Curraghinalt Project County Tyrone

Prepared for Dalradian Gold Limited

Environmental Statement - Volume 3

C19 Air Quality Impact Assessment and Baseline Report (presented as an annex)

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DALRADIAN GOLD

CLIENT: Dalradian Gold Ltd.

PROJECT: Curraghinalt Gold Mine Project

Air Quality & Dust Impact Assessment.

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1 Introduction

Envest was commissioned on behalf of Dalradian Gold Ltd. (DGL) to complete an Air Quality Impact Assessment to provide input to the Environmental Impact Assessment (EIA) and the IPPC Application for the proposed Curraghinalt Project in County Tyrone, Northern Ireland.

The Curraghinalt deposit and associated infrastructure are located within an area comprising a topographic ridge that forms the drainage divide between the Owenkillew River and the Owenreagh River. It is understood that the project has the following components:

- An underground mine;
- A decline, a sloping shaft/ tunnel that will be developed as the main access to the mineral deposit, it will extend from a portal at surface and near to the mineral process plant;
- An existing adit, a horizontal passage that provides access to the mineral deposit, originally developed for exploration of the deposit that will be retained to provide initial access for mine development and secondary/safety access to the mine workings in the operational phase;
- Three ventilation raises that will be used to ventilate the mine workings, one of these exists having been developed as part of the underground exploration programme;
- A mineral processing plant;
- A Dry Stack Facility (DSF) for storage of dry stack tailings and uneconomic rock – this facility will contain some of the flotation tailings from the plant, after they have been dewatered (85% of water removed) by means of a filtration process, and uneconomic rock from development of the mine workings;
- Paste backfill placed in the mine workings, this cement bound material will provide support in the workings and will be derived from tailings from the plant, specifically some of tailings from the flotation process and all of the tailings from the cyanide leaching process, mixed with binders;
- Ancillary infrastructure and services required to support the activities (administrative buildings, mobile maintenance shop, warehouse facilities, chemical and explosive stores, a mine dry, parking, site roads, water supply, water treatment and telecommunications);
- Connections, to offsite infrastructure including the Northern Ireland road network and the electrical grid;
- Passing bays on the Camcosy Road developed for the underground exploration programme and to be retained for the mine development.

A detailed Project Description has been prepared by SRK Consulting.

2 Statutory Consultees Comments

In order to assist in defining the scope of Air Quality baseline monitoring and impact assessment, Envest consulted with the following individuals and statutory bodies;

- Mr. David Gillis and Mr. Brian Furey of the Fermanagh & Omagh District Council (FODC) Environmental Health Department (EHD);
- Ms. Deirdre Findlay and Mr. Philip Cummings of the Northern Ireland Environment Agency (NIEA) Industrial Pollution and Radiochemical Inspectorate (IPRI)[1]; and
- Mr. Eamon Lynch and Mr. Graeme Walker of the Department for Infrastructure (DfI), Strategic Planning Division, which was formerly within the Department of Environment (DoE).

In response to the Pre-Application Discussion (PAD) (LA10/2016/0030/PAD), the Department of Environment compiled a letter dated 26th February 2016 that presented the following comments from NIEA IPRI in relation to dust and air quality:

The Inspectorate recommends that baseline dust deposition and air quality surveys are undertaken during different seasons to account for any variations in weather (ideally over 12 months). The Inspectorate requires the following meteorological data: wind direction and speed, temperature and rainfall to be recorded to coincide with the dust deposition and air quality survey data. The meteorological station should be located in a representative location.

The Inspectorate recommends that the dust and air quality management and monitoring plan is included as part of the site protection plan.

The above comments were coupled with the following note about a Pollution Prevention and Control (PPC) permit, which DGL will have to obtain for listed activities:

Informative

A PPC Permit issued under The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013 (PPC Regulations) covers the activities listed in Schedule 1 of the PPC Regulations. From review of the scoping document these are likely to include:

Site Activities	***Schedule in PPC Regulation 2013***	***Description of Schedule in PPC Regulations 2013***
Crushing and Screening	*Section 3.5 Part B(a)*	*Unless falling within Part A of any section in this Schedule,*

[1] NIEA IPRI is a management unit within the Northern Ireland Environmental Agency (NIEA). Following recent government restructuring, the NIEA has transferred from the former Department of Environment (DOE) to the Department of Agriculture, Environment & Rural Affairs (DAERA).

Activities		*the crushing, grinding or other size reduction, screening or heating of any designated mineral or mineral product except where the operation of the activity is unlikely result in the release into the air of particulate matter.*
Carbon-in-leach / Carbon strip	*Section 2.2 Part A(a)*	*Producing non-ferrous metals form ore, concentrates or secondary raw materials by metallurgical, chemical or electrolytic activities.*
Electrowinning	*Section 2.2 Part A(a)*	*Producing non-ferrous metals form ore concentrates or secondary raw materials by metallurgical, chemical or electrolytic activities.*
Smelting using a furnace (details to be confirmed by the operator during discussions regarding the PPC application process)	*Section 2.2 Part C*	*Melting, including making alloys of non-ferrous metals (other than tin or any alloy which in molten form contains 50 percent or more by weight of tin), including recovered products (refining, foundry casting, etc.) in plant with a melting capacity of 4 tonnes or less per day for lead or cadmium or 20 tonnes or less per day for all other metals and where the designed holding capacity of molten metal is less than 0.5 tonnes (together with any additional refining).*
Use of cement in backfill paste	*Section 3.1 Part B(a)*	*Blending cement in bulk or using cement in bulk other than at a construction site, including the bagging of cement and cement mixtures, the batching of ready mixed concrete and the manufacture of concrete blocks and other cement products where the activity is not related to an activity described in paragraph (a) of Part A of this section and is carried on at the same location as an activity described in Paragraph (a) of Part B of Section 3.5*

NIEA IPRI will permit and control dust and air pollutant emissions from the Part A and Part B processes of the proposed Curraghinalt Project in accordance with the Integrated Pollution Prevention and Control (IPPC) Guidance such as:

- Horizontal guidance for environmental assessment and appraisal of Best Available Techniques (BAT);
- Mining waste operations: additional guidance (Environment Agency) February 2011.

Other potential dust and air quality pollutant sources from the Curraghinalt Project prescribed as Part C activities under the Pollution Prevention and Control (Industrial Emissions Regulations (Northern Ireland) 2013 will be under the jurisdiction of FODC.

NIEA IPRI and FODC EHD will refer to Planning Practice Guidance 'Assessing Environmental Impacts from Mineral Extraction – Dust and Air Quality' (March 2014) when reviewing the planning application. Other relevant guidance includes the Local Air Quality Management Technical Guidance (LAQM.TG16) published in April 2016. This technical guidance (LAQM.TG16) supersedes all previous versions, the most recent being LAQM.TG09. It is designed to support local authorities in carrying out their duties under the Environment Act 1995, the Environment

(Northern Ireland) Order 2002, and subsequent regulations. Local Air Quality Management (LAQM) is the statutory process by which local authorities monitor, assess and take action to improve local air quality.

In correspondence dated 18th March 2016, FODC EHD stated that '*Dust monitoring should be carried out in accordance with best available practices*' and that '*The consultancy is advised to make contact with the EHD or IPRI as appropriate, in advance of undertaking noise/dust monitoring, to discuss monitoring locations, duration and parameters selected*'.

On 18th April 2016, a meeting was held with representatives of FODC EHD, NIEA IPRI and DfI at the DGL office in Omagh to provide a detailed project description of the Curraghinalt Project, discuss matters raised by NIEA IPRI and FODC EHD and to introduce and discuss the baseline air quality and dust monitoring. A field visit to the proposed infrastructure site and existing baseline monitoring locations in the surrounding area was also undertaken. The importance of providing comprehensive long-term baseline studies was agreed and monitoring location selection was discussed in detail with various recommendations proposed by the statutory consultees. The relevance of specific guidance documents and standards was also discussed.

3 Relevant Legislation, Standards & Guidelines

3.1 Relevant Legislation

Industrial Emissions	• Pollution Prevention And Control (Industrial Emissions) Regulations (Northern Ireland) 2013 (SR 160) • Pollution Prevention (Industrial Emissions) (Amendment) Regulations (Northern Ireland) 2014 (SR 304)
Industrial Emissions Directive	• Directive 2010/75/EU of the European Parliament and the Council on industrial emissions is the main EU instrument regulating pollutant emissions from industrial installations. It recasts seven previously existing directives, including the Integrated Pollution Prevention and Control (IPPC) Directive and directives concerning large combustion plants, waste incineration, solvent emissions and waste from the titanium dioxide industry. The 2013/160 Regulations transpose Directive 2010/75/EU
Air Quality Standards	• Air Quality Standards Regulations (Northern Ireland) 2010 (SR 2010/188)

3.2 The Air Quality Standard Regulations (Northern Ireland) 2010

The Air Quality Standards Regulations (Northern Ireland) 2010 (SR 2010/188) came into operation on 11th June 2010. Schedules 2, 3, 4, 5 and 6 of the Regulations outline limit values, target levels, objectives, information and alert thresholds and critical levels for the protection of vegetation for various pollutants including sulphur dioxide (SO_2), nitrogen dioxide (NO_2), benzene (C_6H_6), carbon monoxide (CO), Lead (Pb), particulates including PM_{10} & $PM_{2.5}$, arsenic (As), cadmium (Cd), nickel (Ni) and benzo(a)pyrene ($C_{20}H_{12}$), Ozone (O_3) and oxides of nitrogen (NO_x).

The measured sulphur dioxide (SO_2), nitrogen dioxide (NO_2), benzene (C_6H_6), particulates including PM_{10} & $PM_{2.5}$, arsenic (As), cadmium (Cd), nickel (Ni) and oxides of nitrogen (NO_x) background concentrations have been compared with the relevant values outlined in The Air Quality Standards Regulations (Northern Ireland) 2010 as presented in Table 1.

Table 1: The Air Quality Standards Regulations (Northern Ireland) 2010

SCHEDULE 2 Limit values
Regulation 18(1) and (2)
Sulphur dioxide

Averaging period	*Limit value*
One hour	350 μg/m^3 not to be exceeded more than 24 times a calendar year
One day	125 μg/m^3 not to be exceeded more than 3 times a calendar year

Nitrogen dioxide

Averaging period	*Limit value*
One hour	200 μg/m^3 not to be exceeded more than 18 times a calendar year
Calendar year	40 μg/m^3

Benzene

Averaging period	*Limit value*
Calendar year	5 μg/m^3

Carbon monoxide

Averaging period	*Limit value*
Maximum daily eight hour mean[(1)]	10 mg/m^3

The maximum daily eight hour mean concentration of carbon monoxide shall be selected by examining eight hour running averages, calculated from hourly data and updated each hour. Each eight hour average so calculated will be assigned to the day on which it ends, i.e. the first calculation period for any one day will be the period from 17.00 on the previous day to 01.00 on that day, the last calculation period for any one day will be the period from 16.00 to 24.00 on that day.

Lead

Averaging period	*Limit value*
Calendar year	0.5 μg/m^3

PM_{10}

Averaging period	*Limit value*
One day	50 μg/m^3 not to be exceeded more than 35 times a calendar year
Calendar year	40 μg/m^3

$PM_{2.5}$

Averaging period	*Limit value*	*Margin of tolerance*	*Date by which limit value is to be met*
Calendar year	25 μg/m^3	20% on 11 June 2008, decreasing on the next 1 January and every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2015	1 January 2015

SCHEDULE 3 Target values
Regulation 19(1)

Arsenic, cadmium, nickel and benzo(a)pyrene

Pollutant	*Target value for the total content in the PM_{10} fraction averaged over a calendar year*	*Date by which target value should be met*
Arsenic	6 ng/m^3	31st December 2012
Cadmium	5 ng/m^3	31st December 2012
Nickel	20 ng/m^3	31st December 2012
Benzo(a)pyrene	1 ng/m^3	31st December 2012

Ozone

Objective	*Averaging period*	*Target value*
Protection of human health	Maximum daily eight hour mean **(1)**	120 µg/m^3 not to be exceeded on more than 25 days per calendar year averaged over three years**(2)**
Protection of vegetation	May to July	AOT 40 (calculated from 1h values) 18,000 µg/m^3.h averaged over five years**(2)**

The maximum daily eight-hour mean concentration shall be selected by examining eight-hour running averages, calculated from hourly data and updated each hour. Each eight-hour average so calculated shall be assigned to the day on which it ends, that is, the first calculation period for any one day will be the period from 17.00 hours on the previous day to 01.00 hours on that day, the last calculation period for any one day will be the period from 16.00 hours to 24.00 hours on the day.

If the three or five year averages cannot be determined on the basis of a full and consecutive set of annual data, the minimum annual data required for checking compliance with the target values will be valid data for one year in relation to the target value for the protection of human health and valid data for three years in relation to the target value for the protection of vegetation.

$PM_{2.5}$

Averaging period	*Target value*
Calendar year	25 µg/m^3

SCHEDULE 4 Long term objectives for ozone
Regulation 9(2) and Regulation 21(1)

Objective	*Averaging period*	*Long term objective*	*Date by which long term objective should be met*
Protection of human health	Maximum daily eight hour mean within a calendar year	120 µg/m^3	Not defined
Protection of vegetation	May to July	AOT 40 (calculated from 1h values) 6000 µg/m^3.h.	Not defined

SCHEDULE 5 Information and alert thresholds
Regulation 22
Alert thresholds for Sulphur dioxide and Nitrogen dioxide

Pollutant	*Alert threshold*$^{(1)}$
Sulphur dioxide	500 μg/m^3
Nitrogen dioxide	400 μg/m^3

To be measured over three consecutive hours at locations representative of air quality over the least 100 km^2 or an entire zone, whichever is smaller.

Information and alert thresholds for Ozone

Purpose	*Averaging period*	*Threshold*
Information	1 hour	180 μg/m^3
Alert	1 hour	240 μg/m^3

SCHEDULE 6 Critical levels for the protection of vegetation
Regulation 23
Critical levels for the protection of vegetation

Averaging period	*Critical level*
Sulphur dioxide: Calendar year and winter (1 October to 31 March)	20 μg/m^3
Oxides of nitrogen: Calendar year	30 μg/m^3 NO_x

3.3 Dust Deposition Guidelines

Dust particles can be classified into those that are easily deposited and those that remain suspended in the air for long periods. This division is useful as deposited dust is usually the coarse fraction of particulates that causes dust annoyance, whereas suspended particulate matter is implicated more in exposure impacts. Airborne particles have a large range of diameters, from nano-particles and ultrafine particles (diameters less than 0.1μm) to the very large particles with diameters up towards 100μm. There is no clear dividing line between the sizes of suspended particulates and deposited particulates, although particles with diameters >50 μm tend to be deposited quickly and particles of diameter <10 μm (PM_{10}) have an extremely low deposition rate in comparison. Therefore, the size of suspended and deposited dust particles affects their distribution and as such requires two very different approaches to sampling these fractions. PM_{10} is the fraction of airborne (suspended) particulates which contains particles of diameter less than 10μm. $PM_{2.5}$ is the fraction of airborne (suspended) particulates which contains particles of diameter less than 2.5μm. PM_{10} and $PM_{2.5}$ particles can penetrate deep into the respiratory system increasing the risk of respiratory and cardiovascular disorders. Total Suspended Particles (TSP) is the term used when referring to larger particles which do not have a specified size limit.

It is common for TSP to be measured alongside PM_{10} and $PM_{2.5}$ particularly at industrial sites when dust monitoring is undertaken.

Particulate matter can emanate from natural and anthropogenic sources. Natural sources include sea salt, forest fires, pollen and moulds. Natural sources are unregulated and harder to control. Anthropogenic sources can be regulated and understanding the sources of particulate matter is very important. PM_{10} is most commonly associated with road dust and construction activities. Wear and tear of brakes and tyres on vehicles and crushing activities at construction sites can all contribute to a rise in PM_{10}. $PM_{2.5}$ is associated with fuel burning, industrial combustion processes and vehicle emissions. Larger particles (100µm diameter) are likely to settle within 5-10m of their source under a typical mean wind speed of 4-5 m/s, and particles between 30-100 µm diameter are likely to settle within 100m of the source. Smaller particles, particularly those <10 µm in diameter, i.e. PM_{10}, have a greater potential to have their settling rate impeded by atmospheric turbulence and to be transported further from their source. Dust emissions are exacerbated by dry weather and high wind speeds. The impact of dust therefore, also depends on the wind direction and the relative location of the dust source and receptor.

Currently no UK statutory standards or limits exist for the assessment of dust deposition and its tendency for causing nuisance. Similarly, no official air quality criterion has been set at a European or World Health Organisation (WHO) level, although a range of national 'yardstick' criteria from other countries is found in literature.

In England and Wales, a '*custom and practice*' limit of 200 mg/m^2/day is sometimes referenced using Frisbee-type Deposition Gauges. This value was derived by multiplying a historical, typical UK median background by 3.5 (which was the ratio of the 95th percentile to the median). It should be noted that because background dust levels can vary significantly from place to place and with season, the authors Vallack & Shillito were clear that the preferred approach is to calculate a bespoke site-specific "complaints likely" dust guideline, where sufficient local baseline monitoring data is available (at least 12-months) based on 3.5 times the median background level. However, such bespoke local baseline data is often not available and in such cases the authors recommended using as a fall-back the 95th percentile of typical UK background data. It is important that the limitations of the 200 mg/m^2/day benchmark are appreciated: firstly, it is simply a custom and practice yardstick and it was never based on actual dose-response data; secondly, in deriving this default "complaints likely" guideline, the authors used a dataset that was quite old and not necessarily indicative of today's background levels.

The German TA Luft Regulations, "Technical Instructions on Air Quality Control" state that total dust deposition (soluble and insoluble, measured using Bergerhoff type dust deposit gauges as per German Standard Method for determination of dust deposition rate, VDI 2119) should not exceed a dust deposition rate of 350 mg/m^2/day (when averaged over a 30+/-2 day period). The use of this limit value is appropriate to minimise the impact of airborne dust levels on the receiving environment beyond the site boundary. The German TA Luft criteria for '*possible nuisance'* and '*very likely nuisance'* are 350mg/m^2/day and 650mg/m^2/day, respectively.

Criteria from other countries that can be referred to include;

- In the USA, Washington has set a state standard of 187mg/m^2/day for residential areas.
- Western Australia also sets a two-stage standard, with '*loss of amenity first perceived'* at 133 mg/m^2/day and '*unacceptable reduction in air quality*' at 333mg/m^2/day.
- The Swedish limits promoted by the Stockholm Environment Institute, and used regularly in Scotland, range from 140mg/m^2/day for rural areas to 260mg/m^2/day for town centres.

These go some way to addressing the view that the annoyance impact (and hence potential for complaints) depends on the worsening of dust levels above existing background levels.

In 2005, the UK Highways Agency released an Interim Advice Note 61/05 '*Guidance for Undertaking Environmental Assessment of Air Quality for Sensitive Ecosystems in Internationally Designated Nature Conservation Sites and SSSIs*' as a supplement to the Design Manual for Roads and Bridges (DMRB) Guidelines. This interim guidance states that dust or particles falling onto plants can physically smother the leaves affecting photosynthesis, respiration and transpiration. The literature suggests that the most sensitive species appear to be affected by dust deposition at levels above 1,000 mg/m^2/day which is considerably greater than the level at which most dust deposition may start to cause a perceptible nuisance to humans. As such, once dust deposition rates are maintained within the guidelines for human nuisance the impact of dust deposition on sensitive ecosystems is considered negligible.

