imperceptible	Negligible
R21	14.73	14.74	0.01	Imperceptible	Negligible
R22	17.36	17.36	0.00	Imperceptible	Negligible
R23	15.52	15.52	0.00	Imperceptible	Negligible
R24	15.15	15.17	0.02	Imperceptible	Negligible
R25	14.25	14.26	0.01	Imperceptible	Negligible
R26	14.26	14.28	0.02	Imperceptible	Negligible
R27	14.00	14.01	0.01	Imperceptible	Negligible
R28	14.07	14.07	0.00	Imperceptible	Negligible
R29	16.73	16.73	0.00	Imperceptible	Negligible
R30	15.82	15.82	0.00	Imperceptible	Negligible
R31	14.58	14.59	0.01	Imperceptible	Negligible
R32	14.20	14.21	0.01	Imperceptible	Negligible
R33	14.65	14.65	0.00	Imperceptible	Negligible
R34	14.16	14.17	0.01	Imperceptible	Negligible

Table A13.3.6 Predicted PM_{10} Annual Mean Concentrations (µg.m^{-3}), Magnitude of Change and Impact Descriptors at Receptor Locations in 2030 Without and With Operational Traffic

Receptor ID	Annual Mean PM_{10} Concentration (µg.m^{-3})		Change	Magnitude of Change	Impact
	2030 Without Operational Traffic	2030 With Operational Traffic			
R1	14.52	14.52	0.00	Imperceptible	Negligible
R2	13.82	13.82	0.00	Imperceptible	Negligible
R3	14.47	14.47	0.00	Imperceptible	Negligible
R4	17.31	17.31	0.00	Imperceptible	Negligible
R5	13.98	13.99	0.01	Imperceptible	Negligible
R6	14.04	14.05	0.01	Imperceptible	Negligible
R7	13.81	13.81	0.00	Imperceptible	Negligible
R8	13.75	13.76	0.01	Imperceptible	Negligible
R9	14.32	14.34	0.02	Imperceptible	Negligible
R10	14.48	14.49	0.01	Imperceptible	Negligible
R11	14.35	14.36	0.01	Imperceptible	Negligible
R12	14.26	14.26	0.00	Imperceptible	Negligible
R13	14.91	14.91	0.00	Imperceptible	Negligible
R14	14.05	14.06	0.01	Imperceptible	Negligible
R15	13.62	13.63	0.01	Imperceptible	Negligible
R16	14.36	14.36	0.00	Imperceptible	Negligible
R17	14.59	14.59	0.00	Imperceptible	Negligible
R18	17.18	17.19	0.01	Imperceptible	Negligible
R19	17.84	17.85	0.01	Imperceptible	Negligible
R20	16.92	16.93	0.01	Imperceptible	Negligible
R21	14.82	14.83	0.01	Imperceptible	Negligible
R22	17.54	17.54	0.00	Imperceptible	Negligible

Receptor ID	Annual Mean PM_{10} Concentration (µg.m^{-3})		Change	Magnitude of Change	Impact
R23	15.61	15.61	0.00	Imperceptible	Negligible
R24	15.16	15.18	0.02	Imperceptible	Negligible
R25	14.23	14.24	0.01	Imperceptible	Negligible
R26	14.26	14.27	0.01	Imperceptible	Negligible
R27	13.98	13.99	0.01	Imperceptible	Negligible
R28	14.07	14.07	0.00	Imperceptible	Negligible
R29	16.88	16.89	0.01	Imperceptible	Negligible
R30	15.89	15.89	0.00	Imperceptible	Negligible
R31	14.60	14.60	0.00	Imperceptible	Negligible
R32	14.23	14.24	0.01	Imperceptible	Negligible
R33	14.60	14.61	0.01	Imperceptible	Negligible
R34	14.09	14.10	0.01	Imperceptible	Negligible

Table A13.3.7 Predicted Number of Exceedences of the 24-Hour Mean PM_{10} Objective (days), Magnitude of Change and Impact Descriptors at Receptor Locations in 2015 Without and With Construction Traffic

