6 WATER

6.1 INTRODUCTION

This Chapter presents an assessment of the potential impact of the proposed development on the water environment and should be read in conjunction with the site layout plans (Volume 3 of this EIS) and project description (Chapter 2) of this EIS. Relevant mitigation measures are also presented in this Chapter.

The proposed Drehid MBT Facility site is located in a large Bord na Móna landholding in north Co. Kildare. The entire Bord na Móna landholding comprises 2,554ha, which is divided into a northern portion of 799ha and a southern portion of 1,745ha by the L5025 County Road, which crosses the narrowest section of the peat deposit.

The proposed MBT Facility will occupy an area of 29ha and will be located in the southern portion of the landbank. The Bord na Móna landholding in this area has been utilised for the industrial harvesting of peat over an approximate 50 year period. Artificial drainage of the bog has resulted in an alteration of the natural hydrology and therefore this assessment details the surface water and groundwater environment at its current state.

The information included in Chapter 5 (Soils and Geology) and Chapter 4 (Ecology) should be read in conjunction with this Water Chapter.

6.1.1 Methodology

The assessment of the potential impact of the proposed development on the water environment was carried out according to the methodology specified in the following guidance documents:

- Environmental Protection Agency (EPA) Guidelines on the Information to be Contained in Environmental Impact Statements (2002); and
- EPA Advice Notes on Current Practice (in the Preparation of EIS) (2003).

The following sources of information were utilised to establish the baseline environment:

- The Geological Survey of Ireland (GSI) well card and groundwater records for the area were inspected, with reference to hydrology and hydrogeology;
- Office of Public Works (OPW) flood mapping;
- EPA water quality monitoring data for watercourses in the area;
- Results from the chemical analysis of water samples taken in 2003 - 2011;
- Water Framework Directive Monitoring Programme, EPA 2010;

- Information from the River Basin Management Plan for the South Eastern River Basin District (SERBD); and
- Site visits of the study area.

An area investigation was carried out in November 2011 and January 2012 by TOBIN Consulting Engineers, in order to visually assess the water environment in the vicinity of the MBT Facility site.

Recommendations arising from consultations with both Inland Fisheries Ireland and Kildare County Council (see Chapter 1) were incorporated into the water impact assessment and mitigation measures.

6.2 EXISTING ENVIRONMENT

6.2.1 Drainage

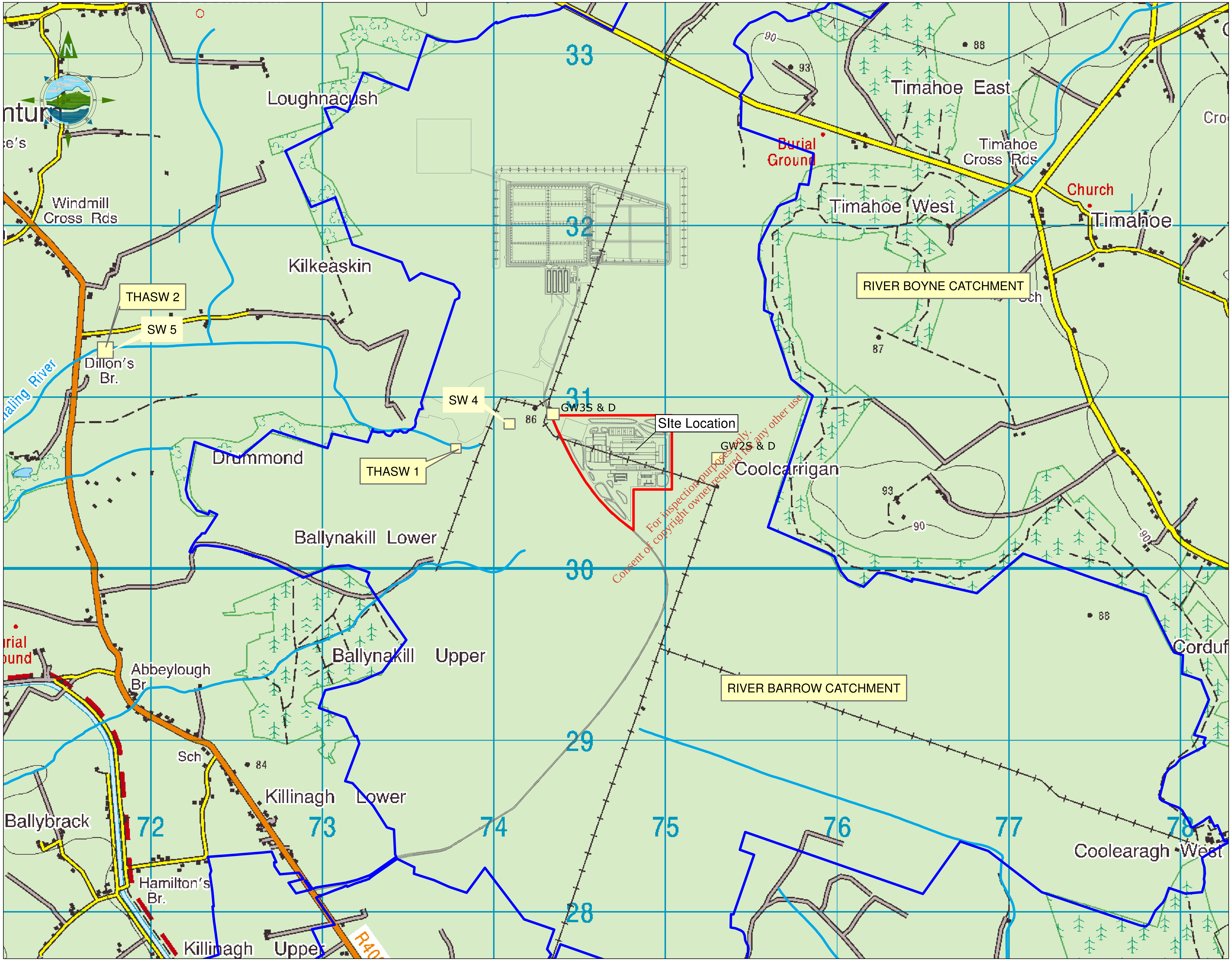
The local and regional surface water features are shown on Figure 6.1 and Figure 6.2. The natural and artificial surface water channels within (and immediately adjacent to) the proposed Drehid MBT Facility site are shown on Figure 6.3.

The 19th Century 6-inch to 1-mile scale geological field sheets indicate that prior to exploitation of the peat resources within the MBT Facility site there were no natural surface water channels crossing the MBT Facility site. The only natural features are recorded close to the margin of the peat deposits.

In its natural state an undisturbed peat bog is predominantly water, with a moisture content of approximately 95% near the surface and reducing to approximately 90% in the deepest layer, due to compaction of material. The eco-system of an undisturbed bog depends solely on rainfall for its water supply. A natural bog comprises two discrete layers, the acrotelm and the underlying catotelm. The acrotelm is the top 10-30cm of living and poorly humified sphagnum mosses, which is periodically aerated and highly permeable. The catotelm is the lower thicker layer which is more highly humified with depth and has low permeability.

Although the surface of an undisturbed bog lies above the natural watertable of the adjoining free draining lands, the watertable lies within 0.3m of the surface within the bog itself. Therefore a bog can be viewed as a very large reservoir of water. The bog will naturally regulate the release of water; therefore there is very little seasonal fluctuation in the watertable within a bog.

Discharges from natural bogs are dependent on seasonal factors. During summer months bogs will largely absorb all precipitation to replenish its reservoir and ensure that the watertable does not fall too low. During winter months precipitation will be absorbed to an optimal level and after which all precipitation will be rejected. Hydrographs at the margins of bogs show peakflows during and shortly after winter rainfall events with quick recessions in surface flow following the cessation of rainfall.



Legend

🟥 Activity Boundary

🟦 Rivers

🟦 Ownership Boundary

☐ Monitoring Locations

0 100 200 400 600 800
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

A	05.06.12	Issued for Waste License	G.F	J.D.
Issue	Date	Description	By	Chkd.

Client:

BORD NA MÓNA

Project:

DREHID
MECHANICAL BIOLOGICAL
TREATMENT (MBT) FACILITY

Title:

SURFACE WATER CATCHMENT
AND MONITORING
LOCATIONS

Scale @ A3: 1:20,000

Prepared by: G.Fil
Checked: J.Dillon
Date: May 2012

Project Director: D.Grehan

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6301

Figure 6.1

A

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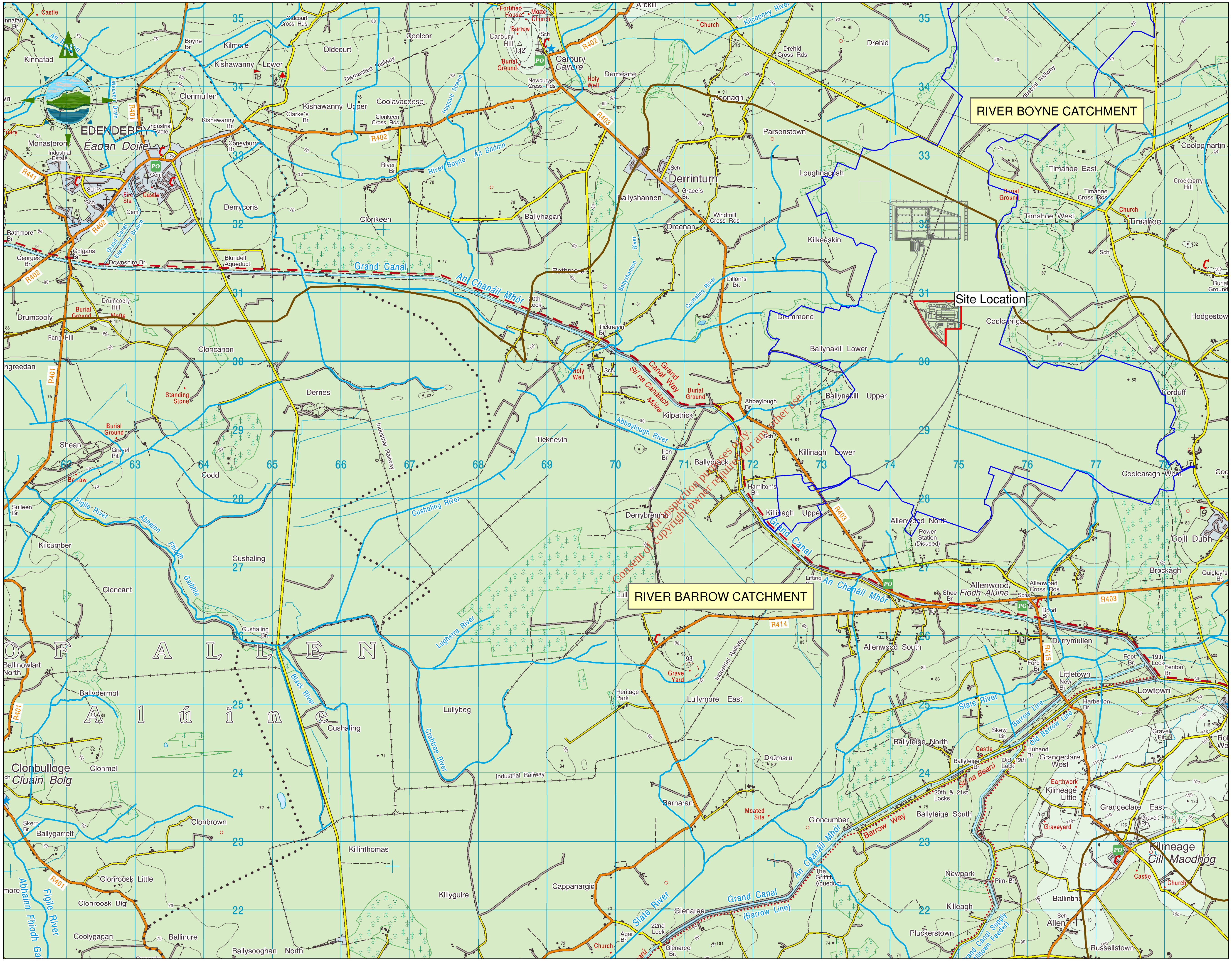

Legend

🟥	Site Boundary
🟦	Ownership Boundary
▭	RiverBasinDistrict
🟦	Rivers

0 250 500 1,000 1,500 2,000
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

A	05.06.12	Issued For Waste License	G.F.	J.D.
Issue	Date	Description	By	Chkd.

Client:

BORD NA MÓNA

Project:

DREHID
MECHANICAL BIOLOGICAL
TREATMENT (MBT) FACILITY

Title:

REGIONAL SURFACE
WATER CATCHMENT

Scale @ A3: 1:50,000

Prepared by:	Checked:	Date:
G.Fil	J.Dillon	May 2012

Project Director: D.Grehan

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Figure 6.2

A

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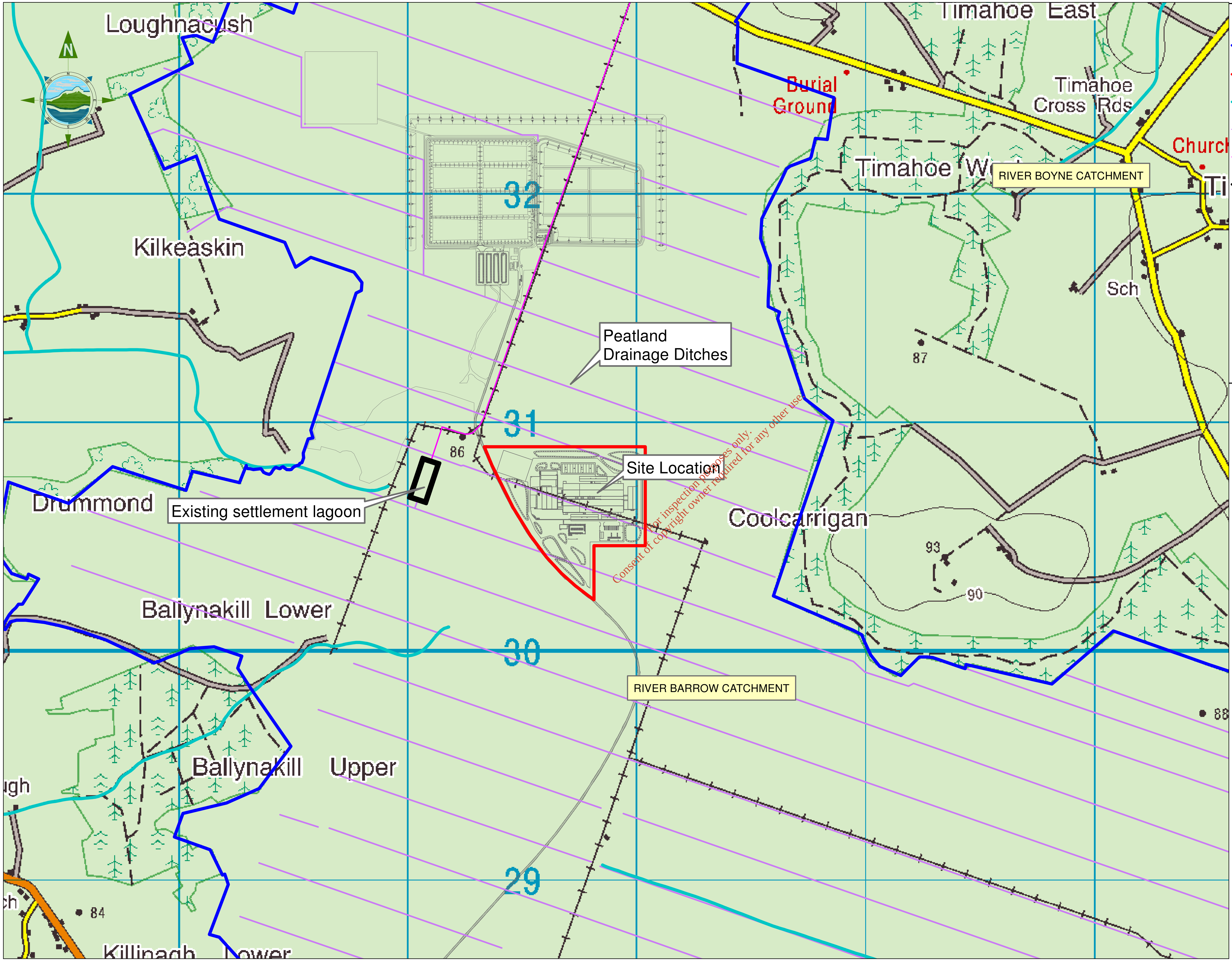

NOTES

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4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	05.06.12	Issued for Waste License	G.F.	J.D.
Issue	Date	Description	By	Chkd.

Client:

BORD NA MÓNA

Project:

DREHID
MECHANICAL BIOLOGICAL
TREATMENT (MBT) FACILITY

Title: SITE DRAINAGE LAYOUT
AND SURFACE WATER
FEATURES

Scale @ A3: 1:15,000

Prepared by:	Checked:	Date:
G.Fil	J.Dillon	May 2012

Project Director: D.Grehan

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6301

Figure 6.3

A

The Bord na Móna landholding has been subject to industrial peat activity over an approximate 50 years period. To reduce the moisture content of the peat material it was necessary to systematically drain the whole bog. A network of large artificial drains were opened up across the bog in order to reduce the water content of the peat and increase the bearing capacity, thus allowing the land to be traversed by heavy plant and machinery. The drainage plan involved the progressively deepening of drains over a period of 7-10 years.

The artificial drainage network heavily influences the current appearance of the bog. The entire Bord na Móna landholding has been divided into a number of compartments, referred to as 'peat fields' due to the excavation of east-west trending artificial surface drains. These artificial surface drains discharge to a central underground culvert, trending in a general north to south direction. The hydraulics of these central drains is controlled by the fall in topographic elevation and the flow to natural hydrological discharge points. Figure 6.3 shows the orientation of the drainage channels within the MBT Facility site.

In the vicinity of the MBT Facility site activity boundary, all water draining from the artificial drains discharges to the central culvert, which flows towards the existing settlement lagoon located (see Figure 6.3). The settlement lagoon allows for treatment prior to discharge to the Cushaling River at the western margins of the bog.

The surface water drainage pattern in the broader vicinity of the applicant's property was also assessed as part of the baseline assessment to determine the catchment conditions in the region. The catchment divides were delineated from the EPA Water Quality in Ireland annual publications (1998 – to date) and the South Eastern River Basin District (SERBD) www.wfdireland.ie. The Ordnance Survey of Ireland (OSI) Discovery Series (Sheet No. 49) was also used to refine the catchment and sub-catchment divides.

Reference to Figure 6.2 indicates that all lands within the MBT Facility activity boundary are located within the catchment of the River Barrow. All surface water from the proposed MBT Facility will drain to the west to the Cushaling River, which is a tributary of the Figile River. The existing access road from the R403 to the Drehid Waste Management Facility passes through the sub-catchment of the Abbeylough River, which is also a tributary of the Figile River (See Figure 6.2). The Figile River is a sub-catchment of the River Barrow.

The Slate River sub-catchment encroaches on the southern portion of the applicant's property. No activities associated with the proposed development are located within the sub-catchment of the Slate River. The Slate River and the Figile River converge to the north of Bracknagh, County Offaly to form a water feature referred to as the Black

River. This Black River converges with the River Barrow just north of Monasterevin, County Kildare.

The catchment divide between the regional catchments of the River Barrow and the River Boyne is delineated approximately 0.75 km to the north east of the MBT Facility activity boundary.

The total flow in the surface water channels is comprised of two different flow mechanisms. The dominant flow mechanism, due to the soil cover in the area, comprises overland run-off of surface water. The flow in the surface water features responds quickly to rainfall during winter months, when the peat is fully saturated. This ‘flashy flow’ is common in areas where bog cover dominates, due to their low infiltration capacity characteristics. The fall off in surface water flow is also relatively quick following the rainfall event.

The second flow mechanism comprises a slow release of shallow groundwater baseflow to the surface water environment at the margins of the bog. This portion of the total surface water flow may be quite small during heavy rainfall events, compared to the surface run-off portion. However during periods of low precipitation and during summer droughts, the groundwater contribution will comprise almost all the surface water flow. This slow release of the groundwater maintains a surface water flow throughout the year.

6.2.2 *Surface Water Flow Measurements*

Hydrological studies have been undertaken in other bog areas to determine the impact of peat harvesting. The removal of surface vegetation from the bog is considered to have the greatest effect on the quantity of surface water run-off which discharges to the receiving waters. The function of the drainage channels within the proposed MBT Facility site is to divert rainwater from the surface of the bog. Research suggests that as much as 80% of rainfall during winter periods will discharge to receiving waters from a drained bog, compared to less than 20% from an intact bog.

It should be noted that harvesting of peat has now ceased within the proposed MBT Facility site and re-vegetation of the bog surface is well established in many areas. The drainage ditches have been excavated to a depth where the base of the ditch is within the mineral subsoil. The drainage ditches are approximately 3-4m wide and approximately 3m deep. Water is retained in the drainage ditches even during summer months, which suggest that the channels are acting as storage channels and discharging to the main drain at a constant rate. Therefore the run-off rate from the current bog environment is considered to be significantly less than when the bog was operational and peat was being harvested.

The only available hydrometric data for surface water flows in this area are from a hydrometric station maintained by the Office of Public Works (OPW) at Clonbulloge on the River Figile. The information available is included in Appendix 6.1 and summarised below.

As detailed above, all surface water generated from the proposed MBT Facility activity boundary drains from the bog to the Cushaling River, which is a tributary of the River Figile. Historical hydrometric data from the OPW hydrometrics station (Stn. 14004) at Clonbulloge are available for the years 1972 to 2002. This hydrometric station records water levels and a rating curve is used to estimate flows. The hydrometric station is approximately 21.4km downstream of the MBT Facility site activity boundary and a number of surface water channels contribute to the flow in the River Figile along its course.

The information interpreted from the hydrometric dataset relates to annual maximum flows from 1957 to 2009. Annual maximum flows on the River Figile at Clonbulloge range from $13.2m^3$/sec to $28.8m^3$/sec. The annual maximum flow in 2008 was significantly elevated above those of previous years, with the flow measured on the 18/08/2008 comprising $28.8m^3$/sec. It is not possible to obtain rainfall data from the Lullymore rainfall gauge as measurements were discontinued in 1990; however this storm event resulted from extreme rainfall across Ireland.

The highest flows on the River Figile were recorded on the 19/11/1965, when flows were estimated to comprise $38.4m^3$/sec. This flow was generated by an extreme rainfall event on the 17/11/1965, when the rainfall comprised 70.8mm over a 24 hour period. Interpretation of the annual maximum flows at Clonbulloge and rainfall measurements from Lullymore indicate that the storm peakflows respond at the hydrometric station approximately two days after the extreme rainfall event.

Site Specific Hydrometric Data

The discharge from the majority of the southern half of the applicant's property, flows into the Cushaling River. This flow is discharged via an existing settlement lagoon, prior to gravity flow to the Cushaling River (See Figure 6.3). The groundwater baseflow to the Cushaling River is considered to be low, due to the artificial drainage of the Bord na Móna landholding.

Two monitoring stations (THASW 1 and THASW 2) were established on the Cushaling River for auto-sampling and hydrometric flow gauging, as shown in Figure 6.1. At each of these locations a hydrometric flow gauge and a data logger were installed to determine the hydrometric conditions on the Cushaling River.

The flow in the watercourse was determined by measuring the water level by using an electronic bubble gauge, in a known cross sectional area of water, with these water levels being recorded every 2 minutes on a data-logger. Using appropriate empirical formulas for the cross-sectional area of the water course and the water levels recorded by the data-logger, it was possible to determine the flow in the watercourse. The hydrographs are presented in Appendix 6.1.

The first monitoring station (Code: THASW 1) is a 12-inch concrete outfall pipe. This 12-inch concrete outfall pipe represents the outfall from the central drain of the northern section of the cutover bog and controls the overall outfall from the Bord na Móna landholding. A faceplate was installed on this pipe to allow the flow across the area of the pipe to be determined and to allow an accurate flow measurement by the instrumentation installed.

At the second location THASW 2, a weir was installed at a monitoring point on the Cushaling River, approximately 1km downstream of the outfall point from the central drain. The monitoring station was established along a narrow section of the watercourse, with a minimal area of flood plain. This weir was constructed using wood and was sealed using local clay fill from the bankside. The weir achieved laminar flow across the weir face and the flow meter (water height) was installed behind this weir.

The hydrometric data was downloaded during each water sampling occasion, and the data logger was serviced to ensure correct operation. The ranges in flow recorded at the flow stations indicate the flashy nature of the Cushaling River. The minimum flow recorded at THASW1, i.e. the commencement of the Cushaling River was 0 m^3/hour and the maximum recorded was 218 m^3/hour (60.6 l/sec), with a median flow of 42 m^3/hour (11.7 l/sec). The minimum flow recorded at THASW2 (at a temporary weir) was 0 m^3/hour and the maximum recorded was 338 m^3/hour (93.9 l/sec), with a median flow of.35 m^3/hour (9.7 l/sec).

The flow on the Cushaling River as it exits the Bord na Móna landholding was approximately 0.0376m^3/sec (3,250m^3/day). The flow on the Cushaling River at Dillon’s Bridge, approximately 2.25km downstream was approximately 0.0771m^3/sec (6,660m^3/day), indicating that the flow had more than doubled in a short lateral interval. As stated above the Cushaling River originates within the Bord na Mona landholding and therefore the stream is gaining flow along its course, as would be expected. The flow in the Cushaling River was well contained within the capacity of the flow channel. It is estimated that the channel could accommodate an approximate three to four fold increase in flow without exceeding the capacity of the stream channel.

