10 MATERIAL ASSETS (ROADS & TRAFFIC)

10.1 INTRODUCTION

This chapter assesses the potential impact that both the construction and operational phases of the proposed development at the Drehid Waste Management Facility (WMF) will have on the surrounding public road network. This assessment will calculate the expected volume of traffic that will be generated by the proposed development, outline proposed haul routes that vehicles associated with the proposed development will follow and assess the potential impact that the generated traffic flows will have on the road network.

10.1.1 Scoping & meetings

A scoping document was issued to Kildare Council Roads Department on the 17th of August 2016 (copy in Appendix 10.8). This Chapter has taken into account the points raised by Kildare County Council during previous scoping and meetings mentioned in Chapter 1 Section 1.6 and in particular Table 1-2 which summarises the responses received.

10.1.2 Methodology

In preparing this chapter, TOBIN Consulting Engineers have made reference to:

- NRA ‘Traffic and Transport Assessment Guidelines’ (May 2014);
- TII Road Link Design (DN-GEO-03031) (February 2012);
- UK DMRB TA 46/97 Traffic Flow Ranges for Use in the Assessment of New Rural Roads;
- Kildare County Development Plan 2011-2017 - Variation No. 1 To Incorporate Small Town Plans (Kill, Prosperous, Rathangan, Athgarvan, Derrinturn & Castledermot);
- Kildare County Development Plan 2017-2023;
- Draft Clane Local Area Plan 2017-2023;
- Clane Local Area Plan 2009;
- Kilcullen Local Area Plan 2014-2020;
- Newbridge Local Area Plan 2013-2019;
- Kildare Local Area Plan 2012-2018;
- Naas, Northwest Quadrat Masterplan 2009; and
- TII (previously NRA) Project Appraisal Guidelines (PE-PAG-02017) Unit 5.3: Travel Demand Projections.

Traffic surveys were carried out at the entrance to the Bord na Móna landholding and at 17 locations on the surrounding road network. These flows were then adjusted to take account of seasonal variation and yearly traffic growth to determine the background traffic flows for each year analysed.

Estimates for the amount of heavy goods vehicle (HGV) traffic to be generated by the construction phase of the proposed development are based on the likely number of deliveries of construction materials to the site. Estimates for the amount of HGV traffic to be generated by the operational phase of the proposed development are based on the quantities of waste and outputs that will be delivered to and from the development. The arrivals and departures of workers/staff during both the construction and operational stages of the proposed development have also been considered in this assessment. The generated traffic was then distributed onto the road network where it was combined with the background traffic flows and subsequently analysed.

As outlined in Section 10.3.1 herein, three traffic scenarios have been considered, as follows:

Scenario 0: Existing Facility and the permitted MBT;
Scenario 1: Existing Facility with the proposed development and the permitted MBT; and
Scenario 2: Existing Facility with the proposed development.

10.2 RECEIVING ENVIRONMENT / BASELINE DESCRIPTION

10.2.1 Baseline Traffic Surveys

Traffic surveys were carried out on the public road network surrounding the Drehid Facility in order to determine background (baseline) traffic flows on the haul routes that will be used by Facility traffic. These counts were carried out by Abacus Transportation Surveys Limited, and the types, locations and dates of the surveys are listed below. The locations of the traffic counts undertaken are shown in Appendix 10.1 and in Figure 10.1: Haul Routes and Traffic Count Locations.

Manual Classified Traffic Surveys:

- Junction 1: R408 and R403 signalised crossroads, Prosperous; Wednesday 28th September 2016 between 07:00 and 19:00.
- Junction 2: R407 and R403 signalised priority junction, Clane; Wednesday 28th September 2016 between 07:00 and 19:00.
- Junction 3: Johnstown Road and R402 roundabout, Enfield; Wednesday 28th September 2016 between 07:00 and 19:00.
- Junction 4: R445 and R415 signalised crossroads, Kildare; Wednesday 28th September 2016 between 07:00 and 19:00.
- Junction 5: Existing Drehid Facility site entrance on R403; Monday 23rd May 2016 between 07:00 and 19:00.

Automated Traffic Counters:

- R402 East of Carbury; Monday 23rd May to Sunday 29th May 2016.
- R402 West of Carbury; Monday 23rd May to Sunday 29th May 2016.
- R403 South of Carbury; Monday 23rd May to Sunday 29th May 2016.
- R403 North of Canal; Monday 23rd May to Sunday 29th May 2016.
- R414 West of Canal; Monday 23rd May to Sunday 29th May 2016.
- R415 South of Allenwood; Monday 23rd May to Sunday 29th May 2016.
- R403 East of Allenwood; Monday 23rd May to Sunday 29th May 2016.
- R409 North of Goatstown; Monday 23rd May to Sunday 29th May 2016.
- R403 East of Prosperous; Monday 23rd May to Sunday 29th May 2016.
- R407 South of Clane; Monday 23rd May to Sunday 29th May 2016.
- R408 North-east of Prosperous; Wednesday 28th September to Tuesday 4th October 2016.
- R415 North-east of Kildare; Wednesday 28th September to Tuesday 4th October 2016.
- R403 North-east of Clane; Wednesday 28th September to Tuesday 4th October 2016.

The surveys distinguished between cars / light goods vehicles, buses and heavy goods vehicles. Details of the results of these surveys are provided in Appendix 10.2 of this Report.

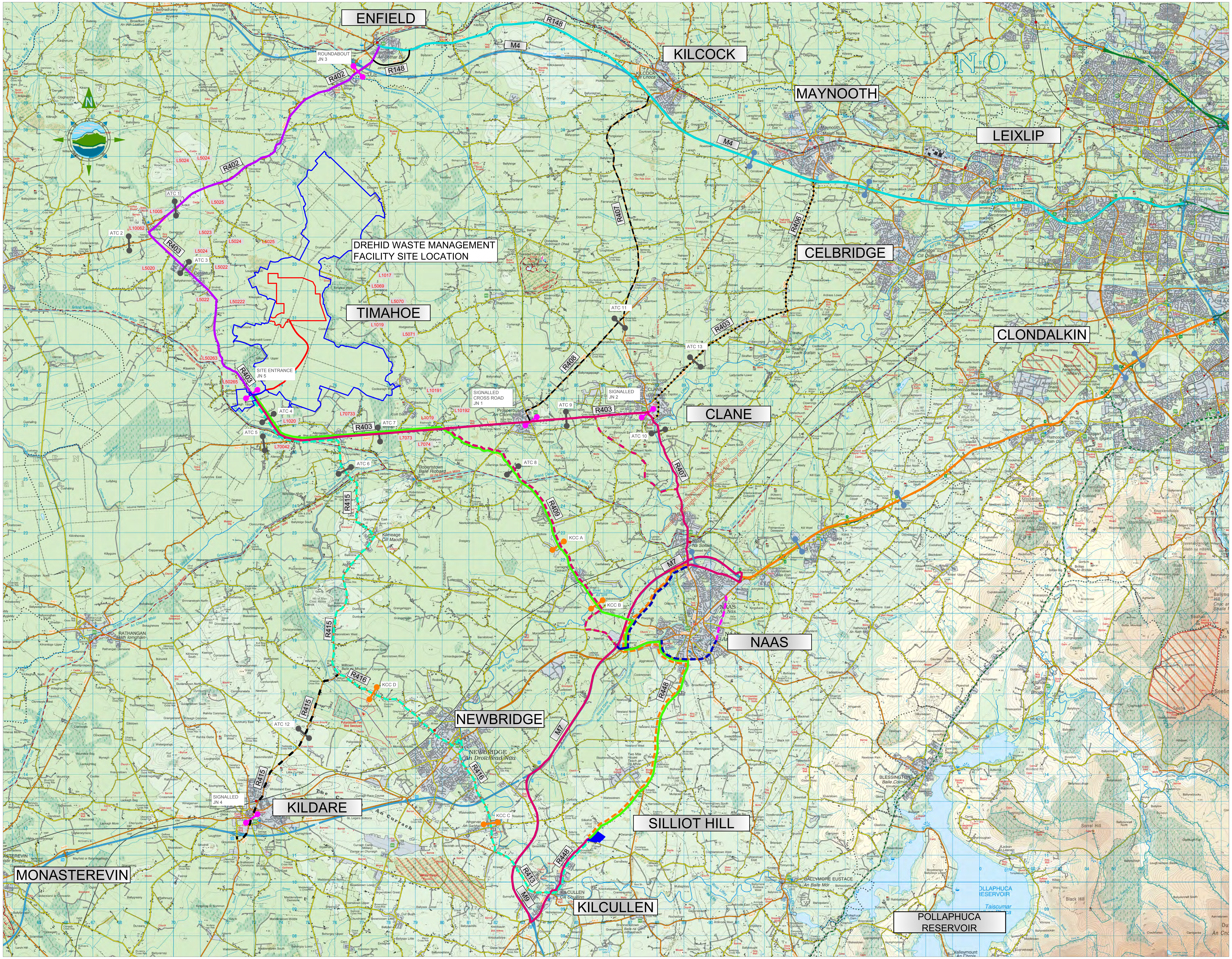
In addition to the traffic surveys listed above, further traffic data has been sourced from Kildare County Council and Transport Infrastructure Ireland, also shown on Figure 10.1.

Automated Traffic Counters (Kildare County Council):

- R409 North-west of Carragh; Monday 13th June 2016.
- R409 South-east of Carragh; Monday 13th June 2016.
- R416 North-west of Newbridge; Monday 13th June 2016.
- R416 South-east of Newbridge; Monday 13th June 2016.

Automated Traffic Counters (Transport Infrastructure Ireland):

- M7 North of Naas, AADT 2016.
- M4 South of Maynooth, AADT 2016.



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GENERAL LEGEND

BORD NA MONA OWNERSHIP BOUNDARY

APPLICATION BOUNDARY

- PERMITTED HAUL ROUTE FROM M50 TO REGIONAL ROAD NETWORK VIA M7/N7
- PERMITTED HAUL ROUTE FROM M50 TO REGIONAL ROAD NETWORK VIA M4/N4
- PERMITTED HAUL ROUTE No.1
- PERMITTED HAUL ROUTE No.1.1 (Temporarily closed to HGV's)
- PERMITTED HAUL ROUTE No.1.2
- PERMITTED HAUL ROUTE No.2 (Section through Carragh village temporarily closed to HGV's)
- HAUL ROUTE No.2.2 (Revised due to restrictions at Carragh village)
- PERMITTED HAUL ROUTE No.3
- PERMITTED HAUL ROUTE No.4
- COMPLETED NAAS ROAD IMPROVEMENTS
- PLANNED NAAS ROAD IMPROVEMENTS
- PROPOSED HAUL ROUTE ALONG ENFIELD RING ROAD
- PROPOSED HAUL ROUTE KILCOCK TO PROSPEROUS
- PROPOSED HAUL ROUTE KILDARE TO MILLTOWN
- PROPOSED HAUL ROUTE MAYNOOTH TO CLANE
- L7074 LOCAL ROAD
- R4## REGIONAL ROAD
- AUTOMATIC TRAFFIC COUNT (2 Way)
- JUNCTION COUNT
- TII TRAFFIC DATA SITE
- KCC TRAFFIC DATA SITE

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Rev	Date	Description	By	Chkd.
A	Nov. '17	PLANNING ISSUE	MN	AA

Client: BORD NA MÓNA Naturally Driven

Project: PROPOSED DEVELOPMENT AT DREHID WASTE MANAGEMENT FACILITY

Title: HAUL ROUTES & TRAFFIC COUNT LOCATIONS

Scale @ A3: 1:130,000

Prepared by: M. Nolan

Checked: A. Austin

Date: November 2017

Project Director: D. Grehan

Drawing Status: EIS

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Drawing No.: Figure 10.1

Revision: A

10.2.2 Road Network

The proposed development, which is the subject of this traffic transport assessment, is located within the townlands of Killinagh Upper, Killinagh Lower, Drummond and Kilkeaskin, Loughnacush, and Parsonstown at Carbury County Kildare within an overall landholding which is under the ownership of Bord na Móna. The existing permitted and operational Drehid Waste Management Facility is located within this Bord na Móna landholding. The site is accessible via a network of regional routes which in turn link with the National Primary Road / Motorway network. Access to the site will be provided by the existing entrance on the R403. The R403 lies south, southwest and west of the site and joins the R402 at Carbury to the northwest of the site.

The haul routes to be followed by traffic associated with the proposed development are presented in Appendix 10.1 and Figure 10.1 and it is proposed that traffic will be dispersed over these routes. Each of these routes is via regional roads or a combination of local, regional roads and national primary routes. All construction contractors, and all contractors delivering waste to the proposed development, will be issued with a map of permitted haul routes such that all materials imported to or exported from the proposed development are transported via one of the identified haul routes. The significant majority of the roads making up the haul routes are sufficiently wide to accommodate two way HGV movement along them. Where there are narrow sections along a haul route, these sections are short in nature with ample opportunities for vehicles to pass.

The haul routes outlined in Appendix 10.1 and Figure 10.1 include four new proposed haul routes, additional to those currently permitted. The first additional proposed route is along the R407 running into the R408 from Junction 8 on the M4 to Prosperous. The second additional proposed route is along the R406 which leads onto R403 from Junction 7 on the M4 to Clane. The third additional proposed route is along the R415 from Junction 13 on the M7 to the R416 at Milltown. The fourth additional proposed route runs south of Enfield starting at the roundabout on the R148 and Johnstown Road, continuing along the R148 to its signalised junction with the R402.

Access is provided into the Drehid Waste Management Facility from the R403 via a previously permitted entrance and a dedicated 4.8 km private access road. The existing entrance on the R403 is located within an 80 km/h speed zone. The R403 has an approximate carriageway width of 6.0 m in the vicinity of the site entrance. A ghost island junction with 3 m wide through lanes and a 3 m wide right turning lane has been provided at the existing entrance with visibility splays of 3.0 x 160 m in accordance with TII DN-GEO-03043 (previously NRA TD41-42).

The site is currently accessed from the north via the R402 and R403. The R402 is a Regional Road and provides access from the M4 Motorway to the site via the R403, where the existing entrance junction is located. The R402 for the majority of the route has a carriageway width of 7.5 m with hard shoulders either side. There are road markings and signage along this route. The junction between the R402 and R403 is a roundabout with adequate visibility.

The site is currently accessed from the south by the R407 and the R416/R415, all of which lead to the R403. The R407 is a Regional Road, which runs from the M7 to the R403 in Clane. The carriageway width of the R407 varies between approximately 6.0 m and 7.0 m. The junction between the R407 and the R403 is located in Clane. It is a traffic signal controlled junction with adequate visibility.

The R416/R415 Regional Road provides access to the R403 from the M9 Motorway. There are 2 bridges along this route at which the road width is restricted to approximately 5.3 m.

The R409 Regional Road provides access from the M7 Naas Bypass to the R403. It is a single carriageway and varies in width from approximately 5.2 m to 6.4 m. The junction between the R409 and the R403 is a priority crossroads with the fourth arm being a local road. Visibility at this location is restricted for cars by the horizontal and vertical geometry of the R403, however visibility is available for HGV traffic. Although this haul route is currently permitted, it is not currently used by facility traffic due to a weight restriction which has been applied by Kildare County County to the bridge over the River Liffey at Carragh.

10.2.3 Proposed Road Network Improvements

The Kildare County Development Plan 2017 – 2023 contains two tables that provide information on improvements to the road network. These are Table 6.1: Priority Road and Bridge Projects and Table 6.2: Regional Roads Identified for Improvements. The relevant improvements have been extrapolated from these tables and are shown in Table 10-1 and Table 10-2 respectively.

Table 10-1: Priority Road and Bridge Projects

Priority Road and Bridge Projects from Kildare County Development Plan 2017 – 2023	
Name	**Route**
Sallins Bypass	R407
Inner Relief, Naas Town LAP road objectives RP04	R410 to R445 c.1.5 km of Blessington Road to Dublin Road
Inner Relief Road, Clane Clane LAP roads objective TR3	R403 to R407 Capdoo (Celbridge Road to Kilcock Road)
Inner Relief Road, Newbridge Newbridge LAP roads objective SR05(a)	L2028 to R416 Between Great Connell Road to Athgarvan Road (Liffey Hall Junction) with bridge crossing over River Liffey

Table 10-2: Regional Roads Identified for Improvements

Regional Roads Identified for Improvements from Kildare County Development Plan 2017 – 2023	
Road No.	**Location**
R402	County boundary at Kishawanny to county boundary at Johnstown Bridge
R403	County boundary at Backweston to Clane via Celbridge
R403	Clane to junction with R402 via Prosperous, Allenwood & Derrinturn
R407	Kilcock to Naas via Clane Inner Relief Road
R408	Prosperous to Maynooth
R415	Allenwood to Kildare via Kilmeague
R416	Junction with R413 at Kinneagh to Newbridge
R416	Newbridge to junction with the R415 at Milltown
R448	Naas to Kilcullen and junction with M9

There are also Local Area Plans (LAP) that set out the local authority's objectives for specific areas. The LAP's and Town Development Plan that are likely to impact on the existing and proposed haul routes are:

- The Kilcullen Local Area Plan 2014-2020;
- Clane Local Area Plan 2009 and Draft Clane Local Area Plan 2017-2023;
- Newbridge Local Area Plan 2013 – 2017;
- Kildare Local Area Plan 2012 – 2018; and,
- The Naas Town Development Plan 2011-2017.

The above LAP's and Town Development Plan were reviewed in conjunction with the Kildare County Development Plan 2017-2023. The main objectives that are highlighted in these plans are shown in Table 10-1.

The Kildare LAP 2012 – 2018 objective RIO 15, is likely to impact on the proposed haul route on the R415 through Kildare Town. This objective highlights the Market Square for implementation of measures that would moderate vehicular movements, to achieve a high pedestrian movement function. No indication is given to the timeline for the implementation of these measures and it is not highlighted as a priority within the Kildare County Development Plan 2017-2023.

The Regional Roads identified for improvement works in the Kildare County Development Plan are highlighted in Table 10-2. Although this table covers which sections are to be improved there is no indication as to the proposed extent of these works. It is noted that the R402 was upgraded from the county boundary at Johnstown Bridge to its junction with the R403. This includes realignment and widening of sections of the road and is part of the R402 Enfield to Edenderry Improvement Scheme. Works undertaken to date and those identified in Table 10-2, are all improvements to the regional road network and would benefit the existing and proposed haul routes, or alter traffic flows in the immediate vicinity of the proposed development.

10.2.4 Likely future environment / do nothing scenario

As traffic grows at Junctions 1 and 2 these junctions will be under further pressure, with or without the development of the proposed facility, if changes are not made to the existing road network and junction layouts.

Junctions 3 and 5 are operating within capacity at present and will still operate within capacity with the proposed facility. Junction 4 which is also operating within capacity at present will however reach a Degree of Saturation (DOS) of 0.895 in 2034 without any development. The maximum DOS for Scenario 1 is 0.963 in 2019 for Stress test 5 on arm D. For the more likely traffic distribution Stress Test 4 (66% Facility traffic to / from the south and 33% to / from the north) the maximum DOS is 0.918 in 2019 on arm D. The maximum impact is during 2019, however this is a temporary impact in the AM peak (see Table 10-20: OSCADY results: Junction 4 - Signalised crossroads R415 & R445 in Kildare AM & PM peak hours (Scenario 1)). The assessment indicates that the junction will operate at 95.5% capacity in 2034.

10.3 POTENTIAL EFFECTS ON TRAFFIC

A comprehensive description of the existing site, proposed development and construction methodology is provided within Chapter 3 of this EIAR.

The nature and volumes of waste included in the existing development and the proposed development are detailed in Table 10-3: Nature and volumes of waste at Existing Drehid Waste Management Facility and Table 10-4: Nature and volumes of waste included in the Proposed development.

Table 10-3: Nature and volumes of waste at Existing Drehid Waste Management Facility

Process	Nature of Waste	Volume of Waste	Life of Facility	Alteration to Existing Development
Existing Landfill	Non-Hazardous	120,000 TPA	2028	No alteration required, this is Permitted & Operational
Existing Composting	Non-Hazardous	25,000 TPA*	2028	No alteration required, this is Permitted & Operational

Table 10-4: Nature and volumes of waste included in the Proposed development

Process	Nature of Waste	Volume of Waste	Life of Facility	Alteration to Existing Development
Existing Composting	Non-Hazardous	25,000 TPA	Remove current restriction	No alteration required, this is Permitted & Operational
Proposed composting	Non-Hazardous	20,000 TPA	Unrestricted	No alteration required, there is capacity available in the existing plant
Proposed composting	Non-Hazardous	45,000 TPA	Unrestricted	A new extension of the existing composting facility is proposed.
Proposed Recovery	Non-Hazardous	15,000 TPA	25 years	A new metals recovery facility is proposed.
Proposed Landfill	Non-Hazardous	250,000 TPA	25 years	A new non-hazardous engineered landfill is proposed.
Proposed Landfill	Hazardous	85,000 TPA**	25 years	A new hazardous engineered landfill is proposed.
Proposed Pre-Treatment	Hazardous	** Included above	25 years	A new hazardous waste pre-treatment facility is proposed.
Leachate Treatment Plant	Non-Hazardous	c. 51,000 m^3 per annum	Unrestricted	A new Treatment Facility is proposed.

In March 2013 Bord na Móna was granted permission for a Mechanical Biological Treatment (MBT) facility south of the existing Drehid facility. The projected construction and operation traffic associated with this facility has been taken into account in the assessment of the projected traffic volumes associated with the proposed development. The traffic impact scenarios also include assessment of traffic generated in the surrounding road network without the MBT facility in the event that the MBT is not constructed.

10.3.1 Existing and Proposed development (Scenarios)

All scenarios take into account pre and post 2028, when the existing landfill permission expires. Traffic assessments are carried out for an expected year of opening 2019 (the earliest assumed commencement date), and design years 2024 (+5 years) and 2034 (+15 years) which are in line with TII Project Appraisal Guidelines. The nature and volumes of waste at the existing facility are covered in Table 10-3 and those for the proposed development are covered in Table 10-4.

The following traffic scenarios have been considered:

- Scenario 0: Existing Facility and the permitted MBT;
- Scenario 1: Existing Facility with the proposed development and the permitted MBT; and
- Scenario 2: Existing Facility with the proposed development.

10.3.2 Cumulative Impacts

A planning search of the areas surrounding the proposed development was carried out. This includes sites which have previously been granted planning permission but which are yet to become operational. Committed developments that were recorded consisted of domestic structures and the proposed Mechanical Biological Treatment (MBT) Facility (09.PA0027). The domestic structures are assumed to be accounted for within the annual growth factors[70] applied to the traffic survey data. The MBT is fully considered within the scenarios assessed as described in Section 10.3.1 above.

10.3.3 Traffic Generation

As stated in 'Section 10.2.1 Traffic Survey', the most recent traffic counts were carried out in October 2016. At this time the Drehid Waste Management Facility was accepting up to 360,000 tpa for disposal to the existing MSW landfill, and therefore the traffic figures that are being used for the traffic assessment of the road network and junctions include the HGV traffic generated by this activity. The total operational flows are shown in Table 10-5: Total Number of Arriving Operational Flows and Table 10-6: Total Number of Departing Operational Flows. Adjustments are therefore required to the HGV traffic figures produced within these tables so that only the net increase / decrease is added to the traffic data. The adjustments to the flows are shown in Table 10-7: Net Arriving Operational Flows and Table 10-8: Net Departing Operational Flows which show the net operational flows.

10.3.3.1 Operational Traffic

The volume of HGV's and cars that are expected to be generated, for the Operational Phase only, by deliveries to/from the facility and staff working there, have been estimated and presented in Table 10-5, Table 10-6, and Table 10-8. These tables cover Scenarios 0, 1 and 2. The existing landfill will have reverted to a permitted waste acceptance of 120,000 tonnes per annum after 1st December 2017 and

[70] TII (previously NRA) Project Appraisal Guidelines (PE-PAG-02017) Unit 5.3: Travel Demand Projections.

will be at that waste acceptance tonnage in 2019, which is the earliest envisaged year of commencement of the operational phase of the proposed development. Table 10-5 below excludes the empty vehicles that would arrive to collect the leachate, however these movements are included within Table 10-10.

Table 10-6 does not include the trucks that would leave empty after delivering full loads to the site, however these are also included in Table 10-10.

Table 10-5: Total Number of Arriving Operational Flows

Estimated Arriving Operational Flows to Drehid Waste Facility				
	Weekly (one-way)		Daily (one-way)	
	HGV's	Car	HGV's	Car
Existing Flow, up to 1st Dec 2017 (Existing Facility with Landfill accepting 360,000 tpa):				
Admin & Site Operations	-	81		14
Existing Landfill	341	60	57	10
Composting Facility	24	18	4	3
Engineering Material	334		56	
Existing Flows (2016)	700	159	117	27
Scenario 0				
Scenario 0 (Existing Facility & MBT) (2019 - 2027):				
Admin & Site Operations		75		13
Existing Landfill	45	48	8	8
Composting Facility	24	18	4	3
Engineering Material	103		17	
MBT	240	432	40	72
Scenario 0 Total (pre 2028)	413	573	69	96
Scenario 0 from 2028 (Existing Facility closed & MBT):				
Admin & Site Operations		42		7
MBT	240	432	40	72
Scenario 0 Total (from 2028)	240	474	40	79
Scenario 1				
Scenario 1 (Existing Facility, Proposed development & MBT) (2019 - 2027):				
Admin & Site Operations & Maintenance		102		16
Existing Landfill	33	60	6	10
Composting Facility	87	42	15	7
Engineering Material	72		12	
Proposed Non-Hazardous Facility	241	18	40	3

Estimated Arriving Operational Flows to Drehid Waste Facility				
	Weekly (one-way)		Daily (one-way)	
	HGV's	Car	HGV's	Car
Proposed Hazardous Facility	92	24	14	4
MBT	240	432	42	73
Scenario 1 Total (pre 2028)	765	678	127	113
Scenario 1 from 2028 (Existing Facility Landfill closed, Proposed development & MBT):				
Admin & Site Operations & Maintenance		84		14
Composting Facility	87	42	15	7
Proposed Non-Hazardous Facility	114	18	19	3
Proposed Hazardous Facility	92	24	15	4
MBT	240	432	40	73
Scenario 1 Total (from 2028)	533	600	89	100
Scenario 2				
Scenario 2 (Existing Facility, Proposed development & No MBT) (2019 - 2027):				
Admin & Site Operations & Maintenance		102		17
Existing Landfill	98	60	19	10
Composting Facility	87	42	15	7
Engineering Material	72		12	
Proposed Non-Hazardous Facility	241	18	40	3
Proposed Hazardous Facility	92	24	14	4
Scenario 2 Total (pre 2028)	590	180	99	41
Scenario 2 from 2028 (Existing Facility Landfill closed, Proposed development & No MBT)):				
Admin & Site Operations & Maintenance		84		14
Composting Facility	87	42	15	7
Non-Hazardous Material	180	18	40	3
Hazardous Material	92	24	15	4
Scenario 2 Total (from 2028)	359	168	60	28

Notes

(1) Bulk Haulage Vehicles – 20 tonne payloads assumed

(2) 312 working days assumed based on 52 weeks per year and 6 days per week for operation

(3) 10 hour working day assumed for HGVs

(4) Numbers of trips have been rounded up to nearest whole number.

(5) Assumed that operational staff will travel to work in their own vehicle (single occupancy).

Table 10-6: Total Number of Departing Operational Flows

Estimated Departing Operational Flows from Drehid Waste Facility				
	Weekly (one-way)		Daily (one-way)	
	HGV's	Car	HGV's	Car
Existing Flows, up to 1st Dec 2017 (Existing Facility with Landfill accepting 360,000 tpa):				
Admin & Site Operations	-	81		14
Existing Landfill	-	60		10
Composting Facility	-	18		3
Leachate	30		5	
Existing Flows (2016)	30	159	5	27
Scenario 0				
Scenario 0 (Existing Facility & MBT) (2019 - 2027):				
Admin & Site Operations		75		13
Existing Landfill	-	48	-	8
Composting Facility	-	18	-	3
Leachate	35		6	
MBT	122	252	21	42
Scenario 1 (pre 2028)	157	393	27	66
Scenario 0 from 2028 (Existing Facility closed & MBT):				
Admin & Site Operations		42		7
Leachate	13		2	
MBT	187	252	32	42
Scenario 1 (pre 2028)	200	294	34	49
Scenario 1				
Scenario 1 (Existing Facility, Proposed development & MBT) (2019 - 2027):				
Admin & Site Operations & Maintenance		102		17
Existing Landfill	-	60	-	10
Composting Facility	-	42	-	7
Leachate	41		7	
Proposed Non-Hazardous Facility	14	18	3	3
Proposed Hazardous Facility	-	24	-	4
MBT	122	252	20	42
Scenario 1 (pre 2028)	177	498	30	83
Scenario 1 from 2028 (Existing Facility Landfill closed, Proposed development & MBT):				
Admin & Site Operations & Maintenance		84		14
Composting Facility	-	42	-	7
Leachate	30		5	

Estimated Departing Operational Flows from Drehid Waste Facility				
	Weekly (one-way)		Daily (one-way)	
	HGV's	Car	HGV's	Car
Proposed Non-Hazardous Facility	14	18	2	3
Proposed Hazardous Facility	-	24	-	4
MBT	122	252	21	42
Scenario 1 from 2028 Total	166	420	28	70
Scenario 2				
Scenario 2 (Existing Facility, Proposed development & No MBT) (2019 -2027):				
Admin & Site Operations & Maintenance		102		17
Existing Landfill	-	60	-	10
Composting Facility	-	42	-	7
Leachate	35		6	
Proposed Non-Hazardous Facility	14	18	3	3
Proposed Hazardous Facility	-	24	-	4
Scenario 2 Total	49	246	9	41
Scenario 2 from 2028 (Existing Facility Landfill closed, Proposed development & No MBT):				
Admin & Site Operations & Maintenance		84		14
Composting Facility	-	42	-	7
Leachate	25		4	
Proposed Non-Hazardous Facility	14	18	3	3
Proposed Hazardous Facility	-	24	-	4
Scenario 2 from 2028 Total	39	168	7	28

Notes (1) Bulk Haulage Vehicles – 20 tonne payloads assumed

(2) 312 working days assumed based on 52 weeks per year and 6 days per week for operation

(3) 10 hour working day assumed for HGVs

(4) Numbers of trips have been rounded up to nearest whole number.

(5) Assumed that operational staff will travel to work in their own vehicle (single occupancy).

The existing traffic generated by the Drehid WMF operations is included within the traffic count figures that are being used for the traffic assessment. To ensure that only the differences in flows are assessed, the net figures need to be established. The net increase / decrease are established by taking the figures from the existing traffic from Scenarios 0, 1 and 2 to find their net impact. Table 10-7 and Table 10-8 detail the net figures for daily flows for Scenarios 0, 1 and 2 for Arrivals and Departures respectively.

Table 10-7: Net Arriving Operational Flows

Estimated Net Arriving Operational Flows for - Drehid Waste Facility		
	Daily HGV's	**Daily Cars**
2016 Existing Total	117	27
Scenario 0		
Scenario 0 (Existing Facility & MBT) (2019 - 2027):		
Scenario 0 estimated flows	69	96
Existing Flows	-117	-27
Scenario 0 Net Total	-48	69
Scenario 0 from 2028 (Existing Facility closed & MBT):		
Scenario 0 estimated flows	40	79
Existing Flows	-117	-27
Scenario 0 from 2028 Net Total	-77	52
Scenario 1		
Scenario 1 (Existing Facility, Proposed development & MBT) (2019 - 2027):		
Scenario 1 estimated flows	127	113
Existing Flows	-117	-27
Scenario 1 Net Total	10	86
Scenario 1 from 2028 (Existing Facility Landfill closed, Proposed development & MBT):		
Scenario 1 from 2028 estimated flows	89	100
Existing Flows	-117	-27
Scenario 1 from 2028 Net Total	-28	73
Scenario 2		
Scenario 2 (Existing Facility, Proposed development & No MBT) (2019 - 2027):		
Scenario 2 estimated flows	99	41
Existing Flows	-117	-27
Scenario 2 Net Total	-18	14

Estimated Net Arriving Operational Flows for - Drehid Waste Facility		
	Daily HGV's	Daily Cars
Scenario 2 from 2028 (Existing Facility Landfill closed, Proposed development & No MBT):		
Scenario 2 from 2028 estimated flows	60	28
Existing Flows	-117	-27
Scenario 2 from 2028 Net Total	-57	1

Table 10-8: Net Departing Operational Flows

Estimated Net Departing Operational Flows - Drehid Waste Facility		
	Daily HGV's	Daily Cars
Existing Flows	5	27
Scenario 0		
Scenario 0 (Existing Facility & MBT) (2019 - 2027):		
Scenario 0 estimated flows	27	66
Existing Flows	-5	-27
Scenario 0 Net Total	22	39
Scenario 0 from 2028 (Existing Facility closed & MBT):		
Scenario 0 estimated flows	34	49
Existing Flows	-5	-27
Scenario 0 from 2028 Net Total	29	22
Scenario 1		
Scenario 1 (Existing Facility, Proposed development & MBT) (2019 - 2027):		
Scenario 1 estimated flows	30	83
Existing Flows	-5	-27
Scenario 1 Net Total	25	56
Scenario 1 from 2028 (Existing Facility Landfill closed, Proposed development & MBT):		
Scenario 1 from 2028 estimated flows	28	70
Existing Flows	-5	-27

Estimated Net Departing Operational Flows - Drehid Waste Facility		
	Daily HGV's	Daily Cars
Scenario 1 from 2028 Net Total	23	43
Scenario 2		
Scenario 2 (Existing Facility, Proposed development & No MBT) (2019 - 2027):		
Scenario 2 estimated flows	9	41
Existing Flows	-5	-27
Scenario 2 Net Total	4	14
Scenario 2 from 2028 (Existing Facility Landfill closed, Proposed development & No MBT):		
Scenario 2 from 2028 estimated flows	7	28
Existing Flows	-5	-27
Scenario 2 from 2028 Net Total	2	1

10.3.3.2 Construction Traffic

Traffic generated by the construction of the proposed development will be related to the delivery of construction materials to and from site. Construction staff will also generate trips to and from the facility. It has been assumed that each member of staff will travel in their own car. It has also been assumed they will all arrive during the AM peak and depart during the PM peak.

The estimates for construction related traffic include the following:

- The proposed development;
  - Extension of the Composting Facility.
  - Construction of the IBA Maturation and Metals Recovery Facility.
  - Construction of the Ash Solidification Facility.
  - Construction of the proposed Non-Hazardous and Hazardous Landfills on a phased basis.
  - Construction of Leachate Treatment Facility.
  - Construction of ancillary infrastructure.
- Construction of the Mechanical & Biological Treatment Facility (Scenarios 0 and 1 only).

Scenario 1 has the biggest impact on the road network during both the Operational and Construction phases.

To assess the impact of construction for the Scenarios a different approach is required. Unlike for the Operational Phase, the Construction will occur on a phased basis for elements such as the hazardous and non-hazardous landfill. Therefore, traffic figures that are used will be dependent not only on the scenario being assessed but also the year of the assessment for that Scenario. The maximum number of HGV construction vehicles that will be on site for that Scenario and year will be used for the traffic inputs and this will also apply to site staff vehicles.

An assumed opening year of 2019 for the commencement of Construction was utilised for the purpose of the traffic assessment. In addition to the opening year, and in accordance with TII guidelines, the capacity assessment was also based on traffic conditions forecast for the design years 2024 (+5 years) and 2034 (+ 15 years).

For Scenarios 1 and 2, additional construction is required for a construction site compound, road and yard associated with both the hazardous and non-hazardous construction. These have been identified in Table 10-9 separately as ancillary site works for year 2019 only. The weekly flows are based on a 5 day working week for both the Construction HGV traffic and cars.

Table 10-9: Total Number of Construction Trips (one-way)

Estimated Construction Flows to Drehid Waste Facility				
	Weekly (one-way)		Daily (one-way)	
	HGV's	Car	HGV's	Car
Scenario 0				
Scenario 0 (Existing Facility & MBT) in 2019:				
Existing Landfill	39	135	8	27
MBT	154	555	31	111
Scenario 0 Total (2019):	193	690	39	138
Scenario 0				
Scenario 0 (Existing Facility & MBT) in 2024:				
Existing Landfill	1	3	1	1
Scenario 0 Total (2024):	1	3	1	1
Scenario 1				
Scenario 1 (Existing Facility, Proposed development & MBT) in 2019:				
Proposed Non-Hazardous Facility	31	135	6	27

Estimated Construction Flows to Drehid Waste Facility				
	Weekly (one-way)		Daily (one-way)	
	HGV's	Car	HGV's	Car
Proposed Hazardous Facility	24	135	5	27
Existing Landfill	39	135	8	27
MBT	154	555	31	111
Ancillary Infrastructure	242	415	49	83
Composting Facility Extension	6	55	1	11
Leachate Treatment Facility	5	55	1	11
Scenario 1 Total (2019)	501	1485	101	297
Scenario 1 (Existing Facility, Proposed development & MBT) in 2024:				
Proposed Hazardous Facility	43	242	8	49
Existing Landfill	1	3	1	1
Scenario 1 Total (2024)	44	245	9	50
Scenario 1 (Existing Facility Landfill closed, Proposed development & MBT) 2034:				
Proposed Hazardous Facility	43	242	9	49
Scenario 1 Total (2034)	43	242	9	49
Scenario 2				
Scenario 2 (Existing Facility, Proposed development & No MBT) in 2019:				
Proposed Non-Hazardous Facility	31	135	6	27
Proposed Hazardous Facility	24	135	5	27
Existing Landfill	39	135	8	27
Ancillary Infrastructure	242	415	49	83
Composting Facility Extension	6	55	1	11
Leachate Treatment Facility	5	55	1	11
Scenario 2 Total (2019)	347	930	70	186

Estimated Construction Flows to Drehid Waste Facility				
	Weekly (one-way)		Daily (one-way)	
	HGV's	Car	HGV's	Car
Scenario 2 (Existing Facility, Proposed development & No MBT) in 2024:				
Proposed Hazardous Facility	43	242	8	49
Existing Landfill	1	3	1	1
Scenario 2 Total (2024)	44	245	9	50
Scenario 2 (Existing Facility Landfill closed, Proposed development & No MBT) in 2034:				
Proposed Hazardous Facility	43	242	9	49
Scenario 2 Total (2034)	43	242	9	49

Notes (1) Bulk Haulage Vehicles – 20 tonne payloads assumed

(2) 260 working days assumed based on 52 weeks per year and 5 days per week for Construction

(3) 10 hour working day assumed for HGVs

(4) Numbers of trips have been rounded up to nearest whole number.

(5) Assumed that construction staff will travel to work in their own vehicle (single occupancy).

10.3.3.3 Combined Operation and Construction Flows for years of assessment

In Table 10-10 below both the Operation totals for each scenario have been added to those for Construction. These totals also include for any movements of HGV's that would enter the site empty (e.g. to pick up leachate) or leave the site empty (e.g. deliveries to facility, MBT etc).

These are the base flows that will be utilised going forward for inputs into the stress tests and also for the years being assessed. Adjustments required for the various years are explained in the paragraphs below.

Table 10-10: Estimated Combined Operational and Construction Flows

Estimated Combined Operational and Construction Flows for Drehid Waste Facility	Daily HGV's	Daily Cars
Scenario 0		
Scenario 0 (Existing Facility & MBT) in 2019:		
Operational Net Total (Arrival)	*-48	69
Operational Net Total (Departing)	*22	39
Construction Total	*39	**138
Scenario 0 Net Total (2019)	26	384
Scenario 0 (Existing Facility & MBT) in 2024:		
Operational Net Total (Arrival)	*-48	69
Operational Net Total (Departing)	*22	39
Construction Total	1	1
Scenario 0 Net Total (2024)	-51	109
Scenario 0 (Existing Facility closed & MBT) in 2034:		
Operational Net Total (Arrival)	*-77	52
Operational Net Total (Departing)	*29	22
Construction Total	-	-
Scenario 0 Net Total (2034)	-96	74
Scenario 1		
Scenario 1 (Existing Facility, Proposed development & MBT) in 2019:		
Operational Net Total (Arrival)	*10	86
Operational Net Total (Departing)	*25	56
Construction Total	*101	**297

Estimated Combined Operational and Construction Flows for Drehid Waste Facility	Daily HGV's	Daily Cars
Scenario 1 Net Total (2019)	272	736
<u>Scenario 1 (Existing Facility, Proposed development & MBT) in 2024:</u>		
Operational Net Total (Arrival)	*10	86
Operational Net Total (Departing)	*25	56
Construction Total	*9	**50
Scenario 1 Net Total (2024)	88	242
<u>Scenario 1 (Existing Facility Landfill closed, Proposed development, & MBT) 2034:</u>		
Operational Net Total (Arrival)	*-28	73
Operational Net Total (Departing)	*23	43
Construction Total	*9	**49
Scenario 1 Net Total (2034)	9	214
Scenario 2		
<u>Scenario 2 (Existing Facility, Proposed development & No MBT) 2019:</u>		
Operational Net Total (Arrival)	*-18	14
Operational Net Total (Departing)	*4	14
Construction Total	*70	**186
Scenario 2 Net Total (2019)	112	400
<u>Scenario 2 (Existing Facility, Proposed development & No MBT) 2024:</u>		
Operational Net Total (Arrival)	*-18	14
Operational Net Total (Departing)	*4	14
Construction Total	*9	**50

Estimated Combined Operational and Construction Flows for Drehid Waste Facility	Daily HGV's	Daily Cars
Scenario 2 Net Total (2024)	-10	128
<u>Scenario 2 (Existing Facility Landfill closed, Proposed development, & No MBT) 2034:</u>		
Operational Net Total (Arrival)	*-57	1
Operational Net Total (Departing)	*2	1
Construction Total	*9	**49
Scenario 2 Net Total (2034)	-92	100

Notes As the above figures are daily flows the following has been applied:

(1) * All HGV's are doubled as HGV's arriving full have to exit the site empty and all HGV's exiting the site full have to enter the site empty.

(2) ** All construction staff vehicles are doubled to allow for arrival and departure from site.

Looking at the Net totals shown in Table 10-10, the scenario that has the biggest impact on the road network for 2019 is Scenario 1, which will increase daily background traffic by 272 HGV's and 736 cars. For 2024, again Scenario 1 has the biggest impact with an addition of 88 HGV's and 242 cars daily to background traffic. Scenario 1 also has the biggest impact for the assessment year 2034, which increases background traffic by 9 HGV's and 214 cars.

The Scenario that requires further assessment in this chapter, and will form part of the detailed traffic analysis, is Scenario 1. In 2019, the combined traffic associated with the majority of the construction activities and the coming online of operational traffic gives the highest traffic flows. The year 2024 is also modelled for Scenario 1 as the majority of the Construction will be completed, with only the cyclic elements of construction for the hazardous and non-hazardous landfills ongoing. This is more reflective of the typical flows that would be expected for this development.

From 2029 onwards, the number of HGV's, and the potential to impact the road network, decreases significantly. In 2034 there will be only an additional 9 HGV's daily, compared to 272 in 2019 and 88 in 2024.

10.3.4 Seasonal Adjustment

In order to undertake an analysis of the junctions, and to take account of the seasonal variation that is experienced with traffic surveys, it may be necessary to apply a correction factor to convert the surveyed traffic figures into seasonally adjusted traffic flows. These seasonally adjusted conversion factors were calculated using data taken from a fixed automatic traffic counter located on the M7 between Junction 7 Kill and Junction 8 Johnstown, over a 12-month period in 2015.

It was found that traffic volumes for both the AM and PM peaks in September and May are above the average peak traffic flows during the other months of that year. In order to provide a robust analysis, no seasonal adjustment was undertaken to the September and May surveyed traffic figures. The Origin Destination Matrices of the traffic counts for the AM and PM peak hours are shown in Appendix 10.3.

10.3.5 Traffic Growth

The background traffic growth factors used in the analysis in this report were established from the TII's *Project Appraisal Guidelines (PE-PAG-02017) – Unit 5.3 Travel Demand Projections* (October 2016) guidance document. Traffic counts undertaken on regional roads in 2012 indicate that traffic flows on these roads have decreased in the period between then and the 2016 counts. However the TII count data indicates a high growth rate on the motorways between 2013 (start of TII data) and 2016. The variations between the regional and motorway growth rates is likely to be down to changes in driver behaviour. It is unlikely this trend will continue as the economy continues to recover and lands zoned for industrial, commercial, residential etc. are developed. This will increase the traffic on the road network. To allow for this, the growth factors used are low growth factors for region 2 (mid-east) on regional roads.

As outlined above, an opening year of 2019 for the proposed construction was utilised. In addition to the opening year, the capacity assessment was also based on traffic conditions forecast for the design years 2024 (+5 years) and 2034 (+ 15 years).

Annual growth indices were updated in 2016 by the TII, with annual indices and cumulative growth forecasts shown for the mid-east region in Table 10-11: Growth Factors. The derived growth factors were applied to 2016 flows to determine background traffic flows for the assessment years. There are different growth factors for light vehicles and heavy vehicles.

Table 10-11: Growth Factors

Low Growth Factor Region 2 - Mid East			
	2019	2024	2034
LV	1.033	1.091	1.120
HV	1.068	1.191	1.373

10.3.6 Trip Distribution

In order to analyse the effect that the traffic generated by the proposed development will have on the surrounding public road network, a number of different distribution scenarios were tested. These were used in order to observe the expected percentage increase in traffic on the R403 and surrounding road network.

The haul routes to be followed are presented in Appendix 10.1 and Figure 10.1 and it is proposed that traffic will be spread over these routes. The exact distribution pattern of traffic generated by the proposed development is not known, and a series of stress tests have therefore been applied to the haul routes using differing distribution patterns in an attempt to illustrate both the highly unlikely distribution, where all traffic journeys to and from the development originate and terminate from either the north or the south, and the more likely distribution where generated traffic is split in some proportion between north and south. The stress tests considered in this Report are as follows:

- Stress Test 1 – 100% north & 0% south;
- Stress Test 2 – 67% north & 33% south;
- Stress Test 3 – 50% north & 50% south;
- Stress Test 4 – 33% north & 67% south; and
- Stress Test 5 – 0% north and 100% south.

Prior to undertaking the Stress tests on the specific links and junctions there is a requirement to check the need for a Traffic and Transport Assessment (TTA) in line with TII (previously NRA) guidelines. It is important to identify proposals that will affect the surrounding road network and which may have other transport implications at the earliest stages of development planning and design. Table 1.4 of the Traffic Management Guidelines (DoT/DoEHLG/DTO, 2003) gives the thresholds above which a Traffic and Transport Assessment is automatically required. The threshold of relevance for this stress tests is – ‘Traffic to and from the development exceeds 10% of the traffic flow on the adjoining roads’.

The results of the stress tests are presented in Table 10-12: Stress Test 1 –100% north and 0% south to Table 10-16: Stress Test 5 – 0% north and 100% south, inclusive and show the percentage increases in total traffic for Scenario 1 for each road forming part of the proposed haul routes.

Table 10-12: Stress Test 1 –100% north and 0% south

					Scenario 1								
					Trip Generation						Net %Total Increase		
					2019		2024		2034				
Location	Counted AADT	2019 AADT	2024 AADT	2034 AADT	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	2019	2024	2034
M04-20	43704	45283	48070	50297	736	273	242	89	214	8	2.23%	0.69%	0.44%
ATC1	5816	6022	6387	6659	736	273	242	89	214	8	16.75%	5.18%	3.33%
ATC2	7728	7998	8476	8810	736	273	242	89	214	8	12.61%	3.90%	2.52%
ATC3	6095	6306	6679	6930	736	273	242	89	214	8	16.00%	4.95%	3.20%
Site Entrance (N)	5169	5366	5715	6050	736	273	242	89	214	8	18.80%	5.79%	3.67%
Site Entrance (S)	5169	5366	5715	6050	0	0	0	0	0	0	0.00%	0.00%	0.00%
ATC4	4973	5155	5478	5750	0	0	0	0	0	0	0.00%	0.00%	0.00%
ATC6	3939	4078	4323	4498	0	0	0	0	0	0	0.00%	0.00%	0.00%
ATC7	7383	7642	8098	8421	0	0	0	0	0	0	0.00%	0.00%	0.00%
ATC9	8075	8359	8862	9223	0	0	0	0	0	0	0.00%	0.00%	0.00%
ATC10	12640	13075	13842	14336	0	0	0	0	0	0	0.00%	0.00%	0.00%
ATC11	3922	4058	4296	4453	0	0	0	0	0	0	0.00%	0.00%	0.00%
ATC12	3783	3913	4141	4281	0	0	0	0	0	0	0.00%	0.00%	0.00%
ATC13	12293	12715	13457	13926	0	0	0	0	0	0	0.00%	0.00%	0.00%
M07-35	35627	36891	39122	40779	0	0	0	0	0	0	0.00%	0.00%	0.00%
M07-25	53986	57310	59352	63935	0	0	0	0	0	0	0.00%	0.00%	0.00%
KCC-Site C	6476	6692	7071	7275	0	0	0	0	0	0	0.00%	0.00%	0.00%
KCC-Site D	4346	4491	4746	4882	0	0	0	0	0	0	0.00%	0.00%	0.00%

Table 10-13: Stress Test 2 – 67% north and 33% south

					Scenario 1								
					Trip Generation						Net %Total Increase		
					2019		2024		2034				
Location	Counted AADT	2019 AADT	2024 AADT	2034 AADT	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	2019	2024	2034
M04-20	43704	45283	48070	50297	493	183	162	60	143	5	1.49%	0.46%	0.30%
ATC1	5816	6022	6387	6659	493	183	162	60	143	5	11.22%	3.47%	2.23%
ATC2	7728	7998	8476	8810	493	183	162	60	143	5	8.45%	2.62%	1.69%
ATC3	6095	6306	6679	6930	493	183	162	60	143	5	10.72%	3.32%	2.15%
Site Entrance (N)	5169	5366	5715	6050	493	183	162	60	143	5	12.60%	3.88%	2.46%
Site Entrance (S)	5169	5366	5715	6050	243	90	80	29	71	3	6.20%	1.91%	1.21%
ATC4	4973	5155	5478	5750	243	90	80	29	71	3	6.46%	1.99%	1.27%
ATC6	3939	4078	4323	4498	243	90	80	29	71	3	8.16%	2.53%	1.63%
ATC7	7383	7642	8098	8421	243	90	80	29	71	3	4.36%	1.35%	0.87%
ATC9	8075	8359	8862	9223	243	90	80	29	71	3	3.98%	1.23%	0.79%
ATC10	12640	13075	13842	14336	243	90	80	29	71	3	2.55%	0.79%	0.51%
ATC11	3922	4058	4296	4453	243	90	80	29	71	3	8.20%	2.54%	1.65%
ATC12	3783	3913	4141	4281	243	90	80	29	71	3	8.51%	2.64%	1.71%
ATC13	12293	12715	13457	13926	243	90	80	29	71	3	2.62%	0.81%	0.53%
M07-35	35627	36891	39122	40779	243	90	80	29	71	3	0.90%	0.28%	0.18%
M07-25	53986	57310	59352	63935	243	90	80	29	71	3	0.58%	0.18%	0.11%
KCC-Site C	6476	6692	7071	7275	243	90	80	29	71	3	4.98%	1.54%	1.01%
KCC-Site D	4346	4491	4746	4882	243	90	80	29	71	3	7.41%	2.30%	1.50%

Table 10-14: Stress Test 3 – 50% north and 50% south

					Scenario 1								
					Trip Generation						Net %Total Increase		
					2019		2024		2034				
Location	Counted AADT	2019 AADT	2024 AADT	2034 AADT	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	2019	2024	2034
M04-20	43704	45283	48070	50297	368	136	121	44	107	4	1.11%	0.34%	0.22%
ATC1	5816	6022	6387	6659	368	136	121	44	107	4	8.38%	2.59%	1.67%
ATC2	7728	7998	8476	8810	368	136	121	44	107	4	6.31%	1.95%	1.26%
ATC3	6095	6306	6679	6930	368	136	121	44	107	4	8.00%	2.48%	1.60%
Site Entrance (N)	5169	5366	5715	6050	368	136	121	44	107	4	9.40%	2.89%	1.83%
Site Entrance (S)	5169	5366	5715	6050	368	136	121	44	107	4	9.40%	2.89%	1.83%
ATC4	4973	5155	5478	5750	368	136	121	44	107	4	9.79%	3.02%	1.93%
ATC6	3939	4078	4323	4498	368	136	121	44	107	4	12.37%	3.83%	2.47%
ATC7	7383	7642	8098	8421	368	136	121	44	107	4	6.60%	2.04%	1.32%
ATC9	8075	8359	8862	9223	368	136	121	44	107	4	6.03%	1.87%	1.20%
ATC10	12640	13075	13842	14336	368	136	121	44	107	4	3.86%	1.20%	0.77%
ATC11	3922	4058	4296	4453	368	136	121	44	107	4	12.43%	3.85%	2.49%
ATC12	3783	3913	4141	4281	368	136	121	44	107	4	12.89%	4.00%	2.59%
ATC13	12293	12715	13457	13926	368	136	121	44	107	4	3.97%	1.23%	0.80%
M07-35	35627	36891	39122	40779	368	136	121	44	107	4	1.37%	0.42%	0.27%
M07-25	53986	57310	59352	63935	368	136	121	44	107	4	0.88%	0.28%	0.17%
KCC-Site C	6476	6692	7071	7275	368	136	121	44	107	4	7.54%	2.34%	1.53%
KCC-Site D	4346	4491	4746	4882	368	136	121	44	107	4	11.23%	3.49%	2.27%

Table 10-15: Stress Test 4 – 33% north and 67% south

					Scenario 1								
					Trip Generation						Net %Total Increase		
					2019		2024		2034				
Location	Counted AADT	2019 AADT	2024 AADT	2034 AADT	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	2019	2024	2034
M04-20	43704	45283	48070	50297	243	90	80	29	71	3	0.74%	0.23%	0.15%
ATC1	5816	6022	6387	6659	243	90	80	29	71	3	5.53%	1.71%	1.10%
ATC2	7728	7998	8476	8810	243	90	80	29	71	3	4.16%	1.29%	0.83%
ATC3	6095	6306	6679	6930	243	90	80	29	71	3	5.28%	1.63%	1.06%
Site Entrance (N)	5169	5366	5715	6050	243	90	80	29	71	3	6.20%	1.91%	1.21%
Site Entrance (S)	5169	5366	5715	6050	493	183	162	60	143	5	12.60%	3.88%	2.46%
ATC4	4973	5155	5478	5750	493	183	162	60	143	5	13.11%	4.05%	2.59%
ATC6	3939	4078	4323	4498	493	183	162	60	143	5	16.58%	5.13%	3.31%
ATC7	7383	7642	8098	8421	493	183	162	60	143	5	8.85%	2.74%	1.77%
ATC9	8075	8359	8862	9223	493	183	162	60	143	5	8.09%	2.50%	1.61%
ATC10	12640	13075	13842	14336	493	183	162	60	143	5	5.17%	1.60%	1.04%
ATC11	3922	4058	4296	4453	493	183	162	60	143	5	16.66%	5.16%	3.34%
ATC12	3783	3913	4141	4281	493	183	162	60	143	5	17.27%	5.35%	3.47%
ATC13	12293	12715	13457	13926	493	183	162	60	143	5	5.32%	1.65%	1.07%
M07-35	35627	36891	39122	40779	493	183	162	60	143	5	1.83%	0.57%	0.36%
M07-25	53986	57310	59352	63935	493	183	162	60	143	5	1.18%	0.37%	0.23%
KCC-Site C	6476	6692	7071	7275	493	183	162	60	143	5	10.10%	3.14%	2.04%
KCC-Site D	4346	4491	4746	4882	493	183	162	60	143	5	15.05%	4.67%	3.05%

Table 10-16: Stress Test 5 – 0% north and 100% south

					Scenario 1								
					Trip Generation						Net %Total Increase		
					2019		2024		2034				
Location	Counted AADT	2019 AADT	2024 AADT	2034 AADT	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	2019	2024	2034
M04-20	43704	45283	48070	50297	0	0	0	0	0	0	0.00%	0.00%	0.00%
ATC1	5816	6022	6387	6659	0	0	0	0	0	0	0.00%	0.00%	0.00%
ATC2	7728	7998	8476	8810	0	0	0	0	0	0	0.00%	0.00%	0.00%
ATC3	6095	6306	6679	6930	0	0	0	0	0	0	0.00%	0.00%	0.00%
Site Entrance (N)	5169	5366	5715	6050	0	0	0	0	0	0	0.00%	0.00%	0.00%
Site Entrance (S)	5169	5366	5715	6050	736	273	242	89	214	8	18.80%	5.79%	3.67%
ATC4	4973	5155	5478	5750	736	273	242	89	214	8	19.57%	6.04%	3.86%
ATC6	3939	4078	4323	4498	736	273	242	89	214	8	24.74%	7.65%	4.94%
ATC7	7383	7642	8098	8421	736	273	242	89	214	8	13.20%	4.09%	2.64%
ATC9	8075	8359	8862	9223	736	273	242	89	214	8	12.07%	3.73%	2.41%
ATC10	12640	13075	13842	14336	736	273	242	89	214	8	7.72%	2.39%	1.55%
ATC11	3922	4058	4296	4453	736	273	242	89	214	8	24.86%	7.70%	4.99%
ATC12	3783	3913	4141	4281	736	273	242	89	214	8	25.78%	7.99%	5.19%
ATC13	12293	12715	13457	13926	736	273	242	89	214	8	7.93%	2.46%	1.59%
M07-35	35627	36891	39122	40779	736	273	242	89	214	8	2.73%	0.85%	0.54%
M07-25	53986	57310	59352	63935	736	273	242	89	214	8	1.76%	0.56%	0.35%
KCC-Site C	6476	6692	7071	7275	736	273	242	89	214	8	15.08%	4.68%	3.05%
KCC-Site D	4346	4491	4746	4882	736	273	242	89	214	8	22.46%	6.97%	4.55%

Summary of Stress Tests results

Scenario 1 which has the biggest impact on the road network, was analysed using the identified relevant threshold, i.e. whether Traffic to and from the development exceeds 10% of the traffic flow on the adjoining roads. The scenario was also stress tested for the five north/south distributions listed above. For all of the stress tests, Scenario 1 for the year 2019 was above the 10% threshold for some of the roads, with a maximum of 25.78% for Stress Test 5 (100% of traffic travelling south). Therefore a TTA is required in line with TII (previously NRA) guidelines. This peak in generated traffic is due to the construction of the MBT and the proposed development coinciding in 2019. This is the worst case and if there was any variation in the programme of works the impact would be lower. However it is noted that Scenario 1 is below the threshold for subsequent years 2024 and 2034 with a maximum of 7.99% for Stress Test 5 in 2024.

10.3.7 Junction Analysis

The existing site access junction, Junction 5 (south of site), and four other junctions that are impacted by the haul routes have been analysed using the Transport Research Laboratory (TRL) computer programs JUNCTION 9 (PICADY and ARCADY) and OSCADY, widely accepted tools used for the analysis of priority junctions, roundabouts and signalised junctions.

PICADY and ARCADY are used to analyse priority junctions and roundabouts respectively. The key parameters examined in the results of the analysis are; the Ratio of Flow to Capacity Value (RFC value – desirable value should be no greater than 0.85 – values over 1.00 indicate the approach arm is over capacity), the maximum queue length on any approach to the junctions and the average delay for each vehicle passing through the junction during the modelled period.

OSCADY is used to assess signal controlled junctions. The key parameters examined in the results of the analysis are the Degree of Saturation (DOS value – desirable value should be no greater than 0.9 for OSCADY – values over 1.00 indicate the approach arm is over capacity), the maximum queue length on any approach to the junction and the average delay for each vehicle passing through the junction during the modelled period.

JUNCTIONS 9 PICADY requires the following input data:

- Basic modelling parameters (usually peak hour traffic counts synthesised over a 90 minute model period);
- Geometric parameters (including lane numbers & widths, visibility, storage provision etc.); and
- Traffic demand data (usually peak hour origin/destination table with composition of heavy goods vehicles input).

OSCADY requires similar input data to JUNCTIONS 9 but also requires signal phasing information.

The performance of the junctions has been analysed for the critical AM peak hours and PM peak hours. The analysis has been undertaken for the opening year 2019, design year 2024 (+5 years) and design year 2034 (+15 years) for Scenario 1. The full OCSADY results are in Appendix 10.4. The full JUNCTIONS 9-PICADY results are in Appendix 10.5 and the full JUNCTIONS 9-ARCADY results are in Appendix 10.6.

10.3.7.1 Junction 1 - R408 & R403 Signalised Crossroads in Prosperous AM & PM Peak Hours

Junction 1 is in Properous and is a 4 armed signalised junction. Arms A and C are the R403 East and West respectively and Arm D is the R408 (Maynooth Road), see Figure 10.3: Junction 2 Layout, for general layout. All arms of the junction have one lane entries only. The existing AM peak is between 08:00-09:00 and PM peak 17:15 and 18:15. The maximum desirable DOS for a signalised junction is 0.9, which means that there is still some capacity left within the junction. A DOS value of 1.0 or above indicates that the junction is performing above its maximum capacity, which can cause delays to traffic.

