13. ATMOSPHERIC EMISSIONS & AIR QUALITY

13.1 RECEIVING ENVIRONMENT

Air pollution is a local, regional and global problem that results from anthropogenic activity. The impact of air pollutants is wide and varied, affecting both the environment and human health.

13.1.1 Atmospheric Emissions

Greenhouse Gases

Increased atmospheric levels of greenhouse gases enhance the natural greenhouse effect and are widely recognised as the leading cause of climate change. The most important long-lived greenhouse gases are Carbon Dioxide (CO_2), Nitrous Oxide (N_2O), and Methane (CH_4). CO_2 arises from a range of sources including the combustion of fossil fuels. According to the EPA[22], Agriculture remains the single largest contributor to overall greenhouse gas emissions in Ireland, at 32.3% of the total, followed by Energy at 19.6% and Transport at 19.1%. The remainder is made up by Industry and Commercial at 15.4%, the Residential sector at 11.1% and Waste at 2.5% (see Figure 13.1).

The Energy sector, which is mainly electricity generation, shows a small decrease in emissions over the period 1990 – 2013. Over the time series, CO_2 emissions from electricity generation have decreased by 0.8%, whereas electricity consumption has increased by 104%. Emissions from electricity generation increased from 1990 to 2001 by 54.5% and have decreased by 36.1% between 2001 and 2013.

National emissions for 2012 and 2013 are presented in Table 13.1, which shows the continuing decrease in contributions from the Energy sector. The decrease reflects the improvement in efficiency of modern gas fired power plants replacing older peat and oil fired plants, and the increased share of renewables, primarily, wind power. Electricity generated from renewables increased by 6.6% between 2012 and 2013 with wind increasing by 13.2%.

Table 13.1: Greenhouse Gas Emissions 2012 & 2013 for Ireland

Mt CO_2 Equivalent	2012	2013	% Change
Energy	12.722	11.306	- 11.1 %
Industry & Commercial	8.987	8.929	- 0.7 %
Agriculture	18.169	18.647	2.6 %
Transport	10.837	11.068	2.1 %
Residential	6.233	6.396	2.6 %
Waste	1.272	1.466	15.2 %
Total	58.221	57.813	- 0.7%

Under the Kyoto agreement, Ireland committed to limiting the increase of greenhouse gases to 13% above its 1990 levels during the period 2008-2012 and a 20% reduction in emissions of 1990 levels by 2020. The baseline emissions total for Ireland was calculated as the sum of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emissions in

[22] Ireland's Greenhouse Emissions in 2013, EPA (October 2014)

1990 and the contribution from fluorinated gases in 1995.

The baseline value in CO_2 equivalent was established at 55.6 Mt and results in total allowable emissions of approximately 314.2 Mt over the commitment period, which equates to the average of 62.8 Mt per annum. Compliance with the Kyoto Protocol limit is achieved by ensuring that Ireland's total emissions in the period 2008-2012, adjusted for any offsets from activities under Article 3.3 and the surrender of any purchased Kyoto Protocol credits, are below 314.2 Mt at the end of the five-year period

The long-term trend in national emissions of greenhouse gases from 1990 to 2013 is shown in Figure 13.2. The total emissions peaked in 2001 at 70.3 Mt of equivalent CO_2 and were estimated to be 57.8 Mt CO_2 equivalent in 2013. Renewable electricity generation is estimated to have reduced CO_2 emissions in 2012 by 1.94 Mt, with the contribution by wind generation being a reduction of 1.51 Mt.

The greenhouse gas emission inventory for 2013 is the first year that compliance under the European Union's Effort Sharing Decision (Decision 406/2009/EC2) will be assessed. This Decision sets 2020 targets for sectors outside of the Emissions Trading Scheme (known as non-ETS sector emissions) and annual binding limits for the period 2013-2020. Ireland's target is to reduce non-ETS emissions by 20% by 2020 compared with 2005 levels.

