9. Air Quality

9.1 Introduction

This chapter describes the current air quality in the vicinity of the proposed road development and predicts the impact of the scheme on air quality in future years. The air quality study focuses on traffic related pollutants, which are nitrogen dioxide (NO_2), particulate matter (PM_{10}), carbon monoxide (CO), 1,3 butadiene and benzene.

9.2 Air Quality Standard

The Air Quality Standards Regulations (2002)(1) deal with sulphur dioxide, nitrogen dioxide, particulate matter, carbon monoxide and benzene. Due to the progressive reduction in the level of sulphur permitted in fuels, sulphur dioxide (SO_2) is no longer a serious issue. These regulations are based on EU Directives 1999/30/EC(2) and 2000/69/EC(3).

Tables 9.1 and 9.2 list the current Air Quality Standards (AQSs) relevant to the assessment of the significance of the cumulative impact of the proposed road development together with the baseline environment. Table 9.1 outlines the standards for nitrogen dioxide and particulate matter of diameter of less than 10µm (PM_{10}). The standards for benzene and carbon monoxide are shown in Table 9.2.

Predicted concentrations of all pollutants have been assessed against the most stringent limit value. Nitrogen dioxide, particulates and benzene have been assessed against the 2010 limit; carbon monoxide is assessed against the 2006 limit value.

No air quality standard for 1, 3-butadiene currently exists in Ireland. Therefore, the suggested annual limit by DEFRA (UK) Expert Panel on Air Quality Standards for 1, 3-butadiene(4) was used which is 2.21µg/m^3.

9.3 Existing Ambient Air Quality

The existing ambient air quality was assessed to determine the current pollutant levels in the vicinity of the proposed road development and along the existing N9/N10. The description below combines the three sections of the scheme, as levels are likely to be similar at locations near the existing N9 and at similar locations along the proposed N9/N10.

Monitoring of PM_{10}, nitrogen dioxide and hydrocarbons BTEX (benzene, toluene, ethylbenzene, xylenes) was undertaken in May and June 2003.

9.3.1 Monitoring Locations

Monitoring locations are shown in Figures 8.1 to 8.11.

Table 9.3 describes the PM_{10} sampling locations along the existing and proposed routes.

Table 9.4 describes the nitrogen dioxide and BTEX sampling locations along the existing and proposed route.

All monitoring locations were chosen to give typical representation of existing air quality along the existing N9 (Mullinavat and Powerstown), in the vicinity of the existing N9 (Paulstown) and along the proposed route (Ballyquirke, Dunbell, Danesfort, Stoneyford, Knocktopher).

9.3.2 Monitoring Methodology

Particulate Matter (PM_{10})

PM_{10} was monitored using a portable OSIRIS real time particulate monitor. This instrument uses a light scattering technique to determine the concentration of airborne particles and dust. Features of the unit include:

- Real – time simultaneous TSP (Total Suspended Particles), PM_{10}, $PM_{2.5}$ and PM_1.
- Heated sample inlet
- Detection limit of 0.01 µg/m^3
- Full data logging and graphing software
- Mains and/or battery operation.

Nitrogen Dioxide (NO_2)

Background levels of NO_2 were determined using diffusion tubes and based on the guidelines originally set out by the DTI (UK) for the determination of NO_2 in ambient atmospheres. The diffusion tubes were placed on stands, in well ventilated areas away from trees and fences and situated approximately 1-2m above ground level.

The sampling location, date and time was recorded for each sample. The tubes were then dispatched to a UKAS accredited laboratory for analysis.

The NO_2 tubes were analysed by ion chromatography and the results expressed as µg/m^3.

Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)

Diffusion tubes were used to determine the background levels of Benzene, Toluene, Ethylbenzene and Xylene isomers (m/p- Xylenes and o- Xylenes) based on the guidelines originally set out by the DTI (UK) for the determination of NO_2 in ambient atmospheres.

The BTEX tubes were analysed by thermal desorption followed by gas chromatography-mass spectrometry and the results expressed as $\mu g/m^3$.

9.3.3 Monitoring Results

The results of the monitoring described above are discussed in the following paragraphs.

Particulate Matter (PM_{10})

Tables 9.5 to 9.7 presents the results of the PM_{10} monitoring carried out at the selected sites along the proposed route.

Nitrogen Dioxide

Table 9.8 presents the results of NO_2 monitoring carried out at the selected sites along the proposed route.

Benzene, Toluene, Ethylbenzene and Xylene (BTEX)

Table 9.9 presents the results of BTEX monitoring carried out at the selected sites on the proposed route.

9.3.4 Discussion of Monitoring Results

Tables 9.5 to 9.7 present the results for the PM_{10} monitoring carried out at the selected sites along the existing and proposed routes. The results at each location indicate that levels of PM_{10} are below the daily $50\mu g/m^3$ limit (not to be exceeded more than 35 times in a year) as laid down in the Air Quality Standards Regulations 2002(1). Slightly elevated PM_{10} levels are recorded at two of the locations (Mullinavat and Paulstown). This is due to the close proximity of the sites in both of these villages to the roadside, which was caused by the necessity of mains power for operation of the instrument.

