Tween Bridge Solar Farm

A Nationally Significant Infrastructure Project in the Energy Sector

Preliminary Environmental Information Report

Technical Appendix 14.1 - Air Quality Impacts on Designated Ecological Sites

March 2025

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Appendices

Tween Bridge Solar Farm

Chapter 14: Air Quality and Greenhouse Gases Appendices

For RWE Renewables

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Air Quality Consultants | Part of Logika Group

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14.1 Air Quality Impacts on Designated Ecological Sites

14.1.1 Chapter 7: Nature Conservation and Biodiversity of the PEIR assesses the effects of the Scheme on the following designated ecological receptors:

- Thorne Moor Special Area of Conservation (SAC), Thorne and Hatfield Moors Special Protection Area (SPA) and Thorne, Crowle and Goole Moors Site of Special Scientific Interest (SSSI);
- Hatfield Moor SAC and SSSI; and
- Hatfield Chase Ditches SSSI.

14.1.2 The locations of the designated habitats[1] relative to the Scheme are shown in Figure 14.1.1.

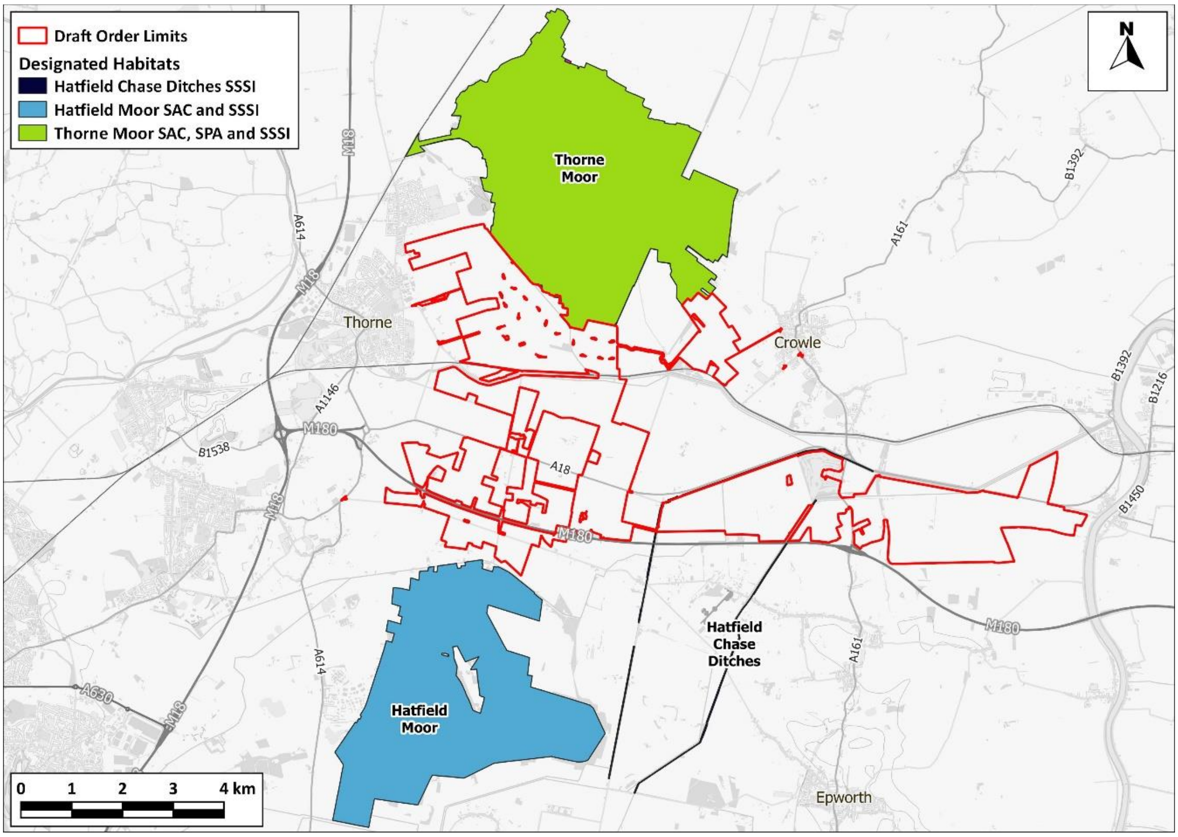

Figure 14.1.1: Locations of Designated Habitats in the Study Area

Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v3.0.

14.1.3 Once construction is complete, the residual traffic associated with the Scheme will be minimal (estimated to be one vehicle daily on average per land parcel), but there is a need to consider the potential effects of emissions from construction traffic albeit that any effects will be temporary (taking place over 30 months).

[1] The Hatfield Chase Ditches SSSI run adjacent and perpendicular to the A18 and M180.

Assessment Approach – Natural England Guidance

14.1.4 The potential for impacts on designated habitats listed in Paragraph 14.1.1 has initially been screened based on the presence of qualifying features sensitive to air pollution within 200 m of roads subject to changes in emissions[2], following Natural England guidance (which recommends the use of the criteria within National Highway's Design Manual for Roads and Bridges[3]). If there are no qualifying features within 200 m of an affected road, then no further assessment is required.