In its overview of Ireland's greenhouse gas emission projections EPA has reported[23] that there continues to a significant risk that Ireland will not meet its 2020 EU targets even under the most ambitious emission reduction scenario. There is projected to be a cumulative distance to target of 7 – 24 Mt for the period 2013-2020 with Ireland breaching its annual limits in 2016-2017. Strong projected growth in emissions from transport and agriculture are the key contributors to this trend.

Other Emissions

The pollutants sulphur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOC) and ammonia (NH_3) are responsible for long-range transboundary air pollution such as acidification, eutrophication and ground-level ozone pollution.

- SO_2 is the major precursor to acid deposition, which is associated with the acidification of soils and surface waters and the accelerated corrosion of buildings and monuments. Emissions of SO_2 are derived from the sulphur in fossil fuels such as coal and oil used in combustion activities.
- NOx emissions contribute to acidification of soils and surface waters, tropospheric ozone formation and nitrogen saturation in terrestrial ecosystems. Motor vehicles are the principal sources of NOx emissions, through high-temperature combustion.
- VOCs are emitted as gases by a wide array of products including paints, paint strippers, glues, adhesives and cleaning agents. They also arise as a product of incomplete combustion of fuels and as such are a component of car exhaust and evaporative emissions.
- NH_3 emissions are associated with acid deposition and the formation of secondary particulate matter. The agriculture sector accounts for virtually all (over 98%) ammonia emissions in Ireland.

Under Article 4.1 of the National Emissions Ceiling Directive (2001/81/EC), Member

[23] Ireland's Greenhouse Gas Emission Projections 2013-2030, EPA (May 2014)

States were required to limit their annual national emissions of SO_2, NOx, VOC and NH_3 to amounts not greater than the emissions ceilings laid down in Annex 1 of the Directive, by the year 2010 at the latest. Ireland's position in 2011, as reported by the EPA[24] in relation to the above was as follows:

Table 13.2: Annual Air Emissions (2012)

Pollutant	Sulphur Dioxide	Nitrogen Oxides	VOC	Ammonia
Limit	42 kt	65 kt	55 kt	116 kt
Emissions	23.2 kt	71.2 kt	43.4 kt	104.6 kt

NOx emissions in Ireland decreased by 44% between 1990 and 2012 and by 32.9 kt, or 32%, since 2008. Nonetheless, limits were exceeded in 2012. The transport sector is the principal source of NOx emissions, contributing approximately 51% of the total in 2012. The power generation and industrial and sectors are the other main sources, accounting for 15% and 14% respectively of emissions with the remainder emanating from the residential / commercial and the agriculture sectors.

13.1.2 Air Quality

Ireland's air quality remains generally good. In this regard the country is fortunate to be located on the fringe of Western Europe, with a relatively mild climate and to have an almost continuous movement of clean air over the country. The prevailing winds from the Atlantic Ocean refresh and cleanse the air.

In 2008 the EU adopted the Clean Air for Europe (CAFÉ) Directive (2008/50/EC), which incorporated and consolidated all the main previous air quality limits and measurements techniques into one Directive. These related to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter (PM_{10}), lead, benzene and carbon monoxide in ambient air. In addition to the previous Directives, it includes a target value for fine particulate matter ($PM_{2.5}$).

The CAFÉ Directive was given effect in Ireland by the Air Quality Standards Regulations 2011, under which the EPA and Local Authorities are responsible for ambient air quality monitoring in Ireland.

EU legislation on air quality requires that Member States divide their territory into zones for the assessment and management of air quality. Ireland is divided into four such zones as shown in Figure 13.3, with the site at Grousemount being in Zone D. (Zones A-C cover the Dublin and Cork conurbations and towns with populations in excess of 15,000).

Air quality in Zone D areas is generally very good.

An EPA report[25] provided an overview of air quality in Ireland for 2013, based on data obtained from the 29 monitoring stations shown in Figure 13.4 that form the national ambient air quality network. The monitoring site in Zone D that is closest to Grousemount is at Valentia, Co. Kerry. Applicable limit values for each parameter and measured values in Zone D for NO_2 (three locations), SO_2 (two locations), O_3 (five locations), PM_{10} (three locations) and $PM_{2.5}$ (two locations) are presented in Table 13.3. All records were below the applicable limit values.