Figure 10.2: Junction 1 Layout

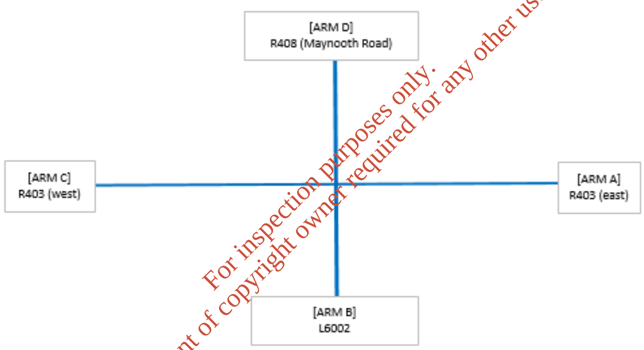


Table 10-17: OSCADY results: Junction 1 - R408 & R403 Signalised Crossroads in Prosperous AM & PM peak hours (Scenario 1)

JUNCTION 1 - EXISTING R408 & R403 SIGNALISED CROSSROADS IN PROSPEROUS AM & PM PEAK HOURS - OSCADY RESULTS (SCENARIO 1)									
Year & Time	Arm A – R403 East		Arm B – L6002		Arm C – R403 West		Arm D – R408 Maynooth Road		Avg Delay (min/veh)
	DOS Value	Max Queue Length	DOS Value	Max Queue Length	DOS Value	Max Queue Length	DOS Value	Max Queue Length	
Existing 2016 AM	0.974	7	0.443	2	1.727	157	1.178	41	7.62
Existing 2016 PM	1.738	108	0.586	2	1.512	56	1.217	31	10.82
Existing 2019 AM	1.015	9	0.461	2	1.803	176	1.220	51	8.76
Existing 2019 PM	1.810	187	0.602	3	1.560	100	1.256	60	12.30
Existing 2024 AM	1.083	18	0.483	2	1.908	203	1.286	66	10.51
Existing 2024 PM	1.934	218	0.637	3	1.648	119	1.328	77	15.05
Existing 2034 AM	1.146	25	0.507	2	2.008	226	1.331	77	12.11
Existing 2034 PM	2.020	239	0.660	3	1.715	134	1.373	89	17.02
Stress Test 2 2019 AM	1.137	16	0.461	2	1.898	192	1.348	81	10.58
Stress Test 2 2019 PM	1.942	209	0.506	2	1.826	164	1.291	67	16.52
Stress Test 2 2024 AM	1.125	23	0.487	2	1.947	211	1.330	77	11.23
Stress Test 2 2024 PM	1.981	227	0.535	2	1.718	138	1.361	85	16.48
Stress Test 2 2034 AM	1.173	29	0.507	2	2.051	232	1.363	85	12.83
Stress Test 2 2034 PM	2.062	247	0.555	3	1.782	151	1.400	95	18.34
Stress Test 3 2019 AM	1.192	34	0.461	2	1.926	196	1.411	98	11.37
Stress Test 3 2019 PM	2.004	219	0.506	2	1.962	199	1.298	67	18.82
Stress Test 3 2024 AM	1.127	24	0.487	2	1.971	214	1.330	78	11.46

JUNCTION 1 - EXISTING R408 & R403 SIGNALISED CROSSROADS IN PROSPEROUS AM & PM PEAK HOURS - OSCADY RESULTS (SCENARIO 1)									
Year & Time	Arm A – R403 East		Arm B – L6002		Arm C – R403 West		Arm D – R408 Maynooth Road		Avg Delay (min/veh)
	DOS Value	Max Queue Length	DOS Value	Max Queue Length	DOS Value	Max Queue Length	DOS Value	Max Queue Length	
Stress Test 3 2024 PM	2.005	231	0.535	2	1.757	148	1.367	86	17.17
Stress Test 3 2034 AM	1.178	30	0.507	2	2.056	234	1.379	90	12.96
Stress Test 3 2034 PM	2.081	250	0.555	3	1.815	159	1.406	97	18.91
Stress Test 4 2019 AM	1.256	44	0.461	2	1.966	203	1.478	116	12.49
Stress Test 4 2019 PM	2.063	228	0.506	2	2.098	235	1.307	71	21.28
Stress Test 4 2024 AM	1.147	28	0.487	2	1.984	216	1.349	83	11.74
Stress Test 4 2024 PM	2.028	235	0.535	2	1.797	156	1.373	88	17.88
Stress Test 4 2034 AM	1.194	32	0.507	2	2.064	235	1.398	95	13.19
Stress Test 4 2034 PM	2.140	260	0.555	3	1.915	184	1.422	100	20.74
Stress Test 5 2019 AM	1.381	68	0.461	2	2.019	212	1.602	152	14.57
Stress Test 5 2019 PM	2.187	247	0.506	2	2.357	304	1.339	78	26.65
Stress Test 5 2024 AM	1.185	19	0.487	2	2.009	220	1.386	93	12.32
Stress Test 5 2024 PM	2.075	244	0.535	2	1.876	178	1.386	91	19.32
Stress Test 5 2034 AM	1.225	37	0.507	2	2.080	237	1.427	102	13.6
Stress Test 5 2034 PM	2.324	296	0.590	3	2.074	223	1.490	118	25.07

The results for Junction 1 Scenario 1 show that this junction is already operating above capacity in 2016 without development. The max DOS values range from 1.738 to 1.217 on Arms A, C and D in the PM peak.

The maximum increase in DOS is on Arm C in the PM peak. In 2019 the DOS increases by 0.797 for Stress Test 5 (100% Facility traffic to / from the south). However for a more likely distribution of 66% Facility traffic to / from the south and 33% to / from the north (stress test 4); the increase is 0.538 with the proposed development. For the design year of 2024 the increase in DOS is 0.228 for Stress Test 5 and 0.149 for Stress Test 4.

Arm B (the L6002) operates well within capacity, with maximum DOS's in 2034 PM of 0.590 for Stress Tests 5. As this junction is already over capacity, improvements would be required to reduce congestion. These could take the form of changes to the signal timings and adjustments to the layout in line with the Design Manual for Urban Roads and Streets (DMURS) guidelines.

10.3.7.2 Junction 2 –Signalised Priority Junction R407 and R403 in Clane AM & PM Peak Hours

Junction 2 is a three armed signalised junction in Clane between the R407 and R403. It has pedestrian crossings on all 3 arms. The R407 north and the R403 arms both have two lanes at the junction. The R407 south is a single lane entry. The existing AM peak is between 08:00-09:00 and PM peak 17:30 and 18:30. As previously stated the maximum desirable DOS for a signalised junction is 0.9, which means that there is still some capacity left within the junction. A DOS value of 1.0 or above indicates that the junction is performing above its maximum capacity, which can cause delays to traffic.

Figure 10.3: Junction 2 Layout

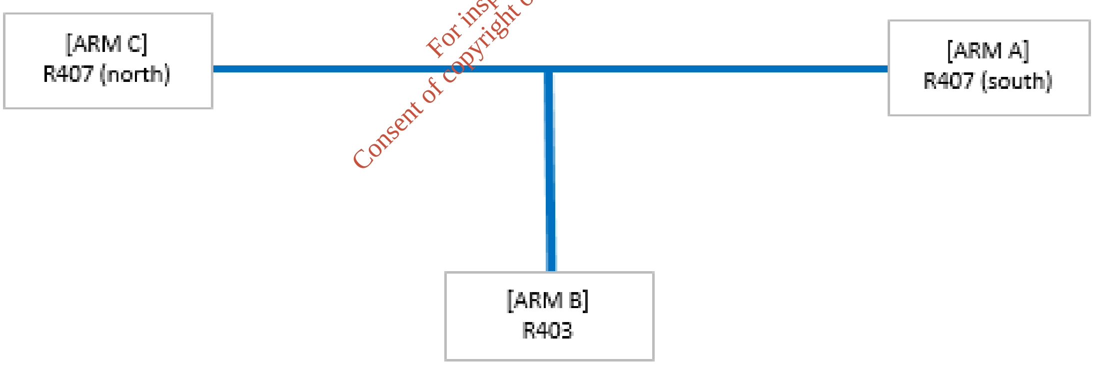


Table 10-18: OSCADY results: Junction 2 - Signalised priority junction R407 & R403 in Clane AM & PM peak hours (Scenario 1)

JUNCTION 2 - EXISTING SIGNALISED PRIORITY JUNCTION R407 & R403 AM & PM PEAK HOURS - OSCADY RESULTS (SCENARIO 1)											
Year & Time	Arm A – R407 South		Arm B – R403				Arm C – R407 North				Avg Delay (min/veh)
	DOS Value	Max Queue Length	DOS Value		Max Queue Length		DOS Value		Max Queue Length		
	Lane 1 (A-B) &(A-C)	Lane 1 (A-B) &(A-C)	Lane 1 (B-C)	Lane 2 (B-A)	Lane 1 (B-C)	Lane 2 (B-A)	Lane 1 (C-A)	Lane 2 (C-B)	Lane 1 (C-A)	Lane 2 (C-B)	
Existing 2016 AM	1.221	55	0.391	0.376	2	2	0.248	0.987	2	12	1.77
Existing 2016 PM	1.388	101	0.252	0.340	1	2	0.265	0.920	2	8	3.46
Existing 2019 AM	1.262	64	0.404	0.388	2	2	0.257	1.021	2	16	2.12
Existing 2019 PM	1.436	114	0.260	0.352	1	2	0.275	0.951	2	9	3.95
Existing 2024 AM	1.339	84	0.428	0.409	2	2	0.273	1.082	2	24	2.86
Existing 2024 PM	1.519	137	0.276	0.370	1	2	0.291	1.006	2	14	4.85
Existing 2034 AM	1.383	96	0.443	0.421	2	2	0.282	1.119	2	30	3.33
Existing 2034 PM	1.563	150	0.284	0.382	2	2	0.301	1.033	2	17	5.35
Stress Test 2 2019 AM	1.415	61	0.402	0.392	2	2	0.262	1.041	2	13	3.48
Stress Test 2 2019 PM	1.427	113	0.252	0.458	1	2	0.270	0.934	2	8	3.76
Stress Test 2 2024 AM	1.404	99	0.426	0.410	2	2	0.278	1.103	2	27	3.48
Stress Test 2 2024 PM	1.505	136	0.268	0.397	1	2	0.286	0.988	2	12	4.65
Stress Test 2 2034 AM	1.404	99	0.426	0.410	2	2	0.278	1.103	2	27	3.48
Stress Test 2 2034 PM	1.549	148	0.276	0.399	2	2	0.399	1.015	1	15	5.15

JUNCTION 2 - EXISTING SIGNALISED PRIORITY JUNCTION R407 & R403 AM & PM PEAK HOURS - OSCADY RESULTS (SCENARIO 1)											
Year & Time	Arm A – R407 South		Arm B – R403				Arm C – R407 North				Avg Delay (min/veh)
	DOS Value	Max Queue Length	DOS Value		Max Queue Length		DOS Value		Max Queue Length		
	Lane 1 (A-B) &(A-C)	Lane 1 (A-B) &(A-C)	Lane 1 (B-C)	Lane 2 (B-A)	Lane 1 (B-C)	Lane 2 (B-A)	Lane 1 (C-A)	Lane 2 (C-B)	Lane 1 (C-A)	Lane 2 (C-B)	
Stress Test 3 2019 AM	1.483	118	0.402	0.395	2	2	0.262	1.041	2	18	4.14
Stress Test 3 2019 PM	1.433	115	0.252	0.516	1	2	0.270	0.934	2	8	3.79
Stress Test 3 2024 AM	1.406	100	0.426	0.413	2	2	0.278	1.103	2	27	3.52
Stress Test 3 2024 PM	1.511	137	0.268	0.414	1	2	0.286	0.988	2	12	4.71
Stress Test 3 2034 AM	1.459	113	0.441	0.422	2	2	0.287	1.140	2	34	4.07
Stress Test 3 2034 PM	1.547	148	0.274	0.414	2	2	0.293	1.015	2	15	5.12
Stress Test 4 2019 AM	1.547	134	0.402	0.398	2	2	0.262	1.041	2	18	4.81
Stress Test 4 2019 PM	1.442	117	0.252	0.577	1	3	0.270	0.934	2	8	3.84
Stress Test 4 2024 AM	1.425	105	0.426	0.413	2	2	0.278	1.103	2	27	3.69
Stress Test 4 2024 PM	1.517	139	0.268	0.432	1	2	0.286	0.988	2	12	4.76
Stress Test 4 2034 AM	1.475	117	0.441	0.442	2	2	0.287	1.140	2	34	4.21
Stress Test 4 2034 PM	1.535	144	0.274	0.429	2	2	0.293	1.015	2	15	4.97
Stress Test 5 2019 AM	1.676	167	0.407	0.406	2	2	0.262	1.041	2	18	6.23
Stress Test 5 2019 PM	1.458	122	0.256	0.700	1	3	0.270	0.934	2	8	3.92
Stress Test 5 2024 AM	1.463	115	0.426	0.416	2	2	0.278	1.103	2	27	4.05
Stress Test 5 2024 PM	1.530	142	0.268	0.464	1	2	0.286	0.988	2	12	4.87

JUNCTION 2 - EXISTING SIGNALISED PRIORITY JUNCTION R407 & R403 AM & PM PEAK HOURS - OSCADY RESULTS (SCENARIO 1)											
Year & Time	Arm A – R407 South		Arm B – R403				Arm C – R407 North				Avg Delay (min/veh)
	DOS Value	Max Queue Length	DOS Value		Max Queue Length		DOS Value		Max Queue Length		
	Lane 1 (A-B) &(A-C)	Lane 1 (A-B) &(A-C)	Lane 1 (B-C)	Lane 2 (B-A)	Lane 1 (B-C)	Lane 2 (B-A)	Lane 1 (C-A)	Lane 2 (C-B)	Lane 1 (C-A)	Lane 2 (C-B)	
Stress Test 5 2034 AM	1.507	125	0.446	0.427	2	2	0.287	1.140	2	34	4.54
Stress Test 5 2034 PM	1.563	152	0.278	0.464	2	2	0.293	1.015	2	15	5.26

The results for Junction 2 Scenario 1 are in Table 10-18: OSCADY results: Junction 2 - Signalised priority junction R407 & R403 in Clane AM & PM peak hours (Scenario 1) and show, that for the existing traffic flows in 2016, the maximum DOS is on Arm A (the R407 south), with a value of 1.388 in the PM peak. However, Arm C is close to capacity for the right turn lane, with a DOS of 0.92 in the PM peak and 0.987 in the AM. The straight ahead lane operates well within capacity with a maximum value of 0.265 DOS.

The maximum increase in DOS is on Arm A in the AM peak. In 2019 the DOS increases by 0.414 for Stress Test 5 (100% Facility traffic to / from the south). However for a more likely distribution of 66% Facility traffic to / from the south and 33% to / from the north (stress test 4), the increase is 0.285 with the proposed development. For the design year of 2024 this drops to increases of 0.124 DOS's for Stress Test 5 and 0.086 for Stress Test 4. This drops further again for the design year of 2034 to increases in DOS of 0.124 for Stress Test 5 and 0.092 for Stress Test 4.

As noted above this junction is currently over capacity and the arms that fail at this junction are on the R407. Arm B (R403) operates well within capacity with a maximum DOS value of 0.464 for Stress Test 5 in year 2034 PM. The Arms that are over capacity at Junction 2 are on the R407 which is an existing problem. As arm A at this junction is already over capacity and arm C is close to capacity indicating that improvements would be required to reduce congestion. These could take the form of changes to the signal timings and adjustments to the layout in line with the Design Manual for Urban Roads and Streets (DMURS) guidelines.

10.3.7.3 Junction 3 –Johnstown Roundabout R402 & Johnstown Road AM & PM Peak Hours

Junction 3 is a four armed roundabout with two lane entries on all arms with the exception of the arm to the cul-de-sac which is a single lane entry and identified as Arm C below on Figure 10.4: Junction 3 Layout. The existing AM peak is between 07:15-08:15 and PM peak 17:15 and 18:15.

Figure 10.4: Junction 3 Layout

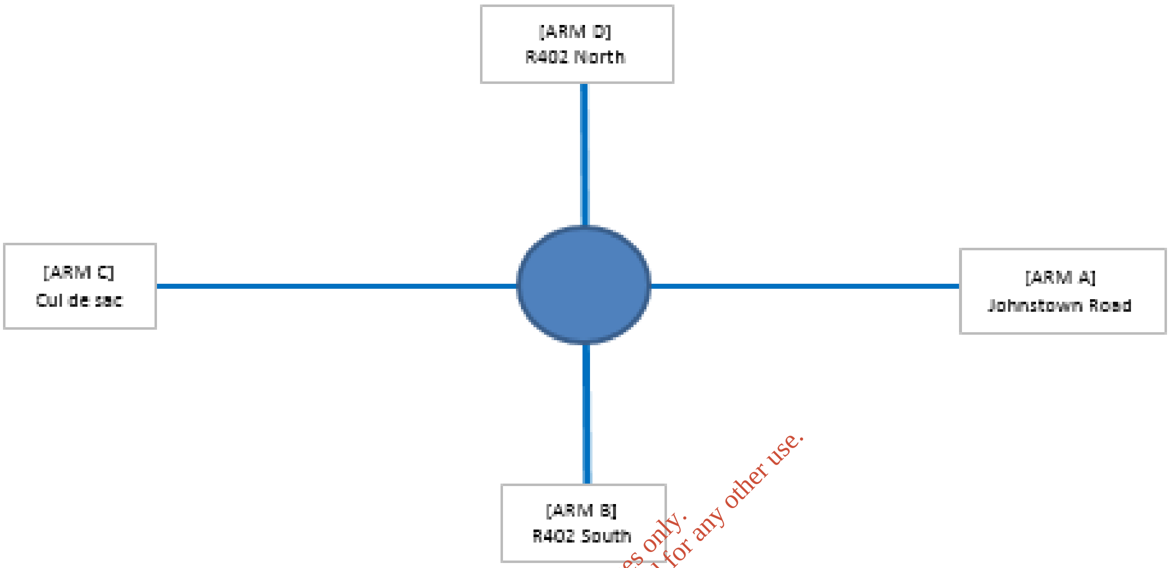


Table 10-19: JUNCTION 9 (ARCADY) results: Junction 3 - Johnstown Roundabout between the R402 & Johnstown Road AM & PM peak hours (Scenario 1)

JUNCTION 3 - EXISTING JOHNSTOWN ROUNDABOUT BETWEEN THE R402 & JOHNSTOWN ROAD AM & PM PEAK HOURS - JUNCTION 9 (ARCADY) RESULTS (SCENARIO 1)									
Year & Time	Arm A – Johnstown Road		Arm B – R402 South		Arm C – Cul-de-sac		Arm D – R402 North		Max Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
Existing 2016 AM	0.08	1	0.28	1	0.01	0	0.05	1	6.64
Existing 2016 PM	0.25	1	0.15	1	0.03	0	0.08	1	6.20
Existing 2019 AM	0.08	1	0.28	1	0.01	0	0.05	1	6.72
Existing 2019 PM	0.26	1	0.16	1	0.03	0	0.09	1	6.24
Existing 2024 AM	0.09	1	0.3	1	0.01	0	0.06	1	6.88
Existing 2024 PM	0.27	1	0.17	1	0.03	0	0.09	1	6.33
Existing 2034 AM	0.09	1	0.33	1	0.2	0	0.06	1	6.98
Existing 2034 PM	0.28	1	0.18	1	0.03	0	0.10	1	6.40
Stress Test 1 2019 AM	0.09	1	0.3	1	0.01	0	0.31	1	6.88
Stress Test 1 2019 PM	0.26	1	0.36	1	0.03	0	0.13	1	8.20
Stress Test 1 2024 AM	0.09	1	0.31	1	0.01	0	0.13	1	6.94
Stress Test 1 2024 PM	0.28	1	0.23	1	0.03	0	0.12	1	6.80
Stress Test 1 2034 AM	0.09	1	0.32	1	0.01	0	0.12	1	7.08
Stress Test 1 2034 PM	0.29	1	0.23	1	0.03	0	0.13	1	6.79
Stress Test 2 2019 AM	0.09	1	0.29	1	0.01	0	0.23	1	6.81
Stress Test 2 2019 PM	0.26	1	0.30	1	0.03	0	0.11	1	7.46
Stress Test 2 2024 AM	0.09	1	0.3	1	0.01	0	0.11	1	6.92

JUNCTION 3 - EXISTING JOHNSTOWN ROUNDABOUT BETWEEN THE R402 & JOHNSTOWN ROAD AM & PM PEAK HOURS - JUNCTION 9 (ARCADY) RESULTS (SCENARIO 1)									
Year & Time	Arm A – Johnstown Road		Arm B – R402 South		Arm C – Cul-de-sac		Arm D – R402 North		Max Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
Stress Test 2 2024 PM	0.28	1	0.21	1	0.03	0	0.11	1	6.65
Stress Test 2 2034 AM	0.09	1	0.32	1	0.02	0	0.10	1	7.02
Stress Test 2 2034 PM	0.29	1	0.21	1	0.03	0	0.12	1	6.66
Stress Test 3 2019 AM	0.09	1	0.29	1	0.01	0	0.19	1	6.80
Stress Test 3 2019 PM	0.26	1	0.26	1	0.03	0	0.11	1	7.10
Stress Test 3 2024 AM	0.09	1	0.3	1	0.01	0	0.09	1	6.91
Stress Test 3 2024 PM	0.28	1	0.20	1	0.03	0	0.11	1	6.56
Stress Test 3 2034 AM	0.09	1	0.32	1	0.02	0	0.10	1	7.04
Stress Test 3 2034 PM	0.29	1	0.20	1	0.03	0	0.11	1	6.59
Stress Test 4 2019 AM	0.09	1	0.29	1	0.01	0	0.14	1	6.78
Stress Test 4 2019 PM	0.26	1	0.23	1	0.03	0	0.11	1	6.78
Stress Test 4 2024 AM	0.09	1	0.3	1	0.01	0	0.08	1	6.91
Stress Test 4 2024 PM	0.28	1	0.19	1	0.03	0	0.11	1	6.48
Stress Test 4 2034 AM	0.09	1	0.33	1	0.01	0	0.06	1	7.14
Stress Test 4 2034 PM	0.29	1	0.18	1	0.03	0	0.12	1	6.44

The results for Junction 3 in Table 10-19: JUNCTION 9 (ARCADY) results: Junction 3 - Johnstown Roundabout between the R402 & Johnstown Road AM & PM peak hours (Scenario 1) above indicate that this roundabout will operate below the maximum 0.85 RFC (desirable value should be no greater than 0.85 – values over 1.00 indicate the approach arm is over capacity) up to and including the design year of 2034 for Scenario 1. The maximum RFC is in 2019 with a value of 0.36 for Arm B, in the PM peak, for Stress Test 1 (which is 100% facility traffic to/from the north). Without any development the RFC for 2034 on Arm B in the PM peak is 0.33. Therefore the proposed development has minimal impact and there is no issue with capacity at this junction for any of the Stress Tests up to the design year 2034.

10.3.7.4 Junction 4 –Signalised Crossroads R445 & R415 in Kildare AM & PM Peak Hours

Junction 4 is a signalised crossroads with one lane entries on all arms. Three of the arms are Regional Roads and one is a Local Road named Bride Street as identified on Figure 10.5: Junction 4 Layout. The existing AM peak is between 08:15-09:15and PM peak 17:15 and 18:15. This junction is in Kildare town and does not form part of the existing haul routes.

Figure 10.5: Junction 4 Layout

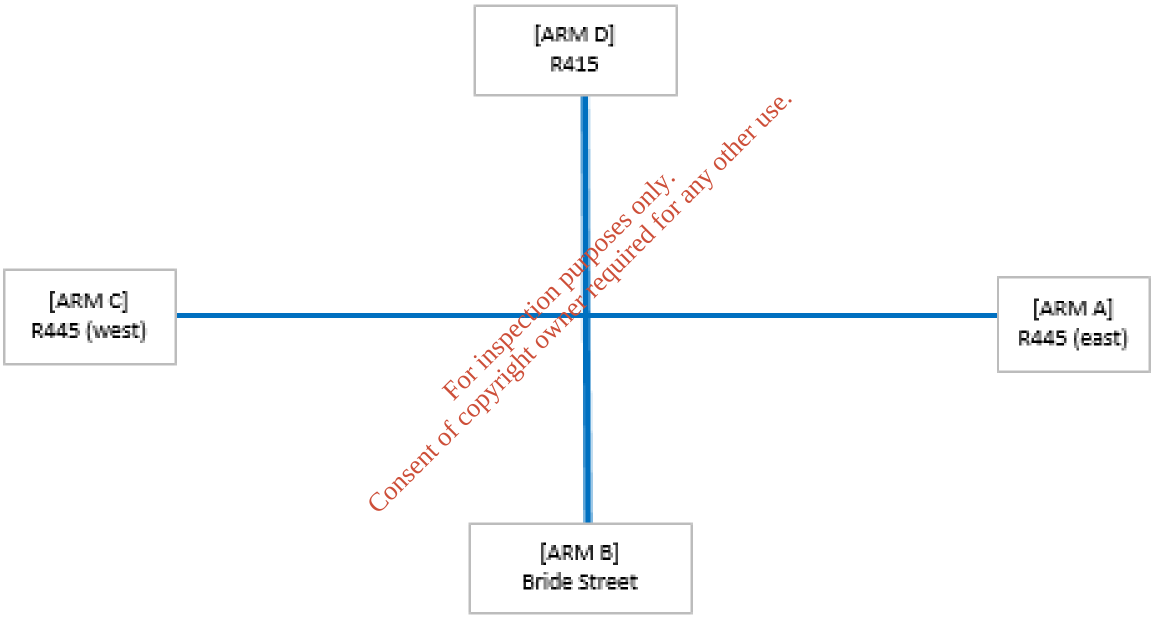


Table 10-20: OSCADY results: Junction 4 - Signalised crossroads R415 & R445 in Kildare AM & PM peak hours (Scenario 1)

JUNCTION 4 - EXISTING SIGNALISED CROSSROADS R445 & R415 IN KILDARE AM & PM PEAK HOURS- OSCADY RESULTS (SCENARIO 1)									
Year & Time	Arm A – R445 West		Arm B – Bride Street		Arm C – R445 East		Arm D – R415		Avg Delay (min/veh)
	DOS Value	Max Queue Length	DOS Value	Max Queue Length	DOS Value	Max Queue Length	DOS Value	Max Queue Length	
Existing 2016 AM	0.423	2	0.558	2	0.685	3	0.750	3	0.21
Existing 2016 PM	0.612	2	0.415	2	0.710	3	0.654	2	0.21
Existing 2019 AM	0.439	2	0.578	2	0.713	3	0.783	3	0.23
Existing 2019 PM	0.638	2	0.432	2	0.734	3	0.687	3	0.22
Existing 2024 AM	0.470	2	0.620	2	0.762	4	0.855	5	0.27
Existing 2024 PM	0.674	3	0.457	2	0.783	4	0.742	3	0.25
Existing 2034 AM	0.488	2	0.649	2	0.795	4	0.895	5	0.31
Existing 2034 PM	0.698	3	0.470	2	0.807	4	0.774	3	0.27
Stress Test 2 2019 AM	0.454	2	0.670	3	0.746	3	0.858	4	0.28
Stress Test 2 2019 PM	0.627	2	0.438	2	0.721	3	0.749	3	0.22
Stress Test 2 2024 AM	0.486	2	0.657	3	0.797	4	0.894	6	0.31
Stress Test 2 2024 PM	0.662	3	0.451	2	0.769	4	0.756	3	0.24
Stress Test 2 2034 AM	0.505	2	0.679	3	0.831	4	0.930	7	0.36
Stress Test 2 2034 PM	0.686	3	0.466	2	0.792	6	0.779	3	0.26
Stress Test 3 2019 AM	0.454	2	0.711	3	0.746	3	0.885	5	0.30
Stress Test 3 2019 PM	0.627	2	0.448	2	0.721	3	0.791	4	0.24
Stress Test 3 2024 AM	0.486	2	0.662	3	0.797	4	0.898	6	0.32
Stress Test 3 2024 PM	0.662	3	0.456	2	0.769	4	0.762	3	0.24

JUNCTION 4 - EXISTING SIGNALISED CROSSROADS R445 & R415 IN KILDARE AM & PM PEAK HOURS- OSCADY RESULTS (SCENARIO 1)									
Year & Time	Arm A – R445 West		Arm B – Bride Street		Arm C – R445 East		Arm D – R415		Avg Delay (min/veh)
	DOS Value	Max Queue Length	DOS Value	Max Queue Length	DOS Value	Max Queue Length	DOS Value	Max Queue Length	
Stress Test 3 2034 AM	0.505	2	0.689	3	0.831	4	0.937	6	0.36
Stress Test 3 2034 PM	0.686	3	0.470	2	0.792	4	0.790	3	0.26
Stress Test 4 2019 AM	0.454	2	0.752	3	0.746	3	0.918	6	0.33
Stress Test 4 2019 PM	0.627	2	0.462	2	0.721	3	0.838	4	0.26
Stress Test 4 2024 AM	0.486	2	0.674	3	0.797	4	0.908	6	0.32
Stress Test 4 2024 PM	0.662	3	0.467	2	0.769	4	0.781	3	0.25
Stress Test 4 2034 AM	0.505	2	0.703	3	0.831	4	0.955	8	0.39
Stress Test 4 2034 PM	0.686	3	0.481	2	0.792	4	0.808	4	0.27
Stress Test 5 2019 AM	0.454	2	0.830	5	0.746	3	0.963	9	0.40
Stress Test 5 2019 PM	0.627	2	0.462	2	0.721	3	0.735	3	0.22
Stress Test 5 2024 AM	0.486	2	0.697	3	0.797	4	0.924	7	0.34
Stress Test 5 2024 PM	0.662	3	0.477	2	0.769	4	0.808	4	0.26
Stress Test 5 2034 AM	0.505	2	0.721	3	0.831	4	0.968	8	0.40
Stress Test 5 2034 PM	0.686	3	0.497	2	0.792	4	0.836	4	0.28

As shown in Table 10-20: OSCADY results: Junction 4 - Signalised crossroads R415 & R445 in Kildare AM & PM peak hours (Scenario 1) for Junction 4 above, the maximum DOS in 2034 for the existing junction is on Arm D with a value of 0.895, which is marginally below the desirable maximum of 0.9. The maximum DOS for Scenario 1 is 0.963 in 2019 for Stress test 5 on arm D. For the more likely traffic distribution Stress Test 4 (66% Facility traffic to / from the south and 33% to / from the north) the maximum DOS is 0.918 in 2019 on arm D. This increases to 0.955 in 2034 this is 0.055 over the desirable maximum DOS of 0.9. At a DOS of 1.0 a junction is operating at 100%. The assessment indicates that the junction will operate at 95.5% capacity in 2034.

10.3.7.5 Junction 5 –Existing Site Entrance AM & PM Peak Hours

Junction 5 is the existing priority junction into the Drehid Waste Management Facility with one lane entries on arms A and B, and a right turn lane on arm C. The junction is on the R403. The existing AM peak is between 07:30-08:30 and PM peak 17:00 and 18:00. At present this junction operates within capacity for all arms. Arm A which is the R403 north, is an unrestricted arm with no constraints for the movements into arms B and C therefore there is no RFC for arm A.

Figure 10.6: Junction 5 Layout

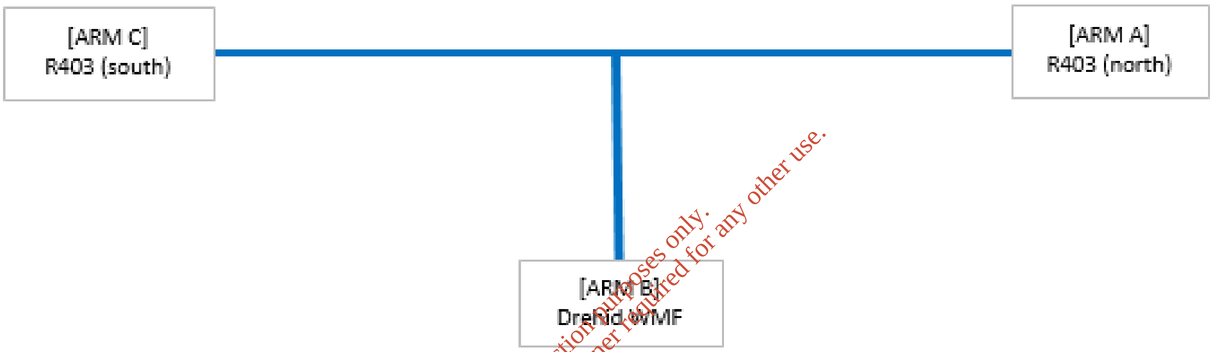


Table 10-21: JUNCTION 9 (PICADY) results: Junction 5 - Existing site entrance AM & PM peak hours (Scenario 1)

JUNCTION 5 - EXISTING SITE ENTRANCE AM & PM PEAK HOURS - JUNCTION 9 (PICADY) RESULTS (SCENARIO 1)							
Year & Time	Arm A – R403 North (unrestricted)		Arm B – Existing Access Junction		Arm C - R403 South		Delay (s)
	RFC Value	Max Queue Length (vehicles)	RFC Value	Max Queue Length (vehicles)	RFC Value	Max Queue Length (vehicles)	
Existing 2016 AM	-	-	0.038	1	0.092	0	10.47
Existing 2016 PM	-	-	0.052	1	0.009	0	10.02
Existing 2019 AM	-	-	0.041	1	0.097	1	10.58
Existing 2019 PM	-	-	0.055	1	0.009	0	10.09
Existing 2024 AM	-	-	0.309	1	0.108	1	11.57
Existing 2024 PM	-	-	0.059	1	0.009	0	10.23
Existing 2034 AM	-	-	0.051	1	0.117	1	10.93
Existing 2034 PM	-	-	0.062	1	0.012	0	10.35
Stress Test 1 2019 AM	-	-	0.098	1	0.117	1	19.839
Stress Test 1 2019 PM	-	-	0.921	9	0.009	0	139.35
Stress Test 1 2024 AM	-	-	0.050	1	0.113	1	17.91
Stress Test 1 2024 PM	-	-	0.312	1	0.009	0	11.47

JUNCTION 5 - EXISTING SITE ENTRANCE AM & PM PEAK HOURS - JUNCTION 9 (PICADY) RESULTS (SCENARIO 1)							
Year & Time	Arm A – R403 North (unrestricted)		Arm B – Existing Access Junction		Arm C - R403 South		Delay (s)
	RFC Value	Max Queue Length (vehicles)	RFC Value	Max Queue Length (vehicles)	RFC Value	Max Queue Length (vehicles)	
Stress Test 1 2034 AM	-	-	0.054	1	0.112	1	20.57
Stress Test 1 2034 PM	-	-	0.276	1	0.012	0	11.31
Stress Test 2 2019 AM	-	-	0.087	1	0.376	1	22.19
Stress Test 2 2019 PM	-	-	0.765	3	0.066	1	39.45
Stress Test 2 2024 AM	-	-	0.058	1	0.163	1	18.45
Stress Test 2 2024 PM	-	-	0.245	1	0.030	0	11.39
Stress Test 2 2034 AM	-	-	0.062	1	0.160	1	20.27
Stress Test 2 2034 PM	-	-	0.226	1	0.055	0	11.92
Stress Test 3 2019 AM	-	-	0.076	1	0.497	2	23.14
Stress Test 3 2019 PM	-	-	0.663	2	0.089	1	32.041
Stress Test 3 2024 AM	-	-	0.061	1	0.196	1	17.49
Stress Test 3 2024 PM	-	-	0.209	1	0.072	1	11.52

JUNCTION 5 - EXISTING SITE ENTRANCE AM & PM PEAK HOURS - JUNCTION 9 (PICADY) RESULTS (SCENARIO 1)							
Year & Time	Arm A – R403 North (unrestricted)		Arm B – Existing Access Junction		Arm C - R403 South		Delay (s)
	RFC Value	Max Queue Length (vehicles)	RFC Value	Max Queue Length (vehicles)	RFC Value	Max Queue Length (vehicles)	
Stress Test 3 2034 AM	-	-	0.062	1	0.187	1	20.01
Stress Test 3 2034 PM	-	-	0.194	1	0.072	0	12.08
Stress Test 4 2019 AM	-	-	0.087	1	0.611	2.0	24.02
Stress Test 4 2019 PM	-	-	0.604	2	0.120	1	25.37
Stress Test 4 2024 AM	-	-	0.064	1	0.231	1	16.72
Stress Test 4 2024 PM	-	-	0.178	1	0.093	1	12.03
Stress Test 4 2034 AM			0.065	1	0.216	1	19.71
Stress Test 4 2034 PM			0.159	1	0.093	1	12.44
Stress Test 5 2019 AM	-	-	0.094	1	0.817	5	35.154
Stress Test 5 2019 PM	-	-	0.637	2	0.168	1	17.47
Stress Test 5 2024 AM	-	-	0.068	1	0.296	1	11.81
Stress Test 5 2024 PM	-	-	0.218	1	0.133	1	12.55

JUNCTION 5 - EXISTING SITE ENTRANCE AM & PM PEAK HOURS - JUNCTION 9 (PICADY) RESULTS (SCENARIO 1)							
Year & Time	Arm A – R403 North (unrestricted)		Arm B – Existing Access Junction		Arm C - R403 South		Delay (s)
	RFC Value	Max Queue Length (vehicles)	RFC Value	Max Queue Length (vehicles)	RFC Value	Max Queue Length (vehicles)	
Stress Test 5 2034 AM			0.064	1	0.272	1	11.76
Stress Test 5 2034 PM			0.196	1	0.128	1	12.95

As can be seen from Table 10-21: JUNCTION 9 (PICADY) results: Junction 5 - Existing site entrance AM & PM peak hours (Scenario 1), the existing site entrance junction operates within capacity up to 2034 with a maximum RFC of 0.117 on Arm C in AM peak. Arm B (existing access) is marginally over capacity at 0.921 (desirable is 0.85) in the 2019 PM peak for Stress Test 1, which is a 100% of the modelled traffic being generated facility traffic to / from the north. However this only equates to a maximum of nine vehicles queuing on this arm. For the more likely traffic distribution, stress test 4 (33% Facility traffic to / from the north and 67% to / from the south) the maximum RFC is 0.604 in 2019 PM peak on Arm B. The maximum queue length for this arm is three vehicles. It can be seen that the maximum RFC on arm B in 2024 is 0.178, dropping further to 0.159 in the PM peak in 2034.

10.3.8 Link Capacity

The link capacity is the maximum potential two-way capacity of a road between junctions. It is typically expressed in terms of Annual Average Daily Traffic (AADT). The capacity of the road network was first assessed using TII DN-GEO-03031 (previously NRA TD 9) Table 6/1 *'Recommended Rural Road Layouts'*. The extract in Table 10-22: Link Capacity – Extract from Table 6/1 Recommended Rural Road Layouts shows the road type and flows applicable for this assessment.

Table 10-22: Link Capacity – Extract from Table 6/1 Recommended Rural Road Layouts

Type of Road [1.]	Capacity[2] (AADT) for Level of Service D	Edge Treatment	Access Treatment	Junction Treatment at Minor Road	Junction Treatment at Major Road
Type 3 Single (6.0m) Carriageway (S2)	5,000	0.5m hard strip. Footways/Cycle Tracks where required,	Minimise number of accesses to avoid standing vehicles and concentrate turning movements.	Simple Priority Junctions	Priority junctions, with ghost islands where necessary.
Type 2 Single (7.0m) Carriageway (S2)	8,600	0.5m hard strips. Footways/Cycle Tracks where required	Minimise number of accesses to avoid standing vehicles and concentrate turning movements.	Priority junctions, with ghost islands where necessary.	Ghost islands
Type 1 Single (7.3m) Carriageway (S2)	11,600	2.5m hard shoulders Footways/Cycle Tracks where required	Minimise number of accesses to avoid standing vehicles and concentrate turning movements.	Priority junctions, with ghost islands where necessary.	Ghost islands or roundabouts [3.]

However, it should be noted that this assessment has its limitations, in that it does not account for the traffic flow profile (i.e. daily peak and through traffic flows) or percentage of HGV's. It is also aimed at new roads and gives an indication of what standard of road is required for the level of flows from the traffic model. Although this check gives an indication of whether the links are sufficient, there are other restrictions which impact capacity along a road network such as junctions, changes in speed limits and inconsistent road widths.

The capacity of the R402, R403 (north and south of Drehid), R407, R408 and the R415 are assessed below using the TII DN-GEO-03031, for all stress tests. The link capacity assessment is based on Scenario 1, the most robust scenario. Scenario 1 is the predicted baseflow traffic flow on the road network in 2019 with the inclusion of the maximum operational (i.e. including MBT) and construction development traffic. Scenario 1 peaks in the design year 2019, with less operational and construction development traffic in the preceding and following design years.

For comparative assessment the following design years were assessed as indicated in the tables:

- 2016 No Development - the existing baseflow traffic in 2016;
- 2019 No Development – the existing baseflow traffic forecasted to 2019 baseflow traffic with no development traffic; and
- 2019 With development – the existing baseflow traffic forecasted to 2019 baseflow with inclusion of the maximum operational (i.e. including MBT) and construction development traffic (Scenario 1).

Table 10-23: Link Capacity – Stress Test 1 (100% Traffic from North)

Link Capacity							
Regional Road Number	Capacity maximum AADT (as per TD 9)	2016 Existing AADT	Utilised Link Capacity 2016 Existing	2019 AADT No development	Utilised Link Capacity 2019 No development	2019 AADT With development (Scenario 1)	Utilised Link Capacity 2019 With development (Scenario 1)
R402	11,600	5,816	50.14%	5,994	51.67%	7,002	60.36%
R403 (North of Junction 5)	5000	6,095	121.90%	6,286	125.72%	7,295	145.9%

Table 10-24: Link Capacity – Stress Test 2 (67% north and 33% south)

Link Capacity							
Regional Road Number	Capacity maximum AADT (as per TD 9)	2016 Existing AADT	Utilised Link Capacity 2016 Existing	2019 AADT No development	Utilised Link Capacity 2019 No development	2019 AADT With development (Scenario 1)	Utilised Link Capacity 2019 With development (Scenario 1)
R402	11,600	5,816	50.14%	5,994	51.67%	6,669	57.49%
R403 (North of Junction 5)	5000	6,095	121.90%	6,286	125.72%	6.962	139.24%
R403 (South of Junction 5)	5000	4,973	99.46%	5,119	102.38%	5,452	109.04%
R407	11,600	12,640	108.97%	13,040	112.41%	13,372	115.28%
R408	11,600	3,922	33.81%	4,046	34.88%	4,378	37.74%
R415	8,600	3,939	45.80%	4,060	47.21%	4,393	51.08%

Table 10-25: Link Capacity – Stress Test 3 (50% north and south)

Link Capacity							
Regional Road Number	Capacity maximum AADT (as per TD 9)	2016 Existing AADT	Utilised Link Capacity 2016 Existing	2019 AADT No development	Utilised Link Capacity 2019 No development	2019 AADT With development (Scenario 1)	Utilised Link Capacity 2019 With development (Scenario 1)
R402	11,600	5,816	50.14%	5,994	51.67%	6,497	56.01%
R403 (North of Junction 5)	5000	6,095	121.90%	6,286	125.72%	6,790	135.81%
R403 (South of Junction 5)	5000	4,973	99.46%	5,119	102.38%	5,623	112.47%
R407	11,600	12,640	108.97%	13,040	112.41%	13,543	116.75%
R408	11,600	3,922	33.81%	4,046	34.88%	4,549	39.22%
R415	8,600	3,939	45.80%	4,060	47.21%	4,564	53.07%

Table 10-26: Link Capacity – Stress Test 4 (33% north and 67% south)

Link Capacity							
Regional Road Number	Capacity maximum AADT (as per TD 9)	2016 Existing AADT	Utilised Link Capacity 2016 Existing	2019 AADT No development	Utilised Link Capacity 2019 No development	2019 AADT With development (Scenario 1)	Utilised Link Capacity 2019 With development (Scenario 1)
R402	11,600	5,816	50.14%	5,994	51.67%	6,326	54.53%
R403 (North of Junction 5)	5000	6,095	121.90%	6,286	125.72%	6,619	132.38%
R403 (South of Junction 5)	5000	4,973	99.46%	5,119	102.38%	5,597	115.90%
R407	11,600	12,640	108.97%	13,040	112.41%	13,715	118.23%
R408	11,600	3,922	33.81%	4,046	34.88%	4,721	40.70%
R415	8,600	3,939	45.80%	4,060	47.21%	4,736	55.07%

Table 10-27: Link Capacity – Stress Test 5 (0% north and 100% south)

Link Capacity							
Regional Road Number	Capacity maximum AADT (as per TD 9)	2016 Existing AADT	Utilised Link Capacity 2016 Existing	2019 AADT No development	Utilised Link Capacity 2019 No development	2019 AADT With development (Scenario 1)	Utilised Link Capacity 2019 With development (Scenario 1)
R403 (South of Junction 5)	5000	4,973	99.46%	5,119	102.38%	6,128	122.56%
R407	11,600	12,640	108.97%	13,040	112.41%	14,048	121.10%
R408	11,600	3,922	33.81%	4,046	34.88%	5,054	43.57%
R415	8,600	3,939	45.80%	4,060	47.21%	5,069	58.94%

As shown in Table 10-23 to Table 10-27: Link Capacity – Stress Test 5 (0% north and 100% south), the R402, R403 (south), R408 and R415 in the year 2016, have spare capacity for all of the stress tests with the R403 (north) and R407 above capacity by 21.9% and 8.97% respectively.

The R403 (south) in 2016 is just below link capacity (99.46%) with the forecasted baseflow traffic to 2019 (i.e. with no development) becoming over capacity with an increase in utilised link capacity to 102.38%. Comparative assessment of the R403 (south) baseflow in 2019 against the 2019 with development stress tests 2 to 5 shows a 9.04% to 22.56% over capacity.

The R407 is over capacity in 2016 by 8.97% and this increases 12.41% for the design year 2019 without development. Comparison of the 2019 baseflow against the 2019 with development shows a further reduction in capacity to an over capacity of 15.28% for stress test 2. The largest reduction in link capacity is demonstrated by stress test 5 (i.e. 100% of traffic south), with a reduction from 112.41% to 121.10% in 2019.

A further check on link capacity was undertaken using UK DMRB TA 46/97 which assesses link capacity on single carriageways. The capacity of the link is worked out on the basis of Congestion Reference Flow (CRF) and measures the performance of a road link between junctions. The CFR takes into account factors such as the exact width of the road, peak hour flows and percentage of HGV's. This check was carried out on the R403 and R407 with the results shown in Table 10-28 to Table 10-32: Link Capacity – Stress Test 5.

Table 10-28: Link Capacity – Stress Test 1

Link Capacity							
Regional Road Number	Capacity maximum AADT (TA 46/97)	2016 Existing AADT	2016 Existing Utilised Link Capacity	2019 AADT No development	2019 No development Utilised Link Capacity	2019 AADT With development (Scenario 1)	2019 With development Utilised Link Capacity
R403 (North of Junction 5)	7651	6,095	79.66%	6,286	82.16%	7,295	95.34%

Table 10-29: Link Capacity – Stress Test 2

Link Capacity							
Regional Road Number	Capacity maximum AADT (TA 46/97)	2016 Existing AADT	2016 Existing Utilised Link Capacity	2019 AADT No development	2019 No development Utilised Link Capacity	2019 AADT With development (Scenario 1)	2019 With development Utilised Link Capacity
R403 (North of Junction 5)	7651	6,095	79.66%	6,286	82.16%	6,962	90.99%
R403 (South of Junction 5)	6743	4,973	73.75%	5,119	75.92%	5,452	80.86%
R407	14,505	12,640	87.14%	13,040	89.90%	13,372	92.19%

Table 10-30: Link Capacity – Stress Test 3

Link Capacity							
Regional Road Number	Capacity maximum AADT (TA 46/97)	2016 Existing AADT	2016 Existing Utilised Link Capacity	2019 AADT No development	2019 No development Utilised Link Capacity	2019 AADT With development (Scenario 3)	2019 With development Utilised Link Capacity
R403 (North of Junction 5)	7651	6,095	79.66%	6,286	82.16%	6,790	88.75%
R403 (South of Junction 5)	6743	4,973	73.75%	5,119	75.92%	5,623	83.40%
R407	14,505	12,640	87.14%	13,040	89.90%	13,543	93.37%

Table 10-31: Link Capacity – Stress Test 4

Link Capacity							
Regional Road Number	Capacity maximum AADT (TA 46/97)	2016 Existing AADT	2016 Existing Utilised Link Capacity	2019 AADT No development	2019 No development Utilised Link Capacity	2019 AADT With development (Scenario 1)	2019 With development Utilised Link Capacity
R403 (North of Junction 5)	7651	6,095	79.66%	6,286	82.16%	6,619	86.51%
R403 (South of Junction 5)	6743	4,973	73.75%	5,119	75.92%	5,795	85.94%
R407	14,505	12,640	87.14%	13,040	89.90%	13,715	94.56%

Table 10-32: Link Capacity – Stress Test 5

Link Capacity							
Regional Road Number	Capacity maximum AADT (TA 46/97)	2016 Existing AADT	2016 Existing Utilised Link Capacity	2019 AADT No development	2019 No development Utilised Link Capacity	2019 AADT With development (Scenario 1)	2019 With development Utilised Link Capacity
R403 (South of Junction 5)	6743	4,973	73.75%	5,119	75.92%	6,128	90.88%
R407	14,505	12,640	87.14%	13,040	89.90%	14,048	96.85%

The link capacity results in accordance with TA 46/97 show that the R403 and R407 are below link capacity. In 2019, the most stringent stress test, Stress Test 1, for the R403 (north) will have a spare capacity of 4.66% with development traffic. For the R403 (south) Stress Test 5 is the most robust with an 9.12% spare capacity with development. Similarly for the R407, Stress Test 5 is the most robust with a spare capacity of 3.15% available with development.

There is a difference in capacities using the different design standards. The TA 46/97 uses actual site specific design parameters such as the actual carriageway width, proportion of total daily flow in peak hour, directional split, actual AADT and AAWT (Annual Average Weekly Traffic) to determine the congestion reference flow (i.e. the traffic limit at which the road becomes congested). In comparison with the TD 9 which only uses the width of the carriageway and the road type, the TA 46/97 gives more site specific outputs.

In addition to this, a review of a similar site (the N84, national secondary road, within the Galway City and County environs) indicates a carrying capacity of 12,177 AADT in 2016 from TII live traffic counters. The N84 has a similar road width to the assessed R403. When compared to the N84 actual flows, TA 46/97 is found to be more representative of the traffic carrying capacity of a road as it takes into account factors such as the actual width of the road and peak hour flows. Therefore, based on the additional check in line with TA 46/97, none of the links will be operating over capacity in 2019 with the most robust development Scenario 1. As previously stated, 2019 Scenario 1 adds the most traffic to the road network as it takes into account both operational and construction development traffic. The development traffic is less on the road network post 2019 as the majority of construction of the development will have been completed.

10.3.9 Pavement Survey

The Kildare County Council Roads, Transportation and Public Safety Department reviewed a scoping letter in relation to the proposed development submitted by Tobin Consulting Engineers dated 10th June 2016 (see Appendix 1.1 of the EIAR). The Roads Department responded to Kildare County Council Planning Section on the 11th July 2016. Within the Conclusion and Recommendation of this response was a request that a full structural assessment of the haul routes, to show pavement depths and subgrade, be undertaken. In compliance with this request, Pavement Management Systems were commissioned to undertake the following surveys on existing and proposed haul routes:

1. Falling Weight Deflectometer (FWD) testing.
2. Ground Penetrating Radar (GPR) and cores where required.
3. Road Condition Data (RCD) using Road Surface Profiler (RSP) including:
   - Digital Video (chainage and GPS referenced).
   - Visual condition survey from video survey using pavement condition index (PCI).
   - Ride quality survey using International Roughness Index (IRI).
   - Transverse profile for rut depth.

Surveys were carried out in December 2016 and January 2017. The surveys were undertaken in line with TII 'Guidelines for the use of the Falling Weight Deflectometer in Ireland'. As per the guidelines for two lane roads, the surveys were carried out in both traffic directions and at 50 m intervals with the tests being staggered in adjacent lanes.

The assessment did not include sections of the haul routes which were on motorway or national roads as these roads have been designed to cater for larger traffic volumes. The Reports for all of the testing mentioned above are shown in Appendix 10.7 and include drawings showing the haul routes and associated chainages.

The FWD level 1 survey covers the testing undertaken to assess the condition of the existing pavement layers and subgrade. The output from these are; D1 - overall pavement structural condition, surface curvature index (SCI) - the upper surface pavement condition, and D7 - the subgrade strength.

In summary the overall pavement condition (D1) from the FWD level 1 surveys show the following:

- Haul Route 1.2: 100% of the route is rated as 'very good';
- Proposed Haul Route Maynooth to Clane: 100% of the route is rated as 'very good';
- Proposed Haul Route along Enfield Ring Road: 100% of the route is rated as 'very good';
- Haul Route 3: 100% of the route is rated as 'very good';

- Proposed Haul Route Kilcock to Prosperous: In the southbound direction the route is rated 88% ‘very good’ and 12% ‘good’. In the northbound direction it is rated as, 88% ‘very good’ and 12% ‘fair’;
- Haul Route 4: In the southbound direction the route is rated 9% ‘good’ and the remaining 91% ‘very good’. In the northbound direction it is rated 12% ‘fair’, 5% ‘good’ with the remaining 83% ‘very good’;
- Proposed Haul Route Kildare to Milltown: In the southbound direction the route is rated 30% ‘good’ and the remaining 70% ‘very good’. In the northbound direction it is rated 48% ‘good’ and the remaining 52% ‘very good’;
- Haul Route 1: 100% of the route is rated ‘very good’; and
- Haul Route 2.2: 100% of the route is rated ‘very good’.

10.3.10 Unplanned Events

In order to address unforeseen events the following incidents have been considered:

- Incident along existing and proposed Haul Routes;
- Incident at the existing access to Waste Management Facility; and
- Incident within the Waste Management Facility.

The unplanned events likely to occur include road collisions, flooding or an oil spillage along a haul route. In such an event, competent personnel such as the Local Authority, Gardaí Siochána and other emergency services would be involved.

10.3.10.1 Incident along existing and proposed Haul Routes

In the event of an incident occurring along any of the haul routes the emergency diversion routes provided by the Gardaí Siochána will be utilised. As shown in Appendix 10.1 the haul routes provide alternative options for the vehicles travelling to/from the facility. The redistribution of the facilities vehicles for an incident along the haul routes have been examined through varying traffic distributions (stress tests).

10.3.10.2 Incident at the existing access to Waste Management Facility

An incident at the existing access of the facility is similar to the occurrence of an incident along the haul routes, as the Gardaí Siochána emergency diversion routes will be utilised. However the facility operators will also contact the HGV drivers to inform them of the significance of the incident and the necessary protocol.

10.3.10.3 Incident within the Waste Management Facility

In the case where an incident occurs internally with the waste management facility, existing emergency protocols in place at the facility will be enacted, with onsite personnel acting in accordance with these protocols.

In order to estimate the likelihood of the above mentioned incidents a general risk assessment is required. The Flood Risk Assessment is outlined in chapter 7 which determines the potential for the existing site to flood.

The following hazards have been determined which are included in the outline risk assessment in Table 10-33: Unplanned Events - Outline Risk Assessment.

Table 10-33: Unplanned Events - Outline Risk Assessment

Outline Risk Assessment			
Hazards and Risks	Personnel at risk from the significant hazards	Risk Control	Responsible persons
Road Collison	Public Drivers of vehicles travelling to/from facility Vulnerable Road Users (Pedestrians and Cyclist)	Maintain hedgerow to maintain optimum visibility Maintain road signage and add signage where necessary Maintain road surfacing and improve where necessary Maintain lighting along road and improve where necessary	Landowners and Local Authority
Road Flooding	Public Drivers of vehicles travelling to/from facility Vulnerable Road Users (Pedestrians and Cyclist)	Maintain road drainage and improve where necessary	Local Authority
Snow/frost on road	Public Drivers of vehicles travelling to/from facility Vulnerable Road Users (Pedestrians and Cyclist)	Maintain a stock of salt and chips and apply prior to snow/frost fall Apply temporary signage where need to notify public of risk and o/or road closures	Local Authority
Injury within the site i.e. slip/trip or fall	Employees of the Facility Drivers of HGVs from external facilities	Adequate training provided to personnel Walkways to be maintained and kept clear	Bord na Móna
Collision within the site i.e. vehicle or personnel struck by vehicle)	Employees of the Facility Drivers of HGVs from external facilities	Personnel use internal walkways Personnel wear high-vis Supervision of HGV's to enforce safe procedures	Bord na Móna

10.3.11 Road Safety

Consideration was given to the TII Road Safety Impact Assessment guidelines (PE-PMG-02001) document. These guidelines are aimed at new road developments or substantial modifications to an existing road network. This proposed development does not fall under either of these criteria. However this chapter includes a review of safety concerns along the haul routes along with the available collision data and the general condition of the existing road pavement.

10.3.11.1 Existing Site Entrance

The speed limit on the R403 at the site entrance junction is 80 km/h. The entrance is a ghost island junction, constructed to the standards set out in NRA DMRB TD41/95, which was the current standard when it was being constructed. NRA DMRB TD41/95 has now been superseded by TII DN-GEO-03043 (previously NRA DMRB TD41-42) which sets out a requirement for visibility splays of 3.0 x 160 metres. The visibility from the site access road on the R403 is fully compliant with TII DN-GEO-03043.

A ghost island junction has been provided at the existing site entrance with a right turning lane. The through lanes on either side are 3.0 m wide and the right turning lane is 3.0 m wide. The length of the ghost island junction provides adequate deceleration length and turning length for a design speed of 85 km/h in accordance with DMRB TD 42/95. Queuing length of 65 m is also provided.

A 7.5 m wide access road is provided with junction radii of 20 m off the R403 to the facility. A recessed gate is also provided at a setback of 80 m from the existing entrance. The access road narrows to 6 m wide on the approach to the facility. This is an adequate width to allow two HGVs to pass one another with a clearance of 1.0 m.

Warning signs and advance direction signs indicating the presence of the entrance to the Bord na Móna landholding and road markings are provided in the vicinity of the site entrance junction.

As part of the construction of the initial stage of the permitted Drehid Waste Management Facility, a road safety audit was carried out in accordance with the relevant sections of the National Roads Authority standard (HD 19/04 and HA42/04) on the constructed site entrance. The road safety audit was subsequently submitted to Kildare County Council who approved the existing site entrance.

10.3.11.2 Accident Data

An investigation was undertaken of road collision data from the Road Safety Authority (RSA) website (source: http://www.rsa.ie/RSA/Road-Safety/Our-Research/Ireland-Road-Collisions/) which has data from 2005 to 2013. It is noted that the Drehid Facility started construction in August 2006 and began operating in February 2008. The facility is licensed to operate Monday to Saturday between 08:00 to 19:00.

A "fatal" collision is defined as one where at least one person is killed as a result of the collision and death occurs within 30 days of the date of the collision from which injuries were sustained.

A "serious injury" can be defined as an injury for which the person is detained in hospital as an 'in-patient', or any of the following injuries whether or not detained in hospital: fractures, concussion, internal injuries, crush injuries, severe cuts and lacerations, severe general shock requiring medical treatment.

A "minor injury" is an injury of a minor character such as a sprain or bruise. All other collisions can be defined as Material Damage Collisions, where no deaths or injuries occur but damage is caused to a vehicle and/or property. In Table 10-34: Summary of Collision data for the Haul Routes all collisions along the existing and proposed haul routes, between the years 2005 to 2013, are summarised. The full set of collision data reviewed is in Appendix 10.9.

Table 10-34: Summary of Collision data for the Haul Routes

	Haul Route 1.2	Proposed Haul Route Maynooth to Clane	Proposed Haul Route Enfield Ring Road	Haul Route 3	Proposed Haul Route Kilcock to Prosperous	Haul Route 4	Proposed Haul Route Kildare to Milltown	Haul Route 1	Haul Route 2.2
Total No. of Fatal Collisions	-	2	-	3	2	4	-	6	2
Total No. of Serious Collisions	-	6	-	1	3	6	-	5	2
Total No. of Minor Collisions	9	23	3	23	26	66	18	47	12
During construction and operational hours of facility involving HGV's									
No. of Fatal Collisions	-	-	-	-	1	-	-	1	1

	Haul Route 1.2	Proposed Haul Route Maynooth to Clane	Proposed Haul Route Enfield Ring Road	Haul Route 3	Proposed Haul Route Kilcock to Prosperous	Haul Route 4	Proposed Haul Route Kildare to Milltown	Haul Route 1	Haul Route 2.2
No. of Serious Collisions	-	-	-	-	-	-	-	1	-
No. of Minor Collisions	1	-	-	2	4	7	1	3	1

Over the construction and operational period of the facility to 2013, there are 19 minor, one serious and three fatal collisions recorded along the total 123 km of haul routes involving HGVs. This compares to totals of 227 minor, 23 serious and 19 fatal collisions along the same length of haul routes.

Each existing and proposed haul route is assessed individually below. Typically a general description of the haul route is given, as well as the pavement condition as taken from the pavement survey information in section 10.4.9 and the reports in Appendix 10.7. Also included is a summary of the collisions from the RSA data, in particular those involving HGVs during the operational hours of the facility.

10.3.11.3 Haul Route 1.2

Haul route 1.2 is approximately 4.6 km in length and is the L2002 (Millicent Road), which is a local road with an 80 km/h speed limit. The road width is approximately 5.6 m with a grass verge on both sides. The route includes a bridge crossing over the River Liffey, where there is a right angled bend in the road just south of this crossing. There is a staggered junction on the L2002 which connects Clane to the east and Carragh to the west. The overall pavement condition of the haul route is rated as 'very good' as per reports in Appendix 10.7 and in section 10.3.9.

There were no fatal or serious collisions recorded along this haul route. Of the nine minor collisions recorded, 4 are at the R403/L2002 crossroads and 3 are at the staggered junction to Carragh/Clane.

Table 10-35: Collision Data involving a HGV within operating hours of the facility, Haul Route 1.2.

Severity	Year	Vehicle	Circumstances	Day of week	Time	Speed Limit
Minor	2007	Goods Vehicle	Angle, right turn	Thursday	07:00-10:00	80 km/h

There was one collision which involves a HGV within the operational hours of the facility as shown in Table 10-35: Collision Data involving a HGV within operating hours of the facility, Haul Route 1.2. above. The minor collision occurred at the Carragh/Clane staggered junction in 2007, on a Thursday between 07:00 and 10:00. The stagger distance is approximately 12 m at this junction therefore the vehicle manoeuvres between minor arms is similar to that of a crossroads. It is noted that TII DN-GEO-03043 (previously TD 41-42) states *crossroads are considered unsuitable for all rural road junction types. The use of a rural crossroads shall be considered as a Departure from Standard on all new and improved roads*. As outlined above, of all the accidents along this route, 78% (7 out of 9) are attributable to the existing crossroad junctions.

10.3.11.4 Proposed Haul Route Maynooth to Clane

The proposed haul route between Maynooth and Clane is approximately 12.2 km in length. The route includes sections of the Clane ring road, the R403 and R406 regional roads. The speed limit along this route is 80 km/h apart from a 50 km/h speed limit through Clane. The ring road is approximately 7.7 m wide, with grass verges and footpaths provided on both sides of the road. There is also a signalised pedestrian crossing on the ring road. The R403 regional road is approximately 6.6 m wide with grass verges on both sides. The cross section changes in the Straffan Manor area for 1.7 km, with the introduction of hard shoulders on both sides of the road. This provides a total pavement width of approximately 12 m.