Impact Assessment

Thorne Moor SAC, Thorne and Hatfield Moors SPA and Thorne, Crowle and Goole Moors SSSI

14.1.5 The boundary of the SAC, SPA and SSSI is over 200 m from any existing road that will be used by construction vehicles to access the primary construction compounds, for example Moor Edges Road and Marsh Road. On this basis, no further assessment is required.

14.1.6 There will be access tracks throughout the Scheme to enable construction vehicles to transport material between land parcels. The routes between the primary compounds and the smaller parcels will be available for the ES, however, it is anticipated that these will be over 200 m from the boundary of the designated site.

Hatfield Moor SAC and SSSI

14.1.7 The boundary of the SAC and SSSI is over 200 m from any existing road that will be used by construction vehicles to access the primary construction compounds, for example Sandtoft Road. On this basis, no further assessment is required.

14.1.8 A small portion of the Draft Order Limits (~4.5 hectares) to the south adjacent to Moor Lane is within 200 m of the SAC and SSSI; however, it is unlikely that the internal access tracks will be built in this area, although this will be confirmed in the ES. On this basis, no further assessment is required.

Hatfield Chase Ditches SSSI

14.1.9 The boundary of the SSSI is within 200 m of an unnamed road, the A18 and M180 which will be used by construction vehicles. The ES will quantify the impact of construction vehicles on the SSSI.

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[2] Beyond 200 m, the contribution from road traffic emissions is not discernible from fluctuations in background concentrations.

[3] Highways England (2019), Design Manual for Roads and Bridges LA 105 Air Quality.

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Technical Appendix 14.2 – Environmental Planning UK (EPUK) and The Institute of Air Quality Management (IAQM) Planning for Air Quality Guidance
March 2025

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14.2 EPUK & IAQM Planning for Air Quality Guidance

14.2.1 The guidance issued by EPUK and IAQM[4] is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

Air Quality as a Material Consideration

"Any air quality issue that relates to land use and its development is capable of being a material planning consideration. The weight, however, given to air quality in making a planning application decision, in addition to the policies in the local plan, will depend on such factors as:

- the severity of the impacts on air quality;
- the air quality in the area surrounding the proposed development;
- the likely use of the development, i.e. the length of time people are likely to be exposed at that location; and
- the positive benefits provided through other material considerations".

Recommended Best Practice

14.2.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

"The basic concept is that good practice to reduce emissions and exposure is incorporated into all developments at the outset, at a scale commensurate with the emissions".

14.2.3 The guidance sets out a number of good practice principles that should be applied to all developments that:

- include 10 or more dwellings;
- where the number of dwellings is not known, residential development is carried out on a site of more than 0.5 ha;
- provide more than 1,000 m^2 of commercial floorspace;
- are carried out on land of 1 ha or more.

14.2.4 The good practice principles are that:

- New developments should not contravene the Council's Air Quality Action Plan, or render any of the measures unworkable;
- Wherever possible, new developments should not create a new "street canyon", as this inhibits pollution dispersion;
- Delivering sustainable development should be the key theme of any application;
- New development should be designed to minimise public exposure to pollution sources, e.g. by locating habitable rooms away from busy roads;

[4] Moorcroft and Barrowcliffe et al (2017), Land-Use Planning & Development Control: Planning For Air Quality v1.2

- The provision of at least 1 Electric Vehicle (EV) "rapid charge" point per 10 residential dwellings and/or 1000 m^2 of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;
- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
    - Spark ignition engine: 250 mgNOx/Nm^3;
    - Compression ignition engine: 400 mgNOx/Nm^3;
    - Gas turbine: 50 mgNOx/Nm^3.
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/Nm^3 and 25 mgPM/Nm^3.

14.2.5 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

"It is important that obligations to include offsetting are proportional to the nature and scale of development proposed and the level of concern about air quality; such offsetting can be based on a quantification of the emissions associated with the development. These emissions can be assigned a value, based on the "damage cost approach" used by Defra, and then applied as an indicator of the level of offsetting required, or as a financial obligation on the developer. Unless some form of benchmarking is applied, it is impractical to include building emissions in this approach, but if the boiler and CHP emissions are consistent with the standards as described above then this is not essential".

14.2.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

- Support and promotion of car clubs;
- Contributions to low emission vehicle refuelling infrastructure;
- Provision of incentives for the uptake of low emission vehicles;
- Financial support to low emission public transport options; and
- Improvements to cycling and walking infrastructures.

Screening

Impacts of the Local Area on the Development

"There may be a requirement to carry out an air quality assessment for the impacts of the local area's emissions on the proposed development itself, to assess the exposure that residents or users might experience. This will need to be a matter of judgement and should take into account:

- *the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives;*
- *the presence and location of Air Quality Management Areas as an indicator of local hotspots where the air quality objectives may be exceeded;*
- *the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular nitrogen dioxide), that would cause unacceptably high exposure for users of the new development; and*
- *the presence of a source of odour and/or dust that may affect amenity for future occupants of the development".*

Impacts of the Development on the Local Area

14.2.7 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the following apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use; and/or
- more than 1,000 m^2 of floor space for all other uses or a site area greater than 1 ha.