The carrying capacity of the river channel was determined by utilising Manning’s Equation. The maximum channel capacity of the Cushaling River at the western boundary of the proposed MBT Facility is estimated to be approximately 8,550 litres/sec, with a channel cross sectional area of approximately 9.5m^2. The maximum channel capacity of the Cushaling River at Dillon's Bridge, where the Cushaling River flows under the R403 road, is estimated to be approximately 9,900 litres/sec, with a channel cross sectional area of 6.61m^2. The culvert under the R403 is a concrete box culvert, of dimensions 3m high and 2.2m wide. The stream channel upstream and downstream of the bridge is incised deeply into the ground and extends to up to 6-7m, with shallow flood plains which attenuate flow in the mid part of the stream.

It should be noted that the water currently discharged from the MBT Facility site naturally drains to the Cushaling River. All surface water collected at the MBT Facility site, following construction, will be treated prior to discharge at a regulated rate.

Flooding Data

Substantial areas of the proposed MBT Facility site and surrounding area catchments have been artificially drained to enable industrial harvesting of peat from the 1960's to 1990's. The OPW 'Flood Hazard Database' was used in order to obtain information on historical flooding events within the proposed MBT Facility site boundary. This information was used to establish the current baseline conditions and specifically if the proposed MBT Facility site is liable to flood. No records of flooding were noted on the OPW website for the site of the proposed MBT Facility.

Data on historical flooding is limited but the records do not indicate that flooding occurred at the proposed MBT Facility site or on the Cushaling River immediately downstream. The network of drainage ditches effectively drain the proposed MBT Facility site and surrounding area. The groundwater monitoring data indicates that the watertable is shallow (<2 m bgl). The presence of tall scrub is also an indication that the proposed MBT Facility site is not waterlogged and is not inundated during winter periods.

6.2.3 Surface Water Quality

Regional Surface Water Quality

The water quality of the major rivers in Ireland is monitored continuously by the EPA. The monitoring programme was established under the Environmental Protection Act 1992. The objectives of the programme include the following:

a) To establish the ongoing quality status of our rivers and streams;
b) To monitor quality changes and trends over time;
c) To assess the performance of pollution control and abatement measures;
d) To provide feedback to the responsible control agencies; and
e) To inform the general public.

Q Values are used by the EPA to express biological water quality, based on changes in the macro invertebrate communities of riffle areas brought about by organic pollution. See Table 6.1 for an explanation of the ratings. Q1 indicates a seriously polluted water body; Q5 indicates unpolluted water of high quality. Appendix 6.2 shows a more detailed description of the Biological Quality Classes.

Table 6-1 Q Rating Table

Quality Ratings	Quality Class	Pollution Status	Condition
Q5, Q4-5, Q4	Class A	Unpolluted	Satisfactory
Q3-4	Class B	Slightly Polluted	Unsatisfactory
Q3, Q2-3	Class C	Moderately Polluted	Unsatisfactory
Q2, Q1-2, Q1	Class D	Seriously Polluted	Unsatisfactory

Available information for the Figile River catchment was referenced to determine the existing quality of the surface water environment. Reference to information obtained from the EPA and Southern Regional Fisheries Board indicates that the Figile and Slate Rivers, of which the Cushaling and Abbeylough Rivers are tributaries, support both salmonid and cyprinid fish populations.

Reference to EPA information indicates that there are four water sampling stations between the MBT Facility site and Clonbulloge (approximately 21.4km downstream of the MBT Facility site). Table 6.2 and 6.3 should be read in conjunction with the Q rating system as outlined in Table 6.1.

According to the EPA, the invertebrate community diversity at Ticknevin Bridge is low to very low. The EPA physio-chemical summary of results indicates that the water quality is low with the dissolved oxygen depleted by either biological or chemical uptake. It is likely that the water in the Cushaling River at Ticknevin Bridge is affected by a high chemical demand on the Dissolved Oxygen, due to the predominance of peat upstream of the sampling point.

Further downstream at Cushaling Bridge (Nat. Grid Ref.: E265100, N225850), approximately 11km downstream of the proposed MBT Facility, the biological analysis indicates that the water quality is moderately polluted (Q2-Q3) between 1997 and 2003 with improvements noted since 2006. The chemical analysis indicates that the Dissolved Oxygen saturation is greater indicating a lower uptake, suggesting the affects of chemical activity of peat is reduced. The location of this sampling point is further downstream from peatland and is adjacent to free draining agricultural lands.

Table 6-2 EPA Monitoring of Biological Quality of Waters on the River Figile

Location	Bridge South of Ticknevin Bridge	Cushaling Bridge	Kilcumber Bridge	Clonbulloge Bridge
Station No	050	100	200	300
Grid Ref.	E269675, N230150	E265100, N225850	E261050, N226800	E261000, N223450
2011	Q3	Q3-4	Q3-4	Q4
2009	Q2-3	Q3-4	Q3-4	-
2006	Q2-3	Q3-4	Q3-4	Q4
2003	Q2	Q3	Q3-4	Q4
2000	Q1-2	Q3	Q3-4	Q4-5
1997	Q1	Q2	Q3	Q3-4
1994	Q1	No Sample	No Sample	No Sample
1993	Q2	Q3-4	Q3-4	No Sample
1990	Q1-2	No Sample	No Sample	No Sample
1989	Q2	Q3-4	Q3	Q4
1986	No Sample	Q3-4	Q3-4	Q4

The biological analysis indicates that the water quality of the River Figile at Kilcumber Bridge (Nat. Grid Ref.: 261050, N226800) is slightly polluted and unpolluted at Clonbulloge Bridge (Nat. Grid Ref.: 261000, N223450). Again the sampling at these locations indicates that the Dissolved Oxygen saturation is higher. The impacts on the water quality at these location appears to be related to agricultural activity, with oxidised nitrogen, ammonia and ortho-phosphate elevated above normal background levels.

The closest sampling station to the proposed MBT Facility is at Dillon's Bridge (Nat. Grid Ref.: E271600, N231230), which is approximately 2.7 km downstream of the MBT Facility activity boundary. This location is monitored as required by the EPA Waste Licence for the Drehid Waste Management Facility (EPA Waste Licence W0201-03). The biological analysis of the surface waters indicates that the surface water quality was considered moderately polluted (Q3-Q4), as shown in Table 6.3 below. The results are comparable to the 2008 assessment, which was carried out prior to waste acceptance at the existing Drehid Waste Management Facility.

Table 6-3 Biological Monitoring at Dillon's Bridge (W0201-03 AER)

Location	**Dillon's Bridge (SW-4)**
Grid Ref.	E271600, N231230
2011	Q3-4
2010	Q3-4
2008	Q3-4

Site Specific Surface Water Quality

Data points

As part of the original environmental site investigations for the existing Drehid Waste Management Facility, a number of water sampling stations were established at the boundary of the Bord na Móna landholding. These monitoring locations included the following:

- SW4 – Dillon's Bridge(Cushaling River); and
- SW5 – Settlement lagoon for Bord na Móna landholding, prior to discharge to the Cushaling River.

The locations are shown on Figure 6.1. As potential surface water discharges from the proposed facility will enter the Cushaling River, it is considered appropriate to focus monitoring on this watercourse. Weekly monitoring in 2011 at Dillon's Bridge (SW4) and the settlement lagoon (SW5) are included in Appendix 6.3. Water quality results indicated that the water samples were within the permitted guidelines.

Discussion of results

The pH of the samples ranges from 7.5 to 8.2, which is within the maximum allowable concentration (MAC) for drinking water and typical of surface water samples in the surrounding environment. The pH values recorded are slightly basic. Slightly elevated levels of ammonia are considered reflective of the reducing conditions within the peat subsoils.

The chloride concentrations at SW4 and SW5 are recorded within the range 10-21mg/l, which is within normal background levels. Weekly surface water results indicate chloride concentrations are typically less than 15 mg/l.

6.2.4 Groundwater Chemistry

No groundwater abstractions occur at the site of the proposed MBT Facility at present, however a groundwater abstraction point is proposed to supply potable water to the proposed facility. The baseline groundwater quality is outlined below and in Table 6.4.

Groundwater samples were taken from GW-2S and GW-3S (See Figure 6.1) on the 19th October 2011 as part of on-going monitoring as required under the EPA waste license for the existing Drehid Waste Management Facility. The pH ranges between 7.0 (GW-2S) and 6.6 (GW-3S), which is slightly acidic. The electrical conductivity ranges from 827 to 832 µS/cm @ 25°C. The hydrochemical signature of the groundwater is calcium bicarbonate.

The concentration of nitrate is very low with all concentrations below 0.05mg/l (as NO_3). Ammonical Nitrogen concentrations however were elevated with groundwater samples exceeding the MAC. This would suggest that reducing conditions are present within the peat and that denitrification may have occurred.

Chloride concentrations in GW-2S and GW-3S are less than 15mg/l, which is considered to be below the mean natural background level of 18mg/l (Baker, G., Crean, D. and Moran, S. 2007[59]) and the groundwater saline intrusion threshold value (S.I. No. 9 of 2010 Groundwater Regulations) of 24 mg/l. This is indicative of a low pollution loading at the proposed MBT Facility site. Exceedance of the ammonium, manganese and iron MACs are likely, based on-site experience and the reducing conditions in the soil and bedrock. Naturally high ammonium, iron and manganese concentrations are known to occur within the limestone bedrock in County Kildare and County Meath where reducing conditions are prevalent. Concentrations of ortho-phosphate in GW-2S and GW-3S varied between 0.12 mg/l (GW-2S) and 0.02 mg/l (GW-3S).

Elevated concentrations of arsenic were detected in 2011 in GW2S (20 µg/l) and GW3S (9 µg/l). These concentrations are above the Groundwater Threshold Value (GTV) level of 7.5 µg/l. In the 2003 monitoring event (in advance of the development of the existing Drehid Waste Management Facility) elevated concentrations of arsenic were detected in groundwater. The source of the arsenic is unknown however it is noted that "*concentrations in groundwater in some areas are sometimes elevated as a result of erosion from natural sources*" (EPA 2001; Parameter of Water Quality). A literature review reveals several studies which attribute arsenic concentrations to reducing conditions associated with peat deposits. As such, these results represent the natural geochemistry beneath the peatland.

Barium concentrations recorded in 2011 in GW2S (756 µg/l) and GW3S (556 µg/l) are elevated compared to studies of typical background concentrations (162 µg/l; Baker, G., Crean, D. and Moran, S. 2007). However, barium concentrations above typical background concentrations were also detected in the 2003 monitoring event where

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[59] Baker, G., Crean, D. and Moran, S. (2007) Establishing Natural Background Levels for Groundwater Quality in Ireland. GSI Groundwater Newsletter No. 46.

concentrations ranged from 90 to 270 µg/l in the deeper boreholes and from 130 to 520 µg/l in the shallow boreholes and (as with arsenic concentration) are believed to be representative of the natural geochemistry beneath the peatlands at the proposed MBT Facility site. Elevated concentrations of nickel were detected in GW2S (34 µg/l) in 2011. Concentrations of nickel in GW3S (6 µg/l) are below the (GTV) value of 15 µg/l.

Elevated concentrations of aluminium were detected in GW2S (517 µg/l), GW3S (326 µg/l), in 2011. At near neutral pH (pH 5-9); concentrations of aluminum are typically low in groundwater samples. As the groundwater wells are screened within the peat and clayey subsoil horizon, it is possible that clay particles containing aluminum are present in the groundwater samples. This would indicate that the elevated concentrations found in the groundwater samples are as a result of the presence of clay in the suspended solids and not dissolved aluminium. Similarly elevated concentrations of iron are likely to reflect natural background conditions in the peat and soil.

The concentrations of sulphate, potassium, sodium, magnesium and calcium are within normal ranges. The potassium: sodium (K:Na) ratio is low at less than 0.2. Calcium concentrations are reflective of the limestone subsoils.

In summary, the groundwater quality monitoring adjacent to the MBT Facility site suggests that reducing conditions are present in the soils. The chloride and K:Na ratio are both low, however high ammonia concentrations are present which commonly occur in these reducing environments.

Table 6-4: Groundwater Quality (19th October 2011)

Borehole	Units	GW-2S	GW-3S	MAC S.I. No. 278 of 2007	GTV S.I. No. 9 of 2010
Temperature	°C	11.6	10.7	-	-
Conductivity	µS/cm	827	832	2500	1875
pH	pH units	7.0	6.6	6.5-9.5	-
Ammonia – N as N mg/l	mg/l	2.04	4.77	0.23	0.136
Chloride	mg/l	12	13	250	187 (24)
Nitrate as N	mg/l	<0.05	<0.05	11.3	8.47
Nitrite	mg/l	<0.03	<0.03	0.5	0.11
Ortho-phosphate	mg/l	0.12	0.02	-	-
Sulphate	mg/l	7.94	2.62	-	187
Sodium	mg/l	7.4	15	200	150
Potassium	mg/l	0.8	1.7	-	-
Magnesium	mg/l	30	18	-	-
Calcium	mg/l	378	218	-	-
Aluminium	µg/l	517	326	250	150
Antimony	µg/l	<2	<2	5	-
Chromium	µg/l	3	2	50	-
Cobalt	µg/l	8	<2	-	-
Manganese	µg/l	901	432	50	-
Nickel	µg/l	34	6	20	15
Copper	µg/l	10	5	2000	1500
Zinc	µg/l	61	48	-	-
Cadmium	µg/l	2	<2	5	3.75
Barium	µg/l	756	556	-	-
Berylium	µg/l	<2	<2	-	-
Silver	µg/l	<2	<2	-	-
Lead	µg/l	10	8	25	15
Selenium	µg/l	2	<2	10	-
Iron	mg/l	17	14	0.2	-
Boron	µg/l	42	25	1000	750
Tin	µg/l	<2	<2	-	-
Arsenic	µg/l	20	9	10	7.5
Mercury	µg/l	<1	<1	1	0.75

M.A.C = Maximum Admissible Concentration under S.I. No. 278, 2007 (Water Quality -Dangerous Substances- Regulations).

G.T.V. = Groundwater Threshold Value (S.I. No. 9 of 2010 Groundwater Regulations)

Table 6-5 Groundwater Chemistry from Samples obtained on 04/02/2003

Parameter	Units	*M.A.C.*	*Detection Limit*	GW 1D	GW 1S	GW 2D	GW 2S	GW 3D	GW 3S	GW 4D	GW 4S	GW 5D	GW 5S
pH			*0.01*	7.51	7.17	7.46	6.93	7.66	7.16	7.75	7.55	7.56	7.53
Electrical conductivity EC	mS/cm	*6.5<pH<9.5*	*0.014*	0.835	1.043	0.755	0.983	0.319	0.936	0.493	0.722	0.9	0.71
Dissolved oxygen (DO)	mg/l	*2500*	*0.1*	4.9	6.1	7.6	6.8	5.4	6.6	8.8	7.5	7.9	8.4
Redox potential	mV	*n/a*		121	14	120	124	102	126	110	119	128	128
COD	mg/l	*n/a*	*10*	178	176	166	193	87	167	95	133	107	114
Total solids	mg/l	*n/a*	*1*	18579	34946	8693	48647	3152	16635	1557	22710	80762	14169
Total suspended solids	mg/l	*n/a*	*10*	16476	31904	10616	43392	2916	15050	1270	18930	73980	11390
Total hardness (as CaCO3)	mg/l	*60 MRC*	*5*	320	520	266	478	300	312	366	258	300	220
Total alkalinity (as CaCO3)	mg/l	*30 MRC*	*1*	380	570	460	520	210	240	290	380	370	350
Ammonia as NH4-N	mg/l	*0.3*	*0.2*	8	1.9	2	2.1	0.5	6.6	0.8	6.1	3.2	7.6
Nitrate NO3	mg/l	*50*	*0.3*	0.3	0.3	2.6	25.6	0.05	0.3	<0.3	<0.3	<0.3	<0.3
Nitrite NO2	mg/l	*0.5*	*0.05*	0.07	0.18	0.39	0.68	0.18	0.1	<0.05	0.11	<0.05	0.3
TON	mg/l	*n/a*	*0.3*	<0.3	<0.3	0.7	6.1	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Chloride Cl	mg/l	*250*	*1*	31	21	44	37	20	39	36	31	37	41
Fluoride F	mg/l	*1*	*0.01*	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphate SO4	mg/l	*250*	*3*	59	31	14	45	10	4	4	13	<3	55
ortho-Phosphate PO4	mg/l	*5*	*0.03*	0.2	0.3	0.2	0.2	0.2	0.2	0.3	1.2	0.2	2.6
Potassium K	mg/l	*12*	*0.2*	3.2	0.8	1.8	4.1	1.3	2.9	1.4	2.4	3	2.1
Sodium Na	mg/l	*200*	*0.2*	39.5	9.2	32	16.8	12.4	17	15.5	40	64	12.2
Calcium Ca	mg/l	*200*	*0.05*	124.9	156	128.2	152	48.51	161.7	81.74	108.5	117.8	119.1
Magnesium Mg	mg/l	*50*	*0.05*	11.11	44.06	9.17	34.72	7.56	11.33	13.68	17.14	11.81	9.64
Aluminium Al	mg/l	*0.2*	*0.05*	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc Zn	mg/l	*1*	*0.005*	0.007	0.011	<0.005	0.008	0.017	0.006	<0.005	<0.005	0.006	0.006
Iron Fe	mg/l	*0.2*	*0.001*	0.008	0.023	0.005	0.02	0.003	0.014	0.002	0.002	0.003	0.004
Manganese Mn	mg/l	*0.05*	*0.001*	0.006	0.242	0.084	0.409	0.082	0.151	0.006	0.142	0.383	0.26
Barium	mg/l	*0.5*	*0.05*	0.12	0.13	0.27	0.18	0.09	0.52	0.17	0.13	0.1	0.4
Boron	mg/l	*1*	*0.05*	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lead Pb	µg/l	*10*	*5*	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Copper	µg/l	*2000*	*5*	<5	7	<5	<5	<5	<5	<5	<5	<5	<5
Mercury Hg	µg/l	*1*	*0.05*	0.12	0.11	<0.05	<0.05	0.1	0.05	0.23	0.11	0.08	0.27
Nickel Ni	µg/l	*20*	*10*	<10	11	<10	<10	14	14	<10	<10	18	13
Arsenic	µg/l	*10*	*5*	19	<5	<5	<5	22	6	8	<5	<5	<5
Cyanide CN	µg/l	*50*	*50*	60	<50	<50	<50	<50	<50	<50	<50	170	<50
Cadmium Cd	µg/l	*5*	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium Cr	µg/l	*50*	*1*	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Silver Ag	µg/l	*10*	*10*	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Selenium	µg/l	*10*	*5*	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Phenols (HPLC)	mg/l	*0.0005*	*0.01*	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
Diesel Range Organics (DRO)	µg/l	*10*	*10*	<10	<10	<10	3303	<10	4441	<10	1649	5533	2731
Mineral Oil	µg/l	*10*	*10*	<10	<10	<10	1486	<10	1776	<10	<10	1383	956
Petrol Range Organics C4-C10	µg/l	*10*	*10*	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Petrol Range Organics C10+	µg/l	*10*	*10*	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
BTEX (MTBE) Compounds	µg/l	*10*	*10*	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PAH (16 EPA Compounds)	ng/l	*100*	*10*	<10	<10	<10	1332	<10	<10	<10	<10	<10	<10
Semi-Volatile Organic Compounds	µg/l		*1*	<1	<1	<1	<1	<1	<1	<1	7	<1	<1
Volatile Organic Compounds	µg/l		*1*	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Coliforms	c.f.u./100ml	*0*	*1*	1450	2880	4130	34480	1480	81640	28	310	4590	1460
Faecal Coliforms	c.f.u./100ml	*0*	*1*	6	2	<1	<1	<1	<1	<1	<1	<1	1
Ionic Balance	%			4.22%	14.14%	5.10%	9.19%	0.19	37.97	8.43	15.97	26.72	2.21

Legend

M.A.C = Maximum Admissable Concentration under S.I. No. 439, 2000(European Communities Drinking Water Regulations).

< = Less than

6.2.5 Water Framework Directive Requirements

The Water Framework Directive (WFD) requires ‘good water status’ for all European waters. This is to be achieved through a system of river basin management planning and extensive monitoring. In 2004 a characterisation and analysis of all River Basin Districts (RBD’s) in Ireland was undertaken as required by Article 5 of the WFD. In this characterisation study the impacts of a range of pressures were assessed including diffuse and point pollution, water abstraction and morphological pressures (e.g. water regulation structures). The Cushaling River was identified as at risk of failing to meet the objectives of the WFD by 2021.

A review of the WFD in relation to the Cushaling River indicates the following:

- There are no RPA (Registered Protected Area) nutrient sensitive rivers within 5 km of the MBT Facility site;
- There are no RPA habitat rivers within 5 km of the MBT Facility site;
- There are no RPA nutrient sensitive lakes and estuaries within 5 km of the MBT Facility site; and
- There are no RPA shell fish areas within 5 km of the MBT Facility site.

Based on the available information, the Cushaling River catchment is *‘at Risk of not achieving Good Status’* in relation to Surface Water (*1a status*). The catchment is predominantly cutover peat and agricultural land.

6.3 POTENTIAL IMPACTS

Both Configuration A (MBT with Composting) and Configuration B (MBT with Dry Anaerobic Digestion and Composting) will have the same footprint and accept the same volume of waste.

In the case of MBT Configuration A (MBT with Composting), all waste water produced by the MBT process will be reused in the process. However, in the case of Configuration B (MBT with Dry Anaerobic Digestion and Composting), the worst case scenario considers that all waste water produced by the MBT process may not be reused in the process and that an estimated 3,285 cubic metres per annum will require treatment off-site at an EPA licensed waste water treatment facility. It should be noted that Bord na Móna has received confirmation from both Rilta Environmental Ltd. (Rilta) and Enva Ireland Ltd. that their licensed facilities have both the capacity and capability to accept and treat waste water from the MBT Facility. This correspondence is included in Appendix 6.5.

As a consequence the potential impacts for each configuration are addressed separately.

6.3.1 Potential Impacts of Configuration A (MBT with Composting)

The purpose of this section is to detail the potential impacts on the surface water and groundwater environment as a result of the construction and operation of the MBT Facility. This section details the water management measures and other mitigation measures, which reduce the potential impact of the MBT Facility activities on the surface water and groundwater environment.

In assessing the potential impacts, it is important to note that MBT process waste water will be fully contained and collected in process waste water tanks. The MBT process waste water collection system will be fully isolated from the surface water collection system during the lifetime of the facility. As such, the potential impact of the proposed MBT Facility is substantially mitigated through avoidance of impacts. Outlined below are potential impacts that may arise during the construction and operational phases.

Construction Phase

The construction of the MBT Facility has the potential to have a negative impact on the surface water and groundwater environment if not managed properly. All construction activities will be confined to a 29ha landbank, which is referred to as the MBT Facility site activity boundary.

It is proposed to re-route existing drainage channels at the periphery of the MBT Facility site to minimise the volume of water that could potentially be impacted during the construction phase. The re-routing of the drainage channels, as shown on Drawing 6301-2502 (Appendix 5 of the Engineering Services Report), will not significantly impact on the drainage of the wider Bord na Móna landholding, as the water will continue to discharge to the main central drain and continue to discharge to the Cushaling River.

As with all construction projects of this scale, the management of surface water and groundwater is a very important aspect of the development. Water control measures and discharge management will be maintained where construction occurs as outlined in Section 6.4.1 below.

Reference to Section 5.3 of Chapter 5 (Soil, Geology and Hydrogeology) indicates that the risk to the groundwater environment is low due to the naturally low permeability of the mineral subsoil across the proposed MBT Facility site. Groundwater seepages to excavations will be minor and insignificant during heavy rainfall events, due to the low permeability of the underlying subsoil material throughout the MBT Facility site.

Sediment Discharges

There is the potential for the release of sediments into watercourses as a consequence of soil stripping (required to construct the MBT Facility roads, site compounds, foundations, etc.) and also due to potential run-off and erosion from soil stockpiles (prior to reinstatement and seeding).

The result of increased sediment loading to watercourses is to potentially degrade the water quality of the receiving waters and change the substrate character. Details of water treatment (where appropriate) is outlined in Section 6.4 below.

Concrete (specifically, the cement component) is highly alkaline and any spillage to a local watercourse could be detrimental to water quality and fauna and flora.

During the construction of the MBT Facility there will be a requirement to provide temporary wastewater facilities at the site compounds. It is not proposed to discharge wastewater from the site compounds. Rather, wastewater from welfare facilities will be transported off-site to a licensed waste water treatment plant.

The regional hydrological setting will not be significantly impacted by the proposed development. Re-routing of artificial drainage ditches at the periphery of the proposed MBT Facility site will be required. The re-routing of the artificial drainage ditches will not significantly impact the receiving environment. The re-routing will however reduce the risk of waters draining from areas upgradient of the MBT Facility site coming in contact with construction activities.

Operational Phase

MBT process waste water will be fully contained and collected in process waste water tanks for reuse in the process. The MBT process waste water collection system will be fully isolated from the surface water collection system during the lifetime of the facility. Therefore, there will be no discharge of waste water in to water environment. As such, the physico-chemical assimilative capacity of the Cushaling River will not be impacted by the operation of the MBT Facility.

At present there is no potable water supply at the MBT Facility site. Potable water will be required at the proposed MBT facility to facilitate the welfare of the workforce. The total daily demand is estimated as 4.69 m^3/day.