Therefore, the following dust limits have been used in the assessment of measured and predicted levels;

- Dust Deposition Rate limit = 350 mg/m^2/day (averaged over a 30+/-2 day period using Bergerhoff Gauge Method).
- Dust Deposition Rate limit affecting sensitive ecological receptors = 1,000 mg/m^2/day
- PM_{10} 24 Hour Mean concentration limit = 50 μg/m^3 not to be exceeded more than 35 times a calendar year
- PM_{10} Annual Mean concentration limit = 40 μg/m^3
- $PM_{2.5}$ Annual Mean concentration limit = 25 μg/m^3

3.4 Metal Deposition Guidelines

The TA Luft Air Quality Standard also specifies deposition limit values for certain trace metals and their inorganic compounds.

Table 2: TA Luft Air Quality Standard deposition limit values for certain trace metals and their inorganic compounds.

Parameter	Averaging Period	Limit Value
Arsenic and inorganic compounds of arsenic (as As)	1 year	4 µg/m^2/day
Cadmium and inorganic compounds of cadmium (as Cd)	1 year	2 µg/m^2/day
Lead and inorganic compounds of lead (as Pb)	1 year	100 µg/m^2/day
Mercury and inorganic compounds of Mercury (as Hg)	1 year	1 µg/m^2/day
Nickel and inorganic compounds of nickel (as Ni)	1 year	15 µg/m^2/day
Thallium and inorganic compounds of thallium (as Tl)	1 year	2 µg/m^2/day

3.5 Planning Practice Guidance 'Assessing Environmental Impacts from Mineral Extraction – Dust and Air Quality'

The Planning Practice Guidance 'Assessing Environmental Impacts from Mineral Extraction – Dust' (March 2014) outlines five key stages to a dust assessment study, as follows:

1. Establish baseline conditions of the existing dust climate around the site of the proposed operations;
2. Identify site activities that could lead to dust emission without mitigation;
3. Identify site parameters which may increase potential impacts from dust;
4. Recommend mitigation measures, including modification of site design; and
5. Make proposals to monitor and report dust emissions to ensure compliance with appropriate environmental standards and to enable an effective response to complaints.

The relevant stages of the dust assessment study are described as follows;

<u>Stage 1: Establish existing baseline conditions:</u>

Existing ambient conditions should be recorded over a period sufficient to identify seasonal variations in the range of existing conditions which naturally exist (ideally by a dust-monitoring programme). The assessment should take into account the principal existing dust sources (other than the site) such as air pollution from urban and industrial areas, existing mineral operations, agricultural activities and construction activities.

The location of residential areas, schools and other dust-sensitive land uses should be identified in relation to the site, as well as proposed or likely sources of dust emission from within the site.

The assessment should explain how topography may affect the emission and dispersal of site dust, particularly the influence of areas of woodland, downwind or adjacent to the site boundary, and of valley or hill formations in altering local wind patterns.

The assessment should explain how climate is likely to influence patterns of dispersal by analysing data from the UK Meteorological Office or other recognised agencies on wind conditions, local rainfall and ground moisture conditions.

<u>Stage 2: Identify site activities that could lead to dust emission without mitigation:</u>
Potential dust sources should be identified and their potential to emit dust assessed with respect to the duration of the activity or the potential of dust to become airborne.

<u>Stage 3: Identify site parameters which may increase potential impacts from dust:</u>
This brings together information collected in Stages 1 and 2 with information on sensitive land uses around the site in order to understand how these uses could be affected by dust. Computer modelling techniques can be used to understand how dust could disperse from a site. Alternatively, a more qualitative approach, relying on professional judgement, could be used to bring together the data collected in Stages 1 and 2.

<u>Stage 4: Recommend mitigation measures and site design modifications:</u>
Measures to control dust should be specified and described in terms of their potential to reduce dust and consequent impacts.

This guidance states that additional dust control measures might be necessary to control fine particulates (PM_{10}) to address any impacts of dust might be necessary if, within a site, the actual source of emission (e.g. the haul roads, crushers, stockpiles etc.) is in close proximity to any residential property or other sensitive use. The guidance recommends that operators should follow the assessment framework for considering the impacts of PM_{10} from a proposed site.

The Planning Practice Guidance 'Assessing Environmental Impacts from Mineral Extraction – Air Quality' (March 2014) outlines the following:

- Why should planning be concerned about air quality?
- What is the role of Local Plans with regard to air quality?
- Are air quality concerns relevant to neighbourhood planning?
- What information is available about air quality?

- When could air quality be relevant to a planning decision?
- Where to start if bringing forward a proposal where air quality could be a concern?
- How detailed does an air quality assessment need to be?
- How can an impact on air quality be mitigated?

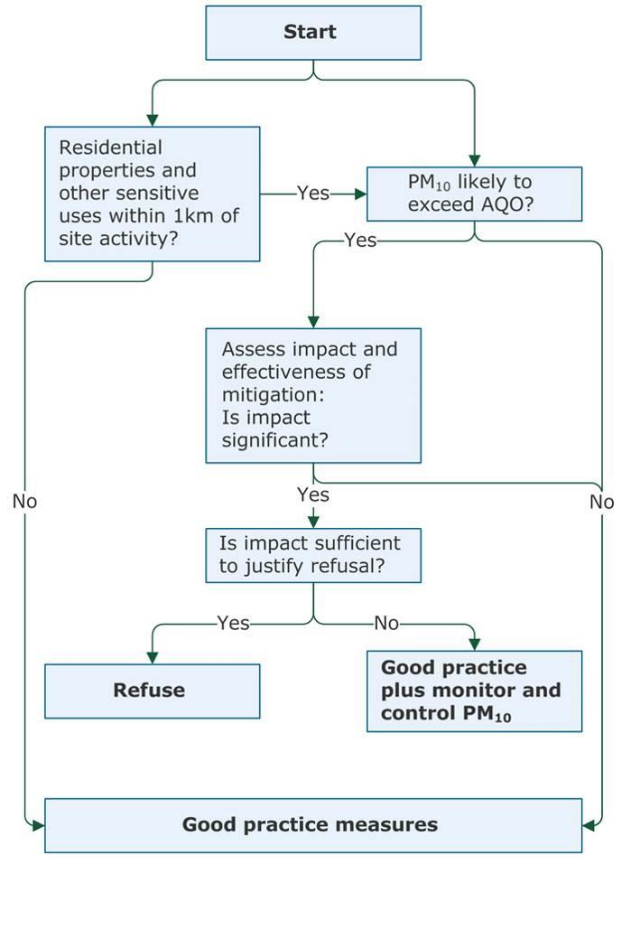
The guidance states that the assessments should be proportionate to the nature and scale of development proposed and the level of concern about air quality, and that the scope and content of supporting information is therefore best discussed and agreed between the local planning authority and applicant before it is commissioned. Therefore, as outlined above, NIEA IPRI and FODC EHD have been consulted.

The guidance advises that the following should be included in air quality impact assessments:

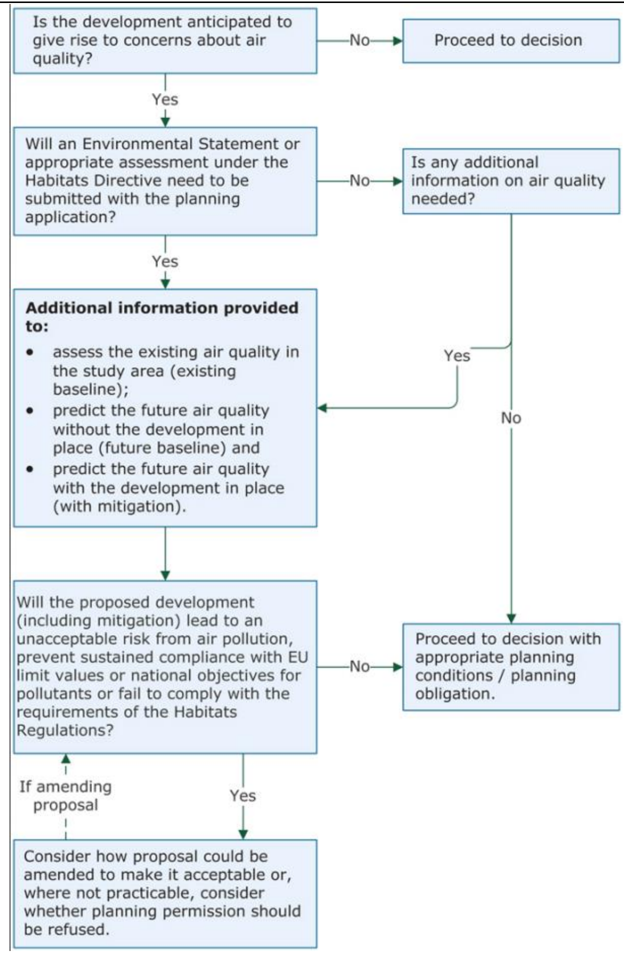
- a description of baseline conditions and how these could change;
- relevant air quality concerns;
- the assessment methods to be adopted and any requirements around verification of modelling air quality;
- sensitive locations;
- the basis for assessing impact and determining the significance of an impact;
- construction phase impact; and/or
- acceptable mitigation measures.

Chart 1: Planning Practice Guidance 'Assessing Environmental Impacts from Mineral Extraction Site Assessment flow charts – Dust and Air Quality.

Dust Assessment flow chart



Air Quality Assessment flow chart



4 Methodology

4.1 Baseline Air Quality & Dust Monitoring Methodology

A detailed baseline Air Quality and Dust monitoring report is included in Annex B.

4.1.1 Baseline Air Quality & Dust Monitoring Locations

The baseline air quality monitoring surveys were carried out in proximity to representative air quality sensitive residential properties spatially distributed around the proposed Project area to establish the current ambient Air Quality and dust deposition levels for the area. Baseline air quality and dust monitoring studies have been undertaken in the area by SLR Consulting (SLR), Dalradian Gold Ltd. (DGL) and Envest since 2011. The baseline air quality monitoring studies undertaken have included the dust and metal deposition monitoring, continuous particulate matter (TSP, PM_{10}, $PM_{2.5}$ and PM_1) monitoring and passive diffusion tube monitoring. Table 3 provides an overview of the air quality monitoring programmes that have been undertaken since 2011 by SLR, DGL and Envest. DGL continue to undertake baseline air quality and dust sampling.

Table 3: Overview of the air quality monitoring programmes undertaken since 2011.

Parties responsible for the monitoring	Locations	Parameters	Frequency	Monitoring Duration	Methodology
SLR	10 locations (D01 to D010)	Dust and heavy metals deposition	Monthly	July 2011 to October 2015	Bergerhoff dust deposition gauges
	4 locations (PT01 to PT04)	Continuous particulate matter (TSP, PM_{10}, $PM_{2.5}$ and PM_1) monitoring	4 short-term monitoring periods of 3 to 5 days	July, Sept and Nov/Dec 2012 and Nov/Dec 2013	Osiris Particulate Monitors
	4 locations (AQ01 to AQ04)	Passive diffusion tube monitoring for NOx, NO_2, SO_2, BTEX and VOC	Monthly	6 monthly periods between April 2012 and October 2013	Passive diffusion tubes
	4 locations (AQ05 to AQ08)			6 monthly periods between July 2012 and October 2013	
DGL	1 location (D-ET01)	Dust and heavy metals deposition	Monthly	Since April 2014	Bergerhoff dust deposition gauges. Dust residue was acid digested and analysed for suite of metals.
	5 locations (D-ET02 to D-ET06)	Dust deposition			

Table 3: (Continued) Overview of the air quality monitoring programmes undertaken since 2011.

Parties responsible for the monitoring	Locations	Parameters	Frequency	Monitoring Duration	Methodology
Envest	7 locations (AQML 1 to AQML7)	Dust and heavy metals deposition monitoring.	Monthly	November 2015 – October 2016.	Bergerhoff dust deposition gauges. Dust residue was acid digested and analysed for suite of metals.
	3 locations (AQML 1, AQML 1B and AQML 5)	Continuous particulate matter (TSP, PM_{10}, $PM_{2.5}$ and PM_1) monitoring	Long-term particulate monitoring over 12 month period.	October 2015 – October 2016	Osiris Particulate Monitors
	7 locations (AQML 1 to AQML7)	Passive diffusion tube monitoring for NOx, NO_2, SO_2, BTEX and VOC	Monthly	October 2015 – October 2016	Passive diffusion tubes

Figure 1: Air Quality and Dust monitoring locations from October 2015 – October 2016 in proximity to the proposed development as selected by Envest.

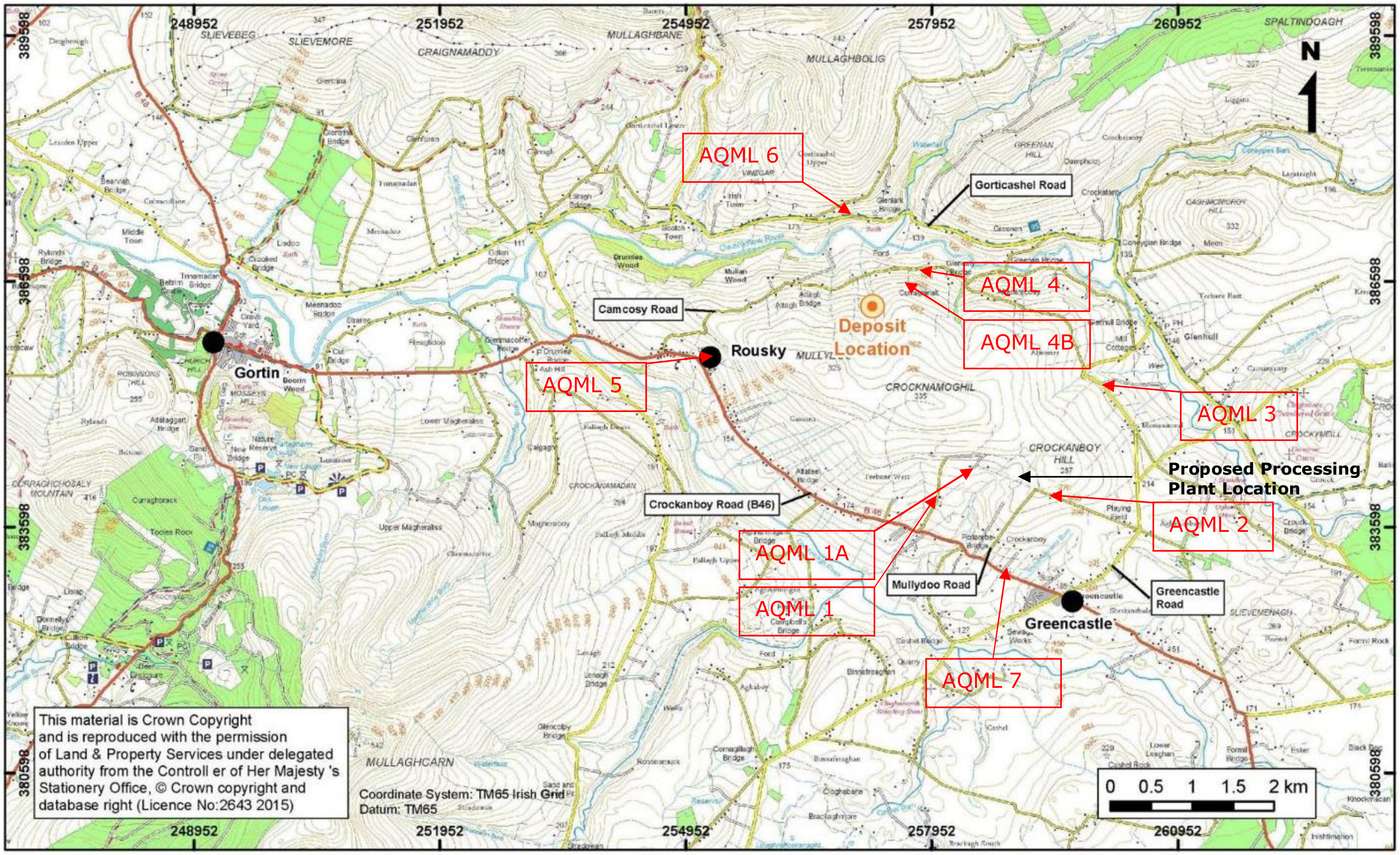


Figure 2: Air Quality and Dust & Heavy Metal Deposition monitoring locations in proximity to the proposed development site from 2011 to 2015 as selected by SLR.