24 Ireland's Transboundary Gas Emissions in 2012; EPA (February 2014)
25 Air Quality in Ireland (2013) – Key Indicators of Ambient Air Quality; EPA

Table 13.3: Summary of Air Quality Assessment at Valentia

Parameter	Limit Value	Monitoring Locations	Zone D Locations	Zone D Result	Comment
NO_2 and NOx	Hourly 200 µg/m³ Calendar year 40 µg/m³	15	3	1 hour 38-100 µg/m³ Year 38-100 µg/m³	Below limit values
SO_2	Hourly 350 µg/m³ human health Daily 125 µg/m³ human health Calendar year 20 µg/m³ vegetation	10	2	1 hour 41-47 µg/m³ Year 2-3 µg/m³	Below limit values
CO	8 hour 10 mg/m³ human health	5	0	-	-
Ozone	Daily 8 hour mean 120 µg/m³ human heath (max. days 25/year) Total May-July 18,000 µg vegetation	11	5	8 hour 120-131 µg/m³ (1-5 days > 120 µg/m³) Year 43-72 µg/m³	Below limit values
Particulate Matter (PM_{10}, and Black Smoke)	Daily 50 µg/m³ (max. days 35/year) Calendar year 40 µg/m³	20	3	Daily 69-77 µg/m³ (2-7 days > 50 µg/m³) Year 11-15 µg/m³	Below limit values
Particulate Matter $PM_{2.5}$	Calendar year 25 µg/m³ (2015) Calendar year 20 µg/m³ (2020)	7	2	Year 8-17 µg/m³	Below limit values

Concentrations of ozone, which is also a transboundary pollutant, are higher in rural areas than is urban areas with locations on the west coast having the highest concentrations in Ireland. This is due to the absence of the nitrogen oxide in rural areas as an ozone scavenger.

Existing sources for potential air quality issues on the site are as follows:

- Exhaust emissions from forestry removal equipment, during extraction and transport of trees from the areas of felling.
- Agricultural activities such as spreading of fertiliser.

These are not considered to be significant.

13.1.3 Climate

The temperature regime in Ireland is greatly affected by the moderating effect of the sea and height above sea level. Mean annual temperatures generally range between 9 ºC and 10 ºC with the highest values in coastal regions. Generally there has been an increase of approximately +0.5 ºC in mean temperatures between the periods 1961-1990 and 19881-2010 with the highest increases in the south east.

The highest rainfall occurs in the western half of the country and on high ground, Averaged all over Ireland, the average annual rainfall is approximately 1,230 mm. On an annual basis, averaged over the country, there has been an increase of approximately 5% in rainfall totals between the periods 1961-1990 and 1981–2010, with the higher increases in the western half of the country.

Mean climatological data for the 30 year period 1961-1900 for the closest meteorological station, which is located at Valentia approximately 70 km west of Grousemount, is summarised in Table 13.4.

13.1.4 Policy

In the context of Natural Environment the Kerry County Development Plan 2009 – 2015 outlines objectives relating to air quality as follows:

Objective No.	It is an objective of the Council to:
EN 11-2	Ensure that policies to counter global warming and climate change are incorporated into the policies and the development management system of Kerry County Council.
EN 11-20	Protect air quality in County Kerry in accordance with prescribed standards.

The proposed development is fully compatible with and is supported by the above Objectives.

13.2 IMPACT OF THE DEVELOPMENT

13.2.1 Atmospheric Emissions

Electricity generation at Grousemount Wind Farm will not lead to environmental emissions.

A study[26] by the International Energy Agency (IEA) showed that renewable energy, and particularly wind energy, must dominate the electricity generation sector in a sustainable energy future. The IEA has clearly acknowledged that wind power is now a main-stream energy technology and that it must play a central role in combating climate change.