The R406 regional road has hard shoulders throughout and is approximately 11.8 m in width. The overall pavement condition of the haul route is rated as 'very good' as previously mentioned in section 10.3.9 and as per reports in Appendix 10.7. A roundabout connects the R403 to the R406 at the Barberstown road.

There have been no collisions along the ring road. However there were two clusters of collisions; entering Clane and at Straffan Manor area. The section in Clane is 500 m in length from the ring road roundabout heading east. The alignment along this stretch of road is straight. The section in the Straffan Manor area is a 1.7 km stretch that includes hard shoulders. At Straffan Manor, the alignment is relatively straight with a wide cross section which can encourage speeding.

There were no collisions along this route involving a HGV within the operational hours of the facility.

10.3.11.5 Proposed Haul Route along Enfield Ring Road

The proposed haul route along Enfield Ring Road (R148) is approximately 1.7 km in length with a 60 km/h speed limit. This ring road is approximately 9.5 m wide with a hard shoulder on both sides of the road. There is a footpath provided on one side of the road. The overall pavement condition of the haul route is rated as 'very good' as per section 10.3.9 and reports in Appendix 10.7.

There have been no fatal or serious collisions along this route. There were three minor collisions on the ring road, two of which are at the R148/Johnstown Road signalised crossroads. The third minor collision involved a HGV on a Friday between 23:00 to 03:00 in 2008. However this occurred outside the operational hours of the facility.

10.3.11.6 Haul Route 3

Haul Route 3 is approximately 19.3 km in length and consists of the R403 and R402 regional roads. There is an 80 km/h speed limit for the majority of the haul route with 50 km/h and 60 km/h speed limits at Killina National School, Derrinturn, Carbury, Kilshanroe and Johnstown Bridge. The road alignment is relatively straight with minor bends and a roundabout connecting the R403 to the R402. The R402 regional road ranges from approximately 7 m to 12 m in width with grass verges along both sides of the road. At Ballynamullagh to the roundabout with the R403 the cross section changes with the introduction of hard shoulders. The R402 regional road is approximately 7 m wide with a grass verge on both sides. The overall pavement condition of the haul route is rated as 'very good' as per section 10.3.9 and reports in Appendix 10.7.

Table 10-36: Collision Data involving a HGV within operating hours of the facility, Haul Route 3.

Severity	Year	Vehicle	Circumstances	Day of week	Time	Speed Limit
Minor	2009	Goods Vehicle	Other	Wednesday	07:00-10:00	80 km/h
Minor	2012	Goods Vehicle	Other	Saturday	10:00-16:00	50 km/h

The collisions along this route are dispersed. All three fatal collisions occurred along the R403. There were two collisions which involve a HGV within the operational hours of the facility as shown in Table 10-36: Collision Data involving a HGV within operating hours of the facility, Haul Route 3.The minor collisions both occurred on the R402; one in 2009 on a Wednesday between 07:00 and 10:00 and the second in 2012 on a Saturday between 10:00 and 16:00. However these occurred along narrow sections of the R402 and it is noted this road has been upgraded since these collisions occurred.

10.3.11.7 Proposed Haul Route Kilcock to Prosperous

The proposed haul route from Kilcock to Prosperous is approximately 15 km in length consisting of the R408 and R407 regional roads. There is an 80 km/h speed limit for the majority of the haul route with a 50 km/h speed limit in Prosperous. The R408 road is approximately 6 m wide with grass verges along both sides of the road. The R407 road is wider at approximately 7.5 m with grass verges along both sides of the road. There is a priority junction connecting the R408 to the R407. A right turn lane is provided on the R407. The overall pavement condition of the haul route for southbound direction is 88% ‘very good’ and 12% ‘good’. In the northbound direction the overall pavement condition is described as, 88% ‘very good’ and 12% ‘fair’.

Table 10-37: Collision Data involving a HGV within operating hours of the facility, Proposed Haul Route Kilcock to Prosperous.

Severity	Year	Vehicle	Circumstances	Day of week	Time	Speed Limit
Minor	2008	Goods Vehicle	Rear end, straight	Monday	10:00-16:00	50 km/h
Minor	2006	Goods Vehicle	Other	Wednesday	10:00-16:00	80 km/h
Minor	2011	Goods Vehicle	Single vehicle only	Monday	16:00-19:00	50 km/h
Minor	2013	Goods Vehicle	Rear end, straight	Wednesday	10:00-16:00	80 km/h
Fatal	2009	Goods Vehicle	Head-on conflict	Wednesday	10:00-16:00	80 km/h

There were four minor collisions and one fatal involving a HGV within the operational hours of the facility as shown in Table 10-37: Collision Data involving a HGV within operating hours of the facility, Proposed Haul Route Kilcock to Prosperous. One minor collision was in Prosperous, another was along the R408 and two along the R407. The collision in Prosperous in 2008, was a rear end collision within the urban area. The remaining three minor collisions were on straight sections of the route. The fatal collision occurred at a bend on the R407. This bend has been improved by the addition of high friction surfacing and warning signs.

10.3.11.8 Haul Route 4

Haul Route 4 is approximately 23 km in length and consists of the R403, R415, R416, R413 and

R448 regional roads. There is an 80 km/h speed limit for the majority of the haul route with 50 km/h and 60 km/h speed limits in Allenwood, Kilmeage, Milltown, Newbridge, Athgarvan, and Kilcullen. There are several junctions along this route connecting the regional roads, all of which are priority junctions. The regional roads vary in road width from 5.7 m to 7 m with grass verges along both sides of the road. The overall pavement condition of these roads show that for the southbound direction 9% is 'good' and the remaining 91% is described as 'very good'. In the northbound direction the overall pavement condition shows that 12% is 'fair', 5% is 'good' with the remaining 83% described as 'very good'.

Table 10-38: Collision Data involving a HGV within operating hours of the facility.

Severity	Year	Vehicle	Circumstances	Day of week	Time	Speed Limit
Minor	2013	Goods Vehicle	Head-on conflict	Tuesday	10:00-16:00	50 km/h
Minor	2008	Goods Vehicle	Head-on conflict	Thursday	10:00-16:00	50 km/h
Minor	2009	Goods Vehicle	Other	Thursday	07:00-10:00	80 km/h
Minor	2011	Goods Vehicle	Rear end, straight	Saturday	16:00-19:00	50 km/h
Minor	2006	Goods Vehicle	Head-on conflict	Saturday	07:00-10:00	50 km/h
Minor	2008	Goods Vehicle	Other	Friday	10:00-16:00	50 km/h
Minor	2007	Goods Vehicle	Pedestrian	Wednesday	10:00-16:00	60 km/h

There were seven minor collisions involving a HGVs within the operational hours of the facility, as shown in Table 10-38: Collision Data involving a HGV within operating hours of the facility. All seven collisions occurred in urban areas of Kilmeage, Newbridge and Kilcullen.

10.3.11.9 Proposed Haul Route Kildare to Milltown

The proposed haul route from Kildare to Milltown is the R415 and is 7.8 km in length. There is an 80 km/h speed limit for the majority of the haul route with 50 km/h and 60 km/h speed limits in Milltown and Kildare. The R415 is approximately 6 m wide with grass verges along both sides of the road. The overall pavement condition of the haul route as shown in Appendix 10.7 shows that in the southbound direction 30% is 'good' and the remaining 70% is described as 'very good'. In the northbound direction, overall pavement condition shows 48% is 'good' and the remaining 52% is described as 'very good'.

Table 10-39: Collision Data involving a HGV within operating hours of the facility, Proposed Haul Route Kildare to Milltown.

Severity	Year	Vehicle	Circumstances	Day of week	Time	Speed Limit
Minor	2009	Goods Vehicle	Pedestrian	Tuesday	10:00-16:00	50 km/h

There was one minor collision involving a HGV and a pedestrian within the operational hours of the facility as shown in Table 10-39: Collision Data involving a HGV within operating hours of the facility, Proposed Haul Route Kildare to Milltown.

10.3.11.10 Haul Route 1

Haul Route 1 is 27 km in length along the following regional roads R403, R407 and the R448. The regional roads have an 80 km/h speed limit with 50 km/h and 60 km/h speed limits at Allenwood, Prosperous and Clane. There is a priority junction connecting the R403 to the R407. The regional roads vary from approximately 5.7 m to 6.5 m in width with grass verges along both sides of the road. The overall condition of the haul route is rated as 'very good' as per section 10.3.9 and reports in Appendix 10.7.

Table 10-40: Collision Data involving a HGV within operating hours of the facility, Haul Route 1.

Severity	Year	Vehicle	Circumstances	Day of week	Time	Speed Limit
Minor	2011	Goods Vehicle	Other	Friday	10:00-16:00	80 km/h
Minor	2009	Goods Vehicle	Rear end, Straight	Thursday	16:00-19:00	50 km/h
Minor	2008	Goods Vehicle	Head-on right turn	Monday	16:00-19:00	80 km/h
Serious	2005	Goods Vehicle	Pedestrian	Saturday	10:00-16:00	50 km/h
Fatal	2010	Goods Vehicle	Pedestrian	Saturday	10:00-16:00	50 km/h

There were five collisions involving a HGV within the operational hours of the facility. Three of these collisions were minor, one serious and the other fatal as shown in Table 10-40 above. The overall condition of the haul route is rated as 'very good' as mentioned in section 10.3.9 and per reports in Appendix 10.7.

The first minor collision in the table is in Allenwood and the second is in Prosperous. The third collision occurred along a bend south of Clane on the R407. The serious and fatal collisions involving pedestrians both occurred in Clane. The fatal collision occurred at the signalised junction in Clane, which has pedestrian crossings on all arms. The serious collision occurred west of Clane on the R403 which has a footpath on one side only.

10.3.11.11 Haul Route 2.2

Haul route 2.2 is 11 km in length and consists of the ring road around Naas and the R448 regional road. There is an 80 km/h speed limit for the majority of the haul route with 60 km/h speed limits entering Naas and along the ring road. There is a roundabout connecting the ring road to the R448. The R448 is approximately 6.4 m wide with grass verges along both sides of the road. The ring road is approximately 9.4 m wide with footpaths on both sides which are segregated from the road by a grass verge. There is also a signalised pedestrian crossing within the 60 km/h speed limit on the R448. The overall pavement condition of the haul route is rated as 'very good' as described in section 10.3.9 and per reports in Appendix 10.7.

Table 10-41: Collision Data involving a HGV within operating hours of the facility, Haul Route 2.2

Severity	Year	Vehicle	Circumstances	Day of week	Time	Speed Limit
Minor	2009	Goods Vehicle	Other	Thursday	16:00-19:00	80 km/h
Fatal	2007	Goods Vehicle	Angle, right turn	Saturday	10:00-16:00	80 km/h

There was one minor and one fatal collision involving HGVs within the operational hours of the facility as shown in Table 10-41: Collision Data involving a HGV within operating hours of the facility, Haul Route 2.2 Both collisions occurred at a staggered junction along the R448. Since these collisions, vehicle activated signs depicting actual speed limits have been installed in both directions either side of the junction.

10.3.12 Speed Surveys

The automated traffic counters (ATC) that are described in section 10.2.1 were also set-up to collect speed data at these locations. The mean speed at the ten ATC's along the haul routes were reviewed and are summarised in Table 10-42: Speed surveys along the haul routes. The locations of the counters are shown in Figure 10.1 and in Appendix 10.1.

Table 10-42: Speed surveys along the haul routes

Severity	Speed Limit	Direction 1		Direction 2	
ATC 1 (R402)	80 km/h	93.5 km/h	eastbound	97 km/h	westbound
ATC 3 (R403)	50 km/h	44 km/h	northbound	43.7 km/h	southbound
ATC 4 (R403)	80 km/h	81.7 km/h	northbound	83 km/h	southbound
ATC 6 (R415)	60 km/h	58.9 km/h	northbound	58.4 km/h	southbound
ATC 7 (R403)	80 km/h	82.2 km/h	eastbound	81.5 km/h	westbound

Severity	Speed Limit	Direction 1		Direction 2	
ATC 8 (R409)	80 km/h	66.9 km/h	northbound	71.3 km/h	southbound
ATC 9 (R403)	80 km/h	72.2 km/h	northbound	74.2 km/h	southbound
ATC 10 (R407)	60 km/h	63.7 km/h	northbound	67.1 km/h	southbound
ATC 11 (R408)	80 km/h	82.5 km/h	northbound	78.2 km/h	southbound
ATC 12 (R415)	60 km/h	75.6 km/h	northbound	71.2 km/h	southbound
ATC 13 (R403)	80 km/h	68.7 km/h	northbound	64.1 km/h	southbound

Only the ATCs with recorded speeds over the designated speed limit are further assessed below. The collisions within close proximity to the ATCs are also reviewed to see if there is a correlation between speeding and collisions at these locations.

- ATC 1 on the R402 is on Haul Route 3. This registers the highest speed over the designated speed limit with vehicles travelling at 97 km/h in an 80 km/h speed zone. However there was only one minor collision in close proximity to this ATC. ATC 3 is on the R403 which is also part of Haul Route 3, within a 50 km/h zone with recorded speeds of 44 km/h. There were three collisions at this location, one fatal involving a pedestrian.

- For Haul Route 1, there are three ATC's with ATC 4 and 7 on the R403 and ATC10 on the R407. Both ATC's on the R403 are within 80 km/h zones and the speeds are marginally over this with a maximum recorded speed of 83 km/h. There was one fatal and one minor collision in close proximity to ATC 4. The fatal collision was a single vehicle collision located on a bend. There were only two minor collisions in close proximity to ATC 7.

  On the R407, the ATC 10 recorded a mean speed of 67.1 km/h within the designated 60 km/h zone. There were three minor and one serious collisions recorded within the proximity of this ATC. Of these four collisions, three involved a single vehicle only, one of which was serious.

- ATC 11 is on the R408 south-west of the junction with the R407. It is located on the Proposed Haul Route Prosperous to Kilcock. The recorded speed at this location is 82.5 km/h in an 80 km/h zone. There was only one minor collision in close proximity to this ATC, which involved a HGV.

- ATC 12 is on the R415 north of Kildare town along the proposed haul route Kildare to Milltown. The recorded speed at this location was 75.1 km/h in a 60 km/h zone. There were no recorded collisions within close proximity to this ATC.

There does not appear to be a correlation between speeding and collisions at the locations above. Where pedestrians have been involved in collisions, these were within 50 km/h zones where the recorded mean speed has been below the speed limit.

Although the above speed surveys do not distinguish between vehicle types, The Road Safety Strategy 2013-2020 shows the percentage of vehicle types that comply with speed limits. These figures have been taken from extensive speed surveys undertaken on all roads types. It was found that 90% of rigid vehicles comply with the speed limits on regional roads compared to 66% of cars.

10.3.13 Pedestrians and Cyclists

The closest village to the facility is Allenwood which is 4 km from the site entrance. The site entrance road is an additional 5 km in length to the facility. This gives a minimum total walking distance of 9 km. The R403 has no footpaths, cycle lanes or hard shoulder. There is a footpath in Allenwood Village. Typically within Transport Strategies that have been produced by e.g. the National Transport Authority, the expectation is that people walk up to 3 km and cycle 5 km to their place of work. As the distance to the facility is at a minimum 9 km it is highly unlikely that either of these forms of transport will be used. Therefore it is proposed that no specific provision be made to accommodate either.

10.3.14 Car Parking

Car parking for 35 additional cars will be provided adjacent to the Welfare Building. An additional 33 parking spaces for HGV parking and eight car parking spaces will be provided at the Waste Control Area. Five No. car parking spaces will include electric car charging facilities (10% of the total number car parking spaces proposed). Specific guidelines for car parking at facilities such as the proposed Drehid Waste Facility are not set out in the Kildare County Council Development Plan. However considering the number of employees, the volume of parking is sufficient to provide adequate parking for both staff and visitors including the number of large vehicles that will be accessing the facility at any given time.

10.3.15 Public Transport

There is no regular public transport service in operation in the immediate vicinity of the Facility; however there are public bus services that run from Dublin to Allenwood, Edenderry and Tullamore. As stated in Section 10.3.9 above, the total walking distance from Allenwood would be approximately 9 km to the Waste Facility. Therefore it is not expected that the staff working at the facility will utilise the existing bus services.

10.4 MITIGATION MEASURES

The following are measures that will be implemented to mitigate the impact associated with the facility:

- Photographic survey of haul roads again, immediately prior to commencement of construction;
- Continuous monitoring of haul roads throughout both the construction and operational phase;
- All contractors, delivering waste to the facility and removing outputs from the facility, and all construction contractors will be issued with a map of the permitted haul routes such that all materials imported into the site and exported out of the site are transported via one of the identified haul routes. A penalty system will be operated by Bord na Móna to ensure haulage operators comply with these requirements;
- Utilise existing wheel wash facilities at the Waste Facility during both the construction and operational phase;
- Maintenance of warning signage on the approach to the entrance;
- Monitoring of parking requirements during the operational phase with additional spaces to be provided if required;
- Maintenance of site entrance ensuring visibility splays remain intact; and
- Monitoring of haul routes for problems such as congestion and refining the traffic routing on the permitted haul routes where required.

10.5 RESIDUAL EFFECTS

10.5.1 Summary

- Adequate visibility splays of 3.0 x 160 m are provided at the existing site entrance junction in accordance with TII DN-GEO-03043 (previously NRA DMRB TD 41-42).
- A ghost island junction with a right turning lane is provided at the existing site entrance which is capable of accommodating the increased traffic associated with the proposed development.
- The existing R408 and R403 signalised crossroads in Prosperous (Junction 1) is currently over capacity on arms A,C and D with a maximum DOS of 1.738 on arm A which rises to 1.810 in 2019 without development.

  As this junction is already is over capacity improvements would be required to reduce congestion. These could take the form of changes to the signal timings and adjustments to the layout in line with the Design Manual for Urban Roads and Streets (DMURS) guidelines.

- The existing R407 and R403 signalised priority junction, Clane (Junction 2), is currently over capacity on arms A and C with a DOS of 1.221 on arm A in the AM peak which reaches 1.260 in 2019 without development.

  As arms A and C at this junction are already over capacity improvements would be required to reduce congestion. These could take the form of changes to the signal timings and adjustments to the layout in line with the Design Manual for Urban Roads and Streets (DMURS) guidelines
- The existing Johnstown Road roundabout, Enfield (Junction 3) results indicate that this roundabout will operate below the maximum 0.85 RFC up to and including the design year of 2034 with the inclusion of traffic from the proposed development. The maximum RFC in 2019 is 0.36 for Arm B, in the PM peak, for Stress Test 1 (which is in the unlikely case of 100% facility traffic to/from the north).
- The existing R445 and R415 signalised crossroads in Kildare town (Junction 4), is currently below capacity with a maximum RFC of 0.750. In 2034 the junction will be marginally below capacity without development with a maximum RFC of 0.895 on arm D in PM peak.

  The maximum DOS for Scenario 1 is 0.963 in 2019 for Stress test 5 on arm D. For the more likely traffic distribution Stress Test 4 (66% Facility traffic to / from the south and 33% to / from the north) the maximum DOS is 0.918 in 2019 on arm D. This increases to 0.955 in 2034 which is only 0.055 over the desirable maximum DOS of 0.9. At a DOS of 1.0, a junction is operating at 100%. The assessment indicates that the junction will operate at 95.5% capacity in 2034.
- At present, the existing priority junction serving the facility on the R403 operates within capacity up to 2034 with a maximum RFC of 0.117 on Arm C in AM peak. Arm B (existing access) is marginally over capacity at 0.921 (desirable is 0.85) in the 2019 PM peak for Stress Test 1, which is 100% of the modelled traffic being generated by facility traffic to / from the north.

  For the more likely traffic distribution, stress test 4 (33% Facility traffic to / from the north and 66% to / from the south) the maximum RFC is 0.604 in 2019 PM peak on Arm B. The maximum queue length for this arm is three vehicles. The maximum RFC on arm B in 2024 is 0.178, and dropping further to 0.159 in the PM peak in 2034.
- The link road analysis shows that R403, R408 and R415 have spare capacity during both operation and construction phases for all the stress tests in accordance with TII DN-GEO-03031 (previously TD9) with R402 and R407 over capacity at present and with the development. However a check on link capacity was undertaken using UK DMRB TA 46/97 which assesses link capacity for single carriageways. The capacity of the link is worked out on the basis of Congestion Reference Flow (CRF) and measures the performance of a road link between junctions. The CFR takes into account factors such as the exact width of the road, peak hour flows and percentage of HGV's. This check was only carried out on the R403 and

R407 and showed that both roads have spare capacity at present and with the proposed development.

- The summary of the FWD pavement survey is in section 10.3.9 and the full reports are in Appendix 10.7. Overall the pavement condition is primarily ranked as 'very good' for the haul routes.
- A review of the collision data on the haul routes within section 10.3.11.2 shows that the majority occur within built up areas at junctions. However, of the collisions reviewed between the years 2005 and 2013, only 37 involved HGV's. Of these, 23 occurred during the years and hours the development was in operation (including construction of development). It is noted that these collisions are over an 8 year period and for 123 km of road network. There does not seem to be a significant issue with HGVs causing collisions on the haul routes.
- There are some sections of road along the haul routes that are narrow, which means that in specific locations vehicles needs to slow down so that they can pass each other. This would occur typically for HGV's meeting on these sections of road. In these areas a combination of signage and road markings would be beneficial to warn drivers of restrictions ahead.
- All contractors, delivering waste to the facility and removing outputs from the facility, and all construction contractors will be issued with a map of the permitted haul routes such that all materials imported into the site and exported out of the site are transported via one of the identified haul routes. A penalty system will be operated by Bord na Móna to ensure haulage operators comply with these requirements.
- It is envisaged that specific and exceptional works required to facilitate the proposed development would be the subject of a special development contribution condition, in accordance with section 48(2)(c) of the Planning and Development Act, as amended.

10.5.2 Residual Effects

The peak traffic has a short-term negative impact during construction however the mitigation measures outlined in section 10.5 minimises any residual effects. A summary justification is as follows:

- A Construction Traffic Management Plan will minimise traffic effects during construction, as far as practicable.
- The haul routes proposed are on national and regional roads, which are established HGVs routes.
- Specific and exceptional works such as those outlined here in relation to junction improvements require to facilitate the proposed development will be funded through an expected special development contribution as conditioned.
- Impacts to the environment will be managed through the mitigations measures outlined above thereby ensuring that the effects are not significant.

11 AIR QUALITY

11.1 INTRODUCTION

AWN Consulting Ltd. has been commissioned to carry out an air quality impact assessment including an air dispersion modelling study of air and odour emissions from the Proposed development at Drehid Waste Management Facility at the townlands of Coolcarrigan, Drummond and Kilkeaskin, Carbury, County Kildare based on the design details.

This chapter was completed Dr. Avril Challoner. She is a Senior Consultant in the Air Quality section of AWN Consulting. She holds a BEng (Hons) in Environmental Engineering from the National University of Ireland Galway, HDip in Statistics from Trinity College Dublin and has completed a PhD in Environmental Engineering (Air Quality) in Trinity College Dublin. She is a Member of the Institute of Air Quality Management and specialises in the fields of air quality, EIA and air dispersion modelling.

At present, Drehid Waste Management Facility comprises an engineered landfill and a Composting Facility, and is licensed by the EPA (IED Licence number W0201-03). The engineered landfill is currently permitted to accept 360,000 tonnes per annum (TPA) of municipal solid waste until 1st December 2017. Thereafter, waste for landfill disposal at the facility is limited to a maximum of 120,000 TPA. The current Composting Facility is permitted to accept 25,000 TPA. A Mechanical Treatment Building (MBT) facility has received planning permission to the south of the current landfill but has not yet been constructed, and is licensed by the EPA (IED Licence number W0283-01).

The Proposed development at the Drehid Waste Management Facility is as described in Chapter 3 herein.

The purpose of this assessment is to determine whether the air and odour emissions from the facility will lead to ambient concentrations which are in compliance with the relevant ambient air quality standards and guidelines for odour, NO_2 & PM_{10}/$PM_{2.5}$. The assessment was conducted using the methodology outlined in “Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (EPA, 2010)”.

This assessment describes the outcome of this study. The study consists of the following components;

- Review of emission data and other relevant information needed for the modelling study;
- Review and use of relevant data from previous EISs for the Drehid Waste Management Facility (including the 2008 EIS) and the EIS for the consented (not yet built) Mechanical Biological Treatment (MBT) facility (W0283-01);
- Summary of background pollutant levels;

- Dispersion modelling of released substances (including odour, NO_x and Particulates) under worst-case emission scenarios;
- Presentation of predicted ground level concentrations of released substances;
- Evaluation of the significance of these predicted concentrations, including consideration of whether these ground level concentrations are likely to exceed the relevant ambient air quality and odour limit values and guideline values; and
- Effect of traffic changes for five pollutants of concern in the vicinity of the facility.

Information supporting the conclusions has been detailed in the following sections. The assessment methodology and study inputs are presented below. The dispersion modelling results and assessment summaries are presented in Section 11.4. The model formulation is detailed in Appendix 11.1. Figure 11.1: Map of Land-Use in The Vicinity Of Drehid Landfill) shows the location of the Proposed development.

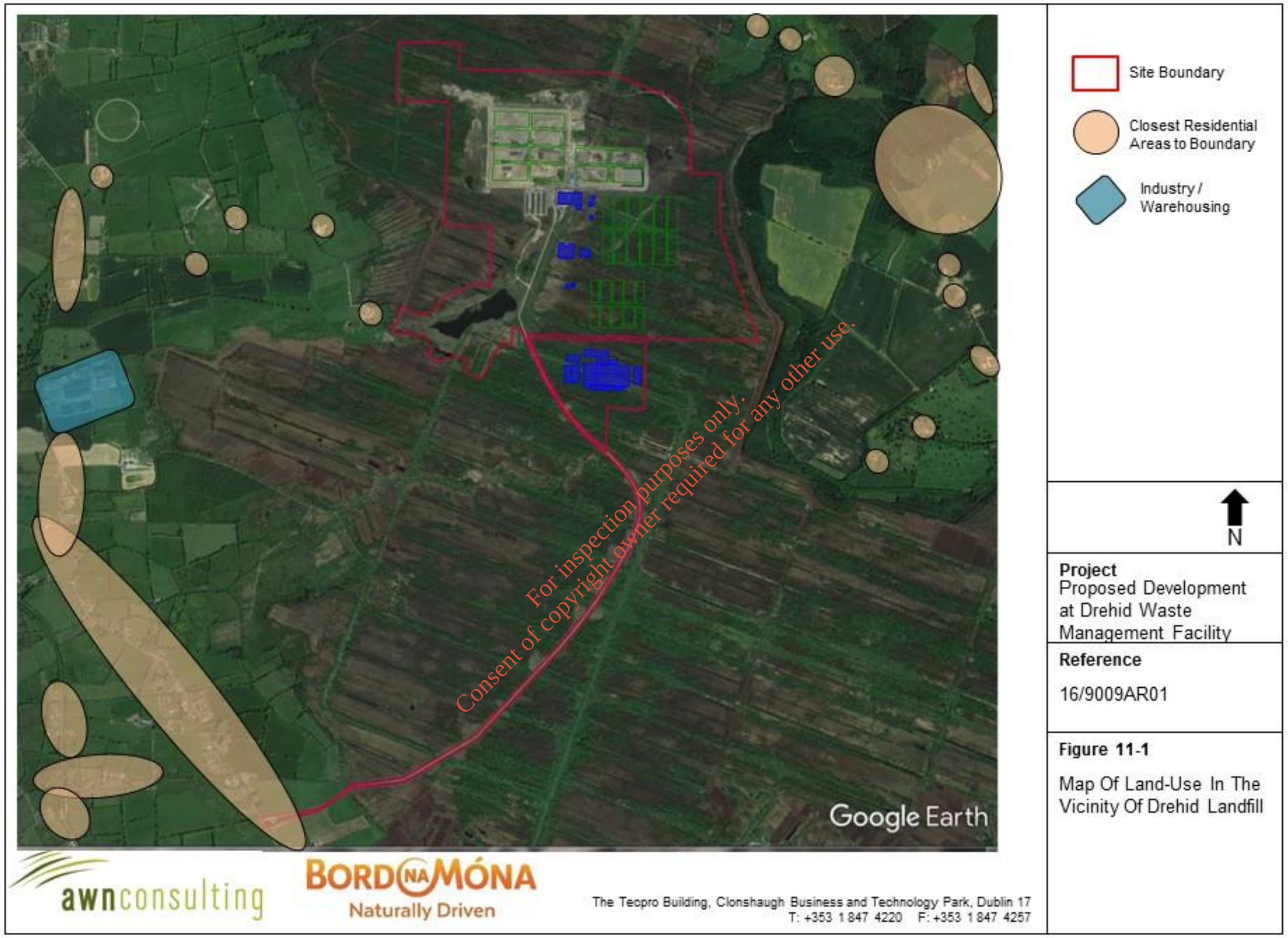


Figure 11.1: Map of Land-Use in The Vicinity Of Drehid Landfill

11.2 METHODOLOGY

Emissions from the facility have been modelled using the AERMOD dispersion model (Version 16216r) which has been developed by the U.S. Environmental Protection Agency (USEPA) (USEPA 2004a) and following guidance issued by the EPA (EPA 2010). The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources and has replaced ISCST3 (USEPA 1995) as the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain (USEPA 1998, 2000, 2005). The model has more advanced algorithms and gives better agreement with monitoring data in extensive validation studies (USEPA 1999, Schulman, L.L et al 2000, Paine, R & Lew F 1997a, 1997b, USEPA 2000). An overview of the AERMOD dispersion model is outlined in Appendix 11.1.

The air quality and odour dispersion modelling input data consisted of information on the physical environment (including building dimensions and terrain features), design details from all emission points on-site and five years of appropriate hourly meteorological data. Using this input data the model predicted ambient ground level concentrations beyond the site boundary for each hour of the modelled meteorological years. The model post-processed the data to identify the location and maximum of the worst-case ground level concentration. This was then compared with the relevant ambient air quality and odour standards to assess the significance of the releases from the site.

The air quality impact associated with increased traffic was carried out following procedures described in the publications by the EPA (EPA 2002, 2003, 2015, 2017) and using the methodology outlined in the policy and technical guidance notes, LAQM.PG(16) and LAQM.TG(16), issued by UK Department for Environment, Food and Rural Affairs. Modelling was carried out for a scenario whereby the Proposed development does not progress and comparing it to one where it does, for both the opening and design years. The derived concentrations are then compared to EU ambient air quality standards.

11.2.1 Odour Assessment

11.2.1.1 Characteristics of Odour

Odours are sensations resulting from the reception of a stimulus by the olfactory sensory system, which consists of two separate subsystems: the olfactory epithelium and the trigeminal nerve. The olfactory epithelium, located in the nose, is capable of detecting and discriminating between many thousands of different odours and can detect some of them in concentrations lower than those detectable by currently available analytical instruments (Water Environment Federation 1995). The function of the trigeminal nerve is to trigger a reflex action that produces a painful sensation. It can initiate protective reflexes such as sneezing to interrupt inhalation. The olfactory system is extremely complex and peoples' responses to odours can be variable. This variability is the result of the following; differences in the ability to detect odour, subjective acceptance or rejection of an odour due to past experience, circumstances under which the odour is detected, and the age, health and attitudes of the human receptor.

11.2.1.1.1 Odour Intensity and Threshold

Odour intensity is a measure of the strength of the odour sensation and is related to the odour concentration. The odour threshold refers to the minimum concentration of an odorant that produces an olfactory response or sensation. This threshold is normally determined by an odour panel consisting of a specified number of people, and the numerical result is typically expressed as occurring when 50% of the panel correctly detect the odour. This odour threshold is given a value of one odour unit and is expressed as 1 OU_E/m^3. The odour threshold is not a precisely determined value, but depends on the sensitivity of the odour panellists and the method of presenting the odour stimulus to the panellists. An odour detection threshold relates to the minimum odorant concentration required to perceive the existence of the stimulus, whereas an odour recognition threshold relates to the minimum odorant concentration required to recognise the character of the stimulus. Typically, the recognition threshold exceeds the detection threshold by a factor of 2 to 10 (Water Environment Federation 1995).

11.2.1.1.2 Odour Character

The character of an odour distinguishes it from another odour of equal intensity. Odours are characterised on the basis of odour descriptor terms (e.g. putrid, fishy, fruity etc.). Odour character is evaluated by comparison with other odours, either directly or through the use of descriptor words.

11.2.1.1.3 Hedonic Tone

The hedonic tone of an odour relates to its pleasantness or unpleasantness. When an odour is evaluated in the laboratory for its hedonic tone in the neutral context of an olfactometric presentation, the panellist is exposed to a stimulus of controlled intensity and duration. The degree of pleasantness or unpleasantness is determined by each panellist's experience and emotional associations. The responses among panellists may vary depending on odour character; an odour pleasant to many may be declared highly unpleasant by some.

11.2.1.1.4 Adaptation

Adaptation, or Olfactory Fatigue, is a phenomenon that occurs when people with a normal sense of smell experience a decrease in perceived intensity of an odour if the stimulus is received continually. Adaptation to a specific odorant typically does not interfere with the ability of a person to detect other odours. Another phenomenon known as habituation or occupational anosmia occurs when a worker in an industrial situation experiences a long-term exposure and develops a higher threshold tolerance to the odour.

11.2.1.2 Odour Guidelines

The exposure of the population to a particular odour consists of two factors; the concentration and the length of time that the population may perceive the odour. By definition, 1 OU_E/m^3 is the detection threshold of 50% of a qualified panel of observers working in an odour-free laboratory using odour-free air as the zero reference (the selection criteria result in the qualified panel being more sensitive to a particular odorant than the general population). The recognition threshold is generally about five times this concentration (5 OU_E/m^3) and the concentration at which the odour may be considered a nuisance is between 5 and 10 OU_E/m^3 based on hydrogen sulphide (H_2S) (Warren Spring Laboratory 1980). Clarkson and Misslebrook (C.R. Clarkson and T.H. Misselbrook 1991) proposed that a "faint odour" was an acceptable threshold criterion for the assessment of odour as a nuisance. Historically, it has been generally accepted that odour concentrations of between 5 and 10 OU_E/m^3 would give rise to a faint odour only, and that only a distinct odour (concentration of >10 OU_E/m^3) could give rise to a nuisance (J.E. McGovern & C.R. Clarkson 1994). However, this criterion has generally been based on waste water treatment facilities where the source of the odour is generally hydrogen sulphide. In 1990, a survey of the populations surrounding 200 industrial odour sources in the Netherlands showed that there were no justifiable complaints when 98%ile compliance with an odour exposure standard of a "faint odour" (5-10 OU_E/m^3) was achieved (CH2M Beca Ltd 2000).

The odour which will be generated within the Facility may consist of the current municipal solid waste landfill, biostabilised waste (pretreated by the Compost Facility) which will be landfilled in the Non-Hazardous Landfill, hazardous waste, the permitted MBT and composting. As detailed further in the discussion on Odour in this chapter, odour will continue to be generated from the capped phases of the MSW landfill, although at a lower emission rate than when the MSW landfill is being actively landfilled. As noted in Section 11.2.1.3 of this Chapter, it is predicted that the C&D waste and IBA will have negligible odour emissions.

In the case of the consented MBT plant, untreated odours are unlikely to be significant, as the waste reception area, Mechanical Treatment Building, Biological Treatment Buildings, SRF Building, Maturation Buildings and Refining and ABP Hygienisation Building will all be under negative pressure, with ducted air directed to biofilters. Biofilter media are solid porous material which react with the odorous material through biological oxidation leading to usually much less odorous compounds. In general, biofilters typically have a distinct residual odour which will not be far below 100-300 OU_E/m^3 (CH2M Beca Ltd 2000, EPA & OdourNet UK 2000). However, this residual odour will in most cases resemble the odour of the soil, which is an earthy odour generally not recognised as annoying, as its character resembles that of odours naturally emitted from soil (CH2M Beca Ltd 2000).

DEFRA (Environment Agency 2002, 2003) in the UK has published detailed guidance on appropriate odour threshold levels based in part on the offensiveness of the odour. As shown in Table 11-1:

Ranking Table For Various Industrial Sources (Environment Agency 2002)), a landfill facility is included in the list with a UK ranking of 20. Green waste composting is also included and is similarly ranked with moderately odorous industries such as fish smoking and sugar production. Composting of MSW is not included in the list although the untreated odour generated could be considered similar, at various stages of the process, to other waste treatment facilities such as landfills or wastewater treatment facilities.

DEFRA has also detailed installation-specific exposure criteria based on the "annoyance potential" (Environmental Agency 2002) which is defined as "the likelihood that a specific odorous mixture will give reasonable cause for annoyance in an exposed population". Industrial sources have been ranked into three categories based on their relative offensiveness which are "low", "medium" and "high" and exposure criteria assigned to each category, as shown in Table 11-2: Indicative Odour Standards Based On Offensiveness Of Odour (Environment Agency 2002)). The relevant exposure criteria vary from 1.5 OU_E/m^3 for highly odorous sources to 6.0 OU_E/m^3 for the least offensive odours. The relevant exposure criteria for green waste composting is 3.0 OU_E/m^3 which should be expressed as a 98th%ile and based on one hour means over a one-year period in the absence of any local factors.

Until 2028, it is anticipated that approximately 45,500 TPA of bio-stabilised waste from the Composting Facility may be deposited in the Non-Hazardous Landfill; post 2028 approximately 63,000 TPA of bio-stabilised waste will be deposited from the Composting Facility. It is noted that the odour model cumulatively considers the bio-stabilised waste outputs from the Proposed development and from the consented MBT. Given that the bio-stabilised waste odour is similar to an earthly / soil-like odour and thus of a medium offensiveness, it may be assumed that 3.0 OU_E/m^3 expressed as a 98th%ile and based on one hour means over a one-year period is the relevant exposure.

It is anticipated that until 2028, approximately 204,500 TPA of both incinerator bottom ash and C&D waste, including soil and stone, will be deposited in the Non-Hazardous Landfill, both of which will have minimal odour, after which time that tonnage will decrease to accommodate the bio-stabilised waste outputs at the site. Post 2028, the odour model accounts for the worst case scenario of the Non-Hazardous Landfill taking approximately 63,000 TPA of bio-stabilised waste from the Composting Facility and the bio-stabilised waste outputs from the consented MBT, noting that the odour emission rate has been considered within the model using a conservative value and that the emission area (the area of the Non-Hazardous Landfill) does not increase.

Table 11-1: Ranking Table For Various Industrial Sources (Environment Agency 2002)

Environmental Odour Industrial Source	Ranking UK Median	Ranking UK Mean	Ranking Dutch Mean
Bread Factory	1	2.5	1.7
Coffee Roaster	2	3.9	4.6
Chocolate Factory	3	4.6	5.1
Beer Brewery	6	7.7	8.1
Fragrance & Flavour Factory	8	8.5	9.8
Charcoal Production	8	9.2	9.4
Green Fraction composting	**9**	**10.3**	**14**
Fish smoking	9	10.5	9.8
Frozen Chips production	10	11	9.6
Sugar Factory	11	11.3	9.8
Car Paint Shop	12	11.7	9.8
Livestock odours	12	12.6	12.8
Asphalt	13	12.7	11.2
Livestock Feed Factory	15	14.2	13.2
Oil Refinery	14	14.3	13.2
Car Park Bldg	15	14.4	8.3
Wastewater Treatment	17	16.1	12.9
Fat & Grease Processing	18	17.3	15.7
Creamery/milk products	10	17.7	-
Pet Food Manufacture	19	17.7	-
Brickworks (burning rubber)	18	17.8	-
Slaughter House	19	18.3	17.0
Landfill	20	18.5	14.1

Table 11-2: Indicative Odour Standards Based On Offensiveness Of Odour (Environment Agency 2002)

Industrial Sectors	Relative Offensiveness of Odour	Indicative Criterion
Rendering Fish Processing Oil Refining Creamery WWTP Fat & Grease Processing	High	1.5 OU_E/m^3 as a 98th%ile of hourly averages at the worst-case sensitive receptor
Intensive Livestock Rearing Food Processing (Fat Frying) Paint-spraying Operations Asphalt Manufacture	Medium	3.0 OU_E/m^3 as a 98th%ile of hourly averages at the worst-case sensitive receptor
Brewery Coffee Roasting Bakery Chocolate Manufacturing Fragrance & Flavouring	Low	6.0 OU_E/m^3 as a 98th%ile of hourly averages at the worst-case sensitive receptor

11.2.1.3 Process Emissions with Potential Odour

The Drehid Waste Management Facility is currently licensed by the EPA (IED Licence number W0201-03), including the operation of a gas utilisation plant and 3 flares. There are not significant odour emissions from either of these processes.

The MBT has a separate licence W0283-01. This facility has not yet been constructed but has planning permission. The associated EIS detailed the potential process contributions with respect to the MBT facility (ABP Ref No. PL09 PA0027). Figures supplied in the MBT EIS have been used in the prediction of odour in this current assessment. Odour sources from the MBT consist of three biofilters as shown in Table 11-4: Drehid Facility, County Kildare. Composting, Leachate, Solidification and Biofilter Odour Emission Source Details).

As well as the existing permission for the disposal of municipal solid waste which has a predicted lifespan to 2028, it is proposed to provide capacity for the sustainable landfilling of 250,000 TPA of non-hazardous wastes including incinerator bottom ash (IBA), stabilised waste arising from the biological treatment of the biodegradable fraction of municipal waste, and construction and demolition (C&D) waste including the fine fraction, soil and stone.

It is predicted that roughly up to 45% of the 250,000 TPA of non-hazardous wastes will be the biostabilised waste which is pre-treated by the Composting and the MBT Facility. Due to the bio stabilisation process this waste has a lower odour emission rate than the municipal solid waste accepted in the currently active landfill. It is predicted that the C&D waste and IBA will have negligible odour emissions. It is envisaged that the Non-Hazardous Landfill will operate for a period of 25 years. The landfill will be divided into 12 phases of approximate equal volume.

Ireland currently has no dedicated hazardous waste landfill disposal facility. It is envisaged that the Hazardous Landfill will provide this and will operate for a period of 25 years. The landfill will be divided into 10 phases of approximate equal volume. Each phase will cater for approximately 2.5 years waste. Hazardous waste has significantly lower odour emissions than municipal solid waste or bio stabilised waste as show in Table 11-3: Drehid Facility, County Kildare. Landfill Odour Emission Source Details). Leachate generated from active phases of the Hazardous Landfill will be collected and transferred to a bunded storage tank where it will be used in the solidification process.

The Ash Solidification Facility provides pre-treatment to fly ash and flue gas treatment residues in advance of disposal in the Hazardous Landfill facility. Enclosed road tankers will deliver both the fly ash and flue gas treatment residues to the Ash Solidification Facility where it will drive into the building and the contents will be pumped into the storage silos. This system is fully enclosed and air is mechanically extracted via an odour control unit including a wet scrubber (see Table 11-4).

It is proposed to increase the volume of waste to be accepted at the existing Composting Facility by 20,000 TPA from the currently permitted 25,000 TPA. In addition, it is proposed to extend the existing facility to provide for the acceptance of an additional 45,000 TPA. The current Composting Facility has two biofilters which treat air prior to being vented from the building. There will be two additional biofilters on the extension to the Composting Facility with an increased volume flow compared to the existing two biofilters.

The facility also contains a Leachate Treatment Facility for the Non-Hazardous Landfill (and the existing MSW landfill) will be collected and treated onsite. The Leachate Treatment Facility has two uncovered tanks, a treated balancing tank and an anoxic/aeration tank, which are a source of odour (see Table 11-5: Drehid Facility, County Kildare. Leachate Treatment Facility Tanks Odour Emission Source Details). The Leachate Treatment Facility also contains a wet odour scrubber associated with the acid tank and the raw leachate balance tank.

Table 11-3: Drehid Facility, County Kildare. Landfill Odour Emission Source Details

Activity Type	Municipal Solid Waste (ou m^{-2} s^{-1}) Note 1	Emissions for Bio stabilised Waste (ou m^{-2} s^{-1}) Note 2	Emissions for Hazardous Waste (ou m^{-2} s^{-1})N 3
Capped	0.10	0.05	0.01
Temp cap	0.67	0.34	0.08
Interim Cap	1.69	0.85	0.21
Active	6.17	3.09	0.77

Note 1: Odour emission rates (ou m^{-2} s^{-1}) taken from the 2012 Drehid EIS.
Note 2: Due to the bio-stabilised nature of waste odour emissions are predicted to be 50% lower than raw MSW.
Note 3: Due to makeup of hazardous waste odour emissions to be are predicted to be 75% lower than bio-stabilised waste.

Table 11-4: Drehid Facility, County Kildare. Composting, Leachate, Solidification and Biofilter Odour Emission Source Details

Stack Reference	Stack Height	Exit Diameter (m)	Temp (K)	Exit Velocity (m/sec actual)	Odour Conc. (OU_E/Nm^3) Note 1	Odour Mass Emission (g/s)
Composting Facility existing facility x 2	15	1.0	283	27.5	600	12500
Composting Facility Extension x 2	15	1.2	283	28.7	600	18750
Leachate Treatment Facility	5	0.15	283	7.0	1000	120
Ash Solidification Facility	15	0.2	308	5.0	1000	140
MBT Biofilter 1	20	1.5	289	15.3	600	15594
MBT Biofilter 2	20	0.9	289	21.6	600	7960
MBT Biofilter 3	20	1.4	289	17.5	600	15628
Flare 1	8	2.3	1323	24.64	-	983
Flare 2	8	2.3	1338	21.23	-	983
Flare 3	10	1.5	1273	49.71	-	983

Note 1: Odour emission rates are based on upper limit of actual working detection for existing composting facility

Table 11-5: Drehid Facility, County Kildare. Leachate Treatment Facility Tanks Odour Emission Source Details

Emission Source Reference	Building Volume (m^3)	Area Of Release (m^2) (Rooftop)	Odour Emission Rate		
			Concentration (OU_E/m^3)	Mass Emission (OU_E/s)	Mass Emission ($OU_E\ m^{-2}\ s^{-1}$)
Balance Tank	716.30	105.68	1000	528	5
ATAD	173.06	109.36	1000	28	0.25

11.2.2 Air Quality Assessment

11.2.2.1 Air Quality Standards

The air quality standards are applicable to both the air quality dispersion model (with respect to NO_x and particulate matter) and the traffic model. Air Quality standards are set for the protection of human health.

In order to reduce the risk to health from poor air quality, National and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set, see Table 11-6: Air Quality Standards Regulations 2011 (based on EU Council Directive 2008/50/EC)).

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the *Air Quality Standards Regulations 2011*, which incorporate *European Commission Directive 2008/50/EC* which has set limit values for the pollutants SO_2, NO_2, PM_{10}, benzene and CO, see Table 11-6. *Council Directive 2008/50/EC* combines the previous *Air Quality Framework Directive (96/62/EC)* and its subsequent daughter directives (including *1999/30/EC* and *2000/69/EC*). Provisions were also made for the inclusion of new ambient limit values relating to $PM_{2.5}$ (see Appendix 11-4).

Table 11-6: Air Quality Standards Regulations 2011 (based on EU Council Directive 2008/50/EC)

Pollutant	*Regulation* Note 1	*Limit Type*	*Margin of Tolerance*	*Value*
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	None	200 µg/m^3 NO_2
		Annual limit for protection of human health	None	40 µg/m^3 NO_2
		Critical level for protection of vegetation	None	30 µg/m^3 NO + NO_2
Lead	2008/50/EC	Annual limit for protection of human health	100% Note 2	0.5 µg/m^3
Sulphur dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	150 µg/m^3	350 µg/m^3

Pollutant	***Regulation*** ***Note 1***	***Limit Type***	***Margin of Tolerance***	***Value***
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	None	125 µg/m³
		Critical level for protection of vegetation	None	20 µg/m³
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50%	50 µg/m³ PM_{10}
		Annual limit for protection of human health	20%	40 µg/m³ PM_{10}
$PM_{2.5}$ (Stage 1)	2008/50/EC	Annual limit for protection of human health	20% from June 2008. Decreasing linearly to 0% by 2015	25 µg/m³ $PM_{2.5}$
$PM_{2.5}$ (Stage 2)	-	Annual limit for protection of human health	None	20 µg/m³ $PM_{2.5}$
Benzene	2008/50/EC	Annual limit for protection of human health	100% until 2006 reducing linearly to 0% by 2010	5 µg/m³
Carbon Monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	60%	10 mg/m³ (8.6 ppm)

Note 1 EU 2008/50/EC – Clean Air For Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC

Note 2 EU 2008/50/EC states - ‘Stage 2 — indicative limit value to be reviewed by the Commission in 2013 in the light of further information on health and environmental effects, technical feasibility and experience of the target value in Member States’

11.2.2.2 Climate

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in 1997 (Framework Convention on Climate Change, 1999 and Framework Convention on Climate Change, 1997). For the purposes of the EU burden sharing agreement under Article 4 of the Kyoto Protocol, Ireland agreed to limit the net anthropogenic growth of the six Greenhouse Gases (GHGs) under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012 (ERM, 1998). The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties (COP22) to the agreement was convened in Marrakesh, Morrocco in December 2016. The previous conference in Paris, COP21, was an important milestone in terms of international climate change agreements. The “Paris Agreement”, agreed by over 200 nations, has a stated aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to greenhouse gas emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made on elevating adaption onto the same level as action to cut and curb emissions.

11.2.2.2.1 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. The initial objective of the Protocol was to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3). To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of 42 kt for SO_2 (67% below 2001 levels), 65 kt for NO_X (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt for NH_3 (6% reduction). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. In relation to Ireland, 2020 emission targets are 25 kt for SO_2 (65% on 2005 levels), 65 kt for NO_X (49% reduction on 2005 levels), 43 kt for VOCs (25% reduction on 2005 levels), 108 kt for NH_3 (1% reduction on 2005 levels) and 10 kt for $PM_{2.5}$ (18% reduction on 2005 levels).

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005 (DoEHLG, 2004). Data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO_2, VOCs and NH_3 but failed to comply with the ceiling for NO_X (EEA, 2011). COM (2013) 920 Final is the “Proposal for a Directive on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC”. The proposal will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020-29 emission targets are for SO_2 (65% below 2005 levels), for NO_X (49% reduction), for VOCs (25% reduction), for NH_3 (1% reduction) and for $PM_{2.5}$ (18% reduction). In relation to 2030, Ireland’s emission targets are for SO_2 (83% below 2005 levels), for NO_X (75% reduction), for VOCs (32% reduction), for NH_3 (7% reduction), for $PM_{2.5}$ (35% reduction) and for CH_4 (7% reduction).

11.2.2.3 Dispersion Modelling Methodology

Emissions from the site have been modelled using the AERMOD dispersion model (Version 16216r) which has been developed by the U.S Environmental Protection Agency (USEPA) and the American Meteorological Society (AMS). The model is recommended as an appropriate model for assessing the impact of air emissions from industrial facilities in the EPA Guidance document "*Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (2010)*".

The model is a "new-generation" steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources. The model is an enhancement of the Industrial Source Complex-Short Term 3 (ISCST3) model which has been widely used for emissions from industrial sources. Details of the model are given in Appendix 11-1. Fundamentally, the model has made significant advances in simulating the dispersion process in the boundary layer. This will lead to a more accurate reflection of real world processes and thus considerably enhance the reliability and accuracy of the model particularly under those scenarios which give rise to the highest ambient concentrations.

The United States Environmental Protection Agency (USEPA) approved AERMOD dispersion model has been used to predict the ground level odour concentrations (GLC) of compounds emitted from the principal emission sources on-site.

The modelling incorporated the following features:

- Two receptor grids were created at which concentrations would be modelled. Receptors were mapped with sufficient resolution to ensure all localised "hot-spots" were identified without adding unduly to processing time. The receptor grids were based on Cartesian grids with the site at the centre. An outer grid extended to 10,000 m^2 with the site at the centre and with concentrations calculated at 100 m intervals. A smaller denser grid extended to 4,500 m^2 from the site with concentrations calculated at 50 m intervals. Boundary receptor locations were also placed along the boundary of the site, at 25 m intervals, giving over 18,400 calculation points for the model as shown in Figure 11.2: AERMOD 2-Tier Receptor Grid.

- All on-site buildings and significant process structures were mapped into the computer to create a three dimensional visualisation of the site and its emission points. Buildings and process structures can influence the passage of airflow over the emission stacks and draw plumes down towards the ground (termed building downwash). The stacks themselves can influence airflow in the same way as buildings by causing low pressure regions behind them (termed stack tip downwash). Both building and stack tip downwash were incorporated into the modelling.

- Detailed terrain has been mapped into the model using SRTM data with 30 m resolution. The site is located in gentle terrain. This takes account of all significant features of the terrain. All terrain features have been mapped in detail into the model using the terrain pre-processor AERMAP (USEPA 2004b) as shown in Figure 11.3: Terrain in the Vicinity of Drehid Facility (UTM Coordinates).

- Hourly-sequenced meteorological information has been used in the model. Meteorological data over a five year period (Casement Aerodrome, 2012 – 2016) was used in the model (see Figure 11.4: Casement Aerodrome Windrose 2012-2016).

- The source and emission data, including stack dimensions, gas volumes and emission temperatures have been incorporated into the model.

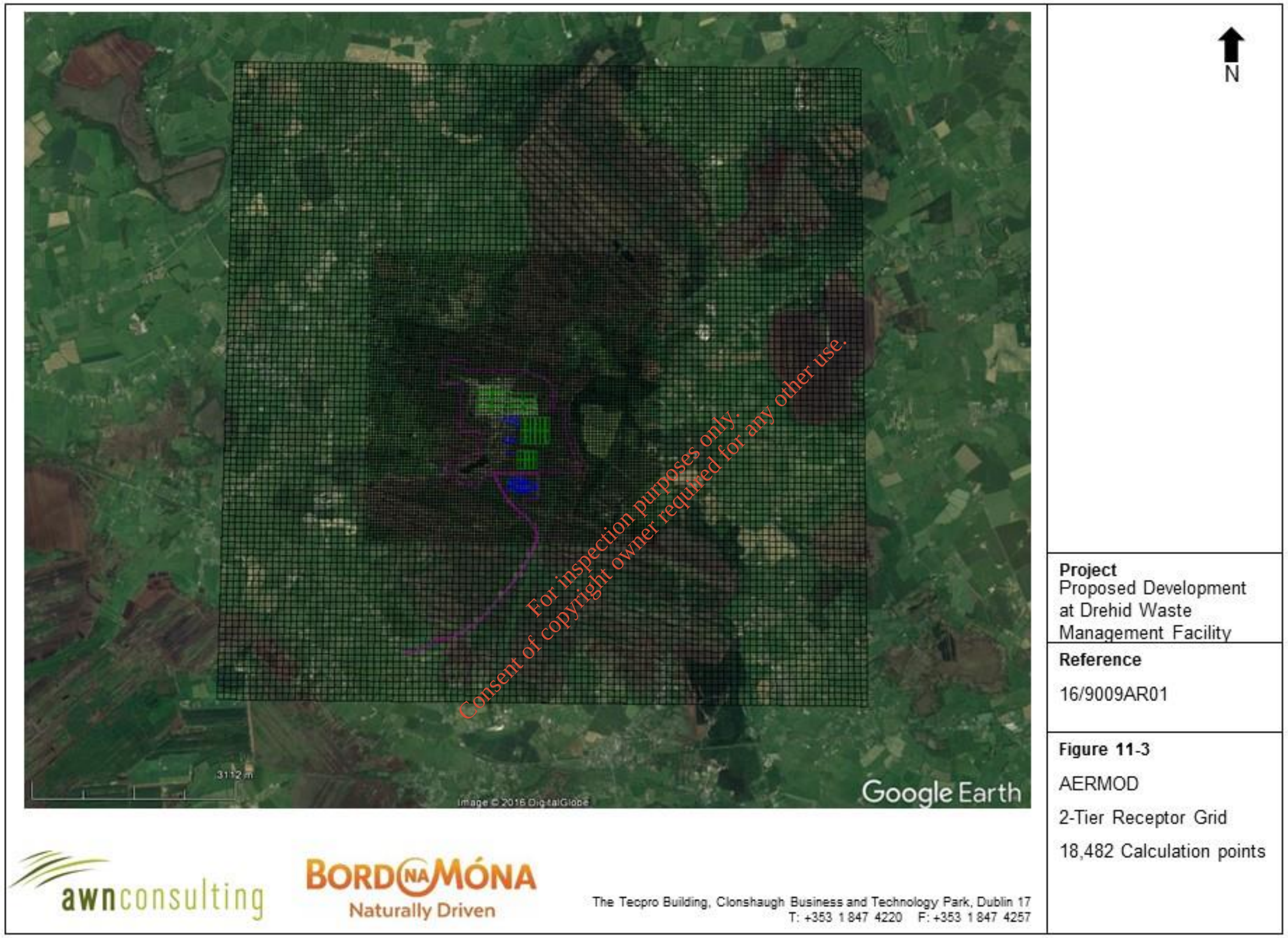


Figure 11.2: AERMOD 2-Tier Receptor Grid

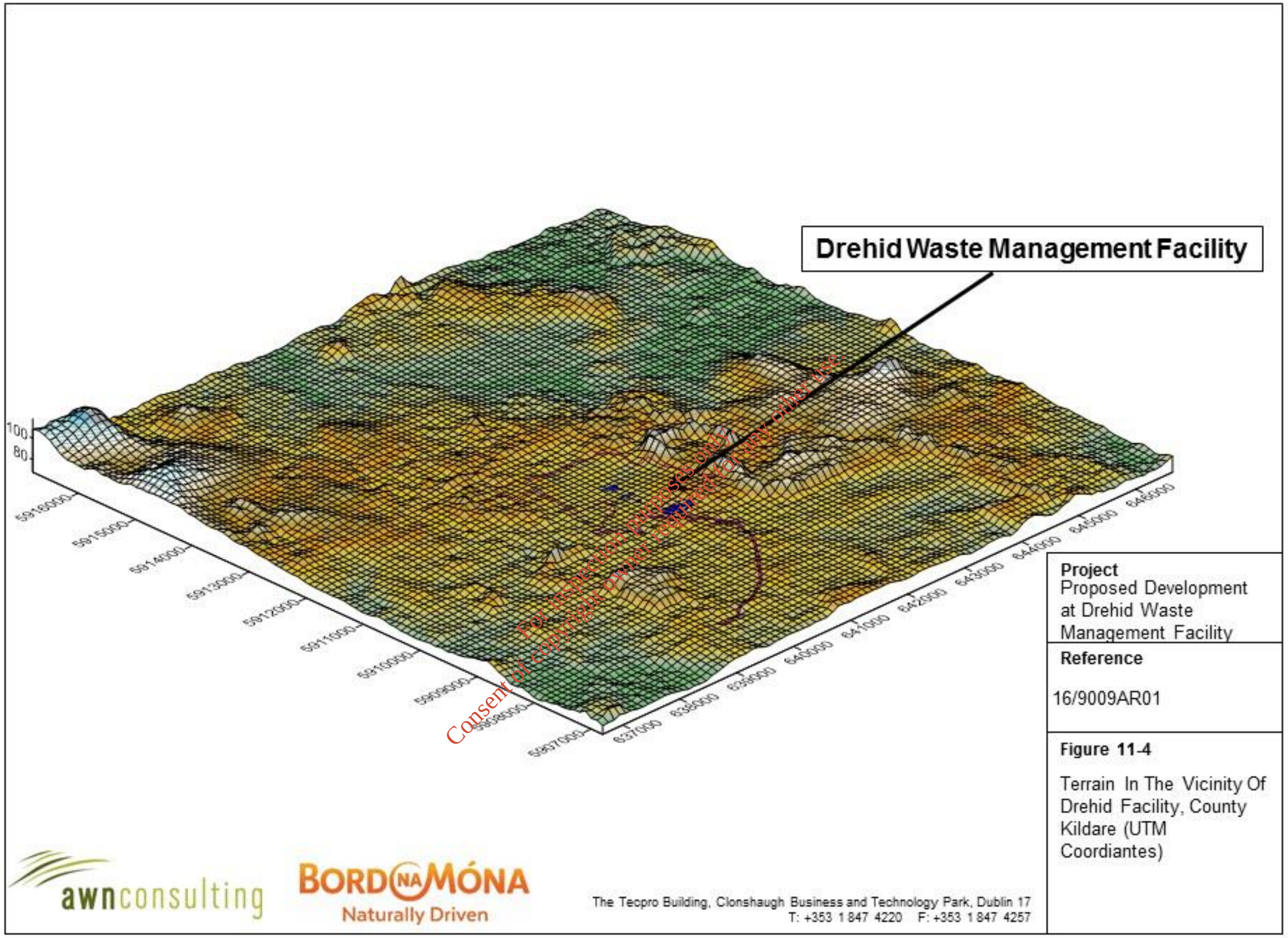


Figure 11.3: Terrain in the Vicinity of Drehid Facility (UTM Coordinates)

11.2.2.3.1 Terrain

The AERMOD air dispersion model has a terrain pre-processor AERMAP (USEPA 2004b) which was used to map the physical environment in detail over the receptor grid. The digital terrain input data used in the AERMAP pre-processor was obtained from SRTM. This data was run to obtain for each receptor point the terrain height and the terrain height scale. The terrain height scale is used in AERMOD to calculate the critical dividing streamline height, H_{crit}, for each receptor. The terrain height scale is derived from the Digital Elevation Model (DEM) files in AERMAP by computing the relief height of the DEM point relative to the height of the receptor and determining the slope. If the slope is less than 10%, the program goes to the next DEM point. If the slope is 10% or greater, the controlling hill height is updated if it is higher than the stored hill height.

In areas of complex terrain, AERMOD models the impact of terrain using the concept of the dividing streamline (H_c). As outlined in the AERMOD model formulation (USEPA 2004a) a plume embedded in the flow below H_c tends to remain horizontal; it might go around the hill or impact on it. A plume above H_c will ride over the hill. Associated with this is a tendency for the plume to be depressed toward the terrain surface, for the flow to speed up, and for vertical turbulent intensities to increase.