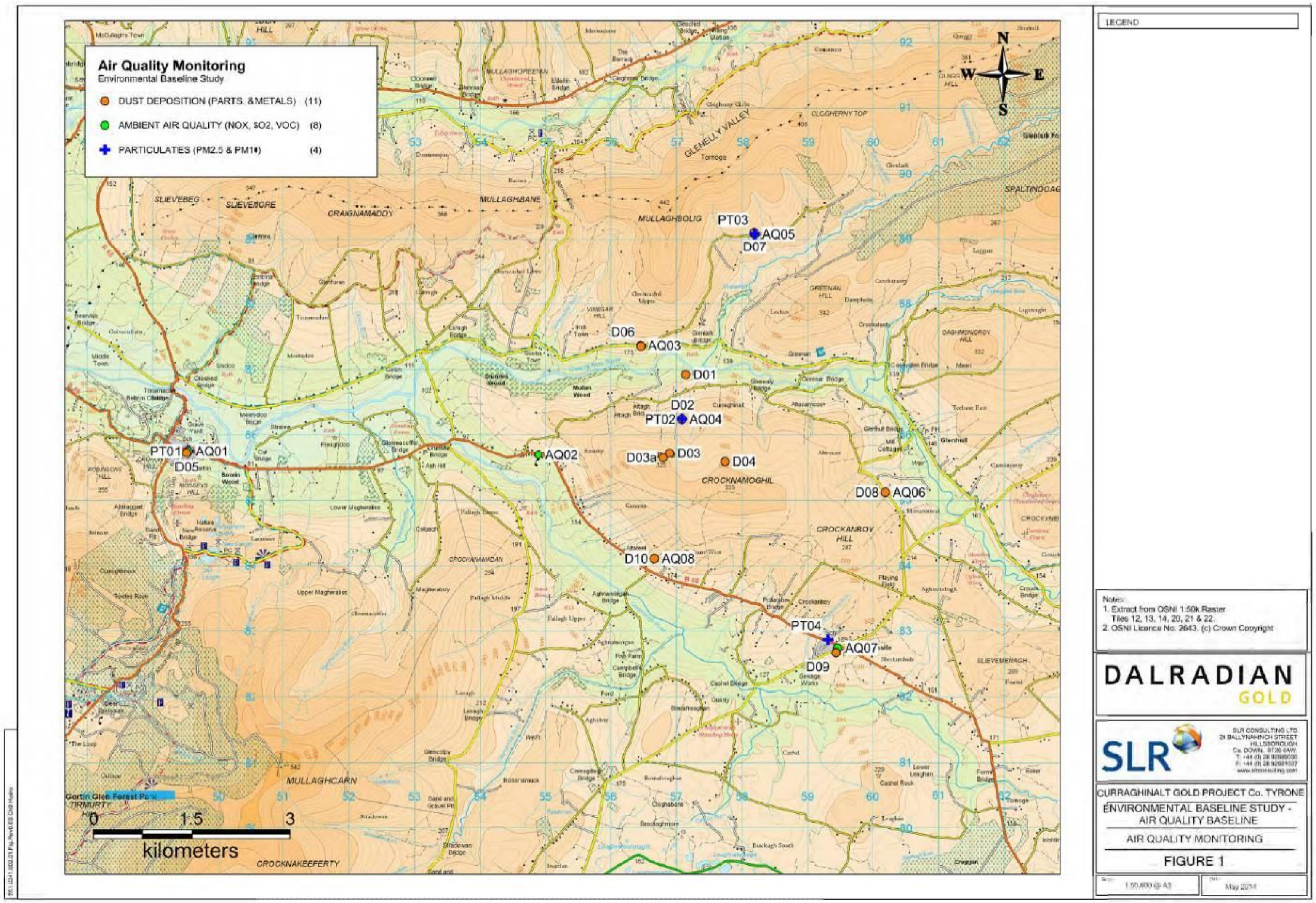
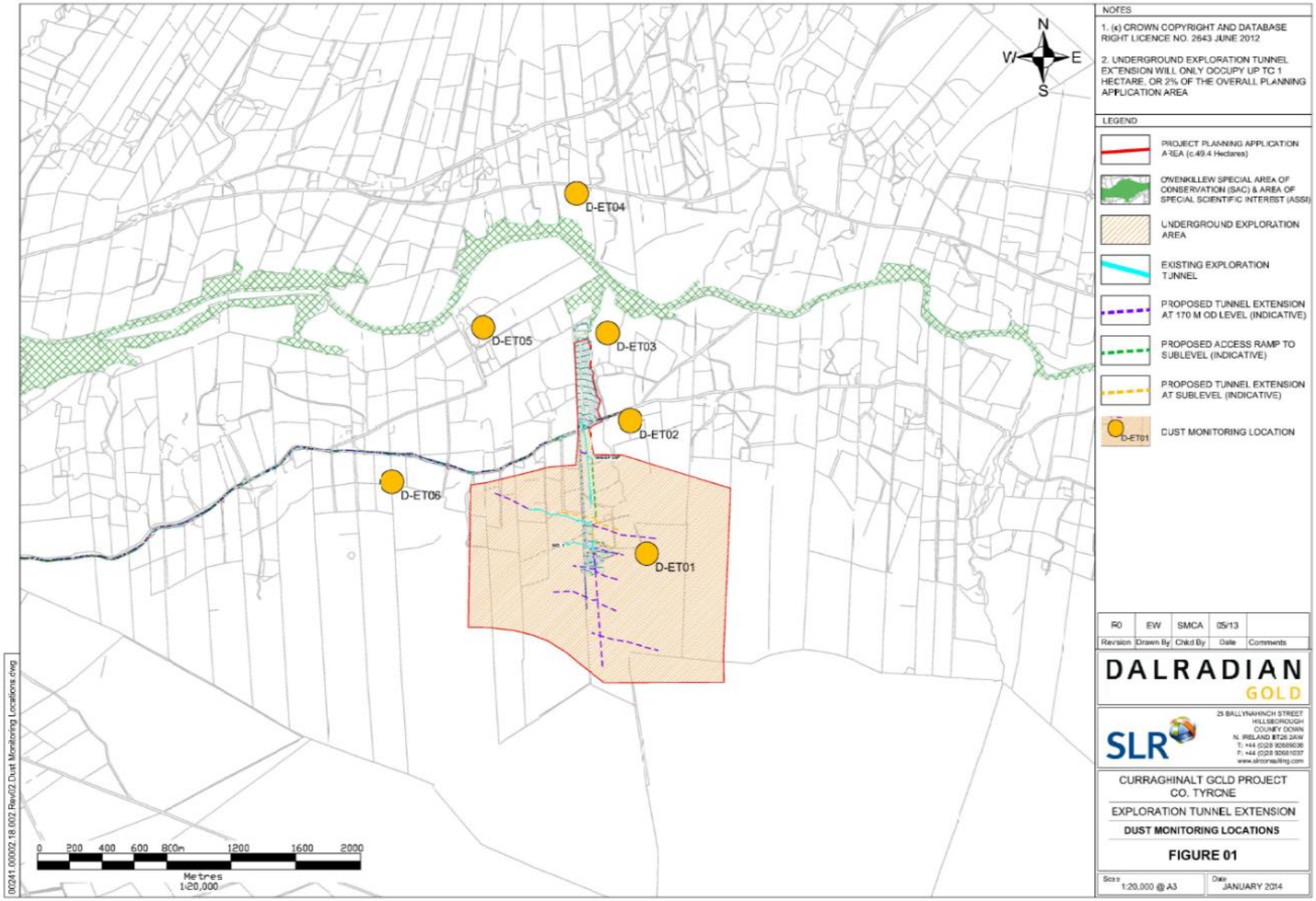


Figure 3: Dust & Heavy Metal Deposition monitoring locations in proximity to the existing exploration adit since April 2014 as selected by DGL.



4.1.2 Dust & Heavy Metal Deposition Monitoring Methodology

Dust deposition monitoring undertaken by Envest, SLR and DGL was carried out using Bergerhoff dust deposition gauges as referred to in the following standards:

- VDI-Standard: 2119 Part 2 Measurement of atmospheric depositions - Determination of the dust deposition according to the Bergerhoff method;
- VDI-Standard: 4320 Part 2 Measurement of atmospheric depositions - Determination of the dust deposition according to the Bergerhoff method.

For determining the rate of dust deposition, the dust deposition gauges were exposed to the atmosphere for the sampling period of 30+/-2 days. The dust samples were collected on a monthly basis and analysed at an accredited analytical laboratory. Dust deposition was calculated from the mass of the dry residue, the exposure period and the aperture size of the dust deposition gauge. The dust residue in the dust deposition gauge was acid digested and analysed for a suite of metals.

4.1.3 Continuous Particulate Monitoring – TSP, PM_{10}, $PM_{2.5}$, & PM_1 & Metal Analysis

Continuous particulate monitoring inclusive of TSP, PM_{10}, $PM_{2.5}$ and PM_1 was undertaken using Turnkey Osiris monitors. The Turnkey Osiris dust and particles monitor use an infra-red laser light source with the scattered light analysed by a photomultiplier tube; the output from which is proportional to the size of the particle. The monitor records ambient concentrations continuously and generates 15-minute average readings, which are recorded and downloaded monthly using AirQ32 software. The results of the continuous particulate matter monitoring allow for direct comparison of results against the relevant PM_{10} and $PM_{2.5}$ limit values outlined in the 'The Air Quality Standards Regulations (Northern Ireland) 2010 (SR 2010/188)'.

Envest also analysed the 25mm GFA filters in the Osiris instruments for a suite of metals. This has allowed for the concentration of metals in the atmosphere to be measured during the continuous particulate matter monitoring.

4.1.4 Diffusion Tube Monitoring - NO, NO_2, SO_2, BTEX and VOC

Passive diffusion tube monitoring for nitrogen oxides (NOx), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), BTEX and volatile organic compounds (VOC) using diffusion tubes was undertaken with analysis provided by Gradko International. Passive diffusion tube monitoring was carried out monthly intervals (30+/-2 day periods).

4.2 Impact Assessment Methodology

4.2.1 Process Stack (Point Source) Emission Rates:

In order to model the emissions from point sources such as process stacks, data is required in relation to the emission point location, stack height and diameter, exit velocity and / or volume flow rate, temperature and pollutant emission rate in grams per second. Emission rates from stacks are typically quoted in grams/second (g/s). Information related to process stack diameters, emission velocities, emission temperatures and site layouts was provided by the project engineers (JDS). The location of the proposed process stacks and adjacent buildings has been extracted from CAD drawings and scaled accordingly in an air dispersion model.

To ensure a worst-case scenario has been investigated, the point sources have been modelled assuming continuous operations for 8,760 hours/annum. When calculating the mass emission (in g/s) from a stack, the volume flow and emission concentration should be at the same temperature, oxygen content and moisture content (typically both normalised to 273K, dry and the reference oxygen content). When modelling, the actual stack exit velocity should be input to the model without correction for moisture, oxygen content or temperature (rather than normalised conditions).

The proposed infrastructure site process stack emission sources, locations and the proposed abatement measures are outlined in Table 4. The emission rates input into the *AERMOD* dispersion model for the proposed infrastructure site are outlined in Table 5. An emission rate (g/s) which has been normalised for temperature but without correction for moisture and oxygen content has been used in the dispersion model.

Table 4: Process Stack emission sources, locations and the proposed abatement measures.

Source ID	Emission Source	Location	Grid Coordinates (mE)	(mN)	Abatement Measures
E1	Primary Crusher Dust Collector Stack	Primary Crushing	258714	384514	Nano-fibre filter media cartridge dust collection system
E2	Stockpile and Reclaim Dust Collector Stack	Covered Stockpile	258850	384505	Nano-fibre filter media cartridge dust collection system
E3	Carbon Regeneration Kiln - Off-Gas	Process Plant	258934	384518	Coarse particulate filtration with wet scrubber, followed by gas cooling, demister vessel and wet scrubbing for fine particulates, followed by duct heating for passage through a HEPA filter and carbon adsorption vessel (SIC) and the exhaust vent.
E4	Reagent - Lime - Fume Extraction	Process Plant - Reagent Mixing	258943	384518	Nano-fibre filter media cartridge dust collection system
E5	Reagent - Zinc/Copper Sulphate - Fume Extraction	Process Plant - Reagent Mixing	258950	384518	Designated extraction system to atmosphere
E6	Reagent - PAX - Fume Extraction	Process Plant - Reagent Mixing	258953	384518	Designated extraction system to atmosphere
E7	Reagent - SMBS - Fume Extraction	Process Plant - Reagent Mixing	258956	384518	Designated extraction system to atmosphere
E8	Reagent - Caustic - Fume Extraction	Process Plant - Reagent Mixing	258958	384518	Designated extraction system to atmosphere
E9	Reagent - Test - Fume Extraction	Process Plant - Reagent Mixing	258961	384518	Designated extraction system to atmosphere
E10	Reagent - Cyanide (Mixing & Storage) - Fume Extraction	Process Plant - Reagent Mixing	258968	384518	Designated extraction system to atmosphere
E11	Acid Wash - Fume Extraction	Process Plant	258928	384489	Designated extraction system to atmosphere
E12	Electrowinning Cells - Fume Extraction	Process Plant - Gold Room	258946	384489	Designated extraction system to atmosphere - typical installation: but EW cell hood can be piped to Furnace Abatement System if required.
E13	Mercury Retort - Scrubber Stack	Process Plant - Gold Room	258956	384488	Off gas is captured through a condenser mercury trap with double chambers, then passes to a demister with a wet scrubber, through a HEPA/Coalescing Filter (one operational and one standby for 100% redundancy), and then the off-gas passes through a Carbon Adsorption Vessel (SIC) and then another HEPA filter as required, then through a vacuum pump to an Air/Liquid Separator prior to exhaust vent.
E14	Smelting Furnace - Bag House - Stack	Process Plant - Gold Room	258961	384488	Furnace hood and skirt extraction that passes through a cartridge filter, a HEPA filter and Carbon Adsorption vessel (SIC) prior to the exhaust vent.
E15	Assay Lab	Assay Lab	259013	384536	Wet scrubber, small nano-fibre cartridge style dust collection.
E16	Fire Water - Standby Diesel Pump	Fresh/Fire Water Tank	258061	384425	Standard exhaust manifold - vented to atmosphere

Table 5: Emission Concentrations (mg/m^3) and Mass Emission Rates (g/s) from process stack sources used in the air dispersion model.

Source ID	Emission Source	Pollutant	Stack Height (m above ground)	Stack Inner Diameter (m)	Cross Sectional Area (m²)	Exit Velocity (m/s)	Exhaust Temp. (°C)	Exhaust Temp. (K)	Volume Flow (m³/s)	Normalised Volume Flow (Nm3/s)	Normalised Volume Flow (Nm³/hr)	Emission Conc. (mg/m³)	Normalised Emission Rate (g/s)
E1	Primary Crusher Dust Collector Stack	TSP	6.95-9.35	1.2	1.130	15	10	283	17.0	16.4	58992.5	20.0	0.3277
		PM_{10}	6.95-9.35	1.2	1.130	15	10	283	17.0	16.4	58992.5	10.0	0.1639
		$PM_{2.5}$	6.95-9.35	1.2	1.130	15	10	283	17.0	16.4	58992.5	5.0	0.0819
E2	Stockpile and Reclaim Dust Collector Stack	TSP	6.95-9.35	1.2	1.130	15	74	347	17.0	13.4	48112.0	3.6	0.0481
		PM_{10}	6.95-9.35	1.2	1.130	15	74	347	17.0	13.4	48112.0	1.8	0.0241
		$PM_{2.5}$	6.95-9.35	1.2	1.130	15	74	347	17.0	13.4	48112.0	0.9	0.0120
E3	Carbon Regeneration Kiln - Off-Gas	TSP	21.9 (Ridgeline Peak) +3	0.3	0.071	15	74	347	1.1	0.8	3007.0	4.0	0.0033
		PM_{10}	21.9 (Ridgeline Peak) +3	0.3	0.071	15	74	347	1.1	0.8	3007.0	2.0	0.0017
		$PM_{2.5}$	21.9 (Ridgeline Peak) +3	0.3	0.071	15	74	347	1.1	0.8	3007.0	1.0	0.0008
E4	Reagent - Lime - Fume Extraction	TSP	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	20.0	0.0075
		PM_{10}	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	10.0	0.0037
		$PM_{2.5}$	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	5.0	0.0019
E5	Reagent - Zinc/Copper Sulphate - Fume Extraction	TSP	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	20.0	0.0075
		PM_{10}	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	10.0	0.0037
		$PM_{2.5}$	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	5.0	0.0019
E6	Reagent - PAX - Fume Extraction	TSP	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	20.0	0.0075
		PM_{10}	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	10.0	0.0037
		$PM_{2.5}$	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	5.0	0.0019

Table 5: (Continued) Emission Concentrations (mg/m^3) and Mass Emission Rates (g/s) from process stack sources used in the air dispersion model.

Source ID	Emission Source	Pollutant	Stack Height (m above ground)	Stack Inner Diameter (m)	Cross Sectional Area (m²)	Exit Velocity (m/s)	Exhaust Temp. (°C)	Exhaust Temp. (K)	Volume Flow (m³/s)	Normalised Volume Flow (Nm3/s)	Normalised Volume Flow (Nm³/hr)	Emission Conc. (mg/m³)	Normalised Emission Rate (g/s)
E7	Reagent - SMBS - Fume Extraction	TSP	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	20.0	0.0075
		PM_{10}	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	10.0	0.0037
		$PM_{2.5}$	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	5.0	0.0019
E8	Reagent - Caustic - Fume Extraction	TSP	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	20.0	0.0075
		PM_{10}	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	10.0	0.0037
		$PM_{2.5}$	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	5.0	0.0019
E9	Reagent - Test - Fume Extraction	TSP	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	20.0	0.0075
		PM_{10}	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	10.0	0.0037
		$PM_{2.5}$	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	5.0	0.0019
E10	Reagent - Cyanide (Mixing and Storage) - Fume Extraction	TSP	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	20.0	0.0075
		PM_{10}	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	10.0	0.0037
		$PM_{2.5}$	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	5.0	0.0019
E11	Acid Wash - Fume Extraction	TSP	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	20.0	0.0075
		PM_{10}	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	10.0	0.0037
		$PM_{2.5}$	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	5.0	0.0019
E12	Electrowinning Cells - Fume Extraction	TSP	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	20.0	0.0075
		PM_{10}	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	10.0	0.0037
		$PM_{2.5}$	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	5.0	0.0019

Table 5: (Continued) Emission Concentrations (mg/m^3) and Mass Emission Rates (g/s) from process stack sources used in the air dispersion model.

Source ID	Emission Source	Pollutant	Stack Height (m above ground)	Stack Inner Diameter (m)	Cross Sectional Area (m²)	Exit Velocity (m/s)	Exhaust Temp. (°C)	Exhaust Temp. (K)	Volume Flow (m³/s)	Normalised Volume Flow (Nm3/s)	Normalised Volume Flow (Nm³/hr)	Emission Conc. (mg/m³)	Normalised Emission Rate (g/s)
E13	Mercury Retort - Scrubber Stack	TSP	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	20.0	0.0075
		PM_{10}	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	10.0	0.0037
		$PM_{2.5}$	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	5.0	0.0019
		Mercury	19.2 (Eve) + 3	0.18	0.025	15.2	10	283	0.4	0.4	1345.0	1.0	0.0004
E14	Smelting Furnace - Bag House - Stack	TSP	21.9 (Eve) + 3	0.3	0.071	15	74	347	1.1	0.8	3007.0	20.0	0.0167
		PM_{10}	21.9 (Eve) + 3	0.3	0.071	15	74	347	1.1	0.8	3007.0	10.0	0.0084
		$PM_{2.5}$	21.9 (Eve) + 3	0.3	0.071	15	74	347	1.1	0.8	3007.0	5.0	0.0042
		Mercury	21.9 (Eve) + 3	0.3	0.071	15	74	347	1.1	0.8	3007.0	1.0	0.0008
		SO_2	21.9 (Eve) + 3	0.3	0.071	15	74	347	1.1	0.8	3007.0	0.4	0.0003
E15	Assay Lab	TSP	5 - 9	0.53	0.221	14.8	10	283	3.3	3.2	11354.2	20.0	0.0631
		PM_{10}	5 - 9	0.53	0.221	14.8	10	283	3.3	3.2	11354.2	10.0	0.0315
		$PM_{2.5}$	5 - 9	0.53	0.221	14.8	10	283	3.3	3.2	11354.2	5.0	0.0158
E16	Fire Water - Standby Diesel Pump Note 1	TSP	1.3	0.41	0.132	0.62	93	366	0.1	0.1	220.1	26.0	0.0016
		PM_{10}	1.3	0.41	0.132	0.62	93	366	0.1	0.1	220.1	15.8	0.0010
		$PM_{2.5}$	1.3	0.41	0.132	0.62	93	366	0.1	0.1	220.1	10.0	0.0006
		NOx	1.3	0.41	0.132	0.62	93	366	0.1	0.1	220.1	15.8	0.0010
		SO_2	1.3	0.41	0.132	0.62	93	366	0.1	0.1	220.1	2.0	0.0001
		CO	1.3	0.41	0.132	0.62	93	366	0.1	0.1	220.1	40.0	0.0024

Note 1: Dispersion modeling not undertaken for the Fire Water - Standby Diesel Pump because this is a standby source, which may never operate.