14.2.8 Coupled with any of the following:

- the development has more than 10 parking spaces; and/or
- the development will have a centralised energy facility or other centralised combustion process.

14.2.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, which sets out indicative criteria for requiring an air quality assessment. The stage 2 criteria relating to vehicle emissions are set out below:

- the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;
- the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights or roundabouts;

- the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere; and
- the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor.

14.2.10 The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria are likely to be more appropriate.

14.2.11 On combustion processes (including standby emergency generators and shipping) where there is a risk of impacts at relevant receptors, the guidance states that:

"Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. As a guide, the 5 mg/s criterion equates to a 450 kW ultra-low NOx gas boiler or a 30kW CHP unit operating at <95mg/Nm^3.

In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.

Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable".

14.2.12 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area, provided that professional judgement is applied; the guidance importantly states the following:

"The criteria provided are precautionary and should be treated as indicative. They are intended to function as a sensitive 'trigger' for initiating an assessment in cases where there is a possibility of significant effects arising on local air quality. This possibility will, self-evidently, not be realised in many cases. The criteria should not be applied rigidly; in some instances, it may be appropriate to amend them on the basis of professional judgement, bearing in mind that the objective is to identify situations where there is a possibility of a significant effect on local air quality".

14.2.13 Even if a development cannot be screened out, the guidance is clear that a detailed assessment is not necessarily required:

"The use of a Simple Assessment may be appropriate, where it will clearly suffice for the purposes of reaching a conclusion on the significance of effects on local air quality. The principle underlying this guidance is that any assessment should provide enough evidence that will lead to a sound conclusion on the presence, or otherwise, of a significant effect on local air quality. A Simple Assessment will be appropriate, if it can provide this evidence. Similarly, it may be possible to conduct a quantitative assessment that does not require the use of a dispersion model run on a computer".

14.2.14 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this chapter.

Assessment of Significance

14.2.15 There is no official guidance in the UK in relation to development control on how to describe the nature of air quality impacts, nor how to assess their significance. The approach within the EPUK/IAQM guidance has, therefore, been used in this assessment. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

14.2.16 The guidance recommends that the assessment of significance should be based on professional judgement, with the overall air quality impact of the development described as either 'significant' or 'not significant'. In drawing this conclusion, the following factors should be taken into account:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts and, in such circumstances, several impacts that are described as 'slight' individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, a 'moderate' or 'substantial' impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health; and
- the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant? In the majority of cases, the impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

14.2.17 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.

14.2.18 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix 14.5.

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Technical Appendix 14.3 – GHG Footprint Methodology

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14.3 GHG Footprint Methodology

Introduction

14.3.1 This Section sets out the methodology for calculating the baseline Greenhouse Gas (GHG) footprint, and GHG footprint for the Scheme. It covers the following GHG emissions sources:

- existing site: agricultural emissions from arable land use;
- construction phase: embodied GHG emissions in materials used in the construction of the Scheme, construction transport and construction site emissions;
- operational phase: operational transport emissions and repair, maintenance and replacement; and
- energy intensity.

14.3.2 The GHG footprint has been calculated for the lifetime of the Scheme, which includes a 30-month construction period (assumed to commence in 2026) and then a 40-year operational period from 2029 onwards.

14.3.3 Details of the methodology to calculate the GHG emissions from each of the emission sources included in the GHG footprint is provided in the following sections.

Baseline Emissions

14.3.4 The existing Site's baseline GHG emissions, are established by taking account the total emissions from current land use such as agricultural activities.

14.3.5 A summary of the data used for the calculation of the current GHG emissions from the Site resulting from agricultural activities is shown in Table 14.3.1. The GHG factor for agricultural land use has been taken from Natural England[5].

Table 14.3.1: Existing Site Data

Land Use	Total Site Area (ha)	GHG Emissions Factor ($kgCO_2e/ha$)	GHG Emissions (tonnes CO_2e)[a]
Agricultural land	2,526	0.29	733

[a] Value rounded to nearest whole number.

Construction Phase

Embodied GHG Emissions in Materials used in the Construction of the Scheme

14.3.6 Embodied carbon emissions from the construction phase of the Scheme have been estimated based on data and information provided by the Applicant, including:

- quantities (mass and/or volume) of key materials such as steel for PV panels and mounting structures;

[5] Natural England (2021) Carbon storage and sequestration by habitat: a review of the evidence (second edition).

- dimensions of key structures on site including battery containers;
- numbers, sizes, weights, dimensions for key components of the solar and BESS systems including PV panels, inverters, transformers, switchgear, battery cells and HVAC systems; and
- lengths, type and specifications of cabling to be used throughout the Scheme.

14.3.7 These input data have been processed and combined with embodied carbon emissions factors from a number of sources to model the embodied carbon emissions.