AERMOD model formulation states that the model “captures the effect of flow above and below the dividing streamline by weighting the plume concentration associated with two possible extreme states of the boundary layer (horizontal plume and terrain-following). The relative weighting of the two states depends on the following; 1) the degree of atmospheric stability; 2) the wind speed; and 3) the plume height relative to terrain. In stable conditions, the horizontal plume "dominates" and is given greater weight while in neutral and unstable conditions, the plume travelling over the terrain is more heavily weighted (USEPA 2004a). The terrain in the region of the facility is reasonably flat however, in general, as shown in Figure 11.3.

11.2.2.3.2 Geophysical Considerations

AERMOD simulates the dispersion process using planetary boundary layer (PBL) scaling theory (USEPA 2004a). PBL depth and the dispersion of pollutants within this layer are influenced by specific surface characteristics such as surface roughness, albedo and the availability of surface moisture. Surface roughness is a measure of the aerodynamic roughness of the surface and is related to the height of the roughness element. Albedo is a measure of the reflectivity of the surface whilst the Bowen ratio is a measure of the availability of surface moisture.

AERMOD incorporates a meteorological pre-processor AERMET PRO (USEPA 2004c) to enable the calculation of the appropriate parameters. The AERMET PRO meteorological pre-processor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10 km from the meteorological station for Bowen Ratio and albedo and to a distance of 1 km for surface roughness in line with USEPA recommendations (USEPA 2004c, 2008) as outlined in Appendix 11-2.

In relation to AERMOD, detailed guidance has been published (Alaska Department of Environmental Conservation 2008) for calculating the relevant surface parameters. The most pertinent features are the following;

- The surface characteristics should be those of the meteorological site (Casement Airport) rather than the installation;
- Surface roughness should use a default 1 km radius upwind of the meteorological tower and should be based on an inverse-distance weighted geometric mean. If land use varies around the site, the land use should be sub-divided by sectors with a minimum sector size of 30º; and
- Bowen ratio and albedo should be based on a 10 km grid. The Bowen ratio should be based on an un-weighted geometric mean. The albedo should be based on a simple un-weighted arithmetic mean.

AERMOD has an associated pre-processor, AERSURFACE (USEPA 2008), which has representative values for these parameters depending on land use type. The AERSURFACE pre-processor currently only accepts NLCD92 land use data which covers the USA. Thus, manual input of surface parameters is necessary when modelling in Ireland. Ordnance survey discovery maps (1:50,000) and digital maps such as those provided by the EPA, National Parks and Wildlife Service (NPWS) and Google Earth® are useful in determining the relevant land use in the region of the meteorological station. The Alaska Department of Environmental Conservation has issued a guidance note for the manual calculation of geometric mean for surface roughness and Bowen ratio for use in AERMET (Alaska Department of Environmental Conservation 2008). This approach has been applied to the current site with full details provided in Appendix 11-2.

11.2.2.3.3 Building Downwash

When modelling emissions from an industrial installation, stacks which are relatively short can be subjected to additional turbulence due to the presence of nearby buildings. Buildings are considered nearby if they are within five times the lesser of the building height or maximum projected building width (but not greater than 800 m).

The USEPA has defined the “Good Engineering Practice” (GEP) stack height as the building height plus 1.5 times the lesser of the building height or maximum projected building width. It is generally considered unlikely that building downwash will occur when stacks are at or greater than GEP (USEPA 1985).

When stacks are less than this height, building downwash will tend to occur. As the wind approaches a building it is forced upwards and around the building leading to the formation of turbulent eddies. In the lee of the building these eddies will lead to downward mixing (reduced plume centreline and reduced plume rise) and the creation of a cavity zone (near wake) where re-circulation of the air can occur. Plumes released from short stacks may be entrained in this airflow leading to higher ground level concentrations than in the absence of the building.

The Plume Rise Model Enhancements (PRIME) (Paine, R & Lew, F. 2010, Schulman, L.L et al 2000) plume rise and building downwash algorithms, calculate the impact of buildings on plume rise and dispersion, and have been incorporated into AERMOD. The building input processor BPIP-PRIME produces the parameters which are required in order to run PRIME. The model takes into account the position of each stack relative to each relevant building and the projected shape of each building for 36 wind directions (at 10º intervals). The model determines the change in plume centreline location with downwind distance based on the slope of the mean streamlines and coupled to a numerical plume rise model (Paine, R & Lew, F. 2010).

Given that most stacks onsite are less than 2.5 times the lesser of the building height or maximum projected building width, building downwash will need to be taken into account and the PRIME algorithm run prior to modelling with AERMOD. The dominant building may change as the wind direction changes for each of the 36 wind directions. The dominant building for each relevant stack will vary as a function of wind direction and relative building heights.

11.2.2.3.4 <u>Construction Phase Dust</u>

Traffic impacts due to the construction phase are not predicted to reach threshold values set out in guidance to cause air quality impacts at receptors and therefore no traffic modelling was carried out for the construction phase. The greatest potential effect on air quality during the construction phase of the proposed development is from construction dust emissions and the potential for nuisance dust and $PM_{10}/PM_{2.5}$ emissions. While construction dust tends to be deposited within 200 m of a construction site, the majority of the deposition occurs within the first 50 m. The large site and long entrance drive ensure that there are no sensitive residential receptors within 200 m of the construction area.

11.2.2.3.5 <u>Air Quality Process Emissions</u>

The Drehid Facility is currently licensed (IED Licence numbers W0201-03) including the operation of a gas utilisation plant and flares. The site has three flares which are assumed to run continuously, two of which are associated with the gas utilisation plant. Flare monitoring reports from 2015 and 2016 indicate that the flares are below the licensed limit under W0201-03, which sets a limit value for NO_x of 150 mg/m^3. The flares have been modelled as being in continuous operation as a worst case scenario; however this is unlikely to be the case.

On site there is also the capture and utilisation of the landfill gas for the generation of electricity for supply to the national grid. As part of the utilisation plant there are four gas engines. These engines are licensed to discharge NO_x and particulates under W0201-03, see Table 11-7: Drehid Facility, County Kildare. Landfill NOx and PM10 Emission Source Details) for details.

The Drehid MBT Facility and its two associated CHP's (enclosed within one stack) are currently licensed but not built. These have been included in the assessment to ensure no cumulative effect in future should the MBT be constructed.

The IBA Metals Recovery Facility has mechanical ventilation designed to prevent the build-up of dust in the building. This extracts air and filters it. There will be an estimated 65,000 m^3/hr drawn through the filtration system as detailed in Table 11-10.

Table 11-7: Drehid Facility, County Kildare. Landfill NO_x and PM_{10} Emission Source Details

Emission Source Reference	Exit Diameter (m)	Temp (K)	Max Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual, wet)	NO_2		PM_{10}	
					Concentration (mg/Nm^3)	Mass Emission (g/s)	Concentration (mg/Nm^3)	Mass Emission (g/s)
CHP1	0.5	700	3113	12.7	500	0.43	50	0.04
CHP2	0.5	700	3113	12.7	500	0.43	50	0.04
Gas Utilisation Plant 1	0.4	733	3,497	28.14	500	0.49	130	0.13
Gas Utilisation Plant 2	0.4	744	3,388	27.0	500	0.47	130	0.12
Gas Utilisation Plant 3	0.4	738	3,563	28.11	500	0.49	130	0.13
Gas Utilisation Plant 4	0.4	746	3,523	28.27	500	0.49	130	0.13
Particulate filter IBA Metals Recovery Facility	1.1	283	65,000	26.65	N/A	N/A	50	0.90
Flare 1	2.3	1323	36,350	24.64	150	1.51	N/A	N/A
Flare 2	2.3	1338	36,350	21.23	150	1.51	N/A	N/A
Flare 3	1.5	1273	29,080	49.71	150	1.21	N/A	N/A

11.2.2.4 Traffic Assessment

The air quality assessment was carried out following procedures described in the publications by the EPA (EPA 2015 and TII 2011) and using the methodology outlined in the policy and technical guidance notes, LAQM.PG(16) and LAQM.TG(16), issued by UK DEFRA (Department for Environment, Food and Rural Affairs) (UK DEFRA 2001, 2009a, 2009b; UK DETR 1998, UK Highways Agency 2007). The assessment of air quality is carried out using a phased approach as recommended by the UK DEFRA (UK DEFRA 2016). The phased approach recommends that the complexity of an air quality assessment be consistent with the risk of failing to achieve the air quality standards. In the current assessment, an initial scoping of key pollutants was carried out at sensitive receptors. These sensitive receptors have the potential to have an effect on the concentration of key pollutants due to the Proposed development.

An examination of recent EPA and Local Authority data in Ireland (EPA 2016, 2017), has indicated that SO_2 and CO are unlikely to be exceeded at locations such as the current one and thus these pollutants do not require detailed monitoring or assessment to be carried out. However, the analysis did indicate potential problems in regards to nitrogen dioxide (NO_2) and PM_{10} at busy junctions in urban centres (EPA 2016, 2017). Benzene, although previously reported at quite high levels in urban centres (EPA 2016, 2017), has recently been measured at several city centre locations to be well below the EU limit value (EPA 2016, 2017). Historically, CO levels in urban areas were a cause for concern. However, CO concentrations have decreased significantly over the past number of years and are now measured to be well below the limits even in urban centres (EPA 2016, 2017). The key pollutants reviewed in the assessment are NO_2, PM_{10}, $PM_{2.5}$, benzene and CO, with particular focus on NO_2 and PM_{10}.

Key pollutant concentrations have been predicted for nearby sensitive receptors for the following five scenarios:

- The Existing scenario (2016), for model verification;
- Opening Year Do-Nothing scenario (DN), which assumes the retention of present site usage with no development in place (2019);
- Opening Year Do-Something scenario (DS), which assumes the Proposed development in place (2019);
- Design Year Do-Nothing scenario (DN), which assumes the Proposed development in place (2024); and
- Design Year of the Do-Something scenario (DS), which assumes the Proposed development plus all other current planning permission for the site are in place (2024).

The assessment methodology involved air dispersion modelling using the UK DMRB Screening Model (UK Highways Agency 2007) (Version 1.03c, July 2007), the NO_x to NO_2 Conversion Spreadsheet (UK

DEFRA, 2016) (Version 5.1), and following guidance issued by the TII (TII 2011), UK Highways Agency (UK Highways Agency 2007), UK DEFRA (UK DEFRA 2016a) and the EPA (EPA 2016, 2017).

The TII guidance (TII, 2011) states that the assessment must progress to detailed modelling if:

- Concentrations exceed 90% of the air quality limit values when assessed by the screening method; or
- Sensitive receptors exist within 50 m of a complex road layout (e.g. grade separated junctions, hills etc).

The UK DMRB guidance (UK Highways Agency 2007), on which the TII guidance was based, states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment:

- Road alignment change of 5 metres or more;
- Daily traffic flow changes by 1,000 AADT or more;
- HDV flows change by 200 vehicles per day or more;
- Daily average speed changes by 10 km/h or more; or
- Peak hour speed changes by 20 km/h or more.

Concentrations of key pollutants were calculated at sensitive receptors which have the potential to be affected by the Proposed development. For road links which are deemed to be affected by the Proposed development and within 200 m of the chosen sensitive receptors inputs to the air dispersion model consist of; road layouts, receptor locations, annual average daily traffic movements (AADT), percentage heavy goods vehicles, annual average traffic speeds and background concentrations. The UK DMRB guidance states that road links at a distance of greater than 200 m from a sensitive receptor will not influence pollutant concentrations at the receptor.

Using this input data the model predicts the road traffic contribution to ambient ground level concentrations at the worst-case sensitive receptors using generic meteorological data. The DMRB model uses conservative emission factors, the formulae for which are outlined in the DMRB Volume 11 Section 3 Part 1 – HA 207/07 Annexes B3 and B4. These worst-case road contributions are then added to the existing background concentrations to give the worst-case predicted ambient concentrations. The worst-case ambient concentrations are then compared with the relevant ambient air quality standards to assess the compliance of the Proposed development with these ambient air quality standards.

The TII *Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes* (TII 2011) detail a methodology for determining air quality impact significance criteria for road schemes. The degree of effect is determined based on both the absolute and relative effect of the Proposed development. The TII significance criteria have been adopted for the Proposed development and are detailed in Table 11-8: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations to Table 11-10: Air Quality Impact Significance Criteria for PM10. The significance criteria are based on PM_{10} and NO_2 as these pollutants are most likely to exceed the annual mean limit values (40 µg/m³). However, the criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment.

Table 11-8: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude of Change	Annual Mean NO_2 / PM_{10}	No. days with PM_{10} concentration > 50 µg/m³	Annual Mean $PM_{2.5}$
Large	Increase / decrease ≥4 µg/m³	Increase / decrease >4 days	Increase / decrease ≥2.5 µg/m³
Medium	Increase / decrease 2 - <4 µg/m³	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 µg/m³
Small	Increase / decrease 0.4 - <2 µg/m³	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 µg/m³
Imperceptible	Increase / decrease <0.4 µg/m³	Increase / decrease <1 day	Increase / decrease <0.25 µg/m³

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes - Transport Infrastructure Ireland (2011)

Table 11-9: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration		
	Small	Moderate	Large
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m³ of NO_2 or PM_{10}) (≥25 µg/m³ of $PM_{2.5}$)	Slight adverse	Moderate adverse	Substantial adverse
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m³ of NO_2 or PM_{10}) (22.5 - <25 µg/m³ of $PM_{2.5}$)	Slight adverse	Moderate adverse	Moderate adverse
Below Objective/Limit Value With Scheme (30 - <36 µg/m³ of NO_2 or PM_{10}) (18.75 - <22.5 µg/m³ of $PM_{2.5}$)	Negligible	Slight adverse	Slight adverse
Well Below Objective/Limit Value With Scheme (<30 µg/m³ of NO_2 or PM_{10}) (<18.75 µg/m³ of $PM_{2.5}$)	Negligible	Negligible	Slight adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m³ of NO_2 or PM_{10})	Slight beneficial	Moderate beneficial	Substantial beneficial

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration		
	Small	Moderate	Large
(≥25 µg/m³ of $PM_{2.5}$)			
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m³ of NO_2 or PM_{10}) (22.5 - <25 µg/m³ of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Moderate beneficial
Below Objective/Limit Value With Scheme (30 - <36 µg/m³ of NO_2 or PM_{10}) (18.75 - <22.5 µg/m³ of $PM_{2.5}$)	Negligible	Slight beneficial	Slight beneficial
Well Below Objective/Limit Value With Scheme (<30 µg/m³ of NO_2 or PM_{10}) (<18.75 µg/m³ of $PM_{2.5}$)	Negligible	Negligible	Slight beneficial

Note 1 Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible
Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes - Transport Infrastructure Ireland (2011)

Table 11-10: Air Quality Impact Significance Criteria for PM_{10}

Absolute Concentration in Relation to Objective / Limit Value (PM_{10})	Change in Concentration		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

Note 1 Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible
Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes - Transport Infrastructure Ireland (2011)

11.2.2.4.1 Conversion of NOx to NO_2

NO_x (NO + NO_2) is emitted by vehicles exhausts. The majority of emissions are in the form of NO, however, with greater diesel vehicles and some regenerative particle traps on HGV's the proportion of NO_x emitted as NO_2, rather than NO is increasing. With the correct conditions (presence of sunlight and O_3) emissions in the form of NO, have the potential to be converted to NO_2.

Transport Infrastructure Ireland states the recommended method for the conversion of NO_x to NO_2 in *"Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes"* (TII, 2011). The TII guidelines recommend the use of DEFRAs NO_x to NO_2 calculator (UK DEFRA, 2016c) which was originally published in 2009 and is currently on version 5.1. This calculator (which can be downloaded in the form of an excel spreadsheet) accounts for the predicted availability of O_3 and proportion of NO_x emitted as NO for each local authority across the UK. O_3 is a regional pollutant and therefore concentrations do not vary in the same way as concentrations of NO_2 or PM_{10}.

The calculator includes Local Authorities in Northern Ireland and the TII guidance recommends the use of Craigavon as the choice of local authority when using the calculator. The choice of *"Armagh, Banbridge and Craigavon*" provides the most suitable relationship between NO_2 and NO_x for Ireland. The "All other Non-Urban UK Traffic" traffic mix option was used.

11.2.2.4.2 Ecological Sites

For routes which pass within 2 km of a designated area of conservation (either Irish or European designation) the TII requires consultation with an Ecologist (TII, 2011). However, in practice the potential to effect an ecological site is highest within 200 m of the proposed scheme and when significant changes in AADT (>5%) occur.

TII's Guidelines for Assessment of Ecological Impacts of National Road Schemes (Rev. 2, Transport Infrastructure Ireland 2009) and Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities (Department of the Environment, Heritage and Local Government 2010) provide details regarding the legal protection of designated conservation areas.

If the two following assessment criteria are met an assessment of the potential for effect due to nitrogen deposition should be assessed; a designated area of conservation within 200 m of the Proposed development and a significant change in AADT flows. There are no designated areas of conservation within 200 m from the site.

11.2.2.4.3 Trends In Air Quality

Air quality is variable and subject to both significant spatial and temporal variation. In relation to spatial variations in air quality, concentrations generally fall significantly with distance from major road sources

(UK Highways Agency 2007). Thus, residential exposure is determined by the location of sensitive receptors relative to major roads sources in the area. Temporally, air quality can vary significantly by orders of magnitude due to changes in traffic volumes, meteorological conditions and wind direction.

In 2011 the UK DEFRA published research (UK DEFRA 2011) on the long term trends in NO_2 and NO_x for roadside monitoring sites in the UK. This study found a marked decrease in NO_2 concentrations between 1996 and 2002, after which the concentrations stabilised with little reduction between 2004 and 2010. The result of this study is that there now exists a gap between projected NO_2 concentrations which UK DEFRA previously published and monitored concentrations. The effect of this ‘gap’ is that the DMRB screening model can under-predict NO_2 concentrations for predicted for future years. Subsequently, the UK Highways Agency (HA) published an Interim advice note (IAN 170/12) in order to correct the DMRB results for future years.

11.2.2.4.4 Traffic Model Inputs

The receptors modelled represented the worst-case locations close to the Proposed development and were chosen due to their close proximity (within 200 m) to the road links impacted by the Proposed development. The traffic data used in this assessment is shown in Table 11-11: Traffic data used in this Assessment), with the percentage of HGV shown in parenthesis below the annual average daily traffic (AADT). Sensitive receptors in the vicinity of the Proposed development are predominately residential. Six sensitive receptors have been chosen as they have the potential to be adversely effected by the Proposed development; these receptors are shown in Table 11-12: Description of Sensitive Receptors (UTM Co-ordinates)).

Table 11-11: Traffic data used in this Assessment

Link Number	Road Link	Base Year	Do-Nothing		Do-Something		Speed (kph)
		2016	2019	2024	2019	2024	
1	ATC1	5816 (7.2%)	5993 (7.5%)	6300 (7.9%)	7002 (10.3%)	6631 (11.6%)	80
2	ATC3	6095 (4.9%)	6286 (5.1%)	6617 (5.4%)	7295 (8.1%)	6948 (9.1%)	80
3	Site Entrance (S)	5169 (9.5%)	5313 (15.1%)	5558 (16.1%)	6322 (17%)	5889 (19.9%)	30
4	ATC4	4973 (10.5%)	5119 (10.9%)	5369 (11.6%)	6128 (13.5%)	5700 (15.7%)	80
5	ATC9	8075 (6.4%)	8323 (6.6%)	8754 (7%)	9332 (8.8%)	9085 (9.8%)	80
6	ATC10	12640 (4.1%)	13039 (4.2%)	13734 (4.5%)	14048 (5.9%)	14065 (6.3%)	80
7	ATC13	12293 (3.7%)	12683 (3.8%)	13362 (4.1%)	13692 (5.5%)	13693 (6%)	80

Table 11-12: Description of Sensitive Receptors (UTM Co-ordinates)

Name	Receptor Type	X	Y
R1	Residential	639847	5907097
R2	Residential	639421	5907576
R3	Residential	655370	5904740
R4	Residential	651089	5906824
R5	Residential	636180	5914183
R6	Residential	655963	5909148

11.3 RECEIVING ENVIRONMENT/BASELINE DESCRIPTION

11.3.1 Air Quality

11.3.1.1 Meteorological Data

The selection of the appropriate meteorological data has followed the guidance issued by the USEPA (USEPA 2005). A primary requirement is that the data used should have a data capture of greater than 90% for all parameters.

A key factor in assessing temporal and spatial variations in the air quality assessment is the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (e.g. traffic levels) (WHO 2006).

Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles ($PM_{2.5}$ - PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

Casement Aerodrome meteorological station, which is located approximately 30 km east of the site, collects data in the correct format and has data capture collection of greater than 90% for the required parameters. Long-term hourly observations at Casement Aerodrome meteorological station provide an indication of the prevailing wind conditions for the region (see Figure 11.4: Casement Aerodrome Windrose 2012-2016). Results indicate that the prevailing wind direction is from a southerly to westerly in direction over the period 2012 - 2016. The mean wind speed is approximately 5.5 m/s over the period 1981-2010.

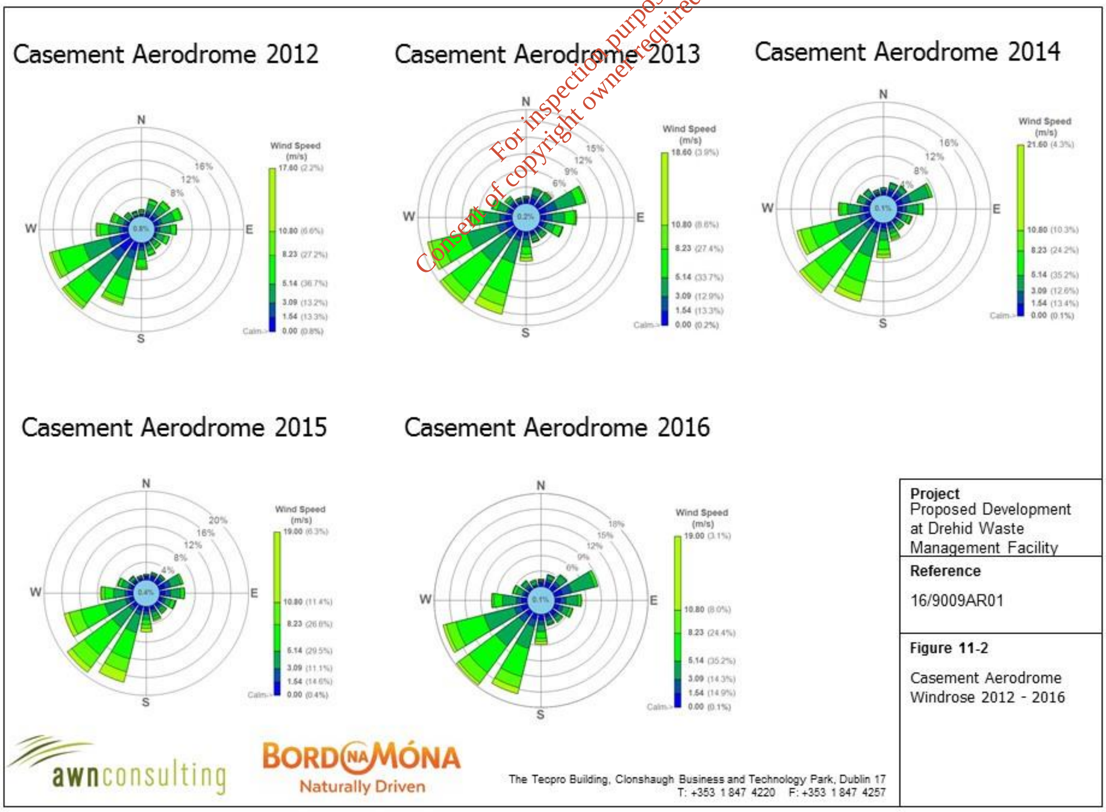


Figure 11.4: Casement Aerodrome Windrose 2012-2016

11.3.1.1 Background Concentrations of Pollutants

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities (EPA 2016, 2017). The most recent annual report on air quality "Air Quality Monitoring Annual Report 2015" (EPA 2016), details the range and scope of monitoring undertaken throughout Ireland. As part of the implementation of the Framework Directive on Air Quality (1996/62/EC), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA 2017). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D. In terms of air monitoring, the area of the facility is categorised as Zone D (EPA 2017).

NO_2 monitoring was carried out at two rural Zone D locations in 2015, Emo and Kilkitt and in two urban areas, Enniscorthy and Castlebar (EPA 2016). The NO_2 annual average in 2015 for both rural sites was 2.5 µg/m^3 with the results for urban stations averaging 8.5 µg/m^3. Hence long-term average concentrations measured at all locations were significantly lower than the annual average limit value of 40 µg/m^3. The average results over the last five years at a range of urban Zone D locations suggests an upper average of no more than 11 µg/m^3 as a background concentration as shown in Table 11-13: Annual Mean NO2 Concentrations In Zone D Locations 2011 - 2015 (µg/m3)). Local diffusion tube monitoring results for NO_2 in November 2011 ranged from 5.5 – 12.9 µg/m^3. Given that background NO_2 concentrations have reduced in the past 6 years a conservative estimate of the background NO_2 concentration in the region of the facility is 11 µg/m^3.

Table 11-13: Annual Mean NO_2 Concentrations In Zone D Locations 2011 - 2015 (µg/m^3)

Year	Enniscorthy	Kilkitt	Emo	Castlebar
2011	-	3	-	8
2012	-	4	-	8
2013	-	4	4	11
2014	13	3	3	8
2015	9	2	3	8
Average	**11**	**3.2**	**3.3**	**8.6**

Long-term PM_{10} monitoring was carried out at the urban Zone D locations of Castlebar, Kilkitt, Enniscorthy and Claremorris in 2015 (EPA 2016). The maximum 24-hour concentration (as a 90th%ile) at each of the Zone D locations is shown in Table 11-14: 90th%ile of 24-Hour PM10 Concentrations In Zone D Locations 2012 - 2015 (µg/m3)). The long-term average of the 90th%ile of 24-hour concentration is 23.1 µg/m^3. The average annual mean concentration measured is 13.4 µg/m^3 (EPA 2016). The average results over the last five years at a range of Zone D locations suggests an upper average of 13.4 µg/m^3 as a background concentration as shown in Table 11-15: Annual Mean PM10 Concentrations In Zone D Locations 2011 - 2015 (µg/m3)). However data monitored on site by AWN between June – August 2016 shows that the actual concentrations are lower.

Table 11-14: 90th%ile of 24-Hour PM_{10} Concentrations In Zone D Locations 2012 - 2015 (µg/m^3)

Year	Claremorris	Kilkitt	Enniscorthy	Castlebar
2012	17.7	15.9	-	19.8
2013	21.0	18.6	-	26.9
2014	15.2	15.4	37.35	20.9
2015	16.4	18.0	33.8	22.1
Average	**17.6**	**17.0**	**35.6**	**22.4**

Table 11-15: Annual Mean PM_{10} Concentrations In Zone D Locations 2011 - 2015 (µg/m^3)

Year	Claremorris	Kilkitt	Enniscorthy	Castlebar
2011	12	9	-	14
2012	10	9	-	12
2013	13	11	-	15
2014	10	9	22	12
2015	10	9	18	13
Average	**11.0**	**9.4**	**20.0**	**13.2**

The results of $PM_{2.5}$ monitoring at Claremorris (Zone D) in 2015 (EPA 2016) indicated an average $PM_{2.5}/PM_{10}$ ratio of 0.6. Based on this information, a conservative ratio of 0.6 was used to generate a rural background $PM_{2.5}$ concentration of 8.0 µg/m^3.

A baseline monitoring study was carried on the current Drehid Landfill Site, close to the administration building from June to August 2016. The results of the survey allow a comparison with the annual limit values for PM_{10}, and the 24-hour limit value for PM_{10}. The results also provide information on the influence of road sources relative to the prevailing background level of these pollutants in the area. The baseline monitoring report is contained in Appendix 11.6.

The PM_{10} & $PM_{2.5}$ monitoring program was carried out by means of Turnkey Instruments® Osiris Environmental Dust Monitor at one location. The Osiris instrument is a light scattering device capable of continuous measurement of Total Suspended Particulate (TSP), PM_{10}, $PM_{2.5}$ and PM_1. The air sample was continuously drawn into the instrument by a pump through a heated inlet at a flow rate of 600 ml/min. The incoming air passed through a laser beam in a photometer. The light scattered by the individual particles of dust was measured by the photometer and this information used to measure the size and concentration of the dust particles.

The average PM_{10} concentration measured over the monitoring period is 8.6 µg/m^3 using the Osiris light scattering monitor. The average concentration is less than 22% of the EU annual limit value of 40 µg/m^3.

The average $PM_{2.5}$ concentration measured over the two month monitoring period is significantly below the annual EU limit value of 25 μg/m^3. The average $PM_{2.5}$ concentration measured over the one-month period is 3.0 μg/m^3 which is significantly below the annual average EU limit value of 25 μg/m^3.

CO concentrations for the representative rural Zone D monitoring stations are between 2011 and 2015 on average 2.4 mg/m^3 for the 8 hour value. This is significantly below the 10 mg/m^3 limit value.

In terms of benzene, there are no Zone D monitoring stations however the average annual mean concentration in the Zone C locations of Mullingar and Kilkenny for 2012 to 2015 was 0.20 µg/m^3. This is well below the limit value of 5 µg/m^3 (EPA 2016). 2012 to 2015 annual mean concentrations ranged from 0.09 – 0.5 µg/m^3. Based on this EPA data, a conservative estimate of the background benzene concentration in Drehid in 2016 is 0.5 µg/m^3.

In relation to the annual averages, the ambient background concentration is added directly to the process concentration. However, in relation to the short-term peaks, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK DEFRA (UK DEFRA 2016a) and the EPA (EPA 2010) advises that for PM_{10} and NO_2 an estimate of the maximum combined pollutant concentration can be obtained as shown below:

PM_{10} - The 90.4th%ile of total 24-hour mean PM_{10} is equal to the maximum of either A or B below:

a) 90.4th%ile of 24-hour mean background PM_{10} + annual mean process contribution PM_{10}

b) 90.4th%ile 24-hour mean process contribution PM_{10} + annual mean background PM_{10}

NO_2 - The 99.8th%ile of total NO_2 is equal to the minimum of either A or B below:

a) 99.8th%ile hourly background total oxidant (O_3 & NO_2) + 0.05 x (99.8th%ile process contribution NO_X)

The maximum of either:

a) 99.8th%ile process contribution NO_X + 2 x (annual mean background NO_2); or

b) 99.8th%ile hourly background NO_2 + 2 x (annual mean process contribution NO_X).

In relation to the annual averages, the ambient background concentration was added directly to the process concentration with the short-term peaks calculated using the equations above.

11.4 POTENTIAL EFFECTS ON AIR QUALITY

11.4.1 Odour

The proposed development has the capacity for the sustainable landfilling of 250,000 TPA of non-hazardous wastes including incinerator bottom ash (IBA), stabilised waste arising from the biological treatment of the biodegradable fraction of municipal waste, and construction and demolition (C&D) waste including the fine fraction, soil and stone. It is predicted that roughly up to 45% of the 250,000 TPA of non-hazardous wastes will be the biostabilised waste which is pre-treated by the Composting and the MBT Facility. Due to the bio stabilisation process this waste has a lower odour emission rate than the municipal solid waste accepted in the currently active landfill. It is predicted that the C&D waste and IBA will have negligible odour emissions.

There is the potential for a number of emissions to the atmosphere during the operational phase of the development. However due to robust odour control systems currently on-site which will be continued to be implemented with the proposed development and the significant distance to sensitive receptors any potential effect will be minimised.

11.4.2 Air Quality and Climate

The greatest potential effect on air quality during the construction phase of the Proposed development is from construction dust emissions and the potential for nuisance dust and PM_{10}/$PM_{2.5}$ emissions. While construction dust tends to be deposited within 200 m of a construction site, the majority of the deposition occurs within the first 50 m. The large site and long entrance drive ensure that there are no sensitive residential receptors within 200 m of the construction area.

There is the potential for a number of emissions to the atmosphere during the operational phase of the development. In particular, the traffic-related air emissions may generate quantities of air pollutants such as NO_2, CO, benzene and PM_{10}.

The Drehid facility is currently licensed (IED Licence numbers W0201-03) including the operation of a gas utilisation plant and flares. The site has three flares which are assumed to run continuously, two of which are associated with the gas utilisation plant. There is a potential for NO_2 and PM_{10} emissions from these licenced points, however the potential effect on sensitive receptors is low due to the distance between the emission points and receptors.

There is the potential for a number of greenhouse gas emissions to the atmosphere during the construction phase of the development. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions.

11.5 MITIGATION MEASURES

11.5.1 Odour

The Drehid facility (W203-01) will operate an odour mitigation and management plan which includes a range of practical odour abatement measures for all processes, including Composting and the MBT facility.

All processes associated with the Composting and the MBT Facility will be internal within buildings under negative pressure so air will not escape from the buildings. Air from the Mechanical Treatment Building and the Refining Building will pass through a dust filter prior to passing through the odour abatement system.

An odour management plan will be developed prior to the detailed design and construction of the Proposed development. This plan will include management strategies for the prevention of emissions and a strict preventative maintenance and management program for ensuring that all odour mitigation techniques remain operational at optimal capacity throughout all operational scenarios. Good housekeeping practices (internally and externally) and a closed-door management strategy will also be maintained at all times.

Stack height determination at the MBT facility was previously undertaken to ensure that the appropriate stack height for the proposed biofilters was selected such that the effect on the surrounding environment would not be significant. The stack height selection process established that a stack height of 20 m for each new biofilter stack and the CHP stack (consisting of two CHP emission points) was appropriate in ensuring that no adverse effect would occur in the surrounding environment in terms of air quality and odour.

If composting temperatures exceed approximately 65°C, odour emissions increase significantly, due to the changes in process biochemistry. Excessive increases in composting temperatures are especially relevant in the first stage of composting when, due to the fast degradation, a lot of energy will be released. Temperature sensors will be used to measure the temperature in the composting tunnels and subsequently in the maturation area. The SCADA control system will ensure that the composting temperature does not exceed 65°C by adding more fresh process air to the composting mass. This will reduces the odour load in the process air being transported to the odour abatement systems.

Critical and key odour abatement system performance parameters will be continually monitored on the SCADA control system. Should any parameter deviate outside of its accepted range, an alarm will be immediately generated. Critical alarms will be texted to selected mobile phone numbers thereby ensuring the communication of critical alarms to responsible individuals on a 24 hour basis.

The biofilters will be maintained to ensure optimum performance. Biofilters will be compartmentalised to facilitate maintenance and replacement of media. Each biofilter will comprise of two sections such that treatment is provided by one of the sections while the other section is being maintained. Biofilters will be covered and hence isolated from extreme weather conditions (e.g. intensive rainfall or intensive heat) thereby providing optimum control of biofilter efficacy.

Biofilters are commonly used to treat odours from animal by-product rendering facilities, MBT facilities, composting works, intensive livestock raising and a number of industrial facilities. Bio-filtration works on the principle of passing the waste gases into a space above or below a bed of organic material. As the gas passes through the filter, the odorants are retained on the filter material, mainly by absorption into the aqueous phase. The compounds are subsequently degraded by microorganisms which reside on the organic material and can mutate and adapt to treat a wide variety of organic and inorganic compounds. A number of media can be used in biofilters, the most common of which are soil, peat, compost and bark. The efficiency of soil biofilters can be >99% and that of peat/heather biofilters >95%(AEA Technology 1994). As well as reducing the odour emissions from a facility, bio-filtration also helps to change the hedonic tone of the odour emitted. This can be an important factor in cases where the odour of the untreated waste gases is particularly unpleasant.

In relation to the Drehid MBT Facility and the extended Composting Facility, it is envisaged that the biofiltration material proposed for the odour abatements systems will either consist of woodchip or other equivalent products such as Monafil or Monashell. Monafil has an odour efficiency of typically between 95 – 98% up to a range of 100,000 OU_E/m^3 whilst Monashell, which is a manufactured shell-based media has an odour efficiency of typically between 95 – 98% for the range of 20,000 - 400,000 OU_E/m^3 falling to a range in efficiency of 90 – 95% for odour concentrations between 5,000 - 20,000 OU_E/m^3.

11.5.2 Air Quality

There is no significant predicted operational phase effect with respect to air quality from traffic. However, some site-specific mitigation measures are required during the operational phase of the Proposed development, in particular the prevention of vehicles from having engines idling while waiting to be processed, even over short time periods.

Mitigation measures in relation to traffic-derived pollutants have focused generally on improvements in both engine technology and fuel quality. EU legislation, based on the EU sponsored Auto-Oil programmes, has imposed stringent emission standards for key pollutants (Regulation (EC) No 715/2007) for passenger cars to be complied with in 2009 (Euro V) and 2014 (Euro VI). With regard to heavy duty vehicles, EU Directive 2005/78/EC defines the emission standard currently in force, Euro IV, as well as the next stage (Euro V) which entered into force in October 2009. In addition, it defines a non-binding standard called Enhanced Environmentally-friendly Vehicle (EEV). In relation to fuel quality, SI No. 407 of 1999 and SI No. 72 of 2000 have introduced significant reductions in both sulphur and benzene content of fuels.

In relation to design and operational aspects of road schemes, emissions of pollutants from road traffic can be controlled most effectively by either diverting traffic away from heavily congested areas or ensuring free flowing traffic through good traffic management plans and the use of automatic traffic control systems. Improvements in air quality are likely over the next few years as a result of the on-going comprehensive vehicle inspection and maintenance program, fiscal measures to encourage the use of alternatively fuelled vehicles and the introduction of cleaner fuels.

CO_2 emissions for the average new car fleet were reduced to 120 g/km by 2012 through EU legislation on improvements in vehicle motor technology and by an increased use of biofuels. This measure has reduced CO_2 emissions from new cars by an average of 25% in the period from 1995 to 2008/2009 whilst 15% of the necessary effort towards the overall climate change target of the EU has been met by this measure alone (Department of Environment, Heritage and Local Government, 2000).

Additional measures included in the National Climate Change Strategy (Department of Environment, Heritage and Local Government, 2006, 2007) include the following; (1) VRT and Motor Tax rebalancing to favour the purchase of more fuel-efficient vehicles with lower CO_2 emissions; (2) continuing the Mineral Oils Tax Relief II Scheme and introduction of a biofuels obligation scheme; (3) implementation of a national efficient driving awareness campaign, to promote smooth and safe driving at lower engine revolutions; and (4) enhancing the existing mandatory vehicle labelling system to provide more information on CO_2 emission levels and on fuel economy.

11.5.3 Demolition, Construction and Decommissioning Dust

The greatest potential effect on air quality during the demolition, construction and decommissioning phases is from dust emissions, $PM_{10}/PM_{2.5}$ emissions and the potential for nuisance dust.

In order to minimise dust emissions during demolition, construction and decommissioning, a series of mitigation measures have been prepared in the form of a dust minimisation plan. Provided the dust minimisation measures outlined in the Plan (see Appendix 11-5) and construction management plan are adhered to, the air quality effects during the construction phase should be not be significant.

In summary the measures which will be implemented will include the following;

- 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;

- Furthermore, any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions;
- Vehicles exiting the site shall make use of a wheel wash facility where appropriate, prior to entering onto public roads;
- Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates;
- Vehicles delivering material with dust potential (soil, aggregates) will be enclosed or covered with tarpaulin at all times to restrict the escape of dust;
- Public roads outside the site will be regularly inspected for cleanliness, and cleaned as necessary;
- 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; and
- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.

At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

11.6 RESIDUAL EFFECTS

11.6.1 Odour Emissions

Details of the 98th%ile of 1-hour mean odour concentrations at the worst case receptor are given in

Table 11-16: Predicted Odour Concentration At Worst-Case Offsite Receptor (OUE/m3)) over a five-year period (2012-2016) based on the USEPA approved AERMOD model (version 16216r).

Table 11-17: Predicted Odour Concentration At Closest Sensitive Receptors (OUE/m3) shows the worst cases of the closest sensitive receptors to the site. The maximum 1-hour 98th%ile odour concentration at the worst case sensitive receptor is 2.3 OU_E/m^3. This is equivalent to 77% of the relevant odour criterion of 3.0 OU_E/m^3 measured as a 98th%ile of mean hourly odour concentrations at the worst case receptor.

It should be noted that concentrations less than 3.0 Ou_E/m^3 are not shown on Figure 11.5: 98th% of 1-Hour Odour Concentrations (OUg/m^3) (Year 2012) because it was not considered either necessary as they below the ambient odour criterion of 3.0 Ou_E/m^3.

Table 11-16: Predicted Odour Concentration At Worst-Case Offsite Receptor (OUE/m3)

Model Scenario / Meteorological Year	Averaging Period	Predicted Odour Concentration (OU_E/m^3)Note 1	Guideline (OU_E/m^3) EPA AG4 (2010)
Ambient Odour Concentration / 2012	Maximum 1-Hour (as a 98th%ile)	2.31	3.0 (UK Guidance)
Ambient Odour Concentration / 2013		1.26	
Ambient Odour Concentration / 2014		1.40	
Ambient Odour Concentration / 2015		1.27	
Ambient Odour Concentration / 2016		1.45	

Table 11-17: Predicted Odour Concentration At Closest Sensitive Receptors (OUE/m^3)

Sensitive Receptor Grid Co-ordinates UTM (Zone 29 N)		Maximum 1-Hour 98th%ile Predicted Odour Conc. (OU_E/m^3)				
		2012	2013	2014	2015	2016
642600.8	5911907	2.31	1.20	1.24	1.13	1.36
642189.4	5912274	2.07	1.22	1.34	1.12	1.36
642374.2	5912133	1.95	1.25	1.40	1.11	1.45
642561.8	5911993	2.23	1.26	1.27	1.11	1.40

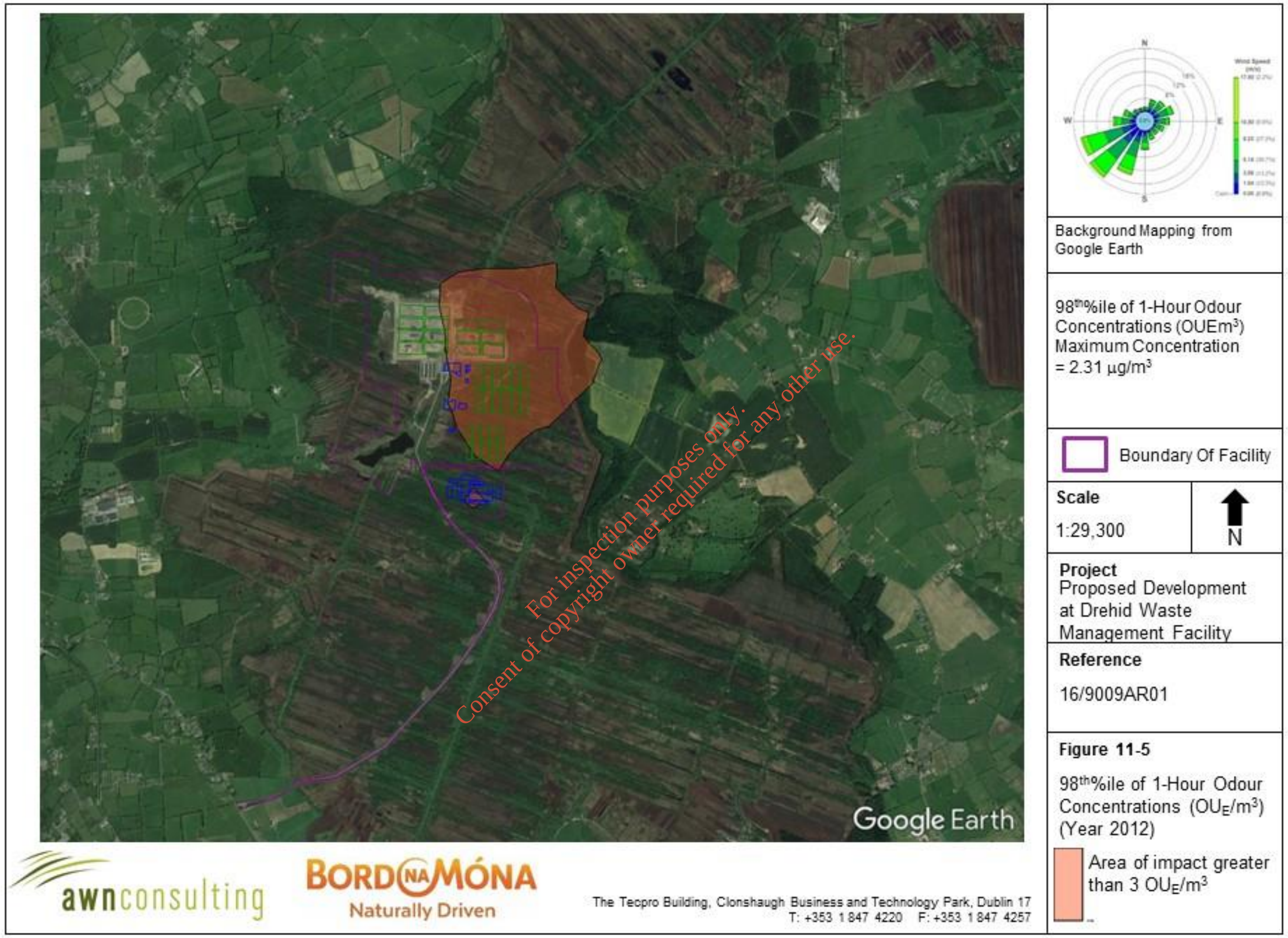


Figure 11.5: 98th% of 1-Hour Odour Concentrations (OUg/m3) (Year 2012)

11.6.2 NOx and Particulate Matter Dispersion Modelling

11.6.2.1 NOx

The NO_2 modelling results are detailed in Table 11-18: Dispersion Model Results– NO2. The results indicate that the ambient ground level concentrations at the worst case ground level location are significantly below the relevant air quality standards for NO_2. Cumulative emissions from the CHP, gas utilisation plant and flares lead to an ambient NO_2 concentration (including background) which is 21.0% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 32.5% of the annual limit value at the worst-case off site location (see Figure 11.6: Annual Mean NO2 Concentrations (µg/m3 (Year 2015)).

Table 11-18: Dispersion Model Results– NO_2

Pollutant/ Meteorological year	Background (µg/m³)	Averaging Period	NO_2 Process Contribution (µg/m³)	NO_2 Predicted Environmental Concentration (PEC) (µg/Nm³)	Standard (µg/Nm³) *Note 1*
NO_2 / 2012	N/A	99.8th%ile of 1-hr means	23.8	41.8	200
	9	Annual Mean	3.6	12.6	40
NO_2 / 2013	N/A	99.8th%ile of 1-hr means	23.6	41.6	200
	9	Annual Mean	3.5	12.5	40
NO_2 / 2014	N/A	99.8th%ile of 1-hr means	23.8	41.8	200
	9	Annual Mean	3.8	12.8	40
NO_2 / 2015	N/A	99.8th%ile of 1-hr means	23.7	41.7	200
	9	Annual Mean	4.0	13.0	40
NO_2 / 2016	N/A	99.8th%ile of 1-hr means	24.0	42.0	200
	9	Annual Mean	3.7	12.7	40

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

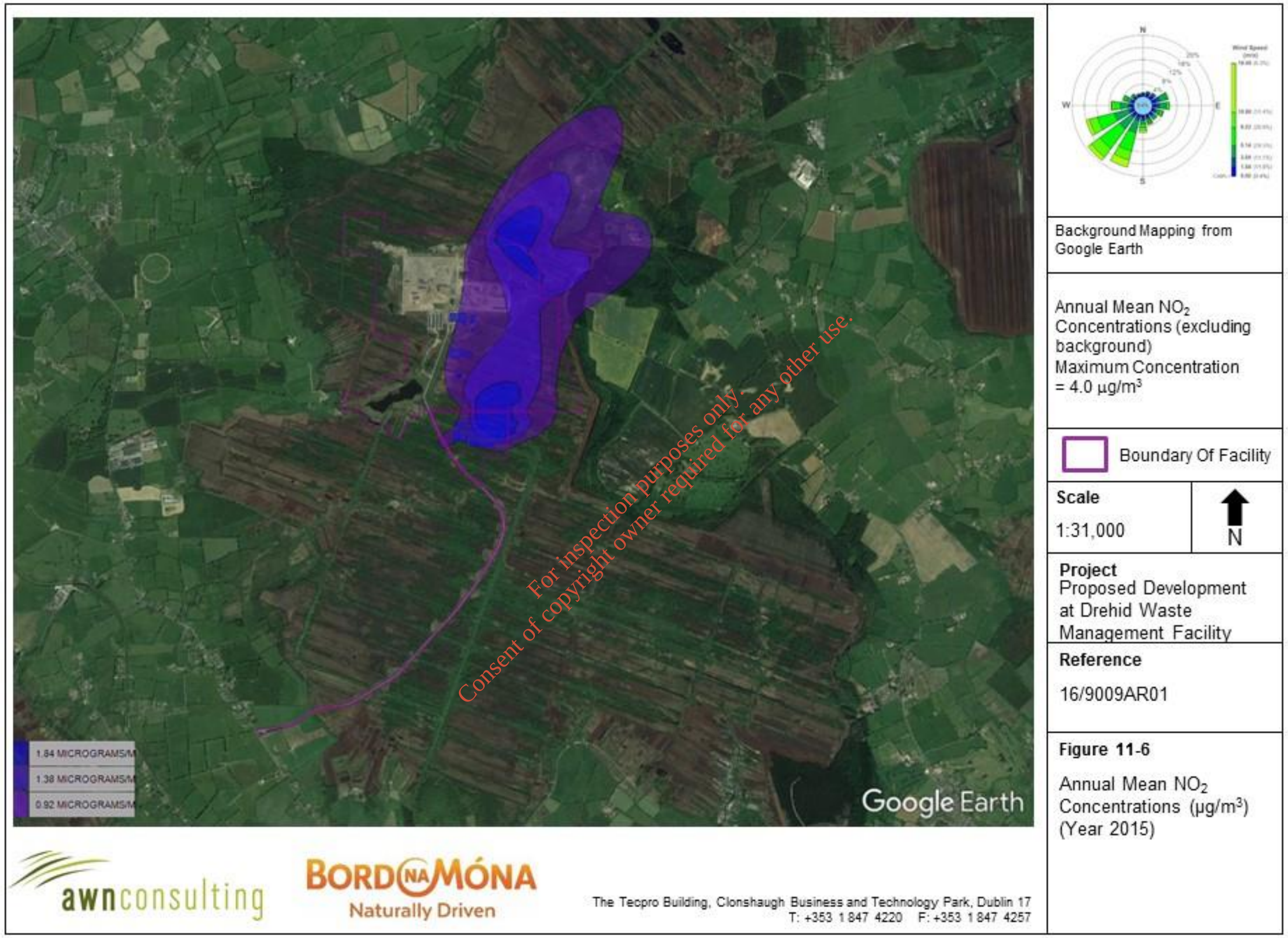


Figure 11.6: Annual Mean NO_2 Concentrations (µg/m^3 (Year 2015)

11.6.2.2 Particulate Matter

The PM_{10} / $PM_{2.5}$ modelling results are detailed in Table 11-19: Dispersion Model Results – PM_{10} and Table 11-20: Dispersion Model Results – PM2.5. The results indicate that the ambient ground level concentration is below the relevant air quality standard for PM_{10} / $PM_{2.5}$. Cumulative emissions from the CHP, gas utilisation plant and the IBA Metals Recovery Facility dust filter lead to an ambient PM_{10} concentration (including background) which is 39% of the maximum ambient 24-hour limit value at the worst-case off site location (see Table 11-19: Dispersion Model Results – PM10 and Figure 11.7: Annual Mean PM10 Concentrations (µg /m3) (excluding background) (Year 2014). In relation to the annual mean concentration, ambient PM_{10} / $PM_{2.5}$ concentration (including background) are at most 25% of the annual mean limit values at the worst-case off site location (see Table 11-20: Dispersion Model Results – PM2.5). At the worst case off site receptor the concentrations for PM_{10} / $PM_{2.5}$ are at most 25% of the annual mean limit values, only 4% of this is a contribution due to the Drehid Waste Management Facility.

Table 11-19: Dispersion Model Results – PM_{10}

Pollutant / Scenario	Annual Mean Background (µg/m³)	Averaging Period	Process Contribution (µg/m³)	Predicted Environmental Concentration (µg/Nm³)	Standard (µg/Nm³) Note 1
PM_{10} / 2012	n/a	Maximum 24-hr mean (as a 90th%ile) Note 2	3.96	19.6	50
	8.6	Annual mean	1.55	10.1	40
PM_{10} / 2013	n/a	Maximum 24-hr mean (as a 90th%ile) Note 2	3.14	19.3	50
	8.6	Annual mean	1.22	9.8	40
PM_{10} / 2014	n/a	Maximum 24-hr mean (as a 90th%ile) Note 2	3.07	19.4	50
	8.6	Annual mean	1.31	9.9	40
PM_{10} / 2015	n/a	Maximum 24-hr mean (as a 90th%ile) Note 2	2.87	19.3	50
	8.6	Annual mean	1.28	9.9	40
PM_{10} / 2016	n/a	Maximum 24-hr mean (as a 90th%ile) Note 2	3.40	19.3	50
	8.6	Annual mean	1.30	9.9	40

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

Note 2 Short-term Environmental Concentrations calculated according to UK DEFRA guidance based on the maximum background 24-hr mean (as a 90th%ile) of 18.0 µg/m³ (based on Kilkitt 2015 data)

Table 11-20: Dispersion Model Results – $PM_{2.5}$

Pollutant / Scenario	Annual Mean Background ($\mu g/m^3$)	Averaging Period	Process Contribution ($\mu g/m^3$)	Predicted Environmental Concentration ($\mu g/Nm^3$)	Standard ($\mu g/Nm^3$) Note 1
$PM_{2.5}$ / 2008	3.0	Annual mean	1.5	4.5	25
$PM_{2.5}$ / 2009	3.0	Annual mean	1.2	4.2	25
$PM_{2.5}$ / 2010	3.0	Annual mean	1.3	4.3	25
$PM_{2.5}$ / 2011	3.0	Annual mean	1.3	4.3	25
$PM_{2.5}$ / 2012	3.0	Annual mean	1.3	4.3	25

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

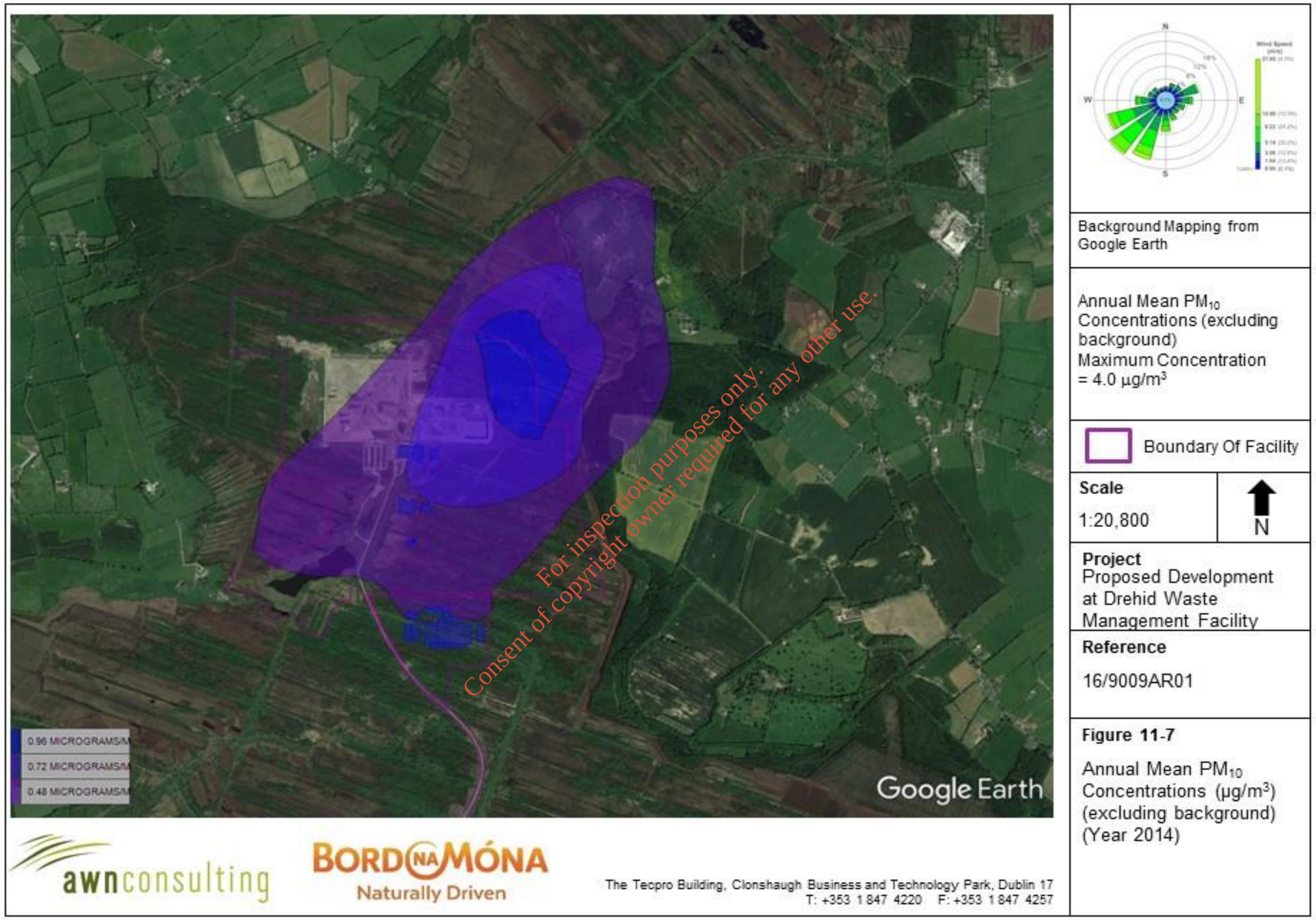


Figure 11.7: Annual Mean PM_{10} Concentrations (µg /m^3) (excluding background) (Year 2014)

11.6.3 Traffic Assessment

The results of the traffic air dispersion modelling study indicate that the residual effects of the Proposed development on air quality and climate are predicted to be imperceptible with respect to the operational phase local air quality assessment for the long and short term. Figure 11.8: Traffic Model Receptor Locations) shows the six receptor locations in the air quality traffic assessment model.

11.6.3.1 "Do Nothing" Scenario

<u>CO and Benzene</u>

The results of the "do nothing" modelling assessment for CO and benzene in the opening and design years are shown in Table 11-21: Maximum 8-hour CO Concentrations (mg/m^3) and Table 11-22: Annual Mean Benzene Concentrations (µg/m^3). Concentrations are well within the limit values at all worst-case receptors. Levels of both pollutants are at maximum 27% and 3% of the respective limit values in 2019, and 27% and 3% in 2024.

<u>PM_{10}</u>

The results of the "do nothing" modelling assessment for PM_{10} in the opening and design years are shown in Table 11-23: Annual Mean PM_{10} Concentrations (µg/m^3). Concentrations are well within the annual limit value at all worst-case receptors. In addition, the 24-hour PM_{10} concentration of 50 µg/m^3, which can only be exceeded 35 times per year within the limit, is found to be in compliance at all receptors (Table 11-23). There are no days of exceedance predicted at any of the six receptors. Annual average PM_{10} concentrations are 23% of the limit value in 2019 and 2024.

<u>$PM_{2.5}$</u>

The results of the "do nothing" modelling assessment for $PM_{2.5}$ in the opening and design years are shown in Table 11-24: PM2.5 $_{Annual}$ Mean PM2.5 Concentrations (µg/m3)). The predicted concentrations at all worst-case receptors are well below the $PM_{2.5}$ limit value of 25 µg/m^3. The annual average $PM_{2.5}$ concentration peaks at 24% of the limit value in 2019 and 2024.

<u>NO_2</u>

The results of the "do nothing" assessment of annual average NO_2 concentrations in the opening and design years are shown in Table 11-25: Annual Mean NO2 Concentrations (µg/m3) (using Interim advice note 170/12 V3 Long Term NO2 Trend Projections) using the Highways Agency IAN 170/12 guidance, and in Table 11-26: Annual Mean NO2 Concentrations (µg/m3) (using UK Department for Environment, Food and Rural Affairs Technical Guidance) respectively. The purpose of IAN 170/12 was to account for the conclusions of UK's Department for Environment, Food and Rural Affairs advice on long term trends, which advises that there is now a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality as previously published in UK Department for Environment, Food and Rural Affairs technical guidance and observed trends. Hence the projections calculated via the IAN 170/12 technique show a slower than previously predicted reduction between the base year and future year predictions. The concentrations are below the limit value at all locations, with levels ranging up to 19% of the limit value in 2019 and 18% in 2024, using the more conservative IAN prediction.

The hourly limit value for NO_2 is 200 µg/m^3 is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The Maximum 1-hour NO_2 concentration for the "do nothing" scenario is not predicted to be exceeded in either 2019 or 2024.

11.6.3.2 "Do Something" Scenario

CO and Benzene

The results of the modelled effect of the scheme for CO and benzene in the opening and design years are shown in Table 11-21 and Table 11-22 respectively. Predicted pollutant concentrations with the Proposed development in place are below the ambient standards at all locations. Levels of both pollutants range from 27% to 3% of the respective limit values in 2019 and 2024. Future trends indicate similarly low levels of CO and benzene.

The effect of the proposed development can be assessed relative to "Do Nothing" levels in 2019 and 2024. Relative to baseline levels, some imperceptible increases in pollutant levels at the worst-case receptors are predicted as a result of the Proposed development. The greatest effect on CO and benzene concentrations in either 2019 or 2024 will be an increase of 0.1% of their respective limit values at Receptor 4. Thus, using the assessment criteria for NO_2 and PM_{10} and applying these criteria to CO and benzene, the effect of the Proposed development in terms of CO and benzene is negligible.

PM_{10}

The results of the modelled effect of the proposed development for PM_{10} in the opening and design years are shown in Table 11-23. Predicted annual average concentrations in the region of the Proposed development are below the ambient standards at all worst-case receptors with levels 23% of the limit value in 2019. In addition, the 24-hour PM_{10} concentration of 50 µg/m^3, which can only be exceeded 35 times per year within the limit, is found to be in compliance at all receptors. It is predicted that the worst case receptors will have up to six exceedance of the 50 µg/m^3 24-hour mean value in 2019 and 2024, however this is significantly below the allowable 35 times per year. Future trends with the Proposed development in place indicate similarly low levels of PM_{10}. Annual average PM_{10} concentrations are also 23% of the limit in 2024.