4.2.2 Ventilation Raise Emission Rates:

Planned air flows into and out of the mine will utilise the existing exploration portal, the proposed new mine portal, the existing ventilation raise and two additional new ventilation raises. The ventilation raises will be designed to deliver the required air volumes and flows required to dilute dust and particulates, carbon monoxide and oxides of nitrogen to provide a safe working environment underground.

- Existing exploration portal (257050, 386660) 200m to AQSR 43, 45 Camcosy Road
- Proposed new mine portal (258125, 384805) 895m to AQSR 12, 216 Crockanboy Road
- Existing Ventilation Raise (257083, 386236) 475m to AQSR 43, 45 Camcosy Road
- New Intake Ventilation Raise (257274, 386263) 420m to AQSR 43, 45 Camcosy Road
- New Exhaust Ventilation Raise (257357, 386011) 680m to AQSR 43, 45 Camcosy Road

The main ventilation system will be augmented by underground secondary ventilation fans that will further distribute fresh air to the individual work areas.

From 9th March 2016 to 4th April 2016, nitrogen dioxide, sulphur dioxide and benzene diffusion tubes were placed at the top and bottom of the existing exhaust ventilation raise. These diffusion tubes allowed for measurement and comparison with the relevant Occupational Exposure Limits for nitrogen dioxide, sulphur dioxide and benzene. The emissions of particulates and carbon monoxide have been modelled using the relevant Occupational Exposure Limits from the EH40 / 2005 Workplace exposure Limits (HSE). The volumetric flow rate from the existing exhaust ventilation raise was measured at a rate of 78,800 m^3/hour.

Table 6: Emission Concentrations (mg/m^3) and Mass Emission Rates (g/s) from the ventilation raise used in the air dispersion model.

Pollutant	Volume Flow (m^3/hr)	Emission Concentration (mg/m^3)	Mass Emission Rate (g/s)	Notes
New Exhaust Ventilation Raise				
NO_2	678277.2	0.20264	0.03818	Concentration as measured over ~1 month. Recommended EC 8-Hour TWA OEL Limit value = 0.955 mg/m3
SO_2	678277.2	0.00103	0.00019	Concentration as measured over ~1 month. Recommended EC 8-Hour TWA OEL Limit value = 1.3 mg/m3
Benzene	678277.2	0.00584	0.00110	Concentration as measured over ~1 month. EH40 8-Hour TWA OEL Limit value = 3.250 mg/m3
Particulate – PM_{10}	678277.2	4	0.75364	Emission Conc. referenced against the EH40 OEL Limit Value for Respirable Dust = 4mg/m^3
CO	678277.2	35	6.59436	Emission Conc. referenced against the EH40 OEL Limit Value for Carbon Monoxide = 35mg/m^3
New Mine Portal				
NO2	117836.3	0.20264	0.00663	Concentration as measured over ~1 month. Recommended EC 8-Hour TWA OEL Limit value = 0.955 mg/m3
SO2	117836.3	0.00103	0.00003	Concentration as measured over ~1 month. Recommended EC 8-Hour TWA OEL Limit value = 1.3 mg/m3
Benzene	117836.3	0.00584	0.00019	Concentration as measured over ~1 month. EH40 8-Hour TWA OEL Limit value = 3.250 mg/m3
Particulate	117836.3	4	0.13093	Emission Conc. referenced against the EH40 OEL Limit Value for Respirable Dust = 4mg/m^3
CO	117836.3	35	1.14563	Emission Conc. referenced against the EH40 OEL Limit Value for Carbon Monoxide = 35mg/m^3

4.2.3 Fugitive Dust Emission Rates:

Dust generation rates were calculated from factors derived from empirical assessment and detailed in the USEPA's AP-42 Compilation of emission factors for use in calculating emissions from stationary point and area sources. The general equation for emissions estimation is:

$E = A \times EF \times (1-ER/100)$

where:

E = emissions;

A = activity rate;

EF = emission factor, and

ER =overall emission reduction efficiency, %

The USEPA's AP-42 Compilation of emission factors has been published since 1972 as a primary compilation of emission factor information. It contains emission factors and process information for more than 200 air pollution source categories. A source category is a specific industry sector or group of similar emitting sources. The emission factors have been developed and compiled from source test data, material balance studies and engineering estimates. The Fifth Edition of AP-42 was published in January 1995. Since then supplements and updates to the fifteen chapters available in Volume I, Stationary Point and Area Sources have been published. The emission factors and rates from various potential sources have been presented below.

4.2.4 Dust Emission Rates from Unpaved Roads & Paved Roads:

Suspended particle emissions from unpaved roads result from dust entrainment by vehicle wheels and the wake created by moving vehicles. When a vehicle travels a road, the movement of the wheels on the road surface causes particles to be lifted and dropped from the rolling wheels. The road surface is exposed to strong air currents in turbulent shear with the surface, as well as the air wake behind the vehicle. The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. The size-specific particulate emissions from an unpaved road, per vehicle km travelled, can be calculated with the use of the following equation from AP-42, Section 13.2.2;

$E = k \times 281.9 \times (s/12)^a \times (W/3)^b \times ((365 - p)/365)$

The quantity of dust emissions from paved roads or publicly accessible road, dominated by light duty vehicles, per vehicle km travelled, can be calculated with the use of the following equation from AP-42, Section 13.2.2;

$E = (k \times 281.9 \times (s/12)^a \times (S/30)^d / (M/0.5)^c – C) \times ((365 - p)/365)$

Where:

E = Emission factor (g/VKT)

k, a, b = Empirical constants (see below)

281.9 = conversion factor from lb/VMT to g/VKT

s = percentage of surface material silt content (%) - assumed to be 10%.

W = mean vehicle weight (tonnes) - 40 tonnes M = surface material moisture content - 10% - based on Appendix G to the Mine Waste Management Plan: the Curraghinalt Project - Dry Stack Facility Technical Design Report Page 10 and 11 (Oct 2017) - worst case as tailings will contain ~13-15% moisture.

S = mean vehicle speed (mph) – estimated to be 20 mph.

C = emission factor for vehicle fleet exhaust, brake wear & tyre wear.

p = number of days with at least 0.254 mm of precipitation per year. The number of days in a year with at least 0.254 mm of precipitation was assumed to be 178. Worst-case scenario as rainfall records on the site indicate that there is >0.2 mm of rainfall for 66% of the days of the year.

Surface water spraying will be frequently undertaken on all the haul roads using a water bowser and the subsequent dust suppression efficiency is assumed to be 75% (NPi,2012).

The constants k, a, b in the equations above for different particle sizes are as follows;

Constant	Industrial Roads			Public Roads		
	$PM_{2.5}$	PM_{10}	PM_{30}*	$PM_{2.5}$	PM_{10}	PM_{30}*
k (lb/VMT)	0.15	1.5	4.9	0.18	1.8	6
a	0.9	0.9	0.7	1	1	1
b	0.45	0.45	0.45	-	-	-
c	-	-	-	0.2	0.2	0.2
d	-	-	-	0.5	0.5	0.5

* Assumed equivalent to total suspended particulate matter (TSP)

The range of source conditions used in developing the equations above are as follows;

Emission Factor	Surface Silt Content (%)	Mean Vehicle Weight		Mean Vehicle Speed		Mean No. of Wheels	Surface Moisture Content (%)
		Mg	Tonnes	Km/hr	Mph		
Industrial Roads	1.8 – 25.2	1.8 - 260	2 – 290	8 – 69	5 – 43	4 - 17	0.03 – 13
Public Roads	1.8 - 35	1.4 – 2.7	1.5 - 3	16 - 88	10 - 55	4 - 48	0.03 - 13

The emission factors for vehicle fleet exhaust, brake wear & tyre wear used in developing the equations above are as follows;

Particle Size Rating	C, emission factor for vehicle fleet exhaust, brake wear & tyre wear (lb/VMT)
$PM_{2.5}$	0.00036
PM_{10}	0.00047
PM_{30}*	0.00047

Based on the above, the following Emission Factors (g/VKT) have been determined for unpaved and paved roads, dominated by light duty vehicles, per vehicle km travelled.

Surface	Emission Factor - g/VKT		
	$PM_{2.5}$	PM_{10}	TSP
Unpaved Roads	59.0	589.8	1998.2
Paved Roads	10.3	104.8	349.3

To determine the Emission rate (g/s) to be used in the dust dispersion model the following equation has been used;

Emission Rate (g/s) = Emission Factor (g/VKT) x VKT/day x (1 day/24) x (1 hour/ 3600) X 0.25 (assuming dust suppression efficiency = 75%)

Table 7: Dust Emission Rates from Paved and Unpaved Roads (g/s) used in the dust deposition model.

Road Type	**Site Road**	**Emission Rate (g/s)**		
		$PM_{2.5}$	**PM_{10}**	**TSP**
Unpaved Roads	DSF Haul Road - Worst case assumption = Travels of 100 km/day by trucks	0.017	0.171	0.578
Paved Roads	Decline Portal to Process Area Road = Travels of 100 km/day by trucks	0.003	0.030	0.101

4.2.5 Dust Emission Rates from Aggregate Handling and ROM Stockpiles:

The potential fugitive dust emissions from the ore stockpile took into account handling of the material and wind erosion of the ore stockpile surfaces. The dust emissions depend on the mean wind speed in the area and the material moisture content of the pile, according to the following equation from AP-42, Section 13.2.4:

$$E = ((k \times (0.0016) \times (u/2.2)^{1.3}) / (M/2)^{1.4}$$

Where:

E = Emission factor per hour of operation (kg/Mg)

k = Particle size multiplier (dimensionless)

PM_{10} fraction: 0.3

$PM_{2.5}$ fraction: 0.1

TSP fraction: 1

u = mean wind speed at site - 3.2 m/s (as measured on site)

M = material moisture content (10 %)

Based on a daily ore fed to the plant (run of mine) between 1,200 and 1,500 tonnes on average per day the following emission rates have been calculated;

Table 8: Dust Emission Rates from Aggregate Handling and ROM Stockpiles (g/s) used in the dust deposition model.

Source	Rate	Emission Rates		
		$PM_{2.5}$	PM_{10}	TSP
Aggregate Handling and ROM Stockpiles	Emission Rate - Kg/Tonne	0.000027	0.000082	0.000274
	Emission Rate - Kg/day	0.036935	0.110806	0.369353
	Emission Rate - g/s	0.000427	0.001282	0.004275

A working area for the ore stockpile operations beside the Crusher building of 20m x 35m, i.e. 700m^2 has been assumed in the dispersion model.

4.2.6 Dust Emission Rates from Earth Moving Emissions & Compaction at DSF

Based on a daily ore feed to the plant (run of mine) of between 1,200 and 1,500 tonnes on average, with approximately 60% of the tailings generated stored underground as backfill, there will be between 480 and 600 tonnes of tailings generated per day. During the operating hours of each day a number of heavy vehicles, including a bulldozer and a vibratory roller and tip trucks are assumed to be active simultaneously on the DSF. The particulate emissions due to tipping, bulldozing, grading and rolling operations were estimated utilising the following equation from AP-42, Section 11.9:

$E_{TSP} = k \times 2.6 \times (s)^{1.2} / (M)^{1.3}$

Where:

E_{TSP} = TSP emission factor per hour of operation (kg/hr)

$k = PM_{10}$: emission conversion coefficient 0.3

$PM_{2.5}$: emission conversion coefficient = 0.1

TSP: emission conversion coefficient = 1

s = percentage of silt content in material (%) (10%)

M = material moisture content (10 %) – worst case as tailings will contain ~15% moisture.

Surface water spraying will be frequently undertaken on all exposed areas using a water bowser and the subsequent dust suppression efficiency is assumed to be 75% (NPi,2012).

Table 9: Dust Emission Rates from Earth Moving Emissions & Compaction at DSF (g/s) used in the dust deposition model.

Source	Rate	Emission Rates		
		$PM_{2.5}$	PM_{10}	TSP
Earth Moving Emissions & Compaction	Emission Rate - Kg/Hour	0.207	0.270	2.065
	Emission Rate - g/s	0.014	0.019	0.143

A working area on the DSF including tipping, bulldozing, grading and rolling operations of 50m x 50m, i.e. 2,500m^2 has been assumed in the dispersion model.

4.2.7 Dust Emission Rates from Crushing Operations & Conveyors

Section 11.24 of AP-42, which deals with metallic minerals processing can be used for generating realistic emission factors from crushing operations. However, dust emissions from the crushing operations and conveying of crushed material will be negligible. This is because the transfer of material from the crusher within the Crusher Building to the Coarse Ore Stockpile to the Sag Mill within the Processing Building will all be enclosed.

The volume of material crushed is estimated to be between 1,200 and 1,500 tonnes per day. Crushing operations could be a potentially significant dust-generating source, if left un-enclosed and uncontrolled. However, in the proposed site layout, it has been determined that for dust and noise control purposes the primary crusher will be enclosed within a purpose designed structure. The coarse ore stockpile, which will store ore post the primary crusher and prior to the SAG Mill, will also be covered. The SAG Mill grinding process will also be enclosed within the proposed Processing Building. The conveyors from the primary crusher to the coarse ore stockpile to the SAG Mill within the Processing Building will also be covered with dust abatement measures installed. All material drops will occur within the coarse ore stockpile and the SAG Mill within the Processing Building. Therefore, there will be little potential for fugitive dust emissions in proximity to these sources.

The dust generated in the crusher building, the conveyors and the covered stockpile will be controlled by the use of dust collectors. The dust collectors will very significantly reduce the potential for dust emission to atmosphere. A small concentration of dust may be released from the dust collectors and this source has been included in the Process Stack (Point Source) emission model.

4.2.8 Road Traffic & On-Site Vehicular Emissions:

Road Traffic Emissions

With regard to Air Quality and Land Use Planning, Belfast City Council Environmental Health Department (BCC EHD) has produced a guidance document for developers and consultants as referenced by all councils in Northern Ireland. The Air Quality and Land Use Planning guidelines provide technical advice on dealing with planning applications, which could have an impact on air quality. Where developments may have the potential to have an adverse impact on air quality and, where it is deemed feasible that this impact will be significant, it is typically requested that an Air Quality Assessment (AQA) be submitted in support of a planning application. This is based on published best practice guidance such as the National Society for Clean Air Development Control: Planning for Air Quality and the Government Technical Guidance. There are two main methods by which a development's impact on air quality can be determined:

- Air quality screening assessments
- Atmospheric dispersion assessments

As stated in the guidelines, in areas where air quality is not currently of particular concern, an initial screening assessment of the potential impact of the potential development should be carried out. If this screening process identifies that the development may have a significant impact on air quality, a more detailed atmospheric dispersion modelling assessment may be required. For both methods, the minimum requirements for a satisfactory assessment are:

- a prediction of the current air quality within the vicinity of the proposed development,
- a prediction of the air quality within the vicinity of the proposed development for the year that the development is due to be operational without the development in place, and
- a prediction of the air quality within the vicinity of the proposed development for the year that the development is due to be operational with the development in place.

A proposed development may be considered to have a significant adverse impact on air quality when it:

- generates air pollution in excess of the National Air Quality Strategy Objectives or EU Limit Values,
- causes a significant increase in ambient concentrations,
- results in the designation of a new AQMA, or expansion of an existing AQMA,
- interferes with the implementation of the Air Quality Action Plan (AQAP), or
- exposes people to poor air quality.

The requirements of an AQIA to the satisfaction of the relevant authorities include:

- Details of the existing and predicted traffic flows generated by the development, if any';
- A screening model or detailed atmospheric model of the existing air quality surrounding the proposed development;
- A prediction of the air quality surrounding the proposed scheme for the year that the development is due to be operational without and with the development in place. This prediction should take account of any forecasted traffic flow as a result of the development and any forecasted increases in the area as a whole;
- Where exceedances are predicted for the year of opening with the development in place then future year projections should be modelled to determine in what year the objectives will be met. If a screening model indicates a significant air quality impact, then a detailed air dispersion model should be completed;

- In order to demonstrate that AQ issues have been adequately addressed, all input data, assumptions, predictions and output data should be clearly presented; and
- It is also required that model outputs should be compared against the relevant NAQS Objectives and EU Limit Values and that the percentage predicted increases in air pollutants associated with the proposed development should also be presented.

The Design Manual for Roads & Bridges (DMRB) guidance states that assessment of affected roads is only considered necessary where proposals would result in:

- An increase in daily traffic flows by 1,000 or more;
- Daily Heavy Goods Vehicles (HGVs) flows will change by 200 or more;
- Daily average speed will change by 10 km/hr or more; or
- Peak hour speed will change by 20 km/hr or more.

Furthermore, the Environmental Protection UK (EPUK) document 'Development Control: Planning for Air Quality' states that an air quality assessment is not normally required unless:

- Proposals that will generate or increase traffic congestion, where 'congestion' manifests itself as an increase in periods with stop start driving; or
- Proposals that will give rise to a significant change in either traffic volumes, typically a change in annual average daily traffic (AADT) or peak traffic flows of greater than ±5% or ±10%, depending on local circumstances (a change of ±5% will be appropriate for traffic flows within an AQMA), or in vehicle speed (typically of more than ±10 kph), or both, usually on a road with more than 10,000 AADT (5,000 if 'narrow and congested'); or
- Proposals that would significantly alter the traffic composition on local roads, for instance, increase the number of HDVs by 200 movements or more per day, due to the development of a bus station or an HGV park (professional judgement will be required, taking account of the total vehicle flow as well as the change); or
- Proposals that include significant new car parking, which may be taken to be more than 100 spaces outside an Air Quality Management Area (AQMA) or 50 spaces inside an AQMA. Account should also be taken of car park turnover, i.e. the difference between short-term and long-term parking, which will affect the traffic flows into and out of the car park. This should also include proposals for new coach or lorry parks. These criteria are designed to trigger the requirement for the assessment of traffic on the local roads. It may also be appropriate to assess the emissions from within the car park itself; or
- Large, long-term construction sites that would generate large HGV flows (>200 movements per day) over a period of a year or more.

The traffic increases during the construction phase are anticipated to be below the level of change requiring further assessment against both DMRB and EPUK criteria. It is therefore considered that the traffic effects of the construction of the proposed infrastructure site will be insignificant in terms of local air quality and construction traffic is deemed to be an effect of negligible significance.

During the operational phase of the proposed infrastructure site, fewer additional traffic movements are anticipated than during the construction period. Therefore, the operational change in traffic flows is considered to be insignificant against the DMRB and EPUK criteria and is therefore deemed to have a negligible significance.

Nevertheless, a prediction of the relative construction and operational air quality impact at the residential receptors in proximity to public roads in the area of the proposed Curraghinalt Project due to increased traffic flows has been undertaken in accordance with the *DMRB Assessment* methodology. The DMRB predictions have been based upon the existing and predicted Annual Average Daily Traffic (AADT) flows which have been taken from the Transport Impact Assessment.

Table 10: Relative increase in daily traffic volumes on the public roads in proximity to the site due to Construction of the proposed Curraghinalt Project.