14.3.8 A summary of the sources and assumptions used in the calculation of embodied carbon emissions is presented in Table 14.3.2.

Table 14.3.2: Sources and Assumptions of Emissions Factors for Embodied Carbon

Component	GHG Emissions Factors Source and Assumptions
Solar Array	
PV Panels	GHG emissions factor of 0.0081 kgCO_2e/kWh calculated using an Environmental Performance Declaration (EPD) for Jolywood JW-HD156N-158.75 monocrystalline solar panels (manufactured in China)[6].
PV Frames & Mounting Structures	GHG emission factor for electro galvanised steel obtained from ICE 3.0 database[7].
Cabling (Low Voltage Distribution Cables and Grid Connection Cables)	Material composition of cables assumed from the Lifecycle Carbon Impact Assessment of the Respond Project Report[8]. GHG emission factors for aluminium, copper, and plastics (XLPE and MDPE) obtained from ICE 3.0[7] and ICE 2.0 databases[9].
HV Infrastructure	
Inverters	EPD CO_2e intensity calculated using and Environmental Environmental Performance Declaration (EPD) for Sungrow central power inverter[10].
Transformers	Typical material composition of transformers obtained from lifecycle analysis of power transformers[11] and emissions factors for steel, copper and insulating paper taken from ICE 2.0[9] and 3.0[7].
Switchgear	GHG intensity of switchgear converters assumed from the Lifecycle Carbon Impact Assessment of the Respond Project Report[8].
BESS	

[6] Environmental Performance Declaration (2020) Jolywood N-type Bifacial Double Glass PV Modules, valid to Nov 2025: https://pvsky.pl/wp-content/uploads/2021/12/Jolywood-JW-HD144N-445-470W-Raport-EPD.pdf
[7] University of Bath (2019) Inventory of Carbon and Energy (ICE) Version 3.0.
[8] FuturoFirma (2018) Lifecycle Carbon Impact Assessment of the Respond Project: https://www.enwl.co.uk/globalassets/innovation/respond/respond-key-documents/carbon-impact-assessment-final-report.pdf
[9] University of Bath (2013) Inventory of Carbon and Energy (ICE) Version 2.0.
[10] Environmental Performance Declaration (2024) EPD Sungrow central power inverter: https://en.sungrowpower.com/Downloads
[11] Hong Guo, Yuting Gao, Junhao Li (2022) The greenhouse gas emissions of power transformers based on life cycle analysis. Energy Reports Volume 8, Supplement 15, Pages 413-419.

Battery Cells	GHG emissions factor of 172 kgCO_2e/kWh calculated using an Environmental Performance Declaration (EPD) for Huawei battery cells[12].
Battery Containers	GHG emissions calculated based on size of structures using GHG emissions factors obtained from RICS guidance for specialist buildings/structures[13].
HVAC Systems	GHG emissions factor for HVAC systems obtained from embodied carbon in HVAC system lifecycle analysis and applied to total area of all battery containers[14].

14.3.9 The resultant embodied carbon emissions are provided in **Table 14.**3.3.

Table 14.3.3: Embodied Carbon Emissions (tonnes CO_2e)

Component	Embodied Carbon (tonnes CO_2e)[a]	% of Total
PV Panels	229,819	46.3%
PV Framework	26,708	5.4%
Cabling (Low Voltage Distribution Cables and Grid Connection Cables)	39,861	8.0%
HV Infrastructure (PCS) (Inverters, Transformers and Switchgear)	31,260	6.3%
BESS (Batteries, Containers, HVAC)	166,783	33.6%
CCTV	1,542	0.3%
Total	**495,973**	**100%**

[a] All values rounded to nearest whole number.

Construction Transport

14.3.10 The transport movements generated by the Scheme during the construction phase have been provided by the project transport consultant. The transport movements included vehicle movements associated with the delivery of goods and materials, and movement of construction site workers by private van and minibus.

14.3.11 GHG factors for construction transport have been obtained from the DfT's WebTAG data book[15], published in 2024. The appropriate GHG factors have been used for the years 2026 to 2028 and take into account decarbonisation of road transport.

[12] Environmental Performance Declaration (2022) Huawei Digital Power Technolgies battery modules valid to Sep 2027: https://www.epditaly.it/wp-content/uploads/2016/12/EPD_Huawei_2022-Battery-Modules.pdf
[13] RICS (2012) Methodology for the calculation of embodied carbon in materials. 1st edition.
[14] Rodriguez Droguett, B (2019) Embodied Carbon of Heating, Ventilation, Air Conditioning and Refrigerants (HVAC+R) Systems. University of Washington.
[15] DfT (2024) TAG data book May 2024 v1.23. Available: https://www.gov.uk/government/publications/tag-data-book.

14.3.12 For construction transport of materials, articulated HGVs are assumed to travel 120 km and rigid HGVs are assumed to travel 80 km. In the absence of trip distance data, distances have been based on the RICS guidance[16].