The operation of the MBT Facility has the potential to increase the rate of surface water runoff from this site. In order to provide the necessary attenuation, it is proposed to construct permanent surface water settlement lagoons. It should be noted that attenuation will also be provided by the existing settlement lagoon located downgradient of the proposed settlement lagoons at the MBT Facility site. The proposed 3 No. settlement lagoons will be required during the operation of the MBT Facility as detailed in Section 6.4 below.

The acceptance and treatment of waste will only take place within fully enclosed and bunded MBT Facility buildings. Waste water will be recycled within the MBT process. It is envisaged that no excess process waste water will be discharged from the facility.

In the event of a fire at the MBT Facility, the management of excess firewater will be required. It is proposed that firewater will be collected within the surface water ponds and managed as detailed in the mitigation measures in Section 6.4.1 below.

No evidence of flooding was recorded during the site investigations, site walkovers or during previous peat harvesting at the MBT Facility site and as such the potential flooding impacts are low/negligible.

6.3.2 Potential Impacts of Configuration B (MBT with Dry Anaerobic Digestion and Composting)

The potential impacts of Configuration B (MBT with Dry Anaerobic Digestion and Composting) are effectively the same as for Configuration A (MBT with Composting) as detailed in section 6.3.1 above.

All potentially contaminated water, including MBT process waste water, will be diverted to the process waste water holding tanks, from where this waste water will be reused within the MBT process where possible.

In the case of Configuration B (MBT with Dry Anaerobic Digestion and Composting), the worst case scenario considers that all waste water produced by the MBT process may not be reused in the process and that an estimated 3285 cubic metres per annum will require treatment off-site at a EPA licensed waste water treatment.

6.4 MITIGATION MEASURES

6.4.1 Mitigation Measures for Configuration A (MBT with Composting)

The purpose of the mitigation measures outlined in this Report is to minimise the direct and indirect impacts of the proposed development on the surrounding water environment during the construction and operational phases.

During the construction phase and the operational phase a high standard of environmental engineering practices will be implemented to minimise the impact of the facility on the surrounding surface water and groundwater environment.

Construction Phase

Wash down and washout of concrete transporting vehicles will take place at a designated bin area to prevent cementitious material and water entering the surface water network.

A number of drainage ditches will be excavated to divert existing surface water drainage away from the proposed excavations and construction activities (see Drawing No. 6301-2502). All rainwater run-off from the hard surfaces will be collected in this drain. The collected water in this drain will flow to the north of the MBT Facility Site, from where the captured water will be discharged to the existing settlement lagoon, to allow settlement of particles prior to discharge to the receiving environment.

In order to reduce the risk of sediment laden water adversely impacting surface water, measures will be implemented during the construction stage to divert such water through treatment systems (settlement lagoons) prior to discharge to receiving waters. During the construction period all water pumped from the base of excavations will be pumped to temporary/mobile sediment control devices, comprising grit traps or devices of similar efficiency. The contract documents will specify the necessity for the contractor to take all precautions needed to prevent silt laden run-off discharging directly to watercourses. Upper limits of sediment in discharges will be specified in contract documents. Frequent sampling of discharges will be a requirement of the contract. It is proposed to construct the proposed settlement lagoons early in the construction phase to optimise the treatment of surface water for the remainder of the construction stage.

The proposed lagoons are designed to reduce the potential impact at source. It should be noted that the overall capacity of the proposed settlement lagoons has been designed to accommodate all impermeable areas at the MBT Facility (including hardstanding areas and roofed areas) and to cater for a 1 in a 100 year storm event. An existing surface water lagoon (adjacent to SW4) will provide further attenuation prior to the discharge of surface water run-off to the Cushaling River. The surface water quality of all water discharged from the MBT Facility will be monitored to ensure that the receiving water quality is not impaired.

To minimise any potential impact on the surface water and groundwater environments from material spillages, all fuel oils and other oils used during the construction phase will be stored within bunded areas. The design of all bunds will conform to EPA bunding specifications. The retention capacity of bunded areas will be 110% of the capacity of the largest tank or drum to be stored within the bunded area. Spill kits will be retained on-site to ensure that all spillages or leakages are dealt with immediately and staff will be trained in their proper use. Any servicing of vehicles on-site will be confined to designated areas.

The presence of significant numbers of workers on site during the construction period will lead to the generation of foul sewage from temporary showers, toilets, canteens and washing facilities. This foul sewage will be collected and tankered off-site for disposal at a licensed waste water treatment facility.

Contractors will be required to ensure that the public roads in the vicinity of the site are maintained free from all mud, dirt and rubbish, which may arise from or by reason of the execution of the works. To facilitate this, contractors will be instructed to use a temporary wheel wash which will be installed at the site of the MBT Facility.

Operational Phase

It is important to note that MBT process waste water will be fully contained and collected in process waste water tanks for reuse in the MBT process. The MBT process waste water collection system will be fully isolated from the surface water collection system during the lifetime of the facility.

Rainwater falling on impermeable areas (including hardstanding areas and roofed areas) will be collected, stored and discharged to the receiving waters in a controlled manner (i.e. at greenfield runoff rates) in accordance with the principles set down by the Greater Dublin Strategic Drainage Study (GDSDS). The control of the surface water discharge rate to the receiving environment can be classified as a SuDs (sustainable urban drainage) measure.

The settlement lagoons have been designed to provide an adequate retention time to allow suspended solids to fall out of suspension prior to discharge of surface water to the receiving environment. The location of the settlement lagoons at the MBT Facility are shown on Drawing 6301-2511 (Appendix 5 of the Engineering Services Report). The settlement lagoons will also serve as a fire water supply and as a supply of fresh water to the MBT process, thereby allowing reuse and recycling of water within the proposed MBT Facility site. Water will be recycled within the MBT Facility where possible.

It is proposed to construct 2 No. water settlement lagoons to the north of the proposed MBT Facility and 1 No. lagoon to the south, adjacent to the car park hardstanding area (See Drawing 6301-2502). All water collected will first pass through an appropriately sized oil interceptor and grit trap. The surface water runoff will subsequently pass through settlement lagoons which have adequate retention time to allow suspended solids to fall out of suspension and provide stormwater storage during extreme rainfall events.

The settlement lagoons will be constructed from suitable material sourced on-site and compacted to ensure stability. Following the completion of earthworks associated with the formation of the lagoons, the integrity of the lagoons will be further secured by the installation of a HDPE geomembrane liner.

The provision of a storm water freeboard has been accounted for in the design of the settlement lagoons, thereby providing for storage of storm water in the event of intense rainfall events. The settlement lagoons are sized to provide sufficient retention time to facilitate adequate settlement of suspended solids prior to discharge to the surface water environment.

Meteorological data was sourced from the closest rainfall gauge at Lullymore. The matrix of extreme rainfall events, detailing rainfall durations and return periods for the rainfall gauge at Lullymore is included in Appendix 6.4. The extreme rainfall event chosen for the sizing of the settlement lagoons is a 1 in 100 year return period.

Interpretation of the meteorological data using the GDSDS/SuDs methodology allows an estimation of the peak rainfall runoff intensity. The surface water management system is designed to capture and control the runoff and allow outflow to receiving waters at a regulated rate. The calculation sheets for the greenfield run-off rate and the sizing of the settlement lagoons are included in the Engineering Services Report in Appendix 2.2 of this EIS.

It is proposed that the maximum outfall rate from the MBT Facility site will be maintained at 5.22 litres/second/ha of land drained (using a flow constriction). Therefore, over the full extent of the MBT Facility site, the discharge rate will be maintained at approximately 140 litres/second or 504m^3/hour

In extreme rain fall events, the storm water freeboard in the settlement lagoons will provide sufficient storage to maintain a regulated discharge rate (i.e. greenfield run off rate) to receiving waters.

The design of the settlement lagoon is based on creating a low energy water environment to settle out suspended solids from aqueous suspension. The theory behind the design of the settlement lagoons is the application of Stoke's Law. The settlement lagoons have been designed to provide sufficient retention time and a low velocity environment to allow suspended solids of a very small particle size to fall out of suspension prior to allowing the water to outfall to the receiving environment. Interpretation of Stoke's Law of settlement indicates that a 12 hour retention time will allow 100% removal of sand and silt down to 10µm. The design calculations for the settlement lagoons are provided in Appendix 6.4. The average retention time is calculated to be in excess of 12.8 days and the efficiency of the settlement lagoons is considered sufficient to ensure that the quality of the discharged water will meet acceptable discharge limits. These calculations do not take into account the additional settlement provided in the existing Bord na Móna settlement lagoon located downgradient of the proposed MBT Facility.

In terms of the capacity of the Cushaling River to transmit the water discharged from the MBT Facility, the channel capacity was assessed at the 2 No. locations where site specific hydrometric readings were taken (refer to Section 6.2.2). The carrying capacity of the river channel was determined by utilising Manning's Equation.

The maximum channel capacity of the Cushaling River at the western boundary of the MBT Facility site is estimated to be approximately 8,550 litres/sec, with a channel cross sectional area of approximately 9.5m^2. The maximum channel capacity of the Cushaling River at Dillon's Bridge, where the Cushaling River flows under the R403 road, is estimated to be approximately 9,900 litres/sec, with a channel cross sectional area of 6.61m^2. The culvert under the R403 is a concrete box culvert, of dimensions 3m high and 2.2m wide. The stream channel upstream and downstream of the bridge is incised deeply into the ground and extends to up to 6-7m, with shallow flood plains which attenuate flow in the mid part of the stream. With respect to the proposed MBT Facility, it is proposed to discharge a maximum of 140 litres/second from the MBT Facility site during extreme rainfall events. This maximum discharge corresponds to the greenfield runoff rate.

All surface water discharged from the MBT Facility will comprise clean treated surface water. The water discharged will be diverted through settlement lagoons to reduce any potential for siltation of the river channel. The surface water quality of all water discharged from the MBT Facility will be continuously monitored to ensure that there is no negative impact on the receiving water quality. Continuous monitoring will take place at the inlet and outlet of the surface water lagoons. Instrumentation linked to a SCADA system will continuously monitor the following parameters:

- Dissolved Oxygen
- pH
- Electrical Conductivity
- Flow Rate

An actuated valve at the surface water lagoon outlets will be controlled by the SCADA system. This valve will be programmed to close should any of the above parameters fall outside permitted levels. The volume of surface water discharged to the surrounding environment will also be controlled through the same actuated valve and SCADA system.

As process wastewater or any other potentially contaminated material from the MBT Facility will be fully contained and isolated from the surface water collection system. As such, the physico-chemical assimilative capacity of the Cushaling River will not be impacted.

All vehicles exiting the MBT Facility site will be required to divert through a wheelwash located along the access road of the MBT Facility site. This infrastructure will ensure that vehicles do not cause soiling of roads. Water will be recycled within the wheelwash facility to minimise the water requirement.A tank will store water for washing purposes; a pump will re-circulate the water back into the tank during washing. Solids that settle at the base of the tank will be removed by a vacuum tanker. Water will only be discharged to the foul water system during the periodic replenishment of the used process water with fresh water.

To minimise any impact on surface water from material spillages, all fuel oils and other oils used during operations will be stored within bunded areas. The design (volume and construction) of all bunds will conform to EPA bunding specifications. The retention capacity of bunded areas will be 110% of the capacity of the largest tank or drum to be stored within the bunded area. Spill kits will be retained on-site to ensure that all spillages or leakages are dealt with immediately & staff will be trained in their proper use. Any servicing of vehicles on-site will take place within the bunded Maintenance Building.

In the event of a fire at the MBT Facility, excess firewater will be collected and retained in the surface water ponds. The firewater will subsequently be analysed prior to possible tankering off-site to an approved wastewater treatment plant.

Water Supply

Currently, no public water supply exists on the site. To eliminate the requirement for a public water supply for the proposed MBT Facility a groundwater supply borehole will be sunk on-site to ensure an adequate supply of potable water to the proposed MBT Facility. This borehole well will be screened within the bedrock aquifer and grout sealed to prevent contamination of the groundwater. There will be no significant adverse direct or indirect impacts on the groundwater environment as a result of the installation of the water well and water supply connections during the construction and operational phase of the development. It is proposed to abstract less than 5 m^3/day of water to supply the MBT Facility. Pump test data (compiled in 2003) indicates a potential yield of >40 m^3/day. This data demonstrates that there is a sufficient supply of groundwater within the bedrock aquifer to satisfy the requirements of the MBT Facility. A supply of 40 m^3/day is consistent with the aquifer classification of the underlying bedrock aquifer. Due to the potential for high ammonium, iron and manganese within the underlying aquifer, a treatment system will be required to meet the drinking water standards. The water main layout including location of valves, hydrants, etc are shown on Drawing No's. 6301–2513 in Appendix 5 of the Engineering Services Report (ESR), that accompanies this EIS. The location of the borehole well is also shown on this drawing**.**

Foul Sewerage

Refer to Drawing No. 6301-2512 of the ESR for details of the MBT Facility site layout. The average foul sewerage volume that will be generated by welfare facilities at the MBT Facility is estimated as 4.69 m^3/day. It is proposed to collect and store foul sewerage in a sealed waste water holding tank for removal and further treatment/disposal offsite. All wastewater will be fully contained and stored at the MBT Facility. Therefore there will be no potential impacts from wastewater on the Cushaling River.

The proposed foul water network is shown on Drawing No. 6301-2512. The design calculations for the foul water network are included in the ESR in Appendix 2.2.

The collection, storage, treatment and monitoring of surface water prior to being discharged at greenfield run off rates is considered the principal mitigation measure to ameliorate the predicted and potential impact of the development post-construction.

6.4.2 *Mitigation Measures for Configuration B (MBT with Dry Anaerobic Digestion and Composting)*

Mitigation Measures for Configuration B (MBT with Dry Anaerobic Digestion and Composting) are the same as for Configuration A (MBT with Composting) as detailed in section 6.4.1 above.

6.5 CONCLUSION

The proposed Drehid MBT Facility will occupy a 29ha site within an overall 2,544ha Bord na Móna landholding within the townlands of Coolcarrigan and Drummond at Carbury, County Kildare. The MBT Facility site has previously been disturbed during the construction of a railway line and during the production of sod peat for energy generation.

All potentially contaminated water, including MBT process waste water, will be fully contained and collected in process waste water holding tanks, from where this waste water will be reused within the MBT process where possible. Sewerage generated by welfare facilities at the facility will be stored on site prior to being transported to a licensed waste water treatment facility.

There will be no uncontrolled discharge from the proposed MBT facility to the surface water or groundwater environment during construction or the operational phase. Regular sampling of the surface water environment will be undertaken downstream to ensure that MBT Facility activities are not causing an adverse impact on the natural water quality. This information will be compared to pre-development water quality data to determine any cumulative impacts or negative trends.

Given the above mitigation measures and the high design standard of the proposed MBT Facility, the risk to the surface water and groundwater environment is significantly reduced. The measures employed will ensure that there is no adverse impact on the surface water or groundwater environment.

Proposed mitigation measures outlined in this Report will seek to reduce any impacts of the proposed MBT Facility development during the construction and operational phases on the wider environment. Given the mitigation measures proposed in this Chapter, it is considered that the impact on the water environment will be low/negligible and permanent.

7 CLIMATE

7.1 INTRODUCTION

This chapter assesses the impact on climate arising from the proposed Drehid MBT Facility located within the Bord na Móna landholding in the townlands of Coolcarrigan and Drummond, Carbury, Co. Kildare.

7.1.1 Methodology

All meteorological data contained in this Report has been received from Met Éireann. This information has been adjusted where necessary to take into account the proposed MBT Facility's location and elevation. All calculations detailed in the report are advised methods as described by Met Éireann.

7.1.2 Weather Observing Stations

Rainfall Stations

There are a number of rainfall measuring stations throughout the country. These stations measure the daily rainfall in millimetres (mm). A number of these stations also measure additional parameters such as soil moisture, temperature, humidity, etc.

Synoptic Stations

Synoptic stations are those, which observe and record all the 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 snapshot hourly observations of the weather known as synoptic observations and daily summaries of the weather known as climate observations. There are currently 14 synoptic stations located throughout Ireland.

7.2 EXISTING ENVIRONMENT

7.2.1 General Climate of Ireland

Over the summer months, the influence of anticyclonic weather conditions on the western and north western regions of Ireland results in dry continental air interspersed by the passage of Atlantic frontal systems. During much of the winter period the climate is characterised by the passage of Atlantic low pressure weather systems and associated frontal rain belts from the west. Occasionally the establishment of a high pressure area or anticyclone over Ireland results in calm conditions and during the winter months these are characterised by clear skies and the formation of low level temperature inversions with light wind conditions at night time. If anticyclonic conditions become established for a few days or more during the summer months, high temperatures during the day might be recorded, especially at inland locations. Long spells of dry weather are relatively rare but should continental air masses or anticyclones persist over Ireland a period of drought conditions may occur which could last up to two or three weeks.

7.2.2 Rainfall

In order to give reliable climatic data on a particular area a weather station should be located within 10km of the site and in operation for at least 30 years. A rainfall station is located at Lullymore (Bord na Móna) approximately 3.9m south west of the proposed MBT Facility. This station was in operation from 1945 to 1992 (47 years). Casement Aerodrome is the nearest synoptic station and it is located approximately 29km east of the proposed facility. This station began operating in 1944. Specifics of these stations relative to the proposed MBT Facility are outlined in Table 7.1.

Table 7-1 Designated Meteorological Stations for the proposed MBT Facility

Location	Grid Reference (Irish National Grid (ING))	Elevation (m O.D.)	Height Difference (m)
Proposed Drehid MBT Facility	274783, 230671 (ING)	83-86	-
Lullymore (Bord na Móna)	268402, 225010 (ING)	84	1
Casement Aerodrome	303285, 229044 (ING)	94	9

The elevation of the proposed MBT Facility ranges from approximately 83m-86m O.D. The elevation of the rainfall gauge at Lullymore (Bord na Móna) is approximately 84m O.D and the elevation of Casement Aerodrome is approximately 94m O.D.

According to Met Éireann, annual precipitation levels increase by 200 – 300mm per 100m elevations. The difference in height between the rainfall gauge at Lullymore and the proposed MBT Facility is relatively small and therefore no adjustment of precipitation levels is considered necessary. The average monthly and annual precipitation recorded at Lullymore is considered to be representative of the proposed MBT Facility location. Average monthly and annual precipitation levels are detailed in Table 7.2.

At the proposed facility, approximately 53% of the total annual rainfall is recorded during the winter period (October – March). This amount of precipitation (including snow) will normally be associated with more prolonged Atlantic frontal weather depressions passing over the region compared to the summer.

Table 7-2 Average Monthly & Annual Precipitation (1960-1990)

Location	Lullymore (Bord na Móna) Rainfall Station
Ht. m O.D.	84m
January	79mm
February	54mm
March	60mm
April	54mm
May	61mm
June	63mm
July	57mm
August	78mm
September	71mm
October	80mm
November	76mm
December	83mm
Annual	816mm

7.2.3 Evapotranspiration and Effective Rainfall

The nearest meteorological station with evapotranspiration measuring equipment is located at Casement Aerodrome. Evapotranspiration is the return of water vapour to the atmosphere by evaporation from land and by the transpiration of plants, generally measured from a short-grass covered surface (such as a permanent pasture) adequately supplied with water. Evaporation is the return of water vapour to the atmosphere by evaporation from a free water surface such as a pan of water, known as a 'Class A Pan', fitted with a depth measuring gauge. The potential evapotranspiration figures for the Casement Aerodrome are detailed in Table 7.3.

It can be noted that evapotranspiration is very low during winter months, when temperatures are lower than 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. Using the estimated rainfall data for the proposed facility and the potential evapotranspiration data for the nearest synoptic station i.e. Casement Aerodrome, the effective rainfall for the study area can be calculated. Refer to Table 7.3. Potential Evapotranspiration (PE) refers to the water flux under unlimited soil water conditions. Actual evapotranspiration is estimated as 95% of potential evapotranspiration to allow for seasonal soil moisture deficits.

Table 7-3 Effective Rainfall for the proposed MBT Facility

Month	Rainfall (mm)	Potential Evapotranspiration (PE) (mm)	Actual Evapotranspiration (mm)	Effective Rainfall (mm)
			(PE x 0.95)	
January	79	7.2	6.8	72.2
February	54	18.1	17.2	36.8
March	60	35	33.3	26.8
April	54	53.9	51.2	2.8
May	61	75.7	71.9	-10.9
June	63	87	82.7	-19.7
July	57	85.5	81.2	-24.2
August	78	68.4	65.0	13.0
September	71	45.9	43.6	27.4
October	80	22.3	21.2	58.8
November	76	7.5	7.1	68.9
December	83	3.7	3.5	79.5
Total	816	510.2	484.7	331.31

Any rain falling on the site will infiltrate to the ground, through the peat and underlying subsoil, evaporate from the surface or become surface water runoff. The surface water runoff drainage system is discussed in more detail in Chapter 6 of this EIS.

7.2.4 Wind

The closest synoptic station with the capability of measuring wind and that has been in operation for at least 30 years is Casement Aerodrome. This station is located approximately 29km east of the proposed facility and is located at an elevation of approximately 94m O.D.

The wind rose for Casement Aerodrome shows that the prevailing winds are from the south west. Refer to Appendix 7.1 'Casement Aerodrome Wind Rose Diagram' for further details. The mean wind speed at Casement Aerodrome is 11.1 knots (5.7m/s). The elevation of the meteorological anemometer is approximately 94m O.D. The mean monthly wind speed from 1968-1996 (available 30 year average report) at Casement Aerodrome was 11 knots (5.6m/s), while the maximum gust reached 81 knots (41.6m/s). The mean number of days with gales during these years was 20.1 days. These wind speeds are likely to be indicative of those at the proposed MBT facility.

7.3 POTENTIAL IMPACTS

7.3.1 Potential Impacts of Configuration A (MBT with Composting)

During the construction phase of the proposed development, the potential impacts on climate will be those associated with dust and exhaust emissions from construction traffic. These impacts will be of temporary duration and their impacts are not considered to be significant.

The proposed MBT Facility will divert waste from landfill, thus contributing to the fulfilment of Ireland's target under the Landfill Directive (1993/31/EC) and the Kyoto Protocol.

7.3.2 Potential Impacts of Configuration B (MBT with Dry Anaerobic Digestion and Composting)

During the construction phase of the proposed development, the potential impacts on climate will be those associated with dust and exhaust emissions from construction traffic. These impacts will be of temporary duration and their impacts are not considered to be significant.

The proposed MBT Facility will divert waste from landfill, thus contributing to the fulfilment of Ireland's target under the Landfill Directive (1993/31/EC) and the Kyoto Protocol.

During the operational phase of the proposed development, the potential impacts on climate are likely to arise from emissions from mobile plant e.g. loading shovels, mechanical grabs etc, the CHP plants and from the standby gas flare (when in use).

Dry anaerobic digestion generates biogas from biodegradable waste. The biogas produced is used to produce renewable electricity and heat. The generation of renewable electricity from biogas results in no net increase in greenhouse gas emissions. Given that the production of renewable electricity displaces the production of electricity from fossil fuels, the dry anaerobic digestion step in Configuration B (MBT with Dry Anaerobic Digestion and Composting) will reduce overall carbon dioxide emissions to the atmosphere and the potential impacts of climate change.

The proposed development will assist Ireland in meeting its commitments under the EU Directive 2001/77/EC on electricity from renewable sources. Furthermore, the Solid Recovered Fuel (SRF) produced by the MBT process will displace the use of fossil fuels in cement kilns.

Methane is a harmful greenhouse gas if it escapes to atmosphere. By virtue of the biological process in the proposed MBT Facility, biodegradable municipal waste will be biostabilised thereby eliminating its potential to generate methane (a harmful greenhouse gas) and leachate, thus contributing to the fulfilment of Ireland's targets under the Landfill Directive (1999/31/EC).

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7.4 MITIGATION MEASURES

7.4.1 *Mitigation Measures for Configuration A (MBT with Composting)*

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.

The proposed MBT Facility will include a building ventilation system and an odour abatement system.

The function of the building ventilation system will be to provide a number of air changes per hour and to maintain a negative air pressure environment within each building. The maintaining of a negative pressure environment within each building will prevent the emission of untreated air to atmosphere.

Air extracted by the building ventilation system and the process air exhausted by the biological treatment process will be treated in an odour abatement system before being vented to atmosphere. The core components of the odour abatement system will include acid scrubbers, humidifiers and biofilters.

7.4.2 *Mitigation Measures for Configuration B (MBT with Dry Anaerobic Digestion and Composting)*

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.

The proposed MBT Facility will include a building ventilation system and an odour abatement system.

The function of the building ventilation system will be to provide a number of air changes per hour and to maintain a negative air pressure environment within each building. The maintaining of a negative pressure environment within each building will prevent the emission of untreated air to atmosphere.

Air extracted by the building ventilation system and the process air exhausted by the biological treatment process will be treated in an odour abatement system before being vented to atmosphere. The core components of the odour abatement system will include acid scrubbers, humidifiers and biofilters.

The dry anaerobic digestion will generate biogas which is considered a carbon neutral fuel, thereby resulting in the production of carbon neutral electricity (i.e. where there is no net increase in greenhouse gas emissions). Emissions from the CHP plants' stack will be maintained below emission limit values imposed by the EPA in the form of a waste licence for the proposed MBT Facility. Monitoring of emissions will be in accordance with the conditions of an EPA waste licence. A standby gas flare will be provided to facilitate the thermal destruction of the biogas in the event of unavailability of the CHP plants and insufficient volume in the biogas storage units.

Further details on potential air emissions and proposed mitigation measures are included in Chapter 8, Air Quality.

7.5 CONCLUSION

Configuration A (MBT with Composting)

The proposed MBT Facility will result in a number of environmental benefits including the lowering of greenhouse gas emissions by the diversion of waste from landfill and by the stabilisation of biodegradable municipal waste prior to landfilling. The proposed development will assist Ireland in meeting its commitments under the Landfill Directive (1999/31/EC) and the Kyoto protocol.