[26] Energy Technology Perspectives; International Energy Agency, 2008

Table 13.4: Monthly and Annual Mean and Extreme Values for Valentia (1961-1990)

Data	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (ºC)	Mean Daily Max.	9.3	9.3	10.5	12.2	14.3	16.4	17.9	18.0	16.6	14.3	11.4	10.1	13.4
	Mean Daily Min.	4.2	3.9	4.6	5.5	7.5	10.1	11.7	11.6	10.3	8.6	6.0	5.0	7.4
	Mean	6.8	6.6	7.6	8.9	10.9	13.3	14.8	14.8	13.5	11.5	8.7	7.6	10.4
	Absolute Max.	13.6	15.1	20.3	24.0	26,9	25.7	29.7	28.4	25.9	22.5	19.8	15.3	29.7
	Absolute Min	-5.9	-7.3	-5.1	-1.6	0.5	2.8	5.3	3.3	2.8	-1.4	-4.0	-5.3	-7.3
Relative Humidity (%)	Mean at 0900 UTC	84	83	83	79	78	81	84	85	85	86	84	85	83
	Mean at 1500 UTC	80	77	75	73	73	77	79	79	78	80	79	81	78
Sunshine (hours)	Mean Daily Duration	1.41	2.16	3.05	5.00	5.81	5.12	4.53	4.50	3.61	2.53	1.72	1.17	3.39
	Greatest daily duration	7.5	9.0	11.1	13.5	15.1	15.8	15.6	14.4	12.1	9.6	8.1	647	15.8
	Mean days with no sun	11	7	6	3	2	4	4	4	4	7	9	13	75
Rainfall (mm)	Mean monthly total	167	123	122	77	89	80	73	111	125	157	147	159	1,430
	Greatest daily total	45.6	46.2	37.1	52.7	37.5	58.3	32.4	85.6	55.6	64.6	86.6	62.0	86.6
Wind (knots)	Mean monthly speed	13.1	12.6	12.1	10.1	10.3	9.1	8.5	8.9	10.0	11.4	11.8	12.6	10.9
	Max. gust	87	79	67	63	61	58	53	60	88	75	70	82	88
	Mean days with gales	2.5	2.0	1.3	0.3	0.4	0.0	0.0	0.1	0.5	0.8	1.5	1.8	11.2
Weather (Mean No. of Days With:)	Snow or sleet	1.5	1.7	1.1	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.8	5.6
	Snow lying at 0900 UTC	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8
	Hail	5.1	4.2	4.6	2.5	1.1	0.1	0.0	0.1	0.3	0.9	2.9	3.6	25.5
	Thunder	1.2	0.8	0.6	0.2	0.3	0.3	0.6	0.4	0.5	0.7	0.8	0.7	7.1
	Fog	0.4	0.4	0.2	0.9	0.9	1.2	1.5	1.2	0.7	0.6	0.4	0.4	8.9

The IEA report acknowledges that wind power, along with energy efficiency and fuel-switching will play the major role in reducing emissions in the power sector in the next 10-20 years, the critical period during which global emissions must peak and then begin to decline if the worst consequences of climate change are to be avoided.

Construction, maintenance and operation of the wind farm will result in CO2 emissions. These emissions arise from steel and cement production and quarrying as well as from transport, erection, track construction, etc.. However, such emissions are also involved with constructing, maintaining and operating conventional electricity plants, where in particular the procurement of the energy source also needs to be taken into account. A wind farm emits far less CO2 per unit energy from construction, maintenance and operation than conventional plants.

Amongst the benefits of electricity generation from wind are considered to be its contribution to environmental sustainability and displacement of imported fossil fuels. Based on an installed generating capacity of 115 MW, it is expected that Grousemount Wind Farm will generate about 350,000,000 kWh of electricity per annum. With an average electricity demand per household in 2012 being 4,902 kWh, this is enough to meet the electricity needs of approximately 70,000 homes, from one of Ireland's greatest natural resources, its wind energy.

The fossil fuel generation mix and the relative generation costs influence the amount of CO_2 emissions displaced by renewable electricity generation. The emissions from coal and peat combustion are considerably greater than those from natural gas combustion.

Figures from the Sustainable Energy Authority of Ireland indicate that the net CO_2 displacement intensity by wind generation was 0.46 t CO_2/MWh in 2012. On that basis the development of Grousemount Wind Farm will lead typically to an annual reduction in equivalent direct air emissions of approximately 160,000t of CO_2.