Receptor ID	Number of Days Exceeding 50(µg.m^{-3})		Change	Magnitude of Change	Impact
	2015 Without Construction Traffic	2015 With Construction Traffic			
R1	0	0	0	Imperceptible	Negligible
R2	0	0	0	Imperceptible	Negligible
R3	0	0	0	Imperceptible	Negligible
R4	2	2	0	Imperceptible	Negligible
R5	0	0	0	Imperceptible	Negligible
R6	0	0	0	Imperceptible	Negligible
R7	0	0	0	Imperceptible	Negligible
R8	0	0	0	Imperceptible	Negligible

Receptor ID	Number of Days Exceeding 50(μg.m^{-3})		Change	Magnitude of Change	Impact
R9	0	0	0	Imperceptible	Negligible
R10	0	0	0	Imperceptible	Negligible
R11	0	0	0	Imperceptible	Negligible
R12	0	0	0	Imperceptible	Negligible
R13	0	0	0	Imperceptible	Negligible
R14	0	0	0	Imperceptible	Negligible
R15	0	0	0	Imperceptible	Negligible
R16	0	0	0	Imperceptible	Negligible
R17	0	0	0	Imperceptible	Negligible
R18	2	2	0	Imperceptible	Negligible
R19	3	3	0	Imperceptible	Negligible
R20	2	2	0	Imperceptible	Negligible
R21	0	0	0	Imperceptible	Negligible
R22	3	3	0	Imperceptible	Negligible
R23	1	1	0	Imperceptible	Negligible
R24	1	1	0	Imperceptible	Negligible
R25	0	0	0	Imperceptible	Negligible
R26	0	0	0	Imperceptible	Negligible
R27	0	0	0	Imperceptible	Negligible
R28	0	0	0	Imperceptible	Negligible
R29	2	2	0	Imperceptible	Negligible
R30	1	1	0	Imperceptible	Negligible
R31	0	0	0	Imperceptible	Negligible
R32	0	0	0	Imperceptible	Negligible
R33	0	0	0	Imperceptible	Negligible
R34	0	0	0	Imperceptible	Negligible

Table A13.3.8 Predicted Number of Exceedences of the 24-Hour Mean PM_{10} Objective (days), Magnitude of Change and Impact Descriptors at Receptor Locations in 2020 Without and With Operational Traffic

Receptor ID	Number of Days Exceeding 50(μg.m^{-3})		Change	Magnitude of Change	Impact
	2020 Without Operational Traffic	2020 With Operational Traffic			
R1	0	0	0	Imperceptible	Negligible
R2	0	0	0	Imperceptible	Negligible
R3	0	0	0	Imperceptible	Negligible
R4	1	1	0	Imperceptible	Negligible
R5	0	0	0	Imperceptible	Negligible
R6	0	0	0	Imperceptible	Negligible
R7	0	0	0	Imperceptible	Negligible
R8	0	0	0	Imperceptible	Negligible
R9	0	0	0	Imperceptible	Negligible
R10	0	0	0	Imperceptible	Negligible
R11	0	0	0	Imperceptible	Negligible
R12	0	0	0	Imperceptible	Negligible
R13	0	0	0	Imperceptible	Negligible
R14	0	0	0	Imperceptible	Negligible
R15	0	0	0	Imperceptible	Negligible
R16	0	0	0	Imperceptible	Negligible
R17	0	0	0	Imperceptible	Negligible
R18	1	1	0	Imperceptible	Negligible
R19	1	1	0	Imperceptible	Negligible
R20	1	1	0	Imperceptible	Negligible
R21	0	0	0	Imperceptible	Negligible