Configuration B (MBT with Dry Anaerobic Digestion and Composting)

The proposed MBT Facility will result in a number of environmental benefits including the lowering of greenhouse gas emissions by the diversion of waste from landfill and by the stabilisation of biodegradable municipal waste prior to landfilling.

The proposed development will assist Ireland in meeting its commitments under the Landfill Directive (1999/31/EC), the Kyoto protocol and the EU Directive 2001/77/EC on electricity from renewable sources.

8 AIR

8.1 AIR QUALITY, ODOUR & BIOAEROSOLS

8.1.1 INTRODUCTION

AWN Consulting Ltd. has been commissioned to carry out an air quality impact assessment including an air dispersion modelling study of air, odour and bioaerosol emissions from the proposed Drehid MBT Facility at the townlands of Coolcarrigan and Drummond, Carbury, Co. Kildare based on the design details. The facility is designed to process municipal solid waste with an overall capacity of 250,000 tonnes per annum.

The purpose of this assessment is to determine whether the air, odour and bioaerosol 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)*"(1).

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;
- Summary of background NO_2 & $PM_{10}/PM_{2.5}$ levels;
- Dispersion modelling of released substances (including odour and bioaerosols) under worst-case emission scenarios;
- Presentation of predicted ground level concentrations of released substances; and
- 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 limit values and guideline values.

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 8.4. The model formulation is detailed in Appendix 8.1 and a review of the meteorological data used is detailed in Appendix 8.2.

8.1.1.1 Methodology

Emissions from the proposed facility have been modelled using the AERMOD dispersion model (Version 11353) which has been developed by the U.S. Environmental Protection Agency (USEPA)(2) and following guidance issued by the EPA(1). The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources and has replaced ISCST3(3) as the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain(4-6). The model has more advanced algorithms and gives better agreement with monitoring data in extensive validation studies(7-11). An overview of the AERMOD dispersion model is outlined in Appendix 8.1.

The air 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 a full year of appropriate meteorological data. Using this input data the model predicted ambient ground level concentrations beyond the site boundary for each hour of the modelled meteorological year. The model post-processed the data to identify the location and maximum of the worst-case ground level concentration. This worst-case concentration was then added to the background concentration to give the worst-case predicted environmental concentration (PEC). The PEC was then compared with the relevant ambient air quality standard to assess the significance of the releases from the site.

Throughout this study a worst-case approach was taken. This will most likely lead to an over-estimation of the levels that will arise in practice. The worst-case assumptions are outlined below:

- Continuous operation of all emission points assumed for 24 hours per day, 365 days per year;
- The maximum predicted ground level air pollutant concentrations for NO_2 and PM_{10} were reported in this study, based on a dense network of receptor girds. These receptors included areas where no residential receptors where present and thus may overestimate the impact at the nearest residential receptors;
- Worst-case background concentrations were used to assess the baseline levels of substances released from the site. The background concentration includes the contribution from existing traffic and additional traffic under scenario 1 (landfill operational and accepting 120,000 tonnes) and scenario 2 (landfill non-operational). The worst-case traffic accessing the site will peak at 164 HGVs and 267 LVs movements per day under Scenario 2 and will contribute an additional 0.5 □g/m^3 to the NO_2 levels and 0.1 □g/m^3 to the PM_{10} levels. In order to account for the additional NO_2 and PM_{10} levels, the contribution from traffic was added to the background NO_2 and PM_{10} levels respectively. This combined background and traffic-derived NO_2 or PM_{10} concentration was then used as the baseline level to which the contribution from the process emissions was added in order to obtain the overall predicted environmental concentration (PEC); and
- The effect of building downwash, due to buildings, has been included in the model.

In relation to odour and bioaerosols, the nearest residential receptors to the Drehid MBT Facility site were specifically mapped into the model and the worst-case ambient odour and bioaerosol concentrations at these specific receptors are reported in this chapter (as highlighted in Figure 8.1).

Characteristics of Odour

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(12). 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 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.

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(12).

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.

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.

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.

Odour Abatement Techniques

Odour abatement options start with process management to limit the production of odour at source. Residual emissions to the atmosphere from industrial processes have traditionally been controlled by end-of-pipe abatement equipment and dispersion of the pollutants using a stack of suitable height. 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%(13). As well as reducing the odour emissions from a facility, bio-filtration also help 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, It is envisaged that the biofiltration material proposed for the current facility will either consist of woodchip or one of two proprietary products (Monafil and 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.

Odour Standards & 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)(14). Clarkson and Misslebrook(15) proposed that a "faint odour" was an acceptable threshold criteria for the assessment of odour as a nuisance. Historically, it has been generally accepted that odour concentrations of between 5 and 10 ou/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(16). However, this criteria has generally been based on waste water treatment plants 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(16).

The odour which will be generated within the MBT Facility may consist of untreated municipal waste (from deliveries and mechanical treatment), composting and anaerobic digestion odours (from the biological treatment areas) and biofilter odour (from the biofilters). However, as the waste reception area, Mechanical Treatment Building, Biological Treatment Buildings, SRF Building, Maturation Buildings and Refining Building will all be under negative pressure, with ducted air directed to six biofilters, untreated odours are unlikely to be significant. 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(17, 18). 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(17).

DEFRA(19,20) in the UK has published detailed guidance on appropriate odourthreshold levels based in part on the offensiveness of the odour. As shown in Table 8.1, a MBT Facility 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 plants.

DEFRA has also detailed installation-specific exposure criteria based on the "annoyance potential"(19) 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 8.2). 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 an MBT Facility with biofilter treatment (with the use of acid scrubbers for certain air streams) is not included, but, given that the biofilter odour is similar to an earthly / soil-like odour and thus of a medium offensiveness, it may be assumed to be 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.

Table 8-1 Ranking Table For Various Industrial Sources(19)

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 8-2 Indicative Odour Standards Based On Offensiveness Of Odour(19)

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

Air Quality Standards for NO_2 & $PM_{10}/PM_{2.5}$

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. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Council Directive 2008/50/EC (published 11/06/08) (see Table 8.3). The ambient air quality standards applicable for NO_2 and PM_{10}/$PM_{2.5}$ are outlined in this Directive.

These standards have been used in the current assessment to determine the potential impact of NO_2 and PM_{10}/$PM_{2.5}$ emissions from the proposed facility on air quality.

Table 8-3 EU Ambient Air Quality Standards (Based on Directive 2008/50/EC (SI 180 of 2011)

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
		Annual limit for protection of vegetation	None	30 µg/m^3 NO + NO_2
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/m^3 PM_{10}
		Annual limit for protection of human health	20%	40 µg/m^3 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/m^3 $PM_{2.5}$
$PM_{2.5}$ (Stage 2)	-	Annual limit for protection of human health	None	20 µg/m^3 $PM_{2.5}$

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

Air Dispersion Modelling Methodology

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

The model 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 Drehid MBT Facility site at the centre. An outer grid extended to 10 km from the site with concentrations calculated at 500 m intervals. A smaller grid extended to 4000 km from the site with concentrations calculated at 100 m intervals. Boundary receptor locations were also placed along the boundary of the site, at 50 m intervals, giving a total of 6638 calculation points for the model.

- 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.

- Hourly-sequenced meteorological information has been used in the model. The meteorological data over a five year period (Casement Aerodrome, 2006 - 2010) was selected for use in the model (see Figure 8.2).

- AERMOD incorporates a meteorological pre-processor AERMET PRO(21). 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 10km from the meteorological station for Bowen Ratio and albedo and to a distance of 1km for surface roughness in line with USEPA recommendations(21).

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

- Terrain has not been mapped into the model as the area is predominantly flat.

Process With Odour Potential from Drehid MBT Facility – Configuration A (MBT with Composting)

Waste Acceptance

Waste delivery vehicles accessing the mechanical treatment building will reverse to the waste receiving doors and discharge waste down into the waste reception bunker. The doors at the waste reception area will be rapid closing doors, with an opening or closing time of approximately 20 seconds. Additionally, doors for the acceptance of waste will be fitted with air curtains to minimise the escape of odorous emissions when a door is open. Based on 3 air changes per hour, a total air volume of 70,125 m^3/hr will be extracted from this area to avoid odour build-up and to ensure a satisfactory working environment. This extracted air, following integration with extracted air from other facility buildings, will ultimately be sent to one of the odour abatement systems for treatment prior to discharge to atmosphere.

Mechanical Treatment Building

The organic fines fraction of the waste stream will contain the majority of the organic items such as food waste and garden waste and thus will be the principal source of odour at the mechanical stage of the process.

Based on 2 air changes per hour, a total air volume of 133,835 m^3/hr will be extracted from the mechanical treatment building to ensure a satisfactory negative pressure, to avoid odour build-up and to ensure a satisfactory working environment. This extracted air, following integration with extracted air from other facility buildings, will ultimately be sent to one of the odour abatement systems for treatment prior to discharge to atmosphere.

Biological Processing Of Waste

The organic fines will reside in the composting tunnels for a period of four weeks. Each tunnel will have an aeration fan which will blow a mixture of fresh air and process air through an air plenum and into the PVC pipes embedded in the floor of the composting tunnel. Pressurised air will flow through the composting material to ensure intensive contact between the air and the composting material thus maintaining aerobic conditions.

The process air from the composting tunnels will flow through a humidifier, chemical acid scrubber (in order to control the ammonia level in the emissions) and a biofilter before being vented to atmosphere. The composting tunnels will be maintained under negative pressure throughout the process in order to prevent odorous air from being released inside the buildings.

Negative pressure will also be created in all of the facility buildings to force odorous air to the odour abatement system thereby preventing uncontrolled emissions from the MBT Facility. Based on 3 air changes per hour, a total air volume of 142,007 m^3/hr will be extracted from the aerobic composting building to ensure a satisfactory negative pressure, to avoid odour build-up and to ensure a satisfactory working environment. This extracted air, following integration with extracted air from other facility buildings, will ultimately be sent to one of the odour abatement systems for treatment prior to discharge to atmosphere.

The material discharged from the composting process will be conveyed to the maturation building for a period of five weeks. The floor of the maturation bays will have aeration pipe work which will be operated as a negative pressure system thereby minimising the generation of odorous compounds within the maturation building. Based on 3 air changes per hour, a total air volume of 144,720 m^3/hr will be extracted from the maturation building to ensure a satisfactory negative pressure, to avoid odour build-up and to ensure a satisfactory working environment. This extracted air, following integration with extracted air from other facility buildings, will ultimately be sent to one of the odour abatement systems for treatment prior to discharge to atmosphere.

Process With Odour Potential from Bord na Móna Drehid MBT Facility – Configuration B (MBT with Dry Anaerobic Digestion and Composting)

Waste Acceptance

Waste acceptance will be as outlined above for Configuration A (MBT with Composting). Based on 3 air changes per hour, a total air volume of 70,125 m^3/hr will be extracted from this area to ensure a satisfactory negative pressure, to avoid odour build-up and to ensure a satisfactory working environment. This extracted air, following integration with extracted air from other facility buildings, will ultimately be sent to one of the odour abatement systems for treatment prior to discharge to atmosphere.

Mechanical Treatment Building

The mechanical process will be as outlined in Configuration A (MBT with Composting) above with all operations taking place within the mechanical treatment building. Based on 2 air changes per hour, a total air volume of 133,835 m^3/hr will be extracted from the mechanical treatment building to ensure a satisfactory negative pressure, to avoid odour build-up and to ensure a satisfactory working environment. This extracted air, following integration with extracted air from other facility buildings, will ultimately be sent to one of the odour abatement systems for treatment prior to discharge to atmosphere.

Biological Processing Of Waste

Dry Anaerobic Digestion Process

Part of the organic fines fraction (approximately 50,000 tpa) will be processed in the dry anaerobic digestion (AD) tunnels, while the remainder of the organic fines fraction will be processed in the composting tunnels along with the digestate from the dry anaerobic digestion process.

The AD process, which occurs in the absence of oxygen, breaks down the organic matter into primarily methane and carbon dioxide. Each dry AD tunnel will consist of a sealed concrete structure equipped with a loading / unloading insulated door provided with a pressurised rubber seal. A slightly positive pressure will be maintained throughout the process in order to prevent air entering the tunnels during the anaerobic phases.

Biogas produced in the dry anaerobic digestion process will be processed (gas cleaning, removal of contaminants and moisture) before it is combusted in the CHP plants. It is envisaged that two CHP plants will be provided to process the biogas thereby producing renewable electricity and heat.

At the end of the process, when the biogas production lowers, the fresh air valve will open and the medium pressure blower will start to purge the tunnel of biogas. When the biogas concentration drops below a certain level, the biogas valve will close and the exhaust air valve will open. This exhaust air, still mixed with traces of biogas, will be diluted with air coming from the MBT buildings such that the exhaust air is below the lower explosion level. The exhaust stream will then be transferred to the biofilter.

The residence time in the dry AD tunnels is expected to be four weeks.

Composting Process

The mixture of digestate and fresh organic fines will reside in the composting tunnels for a period of four weeks. The composting process will be as outlined in Configuration A (MBT with Composting) above.

Negative pressure will also be created in all of the facility buildings to force odorous air to the odour abatement system thereby preventing uncontrolled emissions from the MBT Facility. Based on 3 air changes per hour, a total air volume of 148,044 m^3/hr will be extracted from the anaerobic digestion building and the aerobic composting building to ensure a satisfactory negative pressure, to avoid odour build-up and to ensure a satisfactory working environment. This extracted air, following integration with extracted air from other facility buildings, will ultimately be sent to one of the odour abatement systems for treatment prior to discharge to atmosphere.

The material discharged from the composting process will be conveyed to the maturation building for a period of four weeks. The floor of the maturation bays will have aeration pipe work which will be operated as a negative pressure system thereby minimising the generation of odorous compounds within the maturation building. Based on 3 air changes per hour, a total air volume of 111,132 m^3/hr will be extracted from the maturation building to ensure a satisfactory negative pressure, to avoid odour build-up and to ensure a satisfactory working environment. This extracted air, following integration with extracted air from other facility buildings, will ultimately be sent to one of the odour abatement systems for treatment prior to discharge to atmosphere.

Literature Review Of Odour Emission Rates From MBT Facilities

A significant amount of data is available in the literature in relation to odour emission rates from either MBT facilities or from individual processes within an MBT Facility (i.e. mechanical treatment, composting, anaerobic digestion).

In relation to full MBT assessments, one of the most extensive assessments was undertaken by Sironi et al (2006)(22). The assessment was based on the results of odour measurements conducted over the period 2000 – 2005 at 40 waste MBT facilities in Italy treating either non-segregated organic fraction of MSW or segregated organic material and using composting but not anaerobic digestion. The capacity of the plants monitored ranged from 10,000 – 240,000 tonnes with an average capacity of 60,000 tonnes. Around 50 air samples were taken at each plant giving a total of 2,000 individual samples. The measurements were carried out in different seasons and differing weather conditions. The emission rates determined from the facilities were normalised to the tonnage of waste processed and were presented upstream of any abatement systems. Table 8.4 outlines the average odour concentrations, median and % deviation (which gives an indication of the scatter in the data):

Table 8-4 Average Odour Concentration Values, Median And Percent Deviation(22)

Waste Process	Geometric Mean (OU$_E$/m^3)	Median (OU$_E$/m^3)	% Deviation
Waste Receiving	2,786	3,000	11.8
Aerobic Biological Treatment	10,079	11,000	8.9
Maturation	1,701	3,899	24.1
Overscreen Storage	490	836	29.1
Final Product Storage	414	529	20.5
All Process Steps	7,903	8,234	7.8

The paper used the concentration and throughput to calculate the odour emission factors (OEF) in terms of odour units per tonnage as shown in Table 8-5.

Table 8-5 Average Odour Emission Factors, Median And Percent Deviation(22)

Waste Process	Geometric Mean OEF (10^6 OU$_E$/tonne)	Median of OEF (10^6 OU$_E$/tonne)	% Deviation
Waste Receiving	12.553	11.051	5.0
Aerobic Biological Treatment	139.948	127.042	6.1
Maturation	39.943	29.946	7.4
Overscreen Storage	2.424	3.196	12.0
Final Product Storage	7.536	9.247	8.3
All Process Steps	100.673	123.460	6.5

The overall OER (odour emission rate) in units of odour units per sec (OU$_E$/s) is calculated by the following formula:

$$OER_{TOT} = C\,(OEF_{rec} + OEF_{bio} + OEF_{mat} + OEF_{fp} + OEF_{os})$$

Where:
C = plant capacity (in this case 250,000 tonnes for Configuration A (MBT with Composting))
rec = waste receiving
bio = aerobic biological treatment
mat = maturation
fp = final product storage
os = overscreen storage

The study found that for a 50,000 tonne facility, a representative odour emission rate would be 3.2E+5 OU$_E$/s prior to any abatement. The study compared their results to that of an earlier study (Bidlingmaier (1996)) which found an odour emission rate from composting facilities of about 1E+5 OU$_E$/s (which was independent of plant size).

Many studies are available on specific composting or anaerobic facilities. Fischer et al (2008)(23) and its sister paper Albrecht et al (2008)(24) undertook a 3 year study at 9 composting facilities in Germany. The facilities ranged from open pile and open storage, enclosed tunnels and open storage to enclosed tunnels, biofilters and enclosed storage. The inputs in all cases were predominately domestic waste with tonnage ranging from 6,000 – 60,000 tonnes/annum. Although the actual results were not reported in detail, a summary of the results were outlined in Figure 4 of the publication which is reproduced below:

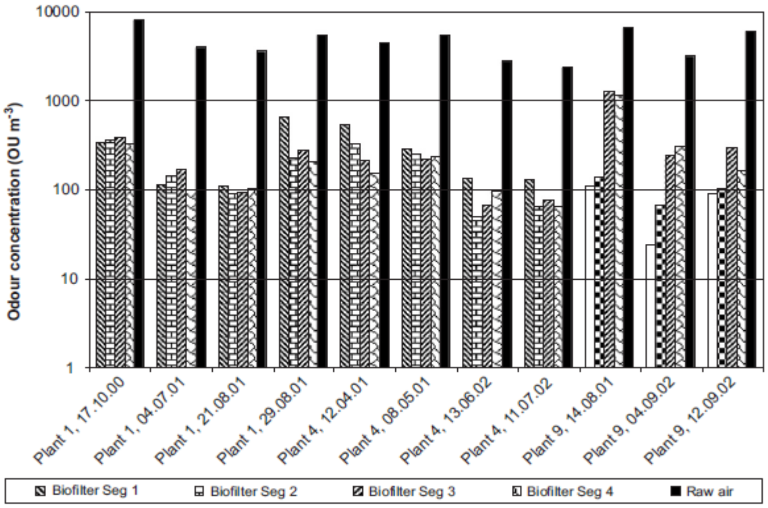

Fig. 4. Odour concentrations in raw and cleaned air in the facilities 1, 4, and 9. The two columns on the left represent data assessed at compost piles and sieving sites of facility 9.

Taken from Fischer et al (2008[23]*) "Analysis of airborne microorganisms, MVOC and odour in the surroundings of composting facilities and implications for future investigations".*

Plant Nos. 1 and 9 are most relevant as they are both enclosed, use biofilters and have enclosed storage with capacities of 40,000 tonnes/annum each. Results indicate that prior to abatement odour concentrations ranged from approximately 5,000 – 9,000 OU_E/m^3. The data also presents information on the efficiency of the abatement system with efficiencies of between 90 – 95% routinely achieved(23,24).

A study by Scaglia et al (2011)(25) of an MBT Facility in northern Italy focused on the composting process and the change in odour concentration during the 90 days of aerobic composting and maturation. The results of the study are outlined in Table 8.6:

Table 8-6 Average Odour Concentrations As A Function Of Processing Days (Taken from Scaglia et al)(25)

Samples	Processing Days (Days)	Odour Concentration (OU_E/m^3)
S_a	0	32,944
S_b	0	24,147
Mean		28,546 ± 6,220
I_a	28	5,838
I_b	28	3,966
Mean		4,902 ± 1,324
E_a	90	3,070
E_b	90	2,067
Mean		2,569 ± 709

Biasioli et al (2004)(26) investigated odours from three composting facilities processing MSW in northern Italy. Results ranged from 24,000 OU_E/m^3 for just prepared windrow of MSW / dead branches (60:40), starting composting pile (100% MSW) which was 5,700 OU_E/m^3 and maturing windrow (55 days) which was 1,300 OU_E/m^3. A second site measured odour concentrations at the exit of the biofilter. The study found values over six samples ranging from 780 – 4,200 OU_E/m^3 with a geometric mean value of 1,759 OU_E/m^3.

At the ECN/ORBIT e.V. Odour Management Workshop (2003) Bockreis(27) reported on an earlier paper by Pohle et al (1993) which reported three stages in composting odours. Firstly, acid starting phase with an odour concentration in the range 6,000 – 25,000 OU_E/m^3, secondly, the thermophile phase with an odour concentration in the range 1,000 – 9,000 OU_E/m^3 and finally the cooling phase with an odour concentration in the range 150 – 3,000 OU_E/m^3.

The data on MBT facilities has tended to focus on aerobic processes (composting) and the data in regards to anaerobic digestion (AD) odour emissions from MBT is more limited. A study by Orzi et al (2010)(28) investigated the odour emissions from a large scale AD plant processing 30,000 tonnes of kitchen waste per annum. The AD had a hydraulic retention time (HRT) of 40 days followed by post-digestion where the material remained for around 10 days. The result of the study is shown in Table 8.7.

Table 8-7 Average Odour Concentrations As A Function Of Processing Days (Taken from Orzi et al (except final row))(28)

Samples	**Processing Days (Days)**	**Odour Emission Rate (OU_E/m^2h)**	**Odour Concentration (OU_E/m^3)**
ND1	0	119,446	66,890
ND2	0	76,017	42,570
ND3	0	36,243	20,296
Mean ND		77,235 ± 41,614	43,252 ± 23,304
D1	40	5,458	3,056
D2	40	17,550	9,828
D3	40	29,331	16,425
Mean D		17,446 ± 11,936	9,770 ± 6,684
PD1	50	13,314	7,456
PD2	50	40,213	22,519
PD3	50	23,087	12,929
Mean PD		25,538 ± 13,615	14,301 ± 7624
Overall mean		**40,079**	**22,444**

(ND = non-digested, D = digested, PD = post-digested)

The results indicate a significant decrease between the non-digested and both digested and post-digested stage. The difference between the digested and post-digested stage is statistically not significant.

Data on the effectiveness of biofilters has been published in many publications. Strecker (2003)(29) reviewed the effectiveness of biofilters from composting facilities. From a review of 150 individual measurements undertaken mainly by TÜV, the following conclusions could be drawn:

- Approx. 10% of values > 1,000 OU_E/m^3
- Approx. 13% of values between 600 – 1,000 OU_E/m^3
- Approx. 77% of values between 50 - 500 OU_E/m^3

Data from the UK DEFRA publication "Good Practice and Regulatory Guidance on Composting and Odour Control for Local Authorities" (DEFRA, 2009)(30) is available on an operational MBT Facility processing 65,000 tonnes of household waste per year. The odour control system is a woodchip biofilter providing 45 second residence time. Typical odour concentrations leaving the MBT process range from 9,000 – 12,000 OU_E/m^3. Compliance testing at the site has confirmed that residual odour concentrations leaving the biofilter range from 133 – 300 OU_E/m^3 (efficiency of between 97 – 99%).

A report undertaken by SEPA / SNIFFER in 2007 entitled "Measurement andModelling of Emissions from Three Composting Sites" (SEPA/SNIFFER, 2007)(31) measured odour emission concentrations from 3 sites one of which was a MSW in-vessel system. The results from the two measurement surveys were 4,700 and 9,376 OU_E/m^3 which were the geometric mean of triplicate sampling.

Literature Review Of Bioaerosol Emission Rates From MBT Facilities

Bioaerosols is a general term for micro-organisms (including fungi and bacteria as well as components such as mycotoxins, endotoxins and glucans) suspended in the air(32). They are generally less than 10 µm and can penetrate the human respiratory system, resulting in inflammatory and allergic responses.

The UK Environment Agency has issued a Position Statement (Number 31) on composting and the potential health effects from bioaerosols(33). The Position Statement indicates that a site-specific bioaerosol risk assessment is required if there is a workplace or dwelling within 250m of a composting facility. The Environment Agency has outlined appropriate levels for bioaerosols which should not be exceeded at the sensitive receptors. The appropriate levels are:

i) bioaerosol levels no greater than:
   - 1,000 colony forming units (cfu) / m^3 total bacteria,
   - 300 cfu/m^3 gram-negative bacteria and
   - 500 cfu/m^3 aspergillus fumigatus.(33)

As no formal guidance is available in Ireland, the UK Environment Agency appropriate levels for composting have been adopted for the current assessment.

<u>Bioaerosol Emission Rates</u>

Data on emission rates of bioaerosols tend to vary significantly in the literature. Data from the Environment Agency publication "Guidance on the Evaluation of Bioaerosol Risk Assessments for Composting Facilities" (2009)(32) indicates a wide range in bioaerosol (fungi, aspergillus fumigatus, bacteria) concentrations from a range of different sources as outlined in Table 8.8.