The effect of the proposed development can be assessed relative to "Do Nothing" levels in 2019 and 2024. Relative to baseline levels, some imperceptible increases in PM_{10} levels at the worst-case receptors are predicted as a result of the Proposed development. With regard to effects at individual receptors, none of the six receptors assessed will experience an increase in concentrations of over 0.18% of the limit value in 2019 and 2024. Thus, the magnitude of the changes in air quality are imperceptible at all receptors based on the criteria outlined in Table 11-9 to Table 11-11.

The greatest effect on PM_{10} concentrations in the region of the Proposed development in either 2019 or 2024 will be an increase of 0.18% of the annual limit value at Receptor 4. Thus, using the assessment criteria outlined in Table 11-9 to Table 11-11, the effect of the Proposed development with regard to PM_{10} is negligible at all six of the receptors assessed.

$PM_{2.5}$

The results of the modelled effect of the proposed development for $PM_{2.5}$ in the opening and design years are shown in Table 11-24. Predicted annual average concentrations in the region of the Proposed development are below the ambient standards at all worst-case receptors, with levels of 24% of the limit value in 2019. Future trends with the proposed development in place indicate similarly low levels of $PM_{2.5}$. Annual average $PM_{2.5}$ concentrations are also 24% of the limit in 2024.

The effect of the proposed development can be assessed relative to “Do Nothing” levels in 2019 and 2024. Relative to baseline levels, imperceptible increases in $PM_{2.5}$ levels at the worst-case receptors are predicted as a result of the proposed development. None of the six receptors assessed will experience an increase or decrease in concentrations of over 0.19% of the limit value in 2019 and 2024. Thus, the magnitude of the changes in air is negligible at all receptors based on the criteria outlined in Table 11-9 to Table 11-11

NO_2

The results of the assessment of the effect of the proposed development for NO_2 in the opening and design years are shown in Table 11-25: Annual Mean NO2 Concentrations (µg/m3) (using Interim advice note 170/12 V3 Long Term NO2 Trend Projections) using the Highways Agency IAN 170/12 Advice Note and in Table 11-26: Annual Mean NO2 Concentrations (µg/m3) (using UK Department for Environment, Food and Rural Affairs Technical Guidance) using the UK Department for Environment, Food and Rural Affairs technique respectively. The annual average concentration is within the limit value at all worst-case receptors using both the UK Department for Environment, Food and Rural Affairs and more conservative IAN technique. Levels of NO_2 are 20% and 20% of the annual limit value in 2019 and 2024 using the IAN technique, while concentrations are 18% and 17% of the annual limit value in 2019 and 2024 using the UK Department for Environment, Food and Rural Affairs technique. Maximum one-hour NO_2 levels with the proposed development in place are not predicted to exceed using either technique. The effect of the proposed development on annual mean NO_2 levels can be assessed relative to “Do Nothing” levels in 2019 and 2024.

Relative to baseline levels, a small increase in pollutant levels is predicted at a number of receptors and imperceptible increases at all other receptors as a result of the proposed development. None of the six receptors assessed will experience an increase in concentrations of over 2% of the limit value in 2019 and 2024. Thus, using the assessment criteria outlined in Table 11-9: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations) and Table 11-10: Air Quality Impact Significance Criteria for PM10) , the impact of the Proposed development in terms of NO_2 is negligible at all of the receptors.

The hourly limit value for NO_2 is 200 μg/m^3 is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The Maximum 1-hour NO_2 concentration for the “Do Nothing” scenario is not predicted to be exceeded in either 2019 and 2024.

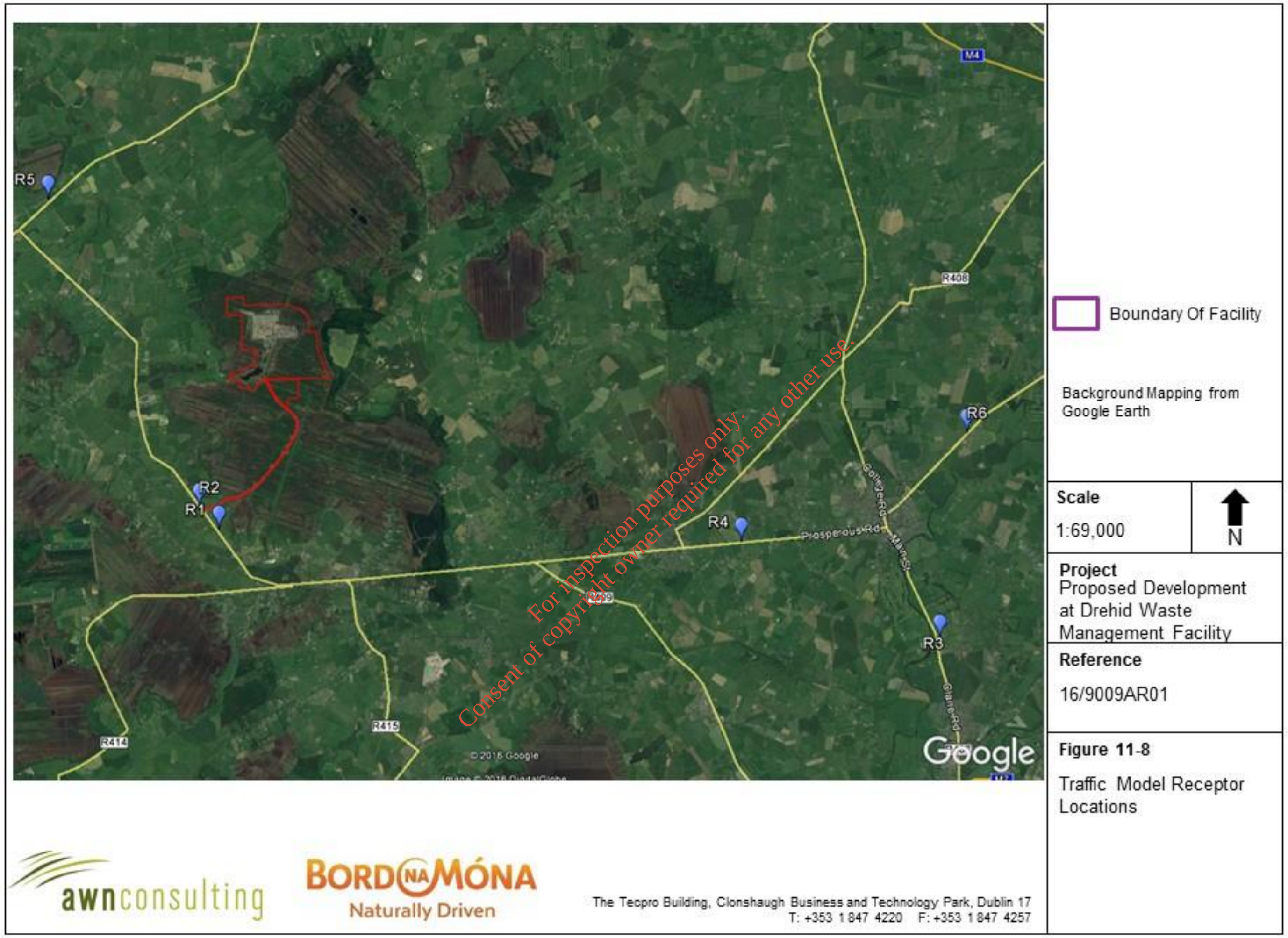


Figure 11.8: Traffic Model Receptor Locations

Table 11-21: Maximum 8-hour CO Concentrations (mg/m^3)

Receptor	Impact Opening Year (2019)					Impact Design Year (2024)				
	DM	DS	DS-DM	Magnitude	Description	DM	DS	DS-DM	Magnitude	Description
1	2.54	2.55	0.009	Imperceptible	Negligible Increase	2.55	2.55	0.004	Imperceptible	Negligible Increase
2	2.57	2.58	0.012	Imperceptible	Negligible Increase	2.57	2.58	0.005	Imperceptible	Negligible Increase
3	2.58	2.59	0.006	Imperceptible	Negligible Increase	2.59	2.59	0.003	Imperceptible	Negligible Increase
4	2.62	2.63	0.014	Imperceptible	Negligible Increase	2.62	2.63	0.006	Imperceptible	Negligible Increase
5	2.54	2.54	0.006	Imperceptible	Negligible Increase	2.54	2.54	0.003	Imperceptible	Negligible Increase
6	2.66	2.67	0.013	Imperceptible	Negligible Increase	2.67	2.67	0.006	Imperceptible	Negligible Increase

Table 11-22: Annual Mean Benzene Concentrations (µg/m^3)

Receptor	Impact Opening Year (2019)					Impact Design Year (2024)				
	DM	DS	DS-DM	DM	DS	DM	DM	DS	Magnitude	DM
1	0.14	0.14	0.002	Imperceptible	Negligible Increase	0.14	0.14	0.000	Imperceptible	Negligible Increase
2	0.14	0.15	0.002	Imperceptible	Negligible Increase	0.14	0.14	0.000	Imperceptible	Negligible Increase
3	0.15	0.15	0.001	Imperceptible	Negligible Increase	0.15	0.15	0.000	Imperceptible	Negligible Increase
4	0.15	0.16	0.003	Imperceptible	Negligible Increase	0.15	0.16	0.000	Imperceptible	Negligible Increase
5	0.14	0.14	0.001	Imperceptible	Negligible Increase	0.14	0.14	0.000	Imperceptible	Negligible Increase
6	0.16	0.17	0.003	Imperceptible	Negligible Increase	0.16	0.16	0.000	Imperceptible	Negligible Increase

Table 11-23: Annual Mean PM_{10} Concentrations (µg/m^3)

Receptor	Impact Opening Year (2019)					Impact Design Year (2024)				
	DM	DS	DS-DM	Magnitude	Description	DM	DS	DS-DM	Magnitude	Description
1	8.6	8.7	0.05	Imperceptible	Negligible Increase	8.6	8.7	0.04	Imperceptible	Negligible Increase
2	8.7	8.8	0.06	Imperceptible	Negligible Increase	8.7	8.8	0.05	Imperceptible	Negligible Increase
3	8.8	8.8	0.03	Imperceptible	Negligible Increase	8.8	8.8	0.03	Imperceptible	Negligible Increase
4	9.0	9.1	0.07	Imperceptible	Negligible Increase	9.0	9.1	0.06	Imperceptible	Negligible Increase
5	8.6	8.6	0.03	Imperceptible	Negligible Increase	8.6	8.6	0.03	Imperceptible	Negligible Increase
6	9.2	9.2	0.06	Imperceptible	Negligible Increase	9.2	9.3	0.05	Imperceptible	Negligible Increase

Table 11-24: $PM_{2.5}$ Annual Mean $PM_{2.5}$ Concentrations (µg/m^3)

Receptor	Impact Opening Year (2019)					Impact Design Year (2024)				
	DM	DS	DS-DM	Magnitude	Description	DM	DS	DS-DM	Magnitude	Description
1	5.6	5.7	0.03	Imperceptible	Negligible Increase	5.6	5.6	0.02	Imperceptible	Negligible Increase
2	5.7	5.7	0.04	Imperceptible	Negligible Increase	5.7	5.7	0.03	Imperceptible	Negligible Increase
3	5.7	5.7	0.02	Imperceptible	Negligible Increase	5.7	5.7	0.02	Imperceptible	Negligible Increase
4	5.9	5.9	0.05	Imperceptible	Negligible Increase	5.9	5.9	0.04	Imperceptible	Negligible Increase
5	5.6	5.6	0.02	Imperceptible	Negligible Increase	5.6	5.6	0.02	Imperceptible	Negligible Increase
6	6.0	6.0	0.04	Imperceptible	Negligible Increase	6.0	6.0	0.04	Imperceptible	Negligible Increase

Table 11-25: Annual Mean NO_2 Concentrations (μg/m³) (using Interim advice note 170/12 V3 Long Term NO_2 Trend Projections)

Receptor	Impact Opening Year (2019)					Impact Design Year (2024)				
	DM	DS	DS-DM	Magnitude	Description	DM	DS	DS-DM	Magnitude	Description
1	4.9	5.3	0.40	Imperceptible	Negligible Increase	4.7	5.2	0.53	Small	Negligible Increase
2	5.3	5.8	0.42	Small	Negligible Increase	5.0	5.7	0.66	Small	Negligible Increase
3	5.4	5.6	0.20	Imperceptible	Negligible Increase	5.2	5.6	0.40	Imperceptible	Negligible Increase
4	7.1	7.6	0.52	Small	Small Increase	6.7	7.5	0.85	Small	Negligible Increase
5	4.5	4.7	0.26	Imperceptible	Negligible Increase	4.2	4.6	0.41	Small	Negligible Increase
6	7.6	7.9	0.38	Imperceptible	Negligible Increase	7.1	7.8	0.74	Small	Negligible Increase

Table 11-26: Annual Mean NO_2 Concentrations (μg/m³) (using UK Department for Environment, Food and Rural Affairs Technical Guidance)

Receptor	Impact Opening Year (2019)					Impact Design Year (2024)				
	DM	DS	DS-DM	Magnitude	Description	DM	DS	DS-DM	Magnitude	Description
1	4.3	4.7	0.35	Imperceptible	Negligible Increase	3.8	4.2	0.43	Small	Negligible Increase
2	4.7	5.1	0.37	Imperceptible	Negligible Increase	4.1	4.7	0.54	Small	Negligible Increase
3	4.9	5.0	0.18	Imperceptible	Negligible Increase	4.3	4.6	0.33	Imperceptible	Negligible Increase
4	6.5	7.0	0.47	Small	Negligible Increase	5.8	6.5	0.73	Small	Negligible Increase
5	3.9	4.1	0.23	Imperceptible	Negligible Increase	3.4	3.7	0.33	Imperceptible	Negligible Increase
6	7.0	7.3	0.35	Imperceptible	Negligible Increase	6.2	6.9	0.65	Small	Negligible Increase

Table 11-27: Regional Air Quality Assessment

Year	Scenario	VOC (kg/annum)	NO_X (kg/annum)	CO_2 (tonnes/annum)
2019	Do Nothing	25434	88564	43989
	Do Something	30575	114978	53033
2024	Do Nothing	21235	52954	36308
	Do Something	22071	55158	37739
Increment in 2020		5141 kg	26413.4 kg	9044.8 Tonnes
Increment in 2035		836.1 kg	2203.6 kg	1431.5 Tonnes
Emission Ceiling (kilo Tonnes) 2020		**46.5**	**56.1**	**42,100**
Emission Ceiling (kilo Tonnes) 2035		**42.2**	**27.5**	**42,100**
Impact in 2020 (%)		0.0110559%	0.047083 %	0.0214840543 %
Impact in 2035 (%)		0.0019832 %	0.008013 %	0.0034002647 %

11.6.4 Climate Assessment

There is the potential for a number of greenhouse gas emissions to atmosphere during the operational phase of the development. Road traffic and space heating of buildings may give rise to CO_2 and N_2O emissions. However, due to the size of the development the effect of the proposed development on national greenhouse gas emissions is predicted to be insignificant in terms of Ireland's obligations under the EU 2020 target.

The regional effect of the proposed development on emissions of NO_x and VOCs has been assessed using the procedures of Transport Infrastructure Ireland (TII 2011) and the UK Department for Environment, Food and Rural Affairs (UK DEFRA, 2016). The results show that the likely effect of the proposed development on Ireland's obligations under the Targets set out by "Proposal for a Directive on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC" are imperceptible and long-term.

For the assessment year of 2019, the predicted effect of the changes in AADT is to increase NO_x levels by 0.047% of the NO_x emissions ceiling and increase VOC levels by 0.011% of the VOC emissions ceiling to be complied with in 2020. For the assessment year of 2024, the predicted effect of the changes in AADT is to increase NO_x levels by 0.008% of the NO_x emissions ceiling and increase VOC levels by 0.002% of the VOC emissions ceiling to be complied with in 2035.

11.6.5 Regional Climate Effects

The regional or transboundary effects of the proposed development on emissions of CO_2 was also assessed using the Design Manual for Roads and Bridges screening model. The results show that the effect of the proposed development in 2019 will be to increase CO_2 emissions by 0.02148% of Ireland's EU 2020 Target. In the design year of 2024, the proposed development will increase CO_2 emissions by 0.0034% of EU 2020 Target. Thus, the effect of the proposed development on national greenhouse gas emissions will be insignificant in terms of Ireland's obligations under the EU 2020 Target (EU 2014).

Total greenhouse gas from landfilling of untreated MSW will not change due to the proposed development. EU research indicates that MSW greenhouse gas emissions amount to 328 kg CO_2eq/tonne MSW. At Drehid landfill, from 2018, onwards this would equate to 0.09% in terms of Ireland's obligations under the EU 2020 Target (EU 2014). The engineered landfill is currently permitted to accept 360,000 tonnes per annum (TPA) of municipal solid waste until 1st December 2017. Thereafter, waste for landfill disposal at the facility is limited to a maximum of 120,000 TPA. As there will be no increased capacity in the landfill due to the proposed development, the GHG emissions from the do-nothing and do-something scenarios will remain equal under both scenarios and therefore there is no effect.

Therefore, the likely overall magnitude of the changes on climate in the operational stage is imperceptible, national and long-term.

11.6.5.1 Effect of Climate Change on the Project

The most likely effect due to climate change on the project is due to flooding, an assessment has been carried out in Chapter 6 of this EIAR to ensure that the development has sufficient capacity in the system for adaption to future increased rainfall due to climate change.

Areas of pluvial flooding were noted on the OPW Preliminary Flood Risk Assessment PFRA mapping, but no records of fluvial flooding were noted on the OPW/CFRAM website for the proposed development site. Drainage improvement works have rectified the drainage on the proposed development site, and reduced the potential for surface water ponding.

The network of drainage ditches effectively drain the proposed development site and surrounding area. Small areas of pluvial flooding occur to the northwest and west of the proposed Non-Hazardous Landfill; however improved drainage and water management has limited the potential for flooding in this area.

No incidents of flooding were noted at the site after detailed review of historical maps, data from CFRAMs and PFRA and internet searches were consulted. Therefore proposed development site is not located in a flood prone area (Flood Zone A or B) based on the preliminary flood risk assessment (PFRA) maps.

11.7 CUMULATIVE EFFECTS

There are a number of other significant developments in the vicinity of the development which have been granted planning permission.

Should the construction phases of the development and any localised permitted developments coincide, it is predicted that once appropriate mitigations are put in place during the construction for the above schemes, effects will not be significant. The cumulative effect of the permitted developments and Drehid landfill development are also predicted to not cause significant effects during the operational phase with respect to local air quality for the long and short term.

Odour effects are below limit values contained within the site boundary, as there are not any other sources of odour within this limited area and therefore it is predicted that cumulative effects will not occur.

NO_x and particulate emissions associated with the project arise due to on site boilers, generators and traffic. Due to the rural natural of the site, the only significant off-site sources of NO_x and particulate emissions are due to road vehicles. Traffic models include current local traffic and such developments in order to predict future flows for the opening and design years and therefore the developments are included in the assessment carried out are part of this chapter.

11.8 WORST CASE EFFECTS

In order to protect nearby sensitive receptors, construction and operational phase effects have been assumed to be worst case for odour, air and climate emissions throughout the assessment.

Potential construction phase effects have been taken to be worst case and therefore strict mitigation measures have been outlined in a dust minimisation plan and construction management plan. The mitigation measures for dust are designed with a number of layers of protocol, therefore if one fails in the short-term it should be eliminated by the next. Construction dust monitoring should be put in place to ensure that, should mitigation measures fail and construction dust effects occur, they will be at worst slight, localised and short term in nature.

The effect in the operational phase is not significant and long term with respect to odour, air quality or climate.

11.9 DIFFICULTIES ENCOUNTERED

There were no difficulties encountered in the assessment of the Drehid Waste Management Facility Development.

11.10 CONCLUSIONS

The scenarios modelled lead to odour concentrations which are in compliance with the relevant odour criterion of 3.0 OUE/m^3 measured as a 98th%ile of mean hourly odour concentrations at the worst case receptor.

The maximum 1-hour 98th%ile odour concentration at the worst case sensitive receptors is 2.3 OUE/m^3. This is equivalent to 77% of the relevant odour criterion of 3.0 OUE/m^3 measured as a 98th%ile of mean hourly odour concentrations at the worst case receptor. This can be classed as an imperceptible, long term, reversible and localised effect at the worst case receptor.

With regard to NO_2, the modelled scenario will lead to ambient NO_2 concentrations (including background) which are in compliance with the relevant limit values, reaching at most 21% of the 1-hour limit value (measured as a 99.8th%ile) and 32.5% of the annual limit value at the worst-case off site location. This can be classed as a imperceptible, long term, reversible and localised effect at the worst case receptor.

With regard to PM_{10} / $PM_{2.5}$, emissions from the facility will lead to ambient PM_{10} / $PM_{2.5}$ levels (including background) which are in compliance with the relevant limit values, with levels reaching at most 39% of the relevant limit values at the worst-case off site location. This can be classed as a imperceptible, long term, reversible and localised effect at the worst case receptor.

It has been assumed that all emission points are continually in operation for the full year as a worst-case assumption.

The results of the traffic air dispersion modelling study indicate that the residual effects of the Proposed development on air quality and climate are predicted to be direct, localised, reversible and not significant with respect to the operational phase local air quality assessment for the long and short term. The likely overall magnitude of the changes on climate in the operational stage is imperceptible, national and long-term.

When the dust minimisation measures detailed in the mitigation section of this Chapter are implemented, fugitive emissions of dust from the site will be not significant, short-term, localised and pose no nuisance at nearby receptors.

In summary, all emissions from the facility under the proposed development at Drehid Waste Management Facility, including the permitted MBT, will be in compliance with the ambient air quality standards and will lead to a direct, not significant and long-term effect of non-compliance or odour nuisance. There is a direct, local, not significant and long-term effect predicted due to increased vehicle emissions during the operational phase.

12 NOISE AND VIBRATION

12.1 INTRODUCTION

This section of the Environmental Impact Assessment Report (EIAR) assesses the noise and vibration effects associated with the proposed development at the Waste Management Facility (WMF) at the Drehid site, Timahoe, County Kildare. Chapter 3 of the EIAR provides the detail of the description of the proposed development.

This chapter was completed by Jennifer Harmon. She is a Senior Acoustic Consultant with AWN Consulting. She holds a BSc (Hons) in Environmental Science from the University of Ulster and a Diploma in Acoustics and Noise Control from the Institute of Acoustics of which she is a full Member.

When considering the potential effects from this development, the key sources will relate to the short term phase during the construction of the on-site buildings and landfill areas and the long term effects associated with the proposed development including on-site fixed and mobile sources, on-site vehicles and traffic along the surrounding roads.

The site of the proposed facility has been carefully considered to avoid, as far as practicable, effects on its surrounding environment, including potential noise and or vibration effects to the nearest sensitive locations.

12.1 METHODOLOGY

The assessment has been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration which are set out within the relevant sections of this chapter and included in the references section. In addition to specific noise guidance documents, the following guidelines were considered and reviewed for the preparation of this chapter:

- Guidelines on the Information to be contained in Environmental Impact Statements', (EPA, 2002);
- 'EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), (EPA, 2003);
- 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports', (Draft August 2017); and
- 'EPA Advice Notes for Preparing Environmental Impact Statements, (Draft, September 2015).

The study has been undertaken using the following methodology:

- A baseline noise survey has been undertaken at off-site noise sensitive locations to determine the existing noise climate associated with the current site activity;
- A review of annual noise monitoring surveys conducted as part of the existing licensed WMF has been undertaken to supplement the baseline surveys in order to characterise the baseline noise levels;
- A review of the relevant noise guidance has been conducted in order to set a range of acceptable noise and vibration criteria for the construction and operational phases of the proposed development;
- Predictive calculations have been performed to assess the potential effects associated with the construction and operation of the development at the most sensitive locations surrounding the development site,
- Cumulative effects associated with the existing WMF, the permitted Mechanical Biological Treatment (MBT) facility and the proposed development have been calculated in order to review the potential worst case operational noise levels at the site, and;
- A schedule of mitigation measures has been proposed to reduce, where necessary, the identified potential effects relating to noise and vibration from the proposed development.

12.2 RECEIVING ENVIRONMENT/ BASELINE DESCRIPTION

The overall Bord na Móna landholding is located within the Timahoe bog in Allenwood, County Kildare. Within the landholding, Bord na Móna operates the permitted Drehid Waste Management Facility, accessed from the regional R403 road, at Killinagh Upper, by a 4.8 km long internal access road, which is dedicated to the waste management facility.

The Drehid Waste Management Facility is licensed by the EPA (IED Licence number W0201-03). This existing facility compromises an engineered landfill, composting facility and associated infrastructure including administration buildings, gas utilisation plant, settlement lagoons, leachate management infrastructure, weighbridge and access roads. The hours of operation of the existing facility are limited to operation between the hours of 08:00 and 19:00 Monday to Saturday. The waste acceptance hours are between 08:00 and 18:30 Monday to Saturday. A Mechanical Biological Treatment (MBT) facility situated to the south of the Drehid WMF, which has received planning permission and is licensed by the EPA (W0283-01), is not yet constructed.

In terms of noise generating activities, the main sources within the existing facility relate to vehicles entering and existing the site, mobile plant and equipment working at landfill areas and accessing composting facility, operational plant serving the composting facility and a gas utilisation plant. All activities cease on site post 19:00 with the exception of the compost facility fans (housed internally) and the gas utilisation plant, both of which operate continuously.

The surrounding environment is rural in nature with residential properties located around all boundaries at varying distances from the landholding boundary. The red line boundary of the Drehid Waste Management Facility is positioned within the central part of the landholding and, hence is significantly set back from noise sensitive properties. The closest properties are at distances of approximately 850 m from the red line boundary of the existing and proposed waste management facility.

12.2.1 Annual Noise Monitoring

In accordance with the conditions of the existing licence (W0201-03), a scheduled noise survey is undertaken on an annual basis over a day and night-time period at the nearest sensitive receptor (N1) and at the boundary locations within the site (N2 to N5). The most recent survey results for the years 2015 and 2016 are summarised in this section.

12.2.1.1 Monitoring Locations

Noise monitoring is undertaken at five locations. One of these locations is a noise sensitive property whilst the remainder four locations are at boundary locations around the perimeter of the site. These are described below and displayed in Figure 12.1.

N1 Noise Sensitive receptor located to the south-west of the WMF footprint.

N2 Boundary location to the north west of the facility on the L5025 road.

N3 Boundary location to the north east of the facility.

N4 Boundary location to the south west of the WMF along the R403 road at the entrance to the facility.

N5 Boundary location to the south east of the facility.

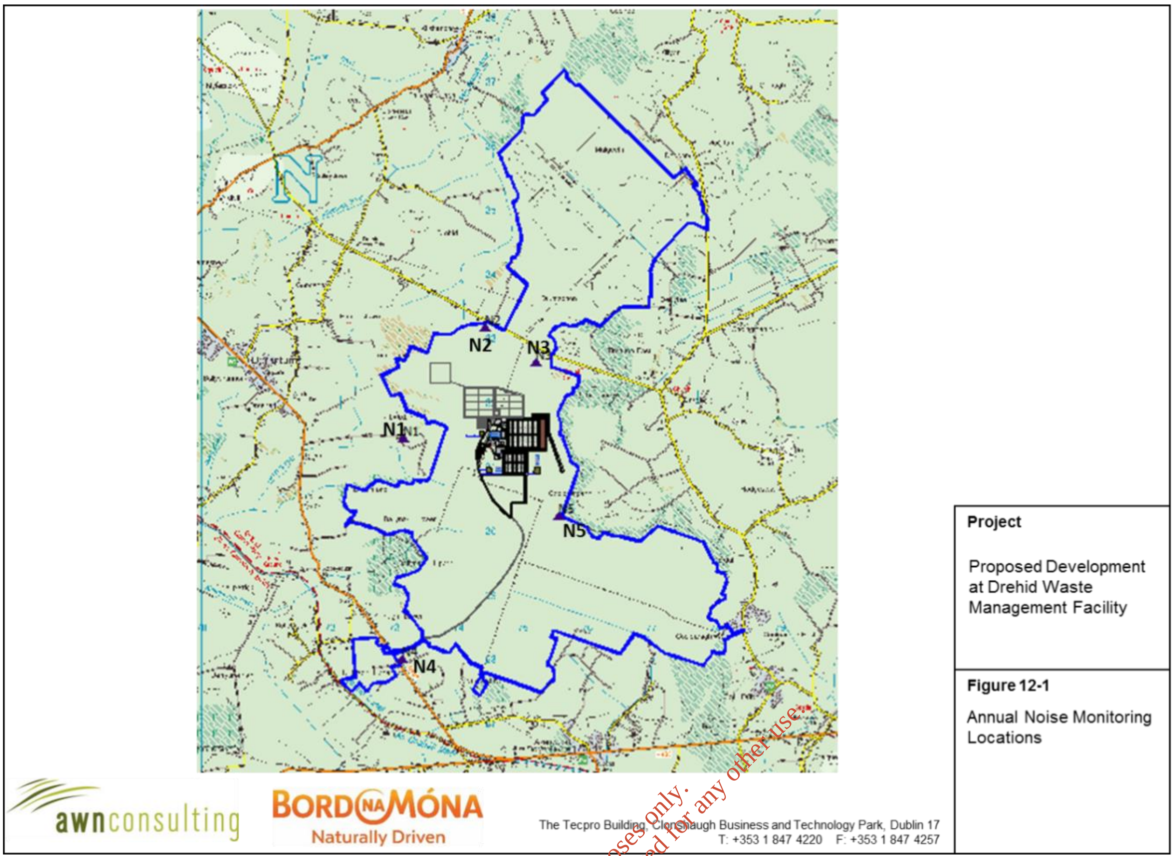


Figure 12.1: Annual Noise Monitoring Locations

12.2.1.2 Monitoring Procedure and Periods

2015: The daytime surveys were conducted on 19 and 20 October 2015.

The night-time surveys were conducted on 20 October and 11 November 2015.

2016: The daytime surveys were conducted on 19 and 20 October 2016.

The night-time surveys were conducted on 20 October 2016.

The surveys were undertaken in general accordance with *ISO 1996-2:2007 Acoustics -- Description, measurement and assessment of environmental noise - Part 2: Determination of environmental noise levels* (2007) and in accordance with the EPA's noise survey and assessment guidance document *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities* (Original Version 2012, updated Guidance 2016). The surveys were undertaken during dry and calm conditions with wind speeds less than <3 m/s.

12.2.1.3 Monitoring Parameters

The noise survey results are presented in terms of the following four parameters:

L_{Aeq} is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.

L_{Amax} is the instantaneous maximum sound level measured during the sample period.

L_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

L_{A10} is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.

12.2.1.4 Monitoring Results

The monitoring results for day and night-time periods surveyed in 2015 for the five survey locations are summarised in Table 12-1: Drehid Facility, 2015 Annual Noise Survey Results.

Table 12-1: Drehid Facility, 2015 Annual Noise Survey Results

Monitoring Location	Time period	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}	Notes
N1 (NSL)	Day	35 - 37	36 - 39	25 - 31	54 - 63	Faint mobile plant. Distant traffic, birdsong & barking dogs
	Night	30 - 31	31 - 33	26 - 28	53 - 54	Distant traffic. Occasional barking dogs.
N2	Day	47 - 54	46 - 55	24 - 35	66 - 72	Machinery faintly audible. Birdsong, passing road traffic
	Night	27 - 50	30 - 52	25 - 34	56 - 71	Faint plant noise. Road traffic dominates
N3	Day	38 - 46	41 - 49	29 - 33	53 - 65	Landfill mobile plant, traffic on local road
	Night	33 - 52	32 - 52	26 - 41	55 - 70	Idling van and traffic dominate. Operational plant, low level hum. Idling
N4	Day	64 - 68	65 - 68	37 - 42	87 - 93	Vehicles on site entrance road, traffic along R403 Road
	Night	46 - 53	43 - 59	25 - 32	72 - 70	Passing traffic along R403
N5	Day	38 - 36	38 - 42	27 - 28	61 - 63	Vehicles along site road, surrounding road traffic. Birdsong
	Night	30 - 32	29	22 - 23	63 - 68	Faint plant noise. Bird and animal noises

The monitoring results for day and night-time periods surveyed in 2016 for the five survey locations are summarised in Table 12-2: Drehid Facility, 2016 Annual Noise Survey Results.

Table 12-2: Drehid Facility, 2016 Annual Noise Survey Results

Monitoring Location	Time period	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}	Notes
N1 (NSL)	Day	35 - 43	35 - 46	28 - 38	58 - 68	Faint mobile plant & reverse alarms. Distant traffic, birdsong & barking dogs
	Night	33 - 34	36 - 37	27 - 30	60 – 61	Distant traffic. Occasional barking dogs. Faint plant audible
N2	Day	51 - 56	49 - 59	30 - 33	74 – 77	Machinery faintly audible. Birdsong, passing road traffic
	Night	27 - 45	24 - 31	19 - 20	60 – 63	Faint plant noise. Road traffic dominates, livestock & dogs barking (round 2)
N3	Day	41 - 49	45 - 52	25 - 31	62 – 70	Traffic on local road dominates. Landfill mobile plant & reverse alarms, low level plant,
	Night	24 - 45	22 - 36	18 - 20	52 – 84	Faint operational plant. Occasional traffic on L5025 (Round 2)
N4	Day	64	65 - 66	40 - 47	85	Vehicles on site entrance road, traffic along R403 Road
	Night	38 - 49	32 - 50	23 - 27	71 – 77	Passing traffic along R403
N5	Day	35 - 39	35 - 41	29 - 33	63 – 67	Vehicles along site road, mobile plant and fans. Surrounding road traffic & birdsong
	Night	34 - 38	31 - 32	24	71 - 89	Faint plant noise. Bird and animal noises

The annual monitoring reports note that activities from the Drehid waste management facility are audible at very low levels in the absence of other surrounding sources such as road traffic. The two sources noted to be faintly audible during the survey periods were occasional mobile plant activity in addition to operational plant. The ambient noise level measured by the L_{Aeq} parameter, at the monitoring locations set back from road traffic, was well below the daytime and night-time noise emission limit values of 55 and 45 dB $L_{Aeq,\ 30mins}$. The steady state background noise level measured by the L_{A90} parameter is low at all monitoring locations indicating the low contribution of the operational facility to the overall noise environment.

12.2.2 Additional Noise Monitoring Survey

A separate noise monitoring survey was undertaken by AWN Consulting in order to further inform this assessment. Survey details are set out below.

12.2.2.1 Monitoring Locations

Monitoring was undertaken at four locations, representative of the closest noise sensitive boundaries of the proposed development where noise sensitive properties are located. These are described as follows and illustrated in Figure 12.2.

Location A	South of facility along R403 Road at entrance to soccer pitch grounds. Location representative of properties along this road in proximity to the site entrance. This location is in proximity to Annual survey location N4.
Location B	Noise Sensitive receptor located to the north-west of the existing and proposed facility.
Location C	South of existing and proposed facility along small local road within North Allenwood.
Location D	East of existing and proposed facility off the L1019 local road in proximity to school and public house.

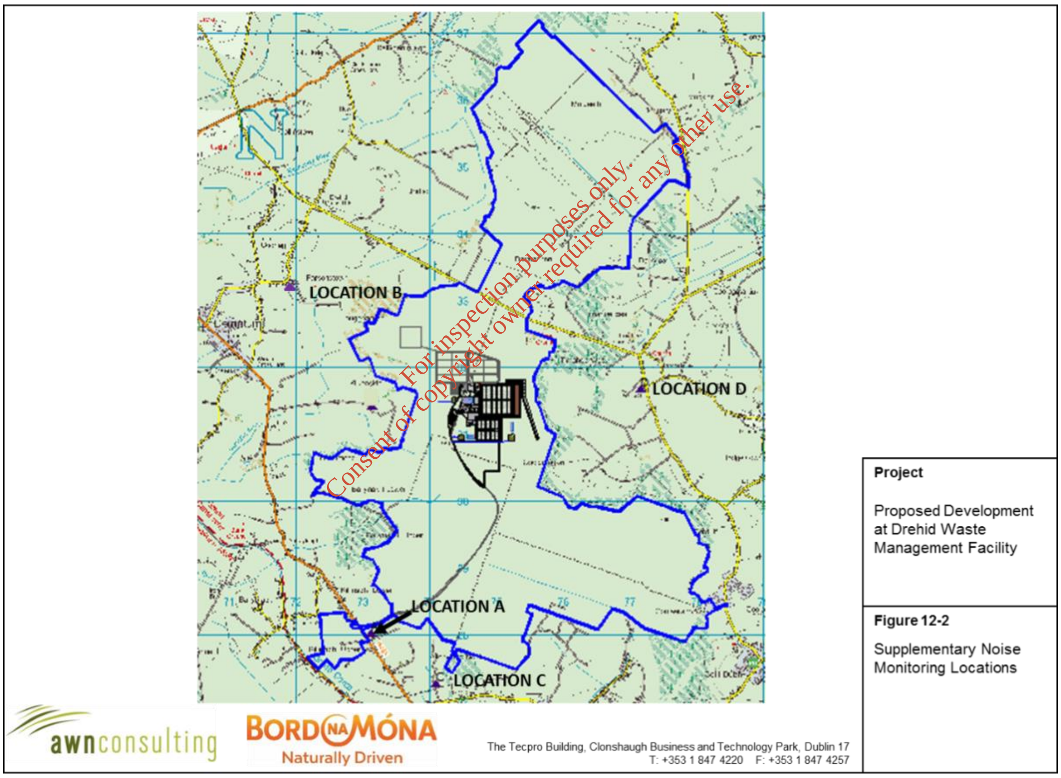


Figure 12.2: Supplementary Noise Monitoring Locations

12.2.2.2 Monitoring Periods and Weather

The daytime surveys undertaken by AWN Consulting were conducted on 11 and 12 July 2016. The night-time surveys were conducted on 18 January 2017. All survey periods were 30 minutes in duration with the exception of the second round of night-time surveys which were 15 minutes in duration. The surveys were undertaken during dry and very calm conditions with wind speeds less than <1 m/s. The same monitoring parameters were recorded as described in Section 12.3.1.3

12.2.2.3 Monitoring Results

The monitoring results for day and night-time periods for the four survey locations are summarised in Table 12-3: Baseline Noise Monitoring 2016/2017.

Table 12-3: Baseline Noise Monitoring 2016/2017

Monitoring Location	Time period	Date /Time	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}	Notes
A	Day	12:30	69	72	37	89	Road traffic along R403 Road and vehicles along site entrance road.
		16:12	70	74	42	89	
		11:53	70	72	39	90	
	Night	23:04	54	46	20	79	Occasional passing traffic along R403. No other significant noise sources, very quiet background noise.
		02:06	47	46	19	68	1 car passing. Distant traffic.
B	Day	13:13	43	45	37	66	Birdsong, leaf rustle, faint plant audible, flowing stream. Livestock noise within nearby field. Tractor within adjacent field
		16:53	40	41	35	62	As above
		12:17	44	43	33	66	As above, No tractor in adjacent field.
	Night	23:47	49	28	20	78	2 vehicles passing along local road. No other significant sources noted.
		02:27	39	32	21	57	No traffic passing monitoring location. Distant traffic.
C	Day	15:33	46	45	37	75	Birdsong, occasional passing traffic, traffic from R403 and Adjacent roads.
		11:17	45	41	33	72	As above, noise from community centre workshops. Children playing outside community centre.
		13:29	46	38	31	74	As above.
	Night	01:18	32	30	27	54	Occasional traffic on R403
		02:51	31	28	25	56	Distant traffic
D	Day	14:50	47	48	37	75	Birdsong, leaf rustle, 1 car passing along L1019
		10:30	39	40	32	64	As above, aircraft overhead. Plant noise faintly audible in background
		12:51	49	40	32	75	As above.
	Night	00:35	36	31	19	59	Very occasional traffic movements
		03:14	28	28	19	50	No passing traffic. No significant sources noted. Very faint distant traffic.

During daytime survey periods, measured noise levels were dominated by road traffic and environmental sources including livestock, birdsong and leaf rustle. During very calm and quiet periods, activity from the existing Drehid facility was audible at low level including mobile plant on site and plant noise. The ambient noise levels were typically in the range of 40 to 49 dB L_{Aeq} with higher noise levels recorded at Location A which was dominated by passing road traffic. The background noise levels recorded during the daytime period were typically in the range of 31 to 37 dB L_{A90} with higher values (up to 42 dB L_{A90}) recorded at Location A.

During the night-time period, noise levels were dominated by passing and distant traffic. Very calm conditions prevailed and hence in absence of leaf rustle or other wind generated noise, background noise levels were low. Operational plant within the existing Drehid waste management facility was not audible.

12.2.2.4 Summary of Baseline Noise Environment

The baseline noise environment in the vicinity of the existing waste management facility is low and typical of a rural setting. The operation of the waste management facility contributes to occasional audible noise levels external to the site at the nearest noise sensitive locations, predominately from on-site mobile plant items and background plant noise. The main sources of noise in the surrounding environment is from local road traffic. In the absence of the proposed development under consideration here, the baseline noise environment would remain similar to that recorded during baseline surveys.

12.3 CHARACTERISTICS OF PROPOSAL

The existing engineered landfill is currently permitted to accept 360,000 tonnes per annum (TPA) of municipal solid waste unit December 2017. Thereafter, waste for landfill disposal at the facility is limited to a maximum of 120,000 TPA. The composting facility is permitted to accept 25,000 TPA. As part of the proposed development, the following changes to the facility are being sought:

- Changes to the volume and nature of wastes to be accepted at the landfill disposal facility;
- Development of additional Non-hazardous and Hazardous Landfill capacity to provide for sustainable landfill of these waste streams for a period of twenty-five years;
- Pre-treatment or processing of certain waste streams prior to landfill;
- Increasing the volume of waste to be accepted at the composting facility, extending composting building, and the removal of the restriction on the operating life of the composting facility contained in Condition 2(2) of ABP Ref No. PL.09.212059;
- On-site treatment of leachate; and,
- Development of associated buildings, plant, infrastructure and landscaping.

A full description is included in Chapter 3 of this EIAR of all works associated with the proposed development.

Potential noise and vibration effects associated with the proposed scheme will be associated with the short term construction phase during the long term operational phase.

During the initial construction phase, excavation, site clearance, levelling, building construction, landscaping, internal road works and paving all have the potential to generate high levels of noise within the site. Vibration will be limited to any minor excavation works depending on ground conditions.

During the operational phase, the key potential sources of noise are associated with the following activities:

- Traffic entering and exiting the site;
- Mobile plant working at landfill areas during its ongoing construction, operation and capping;
- Mobile plant accessing various on-site buildings and waste handling areas;
- External operational plant and equipment;
- Noise breakout from operational activities within on-site buildings.

There are no significant vibration effects sources associated with the operational phase.

The proposed operational hours of the proposed development are between 07:30 and 19:00 Monday to Saturday with the proposed hours of waste acceptance between 07:30 and 18:30.

The potential effects associated with these phases are addressed in the following sections.

12.3.1 Future receiving environment / do nothing scenario

Under the Do-Nothing scenario, the proposed developments relating to the WMF are not in operation but the existing facility remains in place. From a noise point of view, existing noise levels recorded as part of the facilities annual compliance monitoring are expected to remain the same (Refer to Section 12.3). A Mechanical Biological Treatment (MBT) facility has been granted permission within the Bord na Móna Drehid landholding. Should this facility be built and commences operating prior to the proposed WMF, there is potential for noise levels to increase in the surrounding environment. An EIS has previously been prepared for the permitted MBT facility which included a noise impact assessment associated with the operation of the MBT on its surrounding environment (Drehid MBT Facility EIS, 2012). The noise impact assessment included predicted noise levels associated with the operation of the proposed MBT with the operation of the existing WMF in full operation. The calculations were made at the five noise monitoring locations N1 to N5 as described in Section 12.3.1.1 plus an additional location N6, located to the west of the landholding, south of location N1, representing the closest noise sensitive location along the western site boundary. The calculated noise levels associated with the MBT in isolation is insignificant at the nearest noise sensitive locations and when combined to the existing noise levels, no significant increase is predicted. Under this potential scenario, noise levels at the nearest noise sensitive locations all remain comfortably below the facilities operational day and night-time noise emission limit values.

Further discussion on the potential cumulative impacts is discussed in Sections 12.5.2.3 and Sections 12.5.3.3.

12.4 POTENTIAL EFFECTS ON NOISE & VIBRATION

12.4.1 Assessment Criteria

12.4.1.1 Construction Phase

Noise

There is no statutory guidance relating to the maximum noise level permitted during construction. Higher noise levels are generally accepted during a short-term construction phase of a project compared to its long-term operational phase, as construction works are temporary and tend to be varied.

Kildare County Council (KCC) include the following construction noise limits within the *Kildare Local Authorities Second Noise Action Plan (*2013 – 2018) in order to control construction noise impacts at noise sensitive buildings.

Table 12-4: Construction Noise Limits set by Kildare County Council

Day	Working Hours	Level, dB L_{Aeq}	Maximum, dB L_{Amax}
Monday to Friday	07:00 to 19:00	70	80
	19:00 to 22:00	60	65
Saturday	08:00 to 16:30	65	75
Sundays and Bank Holidays	08:00 to 16:00	60	65

It is expected that all construction works can be undertaken during normal daytime working hours between 07:00 and 19:00.

Vibration

The noise action plan does not contain guidance relating to vibration magnitudes or limit values. In this instance, best practice is taken from British Standard *BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Vibration*. This standard recommends that for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak component particle velocity (in frequency range of predominant pulse) of 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. The standard also notes that below 12.5 mm/s PPV the risk of damage tends to zero. It is therefore common, on a cautious basis to use this lower value.

Table 12-5: Recommended Vibration Criteria During Construction Phase summarises the proposed vibration limits during the construction phase for normal light framed structures and or residential buildings.

Table 12-5: Recommended Vibration Criteria During Construction Phase

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of:			
Building Type	**Less than 15 Hz**	**15 to 40 Hz**	**40 Hz and above**
Light framed structures/ residential buildings	12 mm/s	20 mm/s	50 mm/s
Reinforced or framed structures / industrial and heavy commercial buildings	50 mm/s		

12.4.1.2 Operational Phase

Noise

The existing waste management facility activites are licensed by the EPA in Licence (W0201-03). The licence includes operational noise emission limit values (ELV) which are specified under Schedule B *Emission Limits.* Schedule B.3 includes the relevant noise emission limits, reproduced below.

Table 12-6: Operational Noise ELV's from Waste Licence (W0201-03)

Daytime dB(A) $L_{Aeq,\ (30minutes)}$	Night-time dB(A) $L_{Aeq,\ (30minutes)}$
55 Note 1	45 Note 1

Note 1: There shall be no clearly audible tonal component or impulsive component in the noise emission from the activity at any noise sensitive location.

The time periods for day and night-time within the current licence are as follows:

- Daytime: 08:00 to 22:00
- Night-time: 22:00 to 08:00

Should permission be granted for the proposed development, an updated waste licence will be required from the EPA. In line with the EPA Guidance document (NG4 2016), a new evening period (19:00 to 23:00) will form part of the updated waste licence. A lower operational noise limit applies to the evening period, compared to the daytime and the time periods for daytime and night-time are subsequently altered. The following summarises the expected revised operational noise limits and their associated periods:

- Daytime: 07:00 to 19:00 55 dB(A) $L_{Aeq,30mins}$
- Evening: 19:00 to 23:00 50 dB(A) $L_{Aeq,30mins}$
- Night-time 23:00 to 07:00 45 dB(A) $L_{Aeq,30mins}$

The guideline values included within the EPA document are in line with those quoted by the World Health Organisation (WHO) within the document *Guidelines for Community Noise* (1999). This document notes the following with respect to noise and health effects:

The effects of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms, the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30 dB L_{Aeq} for continuous noise and 45 dB L_{AMax} for single sound events. Lower noise levels may be disturbing depending on the nature of the noise source. At night-time, outside sound levels about 1 metre from facades of living spaces should not exceed 45 dB L_{Aeq}, so that people may sleep with bedroom windows open.

To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces and in outdoor living areas.

The design criteria for noise within the EPA document is therefore set in order to avoid health effects for the surrounding population through avoidance of sleep disturbance, daytime annoyance or speech interference.

Vibration

There are no operational vibration limits set within the existing licence. There are no expected sources of vibration associated with the existing or the proposed operations, given the type of activity associated with the development and the distances to the nearest sensitive buildings. In this instance, operational vibration limits are not deemed necessary.

12.4.2 Construction Phase Impacts

12.4.2.1 Construction Noise

Construction works associated with the proposed development will involve excavation works, construction of buildings, landscaping and internal road works. Construction and development of the new Hazardous Landfill and on-going works at the Non-Hazardous Landfill form part of the on-going operations over the lifespan of the landfill and hence are assessed as part of the operational phase.

Due to the nature of the activities required to clear parts of the site and construct the various elements, there is potential for generation of high levels of noise within the site. The flow of vehicular traffic to and from a construction site is also a potential source of relatively high noise levels, the impact at nearby noise sensitive buildings will depend upon a number of variables, the most notable of which are:

- the amount of noise generated by plant and equipment being used at any one time generally expressed as a sound power level;
- the periods of operation of the plant at the development site, known as the "on-time";
- the distance between the noise source and the receptor;
- the attenuation due to ground absorption or barrier screening effects; and;

- reflections of noise due to the presence of hard vertical faces such as walls.

In terms of the proposed development under consideration here, the distance between the red line development boundary and the nearest noise sensitive receptors is such that noise levels generated on site will be significantly reduced due to attenuation with distance.

Given the construction will encompass a range of different activities on a day to day and week to week basis, it is not possible to calculate with a high degree of accuracy the specific levels of noise associated with each phase. It is possible, however, to determine a range of potential worst case scenarios which represent the key construction phases.

The nearest noise sensitive locations to the proposed development are located along the western and eastern site boundaries. The closest noise sensitive locations is approximately 850 m to the south west of the red line boundary whilst closest properties to the east are all in excess of 950 m.

Indicative noise levels associated with construction may be calculated in accordance with the methodology set out in *BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise*. This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations.

Using the typical noise levels for items of construction plant set out in *BS 5228-1:2009+A1:2014*, construction noise levels at specific distances have been calculated for the main construction activities associated with the project. Table 12-7 to Table 12-10 set out assumed plant items to be used during the construction with the associated source reference from BS 5228-1:2009+A1:2014. Construction noise calculations have been conducted at distances of 850 and 950 m representing the closest noise sensitive locations to the likely work phases.

The calculations assume that plant items are operating for 66%[71] of the time and that all plant items associated with the individual phases are operating simultaneously and at the same distance for any one scenario. The calculations do not take into account any screening between the works and nearest noise sensitive locations.

[71] This estimate that assumes that the plant will operate a full 8-hour shift over the proposed 12 hour working period which equates to a 66% on time over a daytime period or 40 minutes over a 1-hour period. The dynamic nature of construction sites is such that this is deemed to be a conservative estimate.

Table 12-7: Indicative Construction Noise Calculations during Site Preparation Works

Site Preparation Works (BS5228 Ref)	Calculated Noise levels at set distances, $L_{Aeq,1hr}$	
	850 m	950 m
Wheeled loader (C2-26) 2 x No.	42	41
Tracked excavator - loading dump truck (C1-10) 2 x No	48	47
Dozer (C.2.10) 2 x No	43	42
Dump Truck (C2.30) 2 x No	42	41
Combined L_{Aeq} from all activities	**50**	**49**

Table 12-8: Indicative Construction Noise Calculations during Foundation and Piling Works

Foundation & Piling Works (BS5228 Ref)	Calculated Noise levels at set distances, $L_{Aeq,1hr}$	
	850 m	950 m
Crawler Mounted Rig (C3.22), 2 x No.	43	39
Tracked Excavator inserting metal cage, (C3.24)	34	33
Concrete Pump & Cement Mixer Truck (C4.24)	27	26
Diesel Generator (C4.76)	21	20
Angle Grinder (C4.93)	40	39
Combined L_{Aeq} from all activities	**45**	**42**

Table 12-9: Indicative Construction Noise Calculations during General Construction Works

General Construction (BS5228 Ref)	Calculated Noise levels at set distances, $L_{Aeq,1hr}$	
	850 m	950 m
Concrete Pump & Cement Mixer Truck (C4.24) 2 x No.	30	29
Angle Grinder (C4.93) 2 x No.	43	42
Mobile Telescopic Crane (C4.45) 2 x No.	45	44
Hand Held Circular Saw (C4.72), 2 x No.	42	41
Dozer (C.2.10), 2 x No.	43	42
Combined L_{Aeq} from all activities	**49**	**48**

Table 12-10: Indicative Construction Noise Calculations during Road and Paving Works

Road Works (BS5228 Ref)	Calculated Noise levels at set distances, $L_{Aeq,1hr}$	
	850 m	**950 m**
Tracked excavator (C2.21)	31	30
Dump Truck (C2.30)	39	38
vibration rollers (C5.20)	35	34
Asphalt Paver & Tipping Lorry (C.5.31)	37	36
Diesel Generator (C4.76)	21	20
Road Rollers (C5.19)	40	39
Combined L_{Aeq} from all activities	**44**	**43**

The construction noise calculations indicate that noise levels associated with the various phases can comfortably work within the recommended daytime weekday, evening and weekend construction noise criteria at the nearest noise sensitive locations. In addition, given the low noise levels calculated and the distances involved, the maximum noise levels associated with the construction phase are expected to be well within the limit values set in Table 12-4. The calculated noise levels are also all below the operational daytime noise limits of 55 dB L_{Aeq} for the facility.

12.4.2.2 Construction Vibration

Potential for vibration impacts during the construction phase programme will be limited given the minimal level of intrusive works required as part of the construction phases. Vehicles used to transport building materials to and from the site will also not result in any significant vibration levels. During the construction of new buildings, the use of piling may be required for building foundations. The use of augured piling generates the lowest levels of vibration whilst the use of impact driven piles generate the highest. For the purposes of this assessment, therefore, vibration levels associated with driven piles are assessed in order to determine potential worst case impacts. British Standard BS 5228 – Part 2: Vibration, includes measured magnitude of vibration associated with different piling types.

Table 12-11: Vibration Magnitudes associated with Sheet Steel Pilingreproduces those associated with steel sheet piling.

Table 12-11: Vibration Magnitudes associated with Sheet Steel Piling

Soil Conditions	Pile Dimensions	Distance, m	PPV, mm/s
Very soft to soft (0 – 10 m), soft to medium clay (10 – 20 m)	U-shaped LX 16 sheet piles	4.8 – 24	4.3 – 0.5
(not provided)	U-shaped piles	7.1	0.3 – 0.7
Made ground 0 – 3 m, loose and very dense sand and silt 3 – 17 m, firm to stiff clay 17 – 25 m	244 mm diameter driven tubular steel piles	5 – 20	13.9 – 4.3
Made ground 0 – 3 m, loose and very dense sand and silt 3 – 17 m, firm to stiff clay 17 – 25 m	275 mm driven square piles	5 – 20	11.4 – 4.3

The vibration magnitudes outlined in Table 12-11 indicate that at distances beyond 20 m, vibration magnitudes are significantly reduced to well below those associated with any form of cosmetic damage to buildings. Considering the of low vibration levels beyond the immediate site works, vibration levels at the nearest buildings, in excess of 850 m from the red line boundary are not expected to pose any notable impact in terms of cosmetic or structural damage given the significant distance. In addition, the range of vibration levels would also be below a level which would cause any disturbance to occupants of nearby buildings.

Considering the magnitude of vibration associated with the proposed site works as well as the nature of the under burden, vibration levels at the nearest buildings are not expected to pose any significance in terms of building damage or human perception. The likely vibration impacts during the construction phase are deemed to be neutral effect and of imperceptible significance.

Notwithstanding the above, any construction activities undertaken on the site will be required to operate below the recommended vibration criteria set out in Table 12-5 during all activities.

12.4.2.3 Cumulative Construction Impacts

In the unlikely event that the permitted MBT facility is constructed at the same time as the proposed WMF, there is potential for higher noise levels to occur at the nearest noise sensitive locations over and above those included in Table 12-7 to Table 12-10. Reference to indicative construction noise calculations included in the EIS for the proposed MBT at the nearest noise sensitive locations are all significantly below the construction noise criteria, calculated in the range of 35 to 52 dB L_{Aeq} (Drehid MBT Facility EIS, Table 9.4, 2012). The potential cumulative noise impacts during this scenario will therefore remain below the construction noise limits at the nearest noise sensitive locations.

12.4.3 Operational Phase Impacts

12.4.3.1 On-site Noise Sources

Once operational, the potential noise sources associated with the proposed development will be from traffic entering and exiting the site, mobile plant working at landfill areas, mobile plant accessing composing and waste treatment buildings, external operational plant and equipment, and any noise breakout from operational activities within on-site buildings.

In order to assess the potential impacts from this phase, a 3D noise model of the proposed development layout was developed, using the following information, provided by the design team:

- OS mapping of surrounding environment;
- Layout plans of proposed development areas,
- Operational plant and equipment types;
- 3D ground contour data; and
- Future predicted traffic flow data entering and exiting the site.

The model developed using a proprietary noise calculation package Brüel & Kjær Type *Predictor.* This is an acoustic modelling package for computing noise levels in the vicinity of different types of noise sources. The calculation standard used in the model for fixed plant and industrial type sources is *ISO 9613-2:1996 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation*. For road traffic noise, the model calculates noise levels in accordance with the UK's *Calculation of Road Traffic Noise* (CRTN - 1988) standard.

The model takes account of the various factors affecting the propagation of sound in accordance with the standard, including:

- the magnitude of the noise source in terms of sound power;
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- attenuation due to atmospheric absorption; and
- meteorological effects such as wind gradient, temperature gradient and humidity.

<u>Non-Hazardous Landfill</u>

As part of the proposed development, it is proposed to provide a Non-Hazardous Landfill up to 250,000 tonnes per annum within the northeast of the development area. This landfill will operate for a period of

25 years and will be divided into 12 phases. The operational hours of this area will be between 07:30 and 19:00. The development of each phase is proposed as follows:

- Construction 0.5 Year
- Operation 2.5 Years
- Capping 2 Years

The key sources of noise from this area of the site will be from delivery vehicles and mobile plant used for clearance, waste deposition and capping. These will essentially be the use of excavators, dump trucks and dozers. For the purpose of this assessment, the use of 1 excavator, 1 dump truck and 1 dozer has been modelled to operate for 66% of the operating day. Given the location of mobile plant within the landfill areas will alter as works progress over the different phases, the location of mobile plant has been modelled along each of the closest boundaries to noise sensitive locations for a range of scenarios. The highest operational noise level calculated for each property has been used for the assessment.

Source data has been taken from BS 5228-1:2009+A1:2014 for the above items of plant, as follows:

Table 12-12: Source Noise Levels Used for Landfill Operations

Plant Item	BS 5228 Ref	dB L_{Aeq} at 10 m
Dozer	C2.10	80
Dump Truck (Tipping Fill)	C2.30	79
Tracked Excavator	C2.14	79

All source data is modelled using an A-weighted octave band spectrum. Octave band data for each of the plant items listed above are provided for in *BS 5228-1:2009+A1:2014*.

<u>IBA Reception & Metals Recovery Facility</u>

This area will be used to recover ferrous and non-ferrous metals from Incinerator Bottom Ash (IBA) prior to the IBA being deposited within the Non-Hazardous Landfill. The recovery system and operations are fully enclosed within the Metals Recovery building. HGV's will deliver the IBA into the Reception and Maturation building to be deposited in a storage area. After the maturation period, the IBA will be transferred to the Metals Recovery Facility. Within this building, the main internal processes will include screening and crushing of material and separating the ferrous and non-ferrous metals from the IBA material. External items of plant include an infeed hopper and de-dusting system. Following processing, residual ash will be loaded onto vehicles for deposition within the Non-Hazardous Landfill whilst the recovered material will be transported offsite. The operational hours of this area will be between 07:30 and 19:00.

In order to model the noise sources from this area, the following assumptions were used, as provided by the design team. In the absence of known operational noise levels associated with each plant item, the following noise levels have been set as maximum noise levels. These will be the upper limit allowable for the plant items on site which will form part of the facilities detailed design. For the majority, the noise levels used are considered to be conservative in order to present a robust worst case scenario.

Table 12-13: Source Noise Levels Used for Non-Hazardous Pre-Processing Area

Plant Item	Quantity	Location	dB L_{Aeq} at 10 m (each item)
Infeed Hopper	1	External	75
Fixed screens	1	Internal	80
Crusher	1	Internal	85
Flip-flop screens	4	Internal	80
Ferrous Separator	1	Internal	75
Eddy current Separators	5	Internal	85
Conveyors	20	Internal	76
Fans	5	Internal	55
De-dusting system	1	External	70

Octave band data for all items are taken from empirical formulae for similar items of operating plant. For items within the pre-treatment building, reverberant noise levels are calculated from the source levels listed above and the level of noise breakout via the roof and walls has been calculated assuming a standard industrial light-weight sandwich panel construction (Kingspan KS 1000 or similar) with a sound reduction value of 24 dB R_w.

Hazardous Landfill

The proposed development includes for a Hazardous Landfill south of the non-hazardous landfill within the eastern part of the development area. This landfill has a proposed capacity of approximately 85,000 TPA with a life span of 25 years which will be divided into 10 phases. The phasing durations are the same as those for the non-hazardous landfill set out in Section 12.5.3.1. The number and type of mobile plant listed in Table 12-12 has been used for the operation of the Hazardous Landfill. The operational hours of this area will be between 07:30 and 19:00.

Ash Solidification Facility

This facility will be used for pre-treatment of fly ash and flue gas treatment residues prior to disposal in the hazardous waste facility. Activities associated with this area include tankers delivering residues into the enclosed building of the Ash Solidification Facility. Process water will be provided by reusing the leachate from the hazardous landfill, which will be pumped from external bunded process water storage tanks. The solidified material will be batched and loaded onto vehicles for disposal within the hazardous landfill. All activities are enclosed within the pre-treatment building with the exception of the screw conveyors which will connect the silos to the pre-treatment internal plant. Internal equipment will include mixers and an OCU/scrubber. The operational hours of this area will be between 07:30 and 19:00.