The wind farm development will have a positive impact on air quality and climate.

In addition to its position regarding CO_2, Ireland has binding international commitments to meet targets for emissions of air pollutants and for local and regional air quality, including cuts in SO_2 and NOx. Meeting these will require significant reductions in emissions from electricity generation.

There are continuing strong pressures for further reductions in these air emissions. The development of renewable energy, and particularly wind energy with zero emissions, is seen as an essential element in achieving these reductions while allowing continuing economic expansion. Increased utilisation of renewable energy for electricity generation forms part of the national response strategy in relation to climate change and is a central feature in the strategy for greenhouse gas abatement.

Loss of Forestry

Carbon sequestration rates in forestry vary by tree species, soil type, regional climate, topography and management practice. In the US, representative annual carbon sequestration rates are cited as being in the range 1.5 – 6.6 t of Carbon per hectare of trees for afforestation, with a range of 0.7 – 5.3 t being cited for reforestation. In Ireland it has been estimated that that forests on average sequester approximately 3.3 t of Carbon per hectare per year.

A loss of forestry of approximately 1 ha will result from completion of the wind turbine delivery route from Clonkeen with an associated loss of carbon sequestration. However,

the equivalent environmental benefit in avoided annual air emissions that Grousemount Wind Farm will confer greatly exceeds the extent of lost carbon sequestration, which clearly is inconsequential.

13.2.2 Air Quality & Climate

The primary air quality issue related to construction is dust potentially arising from the following construction activities:

- Earth moving and excavation equipment including handling and storage of soils and subsoil material.
- Extraction of stone from borrow pits for use on access track construction.
- Transport and unloading of crushed stone around the site during track construction.
- Vehicle movement over hard dry surfaces on the site, particularly freshly laid access tracks.
- Vehicle movement over surfaces off site contaminated by muddy materials brought off the site.

In addition to the type of construction activity being carried out, the potential for dust to be emitted depends on environmental factors including levels of rainfall, wind speeds and wind direction.

The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. All residences are at a significant distance and it highly unlikely that any will be affected by dust or vibration from the site construction works. The majority of any dust that is produced will be deposited close to the potential source and any impacts from dust deposition will typically be within several hundred metres of the construction area.

Construction vehicles and machinery within the site and transport associated with delivery of materials will also give rise to exhaust emissions during the construction phase. The potential impact is not considered significant in the context of the extent of traffic movements arising.

There will be no impacts on ambient air quality during operation of the wind farm. The wind farm will have no emissions to atmosphere and thus no adverse impact on general air quality or climate. It will have a beneficial effect in providing for energy without emissions of recognised environmental pollutants. None of the air quality parameters for which limits values are set will be affected by the development.

13.3 MITIGATION

While a need for significant active dust control during construction is not foreseen, good practice site management measures will be implemented as necessary and will include:

- Wheel wash facilities at the entrance from the public road.
- Dust suppression by water spray on access tracks.
- Use of appropriately covered trucks during delivery of materials to the site.
- Control of vehicle speeds within the site.
- Use of ready-mixed concrete rather than on-site batching.

- Regular inspection of public roads outside the site for cleanliness and cleaning as necessary.

The dust minimisation measures will be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures.

13.4 CONCLUSIONS

The proposed development will not result in significant adverse environmental impacts and will make a positive contribution towards management of environmental emissions from electricity generation.

The applicable Objectives in the Kerry County Development Plan 2009–2015 are EN 11-2 and EN 11-20. The proposed development is fully compatible with these Objectives.