Table 8-8 Bioaerosol Concentrations From A Range Of Different Sources (EA (2009))(32)

Bioaerosol	Source	Quantity	Reference
Fungi (cfu/m^3)	Indoors (UK homes)	28 - >35,000	Swan et al., 2003
	Grain harvesting	10^5-10^7	Swan et al., 2003
	Cattle sheds	10^4-10^5	Swan et al., 2003
	Horse stables	10^3-10^4	Swan et al., 2003
	Pig houses	10^4-10^5	Swan et al., 2003
	Poultry houses	10^3	Swan et al., 2003
	Textile mills	10^5	Swan et al., 2003
	Paper mills	10^2	Swan et al., 2003
	Waste collection	10^4-10^5	Nielsen et al., 1997
	Composting facility	10^3 - 10^4	Wheeler et al., 2001
Aspergillus fumigatus (cfu/m^3)	Outdoor air	0-690	Millner et al., 1994
	Garden waste collection	10^4	Nielsen et al., 1997
	Composting facility	10^6	Clark et al., 1983
	Composting turning activity	10 – 16 × 10^6	Taha et al., 2005
	50m from composting facility	200-1000	Kothary et al., 1984
	250m from composting facility	50	Kothary et al., 1984
Bacteria (cfu/m^3)	Grain harvesting	10^7-10^8	Swan et al., 2003
	Cattle sheds	10^3-10^5	Swan et al., 2003
	Horse stables	10^5	Swan et al., 2003
	Pig houses	10^4-10^6	Swan et al., 2003
	Poultry houses	10^5	Swan et al., 2003
	Textile mills	10^5	Swan et al., 2003
	Paper mills	10^4-10^6	Swan et al., 2003
	Waste collection	10^3-10^4	Nielsen et al., 1997
	Composting facility	10^5 - 10^6	Wheeler et al., 2001
	200m from composting facility	0-1	Gilbert et al., 2002

Another review by Prasad et al (2004)(34) for the Composting Association of Ireland reviewed literature studies on a range of bioaerosols including aspergillus fumigatus and total bacteria. In relation to aspergillus fumigatus, levels ranged mainly from 10^2 to 10^3 cfu/m^3. Highest concentrations were recorded whenever the compost piles were disturbed. The total bacteria concentrations varied from 10^2 to 10^5 cfu/m^3 with most levels around 10^2 cfu/m^3. Again, levels increased as disturbance (turning, shredding) increased.

Taha et al (2006)(35) reported on earlier studies which found static levels of 10^3 cfu/m^3 of aspergillus fumigatus rising to as much as 10^4 – 10^7 cfu/m^3 of airborne fungi and bacteria during agitation. The study found that the bioaerosol emission rate and dispersal was influenced by a number of factors including (i) the material being composted; (ii) the on-site processes involved; (iii) the associated vehicle movements; (iv) the process equipment used;

(v) individual bioaerosol properties; and (vi) the geographical, topographical and meteorological conditions on- and off-site(35). The study found levels of 19 and 29 x 10^3 cfu/m^3 of aspergillus fumigatus from static compost windrows which was similar to reported background levels of aspergillus fumigatus of 10^3 cfu/m^3 (Wheeler et al, 2001) and 42 – 116 (mean 79) x 10^3 cfu/m^3 (Swan et al, 2002). In contrast, emission of aspergillus fumigatus during turning operations was a factor of 3-log higher (of the order of 10^7 cfu/m^3).

A follow-up study by Taha et al (2007)(36) found levels ranging from 10^3 - 10^4 cfu/m^3 of aspergillus fumigatus for static windrows of different ages. The results revealed that the age of the compost had little effect on the bioaerosol concentration from passive windrows. For various agitation activities (turning, shredding) levels ranged generally from 10^4 – 10^5 cfu/m^3 of aspergillus fumigatus for windrows of different ages. Results also showed that emissions from turning compost during the early stages may be higher than during the later stages.

A report undertaken by SEPA / SNIFFER in 2007 entitled "Measurement and Modelling of Emissions from Three Composting Sites" (SEPA / SNIFFER, 2007)(31) measured bioaerosol emission concentrations from 3 sites one of which was a MSW in-vessel system. The results from the three seasonal measurement surveys ranged from 1.3 – 17 x 10^3 cfu/m^3 from the vessels with much lower levels downwind of the source.

Fischer et al (2008)(23) and its sister paper Albrecht et al (2008)(24) undertook a 3 year study at 9 composting facilities in Germany. The facilities ranged from open pile and open storage, enclosed tunnels and open storage to enclosed, biofilters and enclosed storage. The input in all cases was predominately domestic waste with tonnage ranging from 6,000 – 60,000 tonnes/annum. Although the actual results were not reported in detail, the concentrations ranged from 10^2 to 10^5 cfu/m^3 with the lowest values found on the biofilters and the highest values during the turning of the compost.

Kummer et al (2008)(37) investigated the various control measures for the release of bioaerosols from waste facilities. The study reported that semi-permeable membranes can reduce bioaerosol emissions by between 83 - >99% compared to open windrow composting. In relation to biofilters, the study reported that although it was difficult to make a general statement on removal efficiencies, data from Schilling (2003) revealed a removal efficiency for aspergillus fumigatus of up to two orders of magnitude (99% removal) from a range of waste management facilities.

Sanchez-Monedero et al (2003)(38) reported on the effectiveness of bioaerosol control at composting facilities. In relation to aspergillus fumigatus, biofiltration was found to have an average reduction of greater than 90% (geometric mean of 97%). After passing through the biofilter, levels ranged from less than 10^2 to 1.2 x 10^3 cfu/m^3 regardless of the inlet concentration which were of the same magnitude as background concentrations. In relation to mesophilic bacteria, levels prior to the biofilter ranged from 10^3 to 2.2 x 10^5 cfu/m^3. Biofiltration was found to have an average reduction of 73% (as a geometric mean) although the range was broad (39% - 94%). The study found that a major reason for the difference in efficiency between the aspergillus fumigatus and bacteria was the bioaerosol particle size. As aspergillus fumigatus is larger (maximum of diameter size distribution between 2.1 – 3.3 μm compared to 1.1 – 2.1 μm for bacteria), these larger particles will preferentially impact with the bed medium rather than remaining in the gas flow thus increasing removal efficiency.

It is envisaged that the biofiltration material proposed for the current facility will either consist of woodchip or one of two commercial products (Monafil and Monashell). Monafil is a manufactured granular high-density peat media with a media life of up to 10 years. The product brochure quotes an odour efficiency of typically between 95 – 98% up to a range of 100,000 OU_E/m^3. Monashell is a manufactured shell-based media. The product brochure quotes 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.

8.1.2 EXISTING ENVIRONMENT

Meteorological Data

The selection of the appropriate meteorological data has followed the guidance issued by the USEPA(4) and EPA(1). A primary requirement is that the data used should have a data capture of greater than 90% for all parameters. Casement Aerodrome meteorological station, which is located approximately 30 km east of the site, collects data in the correct format and has a data collection of greater than 90%.

Long-term hourly observations at Casement Aerodrome meteorological station provide an indication of the prevailing wind conditions for the region (see Figure 8.2 for the wind profiles for 2006 - 2010). Results indicate that the prevailing wind direction is from south to westerly in direction. The mean wind speed is approximately 5.6 m/s over the period 1968-1996.

Baseline Air Quality

A baseline monitoring study was carried out close to the Drehid MBT Facility as shown in Figure 8.1. The results of the survey allow an indicative comparison with the annual limit values for NO_2. The results also provide information on the influence of road sources relative to the prevailing background level of these pollutants in the area. The monitoring methodology and results are described below.

Nitrogen Dioxide (NO_2)

NO_2 was monitored, using nitrogen dioxide passive diffusion tubes, over a one month period at four locations. The monitoring locations were sited close to the Drehid MBT Facility (see Table 8.9 and Figure 8.1). Passive sampling of NO_2 involves the molecular diffusion of NO_2 molecules through a polycarbonate tube and their subsequent adsorption onto a stainless steel gauze coated with triethanolamine. Following sampling, the tubes were analysed using Gas Chromatography, at a UKAS accredited laboratory (ESG Laboratories, Oxfordshire).

The locations were chosen in order to assess roadside and background levels of NO_2. The results allow an indicative comparison with the annual average limit value and an assessment of the spatial variation of NO_2 away from existing road sources. The spatial variation is particularly important for NO_2, as a complex relationship exists between NO, NO_2 and O_3 leading to a non-linear variation of NO_2 concentrations with distance.

Studies in the UK have shown that diffusion tube monitoring results generally have a positive or negative bias when compared to continuous analysers. This bias is laboratory specific and is dependent on the specific analysis procedures at each laboratory. A diffusion tube bias of 0.75 was obtained for the ESG Oxfordshire laboratory (which analysed the diffusion tubes) from the UK Air Quality Review and Assessment website (University of West England, 2007). This bias was applied to the diffusion tube monitoring results.

The passive diffusion tube survey was designed to assess background and roadside levels close to the Drehid MBT Facility (see Table 8.9 and Figure 8.1). The average monitoring results for NO_2 for the monitoring period ranged from 5.5 – 12.9 $\mu g/m^3$.

All NO_2 concentrations measured over the period were below the annual limit value with worst-case levels reaching 32% of the limit value.

Table 8-9 Results Of NO_2 Diffusion Tube Monitoring Carried Out Near The Proposed Drehid MBT Facility.

Location	Sampling Period	NO_2 Concentration ($\mu g/m^3$)$^{Note\ 1}$
M1 – Timahoe	18/11/11 – 19/12/11	5.5
M2 – Coolearagh East	18/11/11 – 19/12/11	6.6
M3 – Drummond	18/11/11 – 19/12/11	12.9
M4 – Killinagh Upper	18/11/11 – 19/12/11	5.5
Limit Value		*40*$^{Note\ 2}$

Note 1 Diffusion tube bias factor of 0.75 applied to laboratory results.

Note 2 S.I. 180 of 2011 and EU Council Directive 2008/50/EC (as an annual average)

Sulphur Dioxide (SO_2)

Background levels of SO_2 were monitored using sulphur dioxide passive diffusion tubes over a four-week period at two locations in the region of the Drehid MBT Facility (see Table 8.10 and Figure 8.1, Locations M1, M3). The results allow an indicative comparison with the annual average limit value and an assessment of the spatial variation of SO_2 in the region.

Table 8-10 Results Of SO_2 Diffusion Tube Monitoring Carried Out Near The Proposed Drehid MBT Facility.

Location	Sampling Period	NO_2 Concentration ($\mu g/m^3$)
M1 – Timahoe	18/11/11 – 19/12/11	4.7
M3 – Drummond	18/11/11 – 19/12/11	6.7
Limit Value		*20*$^{Note\ 2}$

Note 1 S.I. 180 of 2011 and EU Council Directive 2008/50/EC (as an annual average)

All SO_2 concentrations measured over the period were below the annual limit value with worst-case levels reaching 34% of the limit value.

Background Concentrations

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities(39,40). The most recent annual report on air quality "Air Quality Monitoring Annual Report 2010" (EPA, 2011)(39), 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(39). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 21 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 Bord na Móna landholding is categorised as Zone D(39).

NO_2 monitoring was carried out at two rural Zone D locations in 2010, Glashaboy and Kilkitt(39). The NO_2 annual average in 2010 for both sites was 10 and 3 $\mu g/m^3$ respectively. Hence long-term average concentrations measured at all locations were significantly lower than the annual average limit value of 40 $\mu g/m^3$. The annual mean background NO_2 concentration within the Bord na Móna landholding in 2012 was estimated at 10 $\mu g/m^3$ as a worst-case and the maximum 1-hour averaging period was assessed using real monitoring data for Kilkitt for 2010 in addition to ozone data from Kilkitt in 2010 and using the methodology outlined in Appendix E of AG4(1).

Long-term PM_{10} monitoring was carried out at the rural Zone D location of Kilkitt in 2010. The average concentration measured was 10 $\mu g/m^3$. In addition, the results of a Zone D measurement carried out at Kilkitt in 2009, gave an average level of 9 $\mu g/m^3$(39). Data from the Phoenix Park provides a good indication of urban background levels, with an annual average in 2010 of 11 $\mu g/m^3$(39). Based on the above information, a conservative estimate of the background PM_{10} concentration for within the Bord na Móna landholding of 10 $\mu g/m^3$ has been used and the maximum 24-hour averaging period was assessed using real monitoring data for Kilkitt for 2010 and using the methodology outlined in Appendix E of AG4(1).

The results of $PM_{2.5}$ monitoring at Station Road in Cork City in 2010 (39) indicated an average $PM_{2.5}/PM_{10}$ ratio of 0.68 whilst the ratio in Ennis was 0.59(12). Based on this information, a conservative ratio of 0.70 was used to generate a background $PM_{2.5}$ concentration of 7$\mu g/m^3$.

In relation to the annual averages, the ambient background concentration was added directly to the process concentration. However, in relation to the short-term peak concentration, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK DEFRA(41) and EPA(1) advises that for NO_2 and PM_{10} an estimate of the maximum combined pollutant concentration can be obtained as shown below:

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)

b) The maximum of either:

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

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

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}

8.1.3 POTENTIAL IMPACTS

Odour Emission Rates From the Drehid MBT Facility

As the study undertaken by Sironi et al (2006)(22) was an extensive and wide-ranging study based on the results of odour measurements conducted at 40 waste MBT facilities giving a total of 2,000 individual samples, the average results from this study should give a good indication of likely emissions from the proposed facility. As per this study, the emission rates determined from the Drehid MBT Facility were normalised to the tonnage of waste processed and were presented upstream of any abatement systems.

Configuration A (MBT with Composting)

Table 8.11 outlines the derived odour concentration and odour emission rate from the Drehid MBT Facility based on a tonnage of 250,000 tonnes per annum. The overall OER (odour emission rate) in odour units per sec (OU_E/s) is calculated using the formula of Sironi et al(22). An odour efficiency of 90% was assumed based on worst-case data from the product literature for Monashell and Monafil and on data from the research literature.

Table 8-11 Odour Concentrations & Odour Emission Rate (OER) From The Drehid MBT Facility – Configuration A (MBT with Composting) Based on Emission Rates from Sironi et al(22)

Parameter	Formula	Units
OER_{TOT} =	C ($OEF_{rec} + OEF_{bio} + OEF_{mat} + OEF_{fp} + OEF_{os}$)	OU_E/Year
OER_{TOT} =	250,000*(1.26E+7 + 1.40E+8 + 3.99E+7 + 7.54E+6 + 2.42E+6)	OU_E/Year
OER_{TOT} =	5.06E+13	OU_E/Year
OER_{TOT} =	1.60+6	OU_E/sec
Biofilter Volume Flow	130.6	m^3/sec
Odour Concentration (Pre-abatement)	12,289	OU_E/m^3
Odour Concentration (Post-abatement) Based On 90% Efficiency	1,229	OU_E/m^3

Configuration B (MBT with Dry Anaerobic Digestion and Composting)

Table 8.12 outlines the derived odour concentration and odour emission rate from the Drehid MBT Facility based on a tonnage of 200,000 tonnes per annum. The overall OER (odour emission rate) in odour units per sec (OU_E/s) is calculated using the formula of Sironi et al (2005)(22) with the exception of the anaerobic digestion emission factor which is based on the work of Orzi et al (2010)(28).

Table 8-12 Odour Concentrations & Odour Emission Rate (OER) From The Drehid MBT Facility – Configuration B (MBT with Dry Anaerobic Digestion and Composting) Based on Emission Rates from Sironi et al[(22)] and Orzi et al[(28)]

Parameter	Formula	Units
$OER_{COM}^{\text{Note 1}}$=	C (OEF_{rec} + OEF_{bio} + OEF_{mat} + OEF_{fp} + OEF_{os})	OU_E/Year
OER_{COM} =	200,000*(1.26E+7 + 1.40E+8 + 3.99E+7 + 7.54E+6 + 2.42E+6)	OU_E/Year
OER_{COM} =	4.05E+13	OU_E/Year
OER_{COM} =	1.28E+6	OU_E/sec
Biofilter Volume Flow (Except AD)	100.3	m^3/sec
Odour Concentration (Pre-abatement) (Excluding AD)	12,800	OU_E/m^3
Average AD Concentration$^{\text{Note 2}}$	22,444	OU_E/m^3
AD Volume Flow	21.1	m^3/sec
OER_{AD} =	4.73E+5	OU_E/sec
$OER_{AD + COM}$ =	1.75E+6	OU_E/sec
Biofilter Volume Flow (All)	121.4	m^3/sec
Odour Concentration (Pre-abatement) (Total)	14,470	OU_E/m^3
Odour Concentration (Post-abatement) Based On 90% Efficiency	1,447	OU_E/m^3

Note 1 OER_{COM} = Odour emission rate based on a tonnage of 200,000 tonnes/annum with approximately 100,000 tonnes composted

Note 2 Average AD concentration based on an average of three stages of AD as outlined in Table 8.7 derived from Orzi et al (2010)[(28)]

Bacteria Emission Rates From the Drehid MBT Facility

As the study undertaken by Sanchez-Monedero et al (2003)[(38)] was relatively extensive based on the results of bioaerosol measurements conducted at 7 composting facilities, the highest results from this study should give a pessimistic indication of likely emissions from the composting activities associated with the proposed facility. Based on a highest measured level of 2.2×10^5 cfu/m^3 for any of the bioaerosols (total bacteria, gram-negative bacteria and aspergillus fumigatus) and using a biofilter efficiency of 73% for both total bacteria and gram-negative bacteria and a biofilter efficiency of 97% for aspergillus fumigatus, the emitted bioaerosol concentrations were 59,400 cfu/m^3 for both total bacteria and gram-negative bacteria and 6,600 cfu/m^3 for aspergillus fumigatus.

Table 8.13 and 8.14 outlines the derived bioaerosol concentration and bioaerosol emission rate from the Drehid MBT Facility based on Configuration A (MBT with Composting) and Configuration B (MBT with Dry Anaerobic Digestion and Composting) respectively.

Process Emissions

The information used in the odour and bioaerosol dispersion model for the proposed biofilters emission points is shown in Table 8.15 - 8.20. Emission data for the model was taken from design information supplied by Bord Na Móna and literature studies. The information used in the air dispersion model for the two proposed CHP emission points (enclosed within one stack) is shown in Table 8.21. Data for these emission points was taken from design information supplied by Bord Na Móna.

Table 8-13 Bioaerosol Concentrations & Bioaerosol Emission Rate From The Drehid MBT Facility – Configuration A (MBT with Composting) Based on Emission Rates from Sanchez-Monedero et al (2003)(38)

Parameter	Formula	Units
Biofilter Volume Flow	130.6	m^3/sec
Total Bacteria Concentration (Pre-abatement)	2.2 x 10^5	CFU/m^3
Total Bacteria (Post-abatement) Based On 73% Efficiency	59,400	CFU/m^3
Total Bacteria (Post-abatement) Based On 73% Efficiency	7.8 x 10^6	CFU/s
Gram-Negative Bacteria Concentration (Pre-abatement)Note 1	2.2 x 10^5	CFU/m^3
Gram-Negative Bacteria (Post-abatement) Based On 73% Efficiency	59,400	CFU/m^3
Gram-Negative Bacteria (Post-abatement) Based On 73% Efficiency	7.8 x 10^6	CFU/s
Aspergillus fumigatus Concentration (Pre-abatement)	2.2 x 10^5	CFU/m^3
Aspergillus fumigatus (Post-abatement) Based On 97% Efficiency	6,600	CFU/m^3
Aspergillus fumigatus (Post-abatement) Based On 97% Efficiency	8.6 x 10^5	CFU/s

Note 1 In the absence of detailed information, the concentration of gram-negative bacteria is assumed to be equivalent to total bacteria as a worst-case.

Table 8-14 Bioaerosol Concentrations & Bioaerosol Emission Rate From The Drehid MBT Facility – Configuration B (MBT with Dry Anaerobic Digestion and Composting). Based on Emission Rates from Sanchez-Monedero et al (2003)(38)

Parameter	Formula	Units
Biofilter Volume Flow	121.4	m^3/sec
Total Bacteria Concentration (Pre-abatement)	2.2×10^5	CFU/m^3
Total Bacteria (Post-abatement) Based On 73% Efficiency	59,400	CFU/m^3
Total Bacteria (Post-abatement) Based On 73% Efficiency	7.2×10^6	CFU/s
Gram-Negative Bacteria Concentration (Pre-abatement)Note 1	2.2×10^5	CFU/m^3
Gram-Negative Bacteria (Post-abatement) Based On 73% Efficiency	59,400	CFU/m^3
Gram-Negative Bacteria (Post-abatement) Based On 73% Efficiency	7.2×10^6	CFU/s
Aspergillus fumigatus Concentration (Pre-abatement)	2.2×10^5	CFU/m^3
Aspergillus fumigatus (Post-abatement) Based On 97% Efficiency	6,600	CFU/m^3
Aspergillus fumigatus (Post-abatement) Based On 97% Efficiency	8.0×10^5	CFU/s

Note 1 In the absence of detailed information, the concentration of gram-negative bacteria is assumed to be equivalent to total bacteria as a worst-case.

Table 8-15 **Drehid MBT Facility, County Kildare. Odour Emission Source Details for Configuration A (MBT with Composting)**

Emission Source Reference	Exit Diameter (m)	Temp (K)	Max Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual, wet)	Odour	
					Concentration (OU$_E$/m^3)	Mass Emission (OU$_E$/s)
Biofilter 1A	1.5	289	93567	15.3	1229	31943
Biofilter 1A	1.5	289	93567	15.3	1229	31943
Biofilter 2A	0.90	289	47762	21.6	1229	16305
Biofilter 2B	0.90	289	47762	21.6	1229	16305
Biofilter 3A	1.4	289	93766	17.5	1229	32010
Biofilter 3B	1.4	289	93766	17.5	1229	32010

Table 8-16 **Drehid MBT Facility, County Kildare. Odour Emission Source Details for Configuration B (MBT with Dry Anaerobic Digestion and Composting)**

Emission Source Reference	Exit Diameter (m)	Temp (K)	Max Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual, wet)	Odour	
					Concentration (OU$_E$/m^3)	Mass Emission (OU$_E$/s)
Biofilter 1A	1.5	289	100585	16.4	1447	40430
Biofilter 1A	1.5	289	100585	16.4	1447	40430
Biofilter 2A	0.90	289	32425	14.7	1447	13033
Biofilter 2B	0.90	289	32425	14.7	1447	13033
Biofilter 3A	1.4	289	85447	16.0	1447	34345
Biofilter 3B	1.4	289	85447	16.0	1447	34345

Table 8-17 Drehid MBT Facility, County Kildare. Total & Gram-Negative Bacteria Emission Source Details for Configuration A (MBT with Composting)

Emission Source Reference	Exit Diameter (m)	Temp (K)	Max Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual, wet)	Total Bacteria[Note 1]	
					Concentration (cfu/m^3)	Mass Emission (cfu/s)
Biofilter 1A	1.5	289	93,567	15.3	59,400	1,543,850
Biofilter 1A	1.5	289	93,567	15.3	59,400	1,543,850
Biofilter 2A	0.90	289	47,762	21.6	59,400	788,070
Biofilter 2B	0.90	289	47,762	21.6	59,400	788,070
Biofilter 3A	1.4	289	93,766	17.5	59,400	1,547,130
Biofilter 3B	1.4	289	93,766	17.5	59,400	1,547,130

Note 1 Gram-negative bacteria concentration and emission rate is assumed equivalent to total bacteria as a worst-case

Table 8-18 Drehid MBT Facility, County Kildare. Total & Gram-Negative Bacteria Emission Source Details for Configuration B (MBT with Dry Anaerobic Digestion and Composting)

Emission Source Reference	Exit Diameter (m)	Temp (K)	Max Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual, wet)	Total Bacteria[Note 1]	
					Concentration (cfu/m^3)	Mass Emission (cfu/s)
Biofilter 1A	1.5	289	100,585	16.4	59,400	1,659,650
Biofilter 1A	1.5	289	100,585	16.4	59,400	1,659,650
Biofilter 2A	0.90	289	32,425	14.7	59,400	535,010
Biofilter 2B	0.90	289	32,425	14.7	59,400	535,010
Biofilter 3A	1.4	289	85,447	16.0	59,400	1,409,880
Biofilter 3B	1.4	289	85,447	16.0	59,400	1,409,880

Note 1 Gram-negative bacteria concentration and emission rate is assumed equivalent to total bacteria as a worst-case

Table 8-19 Drehid MBT Facility, County Kildare. Aspergillus Fumigatus Emission Source Details for Configuration A (MBT with Composting)

Emission Source Reference	Exit Diameter (m)	Temp (K)	Max Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual, wet)	Aspergillus Fumigatus	
					Concentration (cfu/m^3)	Mass Emission (cfu/s)
Biofilter 1A	1.5	289	93,567	15.3	6,600	171,540
Biofilter 1A	1.5	289	93,567	15.3	6,600	171,540
Biofilter 2A	0.90	289	47,762	21.6	6,600	87,560
Biofilter 2B	0.90	289	47,762	21.6	6,600	87,560
Biofilter 3A	1.4	289	93,766	17.5	6,600	171,900
Biofilter 3B	1.4	289	93,766	17.5	6,600	171,900

Table 8-20 Drehid MBT Facility, County Kildare. Aspergillus Fumigatus Emission Source Details for Configuration B (MBT with Dry Anaerobic Digestion and Composting)

Emission Source Reference	Exit Diameter (m)	Temp (K)	Max Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual, wet)	Aspergillus Fumigatus	
					Concentration (cfu/m^3)	Mass Emission (cfu/s)
Biofilter 1A	1.5	289	100,585	16.4	6,600	184,410
Biofilter 1A	1.5	289	100,585	16.4	6,600	184,410
Biofilter 2A	0.90	289	32,425	14.7	6,600	59,450
Biofilter 2B	0.90	289	32,425	14.7	6,600	59,450
Biofilter 3A	1.4	289	85,447	16.0	6,600	156,650
Biofilter 3B	1.4	289	85,447	16.0	6,600	156,650

Table 8-21 Drehid MBT Facility, County Kildare. NO_2 and PM_{10} Emissions From The Proposed CHP Emission Points

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

Air Dispersion Modelling Results – Configuration A (MBT with Composting)

Predicted Odour Concentrations – Configuration A (MBT with Composting)

The predicted odour concentration is the maximum concentration predicted at the nearest residential receptor. Odour emissions will occur from six biofilters on-site (see Table 8.15). Emissions from these sources were modelled using design volume flows for the emission sources (as outlined in Table 8.15) and using derived odour concentrations (see Table 8.11). Details of the 98th%ile of 1-hour mean odour concentrations at the nearest residential receptor are given in Table 8.22 over a five-year period.