Location	Arm	Base AADT	Generated	% increase
Junction 1 – A5 Killymore Road	A	15250	42	0.3%
	B	1515	63	4.2%
	C	15250	22	0.1%
Junction 2 – Gortin Village	A	750	8	1.1%
	B	1653	111	6.7%
	C	1365	40	2.9%
	D	1515	63	4.2%
Junction 3 – Rousky Village	A	293	65	22%
	B	1098	139	12.7%
	C	1193	110	9.2%
Junction 4 – Development Access	A	0	172	-%
	B	1098	49	4.5%
	C	1098	8	0.7%
Junction 5 – Greencastle Village	A	959	1	0.1%
	B	1205	40	3.3%
	C	1311	1	0%
	D	1098	41	3.7%
Junction 6 – A505 Crockanboy Road	A	3456	19	0.6%
	B	959	1	0.1%
	C	3456	19	0.6%
	D	1210	40	3.3%
Lenagh Road Junction at HGV Turning Circle	A	1098	198	18%
	B	0	78	100%
	C	1098	120	10.9%
Camcosy Road	A	293	78	26.6%

Table 11: Relative increase in daily traffic volumes on the public roads in proximity to the site due to Operation of the proposed Curraghinalt Project.

Location	Arm	Base AADT	Generated	% increase
Junction 1 – A5 Killymore Road	A	1,5250	46	0.3%
	B	1,515	76	5.0%
	C	1,5250	29	0.2%
Junction 2 – Gortin Village	A	750	14	1.9%
	B	1,653	147	8.9%
	C	1,365	58	4.2%
	D	1,515	76	5.0%
Junction 3 – Rousky Village	A	293	0	0.0%
	B	1,098	155	14.1%
	C	1,193	147	12.3%
Junction 4 – Development Access	A	0	221	N/A
	B	1,098	66	6.0%
	C	1,098	0	0.0%
Junction 5 – Greencastle Village	A	959	1	0.1%
	B	1,205	64	5.3%
	C	1,311	1	0.1%
	D	1,098	66	6.0%
Junction 6 – A505 Crockanboy Road	A	3,456	31	0.9%
	B	959	2	0.3%
	C	3,456	31	0.9%
	D	1,210	64	5.3%

The existing ambient air quality near the proposed development is impacted mainly from nearby traffic flows, and therefore, it has focused on those pollutants that are produced by vehicular traffic. Therefore, the pollutants that have been addressed in detail in this study are Nitrogen Dioxide (NO_2) and Fine Particulates (PM_{10}). The model used in the air quality impact assessment of traffic and vehicular emissions is the DMRB Screening Model, published by the Highways Agency. The DMRB screening model can be run to predict pollutant concentrations at receptor locations near to roads. It can be used to predict annual mean concentrations of nitrogen dioxide (NO_2) and PM_{10}, as well as oxides of nitrogen (NO_x), carbon monoxide, benzene and 1,3-butadiene. It also predicts the number of exceedances of 50 µg/m^3 as a 24-hour mean PM_{10} concentration. The model requires input data on Annual Average Daily Traffic flow (AADT), annual average speeds, the proportion of different vehicle types, the type of road, and the distance from the centre of the road to the receptor. The DMRB screening model is referred to within the Local Air Quality Management Technical Guidance document LAQM TG(16) (April 2016).

4.2.9 Dispersion Modelling Methodology:

In order to determine the potential air quality and dust impacts arising from the operation of the proposed infrastructure site, AERMOD air dispersion models have been prepared. The air quality and dust impact assessment has referenced relevant background air pollutant concentrations and the air dispersion model results have been compared against the relevant Ambient Air Quality Standards.

The air dispersion modelling assessment has been prepared in accordance with the methodology outlined in the Local Air Quality Management Technical Guidance LAQM.TG(16) (April 2016). The air dispersion modelling assessment was carried out in accordance with the following reference documentation;

- Local Air Quality Management Technical Guidance LAQM.TG(16) (April 2016).
- Environmental Protection Agency, Ireland, Office of Environmental Enforcement (OEE), Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (2010).
- Guidelines for the Preparation of Dispersion Modelling Assessments for Compliance with Regulatory Requirements – an Update to the 1995 Royal Meteorological Society Guidance UK Atmospheric Dispersion Modelling Liaison Committee (2004)

Estimates of atmospheric dispersion and the resultant downwind concentrations of pollutants may be predicted through the use of mathematical models to assess the impacts from airborne releases based on the following parameters;

- Source emission characteristics including emission rate of pollutant, velocity of discharge, height of discharge and temperature of the release,
- Prevailing atmospheric conditions including wind speed, direction, cloud cover, precipitation, ambient temperature and the depth of the mixing layer, and
- Topography and local surface conditions

AERMOD is an Environment Agency recognised and approved dispersion model used to predict pollutant concentrations from a wide range of sources that are present at typical industrial facilities. The Northern Ireland Environment Agency also widely uses and approves AERMOD dispersion models submitted as part of the Industrial Licencing and Planning Applications. The model accepts hourly meteorological data to define the conditions for plume rise, transport, diffusion and deposition. It estimates the concentration or deposition value for each source and receptor combination for each hour of input meteorology and calculates user-selected short term averages. Since most air quality standards are stipulated as averages or percentiles, AERMOD allows further analysis of the results for comparison purposes.

Percentile analysis for emissions is calculated for the maximum averages using the AERMOD-percent post-processing utility. This utility calculates the maximum concentration of a pollutant from all receptors at a specific percentile, for a specific period. Employing the percentile method facilitates the omission of unusual short-term meteorological events that may cause elevated pollutant concentrations and hence a more accurate representation of the likely average pollutant concentrations over an averaging period.

The main limitations of AERMOD are as follows:

1. Steady State – does not deal with transient conditions well, limited to a 50km radius.
2. Homogeneous meteorological field – not well suited to areas where the meteorological conditions change quickly.
3. Does not model atmospheric chemistry.

It should be noted that none of these limitations affect the output of the dispersion modeling with regard to the assessment of the operation of the proposed infrastructure site.

Time Averaging and Percentiles

Appropriate time averaging and percentiles have been calculated in terms of the pollutant concentration limit values and criteria detailed in the air quality standards as outlined in Table 1. For example, short-term PM_{10} impacts have been calculated and presented as a 90.4^{th} percentile of maximum 24-hour average concentrations.

The results of the air dispersion modelling study when added to the background air pollutant concentrations as outlined in LAQM TG(16), have been compared against the relevant Air Quality limit values. The approach to the assessment of the potential impact on ambient air quality has involved the following:

- Quantification of the local Ambient Concentration (AC) from measured baseline air pollutant concentrations in the vicinity of the proposed infrastructure site (Annual Mean Concentrations),
- Quantitative assessment of the operational emissions on local air quality from the predicted emissions utilising the AERMOD air dispersion models and a quantification of the Process Contributions (PC).
- Assessment of the resultant Predicted Environmental Concentrations (PEC) through addition of the Ambient Concentration (AC) and the Process Contributions (PC) emissions.

In order to obtain the Predicted Environmental Concentrations (PEC), background concentrations as outlined in Section 3 Existing Environment were added directly to the predicted process concentrations. As outlined in LAQM TG(16), the following approach to adding industrial installation contributions to the background NO_2, SO_2 and PM_{10} concentrations should be adopted.

NO_2

Where this approach suggests that the predicted increase in the 99.8th percentile above the background is more than 75% of the available headroom (the difference between the objective and background), then a more detailed approach will be required.

The 99.8th percentile of total NO_2 is equal to the minimum of either equation a or b:

a) 99.8th percentile hourly background total oxidant + 0.05 × (99.8th percentile process contribution NOx); or

b) the maximum of either:

b1) 99.8th percentile process contribution of NOx + (2 × annual mean background NO_2); or

b2) 99.8th percentile hourly background NO_2 + (2 × annual mean process contribution of NOx).

Note: In equation a, the total oxidant is the sum of O_3 and NO_2 (as NO_2 equivalents) and should be based on summing the hour by hour concentrations from a suitable background monitoring site in order to derive the 99.8th percentile.

SO_2

Where this approach suggests that the concentrations exceed 75% of the air quality objective (for example, if the total predicted 99.9th percentile of 15-minute mean SO_2 concentrations is great than 200 µg/m3) a more detailed approach will be required.

The 99.9th percentile of total 15-minute mean is equal to the maximum of either equation a or b:

a) 99.9th percentile 15-minute mean background + (2 × annual mean process contribution); or

b) 99.9th percentile 15-minute mean process contribution + (2 × annual mean background contribution)

The 99.7th percentile of total 1-hour is equal to the maximum of either equation a or b;

a) 99.7th percentile hourly background + (2 × annual mean process contribution); or

b) 99.7th percentile hourly process contribution + (2 × annual mean background contribution)

The 99.2nd percentile of total 24-hour mean is equal to the maximum of either equation a or b;

a) 99.2nd percentile 24-hour mean background + (2 × annual mean process contribution); or

b) 99.2nd percentile 24-hour process contribution + (2 × annual mean background contribution).

PM_{10}

Where this approach suggests that the predicted increase in the 90.4th percentile above the background is more than 50% of the available headroom (the difference between the objective and background), then a more detailed approach will be required.

The 90.4th percentile total 24-hour mean is equal to the maximum of either equation a or b;

a) 90.4th percentile 24-hour mean background + annual mean process contribution; or

b) 90.4th percentile 24-hour mean process contribution + annual mean background.

Note: for the 90.4th percentile for 24-hour mean, the method does not incorporate twice the annual mean contribution of the process or background.

Building Downwash Effects

Buildings can affect the local mechanical turbulence around the point of release. Air moving over buildings increases in velocity and can cause downwash downwind of the source. Releases can be partly or wholly entrained into the building slip-stream leading to occasional elevated local ground level concentrations when wind direction increases the influence of nearby buildings on dispersion of the plume. Due to this fact, process stack heights as well as building dimensions, shape and orientations have been incorporated into the model. AERMOD includes algorithms to model the effects of building downwash on emissions from nearby or adjacent point sources. The proposed building dimensions, i.e. plans and elevations of the proposed site layout have been provided by the project engineers (JDS).

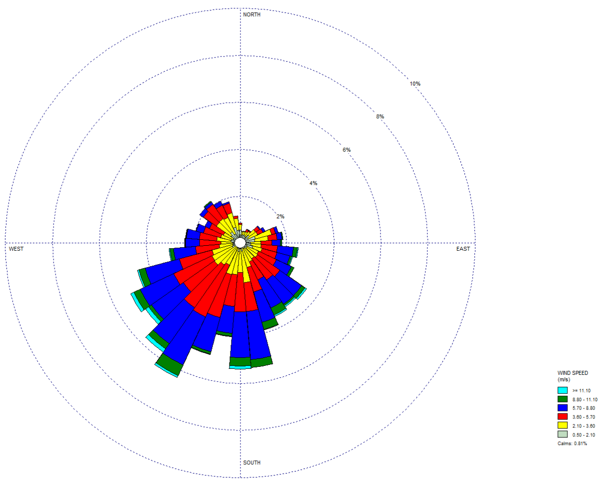
Surface Roughness & Land Use Characteristics

The surface roughness conditions in the vicinity of the site have been adjusted for rural surroundings in the AERMOD model.

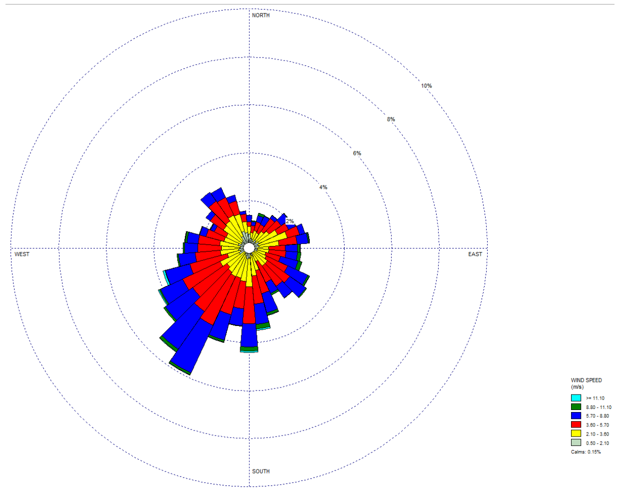
Meteorological Data

Hourly sequential meteorological data from Belfast International (Aldergrove) Airport for the years 2011 to 2015 was used in the air dispersion modelling meteorological data sensitivity assessment. The Belfast International (Aldergrove) Airport meteorological data is appropriate for use as it is representative of meteorological conditions in the area of this development as it is located 34 miles directly east of the proposed infrastructure site. The ground level concentrations presented in Table 12 were predicted for particulates (PM_{10}) using hourly sequential meteorological data from Belfast International (Aldergrove) Airport to determine the worst-case long term (annual average) and short term (1-hour) impacts of emissions from the proposed infrastructure site process stack emissions for each of the years 2011 - 2015. On the basis of the results obtained, 2015 meteorological data was subsequently used for the detailed assessment of all pollutant emissions from the proposed infrastructure site.

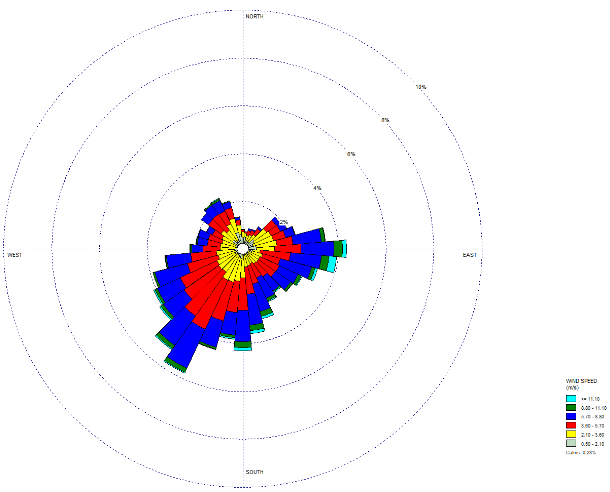
2011 Meteorological Data



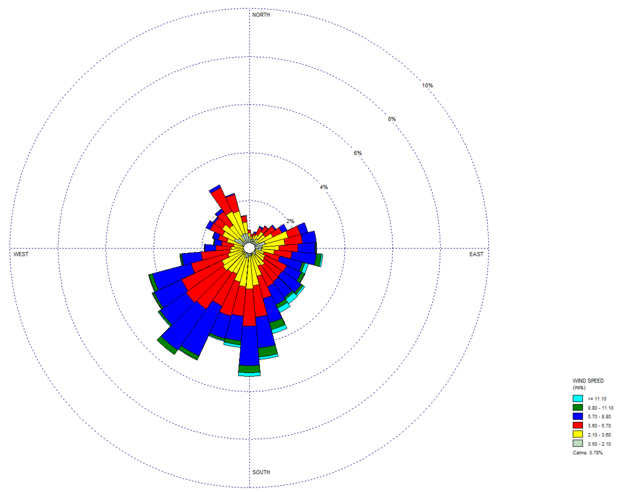
2012 Meteorological Data



2013 Meteorological Data



2014 Meteorological Data



2015 Meteorological Data

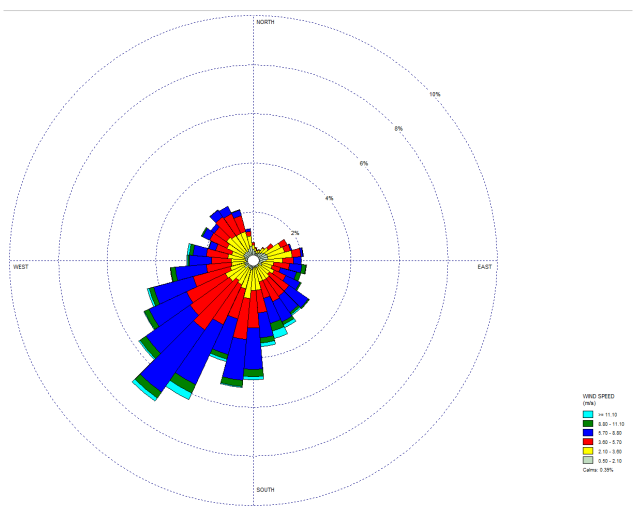
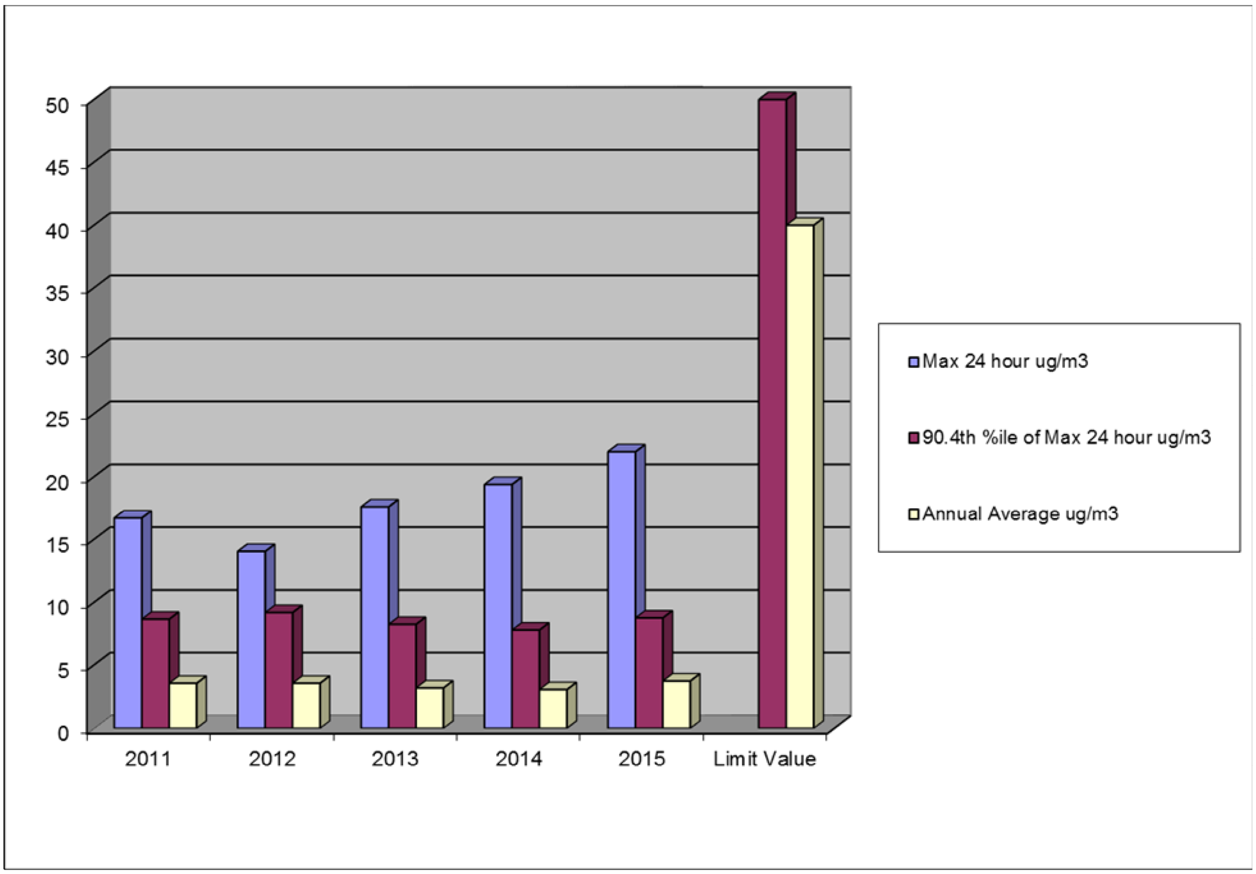


Table 12: Maximum short-term and annual predicted ground level particulate (PM_{10}) concentrations from process stack emissions using hourly sequential meteorological data from Belfast International (Aldergrove) Airport for the years 2011 to 2015.