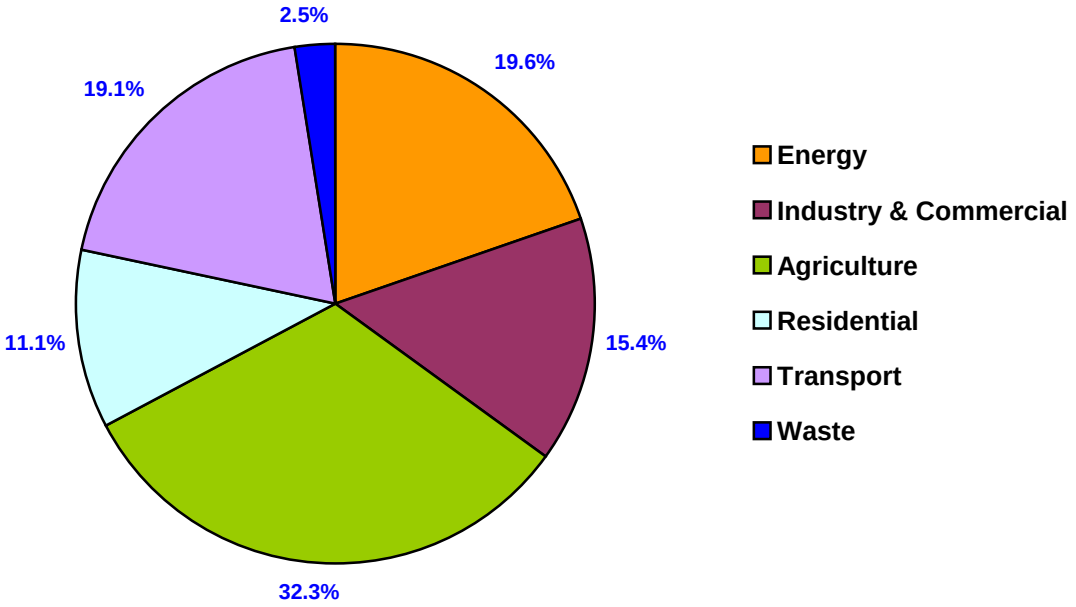

Figure 13.1: Greenhouse Gas Emissions by Sector – 2013 (58 Mt)