Table 8-22 Dispersion Model Results – Predicted Odour Concentration At Worst-case Residential Receptor – Configuration A (MBT with Composting)

Model Scenario / Meteorological Year	Averaging Period	Predicted Odour Conc. (OUE/m3)	Guideline (OUE/m3)
		98th %ile	98th %ile
Odour / 2006	Maximum 1-Hour (as a 98th%ile)	0.62	3.0
Odour / 2007	Maximum 1-Hour (as a 98th%ile)	0.68	
Odour / 2008	Maximum 1-Hour (as a 98th%ile)	0.58	
Odour / 2009	Maximum 1-Hour (as a 98th%ile)	0.66	
Odour / 2010	Maximum 1-Hour (as a 98th%ile)	0.63	

The dispersion modelling results presented in Tables 8.22 and Figure 8.3 show that under Configuration A (MBT with Composting), the 98th%ile of mean hourly odour concentrations ranges from 0.58 – 0.68 OU_E/m^3 at the worst-case residential receptor. The worst-case odour concentration of 0.68 OU_E/m^3 is 23% of the relevant odour criterion.

Predicted Bioaerosol Concentrations – Configuration A (MBT with Composting)

The predicted bioaerosol concentration is the maximum concentration predicted at the nearest residential receptor. Bioaerosol emissions will occur from six biofilters on-site (see Table 8.17). Emissions from these sources were modelled using design volume flows for the emission sources (as outlined in Table 8.17) and using derived bioaerosol concentrations (see Table 8.13). Details of the maximum 1-hour mean bioaerosol concentrations at the nearest residential receptor are given in Table 8.23 over a five-year period.

Table 8-23 Dispersion Model Results – Predicted Bioaerosol Concentrations At Worst-case Receptor – Configuration A (MBT with Composting)

Model Scenario / Meteorological Year	Averaging Period	Predicted Bioaerosol Conc. (cfu/m3)	Guideline (cfu/m3)
		Max 1-Hr	Max 1-Hr
Total Bacteria / 2006	Maximum 1-Hour	187	1000
Total Bacteria / 2007	Maximum 1-Hour	194	
Total Bacteria / 2008	Maximum 1-Hour	194	
Total Bacteria / 2009	Maximum 1-Hour	155	
Total Bacteria / 2010	Maximum 1-Hour	193	
Gram-neg Bacteria / 2006	Maximum 1-Hour	187	300
Gram-neg Bacteria / 2007	Maximum 1-Hour	194	
Gram-neg Bacteria / 2008	Maximum 1-Hour	194	
Gram-neg Bacteria / 2009	Maximum 1-Hour	155	
Gram-neg Bacteria / 2010	Maximum 1-Hour	193	
A. Fumigatus / 2006	Maximum 1-Hour	20.8	500
A. Fumigatus / 2007	Maximum 1-Hour	21.6	
A. Fumigatus / 2008	Maximum 1-Hour	21.5	
A. Fumigatus / 2009	Maximum 1-Hour	17.3	
A. Fumigatus / 2010	Maximum 1-Hour	21.5	

The dispersion modelling results presented in Tables 8.23 and Figure 8.4 show that under Configuration A (MBT with Composting), the maximum 1-hour total bacteria concentration ranged from 155 – 194 cfu/m^3 at the worst-case residential receptor. The worst-case total bacteria concentration of 194 cfu/m^3 is 19% of the relevant total bacteria criterion.

The dispersion modelling results presented in Tables 8.23 show that under Configuration A (MBT with Composting), the maximum 1-hour gram-negative bacteria concentration ranged from 155 – 194 cfu/m^3 at the worst-case residential receptor. The worst-case gram-negative bacteria concentration of 194 cfu/m^3 is 65% of the relevant gram-negative bacteria criterion.

The dispersion modelling results presented in Tables 8.23 and Figure 8.5 show that under Configuration A (MBT with Composting), the maximum 1-hour aspergillus fumigatus concentration ranged from 17.3 – 21.6 cfu/m^3 at the worst-case residential receptor. The worst-case gram-negative bacteria concentration of 21.6 cfu/m^3 is 4% of the relevant aspergillus fumigatus bacteria criterion.

Air Dispersion Modelling Results – Configuration B (MBT with Dry Anaerobic Digestion and Composting)

Predicted Odour Concentrations – Configuration B (MBT with Dry Anaerobic Digestion and Composting)

The predicted odour concentration is the maximum concentration predicted at the nearest residential receptor. Odour emissions will occur from six biofilters on-site (see Table 8.16). Emissions from these sources were modelled using design volume flows for the emission sources (as outlined in Table 8.16) and using derived odour concentrations (see Table 8.12). Details of the 98th%ile of 1-hour mean odour concentrations at the nearest residential receptor are given in Table 8.24 over a five-year period.

Table 8-24 Dispersion model results – Predicted Odour Concentration At Worst-case Receptor – Configuration B (MBT with Dry Anaerobic Digestion and Composting)

Model Scenario / Meteorological Year	Averaging Period	Predicted Odour Conc. (OUE/m3)	Guideline (OUE/m3)
		98th %ile	98th %ile
Odour / 2006	Maximum 1-Hour (as a 98th%ile)	0.68	3.0
Odour / 2007	Maximum 1-Hour (as a 98th%ile)	0.76	
Odour / 2008	Maximum 1-Hour (as a 98th%ile)	0.64	
Odour / 2009	Maximum 1-Hour (as a 98th%ile)	0.72	
Odour / 2010	Maximum 1-Hour (as a 98th%ile)	0.82	

The dispersion modelling results presented in Tables 8.24 and Figure 8.6 show that under Configuration B (MBT with Dry Anaerobic Digestion and Composting), the 98th%ile of mean hourly odour concentrations ranges from 0.64 – 0.82 OU_E/m^3 at the worst-case residential receptor. The worst-case odour concentration of 0.82 OU_E/m^3 is 27% of the relevant odour criterion.

Predicted Bioaerosol Concentrations – Configuration B (MBT with Dry Anaerobic Digestion and Composting)

The predicted bioaerosol concentration is the maximum concentration predicted at the nearest residential receptor. Bioaerosol emissions will occur from six biofilters on-site (see Table 8.18). Emissions from these sources were modelled using design volume flows for the emission sources (as outlined in Table 8.18) and using derived bioaerosol concentrations (see Table 8.14). Details of the maximum 1-hour mean bioaerosol concentrations at the nearest residential receptor are given in Table 8.25 over a five-year period.

Table 8-25 Dispersion model results – Predicted Bioaerosol Concentrations At Worst-case Receptor – Configuration B (MBT with Dry Anaerobic Digestion and Composting)

Model Scenario / Meteorological Year	Averaging Period	Predicted Bioaerosol Conc. (cfu/m3)	Guideline (cfu/m3)
		Max 1-Hr	Max 1-Hr
Total Bacteria / 2006	Maximum 1-Hour	175	1000
Total Bacteria / 2007	Maximum 1-Hour	181	
Total Bacteria / 2008	Maximum 1-Hour	181	
Total Bacteria / 2009	Maximum 1-Hour	144	
Total Bacteria / 2010	Maximum 1-Hour	181	
Gram-neg Bacteria / 2006	Maximum 1-Hour	175	300
Gram-neg Bacteria / 2007	Maximum 1-Hour	181	
Gram-neg Bacteria / 2008	Maximum 1-Hour	181	
Gram-neg Bacteria / 2009	Maximum 1-Hour	144	
Gram-neg Bacteria / 2010	Maximum 1-Hour	181	
A. Fumigatus / 2006	Maximum 1-Hour	19.5	500
A. Fumigatus / 2007	Maximum 1-Hour	20.1	
A. Fumigatus / 2008	Maximum 1-Hour	20.1	
A. Fumigatus / 2009	Maximum 1-Hour	16.0	
A. Fumigatus / 2010	Maximum 1-Hour	20.2	

The dispersion modelling results presented in Tables 8.25 and Figure 8.7 show that under Configuration B (MBT with Dry Anaerobic Digestion and Composting), the maximum 1-hour total bacteria concentration ranged from 144 – 181 cfu/m^3 at the worst-case residential receptor. The worst-case total bacteria concentration of 181 cfu/m^3 is 18% of the relevant total bacteria criterion.

The dispersion modelling results presented in Tables 8.25 show that under Configuration B (MBT with Dry Anaerobic Digestion and Composting), the maximum 1-hour gram-negative bacteria concentration ranged from 144 – 181 cfu/m^3 at the worst-case residential receptor. The worst-case gram-negative bacteria concentration of 181 cfu/m^3 is 60% of the relevant gram-negative bacteria criterion.

The dispersion modelling results presented in Tables 8.25 and Figure 8.8 show that under Configuration B (MBT with Dry Anaerobic Digestion and Composting), the maximum 1-hour aspergillus fumigatus concentration ranged from 16.0 – 20.2 cfu/m^3 at the worst-case residential receptor. The worst-case gram-negative bacteria concentration of 20.2 cfu/m^3 is 4% of the relevant gram-negative bacteria criterion.

Air Dispersion Modelling Results – CHP Emissions

NO_2 Emissions

The NO_2 modelling results from the two CHP emission points, based on the emission information outlined in Table 8.21, are detailed in Table 8.26 and Figure 8.9 and 8.10. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for NO_2. For the worst-case scenario, emissions from the two proposed CHP emission points lead to an ambient NO_2 concentration (including background) which is 39% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 34% of the annual limit value at the worst-case receptor.

Table 8-26 Dispersion Model Results From The CHPs – NO_2 Ambient Concentrations

Pollutant / Scenario	Annual Mean Background (µg/m^3)	Averaging Period	Process Contribution (µg/m^3)	Predicted Immission Concentration (µg/Nm^3)	Standard (µg/Nm^3)Note 1
NO_2 / 2006	-(2)	99.8th%ile of 1-hr means	67.6	75.0	200
	10	Annual Mean	3.0	13.0	40
NO_2 / 2007	-(2)	99.8th%ile of 1-hr means	70.5	77.9	200
	10	Annual Mean	3.2	13.2	40
NO_2 / 2008	-(2)	99.8th%ile of 1-hr means	64.0	71.4	200
	10	Annual Mean	3.2	13.2	40
NO_2 / 2009	-(2)	99.8th%ile of 1-hr means	66.7	74.1	200
	10	Annual Mean	3.6	13.6	40
NO_2 / 2010	-(2)	99.8th%ile of 1-hr means	68.0	75.4	200
	10	Annual Mean	3.0	13.0	40

Note 1 EU Directive 2008/50/EC

Note 2 Short-term Immission Concentrations calculated according to UK DEFRA guidance & process contributions given as NO_X(1) (Immission in this context is the ambient concentration at ground level).

PM_{10}/$PM_{2.5}$ Emissions

The "do something" PM_{10} modelling results, based on the emission information outlined in Table 8.21, are detailed in Table 8.27 and Figure 8.11. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for all scenarios for PM_{10}. For the worst-case scenario, emissions from the site lead to an ambient PM_{10} concentration (including background) which is 64% of the maximum ambient 24-hour limit value (measured as a 90th%ile) and 26% of the annual limit value at the worst-case receptor.

In terms of process contributions, emissions from the site lead to an ambient PM_{10} concentration (excluding background) which is 2% of the maximum ambient 24-hour limit value (measured as a 90th%ile) and 1% of the annual limit value at the worst-case receptor.

Table 8-27 Dispersion Model Results –PM_{10}

Pollutant / Scenario	**Annual Mean Background (µg/m^3)**	**Averaging Period**	**Process Contribution (µg/m^3)**	**Predicted Immission Concentration (µg/Nm^3)**	**Standard (µg/Nm^3)[Note 1]**
PM_{10} / 2006	-[Note 2]	90th%ile of 24-hr means	1.0	31.8	50
	10	Annual Mean	0.38	10.4	40
PM_{10} / 2007	-[Note 2]	90th%ile of 24-hr means	1.0	31.8	50
	10	Annual Mean	0.39	10.4	40
PM_{10} / 2008	-[Note 2]	90th%ile of 24-hr means	0.96	31.8	50
	10	Annual Mean	0.39	10.4	40
PM_{10} / 2009	-[Note 2]	90th%ile of 24-hr means	1.1	31.8	50
	10	Annual Mean	0.45	10.5	40
PM_{10} / 2010	-[Note 2]	90th%ile of 24-hr means	0.97	31.8	50
	10	Annual Mean	0.37	10.4	40

[Note 1] EU Directive 2008/50/EC

[Note 2] Short-term Immission Concentrations calculated according to UK DEFRA guidance(1)

In relation to $PM_{2.5}$ as detailed in Table 8.28, as a worst-case, it is assumed that all dust released from the two CHP emission points is of a particle size of 2.5 microns or less ($PM_{2.5}$). In reality, particles greater than 2.5 microns may also be present and thus the mass of $PM_{2.5}$ release from the facility has been overestimated.

For the worst-case scenario, ambient concentrations will be 30% of the annual mean $PM_{2.5}$ limit value, which comes into force in 2015. Of this, the process contribution will account for less than 2% of the ambient limit value.

Table 8-28 Dispersion Model Results – $PM_{2.5}$

Pollutant / Scenario	Annual Mean Background ($\mu g/m^3$)	Averaging Period	Process Contribution ($\mu g/m^3$)	Predicted Immission Concentration ($\mu g/Nm^3$)	Standard ($\mu g/Nm^3$)$^{Note 1}$
$PM_{2.5}$ / 2006	7	Annual Mean	0.38	7.4	25
$PM_{2.5}$ / 2007	7	Annual Mean	0.39	7.4	25
$PM_{2.5}$ / 2008	7	Annual Mean	0.39	7.4	25
$PM_{2.5}$ / 2009	7	Annual Mean	0.45	7.5	25
$PM_{2.5}$ / 2010	7	Annual Mean	0.37	7.4	25

Note 1 EU Directive 2008/50/EC

8.1.4 MITIGATION MEASURES

8.1.4.1 Construction Phase Mitigation

A dust minimisation plan will be formulated for the construction phase of the project as detailed in the Dust Section below.

8.1.4.2 Operational Phase Mitigation

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

The Drehid MBT Facility site will also operate an odour mitigation / management plan which includes the following:

- Air from the Mechanical Treatment Building and the Refining Building will pass through a dust filter prior to passing through a the odour abatement system;
- The biofilters will be maintained to ensure optimum performance;
- All processes will be internal within buildings under negative pressure so air will not escape buildings;
- Doors at the waste reception area will be rapid closing doors, with an opening or closing time of approximately 20 seconds. Doors for the acceptance of waste will be fitted with air curtains to minimise the escape of odorous emissions or dust when a door is opened;

- All waste delivered to the MBT facility will be in covered/enclosed vehicles. Similarly, all waste residues being removed from the MBT facility will be in covered/enclosed vehicles;
- The first stage of the biological treatment process is the most critical with respect to odour emissions, since easily biodegradable components (e.g. sugars, proteins and fats) are degraded at a high rate, thus causing gaseous by-products. This intensive phase of the biological treatment process will be undertaken in fully enclosed concrete composting/dry AD tunnels located within an enclosed building - thereby providing double containment features;
- The maturation process will be undertaken by means of negative aeration. Negative aeration draws air from within the building through the trapezoidal windrows and into the aeration ductwork. This arrangement will greatly reduces emissions from the trapezoidal windrows within the building, thereby minimising the potential for nuisance odour emissions;
- Air streams with a potential for high ammonia levels will be treated in an acid scrubbers prior to biofiltration;
- An odour management plan will be developed prior to the detailed design and construction of the facility. 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;
- 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 phones numbers thereby ensuring the communication of critical alarms to responsible individuals on a 24 hour basis;
- Good housekeeping practices (internally and externally) and a closed-door management strategy will be maintained at all times;
- 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;
- Normal operational practices will be such that the organic fines fraction (putresible fraction with the highest potential for odour) generated in any day by the mechanical treatment process will be loaded into the composting/dry AD tunnels on the same day;
- Treated air from the biofilters will be emitted through 20m high stacks to facilitate appropriate residual odour dispersion;
- The organic fines fraction will be conveyed from the Mechanical Treatment Building to the biological treatment buildings in fully covered and enclosed galleys;
- 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; and

- In the case of Configuration B (MBT with Dry Anaerobic Digestion and Composting), a standby gas flare will be provided to facilitate the thermal destruction of the biogas in the event of unavailability of the CHP plants and that there is insufficient volume in the biogas storage bladders.

8.1.5 CONCLUSIONS

The odour dispersion modelling results for either Configuration A (MBT with Composting) or Configuration B (MBT with Dry Anaerobic Digestion and Composting) are within the odour guideline criteria and thus will not cause a nuisance at the worst-case residential receptor. The 98^{th}%ile of mean hourly odour concentrations ranges from 0.58 – 0.82 OU_E/m^3 at the worst-case residential receptor under Configuration A (MBT with Composting) or Configuration B (MBT with Dry Anaerobic Digestion and Composting). The worst-case odour concentration of 0.82 OU_E/m^3 is 27% of the relevant odour criterion.

The bioaerosol dispersion modelling results for either Configuration A (MBT with Composting) or Configuration B (MBT with Dry Anaerobic Digestion and Composting) are within the bioaerosol guideline criteria and thus will not cause a health risk at the nearest residential receptor. The maximum hourly bioaerosol concentrations range from 4 – 65% of the relevant odour criterion.

The NO_2 modelling results from the two CHP emission points (enclosed within the one stack) indicate that the ambient ground level concentrations are below the relevant air quality standards for NO_2. For the worst-case scenario, emissions from the proposed CHPs lead to an ambient NO_2 concentration (including background) which is 39% of the maximum ambient 1-hour limit value (measured as a 99.8^{th}%ile) and 34% of the annual limit value at the worst-case receptor.

The $PM_{10}/PM_{2.5}$ modelling results indicate that the ambient ground level concentrations are below the relevant air quality standards for all scenarios for PM_{10} and $PM_{2.5}$. For the worst-case scenario, emissions from the site lead to an ambient PM_{10} concentration (including background) which is 64% of the maximum ambient 24-hour limit value (measured as a 90^{th}%ile) and 26% of the annual limit value at the worst-case receptor. In terms of process contributions, emissions from the site lead to an ambient PM_{10} concentration (excluding background) which is 2% of the maximum ambient 24-hour limit value (measured as a 90^{th}%ile) and 1% of the annual limit value at the worst-case receptor. For the worst-case scenario, emissions from the site lead to an ambient $PM_{2.5}$ concentration (including background) which is 30% of the annual limit value at the worst-case receptor with process contributions accounting for less than 2% of the annual limit value at the worst-case receptor.

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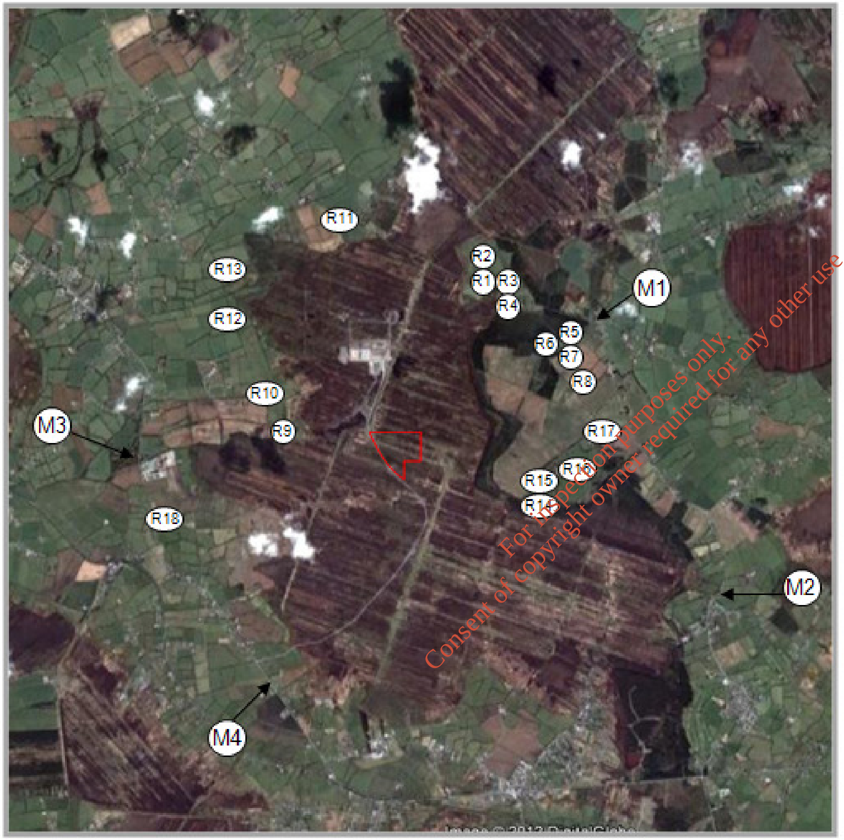


Project

Drehid MBT Facility

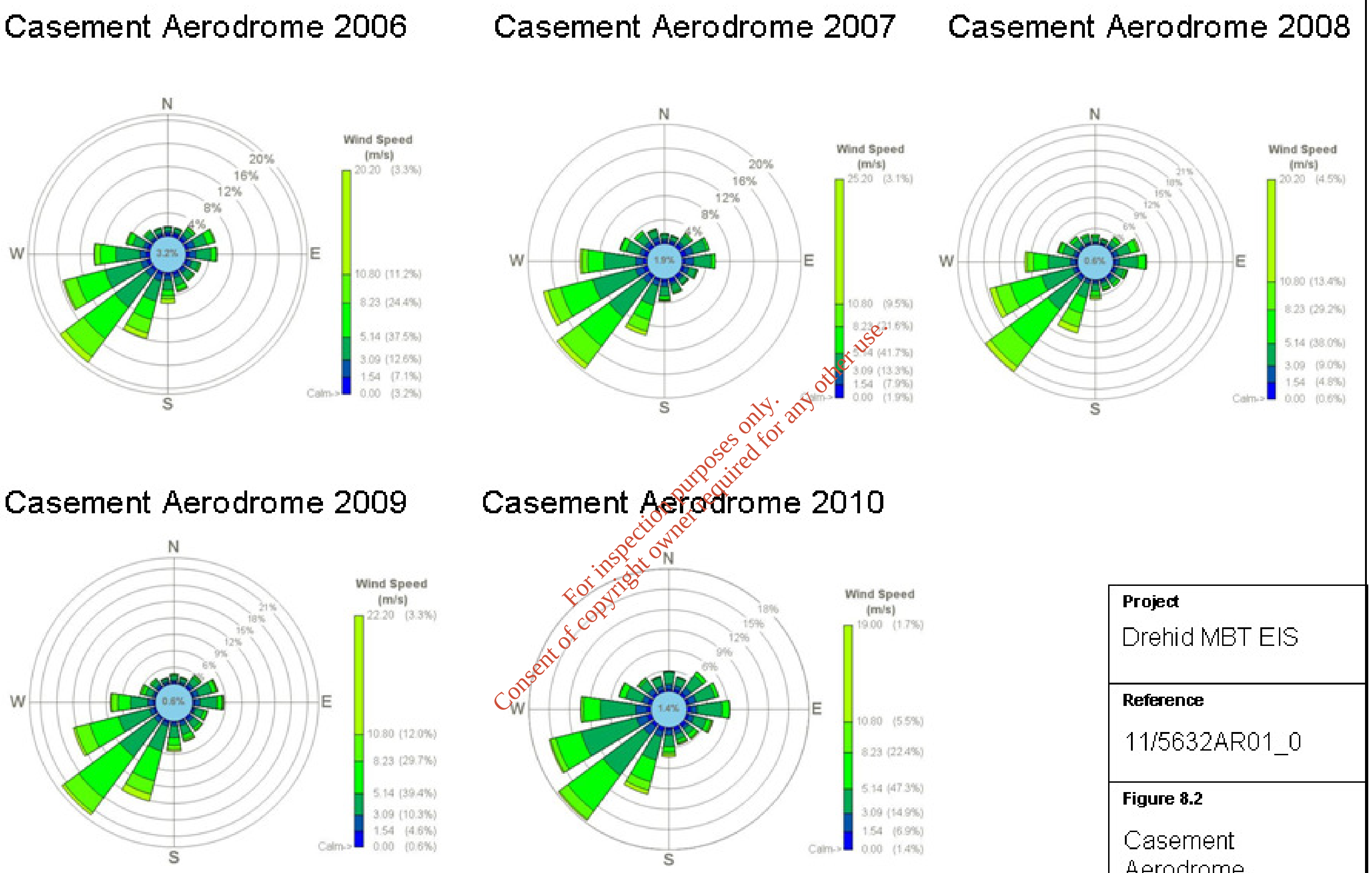
Reference

11/5632AR01

Figure 8.1

Monitoring (M) & Modelled (R) Receptor Locations

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
T: +353 1 847 4220 F: +353 1 847 4257