Receptor ID	Number of Days Exceeding 50(µg.m^{-3})		Change	Magnitude of Change	Impact
R22	1	1	0	Imperceptible	Negligible
R23	0	0	0	Imperceptible	Negligible
R24	0	0	0	Imperceptible	Negligible
R25	0	0	0	Imperceptible	Negligible
R26	0	0	0	Imperceptible	Negligible
R27	0	0	0	Imperceptible	Negligible
R28	0	0	0	Imperceptible	Negligible
R29	1	1	0	Imperceptible	Negligible
R30	0	0	0	Imperceptible	Negligible
R31	0	0	0	Imperceptible	Negligible
R32	0	0	0	Imperceptible	Negligible
R33	0	0	0	Imperceptible	Negligible
R34	0	0	0	Imperceptible	Negligible

Table A13.3.9 Predicted Number of Exceedences of the 24-Hour Mean PM_{10} Objective (days), Magnitude of Change and Impact Descriptors at Receptor Locations in 2030 Without and With Operational Traffic

Receptor ID	Number of Days Exceeding 50(µg.m^{-3})		Change	Magnitude of Change	Impact
	2030 Without Operational Traffic	2030 With Operational Traffic			
R1	0	0	0	Imperceptible	Negligible
R2	0	0	0	Imperceptible	Negligible
R3	0	0	0	Imperceptible	Negligible
R4	1	1	0	Imperceptible	Negligible
R5	0	0	0	Imperceptible	Negligible
R6	0	0	0	Imperceptible	Negligible
R7	0	0	0	Imperceptible	Negligible

Receptor ID	Number of Days Exceeding 50(µg.m^{-3})		Change	Magnitude of Change	Impact
R8	0	0	0	Imperceptible	Negligible
R9	0	0	0	Imperceptible	Negligible
R10	0	0	0	Imperceptible	Negligible
R11	0	0	0	Imperceptible	Negligible
R12	0	0	0	Imperceptible	Negligible
R13	0	0	0	Imperceptible	Negligible
R14	0	0	0	Imperceptible	Negligible
R15	0	0	0	Imperceptible	Negligible
R16	0	0	0	Imperceptible	Negligible
R17	0	0	0	Imperceptible	Negligible
R18	1	1	0	Imperceptible	Negligible
R19	1	1	0	Imperceptible	Negligible
R20	1	1	0	Imperceptible	Negligible
R21	0	0	0	Imperceptible	Negligible
R22	1	1	0	Imperceptible	Negligible
R23	0	0	0	Imperceptible	Negligible
R24	0	0	0	Imperceptible	Negligible
R25	0	0	0	Imperceptible	Negligible
R26	0	0	0	Imperceptible	Negligible
R27	0	0	0	Imperceptible	Negligible
R28	0	0	0	Imperceptible	Negligible
R29	1	1	0	Imperceptible	Negligible
R30	0	0	0	Imperceptible	Negligible
R31	0	0	0	Imperceptible	Negligible
R32	0	0	0	Imperceptible	Negligible
R33	0	0	0	Imperceptible	Negligible

Receptor ID	Number of Days Exceeding 50(µg.m^{-3})		Change	Magnitude of Change	Impact
R34	0	0	0	Imperceptible	Negligible

3.4 Particulate Matter ($PM_{2.5}$) Results and Predicted Changes

Table A13.3.10 Predicted $PM_{2.5}$ Annual Mean Concentrations (µg.m^{-3}), Magnitude of Change and Impact Descriptors at Receptor Locations in 2015 Without and With Construction Traffic

Receptor ID	Annual Mean $PM_{2.5}$ Concentration (µg.m^{-3})		Change	Magnitude of Change	Impact
	2015 Without Construction Traffic	2015 With Construction Traffic			
R1	10.38	10.38	0.00	Imperceptible	Negligible
R2	10.29	10.31	0.02	Imperceptible	Negligible
R3	10.18	10.18	0.00	Imperceptible	Negligible
R4	11.33	11.33	0.00	Imperceptible	Negligible
R5	9.65	9.65	0.00	Imperceptible	Negligible
R6	9.69	9.70	0.01	Imperceptible	Negligible
R7	9.31	9.33	0.02	Imperceptible	Negligible
R8	9.69	9.72	0.03	Imperceptible	Negligible
R9	9.98	10.03	0.05	Imperceptible	Negligible
R10	10.11	10.15	0.04	Imperceptible	Negligible
R11	10.36	10.41	0.05	Imperceptible	Negligible
R12	10.27	10.31	0.04	Imperceptible	Negligible
R13	11.02	11.06	0.04	Imperceptible	Negligible
R14	10.34	10.37	0.03	Imperceptible	Negligible
R15	10.34	10.37	0.03	Imperceptible	Negligible
R16	10.76	10.79	0.03	Imperceptible	Negligible
R17	10.86	10.88	0.02	Imperceptible	Negligible
R18	12.54	12.55	0.01	Imperceptible	Negligible