14.3.13 On-site external tractors and trailer movements will travel 10 km. These movements are contained within the Draft Order Limits.

14.3.14 For construction site staff, an average travel distance of 20 km has been used, which encompasses Doncaster.

14.3.15 It is expected that many of the products and materials used within the Scheme will be manufactured abroad and shipped to the UK for installation. GHG emissions associated with the international shipping of these goods has therefore been accounted for in the GHG footprint. It is likely that the PV modules, cables, inverters, transformers and the BESS will be manufactured in China. The GHG factors for a container ship has been taken from DESNZ GHG conversion factors[17].

14.3.16 A summary of the data used for the calculation of construction transport GHG emissions is shown in Table 14.3.4 to Table 14.3.6.

Table 14.3.4: Construction Vehicles Data and Emissions

Vehicle Type	Year	Number of Two-Way Movements	Distance Travelled (km)	GHG Emissions Factor ($kgCO_2e/km$)	GHG Emissions (tonnes CO_2e)[a]
HGV (Rigid)	2026	9,401	174,428	0.503	88
	2027	9,401	174,428	0.498	87
	2028	9,401	174,428	0.493	86
HGV (Artic)	2026	3,814	457,623	0.976	447
	2027	3,814	457,623	0.958	438
	2028	3,814	457,623	0.941	430

[a] All values rounded to nearest whole number.

Table 14.3.5: Construction Staff Transport Data and Emissions

Vehicle Type	Year	Number of Two-Way Movements	Distance Travelled (km)	GHG Emissions Factor ($kgCO_2e/km$)	GHG Emissions (tonnes CO_2e)[a]
Van	2026	34,457	689,143	0.201	138
	2027	34,457	689,143	0.195	134
	2028	34,457	689,143	0.187	129

[a] All values rounded to nearest whole number.

[16] RICS (2023) Whole life carbon assessment for the built environment, 2nd edition.
[17] DESNZ (2024) Greenhouse gas reporting: conversion factors 2024.

Table 14.3.6: Construction Shipping Data and Emissions

Vehicle Type	Item	Mass (T)	Total (T) [a]	GHG Emissions Factor (kg CO_2 per tonne.km)	GHG Emissions (tonnes CO_2e) [b, c]
Container Ship	PV panels	77,212	118,489	0.016	35,374
	Cables	8,800			
	Inverters	9,106			
	Transformers	1,616			
	BESS	10,982			

[a] Values rounded to nearest whole number.

[b] Includes 10% uplift for packaging and uncertainty.

[c] Based on distance from UK to China via Suez Canal – 18,520 km/10,000NM.

14.3.17 The estimated construction phase transport emissions are 37,351 tonnes CO_2e.

Construction Site Emissions

14.3.18 The approach recommended in guidance on whole life carbon assessment from RICS[16] for calculating emissions arising from on- or off-site construction activities, such as energy consumption for site accommodation, plant use and waste, is based on an emission rate per square meter of Gross Internal Area (GIA). Since GIA relates to the area of a building, and building structures across the Scheme will be limited to Substations and the BESS sites, it is not appropriate to use the full area within the Draft Order Limits, which covers 2,526 hectares.

14.3.19 For the purposes of this assessment, an emission rate of 25 $kgCO_2e/m^2$ has been applied to 2% of the area within the Draft Order Limits (505,200 m^2).

14.3.20 A summary of the sources and assumptions used in the calculation of emissions from on- or off-site construction activities is presented in **Table 14.3.7**.

Table 14.3.7: Construction Site Activities Data and Emissions

Total Site Area (m^2)	GHG Emissions Factor ($kgCO_2e/m^2$)	GHG Emissions (tonnes CO_2e) [a]
25,260,000	25	12,630

[a] Value rounded to nearest whole number.

Operational Phase (including Maintenance)

Operational Transport

14.3.21 The applicant has advised that it is likely that the operational transport movements will be limited to 20 round trip journeys per day with an average travel distance of 20 km per round trip.

14.3.22 The operational transport data and assumptions used in the assessment is shown in Table 14.3.8.

Table 14.3.8: Transport Data, Assumptions and Emissions

Parameter	Value	Unit	Notes
Number of Trips	20	Per day	From the Applicant.
Type of Vehicle	n/a		From the Applicant.
Average Travel Distance	20	km	10 km each way.
GHG Factor (2029)	0.176	$kgCO_2e/km$	DESNZ GHG conversion factors[17].
Annual GHG	51	tonnes CO_2e	Taking account of the decarbonisation of road transport in line with DfT's WebTAG data book[15].
Lifetime GHG (40 Years)	1,013		

Repair, Maintenance and Replacement

14.3.23 Repair, maintenance and replacement of the Scheme over its 40-year operational lifetime is predominated by the embodied carbon associated with parts and products used for repairs, maintenance and replacements.

14.3.24 In order to be conservative, the assessment has used the same embodied carbon emissions factors and intensities as used in the calculation of embodied carbon emissions described above. This is conservative as it ignores the potential future decarbonisation of the mining, processing and manufacturing sectors.