The levels of NO_2 and benzene are also compared to the limit values outlined in S.I. No. 271(1). None of the NO_2 values exceed the annual average limit of $40\mu g/m^3$.

Comparison of the (EU Directive(3)) benzene limit value of $5\mu g/m^3$ as an annual average with the recorded values indicates that the benzene levels at each of the locations are within the limit value. Detailed modelling of benzene is, however, carried out and predicted concentrations compared to the EU Limits(3).

The levels of Toluene, Ethylbenzene and Xylene recorded at each of the locations are within the Danish C-values limits(5) and are typical of rural ambient levels. With such high limit values and minimal traces of these hydrocarbons, Toluene, Ethylbenzene and Xylene are not included in the modelling study.

9.3.5 Background Concentrations

Average background concentrations of NO_2, PM_{10}, CO and benzene were added to the predicted concentrations in the modelling assessment. The background concentrations were calculated from the measured values recorded at locations in the vicinity of the proposed route. Results recorded along the existing route were excluded, as they do not represent background levels because they include the contribution from existing road traffic. As CO was not monitored along the route; background levels were taken from the Local Air Quality Management (LAQM) website(10). Background concentrations of 1, 3-butadiene included in the model were based on rural concentrations of $0.04\ \mu g/m^3$ listed in the DEFRA (UK), Air Quality Standards report on 1, 3-butadiene(4). UK Department of Environment, Food and Rural Affairs (DEFRA) Air Pollution Year Adjustment Calculator v1.1a(11) was used to predict future year background concentrations for PM_{10}, CO, NO_2, 1, 3-butadiene and benzene. The background pollutant concentrations used in the modelling assessment are summarised in Table 9.10.

9.4 Modelling/Prediction Techniques

The impact on air quality of the proposed road development was predicted using two methods:

(a) Use of the method given in the UK *Design Manual for Roads and Bridges, Volume 11*(6); and

(b) Computer modelling using the Trinity Consultants package *BREEZE ROADS5*, which uses computer code approved by the USEPA.

9.4.1 DMRB Screening Method

The DMRB screening method computes concentrations of pollutants based on factors including:

- Volume of Traffic

- Percentage of Heavy Goods Vehicles (HGVs)
- Distance of receptor from road.
- Average speed of traffic
- Year

The DMRB method was used for the main route of the proposed road development while *BREEZE ROADS5* featuring computer modelling was used for the proposed junctions where impacts on air quality are likely to be greatest.

9.4.2 Computer Model – BREEZE ROADS5

The computer model used for the air quality predictions was *BREEZE ROADS5*. This is an air dispersion modelling package designed to predict air quality impacts of Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Particulate Matter (PM_{10}), and other inert pollutant concentrations from moving and idling motor vehicles at or alongside roadways and roadway intersections.

BREEZE ROADS5 features the industry standard mobile source dispersion models, CAL3QHC, CAL3QHCR, and CALINE4.

- **CAL3QHC** is a roadway model designed to predict air pollutant concentrations near roadways and arterial streets due to emissions from motor vehicles operating under both free-flow conditions and idling conditions.
- **CAL3QHCR** is an enhanced version of CAL3QHC. This version can process up to a year of hourly meteorological, and vehicular emissions. In addition, 1-hour and running 8-hour averages of CO or 24-hour and annual block averages of PM_{10} can be calculated.
- **CALINE4** includes similar model theory as is in CAL3QHC, but has an advanced method for calculating the NO_2 concentrations called Discrete Parcel Method.

This model was used to predict CO, PM_{10} and NO_2 concentrations in the vicinity of the six proposed junctions where the impact of emissions from road vehicles is expected to be greatest.

9.5 Significance Criteria

The impact of the road development should be assessed in terms of the relative contribution, as a percentage of the limit value.

Although no relative impact, as a percentage of the limit value, is specified in EU or Irish Legislation, the USEPA has adopted a relative impact criterion based on a road development's impact relative to the applicable limit value. The criterion termed PSD (Prevention of Significant Deterioration)(7) is used alongside the absolute limit values defined by the USEPA (NAAQS - *National Ambient Air Quality Standards*)(8) (See Table 9.11). PSD values have been published only for PM_{10}.

The PSD regulations have been created to ensure air quality remains good, while maintaining a margin for future growth. The PSD is generally applied to industrial facilities whereas the impact of road developments are compared with the absolute limits in the NAAQS.

The PSD approach has been adopted for determining the relative impacts of the road development in the current context by assuming the PSD Increment to be 25% of the EU Air Quality Standard. This 25% is based on a comparison between the US NAAQS and the PSD Increments for PM_{10} in a Class II area. Class I areas are national parks and similar areas. Class II are all areas not originally classified as Class I.