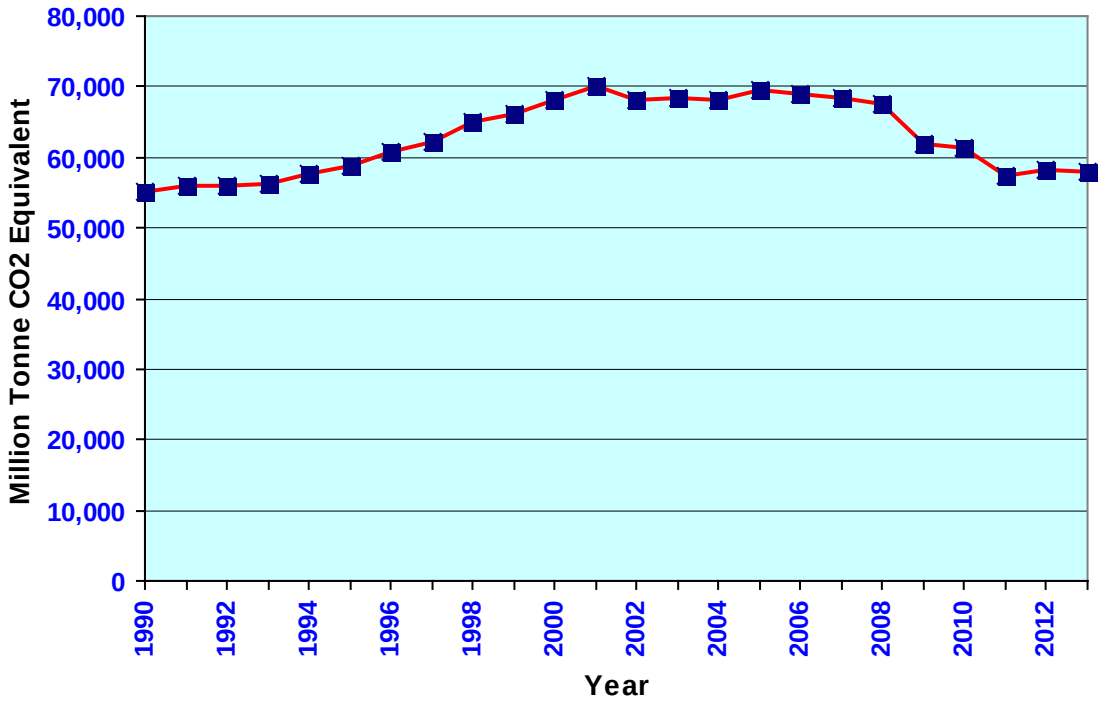

Figure 13.2: Greenhouse Gas Emissions 1990 - 2013

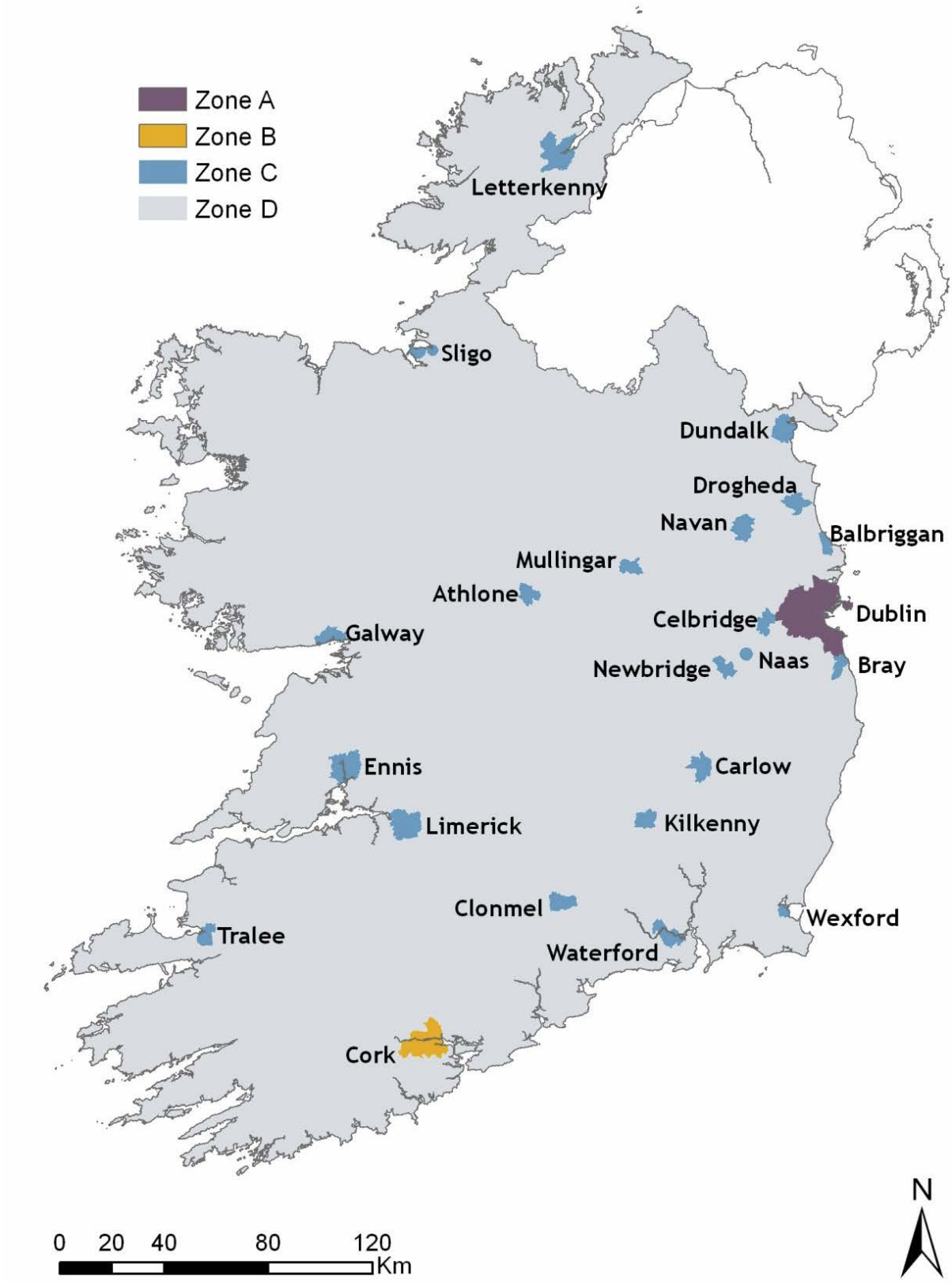