Receptor ID	Annual Mean $PM_{2.5}$ Concentration ($\mu g.m^{-3}$)		Change	Magnitude of Change	Impact
R19	13.11	13.12	0.01	Imperceptible	Negligible
R20	12.54	12.57	0.03	Imperceptible	Negligible
R21	11.15	11.18	0.03	Imperceptible	Negligible
R22	12.80	12.81	0.01	Imperceptible	Negligible
R23	11.80	11.80	0.00	Imperceptible	Negligible
R24	10.62	10.69	0.07	Imperceptible	Negligible
R25	10.50	10.53	0.03	Imperceptible	Negligible
R26	10.40	10.42	0.02	Imperceptible	Negligible
R27	10.19	10.21	0.02	Imperceptible	Negligible
R28	10.37	10.40	0.03	Imperceptible	Negligible
R29	12.50	12.53	0.03	Imperceptible	Negligible
R30	11.59	11.60	0.01	Imperceptible	Negligible
R31	10.92	10.92	0.00	Imperceptible	Negligible
R32	10.60	10.63	0.03	Imperceptible	Negligible
R33	10.41	10.45	0.04	Imperceptible	Negligible
R34	9.64	9.67	0.03	Imperceptible	Negligible

Table A13.3.11 Predicted $PM_{2.5}$ Annual Mean Concentrations ($\mu g.m^{-3}$), Magnitude of Change and Impact Descriptors at Receptor Locations in 2020 Without and With Operational Traffic

Receptor ID	Annual Mean $PM_{2.5}$ Concentration ($\mu g.m^{-3}$)		Change	Magnitude of Change	Impact
	2020 Without Operational Traffic	2020 With Operational Traffic			
R1	9.20	9.20	0.00	Imperceptible	Negligible
R2	9.21	9.22	0.01	Imperceptible	Negligible
R3	9.07	9.07	0.00	Imperceptible	Negligible
R4	10.17	10.18	0.01	Imperceptible	Negligible
R5	8.60	8.60	0.00	Imperceptible	Negligible
R6	8.63	8.63	0.00	Imperceptible	Negligible
R7	8.39	8.40	0.01	Imperceptible	Negligible
R8	8.66	8.66	0.00	Imperceptible	Negligible
R9	8.80	8.81	0.01	Imperceptible	Negligible
R10	8.96	8.97	0.01	Imperceptible	Negligible
R11	9.10	9.10	0.00	Imperceptible	Negligible
R12	9.05	9.05	0.00	Imperceptible	Negligible
R13	9.68	9.68	0.00	Imperceptible	Negligible
R14	9.09	9.10	0.01	Imperceptible	Negligible
R15	9.02	9.02	0.00	Imperceptible	Negligible
R16	9.37	9.37	0.00	Imperceptible	Negligible
R17	9.52	9.52	0.00	Imperceptible	Negligible
R18	10.53	10.53	0.00	Imperceptible	Negligible
R19	11.06	11.07	0.01	Imperceptible	Negligible
R20	10.82	10.83	0.01	Imperceptible	Negligible
R21	9.89	9.89	0.00	Imperceptible	Negligible
R22	10.92	10.92	0.00	Imperceptible	Negligible