Year	Maximum 24-Hour PM_{10} Conc. (µg/m^3)	90.4th %ile of Maximum 24-Hour PM_{10} Conc. (µg/m^3)	Annual Mean PM_{10} Conc. (µg/m^3)
2011	16.71	8.67	3.56
2012	14.05	9.2	3.56
2013	17.61	8.26	3.19
2014	19.39	7.81	3.06
2015	**21.99**	**8.77**	**3.74**

Chart 1: Maximum short-term and annual predicted ground level particulate (PM_{10}) concentrations from process stack emissions using hourly sequential meteorological data from Belfast International (Aldergrove) Airport for the years 2011 to 2015.



4.2.10 Receptors & Cartesian Grids:

The AERMOD model calculates ground level pollutant concentrations at receptor points in the vicinity of the modelled emission points. Ground level pollutant concentrations were predicted at a selection of the nearest residential properties in proximity to the proposed infrastructure site as outlined in Table 13.

The grid coordinates for all sensitive receptors within approximately 5 km of the proposed proposed infrastructure site have been determined and assessed. Of these 738 sensitive receptors it is realistic to assume that the vast majority will be unaffected by the development in terms of air quality and dust impacts. Therefore, 42 sensitive receptor locations have been selected for specific reporting of the potential air quality and dust impact within this report. These 42 sensitive receptor locations are within approximately 2 km of the proposed infrastructure site and are located to the west, south-west, south, south-east, east and north-east to represent the nearest receptors to the proposed infrastructure site. It can be assumed that all other receptors further from the proposed infrastructure site than these locations will experience a lesser impact than those listed in Table 13.

Table 13 indicates that there are significant offset distances between the nearest receptors to the proposed infrastructure site and the main potential air pollutant and dust sources on the proposed infrastructure site, as follows;

- The nearest sensitive receptor to the DSF is 216 Crockanboy Road which is 400m to the south-west.
- The nearest sensitive receptor to the centre of the Crusher Building is 56 Mullydoo Road which is 885m to the east.
- The nearest sensitive receptor to the centre of the Processing Building is 56 Mullydoo Road which is 690m to the east.
- The nearest sensitive receptor to the site access to the proposed infrastructure site is 225 Crockanboy Road which is 50m to the west.
- The nearest sensitive receptor to the decline portal is 216 Crockanboy Road which is 895m to the south.

Such significant offset distances between the main potential air pollutant and dust sources on the proposed infrastructure site will allow for a significantly reduced potential for air quality and dust impacts.

- Existing exploration portal (257050, 386660) 200m to NSR 43, 45 Camcosy Road
- Proposed new mine portal (258125, 384805) 895m to NSR 12, 216 Crockanboy Road
- Existing Ventilation Raise (257083, 386236) 475m to NSR 43, 45 Camcosy Road

- New Intake Ventilation Raise (257274, 386263) 420m to NSR 43, 45 Camcosy Road
- New Exhaust Ventilation Raise (257357, 386011) 680m to NSR 43, 45 Camcosy Road

The air quality impact at ecologically sensitive receptors have been reported and assessed in the Ecology Impact Assessment.

Table 13: Air Quality & Dust sensitive residential receptors input to the air quality prediction model (See Figure 4).

AQSR Ref No.	Address	Receptor ID	X Grid Coordinate (m)	Y Grid Coordinate (m)	Distance to Nearest Area of DSF (m)	Distance to Crusher Building (m)	Distance to Processing Building (m)	Distance to Site Access (m)	Distance to Decline Portal (m)
AQSR 1	184 Crockanboy Road	D-R-0037	256766	384014	1370	1985	2240	1405	1575
AQSR 2	191 Crockanboy Road	D-R-0020	256858	383785	1355	1970	2215	1250	1625
AQSR 3	186 Crockanboy Road	D-R-0024	256885	383970	1265	1885	2135	1280	1495
AQSR 4	193 Crockanboy Road	D-R-0013	256970	383732	1280	1890	2130	1130	1575
AQSR 5	200 Crockanboy Road	D-R-0047	257413	383746	885	1485	1715	705	1280
AQSR 6	184 Crockanboy Road	D-R-0048	257408	384176	710	1325	1580	965	950
AQSR 7	204 Crockanboy Road	D-R-0010	257526	383955	675	1285	1525	725	1040
AQSR 8	210 Crockanboy Road	D-R-0028	257586	383752	745	1335	1555	555	1180
AQSR 9	207 Crockanboy Road	D-R-0045	257619	383594	860	1504	1620	465	1315
AQSR 10	213 Crockanboy Road	D-R-0041	257757	383505	870	1370	1565	310	1345
AQSR 11	212 Crockanboy Road	D-R-0053	257830	383621	725	1230	1425	285	1215
AQSR 12	216 Crockanboy Road	D-R-0030	257965	383915	400	935	1155	460	900
AQSR 13	225 Crockanboy Road	D-R-0051	258011	383448	860	1250	1410	50	1360
AQSR 14	231 Crockanboy Road	D-R-0050	258306	383314	905	1255	1355	280	1490
AQSR 15	234 Crockanboy Road	D-R-0054	258760	383569	550	930	955	700	1385
AQSR 16	238 Crockanboy Road	D-R-0036	258761	383426	700	1080	1095	695	1515
AQSR 17	244 Crockanboy Road	D-R-0043	258829	383385	740	1125	1130	770	1585
AQSR 18	256 Crockanboy Road	D-R-0009	258765	383131	995	1370	1385	775	1795
AQSR 19	254 Crockanboy Road	D-R-0016	259040	383323	825	1225	1180	985	1735
AQSR 20	260 Crockanboy Road	D-R-0044	259153	383254	915	1325	1260	1100	1855
AQSR 21	268 Crockanboy Road	D-R-0022	259259	383040	1155	1570	1495	1270	2090
AQSR 22	264 Crockanboy Road	D-R-0018	259262	383261	950	1365	1275	1210	1925
AQSR 23	56 Mullydoo Road	D-R-0133	259402	383973	480	885	690	1435	1525

Table 13 (Continued): Air Quality & Dust sensitive residential receptors in proximity to the proposed infrastructure site input to the air quality prediction model. (See Figure 4).

AQSR Ref No.	Address	Receptor ID	X Irish Grid Coordinate (m)	Y Irish Grid Coordinate (m)	Distance to Nearest Area of DSF (m)	Distance to Crusher Building (m)	Distance to Processing Building (m)	Distance to Site Access (m)	Distance to Decline Portal (m)
AQSR 24	276 Crockanboy Road	D-R-0011	259487	383042	1245	1665	1555	1480	2225
AQSR 25	146 Greencastle Road	D-R-0064	259644	382933	1415	1830	1710	1665	2410
AQSR 26	164 Greencastle Road (Presbytery)	D-R-0565	259995	383017	1555	1975	1810	1980	2580
AQSR 27	170 Greencastle Road	D-R-0550	260247	383307	1550	1960	1760	2190	2600
AQSR 28	172 Greencastle Road	D-R-0566	260373	383547	1535	1935	1710	2310	2575
AQSR 29	46 Mullydoo Road	D-R-0684	260416	383560	1570	1965	1735	2350	2605
AQSR 30	188 Greencastle Road	D-R-0072	260432	384134	1415	1780	1520	2465	2400
AQSR 31	198 Greencastle Road	D-R-0076	260268	384516	1255	1575	1310	2435	2160
AQSR 32	200 Greencastle Road	D-R-0070	260387	384621	1395	1700	1440	2600	2270
AQSR 33	204 Greencastle Road	D-R-0071	260340	384839	1410	1680	1415	2655	2210
AQSR 34	208 Greencastle Road	D-R-0073	260171	385070	1365	1580	1325	2640	2055
AQSR 35	216 Greencastle Road	D-R-0062	260065	385223	1395	1550	1315	2660	1975
AQSR 36	K/2012/0141/RM Adjacent to 208 Crockanboy Road	D-Prop-0031	257400	384225	720	1320	1570	1010	925
AQSR 37	St Patrick's GFC	D-NR-0043	260322	383649	1440	1835	1615	2260	2475
AQSR 38	Greencastle Amateur Boxing Club	D-NR-0044	260371	383622	1465	1860	1640	2285	2485
AQSR 39	Greencastle Community Association	D-NR-0045	260346	383637	1490	1885	1665	2310	2515
AQSR 40	St Patrick's Church, Sheskinshule	D-NR-0046	260145	383153	1565	1985	1800	2100	2605
AQSR 41	Green Elves Nursery School	D-NR-0048	259345	382813	1405	1810	1735	1435	2340
AQSR 42	Greencastle School	School	259372	382880	1360	1750	1675	1430	2290

Figure 4: Air Quality & Dust sensitive residential receptors in proximity to the proposed infrastructure site input to the prediction model.

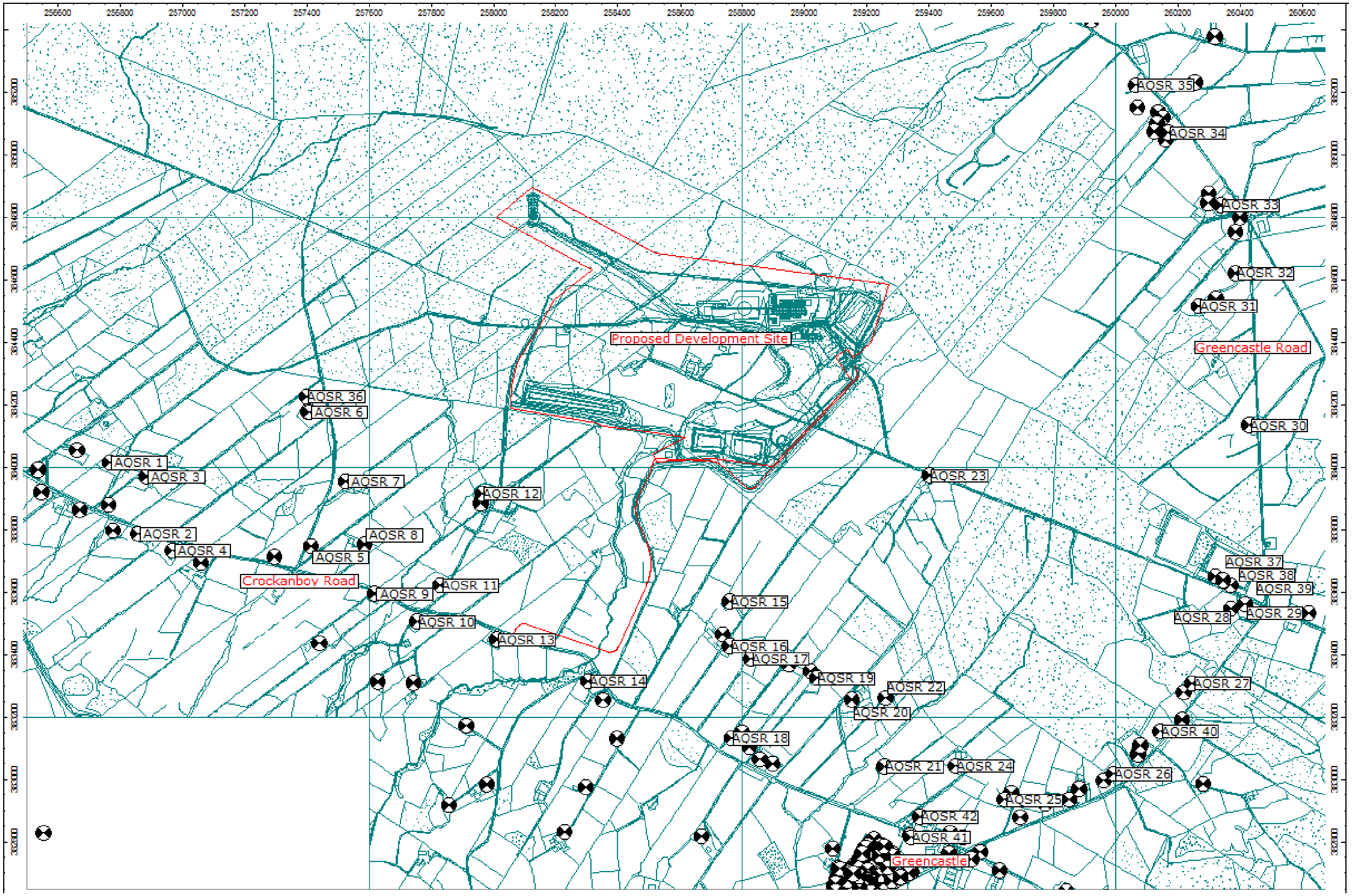
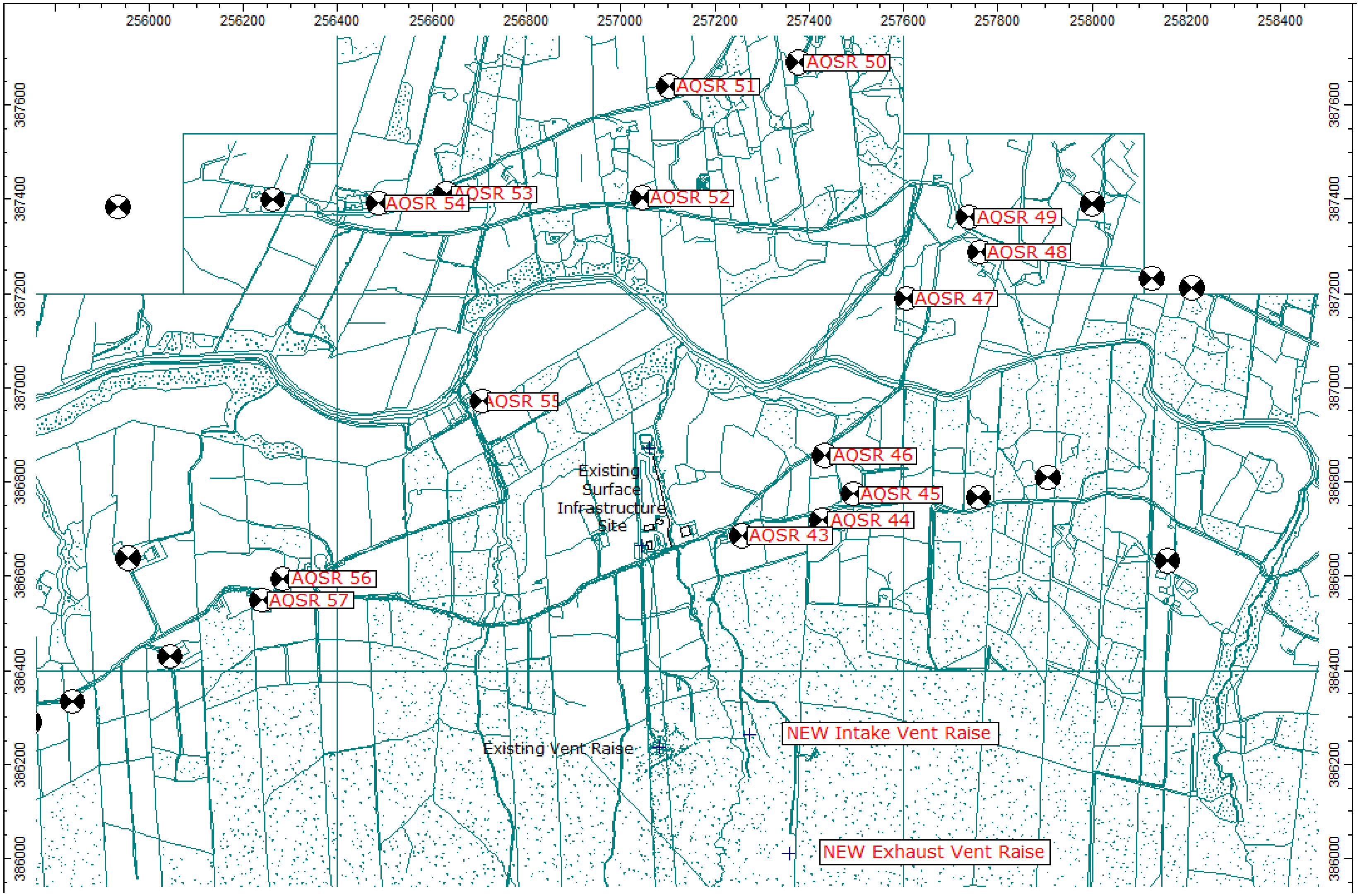


Table 14: Air Quality & Dust sensitive residential receptors in proximity to the existing surface infrastructure site input to the air quality prediction model (See Figure 5).

AQSR Ref No.	Address	Receptor ID	X Grid Coordinate (m)	Y Grid Coordinate (m)	Distance to existing surface infrastructure site (m)
AQSR 43	45 Camcosy Road	D-R-0290	257257	386686	190m
AQSR 44	49 Camcosy Road	D-R-0286	257427	386718	365m
AQSR 45	48 Camcosy Road	D-R-0275	257494	386773	440m
AQSR 46	46 Camcosy Road	D-R-0297	257433	386856	400m
AQSR 47	129 Gorticashel Road	D-R-0528	257607	387189	730m
AQSR 48	131 Gorticashel Road	D-R-0518	257762	387287	910m
AQSR 49	128 Gorticashel Road	D-R-0480	257739	387362	945m
AQSR 50	17 Glencullin Road	D-R-0443	257378	387690	1030m
AQSR 51	12 Glencullin Road	D-R-0444	257103	387639	930m
AQSR 52	122 Gorticashel Road	D-R-0485	257046	387403	700m
AQSR 53	5 Glencullin Road	D-R-0442	256630	387411	820m
AQSR 54	4 Glencullin Road	D-R-0446	256488	387390	890m
AQSR 55	38 Camcosy Road	D-R-0280	256707	386970	440m
AQSR 56	34 Camcosy Road	D-R-0291	256284	386594	780m
AQSR 57	35 Camcosy Road	D-R-0269	256240	386548	830m

Figure 5: Air Quality & Dust sensitive residential receptors in proximity to the existing surface infrastructure site input to the air quality prediction model.



Ground level pollutant concentrations were also predicted at every node on Cartesian grids, with centre coordinates of 258525, 383775, as follows;

- Cartesian Grid 1 – 2,000m x 2,000m @ 100m spacing,
- Cartesian Grid 2 – 5,000m x 5,000m @ 250m spacing,
- Cartesian Grid 3 – 12,000m x 12,000m @ 500m spacing.

Ecologically designated sites within 5 km of the Project Sites including RAMSAR, Special Protection Areas (SPA) & Areas of Special Scientific Interest (ASSI) have been included in the air dispersion models. The locations of the designated sites are shown in Table 15 below.

Table 15: Ecological Statutory Designated Sites within 5 km of the Project Sites.