In order to model the noise sources from this area, the following assumptions were used, as provided by the design team. In the absence of known operational noise levels associated with each plant item, the following noise levels have been set as maximum noise levels. These will be the upper limit allowable for the plant items on site which will form part of the facilities detailed design.

Table 12-14: Source Noise Levels Used for Hazardous Pre-Processing Area

Plant Item	Number	Location	dB L_{Aeq} at 10 m (each item)
Screw Conveyors	12	External	65
Mixer	2	Internal	82
OCU/scrubber	1	Internal	85
Silo Vibrators Note 1	12	External	78

Note 1 This value has been assumed for each vibrator. During the design stage, the choice of silo vibrator should be selected with the lowest noise characteristics, i.e. avoidance of impact (hammer/piston) style vibrators with preference for the use of electric, GT Turbine or damped silent linear type silo vibrators.

Octave band data for all items are taken from empirical formulae for similar items of operating plant. For items within the solidification building, reverberant noise levels are calculated from the source levels listed above and the level of noise breakout via the roof and walls has been calculated assuming a standard industrial light-weight sandwich panel construction (Kingspan KS 1000 or similar) with a sound reduction value of 24 dB $R_{w.}$

Composting Facility

It is proposed to increase the volume of waste to be accepted at the existing composting facility from 25,000 TPA to 45,000 TPA. This can be undertaken without the need for any physical development of the current facility. In addition, it is proposed to extend the existing facility to provide for the acceptance of an additional 45,000 TPA. It is anticipated that the latter will require an approximate doubling of the currently permitted footprint of this facility.

Vehicles will deliver material into the composting building for storage and treatment. Internal activities include shredding, screening and sifting of materials. All operational plant and equipment is fully housed within the building. The operational hours of this area will be between 07:30 and 19:00 with the exception of the compost fans (enclosed) which will run on a continual basis.

In order to model the noise sources from this area, the following assumptions were used, as provided by the design team. The following noise levels have been set as maximum noise levels. These will be the upper limit allowable for the plant items on site which will form part of the facilities detailed design.

Table 12-15: Source Noise Levels Used for Composting Facility

Plant Item	Number	Location	dB L_{Aeq} at 10 m (each item)
Shredder	1	Internal	85
Overband magnet	1		65
Starscreen	1		75
Windsifter	1		75
Flip flow screen	1		75
Conveyors	10		86
12 no. 30kW fans	12		86
1 no. 11kWfan	1		75
1 no. 90kW fan	1		65

The same sound insulation value used for the other on-site buildings (24Rw) has also been used for the composting facility.

Leachate Treatment Facility

A new leachate treatment facility will be constructed as part of the proposed development. A small number of pumps and aerators will operate within the treatment tanks, however, these will all be submerged and hence any noise contribution from these sources will be negligible immediately beyond the leachate treatment area. There are two external fans within this area which will be used to for the OCU. An operational noise limit value of 60 dB L_{Aeq} at 10 m has been modelled for each of these fans.

On-site vehicle Movements

In addition to the fixed working areas noted in the sections above, the noise model has also accounted for on-site vehicle movements along the haul road, leading from the R403 to the parking areas, waste storage area and treatment, landfill areas and the proposed MBT facility.

In order to account for a worst-case assessment, traffic volumes during the year 2019 have been used within the model assuming simultaneous construction and operation of the Drehid WMF in addition to the operation of the MBT facility. This relates to the highest year of traffic flow associated with the proposed development (Please refer to Chapter 10 for full discussion on traffic analysis).

Review of traffic data accessing the site indicates that during ‘off-peak’ hours (10:00 to 11:00 & 15:00 to 16:00), Heavy Good Vehicles (HGV’s) are higher than those during normal AM and PM peaks. The number of Light Good Vehicles (LGV’s) is similar to those associated with the peak hours. In order to assess a worst case analysis, therefore, traffic flow associated with the off-peak hours have been modelled. This equates, in the worst-case scenario (PM off peak), to 396 LGV’s and 94 HGV’s per hour accessing the site along the haul road. These flows relate to the proposed development and existing traffic at the facility.

Traffic is only permitted to enter and exit the site during daytime period (07:00 to 19:00) therefore, no haul road traffic is modelled during evening or night-time periods. A “moving source” has been modelled along the internal roads within the facility and the landfill areas using a noise source data for an articulated dump truck of 81 dB at 10 m in line with BS5228 Source C.2.33 and a vehicle drive by for a LGV of 62 dB at 10 m. Modelled Results

Noise levels have been modelled at a total of 17 locations surrounding the development site, representing the closest noise sensitive locations to the proposed facility. These locations are illustrated in Figure 12.3: Noise Modelling Locations. Table 12-16: Operational Noise Levels, presents the calculated noise levels at each of the assessment locations taking account of the operational noise sources and assumptions outlined above assuming the highest traffic volumes over a one hour period.

Results are calculated for the daytime (07:00 to 19:00, evening (19:00 to 23:00) and night-time period (23:00 to 07:00). The sources included in the model are operating continually (with exception of landfill items of mobile plant which are modelled as 66% over the full working day). For any given time period, therefore the calculated L_{Aeq} will be the same. The results are presented here for a 30minute L_{Aeq} to compare against the facilities EPA noise licence limits.

The calculated noise level at the closest noise sensitive locations to the development site include all of the sources described in Section 12.5.3.1 in operation simultaneously.

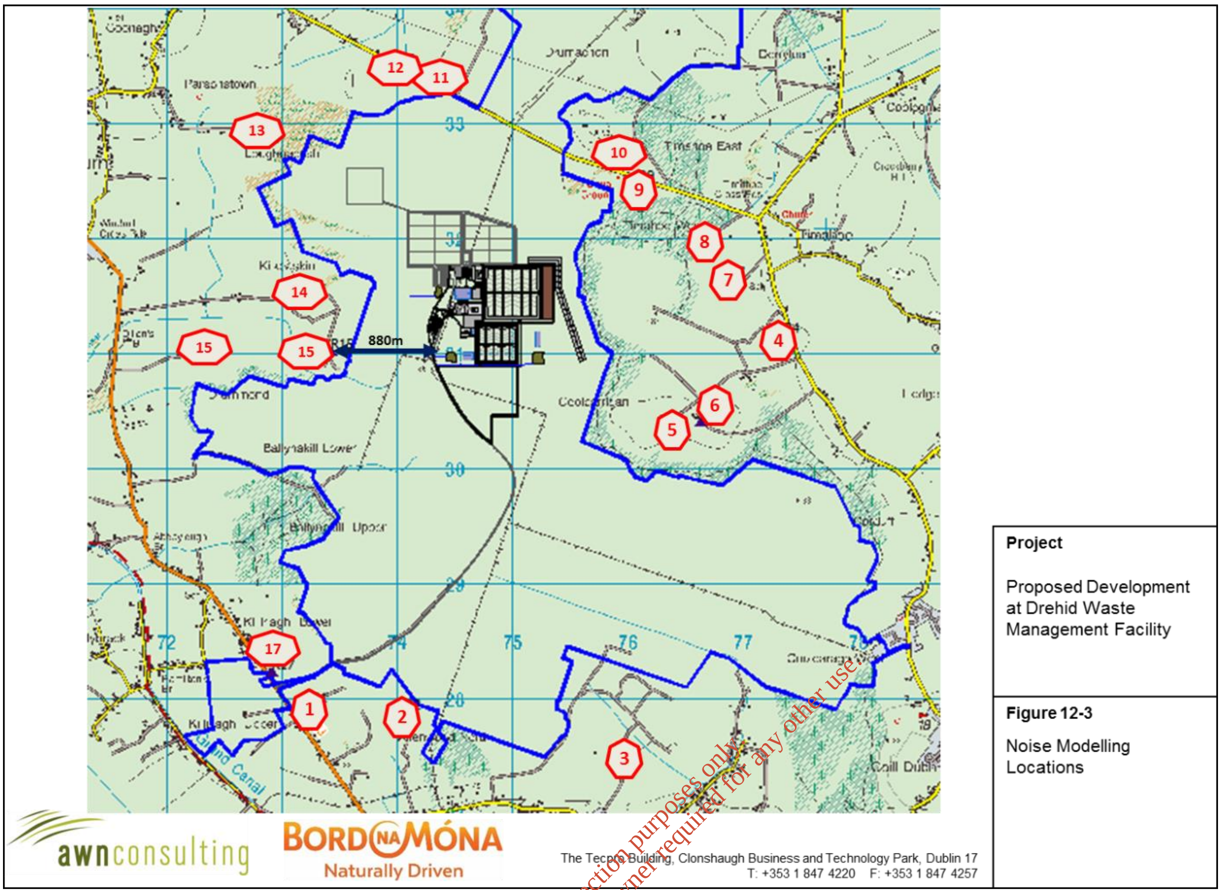


Figure 12.3: Noise Modelling Locations

Table 12-16: Operational Noise Levels

Modelled Location Ref	Description	Calculated Noise Level, dB $L_{Aeq,30mins}$		
		Daytime	Evening	Night-time
R1	South. Off R403 Road (Killinagh Upper)	51	--	--
R2	South – Allenwood North	46	--	--
R3	Southeast - Allenwood	34	--	--
R4	East along L1019	29	--	--
R5	East - Coolcarrigan	41	11	12
R6		40	10	11
R7	Northeast – Timahoe west	37	11	11
R8		36	10	10
R9	Northeast – Timahoe east	39	15	15
R10		39	16	16
R11	Northwest Drumachon	37	15	16
R12		35	13	14
R13	Northwest - Loughnacush	26	11	11
R14	West - Killkeaskin	42	16	17
R15		45	17	18
R16	West - Drummond	36	11	11
R17	South – off R403 (Killinagh Lwr)	52	--	--

Note: " - -" Indicates that the contribution of on-site sources at these locations is below model calculation range. These are all below a level of 1 dB(A)

Daytime Periods

During the daytime periods, calculated noise levels are between 26 and 52 dB L_{Aeq}. Highest noise levels are calculated at modelled locations R1 and R17, located off the R403 road and are dominated by traffic along the internal haul road. Similarly, the next highest modelled noise levels are at locations R2 and R15 located to the south east and west of the facility and are also dominated by traffic along the internal haul road. At the remaining locations, noise levels are in the range of 26 to 41 dB L_{Aeq} and are influenced by external mobile plant at the landfill areas, external fixed plant items, internal site movements and lorry movements along the internal haul road. Due to the extensive distances between the nearest noise sensitive locations and the site activities, the overall contribution of the operational site is low and below the daytime noise limit value of 55 dB L_{Aeq}.

Evening Periods

During the evening periods, the only operational sources are fans within the compost facility. Noise levels are calculated between <10 to 17 dB L_{Aeq} from this source. This source only contributes to those noise sensitive locations along the east, west and northern boundaries. Due to the extensive distance between this source and properties to the south of the facility (2.5 km to 4 km) the noise contribution at these distances is negligible. The contribution of noise levels from the proposed facility during evening periods are well below the evening noise limit value of 50 dB L_{Aeq}.

Night-time Periods

Similar to the evening period, the only operational sources are fans within the compost facility. The same noise levels are calculated for the night-time period and are all below 20 dB L_{Aeq}. The contribution of noise levels from the proposed facility during night-periods are well below the night-time noise limit value of 45 dB L_{Aeq}.

It can be concluded that, once operational, noise levels associated with the proposed development will be well within the day, evening and night-time noise limit values under the worst case scenarios assessed.

12.4.3.2 Traffic Along Surrounding Roads

Traffic travelling to and from the facility will involve potential increases to traffic flows along the surrounding road network. A detailed analysis of traffic generation and traffic impacts has been undertaken and is included in Chapter 10 of this EIAR. Information from the traffic analysis has been used to determine the potential noise changes along the surrounding road network assuming the tested traffic scenarios.

In order to conduct a worst-case analysis, the Traffic 'Scenario 1' has been used for the assessment of noise impacts. This assumes the Drehid WMF is operational after 1st December 2017, accepting 120,000 TPA of Municipal Solid Waste (MSW) and with both the proposed development and the permitted Mechanical Biological Treatment (MBT) facility having been constructed and both being operational in the last quarter during 2019. This will include the composting facility extension, which will be extended in 2019 and become operational in the same year. Therefore, the years of assessment which apply to this scenario are 2019 and 2024.

Two traffic stress tests were analysed for noise:

Stress Test 2: This assumes 67% traffic travels to/from the north and 33% traffic travels to/from the south.

Stress Test 4: This assumes 33% traffic travels to/from the north and 67% traffic travels to/from the south.

The traffic volumes along the affected link roads where traffic will travel have been used to calculate the change in traffic noise levels. In this instance, it is possible to determine the change in noise level by calculating the contribution of noise levels from light good vehicles (LGV's) and Heavy Good Vehicles (HGV's) for both the Do Nothing and Do Something scenarios and calculating the change in noise levels experienced along a road.

Table 12-17: Change in Traffic Noise Levels along Surrounding Road Links – Test 2: 2019 and Table 12-18: Change in Traffic Noise Levels along Surrounding Road Links – Test 2: 2024, present the calculated change in noise levels for the traffic stress Test 2 for both the year 2019 and 2024 using Annual Average Daily Traffic (AADT) Flows. The road links are presented in Figure 8108-1013 of the EIAR.

Table 12-17: Change in Traffic Noise Levels along Surrounding Road Links – Test 2: 2019

Road Link	AADT 2019 Base		AADT 2019 Base + Development		Calculated Change in Noise Levels, dB L_{Aeq}
	Total Vehicles	HGV's	Total Vehicles	HGV's	
M04-20	45,009	4,154	45,502	4,337	+0.2
ATC1	5,993	447	6,486	630	+1.2
ATC2	7,967	478	8,460	661	+1.0
ATC3	6,286	319	6,779	502	+1.4
Site Entrance (N)	5,313	804	5,806	987	+0.8
Site Entrance (S)	5,313	804	5,556	894	+0.4
ATC4	5,119	557	5,362	647	+0.6
ATC6	4,060	269	4,303	359	+0.9
ATC7	7,611	466	7,854	556	+0.6
ATC9	8,323	552	8,566	642	+0.5
ATC10	13,039	553	13,282	643	+0.4
ATC11	4,045	185	4,288	275	+1.2
ATC12	3,903	138	4,146	228	+1.4
ATC13	12,683	486	12,926	576	+0.4
M07-35	36,714	2,702	36,957	2,792	+0.1
M07-25	59,717	6,228	59,960	6,319	+0.1
KCC-Site C	6,687	69	6,930	159	+1.3
KCC-Site D	4,488	46	4,731	136	+1.8

Table 12-18: Change in Traffic Noise Levels along Surrounding Road Links – Test 2: 2024

Road Link	AADT 2024Base		AADT 2024 Base + Development		Calculated Change in Noise Levels, dB L_{Aeq}
	Total Vehicles	HGV's	Total Vehicles	HGV's	
M04-20	47,259	4,631	47,421	4,691	+0.0
ATC1	6,300	499	6,462	559	+0.4
ATC2	8,383	534	8,545	594	+0.3
ATC3	6,617	356	6,779	416	+0.5
Site Entrance (N)	5,558	897	5,720	957	+0.3
Site Entrance (S)	5,558	897	5,638	926	+0.1
ATC4	5,369	622	5,449	652	+0.2
ATC6	4,270	300	4,350	330	+0.3
ATC7	8,008	519	8,088	548	+0.2
ATC9	8,754	616	8,834	646	+0.2
ATC10	13,734	617	13,814	646	+0.1
ATC11	4,260	206	4,340	236	+0.4
ATC12	4,113	154	4,193	183	+0.5
ATC13	13,362	542	13,442	572	+0.1
M07-35	38,595	3,014	38,675	3,044	+0.0
M07-25	58,407	5,403	58,487	5,432	+0.0
KCC-Site C	7,058	77	7,138	106	+0.4
KCC-Site D	4,737	51	4,817	80	+0.6

For Stress Test 2, assuming the north- south traffic split detailed above, the greatest increase in traffic noise is calculated at KCC Site D (R416 between Milltown and Athgarvan). A noise level increase of 1.8 dB (A) is calculated along this road. Along all other links, the calculated change in noise level is less than 1.5 dB (A). During the year 2024, lower traffic volumes are associated with the operation of the proposed development and hence changes in traffic noise are less (<1 dB (A)). Further discussion on changes in traffic noise is presented below.

Table 12-19: Change in Traffic Noise Levels along Surrounding Road Links – Test 4: 2019 and Table 12-20: Change in Traffic Noise Levels along Surrounding Road Links – Test 4: 2024, present the calculated change in noise levels for the traffic stress Test 4 for both the year 2019 and 2024.

Table 12-19: Change in Traffic Noise Levels along Surrounding Road Links – Test 4: 2019

Road Link	AADT 2019 Base		AADT 2019 Base + Development		Calculated Change in Noise Levels, dB L_{Aeq}
	Total Vehicles	HGV's	Total Vehicles	HGV's	
M04-20	45,009	4,154	45,252	4,244	+0.1
ATC1	5,993	447	6,236	537	+0.6
ATC2	7,967	478	8,210	568	+0.5
ATC3	6,286	319	6,529	409	+0.7
Site Entrance (N)	5,313	804	5,556	894	+0.4
Site Entrance (S)	5,313	804	5,806	987	+0.8
ATC4	5,119	557	5,612	740	+1.1
ATC6	4,060	269	4,553	452	+1.7
ATC7	7,611	466	8,104	649	+1.1
ATC9	8,323	552	8,816	735	+0.9
ATC10	13,039	553	13,532	736	+0.8
ATC11	4,045	185	4,538	368	+2.1
ATC12	3,903	138	4,396	321	+2.4
ATC13	12,683	486	13,176	669	+0.9
M07-35	36,714	2,702	37,207	2,885	+0.2
M07-25	59,717	6,228	60,210	6,411	+0.1
KCC-Site C	6,687	69	7,180	252	+2.3
KCC-Site D	4,488	46	4,981	229	+3.1

Table 12-20: Change in Traffic Noise Levels along Surrounding Road Links – Test 4: 2024

Road Link	2024 Base		2024 Base + Development		Calculated Change in Noise Levels, dB L_{Aeq}
	Total Vehicles	HGV's	Total Vehicles	HGV's	
M04-20	47,259	4,362	47,339	4,391	0.0
ATC1	6,300	470	6,380	499	+0.2
ATC2	8,383	503	8,463	532	+0.2
ATC3	6,617	335	6,697	365	+0.2
Site Entrance (N)	5,558	841	5,638	870	+0.1
Site Entrance (S)	5,558	841	5,720	900	+0.3
ATC4	5,369	584	5,531	644	+0.4
ATC6	4,270	283	4,432	343	+0.6
ATC7	8,008	490	8,170	550	+0.4
ATC9	8,754	580	8,916	640	+0.3
ATC10	13,734	582	13,896	642	+0.3
ATC11	4,260	195	4,422	254	+0.8
ATC12	4,113	146	4,275	205	+0.9
ATC13	13,362	512	13,524	571	+0.3
M07-35	38,595	2,841	38,757	2,900	+0.1
M07-25	58,407	6,092	58,569	6,151	0.0
KCC-Site C	7,058	73	7,220	132	+0.8
KCC-Site D	4,737	48	4,899	108	+1.2

For Stress Test 4, assuming the north-south traffic split detailed above, the greatest increase in traffic noise is calculated during the year 2019 for KCC Sites C and D with increases of 2.3 to 3.1 dB(A) calculated. At links ATC 11 (R408 Road) and ATC 12 (R415 Road) noise level increases of 2.1 and 2.4 dB (A) respectively were calculated, which is governed by the increase in HGV's along this link during the Do Something scenario. Along all other links, the calculated change in noise level is less than 2 dB (A). During the year 2024, lower traffic volumes are associated with the proposed facilities operation and hence changes in traffic noise are less.

It should be noted that the traffic volumes used in the calculations are based on the annual average daily traffic spread over a 24-hour period, however, the additional traffic volumes to and from the proposed development will be limited between 07:30 and 19:00. In this instance, the increase in noise levels presented in the above tables will be higher during certain periods, particularly during peak hours.

In order to assess the potential increase in traffic volumes during the morning AM and PM peak periods, traffic volumes along the R403 accessing the site to the north and south have been assessed for the following stress tests:

- All traffic entering / exiting the site will travel in one direction only (100% north or 100% to the south along the R403. (Stress tests 1 and 5)
- Traffic will split in a 67% / 33% mode either north or the south. (Stress tests 2 and 4).

Table 12-21: Change in Traffic Noise Levels– AM and PM Peak – Stress Test 1 and 5 presents the calculated increase in noise level along the R403 assuming all traffic to and from the site travels north only (Stress Test 1) and also assessing all site travelling south only (Stress Test 5). Both these options are highly worst case and highly unlikely.

Table 12-21: Change in Traffic Noise Levels– AM and PM Peak – Stress Test 1 and 5

Tested Scenario	Stress Test 1 & 5				
	2019 Base		2019 Base + Development		Calculated Change in Noise Level, dB
	LGV's	HGV 's	LGV's	HGV 's	
R403 North of site access AM Peak. 100% traffic to North	390	23	743	51	+3.2
R403 North of site access PM Peak – 100% traffic to North	443	23	826	51	+3.2
R403 South of site AM Peak 100% traffic to South	395	46	748	78	+2.4
R403 South of site PM Peak 100% traffic to South	446	23	829	53	+3.3

The calculated change in noise level is up to 3 dB along the R403 in the event that all traffic travels to the along the R403 north during the AM and PM peak periods. In the event that all traffic travels south, the calculated increase in traffic noise is between 2.4 and 3.3 dB during the AM and PM peak hours respectively. The changes in noise level take account of exiting (base) traffic along the road and the addition of traffic from the proposed facility.

Table 12-22: Change in Traffic Noise Levels– AM and PM Peak – Stress Test 2 and 4 presents the calculated increase in noise level along the R403 assuming 67% of traffic travels to the north and 33% to the south (Stress Test 2) and the reverse for Stress Test 4.

Table 12-22: Change in Traffic Noise Levels– AM and PM Peak – Stress Test 2 and 4

Tested Scenario	Stress Test 2 & 4				
	2019 Base		2019 Base + Development		Calculated Change in Noise Level, dB
	LGV's	HGV 's	LGV's	HGV 's	
R403 North of site access AM Peak. 67% North 33% South	390	23	628	43	+2.5
R403 North of site access PM Peak. 67% North 33% South	443	23	701	43	+2.5
R403 South of site AM Peak. 67% South 33% North	395	50	633	70	+1.6
R403 South of site PM Peak. 67% South 33% North	446	25	704	45	+2.4

The calculated change in noise level is up to 3 dB along the R403 North with 67% of traffic travelling in this direction during the AM and PM peak periods. Under the reverse scenario, the calculated increase in traffic noise is between 2 and 2.4 dB along the R403 South assuming 67% of traffic travels south during the AM and PM peak hours respectively. The changes in noise level take account of exiting (base) traffic along the road and the addition of traffic from the proposed facility.

In order to assist with the interpretation of the noise associated with vehicular traffic on public roads, Table 12-23: Subjective Impacts Associated with Changes in Traffic Noise Levels, offers guidance as to the likely impact associated with any particular change in traffic noise level (Source DMRB, 2011).

Table 12-23: Subjective Impacts Associated with Changes in Traffic Noise Levels

Change in Sound Level	Subjective Reaction	Magnitude of Impact
0	Inaudible	No Impact
0.1 – 2.9	Barely Perceptible	Negligible
3 – 4.9	Perceptible	Minor
5 – 9.9	Up to a doubling of loudness	Moderate
10+	Doubling of loudness and above	Major

For the majority of road links, due to the existing volume of traffic and that projected for the future baseline years, the addition of traffic volumes associated with the proposed development will not lead to any significant subjective change in noise level. The increase in traffic noise along the majority of link roads over a daytime period will be of the order of or less than 3 dB (A) which is defined as being of negligible to minor impact. The greatest increase in traffic noise is calculated during the peak traffic periods with noise level increases of up to 4 dB calculated.

An increase of this magnitude is of minor impact and would be perceptible. Further detail on the Traffic Impact Assessment, is given in Chapter 10 of this EIAR.

It should be noted, that the calculations set out herein are based on a series of worst case tested scenarios whereby all existing, permitted and proposed operations within the landholding are operational.

12.4.3.3 Cumulative Operational Impacts

Cumulative impacts will include the operation of the existing WMF, the permitted MBT and the proposed development operating simultaneously. An EIS has previously been prepared for the permitted MBT facility which included a noise impact assessment associated with the operation of the MBT on its surrounding environment (Drehid MBT Facility EIS, 2012). The noise impact assessment included predicted noise levels associated with the operation of the MBT in isolation, in addition to noise levels calculated for the operation of the existing WMF in full operation. The calculations were made at the five noise monitoring locations N1 to N5 as described in Section 12.3.1.1 plus an additional location N6, located to the west of the landholding, south of location N1, representing the closest noise sensitive location along the western site boundary. In order to assess the potential cumulative noise levels associated with the addition of the proposed development, noise levels were calculated at the 6 noise monitoring locations and the results have been added to those previously calculated for the existing WMF and the permitted MBT operations.

Table 12-24: Cumulative Noise Impacts Associated with Existing, Permitted and Proposed Operations presents the cumulative daytime noise levels.

Table 12-24: Cumulative Noise Impacts Associated with Existing, Permitted and Proposed Operations

Source	Calculated Noise Levels at Noise Monitoring Locations, $L_{Aeq,T}$					
	N1	N2	N3	N4	N5	N6
Existing WMF note 1	36	38	44	30	32	35
Permitted MBT note 2	31	29	31	27	40	35
Proposed development note 3	42	38	41	52	47	45
Cumulative	43	41	46	52	48	46

Note 1: Calculated Noise Levels for the existing WMF are taken from EIS prepared for the *Drehid WMF Intensification and Extension* (2008) and include a series of worst case assumptions.

Note 2 Calculated Noise Levels for the MBT are taken from EIS prepared for the *Drehid MBT Facility* (2012) and include the worst case operational levels associated with MBT 'Configuration B'.

Note 3 Calculated Noise levels for the proposed development are based on the noise model assumptions set out in Sections 12.5.3.1 to 12.5.3.6.

The cumulative noise levels presented in Table 12-24, for all potential cumulative operations within the Drehid landholding, indicate that daytime noise levels are still well below the daytime noise limits of 55 dB $L_{Aeq,T}$. Highest noise levels are calculated at Location N4 which is positioned off the R403 road (This is equivalent to modelled Location N17 included in Table 12-16). The noise level at Location N4 is dominated by traffic along the internal haul road, as modelled in the noise model for the proposed development. Locations N3 and N5 are internal boundary locations, therefore calculated noise levels are higher at these positions. These are not noise sensitive locations.

During the evening and night-time periods, given the negligible noise level contribution to the surrounding environment associated with the proposed development, the cumulative noise levels during these time periods will remain governed by the existing surrounding sources. The evening and night-time noise criteria of 50 and 45 dB $L_{Aeq,T}$ respectively during these periods will therefore not be exceeded.

In terms of traffic, the noise impact assessment presented in Section 12.5.3.3 includes the future predicted traffic flows along the surrounding road network associated with the existing WMF, the permitted MBT facility and the proposed development, hence cumulative impacts associated with traffic movements have been considered in detail.

12.5 MITIGATION MEASURES

12.5.1 Construction Phase

The impact assessment in this chapter has determined that during the site preparation and construction phases, noise levels at the nearest noise sensitive locations can operate well within the recommended construction noise limits and are also below the facilities operational noise emission limits set within its existing EPA Licence. This is due to the significant distance between noise sensitive properties and the on-site activities.

Notwithstanding the above, the contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of *BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise* and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001. These measures will ensure that:

- No plant used on site will be permitted to cause an ongoing public nuisance due to noise;
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations;
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract;
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers;
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use, and;
- Any plant, such as generators or pumps that is required to operate before 07:00 or after 19:00 will be surrounded by an acoustic enclosure or portable screen.

During the course of the construction programme, the contractor will be required manage the works comply with the limits detailed in Table 12-4 using methods outlined in *BS 5228-1:2009+A1. Part 1 – Noise*

BS 5228 includes guidance on several aspects of construction site practices, which include, but are not limited to, selection of quiet plant, control of noise sources through noise minimisation practices, screening of noisy works to noise sensitive boundaries, and restricted hours of work.

All of the above best practice measures will be undertaken as part of the construction phase of the proposed development to ensure noise is minimised as far as practicable at noise sensitive locations.

12.5.2 Operational Phase

12.5.2.1 On-Site Noise Sources

The layout and design of the site incorporates inherent noise mitigation measures through the position of the proposed facility away from noise sensitive boundaries, the location of operational sources on-site and the hours of operation. The results of the assessment have indicated that operational noise levels associated with on-site noise sources are all below the noise limit value recommended for day, evening and night-time periods.

In order to ensure noise levels associated with the operational phase of the development are minimised as far as practicable, the following mitigation measures will be incorporated into the site design as best practice;

- External plant will be selected to ensure that the noise source levels set out in Table 12-13 to Table 12-15 are not exceeded.
- The proposed on-site buildings achieve a minimum sound insulation value of 24 dB $R_{w;}$
- All roller shutter doors and building access points are maintained closed at all times and opened only to permit vehicle and personnel entrance/egress.
- All operational plant will be switched off during evening and night-time periods when the facility is not in operation, with the exception of the compost building fans; and
- Where necessary, contractors will be required to erect suitable noise barriers, localised screens or other suitable control measures to minimise noise disturbance in the event that maintenance or other scheduled activities are operated between 19:00 and 07:00.

12.5.2.2 Road Traffic

The haul routes to be followed by traffic associated with the proposed development are presented in Drawing 8108-1013. All construction contractors, and all contractors delivering waste to the proposed development, will be issued with a map of permitted haul routes such that all materials imported to or exported from the proposed development are transported via one of the identified haul routes.

12.6 RESIDUAL EFFECTS

12.6.1 Construction Phase

During the construction phase, given the distances to the nearest residences, the temporary and short-term nature of the construction of phase and the calculated noise levels, the overall noise impact will occur on an intermittent basis, affecting the closest noise sensitive properties in the surrounding environment. The impact is determined to result in a neutral effect, and will be of a short term and slight impact at the majority of noise sensitive locations. Vibration impacts during this phase are determined to be short term and imperceptible. The potential health impacts relating to noise from this phase are deemed to be neutral given the low noise and vibration levels associated with the construction phase and the minimal change in the pre-existing environmental noise levels.

12.6.2 Operational Phase

The assessments outlined in the previous sections have shown that the predicted noise levels at the nearest sensitive locations are well below the operational noise criteria in all instances. Overall, the proposed development has been designed to ensure the operational phase of all sources on the site will not significantly add to the noise environment resulting in a slight overall effect. The proposed development will effect a number of properties in the immediate boundary to the proposed development. The impacts will be continuous, long term and not significant. There are no vibration impacts associated with the operational phase of the proposed development.

In terms of traffic, for the majority of road links, due to the existing volume of traffic and that projected for the future baseline years, the addition of traffic volumes associated with the proposed development are negligible. The increase in traffic noise levels along most link roads is less than 3 dB(A) which is defined as being of negligible impact. For a small number of routes a minor impact is calculated, assuming even distribution of traffic over the course of a typical day. During peak periods, there will be instances where noise level increases are up to 4 dB along the closest access roads to the site. The overall traffic noise is minor to moderate, perceptible impact during peak periods. As noted in Section 12.5.1.2, the limit values applied to the operational phase are designed to avoid any significant health effects associated with high noise levels within dwellings. In addition to the above, noise levels associated with the operational phase of the proposed development are similar to or lower than the pre-existing noise environment measured.

12.7 TRANSBOUNDARY EFFECTS

There are no transboundary noise or vibration impacts associated with this proposed development.

12.8 DECOMMISSIONING EFFECTS

In the event the facility ceases operation and is decommissioned, a slight reduction in noise levels would occur at the nearest noise sensitive locations compared to those measured and described within Section 12.3.

12.9 MONITORING

In line with the existing EPA Licence and any changes arising to that Licence, it is proposed that annual noise monitoring will be undertaken at the same boundary and noise sensitive locations as part of the annual compliance monitoring schedule. The results will be submitted to the EPA for inspection and will be included within the facilities Annual Environmental Report (AER).

13 CULTURAL HERITAGE

13.1 INTRODUCTION

13.1.1 Background and Objectives

Through Time Ltd. (Archaeological Consultants) have been have been commissioned by TOBIN Consulting Engineers to assess the potential effects of the proposed development on the archaeological, architectural and cultural heritage environment. Full details of the proposed development are provided in Chapter 3 of this EIAR and are not repeated here.

For the purpose of this report the effects of the proposed development on the recorded monuments, architectural and cultural heritage features within the site and in the wider archaeological, architectural and cultural heritage landscape were assessed. The assessment of the proposed haul route options included any features of archaeological, architectural and cultural heritage significance potentially effected by the route. The locations of the proposed haul route options are shown in Figure 10.1.

Archaeological Heritage generally refers to objects, monuments, buildings or landscapes of an (assumed) age typically older than 1700 AD and usually recorded as archaeological sites within the Record of Monuments and Places. The term architectural heritage applies to structures, buildings, their contents and setting of an (assumed) age, typically younger than 1700 AD. Cultural heritage is applied to other aspects of the landscape such as historical events, folklore and cultural associations and can accompany archaeological and architectural designation.

A copy of the archaeological report on the drains, undertaken to comply with a recommendation from National Monuments, Department of Culture, Heritage and the Gaeltacht, is included with this application. This information source is of considerable importance in the appraisal of the archaeological and cultural heritage for the application. Details of all recorded monuments and structures both within the Application Site and surrounding it (Table 13-4: Details of Recorded Monuments within the vicinity of Timahoe development) as well as all monuments recorded along the proposed haul route options (Table 13-5-Table 13-12) are also included in the appendices as is a photographic record of the Application Site.

Where appropriate, mitigation measures to limit potentially significant effects to the archaeological, architectural and cultural heritage are documented, and thereafter residual effects are identified and assessed.

13.1.2 Statement of Authority

Through Time Ltd. is a recently rebranded (2017) archaeological consultancy company that has previously traded as Arch Consultancy Ltd. for almost twenty years. Based in Athenry, County Galway, the company is directed by licensed archaeologists Martin Fitzpatrick M.A. and Fiona Rooney B.A. Both have been involved in all stages of development projects from initial design, compilation of EIAs, archaeological monitoring and resolution during construction. The projects managed ranges from the archaeological, architectural and cultural heritage components associated with developments of single dwelling houses to environmental impact assessments for large scale residual landfills, road developments, wind farms and residual landfills. Both directors have been involved in the development of residual landfill facilities for almost twenty years from initial design consultations, impact assessments, EIAs and involvement in ensuring that the archaeological and cultural heritage conditions attached to the developments are completed to the highest professional standards. Martin Fitzpatrick, the author of this report, has worked in Irish archaeology for the past 21 years. He is a graduate of NUIG and completed a master's degree specialising in the architecture of $15^{th}/16^{th}$ century Tower Houses in County Galway. Martin has previously overseen the completion of environmental impact assessments on wind farms, landfill developments and a 60 km motorway development on the M6.

13.1.3 Assessment Structure

This Section contains the following sections:

- Assessment Methodology and Significance Criteria – a description of the methods used in baseline surveys and in the assessment of the significance of effects;
- Baseline Description - a description of the cultural heritage of the proposed development site based on the results of desk based information and a walk over survey;
- Assessment of Potential Effects – identifying the ways in which cultural heritage could be affected by the proposed development, including a summary of the measures taken during design of the proposed development to minimise any effects;
- Mitigation Measures and Residual Effects - a description of measures recommended to off-set potential negative effects and a summary of the significance of the effects of the proposed development after mitigation measures have been implemented;
- Cumulative Effects – identifying the potential for effects of the proposed development to combine with those from other developments to affect the archaeological and cultural heritage resources;
- Summary of Significant Effects; and
- Statement of Significance.

13.2 METHODOLOGY

13.2.1 Assessment Methodology

This assessment methodology has involved the following elements, further details of which are provided in the following sections:

- Legislation and guidance review;

- Desk study, including review of available maps and published information;
- Site walkover;
- Evaluation of potential effects;
- Evaluation of the significance of these effects; and
- Identification of measures to avoid and mitigate potential effects.

The methodology used in this assessment is based on the EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)[72] (EPA, 2003) on Cultural Heritage, including folklore/tradition, architecture/settlements and monuments/features, following a baseline study of the existing cultural heritage features in the area of the proposed development, as well as per the Institute of Archaeologists ("IAI") Good Practice Guidelines. The updated Advice Notes for Preparing Environmental Impact Statements (Draft)[73] (September 2015) have also been used.

13.2.2 Relevant Legislation & Guidance

Archaeological monuments are protected through national and international policy designed to secure the protection of the cultural heritage resource. This is facilitated in accordance with the provisions of the European Convention on the Protection of the Archaeological Heritage (Valletta Convention), which was ratified by Ireland in 1997.

The National Monuments Act 1930 to 2004 and relevant provisions of the National Cultural Institutions Act 1997 are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes. A National Monument is described as:

> "a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto" (National Monuments Act 1930 Section 2).

A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments. These include the Register of Historic Monuments, the Record of Monuments and Places and the placing of Preservation Orders and Temporary Preservation Orders on endangered sites.

The minister may acquire National Monuments by agreement or by compulsory order. The State or the Local Authority may assume guardianship of any National Monument (other than dwellings). The

[72] https://www.epa.ie/pubs/advice/ea/guidelines/EPA_advice_on_EIS_2003.pdf
[73] https://www.epa.ie/pubs/consultation/reviewofdrafteisguidelinesadvicenotes/Draft%20Advice%20Notes%20for%20preparing%20an%20EIS.pdf

owners of National Monuments may also appoint the Minister or the local Authority of that monument if the State or Local Authority agrees. Once the site is in ownership or guardianship of the State, it may not be interfered with without the written consent of the Minister.

Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the Register are afforded statuary protection under the 1987 Act. Any interference with sites recorded on the Register is illegal without the permission of the Minister. Two months' notice in writing is required prior to any work being undertaken on or in the vicinity of a Registered Monument. The Register also includes sites under preservation orders and temporary preservation orders with the written consent, and at the discretion of the Minister.

Section 12 (1) of the 1994 Act requires the Minister to establish and maintain a Record of Monuments and Places where the Minister believes that such monuments exist. The Record comprises a list of monuments and relevant places and a map/s showing each monument and relevant place in respect of each county in the state. All sites recorded on the Record of Monuments and Places receive statuary protection under the National Monuments Act 1994.

Section 12(3) of the 1994 Act provides that:

> "Where the owner or occupier (other than the Minister) of a monument or place included in the Record, or any other person, proposed to carry out, or to cause or permit the carrying out of, any work at or in relation to such a monument or place, he or she shall give notice to the Minister to carry out work and shall not, except in the case of urgent necessity and with the consent of the Minister, commence the works until two months after the giving of notice".

The Architectural Heritage and Historic Properties Act 1999 and the Planning and Development Act of 2000 are the main built heritage legislation. The Architectural Heritage Act requires the Minister to establish a survey to identify, record and assess the architectural heritage of the country. The National Inventory of Architectural Heritage (NIAH) records all built heritage structures within specific counties in Ireland. The document is used to advise local Authorities on the register of a Record of Protected Structures (RPS) as required by the Planning and Development Act, 2000.

The Act of 2000 requires Local Authorities to establish a Record of Protected Structures to be included in the County Development Plan (CDP). Buildings recorded in the RPS can include Recorded Monuments, structures listed in the NIAH or buildings deemed to of architectural, archaeological or artistic importance by the Minister. Once listed in the RPS the sites/areas receive statuary protection from injury or demolition under the 2000 Act. Damage to or demolition of a site registered in the RPS is an offence. The detail of the list varies from County to County. If the Local Authority considers a building to need a repair, it can order conservation and/or restoration works. The owner or developer must make a written application/request to the local Authority to carry out any works on a Protected Structure and its environs.

Fieldwork for the National Inventory of Architectural Heritage (NIAH) for County Kildare was undertaken in 2003. Where an NIAH survey has been carried out, those structures which have been attributed a rating value of international, national or regional importance in the inventory are recommended by the Minister of the Environment, Heritage and Local Government ("EHLG") to the relevant planning authority for inclusion on the RPS. In accordance with Section 53 of the Planning and Development Act 2000, if a planning authority, after considering a recommendation made to it under this section, decides not to comply with the recommendation, it shall inform the Minister in writing of the reason for its decision.

13.2.2.1 Kildare County Development Plan 2017-2023

Kildare County Council has written policies on the preservation of structures, or part of structures, which are of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest. Their aim is:

> "To protect, conserve and manage the archaeological and architectural heritage of the county and to encourage sensitive sustainable development so as to ensure its survival and maintenance for future generations".

Archaeological Heritage AH1-AH9: "It is the policy of the Council to:

- Manage development in a manner that protects and conserves the archaeological heritage of the county, avoids adverse impacts on sites, monuments, features or objects of significant historical or archaeological interest and secures the preservation in-situ or by record of all sites and features of historical and archaeological interest. The Council will favour preservation in–situ in accordance with the recommendation of the Framework and Principals for the Protection of Archaeological Heritage (1999) or any superseding national policy.
- Have regard to the Record of Monuments and Places (RMP), the Urban Archaeological Survey and archaeological sites identified subsequent to the publication of the RMP when assessing planning applications for development. No development shall be permitted in the vicinity of a recorded feature, where it detracts from the setting of the feature or which is injurious to its cultural or educational value.
- Secure the preservation (in-situ or by record) of all sites, monuments and features of significant historical or archaeological interest, included in the Record of Monuments and Places and their settings, in accordance with the recommendations of the Framework and Principles for the

Protection of Archaeological Heritage, DAHG (1999), or any superseding national policy document.

- Ensure that development in the vicinity of a site of archaeological interest is not detrimental to the character of the archaeological site or its setting by reason of its location, scale, bulk or detailing and to ensure that such proposed developments are subject to an archaeological assessment. Such an assessment will seek to ensure that the development can be sited and designed in such a way as to avoid impacting on archaeological heritage that is of significant interest including previously unknown sites, features and objects.
- Contribute towards the protection and preservation of the archaeological value of underwater or archaeological sites associated with rivers and associated features.
- Contribute towards the protection of historic burial grounds within the county and encourage their maintenance in accordance with conservation principles in co-operation with the Historic Monuments Advisory Committee and National Monuments Section of Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs (DAHRRGA).
- Promote and support in partnership with the National Monuments Section of the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs (DAHRRGA), the concept of Archaeological Landscapes where areas contain several Recorded Monuments.
- Encourage, where practicable, the provision of public access to sites identified in the Record of Monuments and Places under the direct ownership, guardianship or control of the Council and/or the State.
- Encourage the provision of signage to publicly accessible recorded monuments.

The following is a summary of the relevant Architectural Heritage section PS 1 – PS 21:
"It is the policy of the Council to:

- Conserve and protect buildings, structures and sites contained on the Record of Protected Structures of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest.
- Protect the curtilage of protected structures or proposed protected structures and to refuse planning permission for inappropriate development within the curtilage or attendant grounds of a protected structure which would adversely impact on the special character of the protected structure including cause loss of or damage to the special character of the protected structure and loss of or damage to, any structures of architectural heritage value within the curtilage of the protected structure. Any proposed development within the curtilage and/or attendant grounds must demonstrate that it is part of an overall strategy for the future conservation of the entire built heritage complex and contributes positively to that aim.
- Require that new works will not obscure views of principal elevations of protected structures.

- Promote best practice and the use of skilled specialist practitioners in the conservation of, and any works to, protected structures. Method statements should make reference to the DAHG Advice Series on how best to repair and maintain historic buildings. As outlined in the Architectural Heritage Protection Guidelines, DAHG, a method statement is a useful tool to explain the rationale for the phasing of works. The statement could summarise the principal impacts on the character and special interest of the structure or site and describe how it is proposed to minimise these impacts. It may also describe how the works have been designed or specified to have regard to the character of the architectural heritage.
- Protect and retain important elements of the built heritage including historic gardens, stone walls, landscapes and demesnes, and curtilage features.
- Require where appropriate that a Conservation Plan is prepared in accordance with DAHG Guidelines and conservation best practice to inform proposed visual or physical impacts on a Protected Structure, its curtilage, demesne and setting.
- Have regard where appropriate to DAHG Guidelines and conservation best practice in assessing the significance and conservation of a Protected Structure, its curtilage, demesne and setting.
- Have regard where appropriate to DAHG Guidelines and conservation best practice in assessing the impact of development on a Protected Structure, its curtilage, demesne and setting.

13.2.3 Desk Study

This involved an examination of the archaeological, historical and cultural heritage context of the area in general and specifically the proposed development site. The assessment is divided into two separate phases. Phase I involved a paper survey of archaeological, historical, architectural, cultural heritage and cartographic sources.

The following sources were examined as part of the assessment:

- Record of Monuments and Places (RMP) for County Kildare;
- Sites and Monuments Record (SMR) for County Kildare;
- The Archaeological Inventory for County Kildare;
- Topographical files of the National Museum of Ireland;
- Kildare County Development Plan 2017-2023;
- National Inventory of Architectural Heritage;
- First edition ordnance survey maps;
- Second edition ordnance survey maps;
- Third edition ordnance survey maps;
- Aerial photography;

- Excavation bulletins; and
- Townland Names.

13.2.4 Field Survey

A walkover survey of the proposed development site and wider survey area site was undertaken in May 2016 to verify the findings of the desk study and to obtain an understanding of the local archaeological and cultural heritage landscape. This allowed the opportunity of first hand observation of the terrain, which can often result in the discovery of hitherto unrecorded sites and finds. The survey was undertaken on a clear, dry day.

Not all areas were accessible due to dense vegetation. The proposed development site was assessed in terms of landscape, land use, vegetation cover and the presence or lack of both known and potential archaeological sites. The areas surrounding the proposed development site were also field walked at the time of the survey. A photographic record of the site inspection was compiled, and extracts are presented in the attached plates.

13.2.5 Predicted Effects on Archaeological, Architectural and Cultural Heritage

The criteria (EPA, 2002; EPA, 2003) for the assessment of effects require that likely impacts are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and trans boundary nature (if applicable). The descriptors used in this EIAR are those set out in EPA (2002) 'Glossary of Impacts' taking into account the recent draft guidelines (EPA: 2017).

Effects may be categorised as follows:

Direct:

- Archaeological sites can be adversely affected by excavation for development, topsoil stripping for roadways and by the effects of heavy machinery passing over features of archaeological significance;
- Permanent and temporary land-take, landscaping, mounding and general excavations associated with construction may result in the loss or damage of archaeological remains or physical loss to the setting of historical landscapes; and
- The weight of permanent embankments can cause damage to sub-surface archaeological layers and features

Indirect:

- Visual effects on the archaeological landscape can arise from construction. Traffic associated with construction, machinery working, and the noise associated with general construction can effect the landscape.

No Effect:

- Where the proposed development has neither negative nor a positive effect upon the archaeological and cultural heritage environment.

Positive effects can also be attributed from development. They may include improved maintenance and access to archaeological monuments and an increase in the level of understanding of an archaeological or historical landscape as a result of archaeological assessments and subsequent fieldwork.

13.2.5.1 Level of Effect

The level of effect on an archaeological, historical or architectural landscape depends on a number of factors which include the existing environment and the type of monument impacted. The level or severity of effect was assessed by taking the following into consideration:

- The proportion of the feature affected and the potential loss of characteristics essential to the understanding of the monument feature or site.
- Consideration of the type, condition, vulnerability and potential amenity value of the landscape, feature, site or monument affected.
- Consideration of the likely effects of visual, noise and hydrological alterations which were informed by other specialist reports or observations.

Effects can be very high, high, medium, low or indeterminable on archaeological, architectural and cultural heritage remains.

Table 13-1: Criteria for Rating Site Attributes

Level of Effect	Significance
Very high	Attribute has a high-quality significance or value on a regional or national scale
High	Attribute has a high-quality significance or value on a local scale
Medium	Attribute has a medium quality significance or value on a local scale
Low	Attribute has a low-quality significance or value on a local scale
Indeterminable	An impact on a feature of unknown archaeological significance

13.2.5.2 Magnitude

The magnitude of potential effects has been defined in accordance with the criteria provided in the 2002 EPA Publication 'Guidelines on the Information to be contained in Environmental Impact Statements'.

Table 13-2: Impact Assessment Criteria

Magnitude of Impact	Description
Imperceptible	An impact capable of measurement but without noticeable consequences
Slight	An impact that alters the character of the environment without affecting its sensitivities
Moderate	An impact that alters the character of the environment in a manner that is consistent with existing or emerging trends
Significant	An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Profound	An impact which obliterates all previous sensitive characteristics

Table 13-3: Criteria for Rating Impact Significance on Archaeological, Architectural and Cultural Heritage

Magnitude of Impact	Criteria	Example
Large Adverse	Result in loss of attribute	Removal of a monument or a Protected structure
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Partial removal of recorded structure or protected structure/heritage feature. This could include any construction of in very close proximity to a recorded monument.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Partial loss of the integrity of an archaeological monument, architectural or Cultural Heritage feature
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of archaeological, architectural, cultural heritage feature/landscape
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of archaeological, architectural, cultural heritage feature/landscape
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of archaeological, architectural, cultural heritage feature/landscape

13.3 RECEIVING ENVIRONMENT / BASELINE DESCRIPTION

13.3.1 Introduction

This section provides a description of the receiving environment and historical background of the proposed development site and wider survey area and is based on the results of the desk based and walk over survey.

The proposed development is located in Timahoe Bog which is part of Bord na Móna’s Allen group of bogs that were first brought into industrial peat production in the 1950’s. Peak production at Timahoe

Bog was during the 1960's when the bog was in sod peat production. The peat was removed from the bog via a railway system. Industrial production at the site was gradually phased out over the last fifteen to twenty years as most of the bog was cut away and the poor quality of the remaining peat made further peat harvesting uneconomical. Small scale production for domestic purposes continues at the margins of the commercially cut away bog.

To reduce the moisture content of the peat material during the years of peak industrial activity it was necessary to drain the entire bog. This was achieved by the excavation of a network of east to west running drains that discharged into a central underground culvert that ran from north to south. The drainage network facilitated heavy plant and machinery to safely traverse the bog. As a result of the drainage channels the entire site is divided into plots referred to as 'peat fields'. These turf plots span the length of the bog. In some areas they have been exploited to a depth of 0.5 m-1 m above the natural mineral soil.

The surface areas of the proposed development site consist of tracts of flat low-lying bog with varying densities of vegetation cover. The walk over survey was restricted to areas where over-growth was sparse or non-existent.

13.3.2 Archaeological and Historical Background

Boglands cover one-sixth of the total landmass of Ireland extending over an approximate area of 1.34 million hectares. They can be divided into two major types, raised bogs and blanket bogs, although both appear similar in character the mode of formation differs greatly. The vast majority of Ireland's raised bogs occur in the central lowlands of the country unlike blanket bogs that are predominately confined to mountainous areas and some occasional lowland areas along the western seaboard.

The anaerobic environment of bogs and wetlands helps create unique circumstances for the preservation of remains and have long been known for their rich abundance of archaeological deposits, which can range from the prehistoric to the medieval periods. One of earliest known sites from a wetland context is the Mesolithic habitation from Lough Boora in County Offaly where radiocarbon dating provided a range of dates from 7000-6500 BC.

A number of archaeological artefacts and sites have been recorded to the north of the proposed development site. All the identified sites are toghers or trackways, called toghers from the Irish word tógher meaning causeway (Harbison 1988), they invariably transverse bogs at the narrowest crossing point. These trackways can vary significantly in size and form, from simple surface brushwood paths to larger timber planked roadways such as the Corlea trackway in County Longford, some gravel and flagstone examples have also been recorded. The presence of trackways could suggest human activity from as early as the Neolithic period (4000-2500 BC).

The cooler and wetter climatic conditions of the Bronze Age together with the impact of farming on vegetation and in particular tree regeneration, led to soils becoming wetter and drainage deteriorated. These conditions facilitated a more rapid increase in the growth and the spread of bogs. Consequently, the crossing of bogs became more difficult and problematic and the archaeological record shows a significant increase in the size and number of toghers constructed during this period. The Bronze Age also saw the deliberate deposition of artefacts as votive offerings in water logged areas and bogs. Boglands have in the past yielded high concentrations of artefacts, particularly Bronze Age flat axes, swords and rapiers. For instance, in north Leinster 48% of Early Bronze Age flat axes have been found in bogs, while in Ireland as a whole, 51% of Late Bronze Age (Dowris Phase) hoards and 59% of later Iron Age (La Tène Phase) weapons have been recovered from bogs (Cooney and Grogan 1994). The topographical files of the National Museum of Ireland record a multi-period assemblage of finds for the Timahoe area and surrounding townlands (Section 12.5). Some such as the bronze rapier from Allenwood Middle indicate activity for the Middle Bronze Age or Bishopsland Phase.

Human remains or 'bog bodies' have been recovered from wetland sites, the most notable being the exceptionally well-preserved 'Gallagh Man', and more recently an example from Cuil na Móna in County Laois. Over eighty burials have been recovered from wetland areas.

Discoveries of bog butter are frequent in Irish bogs, though not entirely an Irish phenomenon, as examples have also been found in Scotland. The practice of burying butter in bogs may possibly date to the sixth century A.D. The preservative properties of the bog would have been ideal for storage, though the desire to produce a special flavour in the butter is a possibility. Containers made from a variety of materials were used to store the butter during its time in the peat, though wooden vessels predominate with some highly decorated examples having been found. Bog butter has also been buried in bark, cloth, wickerwork and animal skin.

Drehid bog is in the barony of Carbury, County Kildare. Although usually known as Drehid bog, after Drehid townland, the bog is also known as Timahoe Bog. Timahoe derives its name from Tígh Mochua or the house of Mochua, from the monastery founded here by St. Mochua in the fifth century. The remnants of a church and a well-preserved twelfth-century round tower are all that survive of this monastic settlement. The area had previously been known as Sidh Neachtain or "The Fairy Hill", a name derived from Nuadha Neacht of Neachtain, who was High King of Ireland for a year, before being slain in 45 AD. The proposed development is located in the townland of Coolcarrigan to the southwest of Timahoe. The townland name Cúil Charraigin translates as the 'Nook of the little rock' (Flanagan & Flanagan, 194). Placenames and townland names are often indicators of past settlement and specific monument types, with Cill (Kill) for example, referring to a church, monastic settlement, churchyard or graveyard. The townlands of Ballynakill (Upper and Lower) located to the southwest of the proposed development refer to the ‘town of the church or wood’. Other townland names in the vicinity of the proposed development refer to features of the landscape, such as Corduff, meaning the ‘black round hill’ (Joyce 1990).

To the south of the site is the Hill of Allen which also has associations with myths. It was here that “Almhuin (was) the palace of Fionn Mac Cumhal in Leinster”, Almhuin being the Hill Of Allen. The Annals of The Four Masters records two battles being fought here in 526 AD and 718 AD (O’Donovan 2002, 100). The last reference to Sidh Neachtain was in the Annals of the Four Masters which records the death of Laoghaire, High King of Ireland, at Sidh Neachtain in 458 AD. The area then became known as “Cairbre Og Ciartha” or Carbury. Cairbre was Laoghaires’ brother and his dynasty controlled the area until the Norman period when Meider Fitzhenry was granted the Carbury area. Fitzhenry subsequently lost the property in 1181.

The next major holders of the Carbury lands were the Fitzgeralds who were a powerful family in Ireland. The 7th Earl served as Chief Governor of Ireland on a number of occasions. Unfortunately for the Fitzgeralds, their power came to an end because of their involvement in the 1641 rebellion. In the aftermath of the Cromwellian War, Timahoe became the property of the Duke of York, brother of Charles II, who later became King of England, and who was defeated at the Battle of the Boyne in 1690. Subsequently, the property was confiscated and given to two brothers, John and Robert Curtis. They leased the property to Theobold Burke and Richard Aylmor, who in turn leased it to a group of Quakers from Northern Ireland. They built a meeting house adjacent to their own cemetery and also a windmill nearby.

The bog played an important part in the 1798 rebellion in North Kildare. “The Prosperous and Clane rebels formed a camp at Timahoe, where it was sited on Hodgestown Hill...” (Cullen 1998, 13). This was an area of dry land within the bog thus making access almost impossible for English cavalry and artillery. At one point there were almost 2,500 rebels camped there, growing to 4,000 when rebels from Wexford and Wicklow joined them. This latter group moved on however, after just a day, (Ibid, 25).

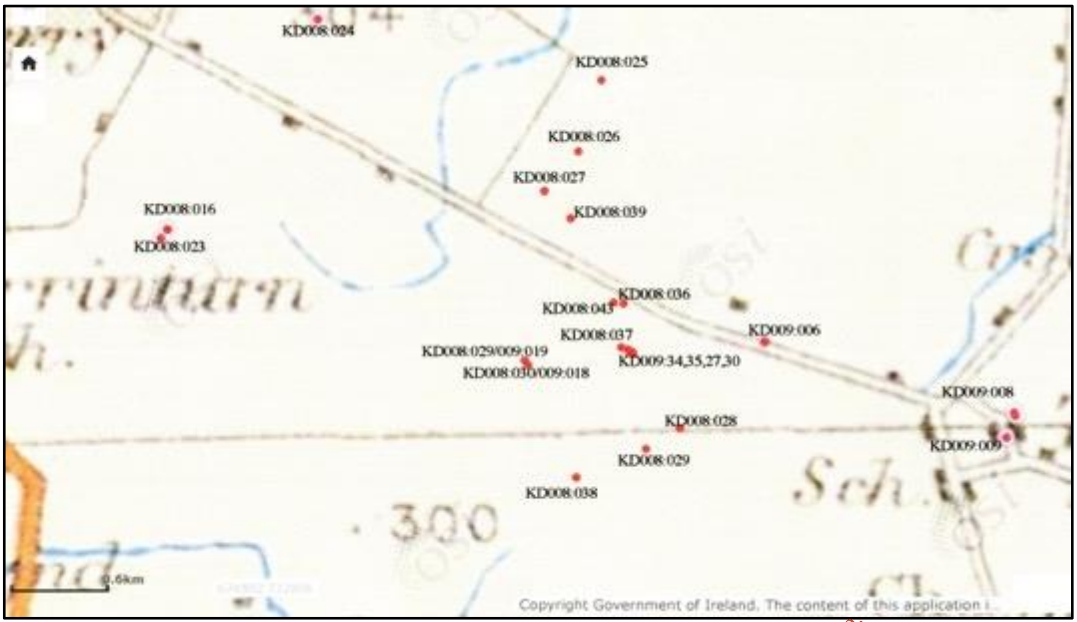
To the east of the proposed development is Coolcarrigan Demesne which contains a Georgian House built in the 1830’s and has a small 19th century Church of Ireland church in the grounds.

13.3.3 Record of Monuments and Places (“RMP”)

All known archaeological monuments are indicated on 6 inch ordnance survey maps and are listed in this record. The RMP and the SMR are not complete records as newly discovered sites may not appear. In conjunction with the RMP and SMR the electronic database of recorded monuments and the files of the Archaeological Survey of Ireland were consulted. Details of Recorded monuments in the townlands surrounding the proposed development are included to highlight the type of sites that survive in the vicinity of the proposed development. The archaeological record indicates one recorded monument (KE008:038) within the proposed development site. The site is recorded as an unclassified roadway. Nothing of the monument survives above ground and the feature is not scheduled for inclusion in the next revision of the Record of Monuments and Places. There are a number of recorded archaeological monuments within Timahoe Bog (Fig. 13.5). North of the proposed development, in the area immediately north of the existing Drehid Waste Management Facility site, two trackways or toghers, (KD009-018 & 019, also known as KD008-029 & 030) are recorded. The monuments were excavated by E. Rynne in the 1960's and by Monroe in 1986, (O'Carroll 2002). One of the trackways was a substantial oak plank trackway whilst the other was a less substantial birch trackway. Monroe thought that the trackways were broadly contemporary, and the oak plank trackway was dendrochronologically dated in the Middle Bronze Age (1987, 22). A walkover survey conducted in preparation for the EIS of the waste management facility in 2002, found no extant trace of either trackway. Subsequent monitoring of all excavations works associated with the development (License 06E0746) revealed no features of archaeological significance. The Irish Archaeological Wetland Unit identified a further 10 sites in the vicinity of the recorded trackways in the 1990's. Two of these trackways were destroyed before they were plotted (information received from Irish Archaeological Wetland Unit). The trackways were recorded to the north and east of the existing waste management facility and will not be effected by the proposed development. The sites originally recorded by the Irish Archaeological Wetland Unit have, since 2010, been updated to the Sites and Monuments Record available at www.archaeology.ie and are detailed in the table below.

Details of Recorded Monuments on or in the immediate vicinity of the proposed haul route options are also included. It should be emphasised that all of the haul route options are along existing roadways and therefore any recorded monuments in the vicinity should not be impacted. The exception is where the proposed Haul Route impact on a bridge structure in Carragh which is also a National Monument (KD019-012----). A National monument is described under the legislation as "a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto" (National Monuments Act 1930 Section 2). The proposed Haul Routes 1, 1.1 and 2.2 will have an effect on the National Monument KD019-012. This narrow, six-arched bridge spans the River Liffey to the north-west of Naas town. While displaying some evidence of 18th and 19th century rebuilding, the bridge could date from as early as 1450 AD to 1650 AD and is an important example of bridge architecture. The bridge is currently closed to HGV traffic.

Figure 13.1: Map indicating recorded monuments (red dot) in relation to the proposed development site (after OSI) in the vicinity of Timahoe development



Possible medieval activity in the area is indicated by the presence of the castle at Timahoe West (KD009-009). There is a church and graveyard (KD009-008 (001, 002)) at Timahoe East.