The significance criteria adopted in the current scheme is detailed in Tables 9.12 and 9.13, which take into account both the absolute and relative impact of the road development.

These criteria are a combination of the predicted concentration in relation to the Air Quality Standard, and the PSD Increment.

9.6 Predicted Impacts of the Proposed Road Development – Operational

9.6.1 General

Detailed traffic flow information was obtained from the traffic consultants for the project (as outlined in Chapter 6 of this EIS) and was used to model pollutant levels to assess whether any significant air quality impact on sensitive receptors may occur.

Background concentrations have been included in the calculations. These background concentrations are year-specific and account for non-localised sources of the pollutants of concern. Appropriate background levels were selected based on the current site-specific monitoring data (see Section 9.3.5 and Table 9.10).

A screening air model (DMRB) was used to model the road development at various distances from the proposed and existing roads. This allowed a prediction to be generated of ambient concentrations of CO, NO_2, benzene, 1,3-butadiene and PM_{10} with and without the scheme in place. Detailed air dispersion modelling (using ROADS5) of a number of receptors in the vicinity of each proposed interchange was carried out.

The design of the proposed road development (Chapter 3 of this EIS) has ensured that the distance between the proposed mainline and the majority of sensitive locations has been maximised.

Highest concentrations of pollutants occur in the immediate vicinity of the road, and the concentration drops off rapidly with distance from the road.

9.6.2 Screening Modelling Assessment – Existing N9/N10

Waterford to King's River

The results for the do-minimum and the do-something scenarios for the worst-case receptor along the existing N9/N10 is shown in Table 9.14 for 2010 and 2025. It is shown that the impact of the road development is neutral for all pollutants as defined in Table 9.13. The results also show that the air quality is predicted to improve along this section of the existing N9/N10. No air quality standards are exceeded.

King's River to Ballyquirke

The results for the do-minimum and the do-something scenarios for the worst-case receptor along the existing N9/N10 is shown in Table 9.15 for 2010 and 2025. It is shown that the impact of the road development is neutral for all pollutants as defined in Table 9.13.

The results also show that the air quality is predicted to improve along this section of the existing N9/N10. No air quality standards are exceeded.

Ballyquirke to Powerstown

The results for the do-minimum and the do-something scenarios for the worst-case receptor along the existing N9/N10 is shown in Table 9.16 for 2010 and 2025. It is shown that the impact of the road development is neutral for all pollutants as defined in Table 9.13.

The results also show that the air quality is predicted to improve along this section of the existing N9/N10. No air quality standards are exceeded.

9.6.3 Screening Modelling Assessment – Proposed Kilkenny Ring Road Extension

The proposed Kilkenny Link will tie in to the proposed Kilkenny Ring Road Extension. The impact of the 2025 Do-Something (Half Network) and Do-Something (Full Network) on the proposed Kilkenny Ring Road Extension will be neutral, as traffic flows will be lower with the proposed networks, and hence air emissions will be lower.

Ballyquirke to Kilcullen was modelled for the screening assessment rather than the Ballyquirke to Powerstown as this was considered a more considerate estimate, as detailed in Section 9.1.

9.6.4 Screening Modelling Assessment – Proposed N9/N10

Waterford Tie-in to King's River

The results of the do-minimum and the do-something scenarios for the worst-case receptor along the existing N9/N10 are shown in Table 9.17 for 2010 and 2025. It is shown that the impact of the road development is neutral for all pollutants as defined in Table 9.13. No air quality standards are exceeded.

King's River to Ballyquirke

The results for the do-minimum and the do-something scenarios for the worst-case receptor along the existing N9/N10 is shown in Table 9.18 for 2010 and 2025. It is shown that the impact of the road development is neutral for all pollutants as defined in Table 9.13. No air quality standards are exceeded.

Ballyquirke to Powerstown – With Northern Scheme

The results for the do-minimum and the do-something scenarios for the worst-case receptor along the existing N9/N10 is shown in Table 9.19 for 2010 and 2025. It is shown that the impact of the road development is neutral for all pollutants as defined in Table 9.13. No air quality standards are exceeded.

9.6.5 Detailed Air Modelling Assessment

Introduction

In this modelling assessment, a number of specific sensitive receptors were identified within the area of junctions i.e. within several hundred metres of the proposed road development. Modelling was carried out for do-something traffic predictions at the building façade of each of these receptors. The results for the worst-case receptor are presented in Tables 9.20 to 9.22 for the sections of the proposed road outlined below. The do-minimum levels are expected to be as background levels outlined in Table 9.10.

Waterford to King's River

The results of the detailed junction modelling assessments for the do-something scenario for this section of the proposed road are shown in Table 9.20 for 2010 and 2025. No air quality standards are exceeded.

King's River to Ballyquirke

The results of the detailed junction modelling assessments for the do-something scenario for this section of the proposed road are shown in Table 9.21 for 2010 and 2025. No air quality standards are exceeded.