14.3.25 The data and assumptions used in the calculation of emissions from repair, maintenance and replacement at provided in Table 14.3.9.

Table 14.3.9: Operational Repair, Maintenance and Replacement Assumptions, Data and Emissions

Component	Number of Replacements during Lifetime	Lifetime Carbon (tonnes CO_2e)[a]
Solar Array		
PV Panels	0.1	22,982
PV Framework & Mounting Structures	1	26,708
Cabling (Low Voltage Distribution Cables and Grid Connection Cables)	1	39,861
HV Infrastructure		
Inverters	1.5	39,078
Transformers	1	5,165
Switchgear	1	43
BESS		
Battery Cells	3	486,425

HVAC Systems	3	2,934
Total		**623,197**

[a] All values rounded to nearest whole number.

Energy Intensity/Offset

14.3.26 The calculation of the lifecycle energy intensity of the Scheme is calculated using the total lifecycle carbon emissions and the total expected lifetime electricity export. To calculate the lifetime electricity exported, the annual (opening year) value has been extrapolated over 40 years, assuming a PV panel degradation rate of 0.45% per annum and 10 % of PV panels being replaced within the 40-year lifetime.

14.3.27 A summary of the energy intensity calculation is provided in Table 14.3.10.

Table 14.3.10: Energy Intensity Calculation

Parameter	Value	Unit
Total Annual Electricity Export	1,000,000,000	MWh
Annual Degradation Rate	0.45[a]	%
Total Lifetime (40-year) Electricity Export	37,925,500	kWh
Total Lifetime GHG Emissions	1,170,163	tonnes CO_2e
Lifecycle Carbon Intensity	30	gCO_2e/kWh

[a] Degradation rate of 0.45% assumed up to year 40.

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Technical Appendix 14.4 – Construction Dust Assessment Procedure

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14.4 Construction Dust Assessment Procedure

14.4.1 The criteria developed by IAQM[18] divide the activities on construction sites into four types to reflect their different potential impacts. These are:

- demolition;
- earthworks;
- construction; and
- trackout.

14.4.2 The assessment procedure includes the four steps summarised below:

STEP 1: Screen the Need for a Detailed Assessment

14.4.3 An assessment is required where there is a human receptor within 250 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 250 m from the site entrance(s), or where there is an ecological receptor within 50 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 250 m from the site entrance(s).

14.4.4 Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is negligible and that any effects will be 'not significant'. No mitigation measures beyond those required by legislation will be required.

STEP 2: Assess the Risk of Dust Impacts

14.4.5 A site is allocated to a risk category based on two factors:

- the scale and nature of the works, which determines the potential dust emission magnitude (Step 2A); and
- the sensitivity of the area to dust effects (Step 2B).

14.4.6 These two factors are combined in Step 2C, which is to determine the risk of dust impacts with no mitigation applied. The risk categories assigned to the site may be different for each of the four potential sources of dust (demolition, earthworks, construction and trackout).

Step 2A – Define the Potential Dust Emission Magnitude

14.4.7 Dust emission magnitude is defined as either 'Small', 'Medium', or 'Large'. The IAQM guidance explains that this classification should be based on professional judgement, but provides the examples in Table 14.4.1.

Table 14.4.1: Examples of How the Dust Emission Magnitude Class May be Defined

Class	Examples
Demolition	

[18] IAQM (2024), Guidance on the Assessment of Dust from Demolition and Construction v2.2, Available: http://iaqm.co.uk/guidance/

Class	Examples
Large	Total building volume >75,000 m^3, potentially dusty construction material (e.g. concrete), on site crushing and screening, demolition activities >12 m above ground level
Medium	Total building volume 12,000 m^3 – 75,000 m^3, potentially dusty construction material, demolition activities 6-12 m above ground level
Small	Total building volume <12,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <6 m above ground, demolition during wetter months
Earthworks	
Large	Total site area >110,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry to due small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >6 m in height.
Medium	Total site area 18,000 m^2 – 110,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 3 m – 6 m in height.
Small	Total site area <18,000 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <3 m in height.
Construction	
Large	Total building volume >75,000 m^3, on site concrete batching; sandblasting
Medium	Total building volume 12,000 m^3 – 75,000 m^3, potentially dusty construction material (e.g. concrete), on site concrete batching
Small	Total building volume <12,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber)
Trackout [a]	
Large	>50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
Medium	20-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m
Small	<20 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m

[a] These numbers are for vehicles that leave the site after moving over unpaved ground.

Step 2B – Define the Sensitivity of the Area

14.4.8 The sensitivity of the area is defined taking account of a number of factors:

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

14.4.9 The first requirement is to determine the specific sensitivities of local receptors. The IAQM guidance recommends that this should be based on professional judgment, taking account of the principles in Table 14.4.2. These receptor sensitivities are then used in the matrices set out in Table 14.4.3, Table 14.4.4 and Table 14.4.5 to determine the sensitivity of the area. Finally, the sensitivity of the area is considered in relation to any other site-specific factors, such as the presence of natural shelters etc., and any required adjustments to the defined sensitivities are made.