Table 13-4: Details of Recorded Monuments within the vicinity of Timahoe development

TOWNLAND	ARCHAEOLOGICAL SITE TYPE	SMR NUMBER	RMP
Parsonstown	Enclosure	KD008:016	YES
Parsonstown	House-indeterminate date	KD008:016001	YES
Parsonstown	Enclosure	KD008:023	YES
Drehid	Moated Site	KD008:024	YES
Drehid	Road Unclassfied Togher	KD008:025/KD009:17	YES
Drehid	Road Unclassfied Togher	KD008:026	YES
Drehid	Road Unclassfied Togher	KD008:027	YES
Timahoe West	Road Class 2 Togher	KD008:036	YES
Coolcarrigan	Road Unclassified Togher	KD008:038	NO
Timahoe West	Road Class 2 Togher	KD008:037	YES
Timahoe West	Peatland Structure	KD008:043	YES
Timahoe West	Road Trackway	KD009:006	YES
Timahoe West	Children Burial Ground	KD009:006001	YES
Coologmartin	Enclosure	KD009:007	YES
Timahoe East	Church & Graveyard	KD009:008	YES
Timahoe West	Castle	KD009:009	YES
Timahoe West	Peatland Structure	KD009:027	NO
Timahoe West	Peatland Structure	KD009:028	NO
Coolcarrigan	Unclassified Road	KD009:029	NO
Timahoe West	Peatland Structure	KD009:030	NO
Timahoe West	Peatland Structure	KD009:034	NO
Timahoe West	Peatland Structure	KD009:035	NO
Parsonstown/Timahoe West	Road Class 1 Togher	KD008:029/KD009:19	YES
Parsonstown/Timahoe West	Road Class 1 Togher	KD008:030/KD009:18	YES

Table 13-5: Details of Recorded Monuments within the vicinity of Haul Route 1- Kilcullen to Naas to Clane to Site Entrance

RMP Number	Townland	Monument	Distance to Proposed Haul Route
KD013-017----	Graigues	Ringfort - rath	18 m
KD013-014----	Curryhills	Font	14 m
KD014-026003-	Clane	Bullaun stone	10 m
KD014-026001-	Abbeyland (Clane ED), Blackhall (Bodenstown ED), Carrigeen Clane, Moat Commons	Historic town	10 m

Table 13-6: Details of Recorded Monuments within the vicinity of Haul Route No. 2 Silliot Hill to Site Entrance and Haul Route 1.1 (Naas to Graigues townland) and Haul Route 2.2 (Silliot Hill to Naas)

RMP Number	Townland	Monument	Distance to Proposed Haul Route
KD018-010----	Carragh	Cross - Wayside cross	On roadside
KD019-012----	Gingerstown, Halverstown (Carragh ED)	Bridge	On road
KD019-068----	Jigginstown	Fulacht fia	On roadside
KD019-032----	Jigginstown	Gatehouse	17 m

Table 13-7: Details of Recorded Monuments within the vicinity of Haul Route 3- Enfield to Site Entrance including Enfield Ring Road

RMP Number	Townland	Monument	Distance to Proposed Haul Route
ME048-027----	Johnstown (Moyfenrath Lower By., Rathcore Par.)	Fulacht fia	5 m
KD004-003----	Johnstown (Cadamstown ed)	Architectural fragment	12 m
KD004-002----	Johnstown (Cadamstown ed)	Armorial plaque	13 m
KD004-001---	Johnstown (Cadamstown ed)	Cross	6 m

Table 13-8: Details of Recorded Monuments within the vicinity of Haul Route No.4

RMP Number	Townland	Monument	Distance to Proposed Haul Route
KD018-036----	Kilmeage	Graveyard	On roadside

Table 13-9: Details of Recorded Monuments within the vicinity of Proposed Haul Route from M50 to regional road network via M7/N7

RMP Number	Townland	Monument	Distance to Proposed Haul Route
KD020-021----	Killhill	Flat Cemetery	Adjacent/Under road
DU021-016----	Belgard, Brideswell Commons, Clondalkin, Newlands Demesne	Road - road/trackway	Adjacent/Under road

Table 13-10: Details of Recorded Monuments within the vicinity of Haul Route Kildare to Milltown

RMP Number	Townland	Monument	Distance to Proposed Haul Route
KD022-075----	Curragh	Ring-ditch	16 m
KD022-076----	Curragh	Barrow – ditch barrow	9 m
KD022-077----	Curragh	Barrow – ditch barrow	33 m

Table 13-11: Details of Recorded Monuments within the vicinity of Haul Route Maynooth to Clane

RMP Number	Townland	Monument	Distance to Proposed Haul Route
KD014-026012-	Abbeyland (Clane ED)	Graveyard	49 m

Table 13-12: Details of Recorded Monuments within the vicinity of Haul Route Kilcock to Prosperous

RMP Number	Townland	Monument	Distance to Proposed Haul Route
KD013-014----	Curryhills	Font	27 m

13.3.4 Topographical Files for the National Museum of Ireland

This is the archive of all known finds recorded by the National Museum. The archive primarily relates to artefacts but also includes references to monuments and previous excavations. The find locations of artefacts are important contributors to the knowledge of the archaeological landscape. Location information relating to finds is an important indicator of human activity. Topographical files examined for the townlands effected by the proposed development indicate human activity in the general area from the Neolithic period with many of the artefacts recovered from a peat environment. While the bogs have since been harvested it is possible that further artefacts and/or features survive in the lower levels of peat.

Timahoe and its environs has evidence for the presence of humans possibly dating from the Bronze Age as indicated by the dendrochronological dating of the toghers from Timahoe Bog. However, the recovery of eight axeheads and a flint arrowhead suggests earlier activity dating to the Neolithic period (4000-2000 BC). Artefacts recovered from the area, which are generally found in a bog environment includes leather shoes and portion of a wooden wheel. The area continued to be occupied throughout the medieval period as indicated by the presence of church and castle sites in the vicinity of the proposed development.

The following archaeological artefacts are included to highlight the type of archaeological activity in the area and the importance of archaeological monitoring as stray finds are frequently found in the course of monitoring of ground works. Archaeological finds recorded in the topographical files of the National Museum of Ireland indicate human activity in the general area from the Neolithic period with many of the artefacts recovered from a peat environment. While the bogs have since been harvested it is possible that further artefacts and/or features survive in the lower levels of peat. A study of the topographical files housed in the National Museum of Ireland yielded the following archaeological artefacts as listed in Table 3-13.

Table 13-13: Archaeological Artefacts recorded from the area: -

Reg No.	Townland	Find Type
1987:72	Allenwood South	Leather Shoe
1987:71	Allenwood South	Bronze Cauldron
1942:1870	Allenwood Middle	Bronze Rapier
1937:2433	Ardkill	Stone Axehead
1937:2438-44	Ballybrack	Stone Implement
1937:2421	Ballybrack	Stone Axehead
1962:75	Ballynakill Lower/Upper	Iron Axehead
-	Ballyteague	Designed Stone
1979:7	Coolcarrig	Wooden Shovel Blade
1979:9	Coolcarrig	Wooden Keg with Bog Butter
1950:31	Demesne	Stone Object
1945:268	Downings	Stone Axehead
1972:355 A&B	Drehid	Bent Wooden Stake
1937:2420	Kileaskin	Stone Axehead
1968:438-439	Kileaskin	2 Polished Stone Axeheads
1994:72	Killinagh	Wood in Bog
1929:1298	Killinagh	Bog Butter
1980:46	Mulgeeth	Wooden Object
1991:44	Mylerstown	Stone Axehead
1987:140	Ticknevin	Leather Shoe
1943:132	Timahoe East	Portion of Wooden Wheel

Reg No.	Townland	Find Type
1938:8560	Timahoe East	Fragment of Large Stone Axehead
1943:286	Timahoe East	Silver Bracelet
1943:130-131	Timahoe East	Wooden Yoke
1950:7	Timahoe East	Iron Axe
-	Timahoe Bog	Bog Body – human forearm
1950:4a, 4b, 4c	Timahoe	3 portions of wooden vessel
1942:409	Timahoe (Derrymahon Bog)	Wooden Object
1978:3	Timahoe East or West	Leather Shoe
1941:1120	Timahoe	Bronze Spearhead
1966:2	Timahoe Bog, Timahoe West	Flint Arrowhead (barbed)
1970:139	Timahoe West	Rough Out
-	Timahoe Bog	Human Skeletal remains
1994:62	Robertstown	Bronze Socketed Axehead

13.3.5 Aerial Photography

The Ordnance Survey of Ireland aerial photographs (www.osi.ie) were consulted to identify any archaeological features in the landscape that may not have been previously recorded. There was no evidence of additional archaeological, architectural or cultural heritage features recorded on the aerial photographs within the area of the proposed development site. More recent maps and aerial photographs highlight the drainage channels throughout the site.

13.3.6 Kildare County Development Plan

The Kildare County Development Plan (2017-2023)was consulted for the schedule of buildings (Record of Protected Structures) and items of cultural, historical or archaeological interest that may be affected by the proposed development. There are no Protected Structures in the area of the proposed development. Coolcarrigan House and Church (Reg. B09-10, B09-11) are both located c. 1.6 km east of the proposed development and will not be directly impacted. Coolcarrigan House was constructed in the 1830's and was originally used as a shooting lodge. It has extensive gardens and a 19th century Hiberno-Romanesque church on the grounds. A mixed coniferous and deciduous tree belt along the eastern edge of the existing bog ensures that these structures will not be visually impacted by the proposed development.

13.3.7 National Monuments in State Care

The Department of Environment, Heritage and Local Government maintains a database on a county basis of National Monuments in State Care. The term National Monument is defined in Section 2 of the National Monuments Act (1930) as a monument or the remains of a monument.

> "The preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto".

The list contains no National Monuments in State care in the area of the proposed development or the wider area. A bridge structure (K019-012) in Carragh is recorded as a National Monument and will be impacted by haul route options No.1.1, No 2 and No.2.2. This narrow, six-arched bridge spans the River Liffey to the north-west of Naas town. While displaying some evidence of 18th and 19th century rebuilding, the bridge could date from as early as 1450 AD to 1650 AD and is an important example of bridge architecture. The bridge is currently closed to HGV traffic.

13.3.8 National Inventory of Architectural Heritage

The NIAH maintains a register of buildings and structures recorded on a county basis. The register indicates that no structures will be directly impacted by the proposed development. Several structures will be impacted by the various haul route options, however all of the route options are located along existing roadways. Structures in the vicinity of or impacted by route options are detailed below (Table 13-16 to Table 13-19), this indicates a number of bridge structures will be impacted.

Table 13-14: Details of Recorded Monuments within the vicinity of Proposed Haul Route No.1 Kilcullen to Naas to Clane to Site Entrance

RPS No	Townland	Feature Type	Route Option
11808013	Abbeyland (Clane Ed)	Bridge	Kilcullen to site entrance via Naas and Clane
11811034	Osberstown	Bridge	Kilcullen to site entrance via Naas and Clane
11819013	Kilcullenbridge (Kilcullen ed)	Bridge	Kilcullen to site entrance via Naas and Clane

Table 13-15: Details of Recorded Protected Structures along Haul Route 2-Silliot Hill to Site Entrance and Haul Route No. 1.1 (Naas to Graigues townland) and Haul Route 2.2 (Silliot Hill to Naas)

RPS No	Townland	Feature Type	Route Option
11901902	Gingerstown	Bridge	Silliot Hill to Site Entrance
11901816	Carragh	Church/Chapel	Silliot Hill to Site Entrance

Table 13-16: Details of Recorded Protected Structures along the Proposed Haul Route No. 3 Enfield to Site Entrance including Enfield Ring Road

RPS No	Townland	Feature Type	Route Option
11801002	Johnstown (Cadamstown ED	Water Pump	Enfield to Site Entrance
11801003	Johnstown (Cadamstown ED	Post Box	Enfield to Site Entrance
11801017	Johnstown (Cadamstown ED	House	Enfield to Site Entrance
11801016	Johnstown (Cadamstown ED	House	Enfield to Site Entrance
11801010	Johnstown (Cadamstown ED	Water Pump	Enfield to Site Entrance
11900811	Carbury Sweep	House	Enfield to Site Entrance
11900810	Ardkill	Post-box	Enfield to Site Entrance

Table 13-17: Details of Recorded Protected Structures within the vicinity of Haul Route No.4

RPS No	Townland	Feature Type	Route Option
11819013	Kilcullenbridge (Kilcullen ed)	bridge	On road
11819041	Castlemartin	demesne walls/gates/railings	Roadside
11819040	Castlemartin	Gate lodge	Roadside
11819042	Castlemartin	demesne walls/gates/railings	Roadside
11819043	Castlemartin	POST BOX	Roadside
11818062	Greatconnel	Gates/railings/walls	Roadside
11818063	Piercetown	Bridge	On road
11901812	Milltown (Feighcullen ed)	Water pump	Road side
11901811	Milltown (Feighcullen ed)	Post Box	Road side
11901305	Ballyteige North	Bridge	On road
11901304	Allenwood Middle	Bridge	On road

Table 13-18: Details of Recorded Protected Structures along the Proposed Haul Route Kildare to Milltown

RPS No	Townland	Feature Type	Route Option
11901814	Milltown (Feighcullen ed)	Bridge	Kildare-Milltown
11817095	Kildare	Bridge	Kildare-Milltown

Table 13-19: Details of Recorded Protected Structures within the vicinity of Proposed Haul Route from M50 to regional road network via M7/N7

RPS No	Townland	Feature Type	Route Option
11812028	Maudlings	Demesne walls/gates/railings	Along Junction 9 at Naas and N7
11812022	Kerdiffstown	Demesne walls/gates/railings	Alongside N7

13.3.9 Previous Archaeological Work in the Area

North of the proposed development site, in the area immediately north of the existing Drehid Waste Management Facility site, two trackways or toghers, (KD009-018 & 019, also known as KD008-029 & 030) are recorded. The monuments were excavated by E. Rynne in the 1960's and by Monroe in 1986, (O'Carroll 2002). One of the trackways was a substantial oak plank trackway whilst the other was a less substantial birch trackway. Monroe thought that the trackways were broadly contemporary and the oak plank trackway was dendrochronologically dated in the Middle Bronze Age (1987, 22). A walkover survey conducted in preparation for the EIS of the waste management facility in 2002, found no extant trace of either trackway

The Irish Archaeological Wetland Unit identified a further 10 sites in the vicinity of the recorded trackways in the 1990's. Two of these trackways were destroyed before they were plotted (information received from Irish Archaeological Wetland Unit). The trackways were recorded to the north and east of the existing waste management facility and there will be no effects by the proposed development. The sites originally recorded by the Irish Archaeological Wetland Unit have, since 2010, been updated to the Sites and Monuments Record available at www.archaeology.ie and are detailed in the table below.

Monitoring of all excavations works associated with the development at the site in 2006 (License 06E0746) revealed no features of archaeological significance (Turrell & Flood 2007). Between 2008 and 2010, further monitoring was undertaken in advance of the construction of additional landfill cells (Phases 3, 4 & 5) to the north of the proposed development (Turrell, 2009). In 2010-2011, archaeological monitoring associated with a biowaste composting facility and monitoring of phase 6 of the development at the waste management facility was undertaken. Further phases of the development at the site were monitored between November 2014 and May 2015 (Jane Whitaker License 06E0746 Ext.). No finds or features of archaeological significance were encountered in the course of any of this monitoring works.

Following consultation with National Monuments, Department of Culture, Heritage, and the Gaeltacht a detailed survey of the existing drains in the area of the proposed development was undertaken under license (License 16E0467) by Fiona Rooney and Martin Fitzpatrick of Arch Consultancy Ltd. The work involved monitoring the cleaning down of the section face of existing drains within the area of the proposed development to record the stratigraphy and identify any possible archaeological remains. The work was undertaken over a period of ten days in September-October 2016. The monitoring found that in general peat levels throughout much of the proposed development site are less than 1 m and in many places, there is between 0.3-0.5 m of peat deposit remaining above the natural. Off centre to the west of the proposed development site produced the deepest levels of peat with up to 2.8 m recorded in an area 100-120 m in length, while peat levels greater than 2 m were also recorded in the north-east of the proposed development site. No archaeological features or artefacts were identified in any of the drains examined.

13.3.10 Cartographic Analysis & Ordinance Survey Maps

An examination of old maps and aerial photographs of the subject site revealed nothing of archaeological significance. The 1752 map by Noble and Keenan records the Bog of Allen with Timahoe and Drehid marked. The area of the proposed development is indicated as part of the vast bog in this mid-18th century map. Alexander Taylor's map of 1783 similarly depicts the area as a vast bog with the Cashanure River to the west. The first edition ordnance survey map produced in the mid-19th century highlights Coolcarrigan Demesne to the east of the site but no features are indicated in the area proposed for development. More recent maps and aerial photographs highlight the drainage channels throughout the site. Nothing of archaeological significance is marked in the area of the proposed development on any of the maps or aerial photographs.

13.3.11 Townland Names

Townlands are the smallest land divisions in the Irish landscape and many may preserve early Gaelic territorial boundaries that pre-date the Anglo-Norman conquest. The layout of Irish townlands was recorded and standardised by the work of the Ordnance Survey in the 19th century. The Irish translation of townland names often refer to natural topographical features but name elements may also give an indication of the presence of past human activities within the townland. Table 13-20: Townlands in the vicinity of Proposed development Site, provides the possible translation of the Irish origin of the townland names within or adjacent to the proposed development site.

Table 13-20: Townlands in the vicinity of Proposed development Site

Townland	Irish Translation	English Meaning
Timahoe	Tigh Mochua	House of Mochua
Coolcarrigan	Cuil Charraigin	Nook of the little Rock
Ballynakill (Upper & Lower)	Baile na Coille	Town of the Church or Wood
Corduff	Cor Dubh	Black Round Hill

13.3.12 Field Work

Plate 6:Digital Global Picture of proposed development site with RMP sites indicated with red dots (After OSI)

The proposed development site is located in an area immediately south of the existing Drehid Waste Management Facility (Plate 13-1). The various ordnance survey maps and earlier cartographic sources all identify the area as comprising of a vast bogland with no features indicated. The archaeological monitoring undertaken as part of this application found that in general peat levels throughout much of the proposed development site are less than 1 m and in many places, there is between 0.3-0.5 m of peat deposit remaining above the natural. The surface areas of the proposed development site consist of tracts of flat low-lying bog with varying densities of vegetation cover. The walk over survey was restricted to areas where over-growth was sparse or non-existent.

One recorded monument (KD0008:038) is located in the area of the proposed development. According to the Archaeological Survey of Ireland this monument is classified as a Road – Unclassified Togher. A tógher or tóchar is a brushwood trackway or more usually a roadway constructed from timber beams held in place by wooden pegs, traversing bogland or wetland. Stone-built roads or tracks were also constructed, and are known in some cases to connect with wooden trackways. Both the roads of wood and stone construction have a broad date span, with some dating to the Neolithic period, while others are assigned a late medieval date. In many cases modern roads follow the line of their more ancient antecedents (O'Brien and Sweetman 1997, 51). The Archaeological Survey of Ireland have divided these roads into various classes. The feature located within the development site was recorded as measuring 72 m in length, 1 m in width and 0.08 m in depth, consisting of several pieces of hazel brushwood (diam. 0.01-0.025 m) in a haphazard arrangement. Some evidence for burning was recorded and it is probably the destroyed remains of a more substantial structure. No trace of this feature survives above ground and the monument is not scheduled for inclusion in the next revision of the RMP.

Further tógher sites are recorded to the north of the proposed development in the townlands of Parsonstown and Timahoe West (KD008:029/KD009:019, KD008:030/KD009:018). A number of toghers originally identified by the Irish Archaeological Wetland Unit have now been updated to the Sites and Monuments Record and are included in Table 13-4. These sites are located predominantly to the north and north-east of the proposed development in the townlands of Coolcarrigan and Timahoe West and are recorded as unclassified roads, peatland structures and toghers. Further north, togher sites are recorded from the townland of Drehid (KD008:025, KD008:026, KD008:027).

Enclosures are recorded in the townlands of Collinstown (KD008:007), Parsonstown (KD008:023) and Coolmartin (KD009:007) with the closest located c. 3 km from the proposed development site. Enclosures are usually distinguished on the basis of their anomalous characteristics, such as their large or small size, or lack of entrance features, which sets them apart from ringforts or other classifiable enclosures. The term usually refers to a site which consists of an enclosing bank surrounding a circular or sub circular area, and with no apparent entrance. Due to the lack of diagnostic remains it is difficult to suggest a period of construction or use for the monuments. Occasionally, the enclosures are surrounded by a ring of trees. The function of these sites is indeterminable from visual inspection alone, that is, without excavation and due to the lack of identifiable features. Sites which are now destroyed but which have been detected on aerial photographs, marked on various Ordnance Survey maps or locally described as circular or sub-circular areas defined by banks and/or fosses are usually categorised as enclosures.

A Children's Burial Ground is recorded from Timahoe West (KD009:006.1), c.2 km to the northeast of the proposed development. These sites are usually found either in isolation or associated with other monuments such as enclosures and are characterised by the presence of numerous small, uninscribed set stones, often arranged in rows.

Medieval churches, which often incorporate the fabric of early Christian churches, are distinguished on the basis of their ground plan and date. Nave and chancel churches are dated to the twelfth to thirteenth century, while single-celled churches are assigned a thirteenth to seventeenth century date. The single-celled churches were generally orientated east/west and were entered at the west end of either the north or south wall. Some churches had opposing doorways at the west end of the church. These churches may also have had a subdivision at the west end of the church, in the form of a cross-wall, or the presence of corbels or beam-holes which indicate the former presence of a loft. These quarters comprised the accommodation for the parish priest. A Church and Graveyard is recorded in the townland of Timahoe East (KD009:008) c. 3 km east of the proposed development site.

A moated site is recorded in the townland of Drehid (KD008:024) c. 3.5 km NNW of the proposed development site. These monuments are square, rectangular or occasionally circular areas, sometimes raised above the ground, enclosed by a wide, often water-filled, fosse, with or without an outer bank and with a wide causewayed entrance. They date to the late 13^{th}/early 14^{th} centuries and were primarily fortified residences/farmsteads of Anglo-Norman settlers though also built by Gaelic lords.

Stone castles date to the Anglo Norman period and would have come after an earlier earth and timber castle, as they took longer to build and were more expensive. A castle was recorded in the townland of Timahoe West (KD009:009) to the north east of the proposed development site, however no surface trace survives today.

13.3.13 Summary

The archaeological assessment identified archaeological monuments within the proposed development site and general surrounds, in addition to the haul route options. All of the sites detailed are recorded in the Record of Monuments and Places and receive statuary protection under the National Monuments Act 1995 (see Section 13.2.2). One recorded archaeological monuments (KD009:038 – A road-Unclassified Togher) is located within the proposed development site. No trace of this monument survives above ground and the monument is not scheduled for inclusion in the next revision of the Record of Monuments and Places. One National Monument, a bridge KD019-012 is impacted by the proposed route options 1.1, 2 and 2.2. This bridge is currently closed to HGV's. There are a number of recorded monuments on or adjacent to haul routes (Table 13-5 to Table 13-12). These will not be directly impacted as the haul routes are along existing roads.

The assessment also identified architectural and cultural heritage features located within the proposed development site, immediate surrounds and the haul route options. No features recorded in the National Inventory of Architectural Heritage are located within the proposed development site. Two structures, recorded in the List of Protected Structures for County Kildare, are located 1.6 km from the proposed development site and will not be impacted.

Numerous structures are located along the proposed haul routes proposed (Table 13-14 to Table 13-19). It should be emphasised that all the haul route options are along existing roadways. One of these structures KD019-012 is a National Monument.

13.4 POTENTIAL EFFECTS TO CULTURAL HERITAGE

Following on from the identification of the baseline environment, the available data is utilised to identify and categorise potential effects likely to affect the archaeological and cultural heritage environment as a result of the proposed development.

13.4.1 Construction Phase – Direct Impacts

The proposed development will involve the mechanical excavation of all peat layers down to and through geologically deposited strata to enable ground engineering works such as access roads, cell development and drainage.

As discussed in Section 13.3.3 above, one recorded archaeological monuments are located within the boundary of the proposed development. No trace of the monument is visible on the ground today and it is not scheduled for inclusion in the next revision of the Record of Monuments and Places

No new above ground features of archaeological potential were noted during field inspection completed in 2016. The uncovering of sub-surface archaeological features during peat removal associated with the construction of the proposed development has a potential effect on the archaeological resource. A survey of the existing drains in the area of the proposed development was undertaken under license (License 16E0467) by Fiona Rooney and Martin Fitzpatrick of Arch Consultancy Ltd (See Section 13.3.10). No archaeological features or artefacts were identified in any of the drains examined.

Machinery tracking over the proposed development site during construction has the potential to disturb the sub-surface archaeological features, particularly those that have no above ground expression.

In the absence of mitigation, potential direct effects of the proposed development on the Construction phase is defined as low, imperceptible, medium adverse.

There are a number of haul route options to the proposed development site. An assessment of the routes found that all routes are along existing roadways. The proposed haul routes 1, 1.1 and 2.2 will impact on the National Monument KD019-012. This narrow, six-arched bridge spans the River Liffey to the north-west of Naas town. While displaying some evidence of 18^{th} and 19^{th} century rebuilding, the bridge could date from as early as 1450 AD to 1650 AD and is an important example of bridge architecture. The bridge is currently closed to HGV traffic and should not be used by heavy good vehicles during construction.

In the absence of mitigation, potential direct effects on the haul route options on the Construction phase are defined as medium quality significance or value on a regional scale, imperceptible, negligible.

13.4.2 Construction Phase – Indirect Effect

The proposed development will involve the construction of an additional landfill facility and associated infrastructure. The construction will see the excavation of a large tract of bog and geological strata and this excavation will not have a visual effect on the surrounding archaeological, architectural and cultural heritage landscape. Within the proposed development site there is one recorded monument that has no surface expression and this site will not be included in the next revision of the Record of Monuments and Places. The construction of the additional landfill facility will not effect the setting of surrounding monuments.

In the absence of mitigation, potential indirect effects on the Construction Phase are defined as low quality significant on a local scale imperceptible, negligible. The haul route options will have no indirect impacts on the archaeological and cultural heritage resource during construction.

In the absence of mitigation, potential indirect effects on the haul route options during the Construction phase are defined as, imperceptible, negligible.

13.4.3 Operational Phase – Direct Impacts

A 25 year operational phase is expected and assessed. The operation of the residual landfill will have no direct effects on the archaeological and cultural heritage resource during the operational phase.
In the absence of mitigation, potential direct effects of the proposed development during the operational phase is defined as low, imperceptible, negligible.

The operation of proposed haul routes 1.1, 2 and 2.2 will have a direct effect on the bridge structure-National Monument KD019-012. This bridge is currently closed to HGV traffic.

In the absence of mitigation, potential direct effects on the haul route options during the operational phase are defined as low, imperceptible, negligible

13.4.4 Operational Phase – Indirect Impacts

The operational phase is concerned primarily with the impact of upstanding structures of the proposed development on the archaeological landscape (i.e. visual and noise). The presence of a landfill facility in the landscape can have a negative impact if located too close to monuments. There is currently no legislation governing the visual impact of a development on recorded monuments, and as such the separation distance between the relevant infrastructure of the proposed development to a recorded monument is not defined.

There will be a visual impact on the human landscape. The monument recorded within the proposed development site has no significant surface element remaining and it is not scheduled for inclusion in the next revision of the Record of Monuments and Places, therefore there will be no significant visual impact on the setting of the development. The upstanding proposed development infrastructure may be visible from surrounding monuments, particularly to the north, however the visual impact of the development will be negated by the existing residual landfill to the immediate north and by the dense vegetation surrounding the site on the other three sides. An assessment of the visual impacts of the proposed development on the surrounding landscape is detailed in Chapter 8 Landscape and Visual Impact Assessment of this EIAR. The photomontages and zone of theoretical visibility ("ZTV") study in Chapter 8 were referred to in this assessment and they indicate that the greatest visual expression will be from the north of the proposed development site. There will be a long-term change to the geological and visual character of the proposed development site with peat and geological layers being replaced by proposed infrastructure. While some of the proposed development will be visible from the surrounding recorded monuments it should still be possible to view any monument from one side or the other without the proposed development in the background.

In the absence of mitigation, potential indirect effects of the proposed development on the operational phase is defined as medium, moderate, small adverse.

In the absence of mitigation, potential indirect effects on the haul route options in the operational phase is defined as medium, imperceptible, negligible.

13.4.5 Decommissioning Phase – Direct Effects

No additional direct effects over and above those identified during the construction phase will occur.

13.4.6 Decommissioning Phase – Indirect Effects

No additional direct effects over and above those identified during the construction phase will occur.

13.5 MITIGATION MEASURES AND RESIDUAL EFFECTS

This sub-section provides a description of measures recommended to off-set potential negative effects identified in Section 13.4 and presents a summary of the significance of the effects of the proposed development after mitigation measures have been implemented.

13.5.1 Construction Phase

The following mitigation measures will be implemented during the construction phase:

- All ground disturbance associated with the construction of the proposed development are recommended to be monitored by a suitably qualified archaeologist working under license from National Monuments, Department of Culture, Heritage and the Gaeltacht; and

- Should archaeological features, finds or deposits be encountered during monitoring the National Monuments Service and all relevant authorities will be notified immediately. Preservation in-situ or preservation by record (excavation) may be required.

13.5.1.1 Construction Phase Residual Impacts - Direct

One archaeological monument, currently recorded in the Record of Monuments and Places, is located within the boundary of the proposed development. No trace of the feature survives and the monument is not scheduled for inclusion in the next revision of the RMP.

Following the imposition of the mitigation measures, the residual direct effects of the construction phase can be defined as low, imperceptible and negligible.

13.5.1.2 Construction Phase Residual Impacts – Indirect

The construction phase of the proposed development involves excavation of the existing peat and geological strata and will be not be visible from the surrounding monuments. As no indirect effects of the construction of the proposed development site or haul route options were identified, no mitigation is required.

13.5.2 Operational Phase Impacts

Mitigation measures proposed to offset potential indirect effects are imbedded in the design of the proposed development via the final landscaping design.

13.5.3 Operational Phase Impacts-Direct

No direct effects are predicted during the operational phase of the proposed development on the archaeological, architectural and cultural heritage environment, therefore no mitigation is required. The proposed haul routes 1, 1.1 and 2.2 will impact on the National Monument KD019-012. This narrow, six arched bridge spans the River Liffey to the north-west of Naas town. While displaying some evidence of 18^{th} and 19^{th} century rebuilding, the bridge could date from as early as 1450 AD to 1650 AD and is an important example of bridge architecture. The bridge is currently closed to HGV traffic.

13.5.4 Operational Phase Impacts-Indirect

There may be a visual impact on the setting of archaeological features in the wider environment. This has, where possible, been mitigated by the design of the proposed development.

13.5.4.1 Decommissioning Phase

No new effects are predicted during the decommissioning phase of the project on the archaeological, architectural and cultural heritage environment, therefore no mitigation is required.

13.6 CONCLUSIONS

This report was undertaken as an archaeological and cultural heritage impact assessment to be submitted as part of the EIAR associated with the proposed development. The assessment included desk based research, on-site field walking and archaeological monitoring to identify areas of archaeological /cultural heritage potential.

There are no protected structures in the area of the proposed development or wider landscape.

There are no National Monuments in State Care in the area of the proposed development or the wider landscape. One monument KD008-038, a Road – Unclassified Togher is recorded in the proposed development site. No trace of this feature survives above ground and no trace has been encountered in either the archaeological monitoring associated with the existing facility to the immediate north or in the inspection of drains undertaken as part of this assessment. This site is not scheduled to be included in the next revision of the RMP.

No features of archaeological significance were noted above ground in the walk over survey.

No artefacts or features of archaeological significance were encountered in the survey of section faces of the existing drains traversing the area of the proposed development. This survey found that peat harvesting has almost completely removed the peat in many areas.

Archaeological monitoring of all previous and current ground disturbance associated with the existing Drehid Waste Management Facility revealed no finds or features of archaeological significance.

Archaeological finds recorded in the topographical files of the National Museum of Ireland indicate human activity in the general area of the proposed development from the Neolithic period with many of the artefacts recovered from a peat environment. While the bogs have since been harvested it is possible that further artefacts and/or features survive in the lower levels of peat.

It is recommended that in advance of construction, all vegetation on the site will be cleared to enable a full appraisal and that during construction all ground disturbance be archaeologically monitored by a suitably qualified archaeologist working under license from the National Monuments, Department of Culture, Heritage and the Gaeltacht.

The proposed haul routes 1, 1.1 and 2.2 will impact on the National Monument KD019-012. This narrow, six arch bridge spans the River Liffey to the north-west of Naas town and is currently closed to HGV traffic.

The mitigation measures proposed here are subject to ratification by National Monuments, Department of Culture, Heritage and the Gaeltacht.

13.7 STATEMENT OF SIGNIFICANCE

Given that only effects of significant impact or greater are considered “significant” in terms of the EIA Regulations, the potential effects of the proposed development and haul route options (except routes 1.1, 2 and 2.2) on the archaeological, architectural and cultural heritage resources are considered to be not significant.

13.8 SUMMARY OF SIGNIFICANT EFFECTS

This assessment has identified no potentially significant effects from the proposed development and haul route options on the receiving environment (except routes 1.1, 2 and 2.2), given the layout and design of the proposed development and the archaeological works already completed at the proposed development site and the mitigation measures recommended during construction of the proposed development.

14 CLIMATE

This chapter assesses the effect on climate arising from the proposed development at the Drehid Waste Management Facility, Carbury, County Kildare.

14.1.1 Methodology

A desk-top assessment of available climatic information was undertaken to characterise the existing climate. Meteorological data contained in this EIAR chapter has been received from Met Éireann and from the Lullymore rainfall station (Bord na Móna). All calculations detailed in the report are carried out using methods advised by Met Éireann.

14.1.2 Weather Observing Stations

14.1.2.1 Rainfall Stations

There are numerous rainfall measuring stations throughout the country, which measure the local daily rainfall in millimetres (mm). Some of these stations also measure additional parameters such as soil moisture, temperature and humidity.

14.1.2.2 Synoptic Stations

Synoptic stations observe and record surface meteorological data. These observations include rainfall, temperature, wind speed and direction, relative humidity, solar radiation, clouds, atmospheric pressure, sunshine hours, evaporation and visibility. They report a mixture of hourly observations of the weather (synoptic observations) and daily summaries of the weather, known as climate observations. There are 25 national synoptic stations[74] and, where required, data have been referenced in this chapter from relevant synoptic stations, including Casement Aerodrome in south County Dublin and Mullingar synoptic station in County Westmeath.

14.2 RECEIVING ENVIRONMENT/BASELINE DESCRIPTION

14.2.1 General Climate of Ireland

The Atlantic Ocean is the dominant influence on the climate in Ireland. As a result, Ireland does not suffer from extremes in temperature, the average annual temperature being about 9° C. Mean annual wind speed varies between about 4 m/sec in the east midlands and 7 m/sec in the northwest. Strong winds tend to be more frequent in winter than in summer. Sunshine duration is highest in the southeast of the country.

According to Met Éireann and their summary data describing the Climate of Ireland[75,] the following observations have been made by the meteorological service. Average annual rainfall varies between

[74] http://www.met.ie/climate/monthly-data.asp
[75] http://www.met.ie/climate/climate-of-ireland.asp

about 800 mm and 2,800 mm across the country. With south-westerly winds from the Atlantic dominating, rainfall figures are highest in the northwest, west and southwest of the country, especially over higher ground. Rainfall accumulation tends to be highest in winter and lowest in early summer. The annual number of days with more than 1 mm of rain varies between about 150 days in the drier parts and over 200 days in the wetter parts of the country.

14.2.2 Rainfall

In order to give reliable climatic data on a particular area, a weather station should be located within 10 km of that area and be in operation for at least 30 years.

A rainfall station is located at Lullymore (Bord na Móna) approximately 4 km southwest of the proposed development. This station was in operation by Bord na Móna from 1945 to 1992 (47 years) and includes a continuous record of rainfall measurements for 30 years (1960 to 1990), which is considered an appropriate period of measurement to provide reliable data. Rainfall data from the Lullymore (Bord na Móna) station have been reproduced in this chapter.

The nearest synoptic weather stations with meteorological conditions similar to those found at the Drehid Waste Management Facility and with a minimum of 30 years operation have been identified as Casement Aerodrome, County Dublin and Mullingar synoptic station, County Westmeath. These stations are located approximately 30 km east of the proposed development and 40 km west of the proposed development respectively.

Met Éireann also operate two meteorological stations with more limited climate measurements, but including rainfall measurement, at Edenderry, County Offaly and at Osberstown, County Kildare. In 2010, Met Éireann placed a new rainfall measurement station at the Lullymore Nature Reserve and this station has recorded rainfall from 2011 to date.

Specifics of the location and elevation of the proposed development site at Drehid relative to the nearest meteorological stations with recorded rainfall measurements are outlined in Table 14-1: Designated Meteorological Stations for the Proposed development.

Table 14-1: Designated Meteorological Stations for the Proposed development

Location	Grid Reference (Irish National Grid (ING))	Elevation (m O.D.)	Height Difference (m)
Proposed development (at Drehid)	274783, 230671 (ING)	85	-
Lullymore (Bord na Móna)	268402, 225010 (ING)	84	-
Casement Aerodrome	303285, 229044 (ING)	94	9
Mullingar	242280; 254331 (ING)	101	16

The elevation of the proposed development ranges from approximately 84 to 85 m O.D while the elevation of the rainfall gauge at Lullymore (Bord na Móna) is approximately 84 m O.D. According to Met Éireann, annual precipitation levels increase by 200 – 300 mm per 100 m rise in elevations[76.] Therefore no adjustment of the dataset of precipitation levels from the Lullymore rainfall station (Bord na Móna) has been necessary. The average monthly and annual precipitation levels recorded at Lullymore are considered to be representative of the proposed development location. Average monthly rainfall levels from the Lullymore rainfall station (Bord na Móna) are given in Table 14-2: Average Monthly Precipitation Lullymore (Bord na Móna) station 1960-1990.

Table 14-2: Average Monthly Precipitation Lullymore (Bord na Móna) station 1960-1990

Location	Lullymore (Bord na Móna) Rainfall Station
Ht. m O.D.	84 m
January	79 mm
February	54 mm
March	60 mm
April	54 mm
May	61 mm
June	63 mm
July	57 mm
August	78 mm
September	71 mm
October	80 mm
November	76 mm
December	83 mm
Annual	**816 mm**

[76] http://www.met.ie/climate-ireland/rainfall.asp

14.2.3 Evapotranspiration and Effective Rainfall

Evaporation is the return of water vapour to the atmosphere. Transpiration accounts for the movement of water within a plant and the subsequent loss of water as vapor through stomata in its leaves.

Potential Evapotranspiration (PE) refers to the amount of water that could potentially be removed from the soil, through evaporation from land and through transpiration by plants, assuming sufficient water is always available within the soil. Actual evapotranspiration is estimated as 95% of potential evapotranspiration to allow for seasonal soil moisture deficits (Misstear and Brown (2008), taken from Tedd et al., 2008)[77].

The nearest relevant inland synoptic meteorological station with evapotranspiration measuring equipment is located at Mullingar synoptic station.

It can be noted that evapotranspiration recorded at Mullingar is lower during winter months, when temperatures are lower than in summer months, relative humidity is generally higher and plant growth is minimal. The vast majority of evapotranspiration during winter months is attributable to direct evaporation from ground surfaces. During summer months the rate of evapotranspiration increases and often exceeds the monthly rainfall. This is due to increased free evaporation from the surface and from transpiration from leaves and plants.

Effective rainfall is defined as precipitation minus actual evapotranspiration. The effective rainfall for the proposed development site was calculated using; rainfall data from the Lullymore (Bord na Móna) site, as the estimated rainfall for the proposed development site at Drehid, and the potential evapotranspiration data for the nearest relevant inland synoptic station (Mullingar). The calculation of Effective Rainfall at the proposed development site is set out in Table 14-3: Calculated Effective Rainfall at the proposed development Site at Drehid.

[77] https://www.epa.ie/pubs/reports/research/water/kteddinterim/tedd-report-erc-17-chapter2.pdf

Table 14-3: Calculated Effective Rainfall at the proposed development Site at Drehid

Month	Rainfall (mm)	Potential Evapotranspiration (PE) (mm)	Actual Evapotranspiration (mm)	Effective Rainfall at Proposed development Site (mm)
	Rainfall mean at Lullymore (1960-1990)	PE mean at Mullingar synoptic station 1981 to 2010[78]	(PE x 0.95)	Rainfall-Actual Evapotranspiration
January	79	10.3	9.8	69.2
February	54	17.4	16.5	37.5
March	60	31.0	29.5	30.6
April	54	51.4	48.8	5.2
May	61	71.9	68.3	0.0
June	63	80.5	76.5	0.0
July	57	79.1	75.1	0.0
August	78	65.0	61.8	16.3
September	71	44.0	41.8	29.2
October	80	22.9	21.8	58.2
November	76	10.3	9.8	66.2
December	83	7.5	7.1	75.9
Total	**816.0**	**491.3**	**466.7**	**388.2**

Any rain falling on the proposed development site can evaporate from the surface, infiltrate to the ground, or become surface water runoff. The surface water drainage system is discussed in more detail in the Water chapter, Chapter 7 of this EIAR.

14.2.4 Wind

Wind data from Casement Aerodrome was used for the assessment of wind conditions at the proposed development site.

The Casement Aerodrome wind rose diagram shows that the prevailing winds are from the south west[79]. (Refer to Appendix 14.1 'Casement Aerodrome Wind Rose Diagram' for further details). Based on the averages between 1981 and 2010, the mean wind speed at Casement Aerodrome[80] is 10.7 knots (5.5 m/s) while the maximum gust reached 82 knots (42.2 m/s). The mean number of days with gales during these years was 18.1 days. The elevation of the meteorological anemometer is

[78] http://www.met.ie/climate/monthly-data.asp?Num=875
[79] 1971 to 2000 data
[80] http://www.met.ie/climate-ireland/1981-2010/casement.html

approximately 94 m O.D. These wind speeds are likely to be indicative of those at the proposed development site in Drehid.

14.2.5 Likely future receiving environment/ do nothing scenario

If the proposed development does not take place (do nothing scenario) the existing baseline conditions detailed above will evolve in a similar manner to proximal climatic conditions, encompassing future climate change, without the potential effects of the proposed development.

14.3 POTENTIAL EFFECTS ON CLIMATE

According to the Irish Peatlands Preservation Council, in their natural state, peatlands act as long-term sinks for atmospheric carbon dioxide. Drainage of a peatland upsets the accumulation process and leads to a vast increase in the amount of carbon dioxide released to the atmosphere from the peatland[81]. The proposed development is not however located on an intact bog. Based on the Von Post scale, the surface peat varies from H2 to H7 and is predominantly Dry (B1 to B2) (refer also to Chapter 6, the Soils and Geology chapter of this EIAR). The proposed development would not therefore significantly effect the environment by draining peatland.

During the construction phase of the proposed development, the potential negative effects on climate will be those associated with dust and exhaust emissions from construction traffic. These effects will be of temporary duration and their effects are not considered to be significant (refer also to Chapter 11 of this EIAR).

During the operational phase of landfills and composting at the proposed site, the potential negative effects are environmental risks associated with emissions to the atmosphere and to water (namely dust, odours and gas, such as CO_2 and CH_4, and water contamination by leachate, if not controlled). There is the potential for a number of greenhouse gas emissions to atmosphere during the operational phase of the development and cumulative developments including the MBT. Effects on climate due to the traffic include regional or transboundary impacts. Road traffic may give rise to CO_2, NO_x and VOCs emissions. These were assessed using the UK Design Manual for Roads and Bridges screening model which is a recommended screening model for assessing the effect of traffic. The inputs to the air dispersion model consisted of information on road layouts, receptor locations, annual average daily traffic movement's, annual average traffic speeds and background concentrations.

The effect of the proposed development on national greenhouse gas emissions will be insignificant in terms of Ireland's obligations under the EU 2020 Target and Ireland's obligations under the Targets set

[81]http://www.ipcc.ie/a-to-z-peatlands/peatland-action-plan/climate-change-and-irish-peatlands/

out by "Proposal for a Directive on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC" are imperceptible and long-term.

Potential effects due to emissions to the atmosphere and to water have however been offset during the design phase. Modern landfills, including the existing landfill at Drehid, are engineered to prevent leachate escaping and to collect landfill gas and emissions. In the case of the relevant consents being granted, leachate and landfill gas emissions will be monitored closely in accordance with the conditions of the applicable Industrial Emissions Directive (I.E.D) licence for the proposed development.

There are also potential positive effects as a result of the proposed development. As part of the proposed development, a metal recovery facility will divert approximately 15,000 Tonnes Per Annum (TPA) of metal waste away from landfill, thus contributing to the fulfilment of Ireland's target under the Landfill Directive (1993/31/EC) the Kyoto Protocol. Recycling metals provides one of the highest benefits per tonne to the environment[82].

Furthermore, as noted below, additional stabilisation of biodegradable waste forms part of the proposed development through the addition of both processing capacity and infrastructure development at the composting facility. The composting process will provide environmental benefit through the treatment of the waste. Methane is a harmful greenhouse gas if it escapes to atmosphere. By virtue of the process in the composting facility, biodegradable municipal waste will be biostabilised thereby minimising its potential to generate methane (a harmful greenhouse gas) and leachate.

It is proposed to increase the volume of waste to be accepted at the existing composting facility at Drehid to 45,000 TPA from the currently permitted 25,000 TPA. This will be achieved without any physical development. It is also proposed to remove the current restriction on the operating life of the existing facility. It is further proposed to extend the facility to provide for acceptance of additional 45,000 TPA, to a total of 90,000 TPA overall. This will be of benefit to Ireland in reaching targets under the Landfill Directive (1993/31/EC) which allows a maximum of 427,000 tonnes of biodegradable municipal waste to be landfilled by July 2016[83]. In July 2016 Ireland notified the European Commission of its intention to avail of the derogation for the 2016 target i.e. to defer the fulfillment of the target from 2016 to 2020. It is also of note that only seven landfills accepted municipal waste for disposal in 2016 compared to 25 in 2010[84].

[82] http://www.epa.nsw.gov.au/resources/warrlocal/100058-benefits-of-recycling.pdf
[83] http://editions.sciencetechnologyaction.com/lessons/6/94/EPA.pdf
[84] https://www.epa.ie/pubs/reports/waste/stats/bmwwaste/EPA_BMW_2013-16_data_release_web.pdf

14.4 MITIGATION MEASURES

During the construction phase of the proposed development, all contractors will ensure that machinery used on site is properly maintained and is switched off when not in use to avoid unnecessary dust and exhaust emissions from construction traffic.

During the operational phase, ongoing monitoring will be carried out in accordance with the waste licence to ensure no contamination or emissions occur that could effect the wider environment.

As discussed further in Chapter 11, air and odour abatement systems (including building ventilation systems, dust suppression), have been designed in accordance with Best Available Techniques (BAT) for use in the proposed development to mitigate potential air quality effects.

14.5 CONCLUSION

The potential for negative effects to occur, in relation to climate as a result of the proposed development, has been evaluated as being insignificant. The proposed development occurs in an area of previously degraded and cut bog that is now considered dry and has therefore likely lost its potential as a carbon sink.

The proposed development will be designed to meet all relevant standards and will reduce any potential risks of contamination or emissions from the site. It will further provide environmental benefit through the stabilisation of biodegradable municipal waste prior to landfilling.

15 POPULATION AND HUMAN HEALTH

15.1 INTRODUCTION

This Chapter assesses the existing environment in addition to the potential effects on population and human health arising from the proposed development.

Section 15.2 of the Chapter will focus on Population including land use, population, employment, tourism and amenities, infrastructure, community gain and health and safety. Mitigation measures will be proposed to mitigate any potential effects arising from the proposed development. The second part of this chapter (Section 15.3) will specifically deal with the potential effects on human health associated with the proposed development. This will include a human health risk assessment which is the process to estimate the nature and probability of adverse health effects in humans as a result of the proposed development.

15.2 POPULATION

15.2.1 Methodology

A desktop study was carried out in order to examine relevant information pertaining to socio economic activity in the area. The following information sources and references were used to compile this Chapter:

- EPA Guidelines – 'Information to be contained in Environmental Impact Statements', 2002;
- *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (September 2003)*;
- *EPA Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports ((Draft) August 2017;)*
- Fáilte Ireland Information in relation to tourism amenity in conjunction with websites of relevant tourism sites and amenities for the area;
- Central Statistics Office (CSO) information;
- Draft Kildare County Development Plan 2017-2023
- Guidelines on the treatment of tourism in an EIS, provided by Fáilte Ireland as part of their submission to the Scoping request issued to them;
- OSI mapping and Aerial Photography to identify land use and possible amenity sites; and
- Environmental Impact Statements for previous developments (within the Bord na Móna landholding) (2004, 2008 and 2012);

15.2.2 Receiving Environment/Baseline Description

The extent of the Bord na Móna landholding, which comprises 2,544 hectares (ha), is outlined in blue in Chapter 1, on EIAR Figure 1.1. The Bord na Móna landholding, outlined in blue on Drawing No. 8108-

2000 & 8108-2001, is located within the County Kildare townlands of Drehid, Ballynamullagh, Kilmurry, Mulgeeth, Mucklon, Timahoe East, Timahoe West, Coolcarrigan, Corduff, Coolearagh West, Allenwood North, Killinagh Upper, Killinagh Lower, Ballynakill Upper, Ballynakill Lower, Drummond, Kilkeaskin, Loughnacush, and Parsonstown.

As described in Chapter 1 of the EIAR, the application area is outlined in red as shown on the planning drawings. The proposed development will occur within this boundary, within an area of 272 ha. The proposed development is confined to the townlands of Timahoe West, Coolcarrigan, Killinagh Upper, Killinagh Lower, Drummond, Kilkeaskin, Loughnacush, and Parsonstown.

The village of Derrinturn is located approximately 2.6 km to the west of the closest edge of the site activity boundary and Timahoe crossroads is located approximately 1.7 km to the east of the closest edge of the site activity boundary.

The land within the proposed development consists of the flat lying and gently undulating topography typical of cut away peatland.

Planning Drawing No. 8108-2000 shows the site location relative to a number of adjacent villages including Derrinturn, Timahoe, Coill Dubh and Allenwood at a scale of 1:25,000. The location of the site boundary relative to the regional roads R402 and R403 is also shown on the drawing.

15.2.2.1 Land Use

The site of the proposed development is located within the same Bord na Móna landownership boundary as the existing permitted Drehid Waste Management Facility. This property is located between the Regional Routes R403 (Lucan/Carbury) and R402 (Enfield/Tullamore) that lie to the south and west of the site, and County Roads L5025 and L1019 located to the north and east of the site.

As shown on Planning Drawing No. 8108-1013, the proposed Hazardous and Non-Hazardous landfills are to be situated directly south of the existing MSW landfill. Land use on and adjacent to the proposed development site is primarily disused cutaway bogland used up to approximately twenty two years ago for production of sod peat for energy generation. Immediately adjacent to the proposed development site there are areas of land where turbary, commercial forestry and agricultural usage are evident.

The site consists of cutover bog with a mosaic of bare peat and revegetated areas with scrub, woodland, heath and grassland communities present. It is located within a mixed rural/urban setting at the north-western extent of County Kildare. Within the extended area, farming enterprises intermingle with a multiplicity of industrial and commercial establishments as well as a number of settlements that have developed primarily along a section of the existing national road system.

A detailed topographical survey was carried out at the proposed development in March 2016. The final output of this survey for the proposed site is presented as a topographic contour map on Drawing No. 8108-2002. As illustrated on the drawing, the proposed site is situated in a relatively flat low-lying cutaway bogland with levels ranging from 82 m to 85 mOD, while the topography throughout the overall landholding is also relatively flat at 80 to 90 mOD.

The proposed development is located within Principal Landscape Character Area 'Western Boglands' as set out in the Kildare County Development Plan 2017-2023. The 'Western Boglands' are listed as Class 3 with a 'High' sensitivity. See Chapter 8 of this EIAR for further details of the landscape assessment.

15.2.2.2 Population

This section provides an overview of the population change over the period 2006-2016 in order to gain an understanding of the socio economic activity in the area. The Bord na Móna landholding is located in the Electoral Divisions (EDs) of Timahoe North, Timahoe South, Drehid, Dunfierth, Kilpatrick, Windmill Cross and Kilmeage North. The proposed development is located within the ED of Timahoe South. According to S.I. No. 52/2014 - County of Kildare Local Electoral Areas and Municipal Districts Order 2014, these EDs are located within the Electoral Areas of Kildare-Newbridge and Maynooth.

The objectives for settlements immediately adjacent to the subject site are outlined in Section 3.3 of the Kildare County Development Plan 2017-2023, in accordance with the Regional Planning Guidelines for the Greater Dublin Area 2004-2017 and in accordance with the Regional Planning Guidelines for the Greater Dublin Area, 2010-2022. Allenwood and Coill Dubh/Coolearagh are described as *Villages,* Prosperous and Derrinturn are *Small Towns*, while Carbury and Timahoe are categorised as *Rural Nodes*.

As described in the Kildare County Development Plan 2017-2023, Section 3.4.3, the role of a Small Town is to develop as a key local centre for services for a population of roughly 1500 to 5000, to cater for local need and support local enterprise. As described in Section 3.4.4, the role of a Village is to develop as a local centre for services and to cater for local need and enterprise at an appropriate scale, with limited scope for expansion.

As the proposed development remains outside the development boundary of Derrinturn and Allenwood, specific planning objectives relating to these settlements do not apply.

All of the existing settlements in the vicinity are at a considerable distance from the subject site, the nearest being Timahoe, at approximately 1.7 km from the application boundary for the proposed development. Derrinturn is approximately 2.6 km from the proposed activity boundary, while both Allenwood and Coill Dubh are in excess of 3 km.

Table 15-1: Population Change 2006-2016 illustrates the population change between 2006-2016 in the State, Leinster, County Kildare, the districts of Kildare-Newbridge and Maynooth and the ED of Timahoe South.

Table 15-1: Population Change 2006-2016

Location	2006	2011	2016	% Change 2006-2016
State	4,239,848	4,588,252	4,757,976*	12.2%
Leinster	2,295,123	2,504,814	2,630,720*	14.6%
County Kildare	186,335	210,312	222,130*	19.2%
Timahoe South	772	772	845*	9.5%

Source: Central Statistics Office (CSO) 2016 [*Note preliminary CSO figures only available for 2016]

Table 15-1 above shows that the population has increased in the state as a whole and in Leinster over the period 2006-2016 by 12.2% and 14.6% respectively. Population during this period has increased significantly in County Kildare, by 19.2%. Population also increased within the ED of Timahoe South (9.5%).

The Draft Kildare County Development Plan 2017-2023 notes the key emerging trends which have been observed during the 2006-2011 period which included the following;

'*The period showed continued increase in population at an average rate of 4,795 persons per annum over the five years, representing a slight decrease in the average of 5,598 over the preceding four years (2002-2006)..*

The greatest growth in population in the County's urban areas was in Newbridge with an increase in population of 4,519 persons, followed by Celbridge (2,275), Maynooth (1,795), Clane (1,734), Sallins (1,477) and Kilcock (1,433).

Continued pressure for development at the edges of the County's main urban centres and in the adjoining rural hinterlands.

A limited number of areas experienced population stagnation including north of Rathangan, south of Ballymore Eustace, Newbridge town centre, Pollardstown, Ballysax, west Athy and south of Maganey' (Ref Section 3.2).

Table 15-2: Population Change 2006-2016

Location	2006	2011	2016	% Change 2006-2016
Maynooth	38,635	46,037	50,543*	23.6%
Kildare-Newbridge	48,807	50,106	52,949*	15.4%

S.I. 52 of 2014 schedule of Local Electoral Areas

Source: Central Statistics Office (CSO) 2016 [*Note preliminary CSO figures only available for 2016]

Table 15-2: Population Change 2006-2016 above shows the population change of the new Local Electoral Areas in Kildare which were changed in 2014 by statutory instrument, S.I. 52 of 2014 schedule of Local Electoral Areas. The table shows that the population has significantly increased in Maynooth and in Kildare-Newbridge over the period 2006-2016 by 23.6% and 15.4% respectively.

Table 15-3: Population Change 2006-2016

Location	2006	2011	2016	% Change 2006-2016
Edenderry No.2 Rural Area	10,059	11,756	12, 359*	22.9%
Naas No.1 Rural Area	74,142	84,049	88,481*	19.3%

Pre-S.I. 52 of 2014 schedule of Local Electoral Areas

Source: Central Statistics Office (CSO) 2016 [*Note preliminary CSO figures only available for 2016]

The Local Electoral Areas for Kildare were changed in 2014 in line with statutory instrument, S.I. 52 of 2014 Schedule of Local Electoral Areas. The Electoral Areas of relevance to this assessment are now Maynooth and Kildare-Newbridge, with population changes shown as per Table 15-3: Population Change 2006-2016. However, as these are newly delineated areas, they do not allow comparison to previous year's data.

As an exercise to allow comparison with previous years data, the individual population data available from CSO for the divisions which make up the old electoral areas (i.e. the individual divisions which formed the pre-2014 electoral areas) were summed and calculated, to look at the change in population, had the overall electoral area boundaries not moved. This data is presented in Table 15-3, and shows that the population has significantly increased in the period 2006-2016 within the areas / boundaries previously delineated as Edenderry No. 2 Rural Area and in Naas No. 1 Rural Area.

Table 15-4: Quarterly National Household Survey (Q1 2016 – Q1 2017)

Time period	State Q1 2016	Mid-East Region Q1 2016	State Q1 2017	Mid-East Region Q1 2017
Unemployment Rate	8.4%	5.9%	6.7%	5%
Participation Rate	59.5%	58.9%	59.8%	60.4%

Source: CSO, 2017

Table 15-4: Quarterly National Household Survey (Q1 2016 – Q1 2017) illustrates the findings from the QNHS, January to March 2017. The unemployment rate is the number of unemployed persons expressed as a percentage of the total labour force. The unemployment rate for the State was 8.4%, while the unemployment rate for the Mid East Region was lower at 5.9%. These figures illustrate that there has been a decrease in unemployment throughout the state and the Mid-East Region.

The participation rate is the number of persons in the labour force expressed as a percentage of the total population (over the age of 15 years). From January to March 2017, the participation rate in the State was 59.5% while the Mid East Region's participation rate was 59.8%, which is marginally lower than that of the State.

The CSO publishes figures relating to the live register. These figures are not strictly a measure of unemployment as they include persons who are legitimately working part time and signing on part time. However they can be used to provide an overall trend within an area.

Table 15-5: Live Register 2016-2017

Location	January 2016	January 2017	% Change
State	321,513	276,892	-13.9%
Mid East Region	17,658	14,512	-17.8%
County Kildare	13,791	11,271	-18.3%

Source: CSO 2017

The figures in Table 15-5: Live Register 2016-2017Table 15-5 show that over the period January 2016 – January 2017 the number of persons on the live register decreased in all regions. Although there is a decrease in the number of people on the Live Register, the moderately high number of people still on the live register indicates a need for significant employment opportunities in the area.

Live Register figures for January 2017 and the Quarterly National Household Survey Q1 2017 illustrate that unemployment rates remain high throughout the State, the Mid-East Region and County Kildare. This underscores the need for immediate employment opportunities in the area.

15.2.3 Socio Economic Profile

Statistics in relation to the occupational group are provided in the 2016 Census for the ED of Timahoe South in which the proposed development is located. These occupational groups are outlined in Table 15-6: Occupational Groups in Timahoe South ED below.

Table 15-6: Occupational Groups in Timahoe South ED

Occupational Group	No. Males	No. Females
Agriculture, forestry and fishing	7	0
Building and construction workers	30	4
Manufacturing industries	25	15
Commerce and trade	56	49
Transport and communication	30	9
Public administration	8	5
Professional services	18	42
Other	21	19
Total	195	143

Source: CSO, 2016.

Commerce and trade workers are the largest occupational group for males in Timahoe South ED (56), commerce and trade is also the largest occupational group for females (49).

The aim of economic development as set out in the Kildare County Development Plan 2017-2023 is to *'provide for the future well being of the residents of the county and the region by facilitating economic development; to promote the growth of employment opportunities in all sectors in accordance with the principles of sustainable development; to achieve a reduction in the unsustainable levels of commuting from the county; to provide a greater focus on community building and improving quality of life'* (Ref Section 5).

It also states that '*Kildare is strategically positioned to benefit from local, national and international markets owing to its location proximate to Dublin and the ports and airports of the GDA. There is also an excellent road and rail network through the county, linking Kildare to important centres of economic, sporting, and cultural activity throughout the State. The county contains a number of employers of significant size including Intel, HP and Maynooth University in north Kildare, Kerry Group in Naas, Pfizer in Newbridge, Bord na Móna in both Newbridge and rural County Kildare, the equine industry and the Defence Forces*' (Ref 5.1).

15.2.3.1 Proximity of Housing and Centres of Population

Housing in the immediate area of the proposed site comprises predominantly single dwellings with adjacent farmyards and new bungalows. A ground truthing of buildings and planning applications within a buffer of 1 km proximity to the planning application boundary was undertaken on 14th November 2016. Figure 15.1: Buildings in Proximity to Drehid WMF shows the outline of the proposed development footprint, and a 500 m and a 1,000 m buffer from the planning application boundary. The largest concentration of houses close to the proposed facility is to the north west of the site in the village of Derrinturn.