Ballyquirke to Powerstown – With Northern Scheme

The results of the detailed junction modelling assessments for the do-something scenario for this section of the proposed road are shown in Table 9.22 for 2010 and 2025. No air quality standards are exceeded.

Ballyquirke to Powerstown – Without Northern Scheme

As detailed in the introduction section 9.1, Powerstown Junction is the only junction modelled in this part of the assessment.

The results of the detailed junction modelling assessments for the do-something scenario for this section of the proposed road are shown in Table 9.22 for 2010 and 2025. No air quality standards are exceeded.

9.7 Predicted Impacts of the Proposed Road Development – Construction

There is the potential for a number of emissions to the atmosphere during the construction phase of the proposed road development. In particular, construction activities may generate quantities of dust through blasting, the transport of material along the proposed route and along access routes and the use of HGVs during construction. Construction vehicles and generators will also give rise to exhaust emissions.

9.8 Mitigation Measures

9.8.1 Operational

There are no air quality standards exceeded, therefore no mitigation measures are formally required.

The scope for mitigation of any adverse impact on air quality by a road development through route choice or design is limited, in comparison with the scope for reductions in emission rates achievable through improved vehicle technology. However, some mitigation measures have already been taken into account, to the greatest practicable extent during the route selection phase (see Chapter 3 of this EIS).

The provision of screen planting is not a specific mitigation measure required as a result of the air quality assessment, but there may be an additional benefit for air quality as a consequence of screen planting proposed as part of the landscape and visual mitigations (refer to Chapter 10 for further details). There is some evidence that dense planting of trees and shrubs can reduce pollution concentrations, either physically through the impact and deposition of particulate pollution or through absorption of gaseous pollutants by the leaves.

9.8.2 Construction

The following construction mitigation measures will be implemented within the construction site:

- Avoid unnecessary vehicle movements and maneuvering, and limit speeds so as to minimize the generation of airbourne dust.
- During dry periods, dust emissions from heavily trafficked locations (on and off site) will be controlled by spraying surfaces with water.
- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic only. Furthermore, any road that has the potential to give rise to fugitive dust will be regularly watered, as appropriate, during dry and/or windy conditions.
- All vehicles exiting the site will make use of a wheel wash facility, preferably automatic, prior to entering onto public roads, to ensure mud and other wastes are not tracked onto public roads. Public roads outside the site will be regularly inspected for cleanliness, and cleaned as necessary. The wheel-

washing facilities will be located away from sensitive receptors.

- Re-suspension in the air of spillages material from trucks entering or leaving the site will be prevented by limiting the speed of vehicles within the site and by use of a mechanical road sweeper.
- Topsoil and other dusty material will be transported to and from the site in covered trucks. Where the likelihood of emitting dust is high and during dry weather conditions, the area of removal from the site will be sprayed by a mobile tanker on a regular basis to control dust emissions.
- Exhaust emissions from vehicles operating within the construction site, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor by ensuring that emissions from vehicles are minimised by routine servicing of vehicles and plant, rather than just following breakdowns; the positioning of exhausts at a height to ensure adequate local dispersal of emissions, the avoidance of engines running unnecessarily and the use of low emission fuels.
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.
- Where drilling or pavement cutting, grinding or similar types of stone finishing operations are taking place, measures to control emissions will be used to prevent a nuisance within the locality, for example the erection of wind breaks or barriers. This may be a significant local source of fine particulate emissions, in particular particles less than 10μm (PM_{10}).
- If cement is stored in a silo on site, a filter will be fitted to the silo. Alternatively, ready-mix concrete will be supplied by truck.
- It is proposed to carry out dust deposition monitoring during the dust generation phases of construction of the road development at the sensitive receptors closest to the construction site. Levels of dust deposition will be monitored using a Bergerhoff Gauge, or similar apparatus. Dust deposition levels will be recorded monthly and compared to the German standard T.A. Luft(9) dust deposition limit value of 350mg/m² per day.

A complaints procedure will be implemented by the contractor and a Project Liaison Officer will be appointed to the site.

9.9 Residual Impact

9.9.1 Operational

No residual impacts are anticipated.

9.9.2 Construction

Once the mitigation measures outlined above are implemented, the residual impact of construction on air quality will not be significant.

9.10 Limitations, Assumptions and Difficulties Encountered

The assessment of the effects of the road development upon air quality is based upon the available information, particularly information regarding the operational traffic generated as a result of the scheme and the existing traffic on the network.

Average background levels of carbon monoxide were downloaded from the Local Air Quality Management (LAQM) website(10). This site holds monitoring data from a number of local authorities in Northern Ireland. It is assumed that the carbon monoxide levels experienced in Northern Ireland would be similar to the background levels in the vicinity of the N9/N10.