Designated Site	Reason for Importance/Designation	Location in Relation to Project Sites	Location in Relation to centre of proposed infrastructure site	Level of Value
Owenkillew River SAC	The Owenkillew River qualifies as a SAC for the following habitats as listed under Annex I of the EU Habitats Directive • Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation; and • Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles. It also qualifies for the presence of the following species listed on Annex II of the EU Habitats Directive: • freshwater pearl mussel (*Margaritifera margaritifera*).	35 m north at closest point	2.5 Km to NE	International
Owenkillew River ASSI	The Owenkillew is a large river, being ultra-oligotrophic in its upland reaches gradually becoming oligotrophic and oligo-mesotrophic through its middle and lower reaches. It is notable for the physical diversity and naturalness of the banks and channel and the richness and naturalness of its plant and animal communities, which include extensive beds of stream water-crowfoot (*Ranunculus penicillatus* ssp. *penicillatus*) and its population of freshwater pearl mussel, the largest remaining population in Northern Ireland.	35 m north at closest point	2.5 Km to NE	National

Designated Site	Reason for Importance/Designation	Location in Relation to Project Sites	Location in Relation to centre of proposed infrastructure site	Level of Value
Drumlea and Mullan Woods ASSI	At 32 ha, Drumlea and Mullan Woods is the third largest intact semi-natural broad-leaved woodland in the Sperrins Mountains and one of the largest representative examples of mature calcifugous oak woodland in Northern Ireland. The woodland is particularly notable for the diversity and abundance of its bryophyte and lichen species particularly those associated with acidic oak woodland. The site is known to support a wide range of mammal and bird species.	79 m north at closest point	3.5 km to NW	National
Owenreagh River pASSI	Site proposed to be designated for its population of freshwater pearl mussel.	945 m south west at closest point	1.9 km to SW	National
Mullaghcarn ASSI	Mullaghcarn, covering some 2068 ha, is of special interest because of features formed by the interaction of ice, rock and water towards the end of the last Ice Age and is one of the best examples of proglacial delta landform assemblage in Northern Ireland. Its biological importance lies in its upland habitat mosaic of peatland, lakes and woodland and associated flora and fauna.	2.3 km south west at closest point	6.8 km to W	National
Murrins ASSI	The Murrins complex is a largely pristine moraine-outwash assemblage which demonstrates the retreat of a major discrete ice body centred on the Omagh Basin late in the last (Midlandian) deglaciation. The landform assemblage is important in demonstrating the complexity of subglacial to proglacial depositional processes during the deglacial cycle and comprises some of the best-preserved moraine ridges in Northern Ireland. An upland peatland complex extends over much of the glacial outwash plain, consisting of several intermediate raised bog units within an enveloping blanket bog mantle. A number of notable plant species have been recorded. To the south-west of Murrins, there are a number of glacial moraines, or eskers, where wet and dry heaths have developed on sands and gravels. A number of distinct upland lakes occur within the kettle holes of the outwash complex. Tall Bog-sedge (*Carex magellanica*) one of the rarest sedges in Ireland is found at some of these lakes.	3.7 km south at closest point	5.1 km to S	National
Black Bog Ramsar site	Black Bog qualifies as a Ramsar site under: • Criterion 1 by being a particular good representative example of lowland raised bog in the UK.	4.3 km south east at closest point	5 km to SE	International

Designated Site	Reason for Importance/Designation	Location in Relation to Project Sites	Location in Relation to centre of proposed infrastructure site	Level of Value
Black Bog SAC	The Black Bog qualifies as a SAC for the following habitats as listed under Annex I of the EU Habitats Directive: • Active raised bogs.	4.3 km south east at closest point	5 km to SE	International
Black Bog ASSI	Black Bog is thought to be the largest remaining area of undamaged lowland raised bog in Northern Ireland. The site is especially important for its extensive hummock-hollow complex, high cover of *Sphagnum* species, and largely intact lagg. In the past Black Bog has suffered from relatively little burning, and there are consequently some very large *Sphagnum* hummocks including *Sphagnum imbricatum* and *Sphagnum fuscum*.	4.3 km south east at closest point	5 km to SE	National
The Murrins NR	A dry raised fan of material that supports a rich heath vegetation which is used by red grouse (*Lagopus lagopus*). The dry ridges extend out into surrounding areas of blanket bog.	4.8 km south at closest point	5.1 km to S	National

4.2.11 Significance of Potential Environmental Effects

Describing the Impact:

The rationale for describing the impact of the proposed development is derived from the Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) guidance (EPUK & IAQM) "Land-Use Planning & Development Control: Planning for Air Quality (January 2017).

There is a two-stage process to be followed in the assessment of air quality impacts

- 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

The suggested framework for describing the impacts is set out in Table 6.3 of the EPUK & IAQM guidance document and is shown in Table 2 below. The term Air Quality Assessment Level (AQAL) has been adopted as it covers all pollutants, i.e. those with and without formal standards. AQAL is used to include air quality objectives or limit values where these exist. The Environment Agency uses a threshold criterion of 10% of the short term AQAL as a screening criterion for the maximum short-term impact. The EPUK & IAQM guidance adopts this as a basis for defining an impact that is sufficiently small in magnitude to be regarded as having an insignificant effect.

Table 16: Impact descriptors for individual receptors

Long term average Concentration at Receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Moderate
103-109% f AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Explanation
1. AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.
2. The Table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. The user is encouraged to treat the numbers with recognition of their likely accuracy and not assume a false level of precision. Changes of 0%, i.e. less than 0.5% will be described as Negligible.
3. The Table is only designed to be used with annual mean concentrations.
4. Descriptors for individual Receptors only; the overall significance is determined using professional judgement (see Chapter 7). For example, a 'moderate' adverse impact at one Receptor may not mean that the overall impact has a significant effect. Other factors need to be considered.
5. When defining the concentration as a percentage of the AQAL, use the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme;' concentration for an increase.
6. The total concentration categories reflect the degree of potential harm by reference to the AQAL value. At exposure less than 75% of this value, i.e. well below, the degree of harm is likely to be small. As the exposure approaches and exceeds the AQAL, the degree of harm increases. This change naturally becomes more important when the result is an exposure that is approximately equal to, or greater than the AQAL.
7. It is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the AQAL. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the AQAL, rather than being exactly equal to it.

2.5.2 Assessing Significance:

The rationale for the assessment of significance is derived from the EPUK & IAQM Guidance (paragraphs 7.1-7.12 referring to Table 6.3) and relates to Table 2 above.

Impacts on air quality, whether adverse or beneficial, will have an effect on human health that can be judged as 'significant' or 'not significant'. An 'impact' is the change in the concentration of an air pollutant, as experienced by a Receptor. This may have an 'effect' on the health of a human Receptor, depending on the severity of the impact and other factors that may need to be taken into account. The impact descriptors set out in Table 2 are not, of themselves, a clear and unambiguous guide to reaching a conclusion on significance. These impact descriptors are intended for application at a series of individual Receptors. Whilst it may be that there are 'slight', 'moderate' or 'substantial' impacts at one or more Receptors, the overall effect may not necessarily be judged as being significant in some circumstances.

Any judgement on the overall significance of effect of a development will need to take into account such factors as:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts; and
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts.
- Other factors may be relevant in individual cases.

5 Existing Environment

5.1 Summary of Baseline Air Quality & Dust Level Monitoring

A detailed baseline Air Quality and Dust monitoring report is included in Annex B.

5.1.1 Dust & Heavy Metal Deposition Monitoring Methodology

The average dust deposition rates recorded in the area of the Curraghinalt Project since July 2011 undertaken by DGL, SLR and Envest are well in accordance with the relevant limit value of 350 mg/m^2/day at all monitoring locations.

Analysis of the monthly metal deposition rate indicates that there was occasional exceedances of TA Luft assessment guideline limits for trace metals in the baseline metal deposition results. However, it was mainly found that many of the reported levels were found to be below the limit of detection of the accredited laboratory procedures.

5.1.2 Continuous Particulate Monitoring – TSP, PM_{10}, $PM_{2.5}$, & PM_1 & Metal Analysis

The average particulate concentrations for PM_{10} and $PM_{2.5}$ since October 2015 at AQML 1, AQML 1A and AQML 5 have been compared against the relevant Air Quality Standards Regulations (Northern Ireland) annual mean limits for PM_{10} and $PM_{2.5}$ which are 40 µg/m^3 and 25 µg/m^3 respectively. The average monthly PM_{10} and $PM_{2.5}$ concentrations for the monitoring period at each monitoring location are significantly less than the annual average limit value. Average PM_{10} concentrations are less than 25% of the relevant annual mean limit value of 40 µg/m^3. Average $PM_{2.5}$ concentrations are less than 20% of the relevant annual mean limit value of 25 µg/m^3. The 24-hour limit value for PM_{10} is 50 µg/m^3, which allows for 35 exceedances of the 50 µg/m^3 limit value during an annual period. At each monitoring location, all of the daily concentrations were well below the daily limit value of 50 µg/m^3.

Analysis of the 25mm GFA filters in the Osiris instruments for a suite of metals allowed for the ambient concentration of metals in the atmosphere to be reported. Ambient metal concentrations were also found to be well below the relevant Air Quality Standards annual mean limit values.

5.1.3 Diffusion Tube Monitoring – NO_x, NO_2, SO_2, BTEX and VOC

The passive diffusion tube monitoring for nitrogen oxides (NOx), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), BTEX and volatile organic compounds (VOC) undertaken at seven locations since October 2015 over single monthly intervals (30+/-2 day periods) has shown that there is no exceedance of the relevant Air Quality Standards Regulations (Northern Ireland) annual mean limits for NOx, NO_2, SO_2 and benzene.

The average NO_2 concentration across the seven monitoring locations is 3.8 µg/m^3, i.e. 9.5% of the relevant Air Quality Standards Regulations annual mean limit for the protection of human health of 40 µg/m^3. The average benzene concentration across the seven monitoring locations is 0.875 µg/m^3, i.e. 17.5% of the relevant Air Quality Standards Regulations annual mean limit for the protection of human health of 5 µg/m^3. The average SO_2 concentration across the seven monitoring locations is 1 µg/m^3, i.e. 5% of the relevant Air Quality Standards Regulations critical levels for the protection of vegetation of 20 µg/m^3. The average NOx concentration measured across the seven monitoring locations is 9 µg/m^3, i.e. 30% of the relevant Air Quality Standards Regulations critical levels for the protection of vegetation of 30 µg/m^3.

6 Impact Assessment

6.1 Construction Air Quality & Dust Impact Assessment

6.1.1 Introduction

The construction phase of the proposed infrastructure site is anticipated to last for a period of approximately 2 years (including construction of infrastructure and initial development of the mine workings). The construction phase will comprise site preparation and construction of mine-related infrastructures and will involve a small amount of blasting, topsoil removal, road grading and construction, bulldozing, material loading and hauling, stockpiling, building construction, etc.

A route for a 33kV powerline from Strabane to the site has also been proposed by NIE. According to NIE, the route takes account of existing linear infrastructure and has been aligned so that it follows property boundaries, fences and hedges where possible. It has also been selected with the aim of avoiding disturbance of houses and potential development sites, forestry sites, agricultural operations and other landowner activities. Furthermore, it has been selected recognising the need to maintain clearances from specified structures such as phone masts and wind turbines and to minimise crossings with other 33kv and 110kv power lines.

Typical construction machinery and equipment will be utilised during the construction of the proposed infrastructure site including:

- Dump trucks
- Front end loaders
- Excavators, mobile crusher & shovels
- Asphalt Paver and Road roller

6.1.2 Construction Dust Impact Assessment

The Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction (2014) has been referenced to assess the potential impact of the construction of the proposed infrastructure site. Good practice construction mitigation measures are recommended to be implemented to minimise emission quantities during construction.

Step 1: Screening the Need for a Detailed Assessment

An assessment will normally be required where there is:

- a ‘human receptor’ within:
    - 350 m of the boundary of the site; or

  - 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s)
- an 'ecological receptor' within:
  - 50 m of the boundary of the site; or
  - 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

STEP 2: Assess the Risk of Dust Impacts

The risk of dust arising in sufficient quantities to cause annoyance and/or health and/or ecological impacts should be determined using four risk categories: negligible, low, medium and high risk. 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 as small, medium or large (STEP 2A); and
- the sensitivity of the area to dust impacts (STEP 2B), which is defined as low, medium or high sensitivity.

These two factors are combined in STEP 2C to determine the risk of dust impacts with no mitigation applied. The risk category assigned to the site can be different for each of the four potential activities (demolition, earthworks, construction and trackout). More than one of these activities may occur on a site at any one time. Where appropriate, the site can be divided into 'zones' for the dust risk assessment.

Step 2A: Define the Potential Dust Emission Magnitude

Earthworks, construction and trackout will occur during the construction phase. No demolition will occur. Table 17 describes the potential dust emission class criteria for each outlined construction activity.

Table 17: Criteria Used in the Determination of Dust Emission Class

Activity	Criteria used to Determine Dust Emission Class		
	Small	Medium	Large
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

The potential dust emission magnitudes for the proposed development were determined using the criteria detailed in Table 17 as follows;

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 will be greater than 100,000m^3.
- Potentially dusty construction material e.g. concrete will be used.
- The dust emission magnitude for construction was therefore defined as **Large**.

Trackout:

- There will be more than 50 outward HGV movements in any one day.
- The unpaved road length on site will be greater than 100m, until all paved site roads are installed as planned.
- The dust emission magnitude for trackout was therefore defined as **Large**.

Step 2B: Define the Sensitivity of the Area

The sensitivity of the area takes 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, such as trees, to reduce the risk of wind-blown dust.

The criteria for determining the sensitivity of receptors is detailed in Table 18 for dust soiling effects and health effects of PM_{10}.

Table 18: 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}
Low	Playing fields, farmland, footpaths, short-term car parks and roads	Public footpaths, playing fields, parks and shopping streets

The criteria detailed in Tables 19 and 20 were used to determine the sensitivity of the area to dust soiling effects and human health impacts. The numbers of properties within the specific distance bands, as detailed in Table 22, from the site boundary were used in the construction phase assessment.

Table 19: Sensitivity of the Area to Dust Soiling Effects on People and Property.

Receptor Sensitivity	Number of Receptors	Distance from Source (m)			
		<20m	<50m	<100m	<350m
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 20: Sensitivity of the Area to Human Health Impacts.

Receptor Sensitivity	Annual Mean PM_{10} Conc	Number of Receptors	Distance from Source (m)				
			<20m	<50m	<100m	<200m	<350m
High	>32 µg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m³	>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

Dust deposition has the potential to affect sensitive habitats and plant communities. Dust can have two types of effect on vegetation: physical and chemical. Direct physical effects include reduced photosynthesis, respiration and transpiration through smothering. Chemical changes to soils or watercourses may lead to a loss of plants or animals for example via changes in acidity. Indirect effects can include increased susceptibility to stresses such as pathogens and air pollution. These changes are likely to occur only as a result of long-term demolition and construction works adjacent to a sensitive habitat. Often impacts will be reversible once the works are completed, and dust emissions cease. Professional judgement is required to identify where on the spectrum between high and low sensitivity a receptor lies, taking into account the likely effect and the value of the ecological asset. A habitat may be highly valuable but not sensitive, alternatively it may be less valuable but more sensitive to dust deposition. The effect of dust deposition on ecologically sensitive receivers has been addressed in the Ecology Impact Assessment.

Table 21: Number of residential properties within 20m, 50m, 100m, 200m and 350m of the site boundary.

Location	Number of Receptors within Distance from Site (m)				
	<20m	<50m	<100m	<200m	<350m
Processing Site Boundary	0	0	0	0	1
Processing Site Entrance & Access Road	0	1	1	1	8

Sensitivity of People to Dust Soiling

- Construction and earthworks:

  There are 11 residential properties within 350m of the proposed infrastructure site boundary including the entrance and access road. There are no hospitals, schools, residential care homes, offices, public footpaths, playing fields, parks and shopping streets within 350m of the proposed infrastructure site boundary. Therefore, the sensitivity of the area is **Low**; in terms of potential construction and earthworks dust impacts.
- Trackout:

  As shown in Table 21, there is one residential property within 50m of site entrance / access road, one residential property within 100m of site access road, one residential property within 200m of site access road and eight residential properties within 350m of site access road. There is no public footpath located within 50m of the site entrance / access road. Therefore, the sensitivity of the area is **Low**; in terms of potential trackout dust impacts.

Sensitivity of People to Health Effects of PM_{10}

The annual mean PM_{10} concentration in the area has been measured over a year long survey to be approximately 11 µg/m^3, i.e. approximately 27.5% of the relevant ambient air quality limit value.

- Construction and Earthworks:
  There are less than 10 residential properties within 350m of the proposed infrastructure site boundary including the entrance and access road. There are no hospitals, schools, residential care homes, offices, public footpaths, playing fields, parks and shopping streets within 350m of the proposed infrastructure site boundary. Therefore, the Sensitivity of People to Health Effects of PM_{10} is Low; in terms of potential construction and earthworks dust impacts.
- Trackout:
  As shown in Table 21, there is one residential property within 50m of site entrance / access road, one residential property within 100m of site access road, one residential property within 200m of site access road and eight residential properties within 350m of site access road. There is no public footpath located within 50m of the site entrance / access road. Therefore, the Sensitivity of People to Health Effects of PM_{10} is Low; in terms of potential trackout dust impacts.

The sensitivity of the area to dust soiling and human health impacts for each activity is summarised in Table 22.

Table 22: Outcome of Defining the Sensitivity of the Area

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

Step 2C: Define the Risk of Impacts

The dust emission magnitude and sensitivity of the area have been combined and the risk of impacts from earthworks, construction and trackout, before mitigation is applied, was determined. The risk of dust soiling and impact on human health before mitigation is summarised in Table 23.

Table 23: Summary Dust Risk Table to Define Site-specific Mitigation

Potential Impact	Risk		
	Earthworks	Construction	Trackout
Dust Soiling	Low Risk	Low Risk	Low Risk
Human Health	Low Risk	Low Risk	Low Risk

Step 3: Site-Specific Mitigation

The construction mitigation measures to be undertaken during the construction of the Curraghinalt Project have been detailed in Section 7.0 Mitigation Measures. Despite the identification of the proposed infrastructure site as a low risk site for human receptors in the area detailed construction dust mitigation measures have been recommended.

Step 4: Determine Significant Effects

Standard and typical construction site dust control measures and good construction site management and practice is capable of effectively mitigating the potential for significant impact of fugitive dust emissions. Therefore, the potential for fugitive dust emission effects at the nearest residential properties will be controlled to ensure impacts are of negligible significance. IAQM (2014) recommends that significance is only assigned to the effect after considering the construction activity with mitigation. Therefore, the detailed mitigation measures have been defined in a form suitable for implementation by way of a planning condition, and will be included in a Construction Environmental Management Plan.

A small number of sensitive residential properties have been noted within 350m of the boundary of the proposed infrastructure site. No ecological receptors of High, Medium or Low Sensitivity to dust impacts are located within 50m of proposed construction works on the proposed infrastructure site. Using the IAQM (2014) methodology for the assessment of air quality impacts from construction activities has indicated that the risk of dust soiling impacts and / or impacts on human health are low. Therefore, in terms of significance of impacts arising from the risks identified are summarised in Table 24. Together with the proposed construction mitigation measures and the existing low background particulate (PM_{10}) concentrations, the construction phase activities on the proposed infrastructure site will not cause an exceedence of the air quality objectives at receptor locations.