Receptor ID	Annual Mean $PM_{2.5}$ Concentration ($\mu g.m^{-3}$)		Change	Magnitude of Change	Impact
R23	10.01	10.01	0.00	Imperceptible	Negligible
R24	9.32	9.33	0.01	Imperceptible	Negligible
R25	9.18	9.19	0.01	Imperceptible	Negligible
R26	9.18	9.19	0.01	Imperceptible	Negligible
R27	9.04	9.04	0.00	Imperceptible	Negligible
R28	9.15	9.15	0.00	Imperceptible	Negligible
R29	10.80	10.81	0.01	Imperceptible	Negligible
R30	10.08	10.09	0.01	Imperceptible	Negligible
R31	9.48	9.48	0.00	Imperceptible	Negligible
R32	9.45	9.45	0.00	Imperceptible	Negligible
R33	9.15	9.16	0.01	Imperceptible	Negligible
R34	8.65	8.65	0.00	Imperceptible	Negligible

Table A13.3.12 Predicted $PM_{2.5}$ Annual Mean Concentrations ($\mu g.m^{-3}$), Magnitude of Change and Impact Descriptors at Receptor Locations in 2030 Without and With Operational Traffic

Receptor ID	Annual Mean $PM_{2.5}$ Concentration ($\mu g.m^{-3}$)		Change	Magnitude of Change	Impact
	2030 Without Operational Traffic	2030 With Operational Traffic			
R1	9.23	9.23	0.00	Imperceptible	Negligible
R2	9.14	9.14	0.00	Imperceptible	Negligible
R3	9.02	9.02	0.00	Imperceptible	Negligible
R4	10.24	10.24	0.00	Imperceptible	Negligible
R5	8.51	8.52	0.01	Imperceptible	Negligible
R6	8.54	8.55	0.01	Imperceptible	Negligible
R7	8.28	8.28	0.00	Imperceptible	Negligible
R8	8.55	8.55	0.00	Imperceptible	Negligible

Receptor ID	Annual Mean $PM_{2.5}$ Concentration (µg.m^{-3})		Change	Magnitude of Change	Impact
R9	8.70	8.70	0.00	Imperceptible	Negligible
R10	8.86	8.87	0.01	Imperceptible	Negligible
R11	8.98	8.98	0.00	Imperceptible	Negligible
R12	8.93	8.93	0.00	Imperceptible	Negligible
R13	9.60	9.60	0.00	Imperceptible	Negligible
R14	8.99	8.99	0.00	Imperceptible	Negligible
R15	8.91	8.91	0.00	Imperceptible	Negligible
R16	9.27	9.27	0.00	Imperceptible	Negligible
R17	9.43	9.43	0.00	Imperceptible	Negligible
R18	10.47	10.48	0.01	Imperceptible	Negligible
R19	11.02	11.02	0.00	Imperceptible	Negligible
R20	10.79	10.79	0.00	Imperceptible	Negligible
R21	9.85	9.85	0.00	Imperceptible	Negligible
R22	10.88	10.88	0.00	Imperceptible	Negligible
R23	9.94	9.94	0.00	Imperceptible	Negligible
R24	9.23	9.24	0.01	Imperceptible	Negligible
R25	9.08	9.08	0.00	Imperceptible	Negligible
R26	9.09	9.09	0.00	Imperceptible	Negligible
R27	8.94	8.94	0.00	Imperceptible	Negligible
R28	9.05	9.05	0.00	Imperceptible	Negligible
R29	10.77	10.77	0.00	Imperceptible	Negligible
R30	10.01	10.01	0.00	Imperceptible	Negligible
R31	9.39	9.39	0.00	Imperceptible	Negligible
R32	9.38	9.38	0.00	Imperceptible	Negligible
R33	9.04	9.04	0.00	Imperceptible	Negligible
R34	8.54	8.54	0.00	Imperceptible	Negligible

4 Operational Phase Vessel Emissions Assessment Methodology

4.1 Dispersion Model Inputs

4.1.1 Pollutant emissions from vessels associated with the operational phase of the Harbour facility were modelled using AERMOD (Lakes Environmental model version 8.8.1). AERMOD is an advanced dispersion model based on the Gaussian theory of plume dispersion and was developed by the United States Environmental Protection Agency (US EPA). It is widely used in the UK for regulatory and assessment purposes. Atmospheric dispersion is determined by input data (stack and pollutant release parameters, the terrain, hourly sequential meteorological data and building dimensions) to calculate ground level pollutant concentrations across a selected receptor grid.