9.11 References

(1) Government of Ireland (2002) Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002).
(2) EU (1999) Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air (OJ L163/41-60, 29/06/1999).
(3) EU (2000) Directive 2000/69/EC of the European Parliament and of the Council of 16 November 2000 relating to limit values for benzene and carbon monoxide in ambient air (OJ L313/12-21, 13/12/200).
(4) UK DEFRA Expert Panel on Air Quality Standards Report on 1-3 butadiene.
(5) Danish EPA (1996) C-Values, Summary on C-Values Assessed by the Danish Environmental Protection Agency.

(6) UK DETR (2003) Design Manual for Roads and Bridges, Volume 11- Environmental Assessment, Section 3, Part 1.
(7) USEPA (1990) Clean Air Act, Part C Prevention of Significant Deterioration of Air Quality.
(8) USEPA (1995) National Ambient Air Quality Standards, 40 CFR.
(9) Federal Department for The Environment, Berlin 2001 Technical Instructions on Air Quality Control (TA Luft).
(10) Air Quality Monitoring Data: www.airquality.co.uk [Obtained 19-07-04].
(11) UK DEFRA (2003) UK DEFRA Air Pollution Year Adjustment Calculator v1.1a. Environment Act 1995 Part IV: Local Air Quality Management: Technical Guidance LAQM.TG (2003), Department for Environment, Food and Rural Affairs, February 2003.

Table 9.1 Air Quality Standards in EC Directive 1999/30/EC

Reference Period	For the Protection of	Number of Times in Year Limit is not to be Exceeded	Equivalent Percentile	Ultimate Air Quality Standard (μg/m³)(1)
NITROGEN DIOXIDE				
Hourly Limit Value	Human Health	18	99.79	200
Annual Limit Value	Human Health	0	N/A	40
Annual Limit Value (2)	Vegetation	0	N/A	30
PARTICULATE MATTER				
24 Hour Limit Value	Human Health	35(3)	90.41(3)	50(3)
24 Hour Limit Value	Human Health	7(4)	98.04(4)	50(4)
Annual Limit Value	Human Health	0	N/A	20(5)

(1) To be totally complied with by 1 January 2010 : A gradual introduction of the standard is proposed, over 5 – 10 years.
(2) Limit for nitrogen oxides
(3) Until 2005
(4) From 2005
(5) 40 µg/m³ until 2005

Table 9.2 EU Ambient Air Standard – Council Directive 2000/69/EC

Pollutant	Limit Type	Margin of Tolerance	Value
Benzene	Annual limit for protection of human health	100% until 2006 reducing linearly to 0% by 2010	5 μg/m³
Carbon Monoxide	8 hour limit (on a rolling basis) for protection of human health	60% until 2003 reducing linearly to 0% by 2006	10,000 μg/m³

Table 9.3 Location of PM_{10} Sampling Locations*

Location No.	Location	Description
2	Paulstown	At the west side of the village
7	Knocktopher	North of the proposed junction on the route
8	Mullinavat	At the north entrance to the town next to the grotto

* Sampling was carried at locations as close to the proposed route within reach of an adequate power supply

Table 9.4 Locations of NO_2 and BTEX Sampling Locations

Location No.	Location	Location Description
1	Powerstown	At proposed junction
2	Paulstown*	North of proposed junction
3	Ballyquirke	On proposed route
4	Dunbell	South of proposed junction on route
5	Danesfort	South of proposed junction on route
6	Stoneyford	On proposed route
7	Knocktopher	North of proposed junction on route
8	Mullinavat	West of proposed junction

* Sampling Tubes were damaged at this location

Table 9.5 Results of PM_{10} Monitoring at Paulstown (Location Number 2)

Sample Date	PM_{10} Concentration (µg/m^3)
4/6/03	21.6
5/6/03	20.6
6/6/03	33.5
7/6/03	39.9
8/6/03	15.2
9/6/03	19.1
10/6/03	Instrument Failure
11/6/03	Instrument Failure
Limit Value	***50 µg/m^3**

* Not to be exceeded more than 35 times a calendar year (daily average)

Table 9.6 Results of PM_{10} Monitoring at Knocktopher (Location Number 7)

Sample Date	PM_{10} Concentration (µg/m^3)
9/5/03	15.6
10/5/03	15.0
11/5/03	9.5
12/5/03	10.9
13/5/03	10.5
14/5/03	16.9
15/5/03	8.6
16/5/03	17.3
Limit Value	***50 µg/m^3**

* Not to be exceeded more than 35 times a calendar year

Table 9.7 Results of PM_{10} Monitoring at Mullinavat (Location Number 8)

Sample Date	PM_{10} Concentration (µg/m^3)
26/5/03	21.6
27/5/03	29.4
28/5/03	29.1
29/5/03	24.8
30/5/03	32.3
31/5/03	21.3
1/6/03	26.8
2/6/03	43.8
3/6/03	42.9
Limit Value	***50 µg/m^3**

* Not to be exceeded more than 35 times a calendar year

Table 9.8 NO_2 Monitoring Results

Location No.	Location	NO_2 (µg/m^3)
1	Powerstown	9.16
2	Paulstown	No result*
3	Ballyquirke	1.25
4	Dunbell	3.431
5	Danesfort	2.81
6	Stoneyford	0.94
7	Knocktopher	1.25
8	Mullinavat	10.61
Limit value as an annual average		**40**