Casement Aerodrome 2006

Casement Aerodrome 2007

Casement Aerodrome 2008

Casement Aerodrome 2009

Casement Aerodrome 2010

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11/5632AR01_0

Figure 8.2

Casement Aerodrome Windrose 2006 - 2010

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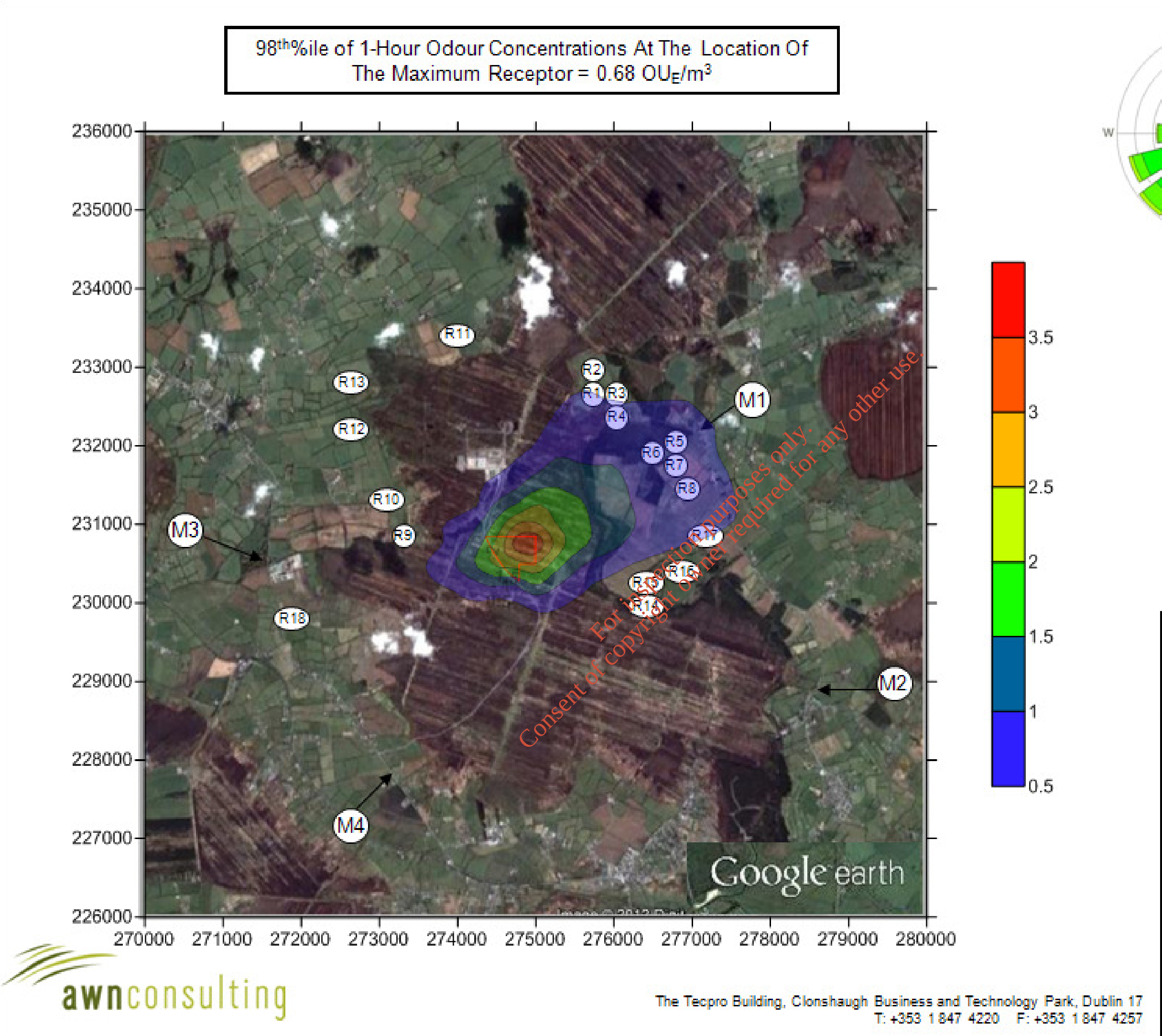

98th%ile of 1-Hour Odour Concentrations At The Location Of The Maximum Receptor = 0.68 OU_E/m^3

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Figure 8.3

98th%ile of 1-Hr Odour Concentrations (OU_E/m^3) (Year 2007) – MBT with Composting (Irish Grid)

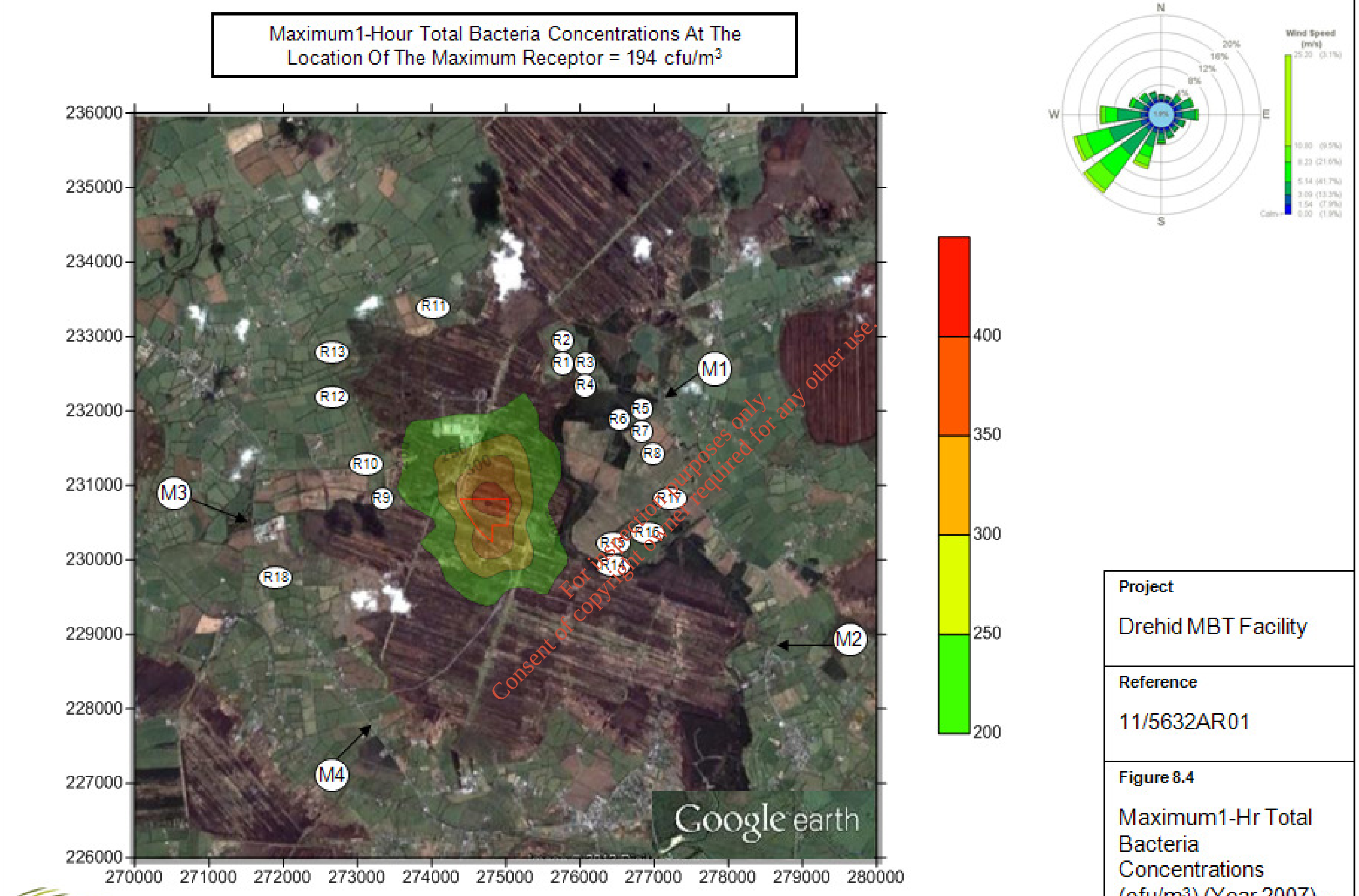

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Figure 8.4

Maximum 1-Hr Total Bacteria Concentrations (cfu/m³) (Year 2007) – MBT with Composting (Irish Grid)

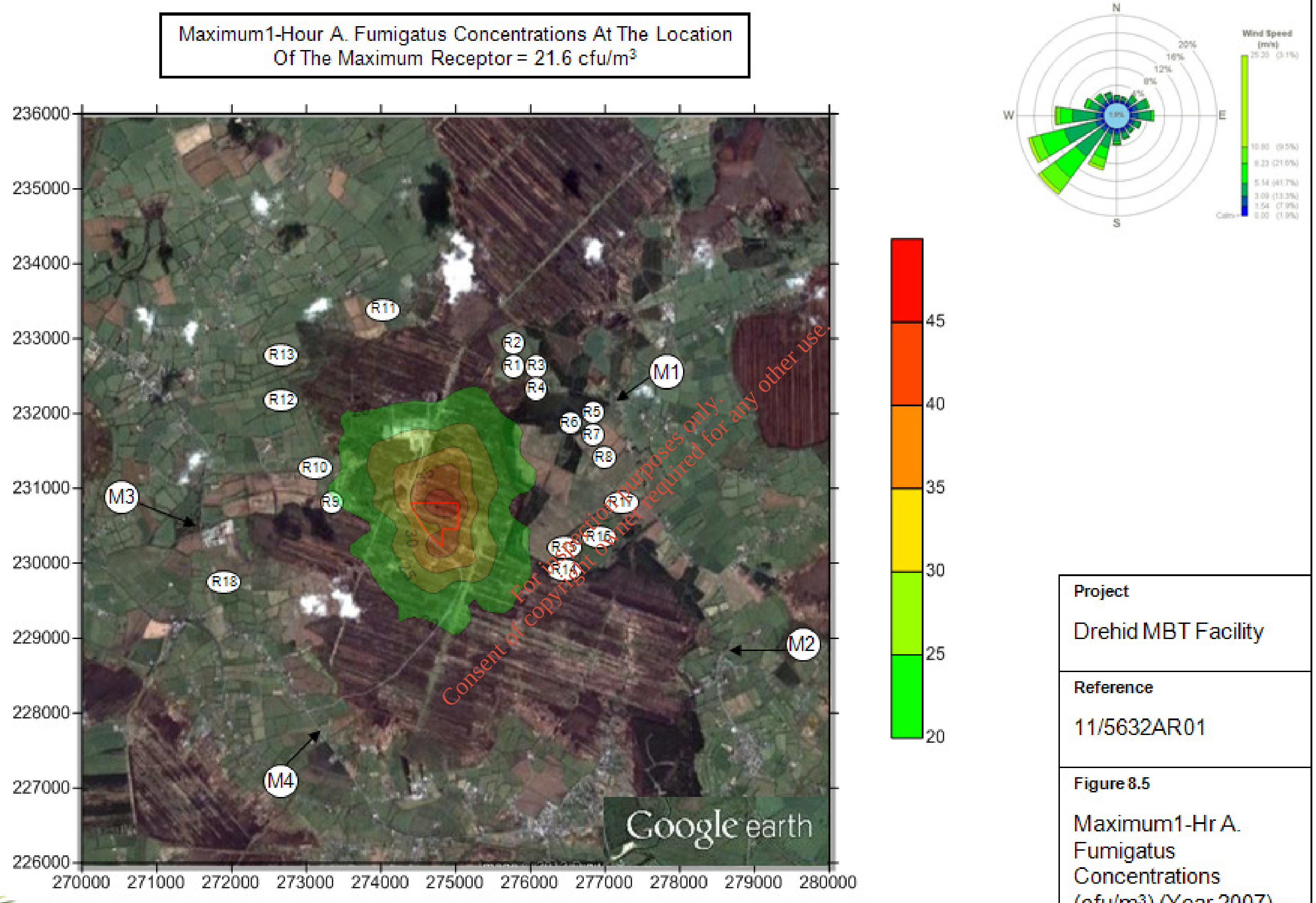

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Figure 8.5

Maximum1-Hr A. Fumigatus Concentrations (cfu/m³) (Year 2007) – MBT with Composting (Irish Grid)

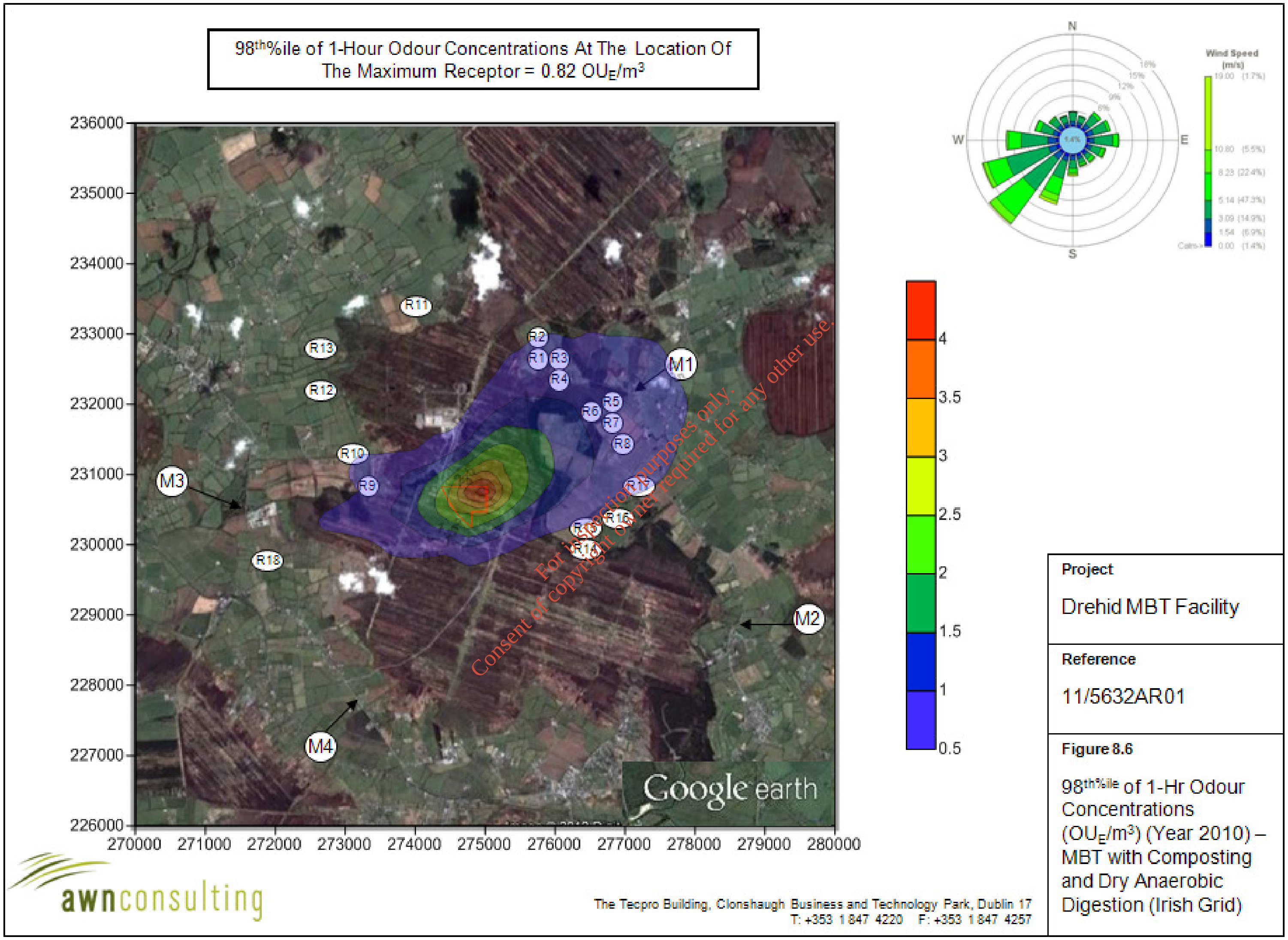

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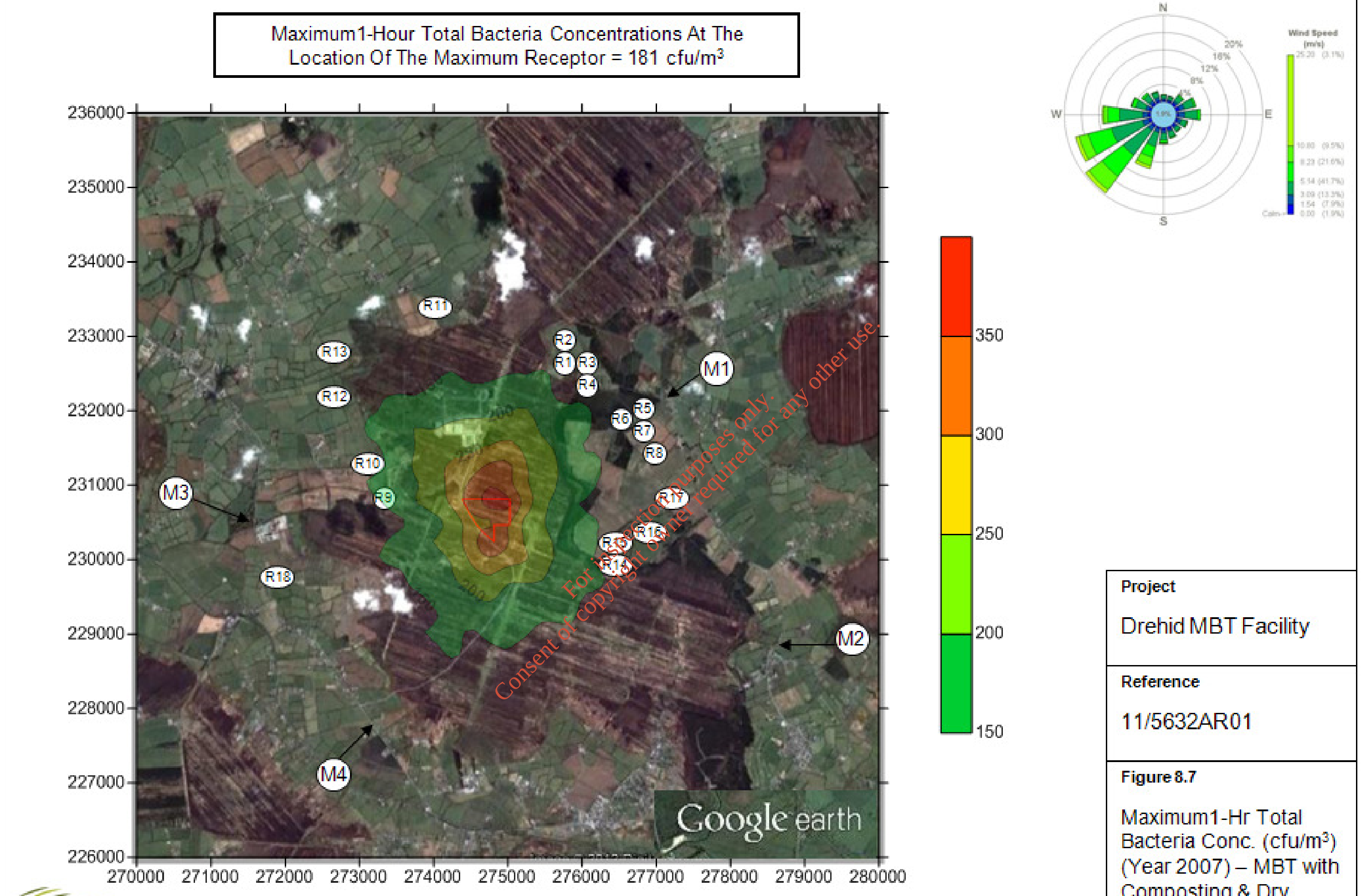
Figure 8.6

98th%ile of 1-Hr Odour Concentrations (OU_E/m^3) (Year 2010) – MBT with Composting and Dry Anaerobic Digestion (Irish Grid)



Maximum1-Hour Total Bacteria Concentrations At The Location Of The Maximum Receptor = 181 cfu/m^3

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11/5632AR01

Figure 8.7

Maximum1-Hr Total Bacteria Conc. (cfu/m^3) (Year 2007) – MBT with Composting & Dry Anaerobic Digestion (Irish Grid)

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Maximum1-Hour A. Fumigatus Concentrations At The Location Of The Maximum Receptor = 20.1 cfu/m^3

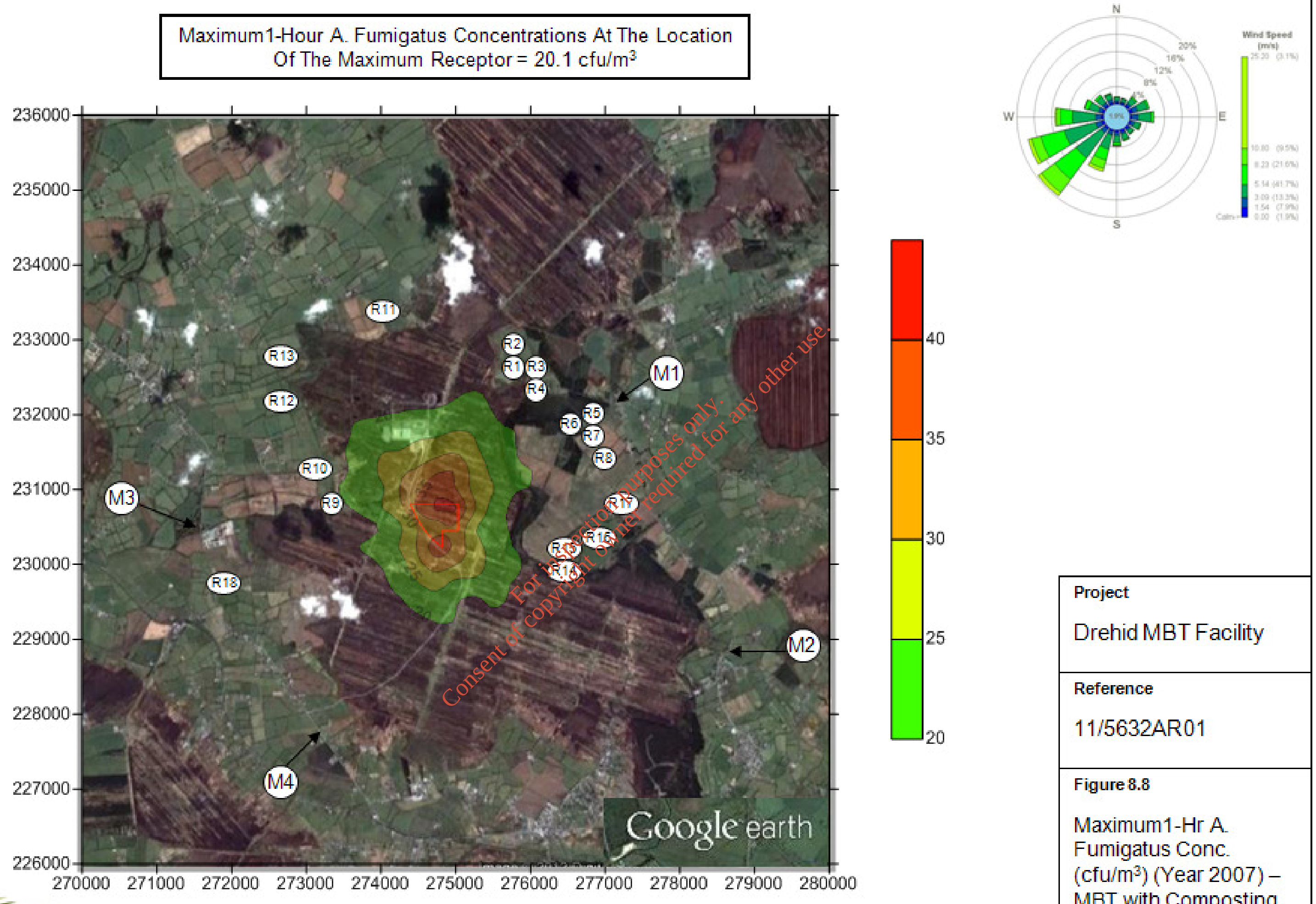

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Figure 8.8

Maximum1-Hr A. Fumigatus Conc. (cfu/m^3) (Year 2007) – MBT with Composting & Dry Anaerobic Digestion (Irish Grid)