4.1.2 Five years (2009 – 2013) of hourly sequential meteorological data from the Teesside recording station was used in the AERMOD model. This is the closest, most representative recording station to the development site.

4.1.3 During the operational phase, emissions of NO_x and sulphur dioxide (SO_2) will occur from vessels transporting product from the Harbour facility. The assessment assumed that a bulk carrier vessel would be hoteling at the proposed quay continuously, utilising auxiliary engines, to provide a conservative assessment. Emission factors for use in the assessment were derived from the US EPA guidance document 'Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories' (US EPA, 2009).

4.1.4 The emission parameters utilised in the vessel emissions assessment are detailed in **Table A13.3.13**.

Table A13.3.13 Vessel Emissions Assessment – Model Input Parameters

Parameter	Vessel
Vessel Type	Bulk carrier (85,000 Dead Weight Tonnage (DWT))
Release height (m)	30
Stack diameter (m)	1
Emission temperature (°C)	200
Exit velocity ($m.s^{-1}$)	20
NOx emission rate ($g.s^{-1}$)	0.69
SO_2 emission rate ($g.s^{-1}$)	0.21

4.2 Identification of Receptor Locations

4.2.1 There are no human receptor locations in the immediate vicinity of the Harbour facility. The closest residential receptors are located approximately 3.2km east of the proposed development in

Dormanstown and 4km south in Grangetown. The following designated ecological sites are located to the north of the proposed Harbour facility:

- South Gare and Coatham Sands Site of Special Scientific Interest (SSSI);
- Seal Sands SSSI;
- Seaton Dunes and Common SSSI;
- Teesmouth and Cleveland Coast Special Protection Area (SPA); and,
- Teesmouth and Cleveland Coast Special Area of Conservation (SAC).

4.2.2 The closest of the above sites to the proposed Harbour facility is the South Gare and Coatham Sands SSSI, which is located approximately 1.2km north of the proposed development.

4.3 Critical Level Assessment

4.3.1 Critical levels are provided for the protection of vegetation and ecosystems and correspond to the concentration of pollutants in air below which adverse impacts are not anticipated. The critical levels for the pollutants considered in the assessment are detailed in **Table A13.3.14**.

Table A13.3.14 Critical Levels for Pollutants Considered in the Assessment

Pollutant	Concentration ($\mu g.m^{-3}$)	Measured As
NOx	30	Annual Mean
	75	24-Hour Mean
SO_2	20	Annual Mean

4.3.2 Maximum modelled concentrations of each pollutant were determined. Background concentrations were then added to the modelled concentrations, and the total concentrations were compared to the critical levels detailed in **Table A13.3.14**.

4.4 Critical Load Assessment

4.4.1 Critical loads (CLs) for habitat sites in the UK are published by the Centre for Ecology and Hydrology (CEH) (CEH 2014). These are the maximum levels of acid and nutrient nitrogen that can be tolerated without harm to the most sensitive features of these habitat sites. The critical loads utilised in the assessment were derived from the most sensitive habitat within the designated ecological sites located in the vicinity of the proposed development, to provide a conservative assessment.

4.4.2 A review of the Air Pollution Information System (APIS) (CEH, 2014) was undertaken to determine the CLs for nutrient nitrogen and acid at each habitat within the designated sites. The habitat with the lowest CL values for both nutrient nitrogen and acid deposition was the habitat 'Coastal dune and sand (coastal stable dune grasslands), located in the Seaton Dunes and Common SSSI. The CLs for nutrient nitrogen and acid deposition for this habitat are detailed in **Table A13.3.15**.