* Sample tubes were damaged at this location

Table 9.9 BTEX (Benzene, Toluene, Ethylbenzene and Xylene isomers (m/p Xylenes and o-Xylenes)) Monitoring Results

Location No.	Location	Benzene (µg/m^3)	Toluene (µg/m^3)	Ethylbenzene (µg/m^3)	m/p-Xylenes (µg/m^3)	o- Xylenes (µg/m^3)
1	Powerstown	0.06	0.51	0.04	0.04	0.04
2	Paulstown *	-	-	-	-	-
3	Ballyquirke	N.D.	N.D	N.D.	< LOD	N.D
4	Dunbell	N.D.	0.12	N.D.	< LOD	0.04
5	Danesfort	N.D.	0.16	N.D.	< LOD	0.13
6	Stoneyford	N.D.	N.D.	N.D.	< LOD	N.D
7	Knocktopher	N.D.	N.D.	N.D.	< LOD	N.D
8	Mullinavat	0.36	1.95	0.35	1.48	0.36
Limit Values		5	400	500	100	100

* Sampling Tubes were damaged at this location
N.D. - Not Detected
< LOD - Less than the limit of detection

Table 9.10 Background Pollutant Concentrations

Year	CO Max. 8-Hr (µg/m^3)	Benzene Annual Mean (µg/m^3)	1, 3 Butadiene Annual Mean (µg/m^3)	NO_2 Annual (µg/m^3)	PM_{10} Annual (µg/m^3)
2010	818	0.16	0.02	3.7	11.58
2025	772	0.16	0.02	3.13	11.12

Table 9.11 US National Ambient Air Quality Standards (NAAQS) & PSD Increments

Pollutant	Averaging Period	Primary & Secondary Standard$^{(1)}$ (µg/m^3)	*PSD Increment Class II*$^{(2)}$ (µg/m^3)
PM_{10}	Annual – Average over 3 years	50	19
	24-Hour – as a 99th%ile over 3 years	150	37
NO_2	Annual Mean	100	
CO	8-Hour – 3-year average of annual 4th highest daily maximum 8-hour concentration	10,000	-
	1-Hour – not to be exceeded more than 3 times in 3 consecutive years	40,000	-
Hydrocarbon (Benzene)	3 Hours (6-9 AM) (corrected for methane)	160	-

1) Primary
2) Standards to protect public health whilst secondary standards are set to protect public welfare
3) Class I areas are national parks and similar areas. Class II are all areas not originally classified as Class I.

Table 9.12 Criteria to Quantify the Potential Impact of Scheme

Degree of Impact	Definition
Severe	Exceedance of Air Quality Standard and increment of greater than 100% of PSD increment for any reference period
Major	Exceedance of Air Quality Standard and increment of between 50% and 100% of PSD Increment for any reference period
Moderate	Exceedance of Air Quality Standard and increment of less than 50% of PSD Increment for any reference period
Minor	Less than Air Quality Standard but increment of greater than 50% of PSD Increment for any reference period
Neutral	Less than Air Quality Standard but increment of less than 50% of PSD Increment for any reference period; this category also includes for situations where the concentration is reduced by the scheme, or the increment is negative, or where an increase is predicted in relation to one parameter, but a decrease in relation to the other.

Table 9.13 Criteria to Quantify the Potential Impact of Scheme – Specific Pollutant Guidance

Degree of Significance	**Criteria (as assessed by detailed air quality modelling)**	**Carbon Monoxide (µg/m³)**	**1,3 – Butadiene (µg/m³)**	**Benzene (µg/m³)**	**Nitrogen Dioxide (µg/m³)**		**Particulates (PM_{10}) (µg/m³)**	
		Maximum 8-hour(3)	**Annual**	**Annual mean(2)**	**99.79 percentile**	**Annual average (1)**	**Annual average(1)**	**98.08 percentile of 24-hr values(1)**
Severe	Exceedance of Air Quality Standard and increment of greater than PSD increment for any reference period	>10,000 >2,500(4)	>2.21 >0.55(4)	>5 >1.25(4)	>200 >50(4)	>40 >10(4)	>20 >5(4)	>50 >12.5(4)
Major	Exceedance of Air Quality Standard and increment of between 50% and 100% of PSD increment for any reference period	>10,000 >1,250 ≤2,500(4)	>2.21 >0.28 ≤0.55(4)	>5 >0.625 ≤1.25(4)	>200 >25 ≤50(4)	>40 >5 ≤5(4)	>20 >2.5 ≤5(4)	>50 >6.25 ≤12.5(4)
Moderate	Exceedance of Air Quality Standard and increment of less than 50% of PSD Increment for any reference period	>10,000 ≤1,250(4)	>2.21 ≤0.28(4)	>5 ≤0.625(4)	>200 ≤25(4)	>40 ≤5(4)	>20 ≤2.5(4)	>50 ≤6.25(4)
Minor	Less than Air Quality Standard but increment of greater than 50% of PSD Increment for any reference period	≤10,000 >1,250(4)	≤2.21 >0.28(4)	≤5 >0.625(4)	≤200 >25(4)	≤40 >5(4)	≤20 >2.5(4)	≤50 >6.25(4)
Neutral	Less than Air Quality Standard but increment of less than 50% of PSD Increment for any reference period or a decrease in levels	≤10,000 ≤1,250(4)	≤2.21 ≤0.28(4)	≤5 ≤0.625(4)	≤200 ≤25(4)	≤40 ≤5(4)	≤20 ≤2.5(4)	≤50 ≤6.25(4)