Figure 13.3: Air Quality Zoning Map

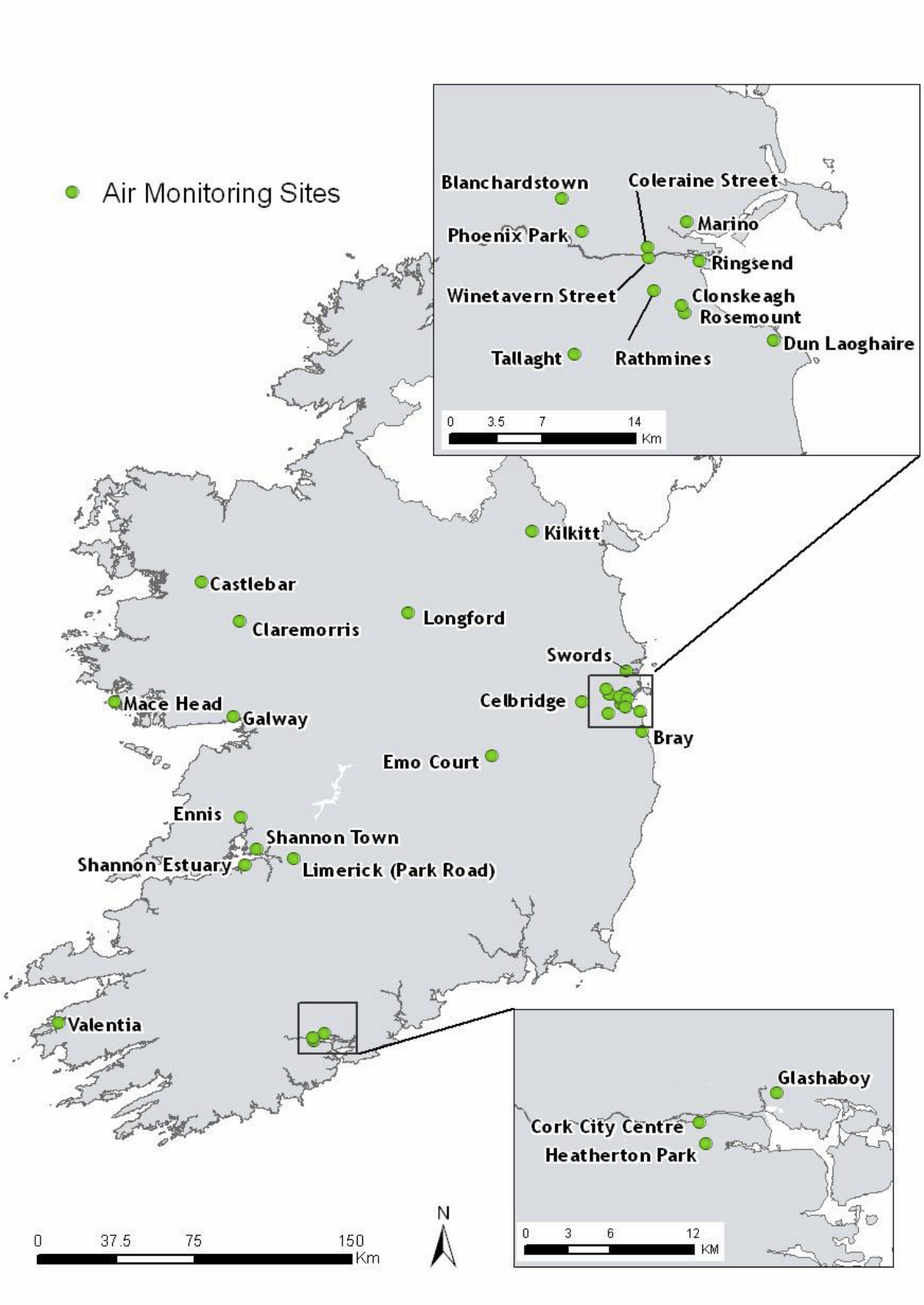

Figure 13.4: Air Quality Monitoring Network