Table A13.3.15 Critical Loads for Pollutants Considered in the Assessment

Site Designation	Feature	Habitat Type	Nutrient Nitrogen CL (kg)	MinCLMinN (keqN.ha.yr^{-1})	MinCLMaxN (keqN.ha.yr^{-1})	MinCLMaxS (keqS.ha.yr^{-1})
Seaton Dunes and Common SSSI	Coastal Dune and Sand	Coastal Stable Dune Grassland	8 – 15	0.223	1.998	1.560

5 Operational Phase Vessel Emission Results

5.1.1 Predicted concentrations of NO_2 and SO_2 at human receptor locations in Dormanstown and Grangetown are detailed in **Table A13.3.16**. Predicted increases in nutrient nitrogen and acid deposition on the most sensitive ecological habitat in the vicinity of the proposed development are detailed in **Table A13.3.17 - Table A13.3.20**.

Receptor	SO_2			NO_2	
	Short-Term 15 Minute 99.9th%ile SO_2 Concentration (µg.m^{-3})	Short-Term 1 Hour 99.73th%ile SO_2 Concentration (µg.m^{-3})	Short-Term 24 Hour 99.18th%ile SO_2 Concentration (µg.m^{-3})	Annual mean NO_2 Conc. (µg.m^{-3})	Short-Term 1 Hour 99.79th%ile NO_2 Concentration (µg.m^{-3})
	Conc.	Conc.	Conc.	Conc.	Conc.
2020 Operational Phase					
Dormanstown	26.72	26.57	26.44	13.89	27.98
Grangetown	13.18	13.05	12.93	13.51	27.20
2030 Operational Phase					
Dormanstown	26.72	26.57	26.44	13.28	26.77
Grangetown	13.18	13.05	12.93	12.28	24.75

Table A13.3.17 Critical Level Assessment Results – 2020 Operational Phase

Habitat	Background NOx/SO_2	Highest Predicted Process Contribution	Total Concentration	Process Contribution /Objective	Total Conc. /Objective
	(µg.m^{-3})	(µg.m^{-3})	(µg.m^{-3})	(%)	(%)
NOx Annual Mean Critical Level Assessment					
Seaton Dunes and Common SSSI	24.86	0.14	25.00	0.46	83.32
NOx 24-Hour Mean Critical Level Assessment					
Seaton Dunes and Common SSSI	31.89	0.76	32.65	1.02	43.54
SO_2 Annual Mean Critical Level Assessment					
Seaton Dunes and Common SSSI	9.1	0.04	9.14	0.21	45.71

Table A13.3.18 Critical Level Assessment Results – 2030 Operational Phase

Habitat	Background NOx/SO_2	Highest Predicted Process Contribution	Total Concentration	Process Contribution /Objective	Total Conc. /Objective
	(µg.m^{-3})	(µg.m^{-3})	(µg.m^{-3})	(%)	(%)
NOx Annual Mean Critical Level Assessment					
Seaton Dunes and Common SSSI	24.28	0.14	24.42	0.46	81.39
NOx 24-Hour Mean Critical Level Assessment					
Seaton Dunes and Common SSSI	31.25	0.76	32.01	1.02	42.68
SO_2 Annual Mean Critical Level Assessment					
Seaton Dunes and Common SSSI	9.1	0.04	9.14	0.21	45.71

Table A13.3.19 Critical Load Assessment Results – Nutrient Nitrogen Deposition

Designation	Feature	Habitat Type	Highest Predicted NN Deposition Rate (kgN.Ha-yr^{-1})	Maximum Modelled NN Deposition Rate as % Critical Load
Seaton Dunes and Common SSSI	Coastal Dune and Sand	Coastal Stable Dune Grassland	0.01377	0.17%

Table A13.3.20 Critical Load Assessment Results – Acid Deposition

Designation	Feature	Highest Predicted Acid Deposition Rate (kgN.Ha-yr-1)		Maximum Modelled Acid Deposition Rate as % Critical Load
		NO_2 (kgN.Ha-yr^{-1})	SO_2 (kgN.Ha-yr^{-1})	
Seaton Dunes and Common SSSI	Coastal Dune and Sand (Coastal Stable Dune Grasslands)	0.00098	0.00503	0.44%