1. EU Council Directive 1999/30/EC – Using Most Stringent Limits (2010)
2. EU Directive 2000/69/EC Using Most Stringent Limits (2010)
3. EU Directive 2000/69/EC Using most stringent Limits (2006)
4. Calculated PSD Increment – Based on 25% of EU Limit Value

Table 9.14 Do-Minimum and Do-Something Scenarios along Existing N9 Waterford to King's River, 2010, 2025 for the Worst-case Receptor

Year Scenario	Distance from centre of existing N9	CO Max. 8-Hr (µg/m³)	Benzene Annual Mean (µg/m³)	1,3 Butadiene Annual Mean (µg/m³)	NO_2 Annual (µg/m³)	PM_{10} Annual (µg/m³)
2010, Do-minimum	10 m	1,207	0.193	0.08	10.15	13.09
2010, Do-something	10 m	875	0.163	0.03	5.62	11.96
2025, Do-minimum	10 m	1,252	0.207	0.09	8.29	12.2
2025, Do-Something	10 m	854	0.167	0.03	4.66	11.39
AQS or Guidelines		10,000µg/m³	5µg/m³	2.2µg/m³	40µg/m³	20µg/m³

Table 9.15 Do-Minimum and Do-Something Scenarios along Existing N9/N10 King's River to Ballyquirke, 2010, 2025 for the Worst-case Receptor

Year Scenario	Distance from centre of existing N9	CO Max. 8-Hr (µg/m³)	Benzene Annual Mean (µg/m³)	1,3 Butadiene Annual Mean (µg/m³)	NO_2 Annual (µg/m³)	PM_{10} Annual (µg/m³)
2010, Do-minimum	10 m	1,352	0.213	0.12	12.3	13.74
2010, Do-something	10 m	1,042	0.173	0.06	8.39	12.62
2025, Do-minimum	10 m	1,353	0.237	0.13	9.14	12.43
2025, Do-Something	10 m	1,054	0.187	0.06	6.9	11.88
AQS or Guidelines		10,000µg/m³	5µg/m³	2.2µg/m³	40µg/m³	20µg/m³

Table 9.16 Do-Minimum and Do-Something Scenarios along Existing N9/N10 Ballyquirke to Powerstown 2010, 2025 for the Worst-case Receptor

Year Scenario	Distance from centre of existing N9	CO Max. 8-Hr (µg/m³)	Benzene Annual Mean (µg/m³)	1,3 Butadiene Annual Mean (µg/m³)	NO_2 Annual (µg/m³)	PM_{10} Annual (µg/m³)
2010, Do-minimum	10 m	1,398	0.223	0.13	12.36	13.78
2010, Do-something	10 m	1,330	0.223	0.11	9.28	12.71
2025, Do-minimum	10 m	1,368	0.247	0.14	9.31	12.48
2025, Do-Something	10 m	1,257	0.207	0.09	8.4	12.23
AQS or Guidelines		10,000µg/m³	5µg/m³	2.2µg/m³	40µg/m³	20µg/m³

Table 9.17 Do-Minimum and Do-Something Scenarios along Proposed N9/N10 Waterford to King's River, 2010, 2025 for the Worst-case Receptor

Year Scenario	Distance from centre of proposed N9/N10	CO Max. 8-Hr (µg/m³)	Benzene Annual Mean (µg/m³)	1,3 Butadiene Annual Mean (µg/m³)	NO_2 Annual (µg/m³)	PM_{10} Annual (µg/m³)
2010, Do-minimum	30 m	818	0.16	0.02	3.7	11.58
2010, Do-something	30 m	992	0.173	0.05	7.94	12.65
2025, Do-minimum	30 m	772	0.16	0.02	3.13	11.12
2025, Do-Something	30 m	1,016	0.177	0.06	6.73	12
AQS or Guidelines		10,000µg/m³	5µg/m³	2.2µg/m³	40µg/m³	20µg/m³

Table 9.18 Do-Minimum and Do-Something Scenarios along Proposed N9/N10 King's River to Ballyquirke, 2010, 2025 for the Worst-case Receptor