Step 2C – Define the Risk of Impacts

14.4.10 The dust emission magnitude determined at Step 2A is combined with the sensitivity of the area determined at Step 2B to determine the risk of impacts with no mitigation applied. The IAQM guidance provides the matrix in Table 14.4.6 as a method of assigning the level of risk for each activity.

STEP 3: Determine Site-specific Mitigation Requirements

14.4.11 The IAQM guidance provides a suite of recommended and desirable mitigation measures which are organised according to whether the outcome of Step 2 indicates a low, medium, or high risk. The list provided in the IAQM guidance has been used as the basis for the requirements set out in Appendix 14.6.

STEP 4: Determine Significant Effects

14.4.12 The IAQM guidance does not provide a method for assessing the significance of effects before mitigation, and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance is clear that the residual effect will normally be 'not significant'.

14.4.13 The IAQM guidance recognises that, even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all of the time, for instance under adverse weather conditions. The local community may therefore experience occasional, short-term dust annoyance. The scale of this would not normally be considered sufficient to change the conclusion that the effects will be 'not significant'.

Table 14.4.2: Principles to be Used When Defining Receptor Sensitivities

Class	Principles	Examples
Sensitivities of People to Dust Soiling Effects		
High	users can reasonably expect enjoyment of a high level of amenity; or the appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land	dwellings, museum and other culturally important collections, medium and long term car parks and car showrooms
Medium	users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or the appearance, aesthetics or value of their property could be diminished by soiling; or the people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land	parks and places of work
Low	the enjoyment of amenity would not reasonably be expected; or there is property that would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or there is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land	playing fields, farmland (unless commercially-sensitive horticulture), footpaths, short term car parks and roads
Sensitivities of People to the Health Effects of PM_{10}		
High	locations where members of the public may be exposed for eight hours or more in a day	residential properties, hospitals, schools and residential care homes
Medium	locations where the people exposed are workers, and where individuals may be exposed for eight hours or more in a day.	may include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}
Low	locations where human exposure is transient	public footpaths, playing fields, parks and shopping streets
Sensitivities of Receptors to Ecological Effects		
High	locations with an international or national designation and the designated features may be affected by dust soiling; or locations where there is a community of a particularly dust sensitive species	Special Areas of Conservation with dust sensitive features
Medium	locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or	Sites of Special Scientific Interest with dust sensitive features

Class	Principles	Examples
	locations with a national designation where the features may be affected by dust deposition	
Low	locations with a local designation where the features may be affected by dust deposition	Local Nature Reserves with dust sensitive features

Table 14.4.3: Sensitivity of the Area to Dust Soiling Effects on People and Property[19]

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<250
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 14.4.4: Sensitivity of the Area to Human Health Effects[19]

Receptor Sensitivity	Annual Mean PM_{10}	Number of Receptors	Distance from the Source (m)			
			<20	<50	<100	<250
High	>32 µg/m³	>100	High	High	High	Medium
		10-100	High	High	Medium	Low
		1-10	High	Medium	Low	Low
	28-32 µg/m³	>100	High	High	Medium	Low
		10-100	High	Medium	Low	Low
		1-10	High	Medium	Low	Low
	24-28 µg/m³	>100	High	Medium	Low	Low
		10-100	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	<24 µg/m³	>100	Medium	Low	Low	Low
		10-100	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	>32 µg/m³	>10	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low

[19] For demolition, earthworks and construction, distances are taken either from the dust source or from the boundary of the site. For trackout, distances are measured from the sides of roads used by construction traffic. Without mitigation, trackout may occur from roads up to 250 m, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Receptor Sensitivity	Annual Mean PM_{10}	Number of Receptors	Distance from the Source (m)			
			<20	<50	<100	<250
	28-32 $\mu g/m^3$	>10	Medium	Low	Low	Low
		1-10	Low	Low	Low	Low
	24-28 $\mu g/m^3$	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
	<24 $\mu g/m^3$	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low

Table 14.4.5: Sensitivity of the Area to Ecological Effects [19]

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Table 14.4.6: Defining the Risk of Dust Impacts

Sensitivity of the Area	Dust Emission Magnitude		
	Large	Medium	Small
Demolition			
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible
Earthworks			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Construction			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Trackout			
High	High Risk	Medium Risk	Low Risk

Sensitivity of the Area	Dust Emission Magnitude		
	Large	Medium	Small
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

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Technical Appendix 14.5 – Professional Experience

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14.5 Professional Experience

Laurence Caird, MEarthSci CSci MIEnvSc MIAQM

Mr Caird is a Technical Director with AQC, with 18 years' experience in the field of environmental consultancy with extensive experience in air quality and climate change assessments for Environmental Impact Assessment (EIA) schemes. He has helped shape a methodology for the assessment of greenhouse gas emissions within EIA to satisfy the requirements of the 2017 EIA Regulations and has produced carbon footprints and greenhouse gas assessments for a number of projects including major aviation projects as well as EIA residential, commercial and mixed-use developments and industrial facilities. Beyond EIA, Mr Caird has produced lifecycle carbon assessments for a range of projects, has undertaken assessments of project's resilience and adaptation to climate change, has developed net zero carbon plans and strategies, and undertaken assessments of carbon sequestration and carbon offsets and carbon assessment for land use, land use change and forestry. He also has extensive experience in the field of air quality, as has a detailed understanding of a range of emissions sources including transport, energy and industry. He is a Member of the Institute of Air Quality Management (and a former IAQM Committee Member) and is a Chartered Scientist.