Table 24: Summary Dust Risk Table to Define Site-specific Mitigation

Potential Impact	**Significance**		
	Earthworks	**Construction**	**Trackout**
Dust Soiling	Negligible	Negligible	Negligible
Human Health	Negligible	Negligible	Negligible

6.1.3 Air Quality & Dust Impact from Construction Traffic on Public Roads

Vehicular Emissions from Public Roads during Construction

The predicted pollutant concentrations during construction in the vicinity of the local public roads due to traffic emissions are outlined in Table 25. This is based on the Annual Average Daily Traffic (AADT) flows in proximity to the proposed development as outlined in Table 10. The DMRB assessment has been based on a worst-case year of assessment of 2018.

Table 25: Predicted pollutant concentrations during construction in the vicinity of the local public roads due to traffic emissions.

Road & Receptor Location	Pollutant concentrations at receptor (excluding Background Concentrations for all pollutants except for PM_{10})						
	CO	Benzene	1,3-butadiene	NO_x	NO_2	PM_{10}	
	Annual mean mg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Days >50 µg/m^3
At Site Entrance - AQSR 13 - Without	0.00	0.00	0.00	6.42	4.11	11.05	0.00
At Site Entrance - AQSR 13 - With	0.00	0.00	0.00	6.52	4.15	11.06	0.00
At Rouskey Village - Without	0.00	0.00	0.00	6.77	4.25	11.09	0.00
At Rouskey Village - With	0.00	0.00	0.00	6.92	4.30	11.10	0.00
At Camcosy Road - Without	0.00	0.00	0.00	6.07	3.97	11.02	0.00
At Camcosy Road - With	0.00	0.00	0.00	6.17	4.01	11.03	0.00
Lenagh Road Junction at HGV Turning Circle - Without	0.00	0.00	0.00	6.71	4.22	11.08	0.00
Lenagh Road Junction at HGV Turning Circle - With	0.00	0.00	0.01	7.30	4.45	11.12	0.00
At Greencastle Village - Without	0.01	0.01	0.01	8.25	4.81	11.24	0.00
At Greencastle Village - With	0.01	0.01	0.01	8.32	4.83	11.24	0.00
Limit Value	10 mg/m^3	3.25 µg/m^3	2.25 µg/m^3	30 µg/m^3	40 µg/m^3	40 µg/m^3	35

The predicted air quality pollutant concentration results have been compared with the relevant Air Quality Standards Regulations (Northern Ireland) 2010 limit values (See Table 1). Using the information as described, the results of the DMRB Screening assessment indicate that there will be a very small increase of the NO_2 and PM_{10} concentrations in proximity to the local public roads due to traffic emissions. Tables 26 & 27 summarise the DMRB Screening assessment predictions and the description of impact on air quality at the relevant receptor locations.

Table 26: Description of impact on NO_2 concentrations during construction in proximity to the local public roads.

Receptor	Absolute Change	Relative Change (% of AQS limit)	Percentage of predicted concentration relative to AQS	Significance
At Site Entrance - AQSR 13	0.04	0.1%	10.08%	Negligible
At Rouskey Village	0.06	0.15%	10.76%	Negligible
At Camcosy Road	0.04	0.1%	10.03%	Negligible
Lenagh Road Junction at HGV Turning Circle	0.23	0.57%	11.13%	Negligible
At Greencastle Village	0.02	0.06%	12.08%	Negligible

Table 27: Description of impact on PM_{10} concentrations during construction in proximity to the local public roads.

Receptor	Absolute Change	Relative Change (% of AQS limit)	Percentage of predicted concentration relative to AQS	Significance
At Site Entrance - AQSR 13	0.01	0.025%	27.66%	Negligible
At Rouskey Village	0.02	0.025%	27.75%	Negligible
At Camcosy Road	0.01	0.025%	27.57%	Negligible
Lenagh Road Junction at HGV Turning Circle	0.04	0.1%	27.79%	Negligible
At Greencastle Village	0.01	0.02%	28.1%	Negligible

As outlined in Section 7 Assessing Significance of EPUK/IAQM guidance document a judgment of significance should be made by a competent professional. There will be a small increase in local traffic flows during the construction phase of the proposed infrastructure site. This will result in a negligible impact on the air quality in the vicinity of the proposed infrastructure site. In accordance with IAQM and the DMRB Screening Assessment guidance and methodology a detailed atmospheric dispersion model is not required.

Dust Emissions from Road Haulage Vehicles during Construction

As the proposed portal site is over 1.5 km from the underground mine, it will take approximately two years to excavate the planned decline to link the mine workings with the main portal entrance. During this time, the current exploration portal entrance will be used to provide access points for underground mine development and for training purposes. The existing adit and exploration portal will permit up to 36 HGVs per day to carry waste rock from the mine development to the new DSF during the construction phase.

Waste rock and ore generated from mine development will be trucked to surface using mine haul trucks. Once on surface the waste will be stockpiled and then re-loaded into HGVs. Waste and ore will be transported Monday to Saturday and approximately 35 trucks loads per day will travel from the existing portal site along the Camcosy Road to Crockanboy Road and then onto the site access road. For safety reasons, the HGVs will be required to turn right onto the Crockanboy road and then use a specific turning area off the main road to turn and continue towards the new mine infrastructure area. The waste rock will be used for road and berm construction with any excess reporting to the DSF. Ore will be delivered to the ore stock pile in preparation for the start of the process plant. Waste rock and ore will be hauled from the exploration portal. Once construction is complete, no further waste or ore will be hauled from the exploration portal. Once the main entrance to the mine has been constructed, the secondary (existing) portal will then be retained as an additional access point to the mine for safety and ventilation purposes, as well as on-going training.

As a means of dust control, the estimated 35 trucks loads per day of waste and ore will be covered by tarpaulin to prevent fugitive dusts from transport along the Camcosy Road, Crockanboy Road and the site access road.

6.2 Operational Air Quality & Dust Impact Assessment

6.2.1 Introduction

Potential sources of Air Quality & Dust impacts at the nearest residential receptors during the Operation Phase include;

- Potential air pollutant & dust emissions from underground mineral extraction operations;
- Potential air pollutant & dust emissions from haulage of extracted mineral from the Decline Portal to the crushing plant;
- Potential dust emissions from crushing activities;
- Potential dust emissions from conveying of crushed materials to the PPC permitted process plant;
- Potential air pollutant & dust emissions from the placement of waste rock and filtered tailings in the DSF including haul road movements;
- Potential air pollutant & dust emissions from development generated road traffic, including employee access and associated HGV movements to and from the site;
- Potential emissions from the ventilation of underground mining operations;
- Potential emissions from process stacks associated with the Processing Building operations; and
- Potential mine shaft and process plant air pollutant & dust sources, such as generators, vents, etc.

Potential dust deposition impacts due to the operation of the mine and associated equipment will result from the following specific sources;

- Dust Emissions from Unpaved Roads / Haul Routes,
- Dust Emissions from Aggregate Handling & ROM Stockpiles,
- Dust Emissions from Crushing Operations & Conveyors, and
- Dust Emissions from Earth Moving & Compaction at DSF

As expected for such a mining development, relatively large scale equipment will be utilised on the site such as:

- Dump trucks
- Front end loaders
- Excavators
- Vibratory Roller
- Conveyors
- Crushing and grinding equipment

The proposed concrete batching plant will be located underground. Therefore, this will not be a significant air pollutant & dust source. Also, as the proposed mineral extraction will occur in underground mine workings, there will be no potential for large scale dust emission rates from the mine workings such as may occur at an open pit mine. The underground mining operations will be ventilated via ventilation raises. Vent raise emission dispersion modelling has been undertaken based on air pollutant monitoring and relevant occupational exposure limits.

A detailed air pollutant and dust emission inventory for the Curraghinalt Project has been prepared and used to produce air pollutant & dust dispersion models to predict potential worst-case impacts at the nearest receptors.

The main potential dust pollution sources of the project are as follows:

- <u>The transport of ore using haul trucks;</u> Blasted waste rock (un-mineralised material) and ore (mineralised material) from the underground mining activities will be loaded by low profile rubber tyre load-haul-dump (LHD) units into 40 tonne capacity trucks for transportation to the designated storage areas and the processing facility on surface. On average, approximately 1,500 tonnes of ore and waste will be hauled to surface daily.

- <u>Crushing;</u> Mineralisation from the mine will be delivered by haul truck to the crushing area where it will be either placed on a Run-of-Mine (ROM) stockpile or carried using a front loader to the crusher which is to be housed in a specifically designed crusher building. A jaw crusher housed indoors in a specifically designed building will reduce the size of the mineralisation such that it is suitable for processing in the grinding circuit. After crushing, the ROM material will be conveyed to a covered dome stockpile for storage prior to grinding in the SAG Mill within the Processing Building via covered conveyors.

- The haulage of waste on trucks to the DSF; Waste rock will be placed in the DSF. The DSF will contain both waste rock and filtered tailings from the floatation plant. The DSF is designed to be built from the ground level to its ultimate crest elevation by placing material at its natural angle of repose in 3m lifts. The toe of each subsequent lift would be set back 9m from the crest of the previous lift, resulting in an overall angle of 3:1V. As the DSF will be sequenced, reclamation will be an ongoing process as the side slopes are developed and each phase is completed. Reclamation details are further developed in the closure planning section of the Environmental Statement. Waste rock will be placed and compacted using a bulldozer and vibratory roller both of which will operate intermittently on the DSF.

6.2.2 Dispersion Modeling of Air Pollutant & Dust Emissions

For the air deposition models, the haulage route to the crusher, the ore offloading and stockpiling area, the DSF area, site access roads, etc. as well as all project infrastructure were accurately imported into the dispersion model as per the design drawings provided. The existing ground contours surrounding the site as well as the proposed ground contours of the proposed infrastructure site were imported into the dispersion model. The following air dispersion models have been prepared;

- *Dispersion Model 1:*
  Particulate emissions from all process stacks (points sources) on site as per the emission rates presented in Table 5. Table 28 presents the predicted particulate (PM_{10}) concentrations at sensitive receptors due to the proposed infrastructure site.
  Column 3 of Table 28 presents the 90.4%ile of 24 Hour PM_{10} Concentrations (µg/m^3) from proposed infrastructure site Process Stack Emissions. Column 4 of Table 28 presents the Annual Mean PM_{10} Concentrations (µg/m^3) from proposed infrastructure site Process Stack Emissions.
  See Annex A - Figures 1 & 2.

- *Dispersion Model 2:*
  Total Suspended Particulate (TSP), PM_{10} and $PM_{2.5}$ emissions from the following sources during Years 1-5 (i.e. with operational area on the DSF in closest proximity to nearest receptors east and south-east of the DSF). Table 29 presents the predicted dust

deposition rates and ambient PM_{10} and $PM_{2.5}$ concentrations at sensitive receptors in proximity to the proposed infrastructure site due to the following sources;

- Paved Road Dust Emissions - Haul Road from Decline Portal to ROM Stockpile & Haul road from Processing Building to DSF (Line Volume Source) as per the emission rates presented in Table 7.
- Unpaved Road Dust Emissions - Haul Road across DSF (Line Volume Source) as per the emission rates presented in Table 7.
- ROM Stockpile Area Dust Emissions – 20m x 35m stockpile area adjacent to Crusher Building (Area Source) as per the emission rates presented in Table 8.
- DSF Working Area Dust Emissions – 50m x 50m area on DSF (Area Source) as per the emission rates presented in Table 9.

Table 29 presents the maximum 24 - Hour Dust Deposition Rate (mg/m^2/day),the Total Annual Particulate Deposition (mg/m^2/year), the 90.4 percentile of 24 Hour PM_{10} concentrations (μg/m^3), the annual mean PM_{10} concentrations (μg/m^3) and the annual mean $PM_{2.5}$ concentrations (μg/m^3) during DSF Operational Years 1 - 5.
See Annex A - Figures 3 & 4 and Figures 18 - 20.

- *Dispersion Model 3:*

Total Suspended Particulate (TSP), PM_{10} and $PM_{2.5}$ emissions from the following sources during Years 16-20 (i.e. with operational area on the DSF in closest proximity to nearest receptors south-west and west of the DSF). Table 28 presents the predicted dust deposition rates at sensitive receptors in proximity to the proposed infrastructure site due to the following sources;

- Paved Road Dust Emissions - Haul Road from Decline Portal to ROM Stockpile & Haul road from Processing Building to DSF (Line Volume Source) as per the emission rates presented in Table 7.
- Unpaved Road Dust Emissions - Haul Road across DSF (Line Volume Source) as per the emission rates presented in Table 7.
- ROM Stockpile Area Dust Emissions – 20m x 35m stockpile area adjacent to Crusher Building (Area Source) as per the emission rates presented in Table 8.
- DSF Working Area Dust Emissions – 50m x 50m area on DSF (Area Source) as per the emission rates presented in Table 9.

Table 29 presents the maximum 24 - Hour Dust Deposition Rate (mg/m^2/day),the Total Annual Particulate Deposition (mg/m^2/year), the 90.4 percentile of 24 Hour PM_{10} concentrations (μg/m^3), the annual mean PM_{10} concentrations (μg/m^3) and the annual mean $PM_{2.5}$ concentrations (μg/m^3) during DSF Operational Years 16 - 20.
See Annex A - Figures 5 & 6 and Figures 21 - 23.

- *Dispersion Model 4:*

Air Pollutant & Dust emissions from the proposed Ventilation Raises

Table 32 presents the predicted Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Sulphur Dioxide (SO_2), PM_{10} and Benzene concentrations from all ventilation raise emissions.

See Annex A - Figures 7 - 15.

- *Dispersion Model 5:*

  Mercury emissions from the Mercury Retort Scrubber Stack and the Smelting Furnace Bag House Stack (points sources) on site as per the emission rates presented in Table 5.

  Table 28 presents the predicted annual mean mercury concentrations at sensitive receptors due to the proposed infrastructure site. The assessment assumes that the Mercury Retort Scrubber Stack and the Smelting Furnace Bag House Stack will operate continuously which will not be the case, as it will operate only over a few hours per week.

  The maximum predicted mercury deposition in proximity to the site is less than the prediction limit in the AERMOD model.

  The mercury retort system will remove all mercury from emissions to atmosphere.

  Column 5 of Table 28 presents the annual mean mercury concentrations (µg/m^3) from proposed infrastructure site Process Stack Emissions.

- *Dispersion Model 6:*

  SO_2 emissions from the Smelting Furnace Bag House Stack (points sources) on site as per the emission rates presented in Table 5.

  Table 28 presents the predicted annual mean SO_2 concentrations at sensitive receptors due to the proposed infrastructure site. The assessment assumes that the Smelting Furnace Bag House Stack will operate continuously which will not be the case, as it will operate only over a few hours per week.

  Column 6 of Table 28 presents the annual mean SO_2 concentrations (µg/m^3) from proposed infrastructure site Process Stack Emissions.

NOTE: The small electric induction furnace and associated ventilation, gas scrubbing, handling and baghouse system will be used only during a gold pour, approximately twice a week. A caustic gas scrubbing system will remove the NOx and SO_2 and the baghouse system captures 99.9% of particulates over 1um in size, by passing through membrane media. As the project is using an electric furnace, there are almost no NOx or SO_2 emissions, i.e. Combustion gas emissions to atmosphere will be negligible. All exhaust gases will emit to atmosphere via stacks which will rise approximately 3m above the ridge height of the building.

Table 28: Predicted Particulate (PM_{10}), Mercury & Sulphur Dioxide Concentrations from Process Stack Emissions at sensitive receptors in proximity to the proposed infrastructure site.

Air Quality & Dust IA Ref No.	Address	90.4%ile of 24 Hour PM_{10} Conc ($\mu g/m^3$) - Process Stack Emissions	Annual Mean PM_{10} Conc ($\mu g/m^3$) - Process Stack Emissions	Annual Mean Mercury Conc ($\mu g/m^3$) - Stack Emissions	Annual Mean SO_2 Conc ($\mu g/m^3$) - Stack Emissions
AQSR 1	184 Crockanboy Road	0.441	0.145	0.00035	6.00E-05
AQSR 2	191 Crockanboy Road	0.519	0.166	0.00037	7.00E-05
AQSR 3	186 Crockanboy Road	0.509	0.163	0.00039	7.00E-05
AQSR 4	193 Crockanboy Road	0.549	0.167	0.00042	8.00E-05
AQSR 5	200 Crockanboy Road	0.526	0.180	0.00047	0.0001
AQSR 6	184 Crockanboy Road	0.670	0.219	0.00057	0.00011
AQSR 7	204 Crockanboy Road	0.760	0.222	0.00064	0.00013
AQSR 8	210 Crockanboy Road	0.556	0.183	0.00046	0.0001
AQSR 9	207 Crockanboy Road	0.558	0.165	0.00044	9.00E-05
AQSR 10	213 Crockanboy Road	0.415	0.135	0.00046	0.0001
AQSR 11	212 Crockanboy Road	0.480	0.155	0.00051	0.00011
AQSR 12	216 Crockanboy Road	0.807	0.230	0.00066	0.00014
AQSR 13	225 Crockanboy Road	0.318	0.108	0.00035	7.00E-05
AQSR 14	231 Crockanboy Road	0.329	0.102	0.00032	6.00E-05
AQSR 15	234 Crockanboy Road	0.441	0.160	0.00059	0.00012
AQSR 16	238 Crockanboy Road	0.380	0.145	0.00052	0.00011
AQSR 17	244 Crockanboy Road	0.428	0.158	0.00051	0.00011
AQSR 18	256 Crockanboy Road	0.328	0.122	0.00039	8.00E-05
AQSR 19	254 Crockanboy Road	0.528	0.216	0.00062	0.00013
AQSR 20	260 Crockanboy Road	0.627	0.222	0.00068	0.00014
AQSR 21	268 Crockanboy Road	0.567	0.192	0.0006	0.00012
AQSR 22	264 Crockanboy Road	0.684	0.227	0.0008	0.00017
AQSR 23	56 Mullydoo Road	1.291	0.401	0.00152	0.00033
AQSR 24	276 Crockanboy Road	0.633	0.195	0.00061	0.00013
AQSR 25	146 Greencastle Road	0.581	0.180	0.00054	0.00011
AQSR 26	164 Greencastle Road (Presbytery)	0.382	0.139	0.0004	8.00E-05
AQSR 27	170 Greencastle Road	0.480	0.151	0.00035	7.00E-05
AQSR 28	172 Greencastle Road	0.546	0.169	0.00044	9.00E-05
AQSR 29	46 Mullydoo Road	0.491	0.167	0.00042	8.00E-05
AQSR 30	188 Greencastle Road	0.597	0.188	0.00052	0.0001
AQSR 31	198 Greencastle Road	0.651	0.207	0.00056	0.0001
AQSR 32	200 Greencastle Road	0.531	0.178	0.00049	9.00E-05
AQSR 33	204 Greencastle Road	0.651	0.206	0.00074	0.00015
Limit Values		50 μg/m3	40 μg/m3	-	20 μg/m3