Year Scenario	Distance from centre of proposed N9/N10	CO Max. 8-Hr (µg/m³)	Benzene Annual Mean (µg/m³)	1,3 Butadiene Annual Mean (µg/m³)	NO_2 Annual (µg/m³)	PM_{10} Annual (µg/m³)
2010, Do-minimum	30 m	818	0.16	0.02	3.7	11.58
2010, Do-something	30 m	1,027	0.173	0.05	8.54	12.83
2025, Do-minimum	30 m	772	0.16	0.02	3.13	11.12
2025, Do-Something	30 m	1,022	0.187	0.06	7.01	12.12
AQS or Guidelines		10,000µg/m³	5µg/m³	2.2µg/m³	40µg/m³	20µg/m³

Table 9.19 Do-Minimum and Do-Something Scenarios along Proposed N9/N10 Ballyquirke to Powerstown, 2010, 2025 for the Worst-case Receptor

Year Scenario	Distance from centre of proposed N9/N10	CO Max. 8-Hr (µg/m³)	Benzene Annual Mean (µg/m³)	1,3 Butadiene Annual Mean (µg/m³)	NO_2 Annual (µg/m³)	PM_{10} Annual (µg/m³)
2010, Do-minimum	30 m	818	0.16	0.02	3.7	11.58
2010, Do-something	30 m	992	0.173	0.05	7.94	12.65
2025, Do-minimum	30 m	772	0.16	0.02	3.13	11.12
2025, Do-Something	30 m	989	0.177	0.05	6.61	12
AQS or Guidelines		10,000µg/m³	5µg/m³	2.2µg/m³	40µg/m³	20µg/m³

Table 9.20 Results of Modelling Junctions between Waterford and King's River, 2010, 2025 for the Worst-case Receptor in the Vicinity of each Junction

Pollutant	Nitrogen Dioxide (µg/m^3)		Carbon Monoxide (µg/m^3)	Particulate Matter (PM$_{10}$) (µg/m^3)			Benzene (µg/m^3)	1,3-Butadiene (µg/m^3)
Year Scenario	Annual	99.79 %ile of 1-hr Avs	8-hour	Annual	90.41 %ile of 24-hr Aves	98.08 %ile of 24-hr Aves	Annual	Annual
AQS	40	200	10,000	20	50	50	5	2.2
Knocktopher Junction								
2010	4.31	9.18	819	11.58	11.62	11.66	0.173	0.022
2025	3.74	8.61	783	11.18	11.22	11.26	0.167	0.022
Mullinavat Junction								
2010	4.21	8.99	817	11.57	11.7	11.62	0.173	0.021
2025	3.64	8.42	781	11.17	11.3	11.22	0.167	0.021

Table 9.21 Results of Modelling Junctions between King's River to Ballyquirke, 2010, 2025 for the Worst-case Receptor in the Vicinity of each Junction

Pollutant	Nitrogen Dioxide (µg/m^3)		Carbon Monoxide (µg/m^3)	Particulate Matter (PM$_{10}$) (µg/m^3)			Benzene (µg/m^3)	1,3-Butadiene (µg/m^3)
Year Scenario	Annual	99.79 %ile of 1-hr Avs	8-hour	Annual	90.41 %ile of 24-hr Aves	98.08 %ile of 24-hr Aves	Annual	Annual
AQS	40	200	10,000	20	50	50	5	2.2
Dunbell Junction								
2010	3.88	7.37	823	11.65	11.62	11.64	0.163	0.02
2025	3.33	7.11	777	11.14	11.18	11.2	0.167	0.021
Danesfort Junction								
2010	4.21	10.36	830	11.66	11.72	11.77	0.173	0.022
2025	3.67	10.19	784	11.2	11.26	11.31	0.177	0.023

Table 9.22 Results of Modelling Junctions between Ballyquirke and Powerstown (With and Without Northern Scheme in Place): Worst-case Receptor

Pollutant	Nitrogen Dioxide (µg/m^3)		Carbon Monoxide (µg/m^3)	Particulate Matter (PM$_{10}$) (µg/m^3)			Benzene (µg/m^3)	1,3-Butadiene (µg/m^3)
Parameter	Annual	99.79 %ile of 1-hr Avs	8-hour	Annual	90.41 %ile of 24-hr Aves	98.08 %ile of 24-hr Aves	Annual	Annual
AQS	40	200	10,000	20	50	50	5	2.2
With Northern Scheme								
Powerstown Junction								
2010	9.34	18.26	840	11.68	11.81	11.89	0.173	0.023
2025	9.4	19.38	829	11.63	11.77	11.85	0.183	0.024
Paulstown Junction								
2010	4.18	7.83	825	11.63	11.66	11.7	0.173	0.022
2025	4.17	7.69	814	11.58	11.6	11.63	0.173	0.022
Without Northern Scheme								
Powerstown Junction								
2010	9.3	20.22	843	11.7	11.89	11.98	0.183	0.024
2025	8.72	19.27	796	11.25	11.42	11.54	0.187	0.024