Dr Frances Marshall, MSci PhD MIEnvSc MIAQM

Dr Marshall is a Principal Consultant with AQC with ten years' relevant experience. Prior to joining AQC, she spent four years carrying out postgraduate research into atmospheric aerosols at the University of Bristol. Dr Marshall has experience preparing air quality assessments for a range of projects, including residential and commercial developments, road traffic schemes, energy centres, energy from waste schemes and numerous power generation schemes. She has experience in producing air quality assessments for EIA schemes, and has also assessed the impacts of Local Plans on designated ecological areas, prepared Annual Status Reports for Local Authorities, and undertaken diffusion tube monitoring studies. She is a Member of both the Institute of Air Quality Management and the Institution of Environmental Sciences.

Lina Locatelli

Miss Locatelli is a Consultant with AQC and joined the company in 2023. Lina's background is in ecological and environmental sciences. During her BSc degree at the University of Edinburgh, she developed an interest around air & environmental pollution and its effects on human health. She completed her master's degree in Earth Future Research at the University of Glasgow, where she expanded her knowledge and passion around climate justice. After graduating, she was involved in delivering a UK-GOV funded net-zero project, where she gained understanding and practical knowledge in carbon accounting and setting science-based emission reduction targets.

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Technical Appendix 14.6 – Construction Mitigation

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14.6 Construction Mitigation

14.6.1 Table 14.6.1 sets out a list of best-practice measures from the IAQM guidance[18] that should be incorporated into the specification for the works. These measures should ideally be written into a Dust Management Plan. Some of the measures may only be necessary during specific phases of work, or during activities with a high potential to produce dust, and the list should be refined and expanded upon in liaison with the construction contractor when producing the Dust Management Plan.

Table 14.6.1: Best-Practice Mitigation Measures Recommended for the Works

Measure	Desirable	Highly Recommended
Communications		
Develop and implement a stakeholder communications plan that includes community engagement before and during work on site		✓
Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environmental manager/engineer or the site manager		✓
Display the head or regional office contact information		✓
Dust Management Plan		
Develop and implement a Dust Management Plan (DMP) approved by the Local Authority which documents the mitigation measures to be applied, and the procedures for their implementation and management		✓
Site Management		
Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken		✓
Make the complaints log available to the local authority when asked		✓
Record any exceptional incidents that cause dust and/or air emissions, either on- or off- site, and the action taken to resolve the situation in the log book		✓
Hold regular liaison meetings with other high risk construction sites within 250 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes		✓
Monitoring		
Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust. Record inspection results, and make the log available to the Local Authority when asked. This should include		✓

Measure	Desirable	Highly Recommended
regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of the site boundary, with cleaning to be provided if necessary		
Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the Local Authority when asked		✓
Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions		✓
Agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it is a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction[20]		✓
Preparing and Maintaining the Site		
Plan the site layout so that machinery and dust-causing activities are located away from receptors, as far as is possible		✓
Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site		✓
Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period		✓
Avoid site runoff of water or mud		✓
Keep site fencing, barriers and scaffolding clean using wet methods		✓
Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below		✓
Cover, seed, or fence stockpiles to prevent wind whipping		✓
Operating Vehicle/Machinery and Sustainable Travel		
Ensure all vehicles switch off their engines when stationary – no idling vehicles		✓
Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery-powered equipment where practicable		✓

[20] IAQM (2018), Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites v1.1

Measure	Desirable	Highly Recommended
Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on un-surfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate)		✓
Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials		✓
Implement a Travel Plan that supports and encourages sustainable staff travel (public transport, cycling, walking, and car-sharing)		✓
Operations		
Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems		✓
Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate		✓
Use enclosed chutes, conveyors and covered skips		✓
Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate		✓
Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods		✓
Waste Management		
Avoid bonfires and burning of waste materials		✓
Measures Specific to Earthworks		
Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable		✓
Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable		✓
Only remove the cover from small areas during work, not all at once		✓
Measures Specific to Construction		
Avoid scabbling (roughening of concrete surfaces), if possible		✓

Measure	Desirable	Highly Recommended
Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place		✓
Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery		✓
For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust	✓	
Measures Specific to Trackout		
Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use		✓
Avoid dry sweeping of large areas		✓
Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport		✓
Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable		✓
Record all inspections of haul routes and any subsequent action in a site log book		✓
Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems or mobile water bowsers, and regularly cleaned		✓
Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable)		✓
Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits		✓
Access gates should be located at least 10 m from receptors, where possible		✓

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