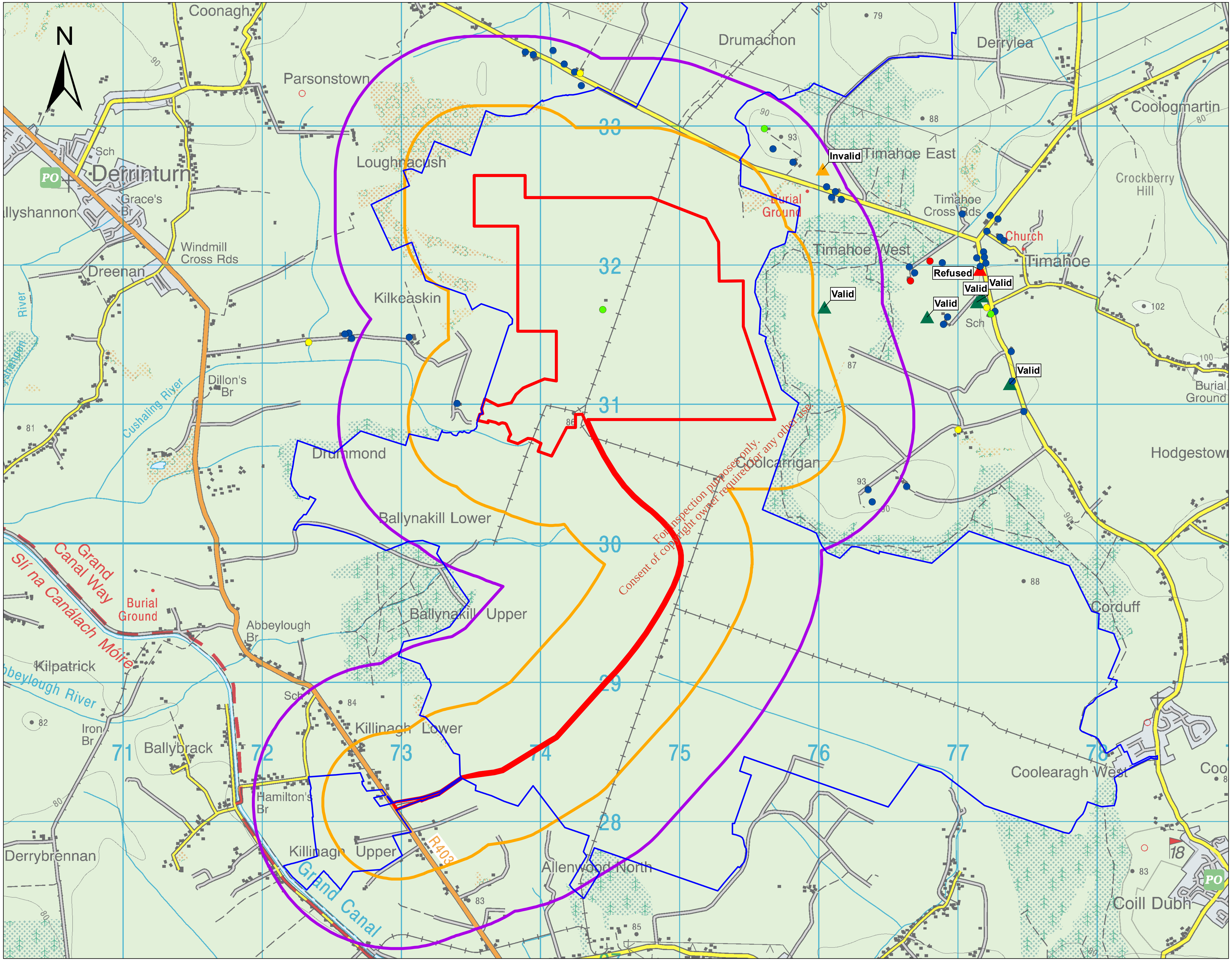
As noted in Chapter 1, the nearest sensitive receptor will be a distance of approximately 865 m from the nearest element of the infrastructure to be used within the proposed development, i.e. the site access road, approximately 1,130 m form the proposed Non-Hazardous Landfill, approximately 1,180 m from the proposed Ash Solidification Facility and being approximately 1,200 m from the proposed Hazardous Landfill.

15.2.3.2 Tourism and Amenities

The Draft Kildare County Development Plan 2017-2023 states the following in relation to tourism;

'Tourism is an important sector of Kildare's economy and it has grown substantially over the last number of years…. In the context of tourism, the natural environment, landscape, built heritage and attractive towns and villages play a key role' (Ref Section 5.15).

County Kildare is located in the East and Midlands tourist region. Statistics from Fáilte Ireland for the year ending December 2016 indicate that approximately 8.742 million overseas visitors arrived in Ireland in 2016 generating total revenue of €4.638 billion. Domestic tourism expenditure amounted to €1.776 billion making tourism in total a €78.308 billion industry in 2016.



Legend

- Site Boundary
- Bord na Móna Ownership Boundary

Buffers

- 1 Km Buffer from Site Boundary
- 500m Buffer from Site Boundary

Dwellings

- Both
- Commercial
- Residential
- Unknown

Planning Applications

- Invalid
- Refused
- Valid

0 125 250 500 750 1,000
Metres

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Issue	Date	Description	By	Chkd.
Rev A	AUG '17	EIAR Issue	F.H.	O.McA

Client:

BORD NA MÓNA
Naturally Driven

Project:

PROPOSED DEVELOPMENT AT DREHID WASTE MANAGEMENT FACILITY

Title:

BUILDINGS IN PROXIMITY TO PROPOSED DEVELOPMENT

Scale @ A3: 1:25,000

Prepared by: F.Healy | Checked: O. McAlister | Date: August 2017

Project Director: D.Grehan

TOBIN
Patrick J. Tobin & Co. Ltd.
Consulting, Civil and Structural Engineers,
Block 10-4, Blanchardstown Corporate Park,
Dublin 15, Ireland.
tel: +353-(0)1-8030406
fax:+353-(0)1-8030409
e-mail: info@tobin.ie
www.tobin.ie

Figure 15.1 | Rev: A

Table 15-7: 2016 Numbers of Overseas Visitors (thousands of visitors)

	Britain (000s)	Europe (000s)	N. America (000s)	Other (000s)	Total (000s)	Revenue (€million)
Visitors to Ireland	3,632	3,102	1,477	531	8,742	4,638 m
East & Midlands	241	234	108	47	630	250 m

Source: Fáilte Ireland, 2016.

Table 15-7: 2016 Numbers of Overseas Visitors (thousands of visitors), illustrates that there were approximately 630,000 overseas visitors to the East and Midlands region in 2016 and this generated revenue of €250 million.

The top visitor attractions identified by Fáilte Ireland for County Kildare for 2010-2014 are listed below and included in Appendix 15.1, with associated visitor numbers:

- Newbridge Silverware Museum of Style Icons;
- Castletown House & Parklands;
- Irish National Stud & Japanese Gardens;
- Maynooth Castle;
- Kildare Town Heritage Centre;
- The Steam Museum, Straffan;
- Larchill Arcadian Gardens;
- Leixlip Castle; and
- Ballitore Library & Quaker Museum.

In addition to top visitor attractions identified above, additional visitor attractions were identified as part of the Tourism assessment and these include:

- Bog of Allen Nature Centre (Lullymore);
- Coolcarrigan House and Gardens;
- The Irish Pewtermill & Moone High Cross Centre;
- Harristown House; and
- A number of golf courses in the wider vicinity.

The Bog of Allen Nature Centre (Lullymore) is located southwest of Allenwood. This centre focuses on Irish Peatland Heritage and all aspects of its history, folklore, nature & wildlife.

Coolcarrigan House has extensive gardens and a 19th century church which are open to visitors. This dwelling is located approximately 1.4 km from the nearest element of the site infrastructure (the proposed Hazardous Landfill) proposed development and is screened from the proposed development by an extensive coniferous forestry plantation to the west of the house. In addition, traffic generated by the proposed development will enter the Bord na Móna landholding directly from the R403 by way of the existing entrance, and will therefore not adversely impact on visitors travelling to Coolcarrigan House.

15.2.3.3 Activities

Walking and Cycling Routes

The Draft Kildare County Development Plan 2017-2023 states the following in relation to walking routes:

Two long distance walking routes are located along the Grand and Royal Canals. Both are scheduled for improvement in the coming years. A development by the Council under Part 8 of the Planning and Development Act 2000 (as amended) has been approved to provide a long distance walking route along the Royal Canal between Maynooth and Moyvalley. Other shorter routes are located mainly in urban settings comprising of heritage trails and Slí na Sláinte routes.. The eastern uplands, the boglands, the water corridors and disused railway lines coupled with a rich natural, architectural and built heritage provide excellent opportunities to develop further long distance routes (cycling/walking). (Ref Section 14.11.3)

Sections of the Grand Canal Way and the Barrow Way pedestrian walks coincide adjacent to the 19th Lock to the southeast of Allenwood, though both are approximately >5 kilometres from the application boundary

There is also a walk at Donadea Demense, which has a lake that is home to a variety of wildfowl which is located approximately >8 kilometres from the application boundary.

Forest Parks/Woodlands & Boglands

The Draft Kildare County Development Plan 2017-2023 states the following in relation to Forest Parks/Woodlands & Boglands:

'Approximately 9,200 hectares of land in Kildare is under forest cover. Forests and woodlands provide benefits over and above the revenue yielded from timber and other wood based products. These include recreational and tourism amenities for local communities…24,300 hectares of peatland cover 14.4% of the county. Of the total bog cover, 10% remains intact, 39% is under industrial peat extraction, 25% consists of cutover and cutaway bog and 24% is modified fen area. Some of these boglands are

used for recreation/education purposes such as the Bog of Allen Nature Centre in Lullymore operated by the Irish Peatland Conservation Council and Lullymore Heritage Park' (Ref Section 14.11.3).
As stated previously, the Bog of Allen Nature Centre (Lullymore) is located southwest of Allenwood. Ardkill Bog/Ardkill Farm offers visitors a chance to see a raised bog in a controlled setting. These are located approximately 7 km and 5.5 km respectively from the site of the proposed development.

In terms of statutory protection, Carbury and Hodgestown Bogs are designated Natural Heritage Areas (NHAs) and are located approximately 6 km to the northwest and 4 km to the east of the proposed development site respectively. Ballynafagh Lake and Bog are designated Special Areas of Conservation (SACs) and cited as proposed NHAs. These are located approximately 5.8 km and 6.4 km to the southeast of the site boundary. The Long Derries, Edenderry is also an SAC and proposed NHA site and is over 7.2 km to the west.

Other Activities

Allenwood Celtic AFC's football pitch is located to the south of the existing entrance on the R403 at Killinagh Upper. A wide belt of mixed deciduous and evergreen trees and shrubs has been planted by the developer along the entire boundary of the Bord na Móna landholding with the grounds of Allenwood Celtic AFC in the interest of visual amenity.

Coarse fishing can be undertaken at both Ballynafagh Lake, near Prosperous and the Grand Canal.

15.2.4 Likely Future Receiving Environment / Do Nothing Scenario

All components of the baseline are constantly changing due to a combination of natural and human processes. When predicting likely direct and indirect effects it is important to remember that there are two available for comparison: the existing baseline environment and the future baseline environment without the implementation of the proposed development but considering natural changes only.

In socio-economic terms, if the development did not go ahead, the proposed development site will remain as an area of regenerating cutaway bog which given its remoteness and unavailability to the general public, will have a neutral effect on the local population. However, the location of the proposed development site adjacent to an existing waste management facility to the north / northwest and a consented but not yet constructed MBT Facility to the south will ensure that the site continues to be subject to development consideration.

15.2.5 Potential Effects

15.2.5.1 Land Use

The proposed development will result in an alteration to that part of the current land use of the Bord na Móna landholding. The land use currently consists of cutover bog with a mosaic of bare peat and revegetated areas with scrub, woodland, heath and grassland communities present.

As described in Chapter 3 of the EIAR, the proposed development will include an extended composting plant, a Non-Hazardous Landfill, a Hazardous Landfill, a metals recovery facility and a leachate treatment plant. As this infrastructure will be located in close proximity to the existing waste management activity, it is considered that it will not result in a significant change of use to the overall Bord na Móna landholding.

15.2.5.2 Population

The development site is located within a large Bord na Móna landholding and is not in close proximity to dwellings. The proposed development will utilise existing internal road infrastructure and access, so effects on the local population will be minimised.

The proposed development is unlikely to have any significant negative effects on the local or broader population numbers. There is likely to be a positive effect on the local population as some of those employed at the proposed development may move into or continue to reside in the locality.

Air emissions from the proposed development will not cause a nuisance at sensitive receptors; refer to Chapter 11 of the EIAR. There will be no disruption to the social travel patterns of those residing adjacent to the development site.

The proposed development will ensure that waste is adequately pre-treated prior to being deposited in landfill. By virtue of the biological process in the extended composting facility, biodegradable municipal waste will be biostabilised thereby minimising its potential to generate methane (a harmful greenhouse gas) and leachate.

Any effects in relation to Noise (Chapter 12), Air (Chapter 11), Water quality (Chapter 6 and Chapter 7), Material Assets (Roads and Traffic) (Chapter 10) and Landscape and Visual (Chapter 8) are dealt with in those relevant chapters of this EIAR.

15.2.5.3 Employment

The proposed development has the potential to create a number of jobs in the area with the resultant off shoot benefits. During construction, it is envisaged that the proposed development will employ up to an additional 80 construction staff in addition to approximately 20 people currently employed in construction work at the site for the existing MSW landfill and ancillary development. Phased construction of the proposed developments is expected to extend over a 25 year period, with up to 100 construction staff employed at the Bord na Móna Drehid site during peak construction, between the existing construction works, consented development and the proposed development.

When operational, it is envisaged that the proposed development will provide full time employment for approximately 17 additional people. This will include management and administrative staff, laboratory technicians, weighbridge operator, maintenance staff, electricians, shift supervisors, technicians, drivers, operatives and cleaning staff.

15.2.5.4 Tourism and Amenities

Tourist amenities and activities are located at such a distance from the proposed development that they will not be impacted. In addition, traffic generated by the proposed development will not adversely effect visitors travelling to any of these attractions. Any potential visual effects are dealt with in Chapter 10 of this EIAR.

Within the general area of the proposed development site, there are golf courses at Knockanally (near Donadea) approximately 8 km to the northeast and Ballygibbon East and Kilshawanny Lower (near Carbury) approximately 10 km west of the site. Allenwood Celtic AFC's pitch is located to the south of the existing site entrance on the R403 at Killinagh Upper.

Ballynafagh Lake (approx. 5.8 km to the east), near Prosperous, is available for coarse fishing as is the Grand Canal, while Ardkill Bog/Ardkill Farm offers visitors a chance to see a raised bog in a controlled setting. Heather Lodge 'B&B', one of the few in this general area, is close to Allenwood AFC's pitch. There is also a walk at Donadea Demense (approx. 8 km to the northeast), which has a lake that is home to a variety of wildfowl. Again, all are a considerable distance from the proposed development.

The Kildare County Development Plan 2017-2023 aims to protect the '*architectural heritage and to encourage sensitive sustainable development so as to ensure its survival and maintenance for future* generations' (Section 12.1).This includes Carbury Castle, Newbury Hall and Demense that has Trinity Well located therein, and Ardkill House. Coolcarrigan House, which is also listed, has extensive gardens and a 19th century Hiberno-Romanesque church that is also formally preserved, both of which are open to visitors.

These tourist attractions are located a significant distance from the proposed facility and will not be impacted by the proposed development. In addition, traffic generated by the proposed development will not adversely affect visitors travelling to any of these attractions.

The only buildings located within the Bord na Móna landownership boundary are the constructed buildings associated with the development of the previously permitted Drehid Waste Management Facility. There are no listed or other buildings of significant architectural or cultural heritage within the vicinity of the proposed development site.

The nearest such building is Coolcarrigan House, which is located approximately 1.4 km from the nearest element of the site infrastructure (the proposed Hazardous Landfill) and is screened from the facility by an extensive coniferous forestry plantation to the west of the house.

There will be no visual effect on any of the surrounding items or facilities of tourist potential. The amenity and tourist potential thereafter, especially of the waterways, will only be compromised if those seeking to travel to such might consider the effect of the traffic movements along the surrounding regional routes, as an intrusion. The Grand Canal is at such a distance from the proposed development, that along with the existing and proposed vegetation cover, views from the Grand Canal of the proposed development will be non-existent.

Allenwood Celtic AFC's football pitch is located to the south of the existing entrance on the R403 at Killinagh Upper. As the access road does not require any additional works, the potential effects on this amenity are not considered significant. A wide belt of mixed deciduous and evergreen trees and shrubs has been planted by the developer along the entire boundary of the Bord na Móna landholding with the grounds of Allenwood Celtic AFC in the interest of visual amenity.

15.2.6 Community Gain

The proposed development has been designed and will be constructed and operated to Best Available Techniques (BAT). All information will be available to interested parties and a complaints register will be maintained at the facility. The EPA will also undertake regular environmental audits, which will record licence compliance.

<u>Community Liaison Committee</u>

Consistent with previous proposals and permissions, a community liaison committee has previously been established under the auspices of Kildare County Council in respect of the existing Drehid Waste Management Facility.

The already established committee comprises eight members, as follows:

- two local community representatives;
- two additional representatives; one from the Maynooth municipal district and one from the Kildare – Newbridge municipal district;

- two personnel from Bord na Móna; and
- two personnel from the Planning Authority (Kildare County Council).

With regard to the proposed development, it is proposed that this or a similar committee (for agreement with Kildare County Council) will identify environmental works and community facilities to be funded by the Drehid Waste Management Facility Community Development Fund, outlined below.

Drehid Waste Management Facility Community Development Fund

Consistent with previous proposals and permissions, Bord na Móna will agree the establishment of a community development fund with Kildare County Council in respect of the proposed development. This fund will contribute to the provision of environmental improvement and recreational or community amenities in the locality. The identification of such projects will be decided by the planning authority in consultation with the Community Liaison Committee. This type of community fund has previously been established for the existing Drehid Waste Management Facility.

Public Education

The educational room in the Administration Building will be used for the provision of a public education area for environmental education needs. Poster presentations and literature on waste management and on the workings of the proposed facility will be available in this meeting room. Provision will also be made for the inspection of the EPA waste licence and Annual Environmental Reports (AERs) in this room.

15.2.7 Health and Safety

TOBIN Consulting Engineers have complied with the obligations as set out in the Safety, Health, and Welfare at Work Construction Regulations 2013. Principles of prevention have been considered and a design risk assessment for the site development elements of the works has been carried out. Hazards have been identified and where possible they have been engineered out. Where this has not been possible, mitigation measures have been included. A record shall be kept of any residual risks arising and these will be passed on to the contractor in the preliminary health and safety plan, prior to the construction stage.

15.2.8 Mitigation Measures

The proposed development will be developed in a manner such that the effect on human beings is minimised. The proposed development will generate significant employment during the construction and operational phase. This effect is positive, therefore no mitigation measures are proposed in relation to employment. Employment at the proposed development may also lead to persons moving into the locality or indeed allowing them to continue to reside in the locality rather than emigrating. Again this is

a positive effect for which no mitigation measures are proposed. There are no potential negative effects on tourism and amenities in the area and therefore no further mitigation measures are required.
The following measures will ensure that the proposed development's effect on the receiving environment is minimised.

- Dust, air, odour, noise and surface/ground water will be monitored on site in compliance with an EPA waste licence;
- Mitigation measures in relation to the visual effect are discussed in Chapter 10 of this EIAR and;
- The Community Development fund will provide benefits for the local community through the provision of environmental improvement and recreational or community amenities in the locality.

Mitigation measures for Landscape & Visual (Chapter 8) Noise & Vibration (Chapter 12), Water Quality (Chapter 6 and Chapter 7), Material Assets (Roads and Traffic) (Chapter 10) and Air/Dust/Odour (Chapter 11) are dealt with in the respective chapters in this EIAR.

15.3 HUMAN HEALTH

15.3.1 Introduction

A human health risk assessment is the process to estimate the nature and probability of adverse health effects in humans as a result of the proposed development.

In summary, the proposed development will include the following at the Drehid Waste Management Facility:

- Changes to the volume and nature of wastes to be accepted at the landfill disposal facility;
- Development of additional non-hazardous (250,000 TPA) and new hazardous landfill (85,000 TPA) capacity to provide for sustainable landfill of these waste streams for twenty five years;
- Pre-treatment or processing of certain waste streams prior to landfill (including recovery from waste stream of non-hazardous waste of approx 15,000 TPA metals);
- Increasing the volume of waste to be accepted at the composting facility and the removal of the restriction on the operating life of the composting facility including the following;
    - increase in the composting processing within the existing built composting infrastructure (increase by 20,000 TPA to 45,000 TPA within current infrastructure); and
    - extension to the existing composting facility to build further infrastructural capacity for an additional 45,000 TPA composting (a combined total of 90,000 TPA where all capacity would be licensed);
- On-site treatment of leachate; and
- Development of associated buildings, plant, infrastructure and landscaping.

The assessment has had regard to the findings of other chapters of this EIAR, and in particular to:

- Chapter 7 Water;
- Chapter 11 Air Quality; and
- Chapter 12 Noise and Vibration.

Drehid is an existing long-established Waste Management facility operated by Bord Na Móna. A description of the baseline local population, including its demographics, is provided in Section 15.2.2 of Chapter 15 of the EIAR. The development site is located within a large Bord na Móna landholding and is not in close proximity to dwellings. The proposed development will utilise existing internal road infrastructure and access so effects on the local population will be minimised.

This assessment is focused on potential human health effects related to potential emissions, either during the construction phase or the operational phase. However, it is acknowledged that people may experience annoyance or other disturbance e.g. from temporary effects of the construction phase. Annoyance or other similar disturbance is not in itself a health effect, and it is also noted that the proposed development is not a greenfield development but is set within the context of an existing Landfill facility with long-established operations. Local residents are therefore accustomed to living in the general environment of an operational landfill and the changes proposed are unlikely to be perceptible in terms of noise or other disturbances during the operational phase. It is unlikely that annoyance on a temporary basis that might occur during construction could lead to adverse health effects.

15.3.2 Methodology

The methodology used in the assessment has had regard to that provided by the US Environmental Prospection Agency (US EPA) in their Human Health Risk Assessment process[85]. The assessment has also had regard to the Draft Guidelines for Preparing Environmental Impact Assessment Reports[86] (EPA, August 2017). The Irish EPA has general guidelines on Human Health Risk Assessment however the US guidelines benefit from being more specific and as a result more user-friendly. Nevertheless there are entirely in keeping with those recommended by the Irish EPA.

The assessment methodology advised by the US EPA follows a 4-step process:

[85] https://www.epa.gov/risk/human-health-risk-assessment
[86] www.epa.ie/pubs/advice/ea/EPA%20EIAR%20Guidelines.pdf

Step 1 – Hazard Identification

Examines whether an agent has the potential to cause harm to humans and if so, under what circumstances. The assessment includes a literature review outlining the findings of relevant medical findings/publications related to the proposed development and its potential effects.

Step 2 – Dose-Response Assessment

Examines the relationship between exposure and effects.

Step 3 – Exposure Assessment

Examines what is known about the frequency, timing, and levels of contact with an agent.

Step 4 – Risk Characterisation

Examines how well the data support conclusions about the nature and extent of the risk from exposure to environmental agents.

Definition of Terms

The following terms are used in the assessment.

Agent

A chemicals or factors in the environment to which humans are exposed that may cause adverse health effects

Vulnerable / Vulnerable Groups

An individual or group of individuals who by nature of their age, health status or other factor is more prone to developing adverse health effects

Robust –

Strong and Healthy

Health based Standard

The dosage of an agent scientifically determined to protect against human health effects

Threshold

The dosage of an agent below which there is no adverse health effect

PM_{10}

Particulate matter of diameter less than 10 µm

$PM_{2.5}$

Particulate matter of diameter less than 2.5 µm

Health Based Standards

Health based standards by their nature are set to protect against human health effects. The level at which the standard is set is chosen to protect the vulnerable, not the robust. They have an in-built measure of significance in that they are set at levels where there will be no significant health effects. An example is Air Quality Standards. They do not necessarily exclude each and every effect. An individual might notice a transient slight irritation in the throat slightly below some Air Quality Standards but fundamental health status would not change. The choice of the relevant standard and the reasons for this choice are explained in the relevant sections below.

This standards based approach is also consistent with the Irish *EPA Revised Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports*. (Aug 2017)

'*The evaluation of effects on these pathways is carried out by reference to accepted standards (usually international) of safety in dose, exposure or risk. These standards are in turn based upon medical and scientific investigation of the direct effects on health of the individual substance, effect or risk. This practice of reliance upon limits, doses and thresholds for environmental pathways, such as air, water or soil, provides robust and reliable health protectors [protection criteria] for analysis relating to the environment.*

Identification of Vulnerable Groups (Sensitivity)

While every human being should be considered a sensitive receptor, clearly the vulnerable are the most sensitive.

Children, particularly younger children, for example constitute a vulnerable group. Older people constitute a very variable group. Older people in general have greater sensitivity to air pollution and potential effects on the respiratory system and cardiovascular system. There are many reasons for this including the possible presence of other medical conditions such as respiratory or cardiovascular disease. Some subtle changes in the environment have the potential to have an adverse effect that would not be experienced by some younger more resilient persons. There are other vulnerable groups also, for example, the disabled or psychologically ill.

Significance of Health Effects

Medicine as in all science uses the concept of statistical significance – that is putting a value on confidence in the data. Confidence measures of 95% or even 99% are commonly used to measure the levels of certainty that any changes are not due to chance alone.

This is a valid approach for the study of the effects on a population or in large studies but is not possible in the assessment of a significant effect on human health in a project such as this. It does not, for example, absolutely exclude a response in an individual. This may be best explained with an example. Low levels of noise emissions, be it from construction or from traffic on a road, may be such that the clear majority of the population do not notice or do not care about them. An individual however, may find them annoying even when all the people in the same location do not.

Given the extent of variability in human response, it is not possible to identify all possible individual effects. However, significance of effects on populations is more readily predicted.

The significance criteria used in the assessment are set out in Table 15-8: Criteria Used in the Assessment of Human Health Effects.

Table 15-8: Criteria Used in the Assessment of Human Health Effects

Effect Level	Significance Criteria
Imperceptible	No significant human health impacts are apparent. An example is no measurable effect attributable to the proposed development.
Slight	A small impact on individual reported symptoms but no change in health status can be attributed to the proposed development. An example is a temporary increase in symptoms in an individual but no change in the severity of the underlying condition or treatment required.
Moderate	A small impact on health status of individuals but no change in morbidity or mortality can be attributed to the proposed development. An example is an individual increasing their use of a treatment attributable to the development but no change in underlying condition.
Significant	A proposed development has the potential to impact on individual health status. An example is an individual's condition becoming measurably more severe as a result of the proposed development.
Very Significant	A proposed development has the potential to impact on the health status of groups. An example is a group of individuals' conditions becoming measurably more severe as a result of the proposed development.
Profound	A proposed development has the potential to impact on the health status of communities. An example is a measurable increase in the incidence or severity of a condition in a community.

15.3.3 Receiving Environment

The overall Bord na Móna landholding is located within the Timahoe bog in Allenwood, County Kildare. Within the landholding, Bord na Móna operates the permitted Drehid Waste Management Facility, accessed from the regional R403 road, at Killinagh Upper, by a 4.8 km long internal access road, which is dedicated to the waste management facility.

The Drehid Waste Management Facility is licensed by the EPA (IED Licence number W0201-03). This existing facility compromises an engineered landfill, composting facility and associated infrastructure including administration buildings, gas utilisation plant, settlement lagoons, leachate management infrastructure, weighbridge and access roads. The hours of operation of the existing facility are limited to operation between the hours of 08:00 and 19:00 Monday to Saturday. The waste acceptance hours are between 08:00 and 18:30 Monday to Saturday. A Mechanical Biological Treatment (MBT) facility situated to the south of the Drehid WMF, which has received planning permission and is licensed by the EPA (W0283-01), is not yet constructed.

The surrounding environment is rural in nature with residential properties located around all boundaries at varying distances from the landholding boundary. The red line boundary of the Drehid Waste Management Facility is positioned within the central part of the landholding and, hence is significantly set back from noise sensitive properties.

The nearest sensitive receptor will be approximately 850 m from the nearest element of the infrastructure to be used within the proposed development, i.e. the site access road, approximately 1,130 m from the proposed Non-hazardous Landfill, approximately 1,180 m from the proposed Ash Solidification Facility and being approximately 1,200 m from the proposed Hazardous Landfill.

15.3.4 Step 1 – Hazard Identification

An essential element of the "Step 1- Hazard Identification" of the assessment methodology advised by the US EPA is the undertaking of a literature review outlining the findings of relevant medical findings/publications related to the proposed development and its potential effects. This literature review will be detailed in the following sections.

The term "landfill" is extremely broad and complex with the potential for a wide variety of exposures and exposure scenarios involving a multiplicity of agents with different toxicological properties.

The site factors affecting the likelihood that a landfill leads to potentially harmful population exposure include: engineering and containment, hydrogeology and topography, the type and quantity of waste contained, the mixing of contents, the presence and depth of leachate and the management practices.

The main concerns on health consequences derive from emissions of chemical mixtures or infectious agents.

Epidemiological studies on the health effects of waste landfills exist, but many share the important weakness of the lack of direct exposure measurement. For this reason the exposure pathways are either modelled (for example using geographical information systems) or, more frequently, assessed through surrogate measures, such as the distance of the residence from the landfill sites.

It is against this background that we reviewed the medical literature specifically in relation to the proposal to apply for permission to develop waste management facilities adjacent to an existing EPA-licensed landfill providing for the acceptance of inert construction & demolition waste, incinerator ash (hazardous/non-hazardous), and other wastes.

The review consisted of:

- PubMed[87] An online resource which comprises over 26 million citations for peer-reviewed biomedical literature from MEDLINE (the U.S. National Library of Medicine® (NLM)), life science journals, and online books.
- Review of health-related literature
- Internet searches performed on Google.

15.3.4.1 Summary of Literature

In Ireland, a report was commissioned by the Health Research Board at the request of the Department the Environment and Local Government. This was published in 2003 and was entitled *Health and Environmental, Effects of Landfilling and Incineration of Waste– A Literature Review*. This will be referred from here as the HRB Report.

In the UK, The University of Birmingham/ Enviros study 2004 published *Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes* also looked at this area. This report was commissioned by the Department of the Environment Food and Rural Affairs (DEFRA). This will be referred to as the DEFRA report. As the name suggests, it concentrated on Municipal Waste but nevertheless does contain a good review of the literature at that time covering all aspects of landfill. The UK report was well resourced and comprehensive. As stated, it is largely a literature review and most of what it contains had already been reported in the HRB report. It did however conclude though that *the "health effects of handling Municipal Solid Waste by methods including, but not exclusively landfilling had at most a minor effect on human health*". It did not make any statement on the landfilling of hazardous material.

The author of this section on Human Health relied heavily on these publications and the following studies which predate their publication and where quoted these are taken directly from either or both documents.

Since then there have been a number of useful reviews. The World Health Organisation (WHO) published *Population health and waste management: scientific data and policy options. Report of a WHO workshop. Rome, Italy,* in March *2007.*

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[87] https://www.ncbi.nlm.nih.gov/pubmed/
4 *arrow.dit.ie/cgi/viewcontent.cgi?article=1002&context=schfsehrep*

Specifically with regard to Hazardous Waste landfills a useful review entitled: An examination of cancer epidemiology studies among populations living close to toxic waste sites was published by Russi et al in 2008, this will be referred to as the Russi review.

There was also a review entitled *Systematic review of epidemiological studies on health effects associated with management of municipal solid waste,* by *Porta et AL* was released in December 2009 by the journal *Environmental Health* 2009, 8:60. While again it is clear from the title that it concentrated on Municipal solid waste it nevertheless has some useful additions. This will be referred to and the Porta review.

Finally a review *Health effects associated with the disposal of solid waste in landfills and incinerators in populations living in surrounding areas: a systematic review.by* Mattiello et al was published in 2011. This will be termed the Mattiello review.

Regarding composting, a review was published in 2015. *Exposures and health outcomes in relation to bioaerosol emissions from composting facilities: a systematic review of occupational and community studies*. By Pearson et al. This concluded that whilst there were some respiratory effects, that these were limited to within 250 metres of the actual composting site. The nearest sensitive receptor or domestic dwelling is a distance > 1 km from the compost plant.

In addition, the author performed electronic searches for more recent publications including a "Pubmed" search using terms "incinerator ash" "landfill" and "health" which is the data base reviewing nearly all significant peer reviewed medical literature. A significant number of articles, many referred to in the reviews above, were found in relation to landfills in general Municipal Solid Waste (MSW) and hazardous landfill, however no significant article dealing with specifically landfilling of incinerator ash was found.

The term "hazardous landfill" includes all receiving any hazardous materials such as chemicals, asbestos etc.

The other major disadvantage in interpreting the literature is that they are by their nature historical. Many of the studies date back some years but also many of the health conditions have a long latent period that is the time between exposure and the development of symptoms which for some effects such as cancer may be many years. They reflect practices which bear little relationship to modern controls such as the limitations on materials entering the facility and perhaps as importantly, the engineering controls in a modern engineered landfill.

15.3.4.2 Important Landfill Health Reviews

Redfearn and Roberts (2002) presented a detailed review of the available epidemiological literature on landfill and health. They separated the available epidemiological studies into four categories as follows:

- Single site studies of waste sites including hazardous waste sites, illegal landfills;
- Multi-site studies of sites including hazardous waste sites, illegal landfills or “inhouse” of industry;
- Single site epidemiological studies of potential health effects associated with landfill including some sites accepting hazardous waste
- Multi-site epidemiological studies of potential health effects associated with waste disposal sites, some accepting hazardous waste.

They discounted the first two groups of studies as concerning sites which did not in any way parallel current UK landfill practice, and which they felt were therefore not useful in interpretation of effects. The papers in the latter two categories are summarized. The **DEFRA** report largely used this summary in their review some two years later.

They categorised studies according to health outcome and whether the study indicated an excess risk for those residing in the vicinity of a landfill for that health outcome and those indicating no excess risk. Those reported as demonstrating excess risk showed a significant positive association between a health outcome and proximity to a landfill site. Those indicated as showing no excess risk, did not show a statistically significant association, although the reason could be lack of statistical power to demonstrate such an association. The majority of the adverse health outcomes studied come under the categories of birth defects and other pregnancy outcomes, and cancers. The balance between studies with and without a positive finding appears more strongly in favour of outcomes with an excess risk in the case of birth defects as opposed to cancer. They cautioned about use of their study to infer that the adverse effects were actually caused by landfill. This is because there were other potential explanations. In epidemiological terms, they could not exclude confounding. An example of this might be simultaneous exposure to other pollutant such as those from industrial sources or for example, social class difference between those who live close to landfills and those who do not. These types of confounders appear repeatedly in all studies and reviews of landfills.

WHO Report

This was quite a wide review published in 2007 about a wide range of Waste Management options. This gave an interesting summary of it’s conclusions in relation to Landfill in particular. It said.

“With regards to waste landfills, a wide variety of exposures, exposure pathways and exposure scenarios are involved, entailing a large complexity and difficulty in estimating the health risks possibly

involved. Only few epidemiological studies have evaluated sites with respect to the types of chemicals they contain and release; most studies on the health effects of waste landfills in fact lack direct exposure measurement, and rely on residential distance from the site or sometimes on exposure modelling. Many health endpoints have been considered in epidemiological studies, including cancer incidence and mortality and reproductive outcomes such as birth defects and low birth weight. Despite the methodological limitations, the scientific literature on the health effects of landfills provides some indication of the association between residing near a landfill site and adverse health effects. The evidence, somewhat stronger for reproductive outcomes than for cancer, is not sufficient to establish the causality of the association. However, in consideration of the large proportion of population potentially exposed to landfills in many European countries and of the low power of the studies to find a real risk, the potential health implications cannot be dismissed."

The report commented on another review by Linzalone and Bianchi (2005)

It concluded that there were no consistent results in studies on cancer incidence, mortality and congenital malformations were reported. Increases in low birth weight and different types of symptoms were consistently found. They stated that the availability of environmental data and individual measurements of exposure was very poor in most of the studies.

The WHO report also noted that concurrently with the workshop, three multi-site studies were published, two of them dealing with United States hazardous sites. In the first one (Kuehn et al., 2007) a series of significant risks for congenital malformations, decreasing with distance from the sites, have been found; in the second one (Mueller et al., 2007), foetal deaths for women residing near the sites were not associated with the distance but an association was observed among women residing less than one mile from pesticide–containing sites. The third study (Jarup et al., 2007) analysed the risk of giving birth to a child with Down syndrome, associated with residence near 6,289 landfill sites (processing special, non-special and unknown waste type) in England and Wales. Postcodes within the two kilometres zone were classified as exposed and people living beyond two kilometres comprised the reference population. No excess risks of Down syndrome related to landfill sites were found and adjustment for socioeconomic status did not influence the estimates. Interestingly, no differences in risk between hazardous waste sites and other landfill sites were found.

The Russi Review 2008

This review carried out Medline searches of the peer-reviewed English language medical literature covering the period from January 1980 to June 2006 using the keywords "toxic sites" and "cancer", and identified articles from published reviews. They studied cancer incidence in communities surrounding hazardous waste landfills. As the authors recognized, some of the location investigated included both toxic wastes and municipal solid wastes. Studies were highly variable with respect to handling of competing risk factors and multiple comparisons.

The Porta review 2009

As stated above, whilst this report did concentrate on MSW sites it did include others studies as well.

It reported:

In most cases the overall evidence was inadequate to establish a relationship between a specific waste process and health effects; the evidence from occupational studies was not sufficient to make an overall assessment. For community studies, at least for some processes, there was limited evidence of a causal relationship and a few studies were selected for a quantitative evaluation. In particular, for populations living within two kilometres of landfills there was limited evidence of congenital anomalies and low birth weight with excess risk of 2 percent and 6 percent, respectively. The excess risk tended to be higher when sites dealing with toxic wastes were considered. For populations living within three kilometres of old incinerators, there was limited evidence of an increased risk of cancer, with an estimated excess risk of 3.5 percent. The confidence in the evaluation and in the estimated excess risk tended to be higher for specific cancer forms such as non-Hodgkin's lymphoma and soft tissue sarcoma than for other cancers.

15.3.4.3 Specific Health Effects

Congenital malformations/ reproductive problems

The HRB report stated that a number of studies have shown an apparent increase in the incidence of low birth weight, birth defects. Problems were reported around some hazardous waste landfills falling significantly below current operating standards, such as Love Canal in the U.S

The report also said studies such as Geschwind et al. (1992), Budnick et al. (1984), Croenet et al. (1997). Roberts et al. (2000) and more recently Goldberg (2005) reported similar findings but also shared common limitations. It is however fair to say that low birth weight is one of the most consistent findings. However, it is also one of the factors most vulnerable to confounders. For example, two factors very closely linked to low birth weight are lower social class and maternal smoking. It has been repeatedly found that deprivation scores are consistently higher around landfills.

The most quoted study in relation to hazardous waste landfills is the European study by Dolk *et. al*., known as the EUROHAZCON which was published in the Lancet on August 8th 1998. This was a multi-centre case control study near hazardous waste landfill sites. This showed statistically significantly raised risks of congenital abnormalities. The author cautioned on interpretation of causal link on the basis of this data however, as other confounders could explain the difference. For example, unlike the proposed facility, the hazardous waste landfill sites tended to be located in the industrial, previously polluted areas and both environmental and possible other factors such as occupational exposures could explain the difference. Nevertheless, the study is useful in dealing with hazardous waste sites. However, as the proposed landfill site for a specific hazardous waste material in a modern landfill this study is of limited relevance.

Chromosomal congenital anomalies, as opposed to total anomalies, were studied in a further report from the EUROHAZCON group (Vrijheid et al. 2002). The investigators reported a higher risk of chromosomal anomalies in those who lived within 3 km of a hazardous waste site when compared to those in the study population who lived between 3 and 7 km from one of the study sites.

A Scottish study (Morris 2003) showed no statistically significant excess risks of congenital anomalies or low birth weight in populations living near special waste landfill sites in Scotland

A Danish study (Kloppenborg 2005) found no association between waste landfill location and congenital anomalies combined or of the nervous system. However, they found small excess risk for congenital anomalies of the cardiovascular system. No causal mechanisms are available to explain these findings, but the authors offered possible alternative explanations including approximated birth rates and residual confounding.

A Welsh study (Palmer 2005) reported an apparent increase in the rate of congenital abnormalities in the vicinity of 24 Welsh landfills after opening from 1983 to 1997. Many of these were “Special waste”, that is hazardous sites. They concluded that a causal relationship could not be established. It is of note that when the study looked at enhanced data from 1998 to 2000 it did not show a significant increase. In addition, the landfills studied were also examined in the earlier but much larger Elliot study. The latter is considered by many, the most complete and its findings are dealt with separately herein.

A British study (Jarup 2007) studied the risk of Down’s syndrome in the population living near 6,829 landfills in England and Wales. It studied those who lived in a two-km zone around each site, people beyond this zone were the reference group. A two-year lag period between potential exposure of the mother and her giving birth to a Down’s syndrome child was allowed. The analysis was adjusted for maternal age, urban-rural status and deprivation index. No statistically significant excess risk was found in the exposed populations, regardless of waste type.

Of note is a January 2004 study published in the Irish Medical Journal by Boyle et al. The occurrence of congenital anomalies in proximity to municipal landfill sites in the Eastern Region (counties Dublin, Kildare, Wicklow) was examined by small area (district electoral division), distance and clustering tendencies in relation to 83 landfills, five of which were major sites. For the more populous areas of the region 50% of the population lived within 2-3 km of a landfill and within 4-5 km for more rural areas. They concluded that congenital anomalies were not found to occur more commonly in proximity to municipal landfills.

Cancers

The HRB report pointed out that Pukkala and Ponka (2001) studied the risk of cancer in people living in houses built on top of an old municipal dump in Finland. They identified a small increase in cancers on the basis of cancer incidence rates in Helsinki. The numbers studied were quite small. The incidence of cancer was also studied around Love Canal, Janerich et al. (1981) and rates were no higher than those calculated for the entire state outside of New York City. Another study by Polednak and Janerich (1989) found no association between death from lung cancer and residence in the selected census tracts around hazardous waste landfills.

Goldberg et al. (1995.) evaluated whether cancer incidence among persons who lived near the Miron Quarry was higher than expected. Some cancers appeared increased but these increases in risk were weak and for most conditions were not statistically significant. Again the evidence was not strong or consistent enough for conclusions to be drawn.

Jarup et al. (2002) examined cancer risks in populations living within 2 km of 9,565 (from a total of 19,196) landfill sites that were operational at some time from 1982 to 1997 in Great Britain. No excess risks of cancers of the bladder and brain, hepato-biliary cancer or leukaemia were found, after adjusting for age, sex, calendar year and deprivation. The study was very large and had high statistical power, so the absence of findings is very reassuring.

The Russi review (2008) concluded:

To date, epidemiological studies of populations living in the vicinity of a toxic waste site have not produced evidence of a quality that most epidemiologists would consider adequate to establish a causal link between toxic waste exposures and cancer risk.

It went on to state that even if there might be an effect the magnitude is too small to be measured.

Again to summarise, the evidence linking landfill to cancer is weak, perhaps even surprisingly so because the areas studied were again hazardous sites with known problems. Certainly, it is reasonable to extrapolate that the human risk of cancer from living adjacent to a well-run landfill are absolutely minimal.

Symptoms of illness

Many studies of symptoms conducted in communities living near landfill sites rely on self-reported symptoms. In essence, no statistically significant reproducible health effects have been demonstrated.

There is also little or no evidence of an increase in psychological illness around a landfill. This is very significant. If for example "stress" related to living close to a landfill was associated with an increase in illness one would certainly expect large numbers of published studies.

Studies of landfills workers

Gelberg et al. (1997) conducted a cross-sectional study to examine acute health effects among employees working for the New York City Department of Sanitation, focusing on Fresh Kills Landfill employees. Telephone interviews conducted with 238 on-site and 262 off-site male employees asked about potential exposures both at home and work, health symptoms for the previous six months, and other information (social and recreational habits, socio-economic status). Landfill workers reported a significantly higher prevalence of work-related respiratory, dermatological, neurologic and hearing problems than controls. Respiratory and dermatologic symptoms were not associated with any specific occupational title or task, other than working at the landfill, and the association remained, even after controlling for smoking status.

Elliot Studies

The largest study carried out on the health effects of landfill sites was that by Elliot *et al*. for the Dept. of Health in the UK published in August 2001. This appeared to show small excess risk, in the region of 1% for overall congenital abnormalities to those living within 2 km radius of a landfill site. It also showed a higher rate for those living near a "special" (hazardous) waste site.

To put this into context, the background rate of congenital abnormalities is about 2% of all births. A 1% increase even if true would give a rate of 2.02%. In an area of low population, one might have to wait several hundred years or even more for an effect.

Interestingly the study showed that approximately 80% of the British population live within 2 km of a landfill site though not all are operational. Though the study is generally well designed, there are a number of limitations in this study, some of which it shares with some of the other studies quoted. By the nature of this type of study, it studies "the good, the bad and the ugly", that is, covering landfill sites in all states of use, age and type of landfill, hazardous or non-hazardous. It will therefore include the well designed and operated but also those which are not. It would be possible for one or two "bad eggs" in terms of poorly managed landfill sites to skew a study particularly given the very small level of reported excess.

There are also anomalies in the data, for example when they studied landfill sites recently opened there was an excess risk of congenital abnormalities predating the opening of the landfill site suggesting demographic or other environmental factors were primarily responsible.

While the study did attempt to allow for confounders such as deprivation etc., in effect it is impossible to allow for all possible confounders and they did not even attempt to control for some potentially relevant factors such as smoking and occupation. Therefore, while noteworthy the findings cannot be relied upon and need to be considered in the light of the other available literature.

Elliot et al. recently updated the previous study (2009) in order to evaluate whether geographical density of landfill sites was related to congenital anomalies. The analysis was restricted to 8,804 sites operational at some time between 1982 and 1997. There were 607 sites handling special (hazardous) waste and 8,197 handling non-special or unknown waste type. The exposure assessment took into account the overlap of the two km buffers around each site, to define an index of exposure with four levels of increasing landfill density. Several anomalies (hypospadias and epispadias, cardiovascular defects, neural tube defects and abdominal wall defects) were evaluated. The analysis was carried out separately for special and non-special waste sites and was adjusted for deprivation, presence or absence of a local congenital anomalies register and maternal age. The study found a weak association between intensity of hazardous sites and some congenital anomalies (all, cardiovascular, hypospadia and epispadias).

15.3.4.4 Summary Of Literature On Health Effects Of Landfilling

One of the main difficulties about reviews of epidemiological evidence is that they are by their nature, historical. While they may accurately reflect the situation as it was; with far more greater controls and engineering controls and much higher level of supervision of what enters landfills and management of potential emissions, it is certain that potential health effects are less than in the past. In others words, we can look at a worst-case scenario, but modern landfill are far better than what was there in the past.

Unfortunately, there does not appear to be any literature specifically on the landfilling of incinerator ash. We are left using studies of hazardous or special landfills but these are a relatively poor substitute for specific data. Again, we can be somewhat comforted that when we look at hazardous landfills in general, these are far worse that the solidified incinerator fly ash or other wastes proposed for this facility.

At present, there is little or no evidence to demonstrate a link between cancer and exposure to landfills.

A few studies have reported putative links between hazardous landfill sites and congenital abnormalities but again these studies are somewhat inconsistent. The association between adverse birth outcomes such as low birth weight and birth defects is somewhat stronger but may reflect socioeconomic factors rather than any exposure.

Reports of increased risk of respiratory, skin and gastrointestinal illnesses are based mainly on self-reported symptoms. Although this evidence must not be dismissed, consideration should be given to the strong possibility of bias and the influence of fears and worry related to the waste

15.3.5 Step 2 - Dose Response Principal

In simple terms, the concept of dose response suggests that the greater the dose to which an individual exposed the greater either the likelihood of a health response and/or the greater the severity of that response. Inbuilt to this concept is the principle of a threshold. The threshold is the level of an agent below which one would expect no adverse response. This is a concept on which many health based standards are based.

To illustrate this concept, we can look at an air pollutant such as nitrogen dioxide or $N0_2$. As levels increase from zero, but remained below the threshold which is the Air Quality Standard, there is still no significant health effects. If, however the levels continue to increase above the threshold, there are an increasing number of people affected and the severity of that effect also increases. Just above the threshold, only the vulnerable are likely to notice anything but as the levels increase more and more people notice an effect and indeed the severity of this effect becomes greater as levels continue to increase. This is the principle of dose response.

15.3.6 Step 3 - Exposure Assessment

Health based standards therefore rely on the dose response concept and try to identify by scientific means the threshold below which no significant health effects would occur. When standards are scientifically set by reliable and recognised or statutory agencies, they are a useful method in assessing the effect of any proposed change.

Health standards are set based on the threshold to protect the robust, who may be more resilient but are primarily there to protect the vulnerable. They are to protect the elderly, the very young, and the ill and by extension thereby, the robust are not affected.

An example of such health standard are the EU Air Quality Standards. These are explained by the Irish EPA (http://www.epa.ie/air/quality/standards/) as follows :

In order to protect our health, vegetation and ecosystems, EU directives set down air quality standards in Ireland and the other member states for a wide variety of pollutants. These rules include how we should monitor, assess and manage ambient air quality.

The European Commission set down the principles to this approach in 1996 with its Air Quality Framework Directive. Four "daughter" directives lay down limits for specific pollutants:

- *1st Daughter Directive: Sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead*
- *2nd Daughter Directive: Carbon monoxide and benzene*
- *3rd Daughter Directive: Ozone*
- *4th Daughter Directive: Polyaromatic hydrocarbons, arsenic, nickel, cadmium and mercury in ambient air*

With regards to particulate matter, for example, the standards relate to relatively smaller particles that is, for example, PM_{10}, which is particulate matter with a diameter of less than 10µm. The reason for this is that this size of dust can be inhaled into the lungs and travel all the way to the alveoli, for which we use the term respirable. Larger particles which are greater than 10µm but less than 30µm are potentially inhaled, that is enter the nose or mouth but do not enter the alveoli and are not respired. These are usually swallowed and do not have effects on the respiratory system.

Dust particles which are greater than 30µm are not inhalable so do not have an effect on human health and typically fall to the ground. The smaller particles can remain airborne. This is why dust on cars does not correlate with a health risk. It is only if the smaller particles are increased that human health issues may arise. In human health, it is the dust which cannot be seen that has potential for health effects, while visible dust, while being a nuisance, and may require more frequent car washing, does not affect human health. Therefore, when we are assessing the effect of practical matter on health it is PM_{10} and smaller that is relevant

15.3.7 Step 4 - Risk Characterisation

In the field of risk assessment, characterizing the nature and magnitude of human health or environmental risks is arguably the most important step in the analytical process. In this step, data on the dose-response relationship of an agent are integrated with estimates of the degree of exposure in a population to characterize the likelihood and severity of risk. In simple terms, in a project such as this, it involves comparing the predicted effects of the change on air quality and comparing those predicted changes with the relevant health based standards. It can be assumed that provided the predicted changes do not result in an exceedance of the health based standards that there will be no significant risk.

15.3.7.1 Assessment of Effects of Proposed development from Emissions to Air

A detailed air quality assessment is provided in Chapter 11 of the EIA Report. The standards used in the air quality assessment include the *Air Quality Standards Regulations 2011*, which incorporate *European Commission Directive 2008/50/EC,* which has set limit values for the pollutants SO_2, NO_2,

PM_{10}, benzene and COUNTY The C*ouncil Directive 2008/50/EC* combines the previous *Air Quality Framework Directive (96/62/EC)* and its subsequent daughter directives (including *1999/30/EC* and *2000/69/EC*). Provisions were also made for the inclusion of new ambient limit values relating to $PM_{2.5}$. These are appropriate and robust standards. The air quality assessment provides detailed information on existing and proposed emission sources and the use of AERMOD modelling.
Odour, Air Quality and Construction Dust are all separately considered

The conclusions can be summarised as follows:

Odour

The scenarios modelled lead to odour concentrations which are in compliance with the relevant odour criterion at the worst-case receptor.

Air Quality

Regarding NO_2, the modelled scenario will lead to ambient NO_2 concentrations (including background) which are in compliance with the relevant limit values at the worst-case off-site location.

With regard to PM_{10} / $PM_{2.5}$, emissions from the facility will lead to ambient PM_{10} / $PM_{2.5}$ levels (including background) which are in compliance with the relevant limit values at the worst-case off site location.

The results of the traffic air dispersion modelling study indicate that the residual effects of the Proposed development on air quality and climate are predicted to be negligible with respect to the operational phase local air quality assessment for the long and short term.

Construction Dust

When the dust minimisation measures are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors.

In summary, all emissions from the facility under the Proposed development at Drehid Waste Management Facility, including the permitted MBT, will be in compliance with the ambient air quality standards and will not lead to a substantive risk of non-compliance or odour nuisance. There is a negligible effect predicted due to increased vehicle emissions during the operational phase.

Assessment of Effect

The human health effect for all receptors arising from potential emissions to air are assessed as being Imperceptible.

15.3.7.2 Assessment of Effects of Proposed development from Noise Emissions

By comparing the predicted noise emissions as detailed in Chapter 12 (Noise & Vibration), with reliable noise standards, we can determine if any health effect is likely as a result.

Construction Phase

The conclusions of that Chapter were that, allowing for mitigation, during the construction phase, given the distances to the nearest residences, the temporary and short-term nature of the construction of phase and the calculated noise levels, the overall noise effect will occur on an intermittent basis, affecting the closest noise sensitive properties in the surrounding environment. The effect is determined to result in a neutral effect, and will be of a short term and slight effect at the majority of noise sensitive locations. Vibration effects during this phase are determined to be short term and imperceptible.

Operational Phase

The conclusions of Chapter 12 were that predicted noise levels at the nearest sensitive locations are well below the operational noise criteria in all instances. There are no vibration effects associated with the operational phase of the proposed development.

In terms of traffic, for the majority of road links, due to the existing volume of traffic and that projected for the future baseline years, the addition of traffic volumes associated with the proposed development are negligible. The increase in traffic noise levels along most link roads is less than 3 dB(A) which is defined as being of negligible effect. For a small number of routes, a minor effect is calculated, assuming even distribution of traffic over the course of a typical day. During peak periods, there will be instances where noise level increases are up to 4 dB along the closest access roads to the site. The overall traffic noise is minor to moderate, perceptible effect during peak periods.

Assessment of Effect

The human health effect for all receptors arising from noise are assessed as being Imperceptible.

15.3.7.3 Assessment of Effects of Proposed development from Emissions to Water

The potential effects on water has been assessed in Chapters 6 and 7 of the EIA Report. These concluded that due to the low magnitude of effect and low sensitivity of the surrounding environment, the residual effects on the surrounding geological and hydrogeological regime at the site are considered to be minor and mainly long term in nature.

Assessment of Effect

Given that there will be no effect on water quality standards, the effects on human health from water are assessed as Imperceptible.

Mitigation Measures

No mitigation measures other than those detailed elsewhere in this EIA Report and associated appendices, or as required under the IE Licence, are required.

Residual Effects

The findings of the literature review and of the detailed assessments is that the proposed development, either during construction or operation, will not give rise to effects on human health.

15.3.7.4 Overall Assessment of Health Effect by the Proposed development

Based on the assessment above the effect on human health is assessed as imperceptible.

16 INTERACTIONS OF THE FOREGOING

The significant effects of the proposed development and the measures proposed to mitigate these effects have been outlined in this EIAR. However, in any development with the potential for environmental effect there is also the potential for interaction between effects of the different environmental aspects.

The result of these interactions may either exacerbate the magnitude of the effect or may in fact ameliorate it. As part of the requirements of an EIAR, the interaction of the effects on the surrounding environment needs to be addressed.

Table 16-1: Interaction between Environmental Aspects outlines the different environmental aspects which have potential to interact as a result of the proposed development. These have been considered by the specialists when preparing this EIAR. Table 16-2: Explanatory note on interactions between environmental aspectsTable 16-2 provides an explanatory note for each interaction.

It is noted that the cumulative impact assessment has been undertaken based on the permitted Mechanical Biological Treatment (MBT) facility being operational concurrent to the proposed development which is subject of this application. It is noted that as the landfill site is currently operational and the facility is operated to Best Available Techniques (BAT), many of the interactions between environmental aspects presented in Table 16-1 and Table 16-2 do not have a significant effect as control measures are already in place to protect the environment.

Potential interactions between the effects of various environmental aspects are as follows:

- Dust suppression and vehicle wheel washes are currently utilised to mitigate the effect of windblown dust around the site and to nearby dwellings. These measures will reduce the effect on human beings and material assets in the community along with local biodiversity.
- Travel patterns will not be disrupted by the proposed development, however vehicle numbers will increase. Mitigation measures, which have been employed at the site entrance, will reduce the effect of the previously permitted facility and its proposed intensification and extension. These measures have improved road safety for all road users.
- Odours are reduced by ensuring the exposed waste face is minimised and covered on a daily basis and that the composting operation is undertaken within fully enclosed buildings.
- Professional vermin control experts will be employed if deemed necessary to ensure vermin activity is minimised. An ecological expert will be consulted to determine suitability and control (e.g. spread of poisons) in the context of protected species in the wider landholding. These measures will reduce effects on human beings, material assets and to local biodiversity.

- Compliance monitoring is currently undertaken (e.g. water, noise, dust etc.), as per regulatory conditions and annual environmental reports have been compiled to detail the performance of the existing facility. These reports are made available to all interested parties, which will allay public concerns as to the operation of the site and will result in a positive interaction with respect to human beings.
- The facility is operated to Best Available Techniques (BAT) as per EPA recommendations. All information is available to interested parties, a complaints register is maintained and the EPA undertakes regular environmental audits, which demonstrate how the facility is performing. These measures result in interaction in all environmental criteria.
- It is noted that throughout the EIAR potential interaction between various environmental criteria are discussed. The previously permitted facility and the proposed development which is subject of this application are sited at a significant distance from the local road network and residential properties. The nearest sensitive receptor will be a distance of approximately 865 m from the nearest element of the infrastructure to be used within the proposed development, i.e. the site access road; approximately 1,130 m form the proposed Non-Hazardous Landfill, approximately 1,180 m from the proposed Ash Solidification Facility and being approximately 1.2 km from the proposed hazardous landfill.
- Avoidance of environmental effects was used throughout the design of the facility. The mitigation measures proposed are designed to further ameliorate the effect of the proposed development on the wider environment.

While there is potential for the environmental aspects to interact and result in a cumulative effect, as described in the individual chapters of the EIAR, these assessments have noted that potential cumulative effect do not result in significant environmental effects.

Table 16-1: Interaction between Environmental Aspects

Interaction Matrix	Biodiversity	Soils, Geology and Hydrogeology	Water	Landscape and Visual	Land	Material Assets (Roads & Traffic)	Air Quality	Noise and Vibration	Cultural Heritage	Climate	Population and Human Health
Biodiversity		√	√	√		√	√	√		√	
Soils, Geology and Hydrogeology			√		√				√		√
Water					√					√	√
Landscape and Visual						√		√	√		√
Land											
Material Assets (Roads & Traffic)							√	√		√	√
Air Quality										√	√
Noise and Vibration											√
Cultural Heritage											
Climate											√
Population and Human Health											

Table 16-2: Explanatory note on interactions between environmental aspects

Interaction Matrix	Biodiversity	Soils,Geology and Hydrogeology	Water	Landscape and Visual	Land	Material Assets (Roads & Traffic)	Air Quality	Noise and Vibration	Cultural Heritage	Climate	Population and Human Health
Biodiversity		Removal of peat and existing habitats.	Potential pollution of surface water. Redirecting, infilling or culverting of existing drainage channels.	Existing habitat removal / damage.		Disturbance to fauna from site traffic.	Air quality changes on flora and fauna – dust.	Disturbance to fauna from noise and vibration generated from site activities.		Potential effects on flora and fauna from changing climate conditions.	
Soils, Geology and Hydrogeology			Potential leachate from deposited material leaching to surface water. Change in runoff from existing soils.		Changes to land use as a result of peat removal and development.				Removal of peat and potential cultural heritage.		Potential effects on drinking water.
Water					Change in runoff from existing soils.					Climate changes have the potential	Potential effects on drinking water.

Interaction Matrix	Biodiversity	Soils,Geology and Hydrogeology	Water	Landscape and Visual	Land	Material Assets (Roads & Traffic)	Air Quality	Noise and Vibration	Cultural Heritage	Climate	Population and Human Health
										to increase flooding events.	
Landscape and Visual						Review of increase in traffic and resulting effect on visual amenity along public road network.		Review of requirements of potential landscape mitigation measures to reduce noise effects/ or screen noise mitigation measures.	Liaison to identify cross-over's in relation to visual effects from listed monuments etc. / impact on historical landscapes.		Review of extent of visual effects experienced by local residents and potential effects on human wellbeing.
Land											
Material Assets (Roads & Traffic)							Increase of traffic on air quality.	Traffic movements within site and along surrounding roads potential to cause noise disturbance.		Increase of traffic on climate.	Potential emissions and accidents.
Air Quality										Air quality and	Increases in air pollutant

Interaction Matrix	Biodiversity	Soils,Geology and Hydrogeology	Water	Landscape and Visual	Land	Material Assets (Roads & Traffic)	Air Quality	Noise and Vibration	Cultural Heritage	Climate	Population and Human Health
										climate effects frequently have similar sources.	concentrations have the potential to impact on human health.
Noise and Vibration											Noise emissions from the operational facility have potential to impact on human health.
Cultural Heritage											
Climate											Global health.
Population and Human Health											

17 GLOSSARY

Bio-waste

Bio-waste is defined as biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants. (http://ec.europa.eu/environment/waste/compost/).

Composting

Composting is the biodegradation of organic matter through a self heating, solid phase, aerobic process. This converts organic matter into a stable humic substance. (http://ec.europa.eu/environment/waste/compost/pdf/econanalysis_finalreport.pdf).

Construction & Demolition Waste

Any waste generated in the activities of companies belonging to the construction sector and included in category 17 of the European List of Wastes. The category 17 provides for codes for several individual materials that can be collected separately from a construction or demolition site. It includes waste streams [hazardous and non-hazardous; inert, organic and inorganic] resulting from construction, renovation and demolition activities. C&D waste originates at sites where construction, renovation or demolition takes place. Construction waste contains several materials, often related to cut-offs or packaging waste. Demolition waste comprises all materials found in constructions. Renovation waste can contain both construction related materials and demolition-related materials. (*EU Construction & Demolition Waste Management Protocol – European Commission - September 2016*).

Fly Ash

(heat recovery system ash) is defined by the International Ash Working Group as *"the particulate matter carried over from the combustion chamber and removed from the flue gas stream prior to addition of any type of sorbent material".*

Flue Gas Treatment Residues

(FGTR) is the residue of the flue gas treatment process. Lime and activated carbon are added into the flue gases. The hazardous compounds of the flue gases, such as chlorides and heavy metals, adhere to the lime and activated carbon particles. These particles in turn are absorbed by fabric filters. The flue gas treatment residue is temporarily stored in a silo. It is stabilised using cement and safely disposed in a Hazardous landfill.

Hazardous

Hazardous waste is any waste covered by Article 1(4) of the Council Directive 91/689/EEC on hazardous waste.

Incinerator Bottom Ash is part of the non-combustible residue (ash) of combustion in an incinerator. This material is discharged from the moving grate of MSW incinerators. Most incineration bottom ash is classified as non-hazardous waste.

Leachate

Means any liquid percolating through the deposited waste and emitted from or contained within a landfill.

Non-Hazardous

Non-hazardous waste is any waste that is not hazardous.

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