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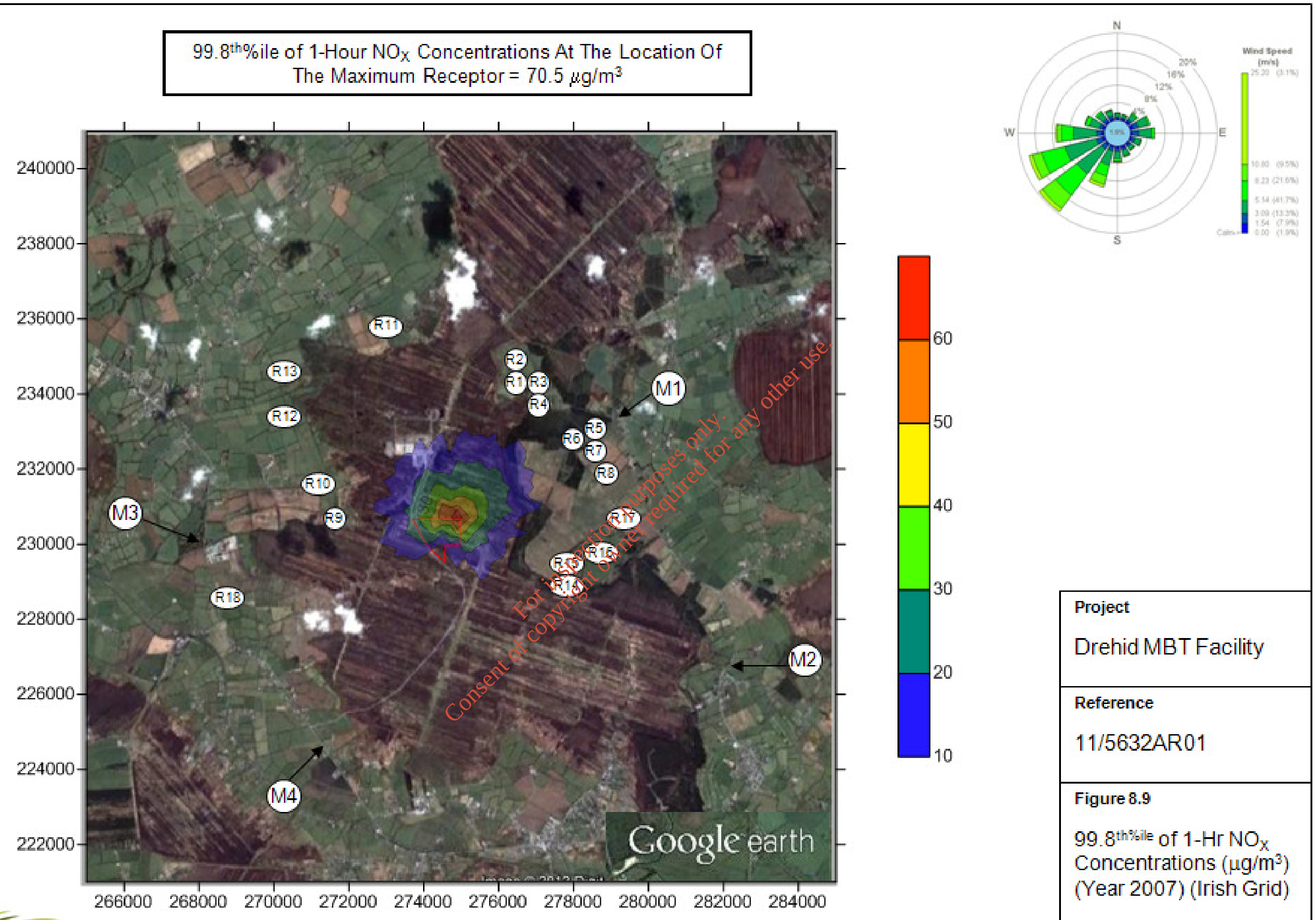

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Figure 8.9

99.8th%ile of 1-Hr NO_X Concentrations (µg/m^3) (Year 2007) (Irish Grid)

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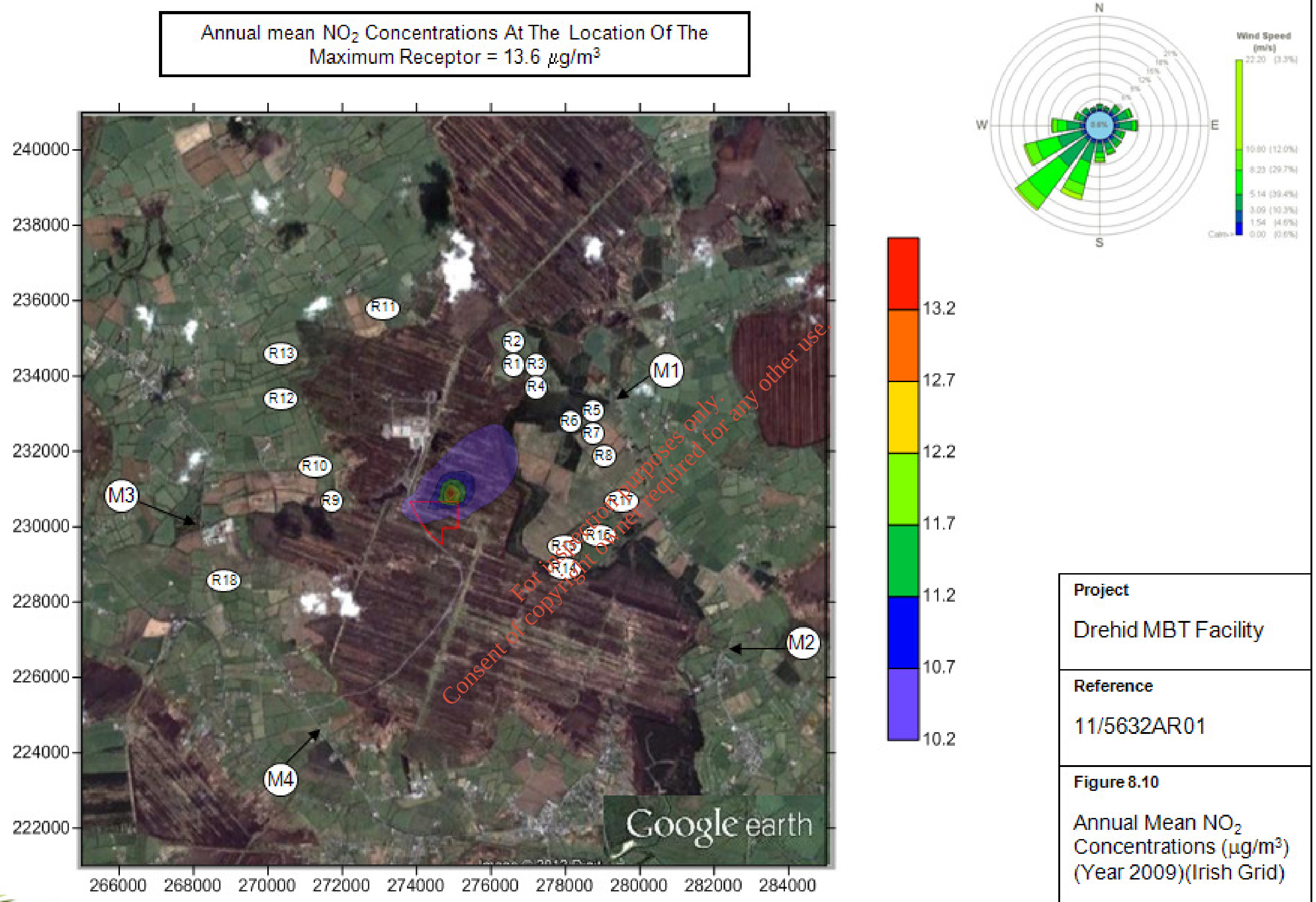

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Figure 8.10

Annual Mean NO_2 Concentrations ($\mu g/m^3$) (Year 2009)(Irish Grid)

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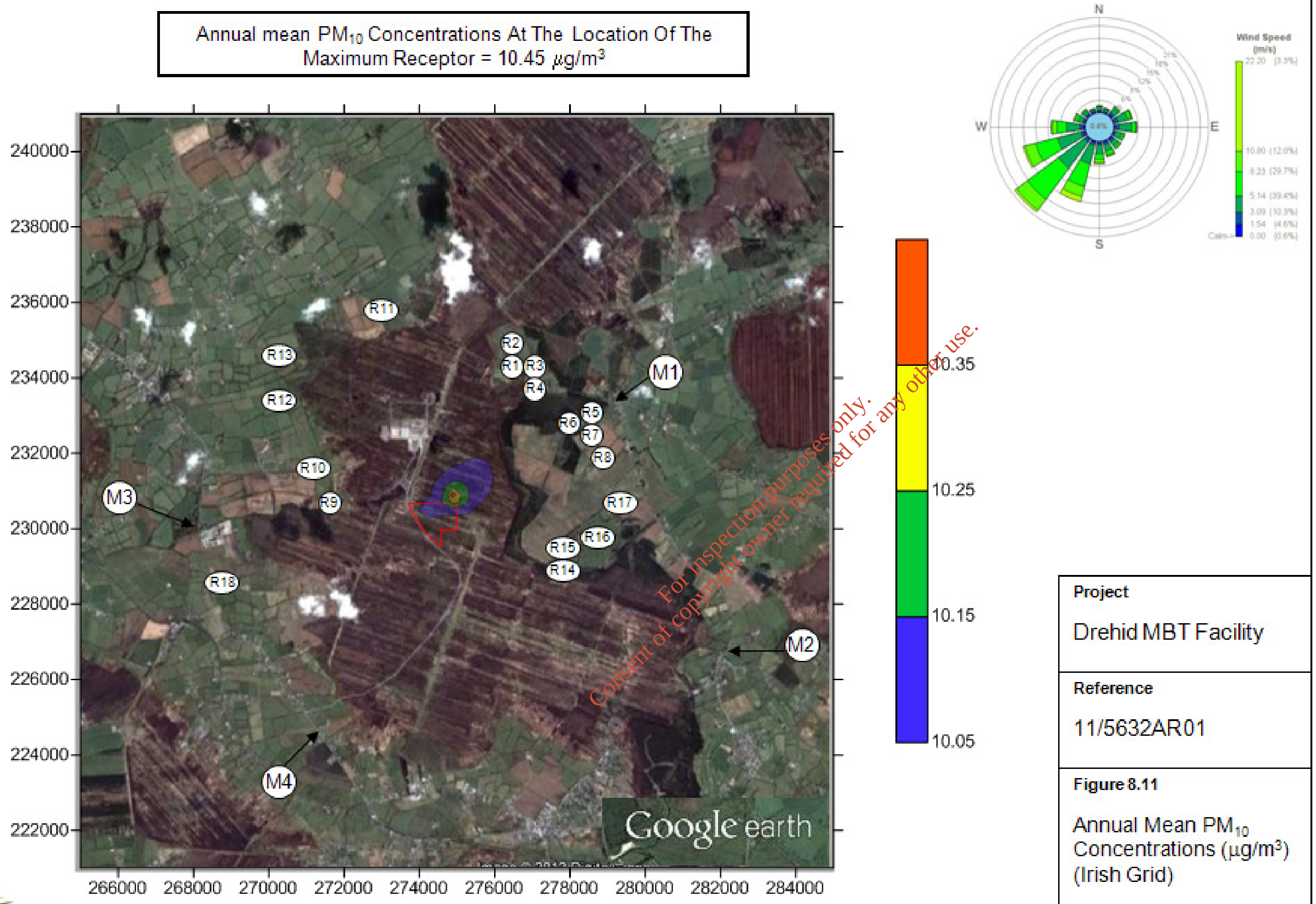
Annual mean PM_{10} Concentrations At The Location Of The Maximum Receptor = 10.45 $\mu g/m^3$



Project

Drehid MBT Facility

Reference

11/5632AR01

Figure 8.11

Annual Mean PM_{10} Concentrations ($\mu g/m^3$) (Irish Grid)

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8.2 DUST

8.2.1 Introduction

All developments, including waste management facilities, have the potential to adversely affect air quality within the surrounding area. Currently in Ireland there are no statutory limits for dust deposition from waste management developments. However, in recent years, the TA Luft/VDI 2119/Bergerhoff Method of dust emission monitoring has become the most commonly used method. This method involves using a direct collection pot to standardised dimensions of either glass or plastic. The system benefits from being a direct collection method i.e. less transferring of material and consequent reduction in sampling errors. This method is defined as an internationally recognised standard and has been adopted by the Environmental Protection Agency (EPA) as the method of choice for licensed facilities.

The proposed Drehid MBT Facility will be located in the townlands of Coolcarrigan and Drummond within the confines of Bord na Móna's landholding at Carbury, Co. Kildare. The existing Drehid Waste Management Facility is also located within this landholding. Bord na Móna is required to carry out a programme of monthly dust deposition monitoring at the Drehid Waste Management Facility in compliance with Waste Licence Register No. W0201-03. The Waste Licence limit for dust deposition at the Drehid Waste Management Facility is given as 350mg/m^2/day as per schedule B1 of its Waste Licence.

This section of the EIS will consider dust monitoring results for dust samples taken by Bord na Móna at the Drehid Waste Management Facility during 2011 as well as the results from specific dust monitoring undertaken in 2012 by TOBIN Consulting Engineers in the vicinity of the proposed Drehid MBT Facility site.

8.2.1.1 Methodology

Total dust deposition is measured using the Bergerhoff gauges specified in the German Engineering Institute VDI 2119 document entitled "Measurement of Dustfall using the Bergerhoff Instrument (Standard Method)". Dust gauges are set up approximately 2m above the ground surface and placed in protective cages. The jars are left open for one month. The jars are then sealed and returned to the laboratory for analysis.

8.2.2 Existing Environment

As mentioned above, Bord na Móna is required to carry out a programme of monthly dust deposition monitoring at the existing Drehid Waste Management Facility in compliance with Waste Licence Register No. W0201-03. The results of dust monitoring undertaken at the facility by Bord na Móna during 2011 are presented in Table 8.1 overleaf.

Table 8-29 Dust Results within the Bord na Móna landholding during 2011

Monitoring Period	Total Dust Deposition (mg/m^2/day)					
	No. of days	**D1**	**D2**	**D5**	**D6**	**D8**
16th Dec 2010 – 17th Jan 2011	32	22	<16	<16	32	43
17th Jan 2011- 17th February 2011	31	22	22	39	50	94
17th February 2011 – 21st March 2011	32	27	32	27	38	70
21st March 2011- 20th April 2011	30	23	<17	29	29	86
20th April 2011 – 18th May 2011	30	92	34	*	**	75
18th May 2011 – 16th June 2011	29	101	107	154	196	137
16th June 2011 – 18th July 2011	32	65	48	27	161	183
18th July 2011 – 19th August 2011	32	43	22	48	134	70
19th August 2011- 19th September 2011	31	139	39	56	122	255
19th September 2011 – 19th October 2011	30	40	40	23	69	46
19th October 2011 – 17th November 2011	29	18	30	65	178	113
17th November 2011 – 19th December 2011	32	86	48	48	70	108

*Invalid Result

** Monitoring location removed due to ongoing construction works

Note: (locations as described in Bord na Móna EPA monitoring reports)
D1 – Northern boundary of Drehid Waste Management Facility
D2 - Eastern boundary of Drehid Waste Management Facility
D5 – Western boundary of Drehid Waste Management Facility
D6 - Internal
D8 – Main entrance at R403

These existing dust monitoring locations are illustrated on Figure 8.12.

It can be seen from Table 8.1 above that all dust result levels recorded at the existing Drehid Waste Management Facility during 2011 are below the compliance threshold limit of 350mg/m^2/day as recommended by the TA Luft/VDI 2119/Bergerhoff Method and as per schedule B1 of the facility's Waste Licence.

For the purposes of this Report, TOBIN installed three new dust monitoring locations within the vicinity of the proposed Drehid MBT Facility development area. The locations are also illustrated on Figure 8.12 and are labelled D9, D10 and D11 so as not to confuse them with historical and existing dust monitoring locations within the Bord na Móna landholding. These monitoring locations were chosen at the boundary of the proposed Drehid MBT Facility for the purposes of providing a baseline at the particular location and are complementary to existing dust monitoring locations. Dust monitoring was completed in January / February 2012 by TOBIN. The results of this dust monitoring period are shown in Table 8-30 and presented in Appendix 8.3.

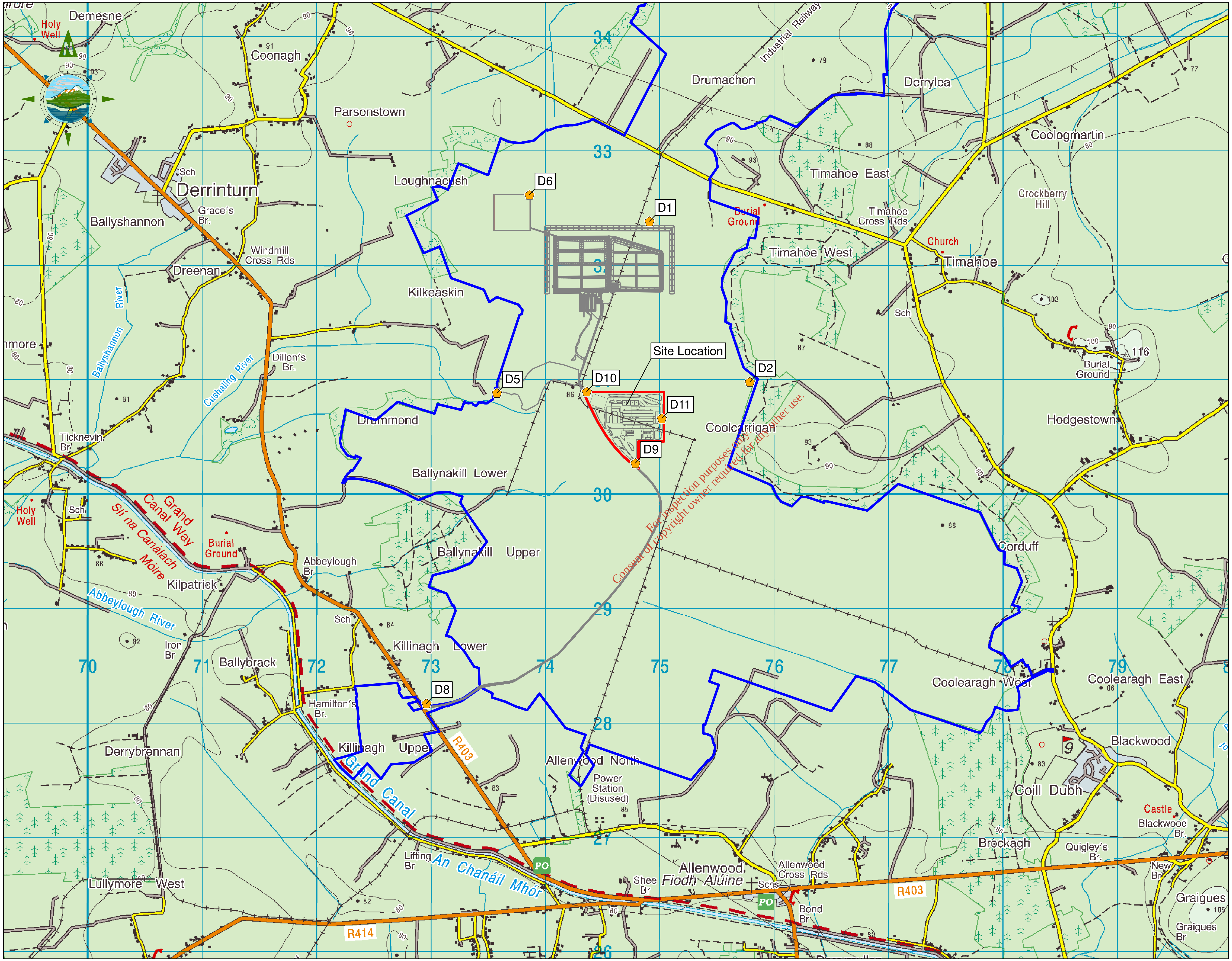
Table 8-30 Dust Results for January/ February 2012 (undertaken by TOBIN Consulting Engineers)

Monitoring Period	**Total Dust Deposition (mg/m^2/day)**			
	No. of days	**D9**	**D10**	**D11**
13th January 2012 - 10th February 2012	29	19	8.33	11.3

Note:
D9 – Southern boundary of proposed MBT Facility
D10- North-western boundary of proposed MBT Facility
D11- Eastern boundary of proposed MBT Facility

It can be seen from Table 8-30 above that dust levels at all monitoring locations are below the compliance threshold limit of 350mg/m^2/day, when measured using the TA Luft Bergerhoff Method.

These levels are also in compliance with the Waste Licence (No. W0201-03) limit set at the nearby Drehid Waste Management Facility.



Legend

- ⬠ Dust Monitoring Locations
- 🟥 Site Boundary
- 🟦 Landownership Boundary

0 0.25 0.5 1
Kilometers

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

A	05-06-12	Issued for Waste License	G.F.	J.D.
Issue	Date	Description	By	Chkd.

Client:
BORD NA MÓNA

Project:
DREHID
MECHANICAL BIOLOGICAL
TREATMENT (MBT) FACILITY

Title:
DUST MONITORING LOCATIONS

Scale @ A3: 1:30,000

Prepared by: G.Fil
Checked: S.Tinnelly
Date: May 2012

Project Director: D.Grehan

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6301

Figure 8.12

A

8.2.3 Potential Impacts

8.2.3.1 Potential Impacts of Configuration A (MBT with Composting)

The primary potential for dust emissions at the proposed Drehid MBT Facility is during the construction of the proposed development. Wind blown dust emissions may arise during the construction phase of the proposed development, which may impact upon the surrounding environment. The deposition of dust and mud on the local roads is also both unsightly and dangerous. It is also recognised that dust may be a particular problem during periods of dry windy weather.

Potential sources of dust during construction include the following:

- Vehicles carrying dust on their wheels;
- Initial excavation works especially in periods of dry weather;
- Un-vegetated soil stockpiles; and
- The handling of construction materials such as soils, cement etc for the construction phase of the development.

Once the Drehid MBT Facility is operational all treatment processes will take place within enclosed buildings thereby significantly reducing the potential for dust emissions arising at the facility.

The main potential source of dust during the operational phase will be from traffic entering and existing the MBT Facility.

8.2.3.2 Potential Impacts of Configuration B (MBT with Dry Anaerobic Digestion and Composting)

The potential dust impact of Configuration B (MBT with Dry Anaerobic Digestion and Composting) is the same as that outlined for Configuration A (MBT with Composting) above. If anaerobic digestion is included within the development this process will also take place indoors within the enclosed biological treatment buildings thereby reducing the potential for dust emissions arising at the facility. The feedstock to the anaerobic digestion process will have a high moisture content as will the digestate exiting the anaerobic digestion process therefore the potential dust emissions arising from the anaerobic digestion process will be negligible.

8.2.4 Mitigation Measures

8.2.4.1 Mitigation Measures for Configuration A (MBT with Composting

Bord na Móna will endeavour to ensure that dust emissions are kept to a minimum at all locations and will take all reasonable steps as far as is practical to minimise dust emissions during both the construction and operational phases of the proposed development.

The following mitigation measures are proposed during the construction phase:

- Material handling systems and stockpiling of materials shall be designed and laid out to minimise exposure to wind.
- Vehicles using site roads shall have their speed restricted, and this speed restriction will be enforced rigidly by site management. Indeed, on any un-surfaced site road, this shall be 20 km per hour, and on hard surfaced roads as site management dictates.
- Vehicles carrying material with dust potential shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust.
- Hard surface roads shall be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic only.
- Public roads outside the site shall be regularly inspected for cleanliness, and cleaned as necessary.
- All internal hauls roads and access routes will be sprayed with water in periods of dry weather to help suppress dust emissions.

The following mitigation measures are proposed during the operational phase:

- All waste delivered to the MBT Facility will be in covered/enclosed vehicles. Similarly, all waste residues being removed from the MBT Facility will be in covered/enclosed vehicles.
- All waste delivered to the MBT Facility will be treated within enclosed buildings.
- Doors at the waste reception area will be rapid closing doors, with an opening or closing time of approximately 20 seconds. Doors for the acceptance of waste will be fitted with air curtains to minimise the escape of odorous emissions and dust when a door is opened.
- In the composting tunnels, negative pressure will be maintained throughout the process in order to prevent uncontrolled air emissions (including dust) from being released inside the buildings.
- Negative pressure will also be created in all of the facility buildings to force odorous air to the odour abatement system thereby preventing uncontrolled emissions (including dust) from the MBT Facility.
- Air extracted from facility buildings, where there is a likelihood of dust generation, will be processed through a dust filter prior to being re-circulated within other facility buildings thereby preventing dust emissions and maintaining appropriate working conditions. It is envisaged that pulse jet bag filters will be used for this purpose.
- The air exhausted from the SRF thermal dryer will be processed through cyclones (to remove dust and particulates) prior to treatment in a humidifier and biofilter.
- Before odourous air flows through biofilters, it will be moistened to reduce the dust content of the process airstream.
- Good housekeeping practices (internally and externally) and a closed-door management strategy will be maintained at all times

- Waste delivery vehicles leaving the facility will be required to use the wheelwash which will be located on an internal access road at the MBT Facility site as shown on Figure 2.2.

It is anticipated that with the implementation of the above mitigation measures the potential for dust emissions will be significantly reduced and any residual dust emissions will not cause a nuisance. This will be verified by measurement using the TA Luft/VDI 2119/Bergerhoff Method at dust monitoring locations and demonstration of compliance with the limit value set in the waste licence to be granted by the EPA for the proposed MBT Facility.

The proposed MBT Facility activity boundary is located approximately 0.75km west and 0.6km east from the Bord na Móna landownership boundary and approximately 1km west and 1.4km east from the nearest sensitive receptor. Considering these distances and the fact that existing dust mitigation measures are already in place at the nearby Drehid Waste Management Facility, it is considered there will not be a significant cumulative impact from dust emissions once the mitigation measures detailed in this chapter are applied.

8.2.4.2 Mitigation Measures for Configuration B (MBT with Dry Anaerobic Digestion and Composting)

Mitigation measures for Configuration B (MBT with Dry Anaerobic Digestion and Composting) are the same as for Configuration A (MBT with Composting) as all treatment processes will take place indoors.

8.2.5 Conclusion

The proposed Drehid MBT Facility development will be located within the townlands of Coolcarrigan and Drummond, Carbury, Co. Kildare.

There is the potential for dust emissions during the construction and operation of the proposed MBT Facility development. However, it is anticipated that with the implementation of the proposed mitigation measures, dust emissions from the proposed MBT Facility will be in compliance with recommended limits when measured using the TA Luft/VDI 2119/Bergerhoff Method and will not have a perceptible impact on the local or regional environment.